

# HFBR-5602/HFCT-5612

## Gigabit Interface Converters (GBIC) for Fibre Channel



### Data Sheet



#### Description

The HFBR-56xx/HFCT-56xx family of interface converters meet the Gigabit Interface Converter specification Rev. 5.4. The family provides a uniform form factor for a wide variety of standard connections to transmission media. The converters can be inserted or removed from a host chassis without removing power from the host system.

The converters are suitable for interconnections in the Fibre Channel mass storage and data transfer environment. The design of these converters is also practical for other high performance, point-to-point communication requiring gigabit interconnections. Since the converters are hot-pluggable, they allow system configuration changes or maintenance simply by plugging in a different type of converter.

The mechanical and electrical interfaces of these converters to the host system are identical for all implementations of the converter regardless of external media type. A 20-pin connector is used to connect the converter to the host system. Surge currents are eliminated by using pin sequencing at this connector and a slow-start circuit. Two ground tabs at this connector also make contact before any other pins, discharging possible component-damaging static electricity. In addition, the connector itself performs a two-stage contact sequence. Operational signals and power supply ground make contact in stage 1 while power makes contact in stage 2.

#### Applications

- Mass storage system I/O
- Computer system I/O
- High-speed peripheral interface
- High-speed switching systems
- Host adapter I/O
- RAID cabinets

#### Features

- Compliant with Gigabit Interface Converter specification Rev. 5.4 (1)
- HFBR-5602 is compliant with ANSI X3.297-1996 Fibre Channel Physical Interface FC-PH-2 Revision 7.4 proposed specifications
- HFCT-5612 is compliant with ANSI 100-SM-LC-L Revision 2 enhancement to X3.297-1996 FC-PH-2 Revision 7.4
- Performance:  
HFBR-5602:  
300 m over 62.5/125  $\mu\text{m}$  MMF  
500 m over 50/125  $\mu\text{m}$  MMF  
HFCT-5612:  
500 m with 50/125  $\mu\text{m}$  MMF  
500 m with 62.5/125  $\mu\text{m}$  MMF  
10 km with 9/125  $\mu\text{m}$  SMF
- Horizontal or vertical installation
- AEL Laser Class 1 eye safe per IEC 60825-1
- AEL Laser Class I eye safe per US 21 CFR
- Hot-Pluggable

#### Related Products

- 850 nm 1 x 9 VCSEL transceiver for Fibre Channel applications (HFBR-53D3)
- 1300 nm, 1 x 9 laser transceiver for Fibre Channel applications (HFCT-53D3)
- Physical layer ICs available for optical or copper interface (HDMP-1536A/46A)
- Versions of both 1 x 9 and GBIC transceiver module for Gigabit Ethernet

The HFBR-5602 has been developed with 850 nm short wavelength VCSEL technology while the HFCT-5612 is based on 1300 nm long wavelength Fabry Perot laser technology.

The HFBR-5602 complies with Annex E of the GBIC specification Revision 5.4. In the Fibre Channel environment, the HFBR-5602 achieves 300 m transmission distance with 62.5  $\mu\text{m}$  and 50  $\mu\text{m}$  multimode fibre.

The HFCT-5612 complies with Annex C of the GBIC specification Revision 5.4 and reaches 10 km with 9/125  $\mu\text{m}$  single mode fiber. Both the HFBR-5602 and the HFCT-5612 are Class 1 Eye Safe laser devices.

#### **Serial Identification**

The HFBR-56xx and HFCT-5612 family complies with Annex D (Module Definition 4) of the GBIC specification Revision 5.4, which defines the Serial Identification Protocol.

Definition 4 specifies a serial definition protocol. For this definition, upon power up, MOD\_DEF(1:2) (Pins 5 and 6 on the 20-pin connector) appear as NC. Pin 4 is TTL ground. When the host system detects this condition, it activates the public domain serial protocol. The protocol uses the 2-wire serial CMOS E<sup>2</sup>PROM protocol of the ATMEL AT24C01A or similar.

The data transfer protocol and the details of the mandatory and vendor specific data structures are defined in Annex D of the GBIC specification Revision 5.4.

#### **Regulatory Compliance**

See the Regulatory Compliance Table for the targeted typical and measured performance for these transceivers.

The overall equipment design will determine the level it is able to be certified to. These transceiver performance targets are offered as a figure of merit to assist the designer in considering their use in equipment designs.

#### **Electrostatic Discharge (ESD)**

There are two design cases in which immunity to ESD damage is important.

