VOLTAGE SAG GENERATOR (VSG)

120V AC or 240VAC max. 20Amps

VSG20-1P

omniverter
tame your power—keep your profits

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Safety Information

WARNING

The Voltage Sag Generator (VSG) is intended for use with voltage and current levels that may be harmful or lethal. It is the responsibility of the user to exercise the necessary safety precautions. Any person using the VSG must have a good knowledge of electrical power and safety practices. The VSG is a custom designed test fixture. While it has been designed with safety in mind, it has not been approved by a safety agency. Improper use or improper handling of the equipment could result in injury or death. Always follow the directions and warnings outlined in this manual.

WARNING

The VSG has been built into a protective enclosure. All user connections can be made without opening the cabinet. However, some fuses are located internally. When replacing fuses, exercise extreme caution when opening the cabinet. High voltages may be present inside the case even after the power has been turned OFF. Always disconnect all supply cables before opening the cabinet.

General

Introduction

The Voltage Sag Generator (VSG)– VSG20-1P is a portable voltage sag generator combined with a built-in data acquisition system. It is a powerful diagnostic tool for determining the ride-through characteristics of industrial processes when subjected to voltage sags in utility voltage. With the VSG, the user can induce voltage sags of controlled depth and duration while monitoring voltages, currents, or other signals from within the process. This allows investigators to identify vulnerable process components. Once the weak links have been identified, it is often possible to apply local ride-through solutions that are much more economical than whole-system power conditioning.

System Description

The VSG system is controlled from a laptop computer using proprietary graphical software that is based on a Windows operating system. It creates voltage sags by switching rapidly between nominal supply voltage and a reduced voltage. The reduced voltage is supplied by a variable transformer which can be adjusted to the desired percentage of nominal voltage. This adjustment is made from the computer interface as the variable transformer is equipped with an electric motor drive

The transfer from nominal voltage to sag voltage and back is performed by solid-state switches (Insulated Gate Bipolar Transistors or IGBT's) that are synchronized with precise timing signals. IGBT's offer important advantages over other types of switches such as point-on-wave control and a fast, uninterrupted transition between the two voltage sources.

The model VSG20-1P can create single-phase voltage sags supplied to equipment at nominal voltages 120V AC up to 240 V AC and can carry steady-state load current up to 20 A_{RMS} maximum. The system is equipped with 8 data acquisition channels for monitoring the response of process components during voltage sags, of these two are internal. Three of the eight are low-voltage channels which are ideal for use with current probes or other sensors, while the other three are isolated, high-voltage channels provided for direct connection to the equipment under test up to 300V. Some typical components to monitor during a sag event are DC power supplies, relays, contactors, and load currents.

The VSG is connected in series between the supply and the load. Figure 1 illustrates the basic connections of a typical test setup. More wiring details are given in later sections of this manual.

Figure 2 shows a typical waveform produced by the VSG based on a 5-cycle sag to 70% of nominal voltage with a 90° point on wave initiation of the voltage sag.

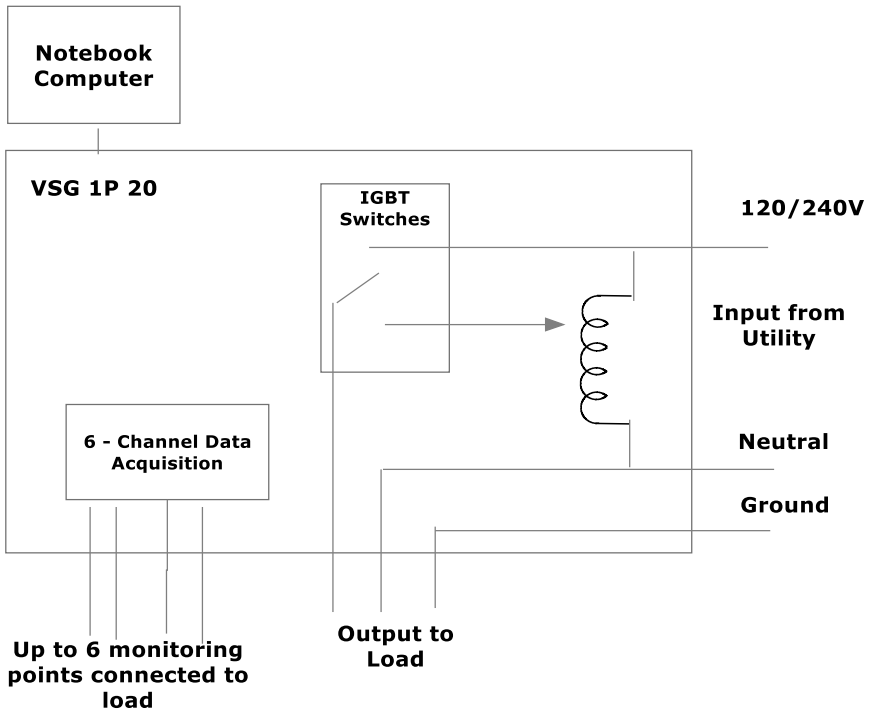


FIGURE 1 VSG TEST SETUP

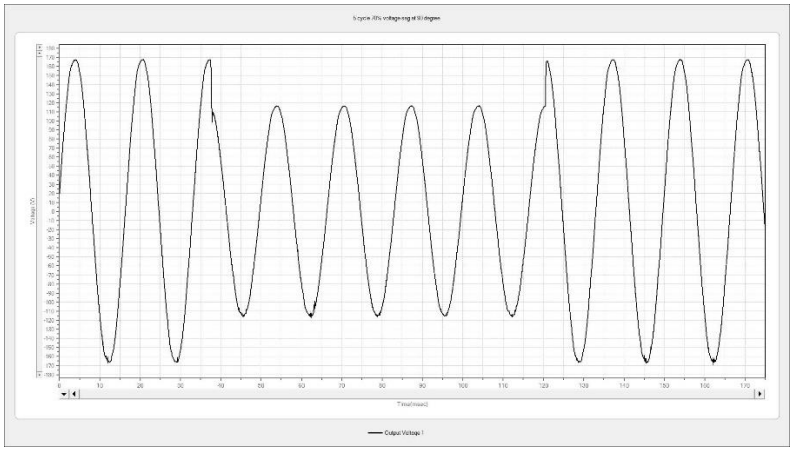
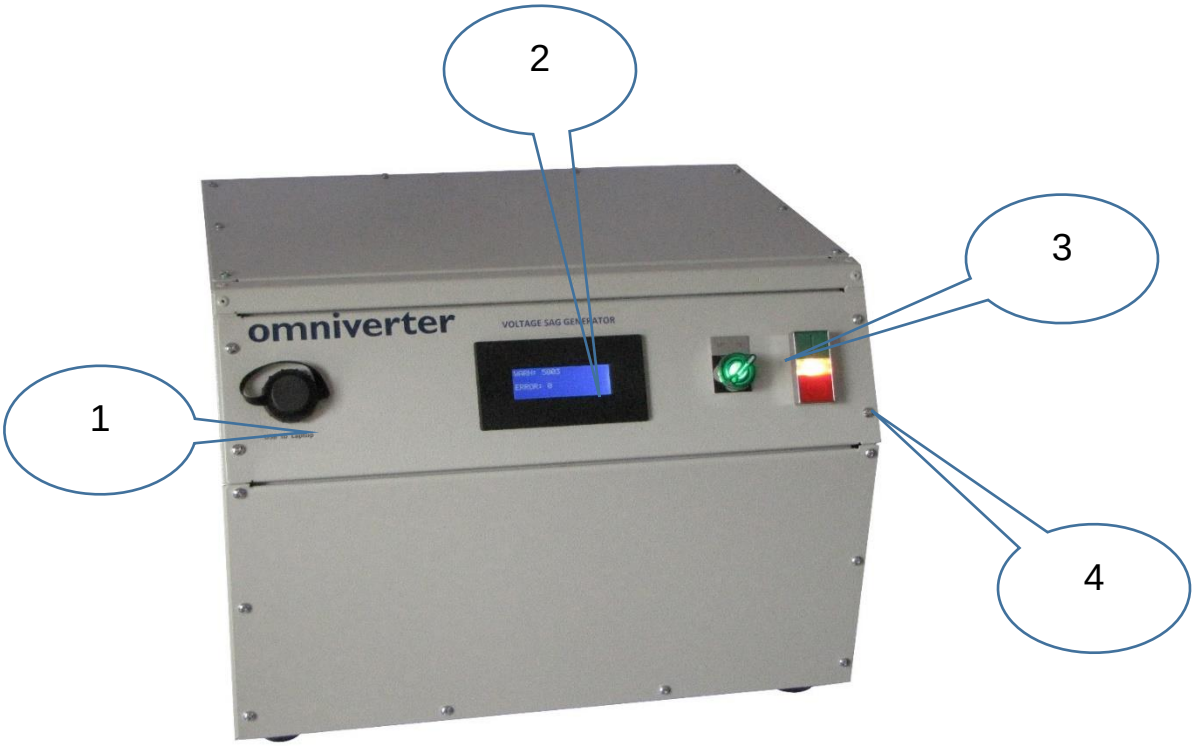


FIGURE 2: 5 cycle 70% Voltage Sag at 90° point on wave



Front View of VSG20-1P

1. USB Hub for connection to Laptop computer
2. Digital meter - a) Input Voltage
   b) Output Sag Voltage
   c) Load Current
   d) Nominal frequency
3. Control Power On/Off switch
4. Input Power Switch

Front Panel

USB Hub

In order to operate the VSG it must first be connected to a computer via the USB connection, Item1. Without this connection the VSG will not operate. All test settings are selected via the computer.

