BROADCOM®

Data Sheet

HFBR-150xAFZ/2555AFZ

Full-Metal Fiber-Optic SMA Transmitter and Receiver for SERCOS Applications

Description

SERCOS, an acronym for SErial Real-time COmmunications System, is a standard digital interface for communication in industrial CNC applications. SERCOS is a European (EN 61491) and international standard (IEC 61491). The optical interface allows data rates of 2, 4, 8, and 16 Mbaud and data transfer between numerical controls and drives via fiber-optic rings, with voltage isolation and noise immunity. The Broadcom® HFBR-150xAFZ and HFBR-2555AFZ products comply with SERCOS specifications for optical characteristics and connector style, and they have guaranteed performance at data rates of 2, 4, 8, and 16 Mbaud.

Features

- Meets the industrial SERCOS standard
- SMA ports
- 650-nm wavelength technology
- Metal housing and port
- Specified for use with 1-mm plastic optical fiber and 200-µm plastic-clad silica
- Auto-insertable and wave solderable
- Supports SERCOS 2, 4, 8, and 16 Mbaud
- RoHS compliant

Applications

- Industrial control data links
- Factory automation data links
- Voltage isolation
- PLCs
- Motor drives
- Sensor, meter, and actuator interfaces

Package Information

The HFBR-150xAFZ transmitters and HFBR-2555AFZ receiver are housed in a dual-inline metal package that is high strength. The package is designed for auto-insertion and wave soldering, so it is ideal for high-volume production applications.

Handling and Design Information

When soldering, it is advisable to 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.

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, or 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.

Specified Link Performance

–40°C to +85°C unless otherwise noted.

Parameter	Symbol	Min.	Max.	Unit	Condition	Reference
Link Distance with HFBR-1505AFZ/2555AFZ	L	0.1 0.1	40 100	m m	POF PCS	Notes [a, b, c, d] Notes [a, d, e, f]
Link Distance with HFBR-1506AFZ/2555AFZ	L	0.1 0.1	45 100	m m	POF PCS	Notes [a, b, c, g] Notes [a, d, e, g]
Pulse Width Distortion HFBR-150xAFZ/2555AFZ	PWD	–11	+11	ns	POF and PCS	Notes [a, h]

a. With recommended Tx and Rx circuits (Figure 4 and Figure 5).

b. POF HFBR-ExxyyyZ 0.23 dB/m worst-case attenuation.

c. Including a 3-dB optical safety margin accounting for link service lifetime.

d. Signaling rate up to 10 Mbaud.

e. PCS worst-case attenuation is 10 dB/km (0°C to 70°C) and 12 dB/km (–40°C to 85°C).

f. Including a 2-dB optical safety margin to account for link service lifetime.

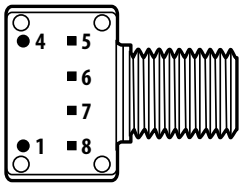
g. Signaling rate up to 16 Mbaud.

h. For PWD calculations, the pulse width of the receiver output is compared to the pulse width of the electrical input signal of the transmitter. PWD = PW_RXout – PW_TXin. Note that the HFBR-2555AZ is an inverting receiver; thus an electrical high pulse at the transmitter input (LED on) causes an electrical low at the receiver output. For the characterization, the transmitter has been driven with an ideal (duty cycle = 50%) PRBS2^7–1 pattern input signal.

CAUTION! The small junction size inherent in the design of these components increases the components' susceptibility to damage from electrostatic discharge (ESD). It is advised that normal static precautions be taken in handling and assembly of these components to prevent damage and/or degradation that may be induced by ESD.

HFBR-150xAFZ Transmitter

The HFBR-150xAFZ transmitters incorporate a 650-nm LED in a metal housing. The high light output power enables the use of both plastic optical fiber (POF) and plastic-clad silica (PCS). The HFBR-1505AFZ can be operated up to 10 Mbaud using a simple driver circuit. For data rates above 10 Mbaud up to 16 Mbaud, the HFBR-1506AFZ should be used. The HFBR-150xAFZ transmitters are compatible with SMA connectors.



