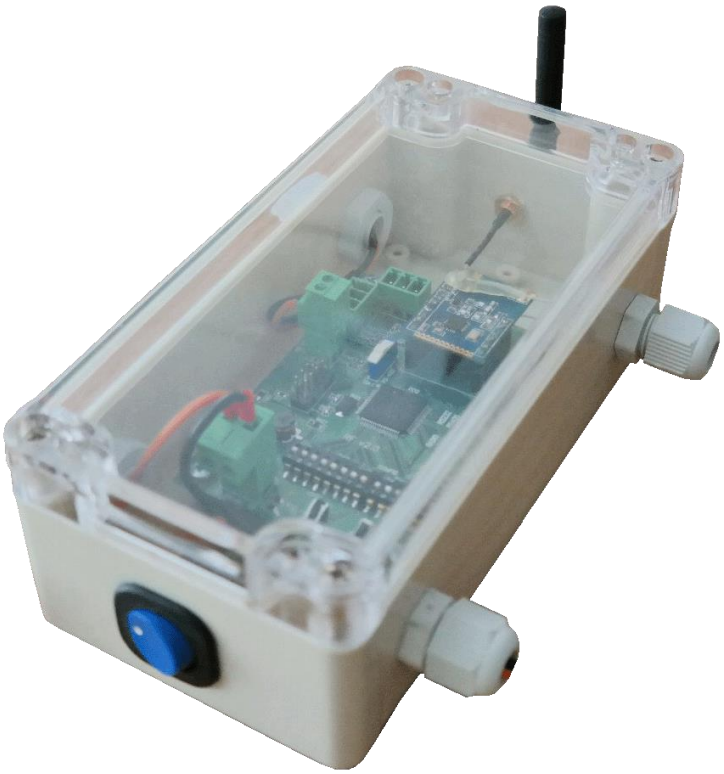
Wireless interface converter RFC for petrol stations

(RS-485/RS-232 to wireless and backwards)



TECHNICAL GUIDE

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REVISION HISTORY

REV	DATE	BY	SECTION	DESCRIPTION
1.01	2017.05.01	Evgeniy Vasyliev	All	First release

PURPOSE OF THE DOCUMENT

This Technical Guide is intended for studying of wireless interface converter RFC for petrol stations. It contains basic information regarding the RFC converter, its principles of operation, structure, configuration and adjustments, maintenance by service personnel. Admission to work with device is allowed only to qualified specialists, who have read and understood current Technical Guide.

Due to a reason that RFC converter is constantly being developed in direction of improvements of its possibilities, changes are possible in its final version, which are not described in given Technical Guide.

During the system development process given Technical Guide will be also expanded and updated and new chapters will be added. Latest version of this Technical Guide can be downloaded from the RFC converter web-page: *http://technotrade.ua/wireless-communication-device.html*.

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In case if you find any mistakes, omissions in this document or have any suggestions on improvements to this document, please feel free to e-mail them to our support mailbox: *support_1a@technotrade.ua*. We will be grateful to you for this valuable information.

All technical questions regarding the RFC converter are welcome to be asked on support mailbox: *support_1a@technotrade.ua*. Our support team will be glad to help you.

Also you can call to us or visit us on:

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APPOINTMENT

Various wired interfaces are often applied for communication exchange between electronic devices at petrol station: RS-232, RS-485, RS-422, current loop, others. These interfaces have many benefits, but all of them have a common disadvantage – they are wired, so require putting of cabling for connection. As a rule wires are put in underground pipes, which requires excavation (removing the top layer of asphalt or other cover, digging of trenches, laying of cables, etc.).

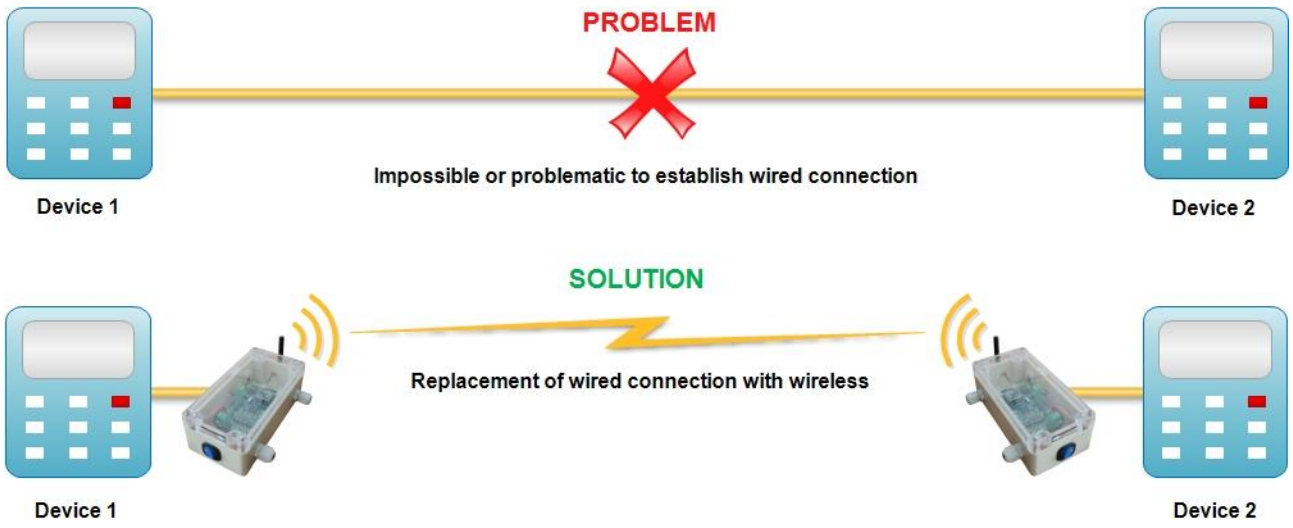
Wireless communication is an alternative to wired connection, it simplifies the whole process and eliminates a necessity of placing cabling – electronic devices are able to communicate, but communication is done over-the-air instead of wired cabling. RFC converter serves for establishing of wireless communication between the devices and have advantages as quick of mounting, flexibility of settings, high noise immunity and others.

