

# **TR-54D**

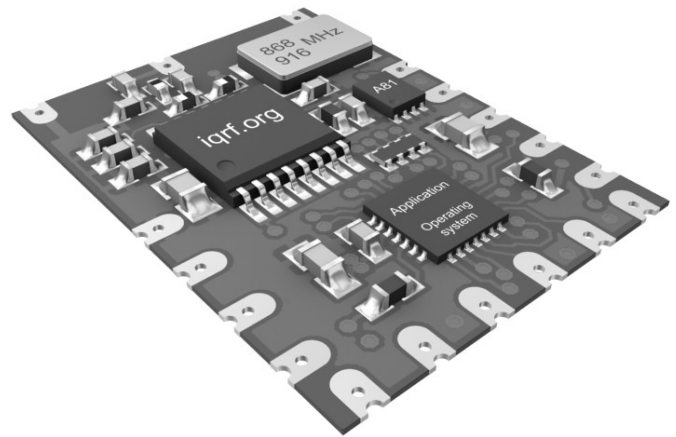
## **Transceiver Module**

### **Data Sheet**



## Description

TR-54D 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. Extra low power consumption fits for battery powered applications. SMT mounting and very small dimensions allow space saving.



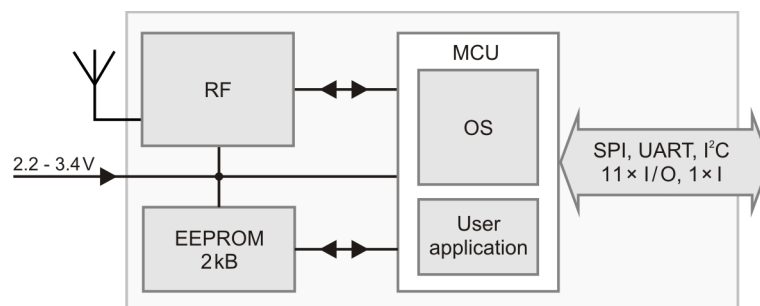
## Applications

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

## Key features

- Complete solution with operating system, easy to use
- FSK modulation
- Selectable band 868 / 916 MHz, multiple channel
- Selectable RF bit rate
- MCU with extended resources
- Serial EEPROM
- Extra low power consumption, power management modes
- SPI interface supported by OS on background
- 18 pins, 11 I/Os, 1 input only, 4 A/D inputs
- Stamp hole pads, SMT mounting, no SIM card compatible
- Very small dimensions

## Block schematics



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

Supply voltage ( $V_{CC}$ ) <sup>1</sup>	2.2 V min., 3.4 V max., <b>3.0 V typ.</b> , stabilized.
Operating temperature	0 °C to +70 °C -40 °C to +85 °C (Industrial) available on request
Supply current	
Sleep mode	380 nA (if all peripherals including MRF49XA disabled <sup>4</sup> )
Additional supply current	800 nA (if watchdog enabled) 7.5 µA (if brown-out detection enabled)
Run mode	1 mA (MRF49XA disabled)
Additional supply current	0.6 mA (MRF49XA on)
Rx mode	13 mA (STD mode) 400 µA (LP mode <sup>5</sup> ) 35 µA (XLP mode <sup>5</sup> )
Tx mode	14 mA – 24 mA (according to RF output power)
RF sensitivity <sup>2</sup>	-110 dBm @ 868 MHz, 1.2 kb/s - 99 dBm @ 868 MHz, 19.2 kb/s -109 dBm @ 916 MHz, 1.2 kb/s -102 dBm @ 916 MHz, 19.2 kb/s
RF output power	Up to 5 dBm, programmable in 8 steps (7 – 0), -3dBm/step
RF range (TR-52DA) <sup>3</sup>	Up to 850 m @ 1.2 kb/s Up to 650 m @ 19.2 kb/s
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, 19.2 kb/s, 57.6 kb/s, 86.2 kb/s
Input voltage on Q4 to Q15 pins	0 V to $V_{CC}$
A/D converter	10 b, 4 inputs (multiplexed S&H, successive approximation)
Input A/D impedance	10 kΩ max.
Dimensions	20.2 mm x 14.9 mm x 3.0 mm (TR-54D) 26.4 mm x 14.9 mm x 3.0 mm (TR-54DA)

**Note 1:** RF power and other parameters depend on supply voltage. Refer to datasheets of MCU and RF IC used. Test your application with respect to required supply voltage range.

