AFBR-3905xxRZ

High-Voltage Galvanic Insulation Link for DC to 5 Mbaud

Certified to IEC 60747-5-5

Description

The Broadcom® AFBR-3905xxZ is a high-voltage galvanic insulation link for DC to 5 Mbaud. The AFBR-3905xxZ 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 insulations

Features

- Data transmission at signal rates of DC to 5 Mbaud
- DC-coupled receiver with CMOS/TTL 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 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

Ordering Information

Part Number	Length	mm	Voltage Suppression
AFBR-390525RZ	1 inch	25	15 kV
AFBR-390550RZ	2 inch	50.4	27 kV
AFBR-390575RZ	3 inch	75.8	40 kV
AFBR-390500RZ	4 inch	101.2	50 kV

Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Units
Signaling Rate	f_s	DC	5	Mbaud
Storage and Operating Temperature	$T_{S,O}$	−40	+85	°C
Receiver Supply Voltage	V_{DD}	−0.5	+5.5	V
Receiver Output Current	I_{OAV}	—	10	mA
Transmitter Peak Forward Input Current	$I_{F,PK}$	—	30	mA
Transmitter Reverse Input Voltage	V_R	—	3	V
Lead Soldering Cycle [a,b] Temp	T_{SOL}	—	+260	°C
Time	—	—	10	sec

a. 1.6 mm below the 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
Rx Power Supply Voltage [a]	V_{CC}	3.135	3.465	V
		4.75	5.25	V
Transmitter Average Forward Current	$I_{F,AV}$	5	10	mA
Signaling Rate	f_s	DC	5	Mbaud

a. < 100 mVpp of 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
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; please note that inhomogeneous field conditions may lead to 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.	Typ.	Max.	Units
Forward Voltage [a]	V_F	1.6	—	2.2	V
Forward Voltage Temperature Coefficient	$\Delta V_F / \Delta T$	—	−1.8	—	mV/°C
Reverse Input Breakdown Voltage [b]	V_{BR}	3.0	13	—	V
Diode Capacitance [c]	C_0	—	30	—	pF

    a. $I_{F,dc}$ = 10 mA

    b. $I_{F,dc}$ = −10 µA

    c. V_F = 0V; f = 1 MHz

Electrical Output Signal Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Units
High Level Output Voltage	V_{OH}	2.5	V_{CC}	V_{CC} + 0.3	V
Low Level Output Voltage	V_{OL}	—	0.22	0.4	V
Output Risetime (10–90%) [a, b]	t_r	—	—	10	ns
Output Falltime (90–10%) [a, b]	t_f	—	—	10	ns
Power Supply Noise Immunity [c]	PSNI	0.1	0.4	—	Vpp
Vcc Level to Deactivate POR [d]	V_{POR_DEACT}	—	2.8	—	V
Vcc Level to Activate POR [d]	V_{POR_ACT}	—	2.6	—	V
POR Deactivate Delay Time [d]	$t_{POR-DEACT\_DEL}$	—	100	—	µs

    a. C_L = 20 pF, R_L = 50 kΩ.

    b. In the recommended drive circuit.

    c. Peak-to-peak sine wave.

    d. Power-on reset (POR) 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}.

Figure 1: Typical Power-On Reset Functionality
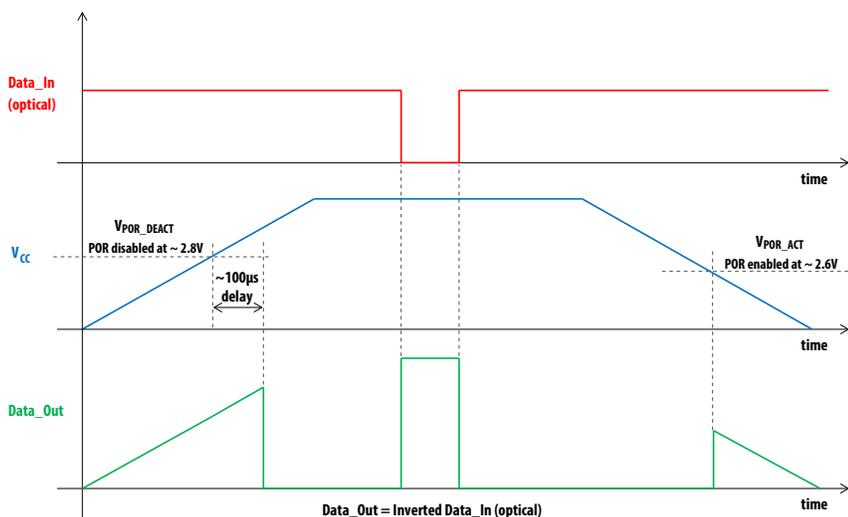
Specified Link Performance

