Release	**Department/Function, Name**	**Date, Signature***
Author	ENG: Sherry Zhang	Sherry Zhang.....
Checked by specialist	ENG: Yufei Liu	Yufei Liu .....
Formally checked and distributed	ENG: Alee Chen	Alee Chen.....
*) Signatures not necessary for draft version		

Distributor	**Description**
Original (showing signatures)	Document Control
Copy for external party	NA

Revision	Description of Change or Change Identifier	APPROVE
A	Initial version EDR :9886	YX BS,JJMI,BT
B	1. Add Mini-console 2. Change spare parts part number ECN:34077	MH,AW,JJ,KD 12/19/17
C	1. Add Certification 2. Add the Tomography function 3. Add the Time Compensation function 4. Add some Error Code Analysis information 5. Add template ECN#34491	MH,AW,JJ,KD 04/27/18
D	1. Add intended use 2. Add Console model and Cable type; Accessory List（Chart for console/cable) need be created in Manual and added to 2.9 of TCF 3. Add High Voltage Cable info 4. Remove Attention symbol 5. DIP switch and tube update for the latest 6. Manual signature and release for new revision 7. Add address ECN 35040	MH,AW 9/13/18
E	REVISED PER ECN 35429	AW 1/3/19
F	1. Change first page cover 2. Change EMC notification and warnings 3. Change Power Requirements 4. Change Conforming Standards-safety 5. Change AC mains cable requirement 6. Add console and min-console picture and dimensions and generator power rating selection 7. Change system interface add one more interface board 8. Change Service tool and CUI 9. Change console information add APR modification 10. Change replacement and adjustment add fuse type 11. Update spare parts list 12. Update Generator accessories 13. Add ZR Series Block Diagram ECN 36054	MH, YL
G	Change manufacturer address and telephone number ECN 39272	JAC 8/12/22
H	Update MDR and new edition standards related regulatory requirements. ECN 40005	YL,JJ,KD 6/6/23
J	Update new software functions description, add regulatory related informatgion ECN 42096	YL, HH, RY 7/24/25

Service Manual

ZEUS Series

X-Ray Generator

Spellman
High Voltage (SIP) Co., LTD
No. 86 Jinjiang Road, SIP, Suzhou, 215127, P.R. China

CE 0598

EC REP

Company:Spellman High Voltage Electronics GmbH
Address: Josef-Baumann-Straße 23, 44805 Bochum, Germany

ZEUS Series

X-Ray Generator Service Manual

Spellman High Voltage Electronics (Suzhou Industrial Park) Co. Ltd.
No. 86 Jinjiang Road, Suzhou Industrial Park, 215127, P.R. China
Tel: 86-512-67630010
Service Manual, English

Note:

The information contained herein is based on the experience and knowledge relating to the subject matter gained by Spellman High Voltage Electronics Corporation (Hereinafter as Spellman) prior to publication.

No patent license is granted by this information. Spellman reserves the right to change this information without notice, and makes no warranty, express or implied, with respect to this information. Spellman shall not be liable for any loss or damage, including consequential or special damages, resulting from any use of this information, even if loss or damage is caused by Spellman's negligence or other fault.

This equipment includes parts and assemblies sensitive to damage from electrostatic discharge. Use caution to prevent damage during all service procedures.

Table of Contents

Chapter 1 Safety Information

Overview

Spellman ZEUS series X-ray Generator is a High Voltage X-ray Generator which is intended for use in digital or analog radiographic X-ray systems. The generator provides high voltage to X ray tube between anode and cathode and current to tube filament to generate diagnostic X-ray exposures within specific time. Personnel operating and maintaining the Spellman X-ray Generator should receive training and be familiar with all aspects of operation and maintenance. To ensure safety, read the Safety Information section carefully before using the generator and observe all **Cautions** and **Important Notes** located throughout this manual and other manuals supplied with the equipment. this service manual provides guidance for the system integration, generator operation and maintenance, and it is not intended for the end-user.

Intended use

Spellman ZEUS series X-ray Generator is a High Voltage X-ray Generator which is intended for use in digital or analog radiographic X-ray systems. The generator provides high voltage to X-ray tube between anode and cathode and filament current to tube cathode filament to generate diagnostic X-ray exposures within specific exposure time.

The operation is only allowed by personnel with knowledge in X-day and after reading and understanding the user manual.

Responsibility of the manufacturer

Allow only authorized, properly trained personnel to operate this equipment. Be certain that all individuals authorized to use the equipment are aware of the danger of excessive exposure to X-ray radiation.

This equipment is sold with the understanding that the manufacturer, its agents, and representatives do not accept any responsibility for over-exposure of patients or personnel to X-ray radiation.

Furthermore, the manufacturer does not accept any responsibility for over-exposure of patients or personnel to X-ray radiation generated by this equipment as a result of poor operating techniques or procedures.

No responsibility is assumed for any unit that has not been serviced and maintained in accordance with the technical service manual, or that has been modified or tampered with in any way.

Spellman High Voltage (SIP) Co., Ltd. may take the responsibility for the technical safety characteristics of its products only if maintenance, service and modifications are performed by personnel specifically authorized to perform such work.

No alteration or modification of any kind may be performed on the device. Connections and adjustment for installation and integration of a system must be made according to the service manuals by an authorized service technician.

Working Principle

Spellman X-ray generator consists of power supply circuit, rectifier circuit, high voltage generation circuit, tube filament driver circuit, tube anode drive circuit, control circuit, application peripheral interface and optional console.

AC line input voltage will be rectified, filtered and converted to high frequency voltage, then it will be sent to HT tank, step-up and filtered to output high voltage DC, the DC voltage will be applied to X-ray tube inside X-ray system to generate X-ray for diagnostics purpose.

Application information

a) Environment:

- General:
  - Hospital use, intended for professional use.
  - Indoor use only
- Conditions of visibility for touch screen console:
  - Ambient luminance range: 100 lux to 1 500 lux.
  - Viewing distance: 20 cm to 40 cm
  - Viewing angle: normal to the display ± 20°
- Physical:
  - Operation temperature range: 10 °C to 40 °C
  - Operation relative humidity range: 20 % to 80 %, non-condensing
  - Storage/ shipping temperature range: -25 °C to 70 °C
- Frequency of use
  - Daily use
- Mobility
  - Generator cabinet is fixed installed, the console can be put on table.

- Noise

  Less than 60dB

Radiographic performance

Output Voltage (kV): 40 - 150kVp, in 1kVp increments

kVp Accuracy: ± (5% + 1) kVp

kV Ripple: ±4% At 100kV with maximum power output, HV cable length 10m (for ripple freq. ⩾ 10 kHz).

Risetime (10-90%): <2ms.

Output Tube Current (mA)

- ZR75PN80 Models: 10 mA - 1000 mA
- ZR75PN65 Models: 10 mA - 800 mA
- ZR75PN50 Models: 10 mA - 630 mA
- ZR75PN40 Models: 10 mA - 500 mA
- ZR75PN40S Models: 10 mA - 500 mA
- ZR75PN32 Models: 10 mA - 400 mA
- ZR75PN32S Models: 10 mA - 400 mA

mA Steps: Variable in mA steps according to ISO 497 Series R'20 or R'10

mA Accuracy: ± (5% +1) mA; for exposure time ⩾ 10ms, and tube current ⩾ 20mA

± (20%) mA; for exposure time < 10ms, or tube current < 20mA

Exposure Time Range: 1ms – 10sec

Exposure Time Steps: Variable in ms steps according to ISO 497 Series R'20 or R'10

Exposure Time Accuracy: ± (2%+0.5) ms: for exposure time ⩾ 5ms

± (10% +1) ms: for exposure time between 1ms – 4 ms

Exposure mAs Range: ZR75PN80, ZR75PN65, ZR75PN50 models: 0.1 – 1000 mAs

ZR75PN40, ZR75PN40S, ZR75PN32, ZR75PN32S models: 0.1 – 500 mAs

mAs Steps: Variable in mAs steps according to ISO 497 Series R'20 or R'10

mAs Accuracy: ± (10% +0.2) mAs

Coefficient of linearity: < 0.05

Coefficient of Reproducibility :< 0.05

Note:

Exposure values (ms, mAs) are measured using a 75% threshold of the voltage waveform for begin and end points. kVp is measured at the peak voltage and mA is measured as an average of the current.

Training

This equipment is intended for use by appropriately educated and skilled professional manufacturing or service technicians who have received specific training on the operation and use of this equipment.

Caution

Only qualified personnel may operate the X-ray generator.

For training in the operation of this equipment, contact Spellman.

Manual Conventions

This manual uses three types of messages to emphasize information or potential risks to personnel or equipment: **Note**, **Important** and **Caution**.

Note

Notes provide additional information, such as expanded explanations, hints, or reminders

Important

Important highlights critical policy information that affects how you use this manual and this product.

Caution

Cautions point out procedures that you must follow precisely to avoid injury to yourself, others, damage to the system or any of its components, loss of data, or corruption of files in software applications. Disregarding the caution statement may lead to abnormal use.

Environmental Specifications

Transport and Storage Environments (with package)

Temperature: -25 to 70 °C

Relative Humidity: 5 to 95% (non-condensing)

Atmospheric Pressure: 70kPa-110kPa

Operating Environments

Temperature: 10 to 40 °C

Relative Humidity: 20 to 80% (non-condensing)

Atmospheric Pressure: 70kPa-110kPa

Caution

This product contains transformer oil. Disposal of components that contain these materials may be regulated due to environmental conditions. For disposal or recycling information, contact your local authorities.

General Use Cautions and Special Messages

Caution

Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

Caution

Do not operate this equipment outside of its operating environment limits. Doing this may cause the equipment to malfunction. The operating environment limits are as follows.

Caution

Only allow trained personnel to use the Operator Console or Service Tool GUI Software.

Radiation and Magnetic Field Cautions

Caution

The Generator applied with X-ray tube and produces ionizing radiation. Operators must meet all international, national, state, and local requirements and regulations.

Caution

This X-ray unit may be dangerous to patients and operators unless safe exposure factors and operating instructions are observed.

Flammable Cautions

Caution

The Generator is not suitable for operation in the presence of a flammable anesthetic mixture with air, oxygen, or nitrous oxide.

Electrical and Mechanical Cautions

Caution

Only a qualified authorized Service Provider should replace electrical and mechanical components.

The following are mechanical safety precautions:

• Do not operate the equipment with covers or access panels removed.

• Route cables properly organized to eliminate hazards from tripping.

Caution

Do not exceed the maximum operating limits, Intended life and reliability will not be obtained unless generators are operated within published specifications.

Caution

Hazardous voltage exist inside the generator whenever the service disconnect is switched on. These areas include, but not limited to: The line fuses, the line filter, the mains contactor, the control transformer, the

mains fuse holder of F3 and F4 and associated circuits on the Rotor Driver Board.

LED D8, D9 and D10 on Filament Driver Board indicates the presence of the high voltage. The ON/OFF switch on the touch screen console does not disconnect the mains power from the above areas inside the generator.

The DC bus capacitors, located in the main cabinet present a safety hazard for at least 5 minutes after the power has been removed from the generator. An LED D3 on Rotor Driver Board indicates the presence of high voltage. Do not rely solely on the bleeder circuits and high-voltage on indicators in the generator to protect you. Due to the possibility of components failure, it must never be assumed that an unlit LED ensures that no high voltage is present. Using a voltmeter, confirm that no high voltage is present before attempting any service.

EMC notification and warnings

Note

The generator needs special precautions regarding EMC and needs to be installed and put into service according to the EMC information provided in this manual.

Note

Portable and mobile RF communications equipment can affect the generator operation.

Note

The stator cable should meet the requirements in Chapter 2 “Starter Connection”.

Note

The communication cable should be shielded, internal pair twisted.

Caution

Use cables other than specified in this manual may result the increased EMISSIONS or decreased IMMUNITY of the generator.

Caution

The generator should not be used adjacent to or stacked with other equipment and that if adjacent or stacked use is necessary, the generator should be observed to verify normal operation in the configuration in which it will be used.

Note

Guidance and manufacturer's declaration – electromagnetic emissions		
The ZR75PNxx/ ZR75PNxxS series of X-ray generators is intended for use in the electromagnetic environment specified below. The customer or the user of ZR75PNxx/ ZR75PNxxS series should assure that it is used in such an environment.		
Emissions test	**Compliance**	**Electromagnetic environment – guidance**
Conducted emissions CISPR 11	Group 1 Class A	The ZR75PNxx series conductive emissions are very low and are not likely to cause any interference in mains power.
RF emissions CISPR 11		The ZR75PNxx series of X-ray generators use RF energy only for its internal functions. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
Harmonic emissions IEC 61000-3-2	Not Applicable	The ZR75PNxx series is suitable for use in all establishments other than domestic and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Voltage fluctuations/ flicker emissions IEC 61000-3-3	Not Applicable	
NOTE: The EMISSIONS characteristics of ZR75PNxx series, make it suitable for use in industrial areas and hospitals (CISPR 11 class A). If it is used in a residential environment (for which CISPR 11 class B is normally required) this equipment might not offer adequate protection to radio-frequency communication services. The user might need to take mitigation measures, such as relocating or re-orienting the equipment.		

Note

Guidance and manufacturer's declaration-electromagnetic immunity			
The ZR75PNxx series of X-ray generators is intended for use in the electromagnetic environment specified below. The customer or the user of ZR75PNxx series should assure that it is used in such an environment.			
IMMUNITY test	**IEC 60601 test level**	**Compliance level**	**Electromagnetic environment – guidance**
Electrostatic discharge (ESD) IEC61000-4-2	±8KV contact ±15KV air	±8KV contact ±15KV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Radiated RF EM fields IEC61000-4-3	3V/m 80 MHz ~ 2.7 GHz 80% AM @ 1kHz ***Table 1-1***	3V/m 80 MHz ~ 2.7 GHz 80% AM @ 1kHz ***Table 1-1***	Portable RF communications equipment including antennas, can effect medical electrical equipment. ZR75PNxx series should be used no closer than 30 cm (12 inches) to any part of the [me equipment or me system], including cables specified by manufacturer.
Electrostatic Transient/burst IEC61000-4-4	±2KV 100kHz for power supply lines ±1KV 100kHz for input/output lines	±2KV 100kHz for power supply lines ±1KV 100kHz for input/output lines	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC61000-4-5	±1KV line to line ±2KV line to earth Signal port :line-to-ground ± 2KV	±1KV line to line ±2KV line to earth Signal port :line-to-ground ±2KV	Mains power quality should be that of a typical commercial or hospital environment.
Conducted disturbances induced by RF fields IEC61000-4-6	3V 0.15MHz ~ 80 MHz 6V in ISM bands between 0.15MHz and 80MHz 80% AM at 1kHz	3V 0.15MHz ~ 80 MHz 6V in ISM bands between 0.15MHz and 80MHz 80% AM at 1kHz	Since the equipment has the possibility of interruption under uncertain condition. ZR75PNxx series should be used no closer than 30 cm (12 inches) to any part of the [me equipment or me system], including cables specified by manufacturer.
Power frequency (50/60 Hz) IEC61000-4-8	30A/m 50/60Hz	30A/m, 50/60Hz	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
Voltage dips, short interruption, and voltage	0% U_T 0.5T at 0° 45°,90°,135°,180°,225	0% U_T 0.5T at 0° 45°,	Mains power quality should be that of a typical commercial or hospital environment. If

variations on power supply input lines IEC61000-4-11	° ,270° and 315° 0% U_T ,1T at 0° ,70% U_T 25T/30T, Single phase at 0° ,0% U_T,250T/300T	90° ,135° , 180° ,225° ,270 ° and 315° 0% U_T ,1T at 0° ,70% U_T 25T/30T, Single phase at 0° 0% U_T,250T/300T	the user of the ZR75PNxx series X-ray generator requires continued operation during power mains interruptions, it is recommended that the X-ray generator be powered from an uninterruptible power supply or battery.
NOTE: U_T is the A.C. mains voltage prior to application of the test level.			

Table 1-1 Test specification for enclosure port immunity to RF wireless communication equipment

Test Frequency (MHz)	Band (MHz)	Service	Modulation	Maximum Power (W)	Distance (m)	Immunity Test level (V/m)
450	430~470	GMRS 460 FRS 460	FM +/- 5kHz deviation 1kHz sine	2	0.3	28
810	800~960	GSM 800/900 TETRA 800 IDEN 820 CDMA 850 LTE Band 5	Pulse modulation 18Hz	2	0.3	28
870						
930						
2450	2400~2570	Blue tooth WLAN 802.11 b/g/n. RFID2450 LTE Band 7	Pulse modulation 217Hz	2	0.3	28
5240	5100~5800	WLAN 802.11 A/N	Pulse modulation 217Hz	0.2	0.3	9
5500						
5785						

NOTE: An exemption has been used and that the equipment has not been tested for radiated rf immunity over the entire frequency range 80 MHz to 6 GHz.

Caution

This EQUIPMENT has been tested for radiated RF IMMUNITY only at selected frequencies, and use nearby of emitters at other frequencies could result in improper operation

Safety Symbols

The following safety-related symbols are found on the equipment.

 Dangerous Voltage

The Exposure in Progress symbol remains yellow and an audible tone sounds will last 200 msec. after the exposure terminated. When X-ray is not being emitted, the symbol is gray and the tone does not sound.

 Protective Earth (ground)

 Alternating Current

 Three-phase alternating current

 Warning, electricity

 Refer to Service Manual for use

Figure 1-1 safety label location

Figure 1-2 safety label location

Figure 1-3 safety label location

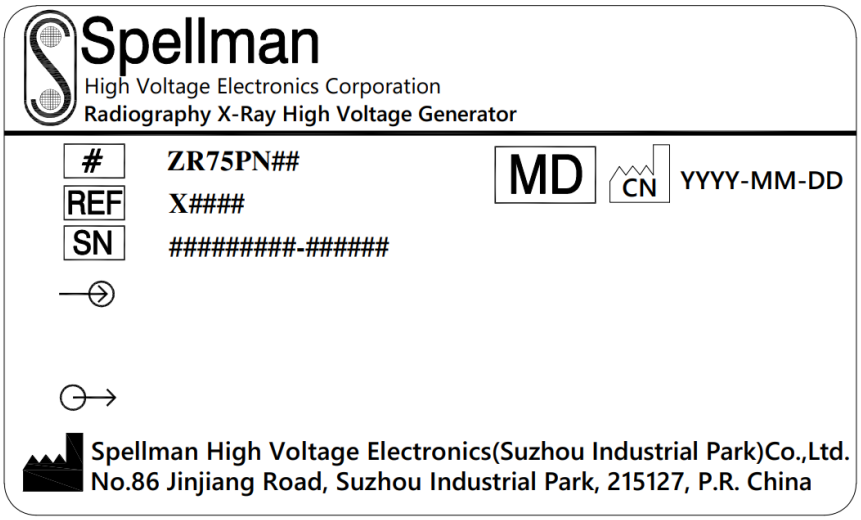
Caution

Don't remove the cover within 5 minutes after the generator powers off, for the internal capacitor needs time to discharge.

Caution

The generator cabinet and HT tank is heavy. Do not attempt to lift assemblies without proper assistance.

Data plate



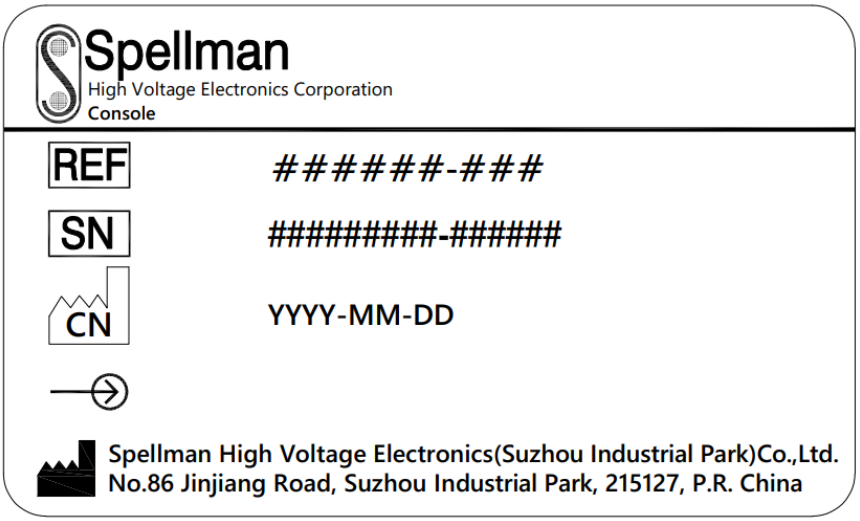


Figure 1-4 data plate template

Table 1-1 data plate content

Labelling	Description
REF	Part Number: X#### ranges from X0000 to X9999 designed for commercial purpose to meet with different customer's requirements that represents other options on generic hardware and software on certified models.
SN	Product Serial Number
#	Model number, the 7th and 8th lower case letter denotes output power in unit kW, it will be 32, 40, 50, 65 and 80, the last uppercase letter denotes power supply, for single phase power supply, will use "S", for three phase power supply, no letter will be used.
	Rating input, Generator details refer to Chapter 1, "Radiographic Performance" and Chapter 2 "Power requirements". 12Vdc, 1 A for consoles.
	Output ratings, details refer to Chapter 1, "Radiographic Performance"
	Manufacturer information.
MD	Medical device.
CN	Country of manufacturer and the date of manufacture

Refer to ***Chapter 2*** for more details.

Certification

Figure 1-5 FDA Listing Statement

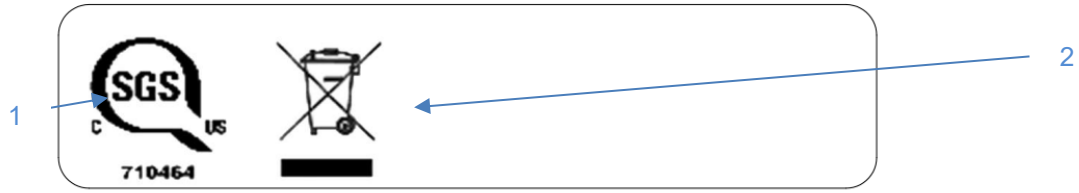


Figure 1-6 Certificated Label

Table 1-2 Certificated Label instruction

Area No.	Description
1	NRTL Certification
2	This symbol indicates that the waste of electrical and the electronic equipment must not be disposed as unsorted municipal waste and must be collected separately. Contact an authorized representative of the manufacturer for information concerning the decommissioning of your equipment.

Figure 1-7 CE Label

Table 1-3 Certificated Label instruction

Area No.	Description
1	European Authorized Representative
2	CE NB CODE

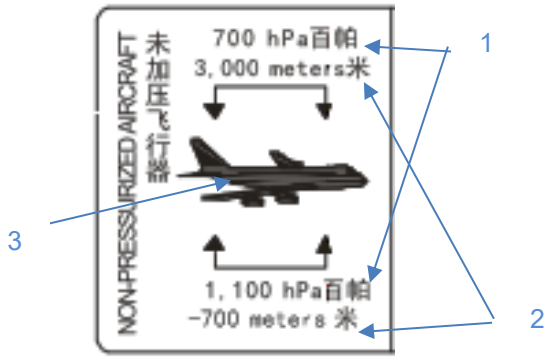


Figure 1-8 Packaging Label

Table 1-4 Packaging Label instruction

Area No.	Description
1	Transportation Atmospheric pressure range： 700hPa to 1100hPa
2	Transportation Altitude range： -700m to 3000m
3	Transportation Non-pressurized Aircraft

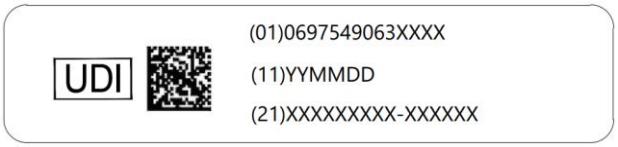


Figure 1-9 UDI label

Table 1-5 UDI label

Labelling	Description
UDI	Unique device identifier

Classification

- Type of protection against electric shock: Class I Equipment
  Permanently installed ordinary equipment
- The degree of protection against ingress of water: IPX0
- According to the degree of safety of application in the presence of a FLAMMABLE ANAESTHETIC MIXTURE WITH AIR or WITH OXYGEN OR NITROUS OXIDE: Equipment not suitable for use in the presence of a FLAMMABLE ANAESTHETIC MIXTURE WITH AIR or WITH OXYGEN OR NITROUS OXIDE
- The mode of operation: CONTINUOUS OPERATION WITH

INTERMITTENT LOADING.

Product Disclosure Table

部件名称 Component name	有毒有害物质或元素 Hazards substances' name					
	铅 (Pb)	镉 (Cd)	汞 (Hg)	六价铬(Cr6+)	多溴联苯(PBBs)	多溴联苯醚(PBDEs)
高压油箱（HV Tank)	X	O	O	O	O	O
电路板（PCBA）	X	O	O	O	O	O
钣金件（Sheetmetal）	O	O	O	O	O	O
线缆（Cable）	O	O	O	O	O	O

o: 该有毒有害物质在该部件所有均质材料中的含量均在 SJ/T 11363-2006 规定的限量要求以下。
×: 该有毒有害物质至少在该部件的某一均质材料中的含量超出 SJ/T 11363-2006 规定的限量要求。
o indicates hazardous substance concentration lower than MCV
×: indicates hazardous substance concentration higher than MCV
环保使用期限 (EPUP) 

在中国大陆，该值表示电子信息产品中含有的有毒有害物质或元素在正常使用的条件下不会发生外泄或突变，用户使用此产品不会对环境造成严重污染或对人身、财产造成严重损害的期限（以年计）。
该值根据操作说明中所规定的产品正常使用条件而定。

Environmental Protection Use Period (EPUP)
In China mainland, this number indicates the time period (calculated by year) within which any hazardous substances present in the product are not expected to be released such that there is risk to human health, property, or the environment. This value is assigned based on normal use of the product as described in the operating instructions.

Conforming Standards – Safety

IEC60601-1: 2020	Medical electrical equipment - Part 1: General requirements for basic safety and essential performance
IEC60601-1-2: 2020	Medical electrical equipment - Part 1-2: General requirements for basic safety and essential performance. Collateral standard: Electromagnetic compatibility.
IEC60601-1-3: 2021	Medical electrical equipment -Part 1-3: General requirements for basic safety and essential performance -Collateral Standard: Radiation protection in diagnostic X-ray equipment
IEC60601-2-54: 2018	Medical electrical equipment - Part 2-54: Particular requirements for the basic safety and essential performance of X-ray equipment for radiography and radioscopy
IEC 60601-1-6: 2020	Medical electrical equipment – Part 1-6: General requirements for basic safety and essential performance – Collateral standard: Usability
IEC 62304: 2015	Medical device software – Software life cycle processes

Acoustic Noise

Acoustic Noise < 70 dB.

Service Life

Generator life time: 10 years.

Mini-console without handle switch: 5.5 years.

Mini-console with handle switch: 2.5 years.

Touch screen console without handle switch: 3 years.

Touch screen console with handle switch: 2.5 years.

Reporting of serious incidents

Any serious incident related to use of this X-ray generator, should be reported to both the manufacturer and the competent authority where the device is installed.

- To report to Spellman:
  Either contact your local service representative, or report to Tel: +49(0)234 87906-0
- Please provide the following information:
  - The X number and the model name of the device as stated on its label affixed on the device
  - The serial number of the device
  - Date of incident
  - Description of incident, including any patient or operator impact/injury
  - Your contact information (facility, address, contact name, title, and telephone number)

Note: ‘serious incident’ means any incident that directly or indirectly led, might have led or might lead to any of the following: (a) the death of a patient, operator or other person. (b) the temporary or permanent serious deterioration of a patient’s, operator’s or other person’s state of health; (c) a serious public health threat.

Chapter 2 System Installation

Power Requirements

The tables in this section show mains power requirements for various configurations.

32kW Single Phase Generator Power Requirements

Model Number: ZR75PN32S

Line Voltage:
- 208 VAC +10%, -5%, single phase.
- 220 VAC +/-10%, single phase.
- 230 VAC +/-10%, single phase.

Line Frequency: 50/60 Hz

Momentary Current:
- 330 Amps/phase at 208 VAC, single phase
- 310 Amps/phase at 220 VAC, single phase
- 300 Amps/phase at 230 VAC, single phase

Standby Current: 1 A

Momentary Power Consumption: 70 kVA

32kW 3 Phase Generator Power Requirements

Model Number: ZR75PN32

Line Voltage:
- 380 VAC +/-10%, 3 phase, no neutral wire.
- 400 VAC +/-10%, 3 phase, no neutral wire.
- 480 VAC +/-10%, 3 phase, no neutral wire.

Line Frequency: 50/60 Hz

Momentary Current:
- 80 Amps/phase at 380 VAC, 3 phase
- 75 Amps/phase at 400 VAC, 3 phase
- 65 Amps/phase at 480 VAC, 3 phase

Standby Current： 1 A

Momentary Power Consumption：50kVA

40kW Single Phase Generator Power Requirements

Model Number: ZR75PN40S

Line Voltage:
- 208 VAC +10%, -5%, single phase.
- 220 VAC +/-10%, single phase.
- 230 VAC +/-10%, single phase.

Line Frequency: 50/60 Hz

Momentary Current:
- 420 Amps/phase at 208 VAC, single phase
- 390 Amps/phase at 220 VAC, single phase
- 380 Amps/phase at 230 VAC, single phase

Standby Current: 1 A

Momentary Power Consumption: 90 kVA

40kW 3 Phase Generator Power Requirements

Model Number: ZR75PN40

Line Voltage:
- 380 VAC +/-10%, 3 phase, no neutral wire.
- 400 VAC +/-10%, 3 phase, no neutral wire.
- 480 VAC +/-10%, 3 phase, no neutral wire.

Line Frequency: 50/60 Hz

Momentary Current:
- 100 Amps/phase at 380 VAC, 3 phase
- 95 Amps/phase at 400 VAC, 3 phase
- 80 Amps/phase at 480 VAC, 3 phase

Standby Current: 1 A

Momentary Power Consumption: 65kVA

50kW 3 Phase Generator Power Requirements

Model Number: ZR75PN50

Line Voltage:
- 380 VAC +/-10%, 3 phase, no neutral wire.
- 400 VAC +/-10%, 3 phase, no neutral wire.
- 480 VAC +/-10%, 3 phase, no neutral wire.

Line Frequency: 50/60 Hz

Momentary Current:
- 120 Amps/phase at 380 VAC, 3 phase
- 115 Amps/phase at 400 VAC, 3 phase
- 95 Amps/phase at 480 VAC, 3 phase

Standby Current: 1 A

Momentary Power Consumption: 76kVA

65kW 3 Phase Generator Power Requirements

Model Number: ZR75PN65

Line Voltage:
- 380 VAC +/-10%, 3 phase, no neutral wire.
- 400 VAC +/-10%, 3 phase, no neutral wire.
- 480 VAC +/-10%, 3 phase, no neutral wire.

Line Frequency: 50/60 Hz

Momentary Current:
- 160 Amps/phase at 380 VAC, 3 phase
- 150 Amps/phase at 400 VAC, 3 phase
- 125 Amps/phase at 480 VAC, 3 phase

Standby Current: 1 A

Momentary Power Consumption: 100kVA

80kW 3 Phase Generator Power Requirements

Model Number: ZR75PN80

Line Voltage:
- 380 VAC +/-10%, 3 phase, no neutral wire.
- 400 VAC +/-10%, 3 phase, no neutral wire.
- 480 VAC +/-10%, 3 phase, no neutral wire.

Line Frequency: 50/60 Hz

Momentary Current:
- 195 Amps/phase at 380 VAC, 3 phase
- 180 Amps/phase at 400 VAC, 3 phase
- 160 Amps/phase at 480 VAC, 3 phase

Standby Current: 1 A

Momentary Power Consumption: 125kVA

AC Mains Cable Requirement

Table 2-1 AC mains cable requirement

Generator Model	Line Voltage (Vac)	Minimum Recommended Mains Wire size (15 ft/5 m max)	Minimum Recommended Service Rating	Minimum Recommended Transformer Rating	Minimum Recommended Ground wire size	Line Impedance < =
ZR75P N32S (32KW)	208	#4 21.1mm^2	120A	70KVA	#4 21.1mm^2	0.06 ohm
	220	#4 21.1mm^2	120A	70KVA	#4 21.1mm^2	0.06 ohm
	230	#4 21.1mm^2	120A	70KVA	#4 21.1mm^2	0.06 ohm
ZR75P N32 (32KW)	380	#6 13.3mm^2	100A	50KVA	#6 13.3mm^2	0.20 ohm
	400	#6 13.3mm^2	100A	50KVA	#6 13.3mm^2	0.22 ohm
	480	#6 13.3mm^2	100A	50KVA	#6 13.3mm^2	0.32 ohm
ZR75P N40S (40KW)	208	#2 33.6mm^2	180A	90KVA	#2 33.6mm^2	0.045 ohm
	220	#2 33.6mm^2	180A	90KVA	#2 33.6mm^2	0.045 ohm
	230	#2 33.6mm^2	180A	90KVA	#2 33.6mm^2	0.045 ohm
ZR75P N40 (40KW)	380	#6 13.3mm^2	100A	65KVA	#6 13.3mm^2	0.20 ohm
	400	#6 13.3mm^2	100A	65KVA	#6 13.3mm^2	0.22 ohm
	480	#6 13.3mm^2	100A	65KVA	#6 13.3mm^2	0.32 ohm
ZR75P N50 (50KW)	380	#6 13.3mm^2	100A	76KVA	#6 13.3mm^2	0.15 ohm
	400	#6 13.3mm^2	100A	76KVA	#6 13.3mm^2	0.17 ohm
	480	#6 13.3mm^2	100A	76KVA	#6 13.3mm^2	0.24 ohm
ZR75P N65 (65KW)	380	#6 13.3mm^2	100A	100KVA	#6 13.3mm^2	0.12 ohm
	400	#6 13.3mm^2	100A	100KVA	#6 13.3mm^2	0.13 ohm
	480	#6 13.3mm^2	100A	100KVA	#6 13.3mm^2	0.19 ohm
ZR75P N80 (80KW)	380	#6 13.3mm^2	100A	125KVA	#6 13.3mm^2	0.09 ohm
	400	#6 13.3mm^2	100A	125KVA	#6 13.3mm^2	0.10 ohm
	480	#6 13.3mm^2	100A	125KVA	#6 13.3mm^2	0.15 ohm

Note

1. All the cable connections and grounding connections must meet the applied regulations.
2. Copper wires must be used in all cables.

3. There shall be a service switch used to isolate generator from supply mains, the rating current should meet the “Minimum Recommended Service Rating” in this table, and the switch shall comply with the CREEPAGE DISTANCES and AIR CLEARANCES as specified in IEC 61058-1 for a MAINS TRANSIENT VOLTAGE of 4 kV.

HV Cable Requirement

ZR series Generator support CA1-type high voltage connector (Claymount) or similar equivalent connector from similar manufactures.

Table 2-2 High Voltage connector technical data

Number of contacts	3
Rated voltage washer/grease or oil	75 / 100 kVDC
Maximum continuous operating temperature	100 °C / 212 °F
Outer diameter	40mm / 1.575 in

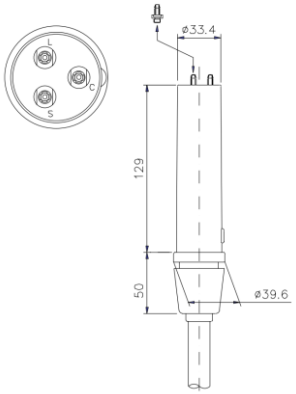


Figure 2-1 CA1-type HV connector dimension

ZR series Generator support L3-type (locflex) 75kVdc rated (Claymount) or similar equivalent HV cable from similar manufactures.

Table 2-3 High Voltage Cable Technical Data

Number of conductors	3
Rated voltage	75 Kvdc
Routine test voltage [high voltage insulation]	120kVDC / 10min
Routine test voltage [conductor insulation]	3.5kVACrms / 5min
Maximum conductor current	1.8 mm^2 : 18A; 1.25mm^2 : 11A
Corona level at 75 kVDC	$\leq$ 10 pC
Nominal outside diameter	16.7mm / 0.657 in / $\pm$0.5mm / $\pm$ 0.020 in
Thickness of PVC jacket	1.0mm / 0.039 in
Thickness of high voltage insulation	4.3 mm / 0.169 in
Diameter of core-assembly	4.7 mm / 0.185 in
Insulation resistance core to shield @ 20 °C	$\geq$5x10^{12} $\Omega \cdot$ m / $\geq$ 15x10^{12} $\Omega \cdot$ ft
Conductor insulation resistance @ 20 °C	$\geq$1x10^{13} $\Omega \cdot$ m / $\geq$ 3x10^{13} $\Omega \cdot$ ft
Conductor resistance bare cond. @ 20 °C	6.6$m\Omega$/m / 2.2$m\Omega$/ft / $\pm$5%
Conductor resistance insul. Cond. @ 20 °C	9.5$m\Omega$/m / 3.1$m\Omega$/ft / $\pm$5%
Shield resistance @ 20 °C	10.9$m\Omega$/m / 3.6$m\Omega$/ft / $\pm$5%
Capacitance between conductors and shield	145 pF/m / 44 pF/ft / $\pm$10%
Capacitance between ins. Cond. and bare cond.	479 pF/m / 157 pF/ft / $\pm$10%
Capacitance between insulated conductors	273 pF/m / 90 pF/ft / $\pm$10%
Cable min. bending radius [static installation]	33mm / 1.3 in
Cable min. bending radius [dynamic installation]	66mm / 2.6 in
Operating temperature	-10/+70°C / +14 / +158°F
Storage temperature	-40/+70°C / -40 / +158°F
Net weight	380kg/km

ZR series Generator support HV cable length: 8m~30m.

Unpacking

1. Inspect the shipping pack(s) for evidence of shipping damage. 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

Do not attempt to lift or move this assembly without proper equipment or assistance.

3. Inspect all items for shipping damage, including loose hardware.

4. Unpack the manuals and any other paperwork that may be packed with the generator.

5. Keep the shipping packs. In case of shipping damage, place the unit(s) back in their shipping pack(s) and notify the carrier and Spellman's customer support department.

6. Remove and set aside the screws and washers securing the cover to the generator chassis.

7. Carefully lift the cover off the chassis.

Dimensions and Main Components

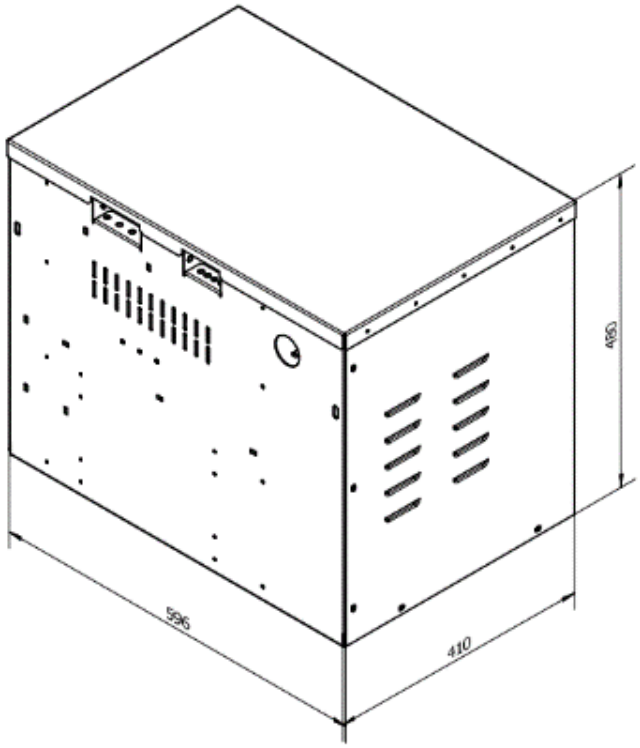


Figure 2-2 *Generator* Dimensions

Weight

Net weight: 62 kg Weight with package: 75kg

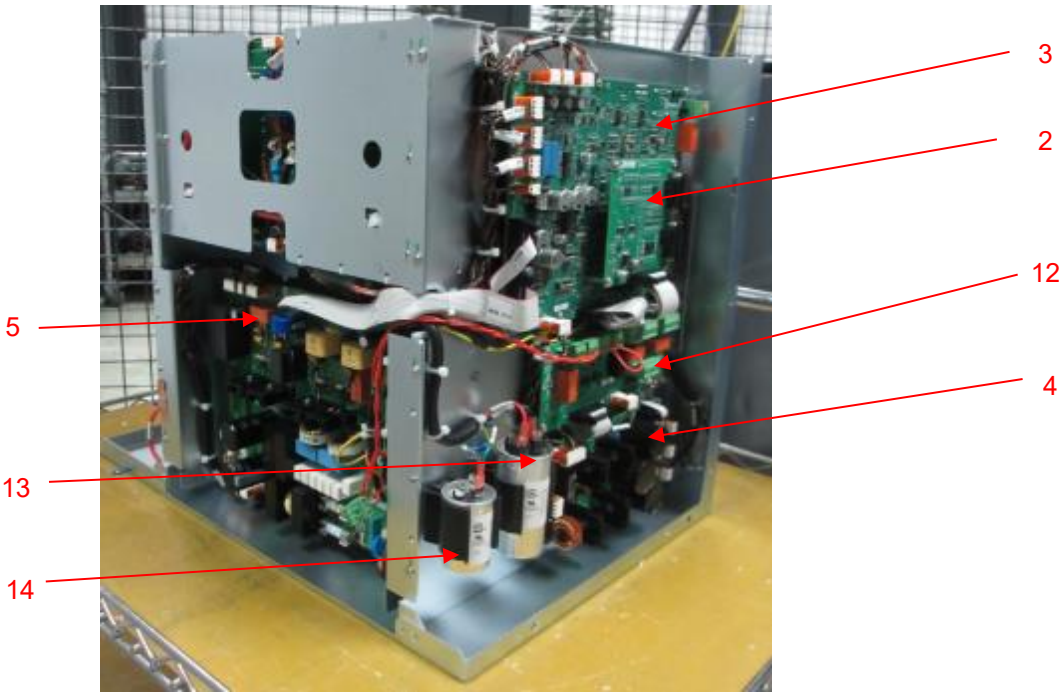


Figure 2-3 Main Components

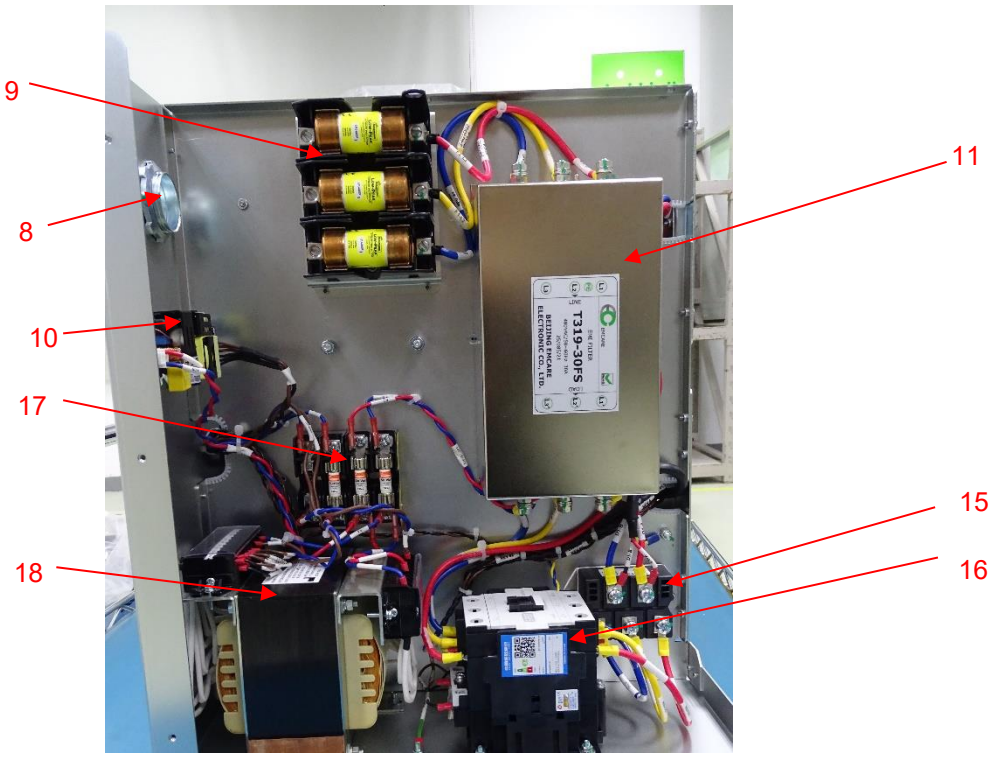


Figure 2-4 Main Components

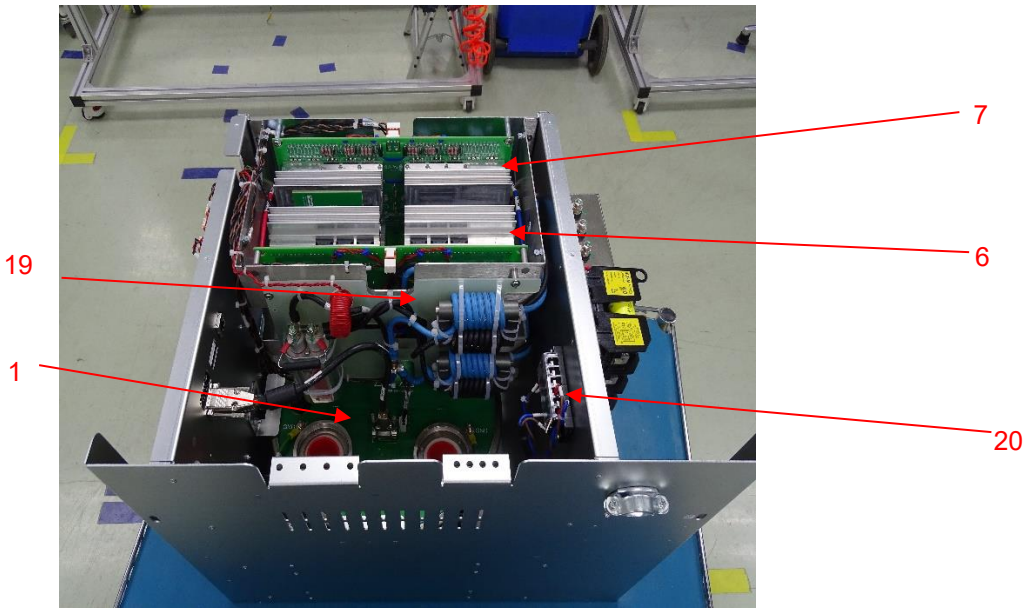


Figure 2-5 Main Components

1. HT Tank
2. AEC Board (Automatic Exposure Control)
3. MCB (Main Control Board)
4. FDB (Filament Driver Board)
5. RDB (Rotor Driver Board)
6. Inv–B (Inverter Board B)
7. Inv–A (Inverter Board A)
8. Mains Input Cable Access
9. Line Fuses
10. Power supply
11. Line Filter
12. RIB (Room Interface Board)
13. LS (Low Speed) Phase-shift Capacitor
14. HS (High Speed) Phase-shift Capacitor
15. Mains Rectifier
16. Mains Contactor
17. Line Fuse of Control Transformer
18. Control Transformer
19. Resonant Board
20. Terminal Block

DIP Switch Setting

Before power on, check the DIP switch S1 and S2 settings on the **Main Control Board (MCB)**. The factory default settings may need be adjusted according to below tables.

Figure 2-6 DIP Switches

Table 2-4 generator power rating selection

Generator Power Rating	S1-1	S1-2	S1-3
32kW, single phase	ON	OFF	OFF
32kW, 3 phase	OFF	ON	ON
40kW, single phase	ON	OFF	ON
40kW, 3 phase	OFF	ON	OFF
50kW, 3 phase	ON	ON	OFF
65kW, 3 phase	ON	OFF	ON
80kW, 3 phase	ON	OFF	OFF

Table 2-5 generator input voltage selection

Generator Type	Input Voltage	S1-6	S1-7
single phase	208V	OFF	OFF
	220/230V	ON	OFF
3 phase	380V	OFF	OFF
	400V	ON	OFF
	480V	OFF	ON

*S1-8：**ON** - Load factory default; **OFF** - Defaults disabled.

*S1-4, S1-5: currently not used.

DIP switch S2 defines the tube type used as below tube selection table.

Table 2-6 Tube type selection

MFG	Model	ID	HVG Type	DIP Switch								Rotor Driver Frequency
				S2-8	S2-7	S2-6	S2-5	S2-4	S2-3	S2-2	S2-1	
TOSHIBA	XRR-3331	16	3Ph	OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF	Low Speed: 60Hz Hi Speed: 180Hz
	E7252 XS-AL	22	3Ph	OFF	OFF	OFF	ON	OFF	ON	ON	OFF	Low Speed: 60Hz Hi Speed: 180Hz
	E7252 XS-RA	26	3Ph	OFF	OFF	OFF	ON	ON	OFF	ON	OFF	Low Speed: 60Hz Hi Speed: 180Hz
	E7254 XS-RB	20	3Ph	OFF	OFF	OFF	ON	OFF	ON	OFF	OFF	Low Speed: 60Hz Hi Speed: 180Hz
	E7876 XS-RA	19	3Ph	OFF	OFF	OFF	ON	OFF	OFF	ON	ON	Low Speed Only: 60Hz
	E7239 XS-AV	23	3Ph	OFF	OFF	OFF	ON	OFF	ON	ON	ON	Low Speed Only: 50Hz
	E7869 XS-AG	24	3Ph	OFF	OFF	OFF	ON	ON	OFF	OFF	OFF	Low Speed: 60Hz Hi Speed: 180Hz
	E7884 XS-AL	34	3Ph	OFF	OFF	ON	OFF	OFF	OFF	ON	OFF	Low Speed: 60Hz
	E7843X	51	3Ph	OFF	OFF	ON	ON	OFF	OFF	ON	ON	Low Speed: 60Hz
	E7884 XS-AL	21	1Ph	OFF	OFF	OFF	ON	OFF	ON	OFF	ON	Low Speed Only: 60Hz
	E7239 XS-AV	27	1Ph	OFF	OFF	OFF	ON	ON	OFF	ON	ON	Low Speed Only: 60Hz
	E7242 XS-RA	28	1Ph	OFF	OFF	OFF	ON	ON	ON	OFF	OFF	Low Speed Only: 60Hz
	E7252 XS-AL	29	1Ph	OFF	OFF	OFF	ON	ON	ON	OFF	ON	Low Speed Only: 60Hz
	E7843X	58	1Ph	OFF	OFF	ON	ON	ON	OFF	ON	OFF	Low Speed Only: 60Hz
VARIAN	RAD-14 Diamond	18	3Ph	OFF	OFF	OFF	ON	OFF	OFF	ON	OFF	Low Speed: 60Hz Hi Speed: 180Hz
	RAD-60 Sapphire	17	3Ph	OFF	OFF	OFF	ON	OFF	OFF	OFF	ON	Low Speed: 60Hz Hi Speed: 180Hz
	RAD-92 Sapphire	25	3Ph	OFF	OFF	OFF	ON	ON	OFF	OFF	ON	Low Speed: 60Hz

												Hi Speed: 180Hz
KAILONG	H1086X	33	3Ph	OFF	OFF	ON	OFF	OFF	OFF	OFF	ON	Low Speed Only: 60Hz
	H1080X	35	3Ph	OFF	OFF	ON	OFF	OFF	OFF	ON	ON	Low Speed: 60Hz Hi Speed: 180Hz
	H2108X	52	3Ph	OFF	OFF	ON	ON	OFF	ON	OFF	OFF	Low Speed: 60Hz Hi Speed: 180Hz
	H1074X	53	3Ph	OFF	OFF	ON	ON	OFF	ON	OFF	ON	Low Speed Only: 60Hz
	H1076X	54	3Ph	OFF	OFF	ON	ON	OFF	ON	ON	OFF	Low Speed Only: 60Hz
	H2100X	55	3Ph	OFF	OFF	ON	ON	OFF	ON	ON	ON	Low Speed: 60Hz Hi Speed: 180Hz
	H1080X	59	1Ph	OFF	OFF	ON	ON	ON	OFF	ON	ON	Low Speed Only: 60Hz
	H1074X	60	1Ph	OFF	OFF	ON	ON	ON	ON	OFF	OFF	Low Speed Only: 60Hz
IAE	X39	36	3Ph	OFF	OFF	ON	OFF	OFF	ON	OFF	OFF	Low Speed: 60Hz
	X42	37	3Ph	OFF	OFF	ON	OFF	OFF	ON	OFF	ON	Low Speed: 60Hz
	X50AH	38	3Ph	OFF	OFF	ON	OFF	OFF	ON	ON	OFF	Low Speed: 60Hz
	RTM782 H	39	3Ph	OFF	OFF	ON	OFF	OFF	ON	ON	ON	Low Speed: 60Hz
	RTM782 HS	40	3Ph	OFF	OFF	ON	OFF	ON	OFF	OFF	OFF	Low Speed: 60Hz Hi Speed: 180Hz
	RTM70 H	56	3Ph	OFF	OFF	ON	ON	ON	OFF	OFF	OFF	Low Speed Only: 60Hz
LUCEM	LUC-8M	41	3Ph	OFF	OFF	ON	OFF	ON	OFF	OFF	ON	Low Speed: 60Hz
	LUC-11M	42	3Ph	OFF	OFF	ON	OFF	ON	OFF	ON	OFF	Low Speed: 60Hz
	LUC-12U	43	3Ph	OFF	OFF	ON	OFF	ON	OFF	ON	ON	Low Speed: 60Hz
	LUC-14M	44	3Ph	OFF	OFF	ON	OFF	ON	ON	OFF	OFF	Low Speed: 60Hz Hi Speed: 180Hz
Mingwei	HX7010	31	3Ph	OFF	OFF	OFF	ON	ON	ON	ON	ON	Low Speed: 60Hz
	HX7360	01	3Ph	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	Low Speed: 60Hz Hi Speed: 180Hz
SIEMENS	RAY-12_1	49	3Ph	OFF	OFF	ON	ON	OFF	OFF	OFF	ON	Low Speed:

												60Hz
	RAY-14_1	50	3Ph	OFF	OFF	ON	ON	OFF	OFF	ON	OFF	Low Speed: 60Hz Hi Speed: 180Hz

Jumpers on Generator

Table 2-7 Jumpers on MCB

Item #	Location	Description
1	JP1	Connect Pin1-Pin2 : work mode; download firmware Connect Pin2-Pin3 : download bootloader
2	JP2	Keep disconnect
3	JP3	Connect Pin1-Pin2 : V_{P1-9} = +24V; V_{P2-8} = +24V; Connect Pin2-Pin3 : V_{P1-9} = +12V; V_{P2-8} = +12V;(Default)

Table 2-8 Jumpers on AEC board

Item #	Location	Description
1	P3	Connect Pin1-Pin2 : P8-9 = left field; Connect Pin2-Pin3 : P8-9 = right field;
2	P4	Connect Pin1-Pin2 : P8-11 = right field; Connect Pin2-Pin3 : P8-11 = left field;
3	P5	Connect Pin1-Pin2 : P7-9 = left field; Connect Pin2-Pin3 : P7-9 = right field;
4	P6	Connect Pin1-Pin2 : P7-11 = right field; Connect Pin2-Pin3 : P7-11 = left field;

Wiring

To avoid the risk of the electric shock, this equipment must be connected to a supply main with the protective earth.

The AC mains cable is routed into the generator via the cable clamp on the rear of the generator.

All the other cables should be routed into the generator main cabinet through the cable access slots at the upper rear of the generator. The cables should be clamped with the cable strain relief. For connections that must be made to the **Rotor Driver Board**, the **AEC Board**, the **Main Control Board**, route the cables and secure them with tie-wraps by the way of the tie wrap slot. All cables should be kept away from high voltage areas in the cabinet, and dressed neatly in place.

AC Mains Cable Connection

1. Pass the AC mains cable through the cable clamp at the upper rear of the generator cabinet.
2. Connect the ground wire to the chassis ground connector.
3. Connect the mains power wires to the terminals on the line fuses.
4. Tighten the clamps to secure the cable.

Note

Wire gauge of the mains cable grounding cable should be in the range of 14–2AWG.

