About This Manual

Subject
This document explains how to operate the XTM-50 optical tunable filter. It also explains how to perform basic maintenance operations.

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

Date
28 June 2018

Manual Reference
XTM-50_UM_2.0v1.1

Typographical Conventions

- **bold**: Identifies graphical interface objects such as menu names, labels, buttons and icons.
- **italic**: Identifies references to other sections or other guides.
- **monospace**: Identifies portions of program codes, command lines, or messages displayed in command windows.
- **IMPORTANT**: Identifies important information to which you must pay particular attention.

Symbols

- **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>FWHM</td>
<td>Full Width Half Maximum</td>
</tr>
</tbody>
</table>

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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.
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1. Product Presentation

The XTM-50 is a reliable optical tunable filter that features wavelength and bandwidth tuning. The large wavelength range, the narrow FWHM and the flat-top shape ensure a clean extraction of the optical signal. It is designed for closely-spaced channel selection and extraction in DWDM applications.

The XTM-50 is based on the use of a reflection diffraction grating mounted in a Littman-Metcalf configuration.

When an optical signal is detected at the XTM-50 input port, the input wave is directed towards the output port after passing through the XTM-50 monochromator.

1.1 Technical Specifications

The following table lists the technical specifications of all the XTM-50 models.

<table>
<thead>
<tr>
<th>Optical Characteristics</th>
<th>Standard</th>
<th>Ultrafine</th>
<th>O-band</th>
<th>Wide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wavelength range</td>
<td>1450–1650 nm</td>
<td>1480–1620 nm</td>
<td>1260–1360 nm</td>
<td>1525–1610 nm</td>
</tr>
<tr>
<td>Wavelength resolution</td>
<td>5 pm*2</td>
<td>5 pm*2</td>
<td>5 pm*2</td>
<td>5 pm*2</td>
</tr>
<tr>
<td>Minimum bandwidth (FWHM)</td>
<td>50 pm (6.25 GHz)</td>
<td>32 pm (4 GHz)</td>
<td>50 pm (8 GHz)</td>
<td>50 pm (6.25 GHz)</td>
</tr>
<tr>
<td>Maximum bandwidth (FWHM)</td>
<td>950 pm (120 GHz)</td>
<td>650 pm (80 GHz)</td>
<td>900 pm (160 GHz)</td>
<td>5000 pm (625 GHz)</td>
</tr>
<tr>
<td>Bandwidth resolution</td>
<td>1 pm</td>
<td>1 pm</td>
<td>1 pm</td>
<td>0.3 % of FWHM typ.</td>
</tr>
<tr>
<td>Filter edge gradient</td>
<td>500 dB/nm typical*3</td>
<td>800 dB/nm typical</td>
<td>500 dB/nm typical*3</td>
<td>500 dB/nm typical*4</td>
</tr>
<tr>
<td>Insertion loss</td>
<td>5 dB (4.5 dB typical)*5,6</td>
<td>5 dB (4.0 dB typical)*6,7</td>
<td>5 dB (4.5 dB typical)*6,8</td>
<td>5 dB (4.5 dB typical)*9,10</td>
</tr>
<tr>
<td>Flatness</td>
<td>0.2 dB*11</td>
<td>0.2 dB*12</td>
<td>0.3 dB*11,13</td>
<td>0.2 dB*14</td>
</tr>
<tr>
<td>Polarization dependent loss</td>
<td>±0.2 dB*5</td>
<td>±0.2 dB*7</td>
<td>±0.2 dB*8</td>
<td>±0.2 dB*9</td>
</tr>
<tr>
<td>Out-of-band suppression (crosstalk)</td>
<td>40 dB (60 dB typical)*15</td>
<td>40 dB (50 dB typical)*15</td>
<td>40 dB (60 dB typical)*15</td>
<td>40 dB (45 dB typical)*15</td>
</tr>
</tbody>
</table>

Interface

- Optical fiber type: SMF or PMF
- Connector type: FC/PC or FC/APC

Operating Conditions

- Maximum optical input power: 30 dBm
- Temperature range: 15° to 35°C, indoor use only
- Storage Temperature: -20°C to 60°C
- Maximum Relative Humidity: 80 % for temperatures up to 31°C decreasing linearly to 50 % relative humidity at 40°C
- Altitude: 2000 m (maximum operating)
1.2 Product Overview

Handle

The handle bar enables you to:

- Carry the XTM-50, if positioned in front of the actuators.
- Tilt the XTM-50 for convenient purpose, if positioned below the unit: see section Unpacking and Installing the XTM-50, p. 11.