T_A = –40°C to +85°C, DC to 5 Mbaud, unless otherwise noted.

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Signaling Rate	f_S	DC	—	5	Mbaud	NRZ
Pulse Width Distortion [a]	PWD	–30	—	30	ns	5 Mbaud
Propagation Delay [b]	t_D	—	—	80	ns	5 Mbaud
Skew [c]	t_S	—	—	20	ns	5 Mbaud
Supply Current Rx [d]	I_{CC}	—	6	10	mA	—

    a. ±15% of the nominal pulse width, provided no pulse width distortion at the electrical input.

    b. Determined from 50% of the rising edge of data_in to 50% of the consecutive rising edge of data_out.

    c. Variations of t_D between multiple devices measured for the same input conditions and the same external signal delay.

    d. C_L = 20 pF, R_L = 50 kΩ.

Block Diagram – AFBR-3905xxRZ
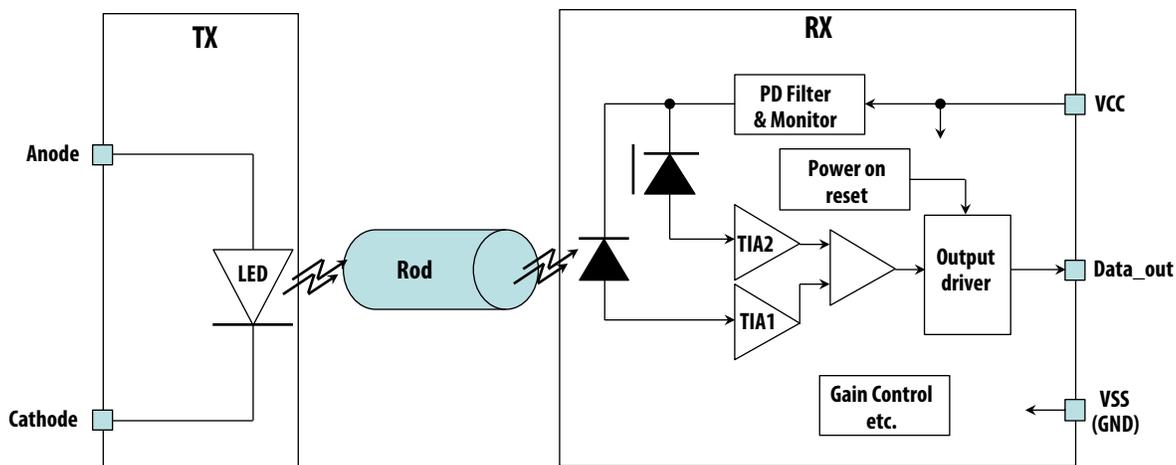
The Rx Data_out signal is inverted, which means that light_on will lead to Data_out low.

The POR remains active during V_{CC} power-up, typically until 100 µs after 2.8V is reached. The POR follows V_{CC} while 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-methylpyrolldone. 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

