



User manual




Quick start




Hardware



Configuration



Parameters



fw 1.3.1.0
10/14/2019
version 1.1

Table of Contents

Important Notice	5
Quick guide	6
List of documentation	8
1. Product	9
1.1. Dimensions	9
1.2. Connectors	12
1.3. Indication LEDs	19
1.4. Ordering codes	21
2. Accessories	22
3. Step-by-step guide	31
3.1. Connecting the hardware	31
3.2. Powering up your RipEX2	32
3.3. Connecting RipEX2 to a programming PC	33
4. Installation	37
4.1. Mounting	38
4.2. Antenna installation	41
4.3. Antenna feed line	41
4.4. Grounding	42
4.5. Connectors	42
4.6. Power supply	43
5. Configuration	44
6. Technical parameters	45
6.1. Detailed Radio parameters	50
6.2. Occupied Bandwidth limits overview	59
7. Safety, environment, licensing	62
7.1. Frequency	62
7.2. Safety distance	62
7.3. High temperature	64
7.4. RoHS and WEEE compliance	64
7.5. Instructions for Safe Operation of Equipment	67
7.6. Important Notifications	67
7.7. EU restrictions or requirements notice	68
7.8. EU Declaration of Conformity	69
7.9. Simplified EU declaration of conformity	70
7.10. IP Certificate	72
7.11. Warranty	74
7.12. PRODUCT maintenance	75
A. Abbreviations	76
Index	78
Revision History	79

List of Tables

1.1. Pin assignment	13
1.2. Ethernet to cable connector connections	15
1.3. COM pin description	16
1.4. USB A Pinout Cable Assembly	17
1.5. Digital Inputs and Outputs	18
1.6. Key to LEDs	19
6.1. Technical parameters	45

6.2. List of connected cables	49
6.3. 12.5 kHz	50
6.4. 25 kHz	52
6.5. 50 kHz	54
6.6. 100 kHz	55
6.7. 150 kHz	56
6.8. 200 kHz	57
6.9. MSE	58
6.10. Maximal power for individual modulations	59
6.11. Channel spacing 6.25 kHz	59
6.12. Channel spacing 12.5 kHz	59
6.13. Channel spacing 25 kHz	60
6.14. Channel spacing 50 kHz	60
6.15. Channel spacing 100 kHz	60
6.16. Channel spacing 150 kHz	60
6.17. Channel spacing 200 kHz	61
6.18. Channel spacing 250 kHz	61
6.19. Channel spacing 300 kHz	61
7.1. Minimum Safety Distance 300–400 MHz	62

Important Notice

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Important Notice

- Due to the nature of wireless communications, transmission and reception of data can never be guaranteed. Data may be delayed, corrupted (i.e., have errors), or be totally lost. Significant delays or losses of data are rare when wireless devices such as the RipEX2 are used in an appropriate manner within a well-constructed network. RipEX2 should not be used in situations where failure to transmit or receive data could result in damage of any kind to the user or any other party, including but not limited to personal injury, death, or loss of property. RACOM accepts no liability for damages of any kind resulting from delays or errors in data transmitted or received using RipEX2, or for the failure of RipEX2 to transmit or receive such data.
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Quick guide

RipEX2 is a widely configurable compact radio modem, more precisely a radio IP router. All you have to do to put it into operation is to connect it to an antenna and a power supply and configure it using a PC (tablet, smart phone) and a web browser.

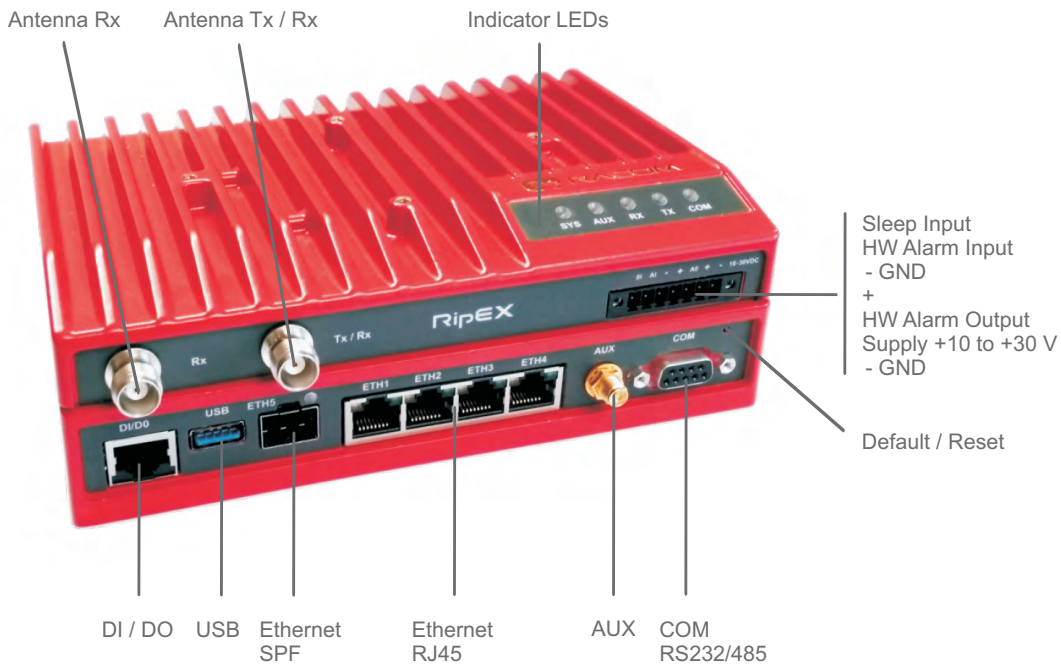


Fig. 1: RipEX2 radio router

RipEX2 access is without default password: you have to set password for “admin” account.

Ethernet

RipEX2 default IP is 192.168.169.169/24, so set a static IP 192.168.169.x/24 on your PC, power on the RipEX2 and wait approximately 48 seconds for the RipEX2 OS to boot. Connect your PC to RipEX2s' ETH interface, start your browser and type <https://192.168.169.169> in the address line.

Before attempting to do any configuration, make sure your RipEX2 is the only powered-up unit around. Since all units coming from factory share the same default settings ex-factory, you could be accessing a different unit over the air without being aware of it.

USB/ETH adapter

When accessing over the optional “XA” USB/ETH adapter, your PC will get its IP settings from the built-in DHCP server and you have to type <https://10.9.8.7> in your browser. You do not need to worry about other RipEX2'es, you will be connected to the local unit in all cases.

Wifi adapter

When accessing over the optional “W1” Wifi adapter, connect your PC (tablet, smart phone) to the RipEX2 Wifi AP first. Its default SSID is “RipEX2 + Unit name + S/N”. By default the WPA2 PSK secured connection with password "123456789" is used.

Your PC will get its IP settings from the built-in DHCP server and you have to type `http://10.9.8.7` in your browser. Remaining steps are the same and you do not need to worry about other RipEX2'es, since you will be connected to the local unit in all cases.

SCADA radio network step-by-step

Building a reliable radio network for a SCADA system may not be that simple, even when you use such a versatile and easy-to-operate device as the RipEX2 radio modem. The following step-by-step checklist can help you to keep this process fast and efficient.

1. Design your network to ensure RF signal levels meet system requirements.
2. Calculate and estimate the network throughput and response times when loaded by your application.
3. Perform a bench-test with 3-5 sets of RipEX2's and SCADA equipment (*Chapter 3, Step-by-step guide*).
4. Design the addressing and routing scheme of the network (*RipEX App notes*¹ and *RipEX App notes-Address planning*²)
5. Preconfigure all RipEX2's (follow the SW manual).
6. Install individual sites
 1. Mount RipEX2 into cabinet (*Section 4.1, “Mounting”*).
 2. Install antenna (*Section 4.2, “Antenna installation”*).
 3. Install feed line (*Section 4.3, “Antenna feed line”*).
 4. Ensure proper grounding (*Section 4.4, “Grounding”*).
 5. Run cables and plug-in all connectors except from the SCADA equipment (*Section 1.2, “Connectors”*)
 6. Apply power supply to RipEX2.
 7. Test radio link quality (follow the SW manual).
 8. Check routing by the ping tool (follow the SW manual) to verify accessibility of all IP addresses with which the unit will communicate.
 9. Connect the SCADA equipment (follow the SW manual).
7. Test your application

¹ <https://www.racom.eu/eng/products/m/ripex/app/index.html>

² <https://www.racom.eu/eng/products/m/ripex/app/routing.html>

List of documentation

User manuals:

- **RipEX2 - User manual**

User manual RipEX2 - this document

- ***RipEX Hot Standby*¹ - User manual**

User manual

Datasheets:

- ***RipEX2 - Datasheet*²**

Application notes:

- ***RipEX - Application notes*³**

- Bridge mode
- Flexible protocol
- Base driven protocol
- Network planing
- Migration solution
- and many others

Contents of the box

Standard RipEX2 package in paper box contents:

- RipEX2 – 1pc
- Removable sticker plate – 1pc
- Power and Control plug connector (counterpart) – 1pc
- DIN set (a pair of DIN rail clips + screws) – 1pc
- SFP port dust cap

¹ <https://www.racom.eu/eng/products/m/ray17/index.html>

² <https://www.racom.eu/download/hw/ripex/free/eng/ripex-dsA4-en.pdf>

³ <https://www.racom.eu/eng/products/m/ripex/app/index.html>

1. Product

RipEX2 is a radio modem platform renowned for overall data throughput in any real-time environment. RipEX2 radio modems are native IP devices, Software Defined with Linux OS that have been designed with attention to detail, performance and quality.

RipEX2 is built into a rugged die-cast aluminium casing that allows for multiple installation possibilities, see *Section 4.1, "Mounting"*.

