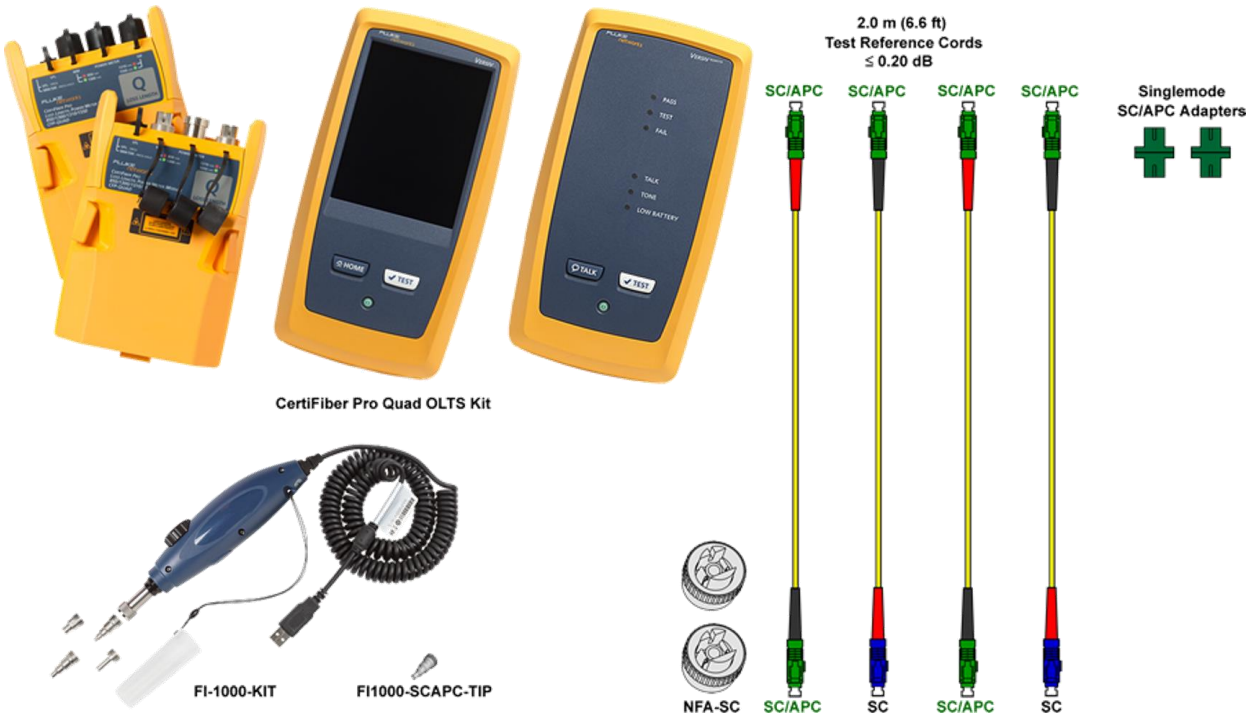
Testing a balanced PON Splitter with CertiFiber® PRO

The CertiFiber® Pro Optical Loss Test Set (OLTS) can be used to check that the loss of a PON Splitter (often referred to in various standards as a non-wavelength-selective or wavelength-selective branching device) to check that it is within the allowed defined limits. The CertiFiber® Pro has an operational mode called “Loopback” that can be employed to test optical splitters, no matter whether they are designed for outdoor, FTTX deployment, or indoor, Passive Optical LAN (POL) use.

This article describes the correct method for testing a balanced PON splitter for port loss using the CertiFiber® Pro, there will be a further article to address unbalanced PON splitters. This method refers to the requirements of ANSI/TIA and ISO/IEC standards with reference to recommended splitter losses and connector losses. As with all fiber testing, inspection is a critical component to successful measurements. Without inspection, you may end up damaging the installed connectors. The CertiFiber Pro® has a USB camera option for the inspection of end face connectors. Users are encouraged to take advantage of this.

Additionally, the CertiFiber® Pro with the USB camera option can automatically grade a fiber end face to IEC 61300-3-35 Ed 2, in around one second. Various tips are available including SC APC and SC UPC.

Equipment that will be required to carry out this procedure.



