



INSTRUCTION MANUAL

SPIKE GENERATOR

MODEL SG-SUS

INSTRUCTION MANUAL

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SPIKE GENERATOR

ELECTRO-METRICS

MODEL SG-SUS

SERIAL NO: N/A

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WARRANTY

This Model SG-SUS Spike Generator is warranted for a period of 12 months (USA only) from date of shipment against defective materials and workmanship. This warranty is limited to the repair of or replacement of defective parts and is void if unauthorized repair or modification is attempted. Repairs for damage due to misuse or abnormal operating conditions will be performed at the factory and will be billed at our commercial hourly rates. Our estimate will be provided before the work is started.

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DESCRIPTION AND USE ELECTRO-METRICS MODEL SG-SUS SPIKE GENERATOR

1.0 Introduction

The SG-SUS Spike Generator is a transient event generator producing high amplitude, narrow width pulses that are coupled onto AC or DC power lines as specified by Method CS06 and RS02 of MIL-STD-461 and MIL-STD-462.

A typical electrical transient rises quickly to a peak value and then decays exponentially to zero. After the spike voltage decays to zero, the waveforms exhibit a ringing characteristic that depends on the load connected to the spike generator.

The amplitude of the output spike is variable from 0 to 600 Vpk. Three different pulse widths are available: 10.0 μ s, 5.0 μ s, and 0.15 μ s. Pulse width is defined as the time required for the output pulse (spike) to rise to a peak value and decay to zero.

The SG-SUS can inject spikes onto AC or DC power lines in variety of modes: asynchronous, synchronized, or single pulse.

2.0 Specifications

2.1 Electrical

Output Amplitude:	Adjustable 0-600 Vpk minimum into 5-ohm non-inductive load at rates of 10 pps or less.
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NOTE: Maximum output voltage will decrease at rates greater than 10 pps.

Output Ratings:

SERIES Connectors:	270 VAC @ 50 A. 500 VDC @ 30 A.
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PARALLEL Connectors:	500 VDC.
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Output Pulse Widths:	10.0 μ s, 5.0 μ s, 0.15 μ s \pm 20% into 5-ohm non-inductive load.
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NOTE: The polarity of the 0.15 μ s pulse is REVERSED with respect to the 10.0 μ s and 5.0 μ s pulses.

Amplitude Display:	LED Display, accuracy $\pm 5\%$. Indicates peak amplitude of output spike as measured into a 5-ohm non-inductive load.
Pulse Repetition Rate:	
SYNC MODE:	
Internal/External:	1-10 pps.
FREE RUN MODE:	
Internal:	0.5-50 pps.
External:	>0-50 pps.
SINGLE PULSE MODE:	Manually generated, pushbutton.
Pulse Positioning:	Positioning range of 1 to 10 pps pulse is adjustable over 360° range of power frequencies from 50 to 800 Hz when in SYNC mode.
Power Requirements:	115/230 VAC, 50-60 Hz ($\pm 10\%$) (Factory selectable only)
	1.0 A at 115 VAC.
	0.5 A at 230 VAC.

2.2 Mechanical

Height:	203 mm (8") with cover. 127 mm (5") without cover.
Depth:	406 mm (16")
Width:	229 mm (9")
Weight:	7 kg (15.5 lbs)

3.0 Power Supply

NOTE: The following voltage/fuse selections are factory selectable only.

3.1 Power Requirements

- a. AC Power Sources:
 - 1) 115 VAC, 50-60 Hz, 1.0 A.
 - 2) 230 VAC, 50-60 Hz, 0.5 A.

3.2 Fuse Specifications

- a. 115 VAC operation: 1.0 A Slow-Blow.
- b. 230 VAC operation: 0.5 A Slow-Blow.

4.0 Description

4.1 Front Panel Controls

- a. **Power Switch**

Type: Two position toggle switch.

Function: Self-explanatory.

- b. **Amplitude Control**

Type: Variable transformer.

Adjusts the peak output spike voltage of the SG-SUS from 0-600 V.

NOTE: At repetition rates greater than 10 pps, the maximum output voltage will decrease.

- c. **Start Switch**

Type: Momentary pushbutton switch.

Function: To enable the SG-SUS output.

- d. **Stop Switch**

Type: Momentary pushbutton switch.

Function: To disable the SG-SUS output.

- e. **Pulse Width Switch**

Type: Three position rotary switch.

Function: To select one of three pulse widths: 10.0 μ s, 5.0 μ s, 0.15 μ s.

