# **SERIES9600**<sup>™</sup>

# **SERVICE MANUAL**



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OEC MEDICAL Systems, inc

# **PROCEDURES** Series 9600 Mobile C-Arm Imaging System

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## **BIOS ROM Error Codes**

The following <u>hexadecimal codes</u> are displayed on the Technique Processor PCB hexadecimal displays. If the <u>Technique Processor PCB</u> fails the <u>boot sequence</u>, the hexadecimal displays on the Technique Processor PCB (<u>U1 and U2</u>) will exhibit the code that corresponds to the test being performed at the time the Technique Processor PCB failed.

| TECHNIQUE<br>PROCESSOR<br>HEX |             | TEST DESCRIPTION                           |
|-------------------------------|-------------|--|
| DISP                          | LAIJ        |  |
| U2<br>(MSB)                   | U1<br>(LSB) |  |
| 0                             | 9           | Checksum BIOS ROM                          |
| 0                             | А           | Initialize Video Interface                 |
| 0                             | E           | Test CMOS Shutdown Byte                    |
| 0                             | F           | Test Extended CMOS (If Present)            |
| 1                             | 5           | Test 1st 64K of System Memory              |
| 1                             | 6           | Set up Interrupt Vector Table              |
| 1                             | 7           | Set Up Video I/O Operations                |
| 1                             | 8           | Test Video Memory                          |
|                               |             | (Except When EGA/VGA is Found)             |
| 1                             | В           | Test CMOS Battery Level                    |
| 1                             | С           | Test CMOS Checksum                         |
| 1                             | D           | Set Configuration From CMOS                |
| 1                             | E           | Sizing System Memory and Compare<br>w/CMOS |
| 1                             | F           | Test Found System Memory                   |
| 2                             | А           | Keyboard Initialization                    |
| 2                             | В           | Diskette Initialization                    |
| 2                             | С           | Serial Port Initialization                 |
| 2                             | D           | Parallel Port Initialization               |
| 2                             | E           | Hard Disk Initialization                   |
| 3                             | 1           | Option ROM Initialization                  |

# SRAM Card Error Codes

If an error occurs while the system is attempting to load software from the SRAM card, one of the error codes listed below will be displayed on the Technique Processor PCB hexadecimal displays.

| TECHNIQUE<br>PROCESSOR<br>HEX<br>DISPLAYS |       | TEST DESCRIPTION            |  |
|---|-------|-----------------------------|--|
| U2  | U1    |                             |  |
| (INISB)                                   | (LSB) |                             |  |
| 5   | 1     | Invalid function error      |  |
| 5   | 2     | Address Mark Not Found      |  |
| 5   | 3     | Write Protect Error         |  |
| 5   | 4     | Sector Not Found            |  |
| 5   | 5     | Diskette Change Line Active |  |
| 5   | 6     | DMA Overrun                 |  |
| 5   | 7     | DMA Boundary Error          |  |
| 5   | 8     | Media Type Not Available    |  |
| 5   | 9     | Bad CRC                     |  |
| 5   | A     | Diskette Controller         |  |
| 5   | В     | Seek Failed                 |  |
| 5   | С     | Time-out                    |  |

Refer to the following C-Arm Software sections:

**Overview** 

Start-up and Software Boot

Loadfing Application Software

**Boot Sequence** 

**SRAM Files** 

**SRAM Card** 

**SRAM Battery Replacement** 

#### Miscellaneous Error Codes

One of the following codes will be displayed on the X-ray control panel display if a <u>communications</u> or software error occurs. If a RT FAIL or I/O FAIL is displayed it will be in the following format: **ERROR HH nnnn.** HH is a hex number and nnnn is the error address.

| CODE             | DESCRIPTION                                |
|------------------|--|
| FRAMING ERROR    | Communications error between the           |
|                  | Control Panel Processor PCB and the        |
|                  | Technique Processor PCB                    |
| OVERFLOW ERROR   | Communications error between the           |
|                  | Control Panel Processor PCB and the        |
|                  | Technique Processor PCB                    |
| PARITY ERROR     | Communications error between the           |
|                  | Control Panel Processor PCB and the        |
|                  | Technique Processor PCB                    |
| RT FAIL HH nnnn  | Indicates a run-time software fatal error. |
| I/O FAIL HH nnnn | Indicates an I/O software fatal error.     |

# **Event Codes & Messages**

The software executed on the Technique Processor PCB monitors operating conditions and hardware states. Transitions in conditions and states are signaled by software event codes.

The most recent 128 event codes are stored in a buffer to provide a record of the events leading up to a failure. The event buffer can be examined using the STATUS mode. The Hexadecimal number indicates the two right digits of the event code. These two hexadecimal digits indicate the specific event. Many event codes signal events which occur during normal operation.

Some event codes are also written to the Control Panel display as error and warning messages. Events that are written to the display as messages are designated as fatal -- they cease system operation -- or as non-fatal. Not all of the events are written to the display as error messages. Event codes and the corresponding messages written to the display are listed in the following table. The type of event/error message is defined as:

- Event = E
- Fatal = F
- Non Fatal = N

| CODE | EVENT / MESSAGE  | TYPE | DESCRIPTION   |
|------|------------------|------|---|
| 01   | ENGLISH          | N/A  | Message only to indicate language   |
| 02   | N/A              | N/A  | N/A   |
| 03   | N/A              | N/A  | N/A   |
| 04   | N/A              | N/A  | N/A   |
| 05   | FOOTSWITCH STUCK | E, F | X-ray ON switch, footswitch, or<br>handswitch has been sensed closed<br>during the boot sequence. Refer to<br><u>X-ray On/Disable</u> section.  |
| 06   | PRECHARGE FAIL   | E, F | System has not completed precharge<br>cycle, sensed by <u>Analog Interface PCB</u><br>from +200V (B+) on<br><u>Generator Driver PCB</u> .<br>Refer to <u>Interlocks/Stator</u> section.   |
| 07   | HV INVERTER ON   | E, F | High Voltage generator sensed on with<br>no X-ray command initiated. Refer to<br><u>X-ray On/Disable</u> and <u>kV Generation</u><br>sections.  |
| 08   | 30 MINUTES       | E    | Time marker groups events in Event file   |
| 09   | MAIN PRGM LOADED | E    | Main program is loaded to RAM   |
| 0A   | INIT COMPLETE    | E    | Hardware initialization complete  |
| 0B   | IFB RESET        | E, F | The <u>Image Function PCB</u> has lost<br>communication with the <u>Technique</u><br><u>Processor PCB</u> and the watchdog timer<br>has reset the IF PCB. Refer to the<br><u>C-Arm Control</u> and <u>Image System</u><br>sections. |

| 0C | AD CHANNEL-0<br>FAILED  | E, F | kVp detected during boot-up without X-<br>ray command initiated. Refer to<br>C-Arm Control and kV Generation<br>sections.                             |
|----|-------------------------|------|---|
| 0D | AD CHANNEL-1<br>FAILED  | E, F | mA detected during boot-up without X-ray command initiated. Refer to<br>C-Arm Control and mA Generation sections.                                     |
| 0E | AD CHANNEL-8 FAILED     | E, F | Voltage sensed on redundant kV sense<br>circuitry in HV tank during boot-up. Refer<br>to <u>C-Arm Control</u> and<br><u>kV Generation</u> sections.   |
| 0F | AD CHANNEL-11<br>FAILED | E, F | To much current sensed from<br><u>Battery Charger PCB</u> during boot-up.<br>Refer to <u>C-Arm Control</u> and<br><u>Power Distribution</u> sections. |
| 10 | MAIN.TXT                | E, F | Error reading MAIN.TXT file from<br>SRAM card during boot-up.   |
| 11 | FLUORO - XRAY           | E    | Indicates last function performed   |
| 12 | PRESS ANY KEY           | N    | Message only.   |
| 13 | FLUORO - XOFF           | E    | Indicates end of fluoro exposure.   |
| 14 | FLUORO - DIAG           | N/A  | Not used.   |
| 15 | FLUORO BOOST            | E    | Indicates fluoro exposure in boost mode.  |
| 16 | FLUOROX - FILM          | E    | Operator initiated transition; fluoro to film   |

| CODE | EVENT / MESSAGE  | TYPE | DESCRIPTION                                    |
|------|------------------|------|--|
| 17   | COLLIMATOR STUCK | E, N | The collimator iris can't open or close.       |
|      |                  |      | Refer to the Image System section.             |
| 18   | IRIS JITTER      | E, N | Collimator cannot maintain specified field     |
|      |                  |      | size.  |
| 19   | FLUOROS - FILM   | E    | Operator initiated transition; standby to film |
| 1A   | FP DEAD          | E, F | Communication loss between Control             |
|      |                  |      | Panel Processor PCB and Technique              |
|      |                  |      | Processor PCB. Refer to C-Arm                  |
|      |                  |      | Control section.                               |
| 1B   | N/A              | N/A  | N/A  |
| 1C   | BAD IRIS POT     | E, F | The collimator iris potentiometer voltage      |
|      |                  |      | is incorrect or out of range. Refer to         |
|      |                  |      | Image System section.                          |
| 1D   | BAD IRIS CAL     | E, F | The collimator iris calibration data           |
|      |                  |      | contained in the EEPROM on the                 |
|      |                  |      | Image Function PCB is not valid. Refer         |
|      |                  |      | to the Image System and                        |
|      |                  |      | Image System Calibration sections.             |
| 1E   | BOOST OVERTIME   | E, N | The boost exposure has been terminated         |
|      |                  |      | after exceeding the preset time limit.         |
|      |                  |      | Refer to                                       |
|      |                  |      | System Configuration in the C-Arm              |
|      |                  |      | Software section.                              |
| 1F   | HOUSING IS WARM  | E, N | Housing temperature is at                      |
|      |                  |      | approximately 60% of its rated heat            |
|      |                  |      | capacity.                                      |
| 20   | HOUSING IS HOT   | E, N | Housing temperature is at approximately        |
|      |                  |      | 80% of its rated neat capacity.                |
| 21   | ANODE IS WARM    | E, N | I ne anode is at 60% of its rated heat         |
|      |                  |      | сарасну.                                       |

# Event Codes & Messages (Cont.)

| 22 | ANODE IS HOT          | E, N | Anode temperature is at approximately 80% of its rated heat capacity.  |
|----|-----------------------|------|--|
| 23 | N/A                   | N/A  | N/A  |
| 24 | HOUSING<br>OVERHEATED | E, F | Housing temperature is at 100% of its rated value and the thermal cutoff switch has activated open.  |
| 25 | WILL OVERHEAT         | E, N | The tube anode or housing is at 80% of<br>its rated heat capacity. Continued use in<br>FILM mode, without allowing the tube to<br>cool may damage the tube. You must<br>wait for the tube to cool before the next<br>FILM exposure is allowed, or select a<br>sufficiently lower technique. The display<br>will also present the message WAIT. |
| 26 | N/A                   | N/A  | N/A  |
| 27 | NO BOOST - HOT        | E, N | The X-ray tube anode or housing is at<br>80% of its rated heat capacity. Continued<br>use in fluoro boost, without cooling, may<br>damage the tube. When displayed, the<br>BOOST ENABLE LED turns off.   |

| CODE     | EVENT / MESSAGE | TYPE  | DESCRIPTION                                   |
|----------|-----------------|-------|---|
| 28       | INSTANT ON - TO | E     | Prearm in FILM mode has timed out after       |
|          |                 |       | no X-ray command has been received.           |
| 29       | INSTANT ON - FP | Е     | Prearm in FILM mode terminated from front     |
|          |                 |       | panel by operator pressing another key.       |
| 2A       | N/A             | N/A   | N/A   |
| 2B       | NO MAPPING FILE | E, F  | Error opening mapping file. See also          |
|          |                 |       | SRAM Card, Overview, Start-up Boot.           |
| 2C       | N/A             | N/A   | N/A   |
| 2D       | IFB TIMEOUT     | E, F  | The Image Function PCB hasn't responded       |
|          |                 |       | to the Technique Processor. Refer to the C-   |
|          |                 |       | Arm Control and Image System sections.        |
| 2E       | FILMX - FLUORO  | E     | Operator initiated transition; film to fluoro |
| 2F       | PLEASE WAIT     | N/A   | Generator loading software, message only      |
| 30       | N/A             |       |   |
| 31       | BATTERY         | E, F  | Batteries not connected or low B+ voltage.    |
|          | DISCONNECTED    |       | Occurs early in boot-up sequence. Refer       |
|          |                 |       | also to the                                   |
|          |                 |       | Power Distribution section.                   |
| 32       | FILMS - FLUORO  | E     | Operator initiated transition; standby to     |
|          |                 |       | fluoro  |
| 33       | STANDBY MODE    | E     | Generator not used for 30 minutes.            |
| 24       |                 |       | Filaments turned off.                         |
| 34       |                 |       | Generator activated after standby condition.  |
| 30       |                 |       | Fypoguro bog opded                            |
| 30<br>27 |                 |       | Exposure rids endeu                           |
| 57       | RELEASED EARLI  | E, IN | was released before the desired mas           |
| 38       |                 | FN    | Proper mA not achieved for allotted time in   |
| 00       |                 | L, IN | FII M mode                                    |
| 39       | N/A             | N/A   | N/A   |
| 3A       | N/A             | N/A   | N/A   |
| 3B       |                 | F.F   | OPTIONS DAT file not found on                 |
|          |                 | _,.   | SRAM card. See also                           |
|          |                 |       | System Configuration                          |
| 3C       | N/A             | N/A   | N/A   |
| 3D       | N/A             | N/A   | N/A   |
| 3E       | N/A             | N/A   | N/A   |

See also Technique Processor PCB and Analog Interface PCB.

# Event Codes & Messages (Cont.)

| 3F | WARNING, HIGH MA      | E, N | <b>mA</b> detected higher than allowed <u>range</u> for desired <u>technique</u> .               |
|----|-----------------------|------|--|
| 40 | WARNING, LOW MA       | E, N | mA detected lower than allowed range for desired technique.                                      |
| 41 | N/A                   | N/A  | N/A  |
| 42 | IRIS TOO LARGE        | E, N | <b>Collimator iris</b> size is incorrect for selected field size. See <b>Image Function</b> PCB. |
| 43 | mA ON IN ERROR        | E, F | mA sensed without an X-ray request   |
| 44 | REGULATOR FAIL        | E, N | Filament voltage out of range on   |
|    |                       |      | mA regulator circuitry. Sensed by  |
|    |                       |      | Analog Interface PCB from FIL B+ SENS  |
|    |                       |      | signal on the X-ray Regulator PCB.   |
| 45 | KV ON IN <u>ERROR</u> | E, F | kVp sensed without an X-ray request  |
| 46 | STATOR NOT ON         | E, F | Anode in X-ray tube sensed not rotating.   |
|    |                       |      | Refer to Interlocks/Stator section.  |
| 47 | OVERLOAD FAULT        | E, F | Excessive current to high voltage tank   |
|    |                       |      | sensed by tuned circuit, L1, C1 on   |
|    |                       |      | generator controller assembly. Refer to  |
|    |                       |      | kV Generation section.   |
| 48 | SATURATION FAULT      | E, F | Darlington driver transistors Q1 and Q2 on   |
|    |                       |      | generator controller assembly not fully  |
|    |                       |      | saturated.   |
| 49 | N/A                   | N/A  | N/A  |
| 4A | INTERLOCKS OPEN       | E, F | +24V generator interlock circuit has been opened.  |
| 4B | N/A                   | N/A  | N/A  |
| 4C | NO RANGE FILE         | E, F | Failure to open Calrange.dat file  |
| 4D | OVER-VOLTAGE          | E, F | Excessive kVp sensed in H.V. tank  |
|    | FAULT                 |      | secondary winding after boot-up.   |
| 4E | NO SERVO TABLE        | E, F | UroView only.  |
| 4F | NO MUXRAM DATA        | E, F | Cannot access data in MUX.DAT file on  |
|    |                       |      | SRAM card.   |
| 50 | CHARGER FAILED        | E, F | The Battery Charger PCB output has been  |
|    |                       |      | detected out of range after boot-up.   |
| 51 | USER END              | E, N | Message indicates Mainframe Menu   |
|    |                       |      | access.  |
| 52 | EXIT PROGRAM          | E, N | Message indicates Mainframe Menu exit.   |
| 53 | N/A                   | N/A  | N/A  |
| 54 | LOADING STATUS        | E, N | Message when Status Mode is accessed.  |
| 55 | N/A                   | N/A  | N/A  |
| 56 | NO MA LIMITS          | E, F | <b>mA Limit file missing</b> . See also 4C and 4F.   |

| 57 | WARNING, HIGH KV          | E, N | kV detected higher than allowed range for desired technique.  |
|----|---------------------------|------|---|
| 58 | WARNING, LOW KV           | E, N | kV detected lower than allowed range for desired technique.   |
| 59 | WAIT                      | N/A  | Message only, displayed alternately with WILL OVERHEAT  |
| 5A | ?? PCT CHARGE             | E    | Used as a message with battery charge state, 50 or 70 percent.  |
| 5B | STANDARD 5R/MIN           | N/A  | Message only, ABS table display name  |
| 5C | LOW DOSE                  | N/A  | Message only, ABS table display name  |
| 5D | CHEST 5R/MIN              | N/A  | Message only, ABS table display name  |
| 5E | <b>EXTREMITIES 5R/MIN</b> | N/A  | Message only, ABS table display name  |
| 5F | STANDARD                  | N/A  | Message only, ABS table display name  |
| 60 | CHEST                     | N/A  | Message only, ABS table display name  |
| 61 | EXTREMITIES               | N/A  | Message only, ABS table display name  |
| 62 | N/A                       | N/A  |   |
| 63 | CHECKSUM ERROR            | N/A  | Message only. During boot, a checksum<br>routine is run on the MAIN software. If<br>checksum is in error this message will be<br>displayed. |
| 64 | BOOT-UP TERMINATED        | N/A  | Message only. Displayed after<br>CHECKSUM ERROR (see above).  |

# Heat Warning Messages

Heat warning messages will appear on the X-ray control panel fluorescent display to alert the operator when a potential <u>X-Ray tube</u> overheat condition will occur. Remedy this condition by allowing the X-Ray tube to cool. These messages alternate with the normal information displayed on the fluorescent display.

# **Fluoro Mode Warnings**

| WARNING                  | DESCRIPTION  |
|--------------------------|--|
| HOUSING IS<br>HOT        | Housing temperature is at approximately 80% of its rated<br>heat capacity. You may continue with fluoro, pulsed-fluoro,<br>fluoro boost, and pulsed-fluoro boost exposures but<br>discretion is advised.   |
| ANODE IS<br>HOT          | Anode temperature is at approximately 80% of its rated<br>heat capacity. You may continue with fluoro, pulsed-fluoro,<br>fluoro boost, and pulsed-fluoro boost exposures but<br>discretion is advised.   |
| NO BOOST -<br>HOT        | The housing or anode temperature is at approximately<br>90% of its rated heat capacity. Continued use in fluoro<br>boost without cooling may damage the X-ray tube. Fluoro<br>and pulsed-fluoro are not prevented.   |
| WAIT<br>WILL<br>OVERHEAT | The housing or anode temperature is at approximately<br>90% of its rated heat capacity. Continued use without<br>cooling may damage the X-ray tube. Wait for the tube to<br>cool before attempting more exposures. All fluoroscopy<br>modes are prevented. |

# Film Mode Warnings

| WARNING               | DESCRIPTION  |
|-----------------------|--|
| HOUSING IS HOT        | Housing temperature is at approximately 80% of its rated heat capacity. You may continue with film exposures but discretion is advised.  |
| ANODE IS HOT          | Anode temperature is at approximately 80% of its rated heat capacity. You may continue with film exposures but discretion is advised.  |
| WAIT WILL<br>OVERHEAT | The predicted (by software) housing or anode<br>temperature is at approximately 90% of its rated heat<br>capacity because the selected technique will exceed<br>the heat rating of the tube if the exposure is taken.<br>Continued use without cooling may damage the X-ray<br>tube. Film exposures are disabled. Wait for the tube to<br>cool or select a sufficiently lower technique before<br>attempting more exposures. |

See also Technique Processor PCB and Analog Interface PCB.

# Low Battery Charge Messages

Under most circumstances the battery condition is never a problem. It is possible however, that during periods of heavy use some consideration must be made to allow adequate <u>recharging</u> time. The messages listed below will be displayed on the X-ray control panel fluorescent display if a <u>battery condition</u> error is sensed.

| MESSAGE          | DESCRIPTION  |
|------------------|--|
| 70 PCT<br>CHARGE | When the batteries are reduced to 70 percent of their effective charge a warning message will appear on the control panel display. |
|                  | The message "70 PCT CHARGE" will alternate with the<br>displayed technique.  |
| 50 PCT<br>CHARGE | If the effective charge drops to 50 percent, the display will alternate the message "50 PCT CHARGE." Film exposures are disabled.  |

See also Technique Processor PCB and Analog Interface PCB.

# **Error Messages During Operation**

Error messages will be displayed on the X-ray Control Panel when conditions occur which result in automatic system shutdown or require system servicing.

| MESSAGE   | DESCRIPTION  |  |
|---|--|--|
| BATTERY   | This error message will appear if the <b>Battery Packs</b> in the  |  |
| DISCONNECT  | Generator are not connected when the system is powered up.   |  |
| ED  | Connect all Battery Packs and reboot the Generator.  |  |
| CHARGER<br>FAILED                                 | The <b>Battery Charger</b> circuit has failed. If this message<br>appears during startup, the system cannot be operated. If the<br>message appears during normal use, the system can still be<br>operated but the Batteries will not be recharged between<br>exposures. This message alternates with the technique<br>display between exposures. |  |
| FOOTSWITCH<br>STUCK                               | A fault has been detected in the footswitch, <u>X-RAY ON</u> switch,<br>or associated switch sensing electronics. Results in automatic<br>shutdown. Occurs only during boot-up.  |  |
| PRECHARGE<br>FAIL                                 | The precharge cycle has failed which may indicate that the Batteries are weak. Results in automatic shutdown.  |  |
| REGULATOR<br>FAIL                                 | A <b>filament regulator circuit</b> failure has been detected. The filament supply voltage is outside the desired voltage.   |  |
| BAD<br>THERMISTOR<br>DETECTED<br>PRESS ANY<br>KEY | A fault has been detected within the (X-ray Tube) housing<br>temperature thermistor or its associated circuitry or cables.<br>Results in automatic shutdown. Occurs only during boot-up.   |  |

| MESSAGE        | DESCRIPTION   |
|----------------|---|
| HV INVERTER ON | High voltage was detected when it should have been off,         |
|                | resulting in system shutdown.                                   |
| KV ON IN ERROR | KV was sensed without an X-ray requested. This indicates        |
|                | a fault with the High Voltage Generator and shuts down          |
|                | the system.   |
| MA ON IN ERROR | MA was sensed without an X-ray requested. This indicates        |
|                | a fault with the High Voltage Generator and shuts down          |
|                | the system.   |
| STATOR NOT ON  | The stator is not rotating. Operation of the system without     |
|                | the stator rotating would be destructive to the Tube.           |
|                | Results in automatic shutdown.                                  |
| OVERLOAD       | Indicates a fault in the high voltage regulator circuit and     |
| FAULT          | results in automatic shutdown. See also                         |
|                | kV Generator.   |
| SATURATION     | Indicates a high voltage regulator fault and results in         |
| FAULT          | automatic shutdown. See also kV Generator.                      |
| INTERLOCKS     | The <i>interlock circuit</i> has been broken. This could be due |
| OPEN           | to a fault sensed by software or a direct hardware failure.     |
|                | Results in automatic shutdown.                                  |
| OVERVOLTAGE    | A high voltage regulation failure was detected. Results in      |
| FAULT          | automatic shutdown. (This fault occurs at about 140 kVp to      |
|                | protect X-ray cables, high voltage power supply, and X-ray      |
|                | Tube.) See Also kV Generator.                                   |

| WARNING, | <b>kV</b> detected higher than allowed range for desired    |  |
|----------|---|--|
| HIGH KV  | technique.  |  |
| WARNING, | kV detected lower than allowed range for desired            |  |
| LOW KV   | technique.  |  |
| WARNING, | mA detected higher than allowed range for desired           |  |
| HIGH MA  | technique.  |  |
| WARNING, | mA detected lower than allowed range for desired            |  |
| LOW MA   | technique.  |  |
| BOOST    | The boost exposure will automatically terminate after 30    |  |
| OVERTIME | seconds, even if the BOOST footswitch is still depressed.   |  |
|          | Release the BOOST footswitch completely and then press      |  |
|          | it again to resume boost exposures. See also System         |  |
|          | Configuration.  |  |
| RELEASED | During a film exposure, the X-RAY ON switch was             |  |
| EARLY    | released early, before the desired mAs was reached.         |  |
|          | Press the switch again and hold it down until exposure time |  |
|          | is complete.  |  |

# **Status Mode**

The Status Mode is used to analyze various system parameters such as battery condition, heat status of the X-ray tube, A/D and PIO status of the Analog Interface PCB, and examine the event history of the system. Use the instructions listed below to enter the STATUS mode. Once in the STATUS mode, the various system parameters can be examined as desired.

# Entering the Status Mode

- 1. Press and hold the <u>C-Arm Mode button</u> on the Control Panel for five seconds. The message *LOADING STATUS* will appear on the Control Panel display.
- 2. The message *STATUS V 1.5* indicates that you have entered the status mode. Once in this mode, press either the kV or mA controls to scroll through the status menus.
- 3. When the desired menu title appears on the Control Panel display, select it by pressing any key on the Control Panel.
- 4. Scroll through the choices listed within this menu by pressing the kV or mA control.
- 5. To read the information or value contained under a menu item, display the item name and press any Control Panel key.
- 6. To return to the first level of status menus, scroll to the message *EXIT THIS MENU* and press any Control Panel key.
- 7. To exit the status menu mode and return to normal operation, scroll to the message *EXIT TO SYSTEM* and press any Control Panel key. When returning to normal system operation the Control Panel will display the message *LOADING SYSTEM*.

# Status Menu Chart

Use the following chart to navigate through the Control Panel Status menu. Use the <u>kV or mA controls</u> to scroll horizontally, then press a function key to select a particular menu.



## Status Menus

The available status menus and the items contained under each are listed below. Note that a typical readout is listed for all applicable menu items.

# **Battery Status**

CHARGE VOLTS LINE VOLTAGE FILAMENT B+ FXIT THIS MENU

/==> Refer to the Power Distribution CHARGE CURRENT / section; Battery Charger PCB, and / Batteries.

==> See Filament Regulator Setup

# **Heat Status**

HOUSING HEAT ANODE HEAT THERMISTOR EXIT THIS MENU Refer to X-Ray Tube

# **AD/DA Status**

Use this menu to read the AD/DA information being received by the Analog Interface PCB.

After selecting this menu, scroll through the AD/DA channels listed below. To read the voltage measured on the selected channel, press any key. The display will change to show the channel number and the associated voltage.

CHANNEL NUMBER:

- 0 MEASURED KVP
- 1 MEASURED MA
- 2 FILAMENT B+
- 3 VIDEO LEVEL
- 4 HOUSING THER.
- 5 DOSIMETER (not used)
- 6 CAMERA POSITION
- 7 CAMERA IRIS WIPER
- 8 TAP VOLTAGE
- 9 LINE VOLTAGE

*10 CHARGE CURRENT* 

11 CHARGE VOLT

12 FILAMENT CURRENT

13 SPARE

14 SPARE

15 SPARE

EXIT THIS MENU

# **PIO Status**

Use this menu to read the status of the PIO's on the Analog Interface PCB.

There are three PIOs on the Analog Interface PCB, each with three ports: A, B, and C. Each port is responsible for 8 signals.

Select the PIO Status Menu, press any key and scroll through the PIO ports: 1A, 1B, 1C, 2A, 2B, 2C, 3A, 3B and 3C. The hexadecimal content of each port is displayed.

With the desired PIO port displayed, press any key. You may now scroll through the individual lines within each port to examine their state - high or low. The name of the signal line is given along with the port designation.

Press any key again to display the associated IC number and the actual IC pin number along with the line state - high or low. You may toggle back and forth between this mode and the mode above by pressing any key.

For example -

| <u>PIO PORT</u> | HEX CONTENTS: |
|-----------------|---------------|
| PIO 1B          | FF H          |

Individual lines can be read by signal name:

B2 STATOR RUN = LO

or by pin number:

U38 PIN 20 = LO

Typical hex values for each of the 9 individual PIO ports are listed below:

| Port 1A=FF H | Port 2A=03 H | Port 3A=B3 H |
|--------------|--------------|--------------|
| Port 1B=00 H | Port 2B=40 H | Port 3B=FF H |
| Port 1C=1D H | Port 2C=D0 H | Port 3C=FF H |

EXIT THIS MENU

# **Panel Diagnostics**

PANEL LED TEST - Tests all control panel LED's and fluorescent display PANEL KEY TEST -Tests all control panel keys and displays the corresponding hex code PANEL KV/MA TEST - Tests operation of kV and mA controls SPEAKER TEST - Tests speaker mounted to Control Panel Processor PCB PANEL SOFTWARE - Displays software revision for the Control Panel Processor PCB

EXIT THIS MENU

# Calibrate Data

| A-Vector Table  | D1-Vector Table | H2-Vector Table |
|-----------------|-----------------|-----------------|
| B-Vector Table  | E-Vector Table  | H3-Vector Table |
| B1-Vector Table | F-Vector Table  | K-Vector Table  |
| C-Vector Table  | G-Vector Table  | L-Vector Table  |
| D-Vector Table  | H1-Vector Table |                 |

LAST CALIBRATE (Contains date of last calibration and initials of calibrator) NO. OF WRITES

EXIT THIS MENU

# **Event History**

**Events codes** are reported in reverse order, with the most recent event first. The events are stored in the EEPROM TABLE and the LOCAL TABLE. Refer to **Event History files** for further information.

The format for event code reporting is:

E - NN = HHHH

where:

NN = event count (1-128) HHHH = the event code

Select EVENT HISTORY, press any key, and scroll through the items listed below.

*EEPROM TABLE* - Last 128 events (beginning with most recent) stored in EEPROM. This table is only updated when a fatal system error occurs.

LOCAL TABLE - Last 128 events (beginning with most recent) stored in RAM.

LAST FATAL ERR - Date and time of last fatal error

TOTAL FATAL ERR - Gives count of total errors; FATAL CNT. = n

EXIT THIS MENU

# **Speaker Pitch**

This menu allows the speaker pitch to be changed.

SELECT TONE EXIT NO SAVE EXIT AND SAVE

#### **Miscellaneous**

Scroll through this menu of miscellaneous data and press any key to read the selected item.

MODEL NUMBER SERIAL NUMBER INFORMATION SOFTWARE PART NUMBER TOTAL DISK SPACE FREE DISK SPACE INSTALLATION NO. FILM SHOTS

EXIT THIS MENU

EXIT TO SYSTEM

#### **Exiting Status Mode**

- 1. Select *EXIT TO SYSTEM* using the Control Panel buttons. Press any key on the Control Panel.
- 2. If Status Mode was executed from the Mainframe Menu, the message *MAINFRAME MENU* appears on the Control Panel display which returns control to the Workstation.

# **Workstation Boot and Error Codes**

The following section contains a listing of the checkpoint codes written to the two character display on the Series 9600 Workstation's <u>Communications PCB</u>.

During the boot process, the alphanumeric LEDs on the rear panel displays two digit codes indicating the status of the boot sequence. Since these codes do not normally indicate an error, they are referred to as *progress codes*. Typically, these codes will be replaced by an E0 code once normal program operation has begun. If the program does not complete the boot process, a code will remain on the LED display, indicating the point where an error occurred.

A description of these codes is provided in the following tables and links are provided to the appropriate sections in the manual describing troubleshooting and service information.

See also: <u>386 AT Motherboard;</u> <u>Boot and Diagnostic LEDs;</u> <u>Workstation Software Overview;</u> <u>Start-up and Software Boot,</u> <u>Workstation Boot Sequence</u>.

# 386 AMI BIOS Post Code Table

These alpha-numeric codes are displayed by the LEDs on the <u>Auxiliary Interface PCB</u> during boot-up. These codes are generated by the <u>AT Motherboard</u>.

- 01 Processor register test about to start.
- 02 NMI disabled.
- 03 Power-on delay completed.
- 04 Any initialization before keyboard BAT is completed.
- 05 Soft reset / power-on determined.
- 06 ROM is enabled.
- 07 ROM BIOS checksum passed, keyboard controller input buffer free.
- 08 BAT command to keyboard controller is issued.
- 09 Keyboard controller BAT command verified.
- 0A Keyboard command byte code is issued.
- 0B Keyboard controller command byte is written.
- 0C Pin-23, 24 of keyboard controller is blocked / unblocked.
- 0D NOP command processing is done.
- 0E CMOS shutdown register R/W test passed.
- 0F CMOS calculation is done, DIAG byte written.
- 10 CMOS initialization (if any) done.
- 11 CMOS status register initialized.
- 12 DMA controller #1, #2 interrupt controller #1, #2 disabled.
- 13 Video is disabled and port-B is initialized.
- 14 Chipset initialization / auto memory detection over.
- 15 CH-2 timer test halfway.
- 16 CH-2 timer test over.
- 17 CH-1 timer test over.
- 18 CH-0 timer test over.
- 19 Memory refresh started.
- 1A Memory refresh line is toggling.
- 1B Memory refresh period 30 micro second test completed.
- 20 Base 64 KB memory test started.
- 21 Address line test passed.

- 22 Toggle parity over.
- 23 Base 64 KB sequential data R/W test passed.
- 24 Setup required before vector initialization completed.
- 25 Interrupt vector initialization done.
- 26 I/O port of 8042 read.
- 27 Global data initialization is over.
- 28 Initialization after interrupt vector is completed.
- 29 Monochrome mode setting is done.
- 2A Color mode setting is done.
- 2B Toggle parity over.
- 2C Processing before video ROM is done.
- 2D Optional video ROM control is done.
- 2E Return from processing after the video ROM control.
- 2F EGA/VGA not found.
- 30 Display memory R/W test passed.
- 31 Display memory R/W test or retrace checking failed.
- 32 Alternate display memory R/W test passed.
- 33 Video display checking over.
- 34 Verification of display adapter done.
- 35 Display mode set completed.
- 36 BIOS ROM data area check over.
- 37 Cursor setting for power on message ID complete.
- 38 Power on message display complete.
- 39 New cursor position read and saved.
- 3A Reference string display is over.
- 3B Hit <ESC> message displayed.
- 40 Preparation for virtual mode test started.
- 41 Returned after verifying from display memory.
- 42 Descriptor tables prepared.
- 43 Entered in virtual mode.
- 44 Interrupts enabled (if diagnostics switch is ON).
- 45 Data initialized.
- 46 Memory remap test is done, memory size calculation is over.

- 47 Pattern to be tested written in extended memory.
- 48 Patterns written in base memory.
- 49 Amount of memory below 1 MB found and verified.
- 4A Amount of memory above 1 MB found and verified.
- 4B BIOS ROM data area check over.
- 4C Memory below 1 MB cleared (soft reset).
- 4D Memory above 1 MB cleared (soft reset).
- 4E Memory test started (no soft reset).
- 4F Memory size display started. This will be updated during memory test.
- 50 Memory test below 1 MB completed.
- 51 Memory size adjusted due to relocation / shadow.
- 52 Memory test above 1 MB completed.
- 53 CPU registers are saved, including memory size.
- 54 Shutdown successful, CPU in real mode.
- 55 Registers restored.
- 56 A20 address line disable successful.
- 57 BIOS ROM data area check halfway.
- 58 BIOS ROM data area check over.
- 59 Hit <ESC> message cleared. <Wait...> message displayed.
- 60 DMA page register test passed.
- 61 Display memory verification over.
- 62 DMA #1 base register test passed.
- 63 DMA #2 base register test passed.
- 64 BIOS ROM data area check halfway.
- 65 BIOS ROM data area check over.
- 66 DMA unit 1 and 2 programming over.
- 67 8259 initialization over.
- 80 Keyboard test started.
- 81 Keyboard reset error / stuck key found.
- 82 Keyboard controller interface test over.
- 83 Command byte written. Global data init done.
- 84 Lock key check over.
- 85 Memory size check done.

- 86 Password checked.
- 87 Programming before setup completed.
- 88 Returned from CMOS setup program and screen is cleared.
- 89 Programming after setup completed.
- 8A First screen message displayed.
- 8B <WAIT...> message displayed. Mouse check and init done.
- 8C Main and video BIOS shadow successful.
- 8D Setup options are programmed.
- 8E Hard disk, floppy reset applied.
- 8F Floppy check returns that floppy is to be initialized.
- 90 Floppy setup is over.
- 91 Hard disk presence test over.
- 92 Hard disk setup complete.
- 93 BIOS ROM data area check halfway.
- 94 BIOS ROM data area check over.
- 95 Memory size adjusted due to mouse support, hard disk type 47.
- 96 Returned after verifying from display memory.
- 97 Any init before C800 optional ROM control is over.
- 98 Optional ROM control is done.
- 99 Any initialization required after optional ROM test over.
- 9A Return after setting timer and printer base address.
- 9B Returned after RS-232 base address.
- 9C Required initialization before co-processor test is over.
- 9D Co-processor initialized.
- 9E Initialization after co-processor test is completed.
- 9F Extended keyboard check is done, ID flag set, num lock ON/OFF.
- A0 Keyboard ID command issued.
- A1 Keyboard ID flag reset.
- A2 Cache memory test over.
- A3 Soft error display complete.
- A4 Keyboard typematic rate set.
- A5 Memory wait states programming over.
- A6 Screen cleared.

- A7 NMI and parity enabled.
- A8 Initialization before E000 ROM control over.
- A9 Returned from E000 ROM control over.
- AA Initialization after E000 optional ROM control is over.
- 00 System configuration displayed.

# **AT Option PROM BIOS Error Codes**

NOTE Some of the error codes used by the AMI BIOS are the same as those codes used by the AT Option PROM and the nobrk.com program. You must check both error codes if any of the following codes are displayed on the LEDs. See also: <u>386 AT Motherboard</u> and <u>Communications PCB</u> in the Workstation Control section.

| Code | Description                 | Possible Causes                                  |
|------|-----------------------------|--|
| 80   | Started Execution of Option | 1. Bad Option PROM                               |
|      | ROM Code                    | 2. Bad Communication PCB                         |
|      |                             | 3. AT Motherboard not functioning                |
| 81   | NEAT TEST Fail -Reset       | 1. Bad Option PROM                               |
|      |                             | 2. Bad Communication PCB                         |
|      |                             | 3. AT Motherboard not functioning                |
| 82   | Bad GSP Load - Self Loop    | 1. Bad Option PROM                               |
|      | with Interrupts Disabled    | 2. Bad Communication PCB                         |
|      |                             | 3. AT Motherboard not functioning                |
| 83   | Undefined                   | 1. Software Corruption                           |
| thru |                             | 2. Bad Sector on Hard Disk                       |
| 8F   |                             | 3. AT Motherboard not functioning                |
| 90   | Started Disk Boot Procedure | 1. Hard Drive                                    |
|      |                             | 2. Communication PCB                             |
|      |                             | 3. AT Motherboard not functioning                |
| 91   | Data Error on Disk Read     | 1. Hard Drive                                    |
|      |                             | 2. Communication PCB                             |
|      |                             | 3. AT Motherboard not functioning                |
| 92   | Controller Error            | 1. Bad Option PROM                               |
|      |                             | 2. Bad Communication PCB                         |
|      |                             | 3. AT Motherboard not functioning                |
| 94   | Seek Failure                | 1. Hard drive                                    |
|      |                             | 2. Communication PCB                             |
|      |                             | 3. AT Motherboard not functioning                |
| 98   | Disk Timed Out (Failed to   | 1. Hard drive                                    |
|      | Respond)                    | 2. Communication PCB                             |
|      |                             | 3. AT Motherboard not functioning                |
| 99   | Undefined                   | 1. Software Corruption                           |
| thru |                             | 2. Bad Sector on Hard Disk                       |
| 9F   |                             | <ol><li>AT Motherboard not functioning</li></ol> |

# Nobrk.com Error Codes (Executed by Nbkshell.Exe)

| Code | Description                  | Possible Causes                   |
|------|------------------------------|-----------------------------------|
| A0   | Undefined                    | 1. Software Corruption            |
|      |                              | 2. Bad Sector on Hard Disk        |
|      |                              | 3. AT Motherboard not functioning |
| A1   | Nobrk Installed Successfully |                                   |
| A2   | Undefined                    |                                   |
| A3   | Nobrk Already Installed      |                                   |
| A4   | Undefined                    |                                   |
| thru |                              |                                   |
| AF   |                              |                                   |

# Tsrser.Exe (Executed by Autoexec.Bat)

| Code | Description                 | Possible Causes                     |
|------|-----------------------------|-------------------------------------|
| B0   | Undefined                   | 1. Software Corruption              |
|      |                             | 2. Bad Sector on Hard Disk          |
|      |                             | 3. AT Motherboard not functioning   |
| B1   | Enter TSR Install           |                                     |
| B2   | Undefined                   |                                     |
| B3   | Previous User Interrupt Not | 1. Possible software corruption     |
|      | Null                        | 2. Possible bad sector on Hard Disk |
| ļ    |                             | 3. AT Motherboard not functioning   |
| B4   | Changing User Interrupt     |                                     |
|      | vector                      |                                     |
| B5   | Initialize Hardware Vector  |                                     |
| B6   | Initialize Vector           |                                     |
| B7   | Undefined                   |                                     |
| thru |                             |                                     |
| BD   |                             |                                     |
| BE   | Successful Installation     |                                     |
| BF   | Tsrser Already Installed    |                                     |

# Ptdtsr.Exe Error Codes (Executed By Autoexec.Bat)

*NOTE:* The following codes will be displayed only on systems with the 4FPS or 30FPS image storage options.

| Code | Description          | Possible Causes                   |
|------|----------------------|-----------------------------------|
| C0   | Undefined            | 1. Software Corruption            |
| thru |                      | 2. Bad Sector on Hard Disk        |
| C9   |                      | 3. AT Motherboard not functioning |
| CA   | Micronics Cache      |                                   |
|      | Initialization       |                                   |
| CB   | Undefined            |                                   |
| CC   | NMI Handler Shutdown |                                   |
| CD   | Undefined            |                                   |
| thru |                      |                                   |
| CF   |                      |                                   |

# Loadip.Exe (Executed By Autoexec.Bat)

| Code | Description                      | Possible Causes                   |
|------|----------------------------------|-----------------------------------|
| D0   | Program Started Execution        | 1 Software Corruption             |
|      |                                  | 2. Bad Sector on Hard Disk        |
|      |                                  | 3. AT Motherboard not functioning |
| D1   | Error Opening GSP Object<br>File |                                   |
| D2   | Undefined                        |                                   |
| D3   | Seek Error                       | 1. Hard Drive                     |
|      |                                  | 2. AT Motherboard not functioning |
| D4   | Seek Error On Data               | 1. Hard Drive                     |
|      |                                  | 2. AT Motherboard not functioning |
| D5   | Virtual Address Error            | 1. Software Corruption            |
|      |                                  | 2. Bad Sector on Hard Disk        |
|      |                                  | 3. AT Motherboard not functioning |
| D6   | Error Reading File Header        |                                   |
| D7   | Error in Test Program            |                                   |
|      | Response Prior to Load           |                                   |
| D8   | Undefined                        |                                   |
| D9   | Undefined                        | 1. Software Corruption            |
|      |                                  | 2. Bad Sector on Hard Disk        |
|      |                                  | 3. AT Motherboard not functioning |
| DA   | Load Complete and                |                                   |
|      | Successful                       |                                   |
| DB   | Undefined                        |                                   |

# Loadip.Exe (Executed By Autoexec.Bat) (Cont.)

| DC | No Acknowledge from GSP         | <ol> <li>Software Corruption</li> <li><u>Image Processor PCB</u></li> <li><u>AT Motherboard</u> not functioning</li> </ol> |
|----|---------------------------------|--|
| DD | Error Reading GSP Ready<br>Flag |  |
| DE | Error Reading GSP Error<br>Flag |  |
| DF | GSP Program Load Failed         |  |

# Cart.Exe (Executed By Autoexec.Bat)

| Code | Description                | Possible Causes                   |
|------|----------------------------|-----------------------------------|
| E0   | Workstation Program        | 1. Software Corruption            |
|      | Executing                  | 2. Bad Sector on Hard Disk        |
|      |                            | 3. AT Motherboard not functioning |
| E1   | Undefined                  |                                   |
| thru |                            |                                   |
| EB   |                            |                                   |
| EE   | Unexpected Processor       |                                   |
|      | Exception                  |                                   |
| EF   | Undefined                  |                                   |
| F0   | Workstation Program Exited |                                   |
|      | to DOS                     |                                   |
| F1   | Undefined                  |                                   |
| thru |                            |                                   |
| FA   |                            |                                   |
| FB   | GSP is not Ready           | 1. Software Corruption            |
|      |                            | 2. Image Processor PCB            |
|      |                            | 3. AT Motherboard not functioning |
| FC   | GSP is not responding      |                                   |
| FD   | Front Panel is not         | 1. Connectors                     |
|      | Functioning                | 2. Front Panel Processor          |
| ļ    |                            | 3. AT Motherboard not functioning |
| FE   | Undefined                  |                                   |
| FF   | Int 19H Boot               |                                   |

# DOS Run-Time Errors

Run-time errors cause the program to display an error message and terminate. Error messages are displayed in the Status Bar, located on the right Workstation monitor. e.g..

System Error nnn at xxxx:yyyy

Where *nnn* is the run-time error number and *xxxx:yyyy* is the run-time address (segment and offset). The run-time errors are divided into four categories:

- DOS errors 1 99
- I/O errors 100 149
- Critical error 150 199
- Fatal errors 200 255

Run-time Errors that are the most likely to occur in the Workstation are included in the following tables:

#### **DOS Errors**

| Code | Description          | Possible Causes                      |
|------|----------------------|--------------------------------------|
| 2    | File not found       | Possible corrupted file on the disk  |
|      |                      | Also caused by incorrectly loaded or |
|      |                      | missing HELP files.                  |
| 3    | Path not found       | Possible corrupted file on the disk  |
| 4    | Too many open files  | Not enough memory to open file       |
| 6    | Invalid file handle  | Possible file name corrupted         |
| 15   | Invalid drive number | Software unable to communicate with  |
|      |                      | the disk drive                       |

#### **I/O Errors**

| Code | Description              | Possible Causes                  |
|------|--------------------------|----------------------------------|
| 100  | Disk read error          | File did not read correctly      |
| 101  | Disk write error         | File written to disk incorrectly |
| 103  | File not open            | Software unable to open file     |
| 104  | File not open for input  | Software unable to open file     |
| 105  | File not open for output | Software unable to open file     |

# **Critical Errors**

| Code | Description          | Possible Causes                         |
|------|----------------------|---|
| 152  | Drive not ready      | Software unable to communicate with     |
|      |                      | the disk drive                          |
| 153  | Unknown command      | Software does not recognize command     |
| 154  | CRC error in data    | Checksum incorrect                      |
| 156  | Disk seek error      | Disk hardware fault                     |
| 158  | Sector not found     | Disk hardware fault                     |
| 159  | Printer out of paper |   |
| 160  | Device write fault   | Error while writing to the disk drive   |
| 161  | Device read fault    | Error while reading from the disk drive |
| 162  | Hardware failure     | Possible fault on AT Motherboard        |

# **Fatal Errors**

| Code | Description               | Possible Causes                          |
|------|---------------------------|--|
| 201  | Range check error         | A numerical value exceeded the limits of |
|      |                           | the software                             |
| 202  | Stack overflow error      | Possible memory error on the AT          |
|      |                           | Motherboard                              |
| 203  | Heap overflow error       | Possible memory error on the AT          |
|      |                           | Motherboard                              |
| 204  | Invalid pointer operation | Possible memory error on the AT          |
|      |                           | Motherboard.                             |
| 250  | Communication error       | Workstation control panel PCB or         |
| thru |                           | cable fault. See also Workstation        |
| 252  |                           | Communications.                          |
| 253* | Communications error      | See below.                               |
| 254  | Communications error      | Workstation control panel PCB or         |
| thru |                           | cable fault.                             |
| 260  |                           |  |

\*Error 253 occurs when the system does not boot fully and displays the "system error #253" message. This message is associated with a loss of serial communication.

If an error message, such as "system error 253 at 0000:01F0" is displayed, the numbers indicate the memory location where software detected the error.



# SERIES 9600 System Service Manual 878772-01

Date of Issue: December 1995

OEC Medical Systems, Inc. 384 Wright Brothers Drive Salt Lake City, UT. 84116
© December 1995

OEC Medical Systems, Inc. 384 Wright Brothers Drive Salt Lake City, UT. 84116-4007

The Mobile Digital Imaging System is manufactured under the following U.S. Patents:

> 4.768.216; 4.797.907; 4.209.706 Other Patents Pending.

This manual contains descriptions, instructions and procedures which apply to the Series 9600 Mobile Digital Imaging System only.

Software diskettes provided with this system contain Microsoft MS-DOS V 5.0 ©MICROSOFT CORPORATION 1991 All rights reserved

#### **Revision History**

| <u>Rev</u> | <u>Dash</u> | Date          | Change Description  |
|------------|-------------|---------------|---|
| Rev A      | -01         | December 1995 | Initial Release   |
| Rev B      | -01         | December 1995 | Changed binder from 1-1/2-inch capacity to 2-inch capacity. |
|            |             | July 1996     | CD-ROM Version Release                                      |

#### (Go back to Table of Contents)

# INTRODUCTION

# PURPOSE

This manual contains service information that will assist trained service personnel, to isolate failures and initiate repairs on the 9600 Mobile Imaging System.

# SCOPE

The information contained within this manual pertains to systems currently being manufactured. However, there are older Series 9600 Systems in existence and, wherever necessary, this manual contains information and procedures necessary to service older systems. Three groups of serial numbers are mentioned in this manual that represent revision changes of the system.

- 69-0001 thru 69-1000
- 69-1001 thru 69-2000
- 69-2001 and higher

# **INTENDED AUDIENCE**

Persons that benefit the most from the information in this manual are service personnel who have been trained to perform the servicing procedures contained within the manual. Reading this manual without proper training does not qualify the reader to service the 9600 Mobile C-Arm system.

# **HOW TO USE THIS MANUAL**

# **SECTIONS**

The Mobile C-Arm has been divided into sections. The sections are separated by index tab dividers. Each index tab divider has a Table of Contents for that section printed on the inside to help locate information.

### **APPENDIX**

An appendix is provided which lists specifications, tolerances, recommended tools, and test equipment.

### INDEX

An index is provided at the end of the manual. The index can be used in addition to the table of contents to locate information. The index entries include the name of the section and the page number where the information is located.

# WARNINGS, CAUTIONS & NOTES

The following warning, caution and note conventions are used throughout the manual to indicate where death, serious injury, or equipment damage may be incurred. It is essential to strictly follow the procedures provided in warning and cautions.

# WARNING... Warnings indicate the threat of death or serious personal injury and are colored bright red.

# CAUTION: Cautions indicate the threat of minor personal injury or equipment damage and are colored dark red.

NOTE: Notes indicate useful information that should be taken into consideration. Notes are colored blue, but are not underlined. An underline indicates a link to another section or subject from the general text.

# **SAFETY PRECAUTIONS**

### **TRAINED SERVICE PERSONNEL**

Personal injury or property damage can result from incorrectly performed service procedures. Observe all operating and safety procedures contained within this manual.

# WARNING... Procedures should be performed by service personnel specifically trained by OEC Medical Systems, Inc. to service or calibrate the Series 9600 System.

### **INGRESS OF WATER AND SOLUTIONS**

Always unplug the AC power cable from the wall outlet before cleaning the equipment. Do not allow water, soap, or other liquids to drip into the equipment and possibly cause short circuits, electric shock and fire hazards.

The system must never be operated or stored in locations where conductive fluids, like water or saline solution, might spill on the equipment unless the system is properly draped or bagged.

### **ELECTRICAL SHOCK**

Electrical circuits inside the equipment use voltages that are capable of causing serious injury or death from electrical shock.

#### WARNING... This equipment contains high power electrical components and should be serviced only by personnel familiar with the circuitry and its operation. At certain locations these voltages are present EVEN WHEN THE POWER CORD IS DISCONNECTED.

Areas where dangerous voltages exist include:

- High voltage generator (located in the Mobile C-Arm), high voltage cable and X-Ray tube assemblies - 125,000 volts
- Image Intensifier Assembly 25,000 30,000 volts
- Line Voltage 120 VAC
- Batteries (located in the C-arm) 225 230 Volts DC
- Monitors in Workstation (15KV)

If the equipment must be serviced with the covers removed, observe the following precautions:

# WARNING... Observe the two person rule when working near high voltages. One person must remain clear of the machine and be prepared to turn it off in an emergency.

High voltage cables and capacitors can retain a charge even when power is removed from the system. Avoid touching these unless you are certain the charge has been removed (shorted to ground). High energy capacitors in the system should be shorted to ground through an adequate resistance to avoid potential burn hazards.

The batteries are capable of delivering high currents at high voltage. They are capable of causing severe burns, injury or death from electrical shock. Use extreme caution when working on circuits energized by or located near the batteries.

Use caution when working near the batteries and their connections. Remove metal rings and watchbands that may inadvertently come in contact with battery powered circuits. Severe skin burns could result if such metal articles were shorted across the battery voltage.

Exercise care when shipping batteries whose terminals are exposed. The terminals should be covered with an insulating material. Do not pack them in such a manner that their terminals can short together. The batteries are heavy and special attention must be given to their packaging.

#### Introduction

### **EXPLOSION HAZARDS**

WARNING... The system must never be operated in the presence of flammable anesthetics, or other flammable or explosive liquids, vapors, or gases. Vapors and gases can be ignited by electrical arcs that can occur during the normal operation of switches, circuit breakers, push buttons, and other circuit components.

If flammable substances are present before the system is turned ON:

- 1. Do not plug the system in.
- 2. Do not turn the system ON.

If flammable substances are detected <u>after</u> the Mobile C-Arm has been turned ON perform the following:

- 1. Do not touch any of the controls, or switches.
- 2. Do not turn it OFF; do not unplug it.
- 3. Evacuate all personnel immediately.
- 4. Ventilate the room to clear the air of the flammable vapor or gas.
- 5. Remove any volatile liquids which are producing flammable vapors to a safe storage area.

# **X-RADIATION HAZARD**

The X-ray tube assembly produces X-radiation when energized. Never operate this device without X-ray shielding in place. Use lead shielding and draping to protect personnel.

# **MOTORIZED MECHANICAL MOTION HAZARD**

The Vertical Column and L-arm are motorized. Observe them continuously while operating these features to avoid collision with people and equipment.

If covers are removed use extreme care when operating motorized features. Do not wear loose clothing that may be caught by gears or chains. Do not operate motorized features when fingers and hands are in the vicinity of motorized equipment.

### **SAFETY INTERLOCK**

Under no circumstances should the safety interlock in the system be bypassed, jumpered, or otherwise disabled.

### WARNING LABELS

The following warning labels may be found on the system:

X-ray Safety Warning

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WARNING THIS X-RAY UNIT MAY BE DANGEROUS TO PATIENT AND OPERATOR UNLESS SAFE EXPOSURE FACTORS AND OPERATING INSTRUCTIONS ARE OBSERVED

Electrical Safety Warning

WARNING UNIT CONTAINS INTERNAL EXPOSED ELECTRICALLY HAZARDOUS PARTS. DISCONNECT POWER AND BATTERIES BEFORE SERVICING.

# WARNING SYMBOLS

The following symbols may be found on the Mobile C-Arm:

Dangerous Voltage Present



Dangerous voltages are present use safety precautions.

Dangerous Voltage Present



Dangerous voltages are present use safety precautions.

Protective Earth Ground



The protective earth ground should be the last electrical connection broken and the first electrical connection made during servicing procedures.

Emitting X-Ray Source



This symbol indicates the presence or potential of producing ionizing X-radiation. Use appropriate precautions.

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# Potential Equalization

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GRN/YEL wire is used to indicate protective earth conductors, accessible parts connected to earth parts, and potential equalization conductors.

Non-Anesthetic Proof



This symbol indicates that equipment is non-anesthetic proof and should not be operated in the presence of flammable vapors, liquids or other substances.

# **UNAUTHORIZED MODIFICATIONS**

Unauthorized changes or modifications could have hazardous consequences. Changes or modifications must not be made unless specifically authorized by OEC.

Modification requests can be made by obtaining a field modification request form from OEC Mecical Systems.

#### NOTE: All OEC 9600 systems comply with International Electrotechnical Commission safety standard IEC-601. Do not connect any external device to the system that does not meet the requirements of IEC-601. Only devices provided or approved by OEC Medical Systems, Inc. should be connected to the system.

When properly assembled with a compatible beam limiting device, this diagnostic source assembly will fully meet the *Federal Performance Standards for Diagnostic X-Ray Systems and Their Components* (21CFR 1020.30-32) provided no components or parts are removed from the unit and no unauthorized adjustments are made in the beam limiting device or tube housing assembly.

- Never remove any part of the housing or beam limiting device.
- Never adjust any part of the beam limiting device unless under the direction of the manufacturer.
- All hardware (i.e. screws, nuts, bolts, etc.) must be re-installed on the equipment.
- All EMI-RFI shielding components must be re-installed on the equipment. Any damaged shielding gasket must be replaced to ensure that the system complies with EMI-RFI regulations.

# **CERTIFIED COMPONENTS**

The following components within the Mobile C-Arm are certified and are considered critical in maintaining system performance. Modification (repair/replacement and some adjustments) of these components require that Form 2579 be completed and filed with OEC Medical Systems, Inc., the FDA, and the State Office.

- Beam Limiting Device<sup>\*</sup>
- Image Intensifier Assembly<sup>\*</sup>
- Spot Film Device (Cassette Holder optional)\*
- X-ray Control Assembly\*
- X-ray Generator Assembly\*
- X-ray Tube Assembly
- \* Complete Report of Assembly, FDA Form 2579 whenever the following assemblies are replaced in their entirety, per 21 CFR 1020.30 (d) (1) (2).

# **SYSTEM OVERVIEW**

# **OVERVIEW**

This section will familiarize you with the 9600 Mobile C-Arm and Workstation. The following topics are discussed and provide an introduction to the system:

- Technical Specifications
- System Configurations and Options
- System Operation
- Cover Removal
- Component Locations
- Circuit Board Functions

# **TECHNICAL SPECIFICATIONS**

# **APPLICATIONS**

The OEC Medical Systems Series 9600 Mobile Digital Imaging System is a multiapplication system that provides solutions to the demanding needs of today's hospital environment. The system has the capacity to handle the most challenging procedures, from orthopedics to interventional neurosurgery, and everything in between.

**Orthopedic Surgery -** 12 mA boost capability for visualizing dense anatomy. The laser aimer gives the surgeon pin-point accuracy for pedicular screws and interlocking nails.

**Laparoscopic Surgery -** The large "C" gives wide clearance around the patient and the table, allowing more room for protruding instruments.

**Endoscopic Studies -** Fixed room quality imaging with a Mobile C-Arm allows the endoscopist the convenience and safety of working in their own department with their own staff and equipment.

**Vascular Surgery -** Integrated dynamic image storage lets the vascular surgeon instantly play back the recorded run to check the integrity of graft anastomosis and vessel patency.

**Pain Management -** The 25° overscan of the Series 9600 allows positioning flexibility for increased viewing options, and because the system plugs into a standard 110V 15A outlet, no site planning is required.



**Emergency And Trauma -** Because of its ability to move from room to room, the Series 9600 can be used in the ER for everything from angiography to foreign body localization without moving the patient.

**Chest And EP Imaging -** The EP imaging capabilities of the Series 9600 include a rotating anode X-ray tube that allows longer fluoro-on times without the worry of system shutdown due to overheated tubes.

**Neurosurgery -** The advanced image processing capabilities of the Series 9600 allow the neurosurgeon the advantages of performing intra-operative angiography and roadmapping, as well as confirming procedural results.

### **SELECTED SPECIAL FEATURES**

- Both C-Arm and Workstation are light and compact for easy transportation and maneuverability. Ideal 90:10 weight distribution and unique multi-position locking wheels provide for "push or pull" operation.
- Connects to any available 110V 15A or 220V 8A outlet with single power cable and single keyswitch for quick operation.
- Flash S-RAM memory card transfers software code for fast start-up time.
- EasyOp user-friendly one-button operation of all functions.
- More space due to large 26" depth of "C" and extra-large 31" free space between X-ray tube and image intensifier gives greater room for protruding instruments and operating room tables.
- Handles, variable-friction locks and the control panel are duplicated on both sides of the system for ease-of-use.
- Motorized iso-centric arcing movements minimize unnecessary repositioning.
- Large 8-inch diameter wheels with integrated cable pushers allow for easy maneuverability and positioning.
- Selectable ABS tables vary mA, kVp and camera gain.
- Extra-long continuous fluoro-on times are possible due to high heat dissipation of the rotating anode X-ray tube.
- Motor-driven iris collimation and dual opposing semi-transparent shutters provide wedge filtration allowing enhanced control of difficult images.
- Compact custom-designed CCD video camera with rapid cooling ensures high signal-to-noise ratio, lag-free, high sensitivity image acquisition.
- Motor-driven 360° image rotation within the CCD camera ensures correctly positioned image annotation on hardcopy documentation.
- On-screen orientation icon allows image rotation to indicated position without generating X-rays.
- Image intensifier and X-ray tube incorporate easy to reach positioning handles.

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#### System Overview

- Digital image processing options include variable edge enhancement, motion artifact reduction (MARS), variable frame averaging, window/level control and real-time auto histogramming.
- Real-time subtraction option with roadmapping, peak opacification, re-registration, variable landmarking, mask save/recall and dynamic digital storage.
- Digital image storage from 4 to 9,000 images via RAM, 3<sup>1</sup>/<sub>2</sub>" disk HD or hard disk options.
- 16-inch square, black etched, anti-static, anti-glare FastScan monitors operate at 73Hz non-interlaced providing flicker-free viewing.
- Keyboard and control panels incorporate icon, language and color coding identification for precise and accurate system operation. Panels are waterproof, and offer raised keys with tactile and audible feedback. Custom-designed optional TrackPad allows rapid and precise system control.
- Ambient room light sensor automatically adjusts monitor brightness regardless of room illumination.
- Multi-LED X-ray "ON" indicator located above monitor displaying real-time fluoro.
- Optional SteriQuick draping system quickly attaches to X-ray tube, II and "C" to ensure sterility.
- Laser Aimer/localizer option, projects a light beam from the image intensifier, enabling exact positioning and site marking in orthopedics and many other procedures.
- All models from ESP and up can be equipped with "Digital Spot" capability. Speed-up your procedure while reducing costs by documenting results via ultrahigh quality laser or standard camera hardcopies.
- Digital laser camera interface provides direct connection to cameras meeting the 3M 952 protocol, for the highest quality film reproduction.

# **X-RAY SYSTEM SPECIFICATIONS**

#### Generator

- High frequency
- 4.0 kW full-wave
- Up to 120 kVp
- Up to 75 mA for radiographic film exposures
- Continuous fluoro boost mode up to 12 mA (optional)
- Pulsed fluoro mode
- Pulsed fluorography mode up to 40 mA (optional)
- Full power from 110V 15A /220V 8A
- Patented energy buffer design

#### X-ray Tube

- Rotating anode X-ray tube
- Focal spots: 0.3 mm and 0.6 mm
- Anode heat capacity: 300,000 H.U.
- Anode cooling rate: 60,000 H.U./min
- Housing heat capacity: 1,600,000 H.U.
- Anode diameter: 3.1 inches
- Anode angle: 8.5° (9-inch Image Intensifier Tube II), 10° (12-inch Image Intensifier Tube)

#### Collimator

- Iris collimation with dual opposing semi-transparent shutters allow elliptical, round and rectangular collimation
- Iris and shutters are continuously variable
- All functions remotely controlled from the C-Arm control panel

#### Fluoroscopy Mode

- Focal spot: 0.3 mm
- kVp range: 40-120
- Maximum ripple: typically 1% @ 120 kVp/5 ma
- mA range: 0.2-5.0 normal mode, 1.0-12 mA continuous fluoro boost mode (optional)

#### System Overview

- Auto and manual modes
- Continuous, one-shot or pulsed operation
- ABS varies mA, kVp and camera gain
- User specific ABS tables

#### **Pulsed Fluoroscopy Mode**

- Focal spot: 0.3 mm
- kVp range: 40-120 kVp
- mA range: 0.2-5.0 mA
- Pulse rate: 1, 2, 4, or 8 pulses per second
- Pulse width: 30 or 50 milliseconds
- Computer controlled ABS, mA, kVp and camera gain
- 4FPS or 30 FPS digital disk (optional)

#### **Pulsed Fluorography Mode (optional)**

- Focal spot: 0.3 mm
- kVp range: 40-120
- mA range: up to 40
- Pulse width: 30 or 50 milliseconds
- Pulse rate: 1,2,4, or 8 pulses per second
- Computer controlled camera iris, mA, kVp, & camera gain
- 4FPS or 30 FPS digital disk (optional)

#### **Radiographic Mode**

- Focal spot: 0.3 mm or 0.6 mm
- Focal spot automatically selected
- mAs range: 1-300
- kVp range: 50-120
- Cassette holder 10 in. x 12 in. / 24 cm x 30 cm

### **VIDEO IMAGING SYSTEM SPECIFICATIONS**

#### **Image Intensifier**

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- Tri-mode 9/6/4.5 inch or 12/ 9/6-inch image intensifier
- Central resolution (typical):

4.5 inch 64 lp/cm 6 inch 56 lp/cm 9 inch 48 lp/cm

Peripheral resolution @ 70% radius (typical):

4.5 inch 58 lp/cm 6 inch 52 lp/cm 9 inch 44 lp/cm

• QDE: 75% (typical @ 1.7 Hz)

#### T.V. Camera

- High resolution CCD camera
- Full frame capture
- 360° motorized rotation
- On-screen orientation indicator (real-time feedback without fluoro)
- Left-right image reversal
- Top-bottom image reversal
- Negative mode
- Bandwidth: 10.5 MHz
- Video signal:

Standard RS 170A 60 Hz, 525 line International CCIR 50 Hz, 625 line

- Aspect ratio: 4:3
- Computer controlled features:

Gain Blanking Camera iris

#### **Video Monitors**

- Dual 16-inch square, black etched, anti-glare, anti-static
- 525/625 lines, FastScan flicker-free 73 Hz non-interlaced VGA compatible
- Ambient room light sensor
- Multi-LED X-ray "ON" indicator
- Remote window/level controls

# **PHYSICAL SPECIFICATIONS**

- Free space in arc: 31 inches (787 mm)
- Depth of arc: 26 inches (660 mm)
- Arc orbital movement: 115°
- Left/right wig-wag scan: ±11°
- Vertical travel: 18" motorized (457 mm)
- Horizontal travel: 8" (203 mm)
- L-arm rotation: ±180° motorized
- Reversible C-Arm: ±180° manual Flip-Flop
- C-Arm dimensions:

Length: 78.5 in. (1994 mm) Height: 68.25 in. (1734 mm) Width: 33 in. (838 mm)

• Workstation dimensions:

Width: 27.25 in. (692 mm) Height: 64.25 in. (1632 mm) Depth: 27.25 in. (692 mm)

• Electrical:

Input power (50 Hz or 60 Hz): 100V 15A 110V 15A 120V 15A 200V 8A 220V 8A 240V 8A

# **System Configurations and Options**

There is one standard model 9600 system available; the SP (Surgical Platform) model. The Extended Surgical Package (ESP) offers features and module options that expand the capabilities of the standard package. Peripheral equipment such as VCRs and other media storage devices are available with the SP and ESP packages.

### SURGICAL PLATFORM (SP)

- 4 image storage with last image hold, 640 x 512 x 10 bit
- Frame averaging (low, medium, high)
- One-shot frame integration (low, medium, high)
- Enhanced integration (low, medium, high)
- MARS (motion artifact reduction)
- Patient annotation keyboard
- Digital window/level
- Real-time auto-histogramming
- Negate
- On-line help menus
- Integrated 2-on-1 or 1-on-1 hardcopy camera (optional)

### **ORTHOPEDIC MODULE (OPTIONAL)**

Available only with the Surgical Platform (SP)

- 16 image storage with last image hold
- 16 image collage
- Laser Aimer/localizer accessory (standard)
- Continuous fluoro boost mode up to 12 mA (standard)
- Pulsed fluorography mode up to 40 mA (standard)

# EXPANDED SURGICAL PLATFORM (ESP) (OPTIONAL)

Available only with the Surgical Platform (SP)

- 100 image storage with last image hold
- 6 image storage on 3<sup>1</sup>/<sub>2</sub>-inch disk (removable)
- 16 image collage of 100 image disk
- TrackPad with superkey

- Variable edge enhancement (TrackPad)
- Variable zoom & roam (TrackPad)
- Patient directory with minified image scroll (TrackPad)
- Anatomical markers
- Procedural dose log (mA, kVp, time, patient)
- Integrated S-VHS VCR (optional)
- Multi-function infra-red remote control (optional)
- 4 FPS digital disk (optional)

# DIGITAL SPOT (CHOLE) MODULE (OPTIONAL)

Available only with the Expanded Surgical Platform (ESP)

- Enhanced digital fluorographic one-shot with 12 mA boost
- Automatically terminates exposure and stores enhanced image to 100 image storage archival disk
- Digital laser camera interface, 3M 952 protocol (optional)
- 4 FPS or 30 FPS digital disk (optional)

# VASCULAR MODULE (OPTIONAL)

Available only with the Expanded Surgical Platform (ESP)

- Continuous fluoro boost mode up to 12 mA
- Pulsed Fluorography mode up to 40 mA
- Real-time subtraction
- Roadmapping
- Peak opacification
- Re-registration (TrackPad)
- Variable landmarking (TrackPad)
- Mask save/recall
- Integrated S-VHS VCR (optional)
- 4 fps digital disk (optional)

# **NEUROVASCULAR MODULE (OPTIONAL)**

Available only with the Expanded Surgical Platform (ESP)

- Continuous fluoro boost mode up to 12 mA
- Pulsed fluorography mode up to 40 mA
- Real-time subtraction
- Roadmapping
- Peak opacification
- Re-registration (TrackPad)
- Variable landmarking (TrackPad)
- Mask save/recall
- Integrated S-VHS VCR (optional)
- 30 FPS digital disk
- Record/play rate: 1, 2, 4, 8, 15 or 30 fps
- Record time: 150, 75, 40, 20, 10 or 5 minutes
- Image storage: 9,000 digital images (60 Hz)
- Instant image access with TrackPad
- Synchronized to pulse with generator, CCD camera and image processor

# 4 FRAMES/SECOND DIGITAL DISK (OPTIONAL)

Available only with the Expanded Surgical Platform (ESP), Digital Spot (Chole) or Vascular Modules

- Record/play rate: 1, 2 or 4 FPS
- Record time: 22, 11 or 6 minutes
- Image storage: 1,350 digital images (60 Hz)
- Instant image access with TrackPad
- Synchronized to pulse with generator, CCD camera and image processor

### **IMAGE STORAGE**

- Last image hold (all configurations)
- Digital memory capacity:

Surgical Platform (SP): 4 images Orthopedic Module: 16 images Expanded Surgical Platform (ESP): 100 images, 6 images (3½" disk) 4 FPS digital disk: 1,350 images (60 Hz) 30 FPS digital disk: 9,000 images (60 Hz)

 Analog memory options: Integrated S-VHS VCR

# HARDCOPY OPTIONS

- Radiographic film capability
- Integrated hardcopy camera 8 in. x 10 in. 2-on-1 or 1-on-1 formats
- Thermal printer

# SYSTEM CONTROLS

- Entire system is computer controlled software upgradeable
- Multi-function infra-red remote control (optional)
- Hand held X-ray remote control
- Multi-function footswitch

# **SYSTEM OPERATION**

This section briefly describes the controls available to the operator on the 9600 C-Arm and Workstation. Refer to the Series 9600 Operator's Guide and Series 9600 Reference Manual for details on how to use these functions.



# **C-ARM CONTROLS**

The controls listed below are found on either side of the C-Arm control panel assembly (see Figure 1). A brief description of the function is given. Refer to the Series 9600 Operator's Guide and Series 9600 Reference Manual for more details.



**NORMAL/MAG1/MAG2** - selects the X-ray field size in FLUORO mode: Normal (approximately 9 inch/23 cm), MAG 1 (approximately 6 inch/15 cm), or MAG 2 (approximately 4 inch/11 cm). In FILM mode, this key has no action. The field size in FILM mode is always the same as the last FLUORO field size selected.

L+A

**L-R** - swaps the video images on the left and right monitors. (Allows storage of up to four images in memory on Surgical Platform models).



**SAVE** - saves the image on the left monitor to the hard disk. The image number appears on the right monitor during the save process.



**CART** (Workstation) **MODE** - selects the different imaging modes on the Workstation



**BOOST ENABLE** - (Option) This key is a safety feature to prevent boost from being inadvertently activated on the Footswitch or Handswitch. Press and hold this key for five seconds to enable the BOOST function. The LED near this key will light to indicate that boost is enabled. Press again briefly to disable. BOOST cannot be used when the ABS table has been set for LOW DOSE.



**C-ARM MODE** - selects either **AUTO FLUORO** mode (where kV, mA, and camera gain are controlled automatically for the best video brightness level), **MANUAL FLUORO** mode (where kV and mA are selected manually), or **FILM** mode.





**IMAGE REVERSAL** - Image is inverted top to bottom (vertical reverse) or reversed left to right (horizontal reverse). There are a total of four possible image orientations. These are indicated by the letter "R" shown in four orientations. The "R" key sequentially selects each of the four orientations. The adjacent LEDs indicate the orientation selected.



CAMERA ROTATION - rotates the image 360 degrees.



**IRIS COLLIMATION** - opens and closes the collimator iris.



**LEAF COLLIMATION** - opens and closes the semi-transparent collimator leaves.



**COLLIMATOR ROTATION** - rotates the collimator leaves clockwise or counter-clockwise.



**KVP CONTROL** - adjusts the kVp in the **MANUAL FLUORO** and **FILM** modes by pressing up or down.



**MA CONTROL** - adjusts the mA in the **MANUAL FLUORO** mode and the mAs in the **FILM** mode by pressing up or down.



**ABS SELECT** - selects different ABS tables.



**PULSE** - selects repeated, timed X-ray pulses in FLUORO mode.



**TECH LOCK** - In AUTO mode, prevents all technique factors, except camera gain, from varying. In MANUAL mode, prevents camera gain from varying, but kVp and mA can be adjusted. Tech Lock also prevents switching between MANUAL and AUTO fluoro modes.



**ALARM RESET** - After five minutes of accumulated exposure time, the beeper will sound a continuous alarm. Press this key briefly to reset the alarm, without resetting the total accumulated time. Press and hold this key for five seconds to reset the accumulated exposure time to zero.

## **WORKSTATION CONTROL PANELS**

The following illustrations depict the control panels for the 9600 SP model, the ESP model Workstations, and optional modules. Refer to the 9600 Operator's Manual for operational details.



Figure 2 - Surgical Platform (SP) Front Panel





Figure 4 - Expanded Surgical Platform (ESP) Front Panel



#### Figure 5 - Expanded Surgical Platform (ESP) Trackpad Panel



Figure 6 - Expanded Surgical Platform (ESP) with Acquire - Front Panel





Figure 8 - ESP Vascular/Neuro-Vascular with Acquire - Front Panel



#### Figure 9 - ESP Vascular/Neuro-Vascular with Acquire - Trackpad Panel

#### System Overview



Figure 10 - QWERTY Keyboard



Figure 11 - Lenzar Hard Copy Camera Control Panel

### **WORKSTATION CONTROLS**

The controls listed below are found on the various 9600 Workstations. A brief description of the function is given as an overview. Refer to the Series 9600 Operator's Guide and Series 9600 Reference Manual For more details. The controls available depend on the system model as follows:

- Surgical Platform (SP) see Figures 2 and 3
- Expanded Surgical Platform (ESP) see Figures 4 and 5
- Expanded Surgical Platform (ESP) with Acquire see Figures 6 and 7
- ESP Vascular/Neuro-Vascular with Acquire see Figures 8 and 9

#### **Front Panels**

FLUORO - basic real time fluoroscopic imaging mode.

**ONE-SHOT** - obtains an image which has been averaged over a number of image frames. X-rays are on only during the integration.

**DIGITAL SPOT** - (Vascular and Expanded Surgical Platform models only) - combines BOOST and ONE-SHOT. Images are automatically saved at the end of the exposure.

**ROADMAP** - (Vascular model only) - provides a subtracted image on the left monitor that is the difference between the current fluoroscopic image and a mask image.

**SUBTRACT** - (Vascular model only) - provides images that are the difference between current images and a mask image obtained at the start of the subtraction process.

**ENHANCED ONE-SHOT** - (Surgical Platform model only) - combines integration with further image sharpening to emphasize the image edges.

**AVERAGING** - selects the level of averaging: LOW, MEDIUM, OR HIGH. Display segments illuminate in succession to indicate the amount of averaging.

| No segments | MINIMUM averaging |
|-------------|-------------------|
| Segment 1   | LOW averaging     |
| Segment 2   | MEDIUM averaging  |
| Segment 3   | HIGH averaging    |

**RECALL** - recalls a stored image saved since bootup to the left monitor.

**SAVE** - saves the image on the left monitor to the hard disk. (Duplicates the L/R function on Surgical Platform models models not equipped with the hard disk option).

**L** - **R** - swaps left and right monitor images. Allows storage of up to four images in short-term memory on Surgical Platform models.

#### **Trackpad Panels**

**WINDOW** - adjusts the apparent contrast of the image on the left monitor. The adjustment is also performed on hardcopy camera video.

**ON/OFF** - turns WINDOW and LEVEL ON or OFF.

**LEVEL** - adjusts the apparent brightness of the image on the left monitor. The adjustment is also performed on hardcopy camera video.

**NEGATE** - changes the image display from a dark image on a light background to a light image on a dark background (reverses gray scale values).

**AUTOHISTO** - performs continuous automatic adjustments in the WINDOW/LEVEL values (automatic use of full gray scale range).

SHARPEN - emphasizes the image edges.

**ZOOM** - magnifies a region of interest on the left monitor image 2 or 4 times. The magnified image is displayed on the right monitor.

VCR PLAY - allows you to review a previously recorded image or run.

VCR RECORD - allows you to record processed or unprocessed images.

**TRACKPAD POINTER** - selects menu options and moves the cursor in menus and on images being annotated.

**SUPERKEY** - (2, either side of Trackpad pointer) - performs the same functions as the ENTER key on the keyboard.

**PLAY/PROCESS** - allows the operator to review cine run images from the 4FPS (four frames per second) or 30FPS (thirty frames per second) digital disk options.

**ACQUIRE** - allows the operator to acquire cine run images to the 4FPS (four frames per second) or 30FPS (thirty frames per second) digital disk options.

**PEAK OPACIFY** - saves the regions of greatest contrast that occur in the image during the contrast media injection.

**REGISTRATION** - realigns the mask with the processed image in subtract or roadmap (pixel shifting in the event of patient movement).

**LANDMARK** - varies the amount of background anatomy on a roadmapped or subtracted image.

#### **Qwerty Keyboard**

**HELP** - displays an index of help topics on the right screen of the Workstation.

**PATIENT (ANNOTATE)** - displays the Annotation Editor on the right screen of the Workstation. The Annotation Editor is used for labeling images with patient name, hospital ID number, doctor, etc.

**DISK VIEW** - displays a page on the right screen of the Workstation containing a collage of sixteen of the one hundred minified images stored on the hard disk. These images can be scrolled thru or selected using the arrow and enter keys or the trackpad pointer and superkeys on the trackpad panel.

**IMAGE DIRECTORY** - displays an alphabetical directory of patient or doctor names on the right Workstation screen.

**MARKERS** - displays the MARKERS screen. Markers are used as an aid to patient annotation.

**X-RAY SUMMARY** - displays a summary file of the X-ray exposures made during a procedure.

**SPECIAL APPS** - There are currently no special applications installed on this system.

**TEST PATTERN** - Brings up a gray scale test pattern.

**CUSTOMIZE** - displays the Customize menu, which allows the pulse rates and VCR configurations to be customized.

**SETUP OPTIONS** - used to set current time and date, display the software ID screen, and access level 2 servicing menus.

**ESC** - Press this key to exit from a function screen or menu.

**PGUP/PGDN** - Press either of these keys to scroll through help screens, or the disk view screens, one screen at a time.

**ARROW KEYS** - Press these keys as an alternative to the trackpad pointer to move the cursor or arrow pointer around the screen.
### Lenzar Hardcopy Camera Control Panel

**RESET** - this key resets the camera to its READY state for EXP1 (exposure 1).

**PROGRAM** - allows the operator to program the various settings.

**LED DISPLAY** - displays the current user number or exposure number.

**EXPOSE** - initiates the hard copy camera exposure.

**ARROW KEYS** - increments, decrements, and advances the camera settings.

## **COVER REMOVAL**

## **MOBILE C-ARM COVERS**

To remove the Mobile C-Arm covers perform the following steps and refer to Figure 12.

## WARNING Electrical circuits inside the equipment use voltages that are capable of causing serious injury or death from electrical shock.

- 1. Unplug the system from AC power.
- 2. Remove the Rear Handle Cover by removing 3 (A) screws located behind the cover door and one screw (B) on each side at bottom, front of cover.
- 3. Remove the Front Cover by removing 2 screws (C) near the top of the vertical shaft under the rubber cover.
- 4. Remove the Front Leg Cover by removing 8 screws: 2 (D) underneath the toe of the cover, 2 (E) underneath each cross beam, and 2 (F) from the top front of the cover.
- 5. Remove the Left Front Cover and Right Front Cover by removing the 3 screws (G) on each side.



Figure 12 - C-Arm Cover Removal

## **CONTROL PANEL**

WARNING Electrical circuits inside the equipment use voltages that are capable of causing serious injury or death from electrical shock. Use appropriate precautions.

- 1. Remove the Hole Plug (A) and 1 Torx screw (B) securing the Cross Arm Brake Handle. Refer to Figure 13.
- 2. Remove 2 Torx screws (C) from the bottom of the Cross Arm Lower Cover. Lift the Cross Arm Center Cover up carefully.
- 3. Remove 5 Torx screws (D) securing the Control Panel Side Covers and disconnect P4, P5, P6, and P7 on the Power Signal Distribution PCB.
- 4. Unplug the Control Panel wiring on the Control Panel Processor PCB. Make sure all connectors are labeled.
- 5. Remove 4 Phillips screws (E) on the front and rear of the Cross Arm Lower Cover.
- 6. Remove hole plug (F) and slotted screw (G) from the Wig Wag Brake Handle and carefully remove the handle. Carefully pull the cover down.



Figure 13 - Control Panel Cover Removal

## **WORKSTATION COVERS**

To remove the Workstation covers perform the following steps. Refer to Figures 14-20.

## WARNING Electrical circuits inside the equipment use voltages that are capable of causing serious injury or death from electrical shock.

1. Rotate each of the eight 1/4-turn fasteners on each side of the rear cover as shown in Figure 14.



Figure 14 - Loosening Rear Cover Screws

2. Move the bottom of the cover outward a few inches and then move the entire cover downward as shown in Figure 15.



Figure 15 - Rear Cover Removal

#### System Overview

3. Pull the left and right side covers to the rear. The covers are fitted into a slot in the base and in the non-removable handle cover as shown in Figure 16.



- 4. Grasp the front cover near the bottom with both hands, and giving equal pressure on both sides, lift the cover upward to free the two ball-nut fasteners mounted on the bottom edge of the cover.
- 5. Move the cover upward under the keyboard.
- 6. Move the bottom outward, then downward, to free the cover as shown in Figure 17.
- **NOTE:** If a Lenzar camera is fitted to the Workstation, the ribbon cable connecting the camera control panel to the camera should be disconnected at this time before removing the front cover.
- WARNING Unplug the system from AC power if the front cover is to be removed. With the system plugged into AC power, there will be a +12V on the keyswitch wiring.
  - NOTE: If the front cover is to be removed, separate the 4-pin Molex connector (J15-P15) on the right side of the frame. These wires are connected to the key switch mounted on the front cover.



Figure 17 - Front Cover Removal

#### System Overview

8. Remove the monitor cover by grasping the cover on each side and pulling the cover to the rear (see Figure 18). This will disengage the ball-nut fasteners, two at the top of the cover and two at the bottom of the cover, near each side.



Figure 18 - Monitor Cover Removal

### **K**EYBOARD

1. Remove the six # 6 Torx-head screws located under the front lip of the keyboard as shown in Figure 19.



Figure 19 - Keyboard Retaining Screw Removal

2. Grasp the top keyboard cover on each side and pull it forward and to one side a short distance and separate it from the base and the monitor bezel as shown in Figure 20.



Figure 20 - Keyboard Removal

- 3. Move the top of the keyboard to the front and turn it over to expose the printed circuit card under the keytops and the Control Panel Processor PCB.
- 4. Disconnect the ribbon cable plugs from their sockets on the Control Panel Processor PCB.
- 5. Remove the # 8 Torx-head screws on the keyboard base to free the three black ground wires.
- NOTE: Normally, the QWERTY and trackpad key panels should not be removed from their mountings. However, if removal is required, care should be taken not to substitute the mounting screws or damage to the key panels will result.

#### **Keyboard Reassembly**

The keyboard should be replaced in the opposite manner to the above disassembly. When replacing the keyboard assembly, be sure the cables and ground wires are folded back over the top of the Control Panel Processor PCB and are not pinched.

- 1. Place the keyboard assembly against the bottom of the monitor bezel and push firmly to seat the keyboard assembly between the bezel and flat spring attached to the monitor base plate.
- **NOTE:** The cutout on the lower rear lip of the keyboard assembly should slip between the spring and the bezel. The raised ridges along the top rear of the keyboard assembly should be under the monitor bezel when the assembly is firmly seated.
  - 2. Replace the screws under the front lip of the keyboard assembly (see Figure 19) and test system operation from the keyboard.

## **COMPONENT LOCATIONS**



Figure 21 - Mobile C-Arm Component Locator

## **MOBILE C-ARM COMPONENT LOCATOR**

| AREA              | COMPONENTS                                      |
|-------------------|---|
| X-ray Head        | X-ray Tube                                      |
|                   | Temperature Sensor                              |
|                   | Collimator Asm                                  |
|                   | Thermal Switch                                  |
| Image Head        | Image Intensifier Asm                           |
|                   | Image Intensifier Power Supply                  |
|                   | Image Function PCB (S/N 69-0001 to 69-<br>2000) |
|                   | CCD Camera and Optics Asm                       |
|                   | Pixel Filter PCB                                |
| Forward Mechanics | Cross Arm Shaft                                 |
|                   | L-arm   |
|                   | L-arm Rotation Motor                            |
|                   | L-arm Motor Power PCB                           |
|                   | L-arm Rotation Limit Switches                   |
|                   | Flip Flop Asm                                   |
|                   | C-arm   |
| Cross Arm Housing | Control Panels                                  |
|                   | Control Panel Processor PCB                     |
|                   | Signal Power Distribution PCB                   |
|                   | Vertical Column Switches                        |
|                   | L-arm Rotation Switches                         |
|                   | X-ray ON Switch                                 |
|                   | Cross Arm Brake                                 |
|                   | Wig Wag Asm & Brake                             |

### Mobile C-Arm Component Locator (Cont.)

| Rear Handle Cover | Electronic Card Rack                   |  |  |  |  |
|-------------------|--|--|--|--|--|
| Asm               | Analog Interface PCB                   |  |  |  |  |
|                   | Technique Processor PCB                |  |  |  |  |
|                   | Image Function PCB (S/N 69-2001 &      |  |  |  |  |
|                   | higher)                                |  |  |  |  |
|                   | Solid State Drive                      |  |  |  |  |
|                   | Motherboard                            |  |  |  |  |
|                   | Generator Controller Asm               |  |  |  |  |
|                   | X-ray Regulator PCB                    |  |  |  |  |
|                   | Generator Driver PCB                   |  |  |  |  |
|                   | Battery Charger PCB                    |  |  |  |  |
|                   | L1, C1: Primary Filter                 |  |  |  |  |
|                   | C2, C3, R1: Precharge Circuit          |  |  |  |  |
|                   | K1: Precharge Relay                    |  |  |  |  |
|                   | K2: Contact Relay                      |  |  |  |  |
|                   | C4, L2 Battery Charger Filter          |  |  |  |  |
|                   | Q1, Q2: Darlington Transistors         |  |  |  |  |
|                   | F1: Fuse                               |  |  |  |  |
|                   | High Voltage Tank                      |  |  |  |  |
|                   | Batteries                              |  |  |  |  |
|                   | +12 VDC Fans (2)                       |  |  |  |  |
| Front Cover       | Vertical Column Limit Switches         |  |  |  |  |
| Front Leg Cover   | PS1: +5 VDC Power Supply               |  |  |  |  |
|                   | Vertical Column Motor and Motor Cap C6 |  |  |  |  |
| Left Side Cover   | Power Panel Interface                  |  |  |  |  |
|                   | Power Signal Interface PCB             |  |  |  |  |
|                   | Power Motor Relay PCB                  |  |  |  |  |
|                   | PS2: +24 VDC Power Supply              |  |  |  |  |
|                   | Stator Transformer T3                  |  |  |  |  |
|                   | Stator Capacitor C5                    |  |  |  |  |
|                   | Vertical Column Chain (Left)           |  |  |  |  |
| Right Side Cover  | H.V. Tank Connectors                   |  |  |  |  |
|                   | CB1: Battery Circuit Breaker           |  |  |  |  |
|                   | Vertical Column Chain (Right)          |  |  |  |  |
| End Cap Cover     | Rear Wheel Mechanics                   |  |  |  |  |



Figure 22 - Workstation Component Locator

## WORKSTATION COMPONENT LOCATOR

| AREA          | COMPONENTS                                  |  |  |  |  |
|---------------|---|--|--|--|--|
| Monitor Cover | Monitors and Circuit Boards                 |  |  |  |  |
|               | Contrast/Brightness PCB                     |  |  |  |  |
|               | Contrast/Brightness Potentiometers          |  |  |  |  |
|               | Infrared Receiver Assembly                  |  |  |  |  |
|               | AC Power Strip                              |  |  |  |  |
| Control Panel | Qwerty Keyboard                             |  |  |  |  |
| Assembly      | Front Control Panel                         |  |  |  |  |
|               | Trackpad Control Panel                      |  |  |  |  |
|               | Workstation Control Panel Processor         |  |  |  |  |
| Front Cover   | Lenzar Camera                               |  |  |  |  |
|               | Isolation Transformer T1 (for removal, with |  |  |  |  |
|               | Lenzar camera removed)                      |  |  |  |  |
| Left Cover    | Electronics Box Side Door                   |  |  |  |  |
|               | Hour meter (on earlier models)              |  |  |  |  |
|               | DC Power Distribution PCB                   |  |  |  |  |
|               | Power Supply PS1 (+5, -5, +12, -12)         |  |  |  |  |
|               | Power Control PCB                           |  |  |  |  |
|               | Power Supply PS4 (+24V)                     |  |  |  |  |
|               | Terminal Block TB2                          |  |  |  |  |
|               | CB2, CB3                                    |  |  |  |  |
|               | J12, J13, J14, J16                          |  |  |  |  |
|               | Secondary Side of Isolation Transformer     |  |  |  |  |
|               | T1  |  |  |  |  |
|               | Workstation End of Interconnect Cable       |  |  |  |  |
| Right Cover   | Surge Suppresser PCB                        |  |  |  |  |
|               | CB1   |  |  |  |  |
|               | J6  |  |  |  |  |
|               | Primary Side of Isolation Transformer T1    |  |  |  |  |
|               | Power Cable Input                           |  |  |  |  |
| Rear Cover    | Electronics Box Rear Door                   |  |  |  |  |
|               | 386 AT Motherboard                          |  |  |  |  |
|               | Image Processor PCB                         |  |  |  |  |
|               | Video Switching PCB                         |  |  |  |  |
|               | Aux Interface PCB                           |  |  |  |  |
|               | AT Communications PCB                       |  |  |  |  |
|               | Fast Scan PCB                               |  |  |  |  |
|               | Disk Controller PCBs                        |  |  |  |  |
|               | Hard Drives                                 |  |  |  |  |
|               | Floppy Drive                                |  |  |  |  |
|               | Laser Printer Interface PCB                 |  |  |  |  |
|               | AC Power Strip                              |  |  |  |  |
|               | J1, J2, J7, J8, J9, J10                     |  |  |  |  |
|               | Fan B1                                      |  |  |  |  |
|               | Terminal Block TB1                          |  |  |  |  |
|               | Hour Meter (on later models)                |  |  |  |  |

## **CIRCUIT BOARD FUNCTIONS**

### **MOBILE C-ARM**

#### Control Panel Processor PCB

Sch. #00-875601 - Asy. #00-875603 - S 9-0001 thru 69-2000 Sch. #00-878486 - Asy. #00-878488 - S/N 69-2001 and up

Interfaces left and right control panels Interfaces X-ray switch and Fast Stop switches to system Drives LEDs on control panels Drives left and right fluorescent displays

#### Control Panel Processor I/O PCB

Sch. #00-878489 - Asy. #00-878491 - S/N 69-2001 and up

Connection point for new Control Panel Processor PCB (Asy. #00-878488)

#### Column I/O PCB

Sch. #00-878492 - Asy. #00-878494 - S/N 69-2001 and up

Cabling connection point - no active circuitry

#### **Technique Processor PCB**

Sch. #00-876735 - Asy. #00-876737 - S/N 69-0001 thru 69-1000 Sch. #00-877742 - Asy. #00-877744 - S/N 69-1001 and up

Controls C-Arm Loads and runs <u>DOS and Applications Software</u> from Solid State Disk Drive Serial communications to <u>C-Arm</u> and <u>Workstation Control Panel Processor</u> and <u>Image Function PCB</u>

Analog Interface PCB

Sch. #00-876738 - Asy. #00-876740 - All S/N

"Slave" to <u>Technique Processor PCB</u> Analog to digital conversion Digital to Analog conversion PIO control outputs and status inputs Counter/timer circuitry for generator drive signals

#### **Mainframe Motherboard**

Sch. #00-875539 - Asy. #00-900588 - S/N 69-0001 thru 69-2000 Sch. #00-878396 - Asy. #00-900970 - S/N 69-2001 and up

Backplane of generator cardrack Power and signal interconnection and distribution

#### Power/Motor Relay PCB

Sch. #00-875997 - Asy. #00-875999 - All S/N

<u>Stator</u> start and run relays Stator current sense circuitry <u>C-Arm lift and rotation motor relays</u> <u>Generator +24V interlock relay</u> <u>Image intensifier</u> relay

#### Power/Signal Interface PCB

Sch. #00-876001 - Asy. #00-876003 - S/N 69-0001 thru 69-1000 Sch. #00-877998 - Asy. #00-878000 - S/N 69-1001 and up

Interfaces AC and DC power Interfaces control signals and serial communications signals

#### X-ray Regulator PCB

Sch. #00-877458 - Asy. #00-877460 - All S/N

KV control and sense MA control and sense Fault PAL circuitry

#### Generator Driver PCB

Sch. #00-877461 - Asy. #00-877463 - All S/N

Filament regulator circuitry for MA Inverter driver circuitry for KV Saturation fault detector circuitry

#### Battery Charger PCB

Sch. #00-876643 - Asy. #00-876644 - S/N 69-0001 thru 69-1000 Sch. #00-877995 - Asy. #00-877997 - S/N 69-1001 and up

Charges <u>batteries</u> Provides <u>precharge voltage</u>

#### Image Functions PCB

Sch. #00-874750 - Asy. #00-874752 - S/N 69-0001 thru 69-2000 Sch. #00-878398 - Asy. #00-878400 - S/N 69-2001 and up

Interfaces controls from <u>Technique Processor</u> to <u>collimator</u>, <u>CCD camera</u>, and <u>Image Intensifier Tube</u> Stores collimator iris field size calibration information

Pixel Filter PCB Sch. #00-877789 - Asy. #00-877791

Filters white pixel noise from video signal

#### **Pixel/Column Filter PCB**

Sch. #00-878045 - Asy. #00-878047

Filters white pixel noise and CCD column shading variations from video signal

### WORKSTATION

#### **DC Power Distribution PCB**

Sch. #00-876839 - Asy. #00-876841 - All S/N

Distributes +5, -5, +12, -12 volts to various locations on the Workstation. Generates system reset signal (SYSRST\*) with <u>power fail circuitry</u>.

#### Surge Suppressor PCB

Sch. #00-876784 - Asy. #00-876786 - All S/N

Suppresses voltage spikes on the line voltage for system protection

#### Power Control PCB

Sch. #00-876547 - Asy. #00-876549 S/N 69-0001 thru 69-1000 Sch. #00-878001 - Asy. #00-878003 - S/N 69-1001 and up

Provides AC interfacing and safety circuits from the **isolation transformer** to the Carm and Workstation.

#### Workstation Control Panel Processor PCB

Sch. #00-876611 - Asy. #00-876613 - All S/N

Interfaces front panel keys and LEDs to/from <u>Communications PCB</u> Interfaces trackpad keys, LEDs, and pointer circuitry to/from Communications PCB Interfaces window/level circuitry to/from Communications PCB Drives audio speaker. Interfaces IR signals to system. Serial communications to Communications PCB via <u>Aux Interface PCB</u>

#### Contrast/Brightness Control PCB

Sch. #00-876351 - Asy. #00-876353 - All S/N

Contrast & brightness control circuitry Auto brightness & contrast signal interfacing

#### **IR Transmitter PCB**

Sch. #00-873936 - Asy. #00-873938 - All S/N

Contained in the IR remote hand controls Generates IR control signals

#### **IR Receiver PCB**

Sch. #00-874220 - Asy. #00-874222 - All S/N

Receives, demodulates, and amplifies IR signals for system interfacing Contains photocell for auto brightness/contrast circuits

#### Auxiliary Interface PCB

Sch. #00-876502 - Asy. #00-876504 - All S/N

Cabling interconnection to interface and distribute signals in Workstation. Provides hospital room interfacing for: Room in use light X-ray on light Power dye injection systems Door interlock LED displays (2) for status & diagnostic information.

#### Video Switching PCB

Sch. #00-872237 - Asy. #00-872239 - All S/N

Video crosspoint switch - 8 input to 6 output Logarithmic video amplifier used in subtraction procedures Anti-aliasing filter Gen-Lock circuitry

#### 386 AT Motherboard

Asy. #00-900658 - All S/N

Controls Workstation - OEM board

#### Image Processor PCB

Sch. #00-875952 - Asy. #00-875954 - All S/N

Performs all image processing functions Graphics processor for text/graphics/circular blanking/ROI (region of interest) Interfaces high speed transfer and storage of digital video images

#### Communications PCB

Sch. #00-872125 - Asy. #00-872127 - All S/N

Serial communications to <u>C-Arm</u> and <u>Workstation Control Panel PCB</u> VCR controls interface COM 1 and COM 2 communications ports Parallel printer port <u>Option PROM</u> Hex display drive to <u>Aux Interface PCB</u> for status and error conditions

#### High Rate Scan Converter PCB

Sch. #00-876397 - Asy. #00-876399 - All S/N

Upscans interlaced digital video signal from the <u>Image Processor</u>, converts to a noninterlaced analog video signal and sends it to the left and right monitors

## **Power Distribution**

## **OVERVIEW**

The information provided in this section is most easily understood when referencing schematics from the schematic manual. Use the correct interconnect diagrams and circuit board schematics for your system indicated below.

#### C-Arm Interconnect Diagram

Schematic # 00-875500 - System S/N 69-0001 thru 69-1000 Schematic # 00-877972 - System S/N 69-1001 thru 69-2000 Schematic # 00-878376 - System S/N 69-2001 and higher

#### Image System Interconnect Diagram

Schematic # 00-875410 - System S/N 69-0001 thru 69-1000 Schematic # 00-877971 - System S/N 69-1001 thru 69-2000 Schematic # 00-878377 - System S/N 69-2001 and higher

#### Workstation Interconnect Diagram

Schematic # 00-876158 - System S/N 69-0001 thru 69-1000 Schematic # 00-877970 - System S/N 69-1001 and higher

#### Surge Suppressor PCB

Schematic # 00-876784 - All S/N

#### Power Control PCB

Schematic # 00-876547 - System S/N 69-0001 thru 69-1000 Schematic # 00-878001 - System S/N 69-1001 and higher

#### DC Power Distribution PCB

Schematic # 00-876839 - All S/N

#### Power/Signal Interface PCB

Schematic # 00-876001 - System S/N 69-0001 thru 69-1000 Schematic # 00-877998 - System S/N 69-1001 and higher

#### Battery Charger PCB

Schematic # 00-876643 - System S/N 69-0001 thru 69-1000 Schematic # 00-877995 - System S/N 69-1001 and higher

#### Power/Motor Relay PCB

Schematic # 00-875997 - All S/N

## WORKSTATION POWER CORD ASSEMBLIES

Two power cord assemblies are available for the 9600 system, one is for use with 200 to 250 VAC, the other for 100 to 127 VAC. Both versions of the power cord assemblies are then connected to the Surge Suppressor PCB within the Workstation.

Part of the power cord assembly is a green lamp that illuminates to indicate that AC is present within the Workstation when it is plugged into a wall socket. The lamp is located above the point of entry of the power cable at the rear of the Workstation.



Figure 1 Workstation Power Components

### **WORKSTATION CIRCUIT BREAKERS**

- CB1 A 10 Amp, reset only breaker, on the AC cord assembly. In line with incoming AC to the Workstation.
- CB2 A 10 Amp, reset only breaker, located below the point of connection of the interconnect cable. In line with AC going to the C-Arm.
- CB3 A 5 Amp, reset only breaker, in line with AC to be distributed thru the Workstation. Located on earlier models on the left side of the Workstation by the Power Control PCB. Accessed by removing rear panel, left side panel, and protective clear plastic cover. The location on later models is next to CB2 by the interconnect cable.



Figure 2 Workstation Power Components

## SURGE SUPRESSOR PCB

#### All S/N - Assy. #00-876786 - Sch. #876784

The Surge Suppressor PCB is located on the bottom right hand side of the Workstation. The right side cover and a clear plastic safety cover must be removed for access.

The purpose of the Surge Suppressor PCB is to protect the equipment by absorbing surges and spikes during typical use. This board also prevents excessive inrush current when the equipment is powered on.

There are four thermistors used for current suppression, RT1-RT4. Two thermistors are in series in each neutral line. RV1 and RV2 are 300 VAC MOV varistors used in conjunction with E1 and E2 gas tube surge arrestors for surge suppression in the common mode (interference on all AC lines). RV3 and RV4 are 150 VAC MOV varistors used with C2 and C3 for surge suppression in the normal mode (interference between line and neutral).



Figure 3 Surge Suppressor PCB

## WORKSTATION ISOLATION TRANSFORMER

#### S/N 69-0001 thru 69-1000

The isolation transformer in the Workstation provides AC to both the Workstation and the C-Arm from a single center-tapped secondary. Two phases (AC1 and AC2) of 115 V nominal, are directed to both the Workstation and the C-Arm via the Power Control PCB.



Figure 4 Isolation Transformer - Earlier Version

The white/blue wire should be on Primary 1 COM, and the blue wire should be on Primary 2 COM. The brown and white/brown wires must be properly strapped to match the input line voltage as indicated by the following table:

| Transformer<br>Tap | 98V   | 104V  | 110V  | 120V  | 128V |
|--------------------|-------|-------|-------|-------|------|
| Input Volt         | 93.8  | 101   | 107   | 114.9 | 124  |
| Range              | to    | to    | to    | to    | to   |
| -                  | 100.9 | 106.9 | 114.8 | 123.9 | 132  |

#### S/N 69-1001 and up

The Workstation isolation transformer has two secondaries isolated from each other. One winding is a 230V center tap winding rated for 4A output. Two phases of 115V (nominal), AC1 and AC2 are directed to the Workstation via the Power Control PCB.

The second winding provides 115 VAC PH and 115 VAC RTN to the C-Arm via the interconnect cable.



Figure 5 Isolation Transformer - Later Version

The white/blue wire should be on Primary 1 COM, and the blue wire should be on Primary 2 COM. The brown and white/brown wires must be properly strapped to match the input line voltage as indicated by the following table:

| Transformer Tap  | 105V | 115V | 125V |
|------------------|------|------|------|
| Input Volt Range | 98   | 108  | 118  |
|                  | to   | to   | to   |
|                  | 107  | 117  | 127  |

## **POWER CONTROL PCB**

#### S/N 69-0001 thru 69-1000 - Assy. #00-876549 - Sch. #00-876547

The Power Control PCB is located in the bottom of the Workstation on the left hand side as shown in Figure 2. Access is gained by removing the left side panel and a clear plastic, protective shield.

AC1 and AC2 from the T1 isolation transformer enters at P1 and is used by both the Workstation and C-Arm. See Figure 4 for details of the isolation transformer windings.

A +12 VDC is created on this board using AC1 through circuit breaker CB1, transformer T1, bridge CR1, and voltage regulator U1. This +12V is sent to the keyswitch on the front of the Workstation, to K3 and K4 relays on the Power Control PCB, and to the delay circuit, U2.

When the keyswitch is closed, the +12V (Key\_Pwr) is sent to K10 on the Power/Motor Relay PCB located within the C-Arm. This switches Phase 1 AC to Power Supplies PS1 (+5V, +15V, -15V) and PS2 (+24V) also located within the C-Arm. The +12V is also sent to activate K1 and K2 on the Power Control PCB. K1 connects AC1 and AC2 to the Workstation. K2 connects +24V from PS4 to the left and right monitors.

### **POWER-ON DELAY CIRCUIT**

The purpose of the delay circuit is to remove AC from the interconnect cable if it is not plugged into the C-Arm and the Workstation is plugged into the AC wall socket. K3 and K4 relays connect AC1 and AC2 from the Workstation to the C-Arm via the interconnect cable. These two relays are turned on by +12V from U1. This occurs whenever the Workstation is plugged into an AC outlet and the interconnect cable is plugged into the C-Arm. This facilitates charging the batteries when the system electronics are switched off.

The return paths for the coils of K3 and K4 are controlled by the U2 delay circuit. The U2 delay circuit is controlled by connections from the interconnect cable.

When the interconnect cable is connected to the C-Arm and the Workstation is plugged into a wall outlet, the CNCT ON line is grounded on the C-Arm at the Power/Motor Relay PCB. This forces U2-1 on the Power Control PCB to a logic low. Resistor R2 and capacitor C3 charge to a logic high in approximately 540 mS. This high is placed on U2-2 and is then cascaded through the rest of the transistor array finally placing a low on U2-13 and U2-12. This low is fed through LOOP2 to the C-Arm and back to the Power Control PCB through LOOP1, resulting in a low on K3-8 and K4-8. With the +12 V output of regulator U1 on K3-1 and K4-1 both of these relays are then energized.

If the interconnect cable is disconnected from the C-Arm while the Workstation remains connected to a wall receptacle, the CNCT ON line is no longer grounded through the interconnect cable. This causes R5 and R1 to pull up U2-1 to a logic high. This, in turn causes the following logic pattern to occur: pin 16 low, pin 15 high, pin 14 low, and pins

12 and 13 remain off. With pins 12 and 13 off, K3 and K4 will de-energize, removing AC power from the interconnect cable. Pins 6 and 3 of both relays are switched to ground potential after a 15 - 20 ms. delay.

#### S/N 69-1001 and up - Assy. #00-878003 - Sch. #00-878001

This version of the Power Control PCB accomodates the two sources of AC from the secondary of the new isolation transformer. A separate winding ("AC" and "RTN") on the isolation transformer provides the AC (115 VAC\_PH and 115 VAC\_RTN) to the C-Arm. This AC is kept separate from that used in the Workstation ("AC1", "AC2", and "CT"). See Figure 5 for details of the isolation transformer windings.

## WARNING... The AC return (RTN) lines carry a voltage potential of 60 VAC and 80 VDC relative to ground.

K3 and K4 relays connect 115 VAC\_PH and 115 VAC\_RTN to the C-Arm via the interconnect cable. K1 connects AC1 and AC2 to the Workstation. K2 functions the same, providing +24V to the monitors from power supply PS4. The relays are energized in the same manner as previously described for the earlier version.

The power-on delay circuit operates exactly as described for the earlier version of this PCB.

### **CIRCUIT BREAKERS AND FUSES**

- **CB1** A 0.2 Amp push button breaker, in line with AC to T1 used to provide the +12V for keypower circuitry.
- **CB2** A 3 Amp push button breaker, in line with +24V to the right monitor.
- **CB3** A 3 Amp push button breaker, in line with +24V to the left monitor.
- **F1** A 2 Amp, 125 V, metric sized, slow-blow fuse, in line with AC to PS4 the +24V power supply for the monitors. Contained in a spring-loaded fuse holder with a quarter turn cap (a thin blade screw driver is required to remove cap).

### **TEST POINTS**

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- TP1 AC from Isolation Transformer T1 (AC2\_T1) to C-Arm (AC2\_GEN) located in circuit between K3 and K4, typically 115 to 120 VAC.
- TP2 AC from Isolation Transformer T1 (AC1\_T1) to C-Arm (AC1\_GEN) located in circuit between K3 and K4, typically 115 to 120 VAC.



Figure 6 Power Control PCB Assembly Drawing

NOTE: The assembly drawing in Figure 6 can be used for all S/N. Component locations vary only slightly between versions.

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## WORKSTATION POWER DISTRIBUTION

#### S/N 69-0001 thru 69-1000

AC1\_CART and AC2\_CART pass through K1 and leave the Power Control PCB at connector P4. These AC signals pass thru CB3 (5 Amp reset only breaker) and are then distributed from terminal block TB2.

AC1\_CART provides power to fan B1 and the Workstation power supply PS1 (+5V, -5V, +12V, -12V). AC2\_CART provides power for fans B2 and B3 and for the Lenzar hard copy camera option.

Both phases provide power to a 120/240 VAC outlet strip used for connection of peripheral equipment such as the VCR and thermal image printer options. The power strip is located inside the Workstation and is accessed by removing the rear cover as shown in Figure 7.

The DC outputs of PS1 (+5V, -5V, +12V, -12V) are inputs to the DC Power Distribution PCB, located in the Workstation electronics box (see Figure 7). These voltages are then distributed throughout the Workstation. PS1 is mounted on the inside of the electronics box on the hinged side panel as shown in Figure 7.

PS4 (+24 VDC) is located near the bottom of the Workstation on the left hand side as shown in Figure 2. It provides the left and right monitors with +24 VDC via the Power Control PCB.

#### S/N 69-1001 and up

AC1\_CART and AC2\_CART leave the Power Control PCB at connector P4 and are distributed by terminal block TB2. Circuit breaker CB3 is in-line between isolation transformer T1 and the Power Control PCB. In earlier models CB3 was located after the Power Control PCB.

AC1\_CART provides power to fan B1 and the Workstation power supply PS1 (+5V, -5V, +12V, -12V). AC2\_CART provides power for fans B2 and B3 and the Lenzar hard copy camera option.