The first case is during handling of the transceiver prior to inserting it into the host system. It is important to use normal ESD handling precautions for ESD sensitive devices. These precautions include using grounded wrist straps, work benches, and floor mats in ESD controlled areas.

The second case to consider is static discharges during insertion of the GBIC into the host system. There are two guide tabs integrated into the 20-pin connector on the GBIC. These guide tabs are connected to circuit ground. When the GBIC is inserted into the host system, these tabs shall engage before any of the connector pins. The mating connector in the host system should have its tabs connected to circuit ground. This discharges any stray static charges and establishes a reference for the power supplies that are sequenced later.

#### **Electromagnetic Interference (EMI)**

Most equipment designs utilizing these high-speed transceivers from Avago will be required to meet the requirements of FCC in the United States, CENELEC EN55022 (CISPR 22) in Europe and VCCI in Japan.

#### **Immunity**

Equipment utilizing these transceivers will be subject to radio-frequency electromagnetic fields in some environments. These transceivers have good immunity to such fields due to their shielded design.

#### **Eye Safety**

Laser-based GBIC transceivers provide Class 1 (IEC 60825-1) and Class I (US 21 CFR[J]) laser eye safety by design. Avago has tested the current transceiver design for compliance with the requirements listed below under normal operating conditions and for compliance under single fault conditions.

#### **Outline Drawing**

An outline drawing is shown in Figure 1. More detailed drawings are shown in Gigabit Interface Converter specification Rev. 5.4.

#### **CAUTION:**

There are no user serviceable parts nor any maintenance required for the HFBR-56xx and HFCT-56xx product family. All adjustments are made at the factory before shipment to our customers. Tampering with or modifying the performance of any Avago GBIC unit will result in voided product warranty. It may also result in improper operation of the circuitry, and possible overstress of the semiconductor components. Device degradation or product failure may result.

Connection of either the HFBR-5602 or the HFCT-5612 to a non-approved optical source, operating above the recommended absolute maximum conditions, or operating in a manner inconsistent with unit design and function, may result in hazardous radiation exposure and may be considered an act of modifying or manufacturing a laser product. The person(s) performing such an act is required by law to recertify the laser product under the provisions of US 21 CFR (Subchapter J).

