INTEGRATED TABLE/TUBESTAND/GENERATOR VETERINARY RADIOGRAPHIC SYSTEM

MODEL S304 TABLE/TUBESTAND
MODEL W400 CONTROL

INSTALLATION AND SERVICE MANUAL

K186
REV. C

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1.0 UNPACKING

The Vet Radiographic System is delivered in the following five packages:

1. Control and High Voltage Transformer
2. X-Ray Tube
3. Collimator
4. Tubestand
5. Table and Accessories

It is the installer's responsibility to inspect the shipment for damage and proper count. Upon receipt of the merchandise, any visible damage to the cartons should immediately be examined while the shipper is present. If the visible damage to the cartons also includes damage to the merchandise, it is the installer's responsibility to either refuse shipment or assume the responsibility for making the merchandise work.

If there is hidden damage to the merchandise, it is the installer's responsibility to discover that damage within a reasonable amount of time and to contact the shipper.

2.0 RADIATION AND MECHANICAL/ELECTRICAL WARNINGS

2.1 RADIATION WARNINGS

X-Rays are dangerous to both operator and others in the vicinity unless established safe exposure procedures are strictly observed.

The useful and scattered beams can produce serious, genetic or potentially fatal bodily injuries to any persons in the surrounding area if used by an unskilled operator. Adequate precautions must always be taken to avoid exposure to the useful beam, as well as to leakage radiation from within the source housing or to scattered radiation resulting from the passage of radiation through matter.

Those authorized to operate, to test, and to participate in or supervise the operation of the equipment must be thoroughly familiar and comply completely with the currently established safe exposure factors and procedures described in publications such as Sub-Chapter J of Title 21 of the Code of Federal Regulations, "Diagnostic X-ray Systems and their Major Components," and the Natural Council on Radiation Protection (NCRP) No. 33, "Medical X-ray and Gamma-Ray Protection for energies up to 10 MeV-Equipment Design and Use," as revised or replaced in the future.

Failure to observe these warnings may cause serious, genetic or potentially fatal bodily injuries to the operator or those in the area.

2.2 ELECTRICAL WARNINGS

Failure to comply with the following may result in serious or potentially fatal bodily injuries to the operator or those in the area.

Only properly trained and qualified personnel should be permitted access to any internal parts. Live electrical terminals may be deadly; be sure line disconnect switches are opened and other appropriate precautions are taken before opening access doors, removing enclosure panels, or attaching accessories.

Do not remove the flexible high voltage cables from the x-ray tube housing or high voltage transformer or the access covers from the generator until the main and auxiliary power supplies have been disconnected.

When disconnecting high-voltage cables, they must be grounded immediately in order to dissipate any electrical charge that may remain on the cables or the tube.

2.3 MECHANICAL WARNINGS

Particular care should be taken when servicing the inside of the tubestand. There is an extreme threat of mechanical pinching between the vertical slide and counterweight due to their close proximity and opposite directions of motion.

All of the movable assemblies and parts of x-ray equipment should be operated with care. Only properly trained and qualified personnel should be permitted access to any internal parts.

3.0 PRELIMINARY MECHANICAL ASSEMBLY

3.1 RADIOGRAPHIC TABLE

1. The table top is designed to be removable. This allows access to the control and transformer for limited service purposes. The table top will be held in place by four (4) wing nuts located under the table top at both ends. However, during shipment, the tabletop is banded to the table base. Cut loose the banding and set the table top aside for assembly later.

2. Loosen the hold-down screws underneath the front rail of the table to release the grid cabinet. Remove packing material from rear of grid cabinet.

3. Install the four feet by threading the foot studs into the threaded holes at the two front corners of the table and the two extreme ends of the back rail. Fully tighten the foot until the shoulder of the foot is firmly against the bottom of the table or the back rail. Do not attempt to level the table at this time.

3.2 TUBESTAND

As shipped from the factory, the tubestand is complete in its entirety except for the tube mount. Do not remove any of the screws from the back cover of the tubestand until after the tube and collimator are assembled. The larger screws secure the counterweight and slide during shipping and installation.

1. Remove tubestand stop on one end of the lower rail of table.

2. Lift the tubestand from behind by holding the upper bearing bracket. Guide the upper bearing into the table track first and then the lower bearing. Push the tubestand fully onto the table. If you experience any "hanging up" of the tubestand, it will probably be due to interference between bolt heads on the bottom of the upper bearing carrier and the sheet metal edge of the table. Merely lift the tubestand slightly higher to clear this interference.

3. Reinstall the tubestand stop on the lower rail.

4. Install the tube mount by inserting the 1 ½" diameter tube arm of the tube mount into the collar on the face of the tubestand. Be sure to fully insert the tube arm. Secure the tube arm by tightening the two set screws on the outside diameter of the collar.

3.3 TUBE AND COLLIMATOR

To install the x-ray tube and collimator, see their respective installation manuals.

You can now remove the two hex head hold-down screws in the back of the tubestand to free the vertical slide and counterweight.

3.4 HIGH VOLTAGE TRANSFORMER

1. Verify that the oil level in the H.V. transformer is approximately ½" to ¾" below the underside of the cover. Refill with "Shell Diala Oil AX" or remove oil as necessary.

2. Position the transformer to the right-hand rear corner of the table enclosure. Loosen the screw on the vent plug to allow for oil expansion. Cover the vent plug and flange with one of the loose fitting plastic covers provided with the H.V. transformer to prevent contaminants from entering the oil.

3.5 POSITION CONTROL

1. Place two short pieces (approx. 30”) of 2 X 4 lumber in front of the table as shown in Figure A.

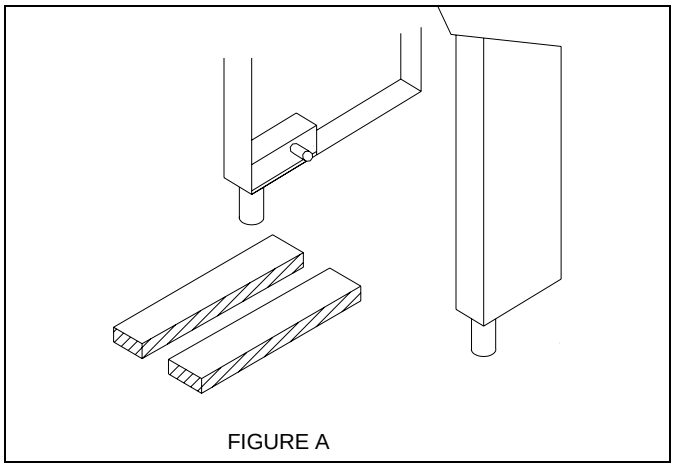


FIGURE A

2. Lift the control by its holding straps and place it on the 2 X 4s with the front face of the control downward and the bottom of the control facing the table, as shown below in Figure B.

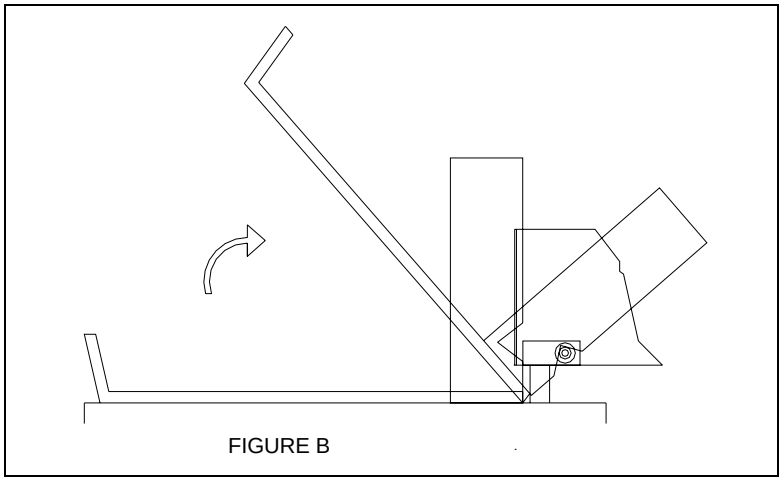


FIGURE B

3. Center the control on the table opening.

4. Push the control along the 2 X 4s toward the table until the control edges contact the front feet of the table.

4.0 CONTROL DATA, HOOKUP and CALIBRATION

4.1 TECHNICAL RATINGS

Rated Line Voltage – 240 VAC, 60 Hz., Singe Phase (50Hz optional).

Range of Line Voltage Regulation at Max. Line Current = 1-5%.

Maximum Line Current (based on input voltage of 240 VAC) = 140A.

Technique Factors that Constitute the Maximum Line Current – 300mA @ 125 kVp.

Control Rating –

a. Output Current = 300mA max.
b. Output Voltage = 125kVp max.

Note: 50 Hz units are programmed with either 100 kVp or 125 kVp Max. limits per customer's specifications.

Control Duty Cycle –

100mA @ 125kVp – 4%
300mA @ 125kVp – 1%

4.2 ELECTRICAL POWER SUPPLY REQUIREMENTS

The information provided below is taken from NEMA standards, Minimum Power Supply Requirements for X-Ray Machines, and National Electric Code.

Equipment Category – 300mA @ 125kVp, Single Phase.

Nominal Line Voltage – 240 VAC, 60 Hz., Single Phase (50 Hz optional).

Note: Alternate line voltages which will provide normal operation are 194-284 VAC.

Maximum Momentary Line Current – 140 amperes (at 240 VAC)

Note: Maximum momentary line current at alternate line voltages can be determined using the following formula:

$$I_2 = \frac{140 \times 240}{V_2}$$

Where V_2 represents the alternate line voltage, and I2 represents the maximum line current at the alternate line voltage, "V_2."

Line Voltage Regulation – Not to exceed 5% at maximum line current.

$$\text{Percent line voltage regulation} = \frac{V_N - V_L}{V_L} \times 100$$

Where V_N represents line voltage under "no load" conditions.
V_L represents line voltage under "full load" conditions.

Minimum Over Current Protection Rating – 50% of maximum line current rating or greater. Assuming maximum line current to be 140 amps, this value would be 70 amperes or greater.

Wire Size from Power Transformer to Disconnect Switch – for 50 feet use #2AWG; for 100 feet use #00AWG; for 200 feet use 250 mcm.

Connection to Supply Circuit (taken from N.F.P.A 70-1984)
A disconnecting means of adequate capacity for at least 50% of the input required for the momentary rating shall be provided in the supply circuit. The disconnecting means shall be operable from a location readily accessible from the x-ray control. Underwriters Laboratories also requires that this disconnecting means be mounted on either the wall behind the x-ray control or the wall directly adjacent to it.

4.3 CONTROL HOOKUP

1. Remove the rear cover of the electrical chassis.

2. Exiting the rear of the control are the following three (3) electrical cables (from the right to the left as viewed from the rear):

   a. HV Transformer primary power (P1, P2, and G)
   b. Line Cable (L1, L2, and G)
   c. HV Transformer auxiliary power (XS, XL, XC and M1)

3. Route the kVp and mAs display cables from the tubestand, under the lower tubestand rail, through the cable opening on the right (viewed from the rear) and behind the component panel connecting them to their respective headers, H4 and H5 on the E860 PCB.

4. Connect the HV transformer primary power cable (P1, P2 & GND) to the transformer.

5. Hook up the HV transformer auxiliary cable (XS, XL, XC & M1) to the transformer.

6. Insert the cable from the foot switch or the optional remove switch through a cable opening of the control and connect to terminals “S1,” “S2” & “S3” on TB-3.

7. Insert the collimator power cable through a cable opening of the control and connect to terminals “C1”, “C2” & GND on TB-3. (Only for 24 VAC collimators)

8. Insert the x-ray tube stator cable through a cable opening of the control and connect to terminals on TB-3 according to the following table:

DESCRIPTION		COLOR CODE FOR STATOR CABLE		
TERMINAL MARKINGS (OF TB3)	**CONNECTIONS**	**EUREKA TUBES**	**MACHLET TUBES**	**SUMMIT AND TOSHIBA TUBES**
07	RUN WDG. OF TUBE STATOR	BLACK	BLACK	BLACK
08	START WDG OF TUBE STATOR	RED	GREEN	RED
09	COM. LEAD OF TUBE STATOR	WHITE	WHITE	WHITE
T5	*THERMAL CUTOUT SWITCH (OPTIONAL)	ORANGE/BROWN	---	YELLOW
T6	*THERMAL CUTOUT SWITCH (OPTIONAL)	BROWN/ORANGE	---	BLUE

*If the tube has a thermal cutout switch, remove jumper across T5 and T6 and connect leads as indicated. If the tube does not have a thermal cutout switch, terminals T5 and T6 of the control must be jumpered together. (Control is shipped with this jumper installed.)

