TR-54D

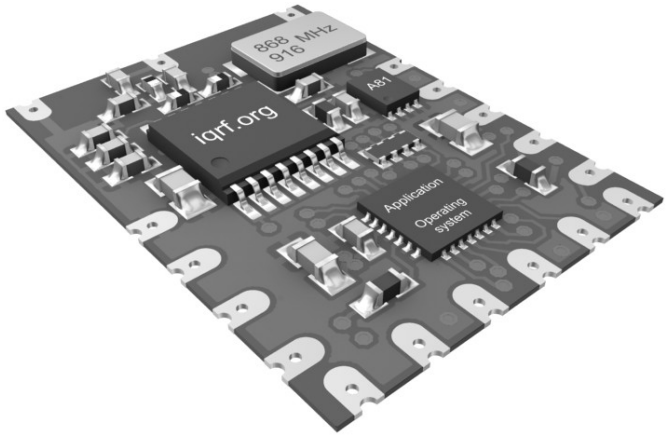
Transceiver Module

Data Sheet

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.



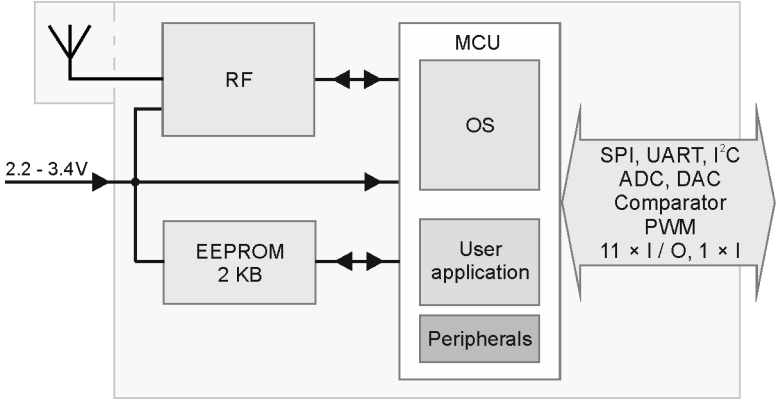
Key features

- 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



Information contained in this publication regarding device applications and the like is provided only for your convenience and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications.

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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])
  - 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: 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)

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 [6], 19.2 kb/s, 57.6 kb/s [6], 86.2 kb/s [6]

RF sensitivity: Depends on frequency band and bit rate:

	bit rate [kb/s]	1.2 [6]	19.2	57.6 [6]	86.2 [6]
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

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-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 (multiplexed S&H, successive approximation)

Input A/D impedance: 10 kΩ max.

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 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.

