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UC2
User Manual
(Rel_11)

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Preface

Objectives

The document describes the UC2 optical module, including features, application scope, models, technical specifications, internal information, structure, installation, and uninstallation. Meanwhile, the document lists Frequently Asked Questions (FAQs) about the UC2 optical module and related solutions. The appendix lists terms and abbreviations involved in this document.

Conventions

Symbol conventions

The symbols that may be found in this document are defined as below.

Symbol	Description
	Indicate a hazard with a medium or low level of risk which, if not avoided, could result in minor or moderate injury.
	Indicate a potentially hazardous situation that, if not avoided, could cause equipment damage, data loss, and performance degradation, or unexpected results.
	Provide additional information to emphasize or supplement important points of the main text.
	Indicate a tip that may help you solve a problem or save time.

General conventions

Convention	Description
Times New Roman	Normal paragraphs are in Times New Roman.
Arial	Paragraphs in Warning, Caution, Notes, and Tip are in Arial.

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Convention	Description
Boldface	Buttons and navigation path are in **Boldface**.
Italic	Book titles are in *italics*.
`Lucida Console`	Terminal display is in `Lucida Console`.
Book Antiqua	Heading 1, Heading 2, Heading 3, and Block are in Book Antiqua.

Change history

Updates between document versions are cumulative. Therefore, the latest document version contains all updates made to previous versions.

Issue 11 (2023-06-01)

Eleventh commercial release

- Fixed known bugs.

Issue 10 (2023-05-01)

Tenth commercial release

- Added the UC2-400G/DCO-WE (B).

Issue 09 (2022-10-01)

Ninth commercial release

- Added the UC2-100G/ZR4.

Issue 08 (2022-08-01)

Eighth commercial release

- Added the UC2-400G/DCO-E (A) and UC2-400G/DCO-E (B).

Issue 07 (2022-07-01)

Seventh commercial release

- Added the UC2-100G/DCO (C) and UC2-200G/DCO-E (C).

Issue 06 (2022-06-01)

Sixth commercial release

- Added the UC2-100G/DCO (B) and UC2-200G/DCO-E (B).

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Issue 05 (2021-09-01)

Fifth commercial release

- Added the UC2-200G/DCO-E (A).

Issue 04 (2021-08-01)

Fourth commercial release

- Added the UC2-100G/DCO (B) and UC2-200G/DCO-E (B).

Issue 03 (2020-07-01)

Third commercial release

- Added the UC2-100G/DCO-E (A) and UC2-200G/DCO (A).

Issue 02 (2019-12-01)

Second commercial release

- Added the UC2-100G/DCO (A).

Issue 01 (2019-09-01)

Initial commercial release

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Contents

1 Overview 1
1.1 Introduction 1
1.2 Features 1
1.3 Applied scenarios 2
1.4 Models 3
2 Technical specifications 5
2.1 Absolute maximum parameters 5
2.2 Recommended operating parameters 6
2.3 Maximum power consumption 6
2.4 Performance indicator 7
2.4.1 Optical features 7
2.4.2 Electical features 29
2.5 Appearance and dimension 38
2.5.1 Optical module 38
2.5.2 Optical interface 39
3 Installation and uninstallation 40
4 Appendix 42
4.1 FAQs 42
4.2 Terms 44
4.3 Abbreviations 46

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1 Overview

This chapter includes the following sections:

- Introduction
- Features
- Applied scenarios
- Models

1.1 Introduction

The Raisecom UC2 module, which adopts the Centum Form-factor Pluggable 2 (CFP2) packaging, is designed for the high-speed and bidirectional communication system. It has the following features:

- Support up to 400 Gbit/s signal transmission.
- Support up to 10 km, 40 km, 80 km, and MAN transmission distance.
- Provide standard Little Connector (LC) dual-fiber connector.
- Comply with ITU-T and IEEE standards and refer to the Multi Source Agreement (MSA) specifications.

1.2 Features

The Raisecom UC2 optical module has the following features:

- Comply with standards and specifications and is easy to operate.
  - Comply with IEEE802.3ba 100GBASE-LR4, 100GBASE-ER4, 100GBASE-ZR4, or OIF-CFP2-DCO-01.0.
  - DDM and the management interface comply with CFP MSA Management Interface Specification.
  - High-speed electrical signals comply with CAUI-4 (IEEE 802.3bm). Low-speed electrical signals comply with CFP2 MSA Hardware Specification v1.0.
  - Comply with RoHS.
  - Comply with 21 CFR 1040.10 & 1040.11 Class 1 laser security standards.

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- Low power consumption, stable performance, high efficiency, and energy conservation
  - Maximum power consumption in normal working conditions: 6 W (UC2-100G/LR4), 7.5 W (UC2-100G/ER4), 9 W (UC2-100/ZR4), 24 W (UC2-100G/DCO(B) and UC2-200G/DCO-E(B)), 25 W (UC2-400G/DCO-E (B) and UC2-400G/DCO-WE (B))
  - Maximum power consumption in low power consumption mode: 2 W
  - Adopt a single +3.3 V power supply.
- Commercial environment standard
  - Operating temperature (altitude: 0–1800 m): 0°C to 70°C for the UC2-100/ZR4, UC2-100G/DCO (B), UC2-200G/DCO-E (B), UC2-400G/DCO-E (B), and UC2-400G/DCO-WE (B)), and -5 to 70°C for other models
  - Relative humidity: 5% to 85% (non-condensing, non-freezing)
- Adopt a metallic packaging and feature outstanding EMC.
  - The ESD threshold (according to the MIL-STD-883E Method 3015.4) is greater than 50 V (for high-speed pins) or 2 kV (for non-high-speed pins).
  - The ESD immunity (according to EN 61000-4-2 level 3) of the UC2-100G/ER4 and UC2-100G/LR4 is greater than 8 kV for contact discharge or 15 kV for air discharge. It meets criteria B: during discharge the performance may decline, but after discharge the performance does not decline and functions are complete.
  - The ESD immunity (according to EN 61000-4-2 level 3) of the UC2-100/ZR4, UC2-100G/DCO (B), UC2-200G/DCO-E (B), UC2-400G/DCO-E (B), and UC2-400G/DCO-WE (B) is greater than 6 kV for contact discharge or 8 kV for air discharge. It meets criteria B: during discharge the performance may decline, but after discharge the performance does not decline and functions are complete.
  - The RF electric magnetic radiated susceptibility complies with IEC 61000-4-3.
  - The RF electric magnetic radiated emission meets requirements for FCC 47CFR Part15 class B products.
- Adopt coherent optical module technologies.
  - The modulation type of the UC2-100G/DCO (B) is Dual Polarization Quadrature Phase Shift Keying (DP-QPSK).
  - The modulation type of the UC2-200G/DCO-E (B) is Dual Polarization 16-ary Quadrature Amplitude (DP-16QAM).
  - The modulation types of the UC2-400G/DCO-E (B) and UC2-400G/DCO-WE (B) are Probabilistic Shaping-16QAM (PS-16QAM) (400 Gbit/s and 200 Gbit/s) and DP-QPSK (200 Gbit/s).

- At an altitude of 1800 m to 5000 m, the maximum operating temperature of the UC2 optical module reduces by 1°C for every 220 m increase in altitude.
- The Digital Coherent Optical (DCO) optical module features long transmission distance, high transmission rate, and high power consumption, so check whether it is supported by the UC2 optical module, and check its power consumption.

1.3 Applied scenarios

The UC2 optical module is applicable to the Metropolitan Area Network (MAN), access network, and high-speed data communication devices, and is mainly applied to the 100GE and OTN OTU4.

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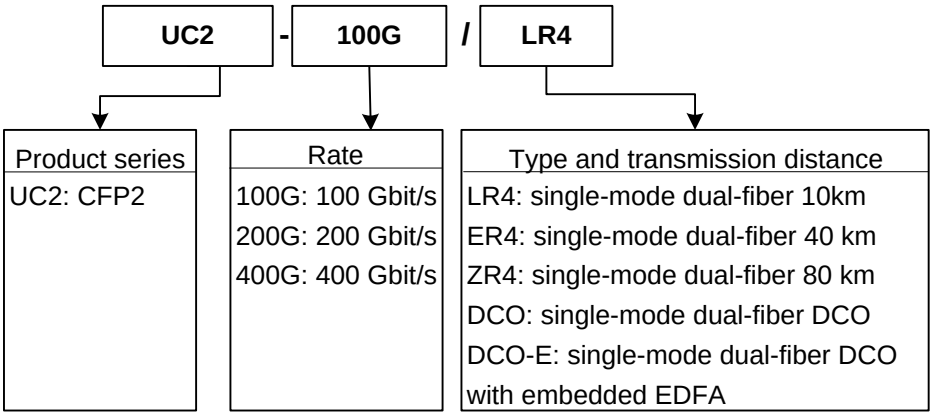
1.4 Models

Naming convention

Figure 1-1 shows the naming convention of the UC2 optical module.

Figure 1-1 Naming convention of the UC2 optical module



Model list

Table 1-1 lists models of the UC2 optical module.

