

X-RAY

18-20V X-RAY GENERATORS

OPERATOR'S
MANUAL

XRS4

XRS3

XR200

XR150



JUNE 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.

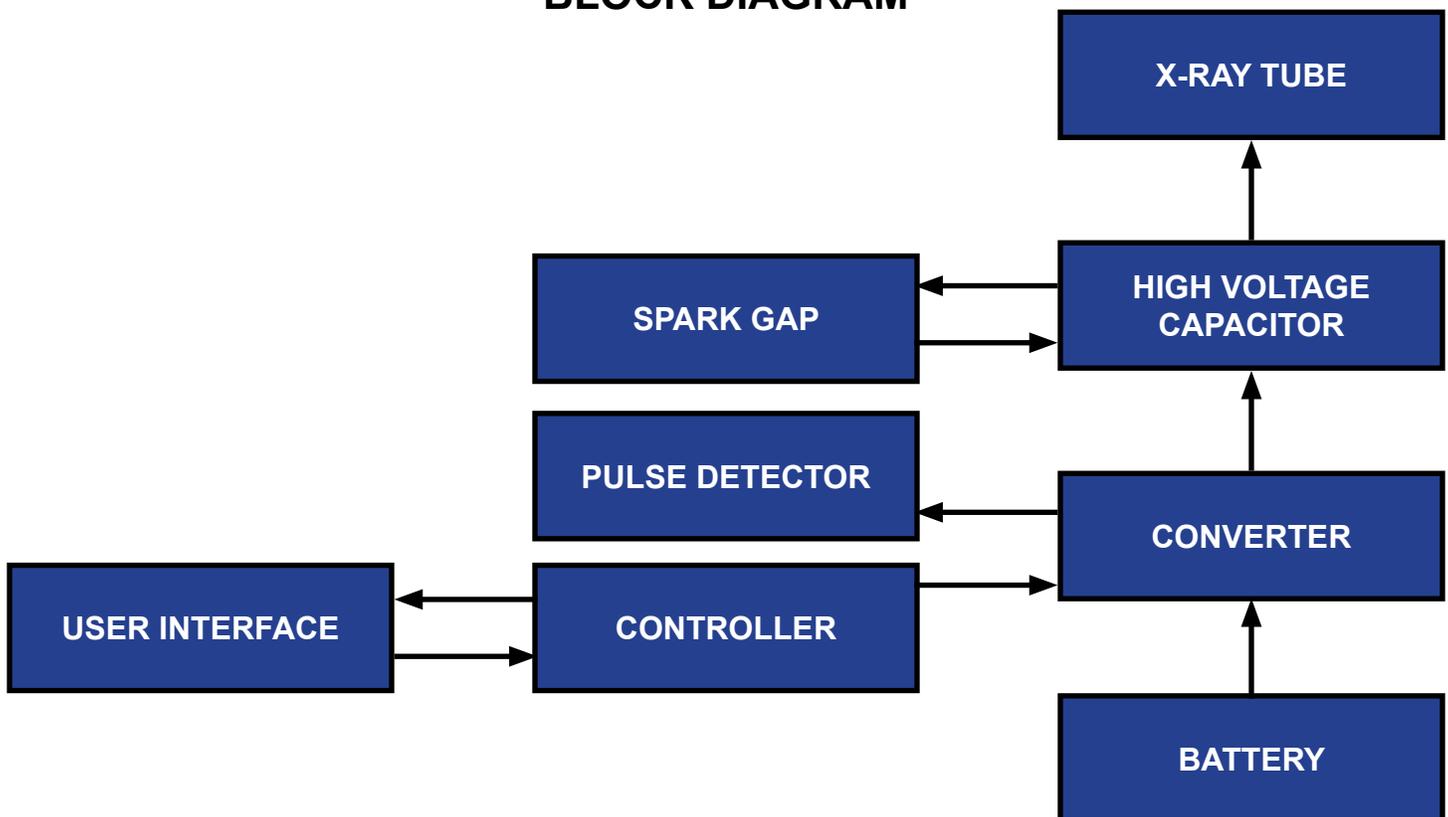
The closing of the High Voltage Switch produces an audible pulsing sound. The X-ray generator cannot produce X-rays without the pulsing sound so it serves as an additional warning the unit is functioning.

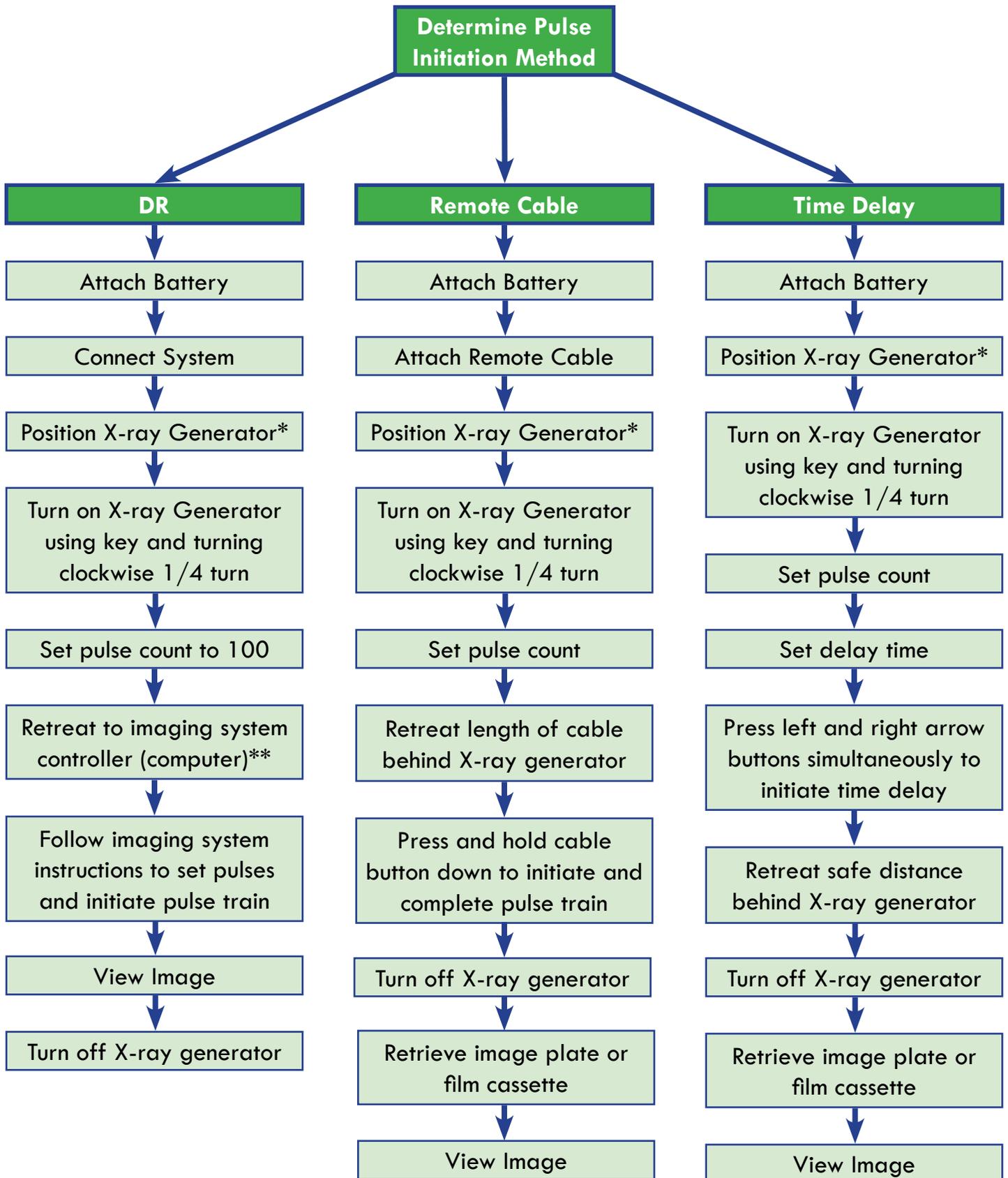
This unit generates X-rays through high voltage bombardment of a tungsten target.

