

# **TR-52D**

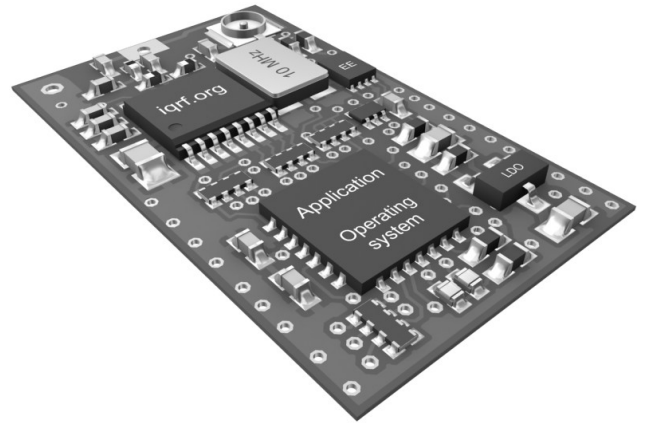
## **Transceiver Module**

### **Data Sheet**



## Description

TR-52D is a family of IQRF transceiver modules operating in the 868 MHz and 916 MHz license free ISM (Industry, Scientific and Medical) frequency band. Its highly integrated ready-to-use design requires no external components. Microcontroller with built-in operating system, excellent development support, integrated LDO regulator, serial EEPROM and optional temperature sensor dramatically reduce time of application development. Ultra low power consumption predetermines these modules for use in battery powered applications.



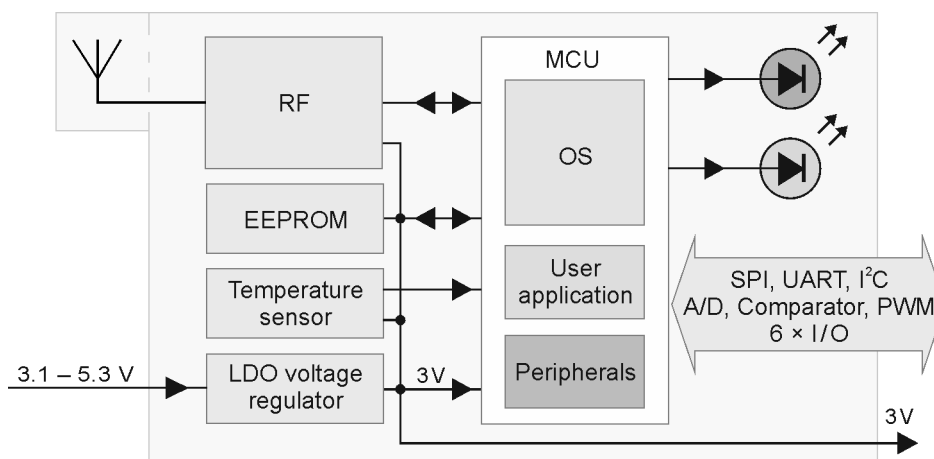
## Key features

- Complete solution with operating system, easy to use
- FSK modulation
- Selectable RF band 868 / 916 MHz, multiple channel
- Selectable RF bit rate
- MCU with extended resources, user interrupt capability
- Extra low power consumption, power management modes
- SPI interface supported by OS on background
- Serial EEPROM
- PWM output
- Programmable HW timer
- +3 V LDO regulator output, battery monitoring
- 2 LEDs
- 8 pins, 6 I/Os
- A/D converter (2 channels), analog comparator
- Options: on-board antenna, U.FL connector, temperature sensor
- SIM card format

## Applications

- Telemetry
- Building automation
- Wireless control & regulation
- Access control
- Remote data acquisition
- Communication links
- RF connectivity in many other areas