NOTE: The polarity of the 0.15 μs pulse is **REVERSED** with respect to the 10.0 μs and 5.0 μs pulses.

f. Internal/External Switch

Type: Two position toggle switch.

Function: To select either internal or external synchronization/trigger.

g. Rate Control

Type: Hot molded carbon, single turn, 320° rotation, 1 M Ω .

Function: To adjust the output pulse rate from minimum to maximum.

h. AMPLITUDE INDICATOR

Type: Three digit LED display.

Color: Red.

Function: Indicates the peak output amplitude, accuracy $\pm 5\%$.

i. Mode Switch

Type: Three position rotary switch.

Function: To select either the FREE RUN, SYNC, or SINGLE PULSE modes of operation.

j. Pulse Position Control

Type: Hot molded carbon, single turn, 320° rotation, 1 M Ω .

Function: To adjust the SG-SUS output through 180° of the power frequency sine wave.

k. Pulse Phase Switch

Type: Two position toggle switch.

Function: To select complementary 180° ranges of power line frequency sine wave.

l. EXT SYNC Switch

Type: Two position toggle switch.

Function: To select the power frequency range (50-200, 200-800) for the SG-SUS.

m. Single Pulse Switch

Type: Momentary pushbutton switch.

Function: To generate the single pulse output for the SG-SUS.

4.2 Front Panel Connectors

a. AC Power Connector

Type: Integrated AC power connector with RFI power line filter.

Function: Self explanatory.

b. AC Fuse Holder

Type: Front panel low profit mount, slot knob style.

Current Rating: 20 Amp.
Voltage Rating: 250 VAC.

Function: Self explanatory.

c. Series Output Connectors

Type: Superior receptacles (red)(270 VAC @ 50 A/500 VDC @ 30 A rating) and corresponding plugs.

Quantity: Two (2).

Function: Series injection of spikes on DC or AC power lines.

d. Parallel Output Connectors

Type: Two three-way binding posts (red and black)(500 VDC).

Function: To inject spikes in parallel with a DC power line.

e. External Sync/Trigger Input Connector

Type: BNC, female.

Function: For external synchronization or triggering of the SG-SUS.

f. Trigger Output Connector

Type: BNC, female.

Function: Trigger pulse is synchronized to the SG-SUS output pulse event. Can be used to synchronize an oscilloscope to the SG-SUS output pulse.

5.0 Operating Instructions

5.1 Power Up Procedure

Connect the AC power cord between the front panel AC power connector and the selected AC power source. Turn on the unit and allow a minimum warm-up time of 10 minutes.

5.2 Output Disable Function

The output pulse is automatically disabled as follows:

- a. Whenever the SG-SUS is turned on,
- b. Switching to a different **Mode** setting,
- c. Switching to a different **Pulse Width**,
- d. Whenever the **Internal/External** Switch is toggled,
- e. Whenever the **Stop** Switch is pushed.

To enable the output pulse, push the **Start** pushbutton.

CAUTION

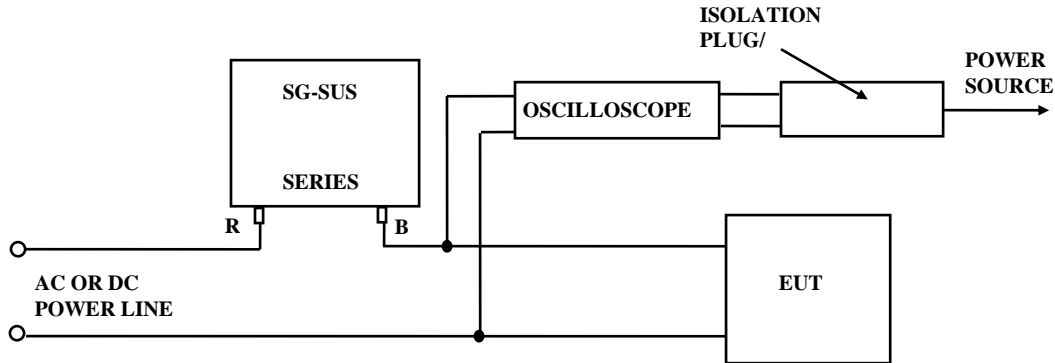
Always turn OFF the SG-SUS or push the STOP Switch to disable the output circuitry before working on or around the OUTPUT CONNECTORS (SERIES, PARALLEL). This includes working on equipment or circuitry connected to the OUTPUT CONNECTORS.

5.3 Series Injection

To inject a spike in series with the AC or DC power lines use the setup shown in Figure 1. The large Superior pin and receptacle connectors, marked SERIES, are used.

