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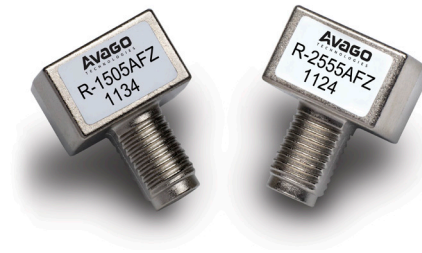


# HFBR-150xAFZ / 2555AFZ (SMA Tx/Rx for SERCOS)

Full Metal Fiber Optic Transmitter and Receiver  
for SERCOS Applications



## Data Sheet



### Description

#### SERCOS

SERCOS, an acronym for SErial Realtime 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 MBd and data transfer between numerical controls and drives via fiber-optic rings, with voltage isolation and noise immunity. The HFBR-150xAFZ and HFBR-2555AFZ products comply with SERCOS specifications for optical characteristics and connector style, and have guaranteed performance at 4, 8, and 16 MBd data rates.

### Features

- Meets industrial SERCOS standard
- SMA ports
- 650 nm wavelength technology
- Metal housing and port
- Specified for use with 1 mm plastic optical fiber and 200  $\mu$ m hard clad silica
- Auto-insertable and wave solderable
- Supports SERCOS 4, 8 and 16 MBd
- RoHS-compliant

### Applications

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

HCS<sup>®</sup> is a registered trademark of OFS Corporation.

**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 which may be induced by ESD.

## Package Information

The HFBR-150xAFZ transmitters and HFBR-2555AFZ receiver are housed in a dual-in-line 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 often is sufficient to remove particles of dirt. Methanol on a cotton swab also works well.

## Recommended Chemicals for Cleaning/Degreasing HFBR-150xAFZ and HFBR-2555AFZ Products

*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-methylpyrrolidone. Also, Avago 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	40	m	POF	Notes 1, 2, 4, 6
		0.1	100	m	HCS®	Notes 1, 3, 5, 6
Link Distance with HFBR-1506AFZ/2555AFZ	L	0.1	45	m	POF	Notes 1, 2, 4, 7
		0.1	100	m	HCS®	Notes 1, 3, 5, 7
Pulse Width Distortion HFBR-150xAFZ/2555AFZ	PWD	-11	+11	ns	POF and HCS®	Notes 1, 8

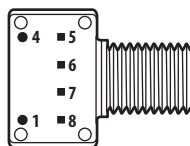
Notes:

1. With recommended Tx and Rx circuits (Figure 4 and Figure 5).
2. POF HFBR-ExxyyyZ 0.23 dB/m worst case attenuation.
3. HCS Worst Case Attenuation is 10 dB/km (0° C to 70° C) and 12 dB/km (-40° C to 85° C).
4. Including a 3 dB optical safety margin accounting for link service lifetime.
5. Including a 2 dB optical safety margin accounting for link service lifetime.
6. Signaling rate up to 10 MBd.
7. Signaling rate up to 16 MBd.
8. For PWD calculation, the pulsewidth of the receiver output is compared versus the pulsewidth 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%) PRBS7 pattern input signal.



## 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 Hard Clad Silica (HCS®). The HFBR-1505AFZ can be operated up to 10 MBd using a simple driver circuit. For data rates above 10 MBd up to 16 MBd, the HFBR-1506AFZ should be used. The HFBR-150xAFZ are compatible with SMA connectors.



BOTTOM VIEW,  
HFBR-150xAFZ

SEE NOTE 9

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

## 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 6
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 7

## Peak Output Power

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

Parameter	Symbol	Min.	Typ. <sup>[1]</sup>	Max.	Unit	Condition	Ref.
HFBR-1505AFZ POF 200 $\mu$ m HCS®	$P_T$	-7.5 -18		-3.5 -10	dBm	$I_F = 60$ mA	Notes 2, 3, 8 Fig. 2
HFBR-1506AFZ POF 200 $\mu$ m HCS®	$P_T$	-6.0 -18		-2.0 -10	dBm	$I_F = 60$ mA	Notes 2, 3, 8 Fig. 2
Optical Power Temperature Coefficient	$\Delta P_T / \Delta T$		-0.02		dB/°C		