Digital Meter (Item 2)

This displays the following parameters

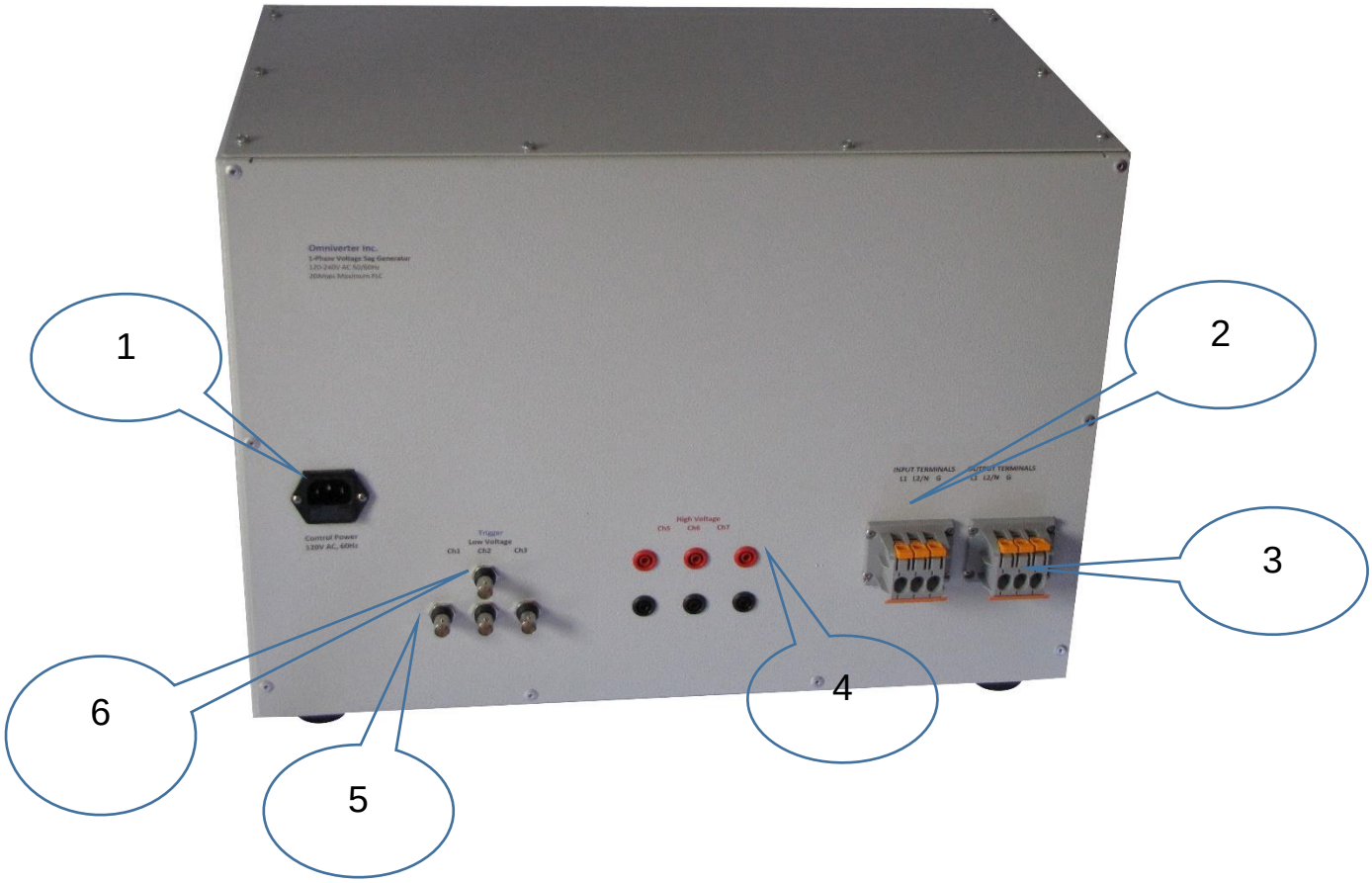
a) Input Voltage
b) Sag Output Voltage
c) Load current
d) Nominal frequency (50Hz or 60Hz)

On/Off Switch (Item3)

This provides control power to the VSG

ON/Off Pushbutton (Item 4)

This acts to connect/ disconnect to the load. The load must be connected before any voltage sag is initiated.



Rear View of VSG20-1P

1. Control Power receptacle and fuse
2. Input Power terminals, L1, L2 or N, G
3. Output Power terminals L1, L2 or N, G
4. High Voltage Probe terminals
5. Low Voltage Probe terminals
6. External Trigger Connection

Rear Panel

Control Power Input Item 1

The control power is designed to be connected to a 120V 60HZ supply and the receptacle contains an integral fuse mounted immediately below the connections which can be replaced without opening any part of the VSG but this does require that the control power be unplugged from the unit before the fuse can be changed.

The control power can also be supplied for use with a 230V 50HZ supply
Input / Output Connections Items 2 and 3

Input and output connections are made at the rear of the main unit see items 2 and 3 via lever lock terminals. To insert a wire, lift orange lever into a vertical position. Then insert wire and close orange lever to horizontal position which will lock the wire in place. Repeat for other terminals. After all terminals are connected the terminals can be locked by removing the orange plate from the lower part of the terminal bock and then inserting this on the upper part of the terminal block.

Please note that the input Terminals can be Line (L1), Neutral (N) and Ground(G) or for North American 240V systems they can be L1, L2 and G.

High Voltage Terminals - Item 4
These three pairs of terminals provide access for high voltage inputs 300Volts AC

Low Voltage Terminals - Item 5
These terminals are rated for 10 Volts maximum

External Trigger Connection – Item 6

Internal Arrangement of switches and contactors

The VSG principle of operation relies on a combination of contactors, IGBT's and SCR's that switch in sequence to create controlled voltage sags. The VSG is designed for a maximum current of 20 Amps and should not be exceeded during sags.

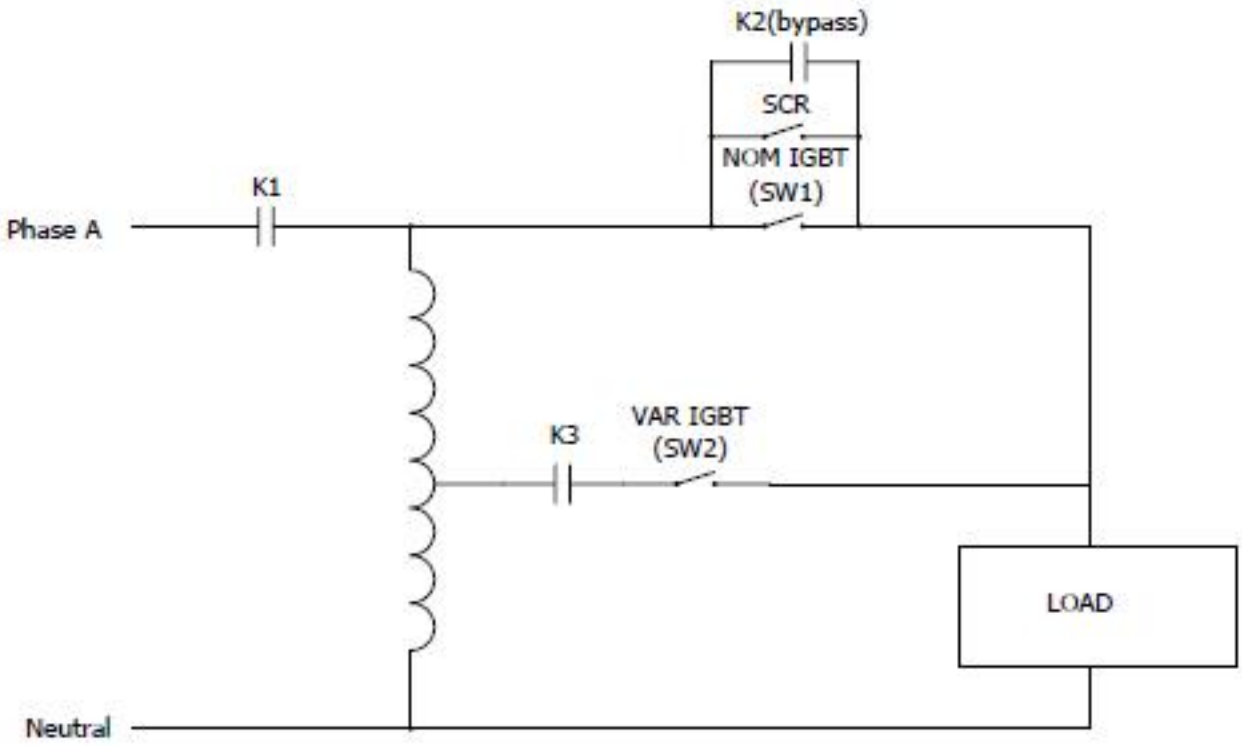
The simplified single line diagram shows the configuration of these elements in the power circuit.
K1 is a contactor which applies or removes voltage to the IGBT's and the load. Operation of K1 is controlled via the software system. If the software link is broken, then K1 will open.

K2 is a bypass contactor which is designed to remain closed until a voltage sag is initiated. When K2 receives a command from the software initiating a voltage sag, K2 opens allowing the SCR and IGBT's to create the controlled voltage sag. When the sag is complete, K2 is designed to close so that the possibility of heat build-up in the IGBT's is reduced.

