INNOVATIVE SCIENTIFIC SOLUTIONS, INC

Pulse Delay Generator (PSG-3)

Operation Manual (Version 2.5)

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Made in U.S.A.

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Features

- Two dual-channel independently programmable pulse generators (each PSG-3 has 4 total channels)
  - The PSG-3 can produce two separate frequency outputs either synchronously or asynchronously.
- Four high-current TTL level outputs
  - Extends the utility of this generator by allowing it to drive low impedance loads (50 Ohms) such as solenoids and drive logic over long cable runs
- Threshold of trigger input (0.05-5V) to PSG-3
- Divide-by circuit (2-255) trigger input
- 10/100 Mbps Ethernet
- Multiple timing bases(s, ms, µs, ns)
- Multiple PSG-3s can be cascaded to increase the number of channels
- BNC inhibit input (TTL high level) to allow the PSG-3 to be gated by an external source
- TCP/IP API command control for integration
- Firmware upgradeability through USB

PSG-3 Front Panel

PSG-3 Back Panel

Specifications

I/O Configuration	
TTL Outputs	4 standard, 4 high-current (mirroring standard)
Inputs	1 Ext. Trig. Input 1 Inhibit
Divide-by-N	1 input, 1 output

Internal Generator	
Repetition Rate	0.100 Hz to 25.00 MHz
Resolution	20 nanoseconds
Burst Mode	1 – 131,072 pulses
Output Modes	Single-shot, burst, continuous
Master Clock	50 MHz, +/- 30 ppm Dual Clocks allow for independent repetition rates from one PSG-3
Timing Clock Settings	20-, 40-, 80-, 160-ns

Programming	
Control Mode	Internally triggered, externally triggered and/or gated. Generator 1 & 2 can be independently set to internally or externally triggered.
Multiplex	None
Divide-by-N	2-255

Trigger Input	
Threshold	0.05 - 5.0 V
Max Input Voltage	7.0 V
Max Input Frequency	5 MHz
Input Impedance	>1 M Ω

TTL Outputs	
Output Impedance	50 Ω
Output Voltage	@ 50 Ω: 2.5 V (Standard outputs) @ 1 K Ω: 4.0 V (High-current outputs)
Pulse Width	20 ns to 10.736 s
Delay Width	20 ns to 10.736 s

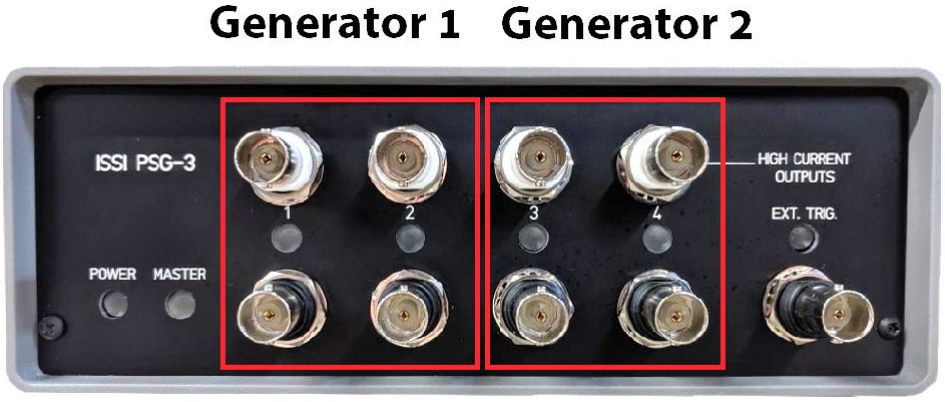
Communication Interfaces	
Ethernet	1 input, 10/100 Mbps
USB 2.0	1 input, type B
RJ-11	2, sync in and sync out (Master/slave config.)

Power Input	
External Power Input	85-264 VAC, 50-60 Hz

Export	
ECCN	EAR99

Description

The PSG-3 has two dual-channel pulse generators. The first generator outputs pulses on BNC connectors marked as 1 and 2 and second on BNC connectors marked as 3 and 4 on the front panel. There are also LED indicators showing the presence of pulses on the output. Please note that LED brightness depends on the duty cycle of the generated sequence.



Each generator's period (inverse of frequency) and number of pulses are programmable. The period and number of pulses can be different between the two generators. Within each generator, the start and duration of pulses in the channels are programmable independently but the period and number of pulses is the same for both channels (these values cannot exceed the period of the pulse sequence and the smallest pulse duration is equal to the timing base). The pulse start position is referenced to the trigger moment (τ_0) which is either initiated by user application or by the external trigger signal.

Front Panel

Power	Device is powered on
Master	Device is acting as 'Master' PSG-3 in Ext. Sync Mode
1, 2, 3, 4	Each channel of the PSG-3. Two channels per generator.
High Current Outputs	Mirrors the output of 1, 2, 3, and 4. Used for long cable lengths or other low impedance loads. Output is ~1A.
Ext. Trig.	External trigger input from external device. Threshold can be set from 0.05-5V.

Back Panel

Trig Inhibit + 5VDC	Inhibits the front panel when 5 VDC is applied. Device will still be triggered.
Divide By Input	External pulse train input for divide-by-N
Divide By Output	Frequency divided pulse train from divide-by-N
Reset	Puts the PSG-3 into firmware upgrade mode
USB	Firmware upgrade / Communication with PC
Ethernet	Communication with PC
Ext. In	Synchronization input with additional PSG-3
Sync Out	Synchronization output with additional PSG-3
85-264 VAC (47-440 Hz)	Device power connection

Network Setup

The PSG-3's network parameters should be set to accommodate the particular needs of the network used to connect the PSG-3(s) to the local network. The default network parameters are as follows:

- Ethernet MAC address: (this is unique to each PSG-3)
- DHCP: disabled
- IP address: 192.168.2.30
- Subnet mask: 255.255.255.0
- Gateway: 10.0.2.2

If this is not suitable or more than one PSG-3 is going to be used on the same network, these parameters should be changed. There are two possibilities to change these parameters:

Note: Each PSG-3 set to the default IP address before it is put into stock. This address is printed on the back panel of each PSG-3 and should only be changed by the user if necessary to communicate over the local network. If the device is reset, it will revert back to the factory default IP of 192.168.2.30 as described in the initial configuration and firmware upgrade section of this manual.

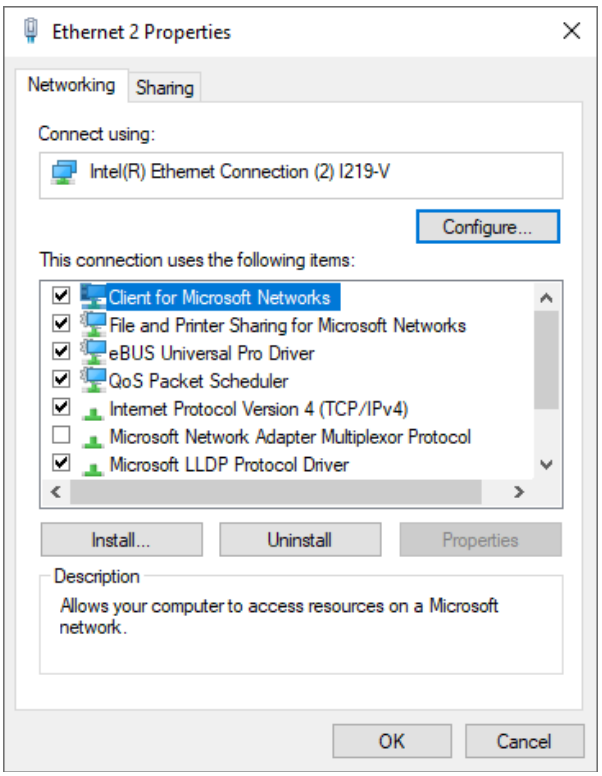
To do configure the PC NIC (network interface card) to properly communicate with the PSG-3, navigate to the *'Network Connections'* page on the control panel where the local networks of the computer is displayed. Right-click on the network where the PSG-3 is connected and select *'Properties.'*

