BROADCOM

Data Sheet

AFBR-16xxZ and AFBR-26x4Z/25x9Z

DC-50Mbaud Versatile Link Fiber-Optic Transmitter and Receiver for 1-mm POF and 200-μm PCS

Description

The AFBR-16xxZ transmitter utilizes a 650-nm LED source with integrated optics and a driver IC for efficient coupling into 1-mm polymer optical fiber (POF). The AFBR-26x4Z/25x9Z receiver consists of an IC with an integrated photodiode to produce a logic compatible output. The transmitter input and receiver output are compatible with TTL logic families. The pair operates any type of signal from DC up to 50 Mbaud at distances up to 50m with 1-mm POF, up to 200m at 10 Mbaud, and up to 120m at 50 Mbaud with 200-μm plastic-clad silica (PCS), respectively.

The transmitter is a 3-pin device and the receiver is a 4-pin device, packed in a Versatile Link housing. Versatile Link components can be interlocked (N-plexed together) to minimize space and to provide dual connections with the duplex connectors. Various simplex and duplex connectors, as well as POF cables, are available for Versatile Link components. For details, contact Broadcom or visit our company website at www.broadcom.com.

AFBR-xxx4Z are delivering non-inverted output signals while AFBR-xxx9Z deliver inverted output signals.

Figure 1: AFBR-xxxxZ – Part Number Selection Guide

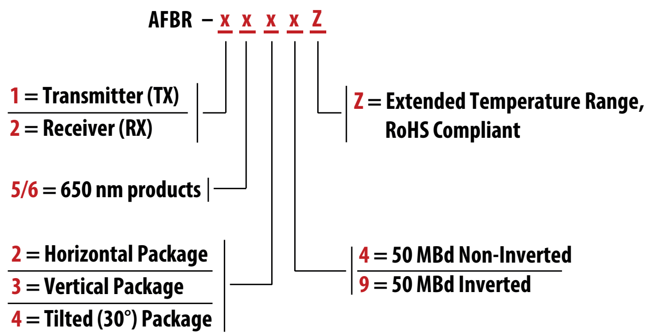


Table 1: Available Options

Horizontal Package	AFBR-x624Z	AFBR-1629Z	AFBR-2529Z
Vertical Package	AFBR-x634Z	AFBR-1639Z	AFBR-2539Z
Tilted (30°) Package	AFBR-x644Z		

Features

- RoHS compliant
- Data transmission at signal rates from DC up to 50 Mbaud
- Transmitter: integrated 650-nm LED and driver IC with TTL input logic
- Receiver: integrated PIN diode and digitalizing IC with TTL output logic
- Up to 50m of distance with 1-mm POF over the operating temperature range
- Up to 200m (10 Mbaud) of distance and 120m (50 Mbaud) of distance with 200-μm PCS over the operating temperature range
- Operating temperature range of –40°C to +85°C
- Compatible with the Broadcom Versatile Link family of connectors, for easy termination of fiber

Applications

Optical transmitter and receiver for 50-Mbaud systems and below:

- Industrial control and factory automation
- Extension of RS-232 and RS-485
- High voltage isolation
- Elimination of ground loops
- Reduction in voltage transient susceptibility

Application Literature

Versatile Link Family: Application Note 1035 (AV02-0730EN).

Package and Handling Information

The compact Versatile Link package is made of a flame-retardant material and uses the same pad layout as a standard, eight-pin dual-inline package. Horizontal, vertical, and tilted (30°) packages are available. These low-profile Versatile Link packages are stackable and are enclosed to provide a dust-resistant seal. Snap action simplex, simplex latching, duplex, and duplex latching connectors are offered with simplex or duplex cables.

Package Orientation

Performance and pinouts for the horizontal, vertical, and tilted (30°) packages are identical. To provide additional attachment support for the vertical Versatile Link housing, the designer has the option of using a self-tapping screw through a printed circuit board into a mounting hole at the bottom of the package. For most applications, this option is not necessary.

Package Housing Color

Versatile Link components and simplex connectors are color coded to eliminate confusion when making connections. Receiver packages are black, and transmitter packages are gray, respectively.

