

INSTRUCTION MANUAL
for
**TELECOM LINE
SURGE GENERATOR**

Model: **SGTEL-168**



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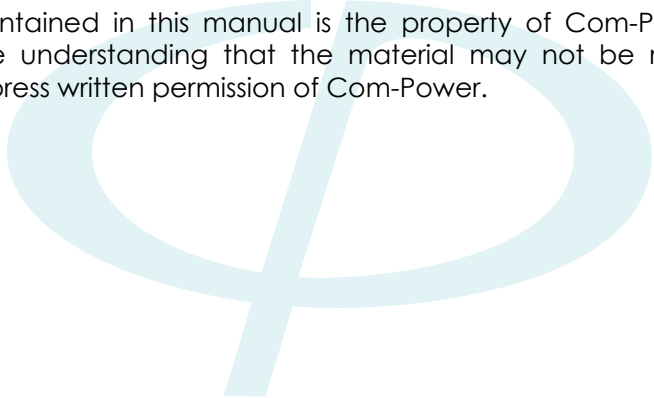
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1.0 Introduction

This manual includes descriptions of front and rear panel ports, controls and indicators; product specifications, safety precautions, operational instructions and warranty information and guidelines and instructions for its proper usage.

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2.0 Products Available from Com-Power



www.com-power.com

3.0 Product Information

3.1 Incoming Inspection

WARNING – To avoid possibility of electrical shock, do not apply power to the Com-Power SGTEL-168 if there is any evidence of shipping damage. If shipping damage to the product or any of the accessories is suspected, or if the package contents are not complete, contact Com-Power or your Com-Power distributor.

Please check the contents of the shipment against the package inventory in section 3.2 to ensure that you have received all applicable items.

3.2 Package Inventory

STANDARD ITEMS:

- ✓ **SGTEL-168 Telecom Line Surge Generator**
- ✓ **Safety Interlock Port Key** (4-pin, 7mm, Push-Pull plug)
- ✓ **4-pin, 7mm, Push-Pull Plug Connector**
(for optional connection of remote switch for safety interlock)
- ✓ **IEC Power Cord (NEMA 5-15R-male to IEC C13-female)**
(for SGTEL-168 system power input)
- ✓ **ABB 216C6 16A IP44 Connector**
(for SGTEL-168 connection to supply for EUT power)
- ✓ **Calibration Certificate and Data**

OPTIONAL ITEMS:

- ✓ **OTA-232 Optical Transceiver Adapter**
 - ✓ **Fiber Optic Cable** (Duplex Latching POF Connector at each end)
 - ✓ **USB Cable** (USB Type A to USB Type B)
- ✓ **TransWare™-168 PC Software on CD**
(for remote operation of generator via fiber optic interface)

3.3 Product Safety Information

3.3.1 Product Hazard Symbols Definitions

The hazard symbols appearing on the product exterior are defined below.



The yellow triangle with an exclamation mark indicates the presence of important operating and/or maintenance (servicing) instructions in the literature accompanying the product.



The yellow triangle with a lightning bolt indicates an alert to the user that uninsulated **dangerous voltages** are present within the product enclosure and on output connectors. These voltages may be of sufficient magnitude to constitute a risk of electric shock to persons.

3.3.2 Product Warning/Caution Statements

WARNING: TO PREVENT ELECTRIC SHOCK, DO NOT OPEN COVER. SERVICING ONLY BY QUALIFIED PERSONNEL. NO USER SERVICEABLE PARTS INSIDE

CAUTION: FOR CONTINUED PROTECTION AGAINST RISK OF FIRE, REPLACE ONLY WITH THE SAME TYPE AND RATING OF FUSE.

3.3.3 General Safety Instructions

The following safety instructions have been included in compliance with safety standard regulations. Please read them carefully.

- **READ AND RETAIN INSTRUCTIONS** - Read all safety and operating instructions before operating the instrument. Retain all instructions for future reference.
- **HEED WARNINGS** - Adhere to all warnings on the instrument and operating instructions.
- **FOLLOW INSTRUCTIONS** - Follow all operating and use instructions.
- **WATER AND MOISTURE** - Do not use the instrument near water.
- **WALL OR CEILING MOUNTING** - Do not mount the instrument on a wall or ceiling.
- **VENTILATION** - The instrument should be situated so that its location or position does not interfere with its proper ventilation. Do not install in a cabinet or in other situations that may impede the flow of air through the ventilation openings.
- **HEAT** - The instrument should be situated away from heat sources such as heat registers or other instruments which produce heat.
- **POWER SOURCES** - Connect the instrument only to the type of power source described in the operating instructions or as marked on the instrument.
- **GROUNDING AND POLARIZATION** - Take precautions to insure that the grounding of the instrument is not defeated. Operate only with a grounded power cord.
- **POWER CORD PROTECTION** - Place power supply cords so that they are not likely to be walked on or pinched by items placed on them or against them.
- **CLEANING** - Clean the instrument only as recommended by the manufacturer.
- **NON-USE PERIODS** - Unplug the power cords of the instrument when it will be left unused for a long period of time.
- **OBJECT AND LIQUID ENTRY** - Take care that objects do not fall and that liquids are not spilled into the enclosure through openings.
- **DEFECTS AND ABNORMAL STRESS** - Whenever it is likely that the normal operation has been impaired, make the equipment inoperable and secure it against further operation.
- **DAMAGE REQUIRING SERVICE** - Instrument should be serviced by qualified personnel when:
 - ✓ The power supply cord or the plug has been damaged.
 - ✓ Objects have fallen or liquid has been spilled into the instrument.
 - ✓ The instrument has been exposed to rain.
 - ✓ The instrument does not appear to operate normally.
 - ✓ The instrument has been dropped, or the enclosure has been damaged.
- **SITTING OR CLIMBING** - Do not sit or climb upon the instrument or use it as a step or ladder.

3.3.4 Safety Guidelines During Surge Testing

- Do not work alone.
- Do not use the equipment in conditions other than reasonable laboratory conditions. There should be no condensing humidity or water standing on the floor or work surfaces; there should not be significant dust or other contamination.
- Ensure that no one is touching the equipment under test (EUT) during the test or immediately after the test until AC power to the EUT has been turned off.
- Ensure that there is a barrier to act as protection in case the equipment under test explodes. The barrier should be interlocked to prevent surging and to disconnect all AC if the barrier is removed.
- The equipment under test must be surrounded by sufficient insulating material to withstand twice the surge voltage. Consider distance to the floor or table and walls if air is the insulating material.
- Ensure that the proper supply mains voltages are applied to both Com-Power equipment and to the equipment under test, and that the AC branch circuit is capable of supplying the current.
- The ground (protective earth), neutral and phase lines of the AC supply to the equipment under test (EUT) and Com-Power equipment must be connected properly. Do not defeat the protective earth connection.
- When surging a powered EUT, the mains supply to the equipment under test must be capable of handling the potential AC fault current (e.g. do not use a UPS to power the EUT).
- Never surge an AC mains line other than through the EUT output connector or compatible Com-Power single-phase or three-phase coupler.
- Use only equipment which is designed to be safe for the test being performed.
- Do not test in a potentially explosive atmosphere (e.g. where there are gas fumes).
- Never use equipment that is operating in a strange manner, or that shows clear indication of abuse.
- If probes are in use, be sure they are differential probes which have no ground connection to the surged ground or to the equipment under test.

3.3.5 Safety Concerns During Surge Testing

Surge testing is hazardous. The equipment under test (EUT) can ignite, possibly explosively. Noxious, toxic and sometimes fatal fumes can be generated by the burning equipment. Accumulated gases may ignite explosively (i.e., flashover).

In an environment where surge testing takes place, it is absolutely crucial that these minimum safety precautions be taken:

- Surge testing should be performed only by properly trained test personnel who are experienced in conducting such tests, or be observed and supervised by such experienced personnel. No person subject to heart or neurological conditions should be allowed to conduct surge tests. Persons with pacemakers should not be allowed in or near the area where testing is conducted.
- Never leave a procedure or a test setup unattended.
- All personnel working in the area must be shielded with appropriate eye protection, body protection and electrical protection. They should not be allowed to work in a direct line of a possible explosion of the equipment under test.
- The test area should be a clear and unobstructed environment dedicated to such tests.
- The test area should be equipped with ventilating hoods and blowers to remove gases that may be caused by exploding or burning components.
- The test area should have nonflammable walls and floors plus shielding to contain exploding parts and flames.
- There must be fire extinguishers certified for use in electrical and chemical fires readily available at the test site. **DO NOT USE WATER TO EXTINGUISH AN ELECTRICAL FIRE.**
- All flammable materials and debris must be outside the test area, and the area must be well marked, preferably by physical barriers, to prevent accidental intervention by non-test personnel while a test is in progress.

3.4 Product Connections/Controls

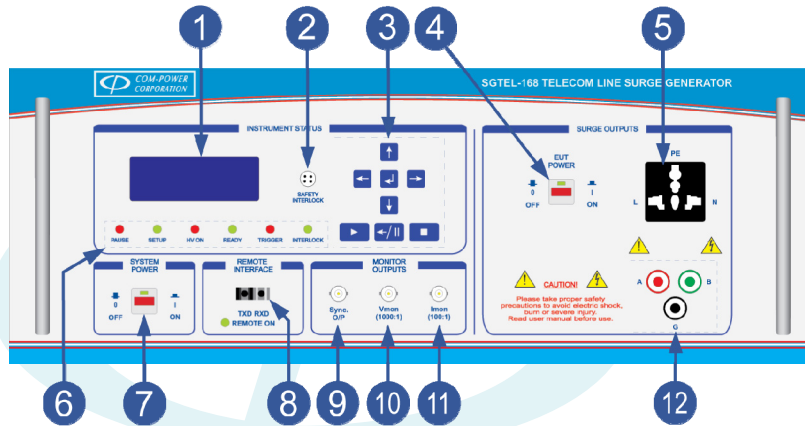


FIGURE 1 - Product Connections/Controls Diagram – Front Panel

- 1 LCD Display**
- 2 Safety Interlock Port**
This is a safety interlock port. Refer to section 4.2.1 for details.
- 3 Control Keypad**
For locally controlling the generator. Refer to section 6 for details.
- 4 EUT Power Switch**
This switch, in conjunction with the *TransWare™* EUT power enable function, are used to disable/enable EUT power at the front panel AC receptacle.
- 5 Surge Output Port - EUT Power Receptacle**
This is the EUT port of the internal coupling/decoupling network (CDN). Power line surges, as well as EUT input power is provided through this port.
- 6 Instrument Status LED Indicators**
These six LED indicators provide the present instrument status for the SGTEL-168.
- 7 System Power Switch**
This switch toggles ON/OFF the SGTEL-168 surge generator.
- 8 Fiber Optic Connector for Remote Interface**
The SGTEL-168 can be remotely controlled by a computer using Com-Power's *TransWare™* software, via this port. See section 4.2.2 for details.
- 9 Sync Monitor Output Port**
The sync output port connects to the external trigger input on an oscilloscope.
- 10 Voltage Monitor Output Port**
This port can be connected to an oscilloscope for verification of surge output.
- 11 Current Monitor Output Port**
This port can be connected to an oscilloscope for verification of current waveform.
- 12 (A,B,G) Surge Output Ports**
For non-powerline applications, EUT lines to be tested may be directly connected to these ports, to which the surges are applied directly (not capacitively coupled). When an external powerline CDN is used, the surge output is coupled to the (A/B) terminals, which connect to the external CDN via a dual conductor cable.