## Block diagram



**Electrical specifications**
*(typical values unless otherwise stated, for brief guidance only)*

Supply voltage ( $V_{CC}$ )	3.1 V to 5.3 V																		
LDO output ( $V_{OUT}$ )	+3 V $\pm$ 60 mV ( $V_{CC} > 3.1$ V), 100 mA max.																		
Operating temperature	0 °C to +70 °C -40 °C to +85 °C (Industrial) available on request																		
Supply current																			
Sleep mode	1.9 $\mu$ A (if all peripherals including MRF49XA disabled <sup>2</sup> )																		
Additional supply current	0.8 $\mu$ A (if watchdog enabled) 7.5 $\mu$ A (if brown-out detection enabled)																		
Run mode	1 mA (MRF49XA disabled)																		
Additional supply current	0.6 mA (MRF49XA on)																		
Additional LED supply current	2 mA (if one or two LEDs on)																		
Rx mode	13 mA (STD mode) LP mode: OS v3.01D: 400 $\mu$ A, from OS v3.02D: 330 $\mu$ A XLP mode: OS v3.01D: 35 $\mu$ A, from OS v3.02D: 25 $\mu$ A																		
Tx mode	14 mA – 24 mA (according to RF output power)																		
Nominal frequency	868.35 MHz or 916.50 MHz (software selectable)																		
Channels	See IQRF OS User's guide, Appendix 2, Channel maps																		
RF data modulation	FSK (frequency-shift keying)																		
RF data transmission bit rate	1.2 kb/s <sup>4</sup> , 19.2 kb/s, 57.6 kb/s <sup>4</sup> , 86.2 kb/s <sup>4</sup>																		
RF sensitivity	Depends on frequency band and bit rate:																		
	<table border="1"> <thead> <tr> <th></th> <th>bit rate [kb/s]</th> <th>1.2<sup>4</sup></th> <th>19.2</th> <th>57.6<sup>4</sup></th> <th>86.2<sup>4</sup></th> </tr> </thead> <tbody> <tr> <td rowspan="2">RF sensitivity [dBm]</td> <td>868 MHz</td> <td>-110</td> <td>-104</td> <td>-99</td> <td>-92</td> </tr> <tr> <td>916 MHz</td> <td>-109</td> <td>-102</td> <td>-97</td> <td>-90</td> </tr> </tbody> </table>		bit rate [kb/s]	1.2 <sup>4</sup>	19.2	57.6 <sup>4</sup>	86.2 <sup>4</sup>	RF sensitivity [dBm]	868 MHz	-110	-104	-99	-92	916 MHz	-109	-102	-97	-90	
	bit rate [kb/s]	1.2 <sup>4</sup>	19.2	57.6 <sup>4</sup>	86.2 <sup>4</sup>														
RF sensitivity [dBm]	868 MHz	-110	-104	-99	-92														
	916 MHz	-109	-102	-97	-90														
RF output power	Programmable in 8 levels (0 – 7), -2.5 dBm/level																		
	<table border="1"> <thead> <tr> <th>level</th> <th>0</th> <th>1</th> <th>2</th> <th>3</th> <th>4</th> <th>5</th> <th>6</th> <th>7</th> </tr> </thead> <tbody> <tr> <td>[dBm]</td> <td>-12.5</td> <td>-10</td> <td>-7.5</td> <td>-5</td> <td>-2.5</td> <td>0</td> <td>2.5</td> <td>5</td> </tr> </tbody> </table>	level	0	1	2	3	4	5	6	7	[dBm]	-12.5	-10	-7.5	-5	-2.5	0	2.5	5
level	0	1	2	3	4	5	6	7											
[dBm]	-12.5	-10	-7.5	-5	-2.5	0	2.5	5											
RF range (TR-52DA) <sup>1</sup>	Up to 850 m @ 1.2 kb/s <sup>4</sup> Up to 650 m @ 19.2 kb/s																		
Input voltage on C1, C2, C5 to C8 pins	0 V to $V_{OUT}$																		
A/D converter	10 bit, 2 inputs (multiplexed S&H, successive approximation)																		
Input A/D impedance	10 k $\Omega$ max.																		
Temperature sensor accuracy	0.5°C max. (0°C to +65°C)																		
Size (L x W x H)	25.0 mm x 14.9 mm x 3.0 mm 31.8 mm x 14.9 mm x 3.0 mm (TR-52DA)																		

