

# **Model SR-130**

## **Portable X-Ray System**

### **Installation/Operation Manual**

(Revision 6 UL, S/N 413 ...)



**Source-Ray, Inc.**

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<u><b>SECTION</b></u>		<u><b>PAGE</b></u>
<b>I</b>	<b><u>GENERAL INFORMATION</u></b>	
1.1	Introduction	1
1.2	Description	1
1.3	Important Notice	1
1.4	Compliance Notice	2
1.5	Safety Standards	2
1.6	Electrical Specifications	3
1.7	X-Ray Tube Characteristics	4
1.8	Mechanical Specifications	6
<b>II</b>	<b><u>INSTALLATION AND CALIBRATION</u></b>	
2.1	Interconnections	10
2.2	Calibration Set-Up	11
2.3	Tube Potential (kVp)	11
2.4	Beam Current (mA)	12
2.5	Exposure Time	12
2.6	Beam Alignment	13
2.7	Yoke Adjustment	14
<b>III</b>	<b><u>OPERATION</u></b>	
3.1	Controls and Indicators	15
3.2	Operating Procedure (Control/Generator)	22
3.3	Operating Procedures (Stand Assy.)	24
<b>IV</b>	<b><u>THEORY OF OPERATION</u></b>	
4.1	System Overview	27
4.2	Generator Assembly	27
4.3	Control / Power Inverter Assembly	28

<b>V</b>	<b><u>MAINTENANCE</u></b>	
5.1	Introduction	31
5.2	Recommended Intervals	31
5.3	Ordering Information	31
5.4	Maintenance Procedure	31
5.4	Cleaning Procedure	32

**LIST OF FIGURES**

<b><u>FIGURE</u></b>	<b><u>DESCRIPTION</u></b>	<b><u>PAGE</u></b>
1.1	System Dimensions	7
1.2	Rating Chart, X-Ray Tube	8
1.3	Cooling Curve, Tube Head Assy.	9
2.1	Yoke Adjustment	14
2.2	Pivot Adjustment	14
3.1	Control Panel Descriptions	18
3.2	Control Module (Rear View)	19
3.3	System (Side View)	20
3.4	Generator Assembly (Bottom View)	21
3.5	Leg Assembly	21
3.6	Transport Mode	25
3.7	Possible Pinch Point	25






**LIST OF TABLES**

<b><u>TABLE</u></b>	<b><u>DESCRIPTION</u></b>	<b><u>PAGE</u></b>
3.1	Technique Charts	26
5.1	Maintenance Checklist	33
5.2	Displayed Fault Conditions	33

**LIST OF SCHEMATICS**

<b><u>P/N</u></b>	<b><u>DESCRIPTION</u></b>	<b><u>Section</u></b>
100021	Schematic, Top Level System	34

LIST OF SYMBOLS

Symbol	DESCRIPTION
	Exposure Switch
	For Human Use
	Protective Earth
	Attention, Consult Accompanying Documents
	Pinch Point, Keep Hands Clear

**GENERAL INFORMATION**

**1.1 INTRODUCTION**

This manual is divided into five sections and contains the following information: Section I describes general information, Section II contains installation and calibration procedures. Section III contains operating procedures and technique guides. Section IV discusses theory of operation and Section V contains maintenance procedures and recommended intervals.

**1.2 DESCRIPTION**

The model SR-130 x-ray system is designed and manufactured by Source-Ray, Inc. It provides a high quality radiographic capability in a portable format. It is a component system consisting of the following items:

- Model: SR-130-G X-Ray Generator/ Tube Housing
- Model: SR-130-C X-Ray Control Module
- Model: SR-130-S Portable X-Ray Stand

**1.3 IMPORTANT NOTICE**

The equipment manufactured by Source-Ray, Inc. and covered in this manual will function properly when operated, maintained, and repaired in accordance with the instructions in this manual. Source-Ray, Inc. does not assume responsibility for any malfunctioning of this equipment resulting from improper operation, maintenance, repair, or modification of its components.

This equipment can be hazardous to both patient and operator unless established safe exposure factors are observed. Source-Ray, Inc. disclaims all responsibility from any injury resulting from improper application of this equipment.

**1.4 COMPLIANCE NOTICE**

The Source-Ray model SR-130 you have purchased has been designed, manufactured and calibrated to comply with the governing Federal Regulations 21 CFR Subchapter J. The maintenance schedules included are crucial to the continued reliability of this equipment with respect to regulatory compliance.

Class I – Intermittent Mode

SR-130 System consisting of:

X-Ray Generator: Model SR-130-G

Control Module: Model SR-130-C

Specified Range of Compliance:

Tube Current: 15 / 30 mA

Tube Voltage: 40 - 100 kVp

Exposure Time: .01 - 4.0 s

**1.5 SAFETY STANDARDS**

The Source-Ray equipment you have purchased has been designed, manufactured, and calibrated to meet the following safety standards:

	<p><b>Model: SR-130-C</b>  <b>Model: SR-130-G</b>                  With Respect To Electric Shock                  Fire, And Mechanical Hazards                  Only</p>	<p><b>In Accordance With</b>                  CAN/CSA C22.2 No. 601.1                  UL 60601-1, IEC 60601-2-7 &amp;                  IEC 60601-2-28</p>

The Model SR-130 is designed to comply with IEC 60601-1-2.

**1.6 ELECTRICAL SPECIFICATIONS**

MILLIAMPERES

Milliamperes will not deviate from the selected value by more than +/- 5% within the operating line voltage range and within the specified range of line voltage regulation.

Measurements made with an Invision mAs meter model 35035 or equivalent at 1.0 second.

KILOVOLTS

Kilovoltage will not deviate from the selected value by more than +/- 5% of full scale

Measurements made with an Unfors Xi Mult-O-meter or equivalent at 0.1 seconds.

**1.6 Continued:****TIMER**

Exposure time will not deviate from the selected value more than +/- 2%, plus +/-5ms within a range of 0.01 - 4.0 seconds.

Measurements made with an Unfors Mult-O-meter Model Xi or equivalent.

**MAS**

MAS will not deviate from the selected value more than +/- 15% or .5 mAs which ever is greater within a range of .15 - 100 mAs. Measurements made with an Inovision mAs meter model 35035 or equivalent.

**MAXIMUM RATING**

30 mA at 100 kVp DC

**LINE VOLTAGE REGULATION**

5% maximum as measured at the x-ray control panel at maximum rated output

**REQUIRED APPARENT RESISTANCE OF SUPPLY MAINS**

115 ~ - 0.25  $\Omega$

**MAXIMUM LINE CURRENT** (30 mA at 100 kVp).

Momentary: 45 A, Long Term: 4 A at 115 ~ (AC)

Measurements made with a FLUKE 179 True RMS DVM and a FLUKE Y1801 clamp-on current probe adaptor.

**LINE VOLTAGE RANGE**

115 ~ (103.5 - 126.5 AC) 50/60 Hz

All portable sources will be adequate provided they meet the requirements of the system input ratings.

**NOMINAL ELECTRIC POWER**

3.0 KW, Constant potential derived from a high frequency inverter system, Regulated for both kVp and mA.

**MINIMUM PERMANENT FILTRATION**

3.6 mm of aluminum equivalent at 100 kVp

**1.6** **Continued:**

REFERENCE CURRENT TIME PRODUCT (Power On Defaults)

Beam Current: 30 mA

Tube Potential: 80 kVp

Exposure Time: 0.1 Sec.

LEAKAGE TECHNIQUE FACTORS

Testing is performed at 100 kVp and 30 mA, 2 sec exposures every 1 minute.

COOLING CURVES

Automatic inhibit circuits provide a delay between exposures proportional to the exposure time. This delay is sufficient to allow proper tube cooling. The delay between exposures varies between 10 seconds and 120 seconds depending on the exposure time

ENVIRONMENTAL

Operating Temperature: 40 - 90 Deg. F. / 5 - 32 Deg. C

Storage Temperature: 30 - 110 Deg. F. / -1 - 43 Deg. C

**1.7** **X-RAY TUBE CHARACTERISTICS**

X-RAY TUBE TYPE

SXR-100-15

ENVELOPE

Hard glass, type 8245 with controlled window thickness of the x-ray port.

ANODE MATERIAL

Tungsten target, copper plated and vacuum cast in copper.

TARGET ANGLE

15 DEGREE.

FOCAL SPOT

1.0 mm nominal as per N.E.M.A. XR-5.

**1.7** Continued:

CATHODE

Tungsten filament, line focus.

INHERENT FILTRATION

Minimum 0.70 mm aluminum equivalent at 100 kVp

COOLING

Natural convection through the insulating medium to the enclosure

INSULATING MEDIUM

Highly refined transformer oil; breakdown dielectric strength of not less than 45 kVp per ASTM

D 877-49

WEIGHT

18.5 ounces (500 grams) approximately

X-RAY SHIELDING

External cylindrical shield with open ends attached to tube. Minimum absorption equivalent to 1.0mm of lead at 90 kVp at any point except the x-ray port.

MAXIMUM VOLTAGE

110 kVp

MAXIMUM ENERGY

3.0 mA continuous at 100 kVp in cooled oil. Maximum temperature of oil not to exceed 70 degrees centigrade.

