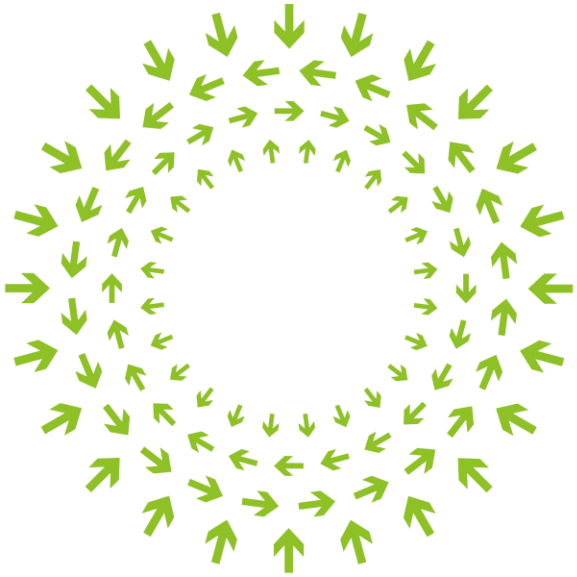

OPEN Compute Project

# <Tencent Optical Platform Chassis(OPC-4) Specification>

<Revision 1.0>

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# 1. Overview

## 1.1 Product Overview

This section provides general information about the hardware features, product concepts, and applications of OPC-4 devices, including: OPC-4 equipment technical specifications, functional support features, DCN and configuration deployment related information.

OPC series products are open optical layer systems based on Tencent open architecture. The OPC-4 is a general optical layer product which based on the open optical network solution of general-purpose and low cost designed on the basis of open architecture. Its advantages include simple structure, powerful functionality, high-level of integration, quick and easy deployment, and simple operation and maintenance. Various requirements of Data Center Interconnect (DCI) application has been optimized, and different usage scenarios has been covered.

OPC-4 is designed to be compact, meeting electrical requirements for deployment in IDCs, and fulfills deployment requirements in different installation scenarios. Its flexible rack design enables deployment in a variety of scenarios and facilitates functional requirements, all in a small chassis form factor. It is an open optical-layer solution that is ahead of the industry.

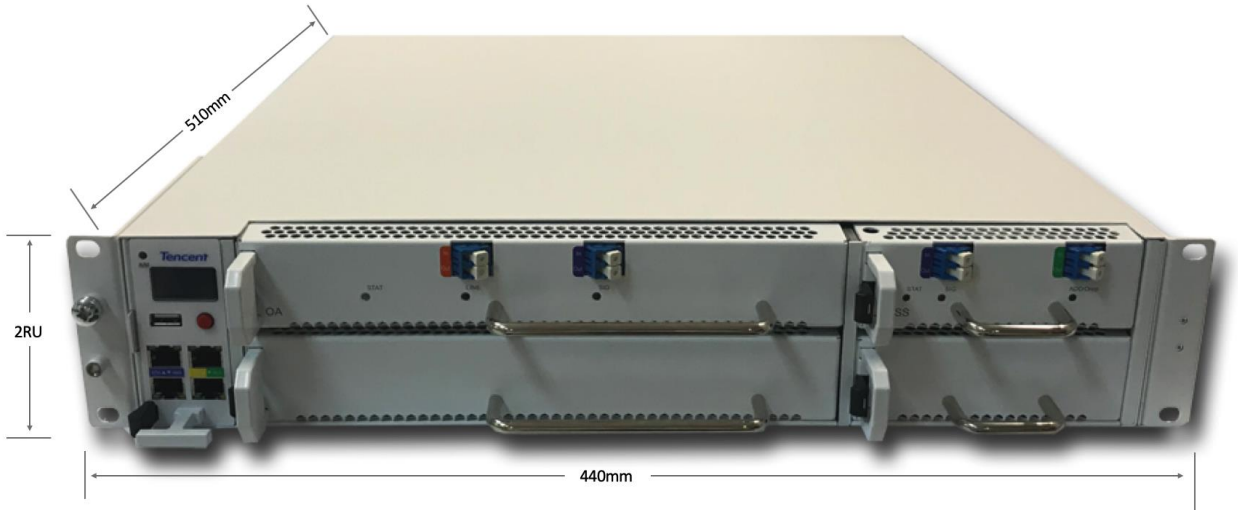


Figure 1-1 *OPC-4 3D Image*

*Tip: As illustrated in Figure 1-1 OPC-4 3D Image, the width of OPC-4 is 483mm (including brackets) and depth of 510mm. It can be installed in a standard 19-inch IDC server cabinet and supports installation in a standard 19-inch cabinet with the depth of 600mm.*

## 1.2 System Overview

Key features of the OPC-4 are as follows:

- Compact size, easy to deploy, suitable for a variety of scenarios such as data centers
- Adopt anti-misplugging/unplugging design on the port label to reduce service loss caused by mishandling.
- Equipped with "on-site confirmation/feedback button", to facilitate feedback confirmation between on-

site operator and NOC operation personnel, reducing the possibility of mishandling.

- Sub-chassis, sub-cards, power supply and fan units are equipped with LED indicators. NOC operator can guide the on-site operator to identify and confirm the corresponding components through prompt status presets.
- The sub-chassis has information prompt function, making it easy for on-site operator to confirm and identify sub-chassis information and status.
- Flexible choice of power supplies, supports AC 110~230v/HDC 230v, DC -48V power system
- Supports 50GHz interval 96-wave system/75Ghz interval 64-wave system/100G interval 48-wave system, and Flex Grid (50GHz +/- 6.25GHz).
- Flexible management network access scheme and DCN scheme.
- 1GE OSC Interactive bandwidth.
- Supports Netconf protocol based control scheme & gRPC protocol for performance data reporting, and Tacacs+ authentication mechanism.
- Supports WSS/OXC-based CDC scenarios. Supported in R2.0 or later

## 1.3 Application Scenario

The OPC series is oriented towards data centers interconnection (DCI) optical network requirements and fully supports the following application scenarios (The Four scenarios below can fulfill all of point to point network requirements. Supports for multi-dimensional, multi-directional application, CDC add/drop are planned in version release 2.0):

**i. Multiplex section model-1, a point-to-point model with wavelength equalization function as shown in Figure 1-2 Multiplex section model-1.**

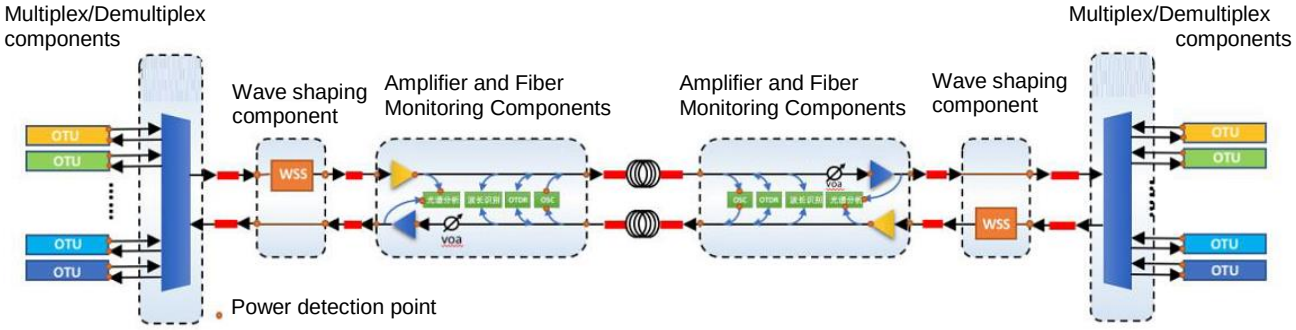


Figure 1-2 *Multiplex section model-1*

*Tip: As shown in Figure 1-2 Multiplex section model-1 diagram, because the system design utilizes passive multiplex/demultiplex devices, the problem of power flatness is taken into account , after OTU multiplex, power flatness is adjusted by the WSS card (multiplexing wave shaping unit), then the signal is go to the amplifier card for power gain and output.*

**ii. Multiplex section model-2 (low-cost solution), point-to-point model without wavelength equalization, as shown in Figure 1-3 Multiplex section model -2**

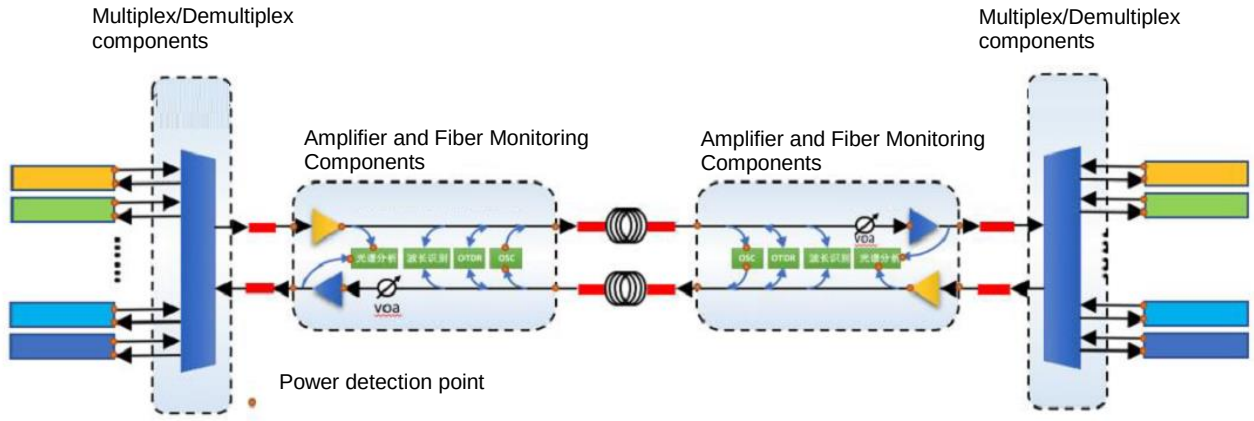


Figure 1-3 *Multiplex section model-2*

*Tip: As shown in Figure 1-3, the multiplex section model-2 diagram should be used for metro system with low fiber loss, where needs low cost requirements, such as IP Optical Convergence solutions. adopting a model where no flatness control is applied and the signal is directly multiplexed and amplified for output.*