The SERIES terminals are rated for 50 A of power frequency current.

An oscilloscope (with sufficient bandwidth) may be used to monitor the output of the SG-SUS as shown in Figure 1. Since the oscilloscope ground is normally referenced to the power line ground, it is necessary to isolate the oscilloscope ground from the power line ground. An isolation plug or transformer can be used.



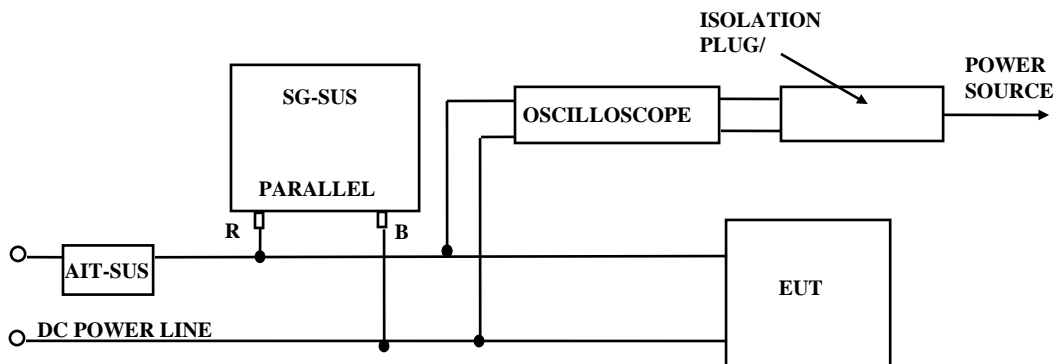
**FIGURE 1
SERIES INJECTION TEST SETUP**

5.4 Parallel Injection

CAUTION

DO NOT ATTEMPT to use PARALLEL INJECTION on AC power lines. PARALLEL INJECTION is used on DC power lines ONLY. Using PARALLEL INJECTION on AC power lines will SEVERELY DAMAGE the SG-SUS output circuitry.

To inject a spike in parallel with DC power lines, use the setup shown in Figure 2. The three way binding post connectors, marked PARALLEL--DC ONLY, are used [red (+), black (-)].



**FIGURE 2
PARALLEL INJECTION TEST SETUP**

As noted in 5.3 for the SERIES test setup, an oscilloscope can be used to monitor the SG-SUS output with the provision of being isolated from the power line ground.

Note that an inductor must be placed in series with one line of the DC power source. DC power sources typically have a low output impedance that would load down the SG-SUS output circuitry. A series inductor makes the DC power source appear as a high impedance to the SG-SUS.

NOTE: To reverse the polarity of the SG-SUS output spike in **SERIES** or **PARALLEL INJECTION** mode, reverse the connections on the respective terminals.

5.5 Amplitude Control And Display

The peak amplitude level of the SG-SUS is set using the front panel **AMPLITUDE CONTROL**. The amplitude can be adjusted with the output either *enable* or *disabled*.

NOTE: 1) When the output is **ENABLED**:

The LED display will lag in indicating the actual output level as the **AMPLITUDE CONTROL** is varied, since the display is updated with each discharge.

2) When the output is **DISABLED**:

The LED display will indicate on a real time basis the actual output level as the **AMPLITUDE CONTROL** is varied.

The magnitude of the output voltage spike is indicated using a front panel three digit LED display. The voltage indicated represents the output amplitude that would be generated with a 5-ohm resistor connected across the output terminals .within an accuracy of $\pm 5\%$.

WARNING

If the AMPLITUDE indication is observed to suddenly drop to 0 V, IMMEDIATELY press the STOP Switch or turn OFF the unit.

Check the load connections, this condition may be the result of improper load connections, e.i wrong ground, setup, etc.

5.6 Mode Selection

The SG-SUS output pulse frequency and synchronization are controlled using the front panel MODE Switch and INT/EXT Switch.

With the MODE Switch set to FREE RUN and the INT/EXT Switch set to INT, the SG-SUS output pulse rate is controlled by an internal asynchronous trigger. The RATE CONTROL is used to vary the pulse rate from 0.5 to 50 pps.

If the INT/EXT Switch is set to EXT, an external trigger/synchronous source is used to control the pulse rate of the SG-SUS (Figure 3).