THERMAL

Oil insulation

ANODE HEAT STORAGE

30,000 Heat Units

ANODE COOLING RATE

19,000 Heat Units/Min.

**NOTE:** Heat Unit = kVp x mA (average) x 1 second

**1.8 MECHANICAL SPECIFICATIONS**

X-RAY CONTROL MODULE

Model: SR-130-C

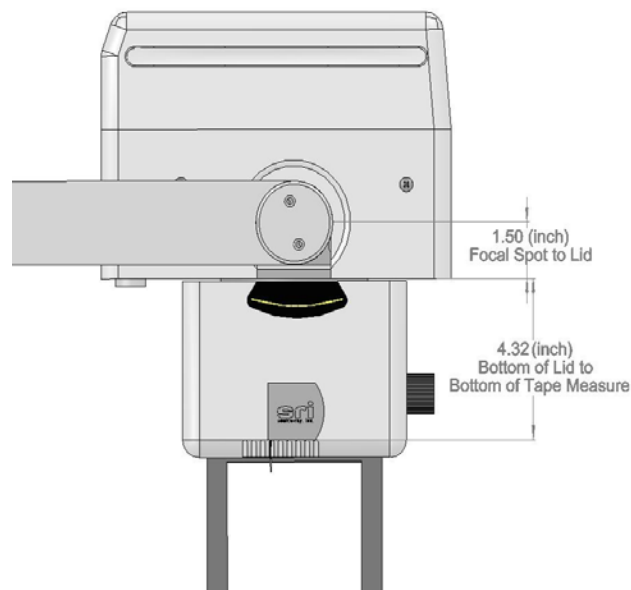
<u>Physical Size:</u>	<u>Length</u>	<u>Width</u>	<u>Height</u>
	7.75 in.	10.0 in.	16.5 in.
	19.7 cm	25.4 cm	41.9 cm
<u>Gross Weight:</u>	9.0 lb., 4.1 KG		

X-RAY GENERATOR/TUBE HOUSING

Model: SR-130-G

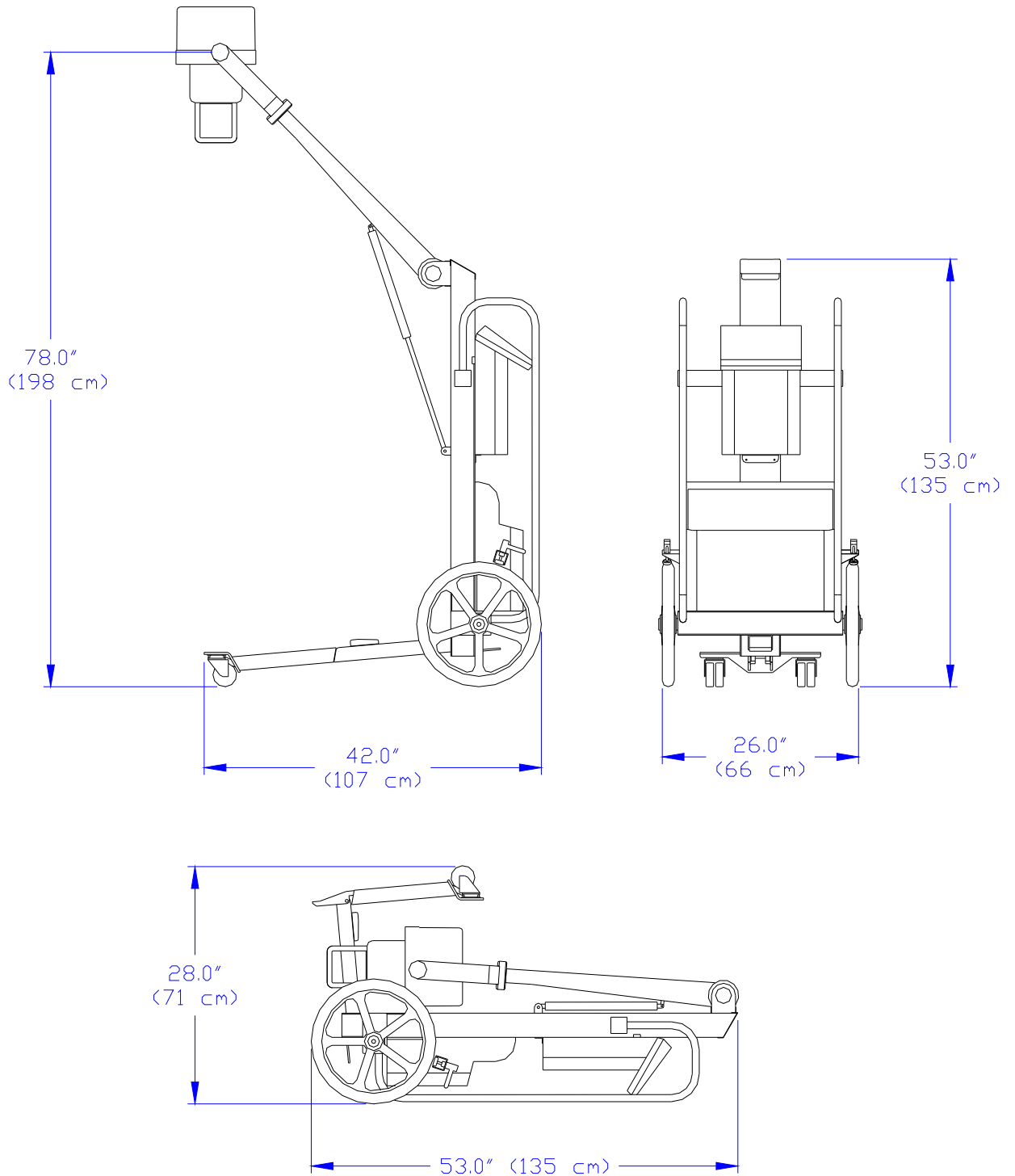
<u>Physical Size:</u>	<u>Length</u>	<u>Width</u>	<u>Height</u>
	9.5 in.	9.5 in.	7.2 in.
	24 cm	24 cm	18 cm
<u>Gross Weight:</u>	40 lb., 18.2 KG		

Focal Spot Location



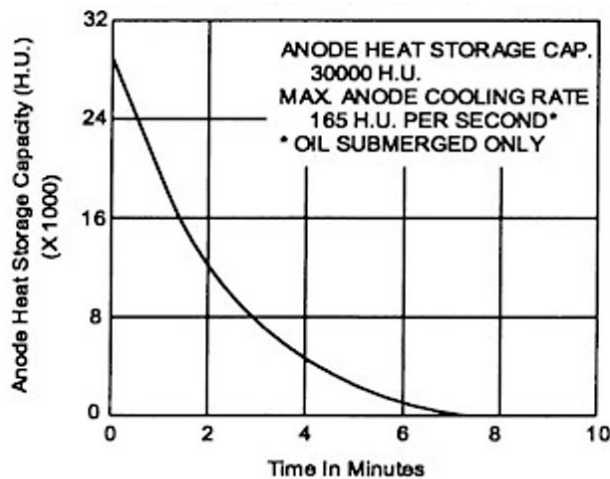
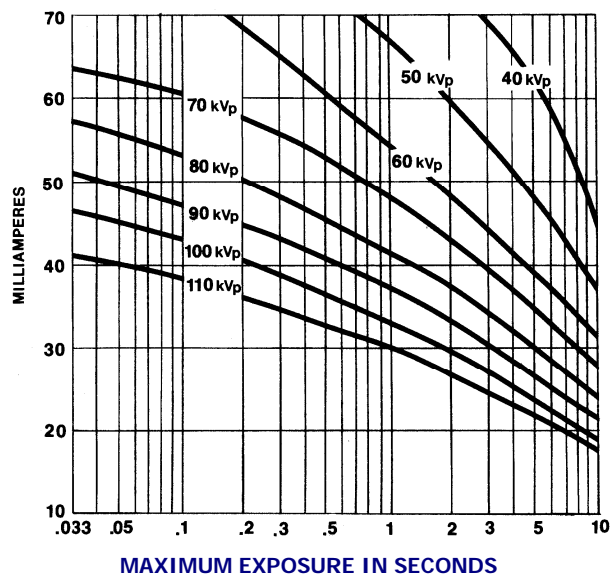
**NOTES:**

- 1) The typical travel stand assembly is described in various sections of this manual.
- 2) When using these modules make sure to use a travel stand that is fully compatible and capable of handling the weights and balances.



