



GE Medical Systems

Technical Publications

Direction 2173223 – 100

Revision 4

AMX – 4+ Calibration (Model 2169360, 2236420 & 2275938 Series)

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Operating Documentation

WARNING

- THIS SERVICE MANUAL IS AVAILABLE IN ENGLISH ONLY.
- IF A CUSTOMER'S SERVICE PROVIDER REQUIRES A LANGUAGE OTHER THAN ENGLISH, IT IS THE CUSTOMER'S RESPONSIBILITY TO PROVIDE TRANSLATION SERVICES.
- DO NOT ATTEMPT TO SERVICE THE EQUIPMENT UNLESS THIS SERVICE MANUAL HAS BEEN CONSULTED AND IS UNDERSTOOD.
- FAILURE TO HEED THIS WARNING MAY RESULT IN INJURY TO THE SERVICE PROVIDER, OPERATOR OR PATIENT FROM ELECTRIC SHOCK, MECHANICAL OR OTHER HAZARDS.

AVERTISSEMENT

- CE MANUEL DE MAINTENANCE N'EST DISPONIBLE QU'EN ANGLAIS.
- SI LE TECHNICIEN DU CLIENT A BESOIN DE CE MANUEL DANS UNE AUTRE LANGUE QUE L'ANGLAIS, C'EST AU CLIENT QU'IL INCOMBE DE LE FAIRE TRADUIRE.
- NE PAS TENTER D'INTERVENTION SUR LES ÉQUIPEMENTS TANT QUE LE MANUEL SERVICE N'A PAS ÉTÉ CONSULTÉ ET COMPRIS.
- LE NON-RESPECT DE CET AVERTISSEMENT PEUT ENTRAÎNER CHEZ LE TECHNICIEN, L'OPÉRATEUR OU LE PATIENT DES BLESSURES DUES À DES DANGERS ÉLECTRIQUES, MÉCANIQUES OU AUTRES.

WARNUNG

- DIESES KUNDENDIENST-HANDBUCH EXISTIERT NUR IN ENGLISCHER SPRACHE.
- FALLS EIN FREMDER KUNDENDIENST EINE ANDERE SPRACHE BENÖTIGT, IST ES AUFGABE DES KUNDEN FÜR EINE ENTSPRECHENDE ÜBERSETZUNG ZU SORGEN.
- VERSUCHEN SIE NICHT, DAS GERÄT ZU REPARIEREN, BEVOR DIESES KUNDENDIENST-HANDBUCH NICHT ZU RATE GEZOGEN UND VERSTANDEN WURDE.
- WIRD DIESE WARNUNG NICHT BEACHTET, SO KANN ES ZU VERLETZUNGEN DES KUNDENDIENSTTECHNIKERS, DES BEDIENERS ODER DES PATIENTEN DURCH ELEKTRISCHE SCHLÄGE, MECHANISCHE ODER SONSTIGE GEFAHREN KOMMEN.

AVISO

- ESTE MANUAL DE SERVICIO SÓLO EXISTE EN INGLÉS.
- SI ALGÚN PROVEEDOR DE SERVICIOS AJENO A GEMS SOLICITA UN IDIOMA QUE NO SEA EL INGLÉS, ES RESPONSABILIDAD DEL CLIENTE OFRECER UN SERVICIO DE TRADUCCIÓN.
- NO SE DEBERÁ DAR SERVICIO TÉCNICO AL EQUIPO, SIN HABER CONSULTADO Y COMPRENDIDO ESTE MANUAL DE SERVICIO.
- LA NO OBSERVANCIA DEL PRESENTE AVISO PUEDE DAR LUGAR A QUE EL PROVEEDOR DE SERVICIOS, EL OPERADOR O EL PACIENTE SUFRAN LESIONES PROVOCADAS POR CAUSAS ELÉCTRICAS, MECÁNICAS O DE OTRA NATURALEZA.

ATENÇÃO

- ESTE MANUAL DE ASSISTÊNCIA TÉCNICA SÓ SE ENCONTRA DISPONÍVEL EM INGLÊS.
- SE QUALQUER OUTRO SERVIÇO DE ASSISTÊNCIA TÉCNICA, QUE NÃO A GEMS, SOLICITAR ESTES MANUAIS NOUTRO IDIOMA, É DA RESPONSABILIDADE DO CLIENTE FORNECER OS SERVIÇOS DE TRADUÇÃO.
- NÃO TENHA TENTADO REPARAR O EQUIPAMENTO SEM TER CONSULTADO E COMPREENDIDO ESTE MANUAL DE ASSISTÊNCIA TÉCNICA.
- O NÃO CUMPRIMENTO DESTA AVISO PODE POR EM PERIGO A SEGURANÇA DO TÉCNICO, OPERADOR OU PACIENTE DEVIDO A CHOQUES ELÉTRICOS, MECÂNICOS OU OUTROS.

AVVERTENZA

- IL PRESENTE MANUALE DI MANUTENZIONE È DISPONIBILE SOLTANTO IN INGLESE.
- SE UN ADDETTO ALLA MANUTENZIONE ESTERNO ALLA GEMS RICHIEDE IL MANUALE IN UNA LINGUA DIVERSA, IL CLIENTE È TENUTO A PROVVEDERE DIRETTAMENTE ALLA TRADUZIONE.
- SI PROCEDA ALLA MANUTENZIONE DELL'APPARECCHIATURA SOLO DOPO AVER CONSULTATO IL PRESENTE MANUALE ED AVERNE COMPRESO IL CONTENUTO.
- NON TENERE CONTO DELLA PRESENTE AVVERTENZA POTREBBE FAR COMPIERE OPERAZIONI DA CUI DERIVINO LESIONI ALL'ADDETTO ALLA MANUTENZIONE, ALL'UTILIZZATORE ED AL PAZIENTE PER FOLGORAZIONE ELETTRICA, PER URTI MECCANICI OD ALTRI RISCHI.

警告

- ・ このサービスマニュアルには英語版しかありません。
- ・ GEMS以外でサービスを担当される業者が英語以外の言語を要求される場合、翻訳作業はその業者の責任で行うものとさせていただきます。
- ・ このサービスマニュアルを熟読し理解せずに、装置のサービスを行わないで下さい。
- ・ この警告に従わない場合、サービスを担当される方、操作員あるいは患者さんが、感電や機械的又はその他の危険により負傷する可能性があります。

注意:

- 本维修手册仅存有英文本。
- 非 GEMS 公司的维修员要求非英文本的维修手册时，客户需自行负责翻译。
- 未详细阅读和完全了解本手册之前，不得进行维修。
- 忽略本注意事项会对维修员，操作员或病人造成触电，机械伤害或其他伤害。

Direction 2173223-100**Revision 4****AMX-4+ Calibration
(Model 2169360, 2236420 & 2275938 Series)****IMPORTANT! . . . X-RAY PROTECTION**

X-ray equipment if not properly used may cause injury. Accordingly, the instructions herein contained should be thoroughly read and understood by everyone who will use the equipment before you attempt to place this equipment in operation. The General Electric Company, Medical Systems Group, will be glad to assist and cooperate in placing this equipment in use.

Although this apparatus incorporates a high degree of protection against x-radiation other than the useful beam, no practical design of equipment can provide complete protection. Nor can any practical

design compel the operator to take adequate precautions to prevent the possibility of any persons carelessly exposing themselves or others to radiation.

It is important that everyone having anything to do with x-radiation be properly trained and fully acquainted with the recommendations of the National Council on Radiation Protection and Measurements as published in NCRP Reports available from NCRP Publications, 7910 Woodmont Avenue, Room 1016, Bethesda, Maryland 20814, and of the International Commission on Radiation Protec-

tion, and take adequate steps to protect against injury.

The equipment is sold with the understanding that the General Electric Company, Medical Systems Group, its agents, and representatives have no responsibility for injury or damage which may result from improper use of the equipment.

Various protective material and devices are available. It is urged that such materials or devices be used.

CAUTION: United States Federal law restricts this device to use by or on the order of a physician.

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If you have any comments, suggestions or corrections to the information in this document, please write them down, include the document title and document number, and send them to:

**GENERAL ELECTRIC COMPANY
MEDICAL SYSTEMS**

MANAGER – INFORMATION INTEGRATION, AMERICAS W-622
P.O. BOX 414
MILWAUKEE, WI 53201-0414

CERTIFIED ELECTRICAL CONTRACTOR STATEMENT



All electrical installations that are preliminary to positioning of the equipment at the site prepared for the equipment shall be performed by licensed electrical contractors. In addition, electrical feeds into the Power Distribution Unit shall be performed by licensed electrical contractors. Other connections between pieces of electrical equipment, calibrations, and testing shall be

performed by qualified GE Medical personnel. The products involved (and the accompanying electrical installations) are highly sophisticated, and special engineering competence is required. In performing all electrical work on these products, GE will use its own specially trained field engineers. All of GE's electrical work on these products will comply with the

requirements of the applicable electrical codes.

The purchaser of GE equipment shall only utilize qualified personnel (i.e., GE's field engineers, personnel of third-party service companies with equivalent training, or licensed electricians) to perform electrical servicing on the equipment.

DAMAGE IN TRANSPORTATION

All packages should be closely examined at time of delivery. If damage is apparent, have notation "**damage in shipment**" written on **all** copies of the freight or express bill **before** delivery is accepted or "signed for" by a General Electric representative or a hospital receiving agent. Whether noted or concealed, damage **MUST** be reported to the carrier **immediately**

upon discovery, or in any event, within **14** days after receipt, and the contents and containers held for inspection by the carrier. A transportation company will not pay a claim for damage if an inspection is not requested within this **14** day period.

Call Traffic and Transportation, Milwaukee, WI (414) 827-3449 /

8*285-3449 **immediately** after damage is found. At this time be ready to supply name of carrier, delivery date, consignee name, freight or express bill number, item damaged and extent of damage.

Complete instructions regarding claim procedure are found in Section "S" of the Policy & Procedure Bulletins.

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REVISION HISTORY

REV	DATE	REASON FOR CHANGE
A	Oct. 30, 1996	Draft release.
0	Dec. 13, 1996	Initial release.
1	Aug. 14, 1997	High Impact Inspection.
2	Sept. 16, 1997	Added Keithly Non-Invasive Divider to kVp calibration and verification (Section 2-3-4).
3	Apr. 12, 1999	Added AMX-4+ Model 2236420 Series.
4	Nov. 8, 2000	Added AMX-4+ Model 2275938 Series.