Table 1-1 Models of the UC2 optical module

Model	Rate (Gbit/s)	Wavelength (nm)	Maximum transmission distance (km)	DDM	RoHS
UC2-100G/LR4	• 103.1 • 111.8	• 1295.56 • 1300.05 • 1304.58 • 1309.14	10	Supported	Compliant
UC2-100G/ER4	• 103.1 • 111.8	• 1295.56 • 1300.05 • 1304.58 • 1309.14	40	Supported	Compliant
UC2-100G/ZR4	• 103.1 • 111.8	• 1295.56 • 1300.05 • 1304.58 • 1309.14	80	Supported	Compliant
UC2-100G/DCO (B)	• 103.1 • 111.8	1528.77 (196.10 THz)–1565 (191.3 THz)	MAN	Supported	Compliant
UC2-200G/DCO-E (B)	• 103.1×2 • 111.8×2	1528.77 (196.10 THz)–1565 (191.3 THz)	MAN	Supported	Compliant

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Model	Rate (Gbit/s)	Wavelength (nm)	Maximum transmission distance (km)	DDM	RoHS
UC2-400G/DCO-E (B)	• 100G×4 • 100G×2 • OTU4×4 • OTU4×2 • 400G×1	1528.77 (196.10 THz)–1565 (191.3 THz)	MAN	Supported	Compliant
UC2-400G/DCO-WE (B)	• 100G×4 • 100G×2 • OTU4×4 • OTU4×2 • 400G×1	1524.11 (196.7 THz)–1572.06 (190.7 THz)	MAN	Supported	Compliant

Note

- For the maximum transmission distance, within the target distances of the UC2-100G/DCO (B), UC2-200G/DCO-E(B), UC2-400G/DCO-E (B), and UC2-400G/DCO-WE (B), no dispersion compensation is required within 2400 km, 1200 km, 600 km, and 600 km.
- The actual transmission distance of customer services is affected by optical signal insertion loss, Signal-to-Noise Ratio (SNR), and other factors. Therefore, it is generally less than the target distance.

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2 Technical specifications

This chapter includes the following sections:

- Absolute maximum parameters
- Recommended operating parameters
- Maximum power consumption
- Performance indicator
- Appearance and dimension

2.1 Absolute maximum parameters

Table 2-1 lists the absolute maximum parameters of the UC2-100/ER4 and UC2-100/LR4.

Table 2-1 Absolute maximum parameters of the UC2-100/ER4 and UC2-100/LR4

Parameter	Minimum value	Maximum value
Storage temperature (℃)	-40	85
Relative humidity (non-condensing)	5%	85%
Supply voltage (℃)	-0.5	3.6

Table 2-2 Absolute maximum parameters of other models

Parameter	Minimum value	Maximum value
Storage temperature (℃)	-40	85
Relative humidity (non-condensing)	5%	85%

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Parameter	Minimum value	Maximum value
Operating case temperature (℃) (altitude: 0–1800 m)	• 0 (UC2-100/ZR4, UC2-100G/DCO(B), UC2-200G/DCO-E (B), UC2-400G/DCO-E (B), and UC2-400G/DCO-WE (B) • -5 (other models)	70
Supply voltage (V)	3.2	3.4
Rx input power (dBm)	–	13
Total Rx input power (dBm)	–	20

2.2 Recommended operating parameters

Table 2-3 lists the recommended operating parameters of the UC2 optical modules.

Table 2-3 Recommended operating parameters of the UC2 optical modules

Parameter	Minimum value	Maximum value
Operating packaging temperature (℃) (altitude: 0–1800 m)	• 0 (applicable to the UC2-100/ZR4, UC2-100G/DCO (B), UC2-200G/DCO-E (B), UC2-400G/DCO-E (B), and UC2-400G/DCO-WE(B)) • -5 (other models)	70
Power supply voltage (V)	3.2	3.4

2.3 Maximum power consumption

Table 2-4 Maximum power consumption

Model	Maximum power consumption in normal conditions (W)	Maximum power consumption in low power consumption mode (W)
UC2-100G/LR4	6	2
UC2-100G/ER4	7.5	
UC2-100G/ZR4	9	
• UC2-100G/DCO (B) • UC2-200G/DCO-E (B)	24	

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Model	Maximum power consumption in normal conditions (W)	Maximum power consumption in low power consumption mode (W)
• UC2-400G/DCO-E (B) • UC2-400G/DCO-WE (B)	25	

2.4 Performance indicator

Caution

Transmission errors may occur when the Rx optical power is greater than the overload optical power. The optical receiver of the modules may be damaged if the optical power exceeds the threshold. Therefore, when using the optical module, you should use the optical power meter to measure the actual value of the optical power and confirm that the value is within the range before accessing optical signals.

Note

- In this chapter, performance indicators listed in the tables are End of Life (EOL) value (except parameters marked with BOL), namely, values that are available even in the allowed worst operating environment (temperature and humidity) until the end of life.
- In this chapter, all listed power values are average ones, except marked with OMA.

2.4.1 Optical features

UC2-100G/LR4

Table 2-5 lists the optical features of the UC2-100G/LR4.

Table 2-5 Optical features of the UC2-100G/LR4

Parameter		Minimum value	Typical value	Maximum value	Remarks
Rate, each lane (Gbit/s)	100GE	–	25.78125	–	Compatible with data services and telecom services
	OTU4	–	27.9525	–	
Transmission distance (km)		–	–	10	The transmission distance is used to classify modules. The real transmission distance also depends on other factors, such as the line loss and SNR.
Laser type: LAN-WDM Laser					

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Parameter		Minimum value	Typical value	Maximum value	Remarks
Central wavelength (nm)		1294.53	1295.56	1296.59	–
		1299.02	1300.05	1301.09	–
		1303.54	1304.58	1305.63	–
		1308.09	1309.14	1310.19	–
SMSR(dB)		30	–	–	–
Total launch average power (dBm)	100GE	–	–	10.5	–
	OTU4	–	–	10.0	–
Launch power, each lane (dBm)	100GE	-4.3	–	4.5	–
	OTU4	-0.6	–	4.0	–
OMA, each lane (100GE) (dBm)		-1.3	–	4.5	–
Difference in launch power between any two lanes (OMA) (dB)		–	–	5	–
Extinction ratio (dB)	100GE	4	–	–	–
	OTU4	4	–	7	–
Average launch power off transmitter, each lane (dBm)		–	–	-30	–
Optical return loss tolerance (dB)		–	–	20	–
TDP, each lane (dB)		–	–	2.2	–
Launch power in OMA-TDP, each lane (dBm)		-2.3	–	–	–
Tx reflection RFL (dB)		–	–	-12	–
$RIN_{20}OMA$(dB/Hz)		–	–	-130	–
Eye mask {X1,X2,X3,Y1,Y2,Y3}		{0.25,0.4,0.45,0.25,0.28,0.4} ITU-T 959.1&IEEE802.3ba, Hit ratio=5E-5			
Receiver type: PIN					
Range of Rx wavelength (nm)		1294.53	1295.56	1296.59	–
		1299.02	1300.05	1301.09	–
		1303.54	1304.58	1305.63	–
		1308.09	1309.14	1310.19	–
Damage threshold, each lane (dBm)		5.5	–	–	–

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Parameter		Minimum value	Typical value	Maximum value	Remarks
Total average launch power (OTU4) (dBm)		–	–	10/8.9	The data on the left is tested when the extinction ratio is 4–7 dB. The data on the right is tested when the extinction ratio is greater than 7 dB.
Average launch power, each lane (dBm)	100GE	-10.6	–	4.5	–
	OTU4	-6.9/-8.8	–	4/2.9	The data on the left is tested when the extinction ratio is 4–7 dB. The data on the right is tested when the extinction ratio is greater than 7 dB.
Rx optical power, each lane (OMA) (dBm)		–	–	4.5	–
Rx power difference between any two lanes (OMA) (dB)		–	–	5.5	–
Rx sensitivity, each lane (OMA) (dBm)	100GE	–	–	-8.6	–
Equivalent Rx sensitivity, each lane (OTU4)(dBm)		–	–	-8.4/-10.3	The data on the left is tested when the extinction ratio is 4–7 dB. The data on the right is tested when the extinction ratio is greater than 7 dB.
Optical path cost (dB)		–	–	1.5	–
Stressed Rx sensitivity (OMA), each lane (100GE) (dBm)		–	–	-6.8	–
VECP, each lane (dB)		–	1.8	–	Conditions for the stressed Rx sensitivity test
Stressed system J2 jitter (UI)		–	0.3	–	
Stressed system J9 jitter (UI)		–	0.47	–	
Rx reflection RFL (dB)		–	–	-26	
LOS assert (dBm)		-25	–	-17	–
LOS de-assert (dBm)		–	–	-15	–
LOS hysteresis (dB)		0.5	–	5	–

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Note

- Test code pattern of 100GE: PRBS 2^{31}-1 @ 25.78Gb/s, BER = 1×10^{-12}
- Test code pattern of OTU4: PRBS 2^{31}-1 @ 27.95Gb/s, BER is 1×10^{-12} when FEC is used or it is 1.8×10^{-4} when FEC is not used.

UC2-100G/ER4

Table 2-6 lists the optical features of the UC2-100G/ER4.

