Making Light Work Lighter

General Photonics
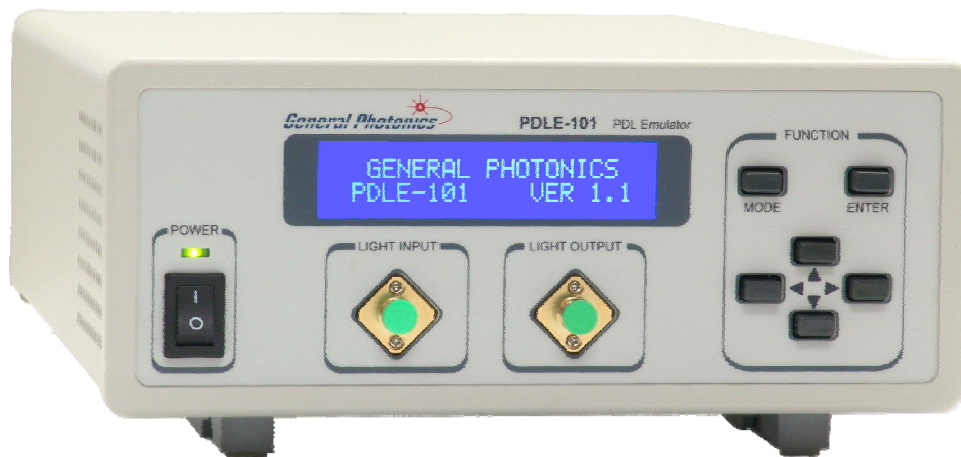
C o r p o r a t i o n

PDLE–101

PDL Emulator

Operation Manual

Version 1.1

June 6, 2011

General Photonics Corp.   Ph: (909) 590-5473
5228 Edison Ave.   Fax: (909) 902-5536
Chino, CA 91710 USA   www.generalphotonics.com

WARRANTY

All of General Photonics' products have been inspected and found to comply with our stringent quality assurance standards before shipping. If any damage occurs during shipment, please contact the carrier and inform us or our distributors as soon as possible.

Please do not, under any circumstances, attempt user repair of any General Photonics product. To avoid further damage, any repair of defective products must be performed by trained engineers.

General Photonics warrants that this product will be free from defects in materials or workmanship for a period of one year from the date of original shipment (listed on the certificate of quality or packing list enclosed with the original shipment). A product found to be defective during the warranty period will be repaired or replaced, at no charge, at General Photonics' option.

If a problem is found, please contact General Photonics for assistance. If necessary, return the defective product, freight prepaid, clearly labeled with the RMA number, with as complete a description of the problem as possible. The repaired or replacement product will be returned, freight prepaid, as soon as possible.

The above warranty specifically excludes products that have been repaired or modified by non-manufacturer-authorized personnel, as well as damage caused by misuse, abuse, improper storage or handling, or acts of nature.

This warranty is in lieu of all other warranties, expressed or implied. General Photonics will not be liable for any indirect or consequential damages or losses resulting from the use of its products.

SAFETY CONSIDERATIONS

The following safety precautions must be observed during operation, service and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. General Photonics Corp. assumes no liability for customers' failure to comply with these requirements.

- **Before operation, the user should inspect the instrument and review the manual carefully.**

- The instrument's rear panel includes a chassis ground terminal for electrical safety.

- Make sure that the instrument is in a secured work environment (in terms of temperature, humidity, electrical power, hazard due to fire or shock, etc.) for proper operation.

- Standard laser safety procedures should be followed during operation.

Table of Contents:

Section 1. Specifications:

Physical Features:

Package Dimensions	2U 19" half rack width
	14" (L) x 8.5" (W) x 3.5" (H)
Fiber Input/Output Connectors	FC/PC, FC/APC, SC/PC, or SC/APC
Weight	6.2 lb.

System Specifications:

Operating wavelength [1]	C band or L band
Insertion Loss (Max.)	3 dB at PDL=0
PDL Range	0.1 to 20 dB
PDL Resolution	0.1 dB
PDL Accuracy [2]	± (0.1 dB +1% of PDL)
PDL switching time [3]	5 ms max., 1 ms typical
Residual PMD	0.1 ps max. at PDL = 0
Return Loss	> 50 dB
Optical Power Damage Threshold	500 mW
Operating Temperature	0 °C to 40 °C
Storage Temperature	−20 °C to 60 °C
Fiber Type	SMF-28
Front Panel Display	2x 20 character LCD display
Power Supply	100-240 VAC, 50-60 Hz (16W)
Communication Interfaces	RS-232, USB, Ethernet, GPIB
Trigger Signal	5V TTL signal, 5mA min.
	Minimum pulse width 150ns

Notes:
1. Other wavelength ranges available upon request.
2. At 23±5°C.
3. Rise time for square wave transition.

Section 2. Overview:

The polarization dependent loss (PDL) of a component is defined as the maximum variation in its insertion loss over all possible polarization states of input light. The PDL of a system is the vector sum of the PDLs of the components in the system. Since the relative orientations of the PDL vectors of different parts of a system can change with temperature or stress on the fiber sections in between, the PDL of a system is a dynamic phenomenon which can significantly impact the quality of data transmission and complicate the problem of polarization mode dispersion (PMD) compensation.
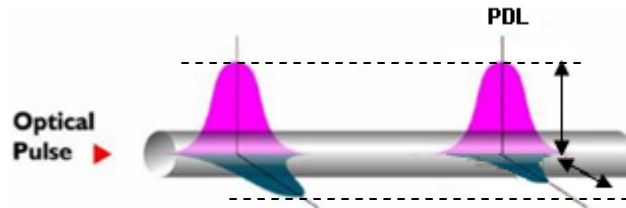
Figure 1 Schematic diagram of the changes in the amplitudes of polarization components of a pulse after propagation through a path with nonzero PDL.

High speed fiber optic transceivers, including those deploying coherent detection technologies for 40Gb/s and 100Gb/s data transmission, must therefore meet stringent PDL tolerance specifications.

General Photonics' PDLE-101 is a PDL emulator specifically designed for PDL tolerance testing of high speed telecommunication systems. It is available with wavelength calibrations for either the C or L bands, and can generate discrete PDL values up to 20 dB with a resolution of 0.1 dB in less than 5 ms. Built-in functions also allow the user to either sweep or randomize PDL values at user-selectable speeds, enabling the user to model different types of PDL effects.

The front panel has two adapters to accommodate the optical input and output. The incoming data stream connects to the light input port of the PDLE. At the output, the generated PDL is applied to the original data stream.
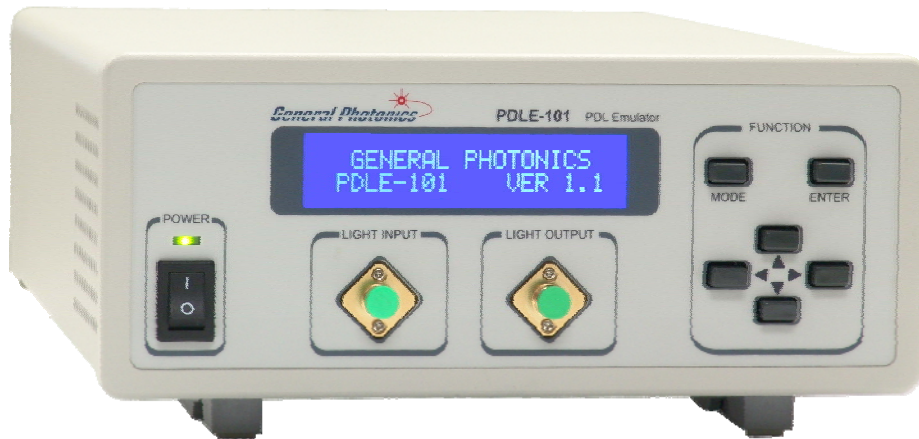
Figure 2 PDL Emulator.

The PDLE-101 employs a large character, backlit liquid crystal display (LCD) for easy readout. In addition to front panel control, it can be remote controlled via built-in RS-232, USB, Ethernet, or GPIB interfaces.

Section 3. Feature Description:

3.1 Optical Features:

The PDLE system has two bulkhead adapters on the front panel to accommodate the optical input and output. The adapters are universal connector interfaces (UCI), which feature a male-type adapter top piece that can be removed for direct access to the ferrule end for routine cleaning and maintenance without removing the entire adapter from the panel. This feature helps avoid high insertion loss, high return loss and measurement instability caused by dirty or contaminated connectors. In addition, the PDLE's universal interchangeable adapter allows the end user to switch to ST, SC, or FC connectors without opening the instrument panel. Although the PDLE is shipped with a standard FC fiber adapter, other interchangeable inserts are available. For additional information on different input fiber adapter inserts, please contact General Photonics.

External fiber connectors should be cleaned using industry standard cleaning methods before connection to the PDLE. If this procedure is followed before each connection, the instrument's internal connector ferrules should not need regular cleaning. However, high insertion loss or measurement instability that does not improve after cleaning the external connectors may indicate that the instrument's internal connector ferrules require cleaning.

Each connector ferrule is contained in a universal connector interface consisting of a front piece that connects to the external fiber connector, and a base piece that is mounted on the front panel of the instrument, as shown in Figure 3. To clean a connector ferrule, first, make sure no external connector is connected to the universal connector interface. Then, using a Phillips screwdriver, remove the two small screws connecting the front and back parts of the adapter, and carefully pull the front flange straight out. (Note: never remove the adapter base from the front panel). The ferrule end should now be exposed. Clean the ferrule using standard cleaning procedures (compressed air or a fresh lint-free tissue and alcohol), taking care to avoid scratching the ferrule surface. Finally, replace the front flange (position it so that the key notch faces up, and the small alignment pin lines up with the hole in the base piece, before pushing it in) and the screws. For frequent measurements, we recommend that the user prepare a patch cord fiber to avoid wear on the internal connector.
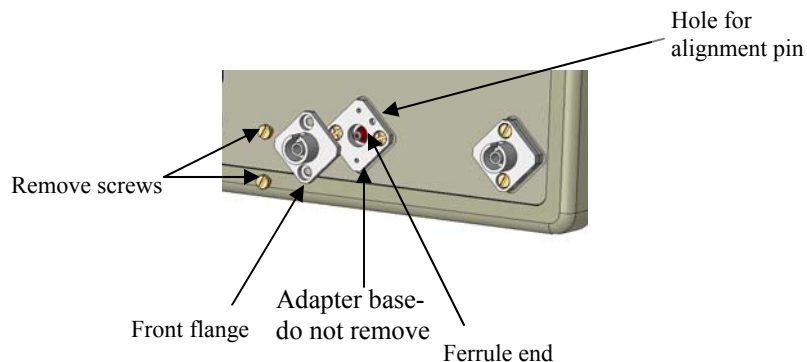

Figure 3 Diagram of universal connector interface

3.2 Electrical Features:

The PDLE-101 system uses the standard wall power supply. The line voltage range is 100-240 VAC. Due to high voltage, the following safety precautions must be exercised during operation.

- The ground pin on the power supply cord must be connected to earth ground of the wall receptacle.
- Never touch the boards inside the package without proper insulation.
- The PDLE-101 is not user serviceable and can be serviced only by factory-authorized personnel.

The front panel of the PDLE-101 is shown in Figure 4. The power switch (Power), liquid crystal display (LCD), push button control pad, and optical connectors are mounted on the front panel. The AC power plug, fuse, RS-232, USB, Ethernet and GPIB interface connectors, and BNC connector for trigger input are mounted on the rear panel, as shown in Figure 5.

The PDLE-101 includes RS-232, USB, Ethernet, and GPIB interfaces for external computer operation of the system and data readout. Control commands, USB driver installation instructions, and remote interface setup instructions are listed in section 4.4.
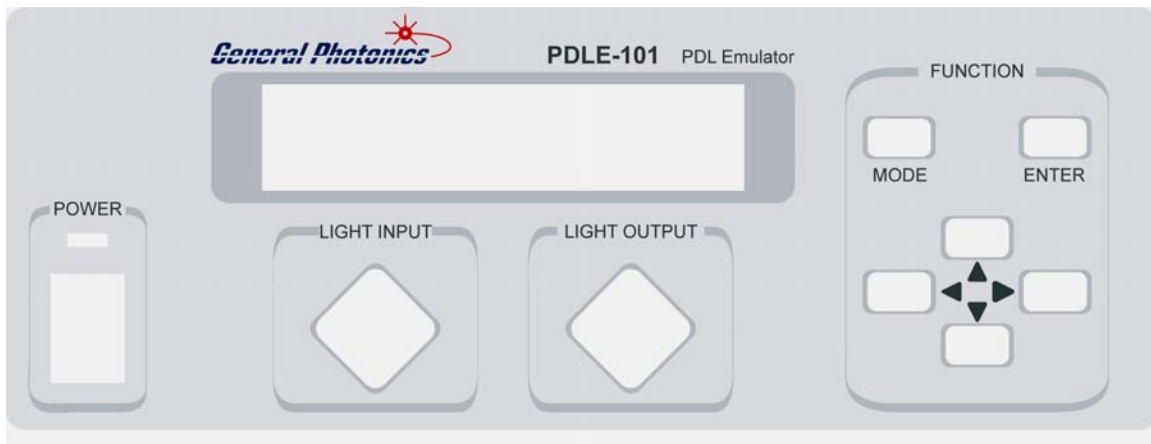

Figure 4 Front panel layout.

Front panel description:

LCD display: displays operation mode and parameters
Power: power on/off switch
LIGHT INPUT: universal connector interface adapter for optical fiber input
LIGHT OUTPUT: universal connector interface adapter for optical fiber output
Keypad: push buttons for status control:

MODE: Accesses operation mode and setup options. Once MODE is pressed, up and down arrows and the ENTER key can be used to select functions or settings.
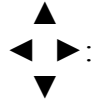
▲
◄ ► : Arrow keys, used to move the cursor and change numbers.
▼

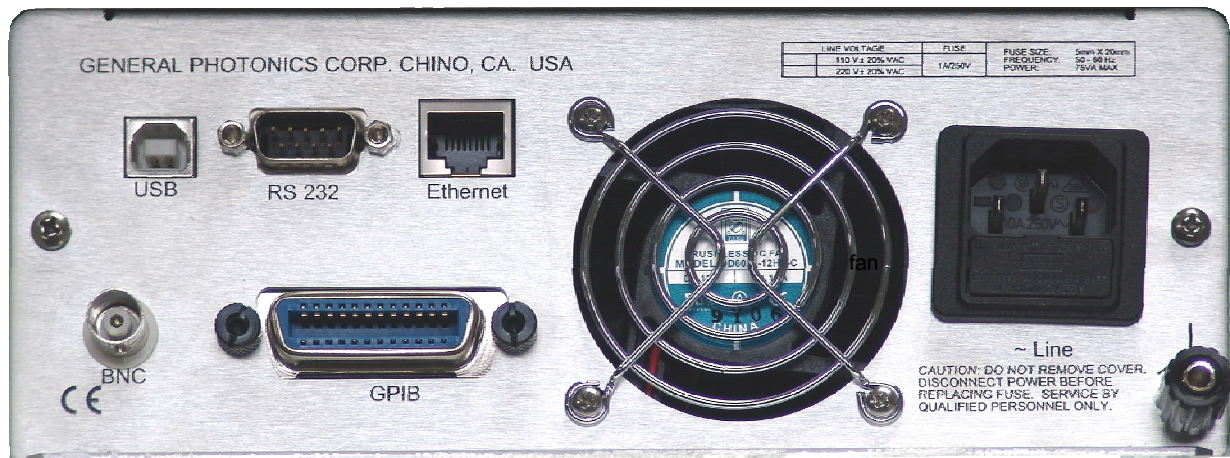ENTER: Used to select operation modes or begin execution of a function after parameters are set.

Figure 5 Rear panel layout.

Rear panel description:

USB: USB interface port
RS-232: serial communication port
Ethernet: Ethernet interface port
BNC: trigger signal input
Line: external AC supply input connector, 100-240 V
GPIB: GPIB interface port
⏚ : chassis ground connector

Fuse location:

Figure 6 shows the location of the fuse compartment, directly under the power cord plug. There are two fuses in the compartment- the one in use and a spare. The fuse further inside the compartment is the active one, and the one closer to the compartment opening is the spare.

If the fuse burns, open the compartment and move the spare to the holder further inside the compartment. Make sure that the electrical supply meets the requirements of the instrument before plugging it in again. Always replace the fuse with one with the exact rating of the original.

Figure 6 Fuse compartment

Trigger Signal

If using a trigger signal, connect the trigger source to the BNC connector on the rear panel of the PDLE. The trigger is controlled by a TTL compatible optically coupled gate state changing from 0 Volts to +5 Volts. The internal optical circuitry provides a guaranteed common mode transient immunity specification up to 15,000 V/μs at V_{cm}=1000Volts, and can be triggered with a minimum current of 5mA. Trigger pulses must be +5 Volts LSTTL/TTL compatible, with a minimum pulse width of 150 ns.

Section 4. Operation Instructions:

Warning:
- **Never look into the light source fiber connector when the light source is turned on. THE OUTPUT LIGHT FROM A HIGH POWER LASER IS HARMFUL TO HUMAN EYES. Please follow industry standard procedures when operating a high power laser source.**

- **The PDLE-101 is designed for indoor use only. Avoid water condensation or liquid spills during storage and operation.**

4.1 Unpacking

Inspect PDLE-101 for any physical damage due to shipping and transportation. Contact carrier if any damage is found. Check the packing list to see if any parts or accessories are missing.

4.2 Front Panel Operation

General:

1. Make sure local AC voltage matches the AC voltage requirement of the PDLE-101 system. If not, do not proceed. Contact General Photonics immediately. The standard model uses 100-240 VAC, 50/60Hz, 1A Fuse.

2. Connect the power cord and plug it into the wall receptacle. Make sure the ground pin of the power cord is connected to earth ground.

3. On power-up, the initialization screen, which shows the hardware and firmware versions, will display for a few seconds before the main display screen appears.

GENERAL PHOTONICS PDLE-101 VER 1.1	→	PDL : 12.3 dB λ: 1550 nm
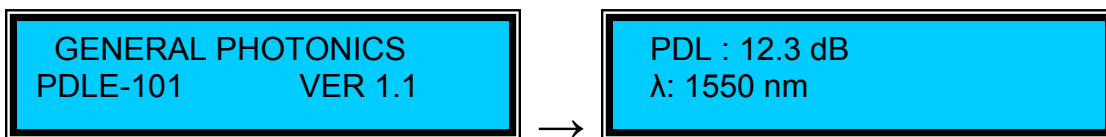
Initialization Screen   *Main Display Screen*

The main display screen shows the current PDL and wavelength settings.

4. Connect the input and output fibers to the PDLE-101. It is important to clean the fiber connectors using industry standard procedures before connecting them. In the case of a high power laser source, turn off the optical power source before connector cleaning. The PDLE-101 is a unidirectional device. Make sure that the light source is connected to the input port.

