Data Sheet

HFBR-1312TZ Transmitter
HFBR-2316TZ Receiver
1300-nm Fiber-Optic Transmitter and Receiver

Description

The HFBR-1312TZ transmitter and HFBR-2316TZ receiver are designed to provide the most cost-effective 1300-nm fiber-optic links for a wide variety of data communication applications from low-speed distance extenders to SONET OC-3 signal rates. Pinouts identical to the Broadcom HFBR-0400Z Series allow designers to easily upgrade their 820-nm links for farther distance. For high flexibility in the choice of fiber, the transmitter and receiver are specified for 50/125-µm and 62.5/125-µm fibers. The receiver also supports the use of 9/125-µm singlemode fibers. The 1300-nm wavelength is in the lower dispersion and attenuation region of fiber, which provides longer distance capabilities than 820-nm LED technology. Typical distance capabilities are 2 km at 125 Mbaud and 5 km at 32 Mbaud.

Features

- RoHS compliant
- Low-cost fiber-optic link
- Signal rates over 155 Mbaud
- 1300-nm wavelength
- Link distances up to 5 km
- Dual-in-line package panel-mountable ST port
- Auto-insertable and wave-solderable
- Specified with 50/125-µm and 62.5/125-µm fiber
- Compatible with the 820-nm Miniature Link Series
- Receiver also specified for the SM cable specification (9/125 µm)

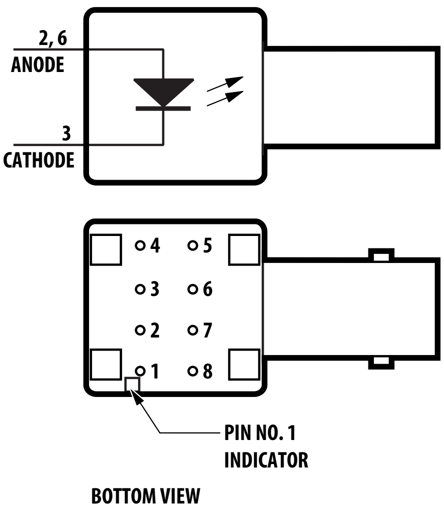
Applications

- Desktop links for high-speed LANs
- Distance extension links
- Telecom switch systems
- TAXIchip compatible

Transmitter

The HFBR-1312TZ fiber-optic transmitter contains a 1300-nm InGaAsP light-emitting diode capable of efficiently launching optical power into 50/125-µm and 62.5/125-µm diameter fiber. Due to the pin compatibility with the 820-nm Miniature Link Series, converting the driver circuit from a HFBR-14xxZ 820-nm transmitter to the HFBR-1312TZ requires the modification of only a few passive components.

Figure 1: HFBR-1312TZ Transmitter



PIN	FUNCTION
1	N.C.
2	ANODE
3	CATHODE
4	N.C.
5	N.C.
6	ANODE
7*	N.C.
8	N.C.

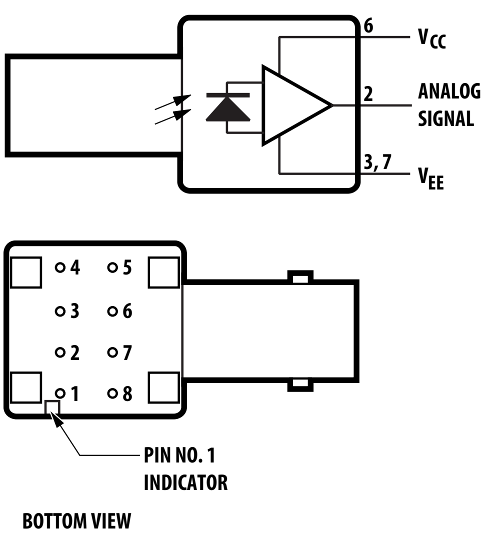
* PIN 7 IS ELECTRICALLY ISOLATED FROM PINS 1, 4, 5, AND 8, BUT IS CONNECTED TO THE HEADER.

PINS 1, 4, 5, AND 8 ARE ISOLATED FROM THE INTERNAL CIRCUITRY, BUT ARE ELECTRICALLY CONNECTED TO EACH OTHER.

