

X-RAY

MD X-RAY GENERATORS OPERATOR'S MANUAL



XRS4MD

XRS3MD

NOVEMBER 2023

ORIGINAL INSTRUCTIONS

 **Golden Engineering**
Portable X-ray Technology

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INTRODUCTION



RADIATION WARNING

*The X-ray generator produces high levels of radiation and must be operated by qualified personnel who have read the **WARNINGS** and **OPERATING INSTRUCTIONS** sections of the manual before operating the device.*

X-ray generators from Golden Engineering are industrial type open beam X-ray generators intended to radiograph inanimate objects. The devices are a pulsed X-ray device that produces X-ray pulses of very short duration (10-50 nanoseconds). The energy produced by the X-ray generator varies from model to model, and can be up to 370kVp, which makes it possible to radiograph up to one (1) inch (2.54 cm) of steel.

Each X-ray generator ships with two keys. Various kits are available with accessories such as battery packs, battery charger, remote cable or carrying case. Refer to the Spare Parts and Accessories section or contact your sales representative for more details.

The X-ray generators from Golden Engineering are pulsed X-ray generators that emit hazardous ionizing radiation when pulsing. The unit should only be operated by **authorized personnel** who are properly trained to safely operate the X-ray generator. The X-ray generator must be **registered** with proper authorities prior to use and should not be used to intentionally expose humans.

Develop and closely follow a safe operating system for using the X-ray generator. The safe operating system must ensure that no one is exposed to radiation above the permissible limits which are 2 mR (0.02 mSv) per hour for a member of the public. The safe operating system must ensure the X-ray generator is used within federal and state guidelines.



All operators and users of the X-ray generator must wear a personal radiation monitoring device, such as a TLD (thermoluminescent dosimeter), film badge, and/or a pocket dosimeter consistent with the appropriate federal, territorial or provincial standards. If an operator or bystander is exposed to an unacceptable level of radiation contact your Radiation Safety Officer and/or appropriate health care provider.

NOTE: Electronic dosimeters and survey meters of the Geiger-Mueller and scintillator types may not detect the X-ray Generator's radiation pulses.

Due to the short pulse width of the pulsed X-ray, survey meters of the Geiger-Mueller and scintillator type do not accurately detect the radiation emitted from pulsed X-ray generators.

Survey meters should be of the ionization chamber (ion chamber) type and should be used in the integration mode. Survey meters must **not** be used in the rate mode because the pulsed X-ray generator does not produce constant radiation. Pulsed X-ray generators produce very high rates of radiation for very short periods of time resulting in either unrealistically high readings or no readings for a survey meter in rate mode.

Do not operate X-ray generators in explosive atmospheres, such as in the presence of flammable liquids, gases, or dust. The internal spark gap creates sparks which may ignite the dust or fumes.

DESCRIPTION OF OPERATION

The block diagram below illustrates how the X-ray generator functions. The following sequence of events takes place each time the unit is fired:

1. User initiates operation of the machine.
2. The controller sends a signal to the converter to begin oscillating.
3. Once oscillating, the converter section changes the DC battery voltage to 22Khz AC.
4. The transformer charges the High Voltage Capacitor to about 9000 volts.
5. The spark gap arcs after the High Voltage Capacitor reaches peak voltage.
6. The pulse detector signals the control block that the unit has pulsed.
7. As the High Voltage Switch is closed, a high voltage transient of between 150,000 and 370,000 volts (depending on the model and 10-30 nanoseconds in duration) is applied across the X-ray tube generating X-rays.

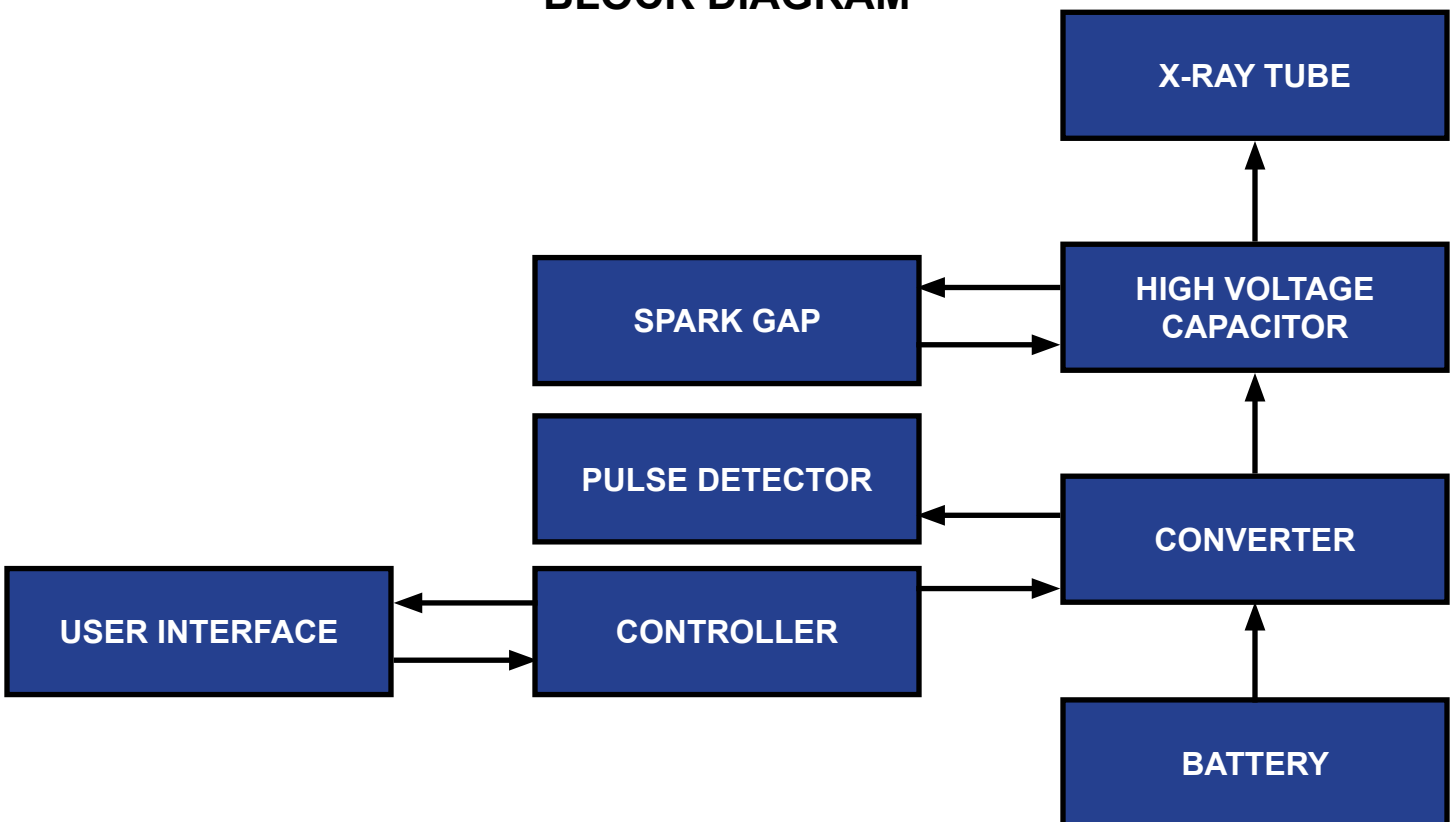
The closing of the High Voltage Switch produces an audible pulsing sound. The X-ray generator cannot produce X-rays without the pulsing sound so it serves as an additional warning the unit is functioning.

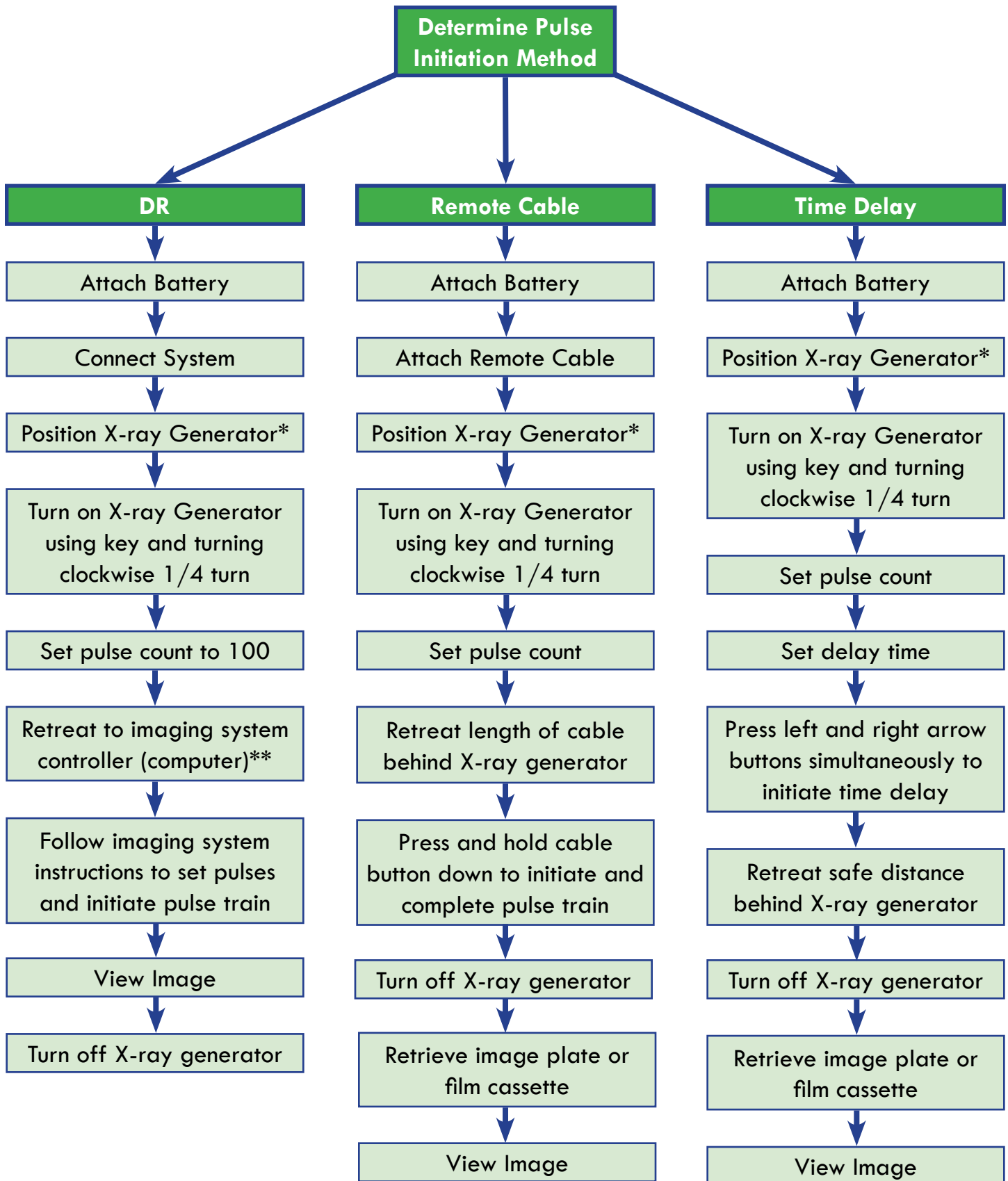
This unit generates X-rays through high voltage bombardment of a tungsten target.

