

## AFBR-3950xxRZ

### High Voltage Galvanic Insulation Link for DC to 50 MBaud



### Description

The Broadcom® AFBR-3950xxRZ is a high-voltage galvanic insulation link for DC to 50 MBaud. The AFBR-3950xxRZ consists of an optical transmitter and receiver operating at 650-nm wavelength. Pin- to-pin distance of approximately 25 mm to 101 mm provides transient voltage suppression in the range of 15 kV to 50 kV.

### Applications

- Drives/inverters
- Galvanic insulation on one single PCB
- Medium voltage power distributions
- Regulated distribution transformers
- Smart grid on-board Insulations

### Ordering Information

Part Number	Length	mm	Voltage Suppression
AFBR-395025RZ	1 inch	25	15 kV
AFBR-395050RZ	2 inch	50.4	27 kV
AFBR-395075RZ	3 inch	75.8	40 kV
AFBR-395000RZ	4 inch	101.2	50 kV

### Features

- Data transmission at signal rates of DC to 50 MBaud
- DC coupled transmitter and receiver with CMOS/TTL input-output for easy designs: no data encoding or digitizing circuitry required
- High noise immunity through receiver IC with integrated photodiode
- RoHS compliant
- Transient voltage suppression in the range of 15 kV up to 50 kV according IEC 60644
- Laser class 1 according to IEC-60825
- Certified according to IEC-60747-5-5
- Housing material UL-V0 with CTI 600
- Optional 3.3V or 5V power supply

# AFBR-3950xxRZ DC to 50 MBaud Data Link

## Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Units	
Signaling Rate	$f_s$	DC	50	MBd	
Storage and Operating Temperature	$T_{S,O}$	-40	+85	°C	
Receiver Supply Voltage	$V_{CCRx}$	-0.5	+5.5	V	
Receiver Supply Current	$I_{CCRx}$	—	30	mA	
Receiver Output Current	$I_{OAV}$	—	10	mA	
Transmitter Supply Voltage	$V_{CCTx}$	-0.5	+5.5	V	
Transmitter Supply Current	$I_{CCTx}$	—	31	mA	
Lead Soldering Cycle <sup>a, b</sup>	Temp	$T_{SOL}$	—	+260	°C
	Time		—	10	seconds

a. 1.6 mm below seating plane; wave soldering only.

b. MSL class 3.

**ATTENTION:** Stresses above those listed here may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## Recommended Operating Conditions

Parameter	Symbol	Min.	Max.	Units
Ambient Temperature	$T_A$	-40	85	°C
Receiver Power Supply Voltage <sup>a</sup>	$V_{CCRx}$	3.135 4.75	3.465 5.25	V
Transmitter Supply Voltage	$V_{CCTx}$	3.135 4.75	3.465 5.25	V
Signaling Rate	$f_s$	DC	50	MBd

a. < 100mVp-p noise.

All the data in this specification refers to the operating conditions above and over lifetime unless otherwise stated.

## Insulation Characteristics

Parameter	Symbol	Min.	Max.	Units
Apparent charge at Sample Test stage and Type Test stage after subgroup 1 (method a) <sup>a</sup>	$q_{pd}$	—	5	pC
Apparent charge at Routine Test stage and Type Test stage, Preconditioning (method b) <sup>b</sup>	$q_{pd}$	—	5	pC