K3 is a contactor which disconnects the variable transformer output from the circuit when the transformer is not needed and acts as a safety device.

K3 is interlocked with K2 and operates simultaneously with K2 but in the opposite state so that only one contactor should be closed at any one time.

Certain loads may have high inrush currents when power is applied or immediately after a sag event. IGBT's are not designed to withstand large inrush currents.

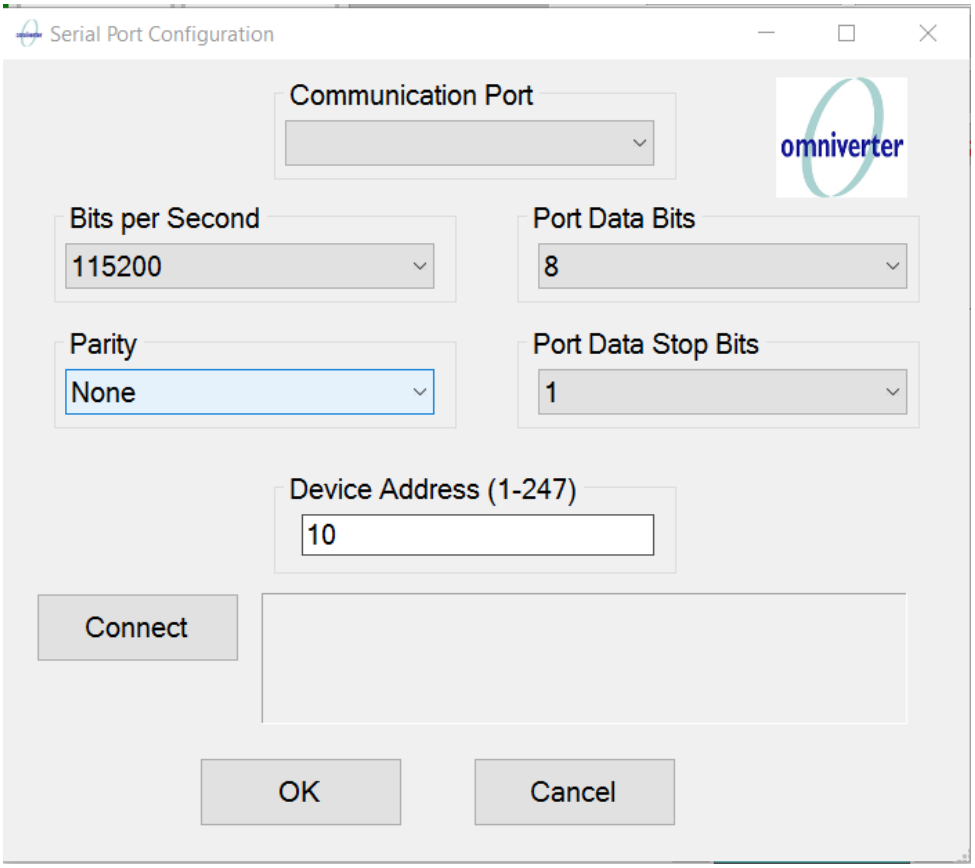


The VSG is also provided with two safety features which will shut down the operation

a) A current sensor which will operate if current is applied in excess of the nominal rated load.
b) An internal heat sensing thermostat which is designed to keep circuits within allowable temperature limits.

USING THE VSG

1) Control Power must be connected to Item 1 on Rear view
2) The VSG needs to be linked to an external computer via Item 1 Front View



Serial Port Configuration Form

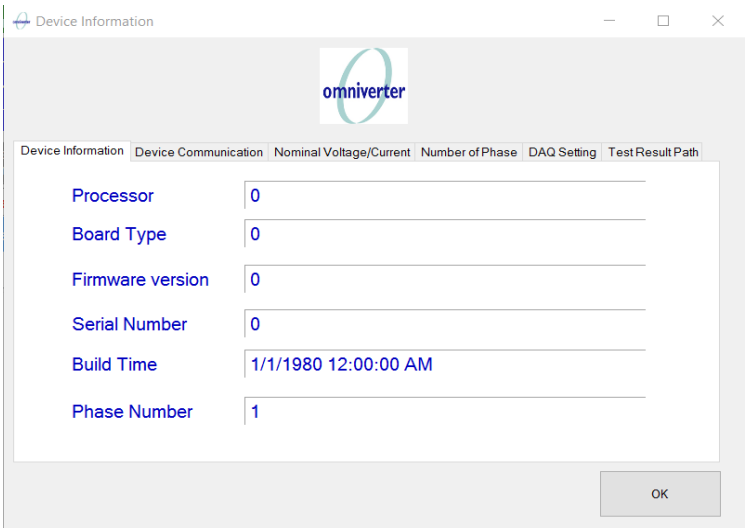
1) Serial Port Setting:
   - Communication Port: list of possible serial ports;
   - Bits per Second: 115200;
   - Port Data Bits: 8;
   - Parity: None;
   - Port Data Stop Bits: 1;
   - Device Address (1-247): 10;
2) Button “Connect”: click to establish communication connection between PC and Sag generator;
3) Connection Message:
   a. Device is ready for working – Sag Generator is connected successfully;
   b. Serial port is closed – PC is not able to communicate with sag generator;
4) Button “OK”: exit serial port configuration form with successful connection;
5) Button “Cancel”: if user doesn’t want to set up serial connection, click button “Cancel” to exit serial port configuration without serial connection;

Device ID of Sag Generator must be 10.

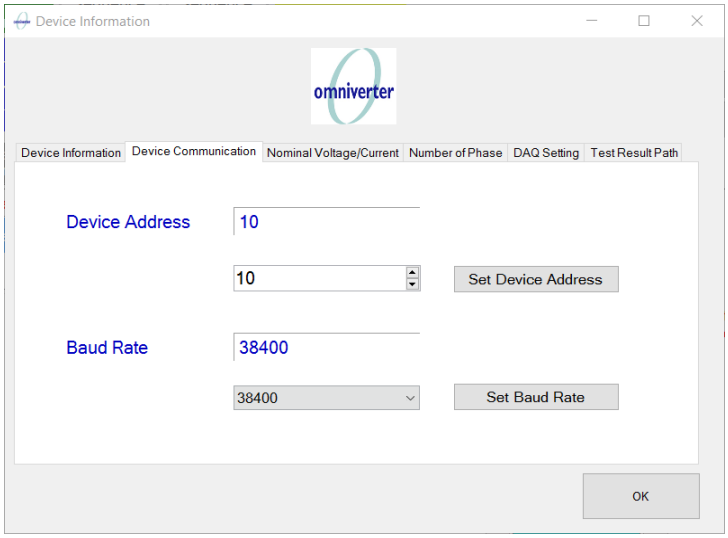
The step to setup serial connection is as follows:

1) Choose serial port from communication port list;
2) Make sure Device ID is set to be 10;
3) Click button “Connect” to try to connect sag generator;
4) If sag generator is online, connection will be established and program will exit serial port configuration form to start main menu form; otherwise, connection message box will display “serial port is closed” or “write is time out”;

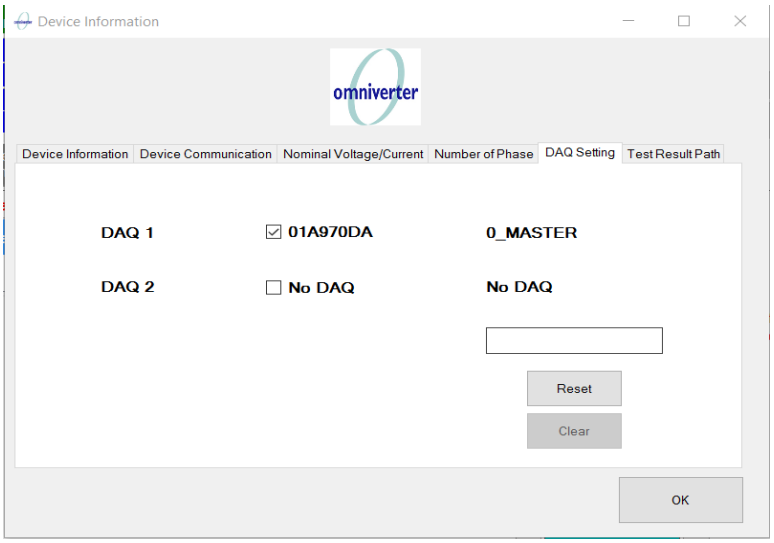
Form “Device Information”



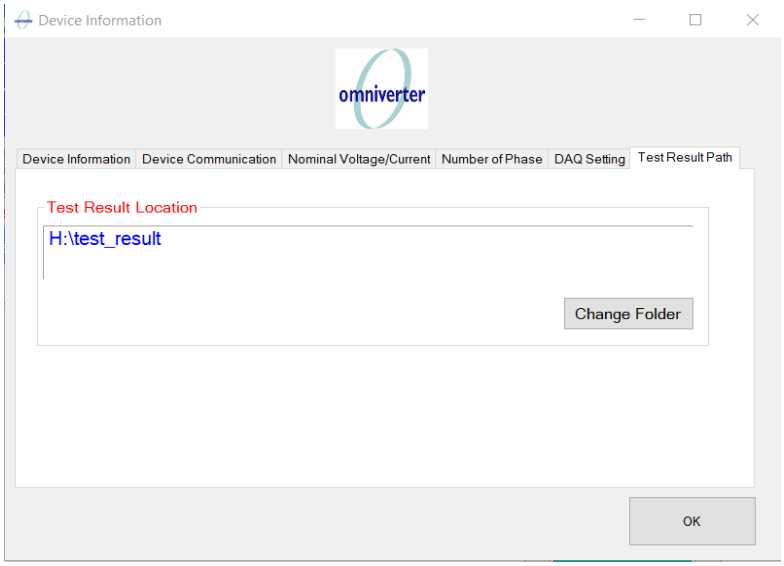
1) Tab page “Device Information”: List connected sag generator equipment information, i.e. processor, board type, firmware information, serial number and phase number
2) Tab page “Device Communication”: List connected sag generator device ID and serial communication speed. The default communication speed is 115200 kbps and device ID must be set to 10



