About This Manual

Subject
This manual explains how to install, set-up and use the OSA20 optical spectrum analyzer. It also explains how to perform basic maintenance operations. This document applies to the OSA20 version 1.10.x.

Intended Readers
Users of this manual must be familiar with fiber optic technology.

Date
19 June 2019

Manual Reference
OSA20_UG_1.10v1.1

Typographical Conventions

<table>
<thead>
<tr>
<th>Conventions</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>bold</strong></td>
<td>Identifies interface objects such as menu names, labels, buttons and icons.</td>
</tr>
<tr>
<td><em>italic</em></td>
<td>Identifies references to other sections or other guides.</td>
</tr>
<tr>
<td>monospace</td>
<td>Identifies portions of program codes, command lines, or messages displayed in command windows.</td>
</tr>
</tbody>
</table>

Symbols

- **Important**
  Identifies important information to which you must pay particular attention.

- **Warning**
  Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury. Do not proceed unless you understand and meet the required conditions.

- **Caution**
  Indicates a potentially hazardous situation which, if not avoided, may result in component damage. Do not proceed unless you understand and meet the required conditions.

Abbreviations Used

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC</td>
<td>Alternating Current</td>
</tr>
<tr>
<td>APC</td>
<td>Angle-Physical Contact</td>
</tr>
<tr>
<td>ASE</td>
<td>Amplified Spontaneous Emission</td>
</tr>
<tr>
<td>DC</td>
<td>Direct Current</td>
</tr>
</tbody>
</table>
Abbreviation | Meaning
--- | ---
DUT | Device Under Test
ELED | Edge Light Emitting Diode
FP | Fabry-Perot
GPIB | General Purpose Interface Bus
MSK HI/LO | High/Low Mask
NF | Noise Figure
PC | Physical Contact
RBW | Resolution Bandwidth
REF | Reference
RMS | Root Mean Square
SELV | Safety Extra-Low Voltage
TRANS | Transfer function
WEEE | Waste Electrical and Electronic Equipment

Copyright

Copyright © 2012–2019 by EXFO. Published by EXFO. All rights reserved.
This documentation is provided as a user guide to EXFO customers and potential customers only. The contents of this document may not be reproduced in any part or as a whole, transcribed, stored in a retrieval system, translated into any language, or transmitted in any form or by any means (electronic, mechanical, magnetic, optical, chemical, photocopying, manual, or otherwise) without the prior written permission of EXFO.

Product Warranty and Limitation of Warranty

For detailed information about the sales terms and conditions, visit the EXFO web site at www.exfo.com/how-to-buy/sales-terms-conditions

Contact Information

To obtain after-sales service or technical support for this product, contact EXFO at one of the following numbers.

**Technical Support Group**

400 Godin Avenue
Quebec (Quebec) G1M 2K2
CANADA

Tel. USA and Canada: 1 866 683-0155
Fax: 1 418 683-9224
E-mail: support@exfo.com

For detailed information about technical support and for a list of other worldwide locations, visit the EXFO web site at www.EXFO.com/support

To accelerate the process, please have information such as the name and the serial number (see the product identification label), as well as a description of your problem, close at hand.
# Table of Contents

About This Manual .............................................................................................................. .................................................. 3  
Table of Contents .............................................................................................................. .......................... 5  
Important Safety Information for Your Product........................................................................................... 9  
1. Product Presentation ......................................................................................................... ............... 13  
  1.1 Technical Specifications .................................................................................................... ................. 13  
  1.2 Product Overview ............................................................................................................ ..................... 16  
    1.2.1 Front Panel ............................................................................................................... .............. 16  
    1.2.2 Left-side Panel: Cooling Fan .............................................................................................. ... 18  
    1.2.3 Right-side Panel: Connectors .............................................................................................. .. 19  
    1.2.4 Rear Panel ................................................................................................................ .............. 21  
2. Installing and Connecting the OSA20 .......................................................................................... 23  
  2.1 Unpacking and Installing the OSA20 .......................................................................................... ........ 23  
  2.2 Connecting the OSA20 to a Power Source...................................................................................... ... 25  
    2.2.1 Connecting the OSA20 to the Wall Socket Using the Power Adapter ................................ 25  
    2.2.2 Connecting the OSA20 to a 48 V DC Power Source ............................................................ 26  
  2.3 Connecting a Light Source to the OSA20 ...................................................................................... ..... 27  
  2.4 Handling USB Devices with the OSA20 ......................................................................................... ..... 28  
    2.4.1 Connecting USB Devices to the OSA20................................................................................ 28  
    2.4.2 Disconnecting USB Storage Devices from the OSA20 ........................................................ 28  
  2.5 Sharing the OSA20 Display with an External Screen ................................................................. 29  
3. Turning on/off the OSA20 and Accessing an Analysis Mode.............................................................. 31  
  3.1 Accessing the OSA20 Home Window................................................................................................. 31  
  3.2 Setting General Parameters .................................................................................................. .............. 32  
  3.3 Accessing an Analysis Mode .................................................................................................. ............ 35  
  3.4 Turning off the OSA20 ........................................................................................................ ................. 39  
4. Defining Scan Measurement Parameters......................................................................................... .. 41  
  4.1 Scanning the Optical Spectrum ............................................................................................... ............ 41  
    4.1.1 Defining Scan Parameters.................................................................................................. ... 41  
    4.1.2 Manually Starting/Stopping the Optical Spectrum Acquisition ............................................ 45  
    4.1.3 Triggering the Optical Spectrum Acquisition ....................................................................... 46  
    4.1.4 Generating Output Trigger Signals ....................................................................................... 47  
  4.2 Operating Scan Traces ....................................................................................................... ................. 48  
    4.2.1 Setting Trace Types ....................................................................................................... ........ 49  
    4.2.2 Displaying/Hiding/Activating Traces.................................................................................... 50  
    4.2.3 Copying/Pasting Trace Data ................................................................................................ .50  
    4.2.4 Saving/Loading Traces ..................................................................................................... ..... 51  
  4.3 Handling Traces Files ....................................................................................................... ................... 53
## 5. Adjusting the Graph Display

5.1 Adjusting the Scale of the Graph With Zoom Commands

5.2 Performing Manual Measurements With Markers

### 6. Analyzing Traces

6.1 Setting Up Peaks and Troughs Search

6.1.1 Defining PT Search Analysis Parameters

6.1.2 Analyzing PT Search Results

6.2 Selecting the Component Under Test (PCT Mode)

6.3 Setting Up Channel Detection

6.3.1 Defining Channel Detection Analysis Parameters

6.3.2 Analyzing WDM Channel Detection Results

6.4 Setting Up Spectral Width Analysis

6.4.1 Defining Spectral Width Analysis Parameters

6.4.2 Analyzing Spectral Width Results

6.5 Setting Up XXdB Width Analysis

6.5.1 Defining XXdB Width Analysis Parameters

6.5.2 Analyzing XXdB Width Results

6.6 Setting Up λmean Analysis

6.6.1 Defining λmean Analysis Parameters

6.6.2 Analyzing λmean Results

6.6.3 Analyzing λpeak Results

6.7 Analyzing λcenter and σ Results

6.8 Analyzing FWHM Results

6.9 Analyzing Side Modes Spacing Analysis

6.10 Setting Up Notch Width Analysis

6.10.1 Defining Notch Width Analysis Parameters

6.10.2 Analyzing Notch Width Results

6.11 Setting Up Level Check Analysis

6.11.1 Defining Level Check Analysis Parameters

6.11.2 Analyzing Level Check Results

6.12 Setting Up SMSR Analysis

6.12.1 Defining SMSR Analysis Parameters

6.12.2 Analyzing SMSR Results

6.13 Setting Up OSNR Analysis

6.13.1 Defining OSNR Analysis Parameters

6.13.2 Analyzing OSNR Results

6.14 Setting Up Ripple Analysis

6.14.1 Defining Ripple Analysis Parameters

6.14.2 Analyzing Ripple Results

6.15 Setting Up Optical Power Analysis

6.15.1 Defining Optical Power Analysis Parameters

6.15.2 Analyzing Optical Power / Gain / Loss Results

6.16 Setting Up Loss Measurement Analysis
# Table of Contents

6.16.1 Defining Loss Measurement Analysis Parameters ......................................................... 103  
6.16.2 Analyzing Loss Measurement Results ................................................................. 103  
6.17 Setting Up Peak Power Density Analysis ................................................................. 104  
6.17.1 Defining Peak Power Density Analysis Parameters ................................................. 104  
6.17.2 Analyzing Peak Power Density Results ................................................................. 104  
6.18 Setting Up Gain and Noise Figure Analysis ................................................................. 105  
6.18.1 Defining Gain & NF Analysis Parameters ............................................................. 105  
6.18.2 Analyzing Gain and NF Results .............................................................................. 107  
6.19 Setting Up Pass Band Test Analysis ............................................................................ 109  
6.19.1 Defining Pass Band Test Analysis Parameters ...................................................... 109  
6.19.2 Analyzing Pass Band Test Results ........................................................................ 113  
6.20 Setting Up Stop Band Test Analysis ........................................................................... 114  
6.20.1 Defining Stop Band Test Analysis Parameters ...................................................... 114  
6.20.2 Analyzing Stop Band Test Results ......................................................................... 118  
6.21 Setting Up Mask Test Analysis .................................................................................... 119  
6.21.1 Defining Mask Test Analysis Parameters ............................................................. 119  
6.21.2 Analyzing Mask Test Results ................................................................................ 120  
7. Saving/Loading Configuration Settings and Handling Files ........................................ 121  
7.1 Saving Analysis Settings and Results ............................................................................ 121  
7.2 Loading Measurement and Analysis Settings ............................................................. 122  
7.3 Handling Files Saved ................................................................................................. 123  
8. Using the OSA20 in Remote Control ............................................................................... 125  
8.1 Preparing the OSA20 for Remote Control ..................................................................... 125  
8.1.1 Modifying the GPIB Address .................................................................................. 125  
8.1.2 Setting the Ethernet Ports ...................................................................................... 125  
8.1.3 Installing the USB Driver on the Remote Computer ............................................. 128  
8.2 Entering the Remote Mode .......................................................................................... 129  
8.3 Switching Back to Local Mode .................................................................................... 129  
9. Performing Basic Maintenance Operations ................................................................... 131  
9.1 Updating the OSA20 Firmware Version ...................................................................... 131  
9.2 Cleaning the OSA20 .................................................................................................... 132  
9.2.1 Cleaning the Cover of the OSA20 ......................................................................... 132  
9.2.2 Cleaning the Fan Grid ........................................................................................... 132  
9.2.3 Cleaning the Multi-touch Screen ........................................................................... 133  
9.3 Replacing the External Power Fuse ............................................................................ 133  
9.4 Cleaning Optical Connectors ...................................................................................... 134  
9.5 Calibrating the OSA20 ............................................................................................... 136  
9.5.1 Performing a User Calibration .............................................................................. 136  
9.5.2 Asking for a Factory Recalibration ....................................................................... 136  
9.6 Carrying the OSA20 ..................................................................................................... 137  
9.7 Packaging for Shipment ............................................................................................. 137  
10. Troubleshooting ........................................................................................................... 139
# Table of Contents

10.1 Handling Errors and Warnings ........................................................................................................ 139
  10.1.1 Dealing with System Error Messages ................................................................................. 139
  10.1.2 Dealing with File Handling Error Messages .................................................................. 141
  10.1.3 Dealing with User Calibration Error Messages ............................................................... 141
  10.1.4 Dealing with Trace Analysis Warning Messages ............................................................. 143
  10.1.5 Forcing the OSA20 to Shutdown & Restart ....................................................................... 143

10.2 Using Remote Assistance Tools .................................................................................................. 144
  10.2.1 Performing a Self-test ....................................................................................................... 144
  10.2.2 Sending Debug Data to EXFO Support Service ................................................................. 144

Certification and Compliance ............................................................................................................. 145

Table of Figures .................................................................................................................................. 147
Important Safety Information for Your Product

Before you start working with your device, you need to first read the important safety information provided in this section. This section provides information that may supplement or add safety information to the user guides of your product. Keep this information close at hand.

You can obtain a copy of the complete user guide for your product at the following link:
www.EXFO.com

Important

- If you see the ⚠ symbol on your unit, make sure that you refer to the instructions provided in this safety notice. Ensure that you understand and meet the required conditions before using your product.
- Other safety instructions relevant for your product are located throughout this documentation, depending on the action to perform. Make sure to read them carefully when they apply to your situation.

Product Safety

Safety Symbols on Your Product

One or more of the following symbols may appear on your product.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>⚡️</td>
<td>Direct current</td>
</tr>
<tr>
<td>~</td>
<td>Alternating current</td>
</tr>
<tr>
<td>🔝</td>
<td>The product is equipped with an earth (ground) terminal.</td>
</tr>
<tr>
<td>⬇️</td>
<td>The product is equipped with a protective conductor terminal.</td>
</tr>
<tr>
<td>🌐</td>
<td>The product is equipped with a frame or chassis terminal.</td>
</tr>
<tr>
<td>✋</td>
<td>On (Power)</td>
</tr>
<tr>
<td>🔫</td>
<td>Off (Power)</td>
</tr>
<tr>
<td>🟢 or 🔴</td>
<td>On/Off (Power)</td>
</tr>
<tr>
<td>🛠</td>
<td>Fuse</td>
</tr>
</tbody>
</table>

Electrical Safety Information

This unit uses an international safety standard three-wire power cable. This cable serves as a ground when connected to an appropriate AC power outlet.
Warning

• The use of voltages higher than those indicated on the label affixed to your unit may damage the unit.
• The use of controls, adjustments and procedures, namely for operation and maintenance, other than those specified herein may result in hazardous radiation exposure or impair the protection provided by this unit.
• If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.
• Use only accessories designed for your unit and approved by EXFO. For a complete list of accessories available for your unit, see its technical specifications or contact EXFO.
• Where applicable, use only the listed and certified AC adapter provided by EXFO with your unit. It provides reinforced insulation between primary and secondary, and is suitably rated for the country where the unit is sold.
• Use only the certified power cord that is suitably rated for the country where the unit is used. Replacing detachable mains supply cords by inadequately rated cords, may result in overheating of the cord and create a fire risk.
• Your unit is equipped with an internal replaceable clock battery to keep time and date accurate. Only authorized personnel can replace this battery. Attempting to replace it yourself could seriously compromise your safety.
• Unless otherwise specified, all interfaces are intended for connection to Safety Extra Low Voltage (SELV) circuits only.
• To avoid electrical shock, do not operate the unit if any part of the outer surface (covers, panels, etc.) is damaged.
• Operation of any electrical instrument around flammable gases or fumes constitutes a major safety hazard.
• Only authorized personnel should carry out adjustments, maintenance or repair of opened units under voltage. A person qualified in first aid must also be present. Do not replace any components while the power cable are connected.
• Use only the listed and certified AC adapter/charger provided by EXFO with your unit. It provides reinforced insulation between primary and secondary, and is suitably rated for the country where the unit is sold.
• Use only fuses with the required rated current and specified type. Do not use repaired fuses or short-circuited fuse holders. For more information, see the section about replacing the fuses in this user documentation.

Caution

• Where applicable, the operation and storage temperatures, as well as the altitude and relative humidity values of some modules may differ from those specified for your platform. In this case, always ensure that you comply with the most restrictive conditions (either module or platform).
• When using the unit while connected to the AC/DC adapter/charger, make sure you do not position the equipment so that it is difficult to disconnect the adapter/charger from the AC mains.
• Position the unit so that the air can circulate freely around it.
Important Safety Information for Your Product

Optical Safety

Safety Symbols on Your Product

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Laser Symbol]</td>
<td>This symbol on your product indicates that the unit is equipped with a laser source, or that it can be used with instrument equipped with a laser source. These instruments include but are not limited to, modules and external optical units.</td>
</tr>
</tbody>
</table>

Optical Safety Instructions

Your instrument is in compliance with standards IEC 60825-1: 2007 and 2014. Laser radiation may be encountered at the optical output port.

The following label indicates that a product contains a Class 1 source:

![CLASS 1 LASER PRODUCT]  
![APPAREIL À LASER DE CLASSE 1]


Warning

- Do not install or terminate fibers while a light source is active.
- Never look directly into a live fiber and ensure that your eyes are protected at all times.

Gas Safety

The OSA20 contains acetylene gas in a sealed cell of less than 2 cm³.
1. Product Presentation

The OSA20 is a diffraction-grating based optical spectrum analyzer, using a touch sensitive display with multi-touch gesture control. It provides an extensive suite of built-in analysis functions enabling input signal measurement and analysis for many common applications. A wide range of communication ports allows remote control operations and export of data. The OSA20 features one general analysis mode and seven application-oriented modes. Each analysis mode has a full suite of analysis functions for a detailed spectrum analysis.

1.1 Technical Specifications

<table>
<thead>
<tr>
<th>Spectral Measurement</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Spectral Range</td>
<td>1250–1700 nm / 239.834–176.349 THz</td>
</tr>
<tr>
<td>Span Range</td>
<td>0.5 nm to full range (450 nm)</td>
</tr>
<tr>
<td>Linearity*1</td>
<td>±6 pm over 1500–1640 nm, ±20 pm over full range / 2.5 GHz @ 1550 nm</td>
</tr>
<tr>
<td>Accuracy*1</td>
<td>±10 pm over 1500–1640 nm, ±25 pm over full range / 2.5 GHz @ 1550 nm</td>
</tr>
<tr>
<td>Repeatability</td>
<td>±2 pm / 0.25 GHz @ 1550 nm</td>
</tr>
<tr>
<td>Sampling Resolution</td>
<td>2 pm / 0.25 GHz @ 1550 nm</td>
</tr>
<tr>
<td>Sampling Points</td>
<td>251 (span of 0.5 nm) to 225,001 (span of 450 nm)</td>
</tr>
<tr>
<td>Reference</td>
<td>Built-in ELED (safety class 1) + Acetylene cell (user calibration by patch cord) Acetylene gas is a NIST standard Reference Material SRM 2517a. The P9 line is used in the case of OSA20</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Optical Power</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Power per Channel</td>
<td>≤ 20 dBm</td>
</tr>
<tr>
<td>Total Safe Power</td>
<td>≤ 25 dBm</td>
</tr>
<tr>
<td>Level Sensitivity*2</td>
<td></td>
</tr>
<tr>
<td>single scan</td>
<td>High (0.5 nm/s): &lt; -76 dBm (-78 dBm typ.)</td>
</tr>
<tr>
<td>with averaging (Avg Nb of scans)*3</td>
<td>High (0.5 nm/s): -80 dBm (Avg 3), -85 dBm (Avg 30), -90 dBm (Avg 380) -75 dBm (2 nm/s): -80 dBm (Avg 7), -85 dBm (Avg 70), -90 dBm (Avg 800)</td>
</tr>
<tr>
<td>Absolute Level Accuracy*1,*4</td>
<td>±0.4 dB at 1310 nm and 1550 nm</td>
</tr>
<tr>
<td>Level Linearity*5</td>
<td>±0.07 dB over the full range (input level -50 to +3 dBm)</td>
</tr>
<tr>
<td>Level/Wavelength Flatness*6</td>
<td>±0.15 dB over 1500–1640 nm, ±0.25 dB over 1260–1680 nm</td>
</tr>
<tr>
<td>Level Sampling</td>
<td>±0.01 dB over -60 to +20 dBm</td>
</tr>
</tbody>
</table>
Monochromator

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolution Bandwidth</td>
<td>20 pm native, adjustable over 50–2000 pm with 1 pm step</td>
</tr>
<tr>
<td>Dynamic Range (ORR)</td>
<td>≥ 30 dB (&gt; 35 dB typ.) beyond ±50 pm from peak</td>
</tr>
<tr>
<td></td>
<td>≥ 50 dB (&gt; 55 dB typ.) beyond ±100 pm from peak</td>
</tr>
<tr>
<td></td>
<td>≥ 60 dB (&gt; 63 dB typ.) beyond ±200 pm from peak</td>
</tr>
<tr>
<td>Stray Light Suppression ratio</td>
<td>≥ 73 dB</td>
</tr>
</tbody>
</table>

Scan Speed

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>-55 dBm at 2000 nm/s to -75 dBm at 2 nm/s</td>
</tr>
<tr>
<td>Sweep Cycle/100 nm</td>
<td>300 ms typ.</td>
</tr>
<tr>
<td>Sampling Rate</td>
<td>1 MHz typ.</td>
</tr>
</tbody>
</table>

*1: After user calibration performed after 1 hour warm-up time.
*2: Noise level of 99 % of all data points over 1520–1620 nm.
*3: Typical values.
*4: Over 18–28°C all sensitivity settings except ±0.6 dB in -55 dBm and Burst sensitivities.
*5: Measured @ 1310 nm & 1500 nm, except ±0.3 dB in -55 dBm and Burst sensitivities.
*6: Except ±0.35 dB in -55 dBm and Burst sensitivities, except for water absorption lines, over 18–28°C all sensitivity settings.
*7: Native 17–24 pm over 1500–1620 nm (except in -55 dBm sensitivity), 17–26 pm over 1250–1700 nm.
*8: Adjustable resolution bandwidth is calculated from the native bandwidth.
*9: Adjustable over 6–400 GHz with 0.1 GHz step on the abscissa in THz.
*10: HeNe laser at 1523 nm with ±2 nm span.
*11: Laser at 1523 nm with ±50 nm span, excluding ±2 nm around peak.
*12: Sweep cycle /100 nm at -60 dBm sensitivity at center wavelength of 1475 nm.

Interface & Electrical

<table>
<thead>
<tr>
<th>Interfaces &amp; Electrical</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optical Interfaces</td>
<td>SMF-28 type fiber</td>
</tr>
<tr>
<td>User Calibration Output</td>
<td>Built-in ELED (safety class 1) + Acetylene cell (user calibration by patch cord)</td>
</tr>
<tr>
<td>Connector (Input and Output)</td>
<td>FC/APC or FC/PC or SC/APC or SC/PC</td>
</tr>
<tr>
<td>Return Loss</td>
<td>&gt; 38 dB (&gt; 42 dB typ.) at 1310 nm and at 1550 nm (APC connector)</td>
</tr>
<tr>
<td>External Devices</td>
<td>VGA Port (x1), DVI-D Port (x1), HDMI (x1)</td>
</tr>
<tr>
<td>Mouse, keyboard, hard disk...</td>
<td>USB 2.0-A (x4), USB 3.0-A (x2)</td>
</tr>
<tr>
<td>Serial Ports (unused)</td>
<td>Male SUBD-9 (x2)</td>
</tr>
<tr>
<td>Sound Ports (unused)</td>
<td>Line-in (x1), Line-out (x1), Microphone (x1)</td>
</tr>
<tr>
<td>Remote Interfaces</td>
<td>Ethernet (2x RJ45) 1 Gb/s max.</td>
</tr>
<tr>
<td></td>
<td>GPIB (1x IEEE 488) 7.2 Mb/s max.</td>
</tr>
<tr>
<td></td>
<td>USB (1x USB 2.0-B) 115 kb/s max.</td>
</tr>
<tr>
<td>Triggers</td>
<td>High level: &gt;3 V</td>
</tr>
<tr>
<td></td>
<td>Low level: &lt;2 V</td>
</tr>
<tr>
<td></td>
<td>Input maximum range: 0–5.5 V</td>
</tr>
<tr>
<td></td>
<td>High level: 4.5 to 5 V on high-impedance load (&gt;10 kΩ)</td>
</tr>
<tr>
<td></td>
<td>Low level: 0 to 0.5 V on high-impedance load (&gt;10 kΩ)</td>
</tr>
</tbody>
</table>
Environmental & Physical

Electrical Specifications

<table>
<thead>
<tr>
<th>Unit</th>
<th>Input power</th>
<th>48 V ~; 3 A (protected by fuse)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuse Type</td>
<td>3.15 A, Fast-acting, Low-breaking, 250 V, Ø5x20 mm</td>
<td></td>
</tr>
<tr>
<td>Internal clock</td>
<td>battery</td>
<td>3V CR2032 (replacement by service personnel only)</td>
</tr>
</tbody>
</table>

AC/DC Adapter

<table>
<thead>
<tr>
<th>Input Power</th>
<th>100–240 V ~, 50/60 Hz, 1.5 A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output Power</td>
<td>48 V ~, 3.13 A</td>
</tr>
</tbody>
</table>

Environmental Specifications

<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>Test and Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment Location</td>
<td>Indoor use only</td>
</tr>
<tr>
<td>Safety Class</td>
<td>Basic insulation, as defined in IEC-61010-1. Grounded product.</td>
</tr>
<tr>
<td>Overvoltage Category</td>
<td>Category II</td>
</tr>
<tr>
<td>Pollution Degree</td>
<td>Degree 2</td>
</tr>
<tr>
<td>Safe Operating Temperature Range</td>
<td>+5 °C to +40 °C, +41 °F to +104 °F (scan stop if temperature &gt; 35°C: see section Error Code -1003, p. 139)</td>
</tr>
<tr>
<td>Performance Guaranteed Temperature Range</td>
<td>+18 °C to +28 °C, +64.4 °F to +82.4 °F</td>
</tr>
<tr>
<td>Storage Temperature Range</td>
<td>-10 °C to +50 °C, +14 °F to +122 °F</td>
</tr>
<tr>
<td>Maximum Relative Humidity</td>
<td>80 % for temperatures up to 31°C decreasing linearly to 50 % relative humidity at 40°C</td>
</tr>
<tr>
<td>Altitude (maximum operating)</td>
<td>2000 m</td>
</tr>
</tbody>
</table>

Physical Specifications

<table>
<thead>
<tr>
<th>Display Screen</th>
<th>12 inch capacitive touch-screen (res. 1024 x 768)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Storage Capacity</td>
<td>18 GB</td>
</tr>
<tr>
<td>Dimensions &amp; Weight</td>
<td>W 413 x H 314 x D 385 mm, 15 kg</td>
</tr>
<tr>
<td>Available Accessory</td>
<td>Rack mount kit</td>
</tr>
</tbody>
</table>

The validity of specifications depends on operating conditions. For more details, see section Calibrating the OSA20, p. 136.
1.2 Product Overview

The OSA20 is delivered with the following accessories:

- 1 front panel protective cover
- 1 power supply cord
- 1 AC/DC power adapter (fastened on the rear panel)
- 1 jumper (for user calibration)
- 1 capacitive touch screen stylus
- 1 manual Getting Started with OSA20
- 1 USB key containing the firmware version installed on the OSA20 and the available drivers, examples, reports and user documentation.

