HFBR-5908E/HFCT-5908E

ATM Fiber Optic Transceivers for SONET OC-12/SDH STM-4

Data Sheet

Description

The HFBR/HFCT-5908E transceivers from Avago allow the system designer to implement a range of solutions for multimode and single mode SONET OC-12/ (SDH STM-4) applications.

These transceivers are supplied in the new industry standard 2 x 5 DIP style package with an MT-RJ fiber connector interface.

ATM 500 m Backbone Links

The HFBR-5908E is a 1300 nm product with optical performance compliant with the SONET STS-12c (OC-12) Physical Layer Interface specification. This physical layer is defined in the ATM forum User Network Interface (UNI) specification version 3.0. This document references the ANSI T1E1.2 specification for the details of the interface for 500 m multimode fiber backbone links.

SONET OC-12/SDH STM-4/ATM 15 km Links

The HFCT-5908E transceiver is a high performance, cost effective module for serial optical communications applications specified for a signal rate of 622 MBd. It is designed to provide a SONET/SDH compliant link for 622 Mb/s intermediate reach links.

Features

- Compliant with ATM forum 622.08 Mb/s physical layer specification (AF-PHY-0046.000)
- Compliant with ANSI Broadband ISDN - physical layer specification T1.646-1995 and T1.646a-1997
- HFBR-5908E is compliant with specifications proposed to ANSI T1E1.2 committee for inclusion in SONET physical layer specifications (T1E1/T1.45)
- HFCT-5908E is compliant to the intermediate SONET OC12/SDH STM(S4.1) specifications
- Multisourced 2 x 5 package style with MT-RJ receptacle
- Single +3.3 V power supply
- Wave solder and aqueous wash process compatible
- Manufactured in an ISO9002 certified facility
- Performance
  HFBR-5908E:
  Links of 500 m with 62.5/125 µm MMF for 622 Mb/s
  HFCT-5908E:
  Links of 15 km with 9/125 µm SMF
- Unconditionally eye safe laser
  IEC 825/CDRH Class 1 compliant

Applications

HFBR-5908E:

- ATM 622 Mb/s MMF links from switch-to-switch in the end-user premise
- Private MMF interconnects at 622 Mb/s SONET STS-12/ SDH STM-4 rate HFCT-5908E:
- ATM 622 Mb/s SMF links from switch-to-switch or switch-to-server in the end-user premise
- Private SMF interconnects at 622 Mb/s SONET STS-12/ SDH STM-4 rate

Functional Description
Receiver Section

Design

The receiver section of the HFBR/HFCT-5908E contains an InGaAs/InP photo detector and a preamplifier mounted in an optical subassembly. This optical subassembly is coupled to a postamp/decision circuit on a separate circuit board.

The postamplifier is ac coupled to the preamplifier as illustrated in Figure 1. The coupling capacitors are large enough to pass the SONET/SDH test pattern at 622 MBd without significant distortion or performance penalty. If a lower signal rate, or a code which has significantly more low frequency content is used, sensitivity, jitter and pulse distortion could be degraded.

Figure 1 also shows a filter network which limits the bandwidth of the preamp output signal. The filter is designed to bandlimit the preamp output noise and thus improve the receiver sensitivity.

These components will also reduce the sensitivity of the receiver as the signal bit rate is increased above 622 MBd.

Noise Immunity

The receiver includes internal circuit components to filter power supply noise. Under some conditions of EMI and power supply noise, external power supply filtering may be necessary. A power supply filter circuit is shown in the Application Section.

The Signal Detect Circuit

The signal detect circuit works by sensing the peak level of the received signal and comparing this level to a reference.

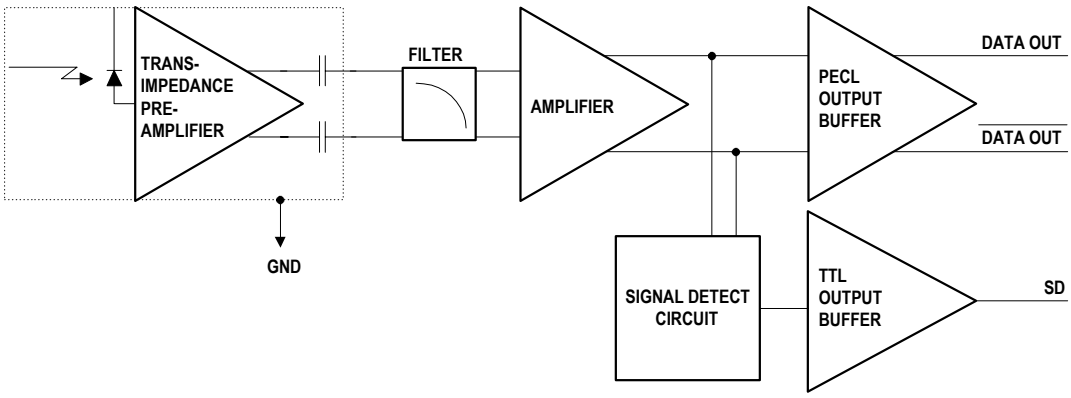


Figure 1. Receiver Block Diagram

Functional Description

Transmitter Section

Design

The transmitter section of the HFBR/HFCT-5908E uses a buried heterostructure Fabry Perot laser as its optical source. The package of this laser is designed to allow repeatable coupling into single mode fiber for the HFCT-5908E and multimode fiber for the HFBR-5908E. In addition, this package has been designed to be compliant with IEC 825 Class 1 and CDRH Class I eye safety requirements. The optical output is controlled by a custom IC which detects the laser output via the monitor photodiode. This IC provides both dc and ac current drive to the laser to ensure correct modulation, eye diagram and extinction ratio over temperature, supply voltage and life.