1.1. Dimensions

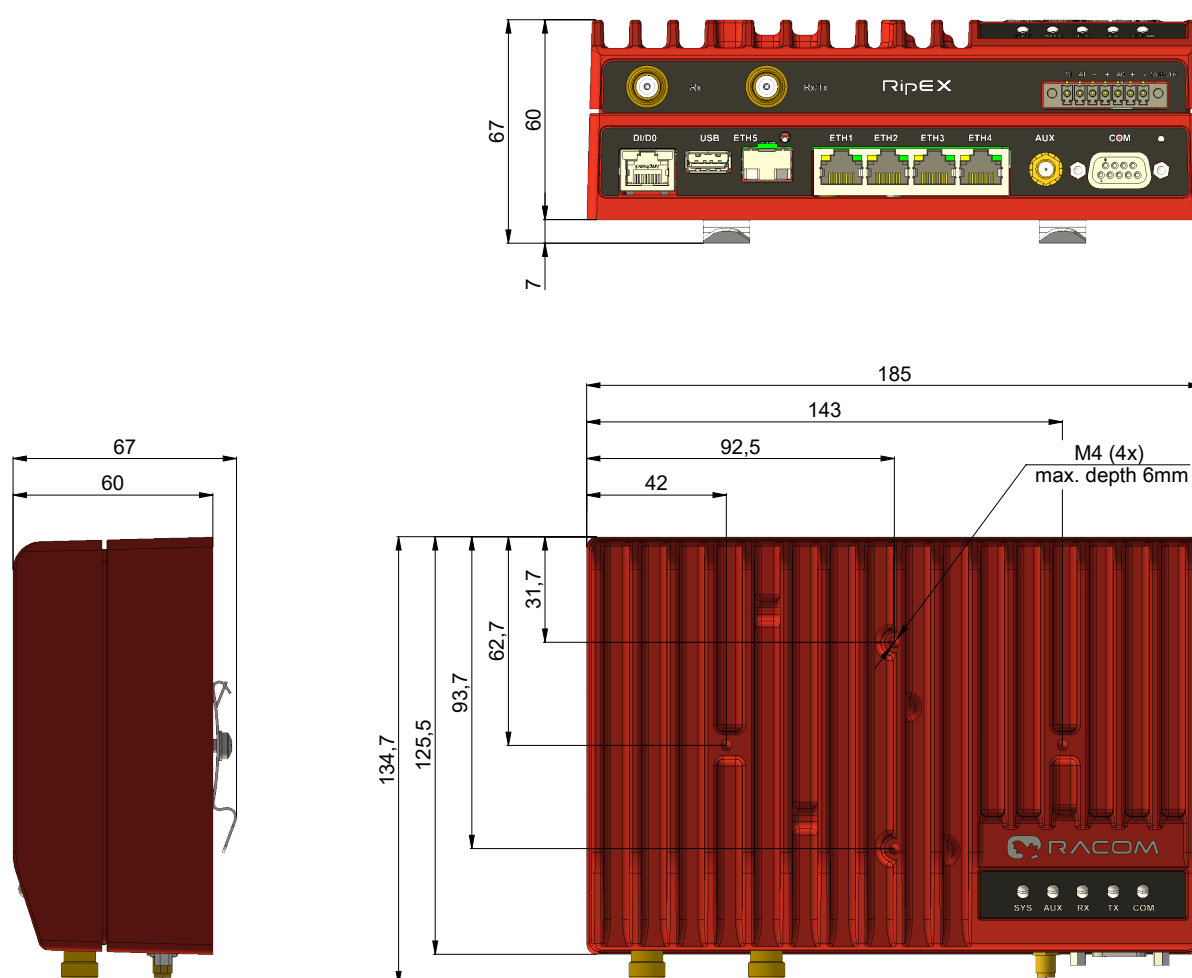


Fig. 1.1: RipEX2 dimensions

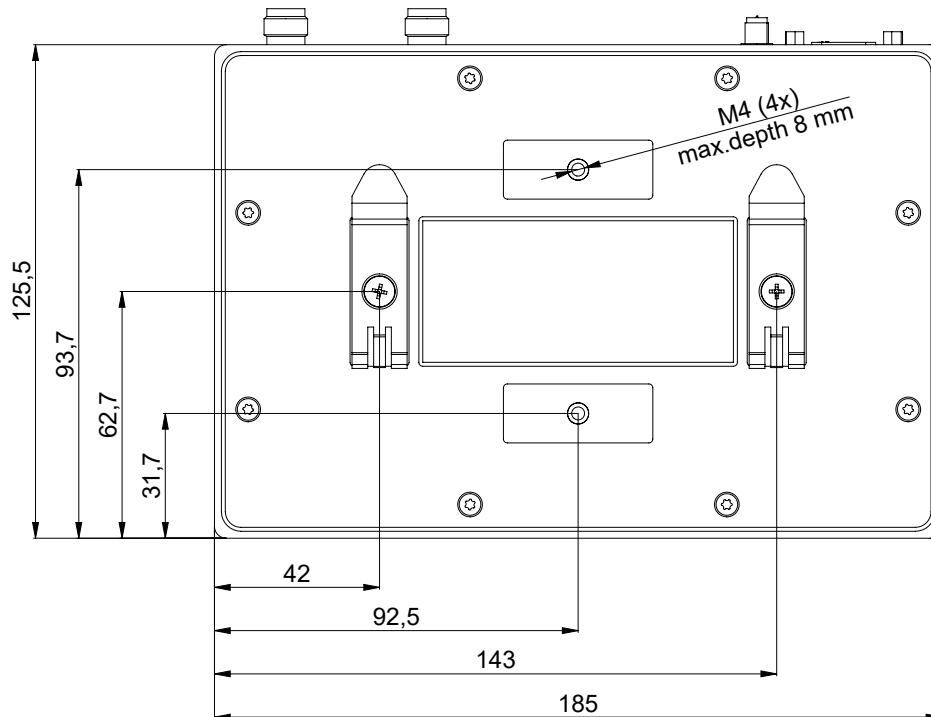


Fig. 1.2: RipEX2 dimensions – bottom

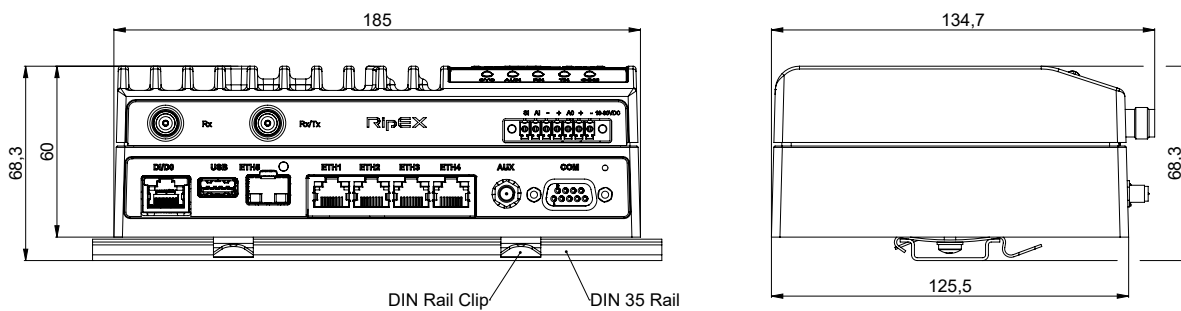


Fig. 1.3: RipEX2 with DIN rail

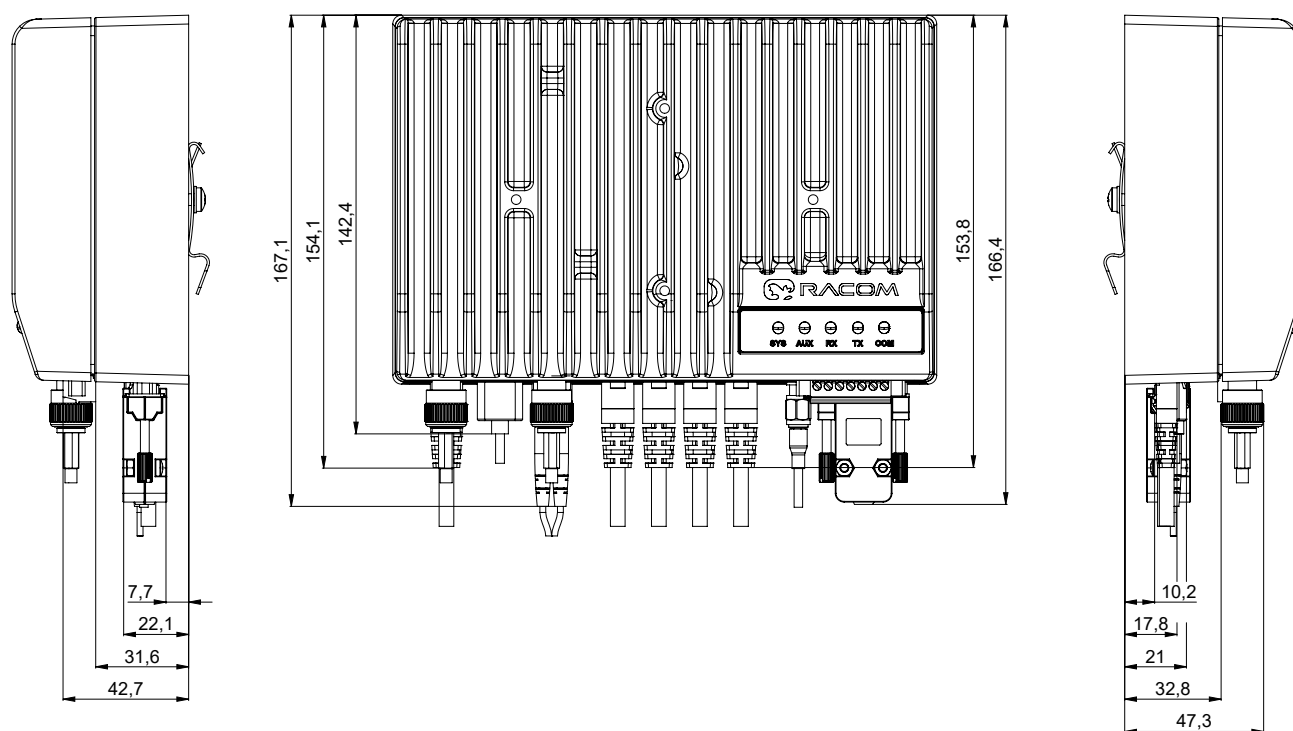


Fig. 1.4: RipEX2 dimensions with connectors

For more information see [and Section 4.1.2, "Flat mounting"](#).

1.2. Connectors

All connectors are located on the front panel. The upper side features an LED panel. The RESET button is located in an opening in the bottom side.

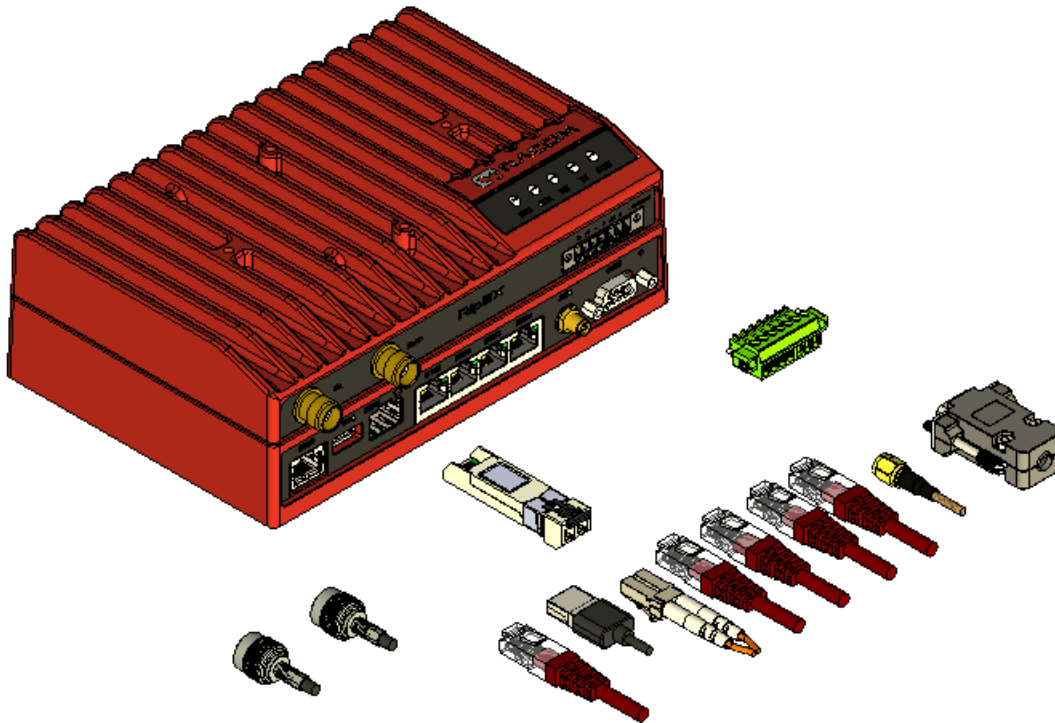


Fig. 1.5: Connectors

1.2.1. Antenna

An antenna can be connected to RipEX2 via TNC female 50Ω connector.

RipEX2 is equipped with two connectors. The Tx/Rx connector will be used for common transmitting and receiving single antenna installation (even with different Rx and Tx frequencies).

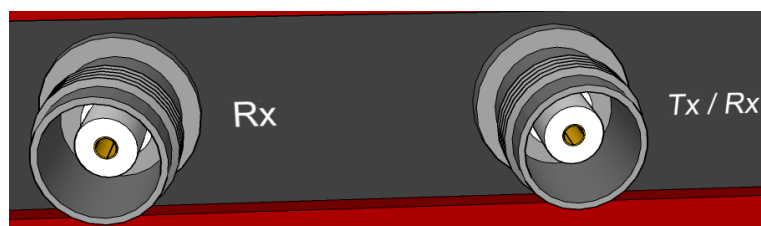


Fig. 1.6: Antenna connectors

Both Rx and Tx/Rx connectors for split installation (two antennas or duplex operation with duplexer) - Rx for receiving and Tx/Rx for transmitting.

Warning: RipEX2 radio modem may be damaged when operated without an antenna or a dummy load.

1.2.2. Power and Control

This rugged connector connects to a power supply and it contains control signals. A Plug with screw-terminals and retaining screws for power and control connector is supplied with each RipEX2. It is Tyco 7 pin terminal block plug, part No. 1776192-7, contact pitch 3.81 mm. The connector is designed for electric wires with a cross section of 0.5 to 1.5 mm². Strip the wire leads to 6 mm (1/4 inch). Isolated cables should receive PKC 108 or less end sleeves before they are inserted in the clip. Insert the cables in the wire ports, tightening securely.

Tab. 1.1: Pin assignment

pin	labeled	signal
1	SI	SLEEP INPUT <ul style="list-style-type: none"> • pull below 1.1VDC to activate (1.1VDC/1.9VDC threshold hysteresis) • max. 30VDC
2	AI	HW ALARM INPUT <ul style="list-style-type: none"> • pull below 1.1VDC to activate (1.1VDC/1.9VDC threshold hysteresis) • max. 30VDC
3	-	-(GND) – for SLEEP IN, HW ALARM INPUT
4	+	+(POWER) – for HW ALARM OUTPUT
5	AO	HW ALARM OUTPUT open drain output max. 30 VDC, 1 A
6	+	+ POWER (10 to 30 V) Undervoltage threshold 8.5 VDC Overvoltage threshold 41 VDC
7	-	- POWER (GND)

Pins 3 and 7 are connected internally.

Pins 4 and 6 are connected internally.

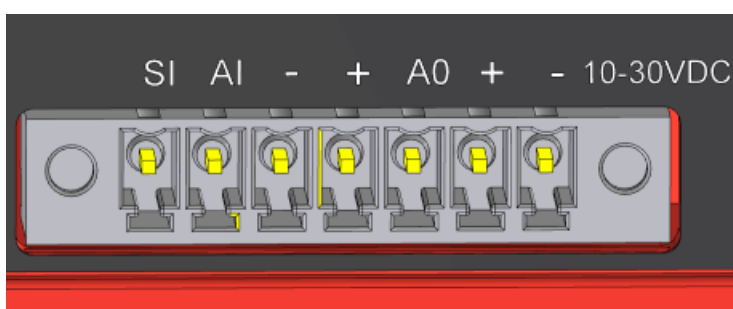


Fig. 1.7: Supply connector

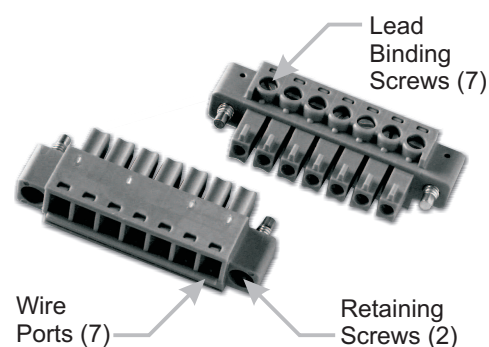
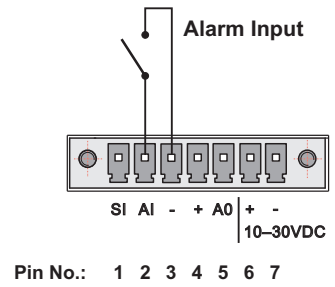


Fig. 1.8: Power and Control - cable plug

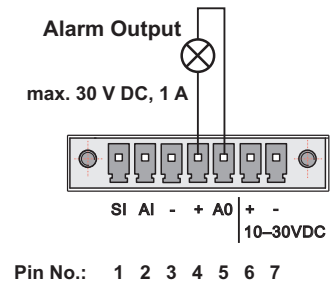
HW ALARM INPUT

HW ALARM INPUT is a digital input. If grounded (e.g. by connecting to PIN 3), an external alarm is triggered. This alarm can be used for example to transmit information using SNMP Notification, informing for instance about a power outage or RTU problem. For details about Alarm management see chapter *Advanced Configuration*.



HW ALARM OUTPUT

HW ALARM OUTPUT is a digital output. It can be activated in Alarm management settings, chapter *Advanced Configuration*. It may be used for instance to inform the connected RTU about a RipEX2 alarm or about the Unit ready status. If an alarm is triggered, HW ALARM OUTPUT is internally connected to GND. If the external device requires connection to positive terminal of the power supply, PIN 4 should be used.



POWER

The POWER pins labelled + and - serve to connect a power supply 10–30 VDC. The requirements for a power supply are defined in and *Chapter 6, Technical parameters [45]*.

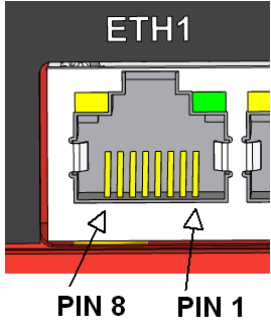
1.2.3. ETH1 - ETH4

Standard RJ45 connectors for Ethernet connection. RipEX2 has 10/100 BaseT Auto MDI/MDIX interfaces so it can connect to 10 Mbps or 100 Mbps Ethernet network. The speed can be selected manually or recognized automatically by RipEX2. RipEX2 is provided with Auto MDI/MDIX function which allows it to connect over both standard and cross cables, adapting itself automatically.

Pin assignment

Tab. 1.2: Ethernet to cable connector connections

PIN	Signal	Direct cable	Crossed cable
1	TX+	orange – white	green – white
2	TX-	orange	green
3	RX+	green – white	orange – white
4	—	blue	blue
5	—	blue – white	blue – white
6	Rx-	green	orange
7	—	brown – white	brown – white
8	—	brown	brown



1.2.4. ETH5 (SFP)

ETH5 is a standard SFP slot for 10/100/1000 Mbps Ethernet SFP modules, user exchangeable. Both fibre optic and metallic Ethernet SFP modules are supported. For optical both single and dual mode fibre optics Ethernet modules (= 2 or 1 fibers) can be used. CSFP modules are not supported. RACOM offers all mentioned types of SFP modules, tested to be RipEX2 compatible as a standard accessory.

The SFP status LED is located just next to the slot. It is controlled by SFP module. Its function is specific for each SFP module. The typical behavior is an indication the received signal from the fibre optic or metallic link to be within operational range.

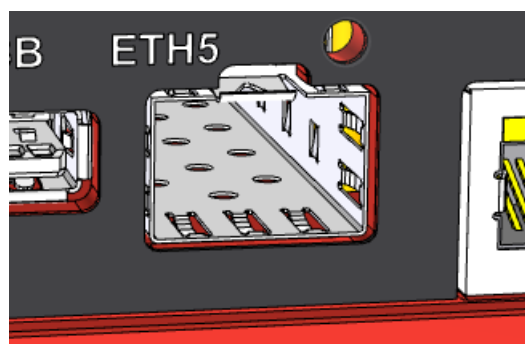


Fig. 1.9: SFP slot



Important

It is strongly recommended to use a high quality SFP module with industry temperature range. The SFP modules listed in Accessories are thoroughly tested by RACOM and are guaranteed to function with RipEX2 units. It is possible to use any other SFP module, but RACOM cannot guarantee they will be completely compatible with RipEX2 units.

1.2.5. COM

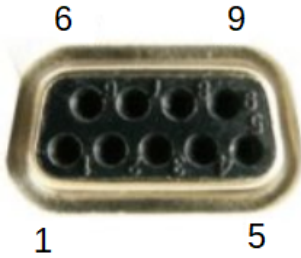
RipEX2 provides serial interface COM terminated by DSUB9F connectors. It can be configured as RS232 or RS485 (more in *Adv. Conf., COM*).

RipEX2's RS232 is a hard-wired DCE (Data Communication Equipment) device. Equipment connected to the RipEX2's serial port should be DTE (Data Terminal Equipment) and a straight-through cable should be used. If a DCE device is connected to the RipEX2's serial port, a null modem adapter or cross cable has to be used.

RipEX2's RS485 is not galvanic isolated and it is not terminated.

Tab. 1.3: COM pin description

DSUB9F pin	COM – RS232		COM – RS485	
	signal	In/ Out	signal	In/ Out
1	CD	Out	—	
2	RxD	Out	line B	In/Out
3	TxD	In	line A	In/Out
4	DTR	In	—	
5	GND		GND	
6	DSR	Out	—	
7	RTS	In	—	
8	CTS	Out	—	
9	—	—	—	



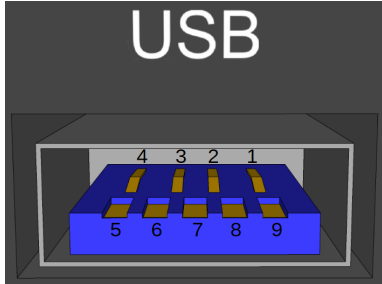
RipEX2 keeps pin 6 DSR at the level of 1 by RS232 standard permanently.

1.2.6. USB

RipEX2 uses USB 3.0, Host A interface. USB interface is wired as standard:

Tab. 1.4: USB A Pinout Cable Assembly

Pin	signal	wire
1	VBUS	Red
2	D-	White
3	D+	Green
4	GND	Black
5	StdA_SSRX-	Blue
6	StdA_SSRX+	Yellow
7	GND_DRAIN	GROUND
8	StdA_SSTX-	Purple
9	StdA_SSTX+	Orange
Shell	Shield	Connector Shell



The USB interface is designed for the connection to an – external ETH/USB adapter or a Wifi adapter. They are optional accessories to RipEX2, for more details see *Section 3.3, “Connecting RipEX2 to a programming PC”*. The adapters are used for service access to RipEX2’s web configuration interface.

The USB interface can also be used for an external flash disc connection, which has been specifically designed to simplify complex maintenance tasks, so that these tasks can be performed by unqualified personnel in the field by simple plugging-in an USB stick and waiting until a LED flashes.

The USB connector also provides power supply (5 V/ 0.5 A). It can be used to temporarily power a connected device, for instance a telephone. The USB connector should not be used as permanent source of power supply.

