Keysight N778xC Series Polarization Instruments

N7781C Polarization Analyzer
N7785C Synchronous Scrambler
N7786C Polarization Synthesizer
N7788C Optical Component Analyzer

KEYSIGHT

USER'S GUIDE

Notices

Copyright Notice

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Safety Notices

CAUTION

A CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

WARNING

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

Contents

General Safety Considerations

The following general safety precautions must be observed during all phases of 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. Keysight Technologies assumes no liability for the customer's failure to comply with these requirements.

WARNING Ensure the proper usage for the instrument. The protection provided by the instrument may be impaired. The operator of this instrument is advised to use the equipment in a manner as specified in this document.

Safety Summary

The following general safety precautions must be observed during all phases of operation of this instrument. Failure to comply with these precautions or with specific warnings or operating instructions in the product manuals violates safety standards of design, manufacture, and intended use of the instrument. Keysight Technologies assumes no liability for the customer's failure to comply with these requirements. Product manuals are provided on the Web. Go to www.keysight.com and type in your product number in the Search field at the top of the page.

General

This product is a Protection Class 1 instrument (provided with a protective earth terminal) and has been manufactured and tested according to international safety standards. The protective features of this product may be impaired if it is used in a manner not specified in the operation instructions.

All Light Emitting Diodes (LEDs) used in this product are Class 1 LEDs as per IEC 60825-1:2014.

Environment Conditions

This instrument is intended for indoor use in an Overvoltage Category II, pollution degree 2 environment. It is designed to operate at a maximum relative humidity of 85% RH, non-condensing and at altitudes of up to 2000 meters. Refer to the specifications tables for the AC mains voltage requirements and ambient operating temperature range.

Temperature

The instrument should be protected from temperature extremes and changes in temperature that may cause condensation within it.

The operating temperature is from 5 °C to +40 °C.

The storage temperature is from -40 °C to +70 °C.

Before Applying Power

Verify that all safety precautions are taken. The power cable inlet of the instrument serves as a device to disconnect from the mains in case of hazard. The instrument must be positioned so that the operator can easily access the power cable inlet. When the instrument is rack mounted the rack must be provided with an easily accessible mains switch.

Ground the Instrument

To minimize shock hazard, the instrument chassis and cover must be connected to an electrical protective earth ground. The instrument must be connected to the AC power mains through a grounded power cable, with the ground wire firmly connected to an electrical ground (safety ground) at the power outlet. Any interruption of the protective (grounding) conductor or disconnection of the protective earth terminal will cause a potential shock hazard that could result in personal injury.

Do Not Operate in an Explosive Atmosphere

Do not operate the instrument in the presence of flammable gases or fumes.

Do Not Remove the Instrument Cover

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made only by qualified personnel.

Instruments that appear damaged or defective should be made inoperative and secured against unintended operation until they can be repaired by qualified service personnel.

Compliance and Environmental Information

Safety Symbol	Description
	This product complies with WEEE Directive (2002/96/EC) marking requirements. The affixed label indicates that you must not discard this electrical/electronic product in domestic household waste. Product Category: With reference to the equipment types in WEEE Directive Annex I, this product is classed as a “Monitoring and Control instrumentation” product. Do not dispose in domestic household waste. To return unwanted products, contact your local Keysight office, or http://-about.keysight.com/en/companyinfo/environment/takeback.shtml for more information.

Instrument Markings

Instrument Marking	Description
	The instruction manual symbol. The product is marked with this warning symbol when it is necessary for the user to refer to the instructions in the manual.
	Standby supply. Unit is not completely disconnected from AC mains when switch is off.
	The CE mark is a registered trademark of the European Community.
	The CSA mark with the 'C' and 'US' subscript indicates the instrument is certified to the applicable Canadian and United States of America standards respectively.
	The C-tick mark is a registered trademark of the Spectrum Management Agency of Australia. This signifies compliance with the Australian EMC Framework regulations under the terms of the Radio Communications Act of 1992.
	The KC mark is the Korean certification mark. This equipment is Class A suitable for professional use and is for use in electromagnetic environments outside of the home.
	The recycling symbol indicates the general ease with which the instrument can be recycled.

Instrument Marking	Description
	China Restricted Substance Product Label. The EPUP (environmental protection use period) number in the center indicates the time period during which no hazardous or toxic substances or elements are expected to leak or deteriorate during normal use and generally reflects the expected useful life of the product.

Declaration of Conformity

Declarations of Conformity for this product and for the Keysight products may be downloaded from the Web. Go to http://www.keysight.com/go/conformity.

You can then search by product number to find the latest Declaration of Conformity.

General

Before operation, review the instrument and manual, including the red safety page, for safety markings and instructions. You must follow these to ensure safe operation and to maintain the instrument in safe condition.

Some circuits are powered whenever the instrument is connected to the AC power source. To disconnect from the line power, disconnect the power cord either at the rear power inlet or at the AC line power source (receptacle). One of these must always be accessible. If the instrument is in a cabinet, it must be disconnected from the line power by the system's line power switch.

WARNING To avoid hazardous electrical shock, do not perform electrical tests when there are signs of shipping damage to any portion of the outer enclosure (covers, panels, etc.).

WARNING Please pay attention to the following laser safety warning:

Under no circumstances look into the end of an optical cable attached to the optical output when the instrument is operational. The laser radiation can seriously damage your eyesight. Do not enable the laser when there is no fiber attached to the optical output connector. Refer servicing only to qualified and authorized personnel.

Operating Environment

In order for the instrument to meet specifications, the operating environment must be within these limits. Refer to Safety Summary on page 16.

WARNING The instrument is not designed for outdoor use. To prevent potential fire or shock hazard, do not expose the instrument to rain or other excessive moisture.

Instrument Cooling

The instrument has a cooling fan mounted internally.

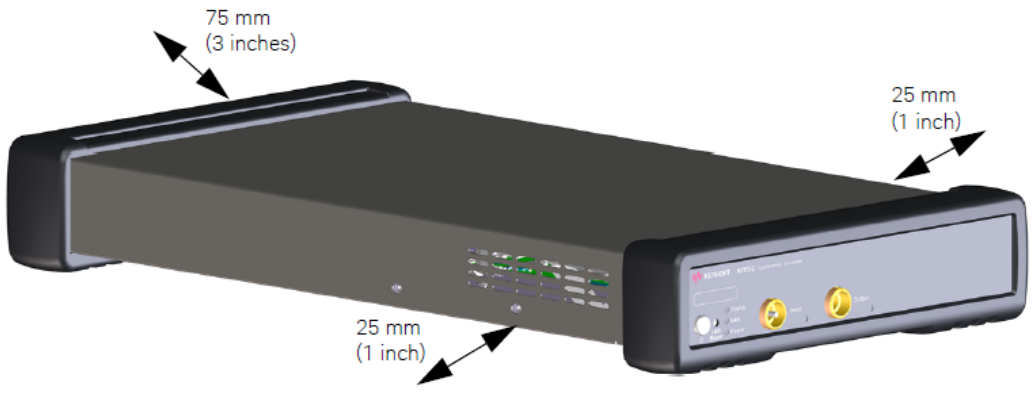
Mount or position your instrument upright and horizontally, as shown in the below figure so that air can circulate through it freely.

Operating Position

When operating the instrument choose a location that provides at least 75 mm (3 inches) of clearance at the rear, and at least 25 mm (1 inch) of clearance at each side. Failure to provide adequate air clearance may result in excessive internal temperature, reducing instrument reliability.

The instrument should not be operated when resting on its rear or side panels.

The following figure shows the correct operating position of Keysight N7785C.



Handling the Instrument

Storage, Carrying and Shipment

Keysight N7781/85/86/88C polarization instruments can be stored, carried and shipped at temperatures between -40 °C and +70 °C.

The N7781/85/86/88C polarization instruments must be stored, carried in its operating position (refer to figure shown in Operating Environment).

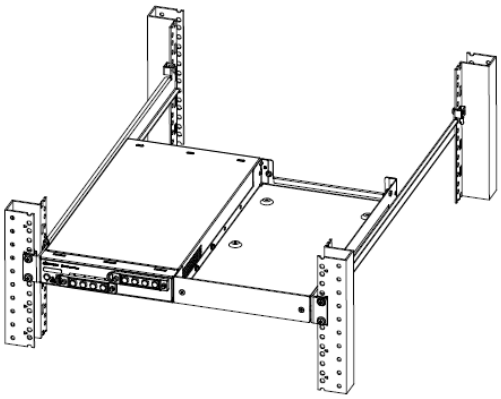
Rack Mount the Instrument

You can mount the instrument in a standard 19-inch rack cabinet using an optional kit which includes instructions and mounting hardware.

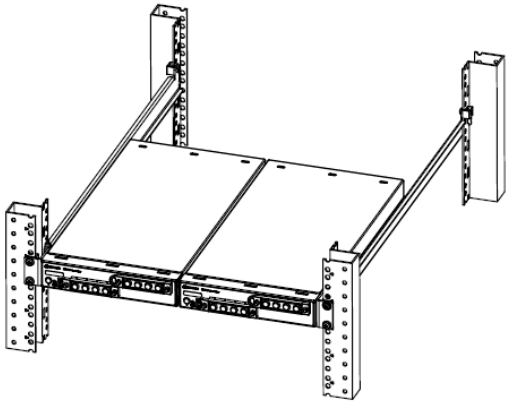
NOTE Remove the carrying handle, and the front and rear rubber bumpers, before mounting the instrument on a rack.

Depending on whether one or two N77xxC instruments are to be mounted, different mounting kits are required:

- N7799C-1CM Rack Mount Kit 1 HU for 2 instruments - Includes low-profile rails. Requires Filler Kit N7799C-0CM for single device (See Figure 2).
- N7799C-0CM Filler Kit for N7799C-1CM - Required for single instrument. Includes front panel and base plate.



A. Single Instrument Mounted on a Rack



B. Two Instruments Mounted on a Rack

Obtaining Source Code

This product uses open source packages. To the extent required by the applicable open source license(s), Keysight makes source code available upon request. To request source code, please contact Keysight Support at www.keysight.com/main/support.jspx.

Third party software acknowledgments and licenses for the N778xC series with the embedded Linux operating system are located at:
https://www.keysight.com/find/N7781C
https://www.keysight.com/find/N7785C
https://www.keysight.com/find/N7786C
https://www.keysight.com/find/N7788C

Keysight Cybersecurity

Product and Solution Cybersecurity

Keysight is dedicated to ensuring the cybersecurity of its products and solutions. For detailed information, visit Product and Solution Cybersecurity.

Report a Product Cybersecurity Issue

If you encounter a cybersecurity issue with a Keysight product, report it immediately at: Product Cybersecurity Issue Reporting.

Responsible Disclosure Program

Keysight encourages responsible disclosure of security vulnerabilities. For more details, visit Responsible Disclosure Program.

Product Software Updates

Keysight releases periodic software updates to fix known defects, incorporate product enhancements, and address cybersecurity vulnerabilities, if any. Ensure that your product software is always up to date. To search for software updates for your product, visit the Keysight Technical Support page at:

https://www.keysight.com/find/N7781C

https://www.keysight.com/find/N7785C

https://www.keysight.com/find/N7786C

https://www.keysight.com/find/N7788C

User Documentation

User documentation includes comprehensive information on features that may impact the secure deployment, use, and decommissioning of our products. This includes details on exposed network ports, the use of cryptography and authentication, and firmware security settings, if necessary.

Getting Started

This chapter describes how to get started with the Keysight N7781/85/86/88C polarization instruments.

Initial Inspection

Inspect the shipping container for damage. If there is damage to the container or cushioning, keep them until you have checked the contents of the shipment for completeness and verified the instrument both mechanically and electrically.

If the contents are incomplete, mechanical damage or defect is apparent, or if an instrument does not pass the operator's checks, notify the nearest Keysight Technologies Sales/Service Office.

WARNING You MUST return malfunctioning instruments to a Keysight Technologies Sales/Service Center for repair and calibration.

Claims and Repackaging

Claims and Repackaging

If physical damage is evident or if the instrument does not meet specification when received, notify the carrier and the nearest Keysight Technologies Sales/Service Office. The Keysight Technologies Sales/ Service Office will arrange for repair or replacement of the unit without waiting for settlement of the claim against the carrier.

Return Shipments to Keysight Technologies

If the instrument is to be shipped to an Keysight Technologies Sales/ Service Office, attach a tag showing owner, return address, model number and full serial number and the type of service required.

The original shipping carton and packing material may be reusable, but the Keysight Technologies Sales/Service Office will provide information and recommendations on materials to be used if the original packing is no longer available or reusable. General instructions for repackaging are as follows:

- Wrap instrument in heavy paper or plastic.
- Use strong shipping container. A double wall carton made of 350-pound test material is adequate.
- Use enough shock absorbing material (3 to 4 inch layer) around all sides of the instrument to provide a firm cushion and prevent movement inside container. Protect control panel with cardboard.

- Seal shipping container securely.
- Mark shipping container FRAGILE to encourage careful handling.
- In any correspondence, refer to the instrument by model number and serial number.

Deleting User Data

If you need to delete all your logged data and user configurations, press and hold the LAN Reset button (approx. 5 seconds) to reset the instrument and all your logged data and user configurations will be deleted.

Power Supply Requirements

Line Power Requirements

The instrument complies with Overvoltage Category II and can operate from the single-phase AC power source that supplies between 100 V and 240 V at a frequency in the range 50/60 Hz. The maximum voltage fluctuation is 10% of the nominal supply voltage. The maximum power consumption is 60 VA with all options installed.

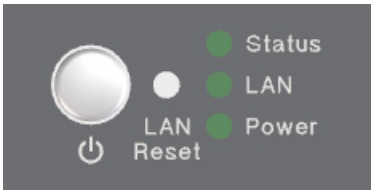
Line Power Cable

In accordance with international safety standards, the instrument has a three-wire power cable. When connected to an appropriate AC power receptacle, this cable earths the instrument cabinet.

CAUTION Please note that the switch on the front panel of the instrument does not stop the flow of power to the instrument.

If you need to turn off the power, unplug the instrument at the mains or remove the power cable connector from the appliance coupler at the rear of the instrument. For this reason, the power cable connection should be easily accessible - allowing you to turn off the power quickly. If the instrument is in a cabinet, it must be disconnected from the line power by the system's line power switch.

The power switch allows you to switch between stand-by mode and power-on mode.



When the instrument is in stand-by mode, the Power LED is orange. When the instrument is powered-on, the Power LED is green.

The AC power requirements are summarized on the rear panel of the instrument.

N778xC Series Polarization Instruments

The Keysight N778xC polarization test products enable high-speed, high performance characterization and verification of optical components and sub-systems.

N7781C Polarization Analyzer

The Keysight N7781C is a compact high-speed polarization analyzer that provides comprehensive capabilities for analyzing polarization properties of optical signals. This includes representation of the state of polarization (SOP) on the Poincaré sphere (Stokes parameter). The on-board algorithms together with the on-board calibration data ensure highly accurate operation across a broad wavelength range.

Due to its real time measurement capability of 1 M samples/s, the instrument is well suited for analyzing disturbed and fluctuating signals as well as for control applications requiring real time feedback of polarization information, for example in digital control loops in automated manufacturing test systems.

The built-in user interface allows a comprehensive analysis of the obtained measurement data and replaces the Polarization Navigator software that was required with the N7781B, the predecessor of N7781C. Programming uses a new SCPI command set and the instrument is addressed as a VISA resource.

The instrument comes in a compact form factor of just one rack height unit, with LAN and USB interfaces.

For further details on its application and key features, refer to the product datasheet available on www.keysight.com.

N7785C Synchronous Scrambler

The Keysight Technologies N7785C is a high-speed synchronous scrambler that can repeatably switch through a series of states of polarization (SOP) with both input and output triggering functions. This unit can operate in various modes:

- As a synchronous scrambler, the device switches the SOP of the output signal in a random but repeatable pattern. Switching of the SOP occurs within a few microseconds. The SOP is stable for a predefined time until it again switches to a new SOP. An electrical trigger input can be used to synchronize the scrambler with external events.
- As an SOP switch, the N7785C allows switching the internal waveplates to user definable angles with very high speed and repeatability.
- As a traditional scrambler, the N7785C varies the output SOP smoothly in a random walk pattern.
- As a polarization stabilizer, the N7785C uses feedback via program commands to set and stabilize the SOP based on an external reference.

Programming uses a new SCPI command set and the instrument is addressed as a VISA resource. The instrument comes in a compact form factor of just one rack height unit, with LAN and USB interfaces and does not contain any moving parts.

For further details on its application and key features, refer to the product datasheet available on www.keysight.com.

N7786C Polarization Synthesizer

The Keysight Technologies N7786C contains a high-speed lithium-niobate based polarization controller and a polarization analyzer that monitors the output signal and provides feedback to the controller. This unit can operate in several modes:

- As a polarization stabilizer, it provides a stable output state of polarization (SOP) even with fluctuations and drifts of the input SOP. The stabilized output signal is guided in a standard single-mode fiber (SMF). The output SOP can be defined in the following ways:
  - When the set-and-forget switch in the user interface is activated, the current SOP is stored and maintained, even if polarization changes occur on the instrument input.
  - Defined Stokes: the target output SOP can be defined by the user using the Stokes parameters, which are then set using the polarization analyzer feedback.

    - Defined sequence: the device switches the SOP of the output signal in a chosen pattern with a cycling speed of up to 100 kSOPs/s.
  - As an SOP switch, the N7786C cycles through a sequence of SOPs at a chosen rate up to more than 40 kHz. The internal settings for the SOP sequence are first determined with the stabilizer function for rapid direct switching. SOP switching occurs within a few microseconds. An electrical trigger input can be used to synchronize the scrambler with external events.
  - As a traditional scrambler, the N7786C varies the output SOP in a random way. Full coverage of the Poincaré Sphere can be achieved within a few milliseconds.
  - As a polarization analyzer, the instrument provides truly high-speed capabilities: Up to 1 M samples can be taken with a sample rate of up to 1 M samples per second.
  - As fast-switching polarization controller for multi-channel, single-sweep wavelength dependent PDL measurements in combination with a tunable laser, a multiport power meter and the photonic application software suite (PAS). See the PAS literature for details: www.keysight.com/find/n7700

Many applications of the N7786C are supported by the built-in user interface. Programming uses a new SCPI command set and the instrument is addressed as a VISA resource.

For further details on its application and key features, refer to the product datasheet available on www.keysight.com.

N7788C Optical Component Analyzer

The N7788C optical component analyzer provides both polarization control and analysis functions in one instrument for flexible laboratory use.

The N7788C is especially used in combination with a tunable laser for measuring how an optical component changes the SOP of a signal. This measurement uses the unique single-sweep polarization dependent method to determine the parameters polarization mode dispersion (PMD) or differential group delay (DGD) and polarization dependent loss (PDL), based on a generalization of the standardized Jones Matrix Eigenanalysis method (JME).

For these spectral measurements of polarization dependent loss and dispersion, the N7788C is combined with a tunable laser and a new N7700 software engine.

Parameters provided by this measurement include:

- DGD/PMD
- PDL
- Power/loss
- TE/TM-loss
- Jones matrices

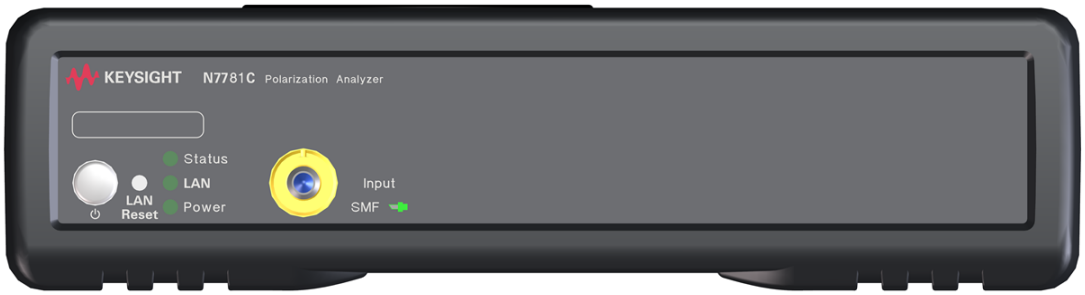
- Mueller matrices
- 2nd-order PMD (depolarization + PCD)

For further details on its application and key features, refer to the product datasheet available on www.keysight.com.

Input and Output Connectors

This section provides information on the front and rear panels of the N7781/85/86/88C polarization instruments.

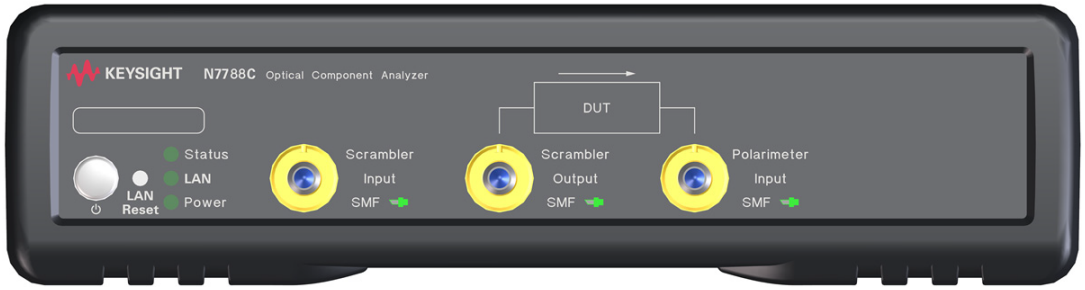
The following figure shows the front panel of the N7781C Polarization Analyzer:



The following figure shows the front panel of the N7785C Synchronous Scrambler:

The following figure shows the front panel of N7786C Polarization Synthesizer.

The following figure shows the front panel of N7788C Optical Component Analyzer.



The following figure shows the rear panel of the N7744N7781/85/86/88C polarization instruments:

Optical Input and Output

Angled Contact Connectors

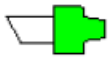
Angled contact connectors help you to control return loss. With angled fiber end-faces, reflected light tends to reflect into the cladding, reducing the amount of light that reflects back to the source. When reflected light remains in the fiber core at two or more locations along the optical path, such as at an open straight-polished

connector output to a power meter, double reflections result in multi-path interference of the coherent light and thus power instability in the measurements.

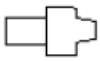
Keysight N7781/85/86/88C polarization instruments can have the following connector interface option:

- Option (0x2) angled connector
- Option (0x1) straight connector (N7781 x=2 N7788C x=3)

CAUTION If the contact connector on your instrument is angled, you can only use cables with angled connectors with the instrument.



Angled Contact Connector Symbol



Straight Contact Connector Symbol

The above figure shows the symbols that tell you whether the contact connector of your instrument is angled or straight. The angled contact connector symbol is colored green.

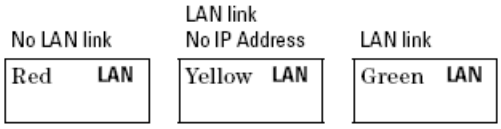
You should connect straight contact fiber end connectors with neutral sleeves to straight contact connectors and connect angled contact fiber end connectors with green sleeves to angled contact connectors.

NOTE You cannot connect angled non-contact fiber end connectors with orange sleeves directly to the instrument.

LAN Interface

The LAN LED

When the LAN connection is made, you will see the following indicators:



There may be a delay between making the LAN link (yellow status) and getting the IP address (green status). This delay may be longer if there is no DHCP server, for example when the instrument is connected directly to a PC.

The LAN Reset Button

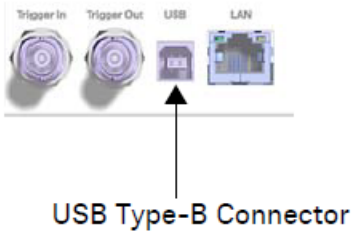
This recessed button has two functions:

- Pressing the button briefly invokes a preset of the instrument and restores default measurement settings. This is equivalent to the following programming command:
  SYSTem:PRESet
- Pressing and holding the button for 5 seconds will reset the LAN parameters to the factory default. This includes removing the password. This is equivalent to the following programming command:
  :SYSTem:COMMunicate:ETHernet:RESet

USB Interface

NOTE It is recommended to use the Keysight IO Libraries Suite to enable instrument communication for a variety of development environments. It is available at: http://keysight.com/find/iolibs

The instrument is a USB device, with a USB Type-B connector which is available on the rear side of the instrument.



Powering Up the Instrument

When you power on the instrument, the LEDs on the front panel show the various stages of booting.

	Power	LAN	Status
Yellow	Standby Mode	Searching for LAN	Warming Up
Green	ON	Connected with LAN	
Blinking Green			Communicating over LAN / USB
Red		Not Connected	

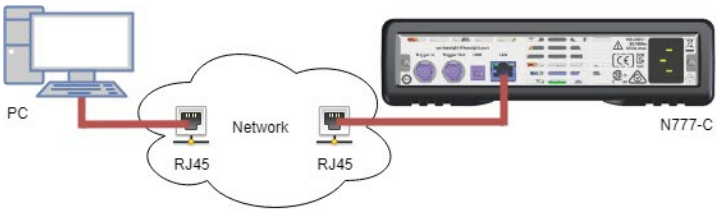
Remote Interface

The N778-C supports remote interface communication over a LAN or a USB interface.

NOTE It is recommended to use the Keysight IO Libraries Suite to enable instrument communication for a variety of development environments. It is available at: http://keysight.com/find/iolibs

LAN Connection with a DHCP server (Site LAN)

A site LAN is a local area network in which LAN-enabled instruments and computers are connected to the network through routers, hubs, and/or switches. They are typically large, centrally-managed networks with services such as DHCP and DNS servers. The following figure illustrates a typical site LAN system.



- Connect the instrument to the site LAN or to your computer using a LAN cable. The as-shipped instrument LAN settings are configured to automatically obtain an IP address from the network using a DHCP server (DHCP is set On). The DHCP server will register the instrument's hostname with the dynamic DNS server. The hostname as well as the IP address can then be used to communicate with the instrument. The front panel LAN indicator will indicate the current LAN state (see The LAN Status Indicators on page 37).
- Use the Connection Expert utility of the Keysight IO Libraries Suite to add the instrument and verify a connection. To add the instrument, you can request the

Connection Expert to discover the instrument. If the instrument cannot be found, add the instrument using its hostname or IP address.

- You can now use Interactive IO within the Connection Expert to communicate with your instrument, or you can program your instrument using the various programming environments. You can also use the Web browser on your computer to communicate with the instrument as described under N778-C Web User Interface Reference.

LAN Connection without a DHCP server (Private LAN)

- A private LAN is a network in which LAN-enabled instruments and computers are directly connected, and not connected to a site LAN. They are typically small, with no centrally-managed resources. The following figure illustrates a typical private LAN system.

NOTE Make sure your computer is configured to obtain its address from DHCP and that NetBIOS over TCP/IP is enabled. Note that if the computer had been connected to a site LAN, it may still retain previous network settings from the site LAN. Wait one minute after disconnecting it from the site LAN before connecting it to the private LAN. This allows the PC to sense that it is on a different network and restart the network configuration.

- The factory-shipped instrument LAN settings are configured to automatically obtain an IP address from a site network using a DHCP server. You can leave these settings as they are. Most Keysight products and most computers will automatically choose an IP address using auto-IP if a DHCP server is not present. Each assigns itself an IP address from the block 169.254.nnn. Note that this may take up to one minute. The front panel LAN indicator will indicate the current LAN state (see The LAN Status Indicators on page 37).
- Use the Connection Expert utility of the Keysight IO Libraries Suite to add the LAN instrument and verify a connection. To add the instrument, you can request the Connection Expert to discover the LAN instrument. If the instrument cannot be found, add the instrument using its hostname or IP address. You can find additional details here: Connecting the Instrument on page 38

NOTE If this does not work, refer to “Troubleshooting Guidelines” in the Keysight Technologies USB/LAN/GPIB Interfaces Connectivity Guide included with the Keysight IO Libraries Suite.

- You can now use Interactive IO within the Connection Expert to communicate with your instrument, or you can program your instrument using the various programming environments. You can also use the Web browser on your computer to communicate with the instrument as described under N778-C Web User Interface Reference.

USB Connection

The following figure illustrates a typical USB interface system:

- Connect your instrument to the USB port on your computer using a USB cable.

NOTE Your PC will detect a new USB Mass Storage Device (read-only) and a new virtual Ethernet link over USB. This interface assigns itself an IP address from the block 100.61.nnn.nnn and your PC 100.61.nnn.nnn (n+1).

