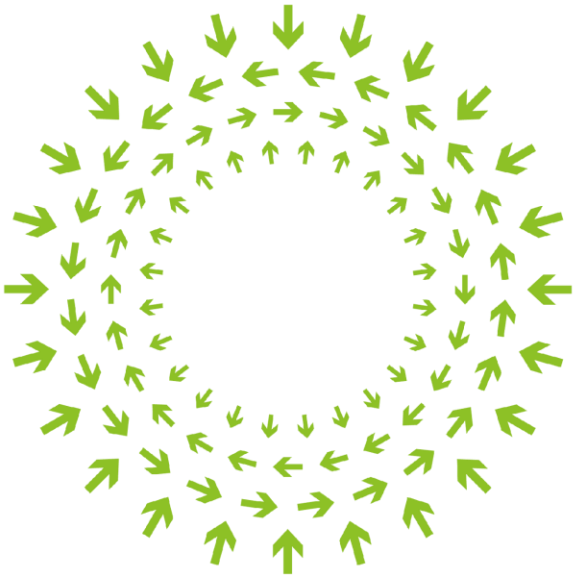


OPEN
Compute Project

# Optical Transceiver

# 200G QSFP56 SR4

# OCP Immersion Active Optical Pigtail (iAOP)

# Specification V0.1

**Product Specification**
Effective July 15th, 2025

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## Compliance with OCP Tenants

## Openness

By migrating the Immersion Active Optical Cable & Pigtail Specifications to the Open Compute foundation, they become open to all to review and implement. In addition, the broad membership of the OCP is able to contribute to the future development of the specification.

## Efficiency

The purpose of the Immersion Active Optical Cable Specification is to drive commonality in implementations of iAOCs/iAOPs in order to reduce friction in adoption users. This directly reduces opex in the form of qualifications and firmware work to adapt to different iAOC/iAOP implementations.

## Impact

Immersion Active Optical Cables or Pigtails have proven to be essential components of hyperscale and service provider networks in order to enable high speed, low cost, low power and highly reliable networks. Migrating this specification to OCP drives commonality in these implementations and a broader membership base to widen impact.

## Scale

Multiple hyperscalers have deployed or are planning to deploy Active Optical Cables. Soon they shall be deployed in immersion cooling.
Similarly to optical connectors in Air/DLC, the CMIS/DDMI monitoring functions ensure the Data Center Fabric is performing at its optimal.

## Sustainability

Active Optical Cables & Pigtails ease fabric connection complexity. Immersion Active Optical Cables & Pigtails allows the fabric to function in immersion cooling, which lowers PUE of data centers for AI/ML/HPC.

# Table of Contents

1 License ..... 4
1.1 Scope ..... 6
1.2 Overview ..... 6
2 Common Terms ..... 7
2.1 Parameter related ..... 7
2.2 Product related ..... 7
2.3 Fiber ..... 8
2.4 Standard ..... 8
3 Operating Conditions ..... 9
4 Specifications ..... 9
4.1 Electrical Transmitter Characteristic ..... 9
4.2 Electrical Receiver Characteristic ..... 9
4.3 Optical Transmitter Characteristic ..... 10
4.4 Optical Receiver Characteristics ..... 10
4.5 Optical Fiber Link Model ..... 11
5 Form Factor ..... 11
5.1 Mechanical Drawing ..... 11
6 Management Interface ..... 12
7 Immersion Cooling Requirements ..... 13
8 Reference ..... 13
9 Revisions ..... 14

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# Scope and Overview

## 1.1 Scope

This document defines the technical specifications for the 200G QSFP56 SR4 OCP Immersion Active Optical Pigtail (iAOP) used in large-scale data center applications.

## 1.2 Overview

The 200G QSFP56 SR4 iAOP OCP optical specification is based on 200GBASE-SR4 as defined in IEEE 802.3 cd.

This optimization involves the adoption of coolant-compatible materials, preservation of optical path integrity, and validated thermal performance to ensure reliable operation in immersion liquid-cooling environments. Considering the characteristics of liquid cooling fluid and the operation mode of the cooling system, temperature specifications of the product have been relaxed. The temperature range shall be relaxed from 0-70°C to RT-70°C. (Note, the RT value depends on dew point of the air).

While this specification is focused on 200G operation, the module shall be compliant to the IEEE 802.3 cd.

# 2 Common Terms

The following terms are used in this document

## 2.1 Parameter related

AOP - Average Optical Power
OMA - Optical Modulation Amplitude
TDECQ - Transmitter Dispersion Eye Closure Quaternary
ER - Extinction Ratio
SMSR - Side Mode Suppression Ratio
BER - Bit Error Rate
FEC - Forward Error Correction
PAM4 - 4-level Pulse Amplitude Modulation
Gbps - Gigabit per second
GBd - Gigabaud

## 2.2 Product related

iAOP - Immersion Active Optical Pigtail
iAOC - Immersion Active Optical Cable
AOC - Active Optical Cable
CT - Commercial Temperature
IT - Industrial Temperature
LPMode - Low Power Mode
I2C - Inter-Integrated Circuit
SR - Short reach
LR - Long reach