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.

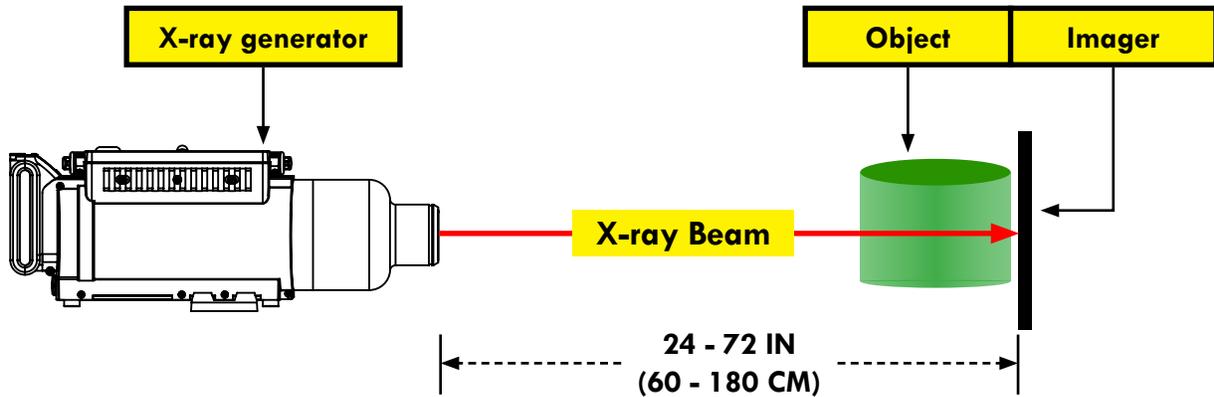
BLOCK DIAGRAM



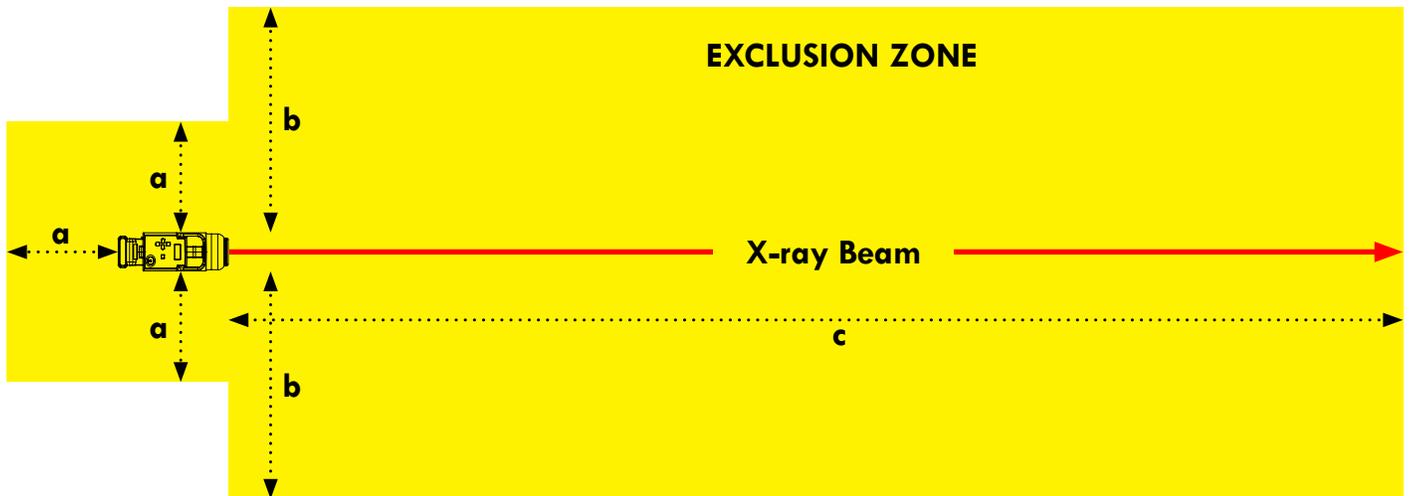


The following are basic operation instructions to take an X-ray image using the X-ray generator. Certain applications may require modifications to these basic procedures.

* 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.



** 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.

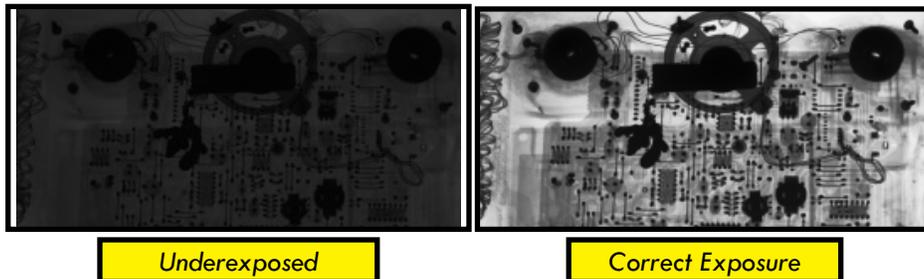


	XR150-20V	XR200	XRS3	XRS4
a	10' (3 m)	10' (3 m)	10' (3 m)	20' (6 m)
b	20' (6 m)	20' (6 m)	25' (7.6 m)	36' (11 m)
c	100' (30 m)	100' (30 m)	100' (30 m)	113' (35 m)

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.