Receiver

The HFBR-2316TZ receiver contains an InGaAs PIN photodiode and a low-noise transimpedance preamplifier that operate in the 1300-nm wavelength region. The HFBR-2316TZ receives an optical signal and converts it to an analog voltage. The buffered output is an emitter-follower, with frequency response from DC to typically 125 MHz. Low-cost external components can be used to convert the analog output to logic compatible signal levels for a variety of data formats and data rates. Due to the pin compatibility with the 820-nm Miniature Link receiver HFBR-2416xxZ, converting from a 820-nm to a 1300-nm receiver circuit is realizable by replacing the HFBR-2416xxZ with the HFBR-2316TZ.

Figure 2: HFBR-2316TZ Receiver

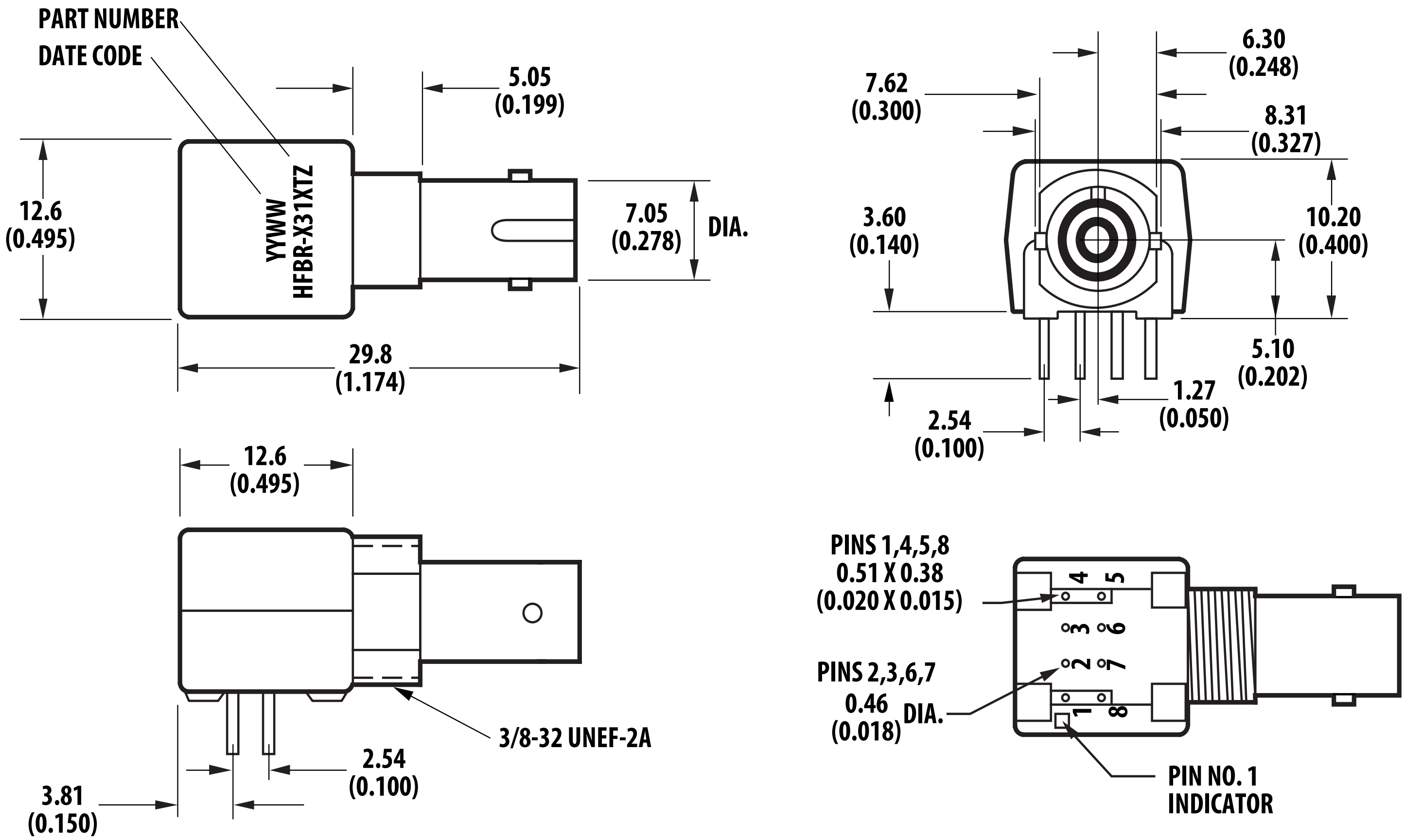


PIN	FUNCTION
1	N.C.
2	SIGNAL
3*	V_{EE}
4	N.C.
5	N.C.
6	V_{CC}
7*	V_{EE}
8	N.C.

