

# *InnoVet*<sup>TM</sup>

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## **Select**

### **Operator's Manual** K287 Rev E



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**Installation and Service Manual Revisions History**

Revision	Pages Affected/Revision Description	Release Date	ECR #
A	RELEASED	-	-
B	CONVERTED TO MS WORD	MARCH 2002	-
C	UPDATED COMPONENT DIAGRAM	APRIL 2002	2564
D	ADDED "COLD" AND "READY" DISPLAY MESSAGES, EXPOSURE COUNT DISPLAY	OCTOBER 2002	2815
E	ADDED 50 HZ. REFERENCE AND TIME STATIONS	JULY 2006	5195

## 1.0 INTRODUCTION

Congratulations! You've purchased an ***InnoVet Select*** Veterinary X-Ray System. The ***InnoVet*** line represents a new concept in veterinary radiography by being the first system to incorporate the x-ray generator into the table. This major innovation led to other significant design breakthroughs yielding the most practical, efficient and compact unit ever created. The result of this innovation and improvement is the ***InnoVet Select*** you have purchased.

Because the ***InnoVet Select*** is so unique, its features and functions are a bit different from those of traditional x-ray systems. The purpose of this manual is to familiarize you with the ***InnoVet Select*** and assist you with operating and maintaining your new system. The manual is divided into indexed sections for quick and easy access to information.

Should a situation arise which cannot be resolved through the troubleshooting procedures described in this manual, please contact the Summit dealer where you purchased your machine for assistance, or call Summit directly at 1-800-972-9776.

## 2.0 PRECAUTIONS

### 2.1 Installation

The ***InnoVet Select*** must be installed and serviced by an authorized Summit dealer. All warranties will be void if such installation or service is performed by persons not authorized by Summit.

### 2.2 Operation

#### 2.2.1 Radiation

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, test 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 National 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.

#### 2.2.2 Electrical

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 tension cables from the x-ray tube housing or high tension generator 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.

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

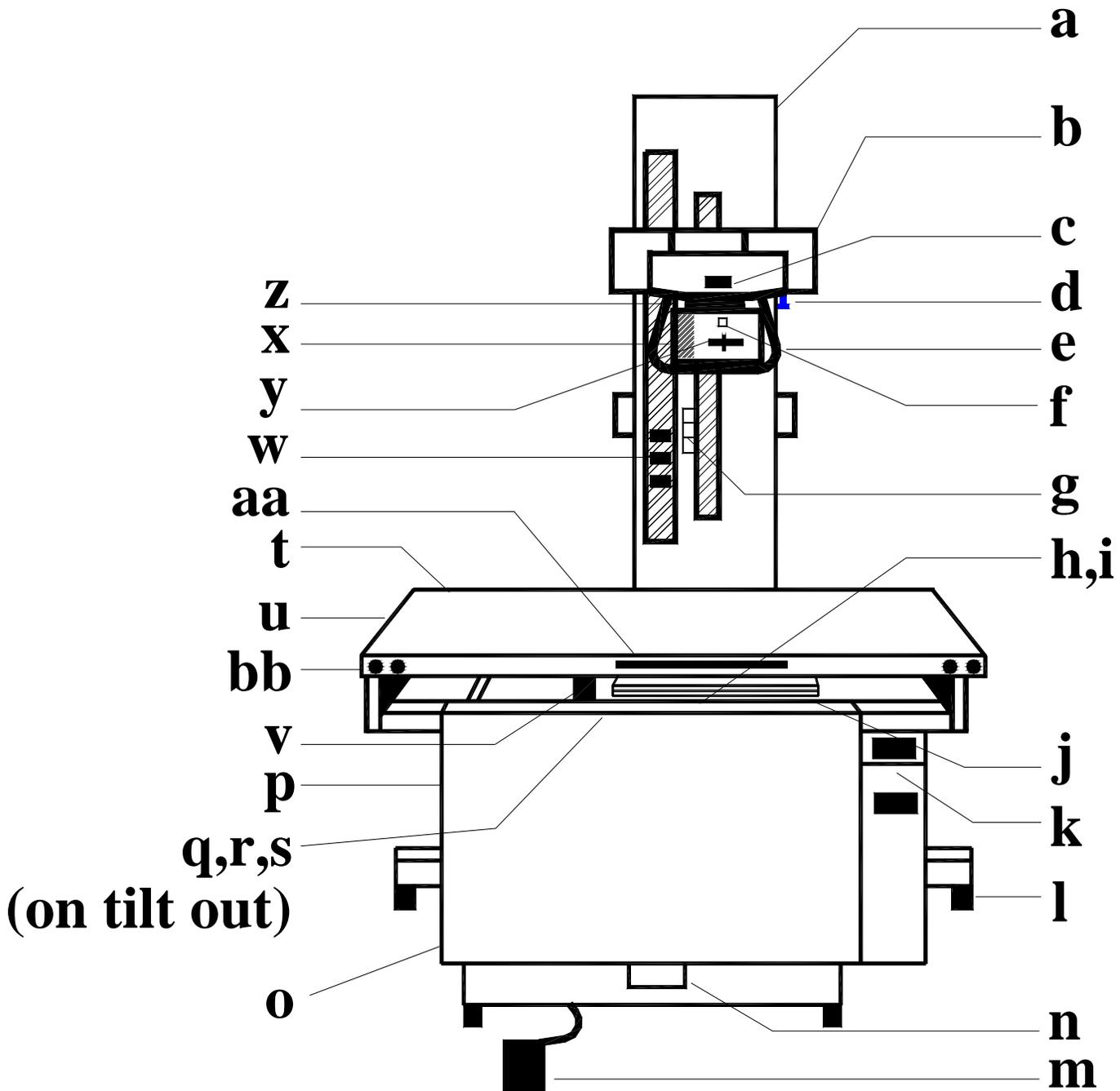
### 2.2.3 Mechanical

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.

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.

3.0 GENERAL PRODUCT OVERVIEW

3.1 Major Components



AWK287-01

- a. Tubestand - Supports collimator and x-ray tube. Moves both horizontally and vertically.
- b. X-Ray Tube
- c. Angulation Dial - Displays degree of x-ray tube angulation.
- d. Angulation Lock - When loosened, allows angulation of x-ray tube.
- e. Handle Bars - Used to move tube vertically or to angle the tube.
- f. Light Switch Button - Turns collimator bulb on and off.
- g. Source-Image Distance (SID) Indicator - When marker aligns with label on tubestand, SID (the distance between the tube focal spot and the film) is 40". There is a position for tabletop work and one for grid cabinet applications.
- h. Grid Cabinet - Lead-lined cabinet holds cassette tray and grid.
- i. Grid, mounted to upper carriage of grid cabinet, absorbs scatter radiation for improved film clarity.
- j. Cassette Tray - Molded indentions hold cassettes in correct position.
- k. Cassette Box (optional) - Opens to store cassettes. Lead lined to protect film.
- l. Rustproof Support Feet - Adjust to level the table.
- m. Exposure Foot Switch - Used to make exposures.
- n. Release Foot Pedal - When depressed, opens front of table to access control panel.
- o. Table Base - All steel, welded construction.
- p. Circuit Breaker - Turns generator on/off (Located on the side of the tilt-out panel).
- q. kVp Dials - One for major adjustment (15 kVp increments); One for minor (2 kVp increments).
- r. mA Dial - Adjusts mA. Two stations; 300 and 100 when using small tube focal spot and 300 when using large. Optional third mA station: either 400 (large focal spot) or 30 (small focal spot).

- s. Time Dial - Adjusts time. 18 stations available:

Line Frequency	Time Stations Available
50 Hz.	1/100, 2/100, 3/100, 4/100, 5/100, 6/100, 8/100, 1/10, 12/100, 18/100, 24/100, 30/100, 36/100, 48/100, 6/10, 9/10, 1 2/10, 1 1/2
60 Hz.	1/120, 1/60, 1/40, 1/30, 1/24, 1/20, 1/15, 1/12, 1/10, 1/8, 3/20, 1/5, 1/4, 2/5, 1/2, 5/8, 3/4, 1

- t. Drain Trough - Minimizes spillage behind table.
- u. Table Top (float table top) - 24" x 53" of Formica (33" x 57" of Formica).
- v. Tubestand/Grid Cabinet Interlock - When engaged, allows tubestand, grid cabinet and cassette tray to move together.
- w. Digital Displays – Upper one for kVp; Center one for mAs, and Lower one for status & error messages.
- x. Collimator - Controls size and rectangular shape of primary beam emitted from x-ray tube and provides coincident light field.
- y. Shutter Adjustment Knobs - One each to determine width and depth of primary beam.
- z. Swivel Mounting Plate - Allows collimator to be rotated.
- aa. Lamp Switches (optional) - Turns Collimator bulb on and off. Located on the front and both ends of the table.
- bb. Float Top Unlock Button (optional). Allows transverse travel of the table top. Located on the front of the table at both corners.

## 3.2 Specifications

### 3.2.1 INTEGRATED GENERATOR

- Tilt-out control.
- 300 mA at 125 kVp.
- Dual-digital timer with 18 time stations (1/100 to 1 1/2 second for 50 Hz. or 1/120 to 1 second for 60 Hz.).
- Adjustable solid state audio exposure signal.
- SCR contactor.
- Programmable tube protect system.
- Tube overload sensor.
- Independent kVp and mA adjustment circuits for each mA station.
- Two or three mA stations: 100S and 300L (30S, 400L Optional).
- mA overload protection.
- 64 kVp stations (40 to 125).
- kVp selection, major 15 kVp increments, minor 2 kVp increments.
- mA, time and kVp knobs.
- Built-in kVp compensation.
- Easy-access exposure count display
- Filament stabilization.
- 16-foot line cable; 4-foot control-to-transformer cable.
- Integral 24-Volt A.C. power supply.
- Programmable line frequency 50 or 60 Hz.
- Programmable power saving mode.
- Latching prep option.

### 3.2.2 TABLE / TUBE STAND

- Enclosed, integrated table. Removable 24" x 53" top.
- Welded base construction.
- Full-travel, lead-lined grid cabinet.
- 103-line, 8:1 aluminum grid.
- Grid cabinet/tubestand interlock.
- Tubestand-mounted digital kVp, mAs and status displays.
- Attached, counterbalanced tubestand; travels full table length.
- Angulation dial and operator handles.
- Two position foot switch.

### 3.2.3 CASSETTE HOLDER

- Easy-fit, removable, ABS plastic holder.
- Accepts 8" x 10", 10" x 12" and 14" x 17" cassettes in either direction.

### 3.2.4 TUBE

- 1.0-2.0 mm focal spots; 140,000 H.U.

### 3.2.5 CABLES

- 10' Max-Flex high voltage cables. Federal terminations.

### 3.2.6 COLLIMATOR

- Manual with light field.
- Swivel-mount.
- 90-second bulb "on" time.
- Gradual turn off warning (Soft Start Bulb Life feature).

### 3.3 Options

#### 3.3.1 TABLE OPTIONS

- ☛ Exposure foot switch.
- ☛ Extra lamp switches.
- ☛ Float top 33" x 57" or Float top 33" x 67".
- ☛ 12" table-top extension. Specify right or left (fixed top only).
- ☛ Upgrade grid to 10:1, 103 line.
- ☛ Animal restraining device.
- ☛ Third mA Station 400 (large filament) or 30 (small filament).
- ☛ Cassette Storage Bin.

#### 3.3.2 TUBE / COLLIMATOR OPTIONS

- ☛ 0.6-1.5 mm; 200,000 H.U.
- ☛ Programmable lamp times - 30, 60, 90, and 120 seconds.

#### 3.3.3 OTHER OPTIONS

- ☛ Remote exposure hand switch.
- ☛ Standard manual tray with sliding jaws; accepts all cassette sizes up to 14" x 17".

## 4.0 FUNCTIONS

### 4.1 Getting Started

4.1.1 Opening Unit - Depress the Release Foot Pedal to open the front access door.

4.1.2 Power Switch - To turn the generator on, move the circuit breaker switch to the up position. The switch is located at the left side of the hinged front door.

It is a good idea to turn the unit off at the end of each day. This ultimately will extend your system's life. If power saving mode is selected, the unit turns off automatically.

4.1.3 Generator Warm up - When the generator is first turned on after being turned off for two hours or more, the tubestand display will indicate "COLD". After ten minutes this display will change to "READY" which will scroll across the tubestand status window. The generator will take exposures when "COLD", but the outputs will be most accurate when the display indicates "READY". For consistent films wait for the "READY" indicator prior to taking exposures.

4.1.4 Tube Warm up - It is recommended that you warm up the unit prior to the first higher-powered exposure to prolong tube life. This is done by taking a series of three, 1/10 second exposures using the 300 mA station. Start with a kVp of 70 and increase to 80; then 90. Exposures should be spaced at least 20 seconds apart.

4.1.5 Storing Cassettes - Cassettes can be stored in the optional storage box or boxes mounted to either side of the table.

4.1.6 Loading Cassettes - Three sizes of cassettes can be used: 8" x 10", 10" x 12" and 14" x 17". Simply place the cassette into the specially-formed grooves of the tray. It will accept the cassette in either lengthwise or crosswise position.

## **IMPORTANT:**

**Although the storage box is lead-lined, it will not protect film from fogging after excessive exposure.**

## 4.2 Positioning the Tube

4.2.1 Moving the Grid Cabinet - The grid cabinet can be moved in tandem with the tubestand, assuring alignment of the primary beam to the center of the film. The grid cabinet can be positioned anywhere along the entire length of the table. Grasp the tubestand handle bars and move to the desired location.

4.2.2 Disengaging the Grid Cabinet - Alternatively, the grid cabinet may be moved independent of the tubestand. Release the interlock by sliding the spring-loaded lever extending from the grid cabinet to the left. The grid cabinet may then move while the tubestand remains stationary. To re-engage the interlock, position grid cabinet in-line with tubestand. The interlock is engaged when you hear a metallic "click" sound and feel the interlock mechanism move into place.

4.2.3 Vertical Movement - The tube can be moved from 10-1/2" to 40" above the table top. For convenience, the SID markers indicate 40" positions from the table top or the grid cabinet. During vertical motion, you will note a pause at one height, which is the pre-set height for optimal exposure, set by adjusting the detents during installation.

4.2.4 Float Top (option) - Push in float top unlock button and move the table. Release the button to lock the top position.

4.2.5 Angulation - Release the lock, which is located on the right side of the tube arm. Grasp the handle bars and turn the tube to proper angle. Turn the lock handle clockwise to hold tube position. The degree of rotation is indicated by the dial located between the handle bars.

## 4.3 Collimator Operation

4.3.1 Light Field - Once the tube is positioned relative to the grid cabinet, press the light button on the front of the collimator or one of the optional "no hands" collimator switches on the front or ends of the table. A light field will appear. **WARNING! DO NOT LOOK DIRECTLY INTO LIGHT SOURCE AS RETINA DAMAGE COULD RESULT.**

- 4.3.2 Programmable Lamp Times - Lamp gradually turns off in one of the following selectable times: 30, 60, 90, 120 seconds. The factory setting is 90 seconds. If you push the button during the lamp's power down ramp, a new "on" cycle starts.
- 4.3.3 Collimator Adjustment - Use the sliding knobs to move the shutters. Scales indicate knob positions that correspond to common cassette sizes. Use the pointer to quickly move shutters into relative position, then fine tune to collimate the x-ray beam to the area of radiographic interest.
- 4.3.4 Swivel Movement - When doing table top work, you may want to swivel the collimator to avoid awkward patient positioning. Simply swivel the collimator to the preferred position. **WARNING:** Do not touch the black lamp cover at the rear of the collimator as it gets quite hot. The collimator hesitates at the 0° and 90° positions for correct re-alignment. This is in order to help find these position accurately.

