

CHAPTER 2

INSTALLATION

CONTENTS:

2.1.0	INTRODUCTION	2-2
2.2.0	UNPACKING	2-2
2.3.0	REMOVING THE GENERATOR COVER	2-2
2.4.0	MAJOR COMPONENT LAYOUT	2-3
2.5.0	EQUIPMENT PLACEMENT	2-3
2.5.1	Main Cabinet	2-3
2.5.2	Control Console	2-3
2.5.3	Anchoring the Generator to the Floor	2-5
2.6.0	WIRING TO THE GENERATOR	2-5
2.6.1	Control Console	2-6
2.6.2	Hand Switch (Optional)	2-10
2.6.3	Stator Connections	2-10
2.6.4	Thermal Switch	2-12
2.6.5	Power Line Mains	2-13
2.6.6	High Tension Cables	2-16
2.6.7	X-Ray Tube Housing Ground	2-16
2.6.8	Room Equipment	2-17
2.6.9	Emergency Power Off / Power Distribution Relay	2-17
2.6.10	Safety Interlocks2	2-17
2.7.0	LOW-SPEED STARTER TUBE COMPATIBILITY	2-18
2.7.1	Setting 120 / 240 VAC Boost Voltage	2-19
2.8.0	PROGRAMMING THE DUAL-SPEED STARTER	2-20
2.8.1	EPROM type / dual-speed starter - applies <i>only</i> to DSS Board #728877-06.	2-20
2.8.2	Tube type setting on DIP switch SW1 for DSS Boards #728877-06 and #903132-02	2-21
2.8.3	Programming DIP switch SW3 for DSS Board #903132-xx	2-24
2.8.4	Inspecting DIP switch SW8 setting for DSS Board #903132-xx	2-27
2.8.5	Configuring dual-speed starter 901297-15 / 901298-15	2-28
2.9.0	GENERATOR CONTROL BOARD DIP SWITCH SETTINGS	2-29
2.10.0	INITIAL RUN-UP	2-29
2.10.1	Auxiliary Transformer Line Voltage Tap Selection	2-29
2.10.2	Initial Voltage Measurements	2-31
2.11.0	TUBE mA AUTO CALIBRATION	2-32
2.12.0	FINAL CHECKS	2-32

Use and disclosure is subject to the restrictions on the title page of this CPI document.

2.1.0 INTRODUCTION

This chapter contains instructions for unpacking and installing the CMP 200® and CMP 200® DR X-ray generators. This chapter also describes the basic wiring and setup of the generator (console, X-ray tube, AC mains, etc), allowing for initial power-up of the generator. This is followed by tube seasoning and auto calibration.

2.2.0 UNPACKING

1. Inspect the shipping pack(s) for evidence of shipping damage.
 - The generator and the membrane control console (if applicable) are shipped in one pack.
 - The optional touchscreen console is shipped in a separate pack from the generator.If there is evidence of shipping damage, note this in the event that a damage claim is justified. Taking pictures of the damage is also recommended.
2. Remove the cardboard outer pack from the generator. See the cautionary note below before removing the pack.

CAUTION: OPEN THE CARDBOARD PACK (S) CAREFULLY. SHARP TOOLS MAY DAMAGE THE CONTENTS.

3. Set aside the cardboard pack.

WARNING: THE GENERATOR MAIN CABINET (WITH HV MODULE) WEIGHS APPROXIMATELY 135 POUNDS (61 KG). ONE PERSON SHOULD NOT ATTEMPT TO LIFT OR MOVE THIS ASSEMBLY WITHOUT PROPER EQUIPMENT OR ASSISTANCE.

4. Remove and unpack the membrane control console, if included. This is strapped to the top of the generator. Then carefully lift the generator from the pallet.
5. Remove and unpack the optional hand switch and the optional mini-console control unit, if included.
6. If applicable, unpack the optional touchscreen console along with the base and console cables.
7. Inspect all items for shipping damage, including loose hardware if applicable.
8. Unpack the manuals and any other paperwork that may be packed with the generator.
9. Keep the shipping packs. In case of shipping damage, place the unit(s) back in their shipping pack(s) and notify the carrier and the customer support department as described in chapter 1 of this manual.

2.3.0 REMOVING THE GENERATOR COVER

1. Remove and set aside the screws and washers securing the cover to the generator chassis.
2. Carefully lift the cover off the chassis.

Use and disclosure is subject to the restrictions on the title page of this CPI document.

2.4.0 MAJOR COMPONENT LAYOUT

Refer to the section *GENERATOR LAYOUT AND MAJOR COMPONENTS* in chapter 1 for major component identification and layout.

2.5.0 EQUIPMENT PLACEMENT

2.5.1 Main Cabinet

Place the generator cabinet in a location that will allow the following:

- Easy front and side access for service and sufficient clearance at the rear for room interface cables. Refer to chapter 1.
- Air circulation: The main cabinet is fan cooled, therefore room-temperature air must be free to circulate around the cabinet. The cooling slots in the cabinet must be unobstructed at all times.
- A stable footing.
- Close proximity to service-disconnect boxes. Cables should not be on the floor where they could be stepped on or tripped over.
- Do not locate the X-ray generator within the patient environment of the X-ray room.

2.5.2 Control Console

NOTE: DO NOT LOCATE THE CONTROL CONSOLE WHERE X-RADIATION MAY BE PRESENT DURING SETUP / CALIBRATION OR NORMAL OPERATION OF THE GENERATOR.

YOU MAY CHOOSE TO TEMPORARILY LOCATE THE CONSOLE NEAR THE GENERATOR FOR INITIAL PROGRAMMING AND CALIBRATION. IF SO, PLEASE COMPLETE THE FINAL CONSOLE INSTALLATION PER THIS SECTION WHEN THE GENERATOR INSTALLATION IS COMPLETED.

Position the control console in its intended location and ensure that it is stable.

- The control console (membrane console, touchscreen console, or mini-console) must be located inside an X-ray shielded control booth within the X-ray room, or outside the X-ray room.
- If the console is located on a shelf, supply index pins or equivalent hardware to the base of the console to prevent slipping.
- Ensure that the console is mounted at a height and angle to allow for easy viewing of the displays.
- If the optional CPI pedestal stand (membrane console) is to be used for the console mounting, follow the mounting instructions supplied with the stand.

Membrane Console

Note: Some jurisdictions require that the console PREP and EXPOSE buttons be disabled if a hand switch is used. This is done by removing JW1 and JW2 from the console board as described below.

1. Turn the console upside down and place it on a clean, non-abrasive surface.
2. Remove and set aside the screws securing the console base to the molded case, and the hardware from the console ground stud.
3. Remove the console base (the metal bottom panel with the feet attached).

Use and disclosure is subject to the restrictions on the title page of this CPI document.

2.5.2 Control Console (Cont)

4. Locate and then remove JW1 and JW2 from the console board. Refer to the appropriate figure in chapter 1, in the section *GENERATOR LAYOUT AND MAJOR COMPONENTS*.
5. Do not discard the jumpers that were removed in the previous step. These will need to be reinstalled if the console PREP and EXPOSE buttons must be enabled in the future.
6. Reinstall the console base by reversing the previous steps.

Touchscreen Console

The touchscreen base is shipped as a separate item, and must be attached to the touchscreen console before continuing with the installation. A Phillips screwdriver is required to attach the base to the touchscreen console. A hex key has been included to adjust the tension on the tilt-arm mechanism.

1. Carefully unpack the touchscreen console and the desk-mount base components and set the packaging aside. Verify that all components are undamaged.
2. Place the touchscreen console facedown on a FLAT, CLEAN, NON-ABRASIVE surface.
3. Note the two sets of VESA (Video Equipment Standards Association) mounting holes on the back plate and on the touchscreen console. One set of holes is spaced at 100 mm, and the other set is spaced at 75 mm. CPI recommends the use of the 100 mm spaced VESA holes. Line up the back plate with the touchscreen (observe orientation). Attach the base using the screws provided. See figure 2-1.

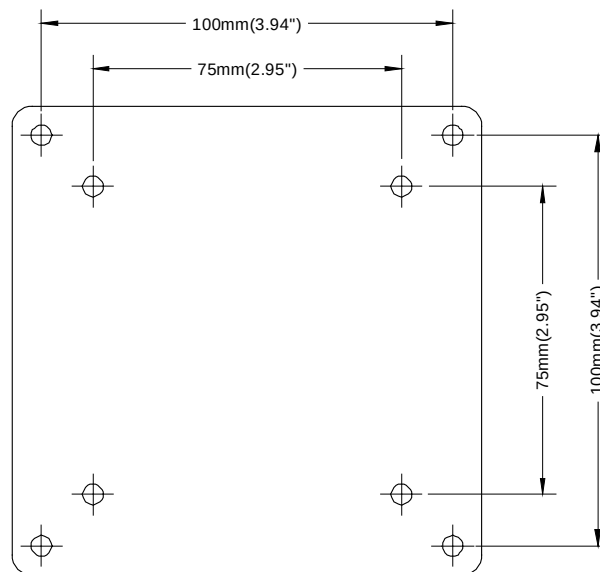


Figure 2-1: Touchscreen base back plate showing VESA mounting holes

Use and disclosure is subject to the restrictions on the title page of this CPI document.