Tx	Value	Tolerance
R1	4.7kΩ	5%
R2	390Ω	1%
C1	0.1µF	20%
C2	1.0µF	20%

Rx	Value	Tolerance
C3	0.1µF	20%
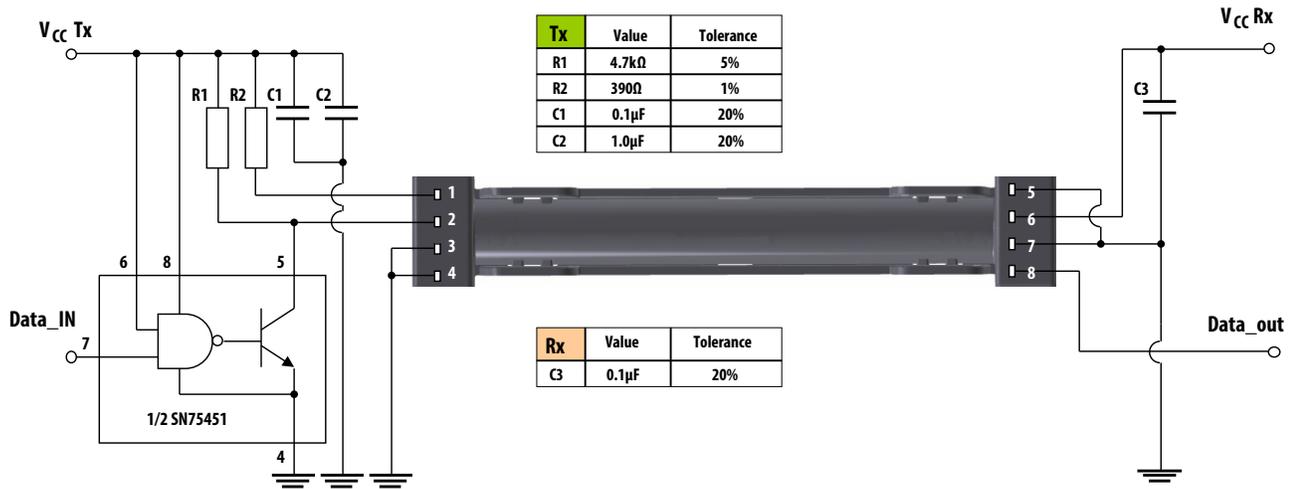
Recommended Drive Circuit (b) – Top View

Rx	Value	Tolerance
C3	0.1µF	20%

Tx	Value	Tolerance
R1	47Ω	5%
R2	1kΩ	5%
R3	390hm	2%
R4	150hm	2%
C1	0.1µF	20%
C2	1.0µF	20%
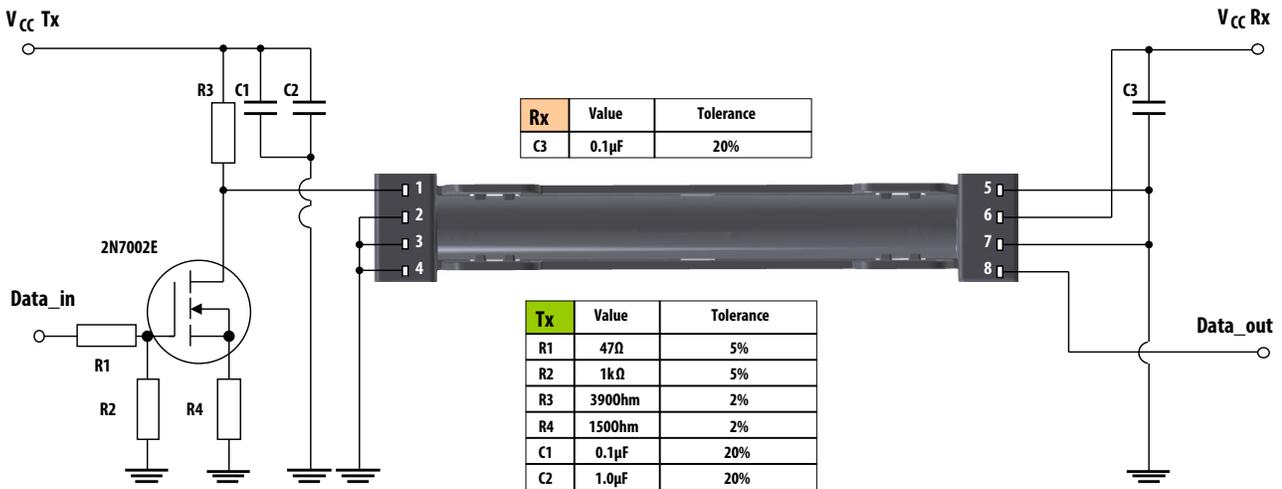
Pin Description

Pin Number	Transmitter
1	Anode
2	Cathode
3	No function [a]
4	No function [a]

Pin Number	Receiver
5	No function [a]
6	VCC
7	GND
8	Data_out

a. It is recommended to connect this pin to signal ground.

