Santec

PDL Scanning Test System Sample Software manual

2025-07- 29

1. Project Overview

This is an example software for a scanning test system for PDL measurements.

development environment (computer)	Labview 2017
Instrument.DLL	Version 3.0.1
STSProcess.DLL	Version 2.2.7
NI DLL	17.6 and its successors

2. configure

instrumentation

(1) Tunable Laser TSL Series (TSL-550/TSL-710/TSL-570/ TSL-770)

(2) Power Meter MPM Series (MPM-210/210H/211/212/213/215)

This sample software allows you to control up to two MPM hosts (MPM-210 or MPM-210H or MPM-220).

(3) Polarization Controller PCU Series (PCU-100/PCU-110)

Communication settings

Tunable Laser (TSL) Control

TSL-550/710: GPIB

TSL-570/ TSL-770: GPIB, TCP/IP, USB

* It can be changed on the source code. The initial value of the separator is CRLF.

Power Meter (MPM) Controls

MPM-210/210H/220: GPIB, TCP/IP

Polarization Controller (PCU) Controls

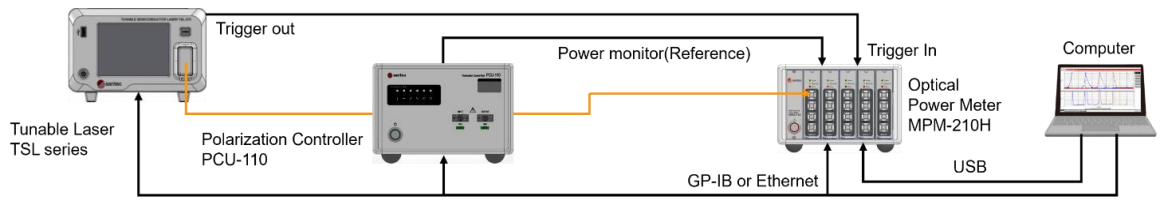
PCU-100: GPIB

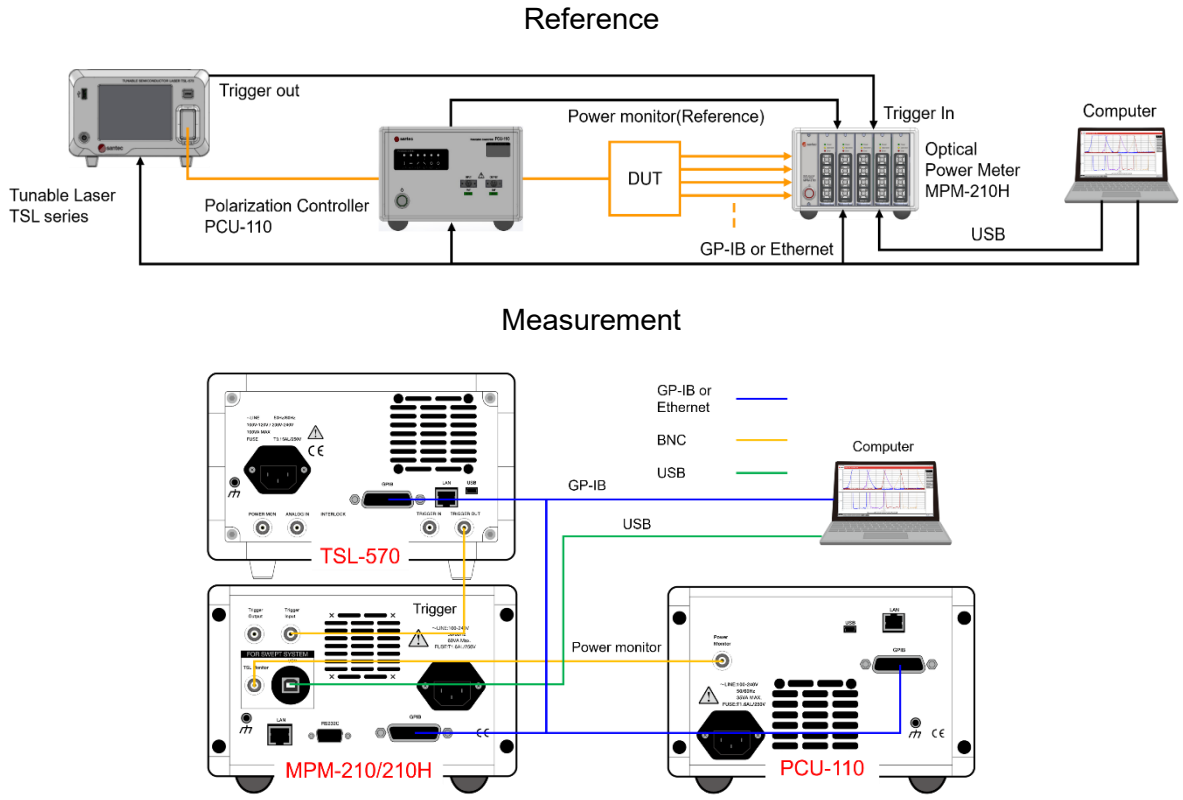
PCU-110: GPIB, TCP/IP and USB

connecting reference

1. MPM-210/210H

PCU-110





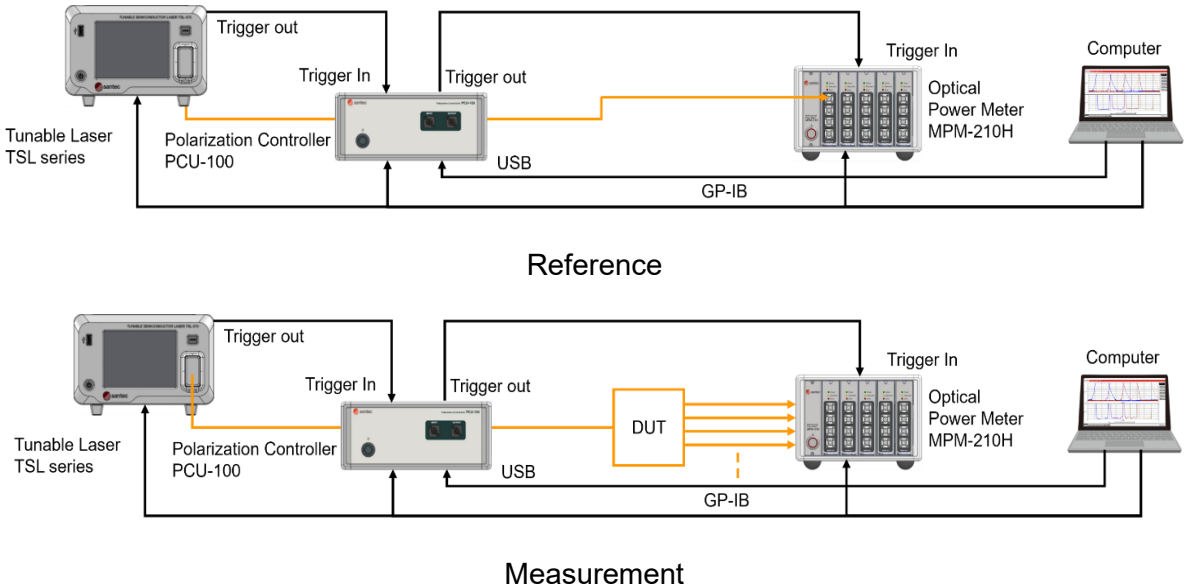
Connect the following parts using BNC cables.

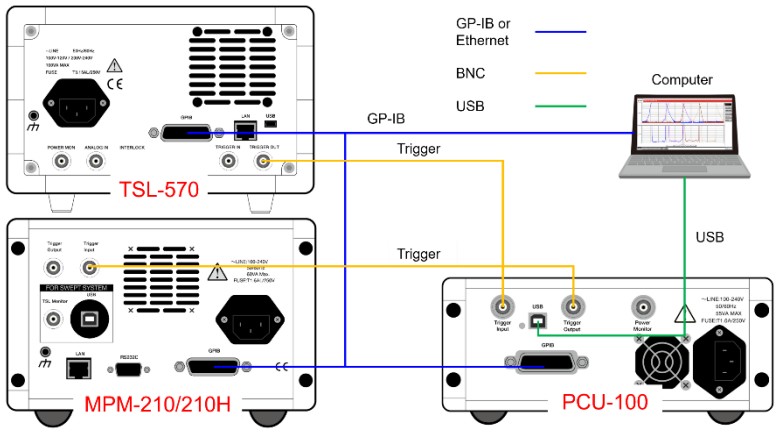
TSL-*** Trigger Output (Trigger Output) -> MPM-210H Trigger Input (Trigger Input)

PCU-110 Power Monitoring Output (Power Monitor) -> MPM-210H TSL Monitor (TSL Monitor)

Figure 1. PCU-110 connection configuration

PCU-100





Connect the following parts using BNC cables.

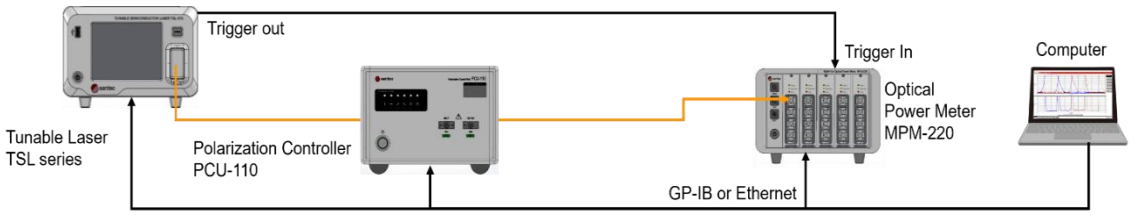
TSL-*** Trigger Output (Trigger Output) -> PCU100 Trigger Input (Trigger Input)

PCU-110 Trigger Output (Trigger Output) -> MPM-210H Trigger Input (Trigger Input)