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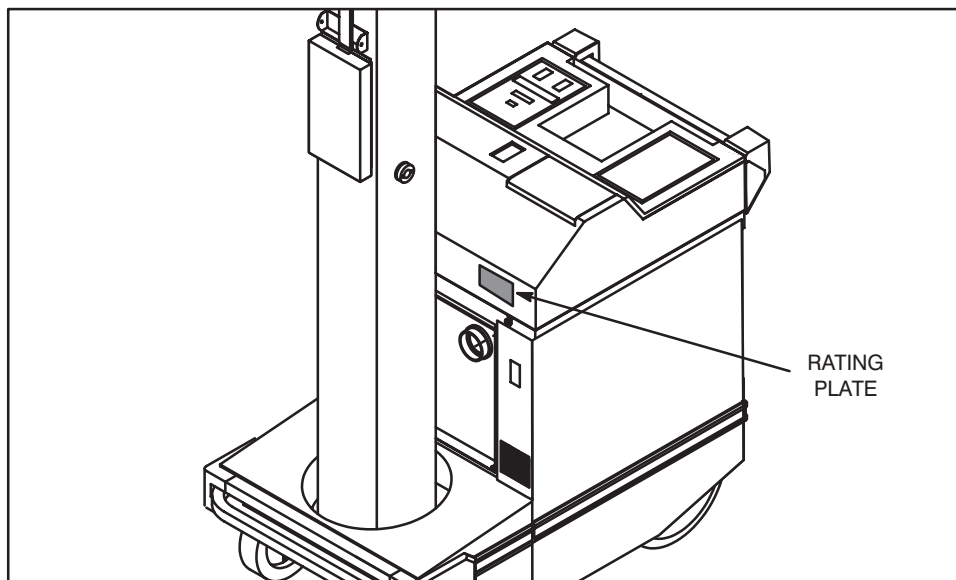
SECTION 1
INTRODUCTION**1-1 Identification**

See Illustration 1-1. The AMX-4+ is identified by Model Number on the rating plate located on the top cover. Model part and catalog numbers are identified in Table 1-1.

TABLE 1-1
AMX-4+ MODELS

DESCRIPTION	PART NUMBER	CATALOG NUMBER	PART NUMBER	CATALOG NUMBER
DOMESTIC	2169360-7	A0659F	2236420-7 & 2275938-7	A0659JF
DOMESTIC, AEC	2169360-8	A0659FA	2236420-8 & 2275938-8	A0659JG
DOMESTIC, TECH SWITCH	2169360-9	A0659FC	2236420-9 & 2275938-9	A0659JH
DOMESTIC, AEC, TECH SWITCH	2169360-10	A0659FB	2236420-10 & 2275938-10	A0659JJ
IEC, EMC	2169360	A0659A	2236420 & 2275938	A0659J
IEC, EMC, AEC	2169360-2	A0659AA	2236420-2 & 2275938-2	A0659JA
IEC, EMC, TECH SWITCH	2169360-3	A0659AB	2236420-3 & 2275938-3	A0659JB
IEC, EMC, AEC, TECH SWITCH	2169360-4	A0659AC	2236420-4 & 2275938-4	A0659JC
JAPAN	2169360-5	A0659C	2236420-5 & 2275938-5	A0659JD
JAPAN SHORT COLUMN	2169360-6	A0659D	2236420-6 & 2275938-6	A0659JE

ILLUSTRATION 1-1
AMX-4+ IDENTIFICATION



1-2 General

The AMX-4+ contains operating safeguards providing maximum safety. Before servicing, be certain proper operating procedures are being used. Refer to Direction 2166911-100, *AMX-4+ Operation*, or Direction 2166913-100, *AMX-4+ International Operation*, for proper operating procedures.

Satisfactory equipment performance requires the use of service personnel specially trained on x-ray apparatus. GE Medical Systems, is responsible for the effects on safety, reliability, and performance only if the following conditions are met:

- The electrical wiring of the relevant rooms complies with all national and local codes.
- All assembly operations, extensions, re-adjustments, modifications, or repairs are carried out by GE Medical Systems, authorized service representatives.
- The equipment is used in accordance with the instructions for use. Refer to Direction 2166911-100, *AMX-4+ Operation*, or Direction 2166913-100, *AMX-4+ International Operation*, for proper operating procedures.

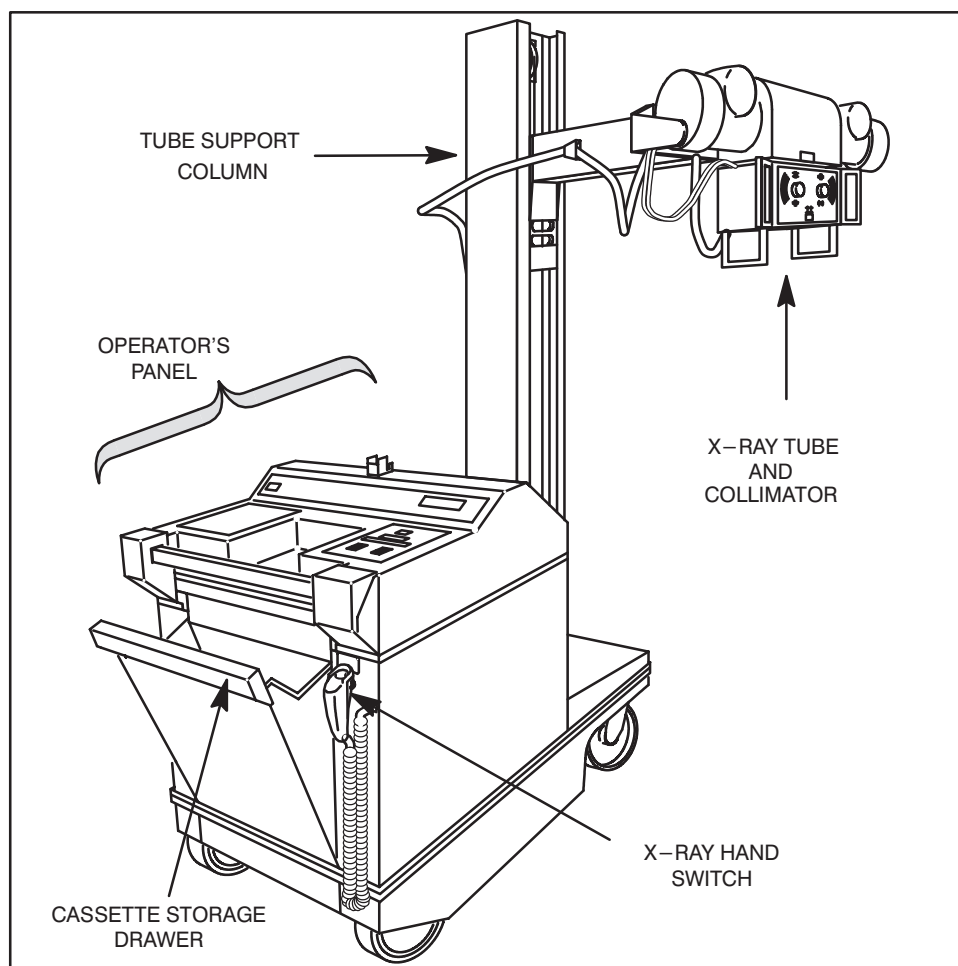


Only trained and qualified personnel should be permitted access to the internal parts of this equipment.

1-3 Component Identification

See Illustration 1-2. The Cassette Storage Drawer must be opened to change the Service switch to its calibration position. X-ray exposures are made with the X-ray Hand Switch. When making x-ray exposures, move the X-ray Tube and Collimator to the bottom of the Tube Support Column. Take adequate precautions to prevent the possibility of any persons carelessly, unwisely, or unknowingly exposing themselves or others to radiation. Entering calibration commands and selecting procedures is done at the Operator's Panel.

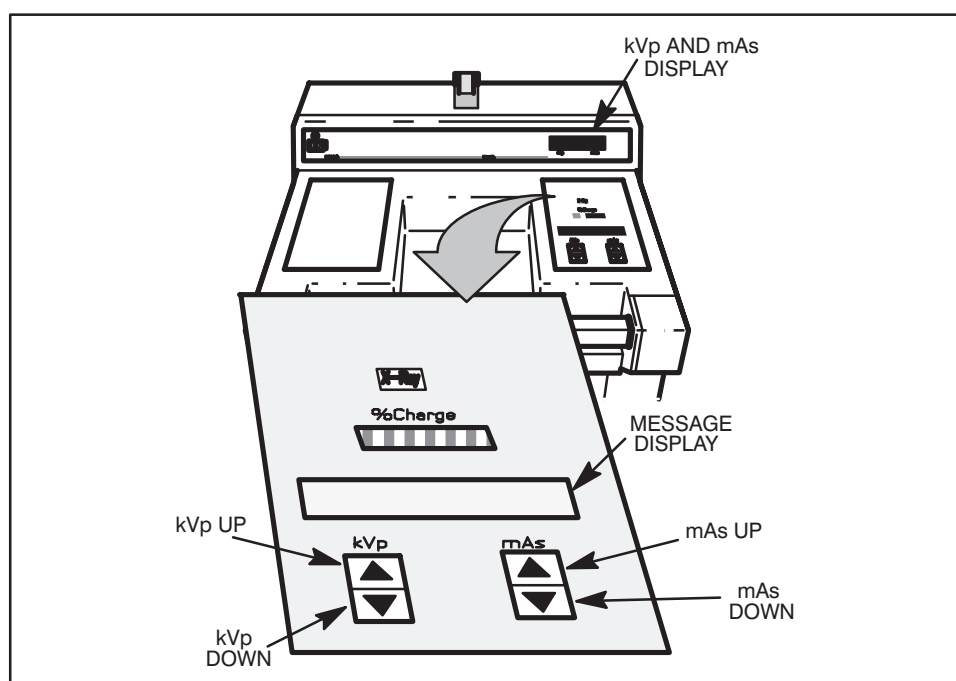
ILLUSTRATION 1-2
AMX-4+ MAJOR COMPONENTS



See Illustration 1-3. Calibration menu selections, prompts, and error codes appear on the Message Display. Values appear on the kVp and mAs Display. Four switches control calibration:

- Pressing **kVp ▲** (kVp up) displays next menu item, or increases a value.
- Pressing **kVp ▼** (kVp down) displays previous menu item, or decreases a value.
- Pressing **mAs ▲** (mAs up) exits selection, or continues after display of a prompt for installation or removal of test equipment. It also continues after display of an error condition.
- Pressing **mAs ▼** (mAs down) executes selection, or saves a value.