**iii. Multiplex section model-3, OMSP model with wavelength equalization, as shown in Figure 1-4 Multiplex section model-2**

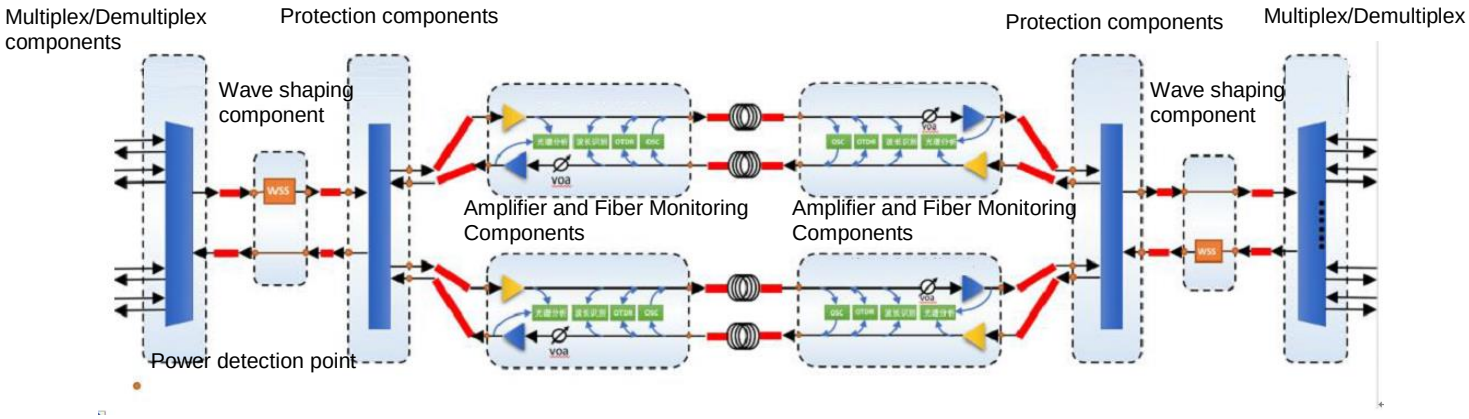


Figure 1-4 *Multiplex section model-3*

*Tip: As shown in Figure 1-4, the multiplex section model-3 diagram adds OMSP protection to a model-1 base.*

**iv. Multiplex section model IV, OMSP model without wavelength equalization function, as shown in Figure 1-4 Multiplex Section Model-2.**

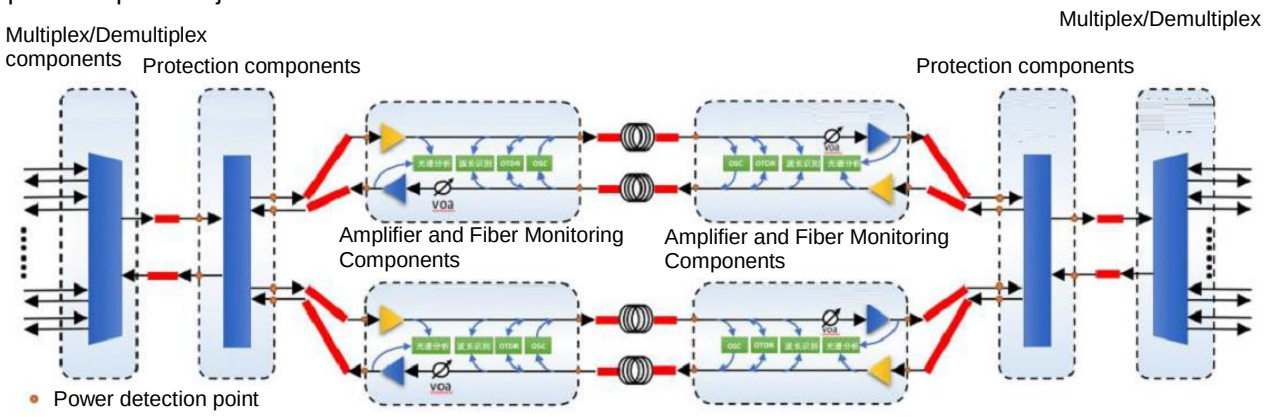


Figure 1-5 *Multiplex section model-4*

*Tip: As shown in Figure 1-5, the multiplex section model-4 diagram adds OMSP protection to a model-1 base.*

New Architecture function & features in Release 2.0 :

***Architecture function:***

*Support fully mesh optical networking.*

*Support Degree 8+ ROADM configurations.*

*Support long haul transmission requirement.*

*CDC add/drop with OXC solution prototype design.*

***New Features:***

*Millisecond level telemetry will be support.*

*New low noise amplifier design.*

*New single card for ILA for multi hop scenarios base on the low noise amplifier.*

# 2. Physical specifications

## 2.1 Size and weight specifications

### 2.1.1. OPC-4 Chassis Product Size and Weight

OPC-4 is a 2RU high optical layer service chassis product with 4 service slots and a depth of 480mm. It can be installed in a 19-inch rack with the depth of 600mm.

| Parameter | OPC-4 |
|---|---|
| Size | With brackets 483mm(W)*480mm(D)*88.9mm(H)<br>Inside brackets 465mm(W)*480mm(D)*88.9mm(H)<br>Without brackets 440mm(W)*480mm(D)*88.9mm(H) |
| Weight (including controllers) | 9.06Kg |

Table 2-1 *OPC-4 Specific Dimensions and Weights*

### 2.1.2. OPC-4 Fan and Power Supply Dimensions and Weight

OPC-4 includes 2 power modules (1+1 backup) supporting AC 220v, HDC 230v, and separate DC -48v power supplies; includes 3 fan units (2+1 backup).

| Parameter | OPC-4 |
|---|---|
| AC100~240/HDC230 power supply | 867.2g / 224.9*73.5*40mm |
| DC -48 v power supply | 867.2g / 224.9*73.5*40mm |
| FAN | 618.4g / 230.4*84*85.5mm |

Table 2-2 *Dimensions and Weights of OPC-4 Fan and Power Supply*

### 2.1.3. OPC-4 Service Board Size and Weight

The OPC optical layer system has flexible slot deployments with a total of four service slots. The R1.0 version consists of 2 types of boards, namely OA and WSS (DGE function). The R1.1 version plans to support OP boards and ILA boards. R2.0 plans to support the WSS board's dimension scheduling functions.

| Board name | Physical parameters |
|---|---|
| OA | 2997.8g / 321.31*257.2*40.8mm |
| ILA | |
| OP | 1006g / 321.1*119.3*40.8mm |
| WSS | 1895g / 321.3*119.3*40.8mm |

Table 2-3 *OPC platform board*

## 2.2 Power Specifications

2.2.1. Power requirements and consumption

OPC-4 has two types of PSU power supply unit, one supports AC 100~240v, HDC 230v; Another supports DC -48v. Specific information for power consumption is shown in the following table:

| Parameter | OPC-4 |
|---|---|
| Voltage | Both PSUs support the following power supply voltage specifications<br>Support AC 100~240v/HDC 230v; Support DC-48v |
| Power rating | Single PSU power rating 450w |

Table 2-4 *OPC-4 chassis Voltage and Power Consumption Parameters*

| Unit name | Working power consumption |
|---|---|
| OA | 50w |
| ILA | |
| WSS | 15w |
| OP | 5w |
| FAN | 33w |
| CU | 10w |
| PANEL | 5w |

Table 2-5 *Function board power consumption list*

## 2.3 Operating Environment Requirements

2.3.1. Storage and transportation environment requirements

| Parameter | OPC-4 |
|---|---|
| Temperature requirements | -40 °C ~ +60 °C |
| Vibration requirements | Meets the vibration requirements of GR63 Zone4 |
| Relative humidity | 5% ~ 95% |
| Sunlight Exposure | Avoiding sunlight or short duration ≤ 1120W/m $^2$ |

Table 2-6 *Storage and Transportation Environment Requirements*

2.3.2. Operating environment requirements

| Parameter | OPC-4 |
|---|---|
| Temperature requirements | Short-term -5 °C ~ +45 °C<br>Long-term 0 °C ~ +40 °C |
| Vibration requirements | Meets the vibration requirements of GR63 Zone4 |
| Relative humidity | 5% ~ 95% |
| Sunlight Exposure | Avoid sunlight |

Table 2-7 *Operating Environment Requirements*

## 2.4 System Reliability Indicators

The designed service life of the system should meet requirements for 8 years of continuous operation in IDC room environments and 5 years in non-data center room environments.

## 3. OPC-4 Product information

OPC-4 is an open optical-layer device based on open architecture and features with low learning costs, easy and rapid deployment, and by ingenious design its can be reduce customer's OPEX cost. OTUs with wavelengths that comply with the G.694 and G.692 specifications within the range of 191.30 THz to 196.05 THz and DCO modules can be connected (L band plan support after R 2.0). User-friendly design elements were added to the chassis. The ports are marked with color to prevent from mis-plugging. Multi-colored indicator lights improve correct recognition of ports. The LCD prompt and confirmation/feedback buttons improve communication between the on-site and the NOC. The product is intended to allow on-site operator without experience in the maintenance of WDM equipment to complete on-site maintenance operations under simple telephone or work instructions.