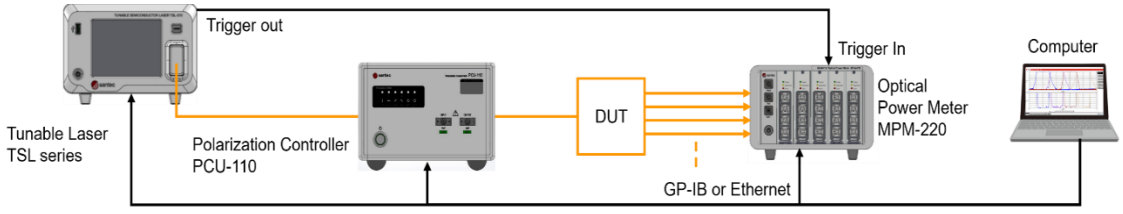
Figure 2. Configuration using PCU-100

2. MPM-220 Standard Mode

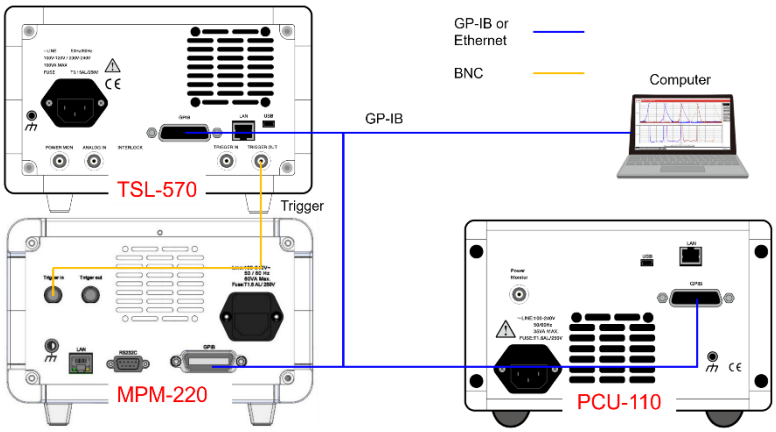
PCU-110



Reference



Measurement

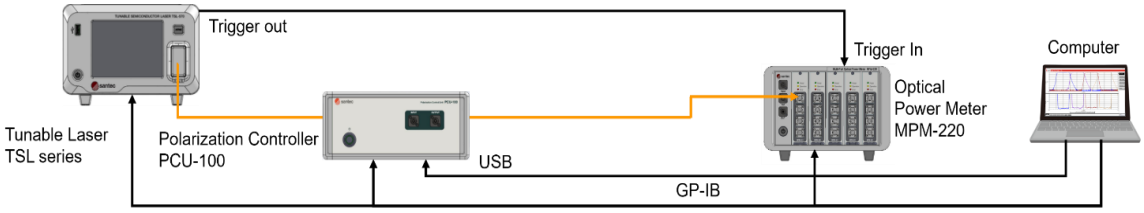


Connect the following parts using BNC cables.

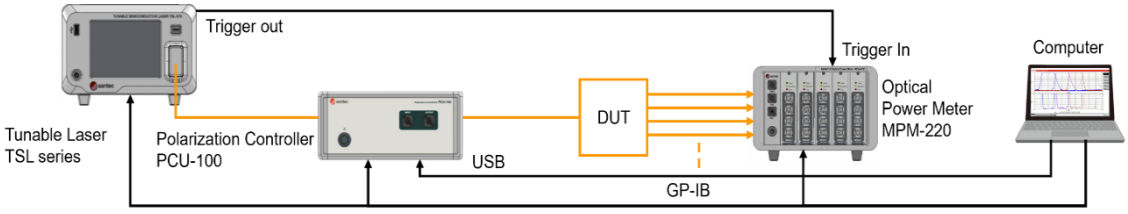
TSL-*** Trigger Output -> MPM-220 Trigger Input