External USB flash disc

An external USB flash disc can be used for firmware upgrade, SW keys upload, configuration backup and restore, ssl certificate and ssh keys upload and tech-support package download. Any common USB stick with several megabytes of free space can be used for these tasks.

1.2.7. AUX

AUX SMA female 50 Ohm connector is used for several purposes according to HW variant.

Standard basic model – the AUX is used as an synchronization signal input.

Input frequency range 1Hz (PPS) - 25 MHz

Input signal level >200 mVp-p @ 220R, up to 5V TTL levels

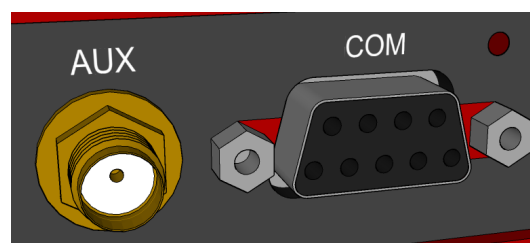


Fig. 1.10: AUX connector SMA

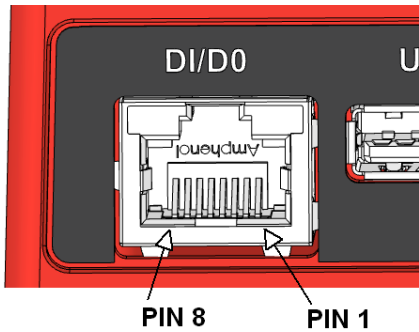
RipEX2 can be equipped with an internal GPS. The GPS module is used for time synchronization of the NTP server inside RipEX2. See *Adv. Conf., Time* for more. In this case the AUX connector serves for connecting the GPS antenna:

- active antenna
- 3.3 VDC supply

1.2.8. DI/DO

Tab. 1.5: Digital Inputs and Outputs

Pin	signal
1	Differential digital input - Positive - (P)
2	Differential digital input - Negative - (N)
3	GND
4	Digital Output 1
5	Digital Output 2
6	GND
7	Digital Input 1
8	Digital Input 2



The diagram shows a close-up of the DI/DO connector on a red PCB. The connector is a multi-pin header. Two arrows point to specific pins: one labeled 'PIN 8' and another labeled 'PIN 1'. The text 'DI/DO' is printed above the connector, and a partial 'U' is visible to the right.

- Digital Outputs:
 - Open drain output max. 30 VDC, 0.2A
- Isolated differential digital input:
 - Input voltage difference (P-N) > 1.9 VDC Logic "H"
 - Input voltage difference (P-N) < 1.1 VDC Logic "L"
 - Maximum differential voltage 30 V
- Digital inputs:
 - Schmitt-triggered inverted input
 - Pull below 1.1 VDC to activate (1.1 VDC/1.9 VDC threshold hysteresis)
 - Max. 30 VDC

1.2.9. HW button

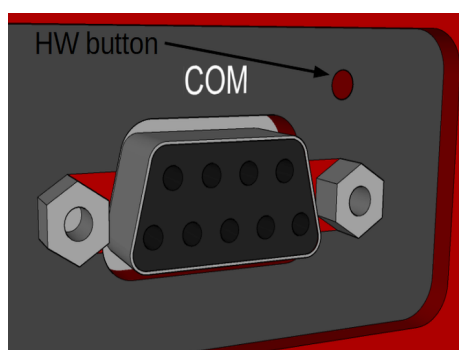


Fig. 1.11: HW button

HW button is placed on the right side of COM interface.

1.3. Indication LEDs



Fig. 1.12: Indication LEDs

Tab. 1.6: Key to LEDs

LED	Colour	Style	Function
SYS	Green	Permanently lit	System OK
		Flashing - period 500ms	Reset button pushed
		One fast (50ms) flash - pause (500 ms)	Reset button to reset
		Three fast (50ms) flashes - pause (500ms)	Reset button factory reset
		Flashing - period 1 sec	Save mode
		Flashing - period 3 sec	Sleep mode
	Red	Permanently lit	Alarm
		Flashing regularly - period 500ms	Serious system error
	Orange	Permanently lit	Unit is starting
Three fast (50ms) flashes - pause (500 ms)		USB attached	
Flashing - period 100 ms		Skip go to sleep mode, boot normally	
		Flashing regularly - period 500 ms	Firmware writing in progress - DO NOT POWER OFF !
AUX	Green	Permanently lit	Activity
	Red	Permanently lit	Alarm

LED	Colour	Style	Function
Rx	Green	Permanently lit	Receiver is synchronized to a packet
	Yellow	Permanently lit, or flashing in 1 sec intervals	Rx mode of operation - high resistance (strong interfering signals - above -45 dBm - are present within the frequency band), adaptive mode of receiver operation
Tx	Red	Permanently lit	Transmitting to radio channel
	Green	no function	no function
COM	Green	Permanently lit	Data receiving
	Yellow	Permanently lit	Data transmitting

Alarm

– is “On” when any controlled item in Alarm management, (see Adv. Conf., Alarm management for more) is in alarm status (out of thresholds) and “SNMP Notification”, “HW Alarm Output” or “Detail graphs start” for any line in the Alarm configuration table are checked.

Adaptive mode of receiver operation

Cognitive function of receiving mode selection is implemented in RipEX2. When exposed in a radio environment where strong interfering signals (stronger than -45 dBm) are present, RipEX2 senses them and adaptively increases its resistance to interference (and lower its sensitivity by 3dB). When interference holds, RipEX2 stays in high resistance mode of receiver operation and signals this state by turning the yellow RX LED on. Once the interfering signals fade away, RipEX2 automatically returns to its high sensitivity mode of receiver operation.

1.4. Ordering codes

RipEX radio modem has been designed to have minimum possible number of hardware variants. Different HW models are determined by frequency, internal GPS and separate connectors for RX and TX antennas.

Upgrade of functionality does not result in on-site hardware changes – it is done by activating software feature keys (see chapter *RipEX in detail* and *Adv. Config., Maintenance*).

All ordering codes are available on Racom website. See <https://www.racom.eu/eng/products/radio-modem-ripex.html#order-codes>.

2. Accessories

Whole accessory list is available on Racom website.

See <https://www.racom.eu/eng/products/radio-modem-ripex.html#accessories>.

1. RipEX2 Hot Standby

RipEX2-HS is redundant Hot Standby chassis. There are two Hot Standby standard RipEX2 units inside. In case of a detection of failure, automatic switchover between RipEX2 units is performed. RipEX2-HS is suitable for Central sites, Repeaters or Important remote sites where no single point of failure is required.



Fig. 2.1: RipEX2-HS

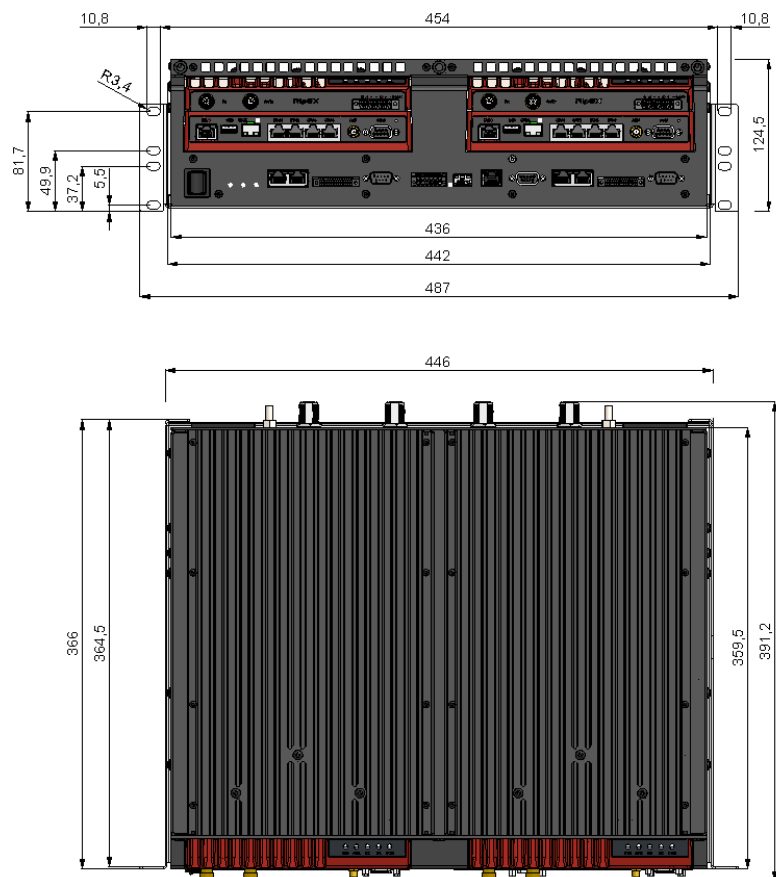


Fig. 2.2: RipEX2-HS dimensions

For more information see RipEX2-HS datasheet or User manual on www.racom.eu¹.

2. RipEX2-RD

¹ <https://www.racom.eu>

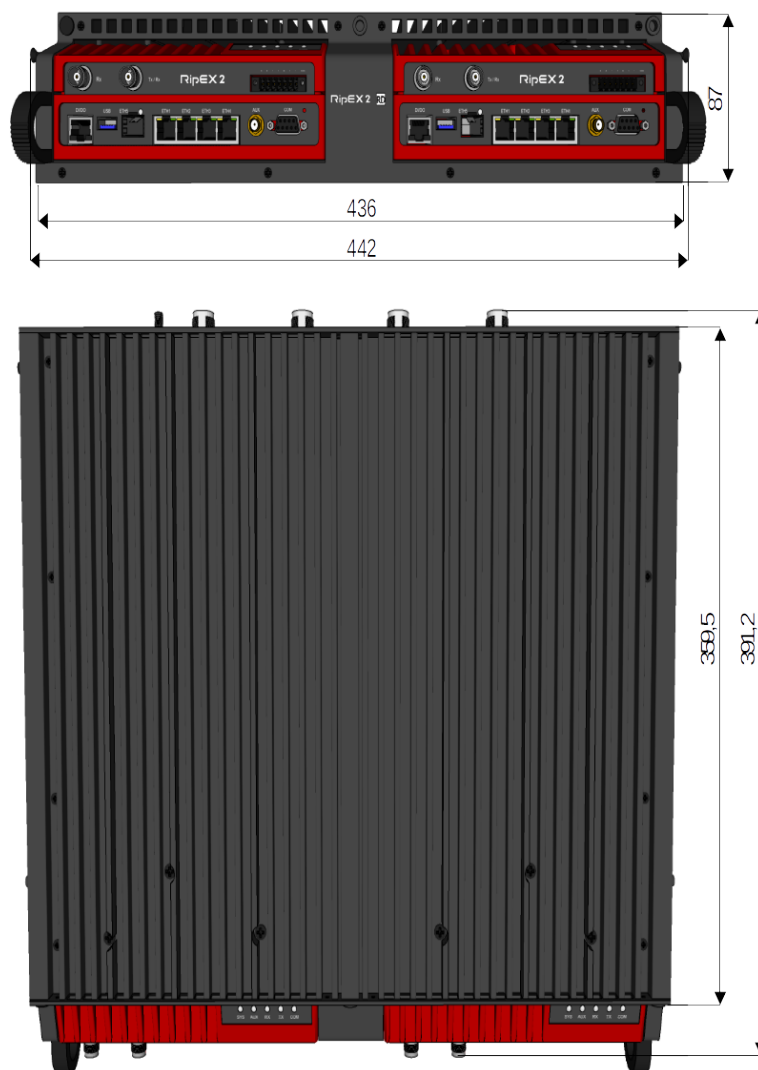


Fig. 2.3: RipEX2-RD

3. RipEX2-RS

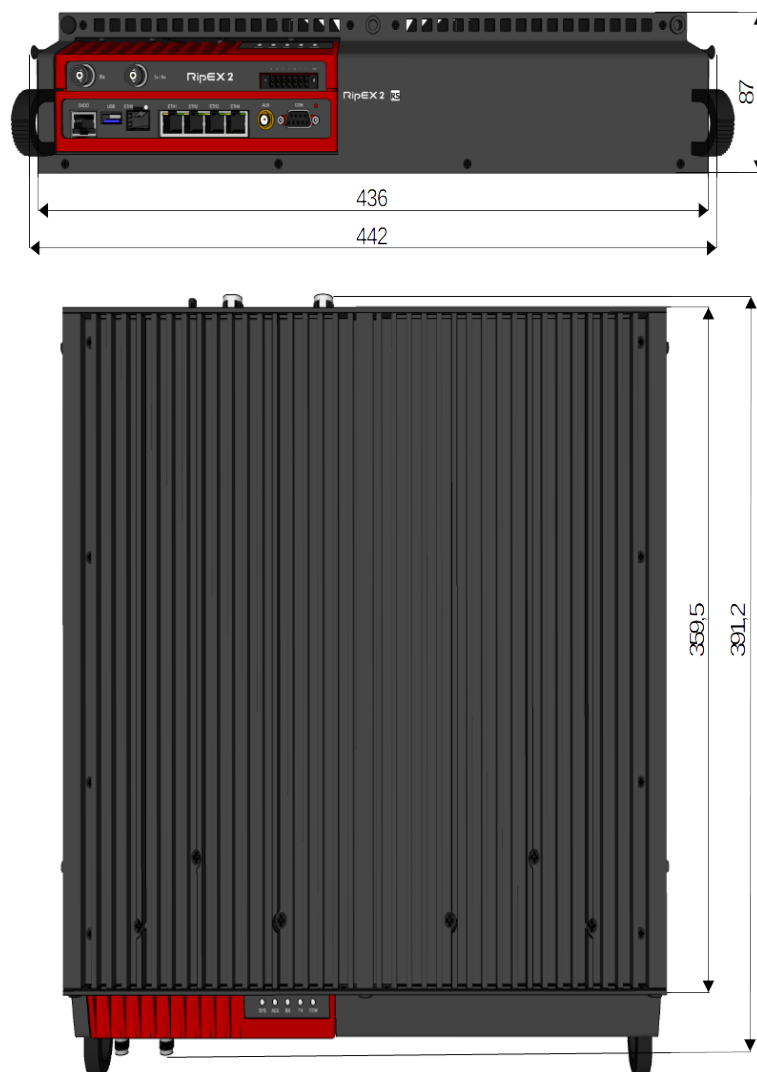


Fig. 2.4: RipEX2-RS

4. ETH/USB adapter

ETH/USB adapter for service access to the web interface via USB connector. Includes a built-in DHCP server which provides up to 5 leases. To access the RipEX always use the fixed IP 10.9.8.7. For details on use see *Section 3.3, "Connecting RipEX2 to a programming PC"*.



Fig. 2.5: ETH/USB adapter

5. Wifi adapter

Wifi adapter for service access to the web interface via USB connector. Includes a built-in DHCP server which provides up to 5 leases. To access the RipEX always use the fixed IP 10.9.8.7. For details on use see *Section 3.3, "Connecting RipEX2 to a programming PC"*.



6. Demo case

Fig. 2.6: WiFi adapter

A rugged plastic case for carrying up to three RipEX2's and one M!DGE2 4G SCADA router. It also contains all the accessories needed to perform an on-site signal measurement, complete application bench-test or a functional demonstration of both radiomodems and the 4G router.



Fig. 2.7: Demo case

Content:

- Brackets and cabling for installation of three RipEX2es and one M!DGE2 (units are not part of the delivery)
- 1× power supply Mean Well GST160A24-R7B (100-240 V AC 50-60 Hz/24 V DC)
- 1× Power cable (European Schuko CEE 7/7 to IEC 320 C13)
- 1× Ethernet patch cable (3 m, UTP CAT 5E, 2× RJ-45)
- Quick start guide

RipEX2 accessories:

- 3× Dummy load antennas
- 1× L-bracket, 1× Flat-bracket samples
- 1× ETH/USB adapter
- 1× Wifi adapter

M!DGE2 accessories:

- Stick antenna (900–2100 MHz, 2.2 dBi, vertical)

Mechanical properties of case

- Outside dimension: 455 × 365 × 185 mm
- Weight approx. 5,5 kg (excluding the RipEX and M!DGE units) / 10,6 kg (including 3x RipEX units and 1 M!dge unit)

7. L-bracket

Installation L bracket for vertical mounting. For details on use see chapter *Mounting* and chapter *Dimensions*.

