

CK-USB-04A

IQRF Programmer and Debugger

HW v1.00, FW v1.14

User's Guide



Description

CK-USB-04A is a development kit intended for programming and debugging of user applications with IQRF transceivers.

It can serve also as an IQRF USB gateway (with USB ↔ SPI and USB ↔ UART converter) or just a simple host for TR transceiver application.



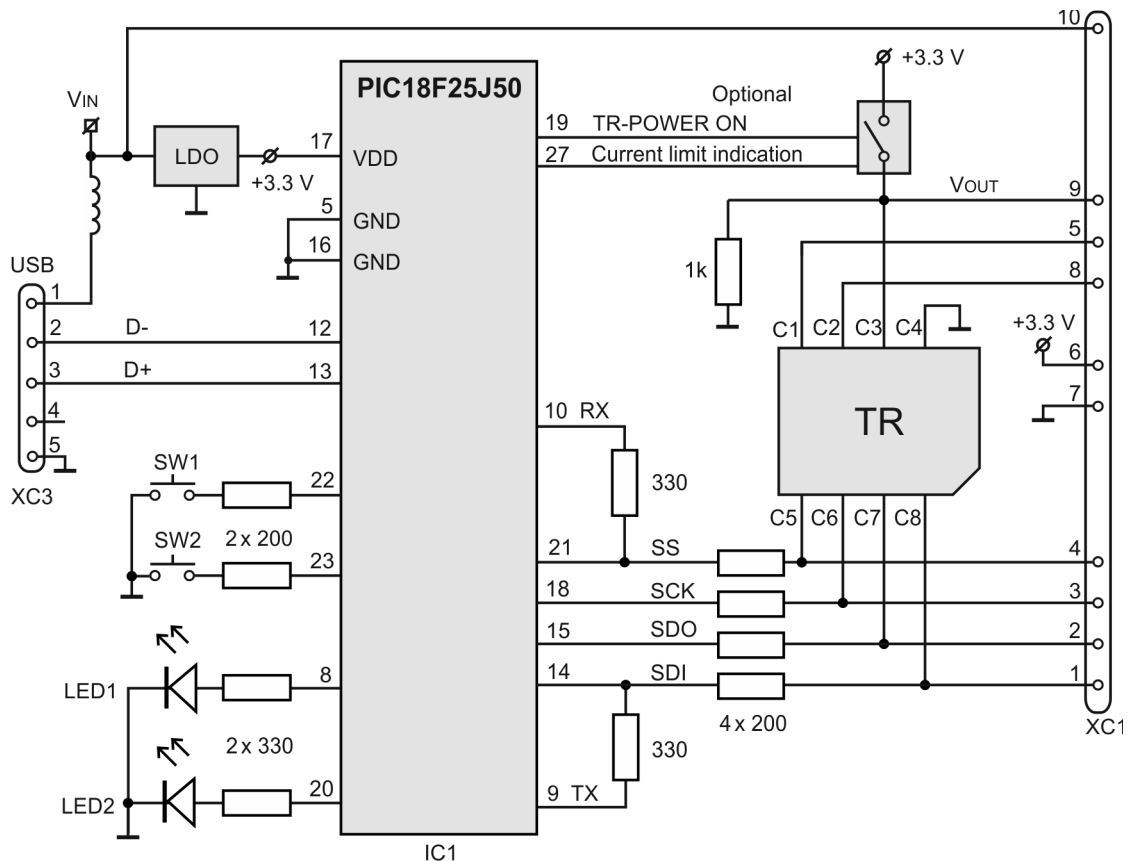
Applications

- Programmer for IQRF transceiver modules
- In-circuit programming supported
- IQRF debugging kit
- End IQRF application host
- USB gateway
- USB to SPI and USB to UART converter
- PC connectivity

Key features

- Supported by the IQRF IDE development environment
- Wired or wireless (RFPGM) upload possible
- SIM connector with plastic holder for TR module
- 2 pushbuttons, 2 LEDs
- USB interface (CDC and Custom device, MICRORISC VID & PID)
- Custom Device, CDC IQRF, CDC SPI and CDC UART modes
- Faster SPI for TR-7xD supported
- I/O, power supply and upload interface via single row connector
- Powered via USB connector
- V_{OUT} controlled by IQRF IDE, optionally current-limited
- Multiple devices controlled by IQRF IDE on single PC
- Firmware upgradeable from IQRF IDE