Before proceeding to test, ensure you have the correct test limit configured for your CertiFiber Pro®. In this example, we shall use a Custom Limit as our test limit. If you are using vendor specific limits, the test methodology described here is the same, but the acceptable connector and splitter loss values may vary. Failing to use a 1-jumper reference for the testing of the splitter could result in negative loss results.

Test Reference Cords (TRCs)

If the TRCs are bad, your test results will be bad too. It represents the largest volume of calls for support. The procedure found here includes a method to verify your TRCs before and during testing. The Fluke Networks TRCs use reference grade connectors (≤ 0.20 dB) in accordance with IEC 61280-4-2 and the ANSI/TIA-568-3.D standards. Note that patch cords from a distributor are typically rated ≤ 0.50 dB and may fail the TRC verification check below.

SRC-9-SCSCAPC-KIT: Singlemode TRC KIT 2 m (2 SCUPC/SCAPC, 2 SCAPC/SCAPC) is the TRC kit available from Fluke Networks that is used in this testing example.

Determining a Loss Budget

Before you can test, you need to determine a loss budget for your splitter. First, you need to determine the style of splitter that you will be testing. Typically there are two types commonly used, 1 x n or 2 x n.

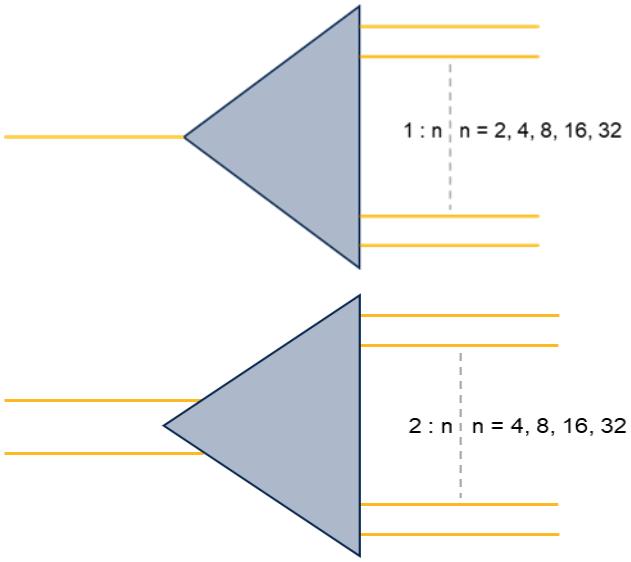


Figure 1. Typical PON splitter arrangements

Split Ratio	Attenuation Max. (dB)	Uniformity Max. (dB)
1x2	3.9	0.5
1x4	7.3	0.8
1x8	10.7	1.1
1x16	14.1	1.4
1x32	17.5	1.7
2x4	7.7	1.3
2x8	11.2	1.7
2x16	14.7	2.1
2x32	18.2	2.5

Table 1. Splitter Losses and Uniformity as per ANSI/TIA-568.3-D

Schematically represented above, the most commonly seen splitters offer split ratios of 1 x 2 through to 1 x 32 or 2 x 4 through to 2 x 32. The table above right shows the allowed splitter losses and loss uniformity between splitter ports, as per ANSI/TIA-568.3-D, Annex D.

In this example, we are going to assess the loss of a 4-port splitter that has a single input port. Conceptually, we can think of the splitter as a box containing the connectors and the optical splitter.

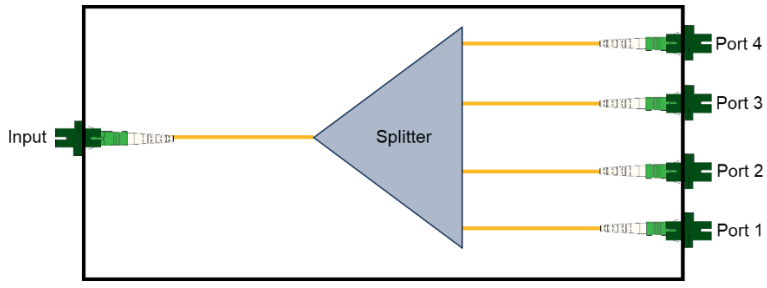


*Figure 2. Conceptual representation of a 1 * 4 PON Splitter*

The connectors, ideally, should have a loss of less than 0.5dB. The fiber lengths within the box are so short that we do not need to consider their losses. From the table above, a 4-port splitter should have no more than 7.3dB of loss on each port, and the uniformity should be within 0.8dB.