The two buttons located at both ends of the handle enable you to rotate it forward or backward.
Micrometer Actuators
Two high resolution micrometer actuators enable you to perform wavelength and bandwidth tuning.
The screw located on top of the actuators enable you to lock the actuator at the wanted setting.
- The bandwidth actuator is composed of two graduated scales:
  - On the sleeve: 13 mm stroke with 0.5 mm graduation interval.
  - On the thimble (rotary part): 250 μm by turn, with 5 μm graduation interval.
- The wavelength actuator includes coarse and fine position adjustments, with four graduated scales:
  - Coarse adjustment:
    - On the sleeve: 13 mm stroke with 0.5 mm graduation interval.
    - On the thimble (rotary part): 0.5 mm by turn, with 0.01 mm graduation interval.
  - Fine adjustment:
    - On the sleeve: 200 μm stroke with 25 μm graduation interval.
    - On the thimble: 25 μm by turn, with 0.5 μm graduation interval.

For more details on how to adjust wavelength and FWHM, see section Setting the Wavelength/Frequency and FWHM Values, p. 13.

Optical Connectors
The two following optical connectors, protected by a dust cap, are located on the front panel:
- Input: channel filter input port.
- Output: channel filter output port.

The two optical connectors are mounted on a drawer, which enables you to access the internal optical connectors for cleaning (see section Cleaning Optical Connectors, p. 19).

Retractable Legs
The retractable legs located underneath the unit enable you to tilt the XTM-50 upward for convenient purpose, so that it stands on both front legs and the rear feet (see section Unpacking and Installing the XTM-50, p. 11).

Labels

<table>
<thead>
<tr>
<th>Label</th>
<th>Description</th>
</tr>
</thead>
</table>
| ![Identification of the Product](image) | Identification of the Product
Indicates serial number, model, options (if any), CE marking (see section Certification and Compliance, p. 27) and date of manufacture. |
| ![Warranty Seal](image) | Warranty Seal
The XTM-50 cover must not be open, otherwise the warranty is not valid anymore. |
2. Installing and Connecting the XTM-50

2.1 Unpacking and Installing the XTM-50

Subject
The XTM-50 is a bench-top instrument designed for indoor use only, and is not dedicated to wet locations. It is designed for use either in the horizontal or tilted position. You can also place the handle in front of the two actuators to carry the unit.

Before Starting
To ensure proper environment conditions:
- Do not expose the XTM-50 to rain or excessive moisture.
- Do not install the XTM-50 near flammable gases or fumes.

Procedure
1. Open the package with care and remove the protective foam.
   **IMPORTANT** When unpacking, handle the device with care and do not damage the original shipping container in case the XTM-50 needs to be returned to EXFO.
2. Pull out the XTM-50 vertically from its packaging.
3. Set the XTM-50 on a flat stable surface free of excessive vibration.
4. Place the XTM-50 in the wanted operating position as illustrated in Figure 2, p. 11.
   To tilt the XTM-50 upward, do one of the following:
   - Deploy the two retractable legs located underneath it.
   - Rotate the handle bar to place it below the unit by pressing simultaneously the two handle buttons located at both sides of the handle.

Figure 2: Possible Operating Positions
2.2 Connecting an Optical Source to the XTM-50

Subject

- Make sure you use the appropriate connector type, corresponding to the one mounted on your XTM-50 (see section Technical Specifications, p. 7 for available models).
- Make sure optical connectors are perfectly clean. It is essential to achieve optimum system performance (see section Cleaning Optical Connectors, p. 19).
- To prevent premature failure of the XTM-50 optical connectors due to frequent connections, always keep a fiber-optic jumper cable connected to the XTM-50 optical port while you use the jumper’s free end to connect to other devices.

Procedure

- Remove the protective cap from the **IN** and **OUT** connectors and connect the appropriate jumper corresponding to the connector type mounted on your product, as indicated next to the connectors (see Figure 1, p. 8).

  **IMPORTANT** Keep protective caps on optical connectors when not in use.
3. Setting the Wavelength/Frequency and FWHM Values

3.1 Adjusting the Central Wavelength

The wavelength actuator enables you to adjust the wavelength with coarse and fine adjustment positions.

- On the coarse adjustment screw, the scale on the thimble is graduated from 0 to 500. One complete revolution of the thimble reaches one graduated marking on the sleeve.
  - On the sleeve: 13 mm stroke with 0.5 mm graduation interval.
  - On the thimble (rotary part): 0.5 mm by turn, with 0.01 mm graduation interval.