Figure 2-7 Mains cable connection

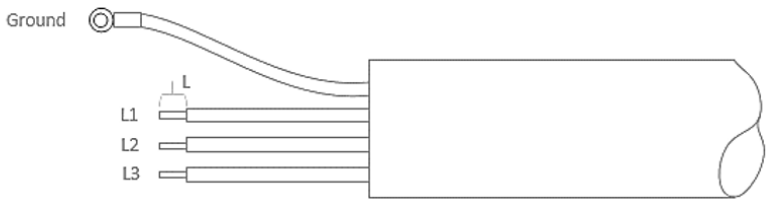


Figure 2-8 Termination of AC main cable

*Strip length (L in *Figure 2-9*) for L1-L3 is 15mm.

*Terminal type for Ground is: RL22-5 (ZR75PN32S), R38-5 (ZR75PN40S), R14-5 (All 3-phase configurations below 80kW).

Caution

If stranded conductors used, it shall not be solder-coated if they are affixed by any clamping means, the poor contact could result in a HAZARDOUS SITUATION.

Caution

If stranded conductors used, a wire or wires of the conductors shall not escape from the conductors.

Control Transformer Line Voltage Connection

The control transformer line voltage connection should be changed to the appropriate position on the transformer primary according to the nominal line voltage.

1. Verify the mains voltage used and it meets the generator power requirements.
2. Be sure the mains cable is not connected.
3. Remove the plastic cover on the primary terminal.
4. 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 nominally 208 VAC.
   --Connect to the 230 V tap if the line voltage is nominally 230 VAC.
   --Connect to the 380 V tap if the line voltage is nominally 380 VAC.
   --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.
   Notes: 220Vac connect to the 230 V tap if the line voltage is nominally 220 VAC, (Only for 104017-165).
5. Retighten the clamping screw.
6. Put the plastic cover on the top of primary terminal.

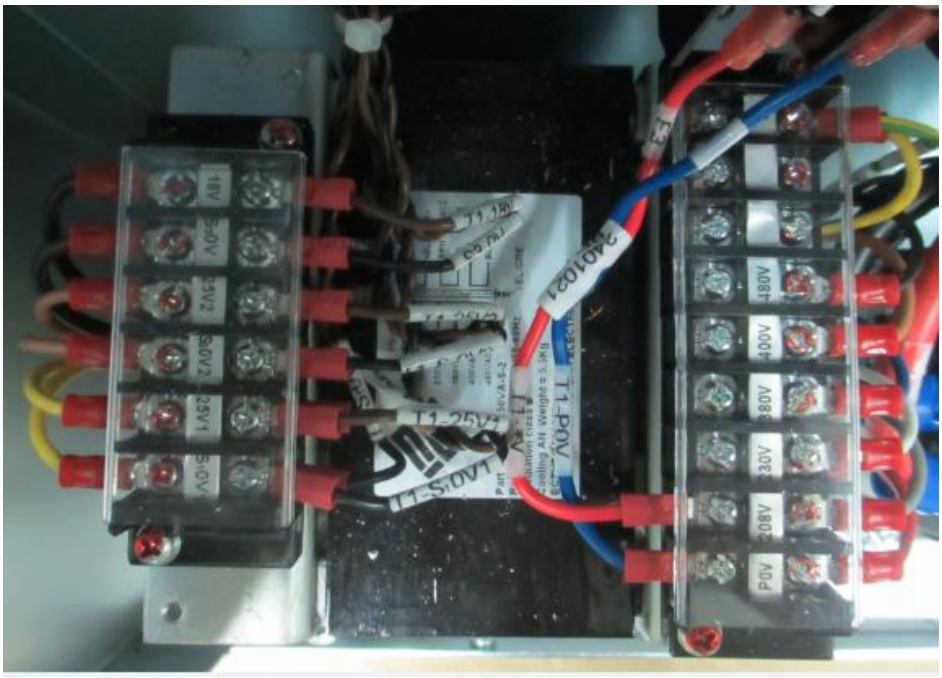


Figure 2-9 Control transformer connection（104017-161）

Figure 2-10 Control transformer connection（104017-162）

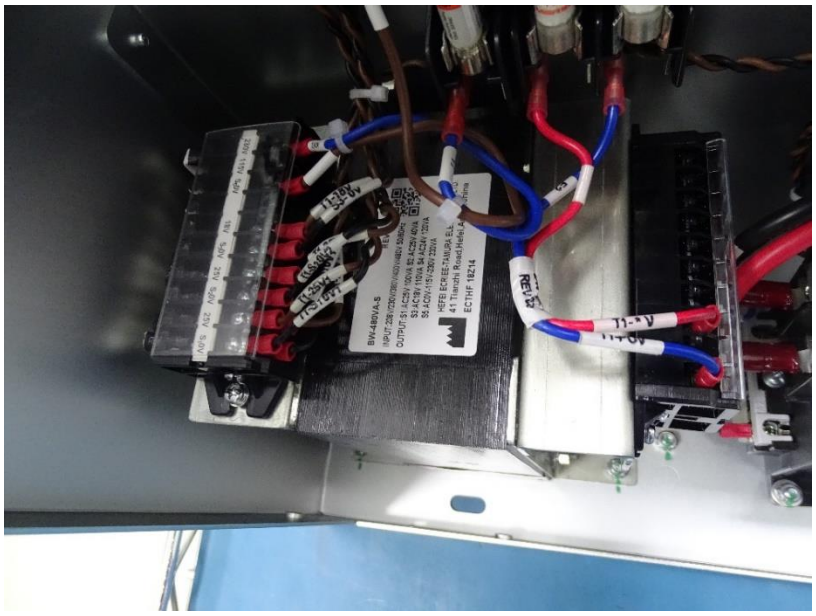


Figure 2-11 Control transformer connection（104017-165）

Starter Connection

1. Verify the tube type is compatible to the generator according to the Tube Selection Table.
2. Replace the two phase-shift capacitors (high speed and low speed) if needed.

Table 2-9 *Phase* shift capacitor configuration

Tube Model		Stator Type	HS Phase Shift Capacitance	LS Phase Shift Capacitance
TOSHIBA/ CANON	XRR-3331X	XS-AL	6 μF	44 μF
	E7252X	XS-AL	6 μF	44 μF
	E7252X	XS-RA	3 μF	24 μF
	E7884X	XS-AL	N/A	44 μF
	E7254FX	XS-RB	6 μF	30 μF
	E7876X	XS-RA	N/A	24 μF
	E7239X	XS-AV	N/A	24 μF
	E7869X	XS-AG	6 μF	44 μF
	E7242X	XS-RA	N/A	24 μF
	E7843X	XS-BA	N/A	30 μF

VARIAN/ VAREX	RAD60	'Q'	18 ~ 21 μF	65 μF
	RAD14	'R'	6μF	30μF
	RAD92	'R'	6μF	30μF
KAILONG	H1086X	1 Φ	N/A	30μF
	H1080X	1 Φ	6μF	30μF
	H1074X	1 Φ	N/A	30μF
	H1076X	1 Φ	N/A	30μF
	H2100X	1 Φ	6μF	30μF
	H2108X	1 Φ	6μF	30μF
IAE	X39	Housing C40	N/A	24μF
	X42	Housing C40	N/A	24μF
	X50AH	Housing C52	N/A	30μF
	RTM782H	Housing C40	N/A	24μF
	RTM782HS	Housing C52	4.5μF	30μF
	RTM70H	C30	N/A	30μF
LUCEM	LUC-8M	1 Φ	N/A	24μF
	LUC-11M	1 Φ	N/A	24μF
	LUC-12U	1 Φ	N/A	24μF
	LUC-14M	1 Φ	3 μF	24μF
MingWei	HX7010A	1 Φ	N/A	44μF
	HX7360X	1 Φ	10uF	44uF
SIEMENS	RAY-12_1	1 Φ	N/A	30uF
	RAY-14_1	1 Φ	6uF	30uF

3. Verify and set the correct configuration of DIP switch S1 and S2.

4. Route the X-ray tube starter cable through the cable access slot and connect the cable to terminal blocks on the Room Interface Board and Rotor Driver Board as below. Secure the cable with tie wraps.

Table 2-10 Terminal type of starter cable

Designator	Connect To	Connector Location	Terminal Model
Common Winding	P2-1	RDB	DEGSON 2EDGK-7.62-3P-14 or equivalent
Main Winding	P2-2		
Phase Shift Winding	P2-3		
Grounding	JP11		KST FDFNYD1-250 or equivalent
Thermal Switch (1)	P5-1	RIB0/1	DEGSON 2EDGKA-5.08-3P-14 or equivalent
Thermal Switch (2)	P5-3 (GND)		
Thermal Switch (1)	P5-1	RIB2	DEGSON 15EDGKD-2.5-3P-14 or equivalent
Thermal Switch (2)	P5-3 (GND)		

*18 AWG shielding cable should be used as the starter cable and the shielding layer needs to be grounded at both tube side and generator side.

Emergence Stop

To connect an emergency switch to the generator, please remove the jumper line between P10-1 and P10-3 at the **Main Control Board** and connect the Emergence Switch wires between P10-1 and P10-3. If the Emergence Switch is not applied, please short circuit P10- 1 and P10-3 by a jumper line via the coupled female connector provided.

*Connector type and location: Degson 2EDGKA-5.08-3P-14, on **Main Control Board.**

Caution

After the Emergence Switch is enabled, mains input voltage still exists. High voltages still remain on line fuses, control transformer fuses, line filter, control transformer and mains contactor.

High Tension Cables Connection

1. Remove the dust caps that cover the high voltage receptacles on the HT tank.
2. Check if the HT cable terminations are clean, and in good condition.
3. Clean the HT cable plugs and the receptacles at the oil tank side and the tube side.
4. Add Si insulating grease or oil provided by the HT cable vendor.
5. Connect the anode and cathode cables to the HT tank. Ensure that the cables are plugged into the proper connectors on the HT tank.
6. Make the HT cable connectors tight between the connector insulator and the screw-down ring.

Room Equipment

Refer to *Chapter 3* for the connection of Stations, interlock, room light and AEC, etc.

Final Check

1. Make sure that all cable connections are tight and secure.
2. Check that all cables are neatly layout inside the cabinet.
3. Put generator cover on, and tighten all screws.

Detailed checklist to confirm that all critical installation steps have been completed before power on generator:

Item #	Item description	Check
1	Has protection Grounding cable been connected tightly?	
2	Have mains power cables been connected?	
3	Have tube Anode, Cathode HV cables and rotor drive cable including tube thermal switch wire been connected correctly?	
4	Has communication cable or related cables been connected?	
5	Has the power level matched with the requirements of generator?	
6	Has the tube files been downloaded as same as actual tube?	
7	Has the tube shift caps been fixed as specific tube's requirements?	
8	Has the tube calibration been completed before normal operation?	

Chapter 3 System Interface

Room Interface

Room Interface board can be an option per application of the customer. RIB provided for option is as followed:

RIB Designation	Differ	P/N
RIB0	No Bucky interface provide, Provide interface Voltage of Detector with 24V/400mA	**2406001**
RIB1	No Bucky interface provide, Provide interface Voltage of Detector with 24V/12V/5V, 400mA	**460452-001**
RIB2	4 Bucky interface provide, Bucky power could be 230Vac/115Vac(220Vac/110Vac) and 24Vac/5A.	**460469-001**

Wiring to Inputs & Outputs

Note

The installer must provide the necessary interfacing cables for wiring to the generator inputs and outputs described in this section.

Caution

Line voltage is present inside the generator at all times when the mains contactor is switched on. For safety, the mains contactor should be switched off and locked out while connecting the room equipment inputs. Station inputs, tube thermal switch, and room door interlock are optical isolated. This means that a relay contact, transistor, or other low-impedance switching device must be connected across each of these inputs. *Table 3-1/2/3* defines the polarity and logic required for the inputs at the terminals. Refer also to *Figure 3-1/2/3* for correct connection.

Caution

Do not disable the function detecting room door interlock, unless the corresponding room equipment is not present. Consult the applicable regulations before disabling any exposure interlocks. Do not violate any regulations for x-ray safety. Never bypass the x-ray tube thermal switch interlock. Observe ionizing radiation personal protection at all times.

Note

The EXP_OK_1 and EXP_OK_2 inputs may be installer-programmed. EXP_OK_1 will normally be programmed to correspond to the table Bucky, and EXP_OK_2 will normally be programmed for the wall stand.

Table 3-1 Room Interface Board input signals RIB0

Pin #	Definition	Cable side Connector type	Description
P1-5	EXP_OK_1	DEGSON 2EDGK-5.08-6P-14 or equivalent	Ready signal from system to generator. Low active.
P1-6	GND		
P2-5	EXP_OK_2	DEGSON 2EDGK-5.08-6P-14 or equivalent	Ready signal from system to generator. Low active.
P2-6	GND		
P3-1	DOOR_INTERLOCK	DEGSON 2EDGK-5.08-3P-14 or equivalent	Dry contact from door interlock. Low active.
P3-3	GND		
P5-1	TUBE_THERMAL_SWITC	DEGSON 2EDGK-5.08-3P-14 or equivalent	Tube thermal switch. A thermal switch closure from P5-1 to P5-3 indicates the tube is over temperature limit.
P5-3	GND		

Table 3-2 Room Interface Board input signals RIB1

Pin #	Definition	Cable side Connector type	Description
P1-2	GND	DEGSON 2EDGK-5.08-6P-14 or equivalent	Ready signal from system to generator. Low/High active.
P1-5	EXP_OK1_L		
P1-6	EXP_OK1_H		
P2-2	GND	DEGSON 2EDGK-5.08-6P-14 or equivalent	Ready signal from system to generator. Low/High active.
P2-5	EXP_OK2_L		
P2-6	EXP_OK2_H		
P3-1	DOOR_INTERLOCK	DEGSON 2EDGK-5.08-3P-14 or equivalent	Dry contact from door interlock. Low active.
P3-3	GND		
P5-1	TUBE_THERMAL_SWITC	DEGSON 2EDGK-5.08-3P-14 or equivalent	Tube thermal switch. A thermal switch closure from P5-1 to P5-3 indicates the tube is over temperature limit.
P5-3	GND		

Table 3-3 Room Interface Board input signals RIB2

Pin #	Definition	Cable side Connector type	Description
P1-5	EXP_OK1_L	DEGSON 15EDGKD-2.5-6P-14 or equivalent	Ready signal from system to generator. Low/High active.
P1-6	EXP_OK1_H		
P1-2	GND		
P2-5	EXP_OK2_L	DEGSON 15EDGKD-2.5-6P-14 or equivalent	Ready signal from system to generator. Low/High active.
P2-6	EXP_OK2_H		
P2-2	GND		
P6-5	EXP_OK3_L	DEGSON 15EDGKD-2.5-6P-14 or equivalent	Ready signal from system to generator. Low/High active.
P6-6	EXP_OK3_H		
P6-2	GND		
P13-5	EXP_OK4_L	DEGSON 15EDGKD-2.5-6P-14 or equivalent	Ready signal from system to generator. Low/High active.
P13-6	EXP_OK4_H		
P13-2	GND		
P3-1	DOOR_INTERLOCK	DEGSON 15EDGKD-2.5-6P-14 or equivalent	Dry contact from door interlock. Low active.
P3-3	GND		
P5-1	TUBE_THERMAL_SWITCH	DEGSON 15EDGKD-2.5-6P-14 or equivalent	Tube thermal switch. A thermal switch closure from P5-1 to P5-3 indicates the tube is over temperature limit.
P5-3	GND		
P19-1	ACL/DC+	DEGSON 2EDGK-5.08-3P-14 or equivalent	Live wire of AC power or positive potential of DC power for BUCKY
P19-3	ACN/DC-		Null wire for AC power or negative potential for DC power for BUCKY

Caution

These inputs are meant for dry contacts only. Do not apply any voltage source to these inputs.

Outputs

Table 3-4/5/6 shows the outputs from generator. Refer also to ***Figure 3-1/2/3*** for correct connection.

Table 3-4 Room Interface Board output signals RIB0

Pin #	Definition	Cable side Connector type	Description
P1-1	EXP_REQ_1	DEGSON 2EDGK-5.08-6P-14 or equivalent	Exposure require signal from generator to system, 24VDC Output

P1-3	+24VDC		+24VDC power supply to system detector
P1-2 or 4	GND		Generator signal ground for reference of interface circuits
P2-1	EXP_REQ_2	DEGSON 2EDGK-5.08-6P-14 or equivalent	Exposure require signal from generator to system, 24VDC Output
P2-3	+24VDC		+24VDC power supply to system detector
P2-2 or 4	GND		Generator signal ground for reference of interface circuits
P7-1	ROOM_LIGHT	DEGSON 2EDGK-5.08-3P-14 or equivalent	Room Light; Relay contact output; Max. 250Vac, 8A.
P7-3	ROOM_LIGHT_RTN		
P8-1	Prep_LED	DEGSON 2EDGK-5.08-6P-14 or equivalent	Prepare phase LED switch, this pin is Optocoupler Open Collector, and optocoupler emitter is GND on RIB.
P8-3	Exp_LED		Exposure phase LED switch, this pin is Optocoupler Open Collector, and optocoupler emitter is GND on RIB.
P8-5	Exp_Buzzer		Exposure phase Buzzer switch, this pin is Optocoupler Open Collector, and optocoupler emitter is GND on RIB.
P8-2 & P8-4 & P8-6	GND		
P10-1	24VDC	DEGSON 2EDGK-5.08-6P-14 or equivalent	+24VDC output to system, maximum current is 200mA
P10-3	GND		

Table 3-5 Room Interface Board output signals RIB1

Pin #	Definition	Cable side Connector type	Description
P1-1	EXP_REQ1_H	DEGSON 2EDGK-5.08-6P-14 or equivalent	Exposure require signal from generator to system, high (24VDC/12VDC/5VDC) output
P1-2	GND		
P1-3	24VDC/12VDC/5VDC		DC power supply to system detector
P1-4	EXP_REQ1_L		Exposure require signal from generator to system, low output
P2-1	EXP_REQ2_H	DEGSON 2EDGK-5.08-6P-14 or equivalent	Exposure require signal from generator to system, high (24VDC/12VDC/5VDC) output
P2-2	GND		
P2-3	24VDC/12VDC/5VDC		DC power supply to system detector
P2-4	EXP_REQ2_L		Exposure require signal from generator to system, low output
P7-1	ROOM_LIGHT	DEGSON 2EDGK-5.08-3P-14 or equivalent	Room Light; Relay contact output; Max. 250Vac, 8A.
P7-3	ROOM_LIGHT_RTN		

P8-1	Prep_LED	DEGSON 2EDGK-5.08-6P-14 or equivalent	Prepare phase LED switch, this pin is Optocoupler Open Collector, and optocoupler emitter is GND on RIB.
P8-3	Exp_LED		Exposure phase LED switch, this pin is Optocoupler Open Collector, and optocoupler emitter is GND on RIB.
P8-5	Exp_Buzzer		Exposure phase Buzzer switch, this pin is Optocoupler Open Collector, and optocoupler emitter is GND on RIB.
P8-2 & P8-4 & P8-6	GND		
P10-1	24VDC/12VDC/ 5VDC, 200mA	DEGSON 2EDGK-5.08-6P-14 or equivalent	+24VDC/12VDC/5VDC,output to system, maximum current is 200mA
P10-3	GND		

Table 3-6 Room Interface Board output signals RB2

Pin #	Definition	Cable side Connector type	Description
P1-1	EXP_REQ1_H	DEGSON 15EDGKD-2.5-6P-14 or equivalent	Exposure require signal from generator to system, high (24VDC/12VDC/5VDC) output
P1-3	24VDC/12VDC/ 5VDC		DC power supply to system detector
P1-4	EXP_REQ1_L		Exposure require signal from generator to system, low output
P1-2	GND		Generator signal ground for reference of interface circuits
P2-1	EXP_REQ2_ H	DEGSON 15EDGKD-2.5-6P-14 or equivalent	Exposure require signal from generator to system, high (24VDC/12VDC/5VDC) output
P2-3	24VDC/12VDC/ 5VDC		DC power supply to system detector
P2-4	EXP_REQ2_L		Exposure require signal from generator to system, low output
P2-2	GND		Generator signal ground for reference of interface circuits
P6-1	EXP_REQ2_ H	DEGSON 15EDGKD-2.5-6P-14 or equivalent	Exposure require signal from generator to system, high (24VDC/12VDC/5VDC) output
P6-3	24VDC/12VDC/ 5VDC		DC power supply to system detector
P6-4	EXP_REQ2_L		Exposure require signal from generator to system, low output
P6-2	GND		Generator signal ground for reference of interface circuits
P13-1	EXP_REQ2_ H	DEGSON 15EDGKD-2.5-6P-14 or equivalent	Exposure require signal from generator to system, high (24VDC/12VDC/5VDC) output
P13-3	24VDC/12VDC/ 5VDC		DC power supply to system detector
P13-4	EXP_REQ2_L		Exposure require signal from generator to system, low output
P13-2	GND		Generator signal ground for reference of interface circuits

P7-1	ROOM_LIGHT	DEGSON 2EDGK-5.08-3P-14 or equivalent	Room Light; Relay contact output; Max. 250Vac, 8A.
P7-3	ROOM_LIGHT_RTN		
P10-1	24VDC/5A	DEGSON 2EDGK-5.08-4P-14 or equivalent	+24VDC output to system, maximum current is 5.0A
P10-2,3	GND		GND
P10-4	12VDC/5VDC, 1.5A		12VDC/5VDC output to system depends on requirements, maximum current is 1.5A
P8-1	Prep_LED	DEGSON 2EDGK-5.08-6P-14 or equivalent	Prepare phase LED switch, this pin is Optocoupler Open Collector, and optocoupler emitter is GND on RIB.
P8-3	Exp_LED		Exposure phase LED switch, this pin is Optocoupler Open Collector, and optocoupler emitter is GND on RIB.
P8-5	Exp_Buzzer		Exposure phase Buzzer switch, this pin is Optocoupler Open Collector, and optocoupler emitter is GND on RIB.
P8-2 & P8-4 & P8-6	GND		
P14-1	BUCKY1_1	DEGSON 2EDGK-5.08-3P-14 or equivalent	Null wire for AC power or negative potential for DC power for BUCKY1
P14-3	BUCKY1_2		Live wire for AC power or positive potential for DC power for BUCKY1
P15-1	BUCKY2_1	DEGSON 2EDGK-5.08-4P-14 or equivalent	Null wire for AC power or negative potential for DC power for BUCKY2
P15-3	BUCKY2_2		Live wire for AC power or positive potential for DC power for BUCKY2
P16-1	BUCKY3_1	DEGSON 2EDGK-5.08-4P-14 or equivalent	Null wire for AC power or negative potential for DC power for BUCKY3
P16-3	BUCKY3_2		Live wire for AC power or positive potential for DC power for BUCKY3
P17-1	BUCKY4_1	DEGSON 2EDGK-5.08-4P-14 or equivalent	Null wire for AC power or negative potential for DC power for BUCKY4
P17-3	BUCKY4_2		Live wire for AC power or positive potential for DC power for BUCKY4

Note

P1 and P2 are for flat panel detector connection, the generator compatible with detectors require or not require power supply.

For detectors require power supply from generator, the power supply can be +24V/12VDC/5VDC

The generator provides DC Power output for auxiliary device control，the current limit is +24V/5A, 12VDC/1.5A, 5VDC/1.5A.

Under certain conditions, *EXP_REQ* relay K1 and K2 on **Room Interface Board** can be used to drive opto-coupler or other low current devices. The leakage current through the varistor snubber is connected across the relay

contacts (R1 for K1, R3 for K2) may be sufficient to energize the Bucky inputs when the relays are open. If this is the case, the varistor should be removed. Removing the parallel varistor will resolve this issue.

Inputs & Outputs (Simplified Schematics)

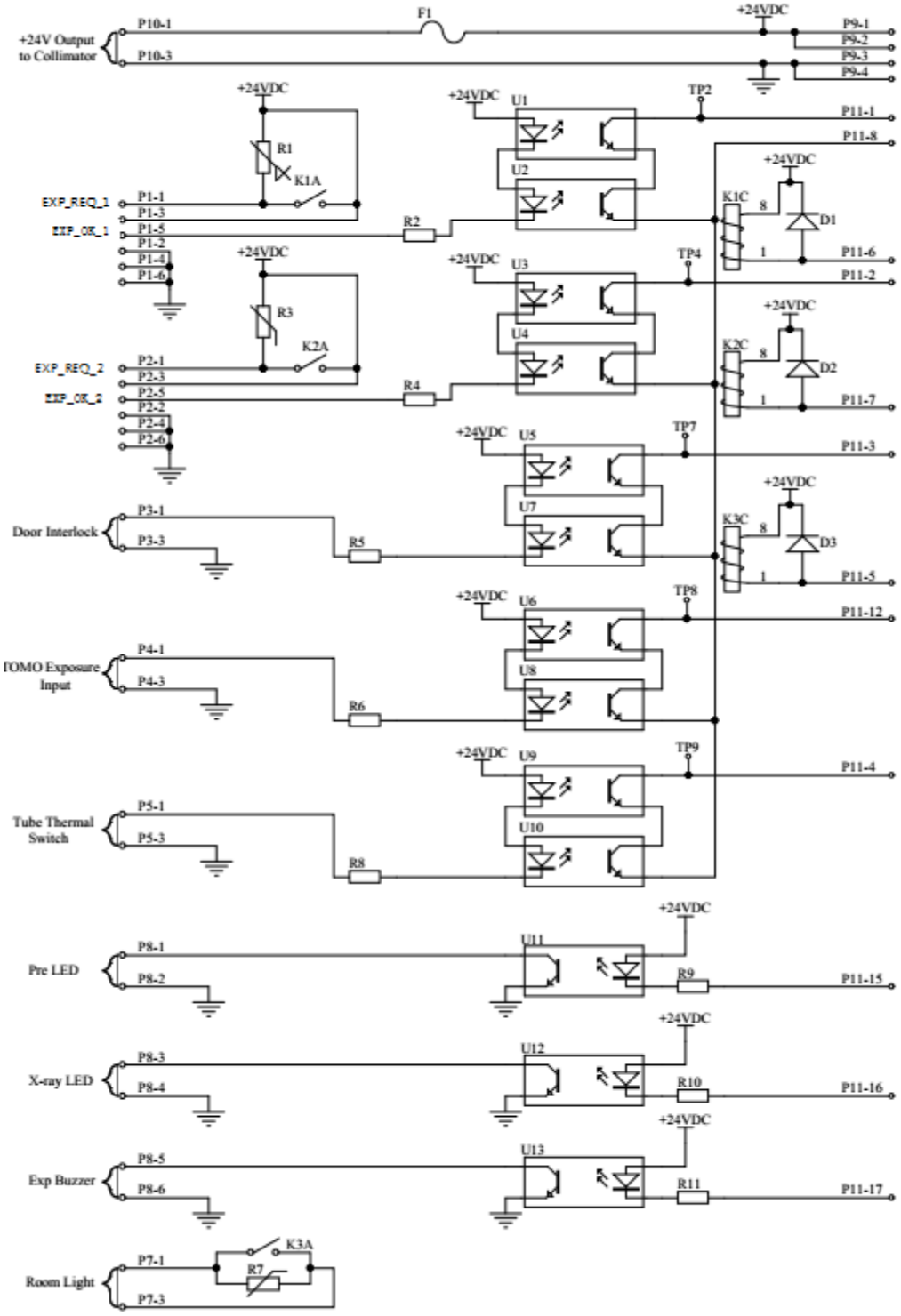


Figure 3-1 P1, P2, P3, P4, P5, P7, P8, P10 input and output (RIB0)

* Required logic level, refer to *table 3-4/5/6*.

** Check whether the door interlock signal grounded. The grounded signal shall be connected to *P3-3*.

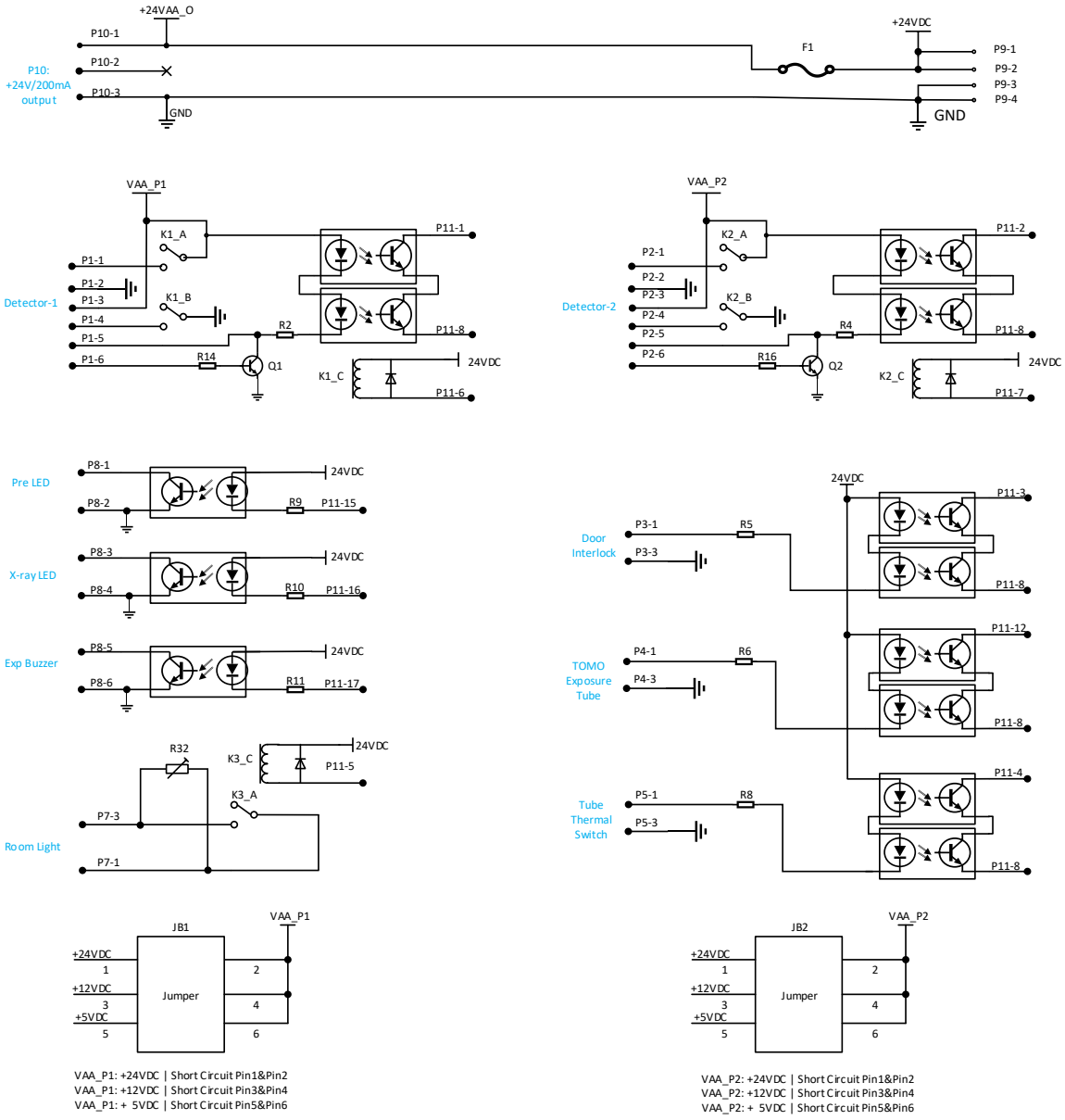


Figure 3-2 P1, P2, P3, P4, P5, P7, P8, P10 input and output (RIB1)

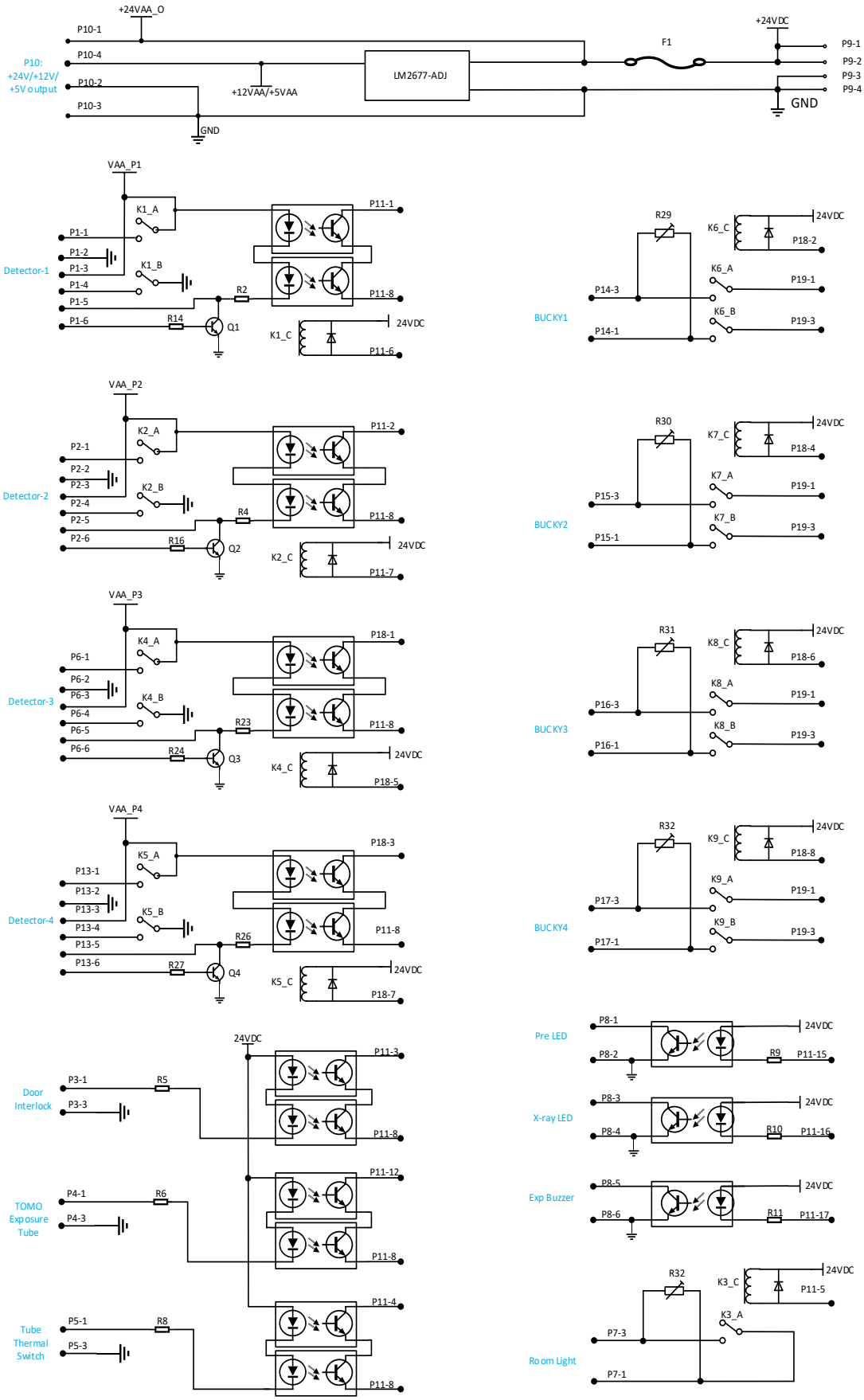


Figure 3-3 P1~ P8, P10, P13, P14, P15, P16, P17 input and output (RIB2)

AEC Interface

Automatic Exposure Control Board can be an option per application of the customer.

AEC provided for option is as followed:

AEC Designation	Difference	P/N
AEC0	AEC for analog 1 - 3 field measuring chambers (2-Channels). High effective.	**460399-002**
AEC1	AEC for analog 1 - 3 field measuring chambers (2-Channels). Low effective.	**460399-001**
AEC2	AEC for Digital 1 - 5 field measuring chambers (2-Channels). High effective.	**409319-001**
AEC3	AEC for Digital 1 - 5 field measuring chambers (2-Channels). Low effective.	**409319-002**

●Terminals definition

Table 3-7 AEC Board input/output signals

Pin #	Definition	Description
P8-1/P7-1	PORTRAIT	Portrait / Landscape, selection of activated fields
P8-2/P7-2	INVERTED	Inverted / not inverted, selection of activated fields
P8-3/P7-3	AEC_FDBK_A	AEC Digital differential feedback signal from chamber
P8-4/P7-4	AEC_FDBK_B	AEC Digital differential feedback signal from chamber
P8-5/P7-5	GND	Generator signal ground for reference of interface circuits
P8-6/P7-6	AEC Feedback	AEC Analog feedback signal from chamber
P8-7/P7-7	GND	Generator signal ground for reference of interface circuits
P8-8/P7-8	START	Start iron chamber
P8-9/P7-9	Left/Right	Ion chamber left or right field selection
P8-10/P7-10	Middle	Ion chamber middle field selection
P8-11/P7-11	Left/Right	Ion chamber middle field selection

P8-12/P7-12	GND	Generator signal ground for reference of interface circuits
P8-13/P7-13	-12V	-12VDC power supply to Ion chamber
P8-14/P7-14	GND	Generator signal ground for reference of interface circuits
P8-15/P7-15	+12V	+12VDC power supply to Ion chamber

*Connector model: DB15, vertical, male.

The AEC interface is compatible with AEC chambers as below:

- Three fields chamber
- +/-12VDC power supply;
- High or low active start/field selection

Five field chamber can also be compatible on demand.

●Schematics

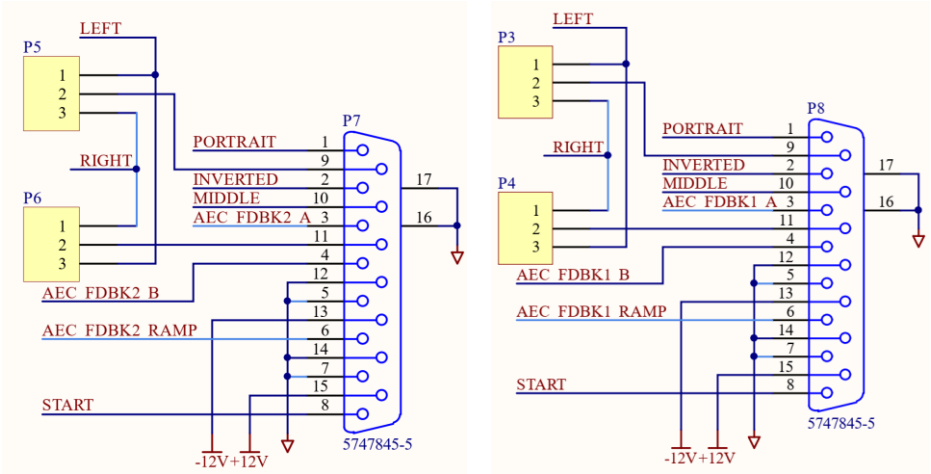


Figure 3-4 *Simplified schematics of AEC Board*

*If R72, R73, R74, R75, R82, R89 are assembled, selection signals on the board should be use as high active

**If R76, R77, R78, R79, R85, R92 are assembled, selection signals on the board should be use as low active

Communication and Hand Switch interface

●Terminals definition

Table 3-8 Signals definition of P1 on MCB

Pin #	Definition	Description
P1-1	NC	
P1-2	RS232-RX	RS232 Receive (in) to generator
P1-3	RS232-TX	RS232 Transmit (out) from generator
P1-4	POWER_ON	User signal to make generator power on
P1-5	GND	Generator signal ground for reference of interface circuits
P1-6	POWER_OFF	User signal to make generator power off
P1-7	PREP	User Signal to alert the generator that exposure sequence will begin. Once this signal is active, exposure parameters are locked in and cannot be changed. The generator enables the starter to boost the rotor and filament
P1-8	XRAY	User Signal to generator to generate X-Rays
P1-9	Console Power Vcc	Power supply to console; Configurable for +24VDC or +12VDC per specific requirements, 1A maximum current output.

*Connector type and location: DB9, vertical, male, on **Main Control Board.**

●Schematics

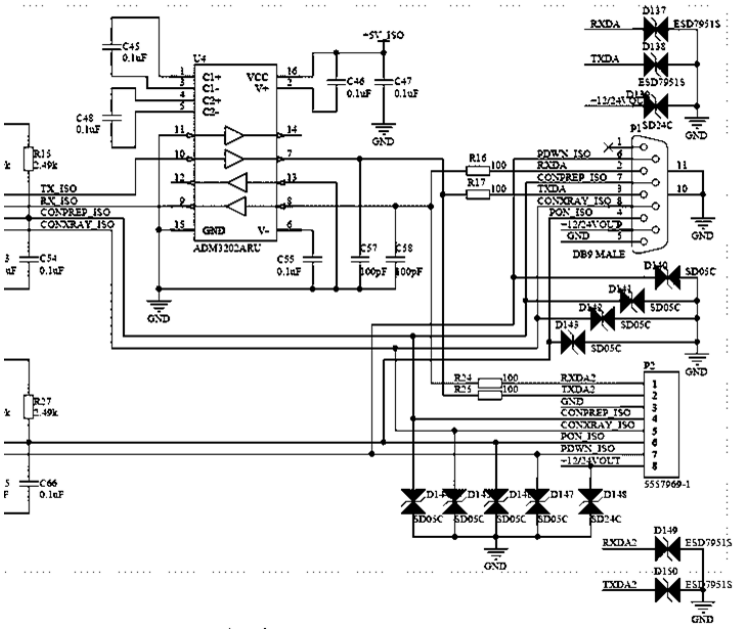


Figure 3-5 Simplified schematics of P1 and P2 (MCB)

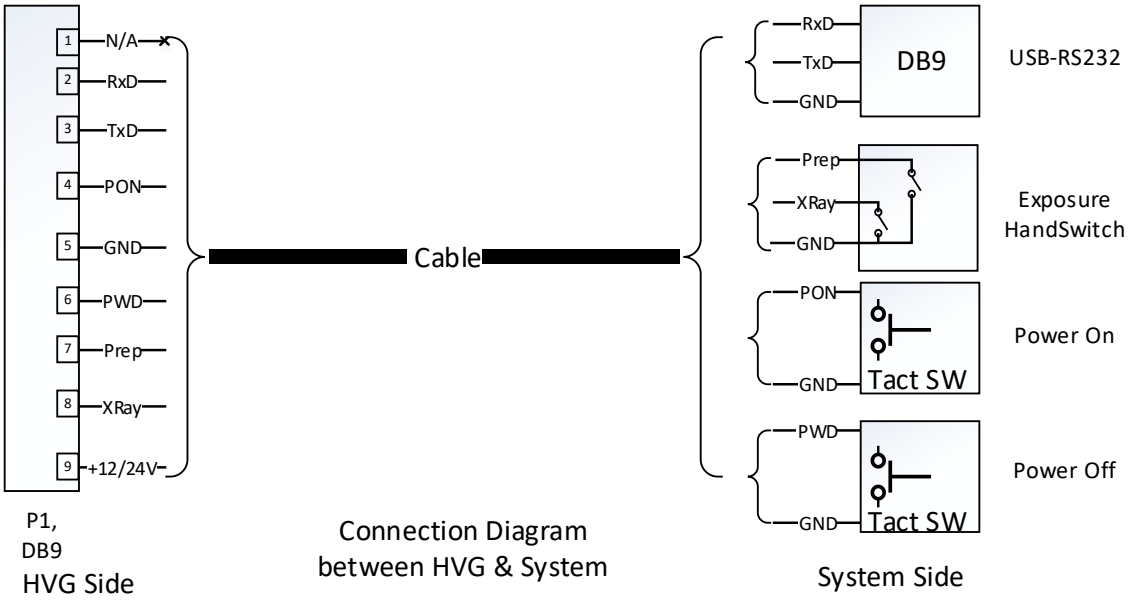


Figure 3-6 Connection diagram between Generator P1 and System Panel

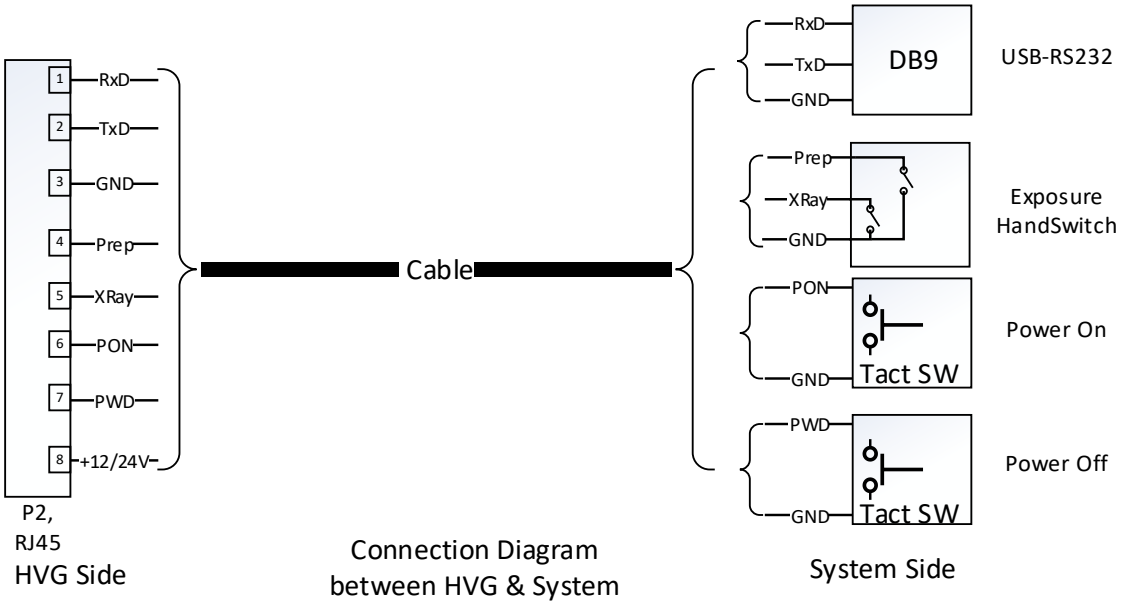


Figure 3-7 Connection diagram between Generator P2 and System Panel

Note: The Fig. 3-6 and Fig. 3-7 are the recommended connection diagram to operate the high voltage generator for system control panel. The DB9 and the RJ45 terminals on MCB of high voltage generator include the RS232 communication, 2 step exposure hand switch, power on/off and the +12/24VDC power output. One adaptor to deconcentrate the cables is recommended, **only RxD, TxD and GND are allowed to connect to the communication DB9 terminal to communicate with system control panel.**

Communication, Handle switch and power on/off interface

●Terminals definition

Table 3-8 Signals definition of P2 on MCB

Pin #	Definition	Description
P2-1	RS232-RX	RS232 Receive (in) to generator
P2-2	RS232-TX	RS232 Transmit (out) from generator
P2-3	GND	Generator signal ground for reference of interface circuits
P2-4	PREP	User Signal to alert the generator that exposure sequence will begin. Once this signal is active, exposure parameters are locked in and cannot be changed. The generator enables the starter to boost the rotor and filament
P2-5	XRAY	User Signal to generator to generate X-Rays
P2-6	POWER_ON	User signal to make generator power on
P2-7	POWER_OFF	User signal to make generator power off
P2-8	Console Power Vcc	Power supply to console; Configurable for +24VDC or +12VDC per specific requirements, 1A maximum current output.

* Connector type and location: RJ45, 8P, on **Main Control Board.**

●Schematics

Refer to ***Figure 3-5***.

Mini Console Interface

●Terminals definition

Table 3-9 Signals definition of **P20** on MCB

Pin #	Definition	Description
P20-1	POWER_ON	User signal to make generator power on
P20-2	PREP_LED	Output signal to indicate generator in prepare phase
P20-3	XRAY_LED	Output signal to indicate generator in exposure
P20-4	+12VDC	+12VDC power supply to mini console
P20-5	GND	Generator signal ground for reference of interface circuits
P20-6	POWER_OFF	User signal to make generator power off
P20-7	PREP	User Signal to alert the generator that exposure sequence will begin. Once this signal is active, exposure parameters are locked in and cannot be changed. The generator enables the starter to boost the rotor and filament

P20-8	XRAY	User Signal to generator to generate X-Rays
P20-9	GND	Generator signal ground for reference of interface circuits
P20-10	EXP_BUZZER	Output signal for mini console buzzer

* Connector type and location: 39-28-8100, Molex Mini-Fit Jr. receptacle housing, dual row, on **Main Control Board.**

●Schematics

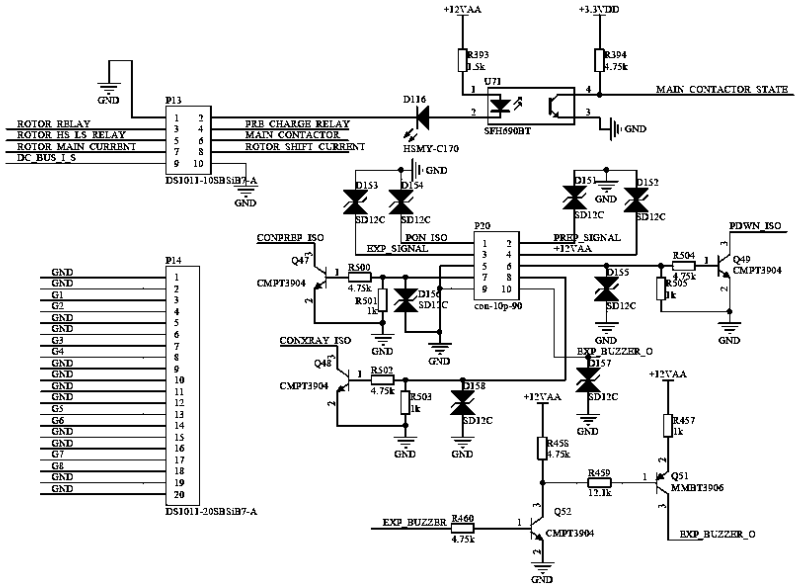


Figure 3-8 Simplified schematics of P20 (MCB)

Foot Switch Connection (Single Phase for Vet version Only)

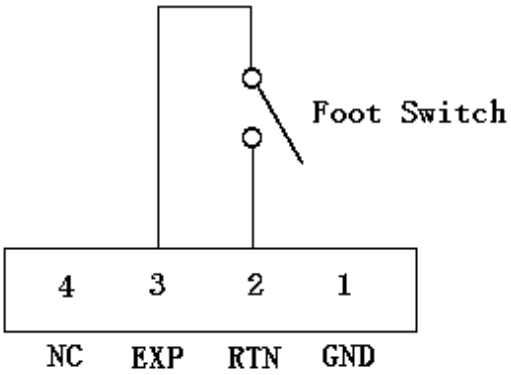


Figure 3-9 Terminals Definition and Cable Connection

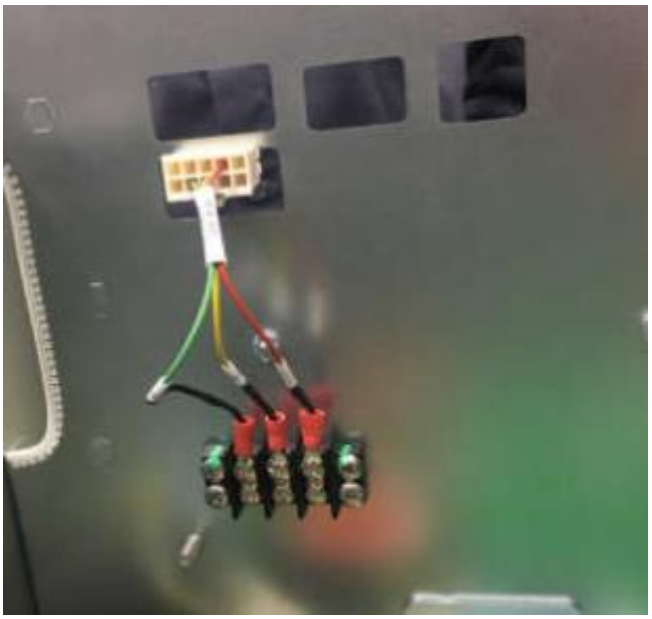


Figure 3-10 Positon of Terminal

Compatibility Tube List

The list on section ‘DIP Switching’, table 2-6 ‘Tube Type Selection’ describes tubes that the ZEUS Generator is compatible with. Other similar tubes may be compatible with our generator. Please contact manufacturer for more details.

Chapter 4 SERVICE TOOL

Service Tool Overview

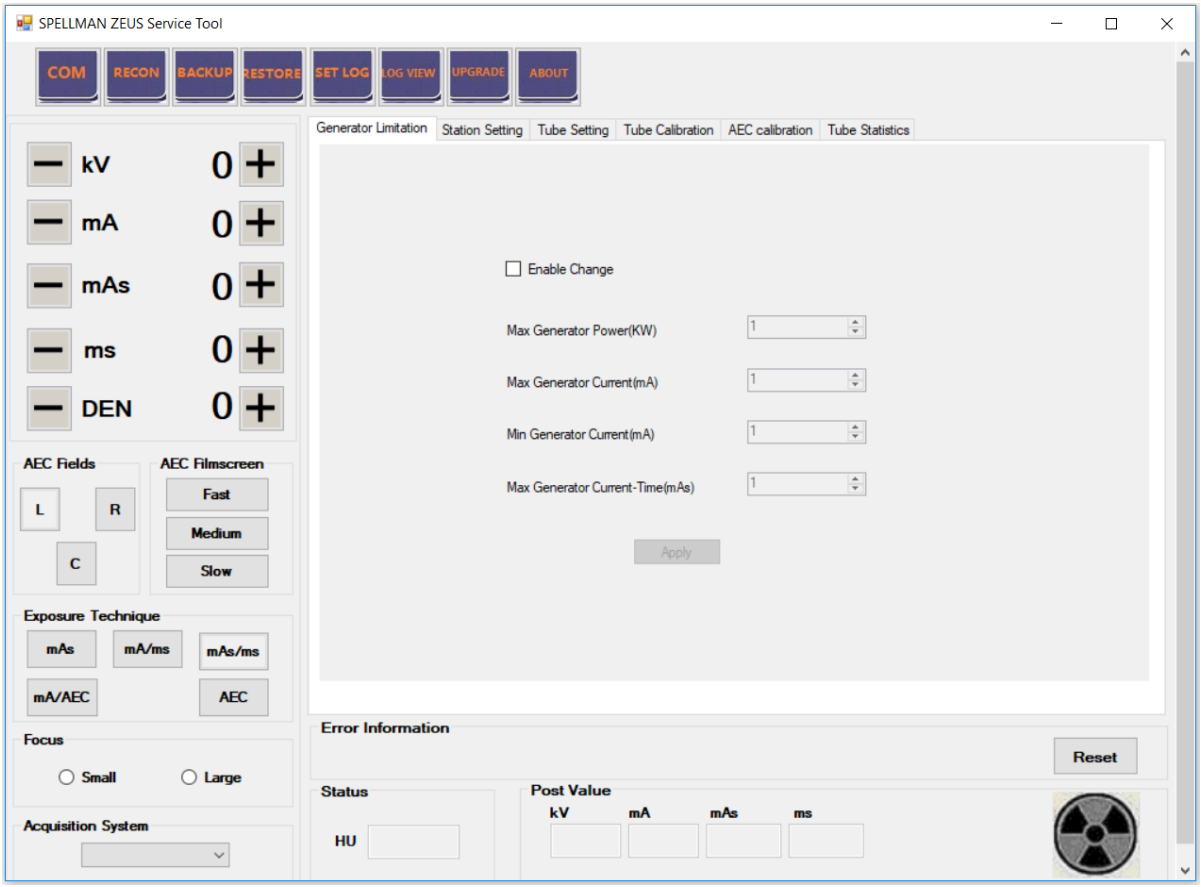


Figure 4-1 Service tool overview

Function Buttons

Overview

The function buttons present the user with following options:

- **COM** -- set the serial port
- **RECON** – reconnect the serial port
- **BACKUP** – backup generator data
- **RESTORE** – restore generator data
- **SET LOG** – set log level
- **LOG VIEW** – view the log

• **UPGRADE** – upgrade the firmware

• **ABOUT** – information about service tool

✧ **COM**

Follow these steps to set serial port:

1. Press button ”COM”;
2. Select Com Port from drop-down list.
3. Press **OK**.

The Serial Port dialog is shown below.