Pinning Schematic

Top View
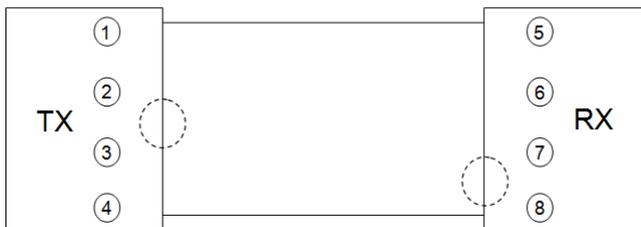
Footprint (Top View)

Dimensions are in mm.
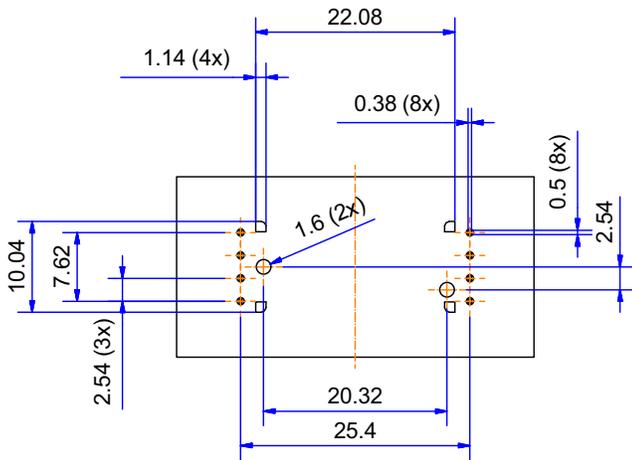
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