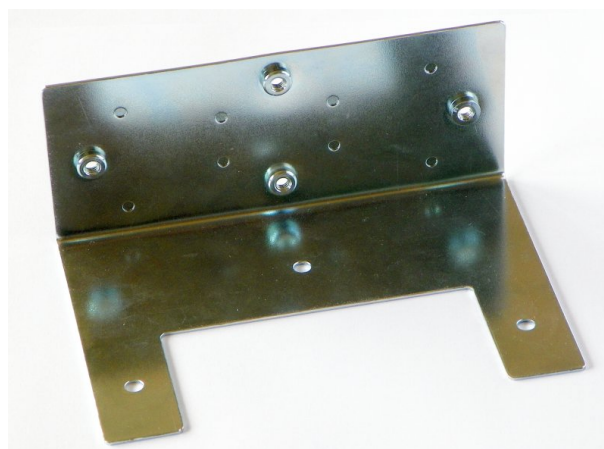


Fig. 2.8: L-bracket

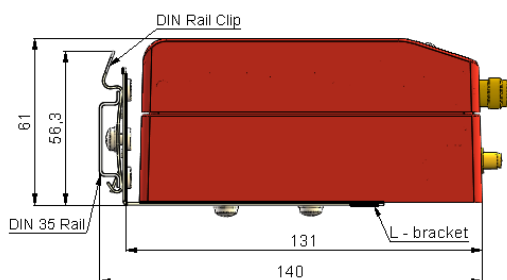
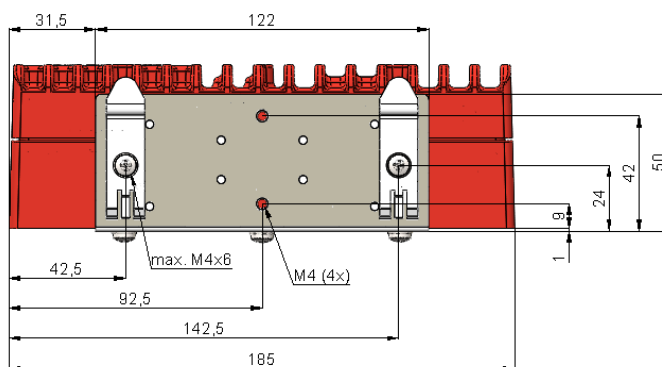


Fig. 2.9: RipEX2 with L-bracket



8. Flat-bracket

Frequency range 100-512 MHz,
connectors N(female) / N(female).



Fig. 2.14: Overvoltage protection

11. Feedline adapter cable

Feedline cable is 50 cm long and is made from the RG58 coaxial cable. There are TNC Male (RipEX2 side) and N Male connectors on the ends. It is intended for use between RipEX2 and cabinet panel.



Fig. 2.15: Feedline adapter cable

12. Others

For other accessories (Power supplies, Antennas, Coaxial overvoltage protection etc.) kindly visit <https://www.racom.eu/eng/products/radio-modem-ripex.html#accessories>

3. Step-by-step guide

3.1. Connecting the hardware

Before installing a RipEX2 network in the field, a bench-test should be performed in the lab. The RipEX2 Demo case is great for this as it contains everything necessary: 3 RipEX2's, Power supply, dummy load antennas, etc.

If you use your own installation for lab tests, don't forget:

- A dummy load or an actual antenna with 50 ohm impedance should be connected to the RipEX2
- The minimum RF output must be set to avoid overloading the dummy antenna and to keep the received signal at reasonable level, between -40 and -80 dBm.
- The power supplies must meet the requirements given in the specifications. Make sure the power supplies do not generate interference in the radio channel and that they can handle very fast changes in the load when RipEX2 switches from reception to transmission and back.

Bench test connection possibilities:

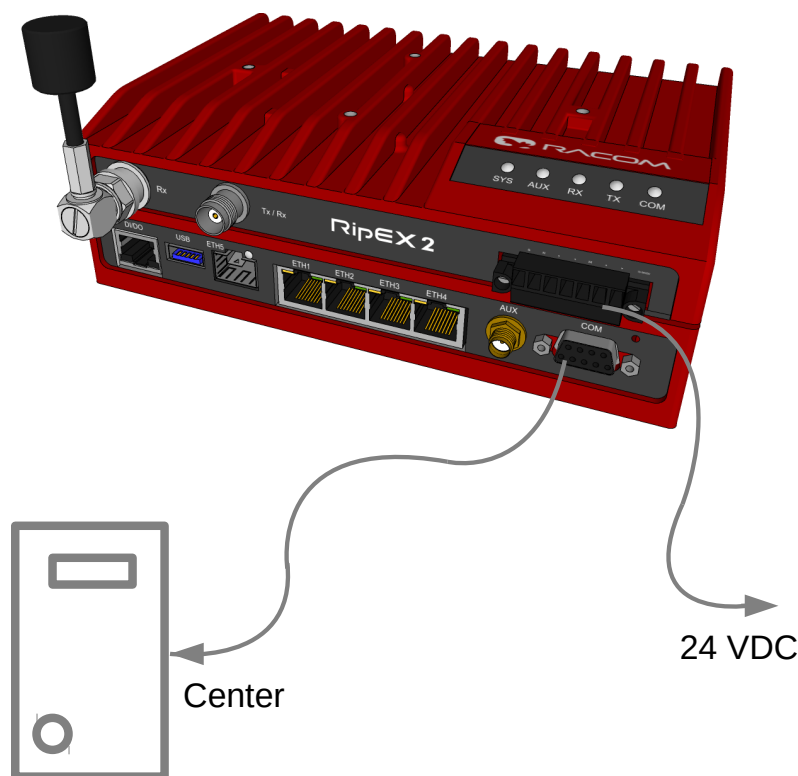


Fig. 3.1: 1.

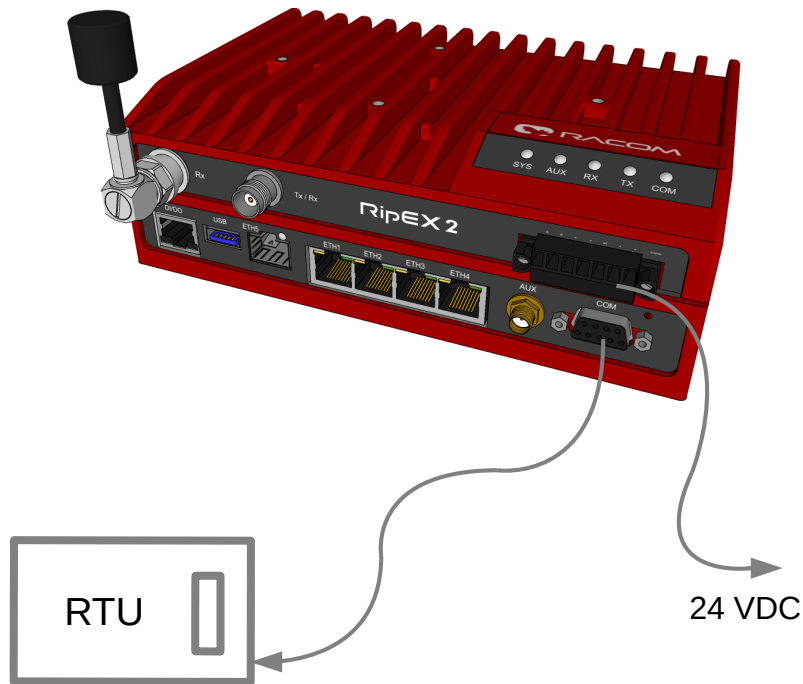


Fig. 3.2: 2.

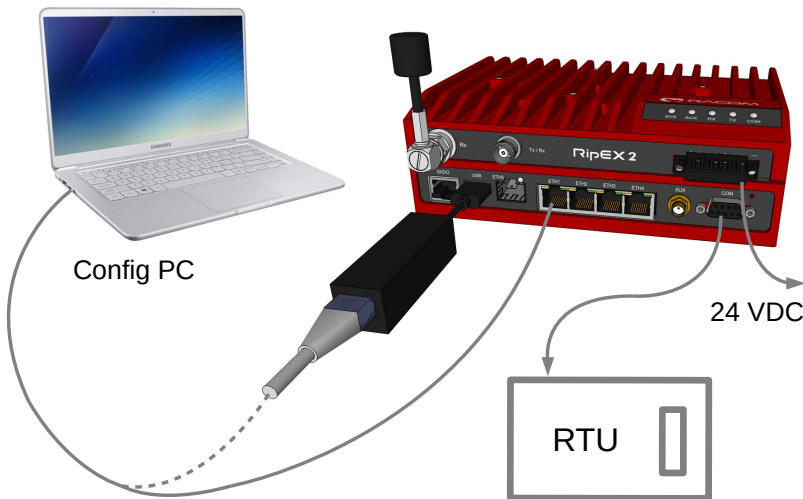


Fig. 3.3: 3.

3.2. Powering up your RipEX2

Switch on your power supply. LED SYS shines orange and after approximately 20 seconds your RipEX will have booted and will be ready, the SYS LED shines green. You'll find the description of the individual LED states in *Section 1.3, "Indication LEDs"*.

3.3. Connecting RipEX2 to a programming PC

To configure a RipEX2 you can connect it to your PC in three ways:

1. Using the external Wifi adapter
2. Using the external ETH/USB adapter
3. Directly over the Ethernet interface

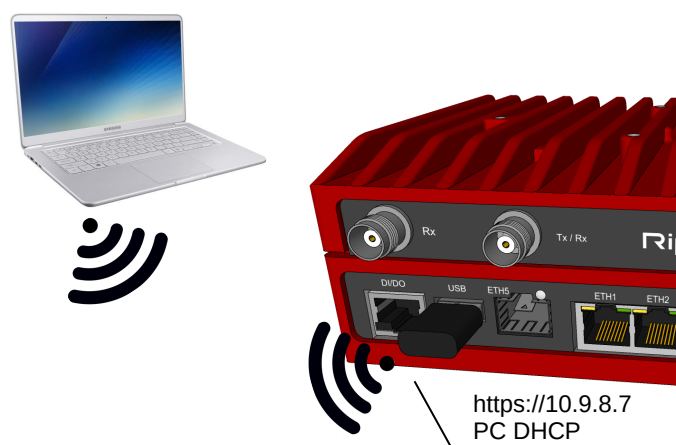


Fig. 3.4: 1. Connecting to a PC over WiFi

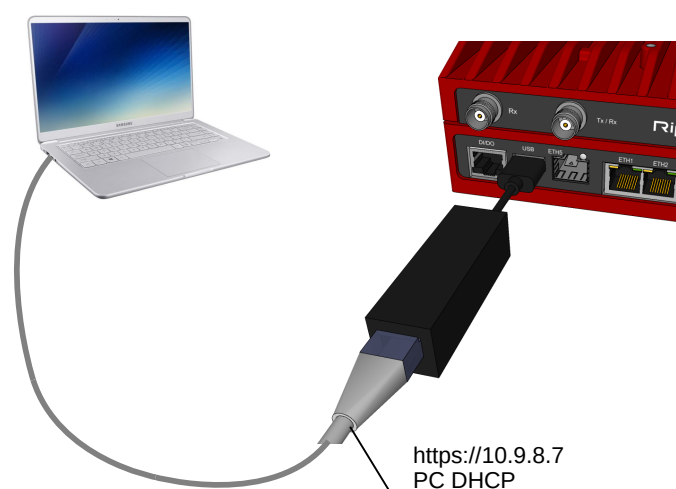


Fig. 3.5: 2. Connecting to a PC over ETH/USB adapter.

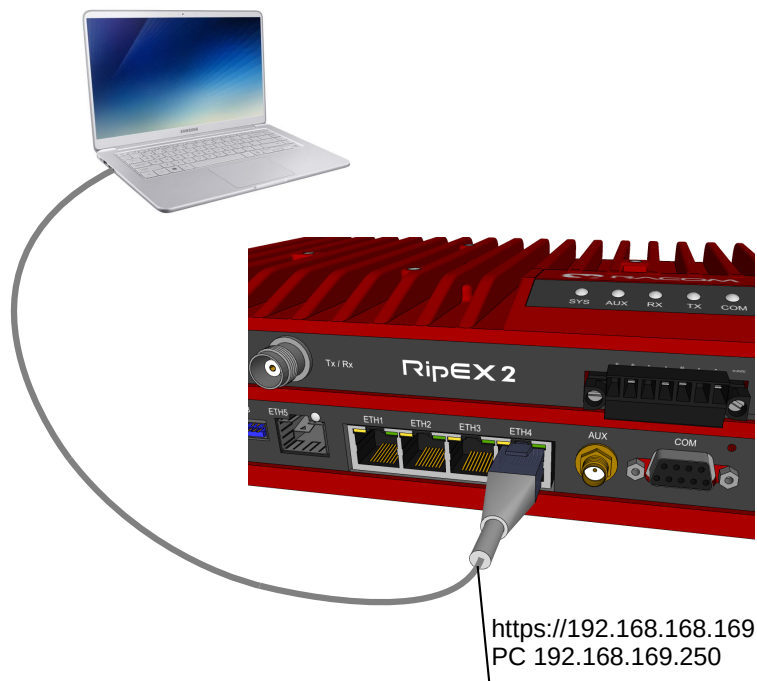


Fig. 3.6: 3. Connecting to a PC over ETH.

1. PC connected via Wifi adapter

We recommend using the "W1" - external Wifi adapter (an optional accessory of the RipEX2). Connect your PC or tablet or smart phone to RipEX2 Wifi AP first. Its default SSID is "RipEX2 + Unit name + S/N". The W1 contains a built-in DHCP server, so if you have a DHCP client in your PC (as most users do), you don't need to set anything up. The RipEX2's IP address for access over the ETH/USB adapter is fixed: 10.9.8.7.

Go to *Login to RipEX*.

2. PC connected via ETH/USB adapter

We recommend using the "XA" - external ETH/USB adapter (an optional accessory of the RipEX2). The ETH/USB contains a built-in DHCP server, so if you have a DHCP client in your PC as most users, you don't need to set anything up. The RipEX2's IP address for access over the ETH/USB adapter is fixed: 10.9.8.7.

Go to *Login to RipEX*.

3. PC connected directly to ETH port

Set a static IP address in PC, example for Windows XP:

Start > Settings > Network & Internet > Ethernet > Change adapter options > Ethernet (right click) > Properties > Protocol IP version 4 (TCP/IPv4) > Properties > Use the following IP address:
IP address 192.168.169.169 - for RipEX in the default state
Subnet mask 255.255.255.0
Default gateway leave empty

OK (Internet Protocol Properties window)

OK (Local Area Properties window)

Some Operating systems may require you to reboot your PC.

1. Windows Settings

Find a setting 



Phone

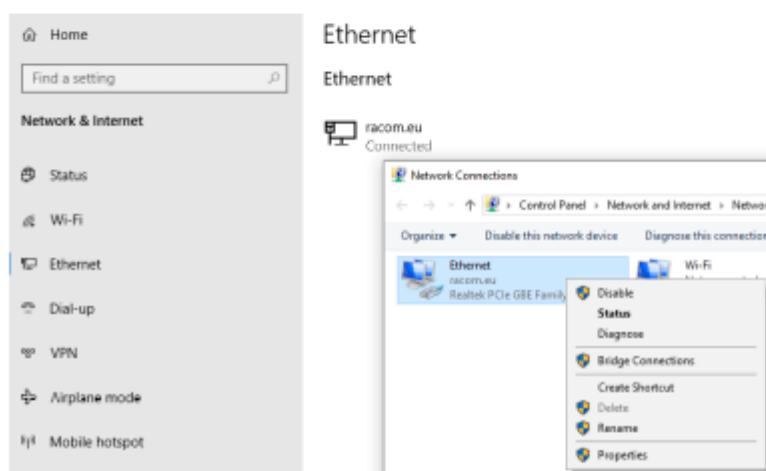
Link your Android, iPhone



Network & Internet

Wi-Fi, airplane mode, VPN

2.



3.

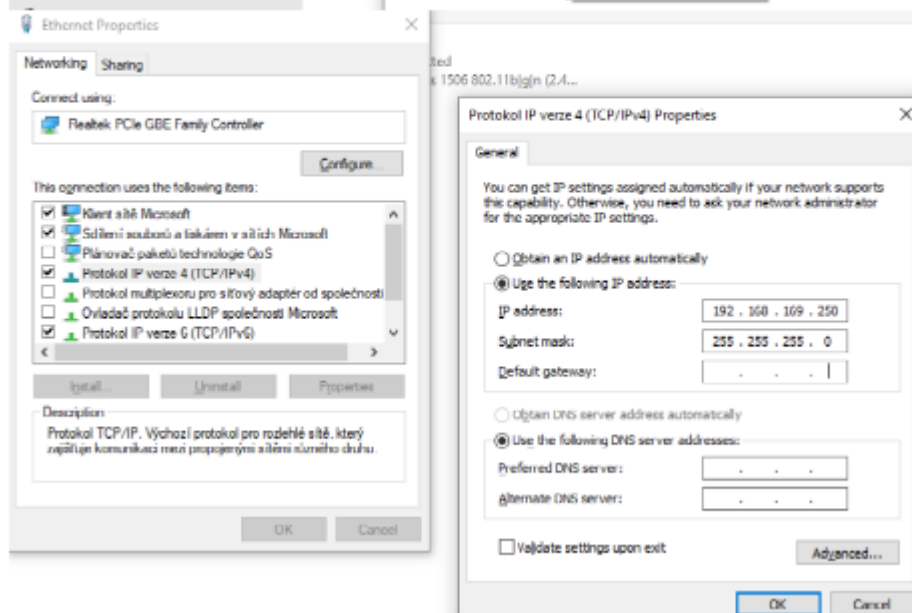


Fig. 3.7: PC address setting



Important

When you change the RipEX2 ETH address from the default value later on and the new IP network does not include the default one, you will have to change your PC's static IP again to be able to continue configuring the RipEX2.