PDL Control

```
PDL : 12.3 dB
λ: 1550 nm
```

The cursor rest position is on the right hand side of the dB unit display. To change the PDL setting, press the left arrow (◄) or the ENTER key to move the cursor to the editing position. Use the left and right arrow keys (◄ ►) to move the cursor position and the up and down arrow keys (▲ ▼) to increment the selected digit. The PDL value is updated in real time as the value is changed on the screen. The PDL range is 0.1 to 20 dB.

Press the ENTER key to return the cursor to its rest position. The ENTER key toggles the cursor position between rest position and edit position.

Note: The wavelength setting determines the calibration used to set the PDL. Therefore, it is important that the wavelength setting match the actual wavelength of the light source. The wavelength setting cannot be changed from the main screen. It can be accessed from the Settings menu.

MODE

From the main (PDL control) screen, pressing the MODE button brings up the Functions/Settings menu. Use the ▲▼keys to select FUNCTIONS or SETTINGS, and the ENTER key to access the corresponding menu.

```
A. FUNCTIONS
B. SETTINGS
```

From a menu or sub-menu, the MODE button is used to move up a level. From the Functions/Settings menu, the MODE button returns the display to the main PDL control screen.

FUNCTIONS:

There are 4 options in the FUNCTIONS menu. Use the ▲▼keys to move between them and the ENTER key to select the highlighted option. Up and down arrows on the right side of the display screen indicate whether additional menu options can be accessed by scrolling up or down.

```
1. PDL TRI VARIATION
2. PDL RAN VARIATION     ↓
```

```
3. PDL SIN VARIATION     ↑
4. PDL SQU VARIATION
```
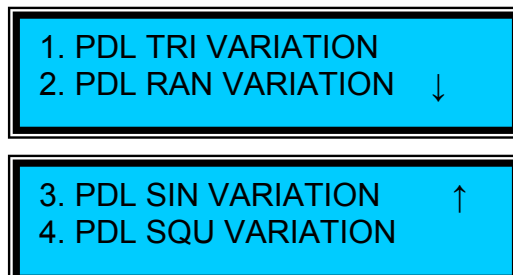
PDL TRIANGLE WAVE VARIATION:

This is a constant-rate sweep function using a triangular waveform. The PDLE-101 sweeps the PDL back and forth between the selected minimum and maximum values at the selected frequency.
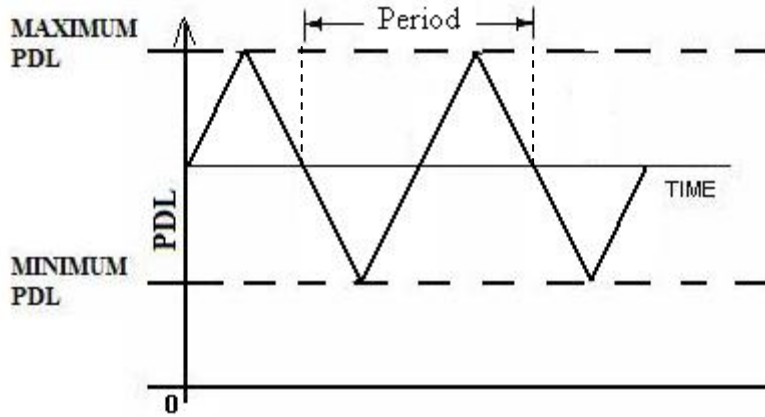

Figure 7 PDL triangular sweep function

When the function is first called, the instrument will be in parameter setting mode. The sweep function is disabled. If Trigger mode is disabled, the screen will display the waveform type (TRI.WAVE), frequency, and upper and lower limit settings.

Trigger Disabled   →

```
TRI. WAVE    F:_10.0 Hz
Max: 20.0     Min:_0.1dB
```

If Trigger mode is enabled, (see SETTINGS section), the word WAVE is replaced by TRG, followed by either ↑ or ↓. The direction of the arrow denotes whether the PDLE is set to trigger on the rising or falling edge of the trigger pulse.

Trigger Enabled   →

```
TRI. TRG↑    F:_10.0 Hz
Max: 20.0     Min:_0.1dB
```

Use the ◄ ►keys to move the cursor position between digits or between parameters. Use the ▲▼keys to increment the selected digit.

The frequency range is 0.1 Hz to 10 Hz.
The range for maximum PDL is 0.2 to 20 dB.
The range for minimum PDL is 0.1 to 19.9 dB.

Note: The maximum PDL cannot be set lower than the minimum PDL. To set the sweep parameters to a lower range than the current minimum PDL setting, reset the minimum value first, then reset the maximum.

After setting the frequency and endpoints, press the ENTER key.

If trigger mode is disabled, the sweep will begin immediately after the ENTER key is pressed. The cursor will move to the right bottom corner of the screen (the cursor run position) and will remain there as long as the sweep function is enabled. To stop the sweep and edit the operation parameters, press the ENTER key. The cursor will move back to the parameter editing area.

If trigger mode is enabled, after the ENTER key is pressed, the PDLE will wait to receive a trigger pulse. The triangle variation will begin 4.6ms after the trigger edge. The timing diagram for a triangle wave set to trigger on a rising edge is shown below. If a second trigger pulse is received after the triangle variation has begun, it will reset and restart from the minimum point 4.6 ms after the new trigger edge.
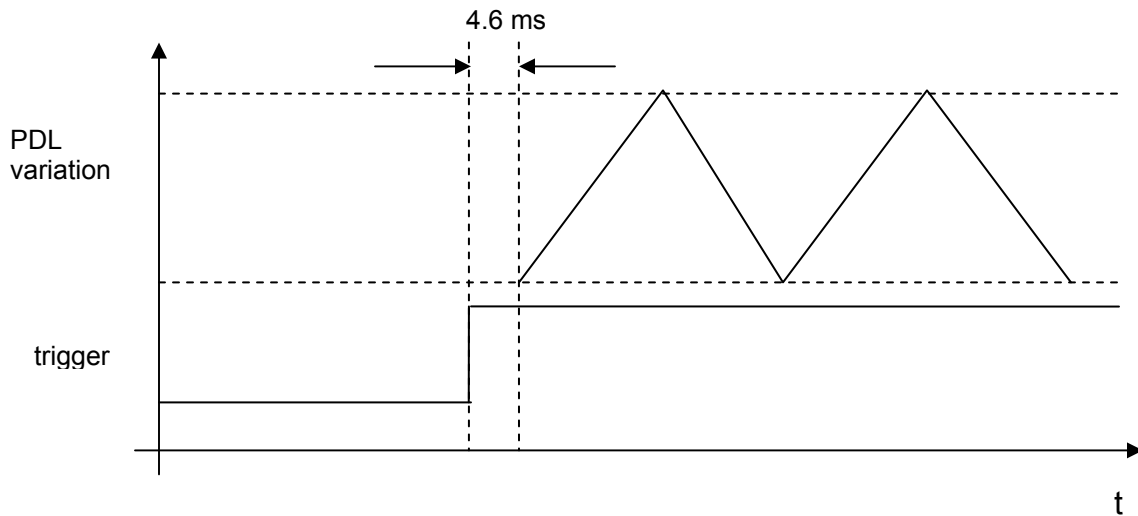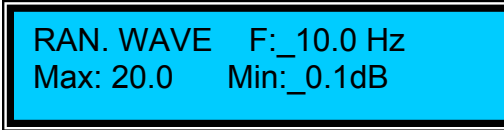

To return to the main screen, press the MODE button 3 times.

PDL RANDOM VARIATION:

In this function, the PDLE-101 generates random PDL values within the range defined by the selected minimum and maximum values. The dwell time at each value is determined by the frequency selection. For example, if the frequency is 1 Hz, the instrument will hold each value for 1 second before switching to the next.

When the function is first called, the instrument will be in parameter setting mode. The random variation is disabled. . If Trigger mode is disabled, the screen will display the variation type (RAN.WAVE), frequency, and upper and lower limit settings.

Trigger Disabled   →

```
RAN. WAVE    F:_10.0 Hz
Max: 20.0    Min:_0.1dB
```

If Trigger mode is enabled, (see SETTINGS section), the word WAVE is replaced by TRG, followed by either ↑ or ↓. The direction of the arrow denotes whether the PDLE is set to trigger on the rising or falling edge of the trigger pulse. In addition, the frequency setting is replaced by the word "Trigger", indicating that the PDL switching is triggered by the external trigger pulses rather than occurring at a set frequency

Trigger Enabled   →

```
RAN. TRG↑    F: Trigger
Max: 20.0    Min:_0.1dB
```

Use the ◄ ►keys to move the cursor position between digits or between parameters. Use the ▲▼keys to increment the selected digit.

The frequency range is 0.1 Hz to 100 Hz.
The range for maximum PDL is 0.2 to 20 dB.
The range for minimum PDL is 0.1 to 19.9 dB.

Note: The maximum PDL cannot be set lower than the minimum PDL. To set the range to lower values than the current minimum PDL setting, reset the minimum value first, then reset the maximum.

After setting the frequency (for nontriggered operation) and range (maximum and minimum), press the ENTER key.

If trigger mode is disabled, random value generation at the set frequency will begin immediately after the ENTER key is pressed. The cursor will move to the right bottom corner of the screen and remain there while the operation is enabled. To stop the random PDL generation and edit the operation parameters, press the ENTER key. The cursor will move back to the parameter editing area.

If trigger mode is enabled, after the ENTER key is pressed, the PDLE will wait to receive the trigger. The PDLE will generate one random state for each trigger pulse. The switching occurs 420µs after the trigger edge. The timing diagram for a random variation set to trigger on a rising edge is shown below.
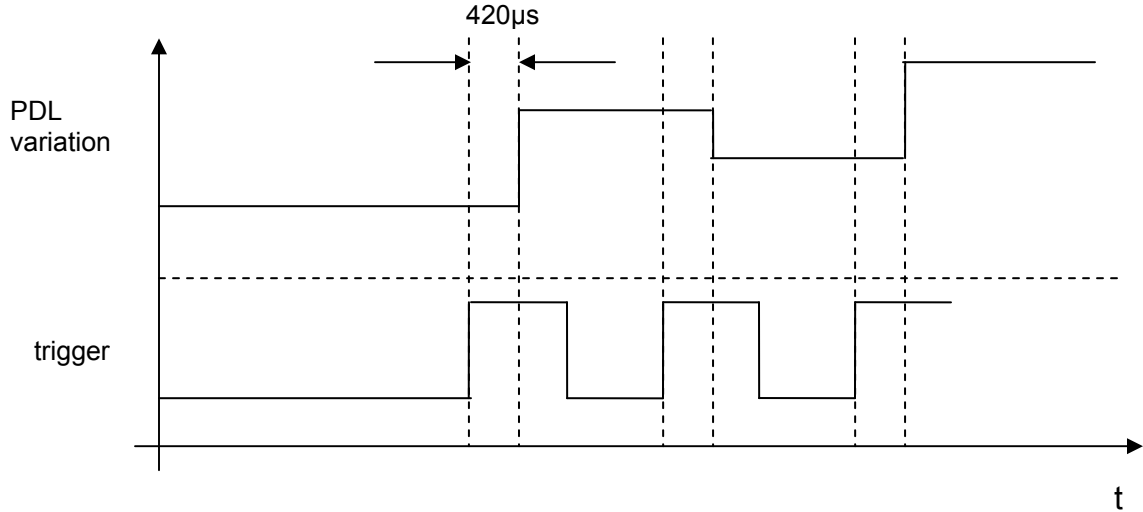
To return to the main screen, press the MODE button 3 times.

PDL SINE WAVE VARIATION:

This is a sinusoidal sweep function. The PDLE-101 sweeps the PDL back and forth between the selected minimum and maximum values at the selected frequency.
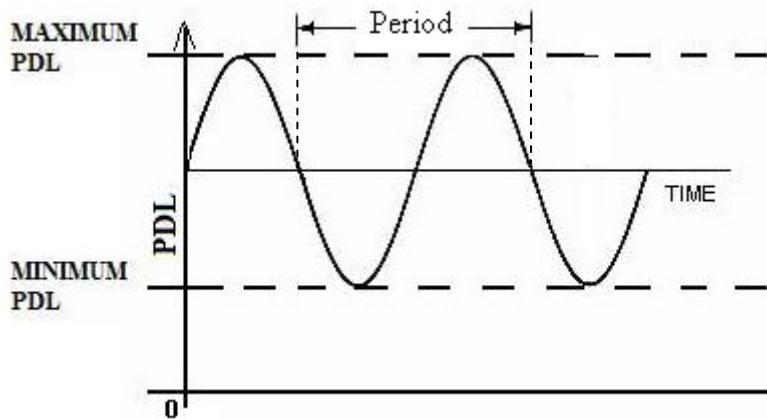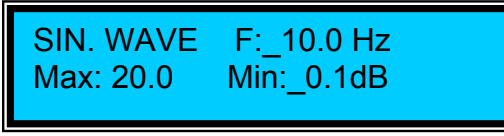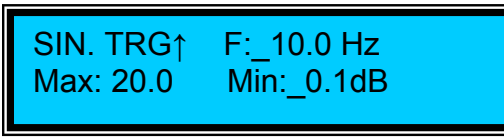

Figure 8 PDL sine wave sweep function

When the function is first called, the instrument will be in parameter setting mode. The sweep function is disabled. If Trigger mode is disabled, the screen will display the waveform type (SIN.WAVE), frequency, and upper and lower limit settings.

```
SIN. WAVE    F:_10.0 Hz
Max: 20.0    Min:_0.1dB
```

Trigger Disabled   →

If Trigger mode is enabled, (see SETTINGS section), the word WAVE is replaced by TRG, followed by either ↑ or ↓. The direction of the arrow denotes whether the PDLE is set to trigger on the rising or falling edge of the trigger pulse.

```
SIN. TRG↑    F:_10.0 Hz
Max: 20.0    Min:_0.1dB
```

Trigger Enabled   →

Use the ◄ ►keys to move the cursor position between digits or between parameters. Use the ▲▼keys to increment the selected digit.

The frequency range is 0.1 Hz to 10 Hz.
The range for maximum PDL is 0.2 to 20 dB.
The range for minimum PDL is 0.1 to 19.9 dB.

Note: The maximum PDL cannot be set lower than the minimum PDL. To set the sweep parameters to a lower range than the current minimum PDL setting, reset the minimum value first, then reset the maximum.

After setting the frequency and endpoints, press the ENTER key.

If trigger mode is disabled, the sweep will begin immediately after the ENTER key is pressed. The cursor will move to the right bottom corner of the screen and remain there as long as the sweep function is enabled. To stop the sweep and edit the operation parameters, press the ENTER key. The cursor will move back to the parameter editing area.

If trigger mode is enabled, after the ENTER key is pressed, the PDLE will wait to receive a trigger pulse. The sine wave variation will begin 4.6ms after the trigger edge. If a second trigger pulse is received after the sine variation has begun, it will reset and restart 4.6 ms after the new trigger edge.
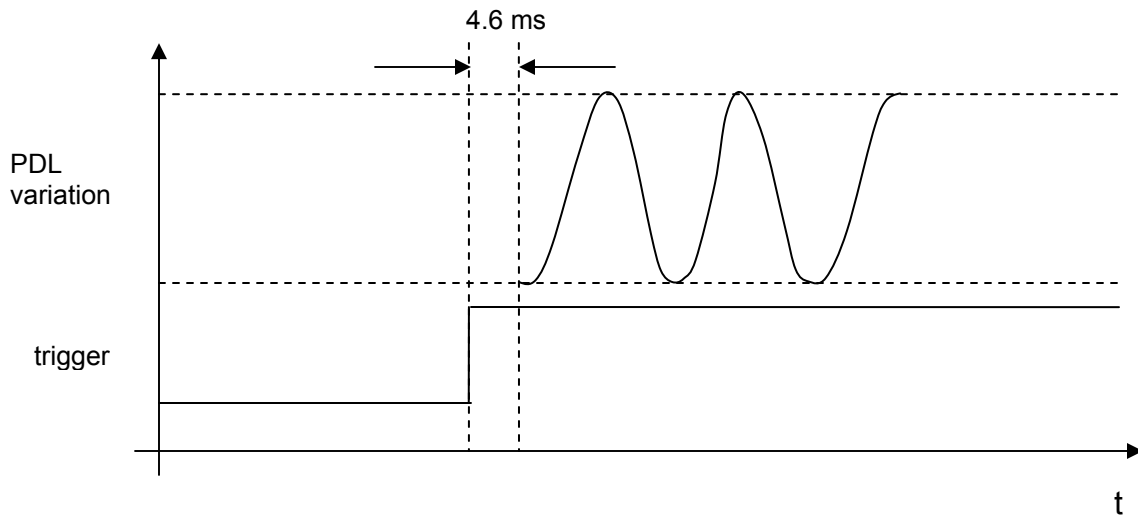
To return to the main screen, press the MODE button 3 times.

PDL SQUARE WAVE VARIATION:

In this function, the PDLE-101 switches the PDL back and forth between the selected minimum and maximum points, executing a square wave at the selected frequency.
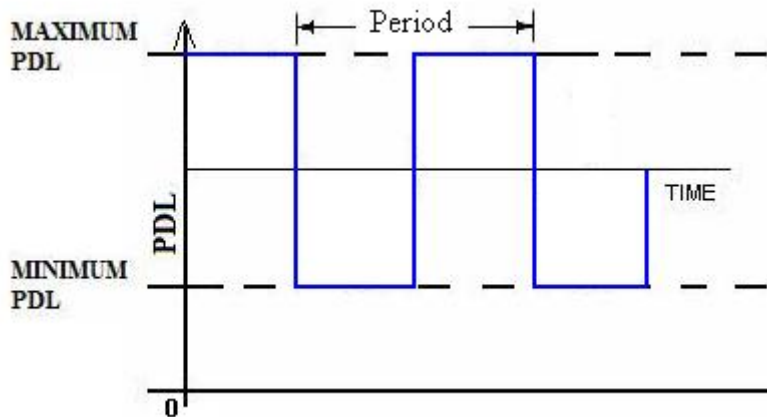

Figure 9 PDL square wave function

When the function is first called, the instrument will be in parameter setting mode. The sweep function is disabled. If Trigger mode is disabled, the screen will display the waveform type (SQU.WAVE), frequency, and upper and lower limit settings.

```
┌─────────────────────────────────┐
│  SQU. WAVE    F:_10.0 Hz         │
│  Max: 20.0     Min:_0.1dB        │
│                                  │
└─────────────────────────────────┘
```

Trigger Disabled   →

If Trigger mode is enabled, (see SETTINGS section), the word WAVE is replaced by TRG, followed by either ↑ or ↓. The direction of the arrow denotes whether the PDLE is set to trigger on the rising or falling edge of the trigger pulse.

```
┌─────────────────────────────────┐
│  SQU. TRG↑  F:_10.0 Hz           │
│  Max: 20.0     Min:_0.1dB        │
│                                  │
└─────────────────────────────────┘
```

Trigger Enabled   →

Use the ◄ ►keys to move the cursor position between digits or between parameters. Use the ▲▼keys to increment the selected digit.