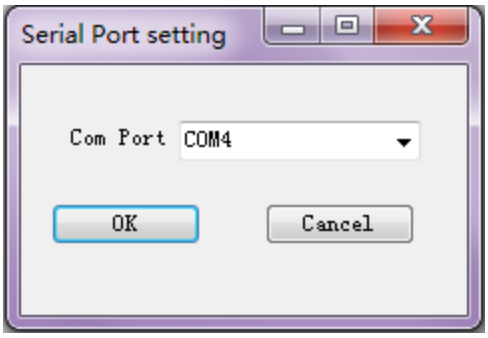


Figure 4-2 Serial port setting

✧ **RECON**

Press **RECON** to reconnect the generator, if not connected to generator, “ER036: Console Communication Error.” Will be displayed.

✧ **BACKUP**

1. Press button “**BACKUP**”.
2. Press button “**Backup all**”, all data shall be backup.
3. Choose the path in which the file will be stored in the dialog popped up.
4. Press **SAVE**, the data will be save with .eve format.

The **BACKUP** dialog is shown below.

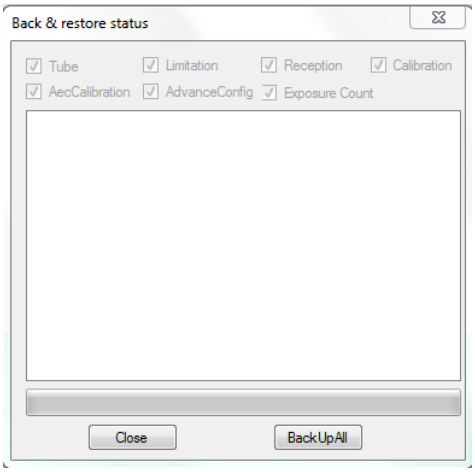


Figure 4-3 Backup data

✧ RESTORE

1. Press button “**RESTORE**”;
2. Choose the items want to restore;
3. Press “**Restore**”, and choose the file which will be restored from the popped up dialog;
4. Press “**Close**” if the window shows that restore process has completed.

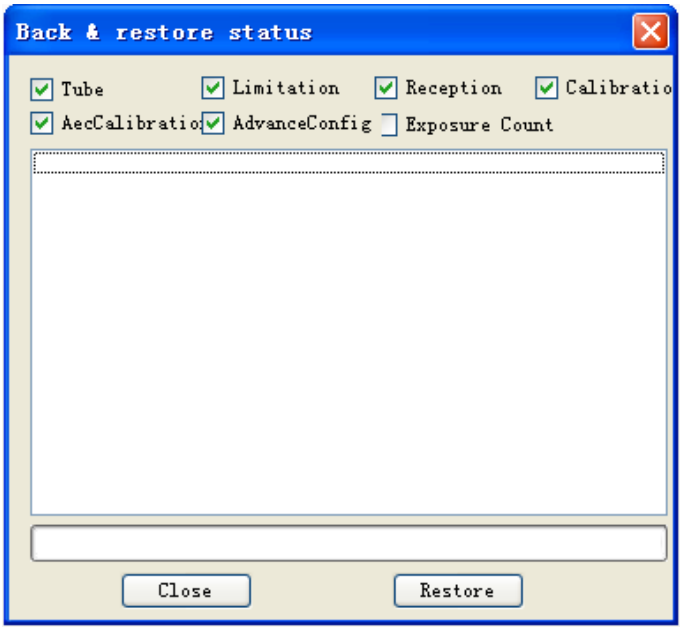


Figure 4-4 Restore data

✧ SET LOG

This utility defines the level for generator to capture the log. The log files are stored in **D:\log** in .txt format.

The Set Log Level dialog is shown below.

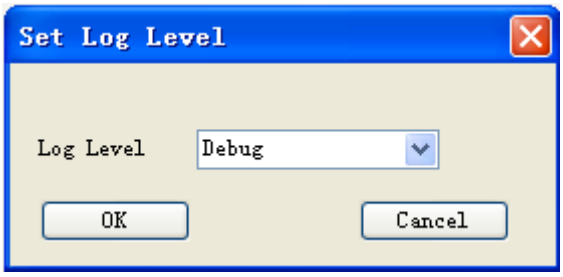


Figure 4-5 Set log level

Follow these steps to set the error log at different level. System will capture the log by the log level.

1. Press “**SET LOG**”;

2. Select Log Level from **Error**, **Warning**, **Information** and **debug**. The default level is **Information**;

3. Press **OK**.

✧ LOG VIEW

Press **LOG VIEW** to view the log.

✧ UPGRADE

Follow these steps to upgrade the firmware:

1. Press button "**UPGRADE**";
2. Input port name to text box "**Port Name**" ;
3. Input baud rate to text box "**BaudRate**"; (Normally 9600)
4. Press "**Browse File**" to select the .hex format file to be downloaded;
5. Press "**Upload**" to start the download process;
6. Press "**Close"** when the process complete.

Note: Don't stop download before it is complete.

The upgrade firmware window is shown below:

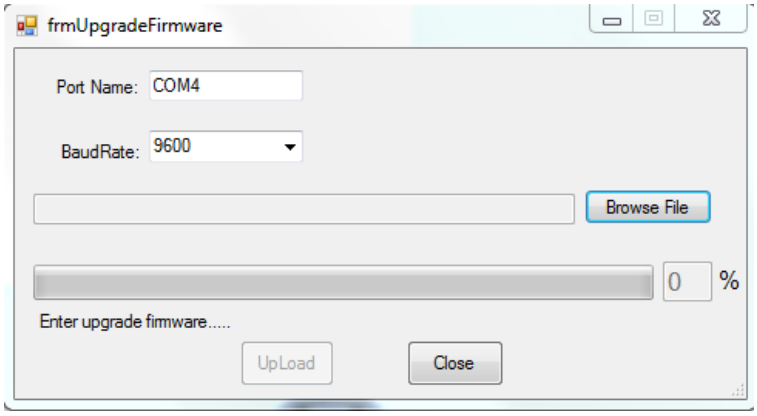


Figure 4-6 Upgrade firmware

✧ **ABOUT**

Press **ABOUT** to view information such as version of service tool.

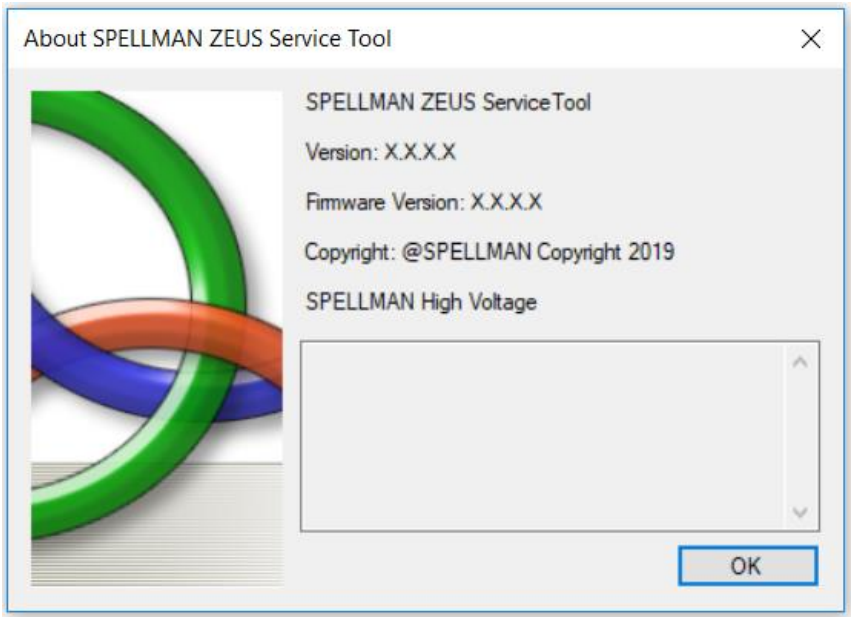


Figure 4-7 About dialogue

Tab Tools

Tab tools provide the following functions:

- **Generator Limitation** – set the limit ratings of the generator
- **Station Setting** – configure acquire system
- **Tube Setting** – set the parameters about tube
- **Tube Calibration** – calibrate the tube automatically
- **AEC Calibration** – calibrate AEC parameters
- **Tube Statistics** – view tube and generator exposure count
- **Stitching Mode** – set the parameters of stitching (*Optional Function)
- **TOMO Mode** – Configure parameters of Tomography
- **DAP** – DAP interface configuration, Software DAP Calibration
- **Dual Energy** – Configure Dual Energy / Multi-Energy parameters

✧ Generator Limitation

The **Generator Limitation** function allows setting of the generator output limits defined below. The **Generator Limitation** panel is shown below.

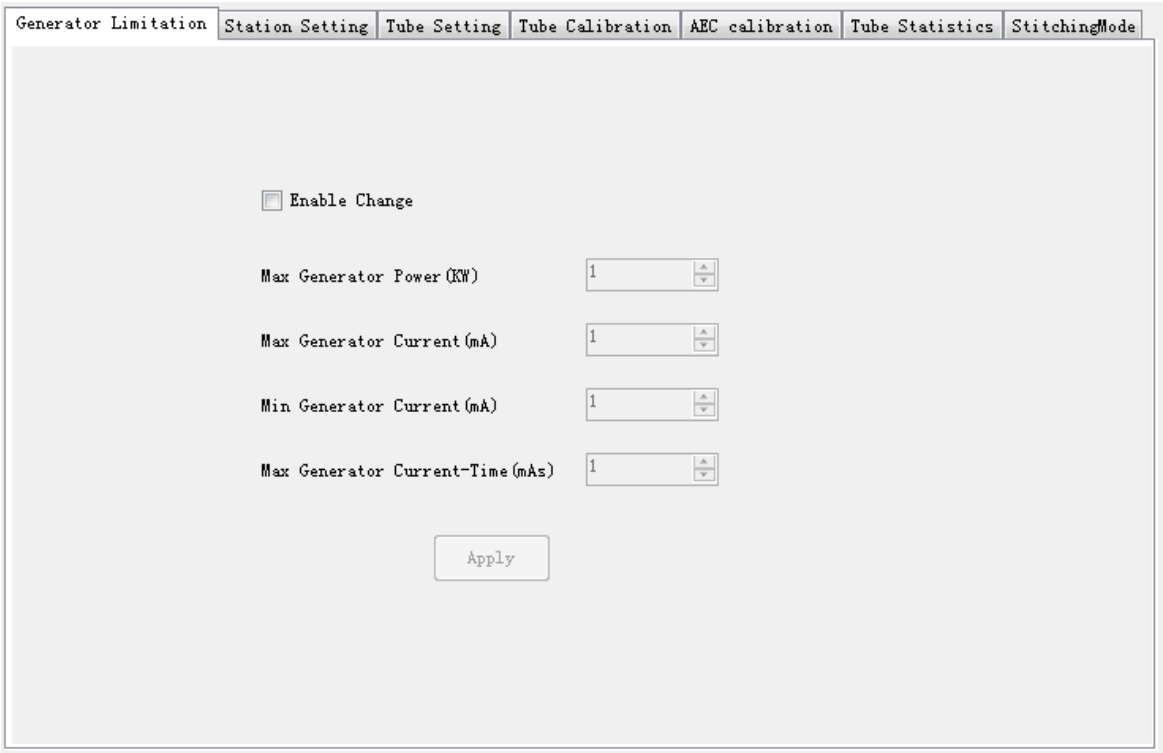


Figure 4-8 Generator limitation setting

Table 4-1 Definitions of **Generator Limits** panel items

Function	Description
Max Generator Power (kW)	Set maximum output power
Max Generator Current(mA)	Set maximum tube current
Min Generator Current (mA)	Set minimum tube current
Max Generator Current - Time (mAs)	Set maximum tube current time product

Note

Before making any changes in this section, check x-ray tube datasheets to ensure that the changes do not exceed the manufacturers' recommend limits. The original generator limits should be recorded before continuing.

Follow these steps to set the generator limits. Refer to the definitions in the previous table.

1. Press tab "**Generator Limits**";
2. Tick the checkbox **Enable Change**;
3. Set the maximum kW via the **Max. Generator Power (kW)** text box, this setting will be limited by selected tube.
4. Set the maximum mA via the **Max. Generator Current (mA)** text box;
5. Set the minimum mA via the **Min. Generator Current (mA)** text box;
6. Set the maximum mAs via the **Max. Generator Current-Time (mAs)** text box;
7. Press **Apply** to save the setting;

Station Setting

The **Station Setting** function allows each of the image receptors to be programmed.

The **Station Setting** panel is shown below.

Figure 4-9 Station setting

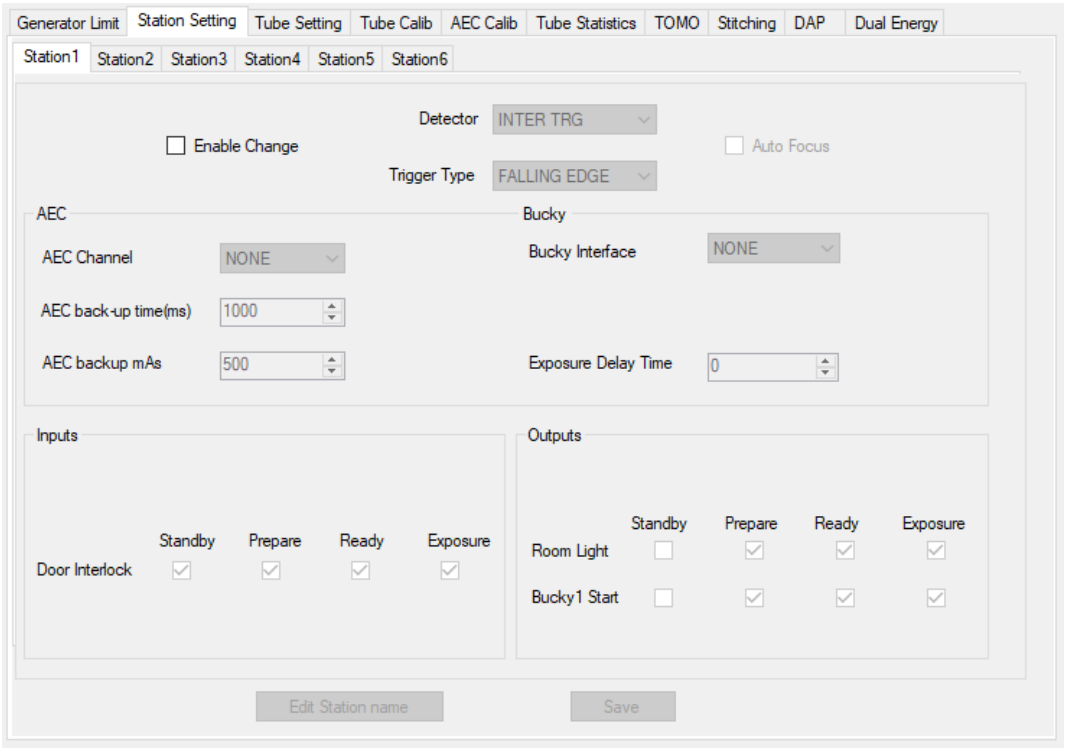


Figure 4-10 Station setting with Bucky configuration

Table 4-2 Definitions of **Station Setting** panel items

Function	Description
Auto Focus	If selected, focus can change from small to large if selected parameters are out of the limitation of small focus.
Interface	Choose the Detector, which is corresponding to the image acquisition system.
Detector	Choose the Detector, which is corresponding to the image acquisition system.
AEC Channel	Select AEC channel; None means disable.
AEC backup mAs	Set the backup mAs in AEC mode; The maximum allowable value is 600.
AEC back-up time (ms)	Set the backup ms in AEC mode.
Bucky Interface	Choose Bucky interface on Room interface board.
Exposure Delay Time	Reserved for specific customer.
Door Interlock	Choose whether to check the status of door interlock in Standby, Prepare, Ready, or Exposure phase.
Bucky1 Ready	Reserved
Bucky2 Ready	Reserved
Extern Ready	Reserved
Room Light	Choose whether to activate the room light in Standby, Prepare, Ready, or Exposure phase.
Bucky1 Start	Configure Bucky power on
Bucky2 Start	Reserved

(*Auto Focus and Exposure Delay Time are optional)

Follow these steps to set up the receptor parameters. Refer to the definitions in the previous table.

1. Press tab “**Station Setting**”;
2. Press the station intended to set;
3. Check the checkbox **Enable Change**;
4. Choose **Detector**, which is corresponding to the image acquisition system.
5. Choose **AEC channel** through the push down list; choose **None** to disable AEC.
6. Select **AEC backup mAs**. Use the arrow buttons to select the maximum backup mAs.
7. Select **AEC back-up time (ms)**. Use the arrow buttons to select the maximum backup ms.
8. Choose **Bucky Interface** to enable bucky control. None means no bucky

connected.

9. Select **Exposure Delay Time**, use the arrow button to select the time from bucky ready to exposure.
10. Check **Door Interlock** in the Standby, Prepare, Ready, or Exposure phase.
11. Check the **Room Light** in the Standby, Prepare, Ready, or Exposure phase to activate the room light in corresponding phase;
12. Press **Save;**
13. Press "**Edit Station name**" to edit the station name;
14. Repeat steps 2 to 12 to set the remaining stations.

✧ Tube Setting

The **Tube Setting** function allows the desired tube type to be selected, and allows setting of the default limits for that tube.

Filament Parameter

The **Filament Parameter** panel is shown below.

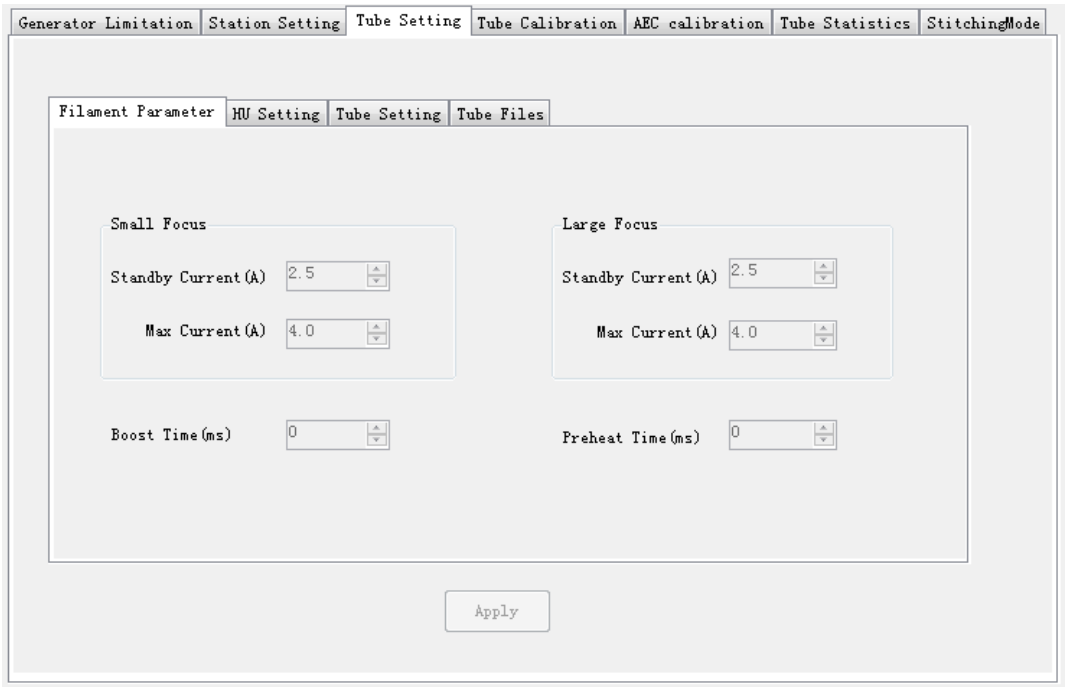


Figure 4-11 Filament parameters setting

Note

All filament parameters are fixed to prevent potentially creating a risky scenario for the X-ray tube. The filament parameters will be automatically set based on the tube selection from tube file.

Table 4-3 Tube setting items

Function	Description
Small Focus: Standby current(mA)	The small focus standby filament current from the X-ray tube data sheets.
Small Focus: Max current(mA)	The small focus maximum filament current from the X-ray tube data sheets.
Large Focus: Standby current(mA)	The large focus standby filament current from the X-ray tube data sheets.
Large Focus: Max current(mA)	The large focus maximum filament current from the X-ray tube data sheets.
Boost Time(MS)	The filament rapid boost duration in order to quickly raise the filament temperature.
Preheat Time(MS)	The time that the filament is held at the required emission level before an exposure is permitted.

HU Setting

The **HU Setting** panel is shown below.

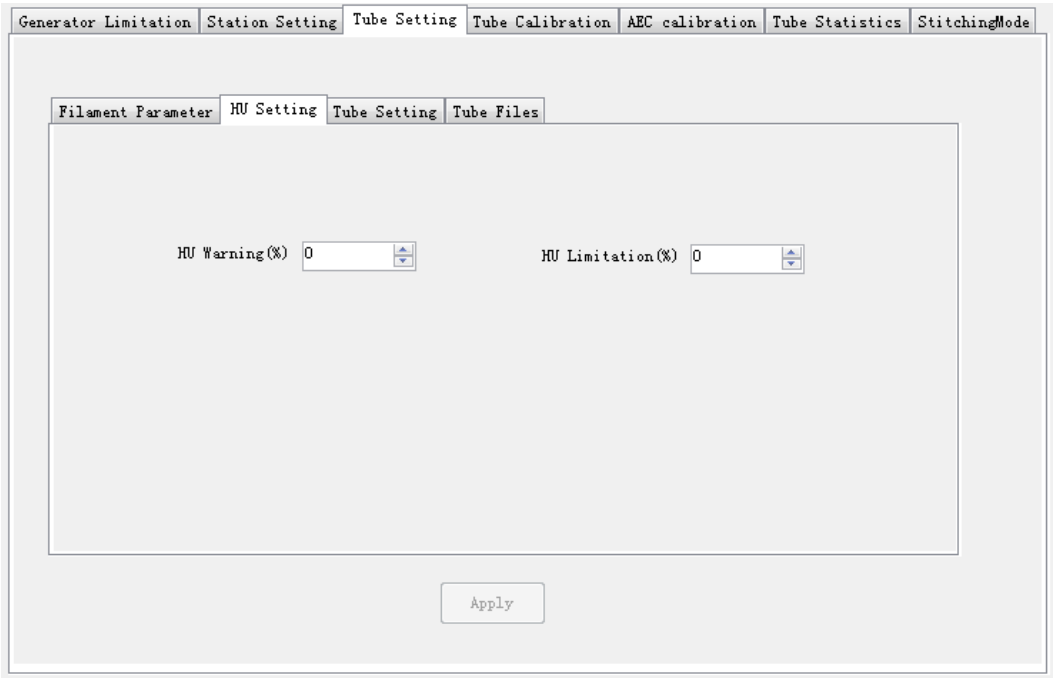


Figure 4-12 HU setting

Table 4-4 Definitions of **HU Setting** panel items

Function	Description
HU Warning (%)	Sets the limit at which the anode heat-warning message is displayed.
HU Limitation (%)	Sets the limit at which exposures will be inhibited. If the anode heating is currently under the limit, the next exposure will be inhibited if the generator calculates that the exposure will exceed the anode HU limit.

Follow these steps to set up **HU Setting**. Refer to the definitions in the previous table.

1. Press tab "**Tube Setting**", then press sub tab "**HU Setting**";
2. Set the desired anode HU warning % via **HU Warning (%)**;
3. Set the desired anode HU limitation % via **HU Limitation (%)** ;
4. Press **Apply.**

Tube Setting

The **Tube Setting** panel is shown below.

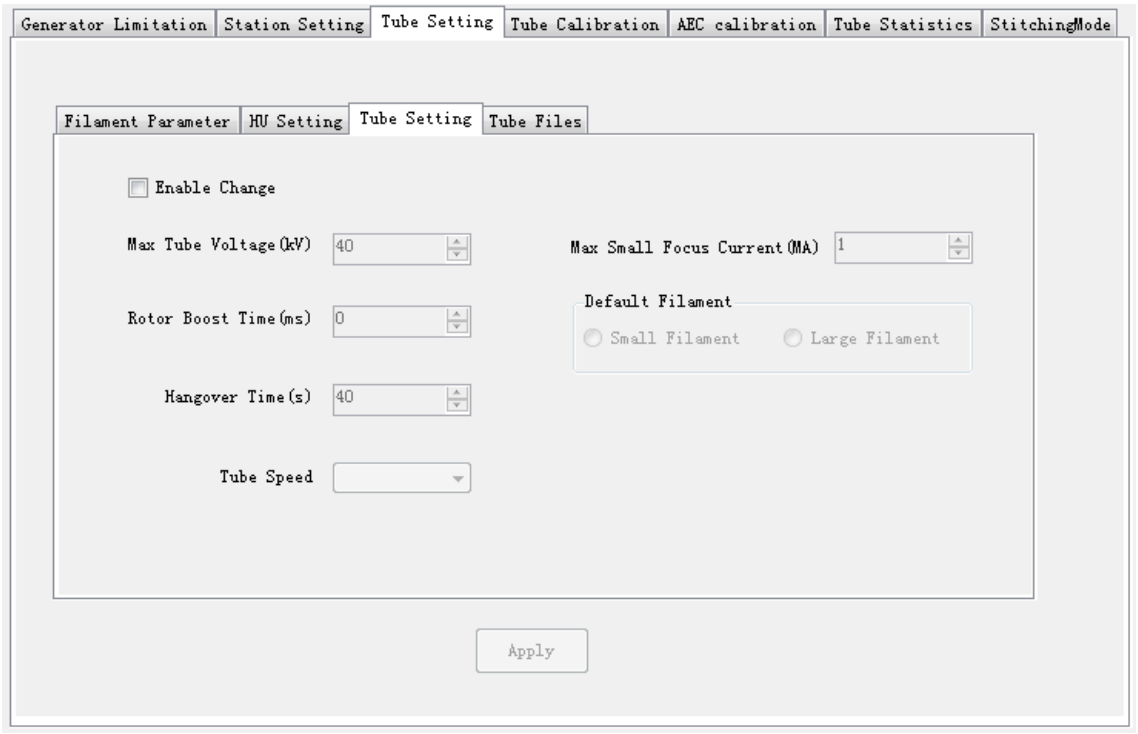


Figure 4-13 Tube Parameters setting

Table 4-5 Definitions of **Tube Setting** menu items

Function	Description
Max Tube Voltage(KV)	Set the maximum kV allowed.
Max Small Focus Current(MA)	Set the maximum mA in small focus.
Rotor Boost time(ms)	Set the additional time(ms) for tube rotator to boost.
Tube Speed	Set the speed of rotor. Three items are optional: Low Speed, High Speed, Dual Speed
Hangover Time(s)	Set the drive time of the rotor after exposure.
Default Filament	Set the default filament when power on.

Follow these steps to set up **Tube Setting**. Refer to the definitions in the previous table.

1. Press tab "**Tube Setting**", then press sub tab "**Tube Setting**";
2. Input maximum allowable KV in text box "**Max Tube Voltage(KV)**";
3. Input maximum allowable current in text box **"Max Small Focus Current(MA)**";
4. Choose the additional boost time through numeric up-down "**Boost time(ms)**";
5. Choose tube speed in the down list of "**Tube Speed**";
6. Choose rotor hangover time through numeric up-down **"Hangover Time(s)**;
7. Choose default filament through combo box "**Default Filament**";
8. Press **Apply** to download the setting to generator.

Tube Files

The **Tube Files** panel is shown below.

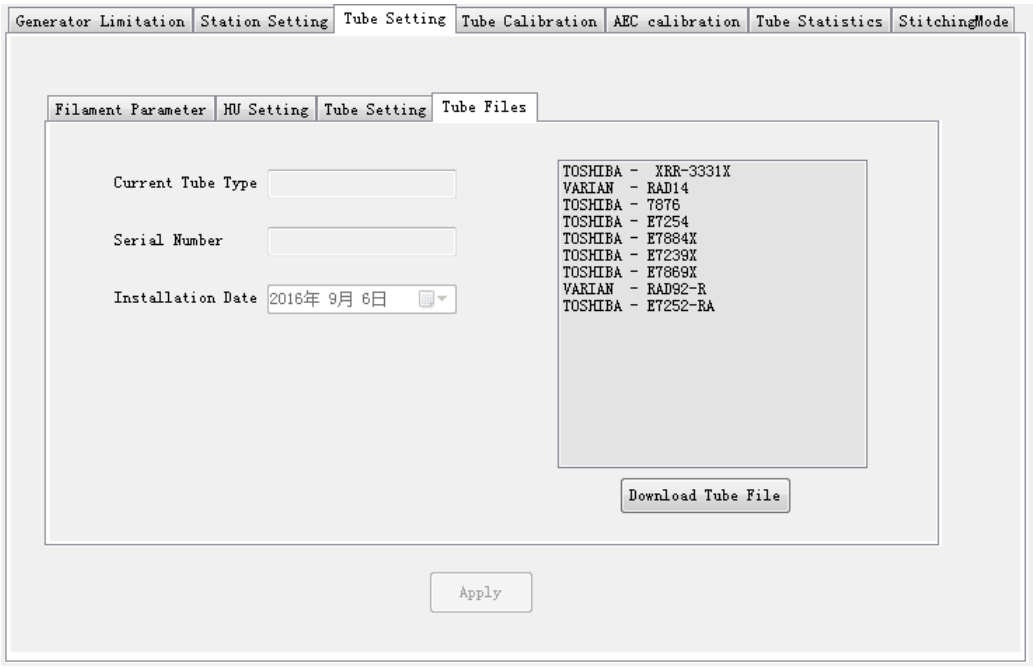


Figure 4-14 Tube files download

Select the tube type in the displayed list, and input the serial number and installation date, then press **Download Tube File** to download the tube file to generator.

Note

The selected tube type should be identical to the setting of DIP switch **S2**.

✧ Tube Calibration

Before beginning tube auto calibration, the tube must be properly configured, and the generator limitation should be programmed. It is recommended that the tube should be conditioned (seasoned), particularly if the tube has not been used for some time.

Caution

The following procedures produce X-rays. Take all safety precautions to protect personnel from X- radiation.

Caution

Always verify the manufacturer of the tube insert. If the X-ray tube has been rebuilt, the tube insert and tube housing may be from different

manufacturers.

To perform the tube auto calibration, follow these steps.

1. Press tab "**Tube Calibration**", and the **Tube Calibration** panel will be shown.

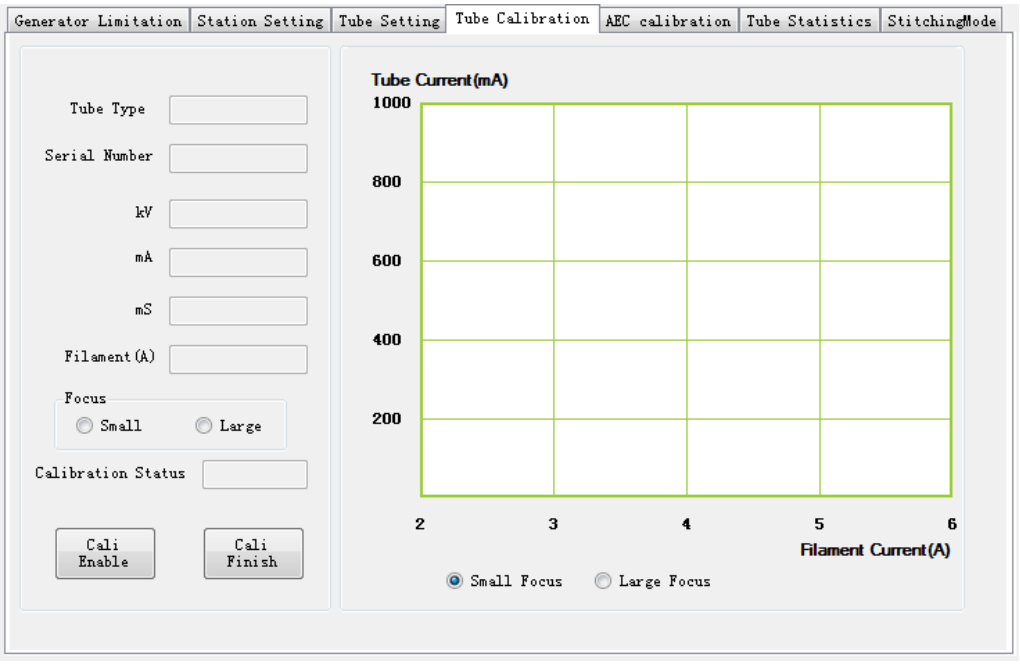


Figure 4-15 Tube calibration

2. Select the focus. Toggle the button to select the desired focal spot to calibrate (Small or Large). Start with Small.
3. Press and hold the X-ray button to begin the calibration procedure.
4. When finished calibrating the small focus, repeat the calibration of the large focus.
5. When the auto calibration is completed, **Calibration Status** displays **Complete**. Press **Cali Finish** to finish the calibration procedure.

To show the calibration curve, press the single choose button on the right down side of the panel.

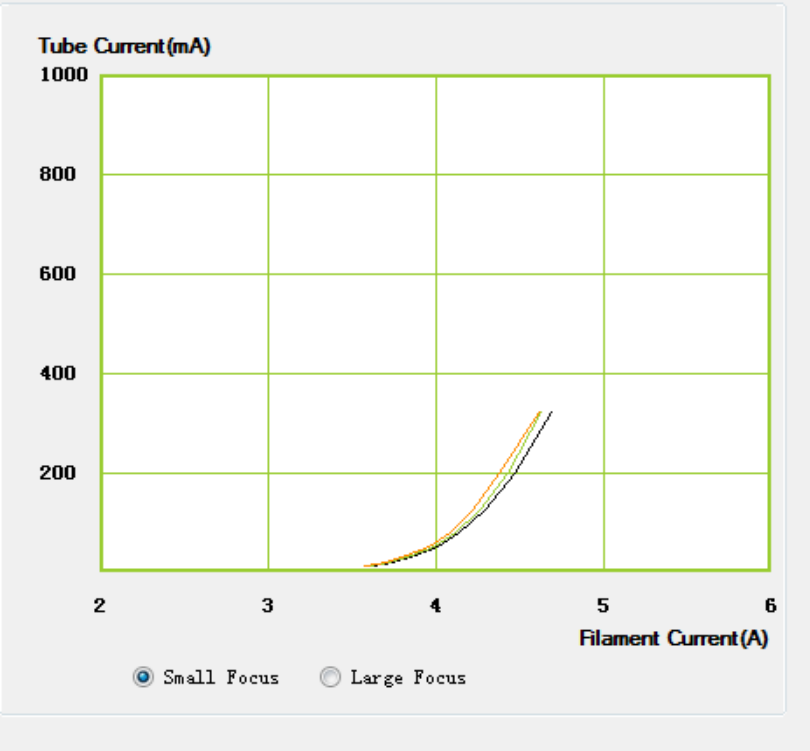


Figure 4-16 Calibration curve of small focus

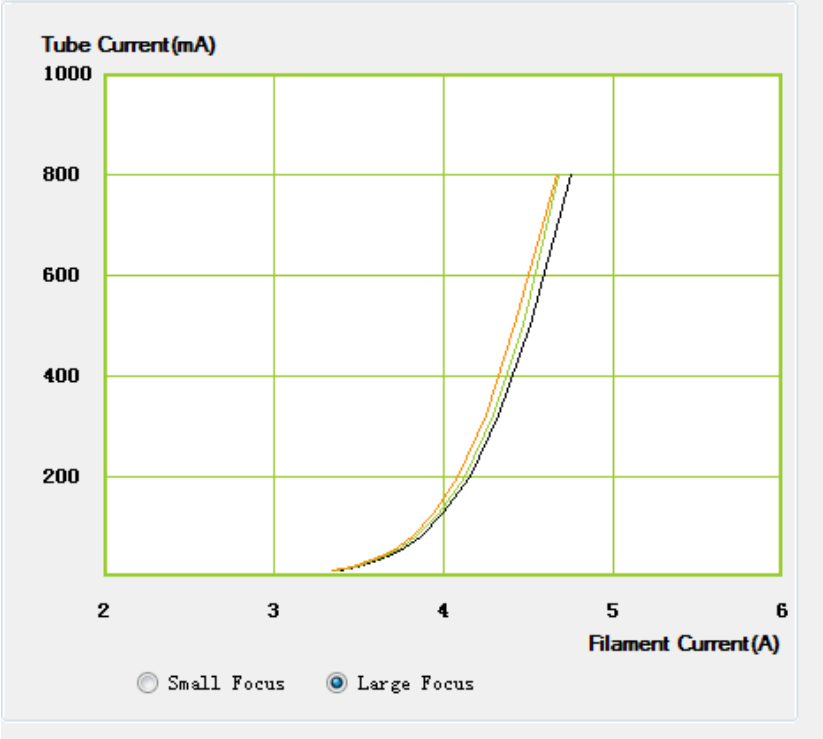


Figure 4-17 Calibration curve of large focus

✧ AEC Calibration

Note

Operating in kV/AEC mode, the tube current is automatically decided per below rules:

Once kV fixed, the tube current (mA) will be the highest reachable value at this kV for selected tube and its focus, and the kV-mA production shall also not exceed generator rated output power.

The exposure time is automatically controlled by chamber feedback, also the exposure time cannot exceed the maximum allowable exposure time for this kV and mA combination for this selected tube and its focus.

If the exposure is interrupted by the monitoring unit or by releasing the exposure switch, an incorrect exposure is indicated, and error information will be displayed on touch screen console or system monitor.

The next exposure is inhibited until the incorrect exposure has been confirmed.

KV Compensation

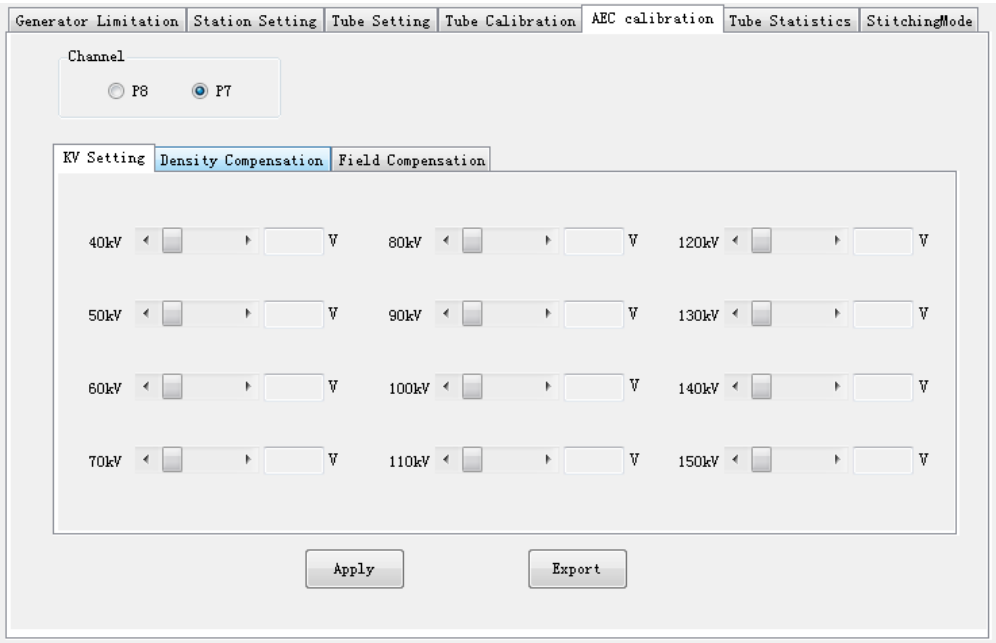


Figure 4-18 AEC calibration-KV compensation

Film screen response to kV is not linear. Therefore, the compensation must be provided in order to maintain the constant film density as kV is changed for different anatomical studies. By selecting and calibrating various kV breakpoints, the overall system response will be compensated so as to yield a constant film density.

Density Setup

The **Density Setup** panel is shown as below:

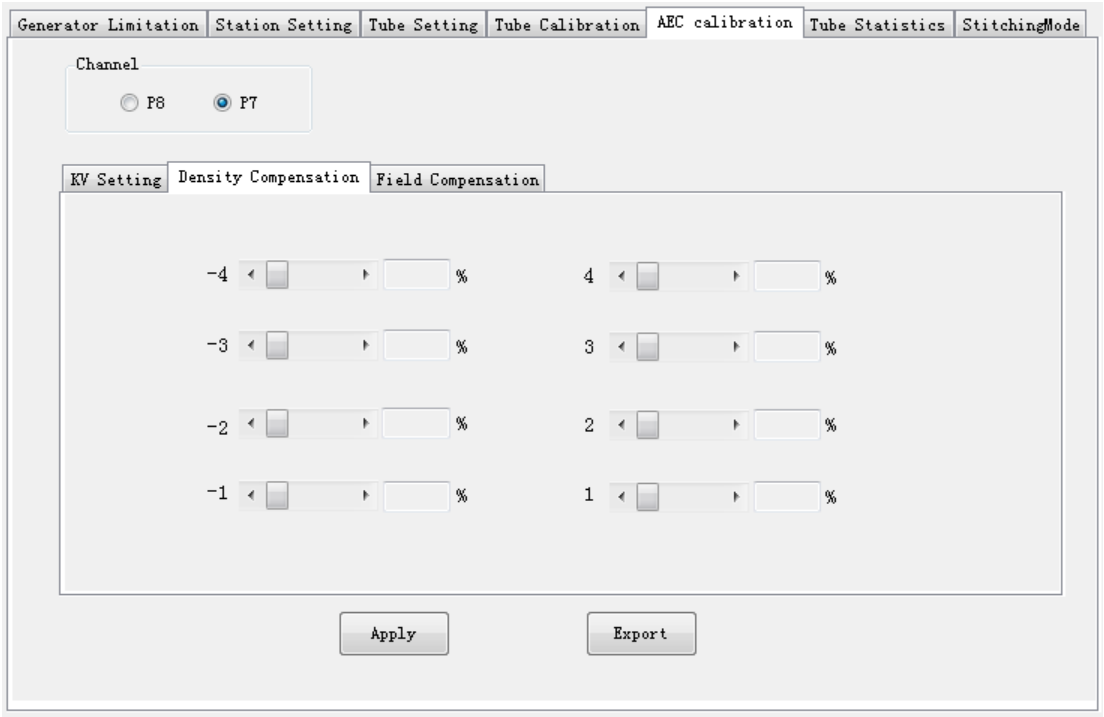


Figure 4-19 AEC calibration-density compensation

- Set up the density step (by %) according to system requirement.
- Up to 4 density plus and 4 density minus steps are available. If less than+/- 4 density steps are required, the unwanted density steps may be deprogrammed. For example, if only +/- 3 density steps are desired, then density steps +/- 4 must be 0.

Field Compensation

If 3 fields of Ion chamber can't be balanced by potentiometers on Ion chamber, adjust the Left Field, Central Field and Right Field accordingly, then click **Apply**.

Figure 4-20 AEC calibration-field compensation

✧ Tube Statistics

This utility shows the tube exposure count. This also allows resetting of the tube 1 exposure counter. The **Tube Statistics** panel is shown as below.

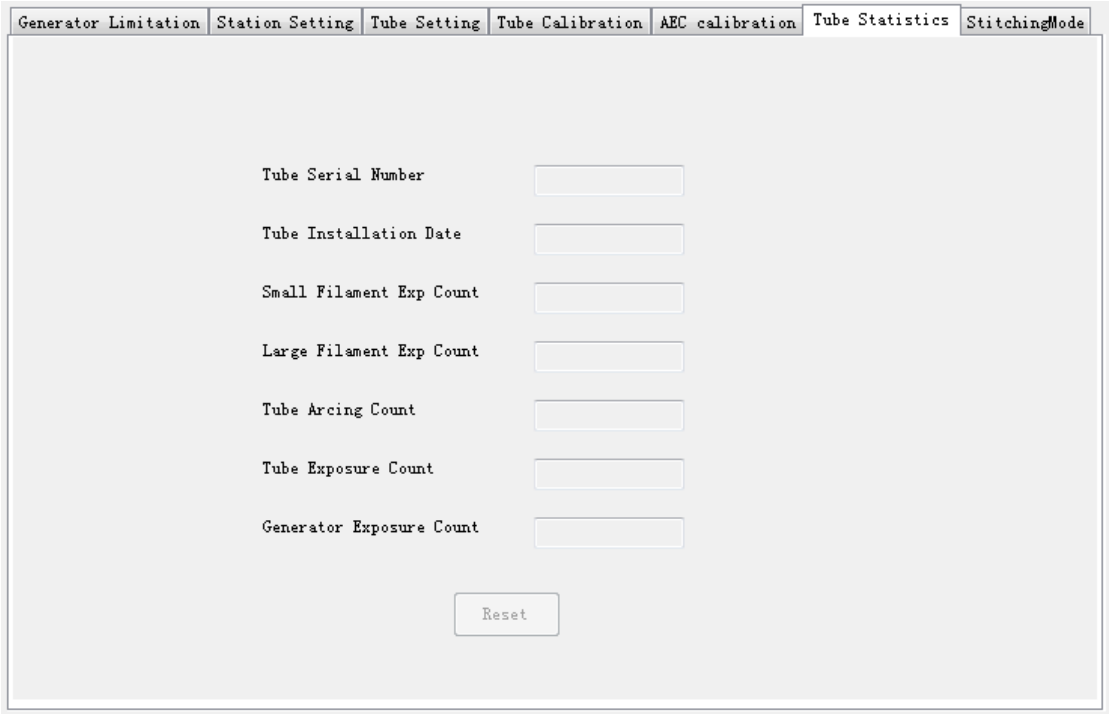


Figure 4-21 Tube statistics

✧ Stitching Mode(Optional)

This function is applied in special fields, not included in the standard product application.

This utility is used to set the parameters of stitching mode. The **Stitching Mode** panel is shown as below.

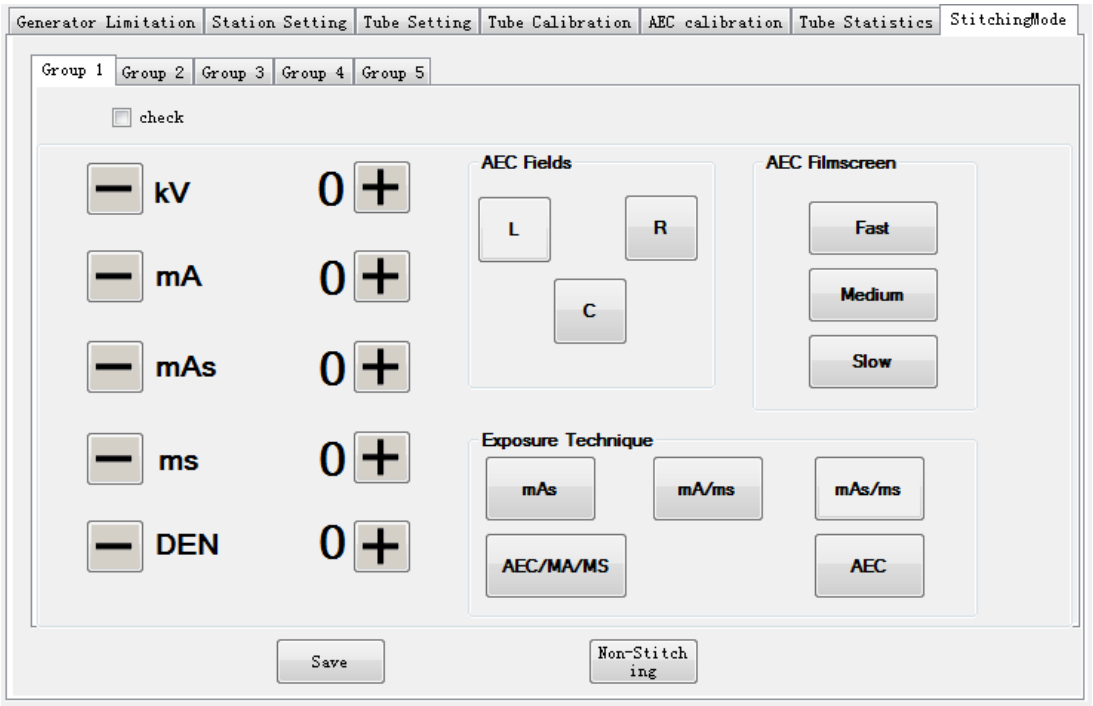


Figure 4-22 Stitching Mode Setting

✧ Tomography Mode(Optional)

This function is applied in special fields, not included in the standard product application.

This utility is used to set the parameters of tomography mode. The **Tomo Mode** panel is shown as below.

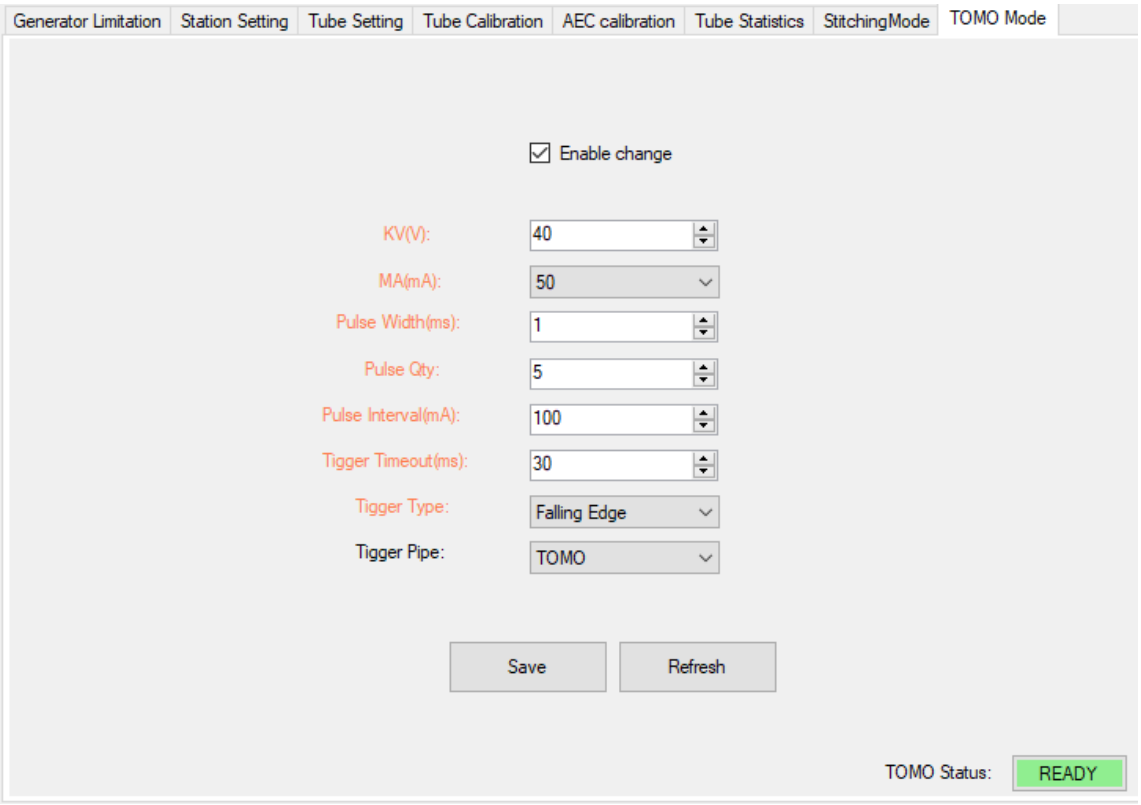


Figure 4-23 Tomo Mode Setting

Introduction of the parameters

1. kV range: 40 ~ 150kV, Step: 1kV
2. mA range: 10 ~ 1000mA according to R'20 Series.
3. Pulse width(ms): 1 ~ 20, Step: 1ms.
4. Pulse quantity: 1 ~ 80, Step: 1.
5. Pulse Interval time(ms): 100 ~ 20000, Step: 1.
6. Trigger type:

   0: Falling Edge 1: Rising Edge
   2: Low Active 3: High Active
7. Trigger Timeout
8. Trigger Pipe:

   0: Inter trigger 1: Bucky1
   2: Bucky2 3: TOMO Trigger

✧ Dual Energy Mode (Optional)

This Dual Energy function is applied in special fields, may be not included in the standard product application.

This utility is used to set the parameters of Dual Energy mode. The **Dual Energy Mode** panel is shown as below.

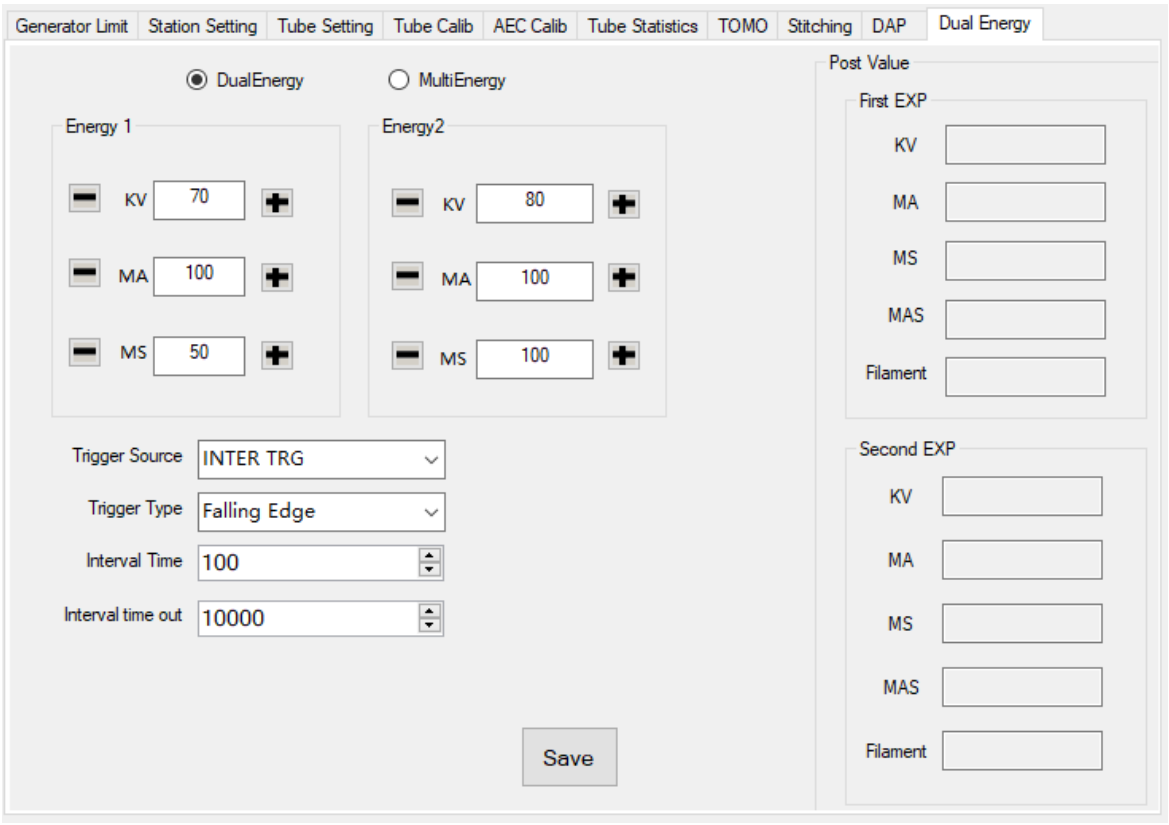


Figure 4-24 Dual Energy Setting

Brief Introduction of Parameters:

Parameters(kV/mA/ms) of Engery1 is for the first shot, meanwhile

Parameters(kV/mA/ms) of Engery2 is for the second one.

The Trigger Source, Trigger Type is for both of two shots.

Interval Time is from 50ms to 10Sec.

Interval Timeout is designed to indicate the warning.

Post parameters are requested after 2 shots finish.

✧ Multi Energy Mode (Optional)

This Multi Energy function is applied in special fields, may be not included in the standard product application.

This utility is used to set the parameters of Multi Energy mode. The **Multi Energy Mode** panel is shown as below.

