...the broadest narrowband money can buy

RACOM
RADIO DATA NETWORKS

Operating manual

Narrowband radio modem ECONOMY RE400

version 1.15
6/25/2013

RACOM s.r.o. • Mirova 1283 • 592 31 Nove Mesto na Morave • Czech Republic
Tel.: +420 565 659 511 • Fax: +420 565 659 512 • E-mail: racom@racom.eu

www.racom.eu

Table of Contents

Abbreviations used 5
Introduction 6
1. Radio modem RE400 7
2. Description 8
    2.1. Compatibility 8
    2.2. Operation modes 8
    2.3. First start of radio modem 11
    2.4. Radio modem configuration 12
    2.5. Diagnostics 14
    2.6. Error log 15
    2.7. Firmware upgrade 17
3. Connectors 20
    3.1. Antenna 20
    3.2. Serial interface 20
    3.3. Ethernet interface 20
    3.4. Power supply 20
    3.5. Indication LEDs 21
4. Table of Technical Parameters 23
5. Dimensions, drawings, manufacturing code 24
    5.1. Dimensional Diagram 24
    5.2. Labelling of Radio Modems 27
6. Radio modem installation 28
    6.1. General description 28
    6.2. Antenna installation 28
    6.3. Supplying power to the equipment 29
    6.4. Technology connection 32
    6.5. Radio modem mounting 32
7. Conditions for Radio Modems Operation 36
    7.1. Important Notifications 36
    7.2. Conditions of Liability for Defects and Instructions for Safe Operation of Equipment 36
    7.3. Product Conformity 37
    7.4. Limitations of Use 38
A. Appendix 40
B. Revision History 44

List of Figures

1. Radio modem RE400 6
2.1. Settings menu 12
2.2. Diagnostics menu 14
2.3. Error log 15
2.4. Transparent loader 19
3.1. Antenna connector SMA 20
3.2. RS232 DSUB9 female 20
3.3. RJ-45F 20
3.4. Appearance of radio modem 21
5.1. Mounting dimensions of the radio modem - version D and H 25
5.2. Mounting dimensions of the radio modem - version R and S 26
6.1. Supplying power over the ethernet interface, using a PoE P.S. 29
6.2. Supplying power over the ethernet interface, using the passive PoE injector 30

6.3. Supplying power over the SCC interface, using a REPWR adaptor and P.S. with battery backup 30
6.4. Supplying power over the ethernet interface directly from the technology 31
6.5. Passive PoE injector 31
6.6. REPWR adaptor 31
6.7. Horizontal body, DIN rail mount, version D 32
6.8. Horizontal body, mount on a plate, version H 33
6.9. Vertical body, DIN rail mount, version R 33
6.10. Vertical body, mount on a plate, version S 34
6.11. Assembly example 35
7.1. CE sign 37
7.2. RE400 consistency declaration 38

Abbreviations used

RFC	Radio frequency channel
SCC	Serial communication channel
ETH	Ethernet channel
CDMA	Carrier detect multiple access - controlled access to RFC
CRC16	Cyclic redundancy check - applied to packet header
CRC32	Cyclic redundancy check - applied to packet data
PoE	Power over Ethernet - supply via the Ethernet cable
AUX	Auxiliary - supply via RS232 DSUB9 connector
TX	Transmitting to RFC
RX	Receiving from RFC
tx	Transmitting to SCC
rx	Receiving from SCC
NoR	Number of repeaters - parameter in the configuration menu
MTU	Maximum transmission unit - max. length of transmitted packet

Introduction

This operating manual serves as the primary document for familiarising users with the parameters of the radio modem, its properties, modifications, and with the parameters of connecting parts. In order to master all the functions of the radio modem and the MORSE system you should refer to other documents.

Transparent radio modems of the ECONOMY range are primarily designed for smaller networks and applications in which security of transmission and access to the radio channel are resolved within the application itself.

Within the MORSE system they are generally installed in separate networks. A combination of PROFI (backbone network) and ECONOMY (last mile) radio modems is usually used in large-scale systems.

Communication protocols on RF channel of PROFI and ECONOMY radio modems are not compatible; they have to be interconnected via SCC or ETH interfaces and different frequencies have to be used.

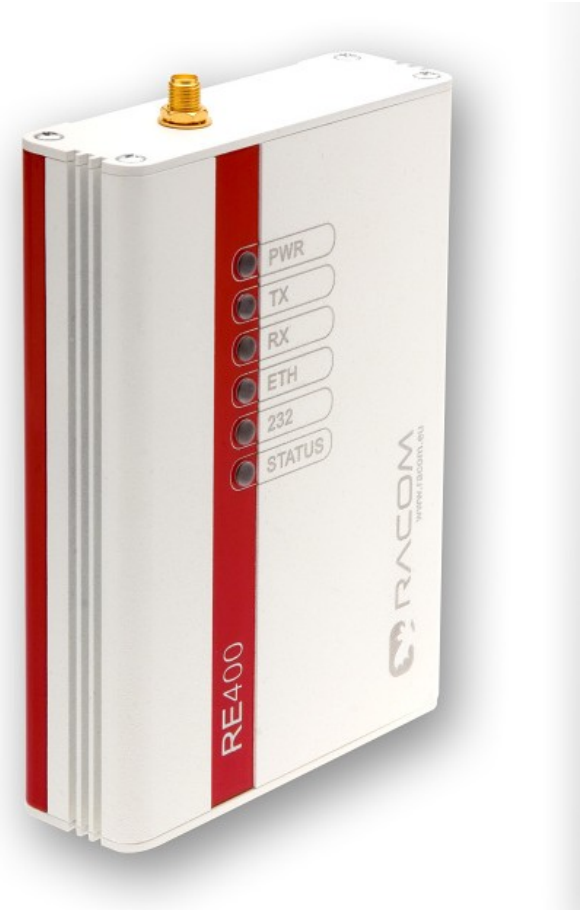


Fig. 1: Radio modem RE400

1. Radio modem RE400

RE400 is a transparent radio modem for wireless data transfer with a modern, digital solution of the radio part (Software Defined Radio). It provides a wide tuning range including software-configurable channel spacing. It is equipped with Ethernet and RS232 interfaces, Powered over Ethernet (PoE) or via pins on a serial interface connector. Configuration is performed via an ordinary Internet browser.

The mechanical construction has been designed to allow excellent dissipation of heat from electronic components on the metal case and the therefore the processor is well protected against excessive overheating. This construction allows for long-term loading. The modem is designed for applications which are permanently in operation.

2. Description

2.1. Compatibility

Firmware version 2.1.x.x is not compatible with older versions 2.0.x.x. Older fw needs to be upgraded with the new version 2.1.x.x, see Section 2.7, “Firmware upgrade”.

2.2. Operation modes

There are 3 possible operation modes:

- Main mode – mode of a standard operation
- Service mode – mode for firmware download
- Bootloader mode – mode for downloading bootloader

2.2.1. Main mode

Main mode is a standard operating mode where the radio modem works as a transparent bridge on the Ethernet interface or as a transparent link (bus) on the serial interface. Main mode is operated after approx. 20 sec. from switching on the supply voltage. The deblock mechanism can be activated after a short-time break and can stretch this time. Main mode is indicated by LED STATUS – green colour 2 sec. ON and 1 sec. OFF.

Default state

When button RST is pressed for 10 sec. during Main mode, the STATUS LED changes its colour to yellow and the parameters are set to default values. After the next 15 sec. default values are saved and the radio modem goes back to Main mode working with default values and IP address 192.168.1.2 hereafter.

Generally

Frames are transmitted to the opposite side of the radio network to an application through the same interface (RS232 or Ethernet) as they have been received.

Communication over serial interface

The data received through SCC is loaded into buffer of depth 5 packets and subsequently sent to RFC.

A packet received through RS232 is closed when its size achieves a value set in the MTU parameter, or after a pause, which is equal to the parameter Idle. Afterwards it is immediately transmitted to the RF channel (neither CDMA nor TDMA RF channel access). All radio modems which receive this packet transmit it to their serial interface. The network works like an RS232 bus, i.e. every one hears each other, so it is suitable for “poll” type applications, when the master station polls requests to slave stations one by one. It is possible to connect more slaves behind one radio modem using an external RS485 converter.

Communication over an Ethernet bridge

The data received on ETH channel are sent immediately to RFC. The packet received during RF transmitting is discarded. The operating with the Repeater when the parameter NoR has a nonzero value is a exception. The input buffer of depth 1 packet is used here. It allows accept the response from ETH device connected in the short time after receiving the packet from RFC. The RFC transmitting is suspended at that time, see the article Repeated packets.

The radio modem works as a standard Ethernet transparent bridge, i.e. received frames are filtered and only frames for addresses behind the RF channel are transmitted to the RF channel. The only exception are broadcast packets which are all transmitted to the RF channel.

More information on http://www.linux-foundation.org/en/Net:Bridge.

Example:

One RE400 is connected to a LAN1 segment, the second RE400 to a LAN2 segment. IP addresses of both RE400 are not important for data transfer itself. They are used only for service purposes (setting up parameters). It is FORBIDDEN, however, to set the IP address of any radio modem to the same value of any equipment in either LAN1 or LAN2 segments.

The first RE400 connected to LAN1 processes frames as follows:

- broadcast (arp req) and arp reply... — transmitted to RF channel
- frame for destination addresses within LAN1 segment — discarded
- frame for destination addresses within LAN2 segment — transmitted to RF channel

Data checking

Before sending to the radio channel the checksum is calculated. After data is received from RFC it is checked. If the CRC does not match the packet is discarded.

Repeater function

If station RE400 has the *Repeater* function switched ON then the received packet will again send another packet to the RF channel. The packet received from the RF channel is also sent to SCC or to the ETH port. In the radio network it is also possible to use more Repeaters without danger of cycling packets. When switching on function Repeater it is necessary to enter the number of Repeaters in the network into parameter *Number of repeaters* (NoR). Parameter NoR is set in the same way in all radio modems of the network.

Repeated packets

Parameter *Number of repeaters* switches on protection mechanisms which prevent collisions with packets sent by the repeater. After transmitting or receiving a packet from RFC further transmission is blocked for the required period to prevent a collision with a packet sent by the Repeater. After transmitting or receiving a packet from RFC recepit of its copy is checked and discarded.

These measures are not active when parameter NoR is zero, i.e. in a network without Repeaters.

Compression

There is built in compression on the RF channel. Its final efficiency depends on the data structure, of course.

Fragmentation

It is possible to set a threshold on the radio channel from which transmitted packets begin to fragment. The receiving modem transmits a packet to the interface only when all fragments are received successfully. This also applies in a Repeater for transmission of a packet to the RF channel.

From fw 2.1.3.0 the fragmented packets are processed in Repeater in the different way. This caused the acceleration of communication but simultaneously the incompatibility with the older versions 2.0.x.x. These older firmware is to be replace by the version 2.1.3.0 or better newer one of the serie 2.1.x.x, see Section 2.7, “Firmware upgrade”.

Remote access

In the case of good conditions for communication on RFC remote access to radio modem RE is an available option. Insert the IP address of the remote modem RE into the www browser attached by Ethernet cable to the RE modem. Leave cursor in the address line and press Enter. We can read and save configurations in the remote modem. Typical reaction time is 20 to 40 sec.

This function is not generally guaranteed because the http protocol is not optimised for work in slow networks. In the case of a slow response from the radio channel the TCP protocol adaptively extends timeout up to tens of seconds. In addition a PC running Windows generally has other protocols installed on the ETH channel which load or worsen communication conditions.

2.2.2. Service mode, Bootloader mode

These modes are used for firmware upgrades (Section 2.7, “Firmware upgrade”): Service mode for firmware downloads, Bootloader mode for bootloader downloads.