## GBIC Serial ID Memory Contents - HFBR-5602

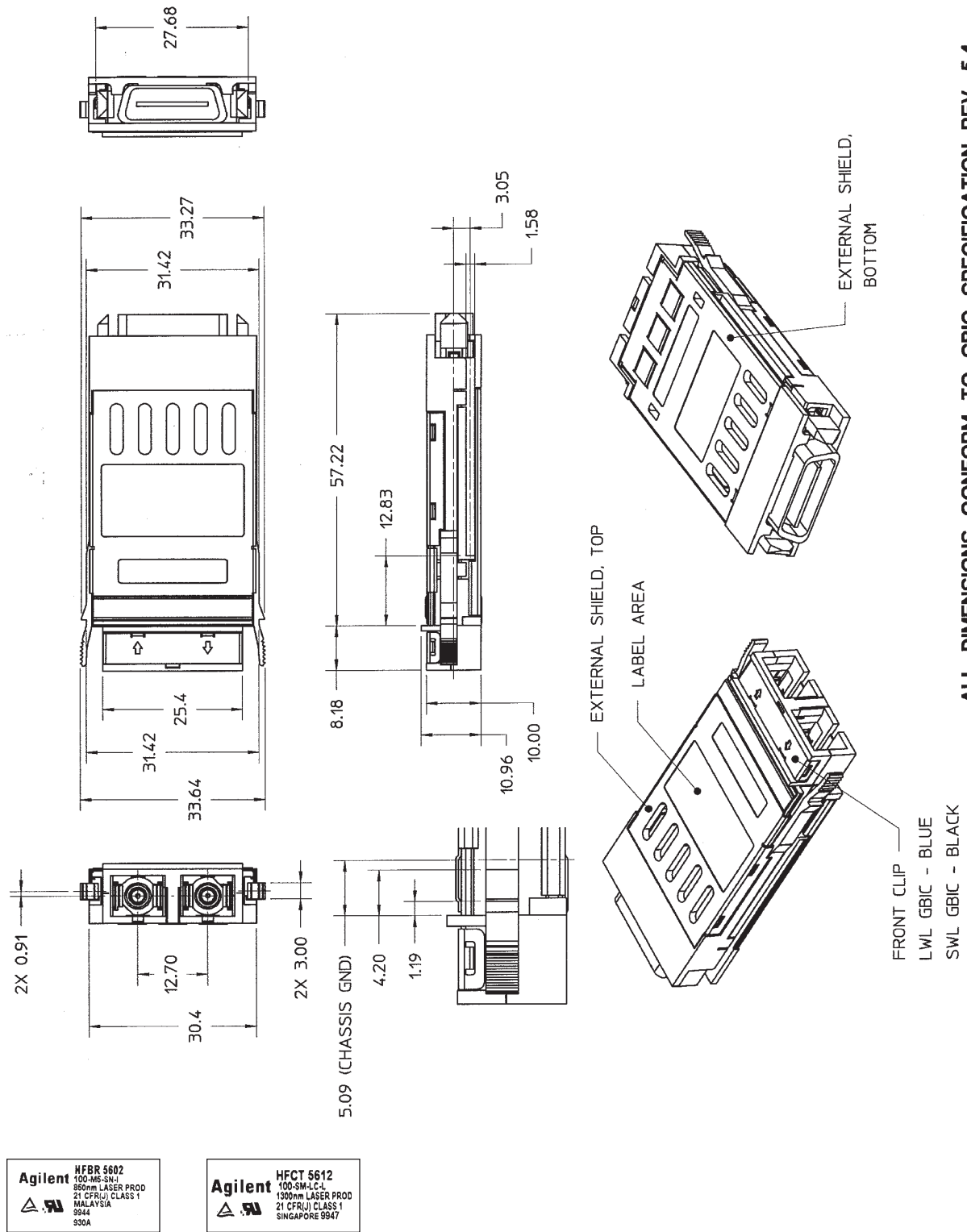
0	1		40	48	H	68	39	9	96	20
1	5		41	46	F	69	38	8	97	20
2	1		42	42	B	70	30	0	98	20
3	0		43	52	R	71	36	6	99	20
4	0		44	2D	-	72	32	2	100	20
5	0		45	35	5	73	33	3	101	20
6	0		46	36	6	74	30	0	102	20
7	40		47	30	0	75	33	3	103	20
8	40		48	32	2	76	32	2	104	20
9	0C		49	20		77	39	9	105	20
10	1		50	20		78	33	3	106	20
11	1		51	20		79	36	6	107	20
12	0B		52	20		80	38	8	108	20
13	0		53	20		81	39	9	109	20
14	0		54	20		82	34	4	110	20
15	0		55	20		83	32	2	111	20
16	32		56	30	0	84	39	9	112	20
17	1E		57	30	0	85	38	8	113	20
18	0		58	30	0	86	30	0	114	20
19	0		59	30	0	87	36	6	115	20
20	41	A	60	0		88	32	2	116	20
21	47	G	61	0		89	33	3	117	20
22	49	I	62	0		90	30	0	118	20
23	4C	L	63	6		91	30	0	119	20
24	45	E	64	0		92	0		120	20
25	4E	N	65	1A		93	0		121	20
26	54	T	66	0		94	0		122	20
27	20		67	0		95	0		123	20
28	20								124	20
29	20								125	20
30	20								126	20
31	20								127	20
32	20									
33	20									
34	20									
35	20									
36	0									
37	0									
38	0									

**Note:** Blanks in ASCII column are numeric values not ASCII characters.

GBIC Serial ID Memory Contents - HFCT-5612

Addr	Hex	ASCII	Addr	Hex	ASCII	Addr	Hex	ASCII	Addr	Hex	ASCII
0	1		40	40	H	68	39	9	66	20	
1	3		41	40	F	69	30	0	67	20	
2	1		42	40	C	70	30	0	68	20	
3	0		43	34	T	71	36	6	69	20	
4	0		44	20	-	72	31	1	100	20	
5	0		45	38	8	73	30	0	101	20	
6	0		46	36	6	74	31	1	102	20	
7	12		47	31	1	75	31	1	103	20	
8	0		48	32	2	76	30	0	104	20	
9	0D		49	20		77	33	3	105	20	
10	1		50	20		78	31	1	106	20	
11	1		51	20		79	32	2	107	20	
12	08		52	20		80	31	1	108	20	
13	0		53	20		81	33	3	109	20	
14	0		54	20		82	30	0	110	20	
15	64		55	20		83	30	0	111	20	
16	32		56	30	0	84	39	9	112	20	
17	32		57	30	0	85	30	0	113	20	
18	0		58	30	0	86	30	0	114	20	
19	0		59	30	0	87	36	6	115	20	
20	41	A	60	0		88	31	1	116	20	
21	4F	G	61	0		89	30	0	117	20	
22	40	I	62	0		90	30	0	118	20	
23	4C	L	63	31		91	30	0	119	20	
24	45	E	64	0		92	0		120	20	
25	4E	N	65	1A		93	0		121	20	
26	54	T	66	0		94	0		122	20	
27	20		67	0		95	E6		123	20	
28	20								124	20	
29	20								125	20	
30	20								126	20	
31	20								127	20	
32	20										
33	20										
34	20										
35	20										
36	0										
37	0										
38	0										
39	0										

