

## TDD-FE5G88

RX/TX Front-End Extension for Software Defined Radios for V2X 5.850 ... 5.925 GHz

### Features

- extends commercial SDRs (Software Defined Radios) with an antenna interface
- separate TX/RX inputs
- common TX/RX antenna port
- integrated RX input filter and TX harmonic filter
- TX monitoring output

### Applications

- C-V2X communication
- 802.11p
- ITS-G5 (ITS: Intelligent Transport Systems)
- test equipment

### At a Glance

C-V2X is part of modern ADAS (Advanced Driver Assistance Systems) which enables communication among cars and between cars and surrounding elements like traffic lights or road signs. Via DSRC (Dedication Short Range Communication) for the distance range 10 m ... 1 km.

TDD-FE5G88 is a compact RX / TX front-end module as extension for commercial SDR (Software Defined Radio) platforms like Ettus or Hack RF in C-V2X applications. SDRs do not have RF interfaces for a direct connection of antennas for an operation in real-world environments. The SDRs are used to generate and receive the physical channel RF signals, but without achieving practical receive and transmit performance. Adding TDD-FE5G88 module to such an SDR system achieves the necessary performance for realistic field tests. The module increases the TX output power capability of up to 2 watts PEP (Peak Envelope Power). The RX signal path has filters for the suppression of unwanted out-of-band signals and a low noise amplifier stage to increase the sensitivity performance of the SDRs.

### TX signal Path

A high linearity power amplifier stage boosts the output power of the SDRs to increase the radio range. A harmonic filter at the output suppresses the radiation of unwanted harmonics.



### TX Monitoring Output

The TX output power and signal quality can be monitored via the TX monitoring output. Via this output also an external TX pre-distortion is possible. Additionally a voltage from an internal TX power detector is superposed at the monitoring output.

### RX Signal Path

The RX signal path contains a bandpass filter as preselection, followed by low noise amplifier with best linearity properties to give the RX path of the SDR an effective suppression of unwanted out-of-band signals coming from the environment and a much better noise performance.

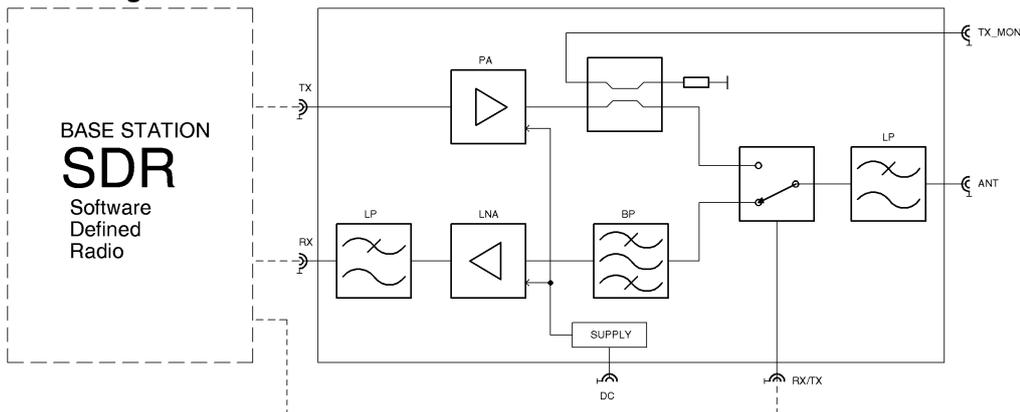
### TX/RX Control

For TDD operation a digital RX/TX control signal is necessary. TDD-FE5G88 has a coaxial connector input to control the RX/TX switch with 3.3 V LVCMOS control signal from the SDR.

### DC Supply

The TDD-FE5G88 is supplied with 12 V DC. The same voltage is normally used to supply SDRs. So the SDR and the front-end extension can be supplied via one common power supply.

