TR-72D-433

RF Transceiver Module

Data Sheet

Preliminary

Smarter Wireless. Simply.

Description

TR-72D-433 is a family of IQRF transceiver modules operating in the 433 MHz license free ISM (Industry, Scientific and Medical) frequency band. Its highly integrated ready-to-use design containing MCU, RF circuitry, integrated LDO regulator, serial EEPROM and optional temperature sensor requires no external components. Extended RF power results in higher RF range. Ultra low power consumption fits for battery powered applications. MCU with built-in operating system significantly reduces application development time. Optional DPA framework supports applications even without programming.

There is no difference between TR and DCTR transceiver versions from IQRF OS v4.02D. All TRs support both OS as well as DPA approaches.

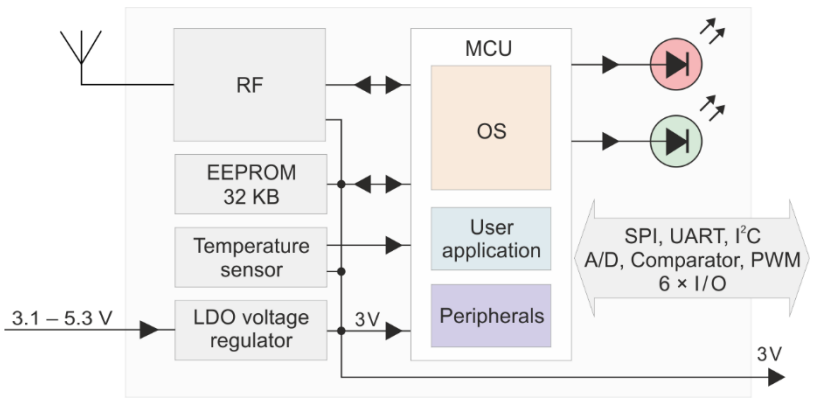
Key features

- Operating system (upgradeable at the user), easy to use
- DPA framework for Data controlled approach (formerly DCTR)
- GFSK modulation
- RF band 433 MHz, multiple channel
- RF output power 8 mW
- MCU with extended resources, user interrupt capability
- Extra low power consumption, power management modes
- SPI interface supported by OS in background
- Serial EEPROM 256 Kb
- 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: U.FL antenna connector, temperature sensor
- SIM card format fits KON-SIM-02 and KON-SIM-01 connectors
- Shielding can

Applications

- Bidirectional RF communication
- Point-to-point or network wireless connectivity
- Telemetry, AMR (automatic meter reading)
- WSN (wireless sensor network)
- Building automation
- Street lighting control
- Wireless monitoring, control and regulation
- Remote data acquisition
- RF connectivity in many other fields
- Also for municipal and indoor areas
- Internet of Things

Block diagram



Electrical specifications

***Typical values** unless otherwise stated*

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

Supply voltage (V_{CC})	3.1 V to 5.3 V
LDO output (V_{OUT})	+3 V ± 60 mV (V_{CC} > 3.1 V), 100 mA max.
Operating temperature [1]	-40 °C to +85 °C
Supply current	
Deep sleep mode (OS v4.00 or higher only)	1.9 µA (all peripherals disabled [2], RF IC in Standby mode)
Sleep mode	2.5 µA (all peripherals disabled [2], RF IC in Sleep mode)
Run mode	
RF sleep	1.6 mA
RF ready	3.0 mA
RX mode	
STD	12 mA
LP [3]	240 µA
XLP [3]	18 µA
TX mode (TR-72DC-433 with no antenna)	8.2 mA – 22.8 mA (according to RF output power)
Additional LED supply current	About 2 mA per LED. Rough value for brief guidance only.
RF band	433 MHz
RF channels	See IQRF OS User's guide, Appendix *Channel maps*
RF data modulation	GFSK (Gaussian Frequency Shift Keying)
RF data transmission bit rate [4]	19.8 kb/s
RF sensitivity	-104 dBm (STD RX mode, `checkRF(0)`)
RF output power (TR-72DC-433 with no antenna)	12.6 dBm (for 50 Ω load), programmable in 8 levels (0 – 7). See *Diagram 1*.
RF interface	Single-ended, output impedance 50 Ω
Input voltage on C1, C2, C5 to C8 pins	0 V to V_{OUT}
A/D converter	10 bit, 2 inputs. Refer to MCU datasheet.
Temperature sensor	MCP9808E/MC (for TR types with 'T' postfix only, e.g. TR-72DT-433)
Size (L x W x H)	25.1 mm x 14.9 mm x 3.3 mm

Note 1: RF range may change with lower temperature. Frost, condensation or humidity over 85% may disable module functionality. Transceiver suitability should be tested in the final application at real conditions before volume use.
Note 2: Additional current is consumed when a peripheral (e.g. watchdog, Brown-out detection etc.) is enabled.
Note 3: Depends on interferences.
Note 4: Several RF bit rates different from 19.8 kb/s will be available in future IQRF OS versions.