**Figure 1.1**  
**System Dimensions**

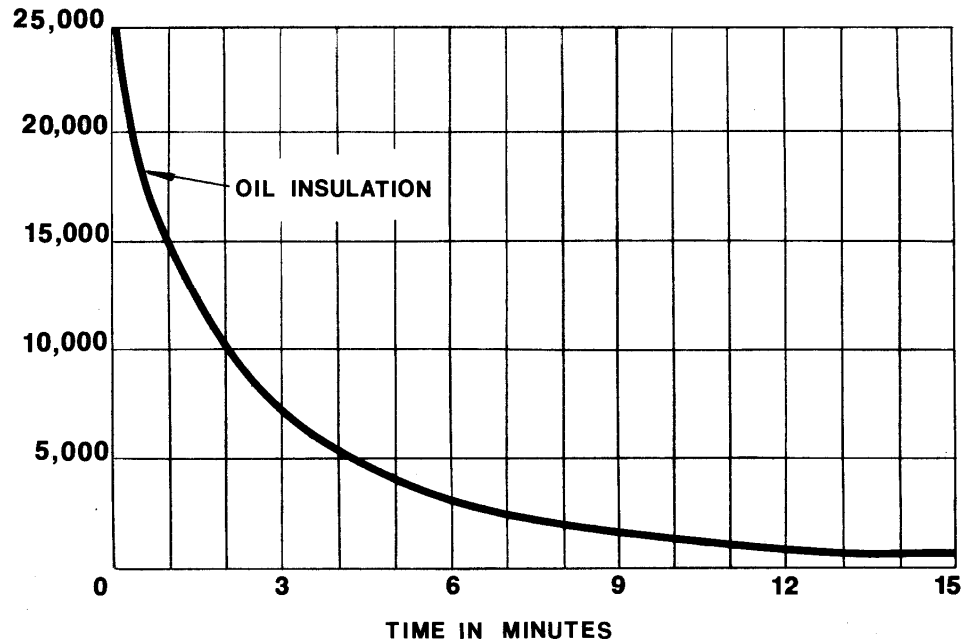
**Rating Chart For Model: SXR-100 15**  
 Three Phase And Constant Potential



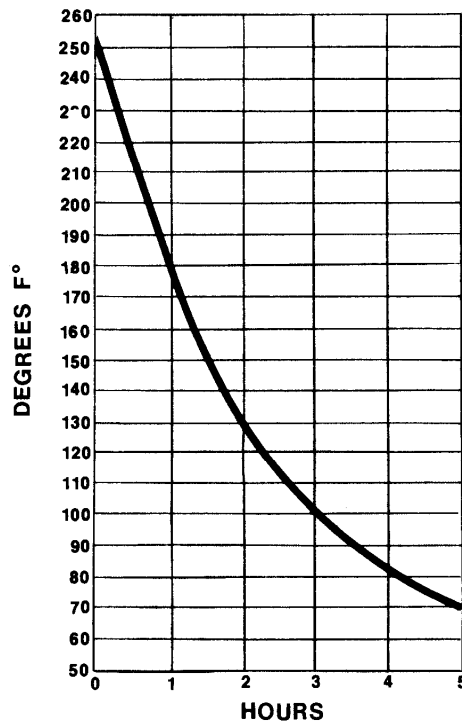
H.U. (Heat Units) = kVp (Kilovolts Peak) x mA (rms) x Time (sec.)  
 Joules = .707 x H.U.

**Figure 1.2**

**X-Ray Tube Rating Charts**



X-Ray Tube Anode Cooling Curve



X-Ray Tube Head Assembly Cooling Curve

Figure 1.3

X-Ray Head Rating Charts

## INSTALLATION AND CALIBRATION

**CAUTION**



### This Section Pertains To Authorized Source-Ray Service Personnel Only

The stand contains a spring-loaded arm with 200 pounds of force. **Never** release the arm without the X-Ray head attached.

#### **2.1** INTERCONNECTIONS

Connect the control module (Model SR-130-C) to the x-ray generator (Model SR-130-G) by means of the interconnecting cable by pushing in the connector and turning clockwise to lock. Connect the power line cord to the x-ray control (Model SR-130-C) by pushing in and turning clockwise to lock. Connect the other end of power line cord to the primary power source (wall outlet).

**Caution**



Be certain that the primary power source (wall outlet) is the same rating as the voltage specified on the label, located on the rear panel of the x-ray control.

## 2.2 CALIBRATION SET-UP

Connect the mAs meter to the phone jack (J3) located in the bottom plate of the Generator Assy. Place the kVp meter (Unfors model 514L) in the X-Ray field @ 40" SID, and run calibration.

## 2.3 TUBE POTENTIAL (kVp)

### 1) Micro-controller Version 1.01 operational modes:

- Manual Operation Mode
- Calibration Mode

### 2) Manual Operation

This is the default mode of operation, which normally appears immediately after the Power On Self Test (POST). To adjust kV output, use the kV Up and kV Down keys

### 3) Calibration Mode

To enter the Calibration Mode, turn the unit ON and press "**kV Up**", "**Reset**", and "**Time Up**" simultaneously for approximately 2 seconds during the POST condition and release.

Successful entrance into the calibration mode will result in the following displays - kVp: 888, mAs: 0130 and Time: 2.00. These displays will hold for approximately 2 seconds. The displays will then change to; kVp: 40, mAs: 0 – 255 and Time: 0.25, indicating that the system is ready to calibrate the 40 kVp range at 30 mA and 0.25 seconds

- a. Make an exposure and measure the actual kVp.
- b. To increase or decrease the kV, Press kV up or down. Each activation of the button increases or decreases the kV by approximately 0.5 kV. The number displayed in the mAs window represents a digital code for kV reference and is increased or decreased by one with each activation of the kV switches.
- c. When the calibration is completed for the 40 kVp range, depress the "**mA Select**" to move to the next kVp range (50).
- d. Repeat steps a – c for the 60, 70, 80, 90 and 100 kVp ranges.
- e. Depressing the mA Select" button will loop back to the 40-kVp range at 15 mA. Repeat steps a – c for the remaining ranges.
- f. When all calibration ranges are completed, re-cycle the main power switch to exit the calibration mode and return to normal operation.

## 2.4 **BEAM CURRENT (mA)**

The kVp meter should be set to display 80 kVp, 30 mA. The squareness of the wave-shape (leading edge) can be adjusted by the service man as follows:

- 1) Collimate the X-Ray beam to size of the filter pack on the kVp meter. Set Channel 2 of the oscilloscope to view the ma wave-shapes via TP3 on the control board and step away from the unit. Set the Control Module for 80kVp, 30mA for a 1 second exposure. Make an exposure and view the mA wave-shape. Adjust R78 on the control board counter-clockwise to raise the leading edge of the mA waveform, or clockwise to lower the leading edge of the ma waveform as necessary.
- 2) Take another test exposure and observe the reading on the MAS meter. The reading should be 30mAs +/- 5%. If adjustment is required, turn R83 on the control board clockwise to raise the mA and counter-clockwise to lower the mA.

## 2.5 **EXPOSURE TIME**

Measure the exposure time on the kVp meter and confirm timer accuracy as indicated on checklist.

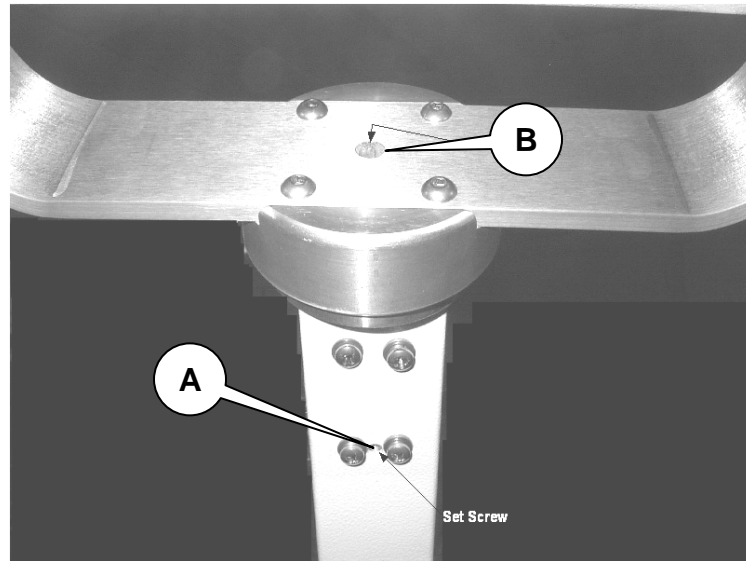
## 2.6 BEAM ALIGNMENT

Tighten yoke block to prevent movement during alignment. Rotate Collimator so that the knobs are facing front and tighten lock. Remove the collimator outer shroud by removing the 4 screws securing the shroud to the collimator. Place the phosphor screen in the beam at 40" and collimate field just to the outside edge of the middle rectangle. Place Beam Alignment Tool in center of field (center dot at intersection of center lines) and adjust beam so that shadow of upper dot covers lower dot. Readjust borders if necessary. Set the Control Module to 80kV, 15mA for about 2 seconds. Take an exposure while observing the X-Ray field through the lead glass window of the test cabinet. Note the difference observed between the light field and the X-Ray field for further adjustment.

If the centers are too far out of alignment, adjustment of Collimator light field is necessary. To adjust the horizontal position of the light field, rotate the collimator 180 degrees to gain access to the mirror adjustment hardware. Loosen the locking screws sufficiently so as to allow the turning of the adjuster cam. Lock the fixing screw and cam after adjusting the mirror position. To adjust the vertical position of the light field, remove the lamp heat dissipator taking care to avoid being burned, as the dissipator can be very hot. Loosen the two lamp support fixing screws and using the hexagonal screw on the side of the lamp, adjust the lamp in the desired direction. Tighten the four screws fixing the lamp support. Finally, to adjust the brightness at the edges of the light field, loosen the screws fixing the screen to the lamp holder, and using an Allen screws, move the screen to obtain the desired adjustment. Tighten the screen fixing screws.