1.2.1 Front Panel

The OSA20 is delivered with a protective cover fastened on the front panel.

**On/Off button**

The label identifies the On/Off button that enables you to turn on or off the OSA20 (see section Turning on/off the OSA20 and Accessing an Analysis Mode, p. 31).

**Multi-touch Screen**

The multi-touch screen enables you to perform all possible operations on the OSA20. To select a parameter, command or function on the screen, touch the corresponding command with the tip of your finger or the stylus, without tapping it.
The following gestures are available on the multi-touch screen:

<table>
<thead>
<tr>
<th>Gesture</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Touch</td>
<td>Gently touch something on the screen with your finger or the stylus to select it.</td>
</tr>
<tr>
<td>Pan</td>
<td>Drag your finger or the stylus across the screen.</td>
</tr>
</tbody>
</table>
| Pinch/Stretch  | Pinch two fingers together or move them apart to zoom in or out:  
|                | • To zoom in, touch two points on the screen and move your fingers away from each other.                                               |
|                | • To zoom out, touch two points on the screen and move your fingers toward each other.                                                      |
| Long press     | Hold your finger or stylus on the graph until a complete circle appears around it to automatically activate the rectangle zoom (see section Adjusting the Scale of the Graph With Zoom Commands, p. 55). |

**USB ports**

The ![USB port] label identifies the two USB 2.0 type-A ports located on the front panel. They enable you to connect USB devices such as:

- Keyboard and mouse if needed (see section Connecting USB Devices to the OSA20, p. 28)
- USB key or hard disk to export your measurement results
- An external multi-touch screen

The USB ports are SELV classified; you must only connect them to interfaces of the same type.

**Optical Connectors**

The two following optical connectors, protected by a dust cap, are located on the front panel:

- The ![Calibration Output] label identifies the ELED and acetylene source output, used for user calibration of the wavelength (see section Calibrating the OSA20, p. 136).
  
  The ![Wrench] label indicates an injury hazard. The user calibration output requires special safety instructions for proper use; see section Calibrating the OSA20, p. 136.

- The ![Optical Input] label identifies the optical input, used to connect a light source.

The two optical connectors are mounted on a plate, which enables you to access the internal optical connectors for cleaning (see section Performing Basic Maintenance Operations, p. 131).
1.2.2 Left-side Panel: Cooling Fan

The cooling fan, located on the left-side panel of the OSA20, extracts warm air from inside. A cover grid protects it.

![Cooling Fan Diagram]

*Figure 2: Left-side panel – Cooling Fan*
1.2.3 Right-side Panel: Connectors

The right-side panel of the OSA20 contains:

- A complete set of communication ports and interfaces for remote control and export of data.
  
  All ports and interfaces are SELV classified and must only be connected to interfaces of the same type.
  
- Ventilation holes for air input.

**Figure 3: Right-side panel – Connectors**

External Screen Connectors

You can connect an external screen to the following ports:

- **VGA** port
- **DVI** port
- **HDMI** port

For more details on how to configure the external screen settings, see section *Sharing the OSA20 Display with an External Screen, p. 29.*

Trigger Ports

The trigger ports enable you to synchronize scans with a signal (see section *Interfaces & Electrical, p. 14* for more details on signal levels).

- **TRIG OUT**: BNC connector for outputting trigger signals. For more details, see section *Generating Output Trigger Signals, p. 47.*
• **TRIG IN**: input BNC connector for starting scan in synchronization with an external trigger signal, as described in section *Triggering the Optical Spectrum Acquisition*, p. 46.

In RLT mode, this port is used as a gate: see paragraphs *RLT – Recirculating Loop Transmission*, p. 35 and *Gate Acquisition (RLT mode only)*, p. 43.

**USB Ports**

- **USB 2.0-A** and **USB 3.0-A**: these ports enable you to connect USB devices such as:
  - Keyboard and mouse if needed (see section *Connecting USB Devices to the OSA20*, p. 28)
  - USB key or hard disk to export your measurement results
  - An external multi-touch screen

The USB ports are SELV classified; you must only connect them to interfaces of the same type.

- **USB 2.0-B**: this port enables you to perform remote control operations from a connected computer. For more information, see section *Using the OSA20 in Remote Control*, p. 125.

**Ethernet Ports**

The two Ethernet ports enable you to perform remote control operations.

- **Ethernet port #1**:
  This port is associated with a DHCP server. It can be used to connect directly a computer that will be assigned automatically an IP address.

- **Ethernet port #2**:
  You can configure this port manually or automatically through a remote DHCP server.

For more information, section *Using the OSA20 in Remote Control*, p. 125.

**Important**

The Ethernet ports can only be used for remote control of the OSA20. Any other use is not possible.

**Audio and Serial Ports**

Unused ports.
1.2.4 Rear Panel

The rear panel holds the power adapter, power switch, fuse holder and GPIB connector.

IEEE 488 Port

This port (also known as GPIB port) enables you to perform remote control operations. For more information, see section Using the OSA20 in Remote Control, p. 125. The IEEE 488 port is SELV classified; you must only connect it to interfaces of the same type.

AC/DC Power Adapter and Power Cord

The AC/DC power adapter is fastened on the rear panel for convenient purpose. It is plugged to the 48 V DC connector, identified by the label.

Caution

To ensure the smooth functioning of the OSA20, you must only use the power adapter provided by EXFO.

The 48 V DC connector is SELV classified and must only be connected to interfaces of the same type.

Fuse Holder

The fuse holder contains a fuse (see section Technical Specifications, p. 13 for fuse type) to protect the OSA20 from overcurrent.
### Labels and Markings

<table>
<thead>
<tr>
<th>Label</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Identification of the Product label" /></td>
<td><strong>Identification of the Product</strong>&lt;br&gt;Indicates serial number, model, options (if any), and date of manufacture.</td>
</tr>
<tr>
<td><img src="image2" alt="Manufacturer Identification label" /></td>
<td><strong>Manufacturer Identification</strong>&lt;br&gt;Contact information of the manufacturer.</td>
</tr>
<tr>
<td><img src="image3" alt="Power and Compliance label" /></td>
<td><strong>Power and Compliance</strong>&lt;br&gt;- <img src="image4" alt="injury hazard icon" /> indicates an injury hazard. It appears on a location that requires special instructions for proper use: see section <em>Important Safety Information for Your Product</em>, p. 9.&lt;br&gt;- <img src="image5" alt="fuse icon" /> : the fuse type is described in section <em>Technical Specifications</em>, p. 13.&lt;br&gt;- Compliances: see section <em>Certification and Compliance</em>, p. 145.</td>
</tr>
<tr>
<td><img src="image6" alt="Windows License Label" /></td>
<td><strong>Windows License Label</strong>&lt;br&gt;The OSA20 embeds Windows Standard Seven.</td>
</tr>
<tr>
<td><img src="image7" alt="Warranty Seal" /></td>
<td><strong>Warranty Seal</strong>&lt;br&gt;The OSA20 cover must not be open, otherwise the warranty is not valid anymore.</td>
</tr>
</tbody>
</table>
2. Installing and Connecting the OSA20

2.1 Unpacking and Installing the OSA20

This section explains how to install the OSA20 as a bench top instrument. To install the OSA20 into a rack, EXFO has designed a special rack mount (for more details, contact your sales representative). The procedure to install the OSA20 into a 19-inch rack is available in the manual delivered with the rack mount kit. The OSA20 is designed for indoor use only, and is not dedicated to wet locations. It must be operated under proper environment conditions, as explained in the following procedure.

Before Starting

Procedure

1. Open the package with care and remove the protective foam.

2. Remove the EXFO tape that closes the plastic bag, and open the plastic bag that contains the OSA20 to make visible the two handles.

3. Pull out the OSA20 vertically from its packaging: hold it by its two retractable handles and keep it horizontal.

4. Set the OSA20 on a flat stable surface free of excessive vibration.

5. Allow the flow of air to circulate freely around the OSA20 and remove any equipment or paper that could block the air flow. Ventilation holes are located on the right and bottom sides of the OSA20.

Caution

To ensure proper environment conditions:

- Make sure the location where the OSA20 will be installed meets the environmental characteristics listed in section Technical Specifications, p. 13.
- Do not install the OSA20 near any source of heat or cold.
- To ensure proper ventilation and cooling, make sure there is sufficient clearance below, on top and at the sides of the OSA20 in the place where it will be installed.

Important

When unpacking, handle the device with care and do not damage the original shipping container in case the OSA20 needs to be returned to EXFO.

Important

When unpacking, handle the device with care and do not damage the original shipping container in case the OSA20 needs to be returned to EXFO.

Do not place anything under or at the sides of the OSA20, as illustrated in the following figure.
6. On the rear panel (see Figure 6, p. 24), make sure the power switch is set to 0.
7. Remove the protective cover from the front panel:
   a. Hold your hands on the two lateral edges of the protective cover.
   b. Slightly splay the lateral edges of the protective cover to unfasten the two side tabs from the back of the front frame.
   c. Gently pull horizontally the protective cover out of the front panel.
8. To tilt the OSA20 upward, deploy the two retractable legs located below it.
2.2 Connecting the OSA20 to a Power Source

The OSA20 is dedicated to be connected to a SELV circuit.

2.2.1 Connecting the OSA20 to the Wall Socket Using the Power Adapter

Subject

The OSA20 has a chassis connected to ground via the power supply cord. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

You must use the AC/DC adapter provided with the OSA20. For voltage specifications, see section Technical Specifications, p. 13.

Before Starting

Warning

- Make sure the wall socket on which the OSA20 will be plugged is protected by a 16 A max circuit breaker.
- Make sure the OSA20 power source does not apply more than 265 Volts RMS between the supply conductors and the ground.
- To avoid the possibility of injury, make sure the socket outlet in which the power supply cord will be plugged is equipped with a protective ground contact, and that the electrical installation fulfills the local safety requirements.

Procedure

1. Make sure the AC/DC adapter is not plugged to the wall socket.
2. Make sure the power switch is set to O.
3. On the rear panel, connect the cord of the adapter to the 48 V connector.
4. Connect one end of the provided power supply cord to the AC/DC adapter located on the rear panel and plug the other end to the proper voltage wall socket outlet (to know the voltage requirement, see section Technical Specifications, p. 13).
5. On the rear panel, set the power switch to I.
2.2.2 Connecting the OSA20 to a 48 V DC Power Source

Subject
You can directly connect the OSA20 to a 48 V DC power source by following the instructions given in this section.

Connector Description

Before Starting

Caution
- Make sure the voltage of the power source is in the range 48–60 V and complies with the requirements of SELV circuit, as defined in the IEC60950-1 standard.
- Make sure you have a Kycon KPPX-4P connector.
- Make sure the cord you associate with the Kycon KPPX-4P connector fits your requirements. The choice of the cord is under your responsibility.

Procedure
1. Make sure the power switch is set to O.
2. On the rear panel, connect the Kycon KPPX-4P connector to the 48 V connector and make sure the five pins are connected.
3. On the rear panel, set the power switch to I.
2.3 Connecting a Light Source to the OSA20

Subject

You can connect any type of light source whose output power is in the range indicated in the technical specifications (see section Technical Specifications, p. 13).

Caution

- Make sure you use the appropriate connector type, corresponding to the one mounted on your OSA20 (see section Interfaces & Electrical, p. 14 for available models).
- Make sure optical connectors are perfectly clean. It is essential to achieve optimum system performance (see section Cleaning Optical Connectors, p. 134).

Procedure

1. Remove the protective cap from the Optical input connector.

   Important
   Keep protective caps on optical connectors when not in use.

2. Connect the light source to the optical input of the OSA20 with the appropriate jumper corresponding to the connector type mounted on your product, as indicated on the connector’s plate (see Figure 1, p. 16).
2.4  Handling USB Devices with the OSA20

2.4.1  Connecting USB Devices to the OSA20

Subject

You can connect storage USB devices, mouse and keyboard to the USB 2.0-A and USB 3.0-A ports located on the front and right-side panels of the OSA20 (see Figure 1, p. 16 and Figure 3, p. 19).

Procedures

Connecting USB Storage Devices

- Connect the USB storage device to one of the available USB ports (you do not need to restart the OSA20).
  - The first time you connect a USB storage device, the driver is installed and can take some time (depending on the connected device).
  - The icon appears at the left of the date and time and the device becomes available for loading or saving data (see section Saving/Loading Configuration Settings and Handling Files, p. 121).

Connecting Mouse and Keyboard

- Connect the USB mouse and keyboard to one of the available USB ports (you do not need to restart the OSA20).
  - All operations available using the multi-touch screen are also accessible using the mouse and keyboard.
  - The Windows keyboard shortcuts are deactivated.
  - The default keyboard setting is QWERTY.

Switching between QWERTY and AZERTY Keyboard

After connection, the default keyboard setting is QWERTY.
- To switch the keyboard to AZERTY: in the Settings window, use the Layout list: see section Setting General Parameters, p. 32.

2.4.2  Disconnecting USB Storage Devices from the OSA20

Subject

If you connect one or more USB storage device(s) to the OSA20, an icon appears on the top right of the screen, next to the date and time. This icon enables you to safely remove USB storage devices from the OSA20, as explained in the following procedure.

Procedure

1. On the OSA20 screen, touch the icon located at the left of the date and time. The list of all connected USB storage devices appears.
2. Touch the Safely remove... menu. A confirmation message appears.
3. Remove the USB device from the OSA20.
2.5 Sharing the OSA20 Display with an External Screen

Subject

You can connect an external screen to the OSA20 to share the display and control (you do not need to restart the OSA20).

Before Starting

Make sure you have the appropriate connection cable to connect your external screen.

Procedure

1. Connect your external screen to one of the available screen connectors located on the right-side panel of the OSA20 (see Figure 3, p. 19) with the appropriate cable.
2. If the external screen is a touchscreen: connect it to the OSA20 with a USB-A cable to be able to operate the OSA20 with multi-touch gestures from the connected screen.
3. In the OSA20 home window, touch the Settings button.
   
   The Settings window appears. The screen you have connected is available in the Screen list. If not, touch the Refresh button to make it appear.
4. In the Display area, select the wanted screen and resolution, as explained in section Setting General Parameters, p. 32.
   
   The OSA20 display immediately appears on the external screen, with the selected resolution.
3. Turning on/off the OSA20 and Accessing an Analysis Mode

3.1 Accessing the OSA20 Home Window

Subject
The home window enables you to access the wanted analysis mode and the main configuration settings of the OSA20.

Before Starting
Make sure the OSA20 is properly installed: see section Installing and Connecting the OSA20, p. 23.

Procedure
• If the OSA20 is turned off:
  • On the front panel, press the button.
    After a few seconds, the button lights up.
    The startup procedure takes approximately 1 minute and 30 seconds.
    Once started, the OSA20 home window appears.
• If the OSA20 is turned on and you have selected an analysis mode or a configuration window:
  • Touch the button.
    The OSA20 home window appears.

Home Window Description

Analysis Mode Selection Area
Each analysis mode has its own traces and analysis tools. For more details, see section Accessing an Analysis Mode, p. 35.
### Turning on/off the OSA20 and Accessing an Analysis Mode

**General Configuration Area**

<table>
<thead>
<tr>
<th>Button</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>System</td>
<td>Provides information about the OSA20 and a customer support contact list.</td>
</tr>
<tr>
<td></td>
<td>The <strong>More</strong> button gives access to additional information on the system and to remote assistance tools (see section Using Remote Assistance Tools, p. 144).</td>
</tr>
<tr>
<td>Settings</td>
<td>Enables you to set the OSA20 general parameters. For more details, see section Setting General Parameters, p. 32.</td>
</tr>
<tr>
<td>Remote</td>
<td>Enables you to set the remote control parameters of the OSA20. For more details, see section Using the OSA20 in Remote Control, p. 125.</td>
</tr>
<tr>
<td>Calibration</td>
<td>Opens the OSA20 user calibration application, which enables you to reference the monochromator to one of the acetylene absorption lines. For more details, see section Calibrating the OSA20, p. 136.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Additional Button</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Power Button]</td>
<td>Turns the OSA20 off. For more details, see section Turning off the OSA20, p. 39.</td>
</tr>
</tbody>
</table>

### 3.2 Setting General Parameters

**Subject**

The **Settings** window allows you to define the OSA20 general parameters.

**Procedure**

1. In the OSA20 home window, touch the **Settings** button. The **Settings** window appears.
2. Specify the wanted general settings as explained in the following **Settings Window Description** subsection, p 33.
3. Touch the ![Home Button] button to go back to the OSA20 home window.
### Settings Window

**Description**

**Figure 9: OSA20 Settings**

<table>
<thead>
<tr>
<th>Setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Display</strong></td>
<td></td>
</tr>
<tr>
<td>Backlight</td>
<td>Screen brightness. Slide the Backlight cursor to increase or decrease the screen brightness.</td>
</tr>
</tbody>
</table>
| Screen                | Only applies if an external screen is connected to one of the screen connectors (see Figure 3, p. 19).
|                       | Screen on which you want to display the OSA20 graphical user interface (GUI):                   |
|                       | • OSA20: the GUI is only displayed on the OSA20 screen.                                       |
|                       | • External: the GUI is only displayed on the external connected screen.                        |
|                       | • OSA20 & External: the GUI is displayed on the external connected screen and on the OSA20 screen. |
|                       | The Refresh button enables you to refresh the list of available screens if you have just connected one. |
| Resolution            | Only applies if an external screen is connected to one of the screen connectors (see Figure 3, p. 19), and if the External screen setting is selected. |
|                       | Resolution of the screen on which you want to display the OSA20 graphical user interface. The resolution immediately changes on the external screen. |
| **Units**             |                                                                                               |
| Spectral Unit         | Wavelength and power units to use in measurement and analysis.                                 |
| Power Unit            | If Power Unit is set to mW, the minimum scale value is 0 mW in all cases, regardless the zoom factor. |
Turning on/off the OSA20 and Accessing an Analysis Mode

### Dark Current Cancellation (Zero)

**Auto Zero**

This zeroing function uses a shutter to perform a dark current measurement on the detection system. It usually takes 2 to 5 seconds.

For best power accuracy measurements, we recommend to leave this function activated during OSA20 operation.

- **(default)**: the dark current is periodically removed from the measurements, as follows:
  - In continuous scanning mode, a zeroing is performed every 5 min over the first 3 hours of operation, and every 10 min after that.
  - In single scanning mode, a zeroing is performed before the scan at 5 min intervals in the first 3 hours of operation, and at 10 min intervals after that.
  - A zeroing is forced at the first scan whenever the sensitivity is changed from -55/-60/-65 to -70/-75/HIGH/Burst, or vice versa.
  - No zeroing is performed during idle time (i.e. if no scan is performed) unless manually activated.

- **: the dark current is never set to zero automatically. You can perform it manually using the Scan menu (see section Defining Scan Parameters, p. 41). This setting resets to the default activated position at startup to avoid erroneous measurements during instrument warm-up.

### Power Offset

**Offset**

Compensation value you want to apply on the detected power upon acquisition.

Possible value: from -2.00 dB to 2.00 dB

### Date & Time

**Date**

Date, time and zone of your location.

**Time**

Touch the Date and Time (hours and minutes) fields to enter date and time, and select your time zone in the displayed Zone list.

### Keyboard (external)

**Layout**

Language layout corresponding to the external keyboard you have connected (if any).

### Settings and Data Management

**Restore Factory Settings**

Deletes all the user customized settings, parameters and traces displayed on screen in the entire OSA20 system and restores the original default settings.

**Delete All User Data on Drive**

Deletes all data saved by a user on the internal OSA20 drive. All user customized settings, parameters and traces displayed on screen are not deleted.
3.3 Accessing an Analysis Mode

The OSA20 provides eight analysis modes. Each mode has its own available traces and analysis tools, which are adapted to the tested application. The available analysis tools by analysis mode are detailed in section Analyzing Traces, p. 59.

Analysis Modes

- **OSA – Optical Spectrum Analyzer**
  This analysis mode is the most open of all. It contains most of the analysis tools available in the OSA20 for the characterization of unknown or mixed sources.

- **BBS – Broadband Source**
  This mode provides a series of analysis tools designed for the characterization of Broad Band Sources such as Semiconductor, Raman or Fibre Optical Amplifiers and superluminescent or Edge-Emitting LED.

- **MML – Multimode Laser**
  This mode provides a series of analysis tools designed for the characterization of sources with a large spectral width and several emission peaks. These sources are also known as Multiple-Longitudinal Mode Lasers, for instance the Fabry-Perot laser diodes.

- **SML – Single Mode Laser**
  This mode provides a series of analysis tools designed for the characterization of single mode lasers such as distributed feedback Bragg laser diodes and external cavity lasers.

- **WDM – Wavelength Division Multiplexing**
  This mode provides a series of analysis tools designed for the characterization of WDM signals such as Coarse WDM, Dense WDM and ROADM.

- **OFA – Optical Fiber Amplifier**
  This mode provides a series of analysis tools designed for the characterization of optical amplifiers such as Erbium Doped Fiber Amplifier (EDFA).

- **PCT – Passive Component Tester**
  This mode provides a series of analysis tools specific to the characterization of passive components such as optical filters, isolators or fibers.

- **RLT – Recirculating Loop Transmission**
  This analysis mode is a special version of WDM and is specifically designed for recirculating loop experiments. In this mode, the acquisition is synchronized with the gated input signal (via the TRIG IN port); at each scan a controlled shift is applied in order to control the scan completion.
The total scan time is widely linked to the gate signal period and its duty cycle.

Before Starting

If you are using the OSA20 for the first time, calibrate it as explained in section *Performing a User Calibration, p. 136* before accessing an analysis mode.