AC1\_CART and AC2\_CART provide power to a 115/230 VAC outlet strip used for connection of peripheral equipment such as the VCR and thermal image printer options. The power strip is located inside the Workstation and is accessed by removing the rear cover as shown in Figure 7.

The DC outputs of PS1 (+5V, -5V, +12V, -12V) are inputs to the DC Power Distribution PCB, located in the Workstation electronics box. These voltages are then distributed throughout the Workstation. PS1 is mounted on the inside of the electronics box on the hinged side panel.

PS4 (+24 VDC) is located at the bottom of the Workstation on the left hand side, near the Power Control PCB. It provides the left and right monitors with +24 VDC via the Power Control PCB (see Power Control PCB for details).



Figure 7 Workstation Components

### **DC POWER DISTRIBUTION PCB**

#### All S/N - Assy. #00-876841 - Sch. #876839

The information for this PCB applies to all system serial numbers. The function of the DC Power Distribution PCB is to distribute the DC outputs from PS1 throughout the Workstation. It is located inside the Workstation electronics box in the upper rear corner. It is accessed by removing the rear cover, the left side cover, the clear plastic protective shield, and opening the side panel of the electronics box. Outputs from PS1 (+5V, -5V, +12V, -12V) are input at P9 and distributed as follows:

P1 - Aux Interface PCB, Video Switching PCB, and Image Processor PCB

- P2 AT Motherboard
- P3 Control Panel Processor PCB, and Contrast/Brightness Control PCB
- P4 Hard Drives
- P6 Floppy Drive
- P8 Elapsed Time Meter

U1 monitors the +5V. If the +5V falls below +4.65V the SYSRST\* (System Reset) signal will go low and reset the AT Motherboard. SYSRST\* will stay low until the +5V line rises above +4.7V. U1 is also active at power up/down. Failure of U1 could be indicated by a recycling of the Workstation boot sequence or lockup of the AT Motherboard during boot-up.

### **TEST POINTS**

TP1 Ground TP2 +5V TP3 +12V TP4 -12V TP5 -5V

### **CIRCUIT BREAKERS**

Circuit Breakers 1 thru 9 are all 5 Amp, SPST, 250 VAC, horizontal PCB mounted.

- CB1 +5 VDC to AT Motherboard
- CB2 +12 VDC to AT Motherboard
- CB3 +5 VDC to hard drives
- CB4 +12 VDC to hard drives
- CB5 +5 VDC to floppy drive and hard drives
- CB6 +5 VDC to Control Panel Processor PCB and Contrast/Brightness Control PCB
- CB7 +12 VDC to floppy drive and elapsed time meter
- **CB8** +12 VDC to Control Panel Processor PCB, Contrast/Brightness Control PCB, Aux Interface PCB, Video Switching PCB, and Image Processor PCB
- **CB9** +5 VDC to Aux Interface PCB, Video Switching PCB, and Image Processor PCB





# WORKSTATION DC MEASUREMENTS AND ADJUSTMENTS

### PS4 (24V)

Remove the monitor cover and measure the +24V on the monitor circuit boards at J6 between the black (GND) and yellow (+24V) wires. Adjust R11 on PS4 to +24 VDC ( $\pm$ 1V) if necessary. See Figure 9 below for location of R11.


## **PS1 (5V and 12V)**

Measure the voltages at the following test points on the Video Switching PCB and adjust as required with R53 (+5) and R21 (+12) on PS1. Refer to Figure 10 below for locations of R53 and R21.

| GND  | ТО   | ADJUST                    | MEASUREMENT | TOLERANCE |
|------|------|---------------------------|-------------|-----------|
| TP25 | TP24 | Not Adjustable            | - 5.0 VDC   | ±0.75 VDC |
| TP25 | TP27 | Adjust PS1 R53            | + 5.0 VDC   | ±0.75 VDC |
|      |      | (OUT1)                    |             |           |
| TP25 | TP28 | Adjust PS1 R21<br>(OUT 2) | +12 VDC     | ±1 VDC    |
| TP25 | TP19 | Not Adjustable            | - 12 VDC    | ±1 VDC    |



## **C-ARM POWER DISTRIBUTION**

#### S/N 69-0001 thru 69-1000

AC1\_GEN and AC2\_GEN leave the Power Control PCB at connector P5, travel thru CB2, a 10 Amp, reset only breaker and then leave the Workstation at J0 over the interconnect cable. They enter the C-Arm at J1 and are routed to connector P12 of the Power Signal Interface PCB. They are now identified as 120V\_PH1 and 120V\_PH2.

120V\_PH1 leaves the Power/Signal Interface PCB at connector P6 and enters the Power/Motor Relay PCB at connector P7 where it is routed to K10 relay (see Figure 12). K10 relay is activated by the signal KEY\_PWR, the +12V from the keyswitch. After 120V\_PH1 passes thru K10 it is designated as 120V\_PH1 SWITCHED. It is then directed to power supply PS1 (+5V, +15V, -15V) and PS2 (+24V).

120V\_PH2 also leaves the Power/Signal Interface PCB at connector P6 and enters the Power/Motor Relay PCB at connector P7 where it is used for C-Arm rotation, elevation, and stator circuitry. See the appropriate section of this service manual for further details of these circuits.

Both 120V\_PH1 and 120V\_PH2 also leave the Power/Signal Interface PCB at connector P1 and enter the Battery Charger PCB at connector P2 where they are connected to CR1 to be rectified and used for charging the battery packs.

DS2 is a green lamp located on the power panel assembly and labeled "Charger". DS2 is connected at P6 across Neutral and 120V\_PH2 to indicate when AC is present for the Battery Charger PCB.

#### S/N 69-1001 and up

## WARNING... The AC return (RTN) lines carry a voltage potential of 60 VAC and 80 VDC relative to ground.

The difference in the distribution from that previously discussed is that this AC comes from a separate winding on the Workstation isolation transformer. There is no longer a "Neutral" center-tap connection, but rather an "AC return" line that does carry a potential. Also, circuit breaker CB2 is in line between isolation transformer T1 and the Power Control PCB, whereas in earlier models it was after the Power Control PCB.

115VAC\_PH and 115VAC\_RTN leave the Power Control PCB at connector P5 and then leave the Workstation at P1 over the interconnect cable. They enter the C-Arm at J1 and are routed to connector P12 of the Power Signal Interface PCB.

115VAC\_PH leaves the Power/Signal Interface PCB at connector P6 and enters the Power/Motor Relay PCB at connector P7 as 115VAC\_PH\_IN where it is routed to K10 relay. K10 relay is activated by the signal KEY\_PWR, the +12V from the keyswitch. After 115VAC\_PH\_IN passes thru K10 it is designated as 115VAC\_PH\_SW (switched). It is then directed to power supply PS1 (+5V, +15V, and -15V) and PS2 (+24V).

115VAC\_PH\_SW also leaves the Power/Signal Interface PCB at connector P6 and enters the Power/Motor Relay PCB at connector P7 as 115VAC\_PH\_MTR where it is used for C-Arm rotation, elevation, and stator circuitry. See the appropriate section of this service manual for further details of these circuits.

115VAC \_PH also leaves the Power/Signal Interface PCB at connector P1 and enters the Battery Charger PCB at connector P2 where it is connected to CR1 to be rectified and used for charging the battery packs.

DS2 is a green lamp located on the power panel assembly and labeled "Charger". DS2 is connected at P6 across Neutral and 120V\_PH2 to indicate when AC is present for the Battery Charger PCB.



Figure 11 C-Arm Power Components





## **POWER/SIGNAL INTERFACE PCB**

The function of the Power Signal Interface PCB is to serve as an interconnect and distribution point for AC and DC powers and for communication signals between the Technique Processor PCB and Control Panel Processor PCB. The communications section of this PCB is discussed in the Control section of this manual.

### **Circuit Breakers**

#### S/N 69-0001 thru 69-1000 - Asy. #00-876003 - Sch. #00-876001

See Figure 13 for circuit breaker locations.

- CB1 AC input to PS2 +24V Power Supply 2Amp 250 VAC
- CB2 AC input to Battery Charger PCB 5 Amp 250 VAC
- **CB3** AC input to Battery Charger PCB 5 Amp 250 VAC
- CB4 -15 VDC Output from PS1 5 Amp 250 VAC
- CB5 +15 VDC Output from PS1 5 Amp 250 VAC
- CB6 +5 VDC Output from PS1 5 Amp 250 VAC
- **CB7** +24 VDC Output from PS2 3 Amp 250 VAC
- CB8 AC Output to K10 on Power/Motor Relay PCB for switched AC 3 Amp 250 VAC
- **CB9** AC output to Power/Motor Relay PCB for rotation, elevation, and stator. 4 Amp 250 VAC

#### **Power Distribution**

#### S/N 69-1001 and up - Asy. #00-877998 - Sch. #878000

See Figure 14 for circuit breaker locations.

- CB1 AC input to PS2 +24V Power Supply 2 Amp 250 VAC
- CB2 AC input to Battery Charger PCB 10 Amp 250 VAC
- CB3 AC input to Battery Charger PCB 10 Amp 250 VAC
- CB4 -15 VDC Output from PS1 5 Amp 250 VAC
- CB5 +15 VDC Output from PS1 5 Amp 250 VAC
- CB6 +5 VDC Output from PS1 5 Amp 250 VAC
- **CB7** +24 VDC Output from PS2 3 Amp 250 VAC
- CB8 AC Output to K10 on Power/Motor Relay PCB for switched AC 4Amp 250 VAC
- **CB9** AC output to Power/Motor Relay PCB for rotation, elevation, and stator. 3 Amp 250 VAC
- CB10 AC return line for PS1 and PS2 3 Amp, 250 VAC
- **CB11** AC return line to Power/Motor Relay PCB for rotation, elevation, and stator 4 Amp 250 VAC
- CB12 +5 VDC Output to Control Panel Processor 3 Amp, 250 VAC



Figure 13 Power/Signal Interface PCB - System S/N 69-0001 - 1000

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Figure 14 Power Signal Interface PCB - System S/N 69-1001 and Higher

## **C-ARM DC MEASUREMENTS AND ADJUSTMENTS**

## PS1 +5V, +15V, -15V

- 1. Measure the +5V across C9 on the Technique Processor PCB and adjust R11 for +5.05 VDC ±0.05 VDC.
- 2. Measure the +15V on the Power/Signal Interface PCB at P7-1 and P7-5 (Ground) for +15 VDC, tolerance is +2.0/-0.0 VDC. There is no adjustment for the +15 VDC, but it is affected by the +5V adjustment.
- 3. Measure the -15V on the Power/Signal Interface PCB at P7-2 and P7-5 (Ground) for -15 VDC, tolerance is +0.0/-2.0 VDC. There is no adjustment for the -15 VDC.



#### S/N 69-0001 thru 69-2000

1. Measure the +24V on the Image Functions PCB at P2-3 and TP2 (Ground). Adjust R9 for +24 VDC ±1 VDC.

#### S/N 69-2001 and higher

1. Measure the +24V on the CCD Camera Assembly at P2-12 (DC COM) and P2-13 (CAM +24V). Adjust R9 for +24 VDC ± 1 VDC.



Figure 16 C-Arm Power Supply PS2 +24V

## **BATTERY CHARGER PCB**

S/N 69-0001 thru 69-1000 - Asy. #00-876644 - Sch. #876643

WARNING... With the keyswitch OFF, AC power is present on the C-Arm when the Workstation is connected to AC power and the interconnect cable is connected to the C-Arm.

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## **AC Input Voltage**

The Battery Charger PCB receives 120V\_PH1 and 120V\_PH2 from the Workstation via the interconnect cable whenever the workstation is plugged into AC and the interconnect cable is connected to the C-Arm.

120V\_PH1 and 120V\_PH2 pass through the Power/Signal Interface PCB where circuit breakers CB2 and CB3, line filters LF1 and LF3, and current limiters RT1 and RT2, provide protection and filtering before arriving at the Battery Charger PCB.

The two phases of AC are connected to bridge rectifier CR1. On the Battery Charger PCB, there is no connection to the minus (-) connnection of CR1, both phases are half wave rectified. The nominal output of CR1 at the plus (+) connection is approximately 160 VDC. As well as being used for charging the batteries, this voltage is scaled down by R7 and sent back to the Analog Interface PCB as line voltage sense (LVOLTSEN).

### Low Voltage Power Supply

120V\_PH1 and Neutral are also connected to transformer T1 to drive a low voltage power supply to provide +12V and -12V for use only on the Battery Charger PCB to power the circuitry so that battery charging can occur while the system is off. T1 drives rectifier VR3 which in turn provides power to be regulated to + 12SEP (separate) and - 12SEP by VR1 and VR2 respectively.

## Regulation

A boost type switching regulator is powered from the DC voltage output of CR1. The regulator is comprised of transistor Q1, inductor L2 located on the generator controller assembly (connected at P1), output filter capacitors C10, C11 and L1. Q1 is turned off and on by the pulse width modulator in voltage regulator U2. The oscillation frequency of U2 is 20 KHz. and is set by R23 and C19. Voltage feedback to U2 is provided by voltage divider R6, R9 and R10. Current sense resistor R1 provides an indication of the instantaneous current through FET Q1 to PWM U2 which removes the drive from the base of Q1 on a pulse-by-pulse basis for current limit control. The basic idea of this circuit is to charge up the inductor L2 and then collapse the field and direct the boosted voltage ( 225V - 235V) thru CR2 to the output fuse F1 (located on the generator controller assembly) and the battery packs.

## **Current Sensing**

Charger current is sensed in the output line by T2. One side of T2 is tied to an ideal or zero drop diode, comprised of U4, CR8, Q9, and associated circuitry. The other side is connected to current to voltage converter U4. The output of U4 goes to U7 which drives DS2, a yellow bar graph to indicate charger current output with a scale from 25 to 625 milliamps. When the output load current gets above 500 mA, comparator U5 output switches high, turning Q7 on, and placing R26 in parallel with the series combination of R9 and R10, changing the feedback divider such that the output voltage goes up by about 12 VDC. This puts the charger in "High Charge Mode".

The signal, HICHGMOD (high charge mode), is in an input from kV control circuitry on the X-ray Regulator PCB that can also put the charger into high charge mode. "HICHGMOD" goes high whenever the measured KVP is above 30 KVP. CHGISEN (charger current sense) is sent to the Analog Interface PCB where charger activity can be monitored.

### **Voltage Sensing**

The charging voltage bargraph indicator, U6, is driven by the VOLTAGE SENSE line which is adjusted by the combination of R11, R28, R29, and R32 (potentiometer). The red bargraph indicator DS1, reads in 10 linear steps from 160 VDC to 250 VDC.

The Battery Charger output voltage is also sensed on the Generator Driver PCB at the resistor network of R11 and R10. This signal, "+200VSEN", is used in the pre-charge cycle (see Boot Sequence section of this manual). It is also used to monitor the battery charger status.

### **Overvoltage Protection**

To guard against battery damage and/or venting, an overvoltage protection circuit is provided. If the last segment (250V) of the voltage bargraph indicator lights, Q8 is turned on, U1 output is set low, turning Q6 ON. This results in both activating the "shutdown" control of the PWM chip and shunting the drive to Q1 to ground, resulting in charger shutdown.

The charger can also be disabled by the Technique Processor PCB via PIO U27-18 on the Analog Interface PCB, this happens during the boot sequence to check for the presence and condition of the batteries and during a FILM exposure. A logic high asserts Charger Disable and a logic low resets the disabled condition.

## **Under Voltage Protection**

A low voltage cutout circuit is provided by Q10 and Q2 to prevent over-current conditions in the event the battery is discharged below 160 VDC. If biasing for Q10 is lost by the output line dropping near 160 VDC, Q2 is turned off and power from CR1 cannot get to L2. With the Battery Charger in the "shut down" condition, the charge in the batteries is slowly restored by a 5-20 mA current limited trickle charger comprised of C26, CR9, and

CR10. When the battery voltage reaches approximately 160 VDC, Q2 turns on again and the charging of the batteries proceeds as normal.

### **Test Points**

- TP1 Volt Feedback feedback voltage from charger output adjust circuitry to U2, pulse width modulator IC.
- TP2 Volt Sense voltage from voltage display adjust circuitry to U6, driver for DS1, voltage bar graph indicator. The charger output voltage is monitored by the Analog Interface PCB via the "+200VSEN" line on the Generator Driver PCB.
- TP3 Current Sense voltage from current sensing circuitry to Analog Interface PCB/Technique Processor PCB to give indication of battery charger current.

### **Battery Charger Output Fuse F1**

The Battery Charger output fuse is located on the generator controller assembly as indicated in Figure 20. It is a 3 Amp, 250 VDC, Slo-Blow fuse contained in a spring-loaded holder with a removable cap. The fuse can be accessed by removing the rear cover of the C-Arm.

## WARNING... High DC voltages are present at fuse F1 and circuit breaker CB1. Use caution when making voltage measurements on these components.

### **Circuit Breaker CB1**

CB1 is a 30 Amp switch, circuit breaker that disconnects the positive and negative sides of the battery packs from other circuitry. It is located on the right side of the chassis just inside from the wheel (see Figure 20). The switch lever is accessible through a hole in the chassis. No covers need to be removed to operate the switch.

### **Battery Charger Output Adjustment**

- 1. Connect a DVM from J1-1 to chassis ground.
- 2. Adjust R10 for 220 Volts on the DVM.
- Adjust R32 until the 220 Volt segment on DS1 goes off and the 210 Volt segment lights.
- 4. Adjust R32 until the 210 Volt segment goes off and the 220 Volt segment just lights.
- 5. Adjust R10 for 225 Volts on the DVM

### **Battery Charger Error Messages**

#### **RECHARGE NEEDED - ALLOW 24 HOURS - PRESS ANY KEY TO CONTINUE**

This message is displayed during boot-up if the system has not been turned for 6 months. If 6 months have past since the system has been plugged in and turned on, let the system run without making X-rays for 24 hours to allow the batteries to recharge and the image tube to de-gas. This error may also be displayed after installing a copy of the backup generator software. In this case, press any key on the control panel and continue use as normal.

#### WARM-UP NEEDED - ALLOW 4 HOURS - PRESS ANY KEY TO CONTINUE

This message is displayed during boot-up if the system has not been turned on for 2 months. If 2 months have past since the system has been plugged in and turned on, let the system run without making X-rays for 4 hours to allow the batteries to recharge and the image tube to de-gas. This error may also be displayed after installing a copy of the backup generator software. In this case, press any key on the control panel and continue as normal.

#### BATTERY DISCONNECTED

This message is displayed during boot-up if the software thinks the batteries are disconnected. This will occur when all but one of the arrows are lit on the control panel display. This is checked by disabling the battery charger, waiting for 2 seconds, and reading the +200V sense line. If 180 Volts or less is read, the software issues a shutdown command and displays this message. If the batteries are disconnected or CB1 is open, the error "Pre-charge Fail" may be displayed instead of "Batteries Disconnected".

#### CHARGER FAILED

This message is displayed if the software senses that the battery voltage is less than 225 volts and the charger output current is less than 1.0 Amp. The software check for charger failure runs in the background all the time except during X-rays.

#### 70% CHARGE

This message is displayed if the software thinks that the charge capacity of the batteries has been depleted to 70% or less. The 70% charge message is displayed intermittently on the control panel display and does not affect system operation.

#### **50% CHARGE**

This message is displayed if the software thinks that the charge capacity of the batteries has been depleted to 50% or less. The 50% charge message is displayed intermittently on the control panel display. System operation in fluoro mode is allowed but film exposures are suspended until the calculated charge of the batteries rises above 50%.



Figure 17 Battery Charger PCB - System S/N 69-0001 - 1000

#### S/N 69-1001 and Higher - Asy. # 00-877997 - Sch. #00-877995

This Battery Charger PCB operates exactly as the earlier version except that 115VAC\_PH and Neutral are connected to CR1 and the minus (-) side of CR1 is now grounded, utilizing the whole bridge and performing full wave rectification on 115VAC\_PH. T1, the transformer for the on-board low voltage power supply is also different to accommodate the one phase input.



Figure 18 Battery Charger PCB (S/N 69-2001 and higher)

## **BATTERIES**

Two battery pack subassemblies, wired in series, which consist of sixteen 6 V batteries, wired in series, provide a nominal voltage of 192 VDC.



**Figure 19 Battery Connections** 

## **Battery Pack Evaluation**

This procedure can be used to verify whether the battery packs are performing adequately.

#### WARNING... Steps within this procedure produce X-rays. Use appropriate precautions.

- 1. Select FILM mode and set the technique for 75 kVp and 200 mAs.
- 2. Make an exposure and verify that an "*X-ray Overtime*" message is not displayed. Verify that other technique errors such as "kV Error" and "mA Error" are not displayed. See kV Generation and mA Generation sections of this manual for details of these error messages.

OR

With the C-Arm covers removed, make an exposure and verify that the red LED bargraph located on the Battery Charger PCB indicates 160 to 170 volts.

3. If the bargraph voltage indicates less than 160 Volts, measure across the battery terminal with a DMM while making an exposure. If the batteries measure less than 160 Volts, weak battery packs or a fault with the Battery Charger PCB may be indicated.

### **Battery Charger Evaluation**

#### NORMAL CHARGE MODE

## WARNING... Dangerous voltages are present when the covers are removed. Observe all safety precautions.

#### S/N 69-0001 thru 69-1000

- 1. Remove the Mobile C-Arm covers and connect a Digital Multimeter to the batteries (set to read DC).
- 2. Measure J1-1 on the Battery Charger PCB and verify a charging voltage of 225 VDC. The voltage bargraph indicator on the Battery Charger PCB Should also indicate approximately 220 VDC.

#### NOTE: If the battery charge is complete, an indication of less than 200 mA is normal

3. The Current bargraph indicator should read less than 450 mA.

#### S/N 69-1001 and up

Measure at J5-1 on the Battery Charger PCB when performing step 2.

#### HIGH CHARGE MODE

## WARNING... Dangerous voltages are present when the covers are removed. Observe all safety precautions.

#### S/N 69-0001 thru 69-1000

- 1. Remove the Mobile C-Arm covers and connect a Digital Multimeter to the batteries (set to read DC).
- 2. Select **FLUORO MANUAL** mode and observe the voltage bargraph indicator while taking a 60 kVp @ 1 mA exposure . Verify that approximately 235 VDC is indicated.
- 3. Measure J1-1 on the Battery Charger PCB and verify a charging voltage of approximately 235 VDC.
- 4. Verify the current bargraph indicator displays a charging current greater than 450 mA.

#### S/N 69-1001 and up

1. Measure at J5-1 on the Battery Charger PCB when performing step 3.

### **Battery Pack Replacement**

#### WARNING... The batteries are capable of delivering high currents at high voltages and should be considered fully charged at all times. Remove jewelry such as rings and watches when working around dangerous voltages.

Refer to Figure 20 for component locations.

- 1. Verify that the Workstation keyswitch is turned to the **OFF** position and the AC power plug is disconnected from the wall receptacle.
- 2. Remove the Rear Handle Cover Assembly by removing 3 screws located behind the assembly door and one screw on each side.
- 3. Remove the Front Cover by removing 2 screws near the top of the vertical shaft.
- 4. Remove the Right Front Cover by removing the 3 screws securing the cover to the Mobile C-Arm.

## CAUTION! Do not turn CB1 to the OFF position unless the AC power cord has been unplugged.

- 5. Turn circuit breaker CB1 to the **OFF** position.
- 6. Cut the cable tie that secures the wiring near CB1 and unplug the battery connectors.
- 7. Remove the spacer from the top of each battery pack.
- 8. Lift the battery pack straight up and then pull the pack straight out.
- NOTE: When installing batteries, reconnect battery connectors black to black, red to red, and blue to blue. Refer to Figure 19. Reset CB1 after the battery connections are made by moving the switch position to ON.



Figure 20 - C-Arm Battery Pack Replacement (Location of F1 and CB1)

## **C-ARM CONTROL**

## **OVERVIEW**

This section describes how the following circuit boards and components control the C-Arm.

- Technique Processor PCB
- Analog Interface PCB
- <u>Control Panel Processor PCB</u>
- <u>Control Panel Processor I/O PCB</u>

The Technique Processor PCB is the controlling circuit board and the Analog Interface PCB is the slave. The Control Panel Processor PCB serves as an input / display liaison for the two control panels and vacuum fluorescent displays (VFD) used by the operator of the system.

When a switch closure is made at either of the two control panels, it is encoded by the Control Panel Processor which sends this information to the Technique Processor via a serial link. The Technique Processor responds to this, sending the data back to the Control Panel Processor to update the VFD and/or turn on the associated LED. The Technique Processor also communicates over a digital bus to the Analog Interface PCB. The Technique Processor PCB also communicates with the Workstation via RS232 serial communications.

The information given in this section is most easily understood while refering to the following schematics. Use the correct interconnect diagrams and circuit board schematics for your system as indicated by the S/N.

#### <u>Control Panel Processor PCB</u>

Schematic # 00-875601 - System S/N 69-0001 thru 69-2000 Schematic # 00-878486 - System S/N 69-2001 and up

#### <u>Control Panel Processor I/O PCB</u>

Schematic # 00-878489 - System S/N 69-2001 and up

#### • Technique Processor PCB

Schematic # 00-876735 - System S/N 69-0001 thru 69-1000 Schematic # 00-877742 - System S/N 69-1001 and up

#### Analog Interface PCB - Schematic # 00-876738 - All S/N

#### <u>Mainframe Motherboard</u>

Schematic # 00-875539 - System S/N 69-0001 thru 69-2000 Schematic # 00-878396 - System S/N 69-2001 and up

#### <u>C-Arm Interconnect Diagram</u>

Schematic # 00-875500 - System S/N 69-0001 thru 69-1000 Schematic # 00-877972 - System S/N 69-1001 thru 69-2000 Schematic # 00-878376 - System S/N 69-2001 and up The Control Panel Processor PCB, vacuum fluorescent displays (VFD), and control panels are contained within the Control Panel Assembly as shown in Figure 1. The Technique Processor PCB and Analog Interface PCB are contained within the card rack assembly.



Figure 1 - Locations of Control Panel Assembly and Card Rack Assembly

- CAUTION: When replacing the EMI/RFI covers over the new Control Panel Processor PCB or the new Card Rack, do not damage the metal gasket material around the edge of the PCB box. The gasket material must be replaced if damaged to ensure compliance with EMI/RFI regulations. When replacing a cover, do the following:
  - 1. Start a corner of the cover over the box
  - 2. Push the cover diagonally from the corner against the spring tension of the gasket material.
  - 3. Make sure the edges of the cover are not pushing on the mounting edge of the gasket material and gently push the cover down over the box.



Figure 2 - Control Path and Serial Communications Diagram

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## **CONTROL PANEL**

The Mobile C-Arm contains two identical, external control panels. Each control panel consists of a 20 character Vacuum Fluorescent Display (VFD), fourteen LED's, and a twenty three position matrix keypad. Software on the Control Panel Processor PCB continuously scans the keypads to determine if any keys have been pressed. Each key is identified by a row number and a column number and is encoded as a hex value. This hex value is sent to the Technique Processor PCB when a key is pressed.



Figure 3 - C-Arm Control Panel

## **CONTROL PANEL PROCESSOR PCB**

## **OVERVIEW**

S/N 69-0001 thru 69-2000 - Assy. #00-875603 - Sch. #00-875601

S/N 62-0001/69-2001 and higher - Assy. #00-878488 - Sch. #00-878486

There are 2 versions of this circuit board (see Figures <u>6</u> and <u>7</u>). The functionality of the two boards is the same. The circuitry on the earlier version (Assy. #00-875603, see <u>Figure 6</u>) was divided to form two new circuit boards; the new Control Panel Processor PCB (assy. #00-878488, see <u>Figure7</u>) and the Control Panel Processor I/O PCB (see <u>Figure 8</u>).

The circuitry on the new Control Panel Processor PCB consists of the active circuitry that required EMI/RFI shielding. The circuitry on the Control Panel Processor I/O PCB consists of cabling connectors and passive components that did not need shielding.

The theory of operation that follows applies to both Control Panel Processor PCBs, however, component designators are different. Designators between brackets, [] refer to the newer boards.

## **MICROPROCESSOR SECTION**

U5 [U11] is an 80C196KC microcontroller running at 10 MHz Y1 is a10 MHz crystal oscillator. DS1 indicates that EPROM code is being executed blinking at two different rates: 200ms if waiting for communcations to be established, and 530ms after communications have been established.

U14 [U3] and associated circuitry create an external watch-dog circuit that must see a falling edge every 150 ms or less. If the falling edge is not detected at pin 7 it will time out and generate a reset to both the micro-controller and PAL U7 [U8].

The Reset\* signal goes low for 250 ms to generate a reset. U14 [U3] also monitors the power supply voltage. It will hold the RESET output pin low whenever VCC is below 4.62 volts (typically). A reset can also be generated by MRESET\* at pin 1 of U14 [U3] from the Technique Processor.

LS1 [on Control Panel I/O PCB] is a tone generator driven by U5 [U11] through Q1 to indicate when X-rays are being produced and to indicate oyher key closures.

E4 - configuration jumpers, currently not used.

## **MEMORY AND ADDRESSING**

U2 [U9] is the boot PROM for microprocessor U5 [U11]. When microprocessor U5 [U11] boots it will read and execute the code contained in boot PROM U2 [U9] and then wait for further instructions from the Technique Processor PCB via serial communication.

Port 3 of microprocessor U5 [U11] is a multiplexed address/data bus. The address is driven on the bus on the rising edge of ALE (address latch enable, U5-62 [U11-62]). U9 [U12] latches the low address byte on the falling edge of ALE. Port 4 is used only for the high address byte by tying U5-64 [U11-64] (BUSWIDTH) low.

U7 [U8] and U3 [U1] are used for chip select signals for address decoding.

U4 [10] is 32Kx8 static RAM used for storage of VFD messages.

U1 [U16], is currently not installed.

## **CONTROLS AND DISPLAY INTERFACE**

U13 [U14] is the keyboard input latch. U12 [U7] is the keyboard output latch. These devices comprise the row/column decoding.

U6 [U13] is a data bus buffer added to prevent a failure in a VFD from hanging up the micro-controller's bus.

U16 [U5] & U11 [U6] are octal latches used to sink the LED currents. Writing a "0" to the appropriate bit turns on an LED.

P1 & P2 connect to the left and right control panels respectively for the left and right keypad matrices, VFDs, and LEDs. [J1 and J2 connect to the Control Panel Processor I/O PCB and distribute all signals to and from the new Control Panel Processor PCB].

## **SERIAL COMMUNICATIONS**

Refer to <u>System Communications</u> in this section for details of serial communications.

## **FAST STOP SWITCHES**

The signals EMEROFF\_HI and EMEROFF\_LO are wired in series through P6 and P7 of the Control Panel Processor PCB. Their source and destination are from the Power Motor Relay PCB, via the Power Signal Interface PCB and the Mainframe Motherboard. When pressed these switches open the +24V interlock circuit, prohibiting C-Arm elevation, L-Arm rotation, and the production of X-rays. See the <u>Interlocks/Stator</u> section of this manual for details of this circuit.

## X-RAY SWITCH

The signals X-RAY\_SWITCH and SECURITY connect at P5 on the Control Panel Processor PCB and are sent to the Analog Interface PCB via the Power/Signal Interface PCB and Mainframe Motherboard. See the <u>X-ray</u> <u>On/Disable</u> section in this manual for details of these signals.

X-RAY\_LAMP also connects at P5 and is sourced from the Power Motor Relay PCB. This signal provides the return path for the lamp in the X-ray switch and is derived through U1 from the signal X-RAY\_ON which is the enabling signal for X-ray production. X-RAY\_LAMP also goes to the Workstation to drive the LED array above the monitors.

On systems with serial number 69-2001 and higher, X-RAY\_SWITCH, SECURITY, and X-RAY\_LAMP pass from the X-ray switch, through the new Column I/O PCB directly to the Power/Signal Interface PCB. See the <u>X-ray</u> <u>On/Disable</u> section for details of these signals.

The following illustration indicates the location of the X-ray switch/lamp and other items previously discussed in this section for the original version of the Control Panel Processor PCB.



Figure 4 - Control Panel Assembly - S/N 69-0001 thru 69-2000

This illustration indicates the location of the X-ray switch/lamp and other items previously discussed in this section for the newer version of the Control Panel Processor PCB and the Control Panel Processor I/O PCB.



Figure 5 - Control Panel Assembly - S/N 69-2001 and higher



Figure 6 - Control Panel Processor PCB - S/N 69-0001 thru 69-2000

**C-Arm Control** 

The functions of this Control Panel Processor PCB are identical to those of the earlier Control Panel PCB except that the connections have been removed and placed upon the Control Panel I/O PCB.



Figure 7 - Control Panel Processor PCB - S/N 69-2001 and higher

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## CONTROL PANEL PROCESSOR I/O PCB

The Control Panel Processor I/O PCB is a mating circuit board (see Figure 8) to the new Control Panel Processor PCB. It contains the connectors to interface the functions of the Control Panel Processor to other circuit boards as on previous models. The separation of the active circuitry from the connectors was done for EMI/RFI shielding.



Figure 8 - Control Panel Processor I/O PCB

## **CARD RACK ASSEMBLIES**

There are two different card rack assemblies possible on the 9600 C-Arm. These are dependent on the serial number range as seen in Figures 9 and 10. The main differences in the newer style are the presence of the Image Function PCB and the design construction to reduce EMI/RFI susceptability and emissions.

# CAUTION: The circuit boards in the card racks are slot specific and must be installed as shown in Figures <u>10</u> and <u>11</u> or damage to circuitry will result.

All hardware (i.e., nuts, bolts, screws, etc.) must be re-installed after servicing in order to ensure compliance with EMI/RFI regulations.



Figure 9 - Original Card Rack Assembly - S/N 69-0001 to 69-2000





CARD RACK REAR COVER

Figure 10 - Newer Card Rack Assembly - S/N 69-2001 and Higher

- CAUTION: When replacing the EMI/RFI covers over the new Control Panel Processor PCB or the new Card Rack, do not damage the metal gasket material around the edge of the PCB box. The gasket material must be replaced if damaged to ensure compliance with EMI/RFI regulations. When replacing a cover, do the following:
  - 1. Start a corner of the cover over the box
  - 2. Push the cover diagonally from the corner against the spring tension of the gasket material.
  - 3. Make sure the edges of the cover are not pushing on the mounting edge of the gasket material and gently push the cover down over the box.
# **TECHNIQUE PROCESSOR PCB**

Assy. #00-876757 - Sch. #00-876735

Assy. #00-877744 - Sch. #00-877742

## **OVERVIEW**

The Technique Processor PCB (see Figures <u>12</u> and <u>13</u>) is responsible for initializing and controlling the 9600 C-Arm. Application software for the system resides on the SRAM card located in the on-board solid state disk drive U13.

The Technique Processor PCB plugs into the Motherboard which serves as the backplane of the card rack (see Figures 1, 9, and 10). The Analog Interface PCB is a slave to the Technique Processor, carrying out commands received on the PC bus.

Two versions of this PCB exist and either of these boards may be used in a system. The difference between the two PCBs, is the communication circuitry which is discussed in <u>System Communications</u> in this section.

## **RESET CIRCUITRY AND WATCHDOG TIMER**

When power is applied to the Technique Processor, power-on reset circuitry (U34 & U9) cause the 80C188 microprocessor (U30) to be reset. An external reset pulse on pin 57 is also generated. This external reset pulse (RST and \*RST via U10) is sent to the real-time clock U29, Dual-Port RAM control PAL U4, the Control Panel Processor PCB, and to the PIOs located on the Analog Interface PCB which sets these items to a default state. Switch S2 is used to manually reset the Technique Processor.

U34 also serves as a "Watchdog Timer" for microprocessor U30. Pin 30 (PCS4) from the microcprocessor must reset U34 at pin 1 every 1.2 seconds or else U34 will reset the microprocessor via U9 as described above. The purpose of the "Watchdog" is to interrupt the microprocessor from any unwanted software loops that may occur.

# **CPU & BUS INTERFACE**

Once reset, microprocessor U30 retrieves instructions from the Boot EPROM U14 used to initialize the Technique Processor. This is accomplished via the internal bus interface circuitry composed of address and I/O decoding circuits U44 - U47 and signal buffer U36. The bus interface circuitry also enables the Technique Processor to interface with other on-board devices such as SRAM (U16 - U19), EEPROM (U20), and a serial communications controller U39.

U51 is an interrupt controller which causes microcontroller U30 to service one of several items including the on-board solid state disk drive, floppy drive controller or serial controller chip.

An external bus interface allows the Technique Processor to access the Analog Interface PCB, and the remaining generator electronics. This external bus interface is composed of address latches/buffers U23 - U28 and a bi-directional data buffer U50.

Clock timer chip U29 contains a small portion of internal NVRAM which contains certain setup parameters such as the Technique Processor's memory map, size allocation, and other items. An internal battery backup allows the timer chip to continuously run, monitoring X-ray exposure lengths and time out periods for specific software routines.

## MEMORY

The Technique Processor uses three basic groups of memory; SRAM, EEPROM (Non-Volatile RAM), and EPROM. The 512k SRAM (U16 - U19) is used for temporary storage of application code and contains an area for "scratchpad" data used in normal operation.

U20 is a 2k EEPROM that contains calibration and configuration data unique to each generator assembly. If the Technique Processor PCB needs to be replaced, this chip (unless suspected defective) should be installed on the replacement PCB due to its contents for that particular generator assembly. If the contents of the EEPROM are corrupted, the EEPROM can be down-loaded with back-up software as described in the <u>C-Arm Software</u> section of this manual.

A 512k EPROM (U14) contains data used to initialize the Technique Processor. The Option ROM (U15) contains instructions for the operation of the solid state disk drive.

# **I/O DEVICES**

### **Solid State Drive**

U13 is a solid state disk drive capable of reading and writing PCMCIA memory card devices. Installed in the drive is a 1 megabyte battery backed SRAM card containing the C-Arm software. Refer to the <u>C-Arm Software</u> section of this manual for details of the SRAM card and software files.

### Floppy Disk Controller

Floppy disk controller chip U48 is not used on the 9600 C-Arm.

## **7-Segment Displays**

Two 7-segment LED displays (U1 & U2) are used to indicate the status of the Technique Processor PCB.

# NOTE: The hex value 00 is displayed after the Technique Processor has completely booted.

For a complete listing of these hexadecimal status codes, refer to the BIOS ROM Code in the <u>C-Arm Software</u> Section of this manual.

## Switch S1

S1 is a four position DIP Switch used for selection of communications and disk type. Switches 1 and 2 must be on (on -02 PCBs and higher) to enable serial communications on the 9600 C-Arm. Switches 3 and 4 are not used.

### **Jumper E1**

Configuration jumper E1 is not used.

## **COMMUNICATIONS**

Refer to <u>System Communications</u> in this section for details of the communications circuitry.

## DUAL PORT RAM (A/D INTERFACE)

U31 is a Dual Port RAM used to store bytes of data representing analog signals digitized by circuitry on the Analog Interface PCB as shown in Figure 11.

The Technique Processor selects one of the sixteen analog input signals via a 4bit address (AMUXSEL0-3) via U11, U40, and U41. After an address has been generated, the SAMPLE signal is made active. This signal latches the selected analog signal into U8, a sample and hold chip.

Simultaneously, U9 on the Analog Interface PCB inverts the logic level of the SAMPLE signal for U7, the A/D converter. This inverted signal is applied to the "Convert" control line for U7. This A/D chip digitizes this analog signal into an 8-bit digital byte. This byte of data is sent back to the Technique Processor and is stored in the Dual Port RAM.

Since this is a continuous process, the Dual Port RAM contains byte values for all sixteen analog signals. By using the Dual Port RAM, the Technique Processor can access the status of any of these analog signals without having to

### **C-Arm Control**

wait for the A/D process to occur. Other functions of the Analog Interface PCB are described in the <u>Analog Interface</u> section.



Figure 11 - A/D Interface Block Diagram

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Figure 12 - Technique Processor PCB - S/N 69-0001 to 69-1000

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Figure 13 - Technique Processor PCB - S/N 69-1001 and Higher

E

# **ANALOG INTERFACE PCB**

All S/N - Assy. #00-876738 - Sch. 876740

## **OVERVIEW**

The Analog Interface PCB is the link between the Technique Processor PCB (primarily a digital board) and the rest of the generator assembly (primarily analog functions). The Technique Processor PCB and Analog Interface PCB plug into the Motherboard which serves as the backplane of the card rack (see Figures 1, 9, and 10). They communicate via a PC bus and the A/D Data bus on the Motherboard.

Analog Interface PCB circuitry can be divided into the following sections:

**A/D Section** - Samples and digitizes signals from the X-ray Regulator PCB to be read by the Technique Processor PCB.

**D/A Section** - Converts data bytes from the Technique Processor into analog signals for such functions as camera gain, kVp control, mA control, and filament control.

CTC Section - Generates the high voltage drive and filament drive signals.

**PIO Section** - Provides a digital interface between the Technique Processor and discrete digital signals.

**Interlock Section** - Interfaces the processor's interlock keep-alive signal with the relay controlled interlock circuits.

**X-ray Switch Logic** - Interfaces X-ray switch closure information from the control panel, footswitch, and handswitch.

Stator Sense - Circuitry to sense current flow to the stator windings.

# **A/D SECTION**

The A/D section is comprised of sample mux U3, sample/hold IC U8, and analog to digital converter U7(AD573). Sixteen A/D inputs (0-10 VDC) are monitored by the Technique Processor CPU. The analog output of MUX U3 whose is fed to U8 which holds the level for digitization by U7, a 10 bit A/D converter. Refer to Figure 11.

The Technique Processor then stores this digitized data value in its DUAL PORT RAM (U31) for each analog MUX input signal, shown below. Sample MUX U3 is addressed by the AMUXSEL lines generated by sequencing circuits on the Technique Processor PCB. Analog Mulitplexer (U3) input pin assignments are listed below in Table 1. Refer to the *C-Arm Software* section in this manual for typical results of these signals using the Control Panel Status software.

| SOFTWARE           | SIGNAL   | FUNCTION                         | SOURCE                |
|--------------------|----------|----------------------------------|-----------------------|
| CHANNEL & PIN      |          |                                  |                       |
| Channel 0 - Pin 19 | KVPMEAS  | kV measure for high voltage      | Tank (1:10,000)       |
|                    |          | servo 1 volt/20kV nominal        | Capacitive Sense      |
| Channel 1 - Pin 20 | MASNS &  | mA measure for tube current      | Tank                  |
|                    | MASNSRE  | servo                            | 100 Turn Anode Sense  |
|                    | F        | FLUORO = 125 mV/mA (±3%)         | Winding               |
|                    |          | FILM = 6.25 mV/mA (±3%)          |                       |
| Channel 2 - Pin 21 | FILSNS   | Filament B+ Sense                | Generator Driver PCB  |
|                    |          | "Regulator Fail" if this voltage | (via R42) P2 pin 11   |
|                    |          | incorrect                        |                       |
| Channel 3 - Pin 22 | VLI      | Video Level Indicator; ABS &     | Camera Assy.          |
|                    |          | Camera Gain satisfy this signal  |                       |
|                    |          | for tracking                     |                       |
| Channel 4 - Pin 23 | HOUSTEM  | Housing Temperature              | X-ray Tube Assy.      |
|                    | Р        | (Thermistor)                     |                       |
| Channel 5 - Pin 24 | DOSIMTR  | not used                         |                       |
| Channel 6 - Pin 25 | CAMROT   | Camera Rotation Indicator        | Potentiometer on CCD  |
|                    |          |                                  | camera                |
| Channel 7 - Pin 26 | AD_SPARE | not used                         |                       |
| Channel 8 - Pin 11 | SECTAPV  | Redundant kV Sense for           | Tank                  |
|                    |          | software                         | 1 Turn Windings       |
|                    |          | ≅0.22 volts (± 0.02 volts)/kVp   | (1:4,300)             |
| Channel 9 - Pin 10 | LINE_SNS | Line Voltage Sensing             | Battery Charger PCB   |
| Channel 10 - Pin 9 | CHGR_I   | Charger Current Sense            | Charger via Generator |
|                    |          |                                  | Driver PCB            |
| Channel 11 - Pin 8 | 200V_SNS | Battery Voltage Sense            | Charger via Generator |
|                    |          |                                  | Driver PCB            |
| Channel 12 - Pin 7 | ADSPARE1 | not used                         |                       |
| Channel 13 - Pin 6 | ADSPARE2 | not used                         |                       |
| Channel 14 - Pin 5 |          | not used                         |                       |
| Channel 15 - Pin 4 |          | not used                         |                       |

Table 1 - Inputs to A/D Section

# **D/A SECTION**

U18 and U31 are quad D/A converters (DAC 8408) which provide analog current output signals. These four current output channels are labeled as IOUT1A - IOUT1D. The current outputs from the D/As are converted to a voltage (0-10 VDC) by current to voltage converters U28, U29, and U33.

The analog outputs for U18 and U31 are described below.

## D/A U18 Pin Assignments

CHA - Pin 4 - Not Used

**CHB - FILCNTRL -** Pin 6 - This is a control voltage for the filament B+ circuitry used to regulate the tube current (mA); see TP10. Refer to <u>mA Generation</u> Section for more information about this signal.

**CHC - CAM\_GAIN -** Pin 25 - This signal controls the video camera gain; see TP13. Refer to the <u>Image System</u> section for more information about this signal.

CHD - Pin 23 - Not Used (CAM\_BLK)

### D/A U31 pin assignments

CHA - Pin 4 - Not Used (Target)

CHB - Pin 6 - Not Used

**CHC - KVCONT -** Pin 25 - This is a control voltage for the high voltage circuitry that is proportional to the desired kV; see TP19. Refer to the <u>kV Generation</u> section for more information about this signal.

**CHD - MACONT -** Pin 23 - This is a control voltage for the tube current circuitry that is proportional to the desired mA; see TP18. Refer to the <u>mA Generation</u> section for more information about this signal.

### **Negative 10 Volt Reference**

The -10 VDC reference, VR1, provides the necessary voltage reference for the digital to analog conversion. Its output is buffered by U30A, Q14 and other related components.

NOTE: Loss of the reference voltage will give a "Regulator Fail" error message on the Control Panel Display after an exposure has been made.

# **COUNTER/TIMER (CTC) SECTION**

The counter/timer section is comprised of a programmable counter/timer chip U12, flip-flop U15, counter U16, PAL U17 (Programmable Array Logic), and drivers U42 and U40.

The timebase (40 kHz, buffered  $\pm$  10 volt level) for the X-ray generator inverter circuits is derived from the CPU clock (7.16 MHz). The CPU clock is applied to U12, a programmable counter timer chip, and is divided by 179 to provide the 40 kHz output of counter 0 on pin 10.

The 2.5 kHz inverter drive signals HVDRVA and HVDRVB are derived by dividing the 40 kHz clock by 16 in U16, a 4 bit binary counter. Its output is fed to U17, a PAL programmed to provide two complimentary 2.5 kHz outputs of 43% duty cycle (active low). These outputs are buffered by U40 and U42 to provide  $\pm$  12 volt logic levels for extra noise immunity and fed to the X-ray Regulator PCB. See the <u>kV Generation</u> section for details of these signals.

The filament drive signals are derived from the outputs above, and the second output of the counter timer chip. This timer is triggered from U17-16 which has a 5 kHz output. The timer provides a variable pulse width 5 kHz signal, which after AND-gating with HVDRVA and HVDRVB generates FILDRVA and FILDRVB respectively. The result is then a pair of complimentary drives with variable duty cycles. These outputs are buffered by U40 to provide  $\pm$  12 volt logic levels for extra noise immunity and are then routed to the X-ray Regulator PCB. See the **mA Generation** section for details of these signals.

# **PIO SECTION**

Several digital inputs and outputs are provided for software interface through PIOs (Parallel Input/Out) U22, U27, and U38. They are connected to the PC bus shared by the Technique Processor PCB and the Analog Interface PCB. Each of the PIO chips have 3 eight bit ports; A, B, and C. The ports are configured by software as either inputs or outputs. These devices monitor status bits and issue various commands via software control. PIO pin assignments are listed below. Refer to the <u>C-Arm Software</u> section for typical results for these signals using the Control Panel Status software.

| BIT #         | PIN #          | SIGNAL            | FUNCTION  | COMMENT   |  |  |
|---------------|----------------|-------------------|---|---|--|--|
| PA0-2,<br>4-7 | 2-4, 37-40     |                   | not used  |   |  |  |
| PA3           | 1              | INTEGRATE<br>(S3) | Integrate function on CCD camera, via<br>Image Function PCB                         | LO= CCD sensor not being<br>scanned                 |  |  |
| PB0           | 18             | CONTACT           | Turn on relay K2 for Pre-Charge   | HI = turn on Q5                                     |  |  |
| PB1           | 19 Output      | PRECHRG           | Turn on relay K1 for Pre-Charge   | HI = turn on Q4                                     |  |  |
| PB2           | 20 -<br>Output | STAT_RUN          | 40 VAC for Stator Run. After 5 min.<br>[sleep mode]; this signal goes LO            | HI = turn on Q3                                     |  |  |
| PB3           | 21             |                   | not used  |   |  |  |
| PB4           | 22             |                   | not used  |   |  |  |
| PB5           | 23 -<br>Output | STATSTRT          | 120 VAC (2 sec) for Stator Start  | HI = turn on Q7 (2 sec)                             |  |  |
| PB6           | 24 -<br>Output | II_ON             | 24 VDC to Image Intensifier<br>in FLUORO MODE only                                  | HI = FLUORO MODE<br>LO = FILM MODE                  |  |  |
| PB7           | 25             |                   | not used  |   |  |  |
| PC0           | 14             |                   | not used  |   |  |  |
| PC1           | 15 - Input     | SECURITY          | Verification signal to ensure an<br>X-ray switch has been pressed                   | HI = When CPP X-ray or any<br>footswitch is pressed |  |  |
| PC2           | 16             |                   | not used  |   |  |  |
| PC3           | 17             |                   | not used  |   |  |  |
| PC4           | 13 - Input     | L/R               | Detects when SAVE Footswitch has been pressed                                       | LO = Save Footswitch<br>Pressed                     |  |  |
| PC5           | 12 - Input     | FLORONLY          | Detects when SCOUT FLUORO<br>Footswitch has been pressed                            | HI = Scout Fluoro<br>Footswitch Pressed             |  |  |
| PC6           | 11 - Input     | BOOST             | Detects when BOOST/DIG. SPOT<br>footswitch has been pressed                         | HI = Boost/Dig. Spot<br>Footswitch Pressed          |  |  |
| PC7           | 10 - Input     | XRAYSW            | Detects when CPP X-ray Switch or<br>DIGITAL PROCESS FLUORO footswitch<br>is pressed | HI = X-ray Switch Pressed                           |  |  |

### NOTE: Not all of these signals can be tested using Control Panel Status.

Table 2 - U38 - PIO 1 Pin Assignments

| BIT # | PIN #       | SIGNAL    | FUNCTION  | COMMENT   |  |
|-------|-------------|-----------|---|---|--|
| PA0   | 4 - Output  | Ma_SCALE  | Change mA Scale Factor circuit on<br>X-ray Reg. PCB for mA Sense logic                                  | LO = FILM MODE (ARM)<br>HI = FLUORO MODE            |  |
| PA1   | 3 - Output  | FOCLSPOT  | Change large/small filament in FILMLO = .6 mm; HI = 0.3 mmMODE; signal HI in FLUOROFILM MODE Only; (ARM |   |  |
| PA2   | 2           |           | not used  |   |  |
| PA3   | 1 - Output  | SHUTDOWN  | Shutdown Command for generator when fatal error/fault detected  | LO = Normal Operation<br>HI = Generator Shutdown    |  |
| PA4   | 40          |           | not used  |   |  |
| PA5   | 39          |           | not used  |   |  |
| PA6   | 38          |           | not used  |   |  |
| PA7   | 37 - Output | FAULTRES  | Reset generator fault condition to resume normal operation  | LO = Normal Operation<br>HI = Fault Condition Reset |  |
| PB0   | 18          | CHRG_DIS  | Charger Disable   | HI = Battery Chrgr Disabled                         |  |
| PB1   | 19 - 23     |           | not used  |   |  |
| PB6   | 24 -Output  | XRAYON    | X-ray On Command for X-rays   | LO = X-rays OK                                      |  |
| PB7   | 25 - Output | CPUINTLK  | Interlock Pulse; Start of Interlocks  | 20 mSec squarewave; TTL                             |  |
| PC0   | 14 - Input  | OVRLDFLT  | Overload Fault; Excess Primary<br>Current (340 A) detected with L1.                                     | HI = Overload Fault                                 |  |
| PC1   | 15 - Input  | SATFAULT  | Saturation Fault; Excess voltage<br>drop across Darlington transistors                                  | HI = Saturation Fault                               |  |
| PC2   | 16          |           | not used  |   |  |
| PC3   | 17 - Input  | FAULT     | Overvoltage Fault; 140 kVp or more detected within generator assy.                                      | HI = Overvoltage Fault                              |  |
| PC4   | 13 - Input  | HVGENON   | HV Generator On; No faults/errors   | HI = X-rays allowed                                 |  |
| PC5   | 12 - Input  | XRAYDISBL | X-ray Disable; No faults/errors   | LO = X-rays allowed                                 |  |
| PC6   | 11 - Input  | INTLK     | Interlock Complete; interlock end   | LO = Interlocks OK                                  |  |
| PC7   | 10 - Input  | STATSENS  | Stator Sense  | LO = Stator OK                                      |  |

Table 3 - U27 - PIO 2 Pin Assignments

## **C-Arm Control**

| BIT # | PIN #        | SIGNAL  | FUNCTION   | COMMENT                             |
|-------|--------------|---------|--|-------------------------------------|
| PA0   | 4            |         | not used   |                                     |
| PA1   | 3 - Output   | VIDSTBL | (To Cart) Video Stable indicates a stable FLUORO image was acquired. | Pulses HI once = Video<br>is Stable |
| PA2   | 2            |         | not used   |                                     |
| PA3   | 1            |         | not used   |                                     |
| PA4   | 40 - Output  | STORE   | (To Cart) Part of X-ray On Logic                                     | LO = X-rays OK                      |
| PA5   | 39           |         | not used   |                                     |
| PA6   | 38           |         | not used   |                                     |
| PA7   | 37           |         | not used   |                                     |
| PB0-7 | 18-25        |         | Used for Calibration Program   | Connected to J2                     |
| PC0-7 | 10-13, 14-17 |         | Used for Calibration Program   | Connected to J1                     |

### Table 4 - U22 - PIO 3 Pin Assignments

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# **INTERLOCK SECTION**

DS1, K1, Q1, Q2, and associated components comprise part of the +24V generator interlock. When DS1 is on it indicates the interlock circuit has been started. This is a result of PIO U27 pin 25 toggling, under software control, every 10 mS. This causes Q1 and Q2 to activate K1 and send +15 VDC out the Analog Interface PCB causing DS1 to light. See the <u>Interlocks/Stator</u> section of this manual for details of the interlock circuit.

# **X-RAY SWITCH LOGIC**

Opto-isolators U50, U51, and U52 receive X-ray switch closure information from the control panel assembly, footswitch, and handswitch. These inputs are examined by software at PIO U38 and used by the Technique Processor to initialize the generation of X-rays. See the <u>X-ray On/Disable</u> section of this manual for details of this circuitry.

# **STATOR SENSOR**

When either 115 or 40 VAC is directed to the X-ray tube stator windings, U19 and U24 receive a low voltage input from current transformer T1 on the Power/Motor Relay PCB. This is translated into a logic low and is input to pin 10 of PIO U27 informing the Technique Processor that current is flowing to the stator and therefore rotating. See the *Interlocks/Stator* section of this manual for details of this circuitry.



Figure 14 - Analog Interface PCB



# **C-ARM MOTHERBOARD**

S/N 69-0001 through 69-2000 - Assy. #00-900588 - Sch. #00-875539

### S/N 69-2001 and higher - Assy. #00-900970 - Sch. #00-878396

The C-Arm Motherboard is the backplane of the card rack as illustrated in <u>Figures 10 and 11</u>. It serves as a connecting point for the Technique Processor PCB, Analog Interface PCB and on newer models, the Image Function PCB. Also, there are many cables that connect to the back of the circuit board. There are two versions of the Motherboard as shown in <u>Figures 15 and 16</u>.

## VR1 and VR2

VR1 regulates the -15VDC from power supply PS1 down to -12VDC. VR2 regulates the +15VDC down to +12VDC. These voltages are used in various places in the C-Arm.

## VR3

Voltage regulator VR3 is only on the newer Motherboard (assy. #900970). It is not used at this time.



Figure 15 - C-Arm Motherboard - S/N 69-0001 to 69-2000

E



Figure 16 - C-Arm Motherboard - S/N 69-2001 and higher

# SYSTEM COMMUNICATIONS

The Technique Processor PCB within the C-Arm and the 386 AT Motherboard within the Workstation are the communication managers of the system. RS232 is used throughout the system except for the RS422 link between the C-Arm Control Panel Processor and Power/Signal Interface PCB.

The following acronymns are used as part of signal names along with designators to specify the channel, source, etc.:

- TXD = Transmit Data connected to RXD of receiving PCB
- RXD = Receive Data connected to TXD of sending PCB
- RTS = Request To Send connected to CTS of receiving PCB
- CTS = Clear To Send connected to RTS of sending PCB

## **C-ARM COMMUNICATION**

The Technique Processor PCB manages the serial communications for the C-Arm utilizing U39-a four channel serial communication controller. The Technique Processor communicates with the following:

- C-Arm Control Panel Processor PCB.
- Image Functions PCB.
- Workstation.

There are two versions of the Technique Processor PCB. They differ in the associated communication circuitry that is used in conjunction with communication controller U39. The newer version, assembly # 00-877744, uses 2 GALs, U53 and U38, to control port selection and communication type.

NOTE: Switches 1 and 2 of S1 on the Technique Processor PCB (-02 and higher) must be "ON"(closed) to enable serial communications on the 9600 system.



NOTE: RTS (Request To Send) and CTS (Clear To Send) lines on U39 (pins 21, 23, 25, 27, 29, 31, 33 & 35) all become a logic low on the Technique Processor during the boot process.

## **Technique Processor to and from Control Panel Processor**

Communication between the Technique Processor PCB and the Control Panel Processor is established during the boot process. When communication is established all of the segments on the Control Panel Display will be illuminated as shown below.

### 

During normal operation, this communication link enables the Control Panel to send commands such as kV, mA, and other user defined input to the Technique Processor. The TXD and RTS signals from Port A of the serial communications controller U39 on the Technique Processor PCB are sent to microprocessor U5 on the Control Panel Processor PCB. They pass through buffer U37 on the Technique Processor PCB, through the Mainframe Motherboard and then to the Power/Signal Interface PCB. RS422 driver U2, on the Power/Signal Interface PCB, translates the signals to RS422 communication signals (see Figure 17). The signals then leave the Power/Signal Interface PCB at P10 and enter the Control Panel Processor PCB at P4. RS422 serial receiver U10 on the Power/Signal PCB then converts the signals back to RS232 and they are received by microprocessor U5 at pins 17 (RXD) and 44 (CTS).

TXD (pin 18) and RTS (39) from microprocessor U5 on the Control Panel Processor PCB are translated to RS422 communication signals by RS422 driver U8 on the Control Panel processor. These signals then leave the Control Panel Processor at P4 and enter the Power/Signal Interface board at P10. RS422 receiver U1, translates the signals back to RS232 and they leave the Power/Signal Interface PCB at P9. The signals then pass through the Mainframe Motherboard and enter the Technique Processor PCB at P2.

On the older Technique Processor PCB (Assy. #876735) the signals then pass through buffer U37 and AND gate U38 and are received by serial communications controller U39 at pins 19 (RXD) and 27 (CTS).

On the newer Technique Processor PCB (Assy. #877744) the signals then pass through buffer U37 and COM SELECT GAL U38 and are received by serial communications controller U39 at pins 19 (RXD) and 27 (CTS).



Figure 17 - RS-422 Driver/Receiver Logic

## **Technique Processor to and from Image Function PCB**

Communication with the Image Function PCB is established during the boot process. The Control Panel Display will display 10 arrows as shown below at this point in the boot process.

#### 

During normal operation, this communication link enables the Technique Processor to send commands such as:

- Request for Status
- Reset Image Function PCB
- Commands to control Camera and Collimator Motors
- Commands to change the Image Intensifier field size
- Commands to control Camera modes such as Unity Gamma, Antivignetting
- Commands to control collimator modes such as Normal, MAG1 and MAG2

On the older Technique Processor PCB, the port D RXD and TXD lines from communications controller U39 pass through U5, an RS-232 driver/receiver and leave the Technique Processor PCB at P2. These signals then pass through the Motherboard and enter the Image Function PCB at P2. They pass through RS232 driver/receiver U17 and are then received by microcontroller U16.

On the newer Technique Processor PCB, the port C TXD line passes through Port Select GAL U53 and then to RS232 Driver/Receiver U5. The signal received at the port C RXD input comes through U5, makes its way through Com Select GAL U38, Port Select GAL U53, and finally to pin 36 (RXD) of communications controller U39.

The signals pass through RS232 Driver/Receiver U17 on the Image Function PCB and enter microcontroller U16, which in turn issues commands on the data bus to perform the desired function.

### NOTE: The CTS and RTS signals are not used in this communication link.

The Technique Processor sends a request for status to the Image Function PCB at least once a second to check for errors and to confirm that the Image Function PCB is still functioning.

NOTE: Refer to the Image System section of this manual for error codes that relate to the Image Function PCB.

## **COMMUNICATION BETWEEN C-ARM AND WORKSTATION**

Communication between the C-Arm and Workstation is established during the boot process. All of the arrows will be displayed on the Control Panel Display as shown below during this part of the boot process.

#### 

During normal operation, the Technique Processor and 386 AT Motherboard send information such as:

- Shot log file information from the C-Arm to the Workstation
- Commands such as L>R, SAVE and CART MODE from the Control Panel to the Workstation
- "Enable Boost" command to the C-Arm when CHOLE/DIGITAL SPOT is selected on the Workstation

The TXD and RTS signals from Port B of the serial communications controller U39 on the Technique Processor PCB are sent to the 386 AT Motherboard on the Workstation. They pass through RS232 driver/receiver U52 on the Technique Processor PCB and then pass through the Mainframe Motherboard, the interconnect cable, and enter the Aux Interface PCB in the Workstation. They pass through the Aux Interface PCB to the AT Communications PCB where they are inverted by U15 and enter DUART U27. U27 interfaces the signals to the data bus of the AT Motherboard.

The 386 AT Motherboard communicates over the data bus to DUART U27 on the AT Communications PCB. TXDA (pin 30) and RTS (pin 29) leave DUART U27, pass through RS232 line driver U16 and leave the AT Communications PCB at P3. They then pass through the Aux Interface PCB, the Interconnect Cable and enter the C-Arm at J1 on the Power Panel. They pass through the Mainframe Motherboard and enter the Technique Processor PCB at P2.

On the older Technique Processor PCB (Assy. #876735) the signals then pass through RS-232 driver/receiver U52 and are received by serial communications controller U39 at pins 8 (RXD) and 23 (CTS).

On the newer Technique Processor PCB (Assy. #877744) the signals then pass through RS232 driver/receiver U52 and COM SELECT GAL U38 and are received by serial communications controller U39 at pins 8 (RXD) and 23 (CTS).

# **C-ARM SOFTWARE**

# **OVERVIEW**

The 9600 C-Arm software is loaded from a PCMCIA style **SRAM card** to RAM located on the Technique Processor PCB, during system start-up. The software remains resident in the RAM until the generator is turned off. The SRAM card is located in the solid state disk drive on the **Technique Processor PCB**.

# **START-UP AND SOFTWARE BOOT**

The key events which occur during start-up are:

- 1. Power supplies stabilize at the proper voltage levels and power is applied to all the microprocessor circuits.
- 2. Microprocessors are reset and program control is transferred to the boot EPROM (U14) on the Technique Processor PCB.
- Technique Processor PCB boot EPROM (U14) software performs critical hardware setups, executes various hardware tests, and loads the boot sectors from the SRAM card.

Critical hardware setup includes initializing all DMA, memory, I/O and bus-oriented devices on the Technique Processor PCB. This setup involves the following steps:

- A. Initialize hardware lines to a defined state
- B. Initialize and test memory
- C. Display boot codes
- 4. Software routines in the Technique Processor PCB boot EPROM (U14) load the boot sectors from the SRAM card.
- 5. Boot sectors, once loaded into the Technique Processor PCB RAM (U16-U19), load the operating system into memory. After the operating system is initialized it assumes program control.

# LOADING APPLICATION SOFTWARE

Application software is by entered utilizing the operating system or from a program such as STATUS. The key events which occur are:

- 1. Technique Processor PCB EEPROM (U20) is checked.
- 2. Default Fluoro and Film parameters are loaded and the system is configured by the OPTIONS.DAT file. Options such as Boost and 40 mA pulsed mode are initialized.
- 3. The 40 kHz clock on the Analog Interface PCB is started.
- 4. Hardware is again initialized as a precaution.
- 5 The MALIMIT.DAT file and ABS tables are loaded.
- 6. Tests are run to determine if the system is capable of functioning.
- 7. Footswitch is checked (for "footswitch stuck" fault).
- 8. Generator Interlock (+24V) is made.
- Capacitors C2 and C3 on Generator Controller Assembly are charged by Battery B+ voltage through pre-charge circuitry.
- 10. The stator line is pulsed.
- 11. Check for disconnected batteries and check B+ voltage.
- 12. The small filament is preheated.
- 13. Generator and X-ray tube control signals are initialized.
- 14. Heat units are computed for the anode and housing.
- 15. If no problems are found, operator input is accepted from the control panel.

## **PERIODIC FUNCTIONS AND ACTIONS**

These are functions executed periodically by the software program, which include Control Panel Processor PCB polling and error checking. Items checked include:

- 1. X-ray tube heating.
- 2. Battery voltage and current.
- Hardware faults such as overloads, saturation, and filaments, stator, collimator, HV inverter, interlocks, communications to Image Function PCB and Control Panel Processor PCB.

# **EEPROM USAGE**

The electrically-erasable PROM (EEPROM) on the Technique Processor PCB (U20) stores historical data about the system for later use by service, marketing, and engineering. Associated with the EEPROM is an SRAM data file that contains an image of the EEPROM contents. Contents of the EEPROM may be accessed by using the STATUS mode. The EEPROM contents consist of:

- Reserved area.
- Event Code array contains the last 128 event codes.
- Highest anode heat records the highest X-ray tube anode heat produced on the system.
- Anode heat conditions.
- Current anode heat data with time.
- Highest X-ray tube housing heat ever recorded.
- Current housing heat data with time.
- Highest housing thermistor reading ever encountered.
- Current battery charge state with time.
- Highest battery voltage ever encountered.
- Lowest battery voltage ever encountered.
- Maximum continuous fluoro on-time ever encountered.
- Maximum cumulative fluoro on-time ever encountered.
- Total film exposures taken on the system.
- System serial number.
- System calibration factors.

A local event table is copied from EEPROM after system start-up. A fatal event will cause the local event table to be copied to EEPROM.

# DEFAULT PARAMETER (OPTIONS.DAT) FILE

The default parameter file (OPTIONS.DAT) defines the generator configuration. It can be accessed via the Mainframe Menu. Refer to Mainframe Menu heading in this section of the manual for information on accessing this menu.

# **BOOT SEQUENCE**

4

During startup, boot codes are issued as the software is loaded and the hardware is initialized. These progressive codes are displayed briefly on the Mobile C-Arm LED display. If any of these messages persist on the display and the system fails to complete the startup sequence, a fault is indicated. Note the code letter and/or the number of segments that are illuminated and refer to the following list.

### NOTE: Illuminated segments are illustrated as white, non-illuminated segments are black.

| X-RAY CONTROL PANEL<br>FLUORESCENT DISPLAY | TECHNIQUE<br>PROCESSOR HEX<br>DISPLAYS |             | CORRESPONDING SYSTEM<br>ACTIVITY   |
|--|--|-------------|--|
|  | U2<br>(MSB)                            | U1<br>(LSB) |  |
|  | 0                                      | 0           | Initialization of interrupts, display and timers completed.  |
|  | 0                                      | 0           | EEPROM checksum verification complete.   |
|  | 0                                      | 0           | Keyboard initialization completed.   |
|  | 0                                      | 0           | Control Panel Processor PCB UART<br>(U4) initialization completed.<br>Control Panel Processor PCB "boot<br>complete" message sent to Technique<br>Processor PCB. |
|  | 0                                      | 0           | Power ON diagnostics for Technique<br>Processor PCB started.   |
|  | 1                                      | 5           | Test first 64K of RAM memory (U16-<br>U19) on Technique Processor PCB.   |
|  | 0                                      | 8           | Initialize CMOS chip on Technique<br>Processor PCB.  |
|  | 0                                      | 6           | Initialize interrupt controller chip (U51) on Technique Processor PCB.   |
|  | 1                                      | 6           | Setting interrupt vector table.  |
|  | 1                                      | E           | Sizing system memory.  |
|  | 1                                      | F           | Testing RAM memory (U16-U19) above first 64K on Technique Processor PCB.   |
|  | 0                                      | 9           | Checksum BIOS ROM.   |
|  | 2                                      | С           | Initializing serial ports on Technique<br>Processor PCB.   |
|  | 0                                      | Α           | Initialize video interface.  |
|  | 1                                      | 3           | Testing keyboard controller interface.   |
|  | 2                                      | 0           | Initializing parallel port.  |
|  | 2                                      | В           | Initializing Solid State Disk Drive.   |

| X-RAY CONTROL PANEL<br>FLUORESCENT DISPLAY | TECHNIQUE<br>PROCESSOR HE<br>DISPLAYS |             | CORRESPONDING SYSTEM<br>ACTIVITY  |
|--|---------------------------------------|-------------|---|
|  | U2<br>(MSB)                           | U1<br>(LSB) |   |
|  | 3                                     | 1           | Initializing Option EEPROM (U15) on Technique Processor PCB.  |
|  | F                                     | F           | Load software from SRAM to<br>Technique Processor PCB RAM<br>memory (U16-U19).  |
|  | 0                                     | 0           | All previous steps completed.   |
|  | 0                                     | 0           | EVENT.EXE loaded and starting initialization.   |
|  | 0                                     | 0           | Data from Option EEPROM (U15) on<br>Technique Processor PCB read into<br>local table. Event buffer initialized.                     |
|  | 0                                     | 0           | Option EEPROM (U15) on Technique<br>Processor PCB and EEPROM.DAT file<br>brought into synchronization.                              |
|  | 0                                     | 0           | EVENT boot process complete.  |
|  | 0                                     | 0           | MAINMENU loaded.  |
|  | 0                                     | 0           | Check for OEC access disk if<br>necessary. If needed and not found,<br>"OEC Boot Disk Needed" will be<br>displayed.                 |
|  | 0                                     | 0           | OPTIONS.DAT file on SRAM card<br>successfully found and ABS index file<br>is OK.  |
|  | 0                                     | 0           | Workstation returned to normal mode and loading Main Application.   |
|  | 0                                     | 0           | Main application loaded. Auxiliary port<br>initialized. System buffers cleared.<br>Error handler set up. Event code file<br>opened. |
|  | 0                                     | 0           | OPTIONS.DAT file opened and read into memory.   |
|  | 0                                     | 0           | Appropriate MAP file opened and loaded into control panel map.  |
|  | 0                                     | 0           | Message file MAIN.TXT opened and<br>messages loaded into message table.<br>Timer interrupt vector set.<br>Control break turned off. |
|  | 0                                     | 0           | Initialize variables. Read command line parameters & Set software switches.   |
|  | 0                                     | 0           | Clock on Analog Interface PCB started<br>and PIO's reset.   |

| X-RAY CONTROL PANEL<br>FLUORESCENT DISPLAY | TECHNIQUE<br>PROCESSOR HEX<br>DISPLAYS |             | CORRESPONDING SYSTEM<br>ACTIVITY   |  |  |
|--|--|-------------|--|--|--|
|  | U2<br>(MSB)                            | U1<br>(LSB) |  |  |  |
|  | 0                                      | 0           | Control panel key pulse rates set.<br>Data files opened and loaded.<br>MUX RAM addresses set & A/D<br>conversion data set.   |  |  |
|  | 0                                      | 0           | Read calibration coefficients from<br>EEPROM.<br>Open ABS index file and store in<br>memory.<br>Find and open default ABS table.<br>Servo to center of default ABS table.<br>Open and load MALIMIT.DAT file.   |  |  |
|  | 0                                      | 0           | Set default values and set variables to the values in OPTIONS.DAT file.  |  |  |
|  | 0                                      | 0           | Hardware integrity checked and interlocks started.   |  |  |
|  | 0                                      | 0           | Cart communications initialized.<br>Table communications initialized.<br>Stator started.<br>Filaments started.<br>Interlocks checked.<br>Faults checked.   |  |  |
|  | 0                                      | 0           | Checked for disconnected batteries.<br>Set Analog Interface PCB to AUTO<br>FLUORO.<br>Set Workstation to AUTO FLUORO.<br>Set speaker pitch.<br>Set control panel to default values,<br>send the default technique to Analog<br>Interface PCB, set up standby timers.<br>Clear control panel and Workstation<br>buffers.<br>Tell Workstation that generator is<br>ready.<br>Open camera iris.<br>Initialize heat parameters.<br>Initialize charger. |  |  |
|  | 0                                      | 0           | kV and mA values displayed on X-ray control panel.   |  |  |

For a listing of Errors and their associated Error Codes, refer to the Error Code <u>Section</u>.

# **MAINFRAME MENU**

The Mainframe Menu (Error Section) is accessed using the Workstation. The Workstation is used as a terminal since the generator assembly does not have its own direct serial link for using this program. This service software contains several options which are explained in the next few pages. Perform the following steps to access this generator service software.

## **ACCESSING THE MAINFRAME MENU**

- 1. With the system powered on, insert the OEC access disk into the floppy drive at the rear of the Workstation.
- 2. Press the SETUP OPTIONS key on the Workstation.
- 3. Use the cursor control keys (or trackpad) to highlight the *Access Level 2 (Service)* sub-menu and press **ENTER** (or superkey).
- 4. Select *Access Mainframe Menu*. When this option is selected, the following menu appears on the left monitor.

| ***** MAINFRAME MENU ******   |  |
|---|--|
| <ul> <li>A. Run Applications (Take X-rays)</li> <li>B. Run Applications with Parameters</li> <li>C. Run Calibration</li> <li>D. System Configuration</li> <li>E. mA Limit File Editor</li> <li>F. Examine Event File</li> <li>G. Run Status</li> <li>H. Collimator Calibration (System will reboot)</li> <li>I. Language Options</li> <li>J. ABS Index File Editor</li> </ul> |  |
| <esc> - Return to DOS</esc>   |  |
| Enter command letter:   |  |

NOTE: When this service software is activated, the generator interlocks are broken in order to prevent X-rays.

### A - Run Applications (Take X-rays)

When you have finished using this generator service software and you want to return the generator to normal operation, select option *A. Run Applications (Take X-rays)*. This option reboots the generator. Press *ESC* twice to clear the right workstation monitor. Remove the diagnostic disk.

### **B** - Run Applications With Parameters

When this option is selected, the following menu appears. This menu allows you to run the normal application software (which allows X-rays) with one or more parameters.

Once all desired parameters have been selected, the option *K*. (*RUN*) *MAIN* must be selected in order to run the main application program with the parameters specified. Press *ESC* twice to clear the right workstation monitor.

| *** PARAMETERS FOR MAINFRAME APPLICATIONS ***   |
|---|
| <ul> <li>A. (RAW) Display Sensor KV and MA after shot.</li> <li>B. (DRO) Display Calibrated Sensor KV and MA after shot.</li> <li>C. (CART) Ignore cart.</li> <li>D. (STATOR) Ignore stator sense.</li> <li>E. (NOCAL) Run machine uncalibrated.</li> <li>F. (HARDWARE) Ignore A/D checks during boot-up.</li> <li>G. (CALCOLL) Calibrate collimator.</li> <li>H. Change Contactor Engage Voltage (enter number): <ol> <li>Delete last parameter.</li> <li>(HEAT) Display heat info.</li> <li>(RUN) MAIN</li> <li>ESC&gt; Return to MAINMENU</li> </ol> </li> </ul> |
| ENTER COMMAND LETTER:   |

### A. (RAW) Display Sensor kV and mA After Shot.

Use this option to display the kV and mA the generator sensed after a FILM or FLUORO shot. The generator sense circuits are run uncalibrated in this mode.

### B. (DRO) Display Calibrated Sensor kV and mA After Shot.

Use this option to display the kV and mA the generator sensed after a FILM or FLUORO shot. The generator sense circuits are run calibrated in this mode.

### C. (CART) Ignore Cart.

# CAUTION: Use this option to ignore cart status/control signals that may be disabling X-rays.

D. (STATOR) Ignore Stator Sense.

#### **C-Arm Software**

### CAUTION: Use this option to ignore the stator sense circuit.

E. (NOCAL) Run machine uncalibrated.

Do not use this option.

F. (HARDWARE) Ignore A/D checks during boot-up.

### CAUTION: Use this option to ignore A/D failures.

G. (CALCOLL) Calibrate collimator.

Use this option to calibrate the collimator. See the *Image Calibration* section for details on this procedure.

H. Change Contactor Engage Voltage (enter number):

### CAUTION: Do not use this option under any circumstances.

#### I. Delete last parameter.

Use this option to delete the last parameter that appears on the same line as option K. (RUN).

#### J. (HEAT) Display Heat Info.

Do not use this option.

#### K. (RUN) MAIN

Use this option to start the generator application software when the desired parameters have been selected. This parameters appear on this same line.

### **C** - Run Calibration

Refer to Generator Calibration regarding this option.

### **D** - System Configuration

When this option is selected, the Control Panel displays "RUNNING OPTUSER" and the following menu appears.

| <ol> <li>Is boost available [Y/N]?</li> </ol>     |     | Y   |
|---|-----|-----|
| 8. Is X-ray Inhibit line active low [Y/N]?        |     | Y   |
| . Fluoro Beeper ON [Y/N]?                         |     | Y   |
| ). Video Level set at:                            | 450 |     |
| . Percent of maximum available boost:             |     | 90  |
| F. Fluoro timer set for [5-10] minutes            |     | 5   |
| 6. Boosted Pulse Available [Y/N]?                 | Y   |     |
| I. Film shots allowed on boost button only [Y/N]? |     | N   |
| . Pulse Video Level set at:                       |     | 315 |
| . Video level dead band:                          |     | 16  |
| K. Boost time:                                    |     | 30  |
| . Default ABS Tables: DOMESTIC                    | 1   |     |

### NOTE: Options B, D, & J should appear as shown above. Other options may differ.

### NOTE: [Y/N] choices toggle when option letter (A, B, etc.) is pressed.

### E - mA Limit File Editor

Refer to Generator Calibration section regarding this option.

### **F** - Examine Event File

When this option is selected, the following menu appears.

|                |                        | × • <del>-</del> •      |
|----------------|------------------------|-------------------------|
|                | A/D CHANNELS PIO L     | JATA                    |
| SATURATION FLT |                        |                         |
| FLUORO BOOST   | 1 MEASURED MA - 0.02   | V PIO1-B: 199 (1100011) |
| FLUORO - XRAY  | 2 FILAMENT B+ - 4.10   | / PIO1-C: 23 (0001011   |
| FLUORO - XOFF  | 3 VIDEO LEVEL - 3.12   | / PIO2-A: 2 (0000001)   |
| FLUORO - XRAY  | 4 HOUSING THER - 3.02  | / PIO2-B: 64 (0100000   |
| FLUORO - XOFF  | 5 DOSIMETER - 3.51V    | PIO2-C: 250 (1111101    |
| FLUORO - XRAY  | 6 SPARE - 5.78V        | PIO3-A: 187 (1011101    |
| FLUORO - XOFF  | 7 SPARE - 0.00V        | PIO3-B: 255 (1111111    |
| FLUORO - XRAY  | 8 TAP VOLTAGE - 0.00   | V PIO3-C: 255 (1111111  |
| FILM - FLUORO  | 9 LINE VOLTAGE - 7.87  | V                       |
| FLUORO - FILM  | 10 CHARGE CURR - 0.00V | /                       |
| FLUORO - XOFF  | 11 CHARGE VOLT - 4.88  | ✓ THERMISTOR FAHR = 8   |
| FLUORO BOOST   | 12 FILAM CURR - 3.53   | V THERMISTOR CENT = 2   |
| FLUORO - XRAY  | 13 SPARE - 0.00V       | LINE VOLTAGE = 116.0    |
| FLUORO - XOFF  | 14 SPARE - 0.00V       | ANODE = 137810.57       |
| FLUORO BOOST   | 15 SPARE - 0.00V       | HOUSING = 194092.57     |
|                |                        |                         |

Up to 16 fatal events are recorded. If less than 16 fatal events are recorded, only these events are displayed. If no fatal events are recorded, this option will return to the main menu.

### G - Run Status

Refer to *Status* heading in this section of the manual regarding this option.

There is no workstation screen associated with this selection. The left monitor will continue to display the Mainframe Menu while in status mode, however no new entries can be made until status mode is exited from the generator Control Panel.

### H - Collimator Calibration (System will reboot)

There is no Workstation screen associated with this selection. When this selection is chosen, the system will reboot so that the iris collimator field sizes can be calibrated and the data stored in the EEPROM on the Image Function PCB. Refer to the <u>Image</u> <u>System Calibration</u> section in this manual for details of using this selection.

### I - Language Options

When this option is selected the following menu will appear on the left Workstation monitor and "RUNNING LANGOPT" will be displayed on the C-Arm control panel display:

LANGUAGE OPTIONS Current language is ENGLISH A ENGLISH B FRENCH C GERMAN D ITALIAN E SPANISH <ESC> - Exit Enter Command letter:

After a letter has been entered from the keyboard and the ESCAPE key has been pressed, the C-Arm will reboot and the messages will be displayed in the selected language.

#### J - ABS Index File Editor

When this option is selected the following menu will appear on the left Workstation monitor and "RUNNING ABS INDEX" will be displayed on the C-Arm control panel display:

ABS INDEX TABLE EDITOR

A. Edit ABS Index File B. Edit In Use ABS Records

<ESC> - Exit Enter Command Letter:

#### A. Edit ABS Index File

NOTE: Do not edit the VLI Offset and PVLI Offset values. These are factory set and must not be changed.

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| ABS INDEX TABLE EDITOR   |                  |              |               |             |             |         |             |      |      |       |
|--|------------------|--------------|---------------|-------------|-------------|---------|-------------|------|------|-------|
| Rec  | Description      |              | ABS Displa    | y Name      | Boost       | In Use  | Boot        | PLS  | VLI  | P VLI |
| Nos  |                  |              |               |             | Avail       |         | Up          | Rate | Ofst | Ofset |
| 1  | Standard for Don | nestic 5R    | Standard 5R   | /Min        | Yes         | Yes     | Yes         | 4    | 0    | 0     |
| 2  | Low Dose for Do  | mestic       | Low Dose      |             |             | Yes     |             | 1    | 0    | 0     |
| 3  | Chest 5R         |              | Chest 5R/Mi   | n           | Yes         | Yes     |             | 4    | -100 | -70   |
| 4  | Extremities 5R   |              | Extremities 5 | 5R/Min      | Yes         | Yes     |             | 4    | 50   | 35    |
| 5  | Standard 10R     |              | Standard      |             | Yes         |         |             | 4    | 0    | 0     |
| 6  | Chest 10R        |              | Chest         |             | Yes         |         |             | 4    | -100 | -70   |
| 7  | Extremities 10R  |              | Extremities   |             | Yes         |         |             | 4    | 50   | 35    |
|  |                  |              |               |             |             |         |             |      |      |       |
| A. Pag   | e Up             | B. Page Do   | own           | C. Top of T | able        | D.E     | nd of Table | e    |      |       |
| E. Sele  | ect Record       | F. Edit in U | se            | G. Edit Boo | ot Up Defau | ult H.E | dit Pulse R | ate  |      |       |
| I. Edit  | VLI Ofst         | J. Edit Puls | se VLI Ofst   |             |             |         |             |      |      |       |
| <esc:< td=""><td>&gt; - Exit</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></esc:<> | > - Exit         |              |               |             |             |         |             |      |      |       |
| Entero   | ommand letter:   |              |               |             |             |         |             |      |      |       |

## B. Edit In Use ABS Records

# NOTE: Do not edit the VLI Offset and PVLI Offset values. These are factory set and must not be changed.

| ABS INDEX TABLE EDITOR   |                          |                    |       |        |      |      |      |       |
|--|--------------------------|--------------------|-------|--------|------|------|------|-------|
| Rec  | Description              | ABS Display Name   | Boost | In Use | Boot | PLS  | VLI  | P VLI |
| Nos  |                          |                    | Avail |        | Up   | Rate | Ofst | Ofset |
| 1  | Standard for Domestic 5R | Standard 5R/Min    | Yes   | Yes    | Yes  | 4    | 0    | 0     |
| 2  | Low Dose for Domestic    | Low Dose           |       | Yes    |      | 1    | 0    | 0     |
| 3  | Chest 5R                 | Chest 5R/Min       | Yes   | Yes    |      | 4    | -100 | -70   |
| 4  | Extremities 5R           | Extremities 5R/Min | Yes   | Yes    |      | 4    | 50   | 35    |
| E. Select Record G. Edit Boot Up Default H. Edit Pulse Rate<br>I. Edit VLI Ofst J. Edit Pulse VLI Ofst |                          |                    |       |        |      |      |      |       |
| <esc></esc>  | > - Exit                 |                    |       |        |      |      |      |       |
| Enter command letter:  |                          |                    |       |        |      |      |      |       |
# **SRAM FILES**

The following software files are found on the SRAM card:

**IO.SYS** MSDOS.SYS COMMAND.COM 9600.MAP AUTOEXEC.BAT ABSINDEX.EXE ABSINDEX.TXT ABSINDEX.DOM ABSINDEX.EUR ABSINDEX.OPT CAL-COEF.EXE CALRANGE.DAT CARM.DC CARM.CAL CARM.VER CHECKSUM.EXE CSUMERR.EXE EDITMA.EXE EEPROM.DAT EVENTEXT.ENG EVENT.EXE EVENTEXT.FRE EVENTEXT.GER EVENTEXT.ITA EVENTEXT.SPA EVENTEXT.TXT EXAMINE.EXE LANGOPT.EXE MALIMIT.DAT MAIN.EXE MAIN.ENG MAIN.FRE MAIN.GER MAIN.ITA MAIN.SPA MAIN.TXT MUX.DAT MAINMENU.EXE OPTIONS.DAT **OPTIONS.FXD** OPTUSER.EXE 5R STD.ABS LOW-DOSE.ABS 10R EXT.ABS 10R\_STD.ABS

**DOS System File DOS System** DOS System **Control Panel Map File** EVENT, MAINMENU Executable file - "J" ABS INDEX FILE EDITOR Text file for ABS index file editor Domestic ABS index file European ABS index file Optional ABS index file Executable file - "C" RUN CALIBRATION Defines calibration parameters Filament Duty Cycle Characterization Data kV & mA Calibration Data kV & mA Calibration Data Checksum program file Checksum program file Executable file -"E" mA LIMIT FILE EDITOR mAs and Calibration Data English text for event file Captures fatal events French text for event file German text for event file Italian text for event file Spanish text for event file Text for event file Executable file - "G" EXAMINE EVENTFILE Executable file - "I" LANGUAGE OPTIONS mA Limit File Data - Created by EDITMA.EXE Executable file for C-Arm applications software English text for MAIN.EXE French text for MAIN.EXE German text for MAIN.EXE Italian text for MAIN.EXE Spanish text for MAIN.EXE Main applications text file Analog MUX data Executable file for Main Menu Options data - created by OPTUSER.EXE Used by OPTUSER.EXE **Executable file - "D" SYSTEM CONFIGURATION** ABS Table for 5R/min Standard Table ABS Table for Low Dose ABS Table for 10R/min Extremities ABS Table for 10R/min Standard Table

#### C-Arm Software

EUR\_STD.ABS EUR\_LOW.ABS OPT\_STD.ABS OPT\_LOW.ABS STATUS.EXE CHECKSUM.CHK CSUMCHEK.CHK FILECHEK.DAT LABEL.RPT RESULT.RPT ALL.DAT

ABS Table for European Standard Table ABS Table for European Low Dose ABS Table for Optional Standard Table ABS Table for Optional Low Dose Table Executable file - "H" CONTROL PANEL STATUS Checksum program file In house file check data In house use only In house use only Created at end of calibration by merging CARM.DC, CARM.CAL, and CARM.VER

# **SRAM CARD**

# COPY FILES FROM 3 1/2-INCH FLOPPY DISK TO SRAM

A 3 1/2" floppy disk containing generator backup software is shipped with every 9600 system. The disk contains the same files as contained on the SRAM card from the Technique Processor PCB. If a problem arises with the SRAM card, the files can be copied from the floppy disk to the card using the following procedure.

Equipment required:

- Computer with PCMCIA port
- Software (loaded on computer) to recognize PCMCIA port (OEC P/N 00-900876-01)
- Generator backup software (3 1/2-inch disk)

# NOTE: The 3 1/2-inch floppy disk contains data that is unique (calibration data, serial number) to that system. Do <u>not</u> use backup software from another system for this procedure.

- 1. Boot computer, insuring that the PCMCIA port is recognized by software.
- 2. Install SRAM card from Technique Processor PCB in PCMCIA port on computer, listen for beep from computer that indicates recognition of card.
- 3. Install 3 1/2-inch floppy backup disk on computer.
- 4. Format the SRAM card with the following command:

Format F:/U/S

5. Use the following command to copy the files from the floppy to the SRAM card:

copy A:\*.\* F:

#### NOTE: Assuming F drive as the PCMCIA port and A drive as the 3 1/2 " floppy drive.

# COPY FILES FROM SRAM TO 3 1/2-INCH FLOPPY DISK

Whenever a generator calibration is performed (see <u>Generator Calibration</u> section in this manual), the new calibration data must be copied from the SRAM card on the Technique Processor PCB to the 3 1/2" backup disk. This preserves the calibration data in the event of an SRAM card failure.

Equipment required:

- Computer with PCMCIA port
- Software (loaded on computer) to recognize PCMCIA port (OEC P/N 00-900876-01)
- Generator backup software (3 1/2-inch disk)
- 1. Boot computer, insuring that the PCMCIA port is recognized by software.
- 2. Install SRAM card from Technique Processor PCB in PCMCIA port on computer, listen for beep from computer that indicates recognition of card.
- 3. Install 3 1/2-inch floppy backup disk on computer.
- Use the following command to copy the files from the SRAM card to the floppy disk: copy F:\*.\* A:

**NOTE:** Assuming F drive as the PCMCIA port and A drive as the 3 1/2-inch floppy drive.

## **HOT-BYTE INFORMATION**

The "Hot-Byte" is a byte of data located at address 0000 in the EEPROM.DAT file in generator software. Depending on the status of the Hot-Byte, the direction of data transfer between EEPROM U58 and the SRAM card, both on the Technique Processor, will change as shown in Figures 1 and 2.

| Hot-Byte Not Set = $(0)$ | 5A at address 0000 in EEPROM.DAT file |
|--------------------------|---------------------------------------|
| Hot-Byte Set = (1)       | A5 at address 0000 in EEPROM.DAT file |

### Hot-Byte Not Set (0)

Under normal operating conditions the Hot-Byte is set at 0 (5A and information such as that for the Event file is written into EEPROM U58 on the Technique Processor as the events occur. At the next boot-up of the system, this information is written from U58 to the corresponding file on the SRAM card as shown in the first case in Figure 1.

If the EEPROM is blank (as shown in the second case in Figure 1), this will be sensed by software during boot-up and the information contained in the EEPROM.DAT file on the SRAM card is written to EEPROM U58.



With the Hot-Byte set at 1, the direction of data transfer will always be from the SRAM card to EEPROM U58 as shown in both cases of Figure 2.

When the EEPROM is blank, this will be sensed by software during boot-up and the information contained in the EEPROM.DAT file on the SRAM card is written to EEPROM U58.

In the second case of Figure 2, the EEPROM is not blank but the Hot-Byte is set at 1. In this case, the information in the EEPROM.DAT file on the SRAM card will overwrite the information already on the EEPROM when the system is booted. After this takes place, the Hot-Byte becomes a "0" and the software is back to normal operation as shown in Figure 1.

This scenario would occur if EEPROM U58 was suspected of being corrupted and it was desired to re-program U58. Before this could be done, the SRAM card would have to be re-loaded with the files from the 3 1/2" floppy backup disk as explained under the *Copy Files from 3 1/2-inch Floppy Disk to SRAM* heading in this section. The Hot-Byte on the backup disk is set at 1 so that this re-write to the EEPROM can be accomplished.



Figure 2 - Data Transfer with Hot-Byte Set at 1

# **SRAM BATTERY REPLACEMENT**

The SRAM card contains 2 batteries, an internal NI-CAD battery that is not replaceable and a 3 Volt Lithium battery which must be replaced annually to prevent loss of the SRAM files. The NI-CAD battery serves as a backup if the Lithium battery should fail.

There are two LEDs on the Solid State Drive that give an indication of the operation of the drive and the status of the Lithium battery. The LED closest to the SRAM is a "Status" LED. It will illuminate RED during disk access if the Lithium battery needs to be replaced. The second LED is a "Busy" LED that indicates when the SRAM is being accessed. If both LEDs illuminate RED during disk access, the lithium battery is not charged adequately.

# WARNING... Do not remove the SRAM from the Solid State Drive when performing this procedure.

- 1. With the system booted and the SRAM <u>in</u> the Solid State Drive, remove the battery holder and the battery as shown in Figure 3.
- 2. Replace the battery with a new 3 Volt, Lithium , 165 mAH battery. (OEC P/N 74-122904-00). Verify that the + sign is pointing up.



Figure 3 - SRAM Battery Replacement

# **INTERLOCK/STATOR**

# **OVERVIEW**

This section describes the operation of the following circuits:

- Generator Interlock
- Pre-charge
- <u>Stator</u>

These circuits are initialized and checked by the Technique Processor during the boot sequence. If a failure is detected during boot-up, the system will hang, not completing the boot sequence. An error message may be displayed on the Control Panel Display.

After system boot, the Technique Processor continues to monitor these circuits. An error message is displayed on the Control Panel Display and X-rays are prohibited, if a failure is detected.

# **REFERENCE DIAGRAMS**

The theory in this section is most easily understood when using the following figures and schematics. Use the correct schematics for your system.

### **Generator Controller Assembly Drawing**

Drawing #00-875392 - All serial numbers

### Analog Interface PCB

Schematic #00-876738 - Assembly #00-876740 - All system serial numbers

### **Mainframe Motherboard**

Schematic #00-875539 - Assembly #00-900588 System serial numbers 69-0001 thru 69-2000 Schematic #00-878396 - Assembly #00-900970 System serial numbers 69-2001 and up

### Power Motor Relay PCB

Figure 4 Figure 5 Schematic #00-875997 - Assembly #875999 All serial numbers

#### **Power Signal Interface PCB**

#### Figure 4

Schematic #00-876001 - Assembly #876003 System serial numbers 69-0001 thru 69-1000 Schematic #00-877998 - Assembly #878000 System serial numbers 69-1001 and up

#### **Battery Charger PCB**

#### Figure 2

Schematic #00-876643 - Assembly #00-876644 System serial numbers 69-0001 thru 69-1000 Schematic #00-877995 - Assembly #00-877997 System serial numbers 69-1001 and up

#### X-ray Regulator PCB

Schematic #00-877458 - Assembly #877460 All serial numbers

#### **Generator Driver PCB**

#### Figure 2

Schematic #00-877461 - Assembly #877463 All serial numbers

#### Control Panel Processor PCB

Schematic #00-875601 - Assembly #875603 All serial numbers

#### C-Arm Interconnect Diagram

Schematic # 00-875500 - System serial numbers 69-0001 thru 69-1000 Schematic # 00-877972 - System serial numbers 69-1001 thru 69-2000 Schematic # 00-878376- System serial numbers 69-2001 and up

#### Image System Interconnect Diagram

Schematic # 00-875410 - System serial numbers 69-0001 thru 69-1000 Schematic # 00-877971 - System serial numbers 69-1001 thru 69-2000 Schematic # 00-878377 - System serial numbers 69-2001 and up

# **GENERATOR INTERLOCK**

### **OVERVIEW**

The interlock circuit provides a means to halt system operation through software when the Technique Processor detects a major system fault or through hardware when a FAST STOP switch is pressed.

The FAST STOP switches are located on either side of the control panel housing. The message, *INTERLOCKS OPEN*, will appear on both control panel displays when either FAST STOP switch is pressed. This is considered a fatal error and is recorded in the EVENT.DAT file. The system is still powered at this time and a system re-boot can be commanded by pressing any key on the control panel.

The interlock circuit is comprised of the following circuits:

- <u>CPU INTERLOCK</u>
- FAST STOP
- +24V INTERLOCK
- JUMPER E5 / RELAY K4

### **CPU INTERLOCK**

During the boot sequence the Technique Processor software toggles PIO U27-25, on the Analog Interface PCB, at a 10 mS rate. Eighteen arrows are displayed on the Control Panel display at the point in the boot sequence that this occurs.

This 10 mS interlock pulse is detected by pulse detector Q1, Q2 and associated circuitry on the Analog Interface PCB. As long as the interlock pulses are present, the pulse detector holds relay K1 energized. This allows +15 VDC to pass through relay K1 contacts 1 & 7 illuminating LED DS1 on the Analog Interface PCB. DS1 indicates that the signal CPU INTERLOCK (+15V) is present.

The CPU INTERLOCK signal passes through the Motherboard to the Power Motor Relay PCB where it can be measured on TP3. CPU INTERLOCK momentarily energizes relay K8 on the Power Motor Relay PCB through the C7/R17 circuit. The CPU INTERLOCK signal also passes through to the FAST STOP circuit described next.

### **FAST STOP**

The CPU INTERLOCK signal passes through both normally closed FAST STOP switches S1 & S2 and then back to the Power Motor Relay PCB. If a FAST STOP switch is pressed the interlock circuit is disabled preventing X-ray generation and motor movement. The path that the CPU INTERLOCK signal takes is described below.

- The CPU INTERLOCK passes through the energized relay K10 contacts 3 & 4 on the Power Motor Relay PCB. Relay K10 is energized by +12V (KEY\_PWR) when the system is turned on. (See Power Distribution section for more information.)
- 2. CPU INTERLOCK then passes through the de-energized relay K4 contacts 11 & 13 on the Power Motor Relay PCB and becomes EMERGENCY\_OFF\_B (+15V).
- EMERGENCY\_OFF\_B passes through the Motherboard, Power Signal Interface PCB and Control Panel Processor PCB where it becomes EMEROF\_HI (+15V).
- EMEROF\_HI passes through both normally closed FAST STOP switches S1 & S2. After passing through S2 it becomes EMEROF\_LO (+15V).
- 5. EMEROF\_LO is then fed back through the Control Panel Processor PCB, Power Signal Interface PCB and Motherboard to the Power Motor Relay PCB where it becomes EMERGENCY\_OFF\_A (+15V).

EMERGENCY\_OFF \_A then passes through the momentarily energized relay K8 contacts 4 & 8, on the Power Motor Relay PCB energizing relay K9. When relay K9 energizes EMERGENCY\_OFF \_A passes through the hold-in contacts 4 & 5 back to the coil. This holds relay K9 energized after the momentary relay K8 de-energizes. Also, +24V (+24V\_IN) passes through contacts 10 & 11 of relay K9 and becomes +24V\_INTERLOCK. The +24V\_INTERLOCK circuit is described next.

### +24V INTERLOCK

The +24V\_INTERLOCK signal passes through the Battery Charger PCB to the X-ray Regulator PCB where it turns on transistor Q1. When Q1 turns on, the signal INTLK goes low. The logic low INTLK signal goes through the Motherboard to the Analog Interface PCB where it passes through buffer U45 pins 13 & 7 to PIO U27-11. The PIO U27 passes the logic low INTLK signal to the Technique Processor via the data bus. This informs the Technique Processor that the interlock circuit is complete.

In addition, the +24V\_INTERLOCK supplies power to other relays in various circuits as listed below.

- Relay K2 The HVDRA & HVDRB safety relay in the kV circuit on the Generator Driver PCB
- Relay K1 The filament select relay in the mA circuit on the Generator Driver PCB.
- Relays K1 & K2 The pre-charge relays.

### INTERLOCK FAULT CONDITIONS

#### **DURING THE SYSTEM BOOT SEQUENCE**

The system will hang with 18 arrows on the Control Panel display if the Technique Processor PCB does not receive the logic low INTLK signal indicating a successful interlock complete.

#### AFTER A SUCCESSFUL SYSTEM BOOT

INTERLOCKS OPEN - This message will appear on the Control Panel display if there is a failure in the interlock circuit that causes the INTLK signal to the Technique Processor PCB to go high. This is a fatal error that prevents X-rays and motor movements. This message will also occur if one of the FAST STOP switches is pressed. The system is still powered at this time and a system re-boot can be commanded by pressing any key on the control panel.

### JUMPER E5/RELAY K4 - POWER MOTOR RELAY PCB

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Jumper E5 on the Power Motor Relay PCB is not installed during normal operation. However, when installed, it gives service personnel the ability to elevate or rotate the C-Arm in the event that the C-Arm will not boot.

Normally relay K4 on the Power Motor Relay PCB is de-energized allowing the interlock circuit to function properly, as described previously. When jumper E5 is installed, the +24V\_IN signal is connected to relay K4's coil, energizing it. The +24V\_IN signal then passes through contacts 6 & 4 of relay K4. This energizes relay K3 in the C-Arm lift and rotation circuit applying power to the motors. (See the lift and rotation sections of the <u>Mechanical</u> section for more information on the motor circuits)



# **PRE-CHARGE**

### **OVERVIEW**

After detecting the interlock is complete during the boot sequence, The Technique Processor PCB initiates the pre-charge circuit. The pre-charge capacitors C2 & C3 are charged to the B+ voltage, (approximately 221 VDC). The pre-charge capacitors C2 & C3, located in the Generator Controller Assembly, provide a buffer between the kV/mA regulation circuits and the batteries/battery charger.

Nineteen arrows are displayed on the Control Panel display at the point in the boot sequence that the pre-charge circuit is initialized.

The pre-charge circuit is comprised of the following circuits:

- Current Limited Pre-Charging
- Normal Pre-Charging
- Pre-Charge Voltage Sensing
- <u>Capacitor Discharge</u>

### **CURRENT LIMITED PRE-CHARGING**

The Technique Processor PCB initiates the pre-charge sequence by commanding PIO U38-19 on the Analog Interface PCB to go high. This high passes through buffer U45 pins 4 & 16, turning on transistor Q4 which places a low on the signal PRECHARGE.

The PRECHARGE signal passes through the Motherboard and X-ray Regulator PCB, energizing Relay K1 located in the Generator Controller Assembly. This allows charging of the pre-charge capacitors C2 & C3 from the batteries/battery charger through relay K1 contacts 6 & 9 and resistor R1. Resistor R1 limits the initial in-rush current to the capacitors.

### NORMAL PRE-CHARGING

The Technique Processor commands the PIO U38-18, on the Analog Interface PCB, to go high after detecting an approximate charge of 185 VDC across the pre-charge capacitors C2 & C3. (See <u>PRE-CHARGE VOLTAGE SENSING</u> for a description of how the Technique Processor PCB senses the voltage across the pre-charge capacitors). This high passes through buffer U45 pins 17 & 3, turning on transistor Q5 which places a low on the signal CONTACT.

The CONTACT signal passes through the Motherboard and X-ray Regulator PCB, energizing Relay K2 located in the Generator Controller Assembly. This allows the continued charging of pre-charge capacitors C2 & C3 directly from the batteries and battery charger through relay K2 contacts 5 & 6, bypassing current limiting resistor R1.

### **PRE-CHARGE VOLTAGE SENSING**

The voltage across the pre-charge capacitors C2 & C3 is applied through fuse F3 on the Generator Driver PCB to the voltage divider R10/R11. This voltage divider scales the precharge capacitor voltage to approximately 2.5% of the original value. This scaled voltage becomes the +200VSNS signal. The +200VSNS signal is monitored by the Technique Processor PCB through A/D Mux U3-8 on the Analog Interface PCB.

When the Technique Processor detects approximately 4.5 VDC on the +200VSNS line (185 VDC across the pre-charge capacitors C2 & C3) it energizes relay K2 as described previously in the <u>Normal Pre-Charging</u> section.

If the Technique processor never sees the +200VSNS signal reach approximately 4.5 VDC during the boot sequence, a pre-charge error is detected. (See *Pre-Charge Error*)

#### **PRE-CHARGE ERROR**

The message PRE-CHARGE FAIL will be displayed on the Control Panel display if the Technique Processor PCB does not see the +200VSNS signal reach approximately 4.5 VDC during the boot sequence (Approximately 185 VDC across pre-charge capacitors). This is a fatal error that prevents the system boot from completing.

### CAPACITOR DISCHARGE

When the system is powered off or the +24 interlock is lost, relay K1 is deactivated. This places resistor R1 between the positive and negative sides of pre-charge capacitors C2 & C3 through relay K1 contacts 3 & 9. Resistor R1 discharges the capacitors.



# STATOR

## **OVERVIEW**

After the completion of the pre-charge cycle during the boot sequence, the Technique Processor PCB initiates the stator motor in the X-ray tube. The stator motor is started by applying 115VAC to it for two seconds. After the two second interval, the voltage applied to the stator motor drops to a continuous 40VAC which maintains the stator speed at approximately 3500 RPM.

Nineteen arrows are displayed on the Control Panel display at the point in the boot sequence that the stator is initialized.

### 

To reduce heat and power consumption, power to the stator motor is terminated after five minutes of no activity sensed on the Control Panel. Power to the stator motor can be restored by pressing a switch (except X-ray switch) on the control panel.

The stator circuit is comprised of the following circuits:

- Stator Start
- Stator Run
- Stator Current Sense
- Stator Thermal Cutoff Switch

### **STATOR START**

The Technique Processor PCB initiates the stator circuit by commanding the Analog Interface PCB PIO U38 pin 20 & 23 to go high.

The high out of PIO U38-20 passes through buffer U45 pins 15 & 5, turning on transistor Q3, causing the STAT\_RUN signal to go low. This low passes through the Motherboard, energizing relay K1 and illuminating LED DS1 on the Power Motor Relay PCB.

The high out of PIO U38-23 passes through buffer U45 pins 13 & 7, turning on transistor Q7, causing the STATSTRT signal to go low. This low passes through the Motherboard, energizing relay K2 and illuminating LED DS2 on the Power Motor Relay PCB.

This applies 115VAC to the stator motor through relay K1 contacts 5 & 6, relay K2 contacts 5 & 6, current sense transformer T1 and circuit breaker CB2. The 115VAC is applied to the stator motor for two seconds, starting the stator and bringing it up to speed.

### **STATOR RUN**

After the initial two second start sequence, the Technique Processor PCB commands the Analog Interface PCB PIO U38-23 low. This low passes through buffer U45 pins 13 & 7, turning off transistor Q7, causing the STATSTRT signal to go high. This high passes through the Motherboard, de-energizing relay K2 and turning off LED DS2 on the Power Motor Relay PCB.

Relay K1 on the Power Motor Relay PCB is still energized at this time, allowing 115VAC to pass through contacts 5 & 6 to the stator transformer T3. (See <u>figure 4</u>) Stator transformer T3 steps the 115VAC down to 40VAC. This 40VAC is applied to the stator motor through the de-energized relay K2 contacts 7 & 6, current sense transformer T1 and circuit breaker CB2. The 40VAC is applied to the stator motor continuously, keeping the stator spinning at approximately 3500 RPM.

### **STATOR CURRENT SENSE**

As discussed previously, the stator current passes through the current sense transformer T1 on the Power Motor Relay PCB. Operational amplifier U19 pins 2 & 3 on the Analog Interface PCB monitors the stator current by sensing the induced current on the secondary of the current sense transformer T1 (STATOR SENSE).

U19 amplifies the STATOR SENSE signal and the output on pin 1 is fed to a voltage clipping circuit comprised of diodes CR5, CR6, CR7, resistor R15, and capacitor C17. The clipping circuit converts the AC waveform from U19-1 to a +5 VDC voltage when stator current is present.

The +5 VDC is inverted by U24 pins 5 & 4 to a logic low signal that is monitored by the Technique Processor PCB through Analog Interface PIO U27-10.

#### **STATOR NOT ON ERROR**

When the stator is drawing current, the signal on the Analog Interface PCB PIO U27-10 is low. The error message STATOR NOT ON will be displayed on the Control Panel display if the Technique Processor detects a high on PIO U27-10 indicating that the stator is not drawing current. This is a fatal error that prevents X-rays and motor movement.

### STATOR THERMAL CUTOFF SWITCH

A thermal cutoff switch, located in the X-ray tube housing assembly, is wired in series with the Stator Neutral. If the temperature within the X-ray Tube Housing exceeds safe operating conditions, the thermal switch opens, interrupting current to the stator motor. This is detected by the Technique Processor PCB through the stator current sense circuit as described previously and a STATOR NOT ON error condition is detected.



Figure 1 X-ray Tube Housing



Figure 2 - Generator Controller Assembly



Figure 3 - Generator Controller Assembly Components



Figure 4 - Stator Xformer/Stator Cap/Power Signal Interface PCB/Power Motor Relay PCB



| Test Point | Description             |
|------------|-------------------------|
| TP1        | +24V IN                 |
| TP2        | DC Return               |
| TP3        | CPU Interlock (+15 VDC) |
| TP4        | +24 to Stator Relays    |

Figure 5 - Power Motor Relay PCB

# X-RAY ON/DISABLE

# **OVERVIEW**

This section describes the following circuits:

- X-ray Enable
- X-ray On
- X-ray Disable

X-rays can be initiated from the control panel, handswitch or the footswitch. Switch closures are monitored by the Technique Processor PCB via the Analog Interface PCB. When an X-ray switch is pressed, the XRAYEN and XRAYON signals go active, enabling the kV and mA servo loops, resulting in the production of X-rays.

The Technique Processor PCB also monitors the XRYDISBL signal from the Workstation, via the Analog Interface PCB. This gives the Workstation the capability of prohibiting X-rays by disabling the XRAYON signal.

# **REFERENCE SCHEMATICS**

The theory in this section is best understood when using the following schematics. Use the correct schematics for your system.