Parameter	Symbol	Min.	Max.	Units
Maximum Transient Voltage, peak <sup>c</sup>	V <sub>IOTM_1inch</sub>	15	—	kV
	V <sub>IOTM_2inch</sub>	27	—	
	V <sub>IOTM_3inch</sub>	40	—	
	V <sub>IOTM_4inch</sub>	50	—	
Maximum Transient Voltage, effective <sup>c</sup>	V <sub>ISO_1inch</sub>	10.5	—	kV
	V <sub>ISO_2inch</sub>	19	—	
	V <sub>ISO_3inch</sub>	28.1	—	
	V <sub>ISO_4inch</sub>	35.2	—	
Maximum Working Voltage, peak <sup>d</sup>	V <sub>IORM_1inch</sub>	4.25	—	kV
	V <sub>IORM_2inch</sub>	8.5	—	
	V <sub>IORM_3inch</sub>	12.75	—	
	V <sub>IORM_4inch</sub>	17.00	—	
Maximum Working Voltage, effective <sup>d</sup>	V <sub>IOWM_1inch</sub>	3	—	kV
	V <sub>IOWM_2inch</sub>	6	—	
	V <sub>IOWM_3inch</sub>	9	—	
	V <sub>IOWM_4inch</sub>	12	—	
Insulation Resistance @ T <sub>amb,max</sub> , min.100°C	R <sub>IO</sub>	10 <sup>11</sup>	—	Ω
Insulation Resistance @ T <sub>S</sub>	R <sub>IO</sub>	10 <sup>9</sup>	—	Ω
Creepage Distance	1inch	25	—	mm
	2inch	50.4	—	
	3inch	75.8	—	
	4inch	101.2	—	
Clearance Distance	1inch	25	—	mm
	2inch	50.4	—	
	3inch	75.8	—	
	4inch	101.2	—	
Surge Isolation Voltage	V <sub>IOSM</sub>	12	—	kV
Comparative Tracking Index	CTI	600	—	
Pollution degree <sup>e</sup>		2	—	
Climatic category <sup>f</sup>		40/085/21	—	
Maximum ambient safety temperature	T <sub>S</sub>	110	—	°C
Maximum input current	I <sub>SI</sub>	60	—	mA
Maximum output current	I <sub>SO</sub>	30	—	mA
Maximum input power dissipation	P <sub>SI</sub>	330	—	mW
Maximum output power dissipation	P <sub>SO</sub>	165	—	mW

a.  $V_{pd(m)} = 1.6 \times V_{IORM}$  (= 6.8 kV for 1inch, =13.6 kV for 2inch, =20.4 kV for 3inch, =27.2 kV for 4inch),  $V_{ini,a} = V_{IOTM}$ ,  $t_{ini,a} = 60s$ ;  $t_m = 10s$ .

b.  $V_{pd(m)} = 1.875 \times V_{IORM}$  (= 8 kV for 1inch, =16 kV for 2inch, =24 kV for 3inch, =32 kV for 4inch),  $V_{ini,b} = V_{IOTM}$ ,  $t_{ini,b} = 1s$ ;  $t_m = 1s$

c. Altitude up to 2000m above sea level.

d. Pollution degree 2; please note that inhomogeneous field conditions may lead to partial discharge through air for these voltages.

e. According IEC-60064-1.

f. According IEC-60068-1.

## Electrical Input Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Units
Input Voltage Low	$V_{IL}$	—	—	0.8	V
Input Voltage High <sup>a</sup>	$V_{IH}$	2	—	$V_{CCTx}$	V
Input Capacitance	$C_{IN}$	—	—	7	pF
Input Resistance	$R_{IN}$	10	—	—	k $\Omega$