9. Connect High Voltage Cables (H.V. Cables)

The high voltage transformer requires the use of H.V. cables constructed with federal standard terminals.

Note: Use extreme care when handling the H.V. cables to avoid damaging the plug or terminal pins.

Be sure that “Anode” of H.V. transformer connects to “Anode” of x-ray tube, and “Cathode” to “Cathode.” H.V. cable terminals must be thoroughly cleaned and then coated with a thick coating of Vapor Proofing Compound (normally provided with the x-ray tube) prior to insertion into the x-ray tube or H.V.

transformer receptacles. Insert the H.V. cable terminals into the appropriate receptacle and screw the cable nut as tightly as possible by hand – Do not use tools for tightening.

10. Ensure that the control's main on/off switch is in the "Off" position and the incoming power safety disconnect is in the "Off" position prior to connecting the line cable.

    Route the line cable under the lower tubestand rail and hook up to the safety disconnect. Connect "L1" to one leg of the incoming line power, "L2" to the other incoming leg and "G" to the ground lug.

4.4 PRELIMINARY CALIBRATION

1. Calibration will normally involve only the adjustment of the current and verification of kVp accuracy. It is recommended that the assembler read and understand the information provided with the x-ray tube prior to making any x-ray exposures. Particular attention should be given to:

    a) Pre-warming of the anode
    b) Initial seasoning of the x-ray tube
    c) Single exposure tube ratings
    d) Long time accumulated heat ratings of tube

    It is also recommended that measuring equipment be connected into the x-ray system and used to monitor mA and kVp throughout the calibration procedure. This reduces the chances of misleading test data and unnecessary backtracking.

2. Line voltage adjustments:

    Terminals on the TB1 are provided for coarse and fine adjustments of line voltage. Measure the line voltage at the disconnect switch and relocate wires marked "LVAC" and "LVAF" to two terminals where the sum of the two terminal markings equal the measured line voltage, ±2 VAC. For example: If line voltage is 240 VAC, connect "LVAC" to "224" and "LVAF" to "+16."

3. Preset all selector switches.

    Prior to turning "on" power, set each selector switch as follows:

    Power "On-Off" -- "Off"
    kVp major and minor --Fully Counterclockwise
    mA selector --300L
    Time selector --1/120 sec (1/100 sec for 50Hz units).

4. Disconnect leads marked P1 and P2 from H.V. transformer and insulate with electrical tape. This will prevent accidental production of x-rays during initial check-out. Switch the power safety disconnect switch "On" and then switch the control's "on-off" switch to "On." Observe the following:

   mA display reads "-E-"
   kVp display is not illuminated at all.

5. While observing the tube filaments through the port of the x-ray tube, verify that the correct filament is lit for each mA station.

6. Depress the foot switch to the 1st stage (Prep), or the "Prep" button on the optional remote switch, and verify anode rotation and filament boost.

7. The kVp meter circuit is factory adjusted, but should be checked to verify its calibration.

   a) With power "Off" connect an AC voltmeter capable of reading 0-250 VAC across the wipers (center terminals of tap switches) of the kVp selector switches (major and minor). This will allow measurement of the "no-load" primary voltage.

   b) Turn on power and adjust the kVp selector switches to result in 220 VAC indicated on the voltmeter.

   c) Compare the kVp meter indications for the mA stations with the values given below:

mA Station	kVp Meter Indication (kVp)
100	114
300	88

   Then reset kVp selectors to result in a voltmeter indication of 160 VAC and compare the kVp meter indications for the mA stations with the values given below:

mA Station	kVp Meter Indication (kVp)
100	81
300	53

   If the kVp meter indication varies by more than 5 kVp from the values given above, proceed to the kVp calibration procedure.

   Switch the disconnect switch to "Off" and reconnect the leads P1 and P2 to the H.V. control.

4.5 mA CALIBRATION

Achieving maximum accuracy of tube current (mA) involves two types of adjustments:

1) Overall mA level (bands of filament resistor RX), and
2) mA balance throughout the useful kVp range (bands of space charge compensating resistor RSCC)

The leads connected to the resistor bands of RX are marked with numbers which correspond to the mA stations. Moving one of these bands toward the control panel increases the mA for the corresponding mA station.

The leads connected to the bands of RSCC are also marked with numbers which correspond to the mA stations. Moving one of these bands toward the control panel causes a reduction of mA at high kVp levels as compared to low kVp levels for the corresponding mA station. This is commonly referred to as the balance adjustment or space charge compensation.

Due to the method of space charge compensation utitlized, normal tracking will result in mA values slightly higher than selected near 80 kVp and mA values equal to one another but slightly lower than selected levels at the high and low ends of the kVp range (125 and 50). See Figure C below for visual presentation of this effect.

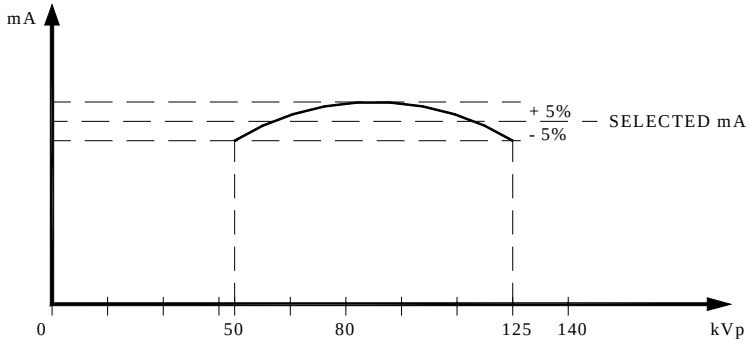


FIGURE C

Connect a Dynalyzer or an mA meter to perform the following procedure. A mA meter can be inserted into the circuit by removing the jumper between TB4-“MA-” and TB4-“MA+” and connecting the meter to those terminals. Replace jumper after removing meter.

1. Select 100 mA and 80 kVp.
2. Adjust the band of RX marked 100A to produce approximately 105 mA (moving the band toward the control panel increases mA).
3. Select 50 kVp and note the mA produced.

4. Select 120 kVp and note the mA produced.
5. If the mA at 120 kVp is higher than the mA at 50 kVp, move the band of RSCC marked 100 toward control panel. If lower, move the band away from control panel.
6. Repeat steps (1) through (5) until no further adjustments are necessary.
7. Check mA tracking from 50 to 120 kVp and fine tune as required. The unit is capable, but fine tuning, to track within ± 5% of selected value.
8. Repeat steps (1) through (7) for the 300 mA station substituting 312 mA for 105 mA, band 300A for 100A and band 300 for 100.

4.6 kVp CALIBRATION

This x-ray control comes equipped with an adjustable circuit used to compensate the kVp meter for loading effects. This circuit is identified as "kVp Meter Compensation Circuit." Its adjustment consists of:

(2) Independent offset pots
(2) Independent slope pots.

These adjustment pots are mounted on the E860, kVp, mAs and Interlock PCB which is mounted inside the control on the electrical chassis.

4.6.1 WITH A MEANS TO MEASURE ACTUAL kVp

Note: In order to make a valid comparison between the measured peak tube potential (kVp) and the kVp meter's pre-read indication, the tube current must be calibrated accurately. Failure to do so will result in an erroneous determination of kVp accuracy.

A. 100 mA STATION

1) Select 100 mA and 50 kVp. While monitoring mA and kVp output, compare the measured kVp meter's pre-read indication.

2) Adjust the 100 mA offset pot, P3, until the kVp meter's pre-read indication matches the measured kVp output.

3) Select 120 kVp. Make an x-ray exposure and adjust the slope pot "P1" until the kVp meter's pre-read indication matches the measured kVp output. Repeat steps 1, 2, and 3 above until no further adjustments are necessary.

4) Check final kVp meter tracking over the entire kVp range. Under normal conditions the kVp meter's indication will not deviate from the measured kVp output by more than 5 kVp.

B. 300 mA STATION

1) Select 300 mA and 50 kVp. While monitoring mA and kVp output, compare the measured kVp to the kVp meter's pre-read indication.

2) Adjust the 300 mA offset pot, P4, until the kVp meter's pre-read indication matches the measured kVp output.

3) Select 120 kVp. Make an x-ray exposure and adjust the slope pot "P2" until the kVp meter's pre-read indication matches the measured kVp output. Repeat steps 1,2, and 3 above until no further adjustments are necessary.

4) Check final kVp meter tracking over the entire kVp range. Under normal conditions the kVp meter's indication will not deviate from the measured kVp output by more than 5 kVp.

4.6.2 WITHOUT A MEANS TO MEASURE ACTUAL kVp

A. 100 mA STATION

1) Connect an AC voltmeter capable of measuring 0-300 VAC to the common terminals of the minor and major kVp tap switches.

2) Select 100 mA and adjust kVp tap switches to give you a reading of 105 VAC.

3) Adjust the 100 mA offset pot, P3, until the kVp meter reads 50 kVp.

4) Adjust the kVp tap switches to give you a reading of 230 VAC.

5) Adjust the 100 mA slope pot, P1, until the kVp meter reads 120 kVp.

6) Repeat steps 2 through 5 until no further adjustments are required.

B. 300 mA STATION

1) Connect an AC voltmeter capable of measuring 0-300 VAC to the common terminals of the minor and major kVp tap switches

2) Select 300 mA and adjust kVp tap switches to give you a reading of 155 VAC.

3) Adjust the 300 mA offset pot, P4, until the kVp meter reads 50 kVp.

4) Adjust the kVp tap switches to give you a reading of 277 VAC.

5) Adjust the 300 mA slope pot, P2, until the kVp meter reads 120 kVp.

6) Repeat steps 2 through 5 until no further adjustments are required.

4.7 X-RAY TUBE PROTECTION SETTINGS

Set dip switches SW2-1 & SW2-2 on the E860 kVp, mAs and Interlock PCB to the appropriate settings for the x-ray tube being used. Refer to the switch setting information on the tag attached to the E860 PCB.

4.8 X-RAY TERMINATION BEEPER SETTINGS

The volume & duration of the x-ray termination beeper is adjustable via (2) pots located on the timer PCB assembly, C118: Turning R48 counter-clockwise increases the volume from quiet to very loud & turning R44 counter-clockwise increases the duration from approx. 0.5 to 2.0 seconds.

Note: The rear cover of the control will quiet the sound considerably so test the sound with the cover in place.

5.0 CONTROL ASSEMBLY AND FINAL MECHANICAL ASSEMBLY

5.1 CONTROL ASSEMBLY

1) The control should still be positioned face down on the floor, as described in section 3.5. Install rear cover of control prior to assembling the control to the base of the table.

2) Cable routing may be performed at this time. While some of the cable routing is customized to the installation, there are some recommendations to allow for proper operation of the control door. Clearance must be left between the cables and the back rail in order for the door to open and close properly. Loop cables and attach to cover, as shown, to aid in routing. See Figure D and Figure E on the next page .