BOTTOM VIEW, HFBR-150xAFZ

PIN	FUNCTION
1	CONNECTED TO PIN 4
4	CONNECTED TO PIN 1
5	NC
6	NC
7	CATHODE
8	ANODE

NOTE: Pins 1 and 4 are for mounting and retaining purposes, but are electrically connected; pins 5 and 6 are electrically isolated. It is recommended that pins 1, 4, 5, and 6 all be connected to ground to reduce coupling of electrical noise.

Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Unit	Reference
Storage and Operating Temperature	T_S	–40	85	°C	—
Peak Forward Input Current	$I_{F,PK}$	—	90	mA	Note [a]
Average Forward Input Current	$I_{F,AVG}$	—	60	mA	—
Reverse Input Voltage	V_R	—	3	V	—
Lead Soldering Cycle	Temp Time	—	260 10	°C s	Note [b]

a. For $I_{F,PK}$ > 60 mA, the duty factor must maintain $I_{F,AVG}$ = 60 mA and pulse width = 1 µs.

b. 1.6 mm below seating plane.

Peak Output Power

–40°C to +85°C unless otherwise noted.

Parameter	Symbol	Min.	Typ.[a]	Max.	Unit	Condition	Reference
HFBR-1505AFZ POF 200-µm PCS	P_T	–7.5 –18	—	–3.5 –10	dBm	I_F = 60 mA	Notes [b, c, d] Figure 2
HFBR-1506AFZ POF 200-µm PCS	P_T	–6.0 –18	—	–2.0 –10	dBm	I_F = 60 mA	Notes [b, c, d] Figure 2
Optical Power Temperature Coefficient	$\Delta P_T/\Delta T$	—	–0.02	—	dB/°C	—	—

a. Typical data at 25°C.

b. Optical power measured at the end of 0.5 meters of 1-mm diameter plastic or 200-µm plastic-clad silica optical fiber with a large area detector.

c. Minimum and maximum values for P_T over temperature are based on a fixed drive current.

d. Output power with 200-µm plastic-clad silica optical fiber assumes a typical –10.5-dB difference compared to 1-mm plastic optical fiber.

Electrical Characteristics

–40°C to +85°C unless otherwise noted.

Parameter	Symbol	Min.	Typ.[a]	Max.	Unit	Condition	Ref.
Forward Voltage	V_F	1.8	2.1	2.65	V	$I_{F,dc}$ = 60 mA	Figure 1
Forward Voltage Temperature Coefficient	$\Delta V_F/\Delta T$	—	–1.8	—	mV/°C	—	Figure 1
Breakdown Voltage	V_{BR}	3.0	13	—	V	$I_{F,dc}$ = –10 µA	—
Peak Emission Wavelength	λ_{PK}	635	650	662	nm	—	Figure 3
Full Width Half Max	FWHM	—	21	30	nm	—	Figure 3
Diode Capacitance	C_O	—	60	—	pF	V_F = 0V, f = 1 MHz	—
Thermal Resistance	θ_{JC}	—	140	—	°C/W	—	Notes [b, c]
Rise Time HFBR-1505AFZ	t_R	—	13	—	ns	I_F = 60 mA	Note [d]
Fall Time HFBR-1505AFZ	t_F	—	10	—	ns	I_F = 60 mA	Note [d]
Rise Time HFBR-1506AFZ	t_R	—	—	15	ns	I_F = 60 mA	Note [d]
Fall Time HFBR-1506AFZ	t_F	—	—	15	ns	I_F = 60 mA	Note [d]

a. Typical data at 25°C.

b. Thermal resistance is measured with the transmitter coupled to a connector assembly and fiber and mounted on a printed circuit board.

c. To further reduce the thermal resistance, the cathode trace should be made as large as is consistent with good RF circuit design.

d. Thresholds for rise time and fall time are 10% and 90%.

EYE SAFETY: The HFBR-150xAFZ is a Class 1 LED product and is eye safe when used within the data sheet limits and under normal operating conditions. This includes all reasonably foreseeable single fault conditions per IEC60825-1 and amendments.