Figure 3. Configured with PCU-110

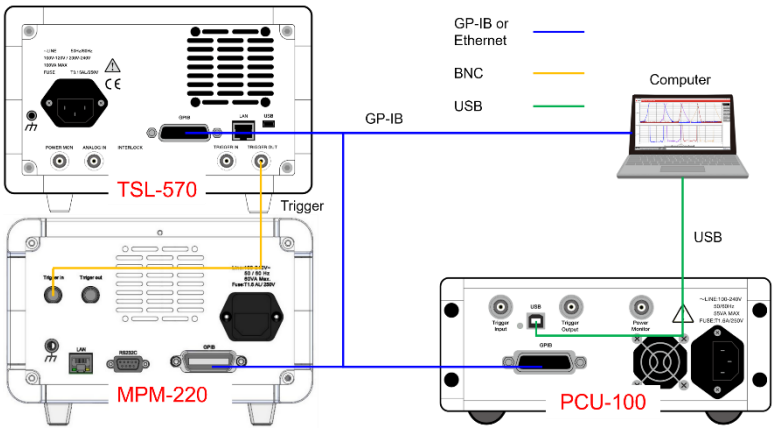
PCU-100



Reference



Measurement



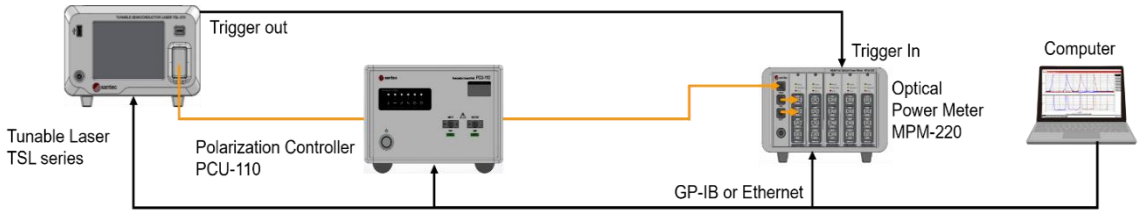
Connect the following parts using BNC cables.

TSL-*** Trigger Output -> MPM-220 Trigger Input

Figure 4. Configured with PCU-100

3. MPM-220 High-Spec Mode

PCU-110



Reference

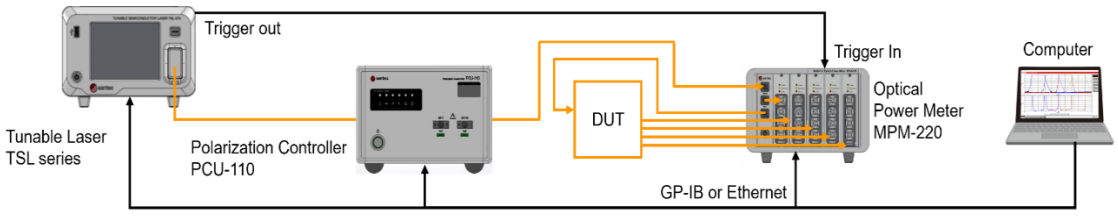
Connect the following parts using optical fiber patch cords.

TSL laser output port (power output) -> PCU laser input port (power input)

PCU laser output port (power output) -> The topmost input port on the left side of MPM-220

The middle output port on the left side of MPM-220 -> The topmost input port of the first module of MPM-220

The bottommost output port on the left side of MPM-220 -> The input port that MPM-220 needs to use



Measurement

Connect the following parts using optical fiber patch cords.

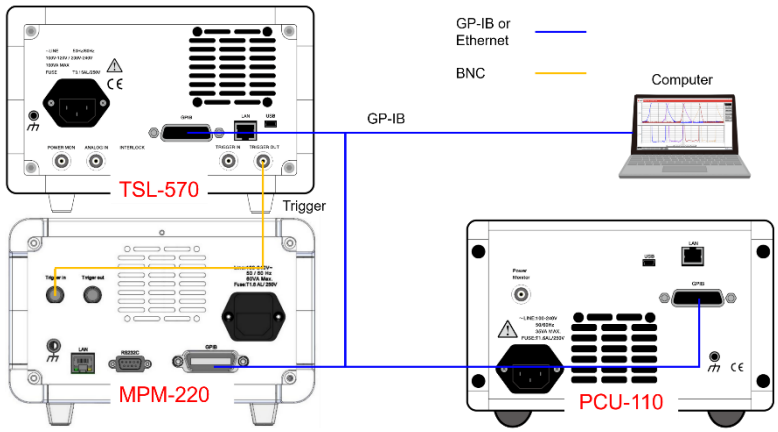
TSL laser output port (power output) -> PCU laser input port (power input)

PCU laser output port (power output) -> The topmost input port on the left side of MPM-220

The middle output port on the left side of MPM-220 -> The topmost input port of the first module on the left side of MPM-220

The bottommost output port on the left side of MPM-220 -> The laser input port of the DUT

The laser input port of the DUT -> The input port that MPM-220 needs to use

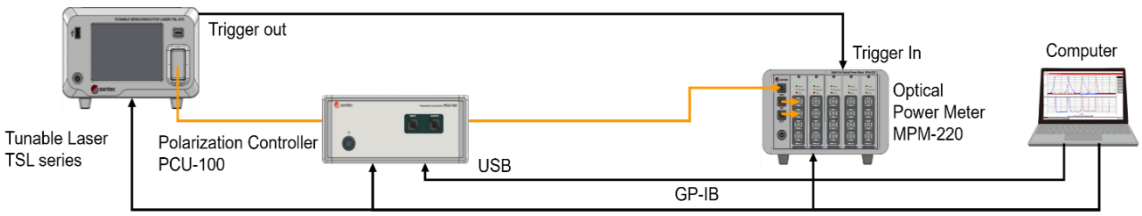


Connect the following parts using BNC cables.