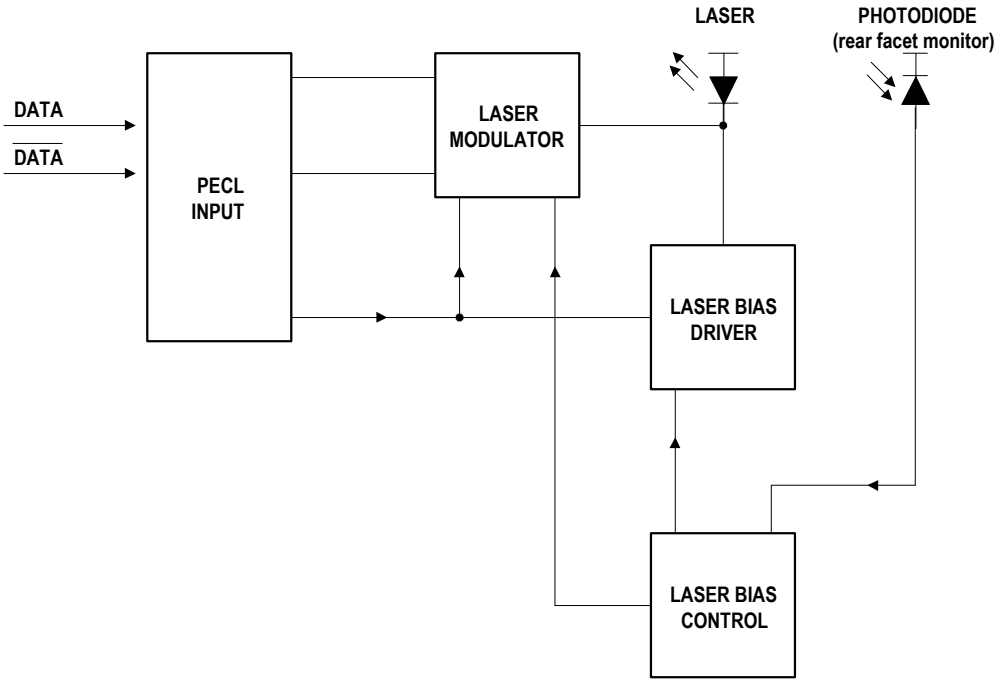
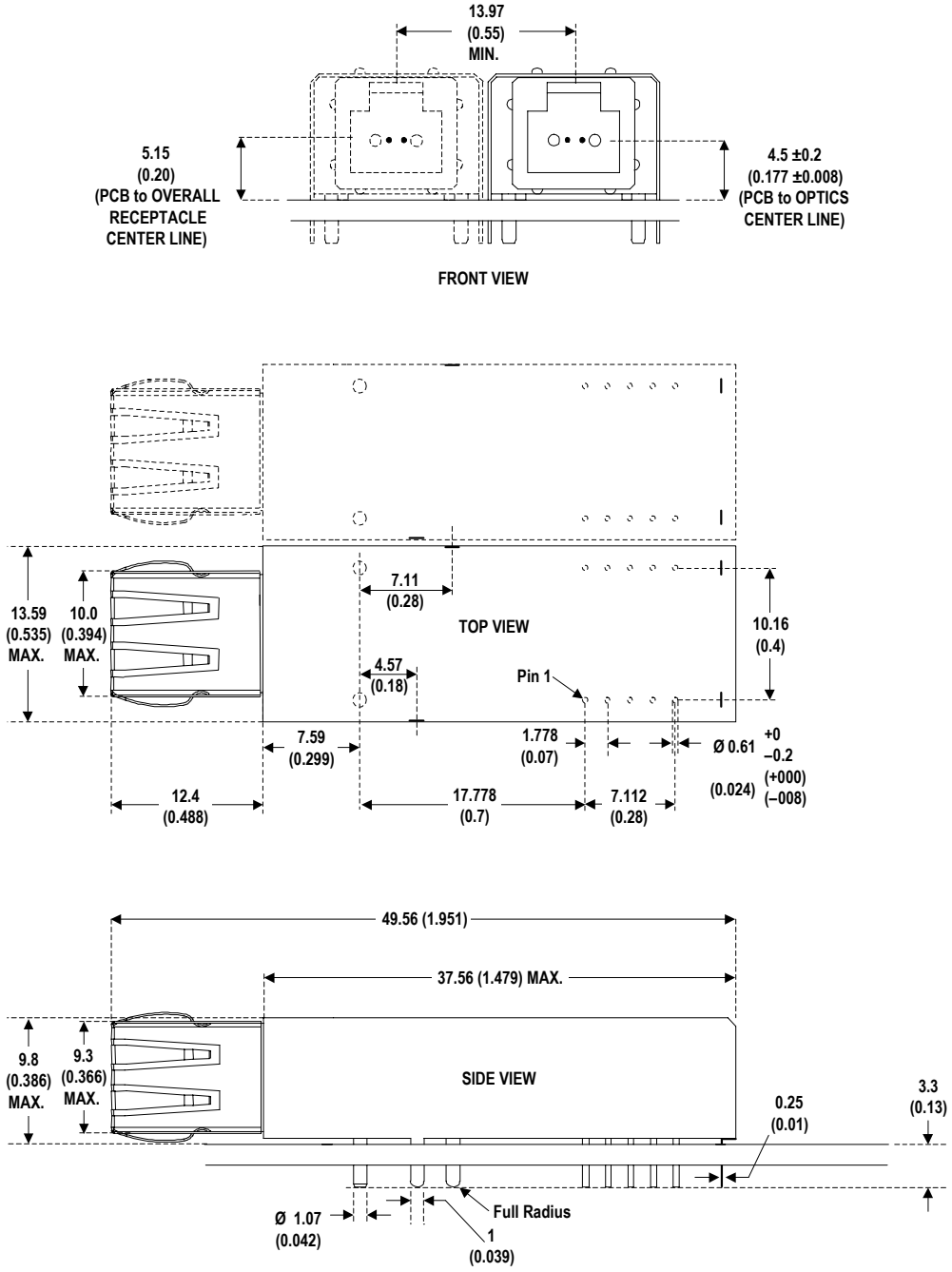