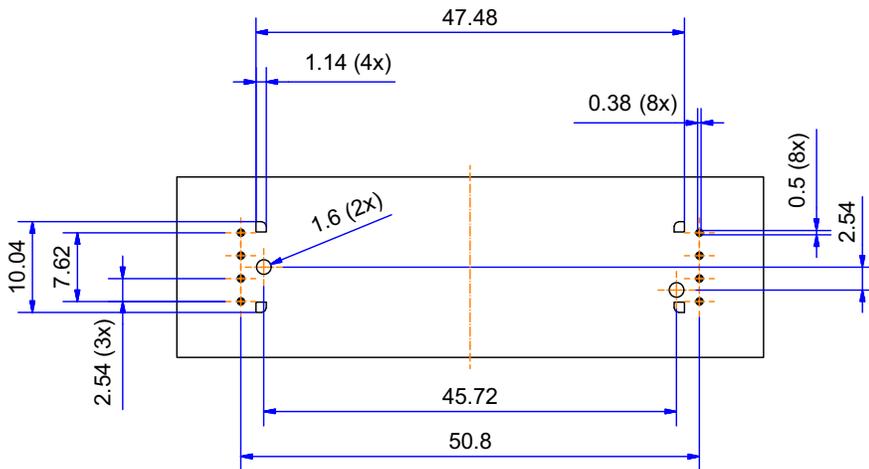
AFBR-390550RZ
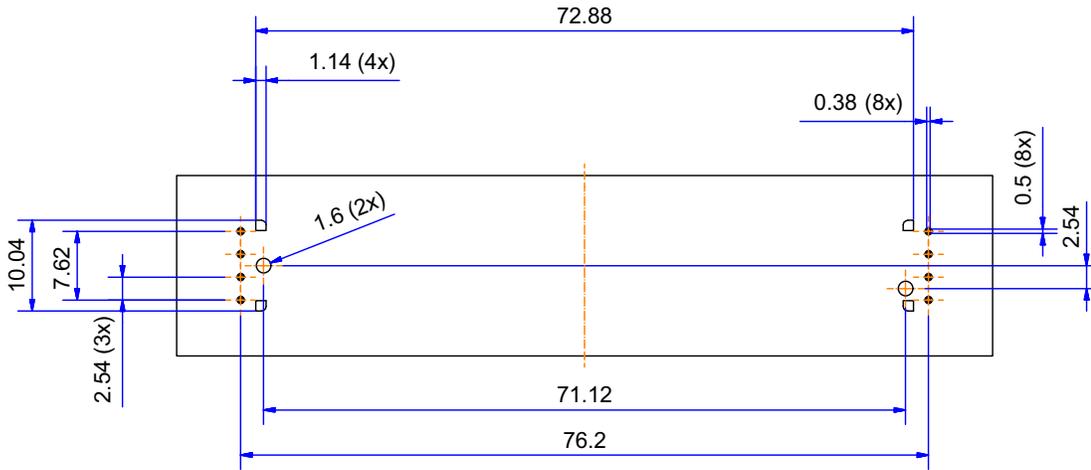
AFBR-390575RZ
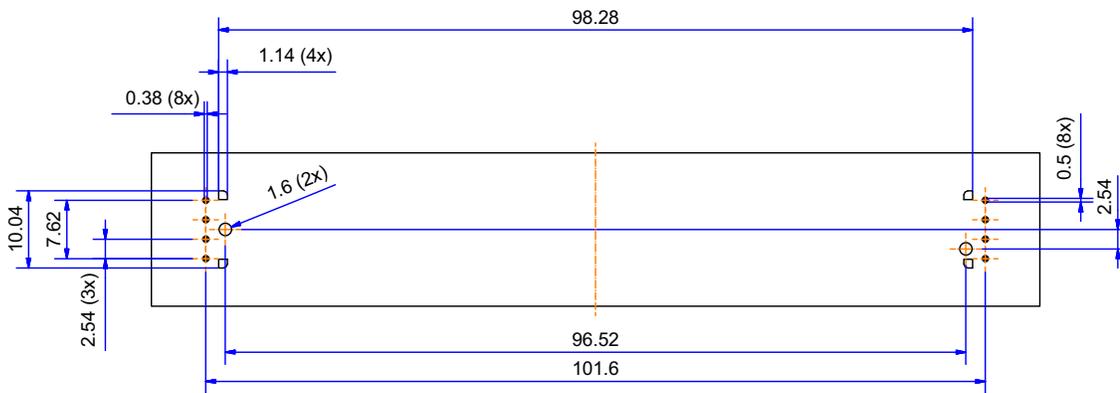
AFBR-390500RZ

