FICER Technology Co., Ltd.
明虹科技股份有限公司
2F, No.138, Daye Rd., Beitou Dist.,
Taipei City 11268, Taiwan
www.Ficer.com

Rev.03T3.30_20231012

100G QSFP28 to 4x25G SFP28 Breakout Active Optical Cable (AOC)
Hot Pluggable, 850nm VCSEL, MMF 1~100M, DDM

Part Number: FAOC-A0G-QPSP-xxx-xx

Overview

FAOC-A0G-QPSP-xxx-xx 100G QSFP+ to 4xSFP28 Breakout Active Optical Cables (AOC) are direct-attach fiber assemblies with QSFP28 and SFP28 form factor. The AOC utilize multi-mode fiber with 850nm VCSEL and PIN PD. It could be used as an alternative solution to QSFP28 to 4xSFP28 passive and active copper breakout cables, while providing improved signal integrity, longer distances, superior electro-magnetic immunity & better bit error rate performance. They are uitable for 1~100 meters distances and offer a cost-effective way for very high port density connections.

Applications

- 100GBASE-SR4 Ethernet to 4x25GBASE-SR Ethernet Link
- InfiniBand QDR, EDR
- Data Center & Storage
- Datacom / Telecom Switch & Router

Features

- Compatible with IEEE802.3bm 100GBASE-SR4
- Compatible with IEEE802.3by 25GBASE-SR
- Compliant with SFF-8665 QSFP28 MSA
- Compliant with SFF-8402 SFP28 MSA
- Compliant to IEEE 802.3bm CAUI-4 Interface
- Support InfiniBand QDR, EDR
- 4 independent full-duplex channels
- Up to 25.78125Gbps data rate per channel
- Hot Pluggable
- 850nm VCSEL array transmitter
- 1x100GBASE-SR4 to 4x25GBASE-SR
- 2-wire interface for management and diagnostic monitor compliant with SFF-8636 (for 100G) and SFF-8472 (for 25G)
- Single 3.3V power supply
- Link distance 100m over MM OM4 fiber and 70m over MM OM3 fiber
- Low power consumption <2.5W (QSFP28)
- Low power consumption <1.0W (SFP28)
- RoHS Compliant

TEL+886-2-2898-3830 FAX+886-2-2898-3840 Sales@Ficer.com Link Fiber to Future

Absolute Maximum Ratings

Parameters	Symbol	Min.	Max.	Unit
Storage Temperature	T_{ST}	-10	+70	°C
Storage Relative Humidity	RH	5	85	%
Supply Voltage	V_{CC}	-0.5	+3.6	V

Recommended Operating Conditions

Parameters		Symbol	Min.	Typ.	Max.	Unit	Note
Case Operating Temperature		T_{OP}	0	-	+70	°C	
Supply Voltage		V_{CC}	+3.13	+3.3	+3.47	V	
Data Rate, per Lane		DR	10.3125	25.78125		Gb/s	
Data Rate Accuracy		ΔDR	-100		+100	ppm	
Bit Error Rate (Pre-FEC)		BER			$5x10^{-5}$		1
Bit Error Rate (Post-FEC)		BER			10^{-12}		1
Supply Current, per QSFP28		I_{CC}			750	mA	
Supply Current, per SFP28		I_{CC}			300	mA	
Power Consumption, per QSFP28		P			2.5	W	
Power Consumption, per SFP28		P			1.0	W	
Power-On Initialization Time					2000	ms	2
Minimum Cable Bending Radius			30			mm	
ModSelL	Module Select	V_{OL}	GND		0.8	V	
	Module Unselect	V_{OH}	2.5		Vcc	V	
LPMode	Low Power Mode	V_{IL}	GND		0.8	V	
	Normal Operation	V_{IH}	2.5		Vcc+0.3	V	
ResetL	Reset	V_{IL}	GND		0.8	V	
	Normal Operation	V_{IH}	2.5		Vcc+0.3	V	
ModPrsL	Normal Operation	V_{OL}	GND		0.4	V	
IntL	Interrupt	V_{OL}	GND		0.4	V	
	Normal Operation	V_{OH}	2.4		Vcc	V	

Note1: Measured with a PRBS 2^{31}-1 test pattern @25.78125Gbps.

Note2: Power-on Initialization Time is the time from when the power supply voltages reach and remain above the minimum recommended operating supply voltages to the time when the module is fully functional.