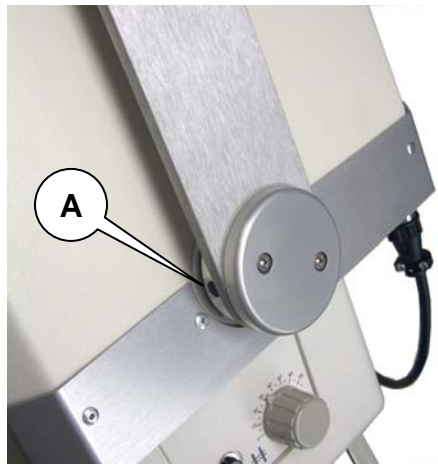
## 2.7 YOKE Adjustment

To set the tension on the Yoke, loosen the pivot set screw (A), (refer to Figure 2.1). Using a 5/16 Allen wrench, tighten or loosen the yoke pivot bolt (B) to the desired tightness. ***Caution*** - Be sure to re-tighten the yoke pivot set screw (A) to lock in the adjustment prior to tension verification.



**Figure 2.1**

To set the tension on the Generator Assembly pivot (refer to Figure 2.2). Adjust the pivot adjustment screw (A) on either side of the Generator Assembly using a 7/64" Allen wrench until the desired tension is achieved.



**Figure 2.2**

**UNIT OPERATION****3.1 CONTROLS AND INDICATORS**

<b><u>DESCRIPTION</u></b>	<b><u>FUNCTION</u></b>
1) POWER ON SWITCH/ CIRCUIT BREAKER	Rocker type switch that controls the primary (25 A) power into the system. Operating the switch turns the unit on. Power should not be turned on until the generator is ready for use. Circuit breaker will trip if excess current is drawn.
2) KVP METER	A digital LED meter that indicates the selected kVp in 1-kVp increments.
3) MAS METER	A digital LED meter that indicates the computed MAS prior to exposure.
4) TIMER METER	A digital LED meter that indicates the preset exposure time from 0.01 to 4 seconds.
5) KVP ADJUST	Two momentary switches that adjust the kVp from 40 to 100 kVp in 1 kVp increments.
6) MA SELECTOR	Momentary switches that toggles selection of either the 15 or the 30 mA station.
7) TIMER ADJUST	Two momentary switches that adjust the exposure time from 0.01 to 4 seconds.
8) READY INDICATOR	Illuminates when unit is ready for operation. Automatically prevents excessive operation by means of a time delay circuit.

**NOTE:** Internal fuses provide protection for auxiliary DC circuits. Replacement to be done by Authorized Source-Ray Personnel only.

3.1 Continued:

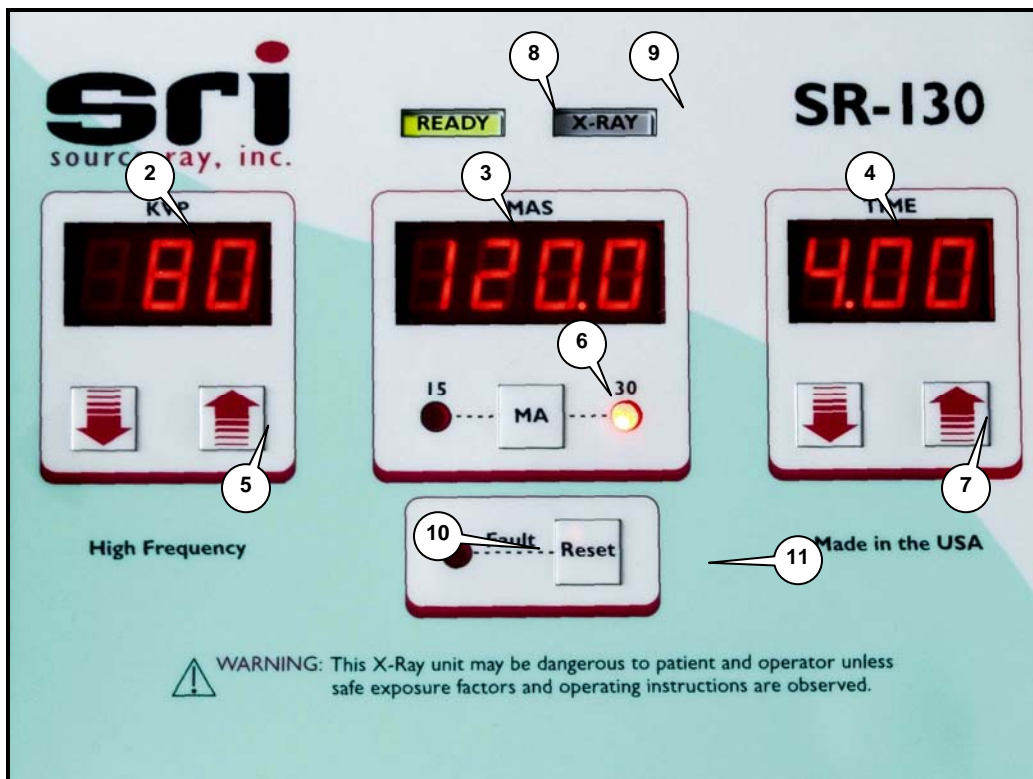
<u>DESCRIPTION</u>	<u>FUNCTION</u>
9) X-RAY ON INDICATOR	Illuminates when exposure switch is depressed to indicate the timed interval of X-ray output. In addition, an audio tone is generated at the same time.
10) FAULT INDICATOR	A lamp that illuminates to indicate that a fault condition has occurred. Refer to table 5.2 for a description of fault conditions.
11) RESET BUTTON	Clears and resets the front panel controls in the event of a fault condition (reference Table 5.2)
12) OPERATE SWITCH	A two-position switch that controls the x-ray output. The first position is for prep (ready light goes out and comes back on when unit is prepped), the second position is for x-ray (x-ray light comes on while x-rays are being produced). Premature release of the exposure switch will terminate the exposure and light the fault lamp. Depress the <b>RESET</b> button to clear the fault and Reset the timer.

3.1 Continued:

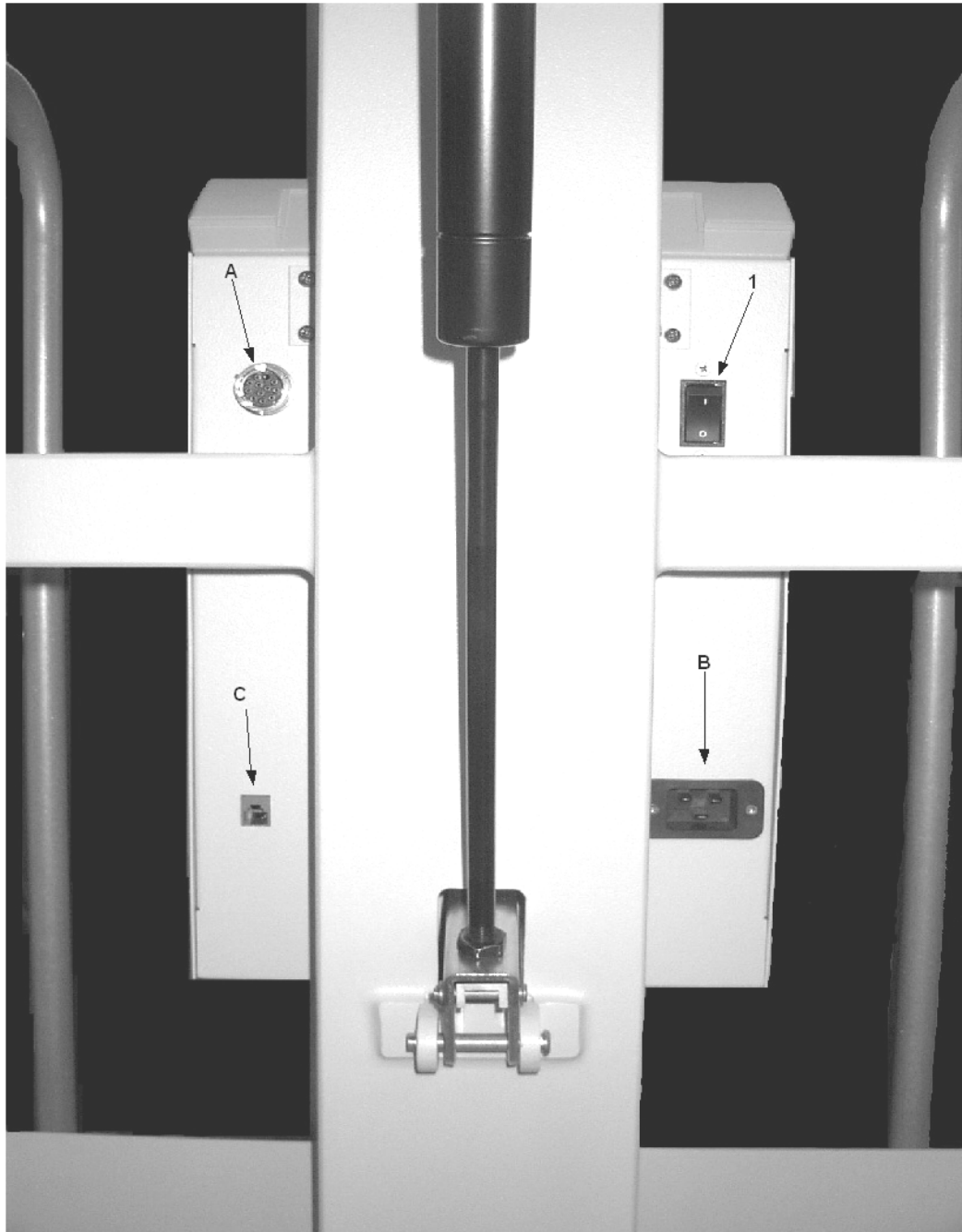
<u>DESCRIPTION</u>	<u>FUNCTION</u>
A) INTERCONNECT CONNECTOR	Connects Control Module to Generator Assembly.
B) A.C. INPUT CONNECTOR	<b><u>CAUTION</u></b> Apply only the voltage specified on the nameplate.
C) INTERCONNECT CABLE	Connects the Generator Assy. To the Control Module.
D) EXPOSURE SW CONNECTOR	Connects the exposure switch to the Control Module.
E) YOKE ASSEMBLY	Controls position of the head assembly. Allows pivoting about two axis's, maintains position with friction locks.
F) BOOM ARM	Controls height adjustment of head assembly.
G) SKIN GUARDS	Limits Source to Skin Distance (SSD). <b><u>WARNING:</u></b> <u>Do not use as handles.</u>
H) BOOM ARM RELEASE	Releases "Piston Lock" allowing movement of the boom arm.
I) SKID BARS	Functions as handles during transport and rest blocks in the storage
J) WHEEL BRAKE	Manual lever. Prevents unit from rolling when positioned on an incline or in the storage mode.
K) LEG RELEASE	Spring loaded slide bracket. Allows front leg to be folded into the storage position
L) COLLIMATOR LAMP	Depressing the button activates the lamp which automatically extinguished after aprox 15 seconds to extend bulb life.