ILLUSTRATION 1-3
OPERATOR'S PANEL



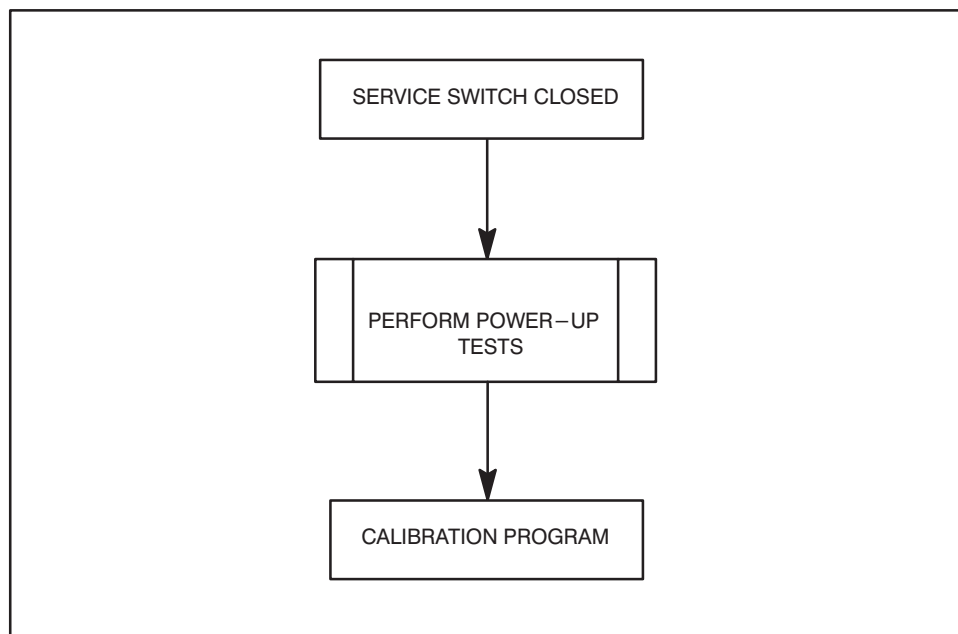
Each independently performed calibration procedure is arranged in menu order. Read and understand each procedure before attempting to perform it. A description of the calibration process and a listing of calibration error codes follows.

Switch selections and prompts are bold to help identify them. Prompts are spelled the way they appear on the Message Display.

1-4 Power-up Sequence

See Illustration 1-4. Power-up sequence starts either when power is applied, or the microprocessor reset switch is pressed. The service program starts when the service switch is closed before power up. With the service switch closed, the power-up program stops only when an error is found that prevents the calibration program from operating properly. Normally it completes testing, then activates the service program by-passing application programs.

ILLUSTRATION 1-4
POWER-UP FLOW CHART

**1-5 Calibration Error Prompts**

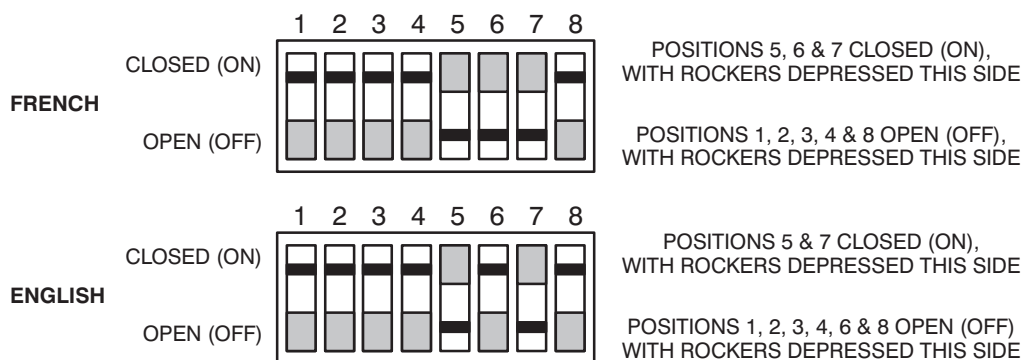
Section 4 contains an alphabetical listing of calibration error prompts. Calibration errors are detected by the service program. An understanding of x-ray generators, good trouble shooting skills, and common sense will help determine the required action if an error prompt displays.

1-6 Jumpers and Switch Positions**1-6-1 Set for French or English Operator Messages**

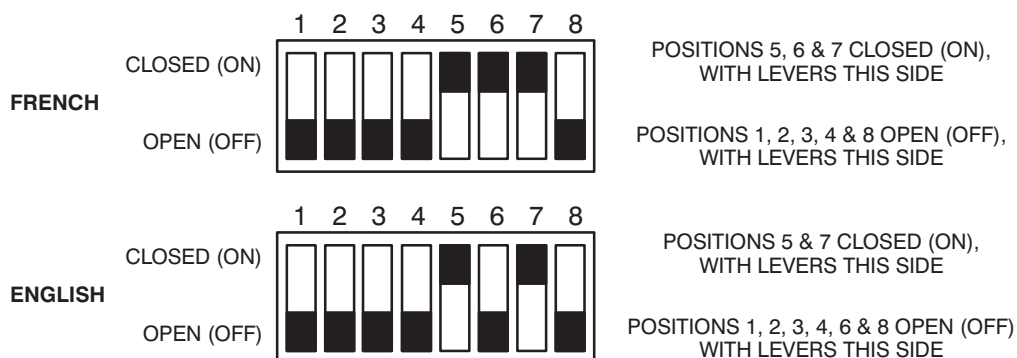
Selection of French or English operator messages is determined by position 6 of DIP switch S75 on the AMX Controller (CPU) Board 46-264974.

1. Look at the operator messages displayed to determine if they are in the desired language.
2. If the operator messages are already in the desired language, do no more in Section 2-2.
3. If you want to change the language of the operator messages, set Position 6 of DIP switch S75 on the AMX Controller (CPU) Board as follows: (The other positions of S75 are shown for reference, but should not require changing.)

a. If S75 is a rocker switch, set to look like this:



b. If S75 is a slide switch, set to look like this:



SECTION 2

ENTERING CALIBRATION

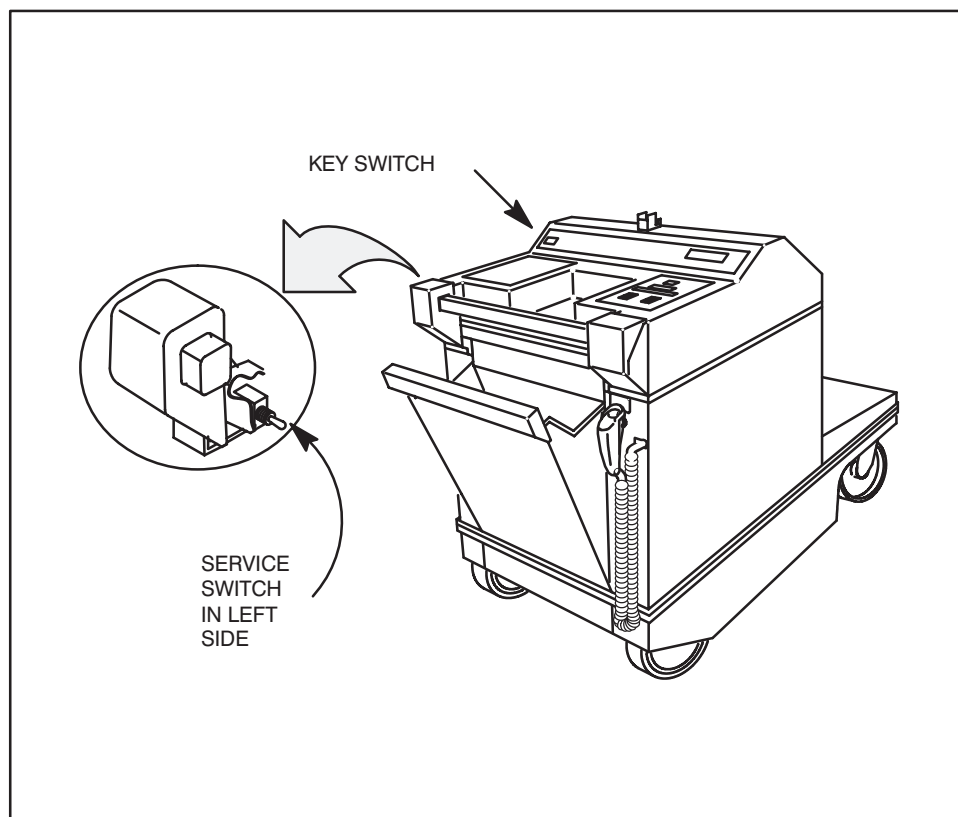
2-1 Start Service Program

The service program must be entered before calibration can be used. The service program starts when the service switch is closed before power up. Start the service program by:

1. See Illustration 2-1. Set the service switch down to the service position.
2. Reset the AMX-4+ using one of the following methods.
 - If power is off, turn the Key Switch to the on position.
 - If power is on and the top cover is installed, turn the power key off and back on.
 - If power is on and the top cover is removed, providing access to the processor board, press the processor reset switch (AMX1 A2 A1-S183).

When the service program is ready, menu selection **END SERVC MODE** appears on the Message Display.

ILLUSTRATION 2-1
SERVICE SWITCH LOCATION



2-2 Enter Calibration

Illustration 2-2 shows calibration selection using the **kVp ▲**, **kVp ▼**, and **mAs ▼** switches. Shaded boxes illustrate the selection path to calibration procedures. There are three choices after entering service program:

- **END SERVC MODE** prompts to set service switch to run position, then to cycle key switch.
- **DATA BASE ACCESS** is proprietary. It requires a password to operate. The password is available by license agreement.
- **CALIBRATE SYSTEM** contains calibration procedures.

Enter calibration by pressing **kVp ▲** until the prompt **CALIBRATE SYSTEM** displays, then press **mAs ▼**.

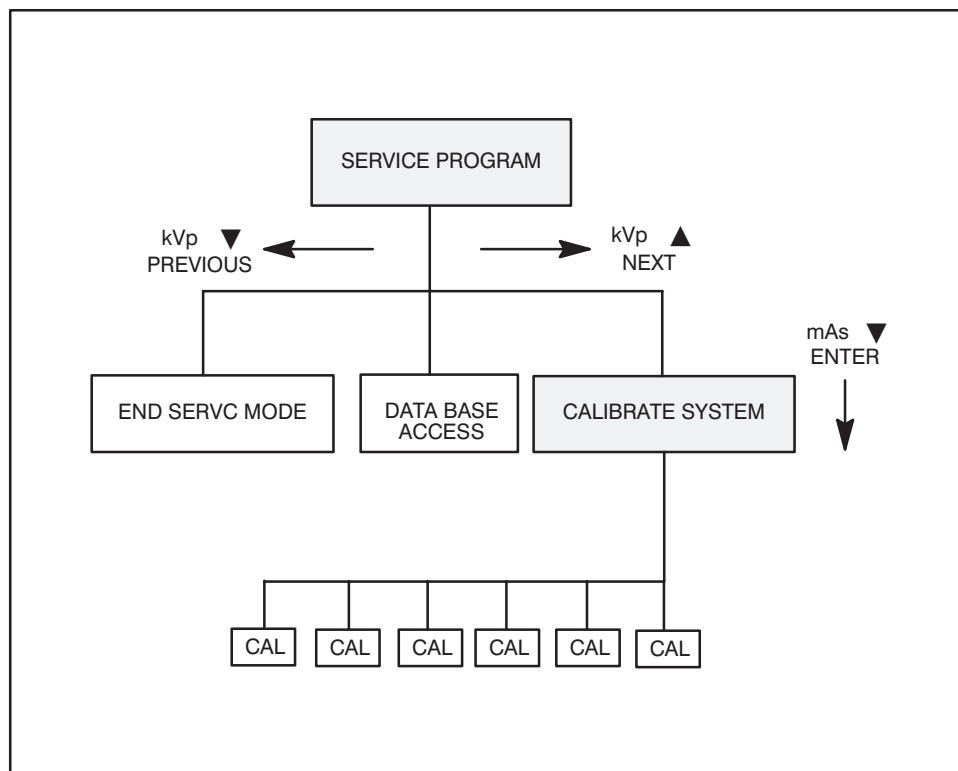
The prompt changes from **CALIBRATE SYSTEM** to **CAL DRIVE HANDLE** indicating that the calibration menu is ready for selection.