**Note 2:** RF sensitivity depends on frequency band and bit rate.

**Note 3:** RF range strongly depends on module orientation and surroundings.

**Note 4:** Additional current is consumed when a peripheral is enabled.

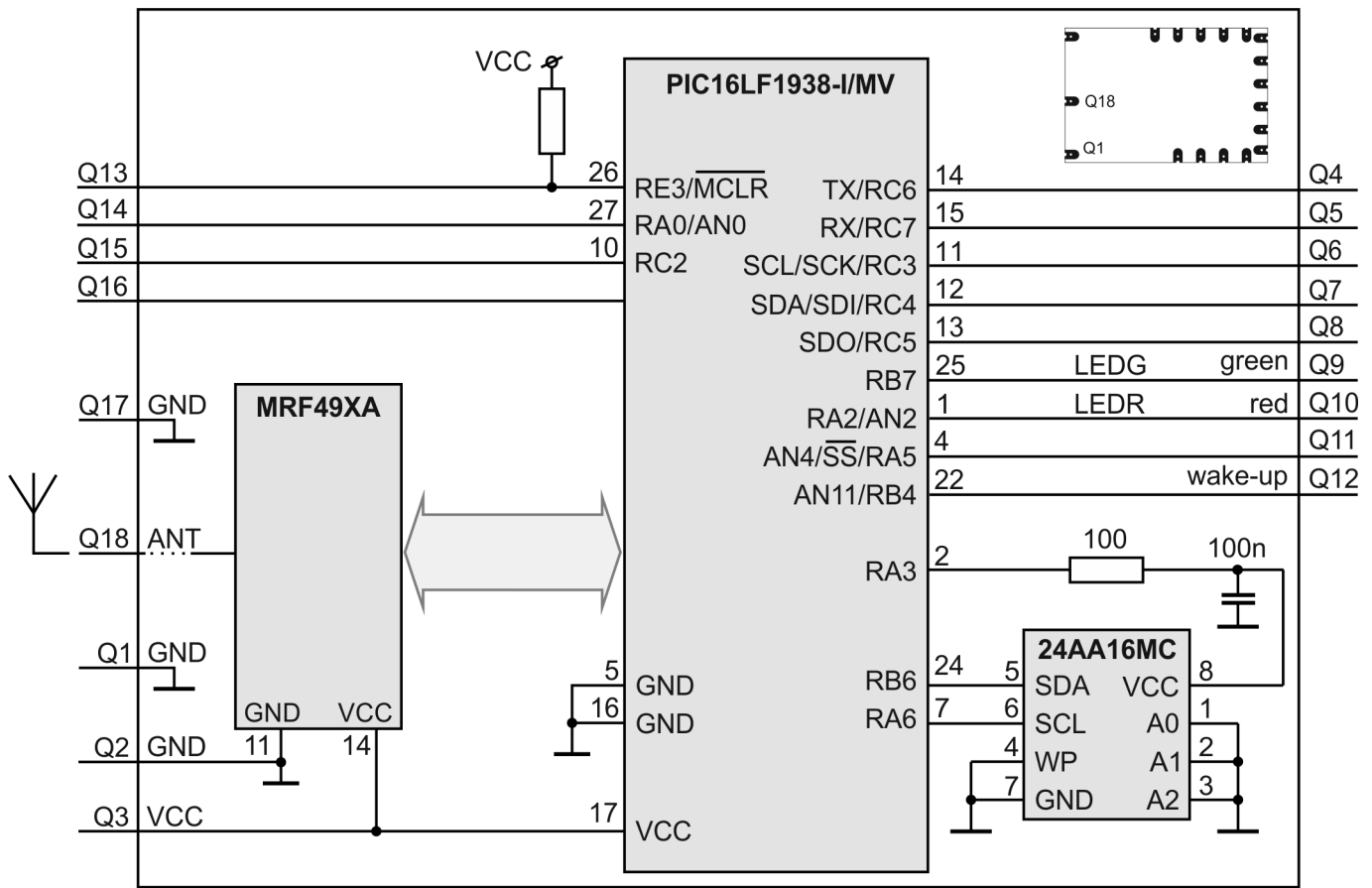
**Note 5:** Depends on interferences.

