



OP940

Insertion Loss & Return Loss Meter

Instruction Manual

(Also supports the OP725 Integration)

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MnOP940-RevD



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Overview

The OP940 is a compact, stand-alone insertion loss and return loss test meter. Using a pulse-based system for return loss measurements the user is not required to perform mandrel wraps or use matching gel on the DUT to get quick and accurate insertion loss and return loss measurements.

The OP940 allows the user to view the IL and RL for up to two wavelengths simultaneously. The color display coupled with user configurable pass/fail (green/red) settings make it extremely easy to qualify fiber optic patchcords for telecom standards.

Additionally, the unit features an Optical Reflectance Scan Mode, On Screen Context Help, and the ability to measure return loss on both ends of a DUT through the front panel.

The OP940 uses the USB interface to communicate and be driven by OptoTest software which further integrates the unit into a highly efficient production line.

Initial Preparation

Unpacking and Inspection

The unit was carefully inspected, mechanically, electrically and optically before shipment. When received, the shipping carton should contain the items listed in Standard Contents. Account for and inspect each item. In the event of a damaged instrument, write or call OptoTest Corp, California.

Note: Be aware that accessories such as detector adapters, remote head detectors, and high performance reference cables will be located inside a small box labeled "Accessories Inside". If this box is not included with the original shipment, contact OptoTest of their nearest distributor.

Please retain the shipping container in case re-shipment is required for any reason.

Damaged In Shipment

All instruments are shipped F.O.B. Camarillo when ordered from OptoTest. If you receive a damaged instrument you should:

1. Report the damage to your shipper immediately.
2. Inform OptoTest Corporation.
3. Save all shipping cartons.

Failure to follow this procedure may affect your claim for compensation.

Standard Contents

1. Model OP940 IL/RL Test Set
2. Power Cord (U.S. Shipments only)
3. USB A-B cable
4. Certificate of Calibration and if requested the Metrology Report
5. Instruction Manual(s)
6. CD/USB with applicable software and documentation (if ordered)
7. Detector Adapters (if applicable)

Powering on Instrument

Prior to powering on the unit, verify that the appropriate power cord is connected. The unit has a C14 female receptacle on the AC inlet on the back panel. A power cord with a C13 male connector (see figure 2) is needed to mate to this receptacle. The other end of the power cord should have a grounded 3 prong connector that is appropriate for the outlets used in the region of operation. For more information please contact OptoTest Corporation.

Note: For customers within the United States an appropriate power cord is supplied.



Figure 2

To power the unit on, rotate the keyed switch 90 degrees from the OFF position to the ON position. The OFF position is marked “O” and the ON position is marked “I” in the image below.

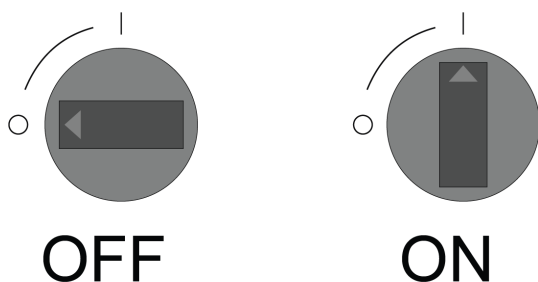


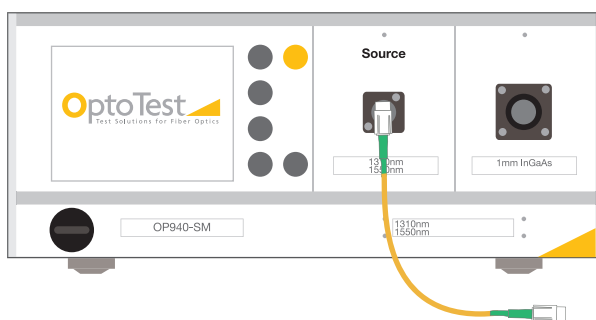
Figure 3

Note that the ON/OFF designators are not present on all OP940 units, but the switch convention is the same: KEY UP – OFF, KEY RIGHT – ON.

Notice Concerning Front Panel Connector

It is advised by OptoTest that the user connects a short SAVER cable to the front panel. This cable must be angle polished on both ends and can range from 0.4m in length to 3m in length. The cable should be of reference quality and should stay on the unit even during down time. One APC end of this cable is connected to the front panel and the other end is where the reference cable would be connected. The sacrificial cable should be replaced or repaired when its open connector becomes damaged. This cable and additional accessories are listed in the *care, cleaning and warranty booklet* also included in this shipment.

Keeping the front panel interface clean and contaminant-free is paramount to good, repeatable insertion loss and return loss measurements, and minimizing the amount of connections made to the front panel will limit the possibility of scratching or contaminating the front panel connector.



The OP940 has a removable panel for the source connector. This will allow the customer to re-polish the front panel connector if it gets damaged without having to send the unit back to OptoTest. Please see the instructions included in this manual for removing the source panel.

Warming up the OP940

For the OP940 to reach equilibrium it is advised that the unit be allowed to warm-up for approximately 15 minutes, so that the lasers and/or LEDs inside the unit can be acclimated. Simply turning on the unit and allowing it to sit idle will not exercise both lasers (for SM systems) or both LEDs (for MM systems). When initially turned on only a single source is on. It is recommended that after the unit is turned on it is placed in IL mode with the **Dual** option selected. This will switch the unit between both source wavelengths allowing both sources to be warmed up concurrently.

Definition of Specifications

Dynamic Range

The dynamic range, or measurement range, of the optical power meter spans from the maximal power level the instrument can measure, without major saturation to the detector, to the minimal power level where the thermal noise of the detector becomes greater than the current produced by the incident light. For accurate power measurements, it is NOT recommended to measure power levels at either end of the dynamic range. (see Linearity). The dynamic range is measured by comparing the absolute measured power against a reference power. When the difference between the two exceeds 1dB either end of the dynamic range has been reached.

Linearity

Photodetectors are, by nature, very linear over a wide range of optical input powers, but the power meter electronics can affect the overall system linearity. The power meter linearity is characterized and specified to know the measurement accuracy and linearity over the full dynamic range. For accurate insertion loss measurements only power levels that fall within the range with the best linearity ($\pm 0.05\text{dB}$ or better) should be measured.

Calibration Wavelength

The calibration wavelengths are the nominal wavelengths of the instruments calibration points. The exact wavelength of each particular calibration is stated in the certificate of calibration.

Calibration Traceability

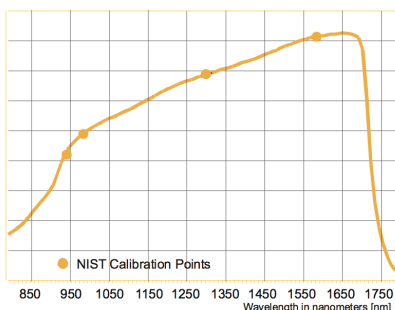
The detector's absolute calibration data is directly traceable to N.I.S.T. at the specified calibration wavelength and the specified power level, typically -10dBm .

Definition of Specifications

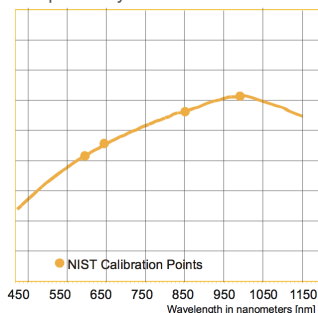
Spectral Responsivity

Depending on the detector type, InGaAs (Indium Gallium Arsenide) or Silicon, the spectral responsivity is the efficiency of the detector to convert optical power into electrical current and it varies with wavelength.

Responsivity of InGaAs Detectors



Responsivity of Silicon Detectors



Note that other detector types are available such as IN5 (5mm InGaAs) IN10 (10mm InGaAs) as well as WSR (wide spectral range) and might exhibit a different spectral responsivity.

Absolute Accuracy

The absolute accuracy specification includes the total measurement uncertainties involved in the calibration process including the transfer of the absolute power standard from N.I.S.T. Contact OptoTest for the detailed chain of uncertainties.

Optical Power Meter, Channel Performance

For multichannel instruments, the power meter circuit converts and digitizes the optical power level with the given sampling interval. Changes in light levels such as modulation will be averaged within that sampling interval.

Instrument, Warm up Time

Optical power meters, in general, do not need any warm-up time unless the instrument has to acclimate to a changing environment. In order to calibrate the instrument or to perform stable measurements, the instrument should be acclimated for 15 minutes for each 5°C of temperature differential. For example if the instrument was stored at 18°C and brought into an environment of 28°C the instrument should be allowed to warm up for 30 minutes.