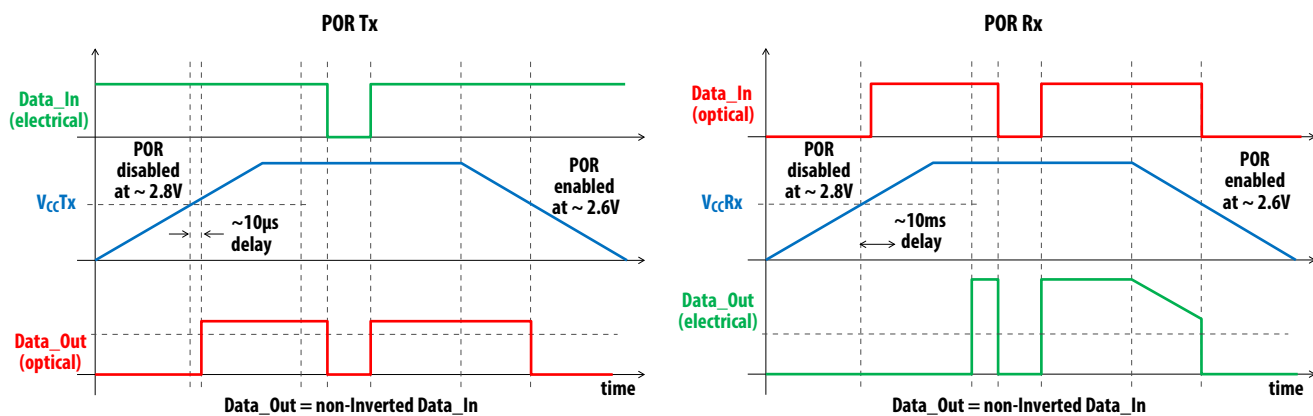
a. Duty Cycle shall be 50% at 1.5V

## Electrical Output Signal Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Units
High Level Output Voltage	$V_{OH}$	2.5	$V_{CCRx}$	$V_{CCRx} + 0.3$	V
Low Level Output Voltage	$V_{OL}$	—	—	0.4	V
Output Risetime (10–90%) <sup>a</sup>	$t_r$	—	—	5	ns
Output Falltime (90–10%) <sup>a</sup>	$t_f$	—	—	5	ns
Power Supply Noise Immunity	PSNI	0.1	0.4	—	V <sub>pp</sub>
Vcc level to deactivate POR <sup>b</sup>	$V_{POR\_DEACT}$	—	2.8	—	V
Vcc level to activate POR <sup>b</sup>	$V_{POR\_ACT}$	—	2.6	—	V
POR deactivate delay time <sup>b</sup>	$t_{POR\_DEACT\_DEL}$	—	10	—	ms

a.  $C_L = 15p$ ,  $R_L = 50 k\Omega$  F.

b. A power-on reset (POR) is both implemented at the transmitter and the receiver. It is active below  $V_{POR\_DEACT}$ . Once  $V_{POR\_DEACT}$  is reached, the POR remains active for  $t_{POR\_DEACT\_DEL}$ . During power-down, POR starts at  $V_{POR\_ACT}$ . During active POR, the output signal is low.  $V_{POR\_DEACT}$  and  $V_{POR\_ACT}$  both apply to Tx and Rx,  $t_{POR\_DEACT\_DEL}$  applies only for the Rx. The delay time of the Tx is typically  $\sim 10 \mu s$ .



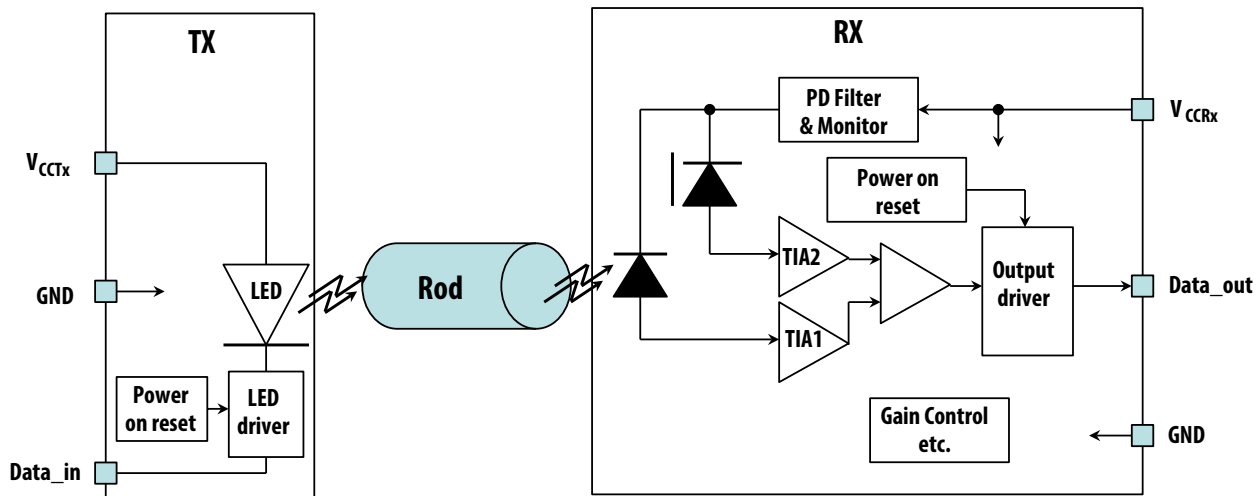
## Specified Link Performance

$T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ , DC to 5 MBaud, unless otherwise noted.