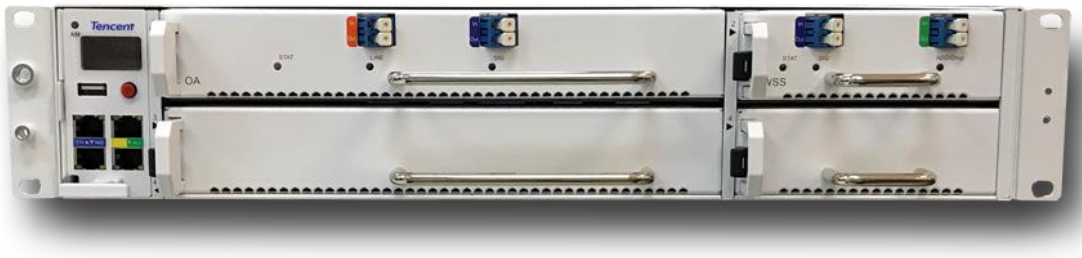


Figure 3-1 *Front view of OPC-4 chassis*

Figure 3-2 *Rear view of the OPC-4 chassis*

The OPC-4 chassis adopts 2RU design to meet future L band or protection scenario, implement one single chassis to fit variety requirement scenario. It can be installed in a standard 19-inch cabinet with the depth of 600mm, supporting AC 100~240v, HVDC 230v and DC-48v power supply. It adopts front air intake rear exhaust heat dissipation design to meet appliance performance requirements in data centers.The chassis is equipped with a total of four optical layer service slots (Our original design about service slots were adopt a uniform size design. Due to some cost factors, current manufacturers use non-uniform slot size designs for their products), 1 Panel slot, 2 PSU power supply slots, 3 Fan slots, and 1 CU controller unit slot. Table 3-1 describes sub-chassis configurable parameter information.

| Unit | Parameter | Usage |
|---|---|---|
| OPC-4 | Description (*Configuration item*) | You can configure the description of this sub-chassis |
| | Active/Maintenance/Disable (*Configuration item*) | Active: The chassis is in active working status, and the PSU & FANs operate normally.<br>Maintenance: The chassis is in the maintenance status and the indicator light is amber blinking as prompt;<br>Disable: The chassis is in sleep status. The PSU only maintains power that is used for quickly waking up chassis. All service boards and slots are powered off. FANs stop working. |
| | ETH/NMS NMS (*Configuration item*) | R1.0 supports IPv4 protocol, configuration management IP address, subnet mask, gateway<br>R2.0 supports IPv6 protocol<br>EHT/NMS interface supports DHCP function<br>Can be used as a cascade application<br>ETH/NMS ports and NMS ports support enable/disable configuration, for the security reason after the accessing the SDN controller the idle port needs to disable by controller<br>The configuration of disable can be activated only through the network management on the OSC. |
| | CIT (*Configuration item*) | This port is enabled by default from factory. Its bit rate can be configured through the controller or local web UI. The bit rate can be set from 9600 to 38400. For the security reason after accessing the SDN controller, this port needs to be disable by SDN controller. |
| | Loopback (*Configuration item*) | R1.0 supports the IPv4 protocol, 32-bit host address, which will be used as the address accessed to chassis |
| | clock (*Configuration item*) | NTP server address and port can be manually entered, but once the controller is connected, it will automatically refresh the NTP server list. The allocation priority is higher than manual input. |
| | Telemetry (*Configuration item*) | Configure Telemetry configuration information |
| | Recovery_local (*Configuration item*) | Enter file path to manually restore the configuration information (USB)<br>Enter file save server and path for manually restoring configuration information, for the security reason after accessing SDN controller USB port needs to disable by controller. |

Table 3-1 *chassis Configurable Parameters (CU)*

# 4. OPC-4 Chassis

## 4.1 Interface & LED

The figure below shows the description of the interfaces and indicators of various service boards of OPC-4.

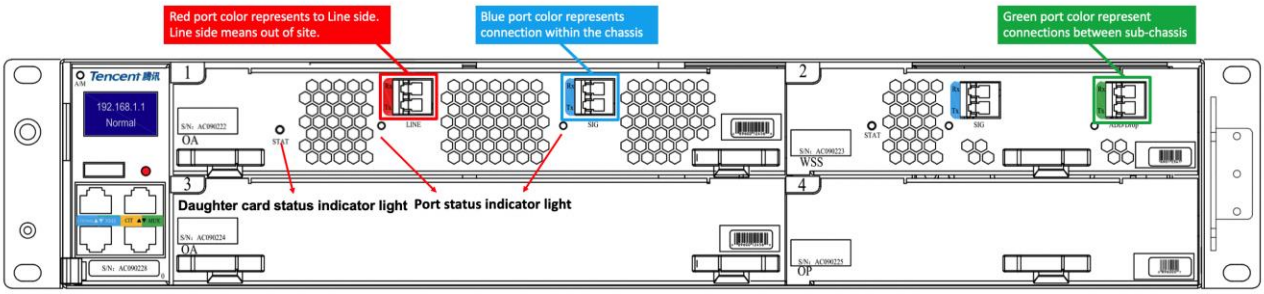


Figure 4-1 *Interface Coloring*

Board ports in the OPC-4 chassis are color-coded according to their different functions, which can help maintenance worker find the corresponding slot and reduce possibility of misplugging/unplugging. As described in Table 4-1, the color coding is as follows:

| Board name | Physical parameters |
|---|---|
| Red | Represent transmission output, this port connects to outbound fiber |
| Blue | Represent link ports within the chassis, interfacing the local board and corresponding ports on other boards within the chassis |
| Green | Represent interface port between this sub-chassis and other sub-chassis |

Table 4-1 *Description of Port Color Rules*

In addition, there are multi-color indicator lights on sub-boards and next to ports showing their different statuses. The status description of the indicators is described in Table 4-2.

| Board name | Physical parameters |
|---|---|
| Green (blinking) | The chassis or board is in the initialization state |
| Green | Board/port is normally status with no alarms. |
| Amber (blinking) | The board/port is in maintenance status to help maintenance worker quickly locate it |
| Amber | The board/port has Major alarm |
| Red | The board/port has Critical alarm |
| Off | Board/port is inactive |

Table 4-2 *Description of Port Color Rules*

## 4.2 Panel

As shown in Figure 4-2, Interface Panel Functions shows that functions of avoiding misoperation, simplifying operating complexity and reducing on-site maintenance cost of OPC product are directly related to the functions of the interface panel.

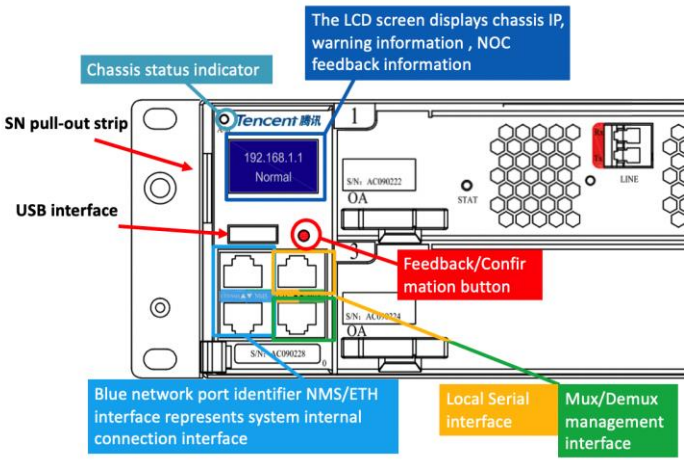


Figure 4-2 *Interface Panel Functions Standard*

The interface panel includes chassis status indicators, LCD information screen, USB data interface, feedback/confirmation button, NMS network management interface, ETH/NMS local webui access interface, CIT serial port, and MUX/DEMUX communication port.

The design of the interface panel is intended to minimize the possibility of misoperations. As we know, The OPC-4 provide the physic connect and carry on huge services by this chassis. Misoperation of optical equipment will cause many services out of service. So we design this panel and function to avoid misoperation as far as possible.

The "LCD screen" and "Feedback/Confirmation button" can help on-site maintenance worker and NOC maintenance worker in confirming changes before the final operation. Especially if there is no mobile network coverage inside the IDC, the final confirmation is made before the interruption of the service operation to prevent misoperation of one optical chassis from affecting several Tbits of services transmitted in that light direction.

As shown in Figure 4-3, each part is labeled with a number, and their functions and usage are described in Table 4-3.

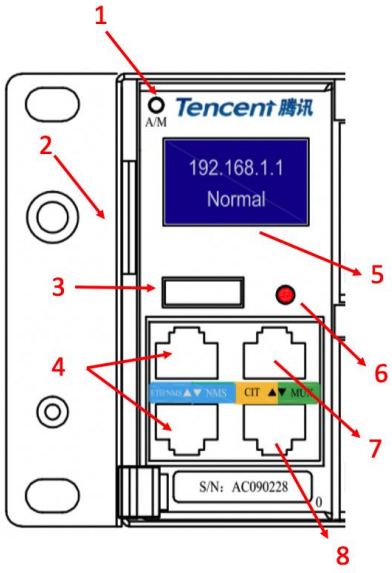


Figure 4-3 *Functions and usage of components in the interface panel*

*Tip: The interface panel can be plugged/unplugged separately. The slot number is 40. The Panel's plugging and unplugging will not cause any service loss. The Panel is only an interface expansion of the CU control unit.*

| Number | Name | Function |
|---|---|---|
| 1 | STAT<br>Indicator light | STAT chassis indicator, Active/Maintenance/Disable<br>Green(blinking):<br>Chassis startup, OS is loading<br>Green:<br>Active, operate normally<br>Amber(blinking):<br>Maintenance, operation and maintenance status, prompting function, facilitating maintenance worker for on-site operation and locating the device;<br>Amber：<br>Major warning on the CPO-4 chassis. Pose certain risks to the service but current services have not been interrupted, including the following events:<br>*Single source power unit or power input/output voltage and current abnormalities;*<br>*Single fan failure;*<br>*Fan is in manual full speed mode;*<br>*Temperature reaches warning range;*<br>*There is a problem with the controller itself;*<br>Red:<br>Critical warning on the CPO-4 chassis. Affect services or cause service interruptions, including the following events:<br>*Two or more fans fail, there is a temperature or a fan failure limit alarm;* |