- On the fine adjustment screw, the scale on the thimble is graduated from 0 to 30. One complete revolution of the thimble reaches one graduated marking on the sleeve.
  - On the sleeve: 200 μm stroke with 25 μm graduation interval.
  - On the thimble: 25 μm by turn, with 0.5 μm graduation interval.

**IMPORTANT** When using thimbles, account for any backlash in the system: always use the thimble in the same rotating direction.

*Fine adjustment, thimble scale*
1 scale graduation corresponds to:
- XTM-50 Standard: 11 pm (typ.)
- XTM-50 Ultrafine: 6.5 pm (typ.)
- XTM-50 O-band: 12 pm (typ.)
- XTM-50 Wide: 11 pm (typ.)

*Fine adjustment, sleeve scale*
1 scale graduation corresponds to:
- XTM-50 Standard: 550 pm (typ.)
- XTM-50 Ultrafine: 325 pm (typ.)
- XTM-50 O-band: 600 pm (typ.)
- XTM-50 Wide: 550 pm (typ.)

*Coarse adjustment, thimble scale*
1 scale graduation corresponds to:
- XTM-50 Standard: 220 pm (typ.)
- XTM-50 Ultrafine: 130 pm (typ.)
- XTM-50 O-band: 240 pm (typ.)
- XTM-50 Wide: 220 pm (typ.)

*Coarse adjustment, sleeve scale*
1 scale graduation corresponds to:
- XTM-50 Standard: 11 nm (typ.)
- XTM-50 Ultrafine: 6.5 nm (typ.)
- XTM-50 O-band: 12 nm (typ.)
- XTM-50 Wide: 11 nm (typ.)

*Figure 3: Wavelength-tuning Actuator – Scale values*
Procedure

1. Move the **Wavelength tuning** coarse thimble as follows:
   - To increase the central wavelength from lower wavelength to higher wavelengths, turn the thimble clockwise (from high to low values).
   - To decrease the central wavelength from higher wavelength to lower wavelengths, turn the thimble counterclockwise (from low to high values).

2. To finely adjust the central wavelength value, move the **Wavelength tuning** fine thimble as follows:
   - To increase the central wavelength from lower wavelength to higher wavelengths, turn the thimble clockwise (from high to low values).
   - To decrease the central wavelength from higher wavelength to lower wavelengths, turn the thimble counterclockwise (from low to high values).

3. Tighten the lock screw (see Figure 1, p. 8) to lock the central wavelength setting.

4. If you had previously adjusted the FWHM, re-adjust it as it may have been slightly altered by the central wavelength change.

**IMPORTANT**

Modifying the FWHM can slightly alter the central wavelength setting. So you may need to re-adjust the central wavelength after FWHM change.
### 3.2 Adjusting the FWHM

**Subject**

The bandwidth actuator is graduated from 0 to 250. Two complete revolution of the thimble reach one graduated marking on the sleeve.

- On the sleeve: 13 mm stroke with 0.5 mm graduation interval.
- On the thimble (rotary part): 250 μm by turn, with 5 μm graduation interval.

**Caution**

To avoid damaging your XTM-50, do not turn the bandwidth actuator beyond the 0 graduation marked on the sleeve.

**Sleeve scale**

1 scale graduation corresponds to:

- XTM-50 Standard: 105 pm (typ.)
- XTM-50 Ultrafine: 68 pm (typ.)
- XTM-50 O-band: 96 pm (typ.)
- XTM-50 Wide: not linear, see Figure 6, p. 15

**Thimble scale**

1 scale graduation corresponds to:

- XTM-50 Standard: 0.21 pm (typ.)
- XTM-50 Ultrafine: 0.14 pm (typ.)
- XTM-50 O-band: 0.19 pm (typ.)
- XTM-50 Wide: not linear, see Figure 6, p. 15

**Figure 5:** Bandwidth-tuning Actuator – Scale values

**Figure 6:** Bandwidth vs Actuator Graduations (Typical values) – XTM-50 Wide only

**IMPORTANT**

Modifying the central wavelength can slightly alter the FWHM. So you may need to re-adjust the FWHM after central wavelength change.
Procedure

1. Move the **Bandwidth tuning** actuator as follows:
   - To increase the FWHM, turn the actuator clockwise (from high to low values)
   - To decrease the FWHM, turn the actuator counterclockwise (from low to high values)

   **Caution**
   To avoid damaging your XTM-50, do not turn the bandwidth actuator beyond the 0 graduation marked on the sleeve.