Note: Blanks in ASCII column are numeric values not ASCII characters.



ALL DIMENSIONS CONFORM TO GBIC SPECIFICATION REV. 5.4

DIMENSIONS IN MILLIMETERS

Figure 1. Outline Drawing of HFBR-5602 and HFCT-5612.

## Regulatory Compliance

Feature	Test Method	Targeted Performance
Electrostatic Discharge (ESD) to the Electrical Pins	MIL-STD-883C Method 3015.4	Class 1 (>2000 V)
Electrostatic Discharge (ESD) to the Duplex SC Receptacle	Variation of IEC 801-2	Typically withstand at least 15 kV without damage when port is contacted by a Human Body Model probe.
Electromagnetic Interference (EMI)	FCC Class B CENELEC EN55022 Class B (CISPR 22A) VCCI Class 1	Margins are dependent on customer board and chassis design.
Immunity	Variation of IEC 801-3	Typically show no measurable effect from a 10 V/m field swept from 27 to 1000 MHz applied to the transceiver without a chassis enclosure
Laser Eye Safety	US 21 CFR, Subchapter J per paragraphs 1002.10 and 1002.12 EN 60825-1: 1994+A11 EN 60825-2: 1994 EN 60950: 1992+A1+A2+A3	AEL Class I, FDA/CDRH HFBR-5602 Accession No. 9720151-04 HFCT-5612 Accession No. 9521220-16 AEL Class 1, TUV Rheinland of North America HFBR-5602 Certificate No. R9771018-7 HFCT-5612 Certificate No. 933/51083 Protection Class III
Component Recognition	Underwriters Laboratories and Canadian Standards Association Joint Component Recognition for Information Technology Equipment Including Electrical Business Equipment.	UL File E173874 (Pending)

**Note:** HFBR-5602 is non-compliant for Tx fault timing.

## 20-Pin SCA-2 Host Connector Characteristics

**Table 1. SCA-2 Host connector pin assignment**

Pin	Name	Sequence	Pin	Name	Sequence
1	RX_LOS	2	11	RGND	1
2	RGND	2	12	-RX_DAT	1
3	RGND	2	13	+RX_DAT	1
4	MOD_DEF(0)	2	14	RGND	1
5	MOD_DEF(1)	2	15	VDDR	2
6	MOD_DEF(2)	2	16	VDDT	2
7	TX_DISABLE*	2	17	TGND	1
8	TGND	2	18	+TX_DAT	1
9	TGND	2	19	-TX_DAT	1
10	TX_FAULT	2	20	TGND	1

**Notes:**

A sequence value of 1 indicates that the signal is in the first group to engage during plugging of a module. A sequence value of 2 indicates that the signal is the second and last group. The two guide pins integrated on the connector are connected to TGND. These two guide pins make contact with circuit ground prior to Sequence 1 signals.

\* This pin is tied high via 10 K pull-up resistor.

**Table 2. Signal Definition**

Pin	Signal Name	Input/Output	Description
1	RX_LOS	Output	Receiver Loss of Signal, TTL High, open collector
2	RGND		Receiver Ground
3	RGND		Receiver Ground
4	MOD_DEF(0)	Output	TTL Low
5	MOD_DEF(1)	Input	SCL Serial Clock Signal
6	MOD_DEF(2)	Input/Output	SDA Serial Data Signal
7	TX_DISABLE	Input	Transmit Disable
8	TGND		Transmitter Ground
9	TGND		Transmitter Ground
10	TX_FAULT	Output	Transmit Fault
11	RGND		Receiver Ground
12	-RX_DAT	Output	Received Data, Differential PECL, ac coupled
13	+RX_DAT	Output	Received Data, Differential PECL, ac coupled
14	RGND		Receiver Ground
15	VDDR	Input	Receiver +5 V supply
16	VDDT	Input	Transmitter +5 V supply
17	TGND		Transmitter Ground
18	+TX_DAT	Input	Transmit Data, Differential PECL, ac coupled
19	-TX_DAT	Input	Transmit Data, Differential PECL, ac coupled
20	TGND		Transmitter Ground