Figure 1: Typical Forward Voltage vs. Drive Current

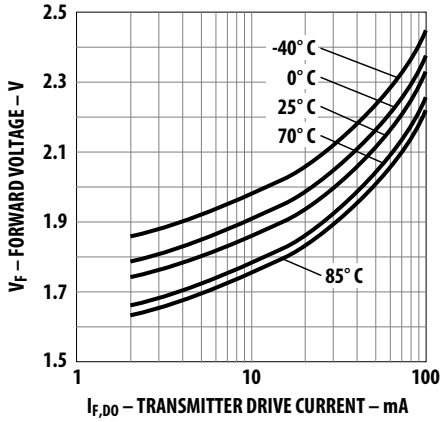


Figure 2: Typical Normalized Optical Power vs. Drive Current

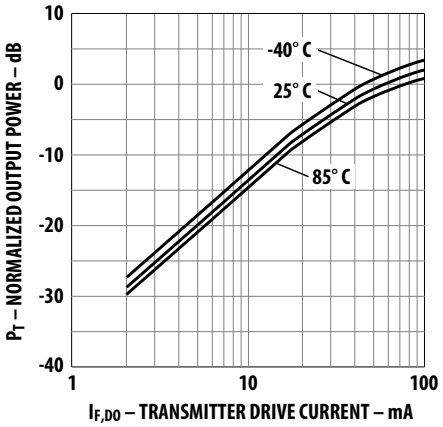
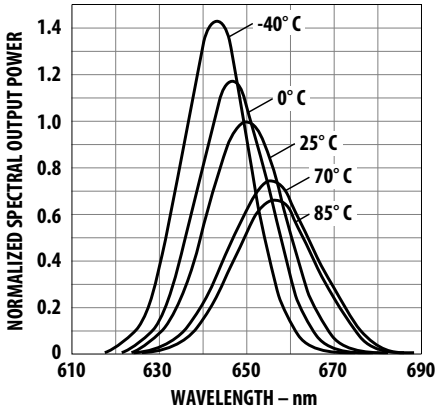
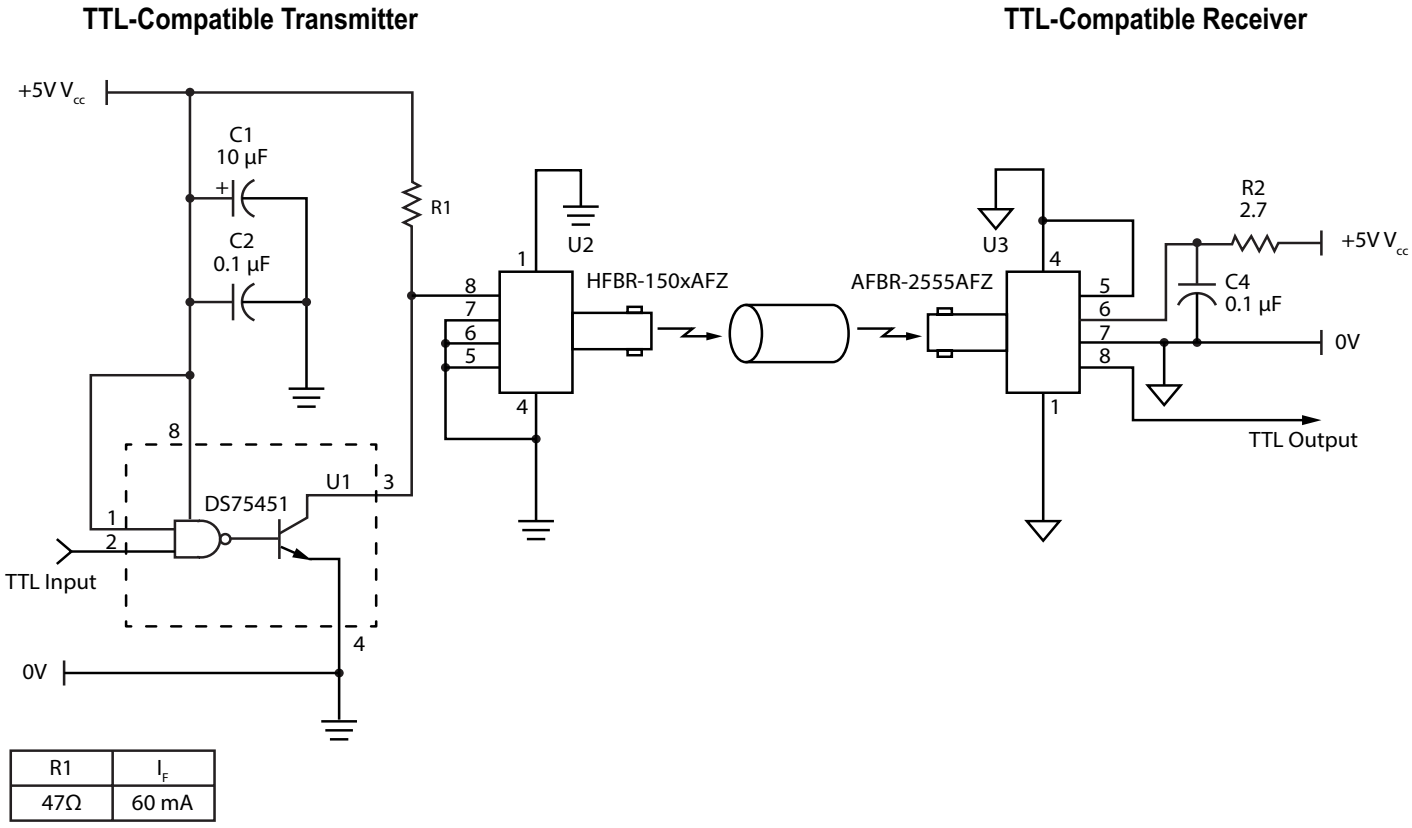