Handling

Versatile Link components are auto-insertable. When wave soldering is performed with Versatile Link components, the optical port plug should be left in to prevent contamination of the port. Do not use reflow solder processes (for example, infrared reflow or vapor-phase reflow). Nonhalogenated water soluble fluxes (for example, 0% chloride), not rosin-based fluxes, are recommended for use with Versatile Link components.

Versatile Link components are moisture sensitive devices and are shipped in a moisture sealed bag. If the components are exposed to air for an extended period of time, they may require a baking step before the soldering process. Refer to the special labeling on the shipping tube for details.

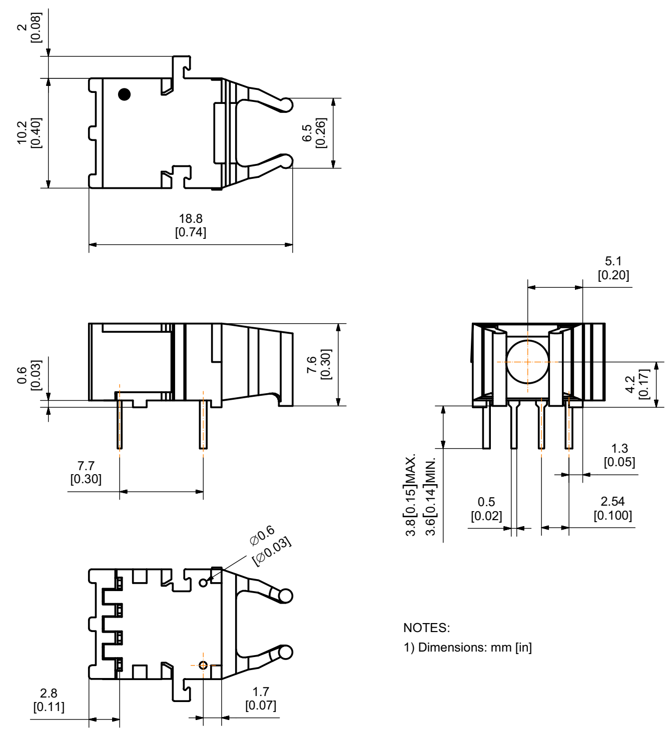
Recommended Chemicals for Cleaning and Degreasing

- 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.

Mechanical Dimensions

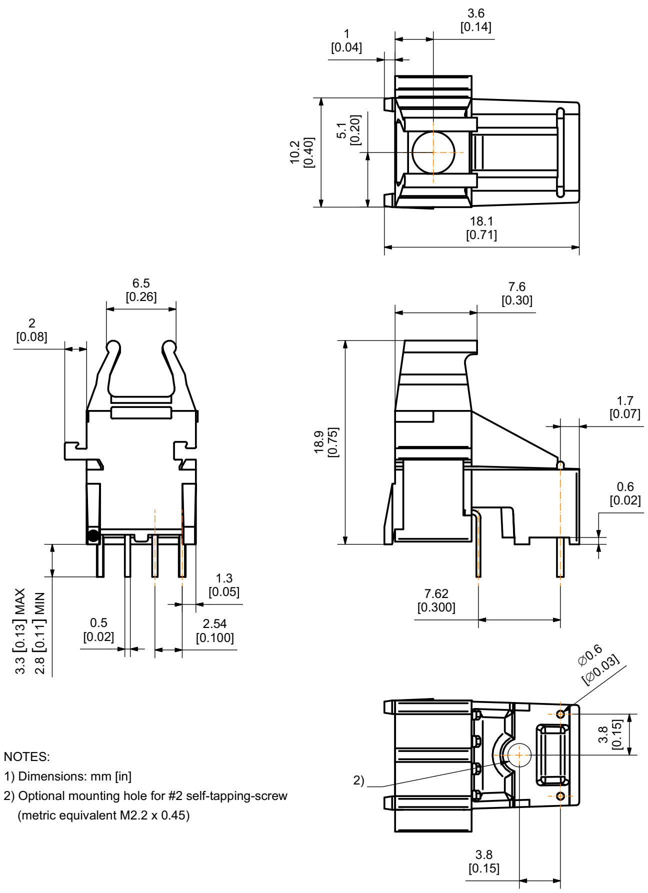
Horizontal Module



NOTES:

1) Dimensions: mm [in]