- Use the Connection Expert utility of the Keysight IO Libraries Suite to add the instrument and verify a connection. To add the instrument, you can request the Connection Expert to discover the instrument. If the instrument cannot be found, add the instrument using its hostname or IP address. You can find additional details here: Connecting the Instrument on page 38
- You can now use Interactive IO within the Connection Expert to communicate with your instrument, or you can program your instrument using the various programming environments.

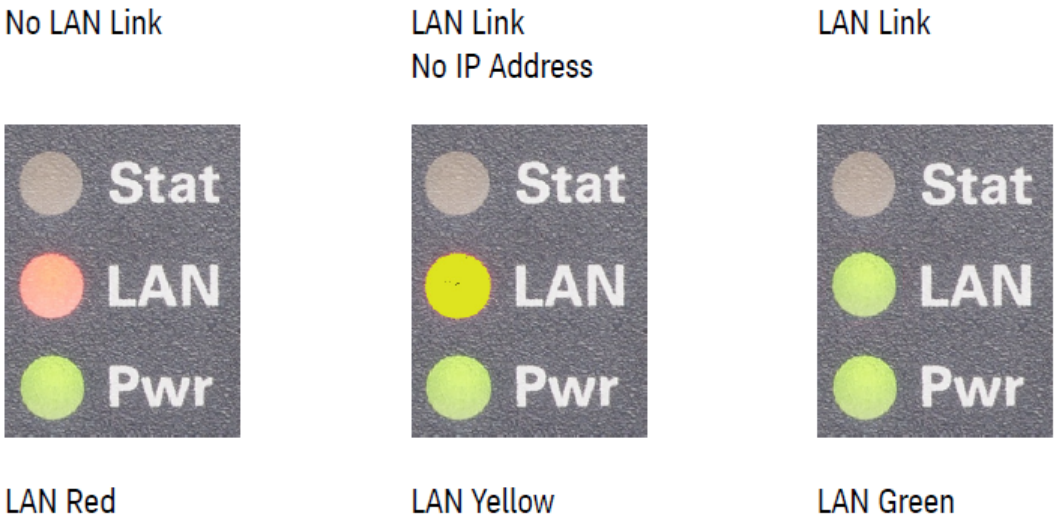
Technical Overview

User Interface	Keysight N777-C

Ethernet Access:	IPv4 and IPv6 Socket connection:
HTTP	http://<ip_address> or http://<host_name>
VXI-11	port 111 (IPv4 only)
SCPI-telnet	port 5024
SCPI-raw	port 5025
USB Access	Remote NDIS (virtual Ethernet link over USB)
	USB Mass Storage functions (read-only)

The LAN Status Indicators

When the LAN connection is made, you will see the following LAN status indicators:



There may be a delay between making the LAN link (yellow status) and getting the IP address (green status). This delay may be longer if there is no DHCP server, for example when the instrument is connected directly to a PC.

The LAN Reset Button

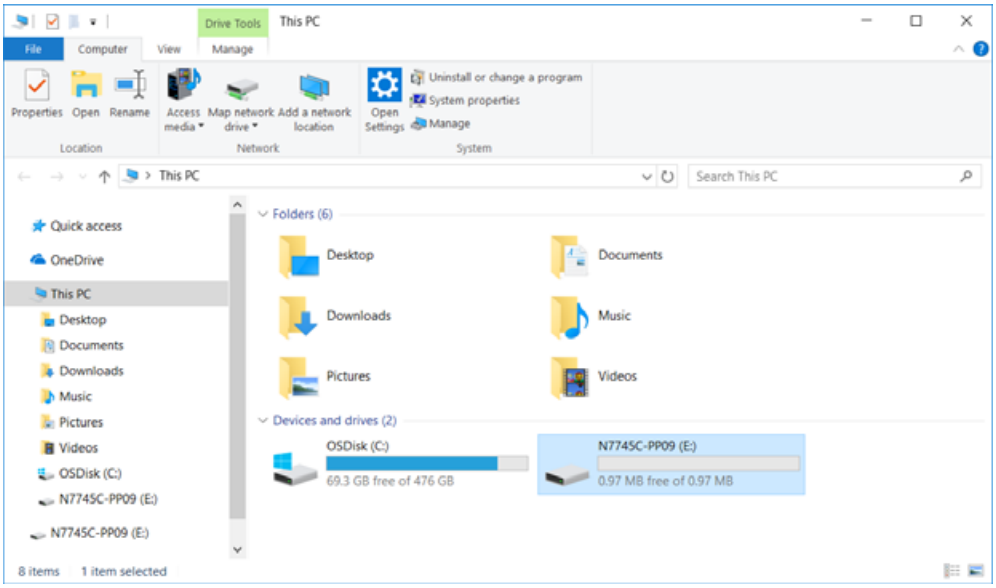
This recessed button has two functions.

- Pressing the button briefly invokes a preset of the instrument and restores default measurement settings. This is equivalent to the following programming command:
  SYSTem:PRESet
- Pressing and holding the button for 5 seconds will reset the LAN parameters to the factory default. This includes removing the password. This is equivalent to the following programming command:
  :SYSTem:COMMunicate:ETHernet:RESet

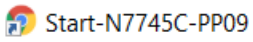
Connecting the Instrument

Connecting over USB

1. Power on the instrument.
2. Connect the PC to the instrument using a USB cable.
3. The operating system will detect and display the new instrument as a new drive.



4. Double-click on this new drive. It will show a shortcut to start the user interface.



5. Double -click on this shortcut. This will open the user interface of the N778xC instrument in a browser.

Connecting over LAN

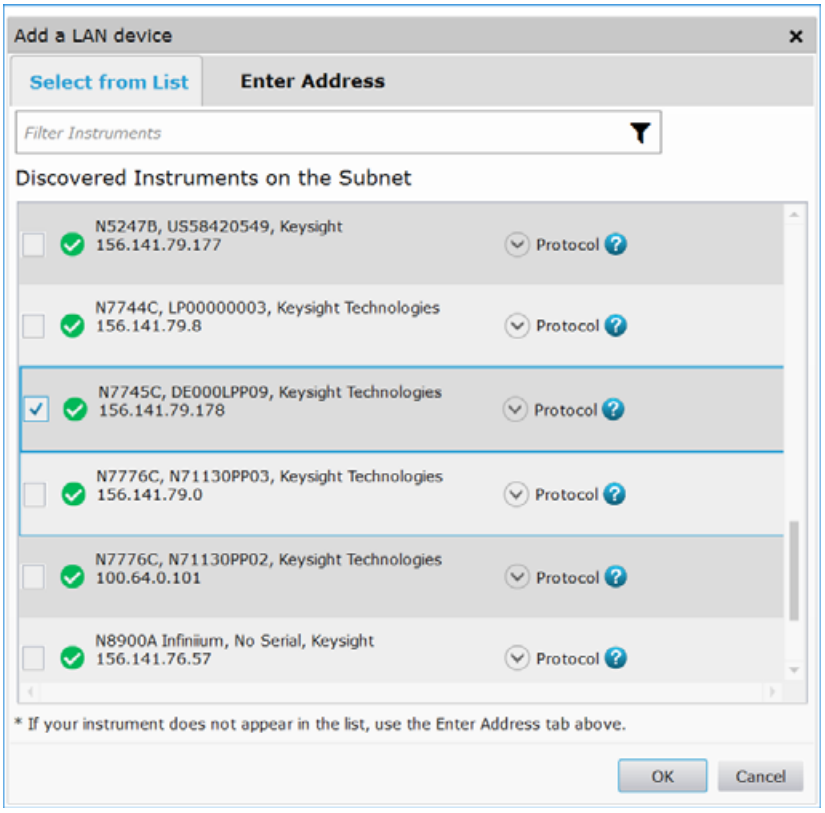
1 Make sure the instrument is connected to the LAN, and that the LAN LED on the front panel is green.

2 If it is not already running, start the Keysight Connection Expert software.

The Discovery Service automatically discovers LAN instruments on the same subnet as the PC on which the service is running.

3 To add LAN instruments to the Connection Expert My Instruments list:

a Click, select LAN Instrument from the context list. This opens the list of discovered LAN instruments.



b Click the check box for each instrument you want to add to the list.

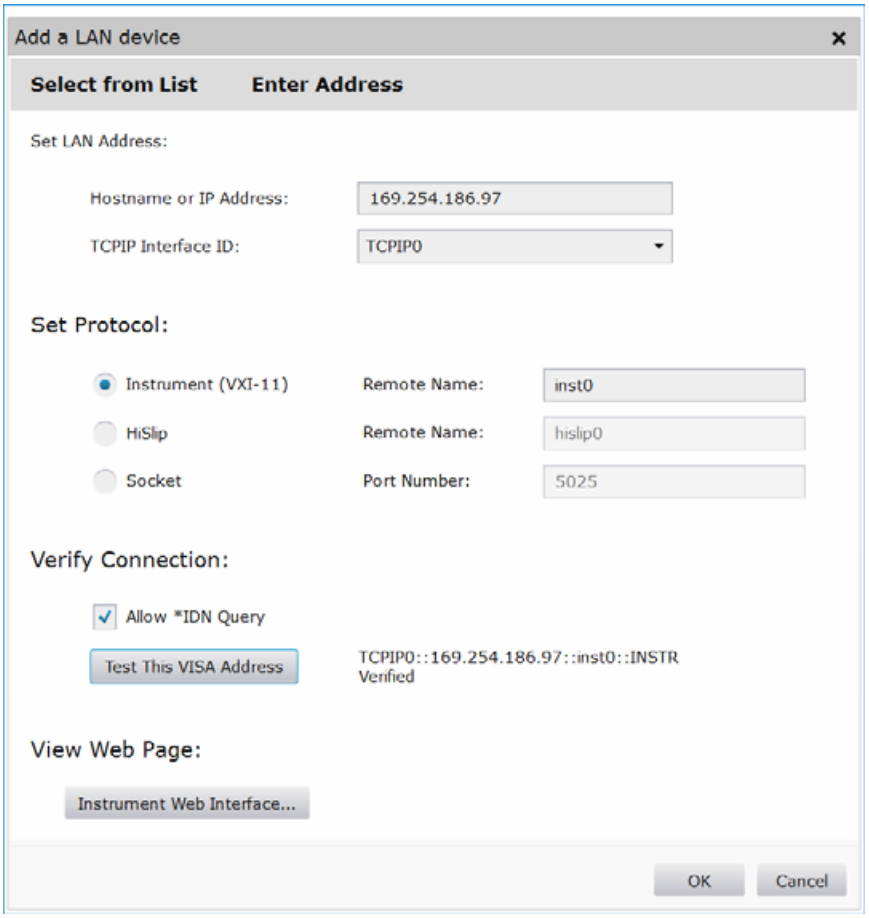
c Click OK.

4 To manually add LAN instruments outside of the local subnet:

a Click, select LAN Instrument from the context list. This opens the list of discovered LAN instruments.

b Click the Enter Address tab.

c Enter the LAN address or host name and select the protocol used to communicate with the instrument.



d Click OK.

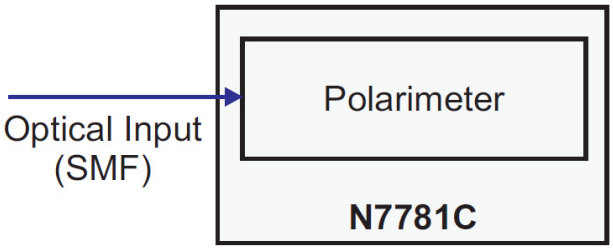
5 Linux or macOS can use the zeroconf / mdns discovery service with tools like Avahi (GNU/Linux) or Bonjour (Mac).

```
steffen@keysight [11:04:34 AM] [~]
-> % avahi-browse --all -t |grep N7781
+   eno1 IPv4 N7781C DE0000PP03 Polarization Analyzer       _vxi-11._tcp         local
+   eno1 IPv4 N7781C DE0000PP03 Polarization Analyzer       _scpi-telnet._tcp    local
+   eno1 IPv4 N7781C DE0000PP03 Polarization Analyzer       _scpi-raw._tcp       local
+   eno1 IPv4 N7781C DE0000PP03 Polarization Analyzer       _lxi._tcp            local
+   eno1 IPv4 N7781C DE0000PP03 Polarization Analyzer       Web Site             local
steffen@keysight [11:11:34 AM] [~]
-> % avahi-browse _scpi-raw._tcp --resolve |grep N7781 -A3
+   eno1 IPv4 N7781C DE0000PP03 Polarization Analyzer       _scpi-raw._tcp       local
--
=   eno1 IPv4 N7781C DE0000PP03 Polarization Analyzer       _scpi-raw._tcp       local
   hostname = [k-n7781c-0pp03.local]
   address = [156.141.78.199]
   port = [5025]
   txt = ["txtvers=1" "Manufacturer=Keysight Technologies" "Model=N7781C" "SerialNumber=DE0000PP03" "FirmwareVersion=V1.000"]
```

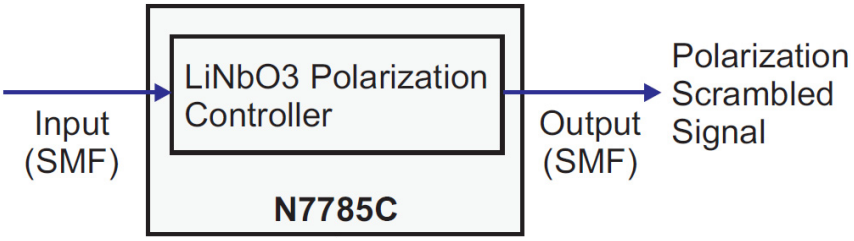
N778xC Instrument Setup

This section demonstrates how to connect your instruments optically and electrically for typical applications. It is strongly recommended that you read through the sections, on page 15, General on page 19, and on page 53 prior to operating the instruments.

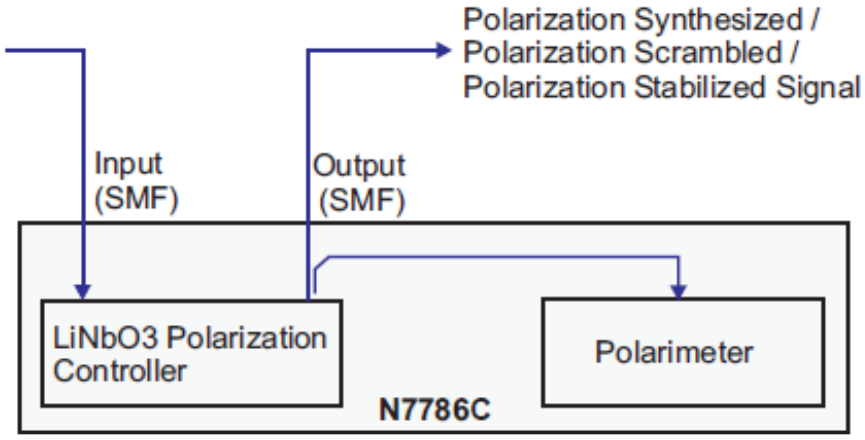
N7781C Setup (Polarimetry)



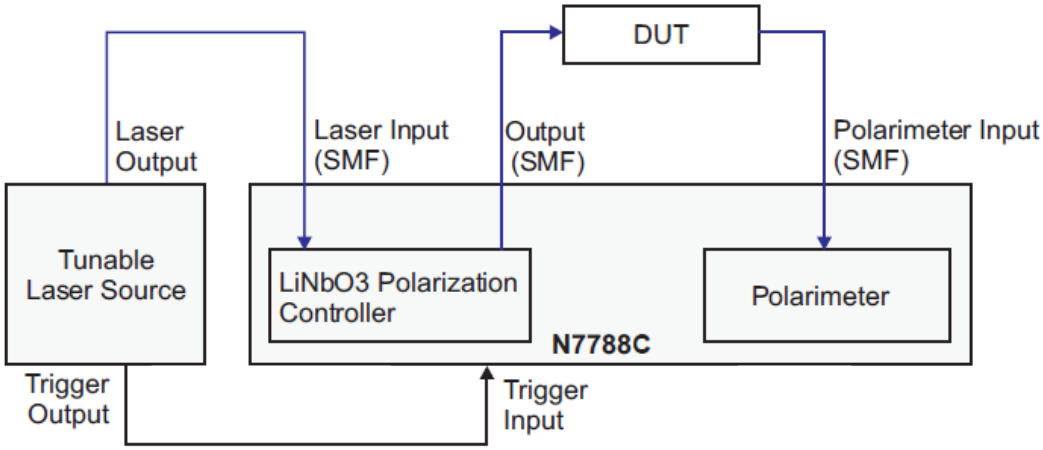
N7785C Setup (Polarization Scrambling)



N7786C Setup (Polarization Synthesis)

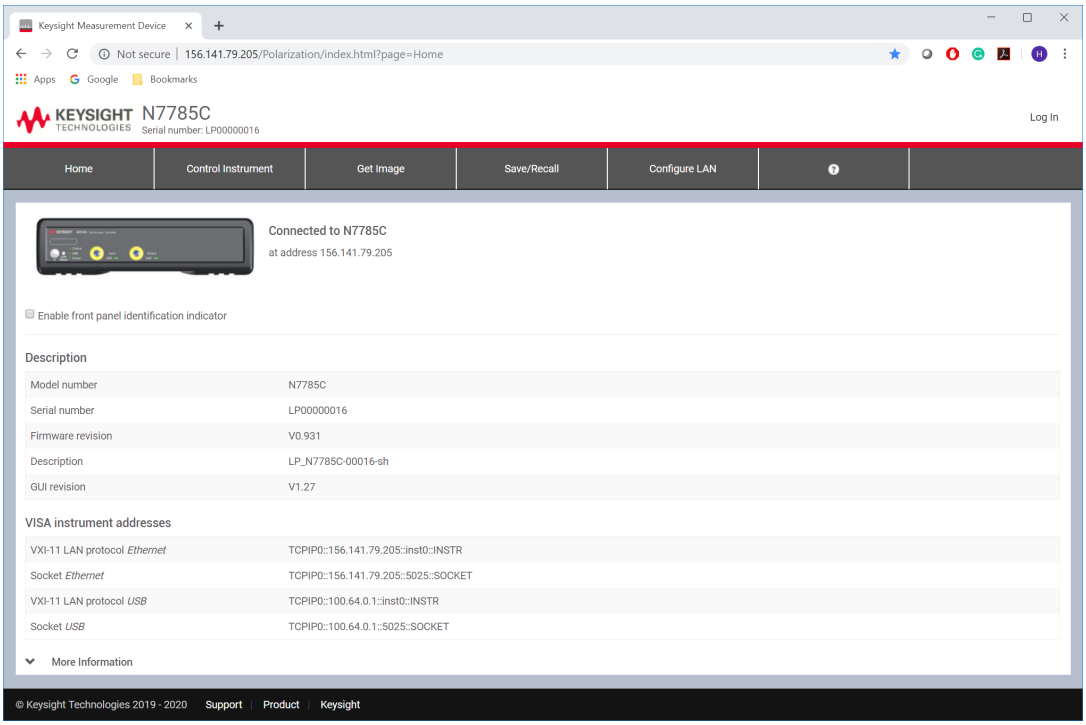


N7788C Setup (PMD/PDL Analysis)



N778xC Instrument User Interface

The following figure depicts an example of N778xC polarization instrument's user interface that displays the instrument's connection settings. The below figure is valid for N7781/85/86/88C polarization instruments.



For details on the N778xC user interface and how to use it to control the instrument, refer to on page 53.

Definition of Terms

This section defines terms that are used in this document.

Specification

Describes warranted product performance that is valid under the specified conditions. Specifications include guard bands to account for the expected statistical performance distribution, measurement uncertainties, changes in performance due to environmental changes and aging of components.

Typical Value (Characteristics)

Characteristics describe the product performance that is usually met but not guaranteed. Typical values are based on data from a representative set of instruments.

Generally, all specifications are valid within the specified temperature range, after warm-up, at the stated operating conditions and measurement settings.

Operating Conditions

The environmental conditions for system operation. The system must not be operated outside these conditions.

Specified Temperature

The temperature range where the specifications apply (if not differently stated).

Ambient Temperature Range

Temperature range of the ambient environment where specifications apply.

Operating Wavelength Range

The wavelength range in which the instrument's internal optics can be used. If the wavelength is outside the specification wavelength range, the SOP/DOP performance can be improved by a user calibration. This calibration is done by applying the desired light source by means of a standard SMF. The calibration data is collected while the SMF is (manually) randomly moved.

Specification Wavelength Range

The wavelength range in which the specified optical performance is met.

Relative Power Uncertainty due to PDL

Two times the standard deviation of the power measured at the polarimeter input when varying the polarization state (SOP).

Relative Power Measurement Error due to Other Factors

Specifies the relative power measurement error when averaging out the polarization dependent loss. For each wavelength, the deviation of the measured power and the input power is measured and the maximum relative deviation over all wavelengths of the defined wavelength range is determined.

Relative Output Power Uncertainty due to PDL

Two times the standard deviation of the measured output power error when varying the polarization state (SOP).

The output power is measured at the (scrambler) output port (N7786C).

Relative Output Power Measurement Error due to Other Factors

Specifies the relative power measurement error when averaging out the polarization dependent loss.

For each wavelength, the deviation of the measured power and the output power is measured and the maximum relative deviation over all wavelengths of the defined wavelength range is determined.

Input Power Range

The range of power levels for which the instrument displays a measurement readout.

Maximum Safe Optical Input Power

Higher power levels than defined by the maximum safe optical input power may damage the instrument irreversibly. Note that proper operation is only provided within the Input Power Range.

WARNING Higher power levels than defined by the maximum safe optical input power may damage the instrument irreversibly.

Output Power

The power level at the output connector interface.

Input Power Range in Stabilizer Mode

The input power range at Port III where specifications for stabilizer mode apply.

Gain (Loss, Insertion Loss)

Insertion Loss (IL) is defined as the difference in the transmitted power, expressed in dB, between the test device measurement, P_b, and the normalization measurement, P_a, given a constant power of the laser source, calculated as:

$$-IL\,[\mathrm{dB}] \;=\; 10\log\frac{P_b}{P_a} \;=\; P_b\,[\mathrm{dBm}] - P_a\,[\mathrm{dBm}]$$

Loss is calculated with the same formula as gain, but with opposite sign (in dB).

NOTE The Polarization Navigator shows gain (rather than loss). That is, lossy test devices are shown with negative values.

Gain (loss) includes connector effects at normalization and at test device measurement.

In general, loss depends on wavelength and polarization state.

Insertion Loss Dynamic Range

The maximum test device loss for which insertion loss measurements can be performed.

State of Polarization (SOP)

The State of Polarization of a signal is defined by the three normalized Stokes Parameters s1, s2 and s3 which define a point in a three-dimensional coordinate system. For fully polarized light (DOP=100%), this point is located on a unity sphere commonly known as Poincaré sphere.

SOP Uncertainty

The SOP uncertainty is defined to be twice the standard deviation of the angular error on the Poincaré sphere.

Degree of Polarization (DOP)

The Degree of Polarization is the square-root of the sum of the squared normalized Stokes Parameters s1, s2 and s3. DOP can be a value between 0 and 1 or between 0% and 100% accordingly:

$$DOP = \sqrt{s_1^{\,2} + s_2^{\,2} + s_3^{\,2}}$$

DOP Uncertainty

The DOP uncertainty is defined to be twice the standard deviation of the DOP from the ideal value:

$$2 \cdot StDev\{DOP_i\}$$

DOPi denotes the measured DOP value and StDev denotes the standard deviation over repetitions i.

If DOP is given in %, the DOP uncertainty has the same unit.

Measurement: The polarization state of a signal with nominally 100% polarized light is randomly scrambled. The readout deviations from 100% are recorded over all polarization states and wavelengths.

NOTE Although the uncertainty unit is %, the deviation is not relative to the actual value.
It is calculated $DOP_{measured}$-DOP_{actual}.

Differential Group Delay (DGD)

The dependence of the group delay at a fixed wavelength resulting from applying all possible polarization states, expressed as the difference between the maximum and the minimum group delay value.

Differential Group Delay (DGD) Error

Specifies the error of the measurement results for differential group delay, expressed as the sum of an offset and a standard deviation.

The offset is calculated by the difference of the mean value of the golden device data and the mean value of the measured data, both mean values calculated over the wavelength.

The standard deviation over wavelength is calculated from the deviations around a calibration line shifted by this offset, again over wavelength.

- Conditions: Stable device-under-test.
- Measurement: Using a standard SM fiber with nominally 0 ps DGD and various PM fibers with specified DGD over the specified wavelength range.

Differential Group Delay (DGD) Measurement Range

Specifies the range of DUT DGD values for which the instrument measures DGD values not disturbed by aliasing effects.

Polarization Mode Dispersion (PMD)

The arithmetic average of the differential group delay (DGD) over a broad specified wavelength span (here unless otherwise noted 100 nm).

NOTE In highly mode-coupled devices, such as standard single mode fibers of kilometer length, the DGD depends on wavelength. Stress or temperature change may change the dependence of DGD on wavelength significantly. It can be shown that the DGD characteristics of such devices can be described statistically by PMD.

Polarization Mode Dispersion (PMD) Error

The PMD error is given by the deviation of the measured PMD and the PMD of the golden device.

- Conditions: Measurement settings and operation mode as specified.

Wavelength span and wavelength increment as specified.

Polarization Mode Dispersion (PMD) Repeatability

The agreement of repeated measurements of PMD on a stable test device and under constant environmental conditions, expressed as:

$$2 \cdot StDev\{PMD_i\}$$

PMDi denotes the measured PMD and StDev denotes the standard deviation over repetitions i.

Polarization Mode Dispersion (PMD) Vector

The PMD vector represents the polarization dependence of the group delay (GD). For a given wavelength, the magnitude of the PMD vector is the Differential group delay (DGD) at that wavelength, and the vector direction corresponds to the fast principal state of polarization in Mueller notation. The PMD vector is denoted by $\vec{\Omega}$.

Second Order PMD

The second-order PMD, S, quantifies the magnitude of the differential change of the Polarization mode dispersion (PMD) vector, with angular optical frequency, **ω**, expressed in [ps^2],

$$S = \left| \frac{d\vec{\Omega}}{d\omega} \right|$$

NOTE Second-order PMD can be expressed in [ps/nm] at a wavelength of 1550 nm by multiplying the [ps^2] value with the factor 0.784 nm/ps.

Polarization-Dependent Chromatic Dispersion (PCD)

The PCD, quantifies the differential change of the magnitude of the Polarization mode dispersion (PMD) vector, with angular optical frequency, **ω**, expressed in [ps^2],

$$PCD = \frac{d\left|\vec{\Omega}\right|}{d\omega}$$

Depolarization Rate

The depolarization rate, d, quantifies the absolute value of the differential change of the normalized Polarization mode dispersion (PMD) vector, with angular optical frequency, ω, weighted with the DGD (expressed in [s^2]).

NOTE The depolarization rate is a measure of how fast the PMD vector changes direction with the rotational frequency of the optical wave (or with the wavelength).

PMD Measurement Range

Specifies the range of DUT PMD values for which the instrument measures PMD values not disturbed by aliasing effects. This value applies for highly mode-coupled devices such as single mode fibers. For non-mode-coupled devices such as polarization maintaining fibers (PMFs), the PMD measurement range equals the DGD measurement range.

Polarization Dependent Loss (PDL)

The dependence of the loss of a device on the input polarization state, calculated as the difference between maximum and minimum loss (both in dB).

Polarization Dependent Loss (PDL) Uncertainty

Specifies the uncertainty of the measurement results for polarization dependent loss, expressed as the sum of an offset and a standard deviation.

The offset is calculated by the difference of the mean value of the golden device data and the mean value of the measured data, both mean values calculated over the wavelength.

The standard deviation over wavelength is calculated from the deviations around a calibration line shifted by this offset, again over wavelength.

Polarization Dependent Loss (PDL) Repeatability

The agreement of repeated measurements of PDL on a stable test device and under constant environmental conditions.

These measurements are performed over the defined wavelength range. For each wavelength the repeatability is calculated by:

$PDL\_repeat = 2 * \{ PDL_j - (PDL_{max} + PDL_{min}) / 2 \}$, with j = number of repetitions.

The PDL Measurement Repeatability is the maximum of all PDL repeatability's over wavelength after excluding one out of 1000 PDL-values and smoothing over 3 neighboring wavelength values.

Polarization Dependent Loss (PDL) Range

Specifies the maximum PDL which can be measured.