## Block diagram



## RF Specification

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
impedance	$Z_{TX}/Z_{RX}$		50		$\Omega$	
low frequency range	$f_L$		4600	5850	MHz	
high frequency range	$f_H$	5925	6000		MHz	
TX gain	$S_{21TX}$	30	33	35	dB	
TX input return loss	$S_{11TX}$		-20	-13	dB	
TX input power	$P_{TX}$			+5	dBm	
TX output power	$P_{1dB}$	+29	+32		dBm	
	$P_{SAT}$	+30	+33		dBm	$P_{TX} = +5$ dBm
3 <sup>rd</sup> order intercept TX	$OIP3_{TX}^*$	+37	+41		dBm	$2x +20$ dBm
TX harmonic distortion	HD		-40		dBc	
RX gain	$S_{21RX}$	6.5	8.5	10	dB	
RX return loss	$S_{11TX}$		-12	-8	dB	
RX noise figure	$NF_{RX}$		5	7	dB	
3 <sup>rd</sup> order intercept RX	$OIP3_{RX}^*$	+23	+27		dBm	$2x +5$ dBm
RX suppression	$S_{21RX}$		-65	-55	dB	$f < 4.2$ GHz, rel. 5.88 GHz
	$S_{21RX}$		-50	-40	dB	$f > 8$ GHz, rel. 5.88 GHz
TX/RX isolation	$S_{TXRX}$		-10	0	dB	RX ON
	$S_{TXRX}$		+20	+30	dB	TX ON
TX monitoring coupling	$a_{TX\_MON}$	-17	-16	-14	dB	referred to ANT connector
TX monitoring voltage	$U_{TX\_MON}$	700	1030	1300	mV	@ +31 dBm
TX monitoring video BW	VBW		35		kHz	
internal DC resistance	$R_{DC}$		47		$\Omega$	
RF connectors	$X_{RF}$	SMA female				
maximum DC Voltage	$U_{max}$			20	V	TX and RX ports
ESD discharge resistor	$R_{ESD}$		4.7		k $\Omega$	TX and RX ports
TX/RX control level	$u_{TX/RX}$	0		3.3	V	LVC MOS33 compatible
TX/RX switching time	$t_{TXRX}$		1		$\mu$ s	50 % trigger to 10 % / 90 %
TX/RX switch connector	$X_{TX/RX}$	SMA female				

\*Measured at 5150 / 5160 MHz, 5500 / 5510 MHz, 5850 / 5860 MHz, 5890 / 5900 MHz, 5915 / 5925 MHz

## Common Specifications

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
power supply	$U_{DC}$	11	12	14	V	
power consumption	$P_{DC}$	18	24	35	W	
power socket	$X_{DC}$	Würth WR-TBL3251-2-3.5-W				
power plug	$X_{DCP}$	Würth WR-TBL3641-2-3.5				part of product set
dimensions	$W \times H \times D$	approx. 125 x 40 x 90			mm	
weight			600		g	
operating temp. range	$T_{AMB}$	-10		+55	$^{\circ}$ C	ambience, free air flow
	$T_{HOUSING}$		+55*	+75	$^{\circ}$ C	Housing, *21 $^{\circ}$ C ambience
storage temp. range	$T_s$	-40		+70	$^{\circ}$ C	
ordering information	TDD-FE5G88	BNT P/N: 1909.8001.1				

Becker Nachrichtentechnik GmbH ■ Kapellenweg 3 ■ 53567 Asbach - Germany ■ [www.becker-rf.com](http://www.becker-rf.com)



