Contents

Introduction to IQRF

IQRF is a platform of wireless communication using the MESH network with low power consumption, low data transfer rate, suitable for smaller data volumes, with the range from tens to hundreds of meters (up to several kilometers in special cases). It can be applied in the fields of telemetry, industrial control, automation of buildings and cities etc. It can be used for any electronic device that requires wireless transmission, for example wireless control, monitoring of remotely obtained data or connection of other devices to a wireless network. Implementation of IQRF is very easy. Radio frequency bands are used for communication: free ISM **868 MHz**, **916 MHz** and **433 MHz**.

Each communication module contains an embedded operating system, which is used for the actual communication. Besides OS, DPA plugins are uploaded into the modules (a different plugin for each device of the type of node and coordinator). These plugins provide the basic superstructure for the OS. If it is necessary to add a user code to the application, it is possible to use Custom DPA Handler, which is a program in C language using DPA commands and functions of the OS.

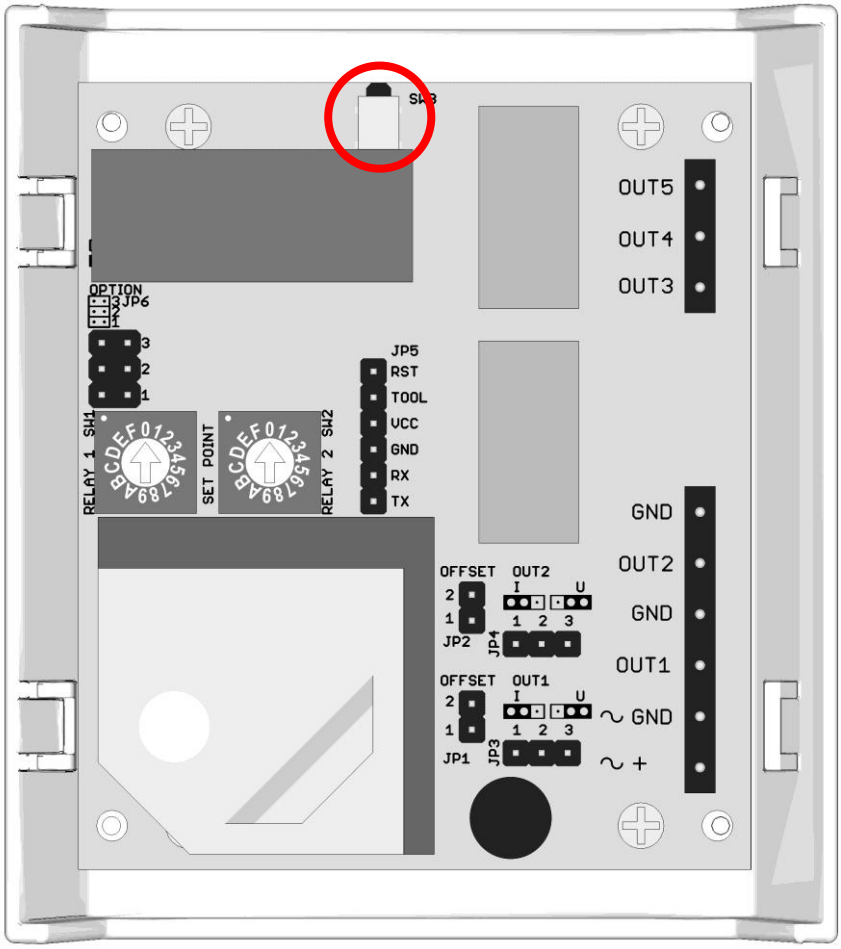
Basic terms in the area of IQRF

node	IQRF module configured as a network node that can participate in delivering the message to the destination node.
coordinator	IQRF module configured as a control element of the network, serving also as an exit point from the network.
bonding	A pairing process between the device of the type coordinator and the device of the type node.
discovery	The process of discovery of the network topology consisting of bonded node devices and the coordinator.

Integrating sensors into the IQRF network

It is necessary to perform three basic steps to create a fully functional network. The first step is to configure the module of the coordinator and the node (sensor) to the same frequency band and the same RF channel. The second one is bonding the sensor to the coordinator. The third step is to perform the so-called discovery on the coordinator. The process of discovery is performed only, when all the elements of the network are bonded and placed in positions, which they will occupy during the operation.

SW3 button located on the right side of the sensor (see the Fig.) is used for the process of bonding, or in some cases potentially unbonding.