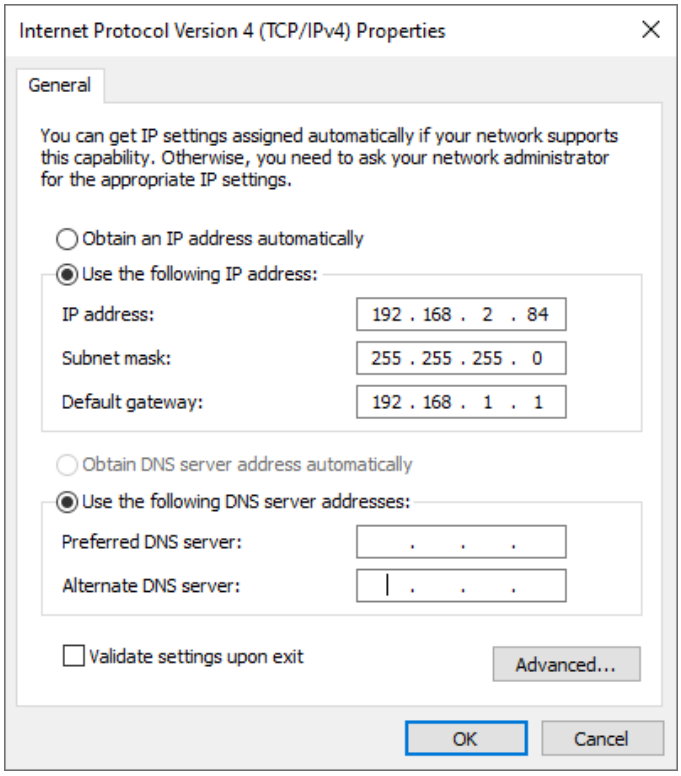
From the *'Local Area Connection X Properties'* window, click on *'Internet Protocol Version 4 (TCP/IPv4)'* and then press the *'Properties'* button, now useable. This will open the *'Internet Protocol Version 4 (TCP/IPv4) Properties'* window. This is where the IP addresses are entered so that PSG-3 can be reached over the local network. The settings needed for communication are **IP Address** and **Subnet mask**.

The IP address of the NIC should use the following conventions:

IP Format: **Network.Network.Subnet.Host**

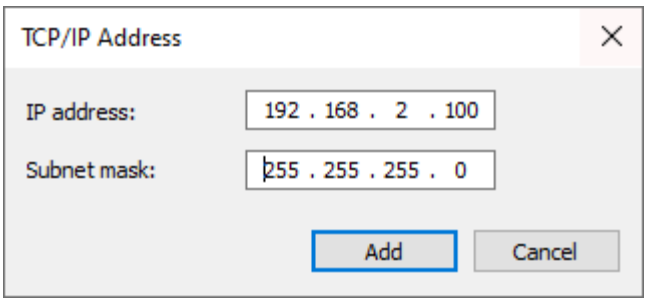
- PSG-3 Default IP: 192.168.2.30
- NIC IP: 192.168.2.XXX





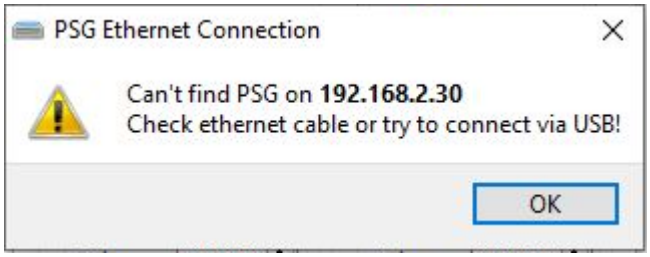
The NIC IP address should have the same network and subnet addresses but a unique host, the last line of the IP address. The host can be any value 1-254 but different from the host address of the PSG-3. The subnet mask should be set to match that of the PSG-3 which, by default is 255.255.255.0. The **Default Gateway** and all other fields can be left blank.

Additional subnetworks can be configured for the same NIC. In the *'Internet Protocol Version 4 (TCP/IPv4)'* window, the **Advanced** button will open the *'Advanced TCP/IP Settings'* window. IP addresses of any subnetwork can be added for that NIC here. If multiple devices are being used on the same network and they have differing subnetworks, this option provides communication for all devices without the need to change IP addresses for each device. Click ***Add*** to add a new IP address to the NIC.

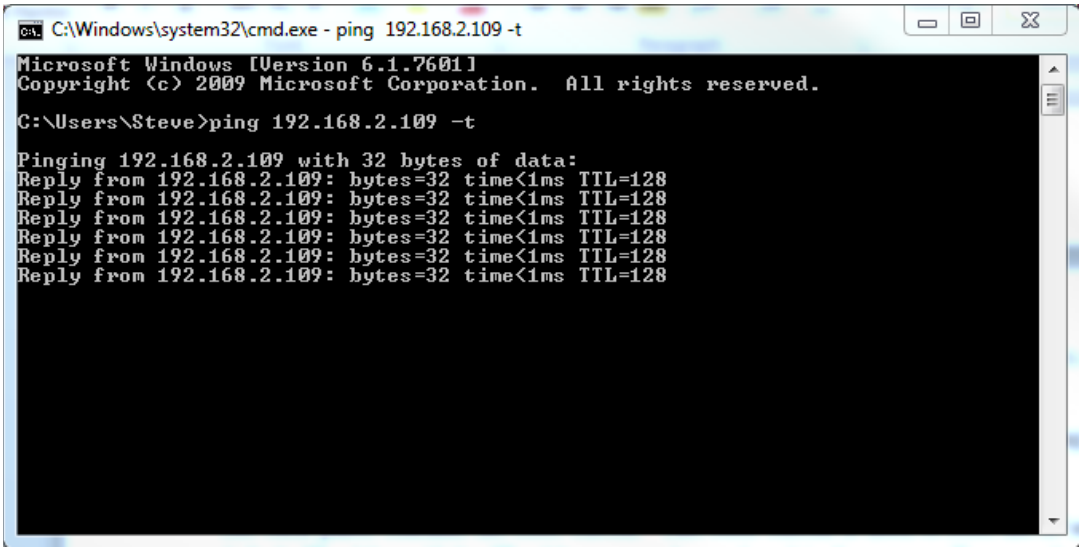


***Note:** Verify that pulse generator default subnetwork (192.168.2.XXX) is configured on the NIC as well as any other subnetwork that may be used to communicate with the PSG-3. Failure to do so will prevent the software interface from finding any connected PSG-3.

If the pulse generator is not connected properly, a connection error (below) will be displayed.



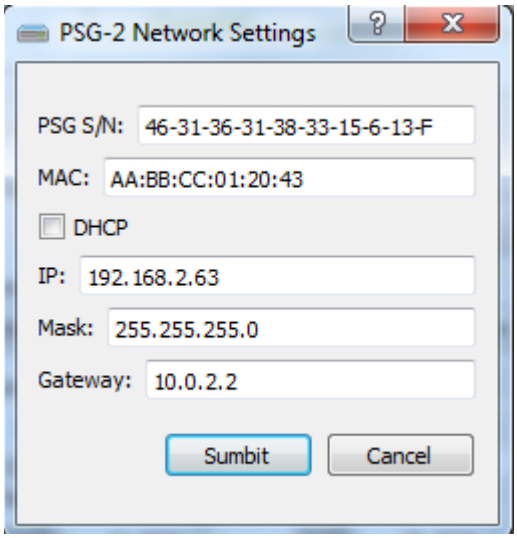
If connection problems persist, check the connection of the Ethernet cable between the computer NIC and the PSG-3. To check that there is a physical connection, ping the IP address of the PSG-3 from the Command Prompt. To do this, open the command prompt window and enter: ***Ping XXX.XXX.XXX.XXX –t***



Communication over USB is plug-and-play using the ***ISSI PSG-3 Interface*** program.

Changing Network Settings – ISSI PSG-3 Interface

The PSG-3 network settings (shown below) can be changed under the '**Settings**' tab on the ***ISSI PSG-3 Interface.*** This can be done via USB or Ethernet connection. If the IP address of the PSG-3 was changed and is not currently known, connecting over USB will display the current IP so it can be recorded or changed. *'Submit'* to affect the changes.