Definition of Specifications

Recommended Recalibration Period

This is the recommended time period for re-calibration in order to maintain accurate specifications. The recommendation is made based upon statistics on detector aging; however it is up to the metrology policies and procedures within each company to define the calibration cycles on optical power meters.

Optical Power Meter, Fiber Compatibility

The amount of areal coverage of the detector, or the portion of the light emitted from the fiber being measured, depends on the mechanical features of the optical interface, the active area of the detector and the numerical aperture (NA) of the fiber. A fiber with a large NA, for example 100/140 multimode fiber, might not under-fill a small area detector hence the absolute power reading will be less than actual.

Return Loss Range

The lower end of the return loss (low return loss = high reflection) defines the level where the instrument is saturated by large reflections. The higher end of the return loss (high return loss = very weak reflections) is given by capability of the instrument to amplify and resolve reflection out of the noise floor.

Return Loss Accuracy

The Return Loss Accuracy is measured using an optical variable attenuator connected to a >98% reflector. The insertion loss of the attenuator is initially quantified against a reference optical power meter. The actual attenuation is then used to calculate the generated reflection, where the resulting reflection = $2 \times (\text{variable attenuation} + \text{insertion loss of attenuator}) + \text{reflector coefficient}$. Accuracy of return loss measurements can also be affected by the reference cable and any excessive losses at the front panel interface.

Definition of Specifications

Reference Cable

The reference cable is the cable with which the DUTs will be measured against. Typically reference cables are required to be of a defined quality with a specified connector/endface polish.

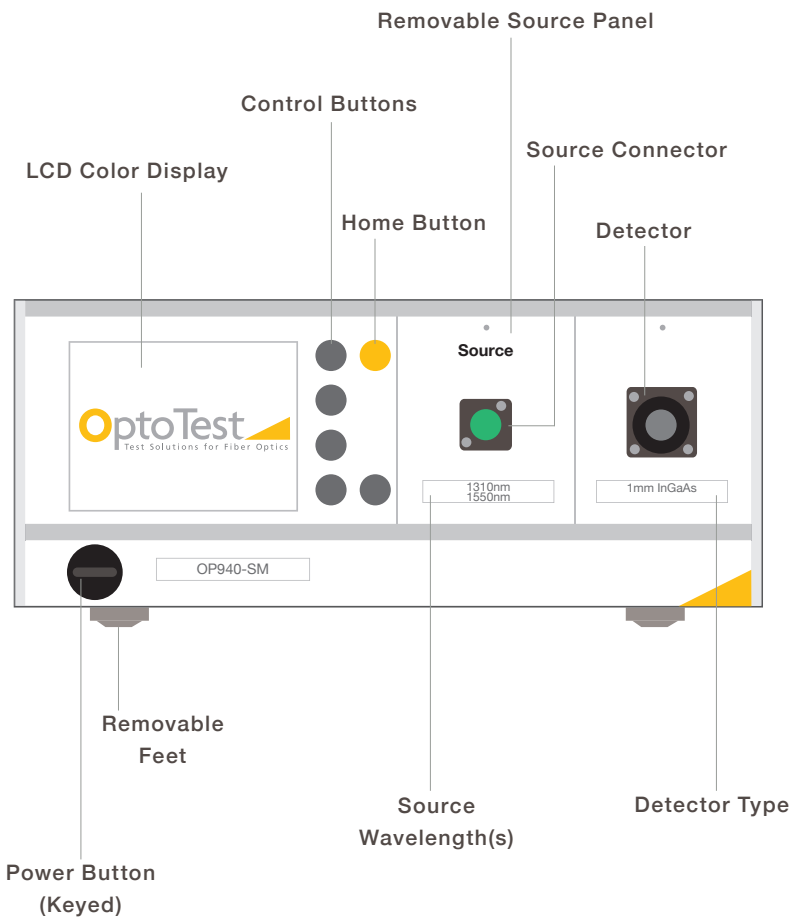
Instrument, Environmental

Operating Temperature: This is the temperature range in which the instrument will conform to the specifications after the specified warm up time.

Storage Temperature: This is the temperature range at which the instrument can be stored with the power off without any damage or any loss of specification to the instrument. It is required that the instrument be brought back to within the operating temperature range before it is turned on.

Humidity: The relative non-condensing humidity levels allowed in the operating temperature range.

Nomenclature



How to Navigate the User Interface

At startup, the unit will load the mode which has been selected as the Startup Mode in the Settings screen. To change mode screens, press the **H** button and the unit will transition to the Mode Select screen.

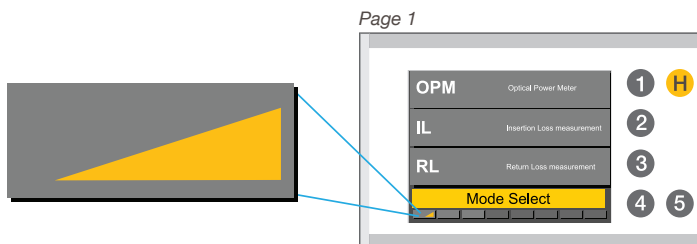
Mode Select Screen

On the Mode Select screen, Buttons **1**, **2**, and **3** will select operation modes for the unit such as **OPM**, **IL**, **RL**, **ILRL**, **Dual ILRL**, **Scan**, and **Settings**. Buttons **4** and **5** will navigate **backward** and **forward**, respectively, through the pages of mode screens. Pressing the **H** button on the Mode Select screen will put the unit back into the mode that it was in most recently.

The Mode Select screen functions as a home screen for the unit. Operators can use the Mode Select screen as a point of reference for the user interface or if they need to change Operation Modes.

The unit's Mode Select screen deploys several modes. Each page has three selections to choose from and the page number is indicated on the bottom of the screen by the placement of the wedge as seen in the figure below.

Below is a brief description of the operation modes on each page of the Mode Select Screen:

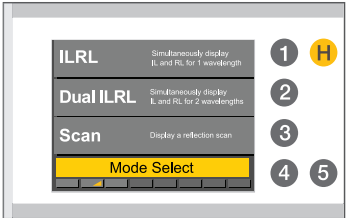


Page 1

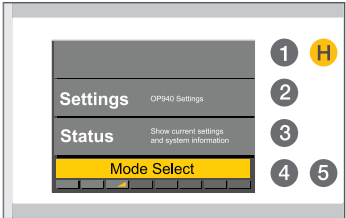
1	Displays the optical power incident on the selected detector
2	References IL and performs IL measurements
3	References RL and performs RL measurements at up to two positions

How to Navigate the User Interface

Page 2



Page 3



Page 2

1	Displays Insertion Loss and Return Loss measurements for one wavelength at a time. Both measurement types can be referenced from this screen as well
2	Displays Insertion Loss and Return Loss measurements for two wavelengths at a time. Both measurement types can be referenced from this screen as well
3	Creates OTDR-style scans to help locate large reflections in test setups. This can be used to diagnose problems encountered in IL and/or RL measurement including bad connections, fiber damage, and dirt

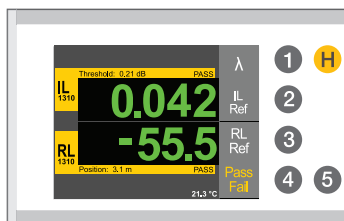
Page 3

1	
2	Allows certain settings—such as pass/fail criteria and measurement adjustment factors—to be changed and saved on the unit
3	Shows current settings and system information

How to Navigate the User Interface

Operation Mode Screens

When the unit is in one of its operation screens, the buttons will operate largely the same. Buttons ①, ②, ③, and ④ will select options such as reference cycles and wavelength/channel switching. Button ⑤ will cycle through the pages of these procedures and options before wrapping back to the first page. Pressing the **H** Button in an operation screen will bring the unit back to the Mode Select Screen and pressing it while in a procedure screen, such as for IL or RL reference, will take the unit back to the root screen for that operation mode.



Front Panel Operation

OPM Mode

This mode controls the optical power meter on the unit, but not the source. OPM mode supports all the functions of a state-of-the-art optical power meter such as multiple wavelength calibrations, absolute mode (dBm), and relative mode (dB).

This is a preferred mode for performing measurements using an external optical source.

The indicators below the power reading visually depict the measured power in terms of the current gain stage of the detector and whether the unit is measuring on the high or low end of that gain stage.

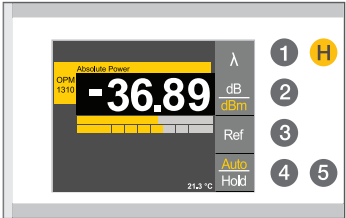
The unit, by default, operates in “Auto Range” mode meaning that it will find the gain stage in which it will be able to most accurately measure the optical power.