The frequency range is 0.0 Hz to 100 Hz.
The range for maximum PDL is 0.2 to 20 dB.
The range for minimum PDL is 0.1 to 19.9 dB.

Note: The maximum PDL cannot be set lower than the minimum PDL. To set the maximum to a lower value than the current minimum PDL setting, reset the minimum value first, then reset the maximum.

After setting the frequency and endpoints, press the ENTER key.

If trigger mode is disabled, the square wave variation will begin immediately after the ENTER key is pressed. The PDLE will begin at the lower PDL setting and switch back and forth between the upper and lower PDL settings at the selected frequency. Please note that the dwell time at each state is half the period, i.e. if the set frequency is 1 Hz, the PDLE will switch states once every 0.5s. The cursor will move to the right bottom corner of the screen and remain there as long as the PDLE is executing the square wave. To stop the square wave and edit the operation parameters, press the ENTER key. The cursor will move back to the parameter editing area.

If trigger mode is enabled, after the ENTER key is pressed, the PDLE will wait to receive a trigger pulse.

If the square wave frequency is set to 0.0 Hz, the PDLE will switch once between states each time it receives a trigger pulse. The first transition will be from low to high PDL. Subsequently, it will toggle between states once for each trigger pulse. The delay between the trigger edge and the PDL transition is 420μs. The timing diagram is shown below, for triggered operation on the rising edge.
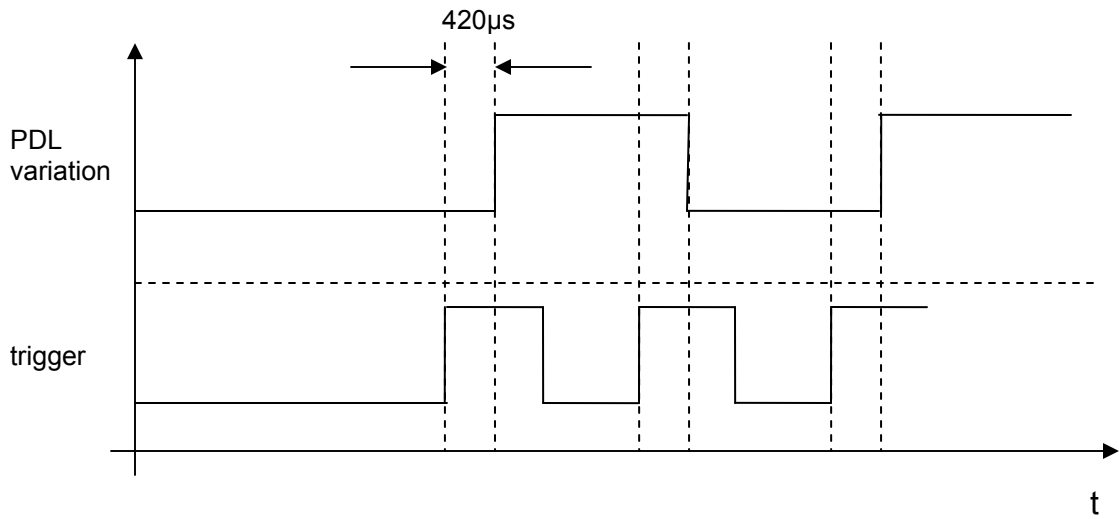
If the square wave frequency is set to a nonzero value, the trigger function is similar to its function for the sine and triangle waves. The PDLE will generate a square wave at the set frequency, starting with a low-to-high transition 420μs after the trigger pulse is received. If another trigger pulse is received while the PDLE is generating the square wave, it will reset and begin generating a square wave 420μs after the new trigger edge. The timing diagram is shown below.
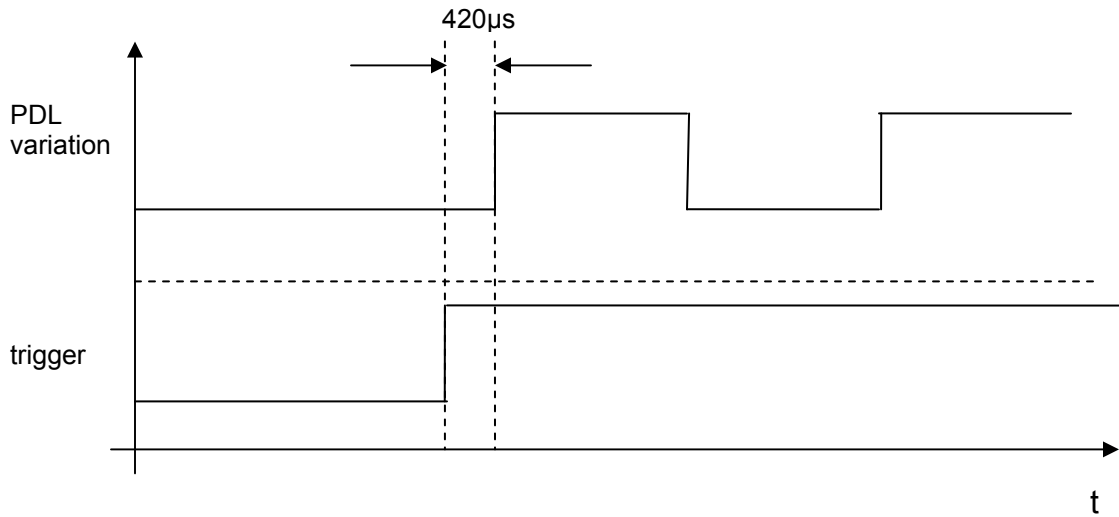
To return to the main screen, press the MODE button 3 times.

SETTINGS:

There are 6 options in the SETTINGS menu. Use the ▲▼ keys to move between them and the ENTER key to select the highlighted option.

```
1. SET TRIGGER
2. SET WAVELENGTH      ↓
```

```
3. GET DYNAMIC IP *    ↑
4. GET STATIC IP       ↓
```

Note: the * next to the dynamic or static IP line indicates the PDLE's current Ethernet communication mode. In this example, the PDLE is set for dynamic IP addressing.

```
5. SET STATIC IP       ↑
6. SET GPIB ADDRESS
```

Set Trigger:

The trigger option allows the user to synchronize the operation of the PDLE with other parts of a system. Triggered operation can be used with any of the PDL variation functions (triangle, random, sine, or square waves). In general, with the trigger enabled, when one of the PDLE's variation modes is activated, instead of beginning the periodic variation immediately, the PDLE waits until it receives a trigger pulse to begin operation. If it receives another trigger pulse while the waveform variation is running, it will restart the waveform from the beginning (usually the lower limit value).

When the SET TRIGGER option is selected, the displayed screen allows the user to enable/disable triggered operation and to select whether the PDLE responds to the rising or falling edge of the trigger pulse.

```
SET TRIGGER CONTROL
MODE: Enab        EDGE: Rise
```
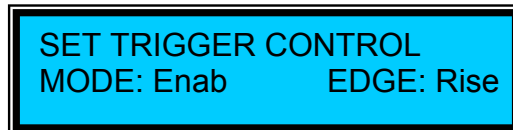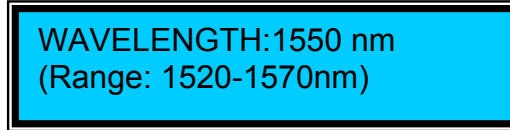
Use the left and right arrow keys to move between MODE and EDGE selection. Use the up and down arrow keys to toggle between Enable and Disable (for MODE selection) and between Rise and Fall (for Edge selection). The selections are applied immediately; it is not necessary to press ENTER after making a selection.

From this screen, press the MODE button twice to return to the main screen.

Set Wavelength:

When this option is selected, the screen shows the current wavelength setting.

```
WAVELENGTH:1550 nm
(Range: 1520-1570nm)
```

Use the arrow keys to set the desired wavelength value (range is 1520-1570nm for a C-band unit), then press ENTER to update and store the wavelength setting to memory. Like the GPIB address, the setting will be retained after the instrument is powered down.

Get Dynamic IP:

The instrument's IP address must be known in order to control it via Ethernet.
See Section 4.4.3 for Ethernet setup details.

The "Get Dynamic IP" option sets the instrument for dynamic IP addressing and requests a dynamic IP address from the server.

If the instrument is able to establish communication with the DHCP server and successfully retrieve a dynamic IP address, the dynamic IP address will be displayed on-screen.

```
GETTING DYNAMIC IP • •
(Please Wait)
```

↓

```
IP: 191.168.0.65
* Dynamic Mode Set
```
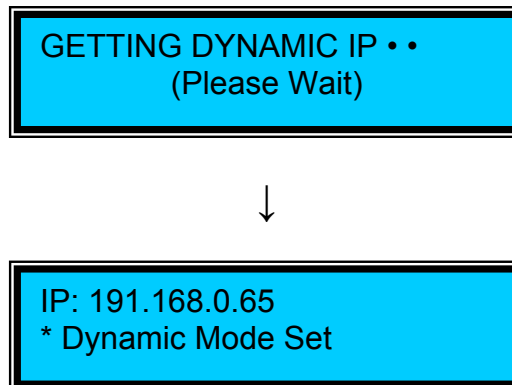
If the dynamic IP address request is unsuccessful, the currently stored static IP address will be displayed on this screen. If no static IP address has been stored by the user, the address displayed will be 0.0.0.0.

Get Static IP:

Sets the instrument for static IP addressing and recalls the static IP address stored in memory.

```
┌──────────────────────────────┐
│                              │
│   GETTING STATIC IP • •      │
│        (Please Wait)         │
│                              │
└──────────────────────────────┘
```

↓

```
┌──────────────────────────────┐
│                              │
│   FIX: 191.168.0.111         │
│   * Static Mode Set          │
│                              │
└──────────────────────────────┘
```

Set Static IP:

Allows the user to set the static IP address, Net Mask, Gateway, Name Server, and Port for Ethernet communication using static IP addressing. The setup screens for this option are as follows:

```
┌──────────────────────────────┐
│                              │
│   >SET IP (Static) ↓         │
│   a. IP: 192.168.000.062     │
│                              │
└──────────────────────────────┘
```

```
┌──────────────────────────────┐
│                              │
│   >SET IP (Static)  ↓↑       │
│   b. NM: 255.255.255.000     │
│                              │
└──────────────────────────────┘
```
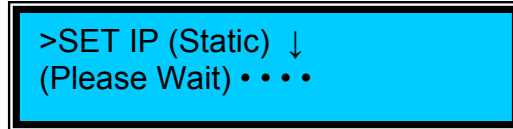
```
┌──────────────────────────────┐
│                              │
│   >SET IP (Static)  ↓↑       │
│   c. GW: 192.168.000.001     │
│                              │
└──────────────────────────────┘
```

```
┌──────────────────────────────┐
│                              │
│   >SET IP (Static)  ↓↑       │
│   d. NS: 192.168.000.002     │
│                              │
└──────────────────────────────┘
```

```
┌──────────────────────────────┐
│                              │
│   >SET IP (Static)  ↑        │
│   e. PORT: _23               │
│                              │
└──────────────────────────────┘
```
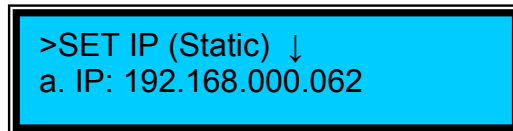
The ">SET IP (Static)" line writes the settings to memory. Use the up and down arrows to move between parameter setting options (the cursor will blink on the option letter). To set a particular parameter, press the ENTER key to move the cursor from the option letter to a parameter setting position. Use the left and right arrow keys to move between digits and the up and down arrow keys to increment the highlighted digit. Press the ENTER key to move the cursor back to parameter selection (cursor blinking on the option letter).

When finished setting all of the Ethernet setup parameters, use the up arrow to move the cursor back to the ">SET IP (Static)" line and press the ENTER key to write the values to memory. The screen will display:

```
>SET IP (Static) ↓
(Please Wait) • • • •
```

while writing the values, and will then return to the default Static IP setting screen when finished.

```
>SET IP (Static) ↓
a. IP: 192.168.000.062
```
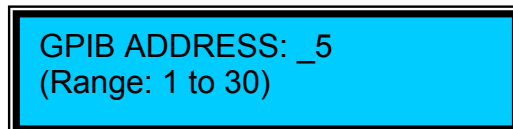
The static IP address and other network parameters can also be set via RS-232 using a LabView program provided with the instrument. See the Ethernet Setup section for details.

Once written to memory, the static IP network parameters can be recalled from the front panel using the "GET STATIC IP" option under the SETUP menu, or via RS-232 using the Ethernet setup LabView program.

Set GPIB address:

The GPIB address is stored in non-volatile memory. On power-up the stored address is read and used as the current address.

When the SET GPIB ADDRESS option is selected, the screen displays the current GPIB address (default value is 5).

```
GPIB ADDRESS: _5
(Range: 1 to 30)
```

Use the arrow keys to select the desired address, then press ENTER to update and store the new address to memory. The GPIB address range is 1 to 30.

From this screen, press the MODE button twice to return to the main screen.

4.4 Remote control and programming:

4.4.1 RS-232 operation

4.4.1.1 RS-232 connection

The RS-232 serial interface port allows the user to remote control the PDLE-101. Any RS-232 communication program can be used to send ASCII commands to the PDLE-101 to remotely access the system. (See the PDLE-101 command list in the next section).

The RS-232 connector on the rear panel of the PDLE-101 is a DB9 male connector. Use a straight connection RS-232 cable to connect the PDLE-101 to the RS-232 port of a computer. To ensure proper communication, use a serial cable with direct pin-to-pin connected wires (see Figure 10) at both ends of the cable.

Note: The PDLE-101 transmits through pin 2 and receives through pin 3 of its connector. A PC transmits through pin 3 and receives through pin 2 of its connector.
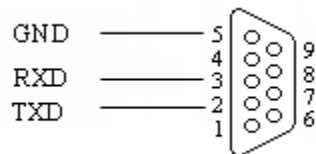

Figure 10 DB9 Male RS-232 connector pin assignment on PDLE-101 rear panel.

4.4.1.2 Remote operation and commands

The following steps and commands are recommended for remote operation of the PDLE-101 using the RS-232 communication port.

1. Connect PDLE-101 to PC using RS-232 straight cable (DB-9 female to female).
2. Turn the power switch on.
3. Referring to **Table 1** on the following page, the user can send a command string, for example, "*IDN?", to the PDLE-101 through the RS-232 port. There are many programming languages that support serial communications, including Visual Basic, LabView, and C.

Table 1 Remote Control Commands

Note: These commands are common to all communication interfaces.

	System	
Command	**Description**	**Response**
*IDN?	Queries the product number	*GP PDLE-101 V1.1#
*VER?	Queries the Firmware Version	*V1.0.100524A-G# (Sample response)
*SER?	Queries instrument serial number	Example: * 136000000007#
*ADR nn#	Set GPIB Address nn Range: 1 ≤ nn ≤ 30	*E00# or other error code
*ADR?	Queries the GPIB ADDRESS	Response: *FF# Example: *10# GPIB address set to 10
*WAV xxxx#	Set the Wavelength Units: nm Range: 1520 nm ≤ xxxx ≤ 1570 nm for C band unit	*E00# or other error code
*WAV?	Queries wavelength setting. Units: nm.	Response: *FFFF# Example: *1550# wavelength setting 1550nm
*HOM#	Go to PDL control mode (main screen) without changing PDL value	*E00# or other error code
*MOD?	Queries Current MODE Setting (corresponds to front panel display)	Possible Responses: *HOM# Main screen *OPT# Function/Settings selection *TRI DIS# Triangular Variation Disabled *RAN DIS# Random Variation Disabled *SQU DIS# Square Variation Disabled *SIN DIS# Sine Variation Disabled *TRI ENA# Triangular Variation Enabled *RAN ENA# Random Variation Enabled *SQU ENA# Square Variation Enabled *SIN ENA# Sine Variation Enabled *FUN OP1# Function selection option 1-triangle *FUN OP2# Function selection option 2-random *FUN OP3# Function selection option 3-sine *FUN OP4# Function selection option 4-square *SET OP1# Settings selection option 1- trigger *SET OP2# Settings selection option 2- λ *SET OP3# Settings selection option 3- dyn. IP *SET OP4# Settings selection option 4- static IP *SET OP5# Settings selection option 5- static IP set *SET OP6# Settings selection option 6- GPIB *ADD# GPIB address selection *WAV# wavelength selection *IPD# IP Address: Dynamic Mode *IPS# IP Address: Static Mode *TRG# Trigger Setup Mode
	Manual PDL Control	
*PDL FF.f#	Set the static PDL Value FF.f Range: 0.1 dB ≤ FF.f ≤ 20 dB	*E00# or other error code
*PDL?	Queries current PDL setting. Units: dB Range: 0.1 dB ≤ FF.f ≤ 20.0 dB	Response: *FF.f# Example: *17.2# PDL set to 17.2 dB
	Trigger Control	
*TRG ENA#	Enable Trigger Mode Note: Trigger pulse will only start function if PDLE is in "Wait-For-Trigger Mode"	*E00# or other error code