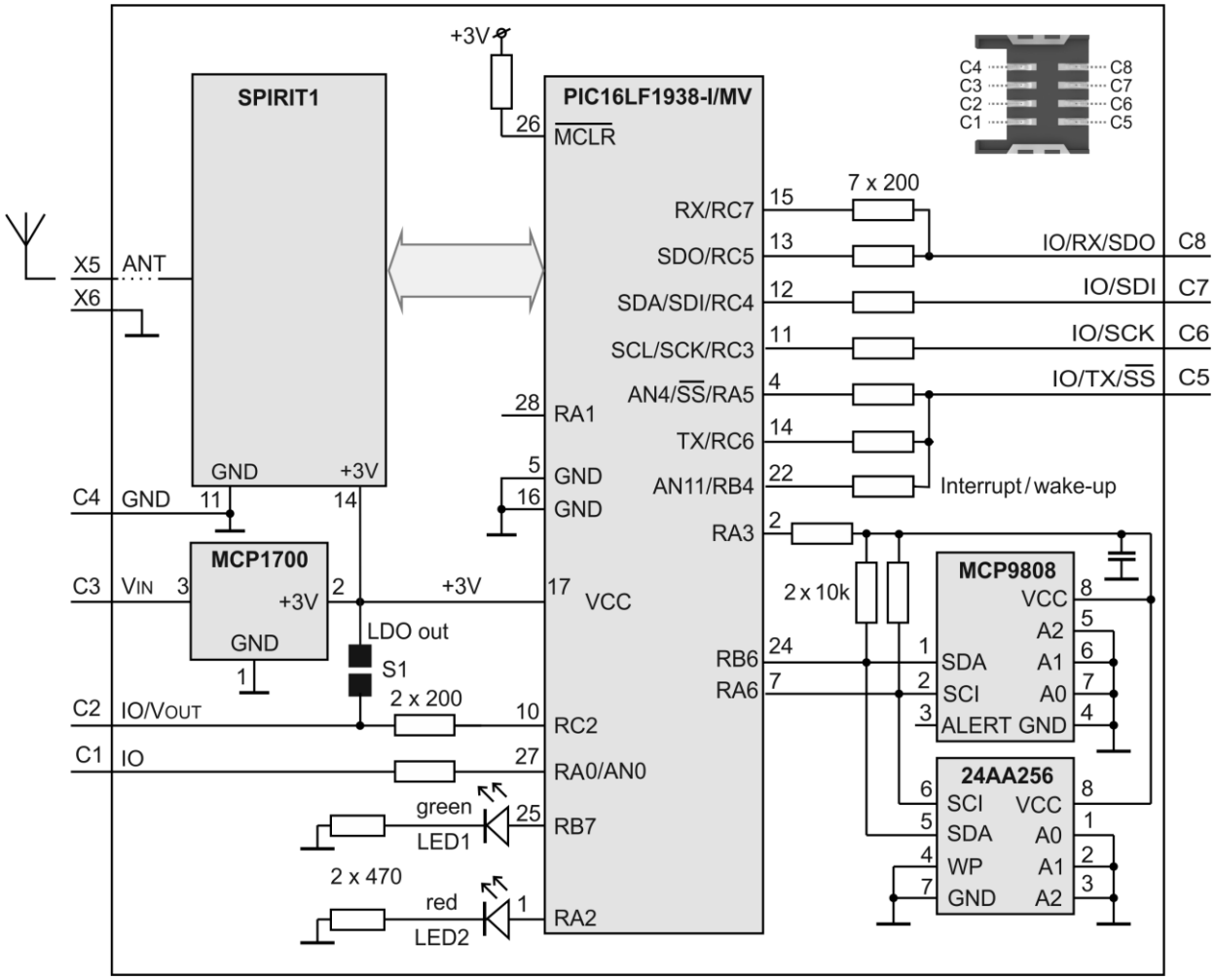
Absolute maximum ratings

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

Supply voltage (V_{CC})	5.5 V
Voltage on C1, C2, C5 to C8 pins (configured as inputs) vs. GND	-0.3 V to (V_{OUT} + 0.3 V)
Storage temperature	-40 °C to +85 °C
Ambient temperature under bias	-40 °C to +85 °C