Analog Interface PCB

Schematic #00-876738 - Assembly #00-876740 All system serial numbers

### Mainframe Motherboard

Schematic #00-875539 - Assembly #00-900588 System serial numbers 69-0001 thru 69-2000 Schematic #00-878396 - Assembly #00-900970 System serial numbers 69-2001 and up

Power Motor Relay PCB

Schematic #00-875997 - Assembly #875999 All serial numbers

#### Power Signal Interface PCB

Schematic #00-876001 - Assembly #876003 System serial numbers 69-0001 thru 69-1000 Schematic #00-877998 - Assembly #878000 System serial numbers 69-1001 and up

#### X-ray Regulator PCB

Schematic #00-877458 - Assembly #877460 - All serial numbers

#### Control Panel Processor PCB

Schematic #00-875601 - Assembly #875603 - All serial numbers

#### C-Arm Interconnect Diagram

Schematic # 00-875500 - System serial numbers 69-0001 thru 69-1000 Schematic # 00-877972 - System serial numbers 69-1001 thru 69-2000 Schematic # 00-878376 - System serial numbers 69-2001 and up

#### Workstation Interconnect Diagram

Schematic # 00-876158 - System serial numbers 69-0001 thru 69-1000 Schematic # 00-877970 - System serial numbers 69-1001 thru 69-2000

#### Video Switching PCB

Schematic # 00-872237 - All serial numbers

Image Processor PCB

Schematic # 00-875952 - All serial numbers

Auxiliary Interface PCB

Schematic # 00-876502 - All serial numbers

Communications PCB

Schematic # 00-872125 - All serial numbers

# X-RAY ENABLE

# SECURITY SIGNAL

When any X-ray mode switch from the control panel, handswitch or footswitch is pressed, a logic high is placed on the SECURITY signal. The logic high SECURITY signal passes through the Motherboard to the Analog Interface PCB optocoupler U51-1.

The logic low output from optoicoupler U51-7 passes through a 300mS delay circuit comprised of R33 and C36 to Inverter U25-1 on the Analog Interface PCB. The logic high SECURITY signal output from inverter U25-2 informs the Technique Processor PCB, through the Analog Interface PCB PIO U38-15, that an X-ray mode switch is pressed. See the <u>X-RAYON</u> for additional information.

# **X-RAYEN SIGNAL**

The logic high SECURITY signal output from inverter U25-2 also passes through inverter U24 pins 3 & 2 and nand gate U41 pins 9,10 & 8 on the Analog Interface PCB. The logic high output from nand gate U41-8 is called XRAYEN and is applied to inverter U6-1 on the X-ray Regulator PCB.

The logic low XRAYEN signal output from inverter U6-3 is applied to the kV Drive PAL U7-5 and FIL Drive PAL U10-3 on the X-ray Regulator PCB. The logic low XRAYEN signal, along with <u>X-RAYON</u> enables the kV and mA servo loops. See the XRAYON for additional information.

# **X-RAY ON**

# X-RAY MODE SWITCH MONITORING

The Technique Processor PCB is informed that an X-ray mode switch is pressed by monitoring the SECURITY signal discussed previously. In addition, the Technique Processor needs to determine what X-ray mode switch is pressed. The Technique Processor accomplishes this by monitoring the Analog Interface PCB PIO U38 pins 10, 11 & 12 according to Table 1.

| SWITCH NAME    | SOURCE     | SIGNAL NAME  | PIO<br>U38<br>PIN | SWITCH<br>PRESSED<br>LOGIC<br>LEVEL |
|----------------|------------|--------------|-------------------|-------------------------------------|
| X-ray          | Control    | X-RAY SWITCH | 10                | High                                |
| Process Fluoro | Footswitch | X-RAY SWITCH | 10                | High                                |
| Boost          | Footswitch | BOOST        | 11                | High                                |
| Scout Fluoro   | Footswitch | FLUORO ONLY  | 12                | High                                |
| Process Boost  | Handswitch | BOOST        | 11                | High                                |
| Scout Fluoro   | Handswitch | FLUORO ONLY  | 12                | High                                |

#### Table 1 X-ray Mode Switch Monitoring

When an X-ray mode switch is pressed, the corresponding signals listed in Table 1 becomes a logic high. This high passes through inverting optocouplers U50 and U52 on the Analog Interface PCB and becomes a logic low. This low is inverted to a logic high by inverter U25 on the Analog Interface PCB and is read by the Technique Processor PCB through PIO U38 as indicated in Table 1 above.

# **X-RAYON SIGNAL**

Provided there is no X-ray disable command from the Workstation (See X-RAY DISABLE for additional information), the Technique Processor PCB acknowledges that it has identified what X-ray mode switch is pressed and has received the SECURITY signal by sending a logic low through the Analog Interface PCB PIO U27-24 to 'or' gate U2-2. Since the SECURITY signal out of inverter U24-2 on the Analog Interface PCB is also a logic low at this time, 'or' gate U21-3 output goes low. See <u>SECURITY</u> for additional information.

This low signal is inverted by 'nand' gate U41 pins 12,13 &11 on the Analog Interface PCB. The logic high output of 'nand' gate U41-11 is called XRAYON and is applied to inverter U6-13 on the X-ray Regulator PCB.

The logic low XRAYON signal output from inverter U6-11 is applied to GAL U35-2. The logic high output of GAL U35-12 is applied to the kV Drive PAL U7-4 and FIL Drive PAL U10-2 on the X-ray Regulator PCB. The logic low XRAYON signal, along with XRAYEN, enables the kV and mA servo loops. See the <u>XRAYEN</u> for additional information.

# **X-RAY DISABLE**

NOTE: Refer to Table 2 for signal logic levels while reading the following theory.

# **DISABLE FROM WORKSTATION GSP**

The Workstation GSP has the ability to disable X-rays if no camera sync is detected. Camera video/sync enters the Workstation through the Auxiliary Interface PCB to TP10 of the Video Switching PCB. The camera video/sync signal is fed through the Video Switching PCB mux U13 pins 5 & 20 to sync stripper U6-2. The camera sync out of sync stripper U6-1 becomes SEPINCSY and is applied to flip-flops U38 pins 9 & 5 and U28 pins 2 & 13 on the Video Switching PCB. The output of flip-flop U28-13, SYNCDET, will be a logic high if camera sync is present and a logic low if camera sync is not present.

SYNCDET is monitored by the Image Processor PCB GSP through PIO U3-18. The GSP will now enable or disable X-rays depending on the logic level of the SYNCDET signal. The GSP accomplishes this by generating a serial control word, VMDAT, out of Image Processor PIO U3-14 that is applied to the serial to parallel shift register U33-14 (TP35) on the Video Switching PCB. Shift register U33-1 is the output bit that represents the SYNCDET logic level and is buffered through 'and' gate U42 pins 4,5 & 6 on the Video Switching PCB.

The output of U42-6 becomes XRAYDIS and is applied to the Auxiliary Interface PCB 'nand' gate U5-13 through inverter U1 pins 13 & 12. The other input to 'nand' gate U5-12 is the output of the door interlock circuit (See *Disable From Workstation Room Interface* below for additional information). The output of nand gate U5-11 becomes the XRAYINH signal, measured on TP14 of the Auxiliary Interface PCB.

XRAYINH is applied through the generator Motherboard to the Analog Interface PCB PIO U27-12 where it becomes XRYDISBL and is monitored by the Technique Processor PCB. If XRYDISBL is low, X-rays are enabled. If XRYDISBL is high, X-rays are disabled.

# **DISABLE FROM WORKSTATION ROOM INTERFACE**

The Workstation will allow a room interface, such as a door interlock, to disable X-rays. The input from the room interface is applied to 'nand' gate U5-12 through inverter U1 pins 9 & 8, U1 pins 5 & 6 and U1 pins 1 & 2 on the Auxiliary Interface PCB. Jumper E1 configures the inverter circuit U1 to accommodate either a low or a high input

The output of 'nand' gate U5-11 becomes the XRAYINH signal as described previously. (See the *Disable From Workstation GSP* above for more information).

| SIGNAL   | X-RAY | X-RAY |
|--|-------|-------|
| XRYDISBL — Analog Interface PCB U27-12         | Low   | High  |
| XRAYINH — Auxiliary Interface PCB TP14         | Low   | High  |
| XRAYDIS — Auxiliary Interface PCB U5-13        | High  | Low   |
| ROOM INTERFACE — Auxiliary Interface PCB U5-12 | High  | Low   |
| SYNCDET — Image Processor U3-18                | High  | Low   |

Table 2 Signal Logic Levels

# **KV GENERATION**



# **OVERVIEW**

kV is regulated by a dynamic, self correcting servo control loop comprised of a duty cycle controlled high voltage drive circuit, drive PAL, control amplifier, error amplifier and sense circuits

In the Auto mode, the Technique Processor PCB varies the kV according to the video level signal received from the CCD camera until the proper level is achieved.

In the Manual mode, the operator varies the kV

Power for X-ray generation is buffered by battery packs. This allows the generator to run on standard single phase AC power.

# **REFERENCE SCHEMATICS**

The theory given in this section is most easily understood while using the following schematics. Use the correct interconnect diagrams and circuit board schematics for your system.

#### Analog Interface PCB

Schematic # 00-876738 - All serial numbers

- Mainframe Motherboard
- Schematic # 00-875539 System serial numbers 69-0001 thru 69-2000

Schematic # 00-878396 - System serial numbers 69-2001 and up

<u>X-ray Regulator PCB</u>

Schematic # 00-877458 - All serial numbers

Generator Driver PCB

Schematic # 00-877461 - All serial numbers

<u>C-Arm Interconnect Diagram</u>

Schematic # 00-875500 - System serial numbers 69-0001 thru 69-1000 Schematic # 00-877972 - System serial numbers 69-1001 thru 69-2000 Schematic # 00-878376 - System serial numbers 69-2001 and higher

# **CONTROL INPUTS**

Initializes the kV circuits by providing a control voltage and two timing (drive) signals. The Technique Processor PCB initializes the Analog Interface PCB to create three primary control and timing signals which control the X-ray Regulator PCB. These signals are:

- kVp Control
- <u>HVDRVA</u>
- <u>HVDRVB</u>

## **KVP CONTROL**

The KVP CONTROL signal is a current signal from the Analog Interface A/D U31. This current signal is converted to a positive DC voltage proportional to the desired kV (75mV/kVp) by the current to voltage converter U33-6 and 7. This signal is software controlled in response to the kV selected and corrected by the calibration parameters. This signal will vary with different kV settings.

The KVP CONTROL voltage is then inverted to a negative DC voltage by U20-6 and 7 on the X-ray Regulator PCB. This negative voltage, proportional to the desired kV, is then applied to the R25/U23-2 summing point to be compared with the actual kV sensed (KVP MEASURED). See <u>KV ERROR CORRECTION</u>, later in this section for more information.

# HVDRVA AND HVDRVB

The HVDRVA and HVDRVB signals are out of phase, fixed duty cycle, 2.5 kHz timing signals from the Analog Interface PAL U17. The duty cycle of these signals will not vary even as different kV settings are selected. These signals serve as timing signals for the X-ray Regulator high voltage drive PAL U7.

# **KV DRIVE**

Generates kV by providing the drive signals to the Darlington Driver transistors. When an X-ray switch is pressed, the X-ray On logic activates the high voltage drive PAL U7 on the X-ray Regulator. U7 then generates its own out of phase, variable duty cycle, 2.5 Khz HVDRVA (pin 12) and HVDRVB (pin 13) drive signals. These drive signals are then applied to the Generator Driver PCB where they are amplified by Q5, Q6 (HVDRVA) and Q7, Q8 (HVDRVB) to approximate 15 VDC drive signals. These amplified drive signals then drive transformers T3 (HVDRVA) and T1 (HVDRVB). The return path for the transformers is through relay K2 on the Generator Driver PCB. Relay K2 is held energized by the 24V Interlock circuit. The purpose of relay K2 is to prevent kV by opening the ground path for the Generator driver transformers T1 and T3 in the event that the 24V Interlock is lost.

Assuming relay K2 is energized, the Darlington driver transformer T3 will drive half of the Darlington transistor Q2 (B1, C1, E1) and half of the Darlington transistor Q1 (B2, C2E1, E2) during HVDRVA time. This causes current to flow from ground through L1, C1 (Located in the Generator Controller Assembly), the High Voltage Transformer primary to B+ (VDC). When HVDRVA time ends and HVDRVB time begins, Darlington Driver transformer T1 will drive the other half of the Darlington transistor Q2 (B2, C2E1, E2) and the other half of the Darlington transistor Q1 (B1, C1, E1). This causes current to flow in the opposite direction through C1, L1 and the High Voltage Transformer primary to B+ (VDC).

In effect, the B+ (VDC) is chopped and then made into a sinusoidal signal by tuning circuit C1 and L1 so the energy is effectively transferred to the Tank. The amount of kV is determined by the on time of the Darlington Transistors. To increase kV the duty cycle of HVDRVA and HVDRVB is increased. To decrease kV the duty cycle of HVDRVA and HVDRVB is decreased.



Figure 1 - Generator Controller Assembly

# **KV SENSE**

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Detects the actual kV generated by the kV drive circuit. The actual kV generated in the High Voltage Tank is detected by a capacitive sense circuit in the Tank. This KV SENSE signal is a sine wave with a 1V/10 kV ratio which is applied to the X-ray Regulator TP10 through buffer U16-3 and U16-1.

The positive peak of the KV SENSE sine wave is then measured by the positive peak detector made up of U18, U22 and U26. The output of this peak detector can be measured on TP12 which has a scale factor of +1 VDC /10 kV. This represents the kV applied to the anode of the X-ray tube.

The negative portion of the KV SENSE sine wave is inverted by inverting buffer U16-6 and U16-7 and measured by the negative peak detector made up of U18, U25 and U26. The output of this peak detector can be measured on TP13 which also has a scale factor of +1 VDC /10 kV. This represents the kV applied to the cathode of the X-ray tube.

The two outputs from the peak detectors are then combined through buffer U20-3 and U20-1. This output can be measured on TP9 which has a scale factor of +1 VDC /20 kV and is called KVP MEASURED. This dc voltage represents the actual kV generated by the High Voltage Tank which is applied across the cathode and anode of the X-ray tube. This actual kV sensed signal (KVP MEASURED) is then applied to the R25 and error amp U23-2 summing point to be compared with the desired kV (KVP CONTROL) from the Analog Interface D/A U31. It is also sent to the Technique Processor via the Analog Interface A/D Mux U3 to be monitored by software for various error conditions.

# **KV ERROR CORRECTION**

To correct for the difference between the desired and actual kV by sending an error correction signal to the kV drive circuit. This causes the drive duty cycles to change accordingly, forcing the actual kV to match the desired kV.

A logic low on the signal KVEREN from the high voltage drive PAL U7-19 holds switch U17 closed during non-exposure time disabling the error amp U23. During exposures, the KVEREN signal goes high, opening switch U17, enabling the error amp U23. The error amp is an inverting device with unity gain. The error amp compares the desired kV (KVP CONTROL) to the actual kV (KVP MEASURED) generating a dc error correction voltage on U23-1 representing the difference between the desired kV (KVP CONTROL) and the actual kV (KVP MEASURED).

This error correction voltage is applied to comparator U34-2 of the pulse width modulator (PWM) which is made up of comparator U34 and flip flop U12. This error correction voltage is compared by U34 to a reference ramp signal applied to U34-3.

The RAMP signal (approximately 0 - 10V) is generated from the ramp generator Q6 with its supporting components. The ramp generator is controlled by a square wave from the drive PAL U7-15 (DRV ST\*).

The result of the comparison of the error correction voltage and the reference ramp is a pulse on TP2 (PWM COMP) of the PWM circuit. The width of this pulse is determined by where the error correction voltage triggered the comparator on the reference ramp signal (RAMP). See diagram below:



Figure 2 - TP2 PWM COMP Waveform

This corrected pulse (PWM COMP) is then applied to the drive PAL U7-8. Drive PAL U7 will respond by varying the duty cycle of its drive signals (HVDRVA and HVDRVB) accordingly, resulting in the actual kV (KVP MEASURED) equaling the desired kV (KVP CONTROL).

# **kV Error Loop Example 1**

Lets assume that the actual kV exceeds the desired kV so it needs to be turned down. In this case the error amp U23 detects that the actual kV (KVP MEASURED) is greater than the desired kV (KVP CONTROL) and the dc voltage output of the error amp U23-1 will decrease. This causes the trip point to the PWM comparator U34, as compared to the ramp signal (RAMP), to decrease.

Because the trigger point on the ramp has decreased, the pulse out of the PWM circuit U12-5 (PWM COMPARATOR) also decreases. This shortened pulse is tracked by the drive PAL U7-8.

Since the pulse width of the PWM COMP signal has decreased, drive PAL U7 decreases the duty cycle of its drive signals (HVDRVA and HVDRVB). The on-time of the Darlington driver transistors is therefore decreased resulting in less energy transferred to the high voltage tank and the actual kV decreasing to equal the desired kV.

# **kV Error Loop Example 2**

Lets assume that the actual kV is less than the desired kV so it needs to be turned up. In this case the error amp U23 detects that the actual kV (KVP MEASURED) is less than the desired kV (KVP CONTROL) and the dc voltage output of the error amp U23-1 will increase. This causes the trip point to the PWM comparator U34, as compared to the ramp signal (RAMP), to increase.

Because the trigger point on the ramp has increased, the pulse out of the PWM circuit U12-5 (PWM COMP) also increases. This lengthened pulse is tracked by the drive PAL U7-8.

Since the pulse width of the PWM COMP signal has increased, drive PAL U7 increases the duty cycle of its drive signals (HVDRVA and HVDRVB). The on-time of the Darlington driver transistors is therefore increased resulting in more energy transferred to the high voltage tank and the actual kV increases to equal the desired kV.



#### Figure 3 kV Servo Control Flowchart (Manual Mode)


# **KV GENERATOR FAULTS**

### FAULT PAL OVERVIEW

Fault PAL U2 monitors the system for the following fatal fault conditions:

- Saturation Fault
- Overvoltage Fault
- Overload Fault

During any of these fault conditions, the FAULT signal which is fed to the HV Drive PAL U7-9 prevents X-rays by disabling the HVDRA and HVDRB signals. The outputs of the fault PAL U2 are also fed to the Technique Processor for software monitoring through the Analog Interface PIO U27. When software detects a fault, the Technique Processor shuts the system down by disabling the 24V interlock circuit. The Technique Processor also displays the appropriate error message on the generator control panel display.

#### **SATURATION FAULT**

The Darlington power transistors Q1 and Q2 drive the primary winding of the high voltage transformer contained within the tank assembly. Normally, the voltage drop across the Darlington's output, when turned-on, is minimal indicating a completely saturated transistor.

However, if a Darlington transistor becomes weak (or if too much current passes through a Darlington transistor) a relatively large voltage is dropped across its output during the on-time. This excess voltage drop is detected by the system and defines a Saturation Fault.

If a fault occurs, the message SATURATION FAULT is displayed on the Control Panel. This is a fatal error resulting in a system shut down preventing X-rays.

#### **Saturation Fault Circuit**

The bridge rectifier VR1 and Q9 on the Generator Driver PCB samples the voltage drop of which-ever of the two upper transistors of the H-Bridge is turned on at the time. This voltage is referenced to ground level by Q9 at R19. In effect, the voltage across R19 represents the voltage across the Darlington power transistor. This voltage is fed through CR23 to TP7 and then to TP3 and comparator U14 on the X-ray Regulator PCB. VR1's negative output samples the drop on the "lower half" of the H-Bridge for the same purpose.

On the X-ray Regulator PCB, this sense voltage (SATDET) is monitored by comparator U14-2. A reference voltage derived by R35 and R36 of approximately 8 VDC is applied to U14-3. This voltage is the comparator's threshold voltage which represents the maximum allowable voltage drop across the Darlington's output during their on-time. A

E

Saturation Fault occurs when the SATDET voltage on U14-2 exceeds the reference voltage on U14-3 causing U14-7 to go high.

A high output from comparator U14-7 (FAULT 1) causes the Fault PAL U2-14 (SATURATION FAULT) and U2-13 (FAULT) to go high.

The logic high FAULT output of Fault PAL U2-13 prevents X-rays by disabling the HVDRVA and HVDRVB signals from the high voltage drive PAL U7.

The logic high SATURATION FAULT output of U2-14 and the logic high FAULT output of U2-13 are also monitored by the Technique Processor PCB via the Analog Interface PIO U27. This condition is a fatal error and causes a system shutdown. The message SATURATION FAULT is displayed on the generator control panel display.

The DRVON signal (U11-8) disables the sample voltage during Darlington off-time, preventing a Saturation Fault from occurring. DRVON is active high when either HVDRVA *or* HVDRVB is active and floats to the sample voltage during this period. DRVON is low (open-collector output to ground) during the off-time of the Darlingtons and pulls the sample voltage to ground. This is necessary because when any transistor is turned off, the voltage drop across its output is typically large.

#### **OVERVOLTAGE FAULT**

High voltage in excess of approximately 140 kVp defines an Overvoltage Fault. If a fault occurs, the message OVERVOLTAGE FAULT is displayed on the Control Panel. This is a fatal error resulting in a system shutdown preventing X-rays.

#### **Overvoltage Fault Circuit**

The high voltage transformer, within the tank assembly, incorporates a one-turn tap in each of its secondary windings. The sinewave from these taps are sent to the X-ray Regulator PCB on P4-4 (TAP2) and P4-5 (TAP1). the ratio for the TAP1 and TAP2 signals are approximately 1V/4.5 kV.

The TAP1 signal is monitored by comparator U32-2. A reference voltage of approximately 5 VDC is applied to U32-3. This is the comparator's threshold voltage which represents the maximum 140 kVp allowed for safe operation.

When the voltage on U32-2 exceeds that of the voltage U32-3, the output of U32-7 goes high indicating an Overvoltage condition. This logic high is felt at the fault PAL U2-5 causing the PAL's output U2-13 (FAULT) to go high.

This high on the FAULT output of fault PAL U2-13 prevents X-rays by disabling the HVDRA and HVDRB signals from the high voltage drive PAL U7. The FAULT signal is also monitored by the Technique Processor software via the Analog Interface PIO U27. This condition is a fatal error and causes a system shutdown. The message OVERVOLTAGE FAULT is displayed on the generator control panel display.

NOTE If the secondary TAP1 and TAP2 signals carried through P4 on the X-ray Regulator PCB are disconnected, pull-up resistors R90 and R100 will cause comparator U16 to trip the OVERVOLTAGE line. This is an important safety factor: all signal lines on P4 must be connected for the Generator to operate without damage.

#### **OVERLOAD FAULT**

Peak currents in excess of 200 Amps in the primary winding of the high voltage tank define an Overload Fault. If a fault occurs, the message OVERLOAD FAULT is displayed on the Control Panel. This is a fatal error resulting in a system shutdown, preventing X-rays.

#### **Overload Fault Circuit**

A sense winding is incorporated in the output-tuning inductor L1, in series with the primary winding of the high voltage transformer which senses the differential voltage across the inductor. This CURRENT LOOP signal is sent to the X-ray Regulator PCB on P2-3 where it is integrated by R7 and C9 to derive a voltage proportional to the current through L1. This voltage can be measured on TP1.

This voltage is monitored by comparator U1-2 and compared to a reference voltage of approximately 1.6 VDC applied to U1-3. This reference voltage is the comparator's threshold, representing the maximum primary input current allowed for safe operation.

When the voltage on U1-2 exceeds that of the voltage on U1-3, the output on U1-7 goes high indicating an Overload condition. This logic high is felt at the fault PAL U2-2 causing the PAL's outputs U2-17 (OVERLOAD) and U2-13 (FAULT) to also go high.

The logic high FAULT output of Fault PAL U2-13 prevents X-rays by disabling the HVDRVA and HVDRVB signals from the high voltage drive PAL U7.

The logic high OVERLOAD output of U2-17 and the logic high FAULT output of U2-13 are also monitored by the Technique Processor PCB via the Analog Interface PIO U27. This condition is a fatal error and causes a system shutdown. The message OVERLOAD FAULT is displayed on the generator control panel display.

### KV ON IN ERROR MESSAGE

With no X-ray switch engaged, the Technique Processor software detected voltage on the KVP MEASURED line indicating high voltage was present but not commanded. The message is displayed and the system is shut down.

### **HIGH KV AND LOW FLUORO KV ERRORS**

The detected kV (KVP MEASURED) and the selected kV technique do not agree within 20%. The message is displayed and the system shuts down for two seconds after the exposure.

# **KV TROUBLESHOOTING**

## **kV CONTROL**

Without making X-rays, select 80 kV in the MANUAL FLUORO mode. You should measure approximately -6 VDC (-75 mV/kV) on amp U20-7 of the X-ray Regulator PCB. As kV is increased, this voltage becomes more negative. As kV is decreased, this voltage becomes less negative.

Without making X-rays, verify the HVDRVA and HVDRVB drive signals at PAL U7-2 and U7-3 are out of phase, 2.5 kHz signals. The duty cycle should not change as different kV settings are selected.

## **KV DRIVE**

With 80 kV selected in the manual Fluoro mode you should measure approximately 15V, out of phase, drive signals on TP5 and TP6 of the Generator Driver PCB. The duty cycle should increase as the kV setting is increased and decrease as the kV setting is decreased.

### **KV SENSE**

With 80 kV selected in the manual Fluoro mode, you should measure an approximate 8V peak-peak sine wave on TP10 (1V/10 kV ratio) of the X-ray Regulator.

TP9 (1 VDC/20 KV) should indicate approximately 4 VDC. TP10 and TP9 should both increase in amplitude as the kV setting is increased and decrease in amplitude as the kV setting is decreased.

## **kV Error Correction Truth Tables**

#### Actual kV Detected is Greater than Desired kV

- X-ray Regulator U23-1 error voltage decreases
- X-ray Regulator TP2 pulse width decreases
- Generator Driver TP6 duty cycle decreases
- Generator Driver TP5 duty cycle decreases
- Actual kV decreases

#### Actual kV Detected is Less than Desired kV

- X-ray Regulator U23-1 error voltage increases
- X-ray Regulator TP2 pulse width increases
- Generator Driver TP6 duty cycle increases
- Generator Driver TP5 duty cycle increases
- Actual kV increases

## **kV DIAGNOSTIC SOFTWARE**

DRO - Run Applications with Parameters. See <u>C-Arm Software</u> section for more information.

# **MA GENERATION**

## **OVERVIEW**



Tube current (mA) is regulated by a dynamic, self correcting servo control loop comprised of a drive PAL, control amplifier, error amplifier, sense circuit, variable filament voltage regulator, and a duty-cycle controlled filament drive circuit.

In the Auto mode, the Technique Processor PCB varies the mA according to the video level signal received from the CCD camera until the proper video level is achieved.

In the Manual mode, the operator varies the mA.

Power for X-ray generation is buffered by battery packs which enable the generator to be powered by standard single phase AC power.

The theory in this section is most easily understood while using the following schematics. Use the correct interconnect diagrams and circuit board schematics for your system.

## **REFERENCE SCHEMATICS**

#### **Analog Interface PCB**

Schematic # 00-876738 - All S/N

#### **Mainframe Motherboard**

Schematic # 00-875539 - System S/N 69-0001 thru 69-2000 Schematic # 00-878396 - System S/N 69-2001 and up

#### X-ray Regulator PCB

Schematic # 00-877458 - All S/N

#### **Generator Driver PCB**

Schematic # 00-877461 - All S/N

#### **C-Arm Interconnect Diagram**

Schematic # 00-875500 - System S/N 69-0001 thru 69-1000 Schematic # 00-877972 - System S/N 69-1001 thru 69-2000 Schematic # 00-878376 - System S/N 69-2001 and up

# **CONTROL INPUTS**

The Technique Processor commands the Analog Interface to generate four primary control signals to the X-ray Regulator PCB. Their purpose is to initialize and control the mA servo loop. These signals are:

- FIL B CONTROL
- MA CONTROL
- <u>FILDRVA</u>
- FILDRVB

### FIL B CONTROL

This is a current signal from the Analog Interface PCB A/D U18-6. This current signal is converted to a positive DC voltage by the current to voltage converter U28 (pins 2 & 1). This signal is software controlled in response to the X-ray mode currently selected. It is used to set up the Filament Regulator on the Generator Driver PCB for the proper output voltage as shown in Table 1. The Filament Regulator output voltage can be measured at the collector of Q4 or at R8 on the Generator Driver PCB.

Fluoro =160 VDC with X-rays off

0.3 mm Film = 175 VDC, Armed 160 VDC

```
0.6 mm Film = 185 VDC, Armed 140 VDC
```



The ratio between the FIL B CONTROL voltage and the Filament Regulator output voltage is approximately 1:40, for every +1VDC on TP10 of the Analog Interface, the filament regulator's output will be approximately +40 VDC. See Filament Regulator Setup, later in this section, for more information.

## **MA CONTROL**

This signal is a current signal from the Analog Interface PCB, A/D U31-23. This current signal is converted to a positive DC voltage proportional to the desired mA by the current to voltage converter U33 (pins 2 & 1). Measured on TP18 of the Analog Interface PCB the ratio is approximately +350 mV/mA Fluoro mode and +70 mV/mA Film mode. This signal is software controlled in response to the mA selected and corrected by the calibration parameters. This signal will vary with different mA settings.

The mA CONTROL voltage from the Analog Interface PCB is inverted to a negative DC voltage by U15 (pins 2 & 1) on the X-ray Regulator PCB and can be measured on TP8. This negative voltage, proportional to the desired mA, is then applied, via switch U13 (pins 6 & 7), to the R27/U13-6 summing point to be compared with the actual mA sensed (MA MEASURED). See mA Error Correction, later in this section for more information.

### FILDRVA AND FILDRVB

These signals are out of phase, variable duty cycle, 2.5 Khz drive signals from the Analog Interface PAL U17 (pins 14 & 15). The duty cycle of these drive signals varies, under system software control, in response to the mA technique selected. The duty cycle increases as selected mA increases. The duty cycle decreases as selected mA decreases.

These drive signals are applied to the X-ray Regulator PCB filament drive PAL U10 (pins 5 & 6), The filament drive PAL U10 (pins 12 & 13) responds by generating its own FILDRA and FILDRB drive signals with the duty cycle commanded by the Analog Interface PCB. See mA Drive and Filament Pre-Heat, later in this section for more information.

# **FILAMENT REGULATOR SETUP**

Provides the initial setup, regulation and monitoring of the filament regulator output voltage. The filament regulator is located on the Generator Driver PCB.

When the system is booted, but no X-rays are commanded, the X-ray Regulator kV drive PAL U7-16 will be a logic low. This disables error amp U15 by holding the contacts (pins 10 & 11) of switch U13 closed. The output of the error amp applied to TP4 should be 0 VDC at this time.

The FIL B CONTROL signal is now applied to the X-ray Regulator R82/U27-6 summing point unaffected by the output of the error amp. The FIL B CNTRL voltage at TP10 on the X-ray Regulator PCB and U27-6 of the Generator Driver PCB are shown in Table 2.

Fluoro = 4 VDC with X-rays OFF 0.3 mm Film = 4.4 VDC, Armed 4 VDC 0.6 mm Film = 4.6VDC, Armed 3.5 VDC

#### Table 2 - Approximate Control Voltages

U27-7, on the X-ray Regulator, provides an approximate +3 to +5 VDC signal (FILREG) to the filament regulator on the Generator Driver PCB. The Filament Regulator is comprised of Q10, Q1, Q2 and associated components. The filament regulator supply is the B+ voltage from the batteries and can be measured at fuse F3 on the Generator Driver PCB.

The FILREG signal from the X-ray Regulator controls the filament regulator output to the proper voltage for the selected X-ray mode as described in Table 1. The filament regulator output supplies power to the filament transformers in the High Voltage Tank through the filament drive transistors Q3 and Q4.

The regulated filament voltage is scaled down by R8 and applied to U27-5 on the X-ray Regulator PCB. This feedback loop is intended to regulate the filament regulator output to within 15%.

The scaled down filament regulator voltage is also applied to U27-3. The output on U27-1 (FIL B+ SENSE) is then sent to the Technique Processor, via the Analog Interface PCB, to be monitored by the system software for abnormal filament regulator voltages. See Regulator Fail error message at the end of this section for more information.

# **MA DRIVE AND FILAMENT PRE-HEAT**

Generates the filament current needed for filament pre-heating and initial tube current.

When a specific mA technique is selected, the system software commands the Analog Interface PCB to generate the FILDRVA and FILDRVB signals out of PAL U17 (pins 14 & 15) with a duty cycle that the software determines will produce the selected mA. This occurs immediately in the Fluoro mode. In the Film mode this occurs in the two seconds prior to an exposure after the X-ray switch is pressed. The duty cycle of the drive signals, once selected by the software, <u>remains constant</u> throughout the exposure.

These drive signals are then applied to the filament drive PAL U10 (pins 5 and 6) on the X-ray Regulator PCB. The filament drive PAL U10 then generates its own FILDRA and FILDRB signals on pins 12 and 13 with the duty cycle commanded by the Analog Interface PCB.

FILDRA and FILDRB (TP3 and TP2-Generator Driver PCB) drive transformer T2 which in turn drives the filament drive transistors Q3 and Q4, chopping the regulated filament voltage (See Table 1) across these transistors. This chopped filament regulator voltage is transferred to the proper filament transformer in the tank via filament select relay K1. The amount of filament pre-heat and the initial tube current are determined by the ontime of these filament drive transistors which are controlled by the duty cycle of the FILDRA and FILDRB signals. This is the initial setup of the mA loop known as <u>coarse</u> tuning.

# FILAMENT SELECTION

The small 0.3 mm filament is always selected in the fluoro mode and at film mode techniques of 100 mAs and lower. Software selects the large .6 mm filament when film mode techniques of greater than 100 mAs are selected.

Filament selection is controlled by the 1 mm MODE signal from the filament drive PAL U10-14 on the X-ray Regulator PCB. The 1 mm MODE signal controls the filament select relay K1, on the X-ray Regulator PCB, through transistor Q11.

## **MA SENSE**

Detects the actual mA generated by the mA drive circuit.

Since the filaments are pre-heated with filament current prior to the exposure, tube current will flow in the X-ray tube once the exposure is initiated and the high voltage comes up. The actual tube current generated (mA) is sensed by windings located around the anode socket inside the High Voltage Tank. Current pulses from these windings (MA SENSE) are applied to the transimpedance amp U31-6 on the X-ray Regulator PCB. Amp U31 converts and scales these current pulses into corresponding mA sense voltage pulses.

The <u>average DC value</u> of the mA sense voltage pulses (as referenced to ground) represents the actual tube current (mA) detected. This DC voltage is passed through buffer U30 (pins 3 & 1) and can be measured on TP7 of the X-ray Regulator PCB. The scale factor on TP7 is 40 mA/Volt in all X-ray modes.

Buffer U30-1 mA sense voltage output is then applied to the low pass filter U30-5. The DC voltage output from low pass filter U30-7 can be measured on TP6 which also has a scale factor of 40 mA/Volt in all X-ray modes.

Low pass filter U30-7 output is then applied to scaling amp U31-3 on the X-ray Regulator PCB. The DC voltage out of scaling amp U31-1 can be measured on TP11 on the X-ray Regulator PCB. The scale factor on TP11 (MA MEASURED) is 40 mA/Volt in the Fluoro mode and 8 mA/Volt in the Film mode.

Scaling for TP11 (MA MEASURED) is determined by selecting the proper feedback resistor for scaling amp U31 through switch U21 on the X-ray Regulator PCB. Relay K1 and associated scaling circuitry for low fluoro scaling are not currently used.

Switch U21 is controlled by the signal MaRANGE which is derived from the signal MA SCALE (High = Fluoro mode, Low = Film mode), from the Analog Interface PIO U27-4. MA SCALE is applied to the X-ray Regulator PCB PAL U2 which responds by generating the Ma RANGE signal on pin 15.

The MA MEASURED signal represents the actual tube current (mA) detected. This signal is applied to the R27 and switch U13-6 summing point to be compared with the desired mA (MA CONTROL) from the Analog Interface PCB. It is also sent to the Technique processor via the Analog Interface PCB to be monitored by the system software for various error conditions. See Generator Errors later in this section for more information.

## **MA ERROR CORRECTION**

Dynamically corrects for the difference between desired and actual tube current (mA) by sending an error correction voltage to the filament regulator circuit. This causes the filament regulator voltage output to change accordingly, forcing the actual tube current (mA) to equal the desired tube current (mA).

Remember, during non-exposure time, error amp U15 on the X-ray regulator is disabled because switch U13 (pins 10 & 11) are held closed as previously discussed in the Filament Regulator Setup section. In addition, there is no input to the error amp U15-6 because U5- 4 is a logic high at this time, holding switch U13 (pins 6 & 7) open.

When an X-ray switch is pressed, kV drive PAL U7-16 on the X-ray Regulator PCB goes to a logic high, enabling error amp U15 by opening pins 10 and 11 of switch U13. As the high voltage applied to the X-ray tube reaches approximately 30 kV, the output of comparator U19-7 goes high applying a logic low through U5 (TP21), on the X-ray Regulator PCB, to switch U13-8. This logic low closes pins 6 and 7 of switch U13, allowing the desired and actual mA summing point to be felt at the error amp input U15-6.

The error amp is an inverting device that compares the desired mA (MA CONTROL) with the actual mA detected (MA MEASURED). This results in a DC error correction voltage on TP4, on the X-ray Regulator PCB, representing the difference between the desired mA (MA CNTRL) and the actual mA (MA MEASURED). The error correction voltage on TP4 may vary between  $\pm$  6 VDC depending on the amount of error detected. A positive voltage on TP4 indicates that the desired mA was greater then the actual mA. A negative voltage on TP4 indicates that the desired mA was less than the actual mA. The closer this voltage is to ground, the smaller the difference was between the desired and actual mA.

A proportional amount of the error correction voltage on TP4 is summed with the FIL B CONTROL voltage at the R82 and U27-6 summing point. This causes the output of U27-7 (FILREG) to increase or decrease accordingly. The typical voltage range for U27-7 (FILREG) is approximately 3-5VDC. The FILREG signal controls the filament regulator on the Generator Driver PCB. As the FILREG signal changes, it results in a change of the filament regulator output voltage that is applied to the filament drive transistors Q3 and Q4 on the Generator Driver PCB. The change in the filament regulator output voltage results in a corresponding change in the actual tube current (mA). Remember, the FILDRA and FILDRB duty cycle, once selected by the system software for a given mA, is <u>held constant</u> during an exposure as previously discussed in the mA Drive and Filament Pre-Heat section of the theory.

This dynamic correction of the filament regulator output voltage during the exposure results in the actual mA equaling the desired mA. This completes the <u>fine tuning</u> of the mA servo loop.

### **MA ERROR LOOP EXAMPLE 1**

Assuming that the actual mA exceeds the desired mA so the actual mA needs to be decreased. In this case, error amp U15 detects that the actual mA (MA MEASURED) exceeds the desired mA (MA CONTROL) and the error correction output voltage on TP4 will go more negative. How negative this voltage goes is determined by the amount of difference detected between the desired and actual mA, the greater the difference, the more negative this voltage becomes.

The voltage on U27-6 (FIL B CONTROL and error correction voltage summing point) becomes less positive. The FIL REG voltage will then go more positive causing the output of the filament regulator to decrease. This results in less filament current which decreases the tube current (mA) until it equals the desired mA.

#### MA ERROR LOOP EXAMPLE 2

Assuming that the actual mA is less than the desired mA so the actual mA needs to be increased. In this case, error amp U15 detects that the actual mA (MA MEASURED) is less than the desired mA (MA CONTROL) and the error correction output voltage on TP4 will go positive. How positive this voltage goes is determined by the amount of difference detected between the desired and actual mA, the greater the difference, the more positive this voltage becomes.

The voltage on U27-6 (FIL B CONTROL and error correction voltage summing point) becomes more positive. The FIL REG voltage will then go less positive causing the output of the filament regulator to increase. This results in more filament current which increases the tube current (mA) until it equals the desired mA.

## **MAS INTEGRATOR**

In the film mode the operator chooses the kV and mAs. The system software then determines what mA to use. During the exposure the system software integrates the mA with respect to time until the desired mAs is reached. Once this happens the system software terminates the exposure.



Figure 1 - mA Servo Control Flowchart (Manual Mode)



Figure 2 - mA Servo Control Flowchart (Auto Mode)

# **MA GENERATOR ERRORS**

## **NO MA LIMITS**

This message appears if the MALIMIT.DAT file is not found. This file must be copied to the SRAM disk. (See the <u>SRAM Backup and Restore</u> sections in the C-Arm Software Section of this manual for procedures.)

### **REGULATOR FAIL**

By monitoring the FILSNS voltage through the Analog Interface during an exposure, the Technique Processor software detected that the filament regulator output voltage has exceeded its voltage range by  $\pm 15\%$  (See <u>Table 1</u> for voltage ranges). This is a non-fatal error, the system shuts down for two seconds after the exposure, X-rays can then be resumed.

### FILAMENT FAULT

With an X-ray switch engaged, the Technique Processor software has detected no voltage on the MA MEASURED line indicating little or no tube current. This is a fatal error and results in a system shut down.

## **MA ON IN ERROR**

With no X-ray switch engaged, the Technique Processor software detected a voltage on the MA MEASURED line indicating tube current was present but not commanded. This is a fatal error and results in a system shut down.

### WARNING, HIGH MA

The Technique Processor software has determined that the actual mA (MA MEASURED) exceeds the selected mA by more than 20%. This is a non-fatal error, the system shuts down for two seconds after the exposure, X-rays can then be resumed.

### LOW FLUORO MA

The Technique Processor software has determined that the actual mA (MA MEASURED) is less than the selected mA by more than 20%. This is a non-fatal error, the system shuts down for two seconds after the exposure, X-rays can then be resumed.

### X-RAY OVERTIME

The Technique Processor system software has determined that the elapsed exposure time (Film mode) has exceeded 10% of the expected exposure time and the exposure is terminated. This is a non-fatal error, the system shuts down for two seconds after the exposure, X-rays can then be resumed.

# **MA TROUBLESHOOTING**

### **MA CONTROL**

With 80 kV @ 5 mA selected in the manual fluoro mode and <u>no X-ray switch pressed</u>, you should measure approximately -1.7 VDC on TP8 of the X-ray Regulator PCB. This voltage should go more negative as the mA setting is increased and less negative as the mA setting is decreased. <u>No X-rays are necessary to perform this check</u>.

The ratio for TP8 is approximately -350 mV/mA in the fluoro mode and approximately - 70 mV/mA in the film mode.

### MA DRIVE

In the manual fluoro mode with <u>no X-ray switch pressed</u>, the FILDRVA and FILDRVB input signals to PAL U10 (pins 5 & 6) on the X-ray Regulator PCB should be out of phase with a frequency of 2.5 kHz. The duty cycle should decrease as less mA is selected and increase as more mA is selected. The FILDRA and FILDRB output signals from PAL U10 pins 12 and 13 should do the same. <u>No X-rays are necessary to perform this check.</u>

### **FILAMENT REGULATOR**

In the Manual or Auto Fluoro mode with <u>no X-ray switch pressed</u>, you should measure approximately +4 VDC on U27-6 (FIL B+ CTRL) of the X-ray Regulator PCB and approximately +160 VDC out of the filament regulator on R8 (or Q4 collector) of the Generator Driver PCB. The FIL B+ SNS voltage on U27-1 of the X-ray Regulator PCB should also measure approximately +4 VDC. All three of these voltages should vary during an exposure.

The ratio for FIL CNTRL is approximately 1:40, for every +1 VDC on TP10 of the Analog Interface there should be approximately +40 VDC out of the filament regulator.

### MA SENSE

During an 80 kV @ 5 mA Manual Fluoro exposure, you should see mA voltage pulses on TP7 of the X-ray Regulator PCB with an amplitude of approximately +950 to +1200mV (using an oscilloscope). However, <u>the average DC voltage component</u> of these voltage pulses on TP7 should be approximately +125 mVDC (measured with a DC Volt meter). The voltage on TP6 should be approximately +125 mVDC and TP11 (MA Measured) should be approximately +625 mVDC. All of these voltages should increase as actual tube current (mA) increases and decrease as actual tube current (mA) decreases.

The ratio for TP6 and TP7 is +40 mA/VDC in both Fluoro and Film modes. The ratio for TP11 is +8 mA/VDC Fluoro mode and +40 mA/VDC Film mode.

# MA ERROR CORRECTION TRUTH TABLES

## ACTUAL MA DETECTED > DESIRED MA

- X-ray Regulator TP4 error voltage decreases
- X-ray Regulator U27-6 summing point decreases
- X-ray Regulator U27-7 (FILREG) increases
- Generator Driver Filament Regulator output (R8) decreases
- Actual tube current (mA) decreases

## ACTUAL MA DETECTED IS < DESIRED MA

- X-ray Regulator TP4 error voltage increases
- X-ray Regulator U27-6 summing point increases
- X-ray Regulator U27-7 (FILREG) decreases
- Generator Driver Filament Regulator output (R8) increases
- Actual tube current (mA) increases

## **DIAGNOSTIC SOFTWARE**

DRO - Run applications with Parameters. See the C-Arm Software Section.

# **GENERATOR CALIBRATION**

The procedures contained in this section are used to test and calibrate the 9600 Mobile C-Arm. The following procedures are included:

- X-ray Calibration
- Entrance Exposure

These procedures assume that all parts are installed and are wired correctly. It is also assumed that all subassemblies are either known to be operational or were previously tested at the factory.

# **X-RAY CALIBRATION**

## **OVERVIEW**

This section describes the X-ray generator calibration procedure for the 9600 Mobile Imaging System. The 9600 C-Arm generator is a precise instrument that is software controlled for exceptional accuracy and repeatability. Each generator is calibrated so that the individual characteristics of the X-ray tube and generator components can be accounted for by software to produce the desired techniques. Please note that generator software is not interchangeable between different 9600 C-Arm systems.

Calibration of the generator is a semi-automatic process once the proper equipment has been installed. The individual performing the calibration is required to press keys, change Dynalyzer settings, and zero Dynalyzer offsets at various times during the calibration process. The operator will be prompted by the software to perform the appropriate actions when needed. The system should never be left unattended during the calibration process.

The following stages have been determined to be the best procedure for performing the calibration:

- 1. **Setup Equipment** The calibration equipment is connected to the C-Arm and setup for the calibration procedure.
- 2. Access Calibration Software Generator calibration software is accessed from the Mainframe Menu.
- 3. **Duty Cycle calibration** Calibration software automatically makes approximately 250 exposures at various kV and mA levels to determine the characteristics of the X-ray tube filaments. This data is written to a file (CARM.DC) for calculations after the exposures have been completed. Calculations are made and the information is written to the EEPROM on the Technique Processor PCB.

During the Duty Cycle the mA servo circuitry on the X-Ray Regulator PCB is disabled by installing the E2 jumper. This insures that the hardware servo will have no affect on tube mA. The kV servo circuitry remains enabled because the kV characteristics of the X-ray tube are well documented and easy to reproduce.

When Duty Cycle starts the X-ray tube is in the 0.3 mm focal spot and is driven by a narrow filament waveform at a constant 40 kV for the first exposure. The "Duty Cycle" for this first shot is designated as 400. For the next exposure the filament waveform is slightly wider while the kV remains at 40, which results in increased tube mA. The "Duty Cycle" for this second shot is 425. For consecutive shots the filament waveform width is increased slightly and the "Duty Cycle" designator increased by 25. The kV is kept at a constant 40 kV until the tube mA is 45 mA or greater. At this point the Duty Cycle switches to the 60 kV portion of the program. If the Duty Cycle reaches 1225 before 45 mA is reached, the Duty Cycle will default to the 60 kV portion of the program.

The tube is again driven by a narrow filament waveform, but kV is increased to 60 kV. The "Duty Cycle" for this first shot is again designated as 400. The filament waveform width is increased for subsequent shots as described in the preceding paragraph until the tube mA is 50 mA or greater. The Duty Cycle program then switches to the 80 kV station where shots are taken in the same manner described above.

This Duty Cycle process continues at 100 kV and 120 kV in the 0.3 mm focal spot and then switches to the .6 mm large focal spot. Table 1 illustrates how the entire Duty Cycle program functions from start to finish. Note that at each kV station the "Duty Cycle Designator" starts at 400 and exposures are taken until an ending mA value is reached. When the ending mA value is reached for a particular kV station the program changes to the next kV station.

At the completion of the entire Duty Cycle program the system software processes the data and calculates the H1, H2, and H3 coefficients. These coefficients are used to compile mA/Duty Cycle curves for each focal spot of the X-ray tube. This data will be used in the next step of the calibration process to produce exposures of a specific kV and mA.

4. kV/mA Calibration - Calibration software automatically makes approximately 40 exposures at various techniques to determine the characteristics of the generator electronics. This data is written to a file (CARM.CAL) for calculations after the exposures have been completed. Calculations are made and correction vectors are written to the EEPROM on the Technique Processor PCB.

During this step the mA servo circuitry is enabled by removing the E2 jumper on the X-Ray Regulator PCB. Specific kV and mA exposures are taken during this step of the calibration. The system software knows what duty cycle will produce the approximate desired mA from the mA/Duty Cycle curves obtained earlier.

As a shot is taken the system monitors the mA and kV sense circuits on the X-Ray Regulator PCB and compares these readings with the actual mA and kV as sensed by the Dynalyzer. System software can now make a direct correlation between the sense circuit values and the Dynalyzer readings.

At the end of the kV/mA Calibration the system software processes the data and calculates the A, B, B1, C, D, D1, and E coefficients. Now the system has all the data necessary to correlate actual mA and kV to the sense circuits, as well as to the mA and kV control voltages.

5. **Calibration Verification** - Calibration software automatically makes approximately 40 exposures and compares the values sensed in the generator with the values sensed by the Dynalyzer. This data is written to a file (CARM.VER) and merged with the previous files after calibration is complete.

This step of the calibration is used to verify that the desired exposures can be taken and fall within specifications. It is important that the operator monitors the actual kV and mA/mAs on the Dynalyzer as the verification data is taken and compare the readings against the desired techniques. If any of the shots are out of tolerance the generator probably has a hardware problem. Correct the problem before continuing any further. The calibration will not work if hardware problems exist.

- 6. **Merge Data Files** The three files created in previous steps are merged into one file, ALL.DAT.
- 7. **Backup Generator Software** Backup copies of the generator software are made with the new calibration information.

| FOCAL SPOT | <b>kV STATION</b> | STARTING DUTY CYCLE | ENDING mA |
|------------|-------------------|---------------------|-----------|
| 0.3 mm     | 40 kV             | 400                 | 45 mA     |
| 0.3 mm     | 60 kV             | 400                 | 50 mA     |
| 0.3 mm     | 80 kV             | 400                 | 50 mA     |
| 0.3 mm     | 100 kV            | 400                 | 40 mA     |
| 0.3 mm     | 120 kV            | 400                 | 33.3 mA   |
| 0.6 mm     | 50 kV             | 400                 | 75 mA     |
| 0.6 mm     | 60 kV             | 400                 | 66.7 mA   |
| 0.6 mm     | 80 kV             | 400                 | 50 mA     |
| 0.6 mm     | 100 kV            | 400                 | 40 mA     |

### **CALIBRATION TIPS**

- 1. At all times the Dynalyzer digital readout should equal the readout on the left monitor of the Workstation.
- 2. During calibration of the .3 mm and .6 mm focal spots, the duty cycle should never reach 1225.
- 3. All shots of less than 1 mA are rejected.
- 4. The system should not take more than eight shots to achieve 1 mA.
- 5. The 0.3 mm focal spot calibration should follow these guidelines:

| A. | 40 kV, mA≅45    | With each increment of 25 for duty cycle mA should increment by 2 to 3. |
|----|-----------------|---|
| В. | 60 kV, mA≅50    | With each increment of 25 for duty cycle mA should increment by 3 to 4. |
| C. | 80 kV, mA≅50    | With each increment of 25 for duty cycle mA should increment by 3.      |
| D. | 100 kV, mA≅40   | With each increment of 25 for duty cycle mA should increment by 3.      |
| E. | 120 kV, mA≅33.3 | With each increment of 25 for duty cycle mA should increment by 3.      |

6. The 0.6 mm focal spot calibration should follow these guidelines;

| Α. | 50 kV, mA≅75   | With each increment of 25 for duty cycle mA should increment by 8.       |
|----|----------------|--|
| В. | 60 kV, mA≅66.7 | With each increment of 25 for duty cycle mA should increment by 8 or 9.  |
| C. | 80 kV, mA≅50   | With each increment of 25 for duty cycle mA should increment by 8 or 9.  |
| D. | 100 kV, mA≅40  | With each increment of 25 for duty cycle mA should increment by 9 or 10. |

- 7. During the verification run, shots will have a duration of 1500 mS. If the batteries are weak this is where they will cave in.
- 8. At the end of the calibration, the duty cycle, calibration coefficients and the verification data are merged to create the ALL.DAT file.
- 9. Before sending the generator diskette to OEC for archiving make sure that the following files were created in the following order:

A:\> dir carm.\*

Volume in drive B has no label

Directory of B:\

| CARM      | DC  | 28,350            | 11-1     | 0-94  | 1:56p |
|-----------|-----|-------------------|----------|-------|-------|
| CARM      | CAL | 3,990             | 11-10-94 | 3:41p |       |
| CARM      | VER | 3,990             | 11-10-94 | 4:01p |       |
| 3 file(s) | 3   | 6,330 bytes       |          | -     |       |
|           | 18  | 84,320 bytes free |          |       |       |

A:\> dir all.\*

Volume in drive B has no label

| Directory of B:\ |     |                    |          |       |
|------------------|-----|--------------------|----------|-------|
| ALL              | DAT | 36,330             | 11-10-94 | 4:05p |
| 1 file(s)        |     | 36,330 bytes       |          | -     |
|                  |     | 184,320 bytes free |          |       |

These files should be date/time stamped as above before the calibration can be checked, validated and archived by Technical Support in Salt Lake City, Utah.

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### **EQUIPMENT SETUP**

Refer to Figures 1, 2, and 3.

# WARNING Verify that the Workstation power cable has been unplugged from the wall receptacle and the Workstation keyswitch is in the OFF position.

1. Open the battery charger circuit breaker and then remove the rear cover from the Xray Generator Assembly and the high voltage cable cover.

#### NOTE: This subsection describes the installation of the Machlett Dynalyzer III.

- 2. Prior to use, check the Dynalyzer pressure gauge for a reading of 15-18 psig.
- 3. Connect the cable between the Dynalyzer tank and DRO as shown in Figure 1.
- 4. Connect the cable between the printer port on the DRO and the Dynalyzer port on the Auto-cal Interface Box (cable part number 00-871434).
- 5. Connect the cable between the Analog Interface PCB port on the Auto-cal Interface Box and J1 and J2 on the Analog Interface PCB (cable P/N 00-871432).

#### NOTE: Do not use an extender PCB with the Analog Interface PCB.

#### CAUTION: Do not remove the High Voltage cable connectors from the X-ray Tube. These connectors will not fit into the Dynalyzer.

# WARNING... Discharge the high voltage cables by grounding the cable tips to the chassis, after removing them from the connector, to avoid electrical shock.

6. Make note of the locations of the Anode and Cathode connectors of the High Voltage cables and remove them from the High Voltage Tank. Carefully lay them aside after discharging them against the chassis.

# CAUTION: Store the Dynalyzer cable connectors in the Dynalyzer tank wells to keep the connectors clean.

- 7. Clean the High Voltage Tank wells with clean paper towels and Freon and avoid contaminating the wells by touching the well surfaces with bare fingers.
- 8. Remove the Dynalyzer tank cables from the "Tube" side of Dynalyzer tank
- 9. Clean the Dynalyzer tank cable connectors with Freon, being careful not to contaminate them by touching them with bare fingers.
- 10. Apply a thin layer of silicone compound to the high voltage connectors.



**Figure 1 - Calibration Equipment Electrical Connections** 

- 11. Observing the correct polarity insert the Dynalyzer tank cable connectors into the wells of the High Voltage Tank. Be careful not to cross-thread the nuts securing the cables to the tank. Tighten with the cable spanner wrench (part number 00-877674).
- 12. Clean the Dynalyzer wells with clean paper towels and Freon. Avoid contaminating the wells by touching the well surfaces with bare fingers.
- Clean the High Voltage cable connectors and apply silicone compound. Observing the correct polarity install the connectors into the "Tube" side wells of the Dynalyzer tank. Be careful not to cross-thread the nuts securing the cables.

#### NOTE: You may need to cut one or two cable-ties perform step 13.

- 14. Plug the Dynalyzer tank, DRO and Auto-cal Interface Box into a 120 VAC outlet. Turn **ON** the power to all the calibration equipment and allow 30 minutes to warmup. The power outlet strip in the Workstation may be used for this purpose
- 15. Set the mA switch on the Dynalyzer tank to Fluoro (see <u>Figure 2</u>) and zero the mA value (±.2mV) by adjusting the "F" mA zero trimpot. Use a DVM set to measure DC millivolts and measure at the BNC connector near the switch (see Figure 2).
- 16. Set the mA switch on the Dynalyzer tank to Rad (see Figure 2) and zero the mA value (±.2mV) by adjusting the "R" mA zero trimpot. Use a DVM and measure at the BNC connector near the switch (see Figure 2).

#### CAUTION: Do not use the Dynalyzer if both readings do not zero out.

#### NOTE: The calibration software will indicate on the left monitor of the Workstation which mA switch setting (RADIOGRAPHIC/FLUORO) on the Dynalyzer tank to use during different stages of the calibration. Set the mA switch setting as requested.

17. Set the controls on the Dynalyzer III DRO (see Figure 3) as follows:

| Displays:       | A+C    |
|-----------------|--------|
| mA/mAs          | mA     |
| Trigger Source: | kVp    |
| Procedure:      | NORMAL |
| Trigger Mode:   | PRESET |
| kV Delay:       | 20 ms  |
| Window Delay:   | OFF    |
| Trigger Level:  | 30     |
| Printer         | AUTO   |
|                 |        |

- 18. Press the **RESET** button on the DRO (see Figure 3). All digits should display 0.
- 19. Turn the X-ray Switch Override on the Autocal Interface Box to **ON** (see Figure 4) and place the D/A -Dosimeter switch to **D/A**.

#### **Generator Calibration**

- 20. Remove the necessary covers to access the X-ray Regulator PCB and jumper across E1 on the X-ray Regulator PCB with a shorting plug to disable the mA servo.
- 21. Plug the system into the AC outlet. Turn on the battery circuit breaker and power up the system.
- 22. Make an exposure in the MANUAL FLUORO mode and verify that the DRO is working.

#### **Generator Calibration**



Figure 2 - mA Zero on Dynalyzer Tank

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Figure 3 - Dynalyzer Digital Read Out (DRO)



Figure 4 - Auto-cal Interface Box

### **ACCESS CALIBRATION SOFTWARE**

- 1. Press **The SETUP OPTIONS** key on the Workstation keyboard. The **Setup Options** screen will appear.
- 2. Insert the OEC service access disk into the floppy disk drive on the rear of the Workstation.
- 3. Select *Access Level 2* and press the ENTER key.
- 4. Select the *Access Mainframe Menu* and press the ENTER key.

The Mainframe Menu will appear on the left monitor. The Control Panel Display will display "MAINFRAME MENU."

| MAINFRAME MENU  |  |
|---|--|
| <ul> <li>A - Run Applications (Take X-rays)</li> <li>B - Run Calibration With Parameters</li> <li>C - Run Calibration</li> <li>D - System Configuration</li> <li>E - mA Limit File Editor</li> <li>F - Examine Event File</li> <li>G - Run Status</li> <li>H - Collimator Calibration</li> <li>I - Language Options</li> <li>J - ABS Index File Editor</li> </ul> |  |
| <esc> - Return to DOS</esc>   |  |
| Enter Command Letter :  |  |

- 5. From the *Mainframe Menu* select: *C Run Calibration*. The Control Panel Display will display "CALIBRATION".
- 6. Enter your initials when prompted: "Enter Initials Please".
- 7. Answer the following question when it appears on the monitor by entering **Y** and pressing the **ENTER** key:

```
Is your Dynalyzer (if any) wired internally for automatic reset?
```

Enter (Y/N): Y

#### **Generator Calibration**

8. The Model 9600 Calibration Menu will appear:



#### **DUTY CYCLE CALIBRATION**

Take Duty Cycle Data

**NOTE:** Refer to the "Calibration Tips" at the end of this procedure for things to watch for during the calibration procedure.

#### WARNING Steps within this procedure produce X-rays. Use appropriate precautions.

1. Enter command letter: *A - Take Duty Cycle Data*.

A screen of instructions will appear for either the Model II or III Dynalyzer. (The model is automatically sensed by the software). Ensure that each instruction on the list has been performed before continuing.

- 2. Depress the FOOTSWITCH (or X-RAY ON button) to select AUTO mode.
- The system will automatically acquire a series of shots (approximately 250). Observe the shots reported on the monitor. These should match those of the DRO. If not there may be a problem with the:
  - Auto-cal box
  - PIOs on the Analog Interface PCB
  - Cabling
- 4. If the Dynalyzer fails to trigger, the calibration software will prompt you to press the **RESET** button on the DRO and then press **ENTER**.
- 5. The Generator automatically switches filaments during duty cycle calibration. When this happens, the following message will appear on the Workstation screen.

\*\*\*SWITCHING FILAMENTS - 1 MINUTE DELAY \*\*\*

NOTE: Exposures will continue until all the calibration data has been acquired.

#### **Calculate Duty Cycle Coefficients**

- 1. When the data acquisition run is complete, you will be returned to the *Model 9600 Calibration Menu*.
- 2. Select: B Calculate Duty Cycle Coefficients to EEPROM.
- 3. The coefficients are calculated and briefly displayed on the screen.

#### Write Duty Cycle Coefficients to EEPROM

- 1. When the calculations are complete, you will be returned to the *Model 9600 Calibration Menu*.
- 2. Select: C Write Duty Cycle Coefficients To EEPROM.
- 3. The following message will appear briefly and then the software returns to the *Model 9600 Calibration Menu*.

Writing duty cycle coefficients to EEPROM.

Duty cycle coefficients have been written to EEPROM.

### **KV/MA TECHNIQUE CALIBRATION**

#### **Acquire Calibration Data**

#### WARNING... Steps within this procedure produce X-rays. Use appropriate precautions.

- 1. From the Model 9600 Calibration Menu select: D Acquire Calibration Data.
- 2. Remove the mA Servo-Disable jumper E1 on the X-ray Regulator PCB and change the tank setting to Radiographic mode for LARGE SPOT calibration.
- Depress the FOOTSWITCH (or X-RAY ON) to select AUTO mode and begin acquisition run.
- 4. The system automatically acquires data for approximately three minutes and then displays the following screen:

\*\*\* SWITCHING FILAMENTS \*\*\*

Change tank setting to Fluoro mode for small spot calibration.

Press {ENTER} on keyboard to continue.

## NOTE: When the \*\*\* Switching Filaments \*\*\* screen appears an audible tone will be heard until the ENTER key is pressed.

5. Change the switch on the Dynalyzer to Fluoro mode and press Enter. Another series of exposures will be taken, taking about five minutes.

#### **Calculate Calibration Coefficients**

- After completion of the acquisition run, the *Model 9600 Calibration Menu* is displayed; select *E - Calculate Calibration Coefficients*.
- 2. The coefficients will be displayed briefly and then the *Model 9600 Calibration Menu* is displayed.

#### Update Coefficients to EEPROM

- 1. From the Calibration Menu select: *F Update Coefficients To EEPROM*.
- 2. When step one is completed the *Model 9600 Calibration Menu* is displayed.

### VERIFICATION

#### **General Information**

Calibration must be verified during regular Periodic Maintenance procedures or when certified components are replaced. Refer to the Appendix for a list of certified components and information concerning when to file *Report of Assembly*, FDA Form 2579.

The measurement values used for these tests are not the design specifications. The test specifications used here take into account measurement limitations; their use will ensure that the design specifications are met. All reference to specifications below are to these TEST specifications.

# **NOTE:** The following tests for kVp and mAs accuracy require installation of a Dynalyzer; the Autocal Interface Unit is not required.

#### Acquire Data for Calibration Verification

#### WARNING... Steps within this procedure produce X-rays. Use appropriate precautions.

- 1. From the Calibration Menu select G Acquire Data For Calibration Verification.
- 2. Follow the menu instructions which appear on the computer terminal before continuing with the procedure.
- 3. Zero the Dynalyzer (in both FLUORO and RAD on the model III). Set the Dynalyzer tank to RAD.
- 4. Depress the FOOTSWITCH (or X-RAY ON switch) to select AUTO mode and begin acquisition run. This screen will appear on the left monitor.

Change Tank Setting to RAD Mode

20 Second Delay

5. The system automatically acquires data for about two minutes. The software will prompt you to change the Dynalyzer III setting with the following message:

\*\*\* SWITCHING FILAMENTS \*\*\*

Change Tank Setting to Fluoro Mode For Small Spot Calibration.

Press {ENTER} on Keyboard to Continue.

6. X-rays begin after a 20 second delay. When the acquisition run is complete (approximately 5 minutes), you will be returned to the *Model 9600 Calibration Menu*.
## MERGE EXISTING DATA FILES

- 1. From the Calibration Menu, select I Return To Main Menu And Merge Existing Data Files.
- NOTE: Option "H" is not for service use. Skip this option.
  - 2. The message "*Merging files, recreated All.Dat*" will be displayed followed by a message stating that the "*EEPROM. Dat file has been updated*". The software then returns you to the *Mainframe Menu*.

### **BACKUP GENERATOR SOFTWARE**

- NOTE: Do not reboot the system from the Mobile C-Arm Menu or cycle power to reboot the system until the generator software has been backed up. Rebooting the system at this time affects the "Hot Byte" as explained in the "C-Arm Software" section of this manual.
  - 1. Remove the <u>SRAM card</u> from the Technique Processor PCB and power off the system.
  - 2. Locate the generator software backup disk (3 1/2-inch HD floppy located on the C-Arm in an anti-static bag).
  - 3. Make two 3 1/2-inch floppy backup copies of the C-Arm disk per the procedure in the *C-Arm Software* section of this manual. Return one backup diskette to the C-Arm and return the other to the Technical Support Office for evaluation and archiving.
  - 4. Reinstall the SRAM card in the Technique Processor and remove the cables from the Analog Interface PCB.
  - 5. Power on the system. Confirm operation.

## ENTRANCE EXPOSURE CALIBRATION

### **OVERVIEW**

Entrance exposure is the amount of radiation available at the entrance point of patient anatomy. Entrance exposure is measured 12" (or 30 cm) above the surface of the Image Intensifier in the center of the X-ray beam. This measurement is used to represent the average thickness of patient anatomy.

### 5R and 10R Systems

FDA requirement 80-8035, Section 1020.32, part D2 states the maximum FLUORO entrance exposure is either 5R/min or 10R/min depending on the manufacturing date. If a system was manufactured before May 19, 1995, the maximum entrance exposure allowed is 5R/min. On or after May 19, 1995, the maximum entrance exposure allowed is 10R/min. This impacts 9600s as indicated by the following system serial numbers:

- 5R systems = S/N 69-0001 to 69-1160
- 10R systems = S/N 69-1161 and higher

The remainder of this chapter is divided into two sections for both groups of system serial numbers as described above. These two sections include theory and calibration information.

## NOTE: Be sure to refer to the correct Entrance Exposure documentation (5R or 10R) contained within this chapter depending upon the serial number of your system.

### 5R THEORY - S/N 69-0001 TO 69-1160

The purpose of this procedure is to ensure compliance with FDA requirement 80-8035, Section 1020.32, part D2 for systems manufactured before May 19, 1995. This requirement refers to the maximum FLUORO dose rate output of 5R/min. To ensure compliance, the 9600 is limited to 4.63 R/min in all FLUORO modes of operation (except BOOST). 4.63R/min is used instead of 5R/min to allow for worst-case equipment tolerances used to calibrate the system.

To satisfy this requirement, the mA Limit File must be modified within generator software. This prevents the 9600 from exceeding 4.63R/min. The reason to limit the mA is shown in the following examples.

### **Example 1**

With the tube current set to 5.0 mA, the 4.63 R/min is exceeded at approximately 90 kV and above. This is shown in the gray area of the graph.



k∨@ 5 m A

Figure 5 - Dose Output Exceeds 5R/Min

### Example 2

When the mA Limit File Editor program has the correct data entered, the output of the system will resemble that of the following graph. Note the 4.63 R/min is not exceeded at 90 kV and above as shown below. This is due to the software limiting the maximum available mA in all FLUORO modes as the kV for the generator increases.



kV with limited mA

Figure 6 - Dose Output Correctly Limited

### **Example 3**

In the following graph, the dose rate output falls below 4 R/min at approximately 110 kV. In this case, the mA limit file maximum values are too small between 110 kV to 120 kV. These software mA limits would need to be increased in order to approach, but not exceed, the desired 4.63 R/min dose rate maximum limit.





#### Figure 7 - Dose Output Incorrectly Limited

## **CONFIRM 5R ABS TABLES**

You can confirm your system has the correct 5R ABS tables by performing the following test:

- 1. Power on the system and allow it to boot completely.
- 2. Press the ABS SELECT button on the mainframe control panel. Using this key, toggle through the four available ABS tables comparing them to the following:
  - Standard for Domestic 5R
  - Low dose for domestic
  - Chest 5R
  - Extremities 5R

If these options do not appear, select the correct ABS tables as described in the "5R ABS Table Configuration" procedure located on the next page.

## 5R ABS TABLE CONFIGURATION (S/N 69-0001 TO 69-1160)

#### NOTE: Confirm your system serial number falls into the above category.

To configure the correct ABS table, use the following procedure:

- 1. Power on the system and allow it to boot completely.
- 2. Insert the diagnostic disk (00-876781-01) in the rear of the Workstation.
- 3. Press the SETUP OPTIONS key on the Workstation.
- 4. Select Access Level 2, then Access Mainframe Menu.
- 5. Select option "J" ABS Index File Editor.
- 6. Select option "A" Edit ABS Index File. The following table should appear:

|  |   |                        | AB          | S INDEX T               | ABLE ED        | ITOR   |             |             |             |                |
|--|---|------------------------|-------------|-------------------------|----------------|--------|-------------|-------------|-------------|----------------|
| Rec<br>Nos   | Description                             | iption ABS Displa      |             | ay Name                 | Boost<br>Avail | In Use | Boot<br>Up  | PLS<br>Rate | VLI<br>Ofst | P VLI<br>Ofset |
| 1  | Standard for Domestic Standard 5R<br>5R |                        | R/Min       | Yes                     | Yes            | Yes    | 4           | 0           | 0           |                |
| 2  | Low Dose for D                          | Domestic               | Low Dose    |                         |                | Yes    |             | 1           | 0           | 0              |
| 3  | Chest 5R                                |                        | Chest 5R/M  | /lin                    | Yes            | Yes    |             | 4           | -100        | -70            |
| 4  | Extremities 5R                          |                        | Extremities | 5R/Min                  | Yes            | Yes    |             | 4           | 50          | 35             |
| 5  | Standard 10R                            |                        | Standard    |                         | Yes            |        |             | 4           | 0           | 0              |
| 6  | Chest 10R                               |                        | Chest       |                         | Yes            |        |             | 4           | -100        | -70            |
| 7  | Extremities 10                          | R                      | Extremities |                         | Yes            |        |             | 4           | 50          | 35             |
|  |   |                        |             |                         |                |        |             |             |             |                |
| A. Pag   | ge Up                                   | B. Page D              | Down        | C. Top of Table         |                | D. E   | nd of Tab   | le          |             |                |
| E. Sel   | E. Select Record F. Edit in Use         |                        | Use         | G. Edit Boot<br>Default |                | H. E   | dit Pulse I | Rate        |             |                |
| I. Edit  | VLI Ofst                                | J. Edit Pulse VLI Ofst |             |                         |                |        |             |             |             |                |
| <esc< td=""><td>&gt; - Exit</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></esc<> | > - Exit                                |                        |             |                         |                |        |             |             |             |                |
| Enter<br>letter:   | command                                 |                        |             |                         |                |        |             |             |             |                |

#### NOTE: Do not change the PLS Rate, VLI Ofst, or the P VLI Ofset settings.

 (a) If your screen matches that the one shown above, no changes are necessary. Press ESC twice, then select A to return the system to normal. Press ESC twice again to clear the right monitor.

(b) *If your screen does not match* the screen shown above, select option "E - Select Record" to configure the system. Follow screen instructions to save these changes.

8. This completes this procedure.

### **5R VERIFICATION PROCESS**

This is the process to ensure compliance with FDA requirements 80-8035, Section 1020.32, part D2.

**NOTE:** The Dynalyzer should not be connected during this procedure. The following equipment is required to perform the entrance exposure tests:

- Keithley Model 35050 dosimeter with Model 96030 ion chamber or equivalent (Calibration must be current).
- Metric Scale or Ruler
- Lead Apron or lead plate
- Probe Holding Fixture

## **NOTE:** To protect the image intensifier from being over driven, place a lead plate or several folds of lead apron over the face plate, under the holding fixture.

#### WARNING... Steps within this procedure produce X-rays. Use appropriate precautions.

- 1. Select FLUORO MANUAL mode, set the technique to 40 kV and 5.0 mA.
- 2. Select NORMAL field size.
- 3. Center an ion chamber in the X-ray beam 12" (30 cm) above the II as shown below.



Figure 8 - Dosimeter and Ion Chamber Set-up for 5R/Min Output

- 3. Increase the kV slowly up to 120 kV allowing the dosimeter to stabilize its reading as kV increases. At no point should the **Actual Dose Rate** (See note below) exceed 4.63 R/min. Notice how the mA decreases as the kV increases at approximately 90 kV.
- *NOTE:* If you are using an open air ion chamber, the measured dose rate (MDR) read on the dosimeter should be corrected for atmospheric pressure. This is know as the Actual Dose Rate (ADR). Calculate the ADR using the following formula.

ADR = (760/P) (273.15 + T/295.15) \* MDR

P = Absolute Pressure in Millimeters of Mercury

T = Temperature in degrees Celsius

4. Perform the *5R Entrance Exposure Calibration* beginning on the next page if the ADR reading exceeds 4.63 R/min or if you have a condition similar to example 3 of the previous page.

### **5R ENTRANCE EXPOSURE CALIBRATION**

Use this procedure to change the mA Limit File data within the generator software.

### **Editing the mA Limit File**

- 1. With the system completely booted, insert the OEC service access disk in the Workstation. Then press SETUP OPTIONS.
- 2. Select Access Level 2. Then select Access Mainframe Menu.
- 3. Select *E mA Limit File Editor*. The following menu appears.

|     | ma Lim<br>MM/DD/YEAR | it File Editor<br>malimit.dat loaded <r w=""></r> |
|-----|----------------------|---|
| kVp | Maximum mA           |   |
| 40  | 5.0                  | A. Fill with constant                             |
| 41  | 5.0                  | B. Clear mA to zero                               |
| 42  | 5.0                  | C. Interpolate Table                              |
| 43  | 5.0                  | D. Set mA high limit                              |
| 44  | 5.0                  | E. Restore Original                               |
| 45  | 5.0                  | F. Edit mA Table                                  |
| 46  | 5.0                  |   |
| 47  | 5.0                  | ESC - QUIT  |
| 48  | 5.0                  |   |
| 49  | 5.0                  |   |
| 50  | 5.0                  | ENTER CHOICE (A,B,):                              |
|     |                      |   |

- 4. Select **A.** *Fill with constant*. Enter a value of 5.0. This allows you to <u>temporarily</u> exceed the 4.63 R/min limit to find the maximum mA allowed for several kV settings.
- 5. Press *ESC*. Then press *Y* to save changes.
- 6. Select *A Run Applications*. Then press *ESC* twice to clear the right monitor.
- In increments of 5 kVp from 40 kVp to 120 kVp determine the mA needed to produce 4.63 R/minute. Use the worksheet on the following page and record the maximum mA values which allow the system to <u>approach but not exceed</u> 4.63 R/min.

NOTE: You may wish to print and photocopy this page to keep this chart for future use. Be sure to include the Correction Factor for your dose rate readings.

| kV  | Max mA | Dose Rate R/Min |
|-----|--------|-----------------|
| 40  | 5.0    |                 |
| 45  |        |                 |
| 50  |        |                 |
| 55  |        |                 |
| 60  |        |                 |
| 65  |        |                 |
| 70  |        |                 |
| 75  |        |                 |
| 80  |        |                 |
| 85  |        |                 |
| 90  |        |                 |
| 95  |        |                 |
| 100 |        |                 |
| 105 |        |                 |
| 110 |        |                 |
| 115 |        |                 |
| 120 |        |                 |

- 8. After the chart is completed, press **SETUP OPTIONS** on the Workstation.
- 9. Select Access Level 2. Then select Access Mainframe Menu.
- 10. Select *E mA Limit File Editor*.
- 11. Select **B Clear mA to Zero**.
- 12. Select *F Edit mA Table*. The following menu appears.

|   | <mal< th=""><th>_ mA Limit File Editor<br/>limit.dat loaded&gt; <r w=""></r></th></mal<> | _ mA Limit File Editor<br>limit.dat loaded> <r w=""></r>  |
|---|--|---|
| kVp<br>40<br>41<br>42<br>43<br>44<br>45<br>46<br>47<br>48 | Maximum mA<br>0.0<br><br><br><br><br>  | <ul> <li>A. Previous Line</li> <li>B. Next Line</li> <li>C. Page Up</li> <li>D. Page Down</li> <li>E. Beginning of Table</li> <li>F. End of Table</li> <li>G. Refresh Screen</li> </ul> |
| 49<br>50  |  | ESC - QUIT  |

13. Enter the data from the worksheet starting with 5.0 mA at the 40 kV entry. Make the next entry at the kV station which required less than 5.0 mA to not exceed the maximum dose rate allowed. From this kV data point, mA limits are entered at 5 kV intervals.

#### NOTE: Observe the following A, B, C, D, & E conditions while entering mA limit data.

A. No two entries can have the same mA values. This is shown as an error in the right column with 5.0 mA entered both 40 and 90 kV.

|     | CORRECT | INCORRECT |        |  |
|-----|---------|-----------|--------|--|
| kVp | Max mA  | kVp       | Max mA |  |
| 40  | 5.0     | 40        | 5.0    |  |
|     |         |           | •      |  |
|     | •       |           | •      |  |
| 90  | 4.9     | 90        | 5.0    |  |
|     |         |           | •      |  |
|     |         |           | •      |  |
|     |         |           | •      |  |
| 120 | 2.9     | 120       | 2.9    |  |

B. mA limits cannot exceed previous entries. This is shown as an error in the right column for entry 95 kV. The 4.9 mA value exceeds the previous 4.8 mA value.

| C   | ORRECT | IN  | INCORRECT |  |  |
|-----|--------|-----|-----------|--|--|
| kVp | Max mA | kVp | Max mA    |  |  |
| 40  | 5.0    | 40  | 5.0       |  |  |
|     |        |     |           |  |  |
|     |        |     |           |  |  |
| 90  | 4.9    | 90  | 4.8       |  |  |
| •   |        |     |           |  |  |
| 95  | 4.4    | 95  | 4.9       |  |  |
| •   |        |     |           |  |  |
| 120 | 2.9    | 120 | 2.9       |  |  |

C. A minimum of three entries must be entered. This is shown as an error in the right column with only two entries at 40 and 120 kV and nothing for the 90 kV entry.

|     | CORRECT | INCORRECT |        |  |
|-----|---------|-----------|--------|--|
| kVp | Max mA  | kVp       | Max mA |  |
| 40  | 5.0     | 40        | 5.0    |  |
|     |         | -         |        |  |
|     | · ·     |           |        |  |
| 90  | 4.9     | 90        |        |  |
|     | ·       |           | •      |  |
|     |         |           | •      |  |
|     |         |           |        |  |
| 120 | 2.9     | 120       | 2.9    |  |

- NOTE: Even though three entries will allow the software to interpolate the mA Limit File for the rest of the values, values must be entered at every 5 kV point to ensure better resolution of the mA limiting.
  - D. The 120 kV entry must contain a value. This is shown as an error in the right column.

|     | CORRECT |     | INCORRECT |
|-----|---------|-----|-----------|
| kVp | Max mA  | kVp | Max mA    |
| 40  | 5.0     | 40  | 5.0       |
|     |         |     |           |
|     |         |     |           |
| 90  | 4.9     | 90  | 4.9       |
|     |         |     |           |
|     |         | 95  | 4.4       |
|     |         |     |           |
| 120 | 2.9     | 120 |           |

E. One of the entries must contain a 5.0 mA value. This is shown as an error in the right column at 40 kV.

|     | CORRECT |     | INCORRECT |
|-----|---------|-----|-----------|
| kVp | Max mA  | kVp | Max mA    |
| 40  | 5.0     | 40  | 4.9       |
|     |         |     |           |
|     |         |     |           |
| 90  | 4.9     | 90  | 4.8       |
|     |         |     |           |
|     | ı       |     |           |
|     |         |     |           |
| 120 | 2.9     | 120 | 2.9       |

- Press *ESC* when the preceding conditions (A E) are met and all mA limits are entered.
- 15 Select *C Interpolate Table*. The following menu appears if the interpolation process was **successful**. Your coefficients will more than likely be different from those shown in this example.

```
mA Entrance Exposure Interpolation Function
1: 1.4200000
2: 0.1301667
3: -0.0010167
Press any key to continue ....
```

*OR* - If the interpolation process was **unsuccessful** an *Interpolation Error* message appears. (see associated A, B, C, D, or E error shown on previous pages)

- 16. Then press *ESC*. Then press *Y* to save, or *N* to exit with no save.
- 17. Select A Run Applications. Then press ESC twice to clear the right monitor.
- 18. Using the verification portion of this procedure from the previous page to ensure compliance.
- NOTE: If any kV station exceeds the 4.63 R/min limit, record the mA value for that station which corrects for this error. Then use the mA Limit File Editor to change individual kV stations. Do not re-interpolate the mA file after changing individual kV stations.

- 19. Without powering off the system, copy the MALIMIT.DAT file from the SRAM to the generator backup software diskette as follows:
  - A. Power on laptop. Select AMICARDZ icon in Windows.
  - B. Remove necessary covers to access the Technique Processor PCB
  - C. Remove the SRAM from the Technique Processor PCB.
  - D. Insert SRAM into PCMCIA slot.
  - E. After the message "Card Inserted in Socket 1" appears, select OK.
  - F. Exit to DOS and go to the F:\ drive.
  - G. Insert backup generator diskette in the floppy.
  - H. Enter the command "COPY MALIMIT.DAT A:"
  - I. Replace the SRAM in the Technique Processor
  - J. Remove the floppy diskette.
- 20. This completes the 5R Entrance Exposure Calibration procedure.

## **10R THEORY - S/N 69-1161 AND HIGHER**

The purpose of this procedure is to ensure compliance with FDA requirement 80-8035, Section 1020.32, part D2 for systems manufactured on or after May 19, 1995. This requirement refers to the maximum FLUORO dose rate output of 10R/min.

To ensure compliance, the 9600 is limited to 9.26 R/min in all FLUORO modes of operation (except BOOST). 9.26R/min is used instead of 10R/min to allow for worst-case equipment tolerances used to calibrate the system.

To satisfy this requirement, the mA Limit File must be modified within generator software to allow all kV stations a 5.0 mA maximum tube current.

## **CONFIRM 10R ABS TABLES**

You can confirm your system has the correct 10R ABS tables by performing the following test:

- 1. Power on the system and allow it to boot completely.
- 2. Press the ABS SELECT button on the mainframe control panel. Using this key, toggle through the four available ABS tables comparing them to the following:

STANDARD

CHEST

EXTREMITIES

LOW DOSE

If these options do not appear, select the correct ABS tables as described in the "10R ABS Table Configuration" procedure located on the next page.

# **10R ABS TABLE CONFIGURATION (S/N 69-1161 AND HIGHER)**

#### NOTE: Confirm your system serial number falls into the above category.

To configure the correct ABS table, use the following procedure:

- 1. Power on the system and allow it to boot completely.
- 2. Insert the diagnostic disk (00-876781-01) in the rear of the Workstation.
- 3. Press the SETUP OPTIONS key on the Workstation.
- 4. Select Access Level 2, then Access Mainframe Menu.
- 5. Select option "J" ABS Index File Editor.
- 6. Select option "A" Edit ABS Index File. The following table should appear:

|                                    | ABS INDEX TABLE EDITOR                                  |            |  |                                       |                                 |  |            |                                |                                 |                               |
|------------------------------------|---|------------|--|---------------------------------------|---------------------------------|--|------------|--------------------------------|---------------------------------|-------------------------------|
| Rec<br>Nos                         | Description   |            | ABS Displ                                      | ay Name                               | Boost<br>Avail                  | In Use                                       | Boot<br>Up | PLS<br>Rate                    | VLI<br>Ofst                     | P VLI<br>Ofset                |
| 1                                  | Standard for D<br>5R                                    | omestic    | Standard 5                                     | R/Min                                 | Yes                             |  | -          | 4                              | 0                               | 0                             |
| 2                                  | Low Dose for<br>Domestic                                |            | Low Dose                                       | Low Dose                              |                                 | Yes  |            | 1                              | 0                               | 0                             |
| 3<br>4<br>5<br>6                   | Chest 5R<br>Extremities 5R<br>Standard 10R<br>Chest 10R |            | Chest 5R/M<br>Extremities<br>Standard<br>Chest | ∕lin<br>₅5R/Min                       | Yes<br>Yes<br><b>Yes</b><br>Yes | Yes<br>Yes                                   | Yes        | 4<br>4<br><b>4</b><br><b>4</b> | -100<br>50<br><b>0<br/>-100</b> | -70<br>35<br><b>0<br/>-70</b> |
| 7                                  | Extremities 10  | DR         | Extremities                                    | S                                     | Yes                             | Yes  |            | 4                              | 50                              | 35                            |
|                                    |   |            |  |                                       |                                 |  |            |                                |                                 |                               |
| A. Pa<br>E. Sel                    | A. Page UpB. Page DownE. Select RecordF. Edit in Use    |            | )own<br>Use                                    | wn C. Top of Tab<br>se G. Edit Boot U |                                 | DIE D. End of Table<br>Up H. Edit Pulse Rate |            | le<br>Rate                     |                                 |                               |
| I. Edit                            | VLI Ofst  | J. Edit Pu | lse VLI Ofst                                   | Delauit                               |                                 |  |            |                                |                                 |                               |
| <esc<br>Enter<br/>letter:</esc<br> | > - Exit<br>command                                     |            |  |                                       |                                 |  |            |                                |                                 |                               |

#### NOTE: Do not change the PLS Rate, VLI Ofst, or the P VLI Ofset settings.

- 7(A). *If your screen matches* that the one shown above, no changes are necessary. Press ESC <u>twice</u>, then select A to return the system to normal. Press ESC <u>twice</u> again to clear the right monitor.
- 7(b). *If your screen does not match* the screen shown above, select option "E Select Record" to configure the system. Follow screen instructions to save these changes.
- 8. This completes this procedure.

### **10R VERIFICATION PROCESS**

This is the process to ensure compliance with FDA requirements 80-8035, Section 1020.32, part D2.

- 1. In the MANUAL FLUORO mode, set the technique to 40 kV and 5.0 mA.
- 2. Center an ion chamber in the X-ray beam 12-inches (30 cm) above the II as shown below.



#### Figure 9 - Dosimeter and Ion Chamber Set-up for 10R/Min Output

 Next, increase the kV slowly up to 120 kV allowing the dosimeter to stabilize its reading as kV increases. At no point should the Actual Dose Rate (See note below) exceed 9.26 R/min.

NOTE: If you are using an open air ion chamber, the measured dose rate (MDR) read on the dosimeter should be corrected for atmospheric pressure. This is know as the Actual Dose Rate (ADR). Calculate the ADR using the following formula.

ADR = (760/P) (273.15 + T/295.15) \* MDR

P = Absolute Pressure in Millimeters of Mercury

T = Temperature in degrees Celsius

4. If necessary, perform the *10R Entrance Exposure Calibration* beginning on the next page.

### **10R ENTRANCE EXPOSURE CALIBRATION**

Use this procedure to change the mA Limit File data within the generator software.

### **Editing the mA Limit File**

- 1. With the system completely booted, insert the diagnostic disk (00-876781) in the Workstation. Then press SETUP OPTIONS.
- 2. Select Access Level 2. Then select Access Mainframe Menu.
- 3. Select E mA Limit File Editor. The following menu appears:

|     | MM/E       | _ mA Limit File Editor<br>DD/YEAR malimit.dat loaded <r w=""></r> |
|-----|------------|---|
| kVp | Maximum mA |   |
| 40  | 5.0        | A. Fill with constant   |
| 41  | 5.0        | B. Clear mA to zero   |
| 42  | 5.0        | C. Interpolate Table  |
| 43  | 5.0        | D. Set mA high limit  |
| 44  | 5.0        | E. Restore Original   |
| 45  | 5.0        | F. Edit mA Table  |
| 46  | 5.0        |   |
| 47  | 5.0        | ESC - QUIT  |
| 48  | 5.0        |   |
| 49  | 5.0        |   |
| 50  | 5.0        | ENTER CHOICE (A,B,):  |
|     |            |   |

- 4. Select *A. Fill with constant*. Enter a value of 5.0.
- 5. Press *ESC*. Then press *Y* to save changes.
- 6. Select *A Run Applications*. Then press *ESC* twice to clear the right monitor.
- Verify system compliance as described on the previous page using the "10R Verification Process" procedure.
- 8. Copy the MALIMIT.DAT file from the SRAM to the generator backup software diskette as follows:
  - Power on laptop. Select AMICARDZ icon in Windows.
  - Remove necessary covers to access Technique Processor PCB
  - Remove the SRAM from the Technique Processor PCB.
  - Insert SRAM into PCMCIA slot.
  - After the message "Card Inserted in Socket 1" appears, select OK.
  - Exit to DOS and go to the F:\ drive.
  - Insert backup generator diskette in the floppy.

- Enter the command "COPY MALIMIT.DAT A:"
- Replace the SRAM in the Technique Processor
- Remove the floppy diskette.
- 9. This completes the 10R Entrance Exposure procedure.

## **MECHANICAL ASSEMBLIES**



## **OVERVIEW**

The following mechanical assemblies are discussed in this section, refer to **Figure 1** as a location guide for the assemblies:

- Horizontal Cross Arm Bearings and Brake Assembly
- <u>C-Arm Rear Capture Bearings and Brake Assembly</u>
- Flip-Flop Assembly
- <u>Wig-Wag Brake Assembly</u>
- Front and Rear Steering Assemblies
- L-Arm Rotation Assembly
- Vertical Lift Assembly



## HORIZONTAL CROSS ARM

### **OVERVIEW**

The Horizontal Cross Arm assembly allows the forward mechanics to be manually extended approximately 8 inches (20 cm). Extension and retraction can be accomplished by releasing the cross arm brake, grasping the handle mounted at the end of the cross arm and manually positioning the cross arm in the desired location.

Position indicator labels that indicate the length of extension can be found on two recessed areas of the cross arm. Tick marks indicate each centimeter and numbers occur in 5 cm increments to a maximum of 20 cm.

### HORIZONTAL CROSS ARM BRAKE

The Horizontal Cross Arm brake may be engaged to prevent the cross arm from moving. When the brake is engaged a brake pad restricts movement of a bearing in the Cross Arm Housing which in turn prevents the cross arm from moving. Refer to Figures 1 and 2.

To remove the brake, perform the following:

- 1. Remove the hole plug.
- 2. Remove 1 Torx screw securing the Cross Arm Brake Handle.
- 3. Remove 2 Torx screws from the bottom of the Cross Arm Lower Cover.
- 4. Lift the Cross Arm Center Cover up carefully and set aside.
- 5. Remove 4 Torx screws that secure the Cross Arm Brake Mount to the housing.
- 6. Remove the Cross Arm Brake Pad.



Figure 2 - Horizontal Cross Arm Brake Assembly

## **ROBOT CABLE ASSEMBLY**

The robot cable routes 115 VAC to the L-arm Rotation Motor. The robot cable is routed from the Power/Signal Distribution PCB or Column I/O PCB, through the hollow Horizontal Cross Arm, to the L-arm Motor Power PCB.

When the robot cable leaves the Power Signal/Distribution PCB or Column I/O PCB it enters the horizontal cross arm through a plate that has been designed to slide in a slot cut in the bottom of the Horizontal Cross Arm.

When the cross arm is extended and retracted through the Cross Arm Housing the plastic plate slides in the slot and thus prevents damage to the robot cable due to mechanical stresses and friction.



### **MECHANICAL STOPS**

The cross arm has mechanical stops mounted in the Cross Arm to limit motion. The mechanical stops consist of metal screws mounted in the Cross Arm itself and polyurethane plugs mounted in the Cross Arm Housing. The polyurethane plugs absorb the shock when the Cross Arm is fully extended or fully retracted.

Perform the following to replace a polyurethane plug in the Cross Arm Housing:

- 1. Remove the Control Panel Housing.
- 2. Remove the plug using a pair of vise grips. Twist the plug out of its mounting (they are glued).
- Replace the plug leaving approximately 1/2 inch exposed. Use Loctite Black Max ZZLAH, OEC P/N - 88-299614-00.

### **CROSS ARM SHAFT & L-ARM DRIVER ASSEMBLY**

Refer to Figures  $\underline{4}$  and  $\underline{5}$ .

- CAUTION: Do not separate the Horizontal Cross Arm and the L-arm Driver Assembly in the field due to the precision mechanical adjustments required during reassembly.
- WARNING... Electrical circuits inside the equipment use voltages that are capable of causing serious injury or death from electrical shock. Use appropriate precautions.

## **NOTE:** The L-arm motor, limit switches, L-arm Motor Power PCB & capacitor may be replaced individually.

- 1. Remove the L-Arm and forward mechanics as described in the L-Arm Rotation Assembly heading of this section of the manual.
- 2. Disassemble the Control Panel Assembly by performing the following:
  - A. Remove the hole plug and Torx screw securing the Cross Arm Brake Handle.
  - B. Remove the Cross Arm Brake Handle.
  - C. Remove 2 Torx screws from the bottom of the Cross Arm Lower Cover.
  - D. Carefully lift the Cross Arm Center Cover and set aside.
  - E. Remove the Control Panel Side Covers.

- F. Remove the metal covers and circuit boards from the top of the cross arm housing.
- G. Disconnect necessary cabling. Make note of orientation for reassembly.
- 3. Disconnect cabling from the Power/Signal Distribution PCB or Column I/O PCB and remove the PCB from the side of the Cross Arm Housing.
- 4. Remove the tie wraps securing the cabling to the side of the Cross Arm Housing.

#### NOTE: It is necessary to remove the snap rings from the top rear roller bearing and move the bearing from side to side to access 2 of the hex bolts in the next step.

#### CAUTION: Ensure that the cross arm is fully retracted while removing the 4 hex bolts that secure the Control Panel Housing to the Vertical Column Flange. The L-arm Driver Assembly weighs approximately 60 lbs and the weight is not balanced on the flange.

- 5. Remove 4 hex bolts securing the Control Panel Housing to the Vertical Column Flange.
- 6. Remove the Cross Arm Housing and L-arm Driver Assembly and place the assembly on it's side.
- 7. Remove the two Torx head screws securing the round metal flange in the bottom of the Cross Arm shaft and remove the round metal flange.
- 8. Disconnect the wires from the TB1 Terminal block on the L-arm Motor Power PCB. Refer to the Interconnect Schematic when rewiring.
- 9. Pull the robot cable through the Cross Arm shaft.
- 10. Disconnect the limit switches by removing 2 allen head screws from each limit switch.

#### NOTE: Pull the motor away from the rubber motor mount as you are backing out the flat head screws. This will increase the space required for the allen ball drivers.

11. Remove 4 flat head bolts securing the L-arm Rotation Motor to the L-arm gear box and remove the L-arm Rotation Motor, Limit Switches, and metal bracket as an assembly.

### NOTE: Use Loctite 222 when reassembling.

12. Use a center punch to drive the pin in the Cross Arm Handle out, and remove the handle.

## HORIZONTAL CROSS ARM BEARING ADJUSTMENT

The following bearing assemblies in the Cross Arm Housing can be adjusted to remove any binding or loose play of the cross arm travel:

- Lower rear bearings
- Upper front bearings
- Right front bearings
- Left rear bearings

The Control Panel covers and circuit boards must be removed to make the adjustments. To adjust the bearing assemblies, perform the following:

- 1. Loosen the accompanying set screw.
- 2. Place the screwdriver in the slot at the end of the shaft and turn the shaft until the there is .003" clearance between the bearing and the Cross Arm.
- 3. Use Loctite 222 and re-tighten the set screw.
- 4. Check for smooth travel of the Cross Arm.



Figure 4 - Control Panel Disassembly



Figure 5 - Cross Arm and L-Arm Assemblies



## **FLIP FLOP ASSEMBLY**

### **OVERVIEW**

The Flip Flop allows the C-arm to be rotated 180° clockwise or counter clockwise. This movement "flips" the position of the C-arm and allows for A/P (Anterior/Posterior) Lateral positioning.

The C-arm connects to the Mobile C-Arm via the Flip Flop assembly and the rear capture bearing design. The rear capture design consists of 8 axial roller bearings and 8 radial roller bearings. These bearings ensure smooth axial and radial movement of the C-Arm in relation to the Flip Flop assembly. The Flip Flop bearings require no lubrication.

## **C-ARM REMOVAL**

## WARNING... Observe safety procedures when operating motorized mechanical features.

Electrical circuits inside the equipment use voltages that are capable of causing serious injury or death from electrical shock. Use appropriate precautions.

- 1. Rotate the L-arm until the C-arm is parallel with the floor and then rest the Carm on a gurney. Be sure that the assembly is fully supported without any binds or stress on any of the welded seams.
- 2. Turn the Workstation keyswitch to the **OFF** position.

### CAUTION: Attempting to remove the "C" by removing the X-ray Tube and Collimator and then sliding the "C" out of the nylon rollers in the Flip Flop assembly could result in severe damage to the nylon rollers..

- 3. Remove 4 hex screws that secure the metal plate behind the Flip Flop pivot, of the L-arm.
- 4. Bend the washer fingers out and then using the Flip Flop spanner wrench loosen and remove the Flip Flop nut.
- 5. Back the gurney away and separate the Flip Flop Assembly from the L-arm.
- 6. Remove the X-ray Tube and Collimator.
- 7. Slide the Flip Flop Assembly off the end of the C-arm.
- 8. After reassembling, perform the Beam Alignment Test procedure contained in the **Image System Calibration** section of this manual.

### FLIP FLOP BRAKE

A friction brake is located in the neck of the Flip Flop assembly. Handles are located on both sides of the Mobile C-Arm. The brake is used to prevent Flip-Flop movement.

The Flip Flop brake pads rest inside the neck of the L-arm and can be removed easily once the Flip Flop Assembly has been removed.

### **Brake Adjustment**

If the end of the brake handle moves more than 2-1/2-inches before brake tension is felt, turn set screws (located above the brake handle) 1/8 to 1/4 turn clockwise and retest.



Figure 6 - Flip Flop Assembly

## **C-ARM BEARINGS AND BRAKE**

### **OVERVIEW**

The C-arm connects to the Mobile C-Arm via the Flip Flop assembly and the rear capture bearing design. The C-arm is manually positioned on its radius and the brake, when engaged, prevents radial C-arm movement.

The rear capture design consists of 8 axial roller bearings and 8 radial roller bearings. These bearings ensure smooth axial and radial movement of the C-Arm in relation to the Flip Flop assembly.

## **C-ARM BRAKE**

The cam-levered C-arm brake is contained in the Flip Flop Assembly. Remove the C-arm as described in the Flip Flop Assembly. Separate the Flip Flop from the C-arm to inspect the brake.

### **REAR CAPTURE C-ARM BEARINGS**

The axial and radial bearings are contained in the Flip Flop Assembly. Remove the C-arm as described in the Flip Flop Assembly heading of this section of the manual. Separate the Flip Flop and C-arm from the L-arm and then separate the Flip Flop from the C-arm. Inspect nylon rollers for cracks or excessive wear. Check for smooth bearing operation. Repair or replace bearings and nylon rollers as required.



Figure 7 - Arm Rear Capture Bearing and Brake Assembly

## WIG WAG BRAKE ASSEMBLY

### **OVERVIEW**

The Wig Wag Assembly allows the forward mechanics to move sideways  $11^{\circ}$  in either direction.

The Wig Wag Assembly should not move when the friction brake is fully engaged. The Wig-Wag brake is non-binding and is easily released and engaged. The brake design allows the user to partially engage the brake for ease of use or fully engage the brake to prevent travel.

The Wig Wag assembly does not have any marked or labeled position indicators.

### WIG WAG BRAKE ADJUSTMENT

If the brake fails to lock the forward mechanics in position (e.g. the brake handle turns without engaging the brake) perform the following:

- 1. Remove the Hole Plug and remove the screw in the brake handle. Remove the Wig Wag brake handle.
- 2. Loosen the set screw.
- 3. Using a standard screwdriver turn the actuator screw approximately 1/4 turn counter-clockwise.
- 4. Reassemble and functionally test the brake.
- 5. If this adjustment fails, disassemble the Wig Wag assembly and inspect the washers and brake pad. Check for worn or damaged parts.

### **CONTROL PANEL HOUSING REMOVAL**

The Control Panel Housing must be removed before the Wig Wag Assembly can be accessed.

### WARNING... Electrical circuits inside the equipment use voltages that are capable of causing serious injury or death from electrical shock. Use appropriate precautions.

- 1. Turn the Workstation keyswitch to the **OFF** position.
- 2. Remove the Hole Plug and 1 Torx screw securing the Cross Arm Brake Handle.
- 3. Remove 2 Torx screws from the bottom of the Cross Arm Lower Cover.
- 4. Lift the Cross Arm Center Cover up carefully and unplug switch wiring on the Control Panel Processor PCB and the Distribution PCB.
- 5. Remove 4 Torx screws securing the Cross Arm Lower Cover and lower the cover so that the Wig Wag Assembly can be accessed.
- 6. Remove the Hole Plug from the bottom of the Wig Wag brake handle and loosen the screw.
- 7. Remove the Wig Wag brake handle.
- 8. Remove 2 flathead Allen screws in the bottom of the retaining plate and remove the retaining plate.
- 9. Loosen the set screw.
- 10. Turn the actuator screw clockwise using a standard slotted screwdriver until the brake assembly can be removed.




## STEERING

## **OVERVIEW**

The 9600 Mobile C-Arm is supported by four wheels with offset casters. This includes two front wheel casters and two rear wheel casters. In addition there is a balance wheel located underneath the battery tray that will prevent the Mobile C-Arm from tipping backwards while transporting the system over an incline.

Four possible versions of the rear caster may be found in the field. The original Surgi-glide I (-01) with side scan installed, an interim Surgi-glide version that had side scan removed (-02), a third version (-03) with side scan reinstalled and the latest version, Surgi-glide II.

Information concerning older versions will be found in shaded boxes throughout this section.



Figure 9 - Series 9600 C-Arm Rear Caster

## **REAR CASTERS**

Unlike the front wheels the two rear wheels have three modes of operation. All three modes of operation are selected by steering pedals located above each rear wheel. Engaging either pedal drives a cam operated actuator shaft that operates both rear wheels. The following modes of operation are selectable:

**Free Swivel Mode** - allows the rear wheel's casters to move in any direction and the wheels turn freely.

**Steering Mode** -locks the rear wheel casters in the forward steering position or the lateral (side-to-side) steering position. The forward steering position improves tracking down corridors and steering around corners and the lateral steering position improves tracking during side-to-side positioning in the operating room.

**Lock Mode** - locks the caster in its current position and engages a brake pad which stops wheel movement.

#### **Older Versions**

Steering pedals on -01 versions operate in reverse from later versions. A lateral (side-to-side) movement is standard on all systems except the -02 version. The -02 version of the Surgi-glide I steering system does not have side scan.

The lateral (side-to-side) feature may be engaged on rear casters equipped with side scan, by placing the pedal in steering mode while the rear casters are pointed perpendicular to the Mobile C-Arm.

### **FRONT CASTERS**

Two front wheel casters support the Mobile C-Arm and allow movement in any direction, much like a shopping cart. Refer to the <u>Repair Replacement</u> section for an illustration.

### **BALANCE WHEEL**

A balance wheel is located underneath the battery trays. The balance wheel has been designed to prevent the Mobile C-Arm from tipping backwards and pinching an operators foot or toe. Refer to the **Repair Replacement** section for an illustration.

## **GENERAL STEERING TEST**

- Select the LOCK mode by pressing the rear of the steering pedal down. Verify that the casters and wheels are locked in position and do not move. If the casters and wheels do not lock into position, refer to the <u>Repair</u> <u>Replacement</u> section.
- 2. Select the **FREE** steering mode by pressing the front of the steering pedal down until the pedal is level with the floor. Verify that the casters move freely in any direction.
- 3. To select the **STEER** forward mode push the Mobile C-Arm forward until the rear casters have aligned themselves with the forward movement of the C-Arm. Now press the front of the steering pedal down and continue to push the Mobile C-Arm forward. The rear casters will lock in place in this position.
- 4. To select the **STEER** lateral mode, push the Mobile C-Arm sideways, until the rear casters have aligned themselves with the sideways movement of the C-Arm. Now press the front of the steering pedal down and continue to push the Mobile C-Arm sideways. The rear casters will lock in place in this position.

## FRONT WHEEL REMOVAL

- 1. Place the C-arm in the vertical position and engage the C-arm rotation brake. Retract the C-arm through the Cross Arm Housing and engage the Cross Arm brake.
- 2. Back the Mobile C-Arm until the rear casters swing into the backing position, then tilt the Mobile C-Arm onto the balance wheel. Block the front of the Mobile C-Arm chassis.
- 3. Remove the decal from the right side of the caster.
- 4. Unscrew the screw and then remove the wheel. Remove the mounting screw and remove the caster.
- 5. Replace the caster and reassemble. Install new decals.



Figure 10 - Front Wheel Removal (Earlier Style Cable Pushers)



Figure 11 - Front Wheel Removal (Newer Style Cable Pushers)

## **REAR WHEELS**

### **Rear Wheel Brake Adjustment**

### CAUTION: Do not adjust the brake tension with the brake engaged (Lock Mode).

- 1. Release the brake.
- 2. Remove the hole plug.
- 3. With a Torx screwdriver, turn the Torx screw located in the caster, 1/4 turn counter clockwise to increase brake pressure.
- 4. Engage the brake and verify the adjustment was successful. Turn the Torx screw another 1/4 turn if necessary.

### Rear Caster Removal Surgi-glide II

- 1. Elevate and block the wheels approximately 2-1/2-inches off the floor.
- 2. Position the C-arm in the vertical position and engage the C-arm brake. Fully retract the C-arm through the cross arm housing and engage the cross arm
- 3. Remove four 2-inch flathead Allen screws securing each wheel caster and end cap and remove both end caps.
- 4. Remove the 3 Allen head bolts located in each steering mode pedal and remove spring pins from each cam using a spring pin punch.
- 5. Slide the actuator shaft out of the brake housing of the caster assembly being replaced.

### Older Models

This procedure was written for -01 version rear casters. Steps may vary slightly on -02 and -03 version rear casters.

- 1. Position the C-arm in the vertical position and engage the C-arm brake. Fully retract the C-arm through the cross arm housing and engage the cross arm brake.
- 2. Remove two 2-inch flathead Allen screws securing each wheel caster and end cap and remove both end caps.
- 3. Remove 2 Torx screws securing each cross beam cover and remove the cover.
- 4. Put the steering pedal in the LOCK (brake) position and then remove 5 of the 6 Allen head bolts located in the steering pedals and loosen the 6th. Loosen the 2 set screws in each cam by varying the position of the steering pedal. Place the steering pedal in the FREE position and remove the remaining Allen head bolt from the steering pedal. 5. Slide or tap the actuator shaft out of the brake housing of the caster assembly being replaced.

NOTE: Elevating the C-Arm, may first be required, in order to alleviate shaft tension.

- 6. Elevate and block the C-Arm so the wheels are approximately 2-1/2" off the floor.
- 7. Remove the 1/2-inch flathead Allen screw from the caster assembly and remove the caster assembly.

### Wheel Removal Surgi-glide II

- 1. Verify the C-arm is positioned in the vertical position and the C-arm brake is fully engaged. Fully retract the C-arm through the cross arm housing and engage the cross arm brake.
- 2. Elevate and block the C-arm so that the wheel doesn't touch the floor.
- 3. Remove the labels from each side of the caster.
- 4. Remove the axle screw.
- 5. Remove the wheel from the caster.

#### Older Models

This procedure was written for -01 version rear casters. Steps may vary slightly on -02 and -03 version rear casters.

- 1. Verify the C-Arm is positioned in the vertical position and the C-Arm brake is fully engaged. Fully retract the C-arm through the Cross Arm Housing and engage the Cross Arm brake.
- 2. Elevate and block the C-Arm so that the wheel doesn't touch the floor.
- 3. Remove the labels from each side of the caster.
- 4. Remove the axle screw and axle nut.
- 5. Remove the wheel from the caster.

### Wheel Replacement Surgi-glide II

- 1. Position the wheel inside the caster and connect the Axle Screw. Use
- 2. Re-label each side of the caster.
- 3. Remove the blocks and lower the C-arm to the floor.
- 4. Check the brake.

### Older Models

This procedure was written for -01 version rear casters. Steps may vary slightly on -02 and -03 version rear casters.

- 1. Position the wheel inside the caster and connect the Axle Screw and the Axle Nut. Use Loctite 242.
- 2. Re-label each side of the caster.
- 3. Remove the blocks and lower the C-arm to the floor.
- 4. Check the brake.

### Rear Caster Replacement Surgi-glide II

- 1. Insert the caster into the Cross Beam with the cam stop pin toward the rear.
- 2. Insert the actuator shaft through the pedals, outer support block, and the cams in the brake housing.
- 3. Install the spring pin through each cam and actuator shaft.
- 4. Install four 2-inch Allen screws through the caster and cross beam, into the end cap. Use Loctite 242.

### NOTE: The pedals should be installed with the lock icon towards the back of the Mobile C-Arm. The cam lobes should also point towards the front of the Mobile C-Arm.

5. Install 3 Allen head screws into the bottom of the pedal using Loctite 242. Position the pedal within 1/16 inch of the end cap and then secure the 3 Allen head screws.



Figure 12 - Rear Caster Asm (Surgi-glide II)

#### **Older Models**

This procedure was written for -01 version rear casters. Steps may vary slightly on -02 and -03 version rear casters.

- 1. Insert the caster into the Cross Beam with the open end of the slot facing forward.
- 2. Install the 1/2-inch Allen screw through the caster and into the cross beam using Loctite 242.

NOTE: The pedals should be installed with the lock icon towards the front of the Mobile C-Arm. The cam lobes should also point towards the front of the Mobile C-Arm. Ensure the cam follower and shim are installed in the new caster assembly before proceeding.

- 3. Insert the actuator shaft through the pedals, outer support block, and the cams in the brake housing.
- 4. Loosely install one Allen head screw into the bottom of one pedal. Place the steering pedal in the LOCK (brake) position. Position each pedal within 1/32" of the outer support block. Install the other five Allen head screws and reinstall the first using Loctite 242.
- 5. Rotate the pedal to the FREE position and center the cam within the brake housing. Install the top cam set screw on each cam using Loctite 222. Rotate the pedal to the LOCK position and install the rear cam set screw in each cam using Loctite 222.
- 6. Place the steering pedal in the FREE, LOCK, and STEER positions and test for proper operation.