However, the unit has an option to operate in “Range Hold” mode wherein it will remain in the same gain stage regardless of the power incident on the detector.

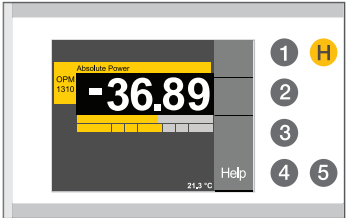
Note: In “Range Hold” one should not be operating at the high or low end of the range. This will increase the error of the measurement.

Front Panel Operation

Page 1



Page 2



Page 1

 1	Changes the selected wavelength for the power meter
 2	Switches the display between absolute (dBm) and relative (dB) measurement modes. The active mode will be in yellow
 3	Performs a measurement of the current optical power and stores it. The unit will then measure the optical power relative to the reference power. A loss in power will be displayed as a negative value
 4	Prevents the unit from changing gain stages on its detector. This option is good if the user is measuring within a limited range of optical power as the accuracy will suffer if the power is not within the optimal limits for that gain stage
 5	Advances to the next page of options
	Returns to the Home Screen

Page 2

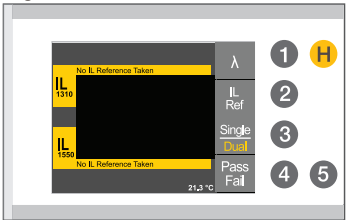
 1	_____
 2	_____
 3	_____
 4	Displays on-screen context help for this mode screen
 5	Returns to page 1
	Returns to the Home Screen

Front Panel Operation

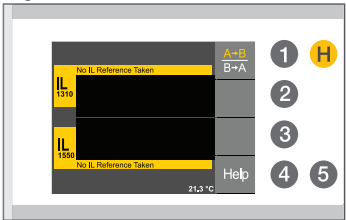
IL Mode

IL mode is designed to measure insertion loss for one or two wavelengths at one time, while allowing the user to toggle between any of the source wavelengths. It also allows the quick referencing of both wavelengths (for example 1310nm and 1550nm) and consecutive measuring of insertion loss on components at both wavelengths. IL measurements will be displayed as positive values. References performed in this mode will carry over to **ILRL** and **Dual ILRL** modes.

Page 1



Page 2



Page 1

	1	Changes the selected wavelength for Insertion Loss measurements (only active for Single and FTTX options)
	2	Navigates to the IL Reference screen
	3	Toggles between measuring one wavelength and measuring two wavelengths at the same time. Single wavelength mode has a faster update speed
	4	Displays on-screen pass/fail results based on Settings defined by the user in the Settings mode
	5	Advances to the next page of options
		Returns to the Home Screen

Page 2

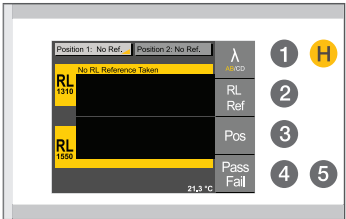
	1	Toggles the OP725 between A→B and B→A directions and updates the screen to reflect the reference values for the appropriate direction (only in Bidirectional Mode)
	2	_____
	3	_____
	4	Displays on-screen context help for this mode screen
	5	Returns to page 1
		Returns to the Home Screen

Front Panel Operation

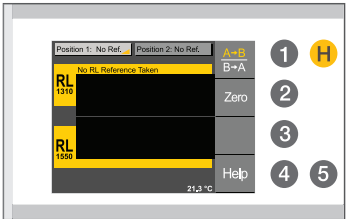
RL Mode

RL mode is designed to measure return loss for two wavelengths at one time. It allows for quick referencing of two wavelengths and simultaneous measuring of return loss of reflective events at both wavelengths. Additionally one also has the ability to reference to and measure return loss of the second connector of the DUT.

Page 1



Page 2



Page 1

 1	Changes the return loss wavelength-pair for units with more than two wavelengths
 2	Navigates to the RL Reference screen
 3	Moves to the next reflection position and begins taking measurements at that point once reference is complete
 4	Displays on-screen pass/fail results based on Settings defined by the user in the Settings mode
 5	Advances to the next page of options
	Returns to the Home Screen

Page 2

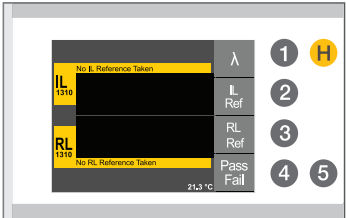
 1	Toggles the OP725 between A→B and B→A directions and updates the screen to reflect the reference values for the appropriate direction (only in Bidirectional Mode)
 2	Toggles whether the RL Zero correction is active. The RL Zero correction is set on the RL Ref screen and will reset to 0.00dB each time the unit is powered down
 3	_____
 4	Displays on-screen context help for this mode screen
 5	Returns to page 1
	Returns to the Home Screen

Front Panel Operation

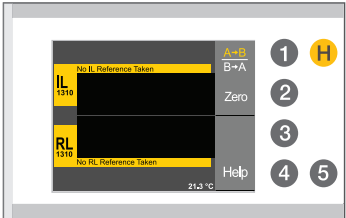
ILRL Mode

ILRL mode is designed to measure insertion loss and return loss for one wavelength simultaneously. It allows the quick referencing of both IL and RL and will display live results for both measurements at one wavelength. IL measurements will be displayed as positive values.

Page 1



Page 2



Page 1

	1	Changes the selected wavelength for both measurements
	2	Begins the IL Reference procedure
	3	Begins the RL Reference procedure
	4	Displays on-screen pass/fail results based on Settings defined by the user in the Settings mode
	5	Advances to the next page of options
		Returns to the Home Screen

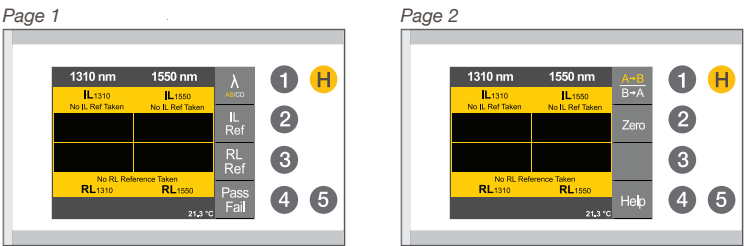
Page 2

	1	Toggles the OP725 between A→B and B→A directions and updates the screen to reflect the reference values for the appropriate direction (only in Bidirectional Mode)
	2	Toggles whether the RL Zero correction is active. The RL Zero correction is set on the RL Ref screen and will reset to 0dB each time the unit is powered down
	3	_____
	4	Displays on-screen context help for this mode screen
	5	Returns to page 1
		Returns to the Home Screen

Front Panel Operation

Dual ILRL Mode

Dual ILRL mode is designed to measure insertion loss and return loss for two wavelengths simultaneously. It allows the quick referencing of both IL and RL and will display live results for both measurements at two wavelengths. IL measurements will be displayed as positive values.



Page 1

λ 45/CO 1	Changes the selected wavelength for both measurements (applicable for FTTX systems only)
IL Ref 2	Navigates to the IL Reference screen
RL Ref 3	Navigates to the RL Reference screen
Pass Fail 4	Displays on-screen pass/fail results based on Settings defined by the user in the Settings mode
➡ 5	Advances to the next page of options
H	Returns to the Home Screen

Page 2

A↔B B↔A 1	Toggles the OP725 between A→B and B→A directions and updates the screen to reflect the reference values for the appropriate direction (only in Bidirectional Mode)
Zero 2	Toggles whether the RL Zero correction is active. The RL Zero correction is set on the RL Ref screen and will reset to 0dB each time the unit is powered down
3	
Help 4	Displays on-screen context help for this mode screen
➡ 5	Returns to page 1
H	Returns to the Home Screen

Front Panel Operation

Scan Mode

Scan mode creates OTDR-style scans as a means of diagnosing problems with insertion loss and return loss reference and measurement. The unit can perform an individual scan or continuously scan a distance of 20m at a time. This mode is not intended to be used for measurement, or high-precision OTDR fault-finding, but as a tool that operators can use in diagnosing roughly where problematic reflections are located to expedite resolution of technical difficulties.

On the Scan Mode screen, the operator will notice a pair of horizontal and vertical axes. The vertical axis indicates the size of the reflection while the horizontal axis indicates the distance of the reflection from the front panel. The horizontal axis is marked in increments of 1 meter with labels every 5 meters.