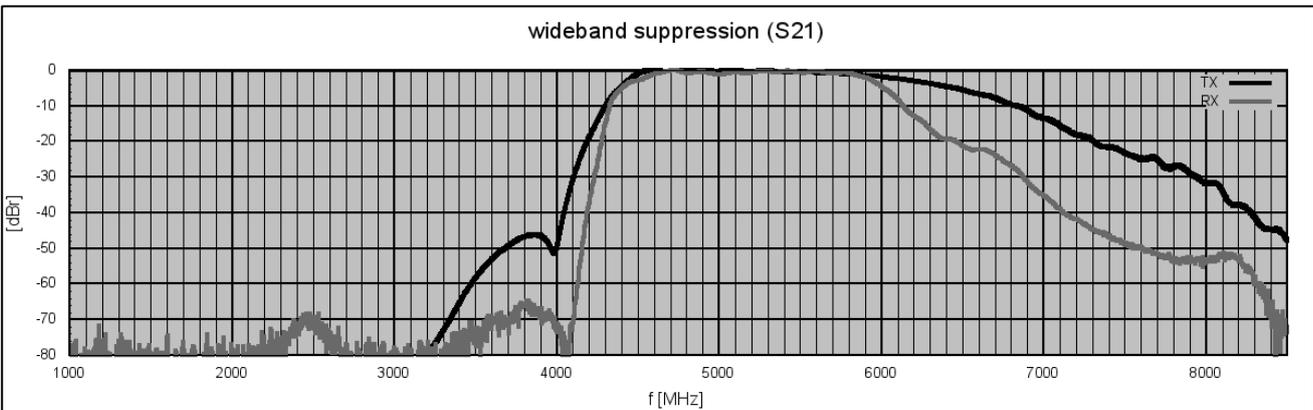
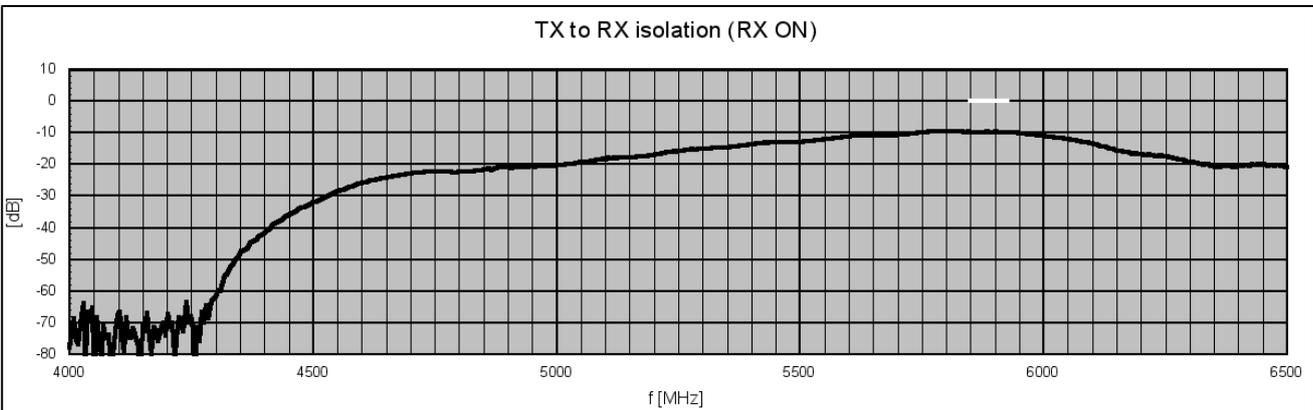
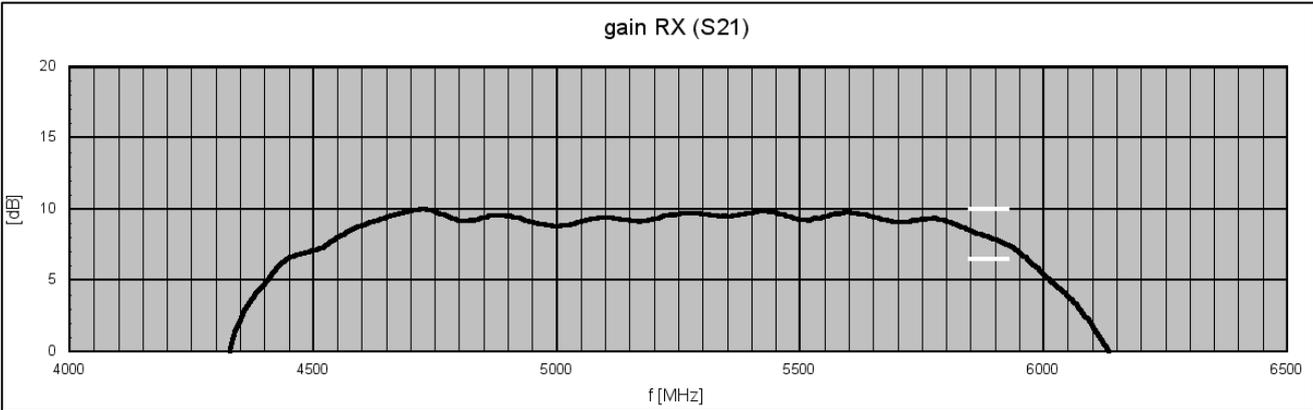
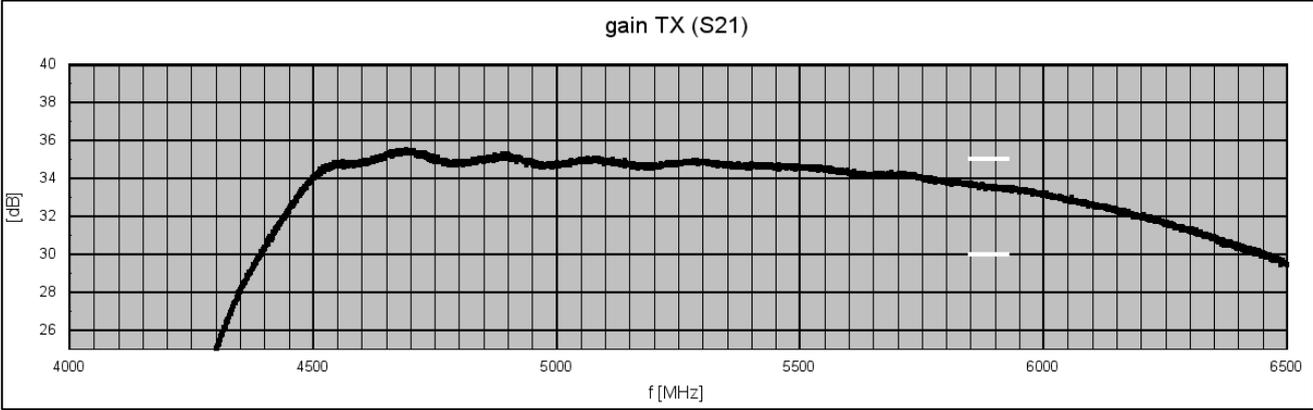
Quality Made in Germany