TSL-*** Trigger Output -> MPM-220 Trigger Input

Figure 5. Configuration using PCU-110

PCU-100



Reference

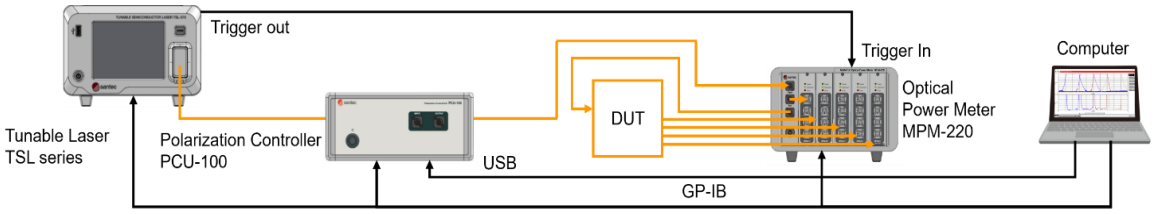
Connect the following parts using optical fiber patch cords.

TSL laser output port (power output) -> PCU laser input port (power input)

PCU laser output port (power output) -> The topmost input port on the left side of MPM-220

The middle output port on the left side of MPM-220 -> The topmost input port of the first module of MPM-220

The bottommost output port on the left side of MPM-220 -> The input port that MPM-220 needs to use



Measurement

Connect the following parts using optical fiber patch cords.

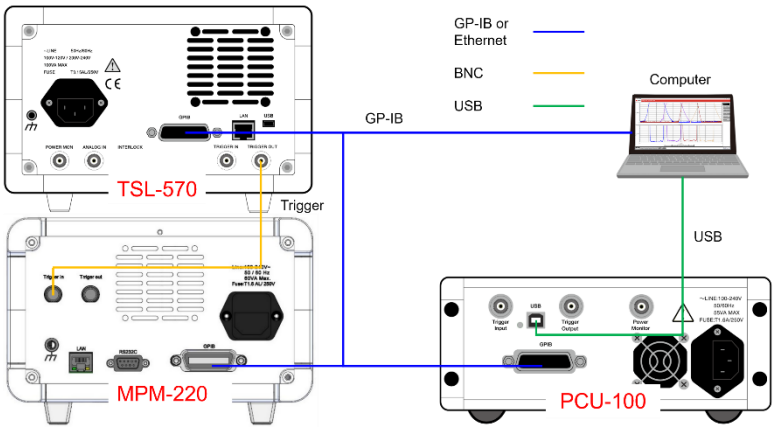
TSL laser output port (power output) -> PCU laser input port (power input)

PCU laser output port (power output) -> The topmost input port on the left side of MPM-220

The middle output port on the left side of MPM-220 -> The topmost input port of the first module on the left side of MPM-220

The bottommost output port on the left side of MPM-220 -> The laser input port of the DUT

The laser input port of the DUT -> The input port that MPM-220 needs to use



Connect the following parts using BNC cables.

TSL-*** Trigger Output -> MPM-220 Trigger Input

Figure 5. Configuration using PCU-100

3. procedure

Software operation is mainly divided into two stages: 1. Instrument connection and parameter setting (completed in the instrument settings window); 2. Reference data acquisition and polarization-related loss measurement (completed in the main window)