**Note 1:** RF range strongly depends on module orientation and surroundings.

**Note 2:** Additional current is consumed when a peripheral is enabled.

**Note 3:** Depends on interferences.

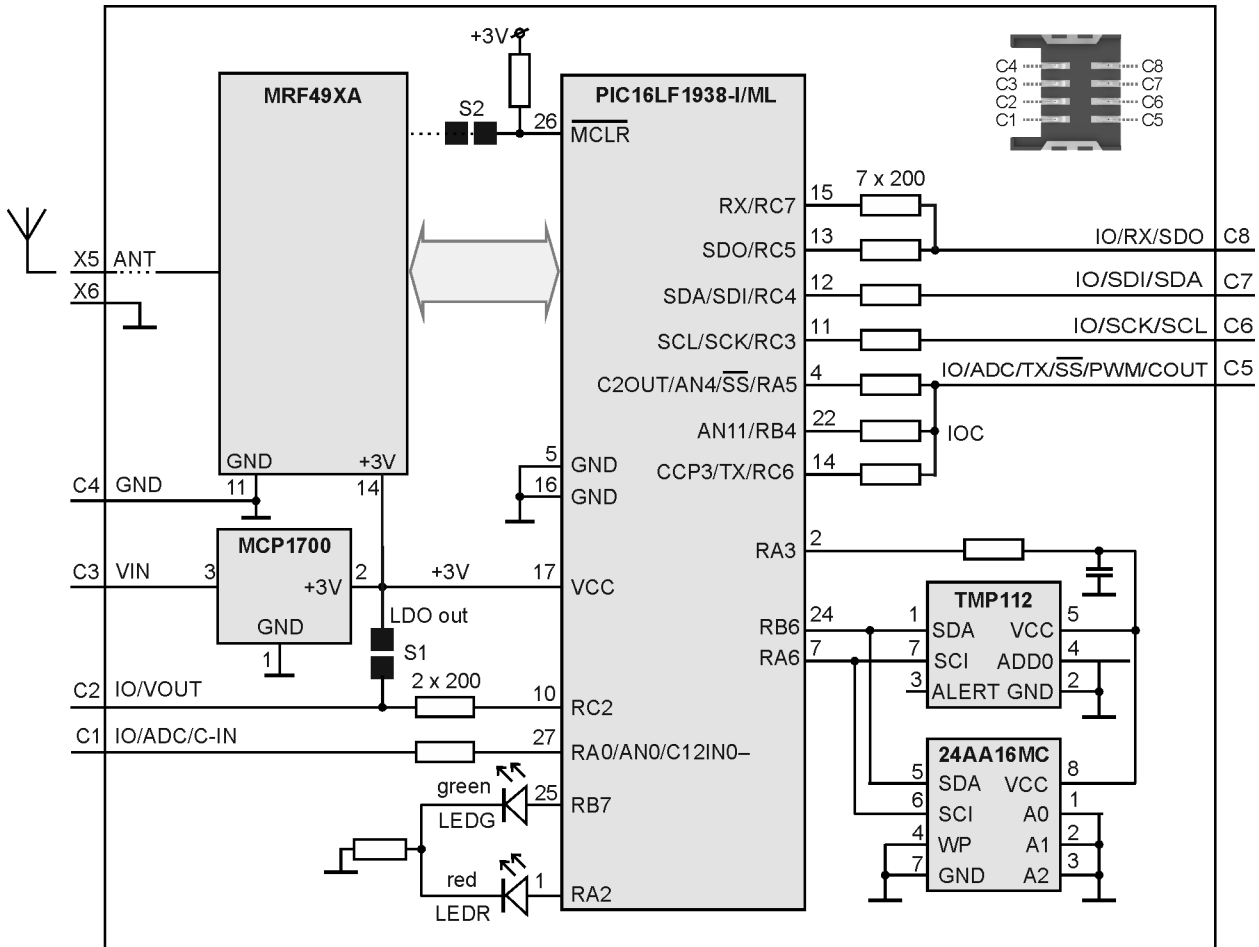
**Note 4:** RF bit rates different from 19.2 kb/s are preliminary, for experimental purpose only.