## Electrical Characteristics

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

Parameter	Symbol	Min.	Typ. <sup>[1]</sup>	Max.	Unit	Condition	Ref.
Forward Voltage	$V_F$	1.8	2.1	2.65	V	$I_{F,dc} = 60 \text{ mA}$	Fig. 1
Forward Voltage Temperature Coefficient	$\Delta V_F / \Delta T$		-1.8		mV/°C		Fig. 1
Breakdown Voltage	$V_{BR}$	3.0	13		V	$I_{F,dc} = -10 \mu\text{A}$	
Peak Emission Wavelength	$\lambda_{PK}$	635	650	662	Nm		Fig. 3
Full Width Half Max	FWHM		21	30	Nm		Fig. 3
Diode Capacitance	$C_O$		60		pF	$V_F = 0 \text{ V}, f = 1 \text{ MHz}$	
Thermal Resistance	$\theta_{JC}$		140		°C/W		Notes 4, 5
Rise Time HFBR-1505AFZ	$t_R$		13		ns	$I_F = 60 \text{ mA}$	Note 10
Fall Time HFBR-1505AFZ	$t_F$		10		ns	$I_F = 60 \text{ mA}$	Note 10
Rise Time HFBR-1506AFZ	$t_R$			15	ns	$I_F = 60 \text{ mA}$	Note 10
Fall Time HFBR-1506AFZ	$t_F$			15	ns	$I_F = 60 \text{ mA}$	Note 10

Notes:

1. Typical data at 25° C.
2. Optical power measured at the end of 0.5 meters of 1 mm diameter plastic or 200  $\mu\text{m}$  hard/plastic clad silica optical fiber with a large area detector.
3. Minimum and maximum values for PT over temperature are based on a fixed drive current.
4. Thermal resistance is measured with the transmitter coupled to a connector assembly and fiber, and mounted on a printed circuit board.
5. To further reduce the thermal resistance, the cathode trace should be made as large as is consistent with good RF circuit design.
6. For  $I_{F,PK} > 60 \text{ mA}$ , the duty factor must maintain  $I_{F,AVG} = 60 \text{ mA}$  and pulse width = 1  $\mu\text{s}$ .
7. 1.6 mm below seating plane.
8. Output power with 200  $\mu\text{m}$  hard clad silica optical fiber assumes a typical -10.5 dB difference compared to 1 mm plastic optical fiber.
9. 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.
10. Thresholds for rise time and fall time are 10% and 90%.