Change of RF band, RF communication channel

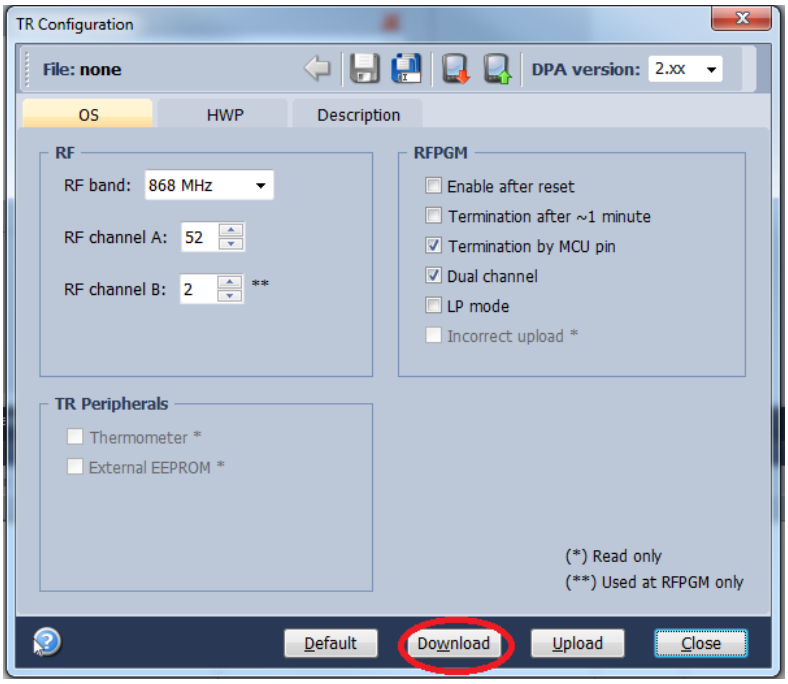
The default configuration of IQRF modules in sensors is the following:

RF band: 868 MHz
RF channel A: 60
TX power: 7
RX filter: 5
Alternative DSM channel: 0

If necessary, you can change any of the parameters from IQRF IDE environment (see www.iqrf.org), if you own one of the products that cooperate with this environment (gateway, development kits) (see www.iqrf.org).

1) Changing the locally connected IQRF module

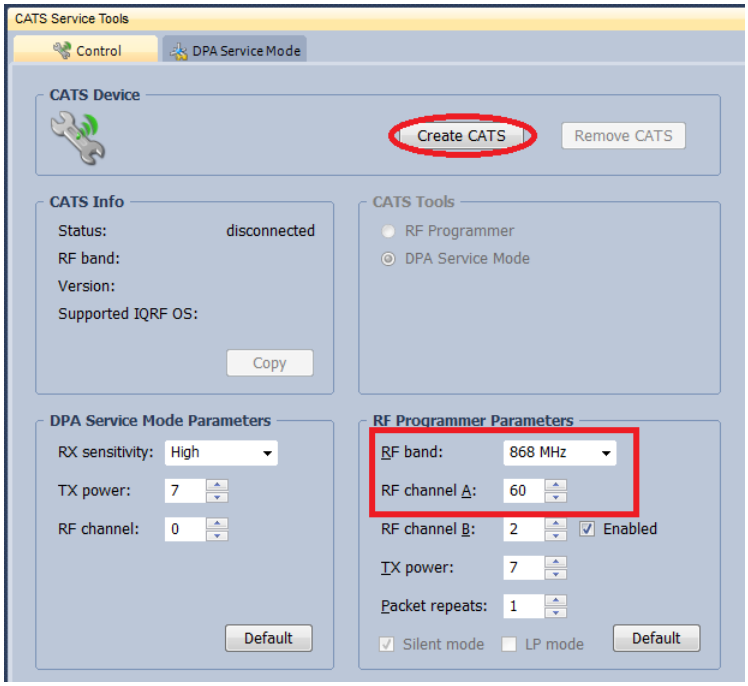
If the module can be inserted directly to these devices, you can change the configuration locally in the menu invoked by pressing CTRL+G after creating a new project in IQRF IDE. First download the current configuration of the module by means of Download button (see the Fig. below).



Now, perform the necessary changes and then upload the created configuration to the module using Upload button.

2) Changing the remotely connected IQRF module (CATS)