* PINS 3 AND 7 ARE ELECTRICALLY CONNECTED TO THE HEADER.

PINS 1, 4, 5, AND 8 ARE ISOLATED FROM THE INTERNAL CIRCUITRY, BUT ARE ELECTRICALLY CONNECTED TO EACH OTHER.

Mechanical Dimensions



NOTE: Dimensions are in mm (inches).

NOTE: A finished hole diameter of at least 1.02 mm (0.04 in.) is recommended for all eight pins to ensure smooth mounting on the PCB.

Package Information

The transmitter and receiver are housed in a dual-in-line package made of high-strength, heat-resistant, chemically resistant, and UL V-0 flame-retardant plastic. The package is auto-insertable and wave-solderable for high-volume production applications.

NOTE: The “T” in the product numbers indicates a threaded ST connector (panel mountable), for both the transmitter and the receiver.

Handling and Design Information

When soldering, leave the protective cap on the unit to keep the optics clean. Good system performance requires clean port optics and cable ferrules to avoid obstructing the optical path. Clean compressed air is often sufficient to remove particles of dirt; methanol on a cotton swab also works well.

Recommended Chemicals for Cleaning/Degreasing

Alcohols: methyl, isopropyl, isobutyl
Aliphatics: hexane, heptane
Other: soap solution, 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, Broadcom does not recommend the use of cleaners that use halogenated hydrocarbons because of their potential environmental harm.

Panel Mounting Hardware

The HFBR-4411Z kit consists of 100 nuts and 100 washers with dimensions as shown in Figure 3. These kits are available from Broadcom or any authorized distributor. Any standard size nut and washer will work, provided that the total thickness of the wall, nut, and washer does not exceed 0.2 inch (5.1 mm).

When preparing the chassis wall for panel mounting, use the mounting template in Figure 4. When tightening the nut, torque should not exceed 0.8 N-m (8.0 in-lb).

Figure 3: HFBR-4411Z Mechanical Dimensions

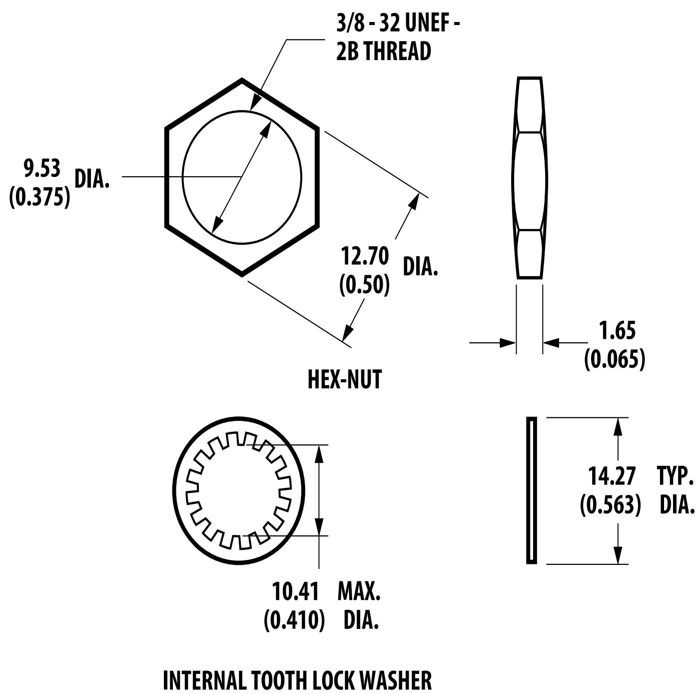
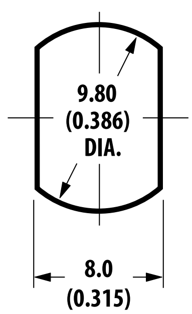


Figure 4: Recommended Cutout for Panel Mounting



NOTE: Dimensions are in mm (inches).