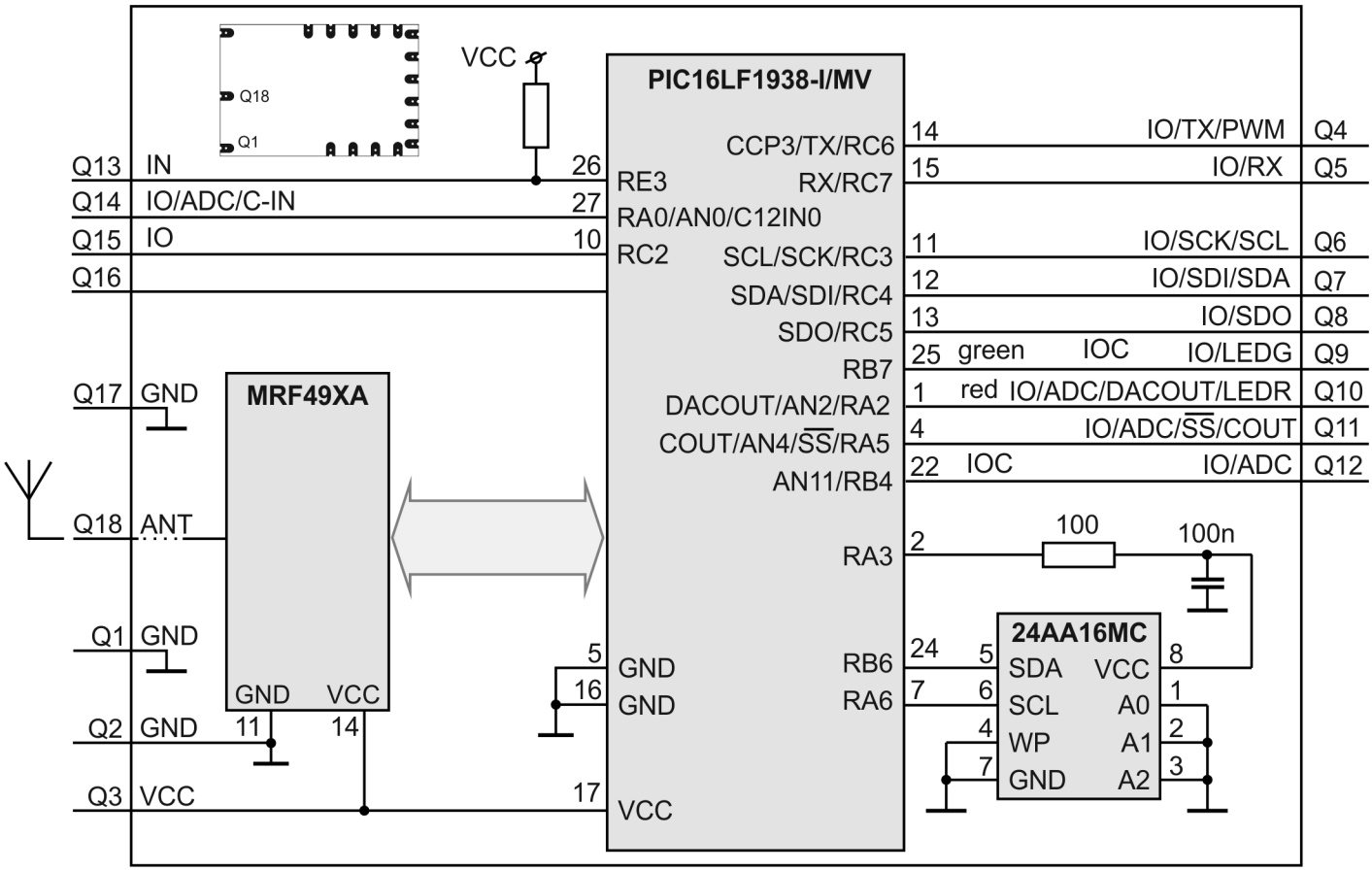
***Caution:** Electrostatic sensitive device. Observe appropriate precautions for handling*

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	-50 °C to +100 °C
Ambient temperature under bias	-40 °C to +85 °C

Simplified schematic



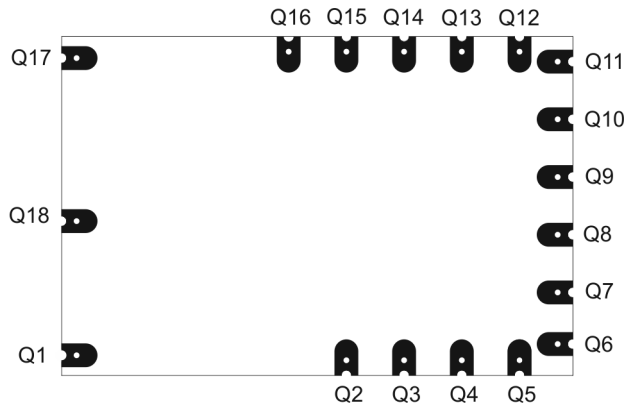
Basic parts

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	**GND**	Ground
Q3	**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	**IO / SCK / SCL**	
	RC3	General I/O pin
	SCK	SPI clock input
	SCL	I²C clock
Q7	**IO / SDI / SDA**	
	RC4	General I/O pin
	SDI	SPI data
	SDA	I²C data
Q8[8]	**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	**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	**IO / ADC / C-IN**	
	RA0	General I/O pin
	AN0	Analog A/D input
	C12IN0	Comparator –input
Q15	**IO**	
	RC2	General I/O pin
Q16	–	Do not use, leave unconnected
Q17[7]	**GND**	Ground
Q18[7]	**ANT**	Antenna

Top view



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.