**Table 3. Module Definition**

Defn.	MOD_DEF(0) Pin 4	MOD_DEF(1) Pin 5	MOD_DEF(2) Pin 6	Interpretation by host
4	TTL Low	SCL	SDA	Serial module definition protocol

**Note:** All Avago GBIC modules comply with Module Definition 4 of the GBIC specification Rev 5.

## Short Wavelength GBIC: HFBR-5602

### Transmitter Section

The transmitter section consists of an 850 nm VCSEL in an optical subassembly (OSA), which mates to the fiber cable. The VCSEL OSA is driven by a custom, silicon bipolar IC which converts differential logic signals into an analog Laser Diode drive current.

### Receiver Section

The receiver includes a silicon PIN photodiode mounted together with a custom, silicon bipolar transimpedance preamplifier IC, in an OSA. This OSA interfaces to a custom silicon bipolar circuit that provides post-amplification and quantization. The post-amplifier includes a Signal Detect circuit that provides TTL compatible logic-low output in response to the detection of a usable input optical signal.

### Eye Safety Design

The laser driver is designed to be Class 1 eye safe (CDRH21 CFR(J), IEC 60825-1) under a single fault condition. To be eye safe, only one of two results can occur in the event of a single fault, the transmitter must either maintain normal eye safe operation or the transmitter should be disabled.

There are three key elements to the safety circuitry: a monitor diode, a window detector circuit, and direct control of the laser bias. The window detection circuit monitors the average optical power using the monitor diode. If a fault occurs such that the dc regulation circuit cannot maintain the preset bias conditions within  $\pm 20\%$ , the transmitter will automatically be disabled. Once this has occurred, an electrical power reset will allow an attempted turn-on of the transmitter. TX\_FAULT can also be cleared by cycling TX\_DISABLE high for a time interval  $\geq 10 \mu\text{s}$ .

### Absolute Maximum Ratings

Stresses in excess of the absolute maximum ratings can cause catastrophic damage to the device. Limits apply to each parameter in isolation, all other parameters having values within the recommended operating conditions. It should not be assumed that limiting values of more than one parameter can be applied to the product at the same time. Exposure to the absolute maximum ratings for extended periods can adversely affect device reliability.

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Storage Temperature	$T_S$	-40		+85	°C	
Supply Voltage	$V_{DDTV_{DDR}}$	-0.5		6.0	V	
Data Input Voltage	TX_DAT	-0.5		$V_{DDT}$	V	1
Transmitter Differential Input Voltage	$\pm TX\_DAT$			2000	mV p-p	
Relative Humidity	RH	5		95	%	

### Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Ambient Operating Temperature	$T_A$	0		+60	°C	
Case Temperature	$T_{CASE}$			+75	°C	2
Supply Voltage	$V_{DDTV_{DDR}}$	4.75	5.0	5.25	V	
Supply Current	$I_{TX} + I_{RX}$		200	300	mA	3

### Transceiver Electrical Characteristics

( $T_A = 0^\circ\text{C}$  to  $+60^\circ\text{C}$ ,  $V_{CC} = 4.75\text{ V}$  to  $5.25\text{ V}$ )

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Surge Current	$I_{SURGE}$			+30	mA	4
Power Dissipation	$P_{DISS}$		1.00	1.58	W	5

#### Notes:

1. Up to applied  $V_{DDT}$ .
2. See Figure 1 for measurement point.
3. Maximum current is specified at  $V_{CC} = \text{maximum}$  @ maximum operating temperature and end of life.
4. Hot plug above actual steady state current.
5. Total  $T_X + R_X$ .