Procedure

1. In the OSA20 home window, touch the right or left blue arrows to navigate to the wanted analysis mode.
2. Touch the button corresponding to the analysis mode you want to enter. The analysis mode window appears.
**Analysis Mode**

**Window Description**

**Figure 11: Analysis Mode Window**

**Analysis Mode Tabs**

<table>
<thead>
<tr>
<th>Tab</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;Analysis Mode&gt;</td>
<td>This tab displays the results of scan measurements and analysis setup: see section <em>Defining Scan Measurement Parameters</em>, p. 41 and section <em>Adjusting the Graph Display</em>, p. 55.</td>
</tr>
<tr>
<td>Analysis Setup</td>
<td>This tab gives access to the analysis tools that are available for the selected analysis mode, and enables you to modify the analysis parameters: see section <em>Analyzing Traces</em>, p. 59.</td>
</tr>
<tr>
<td>Triggers</td>
<td>This tab enables you to define the trigger IN and OUT parameters: see section <em>Triggering the Optical Spectrum Acquisition</em>, p. 46 (trigger IN) and section <em>Generating Output Trigger Signals</em>, p. 47 (trigger OUT).</td>
</tr>
<tr>
<td>Help</td>
<td>This tab displays the OSA20 User Guide. Using the Help tab during a scan may slow it down.</td>
</tr>
</tbody>
</table>

**Graph Display Settings**

This area allows you to adjust the graph display: see section *Adjusting the Graph Display*, p. 55.
Analysis Mode Window Controls

<table>
<thead>
<tr>
<th>Control</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Scan Icon" /></td>
<td>This button enables you to define the scan parameters and to start the acquisition: see section Scanning the Optical Spectrum, p. 41.</td>
</tr>
<tr>
<td><img src="image" alt="Analyze 1 Icon" /></td>
<td>This button enables you to define the analysis parameters and to start analysis: see section Analyzing Traces, p. 59.</td>
</tr>
<tr>
<td><img src="image" alt="Live ON Icon" /></td>
<td>These buttons enable you to operate scan traces: see section Operating Scan Traces, p. 48 and section Handling Traces Files, p. 53.</td>
</tr>
<tr>
<td><img src="image" alt="Clear Icon" /></td>
<td>This button enables you to clear all traces content and analysis results, except for Store type traces.</td>
</tr>
<tr>
<td><img src="image" alt="Load Save Icon" /></td>
<td>This button enables you to save/load analysis settings and results: see section Saving/Loading Configuration Settings and Handling Files, p. 121.</td>
</tr>
</tbody>
</table>
| ![nm dbm Icon](image) | This button enables you to modify the units used for measurement and analysis.  
  - The nm/THz button enables you to modify the spectral unit.  
  - The dBm/mW button enables you to modify the power unit.  
  You need to restart the analysis to apply the change to the analysis results. |
| ![home Icon](image) | This button enables you to go back to the Home window: see section Accessing the OSA20 Home Window, p. 31 |

USB Device Icon

The 🚫 icon appears if you connect a USB device to the OSA20. It means that the device is available for loading or saving data, and enables you to safely remove it: see section Handling USB Devices with the OSA20, p. 28.

"Recommended Calibration" Icon

The ⚠️ icon means that you should perform a user calibration to guarantee measurement accuracy (see section Calibrating the OSA20, p. 136). This icon is displayed in the following cases:
  - Every time the OSA20 is turned on.
  - If the temperature has changed too much since the last calibration.
3.4 Turning off the OSA20

Subject

The following procedure explains how to correctly turn the OSA20 off.

Caution

Never turn the OSA20 off by directly setting the power switch to O.

Procedure

1. Do one of the following:
   - Touch the button and in the home window, touch the button.
   - On the front panel, shortly press the button.
   
   A confirmation message appears.

2. Touch Yes.

   The OSA20 stops.

3. On the rear panel, set the power switch to O.
4. Defining Scan Measurement Parameters

4.1 Scanning the Optical Spectrum

Subject
You can adjust the optical spectrum acquisition with the measurement parameters available from the analysis mode window. The spectrum acquisition is performed on all available traces, according to the type of trace set.

Important
If you are using the OSA20 for the first time, you must calibrate it before performing scan measurements, as explained in section Calibrating the OSA20, p. 136.

4.1.1 Defining Scan Parameters

Subject
You can access the scan parameters from the analysis mode window.

Procedure
1. Enter the wanted analysis mode (see section Accessing an Analysis Mode, p. 35).

2. In the <Analysis Mode> tab, touch the button located to the left of the Scan button.

   The scan menu appears.

   ![Figure 12: Scan Commands]

   3. Set the wanted parameters according to the instructions given in the following Scanning Parameters: Description section, p 42.

      To modify a numeric value, touch the wanted value to display a numeric keypad.

   4. Touch the button or anywhere on the screen outside the menu to exit.
Defining Scan Measurement Parameters

### Scanning Parameters: Description

- **Range**
  Wavelength scanning range, defined by one of the following values:
  - **Start/Stop**: wavelength scanning range. The max/min wavelength range is defined in technical specifications (see section *Technical Specifications*, p. 13).
  - **Span/Center**: wavelength scanning span. Minimum span value: 0.5 nm. In THz, limits are also 0.5 nm span (it is not linear in THz).
  - ![Icon](image)
    sets the scanning range to the maximum possible wavelength range (see section *Technical Specifications*, p. 13).
  - ![Icon](image)
    sets the scanning range to the zoom parameters displayed on graph.
  - ![Icon](image)
    sets the scanning range to the limits specified by the positions of A and B markers (see section *Performing Manual Measurements With Markers*, p. 57).

  Modifying these values changes the O/E/S/C/L/U band selection (see below O/E/S/C/L/U buttons, p. 44).

- **Resolution**
  - **Native** (default): the spectral resolution is automatically set to the OSA20’s monochromator factory-calibrated optical resolution bandwidth (see section *Technical Specifications*, p. 13).
  - **Calculated**: the spectral resolution is set to the value you specify in the value field. In this case, the resolution is constant on the whole wavelength/frequency range, whatever the unit set (THz or nm) selected in the Settings window (see section *Setting General Parameters*, p. 32). Touch the value field to specify the wanted resolution value.

  Possible value: from 50 to 2000 pm or from 6 to 400 GHz

- **Sensitivity**
  Detection sensitivity corresponding to estimated noise around 1575 nm (typ.), which is related to the scanning speed (specified in brackets in the menu). To reduce the noise level, you can use the *Average* or *Roll Average* trace types (see p. 49).
  The fastest total scan time is not necessarily the fastest scan speed so it is recommended to experiment with different sensitivities.

  In RLT mode, the sensitivity is automatically set to -60 dBm and cannot be modified.

  - **Burst**: this sensitivity is adapted to burst signals and dedicated to GPON measurements. It optimizes the detection of optical power during the burst signal by returning the maximum detected level during the burst period ($T_{Burst}$):

    ![Burst Signal](image)

    If several pulses are detected during the $T_{Burst}$ period, only the maximum detected level is recorded.
The duty cycle \( \eta = \frac{T_{on}}{T_{burst}} \) of the signal must be in the range 2–100%.

Enter the period of the signal \( T_{burst} \) in the \( T \) parameter field. It must be between 10 and 2001 μs.

The scan speed depends on the \( T \) value (the typical speed corresponding sensitivity is -75 dBm to High): at low \( T \) value, the scan speed is faster and it decreases as the value increases.

- **Gate Acquisition** (RLT mode only)
  Polarity of the gate signal provided to the TRIG IN BNC connector (see Figure 3, p. 19).
  - **High**: the acquisition is performed when the signal is high.
  - **Low**: the acquisition is performed when the signal is low.

  Timing requirement of the gate signal:
  - Gate period: between 0.2 and 100 ms
  - Gate minimum width: 0.1 ms

- **Zero button**
  Performs a dark current measurement and applies the corresponding offset to the OSA20 detection system. For more details, see section Auto Zero, p. 34.

  If the Auto Zero check-box in the Settings window is cleared (see Figure 9, p. 33), a notification appears below the button.

- **Mode**
  - **Auto Set**
    The OSA20 performs an initial scan of the signal and then automatically defines the range and sensitivity:
    - It zooms on the interesting spectral region: twice the spectral width detected at 20 dB of the main peak.
    - It sets the sensitivity at the last selected sensitivity.
    - It switches to Continuous scan mode.
  - **Single**
    The OSA20 performs a single scan of the optical spectrum (according to the defined trace types) and then stops.

    If a trace is set to Roll Average: \( n \), the OSA20 performs \( n \) scans to be able to calculate the average value and then stops.
  - **Continuous**
    The OSA20 performs a continuous series of scans of the optical spectrum in accordance with the interval set in the Interval parameter (see Interval below), until you touch the Stop button.

- **Start**
  - **Manual**
    You perform the optical spectrum acquisition manually, by following the procedure detailed in section Manually Starting/Stopping the Optical Spectrum Acquisition, p. 45.

  - **Triggered**
    The OSA20 waits for the defined trigger signal to perform the optical spectrum acquisition. For more details, see section Triggering the Optical Spectrum Acquisition, p. 46.
• **Interval**
  This parameter applies to **Continuous** scanning mode, and in **Single** scanning mode, if a trace is set to **Average** type (see section Setting Trace Types, p. 49).
  
  • **Off**
    The OSA20 performs all scans successively with minimum pause between scans.

  • **On**
    The OSA20 observes the period of time specified in the I field before starting the next successive scan.
    
    I: period of time between the beginning of two successive scans.
    - If the interval set is greater than the scan time, the OSA20 waits before the next scan.
    - If the period of time is lower than the scan time, the OSA20 immediately performs the next scan.

• **O/E/S/C/L/U buttons**
  Wavelength scanning range, defined by ITU band selection. The blue line pictures the selected bandwidth.
  
  • To select a single band, touch the corresponding button twice.
  • To select several bands, touch the corresponding adjacent buttons one after another.
  • To modify the boundaries of a band, long press (or right-click) the corresponding band button.
    The numeric keypad enables you to enter the upper limit value of the selected band (no more than ±10 nm shift from the original ITU band)

Selecting a band modifies the values defined in the **Range** area.
4.1.2 Manually Starting/Stopping the Optical Spectrum Acquisition

**Subject**
The optical spectrum acquisition is performed according to the scanning parameters defined in section *Defining Scan Parameters, p. 41*, on traces that are available for scan. Scanning operation has no effect on traces set to **Store** or **None** types (see section *Setting Trace Types, p. 49*).

**Procedure**

**Starting the Acquisition**
1. In the **Scan** menu, set the **Start** parameter to **Manual**.
2. Make sure the type of traces to scan is not set to **Store** or **None**.
3. Touch the **Scan** button.
   - The **Scan** button label displays **Stop** and the acquisition starts using the selected parameters (see section *Defining Scan Parameters, p. 41*).
   - In the scan parameters area above the graph (see Figure 11, p. 37), you can follow the scan progress (in percent) and number of scans. In RLT mode, **Progress** indicates the completion of the overall acquisition (and not only the completion of the scan).
   - If the **Single** scanning mode is selected, the acquisition stops automatically.
   - If the **Auto Zero** check box is selected (see section *Setting General Parameters, p. 32*), the button displays **Zeroing** periodically.

**Stopping the acquisition**
- To stop the acquisition at the end of the scan in progress, touch the **Stop** button.
  - The button label switches to **Abort** until the acquisition stops (at the end of the current scan).
  - If you touch the **Abort** button while the acquisition is stopping, the acquisition does not finish the spectrum scan and stops as quickly as possible.
4.1.3 Triggering the Optical Spectrum Acquisition

Subject

The TRIG IN BNC connector (see Figure 3, p. 19) allows you to externally trigger the optical spectrum acquisition, as explained in the following procedure.

Procedure

1. At the top of the screen, touch the Triggers tab.
   The trigger configuration screen appears.
2. In the Trigger In area, set the wanted parameters for the input trigger, according to the instructions given in the following table.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
</table>
| Auto Rearm      | • (default): the system is automatically rearmed after each triggered scan, so that it is ready for the next triggered scan (Single scanning mode). In Continuous scanning mode, the scan is triggered once and then runs on continuous.  
                  • : the system is not rearmed after a triggered scan. In this case:  
                    • In Single scanning mode, you can only trigger one scan.  
                    • In Continuous scanning mode, the scan is triggered once and then runs on continuous. |
| Slope           | • Positive: the scan is performed when the received signal rises.  
                  • Negative: the scan is performed when the received signal falls.  
                  • Either: the scan is performed when the received signal rises or when it falls. |

3. Connect the external trigger to the TRIG IN BNC connector.
4. Touch the button located to the left of the Scan button to display the scan menu.
5. Select the wanted scanning parameters (see Scanning Parameters: Description, p. 42), and set the Start parameter to Triggered.
   The OSA20 will scan the optical spectrum according to the parameters set in the scan menu and in the Triggers tab.
4.1.4 Generating Output Trigger Signals

Subject
The TRIG OUT BNC connector (see Figure 3, p. 19) allows you to output trigger signals when the OSA20 performs a scan, as explained in the following procedure.

Procedure
1. Touch the Triggers tab.
   The trigger configuration screen appears.
2. In the Trigger Out area, set the wanted parameters for the output trigger, according to the instructions given in the following table.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
</table>
| On Span     | • (default): the OSA20 outputs a trigger signal when it starts and stops scanning the wavelength range defined in the scan menu.  
               • : the OSA20 outputs a trigger signal when it starts and stops scanning the wavelength range defined in the Start/Stop fields.  |
| Inverted Logic | • : the OSA20 outputs a low level signal when it scans.  
                 • (default): the OSA20 outputs a high level signal when it scans.   |
3. Connect the external instrument to the TRIG OUT BNC connector.
4. Touch the button located to the left of the Scan button and select the wanted scanning parameters (see Scanning Parameters: Description, p. 42)
   The scanning operation will trigger an output signal according to the selected parameters.
4.2 Operating Scan Traces

Subject

The number and type of available traces depends on the selected analysis mode. It is adapted to the analysis mode needs:

- In **OSA**, **WDM**, **RLT**, **SML**, **MML** and **BBS** modes, eight traces are available. They are numbered from 1 to 8 and can be set to various types so that it represents the wanted calculation or value.

- In **OFA** mode, four traces are available:
  - **IN** and **OUT** traces for acquisition
  - **ASE in** and **ASE out** traces, calculated from the analysis performed on traces **IN** and **OUT**

- In **PCT** mode, five traces are available:
  - **REF** trace (reference trace) and **DUT** (device under test) traces for acquisition
  - **TRANS** trace (for transfer function), which is the log calculation of the **DUT** trace - **REF** trace
  - **MSK HI** (high mask) and **MSK LO** (low mask) for acquisition of high and low traces that make the mask. For more detail on mask setup, see section *Setting Up Mask Test Analysis*, p. 119.

Each trace is represented by a different color.

![Figure 13: Trace Commands](image-url)

Trace Menu

**Description**

- **Trace configuration button**
- **Trace display button**
- **Trace activation button**
- **Trace information**
  - Range: 1330.000 - 1555.000 nm
  - Resolution: Native
  - Scale: dBm
- **Trace handling buttons**
  - Load
  - Save
  - Copy
  - Paste
- **Trace types**
  - Store
  - Live
  - Average
  - Roll Average
  - Hold Min
  - Hold Max
  - Calculate
  - None

*Figure 13: Trace Commands*
4.2.1 Setting Trace Types

Subject
You can set a different type for each available trace, so that it represents the wanted calculation or value, as explained in the following procedure.

Procedure
1. In the <Analysis Mode> tab, touch the button located to the left of the wanted trace button.
   The trace menu appears.
2. Set the wanted parameters for the selected trace, according to the instructions given in the following table.
3. Touch the button or anywhere on the screen outside the menu to exit.

Trace Types:

<table>
<thead>
<tr>
<th>Trace Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Store</td>
<td>The trace is frozen. It won’t be modified by next scans.</td>
</tr>
<tr>
<td>Live</td>
<td>The trace pictures the next scan.</td>
</tr>
<tr>
<td>Average</td>
<td>The trace pictures the average of all scans performed from the first scan. This trace type is useful to reduce the noise level if necessary.</td>
</tr>
<tr>
<td>Roll Average</td>
<td>The trace pictures the rolling average of a defined number of previous scans. This trace type is useful to reduce the noise level if necessary. To set the number of scans to take into account to calculate the average, touch the Roll Average numeric field. Maximum value: 100 scans</td>
</tr>
<tr>
<td>Hold Min</td>
<td>The trace pictures the minimum scanned values point to point.</td>
</tr>
<tr>
<td>Hold Max</td>
<td>The trace pictures the maximum scanned values point to point.</td>
</tr>
<tr>
<td>Calculate</td>
<td>The trace pictures a calculation from two other defined traces. The traces used for calculation cannot have a number greater than or equal to the current trace (e.g. Trace #4 can only perform a calculation from Trace #1; Trace #2 and Trace #3). To define the calculation, touch the Calculate field: Select the two traces from which you want to make the calculation and the wanted linear or logarithmic operator: • + (LIN): Addition of both traces in mW, leading to a result in dBm/mW. • - (LIN): Subtraction of two traces in mW, leading to a result in dBm/mW. • - (LOG): Subtraction of two traces expressed in dBm, leading to a result in dB/ratio.</td>
</tr>
<tr>
<td>None</td>
<td>Clears the trace content and deactivates the trace.</td>
</tr>
<tr>
<td>ASE in/out</td>
<td>OFA mode only. Analyzed trace that cannot be modified. The trace pictures the ASE, calculated from the analysis performed on traces IN and OUT.</td>
</tr>
<tr>
<td>TRANS</td>
<td>PCT mode only. Calculated transfer function trace that cannot be modified. The trace pictures the log calculation of the DUT trace - REF trace.</td>
</tr>
</tbody>
</table>
4.2.2 Displaying/Hiding/Activating Traces

Subject
By default, all traces are displayed on graph (the trace display button set to ON). The trace activation button (see Figure 13, p. 48) displays the trace number and type, and the corner flag spots the trace displayed in the foreground.

Procedure
- To display a trace, touch the OFF button located to the right of the trace number. The button label changes to ON and the trace appears on the graph (only if there is content to display).
- To hide a trace, touch the ON button located to the right of the trace number. The button label changes to OFF and the trace disappears from the graph.
- To bring to front a displayed trace, touch the trace activation button. A flag appears on the corner of the trace button.

4.2.3 Copying/Pasting Trace Data

Subject
The trace menu enables you to quickly copy/paste traces from one trace number to another (even from one analysis mode to another), with command buttons.

Restriction
You cannot paste a trace to an analyzed trace (i.e. traces ASE in/out in OFA mode and TRANS trace type in PCT mode).

Procedure
1. In the <Analysis Mode> tab, touch the button located to the left of the trace number you want to copy and touch the Copy button.

2. Touch the button located to the left of the trace number on which you want to paste the copied trace and touch the Paste button. The trace type is automatically set to Store.
4.2.4 Saving/Loading Traces

Subject
Traces can be saved in .csv, .xcsv (decimated data) or .tra (OSA20 specific format) formats on the following media:
- The internal OSA20 drive (D:\ USER )
- An external USB key or hard drive.

Restriction
You cannot load a trace in place of an analyzed trace (i.e. traces ASE in/out in OFA mode and TRANS trace type in PCT mode).

Procedures

Saving a Trace

1. If necessary, connect to one of the USB ports the device on which you want to save the trace.

2. In the <Analysis Mode> tab, touch the button located to the left of the wanted Trace button and touch the Save button.

   The Save window appears. All connected drives are displayed.

3. Touch the wanted drive and folder.

4. If you want to create a new folder: touch the button and type a name for the folder (using the on-screen keyboard or a normal keyboard if connected to the OSA20) and touch the Create button.

5. Type a name for the trace: touch the text box at the left of the Save button to display the keyboard.

6. Select a format for the trace:
   - .tra: binary OSA20-specific format (smaller size than .csv format).
   - .csv: ASCII file for export in Excel or similar program:
     Trace data is saved according to the original sampling resolution (1 point every 2 pm).
     The data unit in the file is the unit set in the Settings window (see section Setting General Parameters, p. 32).
   - .xcsv: ASCII file for export in Excel or similar program.
     Trace data is saved with a reduced number of data points, based on the optical sampling resolution in use (set in the scan parameters, see Resolution setting in section Defining Scan Parameters, p. 41) and according to the following formula:
     \[ \text{Sampling} = \frac{2}{20} \times \text{<optical resolution>} \]
For example, if the resolution is set to 100 pm, the sampling resolution will be 1 point every 10 pm.

**Important**
If you load this type of trace file on the OSA20, missing points are generated on the graph by interpolation.

7. **Touch the Save button.**
A confirmation message appears.

The .csv ASCII file contains a header providing information about the trace acquisition conditions.

Example header of a .csv trace file:

```plaintext
EXFO OSA20
Format,1.2
S/N, YO0000001
Start,1530.000,nm
Sampling,0.002,nm
Resolution,0.0186,nm,Native
Sensitivity,-55dBm
Type,Live
Unit,nm,dBm
Length,17501
Wavelength;Power
1530.000;-100.000
1530.002;-100.000
1530.004;-100.000
1530.006;-100.000
1530.008;-100.000
1530.010;-100.000...
```

**Loading a Trace**

1. **If necessary, connect to one of the USB ports the device from which you want to load the trace.**

2. **In the <Analysis Mode> tab, touch the button located to the left of the Trace button where you want to load the trace and touch the Load button.**
   The Open window appears. All connected drives are displayed, with the available files in the selected format.

3. **Touch the file format list bar located below the filename field to select the format of the file you want to load.**

4. **Touch the wanted drive and folder and select the trace file you want to load.**

5. **Touch Open.**
   The trace is loaded in place of the selected trace and appears on the graph display. The trace type is automatically set to Store.
4.3 Handling Traces Files

Subject
You can access the OSA20 internal drive or an external hard drive connected to the OSA20 to handle the saved trace files. You can move trace files from one location to another, for example to copy a trace file saved on the internal drive to an external USB device. You can also delete files you have previously saved on the internal drive.

Procedure
Deleting a Trace File
1. If necessary, connect to one of the USB ports the device from which you want to delete the trace.

2. In the <Analysis Mode> tab, touch the button located to the left of the wanted Trace button and touch the Save or Load button.
   The Save or Open window appears.

3. Touch the wanted drive and folder.

4. Touch the file format list bar located below the filename field to select the format of the file you want to delete.

5. Select the trace you want to delete and touch the button.
   The trace is deleted from the drive.
Copying/Cutting-Pasting a Trace File

1. If necessary, connect to one of the USB ports the device on which you want to copy/cut or paste the trace.

2. In the <Analysis Mode> tab, touch the button located to the left of the wanted Trace button and touch the Save or Load button.

The Save or Open window appears.

3. Select the trace you want to copy or cut and touch the button corresponding to the action you want to perform: copy or cut button.

4. Select the drive and folder in which you want to paste the file and touch the paste button.
5. Adjusting the Graph Display

5.1 Adjusting the Scale of the Graph With Zoom Commands

**Subject**
Zoom commands enable you to adapt the scale of the graph to your needs.
You can activate the zoom function by using multi-touch screen gestures or zoom command buttons.

**Procedure**
- To adjust the graph display using multi-touch screen gestures, do one of the following:

<table>
<thead>
<tr>
<th>Gesture</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Gesture Image]</td>
<td>To zoom in or out, pinch two fingers together or move them apart. Maximum vertical zoom: 1 dBm. If <strong>Power Unit</strong> is set to mW (see section Setting General Parameters, p. 32), the minimum scale value is 0 mW in all cases, regardless the zoom factor.</td>
</tr>
<tr>
<td>![Gesture Image]</td>
<td>To move in the graph, drag your finger across the screen.</td>
</tr>
<tr>
<td>![Gesture Image]</td>
<td>To browse the scale, drag your finger across the horizontal or vertical scale. If Power Unit is set to mW (see section Setting General Parameters, p. 32), the minimum scale value is 0 mW in all cases, regardless the zoom factor.</td>
</tr>
<tr>
<td>![Gesture Image]</td>
<td>To select the exact region of the spectrum that you want to display, hold your finger on the graph until a complete circle appears and draw a rectangle by dragging your finger across the graph on the region you want to zoom in. If you touch the horizontal scale while drawing the rectangle, the zoom only applies to the horizontal scale; the vertical zoom is not taken into account. If you touch the vertical scale while drawing the rectangle, the zoom only applies to the vertical scale; the horizontal zoom is not taken into account.</td>
</tr>
</tbody>
</table>


To adjust the graph display using zoom command, touch the wanted button located in the graph display settings area (see Figure 11, p. 37).