*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.

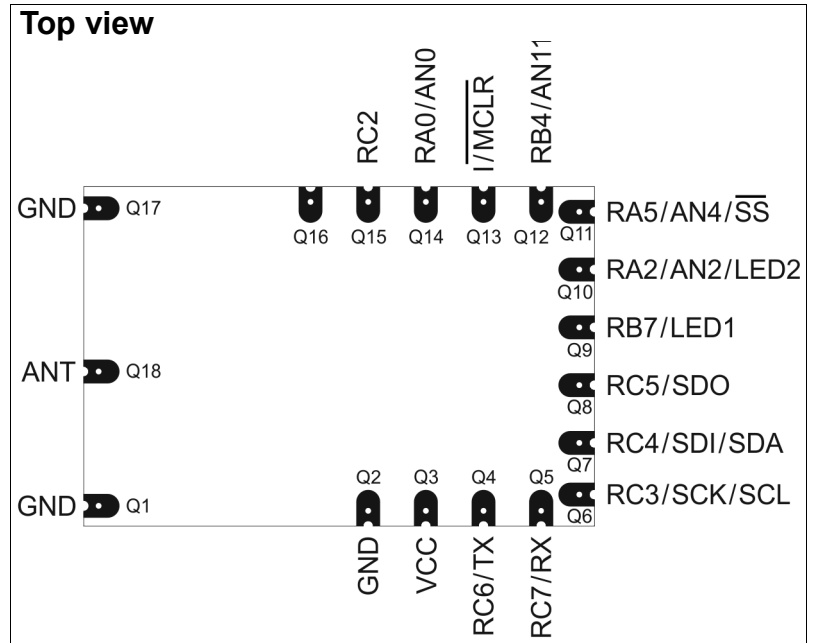
Supply voltage ( $V_{CC}$ )	4 V
Voltage on Q4 to Q15 pins	-0.3 V to ( $V_{CC} + 0.3$ V)
Storage temperature	-50 °C to +100 °C
Ambient temperature under bias	-40 °C to +85 °C

**Simplified schematics**

**Basic parts**

Part	Type	Manufacturer	Note
MCU	PIC16LF1938-I/ML	Microchip	
RF IC	MRF49XA	Microchip	
EEPROM	24AA16/MC	Microchip	2 kB

For more information refer to respective datasheets.

Pin	Name	Description
Q1 <sup>6</sup>	<b>GND</b>	Ground
Q2	<b>GND</b>	Ground
Q3	<b>VCC</b>	Power supply voltage
Q4	<b>IO/TX</b> RC6 TX	General I/O pin UART TX
Q5	<b>IO/RX</b> RC7 RX	General I/O pin UART RX
Q6	<b>IO/SCK/SCL</b> RC3 SCK SCL	General I/O pin SPI clock input I <sup>2</sup> C clock
Q7	<b>IO/SDI/SDA</b> RC4 SDI SDA	General I/O pin SPI data I <sup>2</sup> C data
Q8 <sup>7</sup>	<b>IO/SDO</b> RC5 SDO	General I/O pin SPI data out
Q9	<b>IO/LED1</b> RB7 LED1	General I/O pin LEDR supported by OS
Q10	<b>IO/AN/LED2</b> RA2 AN2 LED2	General I/O pin Analog A/D input LEDR supported by OS
Q11	<b>IO/AN/-SS</b> RA5 AN4 -SS	General I/O pin, Analog A/D input SPI Slave select
Q12	<b>IO/AN</b> RB4 AN11	General I/O pin Analog A/D input
Q13	<b>I</b> RE3	General input only pin
Q14	<b>IO/AN</b> RA0 AN0	General I/O pin Analog A/D input
Q15	<b>IO</b> RC2	General I/O pin
Q16		Do not use, leave unconnected
Q17 <sup>6</sup>	<b>GND</b>	Ground
Q18 <sup>6</sup>	<b>ANT</b>	Antenna