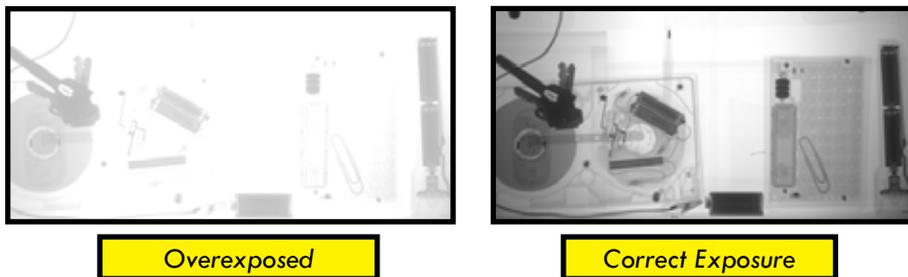
MATERIAL	PULSE SETTING			
	XR150 20V	XR200	XRS3	XRS4
Cardboard, light wood, plastic	2-5	2-5	2-5	1-2
Light metal	10	10	10	5-10
Steel ¼" (6 mm)	25	25	25	25
Steel ½" (13 mm)	50	50	50	35-40
Steel 1" (25 mm)	-	-	99	50
Steel 1½" (38 mm)	-	-	-	99
Brass ⅛" to ¼" (3-6 mm)	-	-	99	50-99

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



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**.



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

PHYSICAL DESCRIPTION

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.



XR150 20V

BEAM ANGLE LABEL



XRS3

COLLIMATOR

The standard collimator located on the front of the head limits the X-ray beam to 40 degrees. Special order collimators are available for some models.

HANDLE

The handle of the XR200 and XRS3 is attached to the front and back of the Control Module. The handle of the XRS4 is integral to the body.





XR200

BATTERY

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

REMOTE CABLE

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

PICATINNY RAIL

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

RADIATION WARNING LABEL

CONTROL MODULE

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

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. The XR150, XR200, and XRS3 come with a quick release tripod mount.



XRS4

CONTROL MODULE

BEAM ANGLE LABEL



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

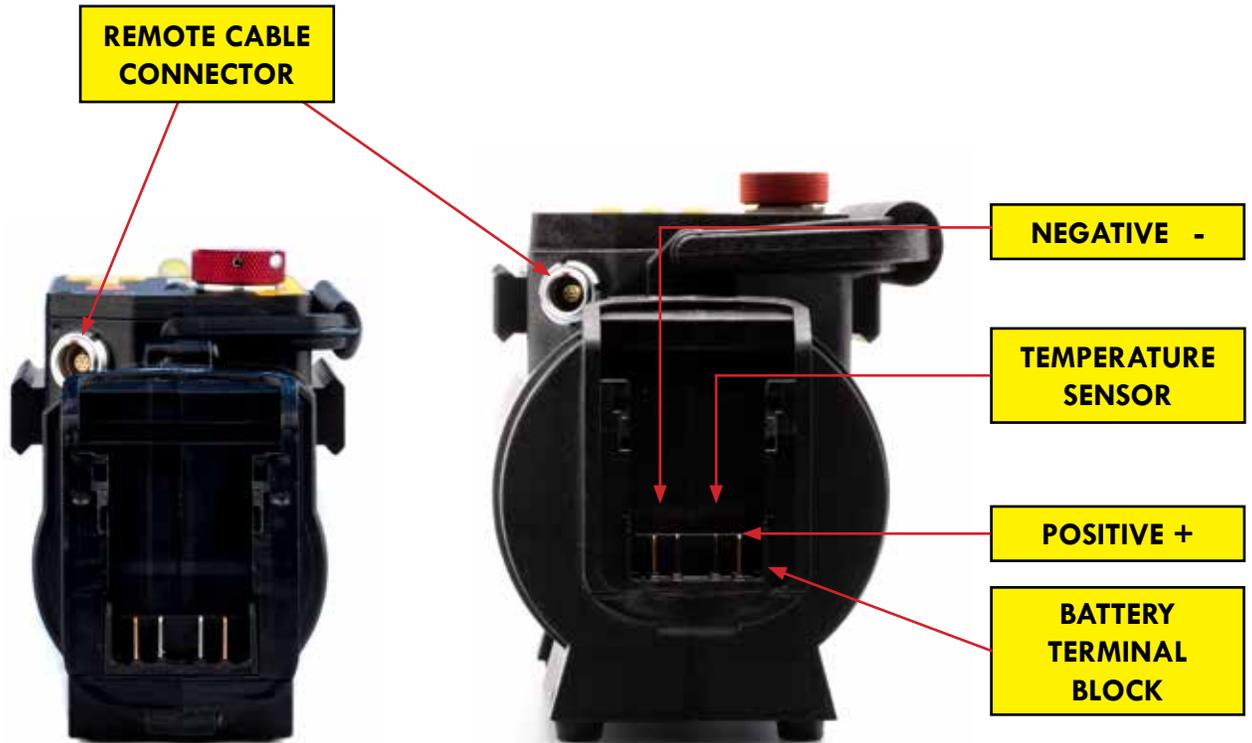


KEY

Main power switch to turn the unit on and off.

*Top View
Control Module*





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



XRS3 - bottom



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. The XR150 is available with a quick release tripod mount.



**QUICK RELEASE
TRIPOD MOUNT**



**TRIPOD MOUNT
RELEASE TAB**

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.

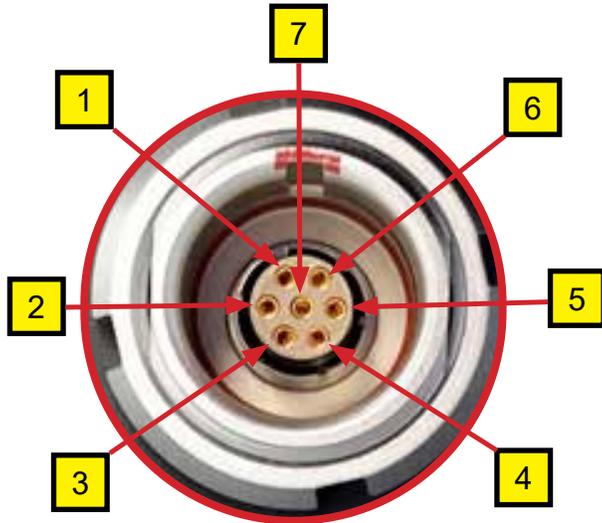


XR150-20V - bottom

REMOTE CABLE CONNECTOR

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.



