FLUKE®
Biomedical

Installation, Operation, and Maintenance

SIGNAL GENERATOR MODULE
Model 960SG-500

Instruction Manual

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Fluke Biomedical
Radiation Management Services

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Section 1
Introduction

1.1 General Description

960SG Signal Generator is utilized to verify the proper operation of the Universal Digital Rate meter 942 Monitoring Systems and the Universal Digital Rate meter 956 Monitoring Systems. It simulates pulses from the radiation detector and is applied to the radiation pulse counting circuit. The 960SG can be supplied as part of a radiation monitoring system or as a separate, stand-alone piece of test equipment. The Model 960SG-500 is designed to mount in a 3-bay rack chassis. Figure 1-1 is the Signal Generator functional block diagram.

The Model 960SG-500 utilizes two independent 960SG boards in a UDR style housing, for UDR applications. Front panel controls include decade range, variable amplitude and variable frequency.

1.2 Application

The signal generator provides pulses to the UDR through the signal input jack. The user can select, via a slide switch, each decade in CPM from 0 CPM to 1 x 10^5 CPM. A variable frequency control is located on the front panel to allow adjustment within the selected range.

1.3 Specifications

The specifications for the signal generator are listed below:

Switch Selectable Frequency	Counts Per Minute:
FREQUENCY	CPM
0	0
.167 Hz	10
1.67 Hz	100
16.7 Hz	1 k
167 Hz	10 k
1.67 kHz	100 k
Output Pulse (BNC Connector)	Positive polarity, 2 V pulse height, 800 ns duration
Output Impedance	51 ohms
Dimensions (H x W x D)	3.5 in. x 5.6 in. x 13.5 in. (8.9 cm x 14.2 cm x 34.3 cm)
Weight	Approximately 2 lbs (0.9 kg)
Operating Temperature	32°F to 122°F (0°C to 50°C)
Power requirements	15 V @ 100mA
Options:	1. Power on indicator 2. Remote detector test input multiplexer

NOTE
The following figure is applicable to both internal 960SG boards.

Section 2
Receiving Inspection

2.1 Receiving Inspection

Upon receipt of the unit:

1. Inspect the carton(s) and contents for damage. If damage is evident, file a claim with the carrier and notify the Fluke Biomedical RMS Customer Service Department.

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2. Remove the contents from the packing material.

3. Verify that all items listed on the packing list have been received and are in good condition.

NOTE

If any of the listed items are missing or damaged, notify the Fluke Biomedical RMS Customer Service Department.

2.2 Storage

Storage of the Victoreen instruments must comply with Level B storage requirements as outlined in ANSI N45.2.2 (1972) Section 6.1.2(.2). The storage area shall comply with ANSI N45.2.2 (1972) Section 6.2 Storage Area, Paragraphs 6.2.1 through 6.2.5. Housekeeping shall conform to ANSI N45.2.3 (1972).

Level B components shall be stored within a fire resistant, tear resistant, weather tight enclosure, in a well-ventilated building or equivalent.

Storage of Victoreen instruments must comply with the following:

1. Inspection and examination of items in storage must be in accordance with ANSI N45.2.2 (1972) Section 6.4.1.

2. Requirements for proper storage must be documented and written procedures or instructions must be established.

3. In the event of fire, post-fire evaluation must be in accordance with ANSI N45.2.2 (1972), Section 6.4.3.

4. Removal of items from storage must be in accordance with ANSI N45.2.2 (1972), Sections 6.5 and 6.6.

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Section 3
Installation

3.1 Installation

WARNING

Ensure that all power is removed, prior to connecting the field wiring.

CAUTION

Personnel performing the following procedure must be familiar with the operation of the monitoring system and the location of each piece of equipment used in the system.

CAUTION

Failure to install the equipment in accordance with the information presented in the assembly drawings could result in damage to the equipment.

NOTE

Refer to the applicable drawings in Appendix A of this manual or in the "Applicable Drawings" appendix of the pertinent system level manual.

Installation of the Model 960SG-500 Signal Generator consists of inserting the unit into a 3-bay rack chassis, providing an electrical interface, and performing an operational check. The customer is responsible for securing the monitoring equipment and for cable interconnecting. The field wiring is shown on the wiring diagrams in Appendix E of the applicable systems manual. Refer to Appendix B of this manual for the schematic diagram. Upon completion of field installation, perform a point-to-point continuity check to verify that all external wiring connections are secure. Use the pawl fastener to secure the signal generator in place.