HFBR-1312TZ Transmitter Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Unit	Reference
Storage Temperature	T_S	–55	85	°C	
Operating Temperature	T_A	–40	85	°C	
Lead Soldering Cycle Temperature	—	—	260	°C	Note [a]
Lead Soldering Cycle Time	—	—	10	seconds	
Forward Input Current DC	I_{FDC}	—	100	mA	
Reverse Input Voltage	V_R	—	1	V	

a. 2.0 mm from where leads enter case.

CAUTION! The small junction sizes inherent to the design of this bipolar component increase the component's susceptibility to damage from electrostatic discharge (ESD). Take normal static precautions in handling and assembling this component to prevent damage and/or degradation that may be induced by ESD.

HFBR-1312TZ Transmitter Electrical/Optical Characteristics

0°C to 70°C unless otherwise specified.

Parameter	Symbol	Min.	Typ.[a]	Max.	Unit	Condition	Reference
Forward Voltage	V_F	1.1	1.4	1.7	V	I_F = 75 mA	Figure 5
		—	1.5	—		I_F = 100 mA	
Forward Voltage Temperature Coefficient	$\Delta V_F/\Delta T$	—	–1.5	—	mV/°C	I_F = 75 mA – 100 mA	
Reverse Input Voltage	V_R	1	4	—	V	I_R = 100 µA	
Center Emission Wavelength	λ_C	1270	1300	1370	nm	—	
Full Width Half Maximum	FWHM	—	130	185	nm	—	
Diode Capacitance	C_T	—	16	—	pF	V_F = 0V, f = 1 MHz	
Optical Power Temperature Coefficient	$\Delta P_T/\Delta T$	—	–0.03	—	dB/°C	I_F = 75 mA – 100 mA DC	

a. Typical data is at T_A = 25°C.

HFBR-1312TZ Transmitter Output Optical Power and Dynamic Characteristics

Parameter	Symbol	Min.	Typ.[a]	Max.	Unit	Condition		Reference
						T_A	$I_{F, peak}$	
Peak Power 62.5/125 µm NA = 0.275	P_{T62}	–16.0	–14.0	–12.5	dBm	25°C	75 mA	Notes [b, c, d] Figure 6
		–17.5	—	–11.5		0°C–70°C	75 mA	
		–15.5	–13.5	–12.0		25°C	100 mA	
		–17.0	—	–11.0		0°C–70°C	100 mA	
Peak Power 50/125 µm NA = 0.20	P_{T50}	–19.5	–17.0	–14.5	dBm	25°C	75 mA	Notes [b, c, d] Figure 6
		–21.0	—	–13.5		0°C–70°C	75 mA	
		–19.0	–16.5	–14.0		25°C	100 mA	
		–20.5	—	–13.0		0°C–70°C	100 mA	
Optical Overshoot	OS	—	5	10	%	0°C–70°C	75 mA	Note [e] Figure 7
Rise Time	t_r	—	1.8	4.0	ns	0°C–70°C	75 mA	Note [f] Figure 7
Fall Time	t_f	—	2.2	4.0	ns	0°C–70°C	75 mA	Note [f] Figure 7

a. Typical data is at T_A = 25°C.

b. Optical power is measured with a large area detector at the end of 1 meter of mode stripped cable, with an ST precision ceramic ferrule (MIL-STD-83522/13), which approximates a standard test connector. Average power measurements are made at 12.5 MHz with a 50% duty cycle drive current of 0 to $I_{F,peak}$; $I_{F,average} = I_{F,peak}/2$. Peak optical power is 3 dB higher than average optical power.

c. When changing from µW to dBm, the optical power is referenced to 1 mW (1000 µW).
Optical power P(dBm) = 10*log[P(µW)/1000 µW].

d. Fiber NA is measured at the end of 2 meters of mode stripped fiber using the far-field pattern. NA is defined as the sine of the half angle, determined at 5% of the peak intensity point. When using another manufacturer's fiber cable, results will vary due to differing NA values and test methods.

e. Overshoot is measured as a percentage of the peak amplitude of the optical waveform to the 100% amplitude level. The 100% amplitude level is determined at the end of a 40-ns pulse, 50% duty cycle. This will ensure that ringing and other noise sources have been eliminated.

f. Optical rise and fall times are measured from 10% to 90% with 62.5-µm/125-µm fiber. LED response time with recommended test circuit (Figure 7) at 25 MHz, 50% duty cycle.