We can calculate our losses from the above values:

Loss = Input Connection Loss + Splitter Loss + Port Connection Loss

Loss = 0.5dB + 7.3dB + 0.5dB

= 8.3dB

We will use this worse case calculated loss value as our testing budget when we configure the CertiFiber® Pro to carry out our testing.

Configuring the CertiFiber® Pro

To carry out our testing, we are going to create a new project on the CertiFiber Pro®, clear the default test and cable IDs, use a setting for OS2 Cable, put the CertiFiber Pro® into "Loopback" mode for Test Type and configure a Custom Test Limit using the budget figure we just calculated for our 4-port splitter. We will also add a SM APC inspection limit for the input and output ports of the splitter. Dirty ports will degrade the loss values attained and can lead to a port failing the loss measurement.

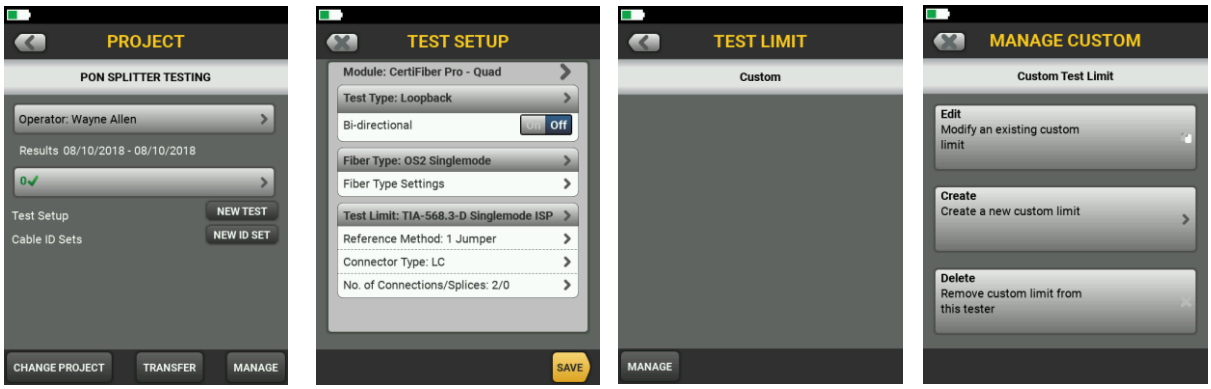


*Figure 3. Create a blank New Project; configure the initial settings; for **Test Limit** navigate to create a Custom Limit*

With our custom limit, the fiber loss does not come into play, the main concern in our example here is the loss from the splitter and connections, a budget of 8.3dB.

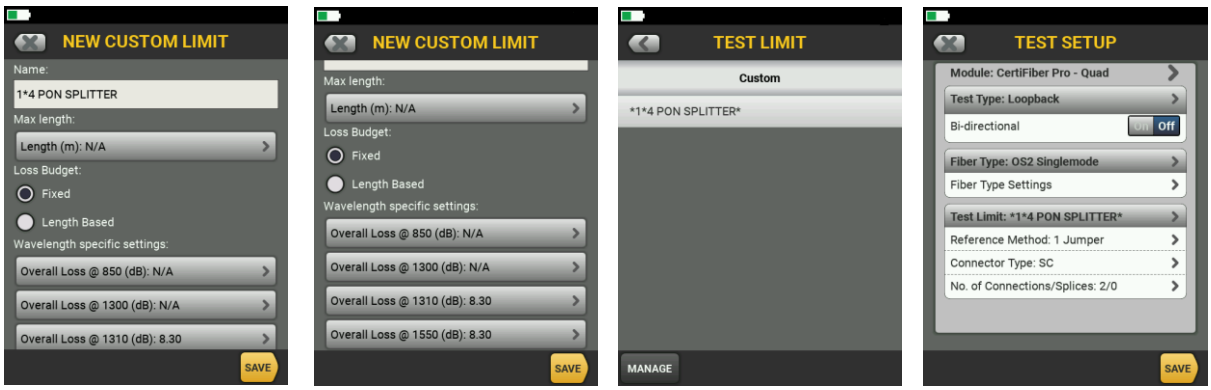


Figure 4. Give the Custom Limit a Name; Set Length to N/A; Select Fixed Loss; set 1310nm and 1550nm to 8.3dB; SAVE; Select the Limit. Set Reference to 1 Jumper; Connector Type to SC or LC as needed; set connector count to 2 (administrative in this case). Remember to SAVE the Test Setup.