4. Login to RipEX2

Start a web browser (Mozilla Firefox, Internet Explorer - JavaScript enabled) on your PC and type the RipEX's default IP in the address line default IP address in the address line field:

- **10.9.8.7** – when connected via external ETH/USB or Wifi adapter. IP address 10.9.8.7 is fixed and cannot be changed; it is independent of the IP address of the RipEX's Ethernet interface.)
- **192.168.169.169** – when connected directly to ETH



Note

https - For security reasons the http protocol with ssl encryption can be used for the communication between the PC and RipEX. The https protocol requires a security certificate. You must install this certificate into your web browser (Mozilla Firefox, Internet Explorer). The first time you connect to the RipEX, your computer will ask you for authorisation to import the certificate into your computer. The certificate is signed by the certification authority Racom s.r.o. It meets all security regulations and you need not be concerned about importing it into your computer. Confirm the import with all warnings and exceptions that your browser may display during installation.

The login screen appears.

The default entries for a new RipEX are:

User name: admin

Password: admin

Warning: Before you start any configuration, make sure only one unit is powered ON. Otherwise, a different radio modem could reply to your requests! (All units share the same IP address and are in Bridge mode when in factory settings.)

5. IP address unknown

If you don't have the adapter or you have forgotten the password, you can reset the access parameters to defaults, see *Section 1.2.9, "HW button"*.

4. Installation

Step-by-step checklist

1. Mount RipEX2 into cabinet (*Section 4.1, "Mounting"*).
2. Install antenna (*Section 4.2, "Antenna installation"*).
3. Install feed line (*Section 4.3, "Antenna feed line"*).
4. Ensure proper grounding (*Section 4.4, "Grounding"*).
5. Run cables and plug-in all connectors except from the SCADA equipment (*Section 1.2, "Connectors"*).
6. Apply power supply to RipEX2.
7. Connect configuration PC (*Section 3.3, "Connecting RipEX2 to a programming PC"*).
8. Configure RipEX2 (follow the SW manual).
9. Test radio link quality (follow the SW manual).
10. Check routing by the ping tool (follow the SW manual) to verify accessibility of all IP addresses with which the unit will communicate.
11. Connect the SCADA equipment
12. Test your application.

4.1. Mounting

4.1.1. DIN rail mounting

The radio modem RipEX2 is directly mounted using clips to the DIN rail. The mounting can be done lengthwise (recommended) or widthwise; in both cases with the RipEX2 lying flat. The choice is made by mounting the clips, one M4 screw per clip. RipEX2 is delivered with two clips, two screws and four threaded holes. Only use the M4×5 mm screws that are supplied.

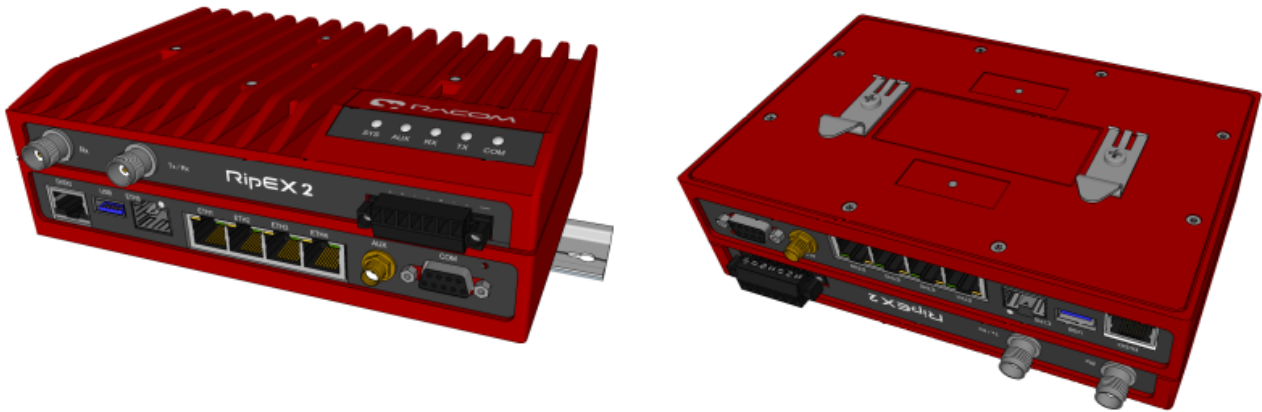


Fig. 4.1: Flat lengthwise mounting to DIN rail – recommended

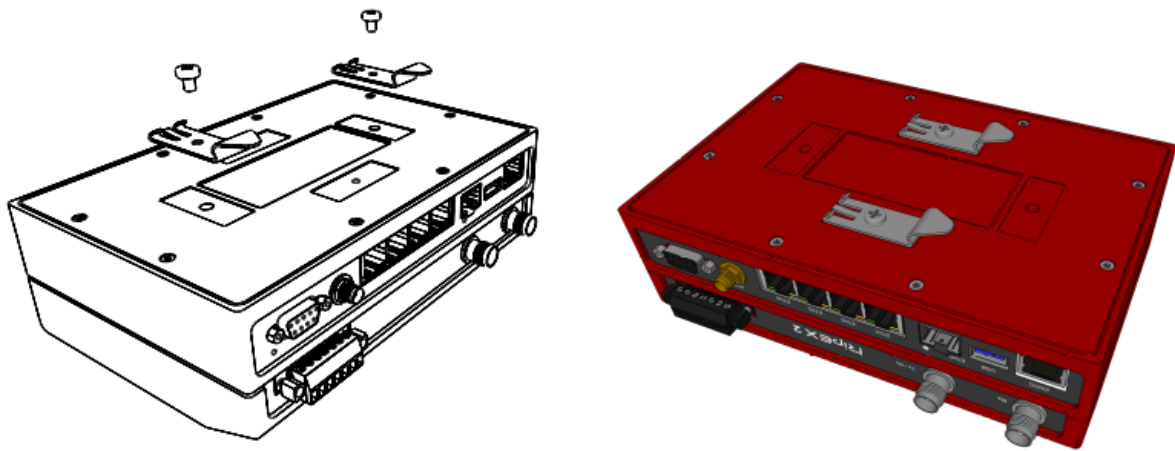


Fig. 4.2: Flat widthwise mounting to DIN rail

When tightening the screw on the clip, leave a 0,5 mm gap between the clip and the washer.

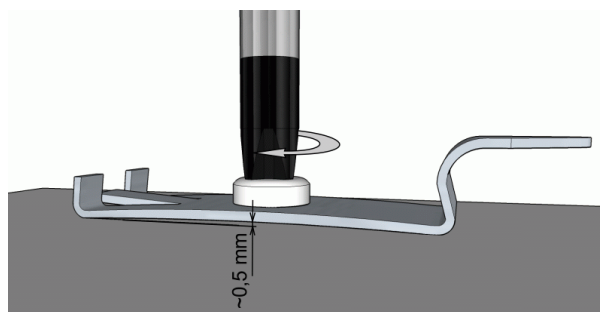


Fig. 4.3: Clip mounting

For vertical mounting to DIN rail, L-bracket (optional accessory) is used. Only use the M4×5 mm screws that are supplied.

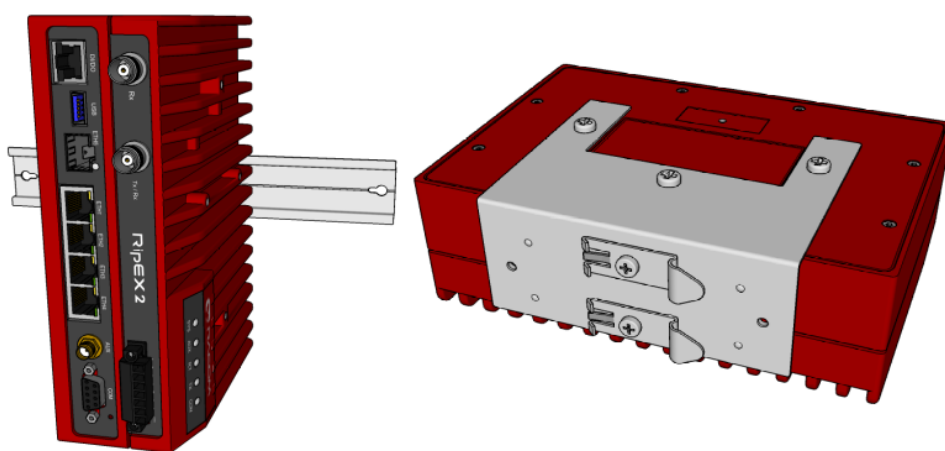


Fig. 4.4: Vertical widthwise mounting to DIN rail

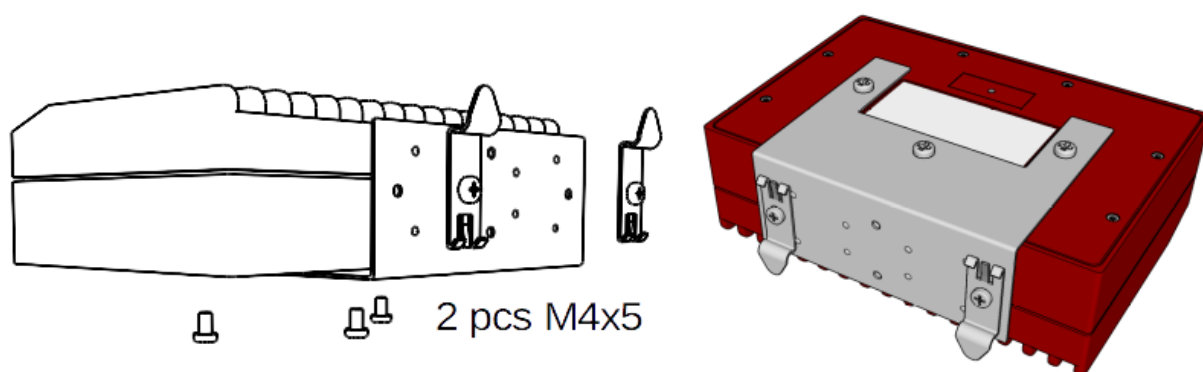


Fig. 4.5: Vertical lengthwise mounting to DIN rail

For more information see *Chapter 2, Accessories – L-bracket*.

4.1.2. Flat mounting

For flat mounting directly to the support you must use the Flat bracket (an optional accessory). Only use the M4×5 mm screws that are supplied.

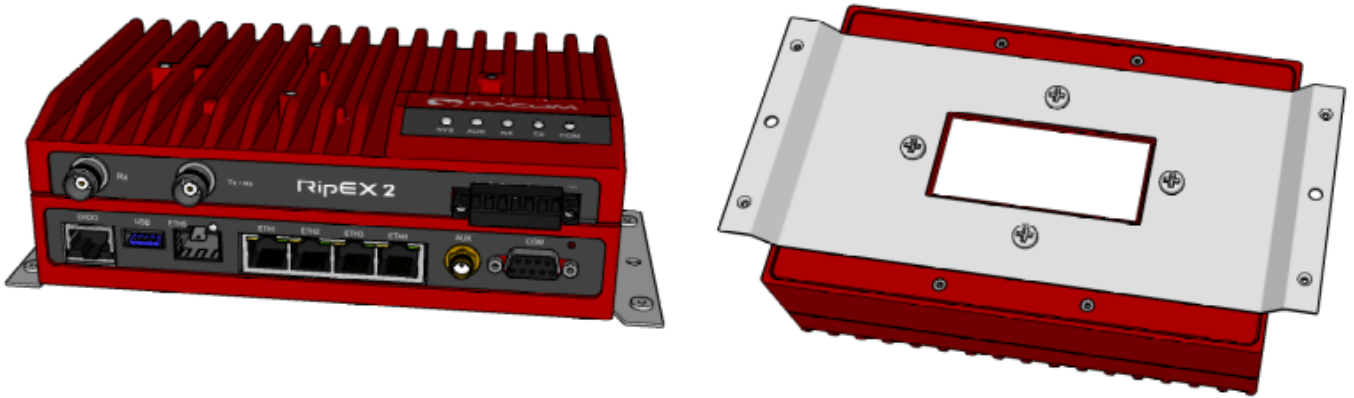


Fig. 4.6: Flat mounting using Flat bracket

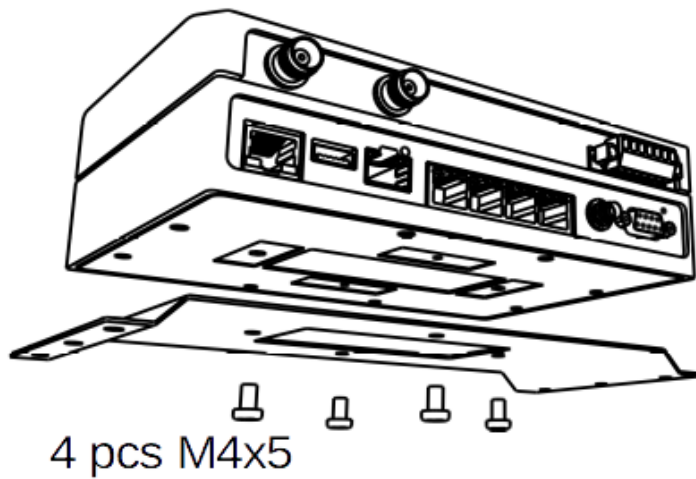


Fig. 4.7: Flat mounting using Flat bracket

For more information see *Chapter 2, Accessories – Flat-bracket*.

4.1.3. IP52 mounting

To meet IP52 protection requirements RipEX2 unit must be physically installed with the connectors facing downward.

Install the SFP port dust cap if the SFP port is not used.

4.2. Antenna installation

The type of antenna best suited for the individual sites of your network depends on the layout of the network and your requirements for signal level at each site. Proper network planning, including field signal measurements, should decide antenna types in the whole network. The plan will also determine what type of mast or pole should be used, where it should be located and where the antenna should be directed to.

The antenna pole or mast should be chosen with respect to antenna dimensions and weight, to ensure adequate stability. Follow the antenna manufacturer's instructions during installation.

The antenna should never be installed close to potential sources of interference, especially electronic devices like computers or switching power supplies. A typical example of totally wrong placement is mount a whip antenna directly on top of the box containing all the industrial equipment which is supposed to communicate via RipEX2, including all power supplies.

Additional safety recommendations

Only qualified personnel with authorization to work at heights are entitled to install antennas on masts, roofs and walls of buildings. Do not install the antenna in the vicinity of electrical lines. The antenna and brackets should not come into contact with electrical wiring at any time.

The antenna and cables are electrical conductors. During installation electrostatic charges may build up which may lead to injury. During installation or repair work all open metal parts must be temporarily grounded.

The antenna and antenna feed line must be grounded at all times.

Do not mount the antenna in windy or rainy conditions or during a storm, or if the area is covered with snow or ice. Do not touch the antenna, antenna brackets or conductors during a storm.

4.3. Antenna feed line

The antenna feed line should be chosen so that its attenuation does not exceed 3 to 6 dB as a rule of thumb. Use 50 Ω impedance cables only.

The shorter the feed line, the better. If RipEX2 is installed close to antenna, the data cable can be replaced by an Ethernet cable for other protocols utilizing the serial port, see *Advanced Configuration, Terminal server*. This arrangement is recommended especially when the feed line would be very long otherwise (more than 15 meters) or the link is expected to operate with low fading margin.

Always follow the installation recommendations provided by the cable manufacturer (bend radius, etc.). Use suitable connectors and install them diligently. Poorly attached connectors increase interference and can cause link instability.

4.4. Grounding

To minimize the odds of the transceiver and the connected equipment receiving any damage, a safety ground (NEC Class 2 compliant) should be used, which bonds the antenna system, transceiver, power supply, and connected data equipment to a single-point ground, keeping the ground leads short.

The RipEX2 radio modem is generally considered adequately grounded if the supplied flat mounting brackets are used to mount the radio modem to a properly grounded metal surface. If the radio modem is not mounted to a grounded surface, you should attach a safety ground wire to one of the mounting brackets or a screw on the radio modem's casing.

A lightning protector should be used where the antenna cable enters the building. Connect the protector to the building grounding, if possible. All grounds and cabling must comply with the applicable codes and regulations.

4.5. Connectors

RipEX2 uses standard connectors. Use only standard counterparts to these connectors.

You will find the connectors' pin-outs in chapter *Section 1.2, "Connectors"*.

4.6. Power supply

We do not recommend switching on the RipEX2's power supply before connecting the antenna and other devices. Connecting the RTU and other devices to RipEX2 while powered increases the likelihood of damage due to the discharge of difference in electric potentials.