TEL+886-2-2898-3830 FAX+886-2-2898-3840 Sales@Ficer.com

QSFP28 Transmitter Electro-optical Characteristics

V_{CC}= 3.13V to 3.47V, T_{OP} = 0 °C to 70 °C

Parameters	Symbol	Min.	Typ.	Max.	Unit	Note
Average Launch Power, per Lane	PAVG	-6.0		+2.4	dBm	
Optical Wavelength, each Lane	λc	840	850	860	nm	
Spectral Width (RMS)	Δλ			0.6	nm	
Optical Extinction Ratio	ER	2			dB	
Input Differential Impedance	ZIN	90	100	110	Ω	
Differential Data Input Swing	VIN	200		1600	mV	

QSFP28 Receiver Electro-optical Characteristics

V_{CC} = 3.13V to 3.47V, T_{OP} = 0 °C to 70 °C

Parameters	Symbol	Min.	Typ.	Max.	Unit	Note
Optical Wavelength, each Lane	λc	840		860	nm	
Output Differential Impedance	ZOUT	90	100	110	Ω	
Differential Data Output Swing	VOUT	200		800	mV	

SFP28 Transmitter Electro-optical Characteristics

V_{CC}= 3.13V to 3.47V, T_{OP} = 0 °C to 70 °C

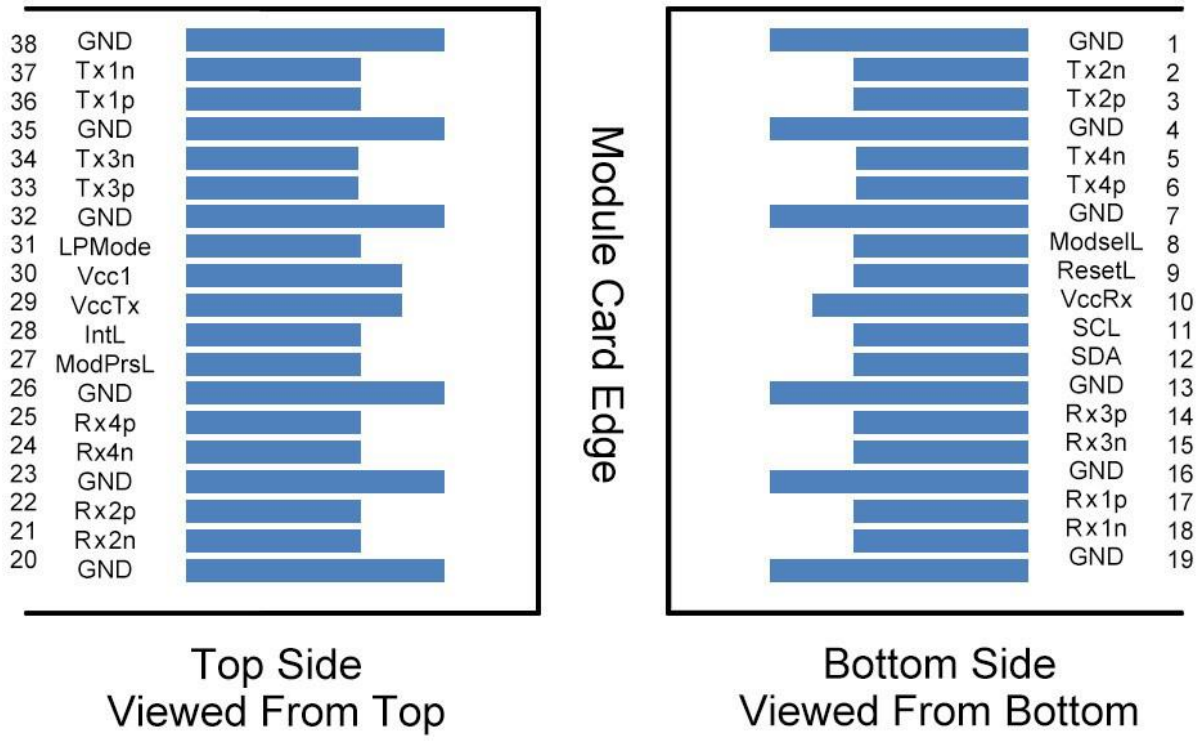
Parameters	Symbol	Min.	Typ.	Max.	Unit	Note
Average Launch Power, per Lane	PAVG	-6.0		+2.4	dBm	
Optical Wavelength, each Lane	λc	840	850	860	nm	
Spectral Width (RMS)	Δλ			0.65	nm	
Optical Extinction Ratio	ER	2			dB	
Input Differential Impedance	ZIN	90	100	110	Ω	
Differential Data Input Swing	VIN	200		1600	mV	
Tx Disable Input Voltage-Low (Tx ON)	TDISVL	GND		0.8	V	
Tx Disable Input Voltage-High (Tx OFF)	TDISVH	2.0		Vcc+0.3	V	
Tx Fault Output Voltage-Low (Tx Normal)	TFLTVL	GND		0.8	V	
Tx Fault Output Voltage-High (Tx Fault)	TFLTVH	2.0		Vcc	V	