Switching to Service mode: approx. 2 sec. after switching on power press the RST button for a few seconds. Service mode is indicated by the yellow STATUS LED flashing every 1+1 sec.

Switching to Bootloader mode: keep RST button pressed while switching on the power for approx. 3 sec. Bootloader mode is indicated by quick flashing of the yellow STATUS LED.

Both Service mode as well as Bootloader mode use 192.168.1.1. IP address.

2.3. First start of radio modem

1. Two radiomodems having **the same address must not be in the common network** neither radio nor ethernet.

   Parameters of each radio modem are set during production with default values : IP address 192.168.1.2, mask 255.255.255.0. It is strictly forbidden to connect a radio modem **to LAN** before setting up the appropriate IP address and mask. (The default IP may already be in use in the LAN and address collision can occur)

   Do not switch on **more than one radio** with default settings at any one time ! Only switch on the next one after setting and storing IP parameters in the first one.
   In default mode radio modems use the same address 192.168.1.2 and communication amongst themselves thus disturbs IP communication between the PC and configured radio modem.

2. Interconnect the ETH interface of the radio modem with your PC. A standard Ethernet cable should be used.

   To connect the power supply, either PoE (Ethernet interface) or AUX (SCC interface) – more Section 3.4, “Power supply”, LEDs PWR and ETH should light. After approx. 20 sec. booting of radio modem is finished and the STATUS LED starts flashing green.

3. To set the IP address and mask of your PC in order for it to be ready to communicate with the default IP of the radio modem. A ping may be used to check that the connection works properly. Read more in Appendix A, *Appendix*.

   Start www browser (e.g. Internet Explorer) in your PC and insert 192.168.1.2. address in the command line instead of internet address.

   Settings menu is displayed. Here it is possible to set all parameters.

4. Select a unique IP address of each radio modem within the network. This address is not used by the connected technology, however, it is required for configuration and testing.

   Individual parameters may be set (see Section 2.4, “Radio modem configuration”). Configuration can be saved into the radio modem using `Save` or into a file using `Save to file`.

   When the IP address is changed and configuration is saved into the radio modem, the connection between your PC and radio modem will be lost. The next configuration is only possible after inserting a new IP address into the www browser. If a new IP is out of the mask of your PC, the IP address of your PC needs to be changed as well (see Appendix A)

   When configuration is ready and saved the radio modem is ready to operate in your network.

5. Before configuring the next radio delete table Art (Start, Run, arp -d) in the PC. Table arp contains a pair of IP addresses 192.168.1.2 and MAC addresses of the radio modem. Another pair must be created for the next radio modem.

6. When basic parameters are set (prior to starting the application), it is recommended to test the radio connection among radio modems using a Ping in the Diagnostic menu, see Section 2.5, “Diagnostics”. An ordinary ping application from Windows, for example, may be used as well. Don't forget to connect the antennas, see Section 3.1, “Antenna”.

   Communication with the application is indicated by LEDs as described in Section 3.5, “Indication LEDs”.

2.4. Radio modem configuration

ON LINE

The radio modem is connected to your PC as described in Section 2.3, “First start of radio modem” and its parameters can now be set:

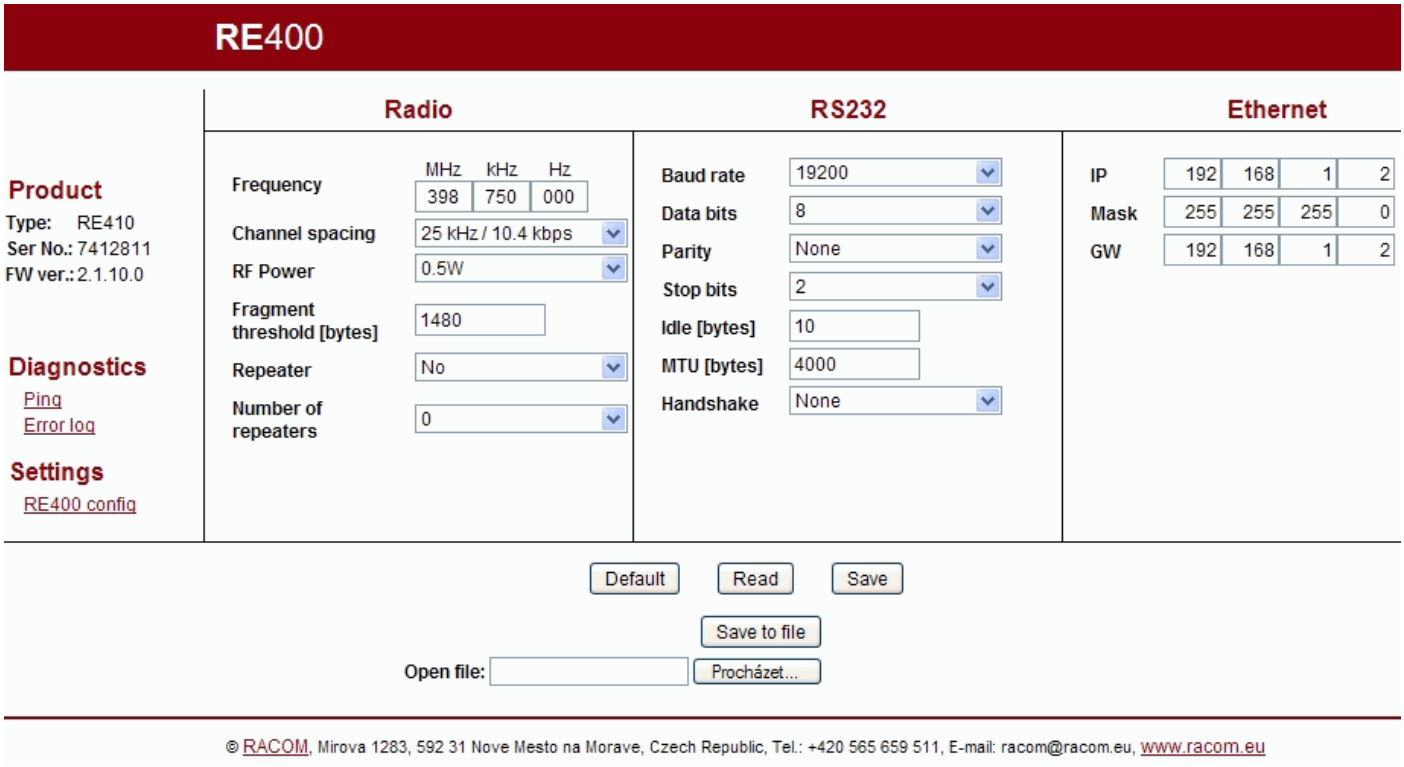


Fig. 2.1: Settings menu

Product
- identification data can’t be changed:
- Type: RE410 — specific type for specific frequency range, see Section 5.2, “Labelling of Radio Modems”
- Product No.: 7347743 — unique production number (it is used for a Ping test, for example)
- FW version: 2.1.7.0 — firmware version downloaded

Diagnostics
- Ping — menu for testing using pings, see Section 2.5, “Diagnostics”
- Error log — log of warn and error messages, see Section 2.6, “Error log”
- RE400 config — this configuration screen

Radio
- Frequency 402 125 000 Hz — working frequency, it has to be set in a 6.25 or 5 kHz grid
- Channel spacing — selection of channel spacing and data rate (modulation)
- RF Power — 0.5 W or 2 W

- Fragment threshold— the threshold, from which the packet fragmentation in RFC starts exert (50 - 1480 bytes). See Section 2.2.1, “Main mode”
- Repeater — repeated transmitting, store and forward transmitting. Set up options:

  No — Repeater not active, default state

  Yes — Packet received from RFC is sent to RF channel and also to serial or ETH port
- Number of repeaters — total number of Repeaters in the network, similar settings throughout the network

  0 — Transparent behaviour of radio modem

  1, 2, >2 — Regulation of transmission to create space for a packet transmitted by the repeater, inspection and discarding of repeated packets.

RS232
- Idle — number of empty bytes. Packet is closed after a pause, which is equal to the number of Idles. Min. value 6.
- MTU — the incoming packet is closed at this size. A shorter packet is closed at Idle. Longer packet is sent to RFC in the length MTU, the remaining part is saved in the input buffer and is sent to RFC subsequently. See Section 2.2.1, “Main mode”
- The rest are standard, well known parameters of serial communication

Ethernet
- Generally known parameters of IP communication.

Executive buttons
- Default — sets default values on the screen
- Read — reads values from radio modem memory
- Save — saves values from the screen into radio modem memory - the screen is refreshed automatically. The button *Continue here* which appears meantime solves the error states only.
- Save to file — saves values from the screen to a file
- Open file — Browse – reads values from a file on the screen.

OFF LINE

Parameters of radio modems can be configured off line using the web page:

http://re400.racom.eu

Using this page you can create a .cnf file that can later be downloaded into the radio modem or you can view and modify parameters already saved in a file. The download is made in two steps - load it into *Configuration menu* using the button *Open file* and save in the radiomodem using button *Save*.

The configuration file may be edited directly as well:

```
IP=192.168.1.47                 BAUD=19200
MASK=255.255.255.0              DBITS=8
GW=192.168.1.47                 PARITY=0
```

```
TX_FREQ=402125000                SBITS=2
RX_FREQ=402125000                IDLE=10
SPACING=1                        SIZE=4000
RFPWR=0                          HANDSHAKE=0
REPEAT=0                         FRS=1480
REPEAT_NO=0
```

Note: Check whether the set frequency is within the range for the specific type of modem; it doesn't work for off line configuration.

2.5. Diagnostics

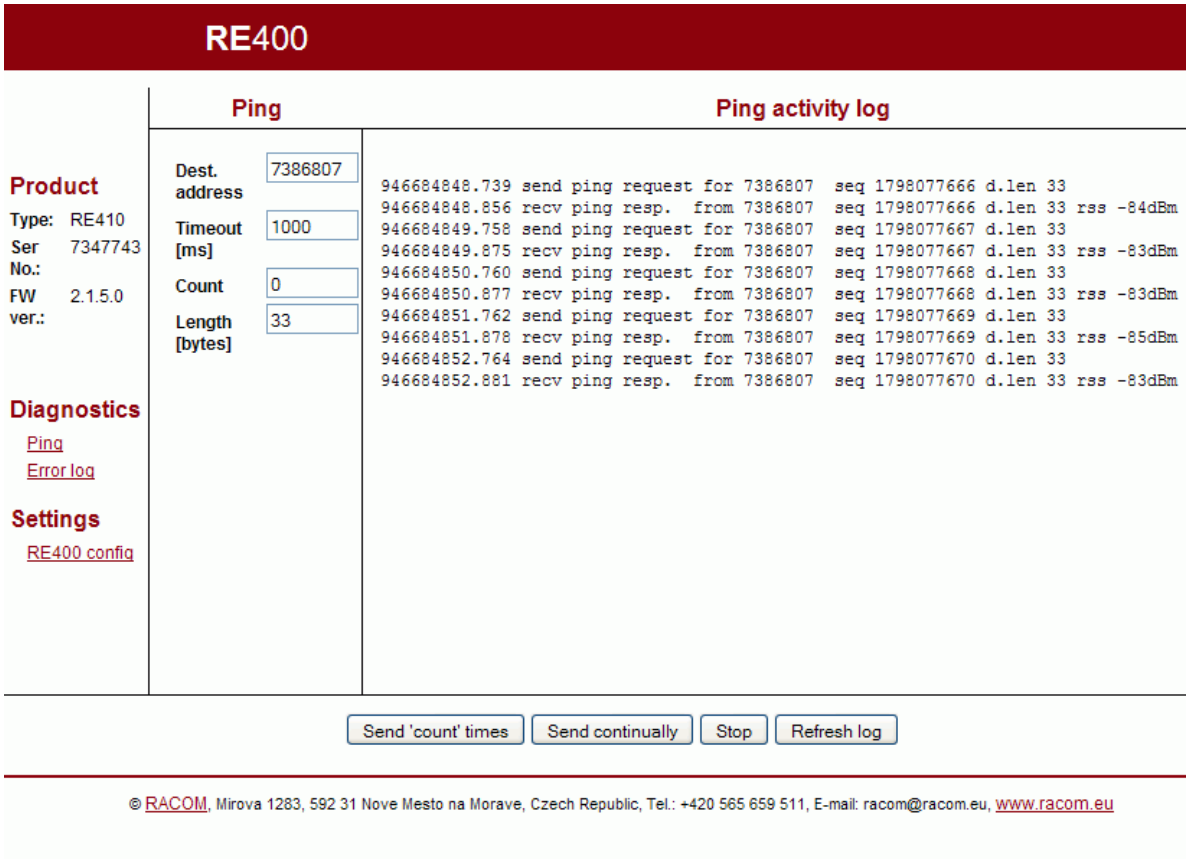


Fig. 2.2: Diagnostics menu

Pings are used for testing response times and signal strengths from remote radio modems.