3.1 Instrument Settings Window

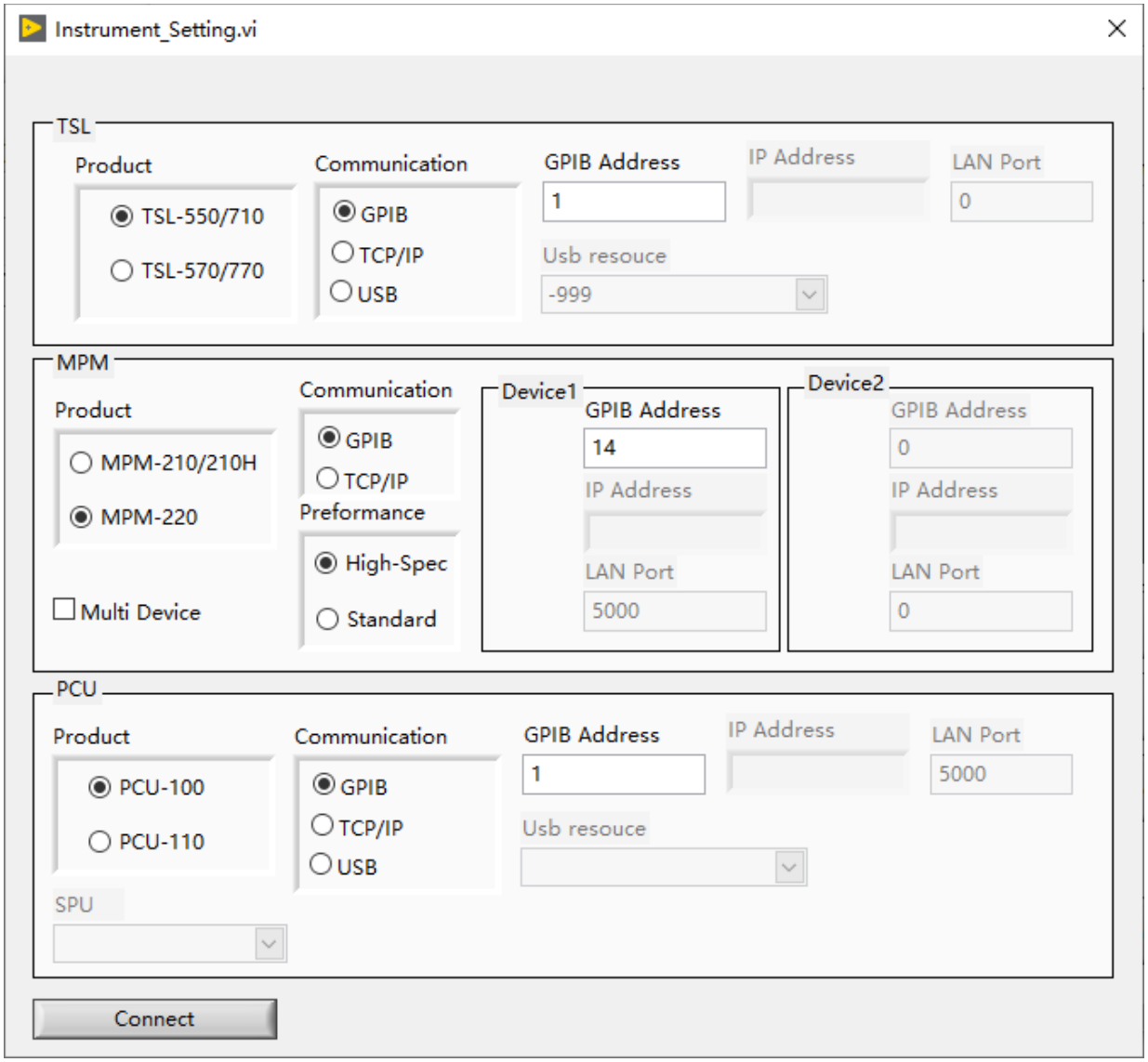


Figure 7. Instrument Setup Window

1) Functions - Instrument Settings

This window will automatically pop up when the software starts (or it needs to be called from the main window). Users need to complete all the basic connection configurations for the testing instruments in this window. After the configuration is completed, click the 'Connect' button, and the software will connect the instruments and enter the main operation interface (Figure 8).

1. Form Load

   The device number of the SPU (DAQ) connected to the PC (**when the power meter model is MPM-210/210H**) and the USB resources (**when the TSL-570 interface is USB**) are received from the main form and displayed in each Combobox control.

2. TSL

Displaying TSL communication setting information

3. MPM

   Display the communication settings information of MPM. It can be used for a maximum of two hosts (**when using MPM-220 High-Spec mode, the first port on the first slot of the power meter is the default reference channel and selection is prohibited**)

4. PCU

   Displaying PCU communication setting information

5. SPU

   Display the device number of DAQ (**This option needs to be set only when using the MPM-210/210H power meter host. For MPM-220 or other hosts, this setting is invalid or hidden**).

6. Connect

   After setting up each measuring instrument in Figure 7, press the "Connect" button and the STS PDL Demo software interface is shown in Figure 8.