Vertical Module

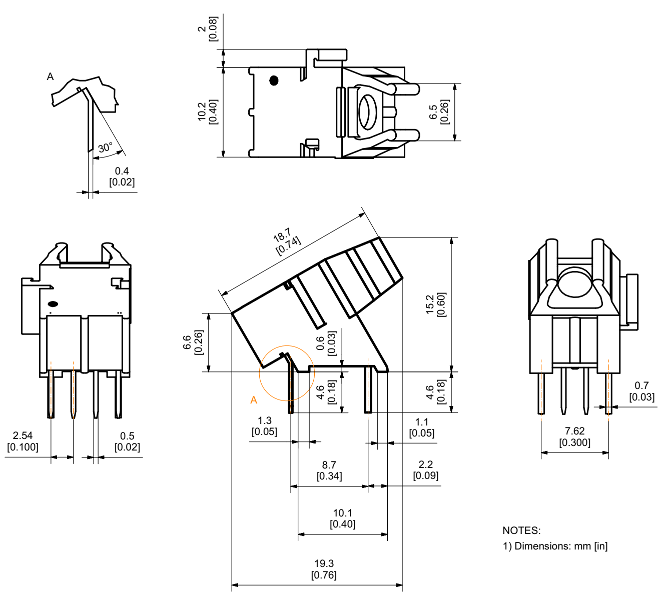


NOTES:

1) Dimensions: mm [in]

2) Optional mounting hole for #2 self-tapping-screw (metric equivalent M2.2 x 0.45)

Tilted (30°) Module

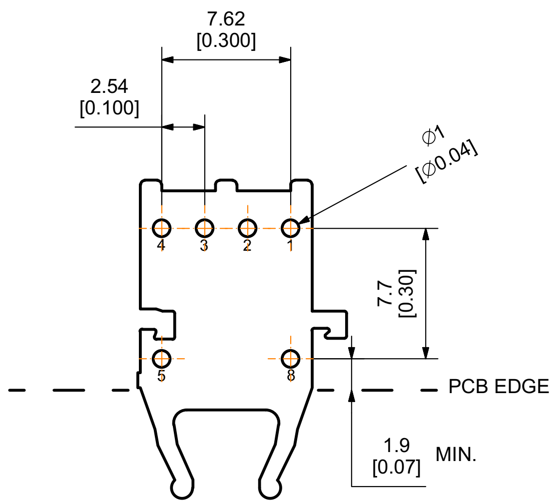


NOTES:

1) Dimensions: mm [in]

Versatile Link Printed Board Layout Dimensions

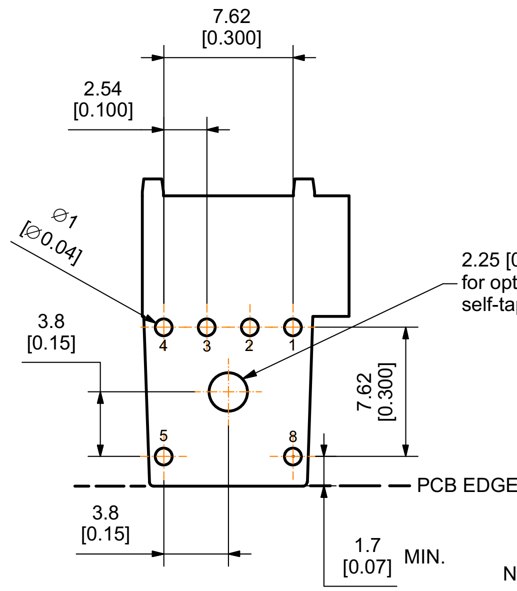
Horizontal Module



NOTES:
1) Dimensions: mm [in]

Footprint - TOP VIEW

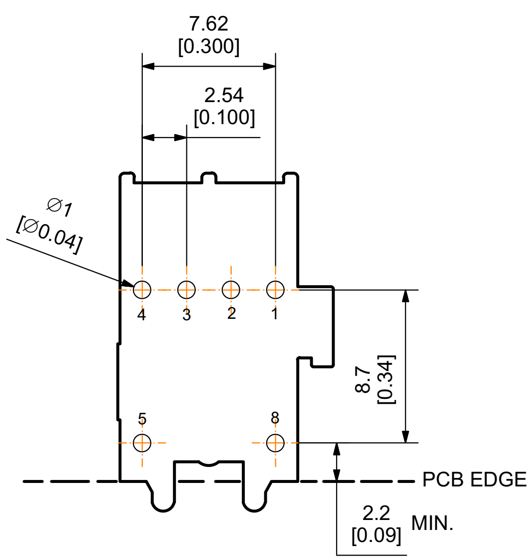
Vertical Module



NOTES:
1) Dimensions: mm [in]