Simplified circuit diagram



Electrical specifications*Typical values (until otherwise specified)*

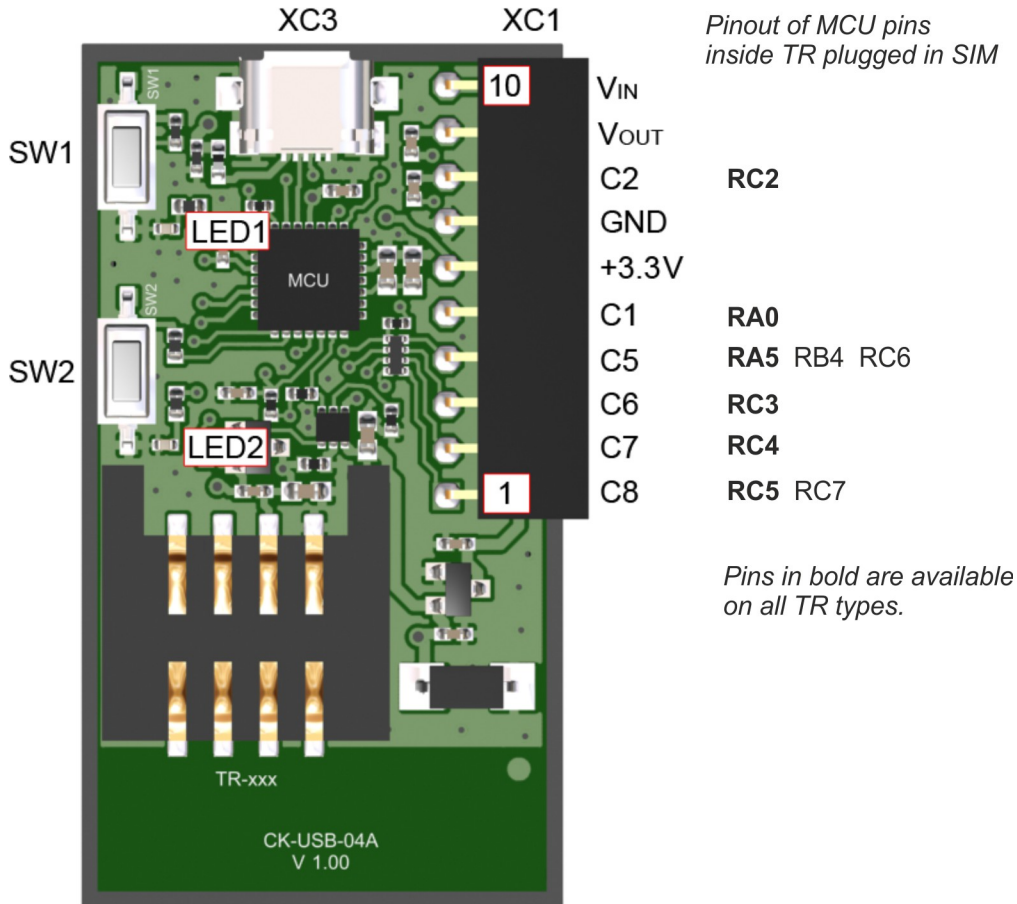
Power supply input (V_{IN})	
Supplied with USB	5.0 V
Supplied via external power connector XC1	3.6 V – 5 V
	USB must be disconnected in this case
Power supply output (V_{OUT})	3.3 V, with optional current limitation
I/O and SPI voltage levels	3.3 V
Operating temperature	0 °C to +70 °C
	-40 °C to +85 °C (Industrial) available on request
Size	48 mm x 27 mm x 11 mm
Weight	10 g

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:	5.5 V
Storage temperature:	-40 °C to +85 °C

Control and indication



Pushbuttons

USB mode selection

- Selection of USB modes can be enabled by pressing the SW1 pushbutton for 2 s. Then LEDs indicate the current mode by a series of flashing (see chapters *USB* and *LEDs* below).
- Every short press of SW1 switches the mode in cyclic order. LEDs always indicate the current mode by a series of flashing.
- SW1 pressing for 2 s stops the switching, stores the current mode and LEDs indicate this newly selected USB mode by a series of flashing.

USB mode selection is canceled (without storing the changes):

- Anytime by short pressing of SW2.
- Automatically, if SW1 is not pressed for 5 s.

SPI speed selection

Switching between *TR5x legacy* and *TR7x faster* modes (see chapter *SPI speed* below) is invoked by pressing both pushbuttons when power is switched on (while USB cable is connecting). The pushbuttons can then be released just after initial LED indication starts (see chapter *LEDs* below).

C5 pin control

- A short press of SW1 sets the C5 pin to log. 0 for 800 ms. During SPI communication this pushbutton is ignored. C5 pin control is applicable in Custom Device and IQRF CDC modes only.