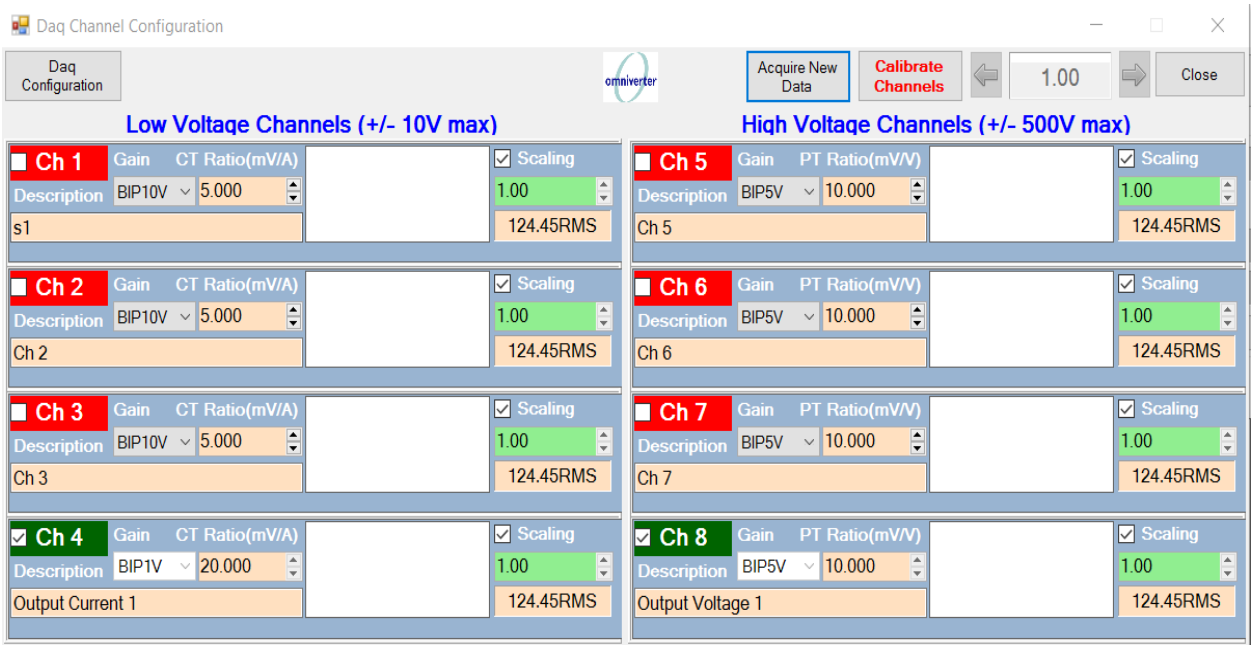
3) Tab page “Nominal Voltage/Current”: display and change nominal voltage and current on connected sag generator
4) Tab page “Number of Phase”: please select “1” which represents a single phase unit
5) Tab page “DAQ Setting”: List DAQ system serial number and states;



6) Tab page “Test Result Path”: List the directory to save test data; When a user performs the test for the first time, software will popup this tab page to require user to set a default directory for test result data; user can change the directory at any time; When test result directory is empty, directory is not set;



DAQ Channel Configuration



Channel Settings:

- Channel Check Box: enable or disable channel;
- Snapshot Chart Display Box: graph chart displays after clicking “Acquire New Data”;
- Value Display Box: the calculated RMS value with DC and AC identification from acquired data;
- Gain: channel measurement ranges; there are four options BIP1V, BIP2V, BIP5V and BIP10V;

Range Name	Measurement Voltage Range
BIP1V	-1V to +1V
BIP2V	-2V to +2V
BIP5V	-5V to +5V
BIP10V	-10V to +10V

- CT Ratio (mV/A): current transformer ratio between primary side and secondary side;
- PT Ratio (mV/V): voltage transformer ratio between primary side and secondary side;
- Description: Chart axis title;
- Scaling Check Box: when this box is checked, user is able to use same scaling factor for all enabled channels; otherwise, user is able to use individual value for itself;
- Scaling Value Box: calibration factor: the range is 0.01 to 2;

Channel quantity, type and specification

Single Phase Sag Generator has 8 data acquisition channels for voltage and current measurement. These 8 channels are separated into two sets. From channel 1 to channel 4 are low voltage channels; from channel 5 to channel 8 are high voltage channels.

Channel 4 and Channel 8 are internal channels. Channel 4 is to measure output current to load and Channel 8 is to measure output voltage to load. These two channels are enabled automatically by program. User is not able to change channel gain, CT/PT ratio and description. User is able to change calibration scaling by button "Calibration". Channel gain, CT/P ratio and description for the internal channel 4 and channel 8 are set automatically by software.

The low voltage channels (1-4) are intended for use with current probes or other transducers having output in the range of tens of millivolts to ±10 Volts maximum.

The high voltage channels (5-8) have an internal circuit that divides by a fixed ratio. In Single Phase Sag Generator, maximum input power voltage is 240Vrms, however, user is able to measure load voltage or other equipment with AC voltage or DC voltage, the voltage range is ±500V.

There are 3 low voltage channel inputs and 3 high voltage channel inputs available on the unit back panel. User is able to use them to connect any transducers or equipment user may wish to test.

Acquiring data

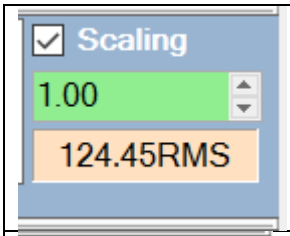
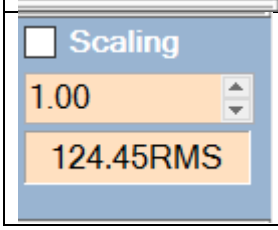
When user clicks button "Acquire New Data", a certain number of data will be acquired from all enabled channels. Software takes a snapshot of acquired data and performs some automatic functions. It first tries to determine whether the signal is AC or DC. Afterward, it calculates a nominal value for each enabled channel. It is assumed at this point that the equipment under test is operating normally and that the acquired signals are indeed representative of nominal conditions. The result will be displayed in value display box with AC and DC identification.

Calibrating the input channels

Occasionally, it might be necessary to check the measurement accuracy of the voltage and current measurements against a calibrated instrument or a known source. Each channel has a scaling factor, or calibration data, which is stored in channel setting file located in the same directory as software installed. If this file is not present, then software will default to factory-set scaling factors (unity gain) for all channels. After user clicks button "Close" to exit DAQ Channel Configuration form, software will save the channel settings into this file automatically.

As we described above, one "scaling" check box and value change box in each channel, and another unified scaling value box are shown below and enabled/disabled by clicking button "Calibrate Channels".

	Calibration Channels is disabled
	Calibration Channels is enabled; user is able to use 2 buttons to decrease or increase scaling or calibration value. The range is 0.01 to 2. This value will be implemented to all enable channels with checked scaling check box.

	Unified scaling factor value is enabled
	Individual scaling factor value is enabled

When user finishes channel calibration, please click button “Calibrate Channels” again to exit channel calibration.

Calibration steps is followed:

1) Open DAQ Channel Configuration form;
2) Click button “Calibrate Channels” to enable calibration mode;
3) Internal channel 4 and channel 8 are always enabled; if user would like to calibrate any other channel, please check channel box to enable channel;
4) If user would like all active channels to use one scaling value, please keep scaling check box checked; otherwise, user needs to change scaling individually;
5) Click “Acquire new Data”;
6) After sample data are acquired, software performs calculation to identify AC signal or DC signal, and also displays RMS value if AC signal is detected and average value display if DC signal is detected;
7) If user agrees the scaling value to get correct data acquiring, user clicks button “Calibrate Channels” to exit calibration mode;
8) The channel setting will be saved into a file located in the same directory of program installed;