Figure 5: Typical Forward Voltage and Current Characteristics

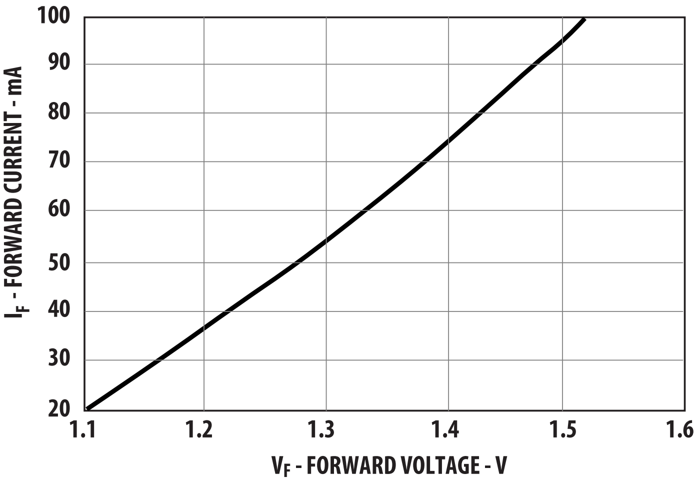


Figure 6: Normalized Transmitter Output Power vs. Forward Current

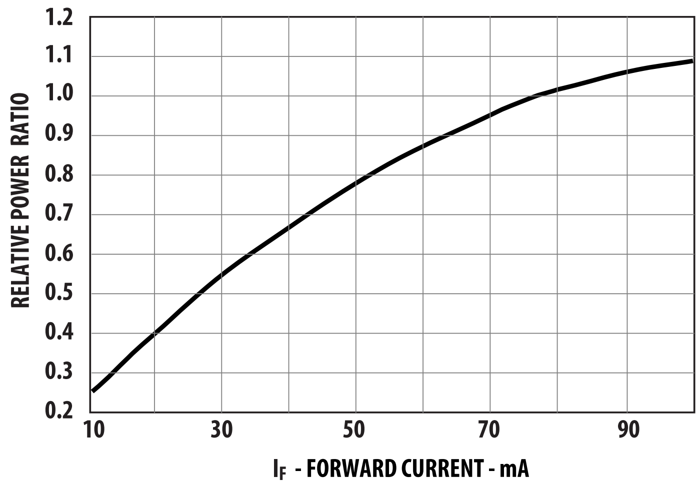
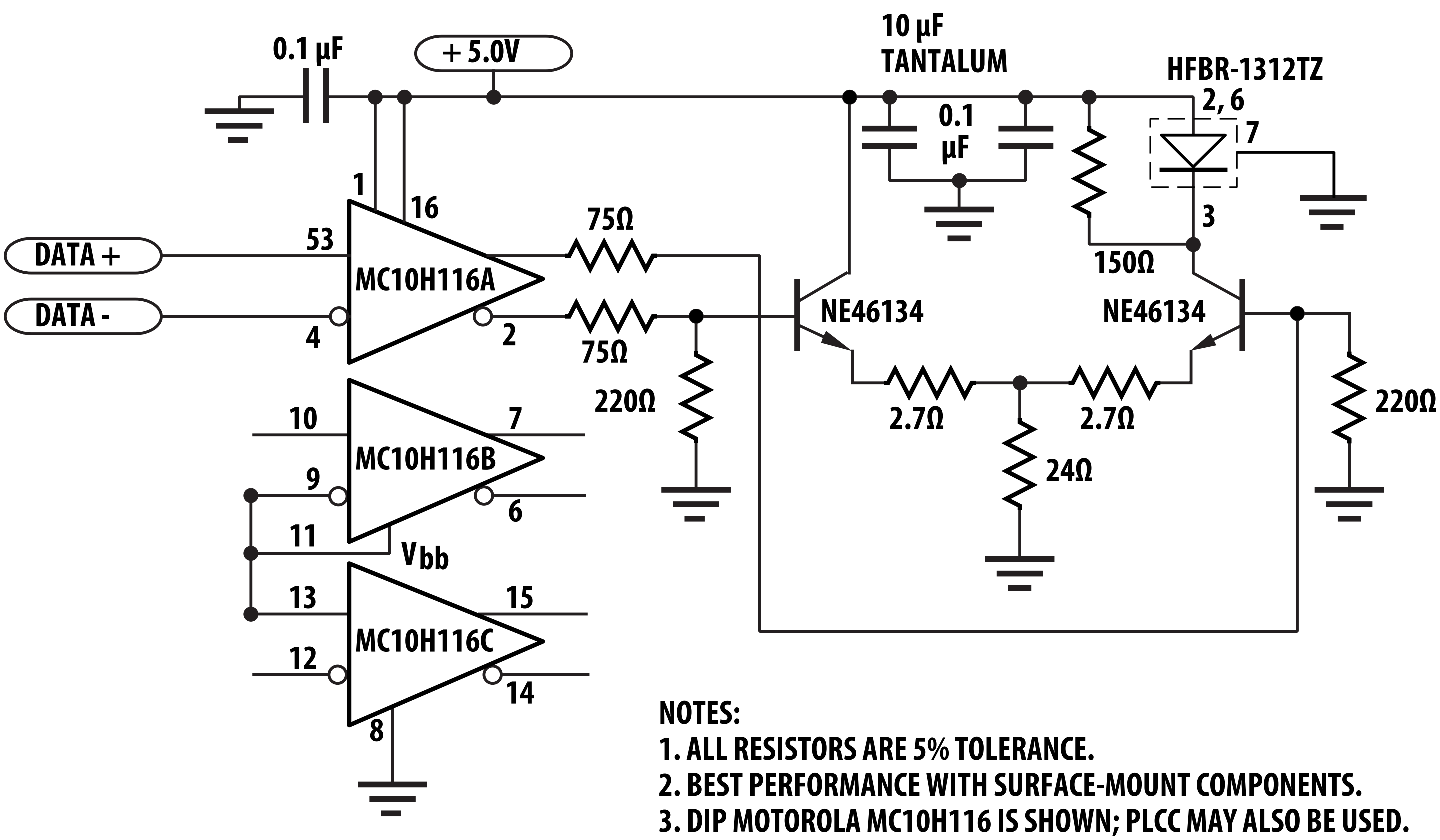