| | | |
|---|---|---|
| | | *Temperature exceeds allowable working range;*<br>*There is a problem with the controller itself;*<br>Red(blinking):<br>The CPO-4 chassis is in Disable status;<br>The power supply only provides wakeup power;<br>Off:<br>The CPO-4 chassis is not powered, or the Panel is faulty; |
| 2 | SN information pull tab | Asset information and sub-chassis SN information will be recorded in the SN pull tab; |
| 3 | USB port | Provides on-site software upgrades, debug export, file copy usage; |
| 4 | ETH/NMS<br>NMS | Both ports have the same function, but for the convenience of wiring, the default below is a link management network interface. The local login can use this interface and can also provide use of the IP-based forwarding port, i.e., it is used as an extension of the management network port.<br>ETH/NMS: Local IP login and NMS uplink interfaces;<br>NMS: Chassis network management interface, located below for easy wiring |
| 5 | LCD screen | The LCD screen is designed to facilitate the on-site verification of chassis information, locate chassis content, and provide NOC and on-site confirmation information during the operations and maintenance, helping operator view current operating status of the chassis. The LCD screen is off by default. When on-site operator is looking for the chassis, the LCD screen will be lit, and contrast colors will be flashed to facilitate easy locating of the box. What's more, during routine inspections, the screen can be lit up by pressing the confirmation/feedback button. Turning on (for 30 minutes) to check the operating status.<br>The LCD screen content is divided into two lines;<br>The first line shows the chassis IP address;<br>The second line shows the current operating status, which is feedback information after on-site operations are confirmed. |
| 6 | Feedback/Confirmation button | This function key can provide on-site maintenance worker and NOC operation worker with confirmation and return confirmation function. During the routine inspection, user can press the button to light the LCD screen and view device operating status, confirmation, warning information. This function key has the following functions:<br>*On-site operator can use this button to remind NOC operator of the status of the on-site equipment during routine inspection (in the case of no wireless signal coverage in the data center). When the on-site operator operates device to be operated, confirm with the NOC operator through the button to avoid human error; on-site operator completes the troubleshooting process by pressing the button to feedback;* |
| 7 | CIT | CIT is a local maintenance port (serial interface) and provides serial port access to complete debugging or other deployment of the local terminal. The specifications of the serial port are as follows;<br>*Support RS-232 serial interface, support 9600~38400bit rate, 1 stop bit, no need for parity check.* |
| 8 | MUX | The MUX interface is used to connect and manage the passive |

| | | |
|---|---|---|
| | | multiplexing and demultiplexing devices, mainly used for asset management of the passive multiplexing and demultiplexing devices, and operations such as rename and write to the unit by network management. |

Table 4-3 *Component functions and usage of various components of the interface panel*

## 4.3 Fan

As shown in Figure 4-4 rear FAN unit view, the OPC-4 takes into account application requirements in many different environmental locations. The Large 8cm fan units are used to increase the air output, and the improvement of thermal dissipation capability can also reduce the operating noise. The temperature sensor inside the FAN unit can monitor the temperature of the air outlet in a real time manner. The entire machine supports 2+1 FAN backup. That is, thermal dissipation with single point failure still meets the design requirements, and system can continuously operate for 48 hours without abnormality when a single FAN unit fails.

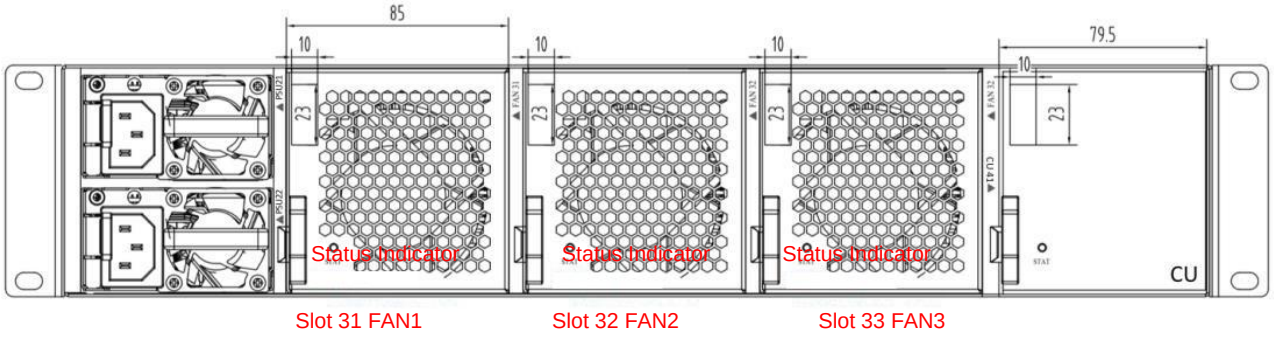


Figure 4-4 *FAN unit layout view*

*Tip: There are 3 FAN slots. In rear view these are slots 31, 32, 33 from left to right.*

The FAN unit supports adjustable speed. The default mode is Auto and can be changed to manual mode. However, the manual mode only forces the fan to run at maximum speed. The FAN unit does not

support Disable configuration, FAN unit will be in working status when OPC-4 sub-box is set to enable.

In system programs, Table 4-4 shows the relevant parameters of the FAN unit.

| Unit | Parameter | Usage |
|---|---|---|
| FAN | STAT<br>Indicator light | STAT indicator<br>Green:<br>Normal operation, normal fan operation, and normal temperature;<br>Amber:<br>Major warning, temperature is too high, fan speed is abnormal, or the fan is in manual mode;<br>Amber(blinking):<br>Represents FAN in maintenance status to facilitate maintenance worker locating it.;<br>Red:<br>Fan failure; |
| | Active/Maintenance<br>(*Configuration item*) | Active: Restores from the Maintenance status to normal operation<br>Maintenance: maintenance status, blinking light for prompt; |
| | Auto/Manual<br>(*Configuration item*) | Auto: Fan speed is adjusted based on temperature automatically, the default mode;<br>Manual: manual maximum speed, fan is set to maximum speed; |

Table 4-4 *FAN unit parameters*

## 4.4 PSU

As shown in Figure 4-5, the rear view of PSU unit view, the OPC-4 chassis has two PSU units that are 1+1 backed up. Each unit can independently power the chassis. There are two types of PSUs, the PSU-AC/HDC450 is an AC/HVDC model and the PSU-DC450 DC-48v model. The PSU adopts compact design to allow interior space to be reserved for function boards. The PSU unit integrates a temperature sensor. When the chassis is disabled, the low power output ensures that the chassis can be waken up and energy consumption can be reduced. For the specific PSU parameter information, please see Table 4-5, PSU Unit Parameters. PSUs support hot swapping without affecting normal services.

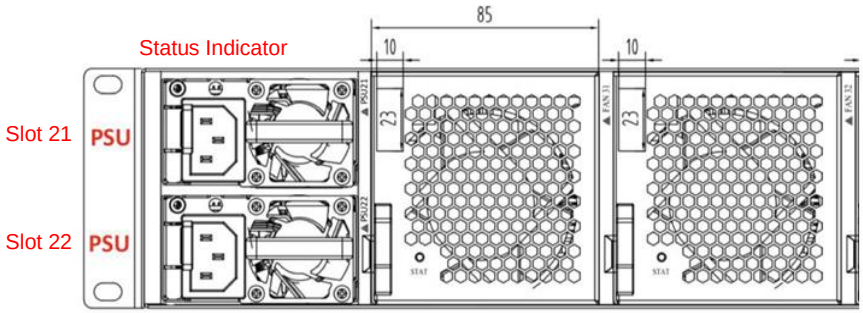


Figure 4-5 *PSU unit layout view*

*Tip: There are 2 PSU slots. In rear view they are slots 21, 22 from top down.*

| Unit | Parameter | Usage |
|---|---|---|
| PSU | STAT<br>Indicator light | Green:<br>Normal operation, PSU is operating normally, and the temperature is normal.<br>Amber:<br>Major warning<br>Amber(blinking):<br>The PSU is in a maintenance status to facilitate maintenance worker for locating<br>Red:<br>Power supply fails or the voltage and current are lower than the operable lower limit. |
| | Active/Maintenance<br>(*Configurable item*) | Active: Restores from the Maintenance status to normal operation<br>Maintenance: maintenance status, flashing light for prompt |
| | Rated power<br>Operating voltage | PSU-AC/HDC450:<br>Rated power 450W, working voltage support 100~240v AC/230v HDC PSU-AC/DC450:<br>Rated power 450w, working voltage support -48v DC |

Table 4-5 *PSU unit parameters*

## 4.5 CU

As shown in Figure 4-6, the CU unit view shows that the OPC-4 sub-chassis design a CU control unit designed on the back of the chassis, and the dimensional space meets the requirements when using the X86 architecture. The CU is connected to the front panel through the backplane. All the sub-chassis configuration items are executed and configured on the CU. The Panel is the IO input/output panel of the CU. In normal operation, removing the CU does not have any impact on the service. However, after the CU is removed, the panel's LCD The screen will remain on and the local IP address before removing the CU will be displayed.