The X-ray generator **does not contain radioactive materials**.

All the high voltage is contained within the aluminum canister and as long as the canister is not punctured the operator is not exposed to dangerous voltages.

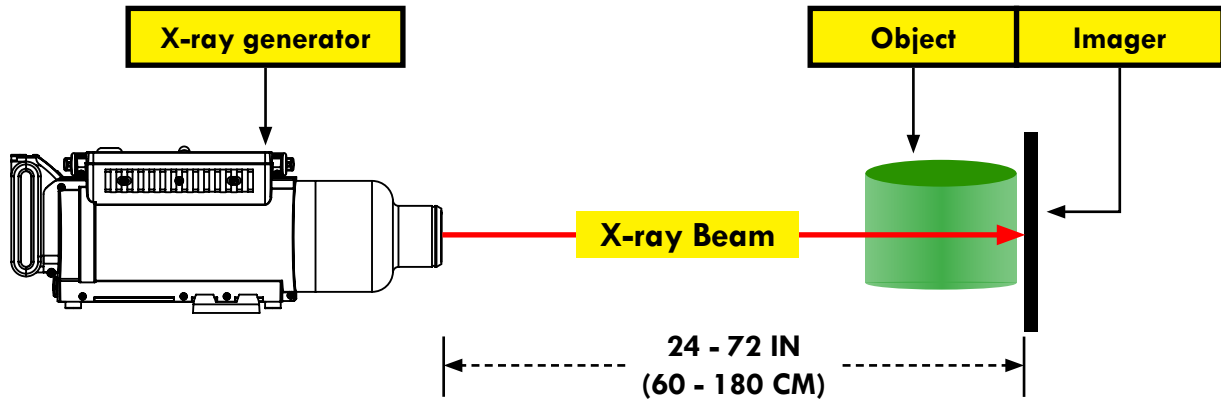
BLOCK DIAGRAM





The following are basic operation instructions to take an X-ray image using the X-ray generator. Certain applications may require modifications to these basic procedures.

* The X-ray generator should be positioned directly in front of the object to be X-rayed and the imager placed directly behind the object to be X-rayed. Imager should be placed as close to the object as possible. Distance between X-ray generator and imager is usually 24 to 72 inches (60 to 180 cm). During operation the unit should be stabilized on a flat surface, a tripod, or a custom fixture suitable for holding the weight of the device. Refer to the Specifications table for details.

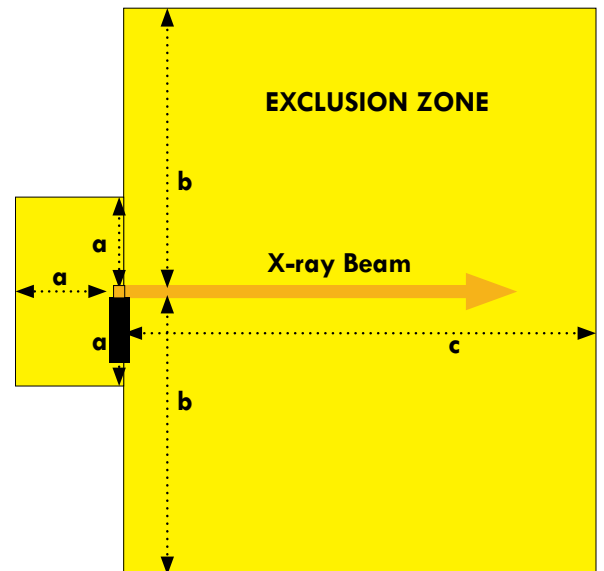
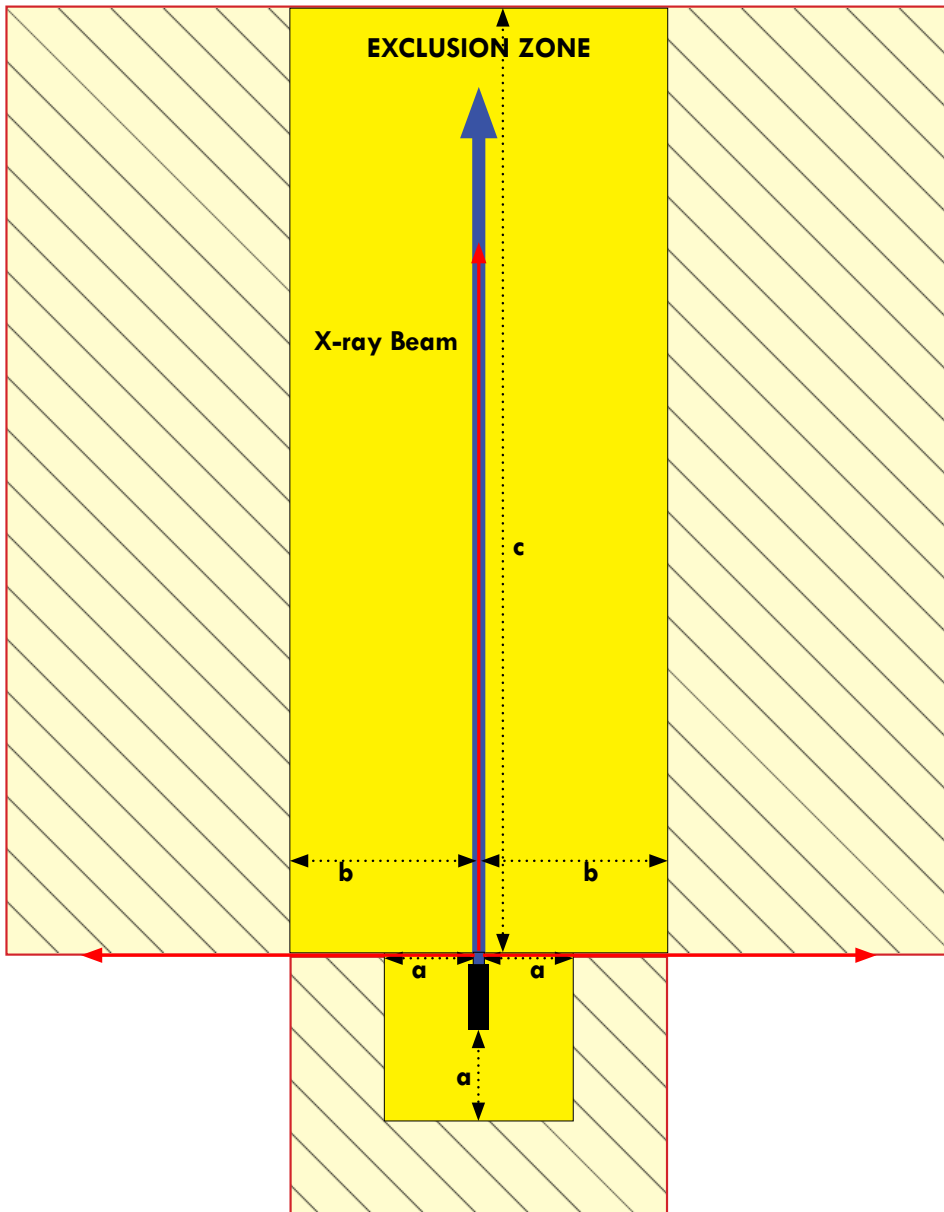


EXCLUSION ZONE

The exclusion zone is based on firing 3000 pulses in an hour, which is slightly higher than the rated maximum duty cycle of the X-ray generator. The exclusion zone is different depending on which model and which collimator cap is installed.

**** The operator should always stand outside of the exclusion zone. The exclusion zone (below) should be a controlled area free of all personnel while X-ray pulses.**

	FORWARD FIRING CAP		SIDE FIRING CAP	
	XRS3	XRS4	XRS3	XRS4
a	10' (3 m)	10' (3 m)	10' (3 m)	10' (3 m)
b	30' (9.1 m)	40' (12.2 m)	30' (9.1 m)	30' (9.1 m)
c	80' (24.4 m)	113' (34.4 m)	50' (15.2 m)	50' (15.2 m)



The X-Ray generator should NOT be fired without the collimator cap installed.

These no cap standoff distances are provided for informational purposes only.

	NO CAP	
	XRS3	XRS4
a	20' (6 m)	20' (6 m)
b	50' (15.2 m)	55' (16.8 m)
c	80' (24.4 m)	113' (35 m)

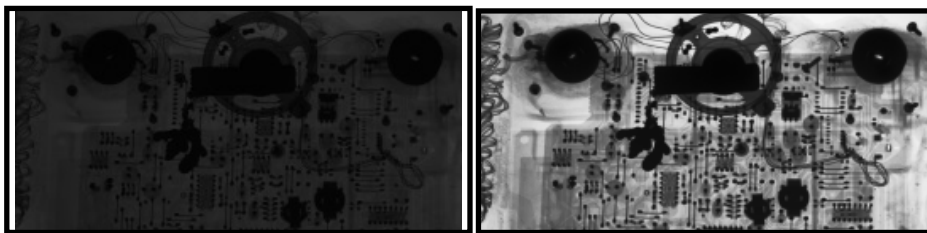
RECOMMENDED PULSE SETTINGS

The chart below lists **approximate** pulses necessary to penetrate various materials. **Settings vary depending on imaging system used.** Refer to imaging system instructions for more information.

MATERIAL	PULSE SETTING	
	XRS3	XRS4
Cardboard, light wood, plastic	2-5	1-2
Light metal	10	5-10
Steel 1/4" (6 mm)	25	25
Steel 1/2" (13 mm)	50	35-40
Steel 1" (25 mm)	99	50
Steel 1 1/2" (38 mm)	-	99
Brass 1/8" to 1/4" (3-6 mm)	99	50-99

When firing to the side, the output is decreased by about 80%. Since the lower energy is largely filtered out, and the higher energy is transmitted, the pulse setting may not need to be adjusted. More importantly, the image should be enhanced in software.

If the radiograph is too dark, the film is **underexposed**.

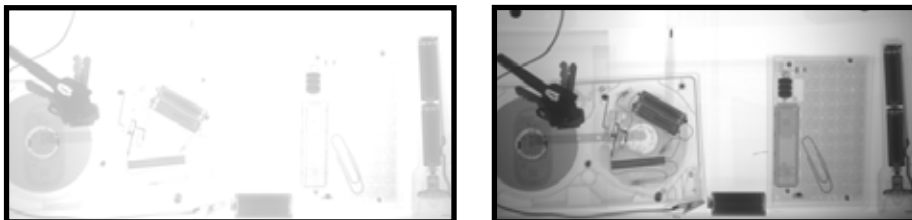


Underexposed

Correct Exposure

Underexposure can be corrected by increasing the number of pulses and/or decreasing the distance between the imaging medium and the X-ray generator.