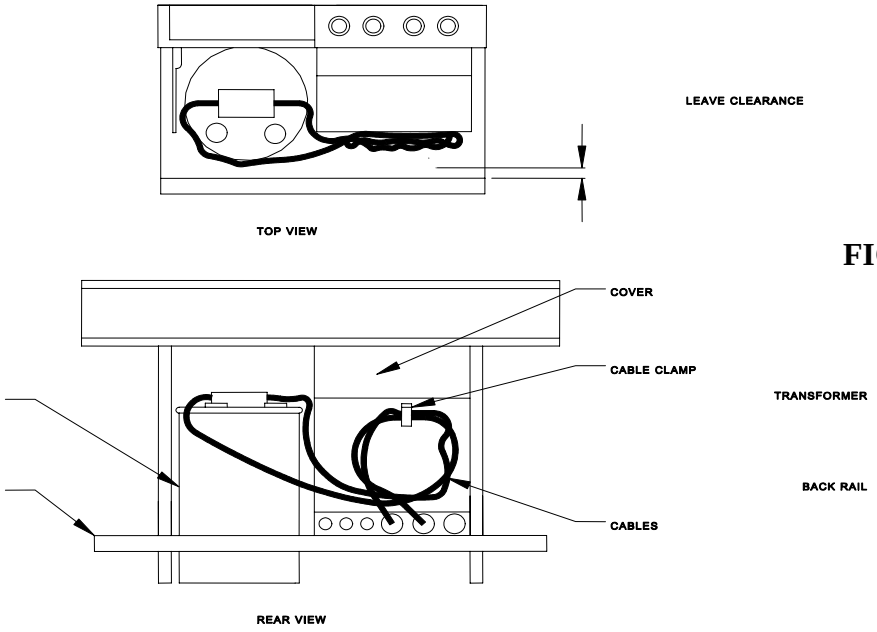


FIGURE D

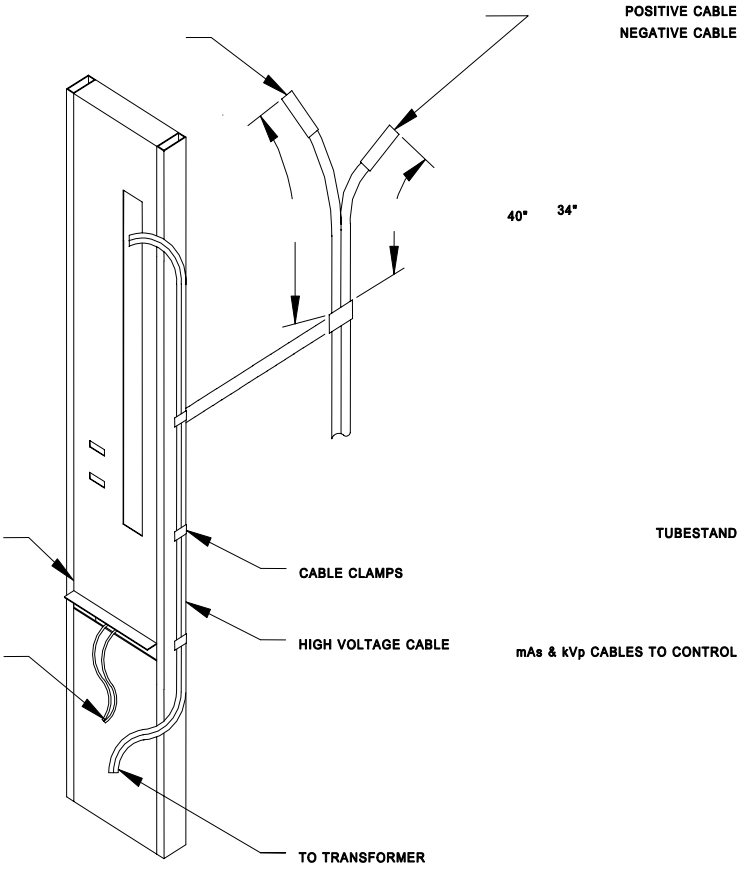


FIGURE E

3) Tilt the control upward until it is nearly vertical. At that time, the notches on the side of the control will engage the pivots at the base of the table. Once this occurs, position the control in its closed position. See Figure B on page 8.

4) Attach air cylinder to front and rear linkages as shown in Figure F.

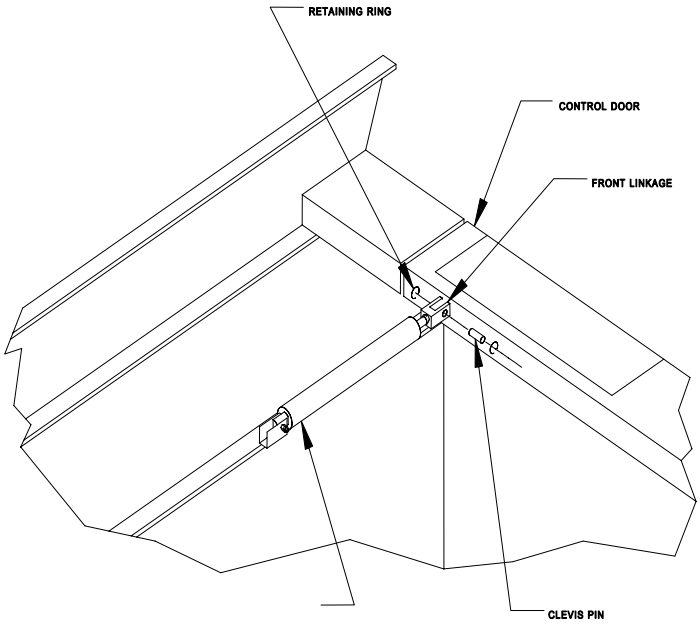


FIGURE F

5) Install foot treadle in the front of the control, as shown in Figure G.

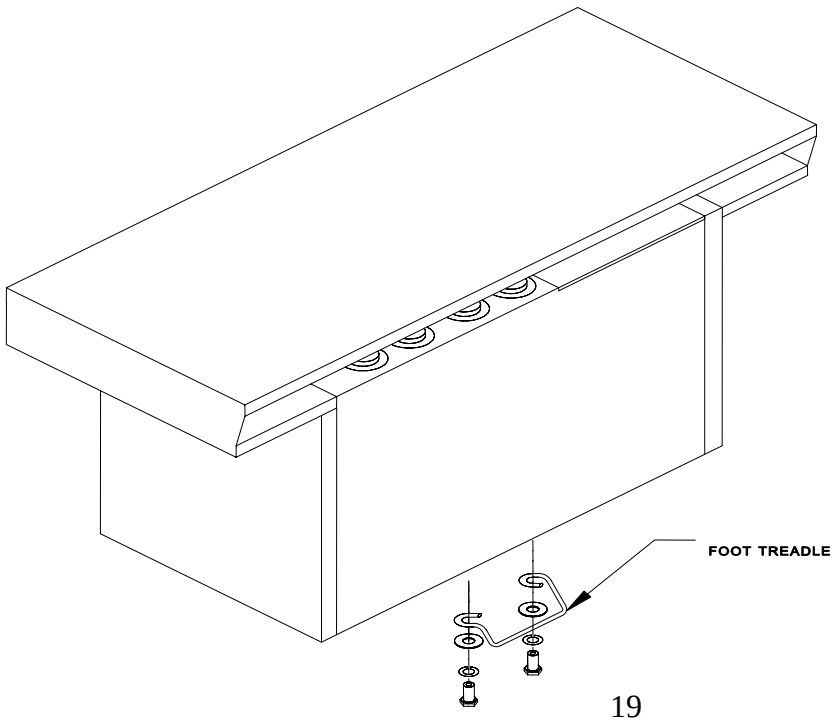


FIGURE G

6) Install the Film Cassette Storage Box Lid by positioning the lid over the opening and forcing, if necessary, the fillister head screws into the two notches to form a pivot.

5.2 GRID CABINET INTERLOCK

As assembled, the Grid Cabinet interlock should engage the striker plate. If this is not the case, the striker plate can be adjusted forward or back.

5.3 TABLE TOP ASSEMBLY

1) To attach table top, align studs in table top with slots in table supports and place in position.

2) Fasten panel to underside using washer and wing nuts provided.

5.4 SECURING TABLE TO FLOOR

Once the table is in position, it can be secured to the floor using the four (4) clamps provided with the feet. Merely slide the clamp into the notch at the base of each foot, turn at 45 degrees to the table and secure with a lag screw.

5.5 TIE DOWN CLEATS (OPTIONAL)

At each end of the table, holes are provided to mount the tie down cleats.

6.0 MECHANICAL ADJUSTMENTS

6.1 TUBE ARM LEVELING

Simply adjust tube arm level by turning the Allen head screw just below the tube arm. Turn clockwise to raise the tube.

6.2 CENTERING THE BEAM ON THE TABLE

The tube arm may be adjusted in or out ± 1/4" by loosening the set screws. Be sure to refasten the set screws securely.

6.3 TUBESTAND PERPENDICULARITY

The tubestand must be perpendicular to the table. If adjustment is required, the tubestand must be removed from the table and the bottom roller of the tubestand must be adjusted.

6.4 VERTICAL SLIDE OPERATION

The vertical slide is balanced to retain its position anywhere along its travel. To position the tube 40" from either the table top or the film cassette, detents are provided. These detents are factory adjusted, however some adjustment is provided if needed. Releasing the front panel from its mounting, will permit the front panel to move forward approximately 4".

WARNING

Particular care should be taken when servicing the inside of the tubestand. There is an **extreme** threat of mechanical pinching between the vertical slide and counterweight due to their close proximity and opposite directions of motion.

All of the movable assemblies and parts of x-ray equipment should be operated with care. Only properly trained and qualified personnel should be permitted access to any internal parts.

6.5 HORIZONTAL BRAKE OPERATION

Horizontal brake is not provided on units shipped after 1997.

6.6 LEVELING THE TABLE

To level the table, you need merely to back out any one of the four feet by turning counterclockwise. You need not lift the table to perform this step. The screw will lift it for you.

Once you have achieved the elevation desired, insert one or more of the shims provided and then tighten the foot against the shim.

CAUTION: *Do not fail to shim any gap between the table and the foot, as the table's stability requires that the foot be firmly tightened against the table base or a shim.*

6.7 ALIGNING THE CONTROL CABINET TO THE TABLE

You may have noticed that while leveling the table the alignment of the upper front corners of the control to the table pedestal, the table from changes slightly. If the lack of symmetry between the left side and right side of assembly of the control/pedestal assembly becomes unsightly, you can bring the joints into better symmetry by making minor adjustments to either of the two front feet.

Specifically, if you want to close the joint in one corner, you may either lower the height of the foot at that corner or raise the height of the opposite front corner of the pedestal. Again, be sure to use shims and securely tighten the foot once the proper height has been ascertained.

6.8 S.I.D. SCALE

The S.I.D. scale has marked positions, “40” table top and “40” film tray. A small hole (0.140 diameter) in the curtain is the indicator. When the indicator is moved to either the “table top” or “film tray” position, the detent will engage.

6.9 TRIMMING THE COUTERWEIGHT

One-half (1/2) pound trim weights are provided in the accessory box. Because of the double pulley design, these are equivalent to adding one whole pound. To add weight, lower the tube to the table top in order to position the counterweight at its highest point. Reach over the top of the tubestand and install the trimmer(s) on the main weight by inserting the ends of the trimmer into the protruding ends of the plastic counterweight guides.

6.10 TABLE TOP EXTENSION (OPTIONAL)

The table top extension adds 12” of additional table top surface and can be mounted on either end of the table. To attach the extension align notches in extension with buttons mounted on end of table support and slide over buttons are shown in Figure H.

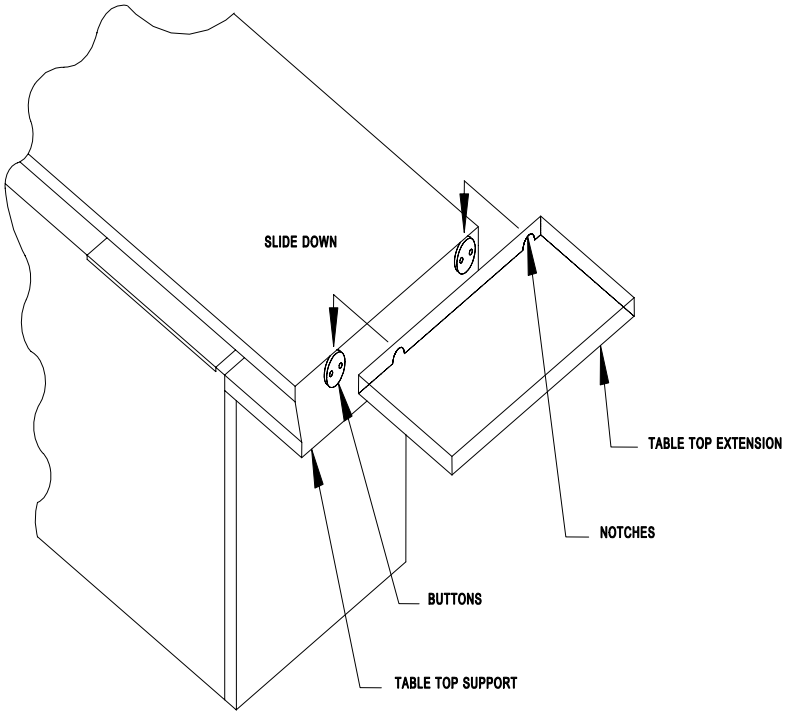
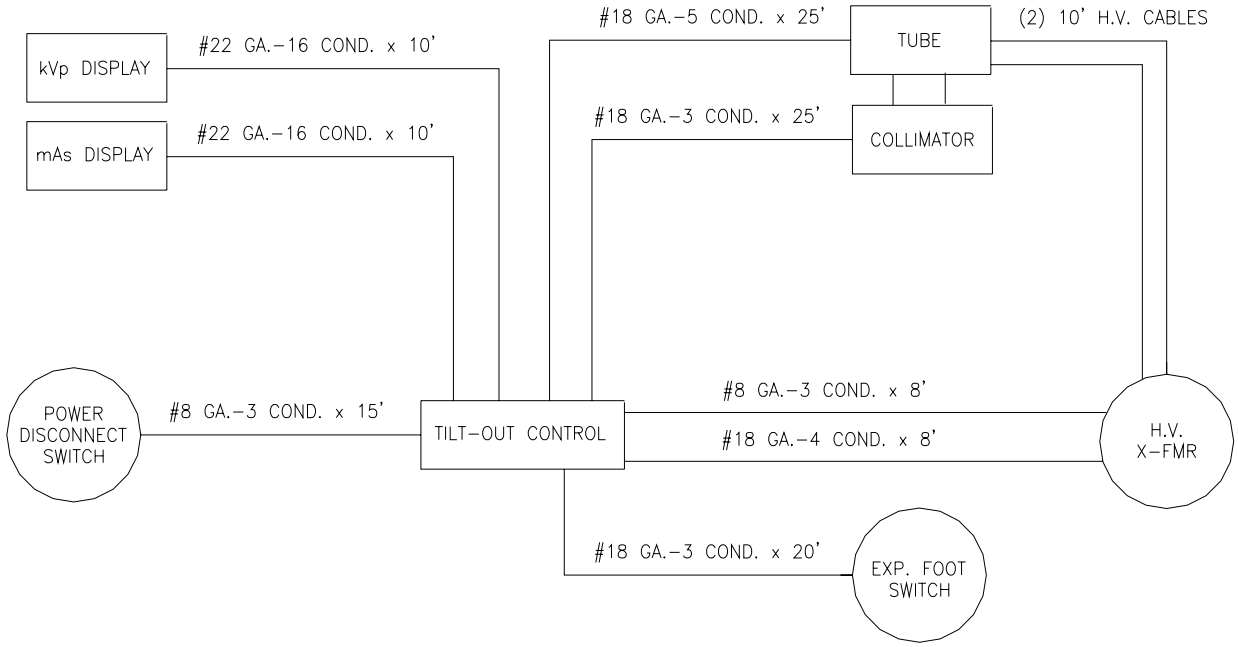