Parameter	Symbol	Min.	Typ.	Max.	Units	Condition
Signaling Rate	$f_s$	DC	—	50	MBd	NRZ
Pulse Width Distortion <sup>a</sup>	PWD	-5	—	+8	ns	50 MBaud
Propagation Delay <sup>b</sup>	$t_D$	—	—	50	ns	50 MBaud
Skew <sup>c</sup>	$t_s$	—	—	5	ns	50 MBaud
Supply Current Tx <sup>d</sup>	$I_{CCTx}$	—	20	31	mA	50 MBaud
Supply Current Rx <sup>d</sup>	$I_{CCRx}$	—	17	30	mA	50 MBaud

- Provided the following characteristics of the electrical input: a) no PWD at 1.5V input level, and b)  $dU/dt$  between 1V and 2V is less than 1 V/ns.
- Determined from 1.5V of the rising edge of Data\_In to 50% of the rising edge of Data\_Out
- The  $t_D$  variation between multiple devices measured for same input conditions and same external signal delay.
- Depends on Supply Voltage and Signal Rate.

## Block Diagram – AFBR-3950xxRZ



A low Input signal at  $Data\_in$  results in a low output signal at  $Data\_out$  (non-inverted Tx to non-inverted Rx).

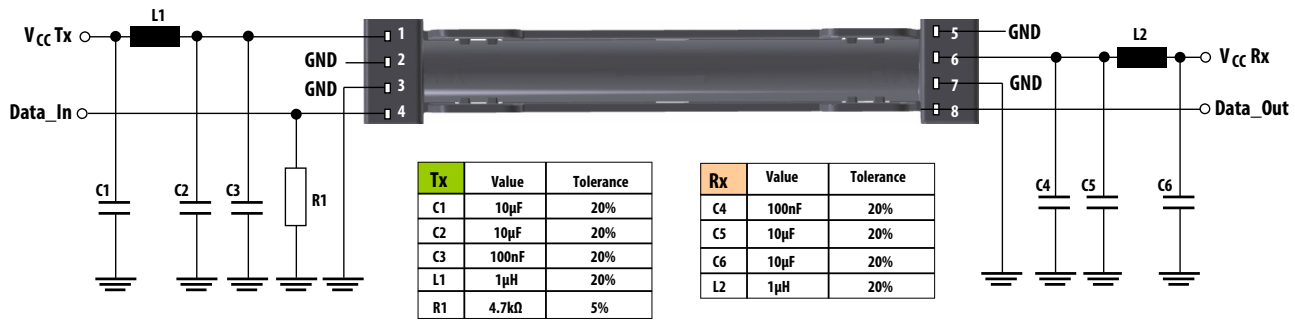
POR remains active during VCC power up, typically until 10  $\mu\text{s}$  for Tx and 10ms for Rx after 2.8V is reached. For both Tx and Rx,  $Data\_out$  is low while POR active.

## 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; or ketones, such as MEK, acetone, chloroform, ethyl acetate, methylene dichloride, phenol, methylene chloride, or N-methylpyrrolidone. Also, Broadcom does not recommend the use of cleaners that use halogenated hydrocarbons because of their potential environmental harm.

## Recommended Drive Circuit (a) – Top View



## Pin Description

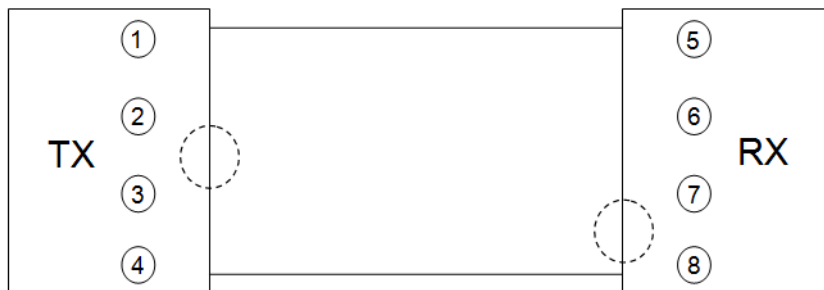
Pin Number	Transmitter
1	VCCTx
2	No function <sup>a</sup>
3	GND
4	Data_in

Pin Number	Receiver
5	No function <sup>a</sup>
6	VCCRx
7	GND
8	Data_out

a. Connect this pin to signal ground.