*TRG DIS#	Disable Trigger Mode If in Run Mode or "Wait-for-Trigger Mode", will move to edit mode.	*E00# or other error code
*TRG RIS#	Set to trigger on rising edge of trigger pulse. If already set for rising edge, command has no effect. (Default setting is rising edge)	*E00# or other error code
*TRG FAL#	Set to trigger on falling edge of trigger pulse. If already set for falling edge, command has no effect. (Default setting is rising edge)	*E00# or other error code
*TRG SET?	Query Trigger Setting	Disabled: *DIS# Enabled, trigger on rising edge: *RIS# Enabled, trigger on falling edge: *FAL#
	Triangle Wave	
*TRI ENA#	Enable Triangle Wave Variation with current frequency and amplitude settings. If trigger is disabled, this command will begin the triangle wave. If trigger is enabled, PDLE will go into "Wait for Trigger" mode. Variation will begin after first trigger.	*E00# or other error code
*TRI DIS#	Disable Triangle Wave Variation and go to triangle wave parameter edit mode	*E00# or other error code
*TRI:FRQ f.f#	Set Triangle Wave Variation Frequency Range: 0.1 to 10.0 Hz	*E00# or other error code
*TRI FRQ?	Queries PDL Triangle Wave Frequency Setting Units: Hz Range: 0.1 Hz ≤ F ≤ 10.0 Hz	Response: *FF.f# Example: *5.3# Frequency set to 5.3 Hz
*TRI:MXA f.f#	Set PDL Triangle Variation **Maximum PDL** Range: 0.2 dB ≤ Max ≤ 20.0 dB	*E00# or other error code
*TRI MXA?	Queries PDL Triangle Wave Maximum PDL Units: dB Range: 0.2 dB ≤ Max ≤ 20.0 dB	Response: *FF.f# Example: *15.0# Max PDL set to 15.0 dB
*TRI:MNA f.f#	Set PDL Triangle Variation **Minimum PDL** Range: 0.1 dB ≤ Min ≤ 19.9 dB Note: Min PDL must be less than Max PDL	*E00# or other error code
*TRI MNA?	Queries PDL Triangle Wave Minimum PDL Units: dB Range: 0.1 dB ≤ Min ≤ 19.9 dB	Response: *FF.f# Example: *2.0# Min PDL set to 2.0 dB
	Random Variation	
*RAN ENA#	Enable Random Variation with current frequency and amplitude settings If trigger is disabled, this command will begin the random variation. If Trigger is enabled, will go into "Wait for Trigger" mode. PDL will switch to a different random value after each trigger pulse.	*E00# or other error code
*RAN DIS#	Disable Random Variation and go to random variation parameter edit mode	*E00# or other error code
*RAN:FRQ f.f#	Set Random Variation Frequency. Range: 0.1 to 100.0 Hz	*E00# or other error code
*RAN FRQ?	Queries PDL Random Variation Frequency Setting Units: Hz Range: 0.1 Hz ≤ F ≤ 100.0 Hz	Response: *FF.f# Example: *8.6# Frequency set to 8.6 Hz
*RAN:MXA f.f#	Set PDL Random Variation **Maximum PDL** Range: 0.2 dB ≤ Max ≤ 20.0 dB	*E00# or other error code
*RAN MXA?	Queries PDL Random Variation Maximum PDL Units: dB Range: 0.2 dB ≤ Max ≤ 20.0 dB	Response: *FF.f# Example: *15.0# Max PDL set to 15.0 dB

*RAN:MNA f.f#	Set PDL Random Variation **Minimum PDL** Range: 0.1 dB ≤ Min ≤ 19.9 dB Note: Min PDL must be less than Max PDL	*E00# or other error code
* RAN MNA?	Queries PDL Random Variation Minimum PDL Units: dB Range: 0.1 dB ≤ Min ≤ 19.9 dB	Response: *FF.f# Example: *2.0# Min PDL set to 2.0 dB
	Sine Wave	
*SIN ENA#	Enable Sine Wave Variation with current frequency and amplitude settings. If trigger is disabled, this command will begin the sine wave. If trigger is enabled, will go into "Wait for Trigger" mode. Variation will begin after first trigger.	*E00# or other error code
*SIN DIS#	Disable Sine Wave Variation and go to sine wave parameter edit mode.	*E00# or other error code
*SIN:FRQ f.f#	Set Sine Wave Variation Frequency Range: 0.1 to 10.0 Hz	*E00# or other error code
*SIN FRQ?	Queries PDL Sine Wave Frequency Setting Units: Hz Range: 0.1 Hz ≤ F ≤ 10.0 Hz	Response: *FF.f# Example: *1.1# Frequency set to 1.1 Hz
*SIN:MXA f.f#	Set PDL Sine Wave Variation **Maximum PDL** Range: 0.2 dB ≤ Max ≤ 20.0 dB	*E00# or other error code
*SIN MXA?	Queries PDL Sine Wave Maximum PDL Units: dB Range: 0.2 dB ≤ Max ≤ 20.0 dB	Response: *FF.f# Example: *8.9# Max PDL set to 8.9 dB
*SIN:MNA f.f#	Set PDL Sine Wave Variation **Minimum PDL** Range: 0.1 dB ≤ Min ≤ 19.9 dB Note: Min PDL must be less than Max PDL	*E00# or other error code
*SIN MNA?	Queries PDL Sine Wave Minimum PDL Units: dB Range: 0.1 dB ≤ Min ≤ 19.9 dB	Response: *FF.f# Example: *0.7# Min PDL set to 0.7 dB
	Square Wave	
*SQU ENA#	Enable Square Wave Variation with current frequency and amplitude settings If trigger is disabled, this command will begin the square wave. If trigger is enabled, will go into "Wait for Trigger" mode. If frequency is set to 0.0, PDL will switch once with each trigger pulse. If frequency is set to a nonzero value, variation will begin at set frequency after first trigger.	*E00# or other error code
*SQU DIS#	Disable Square Wave Variation and go to square wave variation parameter edit mode.	*E00# or other error code
*SQU:FRQ f.f#	Set Square Wave Variation Frequency. Range: 0.0 to 100.0 Hz	*E00# or other error code
*SQU FRQ?	Queries PDL Square Wave Frequency Setting Units: Hz Range: 0.0 Hz ≤ F ≤ 100.0 Hz	Response: *FF.f# Example: *48.1# Frequency set to 48.1 Hz
*SQU:MXA f.f#	Set PDL Square Wave Variation **Maximum PDL** Range: 0.2 dB ≤ Max ≤ 20.0 dB	*E00# or other error code
*SQU MXA?	Queries PDL Square Wave Maximum PDL Units: dB Range: 0.2 dB ≤ Max ≤ 20.0 dB	Response: *FF.f# Example: *18.6# Max PDL set to 18.6 dB
*SQU:MNA f.f#	Set PDL Square Wave Variation **Minimum PDL** Range: 0.1 dB ≤ Min ≤ 19.9 dB Note: Min PDL must be less than Max PDL	*E00# or other error code
*SQU MNA?	Queries PDL Square Wave Minimum PDL Units: dB Range: 0.1 dB ≤ Min ≤ 19.9 dB	Response: *FF.f# Example: *2.5# Min PDL set to 2.5 dB

Note: For random or waveform variation functions, the maximum PDL setting must be greater than the minimum PDL setting. To satisfy this requirement, if a "set maximum" command such as *SIN:MXA f.f# is used to set the maximum PDL to a value lower than the current minimum PDL setting, the minimum PDL setting will then be changed to Min = Max − 0.1 dB. Similarly, if a "set minimum" command such as *SIN:MNA f.f# is used to set the minimum PDL to a value greater than the current maximum PDL setting, the maximum PDL setting will then be changed to Max =Min +0.1 dB.

Error Code Definitions

E00	No error (State OK)
E01	Undefined command
E05	Value out of range

RS-232 command notes:

1. RS-232 port uses asynchronous framing, 8 data bits, no parity bit, 1 stop bit and baud rate: 9600 bps.

2. Only one command is allowed in each command string.

3. The PDLE-101 should respond to control commands with one of the error codes listed above. If a command is a status request, the computer will return either the requested information or an error code of form *Enn#; see the error definition list above.

4. While the PDLE-101 is processing a command and sending back a response ASCII code, any additional commands sent by the computer will be ignored.

4.4.1.3 RS-232 troubleshooting

If a problem occurs during RS-232 control, please check the following:

1. Cable should be straight-wired: Select a straight-wired (pin-to-to pin wired) cable;
2. Verify active Comm Port (COM1, COM2, etc.);
3. Verify Comm Port settings: 8 data bits, 1 stop bit, no parity bits;
4. Check baud rate: must be 9600 bps;
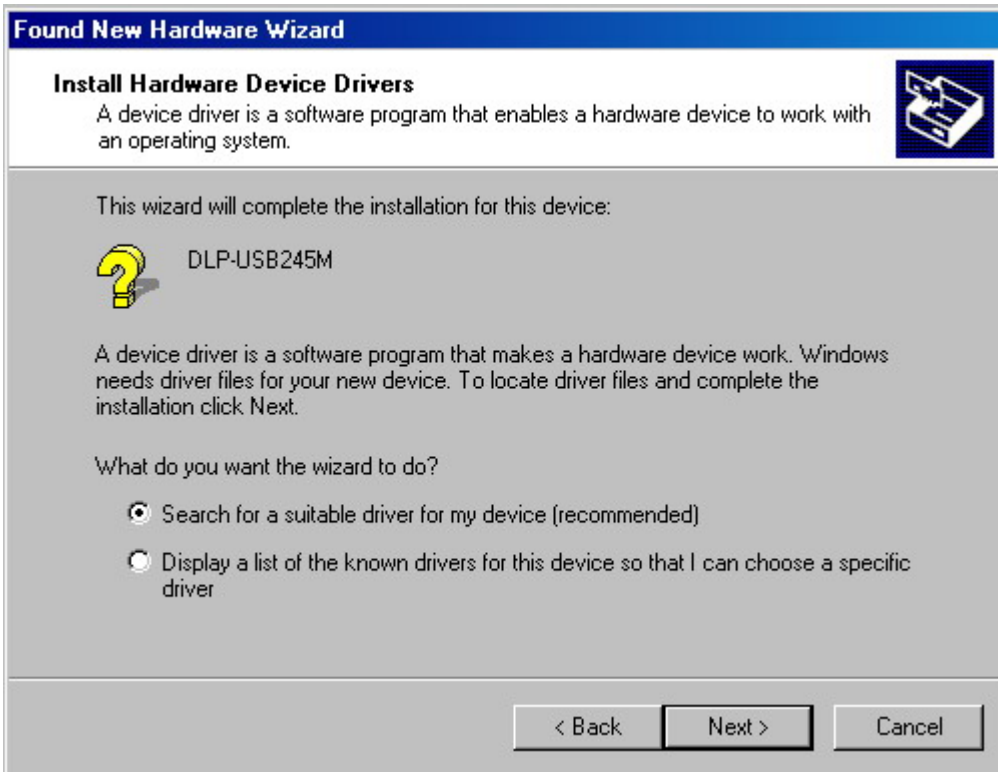5. Check command format: a correct command should begin with "*" and end with "#" or "?".

4.4.2 USB control

4.4.2.1 Procedure for Installing USB VCP driver

1. Copy VCP driver from CD-ROM to the control computer.
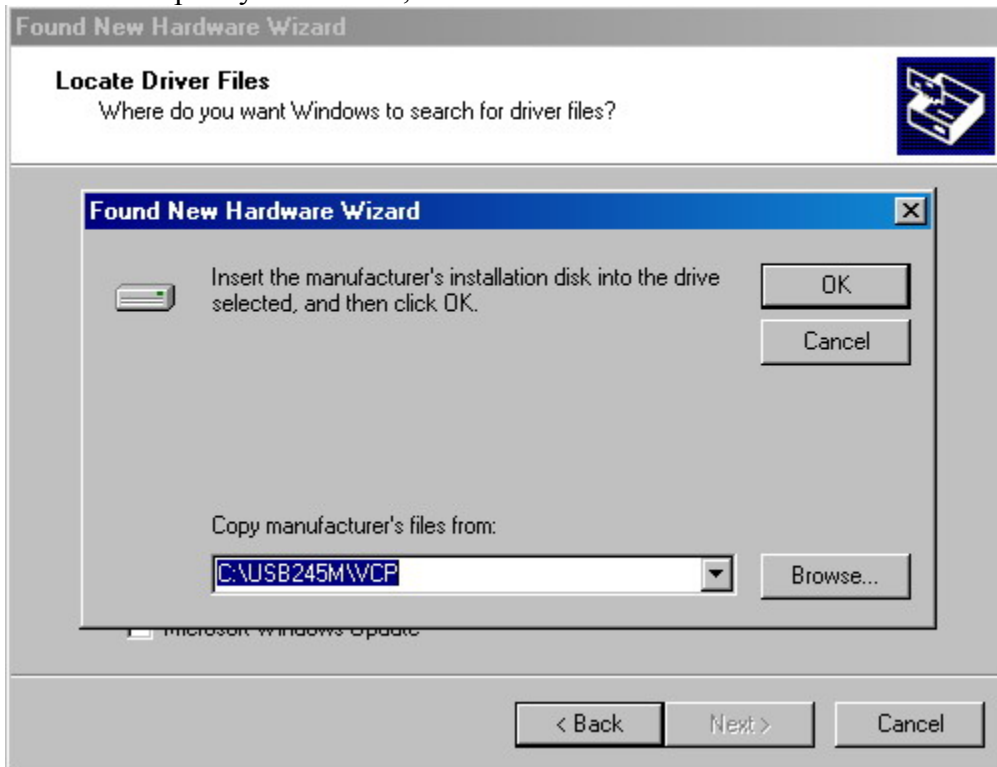2. Turn on instrument power supply and plug in USB cable; this should bring up the "Found New Hardware Wizard":

3. Click "Next":

4. Click "Next":

5. Check "Specify a location", then click "Next":

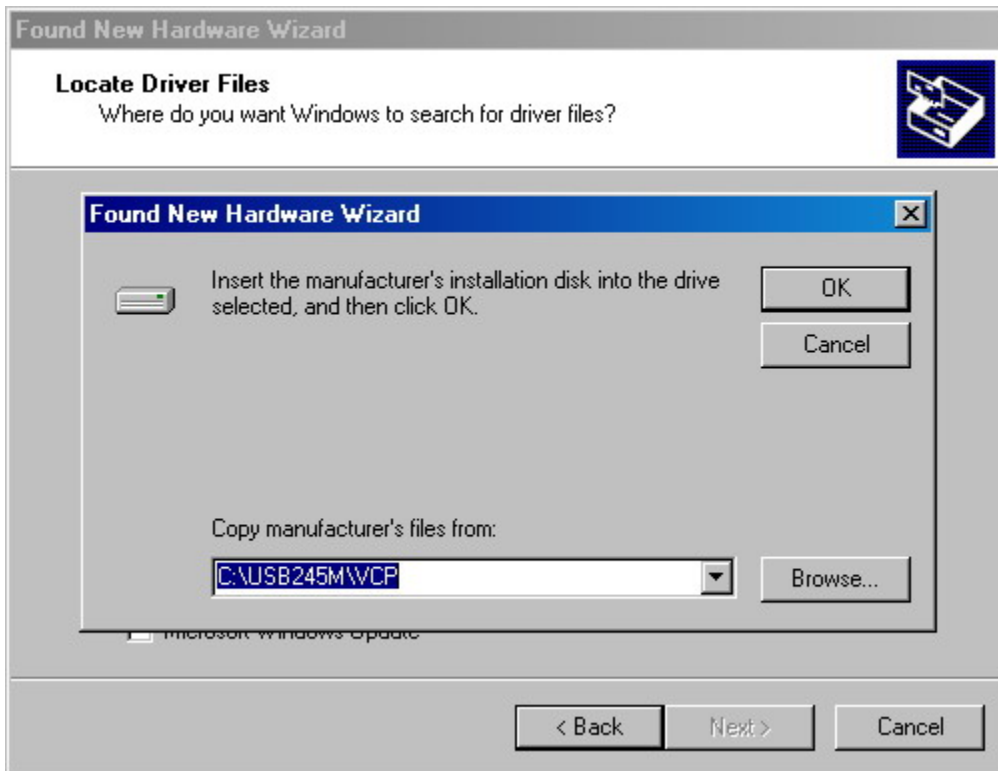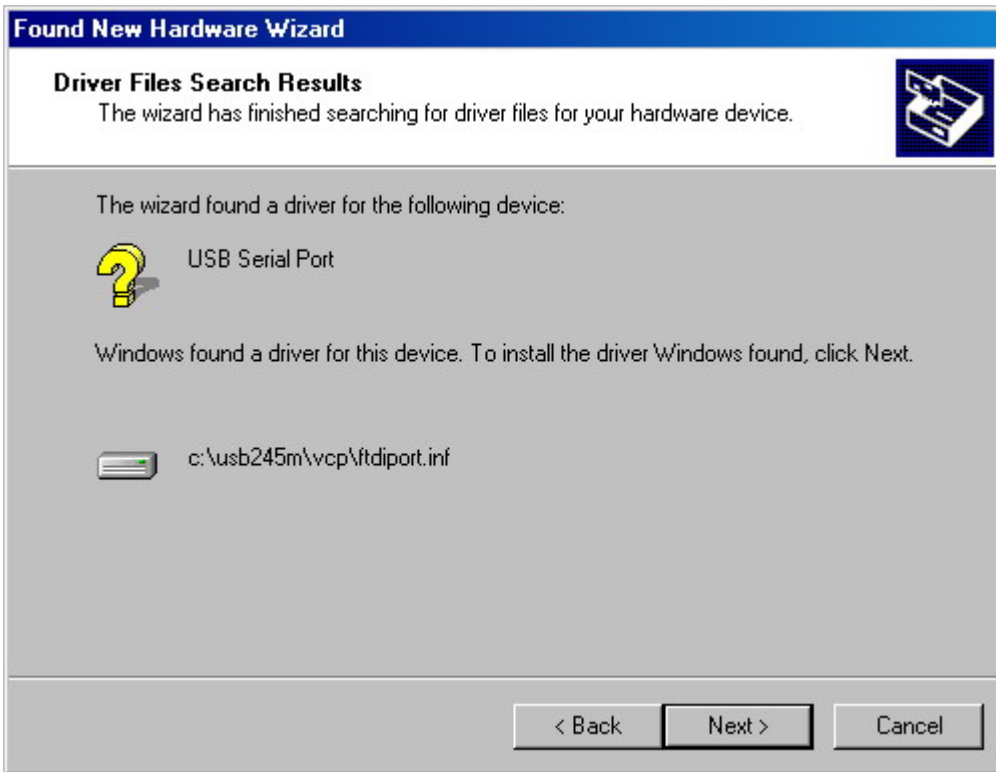6. Use "Browse" to locate the file directory where the VCP driver is. Click "OK" to proceed to the next screen:

Found New Hardware Wizard

Driver Files Search Results
The wizard has finished searching for driver files for your hardware device.

The wizard found a driver for the following device:

DLP-USB245M

Windows found a driver for this device. To install the driver Windows found, click Next.

c:\usb245m\vcp\ftdibus.inf

[< Back] [Next >] [Cancel]

7. Click "Next":

Found New Hardware Wizard

Completing the Found New Hardware Wizard

USB Serial Converter

Windows has finished installing the software for this device.

To close this wizard, click Finish.

[< Back] [Finish] [Cancel]

8. Click "Finish". This completes the first part of the installation, during which the USB to serial converter is installed. The second part consists of the installation of the serial port driver. This should follow automatically once the converter installation is completed:

9. Click "Next":

10. Click "Next":

11. Use "Browse" to locate the file directory where the VCP driver is. Click "OK" to proceed to the next screen:

Found New Hardware Wizard

Driver Files Search Results
The wizard has finished searching for driver files for your hardware device.

The wizard found a driver for the following device:

? USB Serial Port

Windows found a driver for this device. To install the driver Windows found, click Next.

c:\usb245m\vcp\ftdiport.inf

[< Back] [Next >] [Cancel]

12. Click "Next":

Found New Hardware Wizard

Completing the Found New Hardware Wizard

USB Serial Port

Windows has finished installing the software for this device.

To close this wizard, click Finish.