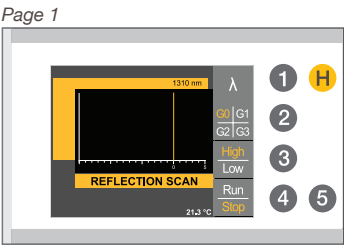
Parallel to the vertical axis are two markers: one to indicate the location of the front panel and another to indicate the location of the on-screen cursor. The front panel marker will always be at 0.0m and can be useful as a “landmark” for the operator.

In Scan Mode, the operator can control several unique options such as the pulse intensity and gain setting of the return loss module. By adjusting the pulse intensity from Low to High, the operator will be able to view reflections in the range of about 30dB to 80dB rather than the range of 10dB to 30dB which Low mode covers.

The gain setting determines how sensitive the return loss meter will be when scanning. The higher the number of the gain setting, the more sensitive the meter is to detect smaller reflections. This means that a large reflection will saturate the meter in a higher gain setting and a smaller reflection may not show up at all on a lower gain setting.

This mode also allows users to manually define reflection positions for use in RL measurements on other operation screens.

Front Panel Operation

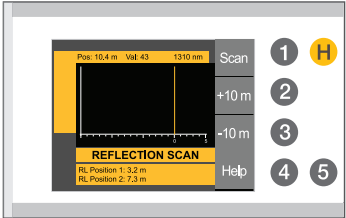


Page 1

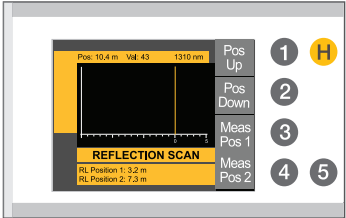
	1	Changes the selected wavelength for the scan
	2	Switches the “gain stage” of the return loss meter. The higher the number, the more sensitive the meter is to detect smaller reflections and the more a large reflection will saturate the meter
	3	Switches the return loss source from high-power to low-power. As with the “gain stage” setting, High will be useful for detecting small reflections, but will saturate the meter if used to scan large reflections (single mode only)
	4	Begins or stops a continuous scan of the displayed range. With Run selected the unit will update the screen continuously
	5	Advances to the next page of options
		Returns to the Home Screen

Front Panel Operation

Page 2



Page 3



Page 2

 1	Performs a single scan of displayed range
 2	Moves the displayed range “forward” by 10m
 3	Moves the displayed range “backward” by 10m
 4	Displays on-screen context help for this mode screen
 5	Advances to the next page of options
	Returns to the Home Screen

Page 3

 1	Moves the on-screen marker “forward” by 0.1m
 2	Moves the on-screen marker “backward” by 0.1m
 3	Sets the first position for Return Loss measurement
 4	Sets the second position for Return Loss measurement
 5	Returns to page 1
	Returns to the Home Screen

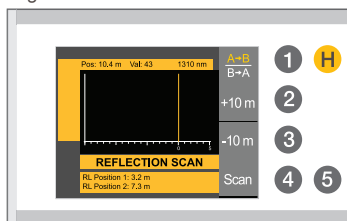
Front Panel Operation

Scan Mode – Using the OP725

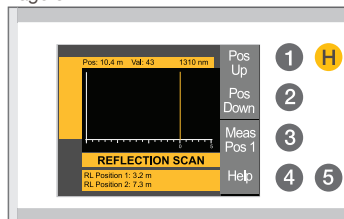
When operated in Bidirectional Mode (see page 32), Scan Mode's screens change to accommodate the addition of a $\frac{A \rightarrow B}{B \rightarrow A}$ feature. All other functionality remains intact.

NOTE: When operating the OP725 | OP940 tandem in Bidirectional Mode, all operations to control the OP725 must be done through the OP940 and not using the front panel controls of the OP725.

Page 2



Page 3



Page 2

$\frac{A \rightarrow B}{B \rightarrow A}$ 1	Toggles the OP725 between $A \rightarrow B$ and $B \rightarrow A$ directions and updates the screen to reflect the reference values for the appropriate direction (only in Bidirectional Mode)
+10 m 2	Moves the displayed range "forward" by 10m
-10 m 3	Moves the displayed range "backward" by 10m
Scan 4	Performs a single scan of displayed range
➡ 5	Advances to the next page of options
H	Returns to the Home Screen

Page 3

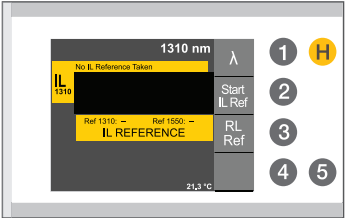
Pos Up 1	Moves the on-screen marker "forward" by 0.1m
Pos Down 2	Moves the on-screen marker "backward" by 0.1m
Meas Pos 1 3	Sets the first position for Return Loss measurement
Help 4	Displays on-screen context help for this mode screen
➡ 5	Returns to page 1
H	Returns to the Home Screen

Front Panel Operation

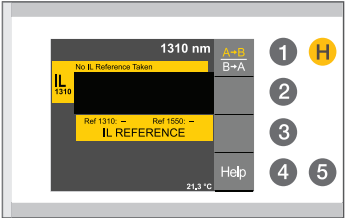
IL Ref

The IL Ref screen is designed specifically to reference insertion loss and will run inside of other mode screens, such as IL, ILRL, and Dual ILRL. References performed will be globally applied.

Page 1



Page 2



Page 1

	1	Changes the selected wavelength for the display measurement (IL reference is always performed at all wavelengths)
	2	Begins the IL reference procedure; the unit cycles through all wavelengths and will display the reference in the top left corner and under the real time power reading
	3	Allows the user to jump from the IL Reference screen directly to the RL Reference screen without needing to go back to the measurement screen first
	4	_____
	5	Advances to the next page of options
		Returns to the Mode Screen

Page 2

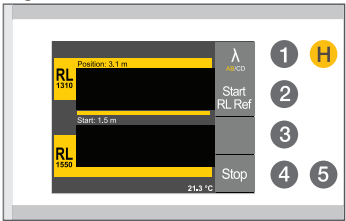
	1	Toggles the OP725 between A→B and B→A directions and updates the screen to reflect the reference values for the appropriate direction (only in Bidirectional Mode)
	2	_____
	3	_____
	4	Displays on-screen context help for this mode screen
	5	Returns to page 1
		Returns to the Mode Screen

Front Panel Operation

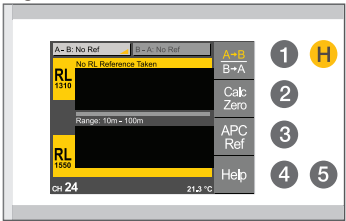
RL Ref

The RL Ref screen is designed specifically to reference return loss and apply temporary adjustments to the return loss reference. It will run inside of other mode screens, such as RL, ILRL, and Dual ILRL. References performed in this screen will be globally applied, except for the case of position 2 in RL Mode.

Page 1



Page 2



Page 1

 1	Changes the selected wavelength for both measurements (if more than two sources)
 2	Begins the RL reference procedure. The unit will begin looking for a "reference" reflection, typically an open PC connector, and once it is found the return loss and distance will be displayed
3	_____
 4	Interrupts the RL reference procedure in case adjustments need to be made. This is useful if something is wrong with the setup
 5	Advances to the next page of options
 H	Returns to the Mode Screen

Page 2

 1	Toggles the OP725 between A→B and B→A directions and updates the screen to reflect the reference values for the appropriate direction (only in Bidirectional Mode)
 2	Calculates the difference between the RL reference value and -14.7dB for each wavelength. This option calculates the return loss correction for an open flat PC connector and will set the return loss to -14.7dB
 3	Allows the user to reference return loss using an open angle-polished connector.
 4	Displays on-screen context help for this mode screen
 5	Advances to the next page of options
 H	Returns to the Mode Screen

Front Panel Operation

Settings Mode

The Settings Mode is designed to allow the user to configure certain parameters for the unit including pass/fail criteria and startup mode.

The buttons will operate identically to Mode Select screen in the root Settings screen in that buttons ①, ②, and ③ will select various settings for the unit such as measurement pass thresholds and the temperature units displayed on the screen. Buttons ④ and ⑤ will navigate backward and forward, respectively, through the pages of settings. Pressing the H button on the Settings screen will put the unit back into the Mode Select screen.

When wavelength-specific settings are selected, the operator will be taken to a screen which allows them to select the particular setting to be set. The buttons in these screens will function exactly as in the root Settings screen. Pressing the H button in a settings screen will bring the unit back to the Settings screen. Meanwhile, pressing H while in a screen devoted to a wavelength-specific setting will bring the unit back to the higher-level screen, but not to the root Settings screen.

