TR-54D

Transceiver Module

Data Sheet

IQRF®

Smarter wireless. Simply.

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.
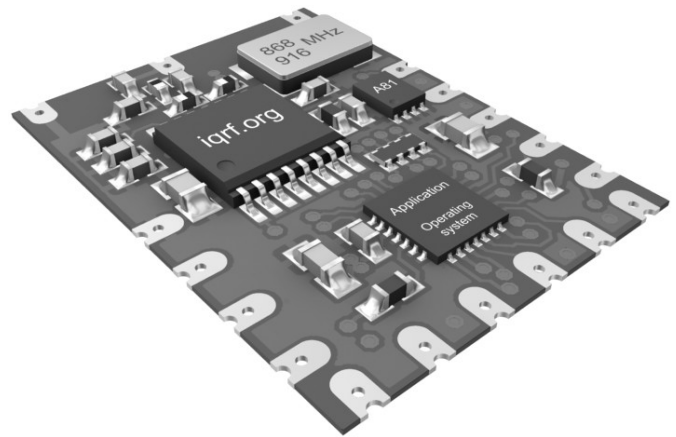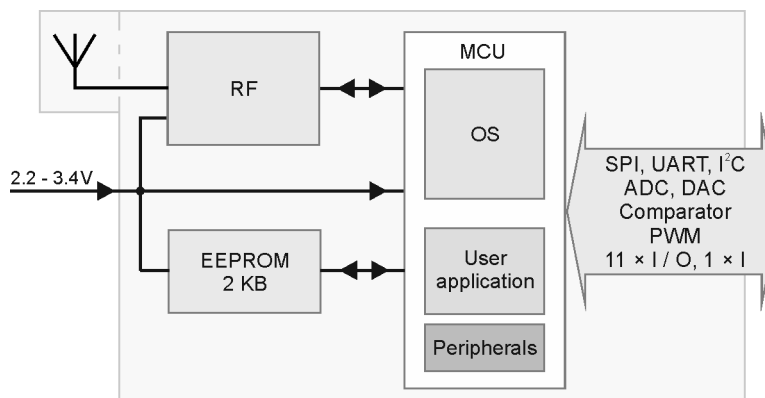
Key features

- Complete solution with operating system, easy to use
- FSK modulation
- Selectable RF band 868 / 916 MHz, multiple channel
- 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
- Battery monitoring
- 18 pins, 11 I/Os, 1 input only
- A/D converter (4 channels), D/A converter
- Analog comparator
- Optional on-board antenna
- Stamp hole pads, SMT mounting, no SIM card compatible
- Very small dimensions

Applications

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

Block diagram

Electrical specifications   *Typical values* unless otherwise stated

Parameters specified in this datasheet are typical values. They are at power supply V_{CC} = 3 V only. V_{CC} voltage different from 3 V can impact on RF range and other parameters.

Supply voltage (V_{cc}) [1]	2.2 V min., 3.4 V max., **3.0 V typ**., stabilized.
Operating temperature [2]	-40 °C to +85 °C
Supply current	
Sleep mode	380 nA (if all peripherals including MRF49XA disabled [4])
Run mode	1 mA (MRF49XA disabled)
Rx mode	STD mode: 13 mA LP mode [5]: OS v3.01D: 400 µA, from OS v3.02D: 330 µA XLP mode [5]: OS v3.01D: 35 µA, from OS v3.02D: 25 µA
Tx mode	14 mA – 24 mA (according to RF output power)
RF Band	868 MHz or 916 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 [6], 19.2 kb/s, 57.6 kb/s [6], 86.2 kb/s [6]
RFIC RF sensitivity	See MRF49XA datasheet
RFIC RF output power	Programmable in 8 levels (0 – 7), -2.5 dBm/level, see MRF49XA datasheet
RF range (TR-54DA) [3]	Up to 850 m @ 1.2 kb/s [6] Up to 650 m @ 19.2 kb/s
Input voltage on Q4 to Q15 pins	0 V to V_{cc}
A/D converter	10 bit, 4 inputs, see PIC16LF1938 datasheet
Dimensions	20.2 mm x 14.9 mm x 2.0 mm (TR-54D) 26.4 mm x 14.9 mm x 2.0 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 range may change with lower temperature. Frost, condensation or humidity over 85% may disable module functionality. Module suitability should be tested in final application before volume use.