## NOTE: The rear wheel brake adjustment may need to be performed on the new caster assembly.

- 7. Reinstall the Cross Beam Covers with the Torx screws.
- 8. Reinstall the End Caps with the 2-inch flathead Allen screws using Loctite 242.



Figure 13 - Old Rear Caster (-01)

### Shim Adjustment

#### **Older Models**

This procedure was written for -01 version rear casters. Steps may vary slightly on -02 and -03 version rear casters.

- Install a 1/4 20 x 2-1/4-inch (1-inch minimum thread) bolt into the threaded hole on the top of the brake housing. This bolt is used for positioning only and will be referred to as the "positioning bolt."
- 2. Access the cam followers via the backside of the brake housing by placing the pedals in the Steering Lock position. Then clamp the upper swivel lock in position by tightening the positioning bolt.
- 3. Install the Cam Follower and the Shims.
- 4. Loosen the positioning bolt several turns.
- 5. Carefully rotate the pedal towards the locked position to check for proper shimming. If there is too much shim thickness the pedal will not rotate easily into this position.
  - A. Do not force the pedal into this position or the cam follower may be damaged.
  - B. Proper shimming has been obtained when there is no free play or preload between the upper and lower swivel locks and minimal free play in the caster swivel rotation.
  - C. When peeling shims; peel the shim from the round side and discard the shim that was peeled off.
- 6. Remove the 1/4" positioning bolt.
- 7. Remove the temporary 5/16-inch nuts and install the End Caps using Loctite 242.

## **BALANCE WHEEL REMOVAL**

### WARNING... Electrical circuits inside the equipment use voltages that are capable of causing serious injury or death from electrical shock. Use appropriate precautions.

- 1. Verify that the Workstation keyswitch is turned to the **OFF** position and the AC power plug is disconnected from the wall receptacle.
- 2. Remove the Rear Handle Cover Assembly by removing 3 screws located behind the assembly door and one screw on each side.
- 3. Remove the Front Cover by removing 2 screws near the top of the vertical shaft.
- 4. Remove the Right Front Cover by removing the 3 screws securing the cover to the Mobile C-Arm.



5. Turn circuit breaker CB1 to the **OFF** position.

### Figure 14 - Balance Wheel Removal

6. Cut the cable tie that secures the wiring near CB1 and unplug the battery connectors.

### WARNING... The batteries are capable of delivering high currents at high voltages and should be considered fully charged at all times. Remove jewelry such as rings and watches when working around dangerous voltages.

- 7. Remove the spacer from the top of the right battery pack.
- 8. Lift the battery pack straight up and then pull the pack straight out.
- 9. Elevate the Mobile C-Arm approximately 4 inches from the floor.
- 10. Remove the bolt (axle) and balance wheel.

## L-ARM ROTATION ASSEMBLY

### **OVERVIEW**

L-arm Rotation is accomplished using an AC motor with a worm drive. Limit switches are provided to stop L-arm Rotation at approximately 365 degrees (stop-to-stop). An L-arm Rotation scale is provided that indicates the L-arms position relative to the vertical and horizontal plane. Zero degrees of rotation have occurred when the L-arm is in the vertical position near the floor. Tick marks on the scale indicate every 15 degrees of rotation and numbering indicates every 90 degrees.

### **DURING BOOT SEQUENCE**

During the Mobile C-Arm boot sequence the +24V Interlock circuit completes, energizing relay K3 on the Power Motor Relay PCB. When K3 is energized 115 VAC PH is routed to L-arm rotation relays K5 and K6 on the Power/Motor Relay PCB. The +24 VDC is also routed to relays K5 and K6 for their control by the switches located on top of the control panel housing.

## **CLOCKWISE ROTATION**

When the L-arm rotation clockwise (CW) switch is pressed the +24 VDC at K6 pin 8 completes a circuit to the DC return line (pin 1) and energizes relay K6. When K6 is energized 115 VAC is switched (pin 5 to pin 6) to the L-arm rotation motor via the Power/Signal Distribution PCB and the L-Arm Motor Power PCB. At the same time, +24 VDC is removed from pin 8 of K5, the counter clockwise (CCW), relay to prevent damage to the motor in case both switches were accidentally pressed at the same time.

## **COUNTER-CLOCKWISE ROTATION**

When the L-arm rotation counter clockwise (CCW) switch is pressed the +24 VDC at K5 pin 8 completes a circuit to the DC return line (pin 1) and energizes relay K5. When K5 is energized 115 VAC is switched (pin 5 to pin 6) to the L-arm rotation motor via the Power/Signal Distribution PCB and the L-Arm Motor Power PCB. At the same time, +24 VDC is removed from pin 8 of K6, the CW relay, to prevent damage to the motor in case both switches were accidentally pressed at the same time.

## **FORWARD MECHANICS**

If the L-arm bearings are suspect the Horizontal Cross Arm and the L-arm Driver Assembly should be replaced as an assembly. The L-arm motor, limit switches, L-arm Motor Power PCB & capacitor may be replaced individually if they fail. Refer to Figure 15.

## CAUTION: Due to the weight of the forward mechanics it is recommended that two people perform this procedure together.

# WARNING... Electrical circuits inside the equipment use voltages that are capable of causing serious injury or death from electrical shock. Use appropriate precautions.

- 1. Turn the Workstation keyswitch to the **OFF** position and disconnect the AC plug from the wall receptacle.
- 2. Disconnect the Interconnect cable from the Mobile C-Arm.
- 3. Place the steering pedal in the **FREE** position so that the Mobile C-Arm can be moved sideways.
- 4. Remove the L-Arm handle by removing two hex bolts.
- 5. Remove the L-Arm end cap by removing the L-Arm Rotation Scale label and Scale ring.
- 6. Using a large standard screwdriver rotate the worm gear until the forward mechanics are parallel with the floor.

### CAUTION: Make sure the forward mechanics are evenly balanced and will not fall from the supporting surface when the L-arm Drive Assembly is withdrawn from the L-arm casting. Be sure that the assembly is fully supported without any binds or stress on any of the welded seams.

- 7. Rest the forward mechanics on a flat surface such as a gurney or table (pad the surface if necessary to prevent scratching the paint).
- 8. Remove 3 large hex bolts securing the L-arm casting and forward mechanics to the L-arm Drive Assembly
- 9. Push the Mobile C-Arm sideways and slide the casting off the drive assembly, being careful not to damage the wiring to the L-arm motor.
- 10. With the L-arm Drive Assembly exposed individual components such as the motor, limit switches and PCBs may be removed.
- 11. With the L-arm Drive Assembly exposed, individual components such as the rotation motor, limit switches, and L-Arm Motor Power PCB can be removed.

## **CROSS ARM SHAFT & L-ARM DRIVER ASSEMBLY**

Refer to the <u>Horizontal Cross Arm heading</u> in this section of the manual for information regarding the removal of the Cross Arm Shaft & L-Arm Driver Assembly





## **VERTICAL COLUMN ASSEMBLY**

## **OVERVIEW**

Raising and lowering of the C-Arm is accomplished by an AC motor that drives two sets of chains, a set (1 horizontal, 1 vertical) on both sides of the vertical column (see Figure 15). The 18 inch travel of the column is restricted at both ends by an upper and lower limit switch. A scale on either side of the column is provided to give an indication of the C-Arm height. Switches on top of the control panel assembly are provided for the operation of the motor.

## INITIALIZATION

During the Mobile C-Arm boot sequence the +24 V Interlock circuit completes, energizing relay K3 on the Power/Motor Relay PCB. When K3 energizes 115 VAC is routed to relays K12 and K13 on the Power Motor Relay PCB. The +24VDC from PS2 is also routed to relays K12 and K13 for their control by the control panel switches located on top of the cross arm housing.

## VERTICAL COLUMN UP

When the Vertical Column lift switch is pressed the +24VDC completes a circuit to the DC return line (pin 1) and energizes relay K12. When K12 is energized 115 VAC is switched (pin 5 to pin 6) to the vertical lift motor via the LIFT\_115 VAC\_B line. At the same time, +24 VDC is removed from pin 8 of K13, the vertical column down relay to prevent damage to the motor in case both switches were accidentally pressed at the same time.

## VERTICAL COLUMN DOWN

When the Vertical Column down switch is pressed the +24VDC completes a circuit to the DC return line (pin 1) and energizes relay K13. When K13 is energized 115 VAC is switched (pin 5 to pin 6) to the vertical lift motor via the LIFT\_115 VAC\_A line. At the same time, +24 VDC is removed from pin 8 of K12 the Vertical Column lift relay to prevent damage to the motor in case both switches were accidentally pressed at the same time.

## **LIMIT SWITCHES**

Two limit switches (LS1 and LS2) are used; one engages near full extension of the Vertical Column and one engages near full retraction. When opened the limit switches remove electrical power from the lift motor and stop the vertical column motion.



Figure 16 - Vertical Column Exploded View

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## **VERTICAL COLUMN MOTOR REPLACEMENT**

Refer to Figure 16.

### WARNING... Circuits inside this equipment contain voltages capable of causing serious injury or death from electrical shock. Observe safety procedures when operating motorized mechanical features.

- 1. Remove the Front Cover, Front Leg Cover and Right Front Cover.
- 2. Turn the Workstation keyswitch to the **ON** position. After the Mobile C-Arm has completed the boot sequence press the Vertical Column switch and raise the Vertical Column approximately 12 inches.
- 3. Block the Vertical Column at the 12-inch height so that the chain linkage is easily accessible through the casting access port.
- 4. Turn the Workstation keyswitch to the **OFF** position.
- 5. Remove PS1 (+5V Power Supply) contained in the forward cavity of the casting.

## **NOTE:** If necessary block the Mobile C-Arm and elevate approximately 3 inches to access the bolt referenced in the next step.

- 6. Release the tension from the horizontal chains by reaching underneath the cabinet with an open ended, 1/2-inch box wrench and loosen the hex bolt approximately 1-1/2-inch.
- 7. Remove 4 hex bolts from the bottom of the casting that secure the motor gear box to the casting.
- 8. Disconnect the Vertical Column motor wiring.
- 9. Remove the horizontal chains from the vertical drive sprockets (be careful not to expose the chains to dirt or debris).
- 10. Remove the motor and the gear box and replace as an assembly.

## **NOTE:** When installing the vertical lift motor tighten the hex bolt until there is 1/8 to 3/16-inch slack in both horizontal chains.

## VERTICAL COLUMN CHAIN REPLACEMENT

### WARNING... Verify that the Workstation keyswitch is in the OFF position.

Observe safety procedures when operating motorized mechanical features.

### Electrical circuits inside the equipment use voltages that are capable of causing serious injury or death from electrical shock. Use appropriate precautions.

Refer to Figure 16.

- 1. Remove the Vertical Column motor and horizontal chains (perform the Vertical Column Motor Replacement procedure).
- 2. To remove the left chain perform the following procedure:
  - A. Remove the +24 VDC Power Supply.
  - B. Disconnect wiring harness's P1 and P8 from the Power/Motor Relay PCB.
  - C. Remove Torx screws (4 screws total) from all four corners of the Power Panel mounting assembly to expose the left Vertical Column chain.
  - D. Loosen the chain tension screw until there is sufficient slack to loosen the 2 hex bolts that secure the upper chain coupling to the vertical column.
  - E. Remove the upper sprocket access plate by removing 2 horizontal support pins secured with snap rings and the 4 outside hex bolts that secure the plate to the casting.
  - F. Remove the master links from both ends of the chain and remove the chain.
- 3. To remove the right chain perform the following procedure:
  - A. Loosen the chain tension screw until there is sufficient slack to remove the master links from both ends of the chain.
  - B. Remove the upper sprocket access plate by removing 2 horizontal support pins secured with snap rings and the 4 outside hex bolts that secure the plate to the casting.
  - C. Remove the master links from both ends of the chain and remove the chain.
- 4. When installing either chain perform the following:
  - A. Route the chain over the top and bottom sprockets and reattach the chain to the chain coupling with the master links.

### WARNING... Do not over tension either the vertical or horizontal chains.

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### WARNING... Do not over tension either the vertical or horizontal chains.

- B. Tighten the tension screw until chain tension is proportional between the left and right chain.
- C. Tighten the hex bolts on the upper chain coupling.
- D. Remove the vertical column block and operate the vertical column until the upper limit switch is reached.
- E. Press the forward portion of the exposed vertical chain with your index finger and verify that there is 1/4 1/2-inch of chain tension.
- F. Press the bottom portion of the exposed horizontal chain with your index finger and verify that there is 1/4 1/2-inch of chain tension.

## **LIMIT SWITCHES**

## WARNING... Circuits inside this equipment contain voltages capable of causing serious injury or death from electrical shock.

## Observe safety procedures when operating motorized mechanical features.

- 1. Turn the Workstation keyswitch to the **OFF** position.
- 2. Remove the Front Cover, Front Leg Cover and Right Side Cover.
- 3. Access the limit switches through the front casting access port. Remove either limit switch by performing the following:
  - A. Disconnect the limit switch wiring and remove 2 Allen screws securing the limit switch.
  - B. Remove the limit switch

### **UPPER ROLLER BEARING**

## WARNING... Circuits inside this equipment contain voltages capable of causing serious injury or death from electrical shock.

## Observe safety procedures when operating motorized mechanical features.

- 1. Remove the Front Cover, Left Side Cover and Right Side Cover.
- 2. Check the roller bearing surface for flat spots, irregularities, and abnormal wear.

- 3. Remove the preload from the upper roller bearing by lowering the forward mechanics onto a sturdy surface.
- 4. Remove the snap ring on the roller bearing and pull the pin out of the side and the roller out of the front.

## IMAGE SYSTEM

## **OVERVIEW**

The following components produce the video signal used by the Image Processor. This section describes their operation and in addition, describes the <u>ABS (Automatic</u> <u>Brightness System)</u> circuit.

- Image Function PCB
- Iris Collimation and Leaf Control
- Image Intensifier
- <u>CCD Camera</u>

The information given in this section is most easily understood while referencing the following schematics from the schematic manual. Use the correct schematics and diagrams for your system.

#### C-Arm Interconnect Diagram

Schematic # 00-875500 - System S/N 69-0001 thru 69-1000 Schematic # 00-877972 - System S/N 69-1001 thru 69-2000 Schematic # 00-878376 - System S/N 69-2001 and higher

#### Image System Interconnect Diagram

Schematic # 00-875410 - System S/N 69-0001 thru 69-1000 Schematic # 00-877971 - System S/N 69-1001 thru 69-2000 Schematic # 00-878377 - System S/N 69-2001 and higher

#### Workstation Interconnect Diagram

Schematic # 00-876158 - System S/N 69-0001 thru 69-1000 Schematic # 00-877970 - System S/N 69-1001 thru 69-2000

#### Technique Processor PCB

Schematic # 00-876735 - System S/N 69-0001 thru 69-1000 Schematic # 00-877742 - System S/N 69-1001 thru 69-2000

Analog Interface PCB

Schematic # 00-876738 - All S/N

Power/Motor Relay PCB

Schematic # 00-875997 - All S/N

#### Mainframe Motherboard

Schematic # 00-875539 - System S/N 69-0001 thru 69-2000 Schematic # 00-878396 - System S/N 69-2001 and higher

#### **Image Function PCB**

Schematic # 00-874750 - System S/N 69-0001 thru 69-2000 Schematic # 00-878398 - System S/N 69-2001 and higher

#### Pixel/Column Filter PCB

Schematic # 00-878045

#### **Pixel Filter PCB**

Schematic # 00-877789

Auxiliary Interface PCB

Schematic #00-876502 - All S/N

**AT Communications PCB** 

Schematic #00-872125 - All S/N



THE CIRCUIT BOARDS IN THE CARD RACK MAY RESULT IN DAMAGE TO ELECTRONIC ASSEMBLIES. THE CIRCUIT BOARDS MUST BE INSTALLED AS FOLLOWS:

IMAGE FUNCTION - TOP TECHNIQUE PROCESSOR - MIDDLE ANALOG INTERFACE - BOTTOM

## **IMAGE FUNCTION PCB**

#### S/N 69-0001 thru 69-2000 - Asy. #00-874752 - Sch. #874750

#### S/N 69-2001 and up - Asy. #00-878400 - Sch. #878398

There are two versions of the Image Function PCB (see Figures 1, 3, and 4). On systems with serial numbers up to 69-2000, the Image Function PCB is located under the CCD camera cover. On systems with serial numbers 69-2001 and higher it can be found in the generator card rack with the Technique Processor and Analog Interface PCB. The two boards are not interchangeable.

There are different revisions of the earlier PCB that is located by the CCD camera. This is indicated by the dash number (-03 and -01) on the first sheet of the schematic. The main difference is that the older (-01) Image Function PCB does not have a +5V voltage regulator which prevents this board from working with a camera assembly that uses a **Pixel/Column Filter PCB**.

The purpose of the Image Function PCB is to control the collimator motors, CCD camera, and the Image Intensifier. The control of these items is determined by user input at the control panel (see Figure 2 below). When a selection is made at the control panel, the switch closure is interpreted by the Control Panel Processor PCB. This information is communicated to the Technique Processor PCB which communicates the commands to the Image Function PCB. See the <u>C-Arm Control</u> section for more information on serial communications.



Figure 2 - Control Path for Image System Function

### MICROCONTROLLER

U16 is a CHMOS 16 bit 80C196KC microcontroller. The 8 MHz. reference is provided by crystal oscillator Y1. LED DS1 blinks on and off during normal operation providing a visual indication that the microcontroller is operating and executing code.

Port 3 (pins 53-60) of the microcontroller is a multiplexed address/data bus. U12 latches the low address byte (A0-A7) on the falling edge of ALE, address latch enable (pin 62 of U16). Port 4 (pins 45-52) is permanently selected for the high address byte (A8-A15) by grounding the signal "BUSWIDTH" (pin 64 of U16).

## **EPROM**

U15 is a 32K x 8 EPROM programmed with operating code for the microcontroller.

## GAL

U13 is a GAL (gate array logic) used in address decoding to provide the chip select (CS) signals for the following:

EPROM - U15 EEPROM - U7 SRAM - U10 INPUT LATCH - U14 OUTPUT LATCH - U6 MOTOR LATCH - U11

## **STATIC RAM**

U10 is a 32K x 8 static ram, used by software for storage of variables. It was added to enhance the amount of memory available for the microcontroller.

## EEPROM

U7 is a 2K x 8 EEPROM used to store the calibration data for the Normal, MAG1, and MAG2 field sizes of the collimator iris. E5 is used in the iris calibration procedure. Details of this circuitry are discussed in the <u>Collimator Motors</u> and <u>Collimator Iris</u> <u>Calibration</u> sections that follow.

## WATCHDOG

U8 provides the reset and "Watchdog" functions. Microcontroller U16 is reset when pin 16 is pulled low during power-up, power-down and during low-voltage brown-out conditions. Pin 7 of U8 is toggled by the output of microcontroller U16 pin 23 every 150 ms to prevent the watchdog from timing out. If a software failure should cause the watchdog to time-out, the reset output from U8 pin 6 will go low for 250 ms and reset the microcontroller. The Master Reset signal (MRESET\*) from the Technique Processor PCB can also initiate a reset. This would occur if the reset switch on the Technique Processor PCB was pressed. Jumper E8 is removed only in the factory for testing and must be in place for proper operation.

### **INPUT/OUTPUT**

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U17 and U19 are RS232 driver/receivers. The Image Function PCB receives its operating instructions at U17 pin 9 (IFBRX), it transmits information at U17 pin 19 (IFBTX). The CST (Clear to Send) and RST (Request to Send) signals are not used. The signal "Integrate" is input to U19 pin 12 and output at pin 11. This signal is discussed under the "Camera Controls" heading. The other inputs, S0, S1, S2, S4, MOTORDIR, MOTOREN, and LATCH are not used.





### Image System



Figure 4 - Image Function PCB - System S/N 69-2001 and higher

## **COLLIMATOR**

## **OVERVIEW**

The iris collimator is located under a cover as shown in <u>Figures 1</u> and <u>10</u>. It has three motors (see Figure 5 below):

- Collimator iris
- Leaf rotation
- Leaf in/out

The operator drives a motor by pressing the desired key on the control panel. The controls shown in the left column of Table 1 are provided on both the left and right C-Arm control panels (see Figure 6).

When an image field size is selected with "NORMAL," "MAG1," and "MAG2," the collimator iris is opened or closed to match the selected field size. The image intensifier receives commands at the same time and adjusts for the selected field. Information on the image intensifier is covered after the collimator section.

The iris motor has a potentiometer mechanically linked to it that provides feedback for indication of iris size. The iris size may be adjusted independently of the "MAG" size, but it cannot be adjusted to exceed the selected field size.

Controls are also provided to open, close, and rotate a pair of semi-transparent copper leaves that provide further collimation of the X-ray beam.



Figure 5 - Iris Collimator



Figure 6 - Field Size and Collimation Controls on C-Arm Control Panel

| Control          | Description  | Components Affected |
|------------------|--------------|---------------------|
| NORMAL           | 9-inch field | Collimator & Image  |
|                  |              | Intensifier         |
| MAG1             | 6-inch field | Collimator & Image  |
|                  |              | Intensifier         |
| MAG2             | 4-inch field | Collimator & Image  |
|                  |              | Intensifier         |
| Collimation Iris | Open & Close | Collimator          |
| Collimation      | Open & Close | Collimator          |
| Leaves           |              |                     |
| Leaf Rotation    | Rotate       | Collimator          |

Table 1 - Controls for Image Magnification and Collimation

### **IRIS MOTOR**

The collimator iris motor is driven by the Image Function PCB when the field size (e.g. NORM, MAG, MAG2) is changed or when the iris size is adjusted with the iris control switch (see Figure 6). U17 on the Image Function PCB receives the commands from the Technique Processor. Microcontroller U16 receives the instructions and communicates the data to U11, the Motor Driver PLD (programmable logic device).

U11 then enables and drives the iris motor in the desired direction via U18, the motor driver IC for the collimator iris motor. See <u>Table 2</u> and <u>Figure 7</u> for details of the drive logic.

Motor speed is varied by pulse width modulation (PWM), output from microcontroller U16, pin 39 (PWM0) to the Motor Driver PLD, U11 pin 11. Pulse width modulation is used instead of direct DC driving so that collimator iris sizing is accomplished more efficiently without "hunting" by overcorrecting and then re-correcting.

The iris motor has a potentiometer mechanically linked to it (see Figure 7) that provides feedback for indication of iris size. Micro-controller U16 pin 9 samples the iris position voltage every 10 ms and compares it with values contained in EEPROM U7 on the Image Function PCB. The values stored in EEPROM U7 reflect the iris potentiometer values for the iris field sizes acquired during calibration of the iris (see Collimator Iris Calibration below). When a field size is selected the iris motor is driven until the value of the potentiometer and the value in the EEPROM match for the selected field size.

If an error, such as the iris size being too large for the selected field, is detected the micro-controller sets the IF\_FAULT signal U6-18 high. If U6-18 is high then DS2 illuminates indicating an error condition. In addition a status word sent via RS-232 serial communication to the Technique Processor PCB every second by the Image Function PCB will indicate there has been an error. The fault line from U5 pin 8 to PIO U38 on the Analog Interface PCB is no longer used by software because of the serial communications.

### **Collimator Iris Calibration**

The collimator iris field sizes are calibrated by using collimator calibration software available on the Mainframe Menu. Jumper E5 is installed and the collimator field sizes are set using the collimator iris controls on the control panel. The calibration information obtained from the voltages from the iris potentiometer (IRIS SIGNAL) are stored in EEPROM U7 on the Image Function PCB. See the <u>Image System Calibration</u> section of this manual for the procedure to perform this calibration.

| Input 1 | Input 2 | Enable | Output 1 | Output  | State                  |
|---------|---------|--------|----------|---------|------------------------|
| Pin 2   | Pin 7   | Pin 1  | Pin 3    | 2 Pin 6 |                        |
| L       | L       | Н      | L        | L       | Motor Off - Brake Mode |
| L       | Н       | Н      | L        | Н       | Motor On - Open        |
| Н       | L       | Н      | Н        | L       | Motor On - Close       |

Table 2 - Truth Table to Drive Collimator Iris Motor



Figure 7 - Diagram of Iris Motor Drive Path

## LEAF IN/OUT MOTOR

The collimator has a set of semi-transparent copper leaves (or shutter blades) that are driven in and out of the beam by using the leaf sizing controls on the control panel (see <u>Figure 6</u>). U17 on the Image Function PCB receives the commands from the Technique Processor. Microcontroller U16 on the Image Function PCB receives the instructions and communicates the data to U11, the Motor Driver PLD (programmable logic device).

U11 then enables and drives the leaf in/out motor in the desired direction via U4, the motor driver IC for the leaf in/out and leaf rotation motors. See Table 3 and Figure 8 for details of the drive logic.

Motor speed is varied by pulse width modulation (PWM), output from microcontroller U16, pin 39 (PWM0) to the Motor Driver PLD, U11 pin 11. Pulse width modulation control was selected because the speed required to operate the leaf in/out motor alone is different than the speed required to operate it when the leaves are rotating. This is a result of the mechanical linking of these two motors. The software and microcontroller can therefore vary the speed of the collimator motors via the PWM signal.

| Input 1 | Input 2 | Enable | Output 1 | Output  | State                  |
|---------|---------|--------|----------|---------|------------------------|
| Pin 2   | Pin 7   | Pin 1  | Pin 3    | 2 Pin 6 |                        |
| L       | L       | Н      | L        | L       | Motor Off - Brake Mode |
| L       | Н       | Н      | L        | Н       | Motor On - Close       |
| Н       | L       | Н      | Н        | L       | Motor On - Open        |





### Figure 8 - Diagram of Leaf In/Out Motor Drive Path
### LEAF ROTATION MOTOR

The collimator has a set of semi-transparent copper leaves (or shutter blades) that are rotated by using the leaf rotation controls on the control panel (see <u>Figure 6</u>). U17 on the Image Function PCB receives the commands from the Technique Processor. Microcontroller U16 receives the instructions and communicates the data to U11, the Motor Driver PLD (programmable logic device).

U11 then enables and drives the leaf rotation motor in the desired direction via U4, the motor driver IC for the leaf in/out and leaf rotation motors. See <u>Table 4</u> and <u>Figure 9</u> for details of the drive logic.

Motor speed is varied by pulse width modulation, output from microcontroller U16, pin 39 (PWM0) to the Motor Driver PLD, U11 pin 11. Pulse width modulation control was selected because the speed required to operate the leaf in/out motor when operated alone is different than the speed required to operate it when the leaves are rotating. This is a result of the mechanical linking of these two motors.

Relay K3 provides a direct short through its normally closed contacts across the leaf rotate motor to provide a high degree of dynamic braking to the motor when it is not being driven. This is done because the mechanical linkage between the motors will tend to back drive the leaf rotation motor when the leaf in/out motor is driven. When the leaf rotation motor is driven, the shorting path through relay K3 is opened by the output of motor driver U18, pin 14.

| Input 3 | Input 4 | Enable | Output 3 | Output 4 | State                  |
|---------|---------|--------|----------|----------|------------------------|
| Pin 10  | Pin 15  | Pin 9  | Pin 11   | Pin 14   |                        |
| L       | L       | Н      | L        | L        | Motor Off - Brake Mode |
| L       | Н       | Н      | L        | Н        | Motor On - CCW         |
| Н       | L       | Н      | Н        | L        | Motor On - CW          |

Table 4 - Truth Table to Drive Leaf Rotation Motor



IMAGE FUNCTIONS PCB

Figure 9 - Diagram of Leaf Rotation Motor Drive Path

# **COLLIMATOR ERROR MESSAGES**

When a collimator error is detected by the Image Function PCB, the error is communicated to the Technique Processor PCB. The Technique Processor communicates this information to the Control Panel Processor PCB to be displayed on the vacuum fluorescent display. The following error messages are possible.

### Iris Too Large (Collimator)

The collimator iris is too large for the selected field size. The Image Function PCB has compared the potentiometer value stored in the EEPROM during calibration with the present value seen on the iris potentiometer and reported to the Technique Processor that the present value exceeds the stored value.

### Motor Stuck (Collimator Iris)

The Image Function PCB has sensed (via the potentiometer) that the iris motor has not arrived at its selected destination. This can occur anytime the iris motor is being driven. This error could also be caused by the motor moving too slowly.

### Iris Jitter (Collimator Iris)

This error will occur when the iris size drifts away from the selected position and the Image Function PCB must repeatedly make a correction.

### **Bad Iris Pot**

This error indicates erroneous or no values are sensed from the iris potentiometer during boot-up of the system.

### **Bad Iris Cal**

During boot-up, the collimator iris is driven to the maximum and minimum sizes and the potentiometer values are compared with those stored in the EEPROM. This error occurs when the values from current behavior do not match those saved.

### **IFB Reset**

This error indicates that the Image Function PCB has been reset. This can be caused by U8, the watchdog timer and power monitor on the Image Function PCB.

### **IFB Time-out**

This error indicates that no serial I/O response has been received from the Image Function PCB.

## **COLLIMATOR REPLACEMENT**

- 1. Turn the Workstation keyswitch to the OFF position.
- 2. Remove 2 hole plugs and Torx screws (A) securing the X-ray Tube Cover.
- 3. Remove 2 Torx screws (B) securing the collimator cover.
- 4. Remove collimator cover (C) by sliding forward.
- 5. Loosen 4 Torx head screws and metal clamps (D) located on the lateral sides of the collimator and alignment bracket.
- 6. Turn the metal clamps to the side while holding collimator.
- 7. Lift and remove the collimator off the 2 guide pins on the alignment bracket.
- 8. Unplug the collimator wiring connector and ground wire.
- 9. Remove the 4 screws that secure the collimator alignment bracket if necessary.
- 10. Install in reverse order.
- 11. Check <u>beam alignment</u> and perform alignment procedure if necessary (see <u>Image</u> <u>System Calibration</u> section for procedure).



Figure 10 - Collimator and Alignment Bracket Removal

# **IMAGE INTENSIFIER**

## **OVERVIEW**

The 9600 Mobile C-Arm uses a Thomson tri-mode (9, 6, 4.5-inch or 12, 9, 6-inch) image intensifier. The user selects the mode with the NORM, MAG 1, and MAG 2 keys on the Mobile C-Arm Control Panel as shown in Figure 11 below. The collimator iris is adjusted to the proper field size.

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Figure 11 - Image Intensifier Controls on C-Arm Control Panel

| Control | Description        | Components Affected |
|---------|--------------------|---------------------|
| NORMAL  | 12 or 9-inch field | Collimator & Image  |
|         |                    | Intensifier         |
| MAG1    | 9 or 6-inch field  | Collimator & Image  |
|         |                    | Intensifier         |
| MAG2    | 6 or 4 1/2-inch    | Collimator & Image  |
|         | field              | Intensifier         |

Table 5 - Controls for Image Intensifier Field Size Selection

### **IMAGE INTENSIFIER POWER**

Power to the Image Intensifier is supplied during the boot sequence, after the +24V interlock is complete. The interlocked +24V is placed on the high side of the coil of K7 on the Power/Motor Relay PCB. The return path for the coil is pulled low by the signal "II\_ON" from the collector of Q6 on the Analog Interface PCB. The output at pin 24 of PIO U38 turns on transistor Q6. With Q6 turned on, the ground path is created through the emitter of Q6. K7 is then energized and +24V from PS2 passes through to the image intensifier power supply. The Image Intensifier is turned off during the FILM mode by placing a low at the base of Q6.

# **FIELD SELECTION**

Field size instructions are written over the serial communications link from the Technique Processor to the Image Function PCB. They are input to U17 and then communicated to the microcontroller. The information is sent to the output latch, U6.

The relays K1 and K2 on the Image Function PCB are used to set up the MAG1 and MAG2 field sizes on the Image Intensifier. Both K1 and K2 coils (pin 1) are provided with +24V (+24/II) after K7 on the Power/Motor Relay PCB is energized. The return path for the coils is described below.

### **Normal Mode**

The NORMAL (9") field size is the default at boot-up of the system. Neither K1 nor K2 is activated when the NORMAL mode is selected and the II receives +24V (+24/II) from the Image Function PCB at P4 pin 7 (Asy. #00-874752) or P2 pin 110 (Asy. #00-878400).

### MAG 1 Mode

When MAG1 is selected, output latch U6-15 goes high, turning on transistor Q2. Relay K2 is energized and +24 VDC passes through K2 pins 2 to 4, and through K1 pins 7 to 6, leaving the Image Function PCB at P4 pin 6 (Asy. #00-874752) or P2 pin 5 (Asy. #00-878400). The +24V is then routed to J7 pin 3 for the internal II high voltage power supply where it configures the II for the 6-inch field size. Jumper E1 must be in place for proper operation of the MAG1 and MAG2 field selection.

### MAG 2 Mode

When the MAG2 is selected, output latch U6-14 goes high, turning on transistor Q1. Relay K1 energizes and +24 VDC passes through K1 pins 4 to 2, leaving the Image Function PCB at P4 pin 5 (Asy. #00-874752) or P2 pin 9 (Asy. #00-878400). The +24V is then routed to J7 pin 7 for the internal II high voltage power supply where it configures the II for the 4.5-inch field size. Jumper E1 must be in place for proper operation of the MAG1 and MAG2 field selection.

### IMAGE INTENSIFIER / POWER SUPPLY REMOVAL

WARNING... Image intensifier tubes may implode if struck or subjected to severe mechanical shock. Minimize the risk of injury from flying glass by wearing protective clothing and safety goggles when servicing this component.

Voltages used inside the II are capable of causing serious injury or death from electrical shock. Use appropriate precautions.

# CAUTION: Always wear a properly grounded static protection wristband when working with the CCD camera.

- 1. Verify that the Workstation keyswitch is in the **OFF** position. Refer to Figure 12.
- 2. Remove the 2 screws securing the camera cover (A).
- 3. Remove the Camera and Optics assembly (B). See <u>CCD camera</u> information in this section.
- 4. Remove the Image Function PCB and mounting plate (can be removed as one assembly).
- 5. Disconnect the wiring between the Image Intensifier and the Image Intensifier Power Supply as indicated in <u>Figure 13</u> and <u>Table 6.</u>
- 6. Disconnect the D style connector (+24 VDC, DC/Com, MEDFLD, SMALLFLD).
- 7. Remove the 6 hex bolts (C) securing the Image Intensifier to the C-arm weldment and remove the Image Intensifier from the C-arm.
- 8. Remove the hardware (D) (5 places) securing the power supply to the C-Arm weldment.

### NOTE: When replacing the Image Intensifier assembly it may be necessary to recalibrate the light level at the CCD by calibrating the Camera Iris. Refer to the Camera Iris Calibration procedure in the Image System Calibration Section.

|     | COLOR       | DESCRIPTION        | CONNECTOR |
|-----|-------------|--------------------|-----------|
| Е   | Blue        | Active Getter      | "Fast On" |
|     |             | Cathode            |           |
| PC  | Red         | Tube Photo Cathode | "Fast On" |
| GND | Green/Yello | Ground             | Fork Lug  |
|     | w           |                    |           |
| G1  | Green       | Electrode          | Twist On  |
| G2  | Black       | Electrode          | Twist On  |
| G3  | Black       | Electrode          | Twist On  |
| G4  | Black       | Electrode          | Twist On  |
| А   | White Cable | Anode              | Twist On  |

Table 6 - Image Intensifier Power Supply Wiring







### Figure 13 - Image Intensifier Power Supply Connections

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# **CCD CAMERA**

### **OVERVIEW**

Refer to Figures 1 and 21 for the location of the CCD camera.

The 9600 uses a CCD (Charge Coupled Device) Camera which produces a video signal of the image it receives from the image intensifier output. The CCD sensor is an analog IC that uses an array of photosensitive elements to convert a variety of light levels into a proportional electrical charge. The brighter the light, the greater the electrical charge. Each photo element in the array stores an electrical charge. Electronic circuitry on the CCD camera PCB sequentially shifts these electrical charges to an output gate creating an output signal. The output signal is an analog representation of the image displayed on the output of the I.I. The analog video signal is combined with the sync signals on the CCD PCB, creating a composite video signal. This composite video signal leaves the camera at P2 for processing and display.





### Figure 14 - CCD Camera

# **CAMERA CONTROLS**

The following controls are provided on both the left and right control panels:

| Control        | Description                 | Affected Components |
|----------------|-----------------------------|---------------------|
| Invert/Reverse | Flips Image vertically and  | Image Processor     |
| Image          | horizontally                |                     |
| Rotate Image   | Rotates Image               | Camera Prism Optics |
| Boost Enable & | Enables Pulsed Fluorography | Camera Iris (during |
| Pulse          |                             | exposure)           |

#### **Table 7 - CCD Camera Controls**



Figure 15 - CCD Camera Controls on the C-Arm Control Panel

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### **Invert Image/ Reverse Image**

The invert/reverse image select switch on the Control Panel toggles between four possible states: normal, invert, reverse, and invert/reverse.

Commands to invert or reverse the image are sent to the Technique Processor. The Technique Processor communicates the instruction to the Workstation via the interconnect cable. The Workstation processes the image and displays the results on the left monitor.

### **Camera Rotation**

The camera rotation controls allow the image to be rotated 360 degrees in either direction. The camera rotation motor drives a potentiometer that provides a voltage feedback to the Workstation (via the Analog Interface PCB and Technique Processor PCB). This voltage is used by the image processor to provide a visual indication of camera rotation on the left monitor. As the image is rotated, a pointer icon is displayed with a stop sign icon to indicate the direction of rotation and the approaching end of travel.

### **Boost & Pulse Mode Enable**

The pulsed Fluorography mode is selected when both the Boost and Pulse modes are selected on the control panel. In this mode, the mA can increase up to 40 mA. To accommodate for the extra light output from the Image Intensifier, the camera iris motor will stop down the camera iris during an exposure in this mode.

Boost and Pulse modes may also be operated separately, but the camera iris motor is not driven.

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# **CAMERA ROTATION MOTOR**

The operator drives the camera rotation motor by pressing the desired key on the control panel. The Technique Processor receives this information from the Control Panel Processor PCB and communicates it via U17 to microcontroller U16 on the Image Function PCB. U16 in turn communicates over its data bus to U11, the Motor Driver PLD (programmable logic device). U11 then enables and drives the rotation motor in the desired direction via U3, the motor driver IC for the camera. See <u>Table 8</u> and <u>Figure 16</u> for details of the drive logic.

The rotation motor physically rotates the prism optics assembly inside the camera to achieve the image rotation. One degree of optics rotation will accomplish two degrees of image rotation. The camera motors are not PWM driven like the collimator motors due to the potential for noise in the high gain camera circuits. Motor driver U3 on the Image Function PCB supplies direct current to the camera motors.

The potentiometer linked to the rotation motor is provided with a +10V supply from voltage regulator U1 on the Image Function PCB. As the camera rotation motor turns, the voltage signal (CAMERA \_ROT\_WIPER) from the wiper of the potentiometer will vary between 0 and 6.8 VDC. This voltage is routed to sample mux U3 on the Analog Interface PCB.

It is then converted to a digital value and the Technique Processor communicates this information via serial communications to the image processor on the Workstation. The image processor uses this information to generate the position of the camera rotation icons on the left monitor of the Workstation.

| Input 1 | Input 2 | Enable | Output 1 | Output  | State                  |
|---------|---------|--------|----------|---------|------------------------|
| Pin 2   | Pin 7   | Pin 1  | Pin 3    | 2 Pin 6 |                        |
| L       | L       | Н      | L        | L       | Motor Off - Brake Mode |
| L       | Н       | Н      | L        | Н       | Motor On - CCW         |
| Н       | L       | H      | Н        | L       | Motor On - CW          |

Table 8 - Truth Table to Drive Camera Rotation Motor



Figure 16 - Diagram of Camera Rotation Motor Drive Path

# **CAMERA IRIS MOTOR**

The camera iris motor is driven by software only during boot-up and when the system is in the Pulsed Fluorography mode (boosted pulse). In this mode, the mA can reach as high as 40 mA. To accommodate the extra light output from the image intensifier at this time, the Technique Processor will stop down the iris <u>during</u> the exposure and then open it back up at the termination of the exposure. During boot-up the software will drive the motor to ensure the iris is in its fully open position.

The Technique Processor communicates the instructions via U17 to microcontroller U16 on the Image Function PCB. U16 in turn communicates over its data bus to U11, the Motor Driver PLD (programmable logic device). U11 then enables and drives the iris motor in the desired direction via U3, the motor driver IC for the camera. See <u>Table 9</u> and <u>Figure 17</u> for details of the drive logic.

The voltage signal (CAM\_IRIS\_WIPER) from the wiper of the iris motor potentiometer is not used at this time.

| Input 3 | Input 4 | Enable | Output 3 | Output 4 | State                  |
|---------|---------|--------|----------|----------|------------------------|
| Pin 10  | Pin 15  | Pin 9  | Pin 11   | Pin 14   |                        |
| L       | L       | Н      | L        | L        | Motor Off - Brake Mode |
| L       | Н       | Н      | L        | н        | Motor On - Closing     |
| Н       | L       | Н      | Н        | L        | Motor On - Opening     |

Table 9 - Truth Table to Drive Camera Iris Motor



IMAGE FUNCTIONS PCB

Figure 17 - Truth Table to Drive Camera Iris Motor

# **CCD CAMERA CONTROL SIGNALS**

The Technique Processor communicates camera control signals to the Image Function PCB via RS-232 serial communication, where receiver U17 communicates them to microcontroller U16. From the data bus of U16, the control signals are latched by output latch U6. The signal "Integrate" is the exception. It is sourced from PIO U38 on the Analog Interface PCB, not from serial communications. The following controls and voltages are directed to the camera from the Image Function PCB:

- Integrate
- Unity Gamma
- Anti-Vignetting
- <u>Test Pattern</u>
- +24 Volts
- DC Common
- <u>Cooler +</u>
- <u>Cooler Return</u>

### Integrate

The Integrate function is sent from the Technique Processor PCB to the Analog Interface PCB via the micro-computer bus. PIO U38 pin 40 on the Analog Interface PCB outputs the signal to U26 pins 12 and 13. U26 pin 11 buffers the output and shifts the voltage level to  $\pm$ 12 VDC for extra noise protection. The signal is then routed to the Image Function PCB where it is received by RS-232 receiver U19 pin 12. The logic output of U19 pin 11 is buffered by U5 (pins 11 and 10) and sent to the CCD Camera.

Integration is provided to halt scanning on the CCD sensor in the camera when in the pulsed mode. The image from the image intensifier is "Integrated" onto the CCD sensor during the X-ray pulse. The signal is TTL "low" during the integration expose phase.

### **Unity Gamma**

The unity gamma signal is sent directly from the Technique Processor PCB to the Image Function PCB via RS-232 serial communication. The command is received by receiver U17 pin 9 and output (pin 10) directly to micro-processor U16 pin 17. Once processed by U16, output latch U6 pin 13 sends the signal to the CCD Camera via buffer U5 (pins 3 and 4).

In normal imaging this input is high (gamma = 0.7) to enhance gain in the dark areas. During subtraction or roadmap it is switched low (gamma = 1.0, unity).

### **Anti-Vignetting**

A selectable anti-vignetting correction input is provided (TTL active low). This feature provides parabolic correction in both the vertical and horizontal axis. The amount of compensation is adjustable up to a minimum of 50% vertically and horizontally over the circular area equal in diameter to the height of the sensor (6.6 mm). This signal dynamically boosts the gain of the video amplifier at the periphery of the image without affecting black level. This is done to accomplish an even shading over the entire area of the image.

The anti-vignetting signal is sent directly from the Technique Processor PCB to the Image Function PCB via RS-232 serial communication. The command is received by receiver U17 pin 9 and output (pin 10) directly to micro-processor U16 pin 17. Once processed by U16, output latch U6 pin 16 sends the signal to the CCD Camera via buffer U5 (pins 13 and 12).

### **Test Pattern**

A test pattern has not been implemented at this time. An intermittent problem of a square black box appearing on the left monitor of the Workstation can be remedied by cutting pin 6 of U5 on the <u>Image Function PCB</u>, which is the "Test Pattern" output to the CCD camera.

### +24 Volts and DC Common

The +24V for the camera comes directly from the C-Arm +24V power supply PS2. It passes through the Power Motor Relay PCB P7-7 to P5-1. It can be measured on that PCB at test point TP1. After leaving the Power Motor Relay PCB, it passes through the Image Function PCB P2-3 to P3-22 and enters the camera at P1-2.

The DC common connection for the camera is made on the Power Motor Relay PCB. It leaves that board at P5-2, and is connected to the camera at P1-1 via the Image Function PCB P2-4 to P3-19.

### **CCD Thermo-Electric Cooling Circuit (TEC)**

The CCD sensor is cooled by a thermo-electric cooling (TEC) and heat sinking apparatus. The cooling module attempts to maintain the CCD temperature at the same temperature as the image intensifier housing. Poor image quality may indicate that the TEC circuit is not working properly.

The heat sinking apparatus is turned off and on periodically by firmware located on the Image Function PCB. The ON and OFF cycle times depend on how long the processor has been running.

A +5 VDC is applied to R4 on the Image Function PCB. Current flows through R4 to the thermo-electric cooler, back into the Image Function PCB and through transistor Q3 to DC common ground. Micro-controller U16 pin 19 controls the base of transistor Q3. A high on pin 19 turns the cooler ON and a low turns the cooler OFF. These times have been determined experimentally and are stored in a look-up table (LUT) on the Image Function PCB. To determine proper operation of the TEC circuit, measure TP3 on the Image Function PCB for a drop to +2.4 VDC  $\pm$  0.75 V. The E9 jumpers are not used at this time.

# **SYNCHRONIZATION STANDARDS**

A 60 Hz and 50 Hz model CCD Camera is available.

Domestic Models - RS-170A Video Waveform Standard, 60 Hz.

**International Models** - CCIR or PAL compatible with 576 lines centered in the unblanked area of the CCIR standard, 50 Hz.

# PIXEL/COLUMN FILTER PCB

#### Asy. #00-878047 - Sch. #878045

The Pixel/Column Filter PCB is mounted on the CCD camera assembly (see Figures 1 and 22). The video signal from the camera passes through the circuitry on this PCB and then on to the Workstation image processor. The Pixel/Column Filter PCB has two functional sections; a column artifact cancellation filter and a pixel artifact filter. The pixel filter section filters out noise from the camera video that appears as white pixels in the image. The column filter circuitry is used to cancel out inherent blemishes of the CCD sensor that appear as columns in the image.

### NOTE: Some systems may have a Pixel Filter PCB instead of a Pixel/Column Filter PCB. The main difference is the lack of column filter circuitry on the Pixel Filter PCB. Later systems may have neither of these PCBs. Also, a -03 revision Image Function PCB must be used with the Pixel/Column Filter PCB. Systems with S/N 69-2001 and higher are expected to have the Pixel Filter PCB only.

### **Pixel Filter Circuitry**

The Pixel Filter section of the PCB is comprised of U4, Q1 and the interconnecting resistors. The circuitry was designed to attenuate pixel blemishes (noise) from the output (P2) of the CCD Camera. The video signal from the CCD camera enters at J1 and is applied to the base of transistor Q1 at pin 2. The signal is also routed through a 60 nS delay IC U4. The 60 nS delayed video signal is applied to the base of transistor Q1 at pin 6. Both transistors are wired to function as emitter followers. In order to match the transistor's characteristics, both transistors are located on the same integrated circuit die (Q1). The emitters of the two transistors are connected to the output resistor R12. The video output signal becomes the more negative voltage of either the delayed or non-delayed video signal. Thus any positive noise glitches (or white pixels) are attenuated as shown in Figure 18 below. The resultant video signal is sent to the Workstation via the Motherboard and the Interconnect Cable.

Power (+5 VDC) is supplied to the Pixel Filter portion of the PCB by the camera (+5P) at J3 pin 6. It is filtered by series resistor R11 and capacitors C10 and C11 to decrease the potential of noise entering the PCB through the power supply.



### **Column Filter Circuitry**

The column filter section of the PCB is comprised of U1, U2, U3, SW1, SW2 and the interconnecting components. The purpose of this circuitry is to produce a signal that cancels column artifacts of the CCD sensor. The CCD sensor manufacturer tests each sensor IC and provides data that locates column artifacts that appear in the video image. This data is stored in EPROM U1. The data is read by U2, an address controller EPLD (Erasable Programmable Logic Device) which performs the logic, counter, multiplexing and positioning functions with the data it receives. One byte of data from the EPROM contains information for two pixels. The EPLD transmits four bits of correction data (DA 0-3) per pixel at a time to the D/A converter U3. The cancellation is done at the pixel clock rate for the EIA (60 Hz) camera at 21.5 MHz. The pixel clock and HDRV (horizontal drive) are the only control lines required by U2.

SW1 provides 1/2 pixel adjustment of error correction data by changing the phase of the clock of the output register of U2 and the D/A. SW2 adjusts the horizontal position of the entire video image. The D/A converts the data to an analog signal to be added to the video and input to the Pixel Filter circuit. Potentiometer R1 is used to fine tune the amplitude of the analog signal. See the <u>Image System Calibration</u> section of this manual for details of adjustments to this circuitry.

Camera gain is used as the reference voltage for the D/A converter. As different technique is used by the generator, the gain of the camera is changed. In order to better cancel the column artifact at both high and low gain, the camera gain signal controls the D/A to allow the canceling signal to match and track in amplitude.

Power to the Column Filter portion (+5) comes from a remote three terminal regulator (U20) on the Image Function PCB. It enters the Pixel/Column Filter PCB at J3 pin 2.







# PIXEL FILTER PCB

#### Asy. #00-877791- Sch. #877789

Some early 9600 systems and systems with serial number 69-2001 and higher will be equipped with a Pixel Filter PCB which does not have column filter circuitry. The circuit functions exactly as the pixel filter circuitry described above for the Pixel/Column Filter PCB. Component designators differ between the two PCBs however. The Pixel Filter PCB obtains power (+5 VDC) from the camera.



Figure 20 - Pixel Filter PCB





Figure 21 - CCD Camera Removal S/N 69-0001 thru 69-2000

# **CCD CAMERA REPLACEMENT**

#### S/N 69-0001 thru 69-2000

WARNING... Electrical circuits inside the equipment use voltages that are capable of causing serious injury or death from electrical shock. Use appropriate precautions.

# CAUTION: Always wear a properly grounded static protection wristband when working with the CCD camera.

#### Refer to Figure 21.

- 1. Turn the Workstation keyswitch to the **OFF** position.
- 2. Remove two screws (A) retaining the Camera cover and remove the cover.
- 3. Remove 4 screws (B) securing the counter-weight and remove the counter-weight.
- 4. Unplug wiring connectors (C) from the camera.
- 5. Remove 4 screws (D) that secure the heat pipe to the Image Intensifier.
- 7. Remove 3 bolts (E) securing the CCD Camera assembly to the Image Intensifier.
- 8. Remove the CCD Camera assembly from the Image Intensifier.

# *NOTE:* When replacing the CCD camera assembly, remove the protective film covering the new CCD camera's lens before installing the new CCD camera assembly.

When replacing the CCD camera assembly it may be necessary to recalibrate the light level at the CCD by calibrating the Camera Iris. Refer to the <u>Camera Iris Calibration</u> procedure in the Image System Calibration Section.

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Figure 22 - CCD Camera Removal S/N 69-2001 and higher

# **CCD CAMERA REPLACEMENT**

#### S/N 69-2001 and higher

WARNING... Electrical circuits inside the equipment use voltages that are capable of causing serious injury or death from electrical shock. Use appropriate precautions.

# CAUTION: Always wear a properly grounded static protection wristband when working with the CCD camera.

Refer to Figure 22.

- 1. Turn the Workstation keyswitch to the **OFF** position.
- 2. Remove two screws (A) retaining the external camera cover and remove the cover.
- 3. Remove the 9 screws (B) from the connector mount that secure it to the internal camera cover.
- 4. Loosen the clamp (C) around the camera cover.
- 5. Carefully remove the internal camera cover/counter weight assembly (D).
- 6. Re-tighten the clamp to secure the connector mount.
- 7. Unplug wiring connectors from the camera (E).
- 8. Remove 4 screws (F) that secure the heat pipe to the Image Intensifier.
- 9. Remove 3 bolts (G) securing the CCD Camera assembly to the Image Intensifier.
- 10. Remove the CCD Camera assembly from the Image Intensifier.

# *NOTE:* When replacing the CCD camera assembly, remove the protective film covering the new CCD camera's lens before installing the new CCD camera assembly.

When replacing the CCD camera assembly, it may be necessary to recalibrate the light level at the CCD by calibrating the Camera Iris. Refer to the <u>Camera Iris Calibration</u> procedure in the Image System Calibration Section.

# ABS

### **OVERVIEW**

The Auto Brightness System (ABS) is a combination of software and hardware that automatically adjusts kVp, mA, and camera gain for an optimal image. An analog voltage from the camera (VIDEO\_LEVEL) is digitized and compared to a reference level in the ABS software. If VIDEO\_LEVEL does not equal the reference voltage, the ABS tables located in software are used to regulate kV, mA, and camera gain until it matches. The functions adjusted are dependent on the Fluoro mode selected as shown in <u>Tables 10</u> through <u>13</u>.

# **ABS TABLE SELECTION CONTROL**

Various ABS tables reside in software, but their availability for selection at the control panel must be setup in system configuration files. Refer to the <u>C-Arm Software</u> section in this manual for details of system configuration.

The operator selects the desired ABS table by pressing the "ABS SELECT" control on the C-Arm control panel (see Figure 23 below). When the control is pressed, the current ABS table will be displayed for 2 seconds on the control panel display. The other tables are displayed if the control is pressed again during the two seconds. If the control is not pressed again, the ABS table that is displayed will be loaded for use if not already active.



### Figure 23 - ABS Table Selection Control on the C-Arm Control Panel

# VIDEO LEVEL INDICATOR (VLI)

Refer to Figure 24.

The VIDEO\_LEVEL or VLI is an analog output that indicates video level within a rectangular sampling window (non-adjustable) on the CCD sensor. The signal is proportional to the sum of the peak and average video levels inside the sampling window. The window is equal in height and width to 45-55% of the picture height.

The video level signal is routed from the CCD Camera through the Image Function PCB and Motherboard back to multiplexor U3 on the Analog Interface PCB. After being converted to a digital signal by A/D U7, it is sent to the dual port ram on the Technique Processor PCB via the A/D 0-7 bus.

The Technique Processor will compare the digital value of the video level with the reference value of the ABS table and adjust the necessary parameters until the reference value is obtained.

kV and mA will be adjusted by varying the signals KVP CONTROL and MA CONTROL on the outputs of the D/A converters on the Analog Interface PCB. The operation of these circuits is discussed in the  $\underline{kV}$  and  $\underline{mA}$  sections of this manual.

Camera gain is also adjusted as described under the next heading.

### **CAMERA GAIN**

The Technique Processor determines the level of camera gain and sends the digital signal to the Analog Interface PCB via the micro-computer bus. The digitized signal is converted to an analog signal by D/A U18. This signal is then converted to a voltage by U29. This analog voltage (0-10 VDC) is then routed via the Motherboard and Image Function PCB to the CCD Camera where it is used to adjust the camera gain circuitry. It is also used on the Pixel/Column Filter PCB (if installed) as a reference voltage for the D/A converter.

# **ABS CONTROL DURING AUTO FLUORO MODE**

| Function    | Description                               |
|-------------|---|
| kVp         | ABS adjusts the kVp index value until the |
|             | video level equals the value contained in |
|             | the video level index                     |
| mA          | ABS adjusts the mA value                  |
| Camera Gain | ABS adjusts the Camera Gain               |
| Camera Iris | Iris fully open                           |

#### Table 10 - Functions Adjusted in Auto Fluoro Mode

# ABS CONTROL DURING MANUAL FLUORO MODE

| Function    | Description   |
|-------------|---|
| kVp         | Manual adjustment of the kVp value  |
| mA          | Manual adjustment of the mA value   |
| Camera Gain | ABS adjusts the Camera gain until the video level equals the value contained in the video level index |
| Camera Iris | Iris fully open   |

Table 11 - Functions Adjusted in Manual Fluoro Mode

# **ABS CONTROL DURING PULSED BOOST FLUORO MODE**

| Function    | Description                                 |
|-------------|---|
| kVp         | kVp is frozen at it's current value by      |
|             | software                                    |
| mA          | mA is incremented until the video level     |
|             | equals the video level index                |
| Camera Gain | Camera gain is reduced, and ABS system      |
|             | adjusts mA to achieve correct video level.  |
|             | If the correct level is not reached before  |
|             | the mA limit is reached, the camera gain is |
|             | increased.                                  |
| Camera iris | Iris fully closed                           |

Table 12 - Functions Adjusted in Pulsed Boost Fluoro Mode

# **ABS CONTROL DURING BOOST FLUORO MODE**

| Function    | Description                                 |
|-------------|---|
| kVp         | kVp is frozen at it's current value by      |
|             | software                                    |
| mA          | mA is incremented until the video level     |
|             | equals the video level index                |
| Camera Gain | Camera gain is reduced, and ABS system      |
|             | adjusts mA to achieve correct video level.  |
|             | If the correct level is not reached before  |
|             | the mA limit is reached, the camera gain is |
|             | increased.                                  |
| Camera iris | Iris fully open                             |

#### Table 13 - Functions Adjusted in Boost Fluoro Mode



Figure 24 - ABS Block Diagram

# **X-RAY TUBE**

## **OVERVIEW**

The X-ray Tube has 0.3 mm and 0.6 mm focal spots and a rotating anode that operates at approximately 3,000 rpm. The .6 mm focal spot is selected by software only in higher techniques in the film mode. The X-ray Tube housing is lead-lined aluminum and is filled with an insulating oil and hermetically sealed. The housing and tube weigh approximately 43 lbs.



Figure 25 - X-ray Tube

# **STATOR CIRCUITRY**

See the <u>Interlocks/Stator</u> section of this manual for details about the X-ray tube stator circuitry.

# X-RAY TUBE TEMPERATURE SENSOR

A temperature sensor, located in the X-ray tube housing assembly senses the heat within the housing. This signal (HOUSING\_TEMP) is monitored by the Technique Processor PCB through A/D mux U3-23 on the Analog Interface PCB. Warning messages such as *Housing Overheated* will be displayed on the Control Panel display if the housing heat exceeds safe operating conditions.

# **STATOR THERMAL CUTOFF SWITCH**

A thermal cutoff switch, is wired in series with the Stator Neutral. If the temperature within the X-ray Tube Housing exceeds safe operating conditions, the thermal switch opens, interrupting current to the stator motor. This is detected by the Technique Processor PCB via the stator current sense circuit as described in the INTERLOCK / STATOR section of the service manual.

### **REPLACEMENT OF X-RAY TUBE**

Refer to Figure 26.

# WARNING... Electrical circuits inside the equipment use voltages that are capable of causing serious injury or death from electrical shock. Use appropriate precautions.

- 1. Verify the Workstation keyswitch is turned to the **OFF** position and the AC power plug is disconnected from the AC receptacle.
- 2. Position the C-arm in the vertical beam position and lock the brake pedals so the Mobile C-Arm will not move.

### WARNING... The X-ray Tube housing can cause severe burns. Do not touch the housing until the housing has cooled.

- 3. Remove the 2 screws (A) securing the X-ray tube connector housing cover and remove the cover.
- 4. Use a spanner wrench (OEC part # 00-877674) to disconnect the anode and cathode cable connectors. Remove the cable nuts and strain relief.

# WARNING... Discharge the high voltage cables by grounding the connector tips to the chassis to prevent possible electrical shock.

- 5. Unplug wiring connector J15 (stator motor power & temperature sensor).
- 6. Disconnect the ground wires from the rear of the X-ray tube.
- 7. Remove the collimator cover, collimator, and collimator alignment bracket as described in <u>Collimator Replacement</u>.
- 8. Remove the four bolts (B) that secure the X-ray Tube housing and remove the housing and tube.

NOTE: Perform a <u>Beam Alignment</u> whenever the X-ray Tube is removed or replaced. Perform an <u>X-ray Calibration verification</u> whenever the X-ray Tube is replaced with a new tube.



### **REPLACEMENT OF HIGH VOLTAGE CABLES**

### WARNING... Electrical circuits inside the equipment use voltages that are capable of causing serious injury or death from electrical shock. Use appropriate precautions.

1. Verify the Workstation keyswitch is in the **OFF** position and the AC power plug is disconnected from the wall socket.

### WARNING... Apply only a small amount of silicon grease to High Voltage cable plugs at the X-ray Tube end and then wipe them off to leave just a very thin layer of grease.

- 2. Remove the X-ray Tube housing cover.
- Remove the collimator cover, collimator and alignment bracket. Refer to <u>Collimator</u> <u>Replacement</u>.
- 4. Use the spanner wrench (OEC part # 00-877674) to disconnect the anode and cathode high voltage cables from the X-ray tube.
- 5. Unplug wiring connector J15 (stator motor power & temperature sensor).
- 6. Disconnect the ground wires from the X-ray tube.
- 7. Remove the High Voltage cable nuts and strain relief.
- Remove the 4 bolts securing the X-ray tube assembly and remove it from the C-arm weldment.
- 9. Release the C-arm brake and position the C-arm horizontal to floor.
- 10. Remove 2 Torx screws securing the camera cover.
- 11. Remove 4 Torx screws securing the Image Function PCB to the C-arm weldment if necessary (Image Function PCB is in generator card rack on later models).
- Remove 6 hex bolts securing the Image Intensifier. Lift the Image Intensifier and place it on a chair while disconnecting 5 Torx screws securing the Image Intensifier power supply. Refer to <u>Image Intensifier/Power Supply Removal</u>.
- 13. Remove 2 set screws securing the main trunk of the High Voltage Cable at the cables injection point into the C-arm and then pull the cable out 4-5 inches.
- 14. Pull the High Voltage cables out until tension is felt and then push the cables back in the cable injection point, towards the II end of the C-arm. Then reach in the II end of the C-arm, grasp the loop of cable and pull the cables out the II end of the C-arm.

### NOTE: H.V. cables entering the C-arm turn immediately and are routed to the X-ray Tube. The cables can't be removed without pulling the cables out the II end of the C-arm first.

- 15. Once the cable connectors have been pulled out of the II end of the C-arm, remove the strain relief and pull the cables out one at a time.
- 16. Remove the Front Cover (2 Torx screws) and the Right Front Cover (3 Torx) and then remove 2 screws securing the C-clamp strain relief.
- 17. Remove the High Voltage Cable ground wires from the chassis and remove the A1J3 connector from the Motherboard PCB.
- Remove the Left Front Cover and disconnect the A4J5 connector from the Power Motor Relay PCB.
- 19. Disconnect the High Voltage connectors from the High Voltage Tank using the spanner wrench.
- 20. To route the High Voltage Cable through the hole in the Right Front Cover disassemble the candlestick cable nut assembly and pull the cables and connectors.

# IMAGE SYSTEM CALIBRATION

The procedures contained in this section are used to test and calibrate the 9600 Mobile C-Arm. The following procedures are included:

- Beam Alignment
- <u>Collimator Iris Calibration (Field Size)</u>
- Camera Iris Calibration (Tracking)
- Pixel/Column Filter PCB Adjustments

# **CALIBRATION OVERVIEW**

These procedures assume that all parts are installed and are wired correctly. It is also assumed that all subassemblies are either known to be operational or were previously tested at the factory.

# **BEAM ALIGNMENT**

This portion of the procedure aligns the X-ray beam, collimation assemblies, and camera imaging system in-line with each other. This section includes the setup of the C-Arm and equipment necessary to perform a beam alignment. Also included in this portion of the Image System Calibration is the camera mechanical/electrical alignments and verifying the calibration of the Workstation monitors.

# **COLLIMATOR IRIS CALIBRATION**

This section includes sizing the collimator iris to all three image intensifier sizes in fluoro modes. A film used for Beam Alignment Verification is created in this section and is used as hard copy proof that a system has met specifications.

# **CAMERA IRIS CALIBRATION**

A long and short method for calibrating the tracking (ABS loop) in the fluoro mode is performed in this section.

# PIXEL/COLUMN FILTER PCB ADJUSTMENTS

This adjustment corrects for any shading imperfections that may appear as columns in the image. Vignetting is also corrected during this portion of the procedure.

# **BEAM ALIGNMENT**

# **OVERVIEW**

The beam alignment procedure has been designed to align imaging chain components with the image intensifier. The following stages have been determined to be the best procedure for performing beam alignment in the field.

- 1. Equipment Setup optimizes equipment setup and positioning to minimize C-Arm flexure and the effects of the earth's magnetic field on the image intensifier.
- 2. CCD Camera Cooler Operation Verify the operation of this circuit.
- 3. Calibrate Rotation Indicator calibrates the camera rotation before starting alignment.
- 4. Monitor/camera Alignment Pattern acquires the Monitor/Camera Alignment Pattern.
- 5. Adjust Monitors Describes how to reset size, centering and linearity of the Workstation monitors using the Monitor/Camera Alignment Pattern.
- 6. Adjust Camera Focus optimizes the camera focus before alignment.
- 7. Adjust Camera Decentration -adjusts the camera's mechanical position with respect to the output port of the image intensifier.
- 8. Adjust Camera Electronic Centering adjusts the camera's electronic center with respect to the output port of the image intensifier (SW1 & SW2).
- 9. Collimator Mechanical Center the secondary collimator is aligned with respect to the variable collimator.
- 10. Image Intensifier Electronic Centering the image intensifier electronic center is located.
- 11. Variable Collimator Centering the entire collimator assembly is aligned with the electronic center of the image intensifier.
- 12. Collimator Iris Calibration the collimator iris field sizes are calibrated.
- 13. Beam Alignment Verification films are taken in the NORM, MAG1, MAG2 and 5cm<sup>2</sup> positions to verify the beam alignment has been successful.
### TOOLS

The following tools are required to perform the procedures in this section:

| • | OEC Boot Disk                           | OEC P/N 00-877444 or 00-876781 |
|---|---|--------------------------------|
| • | Wisconsin mesh resolution tool          | OEC P/N 00-900040-01           |
| • | Converging line resolution tool (LP/mm) | OEC P/N 00-900860-01           |
| • | Beam alignment tool                     | OEC P/N 00-878105-01           |
| • | Bore sight tool                         | OEC P/N 00-877589-01           |
| • | Bristol spline driver (Xcelite 99-61)   | OEC P/N 00-900920-01           |
| • | (QTY of 3) 1mm copper plates            | OEC P/N 00-877682-01           |
|   |   |                                |

NOTE: All quantities are one except where indicated.

### **EQUIPMENT SETUP**

- 1. Verify that the Workstation keyswitch is in the **OFF** position.
- 2. Remove the following covers: Camera Cover, X-ray Tube Housing Cover, Collimator Cover, as shown in Figure 1.
- 3. To minimize C-Arm flexure release the C-Arm brake and position the C-Arm at a 45° angle as shown in Figure 1.



Figure 1 - C-Arm Covers & 45° Position

4. Attach the Wisconsin mesh resolution tool to the Image Intensifier grid at a 45° angle to the Image Intensifier Grid line pairs as shown in Figure 2.

NOTE: Be sure to orient the mesh tool with the 35/24 line pairs to the "top" of the II. This is important for verifying the operation of camera rotation. If using an alternate resolution tool, use a specific portion of it as the 35/24 "top" of the mesh tool.



Figure 2 - Mesh Tool Installation

5. Boot the system and position the Mobile C-Arm so that the effects of the earth's magnetic field are minimized. This can be accomplished by taking AUTO FLUORO images of the mesh tool while simultaneously rotating the Mobile C-Arm in a 360° circle. While imaging, note any changes to linearity and positioning of the mesh tool image.

#### NOTE: Do not change the 45° angle of the "C" itself during this test. Move only the entire C-Arm. This will eliminate mechanical flexing of the "C" which could cause a shift in the image giving a false impression of magnetic interference.

- A. If no changes are noticed, this is not a concern and you may align the beam and camera in any location in the room.
- B. If changes are noticed, position the Mobile C-Arm in the position where mesh tool distortion and/or image shift is minimal.
- 6. Turn the Workstation keyswitch to the **OFF** position.

### VERIFY CCD CAMERA COOLER OPERATION

1. With the system powered off, connect a DVM to R4 of the Image Functions PCB while observing the polarity as shown in Figure 3.



Figure 3 - CCD Cooler Measurement

- 2. Power on the system and verify the CCD cooler control voltage works as follows:
  - 7-10 Seconds  $\approx 2.5$  VDC (Cooler ON)
  - 30-40 Seconds  $\approx 0.0$  VDC (Cooler OFF)
- 3. Confirm the voltage changes for one or two cycles to verify the operation of the CCD cooler logic. Remove the DVM when finished.

### **CALIBRATE ROTATION INDICATOR**

#### WARNING Steps within this procedure produce X-rays. Use appropriate precautions.

- 1. Boot up the system.
- 2. Press the **SETUP OPTIONS** key on the Workstation keyboard. The *Setup Options* menu will appear.
- 3. Insert the OEC Boot and Diagnostic disk into the disk drive.
- 4. Select the Access Level 2 (Service) menu and press ENTER.
- 5. Enter the *Video Calibration* sub-menu and run the *Camera Rotation Calibration* program.

#### NOTE: This program will automatically calibrate the camera rotation indicator displayed on the left monitor to the actual degree of rotation from the stop position.

- 6. Press ESC three times to clear the right monitor.
- During an AUTO FLUORO exposure, rotate the camera to confirm the image can rotate 360°, see Figure 4, and image movement stops when the icon stops at either limit.



Figure 4 - Image Rotation Indicators

8. Return the camera rotation to obtain the following image as shown in Figure 5.



Figure 5 - Image Rotation "A"

9. Without making X-rays, move the icon to the position shown in Figure 6 (left). Then make an X-ray. The image that appears should match the orientation of that in Figure 6 (right).



Figure 6 - Image Rotation "B"

10. Without making X-rays, move the icon to the position shown in Figure 7 (left). Then make an X-ray. The image that appears should match the orientation of that in Figure 7 (right).



Figure 7 - Image Rotation "C"

11. This completes the testing for the image rotation function.

## **MONITOR/CAMERA ALIGNMENT PATTERN**

- 1. With the system booted, press the **SETUP OPTIONS** key on the Workstation keyboard. The *Setup Options* menu will appear.
- 2. Insert the OEC Boot and Diagnostic disk into the disk drive.
- 3. Select Access Level 2 (Service) and press the ENTER key.
- 4. The *Service Options* menu will appear.
- 5. Enter the *Video Calibration* sub-menu, select *Monitor/Camera Alignment* and press the ENTER key.
- 6. The Monitor/Camera Alignment Pattern, shown in Figure 8, is displayed on both monitors.



Figure 8 - Monitor/Camera Alignment Pattern

- 7. This pattern will be used at various times for the remainder of this procedure.
- 8. If the monitors do not show a linear and round image as shown in Figure 8, it may be necessary to adjust the size, centering, and linearity. Proceed to the next portion of this procedure, "Confirm Monitor Size & Linearity".

### **CONFIRM MONITOR SIZE & LINEARITY**

- 1. Confirm the left and right monitors are adjusted correctly, referring to Figure 9, by measuring the following size specification:
  - 5" ( $\pm$  0.125) from the center to the horizontal & vertical edges

## NOTE: The monitor CRT curves and is not flat. The measuring viewpoint must therefore be perpendicular to the monitor screen.



#### Figure 9 - Image Size Measurement

 Also verify the vertical linearity of the monitors by measuring the largest distance between the vertical lines (A), and the smallest distance between the vertical lines (B). The distance should be approximately 1 inch between each line. Calculate the Linearity Error using the following formula:

 $\frac{A - B}{A} X 100\%$  Linearity error must be less than 10%.

#### NOTE: IF THE MONITORS ARE WITHIN SPECIFICATIONS, proceed to the <u>Adjust</u> <u>Camera Focus</u> portion of this procedure. IF THE MONITORS ARE NOT WITHIN SPECIFICATIONS, adjust the monitors by continuing to <u>Step 3</u>.

- Remove the rear cover of the Workstation (8 screws) then slide the monitor cover off by pulling it straight towards the rear of the unit.
- 4. Use the controls, shown in Figure 10, and adjust the monitors.

#### **NOTE:** The following adjustments are interactive.



MONITOR BOTTOM VIEW

#### Figure 10 - Monitor Adjustment Controls

- 5. Set the Vertical Linearity Pot R10 to less than 10% of the Linearity Error.
- 6. Adjust the Vertical Size pot (R7) and Horizontal Size coil (L1) on the Monitor PCB for  $10 \pm 0.15$  inches measured perpendicular to the CRT surface.
- 7. Adjust the Vertical Center pot (R17) and the Horizontal Phase pot (R57) to center the Monitor/Camera Alignment Pattern.

## **ADJUST CAMERA FOCUS**

WARNING... Steps within this procedure produce X-rays. Use appropriate precautions.

# CAUTION: None of the potentiometers located on the CCD Camera PCB are adjusted during the Beam Alignment procedure. Adjustments to these potentiometers should not be performed in the field.

- 1. Press the **ESC** key four times to return the Workstation to NORMAL operation.
- 2. Verify the Mobile C-Arm is in **AUTO FLUORO** mode.
- 3. Insert an Allen wrench (3/32") and turn the adjustment set screw approximately 1/8 of a turn CCW to loosen as shown in Figure 11. Leave the Allen wrench in the screw and use it as a lever to adjust for optimum focus.



Figure 11 - Camera Focus Screw Location

- 4. While making an exposure adjust the focus of the optics assembly for optimum overall focus by observing the mesh tool.
- 5. Tighten the focus set screw to 4 5 in/lbs after the focus is adjusted (Loctite 222 if the set screw was removed).

 Rotate the camera so it scans the mesh tool in the orientation shown in Figure 12. This ensures the CCD camera is scanning "against" the gird lines. This allows for optimum resolution capability.

## NOTE: You may also scan against the grid lines with an image rotated 180° to the one shown in Figure 12. Either orientation will work fine.



#### Figure 12 - Image Rotation After Focus

 Replace the Wisconsin mesh resolution tool with the converging line pair tool. Place the tool at a 45° angle to the image intensifier grid line/pairs (in either orientation) as shown in Figure 13.



Figure 13 - Converging Line Pair Tool Positioning

8. Select the NORMAL, MAG1, and MAG2 field sizes and verify the following minimum line pairs/mm can be achieved in the field selected.

| FIELD SIZE | 60 Hz lp/mm | 50 Hz lp/mm |
|------------|-------------|-------------|
| NORMAL     | 1.4         | 1.2         |
| MAG1       | 2.0         | 1.7         |
| MAG2       | 2.4         | 2.0         |

9. You may need to readjust focus to meet the above specifications.

### **ADJUST CAMERA DECENTRATION**

#### WARNING... Steps within this procedure produce X-rays. Use appropriate precautions.

## NOTE: The purpose of this procedure is to center the physical position of the Beam Alignment Tool in the II's output.

1. Remove the converging line pair tool and install the beam alignment tool on the Image Intensifier as shown in Figure 14. Note the location of the X & Y adjustment screws. You will adjust these in the next few steps.



#### Figure 14 - Beam Alignment Tool Mounting Orientation

2. Acquire the Monitor/Camera Alignment Pattern. This is done to remove circular blanking during an exposure so the full Image Intensifier image can be seen.

## NOTE: Ignore the electronic Monitor/Camera Alignment Pattern overlay during this decentration adjustment of the Beam Alignment Tool.

3. Select **MAG 2** and take an AUTO FLUORO exposure. Rotate the camera until the beam alignment pattern tick marks are at a 45° angle as shown in Figure 15.



#### Figure 15 - Tick Marks for Centering

4. The pattern is centered (using the X & Y screws) when the same number of tick marks are centered within the Image Intensifier limits by observing the non-circular blanked image, also shown in Figure 15.

NOTE: The pattern shown in Figure 15 is not adjusted correctly. Note the uneven number (2, 3, 5, 6) of lines in the "tick marks" from the image of the Beam Alignment Tool. These are the tick marks that must be equally displayed on the image. NOTE: If there is no clipping of the image, proceed to step 6.

*If the image is clipped in a round elliptical manner, see Figure 16, this can be corrected by adjusting the camera decentration screws; proceed to step 4.* 

If the image is clipped by a partial octagonal image, see Figure 17, this can be corrected by loosening the collimator anchor screws and repositioning the collimator; proceed to <u>step 5</u>.



Figure 16 - Elliptical Image Cutoff (Camera Alignment - Step 4)



Figure 17 - Octagonal Image Cutoff (StopSign; Collimator Alignment - Step 5)

4. If the outside edges of the Image Intensifier image cannot be seen due to an elliptical cutoff pattern, as shown in Figure 16, loosen the heat sink screw to adjust the camera's horizontal and vertical decentration screws, as shown in Figure 18, until the whole image is visible.

## NOTE: You may remove the 4 counter-weight screws (not shown) for easier access.



Figure 18 - Location of Camera Decentration Screws

5. If the outside edges of the Image Intensifier image cannot be seen due to an octagonal cutoff pattern, as shown in <u>Figure 17</u>, loosen the collimator's mounting screws (about 1/8 of a turn CCW) and adjust the X & Y screws, as shown in Figure 19, until the whole image is visible. Tighten these screws when finished.



#### Figure 19 - Collimator Mounting Screws & Adjustments

- 5. Press ESC four times to remove the Monitor/Camera Alignment Pattern from the left monitor and return to normal display mode. Rotate the camera in either direction to a stop and then back off the stop a slight amount.
- 6. While taking a **MAG 2** Fluoro exposure and place a dot (0° mark) on the monitor screen with a marker to indicate the center of the beam alignment tool pattern as shown in Figure 20.



#### Figure 20 - Rotation Points on Monitor

- 7. Rotate the camera 90°, 180°, and 270° and mark each center point to indicate the center of the beam alignment tool pattern.
- 8. Draw a cross between the four marks and place a mark at the intersection of the cross.
- 9. While making an exposure, adjust the decentration screws to align the center of the beam alignment tool pattern to the mark at the intersection of the four marks as shown in Figure 21.



Figure 21 - Centering the Four Points

10. While taking a **MAG 2** exposure rotate the camera from stop-to-stop and verify that the center of the pattern <u>does not deviate more than 1.5 mm</u> from the marked center.

## NOTE: Each ring in the "bullseye" of the pattern is 1 mm wide with 1 mm spacing between rings.

- 11. If the pattern center and marked center deviate more than 1.5 mm, repeat the previous steps to determine the correct center.
- 12. Remove the dots from the face of the monitor.
- 13. Tighten the heat sink screw located within the camera assembly.

### **ADJUST CAMERA ELECTRONIC CENTERING**

This step adjusts the camera's horizontal and vertical video timing to match the Workstation's alignment pattern video timing. The Workstation pattern remains fixed on the screen while the camera image is shifted to match the Workstation pattern.

- 1. Acquire the Monitor/Camera Alignment Pattern.
- 2. While taking a **MAG 2** exposure, adjust the camera's vertical and horizontal timing using the 16 position DIP switches SW1 (Vertical Centering) and SW2 (Horizontal Centering) as shown in Figure 22.



Figure 22 - CCD Camera Electronic Centering Adjustments

 Make adjustments until the MAG 2 image of the Beam Alignment Tool pattern is centered on the Monitor/Camera Alignment Pattern outside edges as shown in Figure 23.



Figure 23 - Image After CCD Camera Centering Adjustment

## **COLLIMATOR MECHANICAL CENTER**

#### WARNING... Steps within this procedure produce X-rays. Use appropriate precautions.

- 1. Press ESC four times to remove the Monitor/Camera Alignment Pattern. Then select the **MAG 1** field size.
- 2. While making an AUTO FLUORO exposure, close the collimator until it is approximately the size of the C-ring on the Beam Alignment Tool pattern as shown in Figure 24.



Figure 24 - MAG 1 Collimator Sizing

3. Adjust the X and Y screws on the Beam Alignment Tool to center the collimator around the C-ring. If necessary, reposition the entire collimator assembly to get the image on the CRT.

- 4. Install the Bore Sight Tool as shown in Figure 25 by performing the following:
  - A. Remove the four nuts and washers securing the secondary filter to the collimator.



#### Figure 25 - Installing the Bore Sight Tool

- B. Insert the Bore Sight Tool (with the "cup" facing up) into the secondary collimator. Line up the four bolts on the collimator so they penetrate the four holes in the Bore Sight Tool.
- C. Secure the Bore Sight Tool by tightening the four nuts onto the bolts.
- 5. Take a fluoro exposure and verify that the bore sight is aimed at the center of the pattern as shown in Figure 26.



Figure 26 - Image Position with Bore Sight Tool

#### NOTE: If the Bore Sight Tool is not centered in the image, proceed to step 6. Otherwise, if the Bore Sight Tool is centered in the image, proceed to step 8.

6. Loosen the three screws securing the secondary collimator to the nylon gear on the variable collimator as shown in Figure 27.



#### Figure 27 - Secondary Collimator Mounting Screws

- 7. While making an exposure adjust the secondary collimator position until the bore sight is centered on the pattern image as shown in Figure 26.
- 8. Tighten the screws on the secondary collimator.
- 9. Remove the bore sight tool to perform the next procedure.

### **IMAGE INTENSIFIER ELECTRONIC CENTER**

- 1. In the AUTO FLUORO mode, take a **MAG 2** exposure. Mark the monitor at the center of the Beam Alignment Tool pattern.
- 2. Make a **NORMAL** field exposure and mark the monitor at the center of the Beam Alignment Tool pattern.
- 3. While making a **NORMAL** field exposure, use the target on the beam alignment tool to measure the distance between the **MAG 2** and **NORMAL** marks. Verify the distance is less than or equal to 9 mm.

## **NOTE:** Note that each ring on the target is 1 mm wide with a 1 mm space between rings.

- 4 Make a mark on the monitor midway between the **MAG 2** and **NORMAL** points. The point marked is the "average electronic center".
- 5. Make a **NORMAL** field exposure. Re-adjust the Beam Alignment Mask X and Y screws until the image is centered on the average electronic center (marked in the previous step).
- 6. Leave the Beam Alignment Mask in this position for the remainder of the Beam Alignment procedure.

## VARIABLE COLLIMATOR CENTERING

#### WARNING... Steps within this procedure produce X-rays. Use appropriate precautions.

- 1. Select the NORMAL field size
- 2. Reinstall the Bore Sight Tool.
- 3. Take an exposure to determine whether the Variable Collimator requires adjustment. The bore sight should appear centered on the image.
- 4. If the Variable Collimator does not require adjustment continue to the next section "Collimator Iris Calibration" Otherwise, perform the following:
  - A. Loosen the 4 collimator mounting screws, shown previously in Figure 19, by turning them approximately 1/8 of a turn CCW.
  - B. While making an exposure, adjust the collimator positioning plate with the X and Y adjustment screws and center the X-ray beam in the Beam Alignment Tool pattern as shown in Figure 28.



#### Figure 28 - Positioning the Variable Collimator

- C. Tighten the collimator anchor screws (two with large flat washers) and then verify alignment with another exposure.
- D. Tighten the remaining collimator screws and remove the Bore Sight Tool.
- 5. Reinstall the secondary filter on the collimator using the four washers and nuts.

### **COLLIMATOR IRIS CALIBRATION**

- NOTE: This procedure must be performed whenever the Image Function PCB is replaced. Calibration information for proper collimator iris sizing is stored in an EEPROM on the Image Function PCB.
- WARNING... Steps within this procedure produce X-rays. Use appropriate precautions.
  - 1. Install the E5 jumper on the Image Function PCB as shown in Figure 29.



Figure 29 - E5 Jumper Location

- 2. Press the SETUP OPTIONS key on the Workstation.
- 3. Highlight the Access Level 2 (Service) menu item and press ENTER
- 4. Highlight the *Access Mainframe Menu* and press ENTER.
- 5. Select *H* Collimator Calibration.
- 6. The Mobile C-Arm will reboot into collimator calibration mode.
- 7. After the system has booted, acquire the Monitor/Camera Alignment Pattern to remove the digital mask from the image.
- 8. Verify the system is in the **NORMAL** field size. While making a fluoro exposure, press and release the collimator iris increment/decrement key until the collimator is just observed in the image and then move the collimator just out of the image.

#### NOTE: This movement is quite small and may require many key presses.

9. Select **MAG1** field size and while making an exposure, press and release the collimator iris increment/decrement key until the exposed image is within the "B" ring indicated on the Beam Alignment Tool pattern as shown in Figure 30.



#### Figure 30 - "B" Ring of Beam Alignment Tool

- A. The flat surfaces should be within the ring. After setting the iris position, remove any iris "gear play" by manually turning the iris gear in the open direction (without disturbing the iris servo loop).
- B. If the servo loop is disturbed, select another field size, return to MAG 1 and repeat this step. With the gear play removed, verify the iris remains within the "B" ring. If not, repeat this step until the iris (with gear play removed) is within the "B" ring.

# NOTE: If any inward bow is observed along the "flat edges" of the collimator, the measurement must be made across the flats as though the flats are straight.

10. Select **MAG2** field size and while making an exposure, press and release the collimator iris increment/decrement key until the exposed image is within the "C" tolerance ring (with gear play removed) indicated on the Beam Alignment Tool pattern as shown in Figure 31.





- 11. Turn the Workstation keyswitch to the **OFF** position.
- 12. Remove the E5 jumper from the Image Function PCB.
- 13. Remove the Workstation boot disk and then reboot the Mobile C-Arm by turning the Workstation keyswitch to the **ON** position.
- 14. While taking a fluoro image, select the three field sizes and verify that the collimator leafs do not appear within the images for each field. Repeat procedure if necessary to enlarge collimator sizing.

## NOTE: You may wish to view these images with Circular Blanking removed. This may allow you to view the edges of the collimator blades.

15. This concludes the camera alignment process.

### **BEAM ALIGNMENT VERIFICATION**

- 1. Insert a film cassette into the Beam Alignment Tool.
- 2. Select MANUAL FLUORO mode.
- 3. Select the **NORMAL** field size and set the technique to 50 kVp @ 0.5 mA. Press the X-ray **ON** key for 2 seconds.
- 4. Select **MAG 1** field size and press the X-ray **ON** key for 2 seconds.
- 5. Select **MAG 2** field size and press the X-ray **ON** key for 2 seconds.
- 6. Manually collimate to the minimum field size and press the X-ray **ON** key for 2 seconds.
- 7. Develop the film and confirm the field sizes match the following specifications:

| FIELD SIZE       | RANGE |
|------------------|-------|
| 9" mode (NORMAL) | А     |
| 6" mode (MAG1)   | В     |
| 4" mode (MAG2)   | С     |

- 8. Verify that the minimum field size is less than  $5 \text{ cm}^2$ .
- 9. Use a ruler and verify the center of the image is centered on the sheet of film (in both the X and Y axis) within 20 mm or 13/16".
- 10. Verify the line pair resolution.

| FIELD SIZE | 60 Hz lp/mm | 50 Hz lp/mm |
|------------|-------------|-------------|
| NORMAL     | 1.4         | 1.2         |
| MAG1       | 2.0         | 1.7         |
| MAG2       | 2.4         | 2.0         |

- 11. Send the films to OEC Medical Systems, Inc. Attention: Technical Support, 384 Wright Brothers Drive, Salt Lake City, UT. 84116.
- 12. Remove the Beam Alignment Tool.

## **CAMERA IRIS CALIBRATION (LONG METHOD)**

- 1. Set the camera gain to minimum by:
  - A. In NORMAL field size, select **MANUAL FLUORO** mode with a technique of 80 kVp @ 3 mA.
  - B. Make an exposure for approximately 3 seconds.
  - C. Press the **TECH LOCK** switch. This freezes the camera gain at minimum.
  - D. Verify the "CAM GAIN" output on the Analog Interface is 0.0 VDC  $\pm$  0.1 VDC.
- 2. Place the dosimeter's ion chamber (150 cc only) in the center and on the surface of the Image Intensifier contrast grid.
- 3. Establish a reference radiation level by:
  - A. Placing a 1 mm copper plate near the X-ray Tube (in the beam path).
  - B. Set the technique to 72 kVp and adjust the mA as required to achieve a radiation level of 12.0 mR/minute.

## *NOTE:* The mA is typically 1.2 mA @ 72 kVp. However, varying kVp may help in achieving this level accurately, but stay between 69 and 75 kVp.

- 4. Set the iris and the open iris stop, as shown in Figure 32, to produce 600 mV of video for the reference radiation level as follows:
  - A. Using a 0.048" spline driver, loosen both iris stops. This will allow a full range of adjustment.



#### Figure 32 - Camera Iris Locations

B. While making an exposure adjust the lens iris to produce 600 mV (blanking to peak) video at TP10 on the Video Switching PCB.

- C. Swing the "open iris" stop against the stop pin and tighten and Loctite 222 the set screw. Do not over-tighten the set screw. Check gears to make sure they move easily.
- 5. Increase the radiation level to 48.0 mR/minute (4 x the reference radiation level previously established):
  - A. While taking an exposure increase the mA to produce a radiation level of 48.0 mR/minute.
  - B. If maximum mA is reached the kVp may be increased slightly but must not exceed 75 kVp.
- 6. Set the iris and "closed iris stop" to produce 600 mV of video:
  - A. While taking an exposure adjust the iris to produce 600 mV of video (blanking to peak) at TP10 on the Video Switching PCB.
  - B. Swing the "closed iris" stop against the stop pin and tighten and Loctite 222 the set screw. Do not over-tighten the set screw. Check gears to make sure they move easily.
- 7. Manually open the iris back to the "open iris" stop position.
- 8. Verify proper kV tracking by placing 1 mm copper filters (OEC P/N 00-877682-01) in the beam (under collimator). The following specifications must be met:
  - 1 copper filter = 60 kV  $\pm$  3kV
  - 2 copper filters =  $70kV \pm 3kV$
  - 3 copper filters =  $78kV \pm 3kV$

#### *NOTE: After completing this alignment, proceed to the <u>Pixel/Column Filter</u> <u>Adjustment</u> section.*

## **CAMERA IRIS CALIBRATION (SHORT METHOD)**

## **NOTE:** This method may be used instead of the "Long Method" as long as the confidence tests are successful.

#### **Confidence Tests**

The confidence tests confirms the radiation output of the system (and therefore the accuracy of the generator's kV and mA circuits) and also the functionality of the ABS loop. Perform the confidence tests as described on this page.

#### VERIFY ENTRANCE EXPOSURE

- 1. Place a lead apron over the II.
- 2. Place an Ion Chamber 12" (30 cm) above and centered in the II.
- 3. In the MANUAL FLUORO mode, select 120 kVp & maximum available mA.
- 4. Verify the radiation output is ≅ 4.6 R/min using a 5R ABS table for system serial numbers 69-0001 to 69-1160, *or* verify the radiation output is less than 9.26 R/min using a 10R ABS table for system serial numbers 69-1161 or higher.

#### NOTE: If this radiation level is not met, refer to the Entrance Exposure procedure. This may be out of adjustment and/or may indicate the generator is out of calibration.

#### VERIFY AUTO GAIN

- 1. Selecting the AUTO FLUORO mode with Auto Histo OFF. Make an exposure and allow the image to stabilize.
- 2. Select MANUAL FLUORO and select TECH LOCK to turn it ON.
- 3. Make an exposure and verify that the image stays the same.
- 4. Reduce the mA by one-half the current value and make an exposure. Observe the image becomes darker.
- 5. Select TECH LOCK to turn it OFF.
- 6. Make an exposure and confirm the image returns to normal brightness.

## NOTE: If not, verify the ABS loop is functioning by examining camera adjustments (VLI & Camera Gain) to and from the generator.

This concludes the confidence tests. Proceed to the next page to begin the short method.

### **Adjust Iris Open Stop (Short Method Continued)**

- 1. Select the AUTO FLUORO mode and verify TECH LOCK is OFF.
- 2. Tape 1 copper filter on the bottom of the collimator to ensure it covers the entire X-ray beam.
- 3. Loosen the set screw on the open iris stop as shown in Figure 33.



Figure 33 - Camera Iris Locations

- 4. While making an exposure, turn the gears to adjust the iris (open or closed) until the generator tracks to 60 kV.
- Carefully swing the open iris stop against the stop pin. Tighten the set screw to 10 inch/lbs (about 60° of twist in Bristol driver). DO NOT OVER TIGHTEN THE SET SCREW.
- 6. Check the gears to ensure they move easily.
- 7. Verify tracking with copper filters as follows:

1 copper filter =  $60kV \pm 3kV$ 

- 2 copper filters =  $70kV \pm 3kV$
- 3 copper filters =  $78kV \pm 3kV$

#### **Camera Iris Closed Stop (Short Method Continued)**

- 1. In the AUTO FLUORO mode, verify TECH LOCK is OFF.
- 2. Tape 1 copper filter on the bottom of the collimator to ensure it covers the entire X-ray beam.
- 3. Loosen the set screw on the closed iris stop as shown in Figure 33.
- 4. While making an exposure, turn the gears to adjust the iris (open or closed) until the generator tracks to 68 kV.
- Carefully swing the closed iris stop against the stop pin. Tighten the set screw to 10 inch/lbs (about 60° of twist in Bristol driver). DO NOT OVER TIGHTEN THE SET SCREW.
- 6. Check the gears to ensure they move easily.
- 7. Verify the generator tracks to 68 kV with one copper filter and the iris closed.
- 8. Rotate the iris to the open stop position.
- 9. Reboot the system and re-verify tracking from the specifications on the previous page.
- 10. Remove all copper filters when finished.
# PIXEL/COLUMN FILTER PCB ADJUSTMENTS

This adjustment is for systems that have the Pixel/Column Filter PCB on the camera assembly. The adjustments are performed to correct for any shading differences that appear as "columns" in the image.

#### **Procedure**

- 1. Verify the Monitor Test Pattern is removed by pressing ESC four times.
- Set switch SW2 (coarse pixel adjustment 1 pixel steps) on the Pixel/Column Filter PCB, as shown in Figure 34, to match the switch SW2 (horizontal centering) setting on the CCD camera.



Figure 34 - Pixel/Column Filter Adjustments

- 3. Set switch SW1 (fine pixel adjustment 1/2 pixel steps) on the Pixel/Column Filter PCB to its nominal setting of 8.
- 4. Setup the system as follows:
  - MANUAL FLUORO mode at 50 kV and 2.5 mA
  - 1 copper filter in the beam
  - MAG2 field size
  - Adjust window to a value between 50-60
  - Adjust level to a value between 60-80 until there is a gray field on the left monitor

5. While making an exposure, adjust switch SW1 on the Pixel/Column Filter PCB to get the best cancellation of any column shading differences. Figure 35 demonstrates what characteristics column defects look like and, therefore, what this adjustment is trying to eliminate or reduce.



#### Figure 35 - Unacceptable Column Defect Image

- 6. While making an exposure, adjust R1 (magnitude of the cancellation signal) on the Pixel/Column Filter PCB to increase or decrease cancellation if required. This is shown in Figure 34 and can be accessed from the side of the system as indicated by the arrow.
- 7. Remove the copper filter.

# ANTI-VIGNETTING (SHADING) ADJUSTMENT

This adjustment is to correct for shading differences that appear in the image.

#### Procedure

- 1. Verify the system is in the AUTO FLUORO mode with nothing in the beam path.
- 2. Set the Workstation Window to 80 and Level to 125.
- 3. While imaging, an unacceptable image similar to that shown in Figure 36 may appear. This image indicates vignetting (shading around the periphery of the image) and needs to be adjusted as described in step four. *Otherwise,* the image may appear "flat" with no bright spots indicating this parameter does not need adjustment (A <u>slight</u> overall brightness in the center of the image is acceptable). If this is the case, proceed to step 5 to complete the camera alignment process.



Figure 36 - Image Vignetting

4. Adjust VR16, shown in Figure 37, to achieve a "flat" image with no bright spots located in the image. A <u>slight</u> overall brightness in the center of the image is acceptable.



Figure 37 - VR16 Location

- 5. Remove all test equipment from the system.
- 6. THIS CONCLUDES THE BEAM & CCD CAMERA ALIGNMENT PROCESS.

# **WORKSTATION CONTROL**

# **OVERVIEW**

This section includes all the printed circuit cards and assemblies that have been designed to perform a Workstation control function or that support such a function. The circuit boards and signals used in the control or processing of video signals are discussed in the <u>Video Path</u> and <u>Video Control</u> sections of the manual.

Refer to Figure 1 for an overview of control signal flow and serial communications.

The information given in this section is most easily understood while using the following schematics. Use the correct interconnect diagrams and circuit board schematics for your system.

#### 9600 Workstation Interconnect

Schematic # 00-876158 - System serial numbers 69-0001 thru 69-1000 Schematic # 00-877970 - System serial numbers 69-1001 and higher

#### Auxiliary Interface PCB

Schematic # 00-876502 - All serial numbers

<u>Communications PCB</u>

Schematic # 00-872125 - All serial numbers

#### <u>Control Panel Processor PCB</u>

Schematic # 00-876611 - All serial numbers

• IR Transmitter PCB

Schematic # 00-873936

IR Receiver PCB

Schematic # 00-874220



Figure 1 - Control Path and Serial Communications Diagram

# **CONTROL PANEL ASSEMBLY**

The Control Panel Assembly includes the following components (see Figure 2):

- Front Panel
- Trackpad
- Keyboard
- Control Panel Processor PCB

Refer to the <u>System Overview</u> section of the manual for disassembly of the Control Panel Assembly.



Figure 2 - Workstation Control Panel Assembly

## **FRONT PANEL**

The following functions are controlled from the Front Panel Switches:

- Averaging
- Fluoro
- One-shot
- Enhanced One-shot(Digital Spot)
- Recall
- Save
- L<>R

This panel cannot be repaired in the field. If problems arise, it must be replaced. The defective panel should be sent to the factory for repair. Refer to the <u>Illustrated Parts</u> <u>Manual</u> for part numbers.

Diagnostics are included in the system software that allow testing of the front panel controls.

# **K**EYBOARD

The QWERTY Keyboard is similar to the keyboard used on a computer, but contains specially labeled keys that control system functions. The alpha-numeric keys are used for patient annotation and system control. A drawing of the QWERTY keyboard is contained in the **System Overview** section of the manual.

This keyboard cannot be repaired in the field. If problems arise, it must be replaced. The defective keyboard should be sent to the factory for repair. Refer to the <u>Illustrated Parts</u> <u>Manual</u> for part numbers.

## TRACK PAD

The Track Pad contains function keys for control of system operations, along with a force-sensitive-resistor array (FSR) analog interface that acts as an electronic trackball. Drawings of the Track Pad Panels are contained in the <u>System Overview</u> section of the manual.

This panel cannot be repaired in the field. If problems arise, it must be replaced. The defective panel should be sent to the factory for repair. Refer to the <u>Illustrated Parts</u> <u>Manual</u> for part numbers.

The Track Pad Panel contains buttons which control specific system operations. A pressure-sensitive Track Pad is used to control cursor movement on the monitor screens. Diagnostics are included in the system software that allow testing of the TrackPad panel.

# **CONTROL PANEL PROCESSOR PCB**

#### Microprocessor

U5 is an 80C196KC microcontroller running at 12Mhz. Y1 is the crystal oscillator providing the 12MHz clock signal. This can be measured at TP11.

U24 and associated circuitry comprise a watchdog circuit driven from microcontroller U5, pin 20. This line must be toggled every 1.6 seconds to keep the watchdog from timing out and issuing a reset to the microcontroller. Power monitor U24 is also used as a reset generator to monitor the +5 volt supply to microcontroller U5. The reset output is held low when the +5 supply is less than approximately 4.65 volts. This low will generate a reset to microcontroller U5 and also PAL U4.

U13 is a four channel push-pull driver used to drive an externally mounted piezoelectric tone generator. It is driven from microcontroller U5 pin 28 through inverter U11 pin 12.

A beep is sounded when the Boot process is complete and the Control Panel Interface PCB, QWERTY keyboard, front panel, and TrackPad panel are successfully enabled.

#### **Memory and Addressing**

PAL U4, and latches U2 and U14 are used for address decoding.

U10 is the boot EPROM (32K bytes) containing the code for microcontroller U5.

U1 is read and write Static RAM .

#### **Control Inputs and LEDs**

The Control Panel Processor PCB receives command and text signals from the:

- QWERTY Keyboard
- Track Pad Panel
- Front Panel

The force sensitive resistor (FSR) on the Track Pad pointing device provides four analog signals (S, E, N, W). These signals are input directly to microcontroller U5.

The microprocessor scans the Qwerty Keyboard, Front Panel keys, and Track Pad Panel keys through the row output latches U18 and U22. The microprocessor detects which switch is pressed through keyboard column input latches U15 and U23. Software continuously scans the keypad to determine if any keys have been pressed. U20 & 21, U12, 16, 17, & 19 are octal latches used to sink LED currents. Writing an "0" to the appropriate bit will turn the addressed LED on. U20 & 21 are used to control the LEDs on DS1 which is a diagnostic/status bargraph. U12, 16, 17, & 19 are used to control the LEDs on the Track panel and the Front panel. R29, 30, 37, 36, 28, & 24 are current limiting resistors for the LEDs.

#### **Serial Communications**

As the Control Panel Processor PCB receives instructions from the Keyboard, Front Panel, and Track Pad panel, it sends data to the 386 AT Motherboard via U7, an RS232 serial transceiver. These signals then pass through the Auxiliary Interface PCB to the AT Communications PCB where they are received by DUART U27. U27 then places the information on the 386 AT Motherboard data bus. The Motherboard passes instructions back through DUART U27 to the appropriate circuit board.

E2-E5 are jumpers to configure the serial communications signals for either RS422 or RS232. They are presently configured for RS232.

#### **Diagnostic Bargraph**

DS1 is a diagnostic bargraph used to indicate various operating conditions in the Workstation. Refer to the Workstation Software section for details.

#### **Infrared Input**

U9 is an opto-isolator that receives IR signals from the IR Receiver PCB. The output of U9 passes through AND gate U3 and is then input to microcontroller U5 at pin 15. The incoming infrared signals can be measured at test point TP5. Refer to the <u>Infrared</u> <u>Transmitter/Receiver</u> heading in this section for details.



Figure 3 - Workstation Control Panel Processor PCB



# **ELECTRONICS BOX**

The Electronics Box is the housing for the 386 System Motherboard and most of the other Workstation circuit boards (refer to Figure 4). Two fans are mounted on a bracket under the bottom of the box to aid in air circulation. Doors in the rear and side of the rack provide service access to the system electronics. Rotate the 1/4-turn fasteners on each door and swing the door outward to open.

The elapsed time indicator is mounted on either the top or side door of the electronics box.

#### NOTE: Before performing any adjustments or replacements, OEC Field Service personnel and Dealers are required to confirm that the elapsed time meter is operational and enter the elapsed time on the Field Service Report. It is important to report this time on each FSR.

## CABLING

Cables plugged into the Electronics Box should be removed if the rack is to be removed from the Workstation chassis frame. Cables are attached at the top rear and front lower left side (see Figures 5 and 6). The Lenzar camera video cable is plugged into J6 at the upper right corner of the Electronics Rack, if the camera has been installed.



Figure 5 - Electronics Box Cable Connectors on Lower Left Side



Figure 6 - Electronics Box Top Cable Connectors

### MOUNTING

The Electronics Box is mounted to the Workstation chassis frame with two Torx-head screws through the back wall of the box and two through the base adjacent to the large access door.

# **AUXILIARY INTERFACE PCB**

#### Assy. # 00-876504 - Sch. # 00-876502

The Auxiliary Interface PCB is a primary connection and distribution point for signals within the Workstation. The connector side (see <u>Figure 8</u>) of the circuit board provides external connection points at the rear panel of the Workstation.

## **CONNECTORS**

The following table outlines the cabling connections on the Auxiliary Interface PCB:

| Auxiliary<br>Interface<br>PCB | Signal(s)   |
|-------------------------------|---|
| Connector                     |   |
| P1                            | Camera Video Output to J6 on Video Switching PCB, from P10 (Aux Int.), from C-Arm                                   |
| P2                            | not used  |
| P3                            | Parallel Printer Interface from AT Communications PCB (P4),<br>to P18 (Aux Interface PCB)                           |
| P4                            | not used  |
| P5                            | COM 2 Communications Port on Rear Panel, from P13 (Aux  |
|                               | Interface PCB), from AT Communications PCB (P5)   |
| P6                            | Room Interface Connection on Rear Panel   |
| P7                            | VCR Serial Interface (optional)   |
| P8                            | To X-ray On LED array on top of Workstation via J9/P9 and J11/P11   |
| P9                            | Connects to J8 on Video Switching PCB, interface for<br>"XRAYDIS1*" and "STORE*" signals                            |
| P10                           | Connecting point for interconnect cable (signals) from C-Arm  |
| P11                           | DC Power for Aux Interface PCB from DC Power Distribution PCB   |
| P12                           | Connection to Workstation Control Panel Processor PCB   |
| P13                           | Connects to P5 on AT Communications PCB, for COM 1, COM 2, and drive signals for diagnostic LEDs (U3 and U4) on Aux |
|                               | Interface PCB   |

| Auxiliary<br>Interface<br>PCB<br>Connector | Signal(s)   |
|--|---|
| P14  | Connects to P3 on AT Communications PCB, for VCR  |
|  | controls, Serial Communications, other discrete signals   |
| P15  | VCR control signals, connects to internal VCR   |
| P16  | VCR control signals, connects to Rear Panel for external VCR  |
| P17  | COM 1 Communications Port on Rear Panel, from P13 (Aux<br>Interface PCB), from AT Communications PCB (P5) |
| P18  | Parallel printer connection on Rear Panel, to P3 (Aux Interface PCB), to AT Communications (P4)           |
| P19  | Video to/from Video Switching PCB for external VCR (VCR 2)  |
| P20  | Video from external VCR (VCR 2) to Video Switching PCB via P19 (Aux Interface PCB)                        |
| P21  | Video to external VCR (VCR 2) from Video Switching PCB via P19 (Aux Interface PCB)                        |

#### Table 1 - Auxiliary Interface PCB Connectors

## **K1 - K4 ROOM INTERFACE RELAYS**

Relays K1-K4 are provided to interface an "X-ray On Light" and "Room In Use Light." Call the OEC Tech Support office for more information.

# X-RAY ON LED ARRAY DRIVER

The LED array on top of the Workstation illuminates when X-rays are being produced. The signal "X-RAY LAMP" (active Low) from the Power/Motor Relay PCB on the C-Arm is interfaced to the Aux Interface PCB via the interconnect cable. "X-RAY LAMP" enters inverter U1 pin 3 on the Aux Interface PCB. The output at pin 4 (active HI) turns on Q1, which provides a return path for the LED array current. The power for the array is +5V, jumpered through E3 pins 2 and 3.

#### WARNING... Damage to the LED array will occur if E3 pins 1 to 2 are jumpered together.

### **BOOT AND DIAGNOSTIC LEDS**

LED displays U3 (MSB) and U4 (LSB) provide boot and diagnostic codes from the 386 AT Motherboard on the Workstation. They are driven from the AT Motherboard via the AT Communications PCB. Refer to the *Workstation Software* section for a listing of these codes.

# X-RAY DISABLE CIRCUITRY

U1, U5, and jumper E1 on the Aux Interface PCB are used in the X-ray disable circuitry. Refer to the X-ray On / X-ray Disable section for details of this circuit.



Figure 7 - Auxiliary Interface PCB (component side)



# **COMMUNICATIONS PCB**

#### Assy. #00-872127 - Sch. #00-872125

The Communications PCB provides serial and parallel communications capabilities for the Motherboard with external devices, such as a printer. Internal system communications with the Control Panel Processor PCB and the C-Arm are also handled by the PCB. The circuit board plugs directly into the AT Motherboard (see Figure 4).

## SERIAL COMMUNICATIONS

The Communications PCB handles all of the serial communications for the AT Motherboard to the Workstation Control Panel Processor PCB and the C-Arm.

#### **AT Motherboard to Control Panel Processor**

Signals from the 386 AT Motherboard are received by DUART U27 on the AT Communications PCB via the data bus. U27 converts this information to RS232 serial data. The serial data then passes through the Aux Interface PCB, through RS232 transceiver U7 on the Control Panel Processor and to microcontroller U5. Microcontroller U5 on the Control Panel Processor PCB communicates over the same path to the AT Motherboard

UART U26 on the AT Motherboard handles discrete signals for the room interface relays on the Aux Interface PCB when they are used.

#### **AT Motherboard to C-Arm**

Communication between the C-Arm and Workstation is established during the boot process. All 20 arrows will be displayed on the Control Panel Display, as shown below, during this part of the boot process.

#### 

During normal operation, the Technique Processor and 386 AT Motherboard send information such as:

- Shot log file information from the C-Arm to the Workstation
- Commands such as L>R, SAVE and CART MODE from the Control Panel to the Workstation
- "Enable Boost" command to the C-Arm when (CHOLE)/DIGITAL SPOT is selected on the Workstation

The TXD and RTS signals from Port B of the serial communications controller U39 on the Technique Processor PCB are sent to the 386 AT Motherboard on the Workstation. They pass through RS232 driver/receiver U52 on the Technique Processor PCB and then pass through the Mainframe Motherboard, the Interconnect cable, and enter the Aux Interface PCB in the Workstation. They pass through the Aux Interface PCB to the AT Communications PCB where they are inverted by U15 and enter DUART U27. U27 interfaces the signals to the data bus of the AT Motherboard.

The 386 AT Motherboard communicates over the data bus to DUART U27 on the AT Communications PCB. TXDA (pin 30) and RTS (pin 29) leave DUART U27, pass through RS232 line driver U16 and leave the AT Communications PCB at P3. They then pass through the Aux Interface PCB, the Interconnect Cable and enter the C-Arm at J1 on the Power Panel. They pass through the Mainframe Motherboard and enter the Technique Processor PCB at P2.

On the older Technique Processor PCB (Assy. #876735) the signals then pass through RS232 driver/receiver U52 and are received by serial communications controller U39 at pins 8 (RXD) and 23 (CTS).

On the newer Technique Processor PCB (Assy. #877744) the signals then pass through RS232 driver/receiver U52 and COM SELECT GAL U38 and are received by serial communications controller U39 at pins 8 (RXD) and 23 (CTS).

# VCR CONTROLS

Control signals for the VCRs are interfaced to the AT Motherboard via the AT Communications PCB at P3. Refer to the <u>Peripherals</u> section for details.

# PARALLEL PRINTER INTERFACE

The port for a parallel printer is interfaced through the AT Communications PCB at connector P4. Refer to the **Peripherals** section for details.

# COM 1 AND COM 2 COMMUNICATION PORTS

COM 1 and COM 2 communication ports are currently not used on the 9600 system.

# **OPTION PROM**

Option PROM U25 on the Communications PCB is accessed by the AT Motherboard during the boot process for information such as:

- CGA graphics driver software, used until the Image Processor PCB is initialized.
- CMOS setup.
- OEC software signature stamp, if a diskette is found in the 3 1/2-inch floppy drive.

## CLOCK

Oscillator Y1 and counter U36 provide clock signals for DUARTS U26 and U27 (3.6864 MHz), UARTS U22 and U20 (1.8432 MHz), and the boot and diagnostic LEDs (230.4 Khz) on the Aux Interface PCB.

# JUMPERS E1, E2, E3

Jumpers E1, E2, and E3 on the AT Communications PCB are used to configure the system for the hard drive disk type installed in the Workstation. Refer to the <u>Image</u> <u>Storage</u> section for details.