<table>
<thead>
<tr>
<th>Command Button</th>
<th>Description</th>
</tr>
</thead>
</table>
| ![Zoom Button](image) | Opens a menu that enables you to specify the following scales:  
  • Horizontal wavelength/frequency scale  
  • Vertical power scale.  
  • In case of Calculate trace: vertical secondary scale (in dB) appearing on the right on the graph  
  Touch a numeric value to modify it:  
  • Ref. Level: value of the primary scale that you want to match to the 0 level on the secondary scale.  
  • Zoom Fact: zoom factor compared to the one used on the primary scale. |
| ![Rectangle Button](image) | Enables you to select the exact region of the spectrum that you want to display:  
  1. Touch the button to activate the rectangle zoom.  
     The button icon becomes black.  
     To deactivate the rectangle zoom, touch the button again.  
  2. Drag your finger across the graph to draw a rectangle corresponding to the region you want to zoom in.  
     The rectangle zoom is automatically deactivated. |
| ![Auto Zoom Button](image) | Automatically sets the display to the maximum wavelength and power range (defined in the technical specifications, see section Technical Specifications, p. 13). |
| ![Auto Zoom Button](image) | Automatically zooms on the interesting area of the spectrum: twice the spectral width detected at 20 dB of the main peak.  
The colored flag on the corner of the button indicates the color of the trace on which the zoom applies. |
| ![Auto Zoom Button](image) | Fits the wavelength range to the total range covered by all displayed traces. |
| ![Auto Zoom Button](image) | Fits the power range to the to the total range covered by all displayed traces. |
| ![Auto Zoom Button](image) | Undoes the last zoom action. |
| ![Auto Zoom Button](image) | Disables/Enables all multi-touch screen gestures on the graph. |
5.2 Performing Manual Measurements With Markers

Subject

Four markers are available:

- Two vertical markers (A and B): associated with the displayed trace, to indicate the detected power at the wavelength on which they are positioned.
- Two horizontal markers (C and D) to indicate the optical power.

Markers: Menu Description

Procedure

1. Activate the trace on which you want to position markers by touching the corresponding trace activation button (see Figure 13, p. 48).

   A colored flag appears on the corner of the activation button, indicating that the trace is brought to front and activated.

2. Touch the button to display markers.

   The button icon turns black, the markers appears on the graph, and their corresponding values on a line below the graph.

3. Place the markers at the wanted position on the graph using one of the following methods:

   - On the graph, touch the letter corresponding to the marker you want to move and slide it to the wanted position.
     To make it easier to move markers without moving the graph, you can lock the graph by clicking the button.
• Below the graph, touch the button corresponding to the marker letter you want to set and use the following commands to position the marker more precisely:

<table>
<thead>
<tr>
<th>Button</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Left Arrow" />  <img src="image" alt="Right Arrow" /></td>
<td>Moves the selected marker two picometers to the right or left direction. A long press on the right or left arrow button speeds up the move.</td>
</tr>
<tr>
<td><img src="image" alt="Double Left Arrow" />  <img src="image" alt="Double Right Arrow" /></td>
<td>Moves the selected marker 200 pm to the right or left direction. A long press on the right or left arrow button speeds up the move.</td>
</tr>
<tr>
<td><img src="image" alt="Keypad" /></td>
<td>Opens a numeric keypad allowing you to type the exact marker position value (wavelength value or power value).</td>
</tr>
<tr>
<td><img src="image" alt="Center Button" /></td>
<td>Automatically places the selected marker to the center of the graph.</td>
</tr>
</tbody>
</table>

4. To hide markers, touch the ![Marker Off](image) button. The marker positions are kept in memory.
6. Analyzing Traces

Subject

The analysis consists of tools aimed at studying special aspects of the displayed spectrum. This allows a low interdependence of analysis results. A tool can be used repeatedly to calculate several optical characteristics. The following table gives an overview of the tools available for each analysis mode.

This icon means that the analysis tool is available for the analysis mode and can be modified: you can modify the analysis parameters, and view the corresponding results.

This icon means that the analysis tool is available for the analysis mode and cannot be modified: the analysis is performed automatically according to preset parameters, and you can view the results.

<table>
<thead>
<tr>
<th>Analysis Mode</th>
<th>Analysis Tool</th>
<th>OSA</th>
<th>BBS</th>
<th>MML</th>
<th>SML</th>
<th>WDM</th>
<th>OFA</th>
<th>PCT</th>
<th>RLT</th>
<th>Related Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Trough Search</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>Setting Up Peaks and Troughs Search, p. 64</td>
</tr>
<tr>
<td>Component Selector</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>Selecting the Component Under Test (PCT Mode), p. 67</td>
</tr>
<tr>
<td>Channel Detection</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>Setting Up Channel Detection, p. 68</td>
</tr>
<tr>
<td>Spectral Width</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>Setting Up Spectral Width Analysis, p. 73</td>
</tr>
<tr>
<td>Spectral Width 1</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>Setting Up Spectral Width Analysis, p. 73</td>
</tr>
<tr>
<td>Spectral Width 2</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>Setting Up Spectral Width Analysis, p. 73</td>
</tr>
<tr>
<td>Spectral Width 3</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>Setting Up Spectral Width Analysis, p. 73</td>
</tr>
<tr>
<td>XXdB Width</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>Setting Up XXdB Width Analysis, p. 77</td>
</tr>
<tr>
<td>$\lambda$mean</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>Setting Up $\lambda$mean Analysis, p. 80</td>
</tr>
<tr>
<td>$\lambda$peak</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>Analyzing $\lambda$peak Results, p. 81</td>
</tr>
<tr>
<td>$\lambda$center and $\sigma$</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>Analyzing $\lambda$center and $\sigma$ Results, p. 82</td>
</tr>
<tr>
<td>FWHM</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>Analyzing FWHM Results, p. 83</td>
</tr>
<tr>
<td>Side Modes Spacing</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>Analyzing Side Modes Spacing Analysis, p. 84</td>
</tr>
<tr>
<td>Notch Width</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>Setting Up Notch Width Analysis, p. 85</td>
</tr>
</tbody>
</table>
Procedure

1. In the analysis mode window, touch the **Analysis Setup** tab.

2. Touch the analysis tool you want to configure and set-up the parameters as described in the appropriate analysis tool section. Tool related sections are indicated in the above table.

3. In the `<Analysis Mode>` tab, touch the located at the left of the **Analyze** button. The analysis menu appears.

![Figure 16: Analysis Menu](Image)
4. Define the trace you want to analyze, and set the wanted parameters according to the instructions given in the following table.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trace</td>
<td>Number of the spectral trace to analyze (not available in OFA mode).</td>
</tr>
</tbody>
</table>
| Auto Analysis              | • ✓: the analysis is automatically performed at the end of each scan and after the change of an analysis parameter (except the change of the Between Markers Only parameter). If the Between Markers Only parameter is activated and you have moved a marker, the analysis is not automatically performed: you must launch it manually by touching the Analyze button.  
  • : the analysis is performed when the Analyze button is touched. |
| Between Markers Only       | • ✓: the analysis is only performed on the part of the trace located between markers, highlighted by two grey areas on either side of the selected area (see section Performing Manual Measurements With Markers, p. 57).  
  • : the analysis is performed on the wavelength range of the trace to analyze. |
| Noise Level @ 1575 nm      | Detection threshold of the analysis tools. Sets the level at 1575 nm of the noise detection curve (displayed as a dotted yellow line on the graph), calculated from the noise spectrum and dependent on wavelength below which the signal is not analyzed (this avoids the detection of unwanted peaks in the noisy regions of the spectrum). To ensure good detection of peaks and troughs, it is recommended to use a value close to sensitivity (e.g. -70 dBm if sensitivity is set to -70 dBm). |
| Noise Level Visible        | • ✓: the defined noise level is displayed on the graph.  
  • : the defined noise level is not displayed on the graph. |

To modify a numeric value, touch the wanted value to display a numeric keypad.

5. Touch the button or anywhere on the screen outside the menu to exit.
   • The trace number to analyze appears on the Analyze button.  
   • If you have activated the automatic analysis, the “Auto” flag appears on the top right corner of the Analyze button.

6. Make sure the trace to analyze is not empty. If so, perform a scan to get data on the trace.

7. If the Auto Analysis check box is cleared (or if the Between Markers Only parameter is activated and you have moved a marker), touch the Analyze button.
The analysis is performed according to the parameters set in the **Analysis Setup** tab and in the analysis menu. Analysis results are displayed below the graph: see the following **Result Area Description** subsection, p. 62.

**Important**

The analysis is restricted to 1000 peaks. If more than 1000 peaks are detected, no result is displayed.

If the **Display on graph** option (available in some analysis tools) is activated, graphical display items are displayed on the graph.

**Result Area Description**

Depending on the selected analysis mode, analysis results are grouped by analysis tool or displayed in the form of a table of channels.

**Results Displayed in Boxes Grouped by Analysis Tool**

This type of display is used in the following analysis modes:
- OSA, BBS, MML, SML and PCT analysis modes
- OFA analysis mode, if the **Experimental Setup** parameter of the **Gain & NF** tool is set to **Single Source** (see section **Defining Gain & NF Analysis Parameters**, p. 105).

**Results Displayed in a Table of Channels**

This type of display is used in the following analysis modes:
- WDM and RLT analysis modes.

---

**Figure 17: Analysis Results – Example window (BBS Analysis Mode)**

Results can be displayed in nm or THz, and in dBm or mW, depending on the measurement unit selected in the **Settings** window (see section **Setting General Parameters**, p. 32).

Results are grouped according to occupying the least possible space on screen. If you deactivate a tool, the results reorder.

**Results Displayed in a Table of Channels**

This type of display is used in the following analysis modes:
• **OFA** analysis mode, if the Experimental Setup parameter of the Gain & NF tool is set to **Multichannel** (see section Defining Gain & NF Analysis Parameters, p. 105).

![Figure 18: Analysis Results – Example window (WDM Analysis Mode)](image)

Once the scan is finished, you can touch a column title to sort it.
6.1 Setting Up Peaks and Troughs Search

The Peak Trough Search tool is available for configuration in the OSA, WDM, SML, PCT, RLT and OFA analysis modes. It is performed automatically in all other analysis modes (default values used for calculation are given in this section).

6.1.1 Defining PT Search Analysis Parameters

Subject

The Peak Trough Search tool allows you to identify in a spectral trace all high and low values separated from the detected local noise by a given threshold. Peaks and troughs are only detected above the dotted yellow line of Noise Level @ 1575 nm defined in the Analysis menu (see Figure 16, p. 60). All other analysis tools are calculated from the values detected from the Peaks and Troughs Search.

Procedure

1. In the analysis mode window, touch the Analysis Setup tab.
2. Touch the Peak Trough Search tool and modify the parameters using the instructions given in the following PT Search: Parameters Description subsection, p 64.
   The tool is automatically activated as all other tool results are calculated from the values detected with this tool
3. To make graphical display items of the analysis visible on the graph, select the Display on Graph check box and select the wanted display (see the following Display on Graph description, p. 65).

PT Search: Parameters Description

Search Settings

- **PT Threshold**
  Threshold value for the discrimination of peaks and troughs in the spectrum. Default values:
  - OSA and PCT analysis mode: 0.5 dB
  - WDM, RLT and OFA analysis modes: 3 dB
  - SML analysis mode: 0.5 dB
  - MML and BBS analysis modes (not settable): 3 dB
- **Mode Threshold** (WDM, OFA, PCT and RLT analysis modes only)

![Figure 19: WDM Analysis Mode – PT Search](image)

The only peaks retained are the ones with power higher than: [Max power] - [Mode Threshold].
Default value in WDM, OFA, PCT and RLT analysis modes: 20 dB
Default value in OSA and SML analysis modes (not settable): 100 dB

- **Auto Noise Threshold**
  - ![Select](default): the algorithm automatically detects the localized RMS noise of the measurement (over 10 points surrounding the point of interest) and deduces a value of noise threshold, below which a peak or trough cannot be effectively detected.
  
  This input has been introduced due to the strong dependence of spectral noise to detected power (see Figure 20, p. 65 in which **Noise Level @1575nm** is represented by Calculation Threshold). This noise threshold is then added to the PT threshold for the peak and trough search.

  - ![Select](default): the algorithm does not filter the local noise.

![Figure 20: PT Search](image)

**Display on Graph**

- ![Select](default for OSA, WDM, RLT and OFA analysis modes): analysis graphical items are displayed on the graph.
  - **Peaks** (default): graphical items are displayed on peaks.
  - **Troughs**: graphical items are displayed on troughs.
  - **Both**: graphical items are displayed on peaks and troughs.

- ![Select](default for BBS, MML, PCT and SML analysis modes): no graphical item is displayed on the graph.
6.1.2 Analyzing PT Search Results

- In the **OSA, WDM, RLT, PCT** and **OFA** analysis modes, the results of Peaks and Troughs Search tool are visible on the graph, if you have selected the **Display on Graph** option:
  - : graphical display item displayed on peaks.
  - : graphical display item displayed on troughs.
- In **OFA** mode, PT search runs only on Trace OUT. Results for Trace IN (OSNR IN) are calculated using the list of peaks obtained on Trace OUT.
- In the **WDM, RLT, PCT** and **OFA** analysis modes: result values are displayed for each detected peak, in accordance with the value set for the **Mode Threshold** parameter.
- In all other analysis modes, no result is displayed on graph.
6.2 Selecting the Component Under Test (PCT Mode)

Subject

The Component Selector tool is only available in PCT analysis mode. It enables you to select the component to test and automatically adapts the list of available analysis tools.

Procedure

1. In the PCT analysis mode window, touch the Analysis Setup tab.
2. Touch the Component Selector tool and select the type of component under test. The tool makes available the analysis tools adapted to the selected component.

<table>
<thead>
<tr>
<th>Component Type</th>
<th>Pass Band Filter</th>
<th>Stop Band Filter</th>
<th>Isolator</th>
<th>Fiber</th>
<th>Related Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spectral Width 1 Spectral Width 2 Spectral Width 3</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>Setting Up Spectral Width Analysis, p. 73</td>
</tr>
<tr>
<td>Notch Width 1 Notch Width 2 Notch Width 3</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>Setting Up Notch Width Analysis, p. 85</td>
</tr>
<tr>
<td>Pass Band Test</td>
<td>![Icon]</td>
<td></td>
<td></td>
<td></td>
<td>Setting Up Pass Band Test Analysis, p. 109</td>
</tr>
<tr>
<td>Stop Band Test</td>
<td>![Icon]</td>
<td></td>
<td></td>
<td></td>
<td>Setting Up Stop Band Test Analysis, p. 114</td>
</tr>
<tr>
<td>Loss Measurement</td>
<td></td>
<td></td>
<td>![Icon]</td>
<td></td>
<td>Setting Up Loss Measurement Analysis, p. 103</td>
</tr>
<tr>
<td>Mask Test</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>![Icon]</td>
<td>Setting Up Mask Test Analysis, p. 119</td>
</tr>
</tbody>
</table>
6.3 Setting Up Channel Detection

The Channel Detection tool is available in the WDM, RLT and OFA analysis modes. In OFA mode, the channel detection is only used if the Experimental Setup parameter of the Gain & NF tool is set to Multichannel (see section Defining Gain & NF Analysis Parameters, p. 105).

6.3.1 Defining Channel Detection Analysis Parameters

Subject

The Channel Detection tool allows you to identify in a spectral trace the number, wavelength and power of WDM channels.

Procedure

1. In the analysis mode window, touch the Analysis Setup tab.
2. Touch the Channel Detection tool and modify the parameters using the instructions given in the following Channel Detection: Parameters Description subsection, p. 68.
   
   This analysis tool is always activated as results from the other tools are calculated from the values detected with this tool
3. To make graphical display items of the analysis on the graph visible, select the Display on Graph check box.

Channel Detection: Parameters Description

Channel Detection Settings

The Peaks Trough Search tool (see section Setting Up Peaks and Troughs Search, p. 64) allows the identification of all candidate channels.

WDM Display Mode

Method used to calculate the results of the WDM channels detection algorithm.

- Grid (default)
  
  The grid channel array is first calculated based on the Start Wavelength, the Stop Wavelength and the Grid Spacing.
  
  The reference frequency can be set to any frequency with the Reference Frequency parameter (see below, p. 69). All other channels are then calculated from that reference channel labeled "Channel 0".
In this process, some of the detected peaks are rejected, either because they are not within the range of the grid, or they are duplicate peaks within a single grid channel. In the latter case, the peak with the highest power is set as the mode.

- **Bandwidth Threshold**
  Threshold used in the calculation of the central wavelength/frequency of the signal, that defines two wavelengths $\lambda^-$ and $\lambda^+$ with Power $P = P_{\text{peak}} - \text{Bandwidth Threshold}$.
  For correct identification of channels, it is recommended that this threshold be less than $PT_{\text{Threshold}}$ (see p. 64).
  Central wavelength/frequency $= (\lambda^+ + \lambda^-)/2$
  Default value: 3 dB

- **Grid Spacing**
  Spacing value for the grid.
  Default value: 12.5 GHz

- **Reference Frequency**
  Center frequency value of the channel number 0. The center frequency of channel $N$ is calculated from the Reference Frequency $f$, and the Grid Spacing. All other channels are calculated from this frequency as:
  $f(\text{channel number } N) = f(\text{reference}) + N \times \text{Grid Spacing}$
  Default value: 193.1 THz (ITU standard)

- **Start Wavelength/Frequency**
  Center wavelength or frequency value (depending on the selected measurement unit, see section Setting General Parameters, p. 32) of the first channel on the grid.
  Default value: 1520 nm / 197.232 THz

- **Stop Wavelength/Frequency**
  Center wavelength or frequency value (depending on the selected measurement unit, see section Setting General Parameters, p. 32) of the last channel on the grid.
  Default value: 1620 nm / 185.057 THz

- **Empty Channels:**
  To avoid slowing the acquisition, empty channels are not displayed on graph.
• **Show**: all available channels are displayed in the table of results.

**Important**
Depending on the number of empty channels, selecting this option can slow acquisition and column sorting.

• **Hide** (default): empty channels (i.e. with no detected power) are not displayed in the table of results.

• **Per Channel**
Only the detected channels are labeled and displayed. Channel 1 being the channel with the smallest wavelength or frequency depending on unit used.
The following figure illustrates the Per Channel display mode: **Offset** method on the left, **Spacing** method on the right.

![Figure 22: WDM Display Mode: Per Channel](image)

• **Bandwidth Threshold**
Threshold used in the calculation of the central wavelength/frequency of the signal, that defines two wavelengths $\lambda^-$ and $\lambda^+$ with Power $P = P_{\text{peak}} - \text{Bandwidth Threshold}$.
For correct identification of channels, it is recommended that this threshold be less than **PT Threshold** (see p. 64).
Central wavelength/frequency $= (\lambda^+ + \lambda^-)/2$
Default value: 3 dB

• **Channel Display Mode** (WDM and RLT analysis modes only)
Type of display of channels.
  • **Offset** (default): the wavelength offset and power offset is calculated between the corresponding channel and the **Reference Channel**.
  • **Spacing**: the wavelength spacing and power difference is calculated between each channel $N$ and its corresponding neighbor $N-1$.

• **Reference Channel** (only in WDM and RLT analysis modes, if **Channel Display Mode** is set to **Offset**): reference channel for all calculation.
  • **Maximum** (default): the peak with maximum power detected is the reference channel for calculation.
  • **Channel Number**: the **Channel Number** entered is the reference channel for calculation.
Analyzing Traces

If the channel number does not exist (i.e. Channel Number > Number of channel), the calculation is made on the detected peak with maximum power.

- **Channel Number** (WDM and RLT analysis modes only, if Reference Channel is set to Channel Number): channel to use as reference channel. Default value: 1

- **CWDM**
  Generates a CWDM grid: 20 nm spacing and center wavelength of 1270 nm to 1610 nm or 1271 nm to 1611 nm

- **Bandwidth Threshold**
  Threshold used in the calculation of the central wavelength/frequency of the signal, that defines two wavelengths $\lambda^{-}$ and $\lambda^{+}$ with Power $P = P_{\text{peak}} - \text{Bandwidth Threshold}$.
  For correct identification of channels, it is recommended that this threshold be less than PT Threshold (see p. 64).
  Central wavelength/frequency = $(\lambda^{+} + \lambda^{-})/2$
  Default value: 3 dB

- **First Channel** (WDM, RLT and OFA analysis modes only)
  Wavelength of the first channel of the CWDM grid:
  - 1270 nm: the first CWDM channel is centered on 1270 nm.
  - 1271 nm (default): the first CWDM channel is centered on 1271 nm.

### 6.3.2 Analyzing WDM Channel Detection Results

**Subject**
Analysis results are displayed below the graph (see section Result Area Description, p. 62).

**Important**
The analysis is restricted to 1000 peaks. If more than 1000 peaks are detected, no result is displayed.

**Result Description**
**Results Displayed on Graph**
If you have selected the Display on Graph check box, the following graphical items are displayed on graph:
- Areas alternately pink and grey identify the channels.
- Channel numbers are displayed at the top of the graph.

**Result Area**
- **List** (WDM analysis mode only)
  If no peaks are detected at the end of the scan, no value is displayed.
  - **Nbr of channels**: number of detected channels.
  - **Slope**: linear fit slope of all detected peak power in dB/nm or dB/THz, depending on the selected measurement unit (see section Setting General Parameters, p. 32). It does not take the integrated power in channel, it only takes the peak power.
  - **Uniformity**: difference between maximum and minimum detected peak power. It does not take the integrated power in channel, it only takes the peak power.
• **Total Power**: WDM and RLT modes only. Power measured within the scan range in dBm. If no power (or negative power) is detected, the result displays -100 dBm.

**Table**

<table>
<thead>
<tr>
<th>Column Name</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Grid and CWDM Display Mode</strong></td>
<td></td>
</tr>
<tr>
<td>Ch</td>
<td>Channel number, following the grid channel numbering (even if <strong>Empty Channels</strong> is set to <strong>Hide</strong>).</td>
</tr>
<tr>
<td>(\lambda_{\text{Grid}}/\nu_{\text{Grid}})</td>
<td>WDM and RLT modes only. Wavelength/Frequency of channel of the grid starting from the <strong>Start Wavelength/Frequency</strong> value and stopping at <strong>Stop Wavelength/Frequency</strong> value.</td>
</tr>
<tr>
<td>(\lambda_{\text{Meas}}/\nu_{\text{Meas}})</td>
<td>Measured channel peak wavelength/frequency and its associated power.</td>
</tr>
<tr>
<td>Lvl(\text{Meas})</td>
<td>WDM and RLT modes only. Measured channel peak power.</td>
</tr>
<tr>
<td>(\Delta\lambda/\Delta\nu) to Grid/(\Delta\lambda/\Delta\nu) to Grid</td>
<td>WDM and RLT modes only. Wavelength/Frequency offset of the channel compared to the nearest grid channel.</td>
</tr>
</tbody>
</table>

**Per Channel Display Mode**

| Ch                | Channel number, starting at channel no 1, and incremented every peak.                                                                                                                                    |
| \(\lambda_{\text{Ctr}}/\nu_{\text{Ctr}}\) | Measured channel peak wavelength/frequency.                                                                                                                                                              |
| Lvl\(\text{Ctr}\) | WDM and RLT modes only. Measured channel peak power.                                                                                                                                                     |
| \(\lambda\) Offset/\(\nu\) Offset \(\Delta\lambda\) Offset/\(\Delta\nu\) Offset | WDM and RLT modes only. Only if the **Offset** display mode is selected. Offset in wavelength/frequency and power of the channel compared to the reference channel. The reference channel displays an offset of 0 and a power offset of 0 |
| \(\Delta\lambda/\Delta\nu\) | WDM and RLT modes only. Only if the **Spacing** display mode is selected. Spacing in wavelength/frequency of the channel \(N\) compared to its neighboring channel \((N-1)\).                                       |
| \(\Delta\lambda\) Lvl | WDM and RLT modes only. Only if the **Spacing** display mode is selected. Power difference of the channel \(N\) compared to its neighboring channel \((N-1)\).                                                        |
6.4 Setting Up Spectral Width Analysis

The Spectral Width analysis tool is available in the OSA, MML and SML analysis modes. The Spectral Width 1, Spectral Width 2 and Spectral Width 3 analysis tools are available in the PCT analysis mode.

6.4.1 Defining Spectral Width Analysis Parameters

**Subject**

The Spectral Width tool allows you to identify in a spectral trace the width of the main peak at a given threshold below the peak power, the central wavelength and the number of modes detected. This tool applies only on peaks. For trough width measurement, see section Setting Up Notch Width Analysis, p. 85.

**Procedure**

1. In the analysis mode window, touch the Analysis Setup tab.
2. In PCT mode, touch the Component Selector tool and set the Type parameter to Pass Band Filter. The Spectral Width 1, Spectral Width 2 and Spectral Width 3 analysis tools are automatically active.
3. Touch the Spectral Width tool and modify the parameters using the instructions given in the following Spectral Width Parameters Description subsection, p73.
4. In OSA, MML and SML modes, activate the analysis calculation for the next analysis run by selecting the Activate check box.
5. To make graphical display items of the analysis visible on the graph, select the Display on Graph check box.