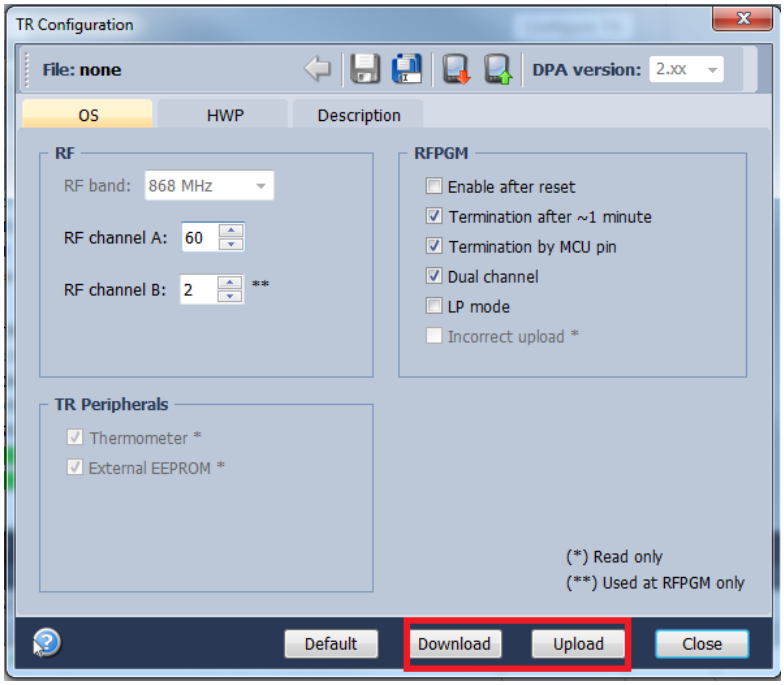
If you cannot insert the module directly to the connected device, it is possible to use CATS service tools invoked by pressing CTRL+ALT+C. First, however, you must create a backup of the plugins, configurations and user code in the device, which will have to be subsequently recovered. Enter the parameters RF band and RF Channel A in CATS according to our defaults and confirm by means of Create CATS button (see the Fig. below).



Afterwards, confirm the popups and create a diagnostic device. Now switch to DPA Service Mode and then to the tab DPA Service Mode. Here, choose MID: First available and then press Connect (see the Fig. below).

Now disconnect and connect the power supply on the sensor. Subsequently, the sensor will be activated in SW. After pressing Configure TR, you can change the required settings (see the Fig. below).

Here, first download the current configuration by clicking on Download button, make the desired changes, and then upload the new configuration to the module by means of Upload button.



Finally, just disconnect the remotely connected sensor by pressing Disconnect button, go to the tab Control and click Remove CATS. This will complete the change. Now perform the recovery of the backed up plugins, configurations and user code, if necessary.

3) Requirement for a change of the configuration before the sale

In case you do not have the possibility of changing the required settings by any of the available options, while this change is absolutely necessary for you, please contact us and we will provide you with a sensor with a customized module adjusted to your requirements.

Bonding

Before the bonding process, it is necessary to verify, whether the module node (our sensor) is not already bonded to coordinator (the sensor is unbounded by default from the factory). If the module is not bonded, after supplying power to the sensor, red light will be flashing for 10s on the IQRF module at two small holes on the metal surface. If no light is on, the module is still bonded to some coordinator, and in such case you must first unbond the module according to the chapter Unbonding.

1) Activate the bonding process on the module coordinator according to the documentation of the manufacturer of the device for the coordinator
2) Press SW 3 button on the sensor
3) Successful bonding is signalled by a flashing green light on the module. Now release SW 3 button.
4) In case of failure, repeat the process from the point 1)

Unbonding

Both on the side of the coordinator and the node

1) If the device of the coordinator supports this unbonding option, bring power to the sensor and proceed according to the manufacturer's instructions for the device of the coordinator.
2) Successful unbonding is signalled by a red light flashing for 10 seconds.

Just on the side of the node

1) Press SW 3 button
2) Perform opening and closing of the sensor power supply
3) Green light lights up on the module
4) Press and hold SW3 button during the period, when the green light is lit
5) As soon as the green indicator goes dark, release SW3 button
6) Successful unbonding is indicated by a brief flash of red light and then the red light is flashing for 10s

Discovery

After successful bonding of all nodes and deployment of modules according to the subsequent common use, activate the process Discovery according to the instructions of the manufacturer of the equipment intended for the coordinator.

If you own any of the equipment connectable to the IQRF IDE environment (see www.iqrf.org) you can perform bonding, unbonding and discovery processes directly in this environment, according to the video tutorials on the mentioned website.

Communication with the sensor

Communication with the sensor is mediated by IQRF module, which is accessed by the customer wirelessly using DPA reports (frameworks). **DPA uses little-endian**, meaning that portions of the framework longer than 1B are transmitted in the order from the lowest to the highest byte. Data in the following frameworks are written in such a way that it is necessary to **rearrange** multiple-byte items of the framework **according to little-endian.**

Parameters of communication of the sensor with IQRF module

The sensor communicates with IQRF module (node) using the standard UART peripherals of IQRF module. When turning on the power supply of the sensor, the module activates the so-called autoexec sequence (part of the code Custom DPA Handler exercised during the start), in which standard UART peripherals on the module side are opened. This means that the user does not have to take care of anything.

Communication is set to 19200 bauds, 8 data bits, no parity bit, 1 stop bit. These parameters cannot be changed, but that is no obstacle, because the module and hence the entire sensor is accessed through RF communication and the IQRF module itself then takes care of everything necessary.