Figure 7: Recommended Transmitter Drive and Test Circuit



HFBR-2316TZ Receiver Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Unit	Reference
Storage Temperature	T_S	–55	85	°C	
Operating Temperature	T_A	–40	+85	°C	
Lead Soldering Temperature	—	—	260	°C	Note [a]
Cycle Time	—	—	10	seconds	
Signal Pin Voltage	V_O	–0.5	V_{CC}	V	
Supply Voltage	$V_{CC} – V_{EE}$	–0.5	6.0	V	Note [b]
Output Current	I_O	—	25	mA	

a. 2.0 mm from where leads enter case.

b. The signal output is referred to V_{CC} and does not reject noise from the V_{CC} power supply. Consequently, the V_{CC} power supply must be filtered. The recommended power supply is +5V on V_{CC} for typical usage with +5V ECL logic. A –5V power supply on V_{EE} is used for test purposes to minimize power supply noise.

CAUTION! The small junction sizes inherent to the design of this bipolar component increase the component's susceptibility to damage from electrostatic discharge (ESD). Take normal static precautions in handling and assembling this component to prevent damage and/or degradation that may be induced by ESD.

HFBR-2316TZ Receiver Electrical/Optical and Dynamic Characteristics

0°C to 70°C; 4.75V < $V_{CC} - V_{EE}$ < 5.25V; the power supply must be filtered (see note [a]).