TR module power off

- During SW2 pressed, V_{OUT} (TR module power) is off. It is useful for TR reset and restart the application program. This is applicable in all USB modes.

LEDs

After CK-USB-04A reset (by reconnecting the USB cable), current USB mode is indicated by a series of flashing¹ of both LEDs as follows:

- Custom Device 1x
- CDC IQRF 2x
- CDC SPI 3x
- CDC UART 4x

In idle state, both LEDs are off. If there is a need to indicate the current USB mode, it is possible either to perform the device reset or initiate the USB mode selection and abandon it then without storing the changes. See chapter *Pushbuttons*.

LED1 flashes 3x after the *Indicate USB Device* command (key *F11*) in respective IQRF IDE (to identify the kit in case of multiple IQRF USB devices or IDE instances).

LED1 flashes¹ once if SW1 is pressed (in Custom Device and CDC IQRF modes only).

LED2 flashes¹ once after TR reset induced by IQRF IDE and shines permanently when SW2 is pressed.

Complementary LED1 and LED2 flashing in ~1 s period means missing firmware or firmware upgrade in progress (see *Firmware upgrade* below).

Note 1: There are two types of flashing possible in these conditions to indicate current SPI speed (see below):

- Continual LED shining during given indication: TR5x legacy mode
- Fast LED blinking during given indication: TR7x faster mode

Connectors

- USB: Micro USB
- SIM: Supported TR types see table *Compatibility* below.
- XC1: I/O/SPI/programming/power interface. Female connector for square 0.635 mm, 2.54 mm pitch pins.

Caution: The TR module can be plugged / unplugged into / from the SIM connector while powered off only.

Tip: Use the SW2 pushbutton for this. The TR module is not powered while the SW2 pushbutton is held.

SPI speed

Depending on TR type, two SPI communication speeds are available.

- TR5x legacy mode – necessary for TR-5xD and lower transceiver types, possible also for all other TR types.
- TR7x faster mode – allowed (and recommended) for TR-7xD and higher transceiver types.

As a matter of interest, details regarding SPI timing are described in documents *SPI Implementation in IQRF for (DC)TR-7xD* and *SPI Implementation in IQRF for TR-5xB and (DC)TR-5xD*, chapter *Timing*.

SPI speed selection:

- Using IQRF IDE Menu *Tools* – *IQRF Device Manager*.
- Using hardware pushbuttons See chapter *Pushbuttons* above.

Refer to chapter *LEDs* for indication of the current mode. The last selected mode is restored after start-up or reset.

USB

USB modes

The device supports four USB modes:

- Custom Device
- CDC IQRF
- CDC SPI
- CDC UART

Both USB drivers (Custom Device and CDC) are installed within the IQRF IDE installation.