*Users have to ensure observing local provisions and restrictions relating to the use of short range devices by software, e.g. the CEPT ERC/REC 70-03 Recommendation and subsequent amendments in EU.*

**Absolute maximum ratings**

Stresses above those values may cause permanent damage to the device. Exposure to maximum rating conditions for extended periods may affect device reliability.

Supply voltage ( $V_{CC}$ )	5.5 V
Voltage on C1, C2, C5 to C8 pins	-0.3 V to ( $V_{OUT} + 0.3$ V)
Storage temperature	-50 °C to +100 °C
Ambient temperature under bias	-40 °C to +85 °C

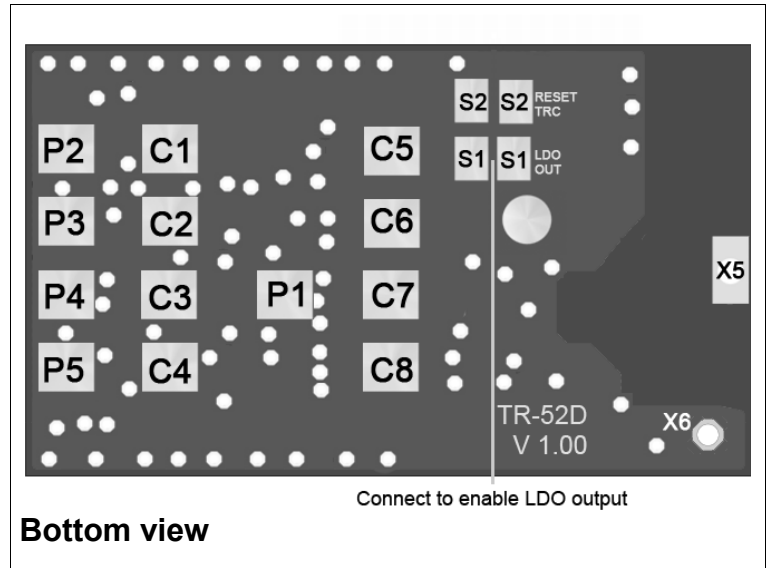
**Simplified schematic**

**Table 1: Basic components**

IC	Type	Manufacturer	Note
<b>MCU</b>	PIC16LF1938-I/ML	Microchip	
<b>RF IC</b>	MRF49XA	Microchip	
<b>LDO voltage regulator</b>	MCP1700	Microchip	
<b>Temperature sensor</b>	TMP112	Texas Instruments	TR-52DT, TR-52DCT and TR-52DAT only
<b>EEPROM</b>	24AA16/MC	Microchip	

For more information refer to datasheets of ICs used.

Pin	Name	Description
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C1	<b>IO/ADC/C-IN</b>		
	RA0	General I/O pin	
	AN0	Analog A/D input	
	C12IN0	Comparator -input	
C2	<b>IO/VOUT</b>		
	RC2	General I/O pin (S1 disconnected)	
	VOUT	On-board +3 V LDO output (S1 connected)	
C3	<b>VIN</b>	Power supply voltage	
C4	<b>GND</b>	Ground	
C5	<b>IO/ADC/TX/-SS /PWM/COUT</b>		
	RA5	General I/O pin,	
	-SS	SPI Slave select	
	AN4	Analog A/D input	
	C2OUT	Comparator output	
	RC6	General I/O pin	
	TX	UART TX	
	CCP3	PWM output	
	RB4	General I/O pin, programmable pull-up and interrupt/wake-up on change (IOC)	
	AN11	Analog A/D input	
	C6	<b>IO/SCK/SCL</b>	
		RC3	General I/O pin
		SCK	SPI clock input
SCL		I <sup>2</sup> C clock	
C7	<b>IO/SDI/SDA</b>		
	RC4	General I/O pin	
	SDI	SPI data	
	SDA	I <sup>2</sup> C data	
C8	<b>IO/RX/SDO<sup>5</sup></b>		
	RC5	General I/O pin	
	SDO	SPI data out	
	RC7	General I/O pin	
	RX	UART RX	
X5	<b>ANT</b>	Antenna input	
X6	<b>GND</b>	Ground	
P1–P5		For factory programming only	
S1		LDO output enable. Connect to enable (default disabled).	
S2		Leave disconnected.	