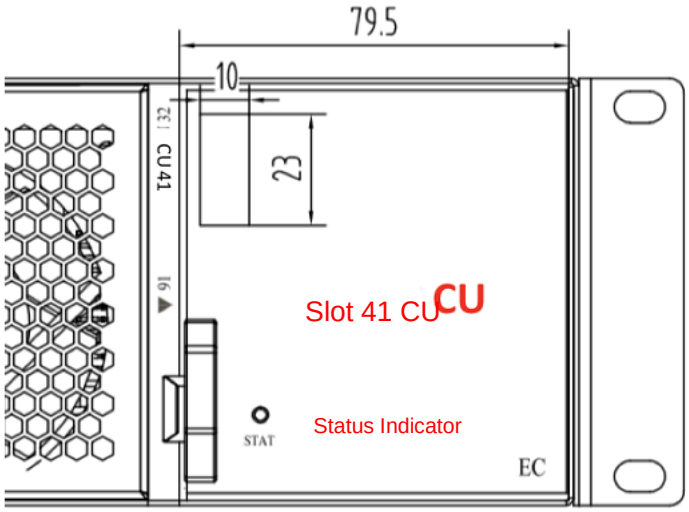


Figure 4-6 *PSU unit layout view*

| Unit | Parameter | Usage |
|---|---|---|
| CU | STAT<br>Indicator light | Steady green: normal operation, normal operation of the CU, and normal temperature;<br>Steady orange: Major warning<br>Orange flashing: the CU is in a maintenance status to facilitate maintenance worker for locating<br>Steady red: The CU unit is in a fault status and has a Critical warning. |
| | Active/Maintenance<br>(*Configurable item*) | Active: Restores from the Maintenance status to normal operation<br>Maintenance: maintenance status, flashing light for prompt |

Table 4-6 CU

# 5. OPC-4 Card

his section describes the optical layer service board of the OPC-4 platform, which cover the functions, principles, ports, and configuration parameters of each board.

## 5.1 OA

The OA board adopts a high-density design and strictly controls the noise of the EDFA unit. As shown in the schematic block diagram of the OA unit in Figure 5-1, a single board enables reduction of physical fiber connection by integrating multiple functional modules and reduces the construction workload as well as complexity of operation and maintenance in later stage.

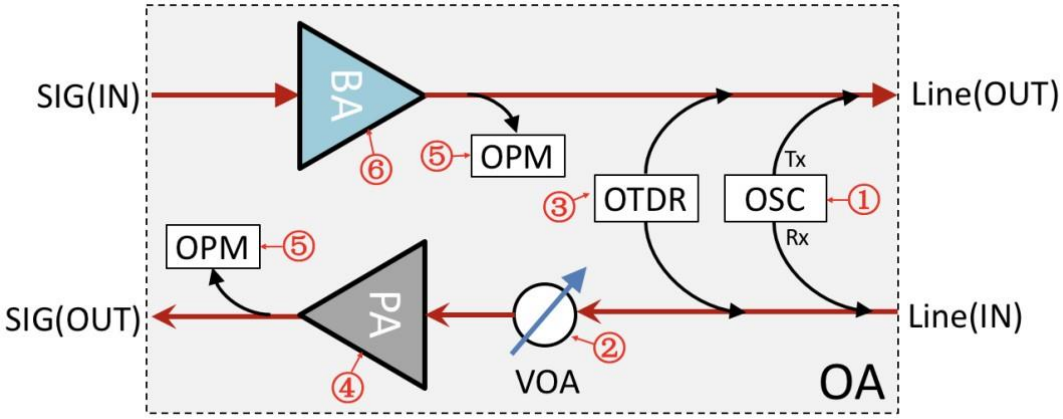


Figure 5-1 *Block diagram of the OA board*

*Tip: As shown in the schematic diagram of the OA card in Figure 5-1, Line is the input/output on the transmission-side, SIG is the internal input/output, and the card has a 4-core fiber connection. All the modules and the functional module are connected by internal fiber connections.*

As shown in the figure, the OA board integrates PA and BA amplifier units, OSC, OTDR and OPM functional components. The OTDR can scan and detect two transmission-side cores through the optical switch; Considering the lifetime of the optical switch and the hope of high frequency telemetry of spectrum information. Therefore, the design incorporates two sets of OPMs. The units scan the wavelengths of the BA output and PA output, respectively, and can achieve Second-level spectrum scanning; the VOA provides loss adjustment before light enters the PA. The functional modules and parameters of each part are shown in "Table 5-1 OA Unit Function Parameters", in which each functional module is shown in red numbers in Figure 5-1.

<table>
<tr><th>Number</th><th>functions</th><th>Parameter</th></tr>
<tr><td>1</td><td>OSC</td><td>OSC module needs to meet the 36dB line cross-loss scenario, support LF/RF alarms or similar mechanisms to implement the APR function ( see APR for details )
<table>
<tr><th>parameter name</th><th>requirements</th></tr>
<tr><td>wavelength</td><td>1510+/-10nm</td></tr>
<tr><td>Data rate</td><td>1Gb/s</td></tr>
<tr><td>Signal transmission power</td><td>+3～-7dBm</td></tr>
<tr><td>Minimum receiver sensitivity (BER=1E-11)</td><td>-33dBm</td></tr>
</table></td></tr>
<tr><td>2</td><td>VOA</td><td>Satisfy adjustment range 0~15dB, response speed within 1000ms</td></tr>
<tr><td>3</td><td>OTDR</td><td>Satisfy no 1510nm mutual interference, dynamic sensitivity 36dB or more</td></tr>
</table>

<table>
<tr>
<td>4</td>
<td>PA</td>
<td>Pre-Amplifier unit performance meets ITU-T G.663 requirements
<table>
<tr><th>Item</th><th>unit</th><th>Requirements</th></tr>
<tr><td>Working channel bandwidth</td><td>nm</td><td>1528-1568</td></tr>
<tr><td>Total input power range</td><td>dBm</td><td>-35 ~ +9</td></tr>
<tr><td>Input power range per channel</td><td>dBm</td><td>-30~-12</td></tr>
<tr><td>Output power range per channel</td><td>dBm</td><td>1~3</td></tr>
<tr><td>Maximum total output power</td><td>dBm</td><td>+23</td></tr>
<tr><td>Noise Figure (NF)</td><td>dB</td><td>< 6.5</td></tr>
<tr><td>Channel gain</td><td>dB</td><td>16-32 (20-30 Flat Gain Range)</td></tr>
<tr><td>Input reflection coefficient</td><td>dB</td><td>>40</td></tr>
<tr><td>Output reflection coefficient</td><td>dB</td><td>>40</td></tr>
<tr><td>Pump source leakage at the input</td><td>dBm</td><td><-30</td></tr>
<tr><td>Input maximum tolerable reflection coefficient</td><td>dB</td><td><-30</td></tr>
<tr><td>Output tolerable maximum reflection coefficient</td><td>dB</td><td><-30</td></tr>
<tr><td>Gain tilt</td><td>dB/dB</td><td>-2~0</td></tr>
<tr><td>Gain flatness</td><td>dB</td><td>±1</td></tr>
<tr><td>Gain response time for channel changes</td><td>ms</td><td><10 (steady status)</td></tr>
<tr><td>Polarization related loss</td><td>dB</td><td><0.5</td></tr>
<tr><td>Polarization mode dispersion</td><td>ps</td><td><0.5</td></tr>
</table>
</td>
</tr>
<tr>
<td>5</td>
<td>OPM</td>
<td>OPM module can monitor the optical signals at high frequency without affecting service. The time required to complete a full scan of the C-band is within 1 s.
<table>
<tr><th>Item</th><th>unit</th><th>Requirements</th></tr>
<tr><td>Operating wavelength range</td><td>nm</td><td>1528.96-1567.33</td></tr>
<tr><td>Center wavelength detection accuracy</td><td>nm</td><td>±0.1</td></tr>
<tr><td>Channel spacing</td><td>GHz</td><td>N*6.25GHz</td></tr>
<tr><td>Single-wave power detection range</td><td>dBm</td><td>-30~+3</td></tr>
<tr><td>Power detection accuracy</td><td>dB</td><td>±1.5</td></tr>
<tr><td>OSNR detection accuracy (100Gbit/s rate signal)</td><td>dB</td><td>±1.5</td></tr>
</table>
</td>
</tr>
<tr>
<td>6</td>
<td>BA</td>
<td>Booster-Amplifier unit performance meets ITU-T G.663 requirements
<table>
<tr><th>project</th><th>unit</th><th>Requirements</th></tr>
<tr><td>Working channel bandwidth</td><td>nm</td><td>1528-1568</td></tr>
</table>
</td>
</tr>
</table>

| | | | | |
|---|---|---|---|---|
| | | Total input power range | dBm | -35 ~ +9 |
| | | Input power range per channel | dBm | -30~-12 |
| | | Output power range per channel | dBm | 1~4 |
| | | Maximum total output power | dBm | +24 |
| | | Noise Figure (NF) | dB | < 6.5 |
| | | Channel gain | dB | 15-31 (15-25 flat gain) |
| | | Input reflection coefficient | dB | >40 |
| | | Output reflection coefficient | dB | >40 |
| | | Pump source input-side leakage | dBm | <-30 |
| | | Input maximum tolerable reflection coefficient | dB | <-30 |
| | | Output maximum tolerable reflection coefficient | dB | <-30 |
| | | Gain tilt | dB | -2~0 |
| | | Gain flatness | dB | ±1 |
| | | Increase/remove channel gain response time (steady status) | ms | <10 |
| | | Polarization related loss | dB | <0.5 |
| | | Polarization mode dispersion | ps | <0.5 |

Table 5-1 OA Unit Function Parameters

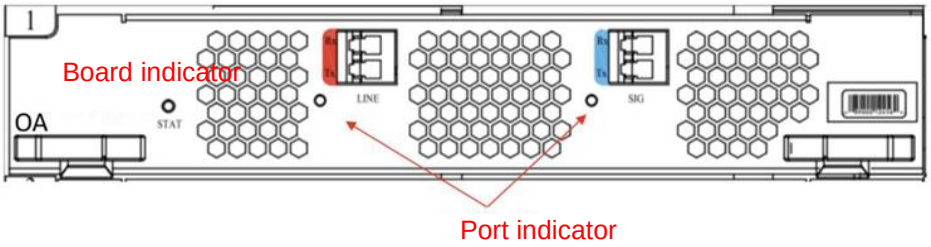


Figure 5-2 *OA board panel view*

As shown in Figure 5-2, the OA board view adopts asymmetrical structure when the design depth is 510mm because the OA board has a high degree of integration. (Our goal is the depth is less than 470mm and adopts symmetrical structure slot design） The OA board adopts a large slot design to fit into the corresponding functional module. The classification for port color conforms with description in *Table 4-1 Port Color Description Rules* in Chapter 4.1. Red represents the line outlet and blue represents the internal connection port of sub-chassis. The specific board parameters are listed in Table 5-2.