- Ping address: 7353743 — product No. of remote radio modem
- Ping timeout: 1000 — transmitting period of pings, ms
- Ping count: 0 — number of pings
- Ping length: 22 — length of data transferred excluding header, Bytes
- Send 'count' times — starts transmitting `Ping count`
- Send continually — starts transmitting pings continuously - a few of seconds later the screen refreshes automatically. For next refresh use the button Refresh log.

- Stop — stops transmitting
- Refresh log — updates the `Ping activity log`
- Ping activity log — standard information + RSS (received signal strength). The message `rss NA (> -73dBm)` is caused by signals stronger than -73dBm. There are separate records for transmitted and received pings.

2.6. Error log

When the radio modem is in operation packet processing messages are generated:

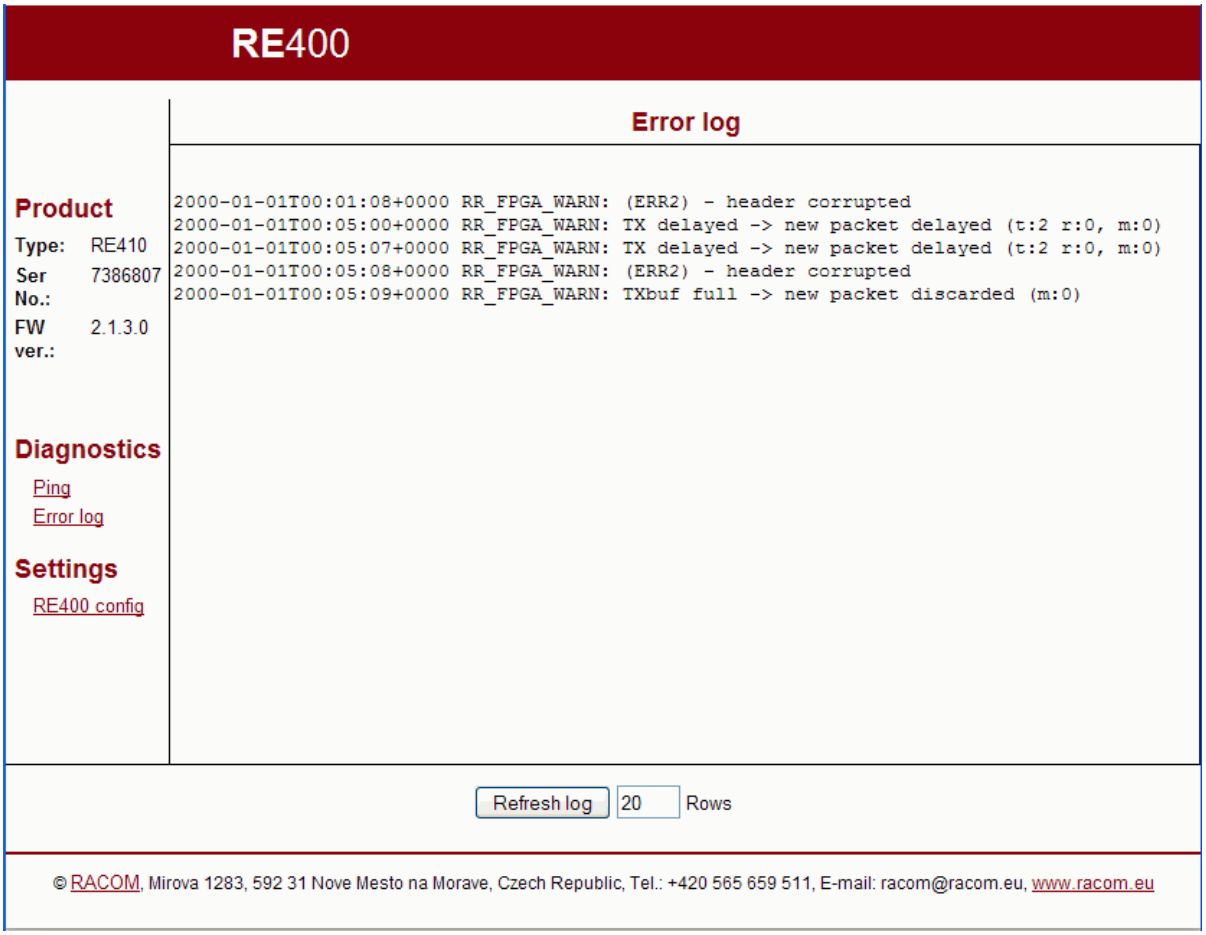


Fig. 2.3: Error log

Overwiev of reports RR_FPGA_WARN:

- TX busy -> new packet discarded (for IP only)
  A new request for transmission is discarded because transmission is currently taking place.
- TXbuf full - timeout!
  A TX_STOP signal didn't arrive from FPGA.
- Input buffer store timeout. Old packet discarded.
  The packet has been waiting for such a long time in the input buffer (4min) that it is discarded.
- Fragment - sequence error

The serial number of the fragment does not correspond to that expected.

- Fragment - total number error
  Information about the total number of fragments does not correspond to the previous fragment.

- Fragment - source address error
  The received fragment is from another source address (serial number of radio modem) than the previous fragment.

- Fragment - receive timeout
  The next fragment (does not apply to the first one) did not arrive within the timeout period (timeout is given by the transmission time of a single fragment in RFC).

- Fragmented packet being transmitted -> new packet delayed
  Transmission of a packet has been held up (the packet is stored in the input buffer) owing to transmission or receipt of a fragmented packet. During receipt this doesn't apply to the first fragment (it is not yet known that it is a fragment).

- Fragment - missing first fragment
  A fragment not marked as the first has been received (and the first hasn't yet been received).

- Compression inflate error
  Packet decompression error.

- Compression deflate error
  Packet compression error.

- Receive process interrupted
  Received data is damaged because transmission occurred during receipt.

- (ERR2) - header corrupted
  FPGA does not understand the packet header (another version of the protocol in the air or interference).

- (CRC16) - header corrupted
  CRC16 didn't appear in the header of the received packet.

- (CRC32) - data corrupted
  CRC32 didn't appear in the data of the received packet.

The following messages only for *Number of repeaters* > 0 :

- Returned packet -> discarded (for NoR>0)
  The same packet that was sent arrived back during the timeout period.

- Same packet -> discarded (for NoR>0)
  The same packet, but with a different source address, was repeatedly received during the timeout period.

- TX delayed -> new packet delayed (for NoR>0)
  Packet transmission has been held up owing to activation of delays related to the repeater.

- TXbuf full -> new packet discarded (for NoR>0)
  A packet for sending is already waiting in the input buffer. A new one is therefore discarded.

2.7. Firmware upgrade

There is fully functional firmware in the radio modem from production. When a firmware upgrade is required, take the following steps (example for fw version 2.1.7.0). It is necessary to use **user account with administrator privileges**. Remember switch off the firewall in the PC.

Install application trloader to your PC

a. Download installation package[1], e.g.: `2.1.7.0/trloader-win-gui-0.1.3.0.exe` here:

`www.racom.eu/Download/Archive/ECONOMY radio modems/`

b. start `trloader-win-gui-0.1.3.0.exe`

Folder `c:\Racom\Trloader` will be created with respective files there.

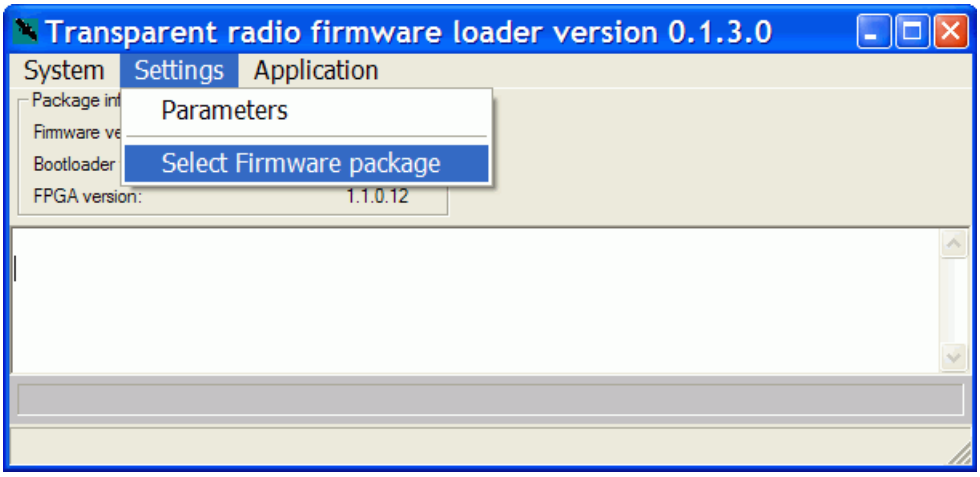
c. Download respective firmware[2], e.g. `2.1.7.0/tr1-2.1.7.0.rpg`, to `c:\Racom\Trloader` folder, the latest version may be downloaded here:

`www.racom.eu/Download/Archive/ECONOMY radio modems/`

Note - do both downloadings from the same folder, e.g.: `2.1.7.0/`.

d. Start `fwtrloader.exe` in `c:\Racom\Trloader` folder.

Use `Settings/Select Firmware package` in order to select a package of respective firmware (e.g. `tr1-2.1.7.0.rpg`). The application creates folder `c:\Racom\Trloader\fw_pkg` with the respective files.



Firmware download

Put in PC suitable statical IP address, e.g. 192.168.1.233/24, connect RE via Ethernet and start it in the bootloader mode
(start with pressed RST button, STATUS LED is flashing yellow quickly, address used 192.168.1.1).