RFC converter is appointed for establishing of wireless communication between devices having interfaces RS-232 and RS-485. RFC converter does not bring any changes to exchanged data between devices, thus RFC converter is a complete analogue to wired cabling connection with the only exception of 35 ms delay at start of data transmission. Data is encrypted during transmission using keys (changing at each data packet transfer), which set the final user can program in the RFC converters at configuration.

After switching-on RFC itself scans the radio channel, searching for any other RFC devices in the network and establishes contact with them without any commands from the device, connected to RFC. Thus, devices connected to the RFC can exchange data over the air the same way as they did it using wired communication.

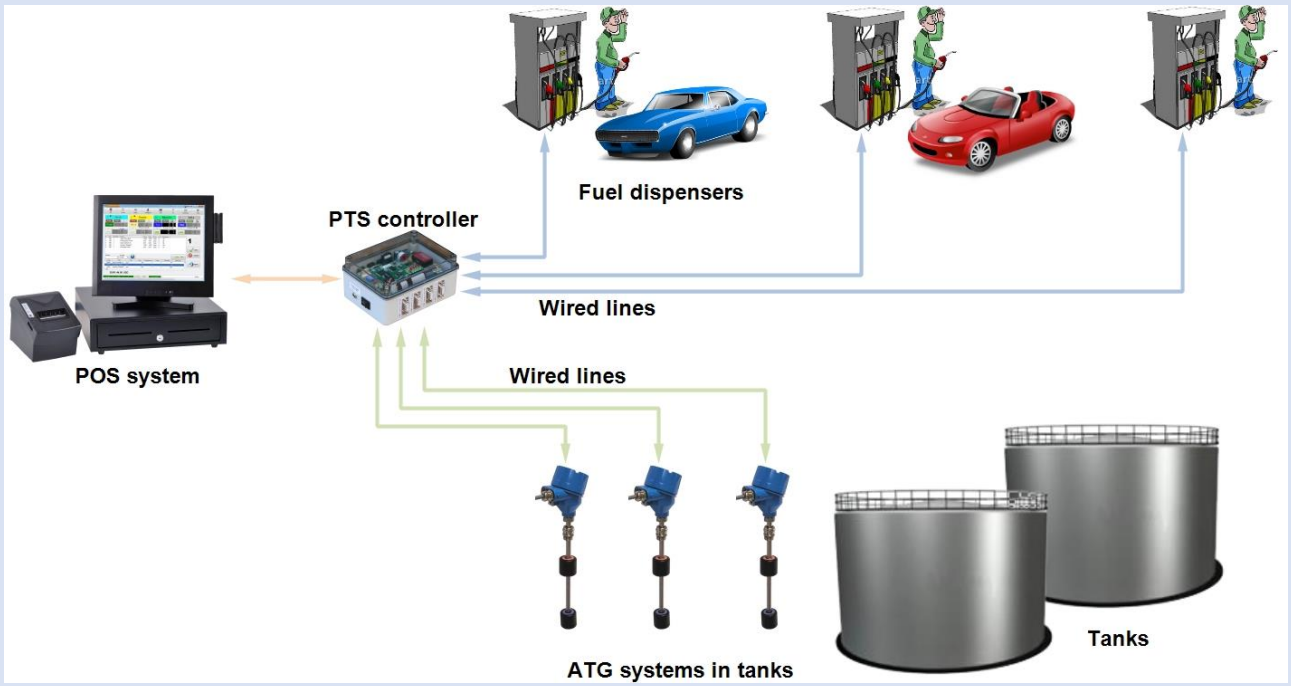
RFC operates in a mode of direct access to the radio channel, thus, external devices can exchange data over the radio channel, using their own protocols, addressing, coding etc. Using the protocol of addressing between external devices, RFC can be used to connect a group of external devices into the common network.

RFC is designed for application in different remote control systems, data collection system, etc. RFC can be easily integrated into already existing systems without redevelopment of the software.