SFP28 Receiver Electro-optical Characteristics

V_{CC} = 3.13V to 3.47V, T_{OP} = 0 °C to 70 °C

Parameters	Symbol	Min.	Typ.	Max.	Unit	Note
Optical Wavelength, each Lane	λc	840		860	nm	
Output Differential Impedance	Z_{OUT}	90	100	110	Ω	
Differential Data Output Swing	V_{OUT}	400		800	mV	
Receiver LOS Signal Output Voltage-Low	$LOSV_L$	GND		0.8	V	
Receiver LOS Signal Output Voltage-High	$LOSV_H$	2.0		Vcc	V	

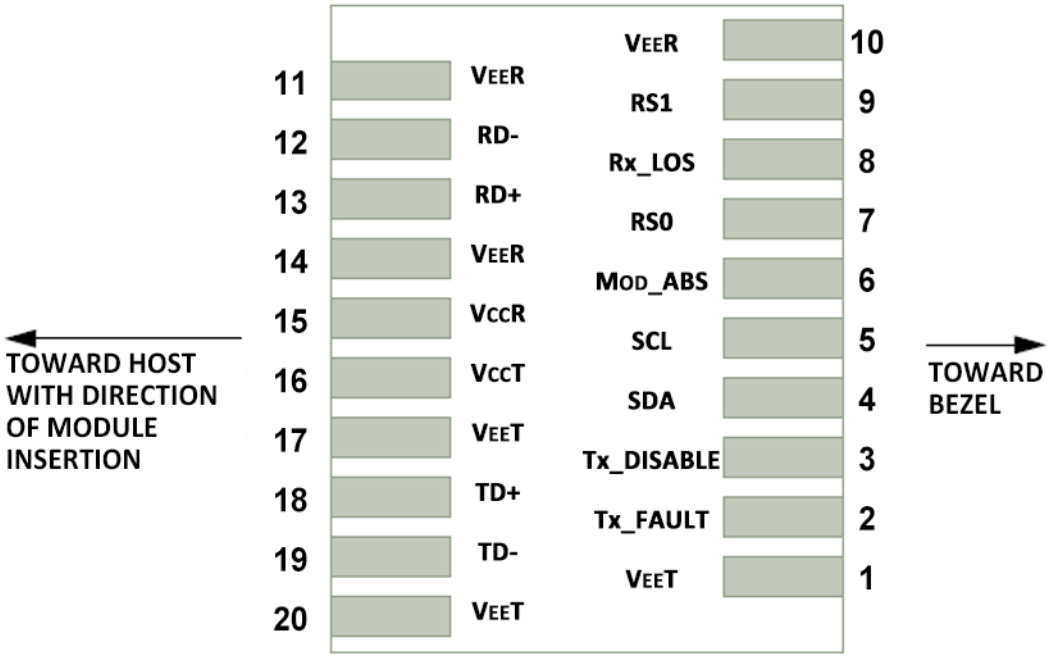
QSFP28 Pin Assignment



Top Side
Viewed From Top

Bottom Side
Viewed From Bottom

SFP28 Pin Assignment



Host PCB SFP28 Pad Assignment Top View

QSFP28 Pin Description

Pin	Logic	Name	Function / Description
1		GND	Module Ground
2	CML-I	Tx2n	Transmitter Inverted Data Input
3	CML-I	Tx2p	Transmitter Non-Inverted Data Input
4		GND	Module Ground
5	CML-I	Tx4n	Transmitter Inverted Data Input
6	CML-I	Tx4p	Transmitter Non-Inverted Data Input
7		GND	Module Ground
8	LVTLL-I	ModSelL	Module Select
9	LVTLL-I	ResetL	Module Reset
10		VccRx	+3.3V Power Supply Receiver
11	LVCMOS-I/O	SCL	2-Wire Serial Interface Clock
12	LVCMOS-I/O	SDA	2-Wire Serial Interface Data
13		GND	Module Ground