To complete the configuration, we need to use the Port Numbers as our Cable ID reference, plus, we need to add an Inspection Test for SM APC connectors.

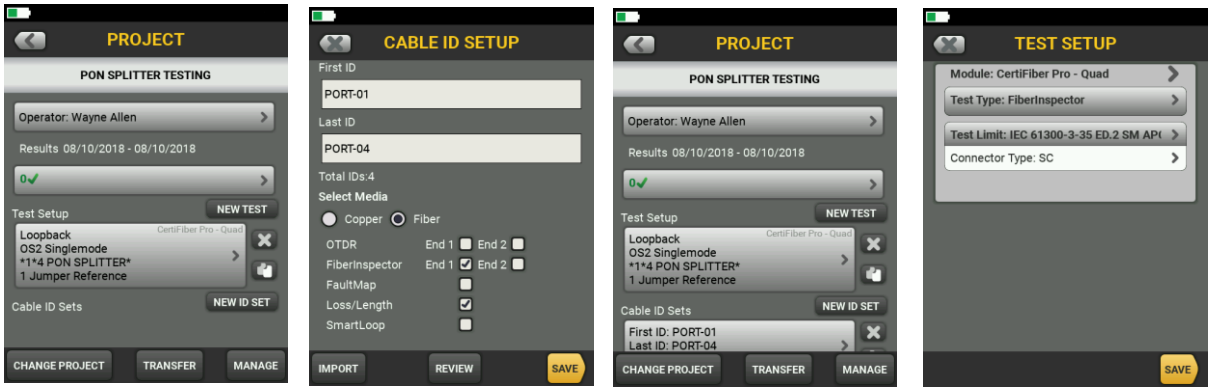


Figure 5. New ID Set; Add your output ports IDs and add Inspection and Loss tests; SAVE; New Test and configure the SM APC Inspection Test; make sure to SAVE the test configuration.

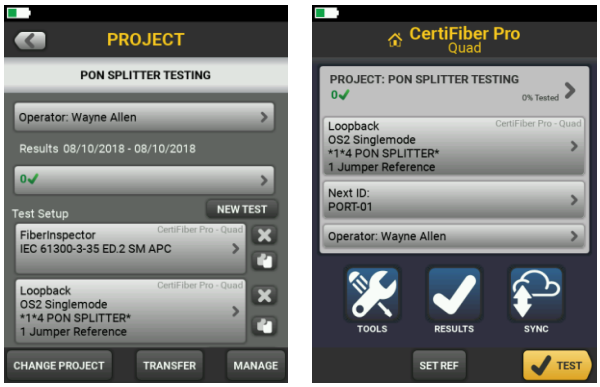


Figure 6. After saving, you will see both tests configured; Press HOME to complete the process.

Carrying out the testing with the CertiFiber® Pro

Once you have configured the tests in the CertiFiber Pro®, you can then carry out testing. First step is to make sure everything is clean by using the Inspection Test we set up earlier. The process is inspect, clean if necessary, then re-inspect if cleaning was carried out.

