

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 a wavelength of 650 nm. A 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 onboard insulation

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 the receiver IC with integrated photodiode
- RoHS compliant
- Transient voltage suppression in the range of 15 kV up to 50 kV according to 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

Absolute Maximum Ratings

| Parameter | Symbol | Min. | Max. | Units | |
|--------------------------------------|------------|-----------|------|-------|---------|
| Signaling Rate | f_s | DC | 50 | Mbaud | |
| 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 ^{a, b} | Temp | T_{SOL} | — | +260 | °C |
| | Time | — | — | 10 | seconds |

a. 1.6 mm below seating plane; wave soldering only. To guard against solder process fluctuations, the recommended nominal soldering time is 5 seconds.

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 ^a | 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 | Mbaud |

a. < 100 mVpp noise.

ATTENTION: 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) ^a | q_{pd} | — | 5 | pC |
| Apparent charge at Routine Test stage and Type Test stage, Preconditioning (method b) ^b | q_{pd} | — | 5 | pC |

| Parameter | Symbol | Min. | Max. | Units |
|---|-------------------------|------------------|------|-------|
| Maximum Transient Voltage, peak ^c | V _{IOTM_1inch} | 15 | — | kV |
| | V _{IOTM_2inch} | 27 | — | |
| | V _{IOTM_3inch} | 40 | — | |
| | V _{IOTM_4inch} | 50 | — | |
| Maximum Transient Voltage, effective ^c | V _{ISO_1inch} | 10.5 | — | kV |
| | V _{ISO_2inch} | 19 | — | |
| | V _{ISO_3inch} | 28.1 | — | |
| | V _{ISO_4inch} | 35.2 | — | |
| Maximum Working Voltage, peak ^d | V _{IORM_1inch} | 4.25 | — | kV |
| | V _{IORM_2inch} | 8.5 | — | |
| | V _{IORM_3inch} | 12.75 | — | |
| | V _{IORM_4inch} | 17.00 | — | |
| Maximum Working Voltage, effective ^d | V _{IOWM_1inch} | 3 | — | kV |
| | V _{IOWM_2inch} | 6 | — | |
| | V _{IOWM_3inch} | 9 | — | |
| | V _{IOWM_4inch} | 12 | — | |
| Insulation Resistance @ T _{amb,max} , min. 100°C | R _{IO} | 10 ¹¹ | — | Ω |
| Insulation Resistance @ T _S | R _{IO} | 10 ⁹ | — | 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 _{IOSM} | 12 | — | kV |
| Comparative Tracking Index | CTI | 600 | — | — |
| Pollution Degree ^e | — | 2 | — | — |
| Climatic Category ^f | — | 40/085/21 | — | — |
| Maximum Ambient Safety Temperature | T _S | 110 | — | °C |
| Maximum Input Current | I _{SI} | 60 | — | mA |
| Maximum Output Current | I _{SO} | 30 | — | mA |
| Maximum Input Power Dissipation | P _{SI} | 330 | — | mW |
| Maximum Output Power Dissipation | P _{SO} | 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; note that inhomogeneous field conditions may lead to a partial discharge through air for these voltages.

e. According to IEC-60664-1.

f. According to IEC-60068-1.

Electrical Input Characteristics

| Parameter | Symbol | Min. | Typical | Max. | Units |
|---------------------------------|----------|------|---------|------------|------------|
| Input Voltage Low | V_{IL} | — | — | 0.8 | V |
| Input Voltage High ^a | V_{IH} | 2 | — | V_{CCTx} | V |
| Input Capacitance | C_{IN} | — | — | 7 | pF |
| Input Resistance | R_{IN} | 10 | — | — | k Ω |