Maximum Sampling Rate

Specifies the maximum sampling rate into instrument memory for acquiring the State of Polarization (SOP) including DOP. Note that the time needed for transferring this data into a PC depends on the used interface.

SOP Cycling Time

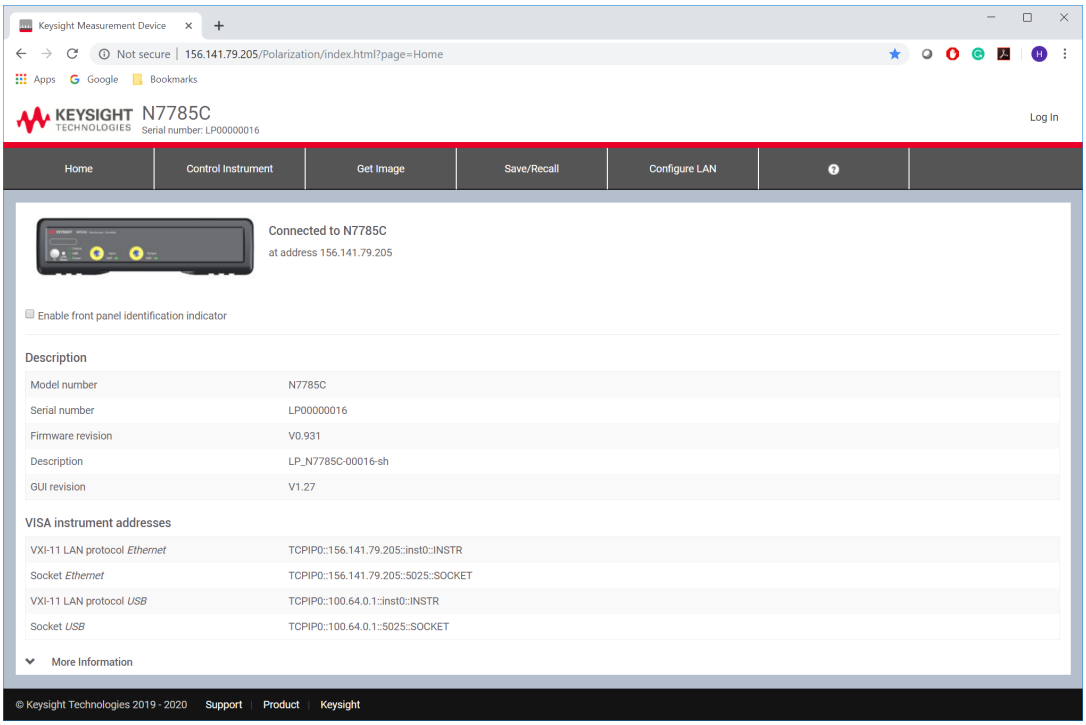
The SOP cycling time is measured by applying a sequence with Stokes vector angles 0° - 90° - 180° - 90° - 0° on the Poincaré sphere at the input of the DUT with 50 kHz. The cycling time is defined as the average of the four Tau **T**90 -values.

Remaining SOP Error After Deterministic SOP Setting

This value is defined to be 5 times the standard deviation of the angular SOP error on the Poincaré sphere while the controller is turned on.

User Interface Application

The following figure depicts an example of the N7785C polarization instruments user interface that displays the instrument's connection settings. The below figure is also valid for N7781/86/88C polarization instruments.



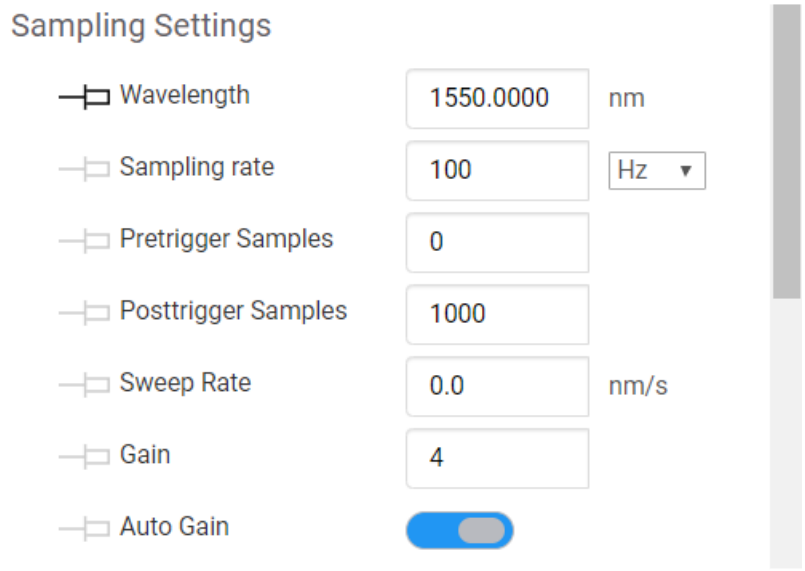
The N778xC user interface has various tabs that help the user to control N7781/85/86/88C instruments:

- **Home** – This tab displays the various instrument settings. For details, refer How to Use Auxiliary Functions on page 66
- **Control Instrument** – This tab allows you to set the parameters to control the instrument. For details, refer to the sections in this chapter that follows.
- **Get Image** – This tab allows you to capture a screen of the Control Instrument window. The image is saved in PNG format in your PC. For details, refer How to Capture an Image? on page 67
- Save/Recall – This tab allows you to save and load the user interface settings. For details, refer How to Save/Recall Measurement Settings? on page 67.
- **Configure LAN** – This tab displays the current LAN configuration of the instrument. In addition, this tab also allows you to edit the current LAN configuration of the instrument. For details, refer How to Configure LAN? on page 70
- **Help** – This tab opens the instrument's online help.

Application: Polarimeter

Choosing the Wavelength

To obtain accurate measurement results the operation wavelength of the light source has to be provided. If you have not already done so, click on **Settings** > **Measurement Settings** and then **Sampling Settings**. Enter the wavelength and choose a sweep rate of 0 nm/s.



Auto Gaining

To provide a wide range of input power, the polarimeter receiver has 10 different input gain settings (0=lowest sensitivity, 9=highest sensitivity).

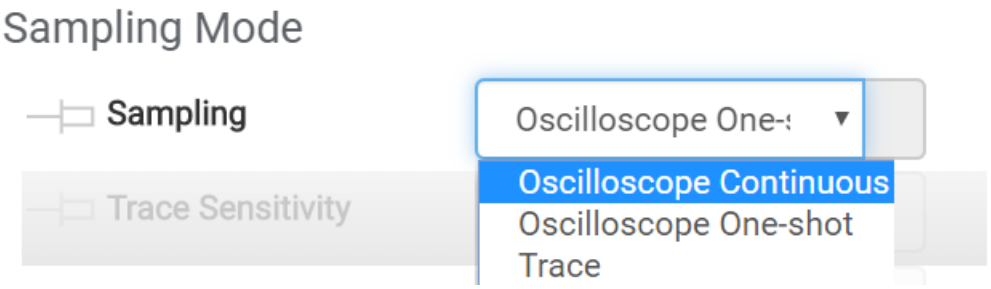
To set the gain manually, click on **Settings** > **Measurement** tab and then go to **Sampling Settings**. Specify the input gain. Usually the instruments choose the correct input gain settings to achieve optimum performance.

You can suppress the gain switching by turning off the **Auto Gain** button.

The Oscilloscope Mode

The default operation mode is Oscilloscope. In this mode, data is sampled at a constant sampling rate. You can choose the desired number of samples.

The sampling rate together with the number of samples determines the observed time scale. The number of samples is defined by setting the Post-Trigger Samples value, even when no external trigger is used.



There are two options in this mode: Continuous and Oneshot. In the continuous mode, the measurement is restarted after receiving a trace. In oneshot mode the acquisition has to be (re)started manually the pressing the Trigger button, when using the Integrated PC Mode.

Triggering

You can synchronize the start of a measurement cycle to certain events such as an external trigger signal.

When using an N778xC instrument, trigger settings are configured using the Trigger option.

Select TTL High or TTL Low to choose the desired trigger edge of an externally applied digital signal. The signal has to be applied to the BNC input named Trig. In. The actual measurement is performed continuously, so the trigger event defines the portion of the measured data stream to be shown. You can set the number of samples to be

stored from right before the trigger event (Pre-Trig. Samples) and right after the trigger event (Post-Trig. Samples).

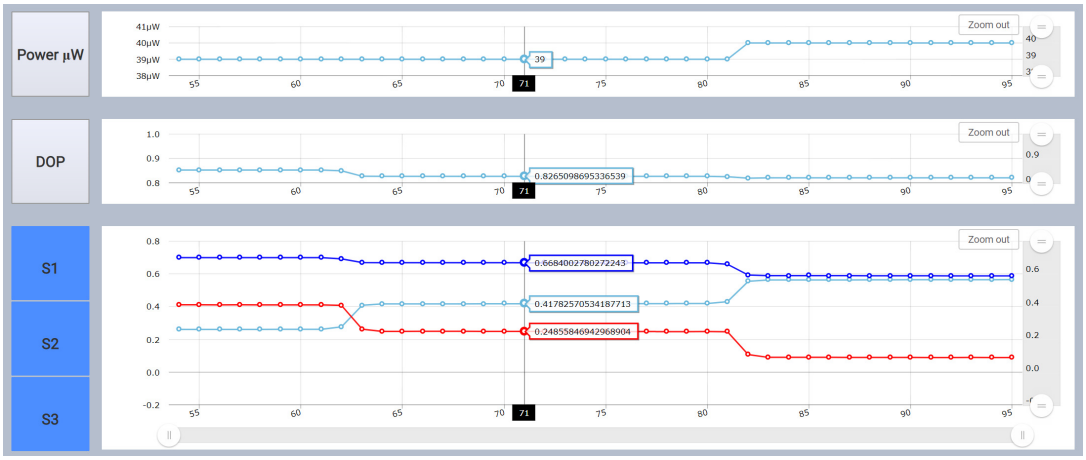
The Trace Mode

In Trace mode, data is sampled and stored only if the SOP has changed by a certain amount. The sensitivity can be adjusted by the ”Trace Sensitivity” value. A value of 0.02 will record a new SOP when the normalized SOP has changed by more than 0.02 on the Poincaré sphere. The displayed buffer operates like a FIFO (first-in-first-out) buffer. Thus the oldest SOPs are discarded when new SOPs are stored. The number of SOPs stored is controlled by the Post-Trig. Samples value. Switch to the Stokes-window and change the input polarization to see how SOPs are stored in this mode.

Graph Views

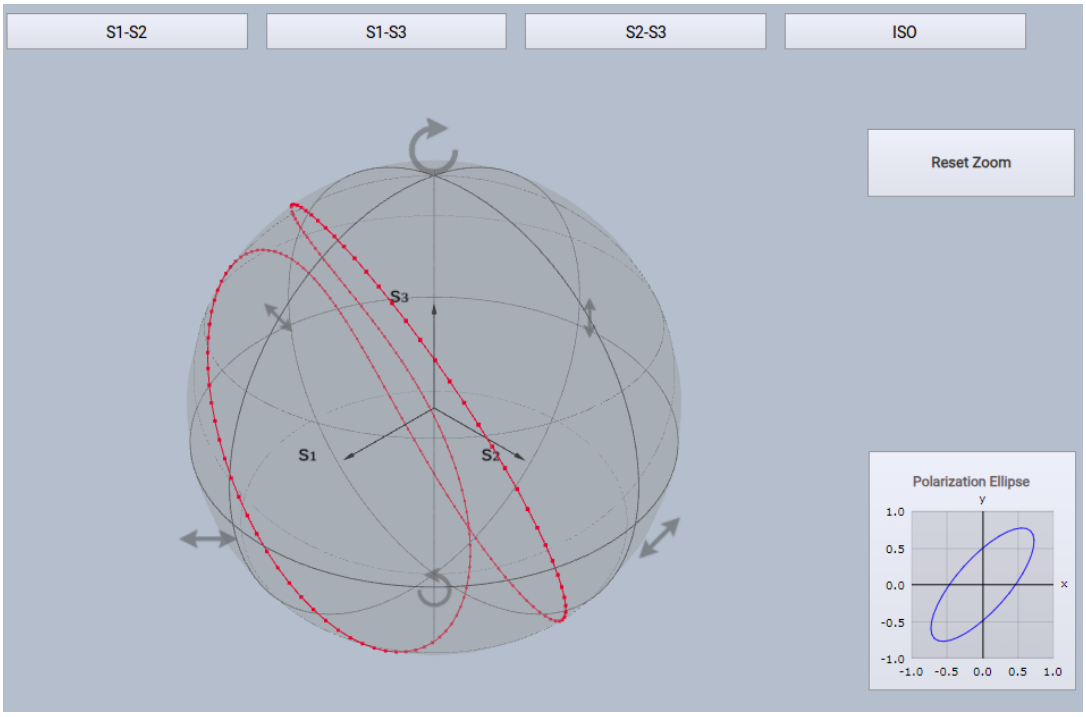
Graph views are used to display the normalized Stokes parameters, the DOP and the power versus time. Click SOP-Time to select the graph view.

Use the mouse (or touch pen) to zoom into the plot by clicking and drawing a rectangle. Click on Zoom out button on the graph area to reset the zoom. Double-click the trace to set the axis properties. By this you can manually set the axis ranges. Select a datapoint to view the markers on the graph.



The Polarimeter View

You can choose different views for the same measurement data. One of these views is the Poincaré sphere window. You can rotate the sphere by clicking onto the sphere and dragging the mouse with the left mouse button held down.



Poincaré View Zoom - You can scroll the wheel of an attached mouse to zoom in the Poincaré View. Click on the Reset Zoom button to zoom out the Poincaré View.

Calculate PER - The polarization extinction ratio (PER) of light in a PMF can be determined by creating circle trajectories on the Poincaré sphere. This can be done in realtime mode by either changing the wavelength or by slightly stretching or warming up the PMF. When you see the circle trajectory, press this button to calculate the PER. Press the button again to remove the displayed PER.

Show Dots/Line Display - Toggles between line-mode (all SOPs are connected by lines) and dots mode (each SOP is displayed as isolated point).

Polarization Controller Basics

This section describes the basic operation of the polarization controller functions of the N778xC instruments.

The operation of the LiNbO3 polarization controller (PC) integrated with most instruments of the N778xC series family is comparable to a cascade of six endlessly rotatable waveplates:

The state of the PC is given by the position of the waveplates which is expressed in terms of six angles $\phi 0 \ldots \phi 5$ measured in degree (ranging from 0..360. Due to the internal structure of the PC the waveplates are endlessly rotatable, i.e. there will be a continuous polarization state transition when increasing the position beyond 360, which is similar to starting from 0 again.

Note that the retardation may slightly differ from the nominal values depending on the operating wavelength and temperature.

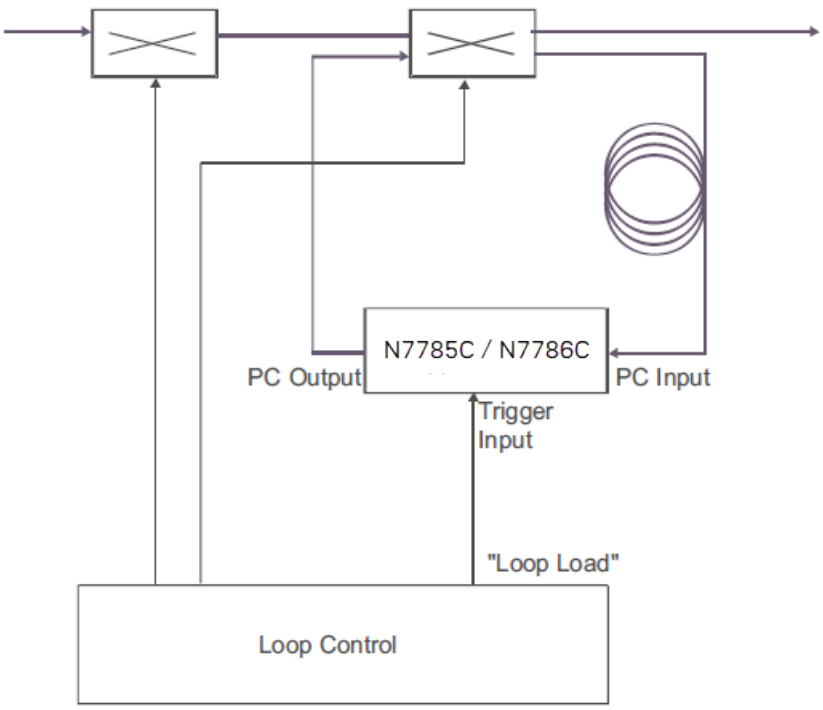
Furthermore there may be a systematic deviation due to the electro-optic properties of the LiNbO3 polarization controller. Usually these deviations are not an issue since in most applications the polarization is adjusted in an adaptive way (like for manual fiber-loop polarization controllers).

Loop Synchronous Operation in Optical Loop Test Beds

In scramble mode and sequence mode the instrument can be synchronized to external events to support synchronous operation to optical loop test beds. Two configurations are recommended:

No Loop Clock - Internal Timebase

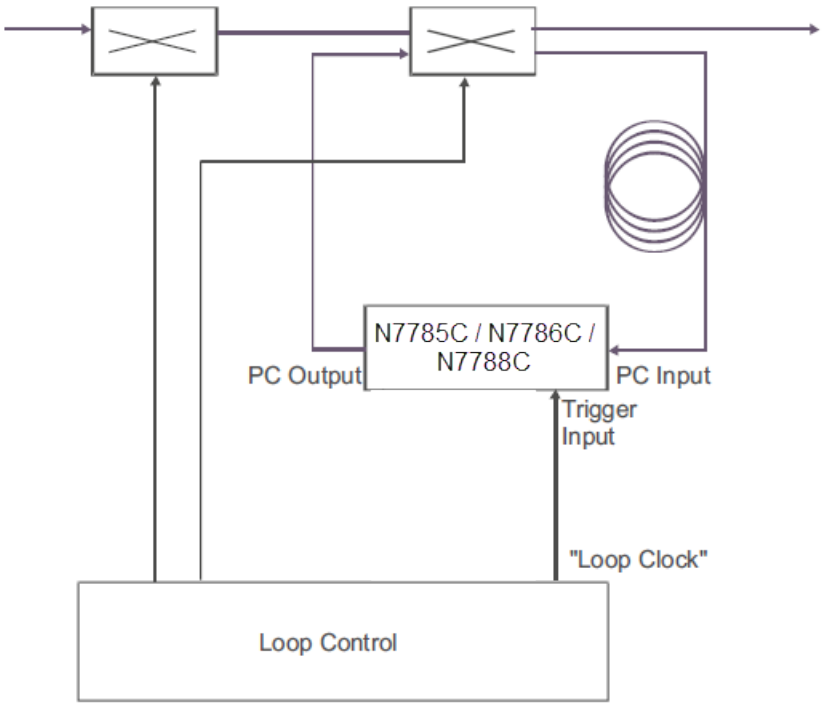
In this configuration the N778xC is synchronized to the beginning of the loop sequence when the fiber loop is loaded with the optical burst data. It then processes the look-up table (either generated for scrambling or loaded from a file) using an internal clock timer. The loop cycle time depends on the length of the fiber loop. You have to find the clock rate and the phase of the PC manually to match the switching times with the loop cycles.



Synchronized to Loop - Clock External Timebase

In this configuration the N778xC is synchronized to the loop clock.

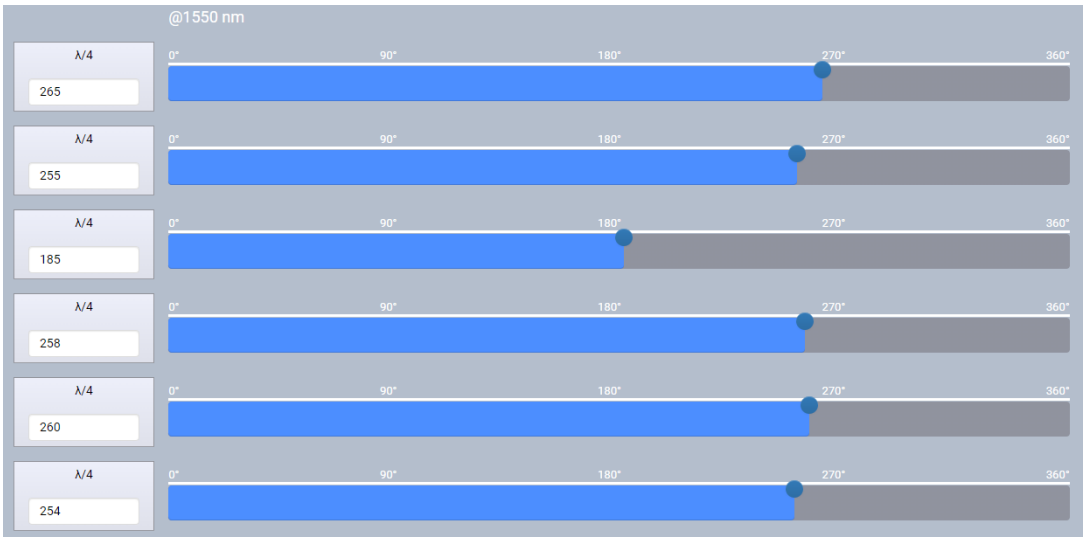
Switching occurs on the trigger event of the signal applied to the trigger input.



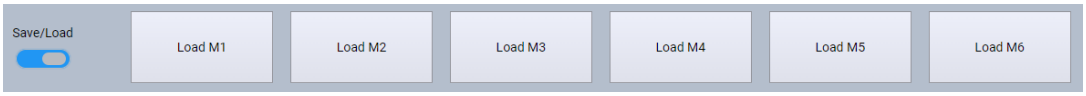
Application: Manual Waveplate Control

In manual operation mode the polarization can be adjusted by manually setting the six angles ϕ0...ϕ5. The operation is comparable to manual fiber-loop polarization controllers. The N778xC user interface allows to save and restore software settings.

The N778xC polarization controller contains six sliders. Move the sliders to adjust the position of each waveplate. The slider ranges represent a virtual λ/4 waveplate rotation up to 360 degress which results in two full rotations on the Poincaré sphere.



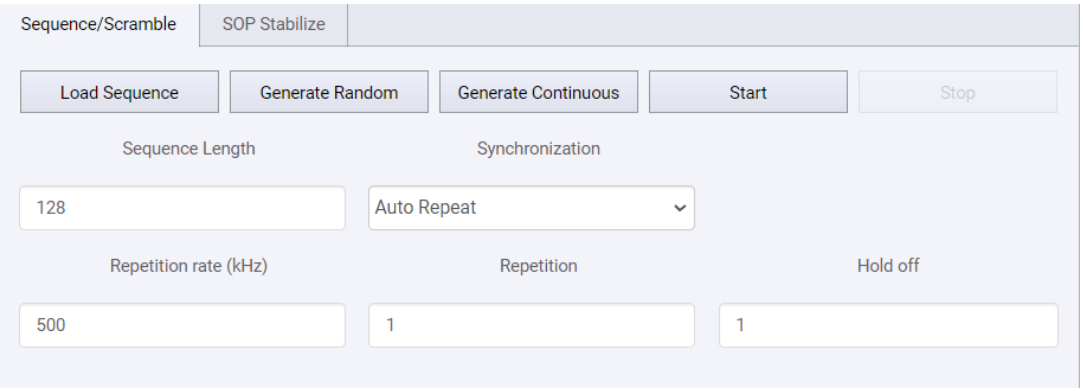
You can store six sets of slider positions by clicking on a memory button. To recall this set any time later, click on the Save/Load slider.



Application: Random Polarization Scrambling

In random scrambling mode, polarization changes are created by setting all (virtual) waveplates to a sequence of randomized rotation angles at an adjustable clock rate.

The scrambler operation is activated by clicking on the Sequence/Scramble tab of the N7786C instrument. This dialog also provides parameters settings for the scrambling operation.



Scrambling is implemented by randomly generating a special look-up-table. The sequence length can be chosen by the field sequence length, the repetition rate and the number of repetitions. A number of 0 repetition means an endless running sequence with the defined sequence length.

If Synchronization is set to Auto Repeat, the scrambling sequence is processed repeatedly without any external synchronization. The sequence will be randomized initially and will be repeated unchanged.

If Synchronization is set to Auto Oneshot, the scrambling sequence is processed just once (the repetition value is ignored in this mode).

If Synchronization is set to External Repeat or External Oneshot, the behavior is similar except that the sequence is restarted when a trigger event occurs at the Trigger Input. The exact time relative to the external trigger signal can be adjusted using the Hold off time. This value defines the delay between the trigger pulse in 1/32 us steps up to 0.1 ms.

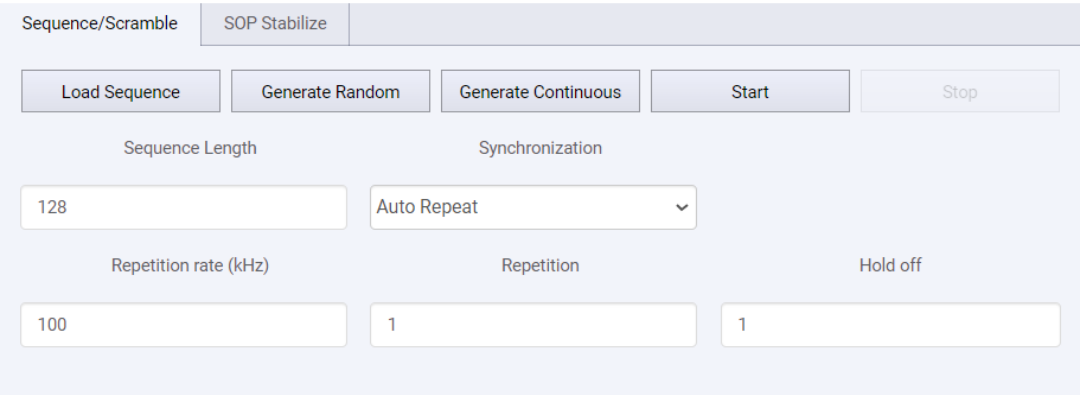
The external trigger signal can also be used as timebase instead of the internal timer. In this mode the sequence is processed at the clock rate applied to Trigger Input. Set Synchronization to External Oneshot to activate this function.

Application: Continuous Scrambling

Use this application to scramble the polarization state in a continuous manner using an N7785C, N7786C or an N7788C. The scrambling behavior resembles that of a motorized fiber-loop polarization controller.

The LiNbO3 waveplates are controlled in a way that creates a continuous movement of the output polarization state with an adjustable scrambling speed.

The scrambling operation is activated by clicking on the Sequence/Scramble tab of the N7786C instrument.

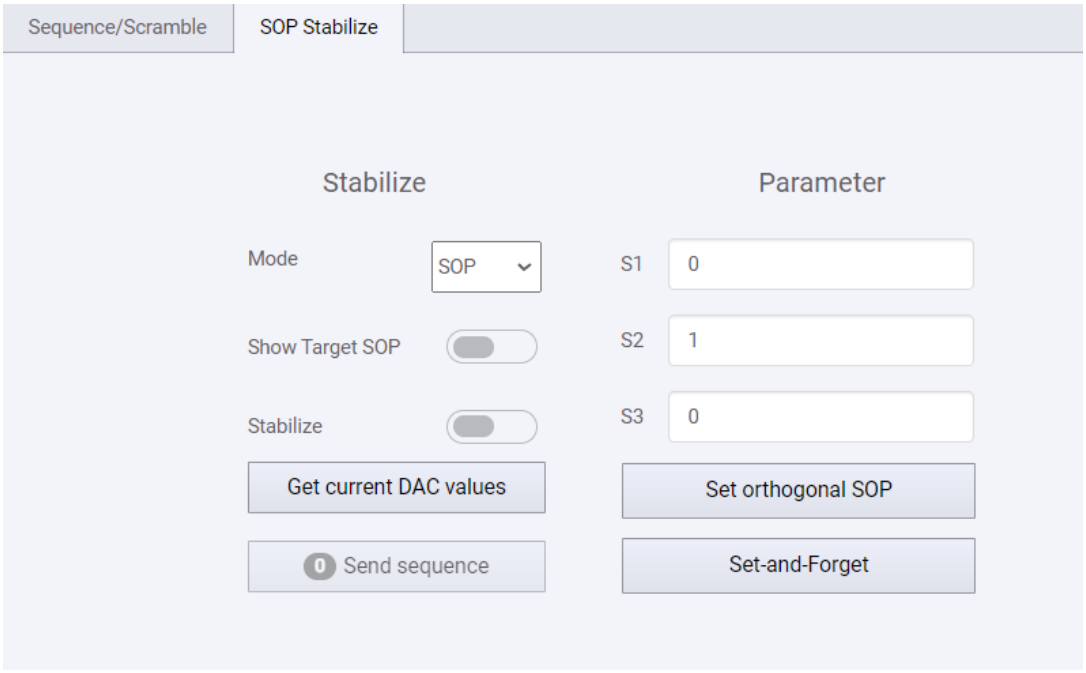


After activating the application Continuous Scrambling, you can start and stop the scrambling operation by pressing **Start** and **Stop**. When pressing **Start** for the first time after activating the application, it may take some seconds until the scrambling sequence has been generated.