## HFBR-5602

### Transmitter Electrical Characteristics

( $T_A = 0^\circ\text{C}$  to  $+60^\circ\text{C}$ ,  $V_{CC} = 4.75\text{ V}$  to  $5.25\text{ V}$ )

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Transmitter Differential Input Voltage	$\pm\text{TX\_DAT}$	650		2000	mV p-p	
Transmit Fault Load	$\text{TX\_FAULT}_{\text{Load}}$	4.7		10	$\text{k}\Omega$	1
TX_DISABLE Assert Time	$t_{\text{off}}$			10	$\mu\text{sec}$	2
TX_DISABLE Negate Time	$t_{\text{on}}$			1	msec	3
Time to initialize, includes reset of TX_FAULT	$t_{\text{init}}$			300	msec	4
TX_FAULT from fault to assertion	$t_{\text{fault}}$			7	msec	5
TX_DISABLE time to start reset	$t_{\text{reset}}$	10			$\mu\text{sec}$	6

### Receiver Electrical Characteristics

( $T_A = 0^\circ\text{C}$  to  $+60^\circ\text{C}$ ,  $V_{CC} = 4.75\text{ V}$  to  $5.25\text{ V}$ )

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Receiver Differential Output Voltage	$\pm\text{RX\_DAT}$	370		2000	mV p-p	
Receiver Output Rise Time	$t_{\text{rRX\_DAT}}$		0.25	0.35	ns	
Receiver Output Fall Time	$t_{\text{fRX\_DAT}}$		0.25	0.35	ns	
Receiver Loss of Light Load	$\text{RX\_LOS}_{\text{Load}}$	4.7		10	$\text{k}\Omega$	1
Receiver Loss of Signal Output Voltage - Low	$\text{RX\_LOS}_L$	0.0		0.5	V	
Receiver Loss of Signal Output Voltage - High	$\text{RX\_LOS}_H$	$V_{CC}-0.5$		$V_{CC}+0.3$	V	
Receiver Loss of Signal Assert Time - Logic low to high	$t_{A,\text{RX\_LOS}}$			100	$\mu\text{s}$	
Receiver Loss of Signal Deassert Time - Logic high to low	$t_{D,\text{RX\_LOS}}$			100	$\mu\text{s}$	

#### Notes:

1. Open collector TTL compatible.
2. Rising edge of TX\_DISABLE to fall of output signal below 10% of nominal.
3. Falling edge of TX\_DISABLE to rise of output signal above 90% of nominal.
4. From power on or hot plug after  $V_{DDT} > 4.75\text{ V}$  or From negation of TX\_DISABLE during reset of TX\_FAULT.
5. From occurrence of fault (output safety violation or  $V_{DDT} < 4.5\text{ V}$ ).
6. TX\_DISABLE HIGH before TX\_DISABLE set LOW.

## HFBR-5602

### Transmitter Optical Characteristics

( $T_A = 0^\circ\text{C}$  to  $+60^\circ\text{C}$ ,  $V_{CC} = 4.75\text{ V}$  to  $5.25\text{ V}$ )

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Output Optical Power 50/125 $\mu\text{m}$ , NA = 0.20 fiber	$P_O$	-10		-4	dBmavg.	
Output Optical Power 62.5/125 $\mu\text{m}$ , NA = 0.275 fiber	$P_O$	-10		-4	dBmavg.	
Optical Extinction Ratio		9			dB	
Center Wavelength	$c$	830	850	860	nm	
Spectral Width - rms				0.85	nm rms	
Optical Rise/Fall Time	$t_r / t_f$			0.26	ns	1, 2 and Figure 2
$RIN_{12}$				-116	dB/Hz	
Deterministic Jitter	DJ			188	ps p-p	
Max. Pout TX_DISABLE Asserted	$P_{OFF}$			-35	dBm	

### Receiver Optical Characteristics

( $T_A = 0^\circ\text{C}$  to  $+60^\circ\text{C}$ ,  $V_{CC} = 4.75\text{ V}$  to  $5.25\text{ V}$ )

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Input Optical Power	$P_{IN}$	-17	-22	0	dBm avg.	
Operating Center Wavelength	$c$	770		860	nm	
Return Loss		12			dB	
Receiver Loss of Signal - TTL Low	$P_{RX\_LOS\ A}$		-23	-17	dBm avg.	
Receiver Loss of Signal - TTL High	$P_{RX\_LOS\ D}$	-31	-26		dBm avg.	

#### Notes:

- 20% to 80% response time.
- Laser transmitter pulse response characteristics are specified by an eye diagram (Figure 2).