**EYE SAFETY:** The HFBR-150xAFZ is a Class 1 LED Product and 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.

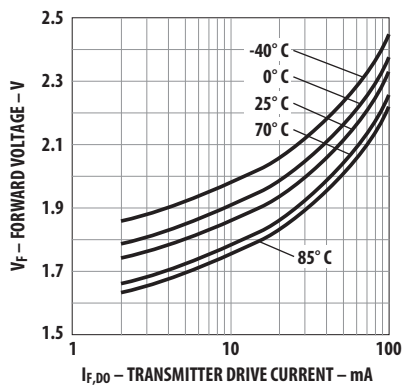


Figure 1. Typical forward voltage vs. drive current

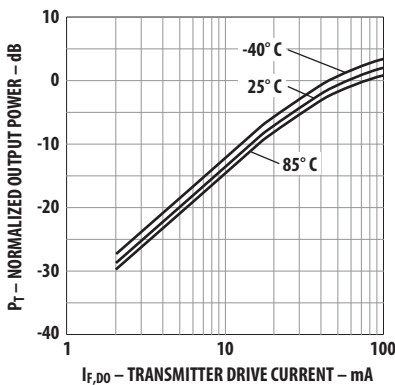


Figure 2. Typical normalized optical power vs. drive current

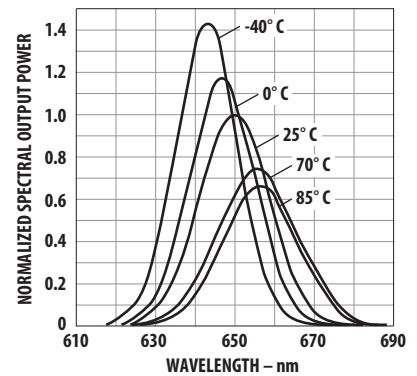


Figure 3. Typical normalized optical spectra

## Recommended Circuitry for HFBR-150xAFZ / 2555AFZ

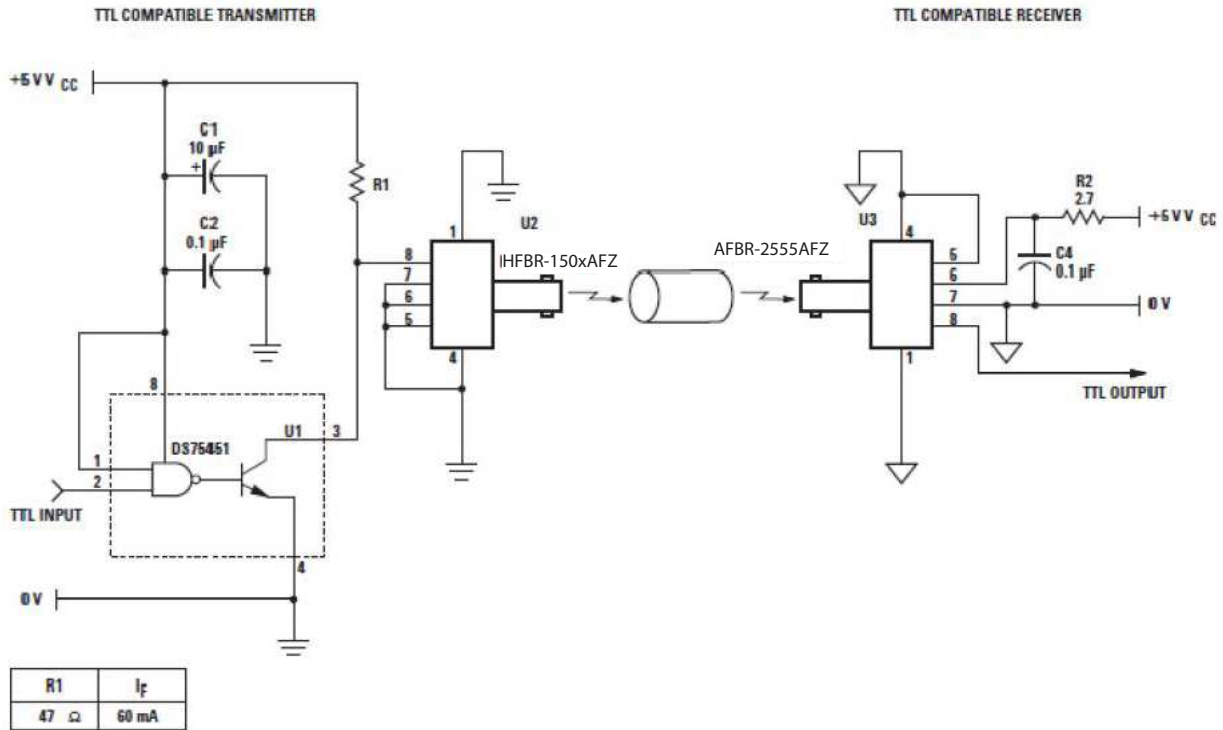


Figure 4. Recommended transmitter and receiver drive circuit ( $I_{f, on} = 60$  mA nominal at  $T_A = 25^\circ$  C) for data rate up to 10 MBd, with transmitter HFBR-1505AFZ