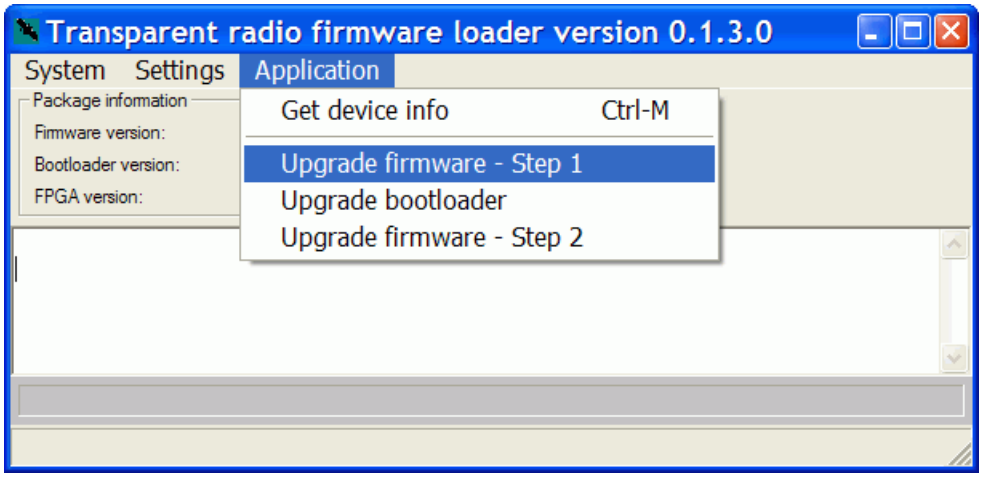
Continue with `fwtrloader.exe`. This utility is accessible also from windows menu Start:

[1] https://www.racom.eu/eng/download/archiv-economy.html
[2] https://www.racom.eu/eng/download/archiv-economy.html

Start, Programs, Racom, TrLoader, Firmware Transparent loader

1. Select `Application/Upgrade firmware-Step1`

   (download the first part of firmware, takes approx. 45 sec, STATUS LED is flashing yellow slowly, address 192.168.1.1)



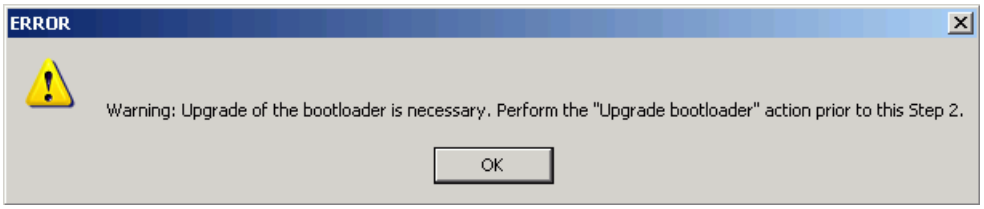
2. Select `Application/Upgrade bootloader`

   (download the new bootloader module, approx. 40 sec, STATUS LED is flashing yellow slowly, address 192.168.1.1)

   This step **can be omitted**, if the bootloader in RE is not older then version mentioned in the file:

   c:\Racom\Trloader\fw_pkg\tr1-2.1.7.0\bootloader\COMPAT

   The check is accomplished automatically at `Upgrade firmware-Step2`. If the return to the step `Upgrade bootloader` is necessary then the report appears:



3. Select `Application/Upgrade firmware-Step2`

   (download the second part of firmware, takes approx. 150 sec, STATUS LED is flashing green slowly, address 192.168.1.2)

4. Select `Application/Get device info`

   returns the actual fw version from the radio modem. It is also possible to set the customer's IP address (`Settings/Parameters/altIP`) instead of the original 192.168.1.2 for reading the fw version from other radio modem. The loader uses the addresses in order 192.168.1.1, 192.168.1.2 and `altIP`.

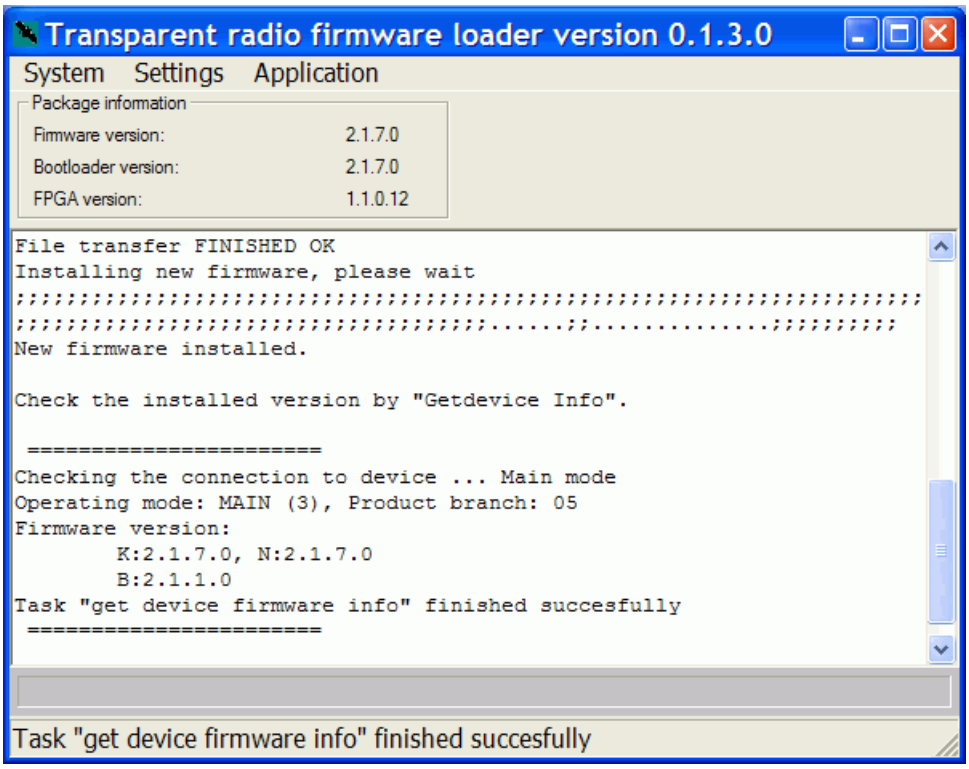


Fig. 2.4: Transparent loader

5. When downloading more consecutive RE, then clear the arp records in PC. In Windows take the following steps:

```
Start / Run / cmd
arp -a               ...reads arp records
arp -d               ...clears all arp records
arp -d 192.168.1.2   ...clears arp records for written address
```

3. Connectors

3.1. Antenna

There is an SMA-jack antenna connector on the radio modem panel. Use only the respective type of connector of the respective impedance on your antenna cable : SMA-plug, 50 Ω. It is recommended to use antenna coaxial cables like this: RG58 up to 10m, RG213 up to 25m, H1000 for longer.

Fig. 3.1: Antenna connector SMA

Important

A radio modem may be destroyed if an antenna or dummy load antenna is not connected.

3.2. Serial interface

Tab. 3.1: RS232

DSUB9F pin	signal
1	CD
2	RxD
3	TxD
4	DTR
5	GND
6	DSR
7	RTS
8	CTS
9	+PWR

Fig. 3.2: RS232 DSUB9 female

3.3. Ethernet interface

- Ethernet connector RJ-45 for 10BaseT and 100BaseT fully matches the standard of Power over Ethernet IEEE802.3af.
- The radio modem recognizes a standard or crossed cable and adapts itself automatically.

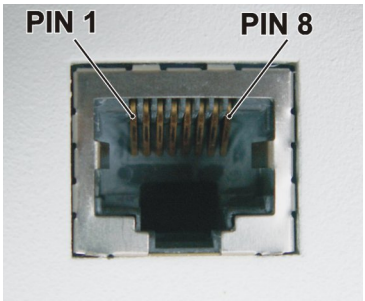


Fig. 3.3: RJ-45F

3.4. Power supply

There are 2 possibilities for the power supply:

- AUX – via RS232 DSUB9 connector, using pins 5 and 9 (see Section 3.2, “Serial interface”). Voltage 10.5-30 V, nominal 13.8 V.

  To connect the power supply via RS232 connector, can be used REPWR adaptor.

- PoE – via Ethernet connector RJ-45 using PoE standard IEEE802.3af. Voltage 38-57 V. Common version of supplying:
  plus to pins 4+5
  minus to pins 7+8
  the polarity can be inverted also
  For other options with PoE adapter see the standard IEEE802.3af.

  To connect the power supply via Ethernet connector, can be used Passive PoE injektor.

Important

Only ONE of the above power supply options can be used !

Examples and details in Chapter 6, *Radio modem installation*.

3.5. Indication LEDs

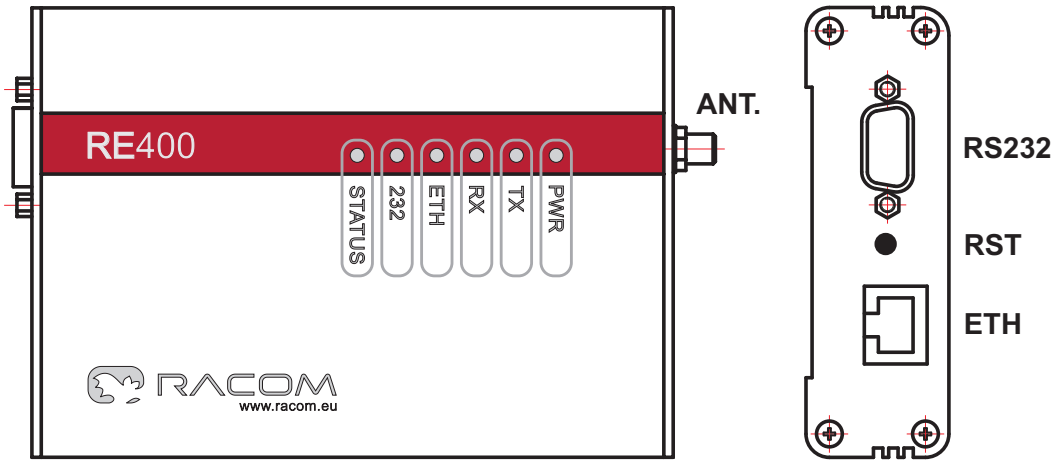


Fig. 3.4: Appearance of radio modem

Key to LEDs

PWR
- Yellow – AUX (power via RS232)
- Green – PoE (power via Ethernet)

TX
- Red - transmitting

RX
- Green – RF sync
- Yellow – there is a signal stronger than -80 dBm on RF channel (or transmitting proceeds)

ETH
- Yellow – connected with 100 Mb/s speed
- Yellow flashing – data transfer with speed of 100 Mb/s
- Green - connected with 10 Mb/s speed

- Green flashing – data transfer with speed of 10 Mb/s

232
- Green – data receiving
- Yellow – data transmitting

STATUS
- status of operating system:
- Green flashing with period 2 sec ON, 1 sec OFF – main mode
- Yellow flashing with period 1 sec ON, 1 sec OFF – Service mode
- Yellow flashing with period 0.2 sec ON, 0.2 sec OFF – Bootloader mode

4. Table of Technical Parameters

Tab. 4.1: Technical parameters

Frequency range		RE400: 373.25–484 MHz	
Channel bandwith		25 kHz or 12.5 kHz or 6.25 kHz *	
Frequency step		5 kHz or 6.25 kHz	
Method of setting working frequency		software	
Rx/Tx switching time		< 1.5 ms	
Data security on RF channel		32 bit CRC	
Receiver sensitivity for BER 10^{-3}		better than -107 dBm	
Output power software adjustable	Low	0.5 W	
	High	2 W	
Data rate in RF channel		2.6 kbps in 6.25 kHz channel *	
		5.2 kbps in 12.5 kHz channel	
		10.4 kbps in 25 kHz channel	
Interfaces		Ethernet, RS232	
Antenna connector		SMA	
MTBF (Mean Time Between Failures)		>100 000 hodin	
Power method		AUX	PoE
Power supply		10.8–30 V (nomin. 13.8 V)	38–57 V
Power consumption (cca)	Idle state (Rx)	430 mA/13.8 V	145 mA/48 V
	Low power Tx	700 mA/13.8 V	230 mA/48 V
	High power Tx	950 mA/13.8 V	310 mA/48 V
Operating temperature range		-25 až +55 °C	
Storage temperature range		-35 až +85 °C	
Case dimensions		137 × 96 × 31 mm	
Weight		0.3 kg	

* *Channel spacing 6.25 kHz is not approved under EU rules.*

Tab. 4.2: Standards complied with

Radio parameters	ETSI EN 300 113-2 V 1.6.1
EMC (Electromagnetic Compatibility)	ETSI EN 301 489-1 V1.6.1
Electrical safety	CENELEC EN 60 950 ed.2:2006; EN 50 385; EN 50 383

5. Dimensions, drawings, manufacturing code

5.1. Dimensional Diagram

There are 4 versions of radio modems in terms of mounting:

D – Horizontal body, DIN rail mount, e.g. RE410**D**

H – Horizontal body, mount on a plate, e.g. RE410**H**

R – Vertical body, DIN rail mount, e.g. RE410**R**

S – Vertical body, mount on a plate, e.g. RE410**S**

Basic type is D. Other types available to order.