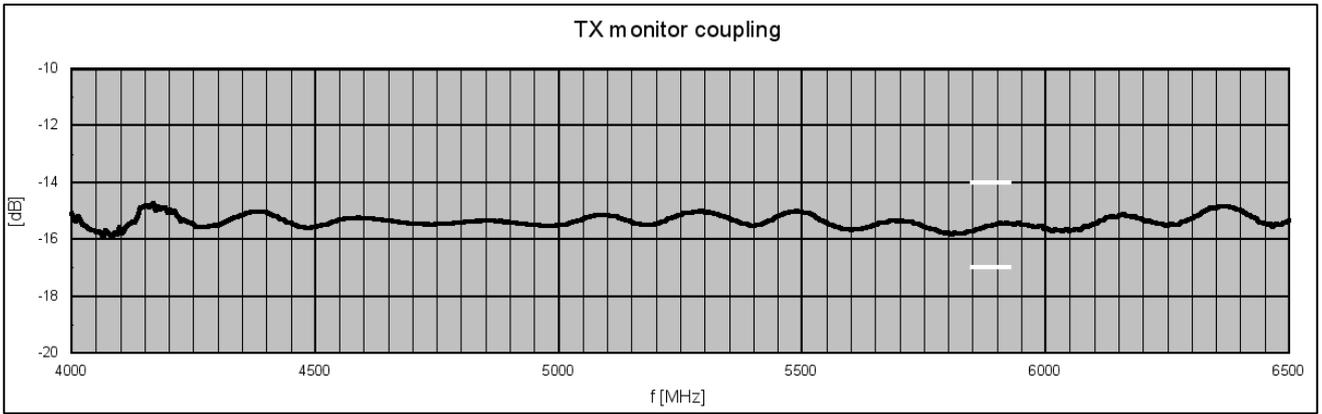
Subject to change in specification and design without notice.  
released version 1.00 - March 2020