#### 4.4 Setting Techniques

- 4.4.1 mA - Adjust mA by moving the pointer to one of two (or three) stations: 100S or 300L (30S, 400L).

When set at 100 mA, the small tube focal spot (1.0 mm in standard tube) is used, yielding a more finely detailed image. At 300 mA, the large focal spot (2.0 mm in standard tube) is used.

- 4.4.2 kVp - Two knobs control kVp - one for coarse adjustments of 15 kVp increments and one for fine tuning with 2 kVp adjustments.

Turn the knobs to select the desired kVp.

The kVp value is displayed on the tubestand-mounted display.

- 4.4.3 Time - The time dial can be set at any of 18 stations; these are marked both in fractions of seconds and in natural numbers:

Line Frequency	Time Stations Available
50 Hz.	1/100, 2/100, 3/100, 4/100, 5/100, 6/100, 8/100, 1/10, 12/100, 18/100, 24/100, 30/100, 36/100, 48/100, 6/10, 9/10, 1 2/10, 1 1/2
60 Hz.	1/120, 1/60, 1/40, 1/30, 1/24, 1/20, 1/15, 1/12, 1/10, 1/8, 3/20, 1/5, 1/4, 2/5, 1/2, 5/8, 3/4, 1

#### 4.5 Making an X-Ray Exposure.

**Note:** If it is desired, to view the total number of X-ray exposures, simply turn the KVP major, KVP minor & mA selector knobs fully counter-clockwise, the bottom display will indicate "EXPO". The KVP display and the mAs display will indicate the total number of exposures taken on this x-ray control.

##### 4.5.1 Making Exposures with the Standard Foot Switch

There are two ways to make a x-ray exposure with the 2-position footswitch.

###### Prep and Expose

When proper patient position is achieved, partially depress the footswitch to activate the x-ray tube prep cycle. When "PREP" is displayed on the Tubestand, watch the patient for respiration phase or proper restraint. At the desired moment, make the x-ray exposure by fully depressing the footswitch. An audible tone will indicate an exposure has been made.

###### Expose

When proper patient positioning is achieved, fully depress the exposure footswitch. The x-ray tube will begin its prep cycle and upon completion of the prep cycle, the x-ray tube will make an exposure. An audible tone will indicate an exposure has been made. Note that in this procedure an x-ray exposure will not be made immediately upon depressing the footswitch. A delay will be experienced due to the x-ray tube prep cycle.

##### 4.5.2 Making Exposures with the Optional Foot Treadle

First depress the Exposure Foot Treadle until the display reads "WAIT." This starts the tube prep cycle. After 1 to 2 seconds the tubestand display will read "PREP." The tube is now ready for an exposure. The exposure will start when you depress the Exposure Foot Treadle. The generator will instantaneously activate and sound an audible "beep" to indicate that an exposure was made.

If the Exposure Foot Treadle is initially depressed and then held, the unit will automatically go through its two-second prep cycle and then expose. Hence, you will note a slight pause between pressing the foot switch and hearing the exposure signal.

#### 4.6 Prep/Expose Tubestand Status Messages

**WAIT** Tube is not yet warmed up. Please wait about 2 seconds. Exposures are not allowed yet.

**PREP** Tube is ready. Exposure starts immediately after initiating with foot switch.

**X-RAY** X-Ray exposure is in progress. Radiation is present.

**DONE** Exposure is completed.

**COLD** Unit needs to warm up for about ten minutes to achieve the most accurate exposure outputs.

**READY** Unit is warmed up and ready for taking exposures.

#### **EXPOSURE COUNT**

With the kVp major, kVp minor and mA selector knobs turned fully counter-clockwise, the bottom display will indicate "EXPO". The KVp display and the mAs display will indicate the total number of exposures taken on this x-ray control.

#### 4.7 Exposure Foot Treadle/Latching PREP (option)

4.7.1 Press exposure foot switch or treadle momentarily and release.

4.7.2 **WAIT** is displayed for 2 seconds while tube is warmed up.

4.7.3 **PREP** is displayed for 20 seconds. Exposure can be made any time during this interval.

4.7.4 For exposure push foot switch or treadle down and hold for duration of exposure.

4.7.5 If after 20 seconds no exposure is made, **PREP** is released.

**5.0 TECHNICAL DATA**

## 5.1 Radiation Leakage (Meets Federal Government Standards)

5.1.1 From the tube housing: less than 50 mR/hr at 1m from focal spot (@4mA, 125kVp)

5.1.2 From collimator: less than 50 mR/hr at 1m (@4mA, 125 kVp)

5.2 Rated line voltage: 240 VAC, 50 / 60 Hz., single phase.

5.3 Range of line voltage regulation at max line current: 1% to 5%.

5.4 Maximum line current (based on input voltage of 240 VAC): 140 AMP

5.5 Technique factors that constitute the max. line current: 300 mA @ 125 kVp.

## 5.5.1 Generator rating:

5.5.1.1. Output current: 100-300 mA.

5.5.1.2. Output voltage: 40-125 kVp.

## 5.5.2 Generator duty cycle:

5.5.2.1. 100 mA @ 125 kVp: 4%

5.5.2.2. 300 mA @ 125 kVp: 1%

## 5.6 Maximum Deviation of technique factors:

The maximum deviation statements provided below are broad and considered "worst case" conditions.

Typical performance will normally be significantly better.

## 5.6.1 Peak Tube Potential (kVp)

The Maximum Deviation of the Peak Tube Potential during an exposure from its pre-indicated value is + 5 kVp.

## 5.6.2 Tube Current

The Maximum Deviation of the tube current during an exposure from its pre-indicated value is + 10% of selected value within a kVp range of 50-125 kVp (inclusive), and + 20% of selected value within a kVp range of 40-50 kVp (exclusive).

## 5.6.3 Exposure Time

The Maximum Deviation of the measured exposure time from its pre-indicated value:

Max Deviation	Time Range
± 1 pulse	1/100 – 12/100 sec. for 50Hz. 1/120 – 1/10 sec. for 60Hz.
± 15%	18/100 – 1 ½ sec. for 50 Hz. 1/8 – 1 sec. for 60 Hz.

**6.0 CLEANING THE *INNOVET SELECT*<sup>™</sup>**

The *InnoVet Select* was designed to withstand the sometimes extreme conditions of a busy veterinary practice. In addition to the drip trough and rust-proof table legs, you'll note that there are no grooves or holes to collect debris.

To periodically clean the unit, use a sponge and a non-abrasive cleanser. Knobs on the control panel are removable for this purpose.

The system must be located in a different room than the processor. Failure to observe this could lead to premature corrosion not covered by warranty.

## **7.0 SCHEDULED DEALER MAINTENANCE**

The following schedule of maintenance for the *InnoVet Select* is required for safety of operation, continued ease of use, and continued long life of the product.

The maintenance program should only be performed by service personnel authorized by Summit Industries. Frequency of the service should be 30 days after installation and annually thereafter.

### **7.1 X-Ray Generator Maintenance**

7.1.1 Verify that all technique selector knobs are mounted solidly.

7.1.2 Verify proper operation of kVp and mAs digital displays.

7.1.3 Verify proper operation of audio and visual x-ray termination.

7.1.4 Verify time, mA, and kVp accuracy.

7.1.5 Examine all electrical connections of the high voltage generator.

7.1.6 Examine oil level of high voltage transformer and refill if fluid level is greater than 3/4" from the top of the lid.

7.1.7 Examine the high voltage cable ends for carbon tracking.

7.1.8 Examine inside of power supply box for any possible fluid leakage.

### **7.2 X-Ray Tube Housing**

7.2.1 Inspect for possible oil leakage.

7.2.2 Assure that the housing is tightly fastened to the tube mount and collimator.

7.2.3 Inspect stator cable for fraying or damage.

7.2.4 Inspect high voltage cable ends for carbon tracking. Clean and Regrease HV Cable ends annually.

7.3 Collimator

7.3.1 Verify accuracy of field size.

7.3.2 Verify accuracy of light field to x-ray field alignment.

7.3.3 Check lamp on-off switch for proper operation.

7.3.4 Inspect collimator cable for fraying or damage.

7.4 Tubestand

7.4.1 Verify set-screws are securely holding tubearm.

7.4.2 Inspect counterweight cables for fraying or damage.

7.4.3 Inspect all tubestand movements for binding or interferences.

7.5 Other

Inspect high voltage cable and all other cabling for damage.

## 8.0 TROUBLESHOOTING

### 8.1 Error Message

Upon error detection, the *InnoVet Select* will display one of the following error codes:

<b>FOOT</b>	Early release of the exposure foot switch or foot treadle during exposure. Films are likely to turn out light. Foot must be depressed for the entire selected exposure time.
<b>TUBE</b>	Single shot tube power limits were exceeded by the selection technique. Reduce kVp, mA and / or time (PREP and EXPOSE locked out). Message clears when the techniques change.
<b>HEAT</b>	Tube heat exceeded. PREP and EXPOSE locked out until technique reduced or tube cools down.
<b>ROTR</b>	Tube rotor error. Call for service.
<b>ZCO</b>	Equipment component (hardware) error. Call for service.
<b>ZZZZ</b>	(Power saver mode only.) Unit will go to sleep within 5 minutes.
<b>FIL1-FIL4</b>	Hardware error. Call for service.
<b>COLD</b>	The unit needs to warm up for best output accuracy, but exposures can be taken if needed. This display should clear about ten minutes after first turn on of the day.

### 8.2 No Exposure

If, after fully depressing the foot switch, there is no audible tone, your unit may not be turned on. Use the circuit breaker to turn on power. If there is still no exposure, call a service representative.

### 8.3 Collimator light bulb burned out.

When the collimator light bulb burns out, you may either call a service person for replacement/realignment or may choose to replace the bulb yourself.

The replacement bulb must be FCS type; 150 Watt at 24 V with a pin base.

**WARNING #1:**

DO NOT LOOK DIRECTLY INTO THE COLLIMATOR LIGHT SOURCE AS RETINA DAMAGE COULD RESULT.

**WARNING #2:**

TURN THE CIRCUIT BREAKER OFF BEFORE ATTEMPTING BULB REPLACEMENT TO AVOID POSSIBLE ELECTRIC SHOCK.

First, remove the back cover of the collimator. The bulb is now visible.

**WARNING #3:**

THE BULB, WHEN LIT, GETS VERY HOT. ALLOW IT TO COOL SEVERAL MINUTES TO AVOID BURNING YOUR FINGERS.

Pull the bulb straight out from the ceramic base.

**WARNING #4:**

DO NOT MAKE DIRECT CONTACT WITH THE REPLACEMENT BULB AS OIL FROM YOUR FINGERS WILL CREATE HOT SPOTS ON THE BULB WHICH SUBSEQUENTLY MAY LEAD TO CRACKING.

To avoid direct contact between bulb and fingers, the replacement bulb is normally packaged in a cellophane wrapper. Tear open one end so that prongs are exposed; hold the glass portion, still in its wrapper, and insert the prongs into the ceramic base. Make sure that each prong is securely fastened into its socket so that the resulting light field is straight. Replace the back cover.

If the light field is out of alignment with the grid cabinet, call an authorized service representative for re-alignment.

#### 8.4 No digital display

If, after turning on the circuit breaker, digital displays do not light up, this indicates lost power. The source may be a blown fuse within the unit or a problem with incoming line power. Call an authorized service representative.

#### 8.5 Circuit tripping

If the circuit breaker shuts off on its own, this indicates mA overload. This could be due to miscalibration of the mA or another malfunction.

In the event that the unit is miscalibrated, you may still be able to operate the unit by moving to 100 mA. This will allow you to take X-Rays until an authorized service representative is called.

#### 8.6 Full kVp range inaccessible.

If this occurs, it means that incoming line voltage is too low. Call an authorized service representative to correct.

#### 8.7 Poor film quality

There are many interrelated factors in the radiographic process which impact the degree of darkening visible on a film. The following is a list of items to check whenever you notice a significant change in film quality:

8.7.1 Film Processing - Has chemistry been changed recently? Is a new brand/type being used? Have developing temperatures varied? All of these affect film quality.

8.7.2 Technique - Were proper technique factors used? Consult with a Summit dealer or call Summit for information on setting up a technique chart.

- 8.7.3 Screens/Cassettes - Screens within the cassettes degrade with time. They typically lose 10% of their light-emitting capability per year. It is recommended that cassettes be re-screened every five to seven years. All screens should be replaced at one time to maintain uniform exposure.
- 8.7.4 Film - Has a new brand/type/speed of film been used? Is the film beyond its expiration date? If so, new film may be purchased or technique factors may need adjustment.
- 8.7.5 Foot switch - If thorax/chest films are blurring more than usual, it could be that the exposure switch is being used incorrectly. See section 4.5 to review how to make exposures.

**9.0 WARRANTY NOTICE**

The *InnoVet Select* is warranted as follows: any Summit manufactured part proving defective will be repaired or replaced free of charge, F.O.B. factory, if the defective part is returned for inspection, freight charges prepaid. This warranty covers parts only and does not include any on-sight labor costs.

This warranty is five years from the date of installation.

This warranty does not apply to collimator glassware or x-ray tubes or damage caused by accident, misuse, neglect, or shipment, and is void if service is performed by persons other than authorized Summit dealers or if equipment is interconnected with components not approved by Summit for compatibility.

The x-ray tube manufacturer's warranty is one year, pro-rated. Summit will extend this warranty to five years, pro-rated on manufacturer's list price at time of claim, provided the tube is purchased and used exclusively with an *InnoVet Select* system.

**Please call your Summit dealer to coordinate the return of a warranty part or call Summit direct at 1-800-972-9776.**

**INNOVET SELECT™**

**Veterinary Radiographic  
System**

**Installation & Service Manual**

**K286**

**Rev J**

**SUMMIT INDUSTRIES INC.  
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Chicago, IL 60625  
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[www.summitindustries.net](http://www.summitindustries.net)**

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**1.0 MANUAL REVISION CHART****TABLE 1**

<b>InnoVet Select™ Installation and Service Manual Text Revisions (K286-T)</b>			
<b>Revision</b>	<b>Date</b>	<b>Description of Revision</b>	<b>Ecr No.</b>
A	OCT 1998	REFORMATTED AND EXPANDED TEXT/FIGURES	-
B	JUNE 1999	REVISED TEXT IN SECTION 9.1	-
C	JUNE 2000	ADDED 4 <sup>TH</sup> POTENTIOMETER FOR KVP CALIBRATION	-
D	FEB 2002	CONVERTED TO MS WORD	-
E	APRIL 2002	REVISED TUBEARM INSTALLATION/LEVELING	2564
F	JULY 2002	REVISED INSTALLATION INSTRUCTIONS FOR ADDING TRIM WEIGHT TO THE TUBE-STAND COUNTERBALANCE	2667
G	OCT 2002	ADDED RC TIMER BOARD, EXPOSURE COUNTER INFORMATION	2815
H	OCT 2004	EXPANDED TROUBLESHOOTING GUIDE	4335
J	JUL 2006	ADDED 50 HZ. REFERENCE AND TIME STATIONS	5195

## 2.0 UNPACKING

The **InnoVet Select™** Radiographic System is delivered in three packages:

- High voltage transformer, control, x-ray tube (palletized).
- Table, collimator and accessories.
- Tubestand.