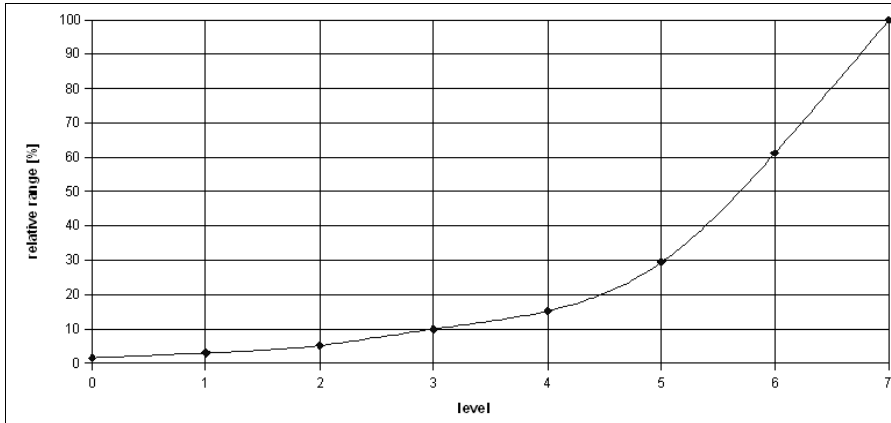


**Note 5:** This pin is used as output during initial ~250 ms boot-up to recognize programming mode.

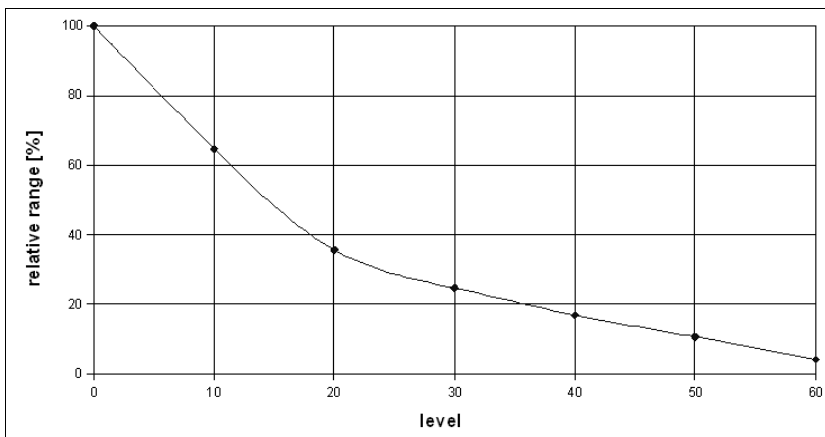
### Application

See IQRF OS User's guide, IQRF OS Reference guide, Application examples and [www.iqrf.org](http://www.iqrf.org) website.