If the radiograph is too light the film is **overexposed**.



Overexposed

Correct Exposure

Overexposure can be corrected by reducing the number of pulses and/or increasing the distance between the imaging medium and X-ray generator.

X-RAY DOSE MEASUREMENT

Using a dosimeter, the average X-ray dose for an X-ray generator can be established. After replacing a tube, or if low output is suspected, follow this procedure to verify output dose.

The leakage sheet illustrates the X-ray dose and maximum allowable radiation leakage levels for each X-ray unit. A completed copy of this form accompanies each X-ray generator.

1. Place the dosimeter 30 cm in front of the case and in line with the center of the beam angle label.
2. Set the unit to 50 pulses and fire the X-ray generator.
3. Refer to the table at right for expected 50-pulse readings.
4. If output is too low, recommend returning the unit for repair.

Model	50 Pulse mR
XRS3MD	100-200
XRS4MD	200-425



TUBE REPLACEMENT

The **XRS3MD** and **XRS4MD** tube cavity is filled with transformer oil, which requires special care for tube replacement. The tube may be replaced in the field using a tube replacement kit. It is important that NO AIR is introduced into the unit during tube replacement, and a tube replacement kit must be used.

If you have a tube replacement kit refer to instructions included with the kit and be sure to purge all air from the tube before inserting it into the case.

If you do not have a kit, the unit must be sent back to Golden Engineering or an Authorized Distributor for tube replacement. Under normal conditions the tube's output will decrease slowly with use. If the tube is broken or the glass cracks, the tube output will cease immediately.

PHYSICAL DESCRIPTION



HANDLE

The handle of the XRS3MD is attached to the front and back of the Control Module. The handle of the XRS4 is integral to the body.

XRS3MD

HIGH VOLTAGE PULSER/TUBEHEAD

The main body of the X-ray Generator is the tube head. The head contains the tube cavity, cold cathode type X-ray tube, spark gap, high voltage capacitor, and transformer.

BASE

The base of the unit contains an identification label containing manufacturer's name and address, model number, serial number, weight, volt, amp, and production date.

The base also contains a 1/4-20 brass insert compatible with standard camera tripods. See page 13 for more.

RADIATION CAUTION LABEL

BATTERY

BATTERY PACK. The standard battery pack is a DeWalt® 20V 2 amp hour Li Ion battery (DCB203).

CONTROL MODULE

The main user interface for the X-ray generator located on top of the unit.

PICATINNY RAIL

The X-ray generator is equipped a 21 mm picatinny rail located on each side of the housing.

BEAM ANGLE LABEL

COLLIMATOR CAP

The XRS3MD and XRS4MD come with 2 interchangeable collimator caps. See page 16 for more detail.

XRS4MD



CONTROL MODULE



COLLIMATOR CAP

X-RAY PULSING LIGHTS

Blinks once per second after time delay button or remote cable button is pressed to warn that the X-ray Generator is going to pulse. The light stays on continuously while the unit is pulsing.

This is a failsafe warning light. If the light does not work the X-ray unit will not pulse. See settings menu for fail-safe override in emergency situations.

LIQUID CRYSTAL DISPLAY (LCD)

The graphical LCD is the main interface with the X-ray generator. See the Operating Instructions for more details on the various control screens.

POWER ON LIGHT

Illuminates when battery voltage is applied to control module.

DIRECTIONAL BUTTONS

Left, Right, Up and Down buttons used to navigate through the menu.

DELAY SWITCH

Pressing both Left and Right arrow buttons simultaneously initiates the delay mode, allowing the operator to use the unit without the remote cable.

ENTER / EMERGENCY STOP

Stops the unit before it begins pulsing or stops the unit in the middle of a pulse train. Also used as the enter button to select desired option.

MODEL IDENTIFICATION

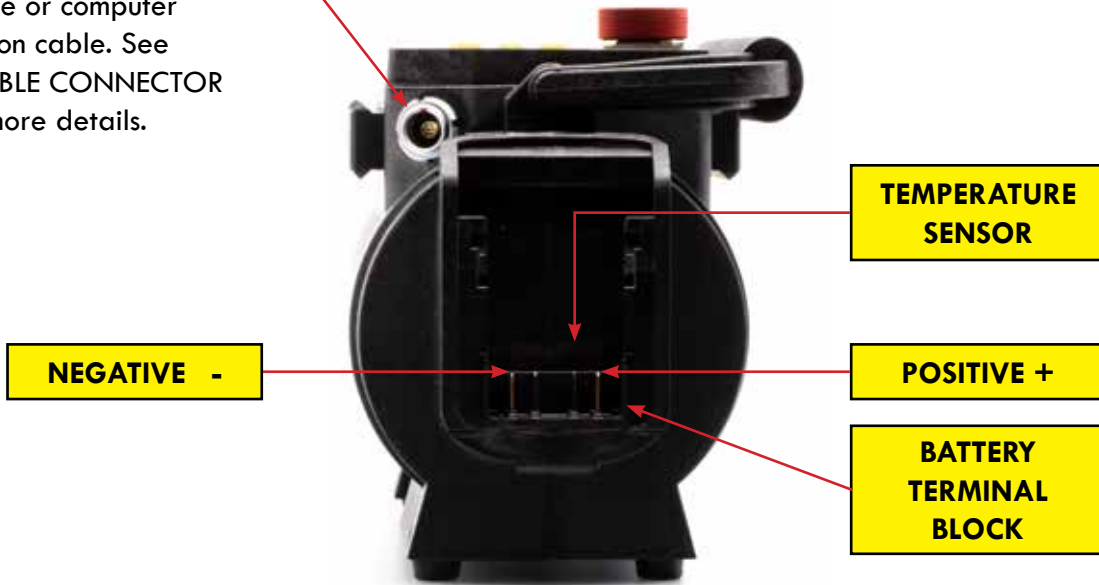
**Top View
Control Module**

KEY

Main power switch to turn the unit on and off.

REMOTE CABLE CONNECTOR

Remote cable or computer communication cable. See REMOTE CABLE CONNECTOR section for more details.



Rear View

BATTERY PACK

The standard battery pack is a DeWalt® 20V 2 amp-hour Li Ion battery (DCB203). The units are compatible with batteries up to 12 amp-hours.



BATTERY CHARGER

The standard battery charger is the DeWalt® DCB115 charger for both 110V and 220V. (Note: DeWalt model numbers may change). Battery charge time is typically less than one hour. See battery charger manual for additional instructions and warnings.

PHYSICAL DESCRIPTION



BASE

The base of the unit contains an identification label and a 1/4-20 brass insert compatible with standard camera tripods. All units are now compatible with Arca-Swiss tripod mounts, and all units feature rubberized non-skid feet for stability when not using a tripod.



NAMEPLATE LABEL

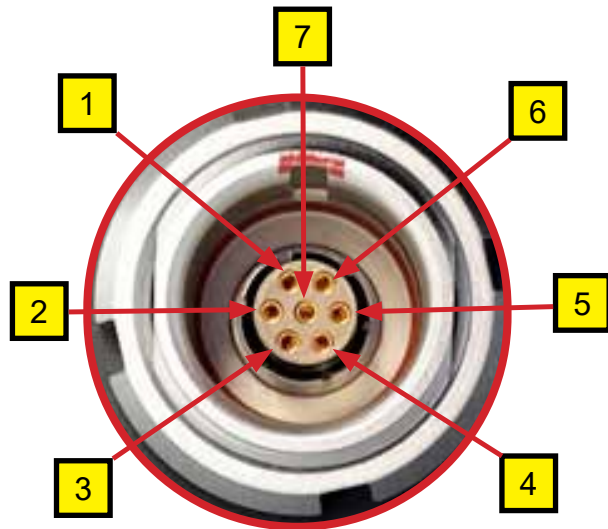
The nameplate identification label located on the bottom of the generator lists the manufacturer's name, model number, serial number, weight, volt, amp, and production date.



XRS3 - bottom

The X-ray Generator is equipped with Lemo 7 pin “K” series connector located on the upper left corner of the back of the control module. This is where the remote cable or imaging system cable is attached.

See the diagrams and table below for the details of each configuration.



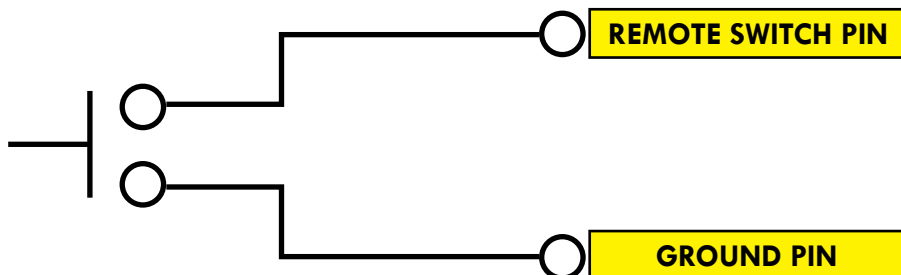
7 PIN K REMOTE CABLE CONNECTOR

REMOTE CONNECTOR: LEMO EGG.0K.307.CLN
 MATING CABLE PLUG: LEMO FGG.0K.307.CYCC50Z



PIN #	7 PIN K CONNECTOR
1	+5 VOLTS 1 A MAXIMUM
2	REMOTE SWITCH (5 sec delay) (+3V)
3	REMOTE SWITCH – NO DELAY (+3V)
4	X-RAY ON / FEEDBACK SIGNAL (+5V)
5	RS232-RX
6	RS232-TX
7	GROUND (COMMON 0 VOLTS)

NOTE: Wire colors indicated by cell color above. When bypassing the Lemo connector, it is the user’s responsibility to use an ohmmeter to verify the correct wires are used.



SERIAL INFORMATION
 Baud Rate: 57600
 8 – bit data
 1 stop bit
 Hardware flow control: None
 Parity: none
 Voltage Input: +/- 25V
 Voltage Output: +/- 6V

Remote switch inputs are activated when connected to ground pin.

NAVIGATING THE MENU

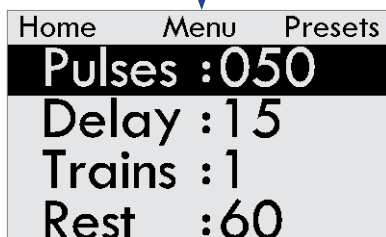
HOME SCREEN - PULSES, DELAY, TRAINS



This is the HOME screen. From here you can set the number of pulses, delay in seconds, and adjust the trains settings. See MANUALLY ENTERING PULSE TRAINS.