Network Settings ISSI PSG-3 Interface

Changing Network Settings – Web browser

- If the network *is* operational, use any internet browser to navigate to the URL corresponding to the PSG-3's network address (i.e http://192.168.2.30 for the default configuration).
  - On the PSG-3's main page, navigate to the '*Network Settings*' link. (i.e http://192.168.2.30/network.shtml address in default settings) - see Figure 5.
  - On the '*Network Settings'* page, enter the desired configuration and click the *'Submit'* button. ****Important:** Make sure that the Ethernet MAC and the IP addresses are unique on the network**

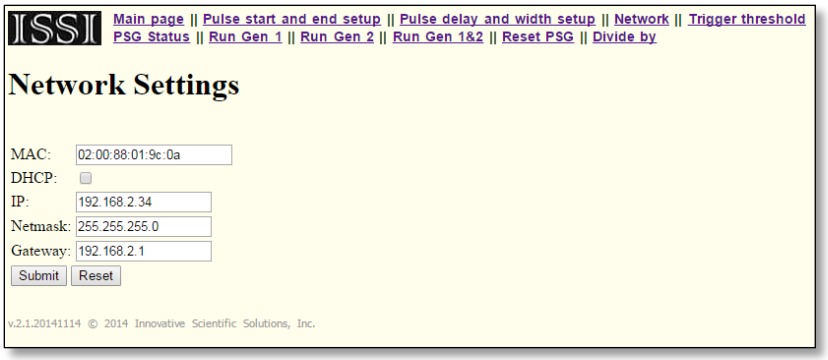


Figure 5: PSG-3 Network Settings page

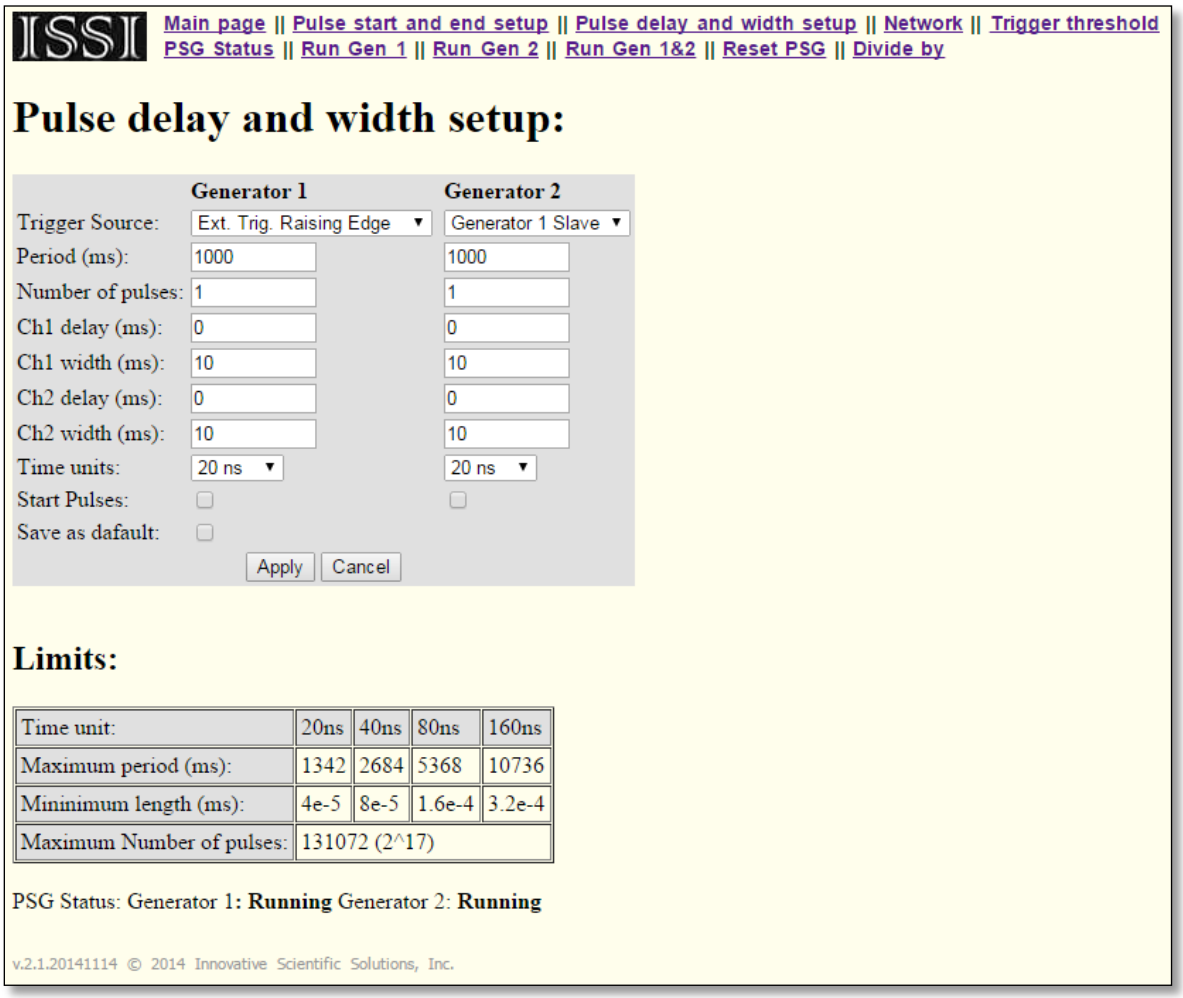
To activate new configuration(s), cycle the power of PSG-3.

Software Operation

There are two options for software operation of the PSG-3. The PSG-3 can be operated over a web browser simply by entering the IP address of the PSG-3 in the address bar (when connected over Ethernet) and also be operated using the ***ISSI PSG-3 Interface***. The PSG-3 will only operate over USB via the software interface. This software installation will automatically install USB drivers to communicate with the PSG-3.

Web Interface

Open any web browser and enter the exact IP address of the PSG-3(s) and press 'Enter'. This will navigate to the web browser interface. Select '**Pulse Delay and Width Setup**' and the control screen will appear.



PSG-3 web interface

The above web interface shows the page under the heading 'Pulse Delay and Width Setup' in a web browser.

Trigger Source

- **Ext. Trig. Raising Edge:** The PSG-3 will send out a pulse or pulse train on the rising edge of a trigger pulse.
- **Ext. Trig. Lowering Edge:** The PSG-3 will send out a pulse or pulse train on the falling edge of a trigger pulse.
- **Ext. Trig. High Level:** The PSG-3 will generate pulses as long as the external trigger remains high.
- **Ext. Sync.:** This is an external trigger control that is used to set one PSG-3 as master and subsequent PSG-3 as slaves to the master PSG-3. It can be used to extend the PSG-3 on the same clock. See section on ***External Synchronization*** for more detail.
- **Software:** All control of the PSG-3 is done through the web interface. The PSG-3 will start sending out pulses when prompted by the user on the GUI.

Period: Inverse of frequency. If the period is set to 0, that generator will remain high and lock on.

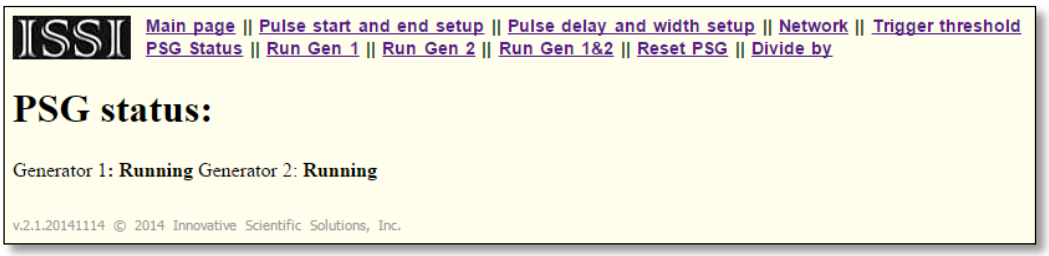
Number of Pulses ('Pulses' in GUI): Number of pulses the PSG-3 will send out once triggered or started in the software. Set to 0 for continuous pulses.

Channel Delay and Width: Channel Delay is the time to delay pulses from trigger (τ_0) (either internal or external). Width is the pulse width output of the selected channel. Note that all are in milliseconds in the web interface and GUI by default.