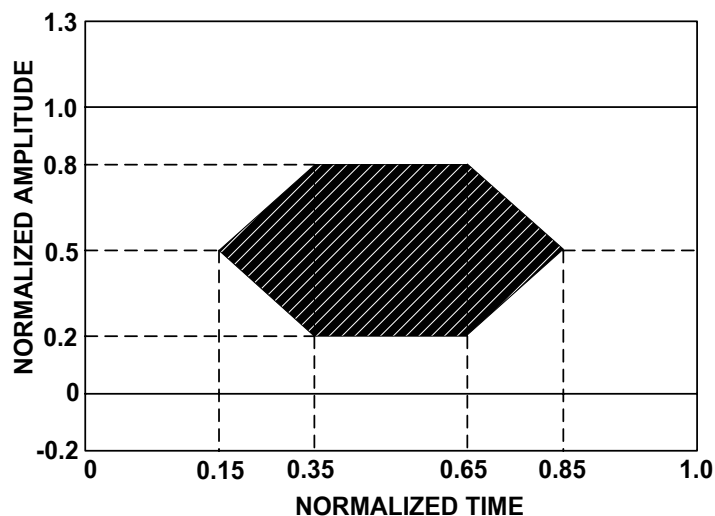


Figure 2. Transmitter Optical Eye Diagram Mask

## Long Wavelength GBIC: HFCT-5612

### Transmitter Section

The transmitter section consists of a 1300 nm MQW Fabry Perot Laser in an optical subassembly (OSA), which mates to the fiber optic cable. The Laser OSA is driven by a custom, silicon bipolar IC which converts differential PECL logic signals (ECL referenced to a +5 V supply) into an analog drive current to the laser.

The laser driver IC incorporates temperature compensation and feedback from the OSA to maintain constant output power and extinction ratio over the operating temperature range.

### Receiver Section

The receiver includes a PIN photodiode mounted together with a custom, silicon bipolar transimpedance preamplifier IC, in an OSA. The OSA interfaces to a custom silicon bipolar circuit that provides post-amplification and quantization. The post-amplifier includes a

Signal Detect circuit that provides TTL compatible logic-low output in response to the detection of a usable input optical signal.

### Eye Safety Design

The laser driver is designed to be Class 1 eye safe (CDRH21 CFR(J), IEC 60825-1) under a single fault condition.

There are three key elements to the safety circuitry: a monitor diode, a window detector circuit, and direct control of the laser bias. The window detection circuit monitors the average optical power using the photo diode in the laser OSA. If a fault occurs such that the dc bias circuit cannot maintain the preset conditions within  $\pm 20\%$ , TX\_FAULT (Pin 10) will be asserted (high).

**Note:** Under any single fault, the laser optical output power will remain within Class 1 eye safe limits.

### Absolute Maximum Ratings

Stresses in excess of the absolute maximum ratings can cause catastrophic damage to the device. Limits apply to each parameter in isolation, all other parameters having values within the recommended operating conditions. It should not be assumed that limiting values of more than one parameter can be applied to the product at the same time. Exposure to the absolute maximum ratings for extended periods can adversely affect device reliability.

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Storage Temperature	$T_S$	-40		+85	°C	
Supply Voltage	$V_{DDTV_{DDR}}$	-0.5		6.0	V	
Data Input Voltage	TX_DAT	-0.5		$V_{DDT}$	V	
Transmitter Differential Input Voltage	$\pm TX\_DAT$			2000	mV p-p	
Relative Humidity	RH	5		95	%	

### Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Ambient Operating Temperature	$T_A$	0		+60	°C	
Case Temperature	$T_{CASE}$			+75	°C	1
Supply Voltage	$V_{DDTV_{DDR}}$	4.75	5.0	5.25	V	
Supply Current	$I_{TX} + I_{RX}$		200	300	mA	2

### Transceiver Electrical Characteristics

( $T_A = 0^\circ\text{C}$  to  $+70^\circ\text{C}$ ,  $V_{CC} = 4.75\text{ V}$  to  $5.25\text{ V}$ )

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Surge Current	$I_{SURGE}$			+30	mA	3
Power Dissipation	$P_{DISS}$		1.00	1.58	W	4

#### Notes:

1. See Figure 1 for measurement point.
2. Maximum current is specified at  $V_{CC} = \text{maximum}$  @ maximum operating temperature and end of life.
3. Hot plug above actual steady state current.
4. Total Tx + Rx.