Figure 2. Simplified Transmitter Schematic



DIMENSIONS IN MILLIMETERS (INCHES)

NOTES:
1. THIS PAGE DESCRIBES THE MAXIMUM PACKAGE OUTLINE, MOUNTING STUDS, PINS AND THEIR RELATIONSHIPS TO EACH OTHER.
2. TOLERANCED TO ACCOMMODATE ROUND OR RECTANGULAR LEADS.
3. THE 10 I/O PINS, 2 SOLDER POSTS AND 4 PACKAGE GROUNDING TABS ARE TO BE TREATED AS A SINGLE PATTERN, SEE FIGURE 8.
4. THE MT-RJ HAS A 750 µm FIBER SPACING.
5. THE MT-RJ ALIGNMENT PINS ARE IN THE MODULE.
6. SEE MT-RJ TRANSCEIVER PIN OUT DIAGRAM FOR DETAILS.

Figure 3. HFBR-5908E/HFCT-5908E Package Outline Drawing

Connection Diagram

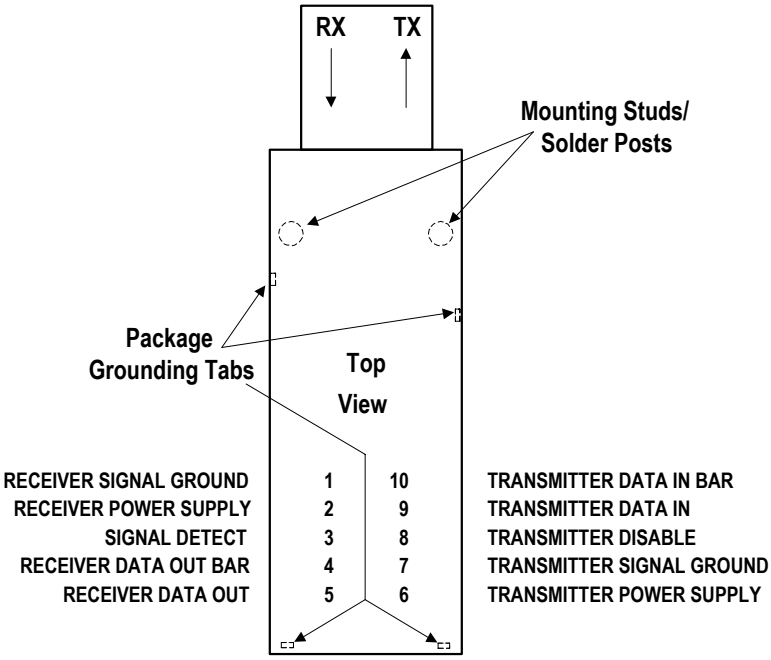


Figure 4. Pin Out Diagram

Pin Descriptions:

Pin 1 Receiver Signal Ground V_{EE} RX:[1]

Directly connect this pin to the receiver ground plane.

Pin 2 Receiver Power Supply V_{CC} RX:

Provide +3.3 V dc via the recommended receiver power supply filter circuit. Locate the power supply filter circuit as close as possible to the V_{CC} RX pin.

Pin 3 Signal Detect SD:

Normal optical input levels to the receiver result in a logic "1" output.

Low optical input levels to the receiver result in a fault condition indicated by a logic "0" output.

This Signal Detect output can be used to drive a TTL input on an upstream circuit, such as Signal Detect input or Loss of Signal-bar.

Pin 4 Receiver Data Out Bar RD-:

No internal terminations are provided. See recommended circuit schematic.

Pin 5 Receiver Data Out RD+:

No internal terminations are provided. See recommended circuit schematic.

Pin 6 Transmitter Power Supply V_{CC} TX:

Provide +3.3 V dc via the recommended transmitter power supply filter circuit. Locate the power supply filter circuit as close as possible to the V_{CC} TX pin.

Pin 7 Transmitter Signal Ground V_{EE} TX:

Directly connect this pin to the transmitter ground plane.

Pin 8 Transmitter Disable T_{DIS}:

Optional feature, connect this pin to +3.3 V TTL logic high "1" to disable module. To enable module connect to TTL logic low "0".

Pin 9 Transmitter Data In TD+:

No internal terminations are provided. See recommended circuit schematic.

Pin 10 Transmitter Data In Bar TD-:

No internal terminations are provided. See recommended circuit schematic.

Mounting Studs/Solder Posts

The two mounting studs are provided for transceiver mechanical attachment to the circuit board. It is recommended that the holes in the circuit board be connected to chassis ground.

Package Grounding Tabs

Connect four package grounding tabs to signal ground.

Note: 1. The Transmitter and Receiver V_{EE} connections are commoned within the module.

Application Information

The Applications Engineering Group at Avago is available to assist you with technical understanding and design trade-offs associated with these transceivers. You can contact them through your Avago sales representative.

The following information is provided to answer some of the most common questions about the use of the parts.

Optical Power Budget and Link Penalties

The worst-case Optical Power Budget (OPB) in dB for a fiber-optic link is determined by the difference between the minimum transmitter output optical power (dBm avg) and the lowest receiver sensitivity (dBm avg). This OPB provides the necessary optical signal range to establish a working fiber-optic link. The OPB is allocated for the fiber-optic cable length and the corre-sponding link penalties. For proper link performance, all penalties that affect the link performance must be accounted for within the link optical power budget.

Electrical and Mechanical Interface

Recommended Circuit

Figure 5 shows the recommended interface for deploying the Avago transceiver in a +3.3 V system. Also present are power supply filtering arrangements which comply with the recommendations of the small form factor multisource agreement. This configuration ensures noise rejection compatibility between transceivers from various vendors.

Data Line Interconnections

Avago's HFBR/HFCT-5908E fiber-optic transceiver is designed to couple to +3.3 V PECL signals. Figure 5 depicts the circuit options. The transmitter driver circuit regulates the output optical power. The regulated light output will maintain a constant output optical power provided the data pattern is reasonably balanced in duty factor. If the data duty factor has long, continuous state times (low or high data duty factor), then the output optical power will gradually change its average output optical power level to its preset value.