RipEX2 may be powered from any well-filtered 10 to 30 VDC power source. The supply must be capable of providing the required input for the projected RF output. The power supply must be sufficiently stable so that voltage doesn't drop when switching from receiving to transmission, which takes less than 1.5 ms. To avoid radio channel interference, the power supply must meet all relevant EMC standards. Never install a power supply close to the antenna. Maximal supply cable length is 3 m minus pole of the power supply. Connector is internally connected to the casing of the RipEX2 unit.

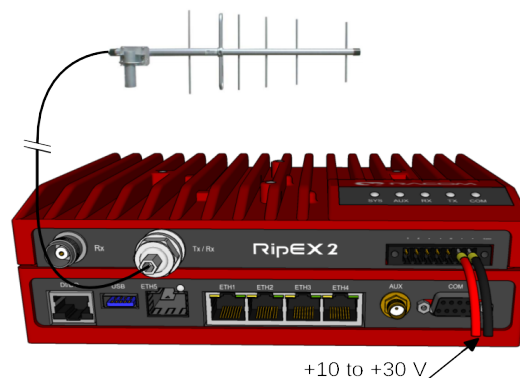


Fig. 4.8: 10–30 VDC Supplying

5. Configuration

For configuration please follow the SW manual.

6. Technical parameters

Tab. 6.1: Technical parameters

Radio parameters	
Frequency bands	400-470 MHz
Channel spacing	6.25 / 12.5 / 25 / 50 / 100 / 150 / 200 kHz
Frequency stability	± 1.0 ppm, ± 0.01 ppm with GPS option
Modulation	QAM: 256QAM, 64QAM, 16DEQAM, D8PSK, $\pi/4$ DQPSK, DPSK FSK: 4CPFSK, 2CPFSK
Data speed (up to)	>1.4 Mbps@200 kHz, >1.1 Mbps@150kHz, >700kbps@100kHz, > 400 kbps@50 kHz; >200 kbps@25 kHz; >100 kbps@12.5 kHz; >50 kbps@6,25 kHz ^[1]
FEC (Forward Error Correction)	Trellis code with Viterbi soft-decoder
<p>^[1] This is gross data speed in above table. User data speed varies and depends heavily on the data structure, optimization effectivity, protocol on Radio channel, signal budgets and many other parameters of the network. Practical tests are recommended.</p>	

Transmitter	
RF Output power (Both Carrier and Modulated)	QAM: 0.1- 5.0 W (20 - 37 dBm) in 1dB step ^{[2][3]} FSK: 0.1 - 10 W (20 - 40 dBm) in 1 dB step ^[4]
Duty cycle	Continuous
Rx to Tx Time	< 1.5 ms / 25 kHz channel
Intermodulation Attenuation	> 40 dB, > 70 dB (with external circulator/isolator)
Spurious Emissions (Conducted)	< -36 dBm
Radiated Spurious Emissions	< -36 dBm
Adjacent channel power	< -60 dBc
Transient adjacent channel power	< -60 dBc
Receiver	
Sensitivity	<i>see details</i>
Anti-aliasing Selectivity	56 kHz @ -3 dB BW applicable for 6.25/12.5/25 kHz 500 kHz @ -3 dB BW applicable for 50/100/150/200 kHz
Tx to Rx Time	< 1.5 ms / 25 kHz channel
Maximum Receiver Input Power	20 dBm (100 mW)
Rx Spurious Emissions (Conducted)	< -57 dBm
Radiated Spurious Emissions	< -57 dBm
Blocking or desensitization	>-23 dBm @ 1MHz >-19 dBm @ 2MHz >-15 dBm @ 5MHz >-13 dBm @ 10MHz
Spurious response rejection	> 70 dB
<p>^[2] Output power displayed as average power, Max peak envelope power (PEP) 10 W (40 dBm)</p> <p>^[3] Modulation dependent (DPSK 5 W ... QAM256 2W)</p> <p>^[4] For output power 10 W it is recommended to use input power above 11 VDC.</p>	

Electrical	
Primary power	10 to 30 VDC, negative GND
Rx	8 W / 13.8 V
Tx - FSK	typ. 40 W, max. 55 W @ 40 dBm
Tx - QAM	typ. 33 W, max. 40 W @ 40 dBm PEP
Sleep mode	0.01 W
Save mode	5 W
Interfaces	
Ethernet	10/100 Base-T Auto MDI/MDIX 10/100/1000 Base-T 1000Base-SX / 1000 Base-LX
COM	RS232/RS485 SW configurable 300 bps – 1 Mbps
USB	USB 3.0
Antenna	50 Ω
DI / DO	2×DI, 2×DO, 1×DDI
GPS	active antenna 3.3 VDC SMA female
GPS	72-channel u-blox M8 engine GPS/QZSS L1 C/A, GLONASS L10F BeiDou B1I, Galileo E1B/C SBAS L1 C/A: WAAS, EGNOS, MSAS, GAGAN
LED panel	
5× tri-color status LEDs	SYS, AUX, RX, TX, COM
Environmental	
IP Code (Ingress Protection)	IP42, IP52
MTBF (Mean Time Between Failure)	> 900.000 hours (> 100 years)
Operating temperature	-40 to +70 °C (-40 to +158 °F)
Operating humidity	5 to 95 % non-condensing
Storage	-40 to +85 °C (-40 to +185 °F) / 5 to 95 % non-condensing
Mechanical	
Casing	Rugged die-cast aluminium
Dimensions	60 H × 185 W × 125 mm D (2.34× 7.2 × 4.9 in)
Weight	1.55 kg (3.4 lbs)
Mounting	DIN rail, L-bracket, Flat-bracket, 19" Rack shelf
SW	
Operating modes	Bridge / Router
User protocols on COM	Modbus, IEC101, DNP3, PR2000, UNI, Comli, DF1, RP570, Profibus, ...
User protocols on Ethernet	Modbus TCP, IEC104, DNP3 TCP, Comli TCP, Terminal server...
Serial to IP convertors	Modbus RTU / Modbus TCP, DNP3 / DNP3 TCP
Protocol on Radio channel	

Multi master applications	Yes
Report by exception	Yes
Collision Avoidance Capability	Yes
Remote to Remote communication	Yes
Addressed & acknowledged serial SCADA protocols	Yes
Data integrity control	CRC 32
Encryption	AES256
Optimization	up to 3× higher throughput
Diagnostic and Management	
Radio link testing	Yes (ping with RSS, Data Quality, Homogeneity)
Watched values (Can be broadcast to neighbouring units. Received info displayed in Neighbours table)	Device – Ucc, Temp, PWR, VSWR, *HW Alarm Input. Radio channel – *RSScom, *DQcom, TXLost[%] User interfaces – ETH[Rx/Tx], COM[Rx/Tx] * not broadcast
Statistics	For Rx/Tx Packets on User interfaces (ETH, COM) and for User data and Radio protocol (Repeats, Lost, ACK etc.) on Radio channel
Graphs	For Watched values and Statistics
History (Statistics, Neighbours, Graphs)	20 periods (configurable, e.g. days)
SNMP	SNMPv1, SNMPv2c, SNMPv3 Trap / Inform alarms generation as per settings
Monitoring	Real time/Save to file analysis of all physical interfaces (RADIO, ETH, COM) and some internal interfaces between software modules (e.g. Terminal servers, Modbus TCP server etc.)

Standards	
CE	RED, RoHS, WEEE
FCC, ATEX	pending
Spectrum	ETSI EN 302 561 V2.1.1 ETSI EN 300 113 V2.2.1
EMC (electromagnetic compatibility)	ETSI EN 301 489-1 V2.1.1 ETSI EN 301 489-5 V2.1.1
Electric power substations environment	IEEE 1613:2009 Class 1 - pending
Safety	EN 62 368-1:2004 + A1:2017
SAR	EN 50385:2017 EN 50383ed.2:2010
Vibration & shock	pending
Seismic qualification	pending
IP rating	EN 60529:1993 + A1:2001 + A2:2014

Tab. 6.2: List of connected cables

Input / Output	Specified length	Shielded / Nonshielded	Recommended cable type
DC power supply 10 – 30 V	As needed	N	V03VH-H 2×0,5
GPIO (Sleep Input, HW Alarm Input, HW Alarm Output)	As needed	S	LiYCY 6×0,14
Antenna connection Rx, Rx/Tx	As needed	S	Coaxial
COM (RS232/485)	As needed, typically up to 15 m (RS232) or 1.2 km (RS485)	S	LiYCY 4×0,14
AUX (used for GPS)	As needed	S	Coaxial
ETH (4 ports)	As needed, typically up to 100 m	S	STP CAT 5e
Optical Ethernet	As needed, typically up to 2 km	N/A	Optical fibre
USB	Max. 3 m	S	USB3
DI / DO	As needed	S	STP CAT 5e

6.1. Detailed Radio parameters

Tab. 6.3: 12.5 kHz

12.5 kHz Rx Baudrate 10.42 kBaud (ETSI EN 300 113)						
Classification			Sensitivity [dBm]			Co-Channel Rejection Ratio
Bitrate [kbps]	FEC	Modulation	BER 10 ⁻²	BER 10 ⁻³	BER 10 ⁻⁶	
3.91	0.75	2CPFSK	-120	-119	-117	-7
5.21	1.00	2CPFSK	-120	-118	-115	-10
7.81	0.75	4CPFSK	-119	-117	-114	-11
10.42	1.00	4CPFSK	-118	-115	-112	-6
7.81	0.75	DPSK	-119	-118	-114	-6.5
10.42	1.00	DPSK	-119	-117	-112	-5
15.62	0.75	$\pi/4$ -DQPSK	-118	-117	-113	-9
20.83	1.00	$\pi/4$ -DQPSK	-117	-115	-110	-10
23.44	0.75	D8PSK	-116	-113	-108	-12
31.25	1.00	D8PSK	-113	-109	-103	-14
31.25	0.75	16DEQAM	-112	-109	-103	-16
41.67	1.00	16DEQAM	-109	-106	-99	-18.5
46.88	0.75	64QAM	-110	-106	-99	-19
62.50	1.00	64QAM	-105	-101	-94	-22.5
62.50	0.75	256QAM	-105	-102	-95	-22
83.33	1.00	256QAM	-100	-97	-90	-28.5

12.5 kHz				
Bitrate [kbps]	Modulation	Emmision code	OBW [kHz]	OBW limit [kHz]
Baudrate 5.21 kBaud (ETSI EN 300 113)				
5.21	2CPFSK	7K00F1DBN	7.0	11.5
10.42	4CPFSK	7K00F1DDN	7.0	11.5
Baudrate 8.68 kBaud (ETSI EN 300 113)				
8.68	DPSK	10K0G1DBN	10.0	11.5
17.36	$\pi/4$ -DQPSK	10K0G1DDN	10.0	11.5
26.04	D8PSK	10K0G1DEN	10.0	11.5
34.72	16DEQAM	10K0G1DEN	10.0	11.5
52.08	64QAM	10K0G1DEN	10.0	11.5
69.44	256QAM	10K0G1DEN	10.0	11.5
Baudrate 10.42 kBaud (ETSI EN 300 113)				
10.42	DPSK	11K9G1DBN	11.9	12.5
20.83	$\pi/4$ -DQPSK	11K9G1DDN	11.9	12.5
31.25	D8PSK	11K9G1DEN	11.9	12.5
41.67	16DEQAM	11K9G1DEN	11.9	12.5
62.50	64QAM	11K9G1DEN	11.9	12.5
83.33	256QAM	11K9G1DEN	11.9	12.5

Tab. 6.4: 25 kHz

25 kHz Rx Baudrate 20.83 (ETSI EN 300 113)						
Classification			Sensitivity [dBm]			Co-Channel Rejection Ratio
Bitrate [kbps]	FEC	Modulation	BER 10 ⁻²	BER 10 ⁻³	BER 10 ⁻⁶	
7.81	0.75	2CPFSK	-118	-117	-115	-6
10.42	1.00	2CPFSK	-118	-116	-113	-7
15.63	0.75	4CPFSK	-117	-115	-112	-10
20.83	1.00	4CPFSK	-115	-113	-109	-6
15.62	0.75	DPSK	-117	-116	-112	-6
20.83	1.00	DPSK	-117	-115	-110	-6
31.25	0.75	$\pi/4$ -DQPSK	-116	-115	-111	-9
41.66	1.00	$\pi/4$ -DQPSK	-115	-113	-108	-10
46.87	0.75	D8PSK	-113	-111	-106	-12
62.49	1.00	D8PSK	-110	-107	-101	-14.5
62.49	0.75	16DEQAM	-110	-107	-101	-16
83.32	1.00	16DEQAM	-108	-105	-98	-18.5
93.75	0.75	64QAM	-108	-104	-97	-19
125.00	1.00	64QAM	-104	-99	-92	-22.5
125.00	0.75	256QAM	-103	-100	-93	-22
166.67	1.00	256QAM	-98	-95	-88	-28.5

25 kHz				
Bitrate [kbps]	Modulation	Emmision code	OBW [kHz]	OBW limit [kHz]
Baudrate 10.42 kBaud (ETSI EN 300 113)				
10.42	2CPFSK	13K8F1DBN	13.8	16
20.83	4CPFSK	13K8F1DDN	13.8	16
Baudrate 13.89 kBaud (ETSI EN 300 113)				
13.89	DPSK	15K9G1DBN	15.9	16
27.78	$\pi/4$ -DQPSK	15K9G1DDN	15.9	16
41.67	D8PSK	15K9G1DEN	15.9	16
55.56	16DEQAM	15K9G1DEN	15.9	16
83.33	64QAM	15K9G1DEN	15.9	16
111.11	256QAM	15K9G1DEN	15.9	16
Baudrate 17.36 kBaud (ETSI EN 300 113, ETSI EN 302 561)				
17.36	DPSK	19K8G1DBN	19.8	20
34.72	$\pi/4$ -DQPSK	19K8G1DDN	19.8	20
52.08	D8PSK	19K8G1DEN	19.8	20
69.44	16DEQAM	19K8G1DEN	19.8	20
104.17	64QAM	19K8G1DEN	19.8	20
138.89	256QAM	19K8G1DEN	19.8	20
Baudrate 20.83 kBaud (ETSI EN 302 561)				
20.83	DPSK	24K0G1DBN	24.0	25
41.67	$\pi/4$ -DQPSK	24K0G1DDN	24.0	25
62.50	D8PSK	24K0G1DEN	24.0	25
83.33	16DEQAM	24K0G1DEN	24.0	25
125.00	64QAM	24K0G1DEN	24.0	25
166.67	256QAM	24K0G1DEN	24.0	25

Tab. 6.5: 50 kHz

50 kHz Rx Baudrate 41.67 kBaud (ETSI EN 300 561)						
Classification			Sensitivity [dBm]			Co-Channel Rejection Ratio
Bitrate [kbps]	FEC	Modulation	BER 10 ⁻²	BER 10 ⁻³	BER 10 ⁻⁶	[dB]
31.25	0.75	DPSK	-114	-113	-109	-7
41.67	1.00	DPSK	-114	-112	-107	-7
62.50	0.75	$\pi/4$ -DQPSK	-113	-112	-108	-10
83.33	1.00	$\pi/4$ -DQPSK	-112	-110	-105	-11
93.75	0.75	D8PSK	-110	-108	-103	-13
125.00	1.00	D8PSK	-107	-104	-98	-15
125.00	0.75	16DEQAM	-107	-104	-98	-17
166.67	1.00	16DEQAM	-105	-102	-95	-19
187.50	0.75	64QAM	-105	-101	-94	-20
250.00	1.00	64QAM	-101	-96	-89	-23
250.00	0.75	256QAM	-100	-97	-90	-23
333.33	1.00	256QAM	-95	-92	-85	-31

50 kHz				
Bitrate [kbps]	Modulation	Emmission code	OBW [kHz]	OBW limit [kHz]
Baudrate 34.72 kBaud (ETSI EN 302 561)				
34.72	DPSK	40K0G1DBN	40.0	40
69.44	$\pi/4$ -DQPSK	40K0G1DDN	40.0	40
104.17	D8PSK	40K0G1DEN	40.0	40
138.89	16DEQAM	40K0G1DEN	40.0	40
208.33	64QAM	40K0G1DEN	40.0	40
277.78	256QAM	40K0G1DEN	40.0	40
Baudrate 41.67 (ETSI EN 302 561)				
41.67	DPSK	45K0G1DBN	45.0	50
83.33	$\pi/4$ -DQPSK	45K0G1DDN	45.0	50
125.00	D8PSK	45K0G1DEN	45.0	50
166.67	16DEQAM	45K0G1DEN	45.0	50
250.00	64QAM	45K0G1DEN	45.0	50
333.33	256QAM	45K0G1DEN	45.0	50