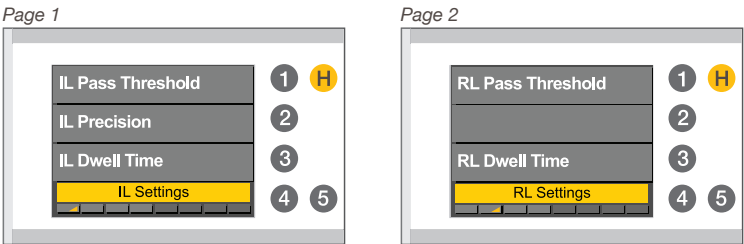
For example, pressing H after changing the 1310nm RL pass criteria will take the unit back to the screen for all of the RL pass threshold settings and then pressing H again will bring the unit back to the root Settings screen.

The screens for non-wavelength-specific settings will treat the buttons as in the operation modes (such as IL and RL modes). Buttons ①, ②, ③, and ④ will select options such as increasing/decreasing digits and selecting different digits. Button ⑤ will cycle through the pages of these procedures and options before wrapping back to the first page. Pressing the H button in a specific setting screen will bring the unit back to the root Settings screen.

For example, pressing H after changing the IL Precision setting will take the unit back to the root Settings screen.

Front Panel Operation

Below is a brief description of the operation modes on each page of the Mode Select Screen.



Page 1

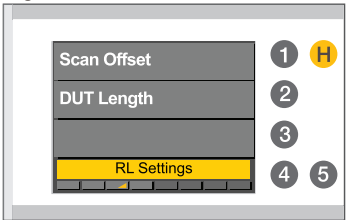
1	IL Pass Threshold is a wavelength-specific setting which controls the pass/fail criteria for insertion loss measurements through the front panel display.
2	IL Precision is a global setting which controls the displayed precision of insertion loss measurements.
3	IL Dwell Time is a global setting which controls how long the unit waits for insertion loss measurements to settle after switching from a different wavelength, channel, or different kinds of measurements.

Page 2

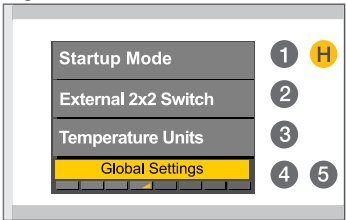
1	RL Pass Threshold is a wavelength-specific setting which controls the pass/fail criteria for return loss measurements through the front panel display.
2	_____
3	RL Dwell Time is a global setting which controls how long the unit waits to perform Return Loss measurements to settle after switching from a different wavelength, channel, or different kinds of measurements.

Front Panel Operation

Page 3



Page 4



Page 3

1	Scan Offset is a global setting which controls where the unit begins referencing for return loss. This is useful if one needs to reference past optical components
2	DUT Length is a global setting which allows the operator to specify how far from the front panel the return loss measurements will be taken to preserve the accuracy of the results
3	_____

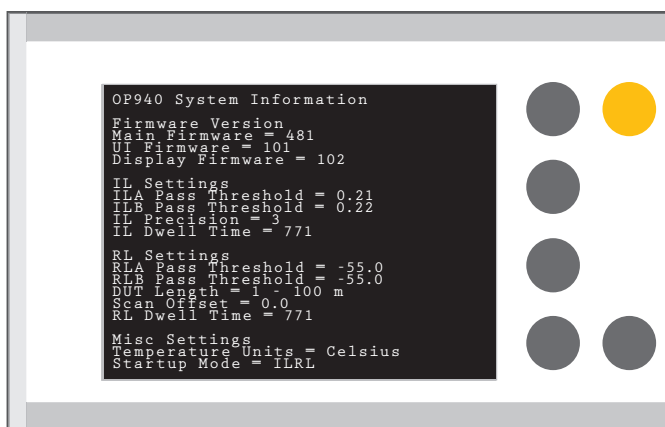
Page 4

1	Startup Mode is a global setting which allows the operator to specify which Operation Mode to load each time the unit is powered on
2	Enabling the external 2x2 switch controls will put the OP940 into Bidirectional Mode and allow it to send commands to an OP725. Disabling this setting allows the unit to work as a unidirectional OP940
3	The Temperature Units setting allows the operator to specify whether they would prefer the unit to display the ambient temperature in Celsius or Fahrenheit

Front Panel Operation

Status Mode

The Status Mode is a troubleshooting tool which displays the state of the various user-configurable settings on the OP940. It can also be used to quickly check the unit's settings before beginning to test. The settings, which are displayed on this screen, are as follows:



IL Settings

- IL Pass Threshold
- IL Precision
- IL Dwell Time

RL Settings

- RL Pass Threshold
- DUT Length
- Scan Offset
- RL Dwell Time

Miscellaneous Settings

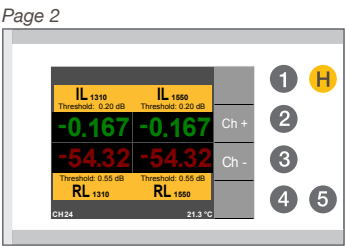
- Temperature Units
- Startup Mode

Additionally, the Status Mode displays the revision numbers for key firmware on the unit.

Front Panel Operation

Multichannel Units

On multichannel versions of the OP940, most mode screens function largely the same. However, some additional functions will be added to the second screen to make the unit switch channels manually.



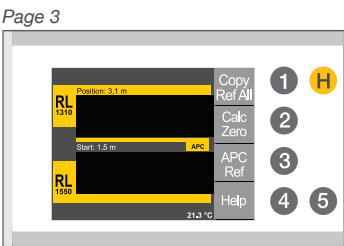
1	_____
2	Moves the source channel up by 1
3	Moves the source channel down by 1
4	_____

On screens which already have a second screen of options, such as IL Ref and Scan Mode, the channel changing screen takes precedence and the screen which would normally come second on the single channel units gets moved to the third page of options. OPM Mode is completely unchanged except in units with multiple power meters.

Front Panel Operation

Multichannel Units

On the RL Ref screen, there is another added feature, which allows the operator to copy the return loss information to all other channels. This feature is useful when testing using cables of equal length and when using fanout cables as reference cables. It can be accessed on the 3rd page of options on the RL Ref screen as seen below:



1	Copies RL reference position from current channel to all channels of the units
2	Calculates the difference between the RL reference value and -14.7dB for each wavelength. This option calculates the return loss correction for an open flat PC connector and will set the return loss to -14.7dB
3	Allows the user to reference return loss using an open angle-polished connector
4	Displays on-screen context help for this mode screen

Front Panel Operation

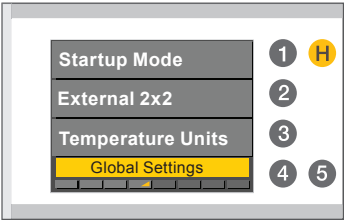
Bidirectional Functionality – OP725

Overview

On single channel **OP940**s, the user has the option to control an **OP725-2x2** to perform bidirectional measurements through the front panel. When operating in this mode, most mode screens will function largely the same as with the standard configuration, but some additional functions will be added to allow the unit to measure bidirectionally and appropriately store the reference values.

Enabling Bidirectional Mode

The mode can be toggled on or off by navigating to the Settings screen and finding the option named **“External 2x2 Switch”**. Selecting **“Enable”** will put the unit into bidirectional mode and **“Disable”** puts the unit into standard mode. In order to have these changes take effect, the unit must be restarted after the settings are saved.



Operating the OP940 Bidirectionally (OP725)

When in bidirectional mode, most of mode screens (IL, RL, ILRL, Dual ILRL, Scan, IL Ref, and RL Ref) have some added features. For example, each of these modes get a $\frac{A \rightarrow B}{B \rightarrow A}$ function that sends a command to the OP725 to toggle between Bar State and Crossed State. Using this function on each of the screens allows the user to switch between the forward direction and the reverse direction. It also saves the reference parameters for insertion loss and return loss in each direction and will use the appropriate parameters when switching directions.

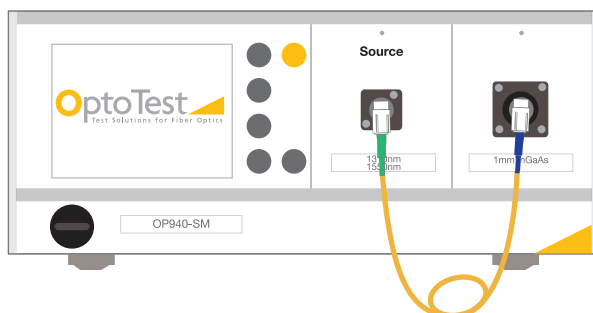
For example, after referencing insertion loss in the forward direction, the user would want to select the $\frac{A \rightarrow B}{B \rightarrow A}$ function to switch directions and reference again in the other direction. The same would be true for return loss referencing and while taking measurements for the device under test.