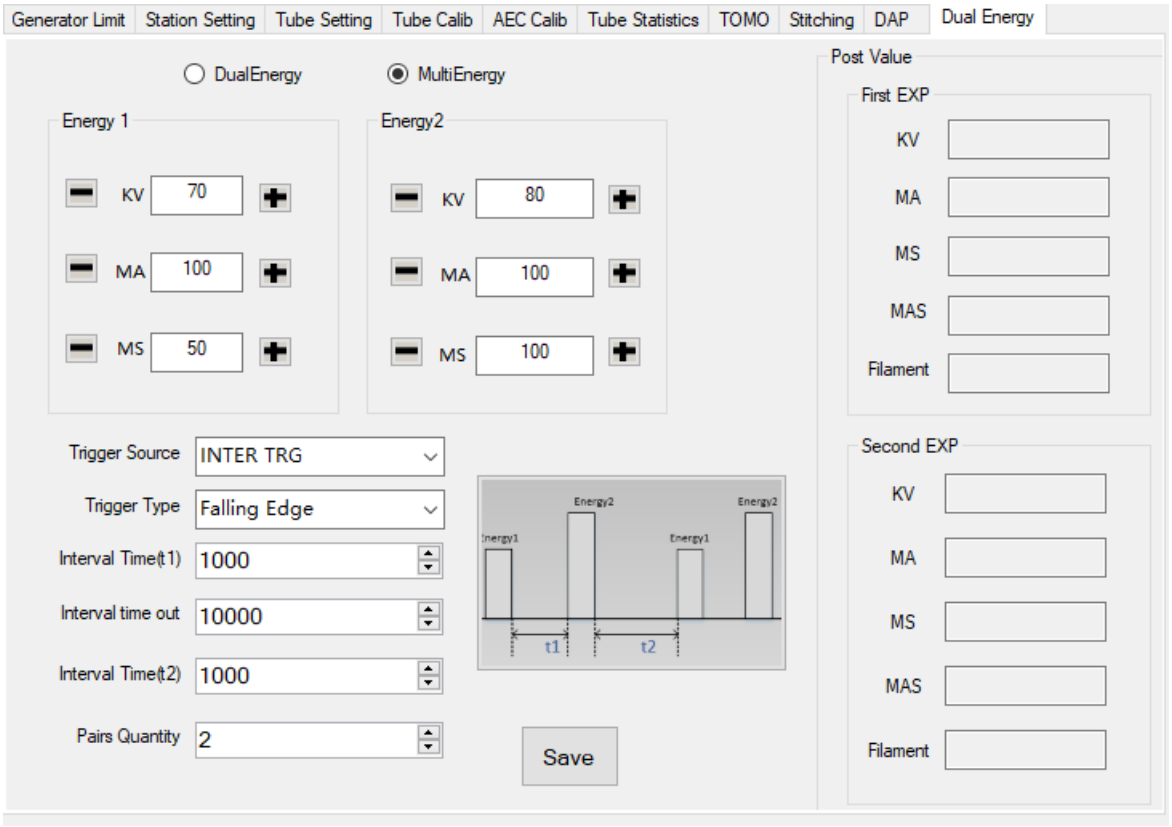


Figure 4-25 Multi Energy Setting

Brief Introduction of Parameters:

Parameters(kV/mA/ms) of Engery1 is for the first shot, meanwhile

Parameters(kV/mA/ms) of Engery2 is for the second one.

The Trigger Source, Trigger Type is for all shots.

Interval Time 1 or 2 is from 50ms to 10Sec.

Interval Timeout 1 or 2 is designed to indicate the warning.

Pairs Quantity is the number of Energy1 and Energy2 combination.

Post parameters are requested after 1 combination finish.

✧ DAP (Optional)

This function is applied in special fields, may be not included in the standard product application.

This utility is used to configure the DAP application. The panel is shown as below.

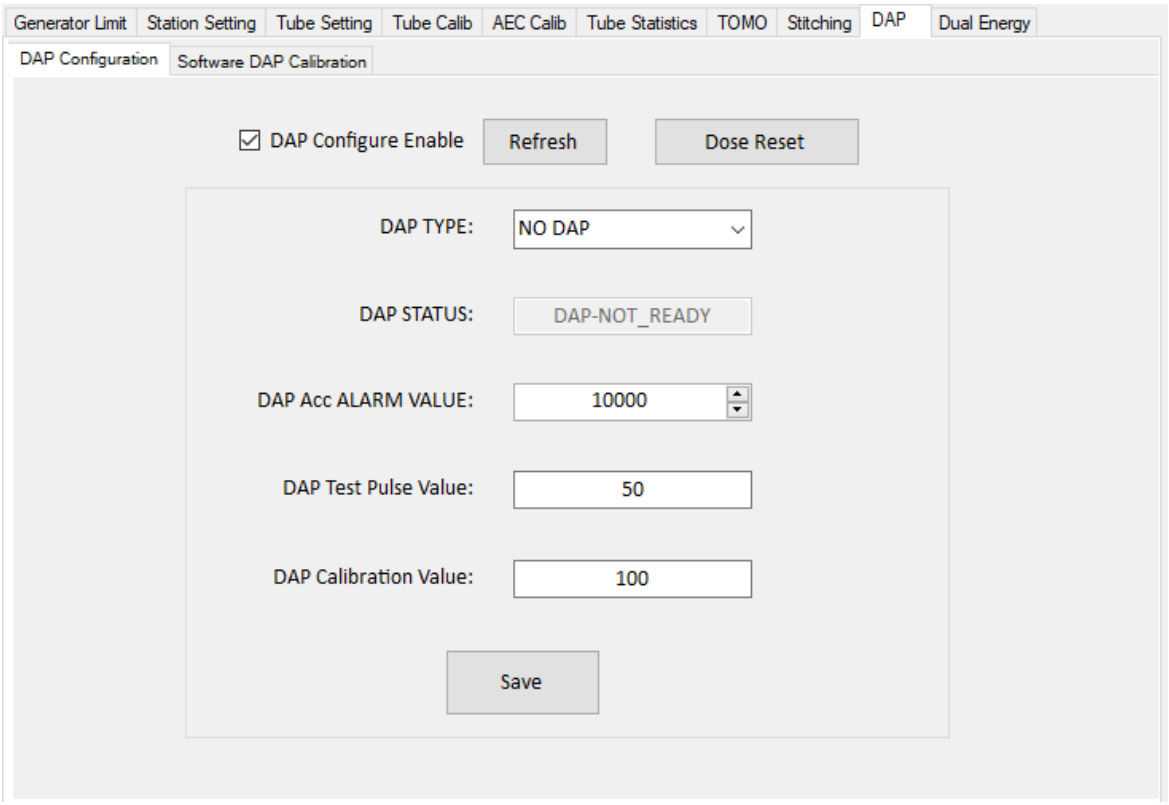


Figure 4-26 DAP configuration

Brief Introduction of Parameters:

DAP Type is for your hardware type.

DAP Status is to show the status of hardware connection.

DAP Acc Alarm Value is a warning of DAP threshold value.

DAP Test Pulse Value is for the test pulse while DAP restarts.

DAP Calibration Value is the DAP correction factor.

If Software DAP is selected, Software Calibration is necessary before it works.

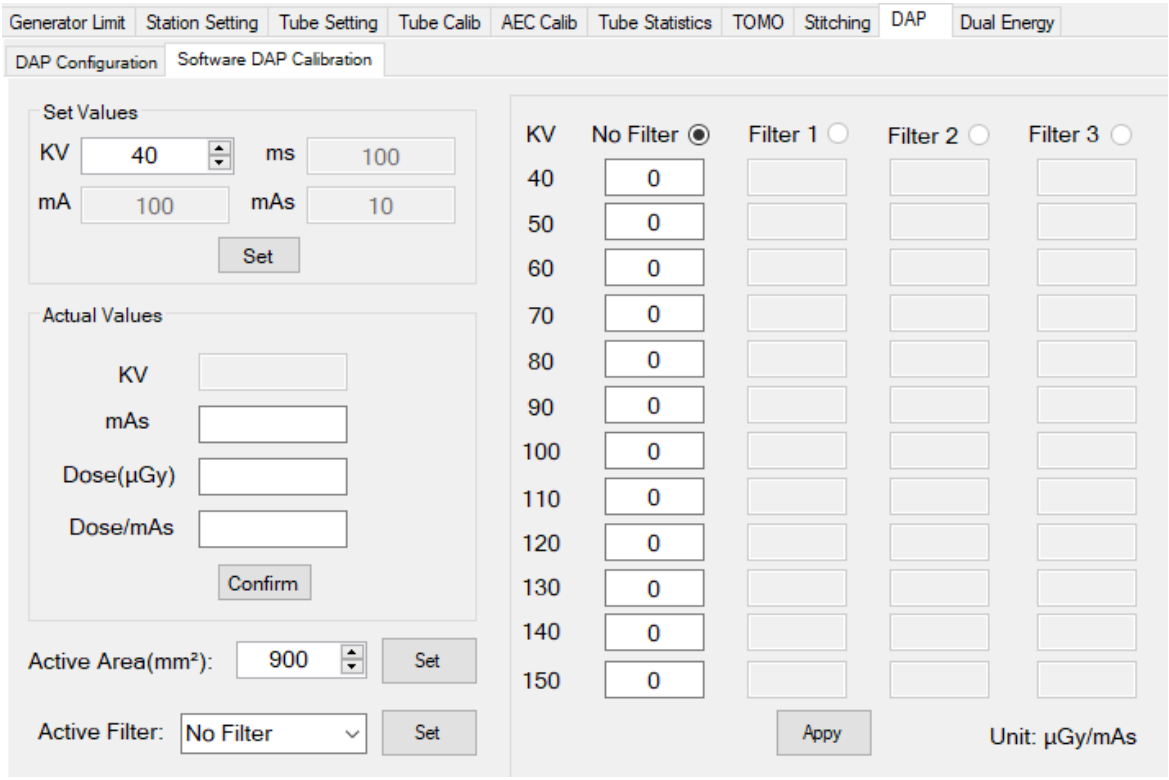


Figure 4-27 Software DAP Calibration

After record the Dose value after exposure finish, and Click ‘Apply’ to save the parameters.

Active Area is received from system to calculate DAP value.

Active Filter : there is 4 available options to cover different applications.

✧ Falling Load Function (Optional)

This function is applied in special fields, may be not included in the standard product application.

This utility is used to compensate the capacity of tube maximum mAs. The panel is shown as below.

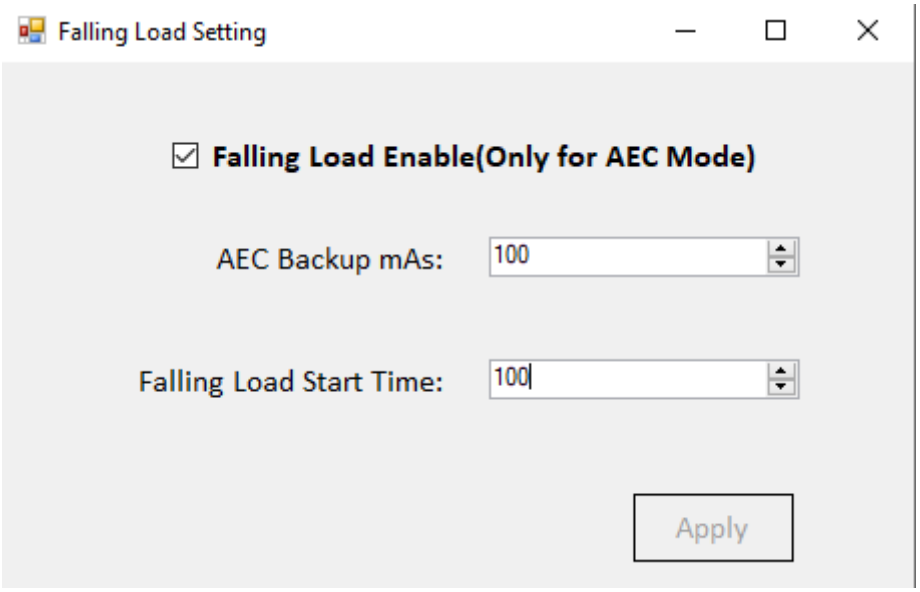


Figure 4-28 Falling Load Configuration

Falling Load is available only for AEC mode to compensate the tube's capacity.

AEC Backup mAs is used to terminate exposure for safety.

Falling Load Start Time is designed to configure the starting time after exposure begins.

✧ Time Compensation (Optional)

This function is applied in special fields, not included in the standard product application.

This utility is used to compensate the exposure time. The panel is shown as below.

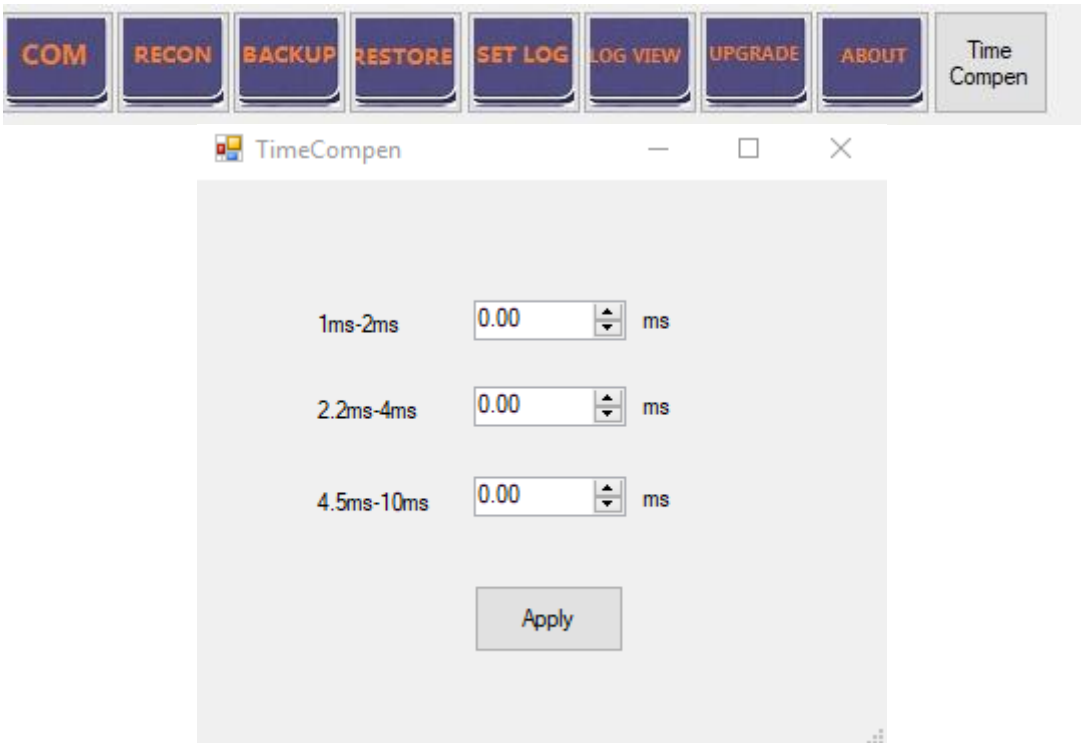


Figure 4-29 Time Compensation Setting

The time compensation is applied to the exposure time not more than 10ms.

The time compensation range is from 0.1 ~ 0.6ms with 0.1ms step.

(This page left blank intended)

Chapter 5 Console

Touch Screen Console (Human Version)

Console Overview

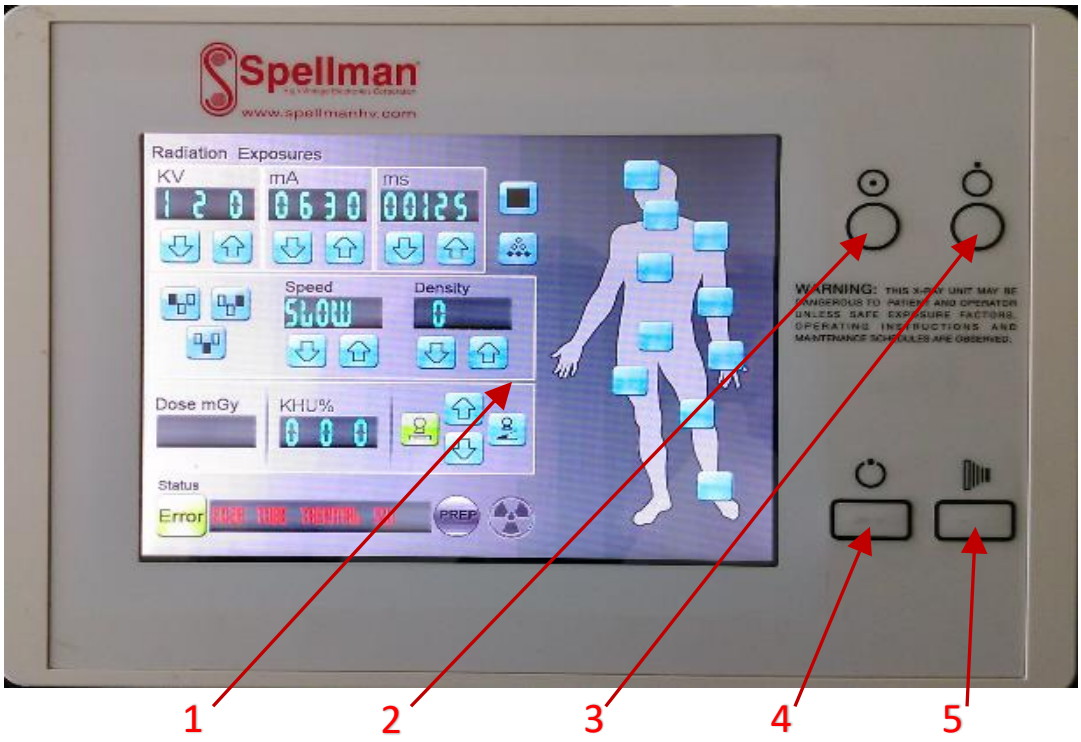
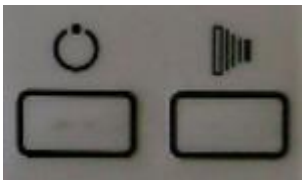


Figure 5-1 Console overview

1. 8 inch touch screen
2. Generator Power ON Button
3. Generator Power OFF Button
4. Preparation Button
5. Exposure ON Button

X-ray control for initiating and terminating



There are two buttons on Touch Screen Console, as above, left one is the “Preparation” button, and right one is the “Exposure” button. An exposure can be made by pressing the “Preparation” button and the “Exposure” button, or made by using the two-stage hand switch.

If the hand switch or any of the “Preparation” and “Exposure” buttons on the Touch Screen Console is released during the exposure, the exposure is terminated instantaneously (dead man switch)

The exposure is terminated under the following conditions:

- When the set mAs product is reached (Manual Mode)
- When the set exposure time is reached (Manual Mode)
- When the automatic exposure control terminates the exposure

Console Cable Connections

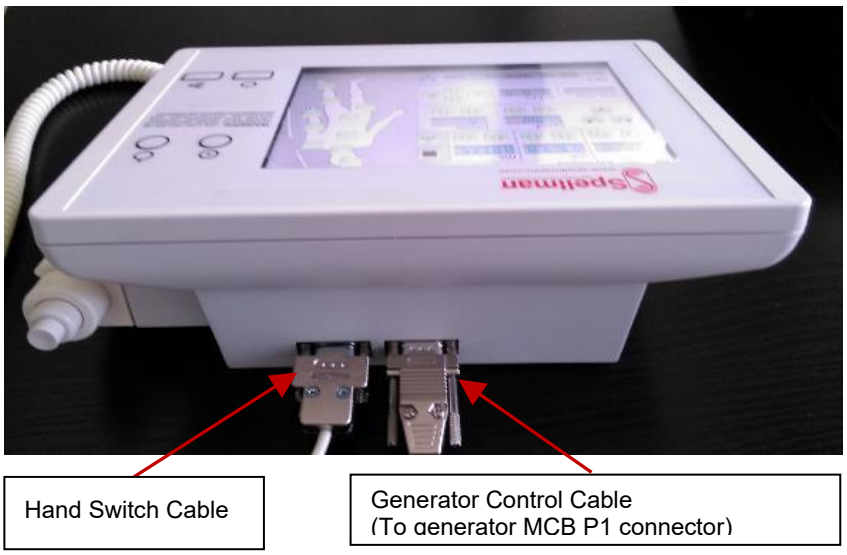


Figure 5-2 Cables connection

** The exposure hand switch & cable assembly and the generator control cable assembly are optional accessories.

Touch Screen Functions

Non-APR Operating Screen

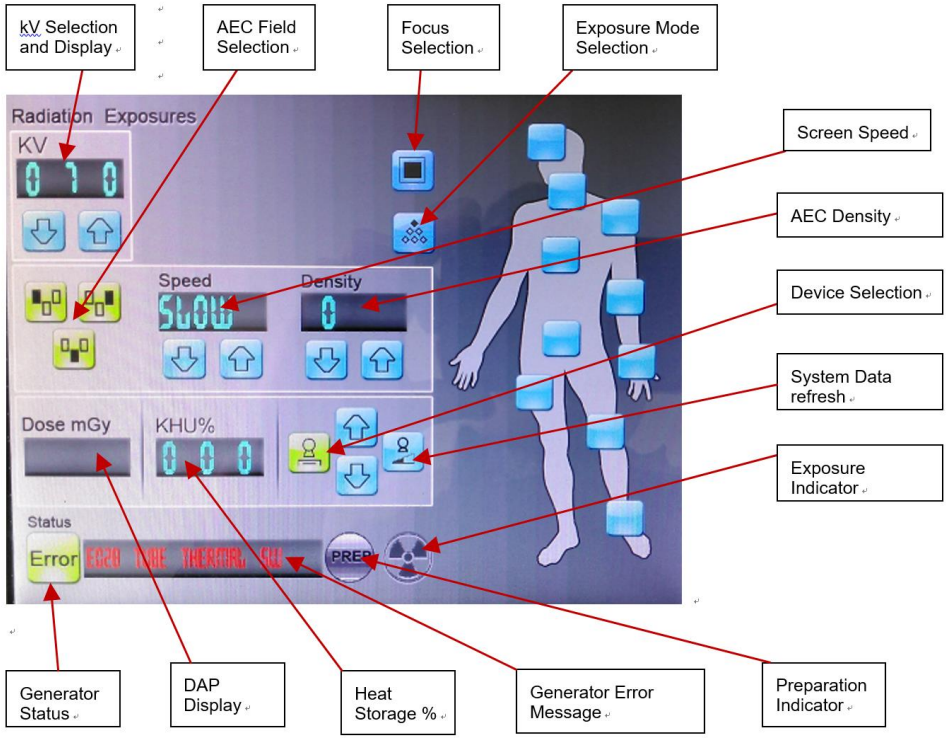


Figure 5-3 Non-APR operation

Clicking Exposure Mode button switches screens among 1-point or 2-point or 3-point exposure mode.

The below pictures show the switch and indicators for AEC selection. There are 3 mode, one-point mode, two-point mode and three-point mode. Press the button, if only the top rhombus change to black, it means AEC mode selected.

One-point mode

Two-point mode

Three-point mode

At 1-point mode, the operator needs to select / confirm the proper kV, AEC Field, Screen Speed, Density and the Device before executing an x-ray exposure.

Below pictures show the field selection of AEC chamber, selected filed will become black

At 2-point mode, the operator needs to select / confirm the proper kV, mAs, Focal Spot Size and the Device before executing an x-ray exposure.

At 3-point mode, the operator needs to select / confirm the proper kV, mA, ms, Focal Spot Size and the Device before executing an x-ray exposure.

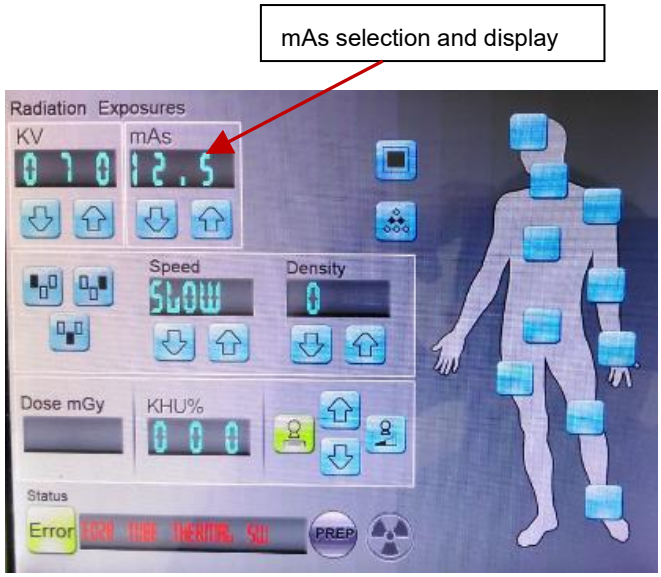


Figure 5-4 mAs selection

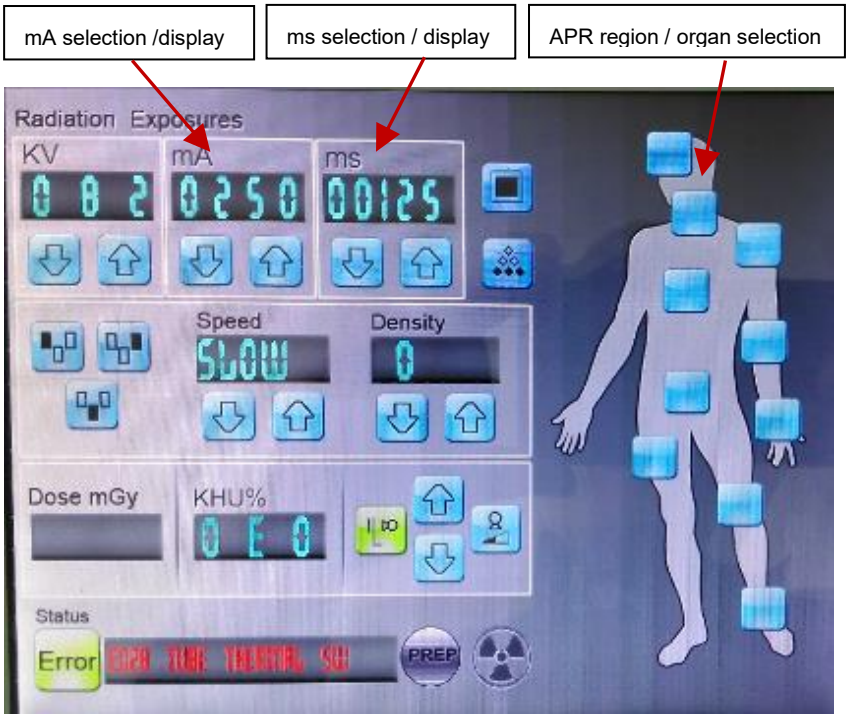


Figure 5-5 mA and ms selection

If an exposure has been terminated by the backup safety device, an error message will be displayed as below picture:

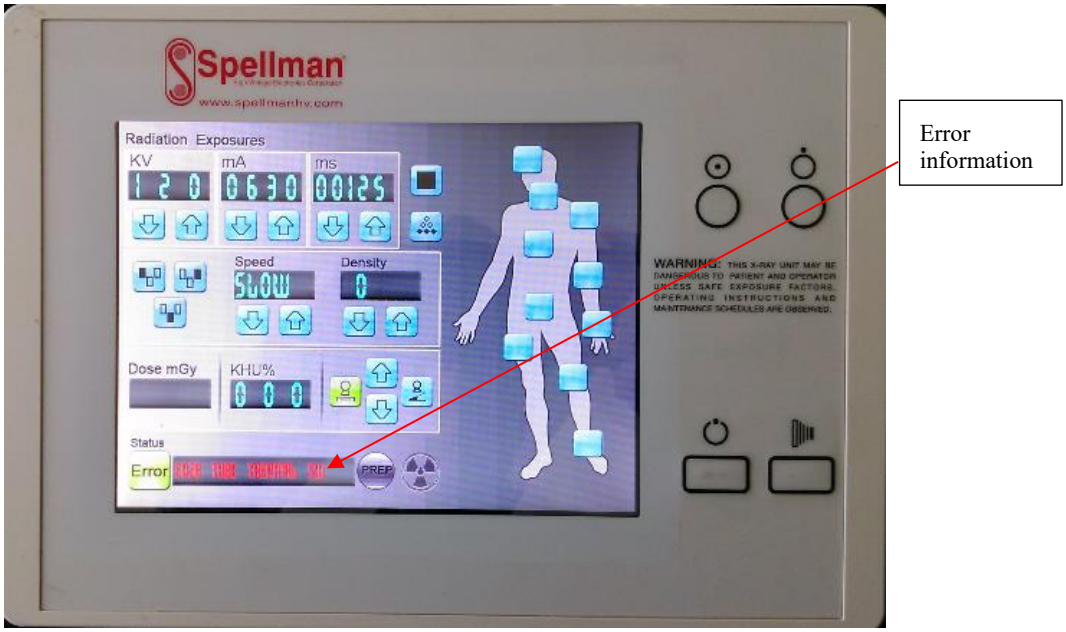


Figure 5-6 *Location of Error information*

Description of Automatic Exposure Control: see Appendix B&C /service manual chapter. If the exposure is interrupted by the monitoring unit or by releasing the exposure switch, an incorrect exposure is indicated, and error information will be displayed in above picture highlighted aera.

The next exposure is inhibited until the incorrect exposure has been confirmed by pressing the highlighted aera.

The following errores are indicated in case of AEC saftey termination

E024	AEC Back-up Timer Exceeded - Exposure Terminated
E025	AEC Back-up MAS Exceeded - Exposure Terminated
E049	AEC is not enable for current reception
E051	AEC Feedback Error (No Feedback Signal Detected)
E055	No AEC field is selected
E057	AEC Stop signal in wrong status
E079	AEC Ion Chamber Disconnect

Clicking any of the APR region / organ button will switch to APR Operating Screen (see section 3.2).

APR Operating Screen

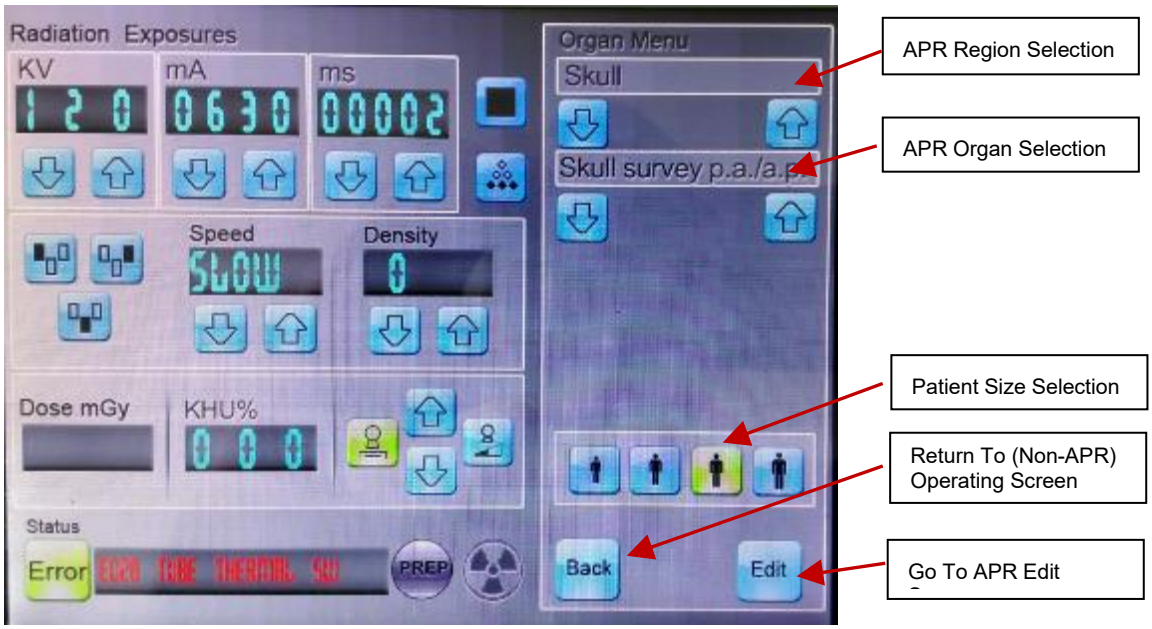


Figure 5-7 APR operation

The exposure parameters (kV @ 1-point mode; kV, mAs @ 2-point mode; kV, mA, ms @ 3-point mode) will be sent to the generator and displayed on the console screen automatically for the selected organ, patient size, focal spot size and exposure mode (1-point or 2 point or 3-point).

Clicking "**Back**" button will return to Non-APR operating screen.

Clicking "**Edit**" button will enter APR Edit screen (see section 3.3).

APR Editing Screen

Figure 5-8 APR editing

APR exposure parameters can be programmed and saved at this screen.

Clicking an existing parameter (kV / mA / ms / mAs) will make the number programmable. Please use the soft keyboard to edit the number and then click "**Enter**" to input the new number.

Clicking "**add**" button will save the programed APR data into the console memory.

Clicking "**back**" button will return to APR Operating Screen.

Note

1).Designated region name, organ name, focal spot size, patience size and exposure mode need to be pre-selected at APR Operating Screen.

2).For Patient Size, there are 4 different body types, from small to large in order:
S: Small; M: Middle; L: Large; XL: Extra Large.

3).For AEC Field (Left/Middle/Right), 1 means selected; 0 means not selected.

4).For Focal Size, 1: small focus; 2: large focus.

5).For Device, 0: horizontal radiography table; 1: vertical radiography stand; 2: tomographic movement without X radiation.

6).For Speed, 0: slow; 1: medium; 2: fast.

Table 5-1 Default APR Region / Organ Table

Region ID	Organ Name	Patient Size	kV	AEC Left	AEC Middle	AEC Right	mA	focal size	device	Density	Speed	ms	mAs
1	Skull survey p.a./a.p.	XL	77	1	1	1	100	1	2	2	1	100	16
2	Skull oblique	XL	73	1	1	1	100	1	2	2	1	100	16
3	Skull axial	XL	85	1	1	1	100	1	2	2	1	100	32
4	Os petrosa sagittal	XL	77	1	1	1	100	1	2	2	1	100	20
5	Os petrosa Stenvers	XL	77	1	1	1	100	1	2	2	1	100	20
6	Optical foramen Rhese	XL	73	1	1	1	100	1	2	2	1	100	16
7	Sinuses p.a.	XL	77	1	1	1	100	1	2	2	1	100	40
8	Nasal bone lateral	XL	44	1	1	1	100	1	0	0	1	100	1.6
9	Mandible lateral	XL	63	1	1	1	100	1	0	0	1	100	10
10	Constance 70kV bucky tab. auto	XL	70	1	1	1	100	2	1	2	1	100	32
11	Constance 100kV wall stand auto	XL	100	1	1	1	100	1	2	2	1	100	5
12	Constance 70kV bucky tab. man.	XL	70	1	1	1	100	2	1	0	1	100	32
13	Worm up	XL	70	1	1	1	100	2	1	0	1	100	32
14	Cervical vertebrae 1-4 ap Dens	XL	66	1	1	1	10	2	2	2	1	3200	13
15	Cervical vertebrae 4-7 a.p.	XL	70	1	1	1	100	2	2	2	1	100	4

16	Cervical spine lateral	XL	73	1	1	1	100	2	2	2	1	100	4
17	Cervical spine oblique	XL	73	1	1	1	100	2	2	2	1	100	4
18	Oesophagus oblique	XL	90	1	1	1	100	2	2	2	1	100	4
19	clavicle tangential	XL	66	1	1	1	100	2	2	2	1	100	13
20	Scapula p.a.	XL	68	1	1	1	100	2	2	2	1	100	16
21	Scapula lateral	XL	73	1	1	1	100	2	2	2	1	100	25
22	Shoulder joint a.p.	XL	66	1	1	1	100	2	2	2	1	100	25
23	Shoulder joint axial	XL	66	1	1	1	100	2	2	2	1	100	13
24	Shoulder no shutter	XL	66	1	1	1	100	2	0	0	1	100	6.2
25	Shoulder transthoraka	XL	90	1	1	1	100	2	2	2	1	100	80
26	Upper arm a.p.	XL	66	1	1	1	100	1	0	0	1	100	5
27	Thoracic spine a.p	XL	77	1	1	1	100	2	2	2	1	100	16
28	Thoracic spine lateral	XL	81	1	1	1	100	2	2	2	1	100	50
29	Thoracic spine oblique	XL	81	1	1	1	16	2	1	2	1	3200	50
30	1.-7. Rib p.a.	XL	70	1	1	1	100	2	2	2	1	100	16
31	8.-12. Rib p.a.	XL	73	1	1	1	100	2	2	2	1	100	16
32	Sternum lateral	XL	85	1	1	1	100	2	2	2	1	100	40
33	Sternum lat. no shutter	XL	85	1	1	1	100	2	0	0	1	100	20
34	Sternum p.a.	XL	77	1	1	1	10	2	2	2	1	3200	16
35	Lungs p.a.	XL	125	1	1	1	100	1	2	5	1	1100	2.5
36	Lungs lateral	XL	125	1	1	1	100	1	2	2	1	100	6.2
37	Lungs a.p. with grid cassette	XL	125	1	1	1	100	1	0	0	1	100	2.5
38	Lungs a.p. bed	XL	85	1	1	1	100	1	0	0	1	100	3.2
39	Lungs lateral (child up to 7)	XL	70	1	1	1	100	1	0	0	1	100	1.6
40	Spine panorama	XL	77	1	1	1	100	2	0	0	1	100	160
41	Spine function	XL	77	1	1	1	100	2	0	0	1	100	160
42	Elbow v.d.	XL	55	1	1	1	100	1	0	0	1	100	5
43	Elbow lateral	XL	55	1	1	1	100	1	0	0	1	100	6.2
44	Forearm v.d.	XL	52	1	1	1	100	1	0	0	1	100	3.2
45	Forearm lateral	XL	52	1	1	1	100	1	0	0	1	100	4
46	Lumbar vertebrae 1-4 a.p.	XL	77	1	1	1	100	1	2	2	1	100	25
47	Lumbar vertebrae 1-4 lateral	XL	90	1	1	1	100	2	2	2	1	100	80

48	Lumbar vertebrae 1-4 oblique	XL	81	1	1	1	100	2	2	2	1	100	40
49	Childs lumbar vertebrae a.p.	XL	72	1	1	1	100	2	2	2	1	100	16
50	Childs lumbar vertebrae lat.	XL	80	1	1	1	100	2	2	2	1	100	50
51	Abdomen survey horizontal	XL	85	1	1	1	100	2	1	5	1	100	13
52	Abdomen survey vertical	XL	87	1	1	1	100	2	2	5	1	100	13
53	Abdomen survey lat. position	XL	90	1	1	1	100	2	1	2	1	100	25
54	Hip a.p., axial	XL	77	1	1	1	100	2	1	2	1	100	40
55	Pelvis	XL	77	1	1	1	100	2	2	5	1	100	32
56	Sacrum, coccyx a.p.	XL	77	1	1	1	100	2	2	2	1	100	25
57	Sacrum, coccyx lateral	XL	90	1	1	1	100	2	2	2	1	100	50
58	Urinary bladder a.p.	XL	81	1	1	1	100	2	2	2	1	100	8
59	Urinary bladder axial	XL	85	1	1	1	100	2	2	2	1	100	13
60	Wrist d.v.	XL	48	1	1	1	100	1	0	0	1	100	8
61	Wrist lateral	XL	48	1	1	1	100	1	0	0	1	100	10
62	Wrist d.v. plaster	XL	52	1	1	1	100	1	0	0	1	100	13
63	Wrist lateral plaster	XL	52	1	1	1	100	1	0	0	1	100	16
64	Hand d.v.	XL	46	1	1	1	100	1	0	0	1	100	6.2
65	Hand lateral/oblique	XL	48	1	1	1	100	1	0	0	1	100	8
66	Finger lateral/oblique	XL	46	1	1	1	100	1	0	0	1	100	6.2
67	Finger baby	XL	43	1	1	1	100	1	0	0	1	100	3.2
68	Femur upper ap	XL	73	1	1	1	100	2	2	2	1	100	13
69	Femur lower se	XL	73	1	1	1	100	2	2	2	1	100	10
70	Leg panorama	XL	77	1	1	1	100	2	0	0	1	100	63
71	Knee a.p.	XL	66	1	1	1	100	2	2	2	1	100	10
72	Knee lateral	XL	66	1	1	1	100	2	2	2	1	100	8
73	Knee-joint	XL	63	1	1	1	100	2	2	2	1	100	10
74	Patella p.a.	XL	65	1	1	1	100	2	2	2	1	100	8
75	Patella axial	XL	63	1	1	1	100	2	2	2	1	100	8
76	Lower leg a.p.	XL	57	1	1	1	100	2	1	2	1	100	4
77	Lower leg lateral	XL	57	1	1	1	100	2	1	2	1	100	3.2
78	Ankle a.p.	XL	55	1	1	1	100	1	0	0	1	100	10
79	Ankle lateral	XL	53	1	1	1	100	1	0	0	1	100	10
80	Heel bone axial	XL	55	1	1	1	100	1	0	0	1	100	6.2
81	Heel bone lateral	XL	52	1	1	1	100	1	0	0	1	100	8

82	Metatarsus d.pl.	XL	50	1	1	1	100	1	0	0	1	100	6.2
83	Metatarsus oblique	XL	50	1	1	1	100	1	0	0	1	100	6.2
84	Foot lateral	XL	55	1	1	1	100	1	0	0	1	100	8
85	Forefoot	XL	48	1	1	1	100	1	0	0	1	100	6.2
86	Toes a.p./oblique	XL	46	1	1	1	100	1	0	0	1	100	5
87	Skull survey p.a./a.p.	L	77	1	1	1	100	1	2	2	1	100	16
88	Skull oblique	L	73	1	1	1	100	1	2	2	1	100	16
89	Skull axial	L	85	1	1	1	100	1	2	2	1	100	32
90	Os petrosa sagittal	L	77	1	1	1	100	1	2	2	1	100	20
91	Os petrosa Stenvers	L	77	1	1	1	100	1	2	2	1	100	20
92	Optical foramen Rhese	L	73	1	1	1	100	1	2	2	1	100	16
93	Sinuses p.a.	L	77	1	1	1	100	1	2	2	1	100	40
94	Nasal bone lateral	L	44	1	1	1	100	1	0	0	1	100	1.6
95	Mandible lateral	L	63	1	1	1	100	1	0	0	1	100	10
96	Constance 70kV bucky tab. auto	L	70	1	1	1	100	2	1	2	1	100	32
97	Constance 100kV wall stand auto	L	100	1	1	1	100	1	2	2	1	100	5
98	Constance 70kV bucky tab. man.	L	70	1	1	1	100	2	1	0	1	100	32
99	Worm up	L	70	1	1	1	100	2	1	0	1	100	32
100	Cervical vertebrae 1-4 ap Dens	L	66	1	1	1	10	2	2	2	1	3200	13
101	Cervical vertebrae 4-7 a.p.	L	70	1	1	1	100	2	2	2	1	100	4
102	Cervical spine lateral	L	73	1	1	1	100	2	2	2	1	100	4
103	Cervical spine oblique	L	73	1	1	1	100	2	2	2	1	100	4
104	Oesophagus oblique	L	90	1	1	1	100	2	2	2	1	100	4
105	clavicle tangential	L	66	1	1	1	100	2	2	2	1	100	13
106	Scapula p.a.	L	68	1	1	1	100	2	2	2	1	100	16
107	Scapula lateral	L	73	1	1	1	100	2	2	2	1	100	25
108	Shoulder joint a.p.	L	66	1	1	1	100	2	2	2	1	100	25
109	Shoulder joint axial	L	66	1	1	1	100	2	2	2	1	100	13
110	Shoulder no shutter	L	66	1	1	1	100	2	0	0	1	100	6.2
111	Shoulder transthoraka	L	90	1	1	1	100	2	2	2	1	100	80
112	Upper arm a.p.	L	66	1	1	1	100	1	0	0	1	100	5
113	Thoracic spine a.p	L	77	1	1	1	100	2	2	2	1	100	16

114	Thoracic spine lateral	L	81	1	1	1	100	2	2	2	1	100	50
115	Thoracic spine oblique	L	81	1	1	1	16	2	1	2	1	3200	50
116	1.-7. Rib p.a.	L	70	1	1	1	100	2	2	2	1	100	16
117	8.-12. Rib p.a.	L	73	1	1	1	100	2	2	2	1	100	16
118	Sternum lateral	L	85	1	1	1	100	2	2	2	1	100	40
119	Sternum lat. no shutter	L	85	1	1	1	100	2	0	0	1	100	20
120	Sternum p.a.	L	77	1	1	1	10	2	2	2	1	3200	16
121	Lungs p.a.	L	125	1	1	1	100	1	2	5	1	1100	2.5
122	Lungs lateral	L	125	1	1	1	100	1	2	2	1	100	6.2
123	Lungs a.p. with grid cassette	L	125	1	1	1	100	1	0	0	1	100	2.5
124	Lungs a.p. bed	L	85	1	1	1	100	1	0	0	1	100	3.2
125	Lungs lateral (child up to 7)	L	70	1	1	1	100	1	0	0	1	100	1.6
126	Spine panorama	L	77	1	1	1	100	2	0	0	1	100	160
127	Spine function	L	77	1	1	1	100	2	0	0	1	100	160
128	Elbow v.d.	L	55	1	1	1	100	1	0	0	1	100	5
129	Elbow lateral	L	55	1	1	1	100	1	0	0	1	100	6.2
130	Forearm v.d.	L	52	1	1	1	100	1	0	0	1	100	3.2
131	Forearm lateral	L	52	1	1	1	100	1	0	0	1	100	4
132	Lumbar vertebrae 1-4 a.p.	L	77	1	1	1	100	1	2	2	1	100	25
133	Lumbar vertebrae 1-4 lateral	L	90	1	1	1	100	2	2	2	1	100	80
134	Lumbar vertebrae 1-4 oblique	L	81	1	1	1	100	2	2	2	1	100	40
135	Childs lumbar vertebrae a.p.	L	72	1	1	1	100	2	2	2	1	100	16
136	Childs lumbar vertebrae lat.	L	80	1	1	1	100	2	2	2	1	100	50
137	Abdomen survey horizontal	L	85	1	1	1	100	2	1	5	1	100	13
138	Abdomen survey vertical	L	87	1	1	1	100	2	2	5	1	100	13
139	Abdomen survey lat. position	L	90	1	1	1	100	2	1	2	1	100	25
140	Hip a.p., axial	L	77	1	1	1	100	2	1	2	1	100	40
141	Pelvis	L	77	1	1	1	100	2	2	5	1	100	32
142	Sacrum, coccyx a.p.	L	77	1	1	1	100	2	2	2	1	100	25
143	Sacrum, coccyx lateral	L	90	1	1	1	100	2	2	2	1	100	50

144	Urinary bladder a.p.	L	81	1	1	1	100	2	2	2	1	100	8
145	Urinary bladder axial	L	85	1	1	1	100	2	2	2	1	100	13
146	Wrist d.v.	L	48	1	1	1	100	1	0	0	1	100	8
147	Wrist lateral	L	48	1	1	1	100	1	0	0	1	100	10
148	Wrist d.v. plaster	L	52	1	1	1	100	1	0	0	1	100	13
149	Wrist lateral plaster	L	52	1	1	1	100	1	0	0	1	100	16
150	Hand d.v.	L	46	1	1	1	100	1	0	0	1	100	6.2
151	Hand lateral/oblique	L	48	1	1	1	100	1	0	0	1	100	8
152	Finger lateral/oblique	L	46	1	1	1	100	1	0	0	1	100	6.2
153	Finger baby	L	43	1	1	1	100	1	0	0	1	100	3.2
154	Femur upper ap	L	73	1	1	1	100	2	2	2	1	100	13
155	Femur lower se	L	73	1	1	1	100	2	2	2	1	100	10
156	Leg panorama	L	77	1	1	1	100	2	0	0	1	100	63
157	Knee a.p.	L	66	1	1	1	100	2	2	2	1	100	10
158	Knee lateral	L	66	1	1	1	100	2	2	2	1	100	8
159	Knee-joint	L	63	1	1	1	100	2	2	2	1	100	10
160	Patella p.a.	L	65	1	1	1	100	2	2	2	1	100	8
161	Patella axial	L	63	1	1	1	100	2	2	2	1	100	8
162	Lower leg a.p.	L	57	1	1	1	100	2	1	2	1	100	4
163	Lower leg lateral	L	57	1	1	1	100	2	1	2	1	100	3.2
164	Ankle a.p.	L	55	1	1	1	100	1	0	0	1	100	10
165	Ankle lateral	L	53	1	1	1	100	1	0	0	1	100	10
166	Heel bone axial	L	55	1	1	1	100	1	0	0	1	100	6.2
167	Heel bone lateral	L	52	1	1	1	100	1	0	0	1	100	8
168	Metatarsus d.pl.	L	50	1	1	1	100	1	0	0	1	100	6.2
169	Metatarsus oblique	L	50	1	1	1	100	1	0	0	1	100	6.2
170	Foot lateral	L	55	1	1	1	100	1	0	0	1	100	8
171	Forefoot	L	48	1	1	1	100	1	0	0	1	100	6.2
172	Toes a.p./oblique	L	46	1	1	1	100	1	0	0	1	100	5
173	Skull survey p.a./a.p.	M	77	1	1	1	100	1	2	2	1	100	16
174	Skull oblique	M	73	1	1	1	100	1	2	2	1	100	16
175	Skull axial	M	85	1	1	1	100	1	2	2	1	100	32
176	Os petrosa sagittal	M	77	1	1	1	100	1	2	2	1	100	20
177	Os petrosa Stenvers	M	77	1	1	1	100	1	2	2	1	100	20
178	Optical foramen Rhese	M	73	1	1	1	100	1	2	2	1	100	16
179	Sinuses p.a.	M	77	1	1	1	100	1	2	2	1	100	40
180	Nasal bone lateral	M	44	1	1	1	100	1	0	0	1	100	1.6

181	Mandible lateral	M	63	1	1	1	100	1	0	0	1	100	10
182	Constance 70kV bucky tab. auto	M	70	1	1	1	100	2	1	2	1	100	32
183	Constance 100kV wall stand auto	M	100	1	1	1	100	1	2	2	1	100	5
184	Constance 70kV bucky tab. man.	M	70	1	1	1	100	2	1	0	1	100	32
185	Worm up	M	70	1	1	1	100	2	1	0	1	100	32
186	Cervical vertebrae 1-4 ap Dens	M	66	1	1	1	10	2	2	2	1	3200	13
187	Cervical vertebrae 4-7 a.p.	M	70	1	1	1	100	2	2	2	1	100	4
188	Cervical spine lateral	M	73	1	1	1	100	2	2	2	1	100	4
189	Cervical spine oblique	M	73	1	1	1	100	2	2	2	1	100	4
190	Oesophagus oblique	M	90	1	1	1	100	2	2	2	1	100	4
191	clavicle tangential	M	66	1	1	1	100	2	2	2	1	100	13
192	Scapula p.a.	M	68	1	1	1	100	2	2	2	1	100	16
193	Scapula lateral	M	73	1	1	1	100	2	2	2	1	100	25
194	Shoulder joint a.p.	M	66	1	1	1	100	2	2	2	1	100	25
195	Shoulder joint axial	M	66	1	1	1	100	2	2	2	1	100	13
196	Shoulder no shutter	M	66	1	1	1	100	2	0	0	1	100	6.2
197	Shoulder transthoraka	M	90	1	1	1	100	2	2	2	1	100	80
198	Upper arm a.p.	M	66	1	1	1	100	1	0	0	1	100	5
199	Thoracic spine a.p	M	77	1	1	1	100	2	2	2	1	100	16
200	Thoracic spine lateral	M	81	1	1	1	100	2	2	2	1	100	50
201	Thoracic spine oblique	M	81	1	1	1	16	2	1	2	1	3200	50
202	1.-7. Rib p.a.	M	70	1	1	1	100	2	2	2	1	100	16
203	8.-12. Rib p.a.	M	73	1	1	1	100	2	2	2	1	100	16
204	Sternum lateral	M	85	1	1	1	100	2	2	2	1	100	40
205	Sternum lat. no shutter	M	85	1	1	1	100	2	0	0	1	100	20
206	Sternum p.a.	M	77	1	1	1	10	2	2	2	1	3200	16
207	Lungs p.a.	M	125	1	1	1	100	1	2	5	1	1100	2.5
208	Lungs lateral	M	125	1	1	1	100	1	2	2	1	100	6.2
209	Lungs a.p. with grid cassette	M	125	1	1	1	100	1	0	0	1	100	2.5
210	Lungs a.p. bed	M	85	1	1	1	100	1	0	0	1	100	3.2

211	Lungs lateral (child up to 7)	M	70	1	1	1	100	1	0	0	1	100	1.6
212	Spine panorama	M	77	1	1	1	100	2	0	0	1	100	160
213	Spine function	M	77	1	1	1	100	2	0	0	1	100	160
214	Elbow v.d.	M	55	1	1	1	100	1	0	0	1	100	5
215	Elbow lateral	M	55	1	1	1	100	1	0	0	1	100	6.2
216	Forearm v.d.	M	52	1	1	1	100	1	0	0	1	100	3.2
217	Forearm lateral	M	52	1	1	1	100	1	0	0	1	100	4
218	Lumbar vertebrae 1-4 a.p.	M	77	1	1	1	100	1	2	2	1	100	25
219	Lumbar vertebrae 1-4 lateral	M	90	1	1	1	100	2	2	2	1	100	80
220	Lumbar vertebrae 1-4 oblique	M	81	1	1	1	100	2	2	2	1	100	40
221	Childs lumbar vertebrae a.p.	M	72	1	1	1	100	2	2	2	1	100	16
222	Childs lumbar vertebrae lat.	M	80	1	1	1	100	2	2	2	1	100	50
223	Abdomen survey horizontal	M	85	1	1	1	100	2	1	5	1	100	13
224	Abdomen survey vertical	M	87	1	1	1	100	2	2	5	1	100	13
225	Abdomen survey lat. position	M	90	1	1	1	100	2	1	2	1	100	25
226	Hip a.p., axial	M	77	1	1	1	100	2	1	2	1	100	40
227	Pelvis	M	77	1	1	1	100	2	2	5	1	100	32
228	Sacrum, coccyx a.p.	M	77	1	1	1	100	2	2	2	1	100	25
229	Sacrum, coccyx lateral	M	90	1	1	1	100	2	2	2	1	100	50
230	Urinary bladder a.p.	M	81	1	1	1	100	2	2	2	1	100	8
231	Urinary bladder axial	M	85	1	1	1	100	2	2	2	1	100	13
232	Wrist d.v.	M	48	1	1	1	100	1	0	0	1	100	8
233	Wrist lateral	M	48	1	1	1	100	1	0	0	1	100	10
234	Wrist d.v. plaster	M	52	1	1	1	100	1	0	0	1	100	13
235	Wrist lateral plaster	M	52	1	1	1	100	1	0	0	1	100	16
236	Hand d.v.	M	46	1	1	1	100	1	0	0	1	100	6.2
237	Hand lateral/oblique	M	48	1	1	1	100	1	0	0	1	100	8
238	Finger lateral/oblique	M	46	1	1	1	100	1	0	0	1	100	6.2
239	Finger baby	M	43	1	1	1	100	1	0	0	1	100	3.2
240	Femur upper ap	M	73	1	1	1	100	2	2	2	1	100	13
241	Femur lower se	M	73	1	1	1	100	2	2	2	1	100	10

242	Leg panorama	M	77	1	1	1	100	2	0	0	1	100	63
243	Knee a.p.	M	66	1	1	1	100	2	2	2	1	100	10
244	Knee lateral	M	66	1	1	1	100	2	2	2	1	100	8
245	Knee-joint	M	63	1	1	1	100	2	2	2	1	100	10
246	Patella p.a.	M	65	1	1	1	100	2	2	2	1	100	8
247	Patella axial	M	63	1	1	1	100	2	2	2	1	100	8
248	Lower leg a.p.	M	57	1	1	1	100	2	1	2	1	100	4
249	Lower leg lateral	M	57	1	1	1	100	2	1	2	1	100	3.2
250	Ankle a.p.	M	55	1	1	1	100	1	0	0	1	100	10
251	Ankle lateral	M	53	1	1	1	100	1	0	0	1	100	10
252	Heel bone axial	M	55	1	1	1	100	1	0	0	1	100	6.2
253	Heel bone lateral	M	52	1	1	1	100	1	0	0	1	100	8
254	Metatarsus d.pl.	M	50	1	1	1	100	1	0	0	1	100	6.2
255	Metatarsus oblique	M	50	1	1	1	100	1	0	0	1	100	6.2
256	Foot lateral	M	55	1	1	1	100	1	0	0	1	100	8
257	Forefoot	M	48	1	1	1	100	1	0	0	1	100	6.2
258	Toes a.p./oblique	M	46	1	1	1	100	1	0	0	1	100	5
259	Skull survey p.a./a.p.	S	77	1	1	1	100	1	2	2	1	100	16
260	Skull oblique	S	73	1	1	1	100	1	2	2	1	100	16
261	Skull axial	S	85	1	1	1	100	1	2	2	1	100	32
262	Os petrosa sagittal	S	77	1	1	1	100	1	2	2	1	100	20
263	Os petrosa Stenvers	S	77	1	1	1	100	1	2	2	1	100	20
264	Optical foramen Rhese	S	73	1	1	1	100	1	2	2	1	100	16
265	Sinuses p.a.	S	77	1	1	1	100	1	2	2	1	100	40
266	Nasal bone lateral	S	44	1	1	1	100	1	0	0	1	100	1.6
267	Mandible lateral	S	63	1	1	1	100	1	0	0	1	100	10
268	Constance 70kV bucky tab. auto	S	70	1	1	1	100	2	1	2	1	100	32
269	Constance 100kV wall stand auto	S	100	1	1	1	100	1	2	2	1	100	5
270	Constance 70kV bucky tab. man.	S	70	1	1	1	100	2	1	0	1	100	32
271	Worm up	S	70	1	1	1	100	2	1	0	1	100	32
272	Cervical vertebrae 1-4 ap Dens	S	66	1	1	1	10	2	2	2	1	3200	13
273	Cervical vertebrae 4-7 a.p.	S	70	1	1	1	100	2	2	2	1	100	4
274	Cervical spine lateral	S	73	1	1	1	100	2	2	2	1	100	4
275	Cervical spine oblique	S	73	1	1	1	100	2	2	2	1	100	4

276	Oesophagus oblique	S	90	1	1	1	100	2	2	2	1	100	4
277	clavicle tangential	S	66	1	1	1	100	2	2	2	1	100	13
278	Scapula p.a.	S	68	1	1	1	100	2	2	2	1	100	16
279	Scapula lateral	S	73	1	1	1	100	2	2	2	1	100	25
280	Shoulder joint a.p.	S	66	1	1	1	100	2	2	2	1	100	25
281	Shoulder joint axial	S	66	1	1	1	100	2	2	2	1	100	13
282	Shoulder no shutter	S	66	1	1	1	100	2	0	0	1	100	6.2
283	Shoulder transthoraka	S	90	1	1	1	100	2	2	2	1	100	80
284	Upper arm a.p.	S	66	1	1	1	100	1	0	0	1	100	5
285	Thoracic spine a.p	S	77	1	1	1	100	2	2	2	1	100	16
286	Thoracic spine lateral	S	81	1	1	1	100	2	2	2	1	100	50
287	Thoracic spine oblique	S	81	1	1	1	16	2	1	2	1	3200	50
288	1.-7. Rib p.a.	S	70	1	1	1	100	2	2	2	1	100	16
289	8.-12. Rib p.a.	S	73	1	1	1	100	2	2	2	1	100	16
290	Sternum lateral	S	85	1	1	1	100	2	2	2	1	100	40
291	Sternum lat. no shutter	S	85	1	1	1	100	2	0	0	1	100	20
292	Sternum p.a.	S	77	1	1	1	10	2	2	2	1	3200	16
293	Lungs p.a.	S	125	1	1	1	100	1	2	5	1	1100	2.5
294	Lungs lateral	S	125	1	1	1	100	1	2	2	1	100	6.2
295	Lungs a.p. with grid cassette	S	125	1	1	1	100	1	0	0	1	100	2.5
296	Lungs a.p. bed	S	85	1	1	1	100	1	0	0	1	100	3.2
297	Lungs lateral (child up to 7)	S	70	1	1	1	100	1	0	0	1	100	1.6
298	Spine panorama	S	77	1	1	1	100	2	0	0	1	100	160
299	Spine function	S	77	1	1	1	100	2	0	0	1	100	160
300	Elbow v.d.	S	55	1	1	1	100	1	0	0	1	100	5
301	Elbow lateral	S	55	1	1	1	100	1	0	0	1	100	6.2
302	Forearm v.d.	S	52	1	1	1	100	1	0	0	1	100	3.2
303	Forearm lateral	S	52	1	1	1	100	1	0	0	1	100	4
304	Lumbar vertebrae 1-4 a.p.	S	77	1	1	1	100	1	2	2	1	100	25
305	Lumbar vertebrae 1-4 lateral	S	90	1	1	1	100	2	2	2	1	100	80
306	Lumbar vertebrae 1-4 oblique	S	81	1	1	1	100	2	2	2	1	100	40
307	Childs lumbar vertebrae a.p.	S	72	1	1	1	100	2	2	2	1	100	16

308	Childs lumbar vertebrae lat.	S	80	1	1	1	100	2	2	2	1	100	50
309	Abdomen survey horizontal	S	85	1	1	1	100	2	1	5	1	100	13
310	Abdomen survey vertical	S	87	1	1	1	100	2	2	5	1	100	13
311	Abdomen survey lat. position	S	90	1	1	1	100	2	1	2	1	100	25
312	Hip a.p., axial	S	77	1	1	1	100	2	1	2	1	100	40
313	Pelvis	S	77	1	1	1	100	2	2	5	1	100	32
314	Sacrum, coccyx a.p.	S	77	1	1	1	100	2	2	2	1	100	25
315	Sacrum, coccyx lateral	S	90	1	1	1	100	2	2	2	1	100	50
316	Urinary bladder a.p.	S	81	1	1	1	100	2	2	2	1	100	8
317	Urinary bladder axial	S	85	1	1	1	100	2	2	2	1	100	13
318	Wrist d.v.	S	48	1	1	1	100	1	0	0	1	100	8
319	Wrist lateral	S	48	1	1	1	100	1	0	0	1	100	10
320	Wrist d.v. plaster	S	52	1	1	1	100	1	0	0	1	100	13
321	Wrist lateral plaster	S	52	1	1	1	100	1	0	0	1	100	16
322	Hand d.v.	S	46	1	1	1	100	1	0	0	1	100	6.2
323	Hand lateral/oblique	S	48	1	1	1	100	1	0	0	1	100	8
324	Finger lateral/oblique	S	46	1	1	1	100	1	0	0	1	100	6.2
325	Finger baby	S	43	1	1	1	100	1	0	0	1	100	3.2
326	Femur upper ap	S	73	1	1	1	100	2	2	2	1	100	13
327	Femur lower se	S	73	1	1	1	100	2	2	2	1	100	10
328	Leg panorama	S	77	1	1	1	100	2	0	0	1	100	63
329	Knee a.p.	S	66	1	1	1	100	2	2	2	1	100	10
330	Knee lateral	S	66	1	1	1	100	2	2	2	1	100	8
331	Knee-joint	S	63	1	1	1	100	2	2	2	1	100	10
332	Patella p.a.	S	65	1	1	1	100	2	2	2	1	100	8
333	Patella axial	S	63	1	1	1	100	2	2	2	1	100	8
334	Lower leg a.p.	S	57	1	1	1	100	2	1	2	1	100	4
335	Lower leg lateral	S	57	1	1	1	100	2	1	2	1	100	3.2
336	Ankle a.p.	S	55	1	1	1	100	1	0	0	1	100	10
337	Ankle lateral	S	53	1	1	1	100	1	0	0	1	100	10
338	Heel bone axial	S	55	1	1	1	100	1	0	0	1	100	6.2
339	Heel bone lateral	S	52	1	1	1	100	1	0	0	1	100	8
340	Metatarsus d.pl.	S	50	1	1	1	100	1	0	0	1	100	6.2
341	Metatarsus oblique	S	50	1	1	1	100	1	0	0	1	100	6.2
342	Foot lateral	S	55	1	1	1	100	1	0	0	1	100	8

343	Forefoot	S	48	1	1	1	100	1	0	0	1	100	6.2
344	Toes a.p./oblique	S	46	1	1	1	100	1	0	0	1	100	5

Making X-ray Exposures

An X-ray exposure can be executed by operating the hand switch or the "**Preparation**" & "**Exposure**" membrane buttons on the console.