*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, the installer is responsible for making all claims with the shipping company.*

*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 contact the shipping company.*

### 3.0 RADIATION AND MECHANICAL/ELECTRICAL WARNING

#### 3.1 RADIATION

##### **WARNING**

*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, test, participate in or supervise the operation of the equipment must be thoroughly familiar and comply completely with the current 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 National 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.*

## 3.2 ELECTRICAL

### WARNING

*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.*

## 3.3 MECHANICAL

### 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.*

*The control is secured to the table with an air cylinder, hinge pin and Truarc retaining ring only. Once the ring and hinge pin are removed, care must be taken to insure that the control does not swing forward in an uncontrolled manner.*

*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.*

## 4.0 SPECIFICATIONS

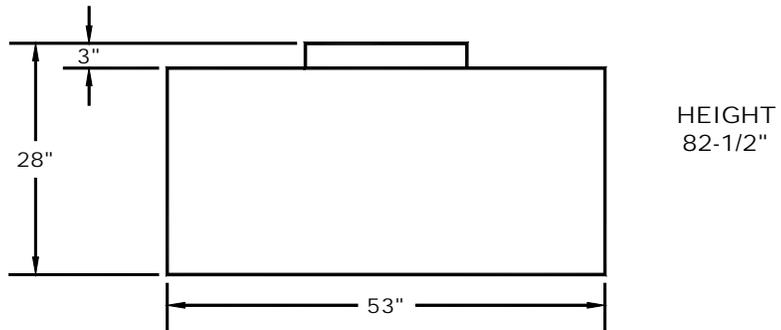
### 4.1 TECHNICAL RATINGS

**TABLE 2 – TECHNICAL RATINGS**

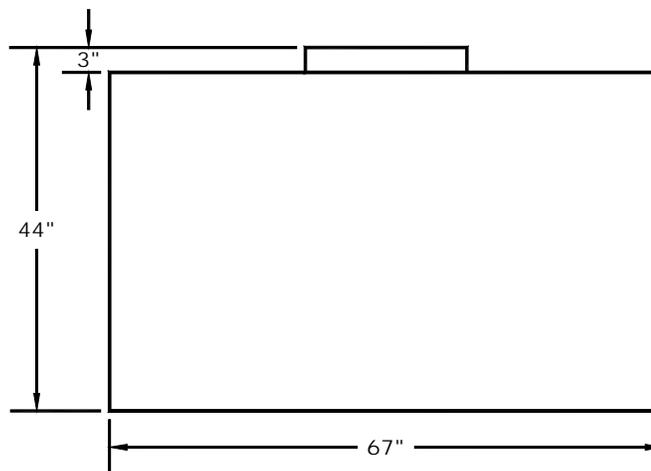
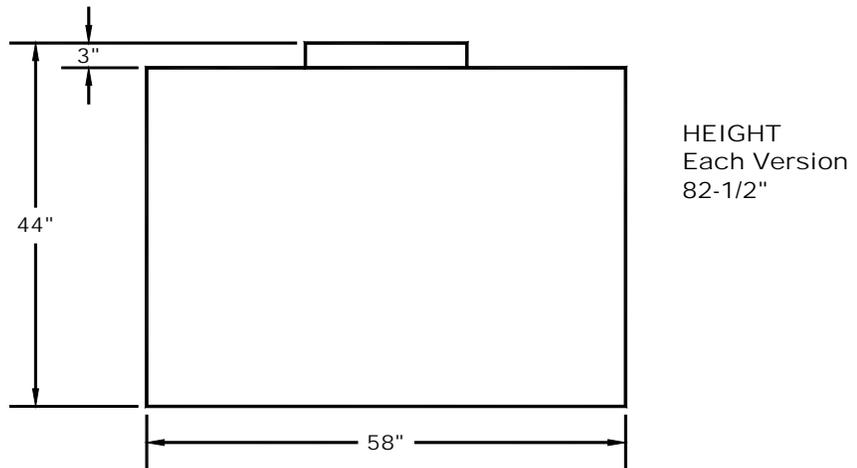
	300mA Station	400 mA Station (Optional)
<u>Rated Line Voltage –</u>	240 VAC, 50 / 60 Hz., Single Phase.	240 VAC, 50 / 60 Hz., Single Phase.
<u>Acceptable Line Voltage Regulation at Maximum Line Current</u>	Not to exceed 5%.	Not to exceed 5%.
<u>Maximum Line Current (240 VAC input)</u>	140A @ 300mA	187A @ 400mA
<u>Technique Factors that Constitute the Maximum Line Current</u>	300 mA @ 125 kVp.	400mA @ 100kVp
<u>Control Rating – Output Current</u>	100 mA and 300mA are standard. Three mA stations of 30, 100, and 300 mA are available as an option.	Three mA stations of 100, 300, and 400 mA are available as an option.
<u>Control Rating – Output Voltage</u>	40 to 125kVp	40 to 125 kVp
<u>Control Duty Cycle –</u>	100 mA @125 kVp-4% 300 mA @ 125 kVp-1%	100 mA @125 kVp-4% 300 mA @ 125 kVp-1% 400 mA @ 100 kVp-1%

## 4.2 SPACE REQUIREMENTS

1. For STANDARD Fixed-Top tables



2. For tables with Float-Top option



### 4.3 ELECTRICAL REQUIREMENTS

**TABLE 3 – ELECTRICAL POWER SUPPLY REQUIREMENTS**

	300mA Station	400 mA Station (Optional)
<b><u>Equipment Category</u></b>	300mA @ 125 kVp, Single Phase	400mA @ 100 kVp. Single Phase
<b><u>Nominal Line Voltage</u></b>	240 VAC, 50 / 60 Hz., Single Phase	240 VAC, 50 / 60 Hz., Single Phase
<b><u>Line Voltage Range Allowed</u></b> (Alternate line voltages which will provide normal operation.)	194-284 VAC.	194-284 VAC.
<b><u>Maximum Momentary Line Current</u></b>	140 amperes (at 240 VAC)	187 amperes (at 240 VAC)
<b>Note:</b> Maximum momentary line current at alternate line voltages can be determined using the formula:	$I_2 = \frac{140 \times 240}{V_2}$ $V_2 = \text{alternate line voltage}$ $I_2 = \text{maximum line current at the alternate line voltage, "V}_2\text{."}$	$I_2 = \frac{187 \times 240}{V_2}$ $V_2 = \text{alternate line voltage}$ $I_2 = \text{maximum line current at the alternate line voltage, "V}_2\text{."}$
<b><u>Line Voltage Regulation under load</u></b>	The line voltage drop under load is not to exceed 5% at maximum line current.	The line voltage drop under load is not to exceed 5% at maximum line current.

<b><u>Calculating line voltage regulation</u></b>	$\frac{(V_{NL} - V_L)}{V_L} \times 100$ <p><math>V_{NL}</math> = line voltage under “no load” conditions</p> <p><math>V_L</math> = line voltage under “full load” conditions</p>	$\frac{(V_{NL} - V_L)}{V_L} \times 100$ <p><math>V_{NL}</math> = line voltage under “no load” conditions</p> <p><math>V_L</math> = line voltage under “full load” conditions</p>
<b><u>Minimum Over Current Protection Rating</u></b> (Service disconnect)	50% of maximum line current rating or greater. (100 Amps is recommended.)	50% of maximum line current rating or greater. (100 Amps is recommended.)
<b><u>Distribution Transformer Requirements</u></b>	Minimum 30 kVA dedicated to the x-ray control	Minimum 37.5 kVA dedicated to the x-ray control
<b><u>Wire Size from Power Transformer to Disconnect Switch</u></b>	for 50 feet use #2 AWG; for 100 feet use #00AWG; for 200 feet use 250 mcm	For 50 feet use #2 AWG; for 100 feet use #00AWG; for 200 feet use 250 mcm

The information provided in Table 3 above and text below is taken from NEMA standards. Minimum Power Supply Requirements for x-ray Machines, and National Electric Code.

**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 to be mounted on either the wall behind the x-ray control or the wall directly adjacent to it.

## 5.0 PRELIMINARY MECHANICAL ASSEMBLY

### 5.1 RADIOGRAPHIC TABLE

1. During shipment, the table top is banded to the table base. Cut loose the banding and set the table top aside for assembly later. 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.
2. Install the five leveling feet by threading them into the holes at the two front corners of the table and at the ends and middle of the back rail. The two feet with a 4" long body should be installed at the front corners of the table. The three feet with a 1" long body should be installed at the back rail. (In the accessory bag there are six blue and six red "U" shaped plastic spacers. When leveling the table fully tighten the foot until the shoulder of the foot is firmly against either these spacers or the bottom of the table/back rail). Use of the spacers makes the table base/leveling feet union a solid "one piece" structure, minimizing any wobble or table base motion.
3. Position the table close to its final location, using the leveling feet and spacers to bring the table close to level at this time. Final leveling can be done at end of assembly.

### 5.2 HIGH VOLTAGE TRANSFORMER

1. Verify that the oil level in the HV transformer is approximately  $\frac{1}{2}$ " to  $\frac{3}{4}$ " below the underside of the cover. Refill with "Shell Diala oil AX" or remove oil as necessary.

2. Using a piece of cardboard to protect the floor, push the transformer onto the transformer shelf in the table by tilting the transformer and sliding it up onto the shelf. Once the transformer is in place, 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 HV transformer to prevent contaminants from entering the oil.

**Note:** The high voltage transformer must be installed before the control is put in place. It is also recommended that the transformer be installed before the tubestand is mounted to the table for maximum stability during installation.

### 5.3 TUBESTAND INSTALLATION

The sequence of assembly is slightly different between Fixed-Top and Float-Top tables.

For Fixed-Top (standard) tables proceed directly to section 5.3.1 below.

For Float-Top (optional) tables the table top frame must first be removed before the tubestand can be mounted. Skip ahead to section 5.3.2 for instructions for this type of table.

**5.3.1 For Standard Fixed-Top Table**

1. Remove tubestand stop from the left end of the table's lower rear rail. See figure 3.



**Figure 3: Tubestand stop at lower left rail**



**Figure 4 – Tubestand Positioning**

2. Position the tubestand so that it is a few inches from the end of the back rail of the table with the lower tubestand bearings in line with the back rail. See Figure 4.

(The tubestand shown in Figures 4 and 5 is for a Float-Top table, but mounting the tubestand to the rail is done the same for either configuration.)



**Figure 5 – Mounting Tubestand on Rail**

3. Carefully tilt the tubestand away from the table until the elevated tubestand bearing can be pushed into the lower bearing rail. Now straighten the tubestand and push it completely into the upper and lower bearing rails. See Figure 5.

4. Reinstall the tubestand stop on the lower rail. If leveled properly in step 5.1, the tubestand should glide easily from end to end and stay in position without drifting to either side.

**5.3.2**     **For Optional Float-Top Table** (Refer to photos on preceding pages for reference.)

1.     Mount the tubestand bearing carriage to the tubestand using the four (4) ¼-20" x 3/8" hex head screws provided. Figures 4 and 5 on page 5-3 show a tubestand with a mounted bearing carriage. **Verify that the safety rollers are mounted on the tubestand bottom to prevent the table from tipping backwards from the weight of the tubestand.** (This may occur if the high voltage transformer is not yet installed.)
  
2.     To mount the tubestand, the table top frame will need to be moved forward for access to the upper tubestand bearing rail at the left end of the table. Refer to Figures 6 and 7 below for reference.
  - A)     Remove the single, large Phillips head screw found at the front and rear interior corners of the table top frame. Their location is shown in Figure 6 (front only shown).

**Figure 6 – Table Top Frame Mounting Screws**

- B) Now that the table top frame is free from the bearing tracks, you can raise the frame slightly to gain access to the four small Phillips head screws which secure the table top frame's bearing track at the exterior head end of the table. Remove these four screws, sliding the bearing track forward. See Figure 7.



**Figure 7 – Table Top Raised; Bearing Track Moved Forward For Mounting Tubestand**

- C) Manually release the transverse lock solenoid pins and slide the table frame forward to expose the upper tubestand bearing rail.

3. Remove the tubestand stop on the left end of the table's lower rear rail. (As viewed from the front.) See Figure 3 – Tubestand Stop on page 5-3 for reference. Position the tubestand so that it is a few inches from the end of the back rail of the table with the lower tubestand bearings in line with the back rail.  
See Figure 4 – Tubestand Positioning, Page 5-4 for reference.
4. Carefully tilt the tubestand away from the table until the lower tubestand bearing can be pushed into the bearing rail. Now straighten the tubestand and push it completely into the upper and lower bearing rails. See Figure 5 – Mounting Tubestand on Bearing Rail, Page 5-4 for reference. Reinstall the tubestand stop on the lower rail. A well leveled table will allow smooth motion of the tubestand with no drift in either direction.
5. Reassemble the table frame by repeating step 2 above in reverse. Replace the tubestand stop on the lower rail. If not done previously, remove the phenolic table top panel at this time via the nuts located at the underside corners of the table top frame.

**5.4 TUBE ARM, X-RAY TUBE AND COLLIMATOR INSTALLATION**

1. Install the tube mount by inserting the 1-1/2" 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.

**Note:** Do not remove the two hex head shipping bolts which lock the main counterweight and vertical carriage together until the tube, collimator and high voltage cables have been mounted.

2. Mount the x-ray tube and collimator. **When using the standard tube and collimator, two 1/8" spacers will achieve the proper field size coincidence.** The standard tube has a part number of C458, and the collimator G800 (refer to their respective manuals for detailed instructions as needed). Refer to Final adjustments Section 8 for central ray to grid cabinet adjustments after x-ray to light field verification and generator calibration is completed later in this manual.
3. Install the high voltage cables. Cable drape brackets are included with the hardware accessories bag. The cable drape brackets are installed above and below the handle on the right side of the tubestand. Loosely drape the HV cables with the collimator and stator cables within the brackets until the vertical slide has been freed to move. The cables will route directly into the right rear of the table base, not beneath the lower tubestand rail.

**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.*

4. Remove the shipping bolts which lock the main counterweight and vertical carriage together, taking care to insure that the counterbalance is adequate to avoid uncontrolled motion of the vertical slide. The trim weights provided in the hardware kit should be used to achieve proper counterbalancing of the tubestand. Remove the back panel of the tubestand, and then insert trim weights as needed into the channels at the top of the main counterweight.

## 5.5 FOOT TREADLE INSTALLATION (skip ahead to 5.6 if using standard foot switch)

If the *InnoVet Select*<sup>™</sup> has the latching prep Foot Treadle Option, the treadle must be installed prior to mounting the control into the table. (If the Foot Treadle Option is being added to an installed system as a field upgrade, refer to Section 9 "Options for Field Installation".)

1. Put the treadle in position across the front of the table base.
2. Thread the spring guide pins located at either end of the treadle up through the table base and lock each guide pin in place with the cotter pin provided.
3. Bolt the foot treadle bracket to the table base using the hex head bolts provided.
4. Plug the foot treadle cable into the S7 location of the junction box at the right side of the table frame. Refer to Figure 14 as needed.

## 5.6 FILM BIN INSTALLATION

(skip ahead to 5.7 if no film bin is to be installed)

The film bin must be installed prior to mounting the control into the table base. The film bin comes in either a right-hand or left-hand configuration. Slide the PEM studs of the film bin through the holes in the front edge of the appropriate side of the table and secure it using the hardware provided. Bolt the back side of the film bin to the rear of the table using the bolts provided. Install the plastic organizer in the top drawer of the film bin. Note that for left-hand film bins the control serial tag may be partially obscured. Be certain to record the control's serial number in the user and installation manual if this is the case.

