

## Measuring Insertion Loss and Return Loss of Hybrid Cables in OPL-Max

### Overview

Obtaining connector-level insertion loss (IL) and return loss (RL) for hybrid cables is complicated by the different connector types on either end of the cable. Hybrid cables cannot simply be flipped to test the reverse direction when the reference and device under test (DUT) connectors are no longer compatible. A test setup comprised of the [OP940 IL and RL Meter](#) with two detectors, the [OP725 Benchtop Optical Switch](#), and [OPL-Max Application Software](#) solves the compatibility issue and allows for hybrid cable testing with high speed, accuracy, and repeatability.

\*Details on how to perform these measurements through the front panel of the OP940 can be found in [Application Note AN-111 Measuring Insertion Loss and Return Loss on Hybrid Cables](#).

### Setup

A [High Performance Reference Cable](#) should be connected from the source port of the OP940 to the input port of the OP725. In order to accommodate the different connectors of the hybrid cable, reference cables for each connector type are mated to the right-hand ports of the switch. The left-hand output port of the OP725 is not used in this test setup and the unit functions as a 1x2 switch.

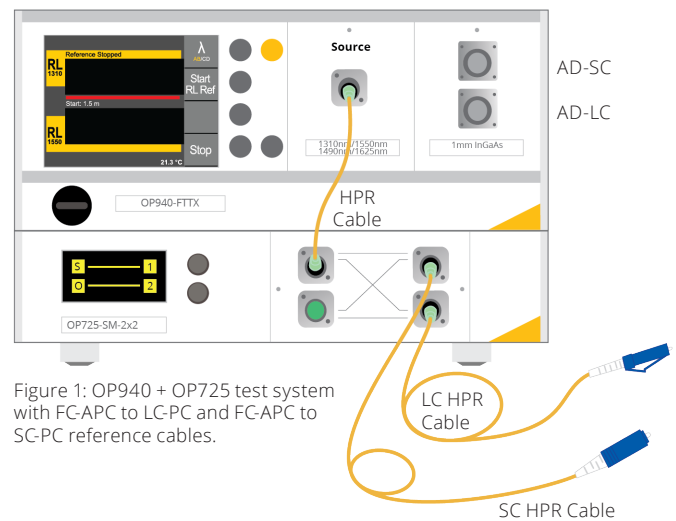


Figure 1: OP940 + OP725 test system with FC-APC to LC-PC and FC-APC to SC-PC reference cables.

### OPL-Max Test Sequence

The sequence file in OPL-Max for this test is as follows:

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
10																			
11		Description	Source Instrument		OPM		Termination for Pass/Fail		Measurement Type	Delay	Comment	Return Loss		Alternate Reference		14dB offset? 0=No, 1=Yes		SN Index	Measurement Direction (1 or 2)
12	Seq	Sequence Label	Source Instrument	Source Channel	WavelengthA	WavelengthB	OPM Rack	OPM Channel				Reflection Number	Reference Channel	Reference Module	Reference Channel				
13	<num>	<string>	<num>	<num>	<num>	<num>	<num>	<num>											
14	1	Side 1	RL1	1	1310	1550	OPMRL1	1	2	1	0	1	1	OPMRL1	1	0	0	1	
15	2	Pause	RL1	1	1310	1550	OPMRL1	1	2	101	0	Disconnect	1	-1	OPMRL1	1	0	1	
16	3	Side 2	RL1	2	1310	1550	OPMRL1	2	5	1	0	1	2	OPMRL1	2	0	1		
17																			

Figure 2: Sequence file for simplex hybrid cable testing.



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For this test, the OP725 will be treated as an external 1x2 switch. It should be connected directly to the computer via USB and assigned as the source switch in the Instruments tab. (Figure 3) For light to emit from the top right port of the OP725, the source channel in column D (Figure 2) should be set 1. Likewise, the source channel should be set to 2 for the bottom right port.

In order to allow the operator to move the DUT from the first reference cable to the second, a pause step is added between the test steps. A pause is not needed during referencing, so the measurement type in column J (Figure 2) is set to 101 to create a test-only pause step.

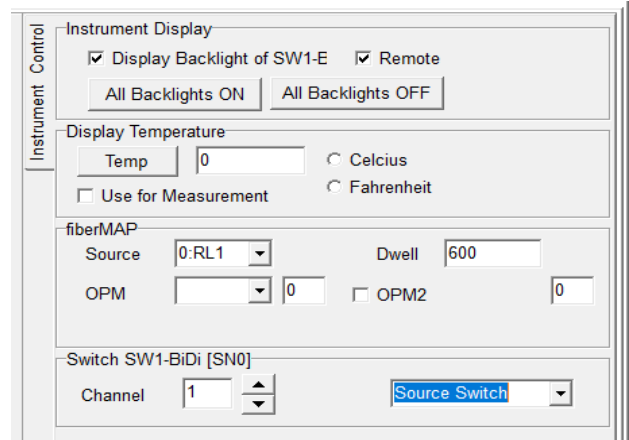


Figure 3: From the Instruments tab of OPL-Max, selecting a switch brings up the switch assignment dropdown.

## Referencing Instructions

To reference IL, connect the reference cables to the detectors of the OP940 using appropriate mating adapters. In this example, the connectors are LC and SC. (Figure 5) Since the connection to the detectors is non-contact, the cables can also be connected this way for the RL reference. Alternatively, they can be disconnected, with the LC and SC connectors open to air. OPL-Max can execute the references in either order. Clicking Ref (Figure 4) on the bottom bar of the software begins the referencing process.



Figure 4: Test controls along the bottom of the screen in OPL-Max.