Error Messages and Handling

When an error occurs, the corresponding error code and brief explanation message will be displayed. Refer to **Chapter 8** for the details and actions.

Console Software Upgrade

1).Prepare an SD card, All the pictures/parameters/software are downloaded into the console with a SD card:

Figure 5-9 SD card

Note: All the files must be in FAT32 format.

2). Format the SD card with below steps before using it for the first time(ignore this item if this is not the first time)

a) Plug the SD card into a computer with Windows operation system

b) Open DOS command window

c) Input the command: format/q g:/fs:fat32/a:4096

Note: g is SD card drive; replace it with the actual drive in the computer

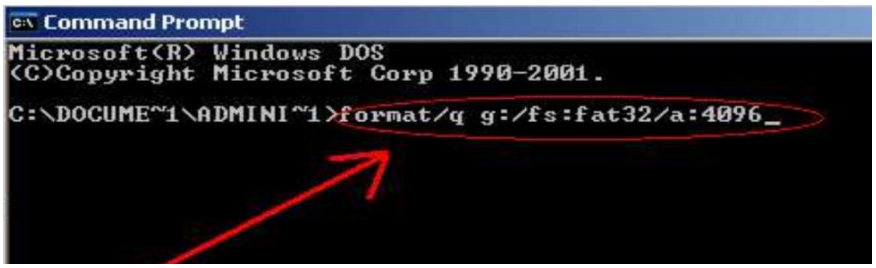


Figure 5-10 Format command

3). Unpack compressed project packet (such like Human.rar or Vet.rar) to any path you want.

4).Open the project file folder, and copy the file folder: DWIN_SET to SD card;

Note: the name of this file folder must be DWIN_SET, do not change it.

5).Loosen the screw of SD card interface on the back of touch screen console housing(please refer below picture for the exact location);then open SD card interface, plug in the SD card in correct direction;

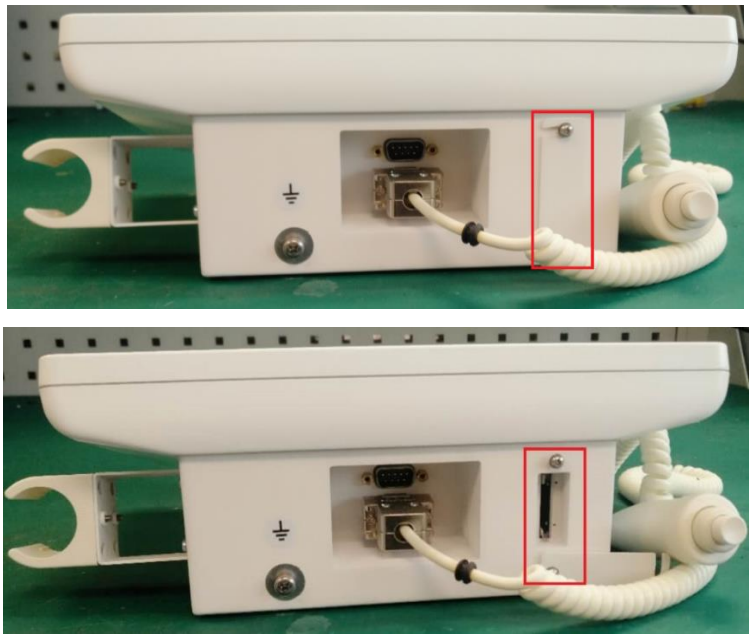


Figure 5-11 Console SD card interface

6).Power on the Touch Screen Console, the GUI Software will be download by DWIN Operation system automatically in a few seconds.

7). Pull out the SD card; close SD card interface and tighten the screws on it.

Batch modification and download APR default Value

1).Create a new excel file, Copy Table 5-1 to sheet1 of the excel file.

Note: a).Table header needs to be carried when copy Table 5-1.

b).Paste the table from A1 cell of Sheet1, no blank cell should be left in front of the table.

2).Modify APR default value as needed, then save the excel file.

3).Need to use below tool to batch modification and download APR default value:

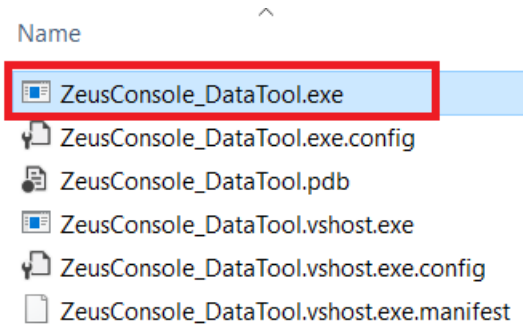


Figure 5-12 APR Data conversion tool for Zeus Touch Screen Console

4).Double click ZeusConsole_DataTool.exe, below dialog box will pop up:

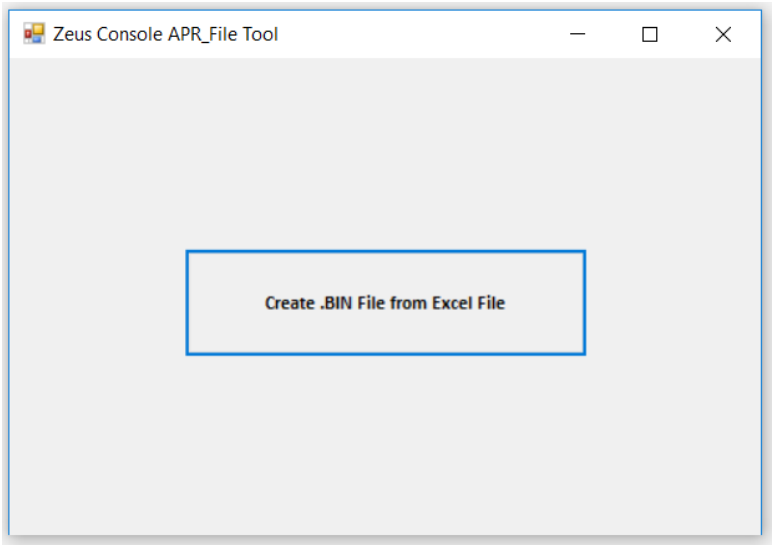


Figure 5-13 APR Data conversion tool dialog box

5).Click “Create .BIN File from Excel File”, following dialog box will pop up:

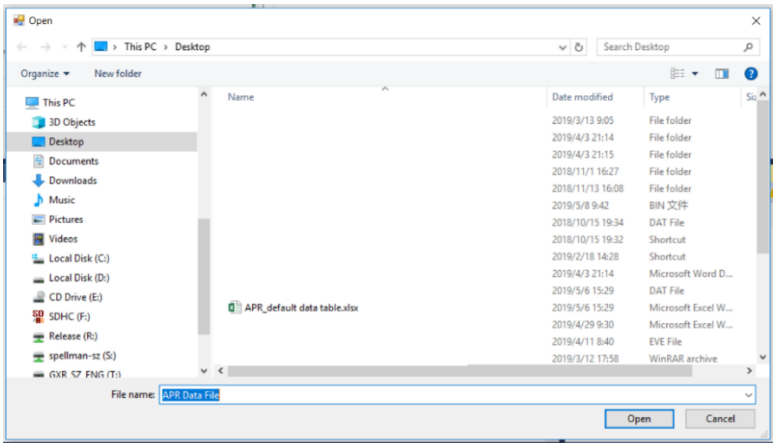


Figure 5-14 Open File Dialog box of PR Data conversion tool

5).Select the Excel file you saved, and click “Open” button, wait for a few seconds, following dialog box will pop-up:

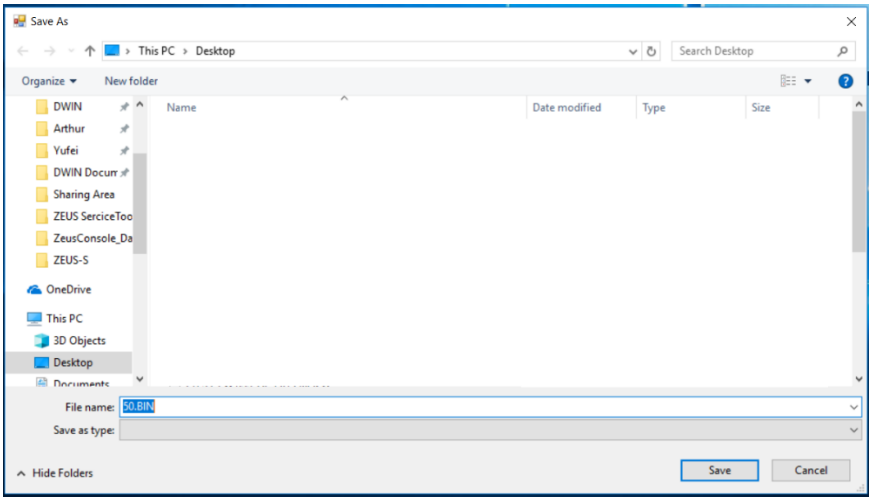


Figure 5-15 Save File Dialog box of PR Data conversion tool

6).Click “Save” button, the .BIN file will be converted successfully.

Note: The file name “50.BIN” should note be modified.

7).Use the same SD card as previous chapter “Console Software Update”, create a new file folder, and name it “**DWIN_SET**”, copy the File “50.BIN” to the file folder.

8).Loosen the screw of SD card interface on the back of touch screen console housing (please refer ***Figure 5-11*** for the exact location); then open SD card interface, plug in the SD card in correct direction;

9).Power on Touch Screen Console, wait for the blue screen end for a few seconds, then the batch import of APR data finished.

10). Pull out the SD card; close SD card interface and tighten the screws on it.

Calibration

The touch screen self-calibration is real-time conducted automatically. Generator Configuration Settings, X-ray Tube Selection / Calibration as well as AEC Exposure Calibration will need to be conducted via the ZEUS Service Tool GUI or the user’s system workstation software. See *Chapter 4* for the ZEUS Service Tool GUI instruction.

Mini Console

Overview

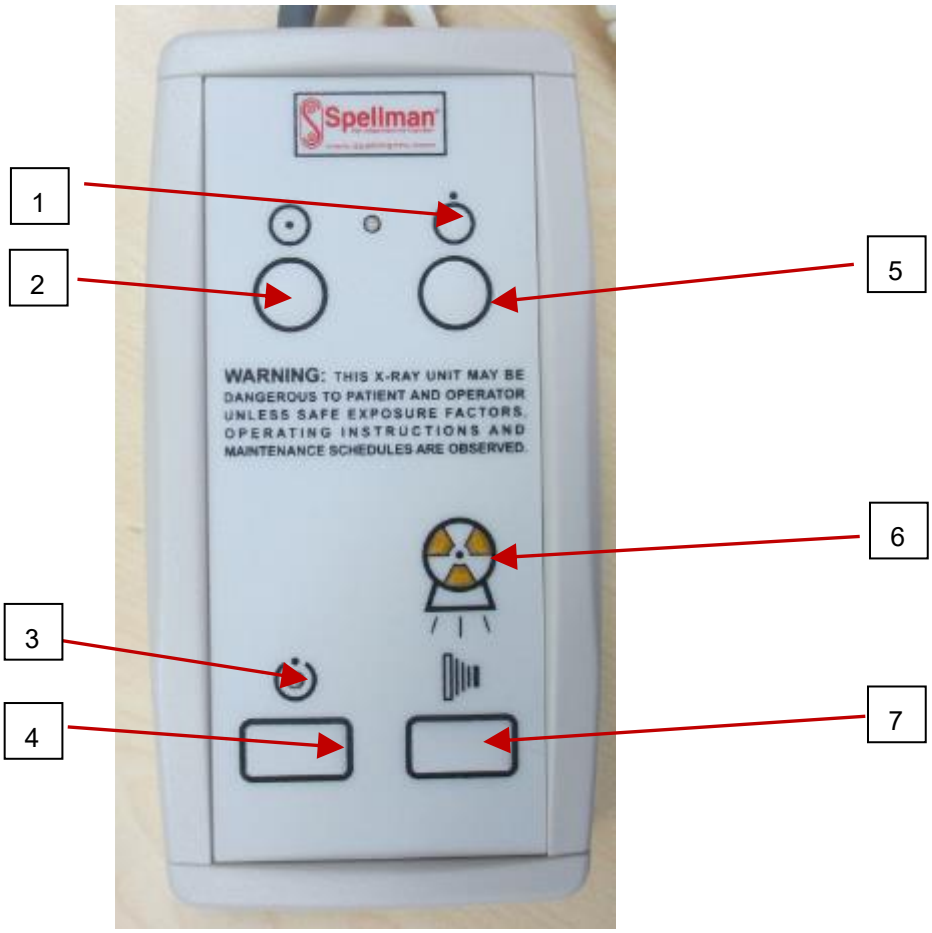


Figure 5-16 Mini Console Panel

Function Items

1 – Power on/off indicator

2 – Power on button

3 – Prepare indicator

4 – Prepare button

5 – Power off button

6 – Indicator of exposure

7 – X-ray button

Function Description

Table 5-2 Function description of Mini-console

Item	Function	Description
1	Power on/off indicator	This indicator will be light on when generator is powered on
2	Power on	Click this button to power on the generator
3	Prepare indicator	This indicator will be light on when prepare button is pressed
4	Prepare button	Press this button to make the generator run into prepare stage
5	Power off button	Click this button to power off the generator
6	Indicator of exposure	This indicator will be light on when x-ray is on
7	X-ray Button	Press this button to make exposure

Cable Connection

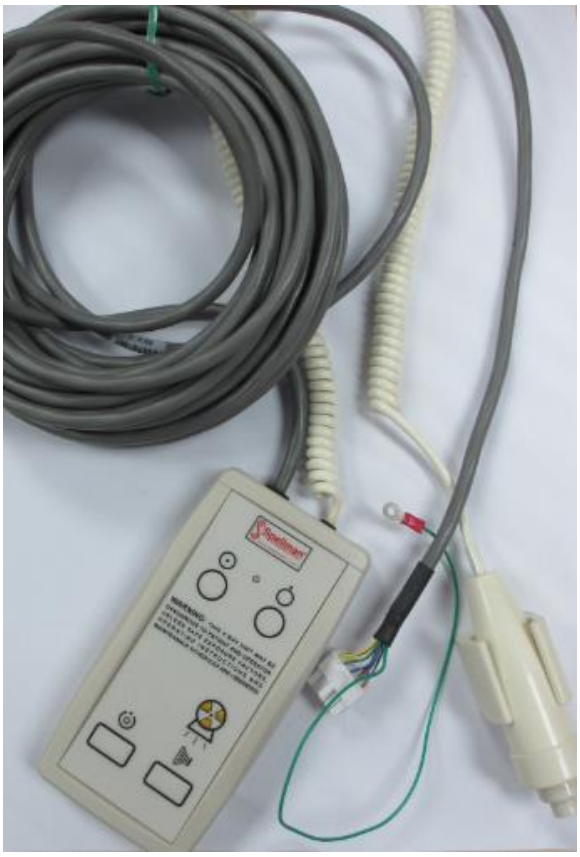


Figure 5-17 Cable of Mini Console

This console will be connected to **P20** of MCB when come into use. Please refer to section "**Mini console interface**" of this manual.

Also a handswitch is connected to the console before leaving the factory.

Usage

This console can't be used individually, and must be cooperated with touch screen console or workstation.

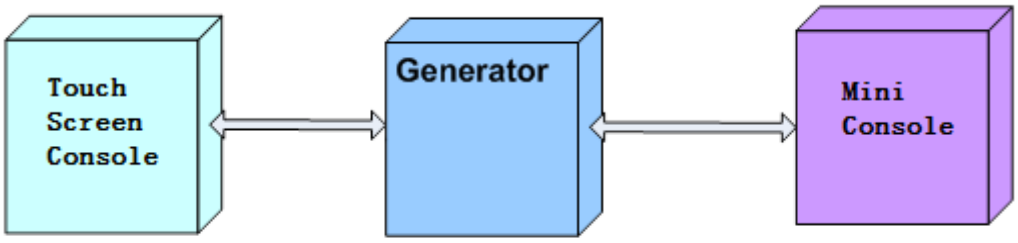


Figure 5-18 Usage method 1 with Mini-Console

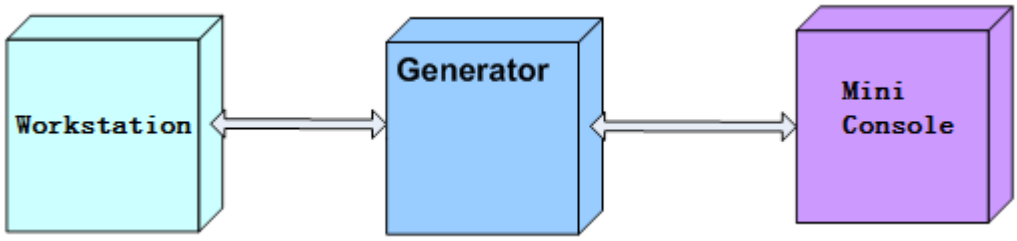


Figure 5-19 Usage method 2 with Mini-Console

An exposure can be done by using the two-stage hand switch or the mini console buttons "Preparation" and "Exposure". The first stage of the hand switch initiates the preparation phase and the second stage starts the exposure.

If the hand switch or any of the "Preparation" and "Exposure" buttons on the mini console is released during the exposure, the exposure is terminated instantaneously (dead man switch).

The exposure is terminated under the following conditions:

- When the set mAs product is reached (Manual Mode)
- When the set exposure time is reached (Manual Mode)
- When the automatic exposure control terminates the exposure

(This page left blank intended)

Chapter 6 Replacement and adjustment

Replacement

Caution

Incorrect replacement of parts may result unacceptable risks, the replacement methods specified in this chapter should be followed.

Caution

All fuse types and ratings are listed below. Fuses may be only replaced with fuses of identical ratings.

Table 6-1 Fuses information

Location	Designator	MPN	Technical data
Mains fuses	/	LPJ-60SP	600 V, 60 A,
Fuse of control transformer input	/	ATQ1	500 V, 1 A,
	/	ATQ2	500 V, 2 A,
	/	ATQ3	500 V, 3 A,
	/	ATQ8	500 V, 8 A,
Filament Driver Board	F2, F3	0215010.	10A, 250V
Filament Driver Board	F4, F5	0215005.	5A, 250V
Filament Driver Board	F8, F9	0215004.	4A, 250V
Rotor Driver Board	F1, F2	SPF010.T	10A, 100VDC
Rotor Driver Board	F3, F4	RO15	10A, 500V
Room Interface Board0/1	F1	0215.400	400mA, 250V
Room Interface Board2	F1	021506.3MXP	6.3A, 250V

Caution

- Dangerous Voltage
- Safety electrical practices shall be used, which include Lockout/Tagout.
- Personal Protection Equipment (PPE) is required.

Table 6-2 Field Replaceable Unit list

Parts	HW/SW programming	Adjustment/Calibration	Estimated Time
Main Control Board	Check dipswitch S1, S2, jumper JP1 Backup and Restore generator settings	kV feedback adjustment (R230) High mA feedback adjustment (R263) Low mA feedback adjustment (R276) Tube calibration	30 mins
Filament Driver Board	/	/	15 mins
Rotor Driver Board	/	/	20 mins
Inverter-Assembly	/	/	30 mins
AEC board	Check jumper P3, P4, P5, P6	/	15 mins
Room Interface Board	/	/	15 mins
HT Tank	/	kV feedback adjustment (R230) High mA feedback adjustment (R263) Low mA feedback adjustment (R276) Tube calibration	30 mins

Main Control Board

Prerequisites

Backup the generator settings (if available).

Refer to section “Backup Generator Setting” on *chapter 4*.

To remove

1. Disconnect and lock out the mains power.

Caution

Do not supply the MAINS POWER until instructed.
Wait the generator to discharge for 5 minutes before next step.

2. Remove:
- 4 screws on AEC board
- AEC board
- All cables/connectors connected to MCB
- 9 screws on Main Control Board
- Main Control Board

To install

Important

Before installing the new Main Control Board, dip switches and jumpers must be set to match the replaced board.

1. On the new **Main Control Board**, check the correct settings for dip switches S1, S2 and jumper JP1.

For DIP switches setting, refer to *Chapter 2.*

2. Reverse the steps in the removal process to install new MCB.

3. Switch on the mains power and power on the generator.

4. Restore the generator settings via service tool.

5. Perform KV adjustment, low mA adjustment and high mA adjustment. Refer to adjustment procedure in this section.

6. Calibrate the tube.

Post-requisites:

None.

Filament Driver Board

Prerequisites

None.

To remove

1. Disconnect and lock out the mains power.

Caution

Do not supply the MAINS POWER until instructed.

Wait the generator to discharge for 5 minutes before next step.

2. Remove:

• All cables/connectors connected to FCB

• 7 screws

• Filament Driver Board

To install

• Reverse the steps in the removal process to install the new FDB.

• Power on the system and make an exposure to verify generator function.

Post-requisites

None.

Rotor Driver Board

Prerequisites

None.

To remove

1. Disconnect and lock out the mains power.

Caution

Do not supply the MAINS POWER until instructed.

Wait the generator to discharge for 5 minutes before next step.

2. Remove

• Safety cover in front of the RDB

• All cables connected to the RDB

• 7 screws

• RDB

To install

• Reverse the steps in the removal process to install new RDB and safety cover.

• Power on the system and make an exposure to verify generator function.

Post-requisites

None.

Inverter-Assembly

Prerequisites

None.

To remove

1. Disconnect and lock out the mains power.

Caution

Do not supply the MAINS POWER until instructed.

Wait the generator to discharge for 5 minutes before next step.

2. Remove the Safety cover on top of the inverter assembly.
3. Disconnect all connectors connected to MCB.
4. Disconnect In1 and In 2 connected to Tank Interface Board.
5. Remove two screws fix the inverter assembly.
6. Carefully pull out the inverter assembly until limited by DC bus cables.
7. Disconnect two DC bus cable.
8. Remove the inverter assembly.

To install

• Reverse the steps in the removal process to install new inverter assembly.

• Power on the system and make an exposure to verify the generator function.

Post-requisites

None.

AEC Board

Prerequisites

None.

To remove

1. Disconnect and lock out the mains power.

Caution

Do not supply the MAINS POWER until instructed.

Wait the generator to discharge for 5 minutes before next step.

2. Remove

• Cables connected to P1, P7 and P8

• 4 screws

• AEC board

To install

1. Reverse the steps in the removal process to install new AEC board.
2. Verify that the jumper setting is the same with the replaced AEC board.
3. Power on the system and check the AEC functions.

Post-requisites

None.

Room Interface Board

Prerequisites

Table 6-3 Jumper adjustment for RIB1

JUMPER	DESCRIPTION	DETAILS
JB1_1 & JB1_2	Chnl_1(P1) logic level High (+24VDC)	Short circuit, Chnl_1 (P1) Exposure request / Exposure feedback signal between generator and system, 24VDC Output
JB1_3 & JB1_4	Chnl_1(P1) logic level High (+12VDC)	Short circuit, Chnl_1 (P1) Exposure request / Exposure feedback signal between generator and system, 12VDC Output

JB1_5 & JB1_6	Chnl_1(P1) logic level High (+5VDC)	Short circuit, Chnl_1 (P1) Exposure request / Exposure feedback signal between generator and system, 5VDC Output
JB2_1 & JB2_2	Chnl_2(P2) logic level High (+24VDC)	Short circuit, Chnl_2(P2) Exposure request / Exposure feedback signal between generator and system, 24VDC Output
JB2_3 & JB2_4	Chnl_2(P2) logic level High (+12VDC)	Short circuit, Chnl_2(P2) Exposure request / Exposure feedback signal between generator and system, 12VDC Output
JB2_5 & JB2_6	Chnl_2(P2) logic level High (+5VDC)	Short circuit, Chnl_2(P2) Exposure request / Exposure feedback signal between generator and system, 5VDC Output

Table 6-4 Jumper adjustment for RIB2

JUMPER1	JUMPER2	DESCRIPTION	DETAILS
JB5_1 & JB5_2	JB1_1 & JB1_2	Chnl_1(P1) logic level High (+24VDC)	Short circuit, Chnl_1 (P1) Exposure request / Exposure feedback signal between generator and system, 24VDC Output
	JB2_1 & JB2_2	Chnl_2(P2) logic level High (+24VDC)	Short circuit, Chnl_12(P2) Exposure request / Exposure feedback signal between generator and system, 24VDC Output
	JB3_1 & JB3_2	Chnl_3(P6) logic level High (+24VDC)	Short circuit, Chnl_3 (P6) Exposure request / Exposure feedback signal between generator and system, 24VDC Output
	JB4_1 & JB4_2	Chnl_4(P13) logic level High (+24VDC)	Short circuit, Chnl_4(P13) Exposure request / Exposure feedback signal between generator and system, 24VDC Output
JB5_1 & JB5_2	JB1_3 & JB1_4	Chnl_1(P1) logic level High (+5VDC)	Short circuit, Chnl_1 (P1) Exposure request / Exposure feedback signal between generator and system, 5VDC Output
	JB2_3 & JB2_4	Chnl_2(P2) logic level High (+5VDC)	Short circuit, Chnl_2(P2) Exposure request / Exposure feedback signal between generator and system, 5VDC Output
	JB3_3& JB3_4	Chnl_3(P6) logic level High (+5VDC)	Short circuit, Chnl_3(P6) Exposure request / Exposure feedback signal between generator and system, 5VDC Output
	JB4_3 & JB4_4	Chnl_4(P13) logic level High (+5VDC)	Short circuit, Chnl_4(P13) Exposure request / Exposure feedback signal between generator and system, 5VDC Output
JB5_2 & JB5_3	JB1_1 & JB1_2	Chnl_1(P1) logic level High (+24VDC)	Short circuit, Chnl_1 (P1) Exposure request / Exposure feedback signal between generator and system, 24VDC Output
	JB2_1 & JB2_2	Chnl_2(P2) logic level High (+24VDC)	Short circuit, Chnl_12(P2) Exposure request / Exposure feedback signal between generator and system,

			24VDC Output
	JB3_1 & JB3_2	Chnl_3(P6) logic level High (+24VDC)	Short circuit, Chnl_3 (P6) Exposure request / Exposure feedback signal between generator and system, 24VDC Output
	JB4_1 & JB4_2	Chnl_4(P13) logic level High (+24VDC)	Short circuit, Chnl_4(P13) Exposure request / Exposure feedback signal between generator and system, 24VDC Output
JB5_2 & JB5_3	JB1_3 & JB1_4	Chnl_1(P1) logic level High (+12VDC)	Short circuit, Chnl_1 (P1) Exposure request / Exposure feedback signal between generator and system, 12VDC Output
	JB2_3 & JB2_4	Chnl_2(P2) logic level High (+12VDC)	Short circuit, Chnl_1 (P2) Exposure request / Exposure feedback signal between generator and system, 12VDC Output
	JB3_3& JB3_4	Chnl_3(P6) logic level High (+12VDC)	Short circuit, Chnl_1 (P6) Exposure request / Exposure feedback signal between generator and system, 12VDC Output
	JB4_3 & JB4_4	Chnl_4(P13) logic level High (+12VDC)	Short circuit, Chnl_2(P13) Exposure request / Exposure feedback signal between generator and system, 12VDC Output

To remove

1. Disconnect and lock out the mains power.

Caution

Do not supply the MAINS POWER until instructed.

Wait the generator to discharge for 5 minutes before next step.

2. Remove

• All cables/connectors connected to the Room Interface Board.

• 6 screws

• Room Interface Board

To install

1. Reverse the steps in the removal process to install new RIB.

2. Power on the system and make an exposure to verify the generator function.

Post-requisites

None.

HT Tank

Prerequisites

None.

To remove

1. Disconnect and lock out the mains power.

Caution

Do not supply the MAINS POWER until instructed.

Wait the generator to discharge for 5 minutes before next step.

2. Remove

• Two high voltage cables

• Feedback cable to MCB

• Inverter cables In1&In2

• Grounding cable

3. Remove the tank strapping.

4. Remove the tank.

Caution

HT tank is heavy (approximate 18kg). Take care to remove and install it.

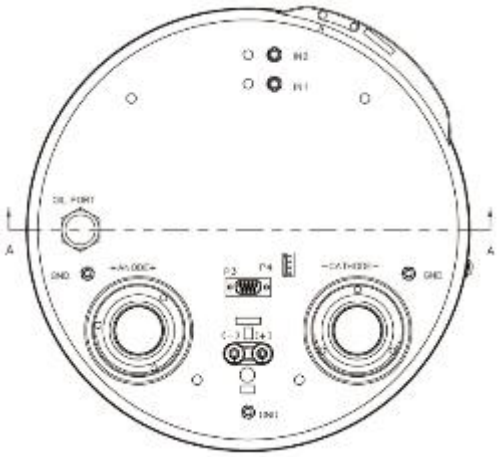


Figure 6-1 Tank Interface Board

To install

1. Reverse the steps in the removal process to install new tank.

2. Power on the generator.

3. Perform KV adjustment, low mA adjustment and high mA adjustment. Refer to section “Adjustment” of this chapter.

4. Calibrate the tube.

Post-requisites:

None.

Other Parts

Caution

Dangerous Voltage.

Caution

Wait the generator to discharge for 5 minutes after disconnecting the mains power.

Following the replace procedure to replace the parts list in the table below.

Table 6-5 Replace procedure

Part	Replace procedure	Comment/Estimated time
3 phase line fuses	1.Disconnect 3-phase cables 2.Remove fuses in failure 3.Install new fuses and re-connect 3- phase cable	Estimated Time: 10 mins
Line filter(3-phase)	1.Disconnect 3-phase cables 2.Remove the Line Filter 3.Install the new line filter and re-connect 3-phase cable	Estimated Time:15 mins
Mains Contactor	1.Disconnect all cables connected to contactor 2.Remove the contactor 3.Install new contactor and connect cables according to labels	Estimated Time:15 mins
Mains Rectifier	1.Disconnect the cables connected to rectifier 2.Remove the rectifier 3.Install rectifier and connect cables according to labels	Estimated Time:15 mins
Control transformer	1.Disconnect the cables connected to transformer 2.Remove the transformer 3.Install transformer and connect cables according to labels	Carefully check the labels Wrong connection may damage PCBs Estimated Time:15 mins
Phase Capacitors	1.Disconnect the cable and remove capacitor(s) 2.Install capacitor(s) and connect cable	AC capacitor, no polarity Estimated Time :10 mins

Adjustment

Adjustment Specification

Purpose: To provide accurate output of kV and mA

Specification: Three potentiometers which are adjusted in the procedure

are respectively used to control the output accuracy of kV, high mA and low mA.

Tools required to carry out this adjustment procedure

1. Dosimeter
2. mAs meter
3. Potentiometer adjustment tool

kV Adjustment (Estimated Time: 15 mins)

1. Place dosimeter detector in the center of x-ray field.
2. Open Service Tools, then set exposure technique to mA/ms mode, set exposure parameters at 100kV, 100mA, and 100ms.

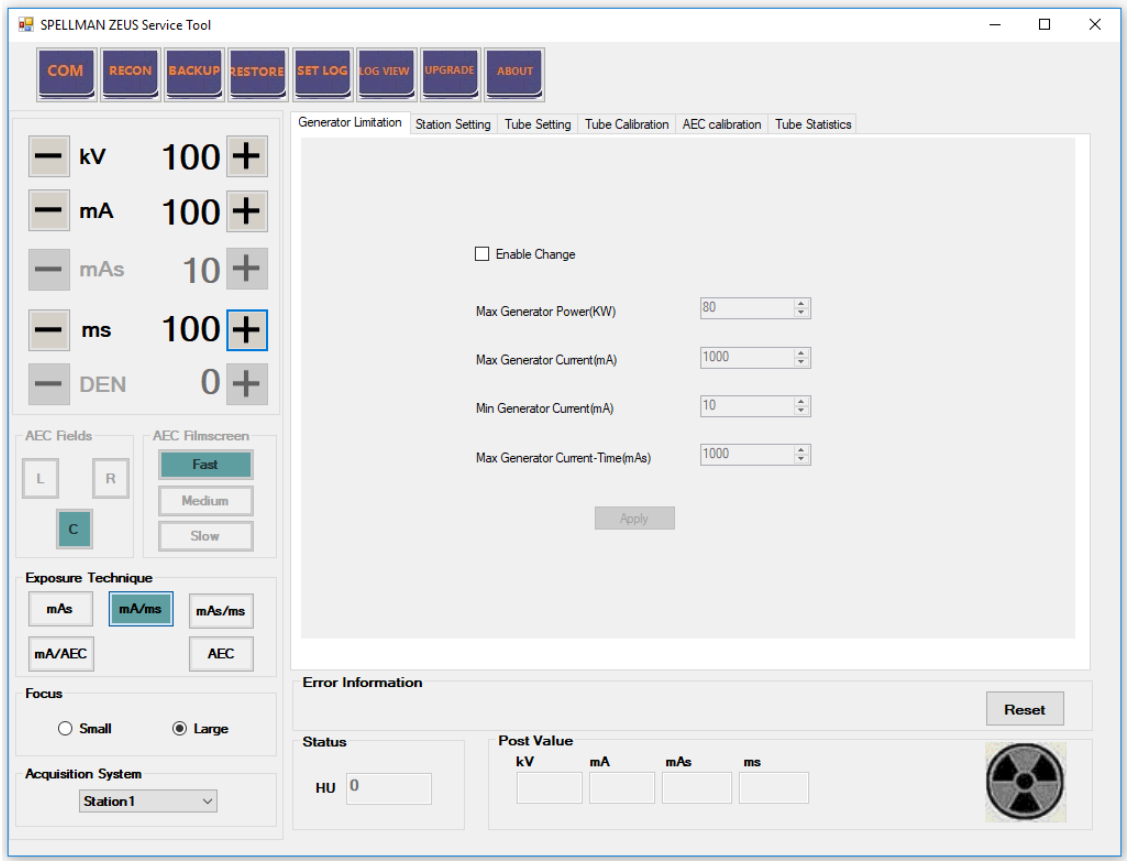


Figure 6-2 Parameters Setting

3. Make an exposure, and read the kV value from the dosimeter. If it is in the range of 99-101kV, there is no adjustment needed.
4. If the kV value is out of the range, adjust potentiometer R230. Clockwise if value <99kV, or counter-clockwise if value>101kV.
5. Repeat step4 and 5, until kV value from the dose meter is in the range of 99-101kV.

6. Calibrate the tube

Low mA Adjustment (Estimated Time: 20 mins)

1. Power off the generator.
2. Remove the link between mAs measurement connectors on Tank Interface Board. Insert the dosimeter probes to the plug of the connectors.
3. Power on the generator. Open service tool, and set the exposure technique to mA/ms mode, set the exposure parameters at 100kV, 20mA and 100ms.

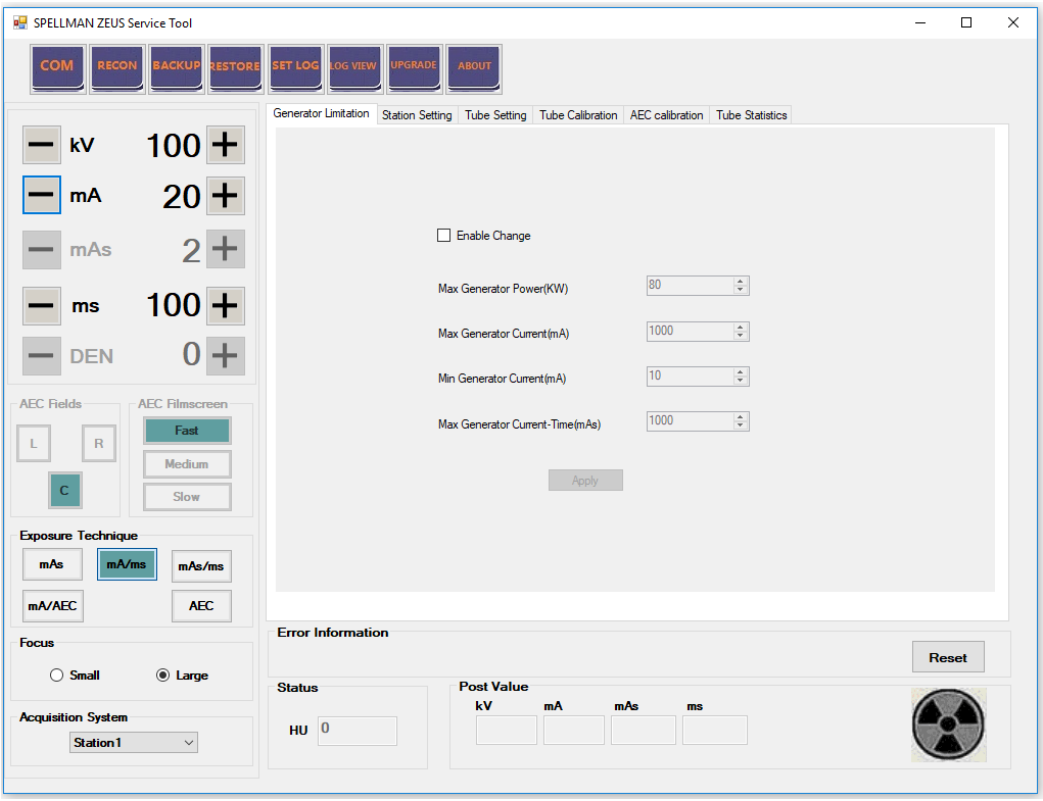


Figure 6-3 Parameters Setting

4. Make an exposure. Read and record the mA value measured by dosimeter.
5. Read and record the mA feedback mA2 from calibration mA form window. If 18<mA<22, no adjustment is needed.

6. If out of the range, adjust potentiometer R276 (Refer to Figure: Potentiometer Layout) and make exposures.
7. Repeat step 4 and 5 until feedback mA is in the range.

High mA adjustment (Estimated Time: 15 mins)

Note

If low mA adjustment is just finished before this adjustment, directly go to step 3.

1. Power off the generator.
2. Remove the link between mAs measurement connectors on Tank Interface Board. Insert the dosimeter probes to the plug of the connectors.
3. Power on the generator. Open service tool, and set the exposure technique to mA/ms mode, set the exposure parameters at 100KV, 200mA and100ms.

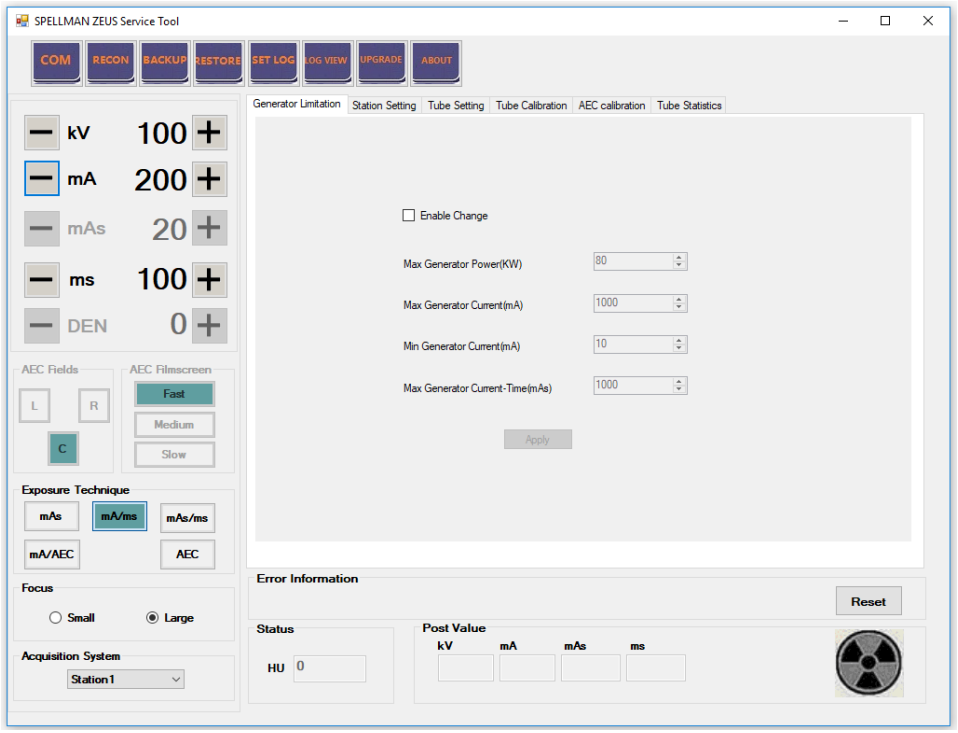


Figure 6-4 Parameters Setting

4. Make an exposure, read and record the mA value measured by dosimeter.
5. If out of the range, adjust potentiometer R263 and make exposures.
6. Repeat step 4 and 5 until mA is in the range.
7. Remove dosimeter probes and reconnect the link between mAs measurement terminals on the Tank Interface Board.

Chapter 7 Maintenance

Introduction

This section provides a recommended schedule for periodic maintenance of the X-ray generators. The initial installation date and location, and all service performed on the generator, should be recorded in below table. The record should be as thorough as possible, detailing the scope and type of work that was performed (all service and a record of all replacement parts that were installed). Additionally, the person performing the work should date and sign the record. This information will be invaluable in the future for traceability and to ensure continued compatibility of the generator.

If a major component (such as the HT tank or a main control board) is replaced, recalibration will be needed.

Caution

Maintenance is to be performed only by competent, trained personnel who are familiar with the potential hazards associated with this equipment.

Note

Maintenance schedule frequency may be dictated by certain regulatory requirements of the country or state in which the installation is located. Always check the local codes and regulations when setting the maintenance schedule.

Caution

Always switch off mains power to the generator and wait a minimum of 5 minutes for capacitors to discharge before beginning any preventative maintenance, including cleaning.

Caution

To assist Service Personnel to repair those repairable parts of the generator, circuit diagrams, component part lists, descriptions, calibration instructions, or other information is available on request.

Table 7-1 Installation and Service Record

INSTALLED BY:	**DATE:**	**LOCATION:**
Service Date	**Description of Service**	**Performed By**

Equipment Cleaning

In order to assure continued safe performance of X-ray equipment, it is the owner's responsibility to supply or arrange for a periodic maintenance program. After installation, perform maintenance on the system per the schedule.

• Do not spray the cleaning solution directly onto the equipment.

• Clean the external surfaces using a soft cloth moistened with clean water.

• If there is any question about cleaning agents, contact Spellman for recommended cleaning solutions and procedures

Equipment Maintenance

Caution

Do not attempt mechanical or electrical repair of the System. Contact your authorized Service Provider if any unit does not perform to your satisfaction.

The System must be maintained in good operating order at all times to provide safe conditions for operating personnel and patients. This section provides a recommended schedule for periodic maintenance of the generator.

DAILY TUBE WARM-UP PROCEDURE

All tube manufacturers recommend X-ray tube seasoning following installation and daily prior to use. Systems used infrequently should have the tube seasoned on a daily basis. A typical daily seasoning procedure is provided below. If the system has not been used for several days, or upon installation, refer to the tube manufacturer's instructions. Proceed as follows:

1. Take exposures listed in Table as below using a 200L mA focal spot and allow 30-seconds between exposures.
2. The system is ready for operation.

Daily X-ray Tube Warm-up Exposures

Table 7-2 Exposure parameters

EXPOSURE	KVP	TIME (SECONDS)
1	50	0.1
2	60	0.1
3	70	0.1
4	80	0.1
5	90	0.1
6	100	0.1
7	110	0.1
8	120	0.1

Semi-annually and Whenever a Related Certifiable X-ray Component is replaced:

1. Clean all HV connections and silicon washers using alcohol.
2. Check that all HV connections are tight.
3. Clean the control console, and main cabinet as needed.
4. Perform the X-ray tube auto calibration routine.
5. Verify the kV, mA accuracy of the generator according to Section Adjustment, adjust the potentiometers if needed.
6. Test the X-ray tube thermal switch circuits in the generator. Disconnect the tube thermal switch and verify the correct error message, and that X-ray exposures are inhibited.
7. Perform any additional tests required by laws governing this installation.
8. For units with the touchscreen console, perform touch screen calibration.

Annually:

1. Examine for any visible damage and replace any damaged components:

a. The exterior of the console, including the membrane switch assembly.

b. The cable between the console and the generator main cabinet.

c. The hand switch (if used) and the cables connecting this to the console.

d. The HT cables.

2. Open the generator main cabinet and examine the unit for any visible damage: missing or loosed ground connections, oil leaks, damaged cables etc.

- Never use anything other than mild soap and water to clean plastic surfaces. Other cleaners may damage the plastic.
- **Never use any corrosive, solvent or abrasive detergents or polishes.**
- Ensure that no water or other liquid can enter any equipment. This precaution prevents short circuits and corrosion forming on components.
- Methods of disinfection used must conform to legal regulations and guidelines regarding disinfection and explosion protection.
- If disinfectants are used which form explosive mixtures of gases, these gases must have dissipated before switching on the equipment again.
- Disinfection by spraying is not recommended because the disinfectant may enter the X-ray equipment.
- If room disinfection is done with an atomizer, it is recommended that the equipment be switched OFF, allowed to cool down and covered with a plastic sheet. When the disinfectant mist has subsided, the plastic sheet may be removed and the equipment be disinfected by wiping.

End of Product Life

If the product has completed its service life, local environmental regulations must be complied with in regard to disposal of possible hazardous materials used in the production of the generator. In order to assist with this determination, the chief materials used in the construction of this generator are itemized below:

- Electrical insulating oil in HT tank. This is a mineral oil with trace additives (11.25 Litre).
- Solder (tin).
- Epoxy fiberglass circuit board materials, tracks are solder on copper.
- Wire, tinned copper. Insulated with PVC, tefzel, or silicone.
- Steel and/or aluminum (generator cabinet and console chassis).
- Plastic (console enclosure and console membrane).
- Electrical and electronic components: IC’s, transistors, diodes, resistors, capacitors, etc.

Caution

The console LCD is made of glass. If the LCD breaks due to rough handling or dropping, and the internal fluid gets in your eyes or on your hands, immediately wash the affected areas with water for at least 15 minutes. Seek medical attention if any symptoms are present after washing.

Measurement of reproducibility and linearity

a) Measurements Setup

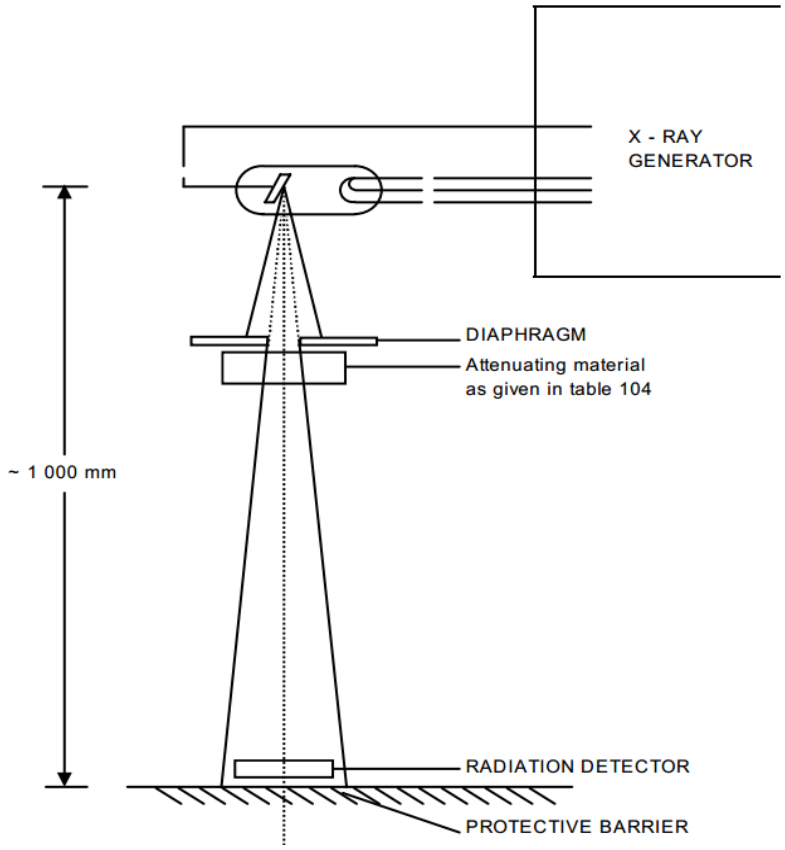
Align the X-RAY tube, the diaphragm and the radiation detector under narrow beam condition.

Arrange the attenuating material in accordance to IEC requirements and make it near the X-RAY tube.

The measurements shall be taken with SID=100 cm or 40”.

The HVL value should be in accordance to IEC /FDA requirements.