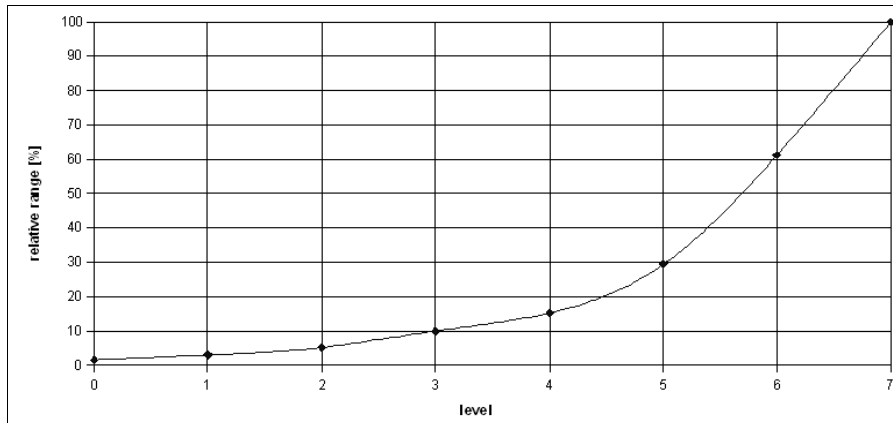


**Note 6:** Not implemented for TR-54DAx.

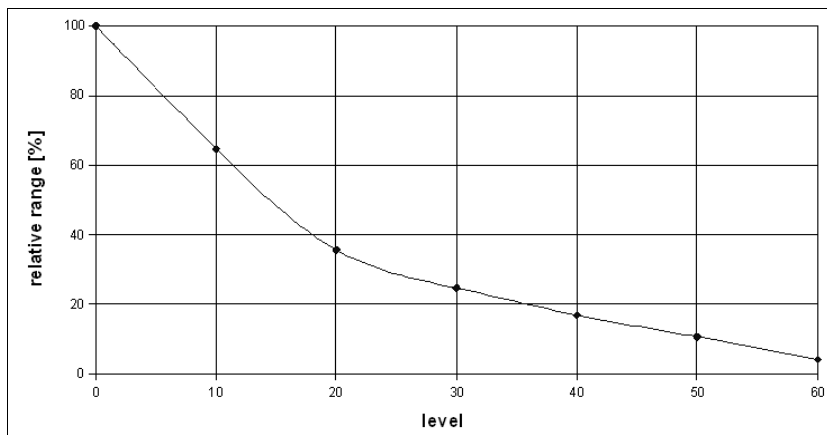
**Note 7:** This pin is used as output during initial ~250 ms boot-up to recognize programming mode.

There are no on-board protection series resistors on I/O pins. It is recommended to use series resistors 200 Ω on each pin used to protect against collisions due to possible failures in HW or SW.

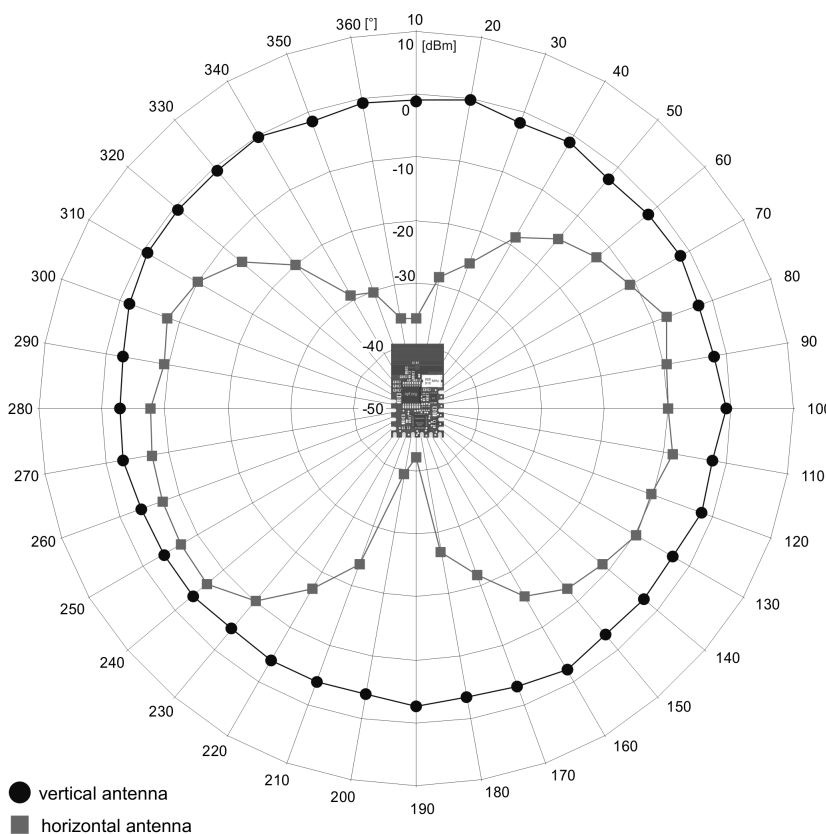
**Figure 1:** Relative RF range vs. level for the `setTXpower(level)` function. Refer to IQRF OS Reference guide.