Figure 3: Typical Normalized Optical Spectra



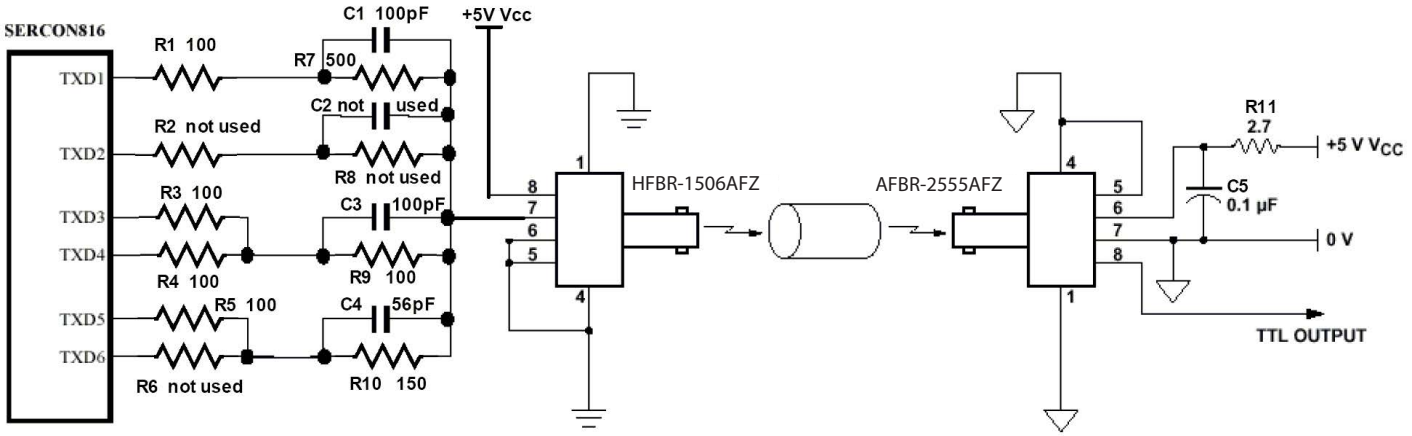
Recommended Circuitry

Figure 4: Recommended Transmitter and Receiver Drive Circuit ($I_{F, on}$ = 60 mA Nominal at T_A = 25°C) for Data Rates up to 10 Mbaud, with Transmitter HFBR-1505AFZ