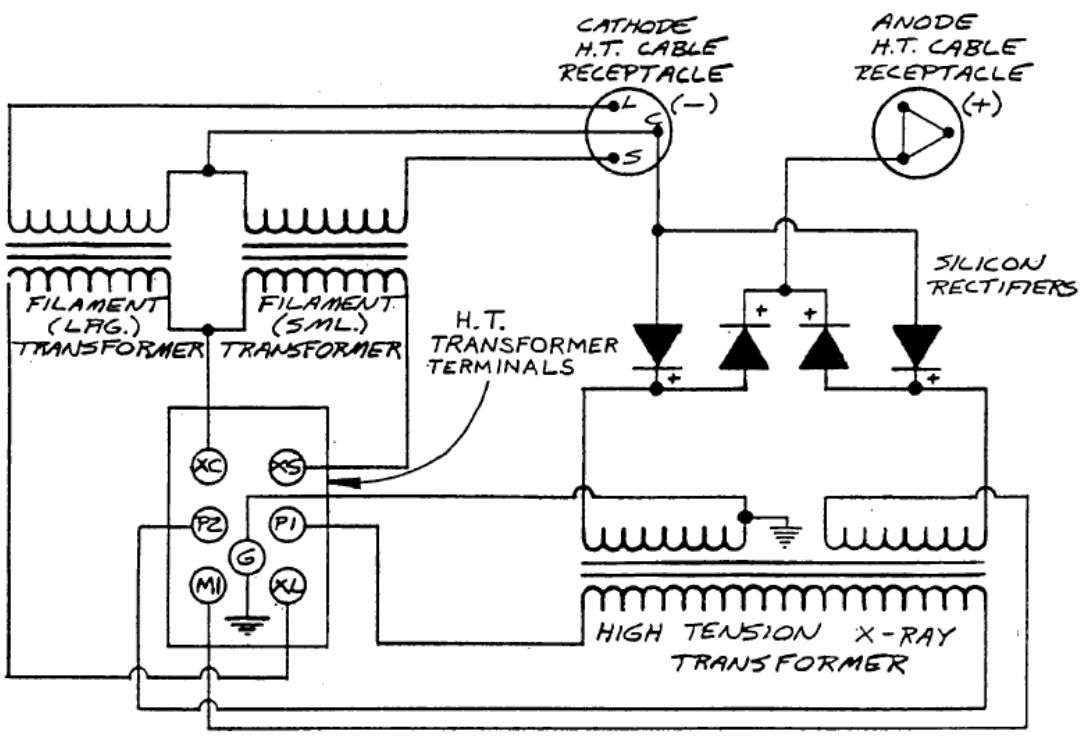
FIGURE H

7.0 ELECTRICAL SCHEMATICS AND DIAGRAMS

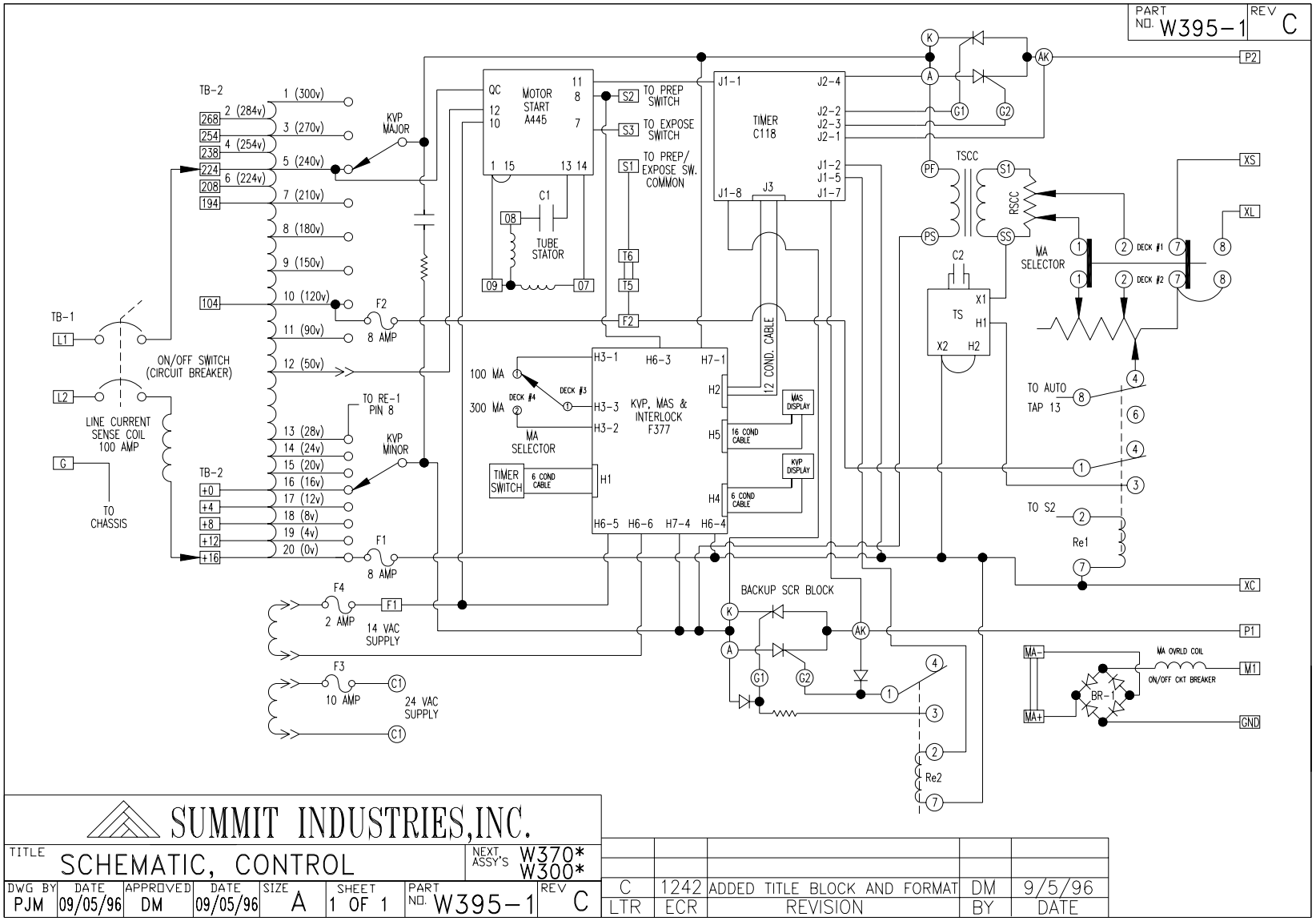


SYSTEMS CABLE ROUTING/INTERCONNECT DIAGRAM
(STANDARD CABLE SIZES & LENGTHS SHOWN)