2.5.2 Control Console (Cont)

NOTE: THE SET SCREW COLLAR MUST BE SECURED ON THE UPPER HALF OF THE TILT ARM TO PREVENT PERSONAL INJURY SHOULD THE TOUCHSCREEN SLIP WHILE ADJUSTING THE VIEWING HEIGHT.

ADJUST THE SET SCREW COLLAR (FIGURE 2-4) USING THE PROVIDED HEX KEY BEFORE ADJUSTING THE HEIGHT OF THE TOUCHSCREEN CONSOLE. THE SET SCREW COLLAR MUST BE POSITIONED SUCH THAT THERE IS NO LESS THAN 25 mm (1 INCH) OF CLEARANCE BETWEEN THE BOTTOM EDGE OF THE TOUCHSCREEN CONSOLE AND THE TOUCHSCREEN BASE PLATE WHEN THE TOUCHSCREEN IS ADJUSTED TO ITS MINIMUM HEIGHT.

PLEASE BE SURE TO SUPPORT THE TOUCHSCREEN CONSOLE WHEN ADJUSTING ITS VIEWING POSITION.

Position the touchscreen console in its intended location and ensure that it is stable.

- The touchscreen console must be placed on a solid and level surface. There must be no risk of it tipping or falling, especially if raised to its maximum viewing height.
- Ensure that the display is positioned at a height and angle to allow for easy viewing.

2.5.3 Anchoring the Generator to the Floor

If it is desired to anchor the generator to the floor, refer to chapter 1. This should not be done until all cable hookups to the generator are completed.

2.6.0 WIRING TO THE GENERATOR

Unless specified otherwise, all cables (except AC mains) should be routed into the generator main cabinet through the cable access slots at the upper rear of the generator. The cables should be secured to the lip on the inside of the cable access slots using tie-wraps or equivalent fasteners. For connections that must be made to the H.V. auxiliary board, AEC board, or to the generator control board, route the cables over the top of the fan-mounting bracket and over the chassis divider panel.

The AC mains cable is routed into the generator via the cable clamp on the rear of the generator, adjacent to the main fuses.

All cables should be kept away from high voltage areas in the cabinet, and dressed neatly in place. Cables should be cut to the correct length if possible, as excess cabling may contribute to EMI/RFI problems. For those cables that cannot be cut to the correct length (HV cables and console cables for example), try to minimize the area inside of any loops of excess cable, as these loops can create an antenna.

Ferrules should be used on the ends of all stranded wires that are connected to terminal connections in the generator. These must be supplied by the installer.

EXCESS LENGTHS OF CABLING MUST NEVER BE BUNDLED UP AND STORED INSIDE THE GENERATOR.

Use and disclosure is subject to the restrictions on the title page of this CPI document.

2.6.0 WIRING TO THE GENERATOR (Cont)**2.6.1 Control Console****Membrane Console**

1. Note the protective cover connected to the console cable. This is intended to protect the console cable connectors during shipping and while routing the console cable during installation. Disconnect the generator end of the cable (the end with the ferrite bead) from the protective cover, and then route the end of the cable with the protective cover attached as required. Remove and discard the protective cover when finished. After removing the protective cover, inspect the console cable connectors for any damage. Please see figure 2-2 for an example of such damage.
2. Route the generator end of the console cable into the generator cabinet via the cable access slot nearest to the generator control board. The cable must be routed as per figure 2-3. Connect the generator end of the console cable to J3 on the generator control board.

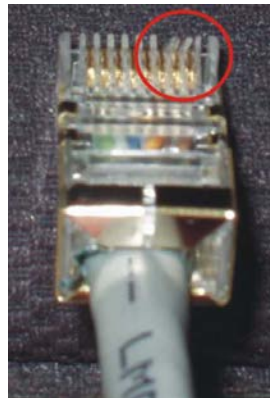


Figure 2-2: Console cable connector damage example

3. Connect the free end of the console cable to J8 at the rear of the console. Leave sufficient slack in the cabling to the console to allow for future service and maintenance.

Touchscreen Console

1. Route the generator end of the console cable into the generator cabinet via the cable access slot nearest to the generator control board. The cable must be routed as per figure 2-3. Connect the generator end of the console cable to J20 on the generator control board.
2. Connect the free end of the console cable to GEN on the rear of the touchscreen console. Leave sufficient slack in the cabling to the console to allow for future service and maintenance.
3. Tighten the screw locks to fully secure the “D” connectors.
4. Connect one end of the supplied ground wire to the touchscreen console ground screw, shown in figure 2-4. Connect the other end of the ground wire to the ground connector near the main line fuses in the generator (figure 2-8). Dress the ground wire away from high voltage areas in the generator. This ground location may have other ground wires already connected; ensure that these existing ground wires are not disconnected when making the X-ray tube ground connection. Note that this ground wire is required for EMC compliance only. It has no safety impact.

Use and disclosure is subject to the restrictions on the title page of this CPI document.

2.6.1 Control Console (Cont)

5. Optional: Connect customer-supplied speakers (minimum 8 ohms) to LO (3.5 mm stereo jack) on the rear of the touchscreen console (do not use externally amplified speakers). Use cable ties to secure the speaker cable to the console cable for support. Pins 1 and 2 (left and right) on the 3.5 mm male stereo jack must be shorted together on the cable that plugs into the touchscreen console.
Please note that connecting external speakers will disable one of the on-board touchscreen speakers.

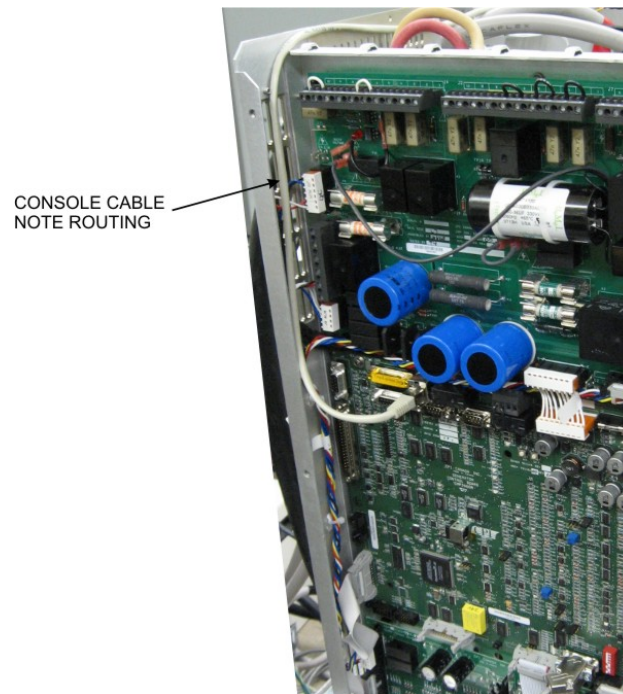
NOTE: CONNECTING THE TOUCHSCREEN CONSOLE CABLE TO ANY CONNECTOR OTHER THAN J20 ON THE GENERATOR CONTROL BOARD MAY CAUSE DAMAGE TO THE GENERATOR. VERIFY THAT THE CONSOLE CABLE HAS BEEN CONNECTED CORRECTLY PRIOR TO POWERING UP THE GENERATOR.

Mini-Console (optional)

1. Route the generator end of the console cable into the generator cabinet via the cable access slot nearest to the generator control board. The cable must be routed as per figure 2-3. Connect the generator end of the console cable to J19 on the generator control board.
2. Connect the free end of the console cable to the 15-pin male connector that is attached to the short piece of console cable connected to the mini-console. Tighten the screw locks to fully secure the "D" connectors on the console cable.
3. An extra cable (9-pin 'D' to RJ45) is included with the optional mini-console. This must be connected from the standard serial port (9-pin 'D' connector) on the imaging computer to J3 on the generator control board *on any DR systems that require serial communication with the generator.*

NOTE: CONNECTING THE MINI-CONSOLE CABLE TO ANY CONNECTOR OTHER THAN J19 ON THE GENERATOR CONTROL BOARD MAY CAUSE DAMAGE TO THE GENERATOR CONTROL BOARD AND MINI CONSOLE BOARD. VERIFY THAT THE CONSOLE CABLE HAS BEEN CONNECTED CORRECTLY PRIOR TO POWERING UP THE GENERATOR.

2.6.1 Control Console (Cont)

*Figure 2-3: Console cable routing***DO NOT CONNECT UNAPPROVED EQUIPMENT TO THE REAR OF THE CONSOLE.**

For the membrane console, J3 is for connection of an external hand switch, J4 is a serial port for use by an external computer, and J8 is for the interconnect cable to the generator main cabinet.

For the touchscreen console, GEN on the rear of the touchscreen is for the interconnect cable to the generator, HS is for connection of an external hand switch, COM 1 & COM 2 are serial ports for use by external devices, LO (3.5 mm stereo jack) is for customer supplied speakers (minimum 8 ohms, do not use externally amplified speakers), ETH is a standard 10/100 Ethernet connection, USBA and USBB are USB ports for connection of external devices, CF is for the compact flash memory card which holds the touchscreen software, and SW1 is the console upgrade button.