14	CML-O	Rx3p	Receiver Non-Inverted Data Output
15	CML-O	Rx3n	Receiver Inverted Data Output
16		GND	Module Ground
17	CML-O	Rx1p	Receiver Non-Inverted Data Output
18	CML-O	Rx1n	Receiver Inverted Data Output
19		GND	Module Ground
20		GND	Module Ground
21	CML-O	Rx2n	Receiver Inverted Data Output
22	CML-O	Rx2p	Receiver Non-Inverted Data Output
23		GND	Module Ground
24	CML-O	Rx4n	Receiver Inverted Data Output
25	CML-O	Rx4p	Receiver Non-Inverted Data Output
26		GND	Module Ground
27	LVTLL-O	ModPrsL	Module Present
28	LVTLL-O	IntL	Interrupt
29		VccTx	+3.3V Power Supply Transmitter
30		Vcc1	+3.3V Power Supply
31	LVTLL-I	LPMode	Low Power Mode
32		GND	Module Ground
33	CML-I	Tx3p	Transmitter Non-Inverted Data Input
34	CML-I	Tx3n	Transmitter Inverted Data Input
35		GND	Module Ground
36	CML-I	Tx1p	Transmitter Non-Inverted Data Input
37	CML-I	Tx1n	Transmitter Inverted Data Input
38		GND	Module Ground

Note1: GND is the symbol for signal and supply (power) common for QSFP28 modules. All are common within the QSFP28 module and all module voltages are referenced to this potential unless otherwise noted. Connect these directly to the host board signal common ground lane.

Note2: VccRx, Vcc1 and VccTx are the receiver and transmitter power suppliers and shall be applied concurrently. Recommended host board power supply filtering is shown below. Vcc Rx, Vcc1 and Vcc Tx may be internally connected within the QSFP28 transceiver module in any combination. The connector pins are each rated for a maximum current of 1000mA.

TEL+886-2-2898-3830 FAX+886-2-2898-3840 Sales@Ficer.com

SFP28 Pin Description

Pin	Name	Function / Description
1	VEET	Transmitter Ground
2	TX_FAULT	Transmitter Fault Indication (1)
3	TX_DISABLE	Transmitter Disable – Turns off transmitter laser output (2)
4	SDA	2-wire Serial Interface Data Line (SDA: Serial Data Signal) (3)
5	SCL	2-wire Serial Interface Clock (SCL: Serial Clock Signal) (3)
6	MOD_ABS	Module Absent, connected to VEET or VEER in the module (3)
7	RS0	Rate Select 0, optional (5)
8	RX_LOS	Receiver Loss of Signal Indication (4)
9	RS1	Rate Select 1, optional (5)
10	VEER	Receiver Ground
11	VEER	Receiver Ground
12	RD-	Receiver Inverted Data output, AC coupled
13	RD+	Receiver Non-Inverted Data output, AC coupled
14	VEER	Receiver Ground
15	VCCR	Receiver 3.3V Power Supply
16	VCCT	Transmitter 3.3V Power Supply
17	VEET	Transmitter Ground
18	TD+	Transmitter Non-Inverted Data Input, AC coupled
19	TD-	Transmitter Inverted Data Input, AC coupled
20	VEET	Transmitter Ground

Note1: Tx Fault is open collector/drain output which should be pulled up externally with a 4.7K~10KΩ resistor on the host board to supply <VccT+0.3V or VccR+0.3V. When high, this output indicates a laser fault of some kind. Low indicates normal operation. In the low state, the output will be pulled to <0.8V.

Note2: Tx Disable input is used to shut down the laser output per the state table below. It is pulled up within the module with a 4.7K~10KΩ resistor. 1) Low(0~0.8V): Transmitter on; 2) Between(0.8V and 2V): Undefined; 3) High (2.0~ VccT): Transmitter Disabled; 4) Open: Transmitter Disabled.

Note3: These are the module definition pins. They should be pulled up with a 4.7K~10KΩ resistor on the host board to supply less than VccT+0.3V or VccR+0.3V. MOD_ABS is grounded by the module to indicate that the module is present.

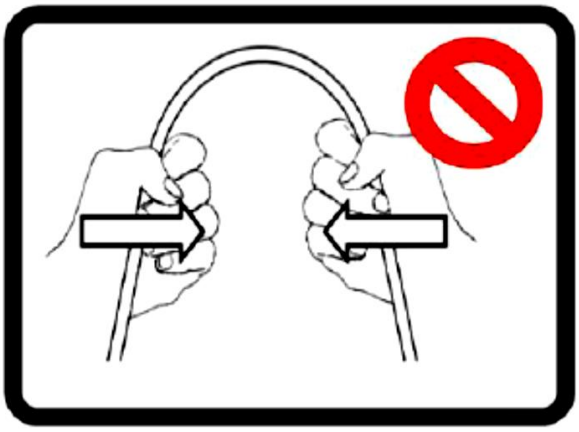
Note4: Rx_LOS (Loss of signal) is an open collector/drain output which should be pulled up externally with a 4.7K~10KΩ resistor on the host board to supply <VccT+0.3V or VccR+0.3V. When high, this output indicates the received optical power is below the worst case receiver sensitivity (as defined by the standard in use). Low indicates normal operation. In the low state, the output will be pulled to <0.8V.