Pulses:	Number of consecutive pulses that will be sent when the unit is fired.
Delay:	Number of seconds before the first pulse, after the Delay sequence is activated. Activate by pressing BOTH the left and right arrows simultaneously.
Trains:	Number of GROUPS of Pulses that will be sent when the unit is fired.
Rest:	Number of seconds between TRAINS

Press the DOWN arrow to navigate to the PULSES settings.



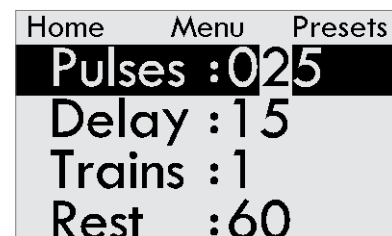
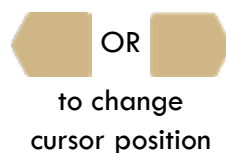
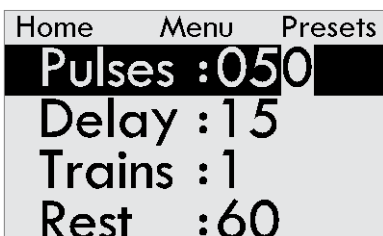
BASIC NAVIGATION

Press LEFT or RIGHT to change position. The highlighted character has the focus. Press ENTER to select - cursor will invert foreground and background colors. Press UP or DOWN to change value of the selected character. Press ENTER to accept.

Use directional buttons to navigate to all settings on the HOME screen. See below changing the Delay setting.



to switch to edit mode.



to accept

BEAM DIRECTION

The Multi-directional X-ray generators are designed to be fired with either a Forward or Side collimator cap installed. The unit should not be fired without a cap installed. If the cap is missing, the unit will still fire, but the exclusion zone becomes much larger. As a reminder when powering on the unit, the display will ask the user to confirm which cap is installed.

Beam Direction

Please select the direction of the X-Ray beam:

Forward Side

This setting does NOT affect the performance of the unit, it simply serves as a reminder to use the correct cap.

Beam Direction

Output is reduced!
Adjust pulses and use image enhancement.

Forward Side



When firing to the side, the output is decreased by about 80%.
Since the lower energy is largely filtered out, and the higher energy is transmitted, the pulse setting may not need to be adjusted.
More importantly, the image should be enhanced in software.

Firmware 4.01 and above: When the unit is powered, the user is presented with the directional screen.

Firmware 4.02 and above: If the backlight is enabled, the color will match the cap as a quick visual indicator that the correct cap is in place.



CAP INSTALLATION AND REMOVAL

The X-ray generator is shipped with the blue cap installed and secured by a screw.



Remove the screw using a T10 screwdriver. Exercise care to remove the screw enough that it will not scar the housing when the cap is being installed or removed.



Pull the cap straight off the nose of the unit.

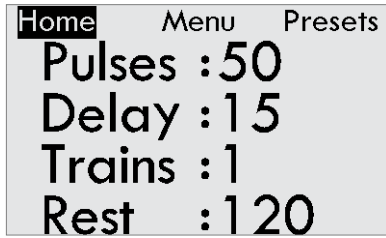


Install the other cap by pressing straight onto the nose of the unit.

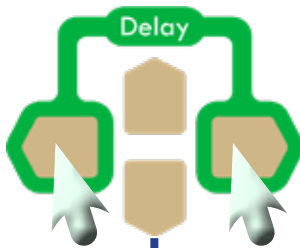


Replace the screw previously removed, or install the knurled screw provided.

BASIC OPERATION - FIRING FROM THE CONTROL MODULE



Enter the desired number of pulses, delay, trains, and rest onto the home screen.



Press LEFT and RIGHT at the same time to fire the unit.



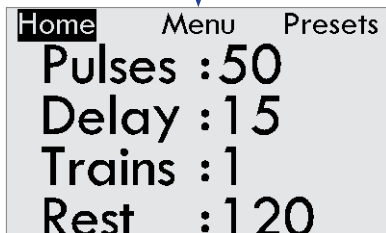
The unit will beep and begin counting down the number of seconds set in the DELAY setting.

Clear the area and retreat a safe distance.

Pressing any button on this screen will cancel the firing request.

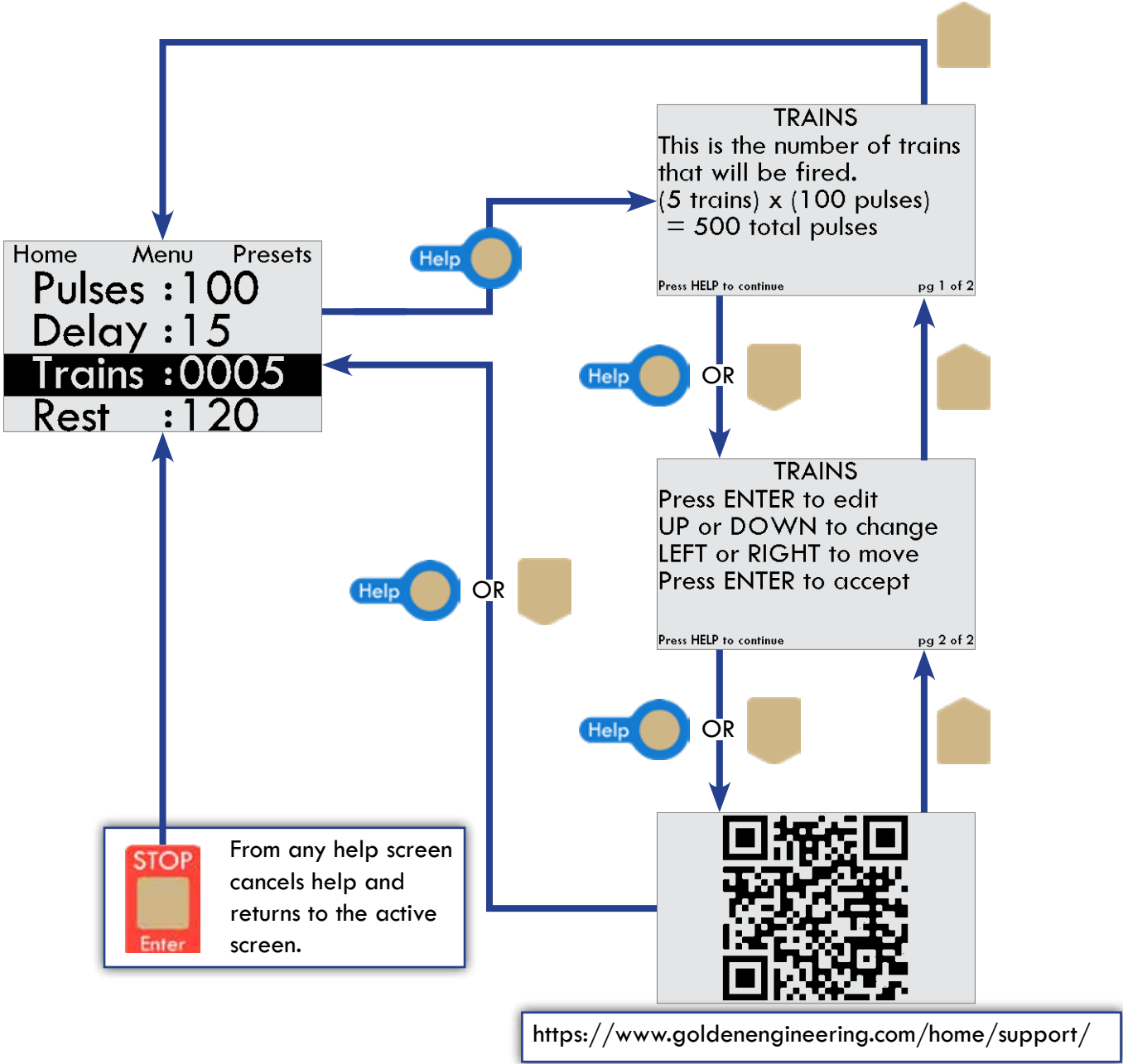


After the unit finishes firing, the display will return to the Home screen.



ON-BOARD HELP

The X-ray Generator features a context-sensitive on-board help system. Simply press the Help button for more information.



SUPPORT

OPERATOR'S MANUALS

TROUBLESHOOTING & SERVICE GUIDES

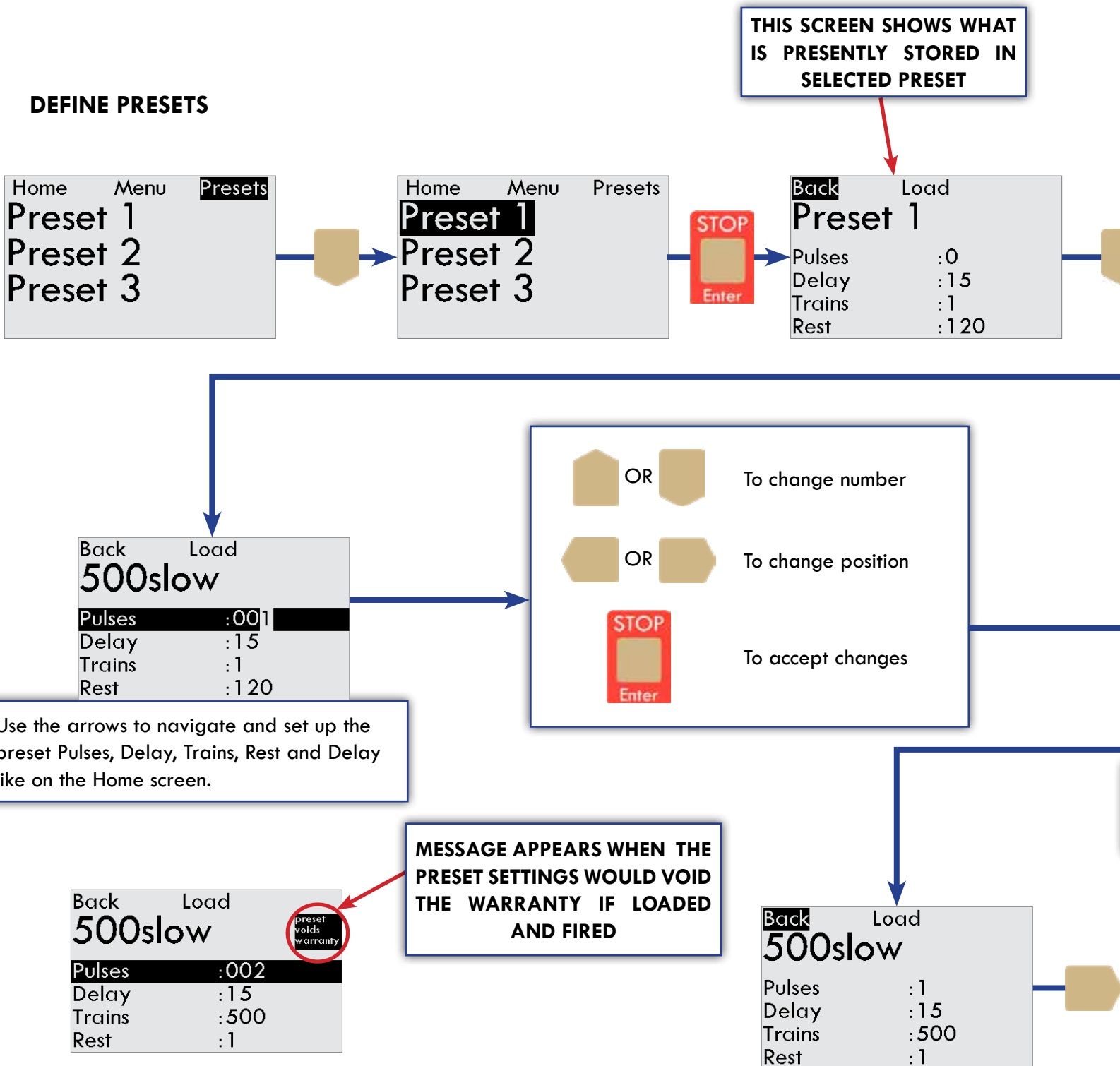
NAVIGATING THE MENU






WORKING WITH PRESETS

Presets allow the operator to save settings that are commonly used, so they can be recalled when needed. This is useful for changing between different pulse train setups.