Footprint - TOP VIEW

Tilted (30°) Module



NOTES:
1) Dimensions: mm [in]

Footprint - TOP VIEW

Interlocked (Stacked) Assemblies

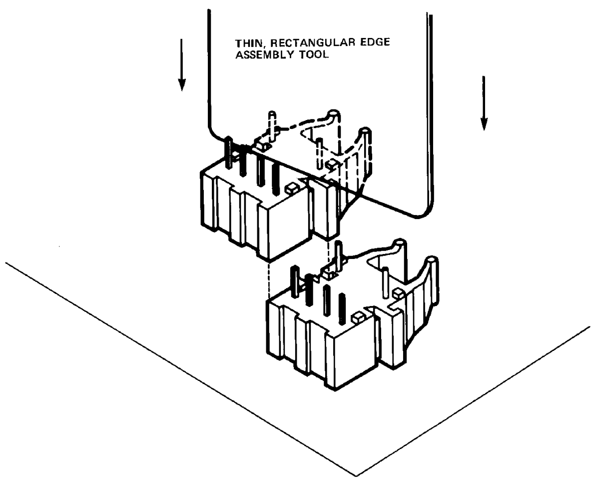
Horizontal packages may be stacked by placing units with pins facing upward. Initially engage the inter-locking mechanism by sliding the L bracket body from above into the L slot body of the lower package. Use a straight edge, such as a ruler, to bring all stacked units into uniform alignment. This technique prevents potential harm that could occur to fingers and hands of assemblers from the package pins. Stacked horizontal packages can be disengaged if necessary. Repeated stacking and unstacking causes no damage to individual units.

To stack vertical packages, hold one unit in each hand, with the pins facing away and the optical ports on the bottom. Slide the L bracket unit into the L slot unit. The straight edge used for horizontal package alignment is not needed.

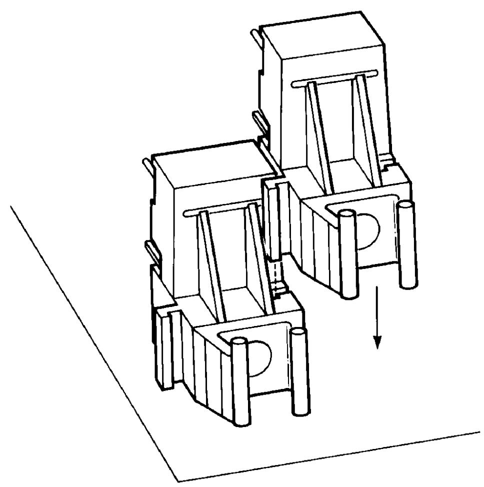
It is recommended to interlock (stack) no more than four compatible housings together.

Figure 2: Interlocked (Stacked) Horizontal, Vertical, and Tilted (30°) Packages

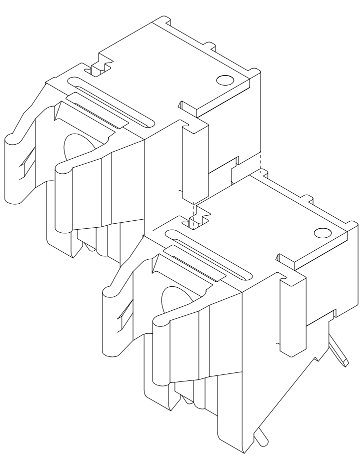
Stacking Horizontal Modules



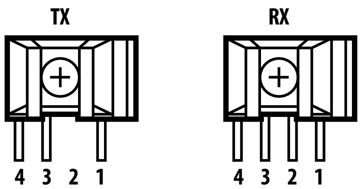
Stacking Vertical Modules



Stacking Tilted (30°) Modules



Pin Description



Transmitter

Fiber port faces front, pins downward, 1 = Rightmost pin to 4 = Leftmost pin.