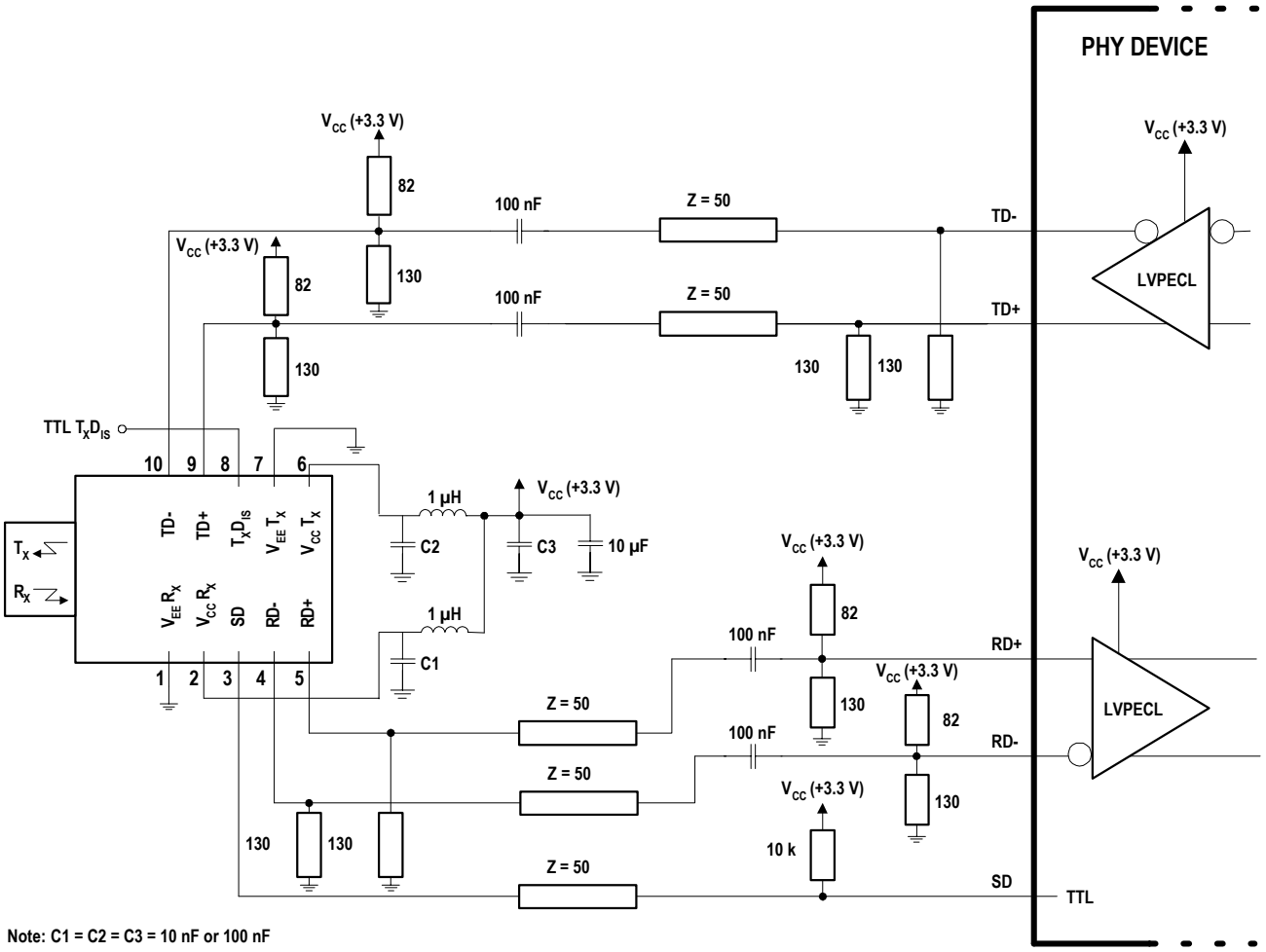


Figure 5. +3.3 V Transceiver Interface with +3.3 V LVPECL Device

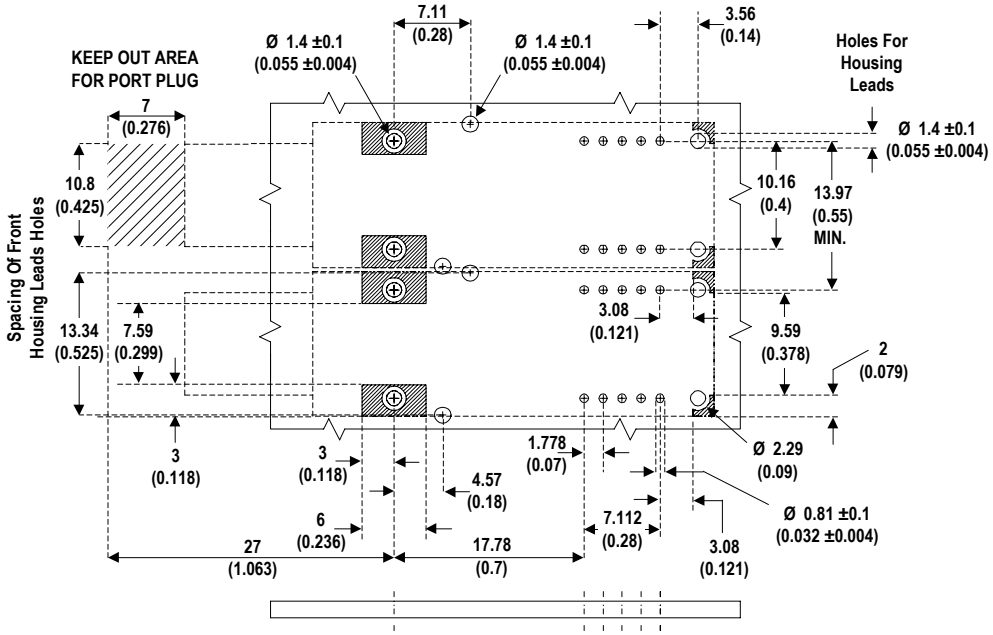
The HFBR/HFCT-5908E feature a transmit disable function which is a single-ended +3.3 V TTL input signal dc-coupled to pin 8.