## 5.7 GENERATOR INSTALLATION

1. Lay the control face down on cardboard, centered in front of the table.
2. Adjust the table legs to measure 34-5/8" between the V grooves of the pivot rollers at the base of the table.
3. Engage the notches on the bottom of the control with the pivot rollers and lift the control so that it hinges up into the table base.
4. Connect the air cylinder to the control using the pin and locking ring as shown in Figure "9". **Note that there is no other device holding the control within the table. If the pin is ever to be removed from the air cylinder, exercise caution to maintain balance of the control within the table.**

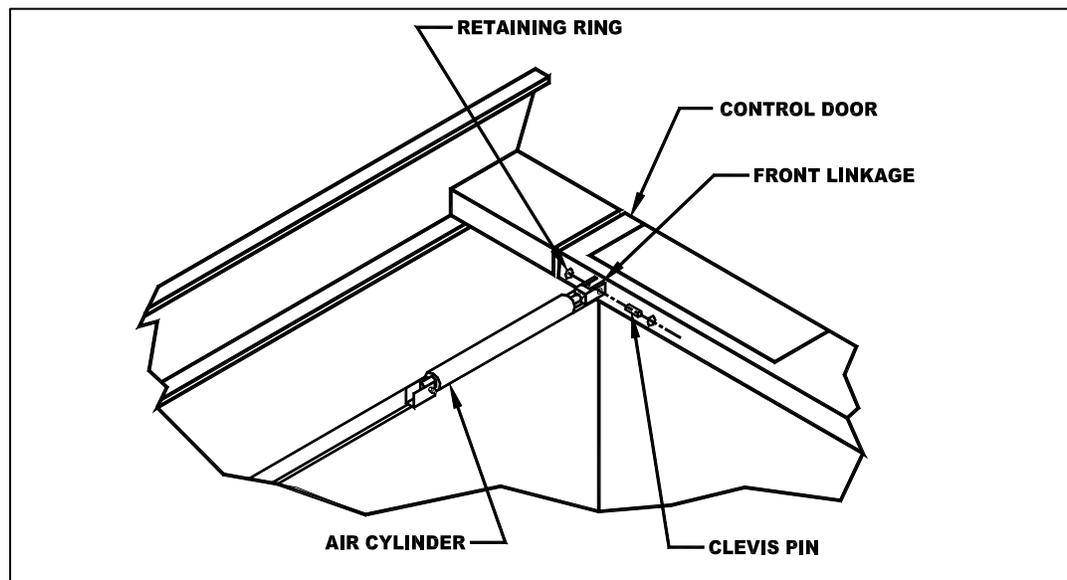
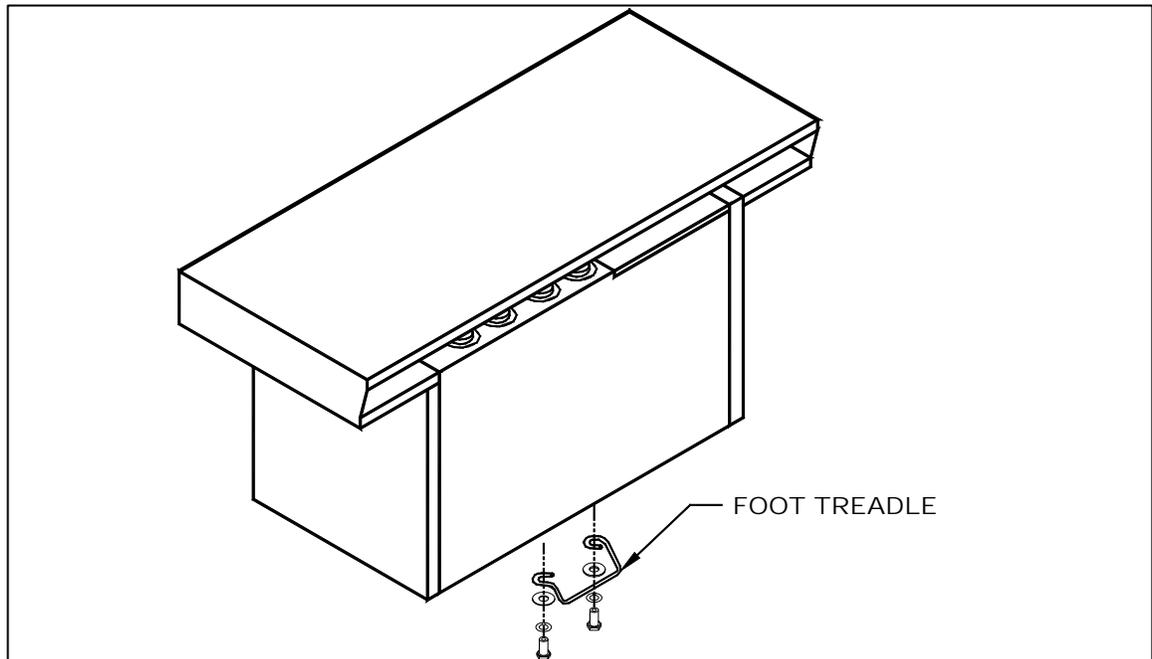


Figure 9: Air Cylinder Attachment – AWW430-06

5. Bolt the foot loop to the bottom of the control as shown in Figure "10".



**Figure 10: Mounting the Foot Loop – AWW430-07**

6. Center the control within the table opening by adjusting the two front feet. If the left side of the control is too close to the left pedestal leg, raise the left front corner of the table slightly. If the right side of the control is too close to the right pedestal leg raise the right front corner slightly. Use the red or blue shims as required to achieve a snug fit between the top of the leveling feet and the bottom of the table for maximum stability.

## 6.0 ELECTRICAL CONNECTIONS

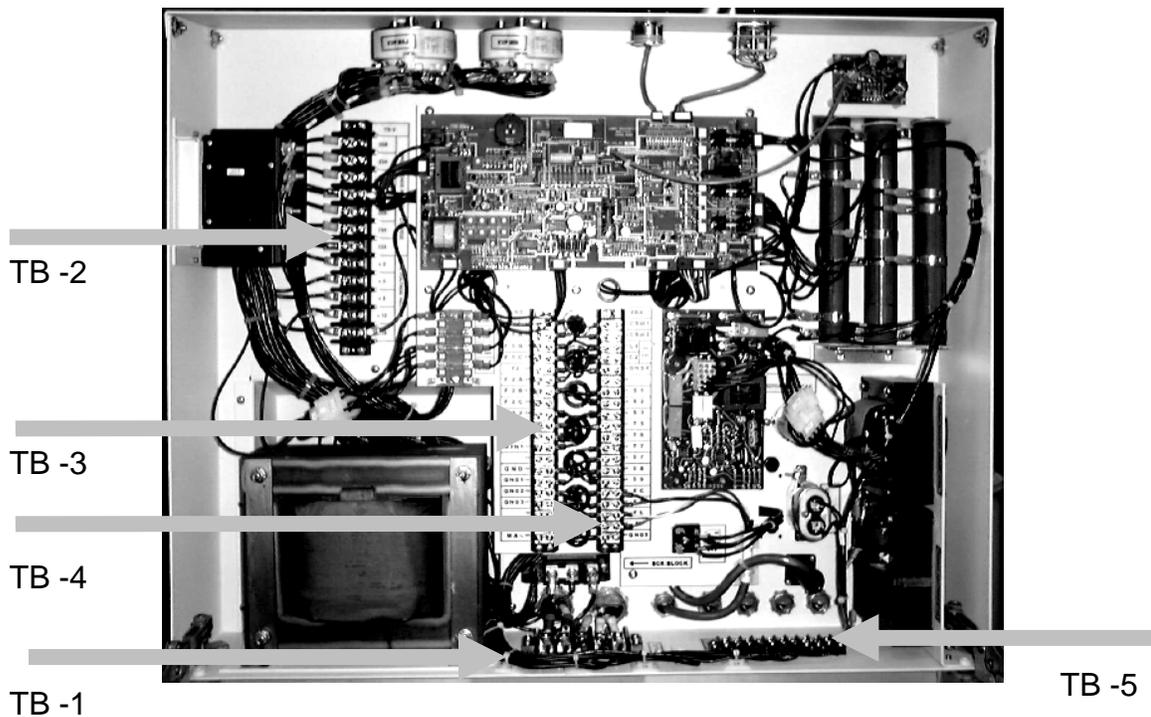
### 6.1 LOCATION OF ELECTRICAL CONNECTIONS

1. Remove the technique select knobs, each of which are secured to their respective switch shafts by two Allen set screws. Remove the two Phillips head screws with rubber gaskets at the top of the control cover. Remove the two shoulder bolts from the bottom corners of the control cover and lift cover away as shown in Figure 11 below.



**Figure 11**  
**Removing the Front Cover**

Once the front cover has been removed, the interfacing terminal strips within the control will be accessible as shown in Figure 12 below.



**Figure 12 – Interior of Control**

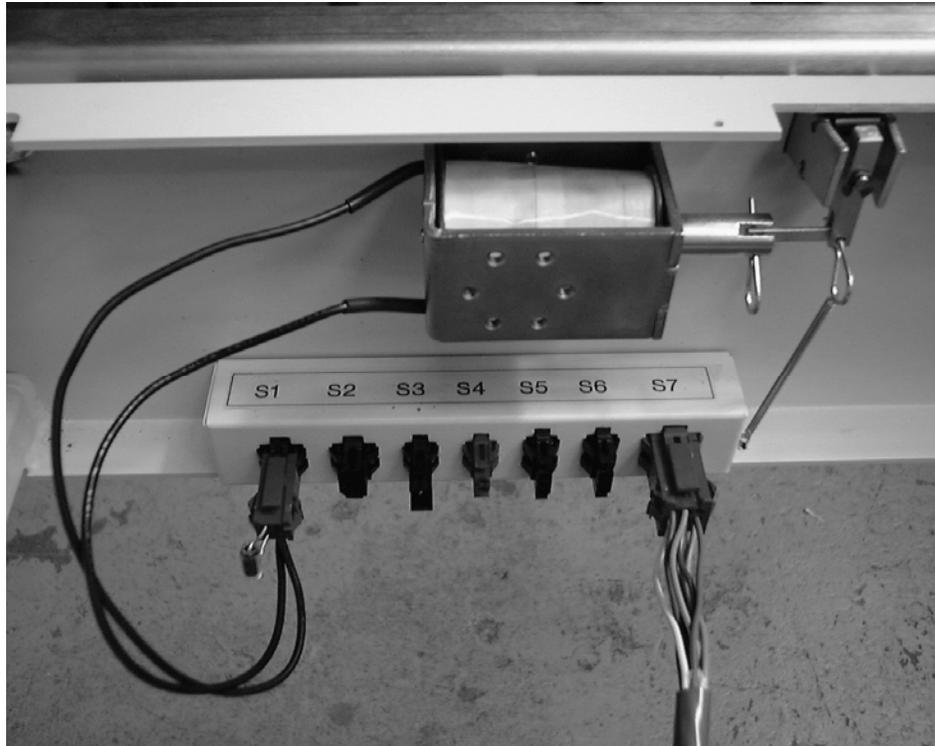
2. If not already done, remove the phenolic table top panel for access to the rear of the control. The table top panel can be removed by a hex nut at each underside corner of the table top. The Line, Primary, Filament, Collimator, Stator, Foot Switch and Table Interface cables will all enter the control as shown in Figure 13 below.



**Figure 13 – Rear of Control Showing Cable Entry Points**

3. There is a “Table Interface Junction Box” where the cables for all Options will plug in. (Refer to Figure 14 below.) There will be one cable from this Junction Box which will enter the control and connect to TB – 5, acting as the interface between the control and all possible table options. The connections will be described in detail in section 6.2.

**Figure 14 – Table Interface Junction Box**



## 6.2 MAKING CONNECTIONS

1. Connect the Primary cable (labeled P1, P2 and GND) and the Filament cable (labeled XS, XL, XC and GND) to the High Voltage transformer terminals which carry the same markings.
2. Route the collimator cable (labeled CSW1, CSW2, C1, C2 and GND) through one of the openings in the rear of the control and connect it to TB – 4 terminals 21, 22, 23, 24 and 25 respectively, which are labeled the same as the cable. (Refer to Figure 15 for reference).

3. Route the tubestand display cable out of the tubestand and into the black connector on the back of the generator. The connectors are keyed for proper orientation. This cable, as the stator and collimator cables, must not limit nor be strained by tubestand motion.
4. Route the x-ray tube stator cable (labeled T5, T6, 07, 08 and 09) through one of the openings in the control and connect to TB -4 terminals 31, 32, 33, 34 and 35 respectively, which are labeled the same as the cable. Refer to Table 4 and Figure 15 for reference. Remove jumper between terminals T5 & T6 of TB4 when connecting tubes thermal cut-out SW.

**Table 4 – Common Stator Cable Designations**

DESCRIPTION		COLOR CODE FOR STATOR CABLE		
TERMINAL TB4 MARKINGS	CONNECTIONS	EUREKA TUBES	MACHLETT TUBES	SUMMIT & TOSHIBA TUBES
T5	THERMAL CUTOFF SWITCH	ORANGE/BROWN	---	YELLOW
T6	THERMAL CUTOFF SWITCH	BROWN/ORANGE	---	BLUE
07	RUN WINDING OF TUBE STATOR	BLACK	BLACK	BLACK
08	START WINDING OF TUBE STATOR	RED	GREEN	RED
09	COM. LEAD OF TUBE STATOR	WHITE	WHITE	WHITE

5. If the system is using the standard two-position Foot Switch, route the cable (labeled S1, S2 and S3) through one of the openings in the control and connect to TB – 4 terminals 27, 28 and 29 respectively, which are labeled the same as the Foot Switch cable. (Refer to Figure 15 below for reference.)

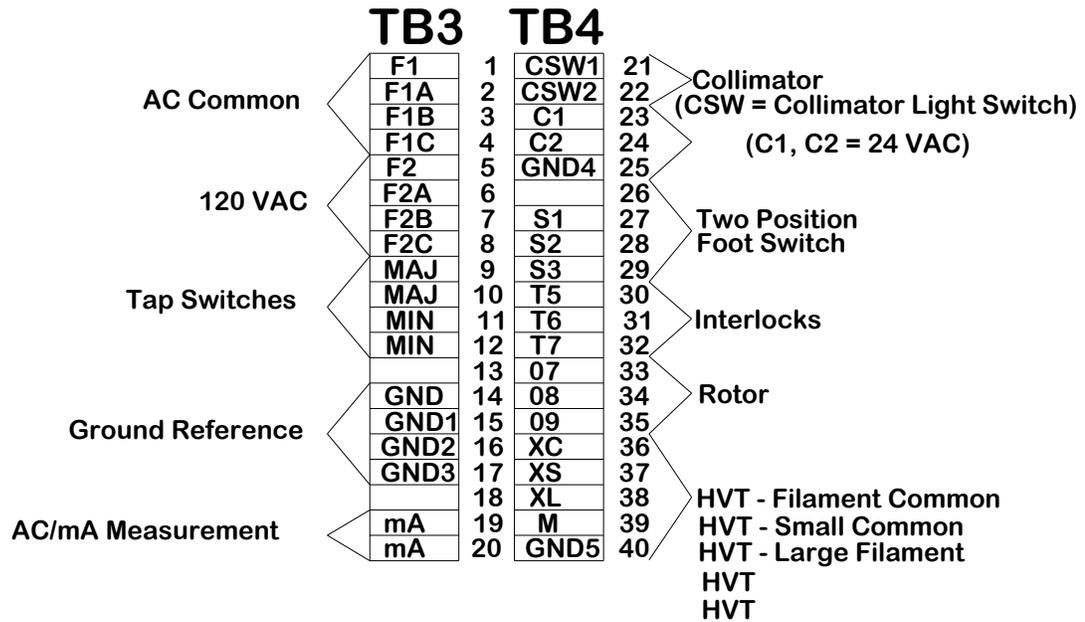


Figure 15 - TB3 and TB4 Terminal Designations

6. If the latching prep Foot Treadle option has been installed, push the air hoses from the foot pads on the air cylinder nozzles protruding from the rear of the control. Plug the two conductor cable from the treadle into the Table Interface Junction Box at S4 (refer to Figure 14 above).
7. At the Table Interface Junction Box plug the interface cable into S7. Route this cable through an opening in the rear of the control and connect it to TB - 5 as show in Table 5 below. (Note that there are no connections made to terminal 1 or 3 on TB - 5).