Time Units: Also called the time base, *base frequency or clock settings. Adjustable from: 20-ns, 40-ns, 80-ns, and 160-ns.

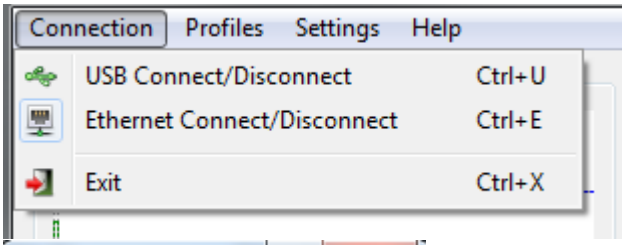
**The base frequency is determined by the duration over which measurements of the waveform are collected. It represents the interval between the spectral bands which can be computed from the waveforms.*

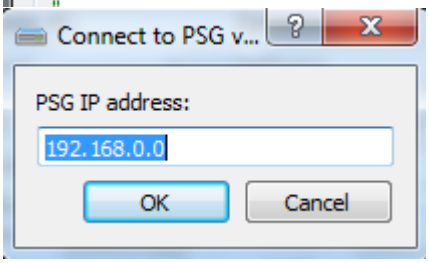
To check the status of the connected pulse generator, the '**Status**' heading will show whether the generators are running or stopped. This is useful for applications where there is no visual access to the PSG-3 connected.

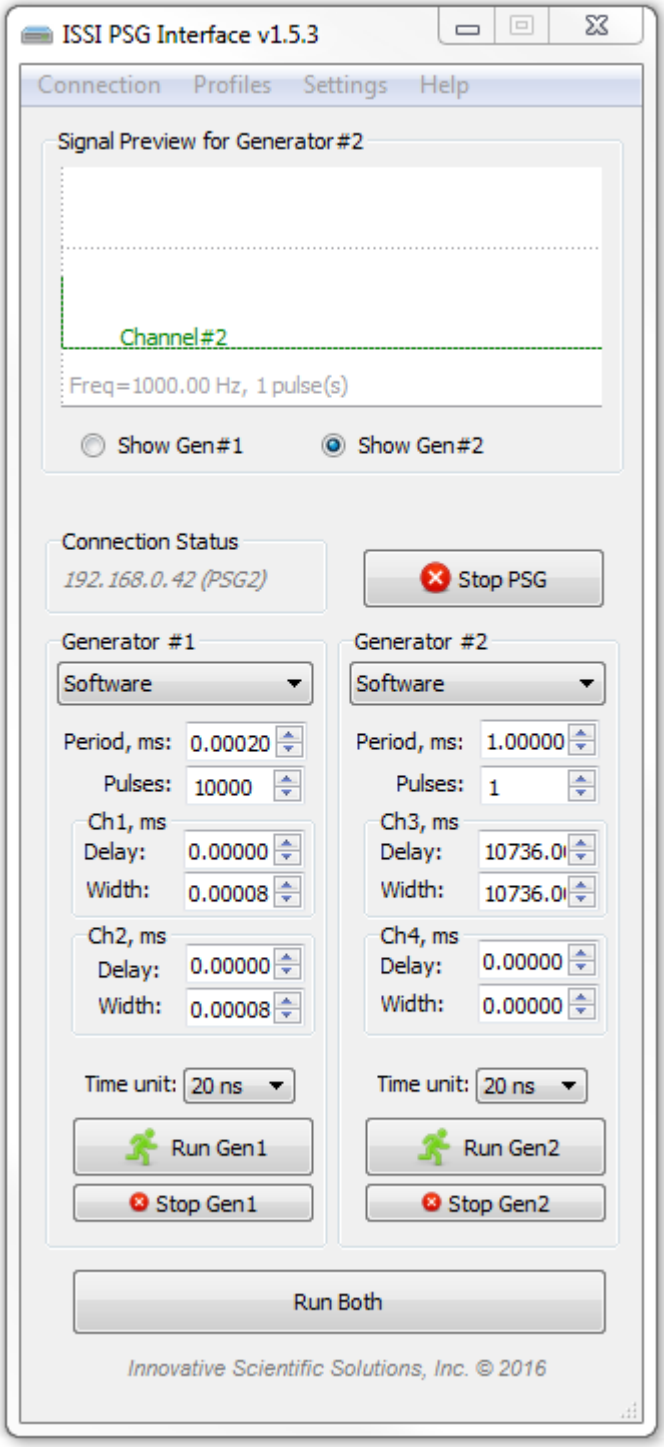


PSG-3 Windows GUI

The ***ISSI PSG-3 Interface*** for Windows is installed as an executable file, '*Setup_PSG2_interface.exe'*. This will automatically install the PSG-3 drivers on the host computer for USB connection with the PSG-3. The GUI will also be installed from the executable file. The GUI gives the option to connect over USB or Ethernet to communicate with the PSG-3.







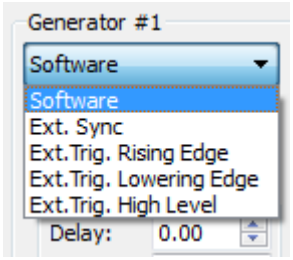
Navigate to the appropriate connection by selecting USB or Ethernet. For USB, it will connect automatically as long as the USB cable is connected. For the Ethernet connection, it will prompt the user to enter the IP address of the attached PSG-3.

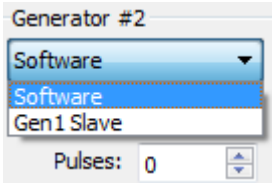
Once connected, the IP address of the connected PSG-3 will be displayed on the front panel in the '**Connection Status**' block.

The PSG-3 GUI has all of the same functionality found in the web browser plus several additional features. This GUI also displays the 'oscilloscope view' of the output of each generator based on the settings input by the user. When connected, the GUI will display all of the buttons and input boxes. When disconnected, all will be grayed out. By default, all values are displayed in milliseconds for Period, Delay and Width.

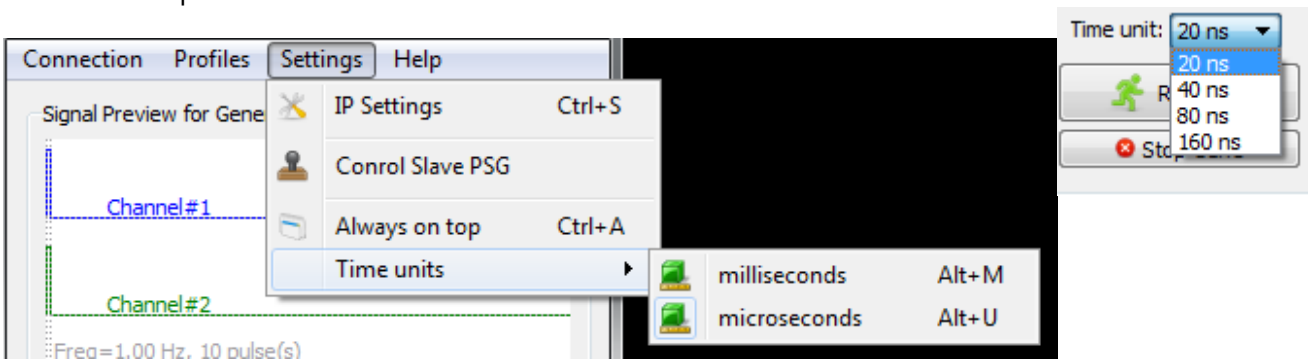
The PSG-3 can be operated either via software or one of the many triggering types, selected from the pull-down menu under Generator #1. Generator #2 can either be used in software mode or slaved to the operation of Generator #1. When the generator mode is changed, it will immediately stop the PSG-3 and change to this mode

on the PSG-3. The triggering options for each generator in the GUI are functionally the same as described for the web interface on page 6.