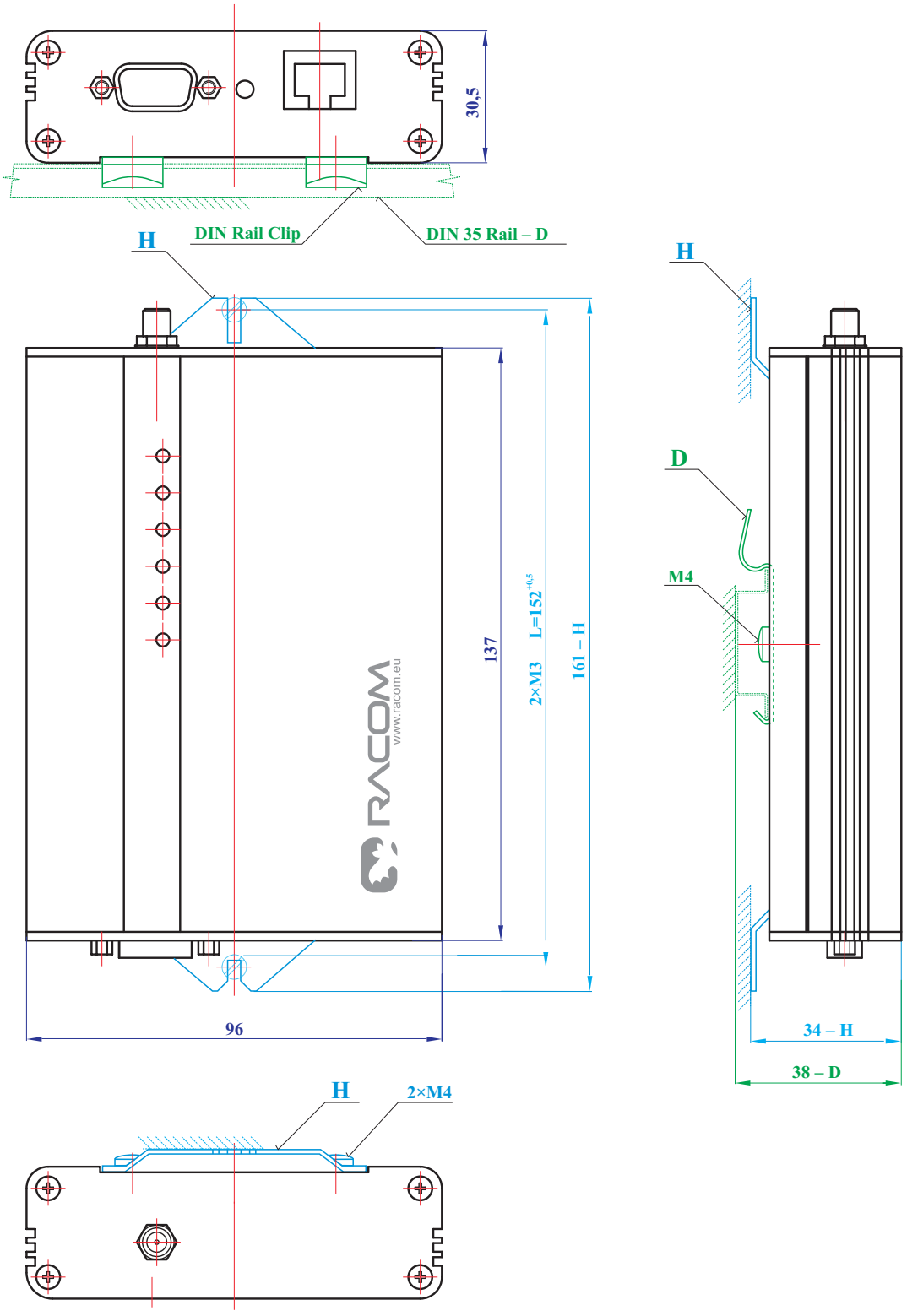


Fig. 5.1: Mounting dimensions of the radio modem - version D and H

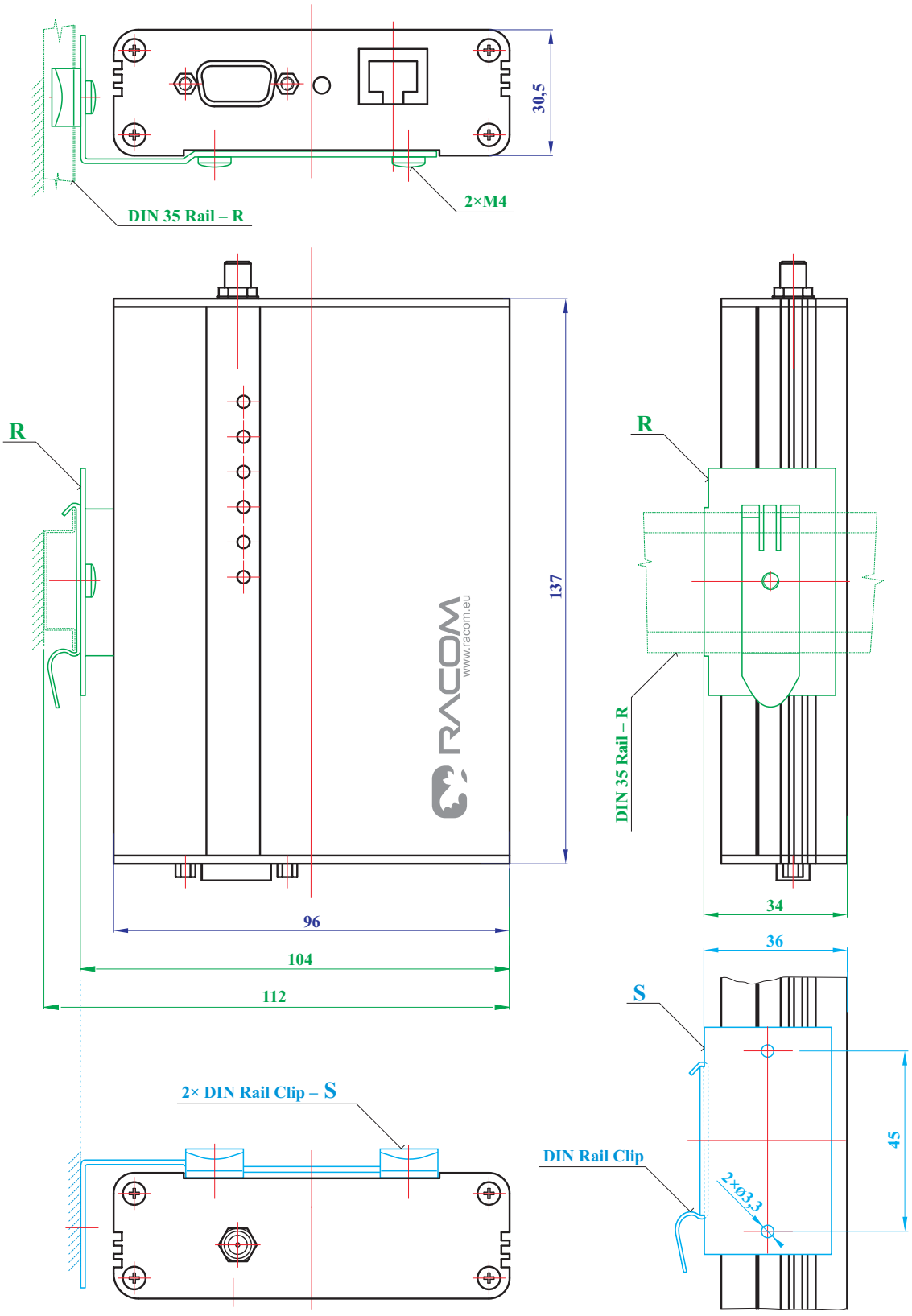
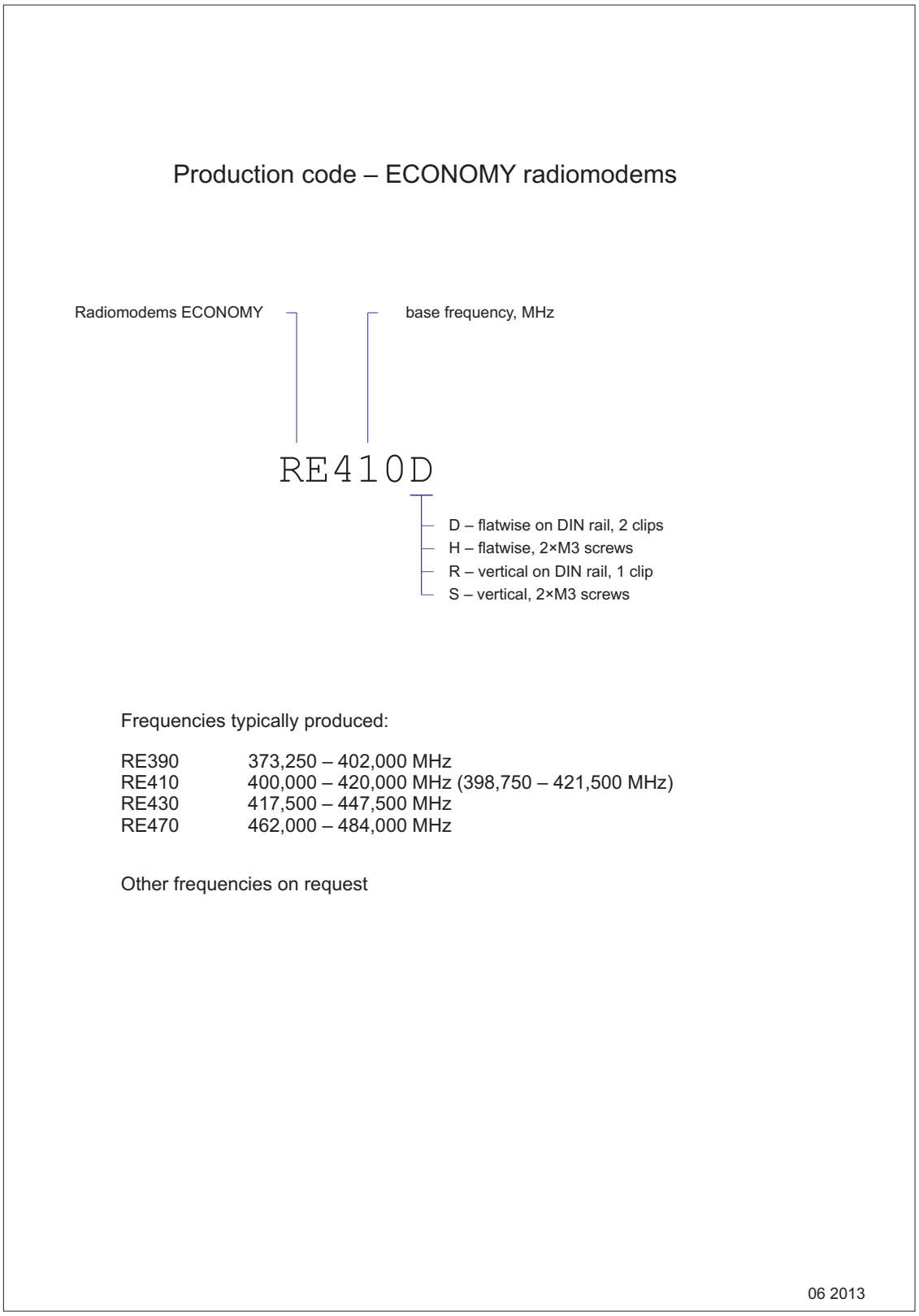


Fig. 5.2: Mounting dimensions of the radio modem - version R and S

5.2. Labelling of Radio Modems

is described in the next table:



6. Radio modem installation

6.1. General description

Racom radio modems feature robust, metallic casing. They are used in different applications in different environments, ranging from air-conditioned offices to heavy-industry plants.