Mechanical Dimensions

Dimensions are in mm.

AFBR-390525RZ
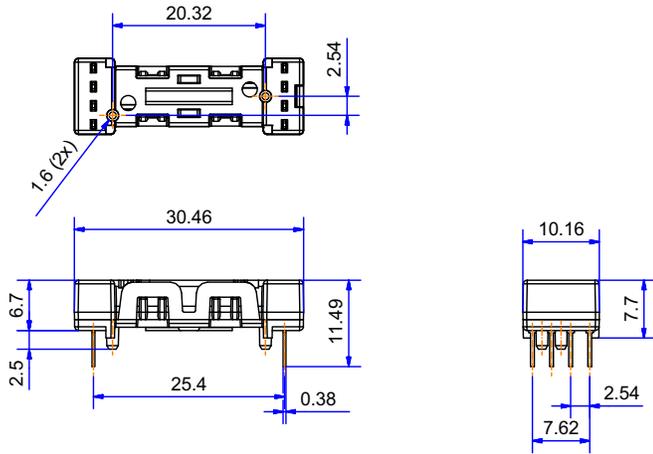
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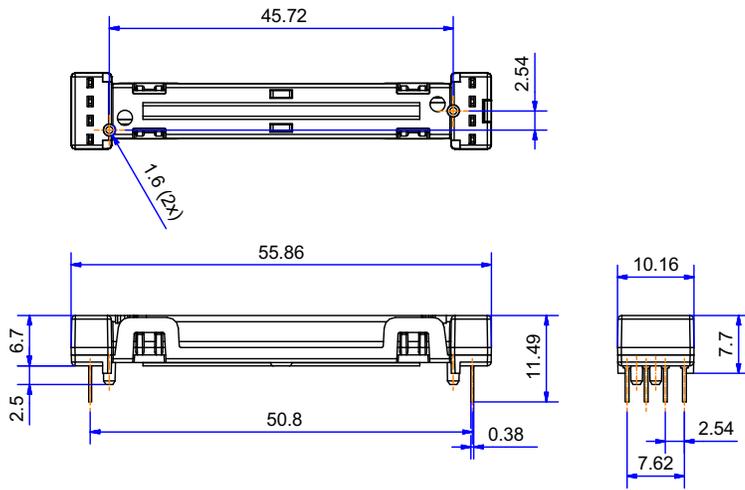
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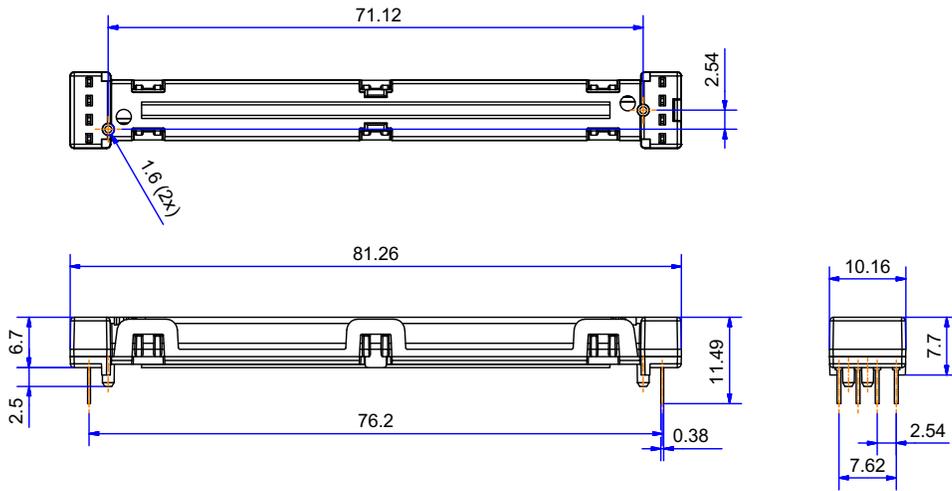
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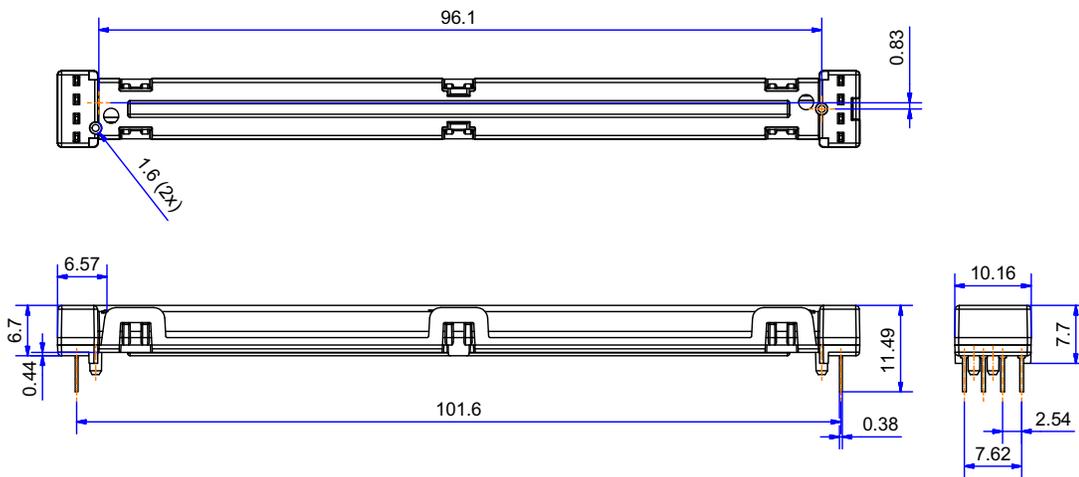
CAUTION! AFBR-3905xxRZ devices must not be bent under any circumstances.

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