Types of DPA frameworks

There are three types of DPA frameworks. The first is DPA Request, by which the coordinator sends requests to the given module node. This is followed by DPA Confirmation, which is sent by the target node back to the coordinator and confirms receipt of DPA request. Finally, the node sends DPA Response, which is a response to DPA Request.

General framework structure

NADR	PNUM	PCMD	HWPID	Pdata
(2B)	(1B)	(1B)	(2B)	(0-56B)

NADR	Module network address (node 1 to 239)
PNUM	Periphery address (Standard peripherals 0 to 31)
PCMD	Command specifying the requested operation for the given peripherals (0 to 62)
HWPID	value for the filter of the type Hardware node device, the command is processed only for the identical HWPID (0xFFFF – check omitted, processed always) HWPID of the sensor is 0x0132
Pdata	The data part depends on the type of the framework, PNUM, PCMD

DPA Request UART peripherals framework of the command Write & Read

Since the sensor communicates with the IQRF module via standard UART peripherals, all DPA Request frameworks (except activating the sleep mode of the module) will have the following form:

NADR	PNUM	PCMD	HWPID	Read timeout	Data
according to bonding	0x0C	0x02	0x0132	0 - 0xFE	data
(2B)	(1B)	(1B)	(2B)	(1B)	(max 32B)

NADR	Address of the sensor specified during bonding
PNUM	0x0C – UART peripherals
PCMD	0x02 – Write & Read
HWPID	0x0132 – HWPID of the sensor
Read timeout	Time interval for delivery of DPA Response in 10 ms units (recommended 0x70 to 0xFE according to the difficulty level of processing of the request)
Data	Data of a particular request (see **dc-Komunikacni_protokol_Cidlo-Modbus-cz-V01-B**) (including Modbus address and CRC)

DPA Response framework of UART peripherals of the command Write & Read

NADR	PNUM	PCMD	HWPID	ErrN	DPA value	Data
according to bonding	0x0C	0x82	0x0132	0	?	data
(2B)	(1B)	(1B)	(2B)	(1B)	(1B)	(max 32B)

NADR	Address of the sensor specified during bonding
PNUM	0x0C – UART peripherals
PCMD	0x82 – Response to Write & Read
HWPID	0x0132 – HWPID of the sensor
ErrN	Numerical designation of the error (0 – no error)
DPA value	see the documentation for DPA Framework (www.iqrf.org)
Data	Data of the response to a particular request (see **dc-Komunikacni_protokol_Cidlo-Modbus-cz-V01-B**) (including Modbus address and CRC)

DPA Request OS peripherals framework of the command Sleep

Since our sensors measure physical variables dependent on temperature, or the temperature itself, it is necessary to limit all effects affecting these variables as much as possible. For this reason it is necessary to activate the sleep mode of the IQRF module, when it is not in use. Use the command sleep of the OS peripherals for this purpose. This command suspends the IQRF module for a set period, during which it is not possible to communicate with the module - and with the sensor either. The ratio between the periods of activity and sleep should not exceed **the limit of 1:25,** if you want to achieve the guaranteed accuracy of the sensors in the full extent.

NADR	PNUM	PCMD	HWPID	Time	Control
According to bonding	0x02	0x04	0x0132	1-0xFFFF	6
(2B)	(1B)	(1B)	(2B)	(2B)	(1B)

NADR	Address of the sensor specified during bonding
PNUM	0x02 – OS peripherals
PCMD	0x04 – Sleep
HWPID	0x0132 – HWPID of the sensor
Time	sleep time value in the units 2.097s or 32.768ms according to Control bit 4
Control	byte serving to set parameters (recommended: 6 – time in 2.097s, one flashing after waking up, calibration of the timer before activating the sleep mode)

DPA Response OS peripherals framework of the command Sleep

NADR	PNUM	PCMD	HWPID	ErrN	DPA value
According to bonding	0x02	0x84	0x0132	0	?
(2B)	(1B)	(1B)	(2B)	(1B)	(1B)

NADR	Address of the sensor specified during bonding
PNUM	0x02 – OS peripherals
PCMD	0x84 –Response to Sleep
HWPID	0x0132 – HWPID of the sensor
ErrN	Numerical designation of the error (0 – no error)
DPA value	see the documentation for DPA Framework (www.iqrf.org)

Summary of the commissioning of the sensor

1) Setting RF parameters of the sensor module, if necessary
2) Bonding the sensor (module node) to your coordinator
3) Implementation of the process Discovery
4) Implementation of the protocol Modbus in the device of the coordinator according to **dc-Komunikacni_protokol_Cidlo-Modbus-cz-V01-B** (including Modbus addresses and CRC)
5) Communication with the sensor using the DPA command of the standard UART peripherals (data part of DPA framework according to the Modbus protocol)
6) Suspend the module (sleep time mode) using DPA command of the standard OS peripherals