When operated in Bidirectional Mode, Scan Mode's screens change to accommodate the addition of a $\frac{A \rightarrow B}{B \rightarrow A}$ feature. All other functionality remains intact.

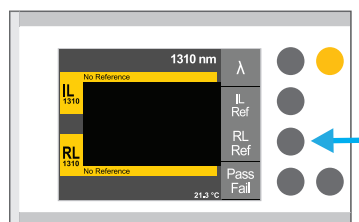
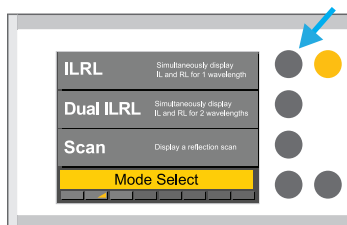
NOTE: When operating the OP725 | OP940 tandem in Bidirectional Mode, all operations to control the OP725 must be done through the OP940 and not using the front panel controls of the OP725.

Example 1: Referencing and Measuring **Return Loss**

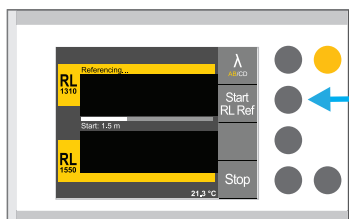
To take the reference for a **return loss measurement**, connect the reference cable from the source directly to the detector port of the instrument.



Select the desired mode screen, such as ILRL, and then select the **RL Ref** option.

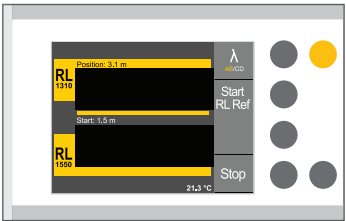


On the proceeding screen, select the **Start RL Ref** option. The instrument will begin scanning for the first large reflection and will store that reference position. This process might take a few seconds.

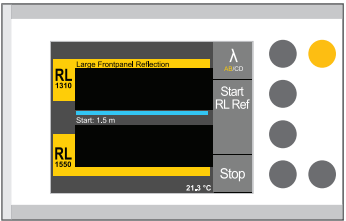


Example 1 (cont.): Referencing and Measuring Return Loss

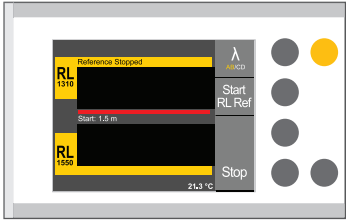
If the reference is good, the OP940 will display the reference distance and RL value, and the progress bar will turn yellow.



If a large reflection is present at the front panel, the progress bar will turn blue.

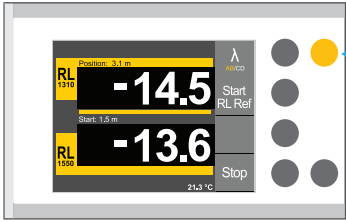


If the RL reference fails or is stopped, the progress bar will turn red.



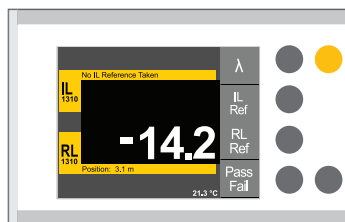
Return Loss

After referencing return loss, the unit will begin to display the return loss readings for both wavelengths in real time. To return to the measurement screen, press the Home Button.

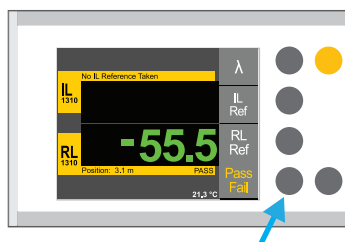


Example 1 (cont.): Referencing and Measuring Return Loss

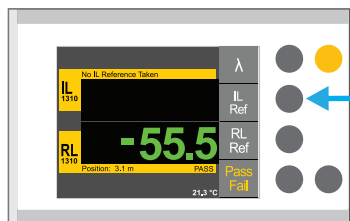
The unit will begin displaying live return loss results.



From the measurement screen, press the Pass/Fail Button to display live test results based on the user-configurable settings.



Additionally, if insertion loss needs to be referenced, simply select the IL Ref option from the measurement screen.

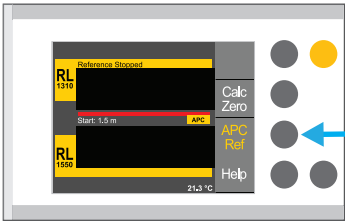


Example 2: Referencing *Return Loss with APC Reference Cables*

If the reference cable is APC-terminated, use a short APC-to-PC cable to reference RL.



Alternatively, utilize the APC Reference option. Once this option is selected, simply press the Start RL Ref button.



With the **APC Reference** option selected, the OP940 will scan for reflections much smaller than it would normally consider to be relevant for **RL referencing** purposes. As a result of the criteria being much broader, the unit is more likely to pick up unintended reflections. To ensure that the unit references to the proper distance, minimize all reflections between the front panel of the unit and the intended reference location.

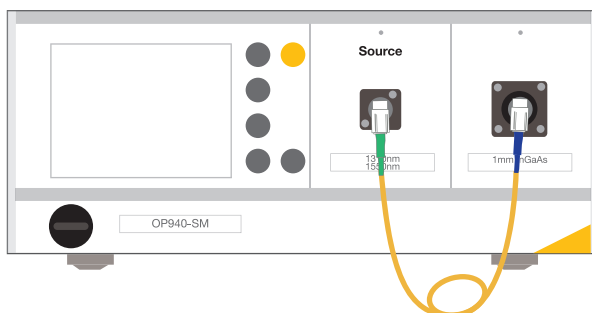
Additionally, it is possible that the reflection from some APC cables is small enough that the unit will have a hard time detecting it. In this case, it is suggested to place a dust cap on the end of the fiber to increase the light reflected back at that location, or one can place the open end into the OPM, which will increase the light reflected as well.

If the APC Reference option still does not allow the unit to reference to the APC connector, it is suggested that a short (three-to-six inch) APC-to-PC cable be utilized to create the large reflection.

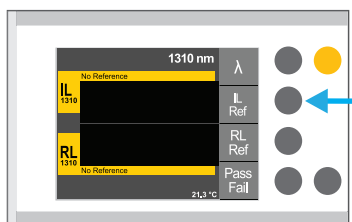
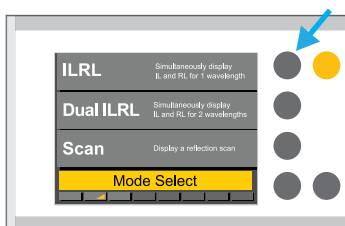
Note: If the unit is referencing to a UPC connector, the APC Reference option should not be utilized.

Example 3: Referencing and Measuring *Insertion Loss*

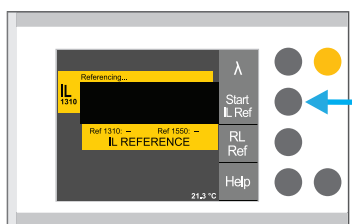
To take the reference for an insertion loss measurement, connect the reference cable from the source directly to the detector port of the instrument.



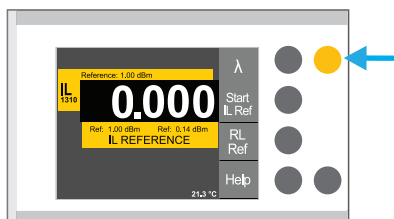
Select the desired mode screen, such as ILRL, and then select the **IL Ref** option.



On the proceeding screen, select the Start IL Ref option. The instrument will select each of the sources, measure their absolute power, and store the reference accordingly. The process might take a few seconds.

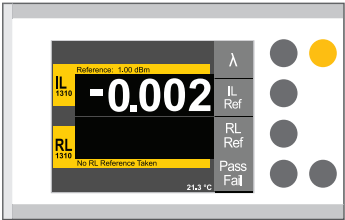


After referencing insertion loss, the unit will begin to display the relative power in real time. After referencing insertion loss, press the Home Button to return to the measurement screen.

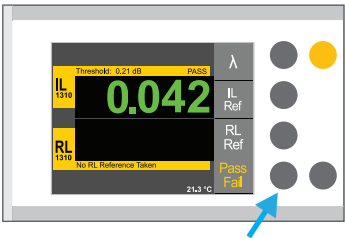


Example 3 (cont.): Referencing and Measuring *Insertion Loss*

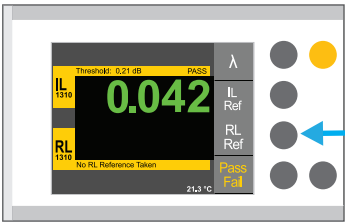
The unit will begin displaying live insertion loss results.