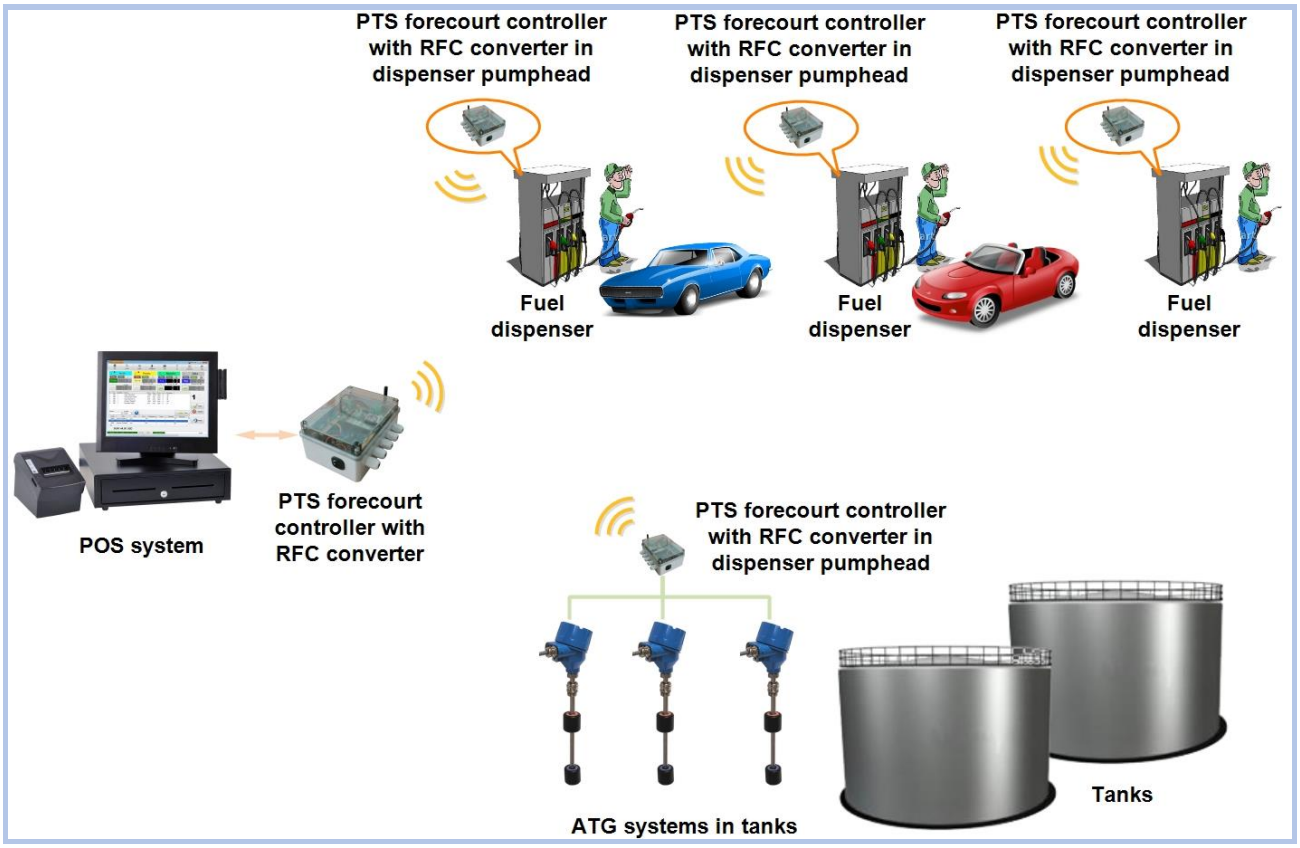


Example of application on petrol station

Typical petrol station with wired connection requires many cabling:



Application of RFC converter allows to minimize wires placing on petrol station and fasten installation:



TECHNICAL SPECIFICATIONS

Technical characteristics	
Nominal power supply voltage	+12 V DC
Power supply voltage range	+9 … +18 V DC
Wired interfaces	RS-232/RS-485
Weight	45 g
Dimensions	85 x58 x 25 mm

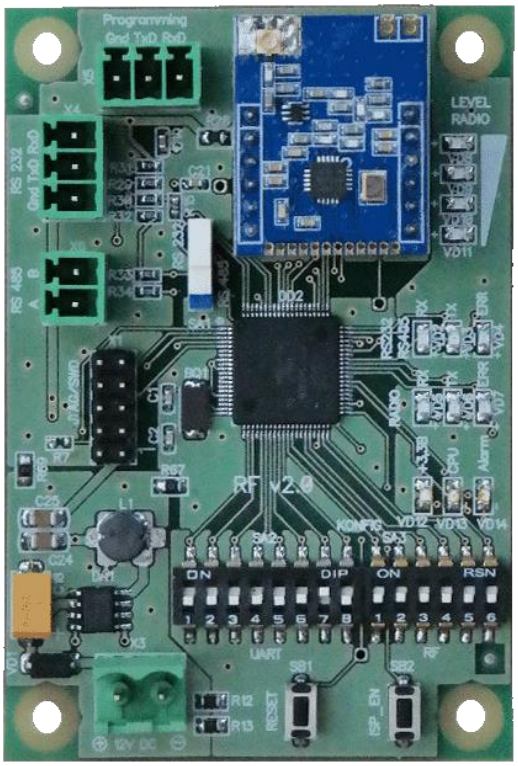
Wireless communication parameters	
Transmission frequency	433 MHz
Modulation type	GFSK
Output power	not more than 10 mW
Baud rate	10000 bits/sec
Delay at transmission	35 ms
Encryption at transmission	RTEA using user-configurable encryption table

Wired interface communication parameters	
Communication protocol	any
Baud rate	1200 … 115200
Data format	- 5 … 8 data bits - 1 stop bit - odd/even/none parity control
Data length	any
Sign of data end	delay of more than 3.5 bytes

Terms of application	
Environment temperature	from –20 till +60°C
Upper limit of relative humidity	Not more than 85%

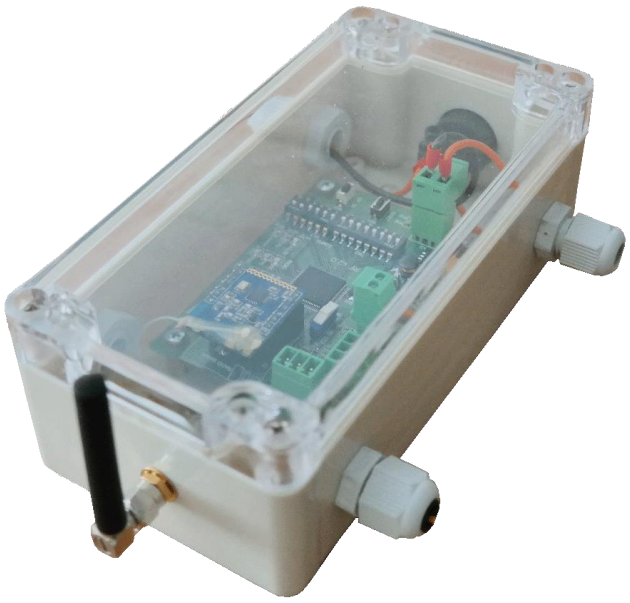
GENERAL VIEW

Board without terminal blocks:

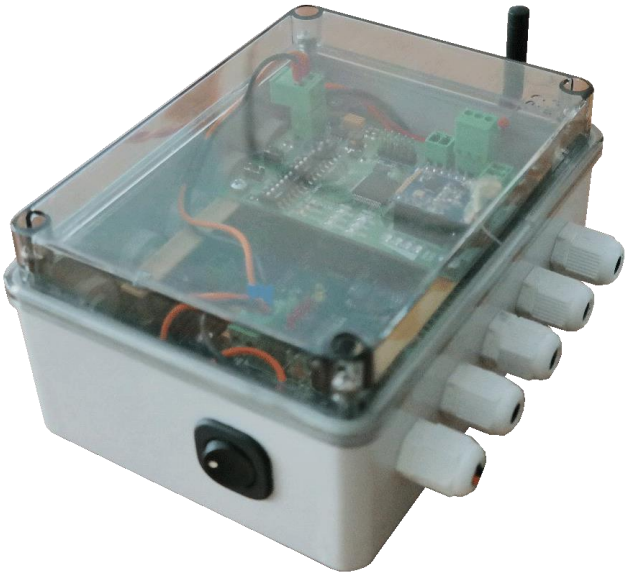


Board with terminal blocks:

RFC converter in a mounting box:

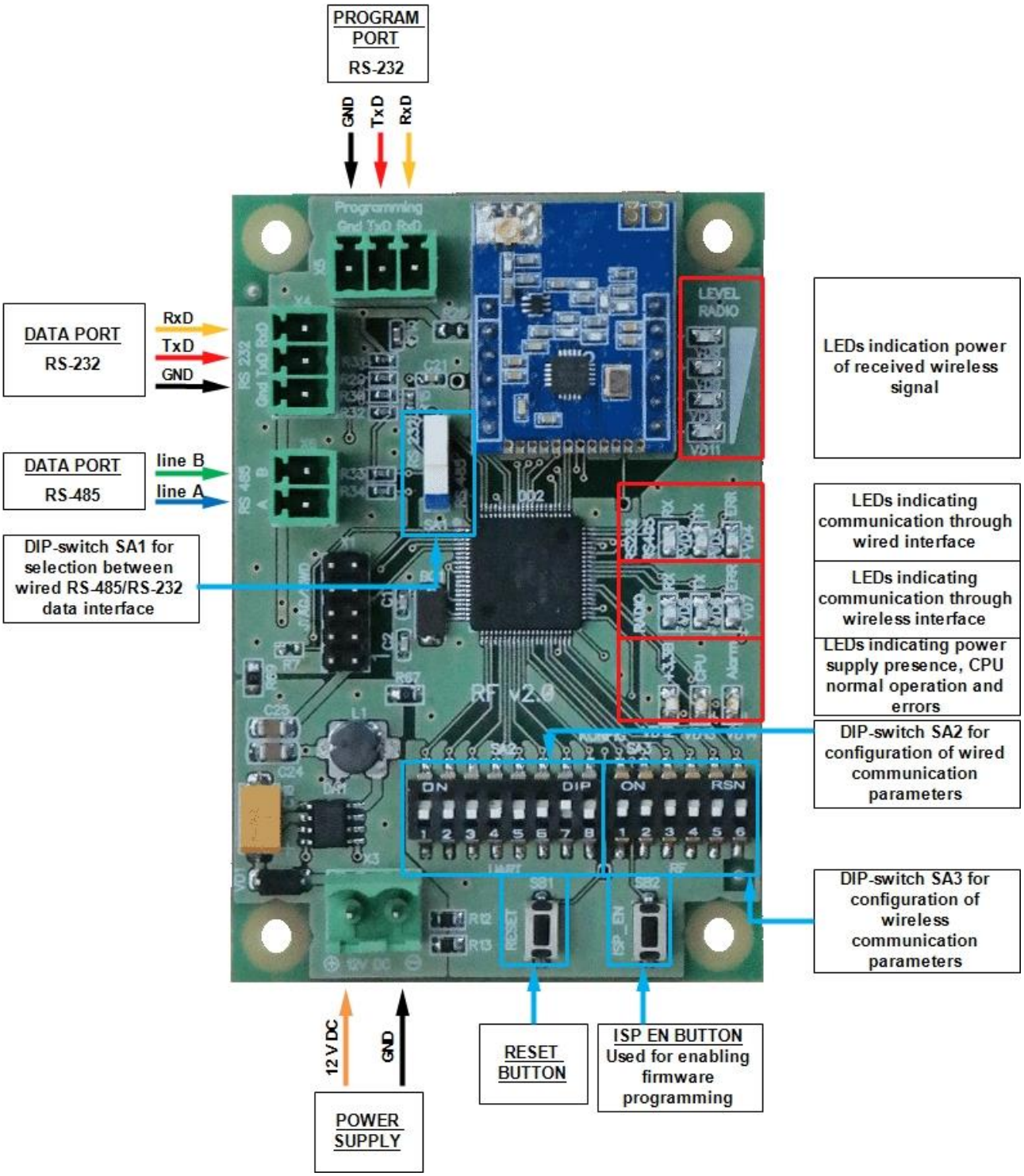


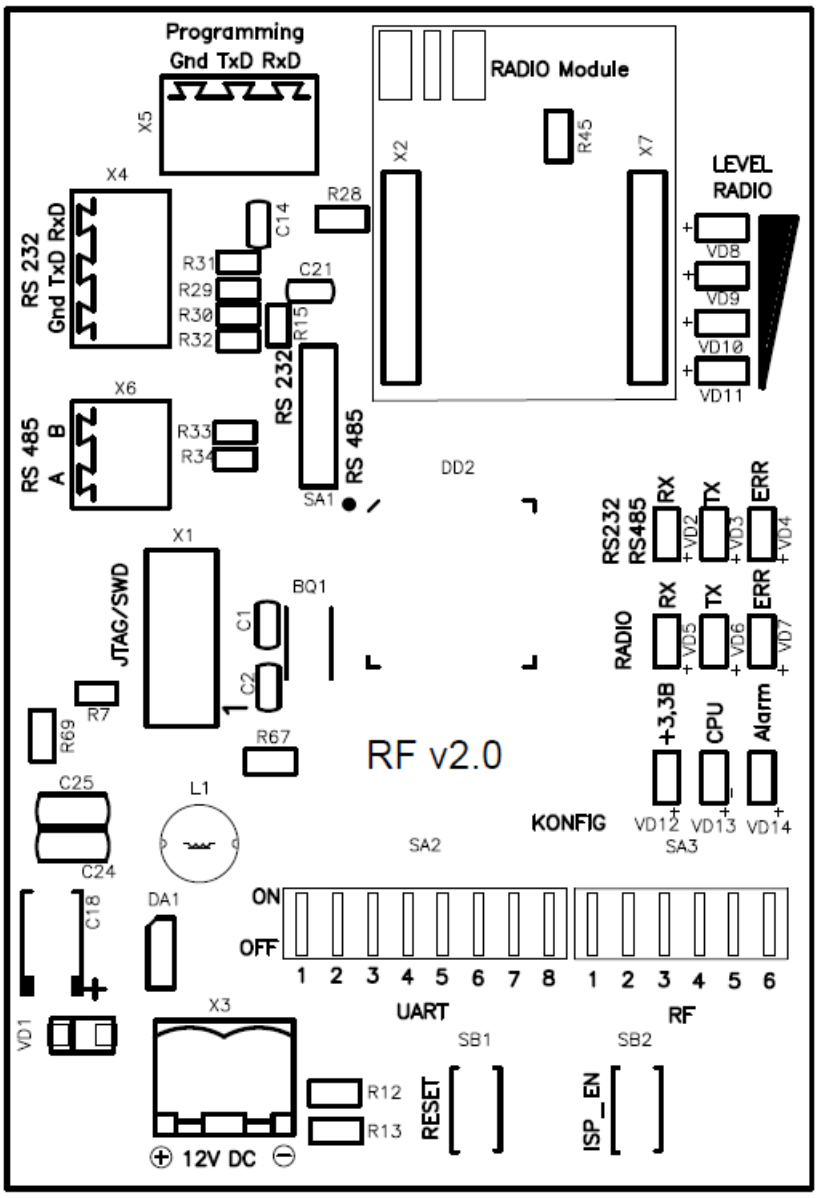
RFC converter with PTS controller in a mounting box:



PCB BOARD OVERVIEW AND OPERATION

PCB board overview





LEDs indication

LEDs on RFC converter board serve for following purposes:

- Reception, transmission and errors in wired communication is displayed on **"RS-232/RS-485"** group of LEDs: VD2 **"RX"**, VD3 **"TX"** and VD4 **"ERR"**
- Reception, transmission and error in wireless communication is displayed on **"RADIO"** group of LEDs: VD5 **"RX"**, VD6 **"TX"** and VD7 **"ERR"**
- Level of input wireless connection is displayed on **"LEVEL RADIO"** group of LEDs: VD11 **"0_25"**, VD10 **"25_50"**, VD9 **"50_75"** and VD8 **"75_100"**
- LED VD12 **"+3,3B"** – presence of voltage +3,3 V DC on CPU
- LED VD13 **"CPU"** – regular blinking means normal operation of CPU (heartbeat)
- LED VD14 **"Alarm"** – short blinking means emergency situation in operation

Description of operation

1. RFC converter has input wired communication interfaces: RS-232 and RS-485. Reception of data done only from 1 of 2 input communication ports same time: RS-232 or RS-485, which is set by DIP-switch SA1.
2. Communication mode: asynchronous.
3. Supported baud rates over wired interfaces: 1200…115200 baud.
4. Wireless interface baud rate: 10000 baud.