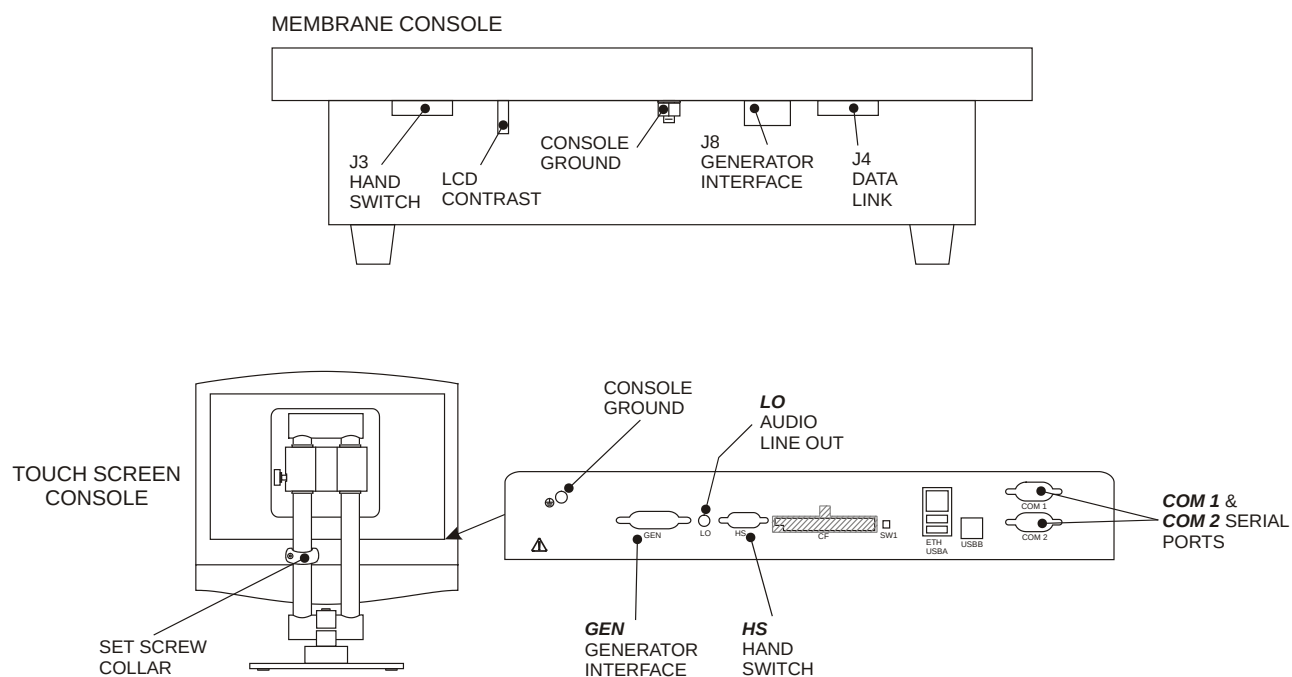
For the mini-console, the short piece of console cable with the attached 15-pin "D" connector is for connection of the console cable that is connected to J19 on the generator control board.

INCORRECT CONNECTIONS OR USE OF UNAPPROVED EQUIPMENT MAY RESULT IN INJURY OR EQUIPMENT DAMAGE.

Use and disclosure is subject to the restrictions on the title page of this CPI document.

2.6.1 Control Console (Cont)

Figure 2-4 shows the designations of the connectors on the rear panel of the membrane and touchscreen consoles.



FILE: CMP RAD_CONS2.CDR

Figure 2-4: Rear of control console

Use and disclosure is subject to the restrictions on the title page of this CPI document.

2.6.2 Hand Switch (Optional)

The optional hand switch, if ordered from CPI Canada Inc, is supplied pre-wired to a male 9 pin subminiature "D" connector. This connects to J3 on the membrane console or to HS on the touchscreen console. A male 9 pin subminiature "D" connector will need to be provided by the installer if the CPI supplied hand switch is not used.

Pin assignments are as follows:

PIN NUMBER	PIN CONNECTIONS (J3 membrane console) / HS touchscreen console)
1	X-ray
2	No Connection
3	Prep
4	No Connection
5	Common (ground)
6	NOT USED
7	NOT USED
8	NOT USED
9	NOT USED

2.6.3 Stator Connections

Low-speed Starter

Refer to figure 2-5 for the X-ray tube stator and thermal switch connections for the low speed starter.

1. Route the X-ray tube stator cable to the stator terminal block J7 on the H.V. auxiliary board. This is shown in figure 2-5.

USE OF A SHIELDED STATOR CABLE IS RECOMMENDED. THE SHIELD FOR THE STATOR CABLE MUST BE PROPERLY GROUNDED AT BOTH THE TUBE END AND THE GENERATOR END OF THE CABLE. CONNECT THE GENERATOR END OF THE SHIELD TO THE GROUND TERMINAL ON J7.

2. Connect the X-ray tube stator and the thermal switch to J7 on the H.V. auxiliary board terminal block as per the table below.

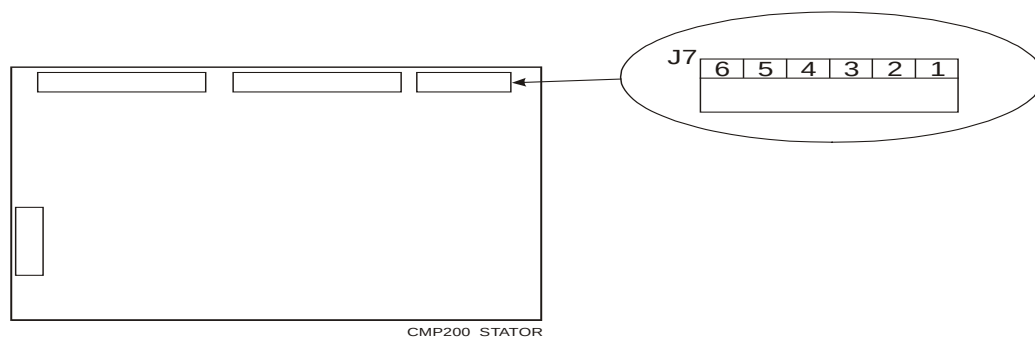


Figure 2-5: Stator / thermal switch connections on H.V. auxiliary board (low speed starter)

Use and disclosure is subject to the restrictions on the title page of this CPI document.

2.6.3 Stator Connections (Cont)

FUNCTION	CONNECT TO
SHIFT	J7-6.
MAIN	J7-5.
COMMON	J7-4.
GROUND	J7-3.
THERMAL SWITCH (Term 1)	J7-2.
THERMAL SWITCH (Term 2)	J7-1.

Dual-speed Starter

Refer to figure 2-6 for the X-ray tube stator connections for the dual-speed starter.

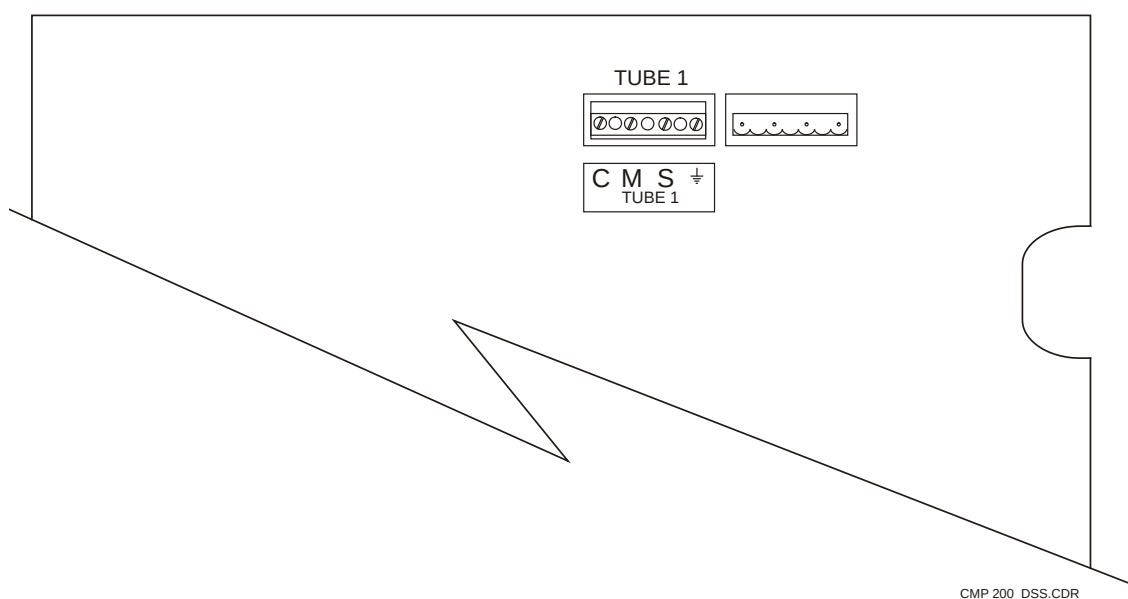


Figure 2-6: Stator connections on dual-speed starter chassis

1. Route the X-ray tube stator cable to the stator terminal block on the back of the dual-speed starter chassis. Refer to figure 2-6.

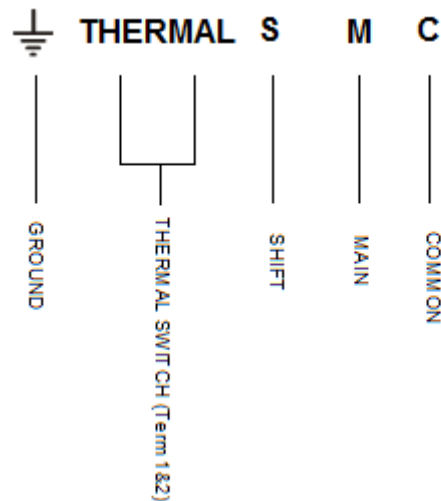
THE STATOR CABLE FOR THE DUAL-SPEED STARTER MUST BE SHIELDED. THE SHIELD FOR THE STATOR CABLE MUST BE PROPERLY GROUNDED AT BOTH THE TUBE END AND THE GENERATOR END OF THE CABLE. CONNECT THE GENERATOR END OF THE SHIELD TO THE GROUND TERMINAL ON THE STATOR TERMINAL BLOCK (FIGURE 2-6).