Information in this chapter describes the standard method of installation, used in common industry applications. It is based on regulatory standards which apply to the equipment and on the long-term experience of our engineers. If your network is large and your application complex, we recommend the network design to be done by one of our partners or directly by Racom[1]. Every network design should begin by field measurements of the signal strength and quality and by careful evaluation of conditions for propagation of radio waves in the area.

Every radio device has to meet conditions for operation in the given frequency range in the respective country and the operator is responsible for the compliance.

A reliable operation of a radio modem requires a proper connection to the data-terminal equipment serviced, the antenna has to be properly installed and connected to it and a proper and safe power supply has to be used. The mounting and the optional housing has to correspond to the environment and must not harm the radio modem performance.

The description of all interface connectors can be found in the Chapter 3, *Connectors*.

6.2. Antenna installation

Optimum installation of the antenna is influenced by a number of factors. The topology of the radio network, the separation of radio points, the terrain profile between them, and conditions for signal propagation all influence the type of antenna to be used and where it should be located. Sometimes the appearance of the structure on which the antenna is to be located and the possibility of its damage in publicly accessible places should also be taken into consideration. Generally it can be said that for point-to-point type connections directional antennas are used, and for more remote points and points with a poorer signal multilink directional antennas with greater gain are used. The height of the antenna above ground level may improve the quality of the signal. The standard height of approx. 5 m can be increased severalfold, but always in consideration of the length of the antenna lead, because each coaxial cable used has its own defined attenuation. For longer leads coaxial cables with lower attenuation are used and generally these have a larger cross-section, worse mechanical properties and are more expensive. When using external antennas we recommend protecting the radio modem with overvoltage protection on the coaxial cable.

We recommend to use vertical polarization for all radio modem networks.

Racom radio equipment in typical installations comply with applicable standards for human exposure to RF electromagnetic fields, namely with standard EN 50385: 2002. The minimal safe distance is ensured by the antenna position on a mast. When special installation is required, the conditions of the standard above have to be met. The distance between the persons and antenna minimal 5 m comply with applicable standards for human exposure of general public to RF electromagnetic fields, namely with standard EN 50385: 2002. It is valid for all power levels and all antenna types which firm Racom provides.

[1] https://www.racom.eu/eng/services/

6.3. Supplying power to the equipment

A power supply has to meet technical specifications of the equipment powered, see Section 4 Table of Technical parameters. Radio modem can be powered either over the Ethernet interface according to the PoE (Power over Ethernet) standard or over the SCC (RS232) interface by DC voltage 10.8-30V (13.8V nominal). When powering over SCC we recommend one of the MORSE power supplies, e.g. MS2000[2], which were specially designed for supplying of radio modems. MS2000 and MSU120 can provide seamless switching to a backup battery while monitoring its state and charging it in an optimum way. When using PoE, we can also recommend a RACOM PoE power supply which includes battery backup option.

The following pictures show the four possible variants of power supply.

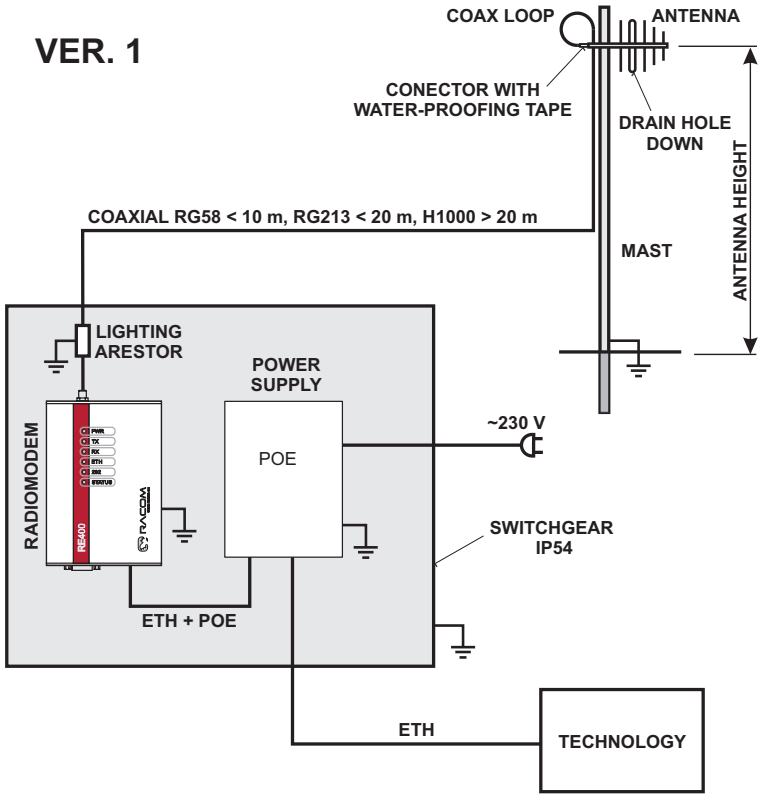


Fig. 6.1: Supplying power over the ethernet interface, using a PoE P.S.

[2] http://www.racom.eu/eng/products/ms2000.html

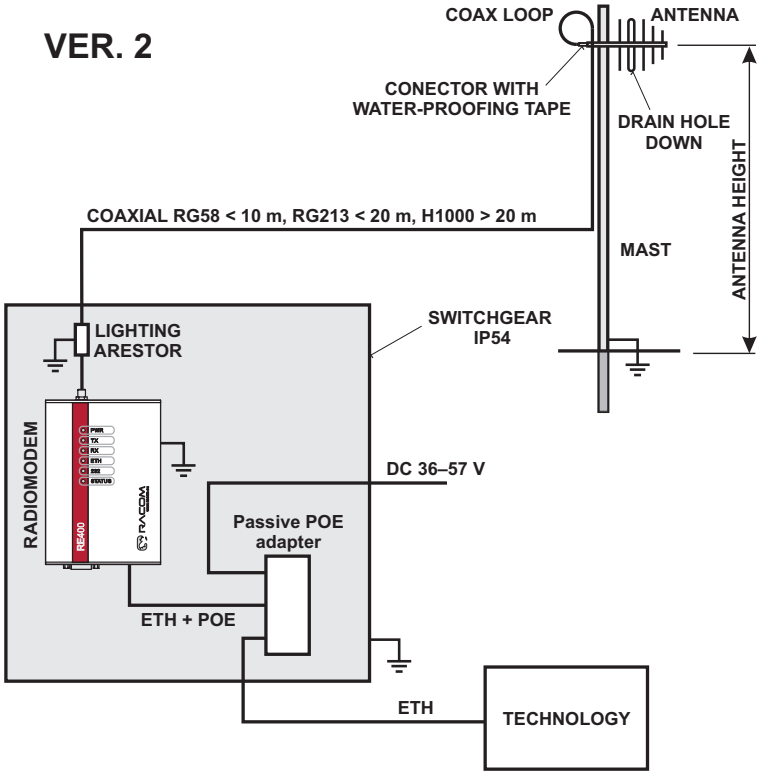


Fig. 6.2: Supplying power over the ethernet interface, using the passive PoE injector

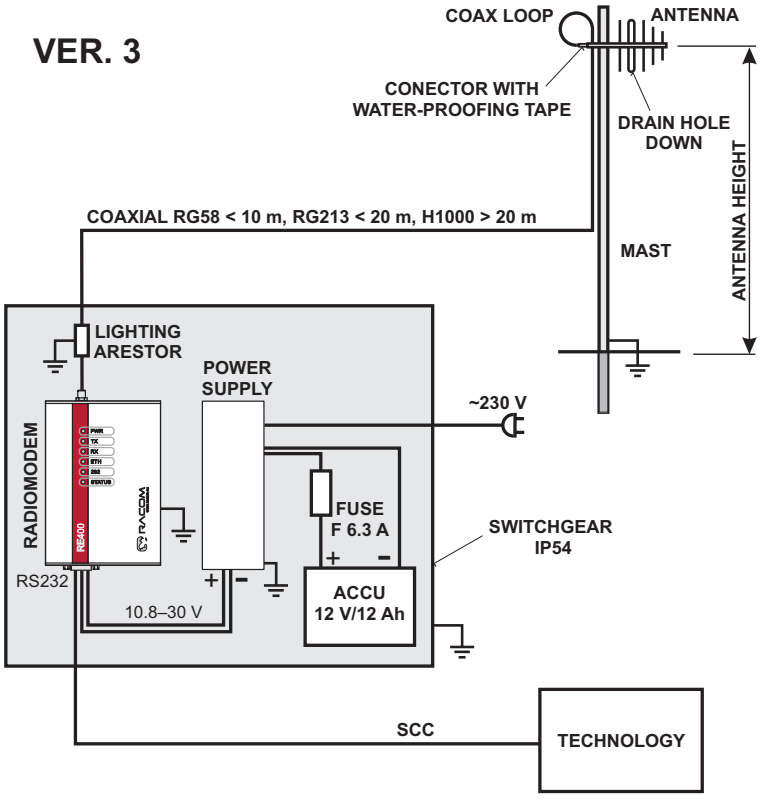


Fig. 6.3: Supplying power over the SCC interface, using a REPWR adaptor and P.S. with battery backup

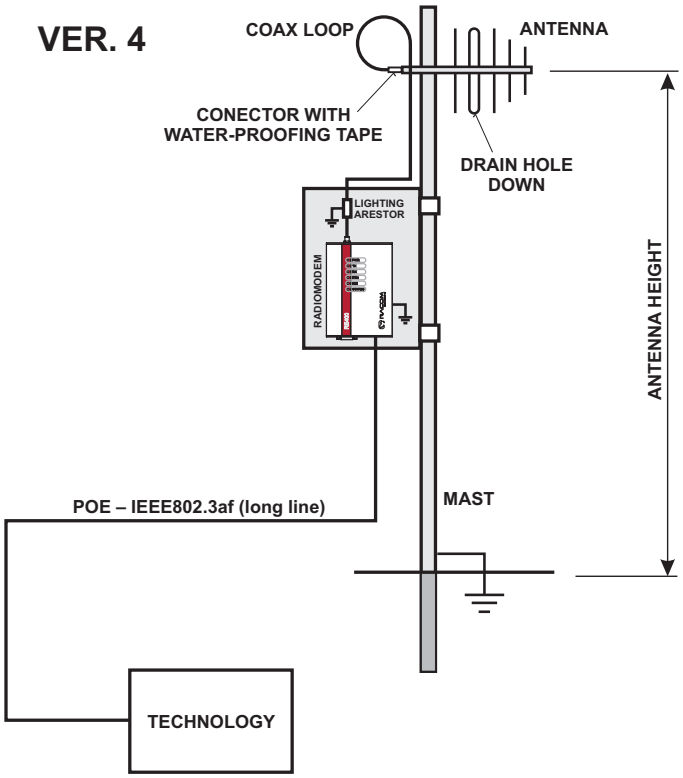


Fig. 6.4: Supplying power over the ethernet interface directly from the technology

The layout of installation showed at ver. 4, i.e. when the radio modem is placed up on the mast (or close to it), provides the valuable advantage of having a short antenna feeder (see section Antenna installation). Remember that the ethernet cable has to meet the PoE standard requirements (IEEE802.3af).