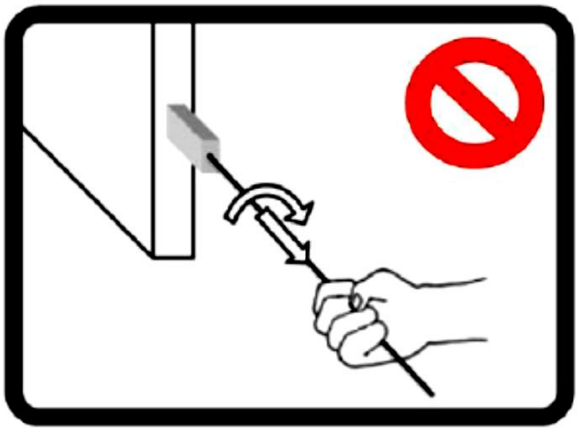
Note5: Tied to ground through a 30K ohm resistor.

2F, No.138, Daye Rd., Beitou Dist.,
Taipei City 11268, Taiwan
www.Ficer.com

Handling

Care should be taken to restrict exposure to the conditions defined in the Absolute Maximum Ratings and Recommended Operating Conditions. Put the product in an even and stable location. If the product falls down or drops, it may cause an injury or malfunction. The cable must not be subject to extreme bends during installation or while in operation. If you bend the cable at a radius less than the cable minimum bend radius, then the cable may get damaged. Don’t twist or pull by force ends of the cable, which might cause malfunction. In addition, the bending direction should be perpendicular to the flat surface of the ribbon cable. Please do not bend or kink the cable in lateral directions of flat surface of the ribbon.





TEL+886-2-2898-3830 FAX+886-2-2898-3840 Sales@Ficer.com

QSFP28 Digital Diagnostic Functions

As defined by the QSFP28 MSA, Ficer's QSFP28 transceivers provide digital diagnostic functions via a 2-wire serial interface, which allows real-time access to the following operating parameters:

- Transceiver temperature
- Laser bias current (4-Channel)
- Transmitted optical power (4-Channel)
- Received optical power (4-Channel)
- Transceiver supply voltage