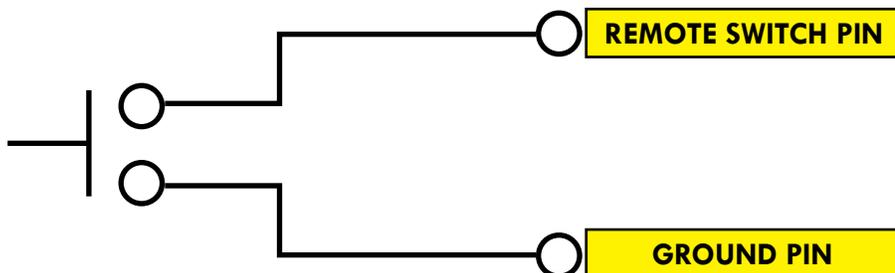
7 PIN K REMOTE CABLE CONNECTOR



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.



Remote switch inputs are activated when connected to ground pin.

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

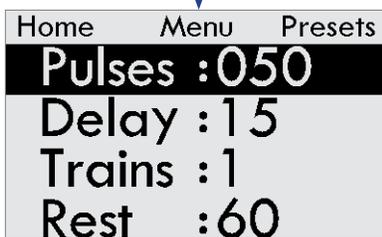
HOME SCREEN - PULSES, DELAY, TRAINS



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.

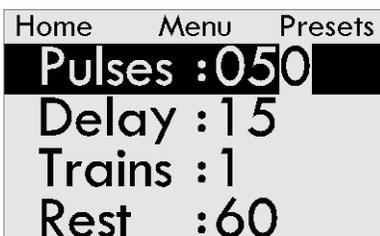


to switch to edit mode.

BASIC NAVIGATION

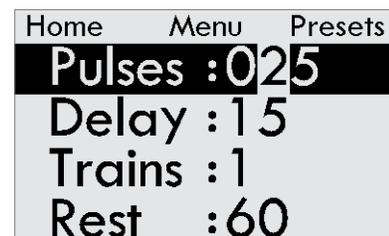
Press LEFT or RIGHT to change position. The highlighted character has the focus. Press ENTER to select - cursor will invert foreground and background colors. Press UP or DOWN to change value of the selected character. Press ENTER to accept.

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



to change cursor position

to change value

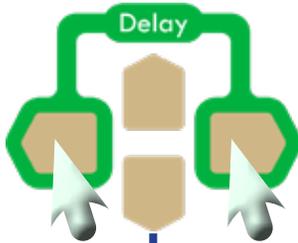


to accept

BASIC OPERATION - FIRING FROM THE CONTROL MODULE

Home Menu Presets
Pulses : 50
Delay : 15
Trains : 1
Rest : 120

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.

Firing in:
15
Press any button to cancel

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.