Pin	Name	Function/Description	Notes
1	V_{CCT}	Transmitter Power 3.3V ± 5% or 5V ± 5%	—
2	No Pin	No physical pin is available	—
3	V_{EET}	Transmitter Ground	—
4	Data In	Transmitter Data Input	a, b
5	Housing Pin	Physical pin is available, recommended to chassis GND	c
8	Housing Pin	Physical pin is available, recommended to chassis GND	c

a. The logic 1 input will turn the light on and the logic 0 will turn the light off for the AFBR-16x4Z. The logic 1 input will turn the light off and the logic 0 will turn the light on for the AFBR-16x9Z.

b. TTL compatible data input and output.

c. Pins 5 and 8 are for mounting and retaining purposes, and they should be connected to chassis GND.

Receiver

Fiber port faces front, pins downward, 1 = Rightmost pin to 4 = Leftmost pin.

Pin	Name	Function/Description	Notes
1	Data Out	Receiver Data Output	a
2	V_{EER}	Receiver Ground	—
3	V_{CCR}	Receiver Power 3.3V ± 5% or 5V ± 5%	—
4	Pin	No function, physical pin is available, recommended to signal GND	b
5	Housing Pin	Physical pin is available, recommended to chassis GND	c
8	Housing Pin	Physical pin is available, recommended to chassis GND	c

a. TTL compatible data input and output.

b. It is recommended to connect this pin to signal GND.

c. Pins 5 and 8 are for mounting and retaining purposes and should be connected to chassis GND.

Regulatory Compliance

Feature	Test Method	Performance
Electrostatic Discharge (ESD) to the Electrical Pins Human Body Model	MIL-STD-883 Method 3015	Min ±2000V
Eye Safety	IEC 60825-1, 2, Class 1	—

Specified Link Performance

TA = –40°C to +85°C, 50 Mbaud.

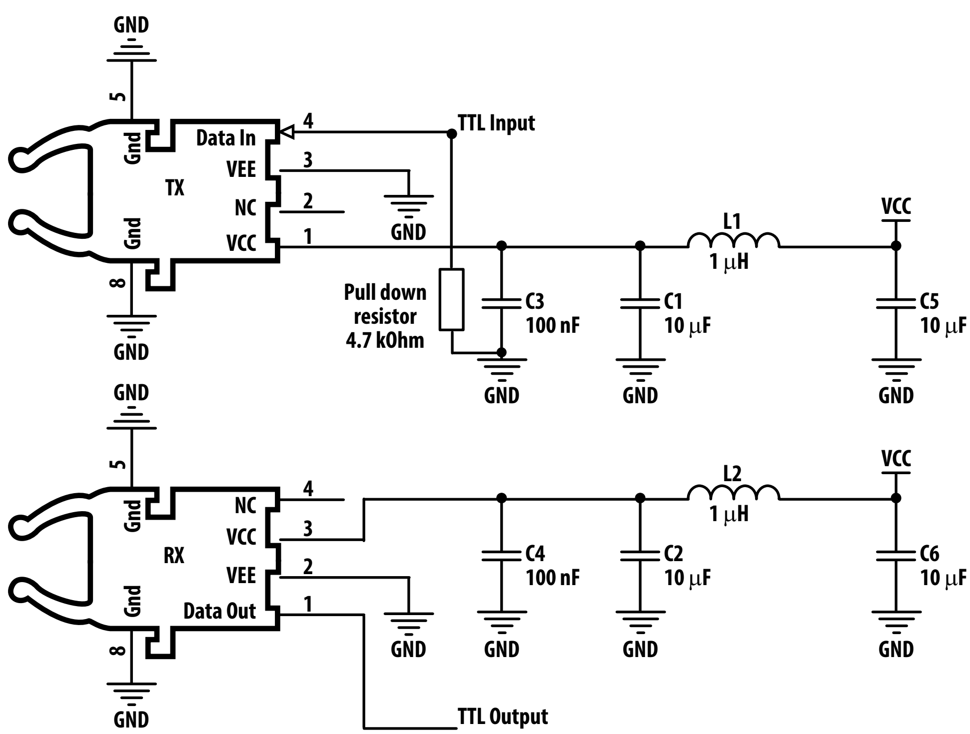
Parameter	Min.	Max.	Unit	Condition	Notes
Link Distance with Standard POF Cable	0.1	50	meters	–40°C to +85°C	a, b
Link Distance with 200-μm PCS (10 Mbaud)	0.1	200	meters	–40°C to +85°C	b, c
Link Distance with 200-μm PCS (50 Mbaud)	0.1	120	meters	–40°C to +85°C	b, c

a. HFBR-R/EXXYYYZ is the part number for 1-mm POF. Worst-case attenuation used (0.27 dB/m for the standard loss POF cable from –40°C to +85°C at 660 nm).

