

## AFBR-2529SIZ

### DC-50MBd Versatile Link Fiber-Optic Receiver with Monitoring Output for 1 mm POF and 200 $\mu$ m PCS



#### Description

The Broadcom® AFBR-2529SIZ receiver consists of an IC with an integrated photodiode providing a TTL logic family compatible output.

The receiver operates any type of signal from DC up to 50 MBd at distances up to 50m with 1 mm Polymer Optical Fiber (POF), up to 200m at 10 MBd and 120m at 50 MBd with 200  $\mu$ m Plastic-Clad Silica (PCS), respectively.

It is a 4-pin device, packed in Versatile Link housing. Versatile Link components can be interlocked (N-plexed together) to minimize space and to provide dual connections with the duplex connectors.

The AFBR-2529SIZ features a monitor output providing an analog voltage proportional to the average optical input power.

Various simplex and duplex connectors, as well as POF cables are available for Versatile Link components.

For optical links with AFBR-2529SIZ, Broadcom's AFBR-16xxZ transmitters use a 650 nm LED source with integrated optics and driver IC recommended.

The AFBR-2529SIZ delivers inverted output signals, which means that LIGHT ON leads to Data out LOW and vice versa.

#### Available Options

Horizontal Package	AFBR-2529SIZ
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#### Features

- RoHS-compliant
- Analog monitoring output (RSSI)
- Data transmission at signal rates from DC up to 50 MBd
- Integrated PIN diode and digitalizing IC with TTL output logic
- Up to 50m distance with 1 mm POF over operating temperature range
- Up to 200m (10 MBd) distance and 120m (50 MBd) distance with 200  $\mu$ m PCS over operating temperature range
- Operating temperature range of  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$
- Receiver power supply of 3.3V or 5.0V
- Compatible with the Broadcom's Versatile Link family of connectors, for easy termination of fiber

#### Applications

Optical receiver for 50-MBd systems and below:

- Industrial control and factory automation
- Extension of RS-232 and RS-485
- High voltage isolation
- Elimination of ground loops
- Reduces voltage transient susceptibility
- Advanced maintenance management of optical links by monitoring the incoming optical receiver power

#### Application Literature

Application Note 1035 (Versatile Link) – 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 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 Housing Color

Versatile Link components and simplex connectors are color-coded to eliminate confusion when making connections. Receiver packages are black, and transmitters are grey.

### Handling

Versatile Link components are auto-insertable. When wave soldering is performed with Versatile Link components, leave the optical port plug in to prevent contamination of the port. Do not use reflow solder processes (that is, infrared reflow or vapor-phase reflow). Use non-halogenated water soluble fluxes (that is, 0% chloride), not rosin based fluxes, 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/Degreasing

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

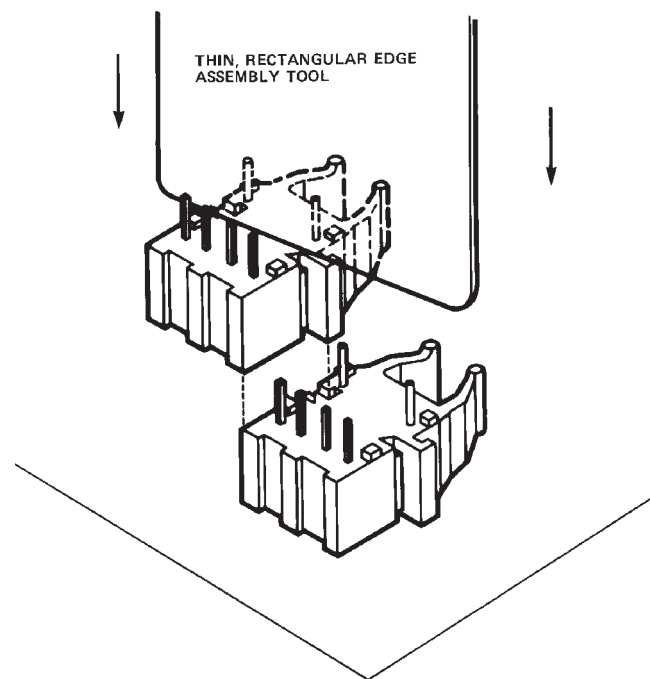
## Interlocked (Stacked) Assemblies

See [Figure 1](#).