## 2.3 Fiber

MMF - Multi-Mode Fiber
SMF - Single-Mode Fiber
OM3 - Optical Multimode 3
PC - Physical Contact
APC - Angled Physical Contact
MPO - Multiple-Fiber Push-On

## 2.4 Standard

CWDM - Coarse Wavelength Division Multiplex
IEEE - Institute for Electrical and Electronics Engineers
MSA - Multi-Source Agreement
SFF - Small Form Factor
QSFP - Quad Small Form Factor Pluggable
QSFP112 - Quad Small Form Factor Pluggable Module 112
QSFP-DD - QSFP–Double Density
OSFP - Octal Small Form Factor Pluggable Module
OSFP-RHS - OSFP-Riding Heat Sink
CMIS - Common Management Interface Specification

# 3 Operating Conditions

| Recommended Operating Conditions | | |
|---|---|---|
| **Parameters** | **Value** | **Unit** |
| Case Operating Temperature | **RT ~ 70** Note1 | ℃ |
| Power Supply Voltage (Typical) | 3.3 | V |
| Power Consumption (Max) | 5 | W |
| Data Rate per Channel (Typical) | 26.5625 | GBd |

Note1: RT (Room Temp) value depends on dew point of the air

# 4 Specifications

## 4.1 Electrical Transmitter Characteristic

| Electrical Transmitter Characteristics | | |
|---|---|---|
| **Parameters** | **Value** | **Unit** |
| Input differential impedance | 90 ~ 110 | ohm |
| Differential pk-pk input Voltage Tolerance (min) | 900 | mVpp |

## 4.2 Electrical Receiver Characteristic

| Electrical Receiver Characteristics | | |
|---|---|---|
| **Parameters** | **Value** | **Unit** |
| Differential data output swing (max) | 900 | mVpp |
| Bit Error Rate Pre-FEC (max) | 2.4E-4 | |

### 4.3 Optical Transmitter Characteristic

| Optical Transmitter Characteristics | | |
|---|---|---|
| **Parameters** | **Value** | **Unit** |
| Center Wavelength (range) | 840 ~ 868 | nm |
| RMS spectral width (max) | 0.65 | nm |
| Average Launch Optical Power, each lane | -6.5 ~ +4.0 | dBm |
| Optical Power OMA, each lane | -4.5 ~ +3.0 | dBm |
| TDECQ (max) | 4.5 | dB |
| ER (min) | 3 | dB |

### 4.4 Optical Receiver Characteristics

| Optical Receiver Characteristics | | |
|---|---|---|
| **Parameters** | **Value** | **Unit** |
| Center Wavelength (range) | 840 ~ 868 | nm |
| Damage threshold (min) | 5 | dBm |
| Average receive power, each lane | -8.4 ~ +4.0 | dBm |
| Receiver reflectance (max) | -12 | dB |
| Receiver sensitivity, each lane (max) | RS = max (-6.5, SECQ -7.9) | dBm |

### 4.5 Optical Fiber Link Model

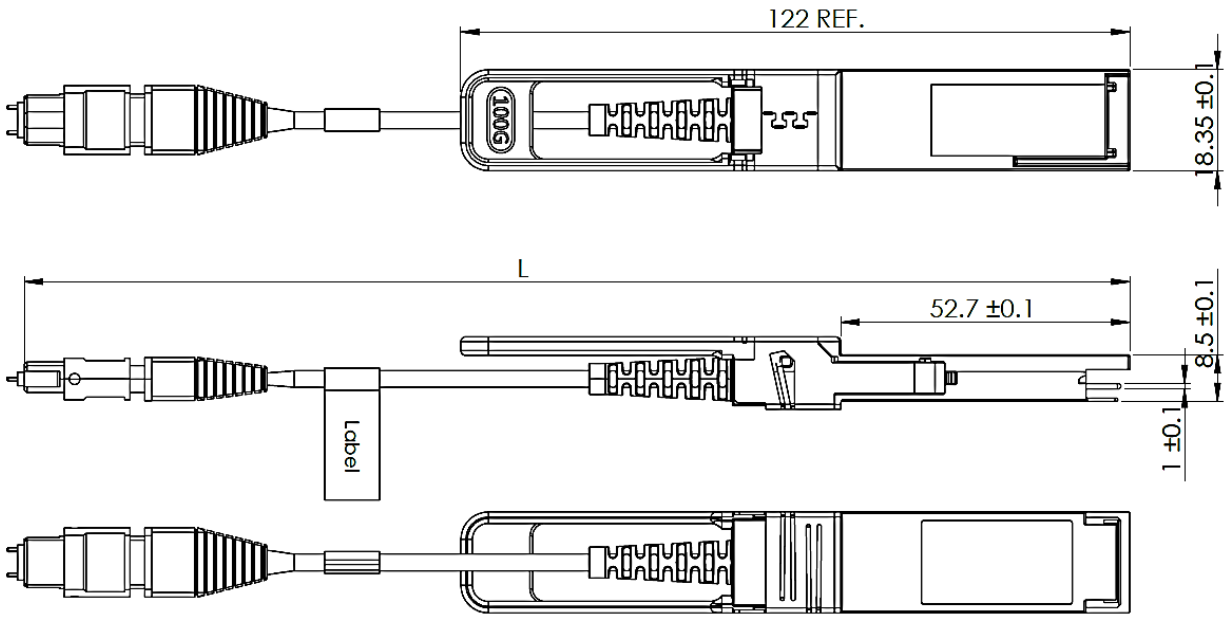
The reference optical fiber link model is based on MMF fiber. The distance. Refer to IEEE 802.3 cd.