| Unit | Parameter | Usage |
|---|---|---|
| OA | Board description (*Configuration item*) | You can configure the board and leave comments |
| | STAT Indicator light | Green(blinking): Firmware loading has not been completed during board startup.<br>Green: Normal operation and no abnormal warning from the board.<br>Amber: Major warning.<br>Amber(blinking): The OA board is in maintenance status, facilitating maintenance worker for locating<br>Red: A critical warning on the board. |
| | Active/Maintenance/Disable (*Configuration item*) | Active: Board is active<br>Maintenance: The board is in maintenance status, facilitating maintenance worker for operation<br>Disable: The board is in deactivated status, the board stands by, pump and other modules do not work.<br>Corresponding port indicator is off |
| | OPM (*Configurable item*) | Input scan information |
| | OTDR (*Configuration item*) | Input scan information |
| | Telemetry (*Configuration item*) | Configure Telemetry configuration information |
| LINE | Port description (*Configuration item*) | You can configure the port description and enter the comment information |
| | LINE Indicator light | Green: Normal operation and no abnormal alarm on the port.<br>Amber: the port has major level alarms. |

| | | |
|---|---|---|
| | | Amber(blinking): LINE port maintenance status, facilitating maintenance worker for locating<br>Red: A critical warning on the LINE port. |
| | Active/Maintenance/Disable<br>(*Configuration item*) | Active: Port is in active working status<br>Maintenance: The port is in maintenance status, facilitating maintenance worker for operation<br>Disable: Port is inactive, BA & PA does not work |
| | PA-Gain<br>(*Configuration item*) | Configurable gain range 16-32 |
| | BA-Gain<br>(*Configuration item*) | Configurable gain range 15-31 |
| | VOA<br>(*Configuration item*) | 0-15 |
| | Optical power | Lookup LINE port input/output power |
| SIG | Port description<br>(*Configuration item*) | You can configure the port description and enter the comment information |
| | SIG<br>Indicator light | Green: Normal operation and no abnormal alarm on the port.<br>Amber: the port has major level warnings.<br>Amber(blinking): maintenance status, SIG port maintenance status, facilitating maintenance worker for locating<br>Red: A critical warning on the SIG port. |
| | Active/Maintenance/Disable<br>(*Configuration item*) | Active: Port is in active working status<br>Maintenance: The port is in maintenance status, facilitating maintenance worker for operation<br>Disable: Port is inactive, BA & PA does not work |
| | Optical power | Lookup LINE input/output power |

Table 5-2 *OA board parameters*

The OA board is equipped with APR function. For details, please refer to APR reference. It provides security protection during maintenance and reduces laser level to Clasrs 1 M. Moreover, the APR function is newly designed and can restore pre-release deadlock when the OSC fails.

## 5.2 ILA

The ILA board card is developed based on OA board card. As shown in the schematic block diagram of the ILA unit in Figure 5-3. The ILA card's optical parameters of each module are consistent with OA card. Compared with OA board card, ILA board card adds an OSC module and realizes OTDR directional expansion through optical switch.

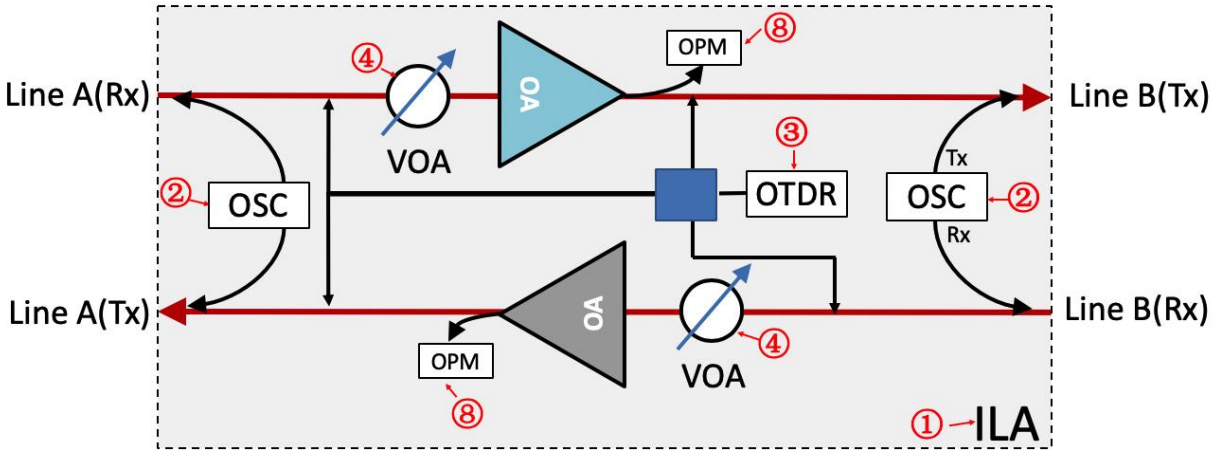


Figure 5-3 *Block diagram of the ILA board*

The panel of ILA card is similar to OA, LED and logic are the same, only the port name has change. LINE port is changed to LINE A, and the name of SIG port is changed to LINE B. The other things similar to OA card, please refer to the design of OA card.

## 5.3 WSS

The WSS board, as shown in the schematic diagram of the WSS board in Figure 5-4, is used as the power flatness adjustment component to provide the response function in the R1.0 version. Subsequently, in the R2.0 version, the WSS-20 will be supplemented with the multi-dimensional and optical layer dispatching applications.

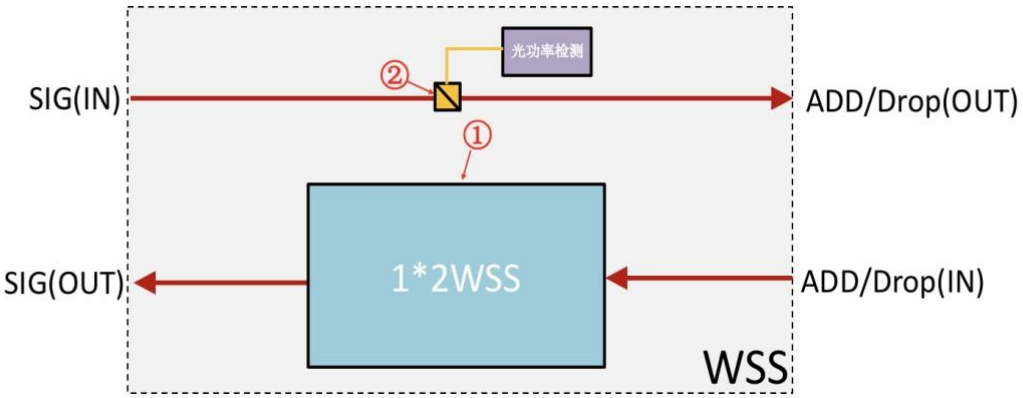


Figure 5-4 *Schematic diagram of a WSS board*

*Tip: As shown in the schematic diagram of the WSS board in Figure 5-4, the SIG ports of the SIG and OA are interconnected as input/output interfaces, and the ADD/Drop ports are local uplink and downlink ports.*

A 1*2WSS unit is built into the WSS board R1.x to adjust the power flatness of the uplink signal. Power detection is enabled in the drop direction by adding a 1/100 light demux to monitor the signal passing

through the board. The WSS board performance parameters are shown in Table 5-3. WSS Unit Parameters

<table>
<tr><th>Number</th><th>functions</th><th>Parameter</th></tr>
<tr><td>1</td><td>1*2WSS</td><td>WSS module performance parameters
<table>
<tr><th>Item</th><th>unit</th><th>requirements</th></tr>
<tr><td>Slice width</td><td>GHz</td><td>12.5</td></tr>
<tr><td>Total slice number (m)</td><td>-</td><td>322</td></tr>
<tr><td>Slice number per slot</td><td>-</td><td>3~32</td></tr>
<tr><td>Slot width</td><td>GHz</td><td>n*12.5; n=3~32</td></tr>
<tr><td>Insertion loss</td><td>dB</td><td>≤8</td></tr>
<tr><td>Maximum insertion loss for each channel</td><td>dB</td><td>1.5</td></tr>
<tr><td>Port isolation</td><td>dB</td><td>>25</td></tr>
<tr><td>Extinction Ratio</td><td>dB</td><td>≥35</td></tr>
<tr><td>Reconstruction time</td><td>second</td><td>≤1</td></tr>
<tr><td>Maximum reflection coefficient</td><td>dB</td><td>-40</td></tr>
<tr><td>Directionality</td><td>dB</td><td>35</td></tr>
<tr><td>Polarization related loss</td><td>dB</td><td>≤1</td></tr>
<tr><td>Upstream attenuation per wavelength</td><td>dB</td><td>0~15</td></tr>
<tr><td>Upstream attenuation per wavelength</td><td>dB</td><td>≤1</td></tr>
<tr><td>Dimensions</td><td>-</td><td>2</td></tr>
</table></td></tr>
<tr><td>2</td><td>Optical power detection</td><td>Power Detection Range -35~+25dBm</td></tr>
</table>

Table 5-3 *WSS unit parameters*

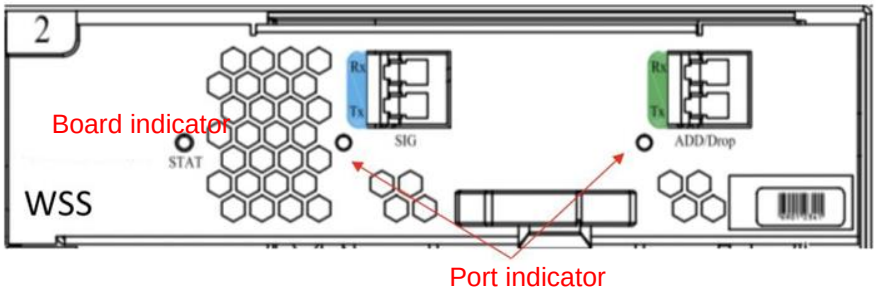


Figure 5-5 *WSS board panel view*

*Tip: As shown in the schematic diagram of the WSS board in Figure 5-5, the SIG ports of the SIG and OA are interconnected as input/output interfaces, and the ADD/Drop ports are local uplink and downlink ports.*

As shown in Figure 5-5, the WSS component is relatively small compared to the OA board.