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

Note 4: Additional current is consumed when a peripheral (e.g. watchdog, Brown-out detection etc.) is enabled.

Note 5: Depends on interferences.

Note 6: 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.

Caution: *Electrostatic sensitive device. Observe appropriate precautions for handling*

Absolute maximum ratings

Stresses above listed maximum values may cause permanent damage to the device and affect device reliability. Functional operation at these or any other conditions beyond those specified is not supported.

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

Simplified schematic
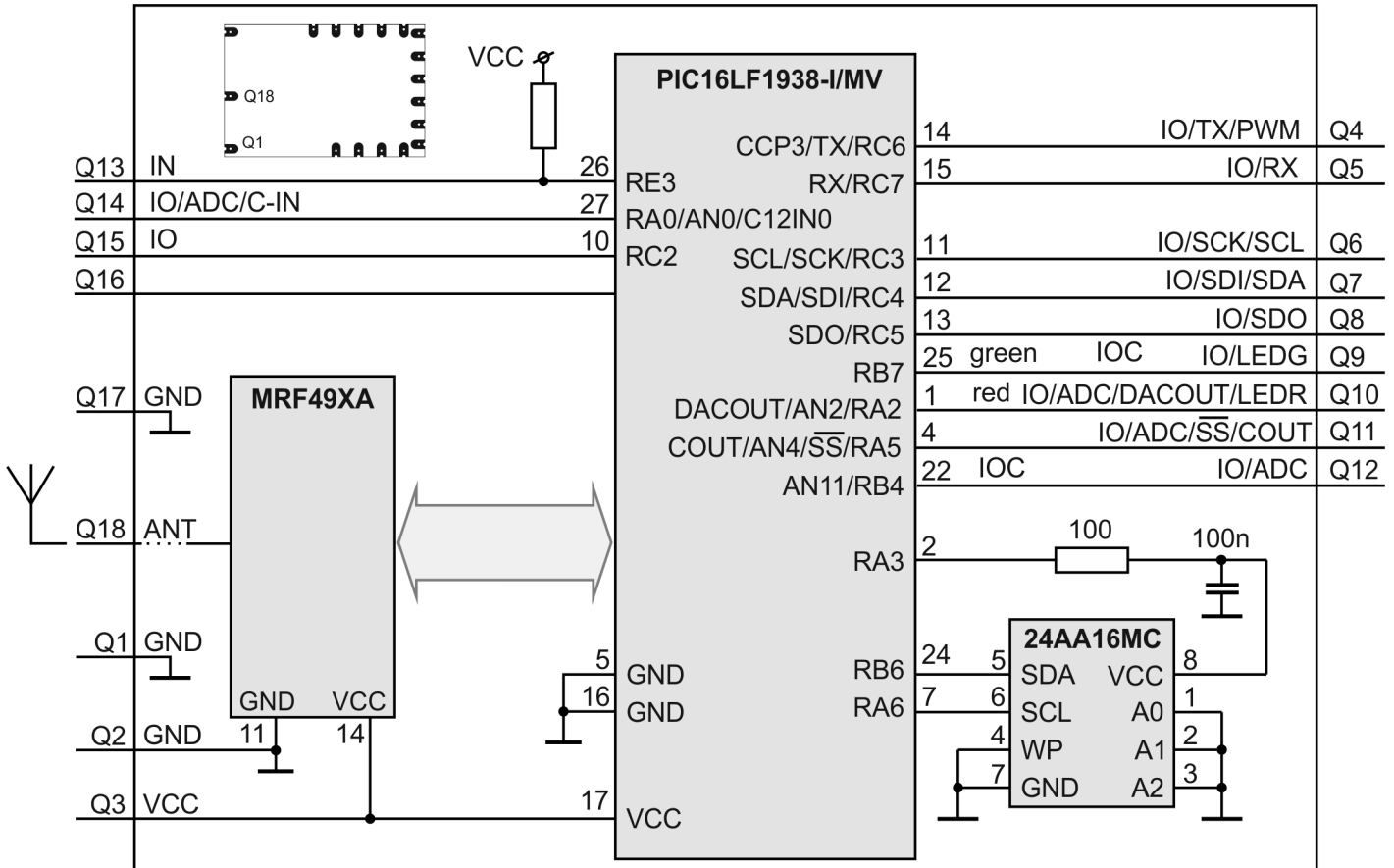
## Basic parts

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

For more information refer to respective datasheets.

Pin	Name	Description
Q1[7]	**GND**	Ground
Q2, C4	**GND**	Ground
Q3, C3	**VCC**	Power supply voltage
Q4	**IO / TX / PWM**	
	RC6	General I/O pin
	TX	UART TX
	CCP3	PWM output
Q5	**IO / RX**	