Parameter	Symbol	Min.	Typ.[b]	Max.	Unit	Condition	Reference
Responsivity	R_P 62.5 µm	6.5	13	19	mV/µW	λ_P = 1300 nm, 50 MHz Multimode Fiber 62.5/125 µm	Note [c] Figure 8, 12
	R_P 9 µm	8.5	17	—		Singlemode Fiber 9/125 µm	
RMS Output Noise Voltage	V_{NO}	—	0.4	0.59	mV_{RMS}	100-MHz Bandwidth, P_R = 0 µW	Note [d] Figure 9
		—	—	1.0	mV_{RMS}	Unfiltered Bandwidth P_R = 0 µW	
Equivalent Optical	$P_{N, RMS}$	—	–45	–41.5	dBm	@ 100 MHz, P_R = 0 µW	Note [d]
Noise Input Power (RMS)	—	—	0.032	0.071	µW		
Peak Input Optical Power	P_R	—	—	–11.0	dBm	50 MHz, 1 ns PWD	Note [e] Figure 10
		—	—	80	µW		
Output Resistance	R_O	—	30	—	Ohm	f = 50 MHz	
DC Output Voltage	$V_{O,DC}$	0.8	1.8	2.6	V	V_{CC} = 5V, V_{EE} = 0V P_R = 0 µW	
Supply Current	I_{CC}	—	9	15	mA	$R_{LOAD} = \infty$	
Electrical Bandwidth	BW_E	75	125	—	MHz	–3 dB electrical	Note [f]
Bandwidth * Rise Time Product	—	—	0.41	—	Hz * s	—	Note [g]
Electrical Rise and Fall Times, 10–90%	t_r, t_f	—	3.3	5.3	ns	P_R = –15 dBm peak, @ 50 MHz	Note [h] Figure 11
Pulse Width Distortion	PWD	—	0.4	1.0	ns	P_R = –11 dBm, peak	Note [e, i] Figure 10
Overshoot	—	—	2	—	%	P_R = –15 dBm, peak	Note [j]

a. The signal output is referred to V_{CC} and does not reject noise from the V_{CC} power supply. Consequently, the V_{CC} power supply must be filtered. The recommended power supply is +5V on V_{CC} for typical usage with +5V ECL logic. A –5V power supply on V_{EE} is used for test purposes to minimize power supply noise.

b. Typical specifications are for operation at T_A = 25°C and V_{CC} = +5 V_{DC}.

c. The test circuit layout should be in accordance with good high-frequency circuit design techniques.

d. Measured with a 9-pole "brick wall" low-pass filter [Mini-Circuits, BLP-100+] with –3 dB bandwidth of 100 MHz.

e. –11.0 dBm is the maximum peak input optical power for which pulse width distortion is less than 1 ns.

f. Electrical bandwidth is the frequency where the responsivity is –3 dB (electrical) below the responsivity measured at 50 MHz.

g. The bandwidth * rise time product is typically 0.41 because the HFBR-2316TZ has a second-order bandwidth limiting characteristic.

h. The specified rise and fall times are referenced to a fast square wave optical source. Rise and fall times measured using an LED optical source with a 2.0-ns rise and fall time (such as the HFBR-1312TZ) will be approximately 0.6 ns longer than the specified rise and fall times. Approximation: measured $t_{r,f} \sim [(\text{specified } t_{r,f})^2 + (\text{test source optical } t_{r,f})^2]^{1/2}$.

i. 10-ns pulse width, 50% duty cycle, at the 50% amplitude point of the waveform.

j. Percent overshoot is defined as: $((V_{PK} - V_{100\%})/V_{100\%}) \times 100\%$. The overshoot is typically 2% with an input optical rise time ≤1.5 ns.