3.2 STS PDL Sample Software Window

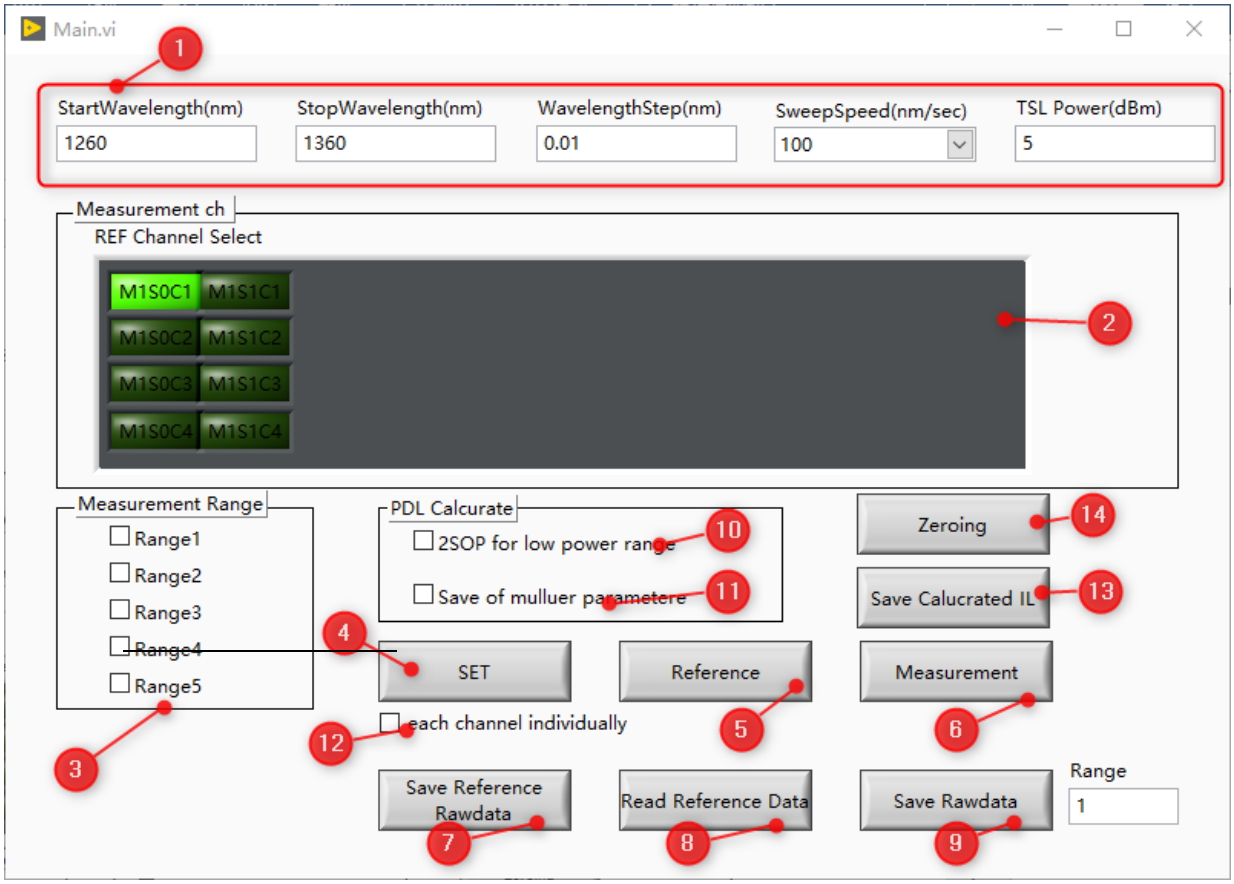


Figure 8. PDL Example Software Window

1) How to use

1. Tunable Laser Settings
   Enter the scanning conditions in the Scan Settings (1) box

Starting wavelength (nm)	starting wavelength
Stop Wavelength(nm)	Stop Wavelength
Step wavelength(nm)	Measurement data step wavelength
Scanning speed (nm/s)	scanning speed
TSL Power (dBm)	TSL Output Power

2. Power meter settings

   Set Measurement ch (2) and Measurement Range (3) within the measurement channel and range framework. **(This option is disabled if using the MPM215 module.)**

   Set the channel of the power meter module at Measurement ch (2). When multiple channels are selected, multiple devices of the measured channel (DUT) can be measured simultaneously.

   Set the range for each scan at Measurement Range (3). When multiple ranges are selected, high dynamic range measurement can be performed. This function is effective when the dynamic range of the DUT is 40 dB or higher (see below for details).

   Each scan can measure approximately 40 dB of dynamic range.

   Selecting multiple channels (2) allows for simultaneous measurement of multiple DUT ports. Selecting multiple ranges (3) is used for high dynamic range measurement (see below for details).

   Under the following conditions,

   the dynamic range of the DUT is set to 60 dB,

   the output power of the light source is set to 8 dBm,

   and the DUT is connected directly without the need to insert a splitter between the tunable devices
   laser (TSL) and power meter (MPM).

   Range number: 2

   1st Range: Range 1

   2nd Range: Range 4

3. Set the set parameters to each instrument
   The set parameters are set to each instrument when the "SET(4)" button is clicked. The set parameters are passed to each instrument class and STS Process class. The STS data structure required to retain data in the STS Process is also set.

This step must be carried out before conducting the reference measurement. Once successfully set up, the instrument status (such as wavelength, power, range) should change accordingly.

4. Reference Test of data
   After clicking Reference (5), each polarization state is scanned and Reference data is acquired under setting conditions 1 and 2. The order of setting polarization states is Vertical → Horizontal → Linear 45° → Right-hand circular.

   *Regarding multiple ranges: "When multiple measurement ranges are set, the reference data is only collected in the first range (Range 1)."
   Regarding multiple channels: "When multiple channels (2) are selected and the 'each channel individually' (3) option is checked, the software will collect and store the corresponding reference data for each selected channel separately.
   When collecting the reference data, the DUT should be removed or bypassed (for example, using a straight-through optical fiber connection between the PCU and the MPM) to establish the reference value without DUT loss. This step is crucial for subsequent calculation of polarization-dependent loss (PDL)."

5. Setting of calculation processing methods
   PDL Calcurate (10) allows you to set the processing method and data storage conditions during PDL measurements (Measurement (6)). When measuring multiple ranges, if "2SOP for low power range" is selected and PDL measurement is performed, only the lower ranges other than range 1 are scanned vertically and horizontally. If PDL measurement is performed without selection, 4 polarization state measurements are performed in all ranges. If "Save of Mueller parameter" is selected and a PDL measurement is performed , the Mueller parameters m11, m12, m13 and m14 calculated from the tested 4-polarized state data are exported in addition to the normal PDL in a separate file when the data is saved.
   m11 = (Horizontal + Vertical)/2
   m12 = (Horizontal-Vertical)/2
   m13 = Linear 45° - m11
   m14 = Right-hand circular - m11

The above is the output information. The unit is mW, but negative values may be output due to subtraction.