	RC7	General I/O pin
	RX	UART RX
Q6, C6	**IO / SCK / SCL**	
	RC3	General I/O pin
	SCK	SPI clock input
	SCL	I²C clock
Q7, C7	**IO / SDI / SDA**	
	RC4	General I/O pin
	SDI	SPI data
	SDA	I²C data
Q8[8], C8	**IO / SDO**	
	RC5	General I/O pin
	SDO	SPI data out
Q9	**IO / LEDG**	
	RB7	General I/O pin, programmable pull-up and interrupt/wake-up on change (IOC)
	LED1	LEDR supported by OS
Q10	**IO / ADC / LEDR**	
	RA2	General I/O pin
	AN2	Analog A/D input
	LED2	LEDR supported by OS
	DACOUT	D/A converter output
Q11, C5	**IO / ADC / -SS / COUT**	
	RA5	General I/O pin,
	AN4	Analog A/D input
	–SS	SPI Slave select
	C2OUT	Comparator output
Q12	**IO / ADC**	
	RB4	General I/O pin, programmable pull-up and interrupt/wake-up on change (IOC)
	AN11	Analog A/D input
Q13	**IN**	
	RE3	General input only pin
Q14, C1	**IO / ADC / C-IN**	
	RA0	General I/O pin
	AN0	Analog A/D input
	C12IN0	Comparator –input
Q15, C2	**IO**	
	RC2	General I/O pin
Q16	–	Do not use, leave unconnected
Q17[7]	**GND**	Ground
Q18[7]	**ANT**	Antenna