Table 2-6 Optical features of the UC2-100G/ER4

Parameter		Minimum value	Typical value	Maximum value	Remarks
Rate, each lane (Gbit/s)	100GE	–	25.78125	–	Compatible with data services and telecom services
	OTU4	–	27.9525	–	
Transmission distance (km)		–	–	40	The transmission distance is used to classify modules. The real transmission distance also depends on other factors, such as the line loss and SNR.
Laser type: LAN-WDM Laser					
Central wavelength (nm)		1294.53	1295.56	1296.59	–
		1299.02	1300.05	1301.09	–
		1303.54	1304.58	1305.63	–
		1308.09	1309.14	1310.19	–
SMSR(dB)		30	–	–	–
Average total launch power (dBm)	100GE	–	–	8.9	–
	OTU4	–	–	8.9	–
Launch power, each lane (dBm)	100GE	-2.9	–	2.9	–
	OTU4	-2.7	–	2.9	–
OMA, each lane (100GE) (dBm)		0.1	–	4.5	–
Difference in launch power between any two lanes (OMA) (dB)		–	–	3.6	–
Extinction ratio (dB)	100GE	7	–	–	–
	OTU4	7	–		–
Average launch power off transmitter, each lane (dBm)		–	–	-30	–

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Parameter		Minimum value	Typical value	Maximum value	Remarks
Eye mask {X1,X2,X3,Y1,Y2,Y3}		{0.25,0.4,0.45,0.25,0.28,0.4} ITU-T 959.1&IEEE802.3ba, Hit ratio=5E-5			
Receiver type: PIN/SOA					
Range of Rx wavelength (nm)		1294.53	1295.56	1296.59	–
		1299.02	1300.05	1301.09	–
		1303.54	1304.58	1305.63	–
		1308.09	1309.14	1310.19	–
Damage threshold, each lane (dBm)		5.5	–	–	–
Total average launch power (OTU4) (dBm)		–	–	10.5	–
Average launch power, each lane (dBm)	100GE	-20.9	–	4.5	–
	OTU4	-23.2	–	4.5	–
Rx optical power, each lane (OMA) (dBm)		–	–	4.5	–
Rx power difference between any two lanes (OMA) (dB)		–	–	4.5	–
Rx sensitivity, each lane (OMA) (dBm)	100GE	–	–	-21.4	–
	OTU4	–	–	-23.2	–
Optical path cost (dB)		–	–	2.5	–
Stressed Rx sensitivity (OMA), each lane (100GE) (dBm)		–	–	-17.9	–
VECP, each lane (dB)		–	3.5	–	Conditions for the stressed Rx sensitivity test
Stressed system J2 jitter (UI)		–	0.3	–	
Stressed system J9 jitter (UI)		–	0.47	–	
Rx reflection RFL (dB)		–	–	-26	
LOS assert (dBm)		-40	–	–	–
LOS de-assert (dBm)		–	–	-26	–
LOS hysteresis (dB)		0.5	–	5	–

Note

- Test code pattern of 100GE: PRBS 2^{31}-1 @ 25.78Gb/s, BER = 1×10^{-12}
- Test code pattern of OTU4: PRBS 2^{31}-1 @ 27.95Gb/s, BER is 1×10^{-12} when FEC is used or it is 1.8×10^{-4} when FEC is not used.

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UC2-100G/ZR4

Table 2-7 lists the optical features of the UC2-100G/ZR4 optical interface.

Table 2-7 Optical features of the UC2-100G/ZR4 optical interface

Parameter		Minimum value	Typical value	Maximum value	Remarks
Rate, each lane (Gbit/s)	100GE	–	25.78125	–	Compatible with data services and telecom services
	OTU4	–	27.9525	–	
Transmission distance (km)		–	–	80	The transmission distance is used to classify modules. The real transmission distance also depends on other factors, such as the line loss and SNR.
Laser type: LAN-WDM Laser					
Central wavelength (nm)		1294.53	1295.56	1296.59	–
		1299.02	1300.05	1301.09	–
		1303.54	1304.58	1305.63	–
		1308.09	1309.14	1310.19	–
SMSR(dB)		30	–	–	–
Average total launch power (dBm)		7	–	12.5	–
Average launch power, each lane (dBm)		1	–	6.5	–
OMA difference between any two lanes (dBm)		–	–	3	–
Extinction ratio (dB)		8	–	–	–
Output launch power off transmitter, each lane (dBm)		–	–	-30	–
Eye mask {X1,X2,X3,Y1,Y2,Y3}		{0.25,0.4,0.45,0.25,0.28,0.4} ITU-T 959.1&IEEE802.3ba, Hit ratio=5E-5			
Receiver type: PIN/SOA					
Range of Rx wavelength (nm)		1294.53	1295.56	1296.59	–
		1299.02	1300.05	1301.09	–
		1303.54	1304.58	1305.63	–
		1308.09	1309.14	1310.19	–
Damage threshold, each lane (dBm)		4.5	–	–	–

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Parameter	Minimum value	Typical value	Maximum value	Remarks
Average Rx optical power, each lane (dBm)	-28	–	4.5	Remark 1
Rx sensitivity, each lane (dBm)	–	–	-28	Remark 1
Rx reflection RFL (dB)	–	–	-26	–
LOS assert (dBm)	-40	–	–	–
LOS de-assert (dBm)	–	–	-29	–
LOS hysteresis (dB)	0.5	–	6	–

Note

- Test code pattern of the eye mask: PRBS 2^{31}-1 @ 25.78Gb/s/27.952 Gb/s
- Remark 1: for the test code pattern of PRBS 2^{31}-1 @ 27.952 Gb/s, BER is 1.8×10^{-4} when FEC is not used, or it is 1×10^{-12} when FEC is used. For the test code pattern of PRBS 2^{31}-1 @ 25.78125 Gb/s, BER is 5×10^{-5} when FEC is not used, or it is 1×10^{-12} when FEC is used.

UC2-100G/DCO (B)

Table 2-8 lists the optical features of the UC2-100G/DCO (B).

Table 2-8 Optical features of the UC2-100G/DCO (B)

Parameter	Minimum value	Typical value	Maximum value	Remarks
Optical interface performance indicators (Tx)				
Laser central frequency (THz)	191.3	193.7	196.10	–
Laser Tx frequency interval (GHz)	–	50	–	–
Laser Tx frequency stability (GHz)	-1.8	–	+1.8	–
SMSR (dB)	36	47	–	–
Launch optical power (dBm)	-9	-7	-2	–
Launch power stability (dB)	-0.5	–	0.5	–
Tx wavelength switching time (s)	–	–	60	–
Tx laser shutdown time (ms)	–	1	3	–
Tx OSNR (dB/0.1nm)	38	–	–	–
Tx optical return loss (dB)	27	–	–	–
Launch optical power off laser (dBm)	–	–	-36	–

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Parameter	Minimum value	Typical value	Maximum value	Remarks
Polarization-related launch optical power (dB)	–	–	1.0	–
Laser line width (kHz)	–	–	300	–
Laser average relative strength noise (dB/Hz)	–	-140	-135	–
I/Q time offset (ps)	–	–	2	–
X/Y time offset (ps)	–	–	5	–
QPSK modulation -20dB spectrum width (GHz)	40	–	–	–
Optical interface performance indicators (Rx)				
Rx central frequency (THz)	191.3	193.7	196.1	–
Optimal input optical power range (dBm)	-18	–	0	–
Rx sensitivity (dBm)	–	–	-32	When OFEC is enabled, OSNR > 35 dB, and the minimum input power sensitivity meets the requirements of post-FEC, the BER < 10^{-15}.
Overloading optical power (dBm)	0	–	–	–
OSNR tolerance (dB/0.1nm)	–	11.5	12.5	–
CD tolerance (ps/nm)	–	–	40000	–
DGD tolerance (ps)	90	–	–	–
LOS Assert power (dBm)	-38	–	–	–
LOS De-assert power (dBm)	–	–	-35	–
LOS Hysteresis power (dB)	–	–	3	–

Note

- The high-speed electrical signal eye mask and jitter comply with the CEI-28G-MR, SR, and VSR.
- The UC2-100G/DCO (B) supports Open Forward Error Correction (OFEC).
- The Optical Signal to Noise Ratio (OSNR) referred to in this document is Back to Back (B2B) value, instead of the system value. To calculate the system value, add the actual system cost (such as the costs on the site, long-distance transmission line, and optical instruments) to the B2B value.

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UC2-200G/DCO-E (B)

Table 2-9 lists optical features of the UC2-200G/DCO-E (B).

Table 2-9 Optical features of the UC2-200G/DCO-E (B)

Parameter	Minimum value	Typical value	Maximum value	Remarks
Optical interface performance indicators (Tx)				
Laser central frequency (THz)	191.3	193.7	196.10	–
Laser Tx frequency interval (GHz)	–	50	–	–
Laser Tx frequency stability (GHz)	-1.8	–	+1.8	–
SMSR (dB)	40	45	–	–
Launch optical power (dBm)	-5	0	5	–
Launch power stability (dB)	-0.5	–	0.5	–
Tx wavelength switching time (s)	–	–	60	–
Tx laser shutdown time (ms)	–	–	3	–
Tx OSNR (in-band, 16QAM) (dB/0.1nm)	35	–	–	–
Tx optical return loss (dB)	27	–	–	–
Launch optical power off laser (dBm)	–	–	-40	–
Polarization-related launch optical power (dB)	–	–	1.0	–
Laser line width (kHz)	100	–	300	–
Laser average relative strength noise (dB/Hz)	–	-140	-135	–
I/Q time offset (ps)	–	–	2	–
X/Y time offset (ps)	–	–	5	–
Optical interface performance indicators (Rx)				
Rx central frequency (THz)	191.3	193.7	196.1	–
Optimal input optical power range (dBm)	-18	–	5	–
16QAM Rx sensitivity (dBm)	–	–	-21	When OFEC is enabled, OSNR > 35 dB, and the minimum input power sensitivity meets the requirements of post-FEC, the BER < 10^{-15}.

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Parameter	Minimum value	Typical value	Maximum value	Remarks
Overloading optical power (dBm)	5	–	–	–
16QAM OSNR tolerance (dB/0.1nm)	–	19.5	21	–
CD tolerance (ps/nm)	–	–	40000	–
DGD tolerance (ps)	50	–	–	–
LOS Assert power (dBm)	-31	–	–	–
LOS De-assert power (dBm)	–	–	-29	–
LOS Hysteresis power (dB)	–	–	3	–

Note

- The high-speed electrical signal eye mask and jitter comply with the CEI-28G-MR, SR, and VSR.
- The UC2-200G/DCO-E (B) supports OFEC.
- The OSNR referred to in this document is B2B value, instead of the system value. To calculate the system value, add the actual system cost (such as the costs on the site, long-distance transmission line, and optical instruments) to the B2B value.

UC2-400G/DCO-E (B)

Table 2-10 lists optical features of the UC2-400G/DCO-E (B).