**Spectral Width Parameters Description**

**Spectral Width Detection Settings**

- **Algorithm**: method used for the calculation of the width.
  - **Threshold** (default)

  The Threshold algorithm detects the wavelengths $\lambda^-$ and $\lambda^+$ at which the power falls below $[\text{Peak Power}] - [\text{Width Threshold}]$. To account for the multimodal nature of some sources, several options are available for this algorithm (see Fitting Options below), illustrated in the following figure.

![Figure 23: Threshold Algorithm](image-url)
• **Envelope**

The Envelope algorithm defines an envelope from the peaks of the spectrum above **Mode Threshold** (linear fit between each peak on log scale) and deduces the width based on that envelope, as shown in the following figure.

![Figure 24: Envelop Algorithm](image)

• **RMS/RMS Peak**

The RMS and RMS Peak algorithms calculate the root mean square value $\sigma$ of the power data above a given **Width Threshold**, taking the full power data (RMS) or simply the Power at Peak (RMS Peak) for the calculation.

![Figure 25: RMS Algorithm](image)

• **Gaussian Fit/Lorentzian Fit**

The Gaussian Fit and Lorentzian Fit algorithms fit a curve to the data and calculate the spectral parameters using **Width Threshold** from this fit.

- If **Modal Analysis** is set to OFF (see **Fitting Options** below), the curve fits a Gaussian or Lorentzian to the main peak.
- If **Modal Analysis** is set to ON, the curve fits a Gaussian or Lorentzian to all peaks above **Mode Threshold**.
• **Multiplier**
  Factor to scale the measured width.
  Default value: 1

• **Width Threshold**
  Threshold level used in the calculation of the width. It defines two wavelengths $\lambda^-$ and $\lambda^+$ with Power $P = P_{\text{peak}} - \text{Width Threshold}$.
  Default value (OSA and SML analysis modes): 3 dB
  Default value (MML analysis mode): 40 dB

• **Mode Threshold** (only for Envelope, Gaussian Fit and Lorentzian Fit algorithms).
  Retains peaks with power $P > P_{\text{peak}} - \text{Mode Threshold}$.
  Default value: 50 dB

### Fitting Options

• **Modal Analysis** (only for Threshold, Gaussian Fit and Lorentzian Fit algorithms).
  • ✓: the measurement includes all detected peaks above Width Threshold (Threshold algorithm) or Mode Threshold (Gaussian Fit/Lorentzian Fit algorithms).
  • : the measurement includes a single peak (the main peak).
  Default value (OSA, and MML analysis modes): ✓
  Default value (SML analysis mode): 

• **Fit to Mode** (only for Threshold algorithm, if Modal Analysis check-box is selected).
  • ✓: the calculation of width is fitted to the nearest detected peaks.
  • (default): the calculation of width is fitted to the curve-threshold crossing (see Figure 23, p. 71).
6.4.2 Analyzing Spectral Width Results

Subject

Analysis results are displayed below the graph (see section Result Area Description, p. 62).

Result Description

Results Displayed on Graph

If you have selected the Display on Graph check box, the following graphical items are displayed on graph:

- ▿ is displayed on the mean wavelength/frequency
- □ is displayed on $\lambda^-$ and $\lambda^+$.
- □ is displayed between $\lambda^-$ and $\lambda^+$.

Result Area

<table>
<thead>
<tr>
<th>Result</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\lambda_{\text{mean}}/\nu_{\text{mean}}$</td>
<td>Calculated central wavelength/frequency and its associated power. For RMS, RMS Peak and Gaussian algorithms, the central wavelength is the mean wavelength.</td>
</tr>
<tr>
<td>Level$_{\text{mean}}$</td>
<td></td>
</tr>
<tr>
<td>$\lambda_{\text{center}}/\nu_{\text{center}}$</td>
<td>(MML analysis mode only) Calculated central wavelength and its associated power. For RMS, RMS Peak and Gaussian algorithms, the central wavelength is the mean wavelength.</td>
</tr>
<tr>
<td>Level$_{\text{center}}$</td>
<td></td>
</tr>
<tr>
<td>$\lambda_{\text{peak}}/\nu_{\text{peak}}$</td>
<td>Spectral Width 1/2/3 tool only. Calculated peak wavelength/frequency and its associated power.</td>
</tr>
<tr>
<td>Level$_{\text{peak}}$</td>
<td></td>
</tr>
<tr>
<td>$\Delta \lambda_{@xxdB}$/$\Delta \nu_{@xxdB}$</td>
<td>Width at Width Threshold using the selected algorithm method. For RMS and RMS Peak algorithms, the width is the standard deviation ($\sigma$).</td>
</tr>
<tr>
<td>Number of Modes</td>
<td>(OSA and MML modes only) Number of detected peaks within the width. For RMS and RMS Peak algorithms, the number of modes is the number of peaks detected above threshold.</td>
</tr>
<tr>
<td>Mode Spacing</td>
<td>(OSA and MML modes only) Calculated mode spacing value. For RMS and RMS Peak algorithms, the spacing is calculated using the peaks above threshold.</td>
</tr>
<tr>
<td>$\sigma$</td>
<td>Only for RMS and RMS Peak algorithms. Standard deviation value of the measured peak.</td>
</tr>
</tbody>
</table>
6.5 Setting Up XXdB Width Analysis

The XXdB Width analysis tool is available in BBS analysis mode.

6.5.1 Defining XXdB Width Analysis Parameters

Subject

The XXdB Width tool allows you to identify the spectral width at a given threshold value.

Procedure

1. In the BBS analysis mode window, touch the Analysis Setup tab.
2. Touch the XXdB Width tool and modify the parameters using the instructions given in the following xxdB Width Parameters Description subsection, p 77.
3. Activate the analysis calculation for the next analysis run by selecting the Activate check box.
4. To make graphical display items of the analysis visible on the graph, select the Display on Graph check box.

xxdB Width Parameters Description

Width Measurement Settings

- **Algorithm**: method used for the calculation of the width.
  - **Threshold** (default)
    
The Threshold algorithm detects the wavelengths $\lambda^-$ and $\lambda^+$ at which the power falls below [Peak Power]-[Width Threshold].

![Figure 27: Threshold Algorithm (BBS Analysis Mode)](image-url)
• **RMS**

The RMS algorithm calculates the root mean square value $\sigma$ of the power data above a given **Width Threshold**, taking the full power data for the calculation.

![Figure 28: RMS Algorithm (BBS Analysis Mode)](image)

• **Gaussian Fit/Lorentzian Fit**

The Gaussian Fit and Lorentzian Fit algorithms fit a curve to the data and calculate the spectral parameters using **Width Threshold** from this fit.

![Figure 29: Gaussian Algorithm (BBS Analysis Mode)](image)

• **Multiplier**

Factor to scale the measured width.
Default value: 1

• **Width Threshold**

Threshold level used in the calculation of the width. It defines two wavelengths $\lambda^-$ and $\lambda^+$ with Power $P = P_{\text{peak}} - \text{Width Threshold}$.
Default value: 20 dB

• **Mode Threshold** (only for Envelope, Gaussian Fit and Lorentzian Fit algorithms).
Retains peaks with power $P > P_{\text{peak}} - \text{Mode Threshold}$.
Default value: 20 dB
6.5.2 Analyzing XXdB Width Results

Subject
Analysis results are displayed below the graph (see section Result Area Description, p. 62).

Result Description Results Displayed on Graph
If you have selected the Display on Graph check box, the following graphical items are displayed on graph:

- is displayed on the mean wavelength/frequency.
- is displayed on $\lambda^+$ and $\lambda^-$. 
- is displayed between $\lambda^-$ and $\lambda^+$.

Result Area

<table>
<thead>
<tr>
<th>Result</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta\lambda@xxdB/\Delta\nu@xxdB$</td>
<td>Width at Width Threshold using the selected algorithm method. For RMS and RMS Peak algorithms, the width is the standard deviation ($\sigma$).</td>
</tr>
</tbody>
</table>
6.6 Setting Up $\lambda_{\text{mean}}$ Analysis

The $\lambda_{\text{mean}}$ analysis tool is available in the BBS and MML analysis mode. It can only be modified in the BBS analysis mode.

6.6.1 Defining $\lambda_{\text{mean}}$ Analysis Parameters

**Subject**

The $\lambda_{\text{mean}}$ tool allows you to identify the mean wavelength of the main peak at a given threshold value.

**Procedure**

1. In the BBS analysis mode window, touch the **Analysis Setup** tab.
2. Touch the $\lambda_{\text{mean}}$ tool and modify the parameters using the instructions given in the following $\lambda_{\text{mean}}$ Parameters Description subsection, p 80.
3. Activate the analysis calculation for the next analysis run by selecting the **Activate** check box.
4. To make graphical display items of the analysis visible on the graph, select the **Display on Graph** check box.

**$\lambda_{\text{mean}}$ Parameters Description**

$\lambda_{\text{mean}}$ Measurement Settings

In the BBS analysis mode, the RMS algorithm is used for the calculation of the mean wavelength (for more details, see Figure 28, p. 78).

- **Width Threshold**
  Threshold level used in the calculation of the width. It defines two wavelengths $\lambda^-$ and $\lambda^+$ with Power $P = P_{\text{peak}} - \text{Width Threshold}$.
  Default value: 20 dB

In the MML analysis mode, the RMS Peak algorithm is used for the calculation of the mean wavelength with the following default parameters (for more details, see Figure 28, p. 78):

- **Width Threshold**: 20 dB
- **Mode Threshold**: 40 dB
- **Multiplier**: 1
- **Fit to Mode**: No
- **Modal analysis**: Yes
6.6.2 Analyzing $\lambda_{\text{mean}}$ Results

Subject
Analysis results are displayed below the graph (see section Result Area Description, p. 62).

Result Description

**Results Displayed on Graph**
If you have selected the Display on Graph check box, the following graphical items are displayed on graph:

- $\bigdiamond$ is displayed on the mean wavelength/frequency.
- $\bigdiamond$ is displayed on $\lambda^+$ and $\lambda^-$.
- $\blacksquare$ is displayed between $\lambda^-$ and $\lambda^+$.

**Result Area**

<table>
<thead>
<tr>
<th>Result</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\lambda_{\text{mean}}/\nu_{\text{mean}}$</td>
<td>Calculated mean wavelength/frequency.</td>
</tr>
<tr>
<td>Level$_{\text{mean}}$</td>
<td>Power level at mean wavelength/frequency.</td>
</tr>
<tr>
<td>$\sigma$</td>
<td>Standard deviation value of the measured peak.</td>
</tr>
</tbody>
</table>

6.6.3 Analyzing $\lambda_{\text{peak}}$ Results

Subject
The peak wavelength is available for the MML analysis mode. The analysis settings cannot be modified.

$\lambda_{\text{peak}}$

**Measurement Settings**
For more details on measurement settings, see section *Defining $\lambda_{\text{mean}}$ Analysis Parameters*, p. 80.

- **Algorithm**: Threshold
- **Width Threshold**: 3
- **Mode Threshold**: 50
- **Multiplier**: 1
- **Fit to Mode**: No
- **Modal Analysis**: No

Result Description

**Results Displayed on Graph**
The following graphical display items are displayed on graph:

- $\bigdiamond$ is displayed on the peak wavelength.
- $\bigdiamond$ is displayed on $\lambda^+$ and $\lambda^-$.
- $\blacksquare$ is displayed between $\lambda^-$ and $\lambda^+$. 
### 6.7 Analyzing $\lambda_{\text{center}}$ and $\sigma$ Results

**Subject**

The central wavelength and sigma value is available in the SML analysis mode. The analysis settings cannot be modified.

**$\lambda_{\text{center}}$ and $\sigma$ Measurement Settings**

- **Algorithm**: RMS
- **Width Threshold**: 3
- **Mode Threshold**: 50
- **Multiplier**: 1
- **Fit to Mode**: No
- **Modal Analysis**: No

**Result Description**

Results Displayed on Graph

The following graphical display items are displayed on graph:

- $\square$ is displayed on the center wavelength.
- $\square$ is displayed on $\lambda+$ and $\lambda-$.
- $\square$ is displayed between $\lambda-$ and $\lambda+$.

**Result Area**

<table>
<thead>
<tr>
<th>Result</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\lambda_{\text{peak}} / \nu_{\text{peak}}$</td>
<td>Wavelength/frequency of the main mode.</td>
</tr>
<tr>
<td>$\text{Level}_{\text{peak}}$</td>
<td>Power of the main mode.</td>
</tr>
<tr>
<td>$\lambda_{\text{center}} / \nu_{\text{center}}$</td>
<td>Central wavelength/frequency</td>
</tr>
<tr>
<td>$\sigma$</td>
<td>Standard deviation of the measured peak.</td>
</tr>
</tbody>
</table>
6.8 Analyzing FWHM Results

Subject

The full width at half maximum result is available for the BBS and MML analysis modes. The analysis settings cannot be modified.

FWHM Measurement Settings

For more details on measurement settings, see section Defining Spectral Width Analysis Parameters, p. 73.

BBS Analysis Mode
• Algorithm: Threshold
• Width Threshold: 3
• Mode Threshold: 12
• Multiplier: 1
• Fit to Mode: No
• Modal Analysis: No

MML Analysis Mode
• Algorithm: Gaussian Fit
• Width Threshold: 3
• Mode Threshold: 20
• Multiplier: 1
• Fit to Mode: No
• Modal Analysis: Yes

Result Description

<table>
<thead>
<tr>
<th>Result</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>FWHM</td>
<td>Full width at half maximum value.</td>
</tr>
</tbody>
</table>
### 6.9 Analyzing Side Modes Spacing Analysis

**Subject**

The Side Modes Spacing analysis result is available in the SML analysis mode. The analysis settings cannot be modified.

**Side Modes Spacing Measurement Settings**

For more details on measurement settings, see section *Defining Spectral Width Analysis Parameters*, p. 73.

- **Algorithm**: Threshold
- **Multiplier**: 1
- **Width Threshold**: 50
- **Modal Analysis**: Yes
- **Fit to Mode**: No

**Result Description**

Analysis results are displayed below the graph (see section *Result Area Description*, p. 62).

<table>
<thead>
<tr>
<th>Result</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Side Modes Spacing</td>
<td>Calculated spacing of the residual side mode detected (when possible) outside of the main peak feature.</td>
</tr>
</tbody>
</table>
6.10 Setting Up Notch Width Analysis

The Notch Width analysis tool is available in the OSA analysis mode.
The Notch Width 1, Notch Width 2 and Notch Width 3 analysis tools are available in the PCT analysis mode.

6.10.1 Defining Notch Width Analysis Parameters

Subject

The Notch Width tool allows you to identify in a spectral trace the width of a trough at a given threshold above the trough power (see "Bottom" in Figure 31, p. 86) or below the surrounding peaks (see "Top" in Figure 31, p. 86).

Procedure

1. In the analysis mode window, touch the Analysis Setup tab.
2. In PCT mode, touch the Component Selector tool and set the Type parameter to Stop Band Filter or Isolator. The Notch Width 1, Notch Width 2 and Notch Width 3 analysis tools are automatically active.
3. Touch the Notch Width tool and modify the parameters using the instructions given in the following Notch Width: Parameters Description subsection, p 85.
4. In OSA mode, activate the analysis calculation for the next analysis run by selecting the Activate check box.
5. To make graphical display items of the analysis visible on the graph, select the Display on Graph check box.

Notch Width Detection Settings

- **Algorithm**: fit to apply for the determination of the width.
  
  The fitting is mono-modal (the Modal Analysis option is not available).
  
  - **Threshold** (default): no fit is applied.
  
  - **Gaussian/Lorentzian Fit**: the Gaussian Fit and Lorentzian Fit algorithms fit a curve to the data and calculate the spectral parameters using Width Threshold from this fit. The curve is fitted to the main trough.
  
- **Multiplier**
  
  Factor to scale the measured width.
  
  Default value: 1

- **Width Threshold**
  
  Threshold level used in the calculation of the width. It defines two wavelengths $\lambda^-$ and $\lambda^+$ with Power $P = P_{\text{peak}} - \text{Width Threshold}$.
  
  Default value: 3 dB

Notch Selection Options

- **Notch Selection**: method used for the selection of the trough to analyze.
  
  - **Deepest Notch**: selection of the feature with biggest difference between trough and adjacent peaks.
  
  - **Minimum Trough** (default): selection of the lowest level trough.
Figure 30: Notch Width – Notch Selection

- **Width Reference**: method used for the measurement of the width.
  - **Bottom** (default): the width is calculated from the trough.
  - **Top**: the width is calculated from the two surrounding peaks on either side of the notch to be analyzed.

Figure 31: Notch Width – Width Reference
6.10.2 Analyzing Notch Width Results

Subject

Analysis results are displayed below the graph (see section Result Area Description, p. 62). If no peaks are detected at the end of the scan, no value is displayed.

Result Description Results Displayed on Graph

If you have selected the Display on Graph check box, the following graphical items are displayed on graph:

- ○ is displayed on the notch wavelength.
- □ is displayed on λ+ and λ-.

Result Area

To be detected correctly, the trough must not be below the Noise Level @1575 nm value (see Figure 16, p. 60).

<table>
<thead>
<tr>
<th>Result</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \lambda_{notch}/\nu_{mean} )</td>
<td>Calculated central wavelength/frequency and its associated power.</td>
</tr>
<tr>
<td>Level(_{notch} )</td>
<td>Notch Width 1/2/3 tool only. Calculated trough wavelength/frequency and its associated power.</td>
</tr>
<tr>
<td>( \lambda_{trough}/\nu_{trough} )</td>
<td>Spectral notch width at Width Threshold using the selected algorithm method.</td>
</tr>
</tbody>
</table>
6.11 Setting Up Level Check Analysis

The Level Check analysis tool is available in the OSA analysis mode.

6.11.1 Defining Level Check Analysis Parameters

Subject

The Level Check tool allows you to measure, on the analyzed trace, the optical power level at several wavelengths, and to calculate the level difference between those wavelengths.

Procedure

1. In the OSA analysis mode window, touch the Analysis Setup tab.
2. Touch the Level Check tool and modify the parameters using the instructions given in the following Level Check: Parameters Description subsection, p 88.
3. Activate the analysis calculation for the next analysis run by selecting the Activate check box.
4. To make graphical display items of the analysis visible on the graph, select the Display on Graph check box.

Level Check: Parameters Description

Level Check Settings
- Reference Point 1/2/3
  Wavelength/frequency of the point for which the power level is measured.

Default values:
- Reference Point 1: 1520 nm or 197.232 THz
- Reference Point 2: 1550 nm or 193.414 THz
- Reference Point 3: 1570 nm or 190.950 THz
### 6.11.2 Analyzing Level Check Results

**Subject**
Analysis results are displayed below the graph (see section Result Area Description, p. 62).

**Result Description**
**Results Displayed on Graph**
If you have selected the Display on Graph check box, the following graphical items are displayed on graph:

- indicates the position of the wavelength reference points and their corresponding power level.

**Result Area**

<table>
<thead>
<tr>
<th>Result</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level @ λ 1/2/3</td>
<td>Optical power measured at reference point 1/2/3.</td>
</tr>
<tr>
<td>Level @ ν 1/2/3</td>
<td></td>
</tr>
<tr>
<td>ΔLvl 2-1</td>
<td>Difference in dB between the power level measured at Reference Point 2 and the power level measured at Reference Point 1.</td>
</tr>
<tr>
<td>ΔLvl 3-1</td>
<td>Difference in dB between the power level measured at Reference Point 3 and the power level measured at Reference Point 1.</td>
</tr>
</tbody>
</table>
6.12 Setting Up SMSR Analysis

The SMSR analysis tool is available in OSA and SML analysis modes.

6.12.1 Defining SMSR Analysis Parameters

Subject

The SMSR tool allows you to get results linked to the Side Mode Suppression Ratio of modes outside a masked area (in nm).

Procedure

1. In the OSA analysis mode window, touch the Analysis Setup tab.
2. Touch the SMSR tool and modify the parameters using the instructions given in the following SMSR: Parameters Description subsection, p 90.
3. Activate the analysis calculation for the next analysis run by selecting the Activate check box.
4. To make graphical display items of the analysis visible on the graph, select the Display on Graph check box.

SMSR: Parameters Description

**Side Mode Detection Settings**

- **Algorithm**
  - LR (default): displays the side modes to the left and the right of the main peak.
  - Next: displays only the largest side mode between the identified left and right side modes outside of the Mask exclusion area.

- **Side Mode Calculation**
  - Highest (default): returns the side modes with highest detected power (as required in IEC 61280-1-3).
  - Nearest: returns the side modes that are closest to the peak, outside the mask area.
• **Mask**
  
  Width of the mask area, centered on the main peak. All modes within this area are excluded from the calculation.
  
  Default value: 0 nm/THz

### 6.12.2 Analyzing SMSR Results

**Subject**

Analysis results are displayed below the graph (see section Result Area Description, p. 62).

**Result Description**

**Results Displayed on Graph**

If you have selected the Display on Graph check box, the following graphical items are displayed on graph:

- ![X] is displayed on the mean wavelength/frequency and on side mode 1 and side mode 2.
- ![Box] is displayed between side mode 1 and side mode 2.

**Result Area**

<table>
<thead>
<tr>
<th>Result</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Main Mode Results</strong></td>
<td></td>
</tr>
<tr>
<td>( \lambda_{\text{peak}} / \nu_{\text{peak}} )</td>
<td>Wavelength/Frequency and power of the main mode.</td>
</tr>
<tr>
<td>( \text{Level}_{\text{peak}} )</td>
<td></td>
</tr>
<tr>
<td><strong>SideBand Results</strong> (only if <strong>Algorithm</strong> is set to <strong>Next</strong>)**</td>
<td></td>
</tr>
<tr>
<td>( \lambda_{\text{SideMode}} / \nu_{\text{SideMode}} )</td>
<td>Only if <strong>Algorithm</strong> is set to <strong>Next</strong>. Wavelength and power of the side mode with the highest power. The side mode is nearest to the peak, or the highest on that side of the peak.</td>
</tr>
<tr>
<td>( \text{Level}_{\text{SideMode}} )</td>
<td></td>
</tr>
<tr>
<td>( \Delta \lambda_{\text{SMSR}} / \Delta \nu_{\text{SMSR}} )</td>
<td>Only if <strong>Algorithm</strong> is set to <strong>Next</strong>. Difference between the wavelength/frequency of the main mode and the wavelength/frequency of the side mode.</td>
</tr>
<tr>
<td><strong>SMSR</strong></td>
<td>Only if <strong>Algorithm</strong> is set to <strong>Next</strong>. Difference between the power of the main mode and the power of the side mode.</td>
</tr>
<tr>
<td><strong>SideBand 1/SideBand 2 Results</strong> (only if <strong>Algorithm</strong> is set to <strong>LR</strong>)**</td>
<td></td>
</tr>
<tr>
<td>( \lambda_{\text{SideMode 1}} / \nu_{\text{SideMode 1}} )</td>
<td>Only if <strong>Algorithm</strong> is set to <strong>LR</strong>. Wavelength and power of the side mode on the left/right of the main mode.</td>
</tr>
<tr>
<td>( \text{Level}_{\text{SideMode 1}} )</td>
<td></td>
</tr>
<tr>
<td>( \lambda_{\text{SideMode 2}} / \nu_{\text{SideMode 2}} )</td>
<td></td>
</tr>
<tr>
<td>( \text{Level}_{\text{SideMode 2}} )</td>
<td></td>
</tr>
<tr>
<td>Result</td>
<td>Meaning</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>$\Delta \lambda_{\text{SMSR 1}} / \Delta v_{\text{SMSR 1}}$</td>
<td>Only if <strong>Algorithm</strong> is set to <strong>LR</strong>. Difference between the wavelength/frequency of the main mode and the wavelength/frequency of the side mode on the left/right of the main mode.</td>
</tr>
<tr>
<td>$\Delta \lambda_{\text{SMSR 2}} / \Delta v_{\text{SMSR 2}}$</td>
<td>Difference between the wavelength/frequency of the main mode and the wavelength/frequency of the side mode on the left/right of the main mode.</td>
</tr>
<tr>
<td><strong>SMSR 1</strong></td>
<td>Only if <strong>Algorithm</strong> is set to <strong>LR</strong>. Difference between the power of the main mode and the power of the side mode on the left/right of the main mode.</td>
</tr>
<tr>
<td><strong>SMSR 2</strong></td>
<td>Difference between the power of the main mode and the power of the side mode on the left/right of the main mode.</td>
</tr>
<tr>
<td><strong>Stop Band</strong></td>
<td>Only if <strong>Algorithm</strong> is set to <strong>LR</strong>. Difference between the wavelength/frequency of the side modes on the left/right of the main mode.</td>
</tr>
<tr>
<td><strong>Center Offset</strong></td>
<td>Only if <strong>Algorithm</strong> is set to <strong>LR</strong>. Difference between the wavelength/frequency of the main mode and the middle of the stop band.</td>
</tr>
</tbody>
</table>
6.13 Setting Up OSNR Analysis

The OSNR analysis tool is available in OSA, SML, WDM, RLT and OFA analysis modes.