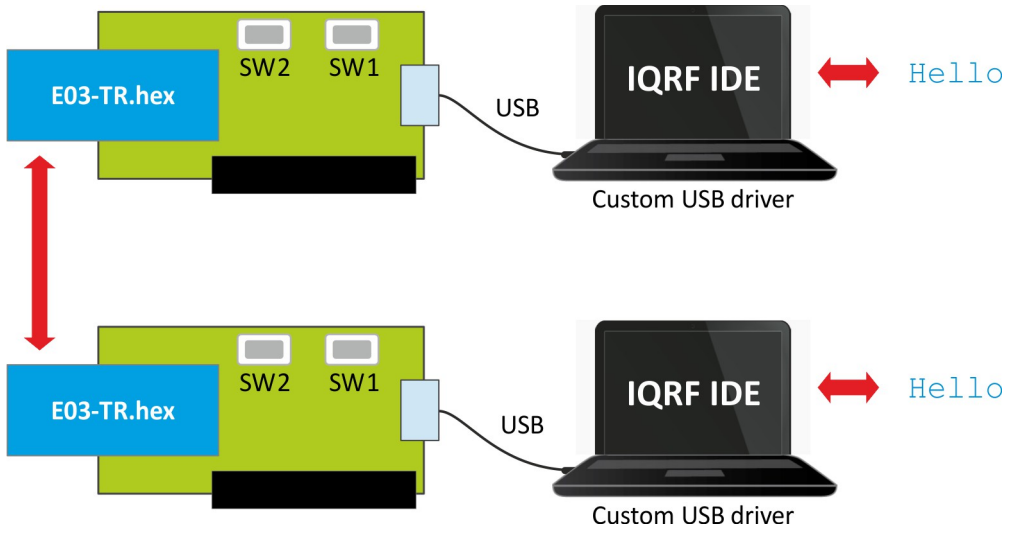
USB mode selection

- Using IQRF IDE: Menu *Tools – USB Classes* (for all modes, see IQRF IDE Help).
- Using the hardware pushbuttons (for all modes). See chapter *Pushbuttons* above.
- Using commands in CDC IQRF protocol (from CDC IQRF mode only). See the *CDC Implementation in IQRF USB devices User's guide* ([User_Guide_CDC_XXXXXX.PDF](#)).
- Using the sequence *1 s inactive *** 1 s inactive* sent from a USB host application (for switching from CDC SPI or CDC UART to CDC IQRF only). The switching is performed after about 5 s.

See chapter *LEDs* for indication of the current mode. The last selected mode is restored after start-up or reset.

Custom Device mode

Full communication with the IQRF IDE is enabled in this mode.



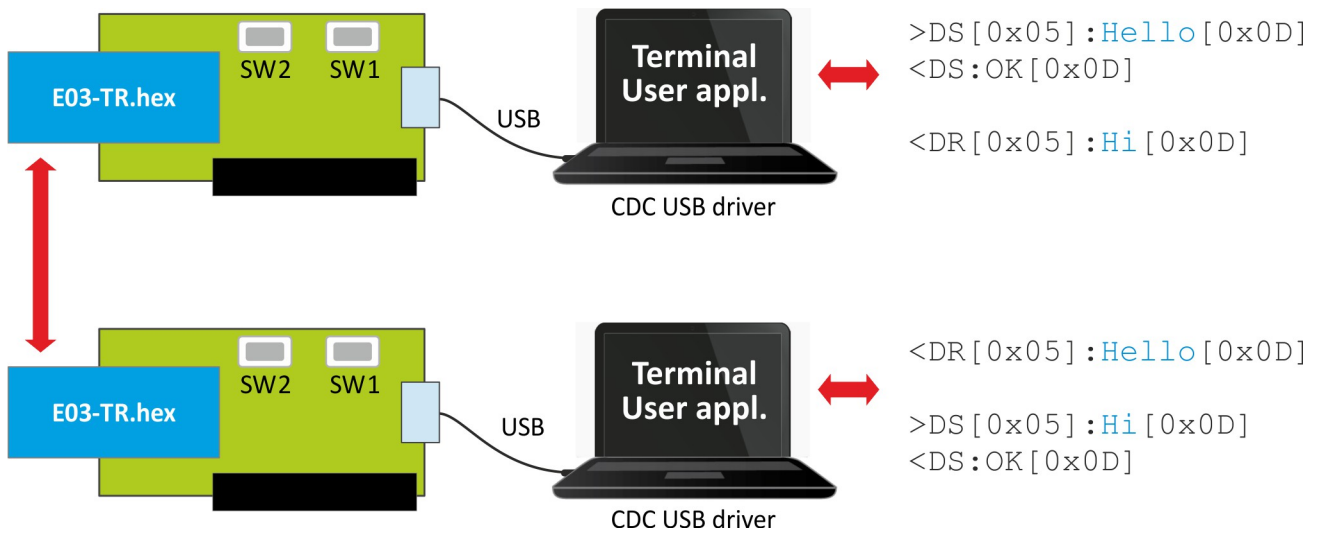
CDC IQRF mode

After connecting to PC a virtual serial port is created in this mode. The user can create one's own PC program and communicate via this port using the protocol described in document *CDC Implementation in IQRF USB devices User's guide*.

This protocol enables:

- Communication with TR module
- Communication with the USB device itself
- Confirmation of commands
- Information about error states

This mode is recommended for communication with custom (USB host) applications and is supported by the IQRF SDK (Software Development Kit, open source). The application in TR transceiver must use SPI communication.



Tip

For testing a communication in CDC mode various SW terminals operating with PC serial ports are available. Select a terminal enabling to issue direct byte commands and data. Refer to the communication protocol described in *CDC Implementation in IQRF USB devices User's guide*.

Recommended terminal: Docklight, www.docklight.de. There is a project containing all supported commands for this terminal available at www.iqrf.org/218. It is necessary just to select the COM port used.