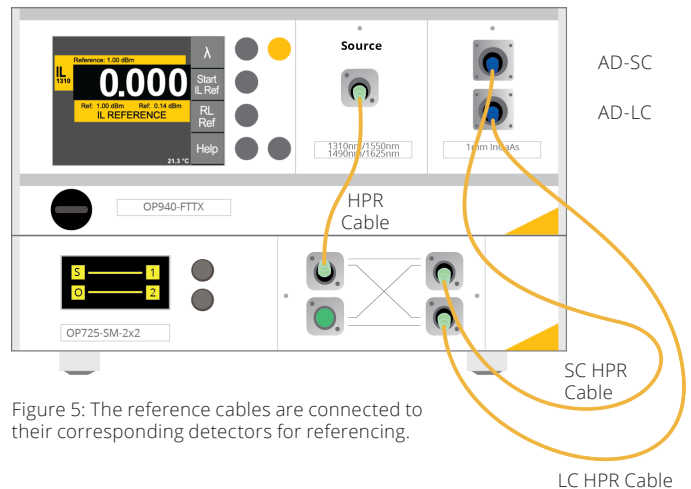


Figure 5: The reference cables are connected to their corresponding detectors for referencing.

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### Measurement Instructions

For testing, the DUT is first connected on one side to the SC reference cable on channel 1 of the OP725 and on the other side to the first detector. (Figure 6) **Note that to achieve this, the adapters on the detectors are swapped so that the correct side can be mated.** This swap does not invalidate or otherwise affect the reference that was just done. The pause step that was built into the sequence gives the operator time to move the DUT to channel 2. The software will also take care of switching channels during both the reference and measurement.

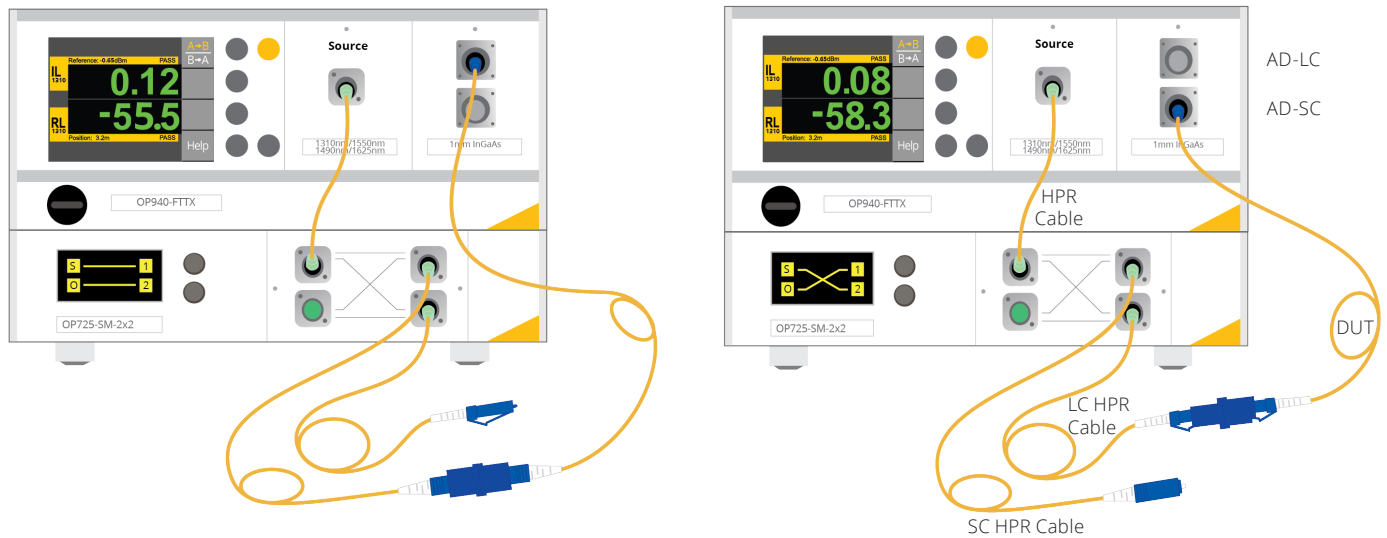


Figure 6: After swapping the adapters on the detectors, the DUT is connected to the SC reference cable and the top detector (left). Then the DUT is moved to the LC reference cable and the bottom detector (right).

### Test Report

The test report contains both IL and RL results for each channel at each wavelength tested, in this case 1310nm and 1550nm. The report also contains operator, work order, and other relevant batch information for the DUT as entered by the operator prior to testing.

	A	B	C	D	E	F	G	H	I	J
1										
2	Test Report									
3	Test Solutions for Fiber Optics									
4	5/22/2019 14:07:17:882									
5	Kevin Durant									
6	test.XLS									
6	<b>Information</b>									
7	Workorder	WO-2-4-2016								
8	Sales Order	07042016								
9	Part Number	SMF-FC-P-P-2016								
10	<b>Results</b>									
12	<b>Serial Number</b>	<b>Connector</b>	<b>Wave A</b>	<b>IL Wave A</b>	<b>RL Wave A</b>	<b>Pass/Fail</b>	<b>Wave B</b>	<b>IL Wave B</b>	<b>RL Wave B</b>	<b>Pass/Fail</b>
13	0	Side 1	1310nm	-0.3214452	52.14	Pass	1550nm	-0.278417	53.58	Pass
14	0	Side 2	1310nm	-0.1490496	53.12	Pass	1550nm	-0.1105562	54.24	Pass
15										

Figure 7: Sample test report