Use and disclosure is subject to the restrictions on the title page of this CPI document.

2.6.3 Stator Connections (Cont)

2. Connect the X-ray tube stator and the thermal switch as per the table and illustration below.

FUNCTION	CONNECT TO
SHIFT	Dual-speed starter chassis, TUBE 1 , terminal S .
MAIN	Dual-speed starter chassis, TUBE 1 , terminal M .
COMMON	Dual-speed starter chassis, TUBE 1 , terminal C .
GROUND/SHIELD	Dual-speed starter chassis, TUBE 1 , terminal  .
THERMAL SWITCH (Terminal 1)	Dual-speed starter chassis, TUBE 1 , terminal 1 for thermal switch
THERMAL SWITCH (Terminal 2)	Dual-speed starter chassis, TUBE 1 , terminal 2 for thermal switch



3. Secure the X-ray tube stator cable and thermal switch wiring to the generator chassis using suitable tie-wraps or equivalent fasteners.

2.6.4 Thermal Switch

The X-ray tube thermal switch is connected to J7-1 and J7-2 on the H.V. auxiliary board for the low speed starter. The dual-speed starter is connected as outlined in the dual-speed starter section 2.6.3.

Use and disclosure is subject to the restrictions on the title page of this CPI document.

2.6.5 Power Line Mains

WARNING: TO AVOID ELECTRICAL SHOCK, ENSURE THAT THE AC MAINS DISCONNECT IS LOCKED IN THE OFF POSITION, AND THAT ALL MAINS CABLES ARE DE-ENERGIZED BEFORE CONNECTING TO THE GENERATOR.

Refer to chapter 1 for generator power and generator power line requirements.

1. Temporarily disconnect the fan by unplugging the fan power-connector at the fan cover.
2. Remove and set aside the hardware securing the fan cover to the generator. Then remove the fan cover with the fan attached.
3. Temporarily remove the safety cover from the main fuses (if fitted). This must be reinstalled after the AC mains connections are made, before reinstalling the fan cover.
4. Prepare the AC mains cable as per figure 2-7 and the **AC Mains Termination Table**, and then strip the ends of the leads to the required length.
5. Pass the AC mains cable through the cable clamp at the upper rear of the generator cabinet, adjacent to the main fuses. Tighten the clamps to secure the cable.
6. Connect the ground wire to the chassis ground connector, and connect the mains power wires to the terminals on the main fuse holder shown in figure 2-8. For 1 phase generators connect the mains to F1 and F2; for 3 phase units connect the mains to L1, L2, and L3.
 - Ferrules should be used on the ends of the AC mains wires. These must be supplied by the installer.
 - For China only, the power cable must be CCC approved.

Use and disclosure is subject to the restrictions on the title page of this CPI document.

2.6.5 Power Line Mains (Cont)

7. Re-install the fan cover and reconnect the fan by reversing the previous steps.



THE FAN MUST BE CONNECTED AT ALL TIMES.

FAILURE TO CONNECT THE FAN WILL RESULT IN GENERATOR MALFUNCTION & ERROR MESSAGES.

8. Do not switch on mains power until requested to do so in a later step.

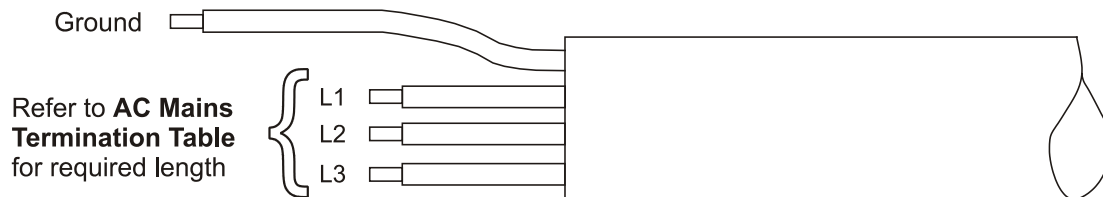


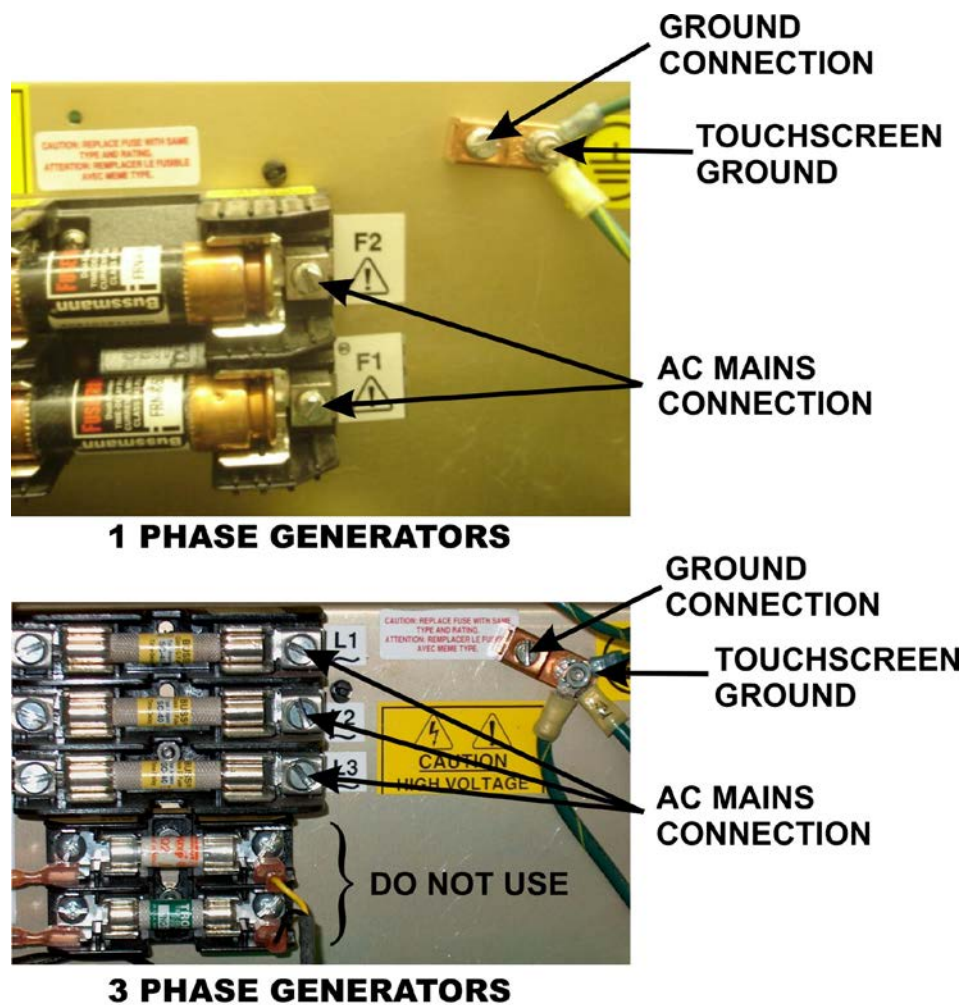
Figure 2-7: Termination of AC mains cable

AC Mains Termination Table				
	GROUND	L1	L2	L3
All 80 kW Configurations	7 (178)	3.25 (83)	3.25 (83)	4.25 (108)
50 kW 208 – 230 VAC, 3P Configurations	7 (178)	5 (127)	4.75 (121)	5 (127)
40 kW & 50 kW 400 – 480 VAC, 3P Configurations	7 (178)	5.75 (146)	5.5 (140)	5.75 (146)
208 – 230 VAC 1P Configurations	7 (178)	5 (127)	5 (127)	N/A

*Dimensions are in inches (mm)

Use and disclosure is subject to the restrictions on the title page of this CPI document.

2.6.5 Power Line Mains (Cont)



CMP200PS_MAINS.CDR

Figure 2-8: Generator mains connection

Use and disclosure is subject to the restrictions on the title page of this CPI document.

2.6.6 High Tension Cables

The X-ray tube should be mounted in its normal fixture i.e. tube stand or other device.

1. Verify that the HV cable terminations are clean, in good condition, and coated with vapor proof compound.
2. Remove the dust caps that cover the high voltage terminals on the HV module.
3. Connect the anode and cathode cables to the HV module. Ensure that the cables are plugged into the proper connectors on the HV module. Refer to figure 2-9.
4. Be sure that the HV module connectors are tight and there is **no play between** the connector insulator and the screw-down ring.