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Section 4
Theory of Operation

4.1 Frequency Generator

Refer to Drawing 960SG-100-13, Sheet 1; Signal Generator schematic in Appendix II while reading this topic. This explanation is applicable to both signal generator circuit boards.

Crystal Y1, U7A, U7F, U7E, and associated circuitry provides the basic 2.000 MHZ frequency at an accuracy of 0.01%. The frequency is fed to four section dividers, U4, U3, U2, and U1. The four ICs produce seven separate frequencies. These frequencies are fed to U6 where they can be individually selected for generator output.

The first divider U4 is configured to divide the 2 Megahertz frequency by twelve. This produces a 167 KHz frequency. The 167 KHz frequency from U4 is fed over to U6 and U3. U3 is a dual divider configured so that each section provides a divide by ten function.

This produces two frequency outputs from U3, one 16.7 KHz and the other 1.67 KHz. The 1.67 KHz frequency is supplied to U2 where it too is divided down in much the same manner as U3, to 167 Hz and 16.7 Hz frequencies. The lower of the two frequencies from U2, 16.7 Hz, goes to U1 where it produces a 1.67 Hz and a 0.167 Hz frequency output.

The dividers are all automatically reset to zero upon signal generator power-up.

4.2 Frequency Selection and Pulse Circuits

The frequency slide switch SW1 and IC U8 makeup a decimal to BCD (binary coded decimal) encoder. When U8's selected inputs are pulled low by slide switch SW1, a corresponding binary output is produced at the outputs. These binary signals are inverted by U7B, U7C, and U7D and supplied to U6.

IC U6 is an eight channel analog input de-multiplexer. It supplies one of its analog inputs as an output to U5. The seven frequencies from the divider circuit are also supplied to U6. The binary input to U6 determines the output frequency selection as shown in Table 4-1. The output pulse frequency depends on the U6 code selection.

The output frequency selected from U6 is used to trigger U5, a one-shot multiplier. The one-shot multiplier circuit produces an 800 ns wide pulse at a rate determined by the input frequency.

Table 4-1. Example of Binary Outputs To U6

Selector Switch U8 Input	*U8 Output (Low True)	U6 Input
1 1	A 0	A 1
2 1	B 1	B 0
3 1	C 0	C 1
4 1	D 1	Not Used
5 0		
6 1		
7 1		
8 1		
9 1		

*Low true equivalent to "5"
1 = High (+5)
0 = Low (GND)

4.3 Pulse Height Circuitry

Potentiometer R24 is preset to provide a 2V amplitude pulse at the output jack. U11 functions as a unity gain voltage follower.

4.4 Preset Circuitry

The output from U5 is fed to U9, which permits the pulse to be selected either as a fixed 2V pulse or as a variable amplitude pulse. The selected preset pulse out of U9 is AC coupled via capacitor C24 and a DC restoration circuit to U10. The DC restoration circuit is comprised of CR1, CR2, and associated components. The signal is fed to U10 where the output polarity is switch selected. The signal from U10 goes to U12; the Op Amp that actually provides the signal polarity change. From U12 the pulse signal is fed to U13. Potentiometer R19 is a gain adjustment. Current driver U13 feeds the pulse to the BNC signal output jack on the front panel. The circuit output is a gain adjusted 800 ns pulse at the appropriate frequency.

4.5 Output Circuitry

The preset pulse is AC coupled via C24 with a DC restoration circuit comprised of CR1, CR2 and associated components, to U12. Current driver U13 provides the pulse to the BNC jack on the front panel. R19 is a gain adjustment for the output circuit.

4.6 Power Supply

The power requirement of 15V @ 100mA is met using an external power supply. The power supply is connected to TB1 on the rear panel of the signal generator. Regulator Q2 provides 5V power to the appropriate components.

Pin connections for TB1 are listed below:

PIN CONNECTIONS TB1

Pin	Designation
1	GND
2	-15V @ 100mA
3	+15V @ 100mA
4	GND

4.7 Power Switch and Power On Indicator

Switch SW5 is utilized to turn the unit on and off. A light emitting diode CR3 is used to indicate whether the power is on or off. The LED is on when the power switch if on.