Power adaptors for RE400

Fig. 6.5: Passive PoE injector

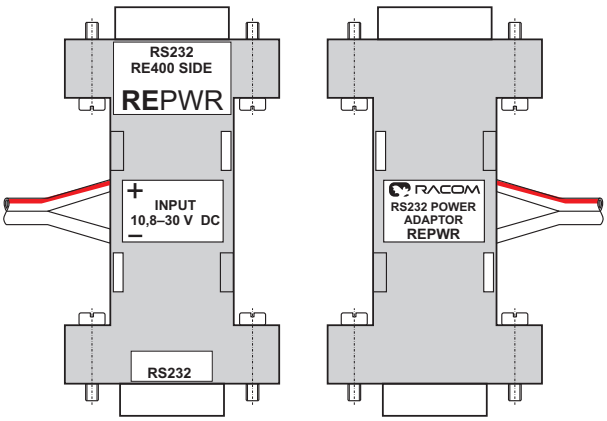


Fig. 6.6: REPWR adaptor

6.4. Technology connection

The Data Terminal Equipment, a programmable controller, a PC or any other device communicating over the radio network, has to be connected to the router by a data cable to the serial or the Ethernet interface according to the respective standard. These interfaces are described in detail in the chapter Connectors.

6.5. Radio modem mounting

Radio modem can be either attached by screws to a mounting plate or simply clipped to a DIN rail. In both cases, the body of the radio modem can be positioned (with respect to the mounting plane) either horizontally (i.e. sitting on the flat base of the casing) or vertically (i.e. sitting on the narrow side). That means there are four basic variants of mounting. The variant for which the mounting accessories are delivered is indicated in the manufacturing code and can be requested in the order by specifying the code, see Section 5.2, “Labelling of Radio Modems”. When no mounting preference is given, the basic variant "D" (DIN rail, horizontal) will be delivered.

Fig. 6.7: Horizontal body, DIN rail mount, version D

Fig. 6.8: Horizontal body, mount on a plate, version H

Fig. 6.9: Vertical body, DIN rail mount, version R

Fig. 6.10: Vertical body, mount on a plate, version S

All the dimensions and detailed drawings relevant for mounting can be found in the Section 5.1, “Dimensional Diagram”. In a typical installation for industrial applications[3] the radio modem is mounted into an IP54 cabinet together with the power supply, the backup battery and the surge protector.

[3] https://www.racom.eu/eng/references/references.html

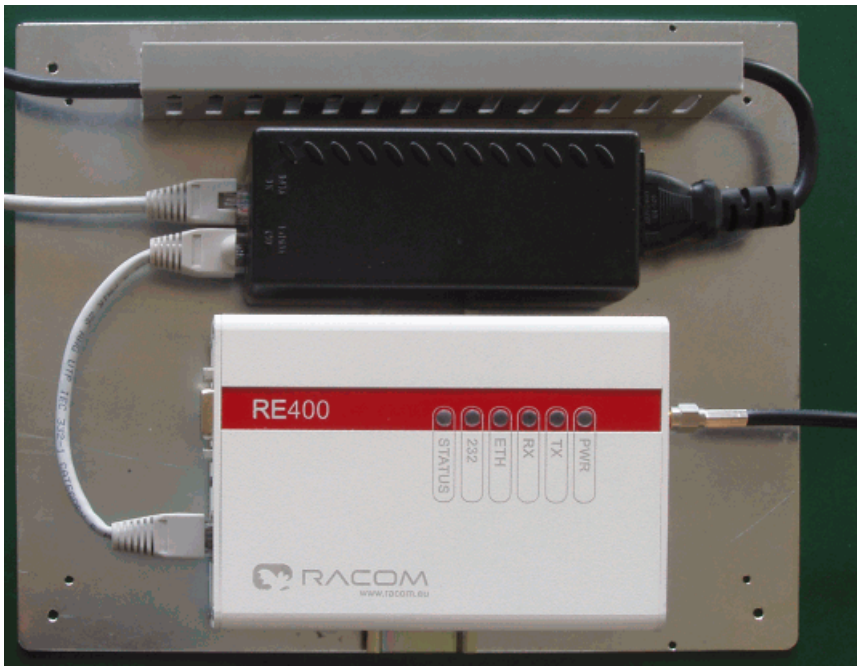


Fig. 6.11: Assembly example

7. Conditions for Radio Modems Operation

7.1. Important Notifications

Sole owner of all rights to this operating manual is the company RACOM s. r. o. (further in this manual referred to under the abbreviated name RACOM). All rights reserved. Drawing written, printed or reproduced copies of this manual or records on various media or translation of any part of this manual to foreign languages (without written consent of the rights owner) is prohibited.

RACOM reserves the right to make changes in the technical specification or in this product function or to terminate production of this product or to terminate its service support without previous written notification of customers.

Conditions of use of this product software abide by the license mentioned below. The program spread by this license has been freed with the purpose to be useful, but without any specific guarantee. Under any circumstances the author or another company or person is not responsible for secondary, accidental or related damages resulting from application of this product.

The producer does not provide the user of any kind of guarantee containing assurance of suitability and usability for his application. Products are not developed, designed nor tested for utilization in devices directly affecting health and life functions of persons and animals, nor as a part of another important device, and does not provide of guarantees if the company product has been used in these aforementioned devices.

RACOM Open Software License

Version 1.0, November 2009
Copyright (c) 2001, RACOM s.r.o., Mírová 1283, Nové Město na Moravě, 592 31

Everyone can copy and spread word-for-word copies of this license, but any change is not permitted.

The program (binary version) is available for free on the contacts listed on http://www.racom.eu. This product contains open source or another software originating from third parties subject to GNU General Public License (GPL), GNU Library / Lesser General Public License (LGPL) and / or further author licences, declarations of responsibility exclusion and notifications. Exact terms of GPL, LGPL and some further licences is mentioned in source code packets (typically the files COPYING or LICENSE). You can obtain applicable machine-readable copies of source code of this software under GPL or LGPL licences on contacts listed on http://www.racom.eu.

7.2. Conditions of Liability for Defects and Instructions for Safe Operation of Equipment

Please read these safety instructions carefully before using the product:

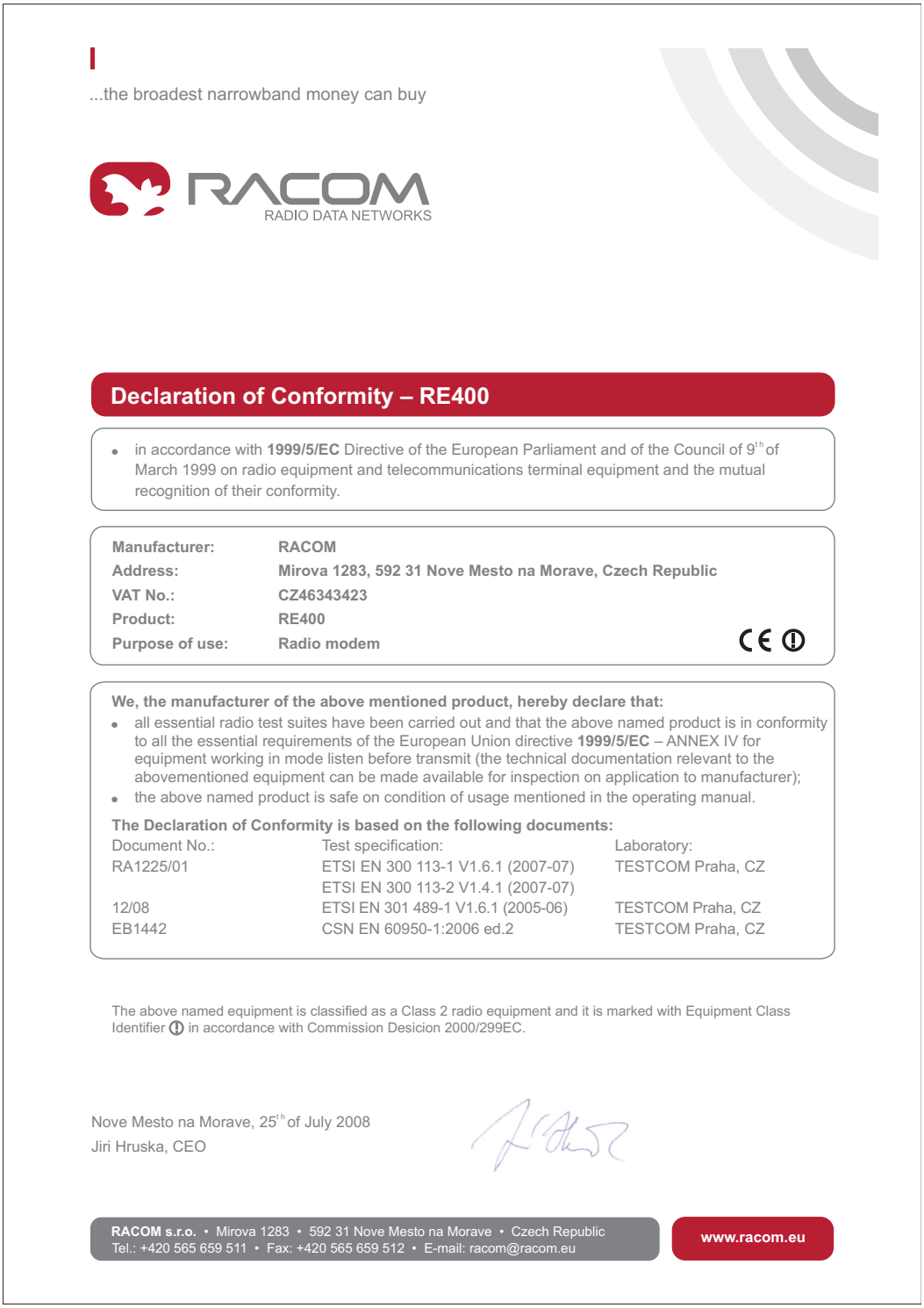
- Liability for defects does not apply to any product that has been used in a manner which conflicts with the instructions contained in this operator manual, or if the case in which the radio modem is located has been opened, or if the equipment has been tampered with.

- The radio modem can only be operated on frequencies stipulated by the body authorised by the radio operation administration in the respective country and cannot exceed the maximum permitted output power. RACOM is not responsible for products used in an unauthorised way.
- Equipment mentioned in this operator manual may only be used in accordance with instructions contained in this manual. Error-free and safe operation of this equipment is only guaranteed if this equipment is transported, stored, operated and controlled in the proper manner. The same applies to equipment maintenance.
- In order to prevent damage to the radio modem and other terminal equipment the supply must always be disconnected upon connecting or disconnecting the cable to the radio modem data interface. It is necessary to ensure that connected equipment has been grounded to the same potential. Before connecting the supply cable the output source voltage should be disconnected.
- Only the undermentioned manufacturer is entitled to repair any devices.

7.3. Product Conformity

Hereby, RACOM s. r. o., declares that this RE400 radio modem is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/ES. This equipment therefore bears the CE marking. The warning exclamation mark in the circle marks the radio modem as class 2 equipment denoting radio equipment with possible limitations or with requirements on authorisation to use radio equipment in certain countries.

Fig. 7.1: CE sign



...the broadest narrowband money can buy

RACOM
RADIO DATA NETWORKS

Declaration of Conformity – RE400

- in accordance with **1999/5/EC** Directive of the European Parliament and of the Council of 9th of March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity.

Manufacturer:	**RACOM**
Address:	**Mirova 1283, 592 31 Nove Mesto na Morave, Czech Republic**
VAT No.:	**CZ46343423**
Product:	**RE400**
Purpose of use:	**Radio modem**

CE (!)