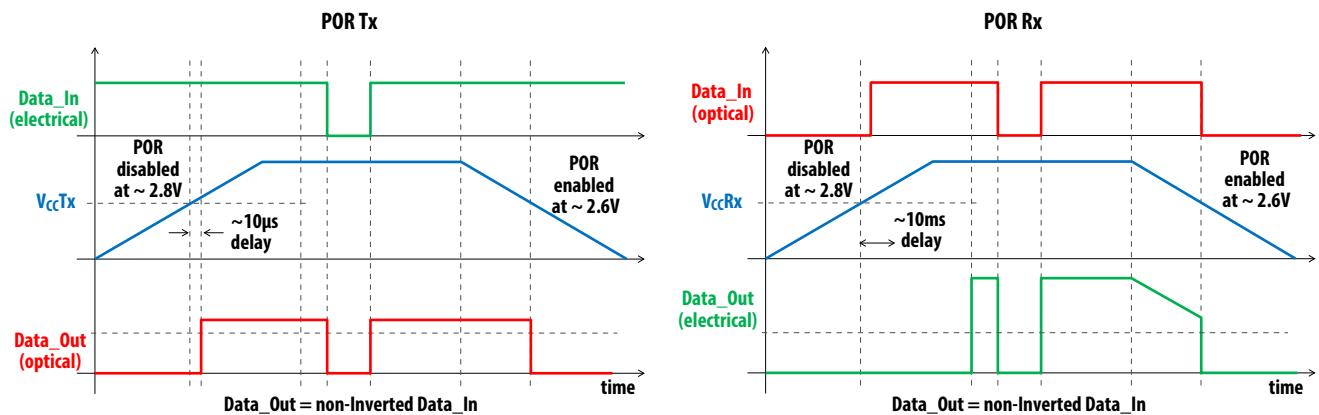
a. Duty cycle shall be 50% at 1.5V.

Electrical Output Signal Characteristics

| Parameter | Symbol | Min. | Typical | 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%) ^a | t_r | — | — | 5 | ns |
| Output Falltime (90–10%) ^a | t_f | — | — | 5 | ns |
| Power Supply Noise Immunity | PSNI | 0.1 | 0.4 | — | V _{pp} |
| Vcc Level to Deactivate POR ^b | V_{POR_DEACT} | — | 2.8 | — | V |
| Vcc Level to Activate POR ^b | V_{POR_ACT} | — | 2.6 | — | V |
| POR Deactivate Delay Time ^b | $t_{POR-DEACT_DEL}$ | — | 10 | — | ms |

a. $C_L = 15$ pF, $R_L = 50$ k Ω .

b. A power-on reset (POR) is implemented at both 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, the POR starts at V_{POR_ACT} . During the active POR, the output signal is low. V_{POR_DEACT} and V_{POR_ACT} apply to both Tx and Rx; $t_{POR-DEACT_DEL}$ applies only for the Rx. The delay time of the Tx is typically ~ 10 μ s.



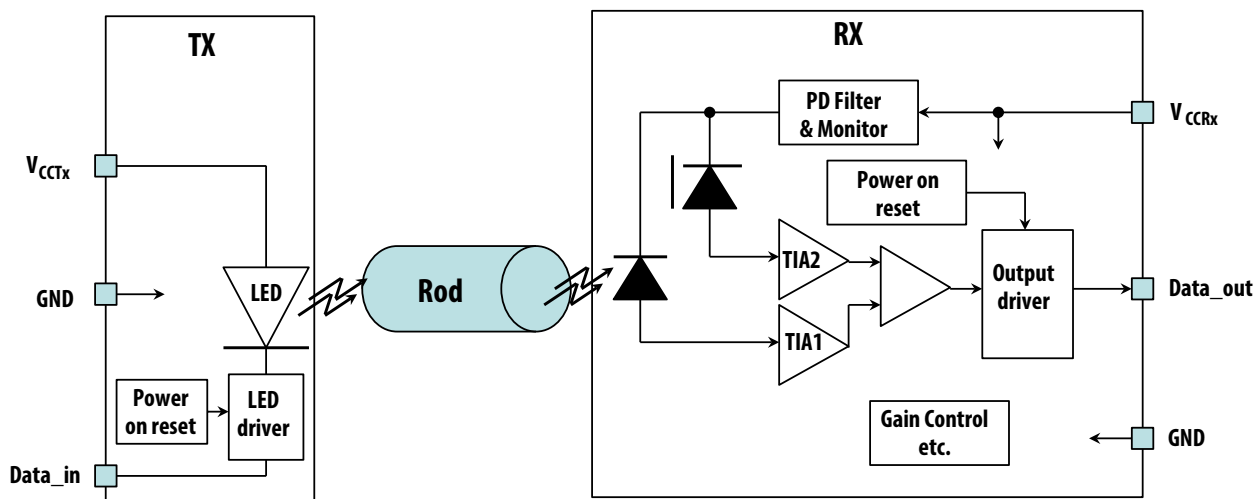
Specified Link Performance

$T_A = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$, DC to 50 Mbaud, unless otherwise noted.