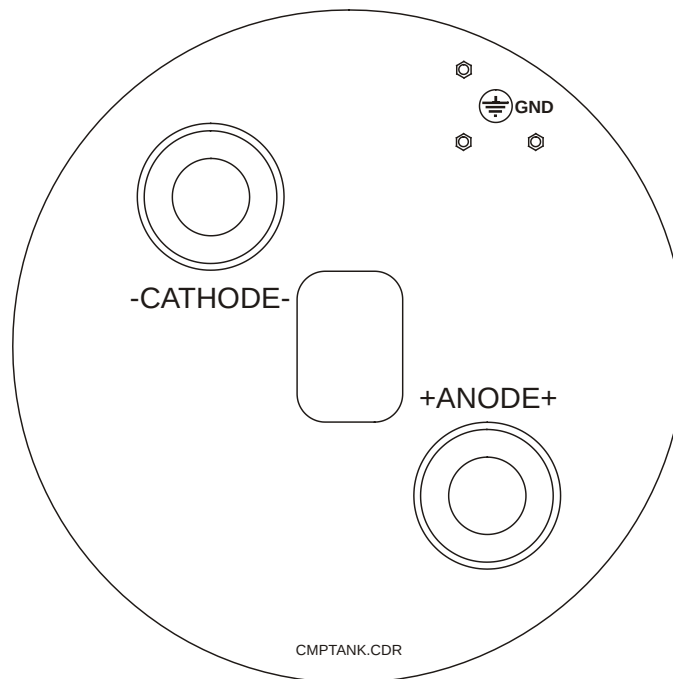


Figure 2-9: HV connector identification

2.6.7 X-Ray Tube Housing Ground

In addition to the X-ray tube manufacturers recommended tube grounding procedure, a separate ground wire (10 AWG, 6mm²) must be connected from the X-ray tube housing to one of the ground studs on the HV module. Refer to figure 2-9 for the location of these ground studs. These ground locations may have other ground wires already connected; ensure that these existing ground wires are not disconnected when making the X-ray tube ground connection.

Failure to make this ground connection may result in intermittent operation and/or exposure errors.

Use and disclosure is subject to the restrictions on the title page of this CPI document.

2.6.8 Room Equipment

Refer to chapter 3C for connection of Buckys, interlocks, room lights, the DR imaging system (if applicable), DAP, collimator lamp and system locks power, and to chapter 3D for installation and calibration of AEC. It is suggested that these items not be connected until the initial run-up of the generator is complete, and the tube auto calibration routine has been performed as described near the end of this chapter.

2.6.9 Emergency Power Off / Power Distribution Relay

To connect an external emergency power-off switch, disconnect the jumper from J2-1 to J2-2 on the generator control board. Then connect the emergency-off switch to J2-1 and J2-2. Refer to MD-0928 in chapter 9.

For installations where installer-supplied auxiliary power distribution circuits are added to the generator, 24 VDC is available on the generator interface board to drive the coil of the power distribution relay. Connect the coil to J2-3 (+) and J2-4 (ground). Refer to MD-0927 in chapter 9. **The maximum current available from this source is 100 mA.**

WARNING: THE EMERGENCY POWER OFF SWITCH DOES NOT REMOVE THE AC MAINS INPUT VOLTAGE. HIGH VOLTAGE STILL EXISTS INSIDE THE GENERATOR IN THE AREA OF THE AUXILIARY TRANSFORMER AND THE H.V. AUXILIARY BOARD. ENSURE THAT THE AC MAINS DISCONNECT IS LOCKED OUT AND ALL CAPACITORS ARE DISCHARGED BEFORE SERVICING.

2.6.10 Safety Interlocks

The room door interlock switch must be wired to the generator as described in **Inputs** in chapter 3C before the generator is powered up. This switch must provide an open contact when the door is open.

NOTE: THE INSTALLER MUST PROVIDE A VISUAL INDICATION OF THE ON/OFF STATE OF EACH EXTERNAL DEVICE THAT CAN PREVENT THE GENERATOR FROM EMITTING RADIATION, OR THAT CAN STOP THE GENERATOR FROM EMITTING RADIATION, OR BOTH.

Use and disclosure is subject to the restrictions on the title page of this CPI document.

2.7.0 LOW-SPEED STARTER TUBE COMPATIBILITY

The Low Speed Starter is integrated into the H.V. Auxiliary Board within the CMP 200[®] and CMP 200[®] DR generators. The phase-shift capacitor is chassis-mounted as shown in figure 1-4.

Before continuing, note the phase-shift capacitor value is compatible with your X-ray tube stator. Please refer to table 1, in the supplement, ***X-ray Tube Start Compatibility Tables*** in this manual. If the value of the phase-shift capacitor is **not** compatible with the desired X-ray tube stator type, please contact CPI product support for assistance.

Confirm that the boost voltage is set correctly for the selected tube type per the referenced Table 1 before continuing. The procedure for setting the boost voltage is detailed in 2.7.1. The boost voltage may be measured from F6 to F7 on the H.V. auxiliary board.

If the desired tube type is not listed, please contact CPI product support for assistance.

Confirm proper stator operation using a suitable tachometer before making any exposures.

WARNING: HIGH VOLTAGE IS PRESENT ON THE H.V. AUXILIARY BOARD AT ALL TIMES THAT THE GENERATOR IS SWITCHED ON. TAKE APPROPRIATE PRECAUTIONS WHEN SERVICING THIS BOARD

Use and disclosure is subject to the restrictions on the title page of this CPI document.

2.7.1 Setting 120 / 240 VAC Boost Voltage

Follow the steps below to verify and configure the low speed starter boost voltage. This is factory configured to 240 VAC.

1. Confirm the required boost voltage for the selected tube as described above. The requirement for the vast majority of tubes in Table 1 of the supplement is 240 V. For tubes that require 120 V boost, this is noted in the table.
2. The boost voltage is configured via jumpers on the H.V. auxiliary board:
 - E16 to E15 selects 240 V boost.
 - E14 to E15 selects 120 V boost.

Swap the connection at E14 and E16 if the boost voltage needs to be changed. The jumper wire (E16 - E15 or E14 - E15) will need to be replaced if making this change. Extra jumper wires are attached to a bag on the lip on the inside of the cable access slot above the HV module. Select the shortest wire from this bag that will connect between the desired tabs on the board that has the proper terminations on the jumpers. Do not discard the existing jumper; place it in the jumper kit to be available for future configuration changes.

Proceed to the next step if the jumper setting is correct.

NOTE: THE ROTOR BOOST TIME MAY BE ADJUSTED IN THE RANGE OF 1 SECOND TO 4 SECONDS. THIS SHOULD BE SET PER THE X-RAY TUBE MANUFACTURERS RECOMMENDATION, OR AS REQUIRED TO ENSURE PROPER ANODE ROTATION AT THE END OF THE PREP CYCLE.
REFER TO ROTOR BOOST, UNDER GENERATOR LIMITS IN CHAPTER 3C FOR THE PROCEDURE TO SET THE ROTOR BOOST TIME.

NOTE: THE LOW SPEED STARTER BOOST MUST NOT EXCEED 5 CONSECUTIVE BOOSTS, AND MUST BE FOLLOWED BY A MINIMUM 10 SECOND WAIT PERIOD.

3. Confirm the proper boost voltage and proper anode rotation as described above.

Use and disclosure is subject to the restrictions on the title page of this CPI document.

2.8.0 PROGRAMMING THE DUAL-SPEED STARTER

CAUTION: *IMPROPER DIP SWITCH SETTINGS WILL RESULT IN IMPROPER ANODE SPEED ROTATION WHICH CAN CAUSE OVERHEATING AND/OR DAMAGE TO THE X-RAY TUBE.*

WARNING: *ENSURE PROGRAMMING THE DUAL-SPEED STARTER IS FULLY UNDERSTOOD AND PROPERLY DONE, BEFORE PUTTING THE GENERATOR IN SERVICE.*

This section applies only to units fitted with a Dual-Speed Starter (DSS). Different settings apply depending on the DSS board number, and subassembly/tab number installed. Check the subassembly number and tab number (as shown in Figure 2-10A), and the board number (printed on the board) installed in your generator and follow the steps outlined in this section to program the DSS.

2.8.1 EPROM type / dual-speed starter - applies only to DSS Board #728877-06.

1. The dual-speed starter EPROM is different for 400 V units and for 480 V units. If a 400 V unit is reconfigured for 480 V, or a 480 V unit is reconfigured for 400 V, the dual-speed starter EPROM will need to be changed. A spare EPROM (the complement of the EPROM that is in the dual-speed starter) is in a bag attached to the lip on the inside of the cable access slot above the HV module. Refer to chapter 6 for the EPROM replacement procedure, and to the table below for the applicable EPROM part numbers.

400 VAC CONFIGURATION		480 VAC CONFIGURATION	
DSS part number	EPROM part #	DSS part number	EPROM part #
901297-02	733159-00	901298-02	735896-00
901297-12	739311-00	901298-12	739313-00
901297-13	733159-00	901298-13	735896-00
901297-15	733159-00	901298-15	735896-00
901297-16	739311-00	901298-16	735313-00

2. If you are making the conversion as per the previous step, use an indelible marker to change the part number of the dual-speed starter assembly (901297-XX to 901298-XX, or vice-versa). The dual-speed starter part number is printed on the opposite side of the board assembly, at the back of the mounting plate (see Figure 2-10A). Keeping the dual-speed starter part number current will maintain configuration control of the product.

NOTE: *DSS BOARD #903132 USES EEPROM* NOT EPROM**. THE TABLE SHOWN ABOVE ONLY APPLIES TO DSS BOARD #728877-06. MORE INFORMATION ON UPGRADING THE DSS BOARD #903132 USING EEPROM IS FOUND IN CHAPTER 6, REGULAR MAINTENANCE.*

NOTE: *THE ABOVE CONFIGURATION AND EPROM PART NUMBERS ONLY APPLY TO SUBASSEMBLIES 901297-XX AND 901298-XX.*

EEPROM* - Electrically Erasable Programmable Read Only Memory

EPROM** - Electrically Programmable Read Only Memory

Use and disclosure is subject to the restrictions on the title page of this CPI document.