6.13.1 Defining OSNR Analysis Parameters

Subject

The OSNR tool allows you to get the calculated Optical Signal to Noise Ratio of a laser peak (in dB).

OSNR Calculation

IEC standard 61280-2-9

For data rates < 10 Gbits/s and for non-modulated signals, the calculation of the OSNR follows the equation defined in the IEC standard 61280-2-9:

\[
OSNR = 10 \times \log \left( \frac{P_i}{N_i} \right) + 10 \times \log \left( \frac{RBW_{OSA}}{RBW_{ref}} \right) = 10 \log \left( \frac{P}{N_{corr}} \right)
\]

Where:

• \( P_i \) is the optical power of the channel in Watts.
• \( N_i \) is the interpolated noise power in Watts measured in the resolution bandwidth of the OSA20.
• \( RBW_{OSA} \) is the resolution bandwidth of the OSA20.
• \( RBW_{ref} \) is the reference optical bandwidth, chosen to be 0.1 nm.
• \( N_{corr} \) is the noise correction:

\[
N_{corr} = \left( \frac{N_i \times RBW_{ref}}{RBW_{OSA}} \right)
\]

In case of OSA20, a correction factor is added to account for the Gaussian shape of the filtering, instead of the rectangular shape obtained at larger bandwidth.

\[
10 \log \left( \frac{RBW_{OSA}}{RBW_{ref}} \times \sqrt{\frac{\pi}{4 \ln 2}} \right)
\]

The standard also indicates that the calculation of \( N_i \), usually not measurable due to the presence of the signal peak, needs to be done based on interpolation (i.e. a fit) of the noise spectrum close to the signal. You must note that the measured signal is in fact the sum of \( P_i + N_i \).

![Figure 33: OSNR Analysis](image-url)
On-Off Method

For polarization multiplexed signals or signals > 40 Gbits/s data rates, the above interpolation method fails to find the relevant noise. In this case, you should use the On-Off Method (only available in WDM and RLT analysis modes), which consists in taking two measurements of the WDM signal: one with all channels turned on and one with the channel of interest turned off.

The signal power is then calculated from the on trace and the noise power is calculated from the off trace. An integration of both powers is then performed for the calculation of the OSNR, still scaling the result to a resolution bandwidth of 0.1 nm:

\[
OSNR = 10 \times \log \left[ \frac{1}{RBW_{ref}} \int_{\lambda_{min}}^{\lambda_{max}} \frac{s(\lambda)}{\rho(\lambda)} d\lambda \right]
\]

Where:
- The integration must be performed from \( \lambda_{min} \) to \( \lambda_{max} \) within the relevant channel (e.g. over 0.4 nm in case of a 50 GHz spaced signal).
- \( RBW_{ref} \) is the reference optical bandwidth, chosen to be 0.1 nm.
- The power \( s(\lambda) \) is the signal power density, excluding the noise, expressed in mW/nm.
- The noise \( \rho(\lambda) \) is the noise power density expressed in mW/nm.
- In case of OSA20, the integration is replaced by a sum of all signal and noise data points, spaced by \( d\lambda = 2 \text{ pm} \).

![Figure 34: OSNR Analysis – On-Off Method](image-url)
Procedure

1. If you want to use the On-Off Method (see section On-Off Method, p. 94):
   a. Make sure you have two measurements of the WDM signal (taken with the same resolution setting):
      • On Trace 1: one measurement with all channels turned on.
      • On any trace from Trace 2 to Trace 8: one measurement with the channel of interest turned off.
   b. In the Analysis menu (see Figure 16, p. 60), select the trace displaying the off measurement for analysis.

2. In the analysis mode window, touch the Analysis Setup tab.

3. Touch the OSNR tool and modify the parameters using the instructions given in the following OSNR: Parameters Description subsection, p 95.

4. In OSA, SML and WDM modes, activate the analysis calculation for the next analysis run by selecting the Activate check box. In OFA mode, the tool is automatically activated.

5. To make graphical display items of the analysis visible on the graph, select the Display on Graph check box.

OSNR: Parameters Description

Noise Detection Settings

- **Noise Point Selection**: method to define the signal to noise spectral distance (with peaks or troughs detected with the PT Search tool).
  - The three following methods measure and calculate the signal power $P_i$ based on **Power Integration** and **Power Integral Range**. The noise selection point is calculated to the left and right of the peak using the **Noise Point Selection**, which is used with the **Noise Range** to calculate the Noise Fit. The OSNR is then calculated using the equation described in section IEC standard 61280-2-9, p. 93.
  - **Fixed** (OSA and SML analysis modes default): fixed distance value from the main peak, entered in the **SN Spectral Distance** field.
  - **Nearest Peaks**: half the distance between the nearest peak and the main peak. If only one peak is detected, the **Nearest Troughs** method is used.
• **Nearest Troughs** (WDM and OFA analysis mode default): the nearest trough of the main peak.

• **On-Off Method** (WDM and RLT analysis modes only): measures and calculates the signal (without noise) and noise power within the On-Off Integration Range. It integrates the signal/noise power and uses the On-Off Method equation (see section On-Off Method, p. 94) for the calculation of OSNR.

• **Noise Range** (only if Noise Point Selection is set to Fixed, Nearest Peaks and Nearest Troughs)
  Width of the noise area around the Noise Point Selection used for the calculation of the noise fit \( N_f \).
  Default value (OSA and SML analysis modes): 0.2 nm / 0.024 THz
  Default value (WDM and OFA analysis mode): 0.01 nm / 0.001 THz

• **On-Off Integration Range** (only if Noise Point Selection is set to On-Off Method)
  Integration width of the On-Off Method in GHz. Make sure this value is identical to the Grid Spacing value selected in the Channel Detection tool (see section Channel Detection: Parameters Description, p. 68).
  Default value: 12.5 GHz

• **SN Spectral Distance** (only if Noise Point Selection is set to Fixed)
  The distance between the peak and the noise area, measured either side of the peak.
  Default value: 0.5 nm / 0.060 THz

• **Fit** (only if Noise Point Selection is set to Fixed, Nearest Peaks and Nearest Troughs)
  Fit to apply to the noise data for interpolation of the noise figure \( N_f \):
  • Linear (default)
  • 3rd Order Polynomial
  • 4th Order Polynomial
  • 5th Order Polynomial
  • Gaussian

• **Reference Optical BW (Bandwidth)**
  \( RBW_{\text{ref}} \) in the calculation given in IEC standard 61280-2-9 subsection, p 93.
  Default value: 0.1 nm (in accordance with IEC 6180-2-9) / 0.012 THz

• **BW Corrected Display**
  • ✓: the noise to be displayed is corrected \( (N_{\text{corr}}) \), as explained in IEC standard 61280-2-9 subsection, p 93.
  • ◯ (default): the noise to be displayed is not corrected \( (N_i) \) as explained in IEC standard 61280-2-9 subsection, p 93.

**Signal Detection Settings**

• **Power Integration** (only if Noise Point Selection is set to Fixed, Nearest Peaks and Nearest Troughs):
  • ✓ (WDM analysis mode default): the signal power is integrated over the defined Power Integral Range.
  • ◯ (OSA, SML and OFA analysis modes default): the signal power is defined as the peak power.
• **Power Integral Range** (only if **Noise Point Selection** is set to **Fixed**, **Nearest Peaks** and **Nearest Troughs**, and if **Power Integration** check box is selected)
  The range of integration of the signal around the peak signal.
  Default value: 10 GHz

• **Power Meter Display** (WDM analysis mode only)
  - (default): the detected signal is displayed on graph, if the **Display on graph** parameter of the **Channel Detection** tool is activated (see section **Defining Channel Detection Analysis Parameters**, p. 68).
  - the detected signal is not displayed on graph.

### 6.13.2 Analyzing OSNR Results

**Subject**
Analysis results are displayed below the graph (see section **Result Area Description**, p. 62).

**Result Description**
**Results Displayed on Graph**
If you have selected the Display on Graph check box, the following graphical items are displayed on graph:

-  is displayed on the signal power/wavelength.

-  is displayed on the noise power.
## Result Area

<table>
<thead>
<tr>
<th>Result</th>
<th>Meaning</th>
</tr>
</thead>
</table>
| **Noise Level/BW**                  | **Corrected Noise**  
OSA and SML analysis modes only. Value of the noise figure $N_i$ or $N_{corr}$ as interpolated with the fitting input parameters.                                                                                      |
| **OSNR/OSNR**<sub>IN/OUT</sub> (OFA)| Value of the OSNR as defined by the calculation given above in IEC standard 61280-2-9 subsection, p 93 for OSA20.                                                                                       |
| $P_{int}$                           | WDM analysis mode only. Integrated power measurement within the **Power Integral Range** if the **Power Integration** check box is selected.                                                             |
| **Noise**<sub>IN/OUT</sub>         | WDM analysis mode only. Noise value (with or without bandwidth correction) at the wavelength of the signal, interpolated from the fit of the spectrum located in the **Noise Range**. |
| $P_{IN/OUT}$                        | OFA analysis mode only. Power level, without integration. This value takes into account the **Input Attenuation/Output Attenuation** parameters set in the **Gain Settings** (see section *Defining Gain & NF Analysis Parameters*, p. 105). |
| **Noise**<sub>IN/OUT</sub>         | OFA analysis mode only. Noise value, without correction. This value takes into account the **Input Attenuation/Output Attenuation** parameters set in the **Gain Settings** (see section *Defining Gain & NF Analysis Parameters*, p. 105). |
6.14 Setting Up Ripple Analysis

The Ripple analysis tool is available in OSA and BBS analysis modes.

6.14.1 Defining Ripple Analysis Parameters

Subject

The Ripple tool allows you to get the calculated parameters of the ripple within a selected area (in nm) and after removal of the baseline.

Procedure

1. In the analysis mode window, touch the Analysis Setup tab.
2. Touch the Ripple tool and modify the parameters using the instructions given in the following Ripple: Parameters Description subsection, p 99.
3. Activate the analysis calculation for the next analysis run by selecting the Activate check box.

Ripple: Parameters Description

Ripple Measurement Settings

- **Detection Threshold**
  Threshold for detection of ripple peaks and troughs once the baseline is removed after the fit (see Figure 36, p. 100).
  Default value: 0.01 dB

- **Span**
  Spectral range around the main peak over which the ripple measurement is performed. It is recommended to set it larger than ten ripple periods. If Span is larger than the analyzed trace span, the calculation is performed on the analyzed trace span.
  Default value: 10 nm / 1.209 THz

- **Refractive index**
  In case of SLED, the ripple is caused by Fabry-Perot (FP) effect. To display the equivalent FP length estimated based on ripple frequency measurement, the refractive index of the material causing the ripple is required.
  Default value: 1.00027326 (air @1550 nm)
6.14.2 Analyzing Ripple Results

Subject

Analysis results are displayed below the graph (see section Result Area Description, p. 62).

Result Description

<table>
<thead>
<tr>
<th>Result</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Amplitude</strong></td>
<td>Measure difference between highest and lowest level of the ripple, after removal of the baseline.</td>
</tr>
<tr>
<td><strong>Spacing</strong></td>
<td>Mean spacing of measured ripple peaks above the detection threshold, after removal of the baseline.</td>
</tr>
<tr>
<td><strong>Equivalent FP Length</strong></td>
<td>Estimated Fabry-Perot length, based on ripple spacing and on the refractive index given as input.</td>
</tr>
</tbody>
</table>
6.15 Setting Up Optical Power Analysis

The Optical Power analysis tool is available in OSA, BBS, MML and SML analysis modes.

6.15.1 Defining Optical Power Analysis Parameters

Subject

The **Power** tool allows you to get the total power measured on the spectrum integrated over a selected spectral range.

Power Calculation

Power calculation, including offset:

\[
Total\ Power = Offset + \Delta \lambda \times \sqrt{\frac{4ln2}{\pi}} \sum_{i}^{N_{\text{samples}}} \frac{P_i}{R_i}
\]

Where:

- \( \Delta \lambda \) is the sampling rate (in nm) of the trace.
- \( \sqrt{\frac{4ln2}{\pi}} \) in the equation takes into account the Gaussian filtering response of the monochromator inside the OSA20.
- \( \sum_{i}^{N_{\text{samples}}} \frac{P_i}{R_i} \) is the sum of all the values of power \( (P_i) \) of the trace, in mW (conversion if needed) divided by the corresponding resolution bandwidth \( (R_i) \).

Procedure

1. In the analysis mode window, touch the **Analysis Setup** tab.
2. Touch the **Optical Power** tool and modify the parameters using the instructions given in the following **Power: Parameters Description** subsection, p 101.
3. Activate the analysis calculation for the next analysis run by selecting the **Activate** check box.

Power Measurement Settings

- **Noise Suppression**
  - ✔️ (default): the Noise Suppression algorithm is used to reduce the dependence of the measurement to noise data.
  - ☐: the raw spectrum is used for the integration of power.

- **Offset**
  Adds the entered value to the measured power.
  Default value: 0 dB
• **Full Span**
  - ✓ (default): the full spectrum is used for the integration of power.
  - □ enables you to enter a span value in the **Span** field.
• **Span** (only if the **Full Span** check box is cleared)
  Span limits the computation of power to a span around the identified main peak wavelength/frequency.
  Default value: 0.02 nm / 0.002 THz

### 6.15.2 Analyzing Optical Power / Gain / Loss Results

**Subject**
Analysis results are displayed below the graph (see section Result Area Description, p. 62).

**Result Description**

<table>
<thead>
<tr>
<th>Result</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Power (dBm)</strong></td>
<td>Power measured within the scan range in dBm. If no power (or negative power) is detected, the result displays -100 dBm.</td>
</tr>
<tr>
<td><strong>Total Power (xW)</strong></td>
<td>Power measured within the scan range in Watt, scaling automatically in pW, nW, uW, mW. If no power (or negative power) is detected, the result displays 0 mW.</td>
</tr>
<tr>
<td><strong>Average Gain/Loss</strong></td>
<td>Only for traces in dB. Average gain/loss measured within the scan range in dB.</td>
</tr>
</tbody>
</table>
6.16 Setting Up Loss Measurement Analysis

The Loss Measurement analysis tool is available in the PCT analysis mode, for Fiber component type. The analysis settings cannot be modified.

6.16.1 Defining Loss Measurement Analysis Parameters

Subject

The Loss Measurement tool allows you to get the average attenuation and the uniformity of a spectral trace obtained from a fiber-type passive component.

Procedure

1. In the PCT analysis mode window, touch the Analysis Setup tab.
2. Touch the Component Selector tool and set the Type parameter to Fiber.
3. The Loss Measurement tool will automatically be calculated on the next analysis.

Loss Measurement: Parameters Description

The analysis settings cannot be modified. For more details on measurement settings, see section Defining Optical Power Analysis Parameters, p. 101.

- Noise Suppression: disabled
- Offset: 0 dB
- Full Span: activated

6.16.2 Analyzing Loss Measurement Results

Subject

Analysis results are displayed below the graph (see section Result Area Description, p. 62).

Result Description

<table>
<thead>
<tr>
<th>Result</th>
<th>Meaning</th>
</tr>
</thead>
</table>
| Average Loss | Only for traces in dB.  
               | Measured fiber attenuation, in dB.                                      |
| Uniformity  | Only for traces in dB.  
               | Difference between minimum and maximum loss within the analysis range, in dB. |
6.17 Setting Up Peak Power Density Analysis

The Peak Power Density analysis tool is available in the BBS analysis mode.

6.17.1 Defining Peak Power Density Analysis Parameters

Subject

The Peak Power Density tool allows you to get the integrated power on 1 nm around the peak, or 1 THz, depending on the selected measurement unit (see section Setting General Parameters, p. 32).

Procedure

1. In the BBS analysis mode window, touch the Analysis Setup tab.
2. Touch the Peak Power Density tool and modify the parameters using the instructions given in the following Peak Power Density: Parameters Description subsection, p 104.
3. Activate the analysis calculation for the next analysis run by selecting the Activate check box.

Peak Power Density: Parameters Description

Peak Power Density Measurement Settings

- Noise Suppression
  - (default): the noise suppression algorithm is used to reduce the dependence of the measurement to noise data: any point with surrounding ±10 pt below 0 mW is considered noise and set to 0 mW.
  - the raw spectrum is used for the integration of power.
- Offset
  Adds the entered value to the measured power.
  Default value: 0 dB

6.17.2 Analyzing Peak Power Density Results

Subject

Analysis results are displayed below the graph (see section Result Area Description, p. 62).

Result Description

<table>
<thead>
<tr>
<th>Result</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Power Density</strong> (dBm/nm or dBm/THz)</td>
<td>Power density measured in dBm/nm or dBm/THz, depending on the selected measurement unit (see section Setting General Parameters, p. 32).</td>
</tr>
<tr>
<td><strong>Power Density</strong> (µW/nm or µW/THz)</td>
<td>Power density measured in µW (or pW, nW, mW)/nm or µW (or pW, nW, mW)/THz, depending on the selected measurement unit (see section Setting General Parameters, p. 32).</td>
</tr>
</tbody>
</table>
6.18 Setting Up Gain and Noise Figure Analysis

The Gain and NF Analysis tool is available in the OFA analysis mode.

6.18.1 Defining Gain & NF Analysis Parameters

Subject

The Gain and NF tool calculates Gain and noise figure of an amplifier based on the OSNR results for both input and output signal of the amplifier.

Procedure

1. In the OFA analysis mode window, touch the Analysis Setup tab.
2. Touch the Gain and NF tool and modify the parameters using the instructions given in the following Gain & NF: Parameters Description subsection, p 105.
3. To make graphical display items of the analysis visible on the graph, select the Display on Graph check box.

Gain & NF: Parameters Description

- Experimental Setup
  - Setup used for the calculation of the amplifier's gain and noise figure:
    - Single Source (default): results are displayed in boxes in the Result area. This selection deactivates the Channel Detection tool.
    - Multichannel: results are displayed in a table and on the graph in dB, Gain and Noise Figure are displayed as a function of wavelength. This selection activates the Channel Detection tool.

Gain Settings
Attenuation you want to apply on traces IN and/or OUT if necessary.

- Input Attenuation
  - Power difference $L_{in}$ between power arriving at the amplifier input and power measured in trace IN.
  - Default value: 0 dB

- Output Attenuation
  - Power difference $L_{out}$ between power at the amplifier output and power measured in trace OUT.
  - Default value: 0 dB

Noise Figure Settings

- Noise Figure Selection
  - Equation used for the calculation of the noise figure:
    - Full (default): the following whole equation is used for the calculation.

\[
G = \frac{(P_{out} - SSE_{out})L_{out}}{(P_{in} - SSE_{in})L_{in}}
\]
with filtering width $\Delta f = 0$, the equation simplifies to:

$$NF = \frac{1}{G} + \frac{P_{ASE}}{h \nu \times G \times \Delta \nu}$$

where:

- $h$: Plank's constant: $6.62 \times 10^{-34}$ (J.s).
- $\nu$: center frequency of the output signal.
- $\Delta \nu$: frequency resolution of the OSA measured on the $P_{in}$ signal or calculated from Calibrated data depending on Resolution.
- $G$: gain at signal wavelength/frequency.
- $P_{ASE}$: power of amplifier's ASE (amplified spontaneous emission)
- $P_{in}$: power of input signal.
- $\Delta f$: filtering width, is the bandwidth of the ASE around the signal, expressed in Hz.

**Simplified**: the simplified version of the equation is used for the calculation, as it appears in the IEC standard 61290-3-1 (2003-08), where only the Signal to Spontaneous emission beating part is used:

$$NF = \frac{P_{ASE}}{h \nu \times G \times \Delta \nu}$$

**Resolution**
The OSA monochromator resolution used for NF calibration:

- **Measured** (default): the FWHM of the detected signal is used.
- **Calibrated**: the resolution as measured at the calibration time is used.

**Filtering Width**
Width (in GHz) of the filter centered around the signal wavelength.
If no filter is used, set this parameter to the width of the optical amplifier output used when Noise Figure Selection is set to Full.

Set this parameter to 0 to achieve simplified IEC equation with shot noise.
Default value: 0 GHz
### 6.18.2 Analyzing Gain and NF Results

**Subject**

Analysis results are displayed below the graph (see section Result Area Description, p. 62).

**Result Description**

![Graph showing power, wavelength or frequency, Gain G, EDFA ASE, Source ASE, IN x G, OUT, IN x G Source ASE x G, Source ASE](image)

**Figure 37: Gain & NF Results**

**Results Displayed on Graph**

If you have selected **Multichannel** in the **Experimental Setup** field, and if the **Display on Graph** check-box is selected, gain and noise figure are displayed on graph (with legend).

**Result Area**

Depending on the parameter selected in the **Experimental Setup** field, results are displayed in boxes grouped by analysis tool (**Single Source**), or in the form of a table of channels (**Multichannel**).

<table>
<thead>
<tr>
<th>Result</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Res</td>
<td>Resolution used in the calculation of the EDFA noise figure.</td>
</tr>
<tr>
<td>( \text{Noise}_{\text{Amp}} )</td>
<td>Noise power measured at signal wavelength/frequency using output OSNR calculations.</td>
</tr>
<tr>
<td>Gain</td>
<td>Gain calculated from output and input signal power and output and input noise power (from OSNR calculation on trace IN and trace OUT).</td>
</tr>
<tr>
<td>NF</td>
<td>Noise figure calculated using PASE, EDFA Gain and Resolution. Depending on <strong>Noise Figure Selection</strong> (and filtering width), the equation for the calculation is simplified or contains all components.</td>
</tr>
<tr>
<td>( \text{OSNR}_{\text{Amp}} )</td>
<td>Optical signal to noise ratio of the output signal power to the ASE noise power (with the <strong>Reference Optical BW</strong> set in the OSNR tool output).</td>
</tr>
<tr>
<td>S</td>
<td>Ratio of signal output power to measured output power.</td>
</tr>
</tbody>
</table>

In **Multichannel** experimental setup, the following results are available above the table:
• **Int. ASE**$_{\text{OUT}}$: integrated ASE noise power calculated from the integrated output spontaneous emission minus the input source spontaneous emission times the EDFA gain.

• **G Flat.**: gain flatness. It provides a comparison of minimum gain to maximum gain across all tested channels.

• **G Slope**: slope of a linear fit to all tested channel’s gain.

• **G$_{\text{Avg}}$**: average gain obtained from all tested channel’s gain.

• **Total P$_{\text{IN}}$**: power of input signal measured within the scan range.

• **Total P$_{\text{OUT}}$**: power of output signal measured within the scan range.
6.19 Setting Up Pass Band Test Analysis

The Pass Band Test analysis tool is available in the PCT analysis mode, for Pass Band Filter component type.

6.19.1 Defining Pass Band Test Analysis Parameters

Subject

The Pass Band Test tool allows you to get cross-talk, average loss, ripple and roll-off characteristics for a pass band filter.

Procedure

1. In the PCT analysis mode window, touch the Analysis Setup tab.
2. Touch the Component Selector tool and set the Type parameter to Pass Band Filter.
3. Touch the Pass Band Test tool and modify the parameters using the instructions given in the following Pass Band Test: Parameters Description subsection, p 109. The analysis tool is always activated.
4. To make graphical display items of the analysis visible on the graph, select the Display on Graph check box.

Pass Band Test: Parameters Description

CrossTalk Settings

- **Reference**
  Reference point taken for the analysis of the characteristics of the filter:
  - **Peak λ** (default): peak wavelength found in the Spectral Width 1 tool results (see section Analyzing Spectral Width Results, p. 76).
  - **Center λ**: center wavelength found in the Spectral Width 1 tool results (see section Analyzing Spectral Width Results, p. 76).

\[
\text{Figure 38: Pass Band Test – In Reference Selection}
\]

- **IN/OUT Band Method**
  Method used in crosstalk calculation for the estimate of the spectral spacing between in and out bands:
• **Bandwidth 1** (default): selects the out band reference points to be exactly a bandwidth away from the in-band point, using the result in **Spectral Width 1** tool (see section Analyzing Spectral Width Results, p. 76).