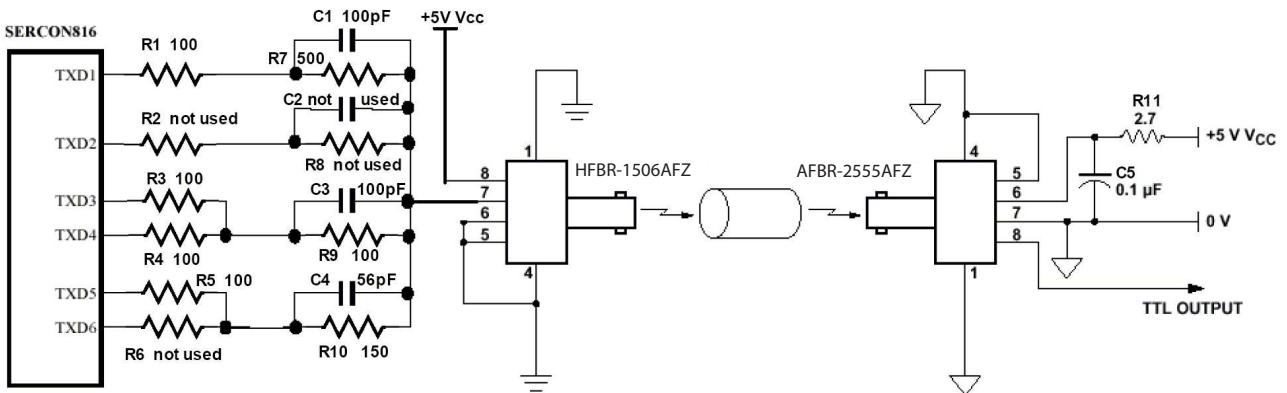
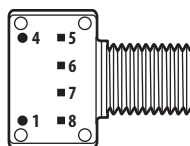


Figure 5. Recommended drive circuit according to SERCOS An17 ( $I_{f, nom} \sim 35$  mA) for data rate up to 16 MBd with transmitter HFBR-1506AFZ

## 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

SEE NOTE 4

PIN	FUNCTION
1	CONNECTED TO PIN 4
4	CONNECTED TO PIN 1
5	NO CONNECT
6	V <sub>CC</sub>
7	GND
8	V <sub>O</sub>

## Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Unit	Reference
Storage and Operating Temperature	T <sub>S</sub>	-40	85	°C	
Supply Voltage	V <sub>CC</sub>	-0.3	5.5	V	
Maximum DC Output Current	I <sub>O,DC</sub>		10	mA	
Lead Soldering Cycle	Temp Time		260 10	°C s	Note 2

## Electrical/Optical Characteristics

-40° C to +85° C, 3.135 V < V<sub>CC</sub> < 5.25 V

Parameter	Symbol	Min.	Typ. <sup>[1]</sup>	Max.	Unit	Condition	Ref.
Optical Input Peak Power Range	P <sub>INPK</sub>	-20 -22		-1 -3	dBm	1 mm POF 200 μm HCS®  PWD  < 11 ns	Notes 3, 5 Fig. 6
Supply Voltage	V <sub>CC</sub>	3.135		5.25	V		
Supply Current	I <sub>CC</sub>		11	20	mA	V <sub>O</sub> = open	
High Level Output Voltage	V <sub>OH</sub>	2.4	V <sub>CC</sub> -0.3	V <sub>CC</sub>	V	R <sub>L</sub> = 2 kΩ	
Low Level Output Voltage	V <sub>OL</sub>		0.2	0.4	V	R <sub>L</sub> = 2 kΩ	
Output Rise Time	t <sub>R</sub>		4	15	ns	C <sub>L</sub> = 10 pF	Note 3
Output Fall Time	t <sub>F</sub>		2	15	ns	C <sub>L</sub> = 10 pF	Note 3

Notes:

1. Typical data are at 25° C, V<sub>CC</sub> = 5.0 V.
2. 1.6 mm below seating plane.
3. In recommended receiver circuit, with an optical signal from the recommended transmitter circuit.
4. 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 metal housing shield effectiveness.
5. Verified with a PRBR7 signal with mark ratio = ½. P<sub>INPK</sub> = P<sub>INAVG</sub> + 3 dB.