Figure 2-10A: DSS subassembly and tab number location

2.8.2 Tube type setting on DIP switch SW1 for DSS Boards #728877-06 and #903132-02

The dual-speed starter must be programmed for the X-ray tube type used at this site. This is done via DIP switch SW1 on the dual-speed starter board.

The following tube functions are set with this switch:

- High-speed start and run voltages.
- Low-speed start and run voltages.
- Brake time and brake voltage.
- Boost times.
- Boost time increments. Boost time may be increased in 100 ms steps in the range of 100 to 700 ms.



DIP switch SW1 on the dual-speed starter must be set correctly to match the X-ray tube in use. Failure to set this correctly may result in improper anode RPM and therefore may damage the X-ray tube.

1. Select the desired tube type from Table 2 of X-Ray Tube Stator Compatibility Tables Supplement 746026-00. Record the tube type number (housing and insert) and the binary code as per the third column in the table. Please note that the tube compatibility applies only to the housing and inserts listed, i.e. for the specific manufacturer(s) shown.
2. If the desired tube type is not listed, please contact CPI product support for assistance.
3. The recommended dual-speed starter used in CMP 200® DR X-ray generators will be one of the following part numbers: 901297-**02, 12, 13, 15** or **16** (400 VAC units), 901298-**02, 12, 13, 15** or **16** (480 VAC units), or 906664-21, 22, 23. Refer to the X-Ray Tube Stator Compatibility Table Supplement 746026-00.

The stated capacitor values are equivalent capacitor values, and are derived from several combinations of relay-selected series / parallel discrete capacitors, depending on the part number. Refer to MD-0924 and MD-1069 in chapter 9 for details.

4. To determine if the dual-speed starter contained within your generator is compatible with the desired tube as selected in step 1, note the part number of the dual-speed starter in your generator. This is printed on the back of the mounting plate, opposite the board assembly (see Figure 2-10A). This part number must appear in the last column of Table 2 in X-Ray Tube Stator Compatibility Tables Supplement 746026-00.

Use and disclosure is subject to the restrictions on the title page of this CPI document.

2.8.2 Tube type setting on DIP switch SW1 for DSS Boards #728877-06 and #903132-02 (Cont)

5. Refer to figure 2-10. Set DIP switch SW1 with the binary code for the selected tube. The binary code shown in the referenced Table 2 programs the tube type (housing and insert), for example housing type Varian Sapphire with standard "R" stator and inserts per Table 2 requires SW1-1 to be set ON, SW1-2 OFF, SW1-3 ON, SW1-4 OFF and SW1-5 OFF. This programs the voltages, brake times, and boost times required.

Additionally, SW1-6 to SW1-8 may be set to give incremental increases in boost time over the preselected values (i.e. to run an older tube with worn bearings). For example, binary 000 gives zero increase, binary 001 gives 100 ms increase, binary 100 gives 400 ms increase, and binary 111 gives a 700 ms increase in boost time. SW1-6 represents bit 1, SW1-7 bit 2, and SW1-8 represents bit 3.

EXAMPLE:

Binary 100 = decimal 4 = 400 ms incremental boost time increase:

1	0	0
Bit 3	Bit 2	Bit 1
SW1-8	SW1-7	SW1-6

6. The DIP switch setting shown in figure 2-10 is for the example in step 5 with an incremental increase in boost time of 200 ms.
7. **Please confirm all settings to ensure proper anode RPM. Before making any exposures, use any of the following:**
- 1) An accelerometer and an oscilloscope with Fast Fourier Transform (FFT) feature or
 - 2) An accelerometer and a spectrum analyzer to verify anode rotation speed or
 - 3) A suitable tachometer that is capable of measuring the anode rotation speed.

or

- Follow the tube's manufacturer's recommendation for verifying anode speed, if available.

NOTE: FOR TUBES WHERE "LOW SPEED OPERATION ONLY" IS INDICATED, THE DUAL-SPEED STARTER MUST BE PROGRAMMED FOR LOW SPEED ONLY, AND WHERE "HIGH SPEED OPERATION ONLY" IS INDICATED, THE DUAL-SPEED STARTER MUST BE PROGRAMMED FOR HIGH SPEED OPERATION ONLY. REFER TO THE TUBE SELECTION SECTION IN CHAPTER 3C FOR THE PROCEDURE TO DO THIS.

Use and disclosure is subject to the restrictions on the title page of this CPI document.

2.8.2 Tube type setting on DIP switch SW1 for DSS Boards #728877-06 and #903132-02 (Cont)

THE DIP SWITCH SHOWN IN FIGURE 2-10 IS REPRESENTATIVE OF ONE STYLE OF SWITCH ONLY. DEPENDING ON MANUFACTURER, YOUR DIP SWITCH STYLE MAY VARY. PLEASE NOTE THE ON / OFF POSITIONS CAREFULLY FOR YOUR UNIT.

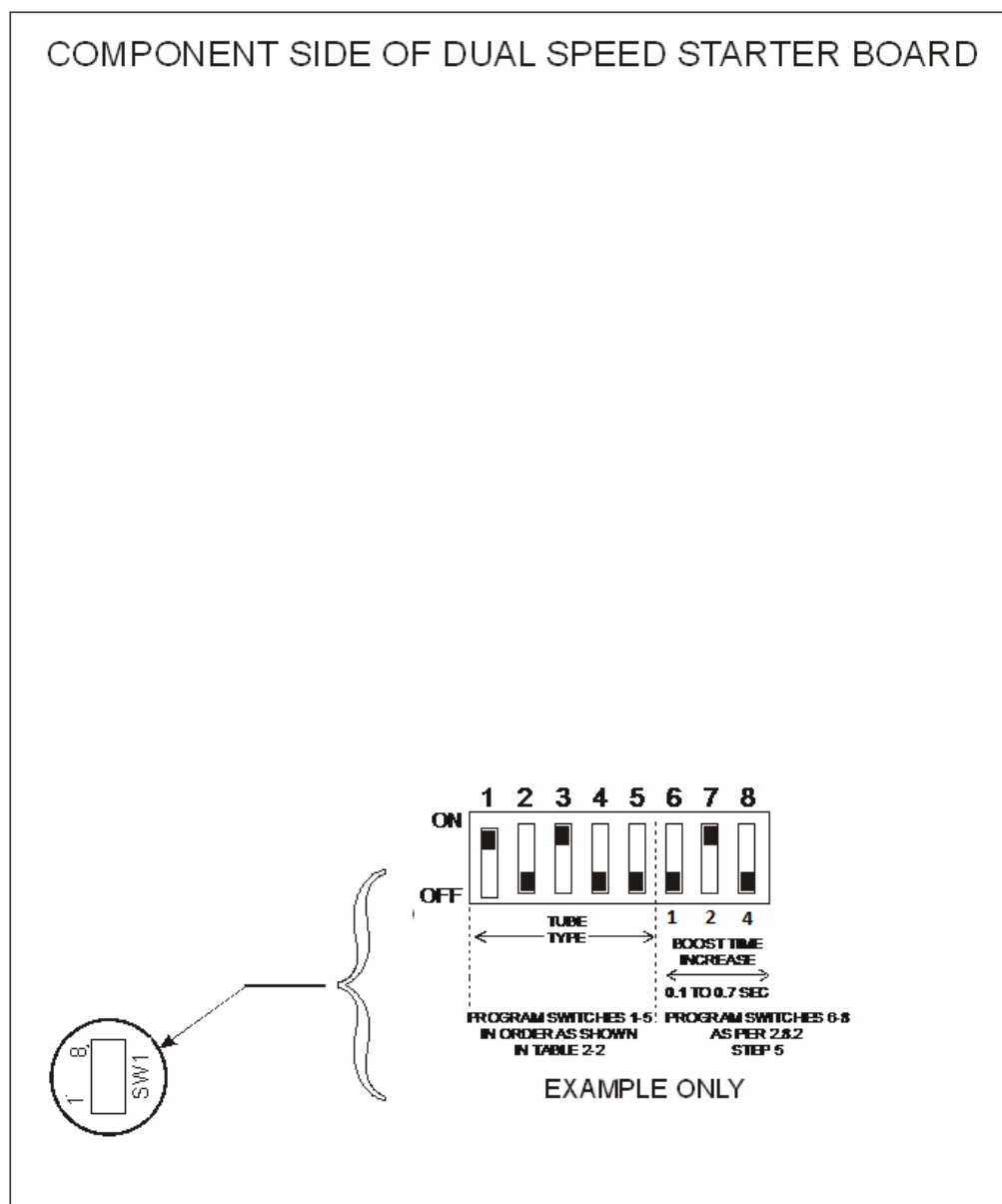


Figure 2-10: Dual-Speed Starter DIP switch SW1

Use and disclosure is subject to the restrictions on the title page of this CPI document.

2.8.3 Programming DIP switch SW3 for DSS Board #903132-xx



DIP switch SW3 on the dual-speed starter must be set correctly. Failure to do this may result in improper anode RPM and therefore may damage the X-ray tube.