Table 2-10 Optical features of the UC2-400G/DCO-E (B)

Parameter	Minimum value	Typical value	Maximum value	Remarks
Optical interface performance indicators (all modulation formats, Tx)				
Laser central frequency (THz)	191.3	193.7	196.10	–
Laser Tx frequency interval (GHz)	–	75	–	–
Laser Tx frequency stability (GHz)	-1.8	–	1.8	–
Laser central frequency offset (GHz)	-1.8	–	1.8	–
Frequency fine tuning range (GHz)	-6.0	–	6.0	–
Frequency fine tuning accuracy (MHz)	–	100	–	–
Channel tuning rate (s)	–	–	45	–
Narrow line bandwidth optical source spectral width FWHM (kHz)	100	–	300	–

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Parameter	Minimum value	Typical value	Maximum value	Remarks
SMSR (dB)	36	37	–	Measured value after scanning the ±2.5 nm range around the target frequency in accuracy of 0.06 nm
Launch optical power (dBm)	-8	0	+5	Configure the step to 0.1 dB in the specified frequency range.
Launch power stability (dB)	-0.5	–	0.5	The output power varies with the temperature and time. It is measured every 10ms.
Power stability (EOL) (dB)	-0.5	–	0.5	Difference of the launch power generated according to the temperature, time, and wavelength
Launch power accuracy (BOL) (dB)	-1	–	1	Time-based difference between the preconfigured value at the early stage and the actual value
Launch power accuracy (EOL) (dB)	-2	–	2	Time-based difference between the preconfigured value at the final stage and the actual value
Hot start light-emitting enabling time (ms)	–	10	15	The module is in the power-on ready status. It is the maximum time from Tx_disable pin being pulled to the bottom to emitting light properly.
Tx laser shutdown time (ms)	–	1	3	The module is in the normal light-emitting status. It is the maximum time from Tx_disable and Low_power pin being pulled to the top to stopping emitting light.

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Parameter	Minimum value	Typical value	Maximum value	Remarks
Cold start light-emitting enabling time (s)	–	–	160	The module is in the lower-power-consumption status. It is the maximum time from Tx_disable and Low_power pin being pulled to the bottom to emitting light properly.
Tx OSNR (dB/0.1nm)	34	–	–	In-band, 16QAM
Tx optical return loss (dB)	27	–	–	–
Launch optical power off laser (dBm)	–	–	-40	–
Polarization-related launch optical power (dB)	–	–	1.0	Maximum optical power difference of the X pole and Y pole
Performance indicators of the optical interface (400G PS-16QAM HG SDFEC Rx)				
Rx central frequency (THz)	191.3	193.7	196.10	C band 75GHz ITU-T grid
Maximum input optical power range (dBm)	-12	–	0	–
OSNR sensitivity (dB/0.1nm)	–	21	22	Measured when the input optical power is -15 to -21 dBm
Rx sensitivity (dBm)	–	–	-20	Measured when the post-FEC is smaller than 1E-15, the OSNR is greater than 35 dB, and internal FEC is enabled
LOS assert (dBm)	–	–	-28	–
LOS de-assert (dBm)	–	–	-25	–
LOS Hysteresis (dB)	–	–	3	–
CD tolerance (ps/nm)	–	–	20000	0.5-dB OSNR penalty generated at the FEC threshold point
DGD tolerance (ps)	70	–	–	0.5-dB OSNR penalty generated at the FEC threshold point

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Parameter	Minimum value	Typical value	Maximum value	Remarks
PDL tolerance (dB)	3.5	–	–	Measured under the following conditions: • Polarization loss generated before loading noise • The SOP change is smaller than 1 r/ms. • 1.5-dB OSNR penalty is additionally generated.
SOP tolerance (rad/ms)	100	–	–	0.5-dB OSNR penalty generated at the FEC threshold point
Input power transient variation tolerance (dB)	3	–	–	When the received power is configured within the reasonable range and the rising/declining time (20–80% phase) of the power change is 50us or less, an OSNR penalty of 0.5 dB will be generated.
Input power reading accuracy (dB)	-2	–	2	–
Optical return loss (dB)	27	–	–	–
Normal time of the cold start receiving function	–	–	160	The module is in the low-power-consumption status and has valid input signals. The time is from releasing the lower-power-consumption signal to normal working of the Rx side.
RX LOS Assert time (us)	–	–	100	–
RX LOS De-assert time (us)	–	–	100	0.5-dB OSNR penalty generated at the FEC threshold point
Performance indicators of the optical interface (200G PS-16QAM SDFEC, Rx)				
Received central frequency (THz)	191.3	193.7	196.10	C band 75GHz ITU-T grid
Optimal input optical power range (dBm)	-18	–	5	–

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Parameter	Minimum value	Typical value	Maximum value	Remarks
OSNR sensitivity (dB/0.1nm)	–	16	17	Measured when the input optical power is -15 to -21 dBm
Rx sensitivity (dBm)	–	–	-21	Measured when the post-FEC is smaller than 1E-15, the OSNR is greater than 35 dB, and internal FEC is enabled
LOS assert (dBm)	–	–	-28	–
LOS de-assert (dBm)	–	–	-25	–
LOS Hysteresis (dB)	–	–	3	–
CD tolerance (ps/nm)	–	–	40000	0.5-dB OSNR penalty generated at the FEC threshold point
DGD tolerance (ps)	70	–	–	0.5-dB OSNR penalty generated at the FEC threshold point
PDL tolerance (dB)	3.5	–	–	Measured under the following conditions: • Polarization loss generated before loading noise • The SOP change is smaller than 1 r/ms. • 1.5-dB OSNR penalty is additionally generated.
SOP tolerance (rad/ms)	100	–	–	0.5-dB OSNR penalty generated at the FEC threshold point
Input power transient variation tolerance (dB)	3	–	–	When the received power is configured within the reasonable range and the rising/declining time (20–80% phase) of the power change is 50us or less, an OSNR penalty of 0.5 dB will be generated.
Input power reading accuracy (dB)	-2	–	2	–
Optical return loss (dB)	27	–	–	–

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Parameter	Minimum value	Typical value	Maximum value	Remarks
Normal time of the cold start receiving function	–	–	160	The module is in the low-power-consumption status and has valid input signals. The time is from releasing the lower-power-consumption signal to normal working of the Rx side.
RX LOS Assert time (us)	–	–	100	–
RX LOS De-assert time (us)	–	–	100	–
Performance indicators of the optical interface (200G DP-QPSK SDFEC, Rx)				
Received central frequency (THz)	191.3	193.7	196.10	C band 75GHz ITU-T grid
Optimal input optical power range (dBm)	-18	–	5	–
OSNR sensitivity (dB/0.1nm)	–	14	15	Measured when the input optical power is -15 to -21 dBm
Rx sensitivity (dBm)	–	–	-21	Measured when the post-FEC is smaller than 1E-15, the OSNR is greater than 35 dB, and internal FEC is enabled
LOS assert (dBm)	–	–	-28	–
LOS de-assert (dBm)	–	–	-25	–
LOS Hysteresis (dB)	–	–	3	–
CD tolerance (ps/nm)	–	–	40000	0.5-dB OSNR penalty generated at the FEC threshold point
DGD tolerance (ps)	70	–	–	0.5-dB OSNR penalty generated at the FEC threshold point

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Parameter	Minimum value	Typical value	Maximum value	Remarks
PDL tolerance (dB)	3.5	–	–	Measured under the following conditions: • Polarization loss generated before loading noise • The SOP change is smaller than 1 r/ms. 1.5-dB OSNR penalty is additionally generated.
SOP tolerance (rad/ms)	100	–	–	0.5-dB OSNR penalty generated at the FEC threshold point
Input power transient variation tolerance (dB)	3	–	–	When the received power is configured within the reasonable range and the rising/declining time (20–80% phase) of the power change is 50us or less, an OSNR penalty of 0.5 dB will be generated.
Input power reading accuracy (dB)	-2	–	2	–
Optical return loss (dB)	27	–	–	–
Normal time of the cold start receiving function	–	–	160	The module is in the low-power-consumption status and has valid input signals. The time is from releasing the lower-power-consumption signal to normal working of the Rx side.
RX LOS Assert time (us)	–	–	100	–
RX LOS De-assert time (us)	–	–	100	–

Note

- The high-speed electrical signal interface complies with CEI-56G-VSR-PAM4 Clause 16(56G PAM4) in the OIF-CEI-04.0 standard or CEI-28G-VSR Clause 13(28G NRZ) in the OIF-CEI-04.0 standard.

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- The UC2-400G/DCO-E (B) supports the following FEC algorithm: SD-FEC. It supports the 75-GHz sending frequency interval for 64 channels of DWDM application or 100-GHz sending frequency interval for 48 channels of DWDM application.
- The Optical Signal to Noise Ratio (OSNR) referred to in this document is Back to Back (B2B) value, instead of the system value. To calculate the system value, add the actual system cost (such as the costs on the site, long-distance transmission line, and optical instruments) to the B2B value.

UC2-400G/DCO-WE (B)

Table 2-11 lists optical features of the UC2-400G/DCO-WE (B).