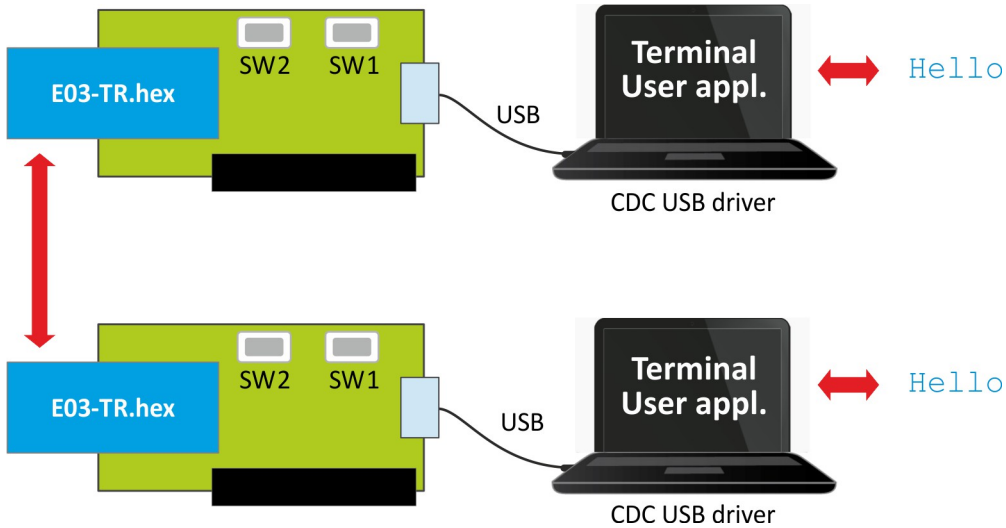
Unsuitable terminals: Windows Hyperterminal and Tera Term.

CDC SPI mode

After connecting to PC a virtual serial port is created in this mode.

This mode is intended for testing of the user application for TR transceiver utilizing SPI communication. It works similarly as the CDC IQRF mode but it has no protocol implemented and the data is transferred transparently. It can be used also in case when the user (a USB host) application does not allow to implement any proprietary protocol. Otherwise, the CDC IQRF mode is recommended.

The application in TR transceiver must use SPI communication.



CDC UART mode

After connecting to PC a virtual serial port is created in this mode.

Application

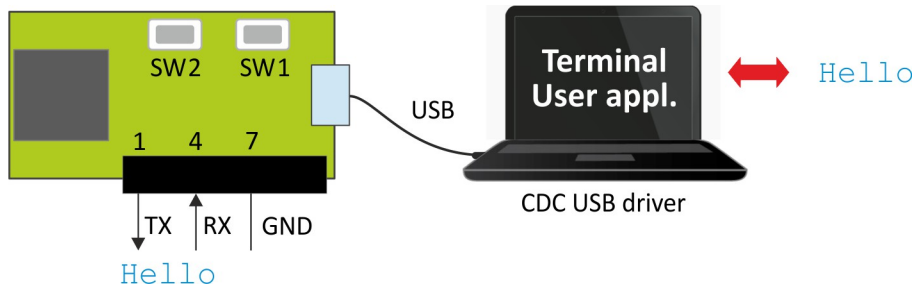
- USB ↔ UART converter
- Testing of user applications for TR transceiver using UART communication

UART parameters

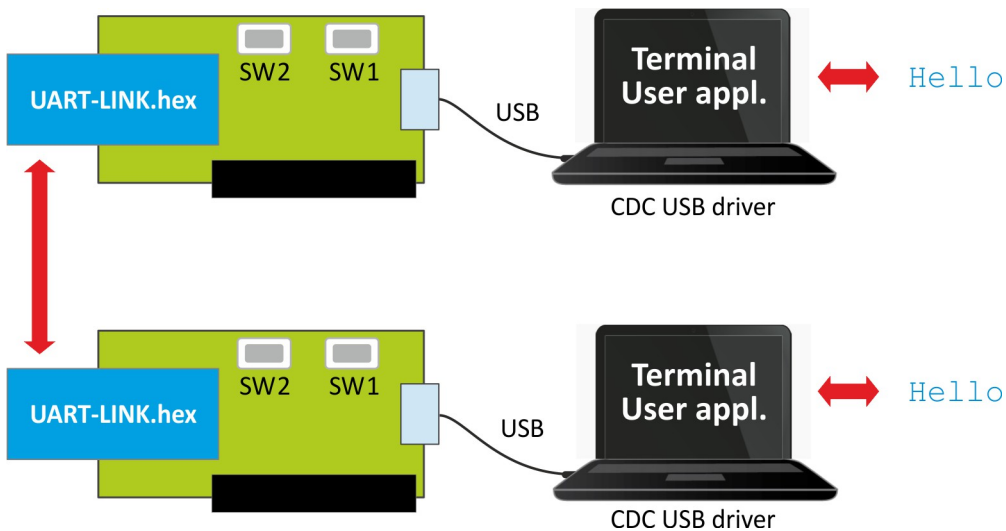
- Voltage levels: 3 V
- Baud rates: 150, 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 76800, 115200 Bd
- Data bits: 8
- Parity: None, Odd, Even, Mark, Space
- Stop bits: 1
- Operation: duplex
- Number of data bytes in a packet: max. 64
- End of packet detection timeout: approx. 3 * transmission time for one byte (with respect to given baud rate)

This mode has no protocol implemented and the data is transferred transparently.