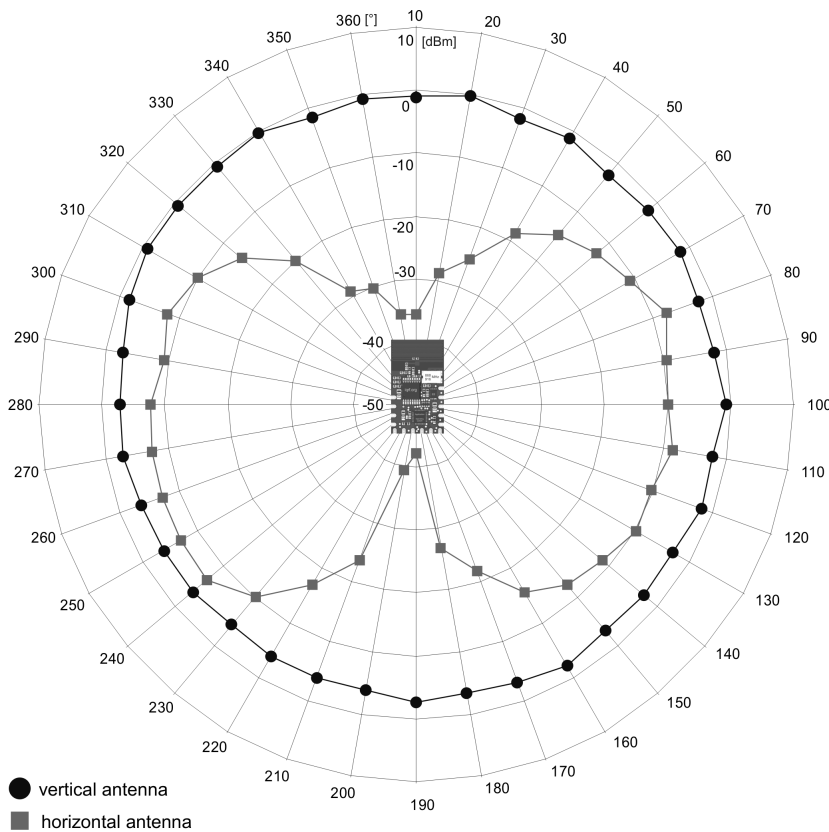
**Figure 1:** Relative RF range vs. level for the `setTXpower(level)` function. Refer to IQRF OS Reference guide.



**Figure 2:** Relative RF range vs. level for the `checkRF(level)` function. Refer to IQRF OS Reference guide.

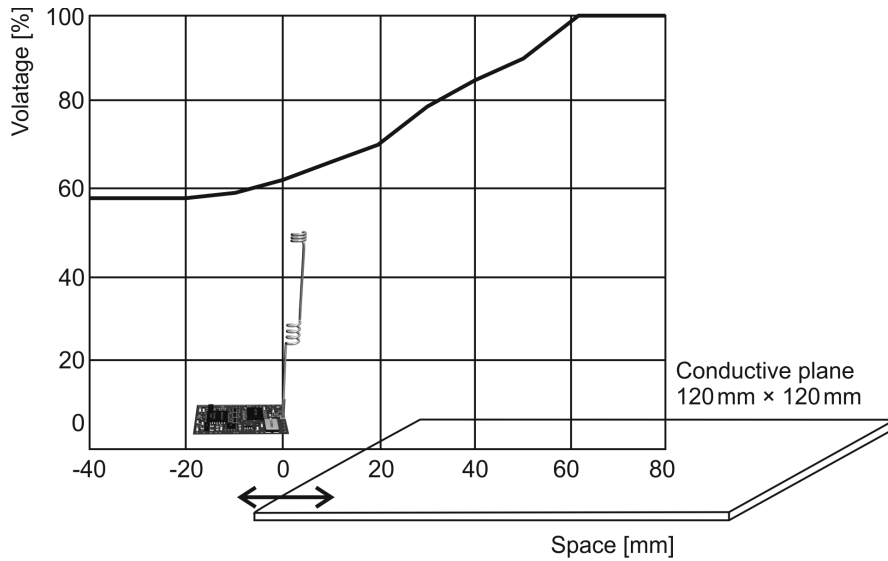
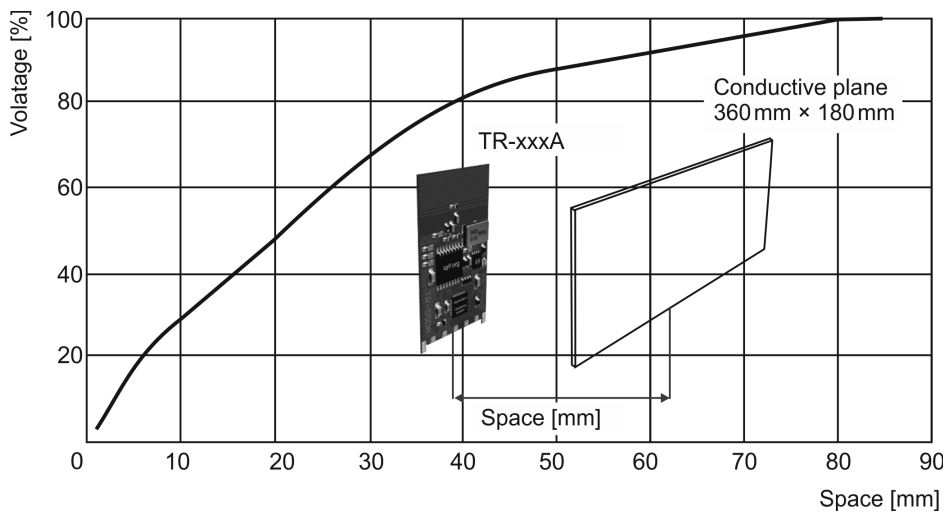