Table 2-11 Optical features of the UC2-400G/DCO-WE (B)

Parameter	Minimum value	Typical value	Maximum value	Remarks
Optical interface performance indicators (all modulation formats, Tx)				
Laser central frequency (THz)	190.7	193.7	196.7	–
Laser Tx frequency interval (GHz)	–	75	–	–
Laser Tx frequency stability (GHz)	-1.8	–	1.8	–
Laser central frequency offset (GHz)	-1.8	–	1.8	–
Frequency fine tuning range (GHz)	-6.0	–	6.0	–
Frequency fine tuning accuracy (MHz)	–	100	–	–
Channel tuning rate (s)	–	–	45	–
Narrow line bandwidth optical source spectral width FWHM (kHz)	100	–	300	–
SMSR (dB)	36	37	–	Measured value after scanning the ±2.5 nm range around the target frequency in accuracy of 0.06 nm
Launch optical power (dBm)	-8	0	+5	Configure the step to 0.1 dB in the specified frequency range.
Launch power stability (dB)	-0.5	–	0.5	The output power varies with the temperature and time. It is measured every 10ms.
Power stability (EOL) (dB)	-0.5	–	0.5	Difference of the launch power generated according to the temperature, time, and wavelength

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Parameter	Minimum value	Typical value	Maximum value	Remarks
Launch power accuracy (BOL) (dB)	-1	–	1	Time-based difference between the preconfigured value at the early stage and the actual value
Launch power accuracy (EOL) (dB)	-2	–	2	Time-based difference between the preconfigured value at the final stage and the actual value
Hot start light-emitting enabling time (ms)	–	10	15	The module is in the power-on ready status. It is the maximum time from Tx_disable pin being pulled to the bottom to emitting light properly.
Tx laser shutdown time (ms)	–	1	3	The module is in the normal light-emitting status. It is the maximum time from Tx_disable and Low_power pin being pulled to the top to stopping emitting light.
Cold start light-emitting enabling time (s)	–	–	160	The module is in the lower-power-consumption status. It is the maximum time from Tx_disable and Low_power pin being pulled to the bottom to emitting light properly.
Tx OSNR (dB/0.1nm)	34	–	–	In-band, 16QAM
Tx optical return loss (dB)	27	–	–	–
Launch optical power off laser (dBm)	–	–	-40	–
Polarization-related launch optical power (dB)	–	–	1.0	Maximum optical power difference of the X pole and Y pole
Performance indicators of the optical interface (400G PS-16QAM HG SDFEC Rx)				
Rx central frequency (THz)	190.7	193.7	196.7	C band 75GHz ITU-T grid

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Parameter	Minimum value	Typical value	Maximum value	Remarks
Maximum input optical power range (dBm)	-12	–	0	–
OSNR sensitivity (dB/0.1nm)	–	21	22	Measured when the input optical power is -15 to -21 dBm
Rx sensitivity (dBm)	–	–	-20	Measured when the post-FEC is smaller than 1E-15, the OSNR is greater than 35 dB, and internal FEC is enabled
LOS assert (dBm)	–	–	-28	–
LOS de-assert (dBm)	–	–	-25	–
LOS Hysteresis (dB)	–	–	3	–
CD tolerance (ps/nm)	–	–	20000	0.5-dB OSNR penalty generated at the FEC threshold point
DGD tolerance (ps)	70	–	–	0.5-dB OSNR penalty generated at the FEC threshold point
PDL tolerance (dB)	3.5	–	–	Measured under the following conditions: • Polarization loss generated before loading noise • The SOP change is smaller than 1 r/ms. • 1.5-dB OSNR penalty is additionally generated.
SOP tolerance (rad/ms)	100	–	–	0.5-dB OSNR penalty generated at the FEC threshold point
Input power transient variation tolerance (dB)	3	–	–	When the received power is configured within the reasonable range and the rising/declining time (20–80% phase) of the power change is 50us or less, an OSNR penalty of 0.5 dB will be generated.

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Parameter	Minimum value	Typical value	Maximum value	Remarks
Input power reading accuracy (dB)	-2	–	2	–
Optical return loss (dB)	27	–	–	–
Normal time of the cold start receiving function	–	–	160	The module is in the low-power-consumption status and has valid input signals. The time is from releasing the lower-power-consumption signal to normal working of the Rx side.
RX LOS Assert time (us)	–	–	100	–
RX LOS De-assert time (us)	–	–	100	0.5-dB OSNR penalty generated at the FEC threshold point
Performance indicators of the optical interface (200G PS-16QAM SDFEC, Rx)				
Received central frequency (THz)	190.7	193.7	196.7	C band 75GHz ITU-T grid
Optimal input optical power range (dBm)	-18	–	5	–
OSNR sensitivity (dB/0.1nm)	–	16	17	Measured when the input optical power is -15 to -21 dBm
Rx sensitivity (dBm)	–	–	-21	Measured when the post-FEC is smaller than 1E-15, the OSNR is greater than 35 dB, and internal FEC is enabled
LOS assert (dBm)	–	–	-28	–
LOS de-assert (dBm)	–	–	-25	–
LOS Hysteresis (dB)	–	–	3	–
CD tolerance (ps/nm)	–	–	40000	0.5-dB OSNR penalty generated at the FEC threshold point
DGD tolerance (ps)	70	–	–	0.5-dB OSNR penalty generated at the FEC threshold point

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Parameter	Minimum value	Typical value	Maximum value	Remarks
PDL tolerance (dB)	3.5	–	–	Measured under the following conditions: • Polarization loss generated before loading noise • The SOP change is smaller than 1 r/ms. • 1.5-dB OSNR penalty is additionally generated.
SOP tolerance (rad/ms)	100	–	–	0.5-dB OSNR penalty generated at the FEC threshold point
Input power transient variation tolerance (dB)	3	–	–	When the received power is configured within the reasonable range and the rising/declining time (20–80% phase) of the power change is 50us or less, an OSNR penalty of 0.5 dB will be generated.
Input power reading accuracy (dB)	-2	–	2	–
Optical return loss (dB)	27	–	–	–
Normal time of the cold start receiving function	–	–	160	The module is in the low-power-consumption status and has valid input signals. The time is from releasing the lower-power-consumption signal to normal working of the Rx side.
RX LOS Assert time (us)	–	–	100	–
RX LOS De-assert time (us)	–	–	100	–
Performance indicators of the optical interface (200G DP-QPSK SDFEC, Rx)				
Received central frequency (THz)	190.7	193.7	196.7	C band 75GHz ITU-T grid
Optimal input optical power range (dBm)	-18	–	5	–

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Parameter	Minimum value	Typical value	Maximum value	Remarks
OSNR sensitivity (dB/0.1nm)	–	14	15	Measured when the input optical power is -15 to -21 dBm
Rx sensitivity (dBm)	–	–	-21	Measured when the post-FEC is smaller than 1E-15, the OSNR is greater than 35 dB, and internal FEC is enabled
LOS assert (dBm)	–	–	-28	–
LOS de-assert (dBm)	–	–	-25	–
LOS Hysteresis (dB)	–	–	3	–
CD tolerance (ps/nm)	–	–	40000	0.5-dB OSNR penalty generated at the FEC threshold point
DGD tolerance (ps)	70	–	–	0.5-dB OSNR penalty generated at the FEC threshold point
PDL tolerance (dB)	3.5	–	–	Measured under the following conditions: • Polarization loss generated before loading noise • The SOP change is smaller than 1 r/ms. 1.5-dB OSNR penalty is additionally generated.
SOP tolerance (rad/ms)	100	–	–	0.5-dB OSNR penalty generated at the FEC threshold point
Input power transient variation tolerance (dB)	3	–	–	When the received power is configured within the reasonable range and the rising/declining time (20–80% phase) of the power change is 50us or less, an OSNR penalty of 0.5 dB will be generated.
Input power reading accuracy (dB)	-2	–	2	–
Optical return loss (dB)	27	–	–	–

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Parameter	Minimum value	Typical value	Maximum value	Remarks
Normal time of the cold start receiving function	–	–	160	The module is in the low-power-consumption status and has valid input signals. The time is from releasing the lower-power-consumption signal to normal working of the Rx side.
RX LOS Assert time (us)	–	–	100	–
RX LOS De-assert time (us)	–	–	100	–

Note

- The high-speed electrical signal interface complies with CEI-56G-VSR-PAM4 Clause 16(56G PAM4) in the OIF-CEI-04.0 standard or CEI-28G-VSR Clause 13(28G NRZ) in the OIF-CEI-04.0 standard.
- The UC2-400G/DCO-E (B) supports the following FEC algorithm: SD-FEC. It supports the 75-GHz sending frequency interval for 80 channels of DWDM application.
- The Optical Signal to Noise Ratio (OSNR) referred to in this document is Back to Back (B2B) value, instead of the system value. To calculate the system value, add the actual system cost (such as the costs on the site, long-distance transmission line, and optical instruments) to the B2B value.

2.4.2 Electical features

Electrical interfaces include Tx (1, 2, 3, 4, 5, 6, 7, and 8) n/p PINs and Rx (1, 2, 3, 4, 5, 6, 7, and 8) n/p PINs. The letter n indicates the negative direction while the letter p indicates the positive direction.

UC2-100G/LR4

Table 2-12 lists electrical features of the UC2-100G/LR4.

Table 2-12 Electrical features of the UC2-100G/LR4

Parameter	Minimum value	Typical value	Maximum value	Remarks
Tx (1, 2, 3, and 4) n/p input PINs				
Differential peak-to-peak voltage (mV)	–	–	900	–
AC common mode output noise (mV)	–	–	17.5	RMS
Common mode input voltage Vcm (V)	-0.3	–	2.8	–

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Parameter	Minimum value	Typical value	Maximum value	Remarks
Stressed input test	CEI-28G-VSR, IEEE 802.3bm			–
Rx (1, 2, 3, and 4) n/p output PINs				
Differential peak-to-peak voltage (mV)	–	–	900	–
AC common mode output noise (mV)	–	–	17.5	RMS
Transient time (20%–80%) (ps)	9.5	–	–	Tr, Tf
Eye width (UI)	0.57	–	–	10^{-15} probability condition
Eye height (mV)	228	–	–	10^{-15} probability condition
Output electric eye mask	CEI-28G-VSR, IEEE802.3bm			–

UC2-100G/ER4

Table 2-13 lists electrical features of the UC2-100G/ER4.

Table 2-13 Electrical features of the UC2-100G/ER4

Parameter	Minimum value	Typical value	Maximum value	Remarks
Tx (1, 2, 3, and 4) n/p input PINs				
Differential peak-to-peak voltage (mV)	–	–	1050	–
AC common mode output noise (mV)	–	–	17.5	RMS
Common mode input voltage Vcm (V)	-0.3	–	2.8	–
Stressed input test	CEI-28G-VSR, IEEE 802.3bm			–
Rx (1, 2, 3, and 4) n/p output PINs				
Differential peak-to-peak voltage (mV)	–	–	1000	–
AC common mode output noise (mV)	–	–	17.5	RMS
Transient time (20%–80%) (ps)	9.5	–	–	Tr, Tf
Eye width (UI)	0.57	–	–	10^{-15} probability condition
Eye height (mV)	228	–	–	10^{-15} probability condition
Output electric eye mask	CEI-28G-VSR, IEEE802.3bm			–

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UC2-100G/ZR4

Table 2-14 lists electrical features of the UC2-100G/ZR4.