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

Simplified schematic

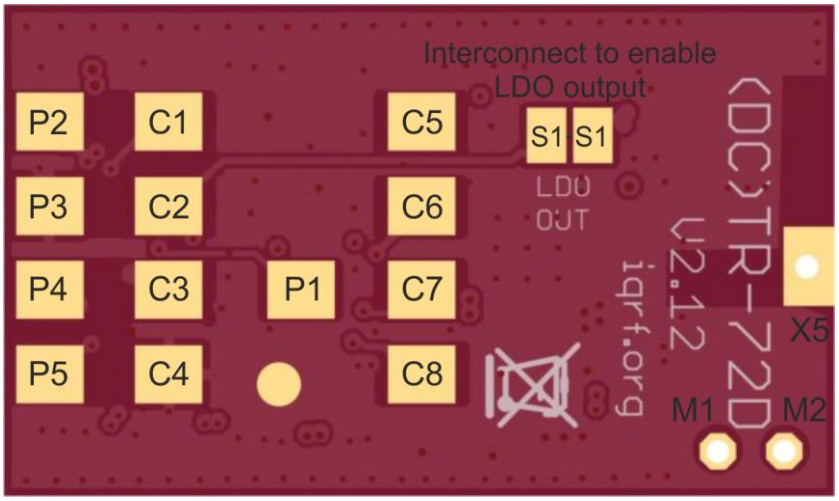


Basic components

IC	Type	Manufacturer	Note
MCU	PIC16LF1938–I/MV	Microchip	
RF IC	SPIRIT1	STMicroelectronics	
RF balun	BALF-SPI-02D3	STMicroelectronics	
LDO voltage regulator	MCP1700T-3002E/TT	Microchip	
Temperature sensor	MCP9808E/MC	Microchip	For types with ‘T‘ postfix only, e.g. TR-72DT-433
EEPROM	24AA256-I/CS16K	Microchip	256 Kb

For more information refer to datasheets of ICs used.

Pin	Name	Description
C1	**IO/ADC/C-IN**	
	RA0	General I/O pin
	AN0	Analog A/D input
	C12IN0	Comparator –input
C2	**IO/VOUT**	
	RC2	General I/O pin (when S1 disconnected)
	VOUT	On-board +3 V LDO output (when S1 connected)
C3	**VIN**	Power supply voltage
C4	**GND**	Ground
C5	**IO/ADC/TX/-SS/PWM/COUT**	
	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, with programmable pull-up and interrupt/wake-up on change (IOC), RFPGM termination
	AN11	Analog A/D input
C6	**IO/SCK/SCL**	
	RC3	General I/O pin
	SCK	SPI clock input
	SCL	I^2C clock
C7	**IO/SDI/SDA**	
	RC4	General I/O pin. Used as input during initial about 200 ms boot-up (after power supply rising-up) to recognize programming mode.
	SDI	SPI data
	SDA	I^2C data
C8	**IO/RX/SDO**	
	RC5	General I/O pin. Used as output during initial about 200 ms boot-up (after power supply rising-up) to recognize programming mode. That is why it should not be interconnected with the C7 pin.
	SDO	SPI data out
	RC7	General I/O pin
	RX	UART RX
X5	**ANT**	Antenna input
P1–P5		For manufacturer only
S1		LDO output enable. Interconnect both S1 pads to enable. Default (from the factory) disabled.
M1, M2		Holes for possible mechanical fixation



Bottom view

RF range

RF range strongly depends on the following design aspects:

- Hardware:
  - Construction of the devices (especially TR location within the device, PCB layout, ground planes, conductive areas and bulk objects such as metallic parts and batteries in the nearest surroundings, with respect to possible reflections and counterpoise effect)
  - Physical arrangement of devices (especially mutual orientations of antennas with respect to polarizations and radiation patterns)
- Application software:
  - RF output power is selectable from 8 levels
  - To increase immunity to RF noise, incoming RF signal can be filtered according to signal strength.