Horizontal packages can be stacked by placing units with pins facing upward. Initially engage the interlocking 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.

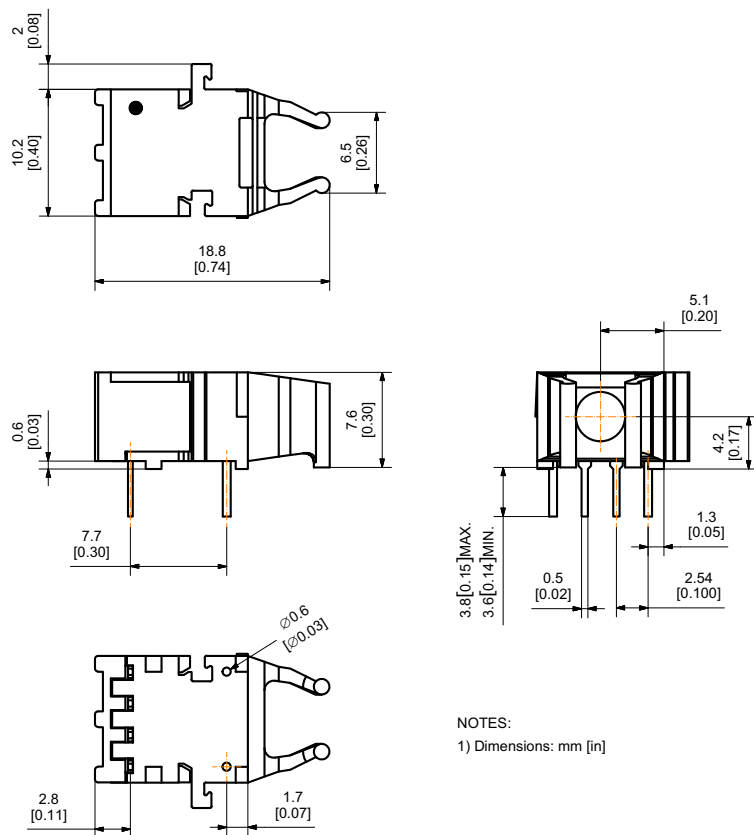
It is recommended to interlock (stack) not more than four compatible housings together.

**Figure 1: Interlocked (Stacked) Horizontal Packages**



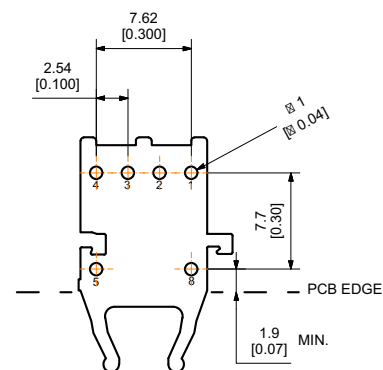
## Mechanical Dimensions

Figure 2: Mechanical Dimensions – Horizontal Packages



## Versatile Link Printed Board Layout Dimensions

Figure 3: PCB Dimensions – Horizontal Packages



## Analog Monitoring Output (RSSI)

The Receiver Signal Strength Indicator (RSSI) is a monitoring output that delivers an output current proportional to the average incoming optical power.

The integrating signal is directed to the RSSI output.

To provide a suitable monitoring voltage across the shunt resistor,  $R_{RSSI}$ , its value should be chosen to the particular optical power situation of the specific application.

The lower the optical receiver power, the higher the resistor value should be.

Do not, however, override the maximum limit of  $V_{RSSI}$ .

The typical analog monitoring voltage,  $V_{RSSI}$ , (across 2 k $\Omega$  shunt resistor) as a function of receiver optical input power for industrial temperature range is shown in [Figure 5](#) and [Figure 6](#).

The monitoring voltage varies linearly with the receiver optical input power. The variation overtemperature is negligible for most applications.

For an almost noise-free RSSI-signal, smoothing components are recommended. A capacitor,  $C_{RSSI}$ , in parallel to the resistor on the RSSI output reduces potential high frequency signal parts. The use of a single 100 nF capacitor for signal smoothing is sufficient in most common applications, as shown in the recommended receiver circuitry in [Figure 4](#).