The application in TR transceiver must use UART communication.



Local connectivity



Wireless connectivity

Application

Installing

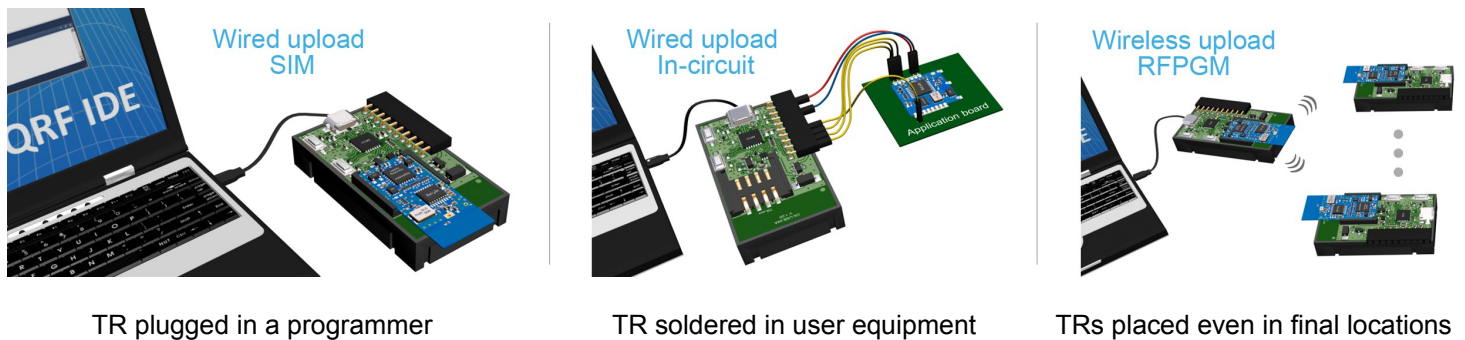
See the IQRF Quick Start guide, IQRF IDE Help and IQRF application examples (www.iqrf.org/examples).

Upload

CK-USB-04A enables to upload an application code into IQRF TR modules in following ways:

- Wired upload
 - TR module plugged in the SIM connector – see the IQRF Quick Start guide.
 - TR module assembled in the user equipment (in-circuit upload via connector XC1), see below.
- Wireless upload (RFPGM – RF Programming™) – see IQRF OS User's guide (Appendix RFPGM) and IQRF IDE (*Programming* → *RF programmer*).

Supported TR types see table *Compatibility* below.



TR plugged in a programmer

TR soldered in user equipment

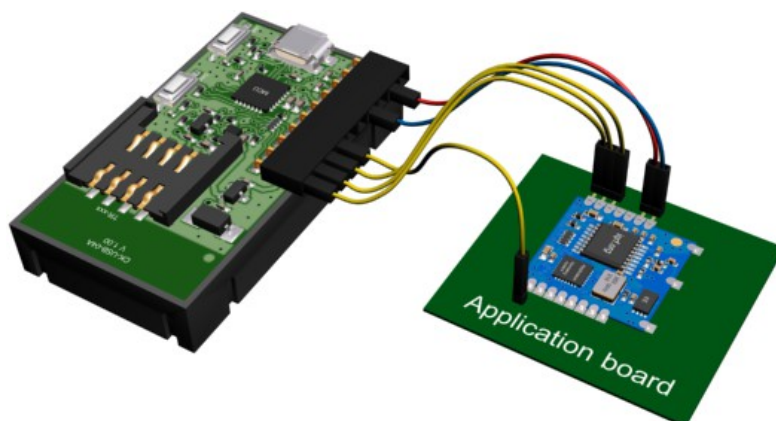
TRs placed even in final locations

In-circuit upload

CK-USB-04A enables to upload an application code also into IQRF TR modules assembled in end user equipment. This allows to manufacture boards with soldered unprogrammed TRs and then upload the code just before shipping the product (to deliver the most recent SW version or a custom modification) or even upgrade the code with a new SW version later on.