Note:

If checksum errors are displayed when entering calibration, record the message for reference and press **mAs ▲** to continue.

To exit calibration see Section 3-7, End Calibration.

ILLUSTRATION 2-2
MENU SELECTION



2-3 Calibration

Illustration 2-3 shows calibration selection path using the **kVp ▲**, **kVp ▼**, and **Menu Items mAs ▼** switches. Shaded boxes represent the six menu selections. Selections are listed below in the order in which they appear when pressing **kVp ▲**.

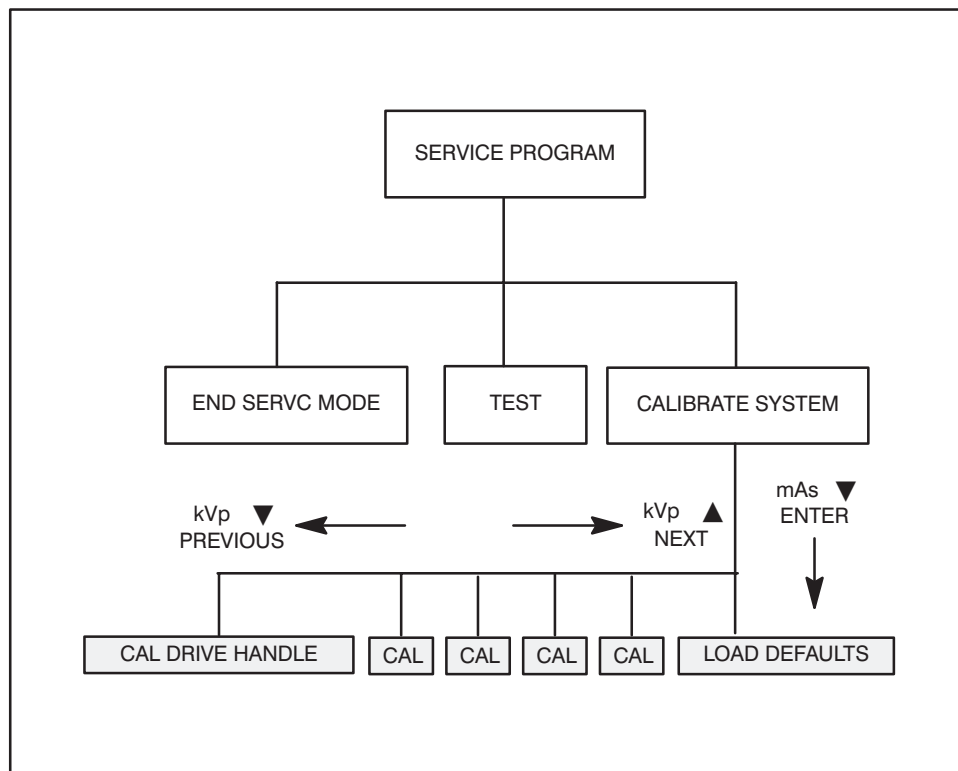
1. **CAL DRIVE HANDLE:** Adjusts drive handle direction and sensitivity.
2. **CAL VOLT METER:** Adjusts volt meter to agree with actual battery voltage. Note: If voltmeter calibration is performed, generator calibration must also be performed.
3. **CAL GENERATOR:** Adjusts kVp, mAs and filament current.
4. **CAL BAT CHARGER:** Adjusts charging current rates for full and trickle charge.
5. **CAL FLD LT TIME:** Adjusts field light illumination time.
6. **LOAD DEFAULTS:** Installs standard operating values.

Note:

If new batteries, a CPU board or a RAM are installed, you must load defaults before running any calibration.

Section 3 contains calibration procedures in the order listed above.

ILLUSTRATION 2-3
MENU SELECTION



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SECTION 3
CALIBRATION

3-1 Calibrate Drive Handle

Note:

This calibration unit can be performed at any time. There are no interactions with other calibration units.

Voltage across sensors on each side of the drive handle changes as drive handle position changes. The microprocessor uses this voltage to determine how fast the drive wheels should turn. Wheel speeds are set separately to allow driving forward and turning.

Press either **kVp ▲** or **kVp ▼** until the prompt **CAL DRIVE HANDLE** displays, then press **mAs ▼**. The prompt changes to **RELEASE HANDLE** indicating that handle Zero Point may be set.

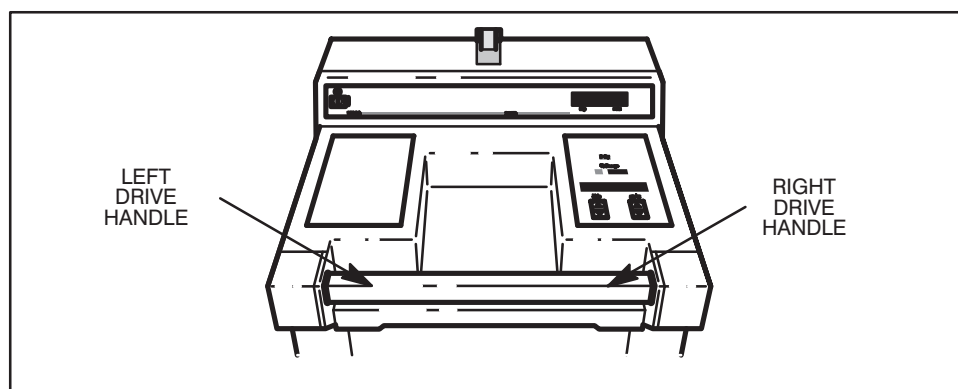
1. To exit **CAL DRIVE HANDLE** without changing any values, press **mAs ▲**.

The prompt changes to **EXITING-----** then to **CAL DRIVE HANDLE** indicating that drive handle calibration is not active and another selection may be made from the main calibration menu.

2. Check the handle to make sure it moves freely and is not being pushed.
3. Press **mAs ▼**. The prompt changes to **ZERO POINT SET** followed by the gain prompt **PRESS LEFT FWD**.
4. See Illustration 3-1. While holding the left side of the handle forward against its stop, press **mAs ▼**. The prompt changes to **PRESS RIGHT FWD**.
5. While holding the right side of the handle forward against its stop, press **mAs ▼**. The prompt changes to **FWD GAINS SET** followed by **PULL LEFT BACK**.
6. While holding the left side of the handle back against its stop, press **mAs ▼**. The prompt changes to **PULL RIGHT BACK**.
7. While holding the right side of the handle back against its stop, press **mAs ▼**. The prompt changes to **REV GAIN SET** followed by **CAL DRIVE HANDLE** indicating that drive handle calibration is completed and another selection may be made from the main calibration menu.

Note:

If an error message is displayed during **CAL DRIVE HANDLE**, record the message for your reference and press **mAs ▲** to continue.

ILLUSTRATION 3-1
DRIVE HANDLE

3-2 Calibrate Voltmeter

Note:

Whenever volt meter calibration is performed, you **MUST** perform the Generator calibration afterwards. This is critical because the battery voltage is checked before each exposure is made.

Volt Meter Calibration matches displayed voltage to the actual battery voltage. Battery voltage is checked before each exposure is made.

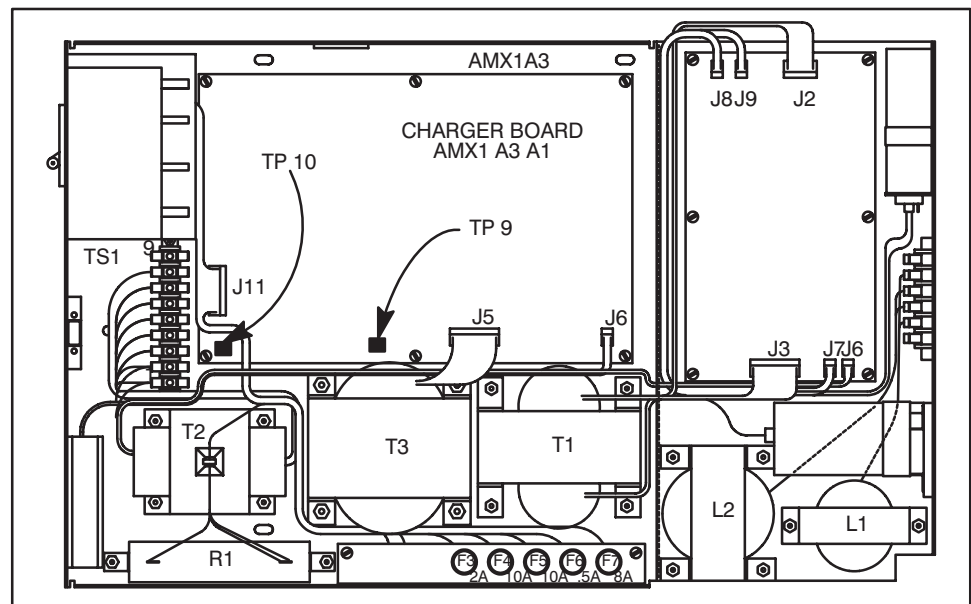
Refer to Direction 2173225-100, *AMX-4+ Service*, for side cover removal.

1. Press either **kVp ▲** or **kVp ▼** until the prompt **CAL VOLT METER** displays, then press **mAs ▼**. The prompt changes to **INSTALL METER**, indicating the volt meter may be calibrated.
2. See Illustration 3-2. Install a digital volt meter + lead to Battery Charger Board AMX1 A3 A1 TP-10 and - lead to TP-9. Select range to to display 150 VDC. Press **mAs ▲**. The prompt changes to **CALIBRATING** then to **ENTER VALUE**. Battery voltage appears on the kVp and mAs display.
3. Match the voltage value displayed on the kVp and mAs display with the reading on the meter.
 - Pressing **kVp ▲** increases displayed voltage.
 - Pressing **kVp ▼** decreases displayed voltage.
4. Press **mAs ▼** when displayed voltage is the same as voltmeter voltage. The prompt changes to **REMOVE METER** indicating Voltmeter is calibrated. You may check volt meter calibration by entering the procedure again and verifying that the displayed value agrees with your meter.
5. Remove Voltmeter from the Battery Charger Board. Press **mAs ▲**. The prompt changes to **CAL VOLT METER**, indicating that another selection may be made from the main calibration menu.