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

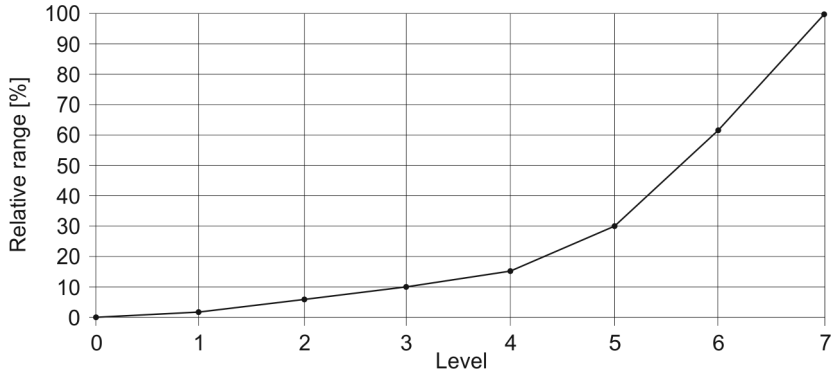


Figure 2: Relative RF range vs. level for the `checkRF(level)` function. Refer to IQRF OS Reference guide.

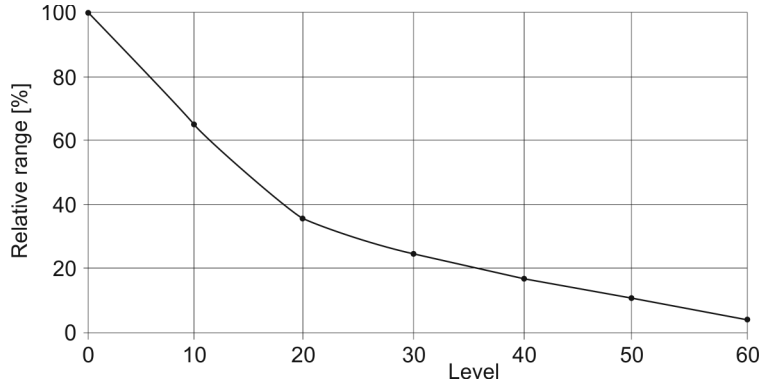
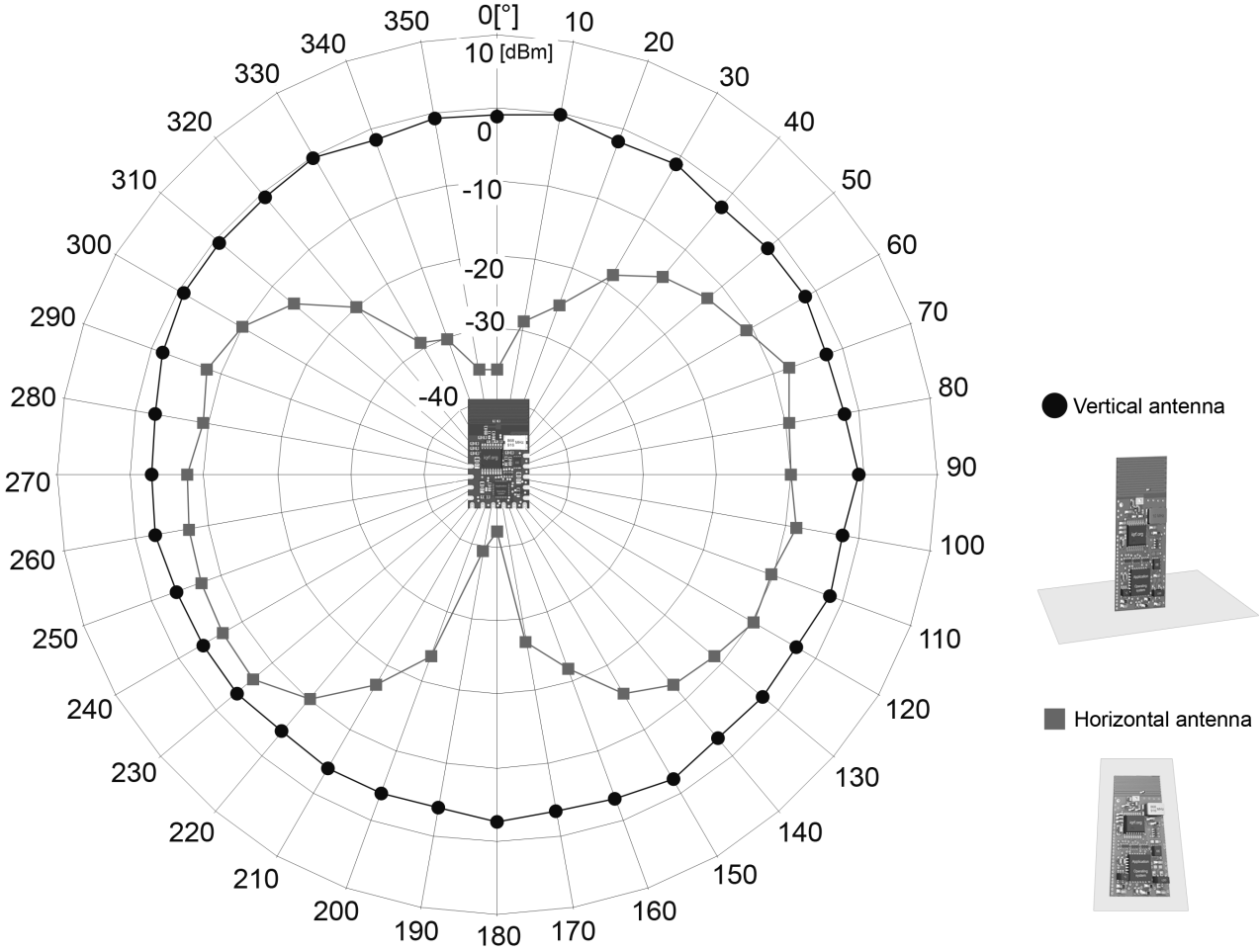