[< Back] [Finish] [Cancel]

13. Click "Finish".

Depending on the system software and the location of the driver, the sequence of screens between the "found new hardware" screen and the "completion" screen may be slightly different, but in all cases, the result will be the installation first of the USB serial converter and then the USB serial port.

Once the installation of the serial port driver has been completed, confirm that the installation has been successful by looking under "Device Manager" on the "System Properties" screen: select Control Panel → System Properties → Hardware → Device Manager, then Select View → Device by type. The resulting screens are shown below. The device should have installed as a USB Serial Port (COMx) attached to USB High Speed Serial Converter.

The USB driver can drive more than one instrument, but the correct port number must be set in the control programs for each of the instruments.
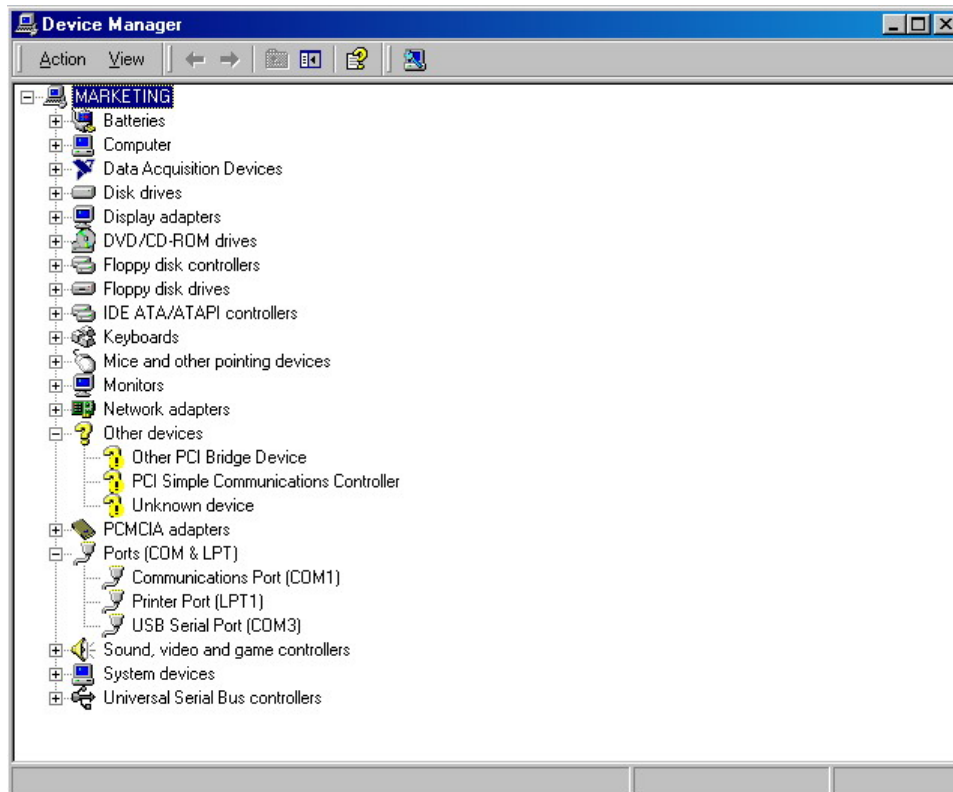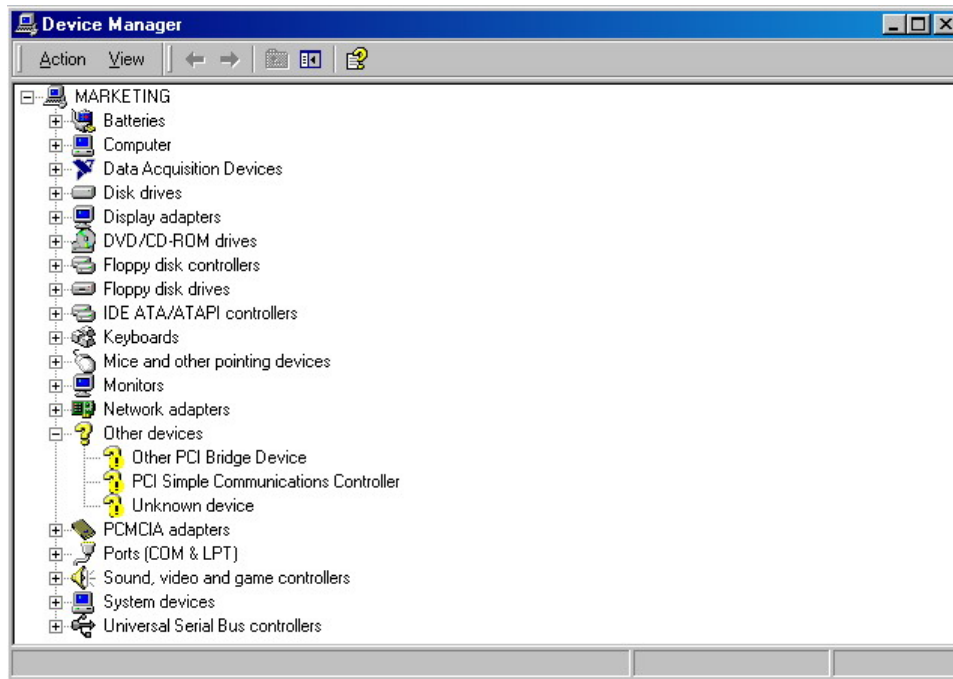
In this example, the USB device is connected to COM3.

4.4.2.2. VCP Uninstall Procedure:

Unplug device. Run "Add/Remove Programs" from Control Panel:
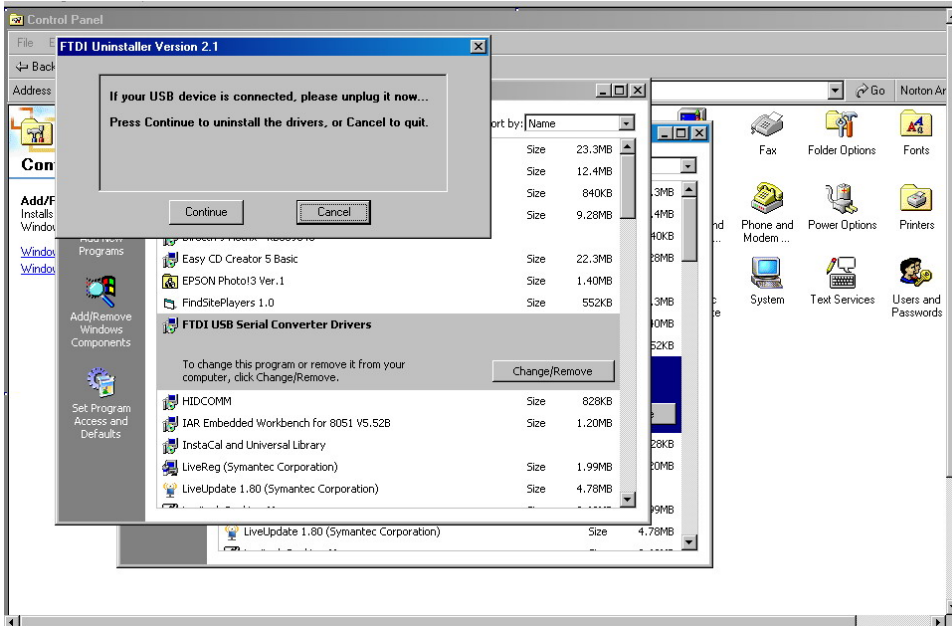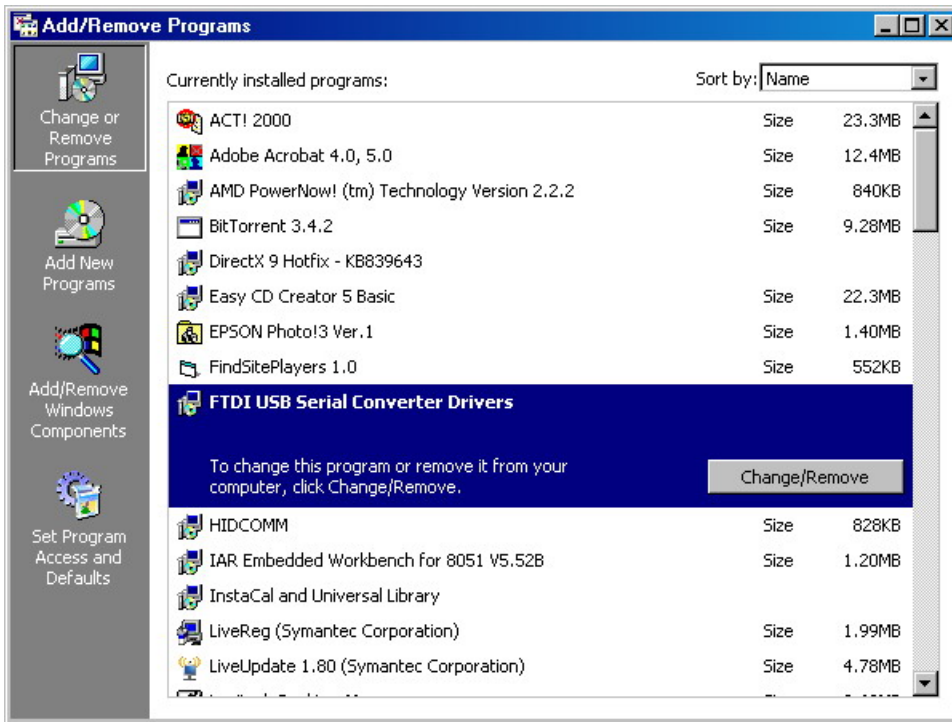
4.4.2.3. PDLE-101 USB Commands

The command list for USB control is the same as for RS-232 (see **Table 1** and the accompanying notes in section 4.4.1.2.)

4.4.2.4. USB Troubleshooting:

Sometimes, for unknown reasons, the USB Serial Port cannot be found in Device Manager. To troubleshoot this issue, run "Add/Remove Programs" from the Control Panel, click FTDI USB Serial Converter Drivers, and then click the Change/Remove button. A warning window will tell you that you have to unplug the USB cable if you want to remove the drives. Unplug USB cable, then press "Continue" button. Restore computer, then run VCP installation procedure again.
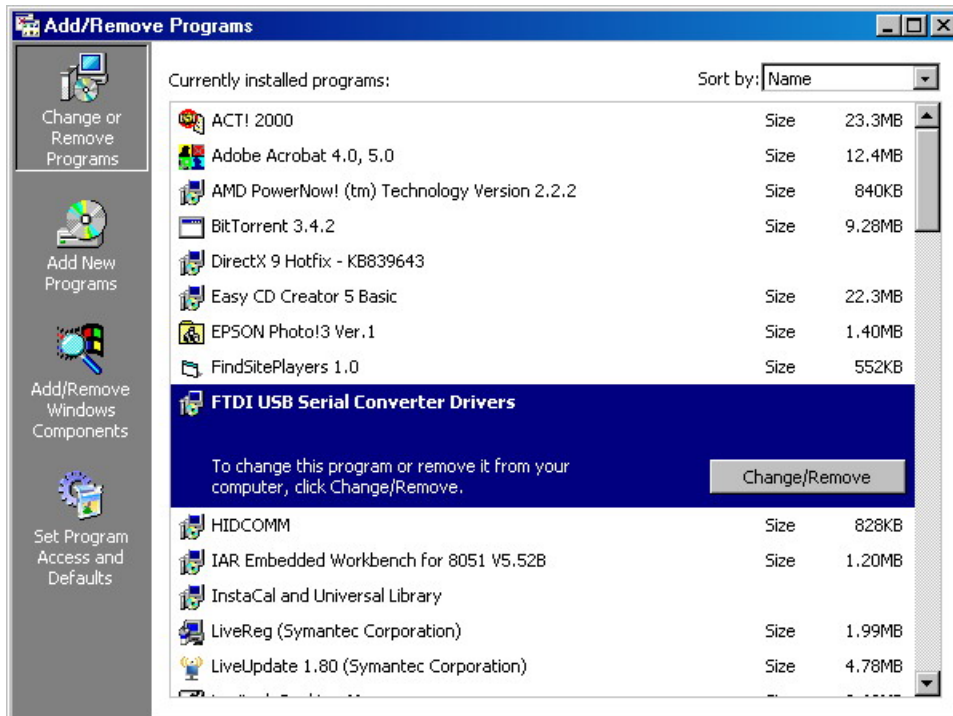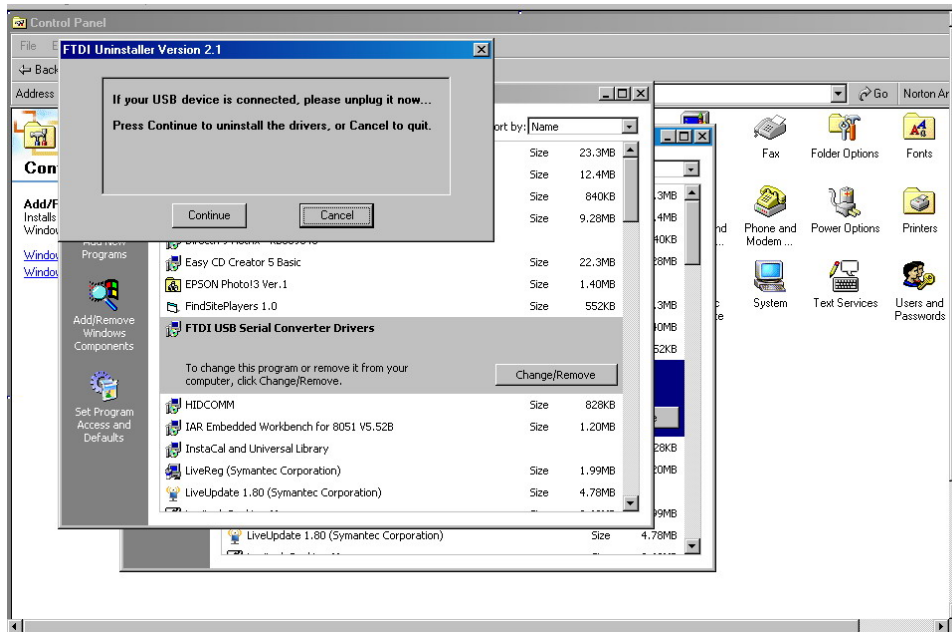
4.4.3. PDLE-101 GPIB and Ethernet Control

The command list for GPIB and Ethernet control is the same as for RS-232 (see **Table 1** and the accompanying notes in section 4.4.1.2.)

GPIB:

While controlled by the IEEE 488 GPIB interface, the PDLE-101 can function as a Talker or Listener on a bus with up to 14 other GPIB devices. The PDLE-101 uses the CB7210.2 GPIB chip.

Ethernet:

The IP address from an ISP is assigned in one of two ways:

- Set to an IP which is only good for a limited time, and which is changed according to the policy set by the ISP's DHCP server. This is a *dynamic IP address*.
- Set to an IP address which can be unchanged for months or years at a time. This is a *static IP address*.

Ethernet Setup:

1. Connections:
   There are two connection configurations for Ethernet control:

   a) Static IP: the administrator assigns the instrument a fixed IP address. Using this connection the instrument is directly connected to the controlling PC, as shown in Figure 11. For this configuration, a cross-linked network cable must be used.
   b) Dynamic IP: the DHCP server assigns the instrument an available address when requested. Connect the instrument with a DHCP server (router or exchange server), as shown in Figure 12. For this configuration, a standard straight-linked network cable must be used.
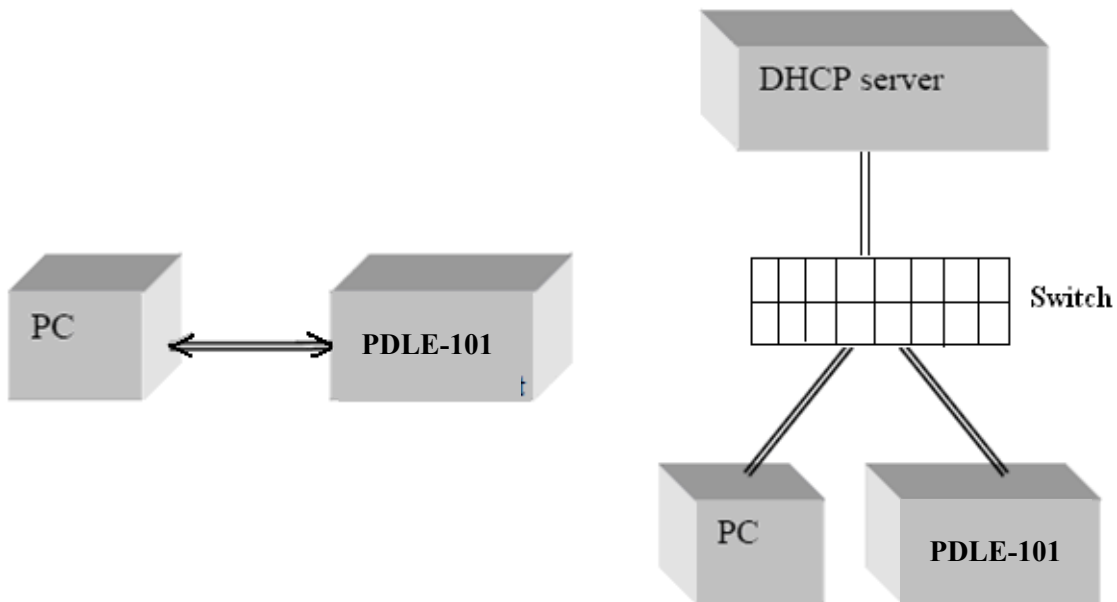
Figure 11 Direct connection: PDLE-101 to PC   Figure 12 Connect PDLE-101 with DHCP server

2. Set Ethernet configuration and get IP address:

   a) Front panel:
   As described in section 4.2, the user can set the PDLE for static or dynamic IP addressing and query the IP address from the SETUP menu. Press the SETUP button on the front panel. GET DYNAMIC IP sets the PDLE for dynamic IP addressing and requests a dynamic IP address from the server. GET STATIC IP sets the PDLE for static IP addressing and requests the static IP address stored in memory.

   The static IP address can be set from the front panel using the SET STATIC IP option under the SETUP menu.

b) LabView program:

A LabView program provided with the instrument can also be used to query the IP address and perform static IP setup.

Open the LabVIEW program *(GP_SET_ETHERNET.vi or GP_SET_ETHERNET.exe)* to set the Ethernet configuration.

NOTE: This program was designed for an RS-232 interface, so the instrument should be connected to the computer via RS-232 before running it. Please see the instructions at the beginning of section 4.4.1 for preparations to run an RS-232 LabView program. The program interface is shown below.

Select the correct serial (RS-232) port from the port configuration box at the top of the screen. The baud rate should be set to 9600. Once these two parameters are set, click the white arrow to run the program.