## Pinning Schematic

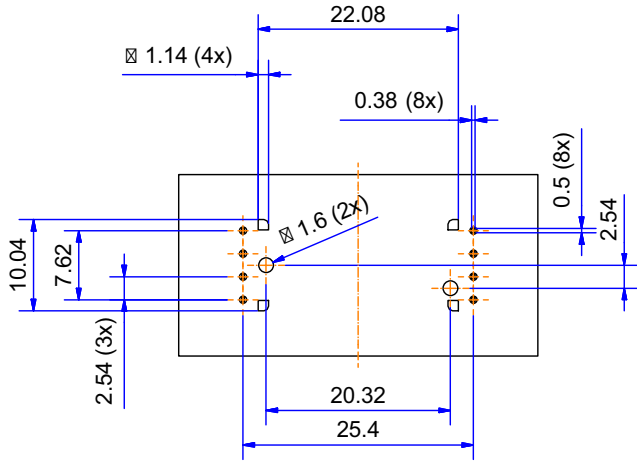
Top View



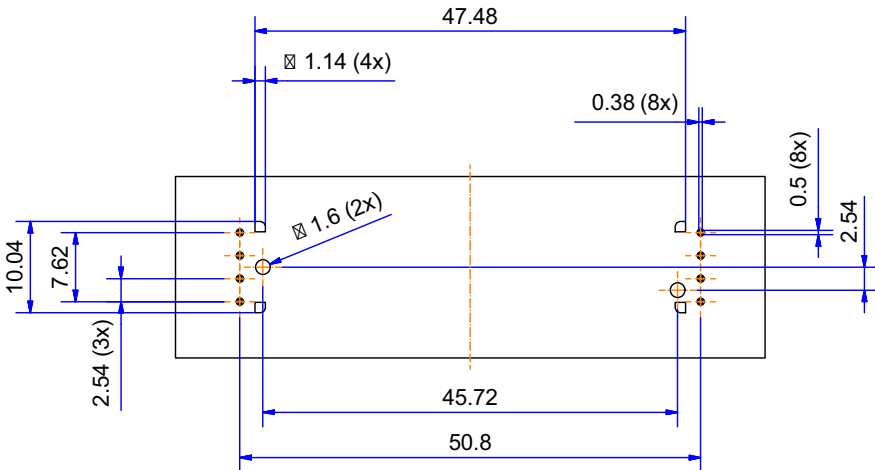
# Footprint (Top View)

Dimensions in mm.