B133 REV. A



HIGH TENSION TRANSFORMER
DIAGRAM A700

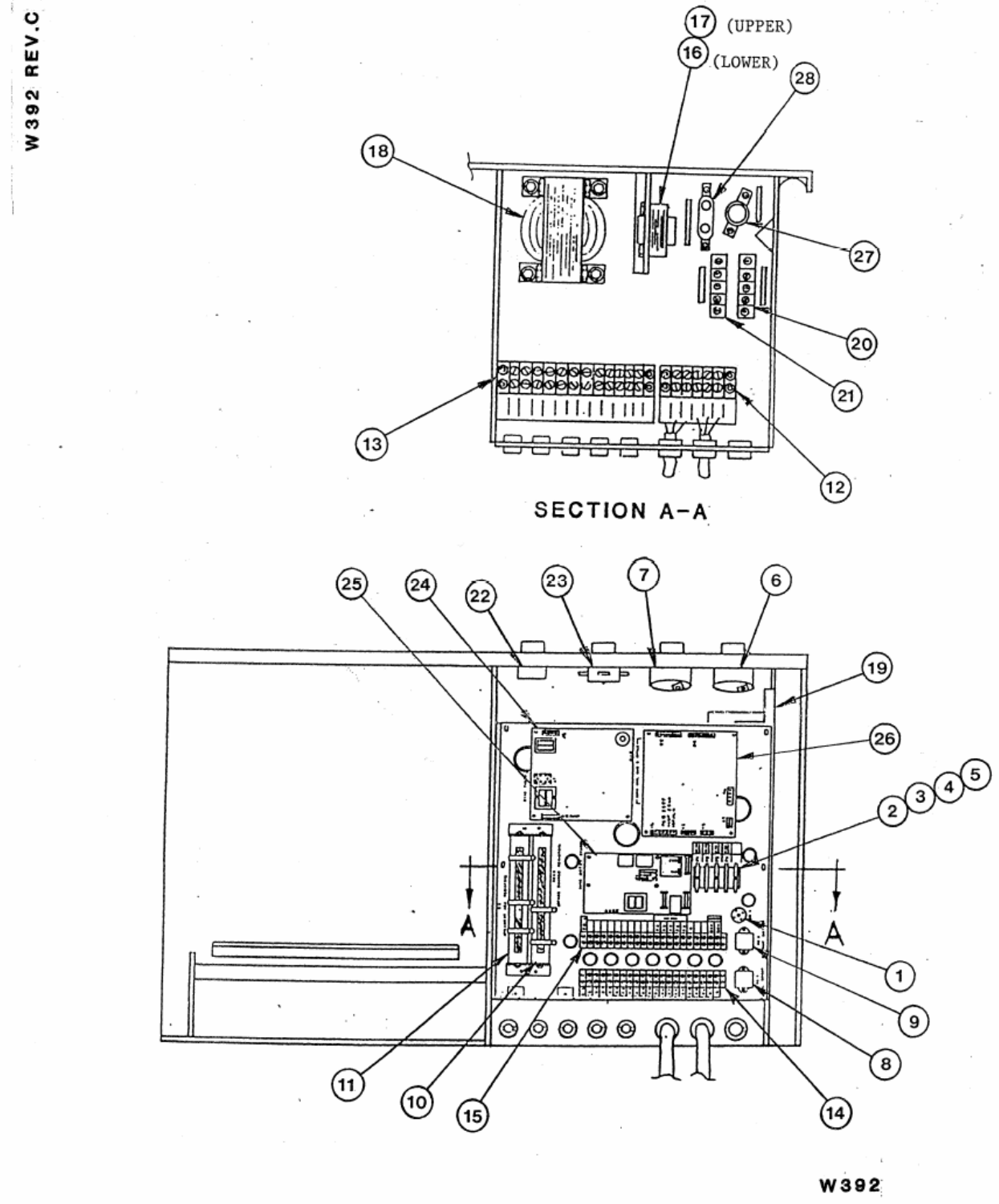

PART NO. W395-1
REV C
TB-2
1 (300v)
2 (284v)
3 (270v)
4 (254v)
5 (240v)
6 (224v)
7 (210v)
8 (180v)
9 (150v)
10 (120v)
11 (90v)
12 (50v)
13 (28v)
14 (24v)
15 (20v)
16 (16v)
17 (12v)
18 (8v)
19 (4v)
20 (0v)
268
254
238
224
208
194
104
+0
+4
+8
+12
+16
KVP MAJOR
KVP MINOR
TB-1
L1
L2
G
ON/OFF SWITCH (CIRCUIT BREAKER)
LINE CURRENT SENSE COIL 100 AMP
TO CHASSIS
TO RE-1 PIN 8
F1
8 AMP
F2
8 AMP
F3
10 AMP
24 VAC SUPPLY
F4
2 AMP
14 VAC SUPPLY
QC
MOTOR START A445
11
8
12
10
7
1
15
13
14
C1
08
09
07
TUBE STATOR
S2
TO PREP SWITCH
S3
TO EXPOSE SWITCH
S1
TO PREP/ EXPOSE SW. COMMON
T6
T5
F2
100 MA
300 MA
DECK #3
DECK #4
MA SELECTOR
TIMER SWITCH
6 COND CABLE
H3-1
H6-3
H7-1
H3-3
H3-2
KVP, MAS & INTERLOCK F377
H1
H2
H5
H4
H6-5
H6-6
H7-4
H6-4
12 COND. CABLE
16 COND CABLE
6 COND CABLE
MAS DISPLAY
KVP DISPLAY
J1-1
J2-4
J2-2
J2-3
J2-1
TIMER C118
J1-2
J1-5
J1-7
J1-8
J3
BACKUP SCR BLOCK
K
A
AK
G1
G2
PF
PS
TSCC
S1
SS
RSCC
C2
TS
X1
H1
X2
H2
MA SELECTOR
DECK #1
DECK #2
TO AUTO TAP 13
TO S2
Re1
Re2
XS
XL
XC
P1
P2
W1
GND
MA-
MA+
BR-1
MA OVRLD COIL
ON/OFF CKT BREAKER
SUMMIT INDUSTRIES,INC.
TITLE
SCHEMATIC, CONTROL
NEXT ASSY'S W370* W300*
DWG BY PJM
DATE 09/05/96
APPROVED DM
DATE 09/05/96
SIZE A
SHEET 1 OF 1
PART NO. W395-1
REV C
C 1242 ADDED TITLE BLOCK AND FORMAT DM 9/5/96
LTR ECR REVISION BY DATE

COMPONENT LOCATION IDENTIFICATION

Item No.	Legend	Description
1	BR1	Bridge Rectifier, mA (10A)
2	F1	Fuse, 8A
3	F2	Fuse, 8A
4	F3	Fuse, 10A
5	F4	Fuse, 2A
6	KV Major	Tap Sw., Ohmite 312-8
7	KV Minor	Tap Sw., Ohmite 312-8
8	RE1	Relay, DPDT, 120VAC HH91
9	RE2	Relay, DPDT, 120VAC HH91
10	RSCC	Resistor, 25 Ohm, 175 W
11	RX	Resistor, 100 Ohm, 175 W
12	TB1	Terminal Strip, 5 Terminals
13	TB2	Terminal Strip, 12 Terminals
14	TB3	Terminal Strip, 20 Terminals
15	TB4	Terminal Strip, 20 Terminals
16	TS	Transformer, Stabilizer (CVT), 120/120 volt
17	TSCC	Transformer, Space Charge, 300/30 volt
18	-----	Transformer, Auto
19	-----	Circuit Breaker/On-Off Switch
20	-----	SCR Block, Main
21	-----	SCR Block, Back-up
22	-----	Switch Assembly, Time Select
23	-----	Switch Assembly, mA Select
24	-----	PCB Assembly, Time Select
25	-----	PCB Assembly, kVp, Motor Start
26	-----	PCB Assembly, kVp / mAs / Interlock
27	C1	Capacitor, Rotor Start
28	C2	Capacitor, Stabilizer

COMPONENT LOCATION DIAGRAM

W392 REV.C



Technical Support Dept.
Ph: (800) 729-9729
ext. 1 for customer service
ext. 2 for Tech Service

Original InnoVet Part Description rev.12/06	Part Number
W300, W375, W400, W438 (Generator L802)	
Air Cylinder, Damper for hinged generator tilt	W369 (Bimba 125)
cable, F377 to C118 Timer PCBA	E948
Cable, kVp display	E950
Cable, mAs display	E951
Curtain Strip, OlderTbST W200	W215
Foot Loop	K090
Grid Cabinet	W048
Knob with pointer	W344
Knob without pointer	A312
kVp Tap Switch (8 position)	02255-000
LED replacement kit	00312-000
mA Selector Switch assy	W354
mA selector switch cable	comes with W354
Manual - (See MASTERS = Not in OBSOLETE)	K186
On/Off Circuit Breaker	A365
pcb, kVp/mAs Interlock	F377
pcb, Motor Start (rotor control)	A455
pcb, Timer Driver	C118
Relay, RE-1 / RE-2	HH91
Relay socket assy for RE-2 (exposure)	W351
Relay socket for RE-1 (boost)	HH81
Remote exposure switch (wall mount)	W413
Resistor, Filament 100 Ohm, 175 W RX/RXS	A347
Resistor, Filament 25 Ohm, 175 W RSCC	A345
Rotor Cap 25uF, 330V	HAB18
SCR Kit (includes Instructions)	00424-000
SCR block ^ Please order with instructions ^	00194-000
Sliders, Front Grid Cabinet	00673-000
Snubber/Suppressor (Tap Switch)	W440
Stabilizer cap, C2, 660V 2.5*u*F	A343
Stator Capacitor, C1, 330V 25*u*F(formerly A351)	HAB18
Switches for RemoteAssy (Cap J783)	C414
Two position prep/exposure switch button	J783
Time encoder EPROM (for F377 Board)	W341
Time Selector Switch assy	J976
Time Selector Switch Cable	comes with J976
Transformer, Space Charge	L926
Transformer, Stabilizer, Filament	A342
TS Capacitor, C2	A343
Two position prep/exposure foot switch	A981

GENERAL TIPS

Verify basic voltages: Line tap is correctly set for supply, 120 VAC F1 to F2, on F377 board, H6-5 to H6-6 is 14 VAC, TP9 is +5 VDC, TP11 is -5 VDC, TP10 common

Verify basic connections: P1 white, P2 black, Ground green. XL white, XS green, XC black, M1 red. Rotor 07 black, 08 red, 09 white; typically 30 ohms 07 to 09 and 60 ohms 08 to 09. Insure tight crimps, receptor studs and screw terminals.

"--E--" in mAs window

This occurs because the F377 does not know the kV, mA or time selected. It can happen from improper kV selection (above 125 or below 40 kVp), bad tap switch, timer switch, mA switch, poor cable connections from these devices, P1/P2 voltage in idle (a loose stud on transformer top), or a failure of the F377 board.

1. **kVp window blank and "--E--" in the mAs window**, suspect no tap switch voltage input to the F377 board. Adjust kVp tap switches so that 200 VAC is present between the common poles. Insure 200 VAC is present at pins H7-1 and H7-4 of the F377 board. Find the open connection or replace the board.

2. **kVp window blank and "--E--" in the mAs window**, a second cause is no mA select signal on H3 of the F377. Insure H3-1 is +5 VDC when selecting small filament, H3-2 is +5 VDC for large filament. Insure +5V on H3-3. Remove the H3 plug short pins H3-3 to H3-2 on the board. If the problem is resolved replace the selector and cable, if not, replace the board.

3. **kVp is between 40 and 125 kVp but the mAs window is "--E--"**, the problem is related to the time station code. Monitor H1 pins 3, 4, 2, 5 and 6 (time station code) to insure binary increment count of +5 VDC as time is changed. The pins on H1 as shown above are in Most Significant Bit to Least Significant Bit sequence. Replace time selector and cable if bits are missing.

4. **kVp display reads "333"**, or some other scrambled, invalid kVp, U18 on F377 board (part number W341) has probably been damaged from electrical noise. Cycling power may clear the problem, and replacing the W341 chip will likely clear the problem. It is important to look for sources of noise, such as arcing in the high voltage secondary, rotor circuitry, solid grounding, and so on. Putting a 0.1mfd capacitor from pin 5 to pin 7 of U6, and another from pin 21 to pin 20 of U18 may help. Confirm that in IDLE, D11 to ground is +5VDC. If less, remove U18 and confirm that D11 returns to +5V. If it does, replace U18 (part #W341--even though removing this chip may not clear the "333" during this test). If +5V does not return, replace the F377 board.

No exposure & No "beep" from timer.

The two most likely causes are a failure of the motor start board to transition from boost to run during the prep cycle (due to 50k pot R17), or an open R30 on the kVp/mAs Interlock board. To determine which is the cause, rotate the kVp tap switches while the unit is in prep. If the kVp display changes the F377 kVp/mAs interlock board resistor is bad, if it does not suspect the A455 motor start board.

1. Does LED 1 on the motor start board light? If not, check stator circuitry, stator cap, and stator connections. Replace A455 motor start board.
2. D11 on F377 board must go from +5 VDC to ground at PREP. This signal turns the time select signal into an anticipated pulse count. Most common cause for this signal to be missing is an open R30 on the F377 board. Replace it with a 12k ohm resistor of at least 3 Watts. OC1 on the board is also suspect.
3. If there is a +5V to ground transition at PREP, verify an anticipated pulse count at the J3 input of C118. Pin one of J3 is the +5V supply, pins 2, thru 11 are Most Significant to Least Significant bits of the binary code for anticipated pulse count. If code and +5/+12 VDC supplies are good, replace C118 timer.
4. Is there 120 VAC between J1-1 and J1-2 on the C118 timer board at EXPOSE? If not, check pin 11 of motor start board, connections, and exposure switch.

No exposure, but timer "beeps"

1. Verify line tap is correctly set; the SCR drive voltage is an unregulated supply.
2. Verify filament voltage and mA. Typically 24 VAC in idle, 52 VAC (XL to XC) for 80 kVp at 300 mA boost. If close to zero volts, look for open in control. If 120 VAC look for an open in high voltage secondary.
3. Verify primary voltage and kVp. Look for RE-2 to close, insure good connections from J2 to primary SCR, confirm primary and backup SCRs conduct. Sometimes a resistor/diode component in the harness of the RE-2 socket will be open, preventing backup SCR gating. Replace C118 timer.

kVp or mAs segments do not light

Insure good connections between the wires and the plugs at either end of the kVp/mAs display cables. Remove the spring clip cover at the plug to inspect. Switch cables at control end, then tubestand end, to determine source of the open.

Unit exposes but no mA can be measured

Verify filament voltages (see description above), lit filaments, and presence of kVp. Ensure that the spark gap is not shorted to the top of the transformer.

CALIBRATION TIPS

mA adjustment

The actual mA output of the InnoVet® will depend upon the filament characteristics of the x-ray tube, but the following voltages and adjustment band positions are typical.

The RB band on resistor RX which controls filament voltage in idle will be at or very near the top end of the resistor, with about 24 VAC on it as measured from XC. Moving this band down will reduce idle filament voltage.

For the 100 mA station:

The 100 mA station resistor band on the filament resistor RX will be about 1/4 of the way up from the bottom of the resistor. Measured from XC to XS, the filament voltage will be about 21 VAC in idle and about 39 VAC in boost when 80 kVp is selected.