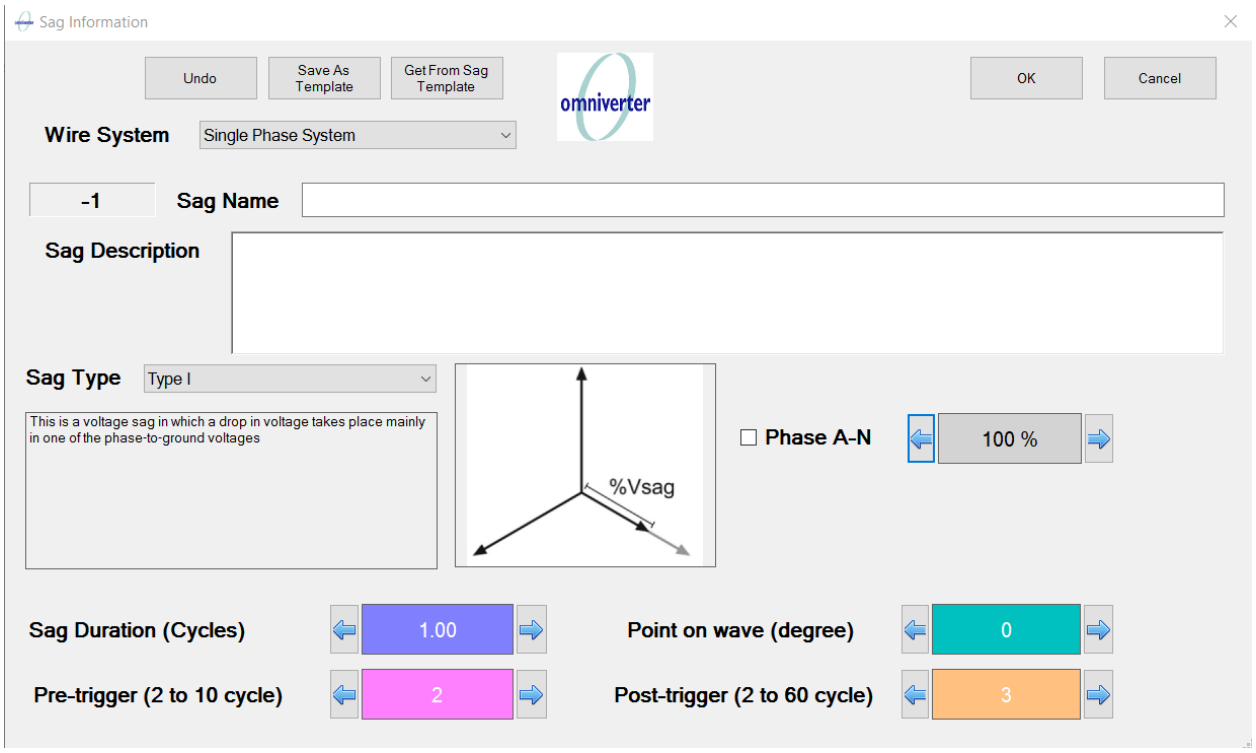
When user connects any of low voltage or high voltage channels to any transducer or any equipment and if user would like to test their accuracy, a calibration procedure is needed which requires the following steps:

1) Identify output of transducer or equipment in voltage range;
2) Connect terminal of transducer or equipment to DAQ input channel plug; Low voltage plug is BNC connector; and High voltage plugs are red/black banana connectors. Before user connects them, please make sure connected equipment specification is appropriate to low voltage channel or high voltage channel;
3) Enable connected channel, and choose a proper gain first;
4) Modify the chart axis title
5) Change CT or PT ratio to adapt specification of connected transducer or equipment;
6) Click button “Acquire New Data”, software will acquire data and perform calculation to decide AC signal or DC signal, and display value for user verification. If user thinks the accuracy is out of tolerance, please go to step (7); otherwise user is able to click button “close” to exit channel setting form or go to step (1) to start another transducer or equipment;
7) Click button “Calibrate Channels” to enable calibration mode;
8) Change scaling value of the calibration channel by using button “up” and “down” to increase or decrease scaling value or double click scaling value box to type the value you want. The new value range is between 0.01 and 2;
9) Click button “Acquire New Data”, software will acquire data and perform calculation with new scaling value to decide AC signal or DC signal, and display value for user verification. If user think the accuracy is enough, user click button “Calibrate Channels” to exit calibration mode; otherwise, user need to repeat step (8) and (9) to redo calibration;
10) When user thinks accuracy check is finished, click button “Calibrate Channels” to exit calibrate mode;

Sag Event Editor

1) Button “Undo”: Cancel all changes of sag event parameters to default value;
2) Button “Save As Template”: Save current sag event into template library for next time use;
3) Button “Get from Sag Template”: Load sag event from template library;
4) Button “OK”: Exit sag information editor form with keeping the change of sag event;
5) Button “Cancel”: Exit sag information editor form without keeping any change of sag event;
6) Wire System: Choose wire system for current editing sag event. When connected sag generator is single phase, user can only choose 1 phase;
7) Sag ID: The identification number for the current editing event. ID number will be -1 before this sag event saves into template library; a new number will be created
8) Sag Name: The user defined name of editing sag event;
9) Sag Description: The detail information for editing sag event;
10) Sag Type: The type of sag event. Only one type I can be selected when connected sag generator is single phase generator;
11) Phase A-N: the percentage voltage of input voltage. This value is between 0 and 100% when sag generator is single phase;

12) Sag Duration: The value is the sag event duration period. The unit is one cycle and the range is 0 to 5400 cycles;
13) Point on wave: the electrical degree value to start the sag event. The range is 0 to 359°;
14) Pre-trigger time: the time period to start DAQ acquisition before the sag event starts. The unit is one cycle and range is 2 to 10 cycles. The default value is 2 cycles;
15) Post-trigger time: the time period to stop DAQ acquisition after sag event finishes. The unit is one cycle and range is 2 to 60 cycles. The default value is 3 cycles;

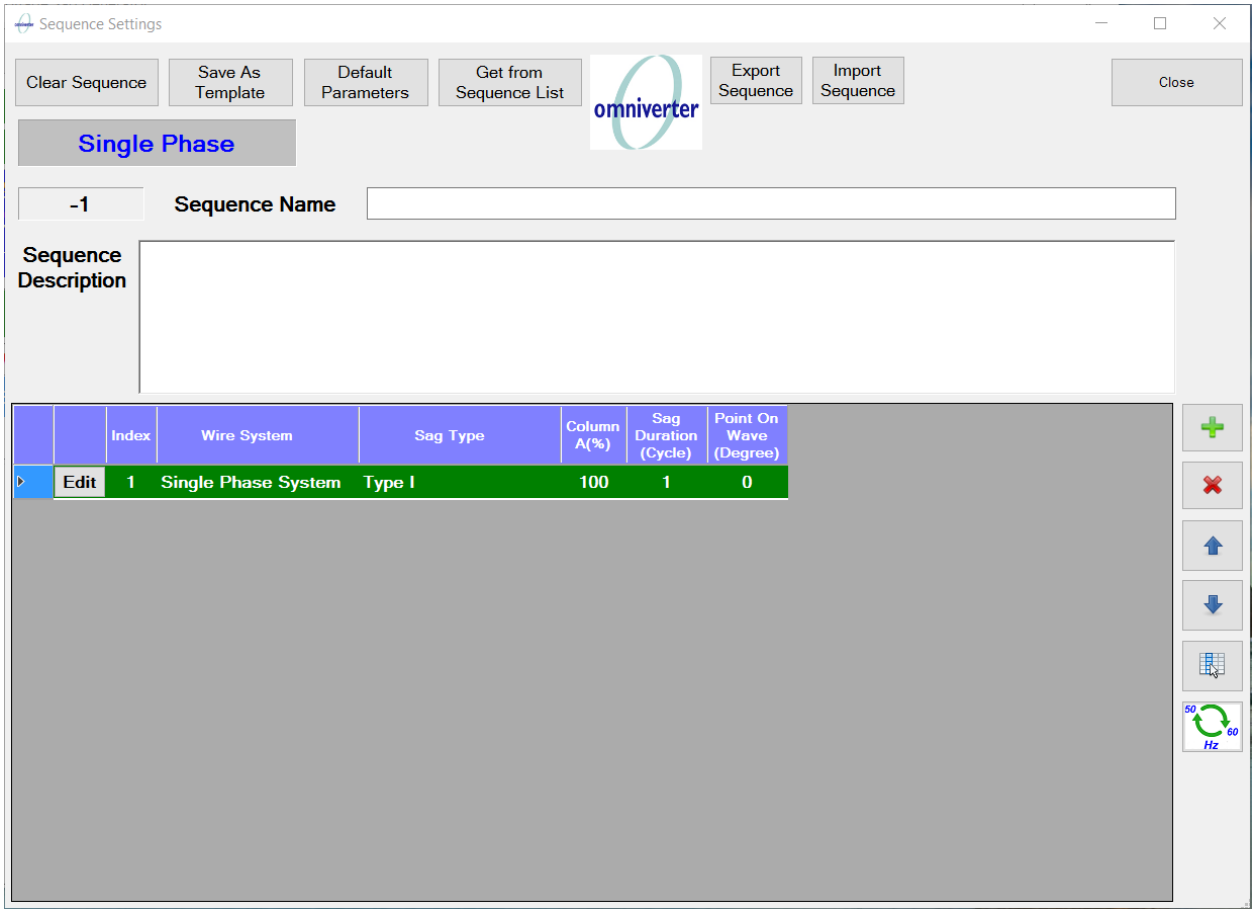


Sag Events Sequence Editor

1) Button “Clear Sequence”: Clear current sag event sequence;
2) Button “Save As Template”: Save sag events sequence into template library for future usage;
3) Button “Default Parameters”: Open default parameters form;
4) Button “Get from Sequence List”: Import sag event sequence from template library;
5) Button “Export Sequence”: Export sag event sequence to a file;
6) Button “Import Sequence”: Import sag event sequence from a file;
7) Sequence Name: the user defined name for editing sequence;
8) Wire System: the type of wire system for this sag event; there are 3 type of wire system according to the number of phase. One is for single phase system, the other two are for 3 phase system (Y connection and Delta connection);
9) Sequence Description: the user defined detail description for editing sequence;
10) Sag Event List: the list of sag event. One sequence can have maximum 27 sag events;
11) Button “Edit”: this button is located the first column on every sag event in the sag event list. Click this buton to open form “Sag Event Editor” to edit sag event parameters;
12) Button “Close”: Exit Sequence Editor to main menu;