| Parameter | Symbol | Min. | Typical | Max. | Units | Condition |
|-------------------------------------|------------|------|---------|------|-------|-----------|
| Signaling Rate | f_s | DC | — | 50 | Mbaud | NRZ |
| Pulse Width Distortion ^a | PWD | -5 | — | +8 | ns | 50 Mbaud |
| Propagation Delay ^b | t_D | — | — | 50 | ns | 50 Mbaud |
| Skew ^c | t_s | — | — | 5 | ns | 50 Mbaud |
| Supply Current Tx ^d | I_{CCTx} | — | 20 | 31 | mA | 50 Mbaud |
| Supply Current Rx ^d | I_{CCRx} | — | 17 | 30 | mA | 50 Mbaud |

- Provided the following characteristics of the electrical input: a) no PWD at the 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 is measured for the same input conditions and the same external signal delay.
- Depends on the supply voltage and the signal rate.

Block Diagram – AFBR-3950xxRZ



A low Input signal at $Data_in$ results in a low output signal at $Data_out$ (noninverted Tx to noninverted Rx).

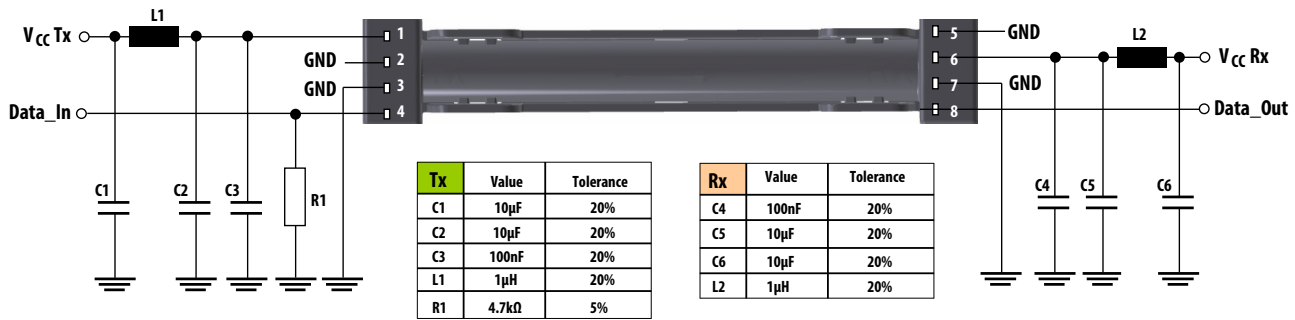
The POR remains active during VCC power-up, typically until 10 μs for Tx and 10 ms for Rx after 2.8V is reached. For both Tx and Rx, $Data_out$ is low while the POR active.

Recommended Chemicals for Cleaning and 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

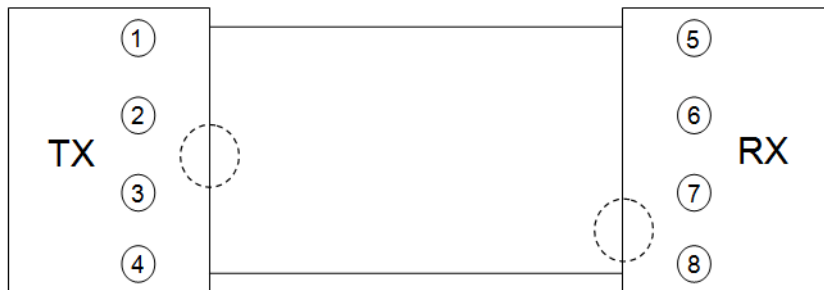
| Pin Number | Transmitter |
|------------|--------------------------|
| 1 | VCCTx |
| 2 | No function ^a |
| 3 | GND |
| 4 | Data_in |

| Pin Number | Receiver |
|------------|--------------------------|
| 5 | No function ^a |
| 6 | VCCRx |
| 7 | GND |
| 8 | Data_out |