From the measurement screen, press the Pass/Fail Button to display live test results based on the user-configurable settings.

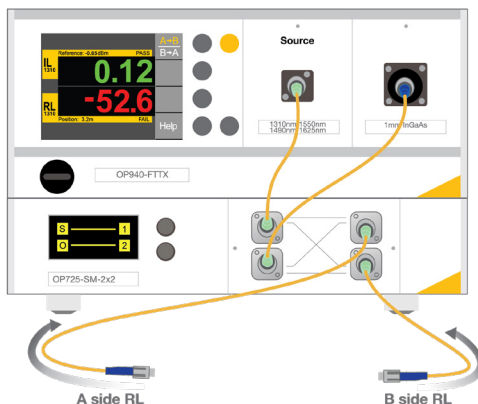


Additionally, if return loss needs to be referenced, simply select the **RL Ref** option from the measurement screen.



Example 4: Referencing *Bidirectional IL and RL* with an OP725

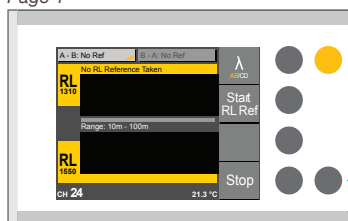
Connect the cables as below, leaving the reference connectors disconnected.



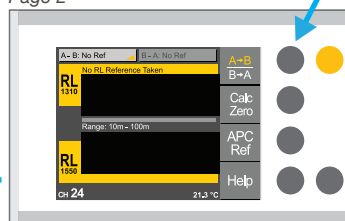
Reference return loss as in Example 1 (page 33).

On the second screen of options in RL Ref mode, select the **A→B** feature to change the direction of the OP725. Then repeat the RL reference for the B→A direction. To return to the measurement screen, press the Home button.

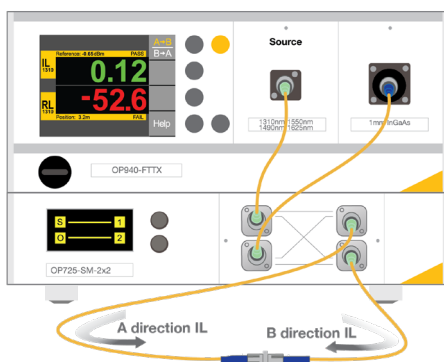
Page 1



Page 2

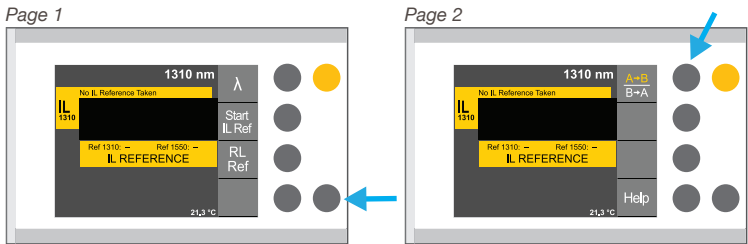


Connect the two reference cables and reference Insertion Loss as in Example 3 (page 37).

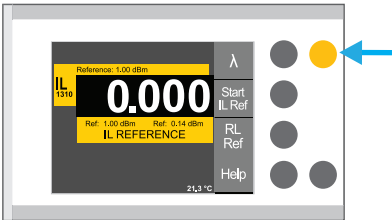


Example 4 (cont.): Referencing Bidirectional IL and RL with an OP725

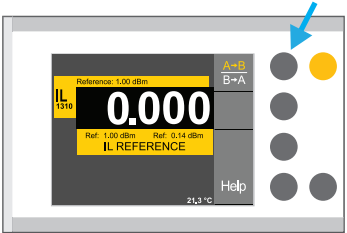
On the second screen of options in IL Ref mode, select the $\frac{A \rightarrow B}{B \rightarrow A}$ feature to change the direction of the OP725. Then repeat the IL reference for the B $\rightarrow$ A direction.



After referencing insertion loss, the unit will begin to display readings in real time. To return to the measurement screen, press the Home button.

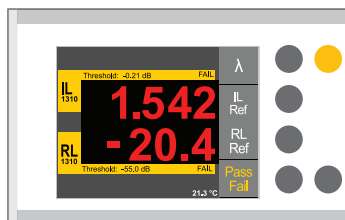


To switch from A $\rightarrow$ B to B $\rightarrow$ A or from B $\rightarrow$ A to A $\rightarrow$ B while in a measurement screen, select the $\frac{A \rightarrow B}{B \rightarrow A}$ option on the second screen of options for the measurement screen.

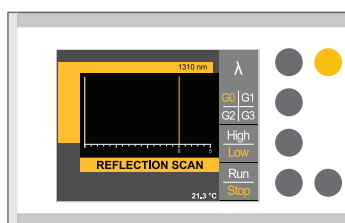
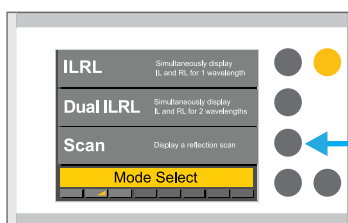


Example 5: Performing OTDR-style trace in Scan Mode

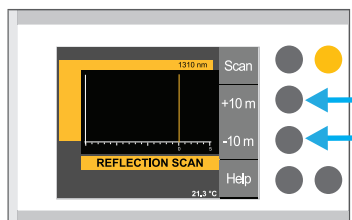
If problems arise during testing of insertion loss or return loss, it can often be helpful to diagnose the problem by using Scan Mode. From the measurement mode where the problems are arising, navigate to the Mode Select screen by pressing the Home button.



From the Mode Select screen, navigate to Scan Mode.



If the problem is suspected to be farther than 5 meters from the front panel of the unit, adjust the display window until the reflection is on the screen.

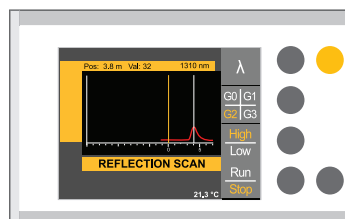
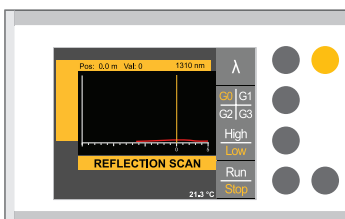


Adjust the pulse mode to the proper setting:

Low mode will give a good scan for reflections between 10dB to 35dB.

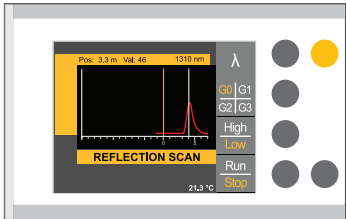
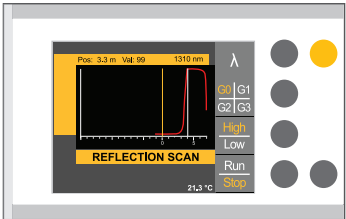
High mode will give better results for reflections between 30dB to 80dB.

Very small reflections in the range of about 70dB to 80dB will be very difficult to see on the screen regardless of the settings. It is suggested that High Mode and G3 be used in these cases.



Example 5 (cont.): *Performing OTDR-style trace in Scan Mode*

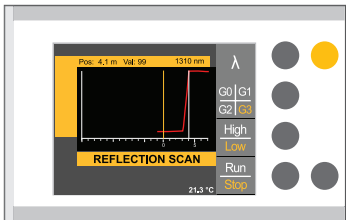
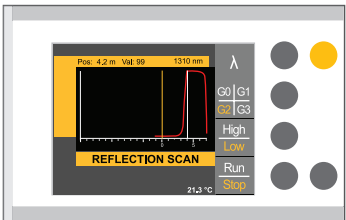
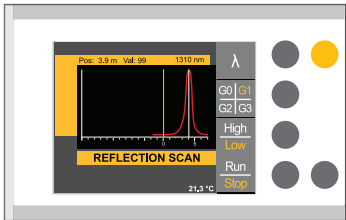
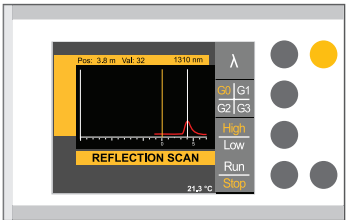
If the scan is saturating while in High mode, switch back to Low mode for a more accurate scan. Conversely, if no reflection is seen in Low mode, try switching it over to High mode to see if that causes a peak to appear.