## HFCT-5612

### Transmitter Electrical Characteristics

( $T_A = 0^\circ\text{C}$  to  $+60^\circ\text{C}$ ,  $V_{CC} = 4.75\text{ V}$  to  $5.25\text{ V}$ )

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Transmitter Differential Input Voltage	$\pm\text{TX\_DAT}$	650		2000	mV p-p	
Transmit Fault Load	$\text{TX\_FAULT}_{\text{Load}}$	4.7		10	k $\Omega$	1
Transmit Fault Output - Low	$\text{TX\_FAULT}_L$	0.0		0.5	V	
Transmit Fault Output - High	$\text{TX\_FAULT}_H$	$V_{CC}-0.5$		$V_{CC}+0.3$	V	2
TX_DISABLE Assert Time	$t_{\text{off}}$		3	10	$\mu\text{sec}$	3
TX_DISABLE Negate Time	$t_{\text{on}}$		0.5	1	msec	4
Time to initialize, includes reset of TX_FAULT	$t_{\text{init}}$		30	300	msec	5
TX_FAULT from fault to assertion	$t_{\text{fault}}$		20	100	$\mu\text{sec}$	6
TX_DISABLE time to start reset	$t_{\text{reset}}$	10			$\mu\text{sec}$	7

### Receiver Electrical Characteristics

( $T_A = 0^\circ\text{C}$  to  $+60^\circ\text{C}$ ,  $V_{CC} = 4.75\text{ V}$  to  $5.25\text{ V}$ )

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Receiver Differential Output Voltage	$\pm\text{RX\_DAT}$	370		2000	mV p-p	
Receiver Output Rise Time	$t_{r\text{RX\_DAT}}$			0.35	ns	8
Receiver Output Fall Time	$t_{f\text{RX\_DAT}}$			0.35	ns	8
Receiver Loss of Light Load	$\text{RX\_LOS}_{\text{Load}}$	4.7		10	k $\Omega$	1
Receiver Loss of Signal Output Voltage - Low	$\text{RX\_LOS}_L$	0.0		0.5	V	
Receiver Loss of Signal Output Voltage - High	$\text{RX\_LOS}_H$	$V_{CC}-0.5$		$V_{CC}+0.3$	V	2
Receiver Loss of Signal Assert Time (off to on)	$t_{A,\text{RX\_LOS}}$			100	$\mu\text{s}$	
Receiver Loss of Signal Deassert Time (on to off)	$t_{D,\text{RX\_LOS}}$			100	$\mu\text{s}$	

#### Notes:

1. Open collector TTL compatible.
2. 4 k7 to 10 k pull-up on host to  $V_{CC}$ .
3. Rising edge of TX\_DISABLE to fall of output signal below 10% of nominal.
4. Falling edge of TX\_DISABLE to rise of output signal above 90% of nominal.
5. From power on or hot plug after  $V_{DDT} > 4.75\text{ V}$  or From negation of TX\_DISABLE during reset of TX\_FAULT.
6. From occurrence of fault (output safety violation or  $V_{DDT} < 4.5\text{ V}$ ).
7. TX\_DISABLE HIGH before TX\_DISABLE set LOW.
8. 20% to 80% response time.

## HFCT-5612

### Transmitter Optical Characteristics

( $T_A = 0^\circ\text{C}$  to  $+60^\circ\text{C}$ ,  $V_{CC} = 4.75\text{ V}$  to  $5.25\text{ V}$ )

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Output Optical Power	$P_O$	-9.5	-7	-3	dBm	
		-11.5		-3	dBm	
		-11.5		-3	dBm	
Optical Extinction Ratio		9			dB	
Center Wavelength	$\lambda_C$	1285	1310	1343	nm	
Spectral Width - rms				2.8	nm rms	
Optical Rise/Fall Time	$t_r / t_f$			0.320	ns	1, 2 and Figure 2
$RIN_{12}$				-116	dB/Hz	
Deterministic Jitter	DJ			188	ps p-p	
Max. Pout TX_DISABLE Asserted	$P_{OFF}$			-35	dBm	

### Receiver Optical Characteristics

( $T_A = 0^\circ\text{C}$  to  $+60^\circ\text{C}$ ,  $V_{CC} = 4.75\text{ V}$  to  $5.25\text{ V}$ )

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Input Optical Power	$P_{IN}$	-20	-25	-3	dBm avg.	
Operating Center Wavelength	$\lambda_C$	1270		1355	nm	
Return Loss		12			dB	
Receiver Loss of Signal -TTL Low	$P_{RX\_LOS A}$		-28	-20	dBm avg.	
Receiver Loss of Signal - TTL High	$P_{RX\_LOS D}$	-31			dBm avg.	

#### Notes:

1. 20% to 80% response time.
2. Laser transmitter pulse response characteristics are specified by an eye diagram (Figure 2).

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