**Figure 3:** TR-52DA relative RF range vs. antenna orientation (radiation patterns)



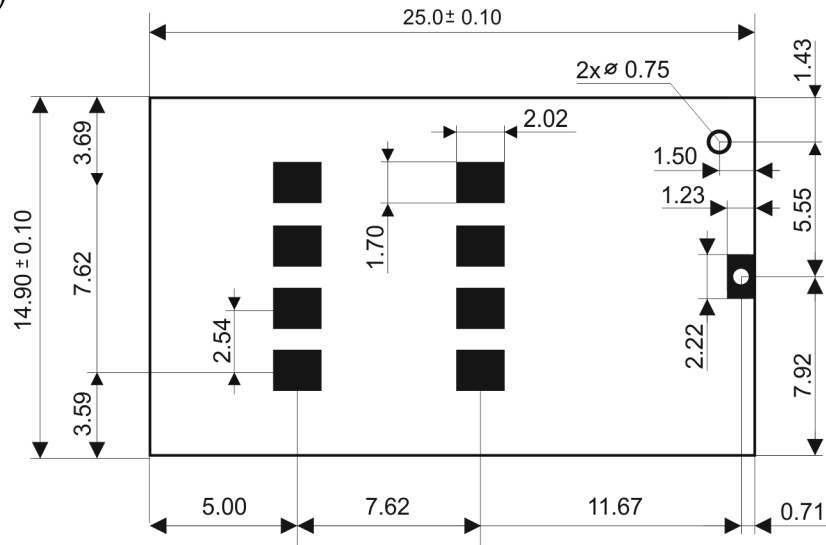
**Relative decrease of RF input signal vs. antenna edge spacing to conductive areas**

Conductive areas close to the antenna must be avoided.