Figure 3: TR-54DA relative RF range vs. antenna orientation (radiation patterns)



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

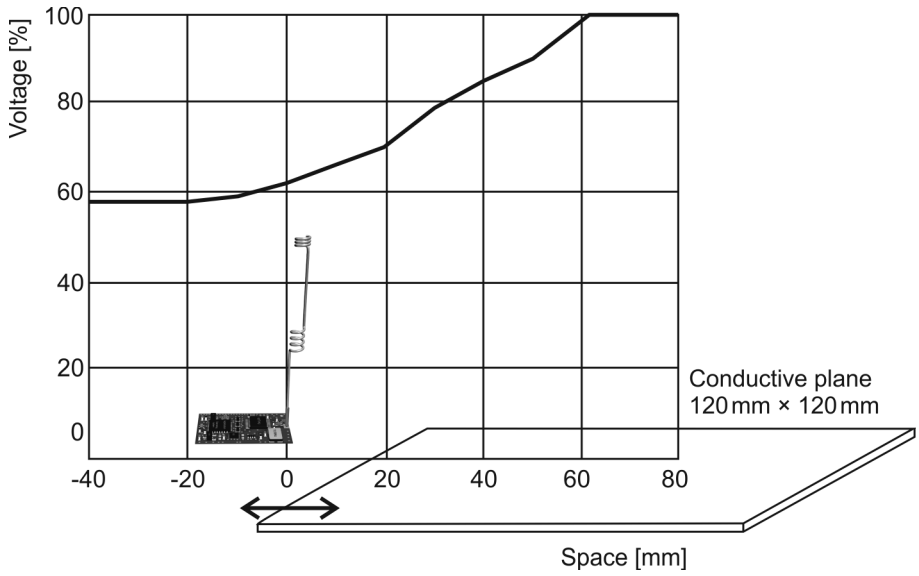
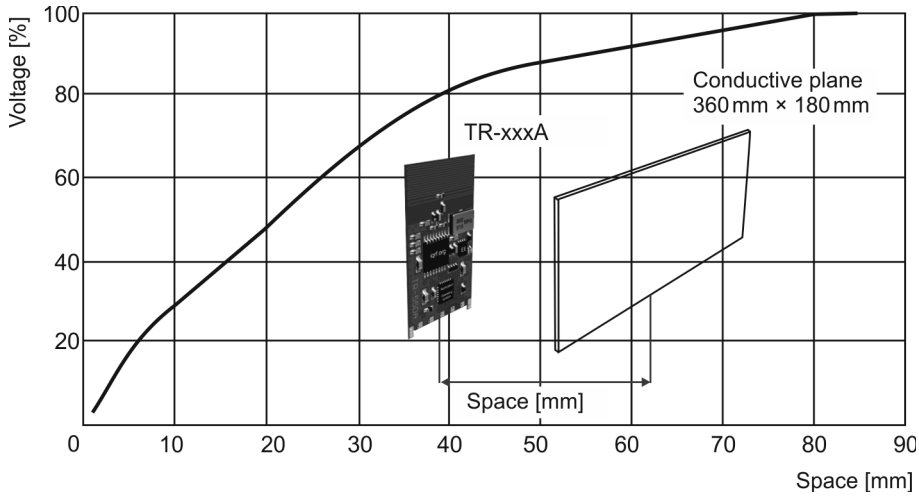
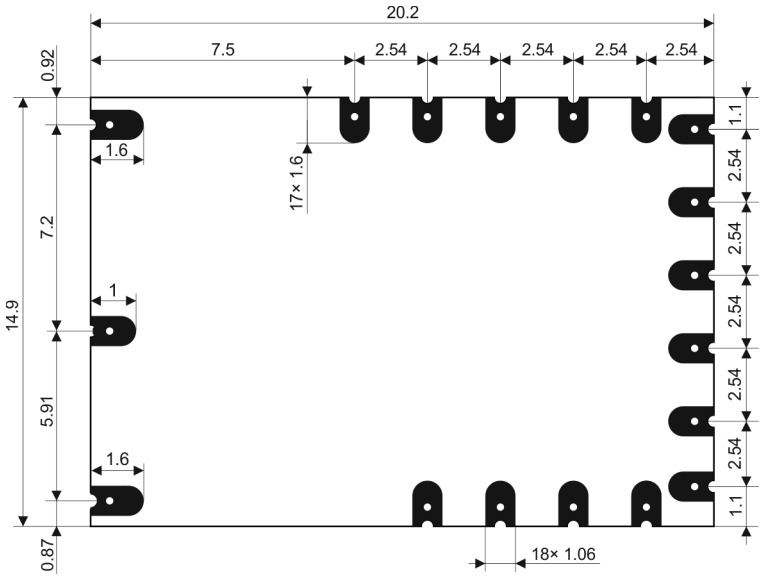