Adjust the gain setting using the

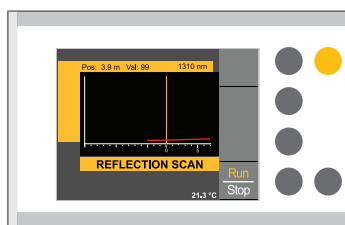
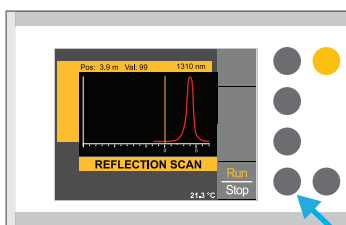
G0	G1
G2	G3

 button until the trace neither saturates the meter nor results in a flat line where a problem is suspected.

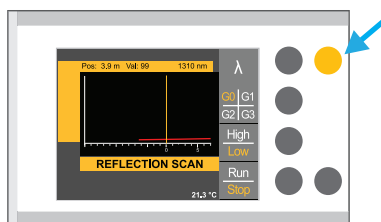


Example 5 (cont.): Performing OTDR-style trace in Scan Mode

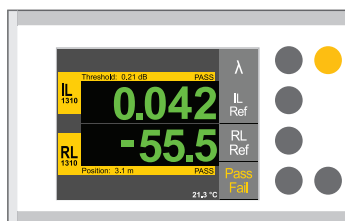
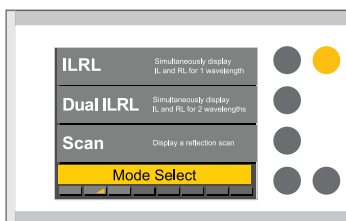
Press Run and adjust the cable setup until the reflection is adequately corrected (*Pressing "Run" will disable all other buttons*). This can involve disconnecting mated cables to scope endfaces for damage and dirt, or to interchange mating adapters or even swapping in different reference cables. When the reflection has reached a value that is closer to the expected value, press Stop.



Press the Home Button to return to the Mode Select screen.



From the Mode Select screen, select the measurement mode that was being used previously. The references from before the diagnostic will remain and the results will update in real time. It is advised that the reference values are verified as accurate before more testing is completed.



Troubleshooting

Troubleshooting

Problem	Possible Cause	Solution
Unstable measurements	Dirt and damage on endfaces	Inspect all endfaces including any SAVER cables and the front panel connector on the instrument. Clean or repolish any dirty or damaged connectors. For more info, please consult Application Note AN-137 .
	Dirt and damage on detectors	Inspect both the detectors and any adapters being used with them for dirt and damage. Clean the detectors and adapters as needed. Replace adapters that appear damaged. In the event of a damaged detector, please contact OptoTest to schedule a repair or replacement.
	Dwell times	Increasing the IL and RL Dwell times in software or on the Settings screen of the unit (see page 27) can improve stability by allowing the detectors more time to settle.
	Damaged bulkheads and detector adapters	Broken ceramic sleeves inside of bulkheads and bulkheads that are damaged or misshapen can cause severe misalignment issues which can affect stability. If the bulkhead on the front panel is damaged, contact OptoTest for a replacement or guidance on the proper bulkhead to replace it with.
	Hybrid bulkheads	The problem generally arises because the ferrules do not properly align due to differences in ferrule alignment. These misalignments lead to decreased repeatability and stability. Additionally, differences in contact force between connector types can sometimes be difficult to rectify and can result in failing values from otherwise passing cables.
Return Loss on connectors takes some time to stabilize	Certain push-in connectors are known for having a long settling time for RL	This is typically a mechanical settling issue with the two ferrules taking time to properly align as the spring force relaxes. Push-in connectors with higher spring force, such as SC and E-2000, take some time for the spring and mating to reach equilibrium. This issue is typically pronounced on new connectors and becomes less prevalent as it gets connected more.
	Dirt and damage	Inspect all endfaces including any SAVER cables and the front panel connector on the instrument. Clean or repolish any dirty or damaged connectors.
	Dwell times	Increasing the IL and RL Dwell times in software or on the Settings screen of the unit (see page 27) can improve stability by allowing the detectors more time to settle.
Unit shows low output power	Dirt and damage	Inspect all endfaces including any SAVER cables and the front panel connector on the instrument. Clean or repolish any dirty or damaged connectors.

Troubleshooting (cont.)

Problem	Possible Cause	Solution
Unit shows low output power	Misaligned adapters	Sometimes FC connectors can screw into place without being properly keyed. This will result in low output power and unstable results. Disconnecting the FC connector and reconnecting it with the proper key alignment should yield a more stable connection. Further, hybrid bulkheads (especially SC-LC) often have issues with alignment. If the cores of the fibers do not align properly, the power will be considerably lower.
	Mismatched fiber size	When launching light into optical fiber, if the DUT or launch cable has a smaller core size than the source, there can be a considerable drop in power. Changing from 62.5/125µm fiber to 50/125µm can result in a drop of about 3-5dB of power, and launching multimode light into a single mode cable can result in a drop of 20dB of power.
Return Loss will not reference	APC connector on DUT	By default, OptoTest units require a large reflection to reference return loss. Using one of a few different options, the unit can reference return loss with APC connectors. Instructions for doing this on a standalone unit can be found in this manual – <u>Example 2: Referencing Return Loss with APC Reference Cables on page 36.</u>
Return Loss measures 80.1dB (SM) or 58.1dB (MM)	Large reflections in front of the connection under test	If there is a reflection of magnitude 60dB or greater within 2-4 meters of the connection under test, the unit could potentially be unable to accurately determine the magnitude of the reflection. Clean the interfaces and if that doesn't improve the result, try increasing the length of the reference cable by 3-5 meters. If the issue persists it might be a damaged front panel connector, in which case it will need to be repolished or replaced.
	Dirt and damage	Inspect all endfaces including any SAVER cables and the front panel connector on the instrument. Clean or repolish any dirty or damaged connectors. For more info, please consult <u>Application Note AN-137.</u>
	Connector measures above the limitations of the unit	In Scan mode, if a reflection is seen when the connector is open, but no reflection is seen once the DUT is connected, it is possible that the DUT has a high quality polish that exceeds the linearized range of the return loss meter. For example, many APC matings will measure better than 80dB for SM cables and 58dB for MM cables when properly mated.

Removing the Source Panel for Repolishing

When the APC connector on the source port of the OP940 becomes damaged, it will interfere with the IL and RL measurements. Often, simply repolishing this connector is enough to fix any measurement issues.

Fortunately, the OP940 has a source panel which can be removed by the customer to access the front panel connector in case it needs to be repolished.

Although the source panel is designed to be removed, caution should be exercised to make sure that no undue strain or tension is put on the fiber during removal.

To remove the source panel, first locate the screw that fastens the source panel to the front of the unit. It will be located above the word **Source** and will be approximately 1mm in diameter. A small Phillips head screwdriver will be needed to remove the screw.



Once the screw is removed, slowly and carefully pull the entire panel forward about 6–12 inches. If there is significant resistance, do not pull the panel anymore.



Removing the Source Panel for Repolishing (cont.)

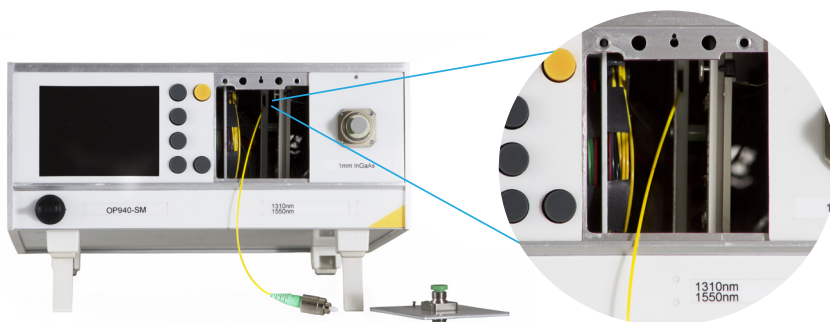
Unscrew the FC/APC connector from the source bulkhead and repolish as needed.



Once the connector has been repaired, turn the unit on and navigate to Scan mode and verify that there is no noticeable reflection at the front panel.



After checking for reflections, mate the FC/APC connector back to the source panel bulkhead. Next, slowly replace the panel back on the front of the unit, making sure that the fiber slides back into the management tray without forming any sharp bends or kinks.



Finally, fasten the source panel to the front of the unit using the screw that was removed earlier.

Warranty Information

See our [Terms and Conditions](#) at www.optotest.com for warranty information.

NOTE: Do not send instruments for any reason without contacting OptoTest headquarters first. To request an RMA contact OptoTest at +1.805.987.1700 or customerservice@optotest.com.

For Application Notes, more detailed Testing Instructions, and the most up-to-date OptoTest News go to www.optobuzz.com





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