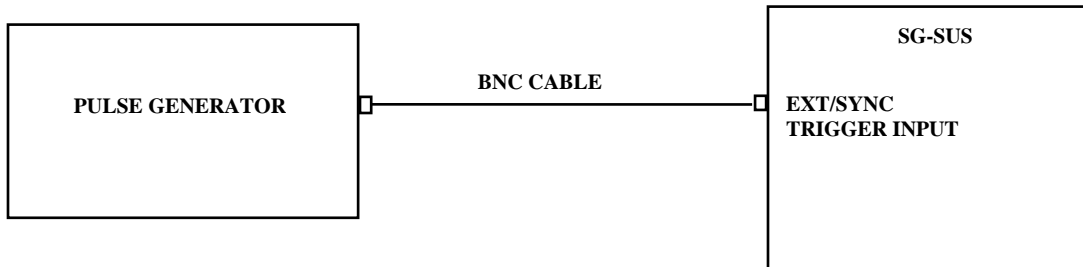


FIGURE 3
EXTERNAL TRIGGER/SYNC INPUT SETUP

NOTE The pulse generator should have a TTL/CMOS compatible output. The trigger pulse width may vary from 50 μ s to 10 ms. The maximum trigger pulse rate is 50 pps. **If pulse rates higher than 50 pps are used, SEVERE DAMAGE to the internal SG-SUS circuitry will occur.**

With the MODE Switch set to SYNC and the INT/EXT Switch set to INT, the SG-SUS output pulse is synchronized to the SG-SUS power line frequency (50 or 60 Hz).

The RATE CONTROL is used to vary the pulse rate from 1 to 10 pps. If the INT/EXT Switch is set to EXT, the SG-SUS output pulse is synchronized to an external power frequency from 50 to 800 Hz (Figure 4).

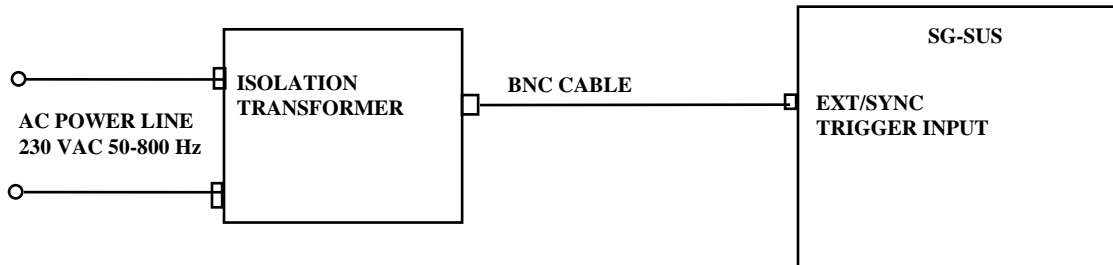


FIGURE 4
EXTERNAL POWER FREQUENCY SYNCHRONIZATION SETUP

Note that an isolation transformer, with appropriate voltage step-down to TTL levels, must be used to convert the power lines to the levels required

for the SG-SUS EXT/TRIGGER INPUT (BNC connector). The RATE CONTROL adjusts the output pulse rate from 1 to 10 pps.

With the MODE Switch set to SINGLE PULSE, the SG-SUS generates one output pulse each time the SINGLE PULSE pushbutton is pressed.

5.7 Pulse Positioning

When the SG-SUS is used for SERIES INJECTION onto AC power lines, the output pulse can be synchronized to any point (0-360°) of the power line frequency sine wave.

The MODE Switch should be set to SYNC. To position the output pulse onto the SG-SUS power line frequency, set the INTENT Switch to INT. The PULSE POSITION CONTROL will vary the output pulse through 180° of the power line frequency sine wave. Toggling the PHASE Switch will allow the PULSE POSITION CONTROL to vary the output pulse through the complementary 180° of the power line frequency sine wave providing a full 360° range.

To allow the use of the pulse positioning feature for power line frequencies not common to the SG-SUS power line frequency, set the INT/EXT Switch to EXT. External synchronization must be used as shown in Figure 4. For power line frequencies from 50 to 200 Hz, set the EXT SYNC Switch to 50-200. For power line frequencies from 200 to 800 Hz, set the EXT SYNC Switch to 200-800. Pulse positioning is accomplished as described in preceding paragraph. In either EXT SYNC Switch setting (50-200, 200-800), the full range of the POSITION CONTROL is used for the lowest stated power frequency (i.e 50 Hz for 50-200 and 200 Hz for 200-800). As the power frequency increases, only part of the POSITION CONTROL is used to adjust the output pulse through 180° of the power line frequency sine wave.

5.8 Trigger Output

The TRIGGER OUTPUT is a pulse that is synchronized to the SG-SUS output pulse event. It can be used to synchronize an oscilloscope to the SG-SUS output pulse occurrence.