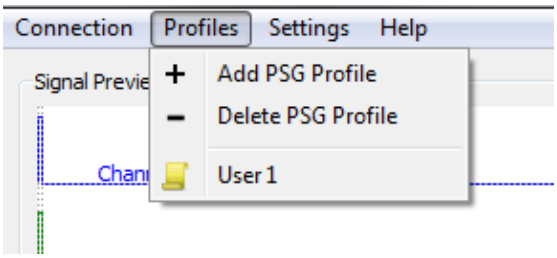
The clock settings can be changed for different repetition rates of the PSG-3. The same limits on the clock settings apply as they are shown on the web browser page. Time units are adjustable between milliseconds and microseconds. This is done in the '**Settings**' tab and selecting '**Time Units**.' This applies the time units update to the entire front panel of the GUI.



'**Always on Top**' will bring the GUI to the front of all other windows open on the desktop.

Profiles

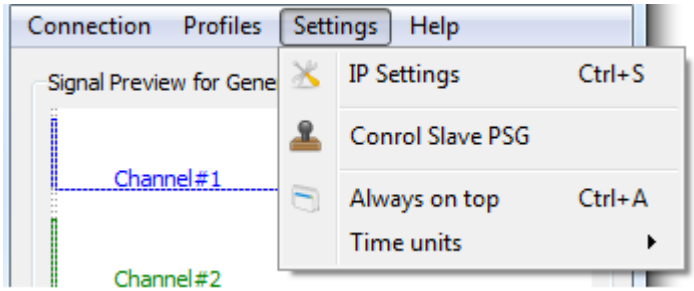
A time-saving feature of the PSG-3 interface is the ability to save user profiles on each computer. From the '**Profiles**' tab, user profiles can be added or removed for different experiments or users. The profile saves everything on the front panel of the PSG Windows interface from trigger method, period, number of pulses, pulse width and delay. These can be recalled from the '**Profiles**' tab by selecting the profile from the drop-down menu.



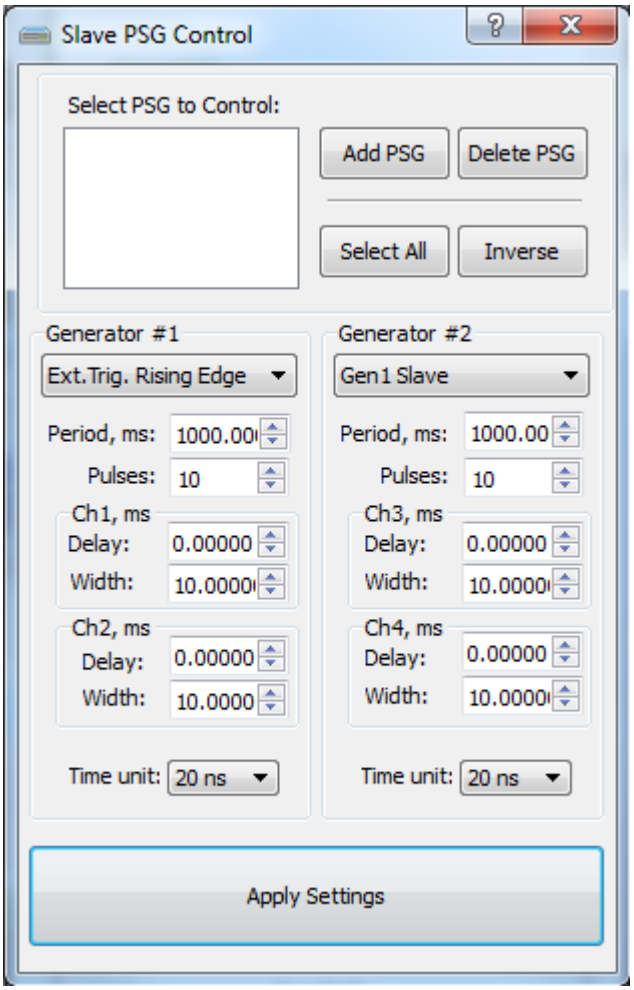
Profiles with the same name will overwrite older profiles.

Slave PSG Control

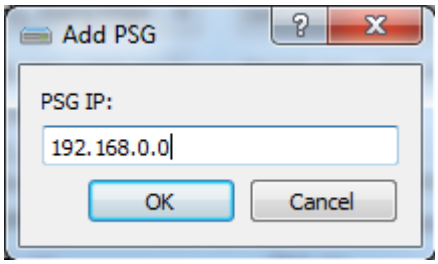
The '**Control Slave PSG**' in the '**Settings**' tab allows users to set the parameters of any PSG-3 connected to the network. For systems with multiple subsystems, each controlled by an individual PSG-3, this can be advantageous in changing settings for the group all at once. Open the slave PSG control from the '**Settings**' tab:

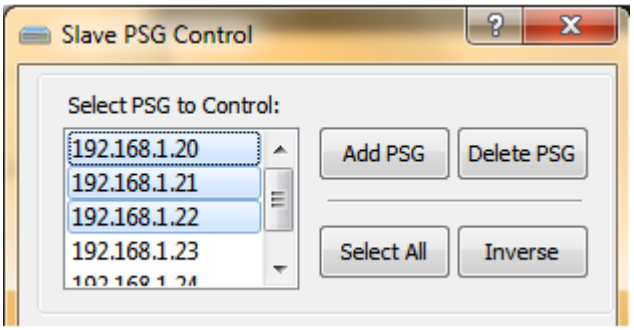


This will open the '**Control Slave PSG**' window.



The window opens with no PSGs selected. Add them and remove them as needed. Adding a new PSG will open up the '**Add PSG**' window. The identification of each PSG is based on the unique IP address of each PSG. Type the IP address to add each new PSG to the list.





Once added, settings entered in the '**Control Slave PSG**' window will be applied to all selected PSGs once '**Apply Settings**' is clicked.

Note: This will not start the generators on each PSG, it will only set those PSGs to those settings. The generators must be started from the main menu or web browser. Each time new settings are applied, the PSGs will stop to apply settings. To select/deselect multiple PSGs, hold down Ctrl and select desired PSGs.

External Synchronization

The PSG-3 can be set to one of two modes: Master or Slave (Master mode is indicated by red LED on the front panel). In Master/Slave configuration PSG-3s are connected using ***SYNC OUT*** (master PSG-3) and ***SYNC IN*** (slave PSG-3) connectors on the rear panel.

Master mode trigger configurations:

- Both generators in the PSG-3 are triggered independently with individual "Start" commands from user's application.
- Both generators in the PSG-3 are triggered at the same time with the "Start" command sent to the first generator. In this case the first generator propagates the trigger to the second generator.
- First generator is triggered from the external signal ('***EXT TRIG***' BNC connector), second generator is triggered with "Start" command from user's application.
- Both generators in the PSG-3 are triggered at the same time from the external signal. The external trigger input connected to first generator only but it gets propagated to the second generator.

Note: External trigger options are described below.

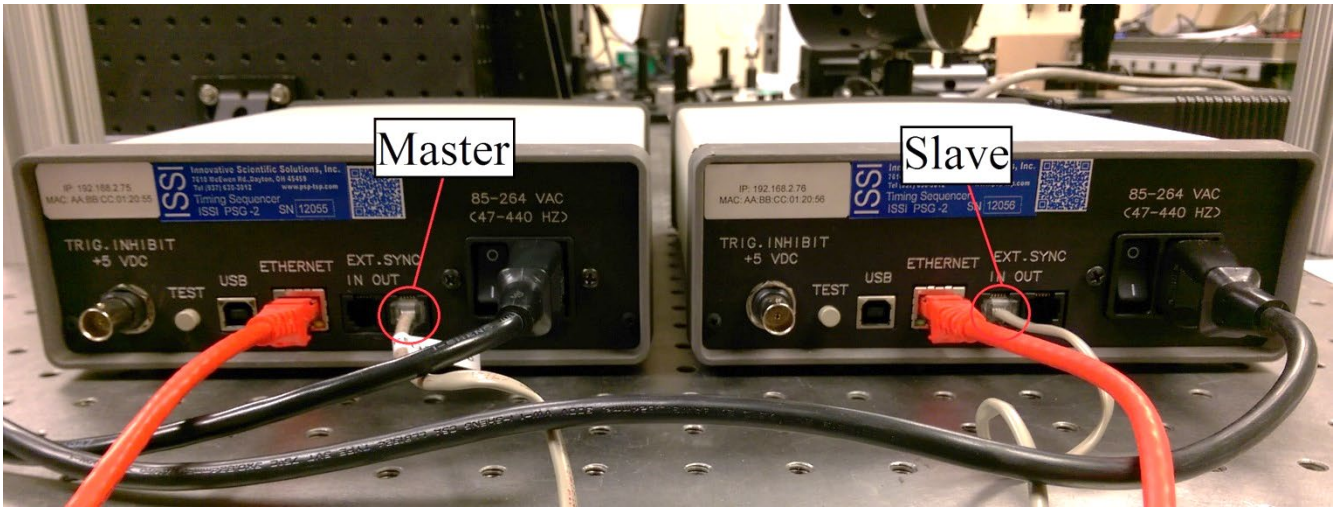
Slave mode trigger configuration:

In slave mode the PSG-3 receives the synchronization signal and master clock from the master PSG-3. In this case both generators in the PSG-3 are triggered from master's PSG-3 first generator. The nominal propagation delay for clock and trigger is ~20 ns, thus the slave's PSG-3 pulse sequences will be delayed by this amount of time. It is still possible to set the second generator in the slave PSG-3 to be triggered from user's application "Start" command.