Refer to IQRF OS Reference guide, function `checkRF` and Application note AN014 *RF range optimizing at TR-7xDx transceivers.*

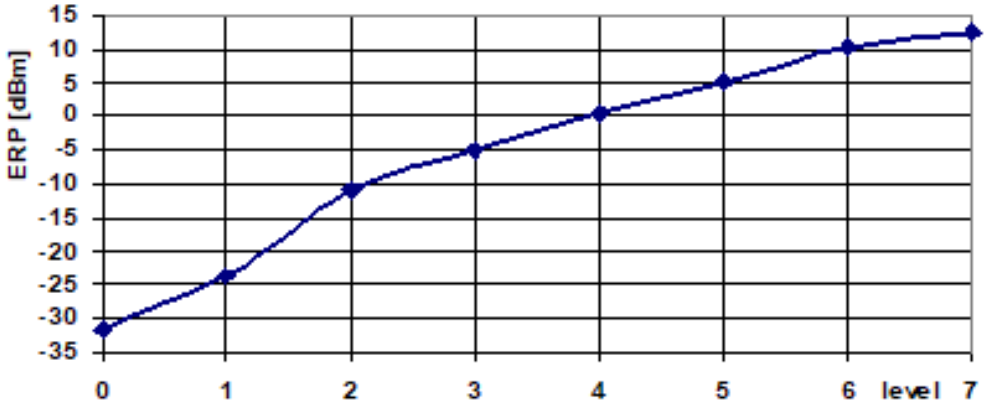


Diagram 1: *Effective radiated power (ERP) vs. level in the `setRFpower(level)` function. Refer to IQRF OS Reference guide. TR-72DC-433 without an antenna and antenna cable.*

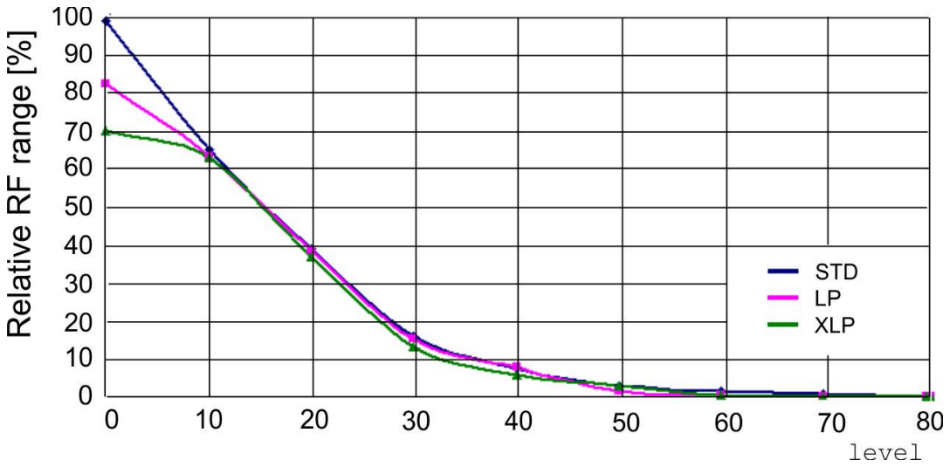
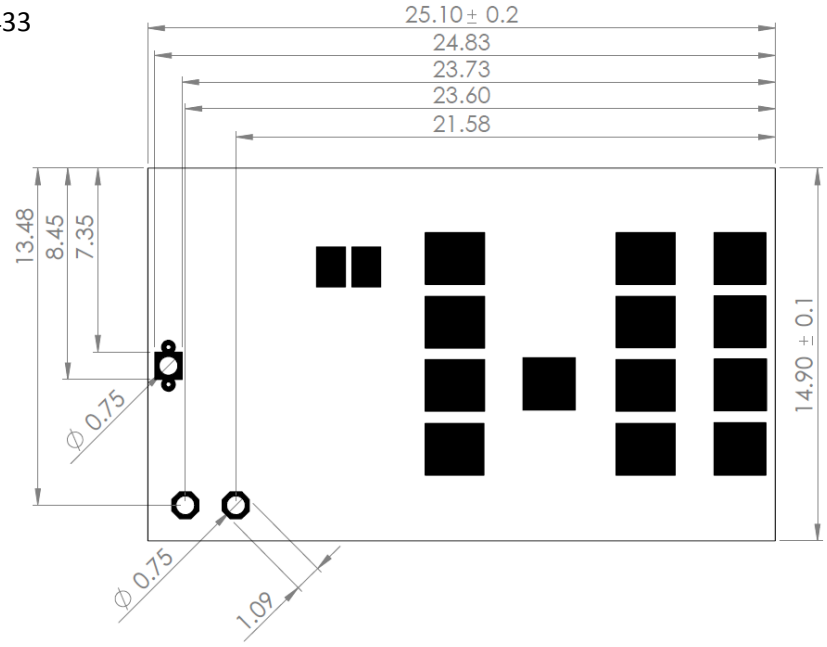


Diagram 4: *Relative RF range vs. `level` in the `checkRF(level)` function in STD, LP and XLP RX modes. Refer to IQRF OS Reference guide.*

Mechanical drawings

TR-72D(C)(T)-433



Top view, Units: mm

Hardware revision

v2.14	Slightly optimized for production.
v2.12	First release.