6-wire programming interface (GND, power supply line and 4-wire SPI) is accessible on the XC1 connector. Pin connection for individual TR modules:

	C5	C6	C7	C8	C4	C3
	–SS	SCK	SDI	SDO	GND	Vout
TR-52D, TR-72D	C5	C6	C7	C8	C4	C3
TR-54D	Q11	Q6	Q7	Q8	Q2	Q3
TR-55D	Q3	Q6	Q5	Q4	Q7	Q1
TR-56D, TR-76D, TR-77D	Q9	Q6	Q7	Q8	Q2	Q3

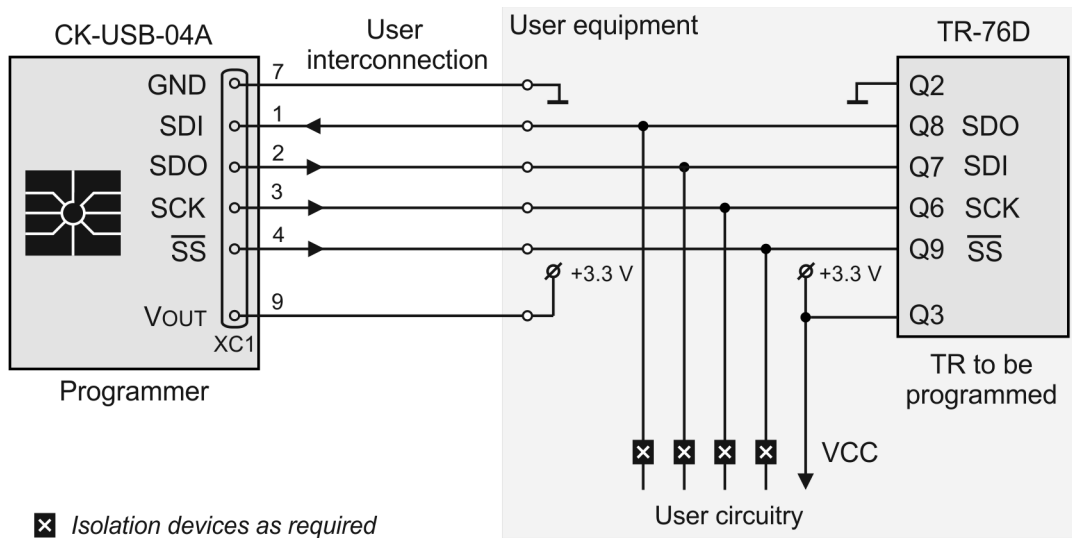


SPI lines must be isolated from other circuitry to avoid influencing on levels by the user equipment. Isolation devices are highly dependent on the specific application and may include devices such as resistors, diodes, or even jumpers. High impedance output can also be considered as a suitable isolation.

There are two typical ways of connection regarding power supply. The following diagrams show examples for TR-76D. For other TR types refer to table *Pin compatibility* above.

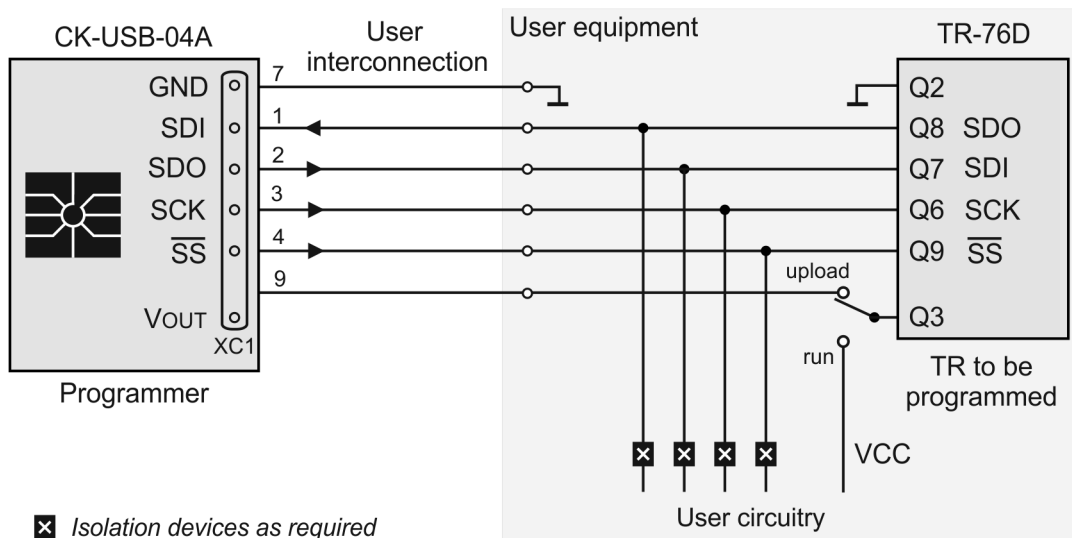
1. Application supplied from the programmer during upload

User applications with **3.3 V** supply voltage, consuming **100 mA max.** can be supplied from the programmer. Target equipment must have its own power source turned off during upload.