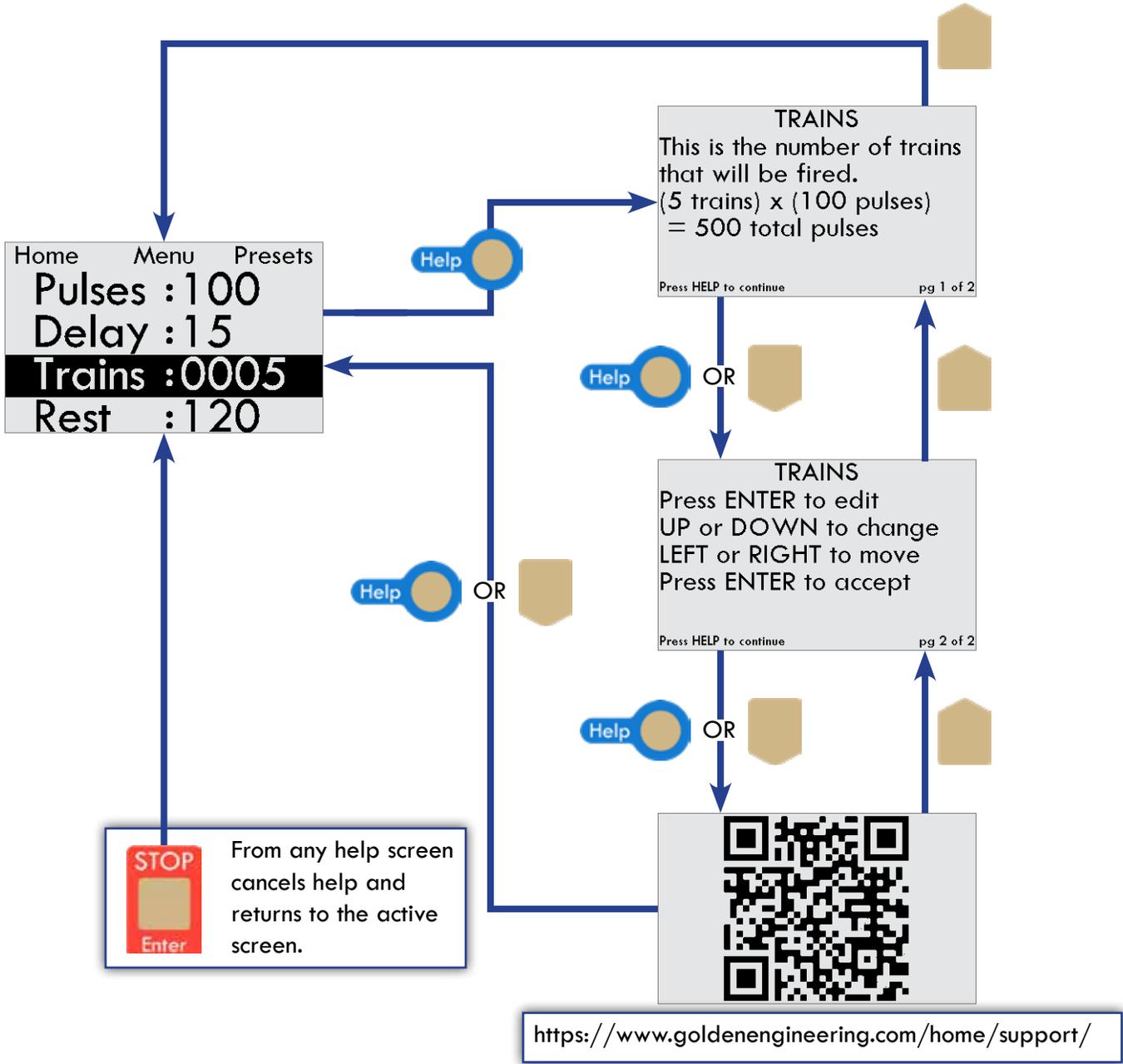
FIRING
Press any button to cancel

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

Home Menu Presets
Pulses : 50
Delay : 15
Trains : 1
Rest : 120

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

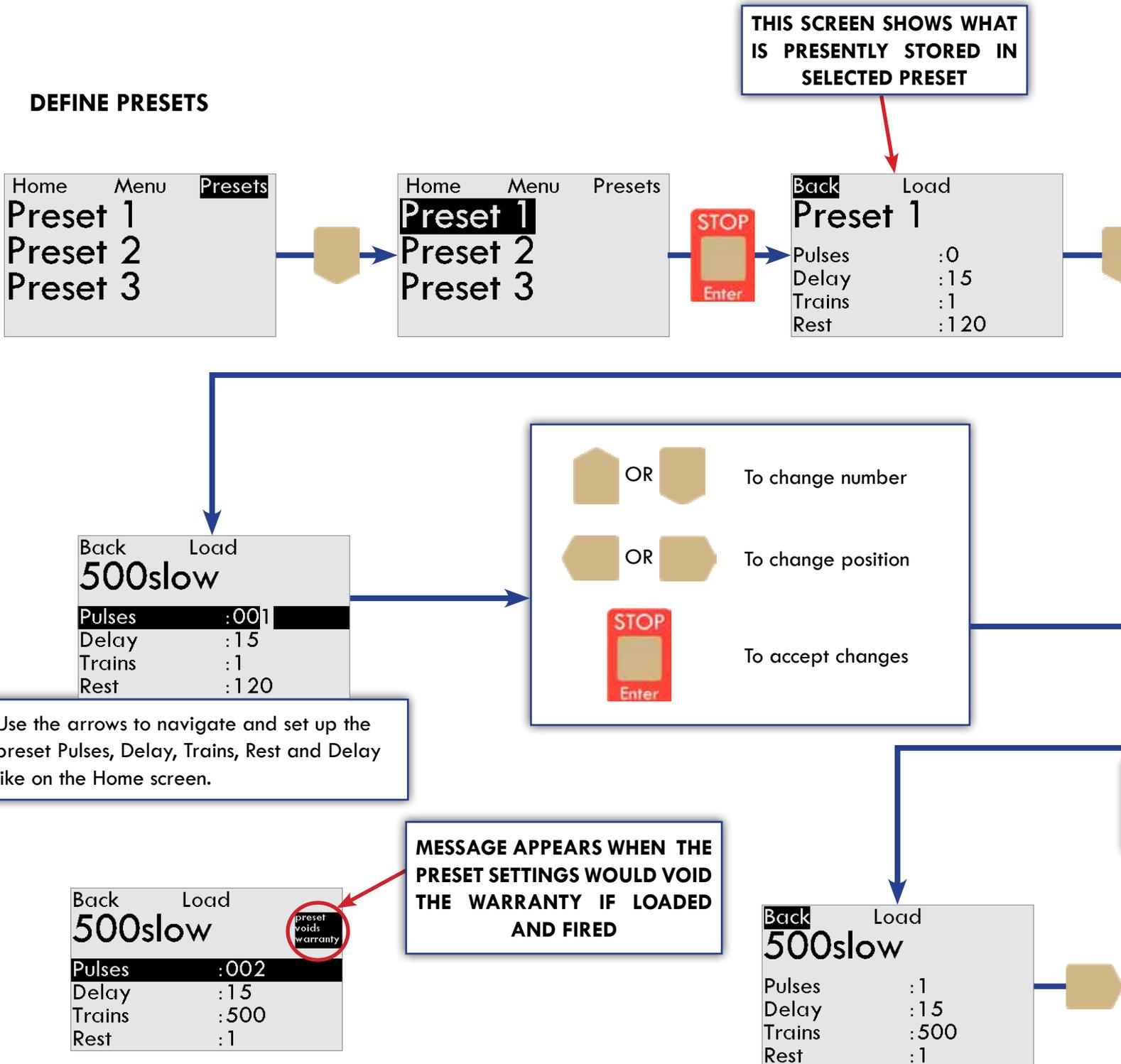
NAVIGATING THE MENU

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



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.

```

Home  Menu  Presets
Pulses :500
Delay :15
Trains :1
Rest :60
    
```



```

SPLIT PULSES
Pulse count
greater than 200.

Split into multiple trains?
YES no
Call +1 (765) 855-3493 for help
    
```



Split Pulses
Select YES and press enter to split the 500 pulses into 10 trains of 50 with a rest period of 60 seconds between trains.
Press HELP to continue pg 1 of 2

Split Pulses
Select NO and press enter to keep the long train of 500 pulses. Continuing with this setting may void the warranty.
Press HELP to continue pg 2 of 2



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:

```

Home  Menu  Presets
Pulses :520
Delay :15
Trains :1
Rest :60
    
```

```

SPLIT PULSES
Pulse count
greater than 200.

Split into multiple trains?
YES no
Call +1 (765) 855-3493 for help
    
```

```

Split Mode
READY TO FIRE
520 Total Pulses
11 Total Trains
(10 x 50) + 20 pulses
Press Enter to edit
    
```

```

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

```

Home  Menu  Presets
Pulses :500
Delay :15
Trains :1
Rest :60
    
```

settings void warranty

```

Home  Menu  Presets
Pulses :50
Delay :15
Trains :10
Rest :60
    
```

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

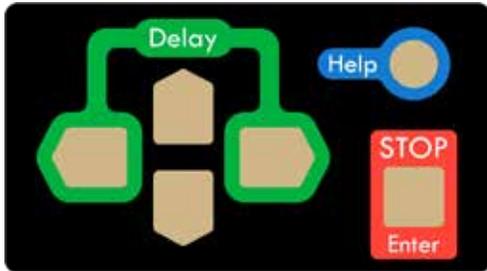
```

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.

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

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.

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.