3.1 Continued:

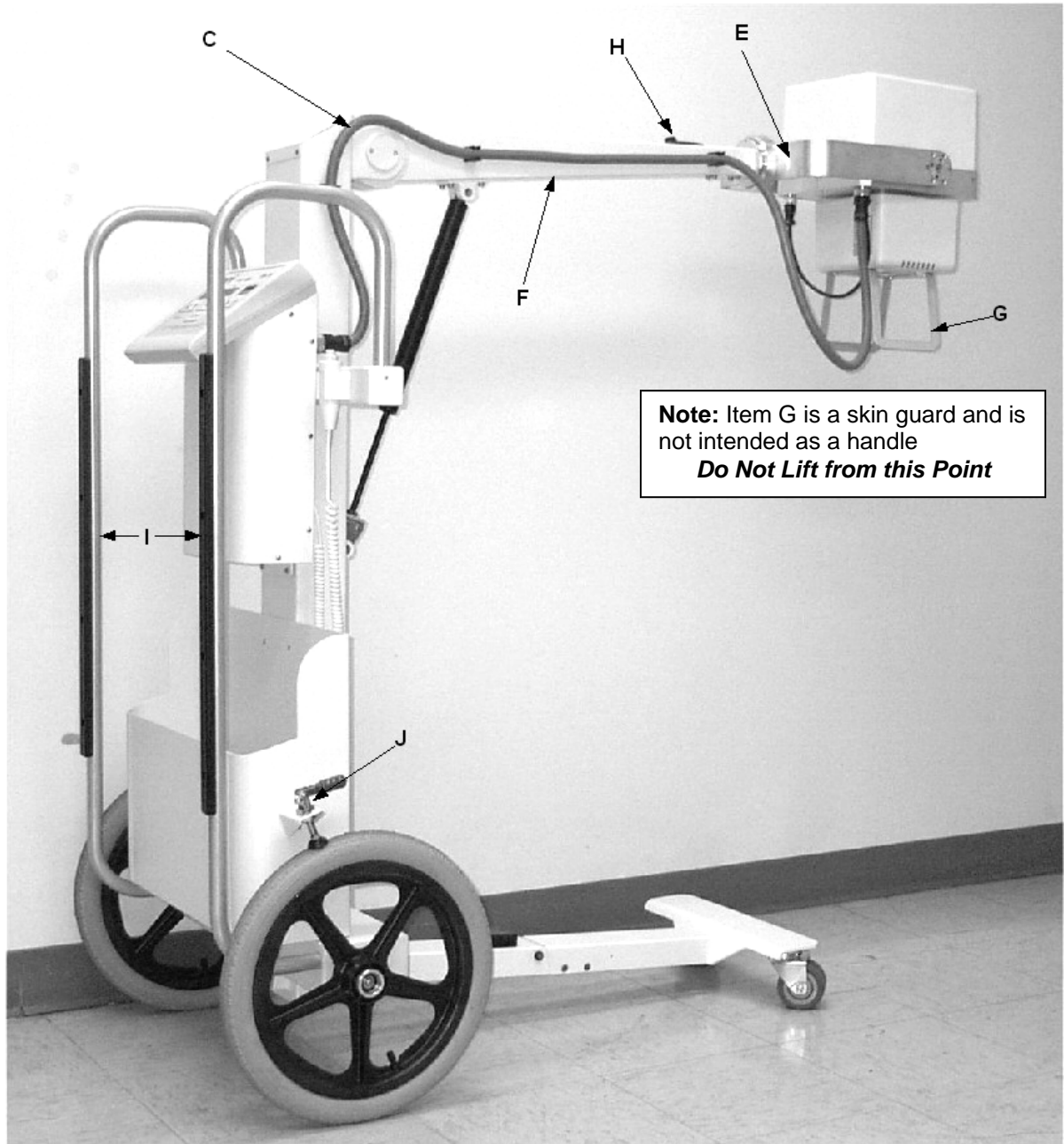
<u>DESCRIPTION</u>	<u>FUNCTION</u>
M) COLLIMATOR INPUT	Connects the collimator to the 24 VDC power supply via the Generator Assembly.
N) MA TEST JACK	Test point for mA during the calibration mode.



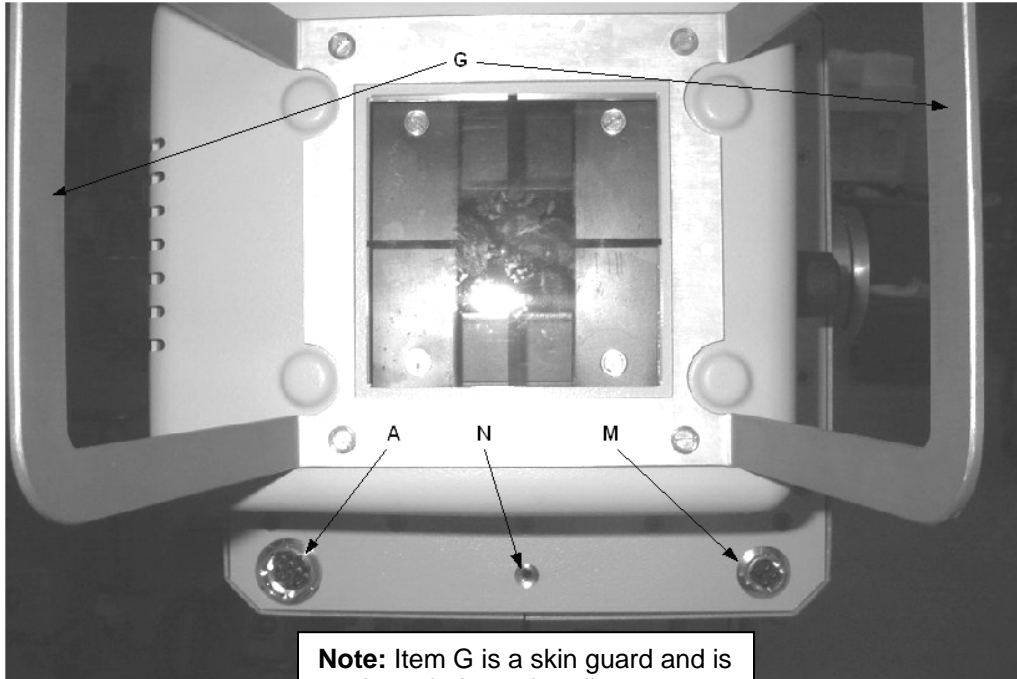
**Figure 3.1**  
**Control Panel Descriptions**