As for the receiver section, it is internally ac-coupled between the preamplifier and the post-amplifier stages. The actual Data and Data-bar outputs of the post-amplifier are dc-coupled to their respective output pins (pins 4, 5). Signal Detect is a single-ended, +3.3 V TTL output signal that is dc-coupled to pin 3 of the module. Signal Detect should not be ac-coupled externally to the follow-on circuits because of its infrequent state changes.

Caution should be taken to account for the proper intercon-nection between the supporting Physical Layer integrated circuits and this HFBR/HFCT-5908E transceiver. Figure 5 illustrates a recommended interface circuit for interconnecting to a +3.3 V dc PECL fiber-optic transceiver.

Power Supply Filtering and Ground Planes

It is important to exercise care in circuit board layout to achieve optimum performance from these transceivers. Figure 5 shows the recommended power supply filter circuit for the SFF transceiver. It is further recommended that a contiguous ground plane be provided in the circuit board directly under the transceiver to provide a low inductance ground for signal return current. This recommendation is in keeping with good high frequency board layout practices.



DIMENSIONS IN MILLIMETERS (INCHES)

NOTES:
1. THIS FIGURE DESCRIBES THE RECOMMENDED CIRCUIT BOARD LAYOUT FOR THE MT-RJ TRANSCEIVER PLACED AT .550 SPACING.
2. THE HATCHED AREAS ARE KEEP-OUT AREAS RESERVED FOR HOUSING STANDOFFS. NO METAL TRACES OR GROUND CONNECTION IN KEEP-OUT AREAS.
3. 2 x 5 TRANSCEIVER MODULE REQUIRES 16 PCB HOLES (10 I/O PINS, 2 SOLDER POSTS AND 4 PACKAGE GROUNDING TABS).
   PACKAGE GROUNDING TABS SHOULD BE CONNECTED TO SIGNAL GROUND.
4. THE SOLDER POSTS SHOULD BE SOLDERED TO CHASSIS GROUND FOR MECHANICAL INTEGRITY AND TO ENSURE FOOTPRINT COMPATIBILITY WITH OTHER SFF TRANSCEIVERS.

Figure 6. Recommended Board Layout Hole Pattern

Package footprint and front panel considerations

The Avago transceiver complies with the circuit board "Common Transceiver Footprint" hole pattern defined in the original multisource announcement which defined the 2 x 5 package style. This drawing is reproduced in Figure 6 with the addition of ANSI Y14.5M compliant dimensioning to be used as a guide in the mechanical layout of your circuit board. Figure 7 shows the front panel dimensions associated with such a layout.

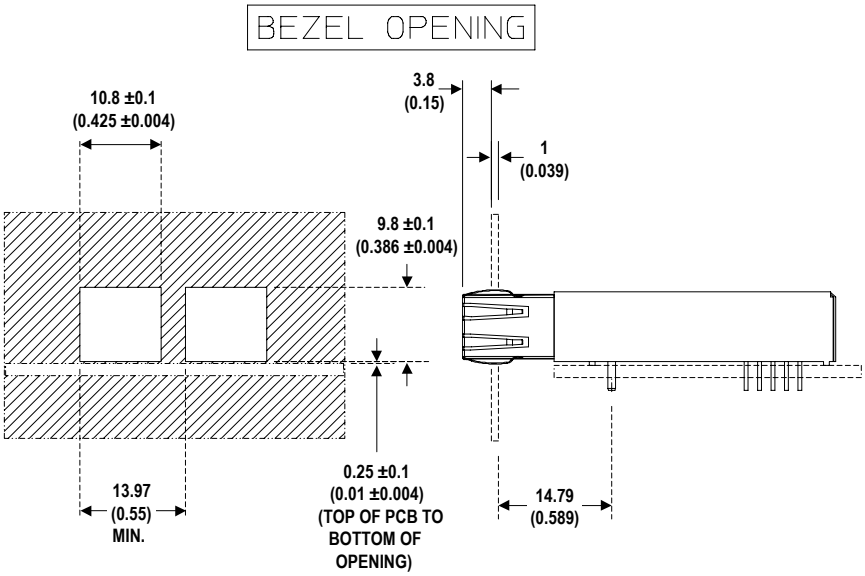
Eye Safety Circuit

For an optical transmitter device to be eye-safe in the event of a single fault failure, the transmit-ter must either maintain eye-safe operation or be disabled.

The HFBR/HFCT-5908E utilizes an optical subassembly consisting of a short piece of single mode fiber along with a current limiting circuit to guarantee eye-safety. It is intrinsically eye safe and does not require shut down circuitry.

Signal Detect

The Signal Detect circuit provides a deasserted output signal when the optical link is broken or when the transmitter is OFF. The Signal Detect threshold is set to transition from a high to low state between the minimum receiver input optical power and -35 dBm avg. input optical power indicating a definite optical fault (e.g. unplugged connector for the receiver or transmitter, broken fiber, or failed far-end transmitter or data source). A Signal Detect indicating a working link is functional when receiving encoded 8B/10B characters. The Signal Detect does not detect receiver data error or error-rate. Data errors can be determined by signal processing offered by upstream PHY ICs.



DIMENSIONS IN MILLIMETERS (INCHES)

NOTE: NOSE SHIELD SHOULD BE CONNECTED TO CHASSIS GROUND.