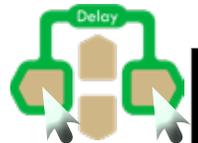
Home	Menu
Life Pulses:	555
Pulse Count 1:	0
Pulse Count 2:	276
Duty Warning	On
Failsafe	Off
More Settings	

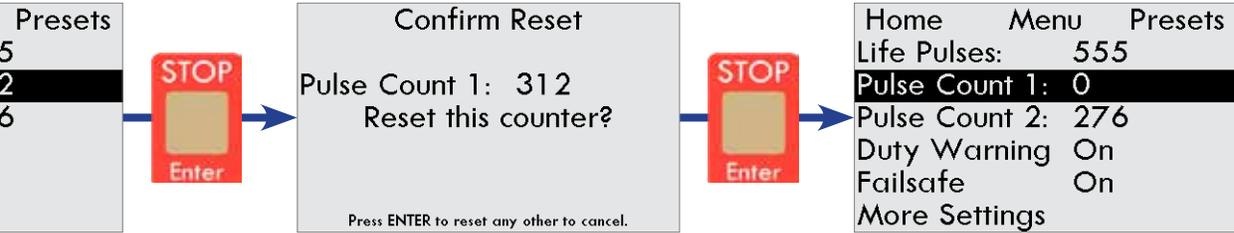
DUTY CYCLE EXAMPLE

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

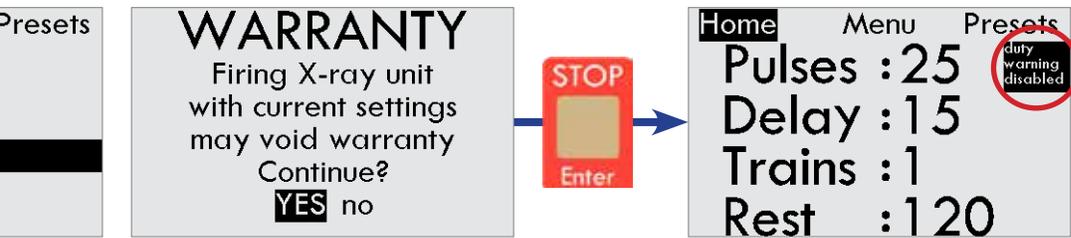


Home	Menu	Presets
Pulses :	30	
Delay :	15	
Trains :	1	
Rest :	60	

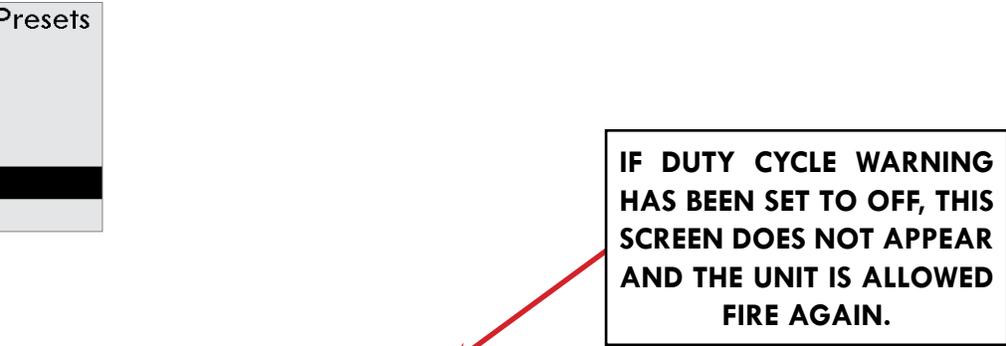




Press ENTER to reset this counter.
Press any other key to keep the count and return to the menu screen.



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.

Firing in: 15
button
FIRING
Press any button to cancel

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



```

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

```

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

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	

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. Select Single to send a single train of pulses. Select Multiple to

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

Single: Send 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.

Multiple: Send the number of Trains set in the home screen with a single press and release of the button. Press the button again to cancel and stop firing.

DISPLAY SETTINGS

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

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

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

Use the Display Settings section to customize the screen. Choose 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: 10
Screen Mode: Normal

UP or DOWN to change selection.

OR

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

UP or DOWN to change selection.

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

UP or DOWN to change selection.

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

UP or DOWN to change selection.

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

UP or DOWN to change selection. ENTER to accept.

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

UP or DOWN to change ENTER to accept.

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

Example of the Home screen in Inverted mode.

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.

MAINTENANCE

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
XR150 20V	80-140
XR200	100-200
XRS3	100-200
XRS4	200-425

The XR150 should be returned for all service needs.



TUBE REPLACEMENT

The XR200 tube should typically last 60,000 pulses or more. Under normal conditions the tube's output will decrease slowly with use. If the tube is broken or glass cracks the tube output will cease immediately. The XR200 tube can be easily replaced in the field should this become necessary, using the below procedure.



1. Remove the battery before unscrewing the collimator.
2. Unscrew the collimator.
3. Using needle nose pliers or your fingers grip the front of the tube and pull straight out.
4. Insert new tube and ensure it is properly seated.
5. Replace the collimator. It is important to ensure the collimator is screwed on tightly. **DO NOT USE A WRENCH**
6. Attach the battery and perform an X-ray dose measurement test to verify the output of the unit.



Unscrew the collimator



Grip the front of the tube and pull straight out



WARNING
Failure to tighten the collimator may lead to poor performance and interfere with the electronics.

On the XR150, XRS3 and XRS4, the head is filled with mineral oil, which requires special care for tube replacement. It is important that NO AIR is introduced into the unit during tube replacement, and a tube replacement kit must be used. The XR150 must be returned for tube replacement.

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.

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

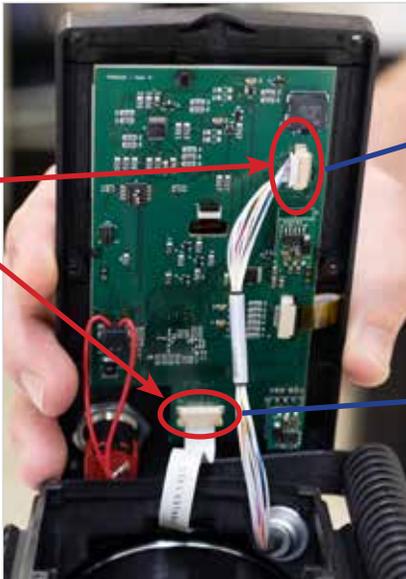


Use T10 Torx driver to remove 6 screws holding control module in place.