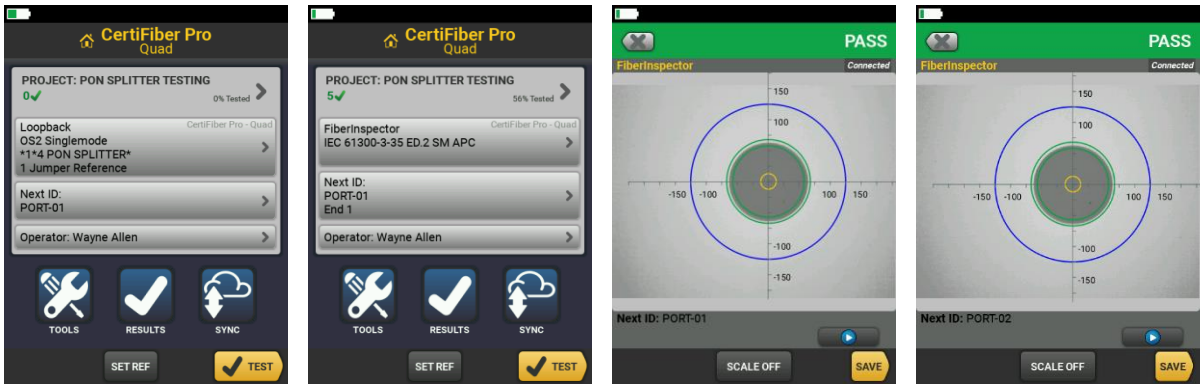


Figure 7. Select the Inspection Tests, carry out the inspection of your TRCs, Splitter input, and output ports. Examples of clean ports are shown here. Do not proceed to testing if your leads or ports are dirty, your results will be incorrect.

Once we have proven and recorded that all test cords and ports are clean, we can proceed to setting a reference, using the Reference Wizard by touching SET REF button.

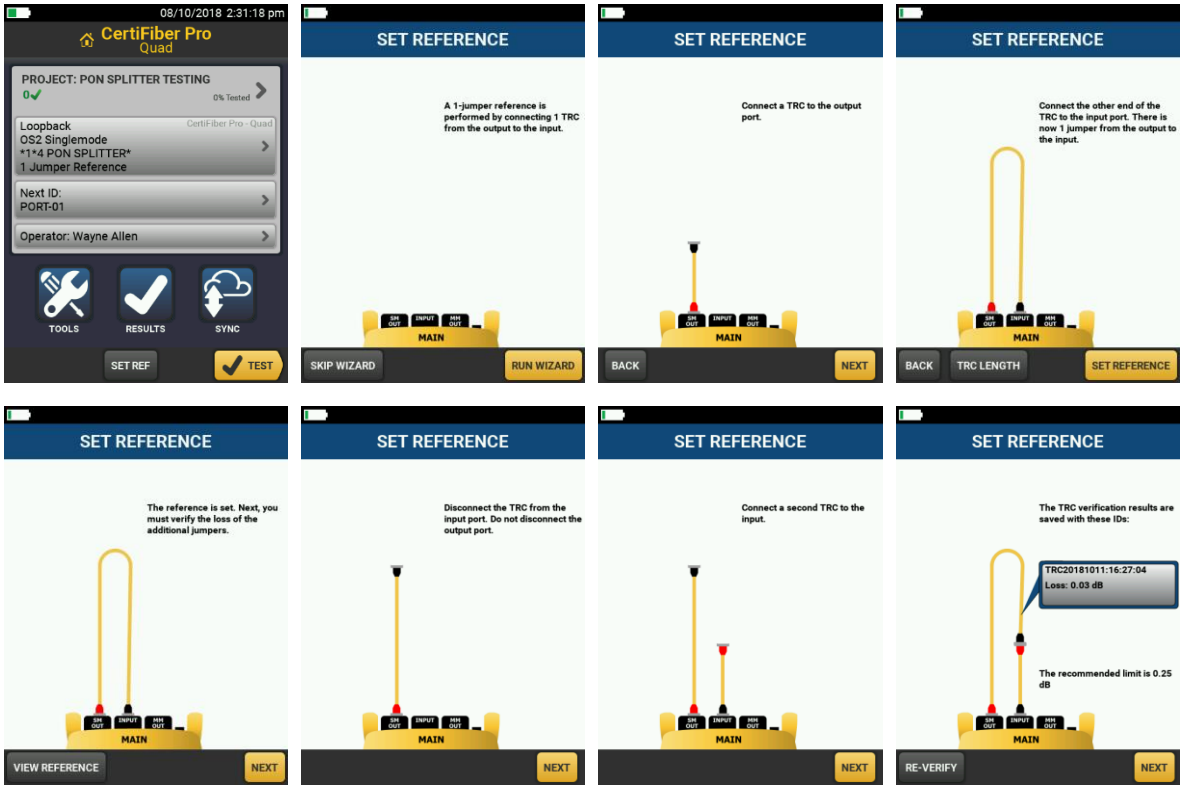


Figure 8. Carry out the Referencing procedure and the TRC validation process. This will ensure good measurement results. For Singlemode TRCs, the loss should be less than 0.25dB.