Application: Polarization Stabilization

In addition to the manual, scramble and sequence modes described before (see previous sections), the N7786C and N7788C can be used to generate a fixed output SOP, even with varying input SOPs.

Click on the SOP Stabilize tab to access the settings for the SOP stabilizer. It provides the following options:



- Mode - This option allows you to select the mode as SOP, External, PMIN or PMAX.
- Show Target SOP - The target SOPs can be shown as well as the SOPs that are actually generated.
- Stabilize - By clicking the SOP Stabilize sub-item of an active N7786C instrument, the settings for the SOP stabilizer can be accessed.
- Parameter - This option allows you to provide a 3-element normalized Stokes vector (s1, s2, s3) to the target SOP .
- Get current DAC values - Click this button to get the current DAC values. Clicking this button will store the values in the sequence which can be send by "Send Sequence" button.
- Send sequence - Click this button to send the sequence of current DAC values to set the polarization controller.
- Set orthogonal SOP - Click this button to set the orthogonal SOP.
- Set-and-Forget - The Set-And-Forget mode activates the controller and stabilizes the output SOP to the output SOP present at the time of activation.

The stabilizer uses fast feedback from the polarimeter, so Auto-Gain is disabled and the lower bandwidth gain levels, 8 and 9, are not used.

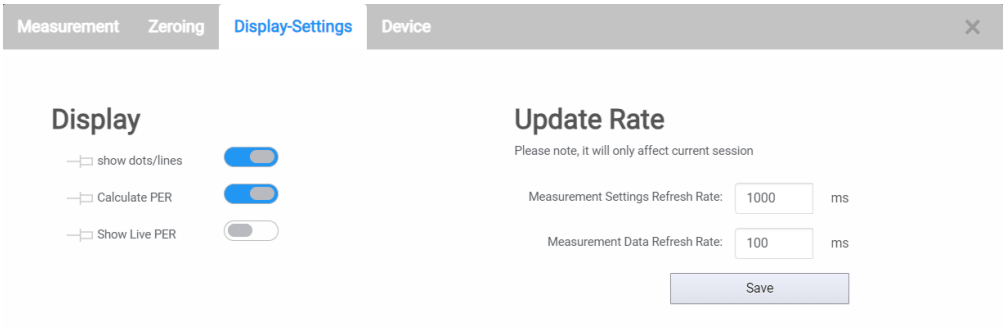
Display Settings

The **Display-Settings** tab allows you to perform the following operations:

- Change display settings
- Update rate

To perform a **Display** setting:

1. On the **Control Instruments** tab, click on the **Settings** button.
2. On the **Settings** window click the **Display** tab. The following screen will appear:



3. Perform the following operation:
4. **Display**:
   a. **Show dots/lines** - Displays line-mode (all SOPs are connected by lines) or dots mode (each SOP is displayed as isolated point) on the Poincaré sphere.
   b. **Calculate PER** - Displays the calculated polarization extinction ratio (PER) of light on the Poincaré sphere.
   c. **Show live PER** - Displays live PER on the Poincaré sphere. This option is only visible when the **Calculate PER** is enabled.
5. **Update Rate** - For details see Update Rate on page 72.

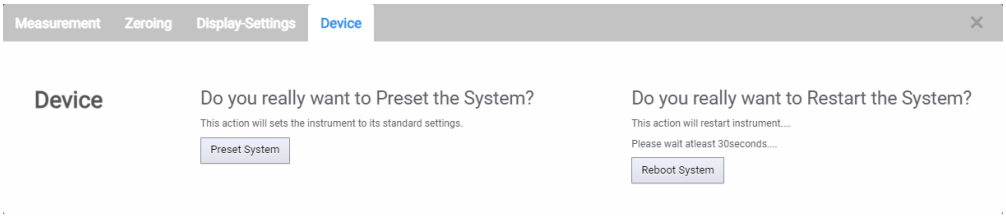
Device Settings

The **Device** tab allows you to perform the following operations:

- Preset the system
- Reboot the device

To perform a **Device** setting:

1. On the **Control Instruments** tab, click on the **Settings** button.
2. On the **Settings** window click the **Device** tab. The following screen will appear:

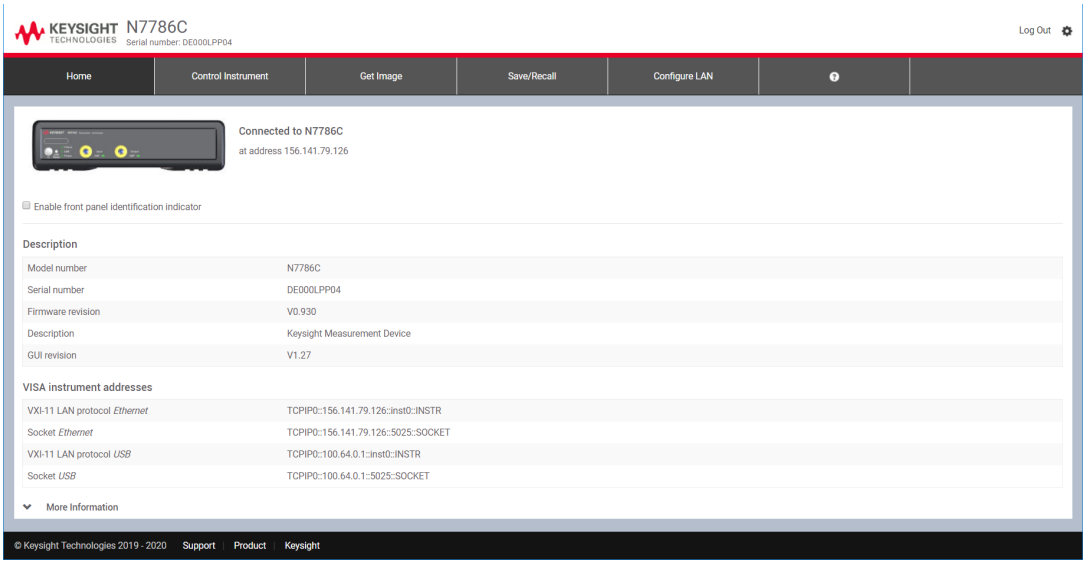


3. Perform the following operation:
4. **Preset the System** - For details, see Preset Device.
5. **Reboot the System** - For details, see Reboot Device.

How to Use Auxiliary Functions

How to Get Current Instrument Settings?

The **Home** tab on the N778xC user interface displays the current instrument settings.



This tab displays the following settings:

· **Description** – Displays the instrument description such as instrument's model no., serial no. and firmware version.

· **VISA Instrument Address** – Displays VISA instrument addresses of the current instrument.

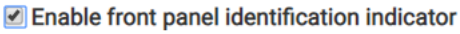
· **LAN Details** – Displays LAN configuration details of the current instrument.

NOTE Please note that the **Home** tab does not allows the user to change the displayed instrument settings.

How to Identity a Module?

Sometimes, you may have many modules mounted in the rack. In this situation, it becomes difficult to identify a particular module which is currently connected.

To identify a particular module, select the check-box **Enable front panel identification indicator** available on the N778xC **Home** tab. The **Status** LED on the front panel of the connected module will start flashing.



How to Capture an Image?

The **Get Image** tab on the N778xC user interface allows you to capture the current screen of the **Control Instrument** tab and save it as a PNG image. The captured image is saved in the "Downloads" folder.

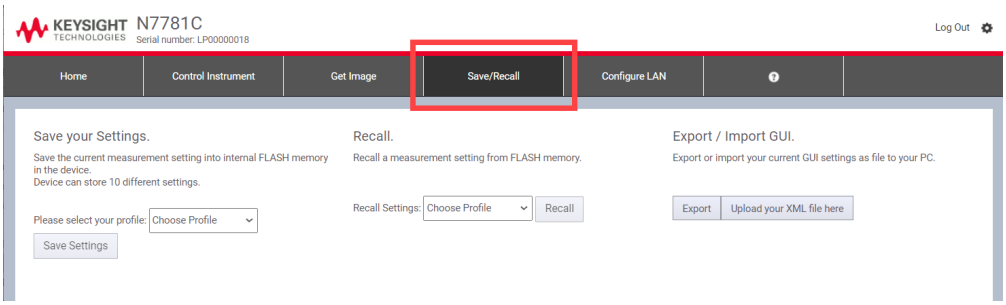
NOTE You can only capture the screen if you are in the **Control Instrument** tab.

How to Save/Recall Measurement Settings?

The **Save/Recall** tab on the N778xC user interface allows you to save and recall the instrument's measurement settings.

To perform the save or recall operation:

1. Click on the **Save/Recall** tab. The following screen will open:



2. To save the current measurement settings, select the profile from 1 to 10 and then click **Save Settings**. The current measurement setting will be saved into the internal FLASH memory in this device.
3. To recall the current measurement settings, select the profile from 1 to 10 and then click **Recall**. Your settings will be restored from the device flash memory.

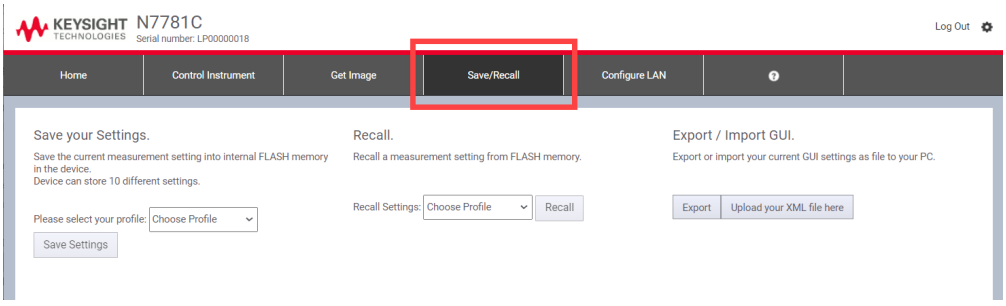
NOTE The last saved settings are recalled automatically after a reboot.

How to Export and Import the User Interface Settings?

The **Save/Recall** tab on the N778xC user interface allows you to export and import the current user interface settings.

To perform the export or import operation:

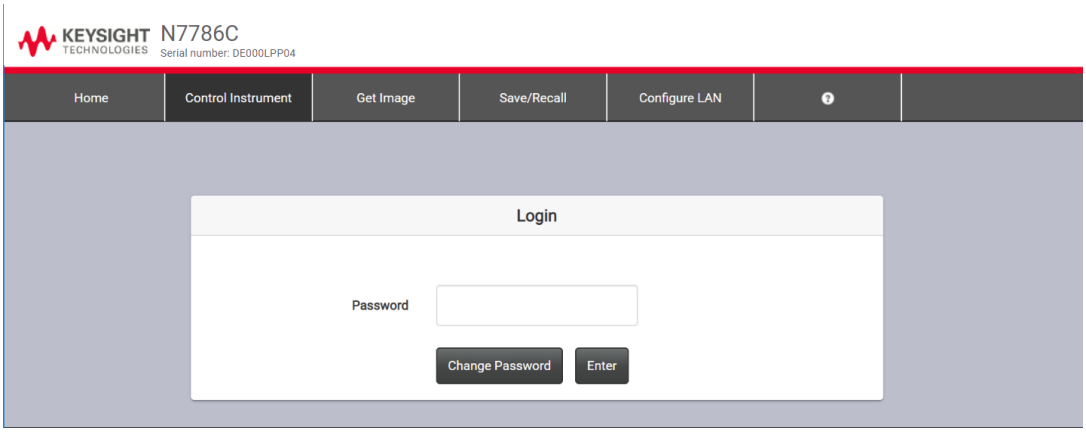
1. Click on the **Save/Recall** tab. The following screen will open:



2. Click the **Export** button to export the current measurement settings on your PC. The settings will be saved as XML file in your PC.
3. Click the **Upload your XML file here** button to import a previously saved measurement settings, A Windows **Open** dialog will appear. Locate the target file and click **Open**. The settings will be loaded to the instrument.

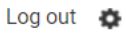
Logging In/Out of the N778xC User Interface

The login screen allows the authorized users to control the N778xC instruments. When the users type in their password and click **Enter**, their credentials are validated and if correct they are logged in.



If you want to create a new password or change an existing password, click on the **Change Password** button. For details, see How to Create/Change the Password? on page 69.

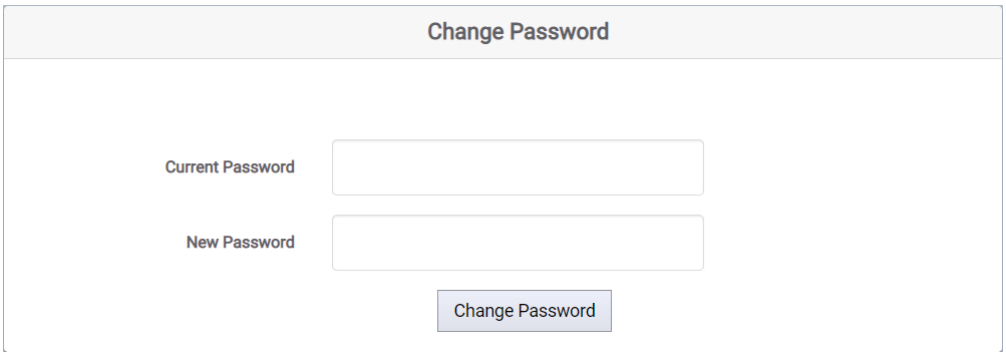
To log out the N778xC user interface, click on the **Log out** icon available on the top right of the user interface.



How to Create/Change the Password?

The password is used for logging in to the web page to control the N778xC instrument. To create or change a password;

1. Click the **Password Options** icon available on the top right of the N778xC user interface. You see a **Change Password** box requesting you to enter the password.



2. Enter the current password (the default password is blank).
3. Enter the new password, using the numerical keypad.
4. Click the **Change Password** button. The password will be changed. Use the new password for logging in to the N778xC web page.

What If You Forget Your Password?

If you forget your password, contact your nearest Keysight Technologies Sales/Service Office. Find contact details by accessing http://www.keysight.com on the Internet.

How to Configure LAN?

Show the Current LAN Settings

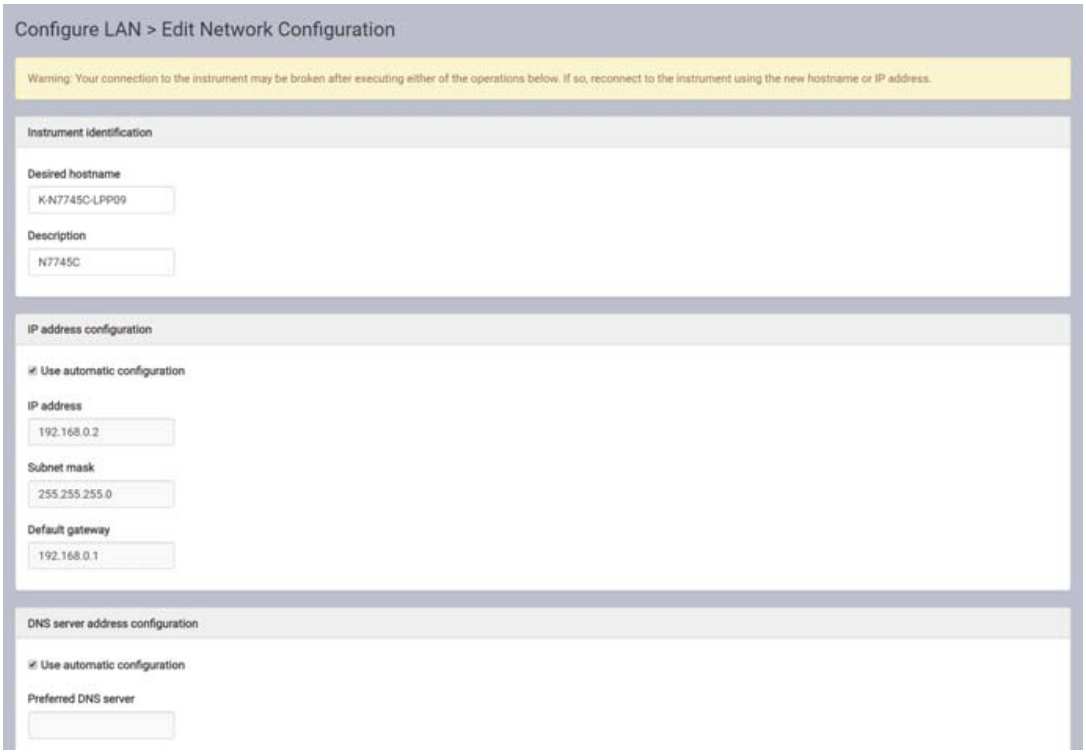
The **Configure LAN** tab on the N778xC user interface displays the currently used LAN settings. It display the following networking parameters:

- IP address configuration
- IP address
- Subnet mask
- Default gateway
- DNS server(s)
- Hostname
- Domain

Edit LAN Settings

The **Configure LAN** tab also allows you to edit the currently used LAN settings. To do so,

1 Click on the **Edit** button. The **Edit Network Configuration** page will appear as shown in the figure below:



WARNING Your connection to the instrument may be broken after executing either of the operations below. If so, reconnect to the instrument using the new hostname or IP address.

2 Enter the descriptions for the following LAN configuration parameters:

- Instrument identification
- IP address configuration
- DNS server address configuration

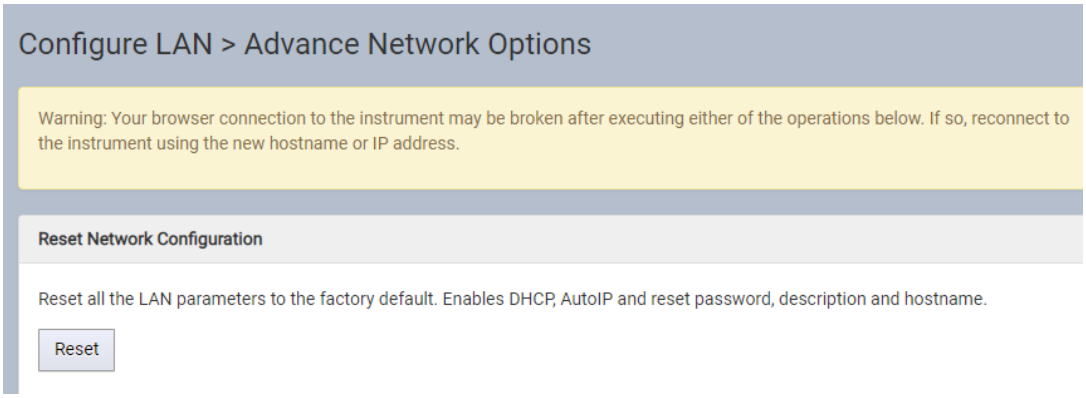
NOTE For IP address and DNS server configuration, you can select the Use Automatic Configuration check-box to automatically select the IP address and DNS server.

3 Once the changes are done, click on the **Apply Changes** button.

NOTE It can take up to 30 seconds for these changes to take effect. You may need to refresh the Configure LAN page after 30 seconds to see the updated settings. Changes in hostname and description require reboot or LAN restart to take effect.

Reset Network Configuration

The **Configure LAN** tab also allows you to reset all LAN parameters to the factory default. To do so, click the **Advance Options** button available on **Configure LAN** tab. The **Advance Network Options** page will appear. Click on the **LAN Reset** button to reset all LAN parameters to the factory default.



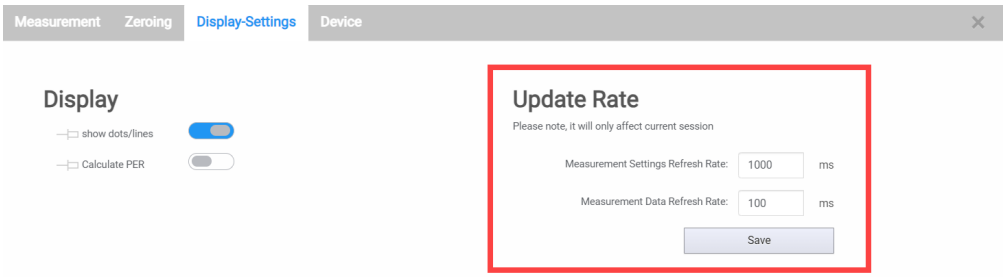
WARNING Your browser connection to the instrument may be broken after executing the reset network configuration operation. If so, reconnect to the instrument using the new hostname or IP address.

Update Rate

You can use the **Update Rate** dialog to set the refresh rates in milliseconds for the measurement settings and measurement data.

To perform an update rate:

1. On the **Control Instruments** tab, go to **Settings** and then click **Display-Settings** tab. The following screen will appear:



2. Enter the following details:
   - refresh rates for measurement settings, and
   - refresh rates for measurement data.
3. Click on the **Save** button.

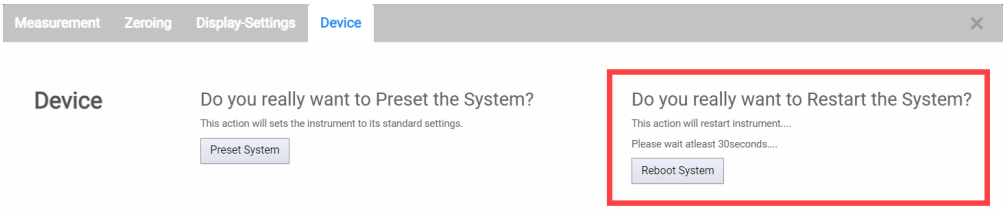
NOTE The new refresh rates will only be effective for the current session.

Reboot Device

A firmware reboot is required if it becomes unresponsive or returns errors.

To perform a reboot:

1. On the **Control Instruments** tab, go to **Settings** and then click **Device** tab. The following screen will appear:



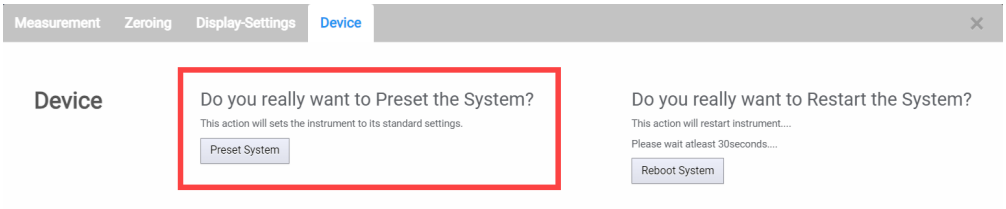
2. Click on the **Reboot System** button. This action will restart the firmware and take at least 30 seconds. Please wait until the reboot process is completed.

Preset Device

A preset option is required to set the instrument to its default settings.

To perform a preset:

1. On the **Control Instruments** tab, go to **Settings** and then click **Device** tab. The following screen will appear:



2. Click on the **Preset System** button. This action will preset the instrument to its default settings.

NOTE Preset will delete all saved measurement settings.

Cleaning Instructions

The following Cleaning Instructions contain some general safety precautions, which must be observed during all phases of cleaning.

Consult your specific optical device manuals or guides for full information on safety matters.

Please try, whenever possible, to use physically contacting connectors, and dry connections. Clean the connectors, interfaces, and bushings carefully after use.

If you are unsure of the correct cleaning procedure for your optical device, we recommend that you first try cleaning a dummy or test device.

Keysight Technologies assume no liability for the customer's failure to comply with these requirements.

Safety Precautions

Please follow the following safety rules:

- Do not remove instrument covers when operating.
- Ensure that the instrument is switched off throughout the cleaning procedures.
- To prevent electrical shock, disconnect the instrument from the mains before cleaning. Use a dry cloth, or one slightly dampened with water, to clean the external case parts. Do not attempt to clean internally.
- After cleaning, do not switch on the instrument when there is no termination to the optical output connector, to the optical fiber or to the attached device. The laser radiation is not visible to the human eye, but it can seriously damage your eyesight.

Why is it important to clean optical devices?

In transmission links optical fiber cores are about 9 µm (0.00035") in diameter. Dust and other particles, however, can range from tenths to hundredths of microns in diameter. Their comparative size means that they can cover a part of the end of a fiber core, and as a result will reduce the performance of your system.

Furthermore, the power density may burn dust into the fiber and cause additional damage (for example, 0 dBm optical power in a single mode fiber causes a power

density of approximately 16 million W/m^2). If this happens, measurements become inaccurate and non-repeatable.

Before you make any connection you must ensure that all cables and connectors are clean. If they are dirty, use the appropriate cleaning procedure.

When inserting the ferrule of a patchcord into a connector or an adapter, make sure that the fiber end does not touch the outside of the mating connector or adapter. Otherwise you will rub the fiber end against an unsuitable surface, producing scratches and dirt deposits on the surface of your fiber.

What materials do I need for proper cleaning?

Some Standard Cleaning Equipment is necessary for cleaning your instrument. For certain cleaning procedures, you may also require certain Additional Cleaning Equipment.

Standard Cleaning Equipment

Before you can start your cleaning procedure you need the following standard equipments:

- Dust and shutter caps
- Isopropyl alcohol
- Cotton swabs
- Soft tissues
- Compressed air

Dust and shutter caps

All of Keysight Technologies' lightwave instruments are delivered with either laser shutter caps or dust caps on the lightwave adapter. Any cables come with covers to protect the cable ends from damage or contamination.

We suggest these protected coverings should be kept on the equipment at all times, except when your optical device is in use. Be careful when replacing dust caps after use. Do not press the bottom of the cap onto the fiber too hard, as any dust in the cap can scratch or pollute your fiber surface.

If you need further dust caps, please contact your nearest Keysight Technologies sales office.

Isopropyl alcohol

This solvent is usually available from any local pharmaceutical supplier or chemist's shop.

If you use isopropyl alcohol to clean your optical device, do not immediately dry the surface with compressed air (except when you are cleaning very sensitive optical devices). This is because the dust and the dirt is solved and will leave behind filmy deposits after the alcohol is evaporated. You should therefore first remove the alcohol and the dust with a soft tissue, and then use compressed air to blow away any remaining filaments.

If possible avoid using denatured alcohol containing additives. Instead, apply alcohol used for medical purposes.

Never try to drink this alcohol, as it may seriously damage to your health.

Do not use any other solvents, as some may damage plastic materials and claddings. Acetone, for example, will dissolve the poxy used with fiber optic connectors. To avoid damage, only use isopropyl alcohol.

Cotton swabs

We recommend that you use swabs such as Q-tips or other cotton swabs normally available from local distributors of medical and hygiene products (for example, a supermarket or a chemist's shop). You may be able to obtain various sizes of swab. If this is the case, select the smallest size for your smallest devices.

Ensure that you use natural cotton swabs. Foam swabs will often leave behind filmy deposits after cleaning.

Use care when cleaning, and avoid pressing too hard onto your optical device with the swab. Too much pressure may scratch the surface, and could cause your device to become misaligned. It is advisable to rub gently over the surface using only a small circular movement.

Swabs should be used straight out of the packet, and never used twice. This is because dust and dirt in the atmosphere, or from a first cleaning, may collect on your swab and scratch the surface of your optical device.

Soft tissues

These are available from most stores and distributors of medical and hygiene products such as supermarkets or chemists' shops.

We recommend that you do not use normal cotton tissues, but multi-layered soft tissues made from non-recycled cellulose. Cellulose tissues are very absorbent and softer. Consequently, they will not scratch the surface of your device over time.

Use care when cleaning, and avoid pressing on your optical device with the tissue. Pressing too hard may lead to scratches on the surface or misalignment of your device. Just rub gently over the surface using a small circular movement.

Use only clean, fresh soft tissues and never apply them twice. Any dust and dirt from the air which collects on your tissue, or which has gathered after initial cleaning, may scratch and pollute your optical device.

Compressed air

Compressed air can be purchased from any laboratory supplier.

It is essential that your compressed air is free of dust, water and oil. Only use clean, dry air. If not, this can lead to filmy deposits or scratches on the surface of your connector. This will reduce the performance of your transmission system.