Setup as below figure.



b) Measurement and calculation

The reproducibility and linearity test shall be performed for 3-point and 2-point technique with test conditions as below tables, table 1 to table 4 are only for reproducibility measurement, and table 5 to table 12 are for reproducibility and linearity measurement.

Compliance shall be determined based on 10 consecutive measurements within an hour for each table.

The CV of each measurement shall be less than 0.05.

The linearity shall be less than 0.1.

3-point technique, minimum kV, maximum mA, 100ms mAs=					
n	x_i(uGy)	$\bar{x}$(uGy)	$x_i - \bar{x}$(uGy)	$(x_i - \bar{x})^2$	CV
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

Table 1: Reproducibility

2-point technique, minimum kV, maximum mAs mAs=					
n	x_i(uGy)	$\bar{x}$(uGy)	$x_i - \bar{x}$(uGy)	$(x_i - \bar{x})^2$	CV
1					
2					
3					
4					
5					
6					
7					
8					
9					

10					

Table 2: Reproducibility

3-point technique, maximum kV, minimum mA, 100ms mAs=					
n	x_i(uGy)	$\bar{x}$(uGy)	$x_i - \bar{x}$(uGy)	$(x_i - \bar{x})^2$	CV
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

Table 3: Reproducibility

2-point technique, maximum kV, minimum mAs mAs=					
n	x_i(uGy)	$\bar{x}$(uGy)	$x_i - \bar{x}$(uGy)	$(x_i - \bar{x})^2$	CV
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

Table 4: Reproducibility

Calculation method of reproducibility as below:

x_i is the measured dose (Air Kerma) of each measurements in uGy;

$\bar{x}$ is the average dose (Air Kerma) of the 10 measurements in uGy;

$x_i - \bar{x}$ is the difference between x_i and $\bar{x}$;

$(x_i - \bar{x})^2$ is the square of the difference between x_i and $\bar{x}$;

Calculate the standard deviation S by using the formula:

$$S = \sqrt{\frac{\sum(x_i - \bar{x})^2}{n-1}}$$

Calculate the coefficient of variation by using the formula:

$$CV = \frac{S}{\bar{x}}$$

Below is an example for reproducibility calculation:

Example			mAs= 1.1		
n	x_i(uGy)	$\bar{x}$(uGy)	$\lvert x_i - \bar{x}\rvert$(uGy)	$(x_i - \bar{x})^2$	CV
1	2.033	2.0349	0.0019	0.00000361	$S = \sqrt{\frac{\sum(x_i - \bar{x})^2}{n-1}}$ $= \sqrt{\frac{0.0015749}{9}}$ $= 0.013228$ $CV = \frac{S}{\bar{x}}$ $= \frac{0.013228}{2.0349}$ $= 0.0065$
2	2.044		0.0091	0.00008281	
3	2.047		0.0121	0.00014641	
4	2.010		0.0249	0.00062001	
5	2.034		0.0009	0.00000081	
6	2.026		0.0089	0.00007921	
7	2.021		0.0139	0.00019321	
8	2.044		0.0091	0.00008281	
9	2.054		0.0191	0.00036481	
10	2.036		0.0011	0.00000121	

Table 5 Example for reproducibility calculation

3-point technique, 50% of maximum kV, 50 ms, mA to give 1-5 uGy dose mAs=					
n	x_i(uGy)	$\bar{x}$(uGy)	$x_i - \bar{x}$(uGy)	$(x_i - \bar{x})^2$	CV
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

Table 6: Reproducibility and linearity

3-point technique, 50% of maximum kV, 50 ms, mA adjacent to the mA setting used in table 5 mAs=					
n	x_i(uGy)	$\bar{x}$(uGy)	$x_i - \bar{x}$(uGy)	$(x_i - \bar{x})^2$	CV
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

Table 7: Reproducibility and linearity

2-point technique, 50% of maximum kV, mAs to give 1-5 uGy dose mAs=					
n	x_i(uGy)	$\bar{x}$(uGy)	$x_i - \bar{x}$(uGy)	$(x_i - \bar{x})^2$	CV
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

Table 8: Reproducibility and linearity

2-point technique, 50% of maximum kV, mAs adjacent to the mAs setting used in table 7. mAs=					
n	x_i(uGy)	$\bar{x}$(uGy)	$x_i - \bar{x}$(uGy)	$(x_i - \bar{x})^2$	CV
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

Table 9: Reproducibility and linearity

3-point technique, 80% of maximum kV, 25 ms, mA to give 1-5 uGy dose mAs=					
n	x_i(uGy)	$\bar{x}$(uGy)	$x_i - \bar{x}$(uGy)	$(x_i - \bar{x})^2$	CV
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

Table 10: Reproducibility and linearity

3-point technique, 80% of maximum kV, 25 ms, mA adjacent to the mA setting used in table 9. mAs=					
n	x_i(uGy)	$\bar{x}$(uGy)	$x_i - \bar{x}$(uGy)	$(x_i - \bar{x})^2$	CV
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

Table 11: Reproducibility and linearity

2-point technique, 80% of maximum kV, mAs to give 1-5 uGy dose mAs=					
n	x_i(uGy)	$\bar{x}$(uGy)	$x_i - \bar{x}$(uGy)	$(x_i - \bar{x})^2$	CV
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

Table 12: Reproducibility and linearity

2-point technique, 80% of maximum kV, mAs adjacent to the mAs setting used in table 11. mAs=					
n	x_i(uGy)	$\bar{x}$(uGy)	$x_i - \bar{x}$(uGy)	$(x_i - \bar{x})^2$	CV
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

Table 13: Reproducibility and linearity

Calculation method of linearity as below:

For each pair of the tables from table 6 to table 13, (6 and 7, 8 and 9, 10 and 11, 12 and 13), record the mAs and average dose $\bar{x}$ values as below:

mAs1=____ $\overline{x_1}$=

mAs2=____ $\overline{x_2}$=

Note: if mAs1 is from table 6, mAs2 must be from table 7. If $\overline{x_1}$ is from table 8, $\overline{x_2}$ must be from table 9, and so on.

Calculated linearity by using formula:

$$L = \frac{\left|\frac{\overline{x_1}}{mAs1} - \frac{\overline{x_2}}{mAs2}\right|}{\frac{\overline{x_1}}{mAs1} + \frac{\overline{x_2}}{mAs2}}$$

Below is an example for linearity calculation:

mAs1= 1.1 $\overline{x_1}$= 2.0348

mAs2= 1.25 $\overline{x_2}$= 2.3308

Calculated linearity by using formula:

$$L = \frac{\left|\frac{\overline{x_1}}{mAs1} - \frac{\overline{x_2}}{mAs2}\right|}{\frac{\overline{x_1}}{mAs1} + \frac{\overline{x_2}}{mAs2}} = \frac{|2.0348 - 2.3308|}{2.0348 + 2.3308} = \frac{0.296}{4.3656} = 0.0678 < 0.1$$

Measurement of loading factors accuracy

a) Measurement method

Align the X-RAY tube, the diaphragm and the radiation detector under narrow beam condition. The measurements should be taken with SID=100 cm or 40”, if the radiation is too weak for dosimeter measurement, the SID can be decreased.

Measuring Peak tube potential, tube current, and exposure time

- Select “3 point technique” on the generator control panel
- Set the “3 point technique” parameters according the following table on the generator control panel
- Select the first triple of Tube Potential (kV), Tube Current (mA) and exposure time from the test protocol
- Enter these values using the generator control panel
- activate exposure
- read the measurement values for kV, mA and exposure time from the dose meter

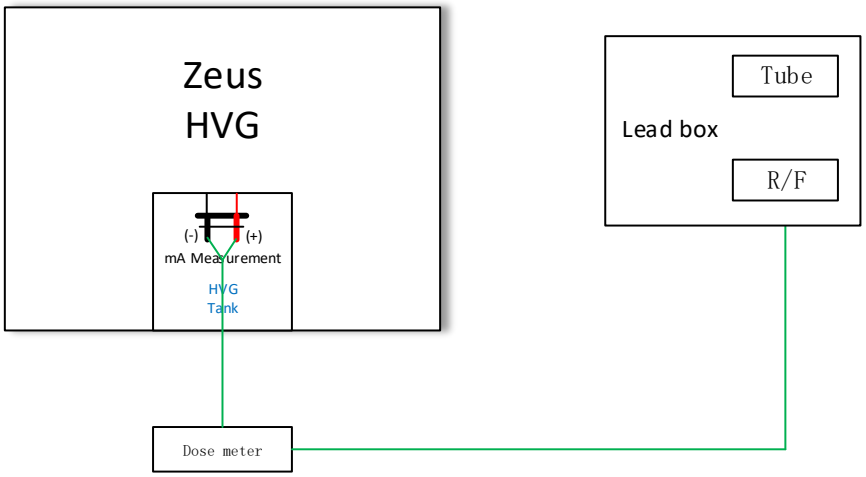
and enter it in the protocol

- Select the next couple of kV, mA and exposure time, repeat these steps until all kV, mA and exposure time triples have been tested
- The test is successfully passed, when all measured values are within the kV, mA, and exposure time ranges (shown in Tables)

Measuring Product mAs

- Select “2 point technique” on the generator control panel
- Select “2 point technique” according to the following table on the generator control
- Select the first Tube Current Exposure Time Product (mAs) from the test protocol
- Enter this value using the generator control panel
- activate exposure
- read the measurement value for kV/mAs from the dose meter and enter it in the protocol
- Select the next value of mAs and repeat these steps until all mAs values have been tested
- The test is successfully passed, when all measured values are within the mAs ranges (shown as Min and Max values in the table)

Measurement connection diagram



b) Measurement settings

Measure accuracy of tube voltage, tube current, exposure time and current-time product per below table:

3 point technique:

Test #	kVp	kVp limits	mA	mA limits	mA	mA limits	mA	mA limits	ms	ms limits
Set-1	50	46.5-53.5	250	236.5-263.5	320	303-337	400	379-421	100	97.5-102.5
M-1										
Set-2	60	56-64	125	117.75-132.25	160	151-169	200	189-211	200	195.5-204.5
M-2										
Set-3	80	75-85	63	58.85-67.15	80	75-85	100	94-106	50	48.5-51.5
M-3										
Set-4	100	94-106	32	29.4-34.6	40	37-43	50	46.5-53.5	10	9.3-10.7
M-4										
Set-5	120	113-127	10	8.5-11.5	20	18-22	25	22.75-27.25	400	391.5-408.5
M-5										

2 point technique, only verify mAs accuracy:

Test #	kVp	mAs	mAs limits	mAs	mAs limits	mAs	mAs limits
Set-1	50	10	8.8-11.2	100	89.8-110.2	500	449.8-550.2
M-1							
Set-2	80	20	17.8-22.2	200	179.8-220.2	400	359.8-440.2
M-2							
Set-3	100	5	4.3-5.7	50	44.8-55.2	80	71.8-88.2
M-3							
Set-4	120	1	0.7-1.3	2	1.6-2.4	3.2	2.68-3.72

M-4				

Measurement of Automatic Exposure Control Limits

Test condition:

1 point setting AEC mode, kV=80kV, backup 600mAs.

Select AEC chamber centre cell, and put lead over the cell, the thickness should make the exposure go to backup.

2 point AEC mode, kV=80kV, mA=500mA, ms=1200ms

Select AEC chamber centre cell, and put lead over the cell, the thickness should make the exposure go to backup.

Measurement of Automatic Exposure Control Minimum Exposure Time

Test condition:

3 point setting AEC Mode: KV =50KV mA=100mA Backup 100mS.

Take exposure when no Plexiglas is over the AEC Chamber

Exposure time shall be less than 1/60 of second or time interval to deliver 5 mAs, whichever is greater

(This page left blank intended)

Chapter 8 Troubleshooting

Introduction

When power off, there is still residual voltage on DC bus, Rotor Driver Board and Inverter Modules. At least 5 minutes is necessary before any operation.

Antistatic tools are necessary when operating the PCBs.

The generator provides several methods for the fault diagnosis.

- **Power on self-diagnosis**
- **Log**
- **Monitor through service tool**
- **Test points on PCBs**
- **LEDs on PCBs**

The generator contains self-diagnostic routines which greatly facilitate the troubleshooting. Self-diagnostic functions require that DSP works correctly. The LED D6 on MCB is used to indicate whether the DSP is working well. When DSP is work normally, the LED should be flashing at a fixed frequency. When any error occurs, the corresponding error code will be shown on the interface of service tool, and exposure is forbidden. Only after the error is cleared, the error message will not appear on the service tool.

As a general rule, the first step in any troubleshooting procedure is to verify correct power supply voltages and perform a visual inspection of all boards and cable connections.

The generator log is saved on D:\log of the PC on which the service tool is installed.

Some tools and equipment are required for troubleshooting:

- **Standard service engineers tool kit**
- **Digital multi-meter with capacitor mode and diode mode**
- **Digital oscilloscope**
- **Antistatic kit**

Indicators on Generator

Table 8-1 Indicators on Main Control Board

Item #	Location	Color	Description
1	D3	Green	RX232 receive indicator
2	D4	Green	RX232 transmit indicator
3	D6	Green	Heart beat
4	D8	Green	Small focus selected
5	D9	Green	Large focus selected
6	D10	Green	Rotor low speed selected
7	D11	Green	Rotor high speed selected
8	D12	Green	Pre-charge indicator
9	D13	Green	Main contactor control status indicator
10	D15	Green	Rotor prepare status indicator
11	D35	Green	Exposure status indicator
12	D1	Yellow	Exposure Handswitch Status
13	D2	Yellow	Prepare Handswith Status
14	D87	Yellow	+12V Power indicator
15	D93	Yellow	-12V Power indicator
16	D116	Yellow	Main contactor status indicator
17	D118	Yellow	Rotor shift over current
18	D19	RED	Inverter capacitor failed
19	D25	RED	Filament fault indicator
20	D72	RED	Tank not connection
21	D73	RED	No kV error
22	D74	RED	Inverter 2 over current
23	D75	RED	Inverter 1 over current
24	D76	RED	Anode mA over current
25	D77	RED	Cathode mA over current
26	D78	RED	Resonance over current
27	D79	RED	kV unbalance
28	D114	RED	Rotor fault indicator

Table 8-2 Indicators on Filament Driver Board

Item #	Location	Color	Description
1	D8	Green	+35V Power indicator
2	D9	Green	-35V Power indicator

3	D10	Green	+24V Power indicator

Table 8-3 Indicators on Rotor Driver Board

Item #	Location	Color	Description
1	D3	RED	DC BUS Voltage indicator

Test Points on Generator

Table 8-4 Test points on Main Control Board

Item #	Location	Description
1	TP12	kV reference
2	TP15	AEC reference
3	TP19	Filament Current reference
4	TP22	Reserved
5	TP26	Filament current feedback(DC)
6	TP27	Filament current feedback(AC)
7	TP28	Resonance current(AC)
8	TP29	Inverter frequency
9	TP31	kV Drive enable
10	TP32	Resonance current(DC)
11	TP34	Inverter driver signal 1
12	TP35	Inverter driver signal 2
13	TP38	kV cathode feedback
14	TP39	kV total feedback
15	TP40	kV anode feedback
16	TP41	High voltage on
17	TP42	kV difference
18	TP43	High mA feedback
19	TP44	Low mA feedback
20	TP45	Inverter current A
21	TP47	Inverter current B
22	TP53	+5V
23	TP55	+3.3V
24	TP57	+1.8V
25	TP59 - TP76	GND
26	TP77	+24VAA
27	TP78	+12V

28	TP80	+12VAA
29	TP82	-12VAA
30	TP84	DC BUS current feedback
31	TP86	Rotor shift current feedback
32	TP87	Rotor main current feedback
33	TP88	Rotor state
34	TP89	Inverter temperature
35	TP90	DC BUS voltage

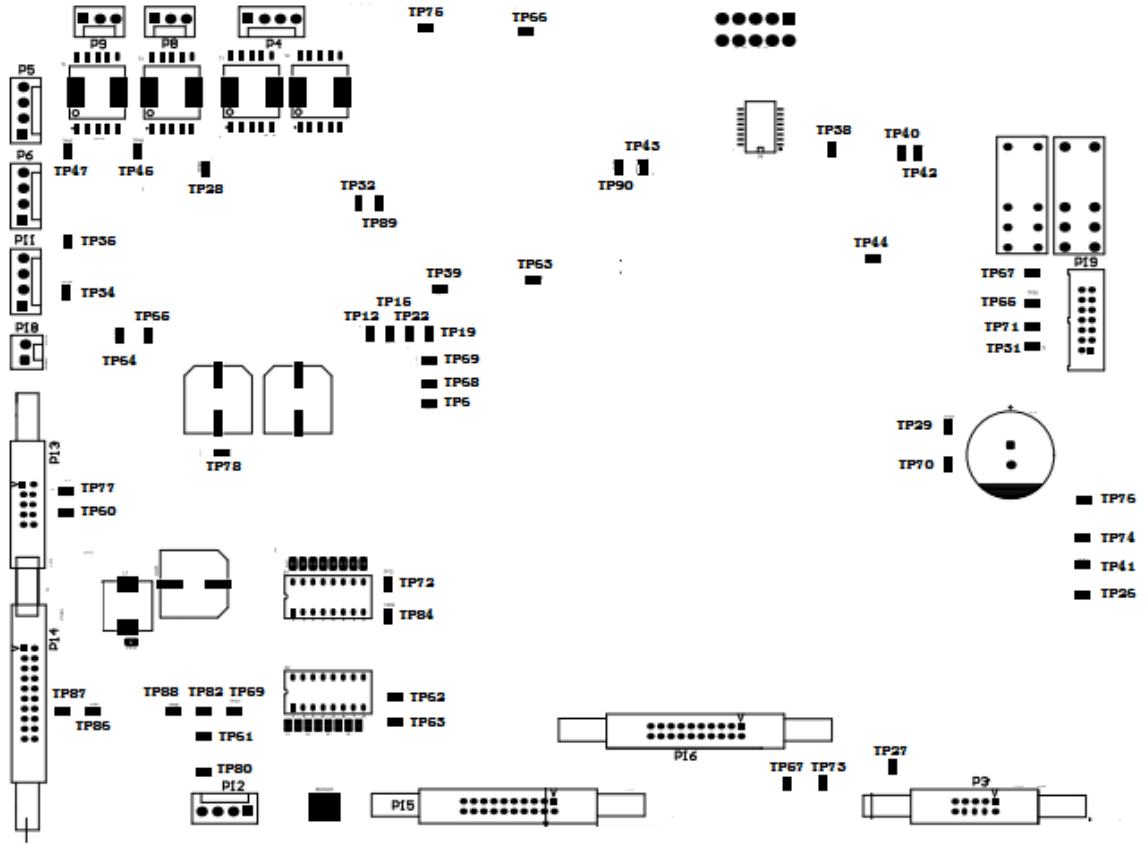


Figure 8-1 Locations of test points on MCB

Table 8-5 Test points on Filament Driver Board:

Item #	Location	Description
1	TP8	Filament select signal
2	TP9	+35VDC
3	TP10	GND
4	TP11	+12VAA
5	TP13	-35VDC
6	TP14	GND
7	TP15	+24VAA

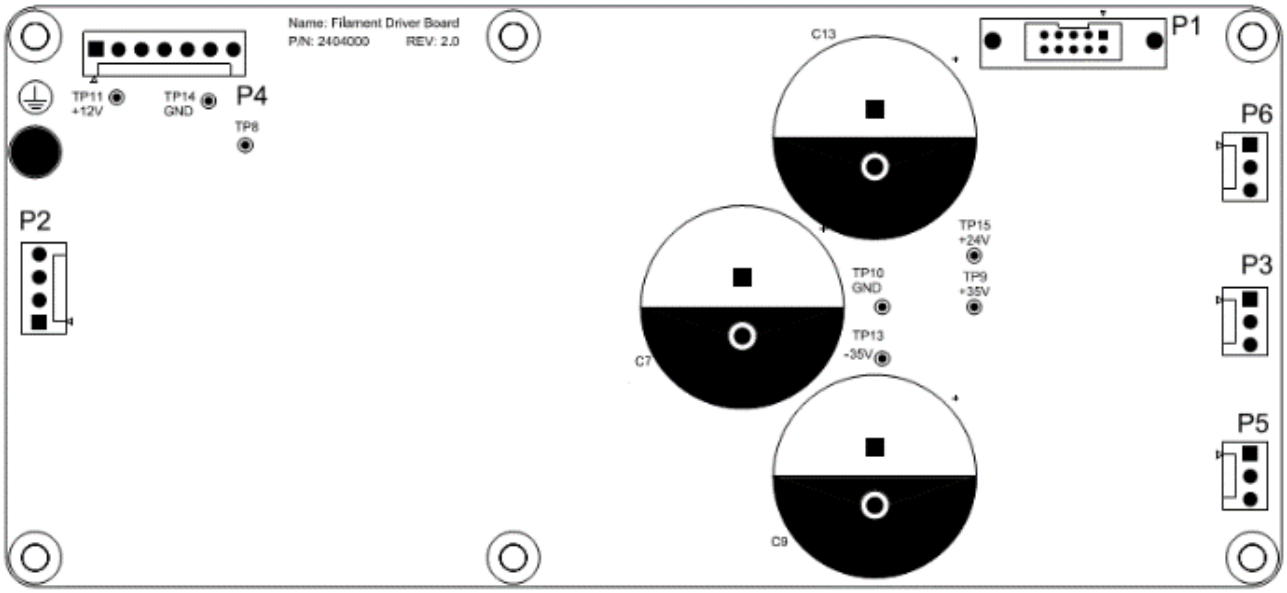


Figure 8-2 Locations of test points on FDB

Table 8-6 Test points on Rotor Driver Board:

Item #	Location	Description
1	TP1	Rotor common coil
2	TP2	Rotor main coil
3	TP3	Rotor shift coil
4	TP4	Main contact state
5	TP5	+12V
6	TP6	-12V
7	TP7	DC BUS current
8	TP8	Rotor relay
9	TP9	Q1-G
10	TP10	Q2-G
11	TP11	Q1-S
12	TP12	Q2-S
13	TP13	Q3-G
14	TP14	Q4-G
15	TP15	Q3–S,Q4-S
16	TP16	Q3–S,Q4-S
17	TP17	Rotor speed relay
18	TP18	Pre-charge relay

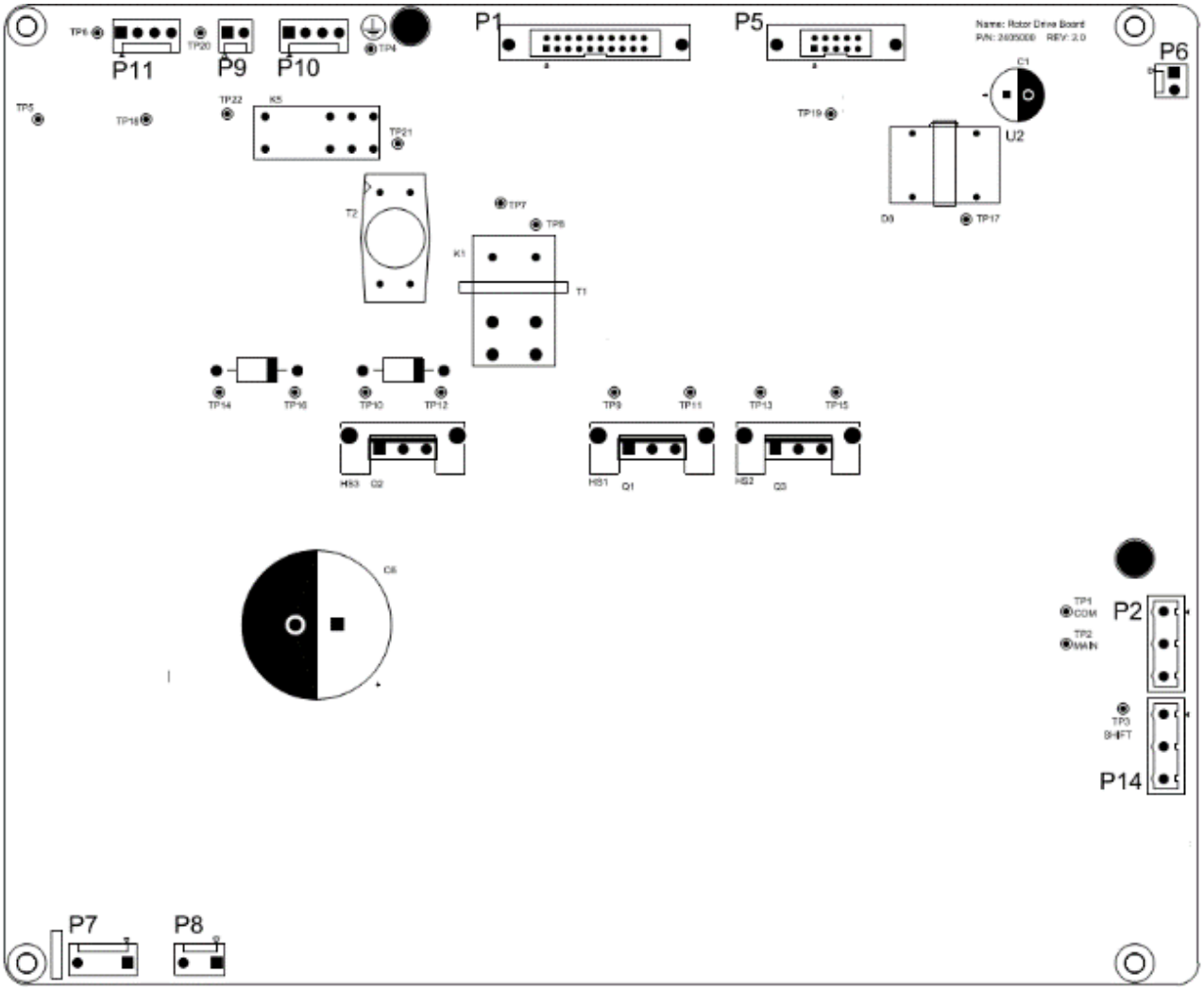


Figure 8-3 Locations of test points on RDB

Table 8-7 Test points on Room Interface Board:

Item #	Location	Description		
		RIB0	**RIB1**	**RIB2**
1	TP1	Bucky1 starts	Bucky1 starts	Detector1 starts
2	TP2	Bucky1 ready	Bucky1 ready	Detector1 ready
3	TP3	Bucky2 starts	Bucky2 starts	Detector2 starts
4	TP4	Bucky2 ready	Bucky2 ready	Detector2 ready
5	TP5	GND	GND	GND
6	TP6	GND	GND	GND
7	TP7	Door interlock	Door interlock	Door interlock
8	TP8	External sync ready	External sync ready	External sync ready
9	TP9	Tube thermal state	Tube thermal state	Tube thermal state
10	TP10	/	/	Detector3 starts
11	TP11	/	/	Detector3 ready
12	TP12	/	/	Detector4 starts

13	TP13	/	/	Detector4 ready
14	TP14	/	/	GND
15	TP15	/	/	GND

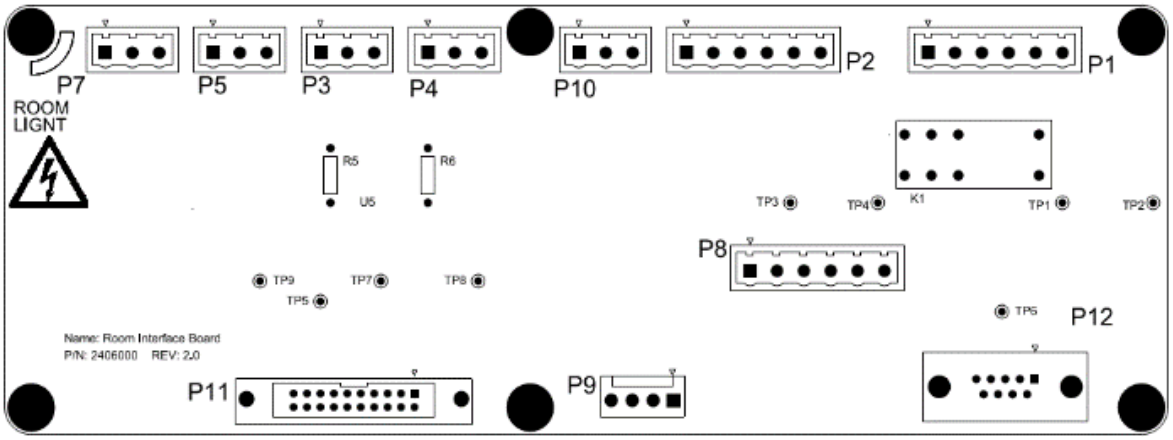


Figure 8-4 Locations of test points on RIB0

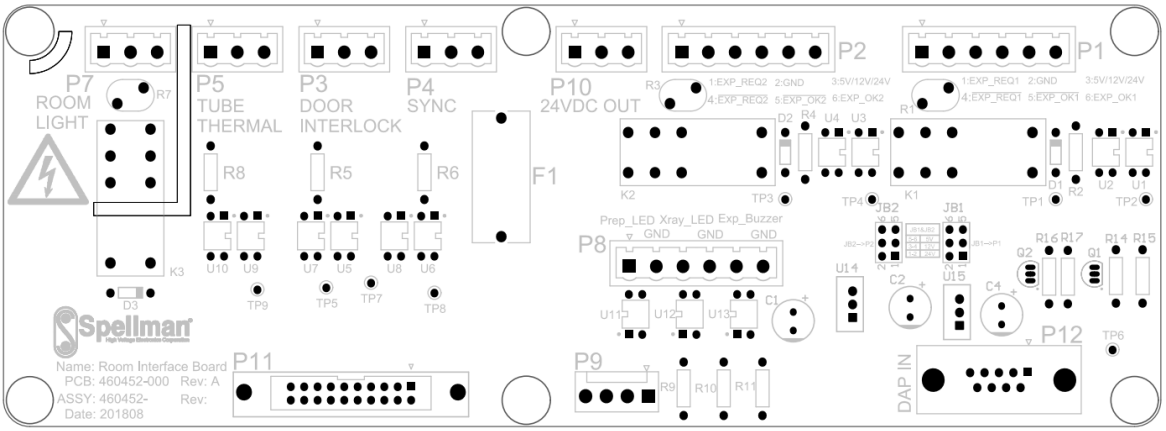


Figure 8-5 Locations of test points on RIB1

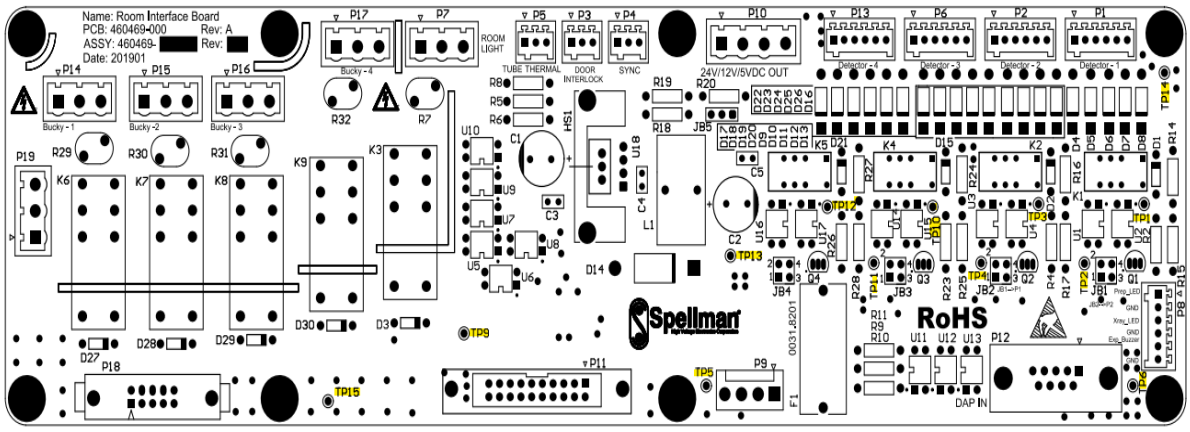


Figure 8-6 Locations of test points on RIB2

Table 8-8 Test points on AEC Board:

Item #	Location	Description
1	TP1	AEC ramp feedback channel 1
2	TP2	AEC ramp feedback channel 2
3	TP3	GND
4	TP4	GND
5	TP5	AEC ramp feedback
6	TP6	AEC stop signal
7	TP8	AEC reference

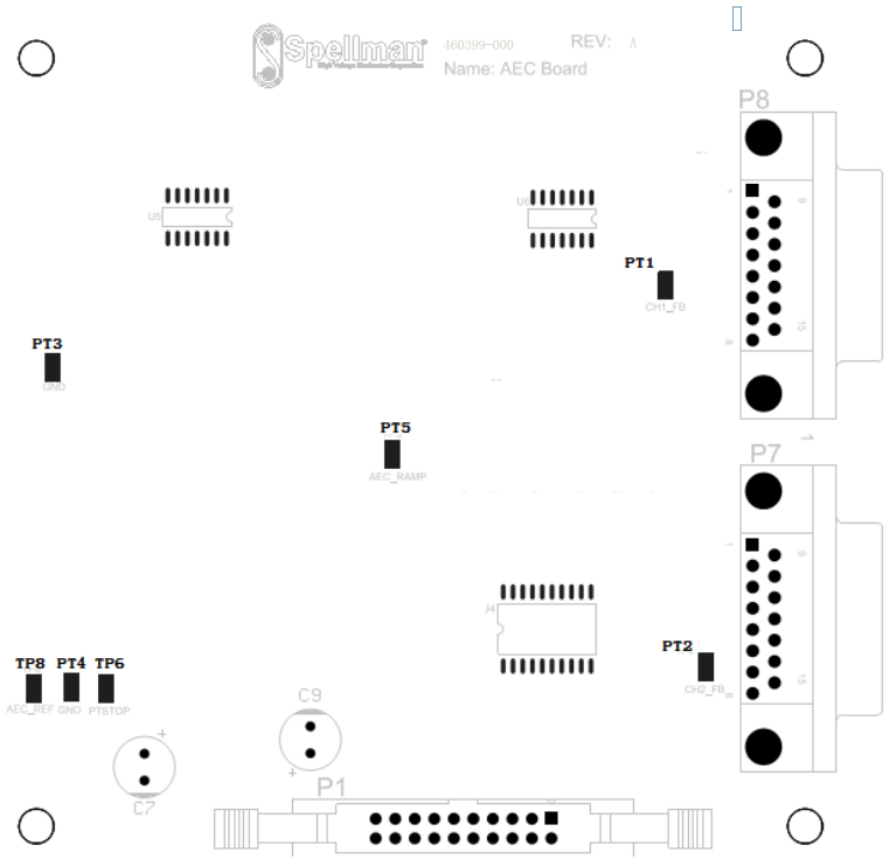


Figure 8-7 Locations of test points on AEC board

Error Code List

Latching Error

These messages indicate that an error has occurred, and should be checked by service personnel before taking further action. Need to restart generator to clear the errors.

Table 8-9 Error code list (Latching Error)

ERROR CODE	MESSAGE
E001	Initialization device error
E003	Generator CPU EEPROM Data Checksum Error
E004	Generator CPU Real Time Clock error
E005	Main Contactor Error

Non-Latching Error

These messages indicate that an error has occurred and generator enters into error state, and should be checked by service personnel before taking further action. Errors need to be cleared by console.

Table 8-10 Error code list (Non-Latching Error)

ERROR CODE	MESSAGE
E006	Rotor Fault
E007	Filament Fault
E009	Beam Cathode Fault
E010	Beam Anode Fault
E011	Beam_INVA Fault
E012	Beam_INVB Fault
E013	Beam_KV Fault
E014	Beam_IR Fault
E015	Beam_tank NC
E016	Beam_KV is not balance
E017	Inverter is too hot
E018	Prepare Hand Switch Press Timeout
E019	Prepare Handle Switch Release timeout
E020	No KV During Exposure
E021	mA During Exposure Too High
E022	mA During Exposure Too Low
E023	Manually Terminated Exposure
E024	AEC Back-up Timer Exceeded - Exposure Terminated
E025	AEC Back-up MAS Exceeded - Exposure Terminated
E026	Exposure Terminated abnormal

E027	Anode heat limit
E028	Thermal Switch Interlock Error
E029	Door Interlock Error
E031	Bucky 1 Not Contact Error
E033	Bucky 2 Not Contact Error
E034	Prep Button Input Active During Initialization Phase
E035	X-ray Button Input Active During Initialization Phase
E036	Console Communication Error
E037	+12VDC Error
E038	-12VDC Error
E043	High Voltage Error - KV Detected in Non X-ray Status
E048	Current reception is not enable
E049	AEC is not enable for current reception
E051	AEC Feedback Error (No Feedback Signal Detected)
E052	Small Focus High Filament Current Error in Standby
E053	Large Focus High Filament Current Error in Standby
E054	AEC Reference out of range
E056	No Tube data has been Programmed
E057	AEC Stop signal in wrong status
E060	High KV Error
E061	Low KV Error
E070	AEC channel error
E071	Boost filament current error
E072	Preheat filament current error
E073	No or invalid Filmscreen
E074	DC BUS voltage is error, voltage too high or too low
E075	Tube count data corrupt
E077	Peripherals Detector Error
E078	Rotor Over Current
E079	AEC Ion Chamber Disconnect
E080	Inverter Capacitor Failed
E081	I2C Write/Read Error

E100	Calibration Error - Maximum mA Exceeded
E101	Calibration Error - Calibration Data Table Exceeded
E102	Calibration Error - Maximum Filament Current Exceeded
E104	Calibration Error - No mA
E106	Calibration Limit, Selected Parameter Not Calibrated
E107	Pre-charge Relay Fault
E108	Large filament set parameter is more than max. filament current
E109	Small filament set parameter is more than max. Filament current.
E110	Prep Parameter kV Error
E111	Prep Parameter mA Error
E112	Prep Parameter ms Error
E113	Prep Parameter Rotor Speed Error
E114	Prep Parameter Focus Error
E121	Detector1 feedback signal timeout
E122	Detector2 feedback signal timeout
E123	Detector3 feedback signal timeout
E124	Detector4 feedback signal timeout

Warning

These messages indicate that parameters exceeds one or more limits or received invalid communication parameter.

Table 8-11 Error code list (warning)

ERROR CODE	MESSAGE
E045	Communication Message Not Supported
E046	Communication Message Not Allowed
E055	No AEC field is selected
E058	Wrong Tube ID
E200	Anode HU Warning Level Exceeded
E202	Generator KW Limit
E203	Generator KV Limit
E204	Generator MA Limit
E205	Generator MS Limit
E206	Generator MAS Limit

E207	Tube KW Limit
E208	Tube KV Limit
E209	Tube MA Limit
E210	Tube MAS Limit
E212	Generator AEC Density Limit
E213	Invalid Communication Parameter
E220	Reset receive buffer
E230	Stitching setting parameters are over limitation
E231	Interval period is longer than limitation
E233	Small focus is selected in stitching mode
E234	Generator Pulse Width limit in TOMO Mode
E235	Generator Pulse Quantity limit in TOMO Mode
E236	Generator Pulse Interval time limit in TOMO Mode
E237	Generator Exposure Technique Error in TOMO Mode
E238	Generator Trigger Mode Exceed in TOMO Mode
E311	Stitching: KV1 is over range
E312	Stitching: KV2 is over range
E313	Stitching: KV3 is over range
E314	Stitching: KV4 is over range
E315	Stitching: KV5 is over range
E316	Stitching: MS1 is over range
E317	Stitching: MS2 is over range
E318	Stitching: MS3 is over range
E319	Stitching: MS4 is over range
E320	Stitching: MS5 is over range
E321	Stitching: MA1 is over range
E322	Stitching: MA2 is over range
E323	Stitching: MA3 is over range
E324	Stitching: MA4 is over range
E325	Stitching: MA5 is over range
E326	Stitching: MX1 is over range
E327	Stitching: MX2 is over range

E328	Stitching: MX3 is over range
E329	Stitching: MX4 is over range
E330	Stitching: MX5 is over range
E331	Stitching: KW1 is over range
E332	Stitching: KW2 is over range
E333	Stitching: KW3 is over range
E334	Stitching: KW4 is over range
E335	Stitching: KW5 is over range

Error Code Analysis

Error Code： ER001_Initialization Device Error

Description：DSP can't initialize the basic functions.

Possible Cause：DSP dose not initialize the peripheral or DAC successfully.

Action：

1. Restart the **MCB**.
2. If the error always occurs, replace **MCB**.

Error Code： ER003_Generator CPU EEPROM Data Checksum Error

Description：DSP can't read from EEPROM or read wrong data.

Possible Cause：The data stored in EEPROM is corrupted; EEPROM breaks down.

Action：

3. Erase the EEPROM

a. Turn off the generator, and set the 8th bit of DIP switch S1 on MCB to ON.

b. Turn on the generator, and wait for about 20 seconds.

c. Turn off the generator, and set the 8th bit of DIP switch S1 on MCB to OFF.

4. Turn on the generator. If error disappears, then restore calibration data and tube file to generator.
5. Else, replace **MCB**.

Error Code： ER004_Generator CPU Real Time Clock Error

Description：DSP cannot read data from RTC.

Possible Cause：The RTC device does not work.

Action：

1. Restart the generator.
2. If error still occurs，replace MCB.

Error Code： ER005_Main Contactor Error

Description：The feedback state of main contact is wrong.

Possible Cause：Mains contact breaks down；The control relay on Rotor Driver Board breaks down; Cables connection is not good.

Action：

9. Cut off the mains power supply.
10. If not，replace the **Main Contact Board**；
11. Turn on the generator，and check whether or not D116 on MCB is on;

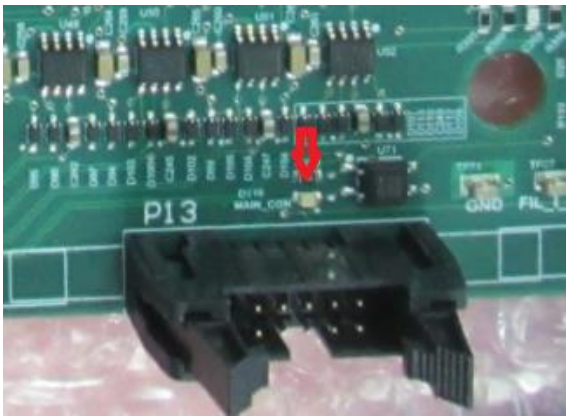


Figure 8-8 Locations of D116

12. If yes，replace the MCB；If not, measure the voltage between TP22 and GND on Rotor Driver Board;
13. If the voltage is 0V, check P10 of Rotor Driver Board. If it is ok, replace main contact; if the voltage is 12V, then check the cable between P13 on MCB and P5 on RDB (Rotor Driver Board). If it is ok, replace MCB；
14. If error still occurs, replace RDB.

Error Code： ER006_Rotor Fault

Description：No rotor current is detected after prepare hand switch is pushed down; or rotor current is detected before prepare hand switch is pushed down.

Possible Cause：Cables connection is not good；MCB or RBD breaks down；Rotor of tube breaks down.

Action：

1. Check the cable between P2 on RDB and tube；
2. Check the cable between P14 on MCB and P1 on RDB and the cable between P13 on MCB and P5 on RDB;
3. Check the cables connecting to shift capacitors and make sure the correct capacitors have been used;
4. Check F1 and F2 on RDB;
5. If all above are ok，replace RDB；
6. If error still occurs, measure the resistance of tube stator coils.

Error Code： ER007_Filament Fault

Description：The feedback filament current value is not the same as set value.

Possible Cause：Cables connection is not good; MCB or FDB (Filament Driver Board) breaks down; something is wrong with tube filament.

Action：

1. Check the HV cable between tank and tube;
2. Check the cable between P2 on FDB and P4 on TIB(Tank Interface Board);
3. Check the cable between P3 on MCB and P1 on FDB;
4. Check the fuses from F2 to F5 on FDB;
5. Check the tube filament according to tube datasheet;
6. If all above are ok，replace FDB or MCB；

Error Code： ER009_ Beam Cathode Fault

Description：Cathode current exceeds the limitation.

Possible Cause： Tank arcing；Tube arcing；HV cables arcing.

Action：

1. If the tube is ageing, replace the tube;
2. Check whether or not a wrong tube file has been downloaded;
3. Check the HV cables; clean the plug, coat the silicon grease and connect the plug reliably;
4. If all above don’t work, replace the tank.

Error Code： ER0010_ Beam Anode Fault

Description：Anode current exceeds the limitation.

Possible Cause：Tank arcing；Tube arcing；HV cables arcing.

Action：

1. If the tube is ageing, replace the tube;
2. Check whether or not a wrong tube file has been downloaded;
3. Check the HV cables; clean the plug, coat the silicon grease and connect the plug reliably;
4. If all above don't work, replace the tank.

Error Code： ER011_Beam_INVA Fault

Description：Excessive invert current of inverter A is detected.

Possible Cause：Arcing；Inverter module A breaks down；Short circuit on inverter A.

Action：

1. Rule out the possibility of short circuit on inverter board.
2. If not, replace inverter module A.

Error Code： ER012_Beam_INVB Fault

Description：Excessive invert current of inverter B is detected.

Possible Cause：Arcing；Inverter module B breaks down；Short circuit on inverter B.

Action：

1. Rule out the possibility of short circuit on inverter board.
2. If not, replace inverter module B.

Error Code： ER013_ Beam KV Fault

Description：Excessive KV output is detected during exposure.

Possible Cause：MCB breaks down; Tank breaks down.

Action：

1. Replace MCB;
2. If error still occurs, replace tank；

Error Code： ER014_ Beam IR Fault

Description：Excessive resonant current is detected during exposure.

Possible Cause：Tank arcing；Tube arcing；HV cables arcing; MCB breaks down.

Action：

1. If the tube is ageing, replace the tube;

2. Check whether or not a wrong tube file has been downloaded;
3. Check the HV cables; clean the plug, coat the silicon grease and connect the plug reliably;
4. If all above don't work, replace the tank.

Error Code： ER015_Tank NC Fault

Description：Tank is not connected to MCB.
Possible Cause：Cable connection between P3 on TIB and P7 on MCB is not good.

Action：

1. Reconnect the cable from P3 on TIB to P7 on MCB;
2. If error still occurs, replace MCB.

Error Code： ER016_kV is not balance between anode and cathode

Description：The difference of voltage on anode and cathode is larger than limitation.
Possible Cause：Tank breaks down; cable is not in good connection.

Action：

1. Reconnect the cable from P3 on TIB to P7 on MCB;
2. Make sure there is no foreign matter on MCB;
3. If error continues, replace tank；
4. Replace MCB.

Error Code： ER017_Inverter is too hot

Description：Inverter module is too hot.

Possible Cause：Exposure too many times in a short time period.

Action：

1. Stop exposing until the inverter module cools down.
2. Replace TSB (Temperature sensor Board)
3. Else, replace MCB.

Error Code： ER018_First level Handle Timeout

Description：No Exposure hand switch pressing is detected after pressing Prep hand switch for 30s.
Possible Cause：Incorrect operation; Hand switch failure; Communication cable failure.

Action：

1. Reduce the time delay between pressing the first and second stage of the hand switch.
2. Replace hand switch if errors continue;
3. Check the cable from hand switch to MCB;
4. Replace MCB.

Error Code： ER019_Handle Switch is not released in 30S timer-out after exposure

Description：After exposure for 30s, the prepare hand switch is still active.

Possible Cause：Incorrect operation; Hand switch failure; Communication cable failure.

Action：

1. Release the prepare hand switch timely after exposure;
2. Replace hand switch if errors continue;
3. Check the cable from hand switch to MCB;
4. Replace MCB.

Error Code： ER020_No KV during exposure

Description：No KV feedback signal is detected during exposure.

Possible Cause：MCB breaks down; Tank breaks down; cable is not in good connection.

Action：

1. Check the waveform between TP34 and TP35 on MCB during exposure. The waveform

Should be like this:

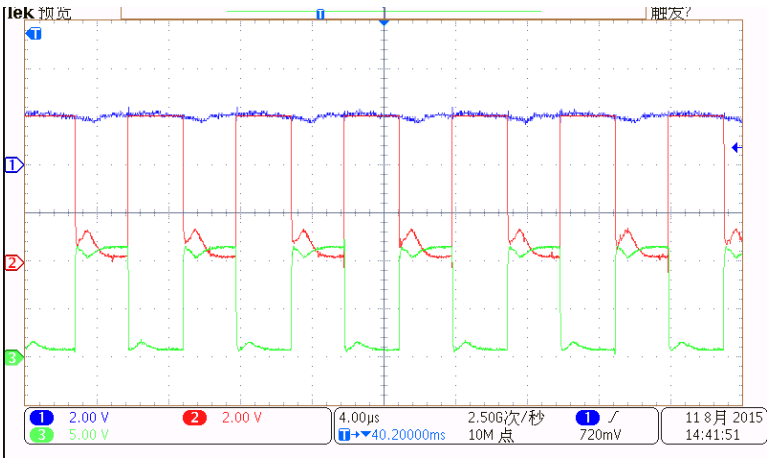


Figure 8-9 Waveform of Driver Signal

2. If the waveform is not good, replace MCB; Else, check the cables between P5,P6 on MCB and P2 on Inerter A and B;
3. Check the cable from P3 on TIB to P7 on MCB;
4. If error continues, replace tank.

Error Code： ER021_MA during exposure too high

Description：The mA feedback signal is much larger than setting.

Possible Cause：Calibration data is not correct; Tube aging.

Action：

1. Recalibrate the tube；
2. Replace MCB;
3. Replace tube if error continues.

Error Code： ER022_ MA during exposure too low

Description：The mA feedback signal is much lower than setting.
Possible Cause：Calibration data is not correct; Tube aging.

Action：

1. Recalibrate the tube；
2. Replace MCB;
3. Replace tube if error continues.

Error Code： ER023_Manually Terminated Exposure

Description：Exposure hand switch is released before the exposure completes.

Possible Cause：Incorrect operation; Hand switch failure; Communication cable failure.

Action：

1. Release the exposure hand switch after the exposure procedure finish;
2. Check the cable from hand switch to MCB;
3. If error continues, replace hand switch.

Error Code： ER024_AEC Back-up Timer-exposure terminated

Description：No exposure terminate signal detected before reaching AEC back up time.

Possible Cause：Wrong AEC setting; Ion chamber breaks down; Ion chamber doesn’t receive x-ray; AEC Board break down.

Action：

1. Make sure the AEC channel setting is consistent with actual physical connection;
2. Make sure the value of AEC backup time is larger than normal exposure time;
3. Check the cables from P7, P8 on AEC Board to Ion chamber;
4. Check the cables from P1 on AEC Board to P16 on MCB;
5. Measure the waveform of TP5 on AEC Board. The reference waveform should be like this:

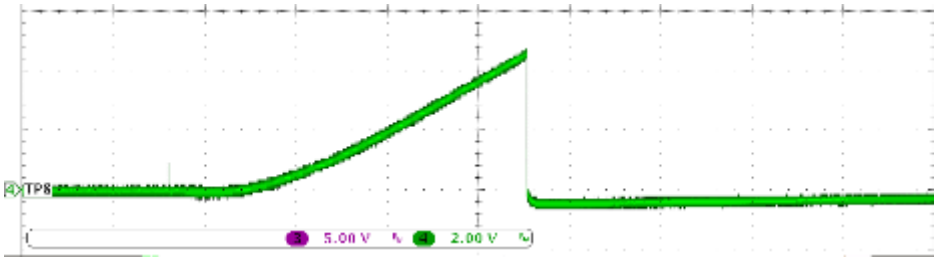


Figure 8-10 Feedback of AEC

6. If the waveform is not good, replace AEC Board or Ion chamber;
7. If error continues, replace MCB.

Error Code： ER025_AEC MAS Limit

Description：No exposure terminate signal detected before reaching AEC back up MAS.

Possible Cause：Wrong AEC setting; Ion chamber breaks down; Ion chamber doesn’t receive x-ray; AEC Board break down.

Action：

1. Make sure the AEC channel setting is consistent with actual physical connection;
2. Make sure the value of AEC backup time is larger than normal exposure time;
3. Check the cables from P7, P8 on AEC Board to Ion chamber;
4. Check the cables from P1 on AEC Board to P16 on MCB;
5. Measure the waveform of TP5 on AEC Board. The reference waveform should be like this:

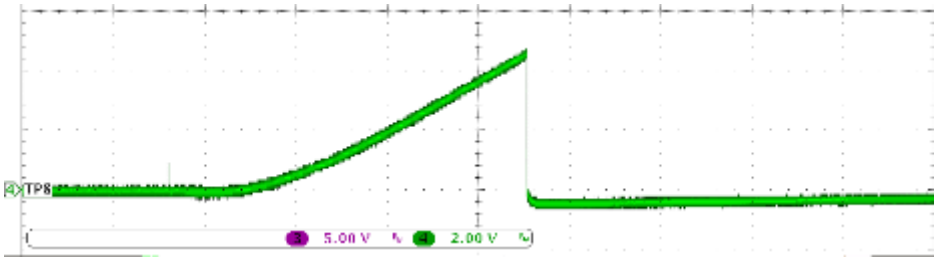


Figure 8-11 Feedback of AEC

6. If the waveform is not good, replace AEC Board or Ion chamber;
7. If error continues, replace MCB.

Error Code： ER026_Exposure Terminated Abnormal

Description：The HV_ON signal is not detected during exposure.

Possible Cause：MCB failure; Parameters are revised during exposure.

Action：

1. Check the cable from P3 on TIB to P7 on MCB;
2. Replace MCB;
3. If error continues, replace tank.

Error Code： ER027_Anode Heat Limit

Description：The HU value exceeds tube heat capacity.

Possible Cause：Too many exposures in a short period of time.

Action：

1. Make sure the setting of HU limitation is right（90% normally）;
2. Stop exposure until the tube cools down.

Error Code： ER028_Thermal Switch Interlock #1 error

Description：The tube thermal switch is open.

Possible Cause：The temperature of tube exceeds limitation; RIB failures.
Action：

1. Check if or not the tube is too hot;
2. If yes, stop using until the tube cools down;
3. Check the cable from P5 on RIB (Room Interface Board) to tube;
4. If error continues, check the thermal switch on tube.

Error Code： ER029_Room Door Interlock

Description：The door is not closed.

Possible Cause：RIB failure; Door switch failure; Cable is not in good connection.

Action：

1. Close the door;
2. If error still occurs, check the cable from door switch to P3 on RIB;
3. Check the cable from P15 on MCB to P11 on RIB;
4. Check the voltage of TP7 on RIB. It should be around 3.3V. If not, replace RIB.
5. Replace MCB if error continues.

Error Code： ER031_Bucky1 Interlock

Description：No feedback from Bucky1.

Possible Cause：The Bucky1 is not contacted; Cable is not in good connection; RIB failure.

Action：

1. Make sure the setting of station is right;
2. Check the cable from P15 on MCB to P11 on RIB;
3. Check the output of P1-1 on RIB. It should be from 0V to 24V;
4. If not ,replace MCB；
5. Check the output of P1-1 on RIB. It should be from 24V to 0V; If not, replace Bucky;
6. Replace RIB if error continues.

Error Code： ER033_Bucky2 Interlock

Description：No feedback from Bucky2.

Possible Cause：The Bucky2 is not contacted; Cable is not in good connection; RIB failure.

Action：

1. Make sure the setting of station is right;
2. Check the cable from P15 on MCB to P11 on RIB;
3. Check the output of P2-1 on RIB. It should be from 0V to 24V;
4. If not, replace MCB；
5. Check the output of P2-1 on RIB. It should be from 24V to 0V; If not, replace Bucky;
6. Replace RIB if error continues.

Error Code： ER034_PREP Hand Switch Abnormal

Description：Prep hand switch is detected during initialization phase.

Possible Cause：Prep hand switch is pressed during generator power on;

Hand switch failure
Action：

1. Release the hand switch when power on;
2. If error still occurs, check the cable from hand switch to MCB;
3. Replace hand switch if necessary.

Error Code： ER035_EXP Hand Switch Abnormal

Description：Exposure hand switch is detected during initialization phase.

Possible Cause：Exposure hand switch is pressed during generator power on; Hand switch failure.
Action：

1. Release the hand switch when power on;
2. If error still occurs, check the cable from hand switch to MCB;
3. Replace hand switch if necessary.

Error Code： ER036_Communication Error

Description：The communication between console and generator is not available.

Possible Cause：Cable failure; MCB breaks down; Console breaks down.