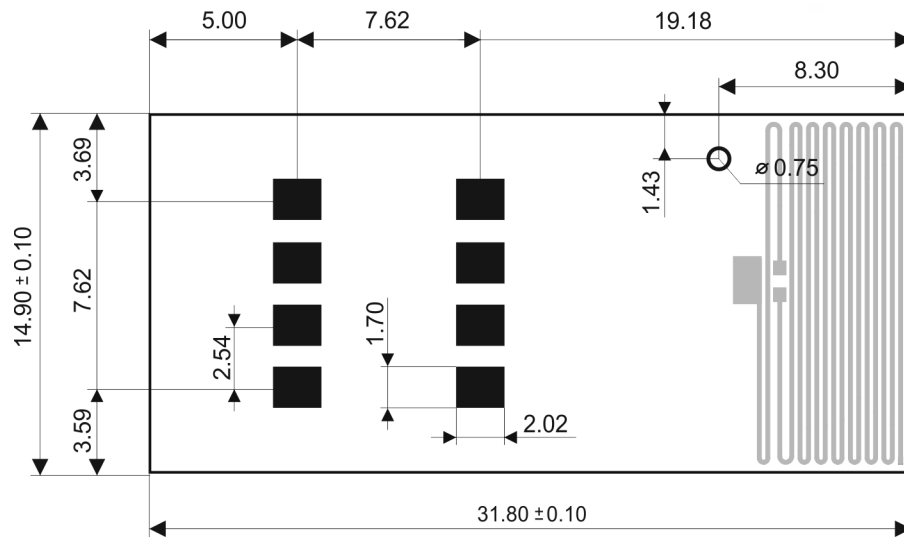
**Figure 4: Perpendicular arrangement**

**Figure 5: Parallel arrangement**


## Dimensions

TR-52D(C)(T)(E)



TR-52DA(T)(E)



Top view, Units: mm

Recommended SIM connector: KON-SIM-01



## Product information

### Ordering codes

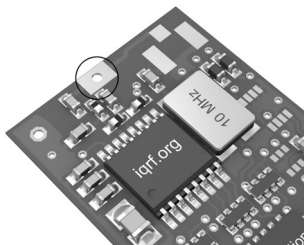
T R - 5 2 D A PP

peripheral options: **ni1** - no other peripheral  
**T** - temperature sensor

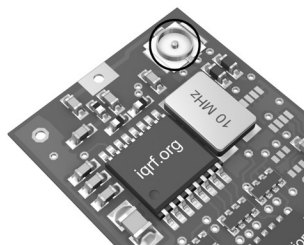
antenna options: **ni1** - soldering padhole (no antenna, no U.FL connector)  
**A** - PCB antenna,  
**C** - U.FL connector (mini coax)

Type	Antenna connection	Temperature sensor	Serial EEPROM
TR-52D	Soldering hole	–	2 kB
TR-52DC	U.FL connector	–	2 kB
TR-52DA	PCB antenna	–	2 kB

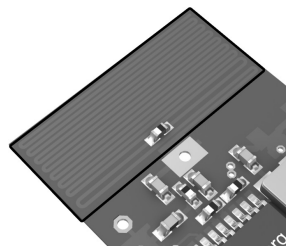
Type	Antenna connection	Temperature sensor	Serial EEPROM
TR-52DT	Soldering hole	Yes	2 kB
TR-52DCT	U.FL connector	Yes	2 kB
TR-52DAT	PCB antenna	Yes	2 kB



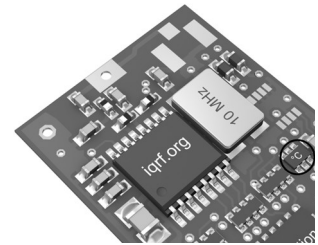
TR-52D



TR-52DC



TR-52DA



TR-52DT

### Document history

- 121001 Information about PWM and analog comparator added.
- 120831 Power consumption for OS v3.02D added.
- 120810 Electrical specification slightly precised. Some minor improvements.
- 120622 Block schematics and Table 6 added.
- 120518 Power consumption in Sleep updated. Version without serial EEPROM cancelled.
- 120425 RF range specified.
- 120322 Slightly improved. Fig. 4 added. Preliminary.
- 111011 Temperature sensor available optionally. Preliminary.
- 110919 Preliminary

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# Sales and Service

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ETSI EN 300220-1:00, ETSI EN 300390-2V.1.1.1:00*

*Complies with FCC directives FCC CFR, Title 47, Part 15, Section 15.209, FCC CFR, Title 47, Part 15, Section 15.249*

*Complies with Directive 2002/95/EC (RoHS)*



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