**Table 5 Interface Cable From Table to Control**

S7 Interface Cable Wire Color	Goes To Control
Brown	TB 5 - 2
Blue	TB 5 - 4
Red	TB 5 - 5
Green	TB 5 - 6
Orange	TB 5 - 7
Violet	TB 5 - 8
Black	TB 5 - 9
White	TB 5 - 10

8. All options (such as table locks, collimator hip switches, latching prep foot treadle) plug into the Table Junction Box. The Junction Box is designed so that each cable can only plug into the proper connector. If a plug will fit into more than one connector then it is a parallel circuit and can go in either connector. Refer to the Electrical Schematic Section 10 for detailed information about how the Junction Box is wired and how it fits into the overall electrical system as needed.
9. Connect the high voltage cables, taking note of the following important points:
  - A) Be careful of the three pins at each end of the cables as they can break if the cable is dropped.
  - B) Route the cables into the rear of the table so that they do not limit or restrict tubestand motion and they are not stressed by the tubestand motion.
  - C) The pins at the end of the HV cables should not be pinched tightly together but be slightly spread apart, about the thickness of a utility knife blade. (For old style split-pins only).
  - D) The HV cable terminals must be thoroughly cleaned and then coated with Vapor Proofing Compound (normally provided with x-

ray tube) prior to insertion into the x-ray tube or HV transformer receptacles. It is common to use dielectric oil in the HV transformer, and vapor proofing compound in the x-ray tube.

- E) Be sure that “Anode” of HV transformer connects to “Anode” of x-ray tube, and “Cathode” to “Cathode”. Insert the HV cable terminals into the appropriate receptacle and screw the cable nut as tightly as possible by hand – Do not use tools for tightening.

**NOTE:** Be certain to verify that the control’s on/off switch is in the “OFF” position, and that the main incoming power at the service disconnect is also in the “OFF” position. It is strongly recommended that a meter be used to confirm no voltage is present before connecting the Line cable to the service disconnect switch.

10. Route the line cable under the lower tubestand rail and wire it into the safety disconnect. Connect “L1” to one leg of the incoming line power, “L2” to the other incoming leg of line power and “G” to the ground lug.

## 7.0 CALIBRATION

### 7.1 PRECALIBRATION CHECKS

1. 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) Initial seasoning of the x-ray tube
  - B) Single exposure tube ratings
  - C) Accumulated heat and anode ratings of tube
  
2. Line voltage adjustments:

Terminals on TB2 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 terminals markings equal the measured line voltage,  $\pm 2$  VAC. For example: If line voltage is 240 VAC, connect "LVAC" to "224" and "LVAF" to "+16".

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

**TABLE 6 – Selector Switch Settings**

Power "On-Off"	"Off"
kVp major and minor	Fully Counterclockwise
mA selector	300L
Time selector	1/120 sec. for 60 Hz. (or 1/100 sec. for 50 Hz.)

4. In order to prevent accidental production of x-rays during initial check-out, disconnect the leads marked P1 and P2 from TB 1 and install a jumper from TP – 13 to TP – 4 of J400 board (this will hold the SCR open). Switch the power safety disconnect switch "On" and then switch the control's "on-off" switch to "On." Observe the following:

**TABLE 7 – Display Readings**

mAs display indicates	2.5
kVp display indicates	<40

5. Rotate kVp knobs so that display indicates >40 kVp. While observing the tube filaments through the port of the x-ray tube, verify that the correct filament is lit for each mA station. The small focal spot should illuminate for 30 or 100 mA, and the large focal spot should illuminate for 300 or 400 mA.
6. Verification of Rotor circuit.
  - A) Traditional Foot Switch  
 Depress the foot switch to the 1<sup>st</sup> stage (PREP), or the “PREP” button on the optional remote switch, and verify anode rotation and filament boost. The bottom status display should show “WAIT” momentarily, then “PREP”.
  - B) Foot Treadle with Latching Prep  
 Depress and release the foot switch. The bottom status display on the tube stand should show “WAIT”, then “PREP”. Verify anode rotation and filament boost. The unit will automatically remain in PREP mode for about 20 seconds, then return to idle condition.
7. The kVp meter circuit is factory adjusted, but display accuracy should be checked prior to other calibration steps.
  1. With power “Off” connect an AC voltmeter capable of reading 0-300 VAC across the wipers (center terminals of tap switches) of the kVp selector switches (major and minor) of TB3 terminals 9 and 10. This will allow measurement of the “no-load” primary voltage.
  2. Turn on power and adjust the kVp selector switches to achieve 220 VAC on the voltmeter. Refer to Table 8 for correct kVp display values
  3. Reset the kVp tap switches to achieve 160 VAC on the meter. Refer to Table 9 for the correct kVp display values.

**TABLE 8 – kVp/mA Readings @ 220 VAC**

<u>mA Station</u>	<u>kVp display on tubestand</u>
30 (if included)	116
100	114
300	87
400 (if included)	70

**TABLE 9 – kVp/mA Readings @ 160 VAC**

<u>mA Station</u>	<u>kVp display on tubestand</u>
30 (if included)	82
100	80
300	53
400 (if included)	-

If the kVp meter varies by more than 5 kVp to the above values, proceed to the kVp calibration procedure **7.4** before adjusting mA.

4. Switch the disconnect switch to “Off” and reconnect the leads P1 and P2 to TB 1 on the control. **Be sure to remove the jumper between TP – 13 and TP – 4 on the J400 PCB.**

## 7.2 mA CALIBRATION

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

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

The leads connected to the resistor bands of resistor RX (the third resistor on the right of the three at the right corner of the Control Board) are marked with letters which correspond to the mA stations (small-SM, medium-MD, large-LG). Moving one of these bands upwards increases the mA for the corresponding mA station.

The leads connected to the bands of RSCC are also marked with SM, MD, LG which correspond to the mA stations. Moving one of these bands upwards increases the space charge compensation, which increases mA at low kVp, and reduces mA at high kVp. Moving one of these bands down reduces the space charge compensation, decreasing mA at low kVp and increasing mA at high kVp.

Normal mA tracking will result in values slightly high at 80 kVp and mA values roughly equal to one another but slightly low at the high and low ends of the kVp range (125 and 50). See Figure 16 below for a visual representation of this effect.

(2) terminals, of TB3, are marked “mA” (term #19 & 20). Remove the factory installed jumper from these 2 terminals & connect an mA<sub>AC</sub> meter to these terminals to measure tube current.

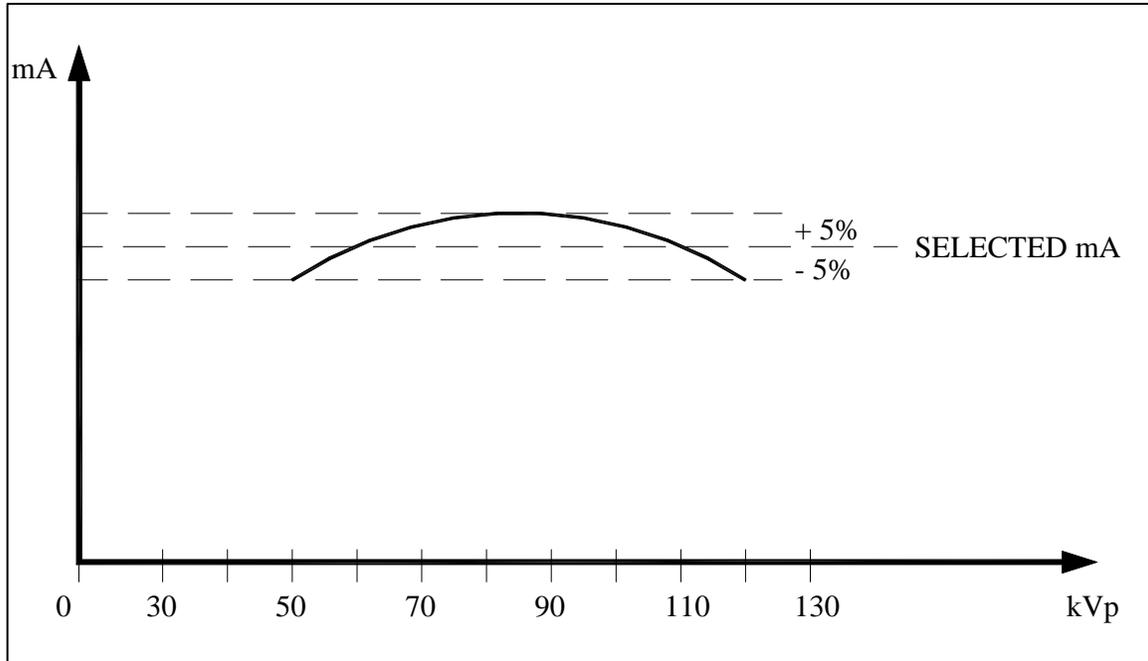


Figure 16 – mA Tracking Example

*For the following steps, use mA values and band designations in the table below:*

**Table 10 – mA Stations/Band Labels**

<b><u>mA Station</u></b>	<b><u>100/300 Configuration</u></b>	<b><u>30/100/300 Configuration</u></b>	<b><u>100/300/400 Configuration</u></b>
30mA	--	SM	---
100mA	SM	MD	SM
300mA	MD	LG	MD
400mA	---	---	LG

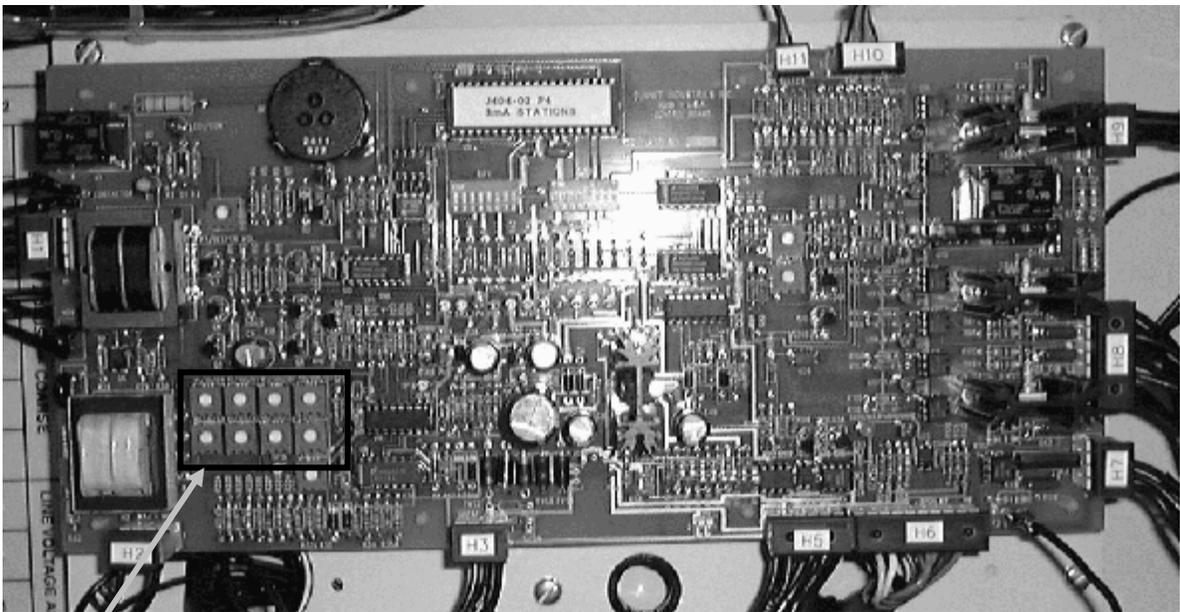
## 7.2 mA Calibration (continued)

In the following procedures, use the SM, MD or LG bands as appropriate for the mA stations available per this unit's configuration according to Table 10 above. Calibration is typically started with the 100mA station.

1. Connect a Dynalyzer or **AC** mAs meter to perform the following procedure. An AC mAs meter can be inserted into the circuit by removing the jumper between TB3-19 "MA~" and TB3-20 "MA~" and connecting the meter to those terminals (**AC readings only**). Be certain to replace the jumper after removing meter.
2. Select 100 mA and 80 kVp.
3. Adjust the appropriate band of filament resistor RX for the mA station chosen to produce the desired mA. Moving the band upward increases mA.
4. Select 50 kVp and note the mA produced.
5. Select 120 kVp and note the mA produced.
6. If the mA at 120 kVp is higher than the mA at 50 kVp, move the band of RSCC appropriate for the selected mA station upward. If lower, move the band downward. Achieve relative balance per Figure 16 above. The unit is capable, by fine tuning, to track within  $\pm 5\%$  of selected value.
7. Repeat steps (3) through (6) until no further adjustments are necessary.
8. Repeats steps 2 through 7 above for the one or two remaining mA options available on your station.
9. Replace jumper after removing the AC mAs meter.

### 7.3 kVp CALIBRATION

The *InnoVet Select™* kVp compensation circuit has four offset potentiometers (one for each possible mA station), and four slope potentiometers. These adjustment pots are located on the J400 control board. See Figure 17 – Electrical Control Board Component Identification for component orientation below.



**Figure 17 – Control Board Component Identification**

kV POTS  
(8 TOTAL)

## 7.4 kVp CALIBRATION WITH A MEANS TO MEASURE ACTUAL kVp

**Note:** In order to make a valid comparison between the actual kVp output and the kVp meter's pre-read indication, the tube current must be calibrated accurately per section 7.2. Failure to do so will result in miscalibration of kVp.

*For the following steps, use values in the table 11 below"*

**TABLE 11 – Adjustment Pot Identification**

<b>Adjustment Pot</b>	<b>mA Configuration</b>
P1	<b>30</b> mA offset
P2	<b>100</b> mA offset
P3	<b>300</b> mA offset
P10	<b>400</b> mA offset
P4	<b>30</b> mA slope
P5	<b>100</b> mA slope
P6	<b>300</b> mA slope
P11	<b>400</b> mA slope

In the following procedure, fine tuning of the kVp display calibration depends on the assumption that mA has been calibrated.

1. *Offset Adjustment:*
  - a. Select 50 kVp and 100 mA. While monitoring mA and kVp output, compare the measured kVp to the kVp meter's readings.
  - b. Adjust the kVp offset pot (from Table 11 above) that corresponds to the mA of your Station (For a 100 mA station the pot is P2) until the kVp meter's pre-read indication matches the actual measured kVp output.
2. *Slope Adjustment:*
  - c. Select 120 kVp. Make an x-ray exposure and adjust the slope pot (See Table 11 above) until the kVp meter's pre-read indication matches the measured kVp output. Repeat steps 1 and 2 until no further adjustments are necessary.

3. Verify that the kVp display tracks well throughout the kVp range.
4. Repeat steps 1, 2 and 3 above for each mA Station, using Table 11 as a guide for identifying the appropriate adjustment potentiometer.

The offset and slope adjustments are interdependent; as an adjustment in the offset is made, it will affect the slope, and as an adjustment is made in the slope it will affect the offset. By anticipating the interactive response it will reduce the number of adjustments required to achieve the desired accuracy of kVp display at each end of the kVp range.

Under normal conditions the kVp meter's indication will not deviate from the measured kVp output by more than 5 kVp.

## 7.5 CALIBRATION OF kVp WITHOUT A MEANS TO MEASURE ACTUAL kVp

The preceding Tables 10 – (mA Stations/Band Labels) and 11 – (Adjustment Pot Identification) contain settings and readings referred to in the following section. In the following procedures, an mA will be chosen, a kVp tap switch voltage will be set, and the kVp display will be adjusted to indicate the value shown in the column on the left side of Table 12 below.

Typically if the 50 kVp and highest (120 or 100) kVp are set in this manner, all values in between will also be correct. The tap switch voltages for kVp outputs between 50 and 100 kVp shown below are not needed for this procedure, but are provided for reference.