b. The optical link performance is guaranteed only with AFBR-16xxZ transmitters and AFBR-26x4Z/25x9Z receivers.

c. PCS, worst-case attenuation (12 dB/km from –40°C to +85°C at 650 nm).

Figure 3: Recommended Transmitter and Receiver Application Circuit



Absolute Maximum Ratings

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Storage Temperature	T_s	–40	—	85	°C	a
Ambient Temperature	T_c	–40	—	85	°C	a
Relative Humidity	RH	0	—	85	%	a
Supply Voltage	V_{CCT}/V_{CCR}	–0.5	—	6	V	a
Data Input Voltage	V_{IN}	–0.5	—	V_{CC} + 0.5	V	a
Data Output Current	I_O	—	—	10	mA	a
Data Rate	—	DC	—	50	Mbaud	—

a. Absolute maximum ratings are those values beyond which damage to the device may occur if these limits are exceeded for other than a short period of time.

Recommended Operating Conditions

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Ambient Temperature	T_A	–40	25	85	°C	a
Supply Voltage	V_{CCT}/V_{CCR}	3.135	3.3	3.465	V	a
		4.75	5	5.25	V	a

a. Recommended operating conditions are those values outside of which functional performance is not intended, device reliability is not implied, and damage to the device may occur over an extended period of time. See the reliability data sheet for specific reliability performance.

Process Compatibility

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Solder Environment	T_{SOLD}	—	—	260	°C	a, b, c
	t_{SOLD}	—	—	10	sec	b, c, d

a. Maximum temperature refers to peak temperature.

b. 1.6 mm below the seating plane.

c. The product is moisture sensitive level 3.

d. Maximum time refers to time spent at peak temperature. To guard against solder process fluctuations, the recommended nominal soldering time is 5 seconds.

AFBR-16xxZ Transmitter

The AFBR-16xxZ transmitter incorporates a 650-nm LED and integrated driver IC in a light gray, nonconductive plastic Versatile Link housing. Its input data is compatible with TTL logic level. This transmitter can operate from DC to 50 Mbaud with any kind of data pattern using 1-mm polymer optical fiber (POF). Within the specified ranges, AFBR-16x4Z and AFBR-16x9Z devices will support a BER < 10E-9.

Transmitter Electrical Characteristics

(T_A = –40°C to +85°C, V_{CCT} = 3.3V ± 5% or 5V ± 5%)

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Supply Current (Optical Power ON)	I_{CCT}	—	21	31	mA	a
Input Voltage – Low	V_{IL}	–0.3	—	0.8	V	b
Input Voltage – High	V_{IH}	2.0	—	V_{CC} + 0.3	V	b
Data Input Capacitance	C_{IN}	—	—	7	pF	—
Data Input Resistance	R_{IN}	2	—	—	kΩ	—
Propagation Delay	t_{TD}	—	—	30	ns	—

a. For any type of data between DC and 50 Mbaud. Typical value of 21 mA for a PRBS–7 pattern at 25°C at 5V and 50 Mbaud.

b. Standard TTL compatible input.