When spraying compressed air, hold the can upright. If the can is held at a slant, propellant could escape and dirty your optical device. First spray into the air, as the initial stream of compressed air could contain some condensation or propellant. Such condensation leaves behind a filmy deposit.

Please be friendly to your environment and use a CFC-free aerosol.

Standard Cleaning Equipment

Before you can start your cleaning procedure you need the following standard equipments:

- Dust and shutter caps
- Isopropyl alcohol
- Cotton swabs
- Soft tissues
- Pipe cleaner
- Compressed air

Dust and shutter caps

All of Keysight Technologies' lightwave instruments are delivered with either laser shutter caps or dust caps on the lightwave adapter. Any cables come with covers to protect the cable ends from damage or contamination.

We suggest these protected coverings should be kept on the equipment at all times, except when your optical device is in use. Be careful when replacing dust caps after use. Do not press the bottom of the cap onto the fiber too hard, as any dust in the cap can scratch or pollute your fiber surface.

If you need further dust caps, please contact your nearest Keysight Technologies sales office.

Isopropyl alcohol

This solvent is usually available from any local pharmaceutical supplier or chemist's shop.

If you use isopropyl alcohol to clean your optical device, do not immediately dry the surface with compressed air (except when you are cleaning very sensitive optical

devices). This is because the dust and the dirt is dissolvedand will leave behind filmy deposits after the alcohol is evaporated. You should therefore first remove the alcohol and the dust with a soft tissue, and then use compressed air to blow away any remaining filaments.

If possible avoid using denatured alcohol containing additives. Instead, apply alcohol used for medical purposes.

Never try to drink this alcohol, as it may seriously damage your health.

Do not use any other solvents, as some may damage plastic materials and claddings. Acetone, for example, will dissolve the poxy used with fiber optic connectors. To avoid damage, only use isopropyl alcohol.

Cotton swabs

We recommend that you use swabs such as Q-tips or other cotton swabs normally available from local distributors of medical and hygiene products (for example, a supermarket or a chemist's shop). You may be able to obtain various sizes of swab. If this is the case, select the smallest size for your smallest devices.

Ensure that you use natural cotton swabs. Foam swabs will often leave behind filmy deposits after cleaning.

Use care when cleaning, and avoid pressing too hard onto your optical device with the swab. Too much pressure may scratch the surface, and could cause your device to become misaligned. It is advisable to rub gently over the surface using only a small circular movement.

Swabs should be used straight out of the packet, and never used twice. This is because dust and dirt in the atmosphere, or from a first cleaning, may collect on your swab and scratch the surface of your optical device.

Soft tissues

These are available from most stores and distributors of medical and hygiene products such as supermarkets or chemists' shops.

We recommend that you do not use normal cotton tissues, but multi-layered soft tissues made from non-recycled cellulose. Cellulose tissues are very absorbent and softer. Consequently, they will not scratch the surface of your device over time.

Use care when cleaning, and avoid pressing on your optical device with the tissue. Pressing too hard may lead to scratches on the surface or misalignment of your device. Just rub gently over the surface using a small circular movement.

Use only clean, fresh soft tissues and never apply them twice. Any dust and dirt from the air which collects on your tissue, or which has gathered after initial cleaning, may scratch and pollute your optical device.

Pipe cleaner

Pipe cleaners can be purchased from tobacconists, and come in various shapes and sizes.The most suitable one to select for cleaning purposes has soft bristles, which

will not produces scratches.

There are many different kinds of pipe cleaner available from tobacco shops.

The best way to use a pipe cleaner is to push it in and out of the device opening (for example, when cleaning an interface). While you are cleaning, you should slowly rotate the pipe cleaner.

Only use pipe cleaners on connector interfaces or on feed through adapters. Do not use them on optical head adapters, as the center of a pipe cleaner is hard metal and can damage the bottom of the adapter.

Your pipe cleaner should be new when you use it. If it has collected any dust or dirt, this can scratch or contaminate your device.

The tip and center of the pipe cleaner are made of metal. Avoid accidentally pressing these metal parts against the inside of the device, as this can cause scratches.

Compressed air

Compressed air can be purchased from any laboratory supplier.

It is essential that your compressed air is free of dust, water and oil. Only use clean, dry air. If not, this can lead to filmy deposits or scratches on the surface of your connector. This will reduce the performance of your transmission system.

When spraying compressed air, hold the can upright. If the can is held at a slant, propellant could escape and dirty your optical device. First spray into the air, as the initial stream of compressed air could contain some condensation or propellant. Such condensation leaves behind a filmy deposit.

Please be friendly to your environment and use a CFC-free aerosol.

Additional Cleaning Equipment

Some Cleaning Procedures need the following equipment, which is not required to clean each instrument:

- Microscope with a magnification range about 50X up to 300X
- Ultrasonic bath
- Premoistened cleaning wipes
- Polymer film
- Infrared Sensor Card

Microscope with a magnification range about 50X up to 300X

A microscope can be found in most photography stores, or can be obtained through or specialist mail order companies. Special fiber-scopes are available from suppliers of splicing equipment.

Ideally, the light source on your microscope should be very flexible. This will allow you to examine your device closely and from different angles.

A microscope helps you to estimate the type and degree of dirt on your device. You can use a microscope to choose an appropriate cleaning method, and then to examine the results. You can also use your microscope to judge whether your optical device (such as a connector) is severely scratched and is, therefore, causing inaccurate measurements.

Ultrasonic bath

Ultrasonic baths are also available from photography or laboratory suppliers or specialist mail order companies.

An ultrasonic bath will gently remove fat and other stubborn dirt from your optical devices. This helps increase the life span of the optical devices.

Only use isopropyl alcohol in your ultrasonic bath, as other solvents may damage.

Warm water and liquid soap

Only use water if you are sure that there is no other way of cleaning your optical device without corrosion or damage. Do not use hot water, as this may cause mechanical stress, which can damage your optical device.

Ensure that your liquid soap has no abrasive properties or perfume in it. You should also avoid normal washing-up liquid, as it can cover your device in an iridescent film after it has been air-dried.

Some lenses and mirrors also have a special coating, which may be sensitive to mechanical stress, or to fat and liquids. For this reason we recommend you do not touch them.

If you are not sure how sensitive your device is to cleaning, please contact the manufacturer or your sales distributor.

Premoistened cleaning wipes

Use pre-moistened cleaning wipes as described in each individual cleaning procedure. Cleaning wipes may be used in every instance where a moistened soft tissue or cotton swab is applied.

Polymer film

Polymer film is available from laboratory suppliers or specialist mail order companies.

Using polymer film is a gentle method of cleaning extremely sensitive devices, such as reference reflectors and mirrors.

Infrared Sensor Card

Infrared sensor cards are available from laboratory suppliers or specialist mail order companies.

With this card you are able to control the shape of laser light emitted. The invisible laser beam is projected onto the sensor card, then becomes visible to the normal eye as a round spot.

Take care never to look into the end of a fiber or any other optical component, when they are in use. This is because the laser can seriously damage your eyes.

Preserving Connectors

Cleaning Instrument Housings

Use a dry and very soft cotton tissue to clean the instrument housing and the keypad. Do not open the instruments as there is a danger of electric shock, or electrostatic discharge. Opening the instrument can cause damage to sensitive components, and in addition your warranty will be voided.

General Cleaning Procedure

Light Dirt

If you just want to clean away light dirt, observe the following procedure for all devices:

- Use compressed air to blow away large particles.
- Clean the device with a dry cotton swab.
- Use compressed air to blow away any remaining filament left by the swab.

Heavy Dirt

If the above procedure is not enough to clean your instrument, follow one of the procedures below. Please consult How to clean connectors for the procedure relevant for this instrument.

If you are unsure of how sensitive your device is to cleaning, please contact the manufacturer or your sales distributor.

Further Cleaning Information

For further information on cleaning and safety matters, refer the following document:

https://literature.cdn.keysight.com/litweb/pdf/5989-4473EN.pdf

Firmware Upgrades

This section provides information about the firmware upgrade process for the N778xC series polarization instruments.

You may need to upgrade firmware because:

- To enhance the usability and functionality of your instrument. New features may be available with new firmware revisions.

Firmware updates can be done by installing the firmware updates installation file, which can be downloaded from www.keysight.com.

CAUTION Ensure to execute the firmware update procedure only under conditions of reliable power and I/O connectivity to the instrument. For example, do not update firmware with an intermittent LAN connection, a loose power cord, or during a thunderstorm that may interrupt power. Loss of power or connectivity may cause the firmware update fail, possibly making instrument non-operational.

NOTE Updating the firmware will not affect your instrument calibration.

Requirements

To upgrade firmware for the N774xC, you require a PC, running Windows 10 on it.

Update Procedure

To update the firmware you need to download the current firmware which consist of two components:

- Firmware Upload Utility
- The latest firmware version (*.bin file)

NOTE This process could take a couple of minutes (5-10 minutes depending on the network speed).

Once you have copied both items to your computer, proceed as follows:

- Run the Firmware Update Utility and select the device you want to update.
- Browse to the location of the firmware that you just downloaded and open the file.
- Press Start.

The update utility will copy the firmware update file on your local PC.

After the firmware has been updated, the instrument will automatically restart itself with the new software.

During the update process the Status and the Active LED will flash periodically.

- Check the firmware version. Go to instrument's user interface **Home** tab and check for the firmware version.

Contact Keysight Technologies

To locate a sales or service office near you, go to www.keysight.com/find/contactus.

Introduction to Programming

This chapter provides general information on how to control your instrument remotely.

Descriptions for the actual commands for the instruments are given in the respective sections. The information in these sections is specific to the N778xC polarization instruments.

Aliases and Alias Manager

By assigning aliases to each instrument, one can address an instrument independently of its current IP address which makes replacement of instrument easier.

This section contains information that applies to Windows, Linux, and Windows on ARM.

Aliases let you create an alternative, common-language name for a VISA address.

This topic covers the following:

- Creating new aliases for a single instrument using the editor in the **Details** > **Connection Strings** section of **Instrument View**.
- Modifying or deleting existing aliases:
  - In Windows, by using the **Alias Manager** tool, (located under the **Settings** > **Tools**).
  - In Linux, directly in **Instrument View** (Connection Strings), where aliases are created.

For more on how aliases can be useful, read the Using VISA Aliases for Program Portability and Readability section below.

About alias names

VISA alias names must be less than 256 characters in length, and can contain any characters except the double quote ("), vertical bar (|), space, and non-printing control characters (such as tab, return, newline, vertical tab, and form-feed).

These VISA aliases also work in the SICL (Windows and Linux) and Keysight 488 (Windows only) APIs.

The case of VISA aliases is preserved, however, case is ignored when an alias is used in place of the VISA address in a viOpen call. For example, UsbDevice1, usbdevice1, and USBDevice1 all refer to the same device.

If you create an alias for an instrument (auto-discovered or manually-added), that alias will be preserved even when the instrument connection is lost or removed. You can see aliases for disconnected or nonfunctioning instruments in the Aliases view.

This allows you to use the same alias again when you reconnect the instrument; it also allows you to modify the same alias to use a different instrument in case the original instrument has been replaced.

Creating and editing aliases (Windows)

Creating a new alias for a specific instrument in Windows

When an instrument is selected in the **My Instruments** list and its details are displayed on the right, the **Connection Strings** section lists any **VISA Addresses** for that instrument.

1. In the **VISA Address Aliases** field, click the ellipsis button. This opens the **Edit Alias** dialog box.
2. Click **Add**
3. In the **Alias Name** field, type the new alias name
4. Click **OK** to save the new alias.

Editing or deleting an alias for a specific instrument in Windows

When an instrument is selected in the **My Instruments** list and its details are displayed on the right, the **Connection Strings** section lists any **VISA Addresses** for that instrument.

- In the **VISA Address Aliases** field, click the ellipsis button to open the **Edit Alias** dialog box. Existing aliases are listed on the left.
- To change an alias name, select it and in the **Alias Name** field, edit the name if needed.
- To delete an alias, click the icon next to the alias you want to remove.

Tip: You can also open the **Edit Alias** dialog box by right clicking on an instrument in the **My Instruments** pane and selecting **Edit Alias** from the menu.

Using Alias Manager for multiple instruments in Windows

The **Alias Manager** feature allows the same control over aliases as the editor, except that it shows aliases all instruments that have had an alias created. To use this feature, click in the **IO Control** title bar, then select **Tools** > **Alias Manager**. Any existing aliases are listed alphabetically, along with the Instrument and **VISA Address** pairing for that alias.

To create a new alias:

1. Click **Add**
2. Click in the **Name** column to set the name for that alias.
3. Select an instrument from the **Instruments** column.
4. Verify the **VISA Address**. If that instrument has multiple addresses, select a different address from the drop-down menu.
5. Click **OK** to save the new alias.

Editing an alias in Alias Manager

- To edit a name, click in the **Name** field, make the desired change, and click **Apply**.
- To delete an alias, click the icon next to the alias you want to remove and click **Apply**.
- To use an existing alias for a different instrument, select it from the Instrument drop-down. The **VISA Address** field will automatically update to an address for that instrument; if an instrument has multiple addresses, verify that the correct address is selected. Click **Apply**.
- To select a different address for an instrument that has more than one VISA address, select the correct one from the drop-down under **Address** and click **Apply**.

Click **OK** to close the **Alias Manager** when finished making changes.

Creating and editing aliases (Linux)

Creating a new alias in Linux

When an instrument is selected in the My Instruments list and its details are displayed on the right, the **Connection Strings** section lists any **VISA Addresses** for that instrument.

1. Locate the Aliases area just below the **VISA Address** field.
2. In the **Alias Name** field, replace the italic words **Create** alias with your new alias name.
3. Click the checkmark next to the field to save the new alias.

Editing or deleting an alias in Linux

When an instrument is selected in the **My Instruments** list, the **Connection Strings** section lists any existing **VISA Addresses** for that instrument, as well as any aliases for that instrument at that addresses.

1. Locate the **Aliases** area just below the **VISA Address** field.
2. To change a specific alias, click on its name and make changes, then click the checkmark next to the field to save.
3. To delete an alias, click the trash icon

Using VISA Aliases for Program Portability and Readability

sISA aliases can be used in various programs. (Windows - use with VISA, VISA.NET, and VISA COM; Linux and and Windows on ARM- Use with VISA). (See below for information about SICL and Keysight 488 aliases.)

A VISA alias is a name of your choosing, which you assign to a device and use in your programs. Once assigned, the alias is a synonym for the device's VISA address, so you

can use it to open a VISA session (using the viOpen function) and to get resource information (using viParseRsrc or viParseRsrcEx).

Why Use VISA Aliases?

Using VISA aliases in your programs, rather than VISA addresses, provides two significant advantages:

1. Portability: If you program using aliases, you can run your program on a new test system that has instruments at different addresses, simply by creating the same aliases on the new system as on your development system. Similarly, you can move or replace instruments without changing or recompiling test code by changing the alias definitions.
2. Readability: Your programs will be much easier to read and understand if, for example, your multimeter is called "myDMM" instead of "GPIB2::14::8::INSTR". This is particularly important in the case of USB instruments, whose VISA addresses are typically long and cumbersome, containing the instrument's serial number among other information.

Creating Multiple VISA Aliases for an Instrument

You may want to create more than one VISA alias for a given instrument if, for example, you need to run several programs that refer to the instrument using different aliases. In this way, you can reuse another programmer's code simply by creating a new alias that matches the one used by that programmer. You do not need to change or even recompile the other programmer's code, nor do you need to change your test system configuration, even if the other programmer's test system was configured differently than yours.

Default Aliases for USB Devices

IO Libraries Suite automatically gives an alias to each instrument you connect via USB, because VISA addresses for USB devices are long and cumbersome. IO Libraries Suite assigns aliases USBInstrument1, USBInstrument2, etc.; you can change these names by selecting the alias in the Aliases view and changing it. As with all aliases, if the instrument is disconnected, the alias is not deleted, but remains available for use when that same instrument is re-connected. You can delete unneeded aliases in the Aliases view.

Using Aliases with SICL and with Keysight 488

When you create a VISA alias, Connection Expert automatically creates a SICL alias of the same name. You can use a SICL alias in place of a SICL address in the iopen function call, with the same advantages described above.

Programming and Syntax Diagram Conventions

A program message is a message containing commands or queries that you send to the instruments. The following are a few points about program messages:

- You can use either upper-case or lower-case characters.
- You can send several commands in a single message. Each command must be separated from the next one by a semicolon (;).
- A command message is ended by a line feed character (LF).
- You can use any valid number/unit combination.

  In other words, 1500NM,1.5UM and 1.5E-6M are all equivalent.

  If you do not specify a unit, then the default unit is assumed. The default unit for the commands are given with command description in the next chapter.

Short Form and Long Form

The instrument accepts messages in short or long forms.

For example, the message

```
:STATUS:OPERATION:ENABLE 768
```

is in long form.

The short form of this message is

```
:STAT:OPER:ENAB 768
```

In this manual, the messages are written in a combination of upper and lower case. Upper case characters are used for the short form of the message.

For example, the above command would be written

```
:STATus:OPERation:ENABle
```

The first colon can be left out for the first command or query in your message. That is, the example given above could also be sent as

```
STAT:OPER:ENAB 768
```

Command and Query Syntax

All characters not between angled brackets must be sent exactly as shown.

The characters between angled brackets (<...>) indicate the kind of data that you should send, or that you get in a response. You do not type the angled brackets in the actual message.

Descriptions of these items follow the syntax description. The following types of data are most commonly used:

string	is ascii data. A string is contained between double quotes ("...") or single quotes ('...').
value	is numeric data in integer (12), decimal (34.5) or exponential format (67.8E-9).
wsp	is a white space.

Other kinds of data are described as required.

The characters between square brackets ([...]) show optional information that you can include with the message.

The bar (|) shows an either-or choice of data, for example, a|b means either a or b, but not both simultaneously.

Extra spaces are ignored, so spaces can be inserted to improve readability.

Units

Where units are given with a command, usually only the base units are specified. The full sets of units are given in the table below.

Unit	Default	Allowed Mnemonics
meters	M	PM, NM, UM, MM, M
decibel	DB	MDB, DB
second	S	NS, US, MS, S
decibel/1mW	DBM	MDBM, DBM
Hertz	HZ	HZ, KHZ, MHZ, GHZ, THZ
Watt	Watt	PW, NW, UW, MW, Watt
meters per second	M/S	NM/S, UM/S, MM/S, M/S

Data Types

With the commands you give parameters to the instrument and receive response values from the instrument. Unless explicitly specified these data are given in ASCII format. The following types of data are used:

- Boolean data may only have the values 0 or 1.
- Integer range is given for each individual command.
- Float variables may be given in decimal or exponential writing (0.123 or 123E-3).
- All Float values conform to the 32 bit IEEE Standard, that is, all Float values are returned as 32-bit real values.

- A string is contained between double quotes ("...") or single quotes ('...'). When the instrument returns a string, it is always included in " " and terminated by <END>.
- When a register value is given or returned (for example *ESE), the decimal values for the single bits are added. For example, a value of nine means that bit 0 and bit 3 are set.
- Larger blocks of data are given as Binary Blocks, preceded by "#<H><Len><Block>", terminated by <END>; <H> represents the number of digits, <Len> represents the number of bytes, and <Block> is the data block. For example, for a Binary Block with 1 digit and 6 bytes this is: #16TRACES<END>. The block represents an array of numbers.
- Each number has the byte ordering least significant byte first, also called LSBfirst, little-endian or Intel byte ordering.

NOTE Note that within your program, calculations with wavelengths may require double-precision 64-bit floats to provide the desired resolution.

Message Queues

The instrument exchanges messages using an input and an output queue.

Error messages are kept in a separate error queue.

How the Input Queue Works

The input queue is a FIFO queue (first-in first-out). Incoming bytes are stored in the input queue. The parser starts if the LF character is received.

Clearing the Input Queue

Switching the power off, or sending a Device Interface Clear signal, causes commands that are in the input queue, but have not been executed to be lost.

The Output Queue

The output queue contains responses to query messages. The instrument transmits any data from the output queue when a controller addresses the instrument as a talker.

Each response message ends with a LF (0A16). If no query is received, or if the query has an error, the output queue remains empty.

The Message Available bit (MAV, bit 4) is set in the Status Byte register whenever there is data in the output queue.

The Error Queue

The error queue is 30 errors long. It is a FIFO queue (first-in first-out). That is, the first error read is the oldest error to have occurred. For example:

1. 1 If no error has occurred, the error queue contains:
   + 0, "No error"
2. After a command such as wav:pow, the error queue now contains:
   + 0, "No error"
   -113, "Undefined header"
3. If the command is immediately repeated, the error queue now contains:
   + 0, "No error"
   -113, "Undefined header"
   -113, "Undefined header"

If more than 29 errors are put into the queue, the message:

-350, "Queue overflow"

is placed as the last message in the queue.

Common Commands

The IEEE 488.2 standard has a list of reserved commands, called common commands. Some of these commands must be implemented by any instrument using the standard, others are optional. Your instrument implements all the necessary commands, and some optional ones. This section provides the description of these commands.

Common Command Summary

The following table provides a summary of the common commands.

Command	Function
*CLS	Clear Status Command
*ESE	Standard Event Status Enable Command
*ESE?	Standard Event Status Enable Query
*ESR?	Standard Event Status Register Query
*IDN?	Identification Query

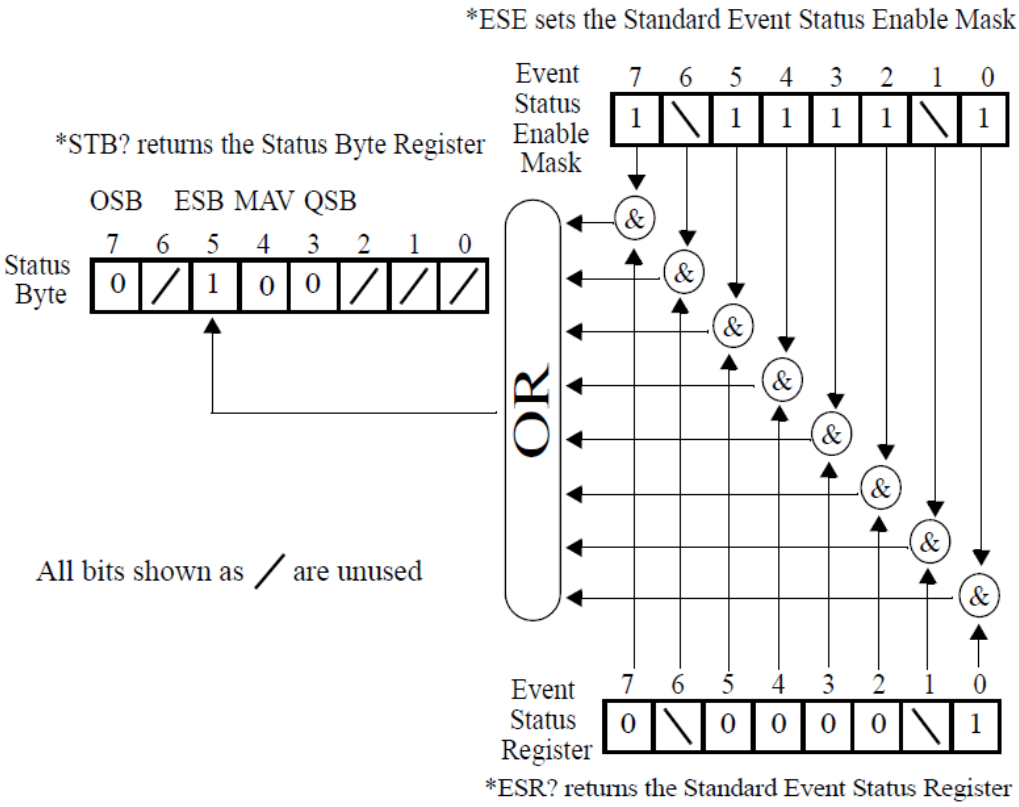
Command	Function
*OPC	Operation Complete Command
*OPC?	Operation Complete Query
*OPT?	Options Query
*RST	Reset Command
*STB?	Read Status Byte Query
*TST?	Self Test Query
*WAI	Wait Command

These commands are described in more detail in IEEE-Common Commands on page 97.

Common Status Information

There are three registers for the status information. Two of these are status-registers and one is an enable-registers. These registers conform to the IEEE Standard 488.2-1987. You can find further descriptions of these registers under *ESE, *ESR?, and *STB?.

The following figure shows how the Standard Event Status Enable Mask (SESEM) and the Standard Event Status Register (SESR) determine the Event Status Bit (ESB) of the Status Byte.



The SESR contains the information about events that are not slot specific. For details of the function of each bit of the SESR, see Standard Event Status Register.

The SESEM allows you to choose the event that may affect the ESB of the Status Byte. If you set a bit of the SESEM to zero, the corresponding event cannot affect the ESB. The default is for all the bits of the SESEM to be set to 0.

NOTE Unused bits in any of the registers change to 0 when you read them.

Instrument Setup and Status

This chapter gives descriptions of commands that you can use when setting up your instrument. The commands are split into the following separate subsytems:

- IEEE specific commands that were introduced in Common Commands on page 94.
- STATus subsystem commands that relate to the status model.
- SYSTem subsystem commands that control the serial interface and internal data.

IEEE-Common Commands

The IEEE 488.2 standard has a list of reserved commands, called common commands. Some of these commands must be implemented by any instrument using the standard, others are optional. Your instrument implements all the necessary commands, and some optional ones. This section provides the description of these IEEE common commands.

Command	Function	Reference
*CLS	Clear Status Command	*CLS on page 98
*ESE	Standard Event Status Enable Command	*ESE on page 98
*ESE?	Standard Event Status Enable Query	*ESE? on page 99
*ESR?	Standard Event Status Register Query	*ESR? on page 99
*IDN?	Identification Query	*IDN? on page 99
*OPC	Operation Complete Command	*OPC on page 100
*OPC?	Operation Complete Query	*OPC? on page 100
*OPT?	Options Query	*OPT? on page 100
*RST	Reset Command	*RST on page 101
*STB?	Read Status Byte Query	*STB? on page 101

Command	Function	Reference
*TST?	Self-Test Query	*TST? on page 102
*WAI	Wait Command	*WAI on page 102

*CLS

Syntax	*CLS
Description	The Clear Status (*CLS) command clears the status byte by emptying the error queue and clearing all the event registers (SESR) including the Data Questionable Event Register, the Standard Event Status Register, the Standard Operation Status Register and any other registers that are summarized in the status byte.
Parameters	none
Response	none
Example	*CLS

*ESE

Syntax	*ESE<wsp><value> 0 ≤ value ≤ 255
Description	The standard Event Status Enable command (*ESE) sets bits in the Standard Event Status Enable Mask (SESEM) that enable the corresponding bits in the standard event status register (SESR). The register is cleared: at power-on, by sending a value of zero. The register is not changed by the *CLS commands.
Parameters	The bit value for the register (a 16-bit signed integer value):

Bit	Mnemonic	Decimal Value
7 (MSB)	Power On	128
6	Not Used	64
5	Command Error	32
4	Execution Error	16
3	Device Dependent Error	8
2	Query Error	4
1	Not Used	2
0 (LSB)	Operation Complete	1

Response	none

Example	*ESE 255

*ESE?

Syntax	*ESE?
Description	The standard Event Status Enable query *ESE? returns the contents of the Standard Event Status Enable Mask (see *ESE for information on this register).
Parameters	none
Response	The bit value for the register (a 16-bit signed integer value).
Example	*ESE? –> 255

*ESR?

Syntax	*ESR?
Description	The standard Event Status Register query *ESR? returns the contents of the Standard Event Status Register. The register is cleared after being read.
Parameters	none
Response	The bit value for the register (a 16-bit signed integer value):

Bit	Mnemonic	Decimal Value
7 (MSB)	Power On	128
6	Not used	64
5	Command Error	32
4	Execution Error	16
3	Device Dependent Error	8
2	Query Error	4
1	Not used	2
0 (LSB)	Operation Complete	1

Example	*ESR? -> +255

*IDN?

Syntax	*IDN?
Description	The IDeNtification query *IDN? gets the instrument identification over the interface.
Parameters	none

Response	The identification, for example: MMMMMMMM manufacturer, Keysight Technologies mmmm instrument model number (for example N7776C) ssssssss serial number rrrrrrrrrr firmware revision level
Example	*IDN? -> Keysight Technologies,N7776C,DE42100168,V1.000

*OPC

Syntax	*OPC
Description	Generates the OPC message in the standard event status register when all pending overlapped operations have been completed.
Parameters	none
Response	none
Example	*OPC

*OPC?