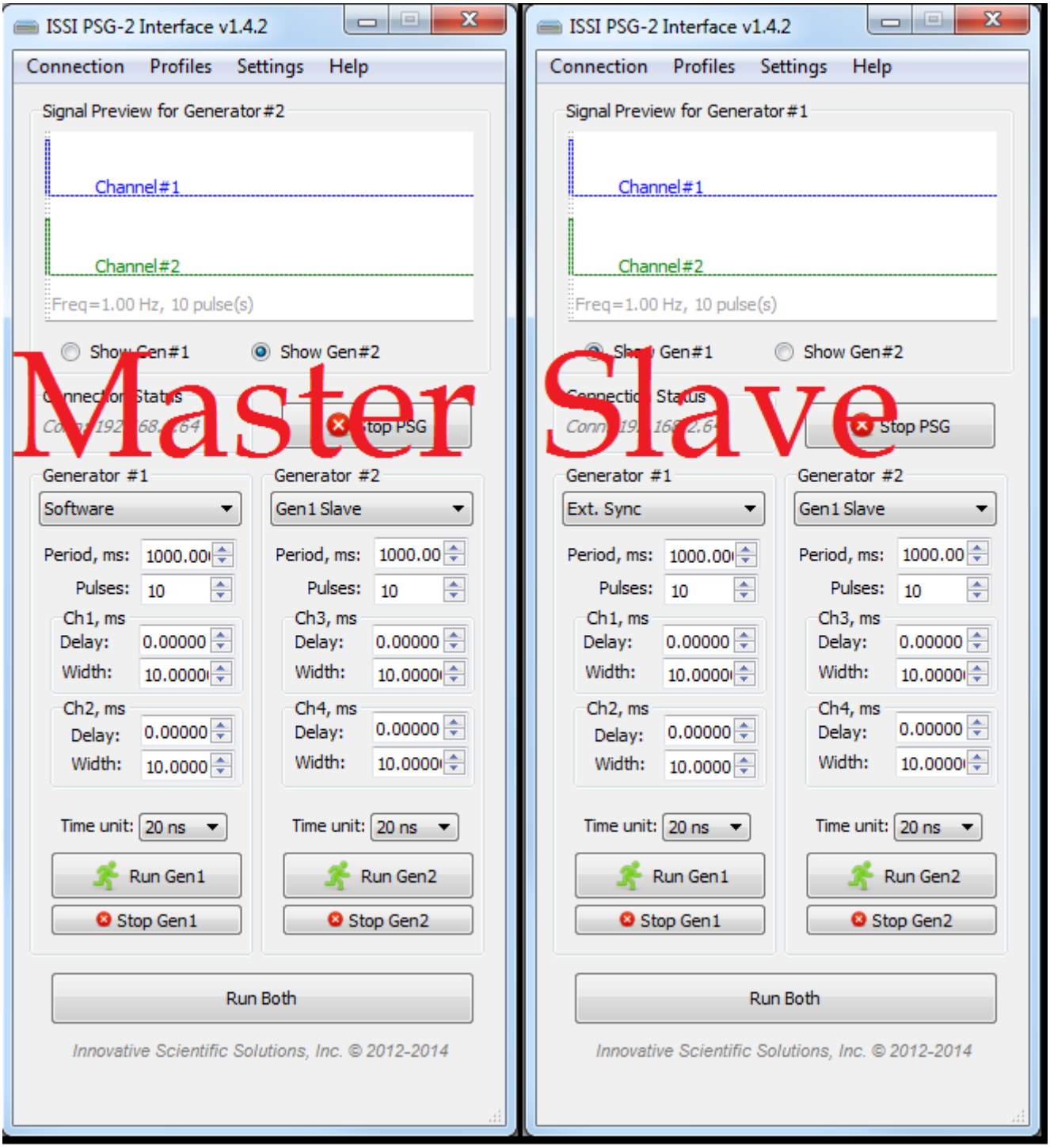
Note: The slave PSG-3 can use different time base settings from master PSG-3.

A special RJ14 connector is used to connect two or more pulse generators using the '***EXT IN***' and '***SYNC OUT'*** connections on the back panel. This allows one PSG-3 to operate as the master and subsequent PSG-3s connected to be slaves, starting from τ_0. This expands the number of individual channels (individually set pulse width and delay) for the PSG-3.

Once the RJ14 cable is connected, one PSG-3 will be shown as master and the other without the master light will be the slave. The slave PSG-3 will start from the start command of the master PSG-3. To configure each as master and slave, the connection with the RJ14 needs to be as shown below.

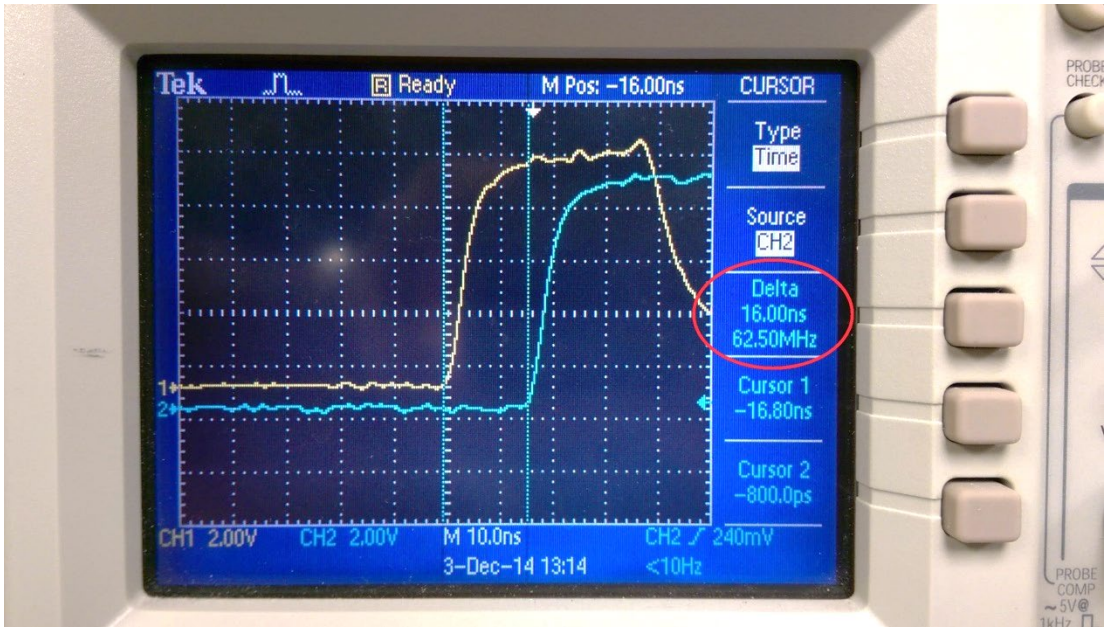


The master PSG-3 sends its synchronization pulse out of '***SYNC OUT***' to the '***EXT IN***' of the slave PSG-3 via the RJ14 cable. The insertion delay between the two is at minimum 20-ns but will increase as the telephone line length increases. The master/slave assignment then needs to be made in the software.