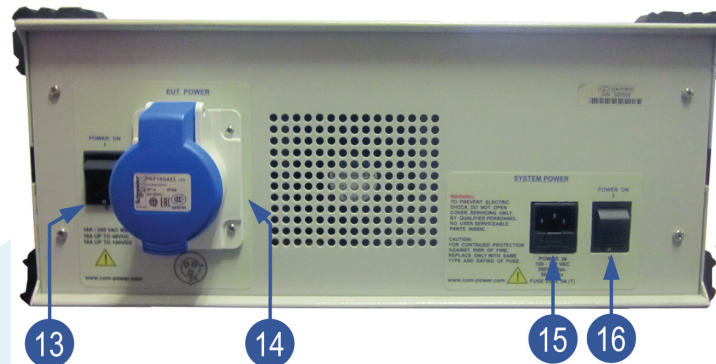


FIGURE 2 - Product Connections/Controls Diagram – Rear Panel

- 13 EUT Power Entry Switch**
Toggles on/off EUT power at the rear entry point, where the EUT power source enters the generator.
- 14 EUT Power Input Port**
This port connects to the EUT power source. See section 3.5 for input power specifications.
- 15 SGTEL-168 System Power Input Port**
This port connects to the power source for the generator. See section 3.6 for input power specifications.
- 16 SGTEL-168 System Power Switch**
This switch toggles on/off the SGTEL-168 system input power. When this switch is in the 'ON' position, the system may be turned on/off using the System Power Switch, located on the front panel **7**.

3.5 Product Specifications

Output Waveform Parameters

Surge Type	Open Circuit Voltage - V_{pk} (Volts)	Rise Time - T_r (μ s)	Decay Time - T_d (μ s)	Short Circuit Current - I_{pk} (Amps)	Rise Time - T_r (μ s)	Decay Time (μ s)
Type A – $\pm 800V$ (metallic)	800 - 880	6 - 10	560 - 860	100 - 115	5 - 10	560 - 760
Type A – $\pm 1500V$ (longitudinal)	1500 - 1650	6 - 10	160 - 260	200 - 230	5 - 10	160 - 210
Type B – $\pm 1000V$ (metallic)	1000 - 1100	9 \pm 2.7	720 \pm 144	25 - 27.5	5 \pm 1.5	320 \pm 64
Type B – $\pm 1500V$ (longitudinal)	1500 - 1650	9 \pm 2.7	720 \pm 144	37.5 - 41.3	5 \pm 1.5	320 \pm 64
Powerline – $\pm 2500V$ (Line to Neutral)	2500 - 2750	1 - 2	10 - 19	1000 - 1250	1 - 2	10 - 19

Monitor Ports

Voltage Monitoring Port (V_{mon})	1000:1 \pm10% ($V_{(actual)} = V_{(measured)} * 1000$)
Current Monitoring Port (I_{mon})	100:1 \pm10% ($I = V_{(measured)} * 100$) [0.01 Volts/Amp]
Sync Output Port	0-5 V_{DC}

Electrical

System Power Input	100-250 V_{AC} (rms), 50/60 Hz (300 VA Max.)
Fuse Type	5 Amps (T)
EUT Power Input	250 V_{AC} (rms) (maximum), 50/60 Hz (16A Max.) 100 V_{DC} (maximum) 16 Amps up to 48 V _{DC} , 10 Amps up to 100 V _{DC}

Input/Output Connections

EUT Power Input Port	ABB 216B6 16A IP44 Socket Inlet (mating connector provided)
SGTEL-168 System Power Input Port	IEC C13 Receptacle
EUT Power Output Port	Universal Multi-Configuration AC Socket
Safety Interlock Port	4-pin, 7mm Receptacle (mating push-pull plug provided)
Fiber Optic Port	Avago Duplex Latching POF jack
(A/B/G) Surge Output Ports	(3) 4mm banana safety sockets
Monitor Output Ports	(3) BNC-type (female)

Mechanical

Dimensions (H)x(W)x(D)	(4U) 7.75" x 19" x 24.25" (19.7 x 48.3 x 61.6 cm)
Weight	61 lbs (27.7 kg)

Environmental

Operating Temperature	40°F to 104°F (5°C to 40°C)
Cooling	Forced Air (integral fan)

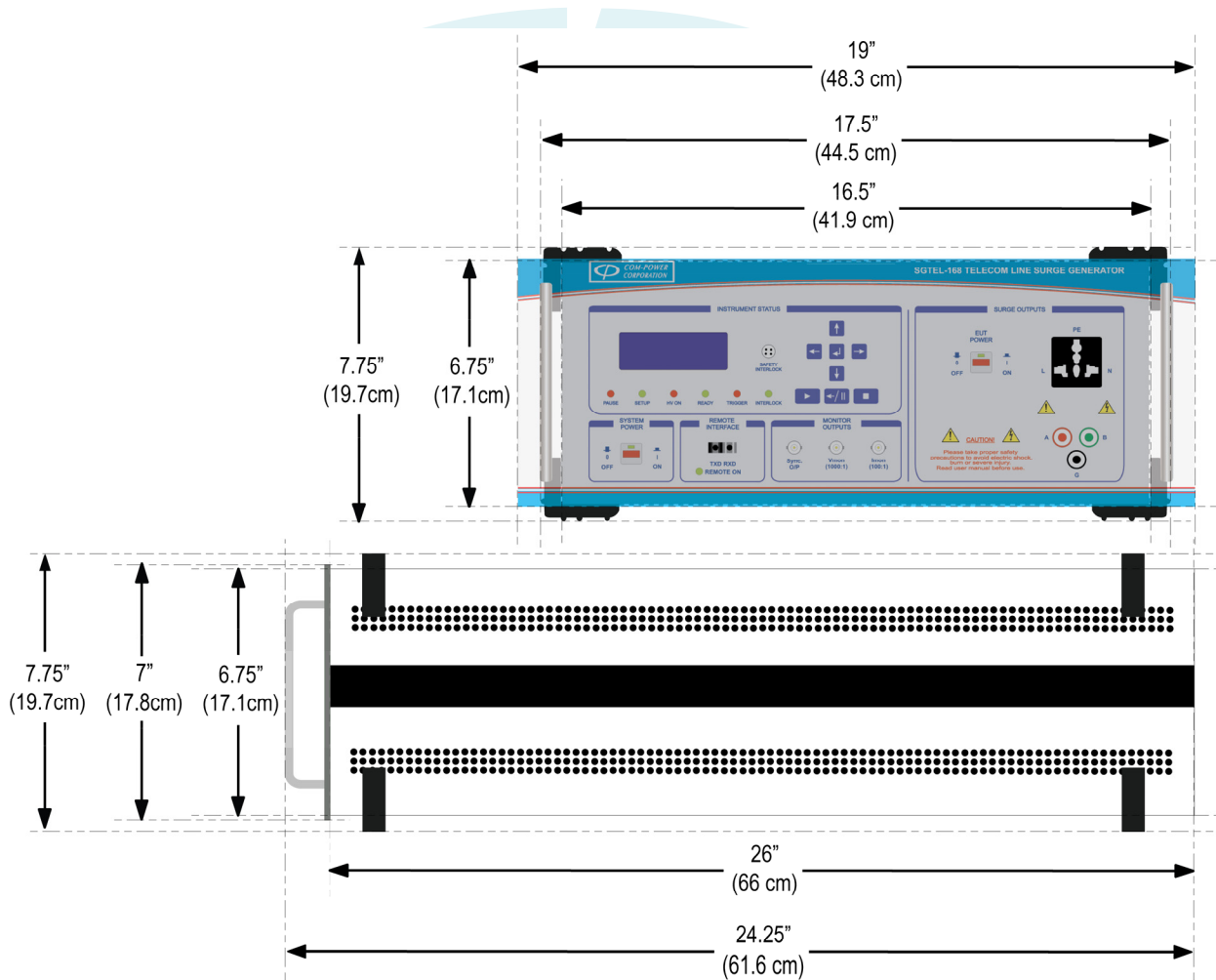


FIGURE 3 - Product Dimensions

4.0 Setting up the SGTEL-168

In the following sections, guidance is provided pertaining to the external electrical connections/interconnections of the SGTEL-168 System and accessories. The guidance is given on a port-by-port basis.

4.1 Input Power Line Ports

WARNING - DO NOT EXCEED THE RELEVANT INPUT POWER SPECIFICATIONS DETAILED IN SECTION 3.5 AND ON THE REAR PANEL OF THE GENERATOR ITSELF.

4.1.1 SGTEL-168 System Power Input Port



The SGTEL-168 requires the following power source:

Voltage:	100-250 V _{AC}
Frequency:	50/60 Hz
Power:	300VA Maximum

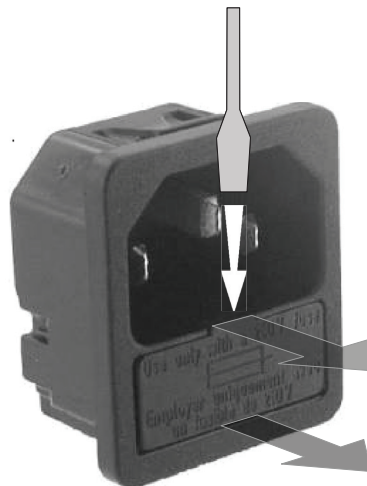
In accordance with international safety standards, this instrument is equipped with a three-wire power cable. When connected to an appropriate AC power outlet, this cable grounds the instrument frame.

WARNING: For protection from electrical shock, the power cable ground must not be defeated.



The power plug must be plugged into an outlet that provides a protective earth ground connection.

4.1.1.1 System Power Input Port Fuse



To access fuse, insert the end of a small flat-blade screwdriver into the slot as shown in Figure 4 to open the compartment.

Replace fuse only with same type and rating [250V, 5A (T)]. After replacing fuse, slide fuse holder firmly back into position within its cavity.

FIGURE 4 - Accessing the Input Power Fuse

4.1.2 Equipment Under Test (EUT) Power Input Port



ONLY AFTER the SGTEL-168 is turned on, the power source which will power the Equipment Under Test (EUT) is to be connected to this input port through the provided, blue-colored AC power connector (wiring not included).

Illustrated in Figure 5 below are the wiring instructions for the connector.

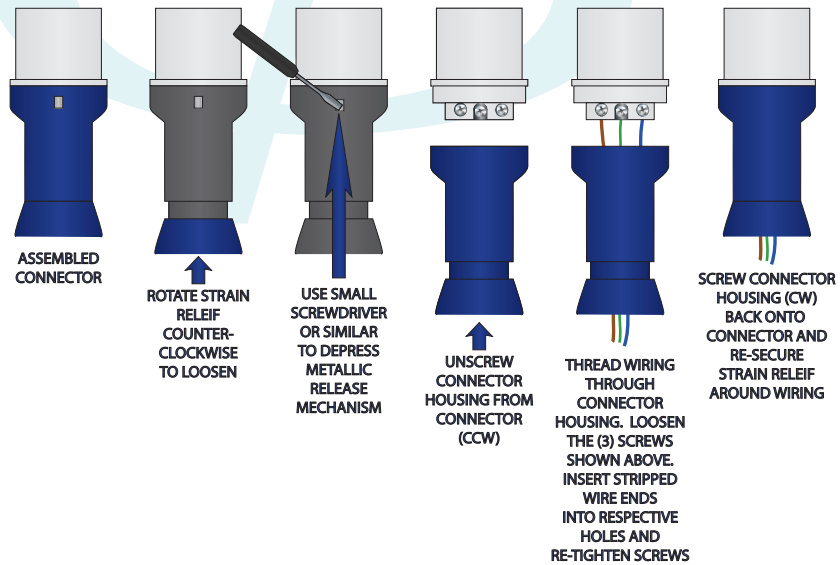


FIGURE 5 - Wiring Procedure for EUT Power Input Plug

The EUT power may be AC or DC. DO NOT EXCEED THE RATINGS FOR THIS PORT DETAILED IN SECTION 3.5 AND/OR THE RATINGS DISPLAYED ON THE SGTEL-168 GENERATOR.