5. Attribute of a message end is pause with duration 3.5 bytes. All subsequent bytes are considered to be a new message.
6. Output communication interface is a radiomodule based on chip SI4432 manufactured by company Silab, USA.
7. Central unit of a board is microcontroller DD2 LPC1754.
8. At power on the RFC converter automatic configuration of the converter on wired and wireless interfaces is performed.
9. RFC converter receives data through one of wired communication interfaces: RS-232 or RS-485. Received data is encrypted using RTEA method, packed and sent over the air on 433 MHz frequency using GFSK frequency modulation. Other RFC converters receive the message on the air, unpack, decrypt and in case of successful decryption send data on both wired communication interfaces. Same way data is sent in opposite direction. Thus, it is possible to organize a network with several RFC converters. Minimal number of RFC converters in network is 2, maximal – unlimited.
10. For avoidance of data losses only 1 RFC converter should be sending data to the air, at this all other RFC converters should be working in a mode of data reception.
11. LED indicators show signals
    - RX (reception)
    - TX (transmission)
    - ERR (Error) on wired RS-232/RS-485 and wireless RADIO interfaces
    - LEVEL RADIO (level of input wireless signal)
    - power supply indicator +3,3 V DC (power supply, is constantly shining)
    - CPU (blinks periodically – CPU is working correctly)
    - Alarm (emergency alarm).