| Optical Fiber Link Model | |
|---|---|
| 200GBase-SR4 | 0.5m to 70m for OM3 |
| | 0.5m to 100m for OM4 |

## 5 Form Factor

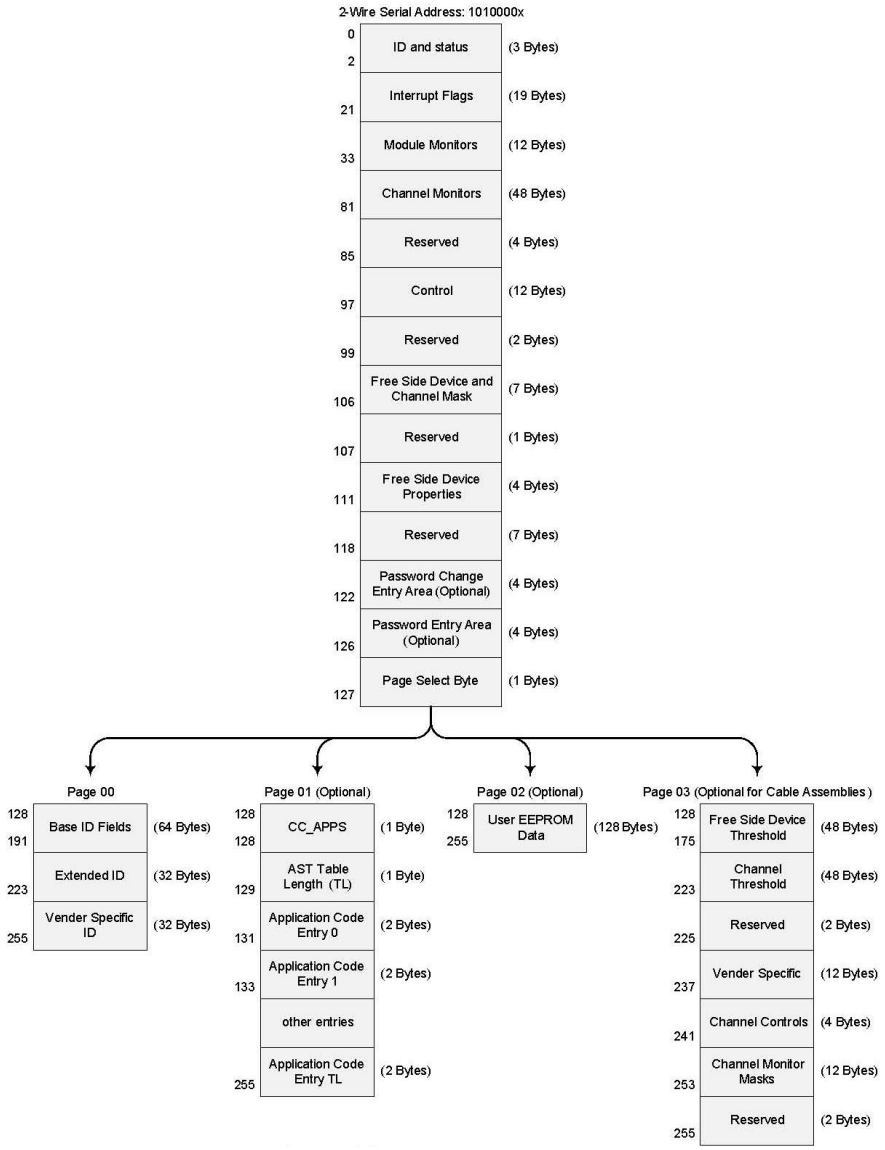
The QSFP56 form factor described in SFF-8665 shall be used. This form factor is commonly referred to as QSFP56 for 200G applications.

### 5.1 Mechanical Drawing



# 6 Management Interface

The module is compliant to SFF-8636.



# 7 Immersion Cooling Requirements

Immersion products must be materially compatible with the immersion fluid and perform equal or better in the immersion fluid.

This involves utilizing the testing conditions specified in the OCP “Material Compatibility in Immersion Cooling” guideline (80°C, 0.8L, 336 hours) and adhering to the acceptance criteria to determine if the material is compatible (< 10% change in weight, length, diameter, etc. before and after test).

Only compatible materials should be used in immersion products.

# 8 Reference

The following documents are referenced in this specification:

IEEE 802.3 cd
SFF-8636
SFF-8665
SFF-8661
SFF-8662
SFF-8679
OCP Material Compatibility in Immersion Cooling Rev 1.0
OCP Immersion Requirements Rev 2.1

# 9 Revisions

| Rev | Date | Description |
|---|---|---|
| 0.1 | July 15th, 2025 | Initial Release |