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



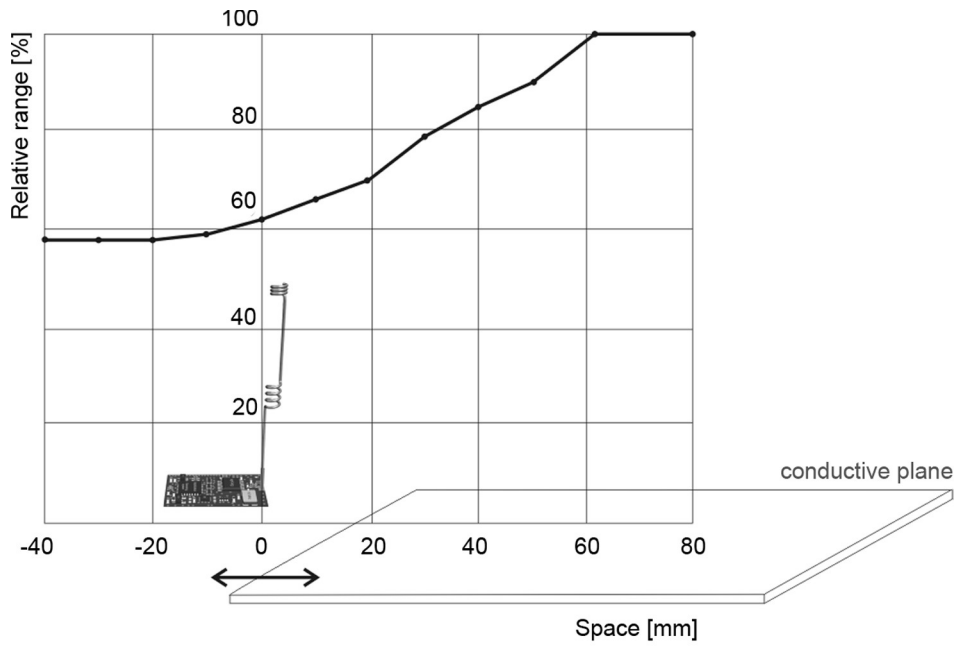
**Figure 3:** Relative RF range vs. antenna orientation (radiation patterns)