Selection of wired interface

Selection of wired interface is done using a DIP-switch SA1 **“RS_232/485”**:

- Position **“RS-232”** means selection of RS-232 interface, so data for wired communication will be used with RS-232 wired data port
- Position **“RS-485”** means selection of RS-485 interface, so data for wired communication will be used with RS-485 wired data port

Configuration of wired communication parameters

Configuration of wired communication parameters is done using a DIP-switch **SA2**:

DIP-switch number	Name	Appointment
1	**BR_1**	**Sets baud rate**
2	**BR_2**	
3	**BR_3**	
4	**BR_4**	
5	**DATA_1**	**Sets number of data bits**
6	**DATA_2**	
7	**PARITY_1**	**Sets parity control**
8	**PARITY_2**	

Setting of baud rate:

BR_1	BR_2	BR_3	BR_4	No.	Value
OFF	OFF	OFF	OFF	0	**BR_Default = BR_9600 baud**
OFF	OFF	OFF	**ON**	1	**BR_1200 baud**
OFF	OFF	**ON**	OFF	2	**BR_2400 baud**
OFF	OFF	**ON**	**ON**	3	**BR_4800 baud**
OFF	**ON**	OFF	OFF	4	**BR_5700 baud**
OFF	**ON**	OFF	**ON**	5	**BR_5787 baud**
OFF	**ON**	**ON**	OFF	6	**BR_9600 baud**
OFF	**ON**	**ON**	**ON**	7	**BR_14400 baud**
ON	OFF	OFF	OFF	8	**BR_19200 baud**
ON	OFF	OFF	**ON**	9	**BR_38400 baud**
ON	OFF	**ON**	OFF	10	**BR_57600 baud**
ON	OFF	**ON**	**ON**	11	**BR_115200 baud**

Setting of number of data bits:

DATA_1	DATA_2	No.	Value
OFF	OFF	0	**8 data bits**
OFF	**ON**	1	**7 data bits**
ON	OFF	2	**6 data bits**
ON	**ON**	3	**5 data bits**

Setting of parity control:

PARITY_1	PARITY_2	No.	Value
OFF	xxx	0	**None parity**
ON	OFF	1	**Even parity**
ON	**ON**	2	**Odd parity**

Configuration of wireless communication parameters

Configuration of wireless communication parameters is done using a DIP-switch **SA3**:

DIP-switch number	Name	Appointment
1	**KANAL_1**	**Wireless channel number**
2	**KANAL_2**	
3	**KANAL_3**	
4	**KANAL_4**	
5	**POWER_1**	**Output power of wireless transmitter**
6	**POWER_2**	

Setting of wireless channel number:

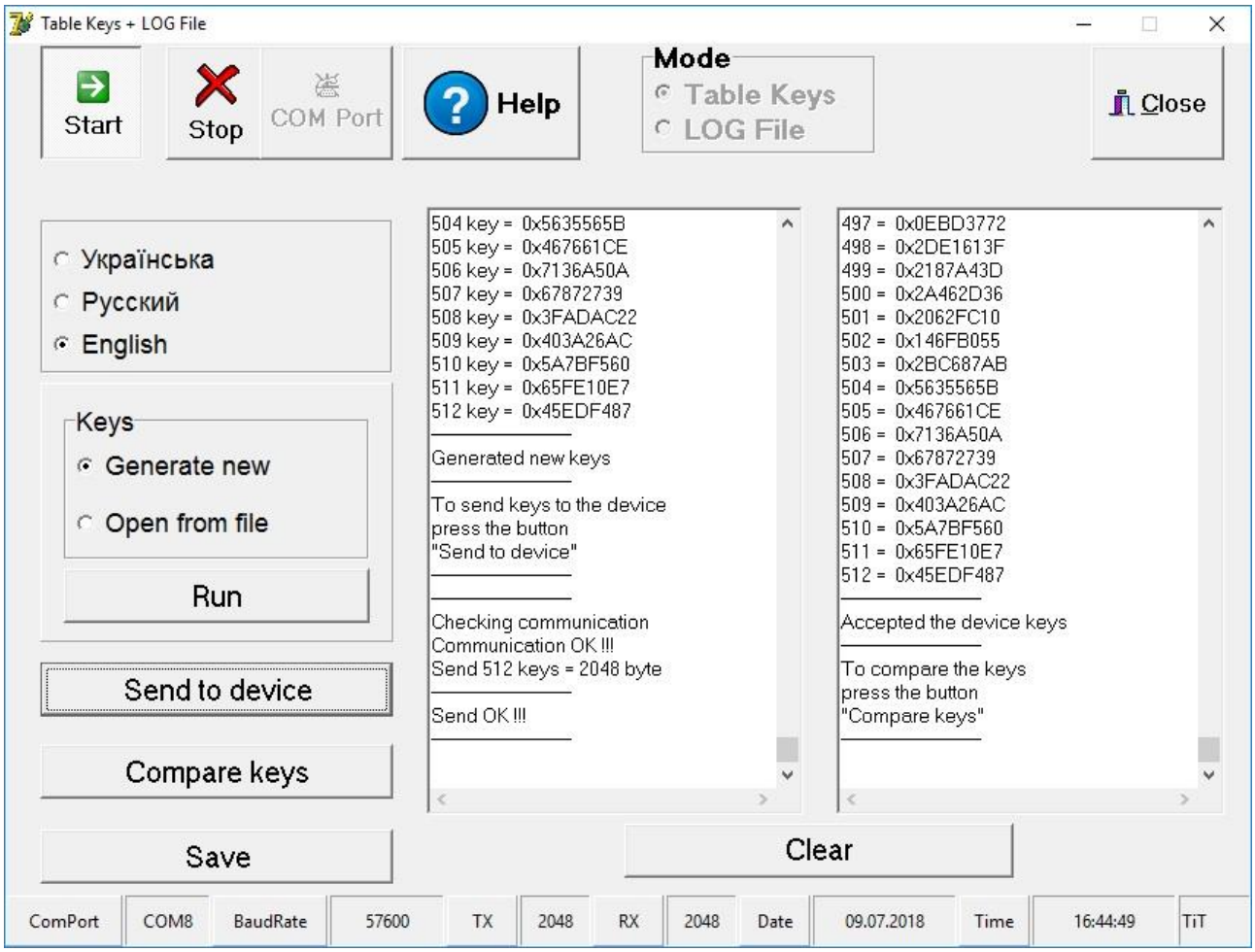
KANAL_1	KANAL_2	KANAL_3	KANAL_4	No.	Value
OFF	OFF	OFF	OFF	0	**Kanal_Default=Kanal_9**
OFF	OFF	OFF	**ON**	1	**Kanal_1**
OFF	OFF	**ON**	OFF	2	**Kanal_2**
OFF	OFF	**ON**	**ON**	3	**Kanal_3**
OFF	**ON**	OFF	OFF	4	**Kanal_4**
OFF	**ON**	OFF	**ON**	5	**Kanal_5**
OFF	**ON**	**ON**	OFF	6	**Kanal_6**
OFF	**ON**	**ON**	**ON**	7	**Kanal_7**
ON	OFF	OFF	OFF	8	**Kanal_8**
ON	OFF	OFF	**ON**	9	**Kanal_9**
ON	OFF	**ON**	OFF	10	**Kanal_10**
ON	OFF	**ON**	**ON**	11	**Kanal_11**
ON	**ON**	OFF	OFF	12	**Kanal_12**
ON	**ON**	OFF	**ON**	13	**Kanal_13**
ON	**ON**	**ON**	OFF	14	**Kanal_14**
ON	**ON**	**ON**	**ON**	15	**Kanal_15**