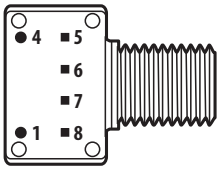
R1	I_F
47Ω	60 mA

Figure 5: Recommended Drive Circuit According to SERCOS An17 (I_{Fnom} ~ 35 mA) for Data Rates up to 16 Mbaud, with Transmitter HFBR-1506AFZ



HFBR-2555AFZ Receiver

The HFBR-2555AFZ receiver consists of an IC with an integrated photodiode to produce a logic-compatible output. The receiver output is a “push-pull” stage compatible with TTL and CMOS logic. The HFBR-2555AFZ is compatible with SMA connectors.



BOTTOM VIEW,
HFBR-2555AFZ

PIN	FUNCTION
1	CONNECTED TO PIN 4
4	CONNECTED TO PIN 1
5	NO CONNECT
6	V_{CC}
7	GND
8	V_O

NOTE: Pins 1 and 4 are electrically connected to the metal housing and are also used for mounting and retaining purposes. It is required that pin 1 and 4 be connected to ground to maintain the effectiveness of the metal housing shield.

Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Unit	Reference
Storage and Operating Temperature	T_S	–40	85	°C	—
Supply Voltage	V_{CC}	–0.3	5.5	V	—
Maximum DC Output Current	$I_{O,DC}$	—	10	mA	—
Lead Soldering Cycle	Temp Time	—	260 10	°C s	Note [a]

a. 1.6 mm below seating plane.

Electrical/Optical Characteristics

–40°C to +85°C, 3.135V < V_{CC} < 5.25V

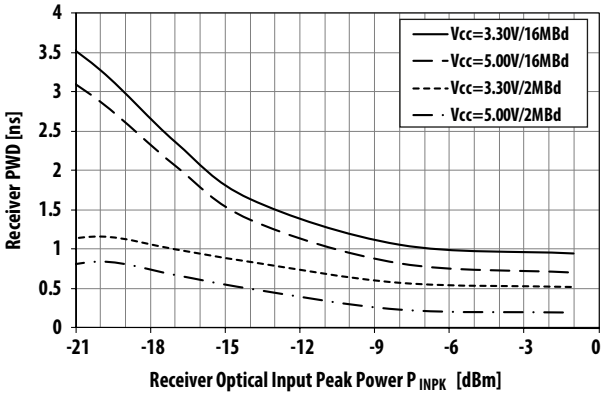
Parameter	Symbol	Min.	Typ.[a]	Max.	Unit	Condition	Reference
Optical Input Peak Power Range	P_{INPK}	–20 –22	—	–1 –3	dBm	1-mm POF 200-µm PCS |PWD| < 11 ns	Notes [b, c] Figure 6
Data Rate	DR	2	—	16	Mbaud	—	Note [c]
Supply Voltage	V_{CC}	3.135	—	5.25	V	—	—
Supply Current	I_{CC}	—	11	20	mA	V_O = open	—
High Level Output Voltage	V_{OH}	2.4	V_{CC} – 0.3	V_{CC}	V	R_L = 2 kΩ	—
Low Level Output Voltage	V_{OL}	—	0.2	0.4	V	R_L = 2 kΩ	—
Output Rise Time	t_R	—	4	15	ns	C_L = 10 pF	Note [b]
Output Fall Time	t_F	—	2	15	ns	C_L = 10 pF	Note [b]

a. Typical data are at 25°C, V_{CC} = 5.0V.