Figure 7. Recommended Panel Mounting

Electromagnetic Interference (EMI)

One of a circuit board designer's foremost concerns is the control of electromagnetic emissions from electronic equipment. Success in controlling generated Electromagnetic Interference (EMI) enables the designer to pass a governmental agency's EMI regulatory standard and more importantly, it reduces the possibility of interference to neighboring equipment. Avago has designed the HFBR/HFCT-5908E to provide excellent EMI performance. The EMI performance of a chassis is dependent on physical design and features which help improve EMI suppression. Avago encourages using standard RF suppression practices and avoiding poorly EMI-sealed enclosures.

Radiated Emissions for the HFBR/HFCT-5908E have been tested successfully in several environments. While this number is important for system designers in terms of emissions levels inside a system, Avago recognizes that the performance of most interest to our customers is the emissions levels, which could be expected to radiate to the outside world from inside a typical system. In their application, SFF transceivers are intended for use inside an enclosed system, protruding through the specified panel opening at the specified protrusion depth.

Along with the system advantage of high port density comes the increase in the number of apertures. Careful attention must be paid to the locations of high-speed clocks or gigabit circuitry with respect to these apertures. While experimental measurements and experiences do not indicate any specific transceiver emissions issues, Avago recognizes that the transceiver aperture is often a weak link in system enclosure integrity and has designed the modules to minimize emissions and contain the internal system emissions by shielding the aperture.

To that end, Avago's OC-12/STM-4 MT-RJ transceivers (HFCT-5908E and HFBR-5908E) have nose shields which provide a convenient chassis connection to the nose of the transceiver. This nose shield improves system EMI performance by closing off the MT-RJ aperture. Localized shielding is also improved by tying the four metal housing package grounding tabs to signal ground on the PCB. Though not obvious by inspection, the nose shield and metal housing are electrically separated for customers who do not wish to directly tie chassis and signal grounds together. The recommended transceiver position, PCB layout and panel opening for both HFBR/HFCT-5908E are the same, making them mechanically drop-in compatible. Figure 7 shows the recommended positioning of the transceivers with respect to the PCB and faceplate.

Package and Handling Instructions

Flammability

The HFBR/HFCT-5908E transceiver housing consists of high strength, heat resistant, chemically resistant, and UL 94 V-0 flame retardant plastic and metal packaging.

Recommended Solder and Wash Process

The HFBR/HFCT-5908E is compatible with industry-standard wave or hand solder processes.

Process plug

This transceiver is supplied with a process plug for protection of the optical port within the MT-RJ connector receptacle. This process plug prevents contamination during wave solder and aqueous rinse as well as during handling, shipping and storage. It is made of a high-temperature, molded sealing material that can withstand +80°C and a rinse pressure of 110 lbs per square inch.

Recommended Solder fluxes

Solder fluxes used with the HFBR/HFCT-5908E should be water-soluble, organic fluxes. Recommended solder fluxes include Lonco 3355-11 from London Chemical West, Inc. of Burbank, CA, and 100 Flux from Alpha-Metals of Jersey City, NJ.

Recommended Cleaning/ Degreasing Chemicals

Alcohols: methyl, isopropyl, isobutyl.
Aliphatics: hexane, heptane
Other: naphtha.

Do not use partially halogenated hydrocarbons such as 1,1.1 trichloroethane, ketones such as MEK, acetone, chloroform, ethyl acetate, methylene dichloride, phenol, methylene chloride, or N-methylpyrolldone. Also, Avago does not recommend the use of cleaners that use halogenated hydrocarbons because of their potential environmental harm.

Regulatory Compliance

(See the Regulatory Compliance Table for transceiver performance) The overall equipment design will determine the certification level. The transceiver performance is 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 mounting it on the circuit board. 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 transceiver perform-ance has been shown to provide adequate performance in typical industry production environments.

The second case to consider is static discharges to the exterior of the equipment chassis containing the transceiver parts. To the extent that the MT-RJ connector receptacle is exposed to the outside of the equipment chassis it may be subject to whatever system-level ESD test criteria that the equipment is intended to meet. The transceiver performance is more robust than typical industry equipment requirements of today.

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. Refer to EMI section (page 8) for more details.

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.

Regulatory Compliance - Targeted Specification

Feature	Test Method	Performance
Electrostatic Discharge (ESD) to the Electrical Pins	MIL-STD-883C Method 3015.4	Class 1 (>1000 V).
Electrostatic Discharge (ESD) to the MT-RJ Receptacle	IEC 61000-4-2	Tested to 8 kV contact discharge.
Electromagnetic Interference (EMI)	FCC Class B CENELEC EN55022 Class B(CISPR 22A) VCCI Class I	Margins are dependent on customer board and chassis designs. Single port emission tests demonstrate a margin in excess of 20 dB is achievable.
Immunity	IEC 61000-4-3	Typically show no measurable effect from a10 V/m field swept from 27 to 1000 MHz applied to the transceiver without a chassis enclosure.

Eye Safety

These laser-based transceivers are classified as AEL Class I (U.S. 21 CFR(J) and AEL Class 1 per EN 60825-1 (+A11). They are eye safe when used within the data sheet limits per CDRH. They are also eye safe under normal operating conditions and under all reasonably foreseeable single fault conditions per EN60825-1. Avago has tested the transceiver design for compliance with the requirements listed below under normal operating conditions and under single fault conditions where applicable. TUV Rheinland has granted certification to these transceivers for laser eye safety and use in EN 60950 and EN 60825-2 applications. Their performance enables the transceivers to be used without concern for eye safety up to 3.6 V transmitter V_{CC}.

CAUTION:

There are no user serviceable parts nor any maintenance required for the HFBR/HFCT-5908E. All adjustments are made at the factory before shipment to our customers. Tampering with or modifying the performance of the HFBR/HFCT-5908E will result in voided product warranty. It may also result in improper operation of the HFBR/HFCT-5908E circuitry, and possible overstress of the laser source. Device degradation or product failure may result.