The dual-speed starter must be programmed to match the input voltage to the generator and the phase shift capacitors connected to the board. The phase shift capacitor configuration is identified by a label located on the back of the DSS panel. This programming is done by setting SW3

1) Power Main Line Input Setting

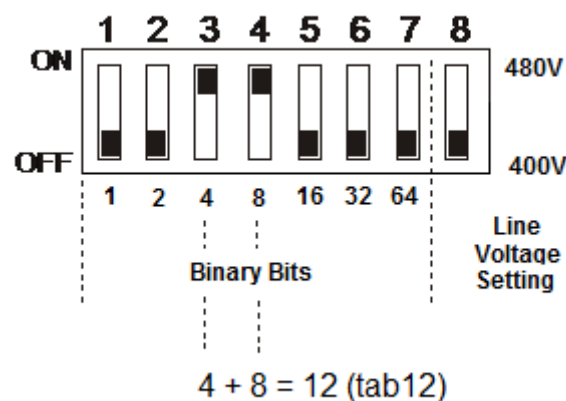
CAUTION: ENSURE THAT SW3-8 SETTING MATCHES THE LINE INPUT VOLTAGE, WHICH SHOULD MATCH THE AUXILIARY TRANSFORMER LINE VOLTAGE TAP SELECTION IN SECTION 2.10.1 OF THIS DOCUMENT.

For generators with a mains input of 400 VAC - Set SW3 - 8 - OFF

For generators with a mains input of 480 VAC - Set SW3 - 8 - ON

2) Capacitor Configuration Setting

Set SW3, switches 1 to 7 according to the subassembly tab number labeled on the back of the DSS panel (see Figure 2-10A).



Example above is configured for a panel assembly 9XXXXX-12, 400V Line Input.

See the next two tables for a list of all the Tab number and their corresponding DIP switch SW3 settings.

Use and disclosure is subject to the restrictions on the title page of this CPI document.

2.8.3 Programming DIP switch SW3 for DSS Board #903132-xx (Cont)

Generator input Voltage	Tab Number	SW3 Setting
400 V	02	
	12	
	13	
	15	
	16	
	21	
	22	
	23	

Use and disclosure is subject to the restrictions on the title page of this CPI document.

2.8.3 Programming DIP switch SW3 for DSS Board #903132-xx (Cont)

Generator input Voltage	Tab Number	SW3 Setting
480 V	02	
	12	
	13	
	15	
	16	
	21	
	22	
	23	

Use and disclosure is subject to the restrictions on the title page of this CPI document.

2.8.4 Inspecting DIP switch SW8 setting for DSS Board #903132-xx

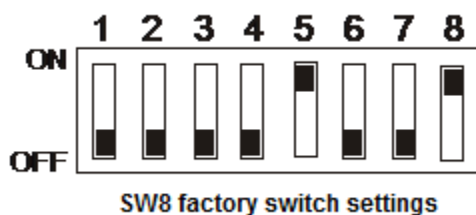


DIP switch SW8 on the dual-speed starter must be set correctly. Failure to do this may result in damage to the X-ray tube or generator.

SW8 is set at the factory. Adjustment of this switch is not required. However it is recommended to inspect the switch to verify that it is set properly before proceeding further. The settings are as follows:

SW8 - switches 1,2,3,4,6,7 - OFF

SW8 - switches 5,8 - ON



NOTE: ONLY CHECK THE SWITCH SETTINGS OF DIP SWITCH SW8. MAKING ADJUSTMENTS DIFFERENT FROM THE ABOVE SETTING WILL RESULT IN IMPROPER ANODE RPM WHICH CAN CAUSE OVERHEATING AND/OR DAMAGE TO THE X-RAY TUBE.

Use and disclosure is subject to the restrictions on the title page of this CPI document.

2.8.5 Configuring dual-speed starter 901297-15 / 901298-15

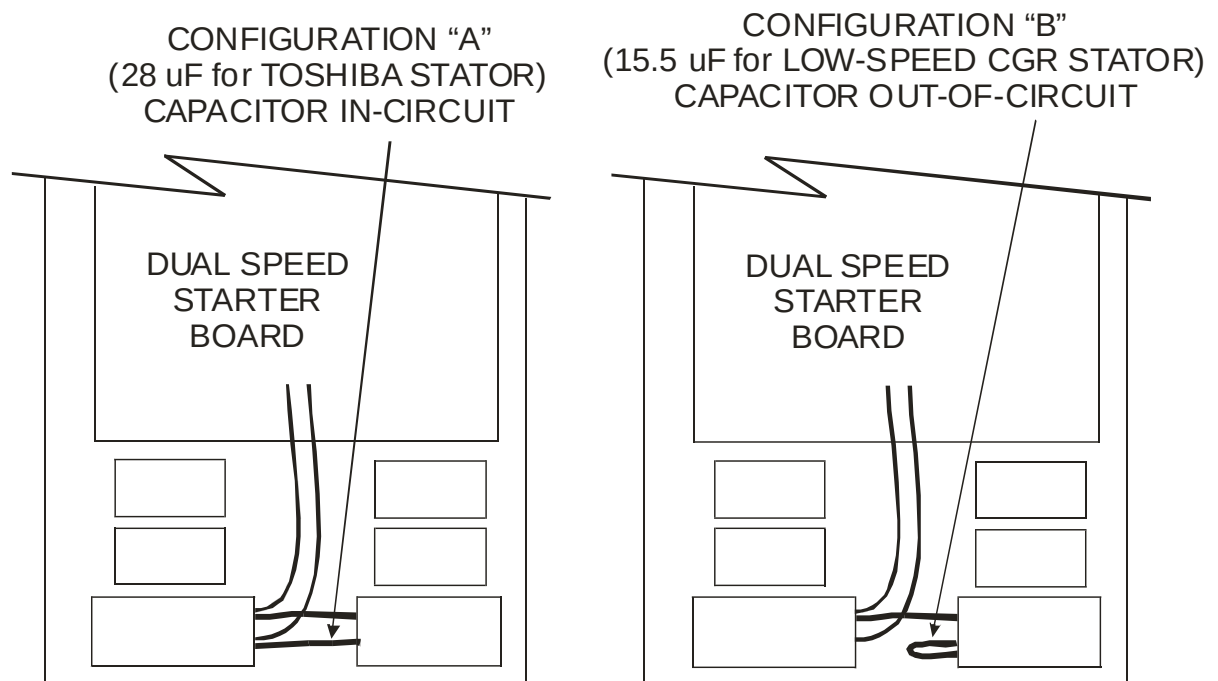
Dual-speed starter part number 901297-15 / 901298-15 is a special configuration in which the low-speed phase shift capacitors may be set to 15.5 μF or 28 μF . The 15.5 μF setting is intended for use in installations where low-speed operation of CGR (GE) Statorix tubes is required. The high-speed capacitance is automatically selected to either 3 μF or 6 μF according to the DIP switch setting.

Refer to figure 2-11. In configuration "A", (28 μF) two leads are connected to the lower right capacitor. Thus, the capacitor is in-circuit in this configuration. Configuration "B" (15.5 μF) has one of the leads removed from the terminals of this capacitor, thus the capacitor is out of the circuit.

- To change from configuration "A" to "B", disconnect the interconnecting lower lead from the lower left capacitor in figure 2-11, and connect it to the same terminal on the lower right. This removes the lower right capacitor from the circuit.
- To change from configuration "B" to "A" in figure 2-11, reconnect the lead between the two capacitors, as shown. This connects the capacitor into the circuit.

After the phase shift capacitors are correctly configured, set the DIP switches as follows:

- Locate the desired tube in table 2 of supplement 746026, which follows Chapter 2. With dual-speed starter 901297-15 / 901298-15 set to configuration "A", this starter is compatible with all tubes requiring a 3 μF or 6 μF high-speed shift capacitor (unless indicated otherwise) and a 28, 30 or 31 μF low-speed shift capacitor. When set to configuration "B", it is only compatible with tubes requiring a 3 μF or 6 μF high-speed shift capacitor (unless indicated otherwise) and a 15.5 μF low-speed shift capacitor.
- Note the DIP switch setting for the desired tube as per table 2.
- Set the DIP switches as per 2.8.2.



CMP200_FIG2-11A.CDR

Figure 2-11: Selection of phase shift capacitance

Use and disclosure is subject to the restrictions on the title page of this CPI document.

2.9.0 GENERATOR CONTROL BOARD DIP SWITCH SETTINGS

Before continuing, verify the DIP switch settings on the generator control board. These switches have been factory set but may have been readjusted, particularly if this generator is a re-install.

GENERATOR CONTROL BOARD:

- Verify the settings on S3. Refer to the table below for the proper settings for this switch.

GENERATOR POWER	MAXIMUM mA	S3-8	S3-7	S3-6	S3-5
32 kW	400 mA	OFF	OFF	OFF	ON
40 kW	500 mA	OFF	OFF	ON	OFF
50 kW	630 mA	OFF	OFF	ON	ON
65 kW	800 mA	OFF	ON	OFF	ON
80 kW	1000 mA	OFF	ON	ON	OFF

S3-1 ON > LOAD FACTORY DEFAULTS * OFF > DEFAULTS DISABLED *

DIP switches S3-2, S3-3, and S3-4 are not used.

* Refer to **Resetting Factory Defaults** in chapter 6 for details regarding this function.

2.10.0 INITIAL RUN-UP

This section describes the procedure for auxiliary transformer line voltage tap selection, and for initial power-on of the generator after it has first been installed.