RoHS compliant in accordance with  
EU Directive 2015/863

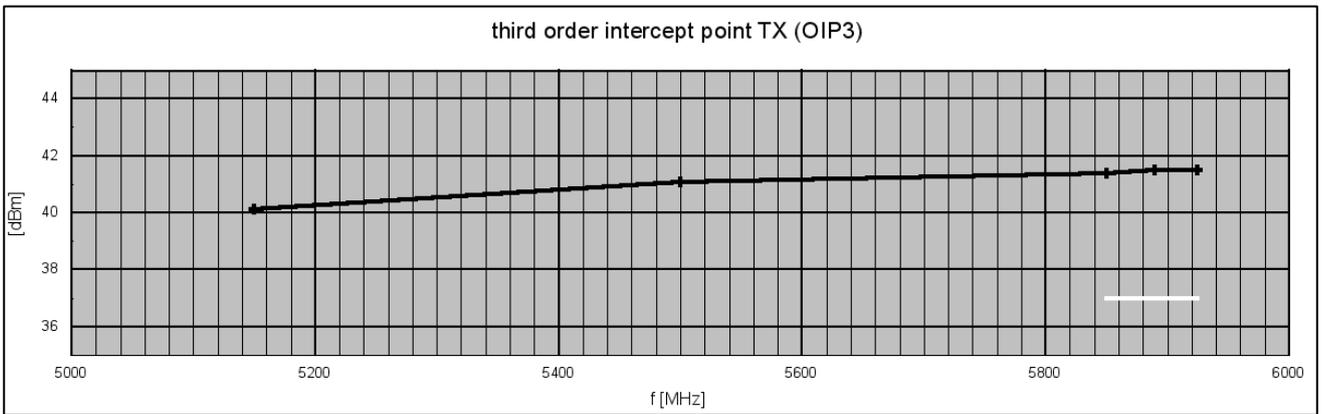
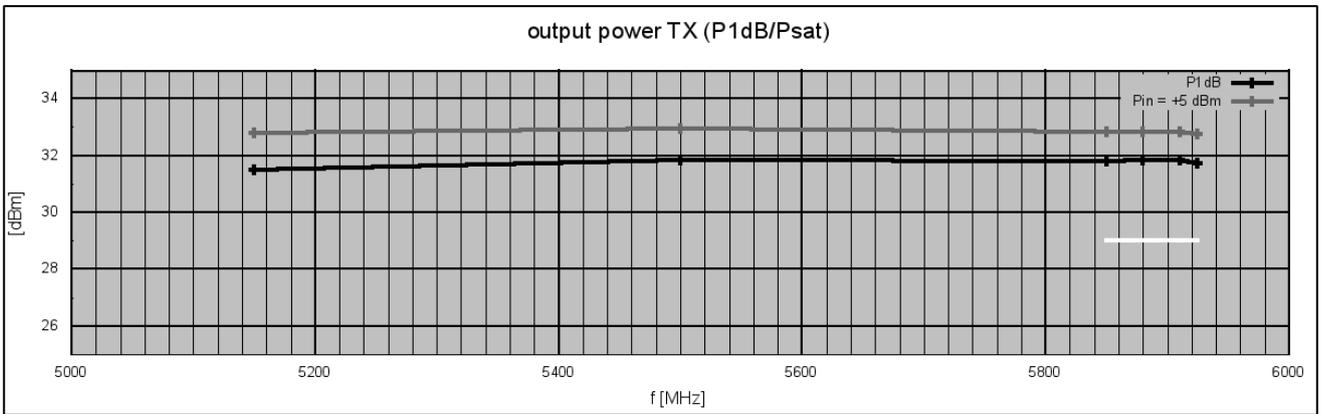
S Parameters (typical responses)