Action：

1. Make sure D6 on MCB is flushing regularly;
2. Make sure the serial port has been recognized;
3. Check the communication cable;
4. Restart the generator or console;
5. If all above don’t work, replace MCB.

Error Code： ER037_+12VDC Error

Description：The value of +12V exceeds the limitation.

Possible Cause：MCB failure; FDB failure.

Action：

1. Remove P12 of MCB; Check the DC voltage of TP15 on FDB. It should be between 22V and 26V; if not, replace FDB.
2. Replace MCB if error still occurs.

Error Code： ER038_-12VDC Error

Description：The value of -12V exceeds the limitation.

Possible Cause：MCB failure; FDB failure.

Action：

1. Remove P12 of MCB; Check the DC voltage of TP15 on FDB. It should be between 22V and 26V; if not, replace FDB.
2. Replace MCB if error still occurs.

Error Code： ER043_High Voltage Error

Description：KV feedback is detected in non-exposure state.

Possible Cause：MCB failure.

Action：

1. Replace MCB.
2.

Error Code： ER044_Invalid Communication Message

Description：Invalid communication message.

Possible Cause：Console sends wrong message; Communication is disturbed.

Action：

1. Reset the error.

Error Code： ER045_Communication Message Not Supported

Description：Message is not consistent with protocol.

Possible Cause：Console sends wrong message; Communication is disturbed.

Action：

1. Reset the error.

Error Code： ER046_Communication Message Not Allowed

Description：Communication message is not allowed.

Possible Cause：Change the settings during exposure.

Action：

1. Don’t change the settings during exposure.

Error Code： ER048_Current Station Not Enable

Description： Current AEC channel is not available.

Possible Cause：AEC channel setting is out of range.

Action：

1. Selected a right AEC channel.

Error Code： ER049_AEC Channel Not Enable

Description：Current station is not available.

Possible Cause：AEC channel is not selected in current station.

Action：

1. Selected the AEC channel in current station and save the change.

Error Code： ER051_AEC Feedback Error

Description：No AEC feedback signal is detected or the signal rises too slowly.

Possible Cause：Ion chamber breaks down; AEC Board breaks down.

Action：

1. Make sure the AEC channel setting is consistent with actual physical connection;
2. Make sure the value of AEC backup time is larger than normal exposure time;
3. Check the cables from P7, P8 on AEC Board to Ion chamber;
4. Check the cables from P1 on AEC Board to P16 on MCB;
5. Measure the waveform of TP5 on AEC Board. The reference waveform should be like this:

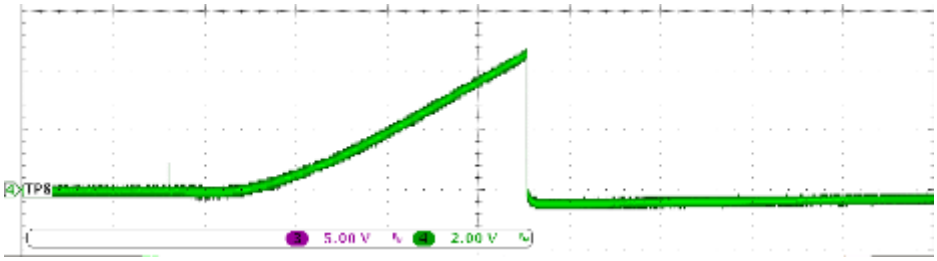


Figure 8-12 Feedback of AEC

6. If the waveform is not good, replace AEC Board or Ion chamber;
7. If error continues, replace MCB.

Error Code： ER052_SF Filament Over Current

Description：The current of small filament is larger than maximum allowable value.

Possible Cause：FBD failure; MCB failure.

Action：

1. Replace FDB;
2. If error continues, replace MCB.

Error Code： ER053_LF Filament Over Current

Description：The current of large filament is larger than maximum allowable value.

Possible Cause：FBD failure; MCB failure.

Action：

1. Replace FDB;
2. If error continues, replace MCB.

Error Code： ER054_AEC Reference Out of Range

Description：The AEC reference is out of range.

Possible Cause：Wrong settings.
Action：

1. Change AEC calibration data.

Error Code： ER055_No Fields Selected in AEC Mode

Description：All the AEC fields are not selected in AEC mode.

Possible Cause：Wrong settings.
Action：

1. At least select one AEC Filed.

Error Code： ER056_No Tube Selected

Description：There is no tube date in generator.

Possible Cause：Tube data corrupted; No tube data has been downloaded.

Action：

1. Download the tube file.

Error Code： ER057_AEC Stop Error

Description：AEC stop signal is detected in no exposure state.

Possible Cause：AEC Board failure; Ion chamber failure.

Action：

1. Check the cable between P16 on MCB and P1 on AEC Board;
2. Measure the voltage of TP6 on AEC board. If it is much higher than 0V, then replace AEC Board;
3. Otherwise, replace MCB.
4. Replace Ion chamber if necessary.

Error Code： ER058_Tube ID Error

Description：The DIP switch setting is not consistent with tube file.

Possible Cause：Wrong setting of DIP switch S2; want to download a wrong tube file

Action：

1. Make sure the right tube file is going to be downloaded;
2. Check the setting of DIP S2 on MCB;
3. Replace MCB if necessary.

Error Code： ER060_High KV Error

Description: The KV feedback is much larger than set value.

Possible Cause：MCB failure; Tank failure.

Action：

1. Check the cable between P3 on TIB and P7 on MCB;
2. If error continues, replace MCB;
3. If else, replace tank.

Error Code： ER061_Low KV Error

Description：The KV feedback is much smaller than set value.

Possible Cause：MCB failure; Tank failure.

Action：

1. Check the cable between P3 on TIB and P7 on MCB;
2. If error continues, replace MCB;
3. If else, replace tank.

Error Code： ER070_AEC Channel Error

Description：AEC Channel Error.

Possible Cause：Wrong settings.

Action：

1. Set the AEC channel number in None / P8 / P7;

Error Code： ER071_Filament Boost Error

Description：The feedback value of filament current is much different with set value.

Possible Cause：FDB failure; MCB failure.

Action：

1. Check the cable between P2 on FDB and P4 on TIB;
2. Replace FDB;
3. Replace MCB if necessary.

Error Code： ER072_Filament Preheat Error

Description：The feedback value of filament current is much different with set value.

Possible Cause：FDB failure; MCB failure.

Action：

1. Check the cable between P2 on FDB and P4 on TIB;
2. Replace FDB;
3. Replace MCB if necessary.

Error Code： ER073_Invalid Film Screen

Description：Invalid film screen setting.

Possible Cause：The setting value is out of range.

Action：

1. Make sure the correct film screen value has been set to generator;
2. Reset the error.

Error Code： ER074_DC Bus Error

Description：The DC BUS voltage is out of range.

Possible Cause：Power supply is too high or low; cable problems; rectifier failure.

Action：

1. Check net voltage, make sure the deviation is within 10%;
2. Measure the output voltage of rectifier; if the value is too high or low, replace the rectifier;

CAUTION：HIGH VOLTAGE!

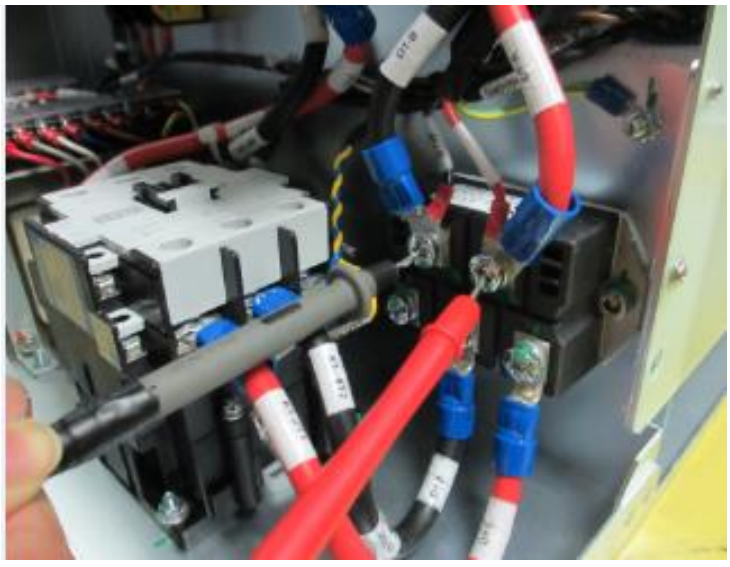


Figure 8-13 Testing DC Bus Voltage

3. Measure the DC voltage between P18-1 and P18-2 on MCB. If the value is about 1/103 of the DC bus voltage, replace MCB;
4. If error continues, replace RBD.

Error Code： ER075_Tube Count Error

Description：Tube count data corrupt is detected.

Possible Cause：The data stored in EEPROM is corrupted.

Action：

1. Reset the tube count data;
2. If error continues, replace MCB;

Error Code： ER077_Peripherals Detector Error

Description：The peripheral output short circuit to ground.

Possible Cause：MCB failure; RIB failure.

Action：

1. Remove P11 on RIB, and Check whether short circuit happens between P2 and P5, P4 and P5, P7 and P5, P9 and P5;
2. If yes, replace RIB;
3. Otherwise, replace MCB.

Error Code： ER078_Rotor Over Current

Description：The rotor drive current is larger than limitation.

Possible Cause：RDB failure; Tube failure.

Action：

1. Check the tube file;
2. Replace RDB if the occur still occurs.

Error Code： ER079_AEC Connection Fault

Description：The ion chamber is not connected reliably.

Possible Cause：Cable is not in good connection; AEC Board failure.

Action：

1. Check the cable from Ion chamber to AEC board and the cable from P16 ON MCB to P1 on AEC Board;
2. Measure the voltage of TP5 on AEC Board, if it is about 2.4V, replace AEC Board or ion chamber;
3. Replace MCB if necessary.

Error Code： ER080_Inverter Capacitor Fault

Description：Large inrush current detected on inverter board.

Possible Cause：The electrolytic capacitor on inverter board is damaged.
Action：

1. Replace inverter module;
2. If error continues, replace MCB.

Error Code： ER081_I2C Error

Description：Can't read DIP switch status.

Possible Cause：MCB failure.

Action：

1. Restart the generator;
2. If error still occurs, replace MCB.

Error Code： ER100_Calibration Error - Maximum MA Limit

Description：The mA feedback value exceeds the maximum permit value during calibration.

Possible Cause：The filament current is not adjusted. MCB failure.

Action：

1. Make sure the setting of maximum mA is correct;
2. Check the cable between P3 on MCB and P1 on FDB;
3. Measure the voltage of TP20 on MCB, if it is about 2.5V, replace FDB. If not, replace MCB;
4. Replace tank if necessary.

Error Code： ER101_Calibration Error - Maximum Data Limit

Description：The calibration number is exceed maximum value at one KV condition.

Possible Cause：The tube aging; MCB failure.

Action：

1. Make sure the correct tube file has been downloaded;
2. Check the cable between P3 on MCB and P1 on FDB;
3. Measure the voltage of TP20 on MCB, if it is about 2.5V, replace FDB. If not, replace MCB;
4. Replace tank if necessary.

Error Code： ER102_Calibration Error - Maximum Filament Current Limit

Description：The filament current exceeds maximum filament permit value during calibration.
Possible Cause：The tube aging; MCB failure.
Action：

1. Make sure the setting of maximum filament value is right;
2. Check the cable between P3 on MCB and P1 on FDB;
3. Measure the voltage of TP20 on MCB, if it is about 2.5V, replace FDB. If not, replace MCB;
4. Replace tank if necessary.

Error Code： ER104_Calibration Error - No MA

Description：No mA feedback is detected during calibration.

Possible Cause： Tube breaks down; Tank breaks down; cable is not in good connection.

Action：

1. Down load calibration data, and check if the exposure is normal;
2. Deal with the error according to error message

Error Code： ER106_Parameter Not Calibrated

Description：Selected parameters have not been calibrated.

Possible Cause：Calibration data is not complete; The tube has not been calibrated.

Action：

1. Restored calibration date or recalibrate the tube.

Error Code： ER107_Precharge Fault

Description：Precharge procedure fails.

Possible Cause：Main power voltage too low; Fuses break; RDB failures.

Action：

1. Make sure D6 on MCB is flushing regularly;
2. Measure the power supply, and check if or not the value is within range;
3. Turn off the generator, check F3 and F4 on RDB;
4. Check the cable from P13 on MCB to P5 on RDB; and the cable from P7,P8 on RDB to main contact;
5. Measure the voltage of TP18 on RDB. If the value is about 12V, replace MCB;
6. Replace RDB is necessary.

Error Code： ER108_LF Filament Setting Out of Limit

Description：The setting value of small filament is larger than maximum allowable value.

Possible Cause：Wrong setting.

Action：

1．Reset the error.

Error Code： ER109_SF Filament Setting Out of Limit

Description：The setting value of small filament is larger than maximum allowable value.

Possible Cause：Wrong setting.

Action：

1．Reset the error.

Error Code： ER110_PrepParameter kV Error

Description：The exposure kV does not match with setting kV.

Possible Cause：The kV parameter is not set successfully.

Action：

1. Reset the kV parameter.

Error Code： ER111_PrepParameter mA Error

Description：The exposure mA does not match with setting mA.

Possible Cause：The mA parameter is not set successfully.

Action：

1. Reset the mA parameter.

Error Code： ER112_PrepParameter ms Error

Description：The exposure ms does not match with setting ms.

Possible Cause：The ms parameter is not set successfully.

Action：

1. Reset the ms parameter.

Error Code： ER113_PrepParameter Rotor Speed Error

Description：The tube does not run at right speed according to exposure parameters.

Possible Cause：The exposure parameter is not set successfully.

Action：

1. Reset the exposure parameter.

Error Code： ER114_PrepParameter Focus Error

Description：The focus is not selected successfully.

Possible Cause：The focus is not selected successfully.

Action：

1. Reset the focus.

Error Code： ER121_Detector1 feedback signal timeout

Description：No feedback from Detector1.

Possible Cause：The Detector1 is not contacted; Cable is not in good connection; RIB failure.

Action：

1. Make sure the setting of station is right;
2. Check the cable from P15 on MCB to P11 on RIB;
3. Check the Detector1 signals are High or low activity.

Error Code： ER122_Detector2 feedback signal timeout

Description：No feedback from Detector2.

Possible Cause：The Detector2 is not contacted; Cable is not in good connection; RIB failure.

Action：

1. Make sure the setting of station is right;
2. Check the cable from P15 on MCB to P11 on RIB;
3. Check the Detector2 signals are High or low activity.

Error Code： ER123_Detector3 feedback signal timeout

Description：No feedback from Detector3.

Possible Cause：The Detector3 is not contacted; Cable is not in good

connection; RIB failure.

Action：

1. Make sure the setting of station is right;
2. Check the cable from P21 on MCB to P18 on RIB;
3. Check the Detector3 signals are High or low activity.

Error Code： ER124_Detector4 feedback signal timeout

Description：No feedback from Detector4.

Possible Cause：The Detector4 is not contacted; Cable is not in good connection; RIB failure.

Action：

1. Make sure the setting of station is right;
2. Check the cable from P21 on MCB to P18 on RIB;
3. Check the Detector4 signals are High or low activity.

Error Code： ER200_Anode Heat Warning

Description：The current HU of tube has reached the warning value.

Possible Cause：Too many exposures during a short period of time.

Action：

1. Check the setting of HU warning value.
2. Stop exposure until the HU drops.

Error Code： ER202_Generator KW Limit

Description：Requesting parameter is not allowed as the KW limitation has been reached.

Possible Cause：Wrong setting.

Action：

1. Check the setting of maximum KW through service tool;
2. Reset the error.

Error Code： ER203_Generator KV Limit

Description：Requesting kV is not allowed as the kV limitation has been reached.

Possible Cause：Wrong setting.

Action：

1. Check the setting of maximum kV through service tool;
2. Reset the error.

Error Code： ER204_Generator MA Limit

Description：Requesting mA is not allowed as the mA limitation has been reached.

Possible Cause：Wrong setting.

Action：

1. Check the setting of maximum mA through service tool;
2. Reset the error.

Error Code： ER205_Generator MS Limit

Description：Requesting ms is not allowed as the ms limitation has been reached.

Possible Cause：Wrong setting.

Action：

1. Check the setting of maximum ms through service tool;
2. Reset the error.

Error Code： ER206_Generator MAS Limit

Description：Requesting mAs is not allowed as the mAs limitation has been reached.

Possible Cause：Wrong setting.

Action：

1. Check the setting of maximum mAs through service tool;
2. Reset the error.

Error Code： ER207_Generator KW Limit

Description：Requesting KW is not allowed as the KW limitation has been reached.

Possible Cause：Wrong setting.

Action：

1. Check the setting of maximum KW through service tool;

2. Check the setting of (kV*ma / 1000).
3. Reset the error.

Error Code： ER208_Tube KV Limit

Description：Calibration KV exceeds limitation.

Possible Cause：The setting of kV limitation is too low.

Action：

1. Check the setting of maximum kV through service tool;
2. Reset the error.

Error Code： ER209_Tube mA Limit

Description：Calibration mA exceeds limitation.

Possible Cause：The setting of mA limitation is too low, or incorrect setting.

Action：

1. Check the setting of maximum mA through service tool;
2. Reset the error.

Error Code： ER210_Tube mAs Limit

Description：Calibration mAs exceeds limitation.

Possible Cause：The setting of kV limitation is too low.

Action：

1. Check the setting of maximum mAs through service tool;
2. Reset the error.

Error Code： ER212_Generator AEC Density Limit

Description：The setting of AEC density is out of range.

Possible Cause：Wrong setting.

Action：

1. Change the setting.

Error Code： ER213_Invalid Communication Parameter

Description：Message is invalid.

Possible Cause：Console sends a wrong message; the communication is disturbed.

Action：

1. Reset the error.

Error Code： ER220_Reset Receive Buffer

Description：The UART receive buffer is reset abnormally.

Possible Cause：The data length is over the maximum.

Action：

1. Decrease the length of data bag and send it again.

Error Code： ER230_Stitching setting parameters are over limitation

Description：The combination of setting parameters is over tube/generator limitation.

Possible Cause：The setting of stitching is out of range.

Action：

1. Check the parameters, and make sure they are available for the generator.

Error Code： ER231_Interval period is longer than limitation

Description：The interval time between two exposures is longer than 20s.

Possible Cause：The exposure handswitch is pressed too later.

Action：

1. Make sure the interval time between two exposures is shorter than 20s.

Error Code： ER233_Small focus is selected in stitching mode

Description：Large focus is a must in stitching mode

Possible Cause：Small focus is selected in stitching mode.

Action：

1. Change to large focus.

Error Code： ER234_TOMO PulsWidth limit

Description：The pulse width is over limit

Possible Cause：Incorrect parameters setting in TOMO Mode.

Action：

1. Reset the error.

Error Code： ER235_TOMO PulsQty limit

Description：The pulse quantity is over limit at one exposure.

Possible Cause：Incorrect parameters setting in TOMO Mode.

Action：

1. Reset the error.

Error Code： ER236_TOMO Interval time limit

Description：The interval time is over limit in one exposure.

Possible Cause：Incorrect parameters setting in TOMO Mode.

Action：

1. Reset the error.

Error Code： ER237_TOMO Exposure Technique Error

Description：The exposure technique is not MA_MS Mode.

Possible Cause：Incorrect parameters setting in TOMO Mode.

Action：

1. Select MA_MS Mode and Reset the error.

Error Code： ER238_TOMO Trigger Mode Error

Description：The trigger mode is over limit.

Possible Cause：Incorrect parameters setting in TOMO Mode.

Action：

1. Select correct trigger mode and Reset the error.

Error Code： ER311-ER335_Refer to table 8-11

Description：Setting stitching parameter is over range

Possible Cause：The corresponding parameter is over the power limitation of tube/generator.

Action：

1. None.

Chapter 9 Spare Parts

Three Phase Generator Series Z####

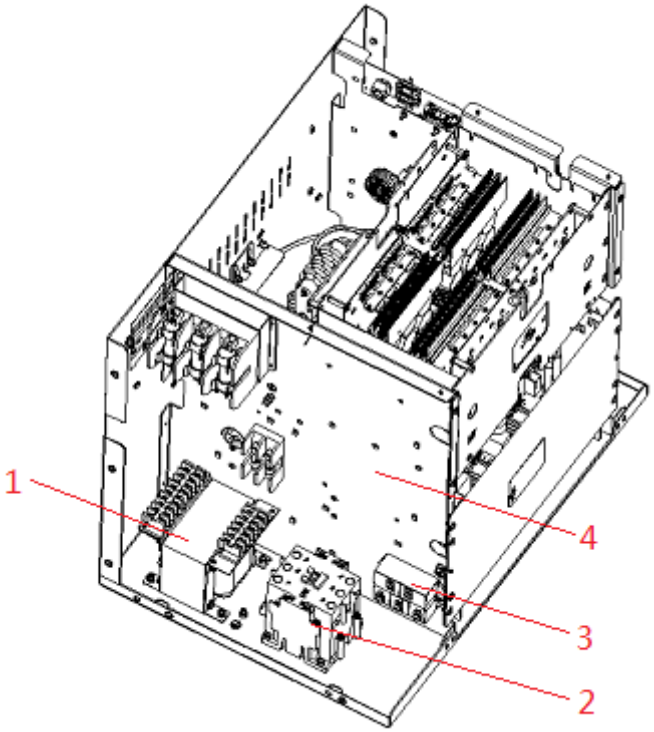
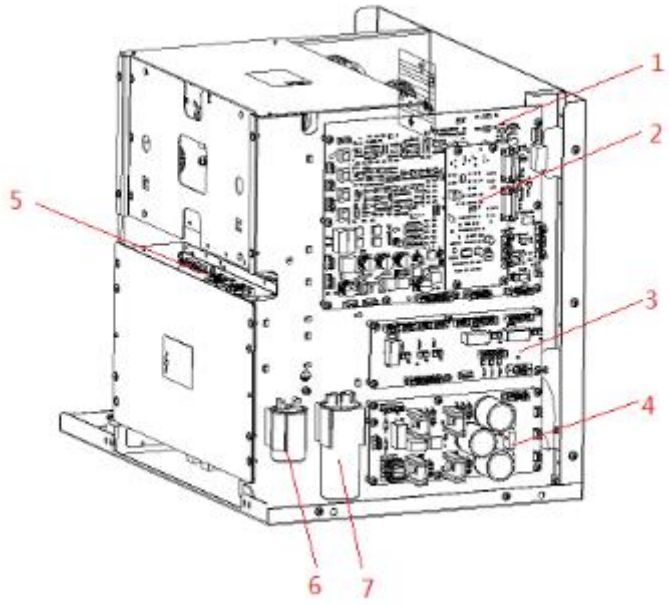


Figure 9-1 Sub-assembly(1)

Table 9-1 Sub-assembly list

Item	PN	Description	Qty.	Notes
1	8710002	Control Transformer 250VA	1	/
2	8710003	Mains Contactor	1	/
3	8710001	Mains Rectifier	1	/
4	8710006	Line Filter	1	Optional

Sub-assembly



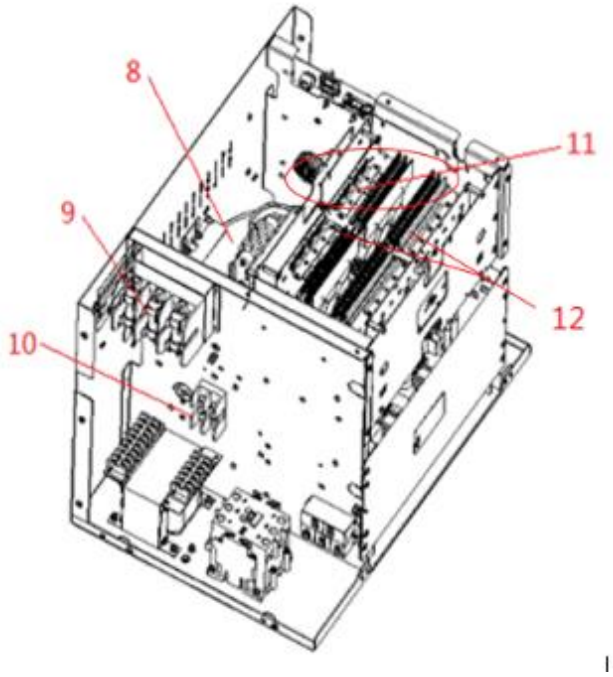


Figure 9-2 Inverter Assembly

Table 9-2 Sub-assembly list (con)

Item	PN	Description	Qty.	Notes
1	460401-001	Main Control Board	1	/

2	460399-001	AEC Board	1	/
3	2406001	Room Interface Board	1	/
4	2404001	Filament Driver Board	1	/
5	2405001	Rotor Driver Board	1	/
6	105207-365	CAP, FILM. 440VAC 3uF AC CAPACITOR	1	For high speed use. Depend on tube version.
	8100103	CAP, 6uF, 440VAC, AC CAPACITOR	1	
7	8100101	CAP, 30uF, 440VAC, AC CAPACITOR	1	For low speed use. Depend on tube version.
	8100102	CAP, 24uF, 440VAC, AC CAPACITOR	1	
	8100104	CAP MET FILM 44uF 440VAC	1	
8	408671-001	HT tank	1	/
9	8701002	LINE FUSE, LPJ-60SP	3	/
10	8701008	Fuse 1A	2	/
11	408608-002	ASSEMBLY-INVERTER, FOR 65KW	1	/
	408608-001	ASSEMBLY-INVERTER, FOR 50KW	1	
12	460400-002	ASSEMBLY-INVERTER BOARD, FOR 65KW	2	Depend on generator version.
	460400-001	ASSEMBLY-INVERTER BOARD, FOR 50KW	2	

Cover

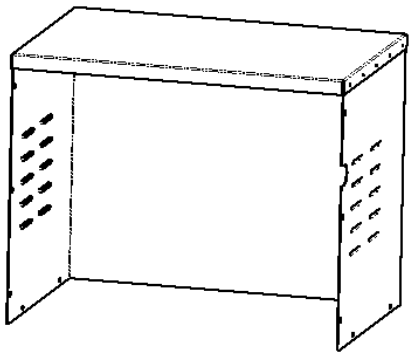


Figure 9-3 Cover

Table 9-3 Cover components list

Item	PN	Description	Qty.	Notes
1	2000077	Generator Cover	1	/

Cable assembly

Table 9-4 Cable list

Item	PN	Description	Qty.	Notes
1	2401001	Cable-From F1-L1 to LF1-L1	1	/
2	2401002	Cable-From F1-L2 to LF1-L2	1	/
3	2401003	Cable-From F1-L3 to LF1-L3	1	/
4	2401004	Cable-From F1-L1/L3 to K1-1L1/5L3 & F2/F3	1	/
5	2401005	Cable-From F1-L2 to K1-3L2	1	/
6	2401007	Cable-From LF1-L1' to K1-1L1	1	/
7	2401008	Cable-From LF1-L2' to K1-3L2	1	/
8	2401009	Cable-From LF1-L3' to K1-5L3	1	/
9	2401010	Cable-From K1-2T1 to D1-C	1	/
10	2401011	Cable-From K1-4T2 to D1-D	1	/
11	2401012	Cable-From K1-6T3 to D1-E	1	/
12	2401013	Cable-From D1-A to INV2_E1	1	/
13	2401014	Cable-From D1-B to INV2_E2	1	/
14	2401015	Cable-From INV1_E1 to INV2_E1	1	/

15	2401018	Cable-From RDB_P7 to K1-3L2&5L3	1	/
16	2401019	Cable-From K1-4T2/6T3 to RDB_P8	1	/
17	2401020	Cable-From D1-A&B to RDB_P3	1	/
18	2401021	Cable-From F2&F3 to T1-380	1	/
19	2401022	Cable-From T1-18V to FDB_P6	1	/
20	2401023	Cable-From T1-25V to FDB_P3	1	/
21	2401024	Cable-From T1-25V to FDB_P5	1	/
22	2401025	Cable-From INV1_P1 to MCB_P8	1	/
23	408770-001	Cable-From MCB_P5 to INV1_P2	1	/
24	408771-001	Cable-From INV2_P1 to MCB_P9	1	/
25	408772-001	Cable-From MCB_P6 to INV2_P2	1	/
26	408773-001	Cable-From TSB_P1 to MCB_P17	1	/
27	408774-001	Cable-From AEC_P1 to MCB_P16	1	/
28	2401031	From TIB_P3 to MCB_P7	1	/
29	2401032	Cable-From FDB_P2 to TIB_P4	1	/
30	408775-001	Cable-From MCB_P11 to RDB_P11	1	/
31	408776-001	Cable-From MCB_P14 to RDB_P1	1	/
32	408777-001	Cable-From MCB_P13 to RDB_P5	1	/
33	408778-001	Cable-From MCB_P18 to RDB_P6	1	/
34	2401037	Cable-From RDB_P10 to K1	1	/

35	2401038	Cable-From T1-25V to RDB_P9	1	/
36	408779-001	Cable-From RDB_P14 to Phase capacitor	1	/
37	2401040	Cable-From HSC to LSC	1	/
38	2401041	Cable-From FDB_P1 to MCB_P3	1	/
39	2401042	Cable-From FDB_P4 to MCB_P12 and RIB_P9	1	/
40	2401043	Cable-From RB capacitor to TIB IN2	1	/
41	408780-001	Cable-From RIB_P11 to MCB_P15	1	/
42	2401045	Cable-From DB_P1 to TIB_P1	1	/
43	2401046	Cable-From DB_P1 to TIB_P6	1	/
44	2401047	Cable-From MB E6 to DB E2	1	/
45	2401048	Cable-From MB E1 to DB E1	1	/
46	2401051	Cable-From DB E3 to receptacle C	1	/
47	2401053	Cable-From tank housing to tank cover	1	/
48	2401054	Cable-From Tank Cover to Generator Frame	1	/
49	2401055	Cable-Absorption Resistor	1	/
50	2401056	Cable-From RB screw terminal to TIB I	1	/
51	408781-001	Cable-From LF-L1'&L3' to F3&F2	1	/
52	2401059	Cable-From Transformers to Generator Frame	1	/

Three Phase Generator Series X####

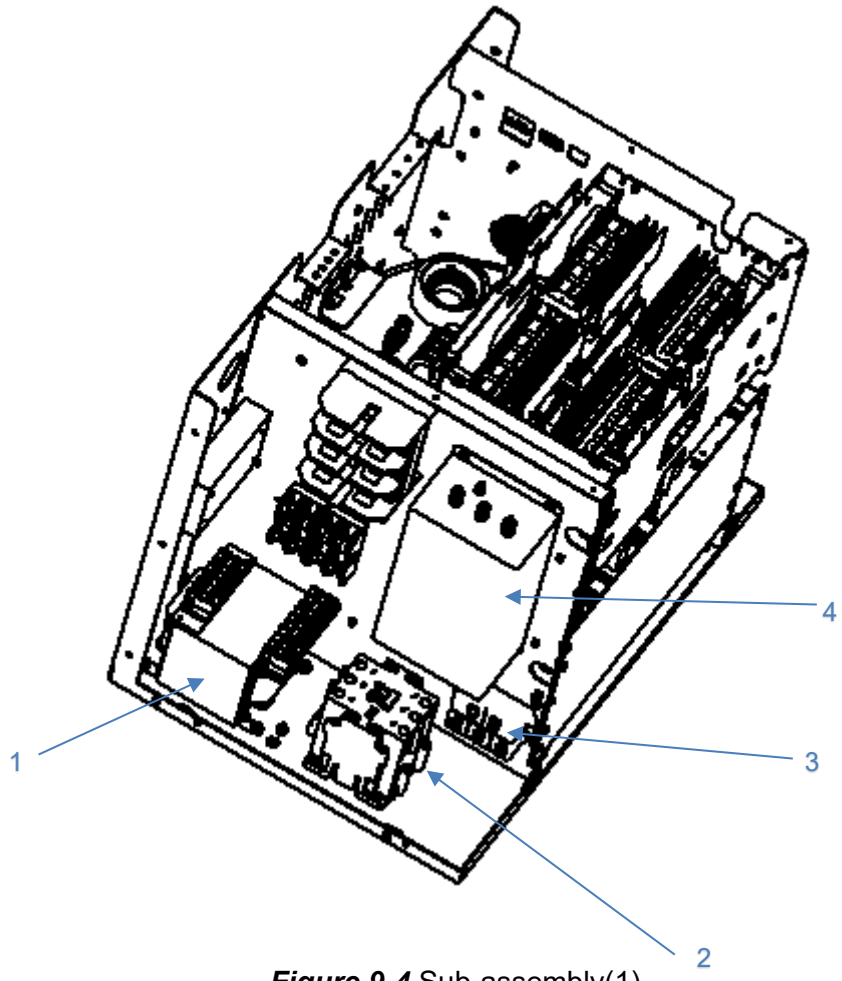


Figure 9-4 Sub-assembly(1)

Table 9-5 Sub-assembly list

Item	PN	Description	Qty.	Notes
1	104017-161	TRANSF. PWR 208V/230V/380V/400V/480V IN,250VA	1	Option 1
	104017-162	TRANSF.PWR 208V/230V/380V/400V/480V,IN 370VA	1	Option 2
	104017-165	TRANSF.PWR 208V/230V/380V/400V/480V,IN 480VA	1	Option 3
2	8710003	Mains Contactor	1	/

3	8710001	Mains Rectifier	1	/
4	8710006	Line Filter	1	/

Sub-assembly

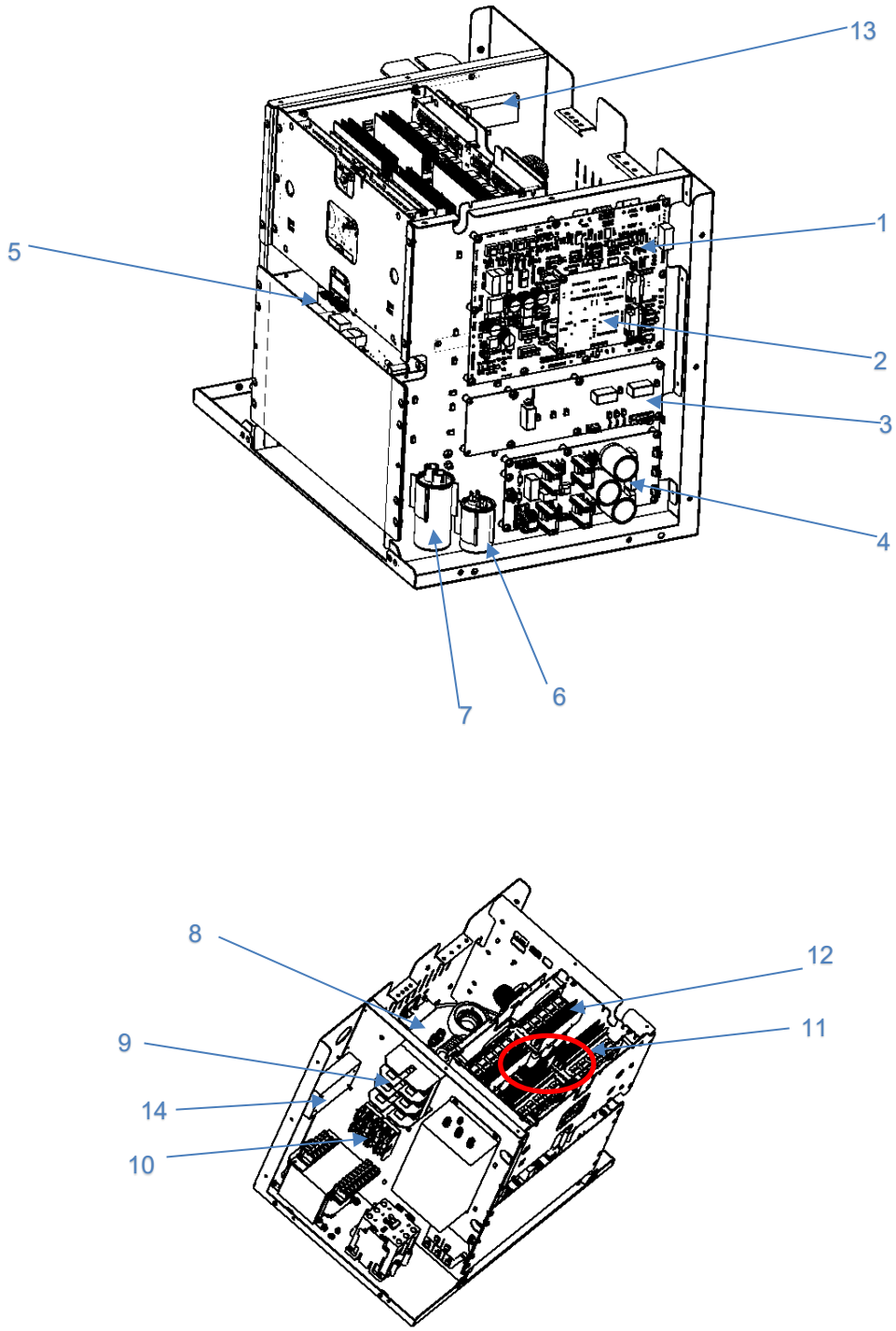


Figure 9-5 Sub- Assembly

Table 9-6 Sub-assembly list

Item	PN	Description	Qty.	Notes
1	460401-001	Main Control Board	1	/
2	460399-001	AEC Board	1	Option 1
	460399-002	AEC Board	1	Option 2
3	2406001	Room Interface Board	1	Option 1
	460452-001	ASSEMBLY-ROOM INTERFACE BOARD 24V/400mA Interface Voltage 24V/12V/5V	1	Option 2
	460469-001	ASSEMBLY-ROOM INTERFACE BOARD 24V/5A&12V(5V)/1.5A	1	Option 3
4	2404001	Filament Driver Board	1	/
5	2405001	Rotor Driver Board	1	/
6	105207-365	CAP, FILM. 440VAC 3uF AC CAPACITOR	1	Depend on tube types
	8100103	CAP, 6uF, 440VAC, AC CAPACITOR	1	
7	8100101	CAP, 30uF, 440VAC, AC CAPACITOR	1	Depend on tube types
	8100102	CAP, 24uF, 440VAC, AC CAPACITOR	1	
	8100104	CAP MET FILM 44uF 440VAC	1	
8	408671-001	HT tank	1	/
9	8701002	LINE FUSE, LPJ-60SP	3	/
10	8701008	Fuse 1A	2	Optional(When 104017-161 or 104017-162 is used), CUSTOMIZED
	105721-272	FUSE 500VAC 2A TIME DELAY	3	Optional , for primary winding and 230V secondary (When 104017-165 is used), CUSTOMIZED
	105721-273	FUSE 500VAC 3A TIME DELAY	1	Optional , for 115V secondary (When 104017-165 is used), CUSTOMIZED
	105721-274	FUSE 500VAC 8A TIME DELAY	1	Optional , for 24V secondary (When 104017-165 is used), CUSTOMIZED

11	2000047	ASSEMBLY-INVERTER, FOR THREE PHASE, 32/40KW	1	/
	408608-002	ASSEMBLY-INVERTER, FOR 65KW	1	
	408608-001	ASSEMBLY-INVERTER, FOR 50KW	1	
	460400-003	ASSEMBLY-INVERTER, FOR 80KW	1	
12	460400-002	ASSEMBLY-INVERTER BOARD, FOR 65KW	2	/
	460400-001	ASSEMBLY-INVERTER BOARD, FOR 50KW	2	/
	460400-003	ASSEMBLY-INVERTER BOARD, FOR THREE PHASE, 32/40/80KW	1/1/2	• 1pcs： 32kW • 1pcs：40kW • 2pcs： 80kW
13	105725-277	TERMINAL BLOCK 6 POS FRRDTH	1	Optional
14	105418-040	POWER SUPPLY 24V 150W	1	Optional

Cover

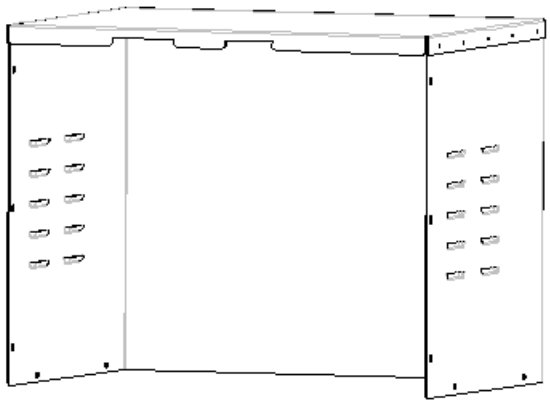


Figure 9-6 Cover

Table 9-7 Cover components list

Item	PN	Description	Qty.	Notes
1	2000093	Generator Cover	1	/

Cable assembly

Table 9-8 Cable list

Item	PN	Description	Qty.	Notes
1	2401001	Cable-From F1-L1 to LF1-L1	1	/
2	2401002	Cable-From F1-L2 to LF1-L2	1	/
3	2401003	Cable-From F1-L3 to LF1-L3	1	/
4	2401004	Cable-From F1-L1/L3 to K1-1L1/5L3 & F2/F3	1	/
5	2401005	Cable-From F1-L2 to K1-3L2	1	/
6	2401007	Cable-From LF1-L1' to K1-1L1	1	/
7	2401008	Cable-From LF1-L2' to K1-3L2	1	/
8	2401009	Cable-From LF1-L3' to K1-5L3	1	/
9	2401010	Cable-From K1-2T1 to D1-C	1	/
10	2401011	Cable-From K1-4T2 to D1-D	1	/
11	2401012	Cable-From K1-6T3 to D1-E	1	/
12	2401013	Cable-From D1-A to INV2_E1	1	/
13	2401014	Cable-From D1-B to INV2_E2	1	/
14	2401015	Cable-From INV1_E1 to INV2_E1	1	/

15	2401018	Cable-From RDB_P7 to K1-3L2&5L3	1	/
16	2401019	Cable-From K1-4T2/6T3 to RDB_P8	1	/
17	2401020	Cable-From D1-A&B to RDB_P3	1	/
18	2401021	Cable-From F2&F3 to T1-380	1	/
19	2401022	Cable-From T1-18V to FDB_P6	1	/
20	2401023	Cable-From T1-25V to FDB_P3	1	/
21	2401024	Cable-From T1-25V to FDB_P5	1	/
22	2401025	Cable-From INV1_P1 to MCB_P8	1	/
23	408770-001	Cable-From MCB_P5 to INV1_P2	1	/
24	408771-001	Cable-From INV2_P1 to MCB_P9	1	/
25	408772-001	Cable-From MCB_P6 to INV2_P2	1	/
26	408773-001	Cable-From TSB_P1 to MCB_P17	1	/
27	408774-001	Cable-From AEC_P1 to MCB_P16	1	/
28	2401031	From TIB_P3 to MCB_P7	1	/
29	2401032	Cable-From FDB_P2 to TIB_P4	1	/
30	408775-001	Cable-From MCB_P11 to RDB_P11	1	/
31	408776-001	Cable-From MCB_P14 to RDB_P1	1	/
32	408777-001	Cable-From MCB_P13 to RDB_P5	1	/
33	408778-001	Cable-From MCB_P18 to RDB_P6	1	/
34	2401037	Cable-From RDB_P10 to K1	1	/

35	2401038	Cable-From T1-25V to RDB_P9	1	/
36	408779-001	Cable-From RDB_P14 to Phase capacitor	1	/
37	2401040	Cable-From HSC to LSC	1	/
38	2401041	Cable-From FDB_P1 to MCB_P3	1	/
39	2401042	Cable-From FDB_P4 to MCB_P12 and RIB_P9	1	/
40	2401043	Cable-From RB capacitor to TIB IN2	1	/
41	408780-001	Cable-From RIB_P11 to MCB_P15	1	/
42	2401045	Cable-From DB_P1 to TIB_P1	1	/
43	2401046	Cable-From DB_P1 to TIB_P6	1	/
44	2401047	Cable-From MB E6 to DB E2	1	/
45	2401048	Cable-From MB E1 to DB E1	1	/
46	2401051	Cable-From DB E3 to receptacle C	1	/
47	2401053	Cable-From tank housing to tank cover	1	/
48	2401054	Cable-From Tank Cover to Generator Frame	1	/
49	2401055	Cable-Absorption Resistor	1	/
50	2401056	Cable-From RB screw terminal to TIB I	1	/
51	408781-001	Cable-From LF-L1'&L3' to F3&F2	1	/
52	2401059	Cable-From Transformers to Generator Frame	1	/
53	408987-001	CABLE FROM T-SEC-0V/230V TO FUSE TO TER 0V/230V	1	Optional
54	408988-001	CABLE FROM T-SEC-0V/115V TO FUSE TO TER 0V/115V	1	Optional

55	408990-001	CABLE FROM TERMINAL TO RIB P19	1	Optional
56	408991-001	CABLE FROM FUSE TO PS P1	1	Optional
57	408992-001	CABLE FROM DC OUT TO RIB P9	1	Optional
58	408996-001	CABEL FROM MCB P21 TO RIB P18	1	Optional
59	408998-001	CABLE FROM T-SEC-24V /0V TO FUSE TO TER 24V/0V	1	Optional

Single Phase Generator Series X####

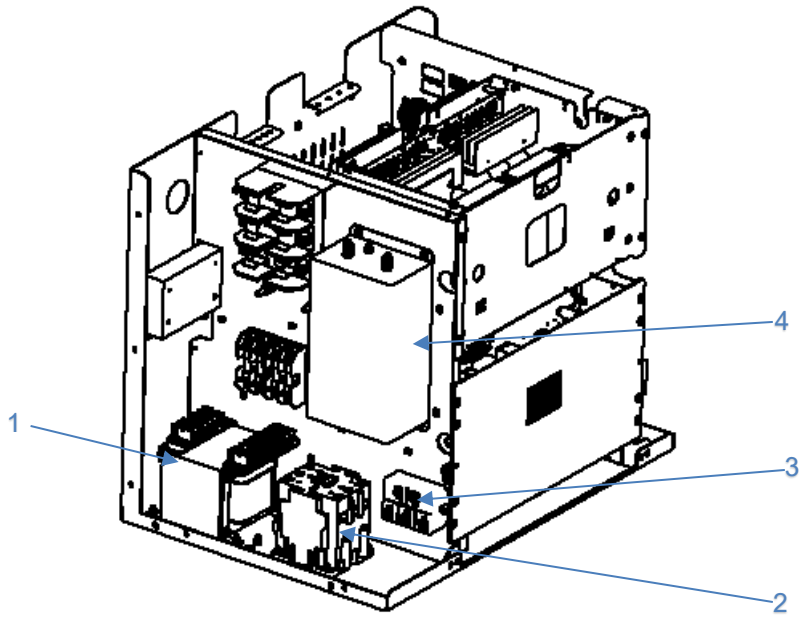


Figure 9-7 Sub-assembly(1)

Table 9-9 Sub-assembly list

Item	PN	Description	Qty.	Notes
1	104017-161	TRANSF. PWR 208V/230V/380V/400V/480V IN,250VA	1	Option 1
	104017-162	TRANSF.PWR 208V/230V/380V/400V/480V,IN 370VA	1	Option 2
	104017-165	TRANSF.PWR 208V/230V/380V/400V/480V,IN 480VA	1	Option 3
2	8710003	Mains Contactor	1	/
3	8710001	Mains Rectifier	1	/
4	8710006	Line Filter	1	/

Sub-assembly

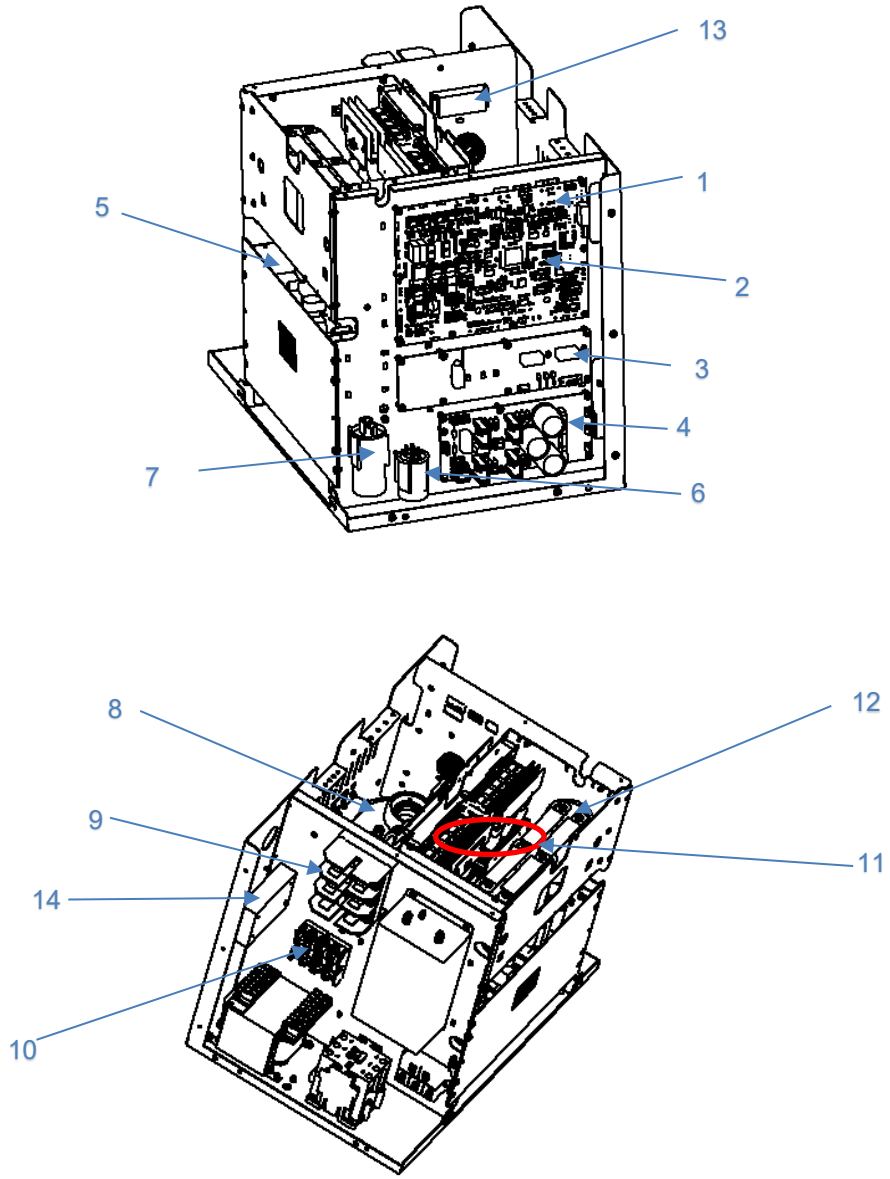


Figure 9-8 Sub Assembly

Table 9-10 Sub-assembly list

Item	PN	Description	Qty.	Notes
1	460401-001	Main Control Board	1	/
2	460399-001	AEC Board	1	Option 1
	460399-002	AEC Board	1	Option 2

3	2406001	Room Interface Board	1	Option 1
	460452-001	ASSEMBLY-ROOM INTERFACE BOARD 24V/400mA Interface Voltage 24V/12V/5V	1	Option 2
	460469-001	ASSEMBLY-ROOM INTERFACE BOARD 24V/5A&12V(5V)/1.5A	1	Option 3
4	2404001	Filament Driver Board	1	/
5	460458-001	Rotor Driver Board	1	/
6	105207-365	CAP, FILM. 440VAC 3uF AC CAPACITOR	1	Depend on tube type
	8100103	CAP, 6uF, 440VAC, AC CAPACITOR	1	
7	8100101	CAP, 30uF, 440VAC, AC CAPACITOR	1	Depend on tube type
	8100102	CAP, 24uF, 440VAC, AC CAPACITOR	1	
	8100104	CAP MET FILM 44uF 440VAC	1	
8	408671-002	HT tank	1	/
9	8701002	LINE FUSE, LPJ-60SP	2	/
10	8701009	Fuse 1A	2	Optional(When 104017-161 or 104017-162 is used), CUSTOMIZED
	105721-272	FUSE 500VAC 2A TIME DELAY	2/3	Optional , for primary winding and 230V secondary (When 104017-165 is used), CUSTOMIZED
	105721-273	FUSE 500VAC 3A TIME DELAY	1	Optional , for 115V secondary (When 104017-165 is used),
	105721-274	FUSE 500VAC 8A TIME DELAY	1	Optional , for 24V secondary (When 104017-165 is used), CUSTOMIZED
11	460408-001	ASSEMBLY-INVERTER, FOR SINGLE PHASE, 32/40KW	1	/
12	2416001	INVERTER BOARD, FOR SINGLE PHASE, 32/40KW	1	/
13	105725-277	TERMINAL BLOCK 6 POS FRRDTH	1	Option 1
14	105418-040	POWER SUPPLY 24V 150W	1	Option 2

Cover

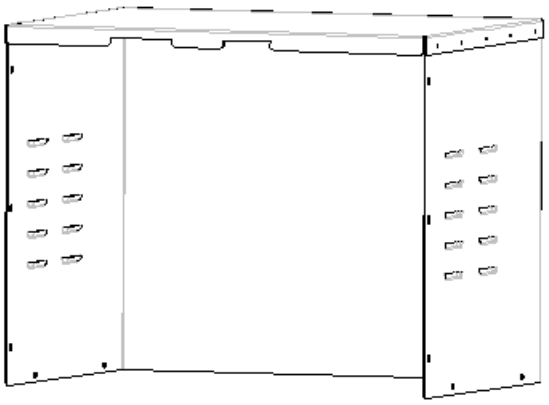


Figure 9-9 Cover

Table 9-11 Cover components list

Item	PN	Description	Qty.	Notes
1	2000093	Generator Cover	1	/

Cable assembly

Table 9-12 Cable list

Item	PN	Description	Qty.	Notes
1	408736-001	Cable-From F1-L to LF1-L	1	/
2	408744-001	Cable-From F1-N to LF1-N	1	/
3	408735-001	CABLE-FROM LF1-L' TO K1-3L2	1	/
4	408745-001	Cable-From LF1-N' to K1-5L3	1	/
5	408742-001	Cable-From K1-4T2 to D1-C	1	/
6	408743-001	Cable-From K1-6T3 to D1-D	1	/

7	2401021	Cable-From F2&F3 to T1-380	1	/
8	2401022	Cable-From T1-18V to FDB_P6	1	/
9	2401023	Cable-From T1-25V to FDB_P3	1	/
10	2401024	Cable-From T1-25V to FDB_P5	1	/
11	2401031	From TIB_P3 to MCB_P7	1	/
12	2401032	Cable-From FDB_P2 to TIB_P4	1	/
13	408776-001	Cable-From MCB_P14 to RDB_P1	1	/
14	408777-001	Cable-From MCB_P13 to RDB_P5	1	/
15	2401041	Cable-From FDB_P1 to MCB_P3	1	/
16	2401042	Cable-From FDB_P4 to MCB_P12 and RIB_P9	1	/
17	408780-001	Cable-From RIB_P11 to MCB_P15	1	/
18	2401054	Cable-From Tank Cover to Generator Frame	1	/
19	408781-001	Cable-From LF-L1'&L3' to F3&F2	1	/
20	2401059	Cable-From Transformers to Generator Frame	1	/
21	408774-001	Cable-From AEC_P1 to MCB_P16	1	Optional
22	408987-001	CABLE FROM T-SEC-0V/230V TO FUSE TO TER 0V/230V	1	Optional
23	408988-001	CABLE FROM T-SEC-0V/115V TO FUSE TO TER 0V/115V	1	Optional
24	408990-001	CABLE FROM TERMINAL TO RIB P19	1	Optional
25	408991-001	CABLE FROM FUSE TO PS P1	1	Optional
26	408992-001	CABLE FROM DC OUT TO RIB P9	1	Optional

27	408996-001	CABEL FROM MCB P21 TO RIB P18	1	Optional
28	408998-001	CABLE FROM T-SEC-24V /0V TO FUSE TO TER 24V/0V	1	Optional

Touch Screen Console (Human Version)

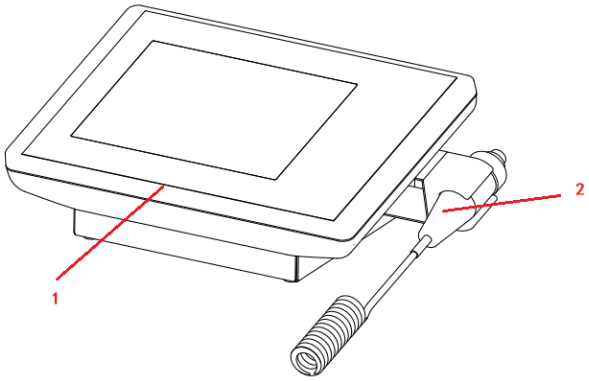


Figure 9-10 Touch Screen Console Assembly

Table 9-13 list

Item	PN	Description	Qty.	Notes
1	408449-009	OPER CONS, TOUCH SCRN, HUMAN, ZEUS MEDICAL	1	Option 1
	408449-010	OPER CONS, TOUCH SCRN, HUMAN, W/O H SWITCH MEDICAL	1	Option 2
	408449-011	OPER CONS, TOUCH SCRN, HUMAN, NO LOGO MEDICAL	1	Option 3
	408449-012	OPER CONS, TOUCH SCRN, HUMAN, NO HS/LOGO, MEDICAL	1	Option 4

Mini Console

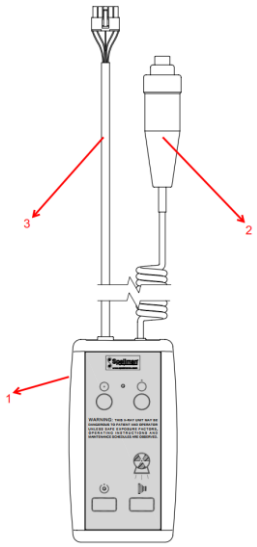


Figure 9-11 Mini-console

Table 9-14 list

Item	PN	Description	Qty.	Notes
1	409003-001	ZEUS MINI CONSOLE SHV W/O REMOTE ,12M	1	Option 1
	409003-002	ZEUS MINI CONSOLE SHV W/REMOTE ,12M	1	Option 2
	409003-003	ZEUS MINI CONSOLE NO LOGO W/O RMT 12M	1	Option 3
	409003-004	ZEUS MINI CONSOLE NO LOGO W/RMT 12M	1	Option 4

Chapter 10 Generator Accessories

Touch Screen Console (Human Version)

Touch Screen console have different type configurations for customer choosing. They are listing in the following table.