We, the manufacturer of the above mentioned product, hereby declare that:

- all essential radio test suites have been carried out and that the above named product is in conformity to all the essential requirements of the European Union directive **1999/5/EC** – ANNEX IV for equipment working in mode listen before transmit (the technical documentation relevant to the abovementioned equipment can be made available for inspection on application to manufacturer);
- the above named product is safe on condition of usage mentioned in the operating manual.

The Declaration of Conformity is based on the following documents:

Document No.:	Test specification:	Laboratory:
RA1225/01	ETSI EN 300 113-1 V1.6.1 (2007-07)	TESTCOM Praha, CZ
	ETSI EN 300 113-2 V1.4.1 (2007-07)	
12/08	ETSI EN 301 489-1 V1.6.1 (2005-06)	TESTCOM Praha, CZ
EB1442	CSN EN 60950-1:2006 ed.2	TESTCOM Praha, CZ

The above named equipment is classified as a Class 2 radio equipment and it is marked with Equipment Class Identifier (!) in accordance with Commission Desicion 2000/299EC.

Nove Mesto na Morave, 25th of July 2008
Jiri Hruska, CEO

RACOM s.r.o. • Mirova 1283 • 592 31 Nove Mesto na Morave • Czech Republic
Tel.: +420 565 659 511 • Fax: +420 565 659 512 • E-mail: racom@racom.eu

www.racom.eu

Fig. 7.2: RE400 consistency declaration

7.4. Limitations of Use

The RE400 radio modem has been developed for the frequency range 370 to 470 MHz. Specific frequencies are used for each country or region. A radio modem user must keep in mind that this radio device cannot be operated without the permission of the respective local radio spectrum administrator who provides a specific frequency for use and issues the appropriate permission for this. The RE400 radio modems can be used in the following countries either based on a general permission agreement

or on frequencies requiring a licence for operation. Country codes according to ISO 3166-1-Alpha-2 standard: AT, AU, BE, BR, BG, CA, HR, CZ, CY, DK, EE, FI, FR, DE, GR, HK, HU, IS, IE, IT, LV, LT, LU, MY, NL, NO, PL, RO, SG, SI, ZA, ES, SE, CH, GB and US.

Important

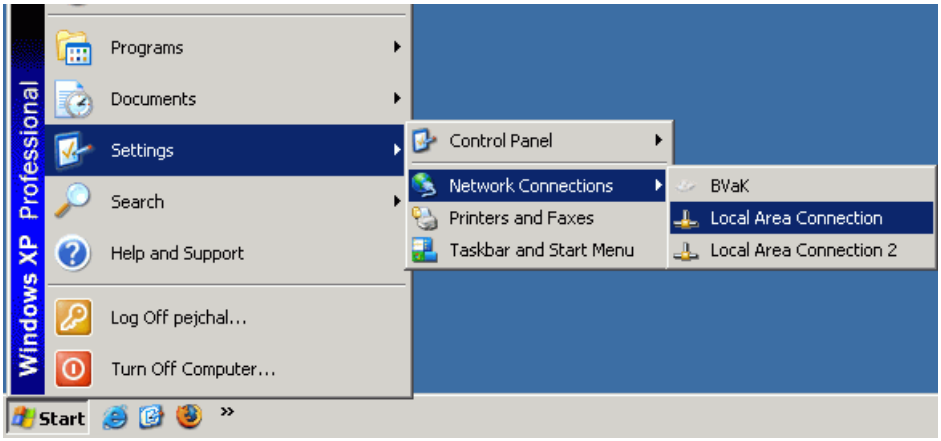
Users of radio modems in North America must be aware that because the 406.0 – 406.1 MHz frequency range is reserved only for the government the use of radio modems on these frequencies is strictly forbidden without proper permission.

Appendix A. Appendix

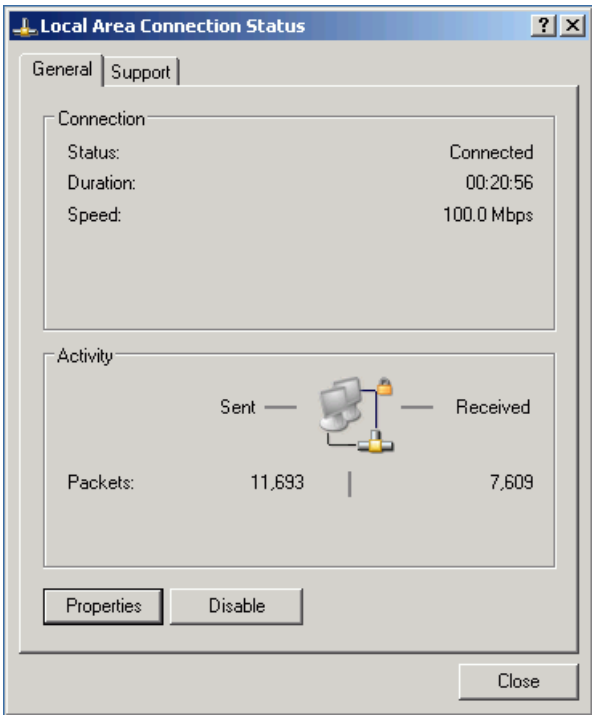
Setting IP addresses in your PC

It is necessary to set the respective IP address in your PC for radio modem configuration, e.g. 192.168.1.233. It is supposed your PC is using DHCP as a primary configuration

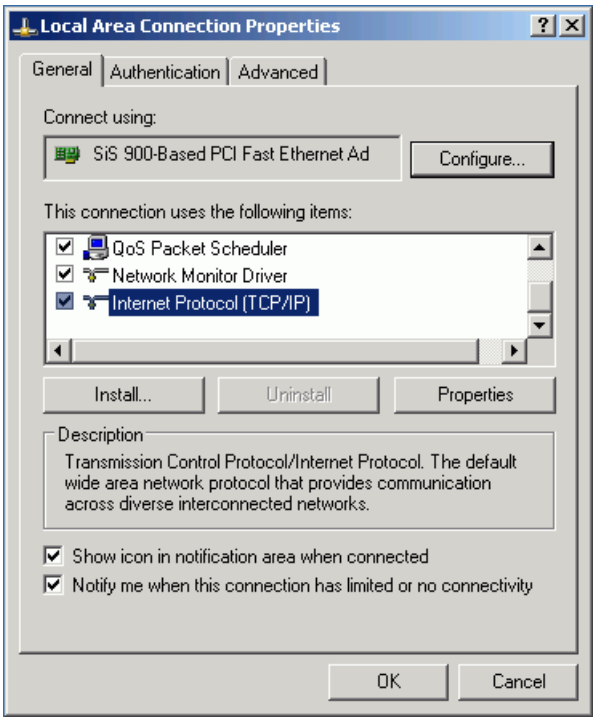
- Open menu Start, **Settings**, **Network connections**, **Local Area Connection**



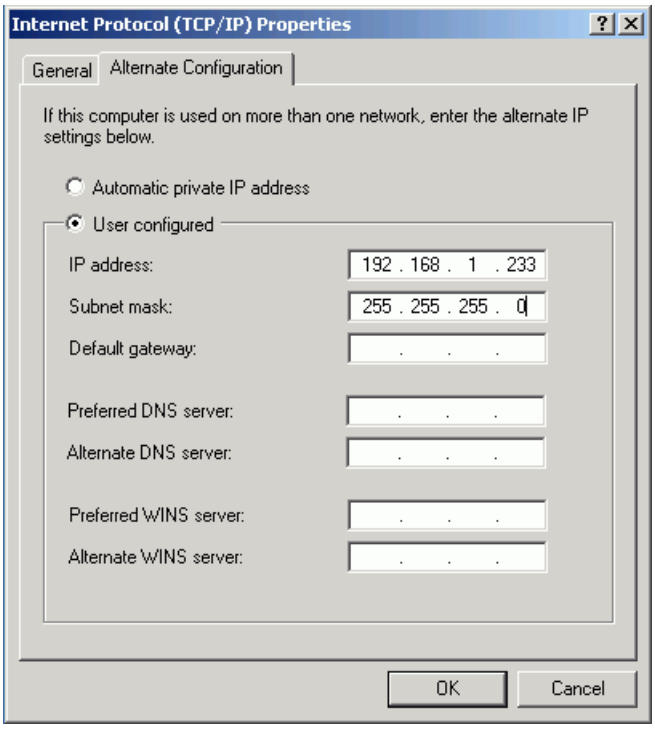
- When window **Local Area Connection Status** is opened, click **Properties**



- Next window is opened. Select **Internet network protocol (TCP/IP)** and click on **Properties**



- The next window is opened
- Select **General** (recomended) and choose **Use the following IP address**
- Insert IP address 192.168.1.233
- Set Subnet mask to 255.255.255.0
- Confirm **OK** in this window and in the previous also
-
- The automatic choice is a second possibility. Then the *General* uses e.g. DHCP server setting and the *Alternate* the IP address 192.168.1.233. This works more slowly and not quite reliably.
- Select **Alternate Configuration**
- Select **User configured**
- Insert IP address 192.168.1.233
- Set Subnet mask to 255.255.255.0



- Confirm **OK** in this window and in the previous also

When you are not using Windows XP follow the instructions in your manual for setting the IP address.

IP address check in PC

While using Windows, proceed e.g. like this:

1. Click menu Start, **Run…**
2. Write the command **cmd**
3. Write **ipconfig** and read the IP address in PC and the mask:

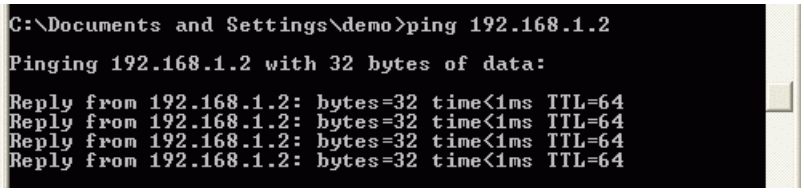
Check the connection PC - radiomodem using Ping

While using Windows, Ping is executed like this:

1. Check the connection between your PC and radio modem via the Ethernet cable.
2. Click menu Start, **Run…**
3. Write the command **cmd**

4. Write **ping 192.168.1.2** and press OK

5. A window will appear with a message:



   When communication doesn't work properly you will get a Timeout expired message.

If the communication between web browser and radiomodem does not work although, check the browser setting. In the menu *File* there is the item *Work offline* which must not be marked off.

Appendix B. Revision History

Revision 1.4 2008-03-26
First edition

Revision 1.5 2008-04-18
First start of radio modem — prevent start of two RE400 in default state together, they both use IP address 192.168.1.2

Revision 1.6 2008-04-22
Table of Technical Parameters — output power, data rate, power consumption.
Labelling of Radio Modems — frequencies

Revision 1.7 2008-05-15
Radio modem configuration — Radio - Repeated packets, RS232 - MTU parameter

Revision 1.8 2008-08-24
Revision history attached

Revision 1.9 2008-09-24
New design of user menu
Firmware upgrade - bootloader
Consistency declaration added
Appendix - Setting IP addresses in PC - fixed address recomended

Revision 1.10 2008-11-05
Firmware 2.1.x.x is not compatible with 2.0.x.x, see Fragmentation
Repeater parameters, Number of repeaters and their default states changed

Diagnostic information in the Error log
Updated for fw version 2.1.3.0

Revision 1.11 2009-03-18
Added possibility to supply using the REPWR Adaptor or passive PoE Injektor + their pictures.

Revision 1.12 2009-03-30
Complete and detailed table of technical parameters
Complete table of production code

Revision 1.13 2009-06-18
Note to admin laws at download
Minor corrections to version 2.1.7.0

Revision 1.14 2009-12-23
Data check in RFC

Revision 1.15 2013-06-25
RE450 removed from production code