Syntax	*OPC?
Description	The OPeration Complete query *OPC? parses all program message units in the input queue, sets the operation complete bit in the Standard Event Status register, and places an ASCII '1' in the output queue, when the contents of the input queue have been processed. Taking advantage of this feature, and using *OPC? in a loop to query until the instrument returns 1, can lead to useful gains in program execution efficiency.
Parameters	none
Response	1 is returned if all modules are ready to execute a new operation. 0 is returned if any module is busy.
Example	*OPC? ->

*OPT?

Syntax	*OPT?
Description	The OPTions query *OPT? returns the options installed in your instrument.
Parameters	none
Response	Returns the part number of all installed options, separated by commas. Slots are listed starting with the lowest slot number, that is, slot 1.
Example	*OPT? -> N7752A-002, N7752A-002, N7752A-001, N7752A-001,

*RST

Syntax	*RST
Description	The ReSeT command *RST sets the mainframe and all modules to the reset setting (standard setting) stored internally. The instrument is placed in the idle state awaiting a command. The *RST command clears the error queue. The *RST command is equivalent to the *CLS command AND the syst:preset command. The following are not changed: Instrument interface address Service request enable register (SRE) Standard Event Status Enable Mask (SESEM) NOTE: When the saved configurations are needed and should not be erased the preset can be done with conf:meas:sett:pres command.
Parameters	none
Response	none
Example	*RST

*STB?

Syntax	*STB?
Description	The STatus Byte query *STB? returns the contents of the Status Byte register.
Parameters	none
Response	The bit value for the register (a 16-bit signed integer value):

Bit	Mnemonic	Decimal Value
7 (MSB)	Operation Status (OSB)	128
6	Not used	0
5	Event Status Bit (ESB)	32
4	Message Available (MAV)	16
3	Questionable Status (QSB)	8
2	Error/Event Queue	4
1	Not used	0
0	Not used	0

Example	*STB? -> 128<END>

*TST?

Syntax	*TST?
Description	The self-TeST query *TST? makes the instrument perform a self-test and place the results of the test in the output queue. If the self-test fails, the results are also put in the error queue. We recommend that you read self-test results from the error queue. No further commands are allowed while the test is running. After the self-test the instrument is returned to the setting that was active at the time the self-test query was processed. The self-test does not require operator interaction beyond sending the *TST? query.
Parameters	none
Response	Selftest failed 1 A value of zero indicates no errors.
Example	*TST? -> 0

*WAI

Syntax	*WAI
Description	The WAIt command prevents the instrument from executing any further commands until the current command has finished executing. Some module firmware includes commands that set a "StatNOPC" flag during execution to indicate that the module is busy. *WAI blocks the GPIB bus to all commands until every module hosted by the instrument is no longer busy. All pending operations, are completed during the wait period.
Parameters	none
Response	none
Example	*WAI

Interface/Instrument Behaviour Settings – The SYSTem Subsystem

The SYSTem subsystem lets you control the instrument's serial interface. You can also control some internal data (like date, time, and so on).

:SYSTem	Reference
:DATE?	:SYSTem:DATE? on page 103
:DATE	:SYSTem:DATE on page 103

:SYSTem	Reference
:HELP:HEADers?	:SYSTem:HELP:HEADers? on page 103
:HELP:ERRors?	:SYSTem:HELP:ERRors? on page 104
:PRESet	:SYSTem:PRESet on page 104
:TIME	:SYSTem:TIME on page 104
:TIME?	:SYSTem:TIME? on page 105
:ERRor[:NEXT]?	:SYSTem:ERRor[:NEXT]? on page 105
:ERRor:COUNt?	:SYSTem:ERRor:COUNt? on page 105
:VERSion?	:SYSTem:VERSion? on page 105
:REBoot	:SYSTem:REBoot on page 106

:SYSTem:DATE?

Syntax	:SYSTem:DATE?
Description	Returns the instrument's internal date.
Parameters	None
Response	The date in the format year, month, day
Example	syst:date? -> +2019,+1,+26

:SYSTem:DATE

Syntax	:SYSTem:DATE<wsp><year>,<month>,<day>
Description	Sets the instrument's internal date.
Parameters	The date in the format year, month, day.
Response	None
Example	syst:date 2019, 1, 26

:SYSTem:HELP:HEADers?

Syntax	:SYSTem:HELP:HEADers?
Description	Returns a list of SCPI commands.
Parameters	None
Response	Returns a list of SCPI commands
Example	syst:help:head? -> Returns a list of all SCPI commands

:SYSTem:HELP:ERRors?

Syntax	:SYSTem:HELP:ERRors?
Description	Return an overview about all Errorcodes and a short description.
Parameters	None
Response	String list of error codes
Example	syst:help:err? -> +0,"No error",-100,"Command error",-101,"Invalid character",-102,"Syntax error",-103,"Invalid separator",-104,"Data type error",-105,"GET not allowed",-108,"Parameter not allowed",...

:SYSTem:PRESet

Syntax	:SYSTem:PRESet
Description	Sets the instrument to the standard settings. The following are not affected by this command: – the interface address, – the output and error queues, – the Service Request Enable register (SRE), – the Status Byte (STB), – the Standard Event Status Enable Mask (SESEM), and – the Standard Event Status Register (SESR). Pressing the "LAN Reset" button for a short time has the same effect. Long pressing of the "LAN Reset" button resets the LAN Parameter.
Parameters	None
Response	None
Example	SYST:PRES

:SYSTem:TIME

Syntax	:SYSTem:TIME<wsp><hour>,<minute>,<second>
Description	Sets the instrument's internal time.
Parameters	24-hour time format: hours (0-23), minutes (0-59), seconds (0-59)
Response	None
Example	:syst:time 20,15,30

:SYSTem:TIME?

Syntax	:SYSTem:TIME?
Description	Returns the instrument's internal time.
Parameters	None
Response	The time in the format hour, minute, second. Hours are counted 0...23 (24 hour time format).
Example	syst:time? -> +20,+15,+30

:SYSTem:ERRor[:NEXT]?

Syntax	:SYSTem:ERRor[:NEXT]?
Description	Returns the next error from the error queue.
Parameters	None
Response	The number of the latest error, and its meaning.
Example	syst:err? -> -113,"Undefined header"

:SYSTem:ERRor:COUNt?

Syntax	:SYSTem:ERRor:COUNt?
Description	Returns the total no. of errors.
Parameters	None
Response	The total count of errors.
Example	syst:err:coun? -> 20

:SYSTem:VERSion?

Syntax	:SYSTem:VERSion?
Description	Returns the SCPI revision to which the instrument complies.
Parameters	None
Response	The revision year and number.
Example	syst:vers? –> 2019.0

:SYSTem:REBoot

Syntax	:SYSTem:REBoot
Description	Reboots the instrument
Parameters	None
Response	None
Example	syst:reb

System Communicate - The :SYST:COMMunicate Subsystem

This section provides the description of the following system commands.

:SYSTem:COMMunicate	Reference
:ETHernet:AUTOip:ENABle?	:SYSTem:COMMunicate:ETHernet:AUTOip:ENABle? on page 108
:ETHernet:AUTOip:ENABle	:SYSTem:COMMunicate:ETHernet:AUTOip:ENABle on page 108
:ETHernet:CANCel	:SYSTem:COMMunicate:ETHernet:CANCel on page 109
:ETHernet:DGATeway	:SYSTem:COMMunicate:ETHernet:DGATeway on page 109
:ETHernet:DGATeway?	:SYSTem:COMMunicate:ETHernet:DGATeway? on page 109
:ETHernet:DGATeway:CURRent?	:SYSTem:COMMunicate:ETHernet:DGATeway:CURRent? on page 109
:ETHernet:DHCP:ENABle?	:SYSTem:COMMunicate:ETHernet:DHCP:ENABle? on page 110
:ETHernet:DHCP:ENABle	:SYSTem:COMMunicate:ETHernet:DHCP:ENABle on page 110
:ETHernet:DOMainname?	:SYSTem:COMMunicate:ETHernet:DOMainname? on page 110
:ETHernet:DOMainname	:SYSTem:COMMunicate:ETHernet:DOMainname on page 110

:SYSTem:COMMunicate	Reference
:ETHer-net:DOMainname:CURRent?	:SYSTem:COMMu-nicate:ETHernet:DOMainname:CURRent? on page 111
:ETHernet:HOSTname?	:SYSTem:COMMunicate:ETHernet:HOSTname? on page 111
:ETHernet:HOSTname	:SYSTem:COMMunicate:ETHernet:HOSTname on page 111
:ETHer-net:HOSTname:CURRent?	:SYSTem:COMMu-nicate:ETHernet:HOSTname:CURRent? on page 111
:ETHernet:NSERver?	:SYSTem:COMMunicate:ETHernet:NSERver? on page 112
:ETHernet:NSERver	:SYSTem:COMMunicate:ETHernet:NSERver on page 112
:ETHernet:NSERver:CURRent?	:SYSTem:COMMu-nicate:ETHernet:NSERver:CURRent? on page 112
:ETHernet:IDN	:SYSTem:COMMunicate:ETHernet:IDN on page 112
:ETHernet:IPADdress?	:SYSTem:COMMunicate:ETHernet:IPADdress? on page 113
:ETHernet:IPADdress	:SYSTem:COMMunicate:ETHernet:IPADdress on page 113
:ETHer-net:IPADdress:CURRent?	:SYSTem:COMMu-nicate:ETHernet:IPADdress:CURRent? on page 113
:ETHernet:MACaddress?	:SYSTem:COMMunicate:ETHernet:MACaddress? on page 113
:ETHernet:NTP:ENABle?	:SYSTem:COMMunicate:ETHernet:NTP:ENABle? on page 114
:ETHernet:NTP:ENABle	:SYSTem:COMMunicate:ETHernet:NTP:ENABle on page 114
:ETHernet:NTP:SERVer?	:SYSTem:COMMunicate:ETHernet:NTP:SERVer? on page 114
:ETHernet:NTP:SERVer	:SYSTem:COMMunicate:ETHernet:NTP:SERVer on page 114
:ETHernet:DESCription?	:SYSTem:COMMunicate:ETHernet:DESCription? on page 115
:ETHernet:DESCription	:SYSTem:COMMunicate:ETHernet:DESCription on page 115
:ETHernet:WHITEList:ENABle?	:SYSTem:COMMu-nicate:ETHernet:WHITEList:ENABle? on page 115
:ETHernet:WHITEList:ENABle	:SYSTem:COMMunicate:ETHernet:WHITEList:ENABle on page 115

:SYSTem:COMMunicate	Reference
:ETHer-net:WHITEList#:IPADdress?	:SYSTem:COMMu-nicate:ETHernet:WHITEList#:IPADdress? on page 115
:ETHer-net:WHITEList#:IPADdress	:SYSTem:COMMu-nicate:ETHernet:WHITEList#:IPADdress on page 116
:ETHernet:WHITEList#:SMASk?	:SYSTem:COMMu-nicate:ETHernet:WHITEList#:SMASk? on page 116
:ETHernet:WHITEList#:SMASk	:SYSTem:COMMu-nicate:ETHernet:WHITEList#:SMASk on page 116
:ETHernet:RESet	:SYSTem:COMMunicate:ETHernet:RESet on page 117
:ETHernet:RESTart	:SYSTem:COMMunicate:ETHernet:RESTart on page 117
:ETHernet:SAVE	:SYSTem:COMMunicate:ETHernet:SAVE on page 117
:ETHernet:SMASk?	:SYSTem:COMMunicate:ETHernet:SMASk? on page 118
:ETHernet:SMASk	:SYSTem:COMMunicate:ETHernet:SMASk on page 118
:ETHernet:SMASk:CURRent?	:SYSTem:COMMunicate:ETHernet:SMASk:CURRent? on page 118

:SYSTem:COMMunicate:ETHernet:AUTOip:ENABle?

Syntax	:SYSTem:COMMunicate:ETHernet:AUTOip:ENABle?
Description	Check whether Automatic IP addressing is enabled or disabled.
Parameters	None
Response	Boolean (0 | 1)
Example	:SYST:COMM:ETH:AUTO:ENAB?

:SYSTem:COMMunicate:ETHernet:AUTOip:ENABle

Syntax	:SYSTem:COMMunicate:ETHernet:AUTOip:ENABle
Description	Enable or disable whether IP addresses can be created automatically by the instrument. Auto-matic IP addressing is only used if DHCP is enabled, but the instrument cannot find a DHCP server.

Parameters	Boolean (0 | 1 | off | on)
Response	None
Example	:SYST:COMM:ETH:AUTO:ENAB 1

:SYSTem:COMMunicate:ETHernet:CANCel

Syntax	:SYSTem:COMMunicate:ETHernet:CANCel
Description	Undo all changes to the network parameters that have been made since the last save, reboot or ":syst:comm:eth:restart" command.
Parameters	None
Response	None
Example	:SYST:COMM:ETH:CANC

:SYSTem:COMMunicate:ETHernet:DGATeway

Syntax	:SYSTem:COMMunicate:ETHernet:DGATeway
Description	Set the default gateway.
Parameters	string (Up to four groups of up to 3 digits, groups separated by ".". Groups with leading zeroes are interpreted as octal numbers.)
Response	None
Example	:syst:comm:eth:dgat “192.168.101.11“

:SYSTem:COMMunicate:ETHernet:DGATeway?

Syntax	SYSTem:COMMunicate:ETHernet:DGATeway?
Description	Get the default gateway.
Parameters	None
Response	String
Example	:syst:comm:eth:dgat? -> “192.168.101.11“

:SYSTem:COMMunicate:ETHernet:DGATeway:CURRent?

Syntax	:SYSTem:COMMunicate:ETHernet:DGATeway:CURRent?
Description	Get the currently used default gateway.

Parameters	None
Response	String
Example	:syst:comm:eth:dgat:curr? -> “192.168.101.11“

:SYSTem:COMMunicate:ETHernet:DHCP:ENABle?

Syntax	:SYSTem:COMMunicate:ETHernet:DHCP:ENABle?
Description	Check whether DHCP is enabled or disabled.
Parameters	None
Response	Boolean (0 | 1)
Example	:syst:comm:eth:dhcp:enab? -> 1

:SYSTem:COMMunicate:ETHernet:DHCP:ENABle

Syntax	:SYSTem:COMMunicate:ETHernet:DHCP:ENABle
Description	Enable or disable DHCP
Parameters	Boolean (0 | 1 | off | on)
Response	None
Example	:syst:comm:eth:dhcp:enab on

:SYSTem:COMMunicate:ETHernet:DOMainname?

Syntax	:SYSTem:COMMunicate:ETHernet:DOMainname?
Description	Get the domain name.
Parameters	None
Response	String
Example	:syst:comm:eth:dom? -> “.companyname.com”

:SYSTem:COMMunicate:ETHernet:DOMainname

Syntax	SYSTem:COMMunicate:ETHernet:DOMainname
Description	Set the domain name (used if DHCP is disabled).
Parameters	String
Response	None
Example	:syst:comm:eth:dom “.companyname.com”

:SYSTem:COMMunicate:ETHernet:DOMainname:CURRent?

Syntax	:SYSTem:COMMunicate:ETHernet:DOMainname:CURRent?
Description	Get the currently used domain name.
Parameters	None
Response	String
Example	:syst:comm:eth:dom:curr? -> ".companyame.com"

:SYSTem:COMMunicate:ETHernet:HOSTname?

Syntax	:SYSTem:COMMunicate:ETHernet:HOSTname?
Description	Get the host name.
Parameters	None
Response	String
Example	:syst:comm:eth:host? -> "K-N7781C-0PP03"

:SYSTem:COMMunicate:ETHernet:HOSTname

Syntax	:SYSTem:COMMunicate:ETHernet:HOSTname
Description	Set the host name.
Parameters	string (maximum 19 characters, though not all characters can be used) The default host name is K-P...P-S...S; where P...P is the product Number, and S...S is as many of the last digits of the serial number as it takes to get a 15 character host name. If you set an empty host name (""), the host name will be set to its default value.
Response	None
Example	:syst:comm:eth:host "N7781C"

:SYSTem:COMMunicate:ETHernet:HOSTname:CURRent?

Syntax	:SYSTem:COMMunicate:ETHernet:HOSTname:CURRent?
Description	Get the current host name.
Parameters	None

Response	String
Example	:syst:comm:eth:host:curr? -> "K-N778xC-12345"

:SYSTem:COMMunicate:ETHernet:NSERver?

Syntax	:SYSTem:COMMunicate:ETHernet:NSERver?
Description	Get the defined (DNS) nameserver for name resolution.
Parameters	None
Response	IP Address String
Example	:syst:comm:eth:nser? -> "1.1.1.1", "2.2.2.2"

:SYSTem:COMMunicate:ETHernet:NSERver

Syntax	:SYSTem:COMMunicate:ETHernet:NSERver
Description	Set one or two nameservers for name resolution. (used if DHCP is disabled).
Parameters	IP Address String
Response	None
Example	:syst:comm:eth:nser "1.1.1.1"

:SYSTem:COMMunicate:ETHernet:NSERver:CURRent?

Syntax	:SYSTem:COMMunicate:ETHernet:NSERver:CURRent?
Description	Get the DNS server addresses assigned from your DHCP sever (this is only valide if DHCP is available and enabled.
Parameters	None
Response	IP Address String
Example	:syst:comm:eth:nser:curr? -> "10.127.72.11","10.127.90.11"

:SYSTem:COMMunicate:ETHernet:IDN

Syntax	:SYSTem:COMMunicate:ETHernet:IDN
Description	The LAN LED on the front panel of the instrument flashes for identification.
Parameters	Boolean (0 | 1 | off | on)
Response	None
Example	:syst:comm:eth:idn 1

:SYSTem:COMMunicate:ETHernet:IPADdress?

Syntax	:SYSTem:COMMunicate:ETHernet:IPADdress?
Description	Get the manually set IP address of the system.
Parameters	None
Response	String
Example	:syst:comm:eth:ipad? -> “192.132.13.2”

:SYSTem:COMMunicate:ETHernet:IPADdress

Syntax	:SYSTem:COMMunicate:ETHernet:IPADdress
Description	Set the IP address of the system manually (used if DHCP is disabled).
Parameters	String (Up to four groups of up to 3 digits, groups separated by ".". Groups with leading zeroes are interpreted as octal numbers.)
Response	None
Example	:syst:comm:eth:ipad “192.132.13.2”

:SYSTem:COMMunicate:ETHernet:IPADdress:CURRent?

Syntax	:SYSTem:COMMunicate:ETHernet:IPADdress:CURRent?
Description	Get the current IP address of the instrument.
Parameters	None
Response	String
Example	:syst:comm:eth:ipad:curr? -> “192.132.13.2”

:SYSTem:COMMunicate:ETHernet:MACaddress?

Syntax	:SYSTem:COMMunicate:ETHernet:MACaddress?
Description	Get the MAC address of the network adapter.
Parameters	None
Response	response string (hexadecimal value).
Example	:syst:comm:eth:mac? -> "00-07-E0-14-AE-08"

:SYSTem:COMMunicate:ETHernet:NTP:ENABle?

Syntax	:SYSTem:COMMunicate:ETHernet:NTP:ENABle?
Description	Returns the usage of a NTP Server
Parameters	None
Response	Boolean (0 | 1)
Example	:syst:comm:eth:ntp:enab? -> 1

:SYSTem:COMMunicate:ETHernet:NTP:ENABle

Syntax	:SYSTem:COMMunicate:ETHernet:NTP:ENABle
Description	Disables or enables instrument's use of NTP. The acronym NTP stands for Network Time Protocol, a protocol for clock synchronization between computer systems.
Parameters	Boolean (0 | 1)
Response	None
Example	:syst:comm:eth:ntp:enab 1

:SYSTem:COMMunicate:ETHernet:NTP:SERVer?

Syntax	:SYSTem:COMMunicate:ETHernet:NTP:SERVer?
Description	Get the defined Network Time Protocol (NTP) server for clock synchronization.
Parameters	None
Response	Address String
Example	:syst:comm:eth:ntp:serv? -> "pool.ntp.org"

:SYSTem:COMMunicate:ETHernet:NTP:SERVer

Syntax	:SYSTem:COMMunicate:ETHernet:NTP:SERVer
Description	Get the defined Network Time Protocol (NTP) server for clock synchronization.
Parameters	Address String
Response	None
Example	:syst:comm:eth:ntp:serv "pool.ntp.org"

:SYSTem:COMMunicate:ETHernet:DESCription?

Syntax	:SYSTem:COMMunicate:ETHernet:DESCription?
Description	Get the desired mDNS service name.
Parameters	None
Example	:syst:comm:eth:desc? -> "Keysight N778xC - 42321"

:SYSTem:COMMunicate:ETHernet:DESCription

Syntax	:SYSTem:COMMunicate:ETHernet:DESCription
Description	Set the desired mDNS service name.
Parameters	Quoted string of up to 260 characters
Response	None
Example	:syst:comm:eth:desc "Keysight N778xC - 42321"

:SYSTem:COMMunicate:ETHernet:WHITEList:ENABle?

Syntax	:SYSTem:COMMunicate:ETHernet:WHITEList:ENABle?
Description	Get the deive access IP whitelist status
Parameters	None
Response	Boolean (0 | 1)
Example	:syst:comm:eth:whitel:enab? +0

:SYSTem:COMMunicate:ETHernet:WHITEList:ENABle

Syntax	:SYSTem:COMMunicate:ETHernet:WHITEList:ENABle
Description	Set or enables the device access IP whitelist
Parameters	Boolean (0 | 1)
Response	None
Example	:syst:comm:eth:whitel:enab 0

:SYSTem:COMMunicate:ETHernet:WHITEList#:IPADdress?

Syntax	:SYSTem:COMMunicate:ETHernet:WHITEList#:IPADdress?

Description	Get one entry from the device access IP whitelist (up to 10 IP Addresses) of permitted client which could control this instrument.
Parameters	IP Address String
Response	None
Example	:syst:comm:eth:whitel1:ipad? " -> 192.168.0.2"

:SYSTem:COMMunicate:ETHernet:WHITEList#:IPADdress

Syntax	:SYSTem:COMMunicate:ETHernet:WHITEList#:IPADdress
Description	Define an entry in the device access IP whitelist (up to 10 IP Addresses) of permitted client which could control this instrument.
Parameters	IP Address String
Response	None
Example	:syst:comm:eth:whitel1:ipad "192.168.0.2"

:SYSTem:COMMunicate:ETHernet:WHITEList#:SMASk?

Syntax	:SYSTem:COMMunicate:ETHernet:WHITEList#:SMASk?
Description	Get an entry in the device access ip whitelist (up to 10 IP Addresses) of permitted client which could control this instrument.
Parameters	Int (1-10)
Response	IP Address String
Example	:syst:comm:eth:whitel1:smas? -> "192.168.0.2"

:SYSTem:COMMunicate:ETHernet:WHITEList#:SMASk

Syntax	:SYSTem:COMMunicate:ETHernet:WHITEList#:SMASk
Description	Define an entry in the device access ip whitelist (up to 10 IP Addresses) of permitted client which could control this instrument.
Parameters	Subnet Mask String
Response	None
Example	:syst:comm:eth:whitel1:smas "192.168.0.2"

:SYSTem:COMMunicate:ETHernet:RESet

Syntax	:SYSTem:COMMunicate:ETHernet:RESet
Description	Press the "LAN Reset" Button for a long time has the same effect. Pressing the "LAN Reset" Button for a short time is the same as system:preset. DHCP On AutoIP On NTP Off Whitelist Off Hostname is a concatenation of product number and serial number. The password for the web based LAN configuration interface is reset to 'blank'.
Parameters	None
Response	None
Example	:syst:comm:eth:res

:SYSTem:COMMunicate:ETHernet:RESTart

Syntax	:SYSTem:COMMunicate:ETHernet:RESTart
Description	Restart the system's network interface with the new parameters. This command only works if the instrument has a working network connection at the time the command is issued. If not you either have to wait until the instrument decides on an IP address using AutoIP or reboot the instrument.
Parameters	None
Response	String
Example	:syst:comm:eth:rest

:SYSTem:COMMunicate:ETHernet:SAVE

Syntax	:SYSTem:COMMunicate:ETHernet:SAVE
Description	Save the system's network interface parameters.
Parameters	None
Response	None
Example	:syst:comm:eth:save

:SYSTem:COMMunicate:ETHernet:SMASk?

Syntax	:SYSTem:COMMunicate:ETHernet:SMASk?
Description	Get the subnet mask.
Parameters	None
Response	String
Example	:syst:comm:eth:smas? -> “255.255.255.0”

:SYSTem:COMMunicate:ETHernet:SMASk

Syntax	:SYSTem:COMMunicate:ETHernet:SMASk
Description	Set the subnet mask.
Parameters	string (Up to four groups of up to 3 digits, groups separated by ".". Groups with leading zeroes are interpreted as octal numbers.)
Response	None
Example	:syst:comm:eth:smas “255.255.255.0“

:SYSTem:COMMunicate:ETHernet:SMASk:CURRent?

Syntax	:SYSTem:COMMunicate:ETHernet:SMASk:CURRent?
Description	Get the currently used subnet mask.
Parameters	None
Response	String
Example	:syst:comm:eth:smas:curr? -> “255.255.255.0”

Measurement Operations & Settings

This chapter gives descriptions of commands that you can use when you are setting up or performing measurements. The commands are split up into the following subsystems:

- Configure subsystem commands that control all instruments.
- TRIGger subsystem commands that control triggering.

Configure Subsystem Commands

This section provides the description of the following commands.

Command	Reference
:CONFigure:MEASurement:SETTing:ACTual?	:CONFigure:MEASurement:SETTing:ACTual? on page 119
:CONFigure:MEASurement:SETTing:NUMBer?	:CONFigure:MEASurement:SETTing:NUMBer? on page 120
:CONFigure:MEASurement:SETTing:PRESet	:CONFigure:MEASurement:SETTing:PRESet on page 120
:CONFigure:MEASurement:SETTing:CANCel	:CONFigure:MEASurement:SETTing:CANCel on page 120
:CONFigure:MEASurement:SETTing:RECall	:CONFigure:MEASurement:SETTing:RECall on page 121
:CONFigure:MEASurement:SETTing:SAVE	:CONFigure:MEASurement:SETTing:SAVE on page 121
:CONFigure:MEASurement:SETTing:ERASe	:CONFigure:MEASurement:SETTing:ERASe on page 121

:CONFigure:MEASurement:SETTing:ACTual?

Syntax	:CONFigure:MEASurement:SETTing:ACTual?
Description	Get the index of the setting currently being used.
Parameters	None

Response	int A value >0 is returned if the setting has been stored in FLASH memory (using :CONFigure:MEASurement:SETTing:SAVE), or has been recalled from FLASH memory (using :CONFigure:MEASurement:SETTing:RECall), and has not been changed since. 0 is returned if the setting has not yet been stored. 0 is returned if the FLASH setting has been deleted (using:CONFigure:MEASurement:SETTing:ERASe) since the last recall or store. -1 is returned if the setting was changed but has not been saved yet.
Example	:conf:meas:sett:act? → +2<END>
Affects	All instruments

:CONFigure:MEASurement:SETTing:NUMBer?

Syntax	:CONFigure:MEASurement:SETTing:NUMBer?
Description	Get the number of settings. In addition to the settings spaces in FLASH memory, the working memory can hold a setting.
Parameters	None
Response	int
Example	:conf:meas:sett:numb? → +1<END>
Affects	All instruments

:CONFigure:MEASurement:SETTing:PRESet

Syntax	:CONFigure:MEASurement:SETTing:PRESet
Description	Resets the setting values in the working memory. In contrast to the *RST and System:Preset commands, the previous stored settings remain in nonvolatile RAM and can be recalled again.
Parameters	None
Response	None
Example	:conf:meas:sett:pres
Affects	All instruments

:CONFigure:MEASurement:SETTing:CANCel

Syntax	:CONFigure:MEASurement:SETTing:CANCel
Description	Discard all the changes to the setting since the last save or recall
Parameters	None
Response	None
Example	:conf:meas:sett:canc
Affects	All instruments

:CONFigure:MEASurement:SETTing:RECall

Syntax	:CONFigure:MEASurement:SETTing:RECall
Description	Recall a setting from FLASH memory.
Parameters	Integer
Response	None
Example	:conf:meas:sett:rec 1
Affects	All instruments

:CONFigure:MEASurement:SETTing:SAVE

Syntax	:CONFigure:MEASurement:SETTing:SAVE
Description	Save the current setting to FLASH memory.
Parameters	Integer
Response	None
Example	:conf:meas:sett:sav 1
Affects	All instruments

:CONFigure:MEASurement:SETTing:ERASe

Syntax	:CONFigure:MEASurement:SETTing:ERASe
Description	Erase a setting from memory.
Parameters	Integer
Response	None
Example	:conf:meas:sett:eras 1
Affects	All instruments

Trigger Subsystem Commands

The TRIGger Subsystem allows you to configure how the instrument reacts to incoming or outgoing triggers. This section provides the description of the trigger commands.