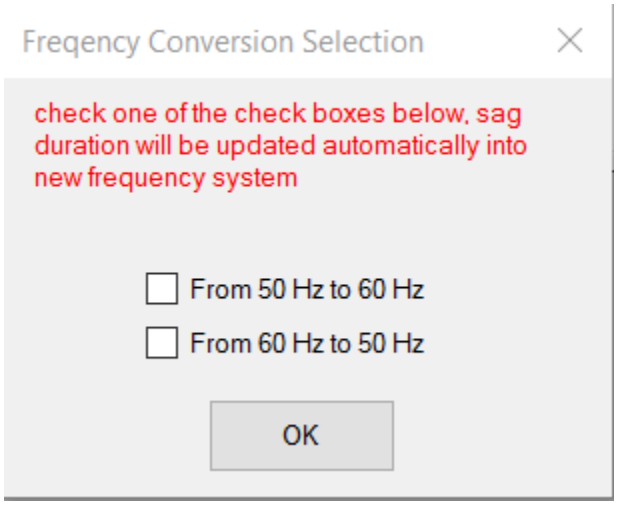
13) Sag List Buttons:

	Append new sag event at the end of existed last sag event
	Delete selected sag event in the sag event list
	Move up selected sag event
	Move down selected sag event
	Open form “Update Parameters Value”. User is able to use this function to update column percentage, sag duration, and point on wave for all existed sag events in the list
	Open form “Frequency Conversion Selection”. User is able to use this function to convert sag duration cycles in 50Hz/60Hz to the cycles of the same time peroid in 60 Hz/50 Hz



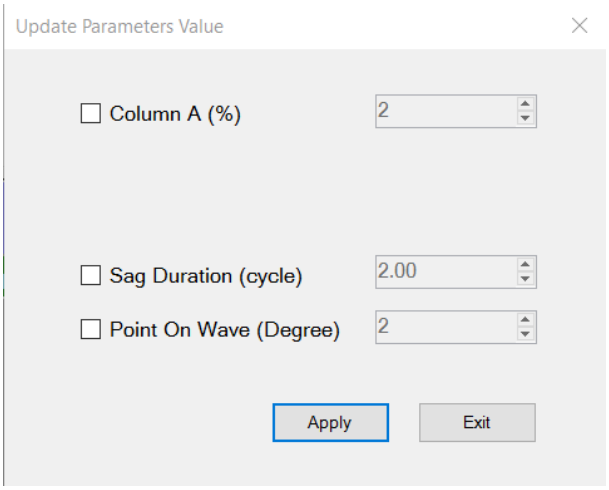
Frequency Conversion Selection

1) Check “from 50 Hz to 60 Hz” or “from 60 Hz to 50 Hz”;
2) Button “OK” to exit frequency conversion selection;

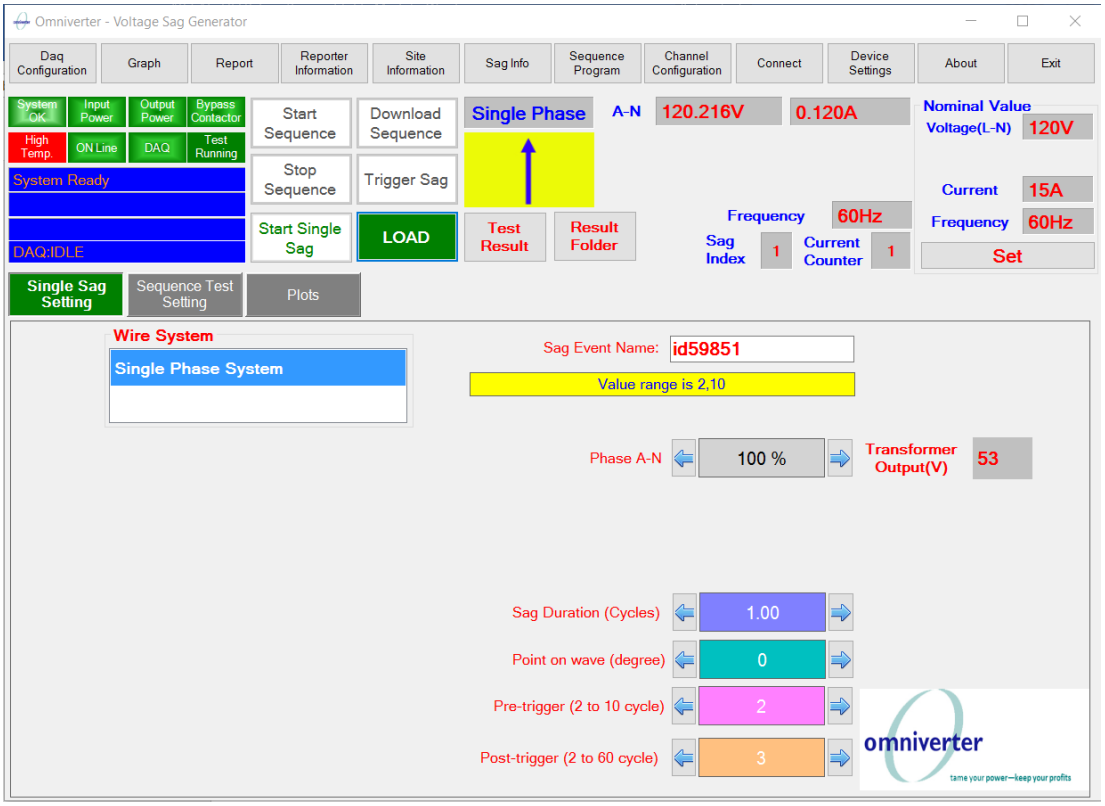


Update Parameters Value

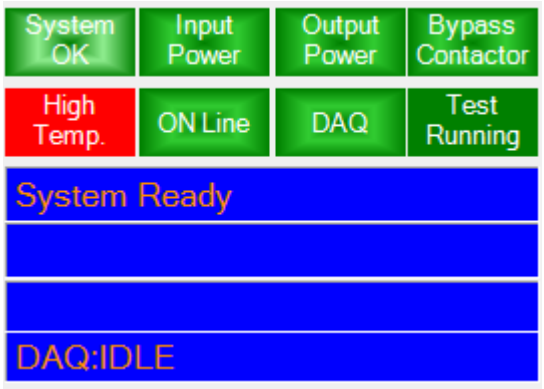
1) Check “Column A%” to enable value edit box; change column A to proper value;
2) Check “Sag Duration(cycle)” to enable value edit box; change Sag Duration to proper cycle;
3) Check “Point On Wave (Degree)” to enable value edit box; change Point On Wave to proper degree;
4) Button “Apply”: Apply the new value to all sag event in the sag event list;
5) Button “Exit”: Cancel the change and exit function;



Main menu ***form***



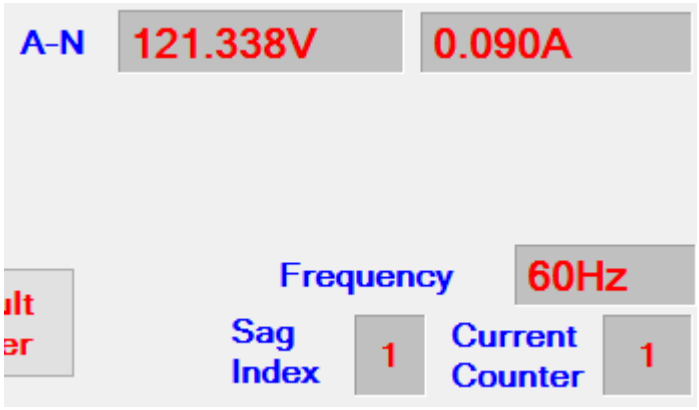
Message display and status of system



When program is connecting sag generator, there are 8 LED's to represent equipment status.

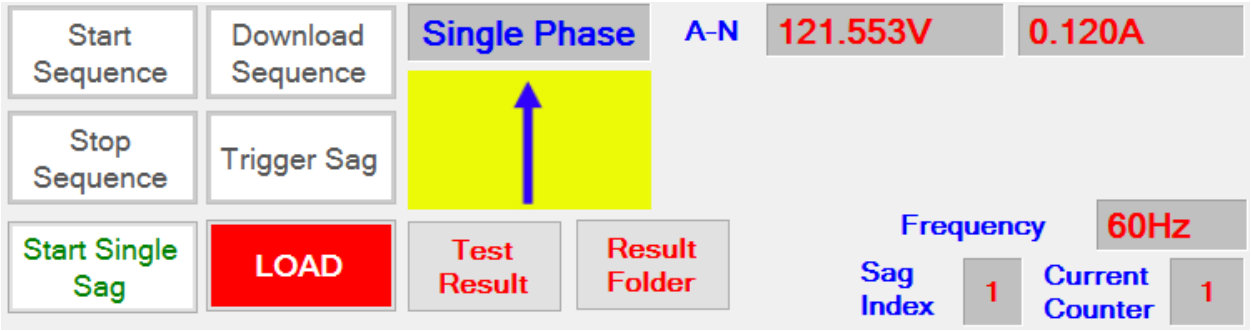
- System Ok: This light will have 3 statuses, when system is in normal status without any warning message or error message, this light will be color lime green; if system has warning message without error message, this light will be color orange with flashing; if system has error message, this light will be color red with flashing;
- Input Power: This light represents input power switch status. When input power is enabled, this light will be color lime green; otherwise the light is color green;
- Output Power: This light represents status of output power to the load. When user clicks button "Load" on main menu form, sag generator will close output contact to deliver power to the load and light will be lime green; otherwise light will be green;
- Bypass Contact: This light represents status of bypass contact status. When this contact is closed, the light will be lime green; otherwise the light will be green;
- High Temp.: This light represents the high temperature in sag generator cabinet. If the temperature in the cabinet of sag generator exceeds pre-setting limits, this light will flash with light red; otherwise, the light is solid red;
- On-Line: This light represents communication status between PC and sag generator. When program is connecting sag generator, the light will be lime green; otherwise the light is green;
- DAQ: This light represents the status of DAQ board. When DAQ board is connected to PC and program detects the DAQ board in correct status, the light will be lime green; otherwise the light will be green;
- Test Running: This light represents the status of sag event test. After user clicks button "start single sag" or button "Start Sequence" and sag generator starts the test properly without any error or warning, this light will be lime green; after the test is stopped or finish correctly, this light will be green;
- The system message box: This box displays system message;
- The warning message box: This box displays warning message;
- The error message box: This box displays error message;
- The DAQ message box: This box displays DAQ message;