## AFBR-395025RZ



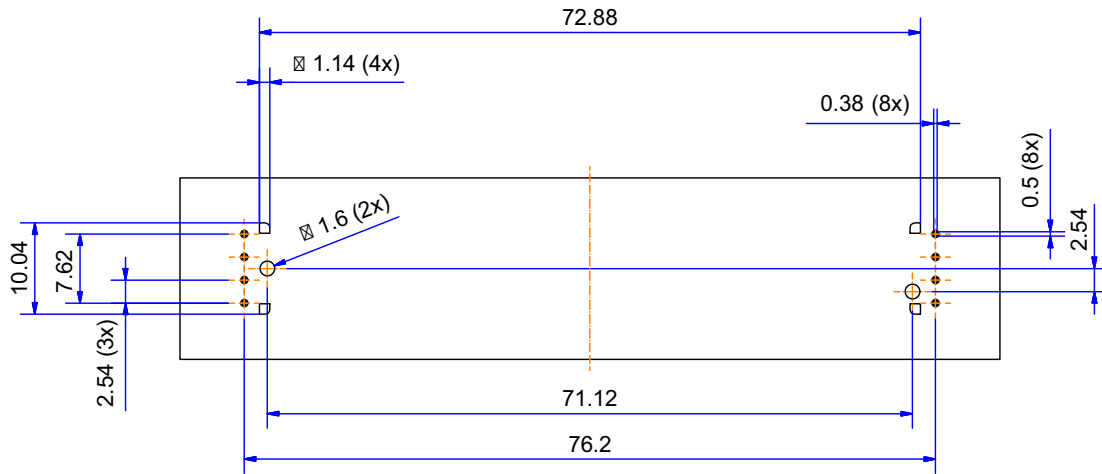
## AFBR-395050RZ



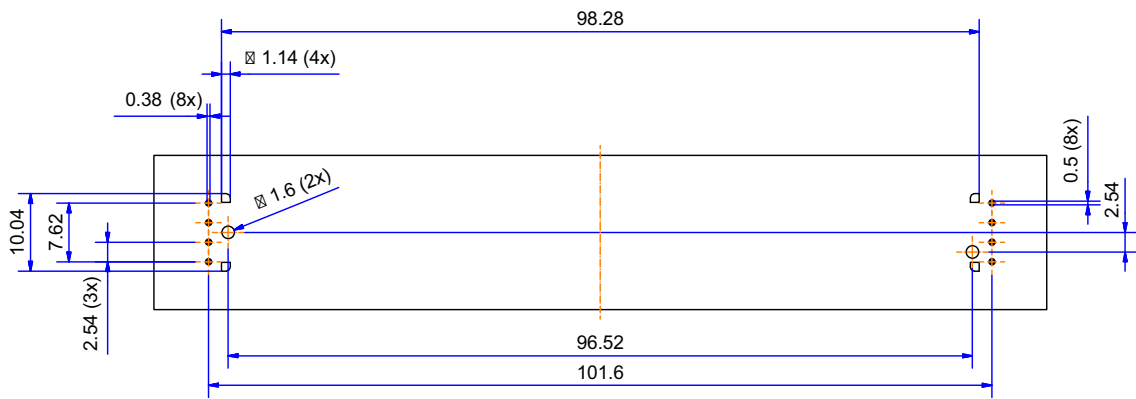
# Footprint (Top View, Continued)

Dimensions in mm.

## AFBR-395075RZ



## AFBR-395000RZ

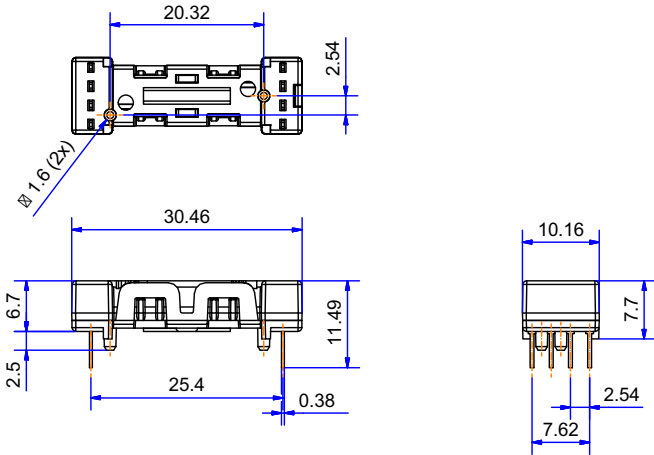




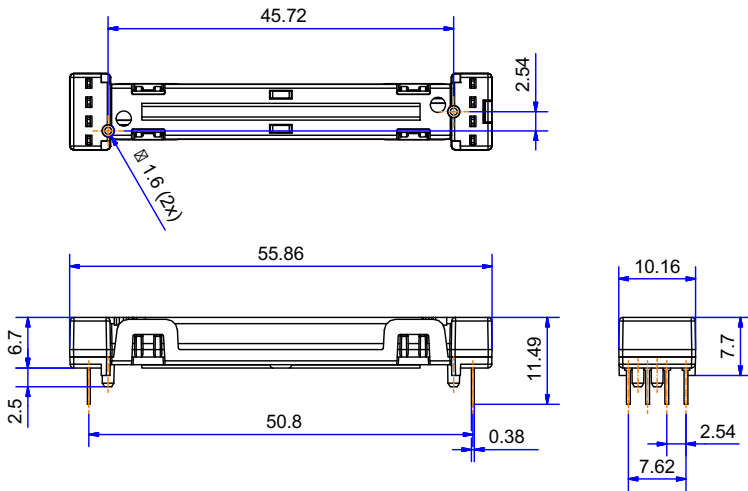
# Mechanical Dimensions

Dimensions in mm.

