40Gb/s QSFP+ SR4 Optical Transceiver Module
HTQS-FM85S

Features

- 4 independent full-duplex channels
- Up to 11.2Gb/s data rate per channel
- High Reliability 850nm VCSEL technology
- MTP/MPO optical connector
- QSFP+ MSA compliant
- Electrically hot-pluggable
- Up to 100m transmission on OM3 multi-mode fiber or 150m links on OM4 multimode fiber
- RoHS compliant and lead-free
- Digital diagnostic capabilities
- Single +3.3V power supply
- Maximum power consumption 1.5W
- All-metal housing for superior EMI performance
- Case operating temperature
  Commercial: 0 ~ +70ºC
  Industrial: -40 ~ +85ºC

Applications

- 40G Ethernet
- Data Center
- Back to Back
- InfiniBand QDR, DDR and SDR

Part Number Ordering Information

Part Number	Data Rate (Gb/s)	Wavelength (nm)	Transmission Distance(m)	Temperature (ºC) (Operating Case)
HTQS-FM85SC	40	850	100m MMF	0~70 commercial
HTQS-FM85SI	40	850	100m MMF	-40~85 Industrial

1. Absolute Maximum Ratings

It has to be noted that the operation in excess of any individual absolute maximum ratings might cause permanent damage to this module.

Parameter	Symbol	Min	Max	Unit	Notes
Storage Temperature	T_S	-40	85	ºC	
Power Supply Voltage	V_{CC}	0	3.47	V	

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Relative Humidity (non-condensation)	RH	5	95	%	
Damage Threshold	TH_d	2.4		dBm	

2. Recommended Operating Conditions and Power Supply Requirements

Parameter	Symbol	Min	Typical	Max	Unit	Notes
Operating Case Temperature	T_{OP}	0		70	ºC	commercial
		-40		85	ºC	Industrial
Power Supply Voltage	V_{CC}	3.135	3.3	3.465	V	
Data Rate			40		Gb/s	
Control Input Voltage High		2		Vcc	V	
Control Input Voltage Low		0		0.8	V	
Link Distance (SMF)	D			100	m	50/125um

3. General Description

HTF' HTQS-FM85SC are designed for use in 40 Gigabit per second links over multimode fiber. They are compliant with the QSFP+ MSA and IEEE 802.3ba.

The optical transmitter portion of the transceiver incorporates a 4-channel VCSEL (Vertical Cavity Surface Emitting Laser) array, a 4-channel input buffer and laser driver, diagnostic monitors, control and bias blocks. For module control, the control interface incorporates a Two Wire Serial interface of clock and data signals. Diagnostic monitors for VCSEL bias, module temperature, transmitted optical power， received optical power and supply voltage are implemented and results are available through the TWS interface. Alarm and warning thresholds are established for the monitored attributes. Flags are set and interrupts generated when the attributes are outside the thresholds. Flags are also set and interrupts generated for loss of input signal (LOS) and transmitter fault conditions. All flags are latched and will remain set even if the condition initiating the latch clears and operation resumes. All interrupts can be masked and flags are reset by reading the appropriate flag register. The optical output will squelch for loss of input signal unless squelch is disabled. Fault detection or channel deactivation through the TWS interface will disable the channel. Status, alarm/warning and fault information are available via the TWS interface.

The optical receiver portion of the transceiver incorporates a 4-channel PIN photodiode array, a 4-channel TIA array, a 4 channel output buffer, diagnostic monitors, and control and bias