PLEASE OBSERVE THE FOLLOWING POINTS REGARDING THE MAIN DISTRIBUTION TRANSFORMER:

- **IF USING A DISTRIBUTION TRANSFORMER WITH AN ISOLATED SECONDARY, THE SECONDARY WINDING MUST BE A WYE (STAR) CONFIGURATION WITH THE CENTER POINT GROUND-REFERENCED. DO NOT USE A DELTA-CONFIGURED SECONDARY, AS THERE IS NO GROUND REFERENCE IN THIS CONFIGURATION.**
- **IF USING AN AUTOTRANSFORMER TYPE DISTRIBUTION TRANSFORMER, THE A.C. INPUT TO THE TRANSFORMER MUST BE GROUND-REFERENCED.**

2.10.1 Auxiliary Transformer Line Voltage Tap Selection

For 208 / 230 V generators, the line voltage taps on the auxiliary transformer must be checked before powering up the generator.

For 400 / 480 V generators, the auxiliary transformer line voltage tap is factory set to match the line voltage that was specified at the time of the order. If these units are to be operated from other than the rated line voltage (i.e. if a 400 V generator is to be operated from 480 V mains), the line voltage tap on the auxiliary transformer must be changed as described below.

For 208 / 230 VAC generators:

1. Verify that the mains voltage and current capacity is correct for the generator installation per *Generator Power Requirements* in chapter 1.
2. Locate the auxiliary transformer inside the generator cabinet. Refer to chapter 1.

Use and disclosure is subject to the restrictions on the title page of this CPI document.

2.10.1 Auxiliary Transformer Line Voltage Tap Selection (Cont)

3. Note the line-voltage tap position on this transformer as determined by the location of the wire on the 208V or the 240V tap on the transformer primary. This is normally set to the 240V tap. Refer to figure 2-12.
4. Based on the nominal line voltage, set the transformer primary voltage tap as follows:
 - Loosen the clamping screws for the current line-voltage tap, and for the required line-voltage tap.
 - Connect to the 208 V tap if the line voltage is 215 VAC or less.
 - Connect to the 240 V tap if the line voltage is 216 VAC or higher.
 - Retighten both of the clamping screws.

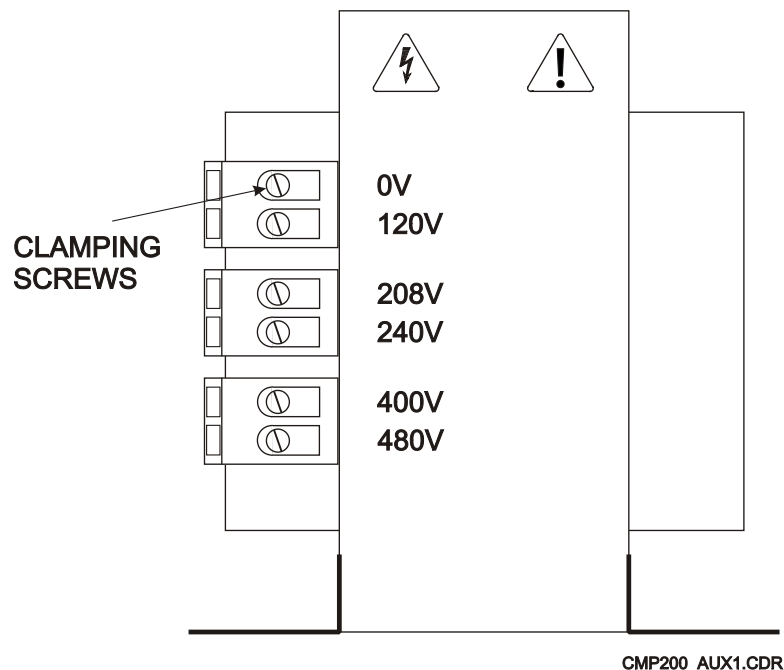


Figure 2-12: Auxiliary transformer, terminal view

For 400 / 480 VAC generators:

The 400 / 480 V tap setting only needs to be changed if a 400 V generator is to be operated from 480 V mains, or if a 480 V generator is to be operated from 400 V.

1. Verify that the mains voltage and current capacity is correct for the generator installation per *GENERATOR POWER REQUIREMENTS* in chapter 1.
2. Locate the auxiliary transformer inside the generator cabinet. Refer to chapter 1.
3. Note the line-voltage tap position on this transformer as determined by the location of the wire on the 400V or the 480V tap on the transformer primary. This is set to the 400 or 480V tap to match the line voltage specified at the time of the order. Refer to figure 2-12.

CAUTION: ENSURE THAT DIP SWITCH SW3-8 SETTING ON THE DUAL-SPEED STARTER BOARD (903132-02) IS SET ACCORDING TO SECTION 2.8.3 OF THIS DOCUMENT, WHICH SHOULD MATCH THE LINE VOLTAGE AND THE SETTING OF THE AUXILIARY TRANSFORMER TAP SELECTED HERE.

Use and disclosure is subject to the restrictions on the title page of this CPI document.

2.10.1 Auxiliary Transformer Line Voltage Tap Selection (Cont)

4. Based on the nominal line voltage, set the transformer primary voltage tap as follows:
 - Loosen the clamping screws for the current line-voltage tap, and for the required line-voltage tap.
 - Connect to the 400 V tap if the line voltage is nominally 400 VAC.
 - Connect to the 480 V tap if the line voltage is nominally 480 VAC.
 - Retighten both of the clamping screws.

2.10.2 Initial Voltage Measurements

1. If the mains supply is compatible with the generator, switch on the main breaker and / or the disconnect switch and check for the following voltages:

NOTE: **DO NOT SWITCH THE GENERATOR ON AT THIS TIME (ONLY THE AC MAINS TO THE GENERATOR IS TO BE SWITCHED ON).**

WARNING: **USE EXTREME CARE IN MEASURING THESE VOLTAGES. ACCIDENTAL CONTACT WITH MAINS VOLTAGES MAY CAUSE SERIOUS INJURY OR DEATH.**

MAINS VOLTAGE WILL BE PRESENT INSIDE THE GENERATOR CABINET, EVEN WITH THE CONSOLE SWITCHED OFF.

THE DC BUS CAPACITORS MAY PRESENT A SAFETY HAZARD FOR A MINIMUM OF 5 MINUTES AFTER THE GENERATOR HAS BEEN SWITCHED OFF. CHECK THAT THESE CAPACITORS ARE DISCHARGED BEFORE TOUCHING ANY PARTS IN THE GENERATOR.

2. Measure and record the voltage across the main line fuses in the generator. Single-phase units will only use one set of voltage measurements.

L1 phase to L2 phase: _____ VAC.	L1 phase to ground: _____ VAC.
L1 phase to L3 phase: _____ VAC.	L2 phase to ground: _____ VAC.
L2 phase to L3 phase: _____ VAC.	L3 phase to ground: _____ VAC.

3. Are the line-to-line and line-to-ground voltages within specification for the unit? For single phase 230 V units, the line to ground voltage should be 99 – 127 V. For 3 phase units, the phase to ground voltage should be 114 – 146 V for 208 / 230 V units, 230 V $\pm$ 10 % for 400 V units, and 277 V $\pm$ 10 % for 480 V units.

___ Check

4. Confirm that the auxiliary transformer line voltage taps are set to the appropriate position as per the measured line voltage.

___ Check

Use and disclosure is subject to the restrictions on the title page of this CPI document.

5. For units fitted with the optional dual-speed starter board 728877-06: if a 400 V unit is reconfigured for 480 V, or a 480 V unit is reconfigured for 400 V, the dual-speed starter EPROM will need to be changed as described in the section **EPROM type / dual-speed starter**. Confirm that this has been done.

___ Check

For units fitted with the optional dual-speed starter board 903132-xx, the line input voltage is sensed automatically by the board and no component needs to be changed.

2.11.0 TUBE mA AUTO CALIBRATION

It is recommended that the generator be tested at this point with only the X-ray tube and rotor / high-tension cables connected. The generator should be able to complete an X-ray tube seasoning and calibration cycle without other equipment connected to the generator (other than the basic interlocks as noted below). This will allow for easier fault isolation as each section of the system is connected and tested.

Before being able to make X-ray exposures, the room door interlock must be closed and the thermal switch must be closed. The interlocks cannot be deprogrammed during tube mA auto calibration.

It is recommended that the tube(s) be conditioned (seasoned) before beginning tube auto calibration, particularly if the tube has not been used for some time. Refer to chapter 6.

Before beginning tube auto calibration, the tube(s) used in this installation must be properly selected, and the generator limits should be programmed. Refer to chapter 3C.

2.12.0 FINAL CHECKS

The room interface connections may now be completed. These items are described in 2.6.8.

- When finished all wiring, check that all connections are tight and secure.
- Check that all cables are dressed neatly inside the main cabinet, and secured as necessary.
- Reconnect any grounds that have been removed from covers. Then reinstall all covers before placing the generator into service.
- For units with the touchscreen console, perform touchscreen calibration. Refer to chapter 3C for the proper calibration procedure.

NOTE:	THE INSTALLER SHOULD ENSURE THAT ALL CABLE CONNECTIONS TO THE GENERATOR ARE SECURE, AND ALL CABLES EXTERNAL TO THE GENERATOR ARE ADEQUATELY PROTECTED AGAINST ACCIDENTAL DISCONNECTION.
--------------	--