Tab. 6.6: 100 kHz

100 kHz Rx Baudrate 69.44 kBaud (ETSI EN 300 561)						
Classification			Sensitivity [dBm]			Co-Channel Rejection Ratio
Bitrate [kbps]	FEC	Modulation	BER 10 ⁻²	BER 10 ⁻³	BER 10 ⁻⁶	[dB]
52.08	0.75	DPSK	-112	-110	-106	-7
69.44	1.00	DPSK	-111	-109	-104	-7
104.17	0.75	$\pi/4$ -DQPSK	-111	-109	-105	-10
138.89	1.00	$\pi/4$ -DQPSK	-110	-108	-102	-11
156.25	0.75	D8PSK	-108	-105	-100	-13
208.33	1.00	D8PSK	-105	-101	-95	-15
208.33	0.75	16DEQAM	-104	-101	-95	-17
277.78	1.00	16DEQAM	-102	-99	-92	-19
312.50	0,75	64QAM	-102	-98	-91	-20
416.66	1.00	64QAM	-98	-93	-86	-23
416.66	0,75	256QAM	-98	-94	-86	-23
555.55	1.00	256QAM	-93	-89	-83	-31

100 kHz				
Bitrate [kbps]	Modulation	Emmision code	OBW [kHz]	OBW limit [kHz]
Baudrate 69.44 kBaud (ETSI EN 302 561)				
69.44	DPSK	80K0G1DBN	80.0	80
138.89	$\pi/4$ -DQPSK	80K0G1DDN	80.0	80
208.33	D8PSK	80K0G1DEN	80.0	80
277.78	16DEQAM	80K0G1DEN	80.0	80
416.66	64QAM	80K0G1DEN	80.0	80
555.55	256QAM	80K0G1DEN	80.0	80

Tab. 6.7: 150 kHz

150 kHz Rx Baudrate 115.74 kBaud (ETSI EN 300 561)						
Classification			Sensitivity [dBm]			Co-Channel Rejection Ratio
Bitrate [kbps]	FEC	Modulation	BER 10 ⁻²	BER 10 ⁻³	BER 10 ⁻⁶	[dB]
86.71	0.75	DPSK	-110	-108	-104	-7
115.74	1.00	DPSK	-109	-107	-102	-7
173.61	0.75	$\pi/4$ -DQPSK	-109	-107	-103	-10
231.48	1.00	$\pi/4$ -DQPSK	-108	-106	-100	-11
260.42	0.75	D8PSK	-106	-103	-98	-13
347.22	1.00	D8PSK	-103	-99	-93	-15
347.22	0.75	16DEQAM	-102	-99	-93	-17
462.96	1.00	16DEQAM	-100	-97	-90	-19
520.83	0.75	64QAM	-100	-96	-89	-20
694.45	1.00	64QAM	-96	-91	-84	-23
694.45	0.75	256QAM	-96	-92	-84	-23
925.93	1.00	256QAM	-91	-87	-81	-31

150 kHz				
Bitrate [kbps]	Modulation	Emmision code	OBW [kHz]	OBW limit [kHz]
Baudrate 115.74 kBaud (ETSI EN 302 561)				
115.74	DPSK	125KG1DBN	125.0	125
231.48	$\pi/4$ -DQPSK	125KG1DDN	125.0	125
347.22	D8PSK	125KG1DEN	125.0	125
462.96	16DEQAM	125KG1DEN	125.0	125
694.45	64QAM	125KG1DEN	125.0	125
925.93	256QAM	125KG1DEN	125.0	125

Tab. 6.8: 200 kHz

200 kHz Rx Baudrate 138.89 kBaud (ETSI EN 300 561)						
Classification			Sensitivity [dBm]			Co-Channel Rejection Ratio
Bitrate [kbps]	FEC	Modulation	BER 10 ⁻²	BER 10 ⁻³	BER 10 ⁻⁶	[dB]
104.17	0.75	DPSK	-109	-107	-103	-7
138.89	1.00	DPSK	-108	-106	-101	-7
208.33	0.75	$\pi/4$ -DQPSK	-108	-106	-102	-10
277.78	1.00	$\pi/4$ -DQPSK	-107	-105	-99	-11
312.50	0.75	D8PSK	-105	-102	-97	-13
416.67	1.00	D8PSK	-102	-98	-92	-15
416.67	0.75	16DEQAM	-101	-98	-92	-17
555.55	1.00	16DEQAM	-99	-96	-89	-19
625.00	0.75	64QAM	-99	-95	-88	-20
833.33	1.00	64QAM	-95	-90	-83	-23
833.33	0.75	256QAM	-95	-91	-83	-23
1111.11	1.00	256QAM	-90	-86	-80	-31

200 kHz				
Bitrate [kbps]	Modulation	Emmision code	OBW [kHz]	OBW limit [kHz]
Baudrate 138.89 kBaud (ETSI EN 302 561)				
138.89	DPSK	150KG1DBN	150.0	175
277.78	$\pi/4$ -DQPSK	150KG1DDN	150.0	175
416.67	D8PSK	150KG1DEN	150.0	175
555.56	16DEQAM	150KG1DEN	150.0	175
833.33	64QAM	150KG1DEN	150.0	175
1111.11	256QAM	150KG1DEN	150.0	175

Tab. 6.9: MSE

Recommended MSE thresholds		
Modulation	FEC	Mean MSE [dB]
2CPFSK	0.75	-10
2CPFSK	1.00	-11
4CPFSK	0.75	-12
4CPFSK	1.00	-15
DPSK	0.75	-10
DPSK	1.00	-11
$\pi/4$ -DQPSK	0.75	-12
$\pi/4$ -DQPSK	1.00	-14
8DPSK	0.75	-17
8DPSK	1.00	-20
16DEQAM	0.75	-19
16DEQAM	1.00	-22
64QAM	0.75	-24
64QAM	1.00	-27
256QAM	0.75	-30
256QAM	1.00	-33

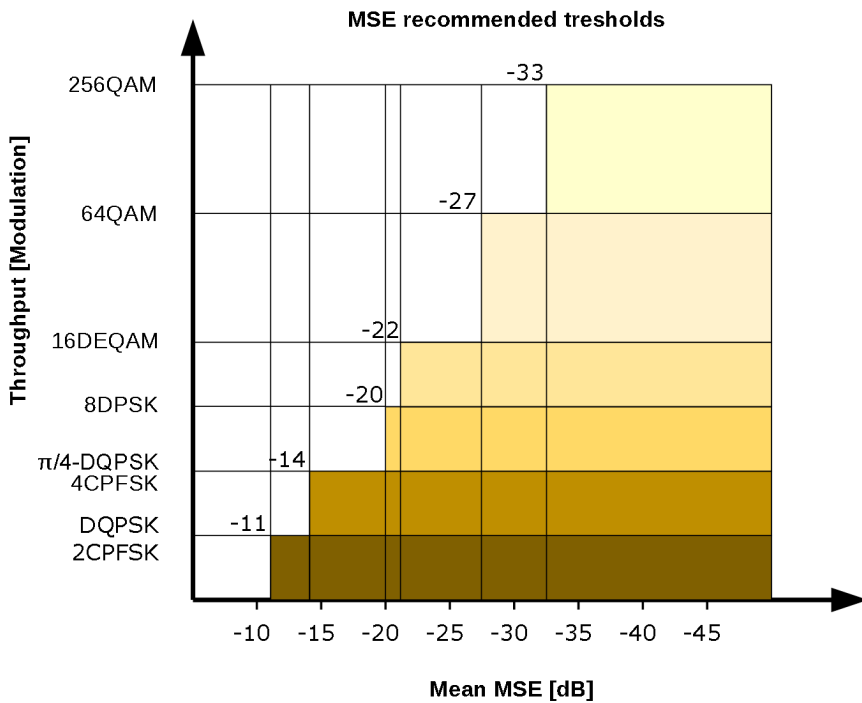


Fig. 6.1: MSE recommended thresholds

Tab. 6.10: Maximal power for individual modulations

Maximum PEP, RMS and PAPR levels			
Modulation	PEP Peak Envelope Power [dBm]	RMS Average Power [dBm]	PAPR Peak to Average Power Ratio [dB]
2CPFSK	40	40	0
4CPFSK	40	40	0
DPSK	40	37	3
$\pi/4$-DQPSK	40	37	3
D8PSK	40	36	4
16DEQAM	40	35	5
64QAM	40	34	6
256QAM	40	33	7

6.2. Occupied Bandwidth limits overview

Tab. 6.11: Channel spacing 6.25 kHz

Channel spacing [kHz]	6.25	
Occupied BW limit [kHz]	5	5
Modulation type	FSK	QAM
RipEX 1 "Mode"	FCC, CE	FCC
OBW [kHz]	3.6	5.0
Baud rate [kBaud]	2.6	4.34
Compliance	FCC Part 90	FCC Part 90

Tab. 6.12: Channel spacing 12.5 kHz

Channel spacing [kHz]	12.5		
Occupied BW limit [kHz]	11	11	12.5
Modulation type	FSK	QAM	
RipEX 1 "Mode"	FCC, CE	FCC	CE
OBW [kHz]	7.0	10.0	11.9
Baud rate [kBaud]	5.21	8.68	10.42
Compliance	RED FCC Part 90	RED FCC Part 90	RED

Tab. 6.13: Channel spacing 25 kHz

Channel spacing [kHz]	25			
Occupied BW limit [kHz]	16	16	20	25
Modulation type	FSK	QAM		
RipEX 1 "Mode"	CE	Narrow	FCC	CE
OBW [kHz]	13.8	15.9	19.8	24.0
Baud rate [kBaud]	10.42	13.89	17.36	20.83
Compliance	RED FCC Part 90	RED FCC Part 90	RED FCC Part 90	RED

Tab. 6.14: Channel spacing 50 kHz

Channel spacing [kHz]	50	
Occupied BW limit [kHz]	40	50
Modulation type	QAM	
RipEX 1 "Mode"	CE	Unlimited
OBW [kHz]	40.0	45.0
Baud rate [kBaud]	34.72	41.67
Compliance	RED	RED

Tab. 6.15: Channel spacing 100 kHz

Channel spacing [kHz]	100	
Occupied BW limit [kHz]	80	100
Modulation type	QAM	
OBW [kHz]	80.0	90.0
Baud rate [kBaud]	69.44	83.3
Compliance	RED	

Tab. 6.16: Channel spacing 150 kHz

Channel spacing [kHz]	150	
Occupied BW limit [kHz]	125	150
Modulation type	QAM	
OBW [kHz]	125	135
Baud rate [kBaud]	115.74	124.01
Compliance	RED	

Tab. 6.17: Channel spacing 200 kHz

Channel spacing [kHz]	200	
Occupied BW limit [kHz]	175	200
Modulation type	QAM	
OBW [kHz]	150	180
Baud rate [kBaud]	138.89	166.67
Compliance	RED	

Tab. 6.18: Channel spacing 250 kHz

Channel spacing [kHz]	250	
Occupied BW limit [kHz]	225	250
Modulation type	QAM	
OBW [kHz]	205	225
Baud rate [kBaud]	189.39	208.33

Tab. 6.19: Channel spacing 300 kHz

Channel spacing [kHz]	300	
Occupied BW limit [kHz]	300	
Modulation type	QAM	
OBW [kHz]	280	
Baud rate [kBaud]	260.42	

7. Safety, environment, licensing

7.1. Frequency

The radio modem must be operated only in accordance with the valid frequency license issued by national frequency authority and all radio parameters have to be set exactly as listed.



Important

Use of frequencies between 406.0 and 406.1 MHz is worldwide-allocated only for International Satellite Search and Rescue System. These frequencies are used for distress beacons and are incessantly monitored by the ground and satellite Cospas-Sarsat system. Other use of these frequencies is forbidden.

7.2. Safety distance



Safety distances with respect to the health limits of the electromagnetic field intensity are in Minimum Safety Distance tables below, calculated for different antennas and RipEX2 power levels. The distances were calculated according to EN 50 385 and EN 50 383 and apply to the far-field region only. Whenever the result is comparable or smaller than the actual size of the respective antenna, the field intensity is even smaller than the far-field based calculation and the safety limit is never exceeded. For the output power 0.2 W or lower the safety limit is not exceeded at any distance and any of the antennas.

The minimal safe distance is typically ensured by the antenna position on a mast. When special installation is required, the conditions of the standard EN 50385: 2002 have to be met. The distance between the persons and antenna shown in the table below comply with all applicable standards for human exposure of general public to RF electromagnetic fields.

Tab. 7.1: Minimum Safety Distance 300–400 MHz

400 MHz/70 cm band – 10 W RF power					
Antenna code	Antenna description	Gain G [dBi]	Gain G [-]	Dist. where the FCC limits are met for	
				General Population / Uncontrolled Exposure [cm]	General Population / Controlled Exposure [cm]
OV380.1	single dipole	4.6	2.9	130	60
OV380.2	stacked double dipole	7.6	5.8	180	80
SA380.3	3 element directional Yagi	7.6	5.8	180	80
SA380.5	5 element directional Yagi	8.7	7.4	200	90
SA380.9	9 element directional Yagi	12.5	17.8	310	140

400 MHz/70 cm band – 5 W RF power					
Antenna code	Antenna description	Gain G [dBi]	Gain G [-]	Dist. where the FCC limits are met for	
				General Population / Uncontrolled Exposure [cm]	General Population / Controlled Exposure [cm]

400 MHz/70 cm band – 5 W RF power					
OV380.1	single dipole	4.6	2.9	90	40
OV380.2	stacked double dipole	7.6	5.8	130	60
SA380.3	3 element directional Yagi	7.6	5.8	130	60
SA380.5	5 element directional Yagi	8.7	7.4	140	70
SA380.9	9 element directional Yagi	12.5	17.8	220	100

400 MHz/70 cm band – 4 W RF power					
Antenna code	Antenna description	Gain G [dBi]	Gain G [-]	Dist. where the FCC limits are met for	
				General Population / Uncontrolled Exposure [cm]	General Population / Controlled Exposure [cm]
OV380.1	single dipole	4.6	2.9	80	35
OV380.2	stacked double dipole	7.6	5.8	110	50
SA380.3	3 element directional Yagi	7.6	5.8	110	50
SA380.5	5 element directional Yagi	8.7	7.4	130	60
SA380.9	9 element directional Yagi	12.5	17.8	200	90

400 MHz/70 cm band – 3 W RF power					
Antenna code	Antenna description	Gain G [dBi]	Gain G [-]	Dist. where the FCC limits are met for	
				General Population / Uncontrolled Exposure [cm]	General Population / Controlled Exposure [cm]
OV380.1	single dipole	4.6	2.9	70	30
OV380.2	stacked double dipole	7.6	5.8	100	45
SA380.3	3 element directional Yagi	7.6	5.8	100	45
SA380.5	5 element directional Yagi	8.7	7.4	110	50
SA380.9	9 element directional Yagi	12.5	17.8	170	80

400 MHz/70 cm band – 2 W RF power					
Antenna code	Antenna description	Gain G [dBi]	Gain G [-]	Dist. where the FCC limits are met for	
				General Population / Uncontrolled Exposure [cm]	General Population / Controlled Exposure [cm]
OV380.1	single dipole	4.6	2.9	60	25
OV380.2	stacked double dipole	7.6	5.8	80	35
SA380.3	3 element directional Yagi	7.6	5.8	80	35
SA380.5	5 element directional Yagi	8.7	7.4	90	40
SA380.9	9 element directional Yagi	12.5	17.8	140	70

400 MHz/70 cm band – 1 W RF power					
Antenna code	Antenna description	Gain G [dBi]	Gain G [-]	Dist. where the FCC limits are met for	
				General Population / Uncontrolled Exposure [cm]	General Population / Controlled Exposure [cm]

400 MHz/70 cm band – 1 W RF power					
				General Population / Uncontrolled Exposure [cm]	General Population / Controlled Exposure [cm]
OV380.1	single dipole	4.6	2.9	40	20
OV380.2	stacked double dipole	7.6	5.8	60	25
SA380.3	3 element directional Yagi	7.6	5.8	60	25
SA380.5	5 element directional Yagi	8.7	7.4	70	30
SA380.9	9 element directional Yagi	12.5	17.8	100	50

400 MHz/70 cm band – 0.5 W RF power					
Antenna code	Antenna description	Gain G [dBi]	Gain G [-]	Dist. where the FCC limits are met for	
				General Population / Uncontrolled Exposure [cm]	General Population / Controlled Exposure [cm]
OV380.1	single dipole	4.6	2.9	30	15
OV380.2	stacked double dipole	7.6	5.8	40	20
SA380.3	3 element directional Yagi	7.6	5.8	40	20
SA380.5	5 element directional Yagi	8.7	7.4	45	20
SA380.9	9 element directional Yagi	12.5	17.8	70	30

7.3. High temperature



If the RipEX2 is operated in an environment where the ambient temperature exceeds 55 °C, the RipEX2 must be installed within a restricted access location to prevent human contact with the enclosure heatsink.