Command	Reference
:TRIGger	:TRIGger on page 122

Command	Reference
:TRIGger:CONFiguration	:TRIGger:CONFiguration on page 122
:TRIGger:CONFiguration?	:TRIGger:CONFiguration? on page 123

:TRIGger

Syntax	:TRIGger<wsp>NODEA|1|NODEB|2
Description	Generates a hardware trigger.
Parameters	1 or NODEA: Is identical to a trigger at the Input Trigger Connector. 2 or NODEB: Generates trigger at the Output Trigger Connector. A hardware trigger cannot be effective in the DISabled triggering mode but can be effective in DEFault, PASSthrough or LOOPback triggering modes, see Trigger Subsystem Commands on page 121 for information on triggering modes.
Response	None
Example	trig 1

:TRIGger:CONFiguration

Syntax	:TRIGger:CONFiguration
Description	Sets the hardware trigger configuration with regard to Output and Input Trigger Connectors.
Parameters	0 or DISabled: Trigger connectors are disabled. 1 or DEFault: The Input Trigger Connector is activated, the incoming trigger response for each slot 2 or PASSthrough: The same as DEFault but a trigger at the Input Trigger Connector generates a trigger at the Output Trigger Connector automatically. No triggers from the instrument at the output. 3 or LOOPback: The same as PASSthrough. This is included for compatibility reasons. 4 or SCRambler2polarimeter: The internal polarization scrambler forward the trigger-out signal to the built-in polarimeter. This signal can be delayed by configure the :PCONtroller:SEQuence:HOLDoff command). 5 or POLarimeter2scrambler: The internal polarimeter forward the trigger-out signal to the built-in scrambler.
Response	None
Example	trig:conf dis
Affects	All modules (SCR and POL are only available at the N7786C and N7788C which have a build-in polarization scrambler and polarimeter).

:TRIGger:CONFiguration?

Syntax	:TRIGger:CONFiguration?
Description	Returns the hardware trigger configuration.
Parameters	None
Response	0 or DISabled: Trigger connectors are disabled. 1 or DEFault: The Input Trigger Connector is activated, the incoming trigger response for each slot 2 or PASSthrough: The same as DEFault but a trigger at the Input Trigger Connector generates a trigger at the Output Trigger Connector automatically. No triggers from the instrument at the output. 3 or LOOPback: The same as PASSthrough. This is included for compatibility reasons. 4 or SCRambler2polarimeter: The internal polarization scrambler forward the trigger-out signal to the built-in polarimeter. This signal can be delayed by configure the :PCONtroller:SEQuence:HOLDoff command). 5 or POLarimeter2scrambler: The internal polarimeter forward the trigger-out signal to the built-in scrambler.
Example	trig:conf? DIS
Affects	All modules (SCR and POL are only available at the N7786C and N7788C which have a build-in polarization scrambler and polarimeter).

Polarization Analyzer Commands

The Polarization Analyzer subsystem includes the following commands:

Command	Reference
:POLarimeter:AGFLag	:POLarimeter:AGFLag on page 126
:POLarimeter:AGFLag?	:POLarimeter:AGFLag? on page 127
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:POLarimeter:AGFLag

Syntax	:POLarimeter:AGFLag
Description	Enable or disable auto gain NOTE - Auto Gain is disabled when setting manual Gain with the POL:GAIN command. NOTE - Auto gain setting is ignored in Logging / Sweep and Stabilizer Mode.
Parameters	0: auto gain off 1: auto gain on
Example	pol:agfl 1
Affects	N7781C / N7786C / N7788C

:POLarimeter:AGFLag?

Syntax	:POLarimeter:AGFLag?	
Description	Returns the auto gain flag	
Parameters	None	
Response	A boolean value:	0 –auto gain is switched off 1 – auto gain is switched on
Example	pol:agfl? -> 1	
Affects	N7781C / N7786C / N7788C	

:POLarimeter:FUNCtion:RESult?

Syntax	:POLarimeter:FUNCtion:RESult?
Description	Returns a binblock with measured power
Parameters	None
Response	binblock float
Example	pol:func:res? → binblock
Affects	N7781C / N7786C / N7788C

:POLarimeter:GAIN

Syntax	:POLarimeter:GAIN<wsp><gain level>
Description	0...5 = High Bandwith about 250kHz 6,7 = Medium Bandwith about 100kHz 8,9 = Slow Bandwith about 10kHz NOTE - Use only gain between 0 and 7 for Stabilizer Mode because 8 and 9 have a small Bandwith. For best results check the Leveling of the Polarimeter. Look at the POL:SWE:LPR? command. Maximum Speed is at Gain 0 to 5 Even Gains have Factors of 10 and odd Gains Factors of 8. Choose what fits better.
Parameters	Gain level as integer
Example	pol:gain 5
Affects	N7781C / N7786C / N7788C

:POLarimeter:GAIN?

Syntax	:POLarimeter:GAIN?
Description	Returns the gain level
Parameters	None
Response	Gain level as integer
Example	pol:gain? -> +8
Affects	N7781C / N7786C / N7788C

:POLarimeter:GUI:PER?

Syntax	:POLarimeter:GUI:PER?
Description	Reads PER (polarization extinction ratio) which was calculated by GUI.
Parameters	None
Response	Gain level as integer
Example	POL:GUI:PER? -> 5.6542
Affects	N7781C / N7786C / N7788C

:POLarimeter:GUI:PER:LIVe?

Syntax	:POLarimeter:GUI:PER:LIVe?
Description	Returns the current value of PER (polarization extinction ratio) which is calculated in the GUI.
Parameters	None
Response	Gain level as integer
Example	:POL:GUI:PER:LIV? -> +1.63092
Affects	N7781C / N7786C / N7788C

:POLarimeter:POWer:FETCh?

Syntax	:POLarimeter:POWer:FETCh?
Description	Returns the power from last measurement
Parameters	None

Response	Float
Example	:POL:POW:FETC? -> +1.53759156E-05
Affects	N7781C / N7786C / N7788C

:POLarimeter:POWer:UNIT

Syntax	:POLarimeter:POWer:UNIT<wsp>DBM|0|Watt|1
Description	Sets the power unit
Parameters	0 or DBM: dBm 1 or Watt: Watts
Example	POL:POW:UNIT 1
Affects	N7781C / N7786C / N7788C

:POLarimeter:POWer:UNIT?

Syntax	:POLarimeter:POWer:UNIT?
Description	Returns the power unit
Parameters	None
Response	0: dBm 1: Watt
Example	POL:POW:UNIT? -> 1
Affects	N7781C / N7786C / N7788C

:POLarimeter:POWer?

Syntax	:POLarimeter:POWer?
Description	Returns the measured optical power in configured power unit
Parameters	None
Response	Float
Example	:POL:POW? -> +1.53759156E-05
Affects	N7781C / N7786C / N7788C

:POLarimeter:SOP:FETCh?

Syntax	:POLarimeter:SOP:FETCh?
Description	Returns the measured S0, S1, S2 and S3 stokes parameter The normalized Stokes parameter are obtained by dividing the Stokes parameters by the total optical power s1 = S1/S0 s2=S2/S0 s3=S3/S0
Parameters	None
Response	Comma-separated values
Example	:POLarimeter:SOP:FETCH? -> +1.53819801E-05,+1.15407602E-05,+4.74578428E06,+5.56273017E-06
Affects	N7781C / N7786C / N7788C

:POLarimeter:SOP?

Syntax	:POLarimeter:SOP?
Description	Returns the measured S0, S1, S2 and S3 stokes parameter The normalized Stokes parameter are obtained by dividing the Stokes parameters by the total optical power s1 = S1/S0 s2=S2/S0 s3=S3/S0
Parameters	None
Response	Comma-separated values
Example	:POLarimeter:SOP? -> +1.53819801E-05,+1.15407602E-05,+4.74578428E-06,+5.56273017E-06
Affects	N7781C / N7786C / N7788C

:POLarimeter:STOP

Syntax	:POLarimeter:SWEep:STOP
Description	Stops logging
Parameters	None
Example	pol:swe:stop
Affects	N7781C / N7786C / N7788C

:POLarimeter:SWEep:CONTinuous:SACCuracy

Syntax	:POLarimeter:SWEep:CONTinuous:SACCuracy
Description	Sets the SOP accuracy in rad used in the continuous sampling mode. A value of 0 causes all samples to be stored. Otherwise SOP changes smaller than SOP accuracy will not cause a sample to be stored.
Parameters	SOP accuracy in rad
Example	pol:swe:cont:sacc 0.1
Affects	N7781C / N7786C / N7788C

:POLarimeter:SWEep:CONTinuous:SACCuracy?

Syntax	:POLarimeter:SWEep:CONTinuous:SACCuracy?
Description	Returns the SOP accuracy in rad used in the continuous sampling mode.
Parameters	None
Response	SOP accuracy in rad
Example	pol:swe:cont:sacc? → +0.00000000E+00
Affects	N7781C / N7786C / N7788C

:POLarimeter:SWEep:GET:INDex?

Syntax	:POLarimeter:SWEep:GET:INDex?
Description	Returns the number of already finished logging loops
Parameters	None
Response	Integer
Example	pol:swe:get:ind? → +1120055703
Affects	N7781C / N7786C / N7788C

:POLarimeter:SWEep:GET?

Syntax	:POLarimeter:SWEep:GET?<wsp>[SOP|NORMalized]
Description	This command returns the measurement result as float binblock.

Parameters	None: returns 4,* dimensional array with S_0, S_1, S_2, S_3 SOP: returns 4,* dimensional array with S_0, S_1, S_2, S_3 NORMalized: returns 3,* dimensional array with S_1, S_2, S_3
Response	float binblock
Example	pol:swe:get? sop
Affects	N7781C / N7786C / N7788C

:POLarimeter:SWEep:LOOP

Syntax	:POLarimeter:SWEep:LOOP
Description	Sets the number of loops, which should be logged after starting
Parameters	integer 0: endless
Example	:POLarimeter:SWEep:LOOP 1
Affects	N7781C / N7786C / N7788C

:POLarimeter:SWEep:LOOP?

Syntax	:POLarimeter:SWEep:LOOP?
Description	Gets the number of loops, which should be logged after starting
Parameters	None
Response	Integer
Example	pol:swe:loop?
Affects	N7781C / N7786C / N7788C

:POLarimeter:SWEep:LPRange?

Syntax	:POLarimeter:SWEep:LPRange?
Description	Returns how well the ADC range was used for the last peak power. If this value is below 0.5, the measurement sweep should be repeated with a higher amplifier gain setting. If the Value is > 1.0 then there is an increasing Risk of Overflow. Select a lower amplifier setting in this case. NOTE: use only gain between 0 and 7 for Stabilizer Mode because 8 and 9 have a small Bandwith

Parameters	None
Response	Float
Example	pol:swe:lpr? → +0.50000000E+00
Affects	N7781C / N7786C / N7788C

:POLarimeter:SWEep:RATe

Syntax	:POLarimeter:SWEep:RATe<wsp>[nm/s|pm/s]
Description	This command sets the sweep rate in m/s. When performing a swept measurement, very often, the wavelength is changed over time. This parameter allows you to inform the instrument about the speed at which the wavelength of the laser source is changing. The start wavelength is given by the property Wavelength. This works for disabled trigger input only. If you want to sweep with trigger input, please set sweep step: :POLarimeter:SWEep:STEP on page 136.
Parameters	Float sweep rate in nm/s. If you do not pass unit, assumption is m/s.
Example	pol:swe:rat 40nm/s
Affects	N7781C / N7786C / N7788C

:POLarimeter:SWEep:RATe?

Syntax	:POLarimeter:SWEep:RATe?
Description	This command returns the sweep rate in m/s.
Parameters	None
Response	float sweep rate
Example	pol:swe:rat? → +4.00000000E-08
Affects	N7781C / N7786C / N7788C

:POLarimeter:SWEep:SAMPles

Syntax	:POLarimeter:SWEep:SAMPles
Description	This command sets the number of samples/logging count (1-1048576)
Parameters	Number of samples
Example	pol:swe:samp 1000
Affects	N7781C / N7786C / N7788C

:POLarimeter:SWEep:SAMPles:CURRent?

Syntax	:POLarimeter:SWEep:SAMPles:CURRent?
Description	This command gets the number of already logged values. Will be 0, if logging finished.
Parameters	None
Response	Number of already logged samples.
Example	pol:swe:samp:curr? → +34
Affects	N7781C / N7786C / N7788C

:POLarimeter:SWEep:SAMPles?

Syntax	:POLarimeter:SWEep:SAMPles?
Description	This command gets the number of samples/logging count
Parameters	None
Response	Interger
Example	pol:swe:samp? → +1000
Affects	N7781C / N7786C / N7788C

:POLarimeter:SWEep:SRATe

Syntax	:POLarimeter:SWEep:SRATe<wsp><value>[Hz|kHz|MHz]|MIN|MAX|DEF [,<value>S|MS|US|MIN|MAX|DEF]
Description	This command sets the sampling rate. You can pass just the sampling rate (or MIN, MAX, DEF) or sampling rate and averaging time (or MIN, MAX, DEF). Sampling periode (1/sampling rate) have to be larger or equal averaging time.
Parameters	Sampling rate in Hz or MIN, MAX, DEF Averaging time in s or MIN, MAX, DEF(optional)
Example	pol:swe:srat 0.5MHz,1us
Affects	N7781C / N7786C / N7788C

:POLarimeter:SWEep:SRATe?

Syntax	:POLarimeter:SWEep:SRATe?[<wsp>MIN|MAX|DEF]

Description	This command gets the sampling rate and averaging time
Parameters	None: to get current sampling rate and averaging time MIN: minimum sampling rate MAX: maximum sampling rate DEF: default sampling rate
Response	No parameter: sampling rate in float averaging time in float MIN|MAX|DEF parameter: sampling rate in float
Example	pol:swe:srat? → +1e+06,+1e-06
Affects	N7781C / N7786C / N7788C

:POLarimeter:SWEep:STARt

Syntax	:POLarimeter:SWEep:STARt<wsp>[SOP|SOPCONTINUOUS]
Description	This command starts the polarimeter logging.
Parameters	None: Starts logging as configured SOP: Starts logging and sets loop to 1 SOPCONTINUOUS: Starts logging and sets loop to 0 (endless logging)
Example	pol:swe:star sop
Affects	N7781C / N7786C / N7788C

:POLarimeter:SWEep:STATe?

Syntax	POLarimeter:SWEep:STATe?
Description	This command returns the current logging state Return value status string e.g SAMPLING,NO_DATA
Parameters	None
Response	IDLE,NO_DATA: No data available, logging stopped SAMPLING,DATA_AVAILABLE: Data available, logging running SAMPLING,NO_DATA: No data available, logging running READY,DATA_AVAILABLE: Data available, logging not running IDLE,DATA_AVAILABLE: Data available, logging stopped
Example	pol:swe:stat? -> SAMPLING,DATA_AVAILABLE
Affects	N7781C / N7786C / N7788C

:POLarimeter:SWEep:STEP

Syntax	:POLarimeter:SWEep:STEP<wsp><value>[m|nm|pm]
Description	Sets the sweep step in m
Parameters	Sweep step in m
Example	pol:swe:step 1pm
Affects	N7781C / N7786C / N7788C

:POLarimeter:SWEep:STEP?

Syntax	:POLarimeter:SWEep:STEP?
Description	In SME mode, this is the step (wavelength increased by this value) which is done for every trigger while logging.
Parameters	None
Response	Sweep step in float
Example	pol:swe:step? → +1.00000000E-12
Affects	N7781C / N7786C / N7788C

:POLarimeter:SWEep:TRIGger:POST:SAMPles

Syntax	:POLarimeter:SWEep:TRIGger:POST:SAMPles
Description	Sets the number of post samples. That means samples after trigger event. Numbers of pre samples and post samples have to be smaller than 1048576.
Parameters	Number of post samples
Example	pol:swe:trig:post:samp 2000
Affects	N7781C / N7786C / N7788C

:POLarimeter:SWEep:TRIGger:POST:SAMPles?

Syntax	:POLarimeter:SWEep:TRIGger:POST:SAMPles?
Description	Returns the number of post samples
Parameters	None

Response	Number of post samples
Example	pol:swe:trig:post:samp? → +2000
Affects	N7781C / N7786C / N7788C

:POLarimeter:SWEep:TRIGger:PRE:SAMPles

Syntax	:POLarimeter:SWEep:TRIGger:PRE:SAMPles
Description	Sets the number of pre samples. That means samples before trigger event. Numbers of pre samples and post samples have to be smaller than 1048576.
Parameters	Number of pre samples
Example	pol:swe:trig:pre:samp 1000
Affects	N7781C / N7786C / N7788C

:POLarimeter:SWEep:TRIGger:PRE:SAMPles?

Syntax	:POLarimeter:SWEep:TRIGger:PRE:SAMPles?
Description	Returns the number of pre samples.
Parameters	None
Response	Number of pre samples
Example	pol:swe:trig:pre:samp? → +0
Affects	N7781C / N7786C / N7788C

:POLarimeter:TRIGger:DELay

Syntax	:POLarimeter:TRIGger:DELay<wsp><value>
Description	Defines factor for delay. delay = factor/32MHz That means, trigger event is excuted after specified time after input trigger.
Parameters	Integer number between 0-997 (including limits)
Example	pol:trig:del 10
Affects	N7781C / N7786C / N7788C

:POLarimeter:TRIGger:DELay?

Syntax	:POLarimeter:TRIGger:DELay?

Description	Returns factor for delay. delay = factor/32MHz
Parameters	None
Response	Factor
Example	pol:trig:del? → +0
Affects	N7781C / N7786C / N7788C

:POLarimeter:TRIGger:INPut

Syntax	:POLarimeter:TRIGger:INPut<wsp><value>
Description	Defines the trigger input
Parameters	NONE: Don't wait for trigger TTLHIGH: Wait for rising edge on BNC input TTLLOW: Wait for falling edge on BNC input PRETRIGGER_TTLHIGH: Specified numbers of samples are logged before rising edge on BNC input PRETRIGGER_TTLLOW: Specified numbers of samples are logged before falling edge on BNC input SMEasure: One sample for every trigger will be logged CMEasure: One trigger excutes one loop with specified number of samples MMEasure: One trigger executes specified number of loops with specified number of samples THReshold: Define minimum and maximum treshold power limits for triggering. You have to pass two paramters additionally. If you don't want minimum or maximum limit, send NAN instead of number.
Example	pol:trig:inp NONE pol:trig:inp THR,1mW,5mW
Affects	N7781C / N7786C / N7788C

:POLarimeter:TRIGger:INPut?

Syntax	:POLarimeter:TRIGger:INPut?
Description	Returns input triger configuration.
Parameters	None
Response	Explanation of the parameter see: POLarimeter:TRIGger:INPut
Example	pol:trig:inp? → NONE
Affects	N7781C / N7786C / N7788C

:POLarimeter:TRIGger:OFFSet

Syntax	:POLarimeter:TRIGger:OFFSet
Description	Defines number of triggers, which will be ignored before first trigger event.
Parameters	Trigger offset (integer)
Example	pol:trig:offs 10
Affects	N7781C / N7786C / N7788C

:POLarimeter:TRIGger:OFFSet?

Syntax	:POLarimeter:TRIGger:OFFSet?
Description	Returns number of triggers, which will be ignored before first trigger event.
Parameters	None
Response	Trigger offset
Example	pol:trig:offs? → +0
Affects	N7781C / N7786C / N7788C

:POLarimeter:TRIGger:OUTPut

Syntax	:POLarimeter:TRIGger:OUTPut
Description	Defines trigger output
Parameters	DISabled: no trigger at output BNC AVGover: trigger when averaging starts at output BNC MEASure: trigger when measuring starts at output BNC
Example	pol:trig:outp dis
Affects	N7781C / N7786C / N7788C

:POLarimeter:TRIGger:OUTPut?

Syntax	:POLarimeter:TRIGger:OUTPut?
Description	Returns trigger output configuration
Parameters	None
Response	see POLarimeter:TRIGger:OUTPut

Example	pol:trig:outp? → DISabled
Affects	N7781C / N7786C / N7788C

:POLarimeter:WAVelength

Syntax	:POLarimeter:WAVelength<wsp><wavelength> [PM|NM|UM|MM|M]|MINimum|MAXimum|DEFault
Description	This command sets the current wavelength / start wavelength.
Parameters	The wavelength as a float value. If you specify no units in your command, meters are used as the default.
Example	:POLarimeter:WAVelength 1.550E-06
Affects	N7781C / N7786C / N7788C

:POLarimeter:WAVelength?

Syntax	:POLarimeter:WAVelength? [MINimum|MAXimum|DEFault]	
Description	Returns wavlength	
Parameters	optional	MINimum Returns the minimum wavelength MAXimum Returns the maximum wavelength DEFault Returns default wavelength
Response	The wavelength as a float value in meters.	
Example	pol:wav? 1.550E-06	
Affects	N7781C / N7786C / N7788C	

:POLarimeter:ZERO

Syntax	:POLarimeter:ZERO
Description	Zeros photodiodes. That means dark current is measured and will be subtracted from future measurements.
Parameters	None
Example	pol:zero
Affects	N7781C / N7786C / N7788C

:POLarimeter:ZERO?

Syntax	:POLarimeter:ZERO?
Description	Returns zero result
Parameters	None
Response	0: last zero was successfull 1: last zero failed (too much light, for example)
Example	pol:zero?
Affects	N7781C / N7786C / N7788C

Polarization Synchronous Scrambler

The Polarization Synchronous Scrambler subsystem includes the following commands:

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:PCONtroller:WPLAtes?	:PCONtroller:WPLAtes? on page 145
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:PCONtroller:SEQuence:LENGth?	:PCONtroller:SEQuence:LENGth? on page 145
:PCONtroller:SEQuence:RRATe	:PCONtroller:SEQuence:RRATe on page 145
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:PCONtroller:STARt	:PCONtroller:STARt on page 151
:PCONtroller:REPetition	:PCONtroller:REPetition on page 152
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:PCONtroller:LOAD:DATA?	:PCONtroller:LOAD:DATA? on page 152
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:PCONtroller:GEN:RANDom?	:PCONtroller:GEN:RANDom? on page 153
:PCONtroller:GEN:SCRAmble?	:PCONtroller:GEN:SCRAmble? on page 153
:PCONtroller:SWITch	:PCONtroller:SWITch on page 154
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:PCONtroller:STOP

Syntax	:PCONtroller:STOP
Description	This command stops the Polcontroller.
Parameters	None
Response	None
Example	:PCONtroller:STOP
Affects	N7785C / N7786C / N7788C

:PCONtroller:WPLAtes

Syntax	:PCONtroller:WPLAtes<wsp><orientation waveplate 1>,<retardation waveplate 1>,...
Description	Sets the orientation and retardation of the polarization controller waveplates. The data consists of 12 double values. The order is given by: Orientation Waveplate 1, Retardation Waveplate 1, Orientation Waveplate 2, Retardation Waveplate 2, Orientation Waveplate 3, Retardation Waveplate 3, Orientation Waveplate 4, Retardation Waveplate 4, Orientation Waveplate 5, Retardation Waveplate 5, Orientation Waveplate 6, Retardation Waveplate 6 The orientation is given in grad, the retardation is given in fractions of Lambda. A retardation of 0.25 corresponds to a quarter waveplate. The maximum retardation value is 0.25.
Parameters	Double array with 12 values
Response	None
Example	:PCONtroller:WPLAtes 10,0.25,20,0.25,30,0.25,40,0.25,50,0.25,60,0.25
Affects	N7785C / N7786C / N7788C

:PCONtroller:WPLAtes?

Syntax	:PCONtroller:WPLAtes?
Description	Returns the orientation and retardation of the polarization controller waveplates
Parameters	None
Response	Double array (comma separated values)
Example	:PCONtroller:WPLAtes? -> +0.00000000E+00,+2.50000000E-01,+0.00000000E+00,+2.50000000E-01,+0.00000000E+00,+2.50000000E-01,+0.00000000E+00,+2.50000000E-01,+0.00000000E+00,+2.50000000E-01,+0.00000000E+00,+2.50000000E-01
Affects	N7785C / N7786C / N7788C

:PCONtroller:SEQuence:LENGth

Syntax	:PCONtroller:SEQuence:LENGth<wsp><length>
Description	Set the polarization controller sequence length.
Parameters	Integer value (0-100000)
Response	None
Example	:PCONtroller:SEQuence:LENGth 5
Affects	N7785C / N7786C / N7788C

:PCONtroller:SEQuence:LENGth?

Syntax	:PCONtroller:SEQuence:LENGth?
Description	Get the polarization controller sequence length.
Parameters	None
Response	Int value
Example	:PCONtroller:SEQuence:LENGth? -> +1
Affects	N7785C / N7786C / N7788C

:PCONtroller:SEQuence:RRATe

Syntax	:PCONtroller:SEQuence:RRATe

Description	Set the polarization controller repetition rate for each data point in kHz.
Parameters	Double value
Response	None
Example	:PCONtroller:SEQuence:RRATe 50.2
Affects	N7785C / N7786C / N7788C

:PCONtroller:SEQuence:RRATe?

Syntax	:PCONtroller:SEQuence:RRATe?
Description	Get the polarization controller repetition rate for each datapoint in kHz
Parameters	None
Response	Double value
Example	:PCONtroller:SEQuence:RRATe? +5.02000000E+01
Affects	N7785C / N7786C / N7788C

:PCONtroller:SEQuence:SMODe

Syntax	:PCONtroller:SEQuence:SMODe<wsp><mode>
Description	Sets the sequence mode. A sequence consist of the number of datapoints multiplied by the repetition (repetition=0 means endless) 0 = Sequence will automatically start and restart when reaching the end. 1 = Sequence will automatically start and run only once (like repetition=1). 2 = Sequence will start when a low/high-transition is detected on the BNC input. When reaching the end of the sequence, it will be restarted. 3 = Same as above, except that the sequence will not be repeated. 4 to 6 = sequence stepped mode - single extern trigger config waveform, define repetitions / repetition rate , set SyncMode, start/arm scrambler (:PCON:STARt)
Parameters	Integer value
Response	None
Example	:PCONtroller:SEQuence:SMODe 0
Affects	N7785C / N7786C / N7788C

:PCONtroller:SEQuence:SMODe?

Syntax	:PCONtroller:SEQuence:SMODe?
Description	Returns the current configured Sequence Mode 0 = Sequence will automatically start and restart when reaching the end. 1 = Sequence will automatically start and run only once. 2 = Sequence will start when a low/high-transition is detected on the BNC input. When reachig the end of the sequence, it will be restarted. 3 = Same as above, except that the sequence will not be repeated. 4 to 6 = sequence stepped mode - single external trigger.
Parameters	None
Response	Integer value
Example	:PCONtroller:SEQuence:SMODe? +0
Affects	N7785C / N7786C / N7788C

:PCONtroller:SEQuence:DCOMpensation

Syntax	:PCONtroller:SEQuence:DCOMpensation<wsp><value>
Description	Set the polarization controller drift-compensation. 0 = drift-compensation is OFF (dynamic correction is inactive) 1 = drift-compensation is ON (dynamic correction is active)(DEFAULT)
Parameters	Boolean integer value
Response	None
Example	:PCONtroller:SEQuence:DCOMpensation 1
Affects	N7785C / N7786C / N7788C

:PCONtroller:SEQuence:DCOMpensation?