WARNING: TO AVOID POSSIBLE DAMAGE TO YOUR SGTEL-168 SURGE GENERATOR, DISCONNECT POWER FROM EUT POWER INPUT PORT WHEN POWERING ON OR OFF THE GENERATOR.

4.1.2.1 Turning ON/OFF EUT Power – LOCAL Control

When the SGTEL-168 is NOT under software control, the EUT power state is controlled via the front and rear panel EUT POWER switches. If the EUT power input port is connected to an active source, power is available at the EUT POWER OUTPUT port when both the rear panel and front panel switches are turned on.


The SGTEL-168 surge generator will automatically check the EUT power status at the start of any test or test sequence which includes surges applied to its internal CDN output terminals.

If the EUT power is not enabled on the SGTEL-168 front panel, the following message will be displayed:

```
      E U T   P O W E R  
    N O T   T U R N E D   O N  
  
▶ C O N T I N U E       ■ A B O R T
```

If the SGTEL-168 uses an power frequency phase detection circuit to determine whether AC power is present at the EUT power port. If AC power is not detected, and EUT power is enabled on the front panel, the following message will be displayed:

```
    A C   P H A S E   R E F E R E N C E  
      N O T   D E T E C T E D  
  
▶ C O N T I N U E       ■ A B O R T
```

If it is your intention to run the test without the presence of AC power, as would typically be the case during waveform verification, for instance; choose the CONTINUE option by pressing the  button, and the test will begin.

Otherwise, choose the ABORT option by pressing the  button to abort the test. After correcting the problem, restart the test.

4.1.2.2 Turning ON/OFF EUT Power – REMOTE Control

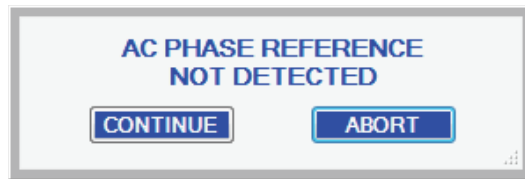
When the SGTEL-168 is under remote control using the TransWare™ software, the EUT power state is controlled via the front and rear panel EUT POWER switches, in addition to the EUT POWER function located on the Control Panel within the TransWare™ software. When the SGTEL-168 front panel EUT POWER switch is turned on, the EUT power status in the TransWare™ Control Panel will change from “OFF” to “READY”. At this point, the EUT power output can be turned on by pressing the TransWare™ EUT POWER button.


The SGTEL-168 surge generator will automatically check the EUT power status at the start of any test or test sequence which includes surges applied to its internal CDN output terminals.


If the EUT power is not enabled on the SGTEL-168 front panel, the following message will be displayed:



If the SGTEL-168 uses an power frequency phase detection circuit to determine whether AC power is present at the EUT power port. If AC power is not detected, and EUT power is enabled on the front panel, the following message will be displayed:



If it is your intention to run the test without the presence of AC power, as would typically be the case during waveform verification, for instance; choose the CONTINUE option by pressing the  button, and the test will begin.

Otherwise, choose the ABORT option by pressing the  button to abort the test. After correcting the problem, restart the test.

4.2 Input/Output Ports

4.2.1 Safety Interlock Port



The safety interlock port (left) can (optionally) be used to disable the surge generator output for safety reasons using an external switch, such as the door contacts of the test chamber, for instance. **In cases where no interlock switch is used, simply connect the safety interlock key (right) to this port to enable the generator.**



For those cases where use of an external switch as the safety interlock is desired, simply wire your switch contacts to pins 2 and 3 of the supplied, spare 7mm push-pull connector as shown in Figure 6. Remove the interlock key from the SGTEL-168 interlock port, and plug in the switch assembly, and the generator will now be enabled/disabled with the opening/closing of the switch contacts.

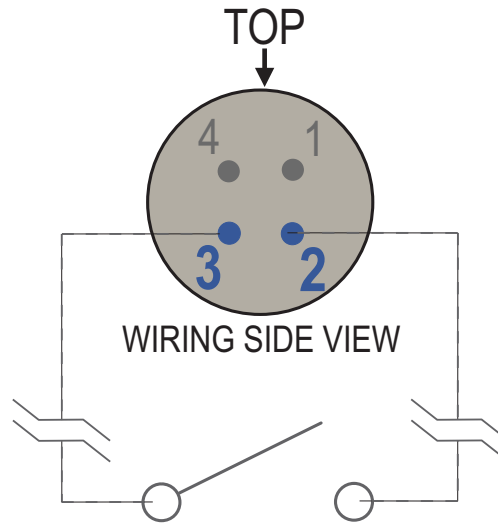
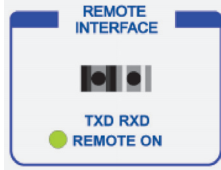


FIGURE 6 - Safety Interlock Connector Pin-Out & Ext. Switch Connection

4.2.2 Fiber Optic Port



The SGTEL-168 surge generator can optionally be remotely controlled by a computer via the fiber optic remote interface, using Com-Power's *TransWare™* software.

4.2.2.1 Setting up the Remote Interface

As shown in Figure 7, connect the supplied fiber optic cable into the fiber optic port on the front of the SGTEL-168. Connect the opposite end of the fiber optic cable into the powered OTA-232 Optical Transceiver Adapter. Finally, connect the OTA-232 Adapter to a computer with the Com-Power *TransWare™* software installed.

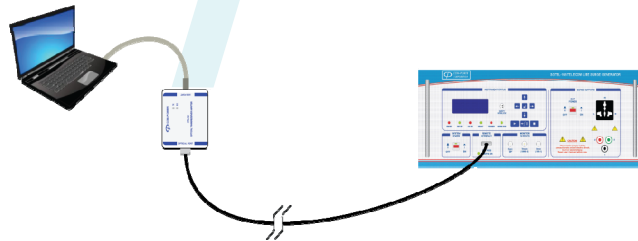


FIGURE 7 - Remote Interface Setup Example

Once connection has been made between the computer and the SGTEL-168, the following message will appear on the front panel display of the generator:

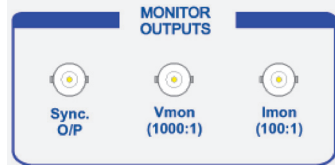


If the *TransWare™* software is closed, or the link is broken, the following message will be will appear on the front panel display of the generator:



Refer to section 7 for instructions for controlling the SGTEL-168 Surge Generator via the *TransWare™* software.

4.2 Monitor Ports



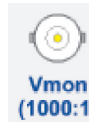
The monitor ports provide a convenient method for verification various surge waveform parameters, and triggering of oscilloscope measurements.

4.3.1 Sync Output Port (Sync. O/P)



The SYNC OUTPUT port is provided as an alternative method of triggering the oscilloscope measurement. The SYNC OUTPUT port connects directly to the external trigger input of any oscilloscope. The output is 5 VDC steady state, and drops to zero volts for a period of 20 ms when the surge generator output is discharged.

4.3.2 Voltage Monitor Port (V_{mon})



The Voltage Monitor Port (V_{mon}) is intended to be connected to a high impedance (>10k Ω) input of an oscilloscope for verification of peak surge voltage for all waveforms. The output scaling is 1V / 1000V (1000:1 ratio).

This port provides a convenient method by which the *open circuit** surge output voltage can be verified. The peak output voltage measured at this port is representative of the voltage at the surge output terminals with a typical accuracy within $\pm 10\%$.

However, the actual wave shape of the surge waveform may become distorted; and therefore this port should not be used for measurement of other parameters, such as rise time or decay time. These parameters must be measured at the surge output terminals.

4.3.3 Current Monitor Port (I_{mon})

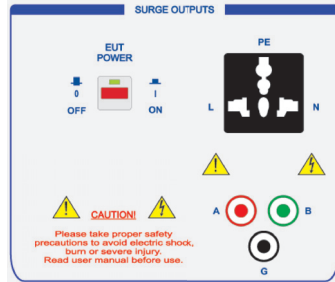


The Current Monitor Port (I_{mon}) is intended to be connected to a high impedance (>10k Ω) input of an oscilloscope for verification of peak surge current for all waveforms. The output scaling is 1V / 100V (100:1 ratio).

This port provides a convenient method by which the *short circuit** surge output current, rise and decay time can be verified. The waveform parameters measured at this port are representative of those at the surge output terminals, with a typical accuracy within $\pm 10\%$.

* Measurements at these ports are within the stated accuracy for open circuit voltage measurements and short circuit current measurements. Open circuit measurements are performed with no external connections to the surge output terminals; while short circuit current measurements are performed with the surge output terminals short circuited. Measured values will vary with alternate terminations (with the EUT connected, for instance).

4.4 Surge Generator Output Ports



Type A and Type B surges are applied at its (A/B/G) output ports. Powerline surges can be applied either to its internal power line coupling/decoupling network (CDN) output port, or to a supported external power line CDN via its (A/B) output ports.

The (A/B/G) output ports are fitted with 4 mm safety sockets.

The internal power line CDN output port is fitted with a Universal Multi-Configuration AC Socket.



CAUTION: Due to the presence of **DANGEROUS VOLTAGES**, the user should avoid all contact with these output port, as well as any cabling which connects to these ports while the SGTEL-168 is in operation. All connections should be made before applying power to the generator.



WARNING: Uninsulated, **DANGEROUS VOLTAGES** may be present on any and all surge output terminals. These voltages may be of sufficient magnitude to constitute a risk of electric shock to persons.

WARNING NEVER CONNECT THE SURGE OUTPUT TERMINALS TO A POWER SOURCE DIRECTLY, AS THIS MAY RESULT IN INTERNAL DAMAGE TO YOUR SGTEL-168 SURGE GENERATOR. THESE ARE OUTPUT PORTS ONLY.

4.4.1 (A/B/G) Surge Output Ports



Type A and Type B surges (metallic and longitudinal) surges are applied to these output terminals as indicated in the following sections.

Connections between the (A/B/G) surge output terminals and the EUT lines under test must have solid, low impedance connections with any excess wire length kept to an absolute minimum in order to reduce the effects of stray capacitance/inductance on the waveforms.

Ideally, EUT lines under test should be fitted with 4mm safety socket connectors, and connected directly to the appropriate SGTEL-168 (A/B/G) output terminals as illustrated for each respective surge waveform in Figures 8, 9, 10, 11 and 12.

Where it is not practical to fit each line to be tested with safety socket connectors, alternative means of connection, such as 'break-out' boxes, can be very convenient in many cases; but should be carefully constructed, with short, solid connections as discussed previously in this section.

When alternative connection methods are employed, it is recommended that the open circuit waveform parameters (peak voltage, front time & decay time), as well as the short circuit waveform parameters (peak current, front time & decay time) be verified for each waveform at the alternative EUT connection points for each surge waveform.