P1–P5   For manufacturer only
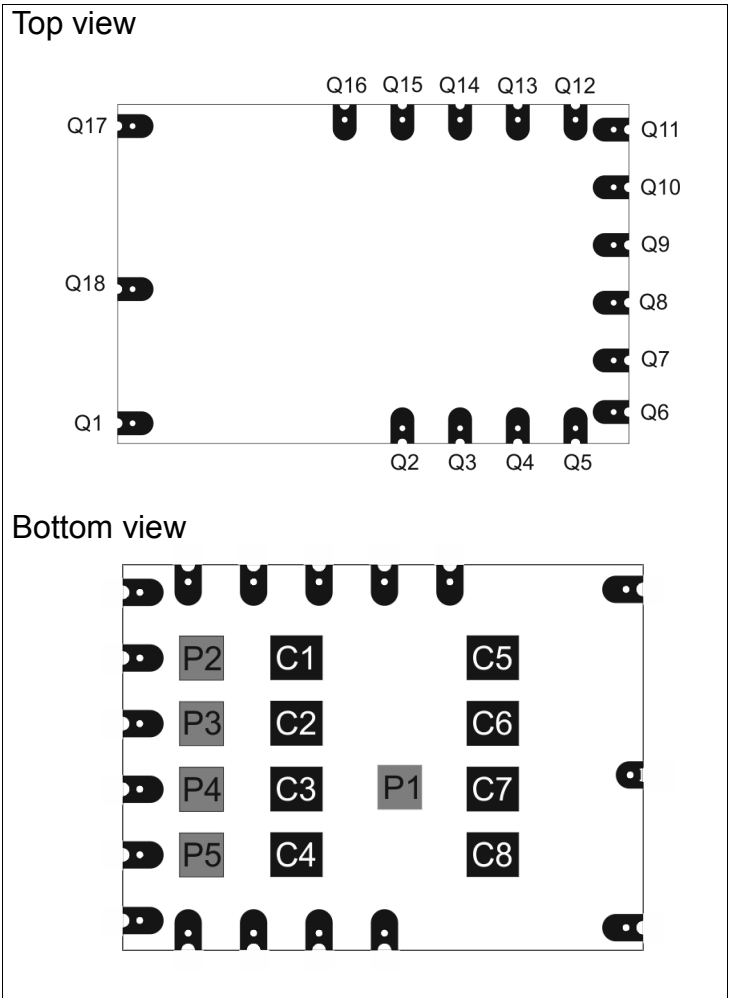
**Note 7:** Not implemented for TR-54DAx.
Note 8: This pin is used as output during initial ~250 ms boot-up to recognize programming mode.

There are no on-board protection series resistors on I/O pins. It is recommended to use 200 Ω series resistors on each pin.

Top view

Q16 Q15 Q14 Q13 Q12
Q17
Q11
Q10
Q9
Q18
Q8
Q7
Q1
Q6
Q2 Q3 Q4 Q5

Bottom view

P2 C1 C5
P3 C2 C6
P4 C3 P1 C7
P5 C4 C8

Figure 1: Relative RF range vs. level for the `setTXpower(level)` function. Refer to IQRF OS Reference guide.
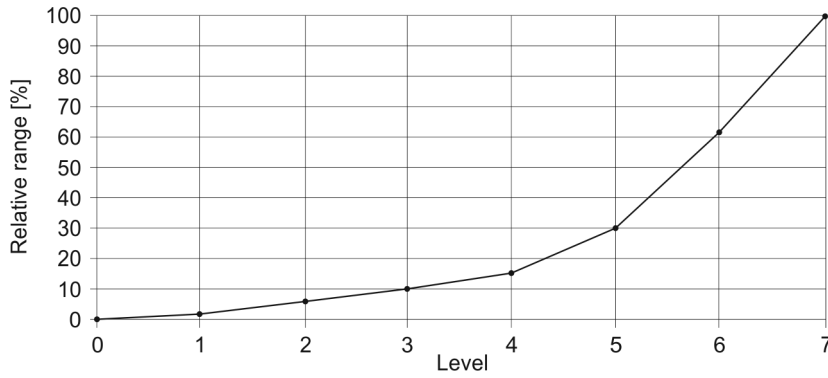
Figure 2: Relative RF range vs. level for the `checkRF(level)` function. Refer to IQRF OS Reference guide.
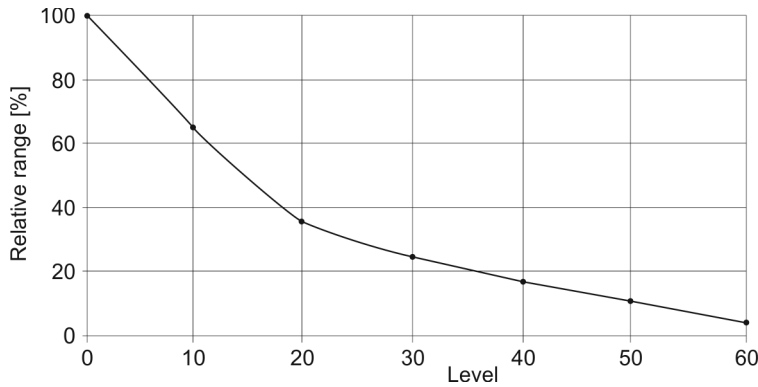
Figure 3: TR-54DA relative RF range vs. antenna orientation (radiation patterns)