Table 2-14 Electrical features of the UC2-100G/ZR4

Parameter	Minimum value	Typical value	Maximum value	Remarks
Tx (1, 2, 3, and 4) n/p input PINs				
Differential peak-to-peak voltage (mV)	85	–	900	–
AC common mode output noise (mV)	–	–	17.5	RMS
Common mode input voltage Vcm (V)	-0.3	–	2.8	–
Stress input test	CEI-28G-VSR, IEEE802.3bm			–
Rx (1, 2, 3, and 4) n/p output PINs				
Differential peak-to-peak voltage (mV)	200	–	900	–
AC common mode output noise (mV)	–	–	17.5	RMS
Transient time (20%–80%) (ps)	12	–	–	Tr, Tf
Eye width (UI)	0.57	–	–	10^{-15} probability condition
Eye height (mV)	228	–	–	10^{-15} probability condition
Output electric eye mask	CEI-28G-VSR, IEEE802.3bm			< 10 GHz

UC2-100G/DCO (B)

Table 2-15 lists electrical features of the UC2-100G/DCO (B).

Table 2-15 Electrical features of the UC2-100G/DCO (B)

Parameter	Minimum value	Typical value	Maximum value	Remarks
Tx (1, 2, 3, and 4) n/p input PINs				
Rate, each lane (Gbit/s)	25.78	–	28.3	• ±20ppm, OTU4 • ±100ppm, 100GE
Differential peak-to-peak voltage (mV)	85	1000	1600	–
DC common mode input voltage (mV)	–	450	–	–
Input impedance (Ω)	80	100	120	–
Common mode return loss (dB)	–	–	-6	< 10 GHz

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Parameter	Minimum value	Typical value	Maximum value	Remarks
	–	–	-4	10 GHz to baud rate
Sinusoidal Jitter, Max (UIpp)	–	–	5	–
Sinusoidal Jitter, High Frequency (UIpp)	–	–	0.05	–
Rx (1, 2, 3, and 4) n/p output PINs				
Rate, each lane (Gbit/s)	25.78	–	28.3	• ±20ppm, OTU4 • ±100ppm, 100GE
Differential peak-to-peak voltage (mV)	0	1000	1200	–
DC common mode output voltage (mV)	–	450	–	–
Output impedance (Ω)	80	100	120	–
Transient time (20%–80%) (ps)	–	9	–	Tr, Tf
Common mode return loss (dB)	–	–	-6	< 10 GHz
	–	–	-4	10 GHz to baud rate
Total jitter	–	–	0.28	–
Total jitter (UIpp)	–	–	0.28	–

UC2-200G/DCO-E (B)

Table 2-16 lists electrical features of the UC2-200G/DCO-E (B).

Table 2-16 Electrical features of the UC2-200G/DCO-E (B)

Parameter	Minimum value	Typical value	Maximum value	Remarks
Tx (1, 2, 3, 4, 5, 6, 7, 8) n/p input PINs				
Rate, each lane (Gbit/s)	25.78	–	28.3	• ±20ppm, OTU4 • ±100ppm, 100GE
Differential peak-to-peak voltage (mV)	85	1000	1600	–
DC common mode input voltage (mV)	–	450	–	–
Input impedance (Ω)	80	100	120	–
Common mode return loss (dB)	–	–	-6	< 10 GHz
	–	–	-4	10 GHz to baud rate

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Parameter	Minimum value	Typical value	Maximum value	Remarks
Sinusoidal Jitter, Max (UIpp)	–	–	5	–
Sinusoidal Jitter, High Frequency (UIpp)	–	–	0.05	–
Rx (1, 2, 3, 4, 5, 6, 7, 8) n/p output PINs				
Rate, each lane (Gbit/s)	25.78	–	28.3	• ±20ppm, OTU4 • ±100ppm, 100GE
Differential peak-to-peak voltage (mV)	0	1000	1100	–
DC common mode output voltage (mV)	–	450	–	–
Output impedance (Ω)	80	100	120	–
Transient time (20%–80%) (ps)	–	9	–	Tr, Tf
Common mode return loss (dB)	–	–	-6	< 10 GHz
	–	–	-4	10 GHz to baud rate
Total jitter (UIpp)	–	–	0.28	–

UC2-400G/DCO-E(B)

Table 2-17 Performance indicators of the high-rate electrical interface on the UC2-400G/DCO-E (B)

Application	Client MDI	Client lane rate (Gb/s)	PCS FEC	Reference
400G	1*400GAUI-8	8*26.56Gbps PAM4(±100ppm)	RS-FEC(544,514)	• IEEE802.3-2018 Clause 91,119 • IEEE802.3-2018 Annex 120E(C2M)
400G	4*100GAUI-2	8*26.56Gbps PAM4(±100ppm)		
400G	4*OTL4.2	8*27.95Gbps PAM4(±20ppm)	GFEC(255,239)	• ITU-T G.Sup58(10/2018) • OIF -CEI-04.0 CEI-28G-VSR Clause 13
200G	2*100G CAUI-4	8*25.78Gbps(±100 ppm)	None	IEEE802.3-2018,Clause 83D,93,91 and Annex 83E(C2M)
200G	2*100G CAUI-4 with KR4 FEC	8*25.78Gbps(±100 ppm)	RS-FEC(528,514)	

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Application	Client MDI	Client lane rate (Gb/s)	PCS FEC	Reference
200G	2*OTL4.4	8*27.95Gbps(±20ppm)	None	• ITU-T G.Sup58(10/2018) • OIF -CEI-04.0 CEI-28G-VSR Clause 13

Table 2-18 Performance indicators of the OHIO interface on the UC2-400G/DCO-E (B) in the 1.25 Gbit/s mode

Parameter	Symbol	Condition	Min	Typical	Max	Unit
Transmitter and receiver indicators						
Serial bit rate	F_bit	1.250±100ppm				Gb/s
Transmitter indicators						
Differential peak-to-peak Output Voltage Transmitter enabled	Vodiff	Note 1	360	–	760	mV
Differential peak-to-peak Output Voltage Transmitter disabled	Vodiff_off	Note 1	–	–	110	mV
Rise and Fall Time	tr,tf	20%~80%	24	–	327	Ps
Differential Skew	tskw	P to N	–	–	25	ps
Deterministic jitter	Dj	Note 2	–	–	0.100	UIpp
Total jitter	Tj	Note 2	–	–	0.240	Uipp
Receiving indicators						
Differential peak-to-peak Input Voltage	Vidiff	–	200	–	1200	mV
Total Input Jitter Tolerance	Jtol_t	Note 2	0.749	–	–	UIpp
Determinstic Input Jitter Tolerance	Jtol_d	Note 2	0.462	–	–	UIpp

Note:

1: voltage measurements were performed by using an AC-coupled 100Ω load.

2. The jitter indicates high frequency jitter (above 657 kHz), not low frequency jitter or drift. The random jitter calculation formula is Random jitter = (Total Jitter) - (Deterministic Jitter), BER = 1E-12. The deterministic jitter pattern is K28.5+/K28.5-pattern.

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Table 2-19 Performance indicators of the OHIO interface on the UC2-400G/DCO-E (B) in the 3.125 Gbit/s mode

Parameter	Symbol	Condition	Min	Typical	Max	Unit
Transmitter and receiver indicators						
Serial bit rate	F_bit	3.125±100ppm				Gb/s
Transmitter indicators						
Differential peak-to-peak Output Voltage Transmitter enabled	Vodiff	Note 1	360	–	760	mV
Differential Output Return Loss Max 312.5MHz<f<625MHz	SD22	Note2	-10			dB
Differential Output Return Loss Max 625MHz<f<3.125MHz			-10+10*log(f/625)			
Deterministic jitter	Dj	Note 3	–	–	0.17	UIpp
Total jitter	Tj	Note 3	–	–	0.35	Uipp
Receiver indicators						
Differential peak-to-peak Input Voltage	Vidiff		200	–	1200	mV
Differential Input Return Loss 100 MHz≤f≤2.5GHz	SD11_d	Note4	–	–	-10	dB
Common-mode Input Return Loss 100 MHz≤f≤2.5GHz	SD11_c		–	–	-6	
Total Input Jitter Tolerance	Jtol_t	Note 3	0.65	–	–	UIpp
Determinstic Input Jitter Tolerance	Jtol_d	Note 3	0.37	–	–	UIpp

Note:

1: voltage measurements were performed by using an AC-coupled 100Ω load.

2. based on 100-Ω benchmark voltage, the frequency f is expressed by MHz.

3. The jitter indicates high frequency jitter (above 1.875 MHz), not low frequency jitter or drift. The random jitter calculation formula is Random jitter = (Total Jitter) - (Deterministic Jitter), BER = 1E-12. The deterministic jitter pattern is K28.5+/K28.5-pattern.

4. The differential return loss is measured based on the 100-Ω benchmark voltage. The common-mode return loss is measured based on the 25-Ω benchmark voltage.