Transmitter Optical Characteristics

(T_A = –40°C to +85°C, V_{CCT} = 3.3V ± 5% or 5V ± 5%)

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Output Optical Power (Peak), 1-mm POF	P_N	–4.5	–2	+2	dBm	a
Output Optical Power (Peak), PCS (200 µm)	P_N	–16.5	–13	–9	dBm	a
Output Optical Power (Average), OFF	P_S	—	—	–50	dBm	—
Extinction Ratio	ER	10	—	—	dB	—
Peak Wavelength	λ_c	630	—	685	nm	—
Rise Time (20%–80%)	t_{RT}	—	—	5	ns	—
Fall Time (20%–80%)	t_{FT}	—	—	5	ns	—
Pulse Width Distortion	PWD	–3	—	+3	ns	b, c
Pulse Width Distortion of First Pulse	PWD	–5	—	+3	ns	c, d

a. Measured with the polished connector end face: after 1 meter 1-mm POF, NA = 0.5, or 200-µm PCS, NA = 0.37.

b. The pulse width is measured at 50% threshold using a rising edge trigger tested with a PRBS–7 pattern.

c. The electrical input pulse width is determined at 1.5V, and dU/dt between 1V and 2V must not be less than 1V/ns.

d. The first optical pulse of the transmitter is shorter because the LED is completely discharged. This also helps to mitigate the increase in pulse width of the receiver's first electrical pulse.

AFBR-26x4Z/25x9Z Receiver

The AFBR-26x4Z/25x9Z receiver consists of a digitalizing IC with an integrated photodiode to produce an output level that is compatible with TTL logic. The integrated photodiode and the receiver's amplifier use a fully differential approach with an active and passive area for improved EMI performance. Within the specified ranges, AFBR-25x9Z and AFBR-26x4Z devices will support a BER <10E-9.

Receiver Electrical Characteristics

(TA = –40°C to +85°C, V_{CCT} = 3.3V ± 5% or 5V ± 5%)

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Supply Current	I_{CCR}	—	20	30	mA	—
Data Output Voltage – Low	V_{OL}	–0.3	—	0.4	V	a, b
Data Output Voltage – High	V_{OH}	2.5	—	V_{CCR} + 0.3	V	a, b
Rise Time (10%–90%)	t_{RR}	—	—	5	ns	b, c
Fall Time (10%–90%)	t_{FR}	—	—	5	ns	b, c
Pulse Width Distortion	PWD	–4	—	+4	ns	b, d, e, f, g
Pulse Width Distortion 1st to 3rd Pulse	PWD_{init}	–5	—	+8	ns	b, f, g, h
Propagation Delay	t_{RD}	—	—	30	ns	—
Max. Initiation Time after Power-Up	T_{INT}	—	—	15	ms	i

a. Standard TTL output.

b. Guaranteed only if the optical input signal to the receiver is generated by AFBR-16xxZ, with ideal alignment to the photodiode using a 1-mm POF (NA = 0.5).

c. Measured with R_L = 50 kΩ and C_L = 15 pF.

d. An optical input signal of 50 Mbaud, PRBS 2^7–1 pattern, and 50% duty cycle.

e. The pulse width is measured at 50% threshold using a rising edge trigger and PRBS 2^7–1 pattern.

f. If the data rate is below 1 Mbaud, the pulse width distortion would be equal to the pulse width distortion of the 1st to 3rd pulses for higher data rates.

g. Because of optical pulse width spreading, the PWD limits must be increased by ±0.1 ns for each 10m fiber length.

h. The threshold of the 1st pulse of a data sequence is difficult to adjust, and therefore the pulse width distortion up to the 3rd pulse is higher than for all other pulses (worst case for the 1st pulse). This strongly depends on the quality of the rising and falling edge of the optical input. The faster the edges, the smaller the pulse width variation. Furthermore, lower data rates would result in the same issue as all the pulse become 1st pulses.

i. The starting point is when the supply voltage passes ~2.8V.

Receiver Optical Characteristics

(TA = –40°C to +85°C, V_{CCT} = 3.3V ± 5% or 5V ± 5%)

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Input Optical Power (Peak), 1-mm POF	P_{IN}	–22	—	+2	dBm	a
Input Optical Power (Peak) Off-State, 1-mm POF	P_{IN_Off}	–40	—	—	dBm	a, b
Input Optical Power (Peak), PCS (200 µm)	P_{IN}	–25	—	–1	dBm	a
Input Optical Power (Peak) Off-State, PCS (200 µm)	P_{IN_Off}	–44	—	—	dBm	a
Optical Spectrum Range	λ	630	—	685	nm	—

a. Guaranteed only if an optical input signal to the receiver is generated by AFBR-16xxZ, with ideal alignment to the photodiode using 1-mm POF (NA = 0.5).

b. Output low for AFBR-26x4Z and output high for AFBR-25x9Z.