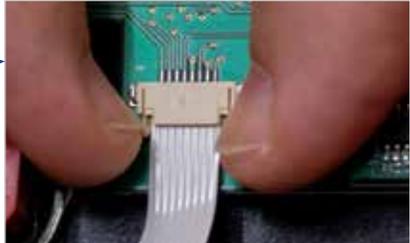
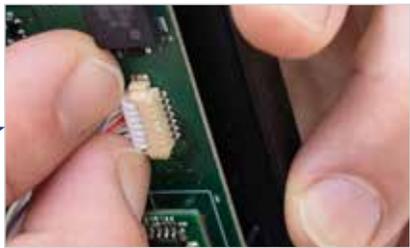


Gently pry the front of the control module with a flat screwdriver.

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



Remove the LEMO cable first



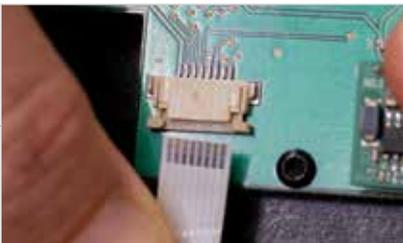
Remove the ZIF ribbon second



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

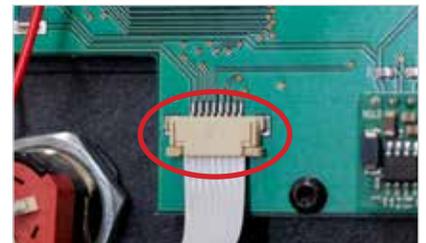


Tip the plate toward the battery to expose the wires.



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.

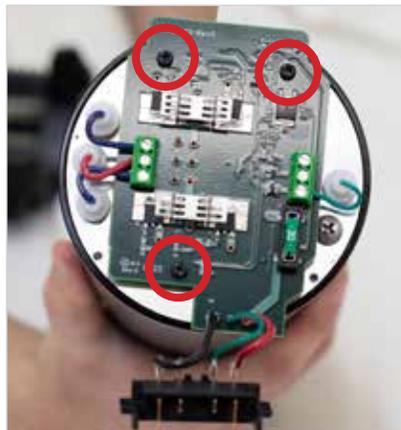


Remove the screws that hold the housing together
XR200 and XRS3 both have 8 screws;
XRS4 has 7 in the main body, plus another 8 in the
handle



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.



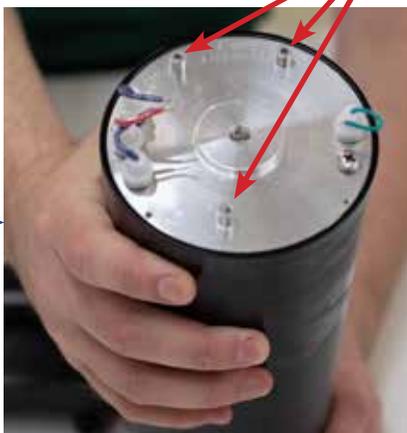
It may require pliers to grip the wires.



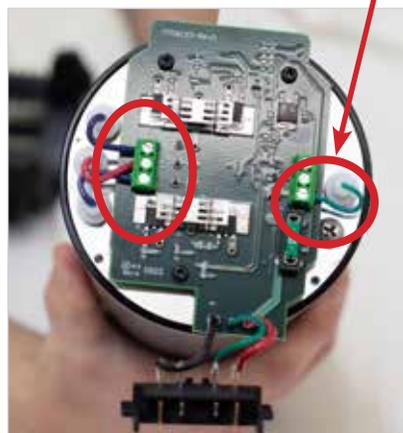
Feedthrough wires removed.

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

GREEN WIRE GOES ON THE BOTTOM TERMINAL



Head is now isolated and can be returned for service.



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

SPECIFICATIONS

PHYSICAL DIMENSIONS INCLUDING BATTERY PACK				
MODEL	XR150 20V	XR200	XRS3	XRS4
LENGTH (with battery)	10.49 in (26.65 cm)	12.17 in (30.91 cm)	15.42 in (39.17 cm)	19.26 in (48.92 cm)
WIDTH (with picatinny rails)	3.54 in (8.99 cm)	4.26 in (10.82 cm)	4.26 in (10.82 cm)	4.80 in (12.19 cm)
HEIGHT (without key)	4.71 in (11.96 cm)	5.83 in (14.81 cm)	5.83 in (14.81 cm)	7.05 in (17.91 cm)
WEIGHT (with battery)	5.7 lb (2.58 kg)	11.00 lb (5.00 kg)	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)	1.8 to 3 mR	2 mR to 4 mR	2 mR to 4 mR	4 mR to 8.5 mR
Pulses per battery charge	9000 +	6000	5500	3000
Pulses per second	11 (Nominal)	10 (Nominal)	21 (Nominal)	9 (Nominal)
Expected tube life (glass tube)	30,000 pulses	60,000 pulses	100,000 pulses	50,000 pulses
X-ray source size	1/8 in. (3mm)	1/8 in. (3mm)	1/8 in. (3mm)	1/8 in. (3mm)
Maximum Photon Energy	150 kVp	150 kVp	270 kVp	370 kVp
Output Power	75 W	75 W	67.5 W	92.5 W
X-ray pulse width (FWHM)	50 nanoseconds	50 nanoseconds	25 nanoseconds	10 nanoseconds
ELECTRICAL AND THERMAL CHARACTERISTICS				
Battery voltage	18-20 V	18-20 V	18-20 V	18-20 V
Battery type	Li Ion	Li Ion	Li Ion	Li Ion
Battery recharge time	1 Hour	1 Hour	1 Hour	1 Hour
Current draw	13A @ 18-20 V	9A @ 18-20 V	20A @ 18-20 V	13A @ 18V
Average X-ray Tube Current	0.5 mA	0.5 mA	0.25 mA	0.25 mA
Storage Temperature	-4° to 158° F (-20 to 70° C)			
Operating Temperature	-4° to 158° F (-20 to 70° C)			
Maximum duty cycle	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	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	IP 54	IP 54
Minimum Standby Time	10 hours	10 hours	10 hours	10 hours
Warm-up	None required	None required	None required	None required