Powerline surges are typically applied through the internal CDN (see section 4.4.2). However, in some cases, when the power requirements of the EUT exceed the specifications of the internal CDN, powerline surges can also be applied through the (A/B) terminals to a compatible external powerline coupling/decoupling network using the cable supplied with that CDN.

4.4.1.1 Type A – 800V Surge (metallic) Terminal Connections

This surge waveform is intended to be applied between any pair of connections on which lightning surges may occur, including (for example):

- a) tip to ring;
- b) tip-1 to ring-1; and,
- c) for a 4-wire connection that uses simplex signaling, tip to ring-1 and ring to tip-1.

The SGTEL-168 applies this surge between Terminals (A) and (B). Therefore, the EUT lines to be tested should be connected to these terminals for this surge, as shown in Figure 8.

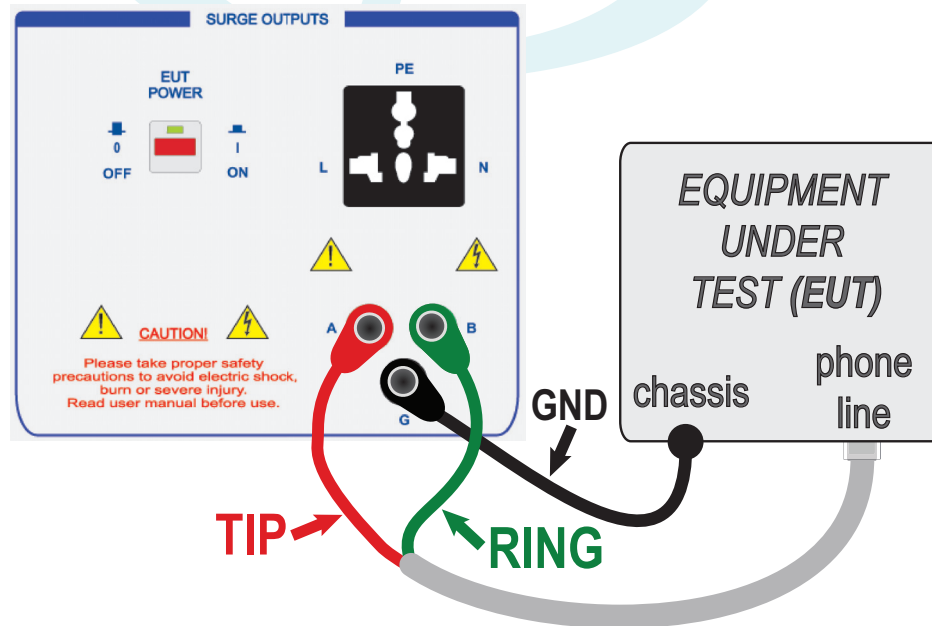


FIGURE 8 - Coupling Example for *Type A – 800V (metallic) Surge*

4.4.1.2 Type A – 1500V Surge (longitudinal) Terminal Connections

This surge waveform is intended to be applied to any pair of connections on which lightning surges may occur. This includes (for example):

- a) tip/ring pair to earth;
- b) tip-1/ring-1 pair to earth; and,
- c) to all leads intended for connection to non-approved equipment, connected together.

The SGTEL-168 applies this surge between Terminal (A) and the Ground Terminal (G). Therefore, the EUT lines to be tested should be connected to these terminals for this surge, as shown in Figure 9.

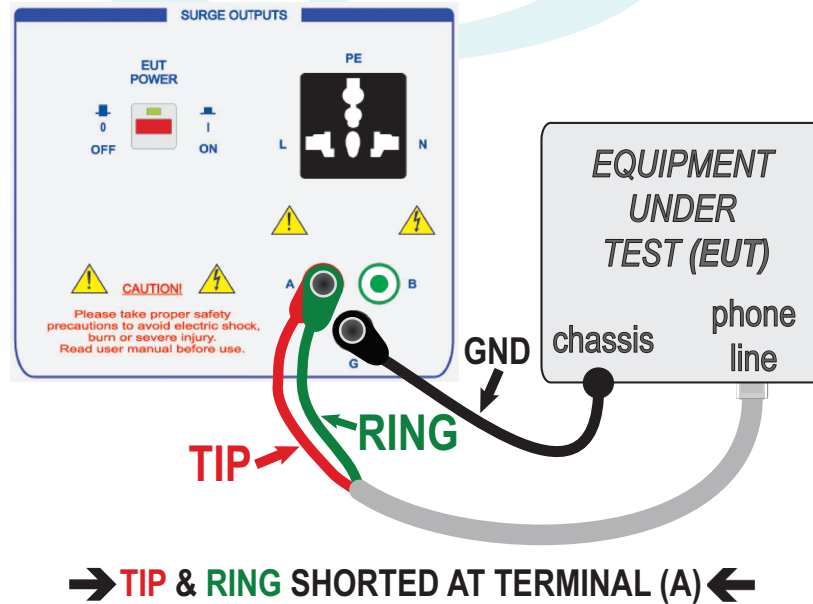


FIGURE 9 - Coupling Example for Type A – 1500V (longitudinal) Surge

4.4.1.3 Type B – 1000V Surge (metallic) Terminal Connections

This surge waveform is intended to be applied between any pair of connections on which lightning surges may occur, including (for example):

- a) tip to ring;
- b) tip-1 to ring-1; and,
- c) for a 4-wire connection that uses simplex signaling, tip to ring-1 and ring to tip-1.

The SGTEL-168 applies this surge between Terminals (A) and (B). Therefore, the EUT lines to be tested should be connected to these terminals for this surge, as shown in Figure 10.

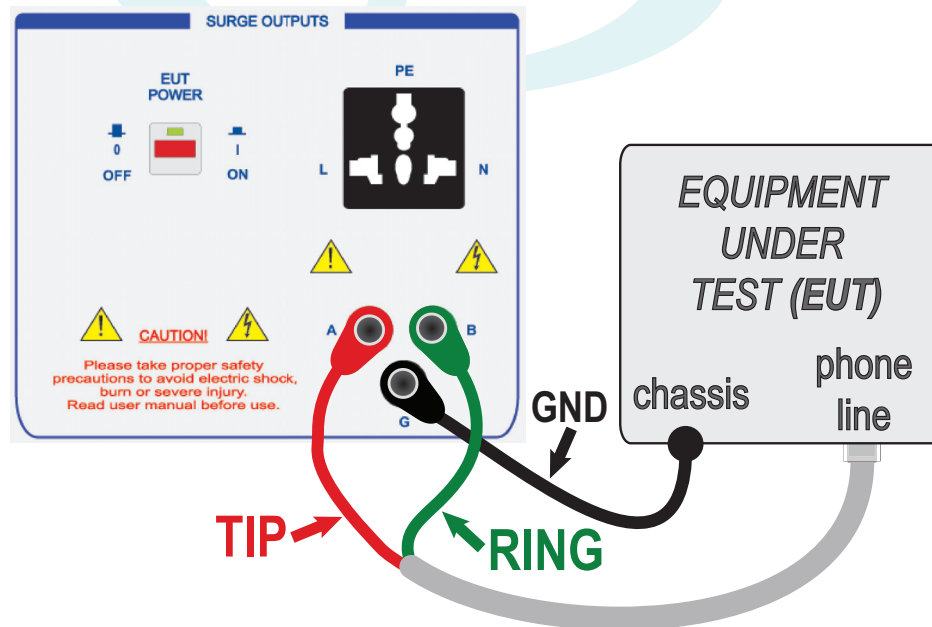


FIGURE 10 - Coupling Example for **Type B – 1000V (metallic) Surge**

4.4.1.4 Type B – 1500V Surge (longitudinal) Terminal Connections

This surge waveform is intended to be applied to any pair of connections on which lightning surges may occur. This includes (for example):

- d) tip/ring pair to earth;
- e) tip-1/ring-1 pair to earth; and,
- f) to all leads intended for connection to non-approved equipment, connected together.

The SGTEL-168 applies this surge from Terminals (A) and (B) to the Ground Terminal (G). Therefore, the EUT lines to be tested should be connected to these terminals for this surge, as shown in Figure 11.

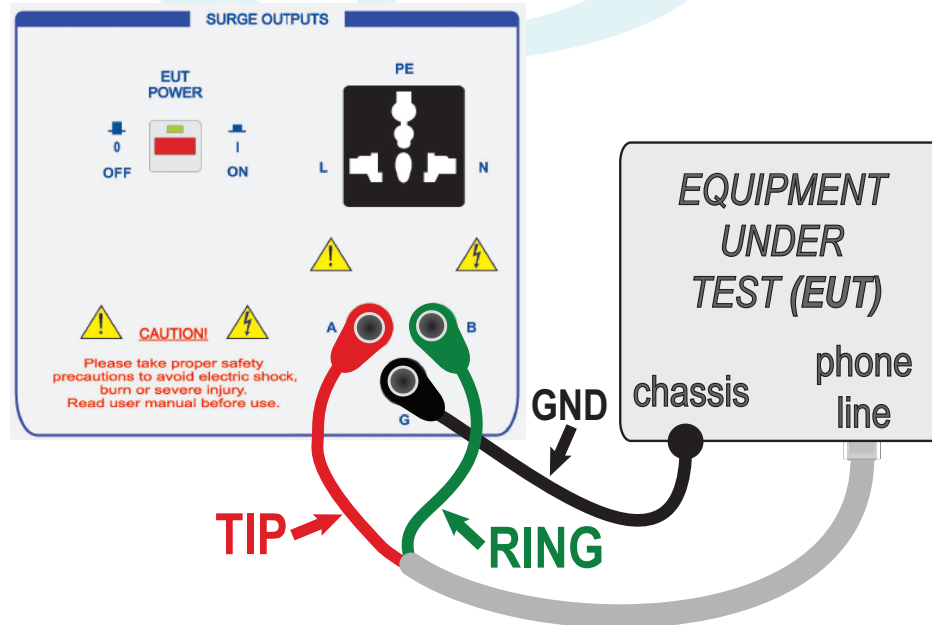
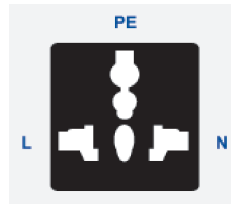


FIGURE 11 - Coupling Example for Type B – 1500V (longitudinal) Surge

4.4.2 Internal Powerline CDN Surge Output Port



Powerline surges will always be applied through a coupling/decoupling network (CDN). The SGTEL-168 surge generator includes an internal CDN for DC or single-phase AC powered devices up to 16 amps.

For devices drawing greater than 16 amps of current and/or devices requiring a 3-phase power system, a compatible Com-Power external CDN is required, which connects to the (A/B) output terminals of the generator.

The powerline surges are applied between the LINE and NEUTRAL terminals of the AC power line while the equipment is powered. A typical test setup is illustrated in Figure 12.