**TABLE 12 – TYPICAL KVP TAP SWITCH VOLTAGES**

<b>kVp</b>	<b>30 mA Station Unloaded Tap Switch Voltage</b>	<b>100 mA Station Unloaded Tap Switch Voltage</b>	<b>300 mA Station Unloaded Tap Switch Voltage</b>	<b>400 mA Station Unloaded Tap Switch Voltage</b>
<b>50</b>	104	108	155	183
<b>60</b>	121	125	173	201
<b>70</b>	139	143	190	218
<b>80</b>	156	160	208	236
<b>90</b>	174	178	225	253
<b>100</b>	191	195	243	271
<b>110</b>	209	213	260	-
<b>120</b>	226	230	278	-

## 7.5 CALIBRATION OF kVp WITHOUT MEANS TO MEASURE ACTUAL kVp (continued)

1. Connect an AC voltmeter capable of measuring 0-300 VAC to the common terminals of the minor and major kVp tap switches, or to TB3 terminals 10 and 11.
2. Select an mA station. Adjust the kVp tap switches to achieve the voltage which should result in 50 kVp per Table 12 above. (For example, at the 100 mA station adjust the tap switches to achieve 108 VAC).
3. Adjust the kV offset pot shown in Table 11 for the mA station selected. (For 100 mA offset adjust P2), until the kVp meter reads 50 kVp
4. Readjust the kVp tap switches to achieve the voltage which should result in 120 kVp per Table 12. (For example, for the 100 mA station adjust the tap switches to achieve 230 VAC.)
5. Adjust the appropriate slope pot until the kVp meter reads 120 kVp.
6. Repeat steps 2 through 5 until no further adjustments are required.
7. Repeat these steps, adjusting tap switch voltages, then offset and slope pots, until the kVp display indicates the appropriate value across the operating range for each mA station.

## 7.6 CONTROL BOARD DIP SWITCH SETTINGS

The InnoVet Select™ has a variety of dip switch settings to enable or disable various functions and to configure the system for the type of x-ray tube used in the system. These switches are typically set at the factory, but can be changed to accommodate the desires of the operator or the needs of the application. The dip switch combinations are shown in Figure 18 below.

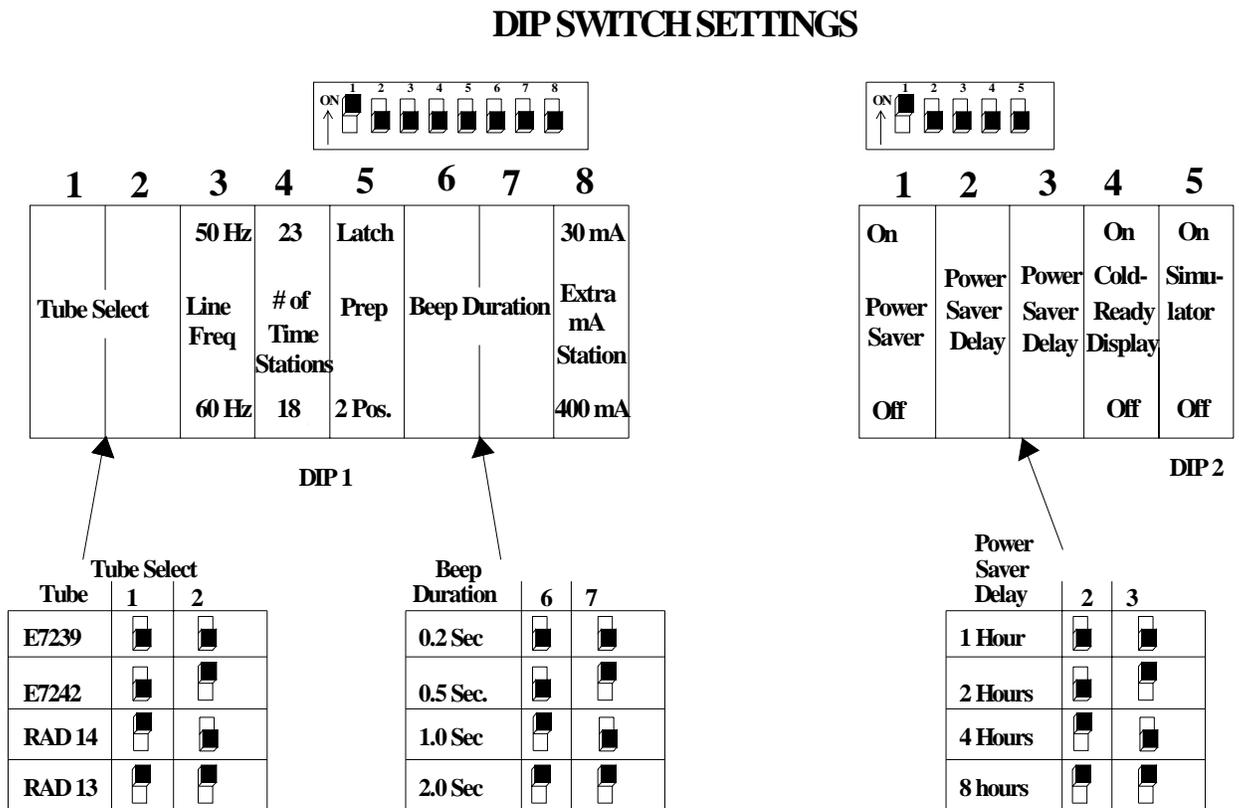


Figure 18 – Dip Switch Settings for Configuring Options and Features

## 7.7 X-RAY TERMINATION BEEPER VOLUME CONTROL

(See Figure 17 – Electrical Control Board Component Identification)

The volume of the x-ray termination beeper can be adjusted by P7, located on the control board. Turning P7 counter-clockwise increases the volume from quiet to very loud. Note: The front cover of the control will quiet the sound considerably so test the sound with the cover in place.

## 7.8 TUBESTAND DISPLAY MESSAGES

The following Messages are displayed by the bottom display on the InnoVet Select<sup>™</sup> tubestand. The COOL and READY features can be disabled via DIP2-4 (see FIG 18).

<b>WAIT</b>	PREP has been requested but the tube is not warmed up yet. The message clears as soon as the tube is ready for an exposure. This typically takes between one and two seconds.
<b>PREP</b>	The tube is warm and now ready for an exposure.
<b>XRAY</b>	Exposure is occurring. Ionizing radiation is present.
<b>GOOD JOB</b>	Exposure completed successfully. The message is cleared when the exposure switch is released.
<b>TUBE</b>	Indicates that the single shot tube power limits are exceeded by the selected techniques. It is accompanied by an error beep and prep is not allowed. The message clears when allowed techniques are selected.
<b>EXPOSURE COUNT</b>	With the kVp major, kVp minor and mA selector knobs turned fully counter-clockwise, the kVp display the bottom display will indicate "EXPO". The mAs and the kVp display will indicate the total number of exposures taken on this x-ray control.
<b>HEAT</b>	Indicates tube heat interlock. The message is accompanied by an error beep and cleared as soon as the x-ray tube cools. PREP is locked out.

<b>ZCO</b>	Line voltage zero crossing signal not detected. Accompanied by error beep. PREP locked out. Message clears as soon as zero crossing signal detected.
<b>FOOT</b>	Foot switch released before exposure is finished. Accompanied by error beep. The message is cleared when any of the techniques change or PREP is requested.
<b>ROTR</b>	Tube rotor error. Accompanied by error beep. PREP is terminated. The message is cleared when any of the techniques change or PREP is requested.
<b>FIL1</b>	Standby filament current too low, or not present. Accompanied by error beep. PREP locked out. Message clears when standby filament current is acceptable.
<b>FIL2</b>	Standby filament current too high. Accompanied by error beep. PREP locked out. Filament circuit disabled. Message will not clear without rebooting system and resolving cause of high idle current.
<b>FIL3</b>	Boost filament current too low. Accompanied by error beep. PREP locked out. The message is cleared when any of the techniques change, PREP is requested, or cause of low boost current is found and resolved.
<b>FIL4</b>	Boost filament current too high. Accompanied by error beep. PREP locked out. The message is cleared when any of the techniques change, PREP is requested, or cause of high boost current is found and resolved.
<b>COLD</b>	The control is cold. Exposures are possible, but the outputs will not be at their maximum accuracy. "COLD" will change to "READY" once the unit is on for about ten minutes.
<b>READY</b>	READY scrolls across the tubestand display once the unit has warmed up to a level that delivers the most accurate outputs, about ten minutes after initial turn-on.
<b>ZZZZ</b>	Sleep timer is 5 minutes away from turning off system. Accompanied by error beep. Active in power saving mode only.

## 7.9 Detailed Troubleshooting Guide for K200 Generator

### I. CIRCUIT BREAKER TRIPS AT TURN ON

#### A. Confirm mechanical latching of breaker

1. Turn OFF main input power at the wall breaker
2. Flip the control circuit breaker ON and OFF several times to confirm the breaker will mechanically latch in the ON position. If not, replace breaker.

#### B. Check for shorted or leaking SCR

1. With the control turned OFF, select DEMO mode by setting DIP2-5 of J400 board to the ON (up) position.
2. If the control turns on, look for voltage between P1 and P2. If more than 4 VAC is present, replace the SCR. If control does not turn on see C below.

#### C. Confirm valid kVp input and J400 board

1. If the breaker still trips when in DEMO mode, disconnect the wire from terminal W2 on the J400 board and turn the control ON. If the display is stuck in "EXPO" mode, the kVp tap switch input voltage is missing at the J400 board header H2. Check the wire-to-plug and plug-to-board connections at H2, and the kVp tap switches for open/resistive contacts or connections.
2. If the kVp display is not stuck in "EXPO" mode, and shows a valid selection between 40 kVp and 125 kVp, replace the J400 board.

### II. CIRCUIT BREAKER TRIPS AT EXPOSURE

The circuit breaker will trip due to either excessive mA or excessive line current. It may appear to be related to a specific mA station, or occur above a specific kVp range, or occur at longer time stations.

#### A. Determine if the mA calibration is valid

1. Remove the jumper between TB3-19 and TB3-20 and connect a mAs meter between these points, ensuring that the meter is set to read AC mA. *The range of the meter scaling must be set to maximum.*
2. Typical filament voltage between XC/XS for 100 mA is 39 VAC during PREP (+/- 2 VAC). Typical filament voltage between XC/XL for 300 mA is 51 VAC during PREP (+/- 2 VAC). Under no circumstances does this voltage need to be more than 56 VAC.
3. Take exposures and measure the mA or mAs output. Readjust the filament voltage as needed to bring mA into range.

4. If the filament voltage is correct but the output is  $\frac{1}{2}$  the expected mAs the SCR or high voltage transformer may be half-waving. See II.D below.

**B. Determine if the line voltage drop is excessive (this test is only valid after the mA calibration has been verified).**

1. Place a voltmeter (set for min/max reading or to the hundreds of volts scale) between L1 and L2 of the control. Record the no-load line voltage. Measure and record the line voltage during an exposure of 90 kVp, 300 mA, 300 mAs. The drop should be less than 7%. If the lights dim, the supply wires rattle in the conduit or the wall breaker buzzes, the wire gauge or distribution transformer may be undersized.

**C. Determine if high voltage breakdown is present (hypot test)**

1. Inspect the high voltage cables, cable ends, and high voltage receptacles for carbon tracking and evidence of high voltage breakdown.
2. Verify that the anode rotates and has no visible melt marks.
3. With the high voltage cables removed from the A700 transformer, fill the receptacles with at least two inches of dielectric oil.
4. Remove the jumper between TB3-19 and TB3-20 and insert a mAs meter set for AC and at maximum range. Connect a jumper between TP12 and TP15 (near kVp comp pots lower left of board).
5. Remove U14 from the J400 board. Turn on the control and adjust P12 to achieve 1.8 VDC (+/- 0.1VDC) at TP15, referenced to TP1.
6. Adjust tap switches for 170 VAC between kVp major and minor common. This will produce a no-load potential of 110 kVp on the transformer.
7. Take exposures. Does the breaker trip or is mA present? If yes, the diode sticks in the transformer are shorting and must be replaced. If no, there may be a problem with the tube or cables not found with visual inspection.

**D. Identification of poor SCR gating or half-waving transformer**

1. Select 50 kVp, 100 mA, and 100 mAs. During exposure there should be about 108 VAC measured between P1 and P2 of the transformer. If the voltage at P1 and P2 is 108 VAC, replace the diode sticks. If the voltage is near 54 VAC, verify the SCR gate leads are tight, replace the SCR.
2. A heavy groan from the transformer during exposure (that worsens as time and power are increased) is likely due to half-waving from the SCR.

3. Open diode sticks will appear as high current draw with one-half the expected mA (when the filament voltages are normal as described in II.A above, and the test equipment is used properly). Non-invasive kVp meters may indicate an 8 millisecond exposure regardless of selected time, due to their resetting during the missing pulse.

### III. CIRCUIT BREAKER TRIPS WITH ROTATION OF KVP TAP SWITCH

- A. Look for a broken connection or poor solder joint on the noise suppression assembly between the common poles of the kVp major and minor tap switches. Replace if suspect, as this problem can damage rectifier sticks in the high voltage transformer.

### IV. "FIL 1" ERROR (low filament current in standby/idle mode)

- A. Open connection at H8 or H9 of J400 board
  1. This could be a pin-to-plug or plug-to-board connection.
- B. Open/loose terminal at either end of filament cable (XC, XL, XS)
- C. Open F1 or F2 fuse in control
- D. Open between resistor and resistor band (RSCC or RX)
- E. Open or loose cathode cable, open filament of x-ray tube
  1. Remove the cathode cable from the tube end. Use a collimator bulb as a dummy filament load by connecting it between XC/XS or XC/XL pins and see if it will light – use standby (idle) mode only. If the collimator bulb lights the tube filament may be open. If not, cathode cable may be open.
  2. Switch cables anode for cathode. If collimator bulb now lights replace the cable formerly in the cathode side.
- F. Check the J400 board
  1. Once it is confirmed there are no open primary connections or open secondary loads, check for about 1.7 VDC (+/- 0.2 V) between TP12 and TP1. If the voltage is missing, confirm LED4 is illuminated. If the light is OFF, jumper pin3 to pin4 of U18 optocoupler. Replace U18 optocoupler if function returns, or the J400 board.

## V. "FIL 2" ERROR (high filament current during standby/idle)

## A. Confirm J400 operation

1. Filament voltage during idle is typically about 24 VAC for small, 28 VAC for large spot as measured XC to XS or XL. This idle voltage typically produces 1.6 to 1.8 VDC at TP12. Turn pot P9 clockwise 1/2 turn. If error goes away, reduce the idling voltage by moving the bottom band on the boost resistor as needed.
2. If FIL2 is still present, remove H8 header from the J400 board and cycle power. The error should change to FIL1, and voltage at TP12 should be near zero. If FIL2 error is still present replace the board.

## VI. "FIL 3" ERROR (low filament current during prep)

## A. Confirm contact of boost resistor band to the resistor

## B. Confirm connection at H8 pins 7 and 8

1. These contacts close to bypass most of the boost resistor. If contacts are good at H8 but closure does not occur at prep, replace A455 motor start board.

## VII. "FIL 4" ERROR (high filament current during prep)

## A. Gross miscalibration

1. Filament voltage is set too high.
  - a) 54 VAC at prep (XC to XS) is more than enough to achieve 300mA. A resistive cathode cable, filament cable or a miswire of XC/XL/XS (causing both filaments to be illuminated at one time) would require setting the filament voltage above this level and create the error.
  - b) 54 VAC at prep will produce about 2.68 VDC at TP12.
2. Faulty or misused test equipment may give an improperly low reading for mA, causing an over-adjustment of the filament circuit and a "FIL4" error. Meters must be set to AC mA, and if equipped with an adjustable range scale (20, 200, 2000) *it must be set to maximum*.
3. Functional test equipment does not see the mA produced.
  - a) Always remove the jumper between the two "AC mA" terminal locations when measuring mA, and always replace the jumper when finished.
  - b) Ensure spark gap on top of the HV transformer at "M1" is not shorted to ground.
4. Failure of J400 board. This is by far the least likely possibility.