2. Tighten the lock screw (see *Figure 1, p. 8*) to lock the FWHM setting.

3. If you had previously adjusted the central wavelength, re-adjust it as it may have been slightly altered by the FWHM change.
3.3 Reaching a Position on the Bandwidth or Wavelength Tuning Actuator

Subject
The Acceptance Test Report delivered with your instrument indicates the actuator position (in mm) of the central wavelength and FWHM on your XTM-50. This section explains how to adjust the actuators to reach the wanted position.

Procedures

Reaching a Position on the Bandwidth Tuning Actuator
The bandwidth actuator is composed of two graduated scales:
• On the sleeve: 13 mm stroke with 0.5 mm graduation interval.
• On the thimble (rotary part): 250 $\mu$m by turn, with 5 $\mu$m graduation interval.
To reach a graduated position on the actuator, you must add both scale values.

Example
To reach the value of 7.275 mm, proceed as follows:
1. Align value 0 of the thimble to value 7 of the scale on the sleeve.
2. Make a full counterclockwise revolution of the thimble to add 0.250 mm.
3. Turn the thimble counterclockwise to add 0.005 mm.

Reaching a Position on the Wavelength Tuning Actuator
The wavelength actuator enables coarse and fine adjustments.
• Coarse adjustment:
  • On the sleeve: 13 mm stroke with 0.5 mm graduation interval.
  • On the thimble (rotary part): 0.5 mm by turn, with 0.01 mm graduation interval.
• Fine adjustment:
  • On the sleeve: 200 $\mu$m stroke with 25 $\mu$m graduation interval.
  • On the thimble: 25 $\mu$m by turn, with 0.5 $\mu$m graduation interval.
To reach a graduated position on the actuator, you must add all four scale values.

Example
To reach the value of 8.852 mm you can use different combinations; the following procedure explains the "8.7+0.152" combination:
1. On the fine adjustment screw, align value 0 of the rotary thimble to value 100 of the sleeve scale.
2. On the coarse screw:
   a. Align value 0 of the thimble to value 8.5 of the sleeve scale.
   b. Turn the thimble counterclockwise to reach value 200, which adds 0.200 mm.
3. On the fine screw:
   a. Align value 0 of the thimble to value 150 of the sleeve scale.
   b. Turn the thimble counterclockwise to add 4 graduations on the thimble scale (which is 0.002 mm).
4. Performing Basic Maintenance Operations

User maintenance of the XTM-50 system is limited to basic maintenance tasks that do not require removing the instrument case-cover or accessing any internal component of the instrument.

Never remove the protective cover of the chassis to perform servicing or maintenance operations to the XTM-50 internal parts and optical components.

You must refer to EXFO service representative (see section Contact Information, p. 4).

4.1 Cleaning Optical Connectors

Subject

To optimize the performance of the instrument 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 XTM-50 optical connectors are mounted on a drawer 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

Use only high quality cleaning supplies that are non-abrasive and leave no residue.

Procedure

1. On the front panel, make sure the protective caps of the connectors are in place.
2. On the front panel, use your fingers to unscrew the two screws of the connector drawer.
   Once unscrewed from the front panel, the two screws stay attached to the drawer.
3. Gently pull the drawer out of the front panel (no more than 70 mm) so that fiber ends are made visible, as illustrated in the following figure.

   Figure 8: Optical Connectors – Cleaning
4. At the rear of the drawer plate, remove one connector end from the plate:

5. Gently clean the connector end, with the following instructions:
   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).

6. Replace the connector end at the rear of the drawer plate: make sure the key of the connector is mated with that of the adapter and screw it back.

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

8. Push the connector drawer back on the front panel and screw the drawer back in its location, making sure no fiber is trapped between the front panel and the drawer plate.

### 4.2 Cleaning the Cover of the XTM-50

**Subject**
If the external cover of the XTM-50 becomes dirty or dusty, clean it by following the instruction below.

Do not use chemically active or abrasive materials to clean the XTM-50.

**Before Starting**
Material needed: lint free cleaning cloth

**Procedure**
- Gently swipe dirt and dust on the external cover of the XTM-50, without applying excessive force onto it.
4.3 Packaging for Shipment

Subject

If you need to return the XTM-50 to EXFO for servicing or calibration, use the original packaging.
For instructions on returning the XTM-50, please contact EXFO (see section Contact Information, p. 4).

Procedure

1. Place the bandwidth actuator on the 0 graduation marked on the sleeve and tighten the lock screw.
2. To avoid unwanted shock on the positioning mechanism, make sure the handle is positioned in front of the micrometer screws as illustrated in the following picture.

![Figure 9: Handle Position for Shipment](image)

3. Place the XTM-50 in the original package for transportation.
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