Once the Reference Wizard has been completed, the last steps in the process are to disconnect the cords and to connect the fiber under test. In this case, we will be connecting to the ports of the splitter. Move to the end of the Reference Wizard ignoring the connection steps.

Connect the CertiFiber Pro as per Figure 9 below. Output port of the CertiFiber Pro® to the input port of the splitter, input port of the CertiFiber Pro® to the output port of the splitter.

The process is to work sequentially across all ports of the splitter, recording the loss of all ports using the CertiFiber Pro®. Make sure you have the “Loopback” Test selected.

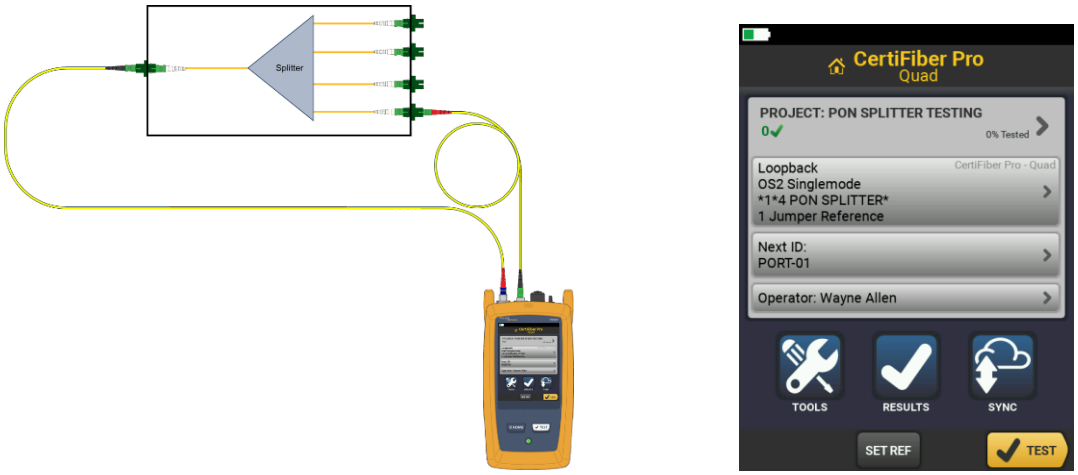


Figure 9. Test connections for measuring splitter port losses; make sure you select the Loopback Loss Test before testing.

Below are the test results for the four ports we have tested for this project.

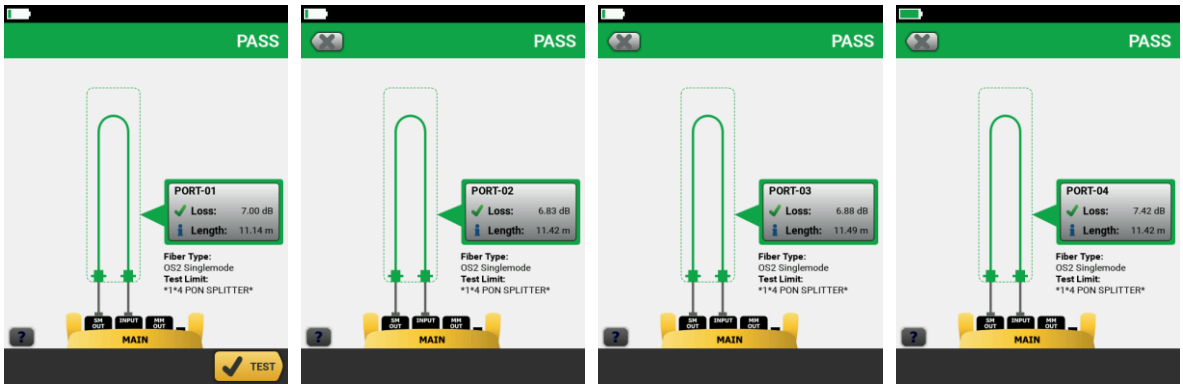


Figure 10. Loss results from the four optical splitter ports.