## AFBR-395025RZ



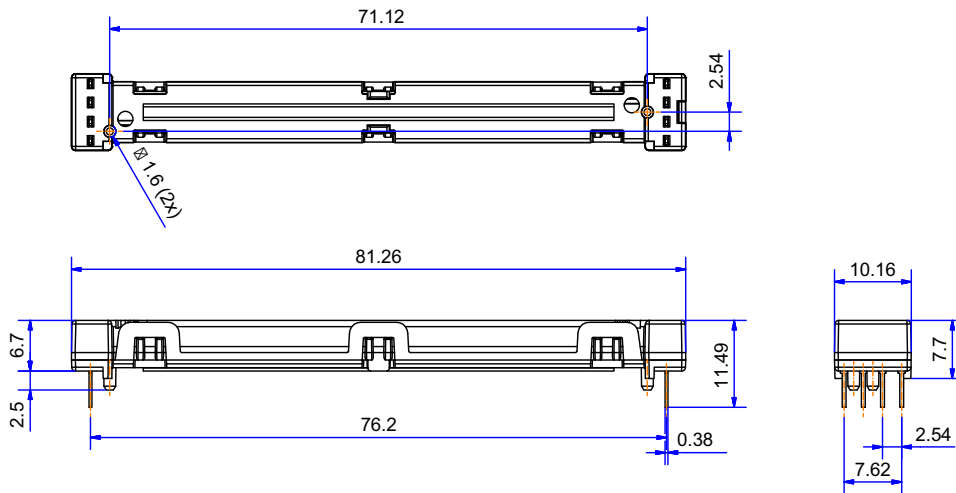
## AFBR-395050RZ



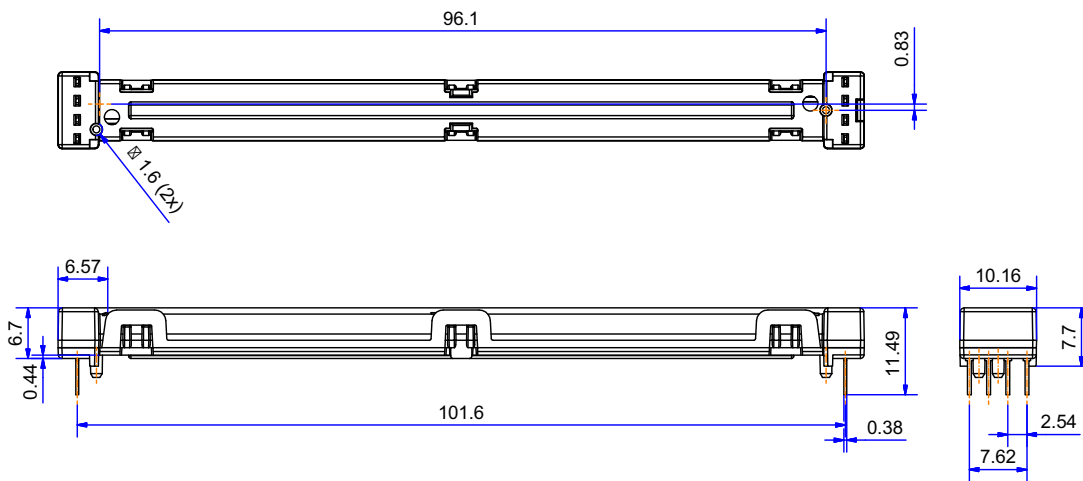
## Mechanical Dimensions (Continued)

Dimensions in mm.

### AFBR-395075RZ



### AFBR-395000RZ



**CAUTION!** Do not bend AFBR-3950xxRZ devices under any circumstances.

Broadcom, the pulse logo, Connecting everything, Avago Technologies, Avago, and the A logo are among the trademarks of Broadcom and/or its affiliates in the United States, certain other countries, and/or the EU.

Copyright © 2015–2018 Broadcom. All Rights Reserved.

The term “Broadcom” refers to Broadcom Limited and/or its subsidiaries. For more information, please visit [www.broadcom.com](http://www.broadcom.com).

Broadcom reserves the right to make changes without further notice to any products or data herein to improve reliability, function, or design. Information furnished by Broadcom is believed to be accurate and reliable. However, Broadcom does not assume any liability arising out of the application or use of this information, nor the application or use of any product or circuit described herein, neither does it convey any license under its patent rights nor the rights of others.