Setting of output power of wireless transmitter:

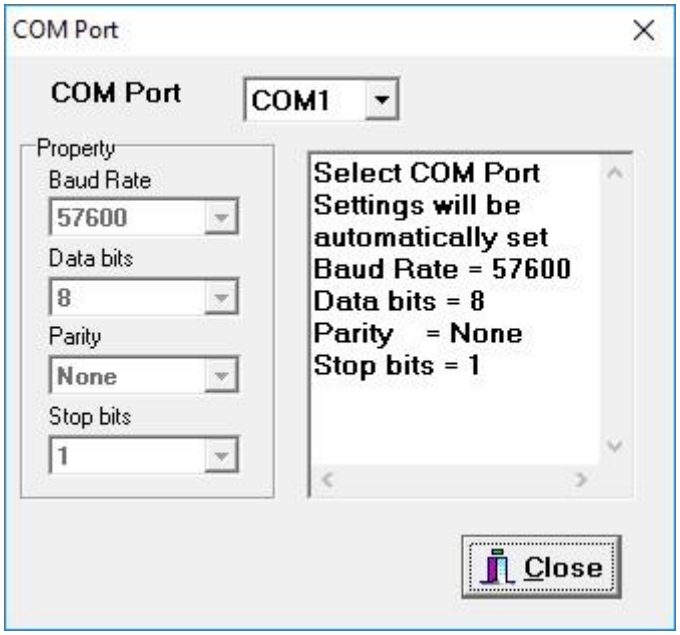
POWER_1	POWER_2	No.	Value
OFF	OFF	0	+11 dBm – minimal power
OFF	**ON**	1	+14 dBm
ON	OFF	2	+17 dBm
ON	**ON**	3	+20 dBm – maximal power

CONFIGURATION UTILITY

Configuration and logging of RFC converter operation is done using a configuration utility.



Connection to the utility is done by selection of the COM-port, which should be connected to port Programming in the RFC converter:



There are 2 main options of this utility:

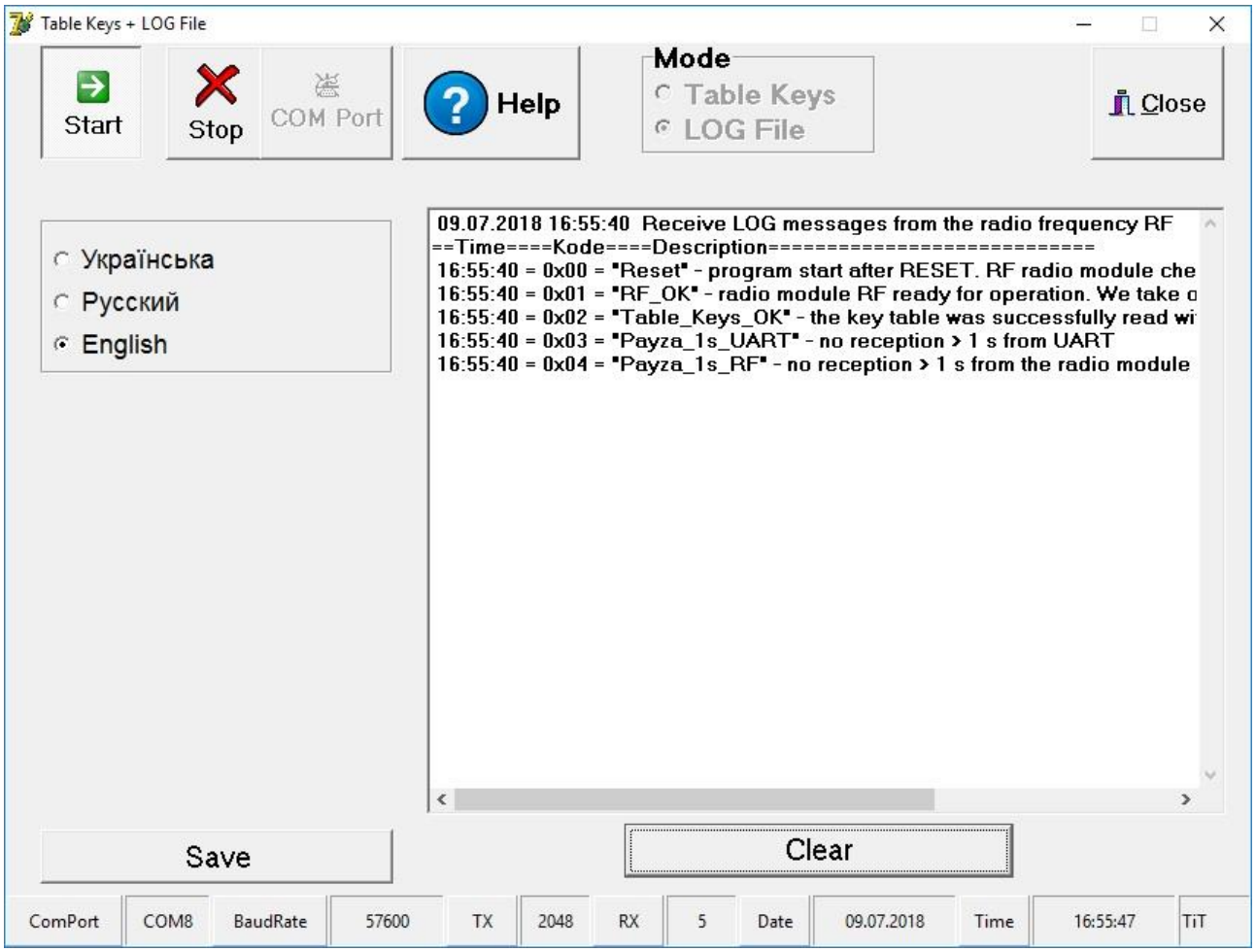
- Operations with encryption keys
- Logging of RFC converter operation