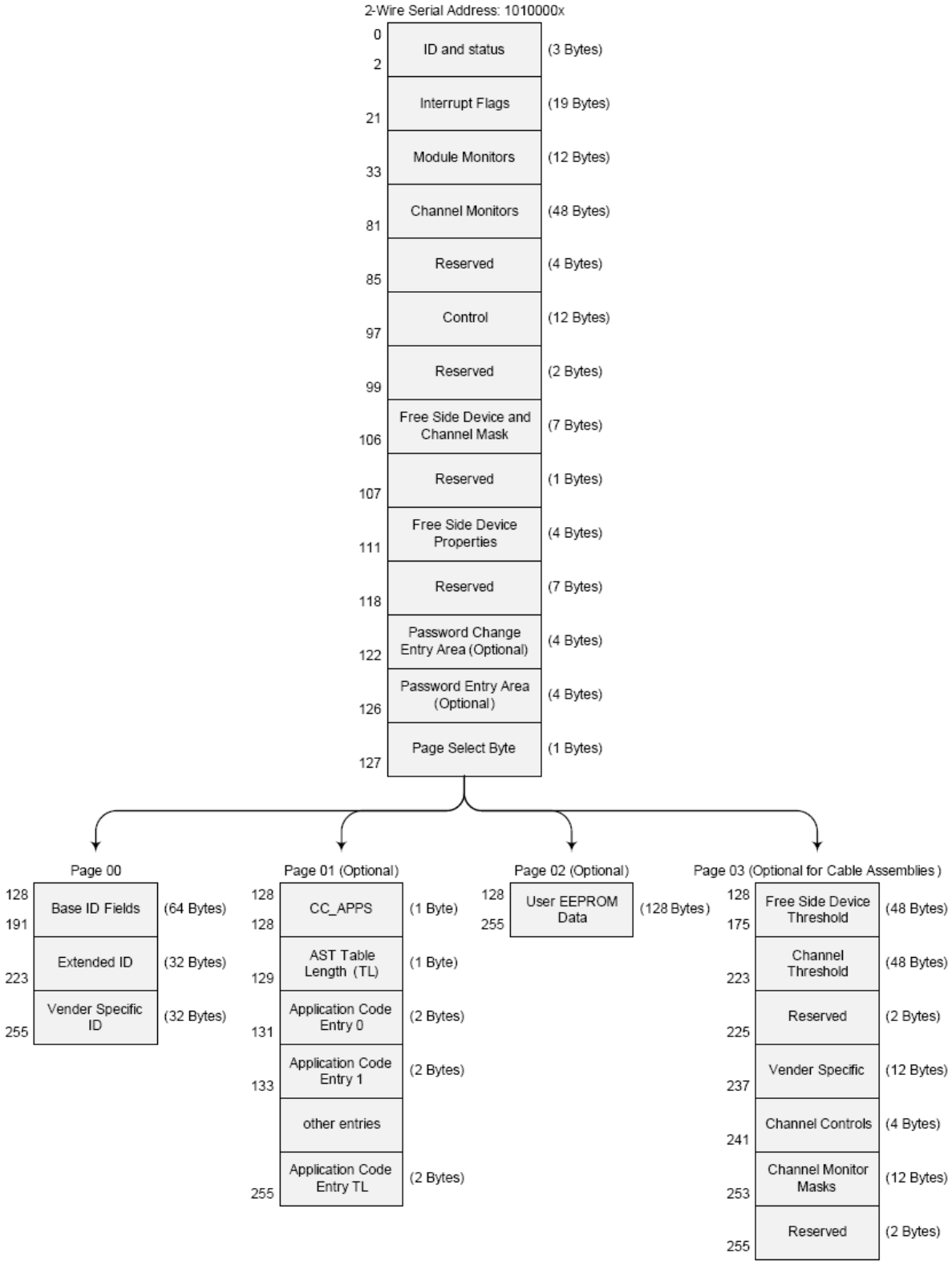
It also provides a sophisticated system of alarm and warning flags, which may be used to alert end-users when particular operating parameters are outside of a factory-set normal range.

The operating and diagnostics information is monitored and reported by a Digital Diagnostics Controller (DDC) inside the transceiver, which is accessed through the 2-wire serial interface. When the serial protocol is activated, the serial clock signal (SCL pin) is generated by the host. The positive edge clocks data into the QSFP28 transceiver into those segments of its memory map that are not write-protected. The negative edge clocks data from the QSFP28 transceiver. The serial data signal (SDA pin) is bi-directional for serial data transfer. The host uses SDA in conjunction with SCL to mark the start and end of serial protocol activation. The memories are organized as a series of 8-bit data words that can be addressed individually or sequentially. The 2-wire serial interface provides sequential or random access to the 8 bit parameters, addressed from 000h to the maximum address of the memory.

For more detailed information including memory map definitions, please see the QSFP28 MSA Specification.

QSFP28 Digital Diagnostic Memory Map

TEL+886-2-2898-3830 FAX+886-2-2898-3840 Sales@Ficer.com


2-Wire Serial Address: 1010000x
0
2
ID and status
(3 Bytes)
21
Interrupt Flags
(19 Bytes)
33
Module Monitors
(12 Bytes)
81
Channel Monitors
(48 Bytes)
85
Reserved
(4 Bytes)
97
Control
(12 Bytes)
99
Reserved
(2 Bytes)
106
Free Side Device and Channel Mask
(7 Bytes)
107
Reserved
(1 Bytes)
111
Free Side Device Properties
(4 Bytes)
118
Reserved
(7 Bytes)
122
Password Change Entry Area (Optional)
(4 Bytes)
126
Password Entry Area (Optional)
(4 Bytes)
127
Page Select Byte
(1 Bytes)
Page 00
128
191
Base ID Fields
(64 Bytes)
223
Extended ID
(32 Bytes)
255
Vender Specific ID
(32 Bytes)
Page 01 (Optional)
128
128
CC_APPS
(1 Byte)
129
AST Table Length (TL)
(1 Byte)
131
Application Code Entry 0
(2 Bytes)
133
Application Code Entry 1
(2 Bytes)
other entries
255
Application Code Entry TL
(2 Bytes)
Page 02 (Optional)
128
255
User EEPROM Data
(128 Bytes)
Page 03 (Optional for Cable Assemblies)
128
175
Free Side Device Threshold
(48 Bytes)
223
Channel Threshold
(48 Bytes)
225
Reserved
(2 Bytes)
237
Vender Specific
(12 Bytes)
241
Channel Controls
(4 Bytes)
253
Channel Monitor Masks
(12 Bytes)
255
Reserved
(2 Bytes)