Figure 9 - AT Communication PCB

# **386 AT MOTHERBOARD**

The System 386 AT Motherboard contains the main system microprocessor. It communicates with the following circuit boards:

DESCRIPTION

COM 2/4 IRQ

COM 1/3 IRQ

- Image Processor PCB
- Communications PCB

JUMPER

W1

W2

These interface boards plug directly into connectors on the Motherboard.

## **386SX MB JUMPER SETTINGS**

POSITION

1 - 2

1 - 2

| 1 - 2  | FLASH   |  |  |  |  |
|--|---|--|--|--|--|
| 1 - 2  | LPT IRQ   |  |  |  |  |
| 2 - 3  | COLOR/MONO  |  |  |  |  |
| 1 - 2  | MICROSOFT   |  |  |  |  |
| OFF  | MOUSE INT   |  |  |  |  |
| 1 - 2  | CMOS RESET  |  |  |  |  |
| 1 - 2  | FREQ SEL  |  |  |  |  |
| 2 - 3  | FREQ SEL  |  |  |  |  |
| 1 - 2  | CMOS BATTERY SEL  |  |  |  |  |
|  | (EXTERNAL)  |  |  |  |  |
|  |   |  |  |  |  |
| Table 2 296 AT Metherheard Jumper Settings   |   |  |  |  |  |
| Table 2 - 500 AT Wornerboard Jumper Settings |   |  |  |  |  |
|  | 1 - 2<br>1 - 2<br>2 - 3<br>1 - 2<br>OFF<br>1 - 2<br>1 - 2<br>2 - 3<br>1 - 2<br>2 - 3<br>1 - 2 |  |  |  |  |

NOTE: The CMOS Battery Jumper, W11, must be in the 1-2 position for the 9600, due to use of an external battery (P/N 74-122854-00, 5.5V Alkaline). The external battery is placed above the System 386 Motherboard and secured to the Electronics Box with double-sided tape.





Figure 10 - 386 AT Motherboard

# **IR (INFRARED) REMOTE CONTROLS**

The Infrared Remote Control provides remote operation of most of the functions of the 9600 Imaging System. The Controls can be used up to 20 feet from the Infrared Receiver that is located between the monitors on the Workstation. Point the remote directly at the receiver for best results. When a push-button is pressed, a brief pause should be allowed before another push-button is pressed.



Figure 11 - Infrared (IR) Remote Controls - Older and Newer Styles

NOTE: The newer style IR Receiver PCB works with the older and newer hand controls, whereas the older style IR Receiver PCB works only with the old style hand controls.

# **IR TRANSMITTER PCB**

#### Assy. #00-873938 - Sch. #00-873936

In standby mode with no push-button pressed, the drive (DRV) lines are low, the sense (SEN) lines are high, and the output of U1 is low.

Pressing a push-button forces a sense input low and starts a keyboard scan cycle (IC U1). Positive pulses equal to the battery voltage turn on Transistors Q1 thru Q6 and Infrared Diodes CR14 thru CR17.



11 - 12 = 9600 Mobile C-Arm

#### Figure 12 - Newer Style IR Remote Control Block Diagram

IC U1 generates a modulated waveform consisting of six pulses per burst, with a complete transmission consisting of 12 bursts (i.e., one start bit, one reference bit, one toggle bit, three address bits and six command bits). Each bit is transmitted as a burst of six pulses at a repetition rate of 53.3 kHz. Pulse distance coding is used. This means the time between each burst of pulses determines whether the bit is a logic one or a logic zero.

Pulse transmission can be monitored with an oscilloscope connected across Resistor R4. When a push-button is pressed, positive-going pulses approximately .7 volts peak should be present. If the pulses are negative-going, reverse the probe connections. The pulses should be approximately 8 micro-seconds wide and should occur in bursts of 6 pulses each.

The circuitry associated with Q7-Q10 monitors the output of U1 and the battery voltage. If the pulses stay above +6.5 volts during transmission, Transistor Q7 is turned on and Transistors Q8-Q10 are turned OFF, preventing the *Low Battery* LED from being turned ON.

If the pulses are below +6.5 volts, transistor Q7 is not turned ON and current flows through R7 and CR5 to charge Capacitors C6 and C7. This turns transistors Q8-Q10 ON and lights the *Low Battery* LED for approximately 5 seconds after the push-button is pressed. If the pulses are below +3.5 volts, the *Low Battery* LED will not light.

#### Older Style

Pressing a push-button forces a sense input low and starts a keyboard scan cycle (IC U1). Positive pulses equal to the battery voltage turn on Transistors Q4 thru Q6 and Infrared Diodes CR14 and CR15.

IC U1 generates a modulated waveform consisting of six pulses per burst, with a complete transmission consisting of 12 bursts (i.e., one start bit, one reference bit, one toggle bit, three address bits and six command bits). Each bit is transmitted as a burst of six pulses at a repetition rate of 37.9 Khz. Pulse distance coding is used. This means the time between each burst of pulses determines whether the bit is a logic one or a logic zero.



#### Figure 13 - Older Style IR Remote Control Block Diagram

## **BATTERY REPLACEMENT**

- 1. A standard +9-volt alkaline battery is used by the Infrared remote control unit.
- 2. Remove the four screws securing the case of the control and lift off the rear half of the case from the front half.
- 3. Remove the 9-volt battery by unplugging the snap fasteners and replace it with a new battery.
- 4. Replace the cover and tighten the screws securely.

### **STRAPPING**

# NOTE: E1 jumpers 1-2 through 13-14 select the sub-system address which determines if the unit is to operate with a C-Arm system or UroView system.

For 9600 Mobile C-Arms jumper E1 11 - 12.

#### **Older Style**

For a 9600 Series Mobile C-Arm system, jumper E1 13-14.

Only one jumper should be placed on the E1 header.

# **IR RECEIVER PCB**

#### Assy. #00-874222 - Sch. #00-874220

The Infrared Receiver PCB consists primarily of IC U1, an infrared preamplifier configured as a narrow band amplifier. The Infrared Receiver PCB assembly is housed in a metal box that is located between the monitors on top of the Workstation.

Transmitted data from the IR Remote Control is detected by infrared diode CR3 and is applied to the IR pre-amp U1-1. The negative going pulses of U1-9 are inverted by transistor Q1 and applied to pin 1 of opto-isolator U9 on the Control Panel Processor PCB. These data pulses (measured at TP 5) are then sent to microcontroller U5 pin 15 through AND gate U3. Microcontroller U5 then passes the data to the 386 AT Motherboard as discussed in the Control Panel Processor PCB serial communications section.

By tuning L2 and C8, the frequency of the IR receiver circuit is tuned to 53.3 Khz on newer style controls and 37.9 Khz on older style controls.

## **FUNCTIONAL TEST**

1. From a distance greater than 20 ft press a push-button on the IR Remote and determine if the receiver has received the signal by watching the Workstation control panel indicators.

NOTE: If the IR Remote doesn't work at a distance greater than 20 feet but works at a distance closer to the Workstation, a problem with the 9 Volt battery may be indicated. The IR Remote can operate the system when the infrared beam is bounced off ceilings, walls and other surfaces. If this effect is not noted, it may indicate a problem with the infrared diodes or 9 Volt battery. If the +9 volt battery voltage drops to between 6.5 volts and 3.5 volts, the Low Battery LED will light for about 5 seconds after each push-button press. If the battery is below 3.5 volts, the LED will not be illuminated and loss of remote infrared functions will occur.

 Verify the push-buttons on the IR Remote operate with a definite clicking action. If a button does not exhibit the click action, the internal dome could be collapsed. If the button is damaged, the entire unit keyboard must be replaced.

# **DIAGNOSTIC TEST**

If a problem is suspected with a push-button, perform the following test:

- 1. Press the SETUP OPTIONS switch and select Access Level 2 (Service).
- 2. Select Run System Diagnostics.
- 3. Select Front Panel Tests.
- 4. From a distance of twenty feet aim the transmitter at the receiver and press each transmitter switch. Verify that the value displayed on the right monitor equals the values listed:

Disk View = 52 Acquire Images = 37 Play/process = 12 Registration = 26 Sharpen = 2 Window = 0 - 80Auto Histo = 32 Averaging Select = 28 Image Dir = 7 Recall = 10 Zoom = 25 Window/Level On/Off = 49 Level = 0 - 80 Negate = 40

#### **Older Style**

The older 9600 Series IR Remote Control will display the following codes when each button is pressed during the diagnostic test. Mode Select = 20Averaging Select = 28 Reset Alarm = 5 Image Dir = 4 Recall = 10Zoom = 25Sharpen = 2Norm/Mag = 17Rotate CW = 1Rotate CCW = 9Open = 16Close = 24Close = 8Open = 0

- 5. Press the **ENTER** switch on the transmitter.
- 6. Verify that the X and Y axis values are displayed.
- 7. Verify that the X and Y axis values change when the direction (arrows) switches on the transmitter are pressed.

# NOTE: The UP/DOWN switches decrease and increase (respectively) the Y axis values and the LEFT/RIGHT switches decrease and increase (respectively) the X axis values.

- 9. Exit the front panel tests and escape out of Level 2 Diagnostics by pressing **ENTER**.
- 10. Take an exposure to obtain a new image on the left monitor.
- 11. Press the **ZOOM** switch on the Workstation. The region of interest (ROI) window should appear within the left monitor image.
- 12. Press and hold the IR receiver direction switches and verify that the ROI window can be moved around on the left monitor image. The ROI should begin moving slowly and increase in speed.

#### NOTE: Before any repairs are done, Field Service personnel are reminded to note the elapsed time on the Field Service Report from the system Elapsed Time Indicator. It is important that this time be reported in each instance.

# **INTERCONNECT CABLE**

The interconnect cable connects the C-Arm to the Workstation. The Workstation end of the cable is hardwired to the Aux Interface PCB and power distribution connectors within the Workstation. The C-Arm end has a plug that connects to a mating receptacle on the power panel of the C-Arm. Matching red dots on the plug and the receptacle are used for connector alignment when plugging the cable to the C-Arm.

CAUTION: Exercise care when handling the interconnect cable connector to avoid dropping it on a hard surface where it may be damaged.



Figure 15 - Interconnect Cable Pinout - Connector at End of Cable

|       | INTERCONNECT CABLE P/N<br>876183  | INTERCONNECT CABLE P/N<br>878027  |
|-------|---|---|
|       | SYSTEM SERIAL NUMBER RANGE<br>69-0001 TO 69-1000<br>USE INTERCONNECT DRAWING<br>#875500 | SYSTEM SERIAL NUMBER RANGE<br>69-1001 AND HIGHER<br>USE INTERCONNECT DRAWING<br>#877972 |
| PIN # | SIGNAL NAME   | SIGNAL NAME   |
| 1     | Spare   | KEY_PWR   |
| 2     | MFRTS   | MFRTS   |
| 3     | MFCTS   | MFCTS   |
| 4     | STORE*  | STORE*  |
| 5     | XRAYINH   | XRAYINH   |
| 6     | XRAY_LAMP   | XRAY_LAMP   |
| 7     | VIDSTAB*  | VIDSTAB*  |
| 8     | MFRXD   | MFRXD   |
| 9     | MFTXD   | MFTXD   |
| 10    | Spare   | LOOP 2  |
| 11    | FLURO   | FLURO   |
| 12    | CNCT_ON   | CNCT_ON   |
| 13    | 120_VAC_PH1   | 115_VAC_PH  |
| 14    | CAMVID  | CAMVID  |
| 15    | CAMVIDRTN   | CAMVIDRTN   |
| 16    | CHASSIS   | CHASSIS   |
| 17    | DC_COM  | DC_COM  |
| 18    | LOOP 1  | LOOP 1  |
| 19    | 120_VAC_PH2   | 115_VAC_RTN   |
| 20    | LOOP 2  | Spare   |
| 21    | KEY_PWR   | Spare   |
| 22    | NEUTRAL   | NEUTRAL   |
| 23    | LMONE   | LMONE   |
| 24    | LMON_RTN  | LMON_RTN  |

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# **WORKSTATION SOFTWARE**

# **OVERVIEW**

Software files for the Workstation reside on a hard disk located within the electronics box in the Workstation. This section discusses the following Workstation software topics:

- Start-up and Software Boot
- Diagnostics

# **START-UP AND SOFTWARE BOOT**

# POWER-ON SELF TEST

When the system is initially powered up, the System 386 Motherboard performs Power-On Self Tests (POST). If the POSTs are successful, the Workstation 386 Motherboard continues through the boot process. LED readouts on the rear panel of the Workstation indicate the status of the boot process. The Boot Sequence and Error Codes displayed are listed and detailed in this section If the boot sequence stops, note the readout and refer to the boot sequence and error codes section for references to possible reasons and locations of the fault.

The following menu shows the information displayed on the monitor screen as the Workstation is booted:

OEC MEDICAL SYSTEMS OPTION ROM P/N 0-877002-02 COPYRIGHT (C) 1993, 1994, OEC MEDICAL SYSTEMS'

(c) American Megatrends, Inc.

# **WORKSTATION BOOT SEQUENCE**

The following procedure describes the Workstation boot sequence that occurs at Workstation power up:

- The AT Processor resets and vectors to 386 AMI BIOSTM software. BIOSTM identifies any Option ROMs and finds the OEC Option PROM on the AT Communications PCB. The date and version of the Option PROM is displayed briefly on the left monitor.
- 2. The CGA video drivers are loaded and the floppy drive is checked (for the presence of a system boot disk) by the AT Option PROM.
- 3. The 386 AMI BIOSTM copyright information is displayed briefly on the monitor. (Award BIOSTM controls information which tells the CPU how and when to access the disk, read the keyboard, load video drivers, run video screens, etc.)
- 4. Workstation performs Power On Self Tests (POST). If all internal motherboard diagnostics pass, the boot sequence continues. If failures occur, the boot sequence stops at the point of failure and an error message appears on the monitor
- 5. The AT Communications PCB initializes the Image Processor.
- 6. The following messages appear briefly on the monitor:
  - FASTOPEN installed: This program speeds up disk access time by keeping track of all files which have been opened.
  - NOBRK installed: This program ensures the boot process cannot be aborted prematurely by the operator and disables NumLock.
  - 4FPSTSR installed: This software enables Workstation communications to the 4FPS or 30FPS disk, if installed. This message does not appear if the Workstation is not equipped with either of these options.
- 7. The Image Processor's GSP (Graphics System Processor) software is reloaded. Both monitors go blank at this point.
- 8. Front panel/pointing device panel communications are enabled. An audible tone can be heard from speaker SP1 when this phase of boot up is complete.
- 9. The Workstation software begins running. The initial Workstation menu appears on the right monitor when the boot up process is complete.

# DIAGNOSTICS

Diagnostic tests are available for use in evaluating the operation of the Workstation electronics. The tests selectable from the *System Diagnostics Menu* are described in the following pages.

- 1. Press the **SETUP OPTIONS** key on the Workstation. The **Setup Options** screen will appear.
- 2. Insert the OEC Boot and Diagnostic disk into the disk drive.
- 3. Select *Access Level 2* and press the ENTER key.
- 4. Select *Run System Diagnostics* and press ENTER.

This screen appears when "*Run System Diagnostics*" is selected from the Service Options Menu.

The tests available from this menu are described below:

| RUN SYSTEM DIAGNOSTICS  |
|---|
| Front Panel Test<br>System Memory Tests<br>Image Processor Tests<br>Toggle Motion Artifact                                      |
| Use the cursor arrow keys to select<br>option, then press ENTER.<br>Press the ESC key to exit<br>and return to previous screen. |
## FRONT PANEL TEST

Selecting *"Front Panel Test"* from the System Diagnostics Menu brings up a screen similar to the one below. (This display will contain only the instructions at the bottom of the screen until the keys are pressed.)

Descriptions for each portion of the screen are given below:

**KBD** - Press each key on the Front Panel and the TrackPad Panel. The *kbd* value should display a different number (which represents the hex keycode) for each key pressed. The value is displayed when each key is released. A different audible tone should also be heard for each key pressed.

**LED** - Use the left and right cursor keys to turn on each LED on the Front Panel and the Trackpad Panel. The *LED* value shown on the screen will change to represent each LED as it lights up.

**IR** - Press each key on the infrared (IR) transmitter. The *ifr* value should display a different keycode for each key pressed.

**X & Y** - These numbers represent the X and Y axis for the TrackPad. The X axis value changes from 80 - 120 as the TrackPad is rotated from left to right. The Y axis value changes from 0 - 48 as the TrackPad is rotated from top to bottom.

**SW &** >\*< - The SW value represents the TrackPad superkey and toggles from 0 to 1 when the superkey is pressed. The >\*< symbol represents trackball movement. Its representative motion is limited to a small area in the upper right corner of the display.

**Level & Window** - These values change with adjustment of Level and Window, respectively. Both values will change from 0 - 80.

## SYSTEM MEMORY TESTS

This screen appears, and memory tests similar to the following, begin automatically when "*System Memory Tests*" is selected from the System Diagnostics Menu.

If failures occur, the program will stop at the point of failure and an error message will display the address of the bad memory location. Press **ENTER** to continue memory tests from that point.

SYSTEM MEMORY TESTS AT Base Memory PASSED AT Extended Memory TESTING

(error messages appear here when failures occur)

Press [ENTER] to Continue Press [ESC] to Exit Press [F2] to Repeat

## **IMAGE PROCESSOR TESTS**

These Image Processor Tests begin automatically when this test option is selected from the System Diagnostics Menu.

If test failures occur, the program will halt at the point of failure and display an error message. Press **ENTER** to continue testing from that point.

|                                  | IMAGE PROCESS                                    |              | Y TESTS  |  |  |
|----------------------------------|--|--------------|----------|--|--|
|                                  | Image Memory                                     | F            | PASSED   |  |  |
|                                  | Left Filter RAM                                  | F            | PASSED   |  |  |
|                                  | Right Filter RAM                                 | F            | PASSED   |  |  |
|                                  | Left Bit Planes                                  | F            | AILED    |  |  |
|                                  | Right Bit Planes                                 | F            | PASSED   |  |  |
|                                  | Left LUT   | TESTING      |          |  |  |
|                                  | Right LUT  |              |          |  |  |
| (error me                        | essages appear here                              | when failure | s occur) |  |  |
| Press [E<br>Press [E<br>Press [F | NTER] to Continue<br>SC] to Exit<br>2] to Repeat |              |          |  |  |

## **TOGGLE MOTION ARTIFACT**

**MOTION ARTIFACT ON** 

#### **MOTION ARTIFACT OFF**

This menu selection is an ON/OFF toggle function.

Motion Artifact Reduction (MARS) provides a built-in reduction of motion artifacts displayed in the averaged image. The result is that noise is averaged, but movements are seen without the usual amount of lag. This allows higher levels of averaging to be used for better noise reduction in many situations.

**NOTE:** Averaging can only be used in the Continuous X-Ray mode. The use of Averaging in the Pulse mode is not allowed.

## **CONTROL PANEL TESTS**

# NOTE: To run these tests, the Control Panel Processor Board located under the Control Panel must be exposed to allow viewing of the Diagnostics LED array.

The Control Panel Processor PCB diagnostic program is called if the diagnostic switch is closed by installing a shorting jumper on E1, pins 7-8. This diagnostic tests the LED drivers and the key matrices and provides visual indications of the integrity of both as each key is pressed.

#### **Diagnostic Key Code Display**

The row and column of any key pressed is displayed on the LED diagnostic array (DS1) with the LSB to the left and the MSB to the right; the row in bits 0-3 and the column in bits 4-7.



Segment #9 always blinks except during RESET.

NOTE: The Diagnostic Display is oriented on the PCB with the least significant bit on the left. When the PCB is oriented so that the PCB annotation can be read, the binary display will appear backwards (LSB to the left, MSB to the right).

The following tables detail the codes displayed when the indicated keys are pressed:

### **Qwerty Keys**

| KEY  | DIAGNOSTIC   | Row,  |
|--|--|---|
|  | DISPLAY  | Col.  |
|  | 0123 4567 89   | <u> </u>  |
| HELP   | 0000 0000 XX   | 0,0   |
| ANNOTATE (PATIENT)   | 0000 1000 XX   | 0,1   |
| DISK VIEW  | 0000 0100 XX   | 0,2   |
| IMAGE DIR  | 0000 1100 XX   | 0,3   |
| (blank)  | 0000 0010 XX   | 0,4   |
| MARKERS  | 0000 1010 XX   | 0,5   |
| X-RAY SUMMARY  | 0000 0110 XX   | 0,6   |
| (blank)  | 0000 1110 XX   | 0,7   |
| SPECIAL APPS   | 0000 0001 XX   | 0,8   |
| TEST PATTERN   | 0000 1001 XX   | 0,9   |
| (blank)  | 0000 0101 XX   | 0,10  |
| CUSTOMIZE  | 0000 1101 XX   | 0,11  |
| SETUP OPTIONS  | 0000 0011 XX   | 0,12  |
| UNLABELED #1   | 0000 1011 XX   | 0,13  |
| UNLABELED #2   | 0000 0111 XX   | 0.14  |
|  | 0000 0111 700  | 0,  |
| (blank)  | 0000 1111 XX   | 0,15  |
| <b>(blank)</b><br>1  | 0000 1111 XX<br>1000 0000 XX   | 0,15  |
| (blank)<br>1<br>2  | 0000 1111 XX<br>1000 0000 XX<br>1000 1000 XX   | 0,15<br>1,0<br>1,1  |
| (blank)<br>1<br>2<br>3   | 0000 1111 XX<br>1000 0000 XX<br>1000 1000 XX<br>1000 0100 XX   | 0,15<br>1,0<br>1,1<br>1,2   |
| (blank)<br>1<br>2<br>3<br>4  | 0000 1111 XX<br>1000 0000 XX<br>1000 1000 XX<br>1000 0100 XX<br>1000 1100 XX   | 0,15<br>1,0<br>1,1<br>1,2<br>1,3  |
| (blank)<br>1<br>2<br>3<br>4<br>5   | 0000 1111 XX<br>1000 0000 XX<br>1000 1000 XX<br>1000 0100 XX<br>1000 1100 XX<br>1000 0100 XX   | 0,15<br>1,0<br>1,1<br>1,2<br>1,3<br>1,4   |
| (blank)<br>1<br>2<br>3<br>4<br>5<br>6  | 0000 1111 XX<br>1000 0000 XX<br>1000 1000 XX<br>1000 0100 XX<br>1000 1100 XX<br>1000 0100 XX<br>1000 0010 XX<br>1000 0010 XX   | 0,15<br>1,0<br>1,1<br>1,2<br>1,3<br>1,4<br>1,5  |
| (blank) 1 2 3 4 5 6 7  | 0000 1111 XX<br>1000 0000 XX<br>1000 1000 XX<br>1000 0100 XX<br>1000 1100 XX<br>1000 0100 XX<br>1000 1010 XX<br>1000 1010 XX<br>1000 0110 XX   | 0,15<br>1,0<br>1,1<br>1,2<br>1,3<br>1,4<br>1,5<br>1,6   |
| (blank) 1 2 3 4 5 6 7 8  | 0000 1111 XX<br>1000 0000 XX<br>1000 1000 XX<br>1000 0100 XX<br>1000 1100 XX<br>1000 0010 XX<br>1000 0010 XX<br>1000 1010 XX<br>1000 0110 XX<br>1000 0110 XX   | 0,15<br>1,0<br>1,1<br>1,2<br>1,3<br>1,4<br>1,5<br>1,6<br>1,7  |
| (blank) 1 2 3 4 5 6 7 8 9  | 0000 1111 XX<br>1000 0000 XX<br>1000 1000 XX<br>1000 1000 XX<br>1000 1100 XX<br>1000 0100 XX<br>1000 0100 XX<br>1000 0110 XX<br>1000 0110 XX<br>1000 1110 XX<br>1000 0001 XX   | 0,15<br>1,0<br>1,1<br>1,2<br>1,3<br>1,4<br>1,5<br>1,6<br>1,7<br>1,8   |
| (blank)  1  2  3  4  5  6  7  8  9  0  | 0000 1111 XX<br>1000 0000 XX<br>1000 1000 XX<br>1000 0100 XX<br>1000 0100 XX<br>1000 0100 XX<br>1000 0100 XX<br>1000 1010 XX<br>1000 0110 XX<br>1000 1110 XX<br>1000 0001 XX<br>1000 1001 XX   | 0,15<br>1,0<br>1,1<br>1,2<br>1,3<br>1,4<br>1,5<br>1,6<br>1,7<br>1,8<br>1,9  |
| (blank) 1 2 3 4 5 6 7 8 9 0 -  | 0000 1111 XX<br>1000 0000 XX<br>1000 1000 XX<br>1000 0100 XX<br>1000 1100 XX<br>1000 0100 XX<br>1000 0010 XX<br>1000 0101 XX<br>1000 01110 XX<br>1000 1001 XX<br>1000 1001 XX<br>1000 0101 XX  | 0,15         1,0         1,1         1,2         1,3         1,4         1,5         1,6         1,7         1,8         1,9         1,10   |
| (blank) 1 2 3 4 5 6 7 8 9 0 - =  | 0000 1111 XX<br>1000 0000 XX<br>1000 1000 XX<br>1000 1000 XX<br>1000 1100 XX<br>1000 0100 XX<br>1000 0100 XX<br>1000 0110 XX<br>1000 0110 XX<br>1000 01110 XX<br>1000 0101 XX<br>1000 0101 XX<br>1000 0101 XX                                | 0,15         1,0         1,1         1,2         1,3         1,4         1,5         1,6         1,7         1,8         1,9         1,10         1,1   |
| (blank)         1         2         3         4         5         6         7         8         9         0         -         =         BKSP                             | 0000 1111 XX<br>1000 0000 XX<br>1000 1000 XX<br>1000 0100 XX<br>1000 1100 XX<br>1000 0100 XX<br>1000 0100 XX<br>1000 1010 XX<br>1000 1010 XX<br>1000 0110 XX<br>1000 0001 XX<br>1000 0101 XX<br>1000 1101 XX<br>1000 0101 XX<br>1000 0011 XX | 0,15         1,0         1,1         1,2         1,3         1,4         1,5         1,6         1,7         1,8         1,9         1,10         1,1         1,12  |
| (blank)         1         2         3         4         5         6         7         8         9         0         -         =         BKSP         ESC                 | 0000 1111 XX<br>1000 0000 XX<br>1000 1000 XX<br>1000 1000 XX<br>1000 1100 XX<br>1000 0100 XX<br>1000 0100 XX<br>1000 1010 XX<br>1000 1010 XX<br>1000 1011 XX<br>1000 1011 XX<br>1000 1011 XX<br>1000 1011 XX                                 | $\begin{array}{c} 3,11\\ 0,15\\ \hline 1,0\\ 1,1\\ 1,2\\ 1,3\\ 1,4\\ 1,5\\ 1,6\\ 1,7\\ 1,8\\ 1,9\\ 1,10\\ 1,1\\ 1,12\\ 1,13\\ \end{array}$  |
| (blank)         1         2         3         4         5         6         7         8         9         0         -         =         BKSP         ESC         (blank) | 0000 1111 XX<br>1000 0000 XX<br>1000 1000 XX<br>1000 1000 XX<br>1000 1100 XX<br>1000 0100 XX<br>1000 0100 XX<br>1000 0110 XX<br>1000 1010 XX<br>1000 1011 XX<br>1000 1011 XX<br>1000 1011 XX<br>1000 1011 XX<br>1000 1011 XX<br>1000 0111 XX | $\begin{array}{c} 0,15\\ \hline 0,15\\ \hline 1,0\\ \hline 1,1\\ 1,2\\ \hline 1,3\\ \hline 1,4\\ \hline 1,5\\ \hline 1,6\\ \hline 1,7\\ \hline 1,8\\ \hline 1,9\\ \hline 1,10\\ \hline 1,1\\ \hline 1,12\\ \hline 1,13\\ \hline 1,14\\ \end{array}$ |

## Qwerty Keys (Cont.)

| KEY      | DIAGNOSTIC   | Row, |
|----------|--------------|------|
|          | DISPLAY      | Col. |
|          | 0123 4567 89 |      |
| ТАВ      | 0100 0000 XX | 2,0  |
| q        | 0100 1000 XX | 2,1  |
| W        | 0100 0100 XX | 2,2  |
| е        | 0100 1100 XX | 2,3  |
| r        | 0100 0010 XX | 2,4  |
| t        | 0100 1010 XX | 2,5  |
| у        | 0100 0110 XX | 2,6  |
| u        | 0100 1110 XX | 2,7  |
| i        | 0100 0001 XX | 2,8  |
| 0        | 0100 1001 XX | 2,9  |
| р        | 0100 0101 XX | 2,10 |
| [        | 0100 1101 XX | 2,11 |
| ]        | 0100 0011 XX | 2,12 |
| HOME     | 0100 1011 XX | 2,13 |
| UP       | 0100 0111 XX | 2,14 |
| PGUP     | 0100 1111 XX | 2,15 |
| CTRL     | 1100 0000 XX | 3,0  |
| а        | 1100 1000 XX | 3,1  |
| S        | 1100 0100 XX | 3,2  |
| d        | 1100 1100 XX | 3,3  |
| f        | 1100 0010 XX | 3,4  |
| g        | 1100 1010 XX | 3,5  |
| h        | 1100 0110 XX | 3,6  |
| j        | 1100 1110 XX | 3,7  |
| k        | 1100 0001 XX | 3,8  |
| <u> </u> | 1100 1001 XX | 3,9  |
| ;        | 1100 0101 XX | 3,10 |
| 1        | 1100 1101 XX | 3,11 |
| CR       | 1100 0011 XX | 3,12 |
| LFT      | 1100 1011 XX | 3,13 |
| (blank)  | 1100 0111 XX | 3,14 |
| RT       | 1100 1111 XX | 3,15 |

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## Qwerty Keys (Cont.)

| KEY   | DIAGNOSTIC  | Row,  |
|---|---|---|
|   | DISPLAY   | Col.  |
|   | 0123 4567 89  | <u> </u>  |
| LSHIFT  | 0010 0000 XX  | 4,0   |
| Z   | 0010 1000 XX  | 4,1   |
| Х   | 0010 0100 XX  | 4,2   |
| С   | 0010 1100 XX  | 4,3   |
| V   | 0010 0010 XX  | 4,4   |
| b   | 0010 1010 XX  | 4,5   |
| n   | 0010 0110 XX  | 4,6   |
| m   | 0010 1110 XX  | 4,7   |
| ,   | 0010 0001 XX  | 4,8   |
|   | 0010 1001 XX  | 4,9   |
| /   | 0010 0101 XX  | 4,10  |
| (blank)   | 0010 1101 XX  | 4,11  |
| RSHIFT  | 0010 0011 XX  | 4,12  |
| END   | 0010 1011 XX  | 4,13  |
| DOWN  | 0010 0111 XX  | 4.14  |
| 501111  |   | .,  |
| PGDN  | 0010 1111 XX  | 4,15  |
| PGDN<br>ALT   | 0010 1111 XX<br>1010 0000 XX  | 4,15<br>5,0   |
| PGDN<br>ALT   | 0010 1111 XX<br>1010 0000 XX<br>1010 1000 XX  | 4,15<br>5,0<br>5,1  |
| PGDN<br>ALT<br>(blank)  | 0010 1111 XX<br>1010 0000 XX<br>1010 1000 XX<br>1010 0100 XX  | 4,15<br>5,0<br>5,1<br>5,2   |
| PGDN<br>ALT<br>(blank)<br>(blank)   | 0010 1111 XX<br>1010 0000 XX<br>1010 1000 XX<br>1010 0100 XX<br>1010 1100 XX  | 4,15<br>5,0<br>5,1<br>5,2<br>5,3  |
| PGDN<br>ALT<br>(blank)<br>(blank)<br>(blank)  | 0010 1111 XX<br>1010 0000 XX<br>1010 1000 XX<br>1010 0100 XX<br>1010 1100 XX<br>1010 0100 XX  | 4,15<br>5,0<br>5,1<br>5,2<br>5,3<br>5,4   |
| PGDN<br>ALT<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)  | 0010 1111 XX<br>1010 0000 XX<br>1010 1000 XX<br>1010 0100 XX<br>1010 1100 XX<br>1010 0010 XX<br>1010 0010 XX<br>1010 1010   | 4,15<br>5,0<br>5,1<br>5,2<br>5,3<br>5,4<br>5,5  |
| PGDN<br>ALT<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)  | 0010 1111 XX<br>1010 0000 XX<br>1010 1000 XX<br>1010 0100 XX<br>1010 1100 XX<br>1010 0100 XX<br>1010 0110 XX<br>1010 0110 XX  | 4,15<br>5,0<br>5,1<br>5,2<br>5,3<br>5,4<br>5,5<br>5,6   |
| PGDN<br>ALT<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)  | 0010 1111 XX<br>1010 0000 XX<br>1010 1000 XX<br>1010 0100 XX<br>1010 1100 XX<br>1010 0010 XX<br>1010 0010 XX<br>1010 0110 XX<br>1010 0110 XX<br>1010 1110 XX  | 4,15<br>5,0<br>5,1<br>5,2<br>5,3<br>5,4<br>5,5<br>5,6<br>5,7  |
| PGDN<br>ALT<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)   | 0010 1111 XX<br>1010 0000 XX<br>1010 1000 XX<br>1010 0100 XX<br>1010 1100 XX<br>1010 0010 XX<br>1010 0010 XX<br>1010 0110 XX<br>1010 0110 XX<br>1010 1110 XX<br>1010 0001 XX  | 4,15<br>5,0<br>5,1<br>5,2<br>5,3<br>5,4<br>5,5<br>5,6<br>5,7<br>5,8   |
| PGDN<br>ALT<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)   | 0010 1111 XX<br>1010 0000 XX<br>1010 1000 XX<br>1010 0100 XX<br>1010 1100 XX<br>1010 0100 XX<br>1010 010 XX<br>1010 1010 XX<br>1010 0110 XX<br>1010 0110 XX<br>1010 0001 XX<br>1010 1001 XX   | 4,15<br>5,0<br>5,1<br>5,2<br>5,3<br>5,4<br>5,5<br>5,6<br>5,7<br>5,8<br>5,9  |
| PGDN<br>ALT<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>Space   | 0010 1111 XX<br>1010 0000 XX<br>1010 1000 XX<br>1010 0100 XX<br>1010 0100 XX<br>1010 0100 XX<br>1010 0100 XX<br>1010 0100 XX<br>1010 0110 XX<br>1010 0101 XX<br>1010 1001 XX<br>1010 0101 XX  | 4,15<br>5,0<br>5,1<br>5,2<br>5,3<br>5,4<br>5,5<br>5,6<br>5,7<br>5,8<br>5,9<br>5,10  |
| PGDN<br>ALT<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(b | 0010         1111         XX           1010         0000         XX           1010         1000         XX           1010         0100         XX           1010         0100         XX           1010         0110         XX           1010         0001         XX           1010         1001         XX           1010         1001         XX           1010         1001         XX           1010         1010         XX           1010         1010         XX           1010         1010         XX | 4,15<br>5,0<br>5,1<br>5,2<br>5,3<br>5,4<br>5,5<br>5,6<br>5,7<br>5,8<br>5,9<br>5,10<br>5,11  |
| PGDN<br>ALT<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)  | 0010 1111 XX<br>1010 0000 XX<br>1010 1000 XX<br>1010 0100 XX<br>1010 100 XX<br>1010 0100 XX<br>1010 0100 XX<br>1010 010 XX<br>1010 0110 XX<br>1010 0110 XX<br>1010 0001 XX<br>1010 0101 XX<br>1010 1101 XX<br>1010 0011 XX  | 4,15         5,0         5,1         5,2         5,3         5,4         5,5         5,6         5,7         5,8         5,9         5,10         5,11         5,12                           |
| PGDN<br>ALT<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(b | 0010 1111 XX<br>1010 0000 XX<br>1010 1000 XX<br>1010 0100 XX<br>1010 100 XX<br>1010 0100 XX<br>1010 010 XX<br>1010 1010 XX<br>1010 0110 XX<br>1010 1001 XX<br>1010 1001 XX<br>1010 1001 XX<br>1010 0011 XX<br>1010 0011 XX<br>1010 1011 XX  | 4,15         5,0         5,1         5,2         5,3         5,4         5,5         5,6         5,7         5,8         5,9         5,10         5,11         5,12         5,13              |
| PGDN<br>ALT<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(blank)<br>(b | 0010 1111 XX           1010 0000 XX           1010 1000 XX           1010 1000 XX           1010 1100 XX           1010 0010 XX           1010 100 XX           1010 0100 XX           1010 100 XX           1010 010 XX           1010 010 XX           1010 010 XX           1010 0110 XX           1010 0110 XX           1010 0001 XX           1010 1001 XX           1010 0101 XX           1010 0101 XX           1010 0101 XX           1010 0111 XX           1010 1011 XX           1010 0111 XX           1010 0111 XX           1010 0111 XX  | 4,15         5,0         5,1         5,2         5,3         5,4         5,5         5,6         5,7         5,8         5,9         5,10         5,11         5,12         5,13         5,14 |

## **Track Pad Keys**

| KEY  | DIAGNOSTIC  | Row,  |
|--|---|---|
|  | DISPLAY   | Col.  |
|  | 0123 4567 89  |   |
| Acquire Images   | 0110 0000 XX  | 6,0   |
| PlayProcess  | 0110 1000 XX  | 6,1   |
| VCR record   | 0110 0100 XX  | 6,2   |
| VCR play   | 0110 1100 XX  | 6,3   |
| SuperKey   | 0110 0010 XX  | 6,4   |
| no key   | 0110 1010 XX  | 6,5   |
| no key   | 0110 0110 XX  | 6,6   |
| no key   | 0110 1110 XX  | 6,7   |
| no key   | 0110 0001 XX  | 6,8   |
| no key   | 0110 1001 XX  | 6,9   |
| no key   | 0110 0101 XX  | 6,10  |
| no key   | 0110 1101 XX  | 6,11  |
| no key   | 0110 0011 XX  | 6,12  |
| no key   | 0110 1011 XX  | 6,13  |
| no kev   | 0110 0111 XX  | 6.14  |
|  |   | - 1   |
| no key   | 0110 1111 XX  | 6,15  |
| no key<br>Landmark   | 0110 1111 XX<br>1110 0000 XX  | 6,15<br>7,0   |
| no key<br>Landmark<br>Register   | 0110 1111 XX<br>1110 0000 XX<br>1110 1000 XX  | 6,15<br>7,0<br>7,1  |
| no key<br>Landmark<br>Register<br>PeakOp   | 0110 1111 XX<br>1110 0000 XX<br>1110 1000 XX<br>1110 0100 XX  | 6,15<br>7,0<br>7,1<br>7,2   |
| no key<br>Landmark<br>Register<br>PeakOp<br>Mask   | 0110 1111 XX<br>1110 0000 XX<br>1110 1000 XX<br>1110 0100 XX<br>1110 0100 XX<br>1110 1100 XX  | 6,15<br>7,0<br>7,1<br>7,2<br>7,3  |
| no key<br>Landmark<br>Register<br>PeakOp<br>Mask<br>no key   | 0110 1111 XX<br>1110 0000 XX<br>1110 1000 XX<br>1110 0100 XX<br>1110 0100 XX<br>1110 1100 XX<br>1110 0010 XX  | 6,15<br>7,0<br>7,1<br>7,2<br>7,3<br>7,4   |
| no key<br>Landmark<br>Register<br>PeakOp<br>Mask<br>no key<br>no key   | 0110 1111 XX<br>1110 0000 XX<br>1110 1000 XX<br>1110 0100 XX<br>1110 0100 XX<br>1110 0100 XX<br>1110 0010 XX<br>1110 0010 XX  | 6,15         7,0         7,1         7,2         7,3         7,4         7,5  |
| no key<br>Landmark<br>Register<br>PeakOp<br>Mask<br>no key<br>no key<br>no key   | 0110 1111 XX<br>1110 0000 XX<br>1110 1000 XX<br>1110 0100 XX<br>1110 0100 XX<br>1110 0100 XX<br>1110 0010 XX<br>1110 1010 XX<br>1110 0110 XX  | 6,15<br>7,0<br>7,1<br>7,2<br>7,3<br>7,4<br>7,5<br>7,6   |
| no key<br>Landmark<br>Register<br>PeakOp<br>Mask<br>no key<br>no key<br>no key<br>no key<br>no key   | 0110 1111 XX<br>1110 0000 XX<br>1110 1000 XX<br>1110 0100 XX<br>1110 0100 XX<br>1110 0100 XX<br>1110 0010 XX<br>1110 0010 XX<br>1110 0110 XX<br>1110 0110 XX  | 6,15         7,0         7,1         7,2         7,3         7,4         7,5         7,6         7,7  |
| no key<br>Landmark<br>Register<br>PeakOp<br>Mask<br>no key<br>no key<br>no key<br>no key<br>no key<br>no key   | 0110 1111 XX<br>1110 0000 XX<br>1110 1000 XX<br>1110 0100 XX<br>1110 0100 XX<br>1110 0100 XX<br>1110 0010 XX<br>1110 0010 XX<br>1110 0110 XX<br>1110 0110 XX<br>1110 0001 XX  | 6,15         7,0         7,1         7,2         7,3         7,4         7,5         7,6         7,7         7,8  |
| no key<br>Landmark<br>Register<br>PeakOp<br>Mask<br>no key<br>no key<br>no key<br>no key<br>no key<br>no key<br>no key   | 0110 1111 XX<br>1110 0000 XX<br>1110 1000 XX<br>1110 0100 XX<br>1110 0100 XX<br>1110 0100 XX<br>1110 010 XX<br>1110 1010 XX<br>1110 0110 XX<br>1110 0001 XX<br>1110 1001 XX   | 6,15         7,0         7,1         7,2         7,3         7,4         7,5         7,6         7,7         7,8         7,9  |
| no key<br>Landmark<br>Register<br>PeakOp<br>Mask<br>no key<br>no key<br>no key<br>no key<br>no key<br>no key<br>no key<br>no key<br>no key   | 0110 1111 XX<br>1110 0000 XX<br>1110 1000 XX<br>1110 0100 XX<br>1110 0100 XX<br>1110 0100 XX<br>1110 0010 XX<br>1110 0110 XX<br>1110 0110 XX<br>1110 0001 XX<br>1110 1001 XX<br>1110 0101 XX  | 6,15         7,0         7,1         7,2         7,3         7,4         7,5         7,6         7,7         7,8         7,9         7,10   |
| no key<br>Landmark<br>Register<br>PeakOp<br>Mask<br>no key<br>no key   | 0110 1111 XX<br>1110 0000 XX<br>1110 1000 XX<br>1110 0100 XX<br>1110 0100 XX<br>1110 0100 XX<br>1110 0100 XX<br>1110 0100 XX<br>1110 0100 XX<br>1110 0101 XX<br>1110 0101 XX<br>1110 0101 XX<br>1110 0101 XX  | 6,15         7,0         7,1         7,2         7,3         7,4         7,5         7,6         7,7         7,8         7,9         7,10         7,11  |
| no key<br>Landmark<br>Register<br>PeakOp<br>Mask<br>no key<br>no key                                     | 0110 1111 XX<br>1110 0000 XX<br>1110 1000 XX<br>1110 0100 XX<br>1110 0100 XX<br>1110 0100 XX<br>1110 010 XX<br>1110 010 XX<br>1110 1010 XX<br>1110 0011 XX<br>1110 1001 XX<br>1110 1101 XX<br>1110 1101 XX<br>1110 0011 XX                                  | 6,15         7,0         7,1         7,2         7,3         7,4         7,5         7,6         7,7         7,8         7,9         7,10         7,12  |
| no key<br>Landmark<br>Register<br>PeakOp<br>Mask<br>no key<br>no key                 | 0110 1111 XX<br>1110 0000 XX<br>1110 1000 XX<br>1110 1000 XX<br>1110 1000 XX<br>1110 0100 XX<br>1110 0100 XX<br>1110 0110 XX<br>1110 0110 XX<br>1110 1011 XX<br>1110 0011 XX<br>1110 0011 XX<br>1110 1011 XX  | 6,15         7,0         7,1         7,2         7,3         7,4         7,5         7,6         7,7         7,8         7,9         7,10         7,11         7,12         7,13              |
| no key Landmark Register PeakOp Mask no key | 0110 1111 XX<br>1110 0000 XX<br>1110 1000 XX<br>1110 1000 XX<br>1110 1000 XX<br>1110 0100 XX<br>1110 0100 XX<br>1110 010 XX<br>1110 0100 XX<br>1110 0110 XX<br>1110 0001 XX<br>1110 0101 XX<br>1110 0101 XX<br>1110 1011 XX<br>1110 1011 XX<br>1110 0111 XX | 6,15         7,0         7,1         7,2         7,3         7,4         7,5         7,6         7,7         7,8         7,9         7,10         7,11         7,12         7,13         7,14 |

## Trackpad Keys (Cont.)

| KEY   | DIAGNOSTIC  | Row,  |
|---|---|---|
|   | DISPLAY   | Col.  |
| -   | 0123 4567 89  |   |
| Zoom  | 0001 0000 XX  | 8,0   |
| Sharpen   | 0001 1000 XX  | 8,1   |
| Histo   | 0001 0100 XX  | 8,2   |
| Negate  | 0001 1100 XX  | 8,3   |
| SuperKey  | 0001 0010 XX  | 8,4   |
| no key  | 0001 1010 XX  | 8,5   |
| no key  | 0001 0110 XX  | 8,6   |
| no key  | 0001 1110 XX  | 8,7   |
| no key  | 0001 0001 XX  | 8,8   |
| no key  | 0001 1001 XX  | 8,9   |
| no key  | 0001 0101 XX  | 8,10  |
| no key  | 0001 1101 XX  | 8,11  |
| no key  | 0001 0011 XX  | 8,12  |
| no key  | 0001 1011 XX  | 8,13  |
| no key  | 0001 0111 XX  | 8,14  |
|   |   | - · -   |
| no key  | 0001 1111 XX  | 8,15  |
| no key<br>Window UP   | 0001 1111 XX<br>1001 0000 XX  | 8,15<br>9,0   |
| no key<br>Window UP<br>Window DN  | 0001 1111 XX<br>1001 0000 XX<br>1001 1000 XX  | 8,15<br>9,0<br>9,1  |
| no key<br>Window UP<br>Window DN<br>OnOff   | 0001 1111 XX<br>1001 0000 XX<br>1001 1000 XX<br>1001 0100 XX  | 8,15<br>9,0<br>9,1<br>9,2   |
| no key<br>Window UP<br>Window DN<br>OnOff<br>Level UP   | 0001 1111 XX<br>1001 0000 XX<br>1001 1000 XX<br>1001 0100 XX<br>1001 1100 XX  | 8,15<br>9,0<br>9,1<br>9,2<br>9,3  |
| no key<br>Window UP<br>Window DN<br>OnOff<br>Level UP<br>Level DN   | 0001 1111 XX<br>1001 0000 XX<br>1001 1000 XX<br>1001 0100 XX<br>1001 1100 XX<br>1001 0100 XX  | 8,15<br>9,0<br>9,1<br>9,2<br>9,3<br>9,4   |
| no key<br>Window UP<br>Window DN<br>OnOff<br>Level UP<br>Level DN<br>no key   | 0001 1111 XX<br>1001 0000 XX<br>1001 1000 XX<br>1001 0100 XX<br>1001 1100 XX<br>1001 0010 XX<br>1001 0010 XX  | 8,15<br>9,0<br>9,1<br>9,2<br>9,3<br>9,4<br>9,5  |
| no key<br>Window UP<br>Window DN<br>OnOff<br>Level UP<br>Level DN<br>no key<br>no key   | 0001 1111 XX<br>1001 0000 XX<br>1001 1000 XX<br>1001 0100 XX<br>1001 1100 XX<br>1001 0010 XX<br>1001 1010 XX<br>1001 1010 XX  | 8,15<br>9,0<br>9,1<br>9,2<br>9,3<br>9,4<br>9,5<br>9,6   |
| no key<br>Window UP<br>Window DN<br>OnOff<br>Level UP<br>Level DN<br>no key<br>no key<br>no key   | 0001 1111 XX<br>1001 0000 XX<br>1001 1000 XX<br>1001 0100 XX<br>1001 1100 XX<br>1001 0010 XX<br>1001 1010 XX<br>1001 0110 XX<br>1001 0110 XX  | 8,15<br>9,0<br>9,1<br>9,2<br>9,3<br>9,4<br>9,5<br>9,6<br>9,7  |
| no key<br>Window UP<br>Window DN<br>OnOff<br>Level UP<br>Level DN<br>no key<br>no key<br>no key<br>no key   | 0001 1111 XX           1001 0000 XX           1001 1000 XX           1001 0100 XX           1001 1100 XX           1001 0010 XX           1001 0010 XX           1001 1010 XX           1001 1010 XX           1001 110 XX           1001 0110 XX           1001 110 XX           1001 110 XX           1001 110 XX           1001 110 XX   | 8,15<br>9,0<br>9,1<br>9,2<br>9,3<br>9,4<br>9,5<br>9,6<br>9,7<br>9,8   |
| no key<br>Window UP<br>Window DN<br>OnOff<br>Level UP<br>Level DN<br>no key<br>no key<br>no key<br>no key<br>no key   | 0001 1111 XX           1001 0000 XX           1001 1000 XX           1001 0100 XX           1001 1100 XX           1001 0010 XX           1001 1001 XX           1001 1010 XX           1001 1110 XX           1001 1001 XX           1001 1001 XX  | 8,15<br>9,0<br>9,1<br>9,2<br>9,3<br>9,4<br>9,5<br>9,6<br>9,7<br>9,8<br>9,9  |
| no key<br>Window UP<br>Window DN<br>OnOff<br>Level UP<br>Level DN<br>no key<br>no key<br>no key<br>no key<br>no key<br>no key<br>no key   | 0001 1111 XX           1001 0000 XX           1001 1000 XX           1001 0100 XX           1001 1100 XX           1001 0010 XX           1001 0010 XX           1001 1010 XX           1001 0110 XX           1001 0110 XX           1001 0110 XX           1001 0110 XX           1001 0101 XX           1001 1001 XX           1001 1001 XX           1001 1001 XX           1001 1001 XX  | 8,15<br>9,0<br>9,1<br>9,2<br>9,3<br>9,4<br>9,5<br>9,6<br>9,7<br>9,8<br>9,9<br>9,9<br>9,10   |
| no key<br>Window UP<br>Window DN<br>OnOff<br>Level UP<br>Level DN<br>no key<br>no key<br>no key<br>no key<br>no key<br>no key<br>no key<br>no key<br>no key   | 0001 1111 XX           1001 0000 XX           1001 1000 XX           1001 0100 XX           1001 1100 XX           1001 0010 XX           1001 0010 XX           1001 1010 XX           1001 0110 XX           1001 0110 XX           1001 0110 XX           1001 0110 XX           1001 110 XX           1001 0001 XX           1001 1001 XX           1001 0101 XX           1001 0101 XX           1001 0101 XX           1001 1101 XX   | 8,15<br>9,0<br>9,1<br>9,2<br>9,3<br>9,4<br>9,5<br>9,6<br>9,7<br>9,8<br>9,9<br>9,9<br>9,10<br>9,11   |
| no key<br>Window UP<br>Window DN<br>OnOff<br>Level UP<br>Level DN<br>no key<br>no key<br>no key<br>no key<br>no key<br>no key<br>no key<br>no key<br>no key<br>no key                               | 0001 1111 XX           1001 0000 XX           1001 1000 XX           1001 0100 XX           1001 1100 XX           1001 0010 XX           1001 1001 XX           1001 0110 XX           1001 0110 XX           1001 1010 XX           1001 0110 XX           1001 0110 XX           1001 0110 XX           1001 0001 XX           1001 1001 XX           1001 0101 XX           1001 0101 XX           1001 1101 XX           1001 0011 XX           1001 1001 XX   | 8,15<br>9,0<br>9,1<br>9,2<br>9,3<br>9,4<br>9,5<br>9,6<br>9,7<br>9,8<br>9,9<br>9,10<br>9,11<br>9,12  |
| no key<br>Window UP<br>Window DN<br>OnOff<br>Level UP<br>Level DN<br>no key<br>no key           | 0001 1111 XX           1001 0000 XX           1001 1000 XX           1001 0100 XX           1001 1100 XX           1001 0010 XX           1001 1001 XX           1001 0110 XX           1001 011 XX           1001 1011 XX           1001 011 XX           1001 0011 XX           1001 1011 XX           1001 0011 XX           1001 1011 XX  | 8,15<br>9,0<br>9,1<br>9,2<br>9,3<br>9,4<br>9,5<br>9,6<br>9,7<br>9,8<br>9,9<br>9,10<br>9,11<br>9,12<br>9,13  |
| no key<br>Window UP<br>Window DN<br>OnOff<br>Level UP<br>Level DN<br>no key<br>no key | 0001 1111 XX           1001 0000 XX           1001 1000 XX           1001 0100 XX           1001 1100 XX           1001 0010 XX           1001 1001 XX           1001 0110 XX           1001 1001 XX           1001 1001 XX           1001 1001 XX           1001 1011 XX           1001 0011 XX           1001 1011 XX           1001 1011 XX           1001 1011 XX           1001 1011 XX | 8,15         9,0         9,1         9,2         9,3         9,4         9,5         9,6         9,7         9,8         9,9         9,10         9,11         9,12         9,13         9,14 |

## **Front Panel Keys**

| KEY      | DIAGNOSTIC<br>DISPLAY<br>0123 4567 89 | Row,<br>Col. |
|----------|---------------------------------------|--------------|
| Recall   | 0101 0000 XX                          | 10,0         |
| Save     | 0101 1000 XX                          | 10,1         |
| L-R      | 0101 0100 XX                          | 10,2         |
| no key   | 0101 1100 XX                          | 10,3         |
| no key   | 0101 0010 XX                          | 10,4         |
| no key   | 0101 1010 XX                          | 10,5         |
| no key   | 0101 0110 XX                          | 10,6         |
| no key   | 0101 1110 XX                          | 10,7         |
| no key   | 0101 0001 XX                          | 10,8         |
| no key   | 0101 1001 XX                          | 10,9         |
| no key   | 0101 0101 XX                          | 10,10        |
| no key   | 0101 1101 XX                          | 10,11        |
| no key   | 0101 0011 XX                          | 10,12        |
| no key   | 0101 1011 XX                          | 10,13        |
| no key   | 0101 0111 XX                          | 10,14        |
| no key   | 0101 1111 XX                          | 10,15        |
| Fluoro   | 1101 0000 XX                          | 11,0         |
| AvgUp    | 1101 1000 XX                          | 11,1         |
| AvgDn    | 1101 0100 XX                          | 11,2         |
| Subtract | 1101 1100 XX                          | 11,3         |
| Roadmap  | 1101 0010 XX                          | 11,4         |
| Chole    | 1101 1010 XX                          | 11,5         |
| One Shot | 1101 0110 XX                          | 11,6         |
| no key   | 1101 1110 XX                          | 11,7         |
| no key   | 1101 0001 XX                          | 11,8         |
| no key   | 1101 1001 XX                          | 11,9         |
| no key   | 1101 0101 XX                          | 11,10        |
| no key   | 1101 1101 XX                          | 11,11        |
| no key   | 1101 0011 XX                          | 11,12        |
| no key   | 1101 1011 XX                          | 11,13        |
| no key   | 1101 0111 XX                          | 11,14        |
| no key   | 1101 1111 XX                          | 11,15        |

#### **Trackpad Pointing Device**

Operation of the Trackpad pointing device will produce output on segments 0 through 7 of the LED array in accordance with the pressure applied. Initial pressure of contact will cause the display for the affected quadrant(s) of the device to display a binary code of "10," with increasing pressure causing the display to advance through "01" and "11" as pressure on the device increases significantly. Trackpad quadrants are displayed North, South, East, West on the LED bargraph as shown below:



#### **RAM Test**

Execute the RAM test by simultaneously pressing and releasing both the CTRL and CUSTOMIZE keys on the QWERTY panel. The RAM Test verifies that the RAM is functional between address 0X8000 and 0XEFFF. It also verifies that the RAM is not accessible from 0XF000 to 0XFFFF, which are decoded as I/O addresses. The RAM test takes approximately 1 second, during which time LEDs 8 and 9 on the diagnostic display will indicate test activity.

If the RAM test is successful, the pattern below is placed on the diagnostic LED display.

#### NOTE: LED segment 9 will be blinking.



If the RAM test fails, the pattern below is put on the diagnostic LED display and the pattern will blink (along with segment #9).



#### **Tone Control Keys**

The following keys on the QWERTY keyboard produce tones. The tone produced is based on the key pressed. Specific tones produced are described below (note that all keys produce a tone in diagnostic mode):

| KEY     | APPROXIMATE TONE |
|---------|------------------|
| PRESSED | PRODUCED         |
| 1       | 100 HZ           |
| 2       | 200 HZ           |
| 3       | 300 HZ           |
| 4       | 400 HZ           |
| 5       | 500 HZ           |
| 6       | 600 HZ           |
| 7       | 700 HZ           |
| 8       | 800 HZ           |
| Ι       | 900 HZ           |
| J       | 1000 HZ          |
| K       | 1100 HZ          |
| COMMA   | 1200 HZ          |
| Μ       | 1300 HZ          |
| Ν       | 1400 HZ          |

#### **LED Control Keys**

Specific keys will turn on specific LED drivers. The tables below indicate the key assignments along with the respective LED drivers activated.

| KEY           | KEY ROW, COL. | LED TURNED ON       |
|---------------|---------------|---------------------|
| 1-8           | 1,0-7         | 0-7, Respectively   |
| Q-I           | 2,1-8         | 8-15, Respectively  |
| A-K           | 3,1-8         | 16-23, Respectively |
| Z-(COMMA)     | 4,1-8         | 24-31, Respectively |
| SETUP OPTIONS | 0,12          | 0-31                |

## LED Control Keys (Cont.)

| KEY PRESSED ON<br>QWERTY KEY PANEL | ILLUMINATES THE LED ASSOCIATED WITH<br>THE FOLLOWING KEY ON SPM PANELS |
|------------------------------------|--|
| 1                                  | Acquire Images   |
| 2                                  | Landmark   |
| 3                                  | Zoom   |
| 4                                  | PlayProcess  |
| 5                                  | Register   |
| 6                                  | Sharpen  |
| 7                                  | VCR record   |
| 8                                  | PeakOp   |
|                                    |  |
| Q                                  | Histo  |
| W                                  | OnOff  |
| E                                  | VCR play   |
| R                                  | Mask   |
| Т                                  | Negate   |
| Y                                  | TrackPad SuperKey  |
|                                    |  |
| Α                                  | Fluoro   |
| S                                  | Subtract   |
| D                                  | Roadmap  |
| F                                  | Chole  |
| G                                  | One Shot   |
| <u> </u>                           | AvgMid   |
| J                                  | AvgLow   |
| K                                  | AvgHigh  |
|                                    |  |
| Ζ                                  | Recall   |
| X                                  | Save   |

#### Watchdog Reset Test Key (Esc)

Pressing the ESC key will test the watchdog timer by disabling interrupts and waiting for a reset from the watchdog. When ESC pressed, the diagnostic LED bargraph will display the ESC key code and **segment 9 will stop blinking** for the period set up on the watchdog (approximately 1.6 seconds) and then return to all off except LED 9, which will resume its normal blinking mode.



Segment #9 stops blinking; may be on or off

#### **IR Remote Control**

The code received from the IR Remote Control (OEC P/N 00-874026-05) will be displayed on the diagnostic LED array as received in accordance with the table below:

| ModeSel   | 14 | 0010 1000 XX |
|-----------|----|--------------|
| AvgSel    | 1C | 0011 1000 XX |
| ResetAIrm | 05 | 1010 0000 XX |
| ImageDir  | 04 | 0010 0000 XX |
| Up-arrow  | 1B | 1101 1000 XX |
| Lft-Arrow | 03 | 1100 0000 XX |
| Dn-Arrow  | 12 | 0100 1000 XX |
| Rt-Arrow  | 13 | 1100 1000 XX |
| Enter     | 0B | 1101 0000 XX |
| Recall    | 0A | 0101 0000 XX |
| Zoom      | 19 | 1001 1000 XX |
| Sharpen   | 02 | 0100 0000 XX |
| Norm/Mag  | 11 | 1000 1000 XX |
| CW        | 01 | 1000 0000 XX |
| CCW       | 09 | 1001 0000 XX |
| Open1     | 10 | 0000 1000 XX |
| Open2     | 00 | 0000 0000 XX |
| Close1    | 18 | 0001 1000 XX |
| Close2    | 08 | 0001 0000 XX |

# **VIDEO PATH**

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# **OVERVIEW**

This section contains information regarding video signals used in the 9600 system. The following topics will be presented:

- Types of Video signals
- The Video Path
- Video Path Peripherals

# **REFERENCE SCHEMATICS**

The following schematic diagrams are referred to in this section.

#### <u>C-Arm Interconnect Diagram</u>

Schematic # 00-875500 - System S/N 69-0001 thru 69-1000 Schematic # 00-877972 - System S/N 69-1001 thru 69-2000 Schematic # 00-878376 - System S/N 69-2001 and higher

#### Motherboard Diagram

Schematic # 875539 - System S/N 69-0001 thru 69-2000 Schematic # 878396 - System S/N 69-2001 and higher

#### Image System Interconnect Diagram

Schematic # 00-875410 - System S/N 69-0001 thru 69-1000 Schematic # 00-877971 - System S/N 69-1001 thru 69-2000 Schematic # 00-878377 - System S/N 69-2001 and higher

#### Pixel Filter PCB

Schematic # 00-877789 Schematic # 00-878045

#### Workstation Interconnect Diagram

Schematic # 00-876158 - System S/N 69-0001 thru 69-1000 Schematic # 00-877970 - System S/N 69-1001 and higher

Auxiliary Interface PCB

Schematic # 00-876502 - All S/N

Video Switching PCB

Schematic # 00-872237 - All S/N

Image Processor PCB

Schematic # 00-875952 - All S/N

High Rate Scan Converter PCB

Schematic # 00-876397 - All S/N

## **VIDEO SIGNAL**

## **INTERLACED VIDEO RS170**

The video signal produced by the CCD camera in the 9600 system meets the RS-170 standard for domestic use and the PAL standard for international use. The following video waveforms illustrate the Horizontal/Vertical timing and video levels present in the domestic 9600 system.



Figure 2 - Horizontal Timing

## HIGH SCAN NON INTERLACED VIDEO

The following video waveforms from the Scan Converter PCB show horizontal and vertical timing and video levels that are sent to the Fast Scan monitors in the domestic 9600 Workstation.





Figure 4 - Horizontal Timing

## **VIDEO PATH**

## **MOBILE C-ARM**

The video signal passes through the following printed circuit boards, connectors and wiring assemblies as it passes through the mobile C-arm.



Figure 5 - Mobile C-Arm Video Path

### WORKSTATION

The video signal passes through the following printed circuit boards, connectors and wiring as it is routed through the workstation.



Figure 6 - Workstation Video Path

For the physical location of the Workstation printed circuit boards shown above see Figure 7 on the next page.

6

F

#### **Circuit Board Location**

7



Figure 7 - Workstation Rear View

#### **Auxiliary Interface PCB**

The purpose of the Auxiliary Interface PCB is to distribute control and video signals to various locations within the electronic box in the Workstation.

Camera video enters the Workstation from the C-Arm through the interconnect cable, connector P1 on pins 14 and 15. The video signal enters the Workstation electronics box at J13. The video signal enters the Auxiliary Interface PCB at connector P10 on pin 1 and exits on coax connector J1. The video signal goes to J6 on the Video Switching PCB.

#### Video Switching PCB

The purpose of the Video Switching PCB is to route video signals to various locations in the Workstation. Video signals are distributed to the Hard Copy camera, internal VCR and Thermal Printer. The routing is accomplished by an 8 input, 6 output, crosspoint switch matrix on the Video Switching PCB and is controlled by a serial to parallel control circuit that originates in the Image Processor PCB. The Video Switching PCB also contains a video clamp, log amplifier, anti-alias filter and Genlock circuits. Refer to the Video Control Section for more information.

The video signal enters the Video Switching PCB at J6 and is buffered by U4 and runs through a DC restoration clamp (U7) to restore the video sync tips to ground. The video can be monitored at TP10. The video signal is sent to the video switching matrix to mux chip U13 IN0 (pin 5). The video signal leaves U13 at VOUT (pin 20). The video signal runs through another DC restoration clamp and is buffered by U15. The video signal can be monitored at TP16 (A/D VIDEO). The video signal is then sent back to the video switching matrix where it can be directed to, or bypass, a logarithmic amplifier (U46 and U26) which can be turned on for subtraction mode. The video signal is then sent back to the video switching matrix where it can be directed to an anti-alias filter (U25 and U24). The anti-alias filter limits the video signal to 5 MHz. The video signal leaves the Video Switching PCB at connector J11 pin 5 and is sent to the Image Processor PCB, P4 pin 5. See the Video Control Section for more information on video routing.

#### Image Processor PCB

The Image Processor PCB is the image data processor that contains a Graphic System Processor or GSP. All Workstation functions are controlled by the GSP on the Image Processor PCB. Because the Image Processor PCB is multi layer and uses surface mount circuits, repair of this PCB outside of the factory is not recommended. To determine the functionality of the Image Processor PCB, the use of system level diagnostics are used. See the <u>Video Control Section</u> for more information.

The video signal enters the Image Processor PCB via connector P4 pin 5. The video signal can be monitored at TP3 on the Image Processor PCB. The video signal is sent to A/D converter U17 where each pixel is converted to an 8 bit digital number. The digital video signal is then processed according to the functions selected on the Workstation. Left and right digital video signals are routed out of the Image Processor PCB as an 8 bit digital signal via connector P8 to the Scan Converter PCB. Video to the internal VCR, Hard Copy Camera and Thermal Printer is supplied as analog video from D/A converters U2 and U16 in the Image Processor PCB and exit via P4 pin 9 which goes back to the Video Switching PCB.

#### Scan Converter PCB

The Scan Converter PCB receives left and right digital video data from the Image Processor PCB in interlace scan format at a horizontal frequency of 15.750 kHz and a vertical frequency of 60 Hz. (domestic) or 50 Hz. (international).

The Scan Converter PCB receives horizontal sync, vertical sync, odd and even field identification, and pixel clock timing signals along with the left and right 8 bit video data from the Image Processor PCB. The signals leave the Image Processor PCB at connector P9 and goes to the Scan Converter PCB via a 40 pin ribbon cable that connects to J2 on the Scan Converter PCB.

The Scan Converter PCB then converts the digital video signal from interlace format to progressive scan format and upscales the horizontal frequency to 37.8 kHz. and the vertical frequency to 72 Hz. (domestic use) or 61 Hz (international use). The left and right digital video is then converted to an analog video signal by D/A converters U20 and U21. The analog video signals from the D/A converters can be monitored at TP4 (left video) and TP1 (right video). The video signals exit the board at J5 (left video) and J4 (right video) and are sent out of the Electronics Box at J8 (left video) and J7 (right video) to the Fast Scan Monitors. An additional left video output is available at J8 on the Scan Converter PCB which can be monitored at TP2. This video signal is sent to J17 (FAST SCAN VIDEO) on the rear panel of the Workstation as an additional video output for an external fast scan monitor.

#### **Fast Scan Monitors**

The Fast Scan monitors receive analog video signals from the Scan Converter PCB in progressive high scan format for image display. See figures 3 and 4 and the <u>Video</u> <u>Control Section</u> for more information.

#### Video Path

#### **Peripherals**

Analog interlace video is provided to the internal VCR, hard copy camera and thermal printer via the Video Switching PCB.

#### VCR

Video to and from the Internal VCR is routed through the Video Switching PCB. The video to the VCR can be supplied as unprocessed or processed which can be selected by the Workstation software. (See Customize VCR Options in the <u>Peripherals Section</u>.)

**Unprocessed Input Video to VCR** - With the VCR configured for unprocessed input video, the video signal is supplied by the CCD Camera via the Video Switching PCB (See Figures 5 and 6). The video signal enters the Video Switching PCB at J6 and is buffered by U4 and runs through a DC Restoration Clamp (U7) to restore the video sync tips to ground. The video signal can be monitored at TP10. The video signal is sent to the video switching matrix where it is routed to mux chip U10 IN0 (pin 5). The video signal leaves U10 at VOUT (pin 20). See the <u>Video Control Section</u> for more information on video routing. The video signal to the VCR can be monitored at TP6 (TOVCR1). The video signal leaves the Video Switching PCB at connector J4 pin 3. The video signal exits the Electronics Box at BNC connector J2 located at the top left rear corner. The video runs from J2 on the Electronics Box to the VIDEO IN BNC connector on the back of the VCR. See the <u>Peripherals Section</u> for VCR video connections.

**Processed Input Video to VCR** - With the VCR configured for processed input video the video signal is supplied by the Image Processor PCB via D/A converter U2. The video signal leaves the Image Processor PCB at P4 pin 9 and is sent to J11 pin 9 on the Video Switching PCB. The video signal runs through a DC Restoration Clamp (U17) to restore the video sync tips to ground. The video can be monitored at TP20 (LDAC) on the Video Switching PCB. The video signal is sent to the video switching matrix where it is routed to mux chip U10 IN2 (pin 9), the video signal leaves U10 at VOUT (pin 20). The video signal to the VCR can be monitored at TP7 (TOVCR1). The video signal leaves the Video Switching PCB at connector J4 pin 3. The video signal exits the Electronics Box at BNC connector J2 located at the top left rear corner. The video runs from J2 on the Electronics Box to the VIDEO IN BNC connector on the back of the VCR. See the *Video Control Section* for more information on video routing.

**VCR Output Video -** When the Workstation is configured for post processing from the internal VCR, the video leaves the VCR at the Video Out BNC connector. The video signal enters the Workstation electronics box at BNC connector J1 located at the back of the electronics box in the upper left hand corner. The VCR video signal enters the Video Switching PCB at connector J4 on pin 3. A DC Restoration clamp (Q2) restores the video sync tips to ground.

The incoming VCR video can be monitored at TP13 (VCR1). The video signal is sent to the video switching matrix to mux chip U13 IN0 (pin 5). The video signal leaves U13 at VOUT (pin 20). The video signal runs through another DC restoration clamp and is buffered by U15. The video signal can be monitored at TP16 (A/D VIDEO). The video signal is then sent back to the video switching matrix where it can be directed to, or bypass a logarithmic amplifier (U46 and U26) which can be turned on for subtraction modes.

The video signal is then sent back to the video switching matrix where it can be directed to an anti-alias filter (U25 and U24). The anti-alias filter limits the video signal to 5 MHz. The video signal from the anti-alias filter circuit can be monitored at TP18 (A/D VIDEO). The video signal leaves the Video Switching PCB at connector J11 pin 5 and is sent to the Image Processor PCB, connector P4 pin 5.

#### Video Path

#### HARD COPY CAMERA

Video to the internal Hard Copy Camera comes from two different sources. The source depends on whether fluoro x-rays are on or off.

**X-Ray Off Condition -** In the X-Ray off condition the video signal is supplied by the Image Processor PCB via D/A converter U2. The video leaves the Image Processor PCB at P4 pin 9 and is sent to J11 pin 9 on the Video Switching PCB. The video signal runs through a DC Restoration Clamp (U17) to restore the video sync tips to ground. The video can be monitored at TP20 (LDAC) on the Video Switching PCB. The video signal is sent to the video switching matrix where it is routed to mux chip U8 IN2 (pin 9). The video signal leaves U8 at VOUT (pin 20). See the *Video Control Section* for more information on video routing. The video signal from U8 is buffered by amplifier U1 and is sent to connector J3 pin 9. The video signal can be monitored at TP5 (HCO). The video signal exits the front of the electronics box at J6 (BNC connector) near the top on the right side. The video signal runs from J6 on the electronics box to the VIDEO IN BNC connector located on the front of the Hard Copy Camera. See the <u>Peripherals Section</u> for more information.

**X-Ray On Condition -** In the X-Ray on condition the video signal is supplied by the CCD Camera via the Video Switching PCB (See Figures 5 and 6). The video signal enters the Video Switching PCB at J6 and is buffered by U4 and runs through a DC Restoration Clamp (U7) to restore the video sync tips to ground. The video can be monitored at TP10. The video signal is sent to the video switching matrix where it is routed to mux chip U8 IN0 (pin 5). The video signal leaves U8 at VOUT (pin 20). See the **Video Control Section** for more information on video routing. The video signal from U8 is buffered by amplifier U1 and is sent to connector J3 pin 9. The video signal can be monitored at TP5 (HCO). The video signal exits the front of the electronics box at J6 (BNC connector) near the top on the right side. The video signal runs from J6 on the electronics box to the VIDEO IN BNC connector located on the front of the Hard Copy Camera. See the **Peripherals Section** for more information.

#### THERMAL PRINTER

Video to the Thermal Printer comes from two different sources. The source depends on whether fluoro x-rays are on or off.

**X-Ray Off Condition -** In the X-Ray off condition the video signal is supplied by the Image Processor PCB via D/A converter U2. The video leaves the Image Processor PCB at P4 pin 9 and is sent to J11 pin 9 on the Video Switching PCB. The video signal runs through a DC Restoration Clamp (U17) to restore the video sync tips to ground. The video can be monitored at TP20 (LDAC) on the Video Switching PCB. The video signal is sent to the video switching matrix where it is routed to mux chip U8 IN2 (pin 9). The video signal leaves U8 at VOUT (pin 20). See the <u>Video Control Section</u> for more information on video routing. The video signal from U8 is buffered by amplifier U1 and is sent to connector J3 pin 5. The video signal can be monitored at TP2 (LVID). The video signal exits the rear of the electronics box at BNC connector J4 labeled VIDEO below the 3.5-inch floppy disk drive. The video signal runs from J4 to the Thermal Printer. See the <u>Peripherals Section</u> for more information.

**X-Ray On Condition -** In the X-Ray on condition the video signal is supplied by the CCD Camera via the Video Switching PCB (See Figures 5 and 6). The video signal enters the Video Switching PCB at J6, is buffered by U4 and runs through a DC Restoration Clamp (U7) to restore the video sync tips to ground. The video signal can be monitored at TP10. The video signal is sent to the video switching matrix where it is routed to mux chip U8 IN0 (pin 5). The video signal leaves U8 at VOUT (pin 20). See the **Video Control Section** for more information on video routing. The video signal from U8 is buffered by amplifier U1 and is sent to connector J3 pin 5. The video signal can be monitored at TP2 (LVID). The video signal exits the rear of the electronics box at J4 (BNC connector) labeled VIDEO below the 3.5-inch floppy disk drive. The video signal runs from J4 to the Thermal Printer. See the **Peripherals Section** for more information.

## Auxiliary Interface PCB (Component Side)



Figure 8 - Auxiliary Interface PCB Component Layout

#### Auxiliary Interface PCB (Connector Side)



Figure 9 - Auxiliary Interface PCB Rear View

#### **Video Switching PCB**



Figure 10 - Video Switching PCB Component Layout

#### **Image Processor PCB**



Figure 11 - Image Processor PCB Component Layout

### Scan Converter PCB



Figure 12 - Scan Converter PCB Component Layout

# **VIDEO CONTROL**

# **OVERVIEW**

This section contains information regarding signals that control video within the 9600 Workstation. The following topics will be covered:

- The Image Processor PCB
- The Video Switching PCB
- The Scan Converter PCB
- Fast Scan Monitors

# **REFERENCE SCHEMATICS**

The following schematic diagrams will be referred to in this section.

#### Workstation Interconnect Diagram

Schematic # 00-876158 - System S/N 69-0001 thru 69-1000 Schematic # 00-877970 - System S/N 69-1001 and higher

#### Auxiliary Interface PCB

Schematic # 00-876502 - All S/N

Video Switching PCB

Schematic # 00-872237 - All S/N

Image Processor PCB

Schematic # 00-875952 - All S/N

#### High Rate Scan Converter PCB

Schematic # 00-876397 - All S/N

High Scan Brightness / Contrast Control PCB

Schematic # 00-876351 - All S/N

IR Receiver PCB Schematic # 00-874220 - All S/N

# **IMAGE PROCESSOR PCB**

The Image Processor PCB is the image data processor that contains a Graphic System Processor (GSP) which is driven by a 50 MHz clock. All Workstation image processing functions are controlled by the Image Processor. The GSP provides control signals to the Video Switching PCB, and Scan Converter PCB. Because the Image Processor PCB is multi layer and uses surface mount circuits, repair of this board outside of the factory is not recommended. Functionality of the Image Processor PCB is determined by the use of system based diagnostic test programs.

## A/D CONVERTER

The video signal enters the Image Processor PCB via connector P4 pin 5. The video signal can be monitored at TP3 on the Image Processor PCB. The video signal is sent to A/D converter U17 where it is converted to an 8 bit digital number. The digital video data is then sent to the scan converter section of the Image Processor PCB.

## **SCAN CONVERTER**

The Scan Converter section consists of a two video frame memory that receives the digital video data from the A/D converter U17. The video data is written into one frame of memory at a time. When the first frame of memory is full, video data is written into the second frame of memory. The first frame of video data is read out to the Image Processor circuitry while the second frame of video data is read in. By changing the way the video data is read out of the frame memory, the scan converter is able to provide horizontal and vertical image reversal control for the images displayed on the monitors and peripherals. This scan converter function is provided because the CCD camera does not offer horizontal and vertical image reversal control.

## **D/A CONVERTERS**

After the video data has been processed by the Image Processor circuitry, left and right video data is sent to the D/A converters U2 (LVID) and U16 (RVID). The D/A converters convert the processed digital video data into an analog video signal. The left video signal is used by the internal VCR, Hard Copy Camera and Thermal Printer. The left video signal exits the Image Processor PCB via P4 pin 9 where it goes back to the Video Switching PCB. The right video signal exits the Image Processor PCB. The right video signal is not being used.

## SCAN CONVERTER PCB INTERFACE

After the video data has been processed by the Image Processor circuitry, left and right video data is also sent to the scan converter interface circuitry. The scan converter interface buffers the left and right video data out of the Image Processor PCB via connector P9 to the Scan Converter PCB.

## PIO

The Image Processor PCB contains two PIO chips. PIO U4 provides internal control signals used within the Image Processor PCB. PIO U3 provides external control signals which go to the Video Switching PCB. Input signals from the Video Switching PCB are read by PIO U3. The Image Processor creates a 24 bit serial data output from PIO U3 that controls the Video Switching PCB. The 24 bit serial data output from U3 to the Video Switching PCB controls the following items:

- Video Crosspoint Switch
- Genlock
- Anti-Alias Filter
- Logarithmic Amplifier
- X-Ray Disable

## **IMAGE PROCESSOR TEST DIAGNOSTICS**

Diagnostic tests are available for use in evaluating the operation of the Image Processor PCB. The tests are selectable from the *System Diagnostics Menu* and are described in the following procedure.

Press the **SETUP OPTIONS** key on the Workstation. The **Setup Options** screen will appear.

- 1. Insert the OEC Boot and Diagnostic disk into the disk drive.
- 2. Select *Access Level 2* and press ENTER.
- 3. Select *Run System Diagnostics* and press ENTER.

This screen appears when *"Run System Diagnostics"* is selected from the Service Options Menu. Select the Image Processor Tests from the menu shown below:

| RUN SYSTEM DIAGNOSTICS  |
|---|
| Front Panel Test<br>System Memory Tests<br>Image Processor Tests<br>Toggle Motion Artifact                                      |
| Use the cursor arrow keys to select<br>option, then press ENTER.<br>Press the ESC key to exit<br>and return to previous screen. |

These Image Processor Tests begin automatically when this test option is selected from the System Diagnostics Menu.

If test failures occur, the program will halt at the point of failure and display an error message. Press ENTER to continue testing from that point.

| IMAGE PROCESSOR MEMORY TESTS  |   |
|---|---|
| Image Memory<br>Left Filter RAM<br>Right Filter RAM<br>Left Bit Planes<br>Right Bit Planes<br>Left LUT<br>Right LUT | PASSED<br>PASSED<br>PASSED<br>FAILED<br>PASSED<br>TESTING |
| (error messages appear here when failures occur)  |   |
| Press [ENTER] to Continue<br>Press [ESC] to Exit<br>Press [F2] to Repeat  |   |

Because the Image Processor PCB is multi layer and uses surface mount circuits, do not attempt to repair this PCB outside of the factory.
# **VIDEO SWITCHING PCB**

The Video Switching PCB is controlled by the Image Processor PCB utilizing a 24 bit serial data control word. The 24 bit serial control word (VMDATA) can be monitored at TP35. VMDATA is sent to the Video Switching PCB at P6 pin 11. VMDATA goes into the first of three serial to parallel shift registers operating in cascade (U33 - U35). VMDATA is clocked into the three serial to parallel converters by VM-DTCLK at pin 11 on each shift register. VM-DTCLK can be monitored at TP37. After the serial control word has been clocked into the shift registers, VM-LTCLK is applied to the each shift register at pin 12. VM-LTCLK can be monitored at TP36. VM-LTCLK latches the control word to the parallel output of the shift registers. The shift register outputs are used to turn on and off control functions on the Video Switching PCB. 18 bits of the control word are used to route video signals in the crosspoint switch circuit. The remaining 6 bits are used to turn on or off the following circuits:

- Logarithmic amplifier
- Anti-Alias Filter
- Genlock
- X-Ray Disable
- 60 / 50 Hz Video

# VIDEO SWITCHING CONTROL

Each of the multiplexers (U8 -U13) in the crosspoint switch circuit have 8 video inputs, one of which is selected at a time. The states of the address control inputs, A0 -A2 of each of the multiplexers control which video input is selected. The input video signal is amplified by an internal video amplifier, and output at pin 20 of each multiplexor. The amplifiers in the multiplexers have a gain of 2, allowing for the proper video termination of each video output.

# LOGARITHMIC AMPLIFIER CONTROL

A logarithmic amplifier is used in subtraction. U46, CR5 and CR6 comprise the logarithmic amplifier. The following amplifier, U26 restores the signal polarity and provides an offset adjustment needed to offset the losses caused by the diodes. The logarithmic amplifier is switched in and out of the video path by multiplexor U19. U19 is controlled by VMDATA bit 20 which comes from serial to parallel shift register U33 pin 4.

The anti-alias filter is designed to eliminate alias artifacts and prevent high frequency noise in the video signal from being sampled by the A/D converter. R73, C57, C54, L9, C52, L10, C16, and R75 comprise the anti-alias filter. The anti alias filter is designed to pass frequencies to 5 MHz The anti-alias filter can be switched in an out of the video path by multiplexor U18. U18 is controlled by VMDATA bit 19 which comes from serial to parallel shift register U33 pin 5. The anti-alias filter is in the video path at all times.

### **GENLOCK CONTROL**

The Genlock circuitry provides timing synchronization between the Image Processor PCB and the incoming video signal from the CCD camera. Genlock control is accomplished by comparing the sync signal from the sync generator U40 located on the Video Switching PCB with the incoming sync signal from the CCD camera. The phase of the internally generated horizontal sync from U40, and that of the incoming video signal from the CCD camera are compared in phase comparator U44. The output of U44 is applied through a low pass filter which forms a control voltage, which is sent to tuning diode CR1 controlling the frequency of voltage controlled oscillator U43 (VCO). The output of the VCO is divided by ten by PAL U29 and is sent to the OS2 input of the sync generator (U40). The CCD camera is the (master) sync source to which the Genlock circuitry synchronizes the sync generator U40 (slave) on the Video Switching PCB. VCO U43 provides the clock for the sync generator U40 under normal conditions when an incoming video signal is present. When no CCD camera sync is present in the Video Switching PCB, sync detector U28, sets PIO U3 pin 18 low on the Image Processor PCB to turn off the Genlock circuit. The Image Processor turns off the Genlock circuit using serial to parallel shift register U33 pin 2 (VMDATA bit 22). When U33 pin 2 is set low, PAL U29 removes the VCO clock signal from sync chip U40 and replaces it with a clock from Y1 (60 Hz operation) or Y2 (50 Hz operation). X-Ray Disable (VMDATA bit 23) is also set HI and is sent to the Generator to override all X-Ray on commands.

The Genlock circuit is adjusted with sync from the CCD camera present. The Genlock adjustment is made by turning C89 on the Video Switching PCB until LED's DS1 and DS2 both illuminate equally. In this condition the VCO output at TP33 should be running at approximately 25.8 MHz and the voltage at TP38 (correction voltage) should be approximately 2.5 volts.

## 50/60 HZ VIDEO CONTROL

50 / 60 Hz video operation is controlled by the system configuration in the Workstation software. The Workstation software sets the condition of serial to parallel shift register U33 pin 3 (VMDATA bit 21). In 60 Hz configuration U33 pin 3 is set low, in 50 Hz configuration U33 pin 3 is set high. The signal from U33 pin 3 is sent to sync generator U40 pin 2 which sets the sync generator to run in 50 Hz or 60 Hz mode. The signal from U33 pin 3 is also sent to pal U29 pin 5 which enables either crystal Y1 for 60 Hz timing or crystal Y2 for 50 Hz timing. Y1 and Y2 are both disabled when the Genlock circuit is turned on. Only in the stand alone condition when no camera video is present from the CCD camera is timing from Y1 or Y2 enabled. The signal from U33 pin 3 is also sent to Image Processor PCB where it is used to configure the scan converter circuit for 50 or 60 Hz operation.

# **SCAN CONVERTER PCB**

## SCAN CONVERTER TIMING CONTROL

The Scan Converter PCB receives the following timing signals from the Image Processor PCB:

- HDRV
- VDRV
- FIELD
- PIXCL

These signals enter the Scan Converter PCB via connector J2 and are sent to the timing generator U22 and U24. The timing generator produces address and control signals used by the Scan Converter PCB to convert the digital video signal from interlace format to high rate progressive scan format.

## VIDEO MEMORY

The Scan Converter receives left and right digital interlaced video data from the Image Processor PCB via connector J2. The digital interlaced video data is written into left and right video memory. The digital high rate progressive scan video data is read out from the left and right video memory and is sent to the left and right D/A converters U20 and U21.

# VIDEO OUTPUT

D/A converters (U20 and U21) convert the high rate progressive scan video data into left and right analog video signals, that are sent to the Fast Scan monitors. The analog video signals from the D/A converters can be monitored at TP4 (left video) and TP1 (right video). The left and right video signals exit the board at J5 and J4 and are sent out of the Electronics Box at J8 (left video) and J7 (right video) to the Fast Scan Monitors.

## **SCAN CONVERTER TEST**

- 1. Power up the system and press the "TEST PATTERN" key on the keyboard.
- Press the L<>R key on the front control panel. The gray scale test pattern should be displayed on both monitors.
- 3. Verify that the test pattern on both monitors is crisp and well defined.
- 4. Visually verify that pixels in the test pattern do not flicker.

# **FAST SCAN MONITORS**







MONITOR SIDE VIEW

FOR MONITOR ADJUSTMENT REFER TO IMAGE SYSTEM CALIBRATION



ADJUSTMENT ACCESS HOLES ARE LOCATED IN THE MONITOR MOUNTING PLATE

#### Figure 2 - Fast Scan Monitor Adjustment Locations

### **CONTRAST AND BRIGHTNESS CONTROL**

Brightness and contrast adjustment is provided to allow the service technician to set up the monitor brightness and contrast. The brightness and contrast of the Fast Scan monitors are controlled by the left and right contrast and brightness pots located behind the top cover of the Workstation as shown in Figure 1. Brightness and contrast pots R2 and R1 from the left monitor, and R4 and R3 from the right monitor, are supplied with +5 volts on one side and DC common on the other. The control voltage is obtained from the wiper on each pot. The control voltage is sent to the High Scan Brightness / Contrast Control PCB where it is summed with portions of the voltage from the ambient room light sensor. The resultant voltage is applied to pins 3, 5, 10, and 12 of U2 on the High Scan Brightness / Contrast Control PCB, where it is amplified. The brightness and controls drive voltages exit the High Scan Brightness / Contrast Control PCB at connector P4 and goes to the monitors.

# AMBIENT ROOM LIGHT CONTROL

Ambient Room Light Control is provided to adjust the brightness and contrast of the monitors as lighting conditions vary. Ambient Room Light Control is obtained from the IR Receiver PCB that is located between the two monitors at the top of the front bezel of the Workstation. The sensor consists of a photocell which provides a variable resistance, depending on the light level entering the sensor through the clear plastic window in the bezel. The sensor is supplied with +12 volts, the output voltage of the photocell is applied to resistor network R13 and R11 on the High Scan Brightness / Contrast Control PCB. The voltage from the photo cell can be monitored at TP1. The photo cell voltage is summed with the voltage from the contrast and brightness pots R2 and R1 from the left monitor and R4 and R3 from the right monitor.

# **CONTRAST AND BRIGHTNESS ADJUSTMENT**

#### NOTE: Set up the monitor contrast and brightness in normal room light conditions

- 1. Turn off AUTO HISTO & WINDOW / LEVEL.
- 2. Display the video test pattern by pressing the TEST PATTERN button on the keyboard and then pressing the L<>R button on the front of the Control Panel.
- 3. Adjust contrast and brightness pots R1 R4 to minimum.
- 4. Adjust brightness pots R1 & R3, until the raster lines on both monitors are barely visible.
- 5. Adjust the contrast pots R2 & R4, so that all step in the gray scale test pattern can be seen without causing the white areas of the test pattern to bloom.



Figure 3 - Gray Scale Test Pattern

E

# HIGH SCAN BRIGHTNESS/ CONTRAST CONTROL PCB



Figure 4 - Component Layout

# **IMAGE STORAGE**

# **OVERVIEW**

A standard Workstation comes equipped with an IDE Hard Disk Drive and a 1.44 MB Floppy Disk Drive. The <u>IDE Hard Disk Drive</u> may be replaced by either of the following options.

- 4FPS SCSI Disk Option
- 30FPS SCSI Disk Option

The Workstation can also contain one or more of the following options. Please refer to the <u>Peripheral</u> section of this manual for details of these options.

- Internal VCR Option
- Lenzar Hard Copy Camera Option
- Laser Camera Interface Option
- <u>Thermal Printer Option</u>

## **IDE HARD DISK DRIVE**

2

The basic 9600 system contains one hard disk with two DOS partitions. One 10 megabyte partition (C: drive) is for Workstation program storage and a 30 Megabyte partition (D: drive) is for the 100 image storage. The hard disk is an IDE-type drive and is controlled by an imbedded controller on the Workstation 386 Motherboard. Jumpers on the <u>Communication</u> <u>PCB</u> must be configured to select between this drive and the SCSI type hard drive.

### **1.44 MB FLOPPY DISK DRIVE**

The 1.44 MB High Density Floppy Disk Drive (A drive) is used by the Workstation AT Motherboard and requires a 3 1/2-inch high density floppy disk for data storage and transfer. The floppy disk drive is installed in all Workstation configurations.



Figure 1 - IDE Hard Drive Block Diagram

# **4FPS SCSI DISK OPTION**

The Four Frames Per Second (4FPS) option is intended for cine runs up to four frames per second. It contains two SCSI Disk Controllers and a SCSI disk drive. The IDE drive is not present with this option. The disk is 400 MB or larger and is DOS-formatted with a 10MB (C drive) and a 30 MB (D drive) partition. Drive C contains the Workstation application software. Drive D is used to store the 100 static images. The portion of the drive used for cine runs does not have a drive designator.

The DOS-SCSI controller performs all of the DOS functions, communicating with the 10 MB and 30 MB partitions. The IP-SCSI controller transfers data to or from the Image Processor and the SCSI disk in the non-DOS (cine loop) area of the disk. Image data is transferred between the Image Processor and the IP-SCSI controller at the four frames per second rate. Image data is then transferred between the IP-SCSI controller and the SCSI disk as 8-bit image data at approximately 1 MB per second.



Figure 2 - 4 FPS Block Diagram

## **30FPS SCSI DISK OPTION**

The 30FPS option contains three SCSI Disk Controllers and two SCSI disk drives. The IDE drive is not present with this option. The disks are 1 GB or larger and one is DOS-formatted with 10 and 30 MB partitions. One SCSI controller (DOS-SCSI) performs all of the DOS functions, communicating with the 10 MB and 30 MB partitions. The other two SCSI controllers (IP-SCSI) transfer data to or from the Image Processor and the SCSI disks in the non-DOS area of the disk. Image data is transferred between the Image Processor and the IP-SCSI controllers at the 30 fps rate. Image data is then transferred between each IP-SCSI controller and its associated disk as 8-bit image data at approximately 3.5 MB per second. Each IP-SCSI controller transfers image data for every other image frame. Even numbered frames are stored on SCSI disk (1) and odd numbered frames are stored to SCSI disk (2).





Figure 4 - 30 FPS Card and Cable Locations

# 4/30 FPS SCSI DISK SETUP

#### NOTE: The Access Level 2, Prepare CINE Disk command when used with an IP-SCSI option does not check for disk media errors nor does it correct for disk errors.

The procedure assumes the IP-SCSI sub-system is already installed in the electronics box.

# SETUP PROCEDURE, FIRST TIME IP-SCSI INSTALLATION

In Access Level 2, the Prepare CINE Disk command must always be run after:

Line Frequency (Hz) is changed in the *Set Configurations* menu Cine Disk parameters are changed in the *Set Configurations* menu A new or different SCSI disk drive is installed.

- 1. Insert the OEC access disk.
- 2. Press Setup Options keyboard.
- 3. The screen displays:

SETUP OPTIONS Set Today's Date Set the Correct Time Software ID Screen Access Level 2 (Service)

- 4. Select Access Level 2 (Service), then press ENTER.
- 5. The screen displays:

| Service Options   |  |
|---|--|
| Run System Diagnostics<br>Prepare CINE Disk<br>Backup MainFrame Disk<br>Video Calibration<br>Access Mainframe Menu<br>Shot Log File<br>System Configuration |  |

6. Select System Configuration, then press ENTER.

7. The screen displays:

SYSTEM Configuration

Set System Configurations Imaging Defaults

#### 8. Select Set System Configurations, then press ENTER.

The screen displays: SET CONFIGURATION

> Line Frequency (Hz) System Model

Cine Disk Language

VCR1

VCR2

#### NOTE: This screen display is only one example; yours may differ according to your system configuration.

60

NONE

VAS

English

Sony

Sony

10. Select the **Cine Disk** menu item, and then using the left or right arrow keys, toggle through to ALTA4 or ALTA30, whichever is appropriate.

OR, if changing the line frequency:

9.

Select the Line Frequency (Hz) configuration, then with the left or right arrow keys, select 50 Hz or 60 Hz frequency.

#### **IMPORTANT...** THE FOLLOWING STEPS (11 - 30) MUST BE PERFORMED IN THE ORDER PRESENTED.

- 11. After selecting **Cine Disk**, or **Line Frequency**, press **ENTER**.
- 12. The following will be displayed at the bottom of the configuration menu:

PRESS SETUP TO CONFIRM

13. Press the Setup Options key. 14. The following will be displayed at the bottom of the configuration menu:

CHANGING CONFIGURATION Restart Workstation

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- 15. Remove the OEC access disk.
- 16. Press **ESC** twice.
- 17. System will now reboot.
- 18. Insert the OEC access disk.
- 19. Press the **Setup Options** key.
- 20. The screen displays:

#### SETUP OPTIONS

Set Today's Date Set the Correct Time Software ID Screen Access Level 2 (Service)

- 21. Select Access Level 2 (Service), then press ENTER.
- 22. The screen displays:

| Service Options   |
|---|
| Run System Diagnostics<br>Prepare CINE Disk<br>Backup MainFrame Disk<br>Video Calibration<br>Access Mainframe Menu<br>Shot Log File<br>System Configuration |

#### 23. Select *Prepare CINE Disk*, the press ENTER.

#### Image Storage

24. The screen displays:

All Cine data will be erased

-Press RETURN to prepare disk--Press ESC to exit-

- 25. Press ENTER.
- 26. The screen displays:

Prepare Completed: No Error. PRESS any key to reboot system

- 27. Remove the OEC access disk.
- 28. Press ENTER.
- 29. System will now reboot.
- 30. Verify cine disk operation by making exposures.

# **DEBUGGING USING IP-SCSI LEDS**

Additional diagnostic information is available from the LEDs located on the IP-SCSI Controller(s). Before switching on the power, open the door of the electronics rack so that the bottom edge of the IP-SCSI is visible and note the 3 LEDs on each PCB.

Switch on the power and notice that **after** the system completes its boot process, the LEDs are as follows, indicating that the system has stabilized and is ready for normal operation.

| Green | Yellow | Red |
|-------|--------|-----|
| OFF   | ON     | OFF |

**NORMAL OPERATION** - The green LED will flash each time a command is received from the AT host. For a 30FPS system, all commands are received by the Master IP-SCSI Controller (A11). The yellow LED indicates the controller is ready to accept a command.

<u>Green Yellow Red</u> Flash ON OFF

**INVALID SYSTEM CONFIGURATION OR IP-SCSI HARDWARE FAILURE INDICATION -** If the LEDs do not change from their power-on (random) state, the IP-SCSI controller is not being initialized. Check System Configuration (Level 2 Service) and the IP-SCSI PCB.

**GENERAL 4/30FPS SCSI DISK SUBSYSTEM FAILURE INDICATION -**

If the yellow LED stays OFF for several seconds during boot or system operation, a 4/30FPS SCSI disk system hardware failure is indicated. Check the following: IP cable from IP PCB to IP-SCSI, IP PCB or IP-SCSI controller.

| Green | Yellow | Red |
|-------|--------|-----|
| OFF   | OFF    | OFF |

**SCSI PROBLEM INDICATION** - If the red LED goes ON during the initial boot process, a problem with the SCSI bus is indicated. Check the SCSI hard disk, the SCSI cable which connects the SCSI hard disk to the IP-SCSI, or the IP-SCSI itself.

| Green | Yellow | Red |
|-------|--------|-----|
| OFF   | ON     | ON  |

### **IP-SCSI TERMINATION RESISTORS**

The termination resistors RP1, RP2 and U15 must all be installed in the controller for the 4FPS PCB and for the Master IP\_SCSI PCB of the 25/30FPS option. RP1, RP2 and U15 must be removed on the Slave IP-SCSI PCB for the 25/30FPS option. Refer to Figures 8 and 9 on the following pages for locations of the resistors.

### TERMINATION RESISTORS FOR SCSI DOS DISK CONTROLLER PCB

SCSI DOS Disk Controller (900659-02) termination resistors RN2, RN3, and RN4 must be removed. Refer to the drawings of the PCB on the following pages for other jumper settings.

### COMMUNICATION PCB JUMPER SETTINGS FOR IP-SCSI

The following table indicates the jumper settings for E1-E3 on the Communications PCB.

| System Type Motherboard and<br>Disk            | E1 | E2 | E3 |
|--|----|----|----|
| 386 AMI BIOS With IDE Disk                     | +  | +  | G  |
| 386 AMI BIOS With SCSI DISK 4<br>FPS or 30 FPS | G  | +  | G  |
| + = +5V, G = Ground                            |    |    |    |

#### Table 1 - Disk Drive Type Jumpers on the Communication PCB



Figure 5 - Communication PCB Jumpers

### PCB ILLUSTRATIONS AND JUMPER SETTINGS

The following pages illustrate the various cards and jumper settings used.



|      |   | JUMPE  | R SET | TING |   |      |   |
|------|---|--------|-------|------|---|------|---|
|      |   | O=OPEN | S=SH  | ORT  |   |      |   |
| J5-1 | 0 | J6-1   | s     | J8-1 | 0 | J9-1 | 0 |
| J5-2 | 0 | J6-2   | s     | J8-2 | 0 | J9-2 | 0 |
| J5-3 | 0 | J6-3   | s     | J8-3 | 0 | J9-3 | 0 |
| J5-4 | 0 | J6-4   | 0     | J8-4 | 0 | J9-4 | 8 |
| J5-5 | ø | J6-5   | 0     | J8-5 | 0 | J9-5 | 0 |
| J5-6 | s | J6-6   | o     | J8-6 | 0 | J9-6 | s |
| J5-7 | 0 | J6-7   | o     | J8-7 | 0 | J9-7 | s |
| J5-8 | 0 | J6-8   | o     | J8-8 | 0 | J9-8 | s |

Figure 6 - SCSI Disk Controller (900659-02)

#### Image Storage



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Figure 8 - IP-SCSI 1-Master (4/30 FPS)



Figure 9 - IP-SCSI 1-Slave (30FPS)



FUGITSU M2623FA OR M2624F DISK DRIVE

Figure 10 - Fujitsu M2623FA or M2624F Disk Drive



Figure 11 - Seagate ST355ON Disk Drive



#### HITACHI DK325C DISK DRIVE



Figure 12 - Hitachi DK325C Disk Drive



TERM. POWER FROM DRIVE:





#### Figure 13 - Seagate ST12550 or 11950 Disk Drive (25/30FPS Option

# PERIPHERALS



# **OVERVIEW**

There are several peripherals available for the 9600 Workstation. These include:

- <u>VCR</u>
- Hard Copy Camera
- Digital Laser Camera Interface
- <u>Thermal Printer</u>
- Paper Printer

This section provides general information on how these peripherals are used and also provides basic service information including configuration & troubleshooting notes. These peripherals (except the VCR and Hard Copy Camera) are connected to the rear panel as shown in <u>Figure 1</u>.

# NOTE: The COM2 Serial Port and the ETHERNET IN/OUT BNCs are not currently used.

Peripherals



Figure 1 - Rear Panel on Workstation

# VCR

VCR Record and VCR Play operate the VCR to store and recall permanent records on Super-VHS video tapes. Super VHS (S-VHS) is a high resolution image recording format that uses special 1/2-inch video cassettes. These tapes cannot be played back on standard VHS recorders. Standard VHS tapes can be used; however, the high resolution of the S-VHS is lost. To make audible annotations to S-VHS recordings, consult the manufacturer's operations manual.

# CONFIGURING THE SVO 9500 S-VHS RECORDER

To set up the SVO 9500 MD S-VHS recorder, set the switches and controls on the front of the recorder as shown in Figure 2.

- Power ON
- Program OFF
- Control (Ctl) INDEX

The basic features of this S-VHS recorder, with front view shown in Figure 2, are:

BLANK - Press this key to search for the next blank place on the tape.
FREEZE - Press this key instead of PAUSE to capture an image for review.
EJECT - Press and hold the eject button for 3 seconds to eject a cassette.





# **RECORD UNPROCESSED VIDEO (VCR 1**

To record to the VCR:

- 1. Insert an S-VHS tape cassette into the recorder.
- 2. Position the tape to the starting point for the recording. Press VCR Play to review the tape if necessary to determine the index number of the new starting point. Reset the index counter or make note of the index reading.
- 3. Press the VCR RECORD key. The recorder LED is lit. Press the **SUPERKEY** to start or stop processing images.
- 4. Proceed with the desired surgical procedure. The recorder records images whenever the **X-ray On** switch or **Process Fluoro** footswitch is pressed. The VCR automatically goes to **PAUSE** when the footswitch is released.
- *NOTE:* During the recording process, the monitor displays the processed image. The image recorded on the tape, however, depends on the VCR configuration. The default configuration is unprocessed video, that is, undigitized video output. Refer to <u>Configuring VCR Options</u> later in this section.
  - 5. Record the tape index counter reading when the recording session is completed.

## **REVIEW THE RECORDING**

To review the video recording:

- 1. Load the recorded S-VHS cassette into the recorder.
- 2. Position the tape at the start of the recording with the recorder's positioning keys (**REV**, **PLAY** and **FORWARD**).
- 3. Press VCR Play on the TrackPad panel. The LED is lit.
- 4. Press the SuperKey to start or stop processing images.

## **CUSTOMIZE VCR OPTIONS**

The Customize function on the Workstation function panel is used to change VCR options. The reasons to change options are:

- During the recording process, the processed image is displayed on the monitor, but the image recorded on the tape depends on the configuration (processed or unprocessed).
- Typically, only one recorder is connected to the system. However, it is possible to record simultaneously on two video recorders, one for processed video and the other for unprocessed video.

To set the recording formats for VCR 1/VCR 2:

 Press the CUSTOMIZE key and select VCR RECORD in the menu bar. The Configure VCR Option menu, as shown in Figure 3, is displayed. The default recording setup is Unprocessed for VCR 1 and Processed for VCR 2.

| FXIT SAVE                 |
|---------------------------|
| CONFIGURE VCR OPTION      |
| VCR 1                     |
| UNPROCESSED     PROCESSED |
| VCR 2                     |
| UNPROCESSED     PROCESSED |
| FLUORO ONLY               |

#### Figure 3 - Menu to Customize VCR Configuration

- Use the TRACKPAD or Arrow Keys to highlight the desired processing mode for VCR 1 and press the SUPERKEY or ENTER key to change the selection. The box next to the selected option will be filled. Repeat for VCR 2 if desired.
- Save the selection by highlighting SAVE on the menu bar and pressing the SUPERKEY or ENTER. Exit the program by selecting EXIT from the menu bar.

# **VCR CONNECTIONS**

To ensure proper operation, confirm the rear of the VCR is connected as shown in Figure 4.



# VCR CONFIGURATION

Verify the VCR is configured properly in software by performing the following steps:

- 1. Power on the Workstation and allow it to boot completely.
- 2. Insert the Diagnostic Diskette in the rear of the Workstation.
- 3. Press the SETUP OPTIONS key on the Workstation Keyboard as shown in Figure 5.



#### Figure 5 - "SETUP OPTIONS" Key on Workstation Keyboard

4. Select Access Level 2 and then the System Configuration option. A menu as shown in Figure 6 appears:

| Line Frequency (Hz)                       | 60                             |
|---|--------------------------------|
| System Model                              | VAS                            |
| Cine Disk                                 | ALTA4                          |
| Language<br>VCR1<br>VCR2<br>Digital Print | ENGLISH<br>Sony<br>Sony<br>YES |
# HARD COPY CAMERA

Images recorded on the Hard Copy Camera are film copies of left monitor images. Window and Level optimize the left monitor image before making the Hard Copy exposure. The **EXPOSE** key on the Hard Copy Camera Control on the Workstation makes the exposure as shown in Figure 7.



Figure 7 - Hard Copy Camera Controls

### USING THE HARD COPY CAMERA

Refer to the Operator's Manual for detailed operation of this unit. To make a film image with the Hard Copy Camera:

- 1. Display the image to be copied on the left monitor.
- 2. Adjust Window and Level to optimize the image.
- 3. Insert the film cassette in the Hard Copy Camera and remove the lower protective slide from the cassette. *EXP 1* appears on the camera display.
- 4. Press the **EXPOSE** key on the Hard Copy Camera. When Expose is pressed, the camera displays *BUSY*. A tone beeps at the end of the exposure and *EXP 2* displays.
- 5. Press the **EXPOSE** key again to take the second image. *BUSY* displays, and a tone beeps at the end of the exposure. Replace the protective slide before removing the cassette. Reverse cassette for additional images.

### **Additional Features**

The following are additional features of the Hard Copy camera:

**VIEW-PORT -** Displays the image on the Hard Copy or when the **Program** key is pressed.

**RESET -** Prepares the camera for the next set of exposures. Press the **Reset** key to go to EXP 1.

PROG - The Program key performs these functions:

- Press to view the image as it will appear in the exposure.
- Hold down to change settings.

### SERVICE INFORMATION (HARD COPY CAMERA)

The following Hard Copy Camera settings are recommended, although they can be modified for film type and processing technique. Refer to the manufacturer's documentation for specific information.

| User Number           | USR 1  |
|-----------------------|--|
| Brightness            | В 70   |
| Contrast              | C 30   |
| Image Polarity        | As desired (IMG+ or IMG-)  |
| Exposure Time         | Т 2  |
| Multiple<br>Interface | IDBL   |
| Input Number          | INP1 (INP2-7 can be set for different film or grayscale, if desired) |

### NOTE: These settings will vary from system to system.

Modify settings by holding the **PROGRAM** key down and pressing one of the following keys:

- **INCREMENT** 1 Increases the value of a selected function.
- **DECREMENT**  $\downarrow$  Decreases the value of a selected function.
- ADVANCE → Advances to next programmable function. In normal operation, advances camera to the next exposure without exposing the film.

### **MOUNTING INFORMATION**

The Hard Copy Camera is mounted as an internal device as shown in Figure 8. The user controls this device via the Interface Panel. The film cassette is inserted through the film slot on the front panel. The camera exposes the film in the film opening.



Figure 8 - Lenzar Camera Mounting

### Internal Connections (Hard Copy Camera)

There are three main connections to the Hard Copy Camera assembly:

- Power Cable Connects TB2 to the Hard Copy Camera assembly.
- BNC Cable Provides video via J6 (interlaced video).
- Ribbon Cable Connects the interface panel to the Hard Copy Camera assembly.

These connections are shown in Figure 9.

# NOTE: The ribbon cable is not keyed at the end for the interface panel. Ensure the red pin is to the right side as viewed from the front of the system or damage may result.



Figure 9 - Lenzar Camera Connections

## **DIGITAL LASER CAMERA INTERFACE**

The Laser Camera Interface system uses specially designed software and circuitry which enables the operator to print multiple X-ray images with a laser camera. The X-ray images print out in a selected matrix format determined by the type of laser camera. The Interface system supports the following laser cameras:

- 3M Laser Imager (P831) with Protocol MMU920
- 3M Laser Imager Plus (M952) restricted to Protocol MMU920
- Kodak Ektascan Laser Printer, with KCL protocol supports models 100, 100-XLP, 1120 and 2180
- Kodak Ektascan Image Manager (KEIM)

The user selects the number of images and their printed format. Each film sheet contains the images in a specified number of rows and columns.

Note that selecting fewer images than the total number of slots on a film sheet results in blank frames. Selecting more images than number of slots results in extra images, and blank frames, printed on the last sheet of film.

Before printing X-ray images, ensure proper cable connections. The 37-pin D-sub parallel connector, labeled LASER CAMERA INTERFACE, and the 9-pin serial connector, labeled COM 1, are located on the rear of the Workstation panel as shown in Figure 12.



#### Figure 10 - Laser Camera Interface and COM 1 Connections on Rear Panel

### DIGITAL LASER CAMERA INTERFACE PRINTING

Follow the steps beginning on the next page to print X-ray images on a laser camera.

# NOTE: The screen displays shown here may vary slightly from those displayed on your Workstation depending on your system. The following example uses a 3M laser camera.

- 1. Switch on the main power to the Workstation with the keyswitch and wait for the OEC logo to display on the right monitor.
- 2. Press the *CUSTOMIZE* key on the Workstation keyboard to display the *CUSTOMIZE OPERATION* menu.
- 3. Press the down arrow key to select **DEFINE PRINTER**, then press **ENTER** to display the **DEFINE PRINTERS** menu.
- 4. Enter data for each of the four **DEFINE PRINTERS** parameters. The following example uses configuration #1 for a 3M laser camera (printer) with a 3x2 film matrix.

#### **CONFIGURATION = 1**

This is the designated number for one set of printing configurations; note that #1 is the default. The system supports a total of 4 different configurations, hence the configuration can only be 1, 2, 3, or 4. Pressing the right arrow key toggles to each consecutive number. Select the desired configuration, then press the down arrow key.