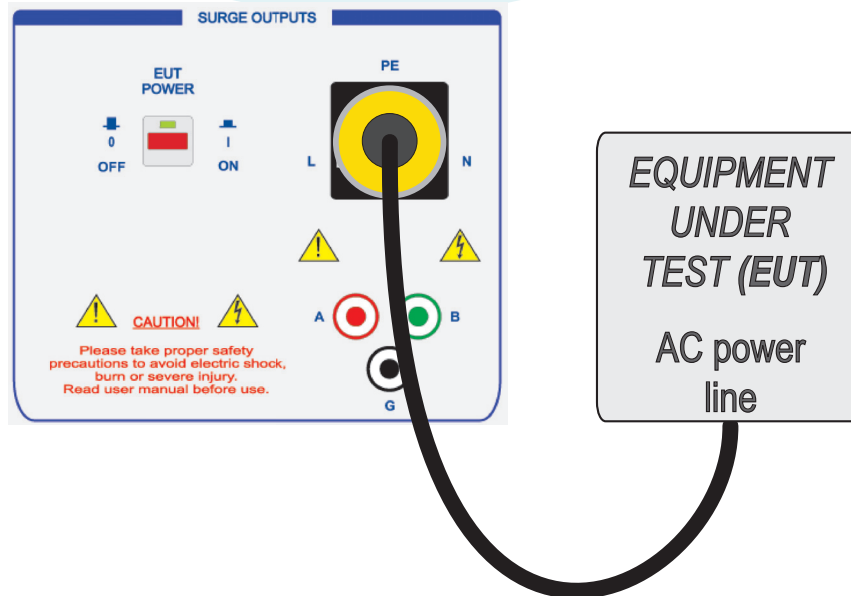


FIGURE 12 - Coupling Example for Powerline – 2500V (L-N) Surge

5.0 Calibration of Surge Output Waveforms

This section provides guidance on the measurement (and associated calculations) of the SGTEL-168 Surge Generator output waveforms at the (A/B/G) output terminals and at the EUT power output port terminals.

5.1 Recommended Test Equipment

Listed below are the three key components recommended for surge waveform measurements.

- 1) Digital Storage Oscilloscope (BW \geq 100 MHz)
- 2) High Voltage (1000x1) Differential Oscilloscope Probes (BW \geq 10 MHz)
- 3) Current Probe (BW \geq 10 MHz, LF cutoff \leq 0.5 Hz) and coaxial cable for connection to oscilloscope input.
- 4) Coaxial cables, adapters and/or fixtures as necessary so that all required connections are made properly.

5.2 Surge Waveform Measurements

As discussed in the following sections, open circuit voltage measurements are to be made using high-voltage differential oscilloscope probes, while the short circuit current measurements are made using an appropriate current probe.

5.2.1 Open Circuit Voltage Measurements

Open circuit voltage waveform measurements are made using high-voltage, differential-type oscilloscope probes connected directly to the appropriate SGTEL-168 output terminals. The required waveform parameters are defined in section 6.3.

5.2.2 Short Circuit Current Measurements

Short circuit current waveform measurements are made by shorting the appropriate output terminals using a short length of wire, routed through an appropriate current probe, which is connected to the input of the oscilloscope.

5.3 Measurement Connections

Examples of typical measurement connection arrangements at the surge output ports of the SGTEL-168 for both open circuit voltage (left) and short circuit current (right) are shown below in Figures 13, 14 and 15.

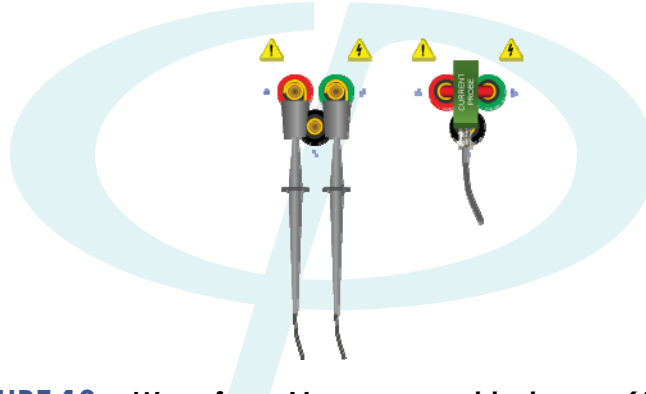


FIGURE 13 - Waveform Measurement between (A) and (B) Terminals

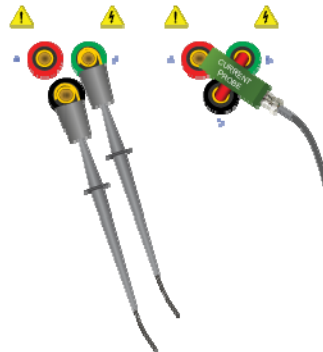


FIGURE 14 - Waveform Measurement between (B) and (G) Terminals

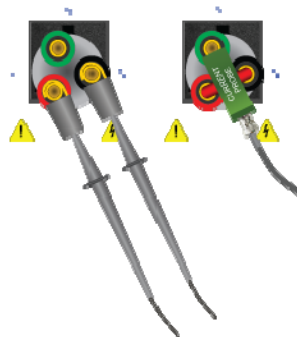


FIGURE 15 - Waveform Measurement between (L) and (N) Terminals

5.4 Surge Waveform Requirements

The surge waveform requirements are defined in terms of both open circuit voltage and short circuit current waveform requirements. For both voltage and current waveforms, the following parameters are defined:

OPEN CIRCUIT VOLTAGE WAVE FORM	SHORT CIRCUIT CURRENT WAVEFORM
Peak Voltage (V_{pk})	Peak Current (I_{pk})
* Rise Time (T_r)	* Rise Time (T_r)
Decay Time (T_d)	Decay Time (T_d)

***NOTE:** In the ANSI/TIA-968-B standard, the terms Front Time (T_r) and Rise Time (T_r) are used interchangeably.

Given in Table I (below) are the limit ranges for the individual waveform parameters for each surge type.

TABLE I – Surge Waveform Requirements

	Waveform Parameter	Type A 800V	Type A 1500V	Type B 1000V	Type B 1500V	Pwr line 2500V
Open Circuit	Peak Voltage (V_{pk})	±800-880V	±1500-1650V	±1000-1100V	±1500-1650V	±2500-2750V
	Rise Time (T_r)	6-10 μ s	6-10 μ s	6.3-11.7 μ s	6.3-11.7 μ s	1-2 μ s
	Decay Time (T_d)	560-860 μ s	160-260 μ s	576-864 μ s	576-864 μ s	10-19 μ s
Short Circuit	Peak Current (I_{pk})	100-115A	200-230A	25-27.5A	37.5-41.3A	1000-1250A
	Rise Time (T_r)	5-10 μ s	5-10 μ s	3.5-6.5 μ s	3.5-6.5 μ s	1-2 μ s
	Decay Time (T_d)	560-760 μ s	160-210 μ s	256-384 μ s	256-384 μ s	10-19 μ s

These waveform requirements are discussed in more detail in the following respective sections. Measurement guidelines, as well as guidelines and examples of the associated calculations are also provided.

5.4.1 Open Circuit Voltage Waveform Requirements

The waveform in Figure 16 defines the open circuit voltage wave shape.

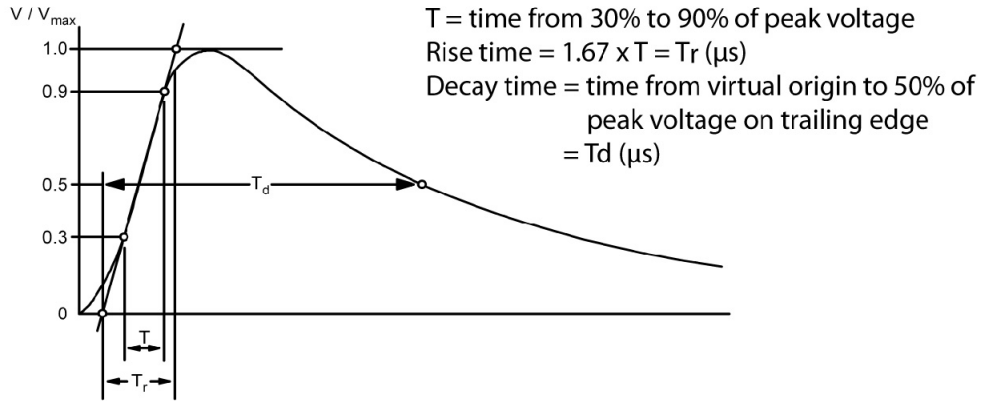


FIGURE 16 - Open Circuit Voltage Wave Shape

TABLE II – Open Circuit Voltage Waveform Requirements

Waveform Parameter	Type A 800V	Type A 1500V	Type B 1000V	Type B 1500V	Pwr line 2500V
Peak Voltage (V_{pk})	±800-880V	±1500-1650V	±1000-1100V	±1500-1650V	±2500-2750V
Rise Time (T_r)	6-10μs	6-10μs	6.3-11.7μs	6.3-11.7μs	1-2μs
Decay Time (T_d)	560-860μs	160-260μs	576-864μs	576-864μs	10-19μs

5.4.1.1 Measurement of Voltage Waveform Parameters

This section discusses the measurement process and calculations for proper determination of the individual waveform parameter values.

PEAK VOLTAGE (V_{pk})

For positive surges, the Peak Voltage (V_{pk}) is the highest measured voltage value within the envelope of the surge waveform. For negative surges, the Peak Voltage (V_{pk}) is the lowest measured voltage value within the envelope of the surge waveform.

RISE TIME (T_r)

The Rise Time (T_r) is calculated based on the measurement of T , which is defined below:

T = Time difference between:

- (A) the first point on the rising slope of the waveform at or above 30% of V_{pk} ; **and**,
- (B) the first point on the rising slope of the waveform at or above 90% of V_{pk} .

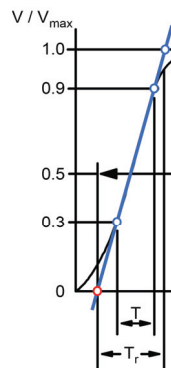
$$T_r = 1.67 \times T$$

DECAY TIME (T_d)

The Decay Time (T_d) [or fall time] is determined through calculation and measurement of the waveform.

T_d = Time difference between:

- (A) virtual origin^{**}; **and**,
- (B) the first point on the falling slope of the waveform at or below **50%** of V_{pk} .



^{**} Virtual Origin is shown as the red circle in the graphic to the left. It is a fictional point at which, ideally, the waveform begins. It is positioned at 'zero' volts and lies on the same slope as the 30%/ V_{pk} and 90%/ V_{pk} points. It is calculated as follows:

$$T_{\text{virtual-origin}} = X_1 - \left(\left(\frac{X_2 - X_1}{Y_2 - Y_1} \right) * Y_1 \right)$$

where:

- X_1 = Time @ 30%/ V_{pk} point
- Y_1 = Voltage @ 30%/ V_{pk} point
- X_2 = Time @ 90%/ V_{pk} point
- Y_2 = Voltage @ 90%/ V_{pk} point

5.4.1.2 Example calculations for Voltage Waveform Parameters

Considered in the following example calculations is a typical Type A, Longitudinal, 1500V surge waveform.