Application

*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.*

See IQRF video tutorial set on www.iqrf.org/videos.

Assembly

TR-72Dx-433 modules should be mounted in SIM connector. They are not intended for SMT reflow soldering. Recommended SIM connector: KON-SIM-02 or KON-SIM-01. It is not allowed to connect wires to pads (except the M1, M2 and S1 pads) by soldering.

Sealing

In case of sealing or protecting TR modules against a harsh environment by coating, encapsulating or potting using a lacquer, gel or other filling matter, the ion cleanness of the TR modules must be less than 1 µg/cm^2 of NaCl equivalent otherwise there is a risk of corrosion.

Such a surface treatment always impacts the RF range. Thus, sealing material should have the relative permeability (μ_r) as close to 1 within given frequency band. E.g. μ_r = 4 **at 433 MHz** decreases relative range to cca 70%.

Protecting materials, methods, accomplishments and handling must comply with general requirements and rules for proper use with electronic devices. Damaging, either chemical or mechanical (even due to the thermal expansivity of the material used) must be avoided. Testing is necessary to ensure that the application meets the specifications.

Operating system

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

DPA framework

See DPA Framework technical guide.

Application software

See IQRF Quick start guide and IQRF application examples.

Programming (upload)

There are the following possibilities to upload an application program in TR-72Dx-433 modules:

- Wired upload with TR-72Dx-433 plugged via the SIM connector in the CK-USB-04(A) programmer.
- For TR-72Dx-433 modules populated in an application:
  - Wired upload
    - Using the CK-USB-04A programmer. See the CK-USB-04A User's guide.
    - Using the CK-USB-04 programmer and the KON-TR-01P adapter. See the KON-TR-01P User's guide.
  - Wireless upload: See the IQRF OS User's guide, Appendix *RFPGM – RF programming™*.

Product information

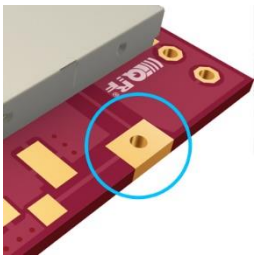
Ordering codes

T R-72D C P-433

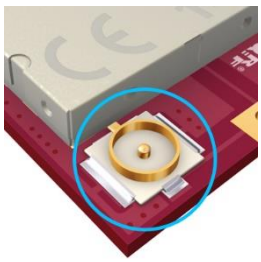
- RF band - 433 MHz
- Peripheral options
  - ***nil*** **-** No other option
  - **T** **-** Temperature sensor
- Antenna options
  - ***nil*** **-** Soldering pad-hole (no antenna, no U.FL connector)
  - **C** **-** U.FL connector (mini-coax)
- Transceiver series

Type	Antenna connection	Data controlled	Temperature sensor
TR-72D-433	Soldering pad-hole	Yes	–
TR-72DC-433	U.FL connector	Yes	–

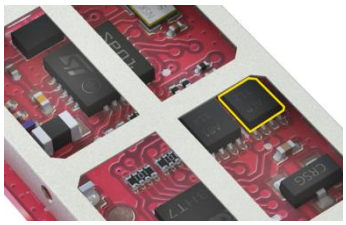
Type	Antenna connection	Data controlled	Temperature sensor
TR-72DT-433	Soldering pad-hole	Yes	Yes
TR-72DCT-433	U.FL connector	Yes	Yes



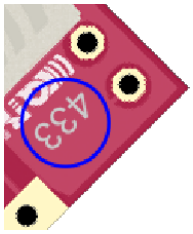
TR-72D-433



TR-72DC-433



TR-72DT-433 (uncovered)



433 MHz band identification

Document history

- 171108 Cosmetic improvements only.
- 170908 First release. Preliminary.

Sales and Service

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Partners and distribution

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Quality management

ISO 9001 : 2009 certified

Complies with ETSI directives EN 301489-1 V1.9.2:2011, EN 301489-3 V1.6.1:2013, EN 300220-1 V2.4.1:2012, EN 300220-2 V2.4.1:2012 and VO-R/10/05.2014-3. Not certified.

Complies with directives 2011/65/EU (RoHS) and 2012/19/EU (WEEE).

Trademarks

Legal

On-line support: support@iqrf.org

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