Vertical antenna

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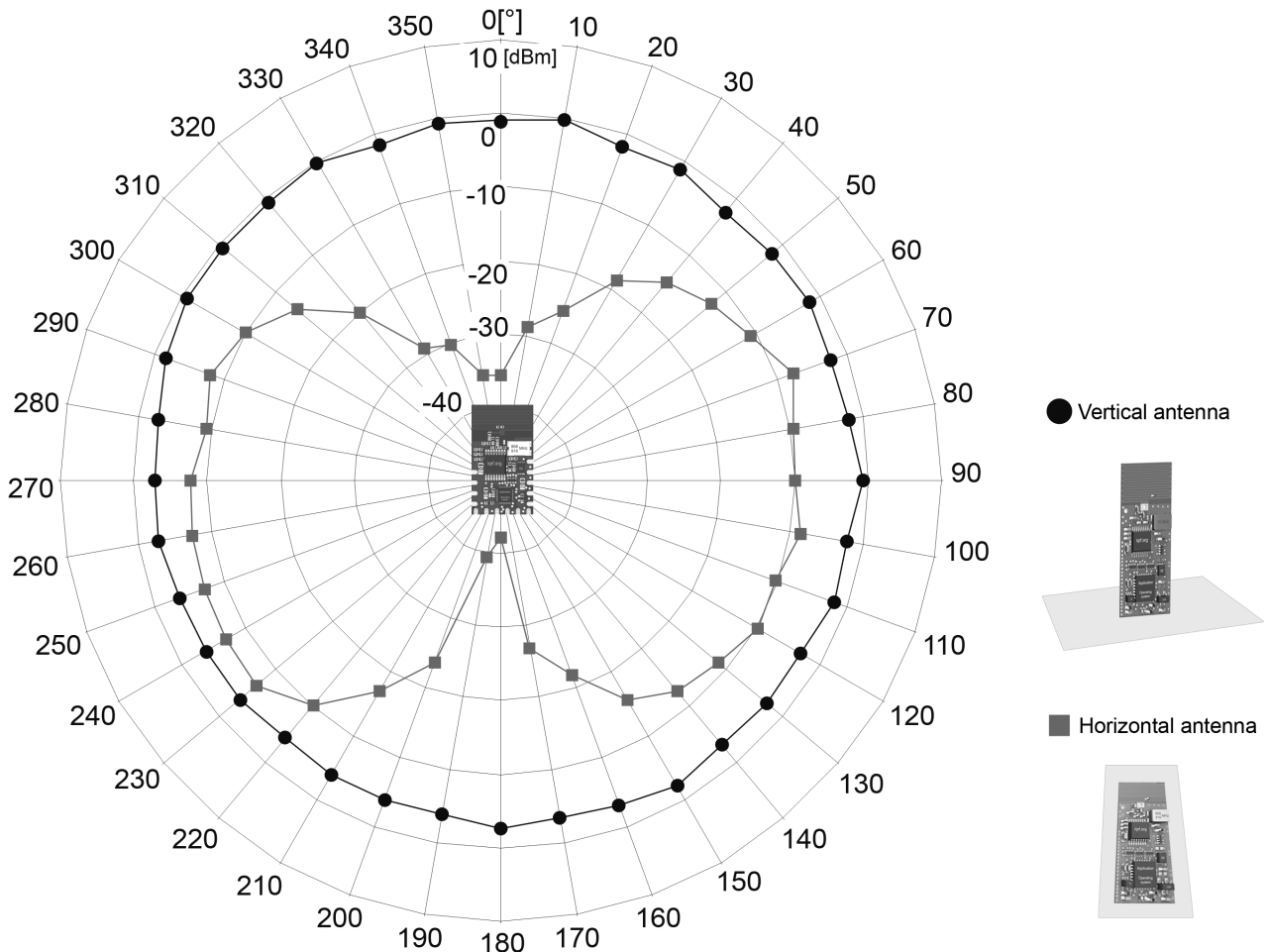
Relative decrease of RF input signal vs. antenna edge spacing to conductive areas

Conductive areas close to the antenna must be avoided.