NOTE: The final values determined for each waveform parameter are shown in blue (with the respective limit range in red)

The following values were measured:

MEASURED VALUES

V_{pk}:	1525.2 Volts	(Limit Range: 1500-1575V)
V _(30%/pk) :	457.56 Volts	T _(30%/pk) : 0.328 μs
V _(90%/pk) :	1372.7 Volts	T _(90%/pk) : 4.515 μs
V _(50%/pk) :	762.60 Volts	T _(50%/pk) : 222.5 μs

Based on these measured values, the following parameters are calculated:

$$\text{RISE TIME (T}_r\text{)} = T * 1.67$$

$$T = T_{(90\%/pk)} - T_{(30\%/pk)}$$

$$T = 4.515 \mu\text{s} - 0.328 \mu\text{s}$$

$$T = \mathbf{4.187 \mu\text{s}}$$

$$T_r = 4.187 \mu\text{s} * 1.67$$

$$T_r = \mathbf{6.992 \mu\text{s}} \quad (\text{Limit Range: } 6\text{-}10 \mu\text{s})$$

$$\text{DECAY TIME (T}_d\text{)} = T_{(50\%/pk)} - T_{\text{VirtOrigin}}$$

$$T_{\text{virtual-origin}} = X_1 - \left(\left(\frac{X_2 - X_1}{Y_2 - Y_1} \right) * Y_1 \right)$$

where:

X₁ = Time @ 30%V_{pk} point

Y₁ = Voltage @ 30%V_{pk} point

X₂ = Time @ 90%V_{pk} point

Y₂ = Voltage @ 90%V_{pk} point

$$T_{\text{virtual-origin}} (\mu\text{s}) = 0.328 - \left(\left(\frac{4.515 - 0.328}{1372.7 - 457.56} \right) * 457.56 \right)$$

$$T_{\text{VirtOrigin}} = \mathbf{-1.766 \mu\text{s}}$$

$$T_d = T_{(50\%/pk)} - T_{\text{VirtOrigin}}$$

$$T_d = 222.5 \mu\text{s} - -1.766 \mu\text{s}$$

$$T_d = \mathbf{224.266 \mu\text{s}} \quad (\text{Limit Range: } 160\text{-}260 \mu\text{s})$$

5.4.2 Short Circuit Current Waveform Parameters

The waveform in Figure 17 defines the short circuit current wave shape.

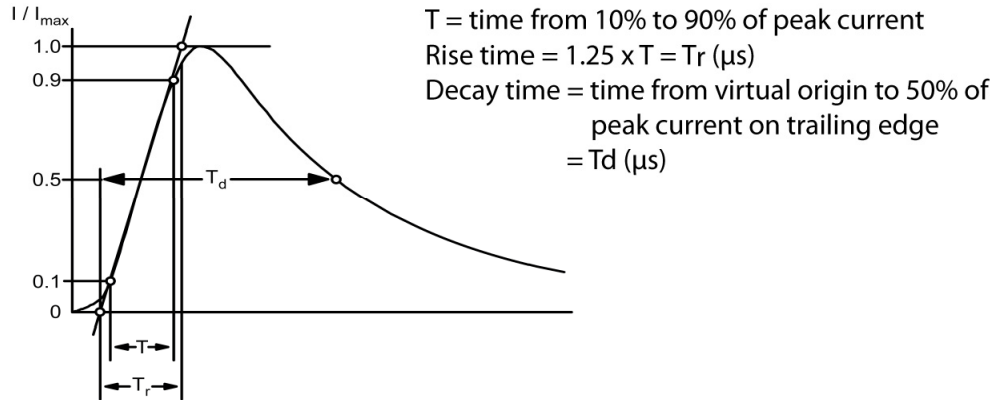


FIGURE 17 - Short Circuit Current Wave Shape

TABLE III – Short Circuit Current Waveform Requirements

Waveform Parameter	Type A 800V	Type A 1500V	Type B 1000V	Type B 1500V	Pwr line 2500V
Peak Current (I_{pk})	100-115A	200-230A	25-27.5A	37.5-41.3A	1000-1250A
Rise Time (T_r)	5-10 μ s	5-10 μ s	3.5-6.5 μ s	3.5-6.5 μ s	1-2 μ s
Decay Time (T_d)	560-760 μ s	160-210 μ s	256-384 μ s	256-384 μ s	10-19 μ s

5.4.2.1 Measurement of Current Waveform Parameters

This section discusses the measurement process and calculation process for proper determination of the individual waveform parameter values.

PEAK CURRENT

The Peak Current (I_{pk}) is the highest measured current value within the envelope of the surge waveform.

RISE TIME

The Rise Time (T_r) is calculated based on the measurement of T , which is defined below:

T = Time difference between:

- (A) the first point on the rising slope of the waveform at or above 10% of I_{pk} ; **and**,
- (B) the first point on the rising slope of the waveform at or above 90% of I_{pk} .

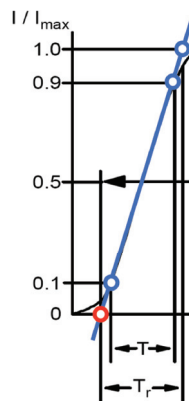
$$T_r = 1.25 \times T$$

DECAY TIME

The Decay Time (T_d) [or fall time] is determined through calculation and measurement of the waveform.

T_d = Time difference between:

- (A) virtual origin^{**}; **and**,
- (B) the first point on the falling slope of the waveform at or below **50%** of I_{pk} .



****** Virtual Origin is shown as the red circle in the graphic to the left. It is a fictional point at which, ideally, the waveform would begin. It is positioned at 'zero' amps and lies on the same slope as the 10%/ I_{pk} and 90%/ I_{pk} points. It is calculated as follows:

$$T_{\text{virtual-origin}} = X_1 - \left(\left(\frac{X_2 - X_1}{Y_2 - Y_1} \right) * Y_1 \right)$$

where:

- X_1 = Time @ 10%/ I_{pk} point
- Y_1 = Current @ 10%/ I_{pk} point
- X_2 = Time @ 90%/ I_{pk} point
- Y_2 = Current @ 90%/ I_{pk} point

5.4.2.2 Example calculations for Current Waveform Parameters

Considered in the following example calculations is a typical Type A, Longitudinal, 1500V surge waveform.

NOTE: The final values determined for each waveform parameter are shown in blue (with the respective limit range in red)

The following values were measured:

MEASURED VALUES

I_{pk}:	218.284 Amps	(Limit Range: 200-230A)
$I_{(10\%/pk)}$:	21.828 Amps	$T_{(10\%/pk)}$: 0.101 μs
$I_{(90\%/pk)}$:	196.46 Amps	$T_{(90\%/pk)}$: 6.789 μs
$I_{(50\%/pk)}$:	109.14 Amps	$T_{(50\%/pk)}$: 166.075 μs

Based on these measured values, the following parameters are calculated:

$$\text{RISE TIME } (T_r) = T * 1.25$$

$$T = T_{(90\%/pk)} - T_{(10\%/pk)}$$

$$T = 6.789 \mu\text{s} - 0.101 \mu\text{s}$$

$$T = \mathbf{6.688 \mu\text{s}}$$

$$T_r = 6.688 \mu\text{s} * 1.25$$

$$T_r = \mathbf{8.36 \mu\text{s}} \text{ (Limit Range: } \mathbf{5-10 \mu\text{s}})$$

$$\text{DECAY TIME } (T_d) = T_{(50\%/pk)} - T_{\text{VirtOrigin}}$$

$$T_{\text{virtual-origin}} = X_1 - \left(\left(\frac{X_2 - X_1}{Y_2 - Y_1} \right) * Y_1 \right)$$

where:

X_1 = Time @ 10% I_{pk} point

Y_1 = Current @ 10% I_{pk} point

X_2 = Time @ 90% I_{pk} point

Y_2 = Current @ 90% I_{pk} point

$$T_{\text{virtual-origin}} (\mu\text{s}) = 0.101 - \left(\left(\frac{6.789 - 0.101}{196.46 - 21.828} \right) * 21.828 \right)$$

$$T_{\text{VirtOrigin}} = \mathbf{-0.735 \mu\text{s}}$$

$$T_d = T_{(50\%/pk)} - T_{\text{VirtOrigin}}$$

$$T_d = 166.075 \mu\text{s} - -0.735 \mu\text{s}$$

$$T_d = \mathbf{166.81 \mu\text{s}} \text{ (Limit Range: } \mathbf{160-210 \mu\text{s}})$$

6.0 Controlling the SGTEL-168 via its Front Panel

The SGTEL-168 Surge Generator is able to perform all of its individual functions from the front panel interface, as described in the following sections. For any given surge type, the user can define the coupling mode, number of surges and delay time between surges, and perform the tests.

Further functionality, such as programming surge sequences with different surge types and creating active test logs for recording results and observations during tests, is available using Com-Power's *TransWare™* PC software, which controls the SGTEL-168 remotely via its fiber optic interface and fiber optic to USB adapter. Refer to section 6 for instructions on controlling the SGTEL-168 using *TransWare™*.

6.1 Self-Test

Each time the SGTEL-168 is turned on, it will automatically perform a three-stage self-test.

- 1) SWITCHING RELAYS ON/OFF - During first stage of Self-Test, relays will toggle ON and OFF several times in order to remove moisture and demagnetize the coil.
- 2) STATUS CHECK OF HIGH VOLTAGE SUPPLY BOARD - During the second stage of the Self-Test, SGTEL-168 will check the operational status of the high voltage (HV) supply board. If a problem is sensed, system will halt and status message will be displayed. If no problem is found, self-test will continue with next step.
- 3) SAFETY INTERLOCK STATUS CHECK - The last stage of the Self-Test will check for a closed loop (short circuit) across the safety interlock port. If an open circuit is sensed, system will halt until safety interlock has been replaced. If short circuit is sensed, self-test will be completed.

After successful completion of the self-test, you will be given the option of entering the "Quick Menu" (see section 6.4) or the "Surge Menu" (see section 6.2).

6.2 Surge Menu



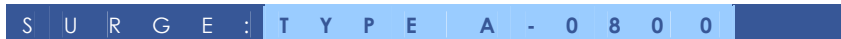
From this single-page Surge Menu Screen, you are able to:



- a) define the **SURGE** type,
- b) define the coupling mode (terminals **ON** which the surge is coupled),
- c) define the number of surges (**TESTS**) to be applied,
- d) define the **DELAY** time between surges,
- e) **SAVE** the defined surge parameters to memory; and
- f) execute the defined surge event(s) (**RUN** the test)

Each of these functions are explained in detail in the following sections.

6.2.1 Surge Menu Items

6.2.1.1 Surge Type

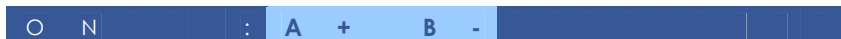




The top line of the display, '**SURGE:**', defines the type of surge waveform to be applied. Use the   keys on the front panel to switch between following surge types:

- 1) TYPE A-0800
- 2) TYPE A-1500
- 3) TYPE B-1000
- 4) TYPE B-1500
- 5) PL-2500

To select the surge type, press the  key.

6.2.1.2 Coupling Mode



The second line, '**ON:**', allows the user to select the front panel output terminals to which the surge is to be coupled (*coupling mode*). Use the   keys on the front panel to switch between coupling modes. The coupling mode options will vary based on the selected surge type.

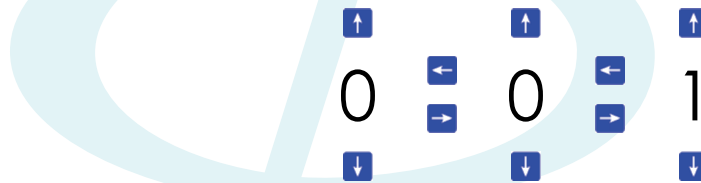
To select the coupling mode, press the  key.

6.2.1.3 Number of Surges



On the left side of the third line, '**TESTS:**' defines the number of times that the selected surge will be repeated. This can be any number between '001' and '999'; and the default value is '001'.

To change this value, use the keys to modify any single digit, and use the keys to switch between digits, as diagrammed below.



Once you have entered the desired number of surges, press the key.

6.2.1.4 Delay Time Between Surges




On the right side of the third line, defines the delay time between surges. The delay time includes the charging time for the charging capacitor, which varies based on the surge type. Therefore, the minimum delay time (which is also the default delay time value) is different for each surge type. The maximum delay time for all surge types is 360 seconds (6 minutes).