Note:

If an error message is displayed during **CAL VOLT METER**, record the message for your reference and press **mAs ▲** to continue.

ILLUSTRATION 3-2
VOLT METER TEST POINTS



3-3 Calibrate Generator

Note: Insure proper generator calibration by performing **CAL VOLT METER** before **CAL GENERATOR**.

Note: Units within the generator calibration section are interrelated and rely on information stored by the previous calibration units. Always perform the generator calibration in complete sequence.

Note: In order to insure exposure accuracy at High Technique and low battery voltage **DO NOT** calibrate generator when battery voltage is greater than 113 V or less than 112 V. (If battery voltage is greater than 113 V, use Battery Load Fixture 46-302882 or run machine around corridors to get voltage down to 113 V. If battery voltage is less than 112 V, charge the machine up to increase voltage to between 112 V and 113 V).

Note: If an external load tool is used to bring the voltage down below 113V per the above note, then a full charge should be performed before using the machine for applications. The battery monitoring algorithm will not be aware that the external load tool was used and may conclude that the batteries are weaker than they really are.

AMX-4+ contains programmed values for mAs, kVp and Filament Current. Due to many variables in each machine, these values are not exact. Generator calibration corrects the variables. Calibrating mAs is done by injecting approximately 100 mA into a voltage to frequency converter. The computer integrates mA for one second to obtain 100 mAs. The mAs reading is then corrected to agree with the injected mA value. Kilovolt peak is calibrated by reading the kV wave form and correcting the computer read value at 52, 64, 85, and 120 kVp. All technique factors are selected by the computer in response to pressing switches. Filament and emission current are corrected by making exposures and letting the processor correct current to provide the proper kVp.

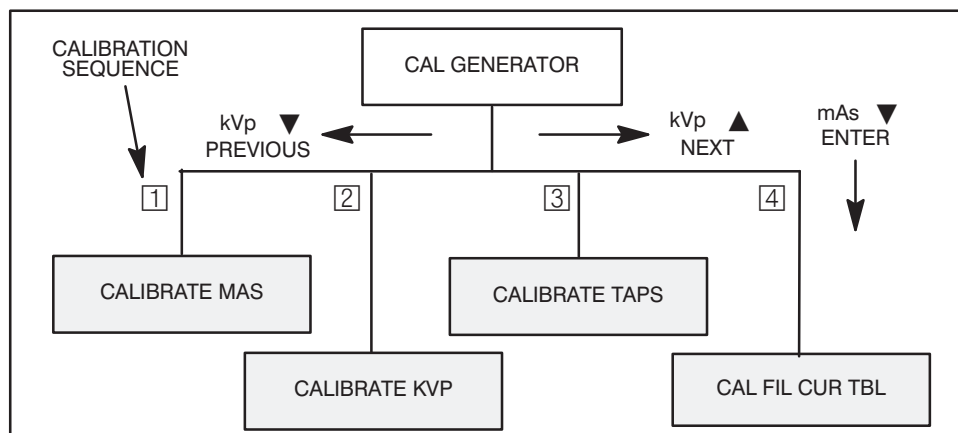
If an error occurs during generator calibration and the prompt **REPEAT EXPOSURE?** displays, press **mAs ▲** to continue calibration or **mAs ▼** to exit.

3-3-1 Cal Generator Menu

Illustration 3-3 shows generator calibration selection path using the **kVp ▲**, **kVp ▼**, and **mAs ▼** switches. Shaded boxes represent menu selections. Selections are listed below in the order in which they appear when pressing **kVp ▲**. This is also the sequence to follow when recalibrating the generator.

1. **CALIBRATE MAS:**
2. **CALIBRATE KVP:**
3. **CALIBRATE TAPS:**
4. **CAL FIL CUR TBL:**

The units should always be performed in order from start to end. If you select a calibration procedure when one before it needs calibration, you may see the message **MAS CAL REQUIRED**, **KVP CAL REQUIRED**, or **TAP CAL REQUIRED** depending on the stage of the sequence you are in.

ILLUSTRATION 3-3
CAL GENERATOR MENU SELECTION**3-3-2** Enter Cal Generator

Press either **kVp ▲** or **kVp ▼** until the prompt **CAL GENERATOR** displays, then press **mAs ▼**. The prompt changes to **CALIBRATE MAS** indicating that the generator calibration menu is ready for selection.

- To exit **CAL GENERATOR** without changing any values, press **mAs ▲**.

The prompt changes to **EXITING-----** then to **CAL GENERATOR** indicating that generator calibration is not active and another selection may be made from the main calibration menu.

3-3-3 Calibrate mAs

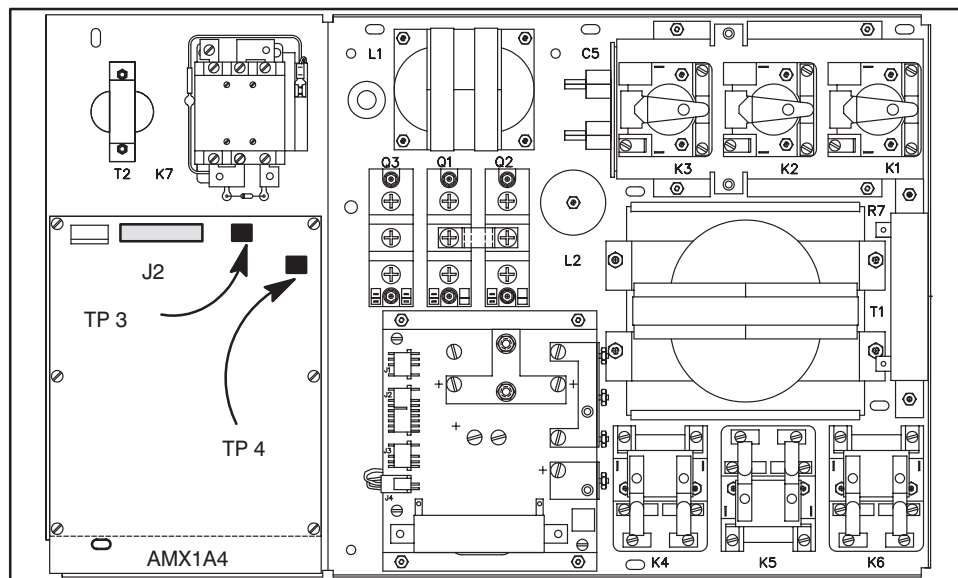
Refer to Direction 2173225-100, *AMX-4+ Service*, for side cover removal.

1. Press either **kVp ▲** or **kVp ▼** until the prompt **CALIBRATE MAS** displays, then press **mAs ▼**. The prompt changes to **INSTALL METER** indicating that mAs may be calibrated.



When installing meter in step 2, make the connection to TP-3 first to prevent shorting TP-4 to ground and tripping the circuit breaker.

2. See Illustration 3-4. Inject approximately 100 mA into the voltage to frequency converter by installing an mA meter between AMX1 A4 A2 TP-4 and TP-3. Select range to display 100 mA dc. Your meter should read between 95 and 105 mA. Press **mAs ▲**. The prompt changes to **CALIBRATING**, then to **ENTER VALUE**.
3. Match the displayed mAs value with the mA reading on the meter installed in step 2.
 - Pressing **kVp ▲** increases display in 0.1 mAs increments.
 - Pressing **kVp ▼** decreases display in 0.1 mAs increments.
4. When displayed mAs and measured mA agree, press **mAs ▼**. The prompt changes to **REMOVE METER** indicating mAs is set.

ILLUSTRATION 3-4
MAS TEST POINTS

5. Confirm mAs metering accuracy by repeating this procedure. Readings in step 3 should agree within ± 0.1 mAs.
6. Remove mA meter by removing TP-4 connection first to prevent shorting TP-4 to ground and tripping the circuit breaker. Press **mAs** ▲. The prompt changes to **CALIBRATE MAS** indicating that another selection may be made from the generator calibration menu.

Note:

If an error message is displayed during **CALIBRATE MAS**, record the message for your reference and press **mAs** ▲ to continue.

3-3-4 Calibrate kVp

Generator kVp is calibrated at 52, 64, 85, and 120 kVp. About 6 to 10 exposures are taken at each kV calibration point. The number of exposures depends on system operating characteristics. After some exposures the system adjusts itself. Other exposures are followed by the prompt **ENTER VALUE**. When **ENTER VALUE** displays, enter the kVp value from the oscilloscope.

Note: Pressing **mAs ▲** in response to the prompt **PRESS PREP --** will exit this procedure. **Note that any kVp calibration will be lost!**

Install test equipment and kVp calibration jumper.

1. To read kVp wave form, install oscilloscope and either:

- **Preferred:** Keithley Non-Invasive kVp Divider (Model 35080A with Deviation 535, or Model 35080B, both using Mobile Filter Pack Plus 37946C and optional Low Range Filter Pack 38237C)(See Section 3 of Direction 46-017561 *HHS Control and Tube Assembly Tests* and Keithley's Operation and Maintenance manuals for installation). **No other substitutions for non-invasive kVp Dividers are approved!**

OR

- **Alternate:** High Voltage Bleeder, Catalog Number C1515A, (Reference Direction 46-013288 *Bleeder, High-Voltage Dual Type T8005G and C1515A Connection ... Applications* for installation)

Note: If an attempt is made to verify a unit calibrated with a C1515A bleeder with a Keithley Non-Invasive divider, kVp readings will read 5-7 kVp higher than when read with the C1515A. This is due to impedance changes in the high voltage circuit with the bleeder removed from the circuit and due to frequency compensation errors present using the C1515A divider with the AMX-4+ waveform.

2. Press either **kVp ▲** or **kVp ▼** until the prompt **CALIBRATE KVP** displays, then press **mAs ▼**. The prompt changes to **INSTALL JUMPER**.

Note: If you are out of sequence, the prompt will change to **MAS CAL REQUIRED**. You will need to calibrate mAs first before proceeding with kVp.