The PASS in all four tests indicate that each port has less loss than the 8.3dB budget that we calculated earlier. The final check we need to complete is the uniformity check of the optical splitter. This can be done using LinkWare® PC Software.

Import the test result from this project into LinkWare® PC.

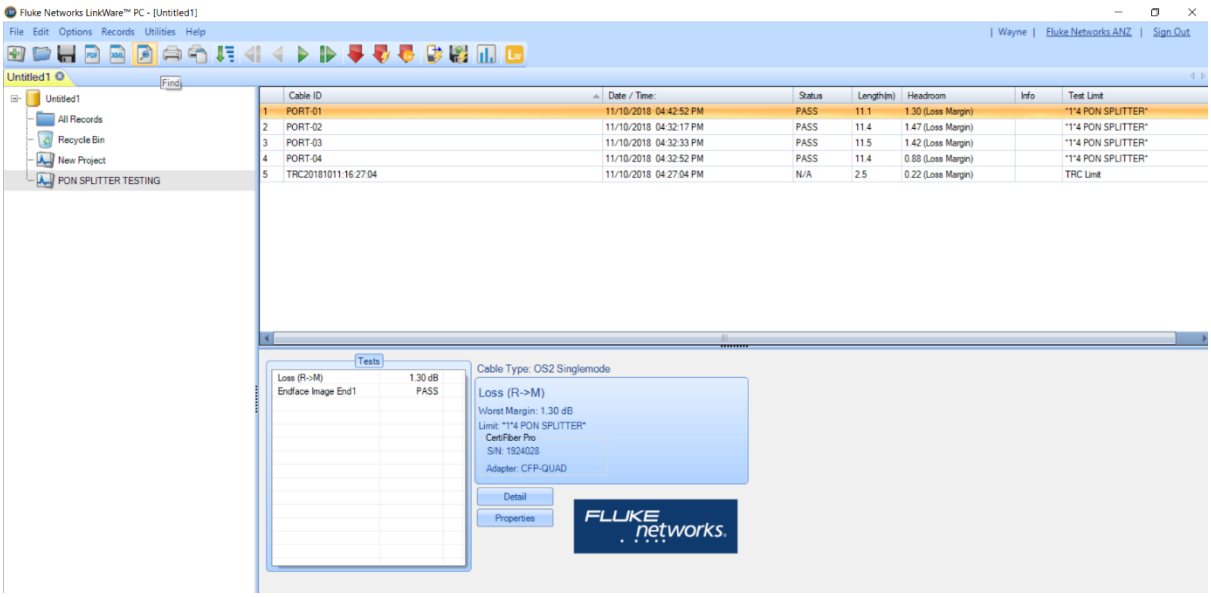


Figure 11. Splitter test results imported into LinkWare® PC Software.

Rearrange the test results so that you can see the Loss Values from lowest to highest in the results panel.