Figure 8: HFBR-2316TZ Receiver Test Circuit

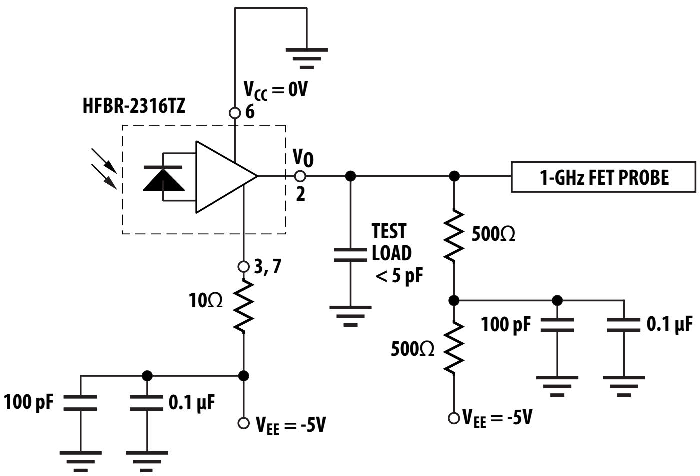


Figure 9: Typical Output Spectral Noise Density vs. Frequency

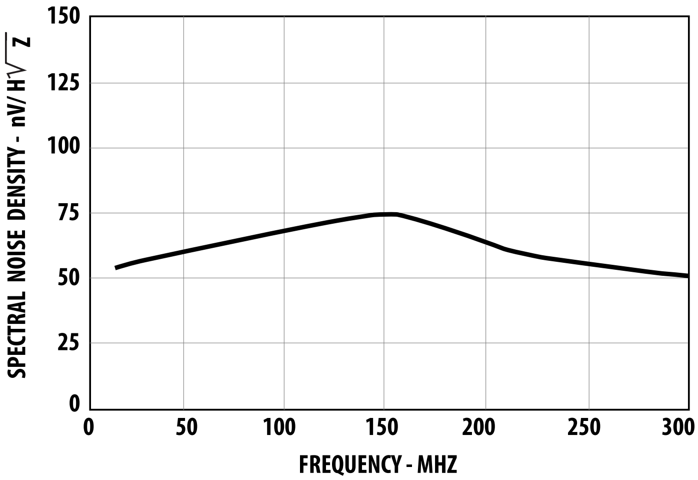


Figure 10: Typical Pulse Width Distortion vs. Peak Input Power

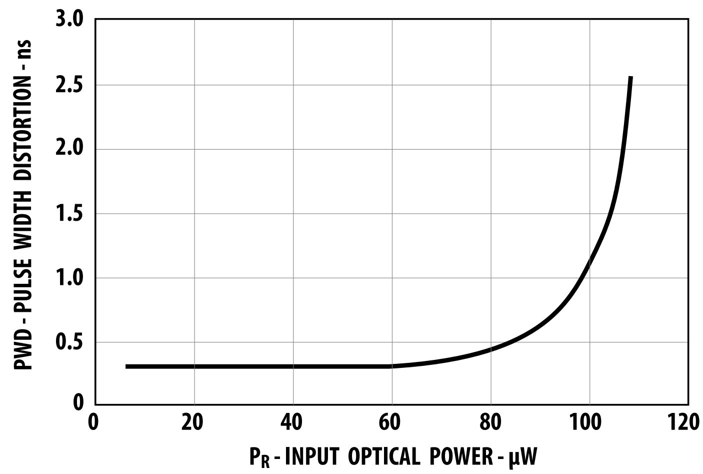


Figure 11: Typical Rise and Fall Times vs. Temperature

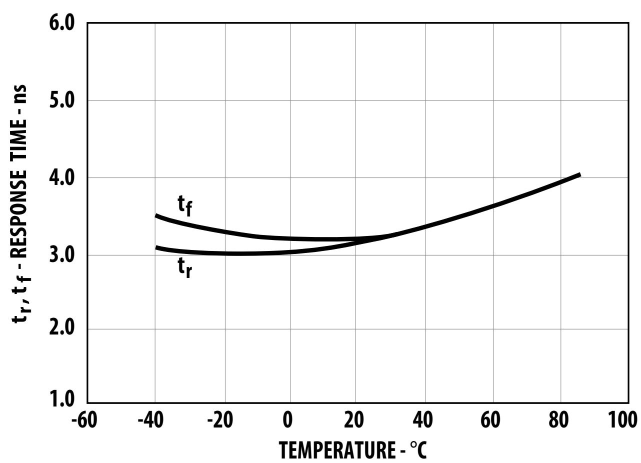
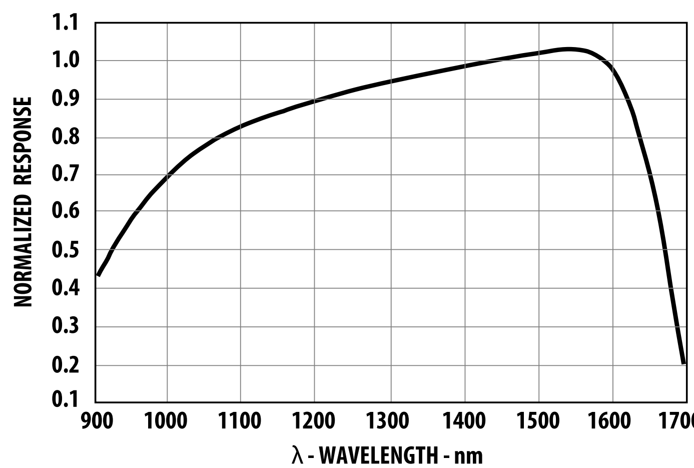


Figure 12: Normalized Receiver Spectral Response



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