The delay time value is changed in the same manner as the number of 'TESTS' using the , and keys (see section 6.2.1.3).


6.2.1.5 Run Test



Pressing  at any time on this menu screen will start the test with the presently defined parameters. Refer to section 6.3 for details on the surge process.

6.2.1.6 Save Test



Pressing  at any time on this menu screen will save the presently defined parameters into one of the ten available non-volatile memory locations. The test is saved under an automatically assigned name, based on the defined parameters of the test, as follows:

Memory Location)	Surge Type/ Voltage	:	Coupling Mode	:	Number of Surges	:	Time between Surges
-----------------	---	------------------------	---	---------------	---	------------------	---	---------------------


So, for the following test parameters:

Surge Type/Voltage: Type A / 800V
 Coupling Mode: A+ B-
 Number of Surges: 001
 Time Between Surges: 074 s

The test would be saved as: x)TA08:A+B-:001:074s

Upon successfully saving the test, the following message will appear: "SAVED SUCCESSFULLY AT MEMORY SLOT x".

6.3 Surging Process

As discussed in section 6.2.1.5, the test is started by pressing the  key. When the test begins, the bottom two lines of the display will change to show the current status of the test and current status of the generator. For each surge event, the following process takes place:

- 1) The first step of the surging process is to discharge the charging capacitor. This is done to make sure that there is no potentially harmful charge stored in the capacitor. During this time, the following status message is displayed, until the capacitor is completely discharged.

```
T E S T S : 0 0 1           0 7 4 s
S T A T U S : W A I T . . .
```

- 2) The second step of the surging process is the pulse delay. The pulse delay is the difference between the charging time for the current surge type and the delay time between surges. If the delay time between surges has been set to minimum (default value), then the pulse delay will be zero, and the third step of the process will begin immediately. In the event of pulse delay, the following status message is displayed:

```
T E S T S : 0 0 1           0 7 4 s
S T A T U S : P U L S E   D E L A Y
```

- 3) The third step of the surging process is the charging of the charging capacitor. The charging time varies depending on the surge type. The percentage of charge will update on the status line in real time until it reaches 100%:

```
T E S T S : 1 / 1           0 0 0 s
S T A T U S : C H A R G I N G   1 0 0 %
```

- 4) Upon reaching 100% charge, status will change to 'READY' briefly:

```
T E S T S : 1 / 1           0 0 0 s
S T A T U S : R E A D Y
```


- 5) Shortly after reaching the 'ready' state, the surge output will automatically be triggered:

```
T E S T S : 1 / 1           0 0 0 s
S T A T U S : T R I G G E R E D
```


- 6) The process will repeat until all surges have been completed:

```
T E S T S : 1 / 1           0 0 0 s
S T A T U S : C O M P L E T E D
```

6.3.1 Pausing the Test

At any point during the test, pressing the  key will pause the current process and will show 'PAUSED' on the status line:



```
T E S T S : 1 / 1      0 0 0 s
S T A T U S : P A U S E D
```

To resume the test, press the  key.

6.3.2 Aborting the Test

At any point during the test, pressing the  key will abort the test process.




```
T E S T S : 1 / 1      0 0 0 s
S T A T U S : A B O R T E D
```


After aborting the test, press  key to restart the same test, or press the  key to return to the Surge Menu.


6.4 Quick Menu

Quick Menu will display all the saved surge events.

```
1 ) T A 0 8 : A + B - : 0 0 1 : 0 7 4 s
2 ) E M P T Y
3 ) E M P T Y
↑ - U P      ← - O K      ↓ - D O W N
```

Press the   keys to scroll through the list. Once the desired test is selected, press the  to load the test.

Long Pressing  key while in Quick menu will Execute all saved tasks one by one.

Long Pressing  key in this menu will clear all the saved sequences inside this menu.

7.0 TransWare™ Software

7.1 Main Screen

The layout of the main screen is as shown in Figure 18.

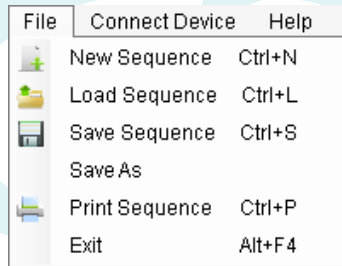


FIGURE 18 - Main Screen - TransWare™ Software

7.1.1 Menu Bar

- 1 The menu bar has three pull-down menus; **File**, **Connect Device** and **Help**.

7.1.1.1 File Menu



The **File** pull-down menu functions in same manner as most windows-based software. It contains the following options:

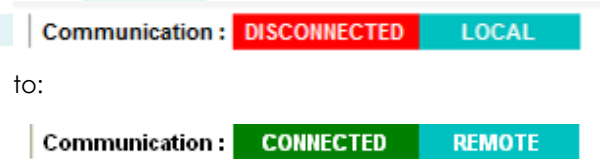
MENU ITEM	DESCRIPTION
New Sequence	Upon creation of a new sequence, <i>TransWare™</i> will prompt you to save any active sequence before opening a blank template on which you can create your desired sequence.
Load Sequence	Opens dialog box from which the user can navigate directory system in order to open a previously saved test sequence (with .cpc extension).
Save Sequence	This function re-saves the sequence under the same file name and directory path.
Save As	Opens dialog window from which the user can navigate directory system, assign a file name and save the active test sequence (with .cpc extension).
Print Sequence	Opens the 'print' dialog window, from which the user can print the active test sequence. If the sequence has previously been saved, the file name under which the sequence was saved is used as the title of the sequence table. If the sequence has not been saved, the user is prompted to assign a title for the sequence table.
Exit	After prompting the user to save changes to any active sequence, exits the <i>TransWare™</i> software.

NOTE: Care must be taken that the software is not closed when the tasks are running. Although for safety reason, we do send a 'Stop' command as well as 'Switch to Local' command in case if GUI is closed by mistake or any reason.

7.1.1.2 Connect Device Menu

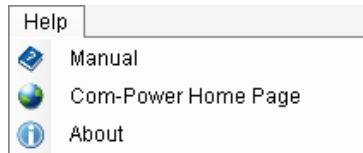
The **Connect Device** option is the only option for this menu.

MENU ITEM	DESCRIPTION
Connect Device	<p>Initiates connection process between computer and SGTEL-168 Surge Generator. The <i>TransWare™</i> software will scan the communication ports and engage connection upon recognition of compatible generator.</p> <p>When the connection has been made, the Communication status at the bottom left corner of the <i>TransWare™</i> window will change from:</p>



This indicates that the unit is in its remote operating mode. In this mode, all the front panel controls on the generator itself are disabled, with the exception of the EUT power switch.

7.1.1.3 Help Menu

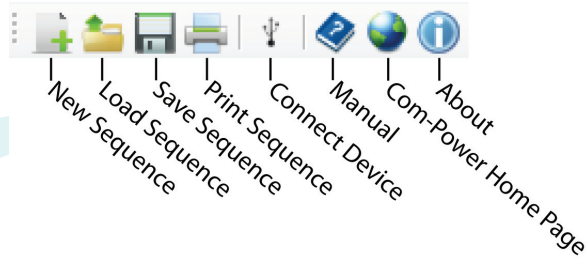


The **Help** menu contains the following options:

MENU ITEM	DESCRIPTION
Manual	Opens a pdf copy of the present manual.
Com-Power Home Page	<p>Opens the computer's default internet browser to the following URL:</p> <p>http://www.com-power.com.</p>
About	Opens a small window showing a short description of the <i>TransWare™</i> software, including version and copyright information.

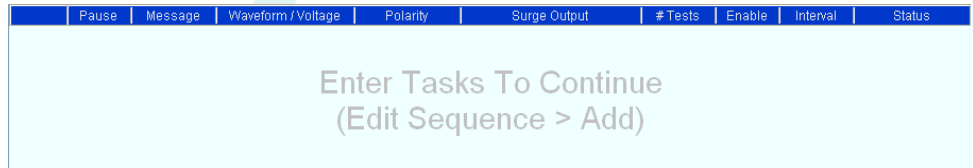
7.1.2 Tool Bar

2 The tool bar provides easy-access shortcuts to several commands from the menu bar.



7.1.3 Sequencing Panel

3 The sequencing panel contains all of the individual surge events in the test sequence. If a sequence has not yet been created, the sequencing panel is blank, as shown below.



Adding, removing and editing surge events is done using the SEQUENCE EDITING FUNCTIONS, which is accessed by selecting the EDIT SEQUENCE option on the TASK OPTIONS panel (see section 7.1.4). Surge events are displayed in table format as shown below, with each surge event displayed on a single row.

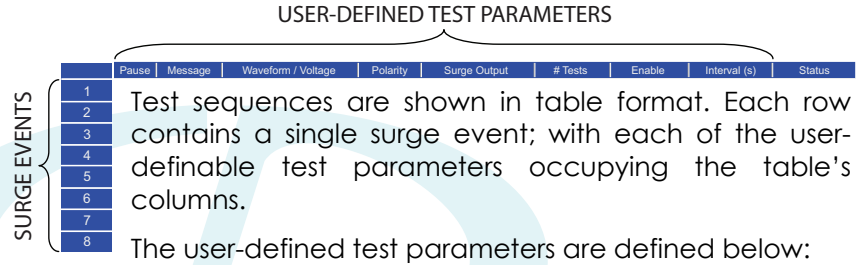
In order to differentiate between surge types in the sequence, events are shaded in different colors based on the waveform type.

	Pause	Message	Waveform / Voltage	Polarity	Surge Output	# Tests	Enable	Interval (s)	Status
1	<input type="checkbox"/>		Type A / 800	Positive	Terminals (A- B)	1	<input checked="" type="checkbox"/>	74	
2	<input type="checkbox"/>		Type A / 800	Negative	Terminals (A- B)	1	<input checked="" type="checkbox"/>	74	
3	<input type="checkbox"/>		Type A / 1500	Positive	Terminals (A- G)	1	<input checked="" type="checkbox"/>	34	
4	<input type="checkbox"/>		Type A / 1500	Negative	Terminals (A- G)	1	<input checked="" type="checkbox"/>	34	
5	<input type="checkbox"/>		Type B / 1000	Positive	Terminals (A- B)	1	<input checked="" type="checkbox"/>	5	
6	<input type="checkbox"/>		Type B / 1000	Negative	Terminals (A- B)	1	<input checked="" type="checkbox"/>	5	
7	<input type="checkbox"/>		Type B / 1500	Positive	Terminals (A/B - G)	1	<input checked="" type="checkbox"/>	7	
8	<input type="checkbox"/>		Type B / 1500	Negative	Terminals (A/B - G)	1	<input checked="" type="checkbox"/>	7	
9	<input type="checkbox"/>		Power Line / 2500	Positive	Internal CDN (L- N)	3	<input checked="" type="checkbox"/>	8	
10	<input type="checkbox"/>		Power Line / 2500	Negative	Internal CDN (L- N)	3	<input checked="" type="checkbox"/>	8	

Each column in the table corresponds to a separate, user-definable test parameter for each surge event. These test parameters are defined in the following section (7.1.3.1).