Figure 5: Parallel arrangement

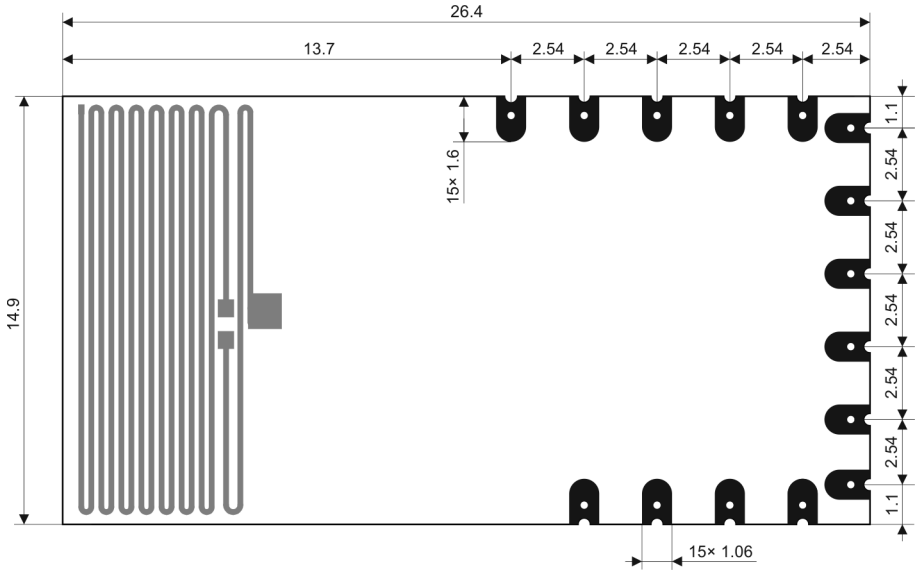


Mechanical drawings

TR-54D



TR-54DA



Top view, units: mm

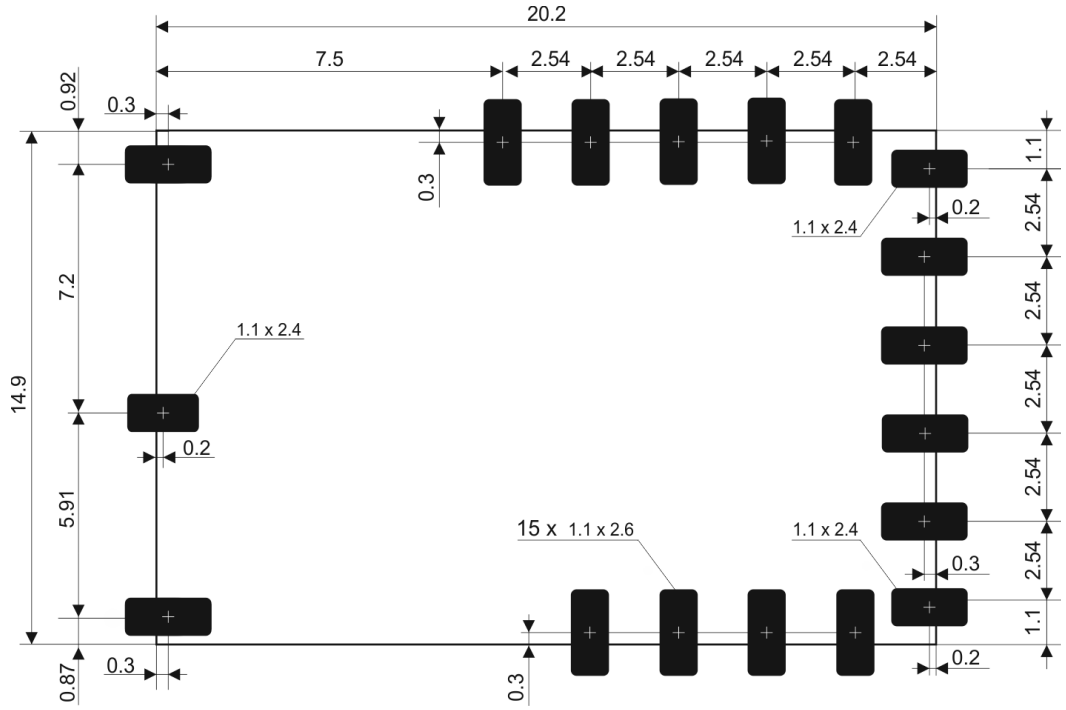
Application

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.

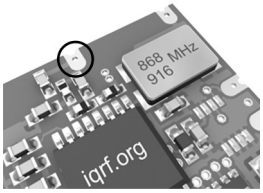
Product information

Ordering codes

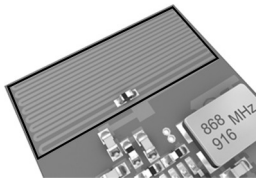
T R - 5 4 D A

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

- 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.

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