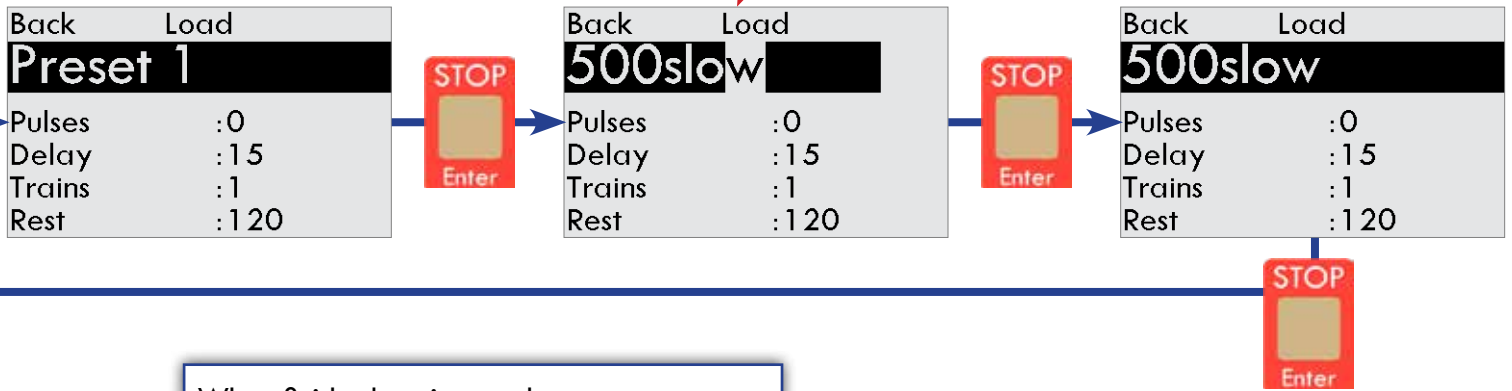
The workflow is different than on previous units. The Presets are now set up entirely in the presets section, and loaded onto the home screen from here.

DEFINE PRESETS

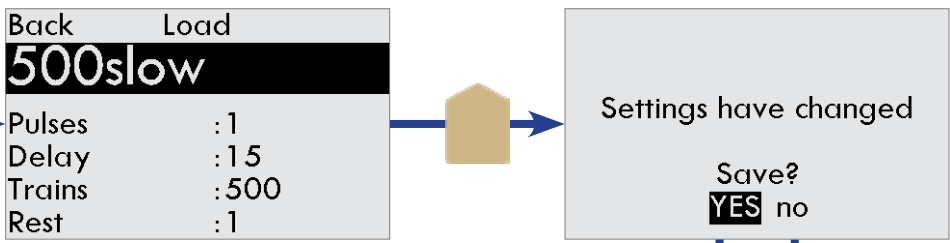


 OR  To change character or number
 OR  To change position
 To accept changes

RENAME PRESETS



When finished setting up the preset, arrow up to the top. If anything has changed, you'll be asked to save.



LOADS WHAT IS SHOWN ON THE PRESET SCREEN TO THE HOME SCREEN

PRESET IS LOADED AND READY TO FIRE

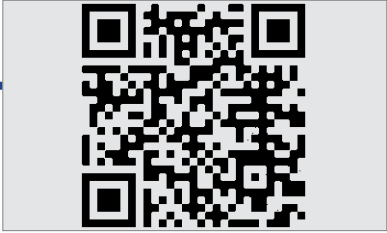
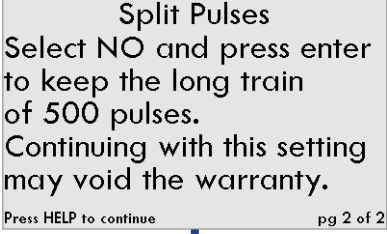
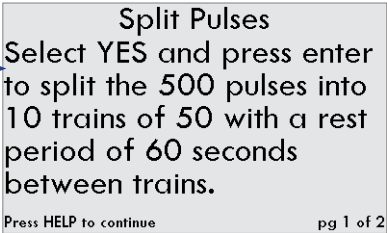
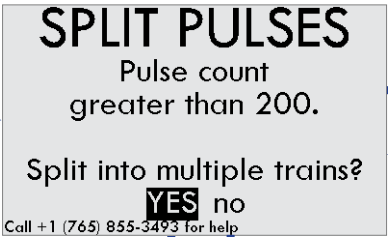
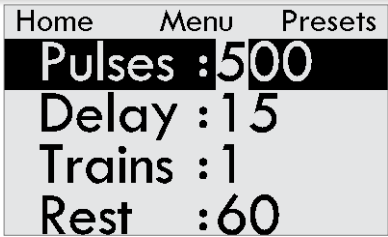


PULSE COUNT EXCEEDS DUTY CYCLE

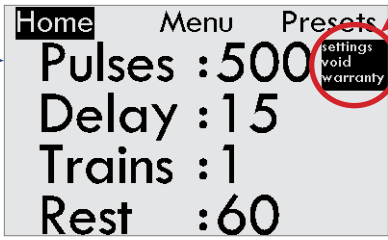
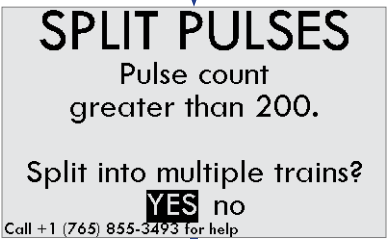
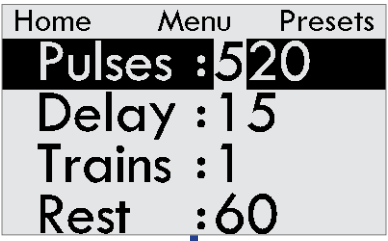
DUTY CYCLE WARNING

The 20V family of X-ray generators are light duty machines that are not made to pulse continuously. The maximum duty cycle for the units is 200 pulses every four minutes. In temperatures above 90°F (32.22°C) or continual use situations, rest a minimum of 30 sec every 50 pulses and 4 min after every 200 pulses. Exceeding the duty cycle will shorten the life of the tube and head, and may also cause thermal damage to the circuit boards.

Set PULSES higher than 200, press Enter.



If the number of pulses exceeds 200, the unit will automatically attempt to split the pulses into consecutive pulse trains with a delay between them. See the example of setting 500 pulses. Pulses that are not multiples of 50 will activate Split Mode. See below:



MANUALLY ENTERING PULSE TRAINS

Arrow down on the HOME screen to adjust Trains and Rest settings.

Trains indicates the number of consecutive pulse groups that will be sent.

Rest indicates the number of seconds between pulse trains.

Home Menu Presets
Pulses : 25
Delay : 15
Trains : 1
Rest : 240

Home Menu Presets
Pulses : 25
Delay : 15
Trains : 0050
Rest : 240

The unit will fire
50 pulse trains of
25 pulses each, with a
4 minute rest period
between trains for a total of
1250 pulses

MESSAGE APPEARS WHEN FIRING THE UNIT WITH THE LOADED SETTINGS WILL VOID THE WARRANTY

Home Menu Presets
Pulses : 25
Delay : 15
Trains : 50
Rest : 1

settings void warranty

Set Pulses and Delay, then adjust Trains and Rest.

MULTIPLE PULSE TRAINS EXCEED DUTY CYCLE

Pulse train settings that exceed the duty cycle of 200 pulses in a 4 minute period will result on the following:

Home Menu Presets
Pulses : 25
Delay : 15
Trains : 50
Rest : 001



DUTY CYCLE
Settings exceed duty cycle (200 / 4 min)
Continue?
YES no

WARRANTY
Firing X-ray unit with current settings may void warranty
Continue?
yes NO

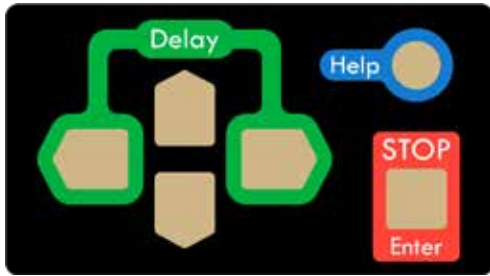
CANCELLING SETS
TRAINS = 1
REST = 240

Home Menu Presets
Pulses : 25
Delay : 15
Trains : 1
Rest : 240

Operator may manually adjust settings and try again

MENU SCREEN

Home	Menu	Presets
Life Pulses:	555	
Pulse Count 1:	312	
Pulse Count 2:	276	
Duty Warning	On	
Failsafe	On	
More Settings		



USE THE ARROW KEYS TO SELECT THE MENU, THEN PRESS ENTER TO NAVIGATE

LIFETIME PULSES

The total number of pulses the unit has sent. This is for informational purposes and cannot be reset in the field.

RESET PULSE COUNTERS

The unit has 2 resettable counters like the trip odometer in a car. Arrow down and press Enter to reset.

Operator can use this feature to track number of pulses since the last tube replacement, number of pulses used on a specific job, or any other event the operator wants to track.

Home	Menu
Life Pulses:	555
Pulse Count 1:	312
Pulse Count 2:	276
Duty Warning	On
Failsafe	On
More Settings	

DISABLE DUTY CYCLE WARNING

This setting allows the operator to disable the duty cycle warning. This is necessary for some DR imaging systems. Leaving the duty cycle warning enabled may interfere with normal operating parameters on these systems.