Pause	Message	Waveform / Voltage	Polarity	Surge Output	# Tests	Enable	Interval (s)	Status
-------	---------	--------------------	----------	--------------	---------	--------	--------------	--------

7.1.3.1 User-defined Surge Test Parameters



TEST PARAMETER	DESCRIPTION
Pause	A check in this check box instructs the SGTEL-168 to pause the test prior to that surge event and display a message box with a pre-defined message to the user. Upon acknowledgement of message, the test sequence automatically continues.
Message	This is the message associated with the PAUSE check box. When the PAUSE check box is checked, the message editor automatically opens, enabling the user to assign which message appears in the message box when the sequence reaches the present surge event. No message can be assigned if the pause box is not checked.
Waveform/ Voltage	This (5) item pull-down menu is used to select the waveform for a given surge event.
Polarity	This (2) item pull-down menu toggles the polarity of the surge between POSITIVE and NEGATIVE.
Surge Output (Coupling)	This pull-down menu is used to select the front panel surge output terminals to which the surge is to be coupled (<i>coupling mode</i>). The available coupling mode options will vary depending on which surge waveform is selected.
# Tests	This field defines the number of times that the present surge event will be repeated (1-999), before proceeding to the next event in the test sequence.
Enable	When checked, the present surge event is enabled. When unchecked, the surge event is disabled. Disabled events are skipped during the surge test.
Interval (s)	Interval defines the time (in seconds) between surges. The default interval value is the minimum time that the surge generator requires to build the required charge. The charging time varies depending on the surge waveform. The interval can be any value between the minimum (default) value and 360 seconds.
Status	The status column displays the generator status while the test is running (discharging, charging, waiting, etc.)

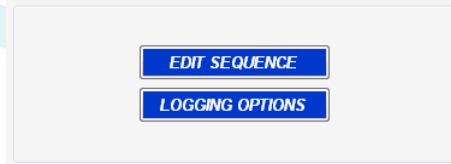
7.1.4 Task Options Panel

- 4 The functions available on the *TASK OPTIONS* panel change depending on which of the two main functions is selected.

Shown to the right is the *TASK OPTIONS* menu. When **EDIT SEQUENCE** is selected, the sequence editing functions are displayed on this panel (see section 7.1.4.1).

When **LOGGING OPTIONS** is selected, the *IN-TEST OBSERVATIONS* *LOGGING* functions are displayed, including the comment entry window as well as other logging related options (see section 7.1.4.2).

These functions are discussed in detail in the following sections.



7.1.4.1 Sequence Editing Functions



The sequence editing functions are displayed on the TASK OPTIONS panel after selecting **EDIT SEQUENCE** on the TASK OPTIONS menu.

Using these functions, the user can create and edit test sequences.

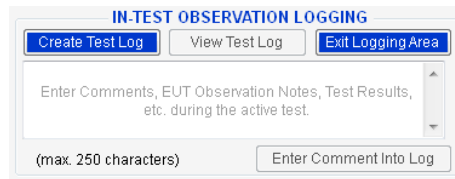
FUNCTION BUTTON	DESCRIPTION
Cut ¹	Cuts (removes) the selected surge event(s) from the sequence. The cut surge event(s) are then kept in the <i>QUEUE</i> (aka: clipboard). ²
Copy ¹	Copies the selected surge event(s) in the sequence. The copy of the surge event(s) are then kept in the <i>QUEUE</i> .
Paste ¹	Pastes the surge event(s) currently in the <i>QUEUE</i> directly above the selected task.
Add	Adds a surge event with default values at the end of the active sequence.
Insert ¹	Inserts a surge event immediately above, and with identical values to, the selected surge event.
Remove ¹	Removes the selected surge event(s) from the sequence.
Move Up ¹	Moves the selected surge event(s) upward by one row in the sequence.
Move Down ¹	Moves the selected surge event(s) downward by one row in the sequence.
Remove All	Removes ALL surge event(s) from the sequence.
Message Editor ³	Opens the <i>MESSAGE EDITOR</i> , where you can edit, delete and assign messages associated with the pause function on the surge event(s).
Done	Exits the <i>SEQUENCE EDITOR</i> and returns to the <i>TASK OPTIONS MENU</i> .

¹ In order for the **CUT**, **COPY**, **INSERT**, **REMOVE**, **MOVE UP** or **MOVE DOWN** functions to be active, surge event(s) must be selected by clicking the numbered column to the left of the sequence for the desired event(s).

² The *QUEUE* is used to temporarily store **CUT** or **COPIED** surge event(s) pending a **PASTE** action. The *QUEUE* will only store surge event(s) from a single **CUT** or **COPY** action. Any item(s) held in the queue prior to an additional **CUT** or **COPY** action are discarded.

³ The **MESSAGE EDITOR** function is only active after selecting the **MESSAGE** column of any surge event.

7.1.4.2 Logging Options



The IN-TEST OBSERVATION LOGGING functions are displayed on the task options panel after selecting **LOGGING OPTIONS** on the TASK

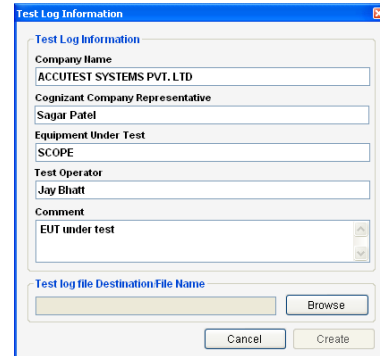
OPTIONS menu.

Here, the user can create a test log; after which he/she can edit, view, and enter comments into, the test log.

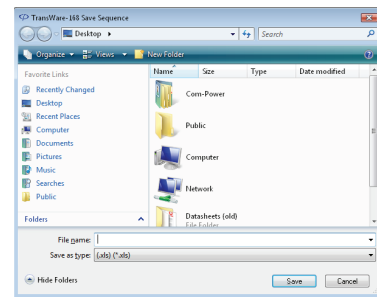
FUNCTION BUTTON DESCRIPTION

Create Test Log

Opens a form window with fields for Company Name, Cognizant Company Representative, Equipment Under Test, Test Operator, Comment and File Path.

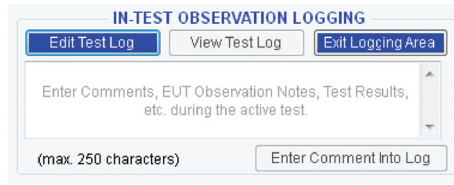


After filling out the form, click the BROWSE button, which will open another window.



In this window, navigate to the desired directory, assign a file name and click save.

Finally, click the CREATE button to finish the process.

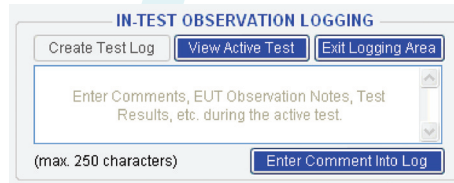


After creating the test log, the IN-TEST OBSERVATION LOGGING functions are as shown to the left and described below.

FUNCTION BUTTON DESCRIPTION

Edit Test Log

Allows the user to modify the information entered in the test log form fields (Company Name, Cognizant Company Representative, Equipment Under Test, Test Operator, Comment and File Path)

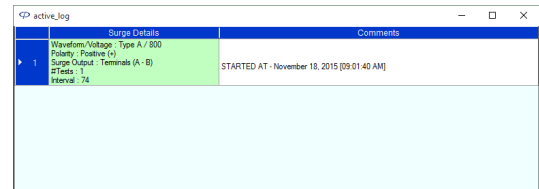


During the test, the IN-TEST OBSERVATION LOGGING functions are as shown to the left and described below.

FUNCTION BUTTON DESCRIPTION

View Active Test

Opens the active log form displaying entered comments and surge details.



Enter Comments Into Log

Allows the user to enter notes or comments (up to 250 characters) before and/or during the test. The intent of this feature is allow the test engineer to record EUT observations, such as signs of susceptibility, unintended operations, malfunctions, etc., as they occur during the course of the test.

Comments are stamped with the exact time/date at which they were entered. The completed test log lists all entered comments chronologically with relation to the corresponding surge event at the time the comment was entered.

Exit Logging Area

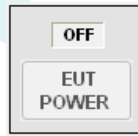
Closes the logging functions and returns to the TASK OPTIONS MENU.

7.1.5 Control Panel

5 The *CONTROLS* are used to toggle EUT power and to start, pause and/or abort the surge test. Prior to starting the test, the controls area appears as shown to the right, and as described below.



FUNCTION BUTTON

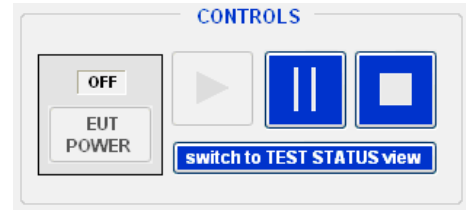






DESCRIPTION

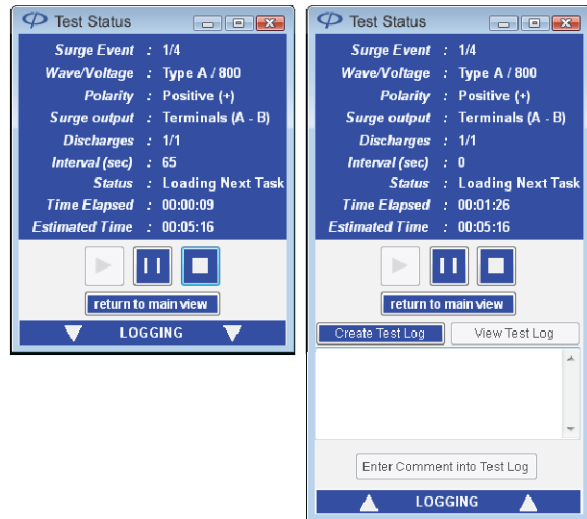
The EUT power button enables/disables the EUT power output on the internal CDN. The EUT power switches on the rear and front panels of the SGTEL-168 must also be in the 'ON' position in order to enable EUT power. Refer to section 4.1.2 for more information.

The PLAY button begins the test by Initiating the active test sequence.

While the test is running, the CONTROLS functions available are as shown to the right and described below.



MENU ITEM	DESCRIPTION
	The PAUSE button pauses the active test. To resume the test from the point at which the test was paused, press the  button again.
	The STOP button aborts the active test. Test cannot be resumed after aborting.
	Changes the <i>TransWare™</i> window to a smaller, compacted, repositionable window, while still providing access to all of the in-test features available with the larger window. This window will remain in front of all other open windows, enabling the user to work with other applications on the computer, while still monitoring the progression of the surge test. Logging functions are contained on a retractable logging subpanel of the TEST STATUS window, as shown below.



7.0 Warranty

Com-Power warrants to its Customers that the products it manufactures will be free from defects in materials and workmanship for a period of three (3) years. This warranty shall not apply to:

- Transport damages during shipment from your plant.
- Damages due to poor packaging.
- Products operated outside their specifications.
- Products Improperly maintained or modified.
- Consumable items such as fuses, power cords, cables, etc.
- Normal wear
- Calibration
- Products shipped outside the United States without the prior knowledge of Com-Power.

In addition, Com-Power shall not be obliged to provide service under this warranty to repair damage resulting from attempts to install, repair, service or modify the instrument by personnel other than Com-Power service representatives.

Under no circumstances does Com-Power recognize or assume liability for any loss, damage or expense arising, either directly or indirectly, from the use or handling of this product, or any inability to use this product separately or in combination with any other equipment.

When requesting warranty services, it is recommended that the original packaging material be used for shipping. Damage due to improper packaging will void warranty.

If you feel that the product is not working as intended, or is malfunctioning, please contact Com-Power for assistance. If the product must be returned to Com-Power, a Return Merchandise Authorization (RMA) number will be supplied to you. The RMA number should be displayed in a prominent location on the packaging and on the product, along with a description of the problem, and your contact information.