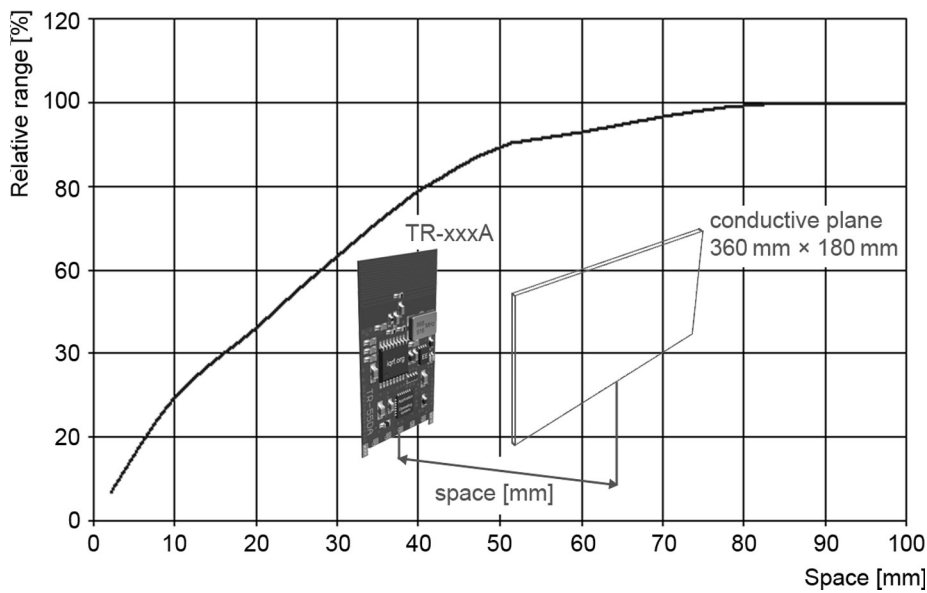
## Relative decrease of RF input signal vs. antenna edge spacing to conductive areas

Conductive areas close to the antenna must be avoided.