If this RSSI function is not required, the output pin can be left floating.

The RSSI-signal is derived from internal controlling loops; therefore, the typical time constant of pure RSSI output current without an external filter can be up to 1 ms. This time constant also depends on the actual average incoming light power.

The integrating (averaging) character of the RSSI output together with the time constant result in a systemic conditioned fluctuation of the RSSI output signal at very low data rates and/or during data communications that show relative long time intervals in which the optical input has constant HIGH or LOW. This should be considered in the application processing/polling of the RSSI output signal accordingly.

## Regulatory Compliance

Feature	Test Method	Performance
Electrostatic Discharge (ESD) to the Electrical Pins Human Body Model	MIL-STD-883 Method 3015	Min $\pm$ 2000 V

## Process Compatibility

Parameter	Symbol	Min.	Typical	Max.	Units
Solder Environment <sup>a,b</sup>	$T_{SOLD}$	—	—	260 <sup>c</sup>	$^{\circ}$ C
	$t_{SOLD}$	—	—	10 <sup>d</sup>	seconds

a. Solder surface must be at least 1.6 mm below the lead frame stops.

b. The product is Moisture Sensitive Level 3.

c. Maximum temperature refers to peak temperature.

d. Maximum time refers to time spent at peak temperature.

## Specified Link Performance, $T_A = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ , 50 MBd

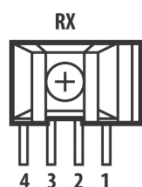
Parameter	Min.	Max.	Units	Condition
Link Distance with Standard POF cable <sup>a, b</sup>	0.1	50	meters	$-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$
Link Distance with 200 $\mu$ m PCS (10 MBd) <sup>b, c</sup>	0.1	200	meters	$-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$
Link Distance with 200 $\mu$ m PCS (50 MBd) <sup>b, c</sup>	0.1	120	meters	$-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$

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

b. The optical link performance is guaranteed only with transmitters AFBR-16xxZ.

c. PCS, worst-case attenuation (12 dB/km from  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$  at 650 nm).

## Pin Description Receiver AFBR-2529SIZ



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

Pin	Name	Function/Description
1	Data Out <sup>a</sup>	Data Output inverted
2	$V_{EE}$	Ground
3	$V_{CC}$	Power 3.3V $\pm$ 5% or 5.0V $\pm$ 5%
4	RSSI <sup>b</sup>	Receiver Signal Strength Indicator
5	Housing Pin <sup>c</sup>	Physical pin is available, recommended to chassis GND
8	Housing Pin <sup>c</sup>	Physical pin is available, recommended to chassis GND

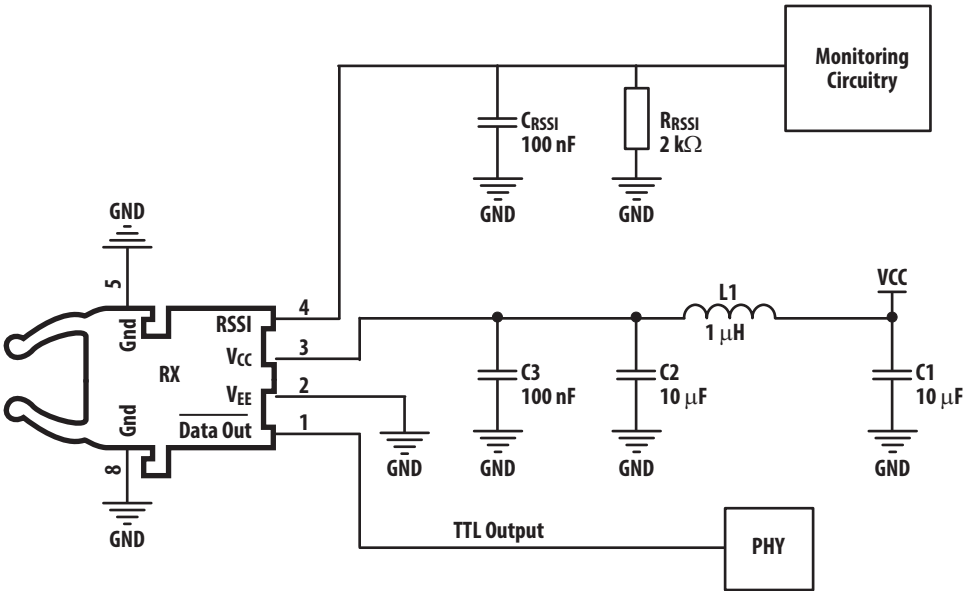
a. TTL compatible data output provides an inverted signal, thus an electrical low in case of light on and vice versa.

b. Analog monitoring output.