4.8 Options

The following paragraphs describe the options available for the signal generator and their associated functions.

Variable Amplitude Adjustment – Potentiometer R30 provides a front panel adjustment of pulse amplitude from 0V to approximately 6V. Switch SW1 allows the user to select the variable adjustment or the fixed 2V pulse amplitude.

Power On Indicator – Light-emitting diode CR3 is the power On/Off indicator. It will be on when power is on and off when there is no power to the unit.

Remote Detector/Test input Multiplexer – An input for a remote switch allows the detector or the test signal to be routed to the 960SG signal output connector J5. Refer to drawing 960SG-500-5 to locate the switch. A contact closure to ground is provided for sensing of this condition by the UDR.

4.9 Operation

To operate the signal generator, the customer's enable switch (pulser control) should be closed. This freezes the ^{241}Am regulator operation and automatically switches on the 960SG Signal Generator. The signal generator can be preset or adjusted during the enable period.

The slide switch can be used to select the desired frequency. In addition, the frequency potentiometer can be adjusted to give a specific frequency between those indicated on the slide switch. The amplitude can be adjusted using potentiometer R30. It will give a pulse amplitude that will fall within the single channel analyzer window by giving a test pulse signal that can trip the HIGH Alarm. This will provide an operational check of the rate meter.

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Section 5
Maintenance

5.1 Maintenance

No periodic maintenance is required for the signal generator.

NOTE

If a maintenance question arises and cannot be resolved by using this manual, please contact the Fluke Biomedical RMS Customer Service Department at (440) 498-2564 for assistance.

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Section 6
Calibration

6.1 Calibration

The 960SG module does not require any calibration.

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Section 7
Troubleshooting

7.1 Troubleshooting

WARNING

Extreme care must be used when troubleshooting a system that has power applied. All standard troubleshooting precautions apply.

WARNING

Once a problem has been located, remove all power before continuing with the repair.

CAUTION

Personnel performing the following procedure must be familiar with the operation of the monitoring system and the location of each piece of equipment used in the system.

If a problem develops, verify that the voltages at connection point inputs and outputs are present and that all wiring is secure. Refer to Appendix B for drawings.

Troubleshoot the signal generator using the schematics provided in Appendix B and standard troubleshooting procedures.

NOTE

If a problem cannot be resolved by using the drawings in Appendix B while applying the troubleshooting instructions found in this manual, please contact the Fluke Biomedical RMS Customer Service Department at (440) 498-2564 for assistance.

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Appendix A
Connector Designators

Pin	Signal	Description
1 (INPUT)	SELECT	To ground selects test signal routed to J5 Open selects detector signal routed to J5
2	GND	To ground indicates test signal is routed to J5
3 (OUTPUT)	MODE	Open indicates detector signal routed to J5
4 (INPUT)	+15V @ 100mA	Power Supply
5 (INPUT)	-15V @ 100mA	Power Supply
6 (INPUT)	GND	Power Supply

PIN CONNECTIONS J3 "Frequency Adjust / Test Mode"

Pin	Description
1	Frequency Adjustment
2	10k Potentiometer
3	Switch to select
4	Variable frequency
5	Fixed frequency
6	Local test switch
7	GND
8	Test mode indicator

CONNECTOR J4 "Detector Input"

See Drawing 960-500-5

CONNECTOR J5 Multiplexed Signal Output"

See Drawing 960-500-5

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Appendix B
Applicable Drawings

DRAWING	DESCRIPTION
960SG-100-13	Schematic Diagram
960SG-500-5	Main Assembly
960SG-500-10	Main Circuit Board Assembly
960SG-500-20	Front Panel Assembly
960SG-500-30	Rear Panel Assembly

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Appendix C
Bills of Material

DOCUMENT	DESCRIPTION
960SG-500	Bill of Material, Dual Signal Generator
960SG-500-5	Bill of Material, Main Assembly
960SG-500-10	Bill of Material, Printed Circuit Board Assembly
960SG-500-20	Bill of Material, Front Panel Assembly
960SG-500-30	Bill of Material, Rear Panel Assembly

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