Figure 4: Perpendicular arrangement
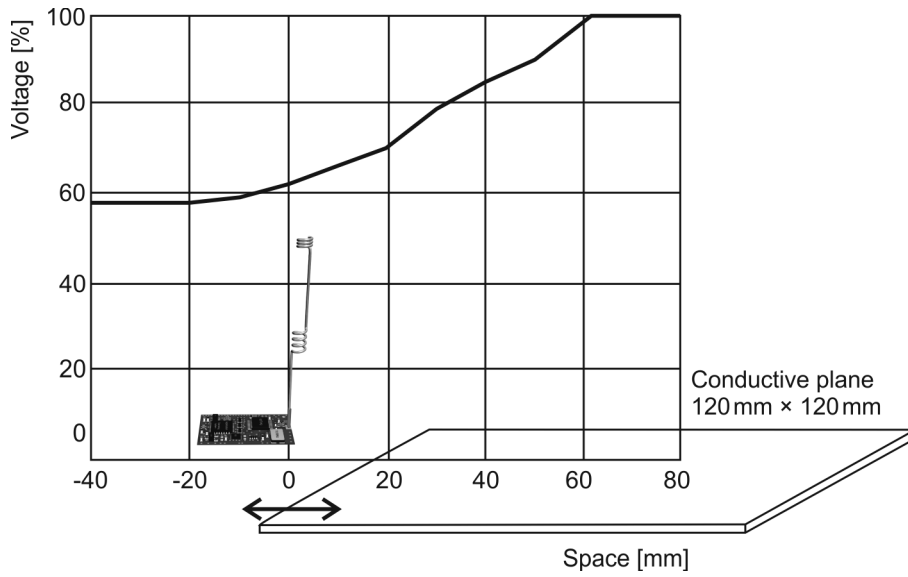
Figure 5: Parallel arrangement