**Figure 3.2**  
**Control Chassis (Rear View)**

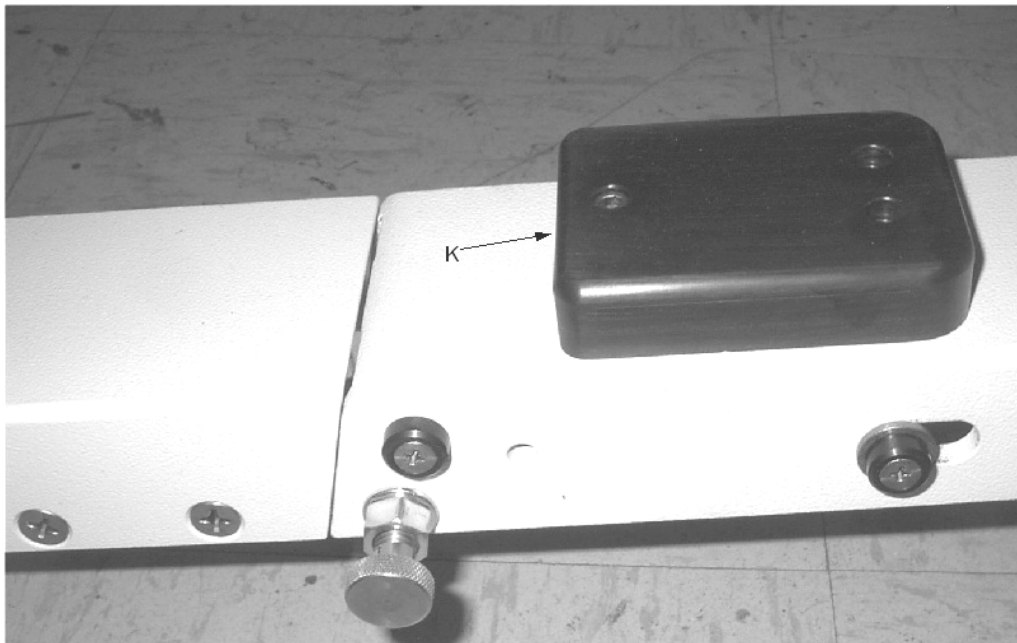


**Figure 3.3**  
**System (Side View)**



**Note:** Item G is a skin guard and is not intended as a handle  
**Do Not Lift from this Point**

**Figure 3.4**  
**Generator Assembly (Bottom View)**



**Figure 3.5**  
**Leg Assembly**

### 3.2 OPERATING PROCEDURES: Control/Generator

#### CAUTION



**Do not attempt to connect or disconnect any interconnect cables without disconnecting the mains supply first.**

- 1) Operate the "Power On" switch to turn the primary power on.
- 2) Position the generator at the desired distance from the film cassette (Ref. Table 3.1 for technique guides). The model R72/32-ET collimator has a built-in tape measure to determine SID (source to image distance) accurately.
- 3) Activate the "**Collimator Lamp**" by depressing the push-button located on the front of the collimator. The collimator lamp will automatically extinguish after a period of approximately 15 seconds to extend bulb life.
- 4) Position the generator so that the collimator light beam is centered on the film cassette.
- 5) Collimate the light field to the area of interest by means of the shutter adjust knobs.
- 6) Select the desired kVp by means of the kVp adjust switches
- 7) Select the desired mA station by means of the mA selector switches
- 8) Adjust the "**Exposure Time**" Control to the desired time interval by means of the Time selectors (7). The resultant mAs is displayed on the mAs meter.
- 9) After the required warm up period, the "**Ready**" Indicator will illuminate. It will not be possible to operate the unit until this has occurred. If the unit has not been operated for a long period of time, an additional 2-minute waiting period is recommended.
- 10) While holding the "**Remote Exposure Control**", step at least 6 feet to the rear or side of the x-ray generator.

**3.2 Continued:**

- 11) Depress the **"X-Ray Switch"** to the first position (prep). The **"Ready Light"** will go off and come back on when the unit is fully prepped.
- 12) Depress the **"X-Ray Switch"** to the second position for immediate exposure. An audio tone will sound in addition to the **"X-Ray"** indicator illuminating for the duration of the exposure. Releasing the **"X-Ray"** switch prior to the pre-selected time interval will terminate the exposure, light the **"FAULT"** Indicator and display a fault condition (Ref. Table 5.2).

**NOTES:**

- 1) Unless the x-ray generator is going to be immediately used again, the "Power ON" switch should be turned off. Leaving the unit turned on provides opportunity for an accidental operation.
- 2) If the unit is going to be operated again, an automatic inhibit circuit will allow the x-ray tube to cool in proportion to the exposure time to prevent damage to the x-ray tube from overheating. At the end of this cycle the **"Ready"** light will illuminate indicating an exposure can be made.

**3.3 OPERATING PROCEDURE: Mechanical Stand**

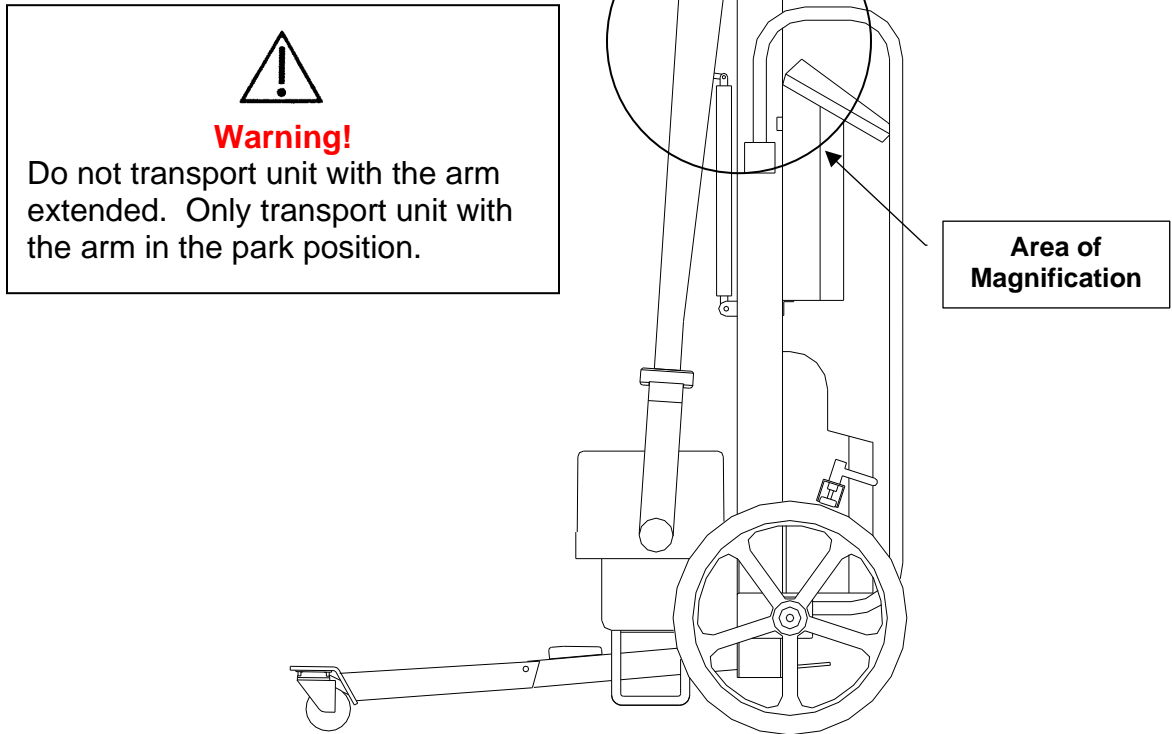
(Applies to additional stand when furnished)

**From Storage Position:**

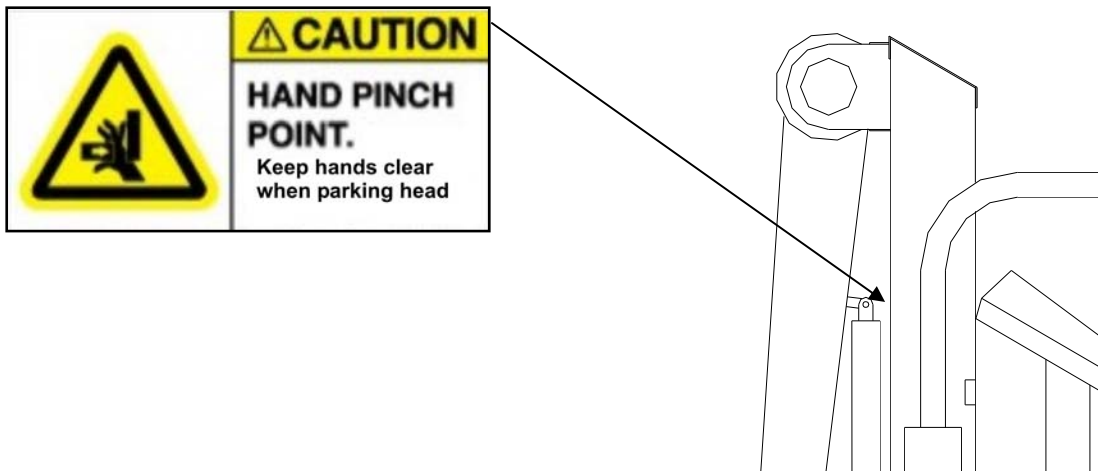
- 1) Pull back on the spring loaded **Safety Pin** and hold, slide release block back and unfold the front leg to its operating position.
- 2) Release the **Safety Pin** to its original position.
- 3) Grab hold of the **Skid Bars** and stand the unit up.
- 4) Release the **Wheel Brakes** and move the unit to the area of interest.
- 5) Pull back and hold the **Boom Arm Release Lever**.
- 6) While holding the **Boom Arm Lever**, raise the **Generator/Collimator** to the desired position.
- 7) Position the **Generator/Collimator Assy**. (All movements are controlled by friction locks and will remain where set).