Table 10-1 Touch screen console configurations

Item	*PN*	*Human Software*	*Handle Switch*	*Cable*
1	408449-009*	√	√	See Table 10-2 Item 1
2	408449-010*	√	×	See Table 10-2 Item 1
3	408449-011*	√	√	See Table 10-2 Item 1
4	408449-012*	√	×	See Table 10-2 Item 1

Notes: part number listed in the 10-1 table with "" are the medical touch screen with IEC60601-1-2(2020) certified.

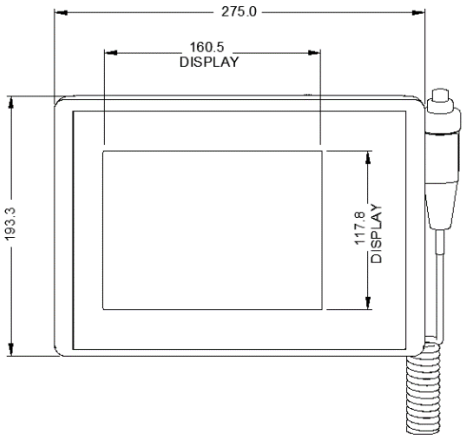
Cable from Touch Screen console to Generator for selection are listing in the following table.

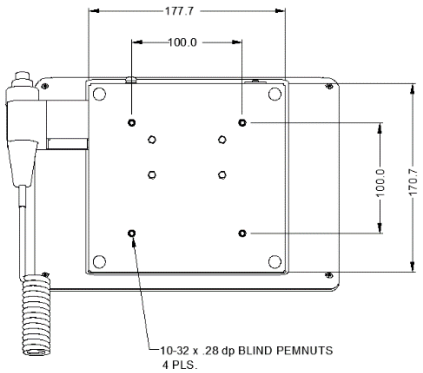
Table 10-2 Cable for touch screen console option

Item	*PN*	*Cable length (m)*	*Connector types*
1	408746-001	15	D-Sub 9

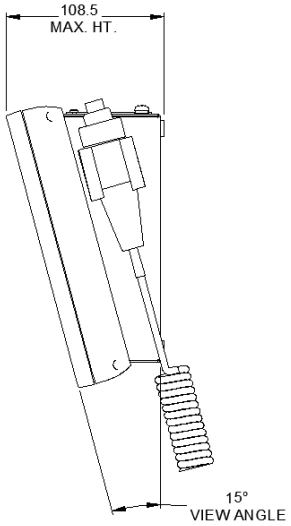
Cable could be customized based on specific customer requirements.

Dimension of touch screen console





BOTTOM VIEW



Cable could be customization based on specific customer requirements.

Mini Console

Mini console has different type configurations for customer choose. They are listing in the following table.

Table 10-3 Mini console configuration

Item	*PN*	*Handle Switch*	*Remote*	*Logo*	*Cable*
1	409003-001*	X	√	√	See Table 10-4 Item 1
2	409003-002*	√	√	√	See Table 10-4 Item 1
3	409003-003*	X	√		See Table 10-4 Item 1
4	409003-004*	√	√		See Table 10-4 Item 1

Notes: part number listed in the 10-3 table with "" are the medical Device with IEC60601-1-2(2020) certified.

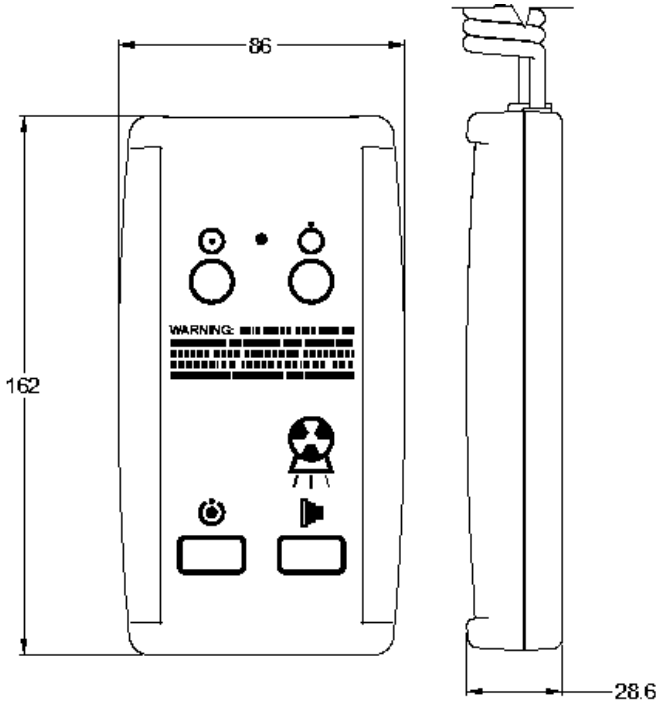
Cable from Mini console to Generator for selection are listing in the following table.

Table 10-4 Cable for mini console option

Item	*PN*	*Cable length (m)*	*Connector types*
1	204876-001	12	Mate-N-Lock, Female, 39012105
2	204876-002	20	Mate-N-Lock, Female, 39012105
3	204876-003	30	Mate-N-Lock, Female, 39012105
4	204876-004	3.6	Mate-N-Lock, Female, 39012105
5	204876-005	15.5	Mate-N-Lock, Female, 39012105

Cable could be customization according to the specific customer requirements.

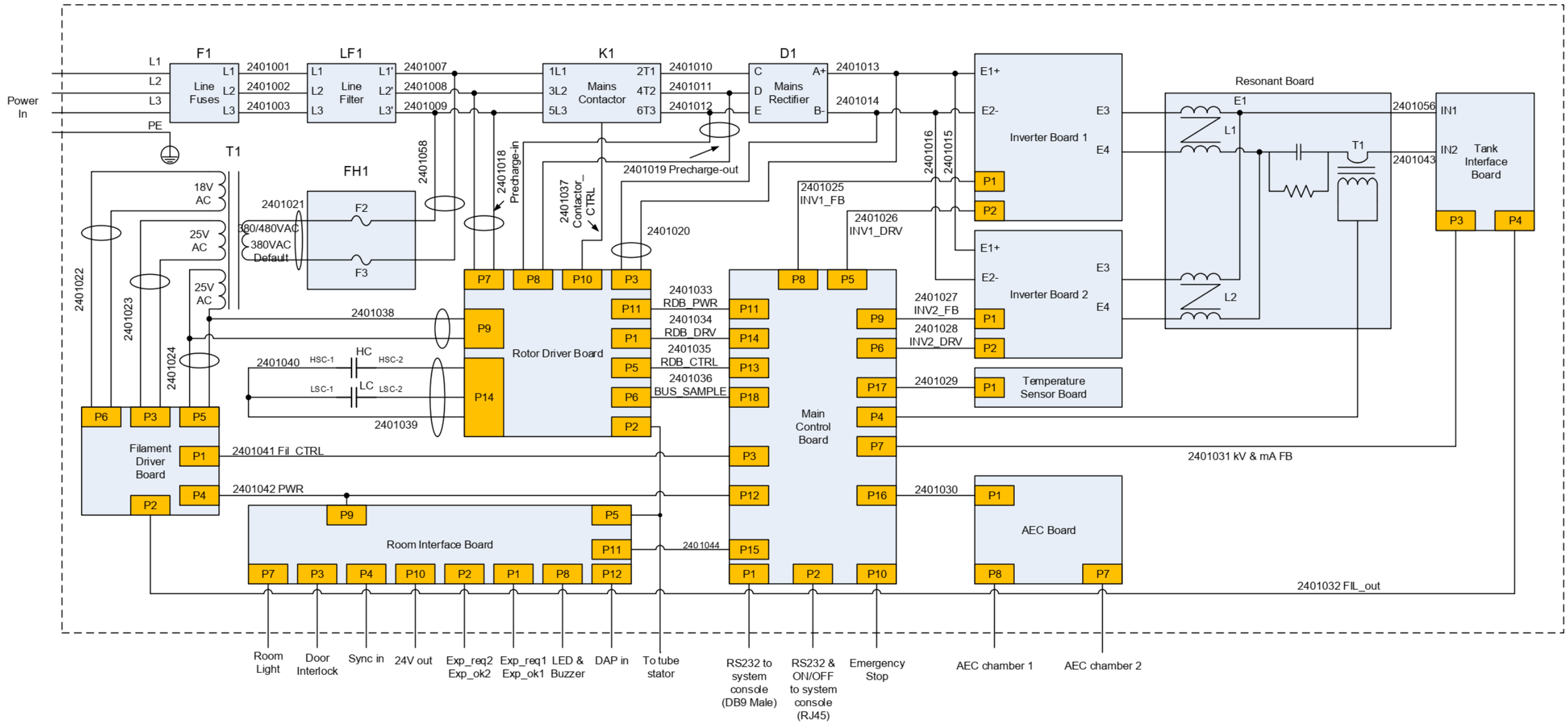
Dimension of Mini console



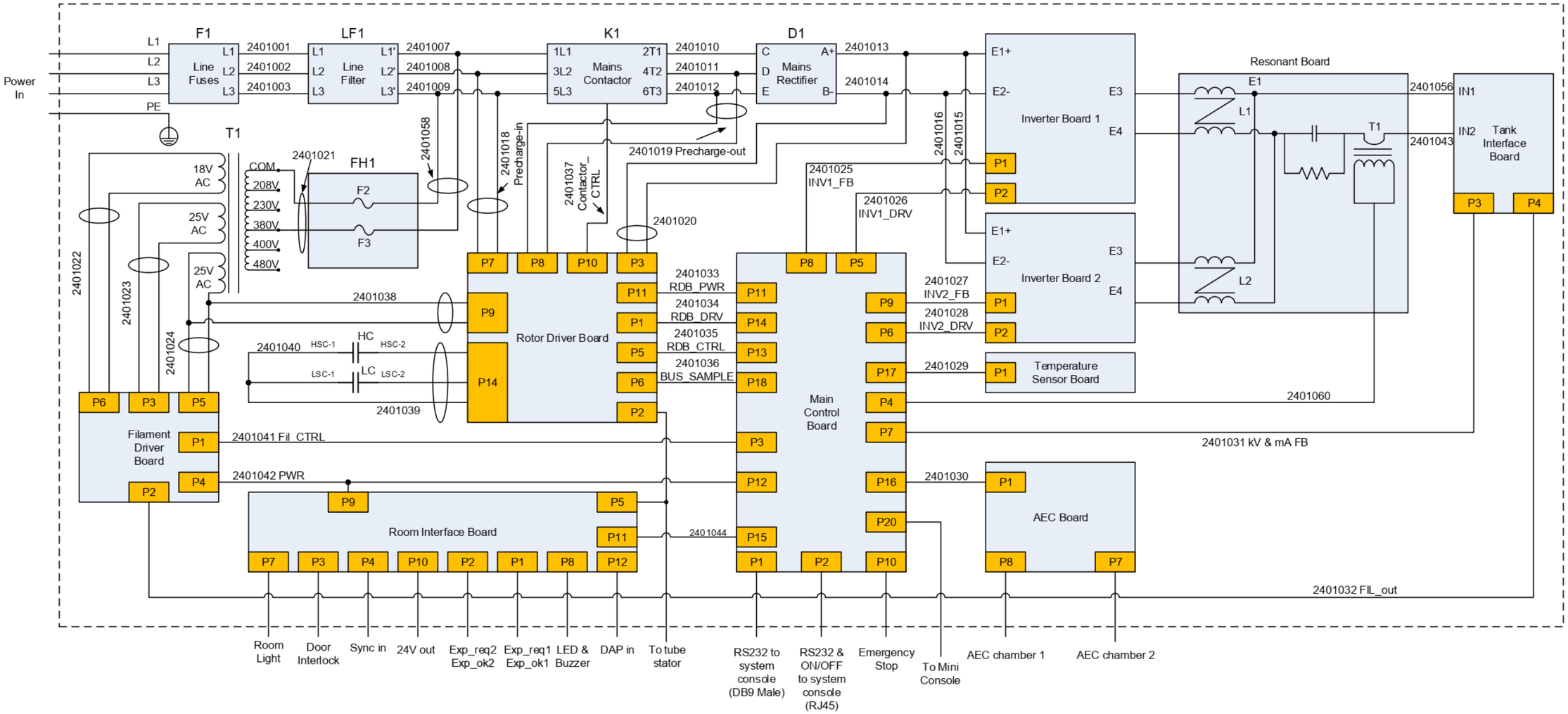
(This page left blank intended)

Chapter 11 ZR Series Block Diagram

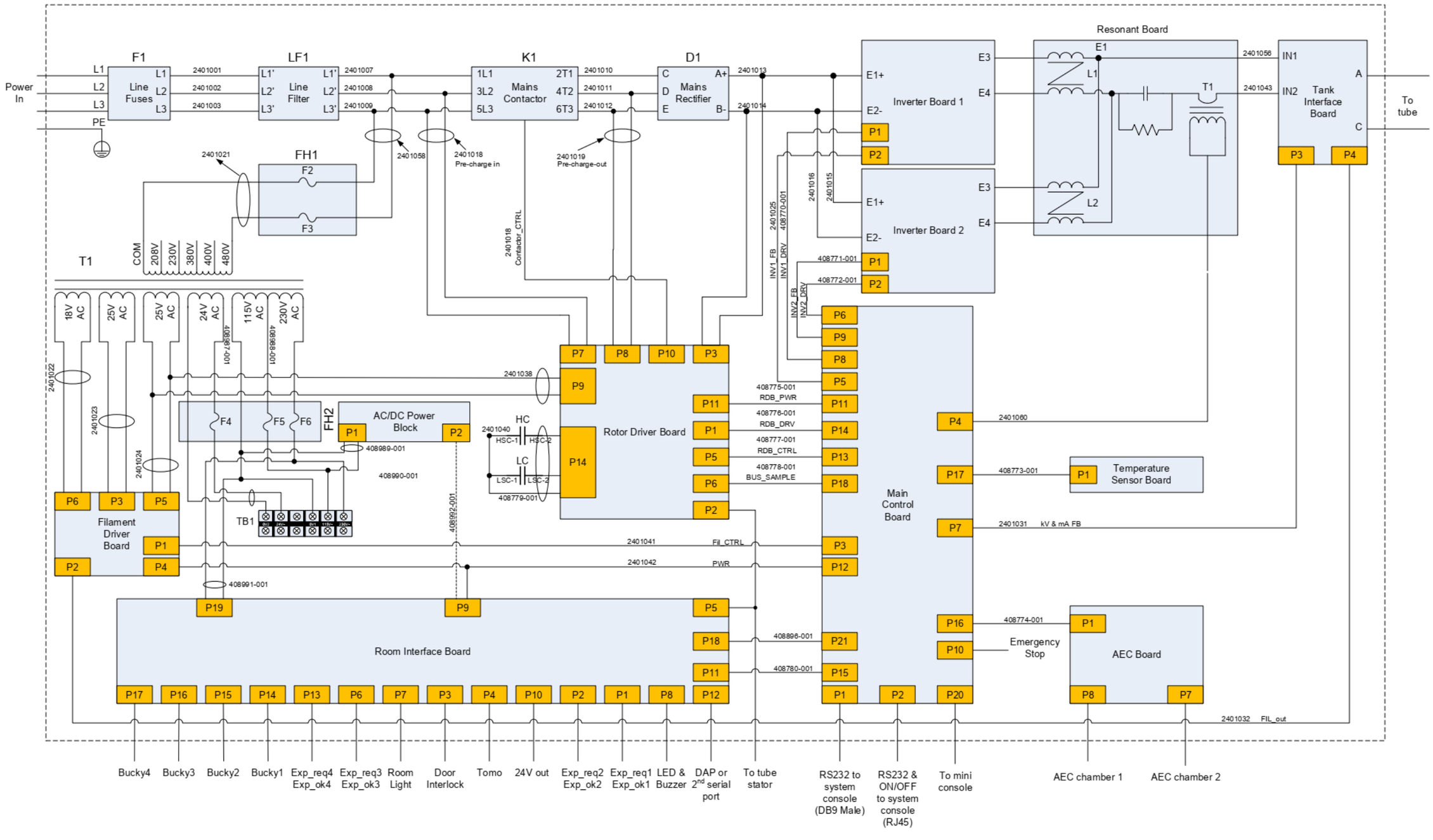
Zeus Three Phase Z####



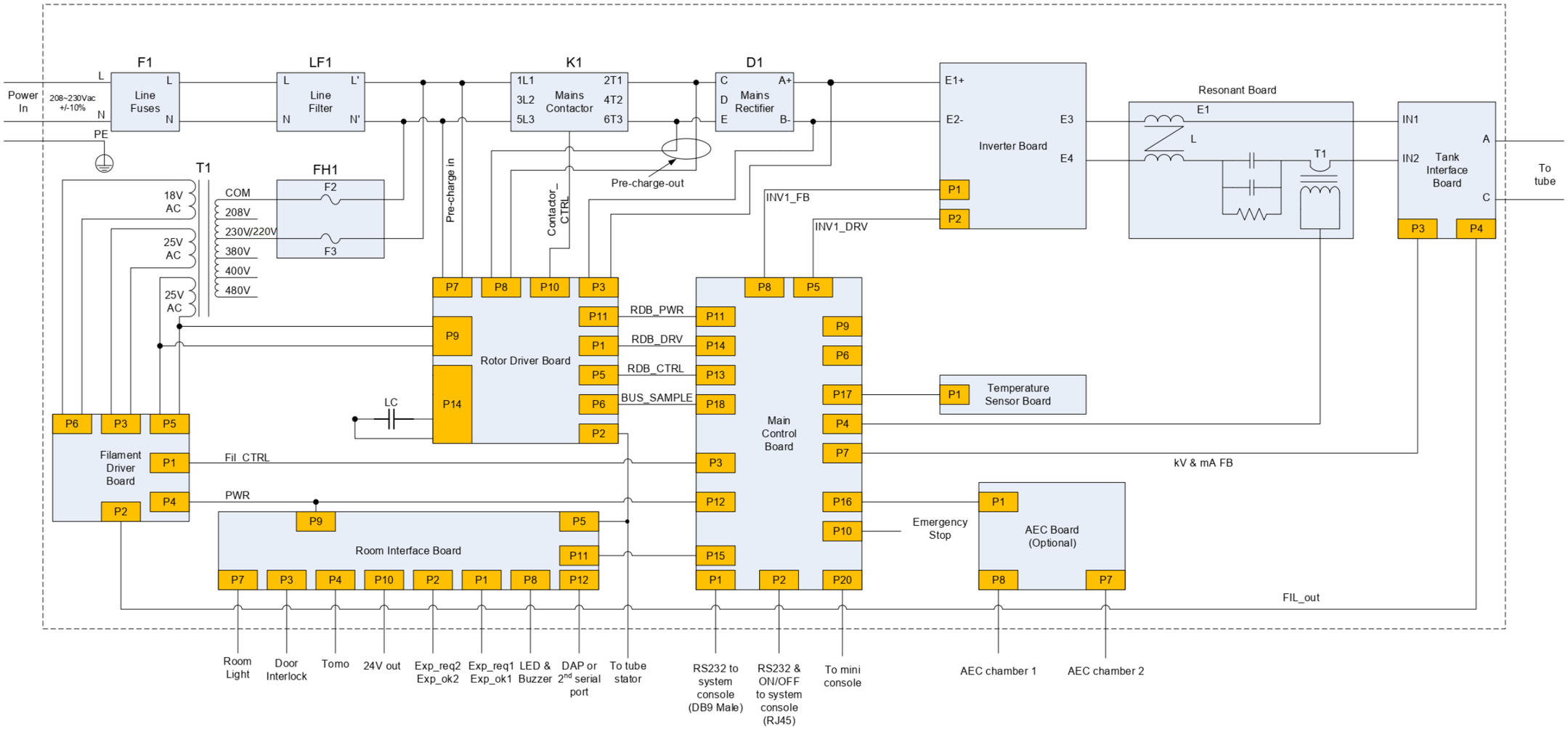
Zeus Three Phase X####



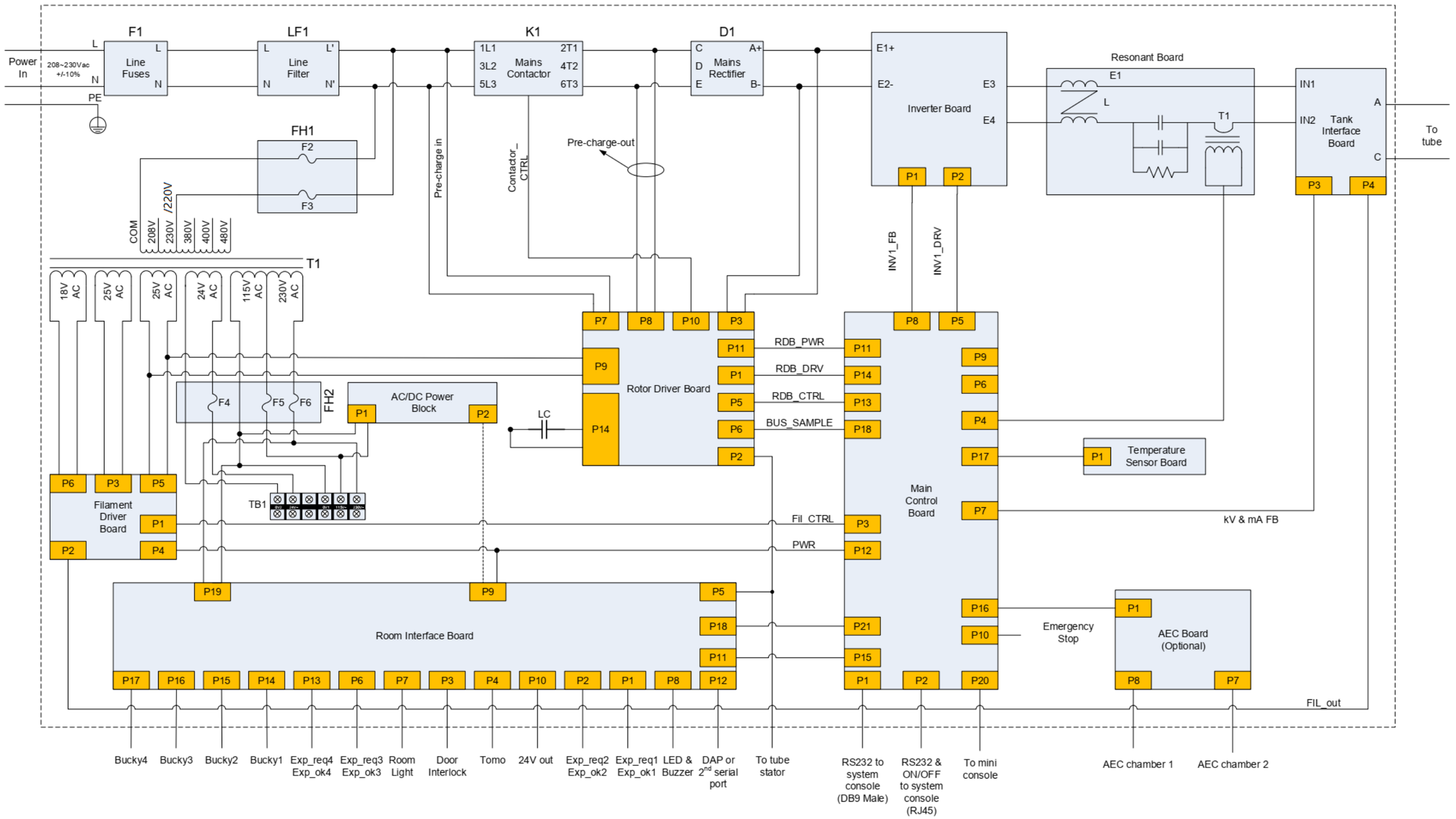
Zeus Three Phase X#### (Max)



Zeus Single Phase X####



Zeus Single Phase X#### (Max)



(This page left blank intended)

APPENDIX 1: Generator Exposure Tables

Following tables show the nominal mAs resulting from preselected ms and mA values. These tables also show the range and interrelation of these loading factors.

Generator Technique Selection (kV/mA/ms mode)

mA/ms/mAs values are according to the Series R'20 ISO 497.

Time	**mA selected**								
(ms)	10	11	12.5	14	16	18	20	22	25
1									
1.1									
1.25									
1.4									
1.6									
1.8									
2									
2.2									
2.5									
2.8									
3.2									
3.6									
4									0.1
4.5								0.1	0.11
5							0.1	0.11	0.125
5.6						0.1	0.11	0.125	0.14
6.3					0.1	0.11	0.125	0.14	0.16
7.1				0.1	0.11	0.125	0.14	0.16	0.18
8			0.1	0.11	0.125	0.14	0.16	0.18	0.2
9		0.1	0.11	0.125	0.14	0.16	0.18	0.2	0.22
10	0.1	0.11	0.125	0.14	0.16	0.18	0.2	0.22	0.25
11	0.11	0.125	0.14	0.16	0.18	0.2	0.22	0.25	0.28

12.5	0.125	0.14	0.16	0.18	0.2	0.22	0.25	0.28	0.32
14	0.14	0.16	0.18	0.2	0.22	0.25	0.28	0.32	0.36
16	0.16	0.18	0.2	0.22	0.25	0.28	0.32	0.36	0.4
18	0.18	0.2	0.22	0.25	0.28	0.32	0.36	0.4	0.45
20	0.2	0.22	0.25	0.28	0.32	0.36	0.4	0.45	0.5
22	0.22	0.25	0.28	0.32	0.36	0.4	0.45	0.5	0.56
25	0.25	0.28	0.32	0.36	0.4	0.45	0.5	0.56	0.63
28	0.28	0.32	0.36	0.4	0.45	0.5	0.56	0.63	0.71
32	0.32	0.36	0.4	0.45	0.5	0.56	0.63	0.71	0.8
36	0.36	0.4	0.45	0.5	0.56	0.63	0.71	0.8	0.9
40	0.4	0.45	0.5	0.56	0.63	0.71	0.8	0.9	1
45	0.45	0.5	0.56	0.63	0.71	0.8	0.9	1	1.1
50	0.5	0.56	0.63	0.71	0.8	0.9	1	1.1	1.25
56	0.56	0.63	0.71	0.8	0.9	1	1.1	1.25	1.4
63	0.63	0.71	0.8	0.9	1	1.1	1.25	1.4	1.6
71	0.71	0.8	0.9	1	1.1	1.25	1.4	1.6	1.8
80	0.8	0.9	1	1.1	1.25	1.4	1.6	1.8	2
90	0.9	1	1.1	1.25	1.4	1.6	1.8	2	2.2
100	1	1.1	1.25	1.4	1.6	1.8	2	2.2	2.5
110	1.1	1.25	1.4	1.6	1.8	2	2.2	2.5	2.8
125	1.25	1.4	1.6	1.8	2	2.2	2.5	2.8	3.2
140	1.4	1.6	1.8	2	2.2	2.5	2.8	3.2	3.6
160	1.6	1.8	2	2.2	2.5	2.8	3.2	3.6	4
180	1.8	2	2.2	2.5	2.8	3.2	3.6	4	4.5
200	2	2.2	2.5	2.8	3.2	3.6	4	4.5	5
220	2.2	2.5	2.8	3.2	3.6	4	4.5	5	5.6
250	2.5	2.8	3.2	3.6	4	4.5	5	5.6	6.3
280	2.8	3.2	3.6	4	4.5	5	5.6	6.3	7.1
320	3.2	3.6	4	4.5	5	5.6	6.3	7.1	8
360	3.6	4	4.5	5	5.6	6.3	7.1	8	9
400	4	4.5	5	5.6	6.3	7.1	8	9	10
450	4.5	5	5.6	6.3	7.1	8	9	10	11
500	5	5.6	6.3	7.1	8	9	10	11	12.5

560	5.6	6.3	7.1	8	9	10	11	12.5	14
630	6.3	7.1	8	9	10	11	12.5	14	16
710	7.1	8	9	10	11	12.5	14	16	18
800	8	9	10	11	12.5	14	16	18	20
900	9	10	11	12.5	14	16	18	20	22
1000	10	11	12.5	14	16	18	20	22	25
1100	11	12.5	14	16	18	20	22	25	28
1250	12.5	14	16	18	20	22	25	28	32
1400	14	16	18	20	22	25	28	32	36
1600	16	18	20	22	25	28	32	36	40
1800	18	20	22	25	28	32	36	40	45
2000	20	22	25	28	32	36	40	45	50
2200	22	25	28	32	36	40	45	50	56
2500	25	28	32	36	40	45	50	56	63
2800	28	32	36	40	45	50	56	63	71
3200	32	36	40	45	50	56	63	71	80
3600	36	40	45	50	56	63	71	80	90
4000	40	45	50	56	63	71	80	90	100
4500	45	50	56	63	71	80	90	100	110
5000	50	56	63	71	80	90	100	110	125
5600	56	63	71	80	90	100	110	125	140
6300	63	71	80	90	100	110	125	140	160
7100	71	80	90	100	110	125	140	160	180
8000	80	90	100	110	125	140	160	180	200
9000	90	100	110	125	140	160	180	200	220
10000	100	110	125	140	160	180	200	220	250

(**Cont**)

Time	**mA selected**								
(ms)	28	32	36	40	45	50	56	63	71
1									
1.1									
1.25									

1.4									0.1
1.6								0.1	0.11
1.8							0.1	0.11	0.125
2						0.1	0.11	0.125	0.14
2.2					0.1	0.11	0.125	0.14	0.16
2.5				0.1	0.11	0.125	0.14	0.16	0.18
2.8			0.1	0.11	0.125	0.14	0.16	0.18	0.2
3.2		0.1	0.11	0.125	0.14	0.16	0.18	0.2	0.22
3.6	0.1	0.11	0.125	0.14	0.16	0.18	0.2	0.22	0.25
4	0.11	0.125	0.14	0.16	0.18	0.2	0.22	0.25	0.28
4.5	0.125	0.14	0.16	0.18	0.2	0.22	0.25	0.28	0.32
5	0.14	0.16	0.18	0.2	0.22	0.25	0.28	0.32	0.36
5.6	0.16	0.18	0.2	0.22	0.25	0.28	0.32	0.36	0.4
6.3	0.18	0.2	0.22	0.25	0.28	0.32	0.36	0.4	0.45
7.1	0.2	0.22	0.25	0.28	0.32	0.36	0.4	0.45	0.5
8	0.22	0.25	0.28	0.32	0.36	0.4	0.45	0.5	0.56
9	0.25	0.28	0.32	0.36	0.4	0.45	0.5	0.56	0.63
10	0.28	0.32	0.36	0.4	0.45	0.5	0.56	0.63	0.71
11	0.32	0.36	0.4	0.45	0.5	0.56	0.63	0.71	0.8
12.5	0.36	0.4	0.45	0.5	0.56	0.63	0.71	0.8	0.9
14	0.4	0.45	0.5	0.56	0.63	0.71	0.8	0.9	1
16	0.45	0.5	0.56	0.63	0.71	0.8	0.9	1	1.1
18	0.5	0.56	0.63	0.71	0.8	0.9	1	1.1	1.25
20	0.56	0.63	0.71	0.8	0.9	1	1.1	1.25	1.4
22	0.63	0.71	0.8	0.9	1	1.1	1.25	1.4	1.6
25	0.71	0.8	0.9	1	1.1	1.25	1.4	1.6	1.8
28	0.8	0.9	1	1.1	1.25	1.4	1.6	1.8	2
32	0.9	1	1.1	1.25	1.4	1.6	1.8	2	2.2
36	1	1.1	1.25	1.4	1.6	1.8	2	2.2	2.5
40	1.1	1.25	1.4	1.6	1.8	2	2.2	2.5	2.8
45	1.25	1.4	1.6	1.8	2	2.2	2.5	2.8	3.2
50	1.4	1.6	1.8	2	2.2	2.5	2.8	3.2	3.6
56	1.6	1.8	2	2.2	2.5	2.8	3.2	3.6	4

63	1.8	2	2.2	2.5	2.8	3.2	3.6	4	4.5
71	2	2.2	2.5	2.8	3.2	3.6	4	4.5	5
80	2.2	2.5	2.8	3.2	3.6	4	4.5	5	5.6
90	2.5	2.8	3.2	3.6	4	4.5	5	5.6	6.3
100	2.8	3.2	3.6	4	4.5	5	5.6	6.3	7.1
110	3.2	3.6	4	4.5	5	5.6	6.3	7.1	8
125	3.6	4	4.5	5	5.6	6.3	7.1	8	9
140	4	4.5	5	5.6	6.3	7.1	8	9	10
160	4.5	5	5.6	6.3	7.1	8	9	10	11
180	5	5.6	6.3	7.1	8	9	10	11	12.5
200	5.6	6.3	7.1	8	9	10	11	12.5	14
220	6.3	7.1	8	9	10	11	12.5	14	16
250	7.1	8	9	10	11	12.5	14	16	18
280	8	9	10	11	12.5	14	16	18	20
320	9	10	11	12.5	14	16	18	20	22
360	10	11	12.5	14	16	18	20	22	25
400	11	12.5	14	16	18	20	22	25	28
450	12.5	14	16	18	20	22	25	28	32
500	14	16	18	20	22	25	28	32	36
560	16	18	20	22	25	28	32	36	40
630	18	20	22	25	28	32	36	40	45
710	20	22	25	28	32	36	40	45	50
800	22	25	28	32	36	40	45	50	56
900	25	28	32	36	40	45	50	56	63
1000	28	32	36	40	45	50	56	63	71
1100	32	36	40	45	50	56	63	71	80
1250	36	40	45	50	56	63	71	80	90
1400	40	45	50	56	63	71	80	90	100
1600	45	50	56	63	71	80	90	100	110
1800	50	56	63	71	80	90	100	110	125
2000	56	63	71	80	90	100	110	125	140
2200	63	71	80	90	100	110	125	140	160
2500	71	80	90	100	110	125	140	160	180

2800	80	90	100	110	125	140	160	180	200
3200	90	100	110	125	140	160	180	200	220
3600	100	110	125	140	160	180	200	220	250
4000	110	125	140	160	180	200	220	250	280
4500	125	140	160	180	200	220	250	280	320
5000	140	160	180	200	220	250	280	320	360
5600	160	180	200	220	250	280	320	360	400
6300	180	200	220	250	280	320	360	400	450
7100	200	220	250	280	320	360	400	450	500
8000	220	250	280	320	360	400	450	500	560
9000	250	280	320	360	400	450	500	560	630
10000	280	320	360	400	450	500	560	630	710

(**Cont**)

Time	**mA selected**								
(ms)	80	90	100	110	125	140	160	180	200
1			0.1	0.11	0.125	0.14	0.16	0.18	0.2
1.1		0.1	0.11	0.125	0.14	0.16	0.18	0.2	0.22
1.25	0.1	0.11	0.125	0.14	0.16	0.18	0.2	0.22	0.25
1.4	0.11	0.125	0.14	0.16	0.18	0.2	0.22	0.25	0.28
1.6	0.125	0.14	0.16	0.18	0.2	0.22	0.25	0.28	0.32
1.8	0.14	0.16	0.18	0.2	0.22	0.25	0.28	0.32	0.36
2	0.16	0.18	0.2	0.22	0.25	0.28	0.32	0.36	0.4
2.2	0.18	0.2	0.22	0.25	0.28	0.32	0.36	0.4	0.45
2.5	0.2	0.22	0.25	0.28	0.32	0.36	0.4	0.45	0.5
2.8	0.22	0.25	0.28	0.32	0.36	0.4	0.45	0.5	0.56
3.2	0.25	0.28	0.32	0.36	0.4	0.45	0.5	0.56	0.63
3.6	0.28	0.32	0.36	0.4	0.45	0.5	0.56	0.63	0.71
4	0.32	0.36	0.4	0.45	0.5	0.56	0.63	0.71	0.8
4.5	0.36	0.4	0.45	0.5	0.56	0.63	0.71	0.8	0.9
5	0.4	0.45	0.5	0.56	0.63	0.71	0.8	0.9	1
5.6	0.45	0.5	0.56	0.63	0.71	0.8	0.9	1	1.1
6.3	0.5	0.56	0.63	0.71	0.8	0.9	1	1.1	1.25

7.1	0.56	0.63	0.71	0.8	0.9	1	1.1	1.25	1.4
8	0.63	0.71	0.8	0.9	1	1.1	1.25	1.4	1.6
9	0.71	0.8	0.9	1	1.1	1.25	1.4	1.6	1.8
10	0.8	0.9	1	1.1	1.25	1.4	1.6	1.8	2
11	0.9	1	1.1	1.25	1.4	1.6	1.8	2	2.2
12.5	1	1.1	1.25	1.4	1.6	1.8	2	2.2	2.5
14	1.1	1.25	1.4	1.6	1.8	2	2.2	2.5	2.8
16	1.25	1.4	1.6	1.8	2	2.2	2.5	2.8	3.2
18	1.4	1.6	1.8	2	2.2	2.5	2.8	3.2	3.6
20	1.6	1.8	2	2.2	2.5	2.8	3.2	3.6	4
22	1.8	2	2.2	2.5	2.8	3.2	3.6	4	4.5
25	2	2.2	2.5	2.8	3.2	3.6	4	4.5	5
28	2.2	2.5	2.8	3.2	3.6	4	4.5	5	5.6
32	2.5	2.8	3.2	3.6	4	4.5	5	5.6	6.3
36	2.8	3.2	3.6	4	4.5	5	5.6	6.3	7.1
40	3.2	3.6	4	4.5	5	5.6	6.3	7.1	8
45	3.6	4	4.5	5	5.6	6.3	7.1	8	9
50	4	4.5	5	5.6	6.3	7.1	8	9	10
56	4.5	5	5.6	6.3	7.1	8	9	10	11
63	5	5.6	6.3	7.1	8	9	10	11	12.5
71	5.6	6.3	7.1	8	9	10	11	12.5	14
80	6.3	7.1	8	9	10	11	12.5	14	16
90	7.1	8	9	10	11	12.5	14	16	18
100	8	9	10	11	12.5	14	16	18	20
110	9	10	11	12.5	14	16	18	20	22
125	10	11	12.5	14	16	18	20	22	25
140	11	12.5	14	16	18	20	22	25	28
160	12.5	14	16	18	20	22	25	28	32
180	14	16	18	20	22	25	28	32	36
200	16	18	20	22	25	28	32	36	40
220	18	20	22	25	28	32	36	40	45
250	20	22	25	28	32	36	40	45	50
280	22	25	28	32	36	40	45	50	56

320	25	28	32	36	40	45	50	56	63
360	28	32	36	40	45	50	56	63	71
400	32	36	40	45	50	56	63	71	80
450	36	40	45	50	56	63	71	80	90
500	40	45	50	56	63	71	80	90	100
560	45	50	56	63	71	80	90	100	110
630	50	56	63	71	80	90	100	110	125
710	56	63	71	80	90	100	110	125	140
800	63	71	80	90	100	110	125	140	160
900	71	80	90	100	110	125	140	160	180
1000	80	90	100	110	125	140	160	180	200
1100	90	100	110	125	140	160	180	200	220
1250	100	110	125	140	160	180	200	220	250
1400	110	125	140	160	180	200	220	250	280
1600	125	140	160	180	200	220	250	280	320
1800	140	160	180	200	220	250	280	320	360
2000	160	180	200	220	250	280	320	360	400
2200	180	200	220	250	280	320	360	400	450
2500	200	220	250	280	320	360	400	450	500
2800	220	250	280	320	360	400	450	500	560
3200	250	280	320	360	400	450	500	560	630
3600	280	320	360	400	450	500	560	630	710
4000	320	360	400	450	500	560	630	710	800
4500	360	400	450	500	560	630	710	800	900
5000	400	450	500	560	630	710	800	900	1000
5600	450	500	560	630	710	800	900	1000	
6300	500	560	630	710	800	900	1000		
7100	560	630	710	800	900	1000			
8000	630	710	800	900	1000				
9000	710	800	900	1000					
10000	800	900	1000						

(**Cont**)

Time	**mA selected**								
(ms)	220	250	280	320	360	400	450	500	560
1	0.22	0.25	0.28	0.32	0.36	0.4	0.45	0.5	0.56
1.1	0.25	0.28	0.32	0.36	0.4	0.45	0.5	0.56	0.63
1.25	0.28	0.32	0.36	0.4	0.45	0.5	0.56	0.63	0.71
1.4	0.32	0.36	0.4	0.45	0.5	0.56	0.63	0.71	0.8
1.6	0.36	0.4	0.45	0.5	0.56	0.63	0.71	0.8	0.9
1.8	0.4	0.45	0.5	0.56	0.63	0.71	0.8	0.9	1
2	0.45	0.5	0.56	0.63	0.71	0.8	0.9	1	1.1
2.2	0.5	0.56	0.63	0.71	0.8	0.9	1	1.1	1.25
2.5	0.56	0.63	0.71	0.8	0.9	1	1.1	1.25	1.4
2.8	0.63	0.71	0.8	0.9	1	1.1	1.25	1.4	1.6
3.2	0.71	0.8	0.9	1	1.1	1.25	1.4	1.6	1.8
3.6	0.8	0.9	1	1.1	1.25	1.4	1.6	1.8	2
4	0.9	1	1.1	1.25	1.4	1.6	1.8	2	2.2
4.5	1	1.1	1.25	1.4	1.6	1.8	2	2.2	2.5
5	1.1	1.25	1.4	1.6	1.8	2	2.2	2.5	2.8
5.6	1.25	1.4	1.6	1.8	2	2.2	2.5	2.8	3.2
6.3	1.4	1.6	1.8	2	2.2	2.5	2.8	3.2	3.6
7.1	1.6	1.8	2	2.2	2.5	2.8	3.2	3.6	4
8	1.8	2	2.2	2.5	2.8	3.2	3.6	4	4.5
9	2	2.2	2.5	2.8	3.2	3.6	4	4.5	5
10	2.2	2.5	2.8	3.2	3.6	4	4.5	5	5.6
11	2.5	2.8	3.2	3.6	4	4.5	5	5.6	6.3
12.5	2.8	3.2	3.6	4	4.5	5	5.6	6.3	7.1
14	3.2	3.6	4	4.5	5	5.6	6.3	7.1	8
16	3.6	4	4.5	5	5.6	6.3	7.1	8	9
18	4	4.5	5	5.6	6.3	7.1	8	9	10
20	4.5	5	5.6	6.3	7.1	8	9	10	11
22	5	5.6	6.3	7.1	8	9	10	11	12.5
25	5.6	6.3	7.1	8	9	10	11	12.5	14
28	6.3	7.1	8	9	10	11	12.5	14	16

32	7.1	8	9	10	11	12.5	14	16	18
36	8	9	10	11	12.5	14	16	18	20
40	9	10	11	12.5	14	16	18	20	22
45	10	11	12.5	14	16	18	20	22	25
50	11	12.5	14	16	18	20	22	25	28
56	12.5	14	16	18	20	22	25	28	32
63	14	16	18	20	22	25	28	32	36
71	16	18	20	22	25	28	32	36	40
80	18	20	22	25	28	32	36	40	45
90	20	22	25	28	32	36	40	45	50
100	22	25	28	32	36	40	45	50	56
110	25	28	32	36	40	45	50	56	63
125	28	32	36	40	45	50	56	63	71
140	32	36	40	45	50	56	63	71	80
160	36	40	45	50	56	63	71	80	90
180	40	45	50	56	63	71	80	90	100
200	45	50	56	63	71	80	90	100	110
220	50	56	63	71	80	90	100	110	125
250	56	63	71	80	90	100	110	125	140
280	63	71	80	90	100	110	125	140	160
320	71	80	90	100	110	125	140	160	180
360	80	90	100	110	125	140	160	180	200
400	90	100	110	125	140	160	180	200	220
450	100	110	125	140	160	180	200	220	250
500	110	125	140	160	180	200	220	250	280
560	125	140	160	180	200	220	250	280	320
630	140	160	180	200	220	250	280	320	360
710	160	180	200	220	250	280	320	360	400
800	180	200	220	250	280	320	360	400	450
900	200	220	250	280	320	360	400	450	500
1000	220	250	280	320	360	400	450	500	560
1100	250	280	320	360	400	450	500	560	630
1250	280	320	360	400	450	500	560	630	710

1400	320	360	400	450	500	560	630	710	800
1600	360	400	450	500	560	630	710	800	900
1800	400	450	500	560	630	710	800	900	1000
2000	450	500	560	630	710	800	900	1000	
2200	500	560	630	710	800	900	1000		
2500	560	630	710	800	900	1000			
2800	630	710	800	900	1000				
3200	710	800	900	1000					
3600	800	900	1000						
4000	900	1000							
4500	1000								

(**Cont**)

Time	**mA selected**				
(ms)	630	710	800	900	1000
1	0.63	0.71	0.8	0.9	1
1.1	0.71	0.8	0.9	1	1.1
1.25	0.8	0.9	1	1.1	1.25
1.4	0.9	1	1.1	1.25	1.4
1.6	1	1.1	1.25	1.4	1.6
1.8	1.1	1.25	1.4	1.6	1.8
2	1.25	1.4	1.6	1.8	2
2.2	1.4	1.6	1.8	2	2.2
2.5	1.6	1.8	2	2.2	2.5
2.8	1.8	2	2.2	2.5	2.8
3.2	2	2.2	2.5	2.8	3.2
3.6	2.2	2.5	2.8	3.2	3.6
4	2.5	2.8	3.2	3.6	4
4.5	2.8	3.2	3.6	4	4.5
5	3.2	3.6	4	4.5	5
5.6	3.6	4	4.5	5	5.6
6.3	4	4.5	5	5.6	6.3

7.1	4.5	5	5.6	6.3	7.1
8	5	5.6	6.3	7.1	8
9	5.6	6.3	7.1	8	9
10	6.3	7.1	8	9	10
11	7.1	8	9	10	11
12.5	8	9	10	11	12.5
14	9	10	11	12.5	14
16	10	11	12.5	14	16
18	11	12.5	14	16	18
20	12.5	14	16	18	20
22	14	16	18	20	22
25	16	18	20	22	25
28	18	20	22	25	28
32	20	22	25	28	32
36	22	25	28	32	36
40	25	28	32	36	40
45	28	32	36	40	45
50	32	36	40	45	50
56	36	40	45	50	56
63	40	45	50	56	63
71	45	50	56	63	71
80	50	56	63	71	80
90	56	63	71	80	90
100	63	71	80	90	100
110	71	80	90	100	110
125	80	90	100	110	125
140	90	100	110	125	140
160	100	110	125	140	160
180	110	125	140	160	180
200	125	140	160	180	200
220	140	160	180	200	220
250	160	180	200	220	250
280	180	200	220	250	280

320	200	220	250	280	320
360	220	250	280	320	360
400	250	280	320	360	400
450	280	320	360	400	450
500	320	360	400	450	500
560	360	400	450	500	560
630	400	450	500	560	630
710	450	500	560	630	710
800	500	560	630	710	800
900	560	630	710	800	900
1000	630	710	800	900	1000
1100	710	800	900	1000	
1250	800	900	1000		
1400	900	1000			
1600	1000				

mA/ms/mAs values are according to the Series R'10, ISO 497.

Time (ms)	mA Selected								
	10	12.5	16	20	25	32	40	50	63
1									
1.25									
1.6									
2									
2.5									
3.2									
4									
5									
6.3									
8									0.5
10								0.5	0.63
12.5							0.5	0.63	0.8
16						0.5	0.63	0.8	1
20					0.5	0.63	0.8	1	1.25
25				0.5	0.63	0.8	1	1.25	1.6
32			0.5	0.63	0.8	1	1.25	1.6	2
40		0.5	0.63	0.8	1	1.25	1.6	2	2.5
50	0.5	0.63	0.8	1	1.25	1.6	2	2.5	3.2
63	0.63	0.8	1	1.25	1.6	2	2.5	3.2	4
80	0.8	1	1.25	1.6	2	2.5	3.2	4	5
100	1	1.25	1.6	2	2.5	3.2	4	5	6.3
125	1.25	1.6	2	2.5	3.2	4	5	6.3	8

160	1.6	2	2.5	3.2	4	5	6.3	8	10
200	2	2.5	3.2	4	5	6.3	8	10	12.5
250	2.5	3.2	4	5	6.3	8	10	12.5	16
320	3.2	4	5	6.3	8	10	12.5	16	20
400	4	5	6.3	8	10	12.5	16	20	25
500	5	6.3	8	10	12.5	16	20	25	32
630	6.3	8	10	12.5	16	20	25	32	40
800	8	10	12.5	16	20	25	32	40	50
1000	10	12.5	16	20	25	32	40	50	63
1250	12.5	16	20	25	32	40	50	63	80
1600	16	20	25	32	40	50	63	80	100
2000	20	25	32	40	50	63	80	100	125
2500	25	32	40	50	63	80	100	125	160
3200	32	40	50	63	80	100	125	160	200
4000	40	50	63	80	100	125	160	200	250
5000	50	63	80	100	125	160	200	250	320
6300	63	80	100	125	160	200	250	320	400
8000	80	100	125	160	200	250	320	400	500
10000	100	125	160	200	250	320	400	500	630

(**Cont**)

Time	mA Selected								
(ms)	80	100	125	160	200	250	320	400	500
1									0.5
1.25								0.5	0.63
1.6							0.5	0.63	0.8
2						0.5	0.63	0.8	1
2.5					0.5	0.63	0.8	1	1.25
3.2				0.5	0.63	0.8	1	1.25	1.6
4			0.5	0.63	0.8	1	1.25	1.6	2
5		0.5	0.63	0.8	1	1.25	1.6	2	2.5
6.3	0.5	0.63	0.8	1	1.25	1.6	2	2.5	3.2
8	0.63	0.8	1	1.25	1.6	2	2.5	3.2	4
10	0.8	1	1.25	1.6	2	2.5	3.2	4	5
12.5	1	1.25	1.6	2	2.5	3.2	4	5	6.3
16	1.25	1.6	2	2.5	3.2	4	5	6.3	8
20	1.6	2	2.5	3.2	4	5	6.3	8	10
25	2	2.5	3.2	4	5	6.3	8	10	12.5
32	2.5	3.2	4	5	6.3	8	10	12.5	16
40	3.2	4	5	6.3	8	10	12.5	16	20
50	4	5	6.3	8	10	12.5	16	20	25
63	5	6.3	8	10	12.5	16	20	25	32
80	6.3	8	10	12.5	16	20	25	32	40
100	8	10	12.5	16	20	25	32	40	50
125	10	12.5	16	20	25	32	40	50	63
160	12.5	16	20	25	32	40	50	63	80

200	16	20	25	32	40	50	63	80	100
250	20	25	32	40	50	63	80	100	125
320	25	32	40	50	63	80	100	125	160
400	32	40	50	63	80	100	125	160	200
500	40	50	63	80	100	125	160	200	250
630	50	63	80	100	125	160	200	250	320
800	63	80	100	125	160	200	250	320	400
1000	80	100	125	160	200	250	320	400	500
1250	100	125	160	200	250	320	400	500	630
1600	125	160	200	250	320	400	500	630	800
2000	160	200	250	320	400	500	630	800	1000
2500	200	250	320	400	500	630	800	1000	
3200	250	320	400	500	630	800	1000		
4000	320	400	500	630	800	1000			
5000	400	500	630	800	1000				
6300	500	630	800	1000					
8000	630	800	1000						
10000	800	1000							

(**Cont**)

Time	mA Selected		
(ms)	630	800	1000
1	0.63	0.8	1
1.25	0.8	1	1.25
1.6	1	1.25	1.6
2	1.25	1.6	2
2.5	1.6	2	2.5
3.2	2	2.5	3.2
4	2.5	3.2	4
5	3.2	4	5
6.3	4	5	6.3
8	5	6.3	8
10	6.3	8	10
12.5	8	10	12.5
16	10	12.5	16
20	12.5	16	20
25	16	20	25
32	20	25	32
40	25	32	40
50	32	40	50
63	40	50	63
80	50	63	80
100	63	80	100
125	80	100	125
160	100	125	160

200	125	160	200
250	160	200	250
320	200	250	320
400	250	320	400
500	320	400	500
630	400	500	630
800	500	630	800
1000	630	800	1000
1250	800	1000	
1600	1000		

APPENDIX 2: Loading Factor

OUTPUT PARAMETER	GENERATOR SERIES	LOADING FACTOR
Maximum X-Ray tube voltage and highest X-Ray tube current at that voltage	32 kW (single phase)	*125 kV, 250 mA 150 kV, 200 mA
	32 kW (3 phase)	150 kV, 200 mA
	40 kW (single phase)	*125 kV, 320 mA 150 kV, 250 mA
	40 kW (3 phase)	150 kV, 250 mA
	50 kW	150 kV, 320 mA
	65 kW	150 kV, 400 mA
	80 kW	150 kV, 500 mA
Maximum X-Ray tube current and highest X-Ray tube voltage at that current	32 kW	400 mA, 80 kV
	40 kW	500 mA, 80 kV
	50 kW	630 mA, 79 kV
	65 kW	800 mA, 81 kV
	80 kW	1000 mA, 80 kV
Combination of X-Ray tube current and X-Ray tube voltage resulting in highest output power	32 kW	320 mA, 100 kV
	40 kW	400 mA, 100 kV
	50 kW	500 mA, 100 kV
	65 kW	630 mA, 103 kV
	80 kW	800 mA, 100 kV
Highest constant output power at 100 kV, 0.1 sec	32 kW	32 kW (320 mA, 100 kV)
	40 kW	40 kW (400 mA, 100 kV)
	50 kW	50 kW (500 mA, 100 kV)
	65 kW	65 kW (630 mA, 100 kV)
	80 kW	80 kW (800 mA, 100 kV)
lowest Current Time Product and its combinations	All models	0.1 mAs at 10 mA and 10 ms combination
Nominal shortest irradiation time (AEC exposures)	All models	10 ms

*Based on tube type

APPENDIX 3: Contact information

Spellman China
Spellman High Voltage Electronics (SIP) Co Ltd.
No.86 JinjiangRoad,
Suzhou Industrial Park 215127 China
Tel: + (86)-512-67630010
Fax: + (86)-512-67630030

Spellman USA and Corporate HQ
475 Wireless Blvd.
Hauppauge, NY 11788
United States
Tel: +1-631-630-3000
Fax: +1-631-435-1620

Spellman High Voltage GmbH
Josef-Baumann- Straße 23
4805 Bochum
Germany
Tel: +49(0)234 87906-0
Fax: +49(0)234 87906-11

(This page left blank intended)