**Figure 4:** Perpendicular arrangement

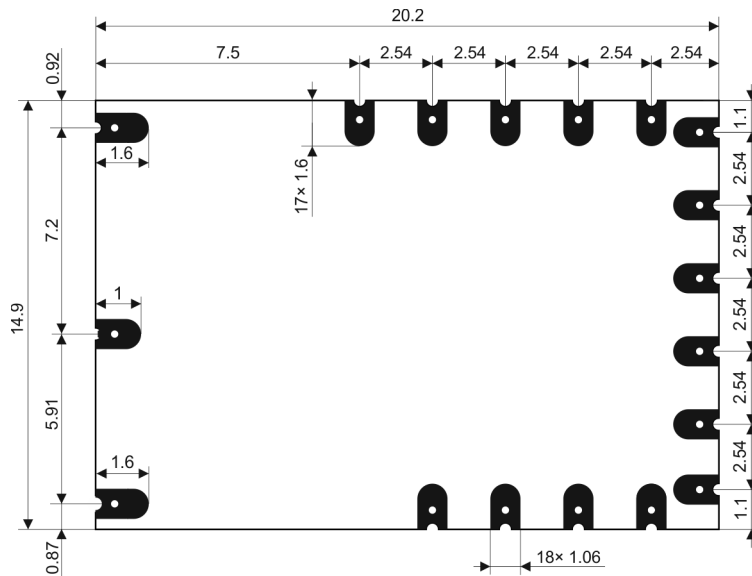


**Figure 5:** Parallel arrangement

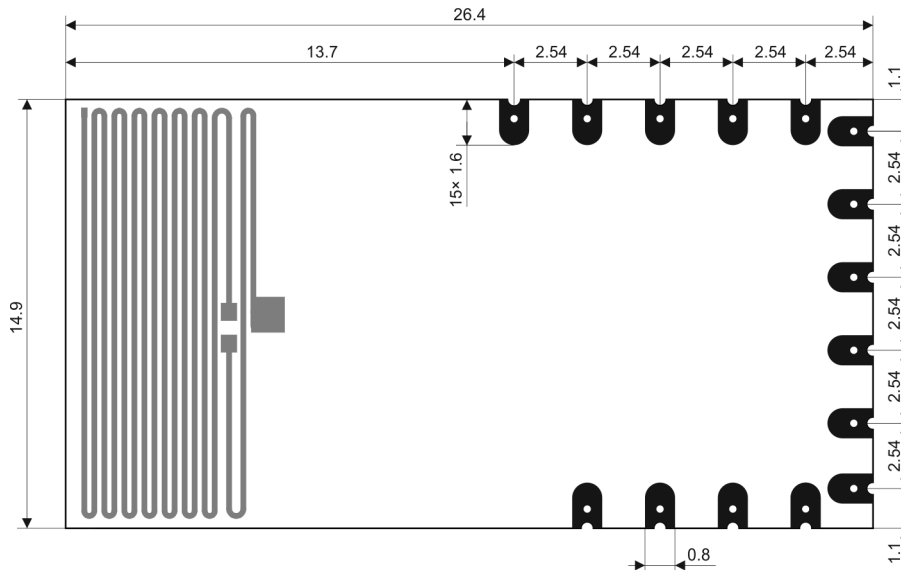


## Dimensions

TR-54D

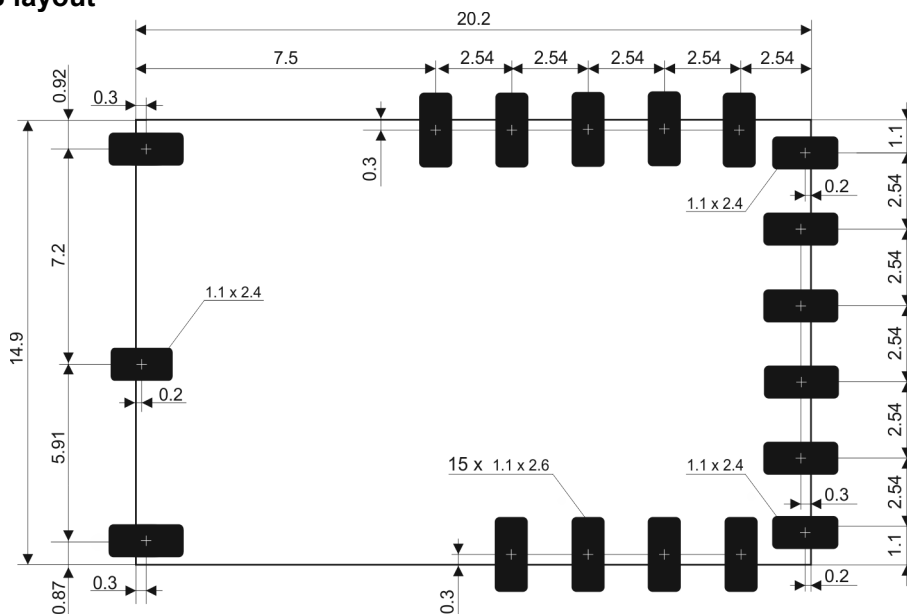


TR-54DA



Top view, units: mm

## Recommended PCB layout



Top view, units: mm



## Application

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

## Development

TR-54Dx must not be plugged in a SIM connector with metallic holder. To utilize advantages of SIM connector for development, the TR-DB-54DA kit containing the TR-54DA is intended. Refer to the TR-DB-54DA User's guide for details.

## Programming

There are two possibilities how to upload a user program in TR-54Dx modules soldered in an application:

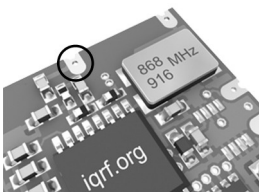
- For wired upload using the CK-USB-04 programmer the KON-PGM-01 adapter is intended. See the KON-PGM-01 User's guide for details.
- Wireless upload (RFPGM). See the IQRF OS User's guide, chapter RFPGM.

## Product information

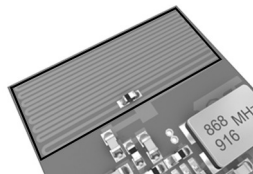
### Ordering codes

**T R - 5 4 D A**  
 antenna options: **nil** - soldering pad-hole (no antenna, no U.FL connector)  
**A** - PCB antenna

Type	Antenna option	Serial EEPROM
<b>TR-54D</b>	Soldering pad-hole	2 kB
<b>TR-54DA</b>	Internal PCB antenna	2 kB



TR-54D



TR-54DA

### Document history

- 120703 Chapter Programming changed.
- 120622 Block schematics and Figure 5 added. Chapter Programming precised. Figures Dimensions and Recommended PCB layout precised.
- 120601 Electrical specifications updated. Chapters Pin description, Development and Programming updated. Recommended PCB layout added. All TR-54Dx are equipped with serial EEPROM.
- 120425 Changes in pins, dimensions and antenna options. RF range specified. Fig. 4 added. Schematics simplified. Preliminary.
- 111011 Preliminary.

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