### NAME = 3M 3X2

The name will be used later when you're asked to select the configuration for printing the X-ray images (in step 11). You should create a name that you recognize as designating the configuration parameters of the previously selected configuration (in this case, #1). Type in an appropriate name, then press **ENTER**.

### PRINTER TYPE = 3M

Press the right arrow key as many times as necessary to select the correct printer type, then press the down arrow key.

### FILM MATRIX = 3X2

The film matrix determines the printed format for the X-ray images in *rows x columns*. The matrix choices are limited to those available from the selected printer. The total number of images printed on one film sheet is the product of the two numbers. In this example, the 3M printer will print a sheet with 6 images, in 3 rows and 2 columns, 2 images per row, 3 images per column. Press the right arrow key as many times as necessary to select the desired matrix, then press ENTER.

 Press *ENTER* again to store the previously entered data into configuration #1 (or *BACKSPACE to* delete), then press ESC to get out of the *DEFINE PRINTERS* menu and back to *CUSTOMIZE OPERATION*.

- 6. When *CUSTOMIZE OPERATION* displays, press the IMAGE DIR key to display the *IMAGE DIRECTORY* menu.
- 7. Select *LIST BY* with the right arrow key, then press ENTER to display the three options for selecting X-ray images.
- 8. This example uses images selected by *DATE*. Select the desired option with the down arrow key, then press *ENTER*.
- 9. Select the appropriate date with the down arrow key, then press **ENTER**.
- 10. Note that the images display in consecutive order from the bottom up. Select *PRINT* with the up arrow key, then press *ENTER* to display the names.
- 11. The names created display in consecutive order from the top down. This example used *3M 3x2* (created in step 4) for the configuration 1 name. Select the desired name with the down arrow key, then press *ENTER*.
- 12. With the up or down arrow key, position the arrow icon next to each image to be printed, then press the spacebar.
- 13. Note the "print" icon to the left of the image selected. Pressing the spacebar a second time on the same image removes the image from print selection. The above example shows three images selected so far. Select the desired number of images, then press *ENTER*.
- 14. The number of each image being prepared to print displays at the lower right of the screen. (In this example, assume 6 images were selected; recall that a total of 6 could be printed on one sheet of film in the selected 3 x 2 matrix.) Note that the image being prepared displays on the left monitor.

Printing Image(s) Please Wait

15. When all the images have been sent to the printer, the screen displays the above message. When this message is gone, the printing is complete.

### **Digital Laser Camera Interface - Internal Connections**

Electrical connections for the Digital Laser Camera Interface are shown in Figure 11. Item "A50" resides in the J7 slot of the AT Motherboard.



Figure 11

The Laser Interface PCB (00-900938) occupies slot J7 of the AT Motherboard and is shown in Figure 12 with its connection from J2 of the PCB to J19 of the rear panel.



Figure 12 - Laser Interface PCB

### **Digital Laser Camera Interface - Configuration**

Ensure the Workstation is configured to communicate with a Digital Laser Camera Interface PCB by performing the following steps.

- 1. Power on the Workstation and allow it to boot completely.
- 2. Insert the Diagnostic Diskette in the rear of the Workstation
- 3. Press the SETUP OPTIONS key on the front panel as shown in Figure 13.



### Figure 13 - "SETUP OPTIONS" Key on Workstation Keyboard

4. Select Access Level 2 and then the System Configuration option. The menu as shown in Figure 14 appears:

| Set configuration        |                         |
|--------------------------|-------------------------|
| Line Frequency (Hz)      | 60                      |
| System Model             | VAS                     |
| Cine Disk                | ALTA4                   |
| Language<br>VCR1<br>VCR2 | ENGLISH<br>Sony<br>Sony |
| Digital Print            | YES                     |
| Serial Number: xx-xxxx   |                         |
| Hospital Name:           |                         |

### Figure 14 - System Configuration Menu

5. Verify the Digital Print = YES configuration entry is correct.

## **THERMAL PRINTER**

Thermal printers are used to produce a hard copy image from the 9600 Workstation. Although the FUJI FTI-210 is shown, most other brands of thermal printers will work with the 9600 Workstation.

### **USING THE THERMAL PRINTER**

Regardless of the brand, allow the thermal printer approximately 5 minutes to warm its internal fixing lamp. A composite video signal (non-interlaced) from the VIDEO BNC connector on the rear of the Workstation is sent to the VIDEO IN connector as shown in Figure 15.



Figure 15 - Thermal Printer Connections

After the unit has been connected to video and powered on, press the **PRINT** button on the front panel to produce a hard copy. Power is indicated by the **POWER** light also shown in Figure 16.





### THERMAL PRINTER SERVICE INFORMATION

If the PRINT light blinks and the system beeps, this is usually caused by no sync or the incorrect sync detected on the VIDEO IN plug. For example, connecting the unit to the FASTSCAN VIDEO BNC output will cause this condition if it is used instead of the VIDEO BNC as shown above. Refer to the thermal printer User's Manual for additional service information.

# **PAPER PRINTER**

A parallel printer can be used to printout a Patient Summary. This summary includes the patient's name, date of imaging, doctor's name, and exposure information. To obtain a Patient Summary, perform the following steps.

 With Workstation power off, connect a parallel printer to the printer port as shown in Figure 17. Use a standard parallel printer cable available from most computer stores.



Figure 17 - Printer Connection

### NOTE: Most parallel printers work with this configuration.

2. Power on the system. After it has booted, press the *X-ray Summary* button as shown in Figure 18.



Figure 18 - "X-ray Summary" Key on Workstation Keyboard

3. Then, select a specific patient. Move the cursor to the top of the screen and press **PRINT.** Data similar to that shown in Figure 19 will be produced.

| SHOT SUMMARY FOR:  |        |         |             |     |
|--------------------|--------|---------|-------------|-----|
| DOE, JOHN          |        | 10/18/9 | 95 12:55    |     |
| 123-45-6789        |        | PHYSI   | CIAN: SMITH |     |
| COMMENTS: HAND     |        |         |             |     |
|                    |        |         |             |     |
| TOTALS: SHOTS = 4  | TIME = | 10.0    | mAs = 5.0   |     |
| Exposure Type      | kVp    | mA      | Time(Secs)  | mAs |
| FLUOR-PROCESSED 42 | 0.5    | 3.7     | 1.9         |     |
| FLUOR-PROCESSED 42 | 0.5    | 2.2     | 1.1         |     |
| FLUOR-PROCESSED 42 | 0.5    | 0.8     | 0.4         |     |
| FLUOR-PROCESSED 42 | 0.5    | 3.3     | 1.6         |     |
|                    |        |         |             |     |

Figure 19 - Patient Shot Summary

NOTE: This data may also be acquired using the FILE option which, using the above example, would create a "TXT format" file called DOE001.PAT by using a formatted floppy in the rear floppy drive of the Workstation.

### **PRINTING THE SHOT LOG FILE (SERVICE OPTION)**

By connecting the printer as described on the previous page, service personnel can obtain a hard copy printout of the shot log file which contains exposure dates and times, kVp, mA, anode and housing temperature, and a other information that may aid in troubleshooting the system.

After the printer has been connected and the system powered on, perform the following steps to obtain a printout of the shot log file.

- 1. Insert Diagnostic Diskette into rear of Workstation.
- 2. Select the Setup Options button as shown in Figure 20.



### Figure 20 - "SETUP OPTIONS" Key on Workstation Keyboard

3. Next, select Access Level 2. Then select the Shot Log File option.

4. Move the cursor to the top of the screen and press PRINT. Data similar to that shown in Figure 21 will be produced.

| This Header Te | ext is loca | ated in the | ASCII file | SHOT  | DUN    | IP.H | DR.    |       |      |        |      |    |    |    |
|----------------|-------------|-------------|------------|-------|--------|------|--------|-------|------|--------|------|----|----|----|
| Log Key:       |             | -           |            |       | _      |      |        |       |      |        |      |    |    |    |
| Abbreviations  |             | Generat     | or Modes:  | PRC   | = Pr   | oces | ssed   | Fluor | 0    |        |      |    |    |    |
|                |             |             |            |       |        | ONI  | _ = FI | uoro  | Only |        |      |    |    |    |
|                |             |             |            | PUL   | = Pu   | Ised | l Fluc | oro   |      |        |      |    |    |    |
|                |             |             |            | FLM   | = Fili | m    |        |       |      |        |      |    |    |    |
| Pat - Patient  |             |             |            |       |        |      |        |       |      |        |      |    |    |    |
|                |             |             |            |       |        |      |        |       |      |        |      |    |    |    |
| FIG - FIEIG    |             |             |            |       |        |      |        |       |      |        |      |    |    |    |
| Ano - Anode    |             |             |            |       |        |      |        |       |      |        |      |    |    |    |
| Hsg - Housing  | g           |             |            | Field | Size   | e:   |        |       |      | L = La | arge |    |    |    |
| khu - kilo Hea | t Units     |             |            |       |        |      |        |       |      | S = SI | mall |    |    |    |
| FI - Fluoro Ti | me          |             |            |       |        |      |        |       |      |        |      |    |    |    |
| SR - Servo     |             |             |            |       |        |      |        |       |      |        |      |    |    |    |
| TB - Table     |             |             |            |       |        |      |        |       |      |        |      |    |    |    |
| SN - Sense     |             |             |            |       |        |      |        |       |      |        |      |    |    |    |
| VID - Video    |             |             |            |       |        |      |        |       |      |        |      |    |    |    |
| STAT - Status  |             |             |            |       |        |      |        |       |      |        |      |    |    |    |
| Mode - Genera  | ator Mode   | •           |            |       |        |      |        |       |      |        |      |    |    |    |
| Type - Shot Ty | /pe         |             |            |       |        |      |        |       |      |        |      |    |    |    |
|                | -           |             |            |       |        |      |        |       |      |        |      |    |    |    |
| FLUORO         |             | Pat         |            |       |        | Fld  | Ano    |       |      | Hsg    | Hsg  | Au | to | FI |
| SR SN SN       |             |             |            |       |        |      |        |       |      |        |      |    |    |    |
| Date           | Time        | Index       | Mode       | kVp   | mΑ     | I.   | khu    | khu   | Tmp  | Gain   | Secs | ΤВ | k٧ | mA |
| 10/18/95       | 12:54       | 0           | ONL        | 42    | 0.5    | L    | 0      | 4     | 305  | 22     | 6.1  | 1  | 41 | 0  |
|                | 12.55       | 1           | PRC        | 42    | 0.5    | L    | 0      | 4     | 305  | 20     | 3.7  | 1  | 41 | 1  |
| 10/18/95       |             |             |            |       |        |      |        |       |      |        |      |    |    |    |

Figure 21 Printing the Shot Log File

**NOTE:** This data may also be acquired using the FILE option which creates a "TXT format" file called SHOTDUMP.TXT by using a formatted floppy in the rear floppy drive of the Workstation.

# **APPENDIX**

# **TOOLS AND TEST EQUIPMENT**

- Common hand tools
- Torx Screwdriver Set
- Spline Driver, .048", OEC P/N 00-900920-01
- Oscilloscope Tektronix 2236 or equivalent
- Digital Volt-Ohm-Meter
- Auto Cal Interface Box, OEC P/N 00-871350-01
- Auto Cal Box to Analog Interface PCB cable, OEC P/N 00-871432-01
- Auto Cal Box to Dynalyzer III DRO's, OEC P/N 00-871434-02
- Dosimeter (Keithley Model 35050, PMX II non-invasive meter or equivalent)
- Model 96030 ion chamber
- Ion Chamber Holding Fixture
- Dynalyzer III
- High Voltage Cable Spanner Wrench, OEC P/N 00-877674
- Mobile C-Arm Extender Card, OEC P/N 00-870775-01
- Bore Sight Tool, OEC P/N 00-877589
- Resolution Tool, Converging Line Pair (LP/mm), OEC P/N 00-900860
- Resolution Tool, Mesh (LP/Inch), OEC P/N 00-900040
- Lead Apron
- 1 mm Copper Filter (3 each req'd), OEC P/N 00-877682-01
- 9600 Boot and Diagnostic Disk (software), OEC P/N 00-877444-01
- Beam Alignment Tool, OEC P/N 00-878105-01
- SRAM (PCMCIA) Software, OEC P/N 00-900876

## **PAINT KITS**

#### PART NUMBER DESCRIPTION

900524-11Paint Kit, Elite Gray, Texture900524-12Paint Kit, Rhinestone, Texture900524-13Paint Kit, Windswept, Texture

# **TORX CRESTCUP TORQUE SPECS**

# CAUTION: The torque specifications given in the table below apply only for hardware being installed into steel or aluminum. When installing hardware into plastic mounted fasteners, tighten only until snug.

| TORX SCREW | NOMINAL      | ACCEPTABLE    |
|------------|--------------|---------------|
| SIZE       | TORQUE VALUE | RANGE         |
| 4-40       | 6 lbs./in    | 5-8 lbs./in   |
| 6-32       | 15 lbs./in   | 13-16 lbs./in |
| 8-32       | 22 lbs./in   | 21-24 lbs./in |
| 10-32      | 30 lbs./in   | 28-31 lbs./in |

# **MATERIAL SAFETY DATA SHEETS**

Refer to the 9600 Operators Manual for MSDS sheet information.

# **CERTIFIED COMPONENTS**

Certified components used in the 9600 Mobile Imaging System include the following:

Beam Limiting Device<sup>\*</sup> Image Intensifier Assembly<sup>\*</sup> Spot Film Device (Cassette Holder - optional) <sup>\*</sup> X-ray Control Assembly<sup>\*</sup> X-ray Generator Assembly<sup>\*</sup> X-ray Tube Assembly

\* Complete *Report of Assembly*, FDA Form 2579 whenever the following assemblies are replaced in their entirety, per 21 CFR 1020.30 (d) (1) and (2).

# **RADIOGRAPHIC MA**

| Techniq    | ue Used    | mA   | Focal Spot |
|------------|------------|------|------------|
| kV         | mAs        | Used | Selected   |
| 50 to 52   | 0.5 to 100 | 45   | 0.3 mm     |
| 50 to 52   | 110 to 300 | 75   | 0.6 mm     |
| 53 to 57   | 0.5 to 100 | 45   | 0.3 mm     |
| 53 to 57   | 110 to 300 | 75   | 0.6 mm     |
| 58 to 62   | 0.5 to 100 | 50   | 0.3 mm     |
| 58 to 62   | 0.5 to 300 | 70   | 0.6 mm     |
| 63 to 67   | 0.5 to 100 | 55   | 0.3 mm     |
| 63 to 67   | 110 to 300 | 65   | 0.6 mm     |
| 68 to 72   | 0.5 to 100 | 60   | 0.3 mm     |
| 68 to 72   | 110 to 300 | 60   | 0.6 mm     |
| 73 to 77   | 0.5 to 100 | 55   | 0.3 mm     |
| 73 to 77   | 110 to 300 | 55   | 0.6 mm     |
| 78 to 82   | 0.5 to 100 | 50   | 0.3 mm     |
| 78 to 82   | 110 to 300 | 52   | 0.6 mm     |
| 83 to 87   | 0.5 to 90  | 50   | 0.3 mm     |
| 83 to 87   | 91 to 100  | 40   | 0.3 mm     |
| 83 to 87   | 110 to 300 | 50   | 0.6 mm     |
| 88 to 92   | 0.5 to 100 | 45   | 0.3 mm     |
| 88 to 92   | 110 to 300 | 45   | 0.6 mm     |
| 93 to 97   | 0.5 to 50  | 45   | 0.3 mm     |
| 93 to 97   | 51 to 100  | 40   | 0.3 mm     |
| 93 to 97   | 110 to 300 | 45   | 0.6 mm     |
| 98 to 102  | 0.5 to 35  | 42   | 0.3 mm     |
| 98 to 102  | 36 to 100  | 40   | 0.3 mm     |
| 98 to 102  | 110 to 300 | 42   | 0.6 mm     |
| 103 to 107 | 0.5 to 80  | 40   | 0.3 mm     |
| 103 to 107 | 81 to 100  | 30   | 0.3 mm     |
| 108 to 112 | 0.5 to 60  | 38   | 0.3 mm     |
| 108 to 112 | 61 to 100  | 30   | 0.3 mm     |
| 113 to 117 | 0.5 to 50  | 36   | 0.3 mm     |
| 113 to 117 | 51 to 100  | 30   | 0.3 mm     |
| 118 to 120 | 0.5 to 40  | 35   | 0.3 mm     |
| 118 to 120 | 41 to 100  | 30   | 0.3 mm     |

# **SPECIFICATIONS & TOLERANCES**

### **Generator Parameters**

| Frequency     | 2.5 kHz Nominal                              |
|---------------|--|
| Power         | 4.0 kW                                       |
| Rectification | Full Wave                                    |
| Modes         | Normal                                       |
|               | Boosted Fluoro                               |
|               | Pulsed Fluoro                                |
| kVp Accuracy  | $\pm$ 5% or $\pm$ 2 kVp whichever is greater |
| mA Accuracy   | ± 15% or ± 0.9 mA whichever is greater       |
| mAs Accuracy  | $\pm$ 5% or 2 mAs                            |
| kVp Rise Time | Less than 10 ms                              |
| kVp Overshoot | Less than 5%                                 |
| mA Rise Time  | Less than 250 mS (filament limited)          |
| Ripple        | < 1 kVp @ 5 mA                               |
|               | 15 kVp - 20 kVp @ 100 mA                     |

### X-Ray Tube Parameters

| Anode                | 2850 - 3450 rpm                       |
|----------------------|---------------------------------------|
| Focal spots          | 0.3 mm/0.6 mm                         |
| Thermal Switch       | NC - opens @ 190° F                   |
| High Voltage Storage | 300,000                               |
| Anode Cooling Rate   | 15,000 HU/min                         |
| Housing Heat         | 1,600,000 HU                          |
| Capacity             |                                       |
| Anode Target         | 3.1"                                  |
| Diameter             |                                       |
| Anode Angle          | 8.5°                                  |
| Weight               | 36 lbs.                               |
| Pulse Mode Pulse     | 30 ms or 50 ms (Depends on Pulse Rate |
| Width                | Selected)                             |
| Linearity            | Film mode linearity < .08             |
| Reproducibility      | C.O.V. < 0.04                         |

### **Operating Parameters**

| Pulse Mode Pulse    | 1, 2, 4, or 8 per second (selectable) |
|---------------------|---------------------------------------|
| Rate                |                                       |
| Pulse Mode Pulse mA | 40 mA maximum                         |
| kVp Range           | 40 - 120 kVp, fluoro mode             |
|                     | 50 - 120 kVp, film mode               |
| mA Range            | 0.2-5 mA normal continuous fluoro     |
|                     | 1.0 - 12 boost mode                   |
|                     | 0.2-40 mA pulsed fluoro               |
|                     | 75 mA film mode                       |
| mAs Range           | 1-300 mAs                             |

## **INPUT POWER**

# NOTE: The system operating voltage is selectable. This change must be made only by an OEC Medical Systems, Inc. field service technician, or by qualified technical service personnel

Line Frequency 60 Hz - 100-127 VAC 15 Amps

Line Frequency 50 Hz - 200-250 VAC 8 Amps

**Line Regulation (Percent)** - 15% at maximum radiographic exposure. Also, under no conditions should the loaded voltage fall below 100VAC, measured on the secondary of the isolation transformer in the Workstation.

**Ground Continuity** - Measures the resistance between the chassis, or any exposed conductive surface of the Workstation and C-Arm, and the ground pin of the attachment plug. The resistance shall be less than 0.5 ohm for each unit.

**Leakage Current** - Should not exceed 100  $\mu$ A*mp* on 115V systems and 500  $\mu$ A*mp* on 230V systems.

# **NOTE:** Line regulation is based on measurements made at the input wall receptacle under standby conditions and at maximum radiographic exposure.

Line Regulation =  $100 \times (Vn - VI)$ VI

Where: Vn = no load voltage (standby)

VI = loaded voltage (maximum radiographic exposure).

# UPDATE



### **12-INCH IMAGE SYSTEM**

### 9600 SYSTEM SERVICE MANUAL

00-878871-01

Rev. B

### **Revision History**

T

| <u>Rev</u> | <u>Dash</u> | <u>Date</u>   | Change Description  |
|------------|-------------|---------------|---|
| Rev A      | -01         | January 1996  | Initial Release   |
| Rev B      | -01         | February 1996 | Changes to physical spec. dimensions, camera cover & cover screws, II mounting screws, and Image Function board |
|            |             | July 1996     | CD-ROM Release  |

Date of Issue: January 1996

OEC Medical Systems, Inc. 384 Wright Brothers Drive Salt Lake City, UT. 84116

# UPDATE

# 9600 12-INCH IMAGE SYSTEM

### **OVERVIEW**

This Update covers field service issues of the 9600 C-Arm 12-inch image system. The 12-inch system is <u>not</u> field retrofittable. (The Workstation configuration does not change with the 12-inch option.) The following sections describe specifications, configurations, and steps in field service procedures unique to 12-inch systems. (Refer to the <u>9600 System</u> <u>Service Manual</u> for 9-inch systems.)

### WARNING... DO NOT MOVE A 12-INCH SYSTEM C-ARM OVER INCLINES GREATER THAN 5 DEGREES WHEN IN OPERATION POSITION, OR OVER INCLINES GREATER THAN 10 DEGREES WHEN IN TRANSPORT POSITION.

### **TECHNICAL SPECIFICATIONS, 12-INCH SYSTEM**

The following sections cite technical specifications for the 12-inch system that are different from the 9-inch system.

#### FIELD SIZE

Note the following nominal field sizes for the 9600 12-inch system:

|                | DIAMETER CIRCLE |         |
|----------------|-----------------|---------|
| FIELD SELECTED | INCHES          | METRIC  |
| NORMAL         | 12 inches       | 30.4 cm |
| MAG1           | 9 inches        | 22.8 cm |
| MAG2           | 6 inches        | 15.2 cm |

### **X-RAY TUBE**

#### OEC PN: 901001-01

Eureka Model RAD-99, rated at max. 125 kVp (anode to cathode) Anode angle: 10°

Removal procedures are identical to those of the 9-inch system.

### COLLIMATOR

OEC PNs: 901000-01, 12-inch variable collimator

878863-01, 12-inch primary collimator/filter

878872-01, 12-inch secondary collimator/filter

Configuration of the 12-inch collimator is slightly different from the 9-inch to compensate for size of the 12-inch image system. Calibration, removal, and operational procedures are identical to the 9-inch system collimator.

### FILM CASSETTE HOLDER

OEC PN: 878820-01

Dimensions: approx. 16.95 inches x 15.50 inches (43.05 cm x 39.37 cm).

Installation, removal, and operational procedures are identical to the 9-inch system cassette holder.

### **12-INCH IMAGE INTENSIFIER**

OEC PN: 900999-01

Tri-mode 12"/9"/6" image intensifier

Central resolution (typical, in line pairs/cm):

| 12-inch | 44 lp/cm |
|---------|----------|
| 9-inch  | 50 lp/cm |
| 6-inch  | 56 lp/cm |

Peripheral resolution @ 70% radius (typical, in line pairs/cm):

| 12-inch | 42 lp/cm |
|---------|----------|
| 9-inch  | 48 lp/cm |
| 6-inch  | 54 lp/cm |

### T.V. CAMERAS (CCDS)

OEC PNs: 878866-01 (60Hz) 878865-01 (50Hz)

Configuration of the 12-inch cameras is slightly different from that of 9-inch system cameras because of the different 12-inch system optics. Calibration and operational procedures are identical to 9-inch cameras; the removal procedure is different (see p. 15).

### **PHYSICAL SPECIFICATIONS, 12-INCH SYSTEM**



Figure 1A - C-Arm Dimensions and Motions

### PHYSICAL SPECIFICATIONS, 12-INCH SYSTEM (CONT.)



Figure 1B - C-Arm Dimensions and Motions

### PHYSICAL SPECIFICATIONS, 12-INCH SYSTEM (CONT.)





Figure 1C - C-Arm Dimensions and Motions

### **COMPONENT LOCATIONS**

### **IMAGE FUNCTION PCB**

The image function PCB, pn 878400, is located in the card rack assembly on a 12-inch system; it is *not* located under the camera cover next to the image intensifier as in older systems. For procedures that require accessing the image function board (for example, camera cooler verification), follow the steps below.

### ACCESSING AND REMOVING IMAGE FUNCTION PCB

- 1. Switch off the main power.
- Remove the rear cover assembly. (Refer to the "Cover Removal" section in the <u>System Overview</u> chapter, 9600 System Service Manual.)
- 3. (a) Remove the 4 screws on the card rack cover, then (b) remove the card rack cover (see Figure 2A next page).

# NOTE: The call-out numbers on Figures 2A and 2B correspond to the same-numbered steps here.

- (a) Grasp the image function board's ejector levers and pull them outward to unlock, then (b) pull the PCB out of the card rack (it should unplug from the motherboard and slide out from the snap guides). See Figure 2B.
- 5. To re-install, make sure the PCB's ejector levers are in the open position, align the PCB in the snap guides, then perform the above steps in reverse order.

#### 9600 Imaging Workstation Service Manual



Figure 2A - Removing the Card Rack Cover

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Figure 2B - Removing the Image Function Board

#### JUMPER E6 AND ROM FIRMWARE

Jumper E6 is connected on a 12-inch system's Image Function Board. ROM firmware U15 is also modified; part number 874756-05 and up applies to the 12-inch system. This E6 connection and modified firmware optimize the duty cycle for camera cooler operation (refer to the "Verify CCD Camera Cooler Operation" section in the *Image System Calibration* chapter, **9600 System Service Manual)**. See also Figure 3 below.



mast component labels not shown for clarity

### Figure 3 - E6 Jumper Connected for a 12-inch Image System IFB

### FLIP FLOP ASM.

OEC PN: 878805-01

The "neck" of the 12-inch system flip flop is slightly longer than that of 9inch system flip flop to compensate for 12-inch II size. Removal, brake adjustment, and operational procedures are identical to the 9-inch flip flop.

### **II POWER SUPPLY REMOVAL**

Note that it is *not* necessary to remove the image intensifier first before removing the II power supply on a 12-inch system.

- 1. Switch the workstation keyswitch to **OFF**.
- 2. Rotate the C-arm to a horizontal position (see Figure 4, next page).

### *Note:* The call-out numbers on Figure 4 correspond to the samenumbered steps here.

- 3. (a) Remove the two large decals and two upper hex screws from the camera cover,
  - (b) remove the two small decals and two lower cover screws,
  - (c) detach the opposite end (where it hooks to the II), then
  - (d) remove the camera cover.
- 4. Note the two parts of the HV cable (900989) connected to the outside of the camera cover weldment, or "camera hat," on the camera hat connector mount (refer also to the interconnect diagram, 878377).

(a) Disconnect the J2 end of the HV cable from the connector mount, then

- (b) disconnect the P1 end of the HV cable from the connector mount.
- (a) Loosen the screw on the hose clamp encompassing the bottom of the camera hat, then
  - (b) slide the camera hat off the camera.

- 6. Lift off the camera hat and set it aside.
- Disconnect all cables from the power supply (see the table and <u>Figure</u>
  <u>5</u>).
- 8. (a) Remove the two screws from the power supply bracket, then(b) lift out the power supply.



Figure 4 - 12-inch II Power Supply Removal



Figure 5 - 12-inch II Power Supply Cable Connections

| Image | Intensifier | Power | Supply | Wiring |
|-------|-------------|-------|--------|--------|
|       |             |       |        |        |

|     | COLOR        | DESCRIPTION           | CONNECTOR |
|-----|--------------|-----------------------|-----------|
| E   | Blue         | Active Getter Cathode | Fork Lug  |
| PC  | Red          | Tube Photo Cathode    | Fork Lug  |
| GND | Green/Yellow | Ground                | Fork Lug  |
| G1  | Green        | Electrode             | Twist On  |
| G2  | Black        | Electrode             | Twist On  |
| G3  | Black        | Electrode             | Twist On  |
| G4  | Black        | Electrode             | Twist On  |
| А   | White Cable  | Anode                 | Twist On  |

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### **IMAGE INTENSIFIER REMOVAL**

CAUTION: If the 12-inch camera mounting plate needs to be replaced with the newest 12-inch mounting plate (part number 878896), position the C-arm to where the II is at the top facing downward and the mounting plate is level (see Figure 6 below). There are spacers and shims below the mounting plate which can fall out if the mounting plate is not at a flat, level position when removed.



Figure 6 - 12-inch Camera Mounting Plate

The following procedure assumes the II power supply has not been removed.

It is recommended that two people perform this procedure.

- 1. Switch the workstation keyswitch to OFF.
- 2. Rotate the C until the II is in a horizontal position (see Figure 7).
### *NOTE:* The call-out numbers on Figure 7 correspond to the samenumbered steps here.

3. (a) Remove the two large decals and two upper hex screws from the camera cover,

(b) remove the two small decals and the two lower cover screws,

(c) detach the opposite end (where it hooks to the II), then

(d) remove the camera cover.

4. Note the two parts of the HV cable (900989) connected to the outside of the camera cover weldment, or "camera hat," on the camera hat connector mount (refer also to the <u>interconnect diagram, 878377</u>).

(a) Disconnect the J2 end of the HV cable from the connector mount, then

(b) disconnect the P1 end of the HV cable from the connector mount. (See Figure 4. p. 11.)

- 5. Disconnect the J7 end of the HV cable from the power supply (see Figure 5).
- 6. Disconnect the green/yellow chassis ground wire from the power supply (see Figure 5).
- 7. Hold the II in place, then

(a) remove the two upper flat-head socket screws, then

(b) remove the two large decals and the two lower flat-head socket screws that secure the II to the C mounting.

8. Lift off the II.

NOTE When replacing the Image Intensifier, it may be necessary to re-calibrate the light level at the CCD by calibrating the Camera Iris. Refer to the Camera Iris Calibration procedure in the <u>Image System Calibration</u> section, 9600 System Service Manual.



### Figure 7 - 12-inch II Removal

## **CCD CAMERA REMOVAL**

To remove the CCD camera, perform steps 1 - 7 of the previous "II Power Supply Removal" section (p. 10) to access the camera, then refer to the "CCD Camera Replacement" section in the <u>Image System</u> chapter, **9600** System Service Manual.

## **COLLIMATOR REMOVAL**

Collimator removal and replacement procedures are identical to those of the 9-inch system. Refer to the "Collimator Replacement" section in the *Image System* chapter, **9600 System Service Manual**.

# **X-RAY TUBE REMOVAL**

X-ray tube removal and replacement procedures are identical to those of the 9-inch system. Refer to the "Replacement of the X-ray Tube" section in the *Image System* chapter, **9600 System Service Manual**.

## **BEAM ALIGNMENT**

Follow the procedures in "Beam Alignment" in the <u>Image System</u> <u>Calibration</u> chapter (9600 System Service Manual), but note the following different components for the 12-inch system. Refer also to Figure 8 (next page) for the beam alignment tool.

### TOOLS

- Beam alignment tool, OEC P/N 00-878867-01 (includes 12-inch alignment grid, p/n 00-878862-01)
- (QTY of 3) 1mm copper plates, OEC P/N 00-877682-02
- Film Cassette Holder Asm., 12-inch, OEC P/N 00-878820-01
- Bore sight alignment tool, 12-inch, OEC P/N 00-877589-02



Figure 8 - 12-inch Beam Alignment Tool

### **BEAM ALIGNMENT VERIFICATION**

Note the following field sizes and ranges on the alignment grid for the 12-inch system:

| FIELD SIZE            | RANGE |  |
|-----------------------|-------|--|
| 12-inch mode (NORMAL) | А     |  |
| 9-inch mode (MAG1)    | В     |  |
| 6-inch mode (MAG2)    | С     |  |

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### **ADJUST CAMERA FOCUS**

Follow the procedures in the "Adjust Camera Focus" section in the **Beam** <u>Alignment</u> chapter (9600 System Service Manual), with this exception: near the end of the procedure, when selecting field sizes to verify the minimum line pairs/mm, use the following resolutions.

| FIELD SIZE | 60 Hz lp/mm | 50 Hz lp/mm |
|------------|-------------|-------------|
| NORMAL     | 1.0         | 1.0         |
| MAG1       | 1.3         | 1.4         |
| MAG2       | 1.6         | 2.0         |

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# **SERIES9600**<sup>TM</sup>





OEC MEDICAL SYSTEMS, INC





























### P4 P10 P3 J3 U11 E3 BUFFER P9 J5 P2 P5 TP12 TP3 TP32 🔴 2 ' (1C4) TP12 🔵 +5V TECH\_TXD\_HI TECH\_TXD\_HI TXD\_A 20 TXD\_TECH TP6 U2 TXD RXD TECH\_TXD\_LO 9 TECH TXD LO -TP4 2 5 TP13 🦲 TP33 **TP11** TP 3, 7, 80C196 (1B7) TECH\_RTS\_HI 14 TECH\_RTS\_H 8,9 RTS\_TECH RTS\_A 25 13 15 RTS\_TECH 3 Ú2 -d RTS U4 15 TECH\_RTS\_LO TECH\_RTS\_LO (CTS) U37 13 TP1 А TP10 🔴 TP30 (4A4) TECH\_RXD\_HI MICROPROCESSOR TECH\_RXD\_HI 15 RXD\_TECH RXD A 18 RXD\_TECH 19 RXD 11 TXD U1 TECH\_RXD\_LO TECH\_RXD\_LO U30 13 TP2 (1B7) O TP31 (1C5) TP10 TP11 ( TECH\_CTS\_HI TECH\_CTS\_HI CTS\_A 39 7 CTS\_TECH COM SEL 13 CTS TECH U15 15 U1 16 (RTS) TECH\_CTS\_LO BUFFERED TECH\_CTS\_LO ADDRESS BUS MICROPROCESSOR MAINFRAME 21 U38 U39 MOTHERBOARD (4B5) (4A7) BUFFERED +5V SCH. #878396 20 DATA BUS CONTROL CONTROL TP3 **TP18** PANEL PANEL TP 1, 4, PROCESSOR PROCESSOR COLUMN I/O POWER/SIGNAL IFBTX RXD\_C 19 80C188 I/O PCB INTERFACE PCB 7, 9 РСВ PCB U5 **TP38** SCH. #878489 SCH. #878492 SCH. #877998 SCH. #878486 TP20 (4B3) 19 36 RXD 23 U53 IFBRX 18 TXD\_C TP40 С (4C5) 10 37 TXD RS-232 DRIVER/ RECEIVER J1 71 73 SERIAL COMMUNICATIONS P2 71 73 CONTROLLER 2 S1 IMAGE (3B8) FUNCTIONS U17 U16 2 U35 18 8 ٦ TECHNIQUE PCB TXD = TRANSMIT DATA (1D8) -0-0-TP6 4 (3B6) PROCESSOR SCH.#878398 16 RTS = REQUEST TO SEND PCB RXD = RECEIVE DATA SCH.# 877742 CTS = CLEAR TO SEND BUFFER O TP5 RX -MICROCONTROLLER

9600 Mobile Digital C-Arm - Generator Block Diagrams, Test Points, and Waveforms

THESE 2 SIGNALS, COM\_MODE\_0 & COM\_MODE\_1 GO TO U53 & U38 TO SELECT SERIAL COMMUNICATIONS FOR C-ARM OR UROVIEW

2 SWITCHES 1 & 2 OF SW1 MUST BE ON TO ENABLE SERIAL COMMUNICATIONS

> USE THIS DIAGRAM ON SYSTEM SERIAL NUMBERS 69-2001 AND HIGHER & 62-0001 AND HIGHER









SIGNAL SHEET

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6/4/96

















### **Test Conditions**









9600 C-ARM

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6/6/96

For Reference Only

MA\_LABSS.DS4



REFERENCE TO C-ARM (MAINFRAME) INTERCONNECT DIAGRAM SCH. #875500 OR #877972


REFERENCE TO C-ARM (MAINFRAME) INTERCONNECT DIAGRAM



# 9600 Mobile Digital C-Arm - Generator Block Diagrams, Test Points, and Signal Waveforms











### 9600 Mobile Digital C-Arm - Generator Block Diagrams, Test Points, and Waveforms



9600 Mobile Digital C-Arm - Generator Block Diagrams, Test Points, and Waveforms







SCH. # 875500, #877972, or 878376

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|            | 9600 C-ARM                 |             |
|------------|----------------------------|-------------|
| OFCMEDICAL | For Reference Only         | Page 1 of 1 |
| Training   | PRECHG.DS4                 | 12/4/96     |
| BL         | PRE-CHARGE<br>.OCK DIAGRAM |             |

9600 Mobile Digital C-Arm - Generator Block Diagrams, Test Points, and Signal Waveforms



#### 9600 Mobile Digital C-Arm - Generator Block Diagrams, Test Points, and Signal Waveforms



## 9600 Mobile Digital C-Arm - Generator Block Diagrams, Test Points, and Signal Waveforms



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#### **RECHARGE NEEDED -ALLOW 24 HOURS** PRESS ANY KEY TO CONTINUE

THIS MESSAGE IS DISPLAYED DURING BOOT UP IF THE SYSTEM HAS NOT BEEN TURNED ON FOR 6 MONTHS.

IE 6 MONTHS HAVE PAST SINCE THE SYSTEM HAS BEEN PLUGGED IN AND TURNED ON LET THE SYSTEM BUN WITHOUT MAKING X-BAYS FOR 24 HOURS TO ALLOW THE BATTERIES TO RECHARGE AND THE IMAGE TUBE TO DEGAS

THIS ERROR MAY ALSO BE DISPLAYED AFTER INSTALLING A COPY OF THE BACKUP GENERATOR SOFTWARE. IN THIS CASE PRESS ANY KEY ON THE CONTROL PANEL AND CONTINUE USE AS NORMAL

#### WARM-UP NEEDED - ALLOW 4 HOURS PRESS ANY KEY TO CONTINUE

THIS MESSAGE IS DISPLAYED DURING BOOT UP IF THE SYSTEM HAS NOT BEEN TURNED ON FOR 2 MONTHS.

IF 2 MONTHS HAVE PAST SINCE THE SYSTEM HAS BEEN PLUGGED IN AND TURNED ON, LET THE SYSTEM RUN WITHOUT MAKING X-RAYS FOR 4 HOURS TO ALLOW THE BATTERIES TO RECHARGE AND THE IMAGE TUBE TO DEGAS.

THIS ERROR MAY ALSO BE DISPLAYED AFTER INSTALLING A COPY OF THE BACKUP GENERATOR SOFTWARE, IN THIS CASE PRESS ANY KEY ON THE CONTROL PANEL AND CONTINUE USE AS NORMAL.

#### BATTERY DISCONNECTED

THIS MESSAGE IS DISPLAYED DURING BOOT UP (-1 ARROWS) IF THE SOFTWARE THINKS THE BATTERIES ARE DISCONNECTED.

THIS IS CHECKED BY DISABLING THE BATTERY CHARGER AND WAITING FOR 2 SECONDS, THE +200 VOLT SENSE LINE IS THEN READ. IF 180 VOLTS OR LESS IS READ, THE SOFTWARE ISSUES A SHUTDOWN COMMAND AND DISPLAYS THE BATTERIES DISCONNECTED" MESSAGE.

IF THE BATTERIES ARE DISCONNECTED OR CB1 IS OPEN THE ERROR "PRECHARGE FAIL" MAY BE DISPLAYED INSTEAD OF BATTERIES DISCONNECTED.

#### **CHARGER FAILED**

THIS MESSAGE IS DISPLAYED IF THE SOFTWARE SENSES THAT THE BATTERY VOLTAGE IS LESS THAN 225 VOLTS AND THAT THE CHARGER OUTPUT CURRENT IS LESS THAN 1.0 AMPS.

THE SOFTWARE CHECK FOR CHARGER FAILURE RUNS IN THE BACKGROUND ALL THE TIME EXCEPT DURING X-RAYS.

#### 70% CHARGE

THIS MESSAGE IS DISPLAYED IF THE SOFTWARE THINKS THAT THE CHARGE CAPACITY OF THE BATTERIES HAS BEEN DEPLETED TO 70% OR LESS. THE 70% CHARGE MESSAGE IS DISPLAYED INTERMITTANTLY ON THE CONTROL PANEL AND DOES NOT AFFECT SYSTEM OPERATION.

#### 50% CHARGE

THIS MESSAGE IS DISPLAYED IF THE SOFTWARE THINKS THAT THE CHARGE CAPACITY OF THE BATTERIES HAS BEEN DEPLETED TO 50% OR LESS.

THE 50% CHARGE MESSAGE IS DISPLAYED INTERMITTANTLY ON THE CONTROL PANEL, SYSTEM OPERATION IN FLUORO MODE IS ALLOWED BUT FILM EXPOSURES ARE SUSPENDED UNTIL THE CALCULATED CHARGE OF THE BATTERIES RISES ABOVE 50%.



9600 C-Arm For Reference Only Page 2 of 3 12/3/96 9600 Battery Charger Signal Sheet

FOR THE OLDER PCB LAYOUT.



Serial # 69-1001 and Higher



5. ADJUST R10 FOR 225 VOLTS ON THE DVM.

9600 Battery Charger Block Diagram Serial # 69-1001 and Higher

## 9600 Mobile Digital C-Arm - Generator Block Diagrams, Test Points, and Waveforms

CONTROL PANEL ASSEMBLY





### 9600 Mobile Digital C-Arm - Generator Block Diagrams, Test Points, and Waveforms



9600 Mobile Digital C-Arm - Generator Block Diagrams, Test Points, and Signal Waveforms





# TP20 XRAYSW

Normally high, goes low when Process Fluoro footswitch or control panel X-ray switch is pressed.

U38-10 (X-RAY SW)

Normally low, goes high when Process Fluoro footswitch or control panel X-ray switch is pressed.

U38-11 (BOOST)

Normally low, goes high when Boost is pressed.

U38-12 (SCOUT FLUORO)

Normally low, goes high when Scout is pressed.

# U27-12 (X-RAY DISABLE)

Normally low, goes high to disable X-rays. Selecting PULSE MODE causes this line to toggle high and low at an 4 pulse per second rate.

| $\bigcirc = \bigcirc$              | 9600 C-ARM         |             |  |
|------------------------------------|--------------------|-------------|--|
| OFCMEDICAL                         | For Reference Only | Page 1 of 1 |  |
| Training                           | XRAYONSS.DS4       | 12/4/96     |  |
| X-RAY ON / DISABLE<br>SIGNAL SHEET |                    |             |  |





















- 1 DS2, WHEN ILLUMINATED, INDICATES THAT THE COLLIMATOR IRIS DID NOT GO TO THE EXPECTED SIZE FOR THE MAG MODE SELECTED
  - THE
     3
     E5 JUMPER INSTALLED ONLY DURING COLLIMATOR

     IRIS SIZE CALIBRATION. WITH E5 INSTALLED THE IRIS
     POTENIOMETER VALUES ARE WRITTEN TO THE

     EEPROM U7 FOR EACH MAG MODE.
     EEPROM U7 FOR EACH MAG MODE.



USE THIS PAGE FOR SERIAL NUMBERS 69-2001 AND HIGHER & 62-0001 AND HIGHER









#### UNITY GAMMA

IFB P3-15, U5-4 OR CAMERA J1-8 HI (+5V WHEN NOT IN SUBTRACTION OR ROAD MAP) LO (0V WHEN IN SUBTRACTION OF ROAD MAP)



TEST PATTERN (NOT USED) IFB P3-16, U5-6 OR CAMERA J1-4 HI WHEN NOT ENABLED LO CAUSES TEST PATTERN 5 1/2" X 5 1/2" REFER TO FSB #94-025

ANTI VIGNETTE IFB P3-14, U5-12 OR CAMERA J1-7 NORMAL MODE - LOW MAG 1 - HI MAG 2 - HI



<u>+24V</u> IFB P2-3, OR CAMERA J1-2 IF FAULT IFB P2-11, U5-8 DS2 OFF - 0V WHEN NOT FAULT DS2 ON - +5V WHEN FAULT IS INDICATED CAMERA GAIN IFB P3-20 OR CAMERA J1-9 MIN. 0V MAX. +9V

VIDEO LEVEL INDICATOR IFB P3-23 OR CAMERA J1-10 MIN. 0V MAX. 9.5V AUTO MODE +4.5V - FLAT FIELD AUTOMODE +4.5V - MESH TOOL CAMERA VIDEO SIGNAL CENTER PIN OF CAMERA J2





CAMERA VIDEO SIGNAL - NO X-RAYS



USE THIS PAGE FOR SERIAL NUMBERS 69-0001 TO 69-2000





LO CAUSES TEST PATTERN 5 1/2" X 5 1/2" REFER TO FSB #94-025

IFB U5-10 OR CAMERA J1-5 PULSE MODE OR PULSE BOOST MODE→ lov ALL OTHER MODES, +5V

SERIAL NUMBERS 69-2001 AND HIGHER & 62-0001 AND HIGHER

|                                   | 9600 C-ARM         |             |  |  |
|-----------------------------------|--------------------|-------------|--|--|
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| COLLIMATOR & CAMERA SIGNAL SHEETS |                    |             |  |  |

CAMERA CONTROLS


9600 Mobile Digital C-Arm - Image System Block Diagrams, Test Points, and Signal Waveforms



### 9600 Mobile Digital C-Arm - Image System Block Diagrams, Test Points, and Waveforms



IMAGE INTENSIFIER CONTROLS SIGNAL SHEET

### 9600 Mobile Digital C-Arm - Image System Block Diagrams, Test Points, and Waveforms







USE THIS PAGE FOR SERIAL NUMBERS 69-2001 AND HIGHER & 62-0001 AND HIGHER







| 1. Press <b>"SETI</b><br>2. Install the se<br>3. Select <b>"Acc</b><br>4. Select <b>"Sys</b><br>5. Select <b>"Set</b><br>6. Set the confi | NFIGURATION<br>UP OPTIONS" on the a<br>ervice disk in the floppy<br>ess Level 2" from the r<br>tem Configuration" fro<br>System Configuration<br>iguration by making sel | Innotation keyboard<br>drive at the rear of the W<br>menu<br>om the menu<br>as" from the menu<br>ections from the following | prkstation<br>menu:                  | CONFIGURATION<br>Line Frequency (Hz):<br>System Model:<br>Archive:<br>Language:<br>Serial Number: 69-1<br>Hospital Name: OE0<br>Mars Table: DOI | : 60<br>: SP<br>: 0<br>: ENGLISH<br>1107<br>C TRAINING<br>MESTIC |  | Image Proc<br>Sch. #8<br>(See Image Path  | P8<br>ressor PCB<br>375952<br>n Block Page 2) |   |
|---|--|---|--------------------------------------|---|--|--|---|---|---|
|   |  |   |                                      | Date Format: MM.<br>Use the cursor arrow key:<br>Press [ENTER] to accept<br>Press [ESC] to exit   | /DD/YYYY<br>s to select  |  |   |   | - 386<br>P,<br>(See 960<br>9600 Worksta<br>Bloo |
| SOFTWARE  | FORMATTED<br>HARD DISK<br>PART #   | DISK<br>CONTROLLER<br>PART #  | AT COMM. PCB<br>OPTION PROM<br>(U25) | DRIVE<br>PARTIONING<br>C: DRIVE 10M   | <u>NOTES</u><br>Drives used: Fujit                               | su M2684TAU  | 1.44 Meg<br>Floppy Drive<br>P/N 900669  | 117   | 7   |
| 10  | 00-877024-02   | NONE  | -02<br>-03                           | D: DRIVE 30M<br>C: DRIVE 10M<br>D: DRIVE 60M  | Sea<br>Wes<br>See page 2 for ha                                  | gate ST3660A<br>tern Digital AC1365<br>rd drive jumper settings. | P1 Power  | P1 Data                                       |   |
|   | TRACKPAD F   | PANEL   |                                      |   | I  |  | J6  | 7   |   |
|   |  | NEGATE  |                                      |   | COMMUNICATIONS B<br>VE SELECTION JUMF<br>FOR IDE DISKS           | OARD<br>PERS E1-E3   | DC Power<br>Distribution PCB<br>876839<br>(See Workstation Power<br>Block Diagram #1) | J2  |   |





### FRONT PANEL











| SYSTEM CON<br>1. Press "SETU<br>2. Install the ser<br>3. Select "Acce<br>4. Select "Syste<br>5. Select "Set S<br>6. Set the config | FIGURATION POPTIONS" on the a vice disk in the floppy ss Level 2" from the r em Configuration" fro system Configuration guration by making sele | nnotation keyboard<br>drive at the rear of the W<br>nenu<br>om the menu<br>s" from the menu<br>ections from the following | /orkstation<br>g menu:               | CONFIGURATION<br>Line Frequency (Hz):<br>System Model:<br>(Digital Spot Option:<br>Cine Disk:<br>Language:<br>VCR1:<br>VCR2:<br>Digital Print:<br>Serial Number: 69-1<br>Hospital Name: OEC<br>Mars Table: DON<br>Measurements: NO<br>Date Format: MM.<br>Use the cursor arrow keys<br>Press [ENTER] to accept<br>Press [ESC] to exit | 60<br>ESP<br>Yes/No)<br>None<br>ENGLISH<br>Sony<br>Sony<br>No<br>107<br>C TRAINING<br>MESTIC<br>//DD/YYYY<br>s to select | P8<br>Image Processor PCB<br>Sch. #875952<br>(See Image Path Block Page 2) | J2<br>J2<br>(See 9600 W<br>9600 Workstatior<br>Block D |
|--|---|---|--------------------------------------|---|--|--|--|
| SOFTWARE<br>VERSION  | FORMATTED<br>HARD DISK<br>PART #  | DISK<br>CONTROLLER<br>PART #  | AT COMM. PCB<br>OPTION PROM<br>(U25) | DRIVE<br>PARTIONING   | NOTES  | 1.44 Meg<br>Floppy Drive   |  |
| 10   | 00-877024-02  | NONE  | -02                                  | C: DRIVE 10M<br>D: DRIVE 30M  | Drives used: Fujitsu M2684TAU<br>Seagate ST3660A<br>Western Digital AC1365   | P/N 900669 J17   |  |
| 11   | 00-877024-03  | NONE  | -03                                  | C: DRIVE 10M<br>D: DRIVE 60M  | See page 2 for hard drive jumper settings.   | P1 Power   |  |
|  | TRACKPAD  | PANEL   | 1                                    | ·   |  | J6   |  |



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FRONT PANEL

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AVERAGING

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| JUMPER SETTING |   |      |   |      |   |      |   |
|----------------|---|------|---|------|---|------|---|
| O=OPEN S=SHORT |   |      |   |      |   |      |   |
| J5-1           | 0 | J6-1 | s | J8-1 | 0 | J9-1 | ο |
| J5-2           | 0 | J6-2 | s | J8-2 | 0 | J9-2 | 0 |
| J5-3           | 0 | J6-3 | s | J8-3 | 0 | J9-3 | 0 |
| J5-4           | 0 | J6-4 | 0 | J8-4 | 0 | J9-4 | s |
| J5-5           | s | J6-5 | 0 | J8-5 | 0 | J9-5 | 0 |
| J5-6           | S | J6-6 | 0 | J8-6 | 0 | J9-6 | s |
| J5-7           | 0 | J6-7 | 0 | J8-7 | 0 | J9-7 | s |
| J5-8           | 0 | J6-8 | 0 | J8-8 | 0 | J9-8 | s |



#### IP SCSI CONTROLLER - MASTER (4/8/15/30 FPS)

ADAPTEC 4 & 8 FPS CINE OPTIONS

Bo Bo I. the Office CI If DO CI I. IP us 2. fill CI Ro See 3. For 1. 2. 3.

#### SCSI Troubleshooting Notes

Boot-up Problems

 If the system Application software boots up, the DOS SCSI Disk Controller PCB is probably OK.
 Otherwise, remove the IP SCSI Disk Controller PCBs and reboot. If this caused the system to not boot, replace this board.
 Try booting with the diagnostic disk in the A:\ drive. If this is successful, you need to replace the DOS SCSI Disk Controller PCB or the Hard Disk Drive.

#### CINE LOOP Problems

 Examine the green, yellow and red LEDs on the IP-SCSI Disk Controller PCB. After boot-up, use the table below to determine the probable cause of failure.
 If only the cine loop is not working, try deleting the Header.Dat file on the C:\ drive BUT YOU WILL LOOSE ALL PREVIOUS CINE RUNS AND ALL 200 PATIENT IMAGES. Reboot the system and verify operation. See also Formatting the Cine Partition.
 Try replacing the IP-SCSI Disk Controller PCBs.

Formatting the Cine Partition.

- 1. With the cart powered on, insert the diag. disk & press
- SETUP OPTIONS, Select Access Level 2.
- 2. Select "Prepare CINE Disk"
- 3. Reboot the system and verify operation.

























IP SCSI CONTROLLER - MASTER (4/8/15/30 FPS)

SCSI Troubleshooting Notes

 Boot-up Problems
 If the system Application software boots up, the DOS SCSI Disk Controller PCB is probably OK.
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- 1. With the cart powered on, insert the diag. disk & press SETUP OPTIONS, Select Access Level 2.
- 2. Select "Prepare CINE Disk"
- 3. Reboot the system and verify operation.

| IP SCSI Disk Controller Status LEDs |     |     |     |                    |  |  |  |  |
|-------------------------------------|-----|-----|-----|--------------------|--|--|--|--|
|                                     | G   | Y   | R   |                    |  |  |  |  |
|                                     |     | •   |     |                    |  |  |  |  |
|                                     | off | on  | off | = Normal Condition |  |  |  |  |
|                                     | on  | on  | off | = IP-SCSI Failure  |  |  |  |  |
|                                     | on  | off | on  | = IP-SCSI Failure  |  |  |  |  |
|                                     | on  | on  | on  | = IP-SCSI Failure  |  |  |  |  |
|                                     | on  | off | on  | = IP-SCSI Failure  |  |  |  |  |
|                                     | off | on  | on  | = SCSI HDD Failure |  |  |  |  |
|                                     |     |     |     |                    |  |  |  |  |







# FUJITSU M2932SAU

### **OEC JUMPERS**

| CN6: | D (INTERNAL DIAGNOSTIC)  | OFF   |
|------|--------------------------|-------|
|      | P (PARITY SETTING)       | ON    |
|      | A (AUTOMATIC MOTOR STAR  | T) ON |
| CN4: | ID0 OFF                  |       |
|      | ID1 OFF                  |       |
|      | ID2 OFF                  |       |
| CN7: | SY (SPINDLE SYNC SIGNAL) | OFF   |
|      | R (DISK DRIVE RESET)     | OFF   |
|      | WP (WRITE PROTECT)       | OFF   |
|      | TM (TERMINATION)         | ON    |
|      |                          |       |

SEAGATE ST32550N

## OEC JUMPERS



JUMPER PINS 1 & 2 (TERMINATE POWER FROM DRIVE) JUMPER PINS 5 & 6 (ENABLE SCSI TERMINATION)

NO JUMPERS ON J2 & J4









DOS SCSI CONTROLLERS

Q LOGIC (2 MODELS) 15 & 30 FPS CINE OPTIONS JUMPER AS ILLUSTRATED





#### SCSI Troubleshooting Notes

Boot-up Problems
1. If the system Application software boots up,
the DOS SCSI Disk Controller PCB is probably OK.
Otherwise, remove the IP SCSI Disk Controller PCBs and reboot.
If this caused the system to not boot, replace this board.
2. Try booting with the diagnostic disk in the A:\ drive.
If this is successful, you need to replace the
DOS SCSI Disk Controller PCB or the Hard Disk Drive.

CINE LOOP Problems 1. Examine the green, yellow and red LEDs on the IP-SCSI Disk Controller PCB. After boot-up, use the table below to determine the probable cause of failure. 2. If only the cine loop is not working, try deleting the Header.Dat file on the C:\ drive BUT YOU WILL LOOSE ALL PREVIOUS CINE RUNS AND ALL 200 PATIENT IMAGES. Reboot the system and verify operation. See also Formatting the Cine Partition. 3. Try replacing the IP-SCSI Disk Controller PCBs.

Formatting the Cine Partition.
1. With the cart powered on, insert the diag. disk & press SETUP OPTIONS, Select Access Level 2.
2. Select "Prepare CINE Disk"
2. Poly with the cart power of the select "Prepare CINE Disk"

3. Reboot the system and verify operation.









# FUJITSU M2932SAU

### **OEC JUMPERS**

| CN6: | D (INTERNAL DIAGNOSTIC)  | OFF   |
|------|--------------------------|-------|
|      | P (PARITY SETTING)       | ON    |
|      | A (AUTOMATIC MOTOR STAR  | T) ON |
| CN4: | ID0 OFF                  |       |
|      | ID1 OFF                  |       |
|      | ID2 OFF                  |       |
| CN7: | SY (SPINDLE SYNC SIGNAL) | OFF   |
|      | R (DISK DRIVE RESET)     | OFF   |
|      | WP (WRITE PROTECT)       | OFF   |
|      | TM (TERMINATION)         | ON    |

SEAGATE ST32550N

## OEC JUMPERS



JUMPER PINS 1 & 2 (TERMINATE POWER FROM DRIVE) JUMPER PINS 5 & 6 (ENABLE SCSI TERMINATION)

NO JUMPERS ON J2 & J4



### 9600 Mobile Digital C-Arm - Workstation Block Diagrams, Test Points, and Waveforms



# 9600 Mobile Digital C-Arm - Workstation Block Diagrams, Test Points, and Signal Waveforms

U2

U16

P4

C

U20-18 SEG. 10 2 Vdc 200 ms 🔽

U10



9600 C-ARM OEC For Reference Only Page 2 of 2 OFC MEDICAL SYSTEMS.INC Training CPI\_BLK1.DS4 6/17/96 9600 CONTROL PANEL PROCESSOR **BLOCK DIAGRAM** 

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OEC-DIASONICS INC COMMUNICATIONS PC 00-872126-01

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U33

### 9600 Mobile Digital C-Arm - Workstation Block Diagrams, Test Points, and Waveforms









Image Processor Enable (This signal has nothing to do with X-ray logic.A TTL Low indicates the system is taking X-rays and the IP is enabled.

|                             | 9600 C-ARM         |             |  |  |  |
|-----------------------------|--------------------|-------------|--|--|--|
| OFCMEDICAL                  | For Reference Only | Page 3 of 5 |  |  |  |
| Training                    | IP_BLK1.DS4        | 12/5/96     |  |  |  |
| IMAGE PATH<br>BLOCK DIAGRAM |                    |             |  |  |  |



To view Left and Right DAC and Monitor

|                             | 9600 C-AF          | RM          |  |  |  |  |
|-----------------------------|--------------------|-------------|--|--|--|--|
| OFCMEDICAL                  | For Reference Only | Page 4 of 5 |  |  |  |  |
| Training                    | IP_BLK1.DS4        | 12/5/96     |  |  |  |  |
| IMAGE PATH<br>BLOCK DIAGRAM |                    |             |  |  |  |  |

AUTO FLUORO MODE - NOTHING IN FIELD



Page 5 of 5 **BLOCK DIAGRAM** 



<sup>9600</sup> Mobile Digital C-Arm - Workstation Block Diagrams, Test Points, and Signal Waveforms

# 9600 Mobile Digital C-Arm - Workstation Block Diagrams, Test Points, and Signal Waveforms



### 9600 Mobile Digital C-Arm - Workstation Block Diagrams, Test Points, and Waveforms


## 9600 Mobile Digital C-Arm - Workstation Block Diagrams, Test Points, and Waveforms



9600 Mobile Digital C-Arm - Workstation Block Diagrams, Test Points, and Waveforms





## 9600 Mobile Digital C-Arm - Workstation Block Diagrams, Test Points, and Signal Waveforms



9600 Mobile Digital C-Arm - Workstation Block Diagrams, Test Points, and Signal Waveforms

## **SERIES9600**<sup>™</sup>







OEC MEDICAL Systems, inc



















05-017-6/92

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| WG. N | 00-872125   <sup>sh</sup> 1  e        | 1        |           |  |
|-------|---------------------------------------|----------|-----------|--|
| (M) e | NGRG REV 6.1                          |          | EDR 01021 |  |
| REV   | DESCRIPTION                           | DATE     | APPROVED  |  |
| A     | RELEASED TO MANUFACTURING PERECO H486 | 03/25/91 | DAVIS     |  |
| в     | REVISED PER ECO H792                  | 06/11/91 | DAVIS     |  |
| С     | ADDED CKT "VCREN*" PER ECO J056       | 08/05/91 | DAVIS     |  |
| C1    | CHG JUMPER CHART PER ECO J219         | 09/20/91 | DAVIS     |  |
| C5    | CHG JUMPER CHART PER ECO L259         | 06/25/92 | MAHON     |  |
| С3    | INACT01, CREATE -02 PER ECO N046      | 08/05/93 | C. BALL   |  |
| D     | REVISED PER ECO N759                  | 11/12/93 | C. BALL   |  |
| D1    | REVISED PER ECD R343A                 | 04/07/94 | C. BALL   |  |
| E     | REVISED PER ECO V267                  |          |           |  |

Π

B

ENABLE OPTION PROM PRINTER 256K PROM SELECT -02) (-03) 512K PROM SELECT UART A/R TIMER COM 2 COM 1

| SYSTEM TYPE                            |    |    |    |
|--|----|----|----|
| MOTHERBOARD & DISK                     | E1 | ES | E3 |
| 286(Award BIOS) WITH<br>IDE DISK       | C  | C  | C  |
| 286(Award B10S) WITH<br>ESDI 4FPS DISK | ·  | G  | G  |
| 286(Award B10S) WITH<br>SCSI DISK      | G  | +  | +  |
| 386(AMI BIOS) WITH<br>IDE DISK         | •  | +  | C  |
| 386(AMI BIOS) WITH<br>SCSI DISK        | C  | +  | G  |

|   | REF DESIGNATIONS | DEVICE   | GND |       | +5V | UNUSED  |
|---|------------------|----------|-----|-------|-----|---------|
|   | U10,37           | 74LS04   | 7   |       | 14  | U10-E,F |
|   | U7,8,17          | 7407     | 7   |       | 14  | U8-B, D |
|   | U36              | 74LS163  | 8   |       | 16  |         |
|   | U11              | 74LS05   | 7   |       | 14  | U11-E,F |
| _ | U6,30,31         | 74LS244  | 10  |       | 50  |         |
|   | U33              | 74LS245  | 10  |       | 50  |         |
|   | U14,23,28,35     | 74LS541  | 10  |       | 50  |         |
|   | 01,3,4,12,15     | MC1489   | 7   |       | 14  | U3-A, B |
|   | U2,5,13,16       | MC1488   |     | SHOWN |     | U5-C,D  |
|   | U32              | GAL16V8  | 10  |       | 50  |         |
|   | U9,18,19,34      | 74ALS574 | 10  |       | 50  |         |
|   | U26,27           | SCN2681  | 50  |       | 40  |         |
|   | U25              | TC57256  | 14  |       | 28  |         |
|   | U20,22           | NS16450  | 50  |       | 40  |         |
|   | U24,29           | S5A10    | 15  |       | 24  |         |
|   | U21              | 74LS125  | 8   |       | 16  | U21-B,C |
|   | U38              | 7408     | 7   |       | 14  | U38-C.D |

-03 SHOWN -02 SHOWN -01 INACTIVE

SHEET 1 OF 2

F

CEC-DIASONICS, INC.

00-872125

COMMUNICATIONS PCB SCHEMATIC DIAGRAM



| 3   |                                       | 2           |          |       | 1         |    |
|-----|---------------------------------------|-------------|----------|-------|-----------|----|
| ME  | M ENGRG REV 4 REVISIONS               |             |          |       | EDR 01131 | 1  |
| REV |                                       | DESCRIPTION |          | DATE  | APPROVED  |    |
| A   | RELEASED TO MANUFACTURING PERECO H482 |             | 03/26/91 | MAHON |           |    |
| A1  | REVISED PER ECO U060A                 |             |          |       |           |    |
|     |                                       |             |          |       |           | ]_ |
|     |                                       |             |          |       |           |    |

| REFERENCE | DESIGNATIONS |
|-----------|--------------|
| HIGHEST   | UNUSED       |
| C8        |              |
| CR17      |              |
| E9        |              |
| P2        |              |
| Q10       |              |
| R11       |              |
|           |              |
| U1        |              |
| Y1        |              |
|           |              |
|           |              |
|           |              |

1. ALL RESISTOR VALUES ARE INOHMS, 1/4W, 5%. 2. ALL CAPACITOR VALUES ARE IN MICROFARADS, 50V.

4. JUMPER PINS 11-12 OF E1 (-03)

NOTES:

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-03 SHOWN -02 INACTIVE -01 INACTIVE Ε

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00-873936





-01 SHOWN










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| OE     | C ME    | DICAL   | SYSTEM    | 15,        | IN | IC |
|--------|---------|---------|-----------|------------|----|----|
| SIZE   | DWG NO. |         |           |            |    | RE |
| D      |         | SCHEMAT | IC DIAGRA | .5330<br>M | ĸ  | F  |
| SCALE: | NONE    | ØØ-87   | 3486      | SHEET      | 2  |    |

A

NOTE 1: PINS 14, 36 & 68

U11

U9

U16

U10

U8

υ4

U15

U2

U13

U3

U1

U7





SHEET 2 OF 2



MEMORY

4



| 0E     | С   | MEI | DICA | L  | SYS  | TE۲ | 15,   | ] | [N | с. |
|--------|-----|-----|------|----|------|-----|-------|---|----|----|
| D      | DWG | N0. | 00-  | -8 | 7774 | 2   |       |   |    | B  |
| SCALE: | NO  | NE  |      |    |      |     | SHEET | 2 | OF | 5  |

DWG NO. 00-877742 SHT REV 2 B

D

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|             | 7 |              | Б                 |   | 5   |               |             | ➡  |              | З                 |                         |            |       | 2           |   | 1          |           |          |
|-------------|---|--------------|-------------------|---|---|---------------|-------------|--|--------------|-------------------|-------------------------|------------|-------|-------------|---|------------|-----------|----------|
|             |   | I            |                   |   | 1   |               |             | •  |              |                   | ME                      | NGIN. REV  | 14    | F           | EVISIONS                                |            | EDR Ø1340 | J        |
|             |   |              |                   |   |   |               |             |  |              |                   | REV                     |            | DES   |             | PED ECO UR                              | DATE<br>15 | APPROVED  | _        |
|             |   |              |                   |   |   |               |             |  |              |                   |                         | RELENSED   |       | I HCTORING  | FER ECO VJ                              | 10         |           |          |
|             |   |              |                   |   |   |               |             |  |              |                   |                         |            |       |             |   |            |           |          |
|             |   |              |                   |   |   |               |             |  |              |                   |                         |            |       |             |   |            |           |          |
|             |   |              |                   |   |   |               |             |  |              |                   | I                       |            |       |             |   |            |           |          |
|             |   |              |                   |   |   |               |             |  |              |                   |                         |            |       |             |   |            |           |          |
|             |   |              |                   |   |   |               |             |  |              |                   |                         |            |       |             |   |            |           |          |
|             |   |              |                   |   |   |               |             |  |              |                   |                         |            |       |             |   |            |           |          |
|             |   |              |                   |   |   |               |             |  |              |                   |                         |            |       |             |   |            |           |          |
|             |   | 1            | - P4 <del>(</del> |   |   | CR1<br>1N4005 | SECURITY    |  |              |                   |                         |            |       |             |   |            |           |          |
|             |   | 3 -          |                   |   |   | CR2           | XRAY_SWITCH |  |              |                   |                         |            |       |             |   |            |           |          |
|             |   | 5.           | - ₽4 ←<br>- ₽4 ←  |   | -   | 1114005       |             | → P10 - 5  |              |                   |                         |            |       |             |   |            |           | E        |
|             |   | 7 -          | - ₽4 ←<br>- ₽4 ←  |   |   |               | R1<br>150   |  | P1 -         | - 1 ←             | ROTATE                  | 115VAC_A   | •     |             | → P3 - 1                                |            |           |          |
|             |   | 9 ·<br>10 ·  | - P4 ←            |   |   |               | +50         | $\rightarrow$ P10 - 1  | P1 -         | - 2 ~             | ROTATE_                 | 115VAC_A   |       |             | →P3 - 2                                 |            |           |          |
|             |   | 11 - 12 -    | - P4              |   |   |               | V_KHT LHNP  | → P10 - 3  | P1 -         | - 3 ←<br>- ⊿ ∠    | -                       |            | Γ     |             | >P3 - 3                                 |            |           |          |
|             |   | 14 -         | - P4 (            |   |   |               | EMEROF_HI   | $\rightarrow P9 - 1$   | P1 -         | - 4 ←<br>- 5 ←    | ROTATE_                 | 115VAC_B   |       |             | >P3 - 4                                 |            |           |          |
|             |   | 16 ·<br>17 · | - ₽4 ←<br>- ₽4 ←  |   |   |               | Г           | $\rightarrow$ Pg - 2<br>$\rightarrow$ Pg - 3                             | P1 -         | - б ←             | ROTATE_                 | 115VAC_B   |       |             | →P3 - 6                                 |            |           |          |
|             |   | 18 ·<br>19 · | - P4 ←            |   |   |               |             | $\rightarrow$ P8 - 1<br>$\rightarrow$ P8 - 2                             | P1 -         | - 7 ←<br>- 8 ∠    | _                       |            |       |             | >P3 - 7                                 |            |           |          |
|             |   | 20 .         |                   |   |   |               | TEC DVD I O | → P8 - 3   | P1 -         | - 9 ←             | ROTATE                  | AC_RTN     |       | _ ↓   `     | ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, |            |           |          |
|             |   |              |                   |   |   |               | TEC_RXD_LO  | $\rightarrow$ J3 - 1   | P1 -         | - 10 ←            | ROTATE_                 | AC_RTN     |       |             |   |            |           |          |
|             |   |              |                   |   |   |               | TECH_CTS_LC | →13 - 3  | P2 -         | - 1 ←             | LIFT_UP                 | _SW        |       |             | → P11 - 3                               |            |           |          |
|             |   |              |                   |   |   |               | TECH_TXD_HI | $\rightarrow$ J3 - 4<br>$\rightarrow$ J3 - 5                             | P2 -         | - 2 ~             | LIFT_DN                 | <u>_SW</u> |       |             | >P5 - 3                                 |            |           |          |
|             |   | 1 -          |                   |   | <b>_</b>     └  |               | TECH_TXD_LC | $\rightarrow$ J3 - 6   | P2 -         | - 3 ←             | ROT_CW                  | _SW        |       |             | > P12 - 3                               |            |           |          |
| Ī           |   | 2.3          |                   |   |   |               | TECH_RTS_LC | → J3 - 8   | P2 -<br>P2 - | - 4 ←<br>- 5 ←    | MOT_AC_                 | RTN_EN     |       | •           | → P7 - 3                                |            |           |          |
|             |   | 4 -<br>5 -   |                   |   | •   |               | +5V         | $\rightarrow$ J3 - 9<br>$\rightarrow$ J3 - 10                            | P2 -         | - 6 <del>(</del>  | SPARE1                  | ~          |       | •           | >P5 - 2                                 |            |           |          |
|             |   | 6 - 7 -      |                   |   |   |               | +5V<br>GND  | $\rightarrow$ J3 - 11  | P2 -         | - 7 ←             | EDODES                  | 54         |       | •           | > P12 - 2                               |            |           | C        |
|             |   | 9 ·<br>10 ·  |                   |   | ¥   |               | GND         | $\rightarrow$ J3 - 12<br>$\rightarrow$ J3 - 13                           | P2 -         | - o ←<br>- g ←    | - SPARE3                |            |       |             | > P11 - 1                               |            |           | S        |
|             |   | 11 ·<br>12 · |                   |   |   |               | +12V        | $\rightarrow$ J3 - 14<br>$\rightarrow$ J3 - 15                           | P2 -         | - 10 <del>(</del> | SHIELD                  |            | +     |             | >P5 - 1                                 |            |           |          |
|             |   | 13 ·<br>14 · |                   |   |   |               |             |  |              |                   |                         |            | t     |             | > P12 - 1                               |            |           | Č.       |
|             |   | 15 -         |                   |   |   |               |             |  |              |                   |                         |            |       |             | 7 Pr - 1                                |            |           | 14       |
|             |   | 18 -         |                   |   |   |               |             |  |              |                   |                         |            |       |             |   |            |           |          |
|             |   | 20 -         | - PG              |   |   | E1 E2         | E3          |  |              |                   |                         | <b>-</b>   |       |             |   |            |           |          |
|             |   |              |                   |   | ſ   |               |             |  |              |                   |                         |            |       |             |   |            |           |          |
|             |   |              |                   |   |   | 0 0           | 0           |  |              |                   |                         |            |       |             |   |            |           |          |
|             |   |              |                   |   | l   | HOLE          | HOLE        |  |              |                   |                         |            |       |             |   |            |           |          |
|             |   |              |                   |   |   |               |             |  |              |                   |                         |            |       |             |   |            |           | B        |
|             |   |              |                   |   |   |               |             |  |              |                   |                         |            |       |             |   |            |           |          |
|             |   |              |                   |   |   |               |             |  |              |                   |                         |            |       |             |   |            |           |          |
|             |   |              |                   |   |   |               |             |  |              |                   |                         |            |       |             |   |            |           |          |
|             |   |              |                   |   |   |               |             |  |              |                   |                         |            |       |             |   | -6         | 21 SHOWN  |          |
|             |   |              |                   |   |   |               |             |  | ITEM         | 1 QTY. P          | PART OR I               | JENT NO.   |       |             | DESCRIPT                                | ION        |           |          |
|             |   |              |                   |   | 1   |               | 1           | CONTROCT NO  |              |                   |                         |            |       | PART LIS    | 6T                                      |            |           |          |
|             |   |              |                   | THIS DOCUME<br>CONTAINED H                | NT AND THE INFORMATION<br>EREIN IS THE PROPERTY   |               |             | CUNTRACT NO.   | MATERIA      | ,                 | APPROVA<br>IRAWN        | .5 [       |       | DEC ME      | EDICAL                                  | SYSTEM     | IS, TNO   | $\cdot$  |
|             |   |              |                   | LOANED TO Y<br>SYSTEMS WOR<br>IT IS NOT T | OU ONLY FOR OEC MEDICAL<br>K.<br>O BE COPIED OR IN ANY WAY  |               |             | UNLESS OTHERWISE SPECIFIE<br>DIMENSIONS ARE IN INCHES<br>TOLERANCES ARE: |              |                   | B. WA                   | ALKER 4-   | 27-95 | AG TITLE    |   | 5.510      |           | F        |
|             |   |              |                   | DISCLOSED 1<br>BE RETURNED<br>UPON DEMAND | O THIRD PARTIES, IT SHALL<br>TO DEC MEDICAL SYSTEMS   | 00-878494     | 9600        | FRACTIONS: +/-<br>DECIMALS: .XX+/-                                       | FINISH       |                   | CHECKED<br>M. UHREY     | 6-         | 12-95 | CO          | LUMN I/                                 | O PCB SC   | HEMATIC   |          |
|             |   |              |                   | BY ACCEPTAN<br>DOCUMENT IN<br>TO THESE RE | ILL: (HOSE WHO HAVE THIS<br>I THEIR POSSESION AGREE<br>STRICTIONS AND SHALL BE<br>LEGAL ACTION BY AFC | NEXT ASSY     | USED ON     | .XXX+/-<br>ANGLES:+/-  |              | E                 | ENGINEERING<br>B. WAIKE | R F-       | 12-95 | IZE DWG NO. | <u>ии-</u>                              | 878492     | R         | EV<br>A  |
|             |   |              |                   | MEDICAL SYS                               | TEMS FOR ALL LOSS OR<br>ING FROM BREACH THEREOF.  | APPLICA       | TION        | DO NOT SCA   | LE DRAWING   | 6                 | APPROVED                |            |       |             |   |            | SHEET LOS |          |
| 05-014-9/93 | 7 |              | 6                 |   | 5   |               |             | •  |              | 3                 |                         |            | 19    | 2           |   | 1          |           | <u> </u> |

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|   | P1 - 1 ← LINE<br>P1 - 2 ← LINE   |                                       |                 |        | RV3  | LINE<br>NEUT_T1_120V<br>P2 - 2   | L<br>2                     |                                  |
|   | PI - 3 <u>LINE_1220</u><br>PI - 4 <u>NEUT_1220</u><br>PI - 5 <u>LINE_1220</u><br>PI - 5 <u>LINE_1220</u><br>PI - 7 <del>[]</del><br>PI - 7 <del>[]</del><br>PI - 8 <u>NEUTRAL</u><br>PI - 9 <u>NEUTRAL</u> |                                       | F E775EL<br>    | C2<br> | 8.47 528/150<br>1580<br>2250/AC<br>X2<br>RV4<br>8.47 1580          | $ \rightarrow P2 - 3$ $ \rightarrow P2 - 4$ $ \rightarrow P2 - 5$ $ LINE_{12}OU \rightarrow P2 - 6$ $ CHASSIS_GND \rightarrow P2 - 7$ $ \rightarrow P2 - 6$ $ NEUT_{1} \rightarrow P2 - 6$ | 3<br>4<br>5<br>7<br>3<br>9 |                                  |
|   | 9-PIN HEADER<br>AMP UNIV.<br>MATE-N-LOK  | RU1 528K388<br>RU1 3880 RU2 382<br>AV | нава (PT2 - 1 ) |        | 2530-AC<br>X2  | 9-PIN HEADER<br>AMP UNIU.<br>MATE-N-LOK  |                            |                                  |
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## **Electrical Schematic Diagram** 00-875972, Image Processor, is not included in this package. The diagram is not currently available in electronic form.







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SCHEMATIC DIAGRAM

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| P1 5 ROTATE_120VAC_B<br>P1 6 ROTATE_120VAC_B   | → P3 3   |   |          |     |                 |              |          |           |   |
| PI 9 ROTATE_NEUTRAL<br>PI 10 ROTATE_NEUTRAL  | ₽3 6   |   |          |     |                 |              |          |           |   |
| P2 1 LIFT_UP_SW<br>P2 2 LIFT_DN_SW<br>P2 3 ROT_CU_SW<br>P2 4 ROT_CCL_SW<br>P2 4 MOT_NEUTRAL_EN<br>P2 5 SPARE1<br>P2 6 SPARE1<br>P2 7 DC_RTN_SW<br>P2 8 SPARE2<br>P2 9 SPARE3 | P4 3<br>P5 3<br>P7 3<br>P7 3<br>P7 2<br>P4 2<br>P5 3<br>P5 5<br>P5 5<br>P5 5<br>P7 3<br>P5 5<br>P5 5<br>P5 5<br>P7 3<br>P5 5<br>P5 5<br>P5 5<br>P5 5<br>P5 5<br>P7 3<br>P5 5<br>P5 5<br>P7 3<br>P5 5<br>P5 5 |   |          |     |                 |              |          |           | E |

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|                       |                                   |   |   | MEMORY   |  |   |  |   |
|                       | BUFFERED_ADDRES                   | SS_BUS<190>   |   |  |  |   |  |   |
|                       |                                   | Y   | Ý   | Ý  | Ý  | Ý   | •  |   |
|                       | S1, AB                            |   |   |  |  |   |  |   |
|                       | S1, AB                            |   |   |  |  |   |  |   |
|                       | S1, B8                            |   |   |  |  |   |  |   |
|                       | S1, BB RAMØ_CS*                   |   |   |  |  |   |  |   |
|                       | S1, BB                            |   |   |  |  |   |  |   |
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|                       | S1, BB                            | BOOT ROM  | OPTION ROM  | RAM Ø  | RAM 1  | RAM 2   | RAM 3  | NON VOLATILE RAM  |
|                       |                                   | U14   | U15   | VCC U19 581001P  | U18<br>581Ø01P   | U16<br>581001P  | U17<br>581001P   | U2Ø<br>   |
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|                       |                                   | 6 4 A6<br>5 5 6 ~                                     | 6 4 A6<br>5 5 5 05                                    |  |  |   |  | A1 2048XB   |
|                       |                                   | 4 6 A4<br>3 7 A3 EEEBEYR                              |   | $4 \qquad B \\ 4 \qquad A4 \\ 3 \qquad 9 \qquad A3 \qquad 1324 \\ a = 1$ | 4 8 A4<br>3 9 A3 133KvB  | 4 8 A4<br>3 9 A3 1334 48                              | $\begin{array}{c} H3 \\ 4 \\ 3 \\ 9 \\ H3 \\ 120 \\ 4 \\ 120 \\ 8 \\ H3 \\ 120 \\ 8 \\ H3 \\ 120 \\ 8 \\ 120 \\ 8 \\ 10 \\ 10 \\ 10 \\ 10 \\ 10 \\ 10 \\ 10$   |   |
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|                       | R11 ROM<br>4.7K ≥ ENBLE<br>74L500 |   |   |  |  |   |  |   |
| RAM_LERK              |                                   | 9   |   |  |  |   |  |   |
| Rem_QE *              | _RAM_WR*                          |   |   |  |  |   |  |   |
| BUFFERED_DATA_BUS(70) | _RAM_OE*                          |   |   |  |  |   |  |   |
| BUFFERED_DATA_BUS<7Ø> |                                   |   |   |  |  |   |  |   |
| BUFFERED_DATA_BUS<70> |                                   |   |   |  |  |   |  |   |
| BUFFERED_DATA_BUS<70> |                                   |   |   |  |  |   |  |   |
|                       | BUFFERED_DATA_E                   | BU5<70>   |   | ×  |  |   |  | )   |

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# SERIES**9600**™

## **Mobile C-Arm Illustrated Parts Manual**



(PN 00-875496-02)

This manual contains information on the SERIES**9600** Mobile C-Arm. It should serve as an aid to field service engineers technicians in locating parts and identifying part numbers. It is not a complete parts list and should and not be used as a substitute for a bill of materials. Furthermore, product changes and improvements may occur at any time and these changes may not be reflected in this manual.

Removing or installing parts should not be attempted by anyone who is not specifically trained by OEC Medical Systems, Inc. to work on the SERIES**9600** Mobile C-Arm System.

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The Mobile Digital Imaging System is manufactured under the following US patents: 4.768.216; 4.797.907; and 4.209.706. Other patents pending.

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#### **Revision History**

| <u>Rev</u> | <u>Dash</u> | <u>Date</u>    | Change Description  |
|------------|-------------|----------------|---|
| А          | -01         | February, 1994 | Release   |
| В          | -02         | January, 1995  | Document batch release changes to 9600 Mobile Imaging System. |

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#### Update December1995

| Fig. | 1 December | 1995 Update | SERIES <b>9600</b> | Mobile C-Arm | 12" II Modifications |  |
|------|------------|-------------|--------------------|--------------|----------------------|--|
| Fig. | 2 December | 1995 Update | SERIES <b>9600</b> | Mobile C-Arm | 12" II Modifications |  |

#### Update May 1996

| Fig. | 1 May | 1996 Update   | Center Pivo | t Steering | Modification | Upgrade, | All Systems |           | .131 |
|------|-------|---------------|-------------|------------|--------------|----------|-------------|-----------|------|
| Fig. | 2 May | v 1996 Update | Center Pivo | t Steering | Modification | Upgrade, | Sytems 2000 | and Under | 133  |
| Fig. | 3 May | v 1996 Update | Center Pivo | t Steering | Modification | Upgrade, | Sytems 2001 | and Up    | .135 |
| Fig. | 4 May | v 1996 Update | Center Pivo | t Steering | Modification | Upgrade, | All Systems |           | .138 |
| Fig. | 5 May | v 1996 Update | Center Pivo | t Steering | Modification | Upgrade, | All Systems |           | .141 |

## Introduction

#### Who Should Use This Manual

This manual is intended for the properly trained engineer or technician who designs, installs, maintains or calibrates the OEC Medical Systems, Inc. SERIES**9600** Mobile C-Arm System.

#### How This Manual is Organized

This manual is organized into sections. Section 1 contains information on replaceable parts for systems with serial numbers 69-001 thru 69-999. Section 2 contains information on replaceable parts for systems with serial numbers 69-1000 and up.

Both sections of this manual provide exploded view illustrations, lists, and descriptions of replaceable parts necessary for repair of the SERIES**9600** Mobile C-Arm System.

Unless they are significantly important to the exploded view, this manual usually does not list common items such as spacers, clips, active and passive electronics devices, wires, IC chips, screws, washers, nuts, and bolts.

#### **Contacting Technical Support**

For assistance with part number changes, contact Technical Support at US 1-800-874-7378, Europe 41 1 811 07 70, others 1-801-536-4688.

**Note:** The item numbers on the illustrations do not match the item numbers on the assembly drawings or the item numbers on the Bills of Materials.



Fig. 1-1 SERIES9600 Mobile C-Arm

|      | FIG. 1-2 PARTS LIST |  |     |  |  |  |  |
|------|---------------------|--|-----|--|--|--|--|
| ITEM | PART NUMBER         | DESCRIPTION                                  | QTY |  |  |  |  |
| 1    | 00-876031-01        | COVER, FRONT, TOP                            | 1   |  |  |  |  |
| 2    | 00-877320-01        | ASSEMBLY, SKIN SPACER, 9600                  | 1   |  |  |  |  |
| 3    | 00-876563-01        | COVER, ASSEMBLY, LEG, FRONT                  | 1   |  |  |  |  |
| 4    | 00-876033-01        | COVER, FRONT, RIGHT                          | 1   |  |  |  |  |
| 5    | 00-876569-01        | MACHINING, END CAP, CROSS BEAM               | 2   |  |  |  |  |
| 6    | 00-876380-01        | ASSEMBLY, FOOT SWITCH, 9600, ENGLISH         | 1   |  |  |  |  |
| 6    | 00-876380-02        | ASSEMBLY, FOOT SWITCH, 9600, GERMAN          | 1   |  |  |  |  |
| 6    | 00-876380-03        | ASSEMBLY, FOOT SWITCH, 9600, FRENCH          | 1   |  |  |  |  |
| 6    | 00-876380-04        | ASSEMBLY, FOOT SWITCH, 9600, SPANISH         | 1   |  |  |  |  |
| 6    | 00-876380-05        | ASSEMBLY, FOOT SWITCH, 9600, ITALIAN         | 1   |  |  |  |  |
| 7    | 00-876565-01        | COVER, ASSEMBLY, CROSS BEAM                  | 1   |  |  |  |  |
| 8    | 00-876754-01        | CLIP, COVER, SIDE                            | 2   |  |  |  |  |
| 9    | 00-876521-01        | ASSEMBLY, REAR COVERS                        | 1   |  |  |  |  |
| 10   | 00-876562-01        | COVER, ASSEMBLY, FRONT, LEFT                 | 1   |  |  |  |  |
| 11   | 00-876368-01        | ASSEMBLY, HAND CONTROL, X-RAY, ENGLISH, 9600 | 1   |  |  |  |  |
| 11   | 00-876368-02        | ASSEMBLY, HAND CONTROL, X-RAY, GERMAN, 9600  | 1   |  |  |  |  |
| 11   | 00-876368-03        | ASSEMBLY, HAND CONTROL, X-RAY, FRENCH, 9600  | 1   |  |  |  |  |
| 11   | 00-876368-04        | ASSEMBLY, HAND CONTROL, X-RAY, SPANISH, 9600 | 1   |  |  |  |  |
| 11   | 00-876368-05        | ASSEMBLY, HAND CONTROL, X-RAY, ITALIAN, 9600 | 1   |  |  |  |  |
| 12   | 00-900524-11        | PAINT KIT, ELITE GRAY, TEXTURE               | 1   |  |  |  |  |
| 13   | 00-900524-12        | PAINT KIT, RHINESTONE, TEXTURE               | 1   |  |  |  |  |
| 14   | 00-900524-13        | PAINT KIT, WINDSWEPT, TEXTURE                | 1   |  |  |  |  |



Fig. 1-2 Covers, Foot Switch, Hand Control Exploded View

| FIG. 1-3 PARTS LIST |              |                                    |     |  |  |  |  |  |
|---------------------|--------------|------------------------------------|-----|--|--|--|--|--|
| ITEM                | PART NUMBER  | DESCRIPTION                        | QTY |  |  |  |  |  |
| 1                   | 00-875538-01 | ASSEMBLY, CARD RACK, 9600          | 1   |  |  |  |  |  |
| 2                   | 00-875596-01 | BRACKET, SHIELD, 9600              | 1   |  |  |  |  |  |
| 3                   | 00-900710-01 | HIGH VOLTAGE TANK, 9600 (SCD)      | 1   |  |  |  |  |  |
| 4                   | 00-875761-01 | BRACKET, MOUNTING, SIDE COVERS     | 1   |  |  |  |  |  |
| 5                   | 00-875647-01 | BRACKET, MOUNTING, FRONT LEG COVER | 1   |  |  |  |  |  |
| 6                   | 00-875549-01 | ASSEMBLY, CASTER, FRONT, 9600      | 1   |  |  |  |  |  |
| 7                   | 00-875736-01 | BRACKET, BREAKER                   | 1   |  |  |  |  |  |
| 8                   | 00-900566-01 | CIRCUIT BREAKER ENERGY LIMITING    | 1   |  |  |  |  |  |
| 9                   | 00-876667-01 | ASSEMBLY, BALANCE WHEEL            | 1   |  |  |  |  |  |
| 10                  | 00-900589-01 | ASSEMBLY, BATTERY PACK             | 1   |  |  |  |  |  |
| 11                  | 00-875583-01 | RETAINER, BATTERY, 9600            | 2   |  |  |  |  |  |



Fig. 1-3 Electronics, Battery Exploded View

| FIG. 1-4 PARTS LIST |              |   |     |
|---------------------|--------------|---|-----|
| ITEM                | PART NUMBER  | DESCRIPTION                             | QTY |
| 1                   | 20-840202-00 | FAN, AXIAL, 12VDC, 33CFM, 4100RPM       | 2   |
| 2                   | 00-875650-01 | BRACKET, MOUNTING, FAN                  | 1   |
| 3                   | 00-876769-01 | BRACKET, MOUNTING, CARD                 | 1   |
| 4                   | 00-900588-01 | PCA, MOTHERBOARD, 9600                  | 1   |
| 5                   | 00-875331-01 | CABLE ASSEMBLY, FLAT, DISK, I/O, 9600   | 1   |
| 6                   | 00-875649-01 | WELDMENT, CARD RACK                     | 1   |
| 7                   | 00-875869-01 | SHIELD, CARD RACK, 9600                 | 1   |
| 8                   | 00-876740-01 | ASSEMBLY, PCB, ANALOG INTERFACE 96/UR26 | 1   |
| 9                   | 00-876737-01 | ASSEMBLY, PCB, TECHNIQUE PROCESSOR 9600 | 1   |
| 10                  | 88-750000-00 | MEMORY CD, SRAM, BAT BK, 1MX8           | 1   |
| 11                  | 22-319823-00 | GUIDE, PCB, SNAP IN, 8.00L, .312W, .062 | 4   |



Fig. 1-4 Card Rack Assembly Exploded View

| FIG. 1-5A PARTS LIST |              |   |     |
|----------------------|--------------|---|-----|
| ITEM                 | PART NUMBER  | DESCRIPTION   | QTY |
| 1                    | 00-876644-01 | ASSEMBLY, PCB, BATTERY CHARGER, 9600                        | 1   |
| 2                    | 00-876641-01 | ASSEMBLY, PCB, GENERATOR DRIVER, 9600                       | 1   |
| 3                    | 67-169336-00 | FU, AXIAL, 2A, 250V, .600 X .190 (F1, F2, F4, F5) NOT SHOWN | 4   |
| 4                    | 67-169337-00 | FU, AXIAL, 5A, 250V, 1.275 X .275 (F3) NOT SHOWN            | 1   |
| 5                    | 00-876642-01 | ASSEMBLY, PCB, X-RAY REGULATOR, 9600                        | 1   |
| 6                    | 00-875620-01 | SHIELD, HIGH VOLTAGE, GENERATOR, 9600                       | 1   |



Fig. 1-5A Generator Controller Assembly Exploded View (Sheet 1 of 2)

| FIG. 1-5B PARTS LIST |              |  |     |
|----------------------|--------------|--|-----|
| ITEM                 | PART NUMBER  | DESCRIPTION                                      | QTY |
| 1                    | 00-871078-01 | CLAMP, MOUNTING. CAPACITOR                       | 1   |
| 2                    | 41-718501-00 | CAPACITOR, POLYP PPR, 30UF, 600V 10%, TERM (C1)  | 1   |
| 3                    | 35-495410-00 | RESISTOR, WW, 1K, 25W, 3% AXL AL HOUSING (R1)    | 1   |
| 4                    | 35-375226-00 | RESISTOR, WW, 20K, 10W, 1%, AXL ALHOUSING (R2)   | 1   |
| 5                    | 41-516049-00 | CAPACITOR, AL, 1800UF, 250V, -10/+50%, SCR (C4)  | 1   |
| 6                    | 00-871079-02 | CLAMP, MOUNTING, CAPACITOR                       | 1   |
| 7                    | 41-718500-00 | CAPACITOR, POLYP PPR, 10UF, 600V, 10%, TERM (C3) | 1   |
| 8                    | 00-871492-01 | BUS BAR  | 1   |
| 9                    | 41-516051-00 | CAPACITOR, AL, 2500UF, 250V, -10/+50%, SCR (C2)  | 1   |
| 10                   | 00-870767-02 | BUS BAR, HIGH VOLTAGE. GENERATOR                 | 1   |
| 11                   | 00-870767-01 | BUS BAR, HIGH VOLTAGE. GENERATOR                 | 2   |
| 12                   | 00-900207-01 | TRANSISTOR, DARLINGTON, DUAL, CL A/B (Q1, Q2)    | 2   |
| 13                   | 00-875648-01 | PLATE, MOUNTING HIGH VOLTAGE. GENERATOR          | 1   |
| 14                   | 00-900097-01 | INDUCTOR, TUNING (SCD) (L1)                      | 1   |

| FIG. 1-5B PARTS LIST (CONT) |              |  |     |  |
|-----------------------------|--------------|--|-----|--|
| ITEM                        | PART NUMBER  | DESCRIPTION  | QTY |  |
| 15                          | 67-135430-00 | FUSE, GL, 3A, 250V, 1/4 X 1-1/4, SLO-BLO (F1)          | 1   |  |
| 16                          | 00-900090-01 | TRANSFORMER, BATTERY CHARGER (SCD) (L2)                | 1   |  |
| 17                          | 72-120990-00 | RELAY, SPDT-NO, 20A, 125VDC (K1)                       | 1   |  |
| 18                          | 72-125913-00 | RELAY, DPDT, 10A, 24VDC (K2)                           | 1   |  |
| 19                          | 00-900130-01 | INSULATOR, TRANSISTOR (NOT SHOWN)                      | 2   |  |
| 20                          | 55-198984-00 | FUSE HOLDER, PANEL, 1 EA., 20A, 250V, 1/4 X 1-1/4      | 1   |  |
| 21                          | 00-871754-01 | INSULATOR, TRANSISTOR CHARGER (NOT SHOWN)              | 1   |  |
| 22                          | 51-407008-00 | CONN, HSG, CA, 5SKT, STR, 1 X 5, .156CTR (NOT SHOWN)   | 1   |  |
| 23                          | 51-407009-00 | CONN, HSG, CA, 3SKT, STR, 1 X 3, .156CTR (NOT SHOWN)   | 1   |  |
| 24                          | 51-231899-00 | CONN, HSG, PWR, F-HNG, 1 PIN, BLK, 30A (NOT SHOWN)     | 1   |  |
| 25                          | 51-231894-00 | CONN, HSG, PWR, F-HNG, 1 PIN, RED, 30A (NOT SHOWN)     | 1   |  |
| 26                          | 51-407007-00 | CONN, HSG, CA, 10SKT, STR, 1 X 10, .156CTR (NOT SHOWN) | 1   |  |
| 27                          | 88-189738-00 | TP, FM, POLYU, 3/4W X 1/16THK (NOT SHOWN)              | AR  |  |



Fig. 1-5B Generator Controller Assembly Exploded View (Sheet 2 of 2)

| FIG. 1-6A PARTS LIST |              |   |     |  |
|----------------------|--------------|---|-----|--|
| ITEM                 | PART NUMBER  | DESCRIPTION                               | QTY |  |
| 1                    | 00-877258-01 | ASSEMBLY, CASTER, REAR, 9600 (FRONT LOCK) | 2   |  |
| 2                    | 00-877258-02 | ASSEMBLY, CASTER, REAR, 9600 (REAR LOCK)  | 2   |  |





ITEM 2 Reversed Brake, Side Scan removed Side Scan Kit available (see section 2, fig. 2-6A, 2-6C)

Fig. 1-6A Actuator, Brake, Rear Caster Exploded View

| FIG. 1-6B PARTS LIST |              |  |     |
|----------------------|--------------|--|-----|
| ITEM                 | PART NUMBER  | DESCRIPTION                                    | QTY |
| 1                    | 00-876586-01 | ACTUATOR, SHAFT                                | 1   |
| 2                    | 00-876833-01 | PEDAL, REAR CASTER/BRAKE                       | 2   |
| 3                    | 12-311114-14 | SCREW, NA, SKT, HEX, 1/4-20, 7/8, SZC, 8       | 6   |
| 4                    | 00-876649-01 | BLOCK, SUPPORT, OUTER                          | 4   |
| 5                    | 21-128807-00 | BEARING, NDL-RLR, .625 ID, .8125 OD, .312 WD   | 4   |
| 6                    | 12-225160-14 | SCREW, SEMS SPRING, PAN, TORX, 10-32, 7/8, SZC | 8   |
| 7                    | 12-332015-08 | SCREW, NA, FL, HEX, 5/16-18, 1/2, SST          | 2   |
| 8                    | 12-332015-31 | SCREW, NA, FL, HEX, 5/16-18, 2-1/8, SST        | 4   |
| 9                    | 88-299477-00 | LUBE, GREASE, GP, 14.1 OZ, CARTRIDGE           | AR  |
| 10                   | 88-299282-00 | ADHESIVE, SEALANT, BLUE, BTL, 10CC, 242-21     | AR  |
| 11                   | 88-299284-00 | ADHESIVE, SEALANT, PURPLE, BTL, 10CC, 222-21   | AR  |
| 12                   | 00-876569-01 | MACHINING, END CAP, CROSS BEAM                 | 2   |



Fig. 1-6B Actuator, Brake, Rear Caster Exploded View

| FIG. 1-6C PARTS LIST |              |   |     |
|----------------------|--------------|---|-----|
| ITEM                 | PART NUMBER  | DESCRIPTION                                     | QTY |
| 1                    | 00-876570-01 | CAM, BRAKE, REAR CASTER                         | 1   |
| 2                    | 11-622008-05 | SCREW, SET, SKT, HEX, 8-32, 5/16, SST, CUP      | 2   |
| 3                    | 00-876573-01 | FOLLOWER, CAM, REAR CASTER                      | 1   |
| 4                    | 14-900027-00 | WASHER, SHIM, .002-LAM, BRASS, NA, ID = .25     | 3   |
| 5                    | 21-259984-00 | CASTER, WHEEL, 8"D, 2"W                         | 1   |
| 6                    | 00-876822-01 | DECAL, OEC LOGO                                 | 4   |
| 7                    | 00-876820-01 | SCREW, AXLE, REAR CASTER                        | 1   |
| 8                    | 20-209903-00 | SHAFT, DR, .12470 OD, 2.620 L SST               | 1   |
| 9                    | 00-877086-01 | CABLE PUSHER, REAR CASTER                       | 2   |
| 10                   | 11-652004-04 | SCREW, SET, SKT, HEX, 4-40, 1/4, SST, CP        | 4   |
| 11                   | 14-999716-00 | WASHER, PL, #8, NYLON, NA, ID = .170, OD = .375 | 1   |
| 12                   | 00-876671-01 | ARM, BRAKE, REAR CASTER                         | 1   |
| 13                   | 00-877103-01 | SPRING, BRAKE ARM, REAR CASTER                  | 1   |
| 14                   | 13-532010-00 | NUT, HEX-LOCK-W/INSR, 8-32, STEEL/Z, THIN       | 1   |
| 15                   | 00-876580-01 | PAD, BRAKE, REAR CASTER                         | 1   |
| 16                   | 23-619909-00 | PLUG, HOLE, .672702HD, NYLON, WHITE             | 1   |
| 17                   | 00-876821-01 | NUT, AXLE, REAR CASTER                          | 1   |
| 18                   | 88-299282-00 | ADHESIVE, SEALANT, BLUE, BTL, 10CC, 242-21      | AR  |
| 19                   | 88-299284-00 | ADHESIVE, SEALANT, PURPLE, BTL, 10CC, 222-21    | AR  |
| 20                   | 88-299477-00 | LUBE, GREASE, GP, 14.10Z, CRTG                  | AR  |



Fig. 1-6C Actuator, Brake, Rear Caster Exploded View

| FIG. 1-7 PARTS LIST |              |   |     |
|---------------------|--------------|---|-----|
| ITEM                | PART NUMBER  | DESCRIPTION                                       | QTY |
| 1                   | 00-875567-01 | PLATE, SUPPORT, WHEEL                             | 1   |
| 2                   | 00-876593-01 | SPACER, YOKE, FRONT CASTER                        | 2   |
| 3                   | 22-678450-00 | RING, RTNG, INT, BASIC, 1-3/8, SPRING, STEEL, SST | 2   |
| 4                   | 21-109912-00 | BEARING, BALL, DBL, .5906 ID, 1.3780 OD, .625 WD  | 2   |
| 5                   | 00-877006-01 | SCREW, MOUNTING, FRONT CASTER                     | 2   |
| 6                   | 11-622004-05 | SCREW, SET, SKT, HEX, 4-40, 5/16, SST, CUP        | 4   |
| 7                   | 00-876619-01 | MACHINING, ARM, FRONT CASTER                      | 2   |
| 8                   | 12-331116-32 | SCREW, NA, FL, HEX, 3/8-16, 2-1/4, SZC, 8         | 2   |
| 9                   | 00-876760-01 | DECAL, CASTER, FRONT                              | 4   |
| 10                  | 00-876357-01 | SPRING, CABLE PUSHER                              | 4   |
| 11                  | 21-259986-00 | CASTER, WHEEL, 4" D, 1-3/8" W (WITH SPACERS)      | 2   |



Fig. 1-7 Front Caster Assembly Exploded View
|      |              | FIG. 1-8 PARTS LIST                                |     |
|------|--------------|--|-----|
| ITEM | PART NUMBER  | DESCRIPTION  | QTY |
| 1    | 00-876003-02 | ASSEMBLY, PCB, POWER/SIGNAL INTERFACE              | 1   |
| 2    | 00-875999-01 | ASSEMBLY, PCB, POWER/MOTOR RELAY                   | 1   |
| 3    | 67-430003-00 | IND, LAMP, NE, 125V GREEN (DS2)                    | 1   |
| 4    | 67-430004-00 | WASHER, PO, LAMP (DS2)                             | 1   |
| 5    | 00-875588-01 | CABLE, ASSEMBLY, HAND/FOOT SWITCH CONT             | 1   |
| 6    | 00-875587-01 | CABLE, ASSEMBLY, LEMO-RELAY                        | 1   |
| 7    | 00-875878-01 | BRACKET, MOUNTING, POWER SUPPLY, 4V                | 1   |
| 8    | 00-900608-01 | POWER SUPPLY, 24V DC (SCD)                         | 1   |
| 9    | 00-875545-01 | ASSEMBLY, STATOR/CAP, 25V P.S.                     | 1   |
| 10   | 00-871329-01 | BRACKET, MOUNTING CAPACITOR                        | 2   |
| 11   | 41-599057-00 | CAPACITOR, AC METER, 30UF, 240V, TERM              | 1   |
| 12   | 00-900218-01 | POWER SUPPLY, 4.8 - 5.3V                           | 1   |
| 13   | 00-875743-01 | WELDMENT, POWER PANEL                              | 1   |
| 14   | 00-875616-01 | CABLE, ASSEMBLY, POWER ENTRY/RELAY (NOT SHOWN)     | 1   |
| 15   | 00-900472-05 | WIRE, HW, 1015, GRN/YEL, 18AWG (NOT SHOWN)         | AR  |
| 16   | 15-608090-00 | TERMINAL, RING, CRP, 22-18, #6, LRR6 (NOT SHOWN)   | 3   |
| 17   | 00-900478-13 | TUBING, HEAT SHRINKABLE/, 3/16, BLACK, (NOT SHOWN) | AR  |



Fig. 1-8 Power Panel Side, Power Supply Exploded View

|      |              | FIG. 1-9 PARTS LIST                           |     |
|------|--------------|---|-----|
| ITEM | PART NUMBER  | DESCRIPTION                                   | QTY |
| 1    | 00-874752-02 | ASSEMBLY, PCB, IMAGE FUNCTION, 9600           | 1   |
| 2    | 00-900752-01 | POWER SUPPLY TH 7194-3P                       | 1   |
| 3    | 00-875536-01 | ASSEMBLY, MAINFRAME, MECHANICAL               | 1   |
| 4    | 00-875338-02 | WELDMENT, C-ARM                               | 1   |
| 5    | 00-875565-01 | STOP, ROTATION, C-ARM, 9600                   | 1   |
| 6    | 00-875607-01 | COVER, X-RAY CABLE                            | 1   |
| 7    | 00-876975-01 | ASSEMBLY, TEMPERATURE, SENSOR, X-RAY          | 1   |
| 8    | 00-900570-01 | TUBE, X-RAY ASSEMBLY 9600 (SCD)               | 1   |
| 9    | 00-876758-01 | GASKET, CAMERA COVER                          | 1   |
| 10   | 00-877030-01 | COLLIMATOR, PRIMARY                           | 1   |
| 11   | 00-876567-01 | BUMPER, X-RAY MOUNT                           | 1   |
| 12   | 00-877253-01 | PLATE, BOTTOM, ALIGNMENT, ASSEMBLY 9600       | 1   |
| 13   | 00-877254-01 | PLATE, MIDDLE, ALIGNMENT, ASSEMBLY 9600       | 1   |
| 14   | 00-877255-01 | PLATE, TOP, ALIGNMENT, ASSEMBLY 9600          | 1   |
| 15   | 00-877256-01 | CLAMP, COLLIMATOR, 9600                       | 4   |
| 16   | 12-225108-12 | SCREW, SEMS SPRING, PAN, TORX, 8-32, 3/4, SZC | 4   |
| 17   | 00-877420-01 | ASSEMBLY, COLLIMATOR, VARIABLE, 9600          | 1   |
| 18   | 00-877251-02 | FILTER, COLLIMATOR, SECONDARY, 9600           | 1   |

|      |              | FIG. 1-9 PARTS LIST (CONT)                         |     |
|------|--------------|--|-----|
| ITEM | PART NUMBER  | DESCRIPTION  | QTY |
| 19   | 14-112008-00 | WASHER, PL, #8 SST, NA, ID = .174, OD = .375       | 4   |
| 20   | 13-311108-00 | NUT, HEX-LOCK-EXT-T, 8-32, SST, NA, A = .344       | 4   |
| 21   | 00-875465-01 | COVER, COLLIMATOR                                  | 1   |
| 22   | 00-900692-01 | GRID, X-RAY, 8:1, 9.76 DIA, CARB FIB               | 1   |
| 23   | 00-871303-01 | GASKET, X-RAY GRID                                 | 1   |
| 24   | 00-900753-01 | TUBE, 9" IMAGE INTENSIFIER W/POWER SUPPLY          | 1   |
| 25   | 00-876759-01 | COUNTERWEIGHT, CAMERA COVER                        | 1   |
| 26   | 00-900634-01 | CAMERA, HI RES CCD, 9" C-ARM 60HZ                  | 1   |
| 27   | 00-876636-02 | MACHINING, COVER, CAMERA, 9600                     | 1   |
| 28   | 00-876758-01 | GASKET, CAMERA COVER (NOT SHOWN)                   | 1   |
| 29   | 00-877221-03 | LABEL, C-ARM ROTATION, 9600, (41.36") (NOT SHOWN)  | 1   |
| 29   | 00-877221-04 | LABEL, C-ARM ROTATION, 9600, (27.29") (NOT SHOWN)  | 1   |
| 30   | 00-877821-01 | BRACKET, SIDE, CAMERA COVER, 9600                  | 2   |
| 31   | 88-495001-00 | GASKET, SHIELD-EMI, FM, 1MMX10MM, ADH MT           | 2   |
| 32   | 00-877439-01 | GASKET, BRACKET, I.I. TUBE, 9600                   | 1   |
| 33   | 00-877322-01 | GASKET, X-RAY TUBE, 9600                           | 1   |
| 34   | 00-877791-01 | ASSEMBLY, PCB, PIXEL FILTER, 9600/URO26            | 1   |
| 35   | 00-875605-01 | BRACKET, MOUNTING, PCB, IMAGE FUNCTION (NOT SHOWN) | 1   |



Fig. 1-9 C-arm Assembly Exploded View

|      |              | FIG. 1-10A PARTS LIST                             |     |
|------|--------------|---|-----|
| ITEM | PART NUMBER  | DESCRIPTION                                       | QTY |
| 1    | 00-900242-02 | MODULE, FLUORESCENT, INDICATOR                    | 2   |
| 2    | 00-900649-01 | ASSEMBLY, PANEL, CONTROL, 9600 (SCD)              | 2   |
| 3    | 00-900750-01 | LENS, OEC (SCD)                                   | 2   |
| 4    | 00-900590-06 | SWITCH, SEALED, PUSH BUTTON, 9600, FAST STOP      | 2   |
| 5    | 00-900590-01 | SWITCH, SEALED, PUSH BUTTON, CCW ROTATION         | 1   |
| 6    | 00-900590-02 | SWITCH, SEALED, PUSH BUTTON, CW ROTATION          | 1   |
| 7    | 00-900590-03 | SWITCH, SEALED, PUSH BUTTON, LIFT UP              | 1   |
| 8    | 00-900590-04 | SWITCH, SEALED, PUSH BUTTON, LIFT DOWN            | 1   |
| 9    | 00-900590-05 | SWITCH, SEALED, PUSH BUTTON, X-RAY ON             | 1   |
| 10   | 00-875867-01 | COVER, BEARING, CROSS ARM                         | 1   |
| 11   | 00-876672-01 | ASSEMBLY, BRAKE, CROSS ARM                        | 1   |
| 12   | 00-877721-01 | TOP, ENCLOSURE, EMI 9600                          | 1   |
| 13   | 00-875603-01 | ASSEMBLY, PCB, CONTROL PANEL PROC, MAINFRAME 9600 | 1   |
| 14   | 00-877722-01 | BOTTOM, ENCLOSURE, EMI 9600                       | 1   |
| 15   | 00-875967-01 | ASSEMBLY, PCB, POWER/SIGNAL DISTRIBUTION, A/F     | 1   |
| 16   | 00-876311-01 | COVER, LOWER, CROSS ARM                           | 1   |
| 17   | 00-876312-04 | PANEL HOUSING, SIDE, LEFT                         | 1   |
| 18   | 00-876312-03 | PANEL HOUSING, SIDE, RIGHT (NOT SHOWN)            | 1   |



Fig. 1-10A Control Panel, Cross Arm Brake Assembly Exploded View (Sheet 1 of 2)

|      |              | FIG. 1-10B PARTS LIST                                |     |
|------|--------------|--|-----|
| ITEM | PART NUMBER  | DESCRIPTION  | QTY |
| 1    | 00-876982-01 | PLUG, MOLDED (RHINESTONE)                            | 1   |
| 2    | 12-225104-08 | SCREW, SEMS SPRING, PAN, TORX, 4-40, 1/2, SZC        | 1   |
| 3    | 00-876344-01 | HANDLE, BRAKE, CROSS ARM                             | 1   |
| 4    | 19-221862-00 | PIN, DOWEL, .1250 OD, .375, SST                      | 1   |
| 5    | 13-102006-00 | NUT, HEX, 6-32, SST, NA, A=.250, C=.094              | 2   |
| 6    | 14-112006-00 | WASHER, PL, #6, SST, NA, ID =.149, OD =.375          | 2   |
| 7    | 21-790207-00 | SPRING, COMPRESSION, .300 OD, .44 LG, .040 WD, SST   | 2   |
| 8    | 00-876340-01 | MOUNT, BRAKE, CROSS ARM                              | 1   |
| 9    | 00-876343-01 | SHOE, BRAKE, CROSS ARM                               | 1   |
| 10   | 00-876345-01 | PAD, BRAKE, CROSS ARM                                | 1   |
| 11   | 88-299614-00 | ADHESIVE, BLACK, MAX, TB, 1OZ, 38050                 | AR  |
| 12   | 00-876342-01 | STEM, BRAKE, CROSS ARM                               | 1   |
| 13   | 19-221857-00 | PIN, DOWEL, .1250OD, .500, SST                       | 1   |
| 14   | 00-876341-01 | RAMP, BRAKE, CROSS ARM                               | 1   |
| 15   | 00-876669-01 | BUSHING, BRAKE, CROSS ARM (NOT SHOWN)                | 1   |
| 16   | 88-299483-00 | LUBE, GREASE, TB, 1/2OZ (NOT SHOWN)                  | AR  |
| 17   | 88-299284-00 | ADHESIVE, SLT, PRP, BTL, 10CC, 222-21 (NOT SHOWN)    | AR  |
| 18   | 12-225160-08 | SCR, SEMS SPR, PAN, TRX, 10-32, 1/2, SZC (NOT SHOWN) | 4   |



Fig. 1-10B Control Panel, Cross Arm Brake Assembly Exploded View (Sheet 2 of 2)

|      | FIG. 1-11 PARTS LIST |  |     |  |
|------|----------------------|--|-----|--|
| ITEM | PART NUMBER          | DESCRIPTION                                      | QTY |  |
| 1    | 00-876986-01         | HANDLE, PUSH, CROSS ARM                          | 1   |  |
| 2    | 00-876881-01         | CROSS ARM HSG., LEFT HALF                        | 1   |  |
| 3    | 00-876882-01         | BEARING. SLEEVE HORIZONTAL TOP AND BOTTOM        | 2   |  |
| 4    | 00-876888-01         | SHAFT, HORIZONTAL                                | 1   |  |
| 5    | 00-876973-01         | ASSEMBLY, L-ARM DRIVE                            | 1   |  |
| 6    | 12-311164-08         | SCREW, NA, SKT, HEX, 1/4-28, 1/2, SZC, 8         | 2   |  |
| 7    | 00-876967-01         | CAP, L-ARM, MACH.                                | 1   |  |
| 8    | 12-333960-14         | SCREW, NA, FL, HEX, 10-32, 7/8, SBO, 8           | 4   |  |
| 9    | 71-999424-00         | SWITCH, SNAP ACTION, SPDT, 11A @ 125/250VAC, CHS | 2   |  |
| 10   | 00-877242-01         | MOTOR, MOUNT, L-ARM DRIVE                        | 1   |  |
| 11   | 00-876963-01         | MOTOR, L-ARM DRIVE (AID)                         | 1   |  |
| 12   | 00-877097-01         | BRACKET, GEAR MOTOR, L-ARM                       | 1   |  |
| 13   | 00-876378-01         | ASSY/SCM, PCB, L-ARM MOTOR/POWER                 | 1   |  |
| 14   | 41-599062-00         | CAPACITOR, AC METER, 17.5 UF, 330VAC, 10%, TERM  | 1   |  |
| 15   | 00-876728-01         | PLUG, SLIDER                                     | 1   |  |
| 16   | 00-876701-01         | SLIDE, STRAIN RELIEF                             | 1   |  |
| 17   | 21-109943-00         | BEARING, BA, .6693 ID, 1.3780 OD, .3937 WD       | 4   |  |
| 18   | 22-678375-00         | RING, RETAINING EXT, BASIC, .669, SPRING STEEL   | 4   |  |
| 19   | 00-877095-01         | RING, SCALE, L-ARM                               | 2   |  |
| 20   | 00-877270-01         | LABEL, ROTATION, L-ARM                           | 1   |  |
| 21   | 00-877308-01         | SHAFT, HORIZONTAL, LONG, CROSS ARM               | 1   |  |
| 22   | 00-877307-01         | STRAP, CROSS ARM HSG (NOT SHOWN)                 | 2   |  |
| 23   | 00-877306-01         | ECCENTRIC NUT, CROSS ARM HSG (NOT SHOWN)         | 2   |  |



Fig. 1-11 Cross Arm Exploded View

|      |              | FIG. 1-12 PARTS LIST                             |     |
|------|--------------|--|-----|
| ITEM | PART NUMBER  | DESCRIPTION                                      | QTY |
| 1    | 00-876927-02 | L-ARM, MACH                                      | 1   |
| 2    | 00-876953-01 | STOP, HOUSING                                    | 1   |
| 3    | 00-876962-01 | PAD, STOP (NOT EXPLODED)                         | 2   |
| 4    | 19-221879-02 | PIN, DOWEL 1/2 X 2 1/2 (NOT EXPLODED)            | 2   |
| 5    | 19-224754-00 | PIN, SPRING, .125OD, 1, SST                      | 1   |
| 6    | 21-709118-00 | SPRING, COMPRESSION, .240OD, 1.50LG, .032WD, SST | 1   |
| 7    | 00-877720-01 | BRAKE SHOE, FLIP FLOP, 9600                      | 2   |
| 8    | 11-614019-10 | SCREW, SET, LKG, SKT, HEX, 3/8-24 X 5/8          | 2   |
| 9    | 00-876698-01 | WELDMENT, HOUSING, FLIP-FLOP                     | 1   |
| 10   | 27-402272-00 | O-RING, 4.487ID X .130 THK NPRN, -157            | 1   |
| 11   | 21-119937-00 | BEARING, ROLLER, TAPER-CUP, 4.1563 OD, .3750 WD  | 1   |
| 12   | 21-119936-01 | BEARING, TAPER ROLL CONE, TIMKEN, LL714649       | 1   |
| 13   | 00-876952-01 | STOP, SHAFT                                      | 1   |
| 14   | 00-877716-01 | BRAKE ACTUATOR, FLIP-FLOP, RIGHT HAND, 9600      | 1   |
| 15   | 00-877715-01 | SHAFT, FLIP-FLOP BRAKE, 9600                     | 1   |
| 16   | 00-877719-01 | INSERT, HANDLE, 9600                             | 2   |
| 17   | 27-402271-00 | O-RING, .734ID X .139 WD, NPRN, -210             | 2   |
| 18   | 00-876981-01 | HANDLE, BRAKE, FLIP-FLOP                         | 2   |

|      |              | FIG. 1-12 PARTS LIST (CONT)                      |     |
|------|--------------|--|-----|
| ITEM | PART NUMBER  | DESCRIPTION                                      | QTY |
| 19   | 12-225160-08 | SCREW, SEMS TORX, SPRING PAN, 10-32 X 1/2 SZC    | 2   |
| 20   | 00-876968-02 | COVER, L-ARM                                     | 1   |
| 21   | 00-877381-01 | SWIVEL, HIGH VOLTAGE CABLE HANGER, 9600          | 2   |
| 22   | 21-139741-00 | BEARING, CYL, FLG, .251 ID, .377 OD, .250 L      | 2   |
| 23   | 21-128917-00 | BEARING THRUST WASHER, .390 ID, .750 OD, .031 WD | 4   |
| 24   | 21-128918-00 | BEARING THRUST WASHER, .250 ID, .687 OD, .030 WD | 4   |
| 25   | 22-678606-00 | RING, RING EXT, BASIC, 1/4, SPRING STEEL         | 2   |
| 26   | 12-312014-10 | SCREW, NA, SKT, HEX, 1/4-20, /5/8, SST           | 1   |
| 27   | 00-876956-01 | CAP, SHAFT BEARING                               | 1   |
| 28   | 21-119938-00 | BEARING, ROLLER, TAPER-CONE, 2.000 ID, .5000 WD  | 1   |
| 29   | 21-119939-00 | BEARING, ROLLER, TPR-CONE, 3.0625 OD, .3750 WD   | 1   |
| 30   | 22-710001-00 | RING, SPL, .526 ID, .105 THK, SPRING STEEL       | 2   |
| 31   | 00-877382-01 | ROD, HIGH VOLTAGE CABLE HANGER, 9600             | 1   |
| 32   | 22-710001-00 | RING, SPL, .526 ID, .105 THK, SPRING STEEL       | 1   |
| 33   | 00-876956-01 | CAP, SHAFT BEARING (NOT SHOWN)                   | 1   |
| 34   | 19-224790-00 | PIN SPRING, .125 OD, .625, SZC (NOT SHOWN)       | 2   |
| 35   | 00-877119-01 | SCREW, PIVOT SHAFT (NOT SHOWN)                   | 1   |



Fig. 1-12 L-arm Exploded View

|      | FIG. 1-13 PARTS LIST |   |     |  |
|------|----------------------|---|-----|--|
| ITEM | PART NUMBER          | DESCRIPTION                                     | QTY |  |
| 1    | 00-876522-01         | ROLLER, AXIAL                                   | 9   |  |
| 2    | 00-876523-01         | ROLLER, RADIAL                                  | 8   |  |
| 3    | 00-876524-01         | AXIAL TOGGLE ARM                                | 4   |  |
| 4    | 00-876525-01         | ARM, TOGGLE, RADIAL                             | 4   |  |
| 5    | 00-877729-01         | SHAFT, RADIAL TOGGLE ARM (AID)                  | 2   |  |
| 6    | 21-109920-00         | BEARING, BALL, .2500 ID, .6250 OD, .196 WD      | 8   |  |
| 7    | 21-109937-00         | BEARING, BALL, .3750 ID, .8750 OD, .281 WD      | 8   |  |
| 8    | 00-877033-01         | PAD, BUMPER, FLIP-FLOP                          | 2   |  |
| 9    | 00-877033-02         | PAD, BUMPER, FLIP-FLOP                          | 2   |  |
| 10   | 00-876698-01         | WELDMENT, HOUSING FLIP-FLOP                     | 1   |  |
| 11   | 22-678606-00         | RING, RING EXT BASIC, 1/4, SPRING STEEL         | 8   |  |
| 12   | 22-678612-00         | RING, RING EXT BASIC, 3/8, SPRING STEEL         | 8   |  |
| 13   | 12-221260-05         | SCREW, MACH, TORX, PAN, 10-32, 5/16 SZC, 8      | 4   |  |
| 14   | 14-146010-00         | WASHER, SHIM, ID = .197, OD = .500, .020 T, SST | 4   |  |

|      | FIG. 1-13 PARTS LIST (CONT) |   |     |  |
|------|-----------------------------|---|-----|--|
| ITEM | PART NUMBER                 | DESCRIPTION                                       | QTY |  |
| 15   | 00-876708-01                | CAM, BRAKE, C-ROTATION                            | 1   |  |
| 16   | 00-876709-01                | SHAFT, BRAKE, C-ROTATION                          | 1   |  |
| 17   | 00-876704-01                | HANDLE, BRAKE, C-ROTATION                         | 2   |  |
| 18   | 21-180004-00                | BEARING, CYL, .3125 ID, .4375 OD, .375 L, PLASTIC | 4   |  |
| 19   | 12-215006-10                | SCREW, MACH, TORX, FLAT, 6-32, 5/8 SZC            | 4   |  |
| 20   | 00-876526-01                | PIN, ROLLER, AXIAL                                | 8   |  |
| 21   | 00-876527-01                | PIN, ROLLER, RADIAL                               | 8   |  |
| 22   | 12-225106-06                | SCREW, SEMS, PAN TORX, SPRING, 6-32, 3/8 SZC      | 2   |  |
| 23   | 00-876705-01                | MOUNT, BRAKE, C-ROTATION                          | 1   |  |
| 24   | 00-876706-01                | BRAKE PAD, C-ROTATION ASSEMBLY                    | 1   |  |
| 25   | 00-876707-01                | CAM, FOLLOWER, BRAKE, C-ROTATION                  | 1   |  |
| 26   | 21-715001-00                | SPRING, COMPRESSION WAVE, 1.250 OD, .600 LG, SST  | 1   |  |
| 27   | 00-876808-01                | SPRING, INNER                                     | 1   |  |
| 28   | 19-225107-00                | PIN, DOWEL, .1875 OD, 1.500 SST                   | 1   |  |

Note: Items 23, 24, 25, 26, 27, and 28 are not shown exploded at this time.