Connection of the HFBR/HFCT-5908E to a non-approved optical source, operating above the recommended absolute maximum conditions or operating the HFBR/HFCT-5908E in a manner inconsistent with its 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 and reidentify the laser product under the provisions of U.S. 21 CFR (Subchapter J).

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	Reference
Storage Temperature	T_S	-40		+85	°C	
Supply Voltage	V_{CC}	-0.5		3.6	V	1
Data Input Voltage	V_I	-0.5		V_{CC}	V	
Output Current	I_D			30	mA	
Relative Humidity	RH	0		95	%	

Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit	Reference
Ambient Operating Temperature	T_A	0		+70	°C	2
Supply Voltage	V_{CC}	3.14		3.47	V	
Power Supply Rejection	PSR		75	100	mV pk-pk	3
Transmitter Differential Input Voltage	V_D	0.3		1.6	V	
Data Output Load	R_{DL}		50		Ω	
TTL Signal Detect Output Current	I_{OL}			1.0	mA	
TTL Signal Detect Output Current	I_{OH}	-400			µA	
Transmit Disable Input Voltage - Low	T_{DIS}			0.6	V	
Transmit Disable Input Voltage - High	T_{DIS}	2.2			V	
Transmit Disable Assert Time	T_{ASSERT}			10	µs	4
Transmit Disable Deassert Time	$T_{DEASSERT}$			1.0	ms	5

Process Compatibility

Parameter	Symbol	Min.	Typ.	Max.	Unit	Reference
Hand Lead Soldering Temperature/Time	T_{SOLD}/t_{SOLD}			+260/10	°C/sec.	
Wave Soldering and Aqueous Wash	T_{SOLD}/t_{SOLD}			+260/10	°C/sec.	6

Notes:

1. The transceiver is class 1 eye safe up to V_{CC} = 3.6 V.
2. Measured with 2 ms^{-1} air flow over the devices.
3. Tested with a 100 mV pk - pk sinusoidal signal in the frequency range from 10 Hz to 2 MHz on the V_{CC} supply with the recommended power supply filter in place. Typically less than a 1 dB change in sensitivity is experienced.
4. Time delay from Transmit Disable Assertion to laser shutdown.
5. Time delay from Transmit Disable Deassertion to laser startup.
6. Aqueous wash pressure <110 psi.

HFBR-5908E

Transmitter Electrical Characteristics

(T_A = 0°C to +70°C, V_{CC} = 3.14 V to 3.47 V)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Reference
Supply Current	I_{CCT}		50	120	mA	
Power Dissipation	P_{DIST}		0.18	0.45	W	
Data Input Current - Low	I_{IL}	-200			µA	
Data Input Current - High	I_{IH}			200	µA	
Data Input Voltage - Low	V_{IL} - V_{CC}	-1.810		-1.475	V	
Data Input Voltage - High	V_{IH} - V_{CC}	-1.165		-0.880	V	
Systematic Jitter Contributed by the Tx	SJ (Tx)		70	300	ps pk - pk	
Random Jitter Contributed by the Tx	RJ (Tx)		35	130	ps pk - pk	

Receiver Electrical Characteristics

(T_A = 0°C to +70°C, V_{CC} = 3.14 V to 3.47 V)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Reference
Supply Current	I_{CCR}		75	120	mA	1
Power Dissipation	P_{DISR}		0.26	0.35	W	2
Data Output Voltage Swing	Vdiff	575		975	mV	3
Data Output Rise Time	t_r			0.5	ns	4
Data Output Fall Time	t_f			0.5	ns	4
Signal Detect Output Voltage - Low	V_{OL}			0.8	V	2
Signal Detect Output Voltage - High	V_{OH}	2			V	2
Signal Detect - Assert Time	AS_{MAX}	4	5	100	µs	
Signal Detect - Deassert Time	ANS_{MAX}	3.2	17	350	µs	
Systematic Jitter Contributed by the Rx	SJ (Rx)		200	300	ps pk - pk	
Random Jitter Contributed by the Rx	SJ (Rx)		175	470	ps pk - pk	

Notes:

1. This does not include the output load current.
2. Power dissipation value is the power dissipated in the receiver itself. It is calculated as the sum of the products of V_{CC} and I_{CC} minus the sum of the products of the output voltages and currents.
3. The voltage swing is compatible with 10 k, 10 kH and 100 k ECL and PECL inputs .
4. These are 20-80% values.

HFBR-5908E

Transmitter Optical Characteristics

(T_A = 0°C to +70°C, V_{CC} = 3.14 V to 3.47 V)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Reference
Output Optical Power	P_{OUT}	-20.0		-14	dBm avg.	1
Optical Extinction Ratio		10			dB	
Center Wavelength	λ_C	1270		1380	nm	
Spectral Width - rms	σ			2.5	nm rms	2
Optical Rise/Fall Time	t_r/t_f			1.25	ns	3
Overshoot			0	25	%	

Receiver Optical Characteristics

(T_A = 0°C to +70°C, V_{CC} = 3.14 V to 3.47 V)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Reference
Receiver Sensitivity	$P_{IN\,MIN}$		-30	-26	dBm avg.	
Input Optical Power Maximum	$P_{IN\,MAX}$	-14	-7		dBm avg.	4
Input Operating Wavelength	λ	1270		1380	nm	
Signal Detect - Asserted	P_A		P_D+2 dB	-31	dBm avg.	
Signal Detect - Deasserted	P_D	-42	-34.5		dBm avg.	
Signal Detect - Hysteresis	$P_A - P_D$	1	2	3	dB	

Notes:

1. Over temperatures, voltage and lifetime for 50µm and 62.5 µm fiber.
2. The relationship between FWHM and RMS values for spectral width can be derived from the assumption of a Gaussian shaped spectrum which results in RMS = FWHM/2.35.
3. These are unfiltered 20-80% values.
4. This specification is intended to indicate the performance of the receiver section of the transceiver when the input power ranges from the minimum level (with a window time-width) to the maximum level. Over this range the receiver is guaranteed to provide output data with a Bit Error Ratio (BER) better than or equal to 1 x 10^{-10}
   - At the Beginning of Life (BOL)
   - Over the specified operating temperature and voltage ranges
   - Input is at 622.08 Mbd, 2^{23}-1 PRBS data pattern with 72 "1"s and 72 "0"s inserted per the CCITT (now ITU-T) recommendation G.958 Appendix 1.
   - Receiver worst-case output data eye-opening (window time-width) is measured by applying worst-case input systematic (SJ) and random jitter (RJ). The worst-case maximum input SJ = 0.5 ns peak-to-peak and the RJ = 0.15 ns peak-to-peak per ANSI T1.646a standard. Since the random jitter contribution is very small and difficult to produce exactly, only the maximum systematic jitter is produced and used for testing the receiver. The corresponding receiver test window time-width must meet the requirement of 0.31 ns or larger. This worst-case test window time-width results from the following jitter equation:
     Minimum Test Window Time-Width = Baud Interval - Tx SJ max. - Rx SJ max. - Rx RJ max.
     Respectively, Minimum Test Window Time-Width = 1.608 ns - 0.50 ns - 0.30 ns - 0.48 ns = 0.328 ns.
     This is a test method that is within practical test error of the worst-case 0.31 ns limit.
   - Transmitter operating with a 622.08 MBd, 311.04 MHz square wave input signal to simulate any cross talk present between the transmitter and receiver sections of the transceiver.

HFCT-5908E

Transmitter Electrical Characteristics

(T_A = 0°C to +70°C, V_{CC} = 3.14 V to 3.47 V)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Reference
Supply Current	I_{CCT}		50	120	mA	
Power Dissipation	P_{DIST}		0.18	0.42	W	
Data Input Current - Low	I_{IL}	-200			µA	
Data Input Current - High	I_{IH}			200	µA	
Jitter Generation (pk to pk)	J pk - pk		60	100	mUI	1
Jitter Generation (rms)	J rms		6	10	mUI	1

Receiver Electrical Characteristics

(T_A = 0°C to +70°C, V_{CC} = 3.14 V to 3.47 V)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Reference
Supply Current	I_{CCR}		75	120	mA	
Power Dissipation	P_{DISR}		0.26	0.35	W	2
Data Output Voltage Swing	Vdiff	575		975	mV	3
Data Output Rise Time	t_r			0.5	ns	4
Data Output Fall Time	t_f			0.5	ns	4
Signal Detect Output Voltage - Low	V_{OL}			0.8	V	
Signal Detect Output Voltage - High	V_{OH}	2			V	
Signal Detect Assert Time (OFF to ON)	AS_{MAX}	4	5	100	µs	
Signal Detect Deassert Time (ON to OFF)	ANS_{MAX}	3.2	17	350	µs	

Notes:

1. Measurement performed using Avago OMNIBER test equipment (Avago 718). The measurement is done in loop back configuration and hence includes some contribution from the module's receiver.
2. Power dissipation value is the power dissipated in the receiver itself. It is calculated as the sum of the products of V_{CC} and I_{CC} minus the sum of the products of the output voltages and currents.
3. This voltage swing is compatible with 10 k, 10 kH, and 100 k ECL and PECL inputs.
4. These are 20-80% values.

HFCT-5908E

Transmitter Optical Characteristics

(T_A = 0°C to +70°C, V_{CC} = 3.14 V to 3.47 V)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Reference
Output Optical Power 9 µm SMF	P_{OUT}	-15.0		-8	dBm	1
Center Wavelength	λ_C	1274		1356	nm	
Spectral Width - rms	σ			2.5	nm rms	2
Optical Rise/Fall Time	t_r/t_f		0.5		ns	3
Extinction Ratio	E_R	8.2			dB	
Output Optical Eye	Compliant with eye mask Bellcore TR-NWT-000253 and ITU-T G.957					

Receiver Optical Characteristics

(T_A = 0°C to +70°C, V_{CC} = 3.14 V to 3.47 V)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Reference
Receiver Sensitivity	$P_{IN\,MIN}$		-31.5	-28	dBm avg.	4
Input Optical Power Maximum	$P_{IN\,MAX}$	-8			dBm avg.	4
Input Operating Wavelength	λ	1270		1380	nm	
Signal Detect - Asserted	P_A		P_D+2 dB	-31	dBm avg.	
Signal Detect - Deasserted	P_D	-42	-34.5		dBm avg.	
Signal Detect - Hysteresis	$P_A - P_D$	1.0		3	dB	

Notes:

1. The output power is coupled into a 1 m single-mode fiber over operating life.
2. The relationship between FWHM and RMS values for spectral width can be derived from the assumption of a Gaussian shaped spectrum which results in RMS = FWHM/2.35.
3. These are unfiltered 20-80% values.
4. Minimum sensitivity and saturation levels for a 2^{23}-1 PRBS with 72 ones and 72 zeros inserted. Over the range the receiver is guaranteed to provide output data with a Bit Error Rate better than or equal to 1 x 10^{-10}.

Design Support Materials

Avago is in the process of creating a number of reference designs with major PHY IC vendors in order to establish full functionality and interoperability. Such design information and results can be made available to the designer as a technical aid. Please contact your Avago representative for further information if required.

Ordering Information

HFxx-5908E

Model Name:
HFBR-5908E - 1300 nm Transceiver for 500 m MMF links
HFCT-5908E - 1300 nm Transceiver for 15 km SMF links

Handling Precautions

1. The HFBR/HFCT-5908E can be damaged by current surges or overvoltage. Power supply transient precautions should be taken.
2. Normal handling precautions for electrostatic sensitive devices should be taken.

Class 1 Laser Product: This product conforms to the applicable requirements of 21 CFR 1040 at the date of manufacture

Date of Manufacture: _____

Avago Technologies Ltd., Depot Road, Singapore

For product information and a complete list of distributors, please go to our web site: **www.avagotech.com**

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