SFP28 Digital Diagnostic Functions

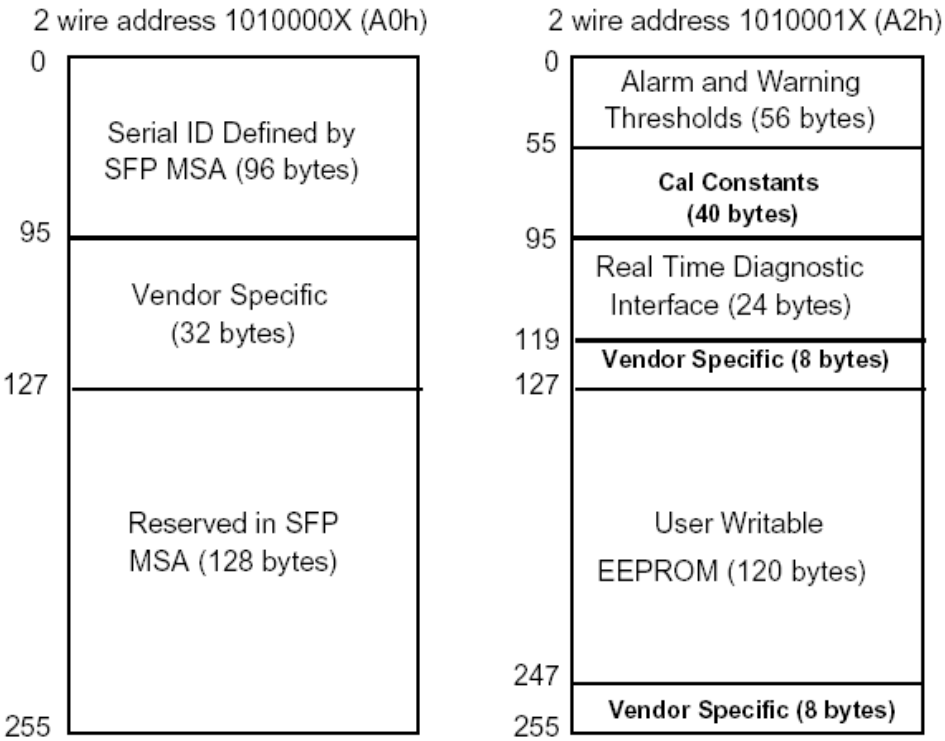
As defined by the SFP MSA (SFF-8472) Ficer's SFP28 transceivers provide digital diagnostic functions via a 2-wire serial interface, which allows real-time access to the following operating parameters:

- Transceiver temperature
- Laser bias current
- Transmitted optical power
- Received optical power
- Transceiver supply voltage

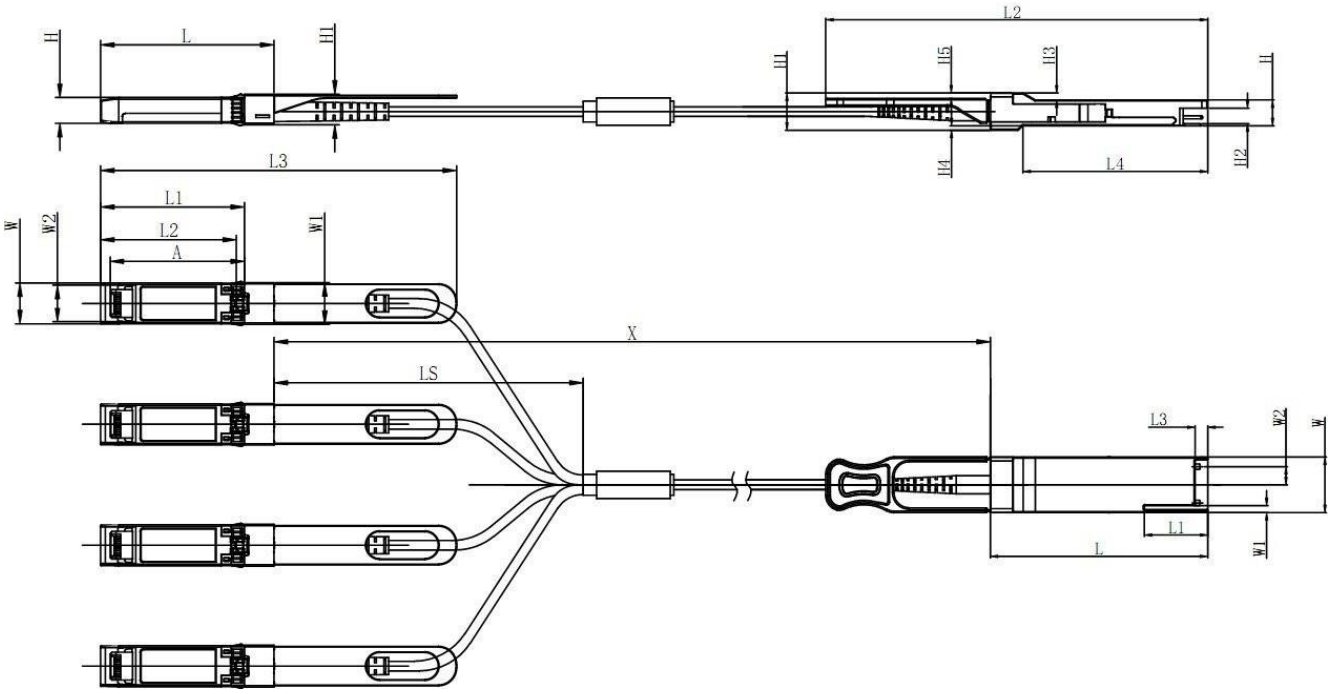
It also provides a sophisticated system of alarm and warning flags, which may be used to alert end-users when particular operating parameters are outside of a factory-set normal range.