Fig. 1-13 Flip-Flop Assembly Exploded View

|      |              | FIG. 1-14 PARTS LIST  |     |
|------|--------------|---|-----|
| ITEM | PART NUMBER  | DESCRIPTION   | QTY |
| 1    | 22-678651-00 | RING, RTNG EXT, BASIC 3/4, SPRING STEEL                     | 2   |
| 2    | 00-876877-01 | SPACER, DELRIN 1 OD, .765 ID, .12 LG                        | 2   |
| 3    | 00-876873-01 | SHAFT, FRONT ROLLER SUPPORT                                 | 1   |
| 4    | 00-876872-01 | SLEEVE, BEARING   | 1   |
| 5    | 21-128806-00 | BEARING, NEEDLE RLR, .750 ID, 1.000 OD, .750 WD (NOT SHOWN) | 2   |
| 6    | 20-500003-00 | LINK, CHAIN, SPRING CL, .375 PD, STEEL                      | 2   |
| 7    | 00-877240-01 | CHAIN, JACK SHAFT BASE                                      | 2   |
| 8    | 41-599063-00 | CAPACITOR, AC METER, 30 UF, 330 VAC 10%, TERM               | 1   |
| 9    | 00-876850-01 | MOTOR, BODINE, VERTICAL LIFT (AID)                          | 1   |
| 10   | 00-876876-01 | PLATE, LOWER CENTER COLUMN BEARING.                         | 1   |
| 11   | 00-876870-01 | ASSEMBLY, IDLER BEARING                                     | 1   |
| 12   | 00-876856-01 | PAD, SIDE ADJ, BASE   | 3   |
| 13   | 00-876885-01 | BASE, MAIN HSG. COVER, MACH                                 | 1   |
| 14   | 00-876855-01 | PAD, LOWER, ADJ, BASE                                       | 1   |
| 15   | 00-876858-01 | PAD, LOWER, FIXED, BASE                                     | 1   |
| 16   | 00-876857-01 | PAD, SIDE, FIXED, BASE                                      | 1   |
| 17   | 00-876903-01 | BOLT, TENSION   | 1   |
| 18   | 00-876884-01 | BASE FRAME, MAIN HOUSING                                    | 1   |



Fig. 1-14 Base Exploded View

|      | FIG. 1-15A PARTS LIST |  |     |  |
|------|-----------------------|--|-----|--|
| ITEM | PART NUMBER           | DESCRIPTION                                    | QTY |  |
| 1    | 00-877239-01          | CHAIN, LIFT, BASE                              | 2   |  |
| 2    | 00-876860-01          | CHAIN, DRIVE LINK, LEFT (TAPPED)               | 1   |  |
| 3    | 00-876930-01          | SUB-ASSEMBLY CROSS ARM                         | 1   |  |
| 4    | 00-876969-01          | ASSEMBLY, CENTER COLUMN                        | 1   |  |
| 5    | 20-500003-00          | LINK, CHAIN, SPRING CL, .375 PD, STEEL         | 4   |  |
| 6    | 00-876862-01          | CHAIN, DRIVE LINK, RIGHT (SLOTTED)             | 1   |  |
| 7    | 00-876871-01          | ASSEMBLY, JACK SHAFT                           | 1   |  |
| 8    | 00-876861-00          | CHAIN, DRIVE LINK, LEFT (SLOTTED)              | 1   |  |
| 9    | 00-876904-01          | CHAINLINK RIGHT HAND TAPPED                    | 1   |  |
| 10   | 00-877094-01          | ACTUATOR, LIMIT SWITCH, VERTICAL, LIFT (LOWER) | 1   |  |
| 11   | 00-877093-01          | ACTUATOR, LIMIT SWITCH, VERTICAL, LIFT (UPPER) | 1   |  |
| 12   | 71-999424-00          | SWITCH, LIMIT (UPPER/LOWER) (NOT SHOWN)        | 2   |  |



Fig. 1-15A Vertical Column, Wig-Wag Brake Exploded View (Sheet 1 of 2)

| FIG. 1-15B PARTS LIST |              |   |     |
|-----------------------|--------------|---|-----|
| ITEM                  | PART NUMBER  | DESCRIPTION   | QTY |
| 1                     | 00-876930-01 | SUB-ASSEMBLY, CROSS ARM                             | 1   |
| 2                     | 12-999538-00 | SCREW, NA, STLDR, HEX 3/8-16, 1/2 X 3/4             | 1   |
| 3                     | 21-128800-00 | BEARING, NEEDLE-ROLLER, 1.750 ID, 2.125 OD, .750 WD | 1   |
| 4                     | 00-876944-01 | BEARING, HOUSING, SHAFT                             | 1   |
| 5                     | 19-221923-00 | PIN, DOWEL, .312 OD, .750, STEEL                    | 2   |
| 6                     | 00-876934-03 | WELDMENT, VERTICAL COLUMN ASSEMBLY                  | 1   |
| 7                     | 00-877223-01 | LABEL, VERTICAL LIFT, 9600                          | 1   |
| 8                     | 21-180009-00 | BEARING, CYL, .500 ID, .750 OD, .625 L              | 2   |
| 9                     | 21-190069-00 | BEARING, CAM FOLLOWER, 1.750 OD, 1.00 WD, .500 ID   | 1   |
| 10                    | 22-678617-00 | RING, RETAIN, EXT BASIC, 1/2, SPRING STEEL          | 2   |
| 11                    | 00-876886-01 | SHAFT, LOWER CENTER COLUMN                          | 1   |
| 12                    | 00-876980-01 | HANDLE, WIG-WAG BRAKE                               | 1   |
| 13                    | 00-877575-01 | ACTUATOR, 9600                                      | 1   |
| 14                    | 00-876940-01 | PLATE, FLOATING HEAD                                | 1   |
| 15                    | 00-877574-01 | PAD, ROTOR, 9600                                    | 1   |
| 16                    | 00-877573-01 | ACTUATOR SCREW, 9600                                | 1   |

Note: Items 3, 4, 5, 7, 8, 9, 10, and 11 are not shown exploded at this time.



Fig. 1-15B Vertical Column, Wig-Wag Brake Exploded View (Sheet 2 of 2)

| FIG. 1-16A PARTS LIST |              |   |     |
|-----------------------|--------------|---|-----|
| ITEM                  | PART NUMBER  | DESCRIPTION                             | QTY |
| 1                     | 00-876751-01 | CABLE ASSEMBLY, X-RAY ON                | 1   |
| 2                     | 00-876750-01 | CABLE ASSEMBLY, EMERGENCY OFF           | 1   |
| 3                     | 00-876691-01 | CABLE ASSEMBLY, DISPLAY                 | 1   |
| 4                     | 00-900699-02 | CABLE ASSEMBLY, FLAT FLEX DUAL          | 1   |
| 5                     | 00-900699-01 | CABLE ASSEMBLY, FLAT FLEX DUAL          | 1   |
| 6                     | 00-876025-01 | CABLE ASSEMBLY, HV/BATTERY CHARGER, I/O | 1   |
| 7                     | 00-876753-01 | CABLE ASSEMBLY, DISPLAY POWER, 2 PIN    | 1   |
| 8                     | 00-876025-01 | CABLE ASSEMBLY, HV/BATTERY CHARGER, I/O | 1   |
| 9                     | 00-875615-01 | CABLE ASSEMBLY, REG/CHARGER POWER, 9600 | 1   |
| 10                    | 00-875337-01 | CABLE ASSEMBLY, SWITCH DARLINGTON       | 1   |
| 11                    | 00-875332-01 | CABLE ASSEMBLY, HI-VOLTAGE TANK, 9600   | 1   |
| 12                    | 00-900602-01 | CABLE ASSEMBLY, HIGH VOLTAGE (SCD)      | 1   |



Fig. 1-16A Interconnect Cable Assembly Diagram, Mobile C-Arm (Sheet 1 of 3)

| FIG. 1-16B PARTS LIST |              |   |     |
|-----------------------|--------------|---|-----|
| ITEM                  | PART NUMBER  | DESCRIPTION                                   | QTY |
| 4                     | 00-900699-02 | CABLE ASSEMBLY, FLAT FLEX DUAL                | 1   |
| 5                     | 00-900699-01 | CABLE ASSEMBLY, FLAT FLEX DUAL                | 1   |
| 8                     | 00-876025-01 | CABLE ASSY, 40 COND RIBBON, HV/BATT CHGR, I/O | 1   |
| 9                     | 00-875615-01 | CABLE ASSEMBLY, REG/CHARGER POWER, 9600       | 1   |
| 12                    | 00-900602-01 | CABLE ASSEMBLY, HIGH VOLTAGE (SCD)            | 1   |
| 13                    | 00-875331-01 | CABLE ASSEMBLY, FLAT DISK, I/O, 9600          | 1   |
| 14                    | 00-875651-01 | CABLE ASSEMBLY, DISK POWER, 9600              | 1   |
| 15                    | 00-875588-01 | CABLE ASSEMBLY, HAND/FOOT SWITCH CONT         | 1   |
| 16                    | 00-875587-01 | CABLE ASSEMBLY, LEMO RELAY                    | 1   |
| 17                    | 00-875563-01 | CABLE ASSEMBLY, DATA CONTROL                  | 1   |
| 18                    | 00-875614-01 | CABLE ASSEMBLY, MB POWER, 9600                | 1   |
| 19                    | 00-900697-01 | CABLE ASSEMBLY, FLAT, FLEX W/O SHIELD         | 1   |
| 20                    | 00-900698-01 | CABLE ASSEMBLY, FLAT, FLEX W/SHIELD           | 1   |
| 21                    | 00-875498-01 | CABLE ASSEMBLY, MOTOR, PWR, ELEVATION, 9600   | 1   |
| 22                    | 00-875545-01 | ASSEMBLY, STATOR/CAPACITOR, 25V P.S.          | 1   |
| 23                    | 00-875358-01 | CABLE ASSEMBLY, 5, 15V POWER SUPPLY           | 1   |
| 24                    | 00-877476-01 | CABLE ASSEMBLY, POWER ENTRY/RELAY, 9600       | 1   |
| 25                    | 00-900608-01 | POWER SUPPLY, 24VDC (SCD)                     | 1   |



Fig. 1-16B Interconnect Cable Assembly Diagram, Mobile C-Arm (Sheet 2 of 3)

| FIG. 1-16C PARTS LIST |              |   |     |
|-----------------------|--------------|---|-----|
| ITEM                  | PART NUMBER  | DESCRIPTION                                 | QTY |
| 15                    | 00-875588-01 | CABLE ASSEMBLY, HAND/FOOT SWITCH CONT       | 1   |
| 16                    | 00-875587-01 | CABLE ASSEMBLY, LEMO RELAY                  | 1   |
| 19                    | 00-900697-01 | CABLE ASSEMBLY, FLAT FLEX W/O SHIELD        | 1   |
| 20                    | 00-900698-01 | CABLE ASSEMBLY, FLAT FLEX W/SHIELD          | 1   |
| 21                    | 00-875498-01 | CABLE ASSEMBLY, MOTOR, PWR, ELEVATION, 9600 | 1   |
| 24                    | 00-877476-01 | CABLE ASSEMBLY, POWER ENTRY/RELAY           | 1   |
| 26                    | 00-876183-01 | CABLE ASSEMBLY, INTERCONNECT, 20', 9600     | 1   |
| 27                    | 00-877204-01 | CABLE ASSEMBLY, MOTION, ELEV, UP            | 1   |
| 28                    | 00-877204-02 | CABLE ASSEMBLY, MOTION, ELEV, DOWN          | 1   |
| 29                    | 00-877204-03 | CABLE ASSEMBLY, MOTION, ROT CW              | 1   |
| 30                    | 00-877204-04 | CABLE ASSEMBLY, MOTION, ROT CCW             | 1   |
| 31                    | 00-875497-01 | CABLE ASSEMBLY, MOTOR, POWER, ROTATION      | 1   |



Fig. 1-16C Interconnect Cable Assembly Diagram, Mobile C-arm (Sheet 3 of 3)

| FIG. 1-17 PARTS LIST |              |   |     |
|----------------------|--------------|---|-----|
| ITEM                 | PART NUMBER  | DESCRIPTION                             | QTY |
| 1                    | 00-876991-01 | CABLE ASSEMBLY, II POWER/CONTROL        | 1   |
| 2                    | 00-875359-01 | CABLE ASSEMBLY, COLLIMATOR CONTROL 9600 | 1   |
| 3                    | 00-876683-01 | CABLE ASSEMBLY, X-RAY TUBE, 9600        | 1   |
| 4                    | 00-900602-01 | CABLE ASSEMBLY, HI-VOLTAGE (SCD)        | 1   |
| 5                    | 00-875748-01 | CABLE ASSEMBLY, CCD CAMERA, 9600        | 1   |



Fig. 1-17 Interconnect Cable Assembly Diagram, Image System



Fig. 2-1 SERIES9600 Mobile C-Arm

| FIG. 2-2 PARTS LIST |              |  |     |
|---------------------|--------------|--|-----|
| ITEM                | PART NUMBER  | DESCRIPTION                                  | QTY |
| 1                   | 00-876031-01 | COVER, FRONT, TOP                            | 1   |
| 2                   | 00-877950-01 | ASSEMBLY, CASSETTE HOLDER, 9600 (OPTION)     | 1   |
| 3                   | 00-877320-01 | ASSEMBLY, SKIN SPACER, 9600                  | 1   |
| 4                   | 00-876563-01 | COVER, ASSEMBLY, LEG, FRONT                  | 1   |
| 5                   | 00-876033-01 | COVER, FRONT, RIGHT                          | 1   |
| 6                   | 00-876569-01 | MACHINING, END CAP, CROSS BEAM               | 2   |
| 6                   | 00-876380-01 | ASSEMBLY, FOOT SWITCH, 9600, ENGLISH         | 1   |
| 6                   | 00-876380-02 | ASSEMBLY, FOOT SWITCH, 9600, GERMAN          | 1   |
| 6                   | 00-876380-03 | ASSEMBLY, FOOT SWITCH, 9600, FRENCH          | 1   |
| 6                   | 00-876380-04 | ASSEMBLY, FOOT SWITCH, 9600, SPANISH         | 1   |
| 7                   | 00-876380-05 | ASSEMBLY, FOOT SWITCH, 9600, ITALIAN         | 1   |
| 8                   | 00-876565-01 | COVER, ASSEMBLY, CROSS BEAM                  | 1   |
| 9                   | 00-876754-01 | CLIP, COVER, SIDE                            | 2   |
| 10                  | 00-876521-01 | ASSEMBLY, REAR COVERS                        | 1   |
| 11                  | 00-876562-01 | COVER, ASSEMBLY, FRONT, LEFT                 | 1   |
| 11                  | 00-876368-01 | ASSEMBLY, HAND CONTROL, X-RAY, ENGLISH, 9600 | 1   |
| 11                  | 00-876368-02 | ASSEMBLY, HAND CONTROL, X-RAY, GERMAN, 9600  | 1   |
| 11                  | 00-876368-03 | ASSEMBLY, HAND CONTROL, X-RAY, FRENCH, 9600  | 1   |
| 11                  | 00-876368-04 | ASSEMBLY, HAND CONTROL, X-RAY, SPANISH, 9600 | 1   |
| 12                  | 00-876368-05 | ASSEMBLY, HAND CONTROL, X-RAY, ITALIAN, 9600 | 1   |
| 13                  | 00-900524-11 | PAINT KIT, ELITE GRAY, TEXTURE               | 1   |
| 14                  | 00-900524-12 | PAINT KIT, RHINESTONE, TEXTURE               | 1   |
| 15                  | 00-900524-13 | PAINT KIT, WINDSWEPT, TEXTURE                | 1   |



Fig. 2-2 Covers, Cassette, Foot Switch, Hand Control Exploded View

| FIG. 2-3 PARTS LIST |              |                                    |     |
|---------------------|--------------|------------------------------------|-----|
| ITEM                | PART NUMBER  | DESCRIPTION                        | QTY |
| 1                   | 00-875538-01 | ASSEMBLY, CARD RACK, 9600          | 1   |
| 2                   | 00-875596-01 | BRACKET, SHIELD, 9600              | 1   |
| 3                   | 00-900710-01 | HIGH VOLTAGE TANK, 9600 (SCD)      | 1   |
| 4                   | 00-875761-01 | BRACKET, MOUNTING, SIDE COVERS     | 1   |
| 5                   | 00-875647-01 | BRACKET, MOUNTING, FRONT LEG COVER | 1   |
| 6                   | 00-875549-01 | ASSEMBLY, CASTER, FRONT, 9600      | 1   |
| 7                   | 00-875736-01 | BRACKET, BREAKER                   | 1   |
| 8                   | 00-900566-01 | CIRCUIT BREAKER ENERGY LIMITING    | 1   |
| 9                   | 00-876667-01 | ASSEMBLY, BALANCE WHEEL            | 1   |
| 10                  | 00-900589-01 | ASSEMBLY, BATTERY PACK             | 1   |
| 11                  | 00-875583-01 | RETAINER, BATTERY, 9600            | 2   |



Fig. 2-3 Electronics, Battery Exploded View
|      | FIG. 2-4 PARTS LIST |   |     |  |
|------|---------------------|---|-----|--|
| ITEM | PART NUMBER         | DESCRIPTION                             | QTY |  |
| 1    | 20-840202-00        | FAN, AXIAL, 12VDC, 33CFM, 4100RPM       | 2   |  |
| 2    | 00-875650-01        | BRACKET, MOUNTING, FAN                  | 1   |  |
| 3    | 00-876769-01        | BRACKET, MOUNTING, CARD                 | 1   |  |
| 4    | 00-900588-01        | PCA, MOTHERBOARD, 9600                  | 1   |  |
| 5    | 00-875331-01        | CABLE ASSEMBLY, FLAT, DISK, I/O, 9600   | 1   |  |
| 6    | 00-875649-01        | WELDMENT, CARD RACK                     | 1   |  |
| 7    | 00-875869-01        | SHIELD, CARD RACK, 9600                 | 1   |  |
| 8    | 00-876740-01        | ASSEMBLY, PCB, ANALOG INTERFACE 9600    | 1   |  |
| 9    | 00-877744-01        | ASSEMBLY, PCB, TECHNIQUE PROCESSOR 9600 | 1   |  |
| 10   | 88-750000-00        | MEMORY CD, SRAM, BAT BK, 1MX8           | 1   |  |
| 11   | 22-319823-00        | GUIDE, PCB, SNAP IN, 8.00L, .312W, .062 | 4   |  |



Fig. 2-4 Card Rack Assembly Exploded View

| FIG. 2-5A PARTS LIST |              |   |     |
|----------------------|--------------|---|-----|
| ITEM                 | PART NUMBER  | DESCRIPTION   | QTY |
| 1                    | 00-877997-01 | ASSEMBLY, PCB, BATTERY CHARGER, 9600                        | 1   |
| 2                    | 00-876641-01 | ASSEMBLY, PCB, GENERATOR DRIVER, 9600                       | 1   |
| 3                    | 67-169336-00 | FU, AXIAL, 2A, 250V, .600 X .190 (F1, F2, F4, F5) NOT SHOWN | 4   |
| 4                    | 67-169337-00 | FU, AXIAL, 5A, 250V, 1.275 X .275 (F3) NOT SHOWN            | 1   |
| 5                    | 00-877460-02 | ASSEMBLY, PCB, X-RAY REGULATOR, 9600                        | 1   |
| 6                    | 00-875620-01 | SHIELD, HIGH VOLTAGE, GENERATOR, 9600                       | 1   |



Fig. 2-5A Generator Controller Assembly Exploded View (Sheet 1 of 2)

|      | FIG. 2-5B PARTS LIST |  |     |  |
|------|----------------------|--|-----|--|
| ITEM | PART NUMBER          | DESCRIPTION                                      | QTY |  |
| 1    | 00-871078-01         | CLAMP, MOUNTING. CAPACITOR                       | 1   |  |
| 2    | 41-718501-00         | CAPACITOR, POLYP PPR, 30UF, 600V 10%, TERM (C1)  | 1   |  |
| 3    | 35-495410-00         | RESISTOR, WW, 1K, 25W, 3% AXL AL HOUSING (R1)    | 1   |  |
| 4    | 35-375226-00         | RESISTOR, WW, 20K, 10W, 1%, AXL ALHOUSING (R2)   | 1   |  |
| 5    | 41-516049-00         | CAPACITOR, AL, 1800UF, 250V, -10/+50%, SCR (C4)  | 1   |  |
| 6    | 00-871079-02         | CLAMP, MOUNTING, CAPACITOR                       | 1   |  |
| 7    | 41-718500-00         | CAPACITOR, POLYP PPR, 10UF, 600V, 10%, TERM (C3) | 1   |  |
| 8    | 00-871492-01         | BUS BAR  | 1   |  |
| 9    | 41-516051-00         | CAPACITOR, AL, 2500UF, 250V, -10/+50%, SCR (C2)  | 1   |  |
| 10   | 00-870767-02         | BUS BAR, HIGH VOLTAGE. GENERATOR                 | 1   |  |
| 11   | 00-870767-01         | BUS BAR, HIGH VOLTAGE. GENERATOR                 | 2   |  |
| 12   | 00-900207-01         | TRANSISTOR, DARLINGTON, DUAL, CL A/B (Q1, Q2)    | 2   |  |
| 13   | 00-875648-01         | PLATE, MOUNTING HIGH VOLTAGE. GENERATOR          | 1   |  |
| 14   | 00-900097-01         | INDUCTOR, TUNING (SCD) (L1)                      | 1   |  |

|      | FIG. 2-5B PARTS LIST (CONT) |  |     |  |
|------|-----------------------------|--|-----|--|
| ITEM | PART NUMBER                 | DESCRIPTION  | QTY |  |
| 15   | 67-135430-00                | FUSE, GL, 3A, 250V, 1/4 X 1-1/4, SLO-BLO (F1)          | 1   |  |
| 16   | 00-900090-01                | TRANSFORMER, BATTERY CHARGER (SCD) (L2)                | 1   |  |
| 17   | 72-120990-00                | RELAY, SPDT-NO, 20A, 125VDC (K1)                       | 1   |  |
| 18   | 72-125913-00                | RELAY, DPDT, 10A, 24VDC (K2)                           | 1   |  |
| 19   | 00-900130-01                | INSULATOR, TRANSISTOR (NOT SHOWN)                      | 2   |  |
| 20   | 55-198984-00                | FUSE HOLDER, PANEL, 1 EA., 20A, 250V, 1/4 X 1-1/4      | 1   |  |
| 21   | 00-871754-01                | INSULATOR, TRANSISTOR CHARGER (NOT SHOWN)              | 1   |  |
| 22   | 51-407008-00                | CONN, HSG, CA, 5SKT, STR, 1 X 5, .156CTR (NOT SHOWN)   | 1   |  |
| 23   | 51-407009-00                | CONN, HSG, CA, 3SKT, STR, 1 X 3, .156CTR (NOT SHOWN)   | 1   |  |
| 24   | 51-231899-00                | CONN, HSG, PWR, F-HNG, 1 PIN, BLK, 30A (NOT SHOWN)     | 1   |  |
| 25   | 51-231894-00                | CONN, HSG, PWR, F-HNG, 1 PIN, RED, 30A (NOT SHOWN)     | 1   |  |
| 26   | 51-407007-00                | CONN, HSG, CA, 10SKT, STR, 1 X 10, .156CTR (NOT SHOWN) | 1   |  |
| 27   | 88-189738-00                | TP, FM, POLYU, 3/4W X 1/16THK (NOT SHOWN)              | AR  |  |



Fig. 2-5B Generator Controller Assembly Exploded View (Sheet 2 of 2)

| FIG. 2-6A PARTS LIST |              |  |     |
|----------------------|--------------|--|-----|
| ITEM                 | PART NUMBER  | DESCRIPTION                              | QTY |
| 1                    | 00-878015-01 | ASSEMBLY, CASTER, REAR, 9600             | 2   |
| 2                    | 00-877258-03 | ASSEMBLY, CASTER, REAR, 9600 (SIDE LOCK) | 2   |



Fig. 2-6A Actuator, Brake, Rear Caster Exploded View

|      | FIG. 2-6B PARTS LIST |  |     |  |
|------|----------------------|--|-----|--|
| ITEM | PART NUMBER          | DESCRIPTION                                      | QTY |  |
| 1    | 00-877949-01         | END CAP, CROSS BEAM, 9600                        | 2   |  |
| 2    | 00-876586-02         | ACTUATOR, SHAFT                                  | 1   |  |
| 3    | 00-876833-01         | PEDAL, REAR CASTER/BRAKE                         | 2   |  |
| 4    | 00-877963-01         | FOLLOWER, CAM, 9600                              | 2   |  |
| 5    | 22-678618-00         | RING, RETAINING EXT, BASIC, 1/2, .050, SPRING ST | 2   |  |
| 6    | 14-122118-00         | WASHER, PLAIN, 1/2, SST, ID = .512, OD = .750    | 2   |  |
| 7    | 21-709177-00         | SPRING, COMPRESSION, .720 OD, 1-1/4 LG, .072 WD  | 2   |  |
| 8    | 00-877962-01         | CAM, REAR CASTER, 9600                           | 2   |  |
| 9    | 19-224944-00         | PIN, SPRING, .250 OD, 1.250, SZC                 | 2   |  |
| 10   | 12-315060-12         | SCREW, NA, SKT, TORX, 10-32, 3/4, SZC, 8         | 12  |  |
| 11   | 00-877961-01         | MACHINING, HOUSING, UPPER, 9600                  | 2   |  |
| 12   | 19-224943-00         | PIN, SPRING, .250 OD, 1.500, SZC                 | 2   |  |
| 13   | 12-311114-14         | SCREW, NA, SKT, HEX, 1/4-20, 7/8, SZC, 8         | 6   |  |
| 14   | 12-332015-31         | SCREW, NA, FL, HEX, 5/16-18, 2-1/8, SST          | 8   |  |
| 15   | 19-221964-00         | PIN, DOWEL, .2500 OD, 2.000, SSL                 | 2   |  |
| 16   | 12-215060-06         | SCREW, MACH, FLAT, TORX, 10-32, 3/8, SZC         | 4   |  |
| 17   | 12-333968-40         | SCREW, NA, FLAT, HEX, 1/2-20, 3, SBO, 8          | 2   |  |
| 18   | 00-876822-01         | DECAL, OEC LOGO                                  | 2   |  |
| 19   | 00-878024-01         | BRACKET, BRAKE PAD, 9600                         | 2   |  |
| 20   | 13-532012-00         | NUT, HEX-LOCK-W/INSR, 10-32, STEEL/Z, THIN       | 2   |  |

|      | FIG. 2-6B PARTS LIST (CONT) |  |     |  |
|------|-----------------------------|--|-----|--|
| ITEM | PART NUMBER                 | DESCRIPTION  | QTY |  |
| 21   | 21-709173-00                | SPRING, COMPRESSION, .180 OD, 1/2 LG, .016 WD, SST       | 2   |  |
| 22   | 00-877965-01                | MACHINING, ACTUATOR, BRAKE, 9600                         | 2   |  |
| 23   | 00-878025-01                | BRAKE PAD, 9600  | 2   |  |
| 24   | 00-878144-01                | PUSHER, CABLE, 9600                                      | 4   |  |
| 25   | 00-878145-01                | BRACKET, CABLE PUSHER, 9600                              | 4   |  |
| 26   | 00-900949-01                | WHEEL, CASTER, 9600                                      | 2   |  |
| 27   | 00-877989-01, -02           | WLDMT, MACH, YOKE, R CASTER, 9600 (-02, W/SIDE SCAN OPT) | 2   |  |
| 28   | 21-119921-00                | BEARING, ROLLER, TAPERED-CUP, 2.3612 OD, .4700 WD        | 4   |  |
| 29   | 00-900716-01                | SPACER, BEARING, REAR CASTER (SCD)                       | 2   |  |
| 30   | 21-119920-00                | BEARING, ROLLER, TAPERED-CONE, 1.3775 ID, .6600 WD       | 4   |  |
| 31   | 00-877987-01                | MACHINING, HOUSING, BEARING, 9600                        | 2   |  |
| 32   | 00-878154-01                | NUT, CASTER STEM, 9600                                   | 2   |  |
| 33   | 11-633910-03                | SCREW, SET, SKT, HEX, 10-32, 3/16, SBO, KNURLED CUP      | 8   |  |
| 34   | 12-225160-14                | SCREW, SEMS SPRING, PAN, TORX, 10-32, 5/8, SZC           | 4   |  |
| 35   | 00-876649-02                | BLOCK, SUPPORT, OUTER                                    | 2   |  |
| 36   | 21-128807-00                | BEARING, NEEDLE-ROLLER, .625 ID, .8125 OD, .312 WD       | 2   |  |
| 37   | 88-299477-00                | LUBE, GREASE, GP, 14.1 OZ, CARTRIDGE                     | AR  |  |
| 38   | 88-299282-00                | ADHESIVE, SEALANT, BLUE, BTL 10CC, 242-21                | AR  |  |
| 39   | 88-299284-00                | ADHESIVE, SEALANT, PURPLE, BTL 10CC, 222-21              | AR  |  |



Fig. 2-6B Actuator, Brake, Rear Caster Exploded View

|      | FIG. 2-6C PARTS LIST |   |     |  |
|------|----------------------|---|-----|--|
| ITEM | PART NUMBER          | DESCRIPTION                                     | QTY |  |
| 1    | 00-876570-01         | CAM, BRAKE, REAR CASTER                         | 1   |  |
| 2    | 11-622008-05         | SCREW, SET, SKT, HEX, 8-32, 5/16, SST, CUP      | 2   |  |
| 3    | 00-876573-01         | FOLLOWER, CAM, REAR CASTER                      | 1   |  |
| 4    | 14-900027-00         | WASHER, SHIM, .002-LAM, BRASS, NA, ID = .25     | 3   |  |
| 5    | 21-259984-00         | CASTER, WHEEL, 8"D, 2"W                         | 1   |  |
| 6    | 00-876822-01         | DECAL, OEC LOGO                                 | 2   |  |
| 7    | 00-876820-01         | SCREW, AXLE, REAR CASTER                        | 1   |  |
| 8    | 20-209903-00         | SHAFT, DR, .12470 OD, 2.620 L SST               | 1   |  |
| 9    | 00-877086-01         | CABLE PUSHER, REAR CASTER                       | 2   |  |
| 10   | 11-652004-04         | SCREW, SET, SKT, HEX, 4-40, 1/4, SST, CP        | 4   |  |
| 11   | 14-999716-00         | WASHER, PL, #8, NYLON, NA, ID = .170, OD = .375 | 1   |  |
| 12   | 00-876671-01         | ARM, BRAKE, REAR CASTER                         | 1   |  |
| 13   | 00-877103-01         | SPRING, BRAKE ARM, REAR CASTER                  | 1   |  |
| 14   | 13-532010-00         | NUT, HEX-LOCK-W/INSR, 8-32, STEEL/Z, THIN       | 1   |  |
| 15   | 00-876580-01         | PAD, BRAKE, REAR CASTER                         | 1   |  |
| 16   | 23-619909-00         | PLUG, HOLE, .672702HD, NYLON, WHITE             | 1   |  |
| 17   | 00-876821-01         | NUT, AXLE, REAR CASTER                          | 1   |  |
| 18   | 88-299282-00         | ADHESIVE, SEALANT, BLUE, BTL 10CC, 242-21       | AR  |  |
| 19   | 88-299284-00         | ADHESIVE, SEALANT, PURPLE, BTL 10CC, 222-21     | AR  |  |
| 20   | 88-299477-00         | LUBE, GREASE, GP, 14.10Z, CRTG                  | AR  |  |



Fig. 2-6C Actuator, Brake, Rear Caster Exploded View

|      | FIG. 2-7 PARTS LIST |   |     |  |
|------|---------------------|---|-----|--|
| ITEM | PART NUMBER         | DESCRIPTION                                       | QTY |  |
| 1    | 00-875567-01        | PLATE, SUPPORT, WHEEL                             | 1   |  |
| 2    | 00-876593-01        | SPACER, YOKE, FRONT CASTER                        | 2   |  |
| 3    | 22-678450-00        | RING, RTNG, INT, BASIC, 1-3/8, SPRING, STEEL, SST | 2   |  |
| 4    | 21-109912-00        | BEARING, BALL, DBL, .5906 ID, 1.3780 OD, .625 WD  | 2   |  |
| 5    | 00-877006-01        | SCREW, MOUNTING, FRONT CASTER                     | 2   |  |
| 6    | 11-622004-05        | SCREW, SET, SKT, HEX, 4-40, 5/16, SST, CUP        | 4   |  |
| 7    | 00-876619-01        | MACHINING, ARM, FRONT CASTER                      | 2   |  |
| 8    | 12-331116-32        | SCREW, NA, FL, HEX, 3/8-16, 2-1/4, SZC, 8         | 2   |  |
| 9    | 00-876760-01        | DECAL, CASTER, FRONT                              | 4   |  |
| 10   | 00-876357-01        | SPRING, CABLE PUSHER                              | 4   |  |
| 11   | 21-259986-00        | CASTER, WHEEL, 4" D, 1-3/8" W (WITH SPACERS)      | 2   |  |



Fig. 2-7 Front Caster Assembly Exploded View

|      |              | FIG. 2-8 PARTS LIST                                  |     |
|------|--------------|--|-----|
| ITEM | PART NUMBER  | DESCRIPTION  | QTY |
| 1    | 00-878000-01 | ASSEMBLY, PCB, POWER/SIGNAL INTERFACE, 9600          | 1   |
| 2    | 00-875999-01 | ASSEMBLY, PCB, POWER/MOTOR RELAY                     | 1   |
| 3    | 67-430003-00 | IND, LAMP, NE, 125V GREEN (DS2)                      | 1   |
| 4    | 67-430004-00 | WASHER, PO, LAMP (DS2)                               | 1   |
| 5    | 00-875588-01 | ASSEMBLY, CABLE, HAND/FOOT SWITCH CONT               | 1   |
| 6    | 00-878063-01 | ASSEMBLY, CABLE, LEMO/RELAY, 9600                    | 1   |
| 7    | 00-875878-01 | BRACKET, MOUNTING, 24V, POWER SUPPLY                 | 1   |
| 8    | 00-900608-01 | POWER SUPPLY, 24V DC (SCD)                           | 1   |
| 9    | 00-875545-01 | ASSEMBLY, STATOR/CAP, 24V P.S.                       | 1   |
| 10   | 00-871329-01 | BRACKET, MOUNTING CAPACITOR                          | 2   |
| 11   | 41-599057-00 | CAPACITOR, AC METER, 30UF, 240V, TERM                | 1   |
| 12   | 00-900218-01 | POWER SUPPLY, 4.8 - 5.3V                             | 1   |
| 13   | 00-875743-01 | WELDMENT, POWER PANEL                                | 1   |
| 14   | 00-878065-01 | CABLE, ASSEMBLY, POWER ENTRY/RELAY, 9600 (NOT SHOWN) | 1   |
| 15   | 00-900472-05 | WIRE, HW, 1015, GRN/YEL, 18AWG (NOT SHOWN)           | AR  |
| 16   | 15-608090-00 | TERMINAL, RING, CRP, 22-18, #6, LRR6 (NOT SHOWN)     | 3   |
| 17   | 00-900478-13 | TUBING, HEAT SHRINKABLE, 3/16, BLACK (NOT SHOWN)     | AR  |



Fig. 2-8 Power Panel Side, Power Supply Exploded View

|      |              | FIG. 2-9 PARTS LIST                           |     |
|------|--------------|---|-----|
| ITEM | PART NUMBER  | DESCRIPTION                                   | QTY |
| 1    | 00-874752-03 | ASSEMBLY, PCB, IMAGE FUNCTION, 9600           | 1   |
| 2    | 00-900752-01 | POWER SUPPLY TH 7194-3P                       | 1   |
| 3    | 00-875536-01 | ASSEMBLY, MAINFRAME, MECHANICAL               | 1   |
| 4    | 00-875338-02 | WELDMENT, C-ARM                               | 1   |
| 5    | 00-875565-01 | STOP, ROTATION, C-ARM, 9600                   | 1   |
| 6    | 00-875607-01 | COVER, X-RAY CABLE                            | 1   |
| 7    | 00-876975-01 | TEMPERATURE, SENSOR, X-RAY                    | 1   |
| 8    | 00-900570-01 | TUBE, X-RAY ASSEMBLY, 9600 (SCD)              | 1   |
| 9    | 00-876758-01 | GASKET, CAMERA COVER                          | 1   |
| 10   | 00-877030-01 | COLLIMATOR, PRIMARY                           | 1   |
| 11   | 00-876567-01 | BUMPER, X-RAY MOUNT                           | 1   |
| 12   | 00-877253-01 | PLATE, BOTTOM, ALIGNMENT, 9600                | 1   |
| 13   | 00-877254-01 | PLATE, MIDDLE, ALIGNMENT, 9600                | 1   |
| 14   | 00-877255-01 | PLATE, TOP, ALIGNMENT, 9600                   | 1   |
| 15   | 00-877256-01 | CLAMP, COLLIMATOR, 9600                       | 4   |
| 16   | 12-225108-12 | SCREW, SEMS SPRING, PAN, TORX, 8-32, 3/4, SZC | 4   |
| 17   | 00-877420-01 | ASSEMBLY, COLLIMATOR, VARIABLE, 9600          | 1   |
| 18   | 00-877251-02 | FILTER, SECONDARY COLLIMATOR, 9600            | 1   |
| 19   | 14-112008-00 | WASHER, PL, #8 SST, NA, ID = .174, OD = .375  | 4   |

|      |                    | FIG. 2-9 PARTS LIST (CONT)                       |     |
|------|--------------------|--|-----|
| ITEM | PART NUMBER        | DESCRIPTION                                      | QTY |
| 20   | 13-311108-00       | NUT, HEX-LOCK-EXT-T, 8-32, SST, NA, A = .344     | 4   |
| 21   | 00-875465-01       | COVER, COLLIMATOR                                | 1   |
| 22   | 00-900692-01       | GRID, X-RAY, 8:1, 9.76 DIA, CARB FIB             | 1   |
| 23   | 00-871303-01       | GASKET, X-RAY GRID                               | 1   |
| 24   | 00-900753-01       | TUBE, 9" IMAGE INTENSIFIER W/POWER SUPPLY        | 1   |
| 25   | 00-876759-01       | CAMERA COUNTERWEIGHT COVER                       | 1   |
| 26A  | 00-900634-01,02,03 | * CAMERA, HI RES CCD, 9" 60HZ                    | 1   |
| 26B  | 00-900930-01       | * CAMERA, HI RES CCD, 9" 50HZ                    | 1   |
| 27   | 00-876636-02       | MACHINING, COVER, CAMERA, 9600                   | 1   |
| 28   | 00-876758-01       | GASKET, CAMERA COVER (NOT SHOWN)                 | 1   |
| 29   | 00-877221-03       | LABEL, C-ARM ROTATION, 9600 (41.36") (NOT SHOWN) | 1   |
| 29   | 00-877221-04       | LABEL, C-ARM ROTATION, 9600 (27.29"),(NOT SHOWN) | 1   |
| 30   | 00-877821-01       | BRACKET, SIDE, CAMERA COVER                      | 2   |
| 31   | 88-495001-00       | GASKET, SHIELD-EMI, EMI, FM, 1MMX10MM, ADH MT    | 2   |
| 32   | 00-877439-01       | GASKET, BRACKET, I.I. TUBE, 9600                 | 1   |
| 33   | 00-877322-01       | GASKET, X-RAY TUBE, 9600                         | 1   |
| 34   | 00-878047-02       | ASSEMBLY, PCB, PIXEL/COLUMN FILTER, 9600         | 1   |
| 35   | 00-875605-01       | BRACKET, MTG, PCB, IMAGE FUNCTION (NOT SHOWN)    | 1   |

\* Note: CCD Camera Replacement Order Information:

When ordering Item 26A (00-900634-01 or 00-900634-02) order PN# 00-878175-01 for the CCD Camera Kit. When ordering Item 26A (00-900634-03) order PN# 00-877815-03 for the CCD Camera Kit. The -03 kit includes a -03 Camera and a -03 Image Functions PCB. The Image Functions PCB is necessary because a connector was added to supply power to the Column/Pixel Filter PCB that is mounted to the camera. The Column/Pixel Filter PCB contains an EPROM that is programmed specifically for the CCD chip to block out white column noise. When ordering Item 26B (00-900930-01) order PN# 00-877814-01 or 00-877814-02 for the CCD Camera Kit. When ordering Item 26B with the PCF order PN# 00-877814-03 for the CCD Camera Kit.



Fig. 2-9 C-arm Assembly Exploded View

|      | FIG. 2-10A PARTS LIST |   |     |  |
|------|-----------------------|---|-----|--|
| ITEM | PART NUMBER           | DESCRIPTION                                       | QTY |  |
| 1    | 00-900242-02          | MODULE, FLUORESCENT, INDICATOR                    | 2   |  |
| 2    | 00-900649-01          | ASSEMBLY, PANEL, CONTROL, 9600 (SCD)              | 2   |  |
| 3    | 00-900750-01          | LENS, OEC (SCD)                                   | 2   |  |
| 4    | 00-900590-06          | SWITCH, SEALED, PUSH BUTTON, 9600, FAST STOP      | 2   |  |
| 5    | 00-900590-01          | SWITCH, SEALED, PUSH BUTTON, CCW ROTATION         | 1   |  |
| 6    | 00-900590-02          | SWITCH, SEALED, PUSH BUTTON, CW ROTATION          | 1   |  |
| 7    | 00-900590-03          | SWITCH, SEALED, PUSH BUTTON, LIFT UP              | 1   |  |
| 8    | 00-900590-04          | SWITCH, SEALED, PUSH BUTTON, LIFT DOWN            | 1   |  |
| 9    | 00-900590-05          | SWITCH, SEALED, PUSH BUTTON, X-RAY ON             | 1   |  |
| 10   | 00-875867-01          | COVER, BEARING, CROSS ARM                         | 1   |  |
| 11   | 00-876672-01          | ASSEMBLY, BRAKE, CROSS ARM                        | 1   |  |
| 12   | 00-877721-01          | ENCLOSURE, TOP, EMI                               | 1   |  |
| 13   | 00-875603-01          | ASSEMBLY, PCB, CONTROL PANEL PROC, MAINFRAME 9600 | 1   |  |
| 14   | 00-877722-01          | ENCLOSURE, BOTTOM, EMI, 9600                      | 1   |  |
| 15   | 00-875967-01          | ASSEMBLY, PCB, POWER/SIGNAL DISTANCE, A/F         | 1   |  |
| 16   | 00-876311-01          | COVER, LOWER, CROSS ARM                           | 1   |  |
| 17   | 00-876312-04          | PANEL HOUSING, SIDE, LEFT                         | 1   |  |
| 18   | 00-876312-03          | PANEL HOUSING, SIDE, RIGHT (NOT SHOWN)            | 1   |  |



Fig. 2-10A Control Panel, Cross Arm Brake Assembly Exploded View (Sheet 1 of 2)

| FIG. 2-10B PARTS LIST |              |  |     |
|-----------------------|--------------|--|-----|
| ITEM                  | PART NUMBER  | DESCRIPTION  | QTY |
| 1                     | 00-876982-01 | PLUG, MOLDED (RHINESTONE)                                  | 1   |
| 2                     | 12-225104-08 | SCREW, SEMS SPRING, PAN, TORX, 4-40, 1/2, SZC              | 1   |
| 3                     | 00-876344-01 | HANDLE, BRAKE, CROSS ARM                                   | 1   |
| 4                     | 19-221862-00 | PIN, DOWEL, .1250 OD, .375, SST                            | 1   |
| 5                     | 13-102006-00 | NUT, HEX, 6-32, SST, NA, A=.250, C=.094                    | 2   |
| 6                     | 14-112006-00 | WASHER, PLAIN, #6, SST, NA, ID =.149, OD =.375             | 2   |
| 7                     | 21-790207-00 | SPRING, COMPRESSION, .300 OD, .44 LG, .040 WD, SST         | 2   |
| 8                     | 00-876340-01 | MOUNT, BRAKE, CROSS ARM                                    | 1   |
| 9                     | 00-876343-01 | SHOE, BRAKE, CROSS ARM                                     | 1   |
| 10                    | 00-876345-01 | PAD, BRAKE, CROSS ARM                                      | 1   |
| 11                    | 88-299614-00 | ADHESIVE, BLACK, MAX, TB, 1OZ, 38050                       | AR  |
| 12                    | 00-876342-01 | STEM, BRAKE, CROSS ARM                                     | 1   |
| 13                    | 19-221857-00 | PIN, DOWEL, .1250 OD, .500, SST                            | 1   |
| 14                    | 00-876341-01 | RAMP, BRAKE, CROSS ARM                                     | 1   |
| 15                    | 00-876669-01 | BUSHING, BRAKE, CROSS ARM (NOT SHOWN)                      | 1   |
| 16                    | 88-299483-00 | LUBE, GREASE, TB, 1/2 OZ (NOT SHOWN)                       | AR  |
| 17                    | 88-299284-00 | ADHESIVE, SLT, PRP, BTL, 10CC, 222-21 (NOT SHOWN)          | AR  |
| 18                    | 12-225160-08 | SCREW, SEMS SPRING, PAN, TORX, 10-32, 1/2, SZC (NOT SHOWN) | 4   |



Fig. 2-10B Control Panel, Cross Arm Brake Assembly Exploded View (Sheet 2 of 2)

|      | FIG. 2-11 PARTS LIST |   |     |  |
|------|----------------------|---|-----|--|
| ITEM | PART NUMBER          | DESCRIPTION                                     | QTY |  |
| 1    | 00-876986-01         | HANDLE, PUSH, CROSS ARM                         | 1   |  |
| 2    | 00-876881-01         | CROSS ARM HSG., LEFT HALF.                      | 1   |  |
| 3    | 00-876882-02         | BEARING. SLEEVE HORIZONTAL TOP AND BOTTOM       | 2   |  |
| 4    | 00-876888-01         | SHAFT, HORIZONTAL                               | 1   |  |
| 5    | 00-876973-01         | ASSEMBLY, L-ARM DRIVE                           | 1   |  |
| 6    | 12-311164-08         | SCREW, NA, SKT, HEX, 1/4-28, 1/2, SZC, 8        | 2   |  |
| 7    | 00-876967-01         | CAP, L-ARM, MACH.                               | 1   |  |
| 8    | 12-333960-14         | SCREW, NA, FL, HEX, 10-32, 7/8, SBO, 8          | 4   |  |
| 9    | 71-999424-00         | SW, SNAP ACTION, SPDT, 11A @ 125/250 VAC, CHS   | 2   |  |
| 10   | 00-877242-01         | MOTOR, MOUNT, L-ARM DRIVE                       | 1   |  |
| 11   | 00-876963-01         | MOTOR, L-ARM DRIVE (AID)                        | 1   |  |
| 12   | 00-877097-01         | BRACKET, GEAR MOTOR, L-ARM                      | 1   |  |
| 13   | 00-876378-01         | ASSY/SCM, PCB, L-ARM MOTOR/POWER                | 1   |  |
| 14   | 41-599062-00         | CAPACITOR, AC METER, 17.5 UF, 330VAC, 10%, TERM | 1   |  |
| 15   | 00-876728-01         | PLUG, SLIDER                                    | 1   |  |
| 16   | 00-876701-01         | SLIDE, STRAIN RELIEF                            | 1   |  |
| 17   | 21-109943-00         | BEARING, BALL, .6693 ID, 1.3780 OD, .3937 WD    | 4   |  |
| 18   | 22-678375-00         | RING, RETAINING EXT, BASIC, .669, SPRING STEEL  | 4   |  |
| 19   | 00-877095-01         | RING, SCALE, L-ARM                              | 2   |  |
| 20   | 00-877270-01         | LABEL, ROTATION, L-ARM                          | 1   |  |
| 21   | 00-877308-01         | SHAFT, HORIZONTAL, LONG, CROSS ARM HSG          | 1   |  |
| 22   | 00-877943-01         | HANDLE, L-ARM, 9600                             | 1   |  |
| 23   | 00-877307-01         | STRAP, CROSS ARM HSG (NOT SHOWN)                | 2   |  |
| 24   | 00-877306-01         | ECCENTRIC NUT, CROSS ARM HSG (NOT SHOWN)        | 2   |  |



## Fig. 2-11 Cross Arm Exploded View

|      | FIG. 2-12 PARTS LIST |  |     |  |
|------|----------------------|--|-----|--|
| ITEM | PART NUMBER          | DESCRIPTION                                      | QTY |  |
| 1    | 00-876927-02         | L-ARM, MACH                                      | 1   |  |
| 2    | 00-876953-01         | STOP, HOUSING                                    | 1   |  |
| 3    | 00-876962-01         | PAD, STOP (NOT EXPLODED)                         | 2   |  |
| 4    | 19-221879-02         | PIN, DOWEL 1/2 X 2 1/2 (NOT EXPLODED)            | 2   |  |
| 5    | 19-224754-00         | PIN, SPRING, .125OD, 1, SST                      | 1   |  |
| 6    | 21-709118-00         | SPRING, COMPRESSION, .240OD, 1.50LG, .032WD, SST | 1   |  |
| 7    | 00-877720-01         | BRAKE SHOE, FLIP FLOP, 9600                      | 2   |  |
| 8    | 11-614019-10         | SCREW, SET, LKG, SKT, HEX, 3/8-24 X 5/8          | 2   |  |
| 9    | 00-876698-01         | WELDMENT, HOUSING, FLIP-FLOP                     | 1   |  |
| 10   | 27-402272-00         | O-RING, 4.487ID X .130 THK NPRN, -157            | 1   |  |
| 11   | 21-119937-00         | BEARING, ROLLER, TAPER-CUP, 4.1563 OD, .3750 WD  | 1   |  |
| 12   | 21-119936-01         | BEARING, TAPER ROLL CONE, TIMKEN, LL714649       | 1   |  |
| 13   | 00-876952-01         | STOP, SHAFT                                      | 1   |  |
| 14   | 00-877716-01         | BRAKE ACTUATOR, FLIP-FLOP, RIGHT HAND, 9600      | 1   |  |
| 15   | 00-877715-01         | SHAFT, FLIP-FLOP BRAKE, 9600                     | 1   |  |
| 16   | 00-877719-01         | INSERT, HANDLE, 9600                             | 2   |  |
| 17   | 27-402271-00         | O-RING, .734ID X .139 WD, NPRN, -210             | 2   |  |
| 18   | 00-876981-01         | HANDLE, BRAKE, FLIP-FLOP                         | 2   |  |

|      | FIG. 2-12 PARTS LIST (CONT) |  |     |  |
|------|-----------------------------|--|-----|--|
| ITEM | PART NUMBER                 | DESCRIPTION                                      | QTY |  |
| 19   | 12-225160-08                | SCREW, SEMS TORX, SPRING PAN, 10-32 X 1/2 SZC    | 2   |  |
| 20   | 00-876968-02                | COVER, L-ARM                                     | 1   |  |
| 21   | 00-877381-01                | SWIVEL, HIGH VOLTAGE CABLE HANGER, 9600          | 2   |  |
| 22   | 21-139741-00                | BEARING, CYL, FLG, .251 ID, .377 OD, .250 L      | 2   |  |
| 23   | 21-128917-00                | BEARING THRUST WASHER, .390 ID, .750 OD, .031 WD | 4   |  |
| 24   | 21-128918-00                | BEARING THRUST WASHER, .250 ID, .687 OD, .030 WD | 4   |  |
| 25   | 22-678606-00                | RING, RING EXT, BASIC, 1/4, SPRING STEEL         | 2   |  |
| 26   | 12-312014-10                | SCREW, NA, SKT, HEX, 1/4-20, /5/8, SST           | 1   |  |
| 27   | 00-876956-01                | CAP, SHAFT BEARING                               | 1   |  |
| 28   | 21-119938-00                | BEARING, ROLLER, TAPER-CONE, 2.000 ID, .5000 WD  | 1   |  |
| 29   | 21-119939-00                | BEARING, ROLLER, TPR-CONE, 3.0625 OD, .3750 WD   | 1   |  |
| 30   | 22-710001-00                | RING, SPL, .526 ID, .105 THK, SPRING STEEL       | 2   |  |
| 31   | 00-877382-01                | ROD, HIGH VOLTAGE CABLE HANGER, 9600             | 1   |  |
| 32   | 22-710001-00                | RING, SPL, .526 ID, .105 THK, SPRING STEEL       | 1   |  |
| 33   | 00-876956-01                | CAP, SHAFT BEARING (NOT SHOWN)                   | 1   |  |
| 34   | 19-224790-00                | PIN SPRING, .125 OD, .625, SZC (NOT SHOWN)       | 2   |  |
| 35   | 00-877119-01                | SCREW, PIVOT SHAFT (NOT SHOWN)                   | 1   |  |



### Fig. 2-12 L-arm Exploded View

|      | FIG. 2-13 PARTS LIST |   |     |  |
|------|----------------------|---|-----|--|
| ITEM | PART NUMBER          | DESCRIPTION                                     | QTY |  |
| 1    | 00-876522-01         | ROLLER, AXIAL                                   | 9   |  |
| 2    | 00-876523-01         | ROLLER, RADIAL                                  | 8   |  |
| 3    | 00-876524-01         | AXIAL TOGGLE ARM                                | 4   |  |
| 4    | 00-876525-01         | ARM, TOGGLE, RADIAL                             | 4   |  |
| 5    | 00-877729-01         | SHAFT, RADIAL TOGGLE ARM (AID)                  | 2   |  |
| 6    | 21-109920-00         | BEARING, BALL, .2500 ID, .6250 OD, .196 WD      | 8   |  |
| 7    | 21-109937-00         | BEARING, BALL, .3750 ID, .8750 OD, .281 WD      | 8   |  |
| 8    | 00-877033-01         | PAD, BUMPER, FLIP-FLOP                          | 2   |  |
| 9    | 00-877033-02         | PAD, BUMPER, FLIP-FLOP                          | 2   |  |
| 10   | 00-876698-01         | WELDMENT, HOUSING FLIP-FLOP                     | 1   |  |
| 11   | 22-678606-00         | RING, RING EXT BASIC, 1/4, SPRING STEEL         | 8   |  |
| 12   | 22-678612-00         | RING, RING EXT BASIC, 3/8, SPRING STEEL         | 8   |  |
| 13   | 12-221260-05         | SCREW, MACH, TORX, PAN, 10-32, 5/16 SZC, 8      | 4   |  |
| 14   | 14-146010-00         | WASHER, SHIM, ID = .197, OD = .500, .020 T, SST | 4   |  |

|      | FIG. 2-13 PARTS LIST (CONT) |   |     |  |
|------|-----------------------------|---|-----|--|
| ITEM | PART NUMBER                 | DESCRIPTION                                       | QTY |  |
| 15   | 00-876708-01                | CAM, BRAKE, C-ROTATION                            | 1   |  |
| 16   | 00-876709-01                | SHAFT, BRAKE, C-ROTATION                          | 1   |  |
| 17   | 00-876704-01                | HANDLE, BRAKE, C-ROTATION                         | 2   |  |
| 18   | 21-180004-00                | BEARING, CYL, .3125 ID, .4375 OD, .375 L, PLASTIC | 4   |  |
| 19   | 12-215006-10                | SCREW, MACH, TORX, FLAT, 6-32, 5/8 SZC            | 4   |  |
| 20   | 00-876526-01                | PIN, ROLLER, AXIAL                                | 8   |  |
| 21   | 00-876527-01                | PIN, ROLLER, RADIAL                               | 8   |  |
| 22   | 12-225106-06                | SCREW, SEMS, PAN TORX, SPRING, 6-32, 3/8 SZC      | 2   |  |
| 23   | 00-876705-01                | MOUNT, BRAKE, C-ROTATION                          | 1   |  |
| 24   | 00-876706-01                | BRAKE PAD, C-ROTATION ASSEMBLY                    | 1   |  |
| 25   | 00-876707-01                | CAM, FOLLOWER, BRAKE, C-ROTATION                  | 1   |  |
| 26   | 21-715001-00                | SPRING, COMPRESSION WAVE, 1.250 OD, .600 LG, SST  | 1   |  |
| 27   | 00-876808-01                | SPRING, INNER                                     | 1   |  |
| 28   | 19-225107-00                | PIN, DOWEL, .1875 OD, 1.500 SST                   | 1   |  |

Note: Items 23, 24, 25, 26, 27, and 28 are not shown exploded at this time.



Fig. 2-13 Flip-Flop Assembly Exploded View

| FIG. 2-14 PARTS LIST |              |  |     |
|----------------------|--------------|--|-----|
| ITEM                 | PART NUMBER  | DESCRIPTION  | QTY |
| 1                    | 22-678651-00 | RING, RTNG EXT, BASIC 3/4, SPRING STEEL                  | 2   |
| 2                    | 00-876877-01 | SPACER, DELRIN 10D, .765ID, .12LG                        | 2   |
| 3                    | 00-876873-01 | SHAFT, FRONT ROLLER SUPPORT                              | 1   |
| 4                    | 00-876872-01 | SLEEVE, BEARING  | 1   |
| 5                    | 21-128806-00 | BEARING, NEEDLE RLR,.750 ID,1.000 OD,.750 WD (NOT SHOWN) | 2   |
| 6                    | 20-500003-00 | LINK, CHAIN, SPRING CL, .375 PD, STEEL                   | 2   |
| 7                    | 00-877240-01 | CHAIN, JACK SHAFT BASE                                   | 2   |
| 8                    | 41-599063-00 | CAPACITOR, AC METER, 30UF, 330 VAC 10%, TERM             | 1   |
| 9                    | 00-876850-01 | MOTOR, BODINE, VERTICAL LIFT (AID)                       | 1   |
| 10                   | 00-876876-01 | PLATE, LOWER CENTER COLUMN BEARING.                      | 1   |
| 11                   | 00-876870-01 | ASSEMBLY, IDLER BEARING                                  | 1   |
| 12                   | 00-876856-01 | PAD, SIDE ADJ, BASE                                      | 3   |
| 13                   | 00-876885-01 | BASE, MAIN HSG. COVER, MACH                              | 1   |
| 14                   | 00-876855-01 | PAD, LOWER, ADJ, BASE                                    | 1   |
| 15                   | 00-876858-01 | PAD, LOWER, FIXED, BASE                                  | 1   |
| 16                   | 00-876857-01 | PAD, SIDE, FIXED, BASE                                   | 1   |
| 17                   | 00-876903-01 | BOLT, TENSION  | 1   |
| 18                   | 00-876884-01 | BASE FRAME, MAIN HOUSING                                 | 1   |



Fig. 2-14 Base Exploded View

| FIG. 2-15A PARTS LIST |              |  |     |
|-----------------------|--------------|--|-----|
| ITEM                  | PART NUMBER  | DESCRIPTION                                | QTY |
| 1                     | 00-877239-01 | CHAIN, LIFT, BASE                          | 2   |
| 2                     | 00-876860-01 | CHAIN, DRIVE LINK, LEFT (TAPPED)           | 1   |
| 3                     | 00-876930-01 | SUB-ASSEMBLY CROSS ARM                     | 1   |
| 4                     | 00-876969-01 | ASSEMBLY, CENTER COLUMN                    | 1   |
| 5                     | 20-500003-00 | LINK, CHAIN, SPRING CL, .375 PD, STEEL     | 4   |
| 6                     | 00-876862-01 | CHAIN, DRIVE LINK, RIGHT (SLOTTED)         | 1   |
| 7                     | 00-876871-01 | ASSEMBLY, JACK SHAFT                       | 1   |
| 8                     | 00-876861-00 | CHAIN, DRIVE LINK, LEFT (SLOTTED)          | 1   |
| 9                     | 00-876904-01 | CHAINLINK RIGHT HAND TAPPED                | 1   |
| 10                    | 00-877094-01 | ACTUATOR, LIMIT SWITCH, VERT, LIFT(LOWER)  | 1   |
| 11                    | 00-877093-01 | ACTUATOR, LIMIT SWITCH, VERT, LIFT (UPPER) | 1   |


Fig. 2-15A Vertical Column, Wig-Wag Brake Exploded View (Sheet 1 of 2)

|      |              | FIG. 2-15B PARTS LIST                               |     |
|------|--------------|---|-----|
| ITEM | PART NUMBER  | DESCRIPTION   | QTY |
| 1    | 00-876930-01 | SUB-ASSEMBLY, CROSS ARM                             | 1   |
| 2    | 12-999538-00 | SCREW, NA, STLDR, HEX 3/8-16, 1/2 X 3/4             | 1   |
| 3    | 21-128800-00 | BEARING, NEEDLE-ROLLER, 1.750 ID, 2.125 OD, .750 WD | 1   |
| 4    | 00-876944-01 | BEARING, HOUSING, SHAFT                             | 1   |
| 5    | 19-221923-00 | PIN, DOWEL, .312 OD, .750, STEEL                    | 2   |
| 6    | 00-876934-03 | WELDMENT, VERTICAL COLUMN ASSEMBLY                  | 1   |
| 7    | 00-877223-01 | LABEL, VERTICAL LIFT, 9600                          | 1   |
| 8    | 21-180009-00 | BEARING, CYL, .500 ID, .750 OD, .625 L              | 2   |
| 9    | 21-190069-00 | BEARING, CAM FOLLOWER, 1.750 OD, 1.00 WD, .500 ID   | 1   |
| 10   | 22-678617-00 | RING, RETAIN, EXT BASIC, 1/2, SPRING STEEL          | 2   |
| 11   | 00-876886-01 | SHAFT, LOWER CENTER COLUMN                          | 1   |
| 12   | 00-876980-01 | HANDLE, WIG-WAG BRAKE                               | 1   |
| 13   | 00-877575-01 | ACTUATOR, 9600                                      | 1   |
| 14   | 00-876940-01 | PLATE, FLOATING HEAD                                | 1   |
| 15   | 00-877574-01 | PAD, ROTOR, 9600                                    | 1   |
| 16   | 00-877573-01 | ACTUATOR SCREW, 9600                                | 1   |

Note: Items 3, 4, 5, 7, 8, 9, 10, and 11 are not shown exploded at this time.



Fig. 2-15B Vertical Column, Wig-Wag Brake Exploded View (Sheet 2 of 2)

|      | FIG. 2-16A PARTS LIST |   |     |  |
|------|-----------------------|---|-----|--|
| ITEM | PART NUMBER           | DESCRIPTION                               | QTY |  |
| 1    | 00-876751-01          | CABLE ASSEMBLY, X-RAY ON                  | 1   |  |
| 2    | 00-876750-01          | CABLE ASSEMBLY, EMERGENCY OFF             | 1   |  |
| 3    | 00-876691-01          | CABLE ASSEMBLY, DISPLAY                   | 1   |  |
| 4    | 00-900699-02          | CABLE ASSEMBLY, FLAT FLEX DUAL            | 1   |  |
| 5    | 00-900699-01          | CABLE ASSEMBLY, FLAT FLEX DUAL            | 1   |  |
| 6    | 00-875866-01          | CABLE ASSEMBLY, DATA I/O                  | 1   |  |
| 7    | 00-876753-01          | CABLE ASSEMBLY, DISPLAY POWER, 2 PIN      | 1   |  |
| 8    | 00-876025-01          | CABLE ASSEMBLY, HV/BATTERY CHARGER, I/O   | 1   |  |
| 9    | 00-878007-01          | CABLE ASSEMBLY, REG CHARGER POWER, 9600   | 1   |  |
| 10   | 00-875337-01          | CABLE ASSEMBLY, SWITCH DARLINGTON         | 1   |  |
| 11   | 00-875332-01          | CABLE ASSEMBLY, HI-VOLTAGE TANK, 9600     | 1   |  |
| 12   | 00-900927-01          | CABLE ASSEMBLY, HIGH VOLTAGE & CONT, 9600 | 1   |  |



Fig. 2-16A Interconnect Cable Assembly Diagram, Mobile C-Arm (Sheet 1 of 3)

|      |              | FIG. 2-16B PARTS LIST                         |     |
|------|--------------|---|-----|
| ITEM | PART NUMBER  | DESCRIPTION                                   | QTY |
| 4    | 00-900699-02 | CABLE ASSEMBLY, FLAT FLEX DUAL                | 1   |
| 5    | 00-900699-01 | CABLE ASSEMBLY, FLAT FLEX DUAL                | 1   |
| 8    | 00-876025-01 | CABLE ASSEMBLY, RIBBON, HV/BATT CHGR, I/O     | 1   |
| 9    | 00-878007-01 | CABLE ASSEMBLY, REG CHARGER POWER, 9600       | 1   |
| 12   | 00-900927-01 | CABLE ASSEMBLY, HIGH VOLTAGE & CONT, 9600     | 1   |
| 13   | 00-875588-01 | CABLE ASSEMBLY, HAND/FOOT SWITCH CONT         | 1   |
| 14   | 00-878063-01 | CABLE ASSEMBLY, LEMO/RELAY, 9600              | 1   |
| 15   | 00-875563-01 | CABLE ASSEMBLY, DATA CONTROL                  | 1   |
| 16   | 00-875614-01 | CABLE ASSEMBLY, MB POWER, 9600                | 1   |
| 17   | 00-900697-01 | CABLE ASSEMBLY, FLAT, FLEX W/O SHIELD         | 1   |
| 18   | 00-900698-01 | CABLE ASSEMBLY, FLAT, FLEX W/SHIELD           | 1   |
| 19   | 00-875498-01 | CABLE ASSEMBLY, MOTOR, POWER, ELEVATION, 9600 | 1   |
| 20   | 00-875545-01 | ASSEMBLY, STATOR/CAPACITOR, 25V P.S.          | 1   |
| 21   | 00-877477-01 | CABLE ASSEMBLY, 5/15V POWER SUPPLY            | 1   |
| 22   | 00-878065-01 | CABLE ASSEMBLY, POWER ENTRY/RELAY, 9600       | 1   |
| 23   | 00-900608-01 | POWER SUPPLY, 24VDC (SCD)                     | 1   |

MATCH LINE CARD RACK ANALOG TECHNIQUE PROCESSOR INTERFACE PCB 12VDC COOLING FANS PCB MATCH P1 P2 P1 P2 LINE J3 J6 J2 J5 P5 L Г CABLE ASSY, HD/FT SW CONT J3 P3 11 MOTHERBOARD P7 ⟨12⟩− P3 11 11 PART OF HIGH J2 P2 VOLTAGE CABLE 11 П 11 P2 11 (14) CABLE ASSY, LEMO RELAY i (8) 11 Т P8 P1 CABLE ASSY, 11 HV/BATT 1 L L CHGR, I/O (16) CABLE ASSY, MB POWER CABLE ASSY, DATA CONTROL  $\langle 15 \rangle$  $\langle 17 \rangle$ POWER PANEL P1 CABLE ASSY, FLAT, FLEX, PART OF H.V. CABLE CABLE ASSY. W/O SHLD P7 P9  $\langle 12 \rangle$ P4 P5 FLAT FLEX DUAL POWER/MOTOR RELAY PCB  $\langle 4 \rangle$ P3 4 - NEUTRAL CABLE ASSY, FLAT, FLEX, W/SHLD P4 1- 120V\_PH1 P7 P2 P6 i(5) $\langle 18 \rangle$ 4 NEUTRAL POWER/SIGNAL P10 INTERFACE PCB (DS2) CABLE ASSY, FLAT FLEX DUAL P6 CABLE ASSY, PWR ENTRY/RELAY  $|\langle 9 \rangle$ P12 (19) ↔ (14) CABLE ASSY, LEMO RELAY CABLE ASSY. REG/CHGR PWR P CABLE ASSY. 9 P2 MOT, PWR, ELEVATION CABLE ASSY, P5 REG/CHGR PWR T3 PWR SUPPLY. CABLE ASSY, ASSY, STATOR/CAP STATOR 5, 15V PWR SUPPLY 24VDC 25V P.S. TRANSFORMER TB1 TB2 4 N 2 3 1 L \_\_\_\_\_ C5 PS1 S+ PS2

Fig. 2-16B Interconnect Cable Assembly Diagram, Mobile C-Arm (Sheet 2 of 3)

|      |              | FIG. 2-16C PARTS LIST                         |     |
|------|--------------|---|-----|
| ITEM | PART NUMBER  | DESCRIPTION                                   | QTY |
| 13   | 00-875588-01 | CABLE ASSEMBLY, HAND/FOOT SWITCH CONT         | 1   |
| 14   | 00-878063-01 | CABLE ASSEMBLY, LEMO/RELAY, 9600              | 1   |
| 17   | 00-900697-01 | CABLE ASSEMBLY, FLAT FLEX W/O SHIELD          | 1   |
| 18   | 00-900698-01 | CABLE ASSEMBLY, FLAT FLEX W/SHIELD            | 1   |
| 19   | 00-875498-01 | CABLE ASSEMBLY, MOTOR, POWER, ELEVATION, 9600 | 1   |
| 24   | 00-876183-01 | CABLE ASSEMBLY, INTERCONNECT, 20', 9600       | 1   |
| 25   | 00-877204-01 | CABLE ASSEMBLY, MOTION, ELEVATION, UP         | 1   |
| 26   | 00-877204-02 | CABLE ASSEMBLY, MOTION, ELEVATION, DOWN       | 1   |
| 27   | 00-877204-03 | CABLE ASSEMBLY, MOTION, ROT CW                | 1   |
| 28   | 00-877204-04 | CABLE ASSEMBLY, MOTION, ROT CCW               | 1   |
| 29   | 00-875497-01 | CABLE ASSEMBLY, MOTOR, POWER, ROTATION        | 1   |
| 30   | 00-877268-01 | CABLE ASSEMBLY, L-ARM POWER                   | 1   |





|      |              | FIG. 2-17 PARTS LIST                      |     |
|------|--------------|---|-----|
|      |              |   |     |
| ITEM | PART NUMBER  | DESCRIPTION                               | QTY |
| 1    | 00-876001-01 | CABLE ASSEMBLY II POWER/CONTROL           | 1   |
|      | 00-070331-01 |   | I   |
| 2    | 00-875359-01 | CABLE ASSEMBLY, COLLIMATOR CONTROL 9600   | 1   |
| 3    | 00-900927-01 | CABLE ASSEMBLY, HI-VOLTAGE (SCD)          | 1   |
| 4    | 00-875748-01 | CABLE ASSEMBLY, CCD CAMERA, 9600          | 1   |
| 5    | 00-878104-01 | CABLE ASSEMBLY, PIXEL/COLUMN FILTER, 9600 | 1   |

Note: Item 5 is used on 60Hz system.



Fig. 2-17 Interconnect Cable Assembly Diagram, Image System

# Section 3 SERIES9600<sup>™</sup> Mobile C-Arm Illustrated Parts Manual Updates



# SERIES9600<sup>™</sup> Mobile C-Arm Illustrated Parts Manual Update October 1995

(P/N 00-878548-02)

This update reflects changes that occurred to the SERIES**9600** Mobile C-Arm Illustrated Parts Manual. Review the contents to familiarize yourself with the field replaceable parts that have changed. Replace the update currently in the Illustrated Parts Manual (P/N 00-878548-01) with this update. If there is no update currently in your manual place this update at the back of your Illustrated Parts Manual.

The EMI/RFI changes are on systems 2001 and higher.

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|      |              | FIG. 1 OCTOBER 1995 UPDATE PARTS LIST  |     |
|------|--------------|--|-----|
| ITEM | PART NUMBER  | DESCRIPTION                            | QTY |
| 1    | 00-878381-01 | ASSEMBLY, ENCLOSURE, CARD RACK, 9600   | 1   |
| 2    | 00-878550-01 | ASSEMBLY, FOOT SWITCH , 9600 (ENGLISH) | 1   |
| 2    | 00-878550-02 | ASSEMBLY, FOOT SWITCH , 9600 (GERMAN)  | 1   |
| 2    | 00-878550-03 | ASSEMBLY, FOOT SWITCH , 9600 (FRENCH)  | 1   |
| 2    | 00-878550-04 | ASSEMBLY, FOOT SWITCH , 9600 (SPANISH) | 1   |
| 2    | 00-878550-05 | ASSEMBLY, FOOT SWITCH , 9600 (ITALIAN) | 1   |

**Note:**All items listed below are not shown exploded. They are listed for reference when reordering replaceable parts for item 2.

| 3 | 00-877215-01 | HOUSING, FOOTSWITCH, MOLDED, 9600                   | 1 |
|---|--------------|---|---|
| 4 | 00-876350-27 | LABEL, FOOTSWITCH, X-RAY, BOOST/DIG. SPOT (ENGLISH) | 1 |
| 4 | 00-876350-31 | LABEL, FOOTSWITCH, X-RAY, MAX MA/DIG DL (GERMAN)    | 1 |
| 4 | 00-876350-29 | LABEL, FOOTSWITCH, X-RAY, GE/GRAPHIE DIG (FRENCH)   | 1 |
| 4 | 00-876350-33 | LABEL, FOOTSWITCH, X-RAY, MAX MA/EXP DIG (SPANISH)  | 1 |
| 4 | 00-876350-35 | LABEL, FOOTSWITCH, X-RAY, GE/IMM DIGITLE (ITALIAN)  | 1 |
| 5 | 00-876350-06 | LABEL, FOOTSWITCH, X-RAY, SAVE ( ENGLISH)           | 1 |
| 5 | 00-876350-14 | LABEL, FOOTSWITCH, X-RAY, SPEICHERN (GERMAN)        | 1 |
| 5 | 00-876350-10 | LABEL, FOOTSWITCH, X-RAY, MEMO (FRENCH)             | 1 |
| 5 | 00-876350-18 | LABEL, FOOTSWITCH, X-RAY, ALMAC (SPANISH)           | 1 |
| 5 | 00-876350-22 | LABEL, FOOTSWITCH, X-RAY, MEMORIZZA (ITALIAN)       | 1 |

|      |              | FIG. 1 OCTOBER 1995 UPDATE PARTS LIST (CONT)       |     |
|------|--------------|--|-----|
| ITEM | PART NUMBER  | DESCRIPTION  | QTY |
| 6    | 00-876350-07 | LABEL, FOOTSWITCH, X-RAY, SCOUT FLUORO (ENGLISH)   | 1   |
| 6    | 00-876350-15 | LABEL, FOOTSWITCH, X-RAY, DL (GERMAN)              | 1   |
| 6    | 00-876350-11 | LABEL, FOOTSWITCH, X-RAY, SCOPIE (FRENCH)          | 1   |
| 6    | 00-876350-19 | LABEL, FOOTSWITCH, X-RAY, FLUORO (SPANISH)         | 1   |
| 6    | 00-876350-23 | LABEL, FOOTSWITCH, X-RAY, SCOPIA (ITALIAN)         | 1   |
| 7    | 00-876350-28 | LABEL, FOOTSWITCH, X-RAY, PROC DIGFLUORO (ENGLISH) | 1   |
| 7    | 00-876350-32 | LABEL, FOOTSWITCH, X-RAY, DIG PROCESS DL (GERMAN)  | 1   |
| 7    | 00-876350-30 | LABEL, FOOTSWITCH, X-RAY, CENT IMAGE DIG (FRENCH)  | 1   |
| 7    | 00-876350-34 | LABEL, FOOTSWITCH, X-RAY, PROC DIGFLUORO (SPANISH) | 1   |
| 7    | 00-876350-36 | LABEL, FOOTSWITCH, X-RAY, SCOPIA DIGITLE (ITALIAN) | 1   |
| 8    | 00-900502-01 | CONNECTOR, PLUG, STRAIGHT, 10 PIN                  | 1   |
| 9    | 00-900502-05 | CONNECTOR, PLUG, STRAIN RELIEF                     | 1   |
| 10   | 00-877216-02 | CABLE ASSEMBLY, MOLDED, 9600                       | 1   |
| 11   | 71-500001-00 | SWITCH, FT SPST-MOM, 5A @ 125VAC                   | 4   |
| 12   | 00-877217-01 | HANDLE, FOOTSWITCH, 9600                           | 1   |
| 13   | 00-877218-01 | PLATE, BOTTOM, FOOTSWITCH, 9600                    | 1   |
| 14   | 12-225160-12 | SCREW, SEMS SPRING, PAN, TRX, 10-32, 3/4, SZC      | 2   |
| 15   | 12-215060-06 | SCREW, MACH, FL, TRX, 10-32, 3/8, SZC              | 4   |
| 16   | 12-215008-10 | SCREW, MACH, FL, TRX, 8-32, 5/8, SZC               | 8   |
| 17   | 00-878710-01 | LABEL, FOOTSWITCH, X-RAY, ENGLISH, 9600/2600       | 1   |
| 18   | 00-877486-07 | LABEL, FOOTSWITCH, X-RAY, BLANK                    | 1   |



Fig. 1 Ocober 1995 Update SERIES9600 Mobile C-Arm EMI/=-RFI Modifications, Foot Switch Assembly

|      |              | FIG. 2 OCTOBER 1995 UPDATE PARTS LIST                  |      |
|------|--------------|--|------|
| ITEM | PART NUMBER  | DESCRIPTION  | QTY  |
| 1    | 00-878408-01 | MOUNT, FAN, CARD RACK, 9600                            | 1    |
| 2    | 20-840202-00 | FAN, AXLE, 12VDC, 33CFM, 4100RPM                       | 2    |
| 3    | 88-495002-00 | SHIELD, STRIP, RFI, BE CU, .32 X 16 L, ADHESIVE MOUNT  | 3 FT |
| 4    | 00-878406-01 | HINGE, CARD RACK, 9600                                 | 1    |
| 5    | 00-878405-01 | MOUNT, HINGE, CARD RACK, 9600                          | 1    |
| 6    | 00-878806-01 | SPRING, TORSION, CARD CAGE                             | 2    |
| 7    | 00-878404-01 | COVER, CARD RACK, REAR, 9600                           | 1    |
| 8    | 00-900970-01 | PCA, MOTHERBOARD, 9600                                 | 1    |
| 9    | 00-878401-01 | WELDMENT, ENCLOSURE, CARD RACK                         | 1    |
| 10   | 22-319823-00 | GUIDE, PCB, SNAP IN, 8.00L, .312W, .062                | 6    |
| 11   | 00-878407-01 | COVER, CARD RACK, 9600                                 | 1    |
| 12   | 00-878400-01 | IMAGE FUNCTION PCB ASSEMBLY, 9600                      | 1    |
| 13   | 00-877744-01 | TECHNIQUE PROCESSOR PCB ASSEMBLY (9600)                | 1    |
| 14   | 88-750000-00 | MEMORY CD, SRAM, BAT BK, 1MX8                          | 1    |
| 15   | 00-876740-01 | ANALOG INTERFACE PCB ASSEMBLY, 9600/URO2600            | 1    |
| 16   | 12-225106-24 | SCREW, SEMS SPRING, PAN, TRX, 6-32, 1-1/2, SZC         | 8    |
| 17   | 12-225106-04 | SCREW, SEMS SPRING, PAN, TRX, 6-32, 1/4, SZC           | 31   |
| 18   | 12-999544-00 | SCREW, NA, SHOULDER, HEX, 1/4-20, 5/16 X 1/4, SB       | 2    |
| 19   | 51-411102-00 | CONN, RCPT, CA, 4SKT, STR 2 X 2 , .165 CTR (NOT SHOWN) | 1    |
| 20   | 51-411114-00 | CONT, SKT, CRP, 18-24 AWG, BRS/AU PL, LSF (NOT SHOWN)  | 3    |
| 21   | 15-647349-00 | TERM, FK, LK, CRP, 16-14, #6, LLB6 (NOT SHOWN)         | 2    |
| 22   | 00-900472-04 | WIRE, HW, 1015, GRN/YEL, 16 AWG (NOT SHOWN)            | AR   |



Fig. 2 Ocober 1995 Update SERIES9600 Mobile C-Arm Card Rack Enclosure Assy EMI/RFI Modification

|      |              | FIG. 3 OCTOBER 1995 UPDATE PARTS LIST                    |     |
|------|--------------|--|-----|
| ITEM | PART NUMBER  | DESCRIPTION  | QTY |
| 1    | 00-878409-01 | COVER, CONTROL PANEL PROCESSOR, 9600                     | 1   |
| 2    | 00-878491-01 | ASSEMBLY, PCB, CONTROL PANEL PROCESSOR I/O, 9600         | 1   |
| 3    | 00-878488-01 | ASSEMBLY, PCB, CONTROL PANEL PROCESSOR, MFRAME/96        | 1   |
| 4    | 88-495002-00 | SHIELDING, STRIP, RFI, BE CU, .32 X 16 L, ADHESIVE MT    | 1.4 |
| 5    | 00-878413-01 | ENCLOSURE, PCB, CONTROL PANEL PROCESSOR                  | 1   |
| 6    | 00-878514-01 | INSULATOR, PCB, COLUMN I/O, 9600                         | 1   |
| 7    | 00-878494-01 | ASSEMBLY, PCB, COLUMN I/O, 9600                          | 1   |
| 8    | 22-407706-00 | STANDOFF, HEX, M/F, 4-40, .188, SST (NOT SHOWN)          | 4   |
| 9    | 22-407702-00 | STANDOFF, HEX, M/F, 4-40, .250L, SST (NOT SHOWN)         | 7   |
| 10   | 12-225104-12 | SCREW, SEMS SPRING, PAN, TRX, 4-40, 3/4, SZC (NOT SHOWN) | 4   |
| 11   |              |  |     |
| 12   |              |  |     |
| 13   |              |  |     |
| 14   |              |  |     |
| 15   |              |  |     |
| 16   |              |  |     |
| 17   |              |  |     |
| 18   |              |  |     |
| 19   |              |  |     |
| 20   |              |  |     |
| 21   |              |  |     |
| 22   |              |  |     |
| 23   |              |  |     |



Fig. 3 Ocober 1995 Update SERIES9600 Mobile C-Arm Control Panel EMI/RFI Modification

|      |              | FIG. 4 OCTOBER 1995 UPDATE PARTS LIST         |     |
|------|--------------|---|-----|
| ITEM | PART NUMBER  | DESCRIPTION                                   | QTY |
| 1    | 00-878411-01 | COVER, CAMERA, EMI/RFI, 9600                  | 1   |
| 2    | 28-993022-00 | CLAMP, HOS, 6-3/4D TO 7-5/8D, SST             | 1   |
| 3    | 00-878412-01 | COUNTERWEIGHT 1, CAMERA COVER                 | 1   |
| 4    | 00-878609-01 | MOUNT, CONNECTOR, CAMERA COVER, WELDMENT      | 1   |
| 5    | 12-225106-04 | SCREW, SEMS, SPRING, PAN, TRX, 6-32, 1/4, SZC | 15  |
| 6    | 00-877538-01 | GASKET, COVER, CAMERA, 9600                   | 1   |
| 7    | 00-876636-02 | MACHINING, COVER, CAMERA                      | 1   |
| 8    | 12-312014-12 | SCREW, NA, SKT, HEX, 1/4 - 20, 3/4, SST       | 2   |
| 9    | 88-299282-00 | ADHESIVE, SLT, BLUE, BTL, 10CC, 242-21-AR     |     |
| 10   |              |   |     |
| 11   |              |   |     |
| 12   |              |   |     |
| 13   |              |   |     |
| 14   |              |   |     |
| 15   |              |   |     |
| 16   |              |   |     |
| 17   |              |   |     |
| 18   |              |   |     |
| 19   |              |   |     |
| 20   |              |   |     |
| 21   |              |   |     |
| 22   |              |   |     |
| 23   |              |   |     |



Fig. 4 Ocober 1995 Update SERIES9600 Mobile C-Arm Camera Cover EMI/RFI Modification

# SERIES9600<sup>™</sup> Mobile C-Arm Illustrated Parts Manual Update December 1995

(P/N 00-878975-01)

This update defines field replaceable parts for the 12-inch image intensifier option. The 12-inch II option is a new feature available to customers. Review the contents to familiarize yourself with the new field replaceable parts. Place this update at the back of your Illustrated Parts Manual along with earlier updates that have been sent out.

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|      |              | FIG. 1 DECEMBER 1995 UPDATE PARTS LIST       |     |
|------|--------------|--|-----|
| ITEM | PART NUMBER  | DESCRIPTION                                  | QTY |
| 1    | 00-878798-01 | COVER, CAMERA, 12" II, 9600                  | 1   |
| 2    | 00-878898-01 | COVER, CAMERA, 12", WELDMENT                 | 1   |
| 3    | 00-878897-01 | MOUNT, CONNECTOR, CAMERA COVER, WELDMENT 12" | 1   |
| 4    | 00-878865-01 | CAMERA, HI RES CCD, 12", 50Hz, 9600          | 1   |
| 4    | 00-878866-01 | CAMERA, HI RES CCD, 12", 60Hz, 9600          | 1   |
| 5    | 00-900752-01 | POWER SUPPLY TH 7194-3P                      | 1   |
| 6    | 00-900999-01 | INTENSIFIER, IMAGE, 12" (SCD)                | 1   |
| 7    | 00-878873-01 | PLATE, II, 12"                               | 1   |
| 8    | 00-878868-01 | GASKET, GRID, X-RAY, 12", 9600               | 1   |
| 9    | 00-901002-01 | GRID, FOCUS, 12" (SCD)                       | 1   |
| 10   | 00-878820-01 | ASSEMBLY, CASSETTE HOLDER, 12" UNIVERSAL     | 1   |
| 11   | 00-878794-01 | WELDMENT, C, 12" II, 9600                    | 1   |
| 12*  | 00-878805-01 | ASSEMBLY, FLIP-FLOP, 12" EXT, 9600           | 1   |

\* If replacing parts within item 12 (P/N 00-878805-01: Flip-Flop Assembly, 12" Ext, 9600), only the weldment (P/N 00-878813-01: Weldment, housing, Ext F/F) is different from the 9" II assembly.



Fig. 1 December 1995 Update SERIES9600 Mobile C-Arm 12" II Modifications

|      |              | FIG. 2 DECEMBER 1995 UPDATE PARTS LIST        |     |
|------|--------------|---|-----|
| ITEM | PART NUMBER  | DESCRIPTION                                   | QTY |
| 1    | 00-878803-01 | COVER, COLLIMATOR, 12" II, 9600               | 1   |
| 2    | 13-311108-00 | NUT, HEX-LOCK-EXT-T, 8-32, SST, NA, A = .344  | 4   |
| 3    | 14-121108-00 | WASHER, PL, #8 SST, NA, ID = .183, OD = .390  | 4   |
| 4    | 00-878872-01 | FILTER, COLLIMATOR, SECONDARY, 12'            | 1   |
| 5    | 00-901000-01 | COLLIMATOR, 12' (SCD)                         | 1   |
| 6    | 12-225108-12 | SCREW, SEMS SPRING, PAN, TORX, 8-32, 3/4, SZC | 4   |
| 7    | 00-877256-01 | CLAMP, COLLIMATOR, 9600                       | 4   |
| 8    | 00-877255-01 | PLATE, TOP, ALIGNMENT, 9600                   | 1   |
| 9    | 00-877254-01 | PLATE, MIDDLE, ALIGNMENT, 9600                | 1   |
| 10   | 00-877253-01 | PLATE, BOTTOM, ALIGNMENT, 9600                | 1   |
| 11   | 00-876567-01 | BUMPER, X-RAY MOUNT                           | 1   |
| 12   | 00-878802-01 | MOUNT, PLUG, X-RAY, 9600                      | 1   |
| 13   | 00-877322-01 | GASKET, X-RAY TUBE, 9600                      | 1   |
| 14   | 00-878863-01 | COLLIMATOR/FILTER, PRIMARY, 9600              | 1   |
| 15   | 00-875626-01 | GASKET, PRIMARY COLLIMATOR                    | 1   |
| 16   | 00-901001-01 | TUBE, X-RAY, 10 DEGREE (SCD)                  | 1   |
| 17   | 00-876975-01 | ASSEMBLY, TEMPERATURE, SENSOR, X-RAY          | 1   |
| 18   | 00-875607-01 | COVER, X-RAY CABLE                            | 1   |



Fig. 2 December 1995 Update SERIES9600 Mobile C-Arm 12" II Modifications

SERIES9600<sup>™</sup> Mobile C-Arm Illustrated Parts Manual Update Center Pivot Steering May 1996 (P/N 00-879203-01)

The Center Pivot Steering design replaces the Surgi-glide steering design and is standard on SERIES**9600** 9-inch Mobile C-Arms starting with system 69-2103 and 12-inch Mobile C-Arms starting with system 62-0003. The Center Pivot Steering design is also offered as an upgrade to systems that were built with the Surgiglide design. Different upgrades kits are available that are dependent on the serial number of the system. This update provides illustrated parts information for standard systems with Center Pivot Steering and systems that have been upgraded with Center Pivot Steering.

**Figure 1** - Illustrates the steering handle/mechanics and end caps that are common to all systems that have been built with Center Pivot Steering or upgraded to Center Pivot Steering.

**Figure 2** - Illustrates the heat sinks and electronic card rack modifications that are specific to systems with serial numbers 69-2000 and lower that have been upgraded with the Center Pivot Steering design.

**Figure 3** - Illustrates the heat sink and cross beam cover modifications that are specific to systems with serial numbers 69-2001 thru 69-2102 that have been upgraded with the Center Pivot Steering design.

**Figures 4 & 5** - Illustrate the remaining mechanical modifications that are common to all systems that have been built with Center Pivot Steering or upgraded to Center Pivot Steering.

Not all systems with serial numbers 69-0001 thru 69-2102 will be upgraded with Center Pivot Steering. If the Mobile C-Arm has castored rear wheels then the system has not been upgraded.

Review the contents to familiarize yourself with the new field replaceable parts. Place this update at the back of your Illustrated Parts Manual along with earlier updates that have been sent out.

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|      |              | FIG. 1 MAY 1996 UPDATE PARTS LIST                |     |
|------|--------------|--|-----|
| ITEM | PART NUMBER  | DESCRIPTION                                      | QTY |
| 1    | 00-878931-01 | HANDLE, REAR, RIGHT, GRIP                        | 1   |
| 2    | 21-180017-00 | FLANGED BEARING                                  | 2   |
| 3    | 00-878932-01 | HANDLE, REAR, LEFT, 9600                         | 1   |
| 4    | 00-878933-01 | HANDLE, REAR, RIGHT, STATIONARY                  | 1   |
| 5    | 00-879244-01 | ASSEMBLY, UPGRADE/FS, REAR COVER, 9600           | 1   |
| 6    | 00-878937-01 | SPACER, TUBE, REAR HANDLE                        | 1   |
| 7    | 00-901113-01 | UNIVERSAL JOINT, UPPER, STEERING, 9600           | 1   |
| 8    | 00-901101-00 | KEY, U-JOINT, .188 X 1 (NOT EXPLODED)            | 1   |
| 9    | 00-878938-01 | SHAFT, TILLER, UPPER STEERING                    | 1   |
| 10   | 12-313915-26 | SCREW, SHC, 5/16-18 X 1-3/4                      | 4   |
| 11   | 11-621117-12 | SCREW, SET, 5/16-18 X 3/4 ZINC                   | 4   |
| 12*  | 00-876569-01 | MACHINING, END CAP, CROSS BEAM                   | 2   |
| 13   | 00-879396-01 | SPACER, TRIM, PLASTIC, 9600 (NOT SHOWN/EXPLODED) | 2   |



Fig. 1 May 1996 Update Center Pivot Steering Modification Upgrade, All Systems

|      |              | FIG. 2 MAY 1996 UPDATE PARTS LIST            |     |
|------|--------------|--|-----|
| ITEM | PART NUMBER  | DESCRIPTION                                  | QTY |
| 1    | 00-878989-01 | BRACKET, MOUNTING, CARD RACK, STEERING, 9600 | 1   |
| 2    | 00-878990-01 | HINGE, CARD RACK, STEERING, 9600             | 1   |
| 3    | 00-878991-01 | HINGE, BRACKET, STEERING, UPGRADE            | 1   |
| 4    | 00-878988-01 | COVER, REAR, CARD RACK, STEERING, UPGRADE    | 1   |
| 5    | 00-901033-01 | PCA, MOTHERBOARD, 9600 (SCD)                 | 1   |
| 6    | 00-875939-02 | HEAT SINK, GENERATOR DRIVER                  | 1   |
| 7    | 00-900647-02 | INSULATOR, HEAT SINK, GENERATOR DRIVER       | 1   |
| 8    | 00-875940-01 | HEAT SINK, X-RAY REGULATOR                   | 1   |
| 9    | 20-209902-00 | SFT, DR, .1872 OD, 3.000 L, SST (NOT SHOWN)  | 1   |



Fig. 2 May 1996 Update Center Pivot Steering Modification Upgrade, Sytems 2000 and Under

| FIG. 3 MAY 1996 UPDATE PARTS LIST |              |                             |     |
|-----------------------------------|--------------|-----------------------------|-----|
| ITEM                              | PART NUMBER  | DESCRIPTION                 | QTY |
| 1                                 | 00-875940-01 | HEAT SINK, X-RAY REGULATOR  | 1   |
| 2                                 | 00-877948-05 | LABEL, PEDAL, REAR CASTER   | 2   |
| 3                                 | 00-876565-02 | COVER, ASSEMBLY, CROSS BEAM | 2   |

Note: Item 1 (P/N 00-875940-01: Heat Sink, X-Ray Regulator) is found on all SERIES**9600** Mobile C-Arm systems.



Fig. 3 May 1996 Update Center Pivot Steering Modification Upgrade, Sytems 2001 and Up

|      |              | FIG. 4 MAY 1996 UPDATE PARTS LIST           |     |
|------|--------------|---|-----|
| ITEM | PART NUMBER  | DESCRIPTION                                 | QTY |
| 1    | 00-876586-01 | ACTUATOR, SHAFT                             | 1   |
| 2    | 12-311114-12 | SCREW, NA, SKT, HEX, 1/4 X 20, 7/8, SZC, 8  | 6   |
| 3    | 00-876833-02 | PEDAL, REAR CASTER/BRAKE                    | 2   |
| 4    | 00-879012-01 | CAM, BRAKE, 9600                            | 2   |
| 5    | 00-879013-01 | SUPPORT, BEARING, BRAKE ROD, STEERING, 9600 | 2   |
| 6    | 00-878940-01 | CROSS, BEAM, CHASSIS                        | 1   |
| 7    | 14-900012-00 | WASHER, PLAIN, #10 ZN                       | 2   |
| 8    | 14-211110-00 | WASHER, HSL, #10 CAD/ZN                     | 2   |
| 9    | 12-313910-26 | SCREW, SHC, 10-24 X 1 3/4 SBO               | 2   |
| 10   | 00-879029-01 | CAP, BRAKE, PLUNGER, STEERING, 9600         | 2   |
| 11   | 21-301785-00 | NUT, LOCK, NT-07                            | 2   |
| 12   | 21-301782-00 | WASHER, LOCK, WT-07                         | 2   |
| 13   | 00-879115-01 | PLUNGER, BRAKE, ADJUSTER, STEERING, 9600    | 2   |
| 14   | 11-999963-00 | SCREW, SET, SKT, HEX                        | 2   |
| 15   | 00-878948-01 | PLUNGER, BRAKE, STEERING, 9600              | 2   |
| 16   | 21-709177-00 | SPRING, COMPRESSION                         | 2   |
| 17   | 00-878944-01 | SPROCKET, YOKE, STEERING, 9600              | 2   |
|      |              | FIG. 4 MAY 1996 UPDATE PARTS LIST (CONT)  |     |
|------|--------------|---|-----|
| ITEM | PART NUMBER  | DESCRIPTION                               | QTY |
| 18   | 21-119920-00 | BEARING, ROLLER CONE, TIMKIN L68149       | 4   |
| 19   | 21-119921-00 | BEARING, ROLLER, TAPERED CUP, L68111      | 4   |
| 21   | 00-878949-01 | SPACER, BEARING, YOKE, STEERING, 9600     | 2   |
| 21   | 00-878944-01 | SPROCKET, YOKE, STEERING, 9600            | 2   |
| 22   | 00-879044-01 | RING, WHEEL COVER, STEERING, 9600         | 2   |
| 23   | 00-878946-01 | HOUSING, BEARING, YOKE, STEERING, 9600    | 2   |
| 24   | 21-109940-00 | BEARING, BALL, RADIAL, BOST, 1616DS       | 2   |
| 25   | 21-139777-00 | BEARING, FLANGED, BUSH, IGUS, MFI-1416-12 | 2   |
| 26   | 21-139776-01 | BEARING, FLANGED, BUSH, IGUS, MFI-0810-12 | 2   |
| 27   | 00-878950-01 | WHEEL COVER, REAR, PLASTIC                | 2   |
| 28   | 00-876822-01 | DECAL, OEC LOGO                           | 4   |
| 29   | 00-878947-01 | YOKE, WHEEL, STEERING, 9600               | 2   |
| 30   | 00-901102-01 | KEY, REAR, STEERING, 9600                 | 2   |
| 31   | 12-333966-01 | SCREW, FHSC, 1/2-20 X 3                   | 2   |
| 32   | 00-901077-01 | WHEEL, 8" DARCOR, 408PL, GRAY THREAD      | 2   |
| 33   | 00-878951-01 | CABLE PUSHER, STEERING, 9600              | 4   |
| 34   | 00-879245-01 | KEY, BRAKE, CAM, 1/8 SQ (NOT SHOWN)       | 2   |

#### SERIES**9600 ™ Mobile C-Arm Illustrated Parts Manual**



Fig. 4 May 1996 Update Center Pivot Steering Modification Upgrade, All Systems

|      |              | FIG. 5 MAY 1996 UPDATE PARTS LIST            |     |
|------|--------------|--|-----|
| ITEM | PART NUMBER  | DESCRIPTION                                  | QTY |
| 1    | 20-842001-00 | COUPLING, CLIMAX, ISCC-062-062               | 1   |
| 2    | 00-879030-01 | SHAFT, TILLER, LOWER, STEERING, 9600         | 1   |
| 3    | 00-878939-01 | COUPLING, U-JOINT, MODIFY, CURTIS            | 1   |
| 4    | 12-225160-14 | SCREW, SEMS, TORX, SPRING, 10-32 X 7/8 ZN    | 4   |
| 5    | 00-879026-01 | HOUSING, BEARING, TILLER, STEERING, 9600     | 1   |
| 6    | 21-109586-00 | BEARING, BALL, RADIAL, CONSOLIDATED, 6190622 | 1   |
| 7    | 00-879116-01 | SUPPORT, BEARING, BRAKE ROD, FLAT, 9600      | 1   |
| 8    | 21-109947-00 | BEARING, BALL, RADIAL, BOST, 1623DC OR 2RS   | 1   |
| 9    | 00-879027-01 | SHAFT, TILLER, SHORT, STEERING, 9600         | 1   |
| 10   | 00-878942-01 | SPROCKET, DRIVE, STEERING, 9600              | 1   |
| 11   | 00-878945-01 | CAM, DETENT, STEERING, 9600                  | 1   |
| 12   | 19-224945-00 | PIN, SPRING, 1/4 X 1 ZN                      | 1   |
| 13   | 13-111114-00 | NUT, HEX, 1/4-20 CAD/ZN                      | 3   |
| 14   | 21-719997-00 | SPRING, EXT ASSOC E0360-055-225 OM           | 1   |
| 15   | 12-312014-12 | SCREW, SHC, 1/4-20 X 3/4 STNL                | 11  |
| 16   | 21-190062-00 | CAM, FOLLOWER, MCGILL, CF-5/8 SB             | 1   |
| 17   | 00-878952-01 | LEVER ARM, DETENT, STEERING, 9600            | 1   |

|      |              | FIG. 5 MAY 1996 UPDATE PARTS LIST (CONT) |     |
|------|--------------|--|-----|
| ITEM | PART NUMBER  | DESCRIPTION                              | QTY |
| 18   | 21-139743-00 | BEARING, BOSTON, FLANGED, FB68-8         | 1   |
| 19   | 12-999539-00 | SCREW, SHOULDER, 5/16-18 3/8 X 1-1/4 SBO | 1   |
| 21   | 21-128814-00 | BEARING, NEEDLE, TORR, BH-812            | 2   |
| 21   | 21-128919-00 | BEARING, THRUST WASHER                   | 4   |
| 22   | 00-878943-01 | SPROCKET, IDLER, STEERING, 9600          | 2   |
| 23   | 12-999545-00 | SCREW, SHOULDER, 1/2 X 1-1/4             | 2   |
| 24   | 14-900012-00 | WASHER, PLAIN, #10 ZN                    | 5   |
| 25   | 14-211110-00 | WASHER, HSL, #10 CAD/ZN                  | 5   |
| 26   | 12-313910-12 | SCREW, SHC, 10-24 X 3/4                  | 3   |
| 27   | 00-879162-01 | CHAIN, STEERING, SHORT, 9600             | 1   |
| 28   | 00-879147-01 | TURNBUCKLE, LEFT HAND                    | 2   |
| 29   | 00-879145-01 | TURNBUCKLE, BODY                         | 2   |
| 30   | 13-121164-00 | NUT, HEX, 1/4-28 CAD/ZN                  | 2   |
| 31   | 00-879146-01 | TURNBUCKLE, RIGHT HAND                   | 2   |
| 32   | 20-500003-00 | CONNECTING LINK, #35 SPRING CLIP         | 4   |
| 33   | 00-878953-01 | CHAIN, STEERING, LONG, 9600              | 1   |

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Fig. 5 May 1996 Update Center Pivot Steering Modification Upgrade, All Systems

# SERIES**9600**™

## Imaging Workstation Illustrated Parts Manual



(PN 00-876789-02)

This manual contains information on the SERIES**9600** Imaging Workstation. It should serve as an aid to field service engineers and technicians in locating parts and identifying part numbers. It is not a complete parts list and should not be used as a substitute for a bill of materials. Furthermore, product changes and improvements may occur at any time and these changes may not be reflected in this manual.