With a small slot design, the current R1.X WSS will use LC port when making power flatness adjustment, but the future R2.0 or later versions will use a multidimensional device for multi-dimensional scheduling applications. The application of MPO interface scheme will extend the panel ports of the small board. The specific configuration parameters of the WSS board are shown in the following table.

| Unit | Parameter | Usage |
|---|---|---|
| WSS | Board description (*Configuration item*) | You can configure the board and leave comments |
| | STAT Indicator light | Green(blinking): Firmware loading has not been completed during board startup.<br>Green: Normal operation and no abnormal alarm on the board.<br>Amber: Major warning.<br>Amber(blinking): indicates that the OA board is in the maintenance status, facilitating maintenance worker for locating<br>Red: A critical warning on the board. |
| | Active/Maintenance/Disable (*Configuration item*) | Active: Board is active<br>Maintenance: The board is in maintenance status, facilitating maintenance worker for operation<br>Disable: The board is inactive and the board WSS module does not work<br>Corresponding port indicator is off |
| | WSS loss adjustment (*Configuration item*) | 0~15dB adjustment |
| | Telemetry (*Configuration item*) | Configure Telemetry configuration information |
| SIG | Port description (*Configuration item*) | You can configure the port description and enter comment information |
| | SIG Indicator light | Green: Normal operation and no abnormal alarm on the port.<br>Amber: the port has major level warnings.<br>Amber(blinking): maintenance status, SIG port maintenance status, facilitating maintenance worker for locating<br>Red: A critical warning on the SIG port. |
| | Active/Maintenance/Disable (*Configuration item*) | Active: Port is in active working status<br>Maintenance: The port is in maintenance status, facilitating maintenance worker for operation<br>Disable: The port is inactive<br>Corresponding port indicator is off |
| | Optical power | Lookup SIG port input/output power |
| ADD/ Dorp | Port description (*Configuration item*) | You can configure the port description and enter comment information |
| | SIG Indicator light | Green: Normal operation and no abnormal alarm on the port.<br>Amber: the port has major level warnings. |

| | | |
|---|---|---|
| | | Amber(blinking): maintenance status, SIG port maintenance status, facilitating maintenance worker for locating<br>Red: A critical warning on the SIG port. |
| | Active/Maintenance/Disable (*Configuration item*) | Active: Port is in active working status<br>Maintenance: The port is in maintenance status, facilitating maintenance worker for operation<br>Disable: Port is inactive, BA & PA does not work<br>Corresponding port indicator is off |
| | Optical power | Lookup ADD/Drop input/output power |

Table 5-4 *Parameters of the WSS board*

## 5.4 OPS

The OPS board, as shown in the schematic in Figure 5-6, will be supported in R1.1. Compared with the traditional OP board, the OPS board adds the power detect function for each port.

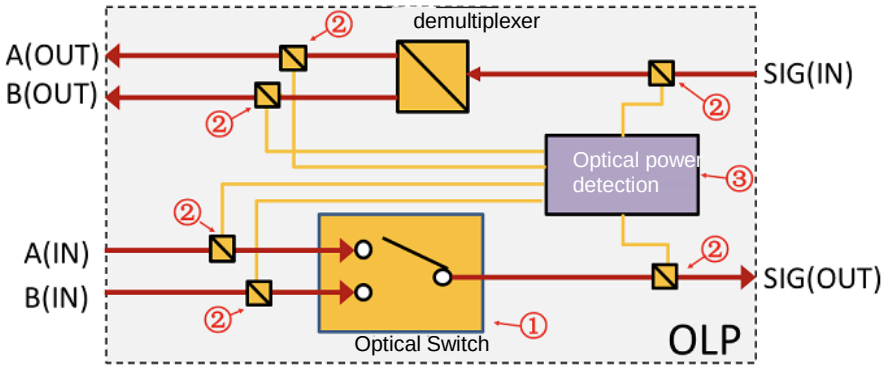


Figure 5-6 *Schematic diagram of an OPS board*

*Tip: As shown in Figure5-6 the SIG is connected to the local uplink and downlink boards, and the ports A and B are connected to the A/B route OA to implement dual-selection OMSP protection function.*

The OPS board only performs OMSP protection and enhanced OMSP protection in the open system architecture.Other protection scenarios are not supported. Other service restoration and protection scenarios rely on the centralized automatic recovery function of the SDN controller. The performance parameters of the OPS board are shown in Table 5-5. OPS Unit Parameters

<table>
<tr><th>Number</th><th>functions</th><th>Parameter</th></tr>
<tr><td>1</td><td>Optical Switch</td><td>Optical switch performance parameters
<table>
<tr><th colspan="2">Item</th><th>unit</th><th>OPS</th></tr>
<tr><td>Transmitter-side insertion loss</td><td>Single mode</td><td>dB</td><td>≤4</td></tr>
<tr><td>Receiver-side insertion loss</td><td>Single mode</td><td>dB</td><td>≤1.5</td></tr>
<tr><td colspan="2">Power detection sensitivity</td><td>dBm</td><td>-35 ~ +25</td></tr>
<tr><td>Optical switch input power range</td><td>Single mode</td><td>dBm</td><td>-35 ~ +25</td></tr>
<tr><td>Operating wavelength range</td><td>Single mode</td><td>nm</td><td>1270~ 1350，<br>1528~ 1567</td></tr>
<tr><td colspan="2">Optical switch switching power difference threshold</td><td>dB</td><td>Default 5<br>Customize</td></tr>
<tr><td colspan="2">Optical power difference warning threshold setting range</td><td>dB</td><td>Customize</td></tr>
</table></td></tr>
<tr><td>2</td><td>demultiplexer</td><td>Less than 1% demux</td></tr>
<tr><td>3</td><td>Optical power detection</td><td>Power detection range -35~+25dBm, accuracy 0.1dBm</td></tr>
</table>

Table 5-5 *OPS unit parameters*

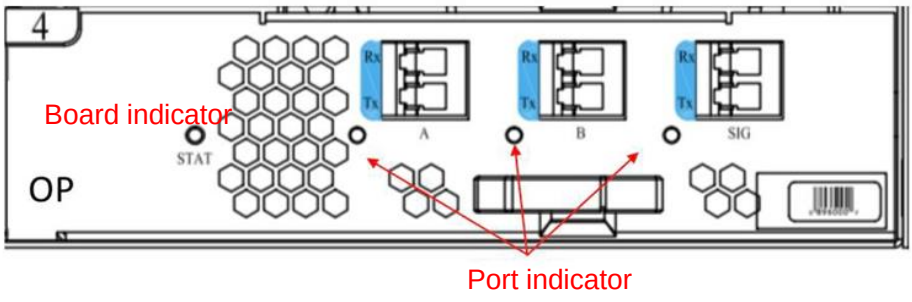


Figure 5-7 *OPS board panel view*

*Tip: As shown in the schematic diagram of the OPS board in Figure 5-7, the SIG is linked to the WSS unit. The A and B ports are connected to the SIG port of the OA board to implement OA dual-selection in different directions, providing OMSP protection.*

The OPS board can switch optical channels between A/B within 50ms. Table 5-6 shows the specific parameters.

| Unit | Parameter | Usage |
|---|---|---|
| OPS | Board description (*Configuration item*) | You can configure the board and leave comments |
| | STAT Indicator light | Green(blinking): Firmware loading has not been completed during board startup.<br>Green: Normal operation and no abnormal alarm on the board.<br>Amber: Major warning.<br>Amber(blinking): OPS board is in a maintenance status, facilitating maintenance worker for locating<br>Red: A critical warning on the board. |
| | Active/Maintenance/Disable (*Configuration item*) | Active: The card is in the active status. Maintenance: The card is in the maintenance status, facilitating maintenance worker for operation<br>Disable: The card is in deactivated status.<br>Corresponding port indicator is off |
| | Operating mode (*Configuration item*) | Auto/Manual/Force |
| | Return mode (*Configuration item*) | Automatic return/automatic no return |
| | Return delay (*Configuration item*) | secs |
| | Telemetry (*Configuration item*) | Configure Telemetry configuration information |
| SIG | Port description (*Configuration item*) | You can configure the port description and enter comment information |
| | SIG Indicator light | Green: Normal operation and no abnormal alarm on the port.<br>Amber: the port has major level warnings.<br>Amber(blinking): SIG port maintenance status, facilitating maintenance worker for locating<br>Red: A critical warning on the SIG port. |
| | Active/Maintenance/ | Active: Port is in active working status<br>Maintenance: The port is in maintenance status, facilitating maintenance worker for operation |
| | Disable (*Configuration item*) | Disable: The port is inactive<br>Corresponding port indicator is off |
| | Optical power | Lookup SIG port input/output power |
| A | Port description (*Configuration item*) | You can configure the port description and enter comment information |
| | A port Indicator light | Green: Normal operation and no abnormal alarm on the port.<br>Amber: the port has major level warnings.<br>Amber(blinking): maintenance status on port A, facilitating maintenance worker for locating |

| | | |
|---|---|---|
| | | Red: Critical warning for port A. |
| | Active/Maintenance/Disable (*Configuration item*) | Active: Port is in active working status<br>Maintenance: The port is in maintenance status, facilitating maintenance worker for operation<br>Disable: The port is inactive<br>Corresponding port indicator is off |
| | Optical power | Lookup A port input/output power |
| B | Port description (*Configuration item*) | You can configure the port description and enter comment information |
| | Port B Indicator light | Green: Normal operation and no abnormal alarm on the port.<br>Amber the port has major level warnings.<br>Amber(blinking): maintenance status on port B, facilitating maintenance worker for locating<br>Red: Critical warning for port B. |
| | Active/Maintenance/Disable (*Configuration item*) | Active: Port is in active working status<br>Maintenance: The port is in maintenance status, facilitating maintenance worker for operation<br>Disable: The port is inactive<br>Corresponding port indicator is off |
| | Optical power | Lookup port B input/output power |

Table 5-6 *OPS board parameters*

# 6. OPC-4 Passive Devices

## 6.1 MUX

The R1.0 version of the MUX is model MUX-96, which is designed as an external passive device, supporting C-band 96-wave, with center wavelength referencing the ITU-T G.694 standard. Passive device design, management layer belongs to the daughter card of OPC-4 with the slot number 5. MUX-96 is connected to the MUX interface of OPC-4 through management cabling, SN/NAME/PN/PD of the MUX unit can be read out through this port. The appearance of the MUX is shown in Figure 6-1. Table 6-1 and Table 6-2 are parameters and wavelength comparisons of the MUX-96.