The program has 3 tabs. The first, "GET IP CONFIG" is used to query the current IP configuration of the PDLE-101. When the "Get IP Config" button at the left of the screen is clicked, the program will read back the instrument's current IP address, net mask, gateway, nameserver, and port, as well as whether the instrument is currently set for static or dynamic IP addressing.
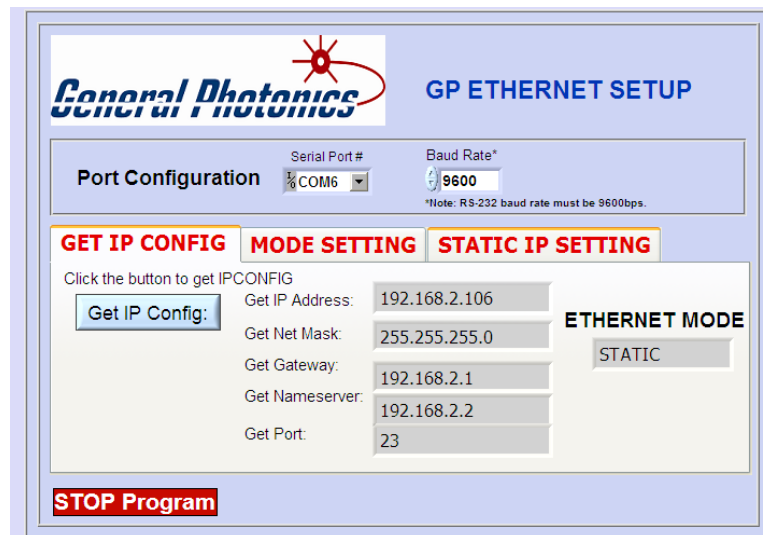
IP Config query screen- Static IP mode result
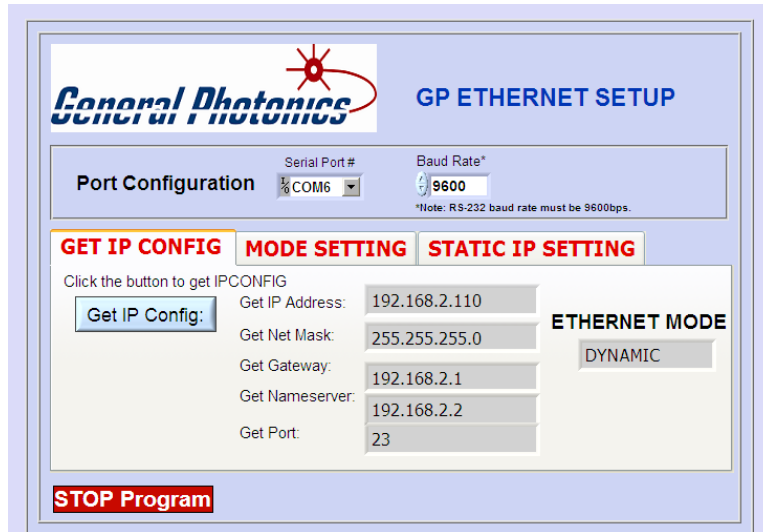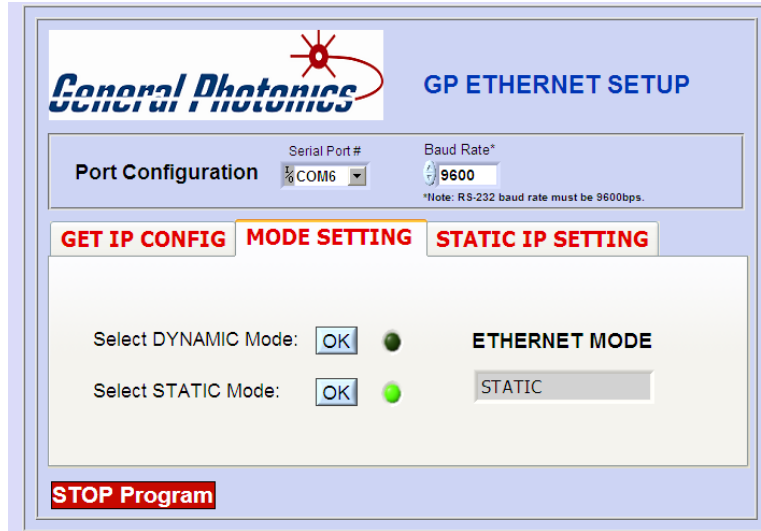
IP Config query screen- Dynamic IP mode result

Use this function to obtain the IP address, which is needed to control the PDLE-101 via Ethernet.

The second tab, "MODE SETTING" allows the user to switch the PDLE-101 between static and dynamic IP addressing modes.
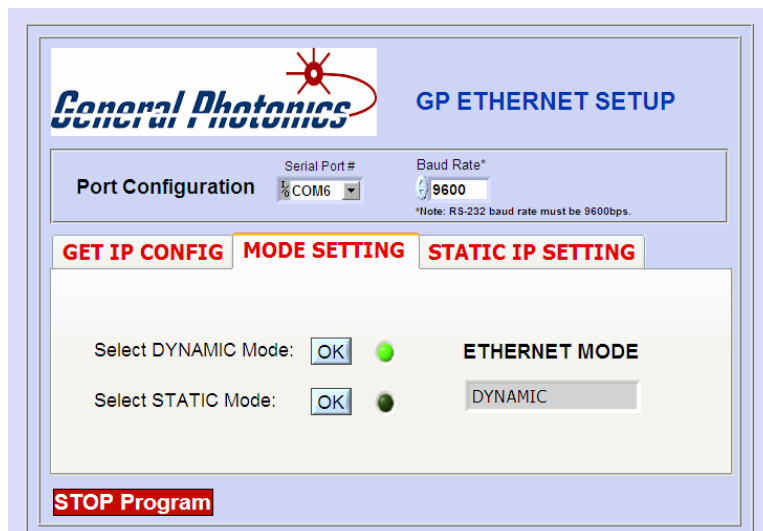
Ethernet mode selection screen- dynamic

Ethernet mode selection screen- static

Clicking the "OK" button for dynamic mode puts the PDLE-101 into dynamic IP mode. The instrument will obtain the dynamic IP information from the server. When it is finished, the indicator for dynamic mode will turn green, and the Ethernet Mode status box will say "DYNAMIC".

Clicking the "OK" button for static mode puts the PDLE-101 into static IP mode. The instrument will recall the static IP settings from its memory. These can then be used for communication. When it is finished, the indicator for static mode will turn green, and the Ethernet Mode status box will say "STATIC".

The PDLE-101 writes its most recently saved static IP settings and its active mode to memory. If it is powered off while in static mode, when it is powered back on, it will be in static mode, and the most recently saved set of IP configuration information can be used for communication.

If the PDLE-101 is powered off while in dynamic IP mode, when it is powered back on, it will be in dynamic IP mode.

The third tab in the program, "STATIC IP SETTING", allows the user to set the static IP configuration information. Input the information into the corresponding boxes and click the "SET" button. As each value is written, its indicator turns green. When all of the information is successfully stored, the "Set OK" indicator will turn green.
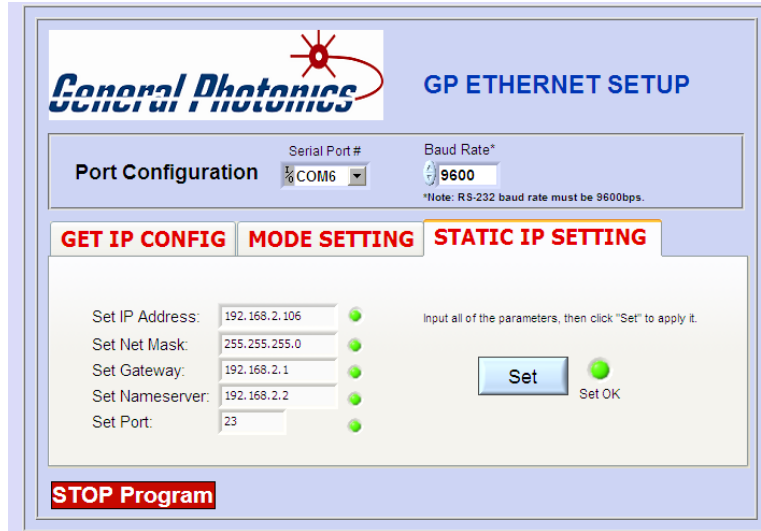
Static IP setup screen.

Notes on configuration:

The net mask and gateway should be the same as those for the control computer (see example below). The first 3 groups of numbers in the IP address should be the same as those for the control computer (192.168.2, for example). The last number can be any available number, but cannot be the same as the IP address of the control computer. If the last number of the computer's subnet mask is n, the available IP address range is n+1 to 254. In this example, n = 0, so the available IP addresses are 1 to 254. If the computer's IP address is 17, for example, the user can set the IP address for the PDLE-101 to any number in the range 1-254 except 17.

To find the IP information for the control computer for static IP mode:
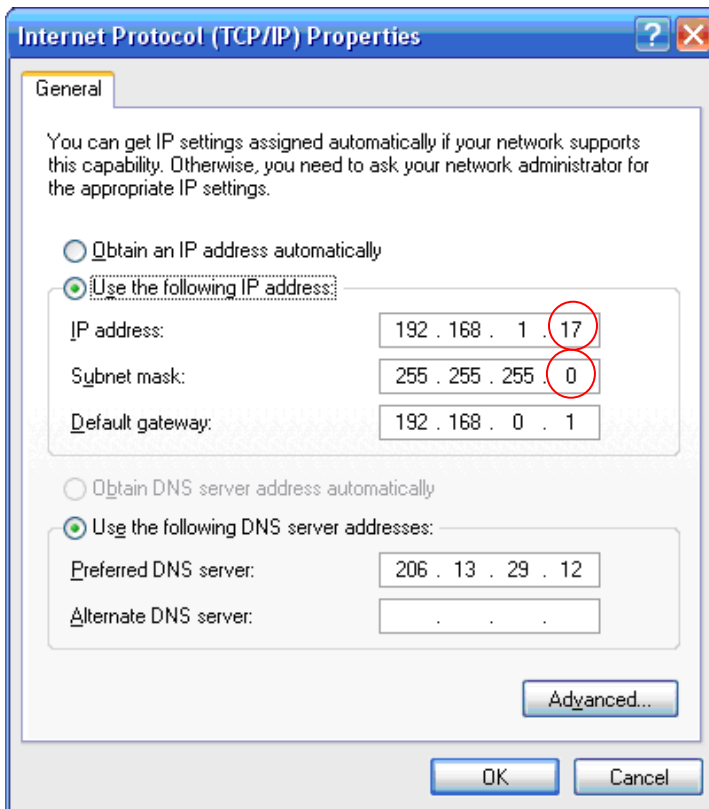
Check the computer's IP address:
Control Panel → Network and Dial-up Connections → Local Area Connection:
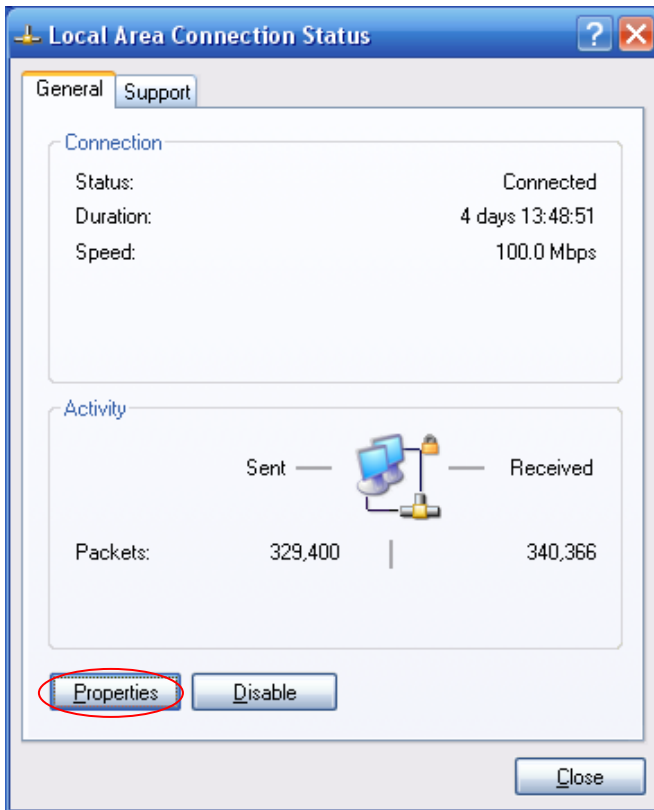
→ Properties (on "General" tab)
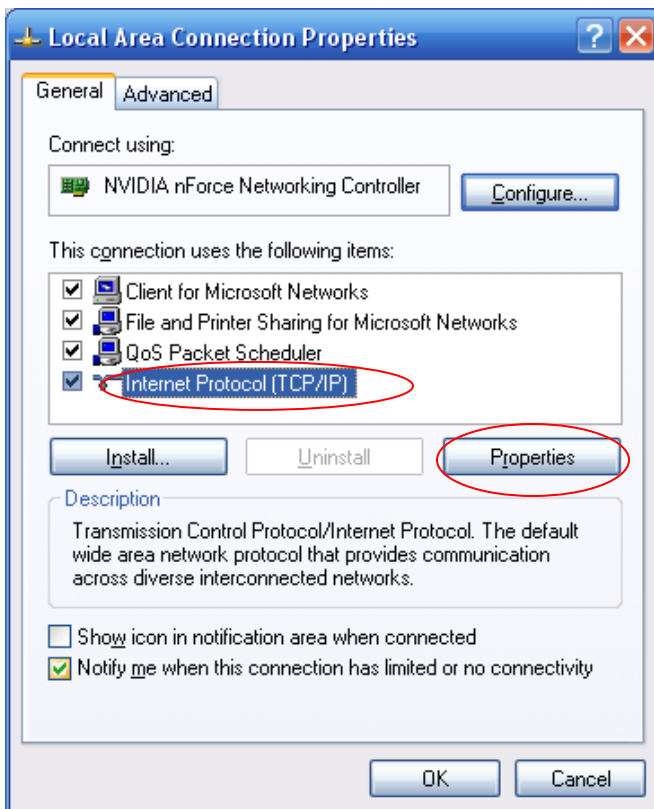
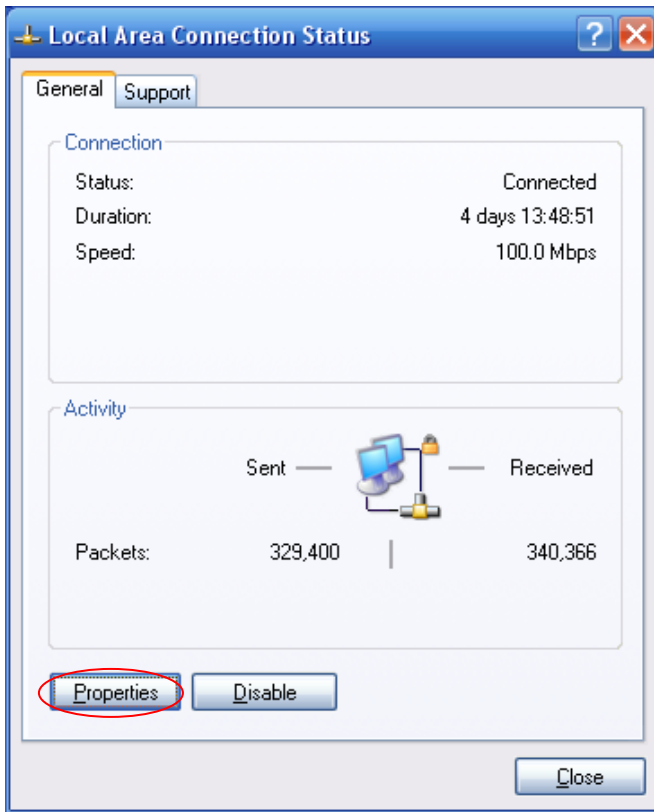→ Internet Protocol → Properties:

Write down the IP address, subnet mask, and gateway.

Dynamic IP configuration using a DHCP server:

To use dynamic IP address assignment, make sure that the DHCP server, switch, computer and PDLE-101 are correctly connected as shown in Figure 12. Check that the correct cables are used and that everything is powered on. Also, check that the control computer is set to obtain its IP address automatically.
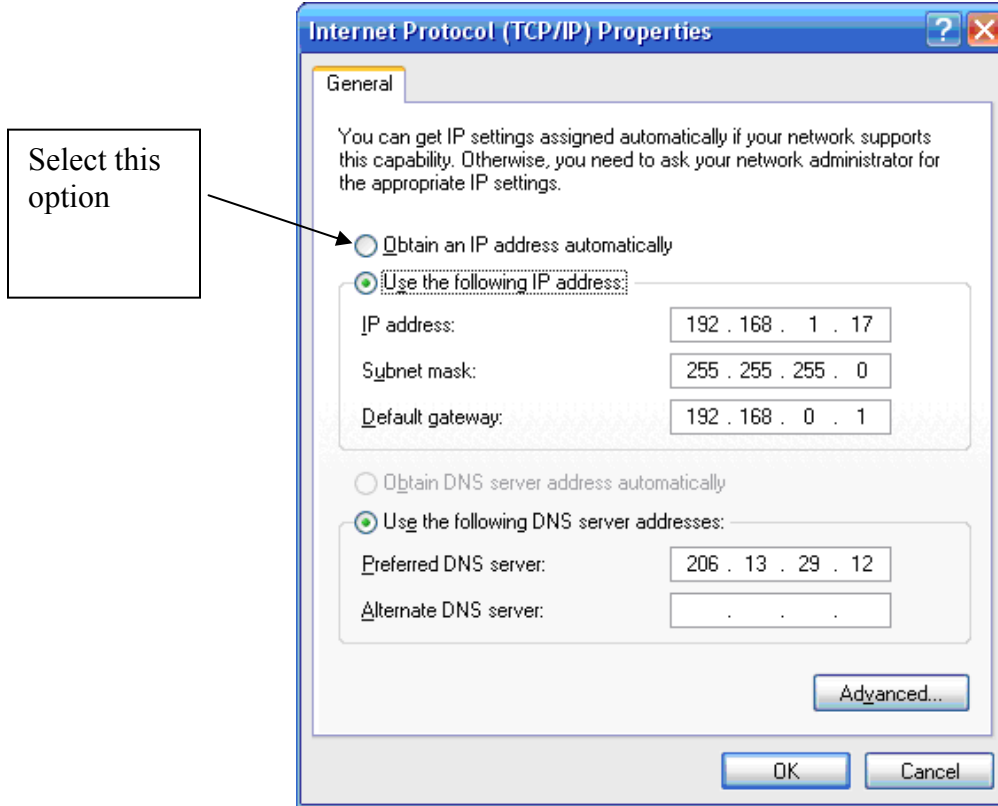
Control Panel → Network and Dial-up Connections → Local Area Connection:

→ Properties (on "General" tab)

→ Internet Protocol → Properties:

Select this
option
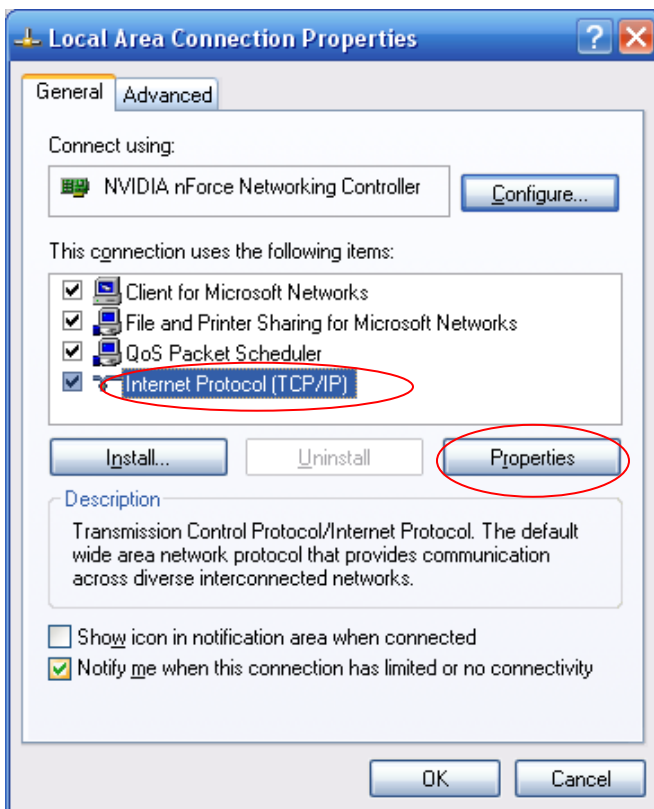
Notes:

- To connect the instrument directly to a PC, use a PC to PC cable. To connect the instrument to a LAN, use a standard network cable.
- For Ethernet control, the serial port is only used during Ethernet setup (if using the LabView Ethernet setup program).
- The remote control command formats for Ethernet and RS-232 are exactly the same.