Removing or installing parts should not be attempted by anyone who is not specifically trained by OEC Medical Systems, Inc. to work on the SERIES**9600** Imaging Workstation System.

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The SERIES**9600** Mobile Digital Imaging System is manufactured under the following US patents: 4.768.216; 4.797.907; and 4.209.706. Other patents pending.

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## **Revision History**

| <u>Rev</u> | <u>Dash</u> | Date          | Change Description  |
|------------|-------------|---------------|---|
| A          | -01         | March, 1994   | Release   |
| В          | -02         | January, 1995 | Document batch release changes to SERIES9600 Mobile Imaging System. |

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## Section 3: SERIES9600 Imaging Workstation Illustrated Parts Manual Updates

## Update July 1995

| Fig. | 1 July 1995 |  |
|------|-------------|--|
|------|-------------|--|

## Introduction

#### Who Should Use This Manual

This manual is intended for the properly trained engineer or technician who designs, installs, maintains or calibrates the OEC Medical Systems, Inc. SERIES**9600** Imaging Workstation System.

#### How This Manual is Organized

This manual is organized into sections. Section 1 contains information on replaceable parts for systems with serial numbers 69-001 thru 69-999. Section 2 contains information on replaceable parts for systems with serial numbers 69-1000 and up.

Both sections of this manual provide exploded view illustrations, lists, and descriptions of replaceable parts necessary for repair of the Imaging Workstation System.

A list of attaching hardware parts have been included for part number reference in the event reordering is necessary located at the back of the manual.

#### **Contacting Technical Support**

For assistance with part number changes, contact Technical Support at US 1-800-874-7378, Europe 41 1 811 07 70, others 1-801-536-4688.

**Note:** The item numbers on the illustrations do not match the item numbers on the assembly drawings or the item numbers on the Bills of Materials.

## **Section 1**



SERIES9600 Imaging Workstation

|      | FIG. 1-1 PARTS LIST |   |     |  |
|------|---------------------|---|-----|--|
| ITEM | PART NUMBER         | DESCRIPTION                                       | QTY |  |
| 1    | 00-875986-01        | COVER, SIDE, LOWER, LEFT                          | 1   |  |
| 2    | 00-876466-01        | HANDLE, MONITOR CART (NOT EXPLODED)               | 2   |  |
| 3    | 00-875981-01        | COVER, SIDE, UPPER LEFT (NOT EXPLODED)            | 1   |  |
| 4    | 00-876746-01        | KIT, VTR, SONY 9500 MD4, 60HZ W/CBL               | 1   |  |
| 5    | 00-875986-02        | COVER, SIDE, LOWER, RIGHT                         | 1   |  |
| 6    | 00-876285-01        | BRACKET, MOUNTING, LENZAR CAMERA                  | 1   |  |
| 7    | 00-877592-01        | BRACKET, MOUNTING, LENZAR CAMERA, LOW (NOT SHOWN) | 1   |  |
| 8    | 00-876544-01        | CABLE ASSEMBLY, KEY SWITCH TO P15                 | 1   |  |
| 9    | 00-875987-02        | COVER, FRONT PANEL, LENZAR                        | 1   |  |
| 10   | 00-900640-01        | PANEL ASSEMBLY, CONTROL, LENZAR, ENGLISH, 9600    | 1   |  |
| 10   | 00-900640-02        | PANEL ASSEMBLY, CONTROL, LENZAR, GERMAN, 9600     | 1   |  |
| 10   | 00-900640-03        | PANEL ASSEMBLY, CONTROL, LENZAR, FRENCH, 9600     | 1   |  |
| 10   | 00-900640-04        | PANEL ASSEMBLY, CONTROL, LENZAR, SPANISH, 9600    | 1   |  |
| 10   | 00-900640-05        | PANEL ASSEMBLY, CONTROL, LENZAR, ITALIAN, 9600    | 1   |  |
| 11   | 00-874026-06        | ASSEMBLY, IR REMOTE CONTROL VAS, 4 GEN            | 1   |  |
| 12   | 00-877611-01        | ASSEMBLY, IR REMOTE CONTROL, ENGLISH              | 1   |  |
| 12   | 00-877611-03        | ASSEMBLY, IR REMOTE CONTROL, GERMAN               | 1   |  |
| 12   | 00-877611-04        | ASSEMBLY, IR REMOTE CONTROL, FRENCH               | 1   |  |
| 12   | 00-877611-05        | ASSEMBLY, IR REMOTE CONTROL, SPANISH              | 1   |  |
| 12   | 00-877611-07        | ASSEMBLY, IR REMOTE CONTROL, ITALIAN              | 1   |  |

|      | FIG. 1-1 PARTS LIST (CONT.) |   |     |  |
|------|-----------------------------|---|-----|--|
| ITEM | PART NUMBER                 | DESCRIPTION   | QTY |  |
| 13   | 00-878031-01                | ASSEMBLY, IR REMOTE CONTROL, 9600, ENGLISH          | 1   |  |
| 13   | 00-878031-02                | ASSEMBLY, IR REMOTE CONTROL, 9600, GERMAN           | 1   |  |
| 13   | 00-878031-03                | ASSEMBLY, IR REMOTE CONTROL, 9600, FRENCH           | 1   |  |
| 13   | 00-878031-04                | ASSEMBLY, IR REMOTE CONTROL, 9600, SPANISH          | 1   |  |
| 13   | 00-878031-05                | ASSEMBLY, IR REMOTE CONTROL, 9600, ITALIAN          | 1   |  |
| 14   | 00-876161-01                | KIT, LENZAR, 60HZ, ENGLISH, 9600                    | 1   |  |
| 15   | 00-900666-01                | CAMERA, LENZAR, 60HZ (NOT EXPLODED)                 | 1   |  |
| 16   | 00-875981-02                | COVER, SIDE, UPPER, RIGHT (NOT EXPLODED/SHOWN)      | 1   |  |
| 17   | 00-876747-01                | KIT, VTR, SONY 9510 MDP4, 50HZ W/CBL (NOT SHOWN)    | 1   |  |
| 18   | 00-900585-01                | RECORDER, SONY VIDEO TAPE 1/2" 60HZ (NOT SHOWN)     | 1   |  |
| 19   | 00-900585-02                | RECORDER, SONY VIDEO TAPE 1/2" 50HZ (NOT SHOWN)     | 1   |  |
| 20   | 00-900267-01                | TAPE, VIDEO, 1/2" (NOT SHOWN)                       | AR  |  |
| 21   | 00-876748-01                | ASSEMBLY, OPTION, THERMAL IMAGER (NOT SHOWN)        | 1   |  |
| 22   | 00-900394-01                | PRINTER, THERMAL IMAGING (NOT SHOWN)                | 1   |  |
| 23   | 00-876178-01                | ASSEMBLY, CRATE, WORKSTATION, 9600/2600 (NOT SHOWN) | 1   |  |



Fig. 1-1 ESP (Expanded Surgical Package) Exploded Front View

|      | FIG. 1-2 PARTS LIST |  |     |  |
|------|---------------------|--|-----|--|
| ITEM | PART NUMBER         | DESCRIPTION                                    | QTY |  |
| 1    | 00-875986-01        | COVER, SIDE, LOWER, LEFT                       | 1   |  |
| 2    | 00-876466-01        | HANDLE, MONITOR CART (NOT EXPLODED)            | 2   |  |
| 3    | 00-875981-01        | COVER, SIDE, UPPER, LEFT (NOT EXPLODED)        | 1   |  |
| 4    | 00-875986-02        | COVER, SIDE, LOWER, RIGHT                      | 1   |  |
| 5    | 00-876544-01        | CABLE ASSEMBLY, KEY SWITCH TO P15              | 1   |  |
| 6    | 00-875987-01        | COVER, FRONT PANEL                             | 1   |  |
| 7    | 00-875992-01        | COVER, SHELF, LOWER (NOT EXPLODED)             | 1   |  |
| 8    | 00-875991-01        | COVER, SHELF, UPPER (NOT EXPLODED)             | 1   |  |
| 9    | 00-875981-02        | COVER, SIDE, UPPER, RIGHT (NOT EXPLODED/SHOWN) | 1   |  |



Fig. 1-2 SP (Surgical Platform) Model Exploded Front View

| FIG. 1-3 PARTS LIST |              |  |     |
|---------------------|--------------|--|-----|
| ITEM                | PART NUMBER  | DESCRIPTION                                    | QTY |
| 1                   | 00-876786-01 | ASSEMBLY, PCB, SURGE SUPPRESSER                | 1   |
| 2                   | 00-900712-01 | TRANSFORMER, ISOLATION WORKSTATION             | 1   |
| 3                   | 66-235026-00 | RECTIFIER, SILICON BRIDGE, 100PRV, 30A         | 2   |
| 4                   | 78-590390-00 | POWER SUPPLY, MOD +24 VDC                      | 1   |
| 5                   | 55-700452-00 | CIRCUIT, BREAKER, 10A DPST 125, 250 VAC, PANEL | 1   |
| 6                   | 00-877037-01 | BRACKET, MOUNTING, CIRCUIT BREAKER             | 1   |
| 7                   | 00-876549-01 | ASSEMBLY, PCB, POWER CONTROL                   | 1   |
| 8                   | 56-996209-01 | TERMINAL BLOCK, PANEL 4 POS, 26-12 AWG, 20A    | 1   |
| 9                   | 56-996214-00 | JUMPER, TERMINAL BLOCK                         | 1   |
| 10                  | 56-996215-00 | TERMINAL BLOCK, END PLATE, 26-12 AWG           | 1   |



Fig. 1-3 Power Control Panel, Transformer, PCB Assy Surge Suppresser Exploded View

| FIG. 1-4 PARTS LIST |              |  |     |
|---------------------|--------------|--|-----|
| ITEM                | PART NUMBER  | DESCRIPTION                                    | QTY |
| 1                   | 55-700452-00 | CIRCUIT BREAKER, 10A, DPST 125, 250 VAC, PANEL | 2   |
| 2                   | 00-876469-01 | BRACKET, INTERCONNECT                          | 1   |
| 3                   | 00-876183-01 | CABLE ASSEMBLY, INTERCONNECT, 20', 9600        | 1   |
| 4                   | 00-876183-02 | CABLE ASSEMBLY, INTERCONNECT, 30', 9600        | 1   |
| 5                   | 20-839918-00 | FAN, SXL, 115 VAC, 115 CFM, 3200 RPM           | 1   |
| 6                   | 20-839926-00 | GUARD, FINGER, FAN                             | 1   |
| 7                   | 00-875990-01 | COVER, REAR PANEL                              | 1   |
| 8                   | 00-876468-01 | BRACKET, POWER CORD                            | 1   |
| 9                   | 00-876180-01 | ASSEMBLY, POWER CORD, 100-127V, 20 FT, 9600    | 2   |
| 10                  | 00-876181-01 | ASSEMBLY, POWER CORD, 220-250V, 20 FT, 9600    | 1   |
| 10                  | 00-876181-02 | ASSEMBLY, POWER CORD, 220-250V, 30 FT, 9600    | 1   |
| 11                  | 00-876182-01 | ASSEMBLY, POWER CORD, 220V, 60 HZ, 20', 9600   | 1   |
| 12                  | 67-430001-00 | IND, LAMP, NE, 110V, GREEN                     | 1   |
| 13                  | 56-299702-00 | TERMINAL STRIP, PANEL, 3 POS, 380V             | 1   |
| 14                  | 00-875981-02 | COVER, SIDE, UPPER RIGHT (NOT EXPLODED)        | 1   |
| 15                  | 27-590972-00 | FILTER, AIR, FRAMELESS, 6 X 6 X .188           | 1   |



Fig. 1-4 Rear Panel, Fan, Power Cord Assy, Interconnect Cable Assy Exploded View

| FIG. 1-5 PARTS LIST |              |   |     |
|---------------------|--------------|---|-----|
| ITEM                | PART NUMBER  | DESCRIPTION   | QTY |
| 1                   | 00-900657-03 | MONITOR, FAST SCAN, 16"   | 2   |
| 2                   | 00-875983-01 | HOUSING, MONITOR  | 1   |
| 3                   | 00-877124-01 | BRACE, BEZEL  | 1   |
| 4                   | 00-876470-01 | BRACKET, IR RECEIVER  | 1   |
| 5                   | 00-874222-04 | ASSEMBLY, PCB, IR RECEIVER 9600                                     | 1   |
| 6                   | 00-900751-01 | LAMP, X-RAY ON (SCD)  | 1   |
| 7                   | 00-875982-01 | BEZEL, MONITOR (NOT EXPLODED)                                       | 1   |
| 8                   | 00-876541-01 | CABLE ASSEMBLY, CONT/BRT POTS                                       | 1   |
| 9                   | 00-876541-02 | CABLE ASSEMBLY, CONT/BRT POTS                                       | 1   |
| 10                  | 00-876471-02 | BRACKET, B/C MOUNTING   | 1   |
| 11                  | 00-877009-03 | ASSEMBLY, OUTLET STRIP, INTL AC (120V AC 50/60 Hz, 240V AC 50/60Hz) | 1   |
| 11                  | 00-877009-04 | ASSEMBLY, OUTLET STRIP, INTL AC (115V AC 50/60 Hz, 230V AC 50/60Hz) | 1   |
| 12                  | 00-900792-01 | PCA, DEFLECTION, MONITOR (SCD)                                      | 2   |
| 13                  | 00-876353-01 | ASSEMBLY, PCB, HI SCAN BRGTS/CTRS CONT                              | 1   |
| 14                  | 00-874661-01 | LENS, FRONT, COLORED (NOT EXPLODED/SHOWN)                           | 1   |
| 15                  | 00-874661-02 | LENS, FRONT, CLEAR (NOT EXPLODED/SHOWN)                             | 1   |



Fig. 1-5 Monitor Rear View Exploded View

| FIG. 1-6 PARTS LIST |              |   |     |
|---------------------|--------------|---|-----|
| ITEM                | PART NUMBER  | DESCRIPTION   | QTY |
| 1                   | 00-875984-01 | COVER, BASE   | 1   |
| 2                   | 00-900696-01 | CASTER, LOCK, 5" (SCD)                              | 2   |
| 3                   | 00-876702-01 | PEDAL, BRAKE  | 1   |
| 4                   | 00-876624-01 | BAR, BRAKE  | 2   |
| 5                   | 00-900695-01 | CASTER, SWIVEL, 5" (SCD)                            | 2   |
| 6                   | 21-709008-00 | SPRING, COMPRESSION, .420 OD, .750 LG, .042 WD, SST | 2   |



Fig. 1-6 Brake, Caster Exploded View

| FIG. 1-7 PARTS LIST |              |   |     |
|---------------------|--------------|---|-----|
| ITEM                | PART NUMBER  | DESCRIPTION                                 | QTY |
| 1                   | 00-876504-01 | ASSEMBLY, PCB, AUX INTERFACE, 9600          | 1   |
| 2                   | 00-872239-01 | ASSEMBLY, PCB, VIDEO SWITCHING 4 GEN        | 1   |
| 3                   | 67-700000-00 | METER, ELEC, DC, HR/TNTS, 6 DIGIT           | 1   |
| 4                   | 00-900689-01 | POWER, SUPPLY, QUAD OUTPUT (SCD)            | 1   |
| 5                   | 00-876841-01 | ASSEMBLY, PCB, DC POWER DIST, 9600          | 1   |
| 6                   | 20-839956-00 | FAN, AXL, 115 VAC, 75 CFM, 2200 RPM         | 2   |
| 7                   | 20-839926-00 | GUARD, FINGER, FAN                          | 2   |
| 8                   | 00-876995-01 | MOUNT, HARD DRIVE MON CART                  | 1   |
| 9                   | 00-875954-01 | ASSEMBLY, PCB, IMAGE PROCESSOR, SMT         | 1   |
| 10                  | 00-876399-02 | ASSEMBLY, PCB, FAST SCAN CONVERTER          | 1   |
| 11                  | 00-872127-04 | ASSEMBLY, PCB, COMMUNICATIONS 4 GEN         | 1   |
| 12                  | 00-900658-01 | PCA, MOTHERBOARD, 386 (SCD)                 | 1   |
| 13                  | 00-900669-01 | DRIVE FLOPPY DISK, 3.5", 1.44 MB            | 1   |
| 14                  | 00-877024-01 | DISK, FORMATTED, DISK DRIVE, 42 MB          | 1   |
| 15                  | 00-876712-01 | MOUNT, MOTHERBOARD, 9600 (NOT SHOWN)        | 1   |
| 16                  | 00-876284-01 | BRACKET, MOUNTING, FLOPPY DRIVE (NOT SHOWN) | 1   |



Fig. 1-7 Electronic Rack, Generic Exploded View

| FIG. 1-8 PARTS LIST |              |   |     |
|---------------------|--------------|---|-----|
| ITEM                | PART NUMBER  | DESCRIPTION                                 | QTY |
| 1                   | 00-876504-01 | ASSEMBLY, PCB, AUX INTERFACE, 9600          | 1   |
| 2                   | 00-872239-01 | ASSEMBLY, PCB, VIDEO SWITCHING 4 GEN        | 1   |
| 3                   | 00-876536-01 | CABLE ASSEMBLY, POWER ETI                   | 1   |
| 4                   | 00-900689-01 | POWER, SUPPLY, QUAD OUTPUT (SCD)            | 1   |
| 5                   | 00-876841-01 | ASSEMBLY, PCB, DC POWER DIST, 9600          | 1   |
| 6                   | 20-839956-00 | FAN, AXL, 115 VAC, 75 CFM, 2200 RPM         | 2   |
| 7                   | 20-839926-00 | GUARD, FINGER, FAN                          | 2   |
| 8                   | 00-876995-01 | MOUNT, HARD DRIVE MON CART                  | 1   |
| 9                   | 00-875954-01 | ASSEMBLY, PCB, IMAGE PROCESSOR, SMT         | 1   |
| 10                  | 00-876399-02 | ASSEMBLY, PCB, FAST SCAN CONVERTER          | 1   |
| 11                  | 00-872127-04 | ASSEMBLY, PCB, COMMUNICATIONS 4 GEN         | 1   |
| 12                  | 00-900658-01 | PCA, MOTHERBOARD, 386 (SCD)                 | 1   |
| 13                  | 00-900669-01 | DRIVE FLOPPY DISK, 3.5", 1.44 MB            | 1   |
| 14                  | 00-877025-01 | DISK, FORMATTED, DISK DRIVE, SCSI           | 1   |
| 15                  | 0-878229-01  | DISK CONT, TESTED ALTA                      | 1   |
| 16                  | 00-900659-01 | DISK CONTROLLER, SCSI (SCD)                 | 1   |
| 17                  | 00-876712-01 | MOUNT, MOTHERBOARD, 9600 (NOT SHOWN)        | 1   |
| 18                  | 00-876284-01 | BRACKET, MOUNTING, FLOPPY DRIVE (NOT SHOWN) | 1   |



Fig. 1-8 Electronic Rack, ESP with 4 FPS Storage Exploded View

| FIG. 1-9 PARTS LIST |              |   |     |
|---------------------|--------------|---|-----|
| ITEM                | PART NUMBER  | DESCRIPTION                                 | QTY |
| 1                   | 00-876504-01 | ASSEMBLY, PCB, AUX INTERFACE, 9600          | 1   |
| 2                   | 00-872239-01 | ASSEMBLY, PCB, VIDEO SWITCHING 4 GEN        | 1   |
| 3                   | 00-876536-01 | CABLE ASSEMBLY, POWER ETI                   | 1   |
| 4                   | 00-900689-01 | POWER, SUPPLY, QUAD OUTPUT (SCD)            | 1   |
| 5                   | 00-876841-01 | ASSEMBLY, PCB, BC POWER DIST, 9600          | 1   |
| 6                   | 20-839956-00 | FAN, AXL, 115 VAC, 75 CFM, 2200 RPM         | 2   |
| 7                   | 20-839926-00 | GUARD, FINGER, FAN                          | 2   |
| 8                   | 00-876995-01 | MOUNT, HARD DRIVE MON CART                  | 1   |
| 9                   | 00-875954-01 | ASSEMBLY, PCB, IMAGE PROCESSOR, SMT         | 1   |
| 10                  | 00-876399-02 | ASSEMBLY, PCB, FAST SCAN CONVERTER          | 1   |
| 11                  | 00-872127-04 | ASSEMBLY, PCB, COMMUNICATIONS 4 GEN         | 1   |
| 12                  | 00-900658-01 | PCA, MOTHERBOARD, 386 (SCD)                 | 1   |
| 13                  | 00-900669-01 | DRIVE FLOPPY DISK, 3.5", 1.44 MB            | 1   |
| 14                  | 00-878230-01 | ASSEMBLY, DISK DRIVE, 30 FPS, FORMATTED     | 2   |
| 15                  | 0-878229-01  | DISK CONT, TESTED ALTA                      | 2   |
| 16                  | 00-900659-01 | DISK CONTROLLER, SCSI (SCD)                 | 1   |
| 17                  | 00-876712-01 | MOUNT, MOTHERBOARD, 9600 (NOT SHOWN)        | 1   |
| 18                  | 00-876284-01 | BRACKET, MOUNTING, FLOPPY DRIVE (NOT SHOWN) | 1   |



Fig. 1-9 Electronic Rack, Vascular with 30 FPS Storage Exploded View

| FIG. 1-10 PARTS LIST |              |   |     |
|----------------------|--------------|---|-----|
| ITEM                 | PART NUMBER  | DESCRIPTION                                       | QTY |
| 1                    | 00-875988-01 | COVER, KEYBOARD, TOP                              | 1   |
| 2                    | 00-900769-01 | PANEL ASSEMBLY, CONTROL, CART SP, 9600 (ENGLISH)  | 1   |
| 2                    | 00-900769-02 | PANEL ASSEMBLY, CONTROL, CART SP, 9600 (GERMAN)   | 1   |
| 2                    | 00-900769-03 | PANEL ASSEMBLY, CONTROL, CART SP, 9600 (FRENCH)   | 1   |
| 2                    | 00-900769-04 | PANEL ASSEMBLY, CONTROL, CART SP, 9600 (SPANISH)  | 1   |
| 2                    | 00-900769-05 | PANEL ASSEMBLY, CONTROL, CART SP, 9600 (ITALIAN)  | 1   |
| 3                    | 00-900641-01 | PANEL ASSEMBLY, QWERTY KEYBOARD ENGLISH 96        | 1   |
| 4                    | 00-900772-01 | PANEL ASSEMBLY, CONTROL, FRONT SP, 9600 (ENGLISH) | 1   |
| 4                    | 00-900772-02 | PANEL ASSEMBLY, CONTROL, FRONT SP, 9600 (GERMAN)  | 1   |
| 4                    | 00-900772-03 | PANEL ASSEMBLY, CONTROL, FRONT SP, 9600 (FRENCH)  | 1   |
| 4                    | 00-900772-04 | PANEL ASSEMBLY, CONTROL, FRONT SP, 9600 (SPANISH) | 1   |
| 4                    | 00-900772-05 | PANEL ASSEMBLY, CONTROL, FRONT SP, 9600 (ITALIAN) | 1   |
| 5                    | 00-876767-01 | ASSEMBLY, ALARM, AUDIO                            | 1   |
| 6                    | 00-877670-01 | COVER, BOX, RFI, 9600 WS                          |     |
| 7                    | 00-876613-01 | ASSEMBLY, PCB, CONT PANEL PROC, 9600 MC           | 1   |
| 8                    | 00-877671-01 | BASE, BOX, RFI., 9600 WS                          | 1   |
| 9                    | 00-876224-01 | NAMEPLATE, PRODUCT, 9600 (NOT EXPLODED)           | 1   |
| 10                   | 00-876533-01 | CABLE ASSEMBLY, QW-CPP (NOT SHOWN)                | 1   |
| 11                   | 00-876693-01 | CABLE ASSEMBLY, FRONT PANEL-CPP (NOT SHOWN)       | 1   |
| 12                   | 00-876538-01 | CABLE ASSEMBLY, CONTROL PANEL TO CPP (NOT SHOWN)  | 1   |



Fig. 1-10 Keyboard, SP (Surgical Platform) Model Exploded View

| FIG. 1-11 PARTS LIST |              |   |     |
|----------------------|--------------|---|-----|
| ITEM                 | PART NUMBER  | DESCRIPTION   | QTY |
| 1                    | 00-875988-01 | COVER, KEYBOARD, TOP                                | 1   |
| 2                    | 00-900768-01 | PANEL ASSEMBLY, CONTROL, CART ESP, 9600 (ENGLISH)   | 1   |
| 2                    | 00-900768-02 | PANEL ASSEMBLY, CONTROL, CART ESP, 9600 (GERMAN)    | 1   |
| 2                    | 00-900768-03 | PANEL ASSEMBLY, CONTROL, CART ESP, 9600 (FRENCH)    | 1   |
| 2                    | 00-900768-04 | PANEL ASSEMBLY, CONTROL, CART ESP, 9600 (SPANISH)   | 1   |
| 2                    | 00-900768-05 | PANEL ASSEMBLY, CONTROL, CART ESP, 9600 (ITALIAN)   | 1   |
| 3                    | 00-900641-01 | PANEL ASSEMBLY, QWERTY KEYBOARD ENGLISH 96          | 1   |
| 4                    | 00-900771-01 | PANEL ASSEMBLY, FRONT, ESP, ESP/4F, 9600 (ENGLISH)  | 1   |
| 4                    | 00-900771-02 | PANEL ASSEMBLY, FRONT, ESP, ESP/ACQ, 9600 (GERMAN)  | 1   |
| 4                    | 00-900771-03 | PANEL ASSEMBLY, FRONT, ESP, ESP/ACQ, 9600 (FRENCH)  | 1   |
| 4                    | 00-900771-04 | PANEL ASSEMBLY, FRONT, ESP, ESP/ACQ, 9600 (SPANISH) | 1   |
| 4                    | 00-900771-05 | PANEL ASSEMBLY, FRONT, ESP, ESP/ACQ, 9600 (ITALIAN) | 1   |
| 5                    | 00-876767-01 | ASSEMBLY, ALARM, AUDIO                              | 1   |
| 6                    | 00-877670-01 | COVER, BOX, RFI, 9600 WS                            |     |
| 7                    | 00-876613-01 | ASSEMBLY, PCB, CONT PANEL PROC, 9600 MC             | 1   |
| 8                    | 00-877671-01 | BASE, BOX, RFI., 9600 WS                            | 1   |
| 9                    | 00-876224-01 | NAMEPLATE, PRODUCT, 9600 (NOT EXPLODED)             | 1   |
| 10                   | 00-876533-01 | CABLE ASSEMBLY, QW-CPP (NOT SHOWN)                  | 1   |
| 11                   | 00-876693-01 | CABLE ASSEMBLY, FRONT PANEL-CPP (NOT SHOWN)         | 1   |
| 12                   | 00-876538-01 | CABLE ASSEMBLY, CONTROL PANEL TO CPP (NOT SHOWN)    | 1   |



Fig. 1-11 Keyboard, ESP/Cholangiography Model Exploded View
| FIG. 1-12 PARTS LIST |              |   |     |
|----------------------|--------------|---|-----|
| ITEM                 | PART NUMBER  | DESCRIPTION   | QTY |
| 1                    | 00-875988-01 | COVER, KEYBOARD, TOP                                  | 1   |
| 2                    | 00-900767-01 | PANEL ASSEMBLY, CONTROL, CART ESP/4F, 9600 (ENGLISH)  | 1   |
| 2                    | 00-900767-02 | PANEL ASSEMBLY, CONTROL, CART ESP/ACQ, 9600 (GERMAN)  | 1   |
| 2                    | 00-900767-03 | PANEL ASSEMBLY, CONTROL, CART ESP/ACQ, 9600 (FRENCH)  | 1   |
| 2                    | 00-900767-04 | PANEL ASSEMBLY, CONTROL, CART ESP/ACQ, 9600 (SPANISH) | 1   |
| 2                    | 00-900767-05 | PANEL ASSEMBLY, CONTROL, CART ESP/ACQ, 9600 (ITALIAN) | 1   |
| 3                    | 00-900641-01 | PANEL ASSEMBLY, QWERTY KEYBOARD ENGLISH 9600          | 1   |
| 4                    | 00-900771-01 | PANEL ASSEMBLY, FRONT, ESP & ESP/4F, 9600 (ENGLISH)   | 1   |
| 4                    | 00-900771-02 | PANEL ASSEMBLY, FRONT, ESP & ESP/ACQ, 9600 (GERMAN)   | 1   |
| 4                    | 00-900771-03 | PANEL ASSEMBLY, FRONT, ESP & ESP/ACQ, 9600 (FRENCH)   | 1   |
| 4                    | 00-900771-04 | PANEL ASSEMBLY, FRONT, ESP & ESP/ACQ, 9600 (SPANISH)  | 1   |
| 4                    | 00-900771-05 | PANEL ASSEMBLY, FRONT, ESP & ESP/ACQ, 9600 (ITALIAN)  | 1   |
| 5                    | 00-876767-01 | ASSEMBLY, ALARM, AUDIO                                | 1   |
| 6                    | 00-877670-01 | COVER, BOX, RFI, 9600 WS                              |     |
| 7                    | 00-876613-01 | ASSEMBLY, PCB, CONT PANEL PROC, 9600 MC               | 1   |
| 8                    | 00-877671-01 | BASE, BOX, RFI., 9600 WS                              | 1   |
| 9                    | 00-876224-01 | NAMEPLATE, PRODUCT, 9600 (NOT EXPLODED)               | 1   |
| 10                   | 00-876533-01 | CABLE ASSEMBLY, QW-CPP (NOT SHOWN)                    | 1   |
| 11                   | 00-876693-01 | CABLE ASSEMBLY, FRONT PANEL-CPP (NOT SHOWN)           | 1   |
| 12                   | 00-876538-01 | CABLE ASSEMBLY, CONTROL PANEL TO CPP (NOT SHOWN)      | 1   |



Fig. 1-12 Keyboard, ESP/Acquire Model Exploded View

| FIG. 1-13 PARTS LIST |              |   |     |
|----------------------|--------------|---|-----|
| ITEM                 | PART NUMBER  | DESCRIPTION                                       | QTY |
| 1                    | 00-875988-01 | COVER, KEYBOARD, TOP                              | 1   |
| 2                    | 00-900766-01 | PANEL ASSEMBLY, CONTROL, CART VAS, 9600 (ENGLISH) | 1   |
| 2                    | 00-900766-02 | PANEL ASSEMBLY, CONTROL, CART VAS, 9600 (GERMAN)  | 1   |
| 2                    | 00-900766-03 | PANEL ASSEMBLY, CONTROL, CART VAS, 9600 (FRENCH)  | 1   |
| 2                    | 00-900766-04 | PANEL ASSEMBLY, CONTROL, CART VAS, 9600 (SPANISH) | 1   |
| 2                    | 00-900766-05 | PANEL ASSEMBLY, CONTROL, CART VAS, 9600 (ITALIAN) | 1   |
| 3                    | 00-900641-01 | PANEL ASSEMBLY, QWERTY KEYBOARD ENGLISH 96        | 1   |
| 4                    | 00-900770-01 | PANEL ASSEMBLY, CONTROL, FRONT, VAS, (ENGLISH)    | 1   |
| 4                    | 00-900770-02 | PANEL ASSEMBLY, CONTROL, FRONT, VAS, (GERMAN)     | 1   |
| 4                    | 00-900770-03 | PANEL ASSEMBLY, CONTROL, FRONT, VAS, (FRENCH)     | 1   |
| 4                    | 00-900770-04 | PANEL ASSEMBLY, CONTROL, FRONT, VAS, (SPANISH)    | 1   |
| 4                    | 00-900770-05 | PANEL ASSEMBLY, CONTROL, FRONT, VAS, (ITALIAN)    | 1   |
| 5                    | 00-876767-01 | ASSEMBLY, ALARM, AUDIO                            | 1   |
| 6                    | 00-877670-01 | COVER, BOX, RFI, 9600 WS                          |     |
| 7                    | 00-876613-01 | ASSEMBLY, PCB, CONT PANEL PROC, 9600 MC           | 1   |
| 8                    | 00-877671-01 | BASE, BOX, RFI., 9600 WS                          | 1   |
| 9                    | 00-876224-01 | NAMEPLATE, PRODUCT, 9600 (NOT EXPLODED)           | 1   |
| 10                   | 00-876533-01 | CABLE ASSEMBLY, QW-CPP (NOT SHOWN)                | 1   |
| 11                   | 00-876693-01 | CABLE ASSEMBLY, FRONT PANEL-CPP (NOT SHOWN)       | 1   |
| 12                   | 00-876538-01 | CABLE ASSEMBLY, CONTROL PANEL TO CPP (NOT SHOWN)  | 1   |



Fig. 1-13 Keyboard, ESP Vascular, Neuro-Vascular Model Exploded View

|      | FIG. 1-14A PARTS LIST |   |     |  |
|------|-----------------------|---|-----|--|
| ITEM | PART NUMBER           | DESCRIPTION                               | QTY |  |
| 1    | 00-876538-01          | CABLE ASSEMBLY, CONTROL PANEL TO CPP      | 1   |  |
| 2    | 00-876533-01          | CABLE ASSEMBLY, QW-CPP                    | 1   |  |
| 3    | 00-876693-01          | CABLE ASSEMBLY, FRONT PANEL-CPP           | 1   |  |
| 4    | 00-876846-04          | CABLE ASSEMBLY, GROUND, CONT PANELS, 9600 | 1   |  |
| 5    | 00-876846-05          | CABLE ASSEMBLY, GROUND, CONT PANELS, 9600 | 1   |  |
| 6    | 00-876846-06          | CABLE ASSEMBLY, GROUND, CONT PANELS, 9600 | 1   |  |
| 7    | 00-876530-01          | CABLE ASSEMBLY, CPP/REM CONT/X-RAY ON     | 3   |  |
| 8    | 00-876770-01          | CABLE ASSEMBLY, X-RAY ON LAMP             | 1   |  |
| 9    | 00-876767-01          | ASSEMBLY, ALARM, AUDIO                    | 1   |  |
| 10   | 00-876541-01          | CABLE ASSEMBLY, CONT/BRT POTS             | 2   |  |
| 11   | 00-876541-02          | CABLE ASSEMBLY, CONT/BRT POTS             | 2   |  |
| 12   | 00-876540-01          | CABLE ASSEMBLY, CONT/BRT RIGHT            | 1   |  |
| 13   | 00-876540-02          | CABLE ASSEMBLY, CONT/BRT LEFT             | 1   |  |
| 14   | 00-876694-01          | CABLE ASSEMBLY, BNC MONITOR RIGHT         | 1   |  |
| 15   | 00-876694-02          | CABLE ASSEMBLY, BNC MONITOR LEFT          | 1   |  |
| 16   | 00-876438-01          | HARNESS ASSEMBLY, POWER CONTROL-PS4       | 2   |  |



Fig. 1-14A Interface Cable Diagram, Imaging Workstation (Sheet 1 of 5)

| FIG. 1-14B PARTS LIST |              |  |     |
|-----------------------|--------------|--|-----|
| ITEM                  | PART NUMBER  | DESCRIPTION                                  | QTY |
| 16                    | 00-876438-01 | HARNESS ASSEMBLY, POWER CONTROL-PS4          | 1   |
| 17                    | 00-876181-01 | ASSEMBLY, POWER CORD, 220-250V, 20 FT, 9600  | 1   |
| 18                    | 00-876181-02 | ASSEMBLY, POWER CORD, 220-250V, 30 FT, 9600  | 1   |
| 19                    | 00-876182-01 | ASSEMBLY, POWER CORD, 220V, 60 HZ, 20', 9600 | 1   |
| 20                    | 00-876180-01 | ASSEMBLY, POWER CORD, 100-270V, 20 FT, 9600  | 2   |
| 21                    | 00-876435-02 | CABLE ASSEMBLY, SAFETY GROUND STRAP          | 1   |
| 22                    | 00-876435-01 | CABLE ASSEMBLY, SAFETY GROUND STRAP          | 1   |
| 23                    | 00-876437-01 | CABLE ASSEMBLY, SURGE SUP T1                 | 1   |
| 24                    | 00-876542-01 | CABLE ASSEMBLY, POWER, POWER CONTROL PCB     | 1   |
| 25                    | 00-876812-01 | CABLE ASSEMBLY, GROUND CURRENT LIMITER       | 1   |
| 26                    | 00-876183-01 | ASSEMBLY, CABLE, INTERCONNECT, 20', 9600     | 2   |
| 27                    | 00-876184-01 | ASSEMBLY, CABLE, INTERCONNECT, 30', 9600     | 2   |
| 28                    | 00-876543-01 | CABLE ASSEMBLY, POWER CONTROL TO TB2         | 1   |
| 29                    | 00-876998-01 | CABLE ASSEMBLY, POWER CONTROL TO J15         | 1   |



|      | FIG. 1-14C PARTS LIST |   |  |     |
|------|-----------------------|---|--|-----|
| ITEM | PART NUMBER           | DESCRIPTION                               |  | QTY |
| 26   | 00-876183-01          | CABLE ASSEMBLY, INTERCONNECT, 20', 9600   |  | 2   |
| 27   | 00-876183-02          | CABLE ASSEMBLY, INTERCONNECT, 30', 9600   |  | 2   |
| 28   | 00-876543-01          | CABLE ASSEMBLY, POWER CONT TO TB2         |  | 1   |
| 29   | 00-876998-01          | CABLE ASSEMBLY, POWER CONT TO J15         |  | 1   |
| 30   | 00-876544-01          | CABLE ASSEMBLY, KEY SWITCH TO P15         |  | 1   |
| 31   | 00-876161-01          | KIT, LENZAR, 60 HZ, 9600, ENGLISH         |  | 3   |
| 32   | 00-876846-07          | CABLE ASSEMBLY, GROUND, CONT PANELS, 9600 |  | 1   |
| 33   | 00-877009-01          | ASSEMBLY, OUTLET STRIP, INTERNATIONAL AC  |  | 1   |
| 34   | 00-876803-01          | CABLE ASSEMBLY, VIDEO, INT, VCR, 9600     |  | 1   |
| 35   | 00-876802-01          | CABLE ASSEMBLY, CONT, INT, VCR, 9600      |  | 1   |
| 36   | 00-876803-02          | CABLE ASSEMBLY, VIDEO, INT, VCR, 9600     |  | 1   |
| 37   | 00-876444-01          | CABLE ASSEMBLY, TB2-J16                   |  | 1   |
| 38   | 00-900740-01          | CABLE ASSEMBLY, A9P10 TO J12, 13, 14      |  | 1   |



Fig. 1-14C Interface Cable Diagram, Imaging Workstation (Sheet 3 of 5)

| FIG. 1-14D PARTS LIST |              |  |     |
|-----------------------|--------------|--|-----|
| ITEM                  | PART NUMBER  | DESCRIPTION                                    | QTY |
| 39                    | 00-900720-01 | CABLE ASSEMBLY, VCR1/VCR2, 9600                | 2   |
| 40                    | 00-900462-01 | CABLE, SIGNAL, VIDEO, SW TO AUX                | 1   |
| 41                    | 00-876448-01 | CABLE ASSEMBLY, SIGNAL, VIDEO, SW/AUX IF       | 1   |
| 42                    | 00-876442-01 | CABLE ASSEMBLY, SIGNAL, VIDEO, SW/AUX I/F      | 1   |
| 43                    | 00-876449-01 | CABLE ASSEMBLY, SIGNAL, AUX INTF/VIDEO SW      | 1   |
| 44                    | 00-900719-01 | CABLE ASSEMBLY, VIDEO, 9600                    | 1   |
| 45                    | 00-876453-01 | CABLE ASSEMBLY, SIGNAL, IP/VIDEO, SW           | 1   |
| 46                    | 00-900721-01 | CABLE ASSEMBLY, COAX, VIDEO SW-IP, 9600        | 1   |
| 47                    | 00-876634-01 | CABLE ASSEMBLY, POWER, IP, VIDEO SW & AUX I/F  | 2   |
| 48                    | 00-876534-01 | CABLE ASSEMBLY, INTERNAL VCR CONTROL           | 1   |
| 49                    | 00-876450-01 | CABLE ASSEMBLY, SIGNAL AT COM 26 PIN           | 1   |
| 50                    | 00-876451-01 | CABLE ASSEMBLY, SIGNAL AT COM 34 PIN           | 1   |
| 51                    | 00-876452-01 | CABLE ASSEMBLY, SIGNAL AT COM 50 PIN           | 1   |
| 52                    | 00-876550-01 | CABLE ASSEMBLY, COAX, NETWORK                  | 1   |
| 53                    | 00-876447-01 | CABLE ASSEMBLY, POWER, DISK DRIVES             | 1   |
| 54                    | 00-876446-01 | CABLE ASSEMBLY, POWER, MOTHERBOARD             | 1   |
| 55                    | 00-876394-01 | CABLE ASSEMBLY, DISK DRIVE & ALTA              | 1   |
| 56                    | 00-877291-01 | CABLE ASSEMBLY, 30 FPS, HARD DRIVE POWER, 9600 | 1   |
| 57                    | 00-876536-01 | CABLE ASSEMBLY, POWER, ETI                     | 1   |
| 58                    | 00-876445-01 | CABLE ASSEMBLY, POWER SUPPLY                   | 1   |
| 59                    | 00-876546-01 | CABLE ASSEMBLY, PS1 TO A10                     | 1   |
| 60                    | 00-876439-01 | CABLE ASSEMBLY, DC POWER & AUX I/F TO J9       | 1   |



Fig. 1-14D Interface Cable Diagram, Imaging Workstation (Sheet 4 of 5)

| FIG. 1-14E PARTS LIST |              |   |     |
|-----------------------|--------------|---|-----|
| ITEM                  | PART NUMBER  | DESCRIPTION   | QTY |
| 45                    | 00-876453-01 | CABLE ASSEMBLY, SIGNAL, IP/VIDEO, SW                  | 1   |
| 46                    | 00-900721-01 | CABLE ASSEMBLY, COAX, VIDEO SW-IP, 9600               | 1   |
| 47                    | 00-876634-01 | CABLE ASSEMBLY, POWER, IP, VIDEO SW & AUX I/F         | 2   |
| 48                    | 00-876534-01 | CABLE ASSEMBLY, INTERNAL VCR CONT (FIG. 1-14D)        | 1   |
| 49                    | 00-876450-01 | CABLE ASSEMBLY, SIGNAL AT COM 26 PIN                  | 1   |
| 50                    | 00-876451-01 | CABLE ASSEMBLY, SIGNAL AT COM 34 PIN                  | 1   |
| 51                    | 00-876452-01 | CABLE ASSEMBLY, SIGNAL AT COM 50 PIN                  | 1   |
| 52                    | 00-876550-01 | CABLE ASSEMBLY, COAX, NETWORK                         | 1   |
| 53                    | 00-876447-01 | CABLE ASSEMBLY, POWER, DISK DRIVES                    | 1   |
| 54                    | 00-876446-01 | CABLE ASSEMBLY, POWER, MOTHERBOARD                    | 1   |
| 55                    | 00-876394-01 | CABLE ASSEMBLY, DISK DRIVE & ALTA                     | 1   |
| 56                    | 00-877291-01 | CABLE ASSEMBLY, 30 FPS HARD DRIVE POWER, 9600         | 1   |
| 57                    | 00-876536-01 | CABLE ASSEMBLY, POWER, ETI (FIG. 1-14D)               | 1   |
| 58                    | 00-876445-01 | CABLE ASSEMBLY, POWER SUPPLY (FIG. 1-14D)             | 1   |
| 59                    | 00-876546-01 | CABLE ASSEMBLY, PS1 TO A10 (FIG. 1-14D)               | 1   |
| 60                    | 00-876439-01 | CABLE ASSEMBLY, DC POWER & AUX I/F TO J9 (FIG. 1-14D) | 1   |
| 61                    | 00-876455-01 | CABLE ASSEMBLY, SIGNAL, FLOPPY DISK                   | 1   |
| 62                    | 00-876367-01 | CABLE ASSEMBLY, DATA FAST SCAN-IP                     | 1   |
| 63                    | 00-877365-01 | CABLE ASSEMBLY, SIGNAL, ALTA 2 HD, 2, 30 FPS          | 1   |
| 64                    | 00-877364-01 | CABLE ASSEMBLY, SIGNAL, ALTA 1-ALTA, 30 FPS           | 1   |
| 65                    | 00-876395-01 | CABLE ASSEMBLY, SIGNAL, ALTA IPI TO IP                | 1   |
| 66                    | 00-877412-01 | CABLE ASSEMBLY, SIGNAL, IP-ALTA                       | 1   |

|      | FIG. 1-14E PARTS LIST (CONT.) |   |     |  |
|------|-------------------------------|---|-----|--|
| ITEM | PART NUMBER                   | DESCRIPTION                             | QTY |  |
| 67   | 00-877363-01                  | CABLE ASSEMBLY, SIGNAL, IP-ALTA, 30 FPS | 1   |  |
| 68   | 00-876393-01                  | CABLE ASSEMBLY, SIGNAL, ALTA TO SCSI HD | 1   |  |
| 69   | 00-877366-01                  | CABLE ASSEMBLY, SIGNAL, ALTA-SCSI/HD    | 1   |  |
| 70   | 00-876454-01                  | CABLE ASSEMBLY, SIGNAL, HD, 40 PIN      | 1   |  |
| 71   | 00-876366-01                  | CABLE ASSEMBLY, FAST SCAN-BNC (RIGHT)   | 1   |  |
| 72   | 00-876366-02                  | CABLE ASSEMBLY, FAST SCAN-BNC (LEFT)    | 1   |  |



Fig. 1-14E Interface Cable Diagram, Imaging Workstation (Sheet 5 of 5)

| ATTACHING HARDWARE |   |     |  |
|--------------------|---|-----|--|
| PART NUMBER        | DESCRIPTION                                   | QTY |  |
| 00-876119-01       | SPACER, HINGE, SIDE, ELECT BOX                | 1   |  |
| 00-876990-01       | CLIP, SPRING, KEYBOARD                        | 1   |  |
| 00-900407-02       | WASHER, COLOR CODED                           | 1   |  |
| 00-900407-03       | WASHER, LOCK, SERRATED                        | 1   |  |
| 00-900407-04       | NUT, MU 0.8                                   | 1   |  |
| 00-900407-05       | WASHER, U/M6                                  | 1   |  |
| 10-601106-04       | SCREW, SLFTAP, PAN, SLT, 6-32, 1/4, SZC       | 2   |  |
| 12-215004-04       | SCREW, MACH, FL, TRX, 4-40, 1/4, SZC          | 4   |  |
| 12-215006-06       | SCREW, MACH, FL, TRX, 6-32, 3/8, SZC          | 18  |  |
| 12-215006-08       | SCREW, MACH, FL, TRX, 6-32, 1/2, SZC          | 10  |  |
| 12-215006-12       | SCREW, MACH, FL, TRX, 6-32, 3/4, SZC          | 8   |  |
| 12-215008-06       | SCREW, MACH, FL, TRX, 8-32, 3/8, SZC          | 1   |  |
| 12-221104-04       | SCREW, MACH, PAN, PHL, 4-40, 1/4, SST         | 7   |  |
| 12-221104-12       | SCREW, MACH, PAN, PHL, 4-40, 3/4, SST         | 2   |  |
| 12-225104-04       | SCREW, SEMS SPRING, PAN, PHL, 4-40, 1/4, SZC  | 2   |  |
| 12-225104-05       | SCREW, SEMS SPRING, PAN, TRX, 4-10, 5/16, SZC | 42  |  |
| 12-225104-06       | SCREW, SEMS SPRING, PAN, TRX, 4-40, 3/8, SZC  | 2   |  |
| 12-225106-04       | SCREW, SEMS APR, PAN, TRX, 6-32, 1/4, SZC     | 6   |  |
| 12-225106-06       | SCREW, SEMS SPRING, PAN, TRX, 6-32, 3/8, SZC  | 31  |  |
| 12-225106-08       | SCREW, SEMS SPRING, PAN, TRX, 6-32, 1/2, SZC  | 23  |  |
| 12-225106-12       | SCREW, SEMS SPRING, PAN, TRX, 6-32, 3/4, SZC  | 10  |  |

| ATTACHING HARDWARE (CONT.) |  |     |  |
|----------------------------|--|-----|--|
| PART NUMBER                | DESCRIPTION                                    | QTY |  |
| 12-225108-06               | SCREW, SEMS SPRING, PAN, TRX, 8-32, 3/8, SZC   | 41  |  |
| 12-225108-08               | SCREW, SEMS SPRING, PAN, TRX, 8/32, 1/2, SZC   | 14  |  |
| 12-225108-12               | SCREW, SEMS SPRING, PAN, TRX, 8/32, 3/4, SZC   | 2   |  |
| 12-225303-08               | SCREW, METRIC SEMS, PAN, TRX, M3X0.5, 6MM, SZ  | 14  |  |
| 12-312014-10               | SCREW, NA, SKT, HEX, 1/4-20, 5/8, SST          | 14  |  |
| 12-600000-08               | SCREW, NA, HEX, CAP, 1/4-20, 1/2, SZY, 8       | 8   |  |
| 12-900711-04               | SCREW, MACH, PAN, SLT, 4-40, 1/4, NYLON        | 2   |  |
| 12-912008-14               | SCREW, METRIC, HEX, CAP, M8X1.25, 12MM, SST    | 4   |  |
| 13-122104-00               | NUT, HEX, 4-40, NYLON, NA, A = .250, C = .094  | 2   |  |
| 13-311104-00               | NUT, HEX-LK-EXT-T, 4-40, SST, NA, A = .250     | 5   |  |
| 13-311106-00               | NUT, HEX-LK-EXT-T, 6-32, SST, NA, A = .313     | 33  |  |
| 13-311108-00               | NUT, HEX-LK-EXT-T, 8-32, SST, NA, A = .344     | 14  |  |
| 13-311114-00               | NUT, HEX-LK-EXT-T, 1/4-20, SST, NA, A = .4     | 11  |  |
| 13-532011-00               | NUT, HEX-LK-W/INSR, 5/16-18, SZC               | 4   |  |
| 14-101104-00               | WASHER, PL, #4, SZC, NA, ID = .125, OD = .312  | 2   |  |
| 14-102014-00               | WASHER, PL, 1/4, SST, NA, ID = .265, OD = .500 | 8   |  |
| 14-111104-00               | WASHER, PL, #4, SST, MS15795-804, ID = .120    | 5   |  |
| 14-201104-00               | WASHER, LK-HLCL-SPR, #4, SST, MS35338-135      | 8   |  |
| 14-211114-00               | WASHER, LK-HLCL-SPR, 1/4, SST, MS35338-        | 8   |  |
| 14-311112-00               | WASHER, LK-EXT-T, 5/16, SST, NA, ID = .320     | 4   |  |

| ATTACHING HARDWARE (CONT.) |   |     |  |
|----------------------------|---|-----|--|
| PART NUMBER                | DESCRIPTION                                     | QTY |  |
| 14-311114-00               | WASHER, LK-EXT-T, 1/4, SST, NA, ID = .256       | 12  |  |
| 14-900002-00               | WASHER, PL, #4, SST, NA, ID = .125, OD = .281   | 2   |  |
| 14-999702-00               | WASHER, PL, #4, NYLON, NA, ID = .125, OD = .250 | 2   |  |
| 21-709008-00               | SPRING, CPRSN, .420OD, 3/4LG, .042WD, SST       | 2   |  |
| 22-012010-00               | CLAMP, CABLE, 7/16D, 1/2W, STL                  | 1   |  |
| 22-012101-00               | CLAMP, CABLE/W, .437 X .39SQ, .219W, NYLON      | 18  |  |
| 22-012102-00               | CLAMP, CABLE/W, .437 X .75SQ, .219W, NYLON      | 5   |  |
| 22-012103-00               | CLAMP, CABLE/W, .437 X .34SQ, .219W, NYLON      | 23  |  |
| 22-012104-00               | CLAMP, CABLE/W, .437 X 1.02SQ, .219W, NYLON     | 6   |  |
| 22-119605-00               | CLAMP, CABLE TIE MT, NYLON                      | 2   |  |
| 22-119650-00               | CLAMP, CABLE TIE, 3/32 X 3-5/8, NYLON           | AR  |  |
| 23-620843-00               | RETAINER, 1/4TRN, .485OD X .013THK, SST         | 8   |  |
| 23-621841-00               | FASTENER, 1/4TRN STD, PHL, SZC                  | 8   |  |
| 23-621843-00               | FASTENER, RCPT, 1/4TRN, CLP-ON, .062/.187       | 8   |  |
| 23-621844-00               | FASTENER, 1/4TRN STD, PHL, MINTR, NYLON         | 6   |  |
| 23-621845-00               | FASTENER, RCPT, 1/4TRN, CLP-ON, .0011/.080      | 6   |  |

## **Section 2**



SERIES9600 Imaging Workstation

| FIG. 2-1 PARTS LIST |              |   |     |
|---------------------|--------------|---|-----|
| ITEM                | PART NUMBER  | DESCRIPTION                                       | QTY |
| 1                   | 00-875986-01 | COVER, SIDE, LOWER, LEFT                          | 1   |
| 2                   | 00-876466-01 | HANDLE, MONITOR CART (NOT EXPLODED)               | 2   |
| 3                   | 00-875981-01 | COVER, SIDE, UPPER LEFT (NOT EXPLODED)            | 1   |
| 4                   | 00-876746-01 | KIT, VTR, SONY 9500 MD4, 60HZ W/CBL               | 1   |
| 5                   | 00-875986-02 | COVER, SIDE, LOWER, RIGHT                         | 1   |
| 6                   | 00-876285-01 | BRACKET, MOUNTING, LENZAR CAMERA                  | 1   |
| 7                   | 00-877592-01 | BRACKET, MOUNTING, LENZAR CAMERA, LOW (NOT SHOWN) | 1   |
| 8                   | 00-876544-01 | CABLE ASSEMBLY, KEY SWITCH TO P15                 | 1   |
| 9                   | 00-875987-02 | COVER, FRONT PANEL, LENZAR                        | 1   |
| 10                  | 00-900640-01 | PANEL ASSEMBLY, CONTROL, LENZAR, ENGLISH, 9600    | 1   |
| 10                  | 00-900640-02 | PANEL ASSEMBLY, CONTROL, LENZAR, GERMAN, 9600     | 1   |
| 10                  | 00-900640-03 | PANEL ASSEMBLY, CONTROL, LENZAR, FRENCH, 9600     | 1   |
| 10                  | 00-900640-04 | PANEL ASSEMBLY, CONTROL, LENZAR, SPANISH, 9600    | 1   |
| 10                  | 00-900640-05 | PANEL ASSEMBLY, CONTROL, LENZAR, ITALIAN, 9600    | 1   |
| 11                  | 00-874026-06 | ASSEMBLY, IR REMOTE CONTROL VAS, 4 GEN            | 1   |
| 12                  | 00-877611-01 | ASSEMBLY, IR REMOTE CONTROL, ENGLISH              | 1   |
| 12                  | 00-877611-03 | ASSEMBLY, IR REMOTE CONTROL, GERMAN               | 1   |
| 12                  | 00-877611-04 | ASSEMBLY, IR REMOTE CONTROL, FRENCH               | 1   |
| 12                  | 00-877611-05 | ASSEMBLY, IR REMOTE CONTROL, SPANISH              | 1   |
| 12                  | 00-877611-07 | ASSEMBLY, IR REMOTE CONTROL, ITALIAN              | 1   |

| FIG. 2-1 PARTS LIST (CONT.) |              |   |     |
|-----------------------------|--------------|---|-----|
| ITEM                        | PART NUMBER  | DESCRIPTION   | QTY |
| 13                          | 00-878031-01 | ASSEMBLY, IR REMOTE CONTROL, 9600, ENGLISH          | 1   |
| 13                          | 00-878031-02 | ASSEMBLY, IR REMOTE CONTROL, 9600, GERMAN           | 1   |
| 13                          | 00-878031-03 | ASSEMBLY, IR REMOTE CONTROL, 9600, FRENCH           | 1   |
| 13                          | 00-878031-04 | ASSEMBLY, IR REMOTE CONTROL, 9600, SPANISH          | 1   |
| 13                          | 00-878031-05 | ASSEMBLY, IR REMOTE CONTROL, 9600, ITALIAN          | 1   |
| 14                          | 00-876161-01 | KIT, LENZAR, 60HZ, ENGLISH, 9600                    | 1   |
| 15                          | 00-900666-01 | CAMERA, LENZAR, 60HZ (NOT EXPLODED)                 | 1   |
| 16                          | 00-875981-02 | COVER, SIDE, UPPER, RIGHT (NOT EXPLODED/SHOWN)      | 1   |
| 17                          | 00-876747-01 | KIT, VTR, SONY 9510 MDP4, 50HZ W/CBL (NOT SHOWN)    | 1   |
| 18                          | 00-900585-01 | RECORDER, SONY VIDEO TAPE 1/2" 60HZ (NOT SHOWN)     | 1   |
| 19                          | 00-900585-02 | RECORDER, SONY VIDEO TAPE 1/2" 50HZ (NOT SHOWN)     | 1   |
| 20                          | 00-900267-01 | TAPE, VIDEO, 1/2" (NOT SHOWN)                       | AR  |
| 21                          | 00-876748-01 | ASSEMBLY, OPTION, THERMAL IMAGER (NOT SHOWN)        | 1   |
| 22                          | 00-900394-01 | PRINTER, THERMAL IMAGING (NOT SHOWN)                | 1   |
| 23                          | 00-876178-01 | ASSEMBLY, CRATE, WORKSTATION, 9600/2600 (NOT SHOWN) | 1   |



Fig. 2-1 ESP (Expanded Surgical Package) Exploded Front View

| FIG. 2-2 PARTS LIST |              |  |     |
|---------------------|--------------|--|-----|
| ITEM                | PART NUMBER  | DESCRIPTION                                    | QTY |
| 1                   | 00-875986-01 | COVER, SIDE, LOWER, LEFT                       | 1   |
| 2                   | 00-876466-01 | HANDLE, MONITOR CART (NOT EXPLODED)            | 2   |
| 3                   | 00-875981-01 | COVER, SIDE, UPPER, LEFT (NOT EXPLODED)        | 1   |
| 4                   | 00-875986-02 | COVER, SIDE, LOWER, RIGHT                      | 1   |
| 5                   | 00-876544-01 | CABLE ASSEMBLY, KEY SWITCH TO P15              | 1   |
| 6                   | 00-875987-01 | COVER, FRONT PANEL                             | 1   |
| 7                   | 00-875992-01 | COVER, SHELF, LOWER (NOT EXPLODED)             | 1   |
| 8                   | 00-875991-01 | COVER, SHELF, UPPER (NOT EXPLODED)             | 1   |
| 9                   | 00-875981-02 | COVER, SIDE, UPPER, RIGHT (NOT EXPLODED/SHOWN) | 1   |



Fig. 2-2 SP (Surgical Platform) Model Exploded Front View

| FIG. 2-3 PARTS LIST |              |  |     |
|---------------------|--------------|--|-----|
| ITEM                | PART NUMBER  | DESCRIPTION                                    | QTY |
| 1                   | 00-876786-01 | ASSEMBLY, PCB, SURGE SUPPRESSER                | 1   |
| 2                   | 00-900712-01 | TRANSFORMER, ISOLATION WORKSTATION             | 1   |
| 3                   | 66-235026-00 | RECTIFIER, SILICON BRIDGE, 100PRV, 30A         | 2   |
| 4                   | 78-590390-00 | POWER SUPPLY, MOD +24 VDC                      | 1   |
| 5                   | 55-700452-00 | CIRCUIT, BREAKER, 10A DPST 125, 250 VAC, PANEL | 1   |
| 6                   | 00-877037-01 | BRACKET, MOUNTING, CIRCUIT BREAKER             | 1   |
| 7                   | 00-876549-01 | ASSEMBLY, PCB, POWER CONTROL                   | 1   |
| 8                   | 56-996209-01 | TERMINAL BLOCK, PANEL 4 POS, 26-12 AWG, 20A    | 1   |
| 9                   | 56-996214-00 | JUMPER, TERMINAL BLOCK                         | 1   |
| 10                  | 56-996215-00 | TERMINAL BLOCK, END PLATE, 26-12 AWG           | 1   |



Fig. 2-3 Power Control Panel, Transformer, PCB Assy Surge Suppresser Exploded View

|      | FIG. 2-4 PARTS LIST |  |     |  |
|------|---------------------|--|-----|--|
| ITEM | PART NUMBER         | DESCRIPTION                                    | QTY |  |
| 1    | 55-700452-00        | CIRCUIT BREAKER, 10A, DPST 125, 250 VAC, PANEL | 2   |  |
| 2    | 00-876469-01        | BRACKET, INTERCONNECT                          | 1   |  |
| 3    | 00-876183-01        | CABLE ASSEMBLY, INTERCONNECT, 20', 9600        | 1   |  |
| 4    | 00-876183-02        | CABLE ASSEMBLY, INTERCONNECT, 30', 9600        | 1   |  |
| 5    | 20-839918-00        | FAN, SXL, 115 VAC, 115 CFM, 3200 RPM           | 1   |  |
| 6    | 20-839926-00        | GUARD, FINGER, FAN                             | 1   |  |
| 7    | 00-875990-01        | COVER, REAR PANEL                              | 1   |  |
| 8    | 00-876468-01        | BRACKET, POWER CORD                            | 1   |  |
| 9    | 00-876180-01        | ASSEMBLY, POWER CORD, 100-127V, 20 FT, 9600    | 2   |  |
| 10   | 00-876181-01        | ASSEMBLY, POWER CORD, 220-250V, 20 FT, 9600    | 1   |  |
| 10   | 00-876181-02        | ASSEMBLY, POWER CORD, 220-250V, 30 FT, 9600    | 1   |  |
| 11   | 00-876182-01        | ASSEMBLY, POWER CORD, 220V, 60 HZ, 20', 9600   | 1   |  |
| 12   | 67-430001-00        | IND, LAMP, NE, 110V, GREEN                     | 1   |  |
| 13   | 56-299702-00        | TERMINAL STRIP, PANEL, 3 POS, 380V             | 1   |  |
| 14   | 00-875981-02        | COVER, SIDE, UPPER RIGHT (NOT EXPLODED)        | 1   |  |
| 15   | 27-590972-00        | FILTER, AIR, FRAMELESS, 6 X 6 X .188           | 1   |  |



Fig. 2-4 Rear Panel, Fan, Power Cord Assy, Interconnect Cable Assy Exploded View

| FIG. 2-5 PARTS LIST |              |   |     |
|---------------------|--------------|---|-----|
| ITEM                | PART NUMBER  | DESCRIPTION   | QTY |
| 1                   | 00-900657-03 | MONITOR, FAST SCAN, 16"   | 2   |
| 2                   | 00-875983-01 | HOUSING, MONITOR  | 1   |
| 3                   | 00-877124-01 | BRACE, BEZEL  | 1   |
| 4                   | 00-876470-01 | BRACKET, IR RECEIVER  | 1   |
| 5                   | 00-874222-04 | ASSEMBLY, PCB, IR RECEIVER 9600                                     | 1   |
| 6                   | 00-900751-01 | LAMP, X-RAY ON (SCD)  | 1   |
| 7                   | 00-875982-01 | BEZEL, MONITOR (NOT EXPLODED)                                       | 1   |
| 8                   | 00-876541-01 | CABLE ASSEMBLY, CONT/BRT POTS                                       | 1   |
| 9                   | 00-876541-02 | CABLE ASSEMBLY, CONT/BRT POTS                                       | 1   |
| 10                  | 00-876471-02 | BRACKET, B/C MOUNTING   | 1   |
| 11                  | 00-877009-03 | ASSEMBLY, OUTLET STRIP, INTL AC (120V AC 50/60 Hz, 240V AC 50/60Hz) | 1   |
| 11                  | 00-877009-04 | ASSEMBLY, OUTLET STRIP, INTL AC (115V AC 50/60 Hz, 230V AC 50/60Hz) | 1   |
| 12                  | 00-900792-01 | PCA, DEFLECTION, MONITOR (SCD)                                      | 2   |
| 13                  | 00-876353-01 | ASSEMBLY, PCB, HI SCAN BRGTS/CTRS CONT                              | 1   |
| 14                  | 00-874661-01 | LENS, FRONT, COLORED (NOT EXPLODED/SHOWN)                           | 1   |
| 15                  | 00-874661-02 | LENS, FRONT, CLEAR (NOT EXPLODED/SHOWN)                             | 1   |



Fig. 2-5 Monitor Rear Exploded View

| FIG. 2-6 PARTS LIST |              |   |     |
|---------------------|--------------|---|-----|
| ITEM                | PART NUMBER  | DESCRIPTION   | QTY |
| 1                   | 00-875984-01 | COVER, BASE   | 1   |
| 2                   | 00-900696-01 | CASTER, LOCK, 5" (SCD)                              | 2   |
| 3                   | 00-876702-01 | PEDAL, BRAKE  | 1   |
| 4                   | 00-876624-01 | BAR, BRAKE  | 2   |
| 5                   | 00-900695-01 | CASTER, SWIVEL, 5" (SCD)                            | 2   |
| 6                   | 21-709008-00 | SPRING, COMPRESSION, .420 OD, .750 LG, .042 WD, SST | 2   |



Fig. 2-6 Brake, Caster Exploded View

| FIG. 2-7 PARTS LIST |              |   |     |
|---------------------|--------------|---|-----|
| ITEM                | PART NUMBER  | DESCRIPTION                                 | QTY |
| 1                   | 00-876504-01 | ASSEMBLY, PCB, AUX INTERFACE, 9600          | 1   |
| 2                   | 00-872239-01 | ASSEMBLY, PCB, VIDEO SWITCHING 4 GEN        | 1   |
| 3                   | 67-700000-00 | METER, ELEC, DC, HR/TNTS, 6 DIGIT           | 1   |
| 4                   | 00-900689-01 | POWER, SUPPLY, QUAD OUTPUT (SCD)            | 1   |
| 5                   | 00-876841-01 | ASSEMBLY, PCB, DC POWER DIST, 9600          | 1   |
| 6                   | 20-839956-00 | FAN, AXL, 115 VAC, 75 CFM, 2200 RPM         | 2   |
| 7                   | 20-839926-00 | GUARD, FINGER, FAN                          | 2   |
| 8                   | 00-876995-01 | MOUNT, HARD DRIVE MON CART                  | 1   |
| 9                   | 00-875954-01 | ASSEMBLY, PCB, IMAGE PROCESSOR, SMT         | 1   |
| 10                  | 00-876399-02 | ASSEMBLY, PCB, FAST SCAN CONVERTER          | 1   |
| 11                  | 00-872127-04 | ASSEMBLY, PCB, COMMUNICATIONS 4 GEN         | 1   |
| 12                  | 00-900658-01 | PCA, MOTHERBOARD, 386 (SCD)                 | 1   |
| 13                  | 00-900669-01 | DRIVE FLOPPY DISK, 3.5", 1.44 MB            | 1   |
| 14                  | 00-877024-01 | DISK, FORMATTED, DISK DRIVE, 42 MB          | 1   |
| 15                  | 00-876712-01 | MOUNT, MOTHERBOARD, 9600 (NOT SHOWN)        | 1   |
| 16                  | 00-876284-01 | BRACKET, MOUNTING, FLOPPY DRIVE (NOT SHOWN) | 1   |



# Note:Location of Item 3Item 3 can be located in either position as shown. Refer to each workstation for exact location.

#### Fig. 2-7 Electronic Rack, Generic Exploded View

| FIG. 2-8 PARTS LIST |              |   |     |
|---------------------|--------------|---|-----|
| ITEM                | PART NUMBER  | DESCRIPTION                                 | QTY |
| 1                   | 00-876504-01 | ASSEMBLY, PCB, AUX INTERFACE, 9600          | 1   |
| 2                   | 00-872239-01 | ASSEMBLY, PCB, VIDEO SWITCHING 4 GEN        | 1   |
| 3                   | 00-876536-01 | CABLE ASSEMBLY, POWER ETI                   | 1   |
| 4                   | 00-900689-01 | POWER, SUPPLY, QUAD OUTPUT (SCD)            | 1   |
| 5                   | 00-876841-01 | ASSEMBLY, PCB, DC POWER DIST, 9600          | 1   |
| 6                   | 20-839956-00 | FAN, AXL, 115 VAC, 75 CFM, 2200 RPM         | 2   |
| 7                   | 20-839926-00 | GUARD, FINGER, FAN                          | 2   |
| 8                   | 00-876995-01 | MOUNT, HARD DRIVE MON CART                  | 1   |
| 9                   | 00-875954-01 | ASSEMBLY, PCB, IMAGE PROCESSOR, SMT         | 1   |
| 10                  | 00-876399-02 | ASSEMBLY, PCB, FAST SCAN CONVERTER          | 1   |
| 11                  | 00-872127-04 | ASSEMBLY, PCB, COMMUNICATIONS 4 GEN         | 1   |
| 12                  | 00-900658-01 | PCA, MOTHERBOARD, 386 (SCD)                 | 1   |
| 13                  | 00-900669-01 | DRIVE FLOPPY DISK, 3.5", 1.44 MB            | 1   |
| 14                  | 00-877025-01 | DISK, FORMATTED, DISK DRIVE, SCSI           | 1   |
| 15                  | 0-878229-01  | DISK CONT, TESTED ALTA                      | 1   |
| 16                  | 00-900659-01 | DISK CONTROLLER, SCSI (SCD)                 | 1   |
| 17                  | 00-876712-01 | MOUNT, MOTHERBOARD, 9600 (NOT SHOWN)        | 1   |
| 18                  | 00-876284-01 | BRACKET, MOUNTING, FLOPPY DRIVE (NOT SHOWN) | 1   |



#### Note: Location of Item 3

Item 3 can be located in either position as shown. Refer to each workstation for exact location.

#### Fig. 2-8 Electronic Rack, ESP with 4 FPS Storage Exploded View
|      | FIG. 2-9 PARTS LIST |   |     |  |
|------|---------------------|---|-----|--|
| ITEM | PART NUMBER         | DESCRIPTION                                 | QTY |  |
| 1    | 00-876504-01        | ASSEMBLY, PCB, AUX INTERFACE, 9600          | 1   |  |
| 2    | 00-872239-01        | ASSEMBLY, PCB, VIDEO SWITCHING 4 GEN        | 1   |  |
| 3    | 00-876536-01        | CABLE ASSEMBLY, POWER ETI                   | 1   |  |
| 4    | 00-900689-01        | POWER, SUPPLY, QUAD OUTPUT (SCD)            | 1   |  |
| 5    | 00-876841-01        | ASSEMBLY, PCB, BC POWER DIST, 9600          | 1   |  |
| 6    | 20-839956-00        | FAN, AXL, 115 VAC, 75 CFM, 2200 RPM         | 2   |  |
| 7    | 20-839926-00        | GUARD, FINGER, FAN                          | 2   |  |
| 8    | 00-876995-01        | MOUNT, HARD DRIVE MON CART                  | 1   |  |
| 9    | 00-875954-01        | ASSEMBLY, PCB, IMAGE PROCESSOR, SMT         | 1   |  |
| 10   | 00-876399-02        | ASSEMBLY, PCB, FAST SCAN CONVERTER          | 1   |  |
| 11   | 00-872127-04        | ASSEMBLY, PCB, COMMUNICATIONS 4 GEN         | 1   |  |
| 12   | 00-900658-01        | PCA, MOTHERBOARD, 386 (SCD)                 | 1   |  |
| 13   | 00-900669-01        | DRIVE FLOPPY DISK, 3.5", 1.44 MB            | 1   |  |
| 14   | 00-878230-01        | ASSEMBLY, DISK DRIVE, 30 FPS, FORMATTED     | 2   |  |
| 15   | 0-878229-01         | DISK CONT, TESTED ALTA                      | 2   |  |
| 16   | 00-900659-01        | DISK CONTROLLER, SCSI (SCD)                 | 1   |  |
| 17   | 00-876712-01        | MOUNT, MOTHERBOARD, 9600 (NOT SHOWN)        | 1   |  |
| 18   | 00-876284-01        | BRACKET, MOUNTING, FLOPPY DRIVE (NOT SHOWN) | 1   |  |



#### Note: Location of Item 3

Item 3 can be located in either position as shown. Refer to each workstation for exact location.

#### Fig. 2-9 Electronic Rack, Vascular with 30 FPS Storage Exploded View

|      | FIG. 2-10 PARTS LIST |   |     |  |
|------|----------------------|---|-----|--|
| ITEM | PART NUMBER          | DESCRIPTION                                       | QTY |  |
| 1    | 00-875988-01         | COVER, KEYBOARD, TOP                              | 1   |  |
| 2    | 00-900769-01         | PANEL ASSEMBLY, CONTROL, CART SP, 9600 (ENGLISH)  | 1   |  |
| 2    | 00-900769-02         | PANEL ASSEMBLY, CONTROL, CART SP, 9600 (GERMAN)   | 1   |  |
| 2    | 00-900769-03         | PANEL ASSEMBLY, CONTROL, CART SP, 9600 (FRENCH)   | 1   |  |
| 2    | 00-900769-04         | PANEL ASSEMBLY, CONTROL, CART SP, 9600 (SPANISH)  | 1   |  |
| 2    | 00-900769-05         | PANEL ASSEMBLY, CONTROL, CART SP, 9600 (ITALIAN)  | 1   |  |
| 3    | 00-900641-01         | PANEL ASSEMBLY, QWERTY KEYBOARD ENGLISH 96        | 1   |  |
| 4    | 00-900772-01         | PANEL ASSEMBLY, CONTROL, FRONT SP, 9600 (ENGLISH) | 1   |  |
| 4    | 00-900772-02         | PANEL ASSEMBLY, CONTROL, FRONT SP, 9600 (GERMAN)  | 1   |  |
| 4    | 00-900772-03         | PANEL ASSEMBLY, CONTROL, FRONT SP, 9600 (FRENCH)  | 1   |  |
| 4    | 00-900772-04         | PANEL ASSEMBLY, CONTROL, FRONT SP, 9600 (SPANISH) | 1   |  |
| 4    | 00-900772-05         | PANEL ASSEMBLY, CONTROL, FRONT SP, 9600 (ITALIAN) | 1   |  |
| 5    | 00-876767-01         | ASSEMBLY, ALARM, AUDIO                            | 1   |  |
| 6    | 00-877670-01         | COVER, BOX, RFI, 9600 WS                          |     |  |
| 7    | 00-876613-01         | ASSEMBLY, PCB, CONT PANEL PROC, 9600 MC           | 1   |  |
| 8    | 00-877671-01         | BASE, BOX, RFI., 9600 WS                          | 1   |  |
| 9    | 00-876224-01         | NAMEPLATE, PRODUCT, 9600 (NOT EXPLODED)           | 1   |  |
| 10   | 00-876533-01         | CABLE ASSEMBLY, QW-CPP (NOT SHOWN)                | 1   |  |
| 11   | 00-876693-01         | CABLE ASSEMBLY, FRONT PANEL-CPP (NOT SHOWN)       | 1   |  |
| 12   | 00-876538-01         | CABLE ASSEMBLY, CONTROL PANEL TO CPP (NOT SHOWN)  | 1   |  |



Fig. 2-10 Keyboard, SP (Surgical Platform) Model Exploded View

|      | FIG. 2-11 PARTS LIST |   |     |  |
|------|----------------------|---|-----|--|
| ITEM | PART NUMBER          | DESCRIPTION   | QTY |  |
| 1    | 00-875988-01         | COVER, KEYBOARD, TOP                                | 1   |  |
| 2    | 00-900768-01         | PANEL ASSEMBLY, CONTROL, CART ESP, 9600 (ENGLISH)   | 1   |  |
| 2    | 00-900768-02         | PANEL ASSEMBLY, CONTROL, CART ESP, 9600 (GERMAN)    | 1   |  |
| 2    | 00-900768-03         | PANEL ASSEMBLY, CONTROL, CART ESP, 9600 (FRENCH)    | 1   |  |
| 2    | 00-900768-04         | PANEL ASSEMBLY, CONTROL, CART ESP, 9600 (SPANISH)   | 1   |  |
| 2    | 00-900768-05         | PANEL ASSEMBLY, CONTROL, CART ESP, 9600 (ITALIAN)   | 1   |  |
| 3    | 00-900641-01         | PANEL ASSEMBLY, QWERTY KEYBOARD ENGLISH 96          | 1   |  |
| 4    | 00-900771-01         | PANEL ASSEMBLY, FRONT, ESP, ESP/4F, 9600 (ENGLISH)  | 1   |  |
| 4    | 00-900771-02         | PANEL ASSEMBLY, FRONT, ESP, ESP/ACQ, 9600 (GERMAN)  | 1   |  |
| 4    | 00-900771-03         | PANEL ASSEMBLY, FRONT, ESP, ESP/ACQ, 9600 (FRENCH)  | 1   |  |
| 4    | 00-900771-04         | PANEL ASSEMBLY, FRONT, ESP, ESP/ACQ, 9600 (SPANISH) | 1   |  |
| 4    | 00-900771-05         | PANEL ASSEMBLY, FRONT, ESP, ESP/ACQ, 9600 (ITALIAN) | 1   |  |
| 5    | 00-876767-01         | ASSEMBLY, ALARM, AUDIO                              | 1   |  |
| 6    | 00-877670-01         | COVER, BOX, RFI, 9600 WS                            |     |  |
| 7    | 00-876613-01         | ASSEMBLY, PCB, CONT PANEL PROC, 9600 MC             | 1   |  |
| 8    | 00-877671-01         | BASE, BOX, RFI., 9600 WS                            | 1   |  |
| 9    | 00-876224-01         | NAMEPLATE, PRODUCT, 9600 (NOT EXPLODED)             | 1   |  |
| 10   | 00-876533-01         | CABLE ASSEMBLY, QW-CPP (NOT SHOWN)                  | 1   |  |
| 11   | 00-876693-01         | CABLE ASSEMBLY, FRONT PANEL-CPP (NOT SHOWN)         | 1   |  |
| 12   | 00-876538-01         | CABLE ASSEMBLY, CONTROL PANEL TO CPP (NOT SHOWN)    | 1   |  |



Fig. 2-11 Keyboard, ESP/Cholangiography Model Exploded View

|      | FIG. 2-12 PARTS LIST |   |     |  |
|------|----------------------|---|-----|--|
| ITEM | PART NUMBER          | DESCRIPTION   | QTY |  |
| 1    | 00-875988-01         | COVER, KEYBOARD, TOP                                  | 1   |  |
| 2    | 00-900767-01         | PANEL ASSEMBLY, CONTROL, CART ESP/4F, 9600 (ENGLISH)  | 1   |  |
| 2    | 00-900767-02         | PANEL ASSEMBLY, CONTROL, CART ESP/ACQ, 9600 (GERMAN)  | 1   |  |
| 2    | 00-900767-03         | PANEL ASSEMBLY, CONTROL, CART ESP/ACQ, 9600 (FRENCH)  | 1   |  |
| 2    | 00-900767-04         | PANEL ASSEMBLY, CONTROL, CART ESP/ACQ, 9600 (SPANISH) | 1   |  |
| 2    | 00-900767-05         | PANEL ASSEMBLY, CONTROL, CART ESP/ACQ, 9600 (ITALIAN) | 1   |  |
| 3    | 00-900641-01         | PANEL ASSEMBLY, QWERTY KEYBOARD ENGLISH 9600          | 1   |  |
| 4    | 00-900771-01         | PANEL ASSEMBLY, FRONT, ESP & ESP/4F, 9600 (ENGLISH)   | 1   |  |
| 4    | 00-900771-02         | PANEL ASSEMBLY, FRONT, ESP & ESP/ACQ, 9600 (GERMAN)   | 1   |  |
| 4    | 00-900771-03         | PANEL ASSEMBLY, FRONT, ESP & ESP/ACQ, 9600 (FRENCH)   | 1   |  |
| 4    | 00-900771-04         | PANEL ASSEMBLY, FRONT, ESP & ESP/ACQ, 9600 (SPANISH)  | 1   |  |
| 4    | 00-900771-05         | PANEL ASSEMBLY, FRONT, ESP & ESP/ACQ, 9600 (ITALIAN)  | 1   |  |
| 5    | 00-876767-01         | ASSEMBLY, ALARM, AUDIO                                | 1   |  |
| 6    | 00-877670-01         | COVER, BOX, RFI, 9600 WS                              |     |  |
| 7    | 00-876613-01         | ASSEMBLY, PCB, CONT PANEL PROC, 9600 MC               | 1   |  |
| 8    | 00-877671-01         | BASE, BOX, RFI., 9600 WS                              | 1   |  |
| 9    | 00-876224-01         | NAMEPLATE, PRODUCT, 9600 (NOT EXPLODED)               | 1   |  |
| 10   | 00-876533-01         | CABLE ASSEMBLY, QW-CPP (NOT SHOWN)                    | 1   |  |
| 11   | 00-876693-01         | CABLE ASSEMBLY, FRONT PANEL-CPP (NOT SHOWN)           | 1   |  |
| 12   | 00-876538-01         | CABLE ASSEMBLY, CONTROL PANEL TO CPP (NOT SHOWN)      | 1   |  |



Fig. 2-12 Keyboard, ESP/Acquire Model Exploded View

|      | FIG. 2-13 PARTS LIST |   |     |  |
|------|----------------------|---|-----|--|
| ITEM | PART NUMBER          | DESCRIPTION                                       | QTY |  |
| 1    | 00-875988-01         | COVER, KEYBOARD, TOP                              | 1   |  |
| 2    | 00-900766-01         | PANEL ASSEMBLY, CONTROL, CART VAS, 9600 (ENGLISH) | 1   |  |
| 2    | 00-900766-02         | PANEL ASSEMBLY, CONTROL, CART VAS, 9600 (GERMAN)  | 1   |  |
| 2    | 00-900766-03         | PANEL ASSEMBLY, CONTROL, CART VAS, 9600 (FRENCH)  | 1   |  |
| 2    | 00-900766-04         | PANEL ASSEMBLY, CONTROL, CART VAS, 9600 (SPANISH) | 1   |  |
| 2    | 00-900766-05         | PANEL ASSEMBLY, CONTROL, CART VAS, 9600 (ITALIAN) | 1   |  |
| 3    | 00-900641-01         | PANEL ASSEMBLY, QWERTY KEYBOARD ENGLISH 96        | 1   |  |
| 4    | 00-900770-01         | PANEL ASSEMBLY, CONTROL, FRONT, VAS, (ENGLISH)    | 1   |  |
| 4    | 00-900770-02         | PANEL ASSEMBLY, CONTROL, FRONT, VAS, (GERMAN)     | 1   |  |
| 4    | 00-900770-03         | PANEL ASSEMBLY, CONTROL, FRONT, VAS, (FRENCH)     | 1   |  |
| 4    | 00-900770-04         | PANEL ASSEMBLY, CONTROL, FRONT, VAS, (SPANISH)    | 1   |  |
| 4    | 00-900770-05         | PANEL ASSEMBLY, CONTROL, FRONT, VAS, (ITALIAN)    | 1   |  |
| 5    | 00-876767-01         | ASSEMBLY, ALARM, AUDIO                            | 1   |  |
| 6    | 00-877670-01         | COVER, BOX, RFI, 9600 WS                          |     |  |
| 7    | 00-876613-01         | ASSEMBLY, PCB, CONT PANEL PROC, 9600 MC           | 1   |  |
| 8    | 00-877671-01         | BASE, BOX, RFI., 9600 WS                          | 1   |  |
| 9    | 00-876224-01         | NAMEPLATE, PRODUCT, 9600 (NOT EXPLODED)           | 1   |  |
| 10   | 00-876533-01         | CABLE ASSEMBLY, QW-CPP (NOT SHOWN)                | 1   |  |
| 11   | 00-876693-01         | CABLE ASSEMBLY, FRONT PANEL-CPP (NOT SHOWN)       | 1   |  |
| 12   | 00-876538-01         | CABLE ASSEMBLY, CONTROL PANEL TO CPP (NOT SHOWN)  | 1   |  |



Fig. 2-13 Keyboard, ESP Vascular, Neuro-Vascular Model Exploded View

|      | FIG. 2-14A PARTS LIST |   |     |  |
|------|-----------------------|---|-----|--|
| ITEM | PART NUMBER           | DESCRIPTION                               | QTY |  |
| 1    | 00-876538-01          | CABLE ASSEMBLY, CONTROL PANEL TO CPP      | 1   |  |
| 2    | 00-876533-01          | CABLE ASSEMBLY, QW-CPP                    | 1   |  |
| 3    | 00-876693-01          | CABLE ASSEMBLY, FRONT PANEL-CPP           | 1   |  |
| 4    | 00-876846-04          | CABLE ASSEMBLY, GROUND, CONT PANELS, 9600 | 1   |  |
| 5    | 00-876846-05          | CABLE ASSEMBLY, GROUND, CONT PANELS, 9600 | 1   |  |
| 6    | 00-876846-06          | CABLE ASSEMBLY, GROUND, CONT PANELS, 9600 | 1   |  |
| 7    | 00-876530-01          | CABLE ASSEMBLY, CPP/REM CONT/X-RAY ON     | 3   |  |
| 8    | 00-876770-01          | CABLE ASSEMBLY, X-RAY ON LAMP             | 1   |  |
| 9    | 00-876767-01          | ASSEMBLY, ALARM, AUDIO                    | 1   |  |
| 10   | 00-876541-01          | CABLE ASSEMBLY, CONT/BRT POTS             | 2   |  |
| 11   | 00-876541-02          | CABLE ASSEMBLY, CONT/BRT POTS             | 2   |  |
| 12   | 00-876540-01          | CABLE ASSEMBLY, CONT/BRT RIGHT            | 1   |  |
| 13   | 00-876540-02          | CABLE ASSEMBLY, CONT/BRT LEFT             | 1   |  |
| 14   | 00-876694-01          | CABLE ASSEMBLY, BNC MONITOR RIGHT         | 1   |  |
| 15   | 00-876694-02          | CABLE ASSEMBLY, BNC MONITOR LEFT          | 1   |  |
| 16   | 00-876438-01          | HARNESS ASSEMBLY, POWER CONTROL-PS4       | 2   |  |



Fig. 2-14A Interface Cable Diagram, Imaging Workstation (Sheet 1 of 5)

|      | FIG. 2-14B PARTS LIST |   |     |  |
|------|-----------------------|---|-----|--|
| ITEM | PART NUMBER           | DESCRIPTION                                   | QTY |  |
| 16   | 00-876438-01          | HARNESS ASSEMBLY, POWER CONTROL-PS4           | 1   |  |
| 17   | 00-876181-01          | ASSEMBLY, POWER CORD, 220-250V, 20 FT, 9600   | 1   |  |
| 18   | 00-876181-02          | ASSEMBLY, POWER CORD, 220-250V, 30 FT, 9600   | 1   |  |
| 19   | 00-877318-01          | ASSEMBLY, POWER CORD, 220V, 60 HZ, 20', 9600  | 1   |  |
| 20   | 00-876180-01          | ASSEMBLY, POWER CORD, 100-270V, 20 FT, 9600   | 2   |  |
| 21   | 00-876435-02          | CABLE ASSEMBLY, SAFETY GROUND STRAP           | 1   |  |
| 22   | 00-876435-01          | CABLE ASSEMBLY, SAFETY GROUND STRAP           | 1   |  |
| 23   | 00-876437-01          | CABLE ASSEMBLY, SURGE SUP T1                  | 1   |  |
| 24   | 00-876542-01          | CABLE ASSEMBLY, POWER, POWER CONTROL PCB      | 1   |  |
| 25   | 00-877318-02          | ASSEMBLY, POWER CORD, WKST, DOM, URO2600, 60' | 1   |  |
| 26   | 00-876183-01          | ASSEMBLY, CABLE, INTERCONNECT, 20', 9600      | 2   |  |
| 27   | 00-876184-01          | ASSEMBLY, CABLE, INTERCONNECT, 30', 9600      | 2   |  |
| 28   | 00-876543-01          | CABLE ASSEMBLY, POWER CONTROL TO TB2          | 1   |  |
| 29   | 00-876998-01          | CABLE ASSEMBLY, POWER CONTROL TO J15          | 1   |  |



Fig. 2-14B Interface Cable Diagram, Imaging Workstation (Sheet 2 of 5)

|      | FIG. 2-14C PARTS LIST |   |     |  |
|------|-----------------------|---|-----|--|
| ITEM | PART NUMBER           | DESCRIPTION                               | QTY |  |
| 26   | 00-876183-01          | CABLE ASSEMBLY, INTERCONNECT, 20', 9600   | 2   |  |
| 27   | 00-876183-02          | CABLE ASSEMBLY, INTERCONNECT, 30', 9600   | 2   |  |
| 28   | 00-876543-01          | CABLE ASSEMBLY, POWER CONT TO TB2         | 1   |  |
| 29   | 00-876998-01          | CABLE ASSEMBLY, POWER CONT TO J15         | 1   |  |
| 30   | 00-876544-01          | CABLE ASSEMBLY, KEY SWITCH TO P15         | 1   |  |
| 31   | 00-876161-01          | KIT, LENZAR, 60 HZ, 9600, ENGLISH         | 3   |  |
| 32   | 00-876846-07          | CABLE ASSEMBLY, GROUND, CONT PANELS, 9600 | 1   |  |
| 33   | 00-877009-01          | ASSEMBLY, OUTLET STRIP, INTERNATIONAL AC  | 1   |  |
| 34   | 00-876803-01          | CABLE ASSEMBLY, VIDEO, INT, VCR, 9600     | 1   |  |
| 35   | 00-876802-01          | CABLE ASSEMBLY, CONT, INT, VCR, 9600      | 1   |  |
| 36   | 00-876803-02          | CABLE ASSEMBLY, VIDEO, INT, VCR, 9600     | 1   |  |
| 37   | 00-876444-01          | CABLE ASSEMBLY, TB2-J16                   | 1   |  |
| 38   | 00-900740-01          | CABLE ASSEMBLY, A9P10 TO J12, 13, 14      | 1   |  |



Fig. 2-14C Interface Cable Diagram, Imaging Workstation (Sheet 3 of 5)

|      | FIG. 2-14D PARTS LIST |   |     |  |
|------|-----------------------|---|-----|--|
| ITEM | PART NUMBER           | DESCRIPTION                                   | QTY |  |
| 39   | 00-900720-01          | CABLE ASSEMBLY, VCR1/VCR2, 9600               | 2   |  |
| 40   | 00-900462-01          | CABLE, SIGNAL, VIDEO, SW TO AUX               | 1   |  |
| 41   | 00-878014-01          | CABLE ASSEMBLY, AUX IF/HRS CONV, WORKSTATION  | 1   |  |
| 42   | 00-876442-01          | CABLE ASSEMBLY, VIDEO, SW/AUX I/F             | 1   |  |
| 43   | 00-876449-01          | CABLE ASSEMBLY, SIGNAL, AUX INTF/VIDEO SW     | 1   |  |
| 44   | 00-900948-01          | CABLE ASSEMBLY, VIDEO, 9600                   | 1   |  |
| 45   | 00-876453-01          | CABLE ASSEMBLY, SIGNAL, IP/VIDEO, SW          | 1   |  |
| 46   | 00-900721-01          | CABLE ASSEMBLY, COAX, VIDEO SW-IP, 9600       | 1   |  |
| 47   | 00-876634-01          | CABLE ASSEMBLY, POWER, IP, VIDEO SW & AUX I/F | 2   |  |
| 48   | 00-876534-01          | CABLE ASSEMBLY, INTERNAL VCR CONTROL          | 1   |  |
| 49   | 00-876450-01          | CABLE ASSEMBLY, SIGNAL AT COM 26 PIN          | 1   |  |
| 50   | 00-876451-01          | CABLE ASSEMBLY, SIGNAL AT COM 34 PIN          | 1   |  |
| 51   | 00-876452-01          | CABLE ASSEMBLY, SIGNAL AT COM 50 PIN          | 1   |  |
| 52   | 00-876550-01          | CABLE ASSEMBLY, COAX, NETWORK (FIG, 2-15E)    | 1   |  |
| 53   | 00-876447-01          | CABLE ASSEMBLY, POWER, DISK DRIVES            | 1   |  |
| 54   | 00-876446-01          | CABLE ASSEMBLY, POWER, MOTHERBOARD            | 1   |  |
| 55   | 00-876394-01          | CABLE ASSEMBLY, DISK DRIVE & ALTA             | 1   |  |
| 56   | 00-877291-01          | CABLE ASSEMBLY, 30 FPS HARD DRIVE POWER, 9600 | 1   |  |
| 57   | 00-876536-01          | CABLE ASSEMBLY, POWER, ETI                    | 1   |  |
| 58   | 00-876445-01          | CABLE ASSEMBLY, POWER SUPPLY                  | 1   |  |
| 59   | 00-876546-01          | CABLE ASSEMBLY, PS1 TO A10                    | 1   |  |
| 60   | 00-876439-01          | CABLE ASSEMBLY, DC POWER & AUX I/F TO J9      | 1   |  |



Fig. 2-14D Interface Cable Diagram, Imaging Workstation (Sheet 4 of 5)

|      | FIG. 2-14E PARTS LIST |   |     |  |
|------|-----------------------|---|-----|--|
| ITEM | PART NUMBER           | DESCRIPTION   | QTY |  |
| 45   | 00-876453-01          | CABLE ASSEMBLY, SIGNAL, IP/VIDEO, SW                  | 1   |  |
| 46   | 00-900721-01          | CABLE ASSEMBLY, COAX, VIDEO SW-IP, 9600               | 1   |  |
| 47   | 00-876634-01          | CABLE ASSEMBLY, POWER, IP, VIDEO SW & AUX I/F         | 2   |  |
| 48   | 00-876534-01          | CABLE ASSEMBLY, INTERNAL VCR CONT (FIG. 1-14D))       | 1   |  |
| 49   | 00-876450-01          | CABLE ASSEMBLY, SIGNAL AT COM 26 PIN                  | 1   |  |
| 50   | 00-876451-01          | CABLE ASSEMBLY, SIGNAL AT COM 34 PIN                  | 1   |  |
| 51   | 00-876452-01          | CABLE ASSEMBLY, SIGNAL AT COM 50 PIN                  | 1   |  |
| 52   | 00-876550-01          | CABLE ASSEMBLY, COAX, NETWORK                         | 1   |  |
| 53   | 00-876447-01          | CABLE ASSEMBLY, POWER, DISK DRIVES                    | 1   |  |
| 54   | 00-876446-01          | CABLE ASSEMBLY, POWER, MOTHERBOARD                    | 1   |  |
| 55   | 00-876394-01          | CABLE ASSEMBLY, DISK DRIVE & ALTA                     | 1   |  |
| 56   | 00-877291-01          | CABLE ASSEMBLY, 30 FPS HARD DRIVE POWER, 9600         | 1   |  |
| 57   | 00-876536-01          | CABLE ASSEMBLY, POWER, ETI (FIG. 1-14D)               | 1   |  |
| 58   | 00-876445-01          | CABLE ASSEMBLY, POWER SUPPLY (FIG. 1-14D)             | 1   |  |
| 59   | 00-876546-01          | CABLE ASSEMBLY, PS1 TO A10 (FIG. 1-14D)               | 1   |  |
| 60   | 00-876439-01          | CABLE ASSEMBLY, DC POWER & AUX I/F TO J9 (FIG. 1-14D) | 1   |  |
| 61   | 00-876455-01          | CABLE ASSEMBLY, SIGNAL, FLOPPY DISK                   | 1   |  |
| 62   | 00-876367-01          | CABLE ASSEMBLY, DATA FAST SCAN-IP                     | 1   |  |
| 63   | 00-877365-01          | CABLE ASSEMBLY, SIGNAL, ALTA 2 HD, 2, 30 FPS          | 1   |  |
| 64   | 00-877364-01          | CABLE ASSEMBLY, SIGNAL, ALTA 1-ALTA, 30 FPS           | 1   |  |
| 65   | 00-876395-01          | CABLE ASSEMBLY, SIGNAL, ALTA IPI TO IP                | 1   |  |
| 66   | 00-877412-01          | CABLE ASSEMBLY, SIGNAL, IP-ALTA                       | 1   |  |

|      | FIG. 2-14E PARTS LIST (CONT.) |   |     |  |
|------|-------------------------------|---|-----|--|
| ITEM | PART NUMBER                   | DESCRIPTION                             | QTY |  |
| 67   | 00-877363-01                  | CABLE ASSEMBLY, SIGNAL, IP-ALTA, 30 FPS | 1   |  |
| 68   | 00-877977-01                  | CABLE ASSEMBLY, LASER CAM I/F, 9600     | 1   |  |
| 69   | 00-877366-01                  | CABLE ASSEMBLY, SIGNAL, ALTA-SCSI/HD    | 1   |  |
| 70   | 00-876454-01                  | CABLE ASSEMBLY, SIGNAL, HD, 40 PIN      | 1   |  |
| 71   | 00-876366-01                  | CABLE ASSEMBLY, FAST SCAN-BNC (RIGHT)   | 1   |  |
| 72   | 00-876366-02                  | CABLE ASSEMBLY, FAST SCAN-BNC (LEFT)    | 1   |  |
| 73   | 00-877901-01                  | CABLE ASSEMBLY, VIDEO, FASTSCAN, 9600   | 1   |  |
| 74   | 00-878014-01                  | CABLE ASSEMBLY, AUX IF/HRS CONV         | 1   |  |



Fig. 2-14E Interface Cable Diagram, Imaging Workstation (Sheet 5 of 5)

| ATTACHING HARDWARE |   |     |
|--------------------|---|-----|
| PART NUMBER        | DESCRIPTION                                   | QTY |
| 00-876119-01       | SPACER, HINGE, SIDE, ELECT BOX                | 1   |
| 00-876990-01       | CLIP, SPRING, KEYBOARD                        | 1   |
| 00-900407-02       | WASHER, COLOR CODED                           | 1   |
| 00-900407-03       | WASHER, LOCK, SERRATED                        | 1   |
| 00-900407-04       | NUT, MU 0.8                                   | 1   |
| 00-900407-05       | WASHER, U/M6                                  | 1   |
| 10-601106-04       | SCREW, SLFTAP, PAN, SLT, 6-32, 1/4, SZC       | 2   |
| 12-215004-04       | SCREW, MACH, FL, TRX, 4-40, 1/4, SZC          | 4   |
| 12-215006-06       | SCREW, MACH, FL, TRX, 6-32, 3/8, SZC          | 18  |
| 12-215006-08       | SCREW, MACH, FL, TRX, 6-32, 1/2, SZC          | 10  |
| 12-215006-12       | SCREW, MACH, FL, TRX, 6-32, 3/4, SZC          | 8   |
| 12-215008-06       | SCREW, MACH, FL, TRX, 8-32, 3/8, SZC          | 1   |
| 12-221104-04       | SCREW, MACH, PAN, PHL, 4-40, 1/4, SST         | 7   |
| 12-221104-12       | SCREW, MACH, PAN, PHL, 4-40, 3/4, SST         | 2   |
| 12-225104-04       | SCREW, SEMS SPRING, PAN, PHL, 4-40, 1/4, SZC  | 2   |
| 12-225104-05       | SCREW, SEMS SPRING, PAN, TRX, 4-10, 5/16, SZC | 42  |
| 12-225104-06       | SCREW, SEMS SPRING, PAN, TRX, 4-40, 3/8, SZC  | 2   |
| 12-225106-04       | SCREW, SEMS APR, PAN, TRX, 6-32, 1/4, SZC     | 6   |
| 12-225106-06       | SCREW, SEMS SPRING, PAN, TRX, 6-32, 3/8, SZC  | 31  |
| 12-225106-08       | SCREW, SEMS SPRING, PAN, TRX, 6-32, 1/2, SZC  | 23  |
| 12-225106-12       | SCREW, SEMS SPRING, PAN, TRX, 6-32, 3/4, SZC  | 10  |

| ATTACHING HARDWARE (CONT.) |  |     |  |  |  |
|----------------------------|--|-----|--|--|--|
| PART NUMBER                | DESCRIPTION                                    | QTY |  |  |  |
| 12-225108-06               | SCREW, SEMS SPRING, PAN, TRX, 8-32, 3/8, SZC   | 41  |  |  |  |
| 12-225108-08               | SCREW, SEMS SPRING, PAN, TRX, 8/32, 1/2, SZC   | 14  |  |  |  |
| 12-225108-12               | SCREW, SEMS SPRING, PAN, TRX, 8/32, 3/4, SZC   | 2   |  |  |  |
| 12-225303-08               | SCREW, METRIC SEMS, PAN, TRX, M3X0.5, 6MM, SZ  | 14  |  |  |  |
| 12-312014-10               | SCREW, NA, SKT, HEX, 1/4-20, 5/8, SST          | 14  |  |  |  |
| 12-600000-08               | SCREW, NA, HEX, CAP, 1/4-20, 1/2, SZY, 8       | 8   |  |  |  |
| 12-900711-04               | SCREW, MACH, PAN, SLT, 4-40, 1/4, NYLON        | 2   |  |  |  |
| 12-912008-14               | SCREW, METRIC, HEX, CAP, M8X1.25, 12MM, SST    | 4   |  |  |  |
| 13-122104-00               | NUT, HEX, 4-40, NYLON, NA, A = .250, C = .094  | 2   |  |  |  |
| 13-311104-00               | NUT, HEX-LK-EXT-T, 4-40, SST, NA, A = .250     | 5   |  |  |  |
| 13-311106-00               | NUT, HEX-LK-EXT-T, 6-32, SST, NA, A = .313     | 33  |  |  |  |
| 13-311108-00               | NUT, HEX-LK-EXT-T, 8-32, SST, NA, A = .344     | 14  |  |  |  |
| 13-311114-00               | NUT, HEX-LK-EXT-T, 1/4-20, SST, NA, A = .4     | 11  |  |  |  |
| 13-532011-00               | NUT, HEX-LK-W/INSR, 5/16-18, SZC               | 4   |  |  |  |
| 14-101104-00               | WASHER, PL, #4, SZC, NA, ID = .125, OD = .312  | 2   |  |  |  |
| 14-102014-00               | WASHER, PL, 1/4, SST, NA, ID = .265, OD = .500 | 8   |  |  |  |
| 14-111104-00               | WASHER, PL, #4, SST, MS15795-804, ID = .120    | 5   |  |  |  |
| 14-201104-00               | WASHER, LK-HLCL-SPR, #4, SST, MS35338-135      | 8   |  |  |  |
| 14-211114-00               | WASHER, LK-HLCL-SPR, 1/4, SST, MS35338-        | 8   |  |  |  |
| 14-311112-00               | WASHER, LK-EXT-T, 5/16, SST, NA, ID = .320     | 4   |  |  |  |

| ATTACHING HARDWARE (CONT.) |   |     |  |  |  |
|----------------------------|---|-----|--|--|--|
| PART NUMBER                | DESCRIPTION                                     | QTY |  |  |  |
| 14-311114-00               | WASHER, LK-EXT-T, 1/4, SST, NA, ID = .256       | 12  |  |  |  |
| 14-900002-00               | WASHER, PL, #4, SST, NA, ID = .125, OD = .281   | 2   |  |  |  |
| 14-999702-00               | WASHER, PL, #4, NYLON, NA, ID = .125, OD = .250 | 2   |  |  |  |
| 21-709008-00               | SPRING, CPRSN, .420OD, 3/4LG, .042WD, SST       | 2   |  |  |  |
| 22-012010-00               | CLAMP, CABLE, 7/16D, 1/2W, STL                  | 1   |  |  |  |
| 22-012101-00               | CLAMP, CABLE/W, .437 X .39SQ, .219W, NYLON      | 18  |  |  |  |
| 22-012102-00               | CLAMP, CABLE/W, .437 X .75SQ, .219W, NYLON      | 5   |  |  |  |
| 22-012103-00               | CLAMP, CABLE/W, .437 X .34SQ, .219W, NYLON      | 23  |  |  |  |
| 22-012104-00               | CLAMP, CABLE/W, .437 X 1.02SQ, .219W, NYLON     | 6   |  |  |  |
| 22-119605-00               | CLAMP, CABLE TIE MT, NYLON                      | 2   |  |  |  |
| 22-119650-00               | CLAMP, CABLE TIE, 3/32 X 3-5/8, NYLON           | AR  |  |  |  |
| 23-620843-00               | RETAINER, 1/4TRN, .485OD X .013THK, SST         | 8   |  |  |  |
| 23-621841-00               | FASTENER, 1/4TRN STD, PHL, SZC                  | 8   |  |  |  |
| 23-621843-00               | FASTENER, RCPT, 1/4TRN, CLP-ON, .062/.187       | 8   |  |  |  |
| 23-621844-00               | FASTENER, 1/4TRN STD, PHL, MINTR, NYLON         | 6   |  |  |  |
| 23-621845-00               | FASTENER, RCPT, 1/4TRN, CLP-ON, .0011/.080      | 6   |  |  |  |

# Section 3 SERIES9600<sup>™</sup> Imaging Workstation Illustrated Parts Manual Updates



# SERIES9600<sup>™</sup> Imaging Workstation Illustrated Parts Manual Update July 1995 (P/N 00-878549-01)

This update reflects changes that occurred to the SERIES**9600** Imaging Workstation Illustrated Parts Manual. Review the contents to familiarize yourself with the field replaceable units that have changed. Place this update in the back of your Illustrated Parts Manual, behind the other sections.

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| FIG. 1 JULY 1995 UPDATE PARTS LIST |              |  |     |  |  |  |
|------------------------------------|--------------|--|-----|--|--|--|
| ITEM                               | PART NUMBER  | DESCRIPTION                                  | QTY |  |  |  |
| 1                                  | 00-900968-01 | PANEL ASSEMBLY, FRONT ESP (ENGLISH)          | 1   |  |  |  |
| 1                                  | 00-900968-02 | PANEL ASSEMBLY, FRONT ESP (GERMAN)           | 1   |  |  |  |
| 1                                  | 00-900968-03 | PANEL ASSEMBLY, FRONT ESP (FRENCH)           | 1   |  |  |  |
| 1                                  | 00-900968-04 | PANEL ASSEMBLY, FRONT ESP (SPANISH)          | 1   |  |  |  |
| 1                                  | 00-900968-05 | PANEL ASSEMBLY, FRONT ESP (ITALIAN)          | 1   |  |  |  |
| 2                                  | 00-900967-01 | PANEL ASSEMBLY, FRONT VAS (ENGLISH)          | 1   |  |  |  |
| 2                                  | 00-900967-02 | PANEL ASSEMBLY, FRONT VAS (GERMAN)           | 1   |  |  |  |
| 2                                  | 00-900967-03 | PANEL ASSEMBLY, FRONT VAS (FRENCH)           | 1   |  |  |  |
| 2                                  | 00-900967-04 | PANEL ASSEMBLY, FRONT VAS (SPANISH)          | 1   |  |  |  |
| 2                                  | 00-900967-05 | PANEL ASSEMBLY, FRONT VAS (ITALIAN)          | 1   |  |  |  |
| 3                                  | 00-875981-03 | COVER SIDE, UPPER LEFT (NOT EXPLODED)        | 1   |  |  |  |
| 4                                  | 00-875981-04 | COVER SIDE, UPPER RIGHT (NOT EXPLODED/SHOWN) | 1   |  |  |  |
| 5                                  | 00-878420-01 | COVER, FRONT PANEL                           | 1   |  |  |  |
| 6                                  | 00-875986-03 | COVER, SIDE LOWER LEFT (NOT EXPLODED)        | 1   |  |  |  |
| 7                                  | 00-875986-04 | COVER, SIDE LOWER RIGHT (NOT EXPLODED)       | 1   |  |  |  |

**Note:** All items listed below are options on the European model.

| 8 | 00-878543-01 | FAN KIT                        | 1 |
|---|--------------|--------------------------------|---|
| 9 | 00-900975-01 | SONY 910 VIDEO GRAPHIC PRINTER | 1 |



Fig. 1 July 1995 Update Front Panel, Front Control Panel, Sony Printer, and Fan Kit Exploded View