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UC2-400G/DCO-WE (B)

Table 2-20 Performance indicators of the high-rate electrical interface on the UC2-400G/DCO-WE (B)

Application	Client MDI	Client lane rate (Gb/s)	PCS FEC	Reference
400G	1*400GAUI-8	8*26.56Gbps PAM4(±100ppm)	RS-FEC(544,514)	• IEEE802.3-2018 Clause 91,119 • IEEE802.3-2018 Annex 120E(C2M)
400G	4*100GAUI-2	8*26.56Gbps PAM4(±100ppm)		
400G	4*OTL4.2	8*27.95Gbps PAM4(±20ppm)	GFEC(255,239)	• ITU-T G.Sup58(10/2018) • OIF -CEI-04.0 CEI-28G-VSR Clause 13
200G	2*100G CAUI-4	8*25.78Gbps(±100 ppm)	None	IEEE802.3-2018,Clause 83D,93,91 and Annex 83E(C2M)
200G	2*100G CAUI-4 with KR4 FEC	8*25.78Gbps(±100 ppm)	RS-FEC(528,514)	
200G	2*OTL4.4	8*27.95Gbps(±20p pm)	None	• ITU-T G.Sup58(10/2018) • OIF -CEI-04.0 CEI-28G-VSR Clause 13

Table 2-21 Performance indicators of the OHIO interface on the UC2-400G/DCO-WE (B) in the 1.25 Gbit/s mode

Parameter	Symbol	Condition	Min	Typical	Max	Unit
Transmitter and receiver indicators						
Serial bit rate	F_bit	1.250±100ppm				Gb/s
Transmitter indicators						
Differential peak-to-peak Output Voltage Transmitter enabled	Vodiff	Note 1	360	–	760	mV
Differential peak-to-peak Output Voltage Transmitter disabled	Vodiff_ off	Note 1	–	–	110	mV
Rise and Fall Time	tr,tf	20%~80 %	24	–	327	Ps
Differential Skew	tskw	P to N	–	–	25	ps
Deterministic jitter	Dj	Note 2	–	–	0.100	UIpp
Total jitter	Tj	Note 2	–	–	0.240	Uipp

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Parameter	Symbol	Condition	Min	Typical	Max	Unit
Receiving indicators						
Differential peak-to-peak Input Voltage	Vidiff	–	200	–	1200	mV
Total Input Jitter Tolerance	Jtol_t	Note 2	0.749	–	–	UIpp
Determinstic Input Jitter Tolerance	Jtol_d	Note 2	0.462	–	–	UIpp
Note: 1: voltage measurements were performed by using an AC-coupled 100Ω load. 2. The jitter indicates high frequency jitter (above 657 kHz), not low frequency jitter or drift. The random jitter calculation formula is Random jitter = (Total Jitter) - (Deterministic Jitter), BER = 1E-12. The deterministic jitter pattern is K28.5+/K28.5-pattern.						

Table 2-22 Performance indicators of the OHIO interface on the UC2-400G/DCO-WE (B) in the 3.125 Gbit/s mode

Parameter	Symbol	Condition	Min	Typical	Max	Unit
Transmitter and receiver indicators						
Serial bit rate	F_bit	3.125±100ppm				Gb/s
Transmitter indicators						
Differential peak-to-peak Output Voltage Transmitter enabled	Vodiff	Note 1	360	–	760	mV
Differential Output Return Loss Max 312.5MHz<f<625MHz	SD22	Note2	-10			dB
Differential Output Return Loss Max 625MHz<f<3.125MHz			-10+10*log(f/625)			
Deterministic jitter	Dj	Note 3	–	–	0.17	UIpp
Total jitter	Tj	Note 3	–	–	0.35	Uipp
Receiver indicators						
Differential peak-to-peak Input Voltage	Vidiff		200	–	1200	mV
Differential Input Return Loss 100 MHz≤f≤2.5GHz	SD11_d	Note4	–	–	-10	dB
Common-mode Input Return Loss 100 MHz≤f≤2.5GHz	SD11_c		–	–	-6	
Total Input Jitter Tolerance	Jtol_t	Note 3	0.65	–	–	UIpp
Determinstic Input Jitter Tolerance	Jtol_d	Note 3	0.37	–	–	UIpp

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Note:

1: voltage measurements were performed by using an AC-coupled 100Ω load.

2. based on 100-Ω benchmark voltage, the frequency f is expressed by MHz.

3. The jitter indicates high frequency jitter (above 1.875 MHz), not low frequency jitter or drift. The random jitter calculation formula is Random jitter = (Total Jitter) - (Deterministic Jitter), BER = 1E-12. The deterministic jitter pattern is K28.5+/K28.5-pattern.

4. The differential return loss is measured based on the 100-Ω benchmark voltage. The common-mode return loss is measured based on the 25-Ω benchmark voltage.

2.5 Appearance and dimension

2.5.1 Optical module

Figure 2-1 shows the dimensions of the UC2 module (the UC2-100G/LR4 pull-tab is blue. The UC2-100G/ER4 pull-tab is red. The UC2-100G/ZR4 pull-tab is white). The color of the pull-tab of other models is subject to the actual module.

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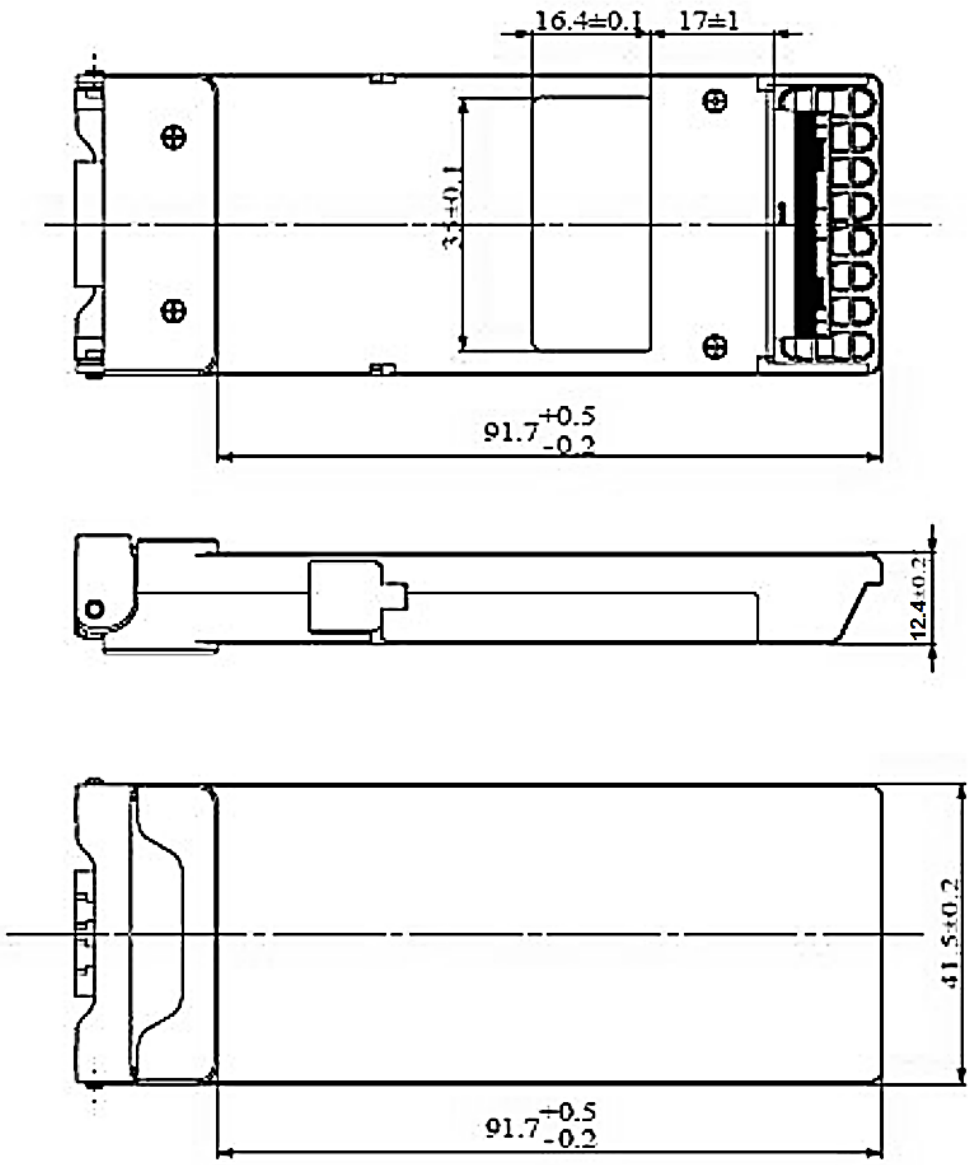
Figure 2-1 Dimensions (mm) of the UC2 optical module

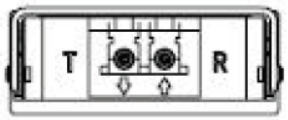


2.5.2 Optical interface

The UC2 module adopts the standard LC dual-fiber connector which needs to be inserted with LC fiber.

- The wavelength of the 4 or 8 channels is added/dropped by the module.
- The definition of the channels is shown in Figure 2-2. The position of the 2 channels in sequential order is: Tx channel (T) and Rx channel (R)

Figure 2-2 Appearance of the LC connector



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3 Installation and uninstallation

- During any operation or maintenance process, pay attention to laser safety. Do not stare into the optical interface or fiber connector with eyes directly or through an instrument, to prevent laser from damaging eyes.
- Before connecting the fiber, use an optical power meter to measure the current optical power of the fiber. When the current optical power is smaller than the overload point of the optical module, you can connect the fiber. When the current optical power is greater than the overload point of the optical module, bit error or device damage may occur. When the current optical power is lower than the sensitivity, services will be blocked.
- When using the UC2 optical module, do not use the optical fiber jumper to performance hardware loopback (in other words, use a fiber to connect the Tx interface of the UC2 optical module to the Rx interface directly), otherwise the device will be damaged. Before using the optical fiber jumper to performance hardware loopback, add a 10-dB fiber attenuator to the UC2 optical module so that the optical power is smaller than the overload point but greater than the Rx sensitivity.