Mechanical drawings

TR-54D

TR-54DA

Top view, units: mm

Application

Assembly

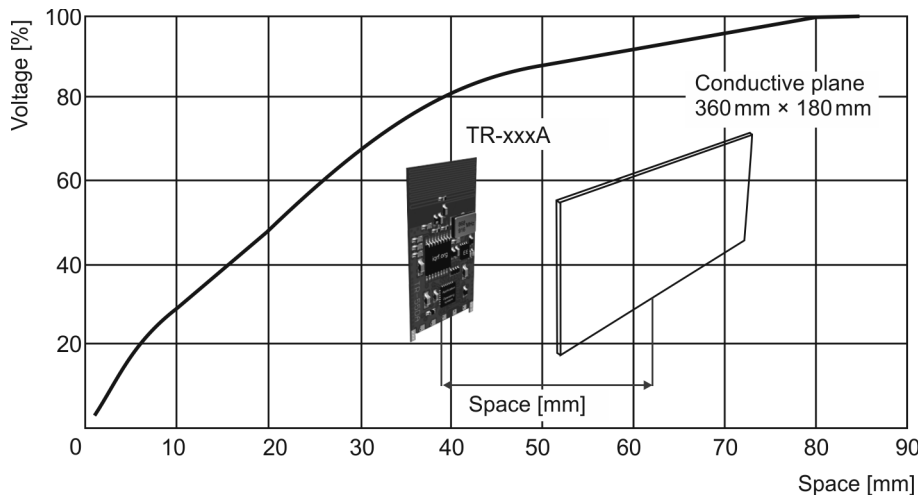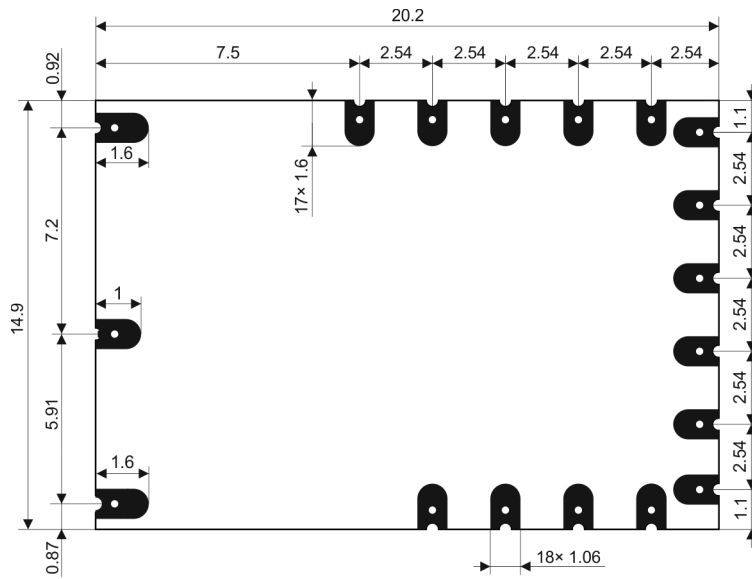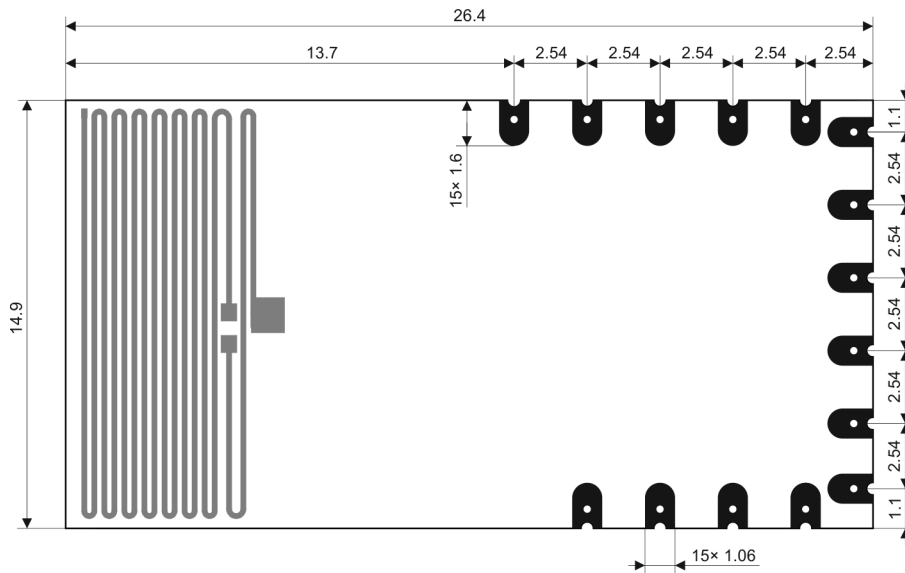For proper mounting of surface mount TR-54Dx modules and avoiding damage during solder reflow assembly the IPC/JEDEC J-STD-020C standard must be observed. The parts must be baked dry according to IPC/JEDEC J-STD-033C, MSL 4 before reflow soldering. For reflow profile and details refer to the AN010 Application note – SMT mounting of IQRF TR modules.

Caution: TR-54Dx must not be plugged in a SIM connector with metallic holder.