**From Working Position:**

- 8) Position **Generator/Collimator Assy** inline with the **Boom Arm**.  
**NOTE:** Skin guards must be positioned to straddle the front leg.
- 9) Pull back and hold the **Boom Arm Release Lever**.
- 10) Slowly move the **Generator/Collimator Assy**. To it's storage position.
- 11) Release **Boom Arm Release Lever**.
- 12) Lock both **Wheel Brakes**.
- 13) Pull back the unit and rest the unit down on the Skid Bars.
- 14) Pull back on the spring loaded **Safety Pin** and hold.
- 15) Slide the **Release Block** back and fold the front leg to its storage position.
- 15) Release the **Safety Pin** to its original position.



**Figure 3.6**  
**Transport Mode**



**Figure 3.7**  
**Possible Pinch Point**

**TABLE 3.1**  
**TECHNIQUE CHART**

**Film Screen:** Regular 400 speed. Grids are 8:1 (multiply technique x 4)

Examination	Thickness	KVP	MAS	Grid	Distance
<b>Note: Kyphotic woman = a large man</b>					
Chest (AP)	Average male	100	1.25	No	60"
	Average female	100	0.75	No	60"
Chest Lateral	Average male	100	3.5	Yes	40"
	Average female	100	3.0	Yes	40"
<b>Use grid for all chests, with exception of combative patients. If patient is breathing rapidly you may wish to shoot without a grid.</b>					
Abdomen	Average	95	10.0	Yes	40"
Pelvis	Small	72	8.0	Yes	40"
	Average	74	12.0	Yes	40"
	Large	80	25.0	Yes	40"
Hip	Small	72	8.0	Yes	40"
	Average	74	12.0	Yes	40"
	Large	80	25.0	Yes	40"
Femur	Average	72	6.0	Yes	40"
Knee	Average	58	2.0	No	40"
<b>If patient is unable to straighten knee completely increase kVp to 62!!</b>					
Tibia/fibula	Average	55	2.5	No	40"
Ankle	AP Average	52	2.0	No	40"
Foot	AP Average	50	1.5	No	40"
	Lat Average	52	1.5	No	40"
Shoulder	Average	62	2.5	No	40"
Humerus	Average	58	2.0	No	40"
Elbow	Average	62	1.5	No	40"
Forearm	Average	55	2.0	No	40"
Wrist	Average	55	1.5	No	40"
Hand	Average	55	1.25	No	40"
T-Spine AP	Average	74	15-18	Yes	40"
T-Spine Lat	Average	80	25.0	Yes	40"
L-Spine AP	Average	85	25.0	Yes	40"
L-Spine Lat	Average	90	40.0	Yes	40"
C-Spine AP	Average	72	12.0	Yes	40"
C-Spine Lat	Average	74	12.0	Yes	40"
Swimmer's	Average	80	30.0	Yes	40"

## THEORY OF OPERATION

### 4.1 SYSTEM OVERVIEW

The Model SR-130-C incorporates three major electrical sub-assemblies. The generator Assembly consists of the high voltage circuitry, the x-ray tube and the collimator (further discussed in section 4.2). The Control Assembly houses all of the electronics, microprocessor, high frequency generating circuits and the front panel controls (further discussed in section 4.3). The Inverter Assembly is part of the Control Assembly, but is discussed in detail in section 4.3.

### 4.2. GENERATOR ASSEMBLY

The X-Ray Generator Assembly is made up of both the High Frequency X-Ray Head and the Collimator, which are both interconnected with the Control / Power Inverter assembly via connector J1 (Ref. Dwg 100022). The voltage used to generate the high voltage at the high frequency head enters the assembly at pins **A & B** of connector J1. The voltage is approximately 650 VPP at an approximate 30 kHz square wave, for a 100-kVp output.

The filament voltage enters at pins **F<G&H** of connector J1. Pin H is at a DC level of approximately 24V, and pins **F & G** have a high frequency voltage of about 48 VPP at approximately 50 KHz with respect to ground. Pin **L** of **J1** is the mA feedback signal (**10V = 30mA**). Pins **C&D** of **J1** provide the **24 VDC** voltage for the collimator lamp and timer. Pin **E** of **J1** is the ground pin, pin **K** of **J1** is the kV feedback signal (10 V=100kV). Connector **J3** (mA jack) places a mA meter in series with the mA line for calibration purposes (Ref. Section 2.3).

### 4.3 CONTROL / POWER INVERTER ASSEMBLY

The Control / Power Inverter Assembly is made up of the following sub-assemblies; Control Board PWA, Microprocessor PWA, the Power Board PWA, the 24V Collimator Power Supply, and the +5V & 24V power Supply.

The Control / Power Inverter Assembly is powered by 120 VAC or 220 VAC via connector **J1**. With circuit breaker **CB1** closed, an AC voltage is applied through current limiting resistor **R1** of the Power Board PWA. This section is made up of Diode Bridge **D1**, energy storage capacitors **C1 - C10**, and bleeder resistors **R2** and **R3**. The Rectifier and Capacitors make up a classical full wave doubler when the 120 VAC mode is selected by connecting the 120VAC to terminal board **TB1**, pins **1** and **2**. When the 220 V mode is selected by connecting the 230VAC to terminal board **TB1**, pins **1** and **3**, the rectifier **D1** becomes a full wave bridge. Resistors **R2** and **R3** are the bleeders for the capacitors, and resistor **R1** is used to limit the in-rush current.

Relay **K1**, contacts **1A** and **1B** short resistor **R1**, on the Power Board PWA, during the **Prep** and **X-ray** period to allow the line to deliver the required power. Transistors **Q1** and **Q2** of the Control / Power Inverter Assembly make up a full bridge high frequency circuit operating at approximately 30 kHz. This circuit is energized during the X-Ray On period and is used to convert the DC voltage back to high frequency AC to drive the high voltage transformer in the generator assembly (approx. 30 kHz).

The Control Board PWA (**A1**) takes commands from the microprocessor PWA and converts them into high frequency signals to drive the full bridge. Current transformer **T1** on the Power Board PWA is used to monitor the high frequency current out of the Full Bridge, and feeds timer **U2**, on the Control Board PWA, which provides an interrupt in the event of excessive current flow. The high frequency voltage output of the full Bridge is taken from transistors **Q1-C2E1** and **Q2-C2E1**.

### 4.3 Continued:

The output signal now flows through capacitor **C11** of the Power Board PWA, which is used to block any DC voltage from entering the primary of the High Voltage Transformer in the Generator Assembly, and goes to connector **J2** pins **A** and **B**.

The microprocessor PWA (**A5**) is used as the brain of the unit, it receives the **X-Ray Prep** and **X-Ray On** signals from the exposure switch, which is connected via **J3**. The x-ray prep signal, which is active high (active high=approx. +5V), goes into the Control Board PWA at **J5** pin **2**, where it activates the filament circuitry. The x-ray prep signal also goes to the Power Board PWA and energizes the step start relay K1. All this prepares the unit for an x-ray exposure. When the x-ray signal (active high), is applied to the Control Board PWA **J5** pin **3** from the exposure switch, the signal is fed into the microprocessor via harness assembly **W1**, on the microprocessor connector **J1** pin **15**. That initiates a timed signal (active high), which exits from the microprocessor at **J1** pin **1** and enters the Control Board PWA (**A2**) at **J6** pin **1**. It is also used to initiate the audible beeper, which is part of the microprocessor PWA (**A5**). The microprocessor also monitors the **FAULT** signal (active low), on **J1** pin **7**, from the Control Board PWA (**A2**) **J6** pin **7**. The microprocessor also outputs an adjustable voltage level from **J1** pin **5**, which is the reference out signal (typical 4 to 10 VDC) and is proportional to the KV output. The microprocessor also selects the **mA** station from connector **J1** pin **4** into **J6** pin **4** of the Control PCB Assembly. A low signal selects the 15 mA station and a high signal selects the 30 mA station. A filament control signal leaves the microprocessor via **J1** pin **9** (Preheat reference), this signal is used to provide a calibrated voltage to the filament during the PREP mode to preheat the filament. During the exposure the control board regulates the amount of filament power needed to produce the current that is set by the operator (15 mA or 30 mA). The microprocessor PWA (**A5**) also houses all the push buttons and indicators for operating the unit.

**4.3 Continued:**

The control board PWA (**A2**) also generates the high frequency voltage that feeds the primary of the filament transformer pins **F**, **H** and **G** on **J2**. A DC-DC converter on the control board PWA converts 24VDC to  $\pm 15$ VDC for the on board electronics.