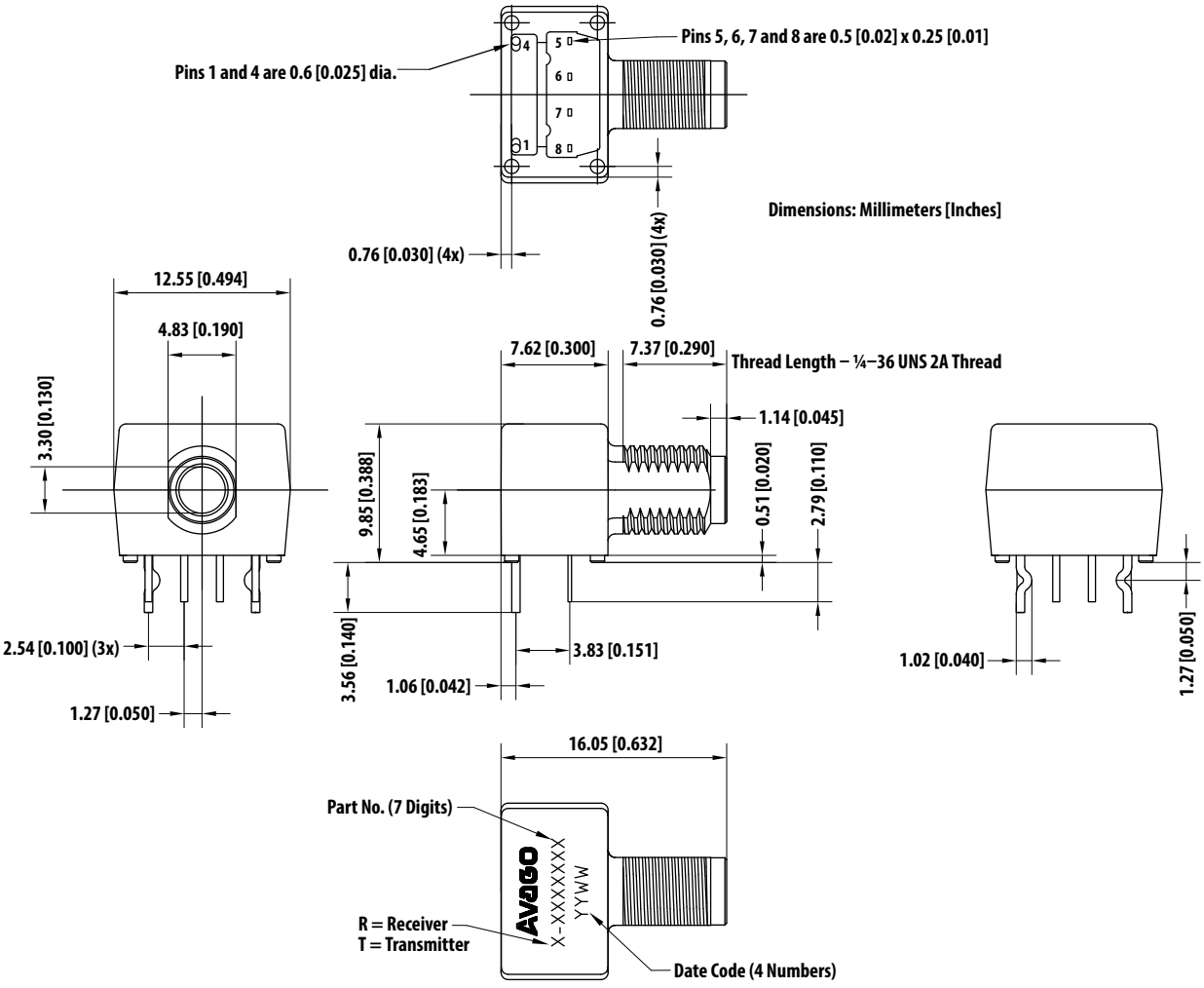
b. In the recommended receiver circuit, with an optical signal from the recommended transmitter circuit.

c. Verified with a PRBS2^7–1 signal with a mark ratio = ½. $P_{INPK} = P_{INAVG}$ + 3 dB.

Figure 6: Typical POF Receiver Pulse Width Distortion vs. Optical Power



Mechanical Dimensions: HFBR-150xAFZ/2555AFZ



NOTE: Dimensions are in mm [in.].

Mouser Electronics

Authorized Distributor

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