Recommended PCB layout for user application
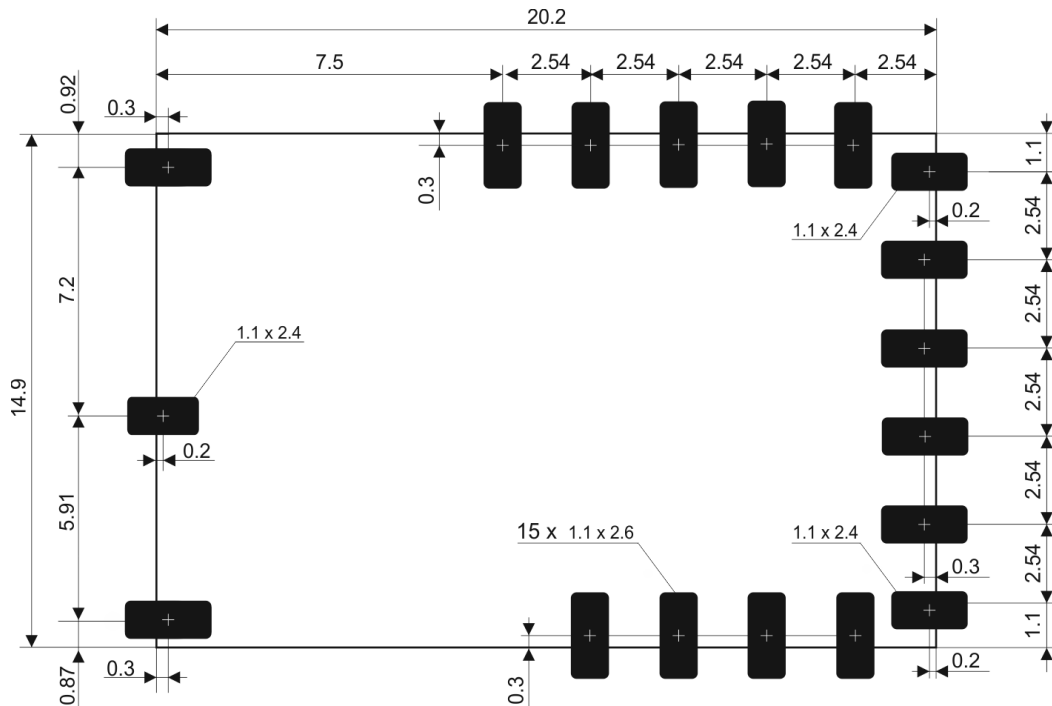
Top view, units: mm

Operating system

See IQRF OS User's guide and IQRF OS Reference guide.

Software

See Application examples on www.iqrf.org website.

Programming

There are two possibilities to upload an application program in TR-54Dx modules soldered in an application:
- For wired upload using the CK-USB-04 programmer the KON-TR-01P adapter is intended. See the KON-TR-01P User's guide for details.
- RFPGM – RF programming™ (wireless upload). See the IQRF OS User's guide, chapter *RF programming*.

Solderless development prototyping

For flexible development the TR-DB-54DA kit is intended. It is a removable SIM-compatible device containing the TR-54DA which can be plugged in the SIM connector in user equipment or in an appropriate IQRF development kit, e.g. DK-EVAL-04. Refer to the TR-DB-54DA User's guide for details.

Product information

Ordering codes

TR-54DA

antenna options:
- **nil** – soldering pad-hole (no antenna, no antenna connector)
- **A** – PCB antenna

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

TR-54D   TR-54DA

Document history

- 131114   Certification updated for the latest directives.
- 130906   Pin description extended, bottom view added. Electrical specification simplified.
- 130607   Operational temperature range extended.
- 130405   Revised. Chapters *Specifications* and *Application* precised.
- 121001   Chapter Assembly added, chapter Development slightly extended. Information about D/A converter, analog comparator, PWM, IOC and pull-ups added. Bug in TR-54DA mechanical drawing fixed.
- 120831   Power consumption for OS v3.02D added.
- 120810   Electrical specification slightly precised. Some minor improvements.
- 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 eqiupped with serial EEPROM.
- 120425   Changes in pins, dimensions and antenna options. RF range specified. Fig. 4 added. Schematics simplified. Preliminary.
- 111011   Preliminary.

Sales and Service

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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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