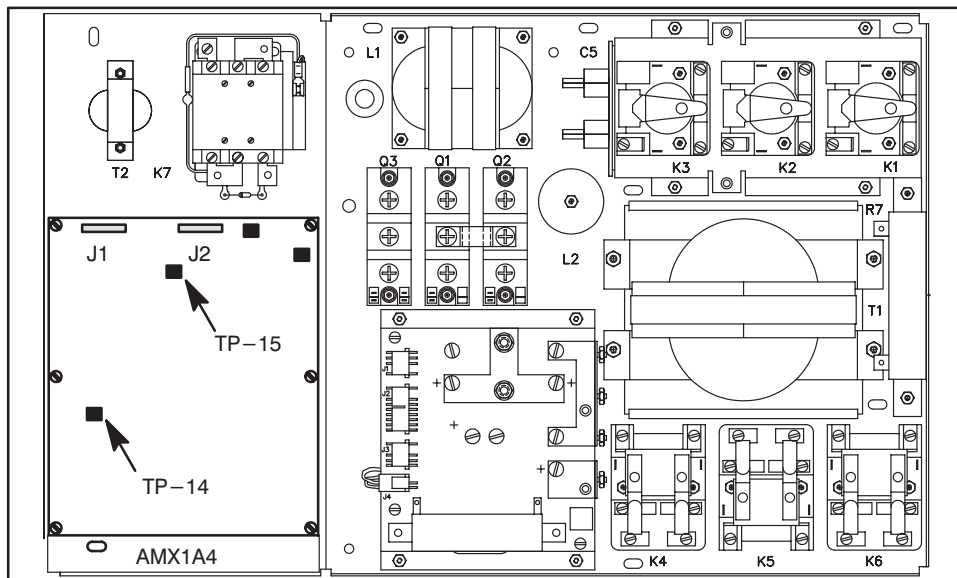
3. See Illustration 3-5. Install a jumper between AMX1 A4 A2 TP-14 and TP-15. Press **mAs ▲**. The prompt changes to **PRESS PREP --**.

Calibrate kVp. Repeat steps 1 through 4 for 52, 64, 85, and 120 kVp. kVp is automatically selected by the AMX-4+. The number of exposures at each calibration point depends on system operating characteristics.

Except on the last exposure, if the oscilloscope does not capture the reading and **ENTER VALUE** displays, enter a value 5 kVp lower than the displayed value. If the scope still hasn't triggered by the next time **ENTER VALUE** is displayed, repeat with 5 kVp higher. Keep alternating between entering 5 kVp higher and lower than displayed until the oscilloscope triggers.

ILLUSTRATION 3-5
KVP JUMPER LOCATION

1. Adjust oscilloscope to trigger on the kV wave form.
2. Press the x-ray prep switch. The prompt changes to **READY FOR X-RAY**.
3. Make an exposure by pressing the x-ray switch. The generator beeps, indicating an exposure has been made. Release both prep and x-ray switches.



4. One of three prompts displays:
 - a. If **ENTER VALUE** displays, read stable kVp value on the oscilloscope. See Illustration 3-6.
 - If displayed kVp is less than stable kVp, press **kVp ▲**. The display will increase in 0.1 kVp increments.
 - If displayed kVp is larger than stable kVp, press **kVp ▼**. The display will decrease in 0.1 kVp increments.
 - When displayed and stable kVp agree within 0.1 kVp, press **mAs ▼**. The prompt changes to **PRESS PREP - -**. Repeat steps 1 through 4.
 - b. If **PRESS PREP - -** displays, repeat steps 1 through 4.
 - c. If **REMOVE JUMPER** displays, kVp calibration is finished.

Remove test equipment and kVp calibration jumper.

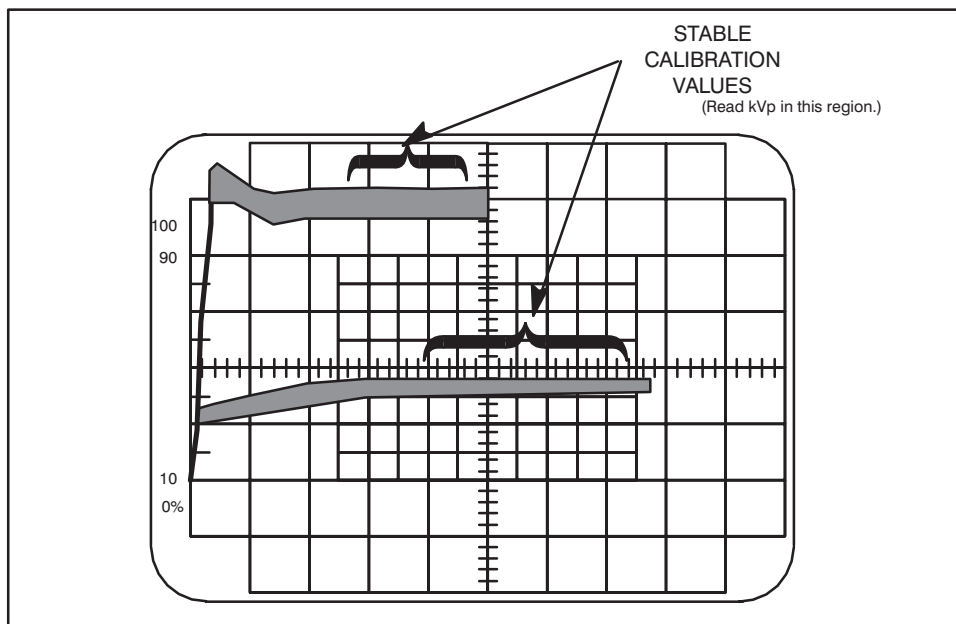
1. Remove jumper from between AMX1 A4 A1 TP-14 and TP-15.
2. You may optionally remove the High Voltage Bleeder and install high voltage cables in tube housing at this time. Reference Direction 2196272-100 *High Voltage Cable Installation and Troubleshooting Procedures*.

- Press **mAs ▲**. The prompt changes to **CALIBRATE KVP** indication that kVp calibration is complete and another selection may be made from the Generator Calibration Menu.

Note:

If an error message is displayed during **CALIBRATE KVP**, record the message for your reference and press **mAs ▲** to continue.

ILLUSTRATION 3-6
KVP WAVE FORM



3-3-5 Calibrate Taps

Calibrate Taps takes about 20 minutes. The expected kVp appears on the kVp and mAs display before each exposure.

- Press either **kVp ▲** or **kVp ▼** until the prompt **CALIBRATE TAPS** displays, then press **mAs ▼**.

One of the following three messages will appear. Select the appropriate option.

- If defaults have been loaded, **PRESS PREP --** will appear.
- If the "Calibrate Taps" procedure has been partially completed, **MAS UP RESUME -- MAS DN NEW CAL** will appear.
- If the "Calibrate Taps" procedure was previously completed, **MAS UP EXIT -- MAS DN NEW CAL** will appear.
- If the generator calibration is out of sequence, one of the following messages will display: **MAS CAL REQUIRED** or **KVP CAL REQUIRED**.

- Press the x-ray prep switch. The prompt changes to **READY FOR X-RAY**.



3. Press the x-ray switch, making an exposure. The generator beeps, indicating an exposure has been made. Release both prep and x-ray switches. The prompt changes to **BATTERY RECOVERY**, then to **PRESS PREP --** indicating that that another exposure must be made.
4. When the last exposure is completed, the prompt changes to **CALIBRATE TAPS**, indicating that tap calibration is complete and another selection may be made from the generator calibration menu.

Note: If an error message is displayed during **CALIBRATE TAPS**, record the message for your reference and press **mAs ▲** to continue.

Note: If x-ray tube spits occur at the high taps, discharge the batteries to between 112.5 and 113.0 volts, and do the "Calibrate Taps" procedure again. This will reduce the maximum kVp at the high taps.

3-3-6 Calibrate Filament Current Table

Calibrate Filament Current Table takes about 15 minutes.

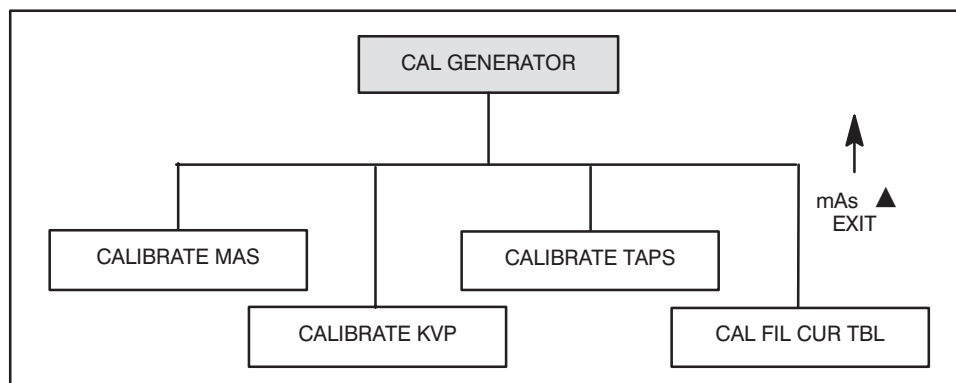


1. Press either **kVp ▲** or **kVp ▼** until the prompt **CAL FIL CUR TBL** displays, then press **mAs ▼**. The prompt changes to **PRESS PREP --**.
2. Press the x-ray prep switch. The prompt changes to **READY FOR X-RAY**.
3. Press the x-ray switch, making an exposure. The generator beeps, indicating an exposure has been made. Release both prep and x-ray switches. The prompt changes to **BATTERY RECOVERY** indicating that battery voltage is stabilizing after the exposure. The prompt changes to **PRESS PREP --**.
4. When the last exposure is completed, the prompt changes to **CAL FIL CUR TBL**, indicating that tap calibration is complete and another selection may be made from the generator calibration menu.

Note: If an error message is displayed during **CAL FIL CUR TBL**, record the message for your reference and press **mAs ▲** to continue.

3-3-7 End Generator Calibration

1. See Illustration 3-7. A generator calibration menu selection must be displayed.
2. Press **mAs ▲**. The prompt changes to **EXITING-----** then to **CAL GENERATOR**, indicating that generator calibration is not active and another selection may be made from the main calibration menu.
3. Remove High Voltage Bleeder and install high voltage cables in tube housing (if not already done previously). Reference Direction 46-013871, *Silicone Grease for Hi Voltage Cable Terminations*.

ILLUSTRATION 3-7
EXIT GENERATOR CALIBRATION**3-4 Calibrate Charger**

This procedure sets the battery charging rate. Charge rate is set at two voltages measured across resistor AMX1 A3 R1. Reference Appendix B for side cover removal.