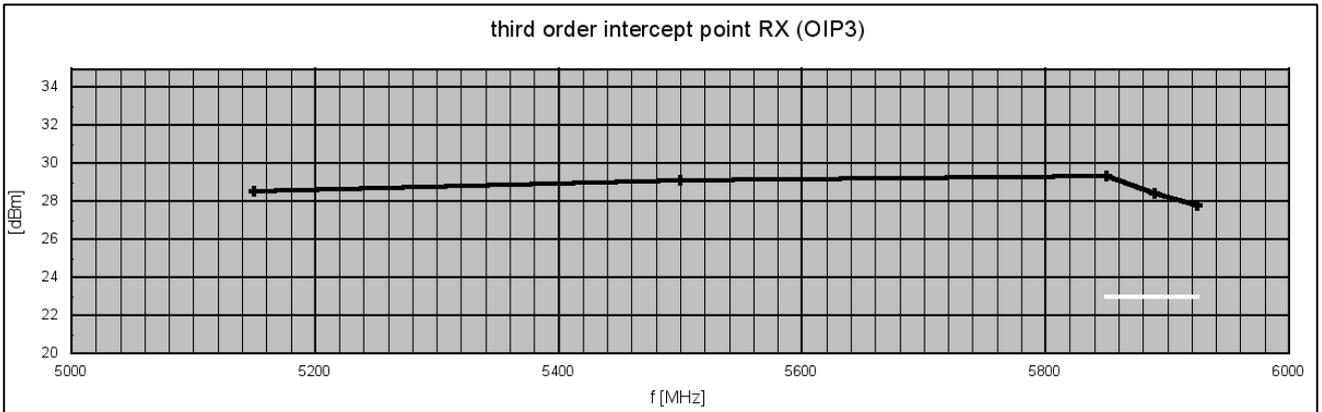
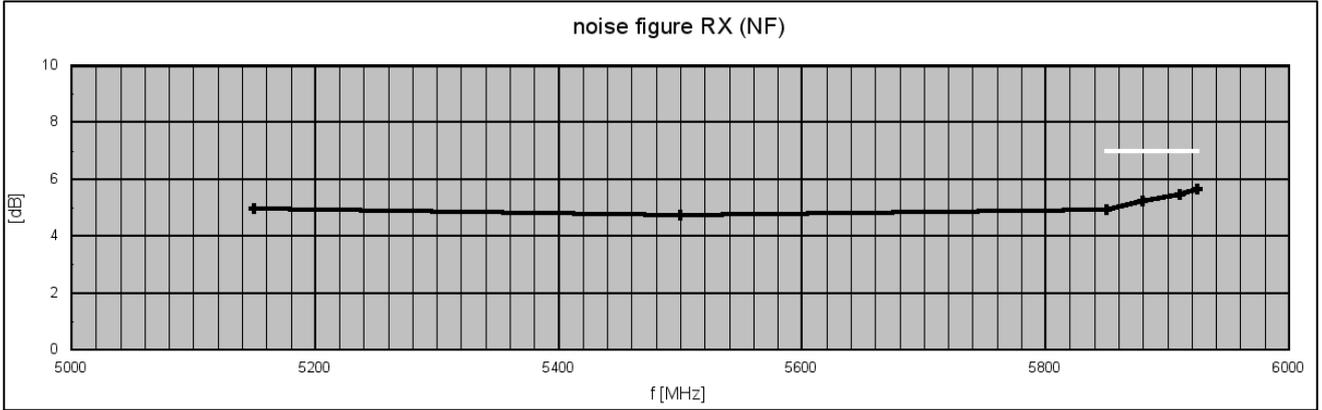