6. PDL measurements

When Measurement (6) is clicked, the PDL performs measurement under the conditions set in 1 and 2. If multiple power measurement ranges are set, Sweep processing is executed with the number of ranges set, and data merging processing is executed in the STS Process class. After that, IL data is calculated for each polarization → PDL calculation is executed and the result is output to a file. After one measurement of data is completed, call TSL_Sweep_Stop.Vi to cancel the TSL Sweep process (trigger standby state) . When setting a new scan parameter without performing this process, TSL will have no parameters.
For more information on the Sweep process, see 4).

7. Preserving Reference Raw Data

After clicking Save Reference Rawdata (7), the STS Data Struct is specified when reading Reference Rawdata from the STS Process class. The saved data is saved in csv format in the specified path. The results of Vertical polarized light, Horizontal polarized light, Linear +45 ° polarized light and Right-hand circular polarized light are saved in separate files. When multiple channels are selected and each channel individually(11) is checked, the monitordata for each channel is saved individually.

8. Preservation of raw data

When you click Save Rawdata (9), the measurement data at Measurement (6) is read from the STS Process class. Specify that the STS Data Struct and Rawdata are saved in the specified path of the csv file. For each range and SOP, the data will be output to a different csv file.

The range is specified in the text box next to the "Save Rawdata" button (9). If the input range is invalid, an error message will be displayed.

9. Reading Reference data

Read the Reference data saved in 7. and pass it to the STS Process class. Specify the Reference file in the order of Vertical polarized light, Horizontal polarized light, Linear +45 ° polarized light and Right-hand circular polarized light. If a reference file other than the one set by the SET button is read, an error message is displayed. When multiple channels

are selected and each channel individually(11) is checked, reading requires each channel to have its own monitordata data.

Note: The loaded reference data must be compatible with the current instrument settings (such as wavelength range, step size, etc.); otherwise, it may lead to calculation errors.

10. Click on "Zeroing" (13) to electrically return the connected MPM to zero.

11. Saved Calculated IL Data

This method must be executed after the PDL calculation.

When clicking "Save Calculated IL" (14), the calculated IL data will be saved.

4. Detailed Explanation of the Scanning Process

4.1 Scanning Procedure

1. Set TSL as the scanning start wavelength and set the power measurement range of the MPM.
2. Set the PCU to the corresponding polarization state.
3. Start TSL scanning and set TSL to Trigger Signal Input Standby mode. *1
4. MPM started recording .
5. SPU started recording . **(Enable with MPM-210H/220. If using MPM220, ignore this action.)**
6. Software trigger for issuing TSLs.
7. Query the operation completion status of MPM and SPU. **(Enable with MPM-210H/220. If using MPM220, ignore this action.)** *2
8. Wait for the TSL scan to complete.
9. Set the TSL to the scanning start wavelength .
10. Execute TSL_ Sweep_Start.Vi for the next measurement and start the TSL scan.
11. Read measurement data from MPM and SPU and these data and STS Data Struct to STS Process class.

1

When performing multi-range measurements in PDL measurement, multiple scans are required to acquire one data. Vi is called before scanning processing for the first scan of one data to start the TSL scan with the trigger standby state set to the

start wavelength. The TSL trigger standby setting (SweepStartMode setting) is performed in the "SET" button.

*2

MPM runs in FreerunMode. If there is no trigger signal input from the TSL, the MPM measurement will not start. In this example software, if the MPM measurement does not complete after a sample time of +2000 milliseconds, Sweep_Process.Vi, which performs the Sweep processing, is coded to return -9999 as an error.

4.2 PDL Calculation Process

PDL calculations use 4-polarization IL data. Perform Rescaling processing and IL calculation processing before performing PDL processing.

1. Acquisition of target wavelength list

   STS_Get_Target_Wavelength_Table.vi

2. PCU wavelength sensitivity data acquisition

   PCU_Cal_All_SOP_Parametar.vi

   The wavelength table obtained in 1 is entered as a variable, and the calibration data calculated in the second variable is returned as a 3-dimensional array.

3. Add PCU wavelength sensitivity data

   STS_Add_PCU_CalData.vi

   Pass the calibration data obtained in 2 to the PDLSTS class.

4. IL Access to data

   STS_Get_IL_Merge_Data.vi gets the data. STS_Get_IL_Merge_Data.vi is called when merging multiple range data.

5. PDL calculations

   STS_Cal_PDL.vi

   Pass the IL data for the 4 polarization states obtained in 4 to the Cal_PDL function and perform the PDL calculation.

   The data to be passed is a two-dimensional array (SOPindex, Wavelengthindex).

   Please enter the SOPindex in the following order.

   0: Vertical, 1: Horizontal, 2: Linear 45° , 3: Right-hand circular

   Note that if this order is different, the calculation may not be performed correctly. The results of the calculation are returned with the parameters 2

(PDL), 3 (IL), 4 (Ilmax), and 5 (ILmin). This function is a PDL calculation for each channel. When calculating multiple channels, pass the IL data for each corresponding channel and perform the procedure.