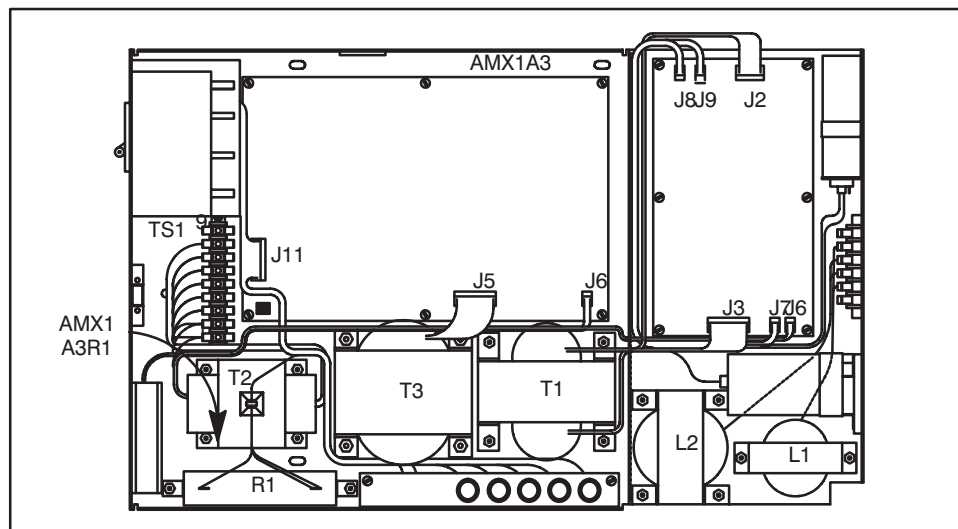
1. Press either **kVp ▲** or **kVp ▼** until the prompt **CAL BATT CHARGER** displays, then press **mAs ▼**.

The prompt changes to **PLUG IN CHARGER** indicating that the battery charge must be plugged into a convenience outlet.

- To exit **CAL BATT CHARGER** without changing any values, press **mAs ▲**.
 - The prompt changes to **EXITING-----** then to **CAL BATT CHARGER** indicating charger calibration is not active and another selection may be made from the main calibration menu.
2. See Illustration 3-8. Connect a digital volt meter across resistor AMX1 A3 R1. Select a range that displays 5.00 volts dc.
 3. Plug charger cord into a convenience outlet. The prompt changes to **CONVERTING**, then to **ENTER VALUE**, indicating that the battery charge rate may be set.
 4. Match the voltage displayed on the kVp and mAs display with the reading on the meter.
 - Pressing **kVp ▲** increases meter voltage reading.
 - Pressing **kVp ▼** decreases meter voltage reading.
 5. Press **mAs ▼** when the displayed voltage is the same as voltmeter voltage. Display changes to **CONVERTING**, then changes to **ENTER VALUE**. The volt meter reading will change several times during the converting cycle.
 6. Repeat step 4 and 5 for the second set point. Display changes to **CONVERTING**, then changes to **REMOVE CHRG CORD**. The volt meter reading will change several times during the converting cycle. Remove charger cord. The prompt changes to **CAL BATT CHARGER** indicating that charger calibration is complete and another selection may be made from the main calibration menu.

Note:

If an error message is displayed during **CAL BATT CHARGER**, record the message for your reference and press **mAs ▲** to continue.

ILLUSTRATION 3-8
CHARGER PANEL

3-5 Adjust Field Light On Time

This procedure adjusts field light illumination time between 5 and 45 seconds, default time is 30 seconds.

- Press either **kVp ▲** or **kVp ▼** until the prompt **CAL FLD LT TIME** displays, then press **mAs ▼**.

The prompt changes to **ENTER VALUE** indicating that Field Light on Time may be set. The kVp and mAs display indicates field light on time.

The display shows tenths of a second, but only seconds are saved. If a value greater than 45 seconds or less than 5 seconds is entered, the error **FLDLIT TIME LIMT** displays until **mAs ▲** is pressed. The Field Light on Time is set to the limit that was exceeded.

- Select the required lamp illumination time. Holding the switch down will scroll the values.
 - Pressing **kVp ▲** increases on time in 0.1 second increments.
 - Pressing **kVp ▼** decreases on time in 0.1 second increments.
- Press **mAs ▼** when the required time displays. The prompt changes to **CAL FLD LT TIME** indicating that field light calibration is complete and another selection may be made from the main calibration menu.

3-6 Load Default Values

DO NOT load defaults for routine calibration.



Loading Default Values replaces ALL calibration values with default values. Any calibration that has been done will be erased. In addition, any reconfiguration of data base values will be changed back to default values.

This procedure replaces all calibration parameters with default values. The parameters provide a starting point for calibration after replacing the CPU Board or RAM.

1. Press either **kVp ▲** or **kVp ▼** until the prompt **LOAD DEFAULTS** displays.
2. Press **mAs ▼**. If defaults were loaded previously, the display will alternate between **mAs UP TO EXIT** and **mAs DWN TO LOAD**. If defaults were not loaded previously, the prompt changes to **DEFAULTS LOADED**, then to **CAL REQUIRED** indicating that Default Values have been set and calibration is required. If loading defaults **IS NOT** desired press **mAs ▲**. If load defaults is desired press **mAs ▼**. This feature prevents accidental loading of defaults after a unit has been calibrated.
3. Press **mAs ▲**. The prompt changes to **LOAD DEFAULTS** indicating that default value loading is complete and another selection may be made from the main calibration menu.

3-7 End Calibration

When calibration is complete, a calibration menu selection appears on the Message Display. End calibration from the menu by doing the following:

1. The prompt **CALIBRATE SYSTEM** displays.
2. Press **kVp ▼** until the prompt **END SERVC MODE** displays.
3. Press **mAs ▼**. The prompt changes to **SWITCH TO RUN**.
4. Set the Service Switch up to the application position. The prompt changes to **CYCLE KEY SWITCH**.
5. Reset the AMX-4+ using one of the following methods:
 - Turn the Power Key off and back on.
 - If the top cover is removed, providing access to the processor board, press the processor reset switch.

Power-up test is performed and the prompt **TESTING COMPLETE** displays.

6. Perform a functional check of calibrated items to ensure proper operation.
7. Replace trim covers. Reference Appendix B for side cover installation.

SECTION 4

CALIBRATION ERROR PROMPTS

4-1 Introduction

All calibration errors are detected by software in the calibration and service PROM. Errors are divided into three categories:

1. Software errors like Battery Error 4 and Check Sum. These involve calculations and parameter passing.
2. Data errors like Cal Charger Err 3. These are the result of comparing calibration values in RAM with allowed maximum or minimum values stored in PROM.
3. Hardware errors like Battery Error 1. These are the result of an error bit set during a read; or comparing a calibration port value with the allowed maximum or minimum value stored in PROM.

Calibration error prompts are a guide to possible problems, not problem solvers. For example, if Battery Error 2 appears during generator calibration, it is informing you that the battery was low when battery voltage was checked. Several conditions could cause this error to occur. A high energy exposure could have made battery voltage drop below the preset minimum for a short time. The battery could need charging. The battery charger could need calibration. An understanding of x-ray generators, good trouble shooting skills, and common sense will help determine the required action.

4-2 Error Prompts

—CALDAT WARNING—

Something is out of limits. A maximum or minimum value was inserted so that calibration can continue. Continue calibrating and watch for maximum or minimum limit errors.

BATTERY ERROR 1

Counter overflowed while determining battery voltage.

- Frequency at Charger Board TP-6 must be less than 10 kHz.
- Multiplexer U76 on Charger Board must be operating properly.

BATTERY ERROR 2

Reading battery voltage port indicated less than 80 volts.

- Battery voltage must be properly calibrated.
- Check connection between CPU and Charger Boards.

BATTERY ERROR 3

Reading battery voltage port indicated more than 150 volts.

- Battery voltage must be properly calibrated.
- Check Charger Board.

BATTERY ERROR 4

Voltage value was not saved. An invalid condition was detected. Could not determine if battery voltage was a loaded or unloaded value.

- Repeat the test or calibration procedure that caused the error.
- Replace PROM if problem continues.

BATRY WORD LIMIT

Data for either upper or lower battery calibration limit has been exceeded.

- Calibrate volt meter.
- Check connection between CPU and Charger Boards.
- Frequency at Charger Board TP-6 must be from 55 to 75 Hz per volt. For example a battery voltage of 115.0 volts should produce a frequency of 6.3 to 8.6 kHz.

CAL CHGR ERR 1

Hardware counter overflowed while determining charging current.

- Frequency at Charger Board TP-6 must be less than 60 kHz.
- Multiplexer U76 on Charger Board must be operating properly.

CAL CHGR ERR 2

Reading battery current port indicated charge current frequency was missing.

- Check connection between CPU and Charger Boards.
- Check for Digital to Analog Converter output at least 0.5 volts at TP-29 on the CPU Board.
- Does charger charge? Does charge voltage develop across charging resistor AMX1 A3 R1?

CAL CHGR ERR 3

Either upper or lower charger calibration limit has been exceeded.

- Calibrate charger.
- Check connection between CPU and Charger Boards.
- Does **CHARGE SCALE-SELECT** signal change state during charger calibration?
- The charge Digital to Analog Converter output voltage at TP-29 on the CPU Board should be, in sequence, as follows:
 - First, 0.5 to 1.5 volts with **CHARGE SCALE-SELECT** not asserted
 - Then, 1.5 to 2.5 volts with **CHARGE SCALE-SELECT** not asserted
 - Then, 2.9 to 4.9 volts with **CHARGE SCALE-SELECT** asserted
 - Then, 6.8 to 8.8 volts with **CHARGE SCALE-SELECT** asserted

- The average frequency at Charger Board TP-6 should be:
 - 1.8 to 2.4 kHz per amp of charge current when **CHARGE SCALE-SELECT** is not asserted
 - 18 to 24 Hz per milliamp of charge current when **CHARGE SCALE-SELECT** is asserted

CAL TAP ERROR 1

The proper mA could not be reached by changing the kVp.

- Repeat the Tap CAL Procedure.
- Check mAs Calibration.
- Check for bad connection in the x-ray generator.

CAL TAP ERROR 2

More than 140 kVp at tube voltage port with a tap selection that should provide less than 140 kVp.

- Repeat the Tap CAL Procedure.
- Check mAs Calibration.
- Calibrate kVp.
- Check generator tap relay wiring.

CAL TAP ERROR 3

More than 35 kVp at tube voltage port with a tap selection that should provide 35 kVp.

- Charge if battery voltage is less than 112 volts.
- Repeat the Tap Calibration Procedure.
- Check mAs Calibration.
- Calibrate kVp.
- Check generator tap relay wiring.

CAL TAP ERROR 4

A high order tap combination produced less kVp than a low order tap combination.

- Check generator tap relay wiring.
- Repeat the Tap Calibration Procedure.

CAL TAP ERROR 5

With the filament current digital to analog converter at full count, reading tube current port indicated maximum filament current does not produce enough emission current.

- Check mAs Calibration.
- Check filament current by checking voltage across Filament and kVp Control Board resistor AMX1 A4 A2 R188. Voltage should be about 0.5 volts. This is 0.1 volt per amp of filament current.

- Check generator tap relay wiring.
- Repeat the Tap Calibration Procedure.

CAL TAP ERROR 6

With the filament current digital to analog converter at its lowest value, reading tube current port indicated filament emission current was high.

- Check mAs Calibration.
- Check filament current by checking voltage across Filament and kVp Control Board resistor AMX1 A4 A2 R188. Voltage should be about 0.5 volts. This is 0.1 volt per amp of filament current.
- Check generator tap relay wiring.
- Repeat the Tap Calibration Procedure.