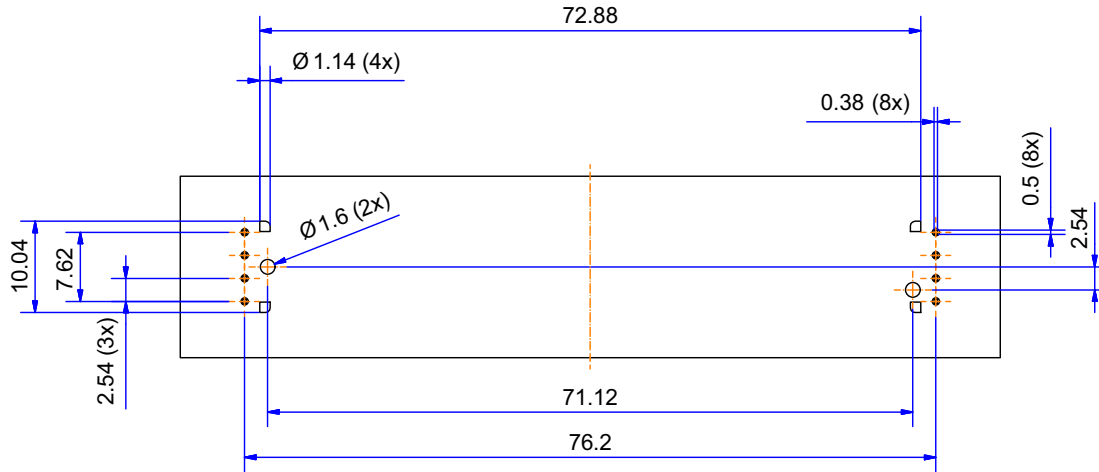
a. Connect this pin to signal ground.

Pinning Schematic

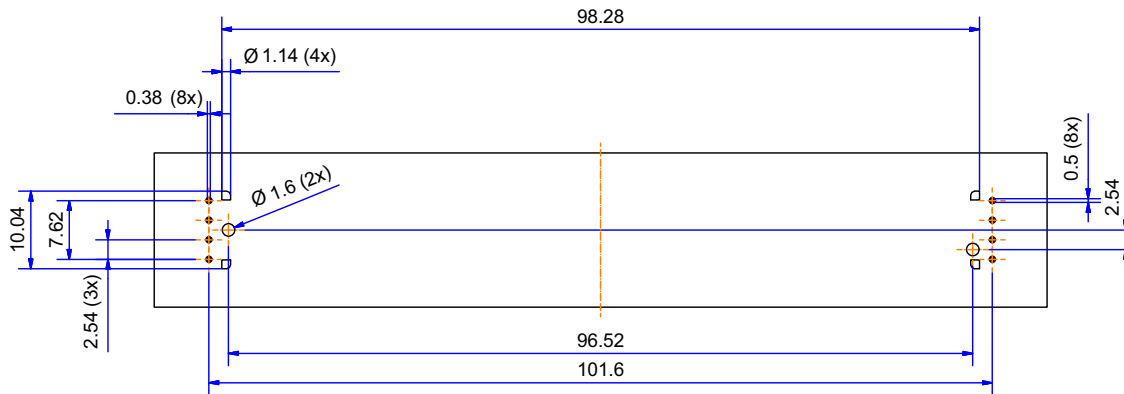
Top View



AFBR-395075RZ



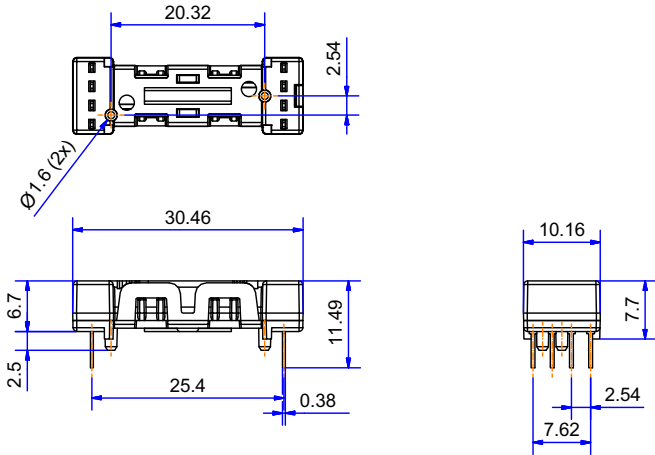
AFBR-395000RZ



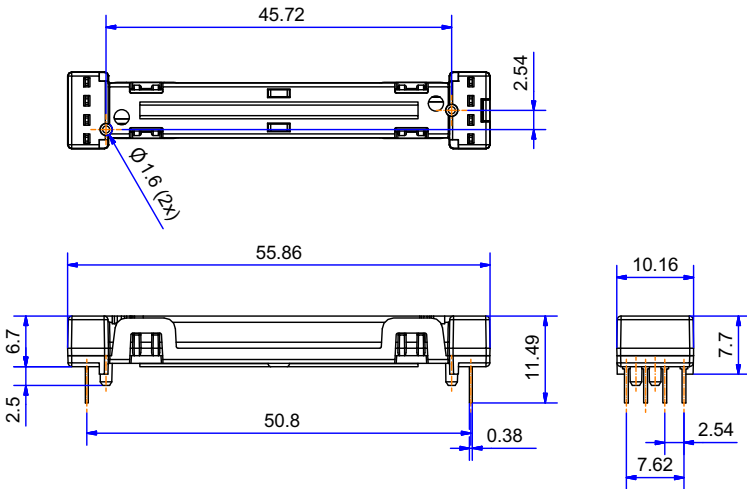
Mechanical Dimensions

Dimensions are in mm.