Operation with encryption keys include the following operations:

- Generating new encryption keys
- Reading of encryption keys from RFC converter
- Comparing of encryption keys between the RFC converter and configuration utility
- Save of encryption keys to file
- Load of encryption keys from file

Encryption keys are used for encryption of the transmitted and received data packets. Same keys are used for both operations. All the modules used within a network should have a same set of encryption keys.

Also it is possible to log all operations performed by the RFC converter for debugging of its operation:



FIRMWARE UPDATE

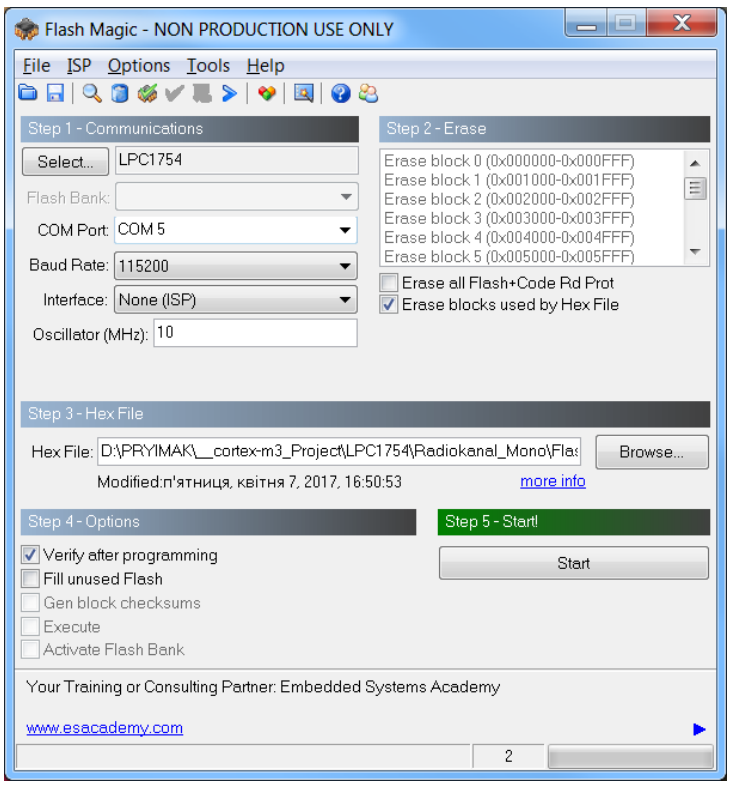
Programming of RFC converter firmware is done using Flash Magic utility from NXP Semicoductors company, which can be downloaded from official website http://www.flashmagictool.com.

First it is necessary to set RFC converter in firmware update mode:

- Connection RS-232 cable from COM-port of PC to connector X5 “Programming” of RFC converter board
- Power on the RFC converter board
- Press and hold a button SB1 “RESET”
- Press and hold a button SB2 “ISP_EN”
- Release a button SB1 “RESET”
- Release a button SB2 “ISP_EN”.

Now the RFC converter is in firmware update mode, now it is needed to send the firmware file to flash memory of RFC converter CPU:

- Run Flash Magic utility
- Select microcontroller type LPC1754 on panel “Step1 - Communications” by pressing a button “Select”
- Select a required COM-port number in “COM-port” field, set “Baut Rate” = 9600 baud, “Interface” = None (ISP) and “Oscillator” (MHz) = 10
- On panel “Step2 -Erase” set a checkbox near “Erase blocks used by Hex File”
- On panel “Step3 - Hex File” select a required .hex file of firmware by pressing a button Browse”
- On panel “Step4 - Options” set a checkbox near “Verify after programming”
- On panel “Step5 - Start” press a button “Start”
- Wait until the firmware update process finishes by Flash Magic utility
- Press and release a button SB1 “RESET”
- Remove RS-232 cable from connector X5 “Programming” of RFC converter board
- Now the RFC converter has a new firmware inside its flash memory.



ORDER INFORMATION

Variant of RFC interface converter supply is marked with RFC-*y*-*z*, where

- y – type of supply:
  - "*PCB*" in case if RFC interface converter is supplied in a view of electric board;
  - "BOX" in case if RFC interface converter is supplied installed in plastic box with hermetic inputs for connection of wires and a button for power supply switching;
  - "PTS" in case if RFC interface converter is supplied installed together with PTS controller in plastic mounted box with hermetic inputs for connection of wires and a button for power supply switching;
- z – variant of supply:
  - 001 – variant of supply with installed terminal blocks for controller ports
  - 002 – variant of supply without terminal blocks for controller ports (connection is made using connectors for stubs)

Examples of order:

- order of RFC interface converter in a view of electric board: RFC-PCB-001;
- order of RFC interface converter installed in a plastic mounting box: RFC-BOX-001.
- order of RFC interface converter installed in a plastic mounting box together with PTS controller: RFC-PTS-001.