Input power voltage, current and frequency are displayed below:



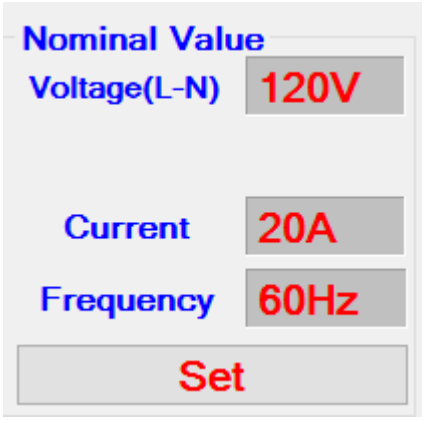
Operation Commands

- Button “Start Sequence”: Click this button to start sag event sequence
- Button “Stop sequence”: Click this button to stop sag event sequence;
- Button “Download Sequence”: Click this button to download sag event sequence program to connected sag generator;
- Button “Trigger Sag”: After user start sag event, sag generator will prepare output voltage first. When sag voltage is ready for replacing the input voltage for output, sag generator will send command to PC to flash this button with color red, user is able to click this button to trigger sag event;
- Button “Start Single Sag”: Click this button to start single sag event;
- Button “Load”: Click this button to request sag generator to close output contact and delivery input power to the load connected on output side of sag generator. When button has red background with white characters, output contact is open and no power is delivered to the load; when button has green background with white characters, output contact is closed and power is delivered to the load;
- Button “Test Result”: Click this button to open test result form. After each sag event test, program will popup a test result form to display calculated actual output voltage for each phase, user is able to identify the sag event and confirm the load response when the sag event happens;
- Button “Result Folder”: Click this button to open the folder to save test result data files;



Nominal Value Setting

User needs to set nominal value before user starts sag test. In single phase sag generator, maximum nominal voltage is 240VAC and 20A nominal current. Nominal value setting is displayed on main menu form and user can click button “Set” to open tab page “Nominal Voltage/Current” in form “Device Information”.

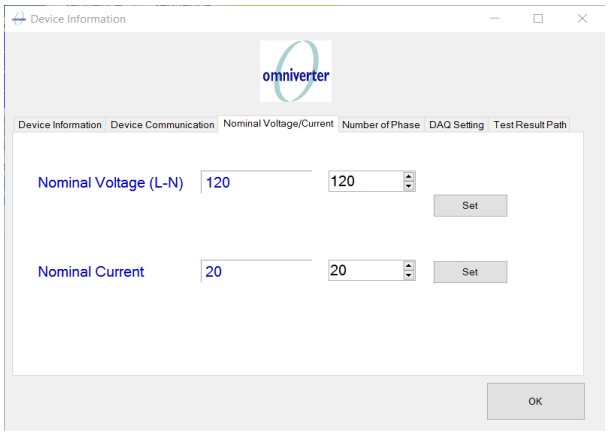


Nominal Value Setting Steps

1) Open tab page “Nominal Voltage/Current” in form “Device Information”;
2) Current nominal value is displayed on the left side of new value;
3) New value is equal to current setting. User is able to change new value to any number less than the maximum restriction. Maximum limits in Nominal Voltage/Current is listed below:

Maximum Nominal Voltage	240VAC
Maximum Nominal Current	20A
Nominal Frequency	50Hz/60Hz

4) Click button “set” to send new value to sag generator after user decides new value;
5) Current value setting will be updated to the same value as new value box after sag generator validate new value and send it back to sag generator HMI control software;
6) Click button “OK” to exit form “Device Information”;



Test Result

- Sag Information:
    1) Nominal Frequency: Display actual nominal frequency of input power;
    2) Phase A (%): Display the pre-set sag event value;
    3) Sag Duration: Display sag event duration in cycle and in millisecond;
    4) Point-on-wave: Display sag event start electrical angle in degree;
- Test Result:
    1) Phase A-N: Display the calculated sag RMS voltage during sag event period;
    2) Check box “Full Operation”,” Self Recovery” and “Assisted Recovery”: These three check boxes are for user to confirm the response from the load during sag event period;
    3) Text Box “Comments”: user is able to write down some comments for this sag event test;
    4) Button “Result Confirmed, Saved and Exit”: Click this button to confirm the test result, save result in the data file and exit “Test Result” form;

Test Result Data

Program will perform DAQ acquisition during the sag event period with 10kHz sample rate. After sag event finishes, program stops data acquisition, plots data into a graph and saves data and sag event settings into the data files. There are 2 data files.

one is sequence summary file to keep sequence program information, system setting information and sag event data file list.

```
<ProgramInformation>

ProgramId=71163
ProgramName=id71163
ProgramDescription=
NumOfPhase=1
NumOfSag=1
StartDateTime=2016/09/29 11:52:47.585
StopDateTime=2016/09/29 11:53:10.180
<SystemInformation>

NominalVLLVoltage=208
NominalVLNVoltage=120
NominalCurrent=15
NominalFrequency=60

<SagEventDataFileList>
sag_1=id71163_2016_9_29_11_52_47_585_idx_1.csv
```

Another file is data file for each sag event in the sag sequence program. The data file includes test result, sag event information, DAQ channel information, and data. The DAQ sample rate is 10kHz per channel.

Data file is a csv file. User can easily import these data files into 3rd party program.

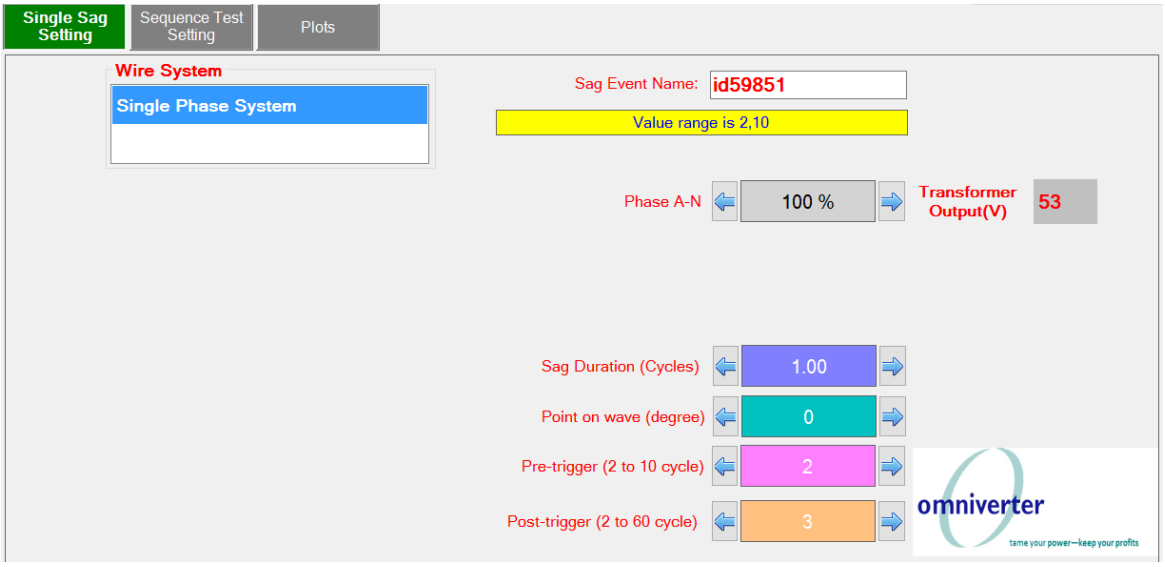
```
<TestResult>
StartDateTime=2016/09/29 11:53:03.880
StopDateTime=2016/09/29 11:53:05.799
PhaseAVolt=84
PhaseBVolt=0
PhaseCVolt=0
IsFullOperation=False
IsSelfRecovery=False
IsAssistedRecovery=False
Comment=
<Sag Information>
SagId=71163
SequenceIndex=1
SagName=id71163
SagDescription=
SagEditFlag=1
WireSystem=1
SagType=1
SagColumnA=70
SagColumnB=100
SagColumnC=100
PointOnWave=0
PreTriggerTime=2
PostTriggerTime=3
PauseInterval=1
DeltaIndex=0
SagDuration=10

<DaqInformation>
ch4=,3,4,0,1,1,20,1,Ch 4,Output Current 1,V,A,0,1,1,1,BIP1V,0
ch8=,7,8,0,1,1,10,1,Ch 8,Output Voltage 1,V,V,0,1,0,1,BIP5V,0

<Data>
Time(msec),ch4,ch8
0,0.0272277822723321,19.9374353419496
0.1,0.02898665863037,25.6710662461854
0.2,0.02898665863037,33.0579526872254
0.3,0.0254689059143054,39.5126844107057
```

Single Sag Test

In main menu, user is able to start single test in the fast way.