The operating and diagnostics information is monitored and reported by a Digital Diagnostics Controller (DDC) inside the transceiver, which is accessed through the 2-wire serial interface. When the serial protocol is activated, the serial clock signal (SCL pin) is generated by the host. The positive edge clocks data into the SFP28 transceiver into those segments of its memory map that are not write-protected. The negative edge clocks data from the SFP28 transceiver. The serial data signal (SDA pin) is bi-directional for serial data transfer. The host uses SDA in conjunction with SCL to mark the start and end of serial protocol activation. The memories are organized as a series of 8-bit data words that can be addressed individually or sequentially. For more detailed information including memory map definitions, please see the SFP MSA (SFF-8472) Specification.

SFP28 Digital Diagnostic Memory Map



Mechanical Dimensions



QSFP+	L	L1	L2	L3	L4	W	W1	W2	H	H1	H2	H3	H4	H5
Max	72.2	-	128	4.35	61.4	18.45	-	6.2	8.6	12.4	5.35	2.5	1.6	2.0
Typical	72.0	-	-	4.20	61.2	18.35	-	-	8.5	12.2	5.2	2.3	1.5	1.8
Min	68.8	16.5	124	4.05	61.0	18.25	2.2	5.8	8.4	12.0	5.05	2.1	1.3	1.6

SFP+	L	L1	L2	L3	W	W1	W2	H	H1	A
Max	57.6	47.7	44.55	119.9	13.8	14.0	12.3	8.7	10.3	45.25
Typical	57.4	47.5	44.35	117.9	13.55	13.8	12.1	8.5	10.1	45
Min	57.2	47.3	44.15	115.9	13.3	13.6	11.9	8.4	9.9	44.65

(All Dimensions are ±0.20mm Unless Otherwise Specified, Unit: mm)

Cable Length (CL)	Tolerance
1m ~ 4.5m	+15 / -0cm
4.6m ~ 14.5m	+30 / -0cm
14.6m ~ 100m	+2% / -0cm
-	-

Cable Length (CL)	Breakout Length (LS)
1m	0.7m
2m	1.4m
3m ~ 4m	2m
5m ~ 100m	3m

TEL+886-2-2898-3830 FAX+886-2-2898-3840 Sales@Ficer.com Link Fiber to Future

2F, No.138, Daye Rd., Beitou Dist.,
Taipei City 11268, Taiwan
www.Ficer.com

Rev.03T3.30_20231012

Ordering Information

FAOC-A0G-QPSP-□□□-L3

Cable Length

□□□meters (including QSFP28, SFP28)

Example: 003=3m, 015=15m, 100=100m, 0X5=0.5m, 3X5=3.5m

Cable Jacket

P: PVC Q: OFNP
L: LSZH* (default)

Fiber Type

2: MM 50/125 OM2
3: MM 50/125 OM3* (default)
4: MM 50/125 OM4

TEL+886-2-2898-3830 FAX+886-2-2898-3840 Sales@Ficer.com Link Fiber to Future