Connect to each PSG-3 via its IP address over Ethernet (by networking both PSG-3s) or USB. The master PSG-3 should be set up in '**Software**' mode for Generator #1 and **Software** or **Gen1 Slave** mode for Generator #2. The slave PSG-3 should be set up in '**Ext. Sync**' for Generator #1 and '**Gen 1 Slave**' for Generator #2. This means the slave PSG-3 will take its start command from the '***EXT IN***' on the rear panel which is coming from the master PSG-3. The frequency, pulse width and delay for the slave PSG-3 will come from the delay and width set in the interface. The start pulse will be synchronized with the master PSG-3. When settings for both PSG-3s are

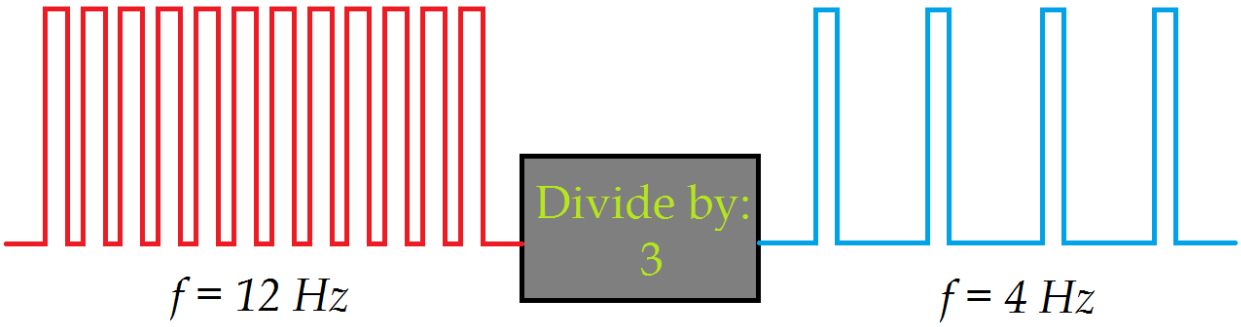
entered, click ***'Run Both'*** on the slave PSG-3 first, then the same on the master PSG-3. The slave PSG-3 will then run until the device runs out of pulses.



The delay between the output of two synchronized PSG-3s is shown on an oscilloscope with nominal delay ~20-ns between the two.

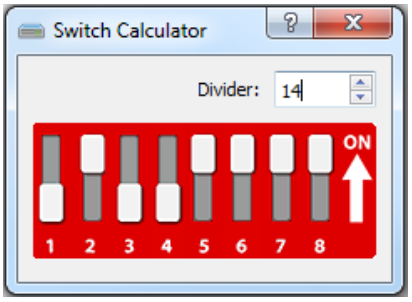
Divide-by-N

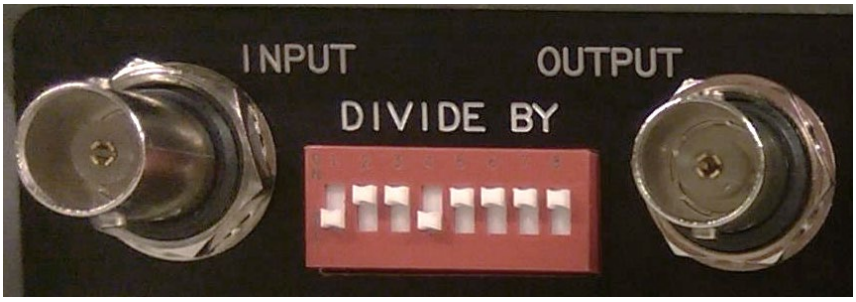
At times, it is necessary to divide the frequency of an incoming trigger source. The divide-by-N feature of the PSG-3 is a frequency divider which divides the incoming pulse train by an integer from 2 to 255. The divide-by-N circuit is located on the back panel of the PSG-3 and uses dip switches to set the divide-by-N number. An incoming pulse train (maximum is 32 Mhz) is input to the ***Input*** BNC of the divide-by-N. Once divided, the ***Output*** sends the divided pulse train out at the same voltage sent into the ***Input*** BNC. This can then be used to directly trigger an event or the front panel of the PSG-3.



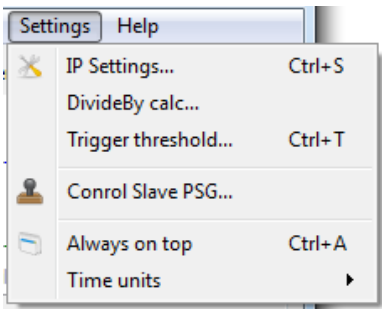
The software interface (both web browser and Windows GUI) features a tool to determine the dip switch setting for

the frequency division. Enter the number to divide the incoming frequency by and apply and the graphic will update to show the correct dip switch setting for that N.





Move each dip switch to the correct setting and the incoming pulse train will be divided accordingly. The input and output will be synchronous. The delay between the ***Input*** and ***Output*** of the divide-by is 100-ns. The divide-by-N is not tied to the front panel of the PSG-3. Attach a BNC cable between the ***Output*** of the divide-by-N to the external trigger input of the PSG-3 to trigger the front panel off of the divided pulse train.



Note: The divide-by circuit will output a slightly smaller pulse width than that of which it receives. This circuit is only intended to be used as an edge trigger to trigger another system or the PSG-3 itself. After triggering the PSG-3 front panel with the divide-by output, specific pulse widths and delays can be set.

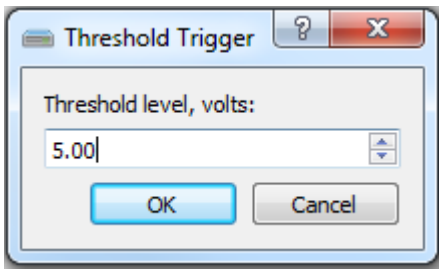
From the GUI, the ***Divide-by calc*** window can be reached from the ***Settings*** tab. The ***Trigger Threshold*** window can also be found in the settings menu in the GUI.

In the web interface, the divide-by and trigger thresholding can be found in the menu at the top of the page.

Thresholding

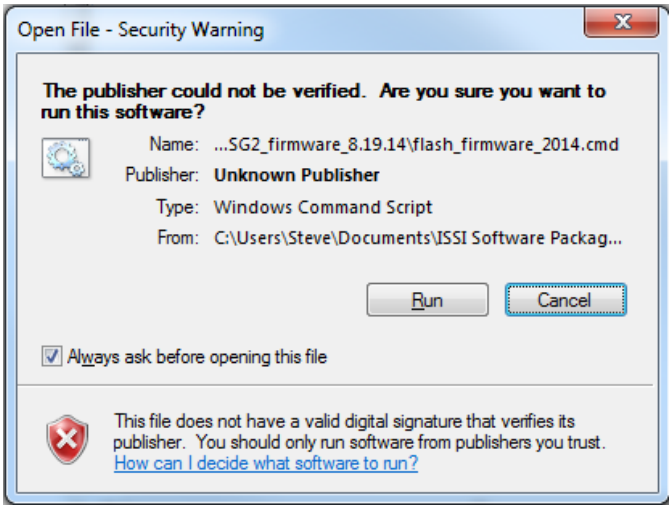
The incoming trigger from a source may not always be TTL level. In those cases, the external trigger input needs to be capable of handling those triggers. Thresholding the trigger level allows those low-voltage triggers to be seen by the PSG-3.

The trigger level can be set from 0.05 V (50 mV, in 10 mV steps) to 5.0 V. This is done in the software in the trigger level setting. Enter the trigger level to the desired trigger level. Once the PSG-3 power is cycled, the trigger level will return to 5V.

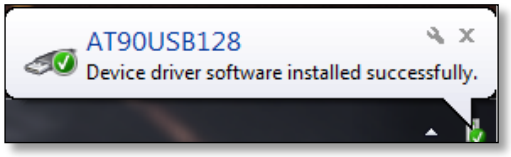


Firmware Upgrade

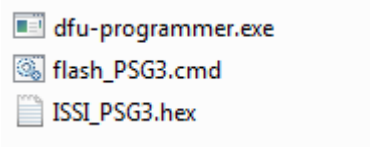
All that is needed is a USB Type-B cable, and PSG USB-drivers.