• **Set Distance**: enables you to set the spacing via the **In/Out Band Distance** parameter.

![Figure 39: Pass Band Test – Out Reference Selection](image)

• **IN/OUT Band Distance** (only if **In/Out Band Method** is set to **Set Distance**)
Spectral spacing in nm/THz between the in-band reference point and the out-band reference points to be used for the crosstalk calculation. Default value: 1 nm

**Average Loss & Ripple Settings**

• **Averaging Range**
Spectral range used in the analysis of in-band and out-band average loss and ripple.

• **Fixed Range**: provides a fixed calculation span (see **Calculation Span** parameter),

![Figure 40: Pass Band Test – Averaging Range: Fixed Range](image)

• **% Bandwidth**: sets the range to a fraction of the bandwidth measured from the **Spectral Width 1** tool (see section Analyzing Spectral Width Results, p. 76).
**Figure 41: Pass Band Test – Averaging Range: % Bandwidth 1**

- **PT Detection**: detects all peaks and troughs within the Bandwidth 1 using Detection Threshold. The span is then set as the distance between the first and last peak detected for a pass band filter.

**Figure 42: Pass Band Test – Averaging Range: PT Detection**

In-band and out-band average loss and ripple/slope calculations are performed across a given calculation span centered on their respective reference points as defined in crosstalk settings.

- **Calculation Span** (only if **Averaging Range** is set to **Fixed Range**)
  Fixed Range in nm/THz over which calculations are done. The range is centered on the reference points for in-band and out-band (set in CrossTalk Settings, p. 109). A range of 0 takes a single point for the calculation.
  Default value: 0.1 nm

- **% Bandwidth** (only if **Averaging Range** is set to **3dB Bandwidth**)
  Fraction (in %) of the bandwidth calculated in Spectral Width 1 over which calculations are done. The range is centered on the reference points for in-band and out-band (set in CrossTalk Settings, p. 109).
  Default value: 50 %
• **Detection Threshold** (only if **Averaging Range** is set to **PT Detection**) Threshold in dB for the detection of in-band extreme peaks over which calculations are done. The range is centered on the reference points for out-band (set in CrossTalk Settings, p. 109). Default: 0.1 dB

**Roll-Off & Transition Band Settings**

• **Transition Reference** Reference point to be used in the transition calculation:

  • **In-Band** (default): the transition band is defined as the part of the trace between Level@ **Transition Reference** - **Min Exclusion Threshold** and Level@ **Transition Reference** - **Max Exclusion Threshold**.

  ![Figure 43: Roll off calculation – Transition In Band](image)

  • **Out-Band**: the transition band is defined as the part of the trace between Level@ **Transition Reference** + **Min Exclusion Threshold** and Level@ **Transition Reference** + **Max Exclusion Threshold**.

  ![Figure 44: Roll off calculation – Transition Out Band](image)

• **Min Exclusion Thresh.** (in dB) Minimum threshold for the exclusion of data outside of the transition band. Default value: 3 dB
6.19.2 Analyzing Pass Band Test Results

Subject

Analysis results are displayed below the graph (see section Result Area Description, p. 62).

Result Description

Results Displayed on Graph

If you have selected the Display on Graph check box, the following graphical items are displayed on graph:

- ▼ are displayed on the reference points (in- and out-band).
- ▲ are displayed on the maximum roll off wavelength within transition range.
- 【】 are display on the transition range.

Result Area

The RollOff measurement is performed on the OSA20 trace, which is a convolution of the filter under test and the OSA20 monochromator.

- In-Band Results

<table>
<thead>
<tr>
<th>Result</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg Loss</td>
<td>Average loss in dB measured across Averaging Range around the in-band reference point.</td>
</tr>
<tr>
<td>Ripple</td>
<td>Uniformity in dB as the min/max level difference measured within Averaging Range around the In-Band reference point.</td>
</tr>
<tr>
<td>Slope</td>
<td>Linear fit slope calculated within Averaging Range around the In-Band reference point.</td>
</tr>
</tbody>
</table>

- Out-Band Side 1 Results & Out-Band Side 2 Results

<table>
<thead>
<tr>
<th>Result</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg Loss</td>
<td>Average loss in dB measured across Averaging Range around the Out-Band reference point.</td>
</tr>
<tr>
<td>Ripple</td>
<td>Uniformity in dB as the min/max level difference measured within Averaging Range around the Out-Band reference point.</td>
</tr>
<tr>
<td>CrossTalk</td>
<td>Crosstalk (pass band) in dB measured between the In-Band Reference point and the Out-Band Reference point. <strong>Important:</strong> the crosstalk is given as difference between points, not between Avg Losses.</td>
</tr>
<tr>
<td>RollOff@XdB*1</td>
<td>Roll off in dB/nm (or dB/THz) measured at XdB (set by the Spectral Width 1 tool) from the Transition Reference point.</td>
</tr>
<tr>
<td>RollOff_max*1</td>
<td>Maximum roll off in dB/nm (or dB/THz), within the transition band.</td>
</tr>
<tr>
<td>λ @RollOff_max*1</td>
<td>Wavelength of maximum roll off in nm.</td>
</tr>
<tr>
<td>Transition Band*1</td>
<td>Wavelength region between Transition Reference -/+ Minimum Threshold and Reference point -/+ Maximum Threshold.</td>
</tr>
</tbody>
</table>

*1: This result is calculated between the two reference points set in CrossTalk Settings, p. 109.
6.20 Setting Up Stop Band Test Analysis

The Stop Band Test analysis tool is available in the PCT analysis mode, for Stop Band Filter component type.

6.20.1 Defining Stop Band Test Analysis Parameters

Subject

The Stop Band Test tool allows you to get isolation depth, average loss, ripple and roll-off characteristics for a pass band filter.

Procedure

1. In the PCT analysis mode window, touch the Analysis Setup tab.
2. Touch the Component Selector tool and set the Type parameter to Stop Band Filter.
3. Touch the Stop Band Test tool and modify the parameters using the instructions given in the following Stop Band Test: Parameters Description subsection, p. 114. The analysis tool is always activated.
4. To make graphical display items of the analysis visible on the graph, select the Display on Graph check box.

Stop Band Test: Parameters Description

Isolation Depth Settings

- **Reference**
  
  Reference point taken for the analysis of the characteristics of the filter:
  
  - **Trough λ** (default): peak wavelength found in the Notch Width 1 tool results (see section Analyzing Notch Width Results, p. 87).
  
  - **Center λ**: center wavelength found in the Notch Width 1 tool results (see section Analyzing Notch Width Results, p. 87).

- **IN/OUT Band Method**
  
  Method used in isolation depth calculation for the estimate of the spectral spacing between in and out bands:
  
  - **Bandwidth 1** (default): selects the out band reference points to be exactly a bandwidth away from the in-band point, using the result in Notch Width 1 tool (see section Analyzing Notch Width Results, p. 87).
• **Set Distance**: enables you to set the spacing via the **In/Out Band Distance** parameter.

![Figure 46: Stop Band Test – Out Reference Selection](image)

- **IN/OUT Band Distance** (only if **In/Out Band Method** is set to **Set Distance**)
  Spectral spacing in nm/THz between the in-band reference point and the out-band reference points to be used for the isolation depth calculation.
  Default value: 1 nm

**Average Loss & Ripple Settings**

- **Averaging Range**
  Spectral range used in the analysis of In-band and out-band average loss and ripple.
  - **Fixed Range**: provides a fixed calculation span (see Calculation Span parameter).

![Figure 47: Stop Band Test – Averaging Range: Fixed Range](image)

- **% Bandwidth**: sets the range to a fraction of the bandwidth measured from the **Notch Width 1** tool (see section Analyzing Notch Width Results, p. 87).
Analyzing Traces

**Figure 48: Stop Band Test – Averaging Range: % Bandwidth 1**

- **PT Detection**: detects all peaks and troughs within the Bandwidth 1 using Detection Threshold. The span is then set as the distance between the first and last trough detected for a stop band filter.

**Figure 49: Stop Band Test – Averaging Range: PT Detection**

In-band and out-band average loss and ripple/slope calculations are performed across a given calculation span centered on their respective reference points as defined in isolation depth settings.

- **Calculation Span** (only if Averaging Range is set to Fixed Range)
  
  Fixed Range in nm/THz over which calculations are done. The range is centered on the reference points for in-band and out-band (set in isolation depth settings). A range of 0 takes a single point for the calculation.
  
  Default value: 0.1 nm

- **% Bandwidth** (only if Averaging Range is set to % 3dB Bandwidth)
  
  Fraction (in %) of the bandwidth calculated in Notch Width 1 over which calculations are done. The range is centered on the reference points for in-band and out-band (set in isolation depth settings).
  
  Default value: 50 %
• **Detection Threshold** (only if Averaging Range is set to PT Detection)
  Threshold in dB for the detection of in-band extreme troughs over which calculations are done. The range is centered on the reference points for in-band (set in isolation depth settings).
  Default: 0.1 dB

Roll-Off & Transition Band Settings

• **Transition Reference**
  Reference point to be used in the transition calculation:
  • **In-Band** (default): the transition band is defined as the part of the trace between Level@ Transition Reference - Min Exclusion Thresh. and Level@ Transition Reference - Max Exclusion Thresh.
  • **Out-Band**: the transition band is defined as the part of the trace between Level@ Transition Reference + Min Exclusion Thresh. and Level@ Transition Reference + Max Exclusion Thresh.

![Figure 50: Roll off calculation – Transition In Band](image)

![Figure 51: Roll off calculation – Transition Out Band](image)

• **Min Exclusion Thresh.**
  (in dB) Minimum threshold for the exclusion of data outside of the transition band.
  Default value: 3 dB
• Max Exclusion Thresh.
  (in dB) Maximum threshold for the exclusion of data outside of the transition band.
  Default value: 20 dB.

6.20.2 Analyzing Stop Band Test Results

Subject
Analysis results are displayed below the graph (see section Result Area Description, p. 62).

Result Description
Results Displayed on Graph
If you have selected the Display on Graph check box, the following graphical items are displayed on graph:

• are displayed on the reference points (in- and out-band).
• are displayed on the maximum roll off wavelength within transition range.
• are display on the transition range.

Result Area

• In-Band Results

<table>
<thead>
<tr>
<th>Result</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg Loss</td>
<td>Average loss in dB measured across Averaging Range around the in-band reference point.</td>
</tr>
<tr>
<td>Ripple</td>
<td>Uniformity in dB as the min/max level difference measured within Averaging Range around the In-Band reference point.</td>
</tr>
<tr>
<td>Slope</td>
<td>Linear fit slope calculated within Averaging Range around the In-Band reference point.</td>
</tr>
</tbody>
</table>

• Out-Band Side 1 Results & Out-Band Side 2 Results

<table>
<thead>
<tr>
<th>Result</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg Loss</td>
<td>Average loss in dB measured across Averaging Range around the Out-Band reference point.</td>
</tr>
<tr>
<td>Ripple</td>
<td>Uniformity in dB as the min/max level difference measured within Averaging Range around the Out-Band reference point.</td>
</tr>
<tr>
<td>Isolation Depth</td>
<td>Isolation depth in dB measured between the In-Band Reference point and the Out-Band reference point.</td>
</tr>
</tbody>
</table>
  **Important:** the isolation depth is given as difference between points, not between Avg Losses.
| RollOff@XdB | Roll off in dB/nm (or dB/THz) measured at X dB (set by the Notch Width 1 tool) from the Transition Reference point. |
| RollOff_{max} | Maximum roll off in dB/nm (or dB/THz), within the transition band. |
| λ_{@RollOff_{max}} | Wavelength of maximum roll off in nm. |
| Transition Band | Wavelength region between Transition Reference -/+ Minimum Threshold and Reference point -/+ Maximum Threshold. |
6.21 Setting Up Mask Test Analysis

The Mask Test analysis tool is available in the PCT analysis mode, for all component types. This tool allows you to compare the transfer function trace to a specified mask and get the pass/fail result.

6.21.1 Defining Mask Test Analysis Parameters

Subject

The Mask Test tool allows you to define your optical component target specification as a mask.

Before Starting

Prepare and save the traces you want to set as high and low masks, which reflect your target specifications: one trace to feature the high mask and one trace to feature the low mask.

You can acquire these traces using the OSA20 or prepare them in .csv files.

Important

The wavelength/frequency range of the mask traces must be higher than or equal to the wavelength/frequency range of the transfer function trace that is analyzed.

Procedure

1. In the PCT analysis mode window, touch the button located to the left of the MSK HI button to define the top mask trace.
The Trace MSK HI menu appears.

![Figure 53: MSK HI Menu](image)

2. Touch the **Load** button and select the trace you want to set as high mask.
3. Set the trace to **Store**. and make sure the trace is set to **ON**.
   
The loaded trace is displayed on graph.
4. Perform steps 1 to 3 with **MSK LO** trace to define the low mask trace.

### 6.21.2 Analyzing Mask Test Results

**Subject**

Analysis results are displayed below the graph (see section Result Area Description, p. 62).

**Result Description**

<table>
<thead>
<tr>
<th>Result</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRANS Between Masks</td>
<td>Alignment of the transfer function within the mask limits:</td>
</tr>
<tr>
<td></td>
<td>• <strong>Pass</strong>: the transfer function trace is within the high and low</td>
</tr>
<tr>
<td></td>
<td>limits of the mask.</td>
</tr>
<tr>
<td></td>
<td>• <strong>Fail LO</strong>: the transfer function runs over the low limit of the</td>
</tr>
<tr>
<td></td>
<td>mask.</td>
</tr>
<tr>
<td></td>
<td>• <strong>Fail HI</strong>: the transfer function runs over the high limit of the</td>
</tr>
<tr>
<td></td>
<td>mask.</td>
</tr>
<tr>
<td></td>
<td>• <strong>Fail HI/LO</strong>: the transfer function runs over the high and low</td>
</tr>
<tr>
<td></td>
<td>limits of the mask.</td>
</tr>
<tr>
<td></td>
<td>• <strong>No Masks</strong>: no mask is defined.</td>
</tr>
<tr>
<td></td>
<td>• <strong>Mask size error</strong>: the wavelength/frequency range of the mask</td>
</tr>
<tr>
<td></td>
<td>traces is lower than the wavelength/frequency range of the transfer</td>
</tr>
<tr>
<td></td>
<td>function trace that is analyzed.</td>
</tr>
</tbody>
</table>
7. Saving/Loading Configuration Settings and Handling Files

7.1 Saving Analysis Settings and Results

Subject
You can save all the measurement parameters, analysis parameters set for the analysis mode, analysis results and screen shots of the displayed window, as explained in the following procedure.

Saving the configuration at the end of a test session enables you to start the next test session with exactly the same configuration.

Procedure
1. If necessary, connect the device on which you want to save your parameters and/or results to one of the USB ports.
2. In the <Analysis Mode> tab, touch the Save button located in the configuration area.
   The Save window appears. All connected drives are displayed.

3. Touch the wanted drive and folder.

4. If you want to create a new folder: touch the button and type a name for the folder (using the on-screen keyboard or a normal keyboard if connected to the OSA20), and touch the Create button.

5. Select the type of file to save:
   - **Settings (*.<analysis mode>):** saves all the measurement and analysis parameters set for the analysis mode in the <filename>.<analysis mode> file, and all the traces in their current state in the .tra format in a separate folder with the same name as the settings file.
   - **Analysis Results (*.csv):** saves the analysis results in a .csv file. You cannot load analysis results back to the system.
   - **Screenshot (*.jpg):** save the displayed window in .jpg format.
   - **Screenshot (*.png):** save the displayed window in .png format.
6. Type a name for the file: touch the text box at the left of the Save button to display the keyboard.

7. Touch the Save button.
   A confirmation message appears.

8. Safely remove the USB device (if any) as explained in section Disconnecting USB Storage Devices from the OSA20, p. 28.

### 7.2 Loading Measurement and Analysis Settings

**Subject**
You can restore measurement and analysis parameters you have previously saved, or the default measurement and analysis parameters set for an analysis mode.

**Procedures**

**Loading Previously Saved Settings**

1. If necessary, connect the device from which you want to load your parameters to one of the USB ports.

2. In the <Analysis Mode> tab, touch the Load button located in the configuration area. The Open window appears. All connected drives are displayed.

3. Select the file to load and touch the Open button. A confirmation message appears.

4. Safely remove the USB device (if any) as explained in section Disconnecting USB Storage Devices from the OSA20, p. 28.

**Loading the Default Measurement Settings**

1. In the configuration area of the wanted analysis mode, touch the Load button. The Open window appears.

2. In the drop-down list, select Default Settings and touch the Open button.
7.3 Handling Files Saved

Subject
You can access the OSA20 internal drive or an external hard drive connected to the OSA20 to handle the settings and screen shot files you have saved. You can move the files from one location to another, for example to copy a file saved on the internal drive to an external USB device. You can also delete files you have previously saved on the internal drive.

Procedure
Deleting a File/Folder
1. If necessary, connect to one of the USB ports the device from which you want to delete the file.
2. In the <Analysis Mode> tab, touch the Save or Load button located in the configuration area.
   The Save or Open window appears.
3. Select the file(s) or folder(s) you want to delete and touch the button.
   The file(s)/folder(s) are deleted from the OSA20 internal drive.

Copying/Cutting–Pasting a File
1. If necessary, connect to one of the USB ports the device on which you want to copy/cut or paste the file.
2. In the <Analysis Mode> tab, touch the Save or Load button located in the configuration area.
   The Save or Open window appears.
3. Select the file(s) you want to copy, cut or paste and touch the button corresponding to the action you want to perform: Copy or Cut button.
4. Select the drive and folder in which you want to paste the selected file(s) and touch the Paste button.
8. Using the OSA20 in Remote Control

You can remotely control the OSA20 by using one of the following ports:

- The GPIB port, located on the rear panel (see section Rear Panel, p. 21).
- The two Ethernet ports, located on the connector panel (see section Right-side Panel: Connectors, p. 19).
- The USB 2.0-B port, located on the connector panel (see section Right-side Panel: Connectors, p. 19).

Maximum transfer rates are available in section Technical Specifications, Interfaces & Electrical, p. 14.

The present section explains how to connect an external device for remote control, and set the remote control parameters. All remote commands and functions are detailed in OSA20 Programming Guide.

8.1 Preparing the OSA20 for Remote Control

8.1.1 Modifying the GPIB Address

Subject
If you want to remotely control the OSA20 through the IEEE 488 port, you can modify the GPIB address.
The default GPIB address is 10. You can set it out between 1 and 30.

Procedure
1. On the OSA20 home window, touch the Remote button.
   The Remote window appears.
2. In the GPIB area, specify the GPIB address: touch the Address field and enter the wanted address value.

8.1.2 Setting the Ethernet Ports

Subject
The two Ethernet ports available on the OSA20 are dedicated to remote control of the instrument from a computer directly connected to the OSA20 (Ethernet port 1), or through your company network (Ethernet port 2)

Before Starting
If you want to use the Ethernet port #1, make sure the IP connection properties of your computer are properly configured, with the Obtain an IP address automatically parameter.

Procedure
1. On the OSA20 home window, touch the Remote button.
   The Remote window appears.
2. In the Ethernet area, specify the TCP Socket Port (see below).
3. Connect the RJ45 cable to the wanted port.
4. Set the corresponding parameters as explained in the following *Ethernet Parameter Description* subsection, p 126.
   - Use **Port 1 (left)** to directly connect a computer to the OSA20. This port provides an automatic IP address configuration.
   - Use **Port 2 (right)** to remotely control the OSA20 from a computer through your company network, or to directly connect a computer to the OSA20 and manually configure the connection parameters.

5. Touch the **Apply** button to validate your configuration.

![Figure 54: OSA20 Remote Parameters](image)

<table>
<thead>
<tr>
<th>Setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TCP Socket</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Port</strong></td>
<td>TCP destination port to be used by the socket to allow data transmission between the OSA20 and the external controller.</td>
</tr>
<tr>
<td><strong>Important:</strong> make sure the firewall of your computer allows communication on this port.</td>
<td></td>
</tr>
<tr>
<td>Default value: 5025 (SCPI-RAW)</td>
<td></td>
</tr>
</tbody>
</table>
### Using the OSA20 in Remote Control

#### Port 1 (left)
This port enables the direct connection to a computer for remote control.

- ✅: indicates that the connection is established and displays the connection speed.
- ☑: indicates that the connection to the external device is not established.
- □: indicates that the port is not connected to any external device.

**DHCP server**
Displays the address automatically assigned to the connected OSA20.
Default OSA20 IP address: 192.168.54.1

#### Port 2 (right)
This port enables the connection to a computer through your company network or the direct connection to a computer (manual configuration).

If you do not know how to configure this port or if the connection does not work, contact your company network administrator.

- ✅: indicates that the connection is established and displays the connection speed.
- ☑: indicates that the connection to the external device is not established.
- □: indicates that the port is not connected to any external device.

**Obtain an IP address automatically**

- ✅ (default): the connection parameters (IP address, subnet mask and default gateway) are automatically retrieved from the connected network, and the connection is automatically established.
- ☑: enables you to manually set the connection parameters.
  - **IP Address**: IP address used by your company network.
  - **Subnet mask**: subnet mask used by your company network.
  - **Default Gateway**: default gateway used by your company network.

**Apply**
Applies the connection configuration parameters.

**Refresh**
Refreshes the automatically set connection parameters.
8.1.3 Installing the USB Driver on the Remote Computer

Subject

To remotely control the OSA20 through the USB-B port, you must install the EXFO USB driver on the computer from which you want to control the OSA20.

Before Starting

- Make sure your computer runs one of the following operating systems: Windows 7, Windows 8 or Windows 10.
  If not, the OSA20 USB driver is not supported by your computer.
- Make sure you have the appropriate USB driver: the EXFO USB driver is provided on the USB key delivered with the OSA20, or can be downloaded from the EXFO website.
- Make sure you have a USB-A to USB-B cable.

Procedure

1. Do one of the following:
   - Connect the OSA20 USB key to the USB-A port of your computer.
   - From the EXFO website (www.EXFO.com/en/exfo-apps), download the OSA20 USB driver and unzip it to a temporary folder on your computer.

2. Connect your computer to the OSA20 by using a USB-A to USB-B cable.
   The first time you connect the OSA20 to your computer, it prompts you to install the driver.

3. Select the `siusbxp.inf` file located in the `USB Driver\OSA20 USB Driver` folder and install the driver by following the instructions displayed on screen.
8.2 Entering the Remote Mode

Subject
You can connect external devices without turning off the OSA20. Once the OSA20 has entered a remote mode (GPIB, USB-B or Ethernet), it can not receive commands from an other port.

Before Starting
- Make sure you have the appropriate cable:
  - For GPIB: IEEE 488 cable.
  - For Ethernet: RJ45 cable.
  - For USB-B: USB-A to USB-B cable.
- If you want to remotely control the OSA20 via USB:
  - Make sure the EXFO USB driver is installed on your computer (see section Installing the USB Driver on the Remote Computer, p. 128 for details).
  - EXFO provides a .dll and a LabVIEW driver allowing you to send commands via the USB port. See OSA20 Programming Guide for details.

Procedure
1. Connect the external controller to the appropriate connector:
   - For GPIB: the GPIB port located on the rear panel of the OSA20 (see Figure 4, p. 21).
   - For Ethernet: one of the two available Ethernet port located on the right side panel of the OSA20 (see Figure 3, p. 19).
   - For USB-B: the USB 2.0-B port located on the right side panel of the OSA20 (see Figure 3, p. 19)
2. Make sure the port you want to use for remote control is properly configured: see section Preparing the OSA20 for Remote Control, p. 125.
3. Send a command from the remote controller.
   When the OSA20 receives a command from an external controller, it enters the remote mode: the multi-touch screen is automatically deactivated and the Local button appears at the bottom right of the screen.

8.3 Switching Back to Local Mode

Subject
In remote mode, the Local button is displayed at the bottom right of the screen.

Procedure
- To get back to the local control of the OSA20, touch the Local button.
  The multi-touch screen is now available and you can use it. The local actions performed will be taken into account when another remote command will be received by the OSA20.
  The OSA20 switches back to remote mode as soon as it receives a command.
9. Performing Basic Maintenance Operations

9.1 Updating the OSA20 Firmware Version

**Subject**
The OSA20 firmware package is a .pkg file available on the EXFO website. Updating the OSA20 firmware version does not affect calibration data nor user data.