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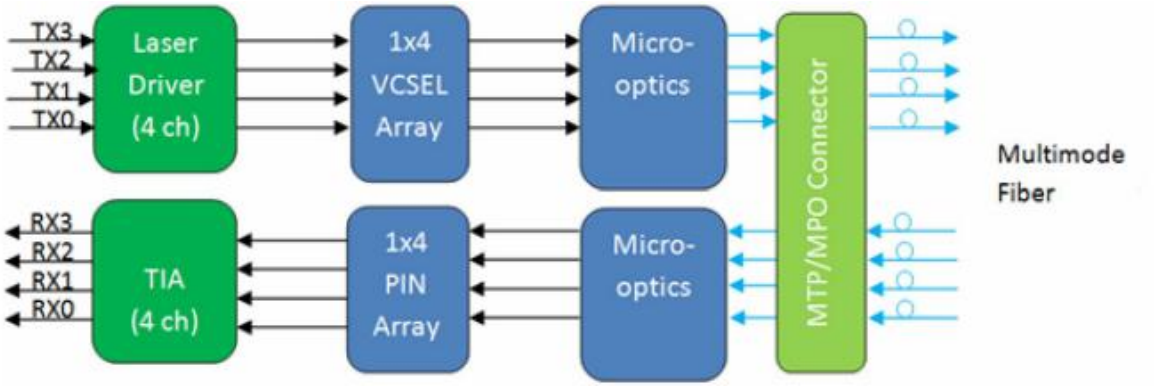
blocks. Diagnostic monitors for optical input power are implemented and results are available through the TWS interface. Alarm and warning thresholds are established for the monitored attributes. Flags are set and interrupts generated when the attributes are outside the thresholds. Flags are also set and interrupts generated for loss of optical input signal (LOS). All flags are latched and will remain set even if the condition initiating the flag clears and operation resumes. All interrupts can be masked and flags are reset upon reading the appropriate flag register. The electrical output will squelch for loss of input signal (unless squelch is disabled) and channel de-activation through TWS interface. Status and alarm/warning information are

4. Transceiver Block Diagram



5. Pin Assignment and Pin Description

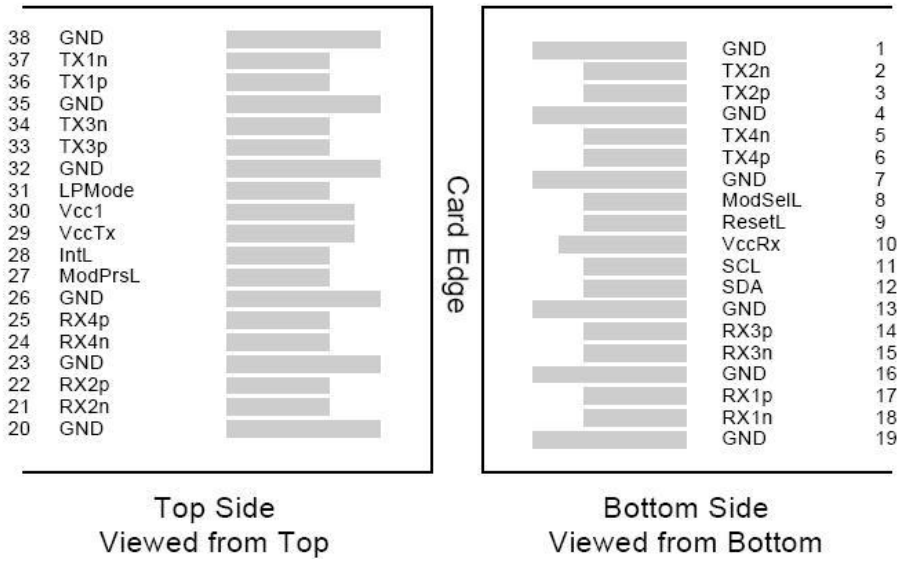


Figure1. QSFP+ Transceiver Electrical Pad Layout

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PIN	Logic	Symbol	Name/Description	Notes
1		GND	Ground	1
2	CML-I	Tx2n	Transmitter Inverted Data Input	
3	CML-I	Tx2p	Transmitter Non-Inverted Data output	
4		GND	Ground	1
5	CML-I	Tx4n	Transmitter Inverted Data Input	
6	CML-I	Tx4p	Transmitter Non-Inverted Data output	
7		GND	Ground	1
8	LVTLL-I	ModSelL	Module Select	3
9	LVTLL-I	ResetL	Module Reset	4
10		VccRx	+3.3V Power Supply Receiver	2
11	LVCMOS-I/O	SCL	2-Wire Serial Interface Clock	5
12	LVCMOS-I/O	SDA	2-Wire Serial Interface Data	5
13		GND	Ground	
14	CML-O	Rx3p	Receiver Non-Inverted Data Output	
15	CML-O	Rx3n	Receiver Inverted Data Output	
16		GND	Ground	1
17	CML-O	Rx1p	Receiver Non-Inverted Data Output	
18	CML-O	Rx1n	Receiver Inverted Data Output	
19		GND	Ground	1
20		GND	Ground	1
21	CML-O	Rx2n	Receiver Inverted Data Output	
22	CML-O	Rx2p	Receiver Non-Inverted Data Output	
23		GND	Ground	1
24	CML-O	Rx4n	Receiver Inverted Data Output	1
25	CML-O	Rx4p	Receiver Non-Inverted Data Output	
26		GND	Ground	1
27	LVTTL-O	ModPrsL	Module Present	6
28	LVTTL-O	IntL	Interrupt	7