2. Application supplied from its own power source during upload

For user equipment consuming more than 100 mA, just the TR module must be supplied from the programmer. Thus, the independent power source supplying the rest of the equipment must be separated during upload.



Interconnection between CK-USB-04A and TR transceiver

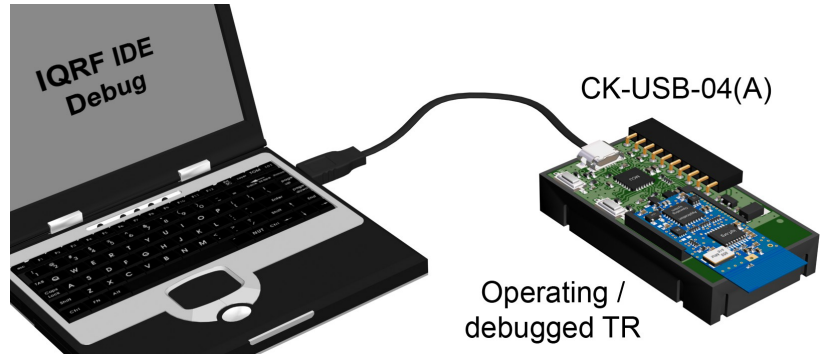
No interconnection cable between the adapter (via connector XC1) and user application is provided. The user should create a connection according to the specific application. **Max. 10 cm cable length is allowed.**

For TR modules with the RJ-45 connector, e.g. TR-58D-RJ, special interconnecting kit KON-RJ-01 is intended.

Programming adapter KON-TR-01P intended for in-circuit upload using CK-USB-04 can also be used with CK-USB-04A.

Debug

See the IQRF Quick Start guide, IQRF IDE Help and IQRF application example E06-RAM (www.iqrf.org/examples).



Compatibility

Supported TR module types, upload methods and corresponding interconnection:

	Plugged in SIM	In-circuit	RFPGM
TR-52D, TR-72D	Yes	XC1	Yes
TR-54D	–	XC1	Yes
TR-55D	Yes	XC1	Yes
TR-56D	Yes	XC1	Yes
TR-76D, TR-77D	Yes	XC1	Yes. RFPGM termination by SW1 pushbutton or by <i>End RFPGM</i> button in IQRF IDE is not possible.
TR-58D-RJ, TR-78D	–	KON-RJ-01	Yes
TR-52B	Yes	XC1	Yes
TR-53B	–	XC1	Yes

Firmware upgrade

CK-USB-04A firmware can be upgraded by the user with new versions possibly released by the IQRF manufacturer using the IQRF IDE 4.21 or higher, menu *Tools – IQRF Device Manager – Upload FW*. See IQRF IDE Help.

Product information

Pack list

- CK-USB-04A IQRF programmer & debugger (without a TR module and interconnection cables).
 V_{OUT} current limitation not implemented.

Recommended options

- CAB-USBABMICRO Standard microUSB communication cable (USB A ↔ micro USB)
- KON-RJ-01 Interconnecting kit to upload TR modules with RJ-45 connector, e.g. TR-58DA-RJ
- [Pinout stickers](#) Labels for description of interface XC1 connector pins, to be printed and glued on the connector

Ordering code

- CK-USB-04A IQRF development kit

Document history

- 170823 Updated for TR-78D transceivers.
- 170810 Chapter *Sales and services* updated.
- 170428 Updated for FW 1.14 and TR-77D. Simplified circuit diagram precised, resistor values added. Diagrams slightly updated for TR-76D transceivers.
- 150921 For FW v1.13. Faster SPI for TR-7xD supported. Table *Compatibility* revised.
- 150805 Extended for TR-72D and TR-76D transceivers.
Bug in in-circuit upload circuitry schematic (pins SDI and SDO) fixed.
- 150119 Updated for 4 USB modes. Pinout of MCU pins added in chapter *Control and indication*.
- 140120 Revised, updated for new TR modules and IQRF IDE. Document file renamed from MNCKUSB04A_131121 to User_Guide_CK-USB-04A_140120.
- 131121 First release.

Sales and Service

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