* output and characterstic 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			
	XR150 20V	XR200	XRS3	XRS4
Tripod Mount	8610065	4000352	4000352	-
Carrying case (holds X-ray, 2 batteries, charger, cable)	1708020	1701520	1701520	1701682
Handle	4000155	4000005	4000005	4000035 R
				4000045 L
Replacement Tube	-	2000020	-	-
10 MIL SNAP ON COPPER FILTER	1800210	1800210	1800210	-
20 MIL SNAP ON COPPER FILTER	-	-	-	1800291
30 MIL SNAP ON COPPER FILTER	1800230	1800230	1800230	1800292
40 MIL SNAP ON COPPER FILTER	1800240	1800240	1800240	1800293
60 MIL SNAP ON COPPER FILTER	1800260	1800260	1800260	1800294
LEAD COLLIMATOR CAP SOLID	1800265	1800265	1800265	1800299
LEAD COLLIMATOR CAP 20 degree	1800251	1800271	1800281	1800286
LEAD COLLIMATOR CAP 30 degree	1800252	1800272	1800282	1800287
LEAD COLLIMATOR CAP Rectangle	1800253	1800273	1800283	-

EU DECLARATION OF CONFORMITY

This 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: Amerlanhuweg 7
Postal code: 3621 ZC
Place: Breukelen
Country: The Netherlands

DESCRIPTION AND IDENTIFICATION OF THE EQUIPMENT

Generic name: XR150 X-ray Generator
Function: Pulsed X-ray
Model: XR150
Serial number range: 6,200 - 25,000
Commercial name: XR150 X-ray Generator
Year in which the CE marking was affixed: 21

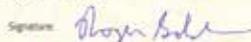
COMPLIANCE

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

EMC Directive 2014/30/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 61000-4-4:2006/A1:2010,
IEC 61000-4-6:2008, EN 63000:2018

Place: Centerville, IN Name: Roger Golden
United States of America Function: President
Date: July 28, 2021 Signature: 

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: XR200 X-ray Generator
Function: Take X-ray imagines of inanimate objects
Model: XR200
Serial number range: 10,625 - 20,000
Commercial name: XR200 X-ray Generator

COMPLIANCE

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

EMC Directive 2014/30/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 61000-4-4:2006/A1:2010, IEC 61000-4-6:2008, EN 50581:2012

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

Date: December 7, 2017

Signature: 

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 2014/30/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 61000-4-4:2006/A1:2010, IEC 61000-4-6:2008, EN 50581:2012

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

Date: December 7, 2017

Signature: 

EU DECLARATION OF CONFORMITY

This 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: Amerlanhuweg 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 inanimate
Model: XRS3
Serial number range: 8,250 - 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 2014/30/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 61000-4-4:2006/A1:2010, IEC 61000-4-6:2008, EN 50581:2012

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

Date: June 17, 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.

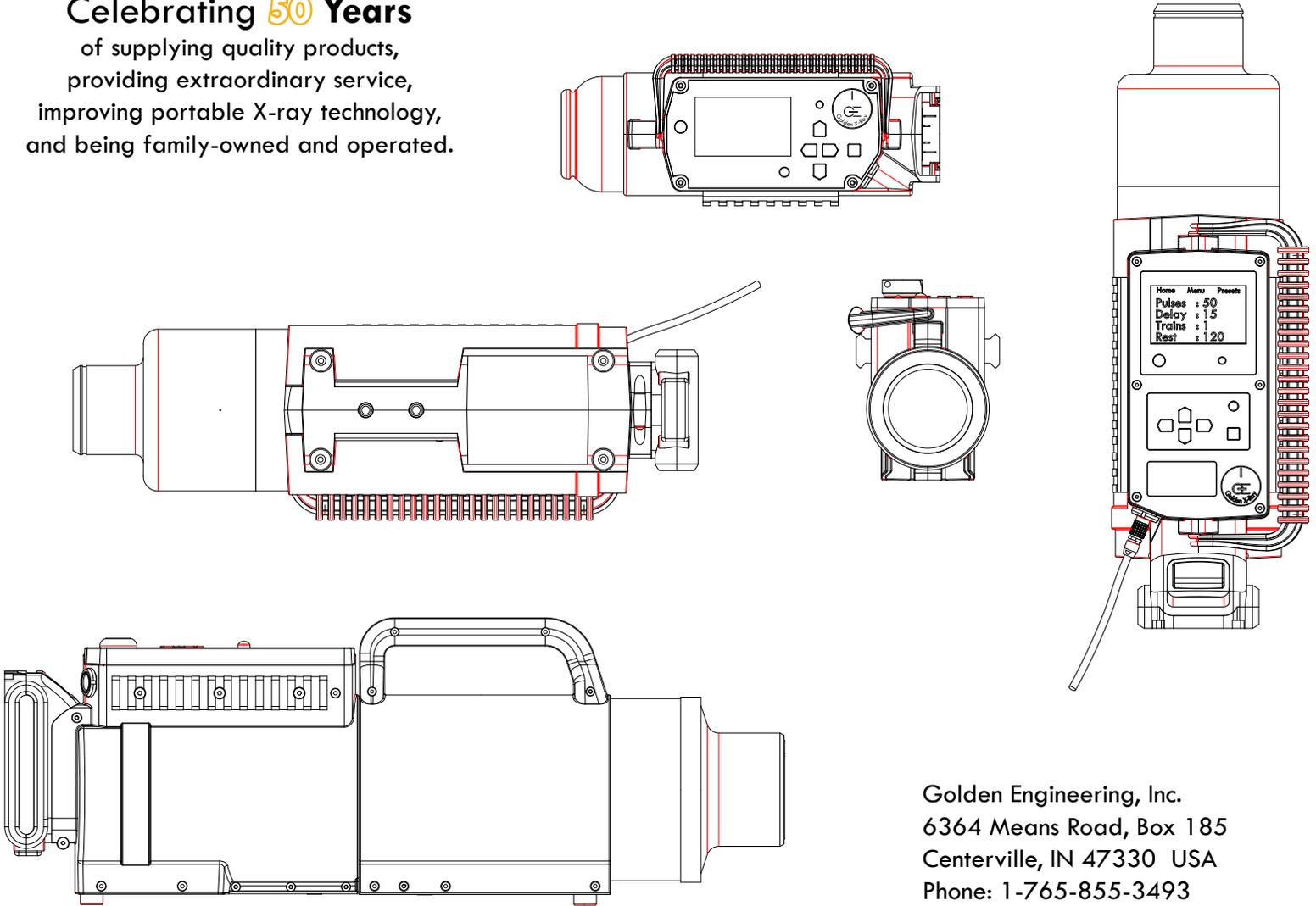
- Remove battery before shipping the unit.
- Accessories are not necessary with units shipped back for repair.
- Be sure the unit is securely packaged for shipment and seal in plastic bag if there is an oil leak.

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	XR150 20V	XR200	XRS3	XRS4
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.
6364 Means Road, Box 185
Centerville, IN 47330 USA
Phone: 1-765-855-3493