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29		VccTx	+3.3 V Power Supply transmitter	2
30		Vcc1	+3.3 V Power Supply	2
31	LVTTL-I	LPMode	Low Power Mode	8
32		GND	Ground	1
33	CML-I	Tx3p	Transmitter Non-Inverted Data Input	
34	CML-I	Tx3n	Transmitter Inverted Data Output	
35		GND	Ground	1
36	CML-I	Tx1p	Transmitter Non-Inverted Data Input	
37	CML-I	Tx1n	Transmitter Inverted Data Output	
38		GND	Ground	1

Notes:

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

2. VccRx, Vcc1 and VccTx are the receiver and transmitter power suppliers and shall be applied concurrently. Recommended host board power supply filtering is shown in Figure 4 below. Vcc Rx, Vcc1 and Vcc Tx may be internally connected within the QSFP+ transceiver module in any combination. The connector pins are each rated for a maximum current of 500mA.

3. Module Select (ModSelL) is an input pin. When held low by the host, the module responds to 2-wire serial communication commands. The ModSelL allows the use of multiple QSFP+ modules on a single 2-wire interface bus – individual ModSelL lines for each QSFP+ module must be used.

4. The ResetL pin enables a complete module reset, returning module settings to their default state, when a low level on the ResetL pin is held for longer than the minimum pulse length. During the execution of a reset the host shall disregard all status bits until the module indicates a completion of the reset interrupt. The module indicates this by posting an IntL (Interrupt) signal with the Data_Not_Ready bit negated in the memory map. Note that on power up (including hot insertion) the module should post this completion of reset interrupt without requiring a reset.

5. Serial Clock (SCL) and Serial Data (SDA) are required for the 2-wire serial bus communication interface and enable the host to access the QSFP+ memory map.

6. Module Present (ModPrsL) is a signal local to the host board which, in the absence of a module, is normally pulled up to the host Vcc. When a module is inserted into the connector, it completes the path to ground though a resistor on the host board and asserts the signal. ModPrsL then indicates a module is present by setting ModPrsL to a “Low” state.

7. Interrupt (IntL) is an output pin. Low indicates a possible module operational fault or a status critical to the host system. The host identifies the source of the interrupt using the 2-wire serial interface. The IntL pin is an open collector output and must be pulled to the Host Vcc voltage on the Host board

8. Low Power Mode (LPMode) pin is used to set the maximum power consumption for the module in order to protect hosts that are not capable of cooling higher power modules, should such modules be accidentally inserted.

6. Electrical Characteristics

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The following electrical characteristics are defined over the Recommended Operating Environment unless otherwise specified.

Parameter	Symbol	Min.	Typ.	Max	Unit	Notes
Power Consumption	p			1.5	W	
Supply Current	Icc			450	mA	
Transmitter						
Single-ended Input Voltage Tolerance	Vcc	-0.3		4.0	V	
Differential Input Voltage Swing	Vin,pp	180		1000	mVpp	
Differential Input Impedance	Zin	85	100	115	Ohm	1
Transmit Disable Assert Time				10	us	
Transmit Disable Voltage	Vdis	Vcc-1.3		Vcc	V	
Transmit Enable Voltage	Ven	Vee		Vee +0.8	V	
Receiver						
Single-ended Input Voltage Tolerance	Vcc	-0.3		4.0	V	
Differential Output Voltage Swing	Vout,pp	300		850	mVpp	2
Differential Output Impedance	Zout	85	100	115	Ohm	
J9 Jitter Output	Jo9			0.65	UI	
LOS Assert Voltage	VlosH	Vcc-1.3		Vcc	V	
LOS De-assert Voltage	VlosL	Vee		Vee +0.8	V	

Notes:

1. Connected directly to TX data input pins. AC coupled thereafter.
2. In to 100 ohms differential termination.

7. Optical Characteristics

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Parameter	Symbol	Min.	Typical	Max	Unit	Notes
Transmitter						
Center Wavelength	λ_C	840	850	860	nm	
Optical Spectral Width	$\Delta\lambda$			0.65	nm	
Average Launch Power Per lane	P_{AVG}	-7.6		0.5	dBm	1
Optical Extinction Ratio	ER	3.0			dB	
Transmitter OFF Output Power	Poff			-30	dBm	
Transmitter and Dispersion Penalty each lane	TDP			3.5	dB	
Optical Return Loss Tolerance	ORLT			12	dB	
Transmitter Eye Mask	Compliant with IEEE802.3ae					
Receiver						
Center Wavelength	λ_C	840	850	860	nm	
Receiver Sensitivity in average power	Sen.			-9.5	dBm	2
Input Saturation Power (overload)	Psat	2.4			dBm	
LOS Assert	LOSA	-30			dBm	
LOS De-assert	LOSD			-12	dBm	
Receiver Reflectance	Rr			-12	dB	
LOS Hysteresis	LOSH	0.5			dB	

Notes:

1. Class 1 Laser Safety per FDA/CDRH and IEC-825-1 regulations.
2. Measured with Light source 850nm, ER=3.0dB; BER =<10^-12 @10.325Gbps, PRBS=2^31-1 NRZ.

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8. Digital Diagnostic Functions

The following digital diagnostic characteristics are defined over the Recommended Operating Environment unless otherwise specified. It is compliant to SFF-8436.

Parameter	Symbol	Min.	Max	Unit	Notes
Temperature monitor absolute error	DMI_ Temp	-3	3	degC	Over operating temp
Supply voltage monitor absolute error	DMI _VCC	-0.15	0.15	V	Full operating range
RX power monitor absolute error	DMI_RX	-2	23	dB	
Bias current monitor	DMI_ bias	-10%	10%	mA	
TX power monitor absolute error	DMI_TX	-2	2	dB	

9. Mechanical Dimensions

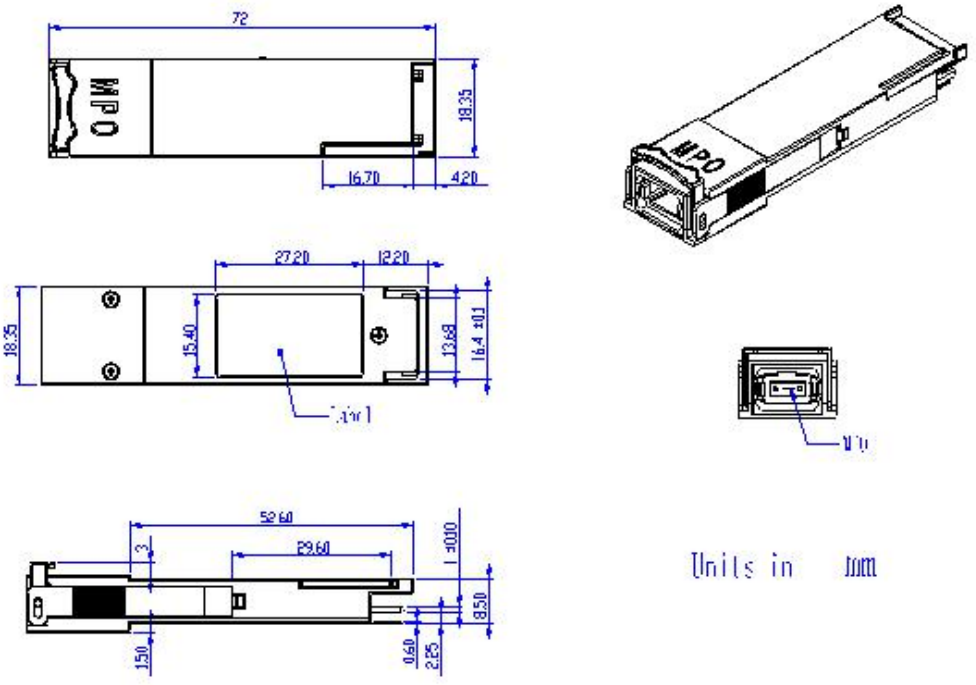

Figure2. Mechanical Outline

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