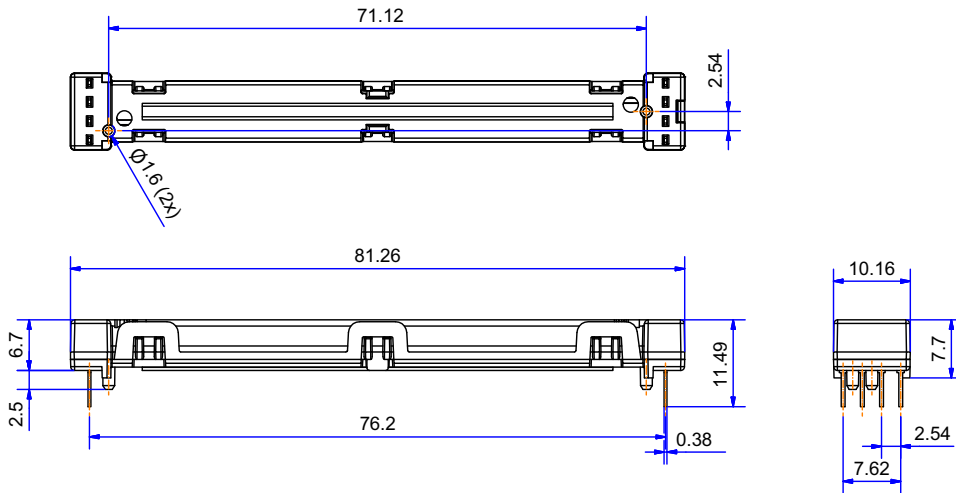
AFBR-395025RZ



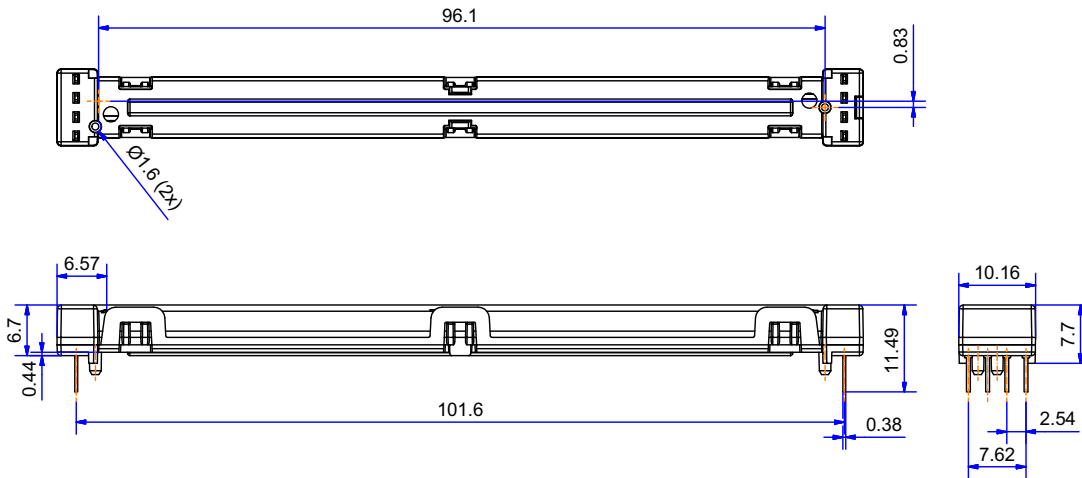
AFBR-395050RZ



AFBR-395075RZ



AFBR-395000RZ



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

Copyright © 2015–2023 Broadcom. All Rights Reserved. The term “Broadcom” refers to Broadcom Inc. and/or its subsidiaries. For more information, go to www.broadcom.com. All trademarks, trade names, service marks, and logos referenced herein belong to their respective companies.

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.

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[Broadcom Limited:](#)

[AFBR-395025RZ](#) [AFBR-395050RZ](#) [AFBR-395000RZ](#) [AFBR-395075RZ](#)