The power supply assembly (**A3**) provides the **+5VDC** and **+24 VDC** for all the low voltage (signal processing) electronics.

The power supply assembly (**A4**) provides 24VDC and goes to connector **J2** pins **C** and **D** to power up the collimator lamp.

## UNIT MAINTENANCE

**CAUTION**



### This Section Pertains To Authorized Source-Ray Service Personnel Only

#### 5.1 INTRODUCTION

In order to keep the Source-Ray unit operating properly, it must be inspected and checked in accordance with the recommended intervals depending on the age and use of the equipment. If there is a problem, call an authorized serviceman. DO NOT OPERATE THE EQUIPMENT UNTIL REPAIRS ARE COMPLETED.

#### 5.2 RECOMMENDED INTERVALS

Periodic preventive maintenance including cleaning, mechanical and electrical adjustments, are to be performed every six months or 3000 exposures. The periodic maintenance schedule is required to maintain the unit in proper and accurate working condition.

#### 5.3 ORDERING INFORMATION

To order replacement parts contact your local authorized Source-Ray dealer. Authorized Source-Ray dealers should contact the main office at (631) 244-8200 between the hours of 8:00 AM and 5:00 PM. When ordering replacement parts, be prepared to submit the following information: purchase order no. (if possible), Source-Ray part number, part description, quantity required and shipping instructions. If replacement parts are for a unit under warranty, be prepared to submit model numbers and serial numbers to expedite your order.

#### 5.4 MAINTENANCE PROCEDURE

Reference the checklist on following page

TABLE 5.1  
MAINTENANCE CHECKLIST

MODEL: SR-130

SERIAL # \_\_\_\_\_

- 1) Beam Current (Reference Section 2.3) \_\_\_\_\_
- 2) Tube Potential (Reference Section 2.4). \_\_\_\_\_
- 3) Exposure time (Reference Section 2.5). \_\_\_\_\_
- 4) Beam Alignment (Reference Section 2.6) \_\_\_\_\_
- 5) Check voltage on X-Ray Generator at J2 pins A and B  
(collimator supply) with collimator unplugged (24 VDC). \_\_\_\_\_
- 6) Check that all Indicator lights are operating. \_\_\_\_\_
- 7) Check that all hardware is tightly secured. \_\_\_\_\_
- 8) Check that collimator-mounting ring is tight. \_\_\_\_\_
- 9) Check all interconnect cables for broken or frayed wires. \_\_\_\_\_
- 10) Check that all hardware is secure and properly fastened. \_\_\_\_\_
- 11) Check that all friction locks (head rotation) are properly  
adjusted, tighten as required. \_\_\_\_\_
- 12) Inspect piston mounts. Make sure all mounting  
hardware is secure. (tighten if necessary) \_\_\_\_\_
- 13) Inspect piston strength, if unit drifts down when lock is not  
engaged, replace piston. \_\_\_\_\_

**NOTE:** When cleaning, use a cloth moistened in warm soapy water (use mild soap).  
**Do not** soak the unit and **do not** use strong cleaners or solvents as they may  
blur the lettering or dull the finish. Polish with pure liquid or paste wax. Do  
not use a wax containing a cleaning substance. Do not polish the meter  
windows.

**SERVICE ENGINEER:** \_\_\_\_\_

**DATE:** \_\_\_\_\_

**TABLE 5.2**  
**DISPLAYED FAULT CONDITIONS**

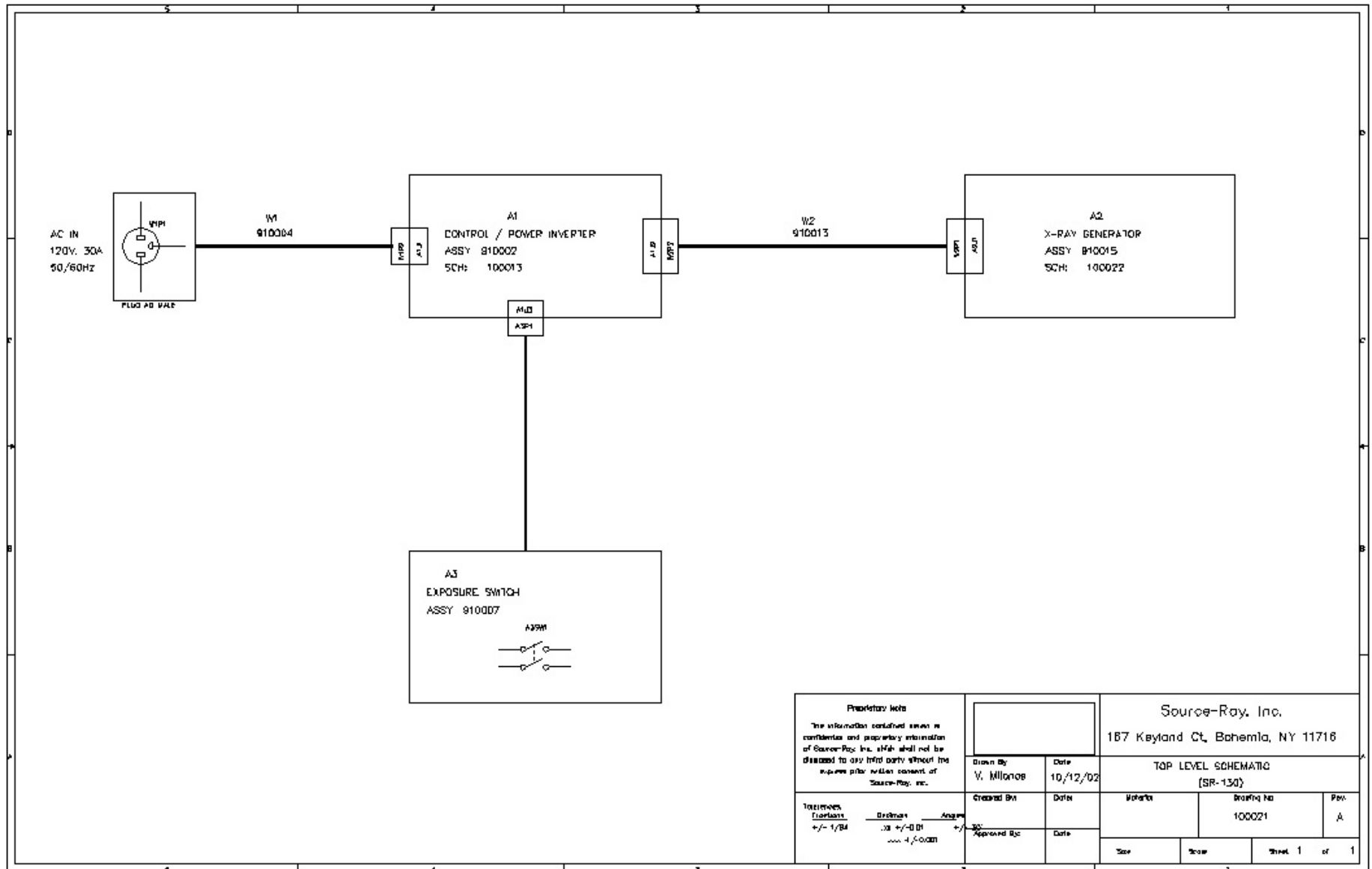
<b><u>DISPLAY</u></b>	<b><u>FAULT DESCRIPTION</u></b>	<b><u>ACTION REQUIRED</u></b>
1	Inverter Fault. (1)	Call for Service
2	No or low mA signal during exposure	Call for Service
3	Exposure terminated by operator	Reset unit
4	Stuck or shorted exposure switch.	Check or replace switch.
5	Stuck or shorted Keypad switch.	Call for Service
6	High Voltage circuit failure	Call for Service
99	Blank EEPROM or EEPROM Failure	Call for Service

**NOTES:**

- 1) May indicate a timer problem. Depress the reset button to clear the fault condition and continue. If the problem persists, call for service.

**LIMITED WARRANTY**

*Source-Ray, Inc.* warrants its Model SR-130 Portable X-Ray System to be free of manufacturing defects, which can impair their normal operation when used within their specified ratings. Claims under this warranty must be made within 3 years after shipment from the factory. Such warranty shall not apply to defects resulting from accidents, alterations, abuse or misuse. X-Ray Tube and Collimator warranty is limited to that provided by the manufacturer. Liability under this warranty is limited to repair or replacement of defective components at the factory. ***Shipping costs are not included.*** This warranty is in lieu of any other warranty expressed or implied. Collimator bulbs, exposure cord assemblies, interconnect cables and tires are considered normal wear and tear and are not covered under this limited warranty.



<b>Proprietary Note</b> The information contained herein is confidential and proprietary information of Source-Ray, Inc. which shall not be disclosed to any third party without the express prior written consent of Source-Ray, Inc.		Source-Ray, Inc. 187 Keyland Ct, Bohemia, NY 11716	
Drawn By: V. Milonice	Date: 10/12/02	TOP LEVEL SCHEMATIC (SR-130)	
Title: +/- 1/32"	Order: +/- 0.01"	Drawing No: 100021	Rev: A
Approved By: _____	Date: _____	Size:	Sheet 1 of 1