Home	Menu
Life Pulses:	555
Pulse Count 1:	0
Pulse Count 2:	276
Duty Warning	Off
Failsafe	On
More Settings	

DISABLE FAILSAFE CIRCUIT

Disabling the failsafe circuit may be necessary if the Check Warning LED error message is displayed but the LED is actually working. This will allow the unit to continue operating but service may be required. Contact Golden Engineering.

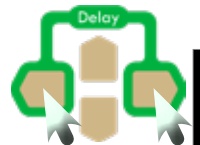
Home	Menu
Life Pulses:	555
Pulse Count 1:	0
Pulse Count 2:	276
Duty Warning	On
Failsafe	Off
More Settings	

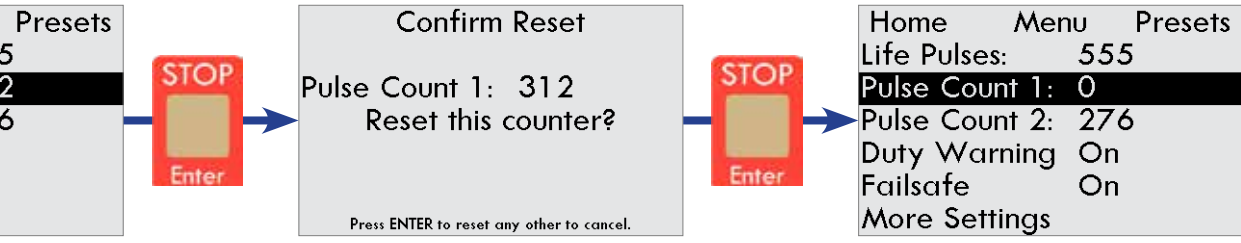
DUTY CYCLE EXAMPLE

Home	Menu	Presets
Pulses :	199	
Delay :	15	
Trains :	1	
Rest :	60	

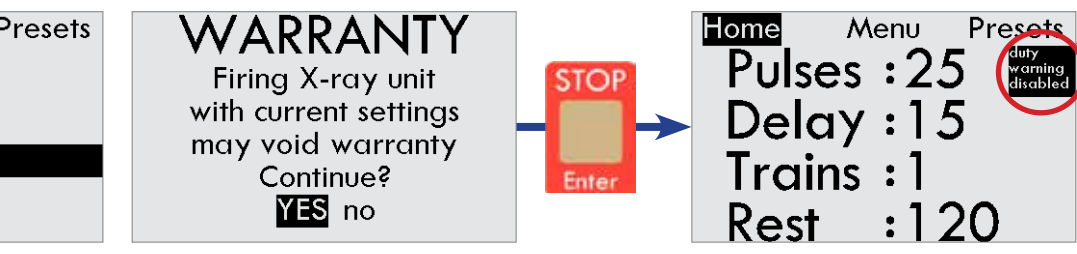


Home	Menu	Presets
Pulses :	30	
Delay :	15	
Trains :	1	
Rest :	60	

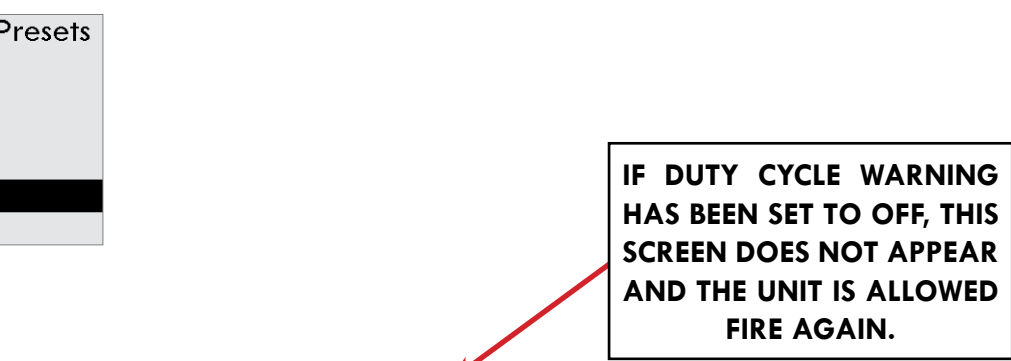




Press ENTER to reset this counter.
Press any other key to keep the count and return to the menu screen.



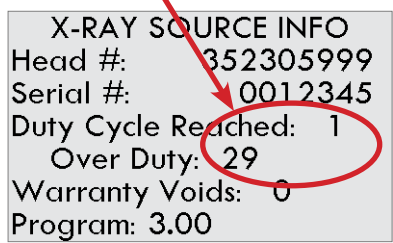
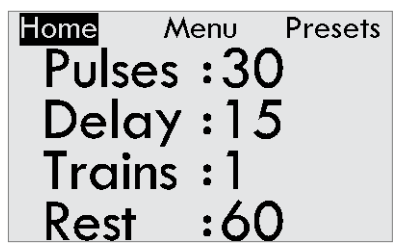
MESSAGE APPEARS WHEN DUTY WARNING HAS BEEN DISABLED.



THE UNIT TRACKS THE NUMBER OF TIMES THE DUTY CYCLE HAS BEEN REACHED, AND THE TOTAL OVER-DUTY PULSES.



DUTY CYCLE
Maximum Duty Cycle has been reached.
Please let unit rest before firing again.
Call +1 (765) 855-3493 for help



X-RAY SOURCE INFORMATION

Displays information about the head number, serial number, and software version of the unit. This is for informational purposes and cannot be edited in the field.

Home	Menu	Presets
X-Ray Source Info		
Display Settings		
Feedback	Pulse	
Remote	Single	

X-RAY SOURCE INFO	
Head #:	352305999
Serial #:	0012345
Duty Cycle Reached:	1
Over Duty:	29
Warranty Voids:	0
Program:	3.00

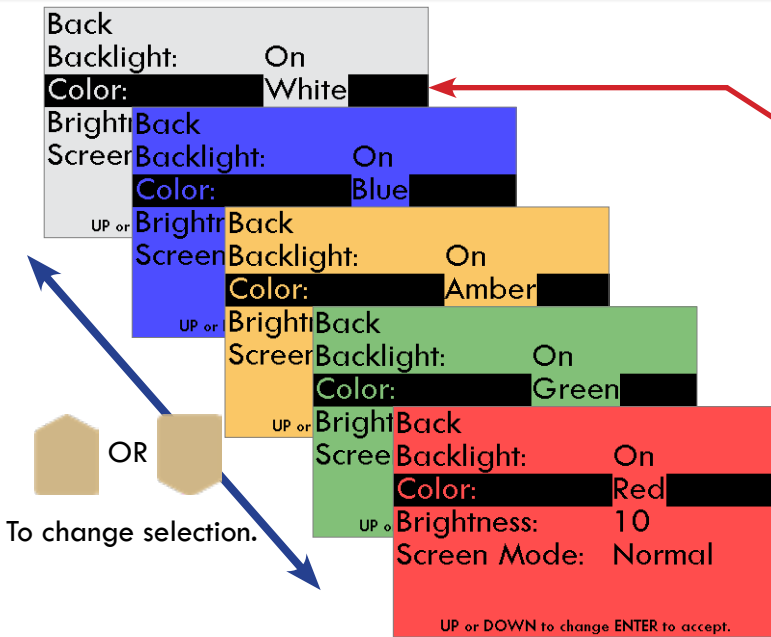
DISPLAY SETTINGS

Displays information about the head number, serial number, and software version of the unit. This is for informational purposes and cannot be edited in the field.

Home	Menu	Presets
X-Ray Source Info		
Display Settings		
Feedback	Pulse	
Remote	Single	

Back	
Backlight:	On
Color:	White
Brightness:	10
Screen Mode:	Normal

Use the Display Settings section to customize the screen. Choose the background color and brightness, or turn the light off. The display is daylight viewable without the light on, and it will remain off during countdown and firing.



Back	
Backlight:	On
Color:	White
Brightness:	9
Screen Mode:	Normal

Back	
Backlight:	On
Color:	White
Brightness:	10
Screen Mode:	Normal

Back	
Backlight:	On
Color:	White
Brightness:	10
Screen Mode:	Normal

Example of the Home screen in Inverted mode.

Home	Menu	Presets
Pulses : 25		
Delay : 15		
Trains : 1		
Rest : 240		

Back	
Backlight:	On
Color:	White
Brightness:	10
Screen Mode:	Inverted

UP or DOWN to change ENTER to accept.

Back	
Backlight:	On
Color:	White
Brightness:	10
Screen Mode:	Normal

FEEDBACK MODE SETTING

Select Per Pulse to send the feedback signal on the cable for every pulse (every pulse is counted).
 Select On/Off to send a "TRUE" signal (+5V) for the duration of a pulse train.

Home	Menu	Presets
X-Ray Source Info		
Display Settings		
Feedback	Pulse	
Remote	Single	

REMOTE CABLE SETTING

This setting affects the NO DELAY pin in the remote cable. Normal operation of the remote cable completely ignores the Trains setting and will only fire one train of pulses.
 If the operator wants to fire multiple trains using the remote cable or remote robot integration through the NO DELAY pin, set the Remote setting to Multiple.

Home	Menu	Presets
X-Ray Source Info		
Display Settings		
Feedback	Pulse	
Remote	Single	

Home	Menu	Presets
Pulses : 50		
Delay : 15		
Trains : 3		
Rest : 240		

Single: Fire a single train of pulses. The TRAINS setting is ignored. The unit will only pulse *while the remote cable button is pressed*. Releasing the button stops firing. In order to fire the trains specified on the home screen, use the Delay buttons on the top plate.

Home	Menu	Presets
X-Ray Source Info		
Display Settings		
Feedback	Pulse	
Remote	Multiple	

Home	Menu	Presets
Pulses : 50		
Delay : 15		
Trains : 3		
Rest : 240		

Multiple: Fire the number of Trains set in the home screen (even if it is set to 1 train) with a single press and release of the button. Press and release the button a second time to cancel and stop firing.
Firmware 4.01 and above: the home screen will display the "remote multiple enabled" message.

SIDE EFFECT OF REMOTE CABLE SETTING WITH IMAGING SYSTEMS

Important Note: When the Remote Cable setting is set to Multiple, imaging systems which use the physical remote NO DELAY input pin may have compatibility issues. Triggering the NO DELAY pin will cause the unit to execute the entire pulse train settings in the unit until any ONE of the following occurs:

- the NO DELAY pin is triggered again
- the complete pulse train has been fired
- any button on the top plate is pressed
- the unit is powered off

This may be a single long train, or multiple shorter trains. To avoid this possible issue, either place the unit in Single mode or modify the DR software to allow a second trigger of the NO DELAY pins to stop the X-ray from firing.

ERROR MESSAGES

DUTY CYCLE

Maximum Duty Cycle has been reached. Please let unit rest before firing again.