**Procedure**
1. From the EXFO website (www.EXFO.com/en/exfo-apps), download the last OSA20 firmware update (compressed into a .zip file) and unzip it to a USB device, so that the necessary .pkg file is located at the USB device root.
2. Connect the USB device to one of the available USB ports on the front panel (see section *Front Panel*, p. 16).
3. Turn off the OSA20 (see section *Turning off the OSA20*, p. 39).
4. On the front panel, press the button to turn on the OSA20.
   The OSA20 automatically detects the .pkg file on the USB device and starts the firmware update wizard.

**Caution**
To avoid serious system problems:
- Do not turn the OSA20 off during the firmware update.
- Do not remove the USB device before the end of the upgrade process.
5. Follow the instructions displayed on screen to update the firmware version. Once the update is finished, the OSA20 starts normally.
6. Safely remove the USB device as explained in section *Disconnecting USB Storage Devices from the OSA20*, p. 28.
9.2 Cleaning the OSA20

9.2.1 Cleaning the Cover of the OSA20

Subject If the external cover of the OSA20 becomes dirty or dusty, clean it by following the instruction below.

Caution Do not use chemically active or abrasive materials to clean the OSA20.

Before Starting Material needed:
- Cleaning cloth
- Isopropyl alcohol

Procedure 1. Turn the OSA20 off (see section Turning off the OSA20, p. 39) and unplug the power supply cord from the wall socket.
2. Slightly damp the cloth with an isopropyl alcohol liquid and gently swipe dirt and dust on the external cover of the OSA20, without applying excessive force onto it.

9.2.2 Cleaning the Fan Grid

Subject To ensure proper cooling of the OSA20 from the fan, the fan grid must not be dusty, you must clean it regularly.

Caution Do not use a vacuum cleaner to clean the fan as this may apply excessive force to it and cause damage to the fan.

Procedure 1. Turn the OSA20 off (see section Turning off the OSA20, p. 39) and unplug the power supply cord from the wall socket.
2. Using a duster or a slightly moist cloth, gently clean the external grid of the fan without pressing it.
9.2.3 Cleaning the Multi-touch Screen

Subject To ensure proper functioning and accuracy of the multi-touch screen, you must clean it regularly.

Before Starting Material needed:
- Lint-free cleaning cloth
- Isopropyl alcohol

Procedure
1. Turn the OSA20 off (see section Turning off the OSA20, p. 39) and unplug the power supply cord from the wall socket.
2. Using a lint-free cloth slightly damped with isopropyl alcohol, gently swipe dirt on the screen.
   Make sure to avoid drops and prevent alcohol from entering the OSA20.

9.3 Replacing the External Power Fuse

Subject You must verify the power fuse in case you cannot turn on the OSA20.

Warning
To avoid fire hazard, only use the correct fuse type, voltage and current ratings.

Before Starting Make sure you have the following equipment:
- 1 slot screwdriver (4 to 6 mm).
- 1 replacement fuse (for fuse type, see section Technical Specifications, p. 13).

Procedure
1. Turn the OSA20 off (see section Turning off the OSA20, p. 39) and unplug the power supply cord from the wall socket.
2. Unplug the cord of the adapter from the 48 V connector.
3. Insert the screwdriver in the fuse holder notch and unscrew the fuse holder from its housing.
4. Pull out the defective fuse from the fuse holder and replace it with the new one.
5. Replace the fuse holder in its housing on the rear panel and screw it back.
6. Plug the power cord of the adapter to the 48 V connector.
9.4 Cleaning Optical Connectors

Subject
To ensure measurement accuracy and prevent loss of optical power, you must verify that optical connectors are clean every time you connect a fiber.

Important
To reduce the need for cleaning, immediately replace protective caps on the optical connectors when not in use.

The OSA20 optical connectors are mounted on a removable plate to ease the cleaning of internal connectors.

Before Starting
Make sure you have the following material:
- Optical grade cleaning cotton swabs
- Canned air
- Isopropyl alcohol
- Fiberscope or similar if available
- Lint-free tissue or cleaning cartridges

Procedure
1. Turn the OSA20 off (see section Turning off the OSA20, p. 39) and unplug the power supply cord from the wall socket.
2. On the front panel, make sure the protective caps of the connector's plate are in place.
3. On the front panel, use your fingers to unscrew the two screws of the connector plate.

Caution
Do not drop the connectors plate as the weight could damage the fiber.

Once unscrewed from the front panel, the two screws stay attached to the plate.
4. Gently pull the plate out of the front panel (no more than 70 mm) so that fiber ends are made visible, as illustrated in the following figure.

![Figure 55: Optical Connectors (FC type) – Cleaning](image)

5. At the rear of the plate, remove one connector end from the plate:
   - For FC connectors, unscrew the connector end from the plate.
   - For SC connectors, pull out the connector end from the plate.
6. Gently clean the connector end, with the following instructions:
Performing Basic Maintenance Operations

a. Hold the can of compressed air upright and spray the can into the air to purge any propellant.

b. Spray the clean compressed air on the connector to remove any loose particles or moisture.

c. Moisten a clean optical swab with isopropyl alcohol and lightly wipe the surfaces of the connector with gentle circular motion.

d. Spray the clean compressed air on the connector again to remove any loose particles or isopropyl alcohol.

e. Check that the connector is clean with a fiberscope (or similar).

7. Replace the connector end at the rear of the plate: make sure the key of the connector is mated with that of the adapter and screw or push it back (depending on the connector type).

8. Perform steps 5 to 7 on the second connector.

9. Replace the connector’s plate on the front panel:

   a. Gently place fibers and labels into the hole on the front panel.

   b. Screw the plate back in its location, making sure no fiber is trapped between the front panel and the plate.
9.5 Calibrating the OSA20

9.5.1 Performing a User Calibration

Subject

The user calibration application enables you to calibrate the OSA20 wavelength (not the power). It is available from the home window. To make sure the OSA20 meets the applicable specifications, you must perform a user calibration in the following cases:

- You are using the OSA20 for the first time.
- The OSA20 has changed location or environment.
- The temperature of the room has changed by more than 3 °C.
- The OSA20 has been user calibrated before the one-hour warm-up at constant room temperature.
- The icon is displayed in the Analysis Mode windows (see Figure 11, p. 37).

The OSA20 has a built-in light source (Calibration Output), which is safe under normal conditions of use. The built in source is switched off if not in calibration mode. For details on the acetylene gas cell, see section Technical Specifications, p. 13.

Before Starting

- Make sure the room temperature is stabilized, and the OSA20 is at room temperature.
- Make sure the OSA20 has been turned on at least for one hour. The user calibration process must only be performed after at least one hour warm-up.
- Make sure the calibration output and optical input connectors are perfectly clean (see section Cleaning Optical Connectors, p. 134).

Procedure

1. In the OSA20 home window, touch the Calibration button.
2. Remove the Calibration Output and the Optical Input protective covers.
3. On the front panel, connect the jumper provided with the OSA20 between the Calibration Output and the Optical Input, and follow the instructions displayed on screen.

   If an error message occurs, see section Dealing with User Calibration Error Messages, p. 141 for instructions.

   The user calibration process takes approximately 45 seconds.

9.5.2 Asking for a Factory Recalibration

Subject

The calibration validity period depends on the intensity of use and environmental conditions. You can determine the adequate calibration interval for your OSA20 according to your accuracy requirements.

Under normal conditions of use, we recommend to perform a factory recalibration of the OSA20 after one year of normal use.

Procedure

Contact the EXFO customer support service (see section Contact Information, p. 4)
9.6 Carrying the OSA20

Subject

The two flexible handles located on the top side of the OSA20 allow you to carry it from one location to another, as explained in the following procedure.

Before Starting

Caution
Never carry the OSA20 if it has been abruptly turned off (see section Forcing the OSA20 to Shutdown & Restart, p. 143).
If it has been abruptly turned off, you must turn it on again and turn it off normally as explained in section Turning off the OSA20, p. 39)

Procedure

1. Turn the OSA20 off normally (see section Turning off the OSA20, p. 39).
2. Unplug the power cord from the wall socket outlet.
3. Fasten the protective cover on the front panel:
   a. Hold the protective cover with two hands, the hollow side facing the front panel.
   b. Slightly splay the side edges of the protective cover and push it horizontally on the front panel until the two side tabs reach the back of the front frame.
4. Carry the OSA20 with two hands using the two handles on the top side to keep it horizontal.

9.7 Packaging for Shipment

Subject

If you need to return the OSA20 to EXFO for servicing or factory calibration, use the original packaging.

Procedure

Caution
Before packing the OSA20 in its original packaging:

- Unplug the cord from the 48 V DC connector and wrap the cord connector to avoid scratching the OSA20 cover.
- Unplug the power cord from the AC/DC adapter.

For instructions on returning the OSA20, please contact EXFO (see section Contact Information, p. 4).
10. Troubleshooting

10.1 Handling Errors and Warnings

This section lists all the possible error and warning messages, and how to handle them. Errors are classified by functions and the following table enables you to refer to the appropriate section.

<table>
<thead>
<tr>
<th>Trouble</th>
<th>Error/Warning Code</th>
<th>Possible Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>System error message</td>
<td>-1000 to -1015</td>
<td>See section Dealing with System Error Messages, p. 139</td>
</tr>
<tr>
<td>System crash</td>
<td>n/a</td>
<td>See section Forcing the OSA20 to Shutdown &amp; Restart, p. 143</td>
</tr>
<tr>
<td>File handling error message</td>
<td>-2000</td>
<td>See section Dealing with File Handling Error Messages, p. 141</td>
</tr>
<tr>
<td></td>
<td>-2001</td>
<td></td>
</tr>
<tr>
<td>User calibration error message</td>
<td>-2002</td>
<td>See section Dealing with User Calibration Error Messages, p. 141</td>
</tr>
<tr>
<td></td>
<td>-2003</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-2004</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2000</td>
<td></td>
</tr>
<tr>
<td>Trace analysis warning message</td>
<td>2001</td>
<td>See section Dealing with Trace Analysis Warning Messages, p. 143</td>
</tr>
<tr>
<td>Frozen screen</td>
<td>n/a</td>
<td>See section Forcing the OSA20 to Shutdown &amp; Restart, p. 143</td>
</tr>
</tbody>
</table>

10.1.1 Dealing with System Error Messages

Error Codes
-1000 to -1002
-1004 to -1007
-1010 to -1013
-1015

Description
System error.

Possible Resolution
- Turn the OSA20 off, turn it on again and try to perform the action that caused the error.
- If the error appears again, turn the OSA20 off immediately (see section Turning off the OSA20, p. 39) and contact the EXFO customer support service (see section Contact Information, p. 4).

Error Code
-1003

Description
The system is overheating.
Troubleshooting

Possible Resolution

- The flow of air cannot circulate freely around the OSA20.
  
  -> Remove all objects that could block the ventilation holes (located at the bottom and right panels of the OSA20) or the cooling fan.

- The cooling fan grid is dirty.
  
  -> Clean the fan as explained in section Cleaning the Fan Grid, p. 132.

- The room temperature is higher than 35 °C (95 °F).
  
  -> Turn the OSA20 off (see section Turning off the OSA20, p. 39) and make sure the temperature room is lower than 35°C before turning on the OSA20 again.

- If the previous steps do not solve the problem, turn immediately the OSA20 off (see section Turning off the OSA20, p. 39) and contact the EXFO customer support service (see section Contact Information, p. 4).

Error Codes

-1008 and -1009

Description
System error.

Possible Resolution

Turn the OSA20 off (see section Turning off the OSA20, p. 39) and contact the EXFO customer support service (see section Contact Information, p. 4).

Error Codes

-1014

Description
Fan error.

Possible Resolution

- Turn the OSA20 off and clean the fan as explained in section Cleaning the Fan Grid, p. 132.

- If the error appears again, turn the OSA20 off immediately (see section Turning off the OSA20, p. 39) and contact the EXFO customer support service (see section Contact Information, p. 4).
10.1.2 Dealing with File Handling Error Messages

Error Code -2000

Description

The system cannot save the file.

Possible Resolution

• The device on which you are trying to save is full.
  -> Free space on the device.
• The device is not properly connected to the OSA20.
  -> Verify the connection of the device to the USB connector.

Error Code -2001

Description

The system cannot load the file.

Possible Resolution

• The file you are trying to load is corrupted or in a format that is not supported.
  -> Verify that the file you want to load.
• The device from which you are trying to load is corrupted.
  -> Verify that the device is working properly.

10.1.3 Dealing with User Calibration Error Messages

Error Code -2002

Description

The calibration shift is greater than 5 nm since last factory calibration, the system cannot calibrate the OSA20.

Possible Resolution

• The optical source is not properly connected to the OSA20.
  -> Verify that the jumper is properly connected to the calibration output connector and to the optical input connector, as explained in section Performing a User Calibration, p. 136.
• Fiber ends or optical connectors are dirty.
  -> Clean fiber ends and optical connectors, as described in section Cleaning Optical Connectors, p. 134.
• If optical fibers and connectors are perfectly clean, a factory recalibration may be required, contact the EXFO customer support service (see section Contact Information, p. 4).

Error Code -2003

Description

The input calibration signal power is too low, the system cannot calibrate the OSA20.

Possible Resolution

• The optical source is not properly connected to the OSA20.
Troubleshooting

-> Verify that the jumper is properly connected to the calibration output connector and to the optical input connector, as explained in section Performing a User Calibration, p. 136.

- The optical connectors are dirty.
  -> Clean the calibration output connector, the optical input connector (as explained in section Cleaning Optical Connectors, p. 134), and connectors of the jumper.

- If the previous steps do not solve the problem, contact the EXFO customer support service (see section Contact Information, p. 4).

Error Code -2004

Description
The calibration procedure has exceeded the allowed period of time.

Possible Resolution
- Turn the OSA20 off, turn it on again and try to perform the calibration procedure as explained in section Performing a User Calibration, p. 136.
- If the error appears again, turn the OSA20 off immediately (see section Turning off the OSA20, p. 39) and contact the EXFO customer support service (see section Contact Information, p. 4).

Error Code -2005

Description
The input calibration signal not recognized, the system cannot calibrate the OSA20.

Possible Resolution
- The optical source is not properly connected to the OSA20.
  -> Verify that the jumper is properly connected to the calibration output connector and to the optical input connector, as explained in section Performing a User Calibration, p. 136.
- If the previous steps do not solve the problem, contact the EXFO customer support service (see section Contact Information, p. 4).

Warning Code 2000

Description
The calibration shift since last factory calibration is greater than 1 nm. The power measurement can be less accurate.

Possible Resolution
Contact the EXFO customer support service (see section Contact Information, p. 4) to program the recalibration of the OSA20.
10.1.4 Dealing with Trace Analysis Warning Messages

**Warning Code 2001**

**Description**
No result is displayed because too many peaks have been detected.

**Possible Resolution**
- The analysis is restricted to 1000 peaks. If more than 1000 peaks are detected, no result is displayed.
  - > Modify the analysis parameters.

10.1.5 Forcing the OSA20 to Shutdown & Restart

**Subject**
In case of system crash and frozen screen, you can abruptly turn the OSA20 off as explained in the following procedure.

**Caution**
- Do not stop the OSA20 with this procedure if you can turn it off normally as explained in section *Turning off the OSA20, p. 39*.
- Never carry the OSA20 if it has been abruptly turned off: see section *Carrying the OSA20, p. 137*.

**Procedure**
1. If the touchscreen is frozen: connect a mouse to one of the USB port and try to shutdown the OSA20 as explained in section *Turning off the OSA20, p. 39*.
   If this does not work, follow the rest of these instructions.
2. Press the On/Off button during 4 seconds.
   The system abruptly stops.
3. On the rear panel, set the power switch to O.
4. Wait 10 seconds and set the power switch back to I.
5. Restart the OSA20 as explained in section *Accessing the OSA20 Home Window, p. 31*. 
10.2  Using Remote Assistance Tools

10.2.1  Performing a Self-test

Subject
Performing a self-test enables you to detect possible errors on the system, and may be used for remote assistance from the EXFO customer support service.

Procedure
1. In the OSA20 home window, touch the **System** button.
2. Touch the **More** button to access the system additional information screen.
3. Launch the system self-test by touching the **Self-test** button and wait for its execution.
   The result of the test is displayed on screen.

10.2.2  Sending Debug Data to EXFO Support Service

Subject
Saving debug data and sending it to the EXFO customer support service can be useful for remote assistance.

Procedure
1. In the OSA20 home window, touch the **System** button.
   If an error occurs at startup and you cannot access the **System** menu, the **Save Debug Data** button is also available in the failed startup window,
2. Touch the **More** button to access the system additional information screen.
3. Connect a USB key on one of the available USB ports on the front panel (see section *Front Panel, p. 16*).
4. Touch the **Save Debug Data** button.
5. Enter a name for the .zip file and save it on the USB key.
6. Send the saved file to the EXFO customer support service (for contact details, see section *Contact Information, p. 4*).
Certification and Compliance

Electromagnetic Compatibility

Canada and USA Electromagnetic Interference Regulatory Statement
Electronic test and measurement equipment is exempt from FCC part 15, subpart B compliance in the United States of America and from ICES-003 compliance in Canada. However, EXFO Inc. makes reasonable efforts to ensure compliance to the applicable standards.

The limits set by these standards are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the user guide, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Modifications not expressly approved by the manufacturer could void the user’s authority to operate the equipment.

European Electromagnetic Compatibility Regulatory Statement
Warning: This is a class A product. In a domestic environment, this product may cause radio interference in which case the user may be required to take adequate measures.

European Declaration of Conformity
The European Declaration of Conformity is available at www.EXFO.com/en/resources/legal-documentation

Recycling and Disposal

This symbol on the product means that you should recycle or dispose of your product (including electric and electronic accessories) properly, in accordance with local regulations. Do not dispose of it in ordinary garbage receptacles.

For complete recycling/disposal procedures and contact information, visit the EXFO website at www.EXFO.com/recycle.
China Table of Toxic and Hazardous Substances

CHINESE REGULATION ON RESTRICTION OF HAZARDOUS SUBSTANCES (RoHS)

NAMES AND CONTENTS OF THE TOXIC OR HAZARDOUS SUBSTANCES OR ELEMENTS CONTAINED IN THIS EXFO PRODUCT

包含在本 EXFO 产品中的有毒有害物质或元素的名称及含量

<table>
<thead>
<tr>
<th>Part Name</th>
<th>Lead (Pb)</th>
<th>Mercury (Hg)</th>
<th>Cadmium (Cd)</th>
<th>Hexavalent Chromium (Cr(VI))</th>
<th>Polybrominated biphenyls (PBB)</th>
<th>Polybrominated diphenyl ethers (PBDE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enclosure</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Electronic and electrical sub-assembly</td>
<td>X</td>
<td>O</td>
<td>X</td>
<td>O</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Optical sub-assembly</td>
<td>X</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Mechanical sub-assembly</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

Note:

This table is prepared in accordance with the provisions of SJ/T 11364.

O: Indicates that said hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement of GB/T 26572.

X: Indicates that said hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement of GB/T 26572. Due to the limitations in current technologies, parts with the "X" mark cannot eliminate hazardous substances.

a. If applicable.

MARKING REQUIREMENTS

<table>
<thead>
<tr>
<th>Product</th>
<th>Environmental protection uses period (years)</th>
<th>Logo</th>
</tr>
</thead>
<tbody>
<tr>
<td>This EXFO product</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Battery</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

a. If applicable.
Table of Figures

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 1: Front Panel</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Figure 2: Left-side panel – Cooling Fan</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Figure 3: Right-side panel – Connectors</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>Figure 4: Rear Panel</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>Figure 5: Air Flow</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>Figure 6: Retractable Legs</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>Figure 7: Rear Panel – 48 V connector</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>Figure 8: OSA20 – Home Window</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>Figure 9: OSA20 Settings</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>Figure 10: RLT Mode – Typical Use</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>Figure 11: Analysis Mode Window</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>Figure 12: Scan Commands</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>Figure 13: Trace Commands</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td>Figure 14: Trace Saving</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>Figure 15: Marker Positioning</td>
<td>57</td>
<td></td>
</tr>
<tr>
<td>Figure 16: Analysis Menu</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>Figure 17: Analysis Results – Example window (BBS Analysis Mode)</td>
<td>62</td>
<td></td>
</tr>
<tr>
<td>Figure 18: Analysis Results – Example window (WDM Analysis Mode)</td>
<td>63</td>
<td></td>
</tr>
<tr>
<td>Figure 19: WDM Analysis Mode – PT Search</td>
<td>64</td>
<td></td>
</tr>
<tr>
<td>Figure 20: PT Search</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>Figure 21: WDM Display Mode: Grid</td>
<td>69</td>
<td></td>
</tr>
<tr>
<td>Figure 22: WDM Display Mode: Per Channel</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>Figure 23: Threshold Algorithm</td>
<td>73</td>
<td></td>
</tr>
<tr>
<td>Figure 24: Envelop Algorithm</td>
<td>74</td>
<td></td>
</tr>
<tr>
<td>Figure 25: RMS Algorithm</td>
<td>74</td>
<td></td>
</tr>
<tr>
<td>Figure 26: Gaussian Algorithm</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>Figure 27: Threshold Algorithm (BBS Analysis Mode)</td>
<td>77</td>
<td></td>
</tr>
<tr>
<td>Figure 28: RMS Algorithm (BBS Analysis Mode)</td>
<td>78</td>
<td></td>
</tr>
<tr>
<td>Figure 29: Gaussian Algorithm (BBS Analysis Mode)</td>
<td>78</td>
<td></td>
</tr>
<tr>
<td>Figure 30: Notch Width – Notch Selection</td>
<td>86</td>
<td></td>
</tr>
<tr>
<td>Figure 31: Notch Width – Width Reference</td>
<td>86</td>
<td></td>
</tr>
<tr>
<td>Figure 32: SMSR Analysis</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>Figure 33: OSNR Analysis</td>
<td>93</td>
<td></td>
</tr>
<tr>
<td>Figure 34: OSNR Analysis – On-Off Method</td>
<td>94</td>
<td></td>
</tr>
<tr>
<td>Figure 35: OSNR Parameters</td>
<td>95</td>
<td></td>
</tr>
<tr>
<td>Figure 36: Ripple Results</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Figure 37: Gain &amp; NF Results</td>
<td>107</td>
<td></td>
</tr>
<tr>
<td>Figure 38: Pass Band Test – In Reference Selection</td>
<td>109</td>
<td></td>
</tr>
<tr>
<td>Figure 39: Pass Band Test – Out Reference Selection</td>
<td>110</td>
<td></td>
</tr>
<tr>
<td>Figure 40: Pass Band Test – Averaging Range: Fixed Range</td>
<td>110</td>
<td></td>
</tr>
<tr>
<td>Figure 41: Pass Band Test – Averaging Range: % Bandwidth 1</td>
<td>111</td>
<td></td>
</tr>
<tr>
<td>Figure 42: Pass Band Test – Averaging Range: PT Detection</td>
<td>111</td>
<td></td>
</tr>
<tr>
<td>Figure 43: Roll off calculation – Transition In Band</td>
<td>112</td>
<td></td>
</tr>
<tr>
<td>Figure 44: Roll off calculation – Transition Out Band</td>
<td>112</td>
<td></td>
</tr>
<tr>
<td>Figure 45: Stop Band Test – In Reference Selection</td>
<td>114</td>
<td></td>
</tr>
<tr>
<td>Figure 46: Stop Band Test – Out Reference Selection</td>
<td>115</td>
<td></td>
</tr>
<tr>
<td>Figure 47: Stop Band Test – Averaging Range: Fixed Range</td>
<td>115</td>
<td></td>
</tr>
</tbody>
</table>
Table of Figures

Figure 48: Stop Band Test – Averaging Range: % Bandwidth 1 ..................................................................... 116
Figure 49: Stop Band Test – Averaging Range: PT Detection ........................................................................ 116
Figure 50: Roll off calculation – Transition In Band ...................................................................................... 117
Figure 51: Roll off calculation – Transition Out Band .................................................................................... 117
Figure 52: PCT Analysis – Example of Mask Traces ...................................................................................... 119
Figure 53: MSK HI Menu ........................................................................................................................... 120
Figure 54: OSA20 Remote Parameters .......................................................................................................... 126
Figure 55: Optical Connectors (FC type) – Cleaning .................................................................................... 134