**Dynamic Range (typical responses)**

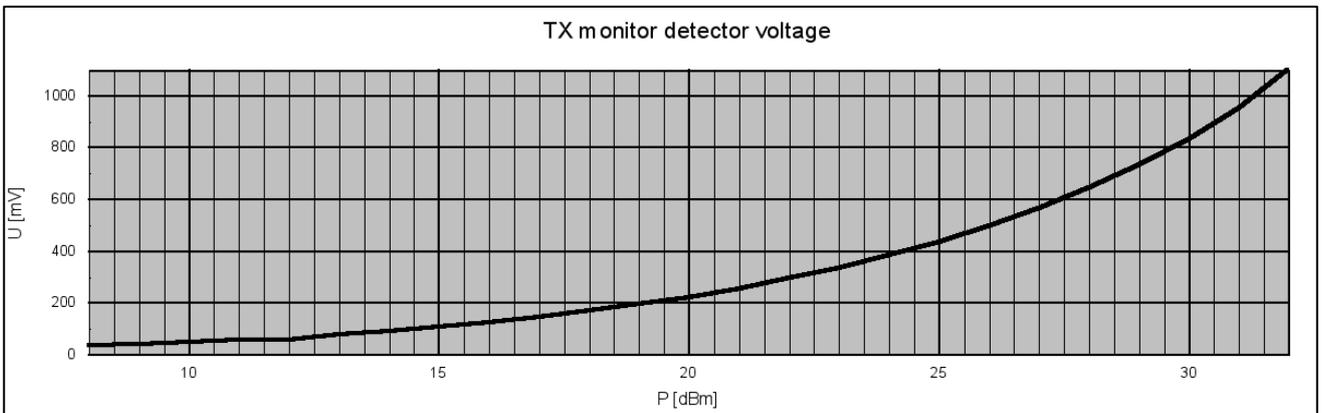
TX signal path



RX signal path



TX Level Detector Output (typical responses)



### Appearances



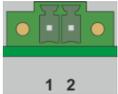
power connector,  
TX\_MON , ANT RF ports,  
STATUS LED



RX/TX select,  
RX output and TX input  
(SDR side)

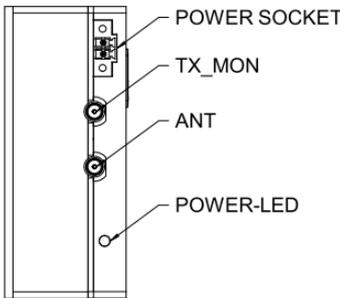
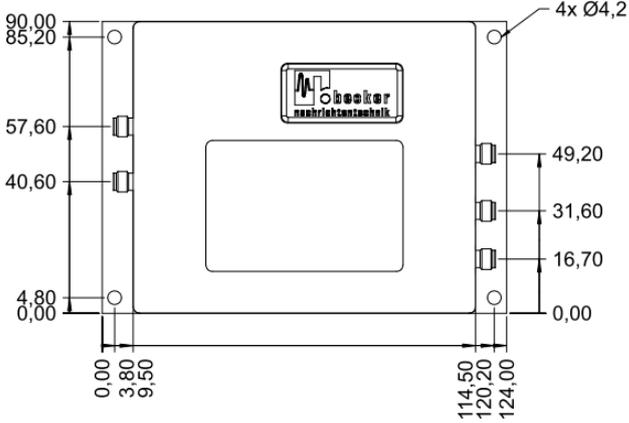
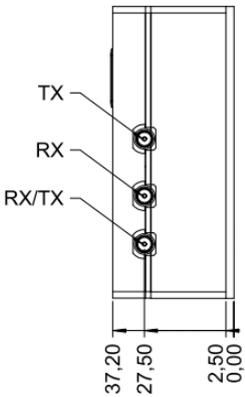
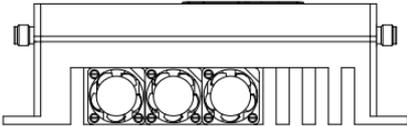
### DC Supply Pin Assignment

TDD-FE has a two pole DC input socket at the module side. The associated plug is mountable is fastable with screws. The DC input is save against reverse polarity.



1: +Ub  
2: GND (-)

### Mechanical Drawing



don't scale from this drawing  
all dimensions in mm  
± 2 mm