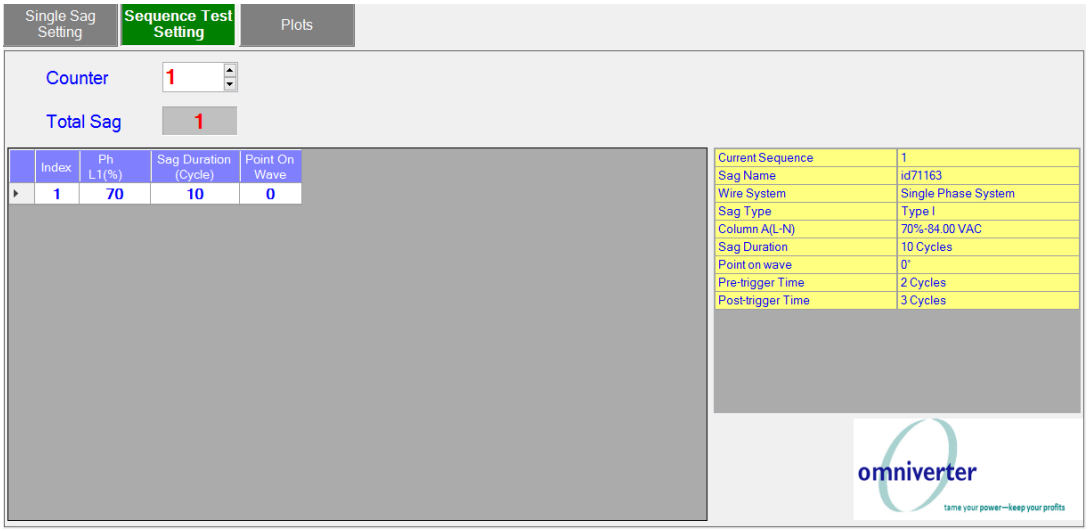
1) Sag Event Name: this name can be set automatically by program. But user is also able to change it;
2) Wire System: the type of wire system for this single sag event test. If program is connecting to a sag generator, the phase number of this sag generator will decide the type of wire system. Single phase unit will only have one wire system – single phase system; 3 phase systems have 2 type of wire system (Y connection and Delta connection);
3) Phase A-N: the number as percentage of nominal voltage for sag event. For single phase system, output voltage is only changed between 0 and 100% of nominal voltage;
4) Sag Duration (cycle): the time period for sag event. The time unit is one cycle;

5) Point on wave (degree): the electrical degree that sag event will start, this will be between 0° and 359°;
6) Pre-trigger(cycle): the time period to start DAQ process before the sag event starts. The value range is between 2 and 10 cycles;
7) Post-trigger(cycle): the time period to start DAQ process after the sag event finishes. The value range is between 2 and 60 cycles;
8) Transformer Output (V): the actual output voltage of sag voltage transformer in single phase sag generator;



Sequence Test

- Counter: The number of execution cycle for current sequence program; this counter range is from 1 to 100;
- Total Sag: the sag event number of this sequence program;
- Sequence program list box: list all sag events in the current sequence program;
- Sag event detail box: Display the current executing sag event;



Fuse List

Power socket fuse holder	**F1-1, F1-2**	**2 x 6A@250VAC, 5 X 20 mm**
Main Input Power fuse	**FL1/FL2**	**2 x 20A@600VAC,**
24VDC Fuse	**F4**	**1 x 2.5A@250VAC, 5 X 20 mm**
5VDC Fuse	**F5**	**1 x 1.25A@250VAC, 5 X 20 mm**
12VDC Fuse	**F6**	**1 x 5A@250VAC, 5 X 20 mm**

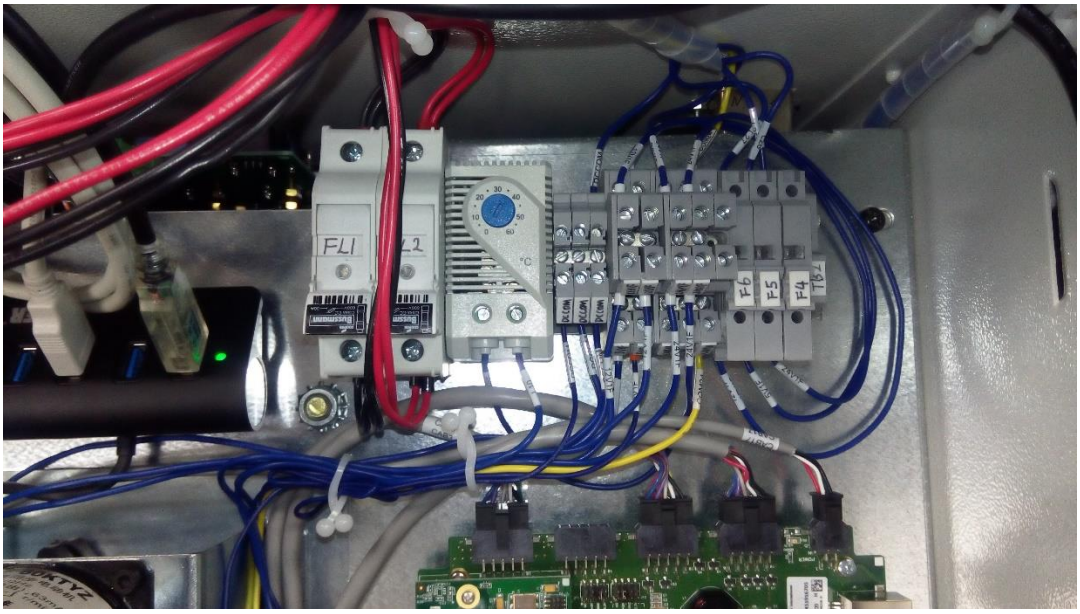


Figure 1 Fuse FL1/FL2, F4, F5, and F6 Location

Figure 2 Fuse F1-1 and F1-2 Location

(H) External Trigger Setting

In Signal Module, jumper JP6 can set external triggering signal. Jumper JP6 is 3 pin. If 1-2 is connected, logic low (0 VDC) will be triggering signal; if 2-3 is connected, logic high (5VDC) will be triggering signal.

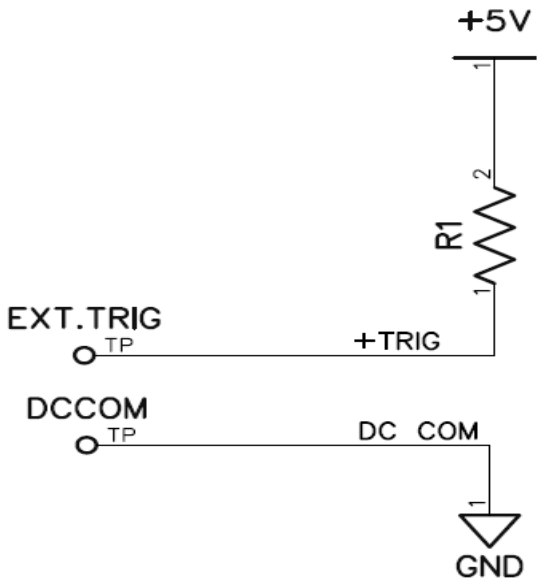


Figure 3 External Trigger Wiring Diagram

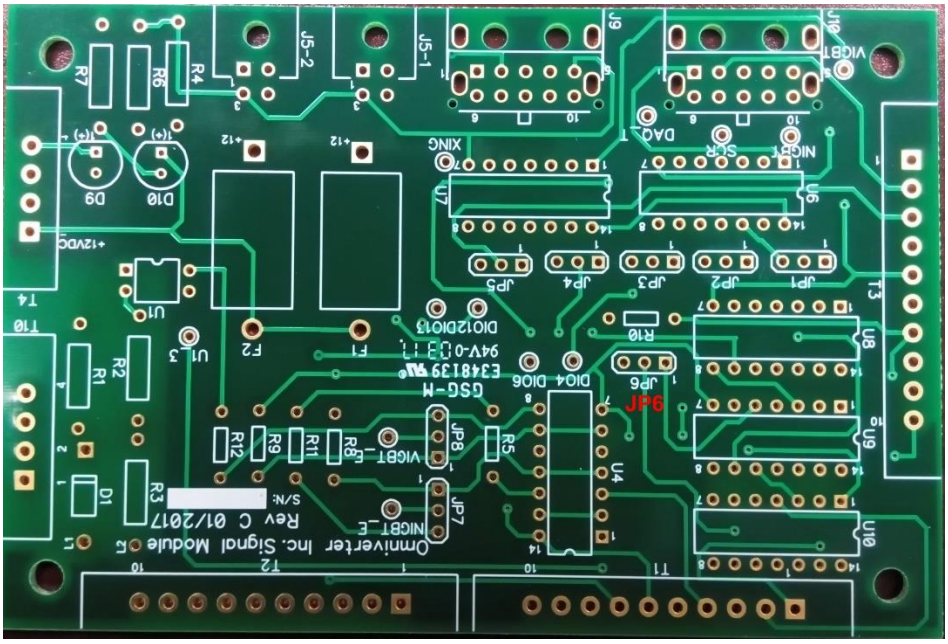


Figure 4 Signal Module JP6