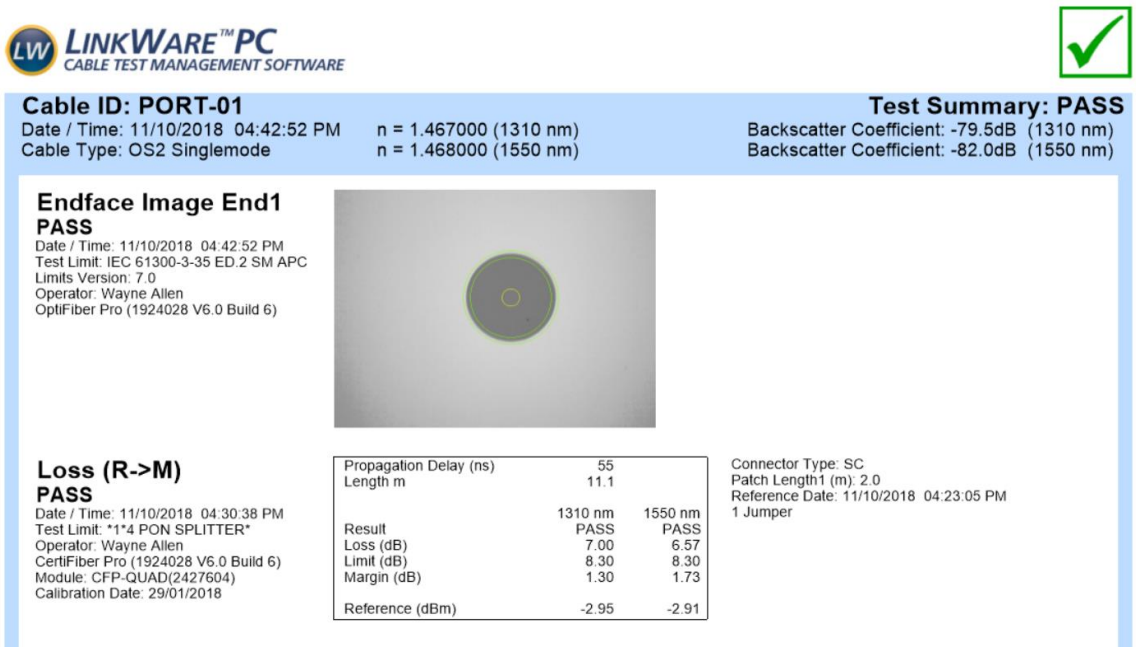
	Cable ID	Date / Time:	Status	Length(m)	Headroom	Info	Test Limit
1	TRC20181011:16:27:04	11/10/2018 04:27:04 PM	N/A	2.5	0.03 (Loss Value)		TRC Limit
2	PORT-02	11/10/2018 04:32:17 PM	PASS	11.4	6.83 (Loss Value)		*1*4 PON SPLITTER*
3	PORT-03	11/10/2018 04:32:33 PM	PASS	11.5	6.88 (Loss Value)		*1*4 PON SPLITTER*
4	PORT-01	11/10/2018 04:42:52 PM	PASS	11.1	7.00 (Loss Value)		*1*4 PON SPLITTER*
5	PORT-04	11/10/2018 04:32:52 PM	PASS	11.4	7.42 (Loss Value)		*1*4 PON SPLITTER*

Figure 12. Results rearranged to show loss, from lowest to highest value.

Our uniformity is to be better than 0.8dB, worse case is 7.42dB, best case is 6.83dB; difference is 0.59dB, therefore our splitter under test also passes the uniformity requirements.

Also note the TRC test; you should always include this result in your test reports. It shows that the TRCs you used for the measurements were in good condition.

From the LinkWare® PC software, you can also generate a professional test report to prove that the optical splitter met the performance criteria required. The report will also add the end face image (if saved) to the loss result, providing complete documentation.



LINKWARE™ PC
CABLE TEST MANAGEMENT SOFTWARE

Cable ID: PORT-01
Date / Time: 11/10/2018 04:42:52 PM
Cable Type: OS2 Singlemode

n = 1.467000 (1310 nm)
n = 1.468000 (1550 nm)

Test Summary: PASS
Backscatter Coefficient: -79.5dB (1310 nm)
Backscatter Coefficient: -82.0dB (1550 nm)

Endface Image End1
PASS
Date / Time: 11/10/2018 04:42:52 PM
Test Limit: IEC 61300-3-35 ED.2 SM APC
Limits Version: 7.0
Operator: Wayne Allen
OptiFiber Pro (1924028 V6.0 Build 6)

Loss (R->M)
PASS
Date / Time: 11/10/2018 04:30:38 PM
Test Limit: *1*4 PON SPLITTER*
Operator: Wayne Allen
CertiFiber Pro (1924028 V6.0 Build 6)
Module: CFP-QUAD(2427604)
Calibration Date: 29/01/2018

Propagation Delay (ns)	55	
Length m	11.1	
	1310 nm	1550 nm
Result	PASS	PASS
Loss (dB)	7.00	6.57
Limit (dB)	8.30	8.30
Margin (dB)	1.30	1.73
Reference (dBm)	-2.95	-2.91

Connector Type: SC
Patch Length1 (m): 2.0
Reference Date: 11/10/2018 04:23:05 PM
1 Jumper

Figure 13. LinkWare PC report showing End Face image and Loss of Port 1 of our splitter.