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

**NOTE:** The AFBR-2529SIZ delivers inverted output signals, therefore, an inverting transmitter, for example, AFBR-1629Z, should be used accordingly.

Figure 4: Recommended Receiver Application Circuit



Absolute Maximum Ratings

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.

Parameter	Symbol	Min.	Typical	Max.	Units
Storage Temperature	T <sub>S</sub>	−40	—	85	°C
Ambient Temperature	T <sub>A</sub>	−40	—	85	°C
Relative Humidity	RH	0	—	85	%
Supply Voltage	V <sub>CC</sub>	−0.5	—	6	V
Data Output Current	I <sub>O</sub>	—	—	10	mA

Recommended Operating Conditions

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. Refer to the Reliability Data Sheet for specific reliability performance.

Parameter	Symbol	Min.	Typical	Max.	Units
Ambient Temperature	T <sub>A</sub>	−40	25	85	°C
Supply Voltage	V <sub>CC</sub>	3.135	3.3	3.465	V
	V <sub>CC</sub>	4.75	5.0	5.25	V
Data Rate		DC	—	50	MBd

## AFBR-2529SIZ Receiver

The receiver consists of a digitalizing IC with integrated photodiode to produce an output level that is compatible with TTL logic.

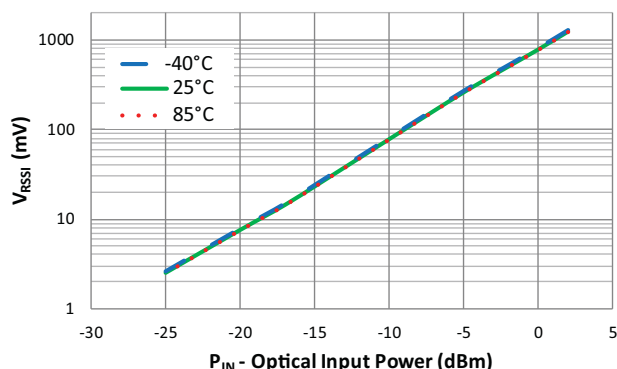
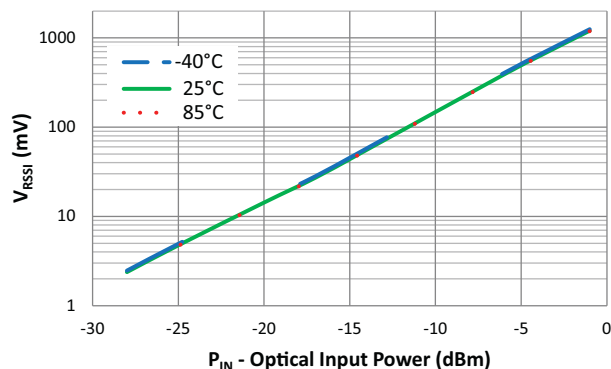
The integrated photodiode and the following amplifier use a fully differential approach with an active and a passive area for an improved EMI performance. Within the specified ranges the receiver will support a BER <10E-9.

## Receiver Electrical Characteristics

( $T_A = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ,  $V_{CC} = 3.3\text{V} \pm 5\%$  or  $5.0\text{V} \pm 5\%$ )