Call +1 (765) 855-3493 for help

The unit has reached the duty cycle of 200 pulses in less than 4 minutes and required a cool-down period of up to 4 minutes.

LOW BATTERY

Low battery, please replace or charge

Call +1 (765) 855-3493 for help

Battery voltage is at or below 15V. It is not recommended to leave the unit powered on once this message is displayed.

WARNING LED

Failsafe warning LED fail. Disable failsafe in Settings and try again.

If problem persists
Call +1 (765) 855-3493 for help

The failsafe warning LED is not lighting up. The control board may need to be replaced or the unit may need to be returned for service. Operation may continue by disabling the failsafe circuit. See Disabling Failsafe in the EXTRA SETTINGS section.

NO PULSE

IN 1 SEC
No pulse detected within one second of previous pulse.

Call +1 (765) 855-3493 for help

The unit has not detected a pulse within the past second. The battery may be low or there may be a problem with the oscillator circuit or another problem in the head. Try using a new, unused, fully charged battery. If the problem persists the unit should be returned for service.

NO FEEDBACK

No feedback signal detected from internal capacitor.

Call +1 (765) 855-3493 for help

The controller is not detecting the feedback signal. Try using a new, unused, fully charged battery. If the problem persists, the unit will not pulse and must be returned for service.

The control board is not receiving power. This may be a dead battery (try charging or replacing it). The ribbon cable connecting the oscillator board to the control board may be disconnected. Remove the control panel and verify or correct the issue.

Current settings:
5 Trains of
100 Pulses
Continue with these settings?
yes **NO**

The unit was powered off with 5 pulse trains set. Select YES to continue with the multiple pulse trains. Select NO to set the trains back to 1 and time between to 240. The number of pulses is not reset, only the trains and time between.

SYMPTOM	TEST	ACTION
Unit makes loud popping noise while pulsing.		Stop and return unit for repair. Continued use in this condition will cause additional damage to the unit.
Oil leaking from unit.	Remove oil from surface and see if it returns.	If oil returns, send unit back for repair.
No “power on” light	Check battery voltage Check battery connection	Replace or charge battery Ensure battery is securely attached and battery clips are not bent or broken.
Power on lights, but X-ray does not pulse.	Check the battery voltage. Check the oscillator fuse.	Charge or replace the battery. Replace the fuse if necessary. Repeated blown fuses indicate a real problem and the unit should be returned for repair. Use Littelfuse Low Profile MINI Blade Fuse or equivalent. XR150 - replace with 20A fuse XR200, XRS3, XRS4 - replace with 30A fuse
Power on lights, X-ray pulsing light does not illuminate, X-ray does not pulse	Check the battery voltage.	Go to settings menu failsafe disable To fix light replace processor board
Low Battery Please Charge	Appears if battery is below 15V	Charge the battery
X-ray pulses, but no image or black image.	Test X-ray output.	Return unit for tube replacement if no X-ray output dose.
XR200 Unit pulses once regardless of pulse setting. Unit pulses fewer times than expected. Pulses are not added to Life Pulse Count.	This condition may occur after changing a tube. Check tightness of collimator cap.	Hand tighten collimator as tight as it will go. DO NOT USE A WRENCH If problem continues, contact Golden Engineering for further diagnosis.

INSTRUCTIONS FOR REPAIR

DISASSEMBLY INSTRUCTIONS

In some cases it may be necessary to disassemble an X-ray generator to replace a board, or to isolate the head to return just that part for service.

Follow these instructions to complete the disassembly process.

REMOVING THE CONTROL MODULE

Keep track of where each of the screws came from as you disassemble the unit. They are all T10, but have different thread and length



WARNING

Risk of electric shock
Remove battery before
disassembling X-ray generator

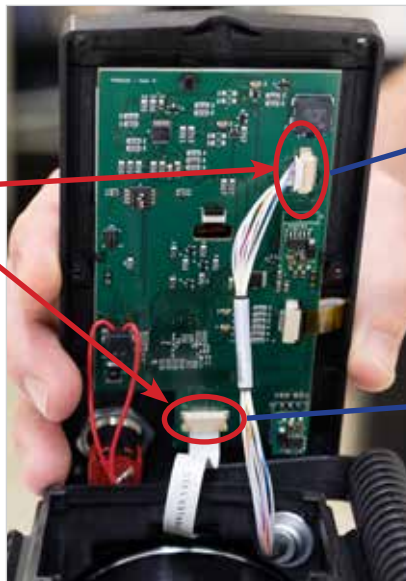


Use T10 Torx driver to remove 6 screws holding control module in place.

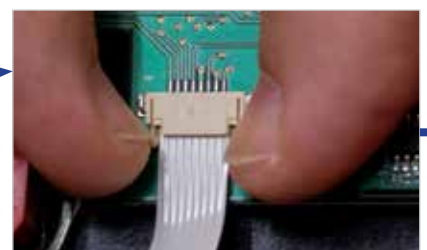


Gently pry the front of the control module with a flat screwdriver.

Disconnect the LEMO cable and the ZIF Ribbon.
These two wires will be disconnected.



Remove the LEMO cable first



Remove the ZIF ribbon second



Lift the top plate from the front (nose) of the unit.



Tip the plate toward the battery to expose the wires.



The Control Module is removed.

When installing the ZIF ribbon cable, ensure the cable is fully seated and the connector retaining tabs are pushed all the way in.



REMOVING THE HEAD

In some cases it may be necessary to disassemble an X-ray generator to replace a board, or to isolate the head to return just that part for service.

Follow these instructions to complete the disassembly process.

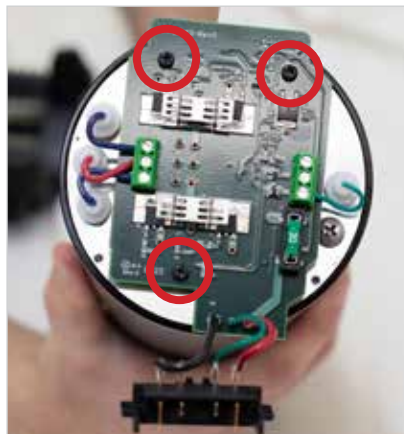


Remove the screws that hold the housing together
XR200 and XRS3 both have 8 screws;
XRS4 has 7 in the main body, plus another 8 in the handle



Remove one side of the housing.
Lift out the head and oscillator board assembly.
When reassembling, ensure the brass tripod inserts and battery terminals are seated properly.

Keep track of where each of the screws came from as you disassemble the unit. They are all T10, but have different thread and length



Remove the three screws that connect the oscillator board to the head.



Remove the oscillator board.



Loosen the four screws that hold the feedthrough wires in place.



It may require pliers to grip the wires.



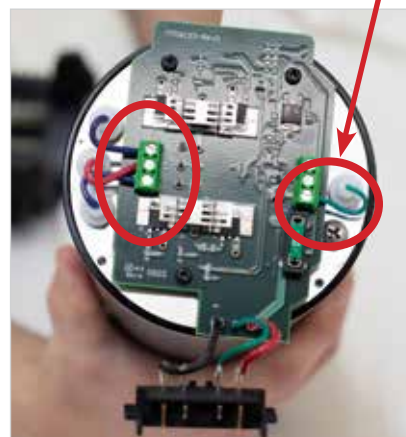
Feedthrough wires removed.

SAVE THESE 3 SPACERS. THEY WILL BE LOOSE WHEN THE BOARD IS REMOVED.



Head is now isolated and can be returned for service.

GREEN WIRE GOES ON THE BOTTOM TERMINAL



When reassembling the oscillator board to the head, note the position of the feedthrough wires.

SPECIFICATIONS

PHYSICAL DIMENSIONS INCLUDING BATTERY PACK		
MODEL	XRS3MD	XRS4MD
LENGTH (with battery)	15.42 in (39.17 cm)	19.26 in (48.92 cm)
WIDTH (with picatinny rails)	4.26 in (10.82 cm)	4.80 in (12.19 cm)
HEIGHT (without key)	5.83 in (14.81 cm)	7.05 in (17.91 cm)
WEIGHT (with battery)	11.80 lb (5.40 kg)	18.30 lb (8.30 kg)
X-RAY OUTPUT		
X-ray dose per pulse (12 inches in front of unit)	2 mR to 4 mR	4 mR to 8.5 mR
	0.4 mR to 0.86 mR	1.5 mR to 3.2 mR
Pulses per battery charge	5500	3000
Pulses per second	15 (Nominal)	9 (Nominal)
Expected tube life (glass tube)	100,000 pulses	50,000 pulses
X-ray source size	1/8 in. (3mm)	1/8 in. (3mm)
Maximum Photon Energy	270 kVp	370 kVp
Output Power	67.5 W	92.5 W
X-ray pulse width (FWHM)	25 nanoseconds	10 nanoseconds
ELECTRICAL AND THERMAL CHARACTERISTICS		
Battery voltage	18-20 V	18-20 V
Battery type	Li Ion	Li Ion
Battery recharge time	1 Hour	1 Hour
Current draw	20A @ 18-20 V	13A @ 18V
Average X-ray Tube Current	0.25 mA	0.25 mA
Storage Temperature	-4° to 158° F (-20 to 70° C)	-4° to 158° F (-20 to 70° C)
Operating Temperature	-4° to 158° F (-20 to 70° C)	-4° to 158° F (-20 to 70° C)
Maximum duty cycle	200 pulses every 4 min (3000 pulses per hour)	200 pulses every 4 min (3000 pulses per hour)
High Temperature or High Use Duty Cycle	Rest 30 sec every 50 pulses and 4 min every 200 pulses	Rest 30 sec every 50 pulses and 4 min every 200 pulses
IP Rating	IP 54	IP 54
Minimum Standby Time	10 hours	10 hours
Warm-up	None required	None required

* output and characteristic measurements are nominal based on fully charged battery

FWHM = Full Width Half Max value of a pulse

ITEM	PART NUMBER	
Thumbwheel Key	2002000	
Flat key	5951020	
DeWalt® Battery 20V DCB203 (2 Ah)	1800106	
DeWalt® Battery Charger (110V) DCB115	1800151	
DeWalt® Battery Charger (220V) DCB115	1800164	
7-Pin K Remote Cable	1809030	
ADAPTER CABLE (5 PIN K PLUG / 5 PIN B RECEPTACLE)	1809023	
ADAPTER CABLE (5 PIN K PLUG / 4 PIN B RECEPTACLE)	1809024	
ADAPTER CABLE (5 PIN K PLUG / 7 PIN K RECEPTACLE)	1809033	
ADAPTER CABLE (7 PIN K PLUG / 5 PIN B RECEPTACLE)	1809031	
ADAPTER CABLE (7 PIN K PLUG / 5 PIN K RECEPTACLE)	1809032	
ADAPTER CABLE (7 PIN K PLUG / 4 PIN B RECEPTACLE)	1809034	
	XRS3MD	XRS4MD
Tripod Mount	4000352	-
Carrying case (holds X-ray, 2 batteries, charger, cable)	1701558	1701684
Handle	4000005	4000035 R
		4000045 L
Replacement Tube	-	-
10 MIL SNAP ON COPPER FILTER	1800210	-
20 MIL SNAP ON COPPER FILTER	-	1800291
30 MIL SNAP ON COPPER FILTER	1800230	1800292
40 MIL SNAP ON COPPER FILTER	1800240	1800293
60 MIL SNAP ON COPPER FILTER	1800260	1800294
LEAD COLLIMATOR CAP SOLID	1800265	1800299
LEAD COLLIMATOR CAP 20 degree	1800281	1800286
LEAD COLLIMATOR CAP 30 degree	1800282	1800287
LEAD COLLIMATOR CAP Rectangle	1800283	-