**VIII. DIGITAL DISPLAY PROBLEMS****A. Status display does not change or is at wrong state**

1. On J400 board set DIP2-4 to OFF (down), disabling “ready/cold” feature. If the display now updates, the “ready/cold” feature is not available with the display’s software version. Update the software or leave switch OFF.
2. If locked in “wait” check for shorted footswitch.

**B. Scrambled characters/missing segments**

1. Verify that each of the conductors on the cable going into H6 of J400 board is secured to the plug by looking beneath the plug cover.
2. Confirm the Mate & Lock plug pins of the display cable at the rear of the control are seated and making contact.
3. Confirm the plug and wires are well seated at J350 board in tubestand.

**C. Blank display**

1. Verify the Display cable connections at the H6 header of the J400 board, the pins in the Mate & Lock plug at the back of the control, and at the J350 display board.
2. Confirm +20 VDC at TP3, +12VDC at TP5 of J400.

**D. kVp changes without tap switch adjustment**

1. Select 100 mA and 143 VAC between the leads of MOV1 on the J400 board, located near H2. 70 kVp should be displayed. If the voltage varies check H2 and kVp tap switch connections.
2. Confirm a stable 1 VAC between the junction of R35A/R36 and TP1. If this voltage is unstable replace the J400 board. If the voltage is stable and the kVp is still variable replace the J350 board.

**E. “HEAT” Error**

1. Verify TB4 “T5/T6” tube thermal switch connections are closed.
2. Verify zero ohms on J400 board between U22 pin 1 and pin 2.
3. Replace U22 or J400 board.

**F. “TUBE” Error**

1. Select 70 kVp and 10 mAs. The “Tube” Error should go away.
2. If 70 kVp and 10 mAs cannot be selected, the J400 board may not be getting a valid kVp, time or mA input, or the board may be bad.
  - a) Adjust kV major/minor tap switches to achieve 180 VAC between the two leads of MOV1 on the J400 board. If no

voltage is present inspect H2 and kVp tap switch common poles for open connection.

- b) Remove the H10 plug from the J400 board. Place a jumper between pins 1 and 3 on the board. If the “Tube” error is cleared inspect the connections at the cable plug, replace time selector.
- c) Remove the H11 plug from the board, and jumper pin 1 to pin 2. If the error clears, inspect the switch and connections, replace the mA selector.
- d) If the error still exists replace the J400 board.

### G. “ZCO” ERROR

1. Verify 14 VAC between TP1 and TP2 on J400 board. If voltage is present switch the wires in H3 pins 2 and 3. If error is still present, switch the wires back to their original locations and replace the J400 board.

## IX. LONG “WAIT” DISPLAY, “ROTR” ERROR AT EXPOSURE ATTEMPT

### A. Verify rotor circuit

1. The A455 motor start board controls rotor delay time. 240 VAC is applied between stator main (07) and common (09) for 1.5 seconds, and then the voltage drops to 50 VAC. The red LED on the motor start board turns on at that time. If the voltage stays at 240 VAC for longer than 1.5 seconds, adjust R17, replace C4, or replace the board.
2. If the red LED on the A455 board does not light, confirm 240/50 VAC at 07-09 stator connections of the control and at tube end. Verify stator resistance (30 ohms 07-black to 09-white, 60 ohms 08-red to 09-white, 90 ohms 07-black to 08-red), replace A455 board if voltages and connections are correct.

## X. EXPOSURE BEEP or PREP AT TURN ON

### A. Check for shorted exposure switch.

1. If Latching Prep option is installed, verify open contacts between TB5-2 and TB5-4. If a short is measured, remove red and black wires from air switches at TB5-1 and TB5-4 and recheck measurement to determine if the short is in the air or strip switches.
2. If a two-position foot switch is installed, confirm open contacts between S1, S2 and S3 on TB3.
3. Remove H5 at J400 board. If problem continues replace J400.

**XI. mAs DISPLAY IS INCORRECT FOR SETTINGS****A. Verify mA switch inputs**

1. Confirm proper number of switch positions (two and three mA station units are available). If three positions are available on a two mA station unit, rotate switch fully CCW and remove the switch. With shaft pointing upwards, move the stop tab to the fully CCW position.
2. Remove H11 plug on J400 to force in a good low mA station selection. Jumper pin 1 to pin 2 on J400 board H11 for medium mA station. Jumper pin 1 to pin 3 for high mA station (if third station exists). If mAs display responds to change of mA station replace mA switch, if not, replace J400 board.

**B. Verify time selector switch inputs**

1. Select 100 mA. Remove H10 plug from J400 board. Without H10 connected mAs display should be 0.83. Jumper pin 1 to pin 3 on the board, and display should change to 8.3. If it does, change time selector switch. If not, replace J400 board.

**XII. NO mA MEASURED WITH RADIATION PRESENT****A. Spark gap is shorted to top of transformer.**

1. The metal tab should not make contact with transformer lid. Normal spacing is equal to the thickness of radiographic film.

**B. Jumper is still present between TB3-19 and TB3-20.****C. Faulty mA / mAs meter or leads.****XIII. UNIT WILL NOT GO INTO SLEEP MODE****A. Ensure DIP2-1 on J400 is set to UP (ON) to enable feature.****B. Poor connection between “W2” on J400 and mA overload coil of ON/OFF breaker.****C. Shorted spark gap on top of transformer between M1 and GND.**

1. Proper spacing is the thickness of a piece of radiographic film.

**D. High line voltage fluctuation; new software may be less sensitive.**

## **8.0 FINAL ADJUSTMENTS AND QUALITY ASSURANCE**

### **8.1 LEVELING THE TUBE ARM**

An adjustment screw for leveling the tube arm is provided on the front of tubestand, just below the tube arm base. Turn the Allen screw clockwise to raise the tube arm or counterclockwise to lower the tube arm.

### **8.2 40 INCH SID DETENTS**

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. Access to the adjustments are from the rear of the tubestand.

### **8.3 VERIFICATION OF X-RAY TO LIGHT FIELD COINCIDENCE**

The coincidence of x-ray to light field must be verified. Specific instructions can be found in the manual for the G800 collimator.

### **8.4 VERIFICATION OF X-RAY TO IMAGE RECEPTOR ALIGNMENT**

Any left-to-right adjustment required to achieve coincidence between the central ray and the center of the image receptor can be achieved by adjusting the grid cabinet-to-tubestand interlock bracket, located on the lower front surface of the tubestand.

1. Any front-to-back adjustment of the central ray necessary (after the arm has been leveled from 8.1 above) can be achieved by the slotted holes in the tube mounting platform. Slightly loosen the collimator mounting bolts, shift the tube and collimator as required, and re-tighten the mounting bolts.

### **8.5 SECURING TABLE TO FLOOR**

Once the table is in final position and all checks have been made, 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° to the table and secure with a lag screw.

## 9.0 OPTIONS FOR FIELD INSTALLATION

Many options for the *InnoVet Select*<sup>™</sup> will arrive at the jobsite pre-installed. However, all of the following features can be added after the installation is complete if the user so desires.

### 9.1 FILM BIN

The film bin comes in either a right hand or left hand configuration. See instructions that are provided with film bin kit.

### 9.2 TABLE TOP EXTENSION (For Fixed-Top tables only)

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 as shown in Figure 19.

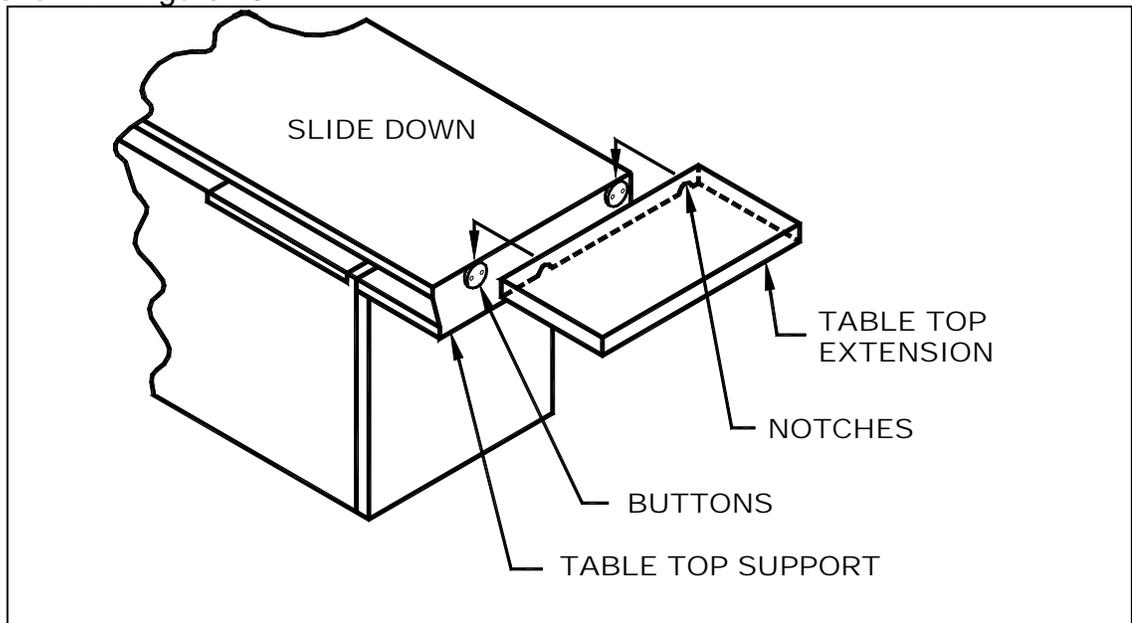


Figure 19: Table Top Extension – AWW430-08

### 9.3 ANIMAL RESTRAINTS

The animal restraints used are nautical style tie-down cleats. They are screwed to the underside of the table top frame at either end of the table. This prevents lead aprons from snagging on the cleats.

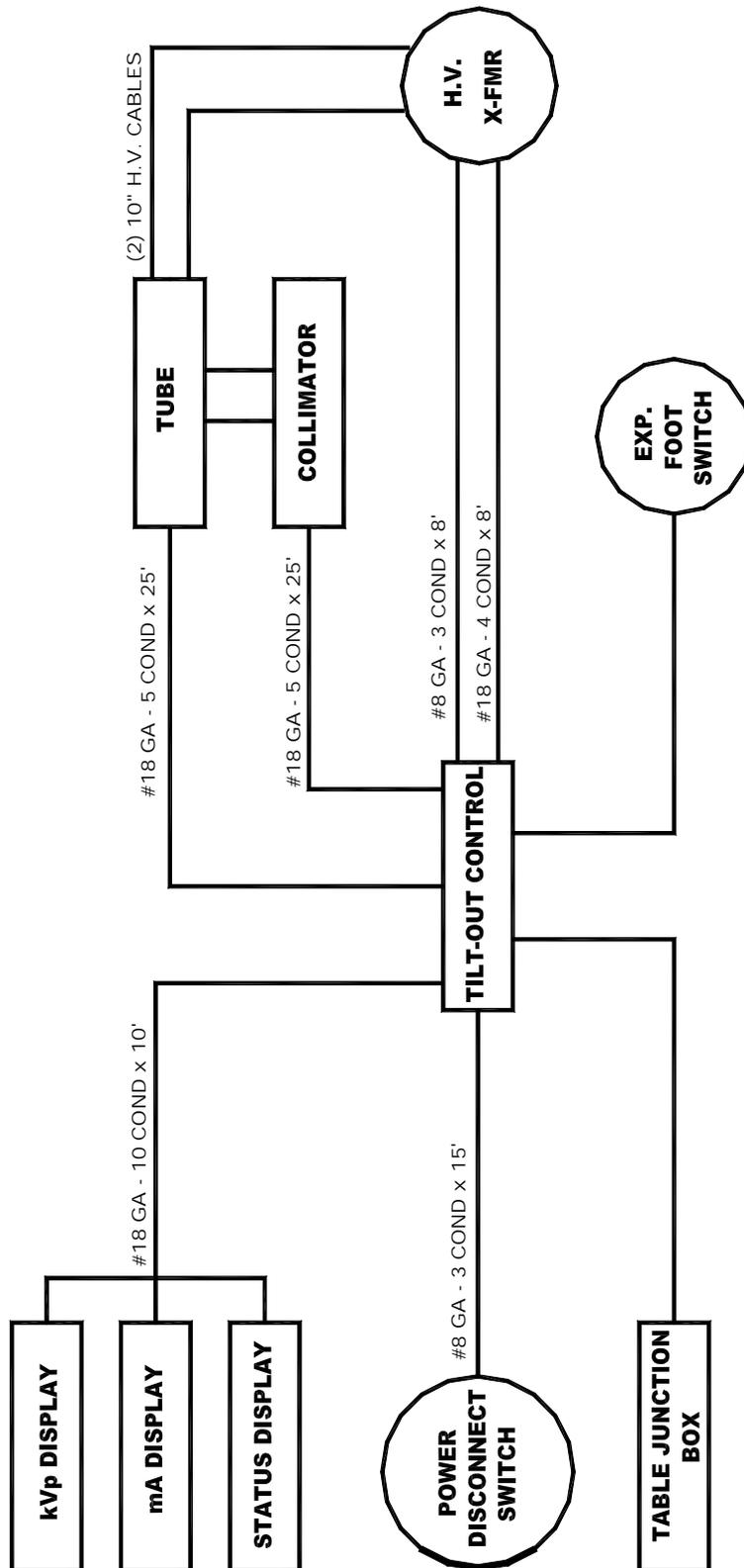
## 9.4 FOOT TREADLE

If the *InnoVet Select*<sup>™</sup> has the latching prep Foot Treadle Option, the treadle must be installed prior to mounting the control into the table. If the Foot Treadle Option is being added to an existing system, the control will need to be removed from the table base and laid flat on the floor to install the treadle.

1. Remove the control from the table base by unclipping the truarc ring and extracting the hinge pin which hold the control to the air cylinder. Lay the control face down on cardboard and pull it slightly away from the table.
2. Put the treadle in position across the front of the table base.
3. Thread the spring guide pins located at either end of the treadle up through the table base until they protrude out the top of the base, securing each guide pin in place with cotter pin provided.
4. Bolt the foot treadle brackets to the underside of the table base using the hex head bolts provided.
5. Plug the foot treadle cable into the S4 location of the junction box at the right side of the table frame.
6. Slide the control so that the notches engage the pivot rollers, lift the control up into the table opening and resecure the control to the air cylinder using the pin and locking ring.
7. Remove the front panel of the control. Install the air switch packets using the screws and nuts provided so that the nozzle of each exits the rear of the control.
8. Connect the wires from the air switches to TB5-2 and TB5-3 in the bottom of the control. Connect the air hoses to the air switches by pushing them over the nozzles which exit the rear of the control.
9. Place a jumper between TB5 – 1 and TB 5 – 2, and another jumper between TB5-3 and TB5-4. Verify on the J400 control board that DIP 1-5 is in the UP position. (To enable the Latching Prep mode as shown in Figure 18, page 7-12).
10. If any existing exposure switches are to be left in the system, alert the user that they will now operate like the Treadle; that is step on and release to start PREP, then step on and release to start EXPOSURE. Generally, removing these old two-position switches is recommended.