Parameter	Symbol	Min.	Typical <sup>a</sup>	Max.	Units
Supply Current	$I_{CC}$	—	20	30	mA
Data Output Voltage – Low <sup>b,c</sup>	$V_{OL}$	–0.3	—	0.4	V
Data Output Voltage – High <sup>b,c</sup>	$V_{OH}$	2.5	—	$V_{CC} + 0.3$	V
Rise Time (10% to 90%) <sup>b,d</sup>	$t_R$	—	—	5	ns
Fall Time (90% to 10%) <sup>b,d</sup>	$t_F$	—	—	5	ns
Pulse Width Distortion <sup>b,e,f,g,h</sup>	PWD	–4	—	+4	ns
Pulse Width Distortion first to third pulse <sup>b,e,f,i</sup>	$PWD_{init}$	–5	—	+8	ns
Propagation Delay	$t_{RD}$	—	—	30	ns
Maximum Initiation Time after Power Up <sup>j</sup>	$T_{INT}$	—	—	15	ms
RSSI Output Responsivity, 1 mm POF <sup>k</sup>	$I_{RSSI} / P_{IN}$	—	0.4	—	A/W
RSSI Output Responsivity, PCS (200 µm) <sup>k</sup>	$I_{RSSI} / P_{IN}$	—	0.7	—	A/W
Voltage at RSSI Output	$V_{RSSI}$	0	—	$V_{CC} - 1$	V

- Typical values are mean values measured at  $T_A = 25^{\circ}\text{C}$ .
- Guaranteed only if optical input signal to the receiver is generated by AFBR-16xxZ, with ideal alignment to photo diode using 1 mm POF (NA=0.5) or 200 µm PCS (NA = 0.37).
- Standard TTL output
- Measured with  $R_L = 50\text{ k}\Omega$  and  $C_L = 15\text{ pF}$ .
- If data rate is below 1 MBd, the pulse width distortion would be equal to the pulse width distortion of the first to third pulses for higher data rates.
- Because of optical pulse width spreading, the PWD limits have to be increased by  $\pm 0.1\text{ ns}$  for each 10m fiber length.
- Optical input signal of 50 MBd, PRBS  $2^7 - 1$  pattern and 50% duty cycle.
- Pulse width is measured at 50% threshold using a rising edge trigger and PRBS  $2^7 - 1$  pattern.
- The threshold of the first pulse of a data sequence is difficult to adjust and, therefore, the pulse width distortion up to the third pulse is higher than for all other pulses (worst case for the first 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 first pulses.
- Starting point is when supply voltage passes  $\sim 2.8\text{V}$ .
- Average value verified with an external resistor  $R_{RSSI}$  at optical input signal of 50 MBd, PRBS  $2^7 - 1$  pattern with 50% duty cycle. Measured with ideal alignment to photo diode using 1 mm POF (NA=0.5) or 200 µm PCS (NA = 0.37). The RSSI output provides stable signal for data rates from 1 MBd to 50 MBd.

**Figure 5: Typical RSSI Output Voltage across  $R_{RSSI} = 2\text{ k}\Omega$ , 1 mm POF****Figure 6: Typical RSSI Output Voltage across  $R_{RSSI} = 2\text{ k}\Omega$ , 200  $\mu$ m PCS**

**NOTE:** To provide a suitable monitoring voltage, choose the value of  $R_{RSSI}$  according to the particular optical power situation. For the illustration of the responsivity,  $2\text{ k}\Omega$  was used. The lower the optical input power, the higher the resistor value should be. Do not, however, override the max. limit of  $V_{RSSI}$ .

## Receiver Optical Characteristics

( $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ ,  $V_{CC} = 3.3\text{V} \pm 5\%$  or  $5.0\text{V} \pm 5\%$ )

Parameter	Symbol	Min.	Typical	Max.	Units
Input Optical Power (Peak), 1-mm POF <sup>a</sup>	$P_{IN}$	-22	—	+2	dBm
Input Optical Power (Peak) Off -State, 1 mm POF <sup>a,b</sup>	$P_{IN\_Off}$	-40	—	—	dBm
Input Optical Power (Peak), PCS (200 $\mu$ m) <sup>a</sup>	$P_{IN}$	-25	—	-1	dBm
Input Optical Power (Peak) Off -State, PCS (200 $\mu$ m) <sup>a,b</sup>	$P_{IN\_Off}$	-44	—	—	dBm
Optical Spectrum Range	$\lambda$	630	—	685	nm

a. Guaranteed only if optical input signal to the receiver is generated by AFBR-16xxZ, with ideal alignment to photo diode using 1mm POF (NA=0.5) or 200  $\mu$ m PCS (NA = 0.37).

b. Electrical Receiver Output HIGH (AFBR-2529SIZ delivers inverted output).

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