- While transporting and using the optical module, avoid violent vibration and crash. Otherwise, the precise photoelectric components inside the optical module may be damaged.
- While installing the optical module, take ESD measures to prevent the optical module from being damaged. The module interface and optical fiber are highly precise, do not insert them and pull them out frequently.
- If the Rx optical power at the Rx end of the optical module exceeds the threshold, the optical module may be damaged.
- Clean the fiber end face before inserting the fiber jumper to the optical module interface so as to keep the optical module interface clean. Otherwise, the performance of the optical module may be affected.
- While removing the optical module, unlock it from the device. Otherwise, the optical module or the connector may be permanently damaged.
- When you do not use the UC2 optical module, put the dustproof plug over the interface of the module and the fiber and put the optical module in an anti-static bag. Therefore, keep the dustproof plug for future use while installing the optical module. In addition, keep the slots on the UC2 away from dust.
- Do not fix the optical module by yourself.

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The installation and uninstallation of the UC2 optical module are simple.

For installation, install the UC2 module, and then insert the fiber.

Step 1 Insert it to the slot.

Step 2 Push it to the end of the slot until it is locked with the device.

For uninstallation, remove the fiber from the UC2 optical module, and then remove the UC2 optical module.

Step 1 Bend the pull tab to a degree of 90 °to unlock the UC2 optical module from the guide rail.

Step 2 Pull out the optical module from the guide rail at this angle of the pull tag.

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4 Appendix

This chapter includes the following sections:

- FAQs
- Terms
- Abbreviations

4.1 FAQs

This chapter mainly describes the FAQs and the corresponding solutions, as listed in Table 4-1.

Table 4-1 FAQs and solutions

No.	Fault	Solution
1	The LOS LED is lit up (or the LNK LED is off) when the UC2 optical module accesses optical signals.	• Check the cleanness of the optical interface of the UC2 optical module. • Confirm that the speed of accessed optical signals matches with the UC2 optical module. • Confirm that the configured rate of the optical interface of the UC2 optical module matches with the UC2 optical module. • Check whether the Rx optical power of the related optical interface is greater than the minimum overload or is smaller than the Rx sensitivity. If the Rx optical power is greater than the minimum overload, it may damage the UC2 optical module. • If the Rx optical power is smaller than the Rx sensitivity, it may cause the device to fail to be registered. If it is a SM UC2 optical module, check whether the wavelength and rate of the UC2 optical modules on both ends are matched.

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No.	Fault	Solution
2	No optical power is output when the UC2 optical module is powered on.	• Check the cleanness of the optical interface of the UC2 optical module. • Check whether the end-face of the jumper is contaminated or damaged. • Check whether the UC2 optical module is damaged. • Check whether the device is enabled with functions that may cause the laser to be shut down, such as link-state tracking or ALS. • Check whether the Tx-side laser of the optical interface is shut down. • If there is a Tx_fault alarm, perhaps the operating condition is bad or the UC2 optical module fails.
3	DDM data exceeds the normal range and alarms are generated.	• If the temperature alarm is generated frequently, we recommend improving the heat-dissipation environment. • The generation of current/voltage alarms concerns the operating status of the device. • The Tx optical power alarm may cause Tx_fault. Therefore, we recommend changing the UC2 optical module. • If the alarm is generated because the Rx optical power is low, maybe the Rx-side optical power is too low or the UC2 optical module is damaged, we recommend changing the UC2 optical module. If the alarm is generated because the Rx optical power exceeds the threshold, we recommend adding an optical attenuator.
4	DDM Tx/Rx optical power is normal but the measured optical power is abnormal.	• Check the cleanness of the optical interface of the UC2 optical module. • Check whether the end-face of the jumper is contaminated or damaged. • Check whether the precision of the optical power meter is normal.
5	The LOL LED is lit up after the UC2 optical module is powered on.	• Check whether the Rx side of the UC2 optical module has accessed optical signals. If not, the LOS alarm threshold of the UC2 optical module is configured too small. Therefore, you should change the UC2 optical module. • If the problem still exists after services are accessed at the UC2 optical module side, check rate configurations of the optical interface. • Pull out and then insert the UC2 optical module again or restart the device.
6	After the UC2 optical module is powered on, the Tx optical power is normal. However, the device fails to communicate with the remote device.	• Check whether the Rx side of the UC2 optical interface can work properly. • Check whether the remote device is configured properly. • Check whether the vendor has specific customized requirements on the UC2 optical module. • Check LEDs of the device.

Usually, when the Rx optical power of the UC2 optical module exceeds the normal range, it may cause link fault. Therefore, when solving the link fault problem, you can first check whether the Rx optical power of the UC2 optical module is normal. For optical performance indicators of optical modules, see Chapter 2 Technical specifications.

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4.2 Terms

A

Alarm	Alarm refers to a human-observable indication that draws attention to a failure (detected fault) usually giving an indication of the severity of the fault. It is reported when a fault is detected by a device or by the NMS during the process of polling devices. Each alarm corresponds to a recovery alarm. After a recovery alarm is received, the status of the corresponding alarm changes to cleared.
ALS	The technology that is used for automatically shutting down the laser to avoid the maintenance and operation risks when the fiber is pulled out or the output power is over great.

E

Encapsulation	A technology used by the layered protocol. When the lower protocol receives packets from the upper layer, it will map packets to the data of the lower protocol. The outer layer of the data is encapsulated with the lower layer overhead to form a lower protocol packet structure. For example, an IP packet from the IP protocol is mapped to the data of 802.1Q protocol. The outer layer of the IP packet is encapsulated with the 802.1Q frame header to form a VLAN frame structure.
Ethernet	It is founded by Xerox Corporation and defined by DEC, Intel, and Xerox. Ethernet is the most widely used LAN. Its rates include 10 Mbit/s, 100 Mbit/s, and 1000 Mbit/s. Ethernet adopts CSMA/CD mechanism and complies with IEEE 802.3 standard.
Extinction ratio	The extinction ratio refers to the smallest ratio of A and B in complete modulation under the worst reflection conditions, that is ER=10lg (A/B). Wherein, A refers to the average Tx optical power at high voltage level and B refers to that at low voltage level.
Eye mask	After being binary or N-nary signals are transmitted, they are displayed as a continuous overlapping waveforms on the oscilloscope, which are similar to human eyes. Therefore, it is named as the eye pattern. With eye pattern, you can learn the degree of the intersymbol interference. An open eye pattern corresponds to minimal signal distortion. A close eye pattern corresponds to maximal signal distortion.

F

Fiber	It refers to the filamentous optical waveguide made of dielectric substance, which is used to guide electromagnetic energy in a form of optical wave.

L

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Loopback	It is the process that a signal is sent out and then sent back to the sender. It is used to detect and analyze potential faults in a ring network.
Laser	A laser is a device that emits light through a process of optical amplification based on the stimulated emission of electromagnetic radiation.
Link-state tracking	Link-state tracking is used to provide interface linkage scheme for specific application and it can extend range of link backup. By monitoring uplinks and synchronizing downlinks, add uplink and downlink interfaces to a link-state group. Therefore, the fault of the upstream device can be informed to the downstream device to trigger switching. Link-state tracking can be used to prevent traffic loss due to failure in sensing the uplink fault by the downstream device.

M

Modulation	It refers to the process in which certain characteristics of an oscillation or wave change in accordance with another oscillation or wave.
Metropolitan Area Network (MAN)	A high-speed computer network which connects multiple LANs within the effective distance in the urban region. The coverage of MAN is larger than that of LAN and smaller than that of WAN. The transmission medium is fiber and the MAN can be used as the backbone network.

O

	The work done by light within a time unit
Optical power	Units of optical power include mW and dBm, of which the former is a linear unit and the latter is a logarithmic unit. The relationship between the two units is: P(dBm)=10Log(P(mW)/1mW)
Optical Modulation Amplitude (OMA)	The optical modulation amplitude is: OMA=A-B. A: Logic "1", the output optical power when it is high level (mark), the unit is mW or dBm. B: Logic "0", the output optical power when it is low level (vacant number), the unit is mW or dBm.
Optical fiber	A filament-shaped optical waveguide made of dielectric material to guide electromagnetic energy in the form of light waves.

R

Rx sensitivity	The minimum average input optical power received by the optical receiver when the frame loss rate of the fiber transceiver is zero in full-load data traffic conditions
Relative Humidity (RH)	Ratio of absolute humidity to saturated humidity in the air within a certain period, in unit of percentage

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S

Side Mode Suppression Ratio	It refers to the logarithm of the ratio of the main longitudinal mode optical power intensity (Pm0) to the maximum side mode optical power intensity (Pm1) under the worst reflection and full modulation conditions,, that is, SMSR=10log(Pm0/Pm1).
Sensitivity	The minimum average input optical power received by the optical receiver when the frame loss rate of the fiber transceiver is zero in full-load data traffic conditions

4.3 Abbreviations

A

AC	Alternating Current

B

BER	Bit Error Rate
BOL	Beginning of Life

C

CD	Chromatic Dispersion

D

DC	Direct Current
DP-DQPSK	Dual Polarization Differential Quadrature Phase Shift Keying
DP-QPSK	Dual Polarization Quadrature Phase Shift Keying

E

EMC	Electro Magnetic Compatibility
EOL	End of Life
ER	Extinction Ratio
ESD	Electro Static Discharge

F

FEC	Forwarding Error Correction

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I

IEC	International Electro technical Commission
IEEE	Institute of Electrical and Electronics Engineers
ITU-T	International Telecommunications Union - Telecommunication Standardization Sector

L

LAN	Local Area Network
LC	Little Connector
LOS	Loss of Signal

M

MSA	Multi Source Agreement

O

OMA	Optical Modulation Amplitude
OSNR	Optical Signal to Noise Ratio
OTN	Optical Transport Network

P

PIN	P type-intrinsic-n type
PMD	Physical Medium Dependent

R

RMS	Root Mean Square

S

SMSR	Side Mode Suppression Ratio

T

TDP	Transmitter and Dispersion Penalty

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