For the 300 mA station:

The 300 mA resistor band on the filament resistor RX will be about 3/8 of the way up from the bottom of the resistor. Measured from XC to XL, the filament voltage will be about 21 VAC in idle and 51 VAC in boost when 80 kVp is selected.

kVp adjustment

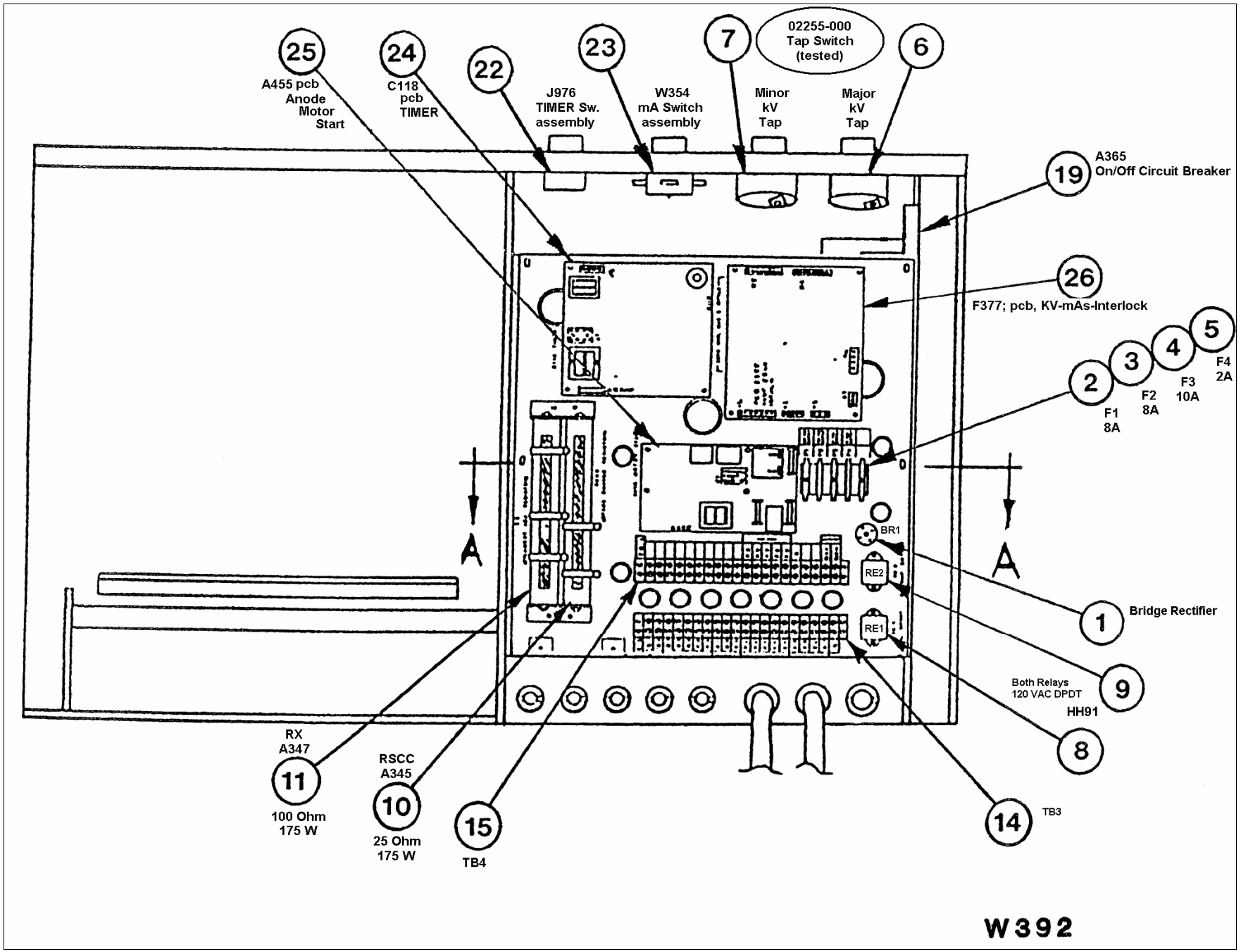
The actual kVp output of the InnoVet® can be predicted by the AC voltage measured between the common poles of the major and minor kVp tap switches for each mA station. As a result, it is possible to "pre-calibrate" the kVp display to read what the expected output should be, assuming the mA level is correct and the line voltage drop under load is within acceptable limits.

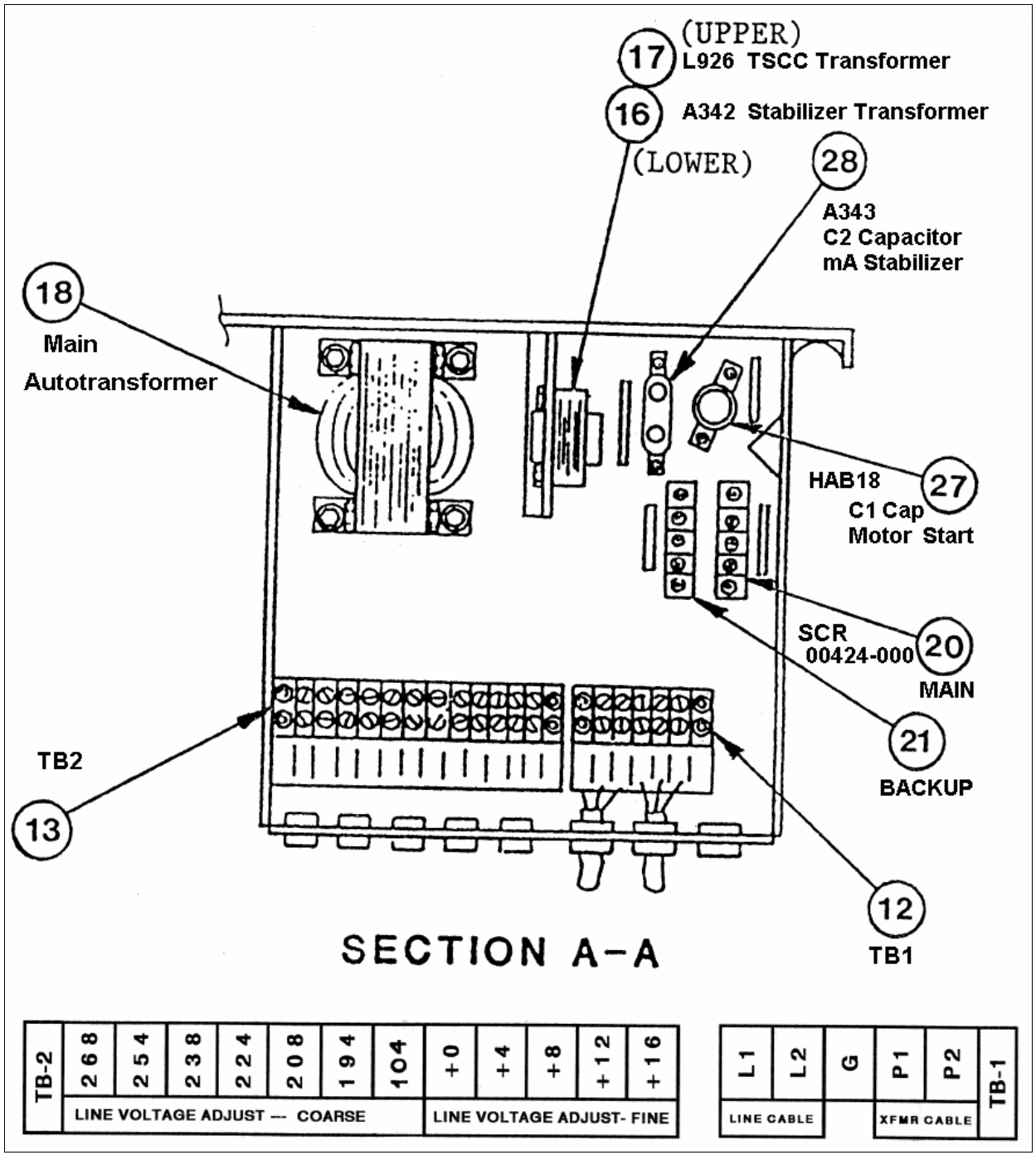
For the 100 mA station (these adjustments are interactive):
With 107 VAC between the tap switches, adjust P3 to display 50 kVp.
With 230 VAC between the tap switches, adjust P1 to display 120 kVp.
Typically 160 VAC between the tap switches will result in 80 kVp.

For the 300 mA station (these adjustments are interactive):
With 155 VAC between the tap switches, adjust P4 to display 50 kVp.
With 280 VAC between the tap switches, adjust P2 to display 120 kVp.
Typically 207 VAC between the tap switches will result in 80 kVp.

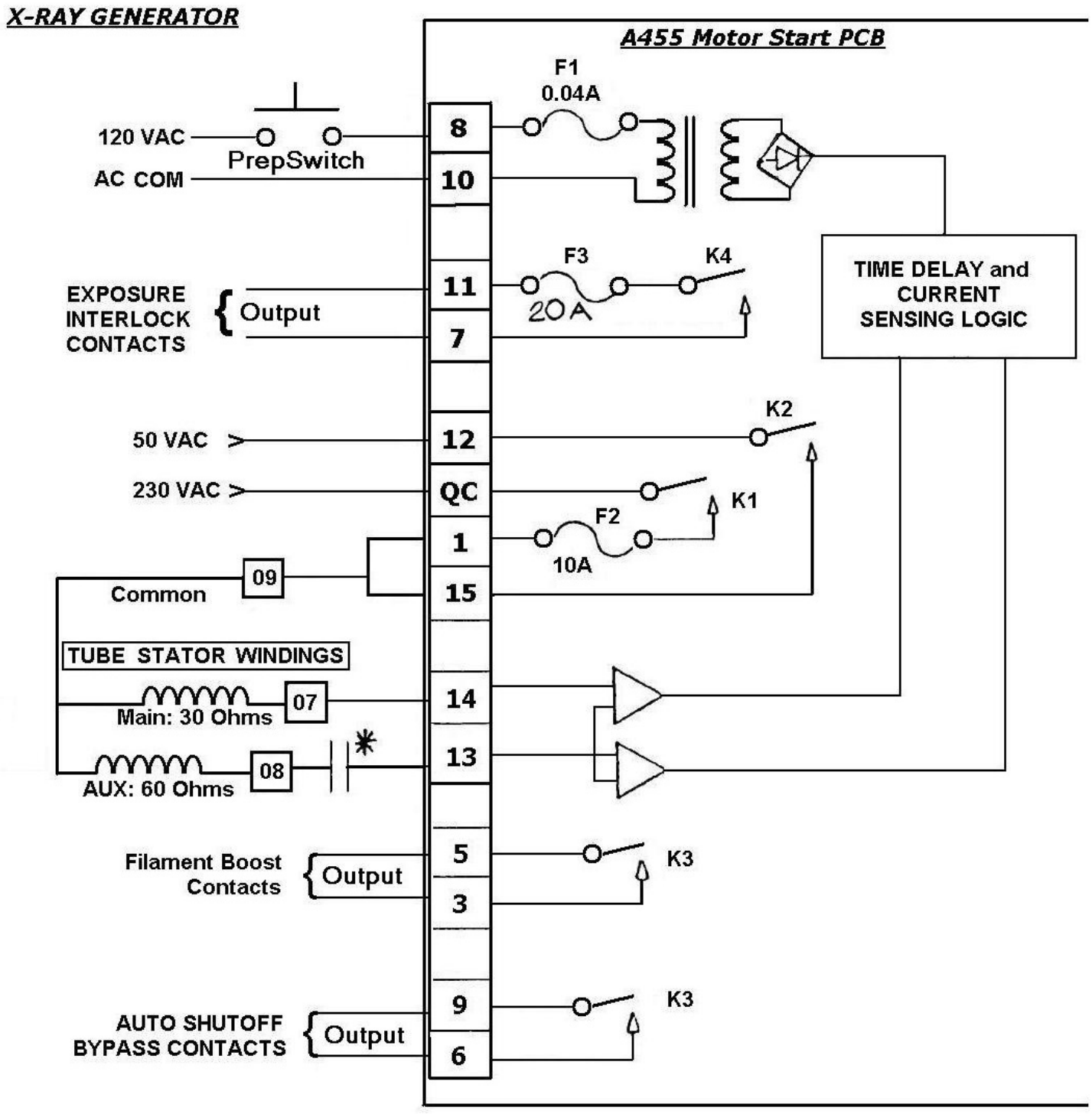
Space charge adjustment

On the space charge resistor RSCC, the 100 mA band will measure about 18 VAC from XC with 80 kVp selected. The 300 mA band will measure about 22 VAC from XC with 80 kVp selected. As the band is moved up on the resistor, the space charge compensation will increase, increasing mA at lower kVp and reducing mA at higher kVp. The goal is to have mA reasonably equal at low and high kVp.