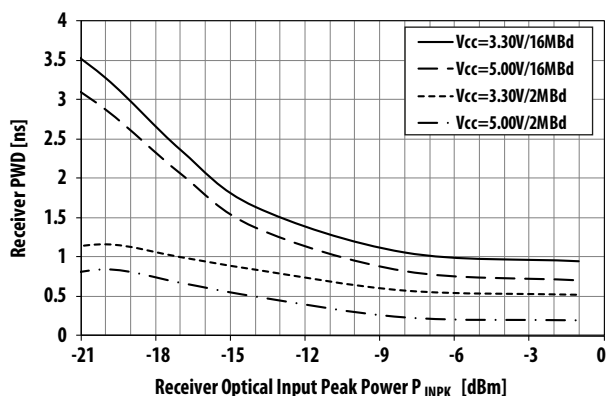
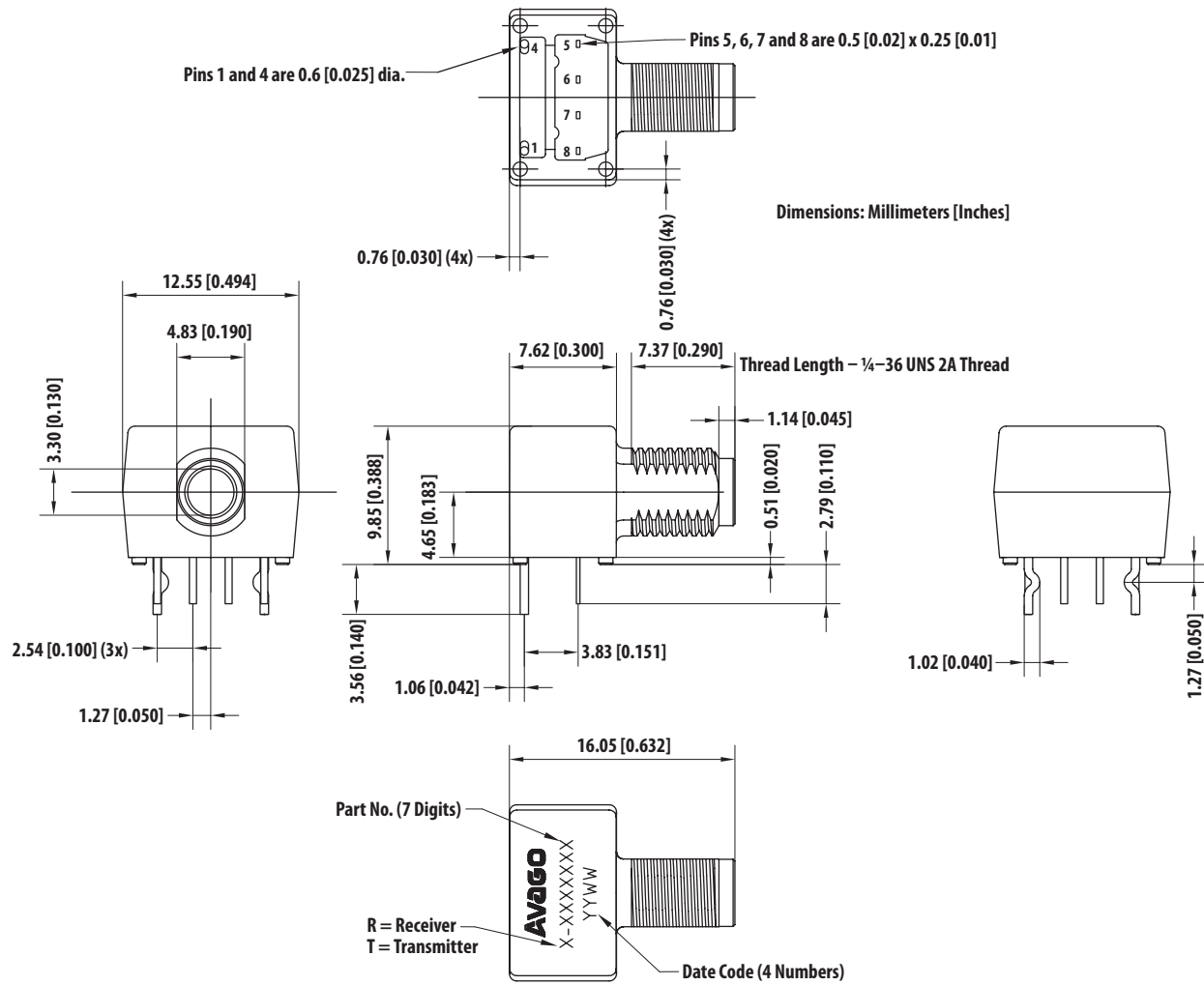


Figure 6. Typical POF receiver pulse width distortion vs. optical power

# Mechanical Dimensions

## HFBR-150xAFZ / 2555AFZ



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