CAL TAP ERROR 7

One or more of the tap calibration parameters was out of limits, data exceeded either upper or lower limit value of selected tap.

- Either upper or lower limit of filament current calibration points has been exceeded.

CAL TUBE ERR 1

This error always occurs after a limit error.

- Refer to the limit error description for additional information.

CAL TUBE ERR 3

One or more of the Filament current table data field limits was exceeded.

- This error always occurs after a limit error. Refer to the limit error description for additional information.

CHARG BYTE LIMIT

Reading battery charger port indicated either upper or lower calibration limit exceeded.

- Calibrate charger.

CHARG WORD LIMIT

Reading battery charger port indicated either upper or lower calibration limit exceeded.

- Calibrate charger.
- Check connection between CPU and Charger boards.
- Does **CHARGE SCALE-SELECT** signal change state during charger calibration?

- The charge Digital to Analog Converter output voltage at TP-29 on the CPU Board should be, in sequence, as follows:
 - First, 0.5 to 1.5 volts with **CHARGE SCALE-SELECT** not asserted
 - Then, 1.5 to 2.5 volts with **CHARGE SCALE-SELECT** not asserted
 - Then, 2.9 to 4.9 volts with **CHARGE SCALE-SELECT** asserted
 - Then, 6.8 to 8.8 volts with **CHARGE SCALE-SELECT** asserted
- The average frequency at Charger board TP-6 should be:
 - 1.8 to 2.4 kHz per amp of charge current when **CHARGE SCALE-SELECT** is not asserted
 - 18 to 24 Hz per milliamp of charge current when **CHARGE SCALE-SELECT** is asserted

CHECK SUM ERR 1

Drive calibration bytes check sum failed. Recalibrate drive.

CHECK SUM ERR 2

Drive calibration words check sum failed. Recalibrate drive.

CHECK SUM ERR 3

Charger calibration bytes check sum failed. Recalibrate charger.

CHECK SUM ERR 4

Charger calibration words check sum failed. Recalibrate charger.

CHECK SUM ERR 5

Battery calibration words check sum failed.

- Calibrate voltmeter and generator.

CHECK SUM ERR 6

X-Ray calibration bytes check sum failed.

- Calibrate generator.

CHECK SUM ERR 7

X-Ray calibration words check sum failed.

- Calibrate generator.

CHECK SUM ERR 8

Field light calibration bytes check sum failed.

- Calibrate field light.

CHECK SUM ERR 9

Turns ratio word check sum failed.

- Calibrate generator.

CHECK SUM ERR 10

X-Ray circuit resistance words check sum failed.

- Calibrate generator.

CHECK SUM ERR 11

Filament current tables have a check sum error, or were not calibrated.

- If no other generator checksums are present, Calibrate Filament Current

DRIVE BYTE LIMIT

Reading drive port indicated either upper or lower calibration limit was exceeded.

- Calibrate drive.
- Check wiring to drive handle transducers.
- Check for +10 volts at transducer input.
- Does transducer output change when handle is moved?
- Is transducer output always between 1 and 9 volts? Check the "Handle Check*" circuitry, AMX1 A1A1 shell 5-A4. TP 29 should be 9.9V $\pm 1\%$ during Handle Calibration.

DRIVE WORD LIMIT

Reading drive port indicated either upper or lower calibration limit was exceeded.

- Calibrate drive.
- Check wiring to drive handle transducers.
- Check for +10 volts at transducer input.
- Does transducer output change when handle is moved?
- Is transducer output always between 1 and 9 volts?
- Check the "Handle Check*" circuitry AMX1 A1A1 shell 5-A4. TP 29 should be 9.9V $\pm 1\%$ during Handle Calibration.

FLDLIT TIME LIMIT

An invalid time was entered during field light calibration.

- Calibrate field light.

FLDLT BYTE LIMIT

Reading field light data indicated either upper or lower time limit was exceeded.

- Calibrate field light.

HIGH FIL LIMIT

One or more of the filament current calibration data parameters exceed the limit.

IGNORE IF:

- The unit is being calibrated for the first time with a new battery backed RAM.
- The message did not occur during filament current calibration.

OTHERWISE:

- Calibrate mAs.
- Check filament current by checking voltage across Filament and kVp Control Board resistor AMX1 A4 A2 R188 (sheet 2 location F-9). Voltage should be about 0.5 volts. This is 0.1 volt per amp of filament current.
- Check x-ray tube
- Check filament transformer

HNDL CAL ERR 1

Reading drive handle port indicated zero point value limit exceeded.

- Calibrate drive.
- Check wiring to drive handle transducers.
- Check for +10 volts at transducer input.
- Is transducer output between 2.5 and 7.5 volts?
- Does transducer output change when handle is moved?

HNDL CAL ERR 2

Calculated forward gain was out of range.

- Calibrate drive.
- Check wiring to drive handle transducers.
- Check for +10 volts at transducer input.
- Does transducer output change when handle is moved?
- Check that TP29 is 9.9V $\pm$ 1% during Handle Calibration.

HNDL CAL ERR 3

Calculated reverse gain was out of range.

- Calibrate drive.
- Check wiring to drive handle transducers.
- Check for +10 volts at transducer input.
- Does transducer output change when handle is moved?
- Check that TP29 is 9.9V $\pm$ 1% during Handle Calibration.

HANDLE CAL ERR 4

Reading drive handle port indicated improper polarity relationship between zero, forward, and reverse calibration voltages.

- Was the handle moved in the correct direction in response to prompts?
- Calibrate drive.
- Check that TP29 is 9.9V $\pm$ 1% during Handle Calibration.

KVP CAL ERROR 1

The required kVp and mA can not be reached. Tap combinations do not go high enough.

- Are tap relays functioning properly?
- Calibrate mAs.

KVP CAL ERROR 2

No tap relays pulled in and the required kVp and mA still can not be reached.

- Are tap relays functioning properly?
- Check HV cables for shorts.
- Calibrate mAs.

KVP CAL ERROR 4

One or more of the calibration parameters is out of limits.

- Were kVp values entered correctly?
- Is bleeder properly calibrated?
- Are all tap relays functioning properly?

LOW FIL LIMIT

One or more of the filament current calibration data parameters is less than the minimum allowed.

IGNORE IF:

- The unit is being calibrated for the first time with a new battery backed RAM.
- The message did not occur during filament current calibration.

OTHERWISE:

- Calibrate mAs.
- Check filament current by checking voltage across Filament and kVp Control Board resistor AMX1 A4 A2 R188 (sheet 2 location F-9). Voltage should be about 0.5 volts. This is 0.1 volt per amp of filament current.
- Check x-ray tube
- Check filament transformer

MAS CAL ERROR 1

The frequency produced by injecting 100 mA during mAs meter calibration was too high causing the counter to overflow.

- Was the injected current more than 110 mA?
- Is the frequency at Filament and kVp Control Board TP-2 more than 18 kHz?

MAS CAL ERROR 4

The check to see if data base parameters are being written correctly produced an error.

- Check data bus connection to CPU Board.
- Check battery backed RAM.

RAM READBACK ERR

Data read from memory location is not what was written to that location.

SYS RESIST LIMIT

The slope of emission current versus kVp was calculated to be either too flat or too steep at the last tap selection. This error is valid only during tap calibration.

- Is mAs properly calibrated?
- Is kVp properly calibrated?
- Batteries may be soft. Charge the batteries.

TURN RATIO LIMIT

The battery voltage to kVp multiplication factor (effective turns ratio) was out of range for one or more tap combinations.

- Is mAs properly calibrated?
- Is kVp properly calibrated?
- Batteries may be soft. Charge the batteries.

VOLTMETER ERR 1

Battery voltage frequency is too high causing the counter to overflow.

- Is the frequency at Charger Board TP-6 more than 10 kHz?
- Is multiplexer U76 on Charger Board functioning properly?

VOLTMETER ERR 4

One or more of the battery voltage calibration data base parameters is out of range.

- Calibrate volt meter.
- Check connection between CPU and Charger Boards.
- Frequency at Charger Board TP-6 must be from 55 to 75 Hz per volt. For example a battery voltage of 115.0 volts should produce a frequency of 6.3 to 8.6 kHz.

X-RAY BYTE LIMIT

One or more of the x-ray calibration parameters just adjusted are out of range.

DURING MAS CALIBRATION:

- Was correct mA value entered?
- Check connection between CPU and Filament/kVp Boards.
- Frequency at Filament and kVp Board TP-2 must be between 14 and 18 kHz.
- Is your mA meter working properly?

DURING TAP CALIBRATION:

Indicates not enough taps could be calibrated without exceeding the maximum allowable kVp.

- Is kVp calibration correct?
- is mAs calibration correct?
- Is battery voltage more than 117 volts?

X-RAY WORD LIMIT

One or more of the x-ray calibration parameters just adjusted is out of limits.

DURING MAS CALIBRATION:

- Was correct mA value entered?
- Check connection between CPU and Filament/kVp boards.
- Frequency at CPU Board TP-2 must be between 14 and 18 kHz.
- Is your mA meter working properly?

DURING KVP CALIBRATION:

- Were kVp values entered correctly?
- Is the bleeder properly calibrated?
- Are all tap relays functioning properly?

DURING FILAMENT TABLE CALIBRATION:

Indicates that the turn off delay, the time from the stop command being asserted to x-ray on going away is greater than 2.0 ms.

- Is the kVp calibration jumper removed?

APPENDIX A

SYMBOLS

All symbols used on the equipment and in its accompanying documents are shown and explained in this appendix.



Caution advises of an avoidable condition that could cause minor physical injury, or damage to equipment or data.



Warning advises of an avoidable condition that may allow or cause a personal injury or the catastrophic destruction of equipment or data.



Danger advises of an avoidable condition that will cause serious or fatal injury.



Type B Equipment. Internal electrical power source provides an adequate degree of protection against electrical shock.



X-ray emission. X-ray tube head is emitting x-rays. Take adequate precautions to prevent the possibility of any persons carelessly, unwisely, or unknowingly exposing themselves or others to radiation.



Battery power on. This does not apply mains voltage.



Battery power off. This does not remove mains voltage.



Control for indicating radiation field by using light.



Collimator blades closed. The controlled blades are shown in thicker lines.



Collimator Blades open. The controlled blades are shown in thicker lines.



Functional Earth (ground) Terminal. Terminal directly connected to a point of a measuring supply or control circuit or to a screening part which is intended to be earthed for functional purposes.



Alternating Current. Indicates equipment that is suitable for alternating current only.



Direct Current. Indicates equipment that is suitable for direct current only.



Equipotentiality. Identifies terminals that bring the various parts of equipment or systems to the same potential when connected together. These terminals are not necessarily at earth (ground) potential. The value of the potential may be indicated next to the symbol.



Indicates lock release or brake release.



Indicates receptacle location for hand-held radiographic prep/expose and field-light control cable.



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