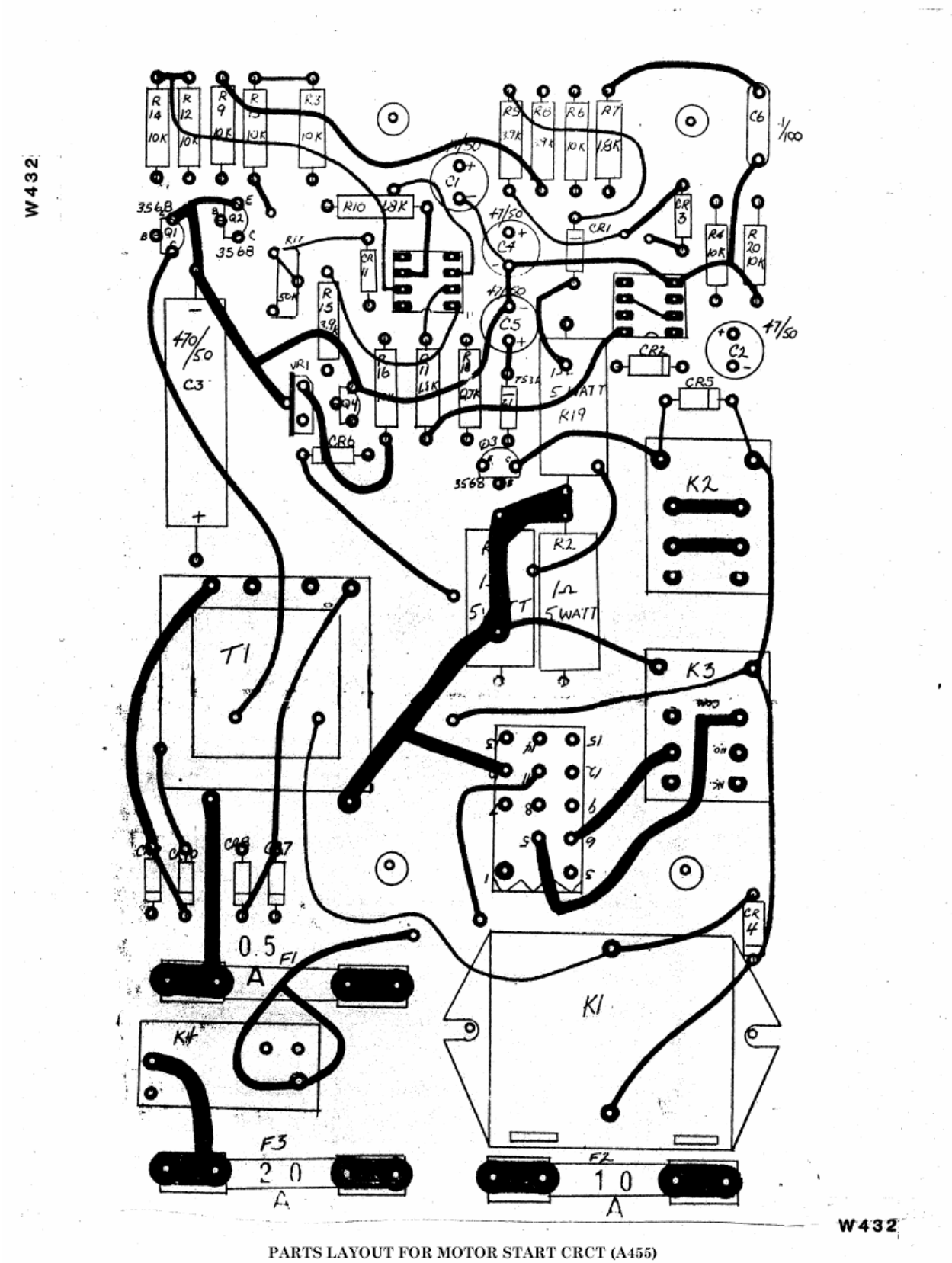

25
A455 pcb
Anode
Motor
Start
24
C118
pcb
TIMER
22
23
J976
TIMER Sw.
assembly
W354
mA Switch
assembly
7
02255-000
Tap Switch
(tested)
Minor
kV
Tap
6
Major
kV
Tap
19
A365
On/Off Circuit Breaker
26
F377; pcb, KV-mAs-Interlock
2
3
4
5
F1
8A
F2
8A
F3
10A
F4
2A
A
A
BR1
RE2
RE1
1
Bridge Rectifier
9
Both Relays
120 VAC DPDT
HH91
8
14
TB3
RX
A347
11
100 Ohm
175 W
RSCC
A345
10
25 Ohm
175 W
15
TB4
W392


(UPPER)
17
L926 TSCC Transformer
16
A342 Stabilizer Transformer
(LOWER)
28
A343
C2 Capacitor
mA Stabilizer
18
Main
Autotransformer
HAB18
27
C1 Cap
Motor Start
SCR
00424-000
20
MAIN
21
BACKUP
TB2
13
12
TB1
SECTION A-A
TB-2
268
254
238
224
208
194
104
+0
+4
+8
+12
+16
LINE VOLTAGE ADJUST — COARSE
LINE VOLTAGE ADJUST- FINE
L1
L2
G
P1
P2
TB-1
LINE CABLE
XFMR CABLE

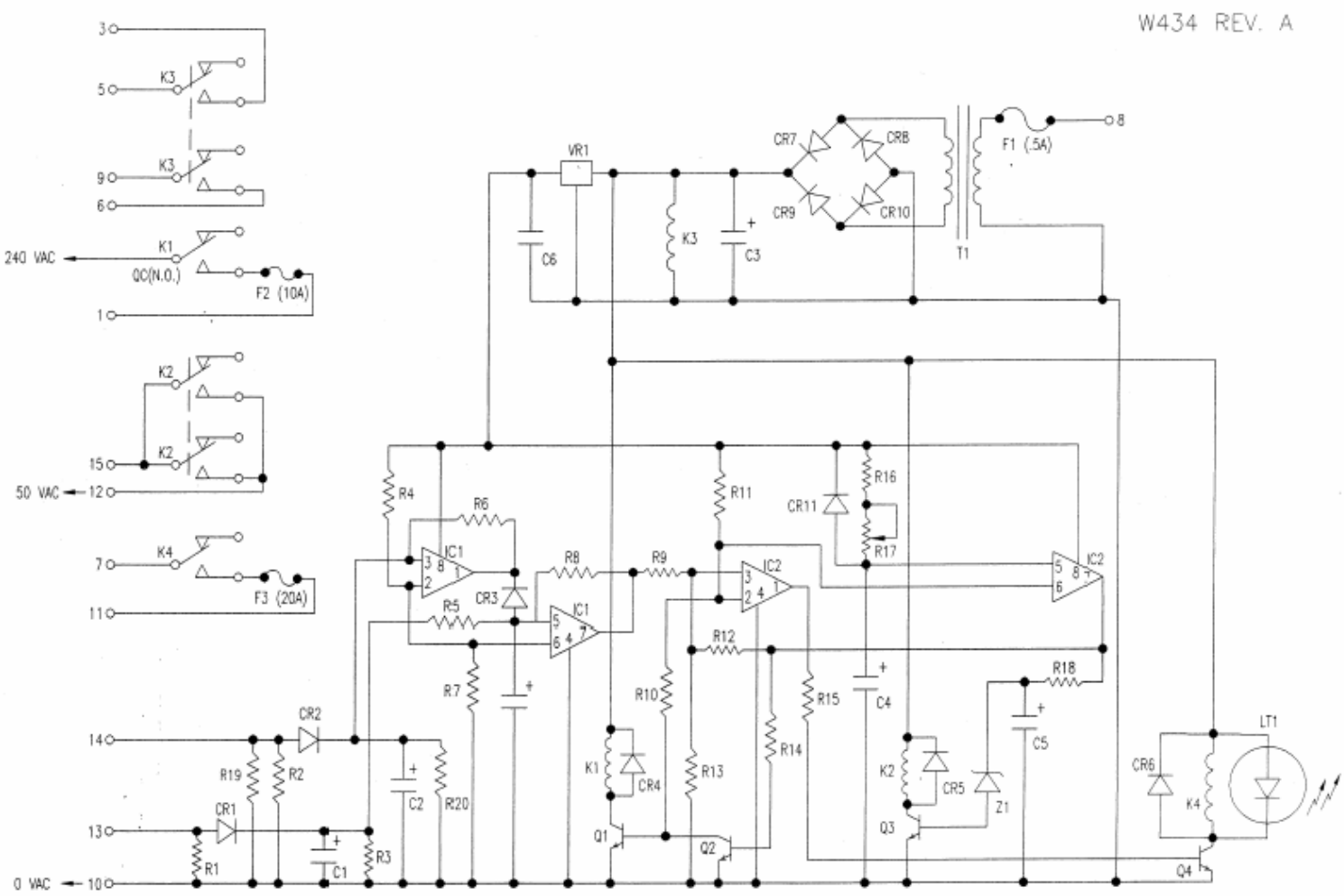
A455 Motor Start Board, Interfacing to the X-Ray Generator



✳ PHASE SHIFT CAPACITOR: $25uF$: Summit Part Number HAB18

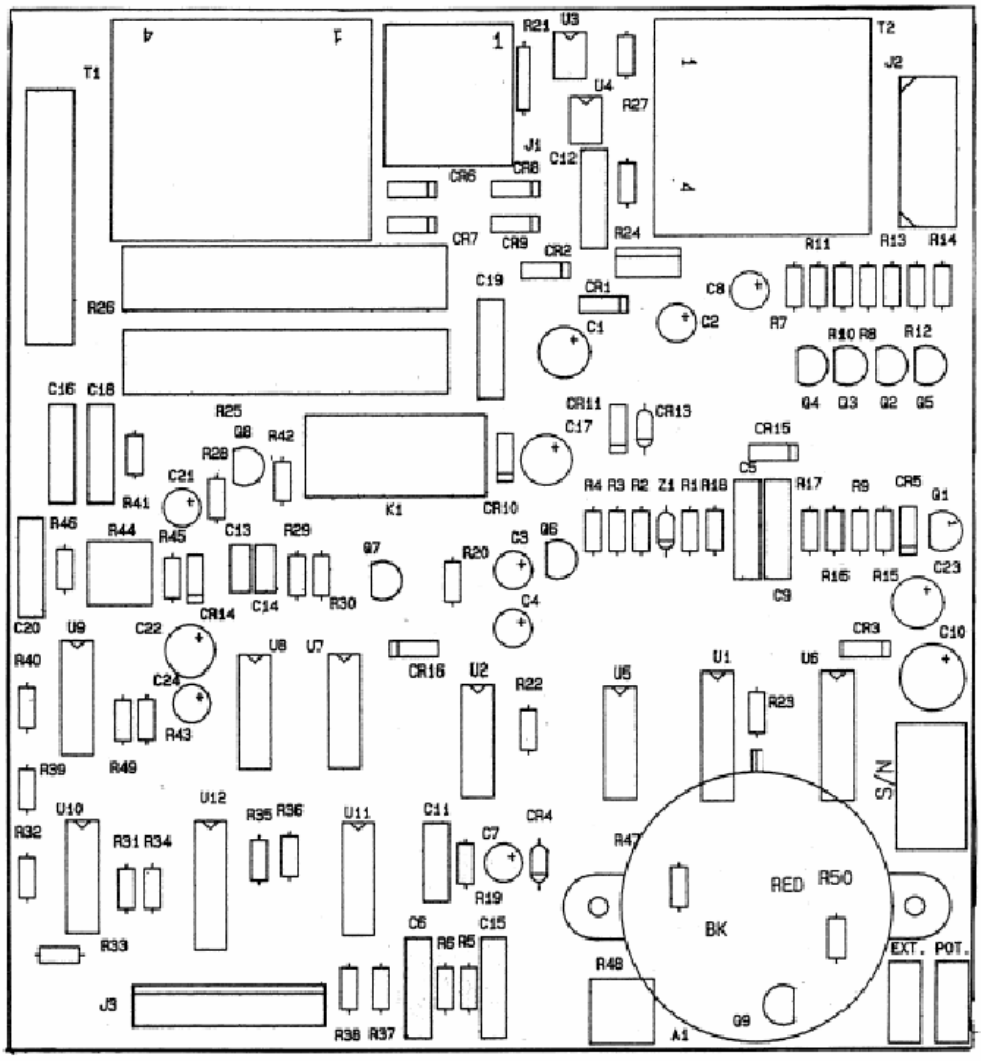


PARTS LAYOUT FOR MOTOR START CRCT (A455)