EC DECLARATION OF CONFORMITY

This declaration of conformity is issued under the sole responsibility of the manufacturer

MANUFACTURER

Company name: Golden Engineering, Inc.
 Full address: 6364 Means Rd
 Postal code: 47330
 Place: Centerville, IN
 Country: USA

EUROPEAN AUTHORISED REPRESENTATIVE

Which is established in the European Union and has access to the Technical File

Company name: Certification Experts
 Full address: Nieuwstad 100
 Postal code: 1381 CE
 Place: Weesp
 Country: The Netherlands

DESCRIPTION AND IDENTIFICATION OF THE EQUIPMENT

Generic name: XRS3 X-ray Generator
 Function: Take X-ray imagines of inanimate objects
 Model: XRS3
 Serial number range: 8.250 - 25.000
 Commercial name: XRS3 X-ray Generator

COMPLIANCE

The manufacturer declares that the above mentioned equipment fulfills all relevant provisions of


EMC Directive 2014/53/EU Low Voltage Directive 2014/35/EU
 RoHS Directive 2011/65/EU

In conjunction with the following harmonised standards and where appropriate other technical standards and specifications for the risk assessment

EN-ISO 12100:2010
 for the design and manufacture

IEC 61236-1:2012, IEC 61000-4-2:2009, IEC 61000-4-3:2006/A1:2007/A2:2010,
 IEC 61000-4-4:2004/A1:2010, IEC 61000-4-6:2008, EN 50811:2012

Place: Centerville, IN Name: Roger Golden
 United States of America Function: President

Date: December 7, 2017 Signature: 

EU DECLARATION OF CONFORMITY

The EU Declaration of Conformity is issued under the sole responsibility of the manufacturer

MANUFACTURER

Company name: Golden Engineering, Inc.
 Full address: 6364 Means Rd
 Postal code: 47330
 Place: Centerville, IN
 Country: United States of America

EUROPEAN AUTHORISED REPRESENTATIVE

Which is established in the European Union and has access to the Technical File

Company name: Certification Experts
 Full address: Herengedweng 7
 Postal code: 3621 ZC
 Place: Breukelen
 Country: The Netherlands

DESCRIPTION AND IDENTIFICATION OF THE EQUIPMENT

Generic name: XRS3 X-ray Generator
 Function: Examination of objects (hardware)
 Model: XRS3
 Serial number range: 920 - 10.000
 Commercial name: XRS3 X-ray Generator
 Year in which the CE marking was affixed: 19

COMPLIANCE

The manufacturer declares that the above mentioned equipment fulfills all relevant provisions of

EMC Directive 2014/53/EU
 Low Voltage Directive 2014/35/EU
 RoHS Directive 2011/65/EU

In conjunction with the following harmonised standards and where appropriate other technical standards and specifications

EN-ISO 12100:2010, IEC 61236-1:2012, IEC 61000-4-2:2009, IEC 61000-4-3:2006/A1:2007/A2:2010,
 IEC 61000-4-4:2004/A1:2010, IEC 61000-4-6:2008, EN 50811:2012

Place: Centerville, IN Name: Roger Golden
 United States of America Function: President

Date: June 12, 2019 Signature: 

Golden Engineering, Inc. warrants XR150-20V XR200, XRS3, and XRS4 X-ray units made and sold by it or its authorized representatives to be free of **defects in materials and workmanship** for a period of twelve (12) months from the date of shipment to the end user. **Warranty does not cover maintenance required due to life.** To make a claim under this limited warranty, customer must ship the entire unit (or the component believed to be defective) to Golden Engineering, post-paid. Golden Engineering, Inc. assumes no liability for units or components shipped until they are actually in the custody of Golden Engineering, Inc. Provided Golden Engineering, Inc. in its sole discretion, is satisfied that the failure is not the result of excessive use, abuse, misuse, accident, modification or improper disassembly or repair, Golden Engineering will provide parts and labor required to repair the unit. Golden Engineering reserves the right to use reconditioned and remanufactured components that meet original specifications. The unit or component will be returned and shipped to customer at customer’s expense. THIS EXPRESS LIMITED WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES AND GUARANTEES, EITHER EXPRESS OR IMPLIED OR CREATED BY OPERATION OF LAW.

INSTRUCTIONS FOR TRANSPORTATION, STORAGE, AND DISPOSAL

The X-ray generator is shipped in a rigid case or strong fiberboard box with custom foam insert. When transporting, remove the battery pack and transport in a rigid case or fiberboard box with sufficient cushioning. Store the X-ray generator in a dry environment within temperature ranges within in the specifications. For disposal remove the tube and follow all applicable environmental laws. Alternatively, the X-ray generator may be returned to Golden Engineering for proper disposal.

BATTERY DISPOSAL

Follow all federal, state, and local laws for disposal of lithium-ion batteries. Batteries may be returned to Golden Engineering for proper disposal.

RETURNING UNIT FOR REPAIR

Complete the repair form at www.goldenengineering.com/technical.html and include a copy of the printed form with the repair. If you do not have internet access prior to sending repair then include a letter containing a brief description of the problem, contact name, phone number, and return address.

- Remove battery before shipping the unit.
- Accessories are not necessary with units shipped back for repair.
- Be sure the unit is securely packaged for shipment and seal in plastic bag if there is an oil leak.

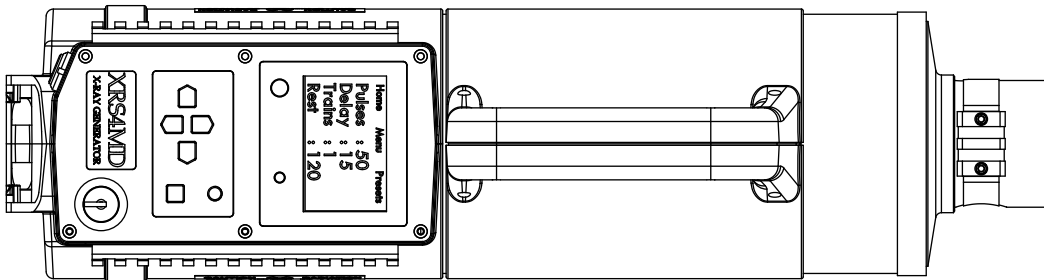
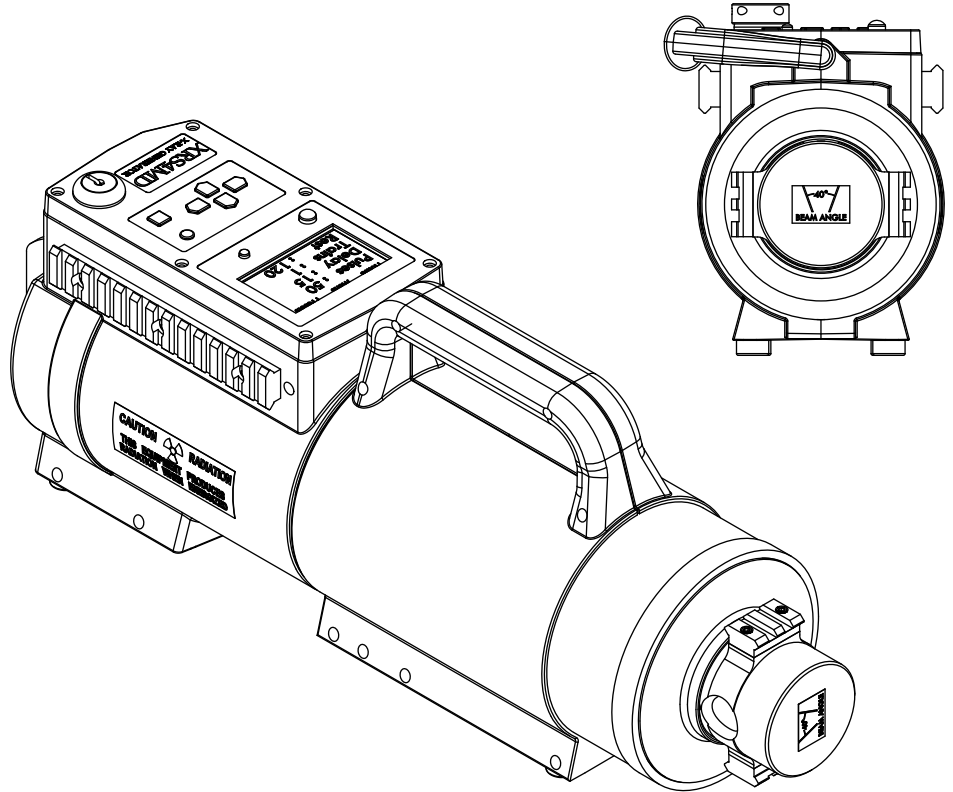
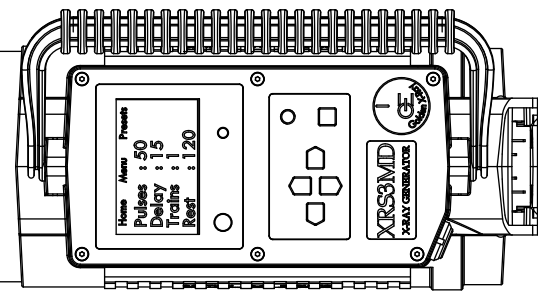
Manufactured by:
 GOLDEN ENGINEERING, INC.
 6364 Means Road, Box 185
 CENTERVILLE, IN 47330 USA
Phone: 1-765/855-3493
Fax: 1-765/855-3492
Web: www.goldenengineering.com
Email: service@goldenengineering.com

European Representative:
 Certification Experts Europe
 Nieuwstad 100
 1381 CE Weesp,
 The Netherlands

Country of Origin	USA	
Model	XRS3MD	XRS4MD
Serial Number		
Delivery Date		

Celebrating 50 Years

of supplying quality products,
 providing extraordinary service,
 improving portable X-ray technology,
 and being family-owned and operated.



Golden Engineering, Inc.
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 Centerville, IN 47330 USA
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