4.4.4. Remote Control Program Interface

LabView based control programs are provided for computer control of the PDLE-101 through different control interfaces. If the LabView development environment (version 8.2 or above) is installed on the control computer, either the source code (vi) or the executable versions of the remote control programs can be used without installing further drivers. To control the PDLE through the USB port, the USB drivers need to be installed (see section 4.4.2)

Note: For simple control of the instrument, it is often easier to use the executable versions of the program than the source code. However, the executable versions will not run properly while LabView is running. If using the executable versions of the program on a computer with LabView installed, the user should quit LabView before running them.

To run the executable versions of the control program, the user should set up the LabVIEW Run-Time engine by running the programs under "\LVRunTimeEng_8.2" (on the CD-ROM), and install the driver program for VISA (used for RS-232, distributed by National Instruments) by running the program named "Visa400runtime.exe". For USB control, the USB drivers also need to be installed (see section 4.4.2). For details on Ethernet and GPIB setup, see section 4.4.3. Once the necessary drivers and other setup parameters are in place, the executable programs in the application directory can be run.

After the necessary drivers are installed, the programs (executable and/or source code) should be copied to the hard drive and run from there.
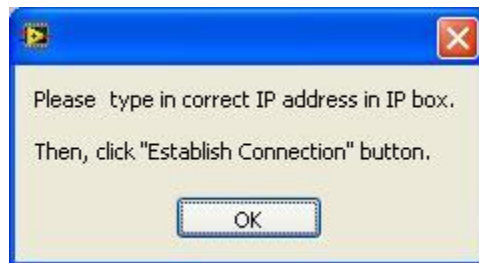
Note: Always close the control program (and LabView as well if using the VI version of the control program) before turning off the instrument.

When the program is first started, it will ask whether the communication interface to be used is Ethernet or something else.


Ethernet

If the user selects "Ethernet", the program will ask for the IP address:

Click "OK".

Type the instrument's IP address into the IP Address text box and click the "Establish Connection" button at the top left of the screen. The program will attempt to connect to the PDLE.

If the connection is successful, the connection status indicator at the top left of the screen will turn green, and the main screen will show the single PDL setting interface.

"Establish Connection" button

IP address box

Communication interface indicator/ selection button
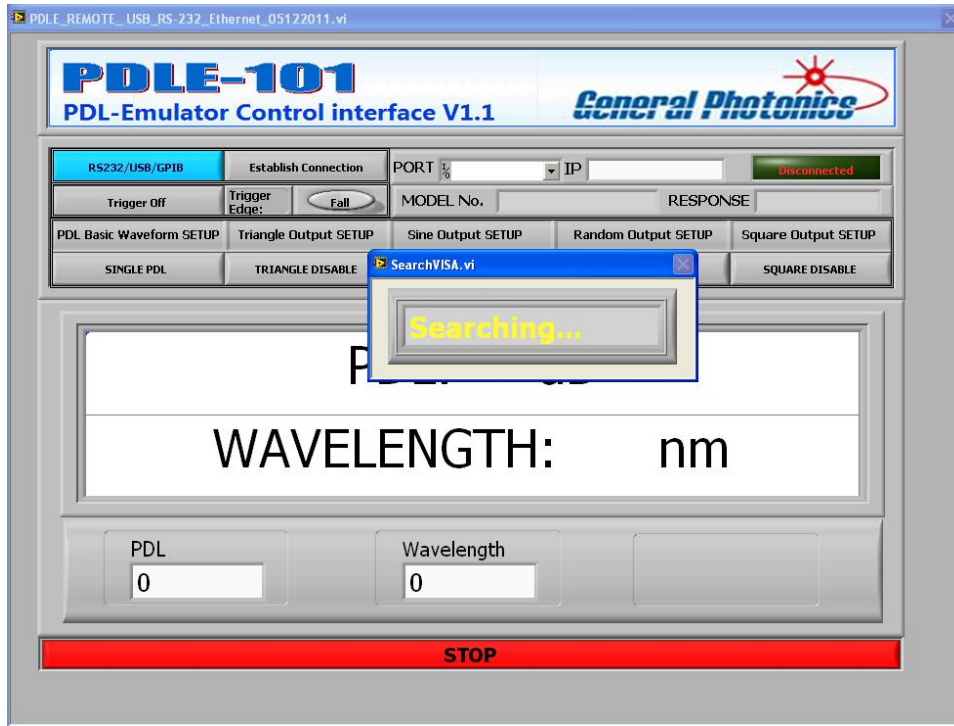
Connection status indicator
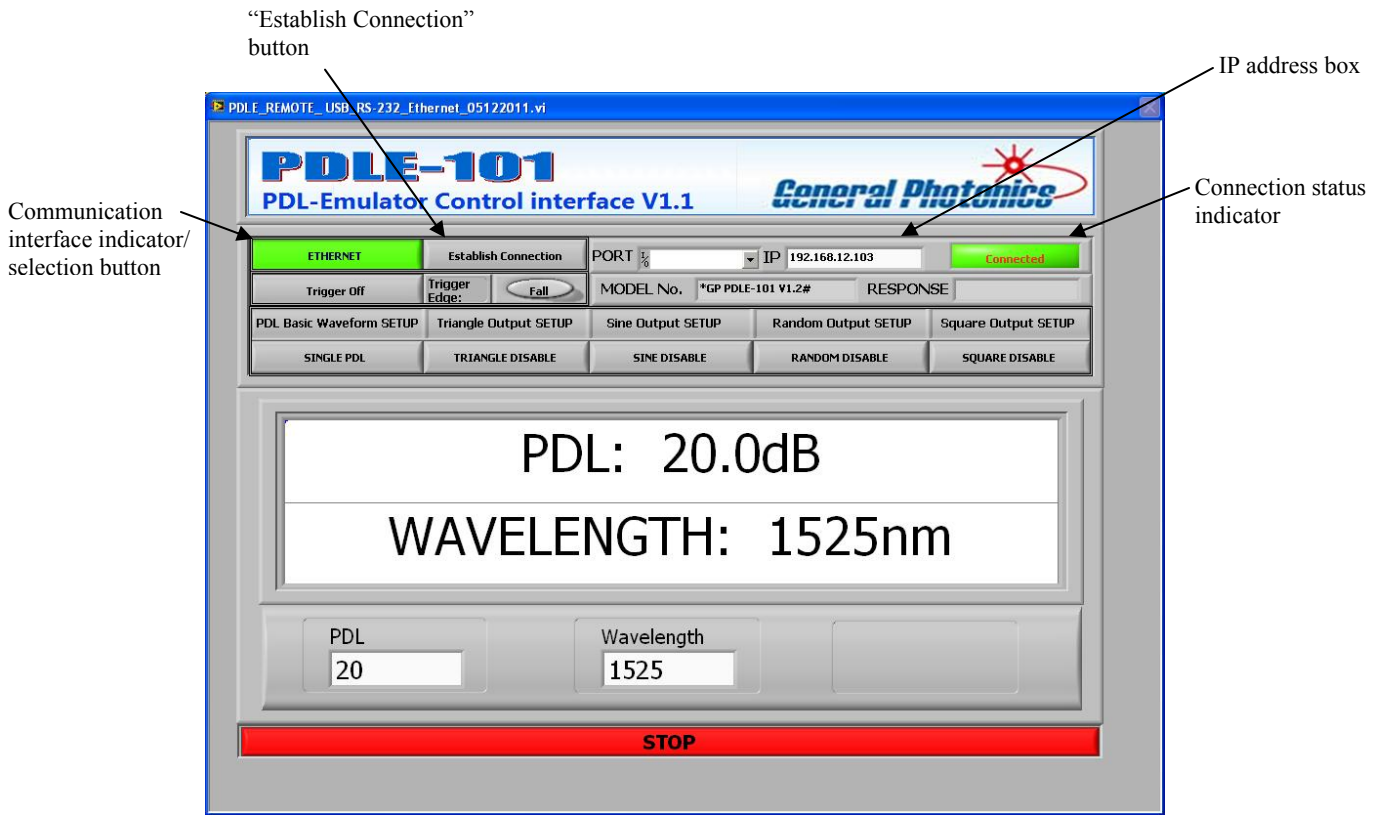
If the program is unable to establish the connection, the connection status indicator will remain dark and the IP address request message will reappear. Check the connections, IP addressing mode (static or dynamic) and IP address, then re-enter the IP address in the IP Address box and click the "Establish Connection" button again.

RS-232/USB/GPIB

To use an interface other than Ethernet, make sure that the necessary hardware connections are in place, then click the RS232/USB/GPIB button on the initial interface query window.

The program will initiate a port search:

If the port search is successful, the detected port will appear as the selected port in the port selection menu box. If the connection status indicator is still dark, click the "Establish Connection" button to connect to the PDLE using the detected port.

Port selection menu

Connection status indicator

Communication interface indicator/ selection button
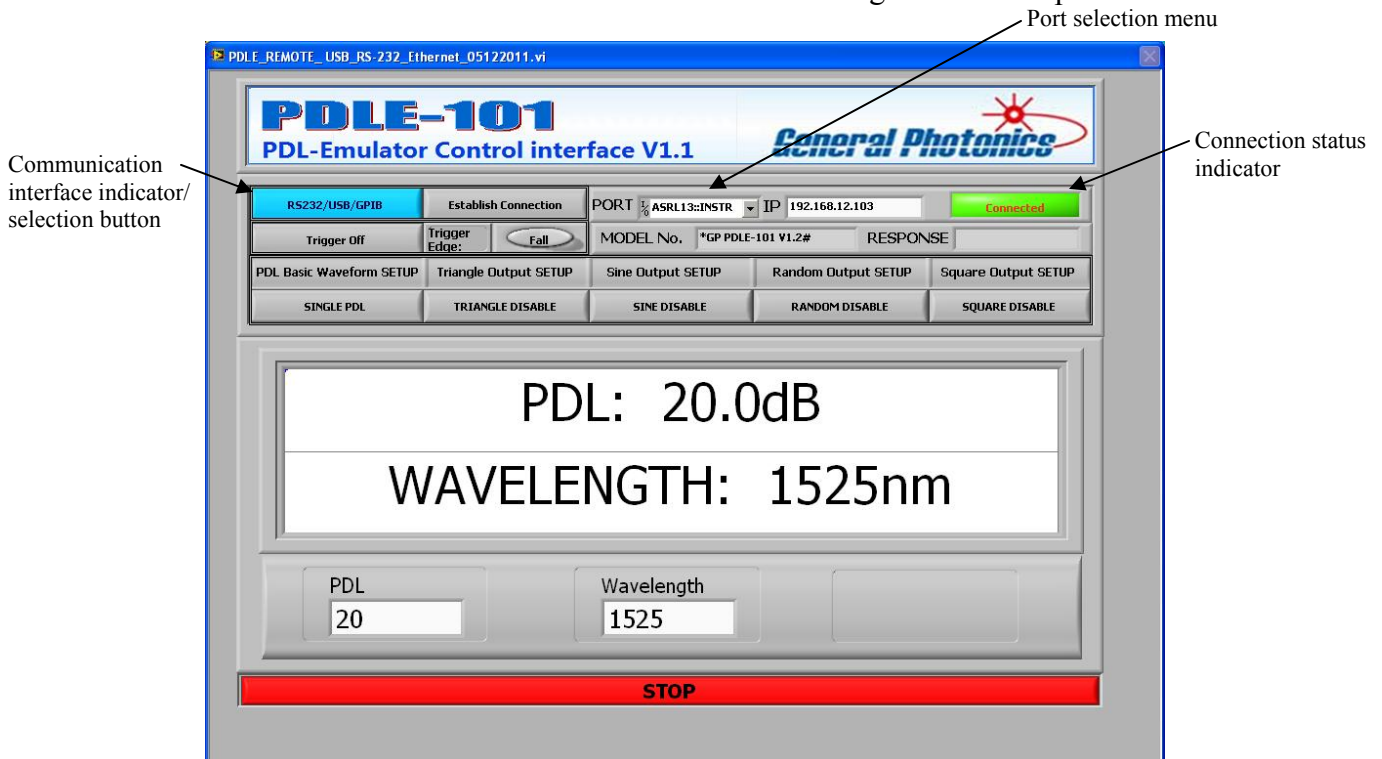
If the connection is successful, the connection status indicator will turn green and the main screen will show the single PDL setting interface.

To re-establish a lost connection or to switch to a different communication port, select a port from the port selection menu and click the "Establish Connection" button.

The communication interface selection button at the top left of the screen can be used to switch between Ethernet and other communication interfaces. After this button is used, the connection will have to be re-established by typing the IP address in the IP address box (for Ethernet) or selecting a communication port (for other interfaces) and clicking the "Establish Connection" button.

Single PDL value setting

The default screen after communication with the PDLE is established is the single PDL value setting screen. This operation mode allows the user to set a single, static PDL output value.
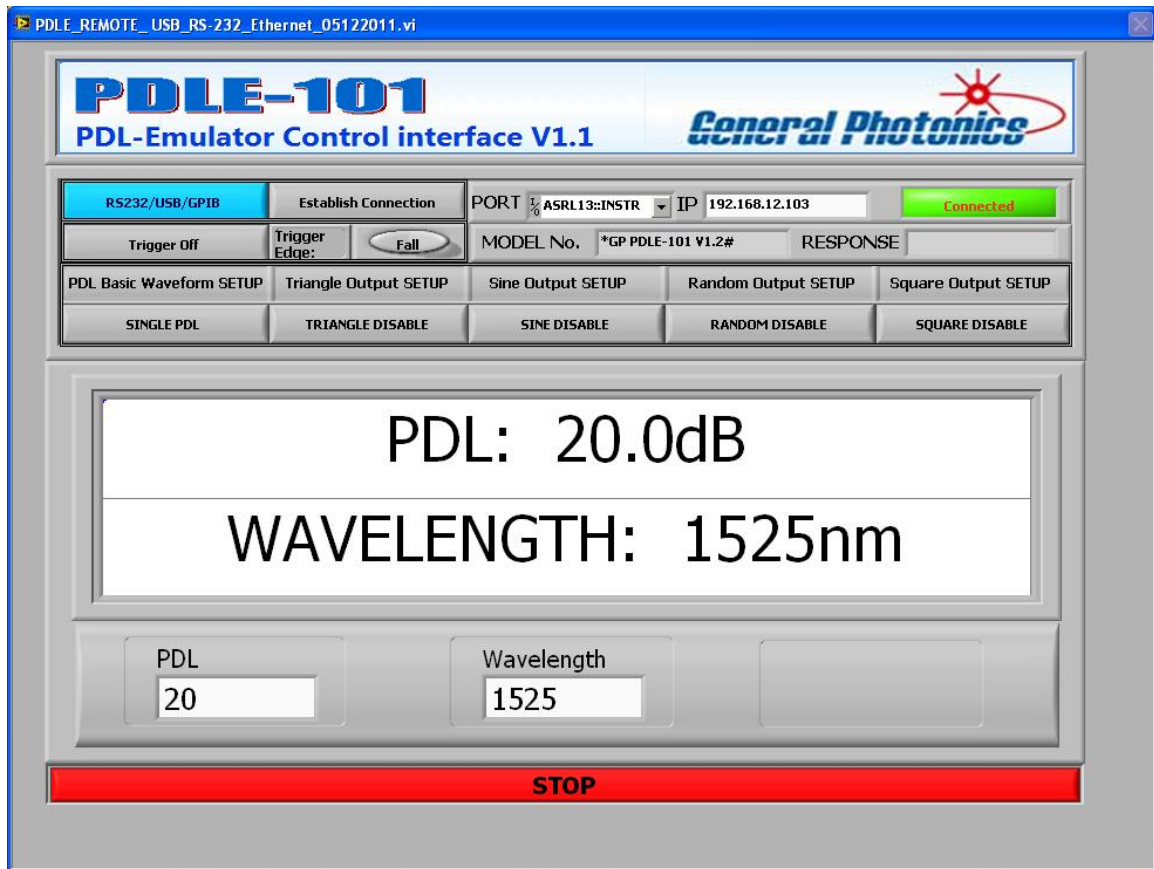
The indicator boxes in the middle of the screen show the latest PDL value and wavelength setting.

To change the PDL or wavelength setting, type the desired value in the corresponding box at the bottom of the screen and either press ENTER or click outside the text box whose value has just been changed.