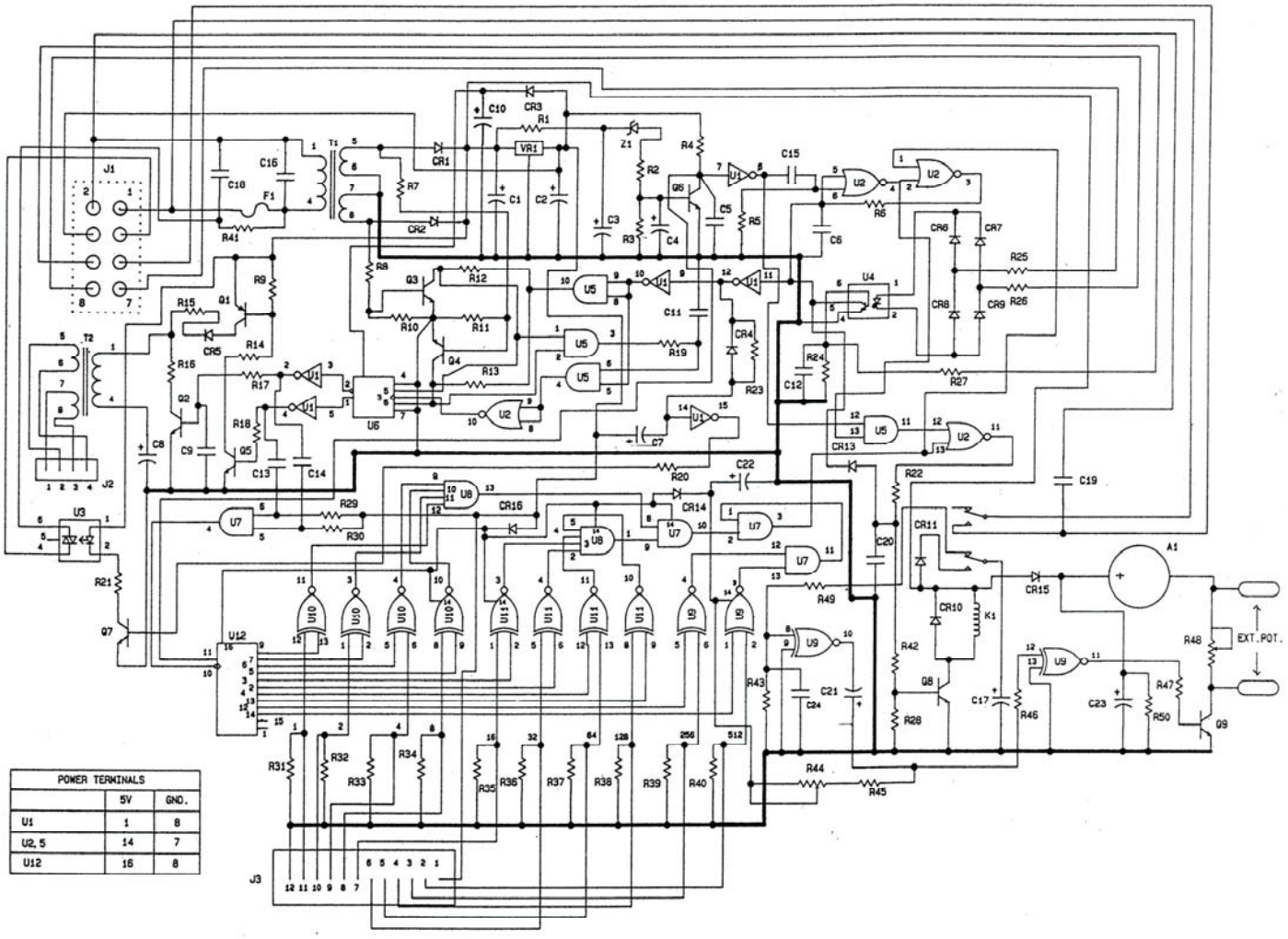
SCHEMATIC, MOTOR START CIRCUIT

W433 REV. A



C118 TIMER PCB LAYOUT

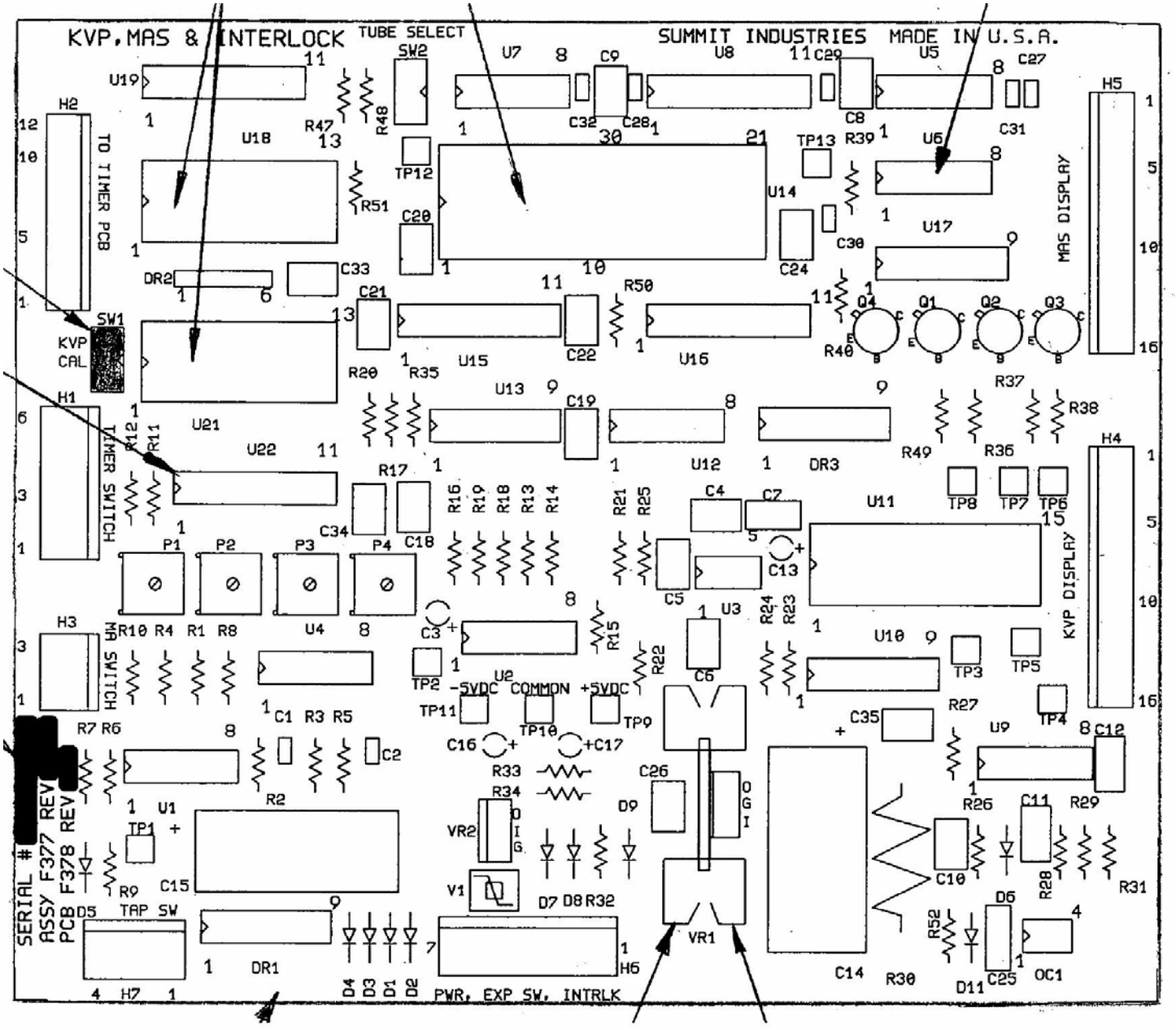
W431 REV. A



SCHEMATIC, C118 TIMER

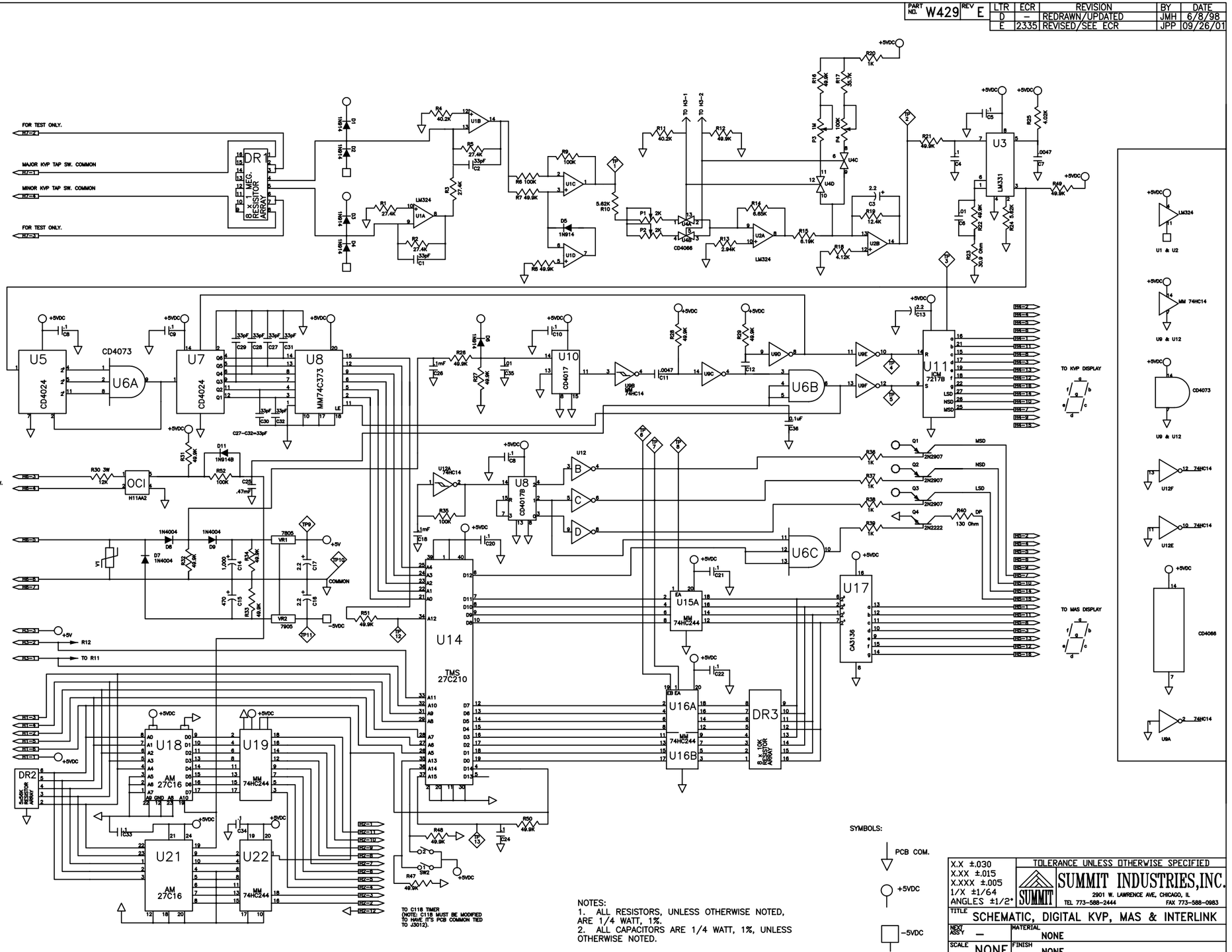
F377 Component Layout

Drawing No. W437



PART NO.	REV
W429	E

LTR	ECR	REVISION	BY	DATE
D	–	REDRAWN/UPDATED	JMH	6/8/98
E	2335	REVISED/SEE ECR	JPP	09/26/01



SYMBOLS:

PCB COM.

+5VDC

-5VDC

NOTES:
1. ALL RESISTORS, UNLESS OTHERWISE NOTED, ARE 1/4 WATT, 1%.
2. ALL CAPACITORS ARE 1/4 WATT, 1%, UNLESS OTHERWISE NOTED.

X.X ±.030
X.XX ±.015
X.XXX ±.005
1/X ±1/64
ANGLES ±1/2°

TOLERANCE UNLESS OTHERWISE SPECIFIED

SUMMIT INDUSTRIES,INC.
2901 W. LAWRENCE AVE, CHICAGO, IL
TEL 773-588-2444 FAX 773-588-0983

TITLE: SCHEMATIC, DIGITAL KVP, MAS & INTERLINK

NEXT ASSY: –
MATERIAL: NONE
SCALE: NONE
FINISH: NONE

Part Number : F377 Description: kV, mAs Interlock Board