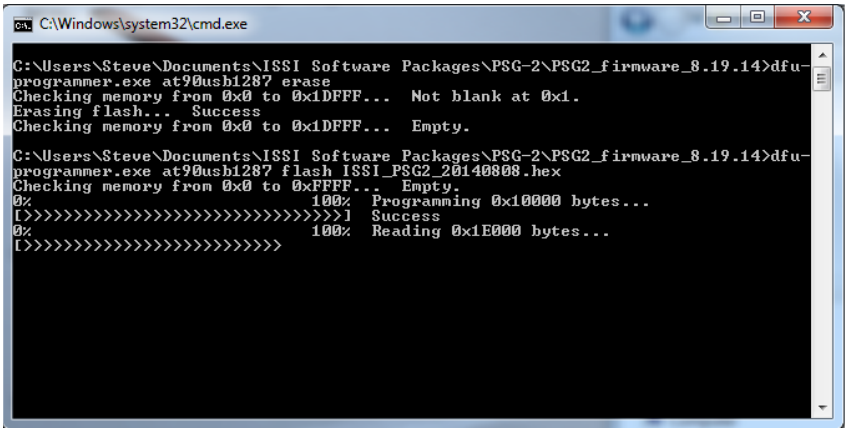
<u>The procedure is simple:</u>
1) Turn off PSG.
2) Push and hold ***Reset*** button PSG and turn on PSG;
3) Wait 5 second, and release ***Reset*** button;
4) In the device manager, the AT90USB128 will be displayed.



Once the driver is installed ^^,
4) Save all firmware files in the same folder.



5) Run ***flash_PSG3.cmd*** file wait until it is finished (the name may change with version number);

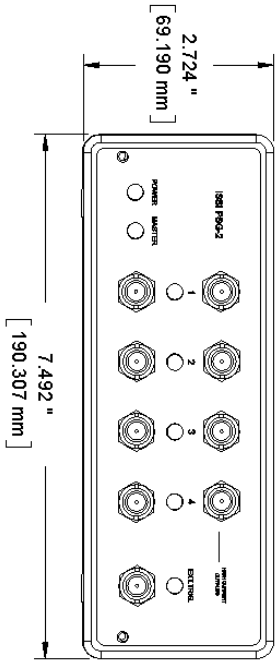


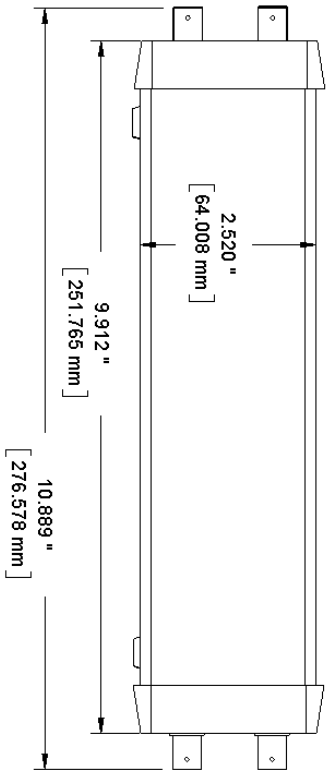
5) Restart (by power) PSG;

If the firmware does not automatically run when the ***flash_PSG3.cmd*** file is run, open the command prompt and navigate to the folder where the file is saved. Then enter ***flash_PSG3.cmd*** into the command prompt window.

Important! This firmware will only upgrade the PSG logic, and will not change PSG time settings and network settings.

Dimensions


2.724 "
[69.190 mm]
7.492 "
[190.307 mm]


2.520 "
[64.008 mm]
9.912 "
[251.765 mm]
10.889 "
[276.578 mm]

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Appendix A

API Commands

Based on HTTP/1.0 protocol, 80/tcp port is used for communication.

HTTP requests should be like this **http://{ipaddress}/{request}**

Main PGS-3 requests below:

Action: *Run Generator 1*
Command: /sg_run.shtml?sg1_run=1

Action: *Run Generator 2*
Command: /sg_run.shtml?sg2_run=1

Action: Run Generator 1 and 2
Command: */sg_run.shtml?sg1_run=1&sg2_run=1*

Action: Stop Generator 1 and 2
Command: /sg_run.shtml?reset1=1&reset2=1

Action: Set settings for Generator 1 and 2
Command:
/sg_hr_run.shtml?ts1=0&ts2=1&p1=100&p2=1000&pn1=9&pn2=15&ch1_st1=0&ch1_st2=0&ch1_et1=11&ch1_et2=12&ch2_st1=0&ch2_st2=0&ch2_et1=11&ch2_et2=12&freq1=0&freq2=0&save=1

Where:
ts1 = 0 means **Trigger Source = Software** for Generator 1
ts1 = 1 means **Trigger Source = External Sync** for Generator 1
ts1 = 2 means **Trigger Source = External Trigger (Rising Edge)** for Generator 1
ts1 = 4 means **Trigger Source = External Trigger (Lowering Edge)** for Generator 1
ts1 = 6 means **Trigger Source = External Trigger (High Level)** for Generator 1

ts2 = 0 means **Trigger Source = Software** for Generator 2
ts1 = 1 means **Trigger Source = Generator 1 Slave** for Generator 2

p1 and **p2** - represents Period in ms for Generator 1 and Generator 2 respectively;

pn1 adn **pn2-** represents Number of pulses for Generator 1 and Generator 2 respectively;
ch1_st1 - start time (in ms) for Channel 1 Generator 1
ch1_et1 - end time (in ms) for Channel 1 Generator 1
(ch1_et1 - ch1_st1 = pulse width for Ch1 Gen1)

ch2_st1 - start time (in ms) for Channel 2 Generator 1
ch2_et1 - end time (in ms) for Channel 2 Generator 1
(ch2_et1 - ch2_st1 = pulse width for Ch2 Gen1)
ch1_st2 - start time (in ms) for Channel 1 Generator 2
ch1_et2 - end time (in ms) for Channel 1 Generator 2
(ch1_et2 - ch1_st2 = pulse width for Ch1 Gen2)
ch2_st2 - start time (in ms) for Channel 2 Generator 2
ch2_et2 - end time (in ms) for Channel 2 Generator 2
(ch2_et2 - ch2_st2 = pulse width for Ch1 Gen2)

freq1 - represents the time units from 0 to 3, see the table below

	0	1	2	3
Time Units:	**20ns**	**40ns**	**80ns**	**160ns**
Maximum period (ms):	**1342**	**2684**	**5368**	**10736**
Minimum length (ms):	**4e-5**	**8e5**	**1.6e4**	**3.2e-4**
Maximum number of Pulses	**131072**			

save=1 - allow to save all this settings in EEPROM (non-volatile memory), so your settings will be available even after restart.

Action: Set threshold level in volts
Command: */tt.shtml?volt=4.21*

Appendix B

Example API Perl/Python scripts to control PSG-3:

```
=====================================================================
==================       Perl Script to control the PSG-3   ========================
=====================================================================
#!/usr/bin/perl -w

use LWP::Simple qw($ua get);
$ua->timeout(2);

# url to set PSG on 192.168.1.171
$url =
"http://192.168.1.171/sg_hr_run.shtml?ts1=0&ts2=1&p1=100&p2=1000&pn1=9&pn2=15&ch1_st1=0&ch1_st2=0&
ch1_et1=11&ch1_et2=12&ch2_st1=0&ch2_st2=0&ch2_et1=11&ch2_et2=12&freq1=0&freq2=0&save=1";

my $html = get $url || die "Timed out!";

print $html;
=====================================================================
==================       Python Script to control the PSG-3  ======================
=====================================================================
#!/usr/bin/env python

import socket
import urllib
import urllib2

# timeout in seconds
timeout = 2
socket.setdefaulttimeout(timeout)

data = {}
data['sg1_run'] = '1'
data['sg2_run'] = '1'
url_values = urllib.urlencode(data)
url = 'http://192.168.1.171/sg_run.shtml'
full_url = url + '?' + url_values
data = urllib2.urlopen(full_url)
print data.read()
=====================================================================
```