## 10.0 ELECTRICAL SCHEMATICS AND DIAGRAMS

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K158	Schematic, InnoVetSelect Table	
J499	Schematic, K200 Control	
J402	Schematic, Control Board (J400)	
J352	Schematic, Display Board (J350)	
01032	Schematic, RC Timer Board (01030-000)	



SYSTEM CABLE ROUTING / INTERCONNECT DIAGRAM  
STANDARD CABLE SIZES & LENGTHS SHOWN

Figure 20: System Cable Routing – AWW430-09

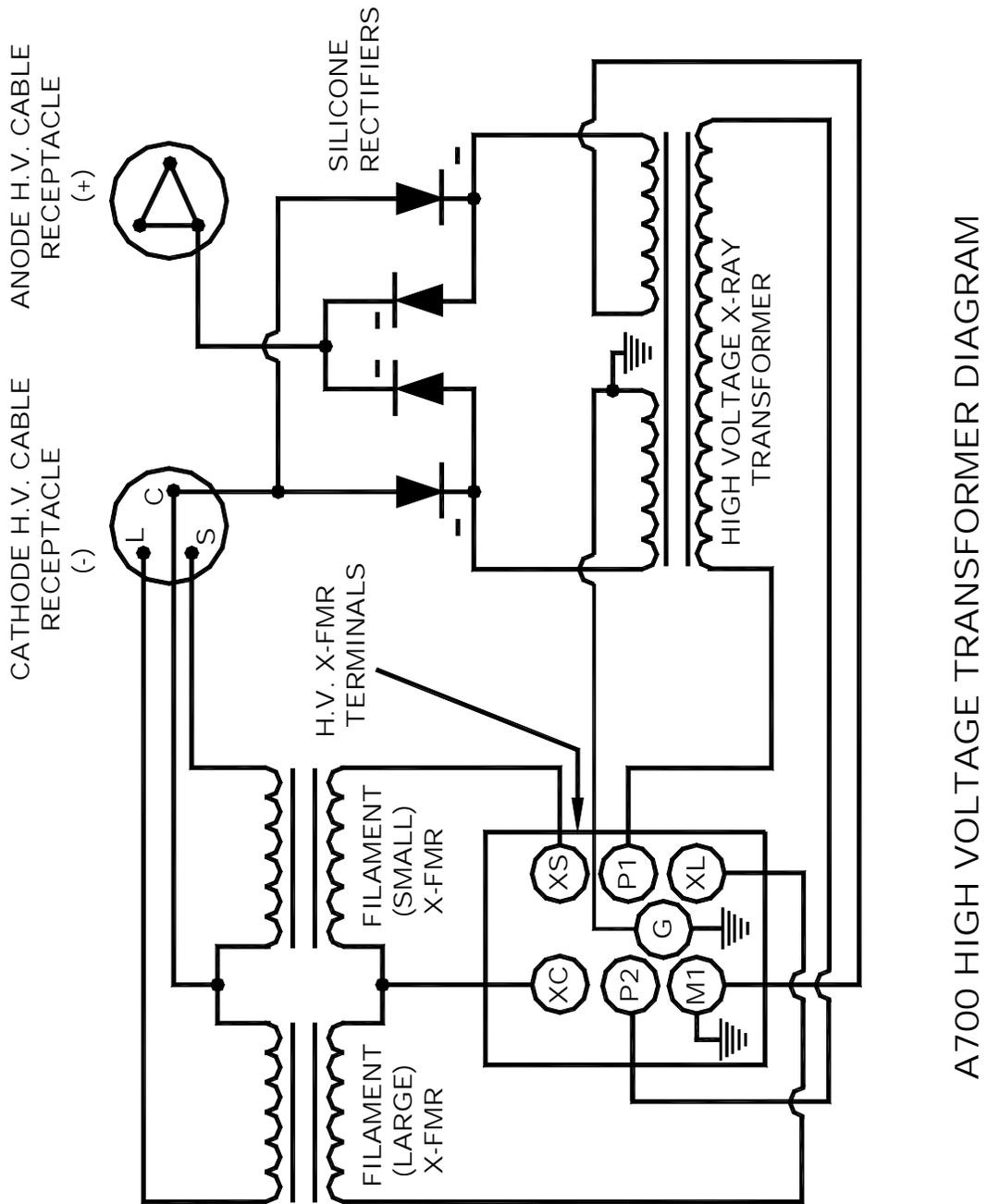


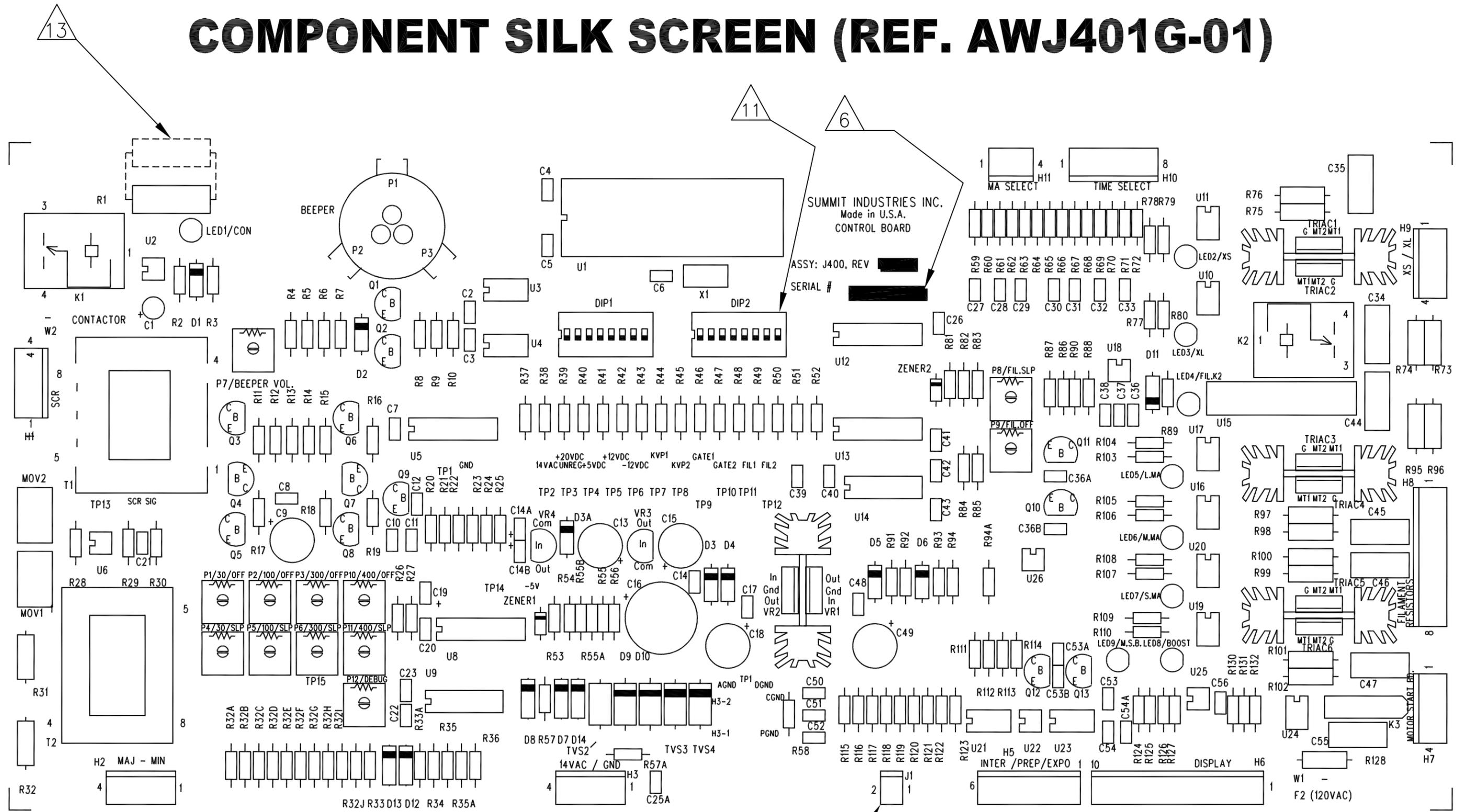
Figure 21: High Voltage Transformer Diagram – AWW430-10



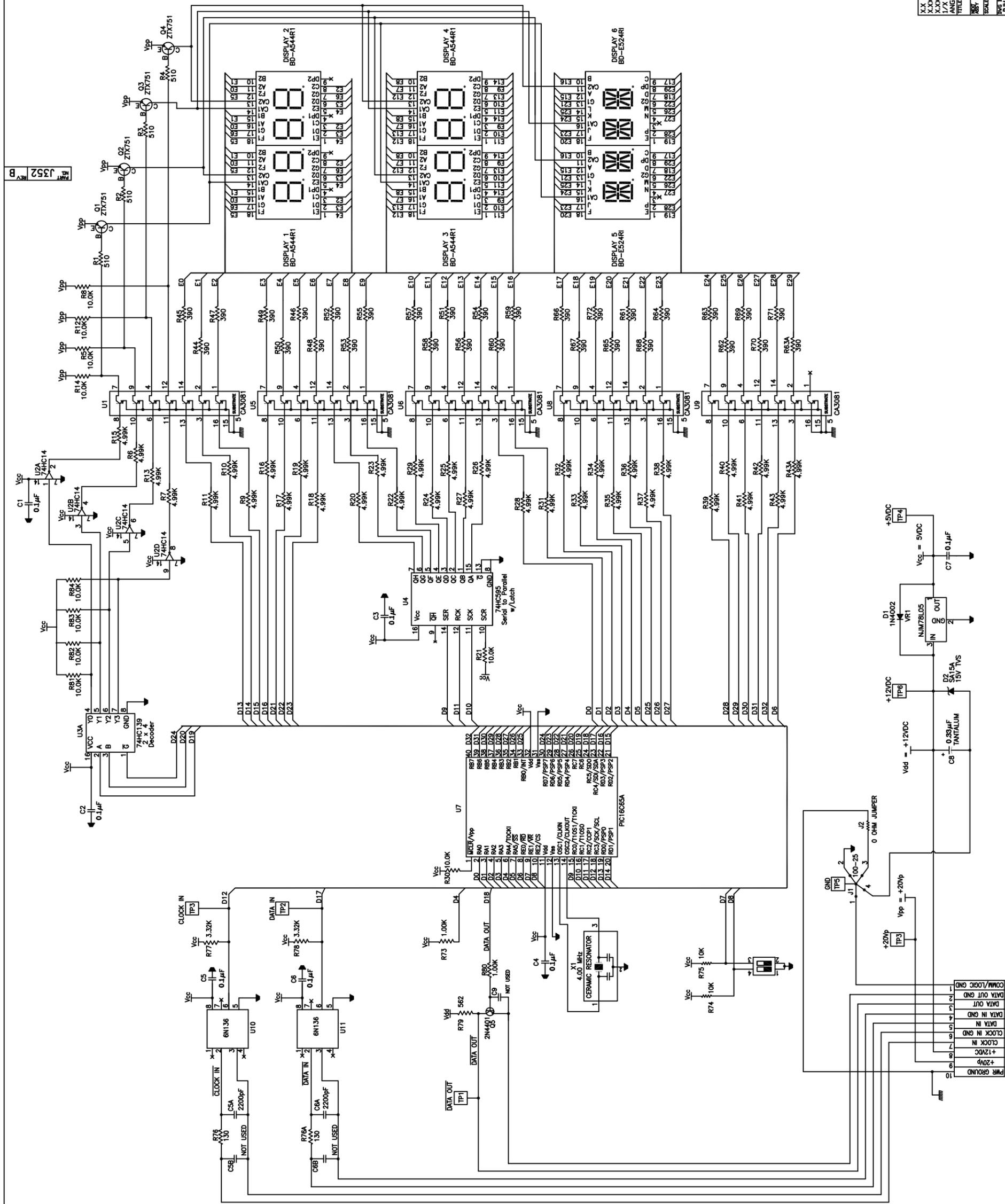




# COMPONENT SILK SCREEN (REF. AWJ401G-01)



LTR	ECK	REVISION	BY	DATE
A	1398	RELEASED	S.C.	03/09/98
B	2656	ITEM R77 & R78 WERE 2.00 K	R.F.	7/10/02

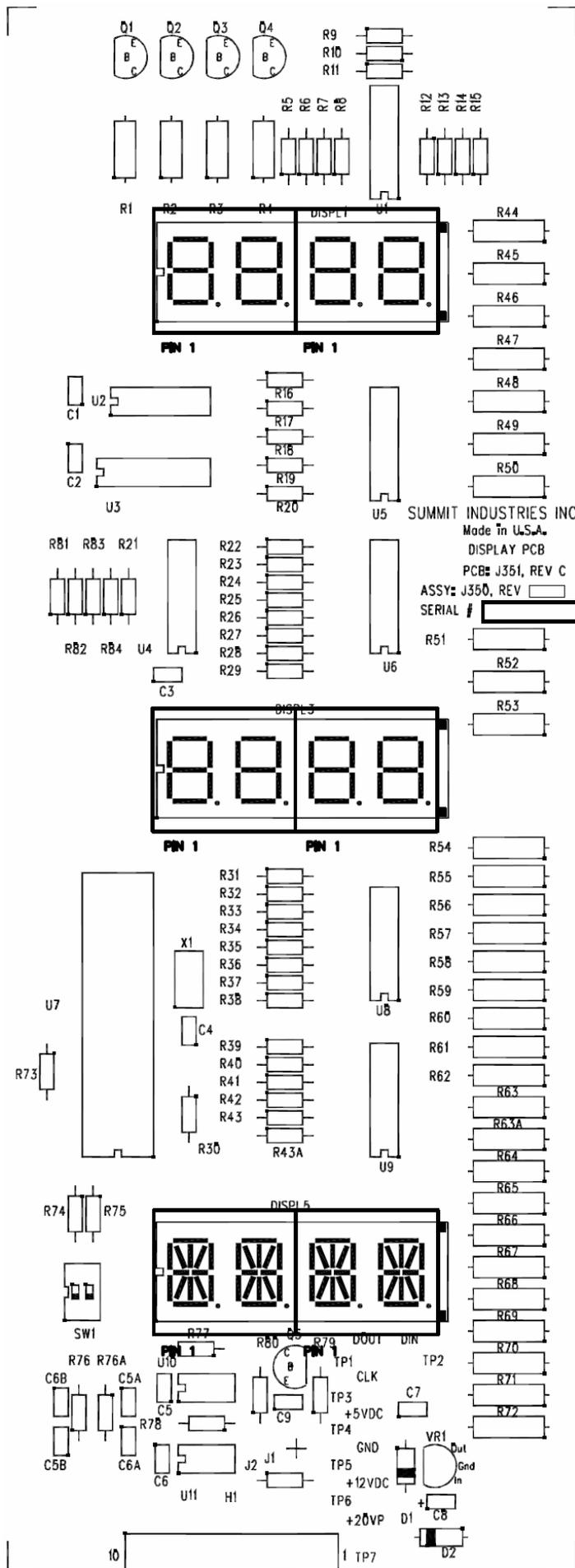


J352

Q050 C:\MASTERS

TOLERANCE UNLESS OTHERWISE SPECIFIED	
XX ±0.30	SUMMIT INDUSTRIES, INC.
XXX ±0.05	2801 W. LAWRENCE AVE. CHICAGO, IL
1/XX ±1/64	TEL: 773-508-8075
ANGLES 45°/2°	FAX: 773-508-8080
TITLE SCHEMATIC, DISPLAY BOARD	
REV: J350	MATERIAL: NONE
SCALE: NONE	DATE: 03/09/98
DESIGNED BY: S.C.	APPROVED BY: R.F.
DRAWN BY: S.C.	CHECKED BY: S.C.
SHEET: 1	OF: 1
REV: J352	REV: B

# COMPONENT LAYOUT for J350 DISPLAY PCBA



# 00130-000 RC Timing Control