Syntax	:PCONtroller:SEQuence:DCOMpensation?
Description	Get the polarization controller drift-compensation. 0 = drift-compensation is OFF (dynamic correction is inactive) 1 = drift-compensation is ON (dynamic correction is active)
Parameters	None
Response	Boolean integer value
Example	:PCONtroller:SEQuence:DCOMpensation? 1

Affects	N7785C / N7786C / N7788C

:PCONtroller:SEQuence:HOLDoff

Syntax	:PCONtroller:SEQuence:HOLDoff<wsp><number>
Description	Define an external trigger delay after changing the SOP value
Parameters	Integer value (0-32766) 1 means 1/32 us
Response	None
Example	:PCONtroller:SEQuence:HOLDoff 10
Affects	N7785C / N7786C / N7788C

:PCONtroller:SEQuence:HOLDoff?

Syntax	:PCONtroller:SEQuence:HOLDoff?
Description	Get the external trigger delay after changing the SOP value
Parameters	None
Response	Integer value (0-32766) 1 means 1/32 us
Example	:PCONtroller:SEQuence:HOLDoff? +1
Affects	N7785C / N7786C / N7788C

:PCONtroller:SEQuence

Syntax	:PCONtroller:SEQuence<wsp><488.2 Binary Block>
Description	Sets the polarization controller sequence using waveplate positions and retardations. The parameter list is a series of floating point values. Each waveplate is controlled by two float values: Orientation in grad and Retardation in fractions of Lambda (0.25 corresponds to Lambda 4). Thus, each sequence row contains 12 float values. Hence, the series length has to be a multiple of 12. The order is given by: Orientation Waveplate 1, Retardation Waveplate 1, Orientation Waveplate 2, Retardation Waveplate 2, Orientation Waveplate 3, Retardation Waveplate 3, Orientation Waveplate 4, Retardation Waveplate 4, Orientation Waveplate 5, Retardation Waveplate 5, Orientation Waveplate 6, Retardation Waveplate 6
Parameters	488.2 Binary Block <real32 / double>
Response	None
Example	:PCONtroller:SEQuence <488.2 Binary Block>

Affects	N7785C / N7786C / N7788C

:PCONtroller:SEQuence?

Syntax	:PCONtroller:SEQuence?
Description	Read the last transferred sequence the polarization controller sequence using waveplate positions and retardations Return value: binary block (float values / 32 bit). Each point consist of Orientation in grad and Retardation in fractions of Lambda (0.25 corresponds to Lambda 4). Each sequence data point contains 12 float values. The order is given by: Orientation Waveplate 1, Retardation Waveplate 1, Orientation Waveplate 2, Retardation Waveplate 2, Orientation Waveplate 3, Retardation Waveplate 3, Orientation Waveplate 4, Retardation Waveplate 4, Orientation Waveplate 5, Retardation Waveplate 5, Orientation Waveplate 6, Retardation Waveplate 6
Parameters	None
Response	488.2 Binary Block <real32 / double>
Example	:PCONtroller:SEQuence? <488.2 Binary Block>
Affects	N7785C / N7786C / N7788C

:PCONtroller:SEQuence:SEQVoltage

Syntax	:PCONtroller:SEQuence:SEQVoltage<wsp><488.2 Binary Block>
Description	Sets the polarization controller sequence using the DAC connected to the polarisation controller
Parameters	488.2 Binary Block <word / short>
Response	None
Example	:PCONtroller:SEQuence:SEQVoltage <488.2 Binary Block>
Affects	N7785C / N7786C / N7788C

:PCONtroller:SEQuence:SEQVoltage?

Syntax	:PCONtroller:SEQuence:SEQVoltage?
Description	Get the polarization controller sequence DAC voltage sequence
Parameters	None
Response	488.2 Binary Block <word / short>

Example	:PCONtroller:SEQuence:SEQVoltage?
Affects	N7785C / N7786C / N7788C

:PCONtroller:SCRambler:ENABle

Syntax	:PCONtroller:SCRambler:ENABle
Description	Enables (1) or disables (0) the Scrambler (same function like :PCONtroller:STARt and :PCONtroller:STOP).
Parameters	Integer value 1 = Polcontroller is running 0 = Polcontroller is disables
Response	None
Example	:PCONtroller:SCRambler:ENABle 1
Affects	N7785C / N7786C / N7788C

:PCONtroller:SCRambler:ENABle?

Syntax	:PCONtroller:SCRambler:ENABle?
Description	Returns the current polcontroller state
Parameters	None
Response	Integer value 1 = Polcontroller is running 0 = Polcontroller is disables
Example	:PCONtroller:SCRambler:ENABle? Return +0
Affects	N7785C / N7786C / N7788C

:PCONtroller:STAGe:DAC:ALL?

Syntax	:PCONtroller:STAGe:DAC:ALL?
Description	Returns DAC values for all stages
Parameters	None
Response	Comma separated integer value
Example	:PCONtroller:STAGe:DAC:ALL? -> 39809,49050,39379,42927,37855,46651,36141,46622,34925,49251,35056,49431

Affects	N7785C / N7786C / N7788C

:PCONtroller:STAGe<stage>:DEGree

Syntax	:PCONtroller:STAGe<stage>:DEGree<wsp><orientation>
Description	Set the orientation for each waveplate (lambda/4 plate)
Parameters	<stage> integer value between 1 to 6 <orientation> float value from 0.0 to 359.999
Response	None
Example	:pcon:stag1:deg 75.4
Affects	N7785C / N7786C / N7788C

:PCONtroller:STAGe<stage>:DEGree?

Syntax	:PCONtroller:STAGe<stage>:DEGree?
Description	Get the orientation for each waveplate (lambda/4 plate)
Parameters	<stage> integer value from 1 to 6
Response	Float value
Example	:PCON:STAG5:DEG? -> +2.30000000E+01
Affects	N7785C / N7786C / N7788C

:PCONtroller:STARt

Syntax	:PCONtroller:STARt
Description	Start the polarization sequence with the configured repetition rate, and Sequence Mode
Parameters	None
Response	None
Example	:pcon:star
Affects	N7785C / N7786C / N7788C

:PCONtroller:REPetition

Syntax	:PCONtroller:REPetition<wsp><repetitions>
Description	Sets the polarization controller repetition
Parameters	<repetitions> NOTE: 0 means endless
Response	None
Example	:pcon:rep 10
Affects	N7785C / N7786C / N7788C

:PCONtroller:REPetition?

Syntax	:PCONtroller:REPetition?
Description	Get the polarization controller repetition
Parameters	None
Response	Integer value between 0 to 2147483647
Example	:pcon:rep -> +10
Affects	N7785C / N7786C / N7788C

:PCONtroller:LOAD:DATA?

Syntax	:PCONtroller:LOAD:DATA?<wsp><filename>
Description	Loads a specified arb segment from the internal memory
Parameters	Quoted string filename
Response	status message: "load x datapoints" error message: "Error on dataload"
Example	:PCON:LOAD:DATA? "random.bin" -> "load 40 datapoints"
Affects	N7785C / N7786C / N7788C

:PCONtroller:SAVE:ARB?

Syntax	:PCONtroller:SAVE:ARB?
Description	Save the current arb sequence in nonvolatile memory

Parameters	None
Response	"save 4 datapoints"
Example	:pcon:save:arb? -> "save 4 datapoints"
Affects	N7785C / N7786C / N7788C

:PCONtroller:LOAD:ARB?

Syntax	:PCONtroller:LOAD:ARB?
Description	Load an arbitrary waveform
Parameters	None
Response	Status message: "load x datapoints" Error message: "Error on dataload"
Example	:pcon:load:arb? -> "load 4 datapoints"
Affects	N7785C / N7786C / N7788C

:PCONtroller:GEN:RANDom?

Syntax	:PCONtroller:GEN:RANDom? <datapoints>,<stepwidth>
Description	Generate a random walk sequence with a maximum stepwidth
Parameters	<datapoints> integer value between 0 to 1000000 <stepwidth> integer value between 0 to 65535
Response	String "GEN DONE"
Example	:PCON:GEN:RAND? 4,2000' -> "GEN DONE"
Affects	N7785C / N7786C / N7788C

:PCONtroller:GEN:SCRAmble?

Syntax	:PCONtroller:GEN:SCRAmble?<wsp><number>
Description	Generate a random sequence. Example: :PCON:GEN:SCRA? #Datapoints Example: :PCON:GEN:SCRA 120000 Return Value = status string "GEN DONE"
Parameters	<number> integer value from 1-1000000
Response	Status message: "GEN DONE" when the generation is finished

Example	:PCONtroller:GEN:SCRAmble? 300' -> "GEN DONE"
Affects	N7785C / N7786C / N7788C

:PCONtroller:SWITch

Syntax	:PCONtroller:SWITch
Description	Sets the optical switch in the N7788B
Parameters	Integer value 0 = optical Scrambler Input signal will be routed to the internal polarimerer 1 = optical Scrambler Input signal will be routed to the Scrambler Output
Response	None
Example	:pcon:swit 1
Affects	N7788C

:PCONtroller:SWITch?

Syntax	:PCONtroller:SWITch?
Description	Gets the optical switch build in the N7788C NOTE: this value is the last set value to set the latching MEMS-switch!
Parameters	None
Response	Integer value 0 = optical Scrambler Input signal will be routed to the internal polarimerer 1 = optical Scrambler Input signal will be routed to the Scrambler Output
Example	:pcon:swit? -> +0
Affects	N7788C

Polarization Synthesizer / Polarization Component Analyzer

Command	Reference
:STABilizer:STABilize	:STABilizer:STABilize on page 155
:STABilizer:STABilize?	:STABilizer:STABilize? on page 156
:STABilizer:STABilize:DIFFerence?	:STABilizer:STABilize:DIFFerence?
:STABilizer:SOP	:STABilizer:SOP on page 157
:STABilizer:SOP?	:STABilizer:SOP? on page 157

:STABilizer:STABilize

Syntax	:STABilizer:STABilize<wsp> <value>,[SOP|EXTernal|PMAX|PMIN]
Description	Sets the Stabilizer Operating Mode. NOTE - The stabilizer function configures and controls both, the Scrambler and the Polarimeter including intern and extern Trigger Configuration. After Stopping the Stabilizer Mode use System:Preset or *RST to activate the normal Scrambler and Polarimeter Mode NOTE - Use only gain between 0 and 7 for Stabilizer Mode because 8 and 9 have a small Bandwith e.g. POL:GAIN 6 Auto Gain is disabled when using Logging / Sweep and Stabilizer Mode For best results check the Leveling of the Polarimeter. Look at the POL:SWE:LPR? command. Maximum Speed is at Gain 0 to 5 Even Gains have Factors of 10 and odd Gains Factors of 8. Choose what fits better. NOTE - If the stabilizer function is active then most other Commands to Scrambler and Polarimeter including Zeroing are blocked. NOTE - An "On Startup Stabilize Mode" where stabilizing is automatically on after reboot can be enabled by saving the Configuration in one of the 10 Setting Positions e.g. with following commands: :stab:sop 1,0,0 :stab:stab 1 :conf:meas:sett:save 1

Parameters	– 0 = Stabilizer Off (Default) – 1 = Stabilizer On optional Parameter – SOP: stabilizes the SOP. Same as without optional parameter (N7786C/88C) – EXTernal: External Feedback manual Mode known from N7785C also for N7786C/88C – PMAX: stabilize the intern polarimeter power to MAX. Only for N7788C – PMIN: stabilize the intern polarimeter power to MIN. Only for N7788C
Response	None
Example	:STAB:STAB 1 :STAB:STAB 1,EXT
Affects	N7785C, N7786C, N7788C

:STABilizer:STABilize?

Syntax	:STABilizer:STABilize?
Description	Gets the Stabilizer Operating Mode.
Parameters	None
Response	– 0 = Stabilizer Off (Default) – 1 = Stabilizer On – 1,EXTernal = Stabilizer On with external Feedback – 1,PMAX = Stabilizer On, stabilize the intern polarimeter power to MAX(only N7788C) – 1,PMIN = Stabilizer On, stabilize the intern polarimeter power to MIN (only N7788C)
Example	:STAB:STAB? → 1
Affects	N7785C, N7786C, N7788C

:STABilizer:STABilize:DIFFerence?

Syntax	:STABilizer:STABilize:DIFFerence?
Description	Gets the stabilizer difference radian angle from the current SOP to target SOP. Only in N7786C and N7788C in the SOP Stabilizer Mode.
Parameters	None
Response	radian angle from the current SOP to target SOP
Example	:STAB:STAB? → +1.06229
Affects	N7786C, N7788C

:STABilizer:SOP

Syntax	:STABilizer:SOP<wsp> <s1>,<s2>,<s3>[,<Factor>]
Description	Sets the target SOP for the Stabilizer. – For the N7786C and N7788C which have a build in Polarimeter the target SOP must be provided as a 3-element normalized Stokes vector (s1,s2,s3 with DOP=1). If the DOP is not 1, then it will be normalized before processing. – For stabilizing in the :STAB:STAB 1,EXTernal Mode, the fourth parameter must be used. The first 3 parameters (s1, s2,s3) are ignored. The feedback parameter (<Factor>) is a positive real number and is determined from a measurement at the DUT that depends on the incoming polarization, such as a power measurement of the output signal from the DUT. By repeatedly sending updates of this value to the N7785C, the instrument adjusts its output polarization to minimize the parameter value after sending a 'TRIG 1' command. Further details can be found in Applications Note 3120-1564 (Polarization Alignment Methods). – The procedure for stabilizing in the :STAB:STAB 1,EXTernal Mode is: – STABilizer:STABilize 0 to deactivate stabilization – STABilizer:STABilize 1 to activate stabilization – STABILIZER:SOP 0,0,0,<Factor> to enter the feedback parameter – TRIG 1 to trigger the next stabilization dithering step – The last 2 steps should be repeated with updated values
Parameters	– normalized Stokes vector optional: – for the N7788C in the PMAX or PMIN Mode the fourth parameter must be used. The first 3 parameters (s1, s2,s3) are ignored. The loop gain parameter (<Factor>) is a positive real number between 0.0001 and 10000. Default is 1.0
Response	None
Example	N7786C/88C: → stab:sop 0,1,0 N7785C/86C/88C: → stab:sop 0,0,0,1.234 in the :STAB:STAB 1,EXTernal Mode
Affects	N7785C, N7786C, N7788C

:STABilizer:SOP?

Syntax	:STABilizer:SOP?<wsp>[SOP|EXTernal|PMAX|PMIN]
Description	Gets the target SOP. NOTE - For the N7786C/88C, when the Stabilizer invert is On, then the STABilizer:SOP? command returns the inverted Target SOP which is the SOP the Stabilizer uses.

Parameters	optional Parameter – SOP: returns the three SOP states. Same as without optional parameter (N7786C/88C) – EXTernal: returns the last of the 4 Response Values is the External Feedback manual Mode – PMAX: returns the stabilize intern polarimeter power to MAX – PMIN: returns the stabilize intern polarimeter power to MIN
Response	A 4-element Stokes vector.
Example	N7785C: stab:sop? → +0.00000000E+00,+0.00000000E+00,+0.00000000E+00,+1.23400000E+00 N7786C/88C: stab:sop? → +0.00000000E+00,+1.00000000E+00,+0.00000000E+00 N7786C/88C: stab:sop? PMAX → +0.00000000E+00,+1.00000000E+00,+0.00000000E+00 ,+1.23400000E+00
Affects	N7785C, N7786C, N7788C

Error Codes

This chapter gives information about error codes used with the N777xC Tunable Laser Source.

Error strings in the range -100 to -183 are defined by the SCPI standard, downloadable from: http://www.ivifoundation.org/docs/scpi-99.pdf

Error Number	Error String
0	"No error"
-100	"Command Error" [This is the generic syntax error used when a more specific error cannot be detected. This code indicates only that a Command Error as defined in IEEE 488.2,11.5.1.1.4 has occurred.]
-101	"Invalid character" [A syntactic element contains a character which is invalid for that type; for example, a header containing an ampersand, SETUP&. This error might be used in place of error -114 and perhaps some others.]
-102	"Syntax error" [An unrecognized command or data type was encountered; for example, a string was received when the device does not accept strings.]
-103	"Invalid separator" [The parser was expecting a separator and encountered an illegal character; for example, the semicolon was omitted after a program message unit]
-104	"Data type error" [The parser recognized a data element different than one allowed; for example,numeric or string data was expected but block data was encountered.]
-105	"GET not allowed" [A Group Execute Trigger was received within a program message (see IEEE488.2, 7.7).]
-108	"Parameter not allowed" [More parameters were received than expected for the header]
-109	"Missing parameter" [Fewer parameters were received than required for the header]
-110	"Command header error"
-111	"Header separator error"

Error Number	Error String
-112	"Program mnemonic too long" [The header contains more than twelve characters (see IEEE 488.2, 7.6.1.4.1).]
-113	"Undefined header" [The header is syntactically correct, but it is undefined for this specific device; for example, *XYZ is not defined for any device.]
-114	"Header suffix out of range"
-115	"Unexpected number of parameters"
-120	"Numeric data error" [This error, as well as errors -121 through -129, are generated when parsing a data element which appears to be numeric, including the nondecimal numeric types. This error message is used if the device cannot detect a more specific error.]
-121	"Invalid character in number" [An invalid character for the data type being parsed was encountered; for example, an alpha in a decimal numeric]
-123	"Exponent too large" [The magnitude of the exponent was larger than 32000 (see IEEE 488.2,7.7.2.4.1).]
-124	"Too many digits" [The mantissa of a decimal numeric data element contained more than 255 digits excluding leading zeros (see IEEE 488.2, 7.7.2.4.1).]
-128	"Numeric data not allowed" [A legal numeric data element was received, but the device does not accept one in this position for the header.]
-130	"Suffix error"
-131	"Invalid suffix" [The suffix does not follow the syntax described in IEEE 488.2, 7.7.3.2, or thesuffix is inappropriate for this device.]
-134	“Suffix too long” [The suffix contained more than 12 characters (see IEEE 488.2, 7.7.3.4).]
-138	“Suffix not allowed” [A suffix was encountered after a numeric element which does not allow suffixes.]
-141	“Invalid character data” [Either the character data element contains an invalid character or the particular element received is not valid for the header.]
-144	"Character data too long"

Error Number	Error String
-148	“Character data not allowed” [A legal character data element was encountered where prohibited by the device.]
-150	“String data error” [This error, as well as errors -151 through -159, are generated when parsing a string data element. This error message is used when the device cannot detect a more specific error.]
-151	“Invalid string data” [A string data element was expected, but was invalid for some reason (see IEEE 488.2, 7.7.5.2); for example, an END message was received before the terminal quote character.]
-158	“String data not allowed” [A string data element was encountered but was not allowed by the device at this point in parsing.]
-160	"Block data error"
-161	“Invalid block data” [A block data element was expected, but was invalid for some reason (see IEEE 488.2, 7.7.6.2); for example, an END message was received before the length was satisfied.]
-168	“Block data not allowed” [A legal block data element was encountered but was not allowed by the device at this point in parsing.]
-170	“Expression error” [This error, as well as errors -171 through -179, are generated when parsing an expression data element. This particular error message is used when the device cannot detect a more specific error.]
-171	“Invalid expression” [The expression data element was invalid (see IEEE 488.2, 7.7.7.2); for example, unmatched parentheses or an illegal character.]
-178	“Expression data not allowed” [A legal expression data was encountered but was not allowed by the device at this point in parsing.]
-180	"Macro error"
-181	“Invalid outside macro definition” [Indicates that a macro parameter placeholder ($<number) was encountered outside of a macro definition.]
-183	“Invalid inside macro definition” [Indicates that the program message unit sequence, sent with a *DDT or *DMC command, is syntactically invalid (see IEEE 488.2, 10.7.6.3).]

Error Number	Error String
-185	“Subop out of range” Description: Suboperations are parameters that are passed to refine the destination of a command. They are used to address slots, channels, laser selections and GPIB/SCPI register levels. This error is generated if the parameter is not valid in the current context or system configuration. Example: This error occurs if the user queries the status of a summary register and passes an invalid status level. Note: Incorrect slots and channels addresses are handled by error code -301
-200	“Execution error (StatExecError)" Description: This error occurs when the current function, instrument or module state (or status) prevents the execution of a command. This is a generic error which can occur for a number of reasons. Example: When a power meter has finished a logging application and data is available, the user is not able to reconfigure the logging application parameters. First, the user must stop the logging application.
-201	"Invalid while in local" "Please be patient - GPIB currently locked out" Description: Some operations block the complete system. Since no sensible measurements are possible while this is true, the GPIB is locked out. Example: When ARA, Lambda zeroing or zeroing is executing on a TLS module, the GPIB is not accessible.
-202	"Settings lost due to rtl"
-203	"Command protected"
-210	"Trigger error"
-211	“Trigger ignored” Description: A trigger has been detected but ignored because of timing contraints. (For Example: average time to large).
-212	“Arm ignored” Description: The user can set the automatic re-arming option for input and output trigger events. When this error occurs, the device ignores the setting because the current module status does not allow the change of trigger settings.

Error Number	Error String
-213	“Init ignored” Description: The INIT:IMM command initiates a trigger and completes a full measurement cycle. The continuous measurement must be DISABLED. This error code is generated if the module is still in cont. measurement mode.
-214	"Trigger deadlock"
-215	"Arm deadlock"
-220	"Parameter error (StatParmError)” Description: The user has passed a parameter that cannot be changed in this way. The device cannot detect one of the following more specific errors:
-220	-220, "Parameter error (StatParmOutOfRange)" Description: The user has passed a parameter that exceeds the valid range for this parameter.
-220	"Parameter error (StatParmIllegalVal)" Description: The user has passed a parameter that does not match a value in a list of possible values.
-221	"Settings conflict (StatParmInconsistent)" Description: The user has passed a parameter that conflicts with other already configured parameters. Example: There are constrains for TLS sweep parameters: this error is generated when lambda step size exceeds the difference between start and stop wavelength. If error -221 is returned after you try to start a wavelength sweep, one of the following cases of sweep parameter inconsistency has occurred: Continuous Sweep mode AND l Start is less than l Stop. Continuous Sweep mode AND Sweep Time is too short. Adjust Sweep Speed, l Start, or l Stop. Continuous Sweep mode AND Sweep Time is too long. Adjust Sweep Speed, l Start, or l Stop. Continuous Sweep mode AND Trigger Frequency is too high. Adjust Step Size. Trigger Frequency is the Sweep Speed divided by the Step Size. Stepped Sweep mode AND Lambda Logging Enabled. Continuous Sweep mode AND Lambda Logging Enabled AND Output trigger mode not set to STFinished (Step finished). Continuous Sweep mode AND Lambda Logging is Enabled AND Modulation Source is not set to OFF. Continuous Sweep mode AND Lambda Logging is Enabled AND Sweep Cycles is not set to 1.

Error Number	Error String
-222	"Data out of range (StatParmTooLarge)" Description: The user has passed a continuous parameter that is too large. Example: Wavelength 1800nm when maximum wavelength is 1700nm.
-222	"Data out of range (StatParmTooSmall)" Description: The user has passed a continuous parameter that is too small. Example: Wavelength 700nm when minimum wavelength is 800nm.
-223	“Too much data” Description: A function returns more data or the user requests more data than the application is able to handle. Example: A tunable laser source produces more data when lambda values of a sweep are stored than the 816x instrument is able to handle. Use the new SENSE:FUNC:RES:BLOCK? command to split the data aquisition into multiple parts.
-224	“Illegal parameter value” [Used where exact value, from a list of possibles, was expected.]
-225	"Out of memory" Description: The request application or function cannot be executed because the instrument runs out of memory.
-226	"Lists not same length"
-230	"Data corrupt or stale"
-231	"Data questionable (StatValNYetAcc)" Description: The data that is returned is not accurate or reliable. The user should repeat the operation. The reason for this error is unspecific. Example: A powermeter configured a long average time has not completed its current measurement cycle when the user queries the current power.
-231	"Data questionable (StatRangeTooLow)" Description: As -231 (StatValNYetAcc) but for a more specific reason: The powermeter readout data is not reliable because the currently set (manual) range does not correspond with the input power.
-232	"Invalid format"
-240	"Hardware error"
-241	"Hardware missing"
-250	"Mass storage error"
-251	"Missing mass storage"
-252	"Missing media"
-253	"Corrupt media"

Error Number	Error String
-254	"Media full"
-255	"Directory full"
-256	"File name not found"
-257	"File name error"
-258	"Media protected"
-260	"Expression error"
-261	"Math error in expression (StatUnitCalculationError)" Description: This may occur when the user attempts to transform data in a way that is currently not possible. Example: When a powermeter is measuring very small power values in dBm (such as noise power), negative power values in Watt may also be present (such as when the powermeter calibration wavelength does not correspond to the wavelength of input signal). The instrument cannot transform negative Watt values to dBm because the logarithm of a negative value is not defined.
-270	"Macro error"
-271	"Macro syntax error"
-272	“Macro execution error” [Indicates that a syntactically legal macro program data sequence could not be executed due to some error in the macro definition (see IEEE 488.2, 10.7.6.3.)]
-273	“Illegal macro label” [Indicates that the macro label defined in the *DMC command was a legal string syntax, but could not be accepted by the device (see IEEE 488.2, 10.7.3 and 10.7.6.2); for example, the label was too long, the same as a common command header, or contained invalid header syntax.]
-274	"Macro parameter error"
-275	"Macro definition too long"
-276	“Macro recursion error” [Indicates that a syntactically legal macro program data sequence could not be executed because the device found it to be recursive (see IEEE 488.2, 10.7.6.6).]
-277	“Macro redefinition not allowed” [Indicates that a syntactically legal macro label in the *DMC command could not be executed because the macro label was already defined (see IEEE 488.2,10.7.6.4).]

Error Number	Error String
-278	“Macro header not found” [Indicates that a syntactically legal macro label in the *GMC? query could not be executed because the header was not previously defined.]
-280	"Program error"
-281	"Cannot create program"
-282	"Illegal program name"
-283	"Illegal variable name"
-284	"Function currently running (StatModuleBusy)" Description: This error is generated when a function is currently running on a module so that it cannot process another command. Example: When a powermeter is running a logging application, you are not able to configure the logging application parameters (also see -200).
-285	"Program syntax error"
-286	"Program runtime error"
-290	"Memory use error"
-291	"Out of memory"
-292	"Referenced name does not exist"
-293	"Referenced name already exists"
-294	"Incompatible type"
-300	"Device-specific error"
-303	"Module slot empty or slot / channel invalid" Description: The user has send a command to an empty slot.
-310	“System error” [Indicates that some error, termed “system error” by the device, has occurred. This code is device-dependent.]
-311	"Memory error"
-312	"PUD memory lost"
-313	"Calibration memory lost"
-314	"Save/recall memory lost"
-315	"Configuration memory lost"
-320	"Storage fault"
-321	“Out of memory” [An internal operation needed more memory than was available.]

Error Number	Error String
-330	“Self-test failed” Description: You have started the self test, but the module has detected an error while executing it
-340	"Calibration failed"
-350	“Queue overflow” [A specific code entered into the queue in lieu of the code that caused the error. This code indicates that there is no room in the queue and an error occurred but was not recorded.]
-360	"Communication error"
-361	"Parity error in program message"
-362	"Framing error in program message"
-363	"Input buffer overrun"
-365	"Time out error"
-368	"LambdaStop<=LambdaStart"
-369	"sweepTime < min"
-370	"sweepTime > max"
-371	"triggerFreq > max"
-372	"step < min"
-373	"triggerNum > max"
-374	"LambdaLogging = On AND Modulation = On AND ModulationSource! = CoherenceControl"
-375	"LambdaLogging = On AND TriggerOut! = StepFinished"
-376	"Lambda logging in stepped mode"
-377	"step not multiple of 0.1pm"
-378	"triggerFreq < min"
-400	“Query error” [This is the generic query error for devices that cannot detect more specific errors. This code indicates only that a Query Error as defined in IEEE 488.2, 11.5.1.1.7 and 6.3 has occurred.]
-410	“Query INTERRUPTED” [Indicates that a condition causing an INTERRUPTED Query error occurred (see IEEE 488.2, 6.3.2.3); for example, a query followed by DAB or GET before a response was completely sent.]

Error Number	Error String
-420	"Query UNTERMINATED" [Indicates that a condition causing an UNTERMINATED Query error occurred (see IEEE 488.2, 6.3.2.2); for example, the device was addressed to talk and an incomplete program message was received.]
-430	"Query DEADLOCKED" [Indicates that a condition causing an DEADLOCKED Query error occurred (see IEEE 488.2, 6.3.1.7); for example, both input buffer and output buffer are full and the device cannot continue.]
-440	"Query UNTERMINATED after indef resp" [Indicates that a query was received in the same program message after an query requesting an indefinite response was executed (see IEEE 488.2, 6.5.7.5).]

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