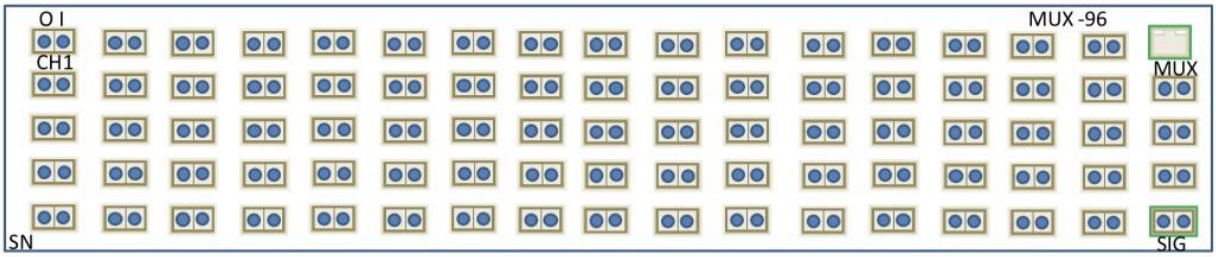


Figure 6-1 *MUX-96 appearance view*

*Tip: A total of 96 wavelength channels, CH1 ~ CH96, where the SIG port is the local upstream and downstream port, while MUX is the management cabling interface.*

<table>
<tr><th>Unit</th><th>Parameter</th><th>Usage</th></tr>
<tr><td></td><td>Board description<br>(Configuration item)</td><td>You can configure the board and leave comments</td></tr>
<tr><td></td><td>Active/Maintenance/Disable<br>(Configuration item)</td><td>Active: Software confirms it is in use<br>Maintenance: The software confirms that it is in maintenance status and unlocks other operating rights<br>Disable: The software confirms that it is not in use and can delete or change the name</td></tr>
<tr><td>MUX</td><td>Performance</td><td>demultiplex:
<table>
<tr><th>Item</th><th>unit</th><th>Requirements (96 waves)</th></tr>
<tr><td>Channel spacing</td><td>GHz</td><td>50</td></tr>
<tr><td>Insertion loss</td><td>dB</td><td><8</td></tr>
<tr><td>Light reflectance</td><td>dB</td><td>40</td></tr>
<tr><td>Adjacent channel isolation</td><td>dB</td><td>>25</td></tr>
<tr><td>Non-adjacent channel isolation</td><td>dB</td><td>>25</td></tr>
<tr><td>Polarization related loss</td><td>dB</td><td><0.5</td></tr>
<tr><td>Maximum difference in insertion loss of each channel</td><td>dB</td><td><2</td></tr>
<tr><td>Temperature characteristics</td><td>nm/。C</td><td>*</td></tr>
<tr><td>-1dB bandwidth</td><td>nm</td><td>>0.2</td></tr>
<tr><td>-20dB bandwidth</td><td>nm</td><td><0.6</td></tr>
<tr><td>Polarization mode dispersion</td><td>ps</td><td><0.5</td></tr>
</table>
Multiplex:
<table>
<tr><th>Item</th><th>unit</th><th>Requirements (96 waves)</th></tr>
<tr><td>Channel spacing</td><td>GHz</td><td>50</td></tr>
<tr><td>Insertion loss</td><td>dB</td><td><10</td></tr>
<tr><td>Light reflectance</td><td>dB</td><td>>40</td></tr>
<tr><td>Operating wavelength range</td><td>nm</td><td>1529.16～1567.14</td></tr>
<tr><td>Polarization related loss</td><td>dB</td><td><0.5</td></tr>
<tr><td>Adjacent channel isolation</td><td>dB</td><td>>22</td></tr>
<tr><td>Non-adjacent channel isolation</td><td>dB</td><td>>25</td></tr>
<tr><td>Maximum difference in insertion loss of each channel</td><td>dB</td><td><3</td></tr>
<tr><td>Polarization mode dispersion</td><td>ps</td><td><0.5</td></tr>
</table></td></tr>
<tr><td>SIG</td><td>Port description<br>(Configuration item)</td><td>You can configure the port description and enter comment information</td></tr>
</table>

| | | |
|---|---|---|
| | Active/Maintenance/Disable<br>(*Configuration item*) | Active: Software confirmed to be in use<br>Maintenance: The software confirms that it is in maintenance status and unlocks other operating rights<br>Disable: The software confirms that it is not in use and can delete or change the name |

Table 6-1 *MUX board performance and parameters*

| Number | Center frequency（THz） | wavelength（nm） | Number | Center frequency（THz） | wavelength（nm） | Number | Center frequency（THz） | wavelength（nm） | Number | Center frequency（THz） | wavelength（nm） |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 196.05 | 1529.16 | 25 | 194.85 | 1538.58 | 49 | 193.65 | 1548.11 | 73 | 192.45 | 1557.77 |
| 2 | 196 | 1529.55 | 26 | 194.8 | 1538.98 | 50 | 193.6 | 1548.51 | 74 | 192.4 | 1558.17 |
| 3 | 195.95 | 1529.94 | 27 | 194.75 | 1539.37 | 51 | 193.55 | 1548.91 | 75 | 192.35 | 1558.58 |
| 4 | 195.9 | 1530.33 | 28 | 194.7 | 1539.77 | 52 | 193.5 | 1549.32 | 76 | 192.3 | 1558.98 |
| 5 | 195.85 | 1530.72 | 29 | 194.65 | 1540.16 | 53 | 193.45 | 1549.72 | 77 | 192.25 | 1559.39 |
| 6 | 195.8 | 1531.12 | 30 | 194.6 | 1540.56 | 54 | 193.4 | 1550.12 | 78 | 192.2 | 1559.79 |
| 7 | 195.75 | 1531.51 | 31 | 194.55 | 1540.95 | 55 | 193.35 | 1550.52 | 79 | 192.15 | 1560.2 |
| 8 | 195.7 | 1531.9 | 32 | 194.5 | 1541.35 | 56 | 193.3 | 1550.92 | 80 | 192.1 | 1560.61 |
| 9 | 195.65 | 1532.29 | 33 | 194.45 | 1541.75 | 57 | 193.25 | 1551.32 | 81 | 192.05 | 1561.01 |
| 10 | 195.6 | 1532.68 | 34 | 194.4 | 1542.14 | 58 | 193.2 | 1551.72 | 82 | 192 | 1561.42 |
| 11 | 195.55 | 1533.07 | 35 | 194.35 | 1542.54 | 59 | 193.15 | 1552.12 | 83 | 191.95 | 1561.83 |
| 12 | 195.5 | 1533.47 | 36 | 194.3 | 1542.94 | 60 | 193.1 | 1552.52 | 84 | 191.9 | 1562.23 |
| 13 | 195.45 | 1533.86 | 37 | 194.25 | 1543.33 | 61 | 193.05 | 1552.93 | 85 | 191.85 | 1562.64 |
| 14 | 195.4 | 1534.25 | 38 | 194.2 | 1543.73 | 62 | 193 | 1553.33 | 86 | 191.8 | 1563.05 |
| 15 | 195.35 | 1534.64 | 39 | 194.15 | 1544.13 | 63 | 192.95 | 1553.73 | 87 | 191.75 | 1563.46 |
| 16 | 195.3 | 1535.04 | 40 | 194.1 | 1544.53 | 64 | 192.9 | 1554.13 | 88 | 191.7 | 1563.87 |
| 17 | 195.25 | 1535.43 | 41 | 194.05 | 1544.92 | 65 | 192.85 | 1554.54 | 89 | 191.65 | 1564.27 |
| 18 | 195.2 | 1535.82 | 42 | 194 | 1545.32 | 66 | 192.8 | 1554.94 | 90 | 191.6 | 1564.68 |
| 19 | 195.15 | 1536.22 | 43 | 193.95 | 1545.72 | 67 | 192.75 | 1555.34 | 91 | 191.55 | 1565.09 |
| 20 | 195.1 | 1536.61 | 44 | 193.9 | 1546.12 | 68 | 192.7 | 1555.75 | 92 | 191.5 | 1565.5 |
| 21 | 195.05 | 1537 | 45 | 193.85 | 1546.52 | 69 | 192.65 | 1556.15 | 93 | 191.45 | 1565.91 |
| 22 | 195 | 1537.4 | 46 | 193.8 | 1546.92 | 70 | 192.6 | 1556.55 | 94 | 191.4 | 1566.32 |
| 23 | 194.95 | 1537.79 | 47 | 193.75 | 1547.32 | 71 | 192.55 | 1556.96 | 95 | 191.35 | 1566.73 |
| 24 | 194.9 | 1538.19 | 48 | 193.7 | 1547.72 | 72 | 192.5 | 1557.36 | 96 | 191.3 | 1567.14 |

Table 6-2 *MUX-96 wavelength correspondence table*