Ranges:
        PDL: 0.1 to 20 dB
        Wavelength: 1520 to 1570nm


PDL Waveform Variations

Trigger

As described in the front panel control section, the waveform generation modes can be operated in either standard or triggered operation modes. Trigger settings are controlled by two buttons in the second row at the top of the screen:

  Trigger on/off: enables/disables triggered operation
  Trigger edge (rise/fall)   selects whether the PDLE triggers on the rising or falling edge of the trigger pulse

Triangle Waveform

The triangle waveform mode generates a triangular variation with user-set endpoints and frequency.
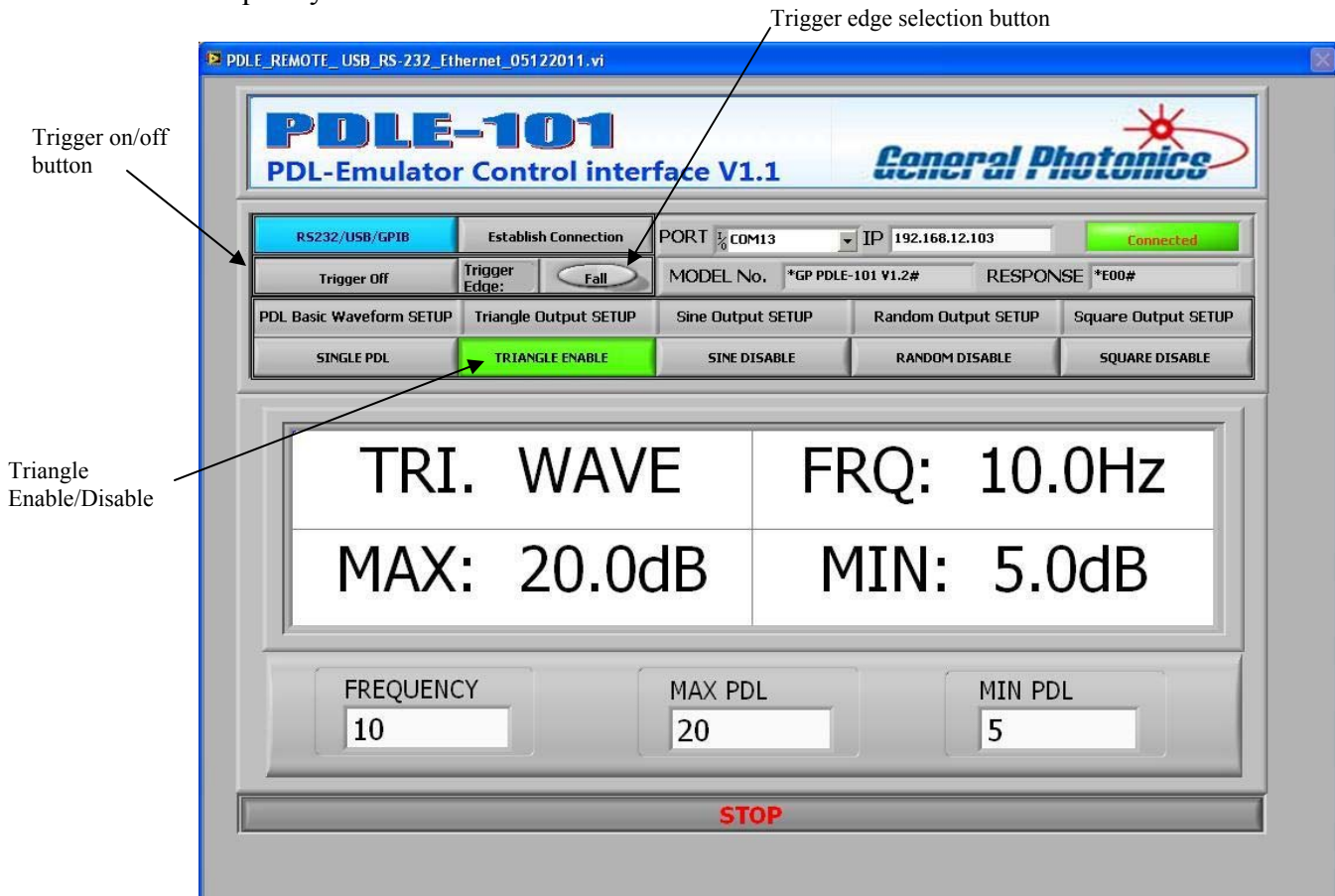
Click the "Triangle Enable/Disable" button to enter triangle mode. The interface screen is displayed above.

The indicator boxes in the middle of the screen display the waveform/trigger status, frequency, and scan limits.

If the trigger is off, the top left indicator box will display the waveform type (TRI. WAVE). If the trigger is on, it will display the waveform type, trigger status, and selected trigger edge, ex. (TRI. TRG Rise).

To set the frequency and PDL limit values, type the desired values in the corresponding boxes at the bottom of the screen and either press ENTER or click outside the box whose value has just been modified.

Ranges:

Frequency:	0.1 to 10 Hz
Max. PDL:	0.2 to 20 dB
Min. PDL:	0.1 to 19.9 dB

If the trigger is off, the waveform generation will begin as soon as the triangle mode is enabled (button will be green, as in the screenshot above).

If the trigger is on, when triangle mode is enabled, the PDLE will wait for a trigger pulse and will begin generating the variation on receipt of the trigger pulse. Each subsequent pulse will restart the triangle variation.

Sine Waveform

This mode generates a sine wave variation with user-set endpoints and frequency.
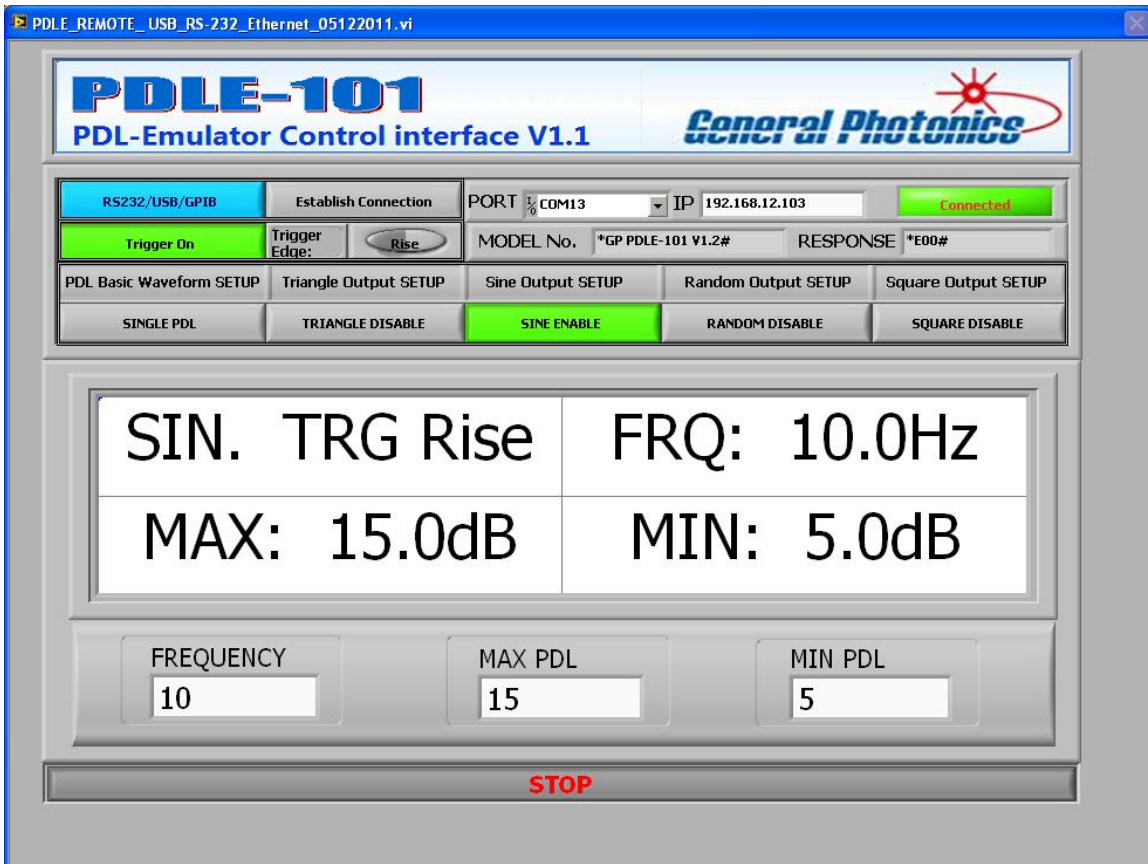
Click the "Sine Enable/Disable" button to enter sine wave mode. The interface screen is displayed above.

The indicator boxes in the middle of the screen display the waveform/trigger status, frequency, and scan limits.

If the trigger is off, the top left indicator box will display the waveform type (SIN. WAVE). If the trigger is on, it will display the waveform type, trigger status, and selected trigger edge, ex. (SIN. TRG Rise).

To set the frequency and PDL limit values, type the desired values in the corresponding boxes at the bottom of the screen and either press ENTER or click outside the box whose value has just been modified.

Ranges:
      Frequency: 0.1 to 10 Hz
      Max. PDL: 0.2 to 20 dB
      Min. PDL: 0.1 to 19.9 dB

If the trigger is off, the waveform generation will begin as soon as the sine mode is enabled (button will be green, as in the screenshot above).

If the trigger is on, when sine mode is enabled, the PDLE will wait for a trigger pulse and will begin generating the variation on receipt of the trigger pulse. Each subsequent pulse will restart the sine variation.

Random Waveform

This mode generates a series of random values bounded by the user-set endpoints. If triggered operation is on, a random point is generated for each trigger pulse. If triggered operation is off, random states are generated at the user-set frequency (e.g. 1 Hz = 1 point/sec.)
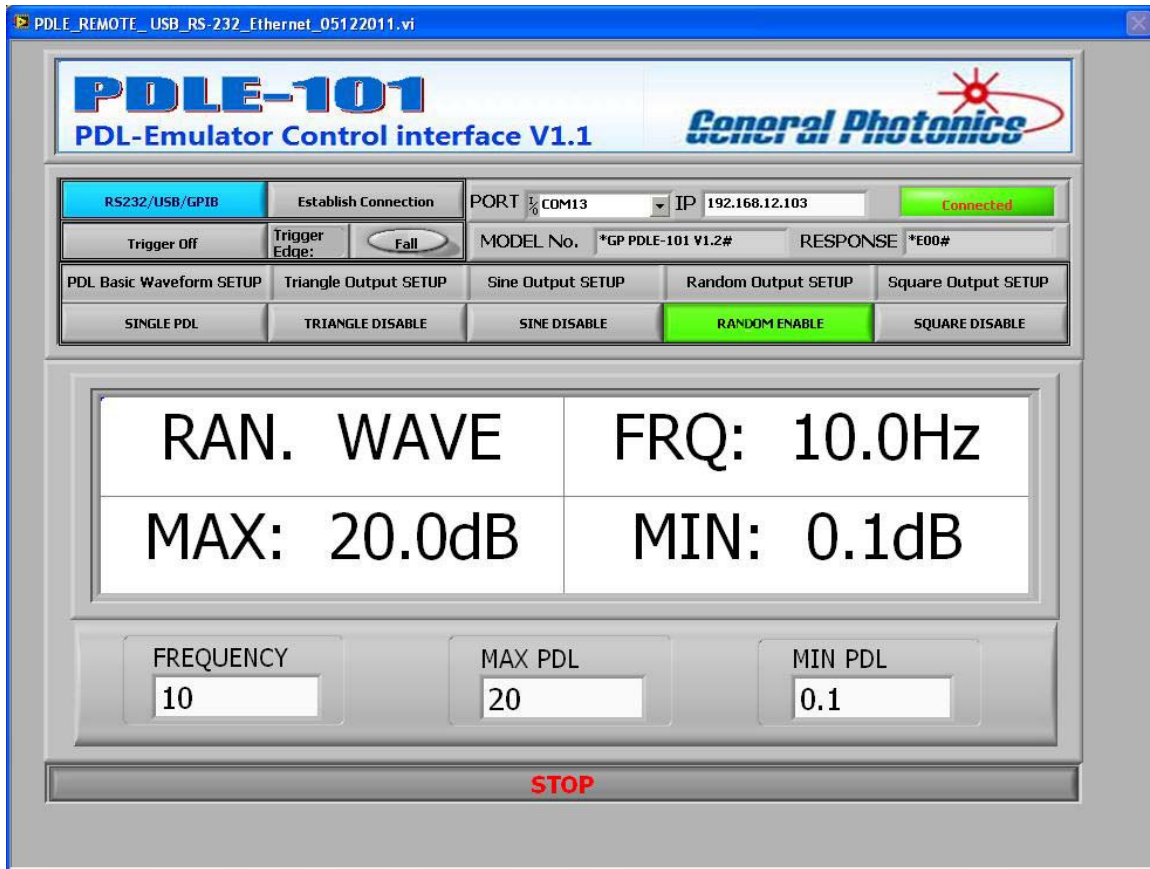
Click the "Random Enable/Disable" button to enter random mode. The interface screen is displayed above.

The indicator boxes in the middle of the screen display the waveform/trigger status, frequency, and scan limits.

If the trigger is off, the waveform/trigger status indicator box (top left) will display the waveform type (RAN. WAVE), and the frequency box will display the selected frequency. If the trigger is on, the waveform/trigger status box will display the waveform type, trigger status, and selected trigger edge, ex. (RAN. TRG Rise), and the frequency box will display "FRQ: Trigger", indicating that the frequency corresponds to the frequency of the trigger signal.

To set the frequency and PDL limit values, type the desired values in the corresponding boxes at the bottom of the screen and either press ENTER or click outside the box whose value has just been modified.

Ranges:
        Frequency: 0.1 to 100 Hz
        Max. PDL: 0.2 to 20 dB
        Min. PDL: 0.1 to 19.9 dB

If the trigger is off, the waveform generation at the selected frequency will begin as soon as the random mode is enabled (button will be green, as in the screenshot above).

If the trigger is on, the PDLE will generate one random state on receipt of each trigger pulse.

Square Waveform

This mode generates a square wave (switching between the user-set endpoints).

If triggered operation is on and the frequency is set to 0 Hz, the PDLE will perform one transition each time it receives a trigger pulse (similar operation to triggered random mode).

If triggered operation is on and the frequency is set to a nonzero value, or if triggered operation is off, the square wave is generated at the user-set frequency (see front panel operation section for diagram).
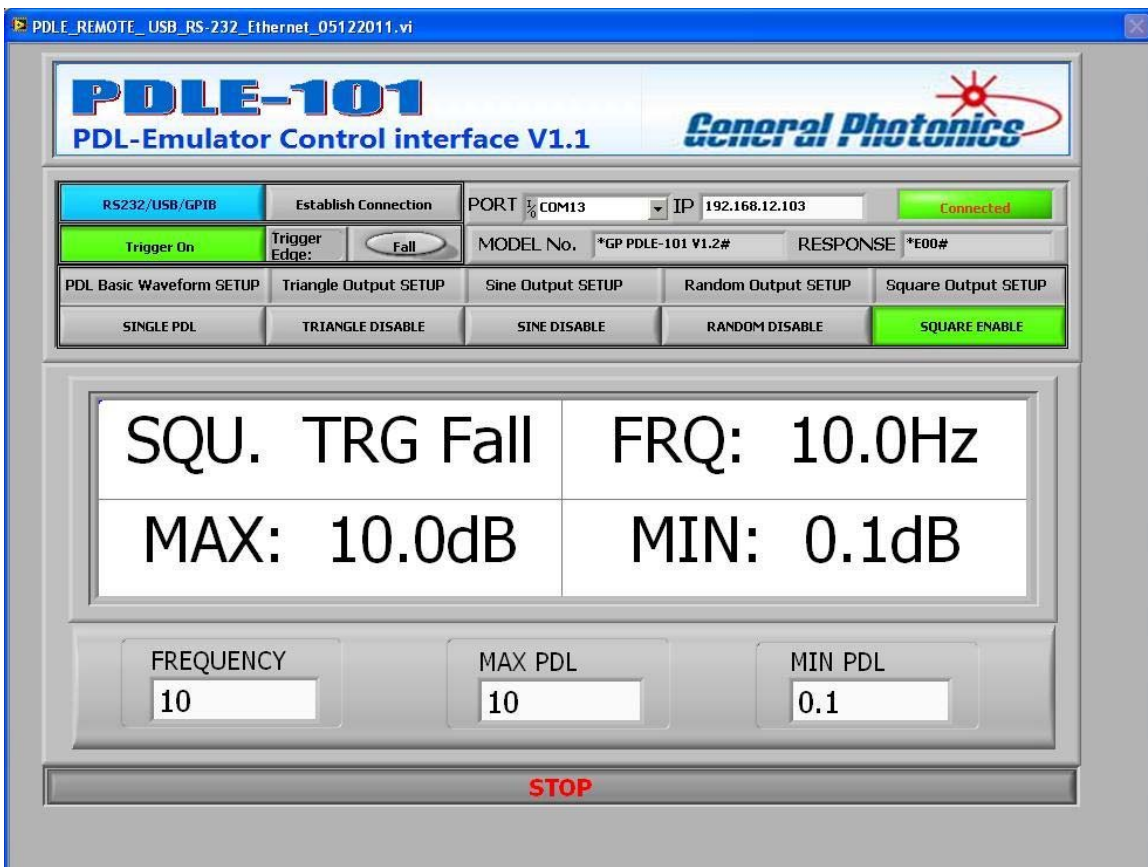
Click the "Square Enable/Disable" button to enter square wave mode. The interface screen is displayed above.

The indicator boxes in the middle of the screen display the waveform/trigger status, frequency, and scan limits.

If the trigger is off, the top left indicator box will display the waveform type (SQU. WAVE). If the trigger is on, it will display the waveform type, trigger status, and selected trigger edge, ex. (SQU. TRG Fall).

To set the frequency and PDL limit values, type the desired values in the corresponding boxes at the bottom of the screen and either press ENTER or click outside the box whose value has just been modified.

Ranges:
        Frequency: 0.0 to 100 Hz
        Max. PDL: 0.2 to 20 dB
        Min. PDL: 0.1 to 19.9 dB

If the trigger is off, the waveform generation at the selected frequency will begin as soon as the square wave mode is enabled (button will be green, as in the screenshot above). The first transition will be from low to high PDL. Please note that the dwell time at each state is half the period, i.e. if the set frequency is 1 Hz, the PDLE will switch states once every 0.5s.

If the trigger is on and the frequency is set to a nonzero value, once the square mode is enabled, the PDLE will wait for a trigger pulse and will begin generating the variation at the selected frequency on receipt of the trigger pulse, starting with a low-to-high transition. Each subsequent pulse will restart the variation.

If the trigger is on and the frequency is set to 0.0 Hz, the PDLE will switch once between states each time it receives a trigger pulse. The first transition will be from low to high PDL. Subsequently, it will toggle between states once for each trigger pulse.

Section 5. Technical Support

General Photonics is committed to high quality standards and customer satisfaction. For any questions regarding the quality and use of the PDLE-101, or future suggestions, please contact General Photonics Corporation at (909)-590-5473 (telephone) or (909)-902-5536 (fax), or by e-mail at info@generalphotonics.com. General Photonics will respond to all customer questions within 24 hours during regular business hours. General Photonics can also be contacted by mail at:

General Photonics
5228 Edison Avenue
Chino, California 91710
USA