7.4. RoHS and WEEE compliance

RoHS
compliant

WEEE
compliant

This product is fully compliant with the European Parliament's 2011/65/EU RoHS (Restriction of Certain Hazardous Substances in Electrical and Electronic Equipment) and 2012/19/EU WEEE (Waste Electrical and Electronic Equipment) environmental directives.



Used equipment must be collected separately, and disposed of properly. COMPANY has instigated a programme to manage the reuse, recycling, and recovery of waste in an environmentally safe manner using processes that comply with the WEEE Directive.

Battery Disposal - This product may contain a battery. Batteries must be disposed of properly, and may not be disposed of as unsorted municipal waste within the European Union. See the product documentation for specific battery information. Batteries are marked with a symbol, which may include lettering to indicate cadmium (Cd), lead (Pb), or mercury (Hg). For proper recycling, return the battery to your supplier or to a designated collection point.



EU DECLARATION OF CONFORMITY

Equipment	RipEX, RipEX2 RAy2, RAY3 MIDGE, MIDGE2 MRxxx, MDxxx
Manufacturer	RACOM s.r.o. Mirova 1283, 592 31 Nove Mesto na Morave, Czech Republic

This declaration of conformity is issued under the sole responsibility of the manufacturer.

The equipment described above is in conformity with the Directive 2011/65/EU of the European Parliament and of the Council on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS), as amended by Directive (EU) 2015/863, and Directive 2012/19/EU of the European Parliament and of the Council on waste electrical and electronic equipment (WEEE).

RoHS Applicable Exemption: 7(b)

Compliance has been verified via internal design controls, supplier declarations and/or analytical test data.

Signed for and on behalf of the manufacturer:

Nove Mesto na Morave, 11th July 2019
Jiri Hruska, CEO

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www.racom.eu

ver. 1.0

Fig. 7.1: EU Declaration of Conformity RoHS, WEEE

7.5. Instructions for Safe Operation of Equipment

Please read these safety instructions carefully before using the product:

- The radio equipment can only be operated on frequencies stipulated by the body authorized 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 unauthorized way.
- Equipment mentioned in this User 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.
- Only undermentioned manufacturer is entitled to repair any devices.

7.6. Important Notifications

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Version 1.0, November 2009

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7.7. EU restrictions or requirements notice

There are restrictions on putting into service or any requirements for authorisation of use within the EU countries listed below.



BE	BG	CZ	DK	DE	EE	IE
EL	ES	FR	HR	IT	CY	LV
LT	LU	HU	MT	NL	AT	PL
PT	RO	SI	SK	FI	SE	UK

Fig. 7.2: EU restrictions or requirements

The RipEX radio modem predominantly operates within frequency bands that require a site license be issued by the radio regulatory authority with jurisdiction over the territory in which the equipment is being operated.

7.8. EU Declaration of Conformity



EU DECLARATION OF CONFORMITY

Radio equipment type	Radio modem RipEX2-4	Radio SW version 1.0.0
Manufacturer	RACOM s.r.o. Mirova 1283, 592 31 Nove Mesto na Morave, Czech Republic	

This declaration of conformity is issued under the sole responsibility of the manufacturer.


The radio equipment described above is in conformity with the Directive 2014/53/EU of the European Parliament and of the Council on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC.

Harmonised standards used for demonstration of conformity:

Spectrum	EN 302 561 V2.1.1 EN 300 113 V2.2.1
EMC	EN 301 489-1 V2.1.1 EN 301 489-4 V2.2.1
Safety	EN 62368-1:2014 + A11:2017
SAR	EN 50385:2017 EN 50383ed.2:2010

Signed for and on behalf of the manufacturer:

Nove Mesto na Morave, 22nd of May 2019
Jiri Hruska, CEO



RACOM s.r.o. | Mirova 1283 | 592 31 Nove Mesto na Morave | Czech Republic
Tel.: +420 722 937 522 | E-mail: racom@racom.eu

www.racom.eu

ver. 1.0

Fig. 7.3: RED EU Declaration of Conformity

7.9. Simplified EU declaration of conformity

BG

С настоящото RACOM s.r.o. декларира, че този тип радиосъоръжение RipEX2 е в съответствие с Директива 2014/53/ЕС.

ES

Por la presente, RACOM s.r.o. declara que el tipo de equipo radioeléctrico RipEX2 es conforme con la Directiva 2014/53/UE.

CS

Tímto RACOM s.r.o. prohlašuje, že typ rádiového zařízení RipEX2 je v souladu se směrnicí 2014/53/EU.

DA

Hermed erklærer RACOM s.r.o., at radioudstyretypen RipEX2 er i overensstemmelse med direktiv 2014/53/EU.

DE

Hiermit erklärt RACOM s.r.o., dass der Funkanlagentyp RipEX2 der Richtlinie 2014/53/EU entspricht.

ET

Käesolevaga deklareerib RACOM s.r.o., et käesolev raadioseadme tüüp RipEX2 vastab direktiivi 2014/53/EL nõuetele.

EL

Με την παρούσα ο/η RACOM s.r.o., δηλώνει ότι ο ραδιοεξοπλισμός RipEX2 πληροί την οδηγία 2014/53/ΕΕ.

EN

Hereby, RACOM s.r.o. declares that the radio equipment type RipEX2 is in compliance with Directive 2014/53/EU.

FR

Le soussigné, RACOM s.r.o., déclare que l'équipement radioélectrique du type RipEX2 est conforme à la directive 2014/53/UE.

HR

RACOM s.r.o. ovime izjavljuje da je radijska oprema tipa RipEX2 u skladu s Direktivom 2014/53/EU.

IT

Il fabbricante, RACOM s.r.o., dichiara che il tipo di apparecchiatura radio RipEX2 è conforme alla direttiva 2014/53/UE.

LV

Ar šo RACOM s.r.o. deklarē, ka radioiekārta RipEX2 atbilst Direktīvai 2014/53/ES.

LT

Aš, RACOM s.r.o., patvirtinu, kad radijo įrenginių tipas RipEX2 atitinka Direktyvą 2014/53/ES.

HU

RACOM s.r.o. igazolja, hogy a RipEX2 típusú rádióberendezés megfelel a 2014/53/EU irányelvnek.

MT

B'dan, RACOM s.r.o., niddikjara li dan it-tip ta' tagħmir tar-radju RipEX2 huwa konformi mad-Direttiva 2014/53/UE.

NL

Hierbij verklaar ik, RACOM s.r.o., dat het type radioapparatuur RipEX2 conform is met Richtlijn 2014/53/EU.

PL

RACOM s.r.o. niniejszym oświadcza, że typ urządzenia radiowego RipEX2 jest zgodny z dyrektywą 2014/53/UE.

PT

O(a) abaixo assinado(a) RACOM s.r.o. declara que o presente tipo de equipamento de rádio RipEX2 está em conformidade com a Diretiva 2014/53/UE.

RO

Prin prezenta, RACOM s.r.o. declară că tipul de echipamente radio RipEX2 este în conformitate cu Directiva 2014/53/UE.

SK

RACOM s.r.o. týmto vyhlasuje, že rádiové zariadenie typu RipEX2 je v súlade so smernicou 2014/53/EÚ.

SL

RACOM s.r.o. potrjuje, da je tip radijske opreme RipEX2 skladen z Direktivo 2014/53/EU.

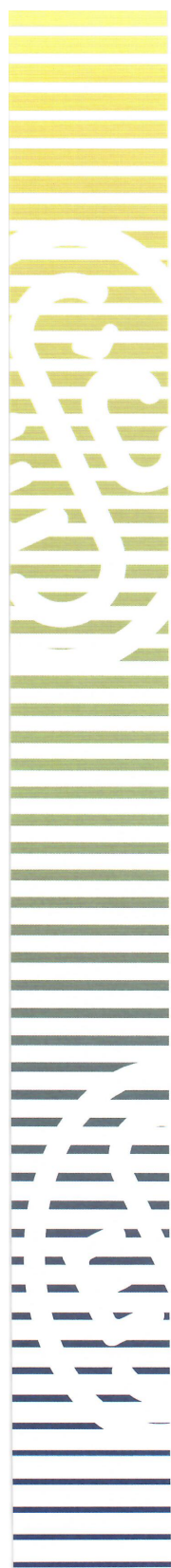
FI

RACOM s.r.o. vakuuttaa, että radiolaitetyyppi RipEX2 on direktiivin 2014/53/EU mukainen.

SV

Härmed försäkrar RACOM s.r.o. att denna typ av radioutrustning RipEX2 överensstämmer med direktiv 2014/53/EU.

7.10. IP Certificate



ELEKTROTECHNICKÝ ZKUŠEBNÍ ÚSTAV



ELECTROTECHNICAL TESTING INSTITUTE - CZECH REPUBLIC
ELEKTROTECHNISCHE PRÜFANSTALT - TSCHECHISCHE REPUBLIK
INSTITUT ELECTROTECHNIQUE D'ESSAIS - RÉPUBLIQUE TCHÈQUE
ЭЛЕКТРОТЕХНИЧЕСКИЙ ИСПЫТАТЕЛЬНЫЙ ИНСТИТУТ - ЧЕШСКАЯ РЕСПУБЛИКА

Pod lišem 129/2, 171 02 Praha 8 - Troja

CERTIFICATE

No.: 1180704

Product: Device

Type: RipEX2

Rating: IP42

Ordering firm: RACOM s.r.o.
Mírová 1283, 592 31 Nové Město na Moravě, Czech Republic

Manufacturer: RACOM s.r.o.
Mírová 1283, 592 31 Nové Město na Moravě, Czech Republic

Trade mark:

The test results are stated in the test-report No.: 803317-01/01 of: 08.10.2018

A sample of the product was found to be in conformity with:
ČSN EN 60529:1993+A1:2001+A2:2014

Other data:

The validity of the certificate is limited to: 31.10.2021

23.10.2018

Prague

Mgr. Miroslav Sedláček
Head of Certification Body



803317-01

Fig. 7.4: IP42 Certificate

ELEKTROTECHNICKÝ ZKUŠEBNÍ ÚSTAV



ELECTROTECHNICAL TESTING INSTITUTE - CZECH REPUBLIC
 ELEKTROTECHNISCHE PRÜFANSTALT - TSCHHECHISCHE REPUBLIK
 INSTITUT ELECTROTECHNIQUE D'ESSAIS - RÉPUBLIQUE TCHÉQUE
 ЭЛЕКТРОТЕХНИЧЕСКИЙ ИСПЫТАТЕЛЬНЫЙ ИНСТИТУТ - ЧЕШСКАЯ РЕСПУБЛИКА

Pod lisem 129/2, 171 02 Praha 8 - Troja

CERTIFICATE

No.: 1180703

Product: Device

Type: RipEX2 + SET_RipEX2_IP52

Rating: IP52

Ordering firm: RACOM s.r.o.
 Mírová 1283, 592 31 Nové Město na Moravě, Czech Republic

Manufacturer: RACOM s.r.o.
 Mírová 1283, 592 31 Nové Město na Moravě, Czech Republic

Trade mark:

The test results are stated in the test-report No.: 803317-01/02 of 17.10.2018

A sample of the product was found to be in conformity with:
 ČSN EN 60529:1993+A1:2001+A2:2014

Other data:

The validity of the certificate is limited to: 31.10.2021

23.10.2018

Prague

Mgr. Miroslav Sedláček
 Head of Certification Body



803317-01

Fig. 7.5: IP52 Certificate

7.11. Warranty

COMPANY-supplied parts or equipment ("equipment") is covered by warranty for inherently faulty parts and workmanship for a warranty period as stated in the delivery documentation from the date of dispatch to the customer. The warranty does not cover custom modifications to software. During the warranty period COMPANY shall, on its option, fit, repair or replace ("service") faulty equipment, always provided that malfunction has occurred during normal use, not due to improper use, whether deliberate or accidental, such as attempted repair or modification by any unauthorised person; nor due to the action of abnormal or extreme environmental conditions such as overvoltage, liquid immersion or lightning strike.

Any equipment subject to repair under warranty must be returned by prepaid freight to COMPANY direct. The serviced equipment shall be returned by COMPANY to the customer by prepaid freight. If circumstances do not permit the equipment to be returned to COMPANY, then the customer is liable and agrees to reimburse COMPANY for expenses incurred by COMPANY during servicing the equipment on site. When equipment does not qualify for servicing under warranty, COMPANY shall charge the customer and be reimbursed for costs incurred for parts and labour at prevailing rates.

This warranty agreement represents the full extent of the warranty cover provided by COMPANY to the customer, as an agreement freely entered into by both parties.

COMPANY warrants the equipment to function as described, without guaranteeing it as befitting customer intent or purpose. Under no circumstances shall COMPANY's liability extend beyond the above, nor shall COMPANY, its principals, servants or agents be liable for any consequential loss or damage caused directly or indirectly through the use, misuse, function or malfunction of the equipment, always subject to such statutory protection as may explicitly and unavoidably apply hereto.

7.12. PRODUCT maintenance

Action	Period	Note
Visual check – Antenna: Draining hole on dipole must be downward pointing There should be no damaged elements on the antenna Angle of elevation of antenna Azimuth (angle of horizontal deviation) in accordance with design	Quarterly	
Visual check – Coaxial Cable: Mechanical damage Solar degradation Entire cable correctly mounted to surface Connectors tightened to function optimally Self-vulcanizing tape used for all connections requiring insulation PSV & RF measurements	Annually	
Visual check – Cabinet: Mechanical damage Damage resulting in lower categorization for cabinet coverage Bushings for running cables	Annually	
Visual check – Electricity Supply: Insulation damage Connection to terminals	Annually	
Visual check – Accumulator: Capacity in accordance with customer requirements Condition of the accumulator	Annually	
Functionality check – power source: Overcharging Accumulator damage	Annually	
Full utilization of provided protective coverings	Annually	
Remove any items which are not part of the installation	Annually	
Fix and secure makeshift installations correctly	Annually	
Check grounding connections	As required	
Check lightning arrester : connectors must be tightened	As required	
Check data connectors connected including securing screws	Annually	
Evaluate the RSS and DQ values as a preventive measure against the failure of the connection. RSS and DQ values be similar to those at time of comissioning.	Monthly	
Check activity logs to detect abnormalities in data transmissions	Monthly	
Check if internal temperature alarm has been triggered	Monthly	
Check that firmware is latest stable version – upgrading FW recommended when new features required	As required	

If you are unsure on any of the above please contact COMPANY technical support.

Appendix A. Abbreviations

ACK	Acknowledgement	MDIX	Medium dependent interface crossover
AES	Advanced Encryption Standard	MIB	Management Information Base
BER	Bit Error Rate	NMS	Network Management System
CLI	Command Line Interface	N.C.	Normally Closed
CRC	Cyclic Redundancy Check	N.O.	Normally Open
CTS	Clear To Send	NTP	Network Time Protocol
dBc	decibel relative to the carrier	MRU	Maximum Reception Unit
dB _i	decibel relative to the isotropic	MTU	Maximum Transmission Unit
dBm	decibel relative to the milliwat	OS	Operation System
DCE	Data Communication Equipment	PC	Personal Computer
DHCP	Dynamic Host Configuration Protocol	PER	Packet Error Rate
DNS	Domain Name Server	PWR	Power
DQ	Data Quality	RF	Radio Frequency
DTE	Data Terminal Equipment	RoHS	Restriction of the use of Hazardous Substances
EMC	Electro-Magnetic Compatibility	RPT	Repeater
FCC	Federal Communications Commission	RSS	Received Signal Strength
FEC	Forward Error Correction	RTS	Request To Send
FEP	Front End Processor	RTU	Remote Terminal Unit
GPL	General Public License	RX	Receiver
https	Hypertext Transfer Protocol Secure	SCADA	Supervisory control and data acquisition
IP	Internet Protocol	SDR	Software Defined Radio
kbps	kilobit per second	SNMP	Simple Network Management Protocol
LAN	Local Area Network		
LOS	Line-of-sight		
MAC	Media Access Control		

TCP	Transmission Control Protocol
TS5	Terminal server 5
TX	Transmitter
UDP	User Datagram Protocol
VSWR	Voltage Standing Wave Ratio
WEEE	Waste Electrical and Electronic Equipment

sw-keys

conf-ex

dq-value

login to RipEX

h menu

leds

dq-value

accessories1

dimensions

mounting

"def-access"

Index

A

accessories, 22
antenna, 12
 dummy load, 29, 31
 mounting, 41
 overvoltage, 29
 separated, 21
AUX, 17

B

bench test, 31
box content, 8

C

connect PC, 33
connecting HW, 31
connectors, 12
Copyright, 5

D

default
 parameters, 6, 33
 setting, 19
demo case, 26
dimensions, 9

E

environment, 62

F

feedline cable, 30

G

GNU licence, 67
GPS, 21
grounding, 42

I

important notifications, 67
installation, 37

L

LED, 19
licensing, 62

M

model offerings, 21
mounting

 bracket, 27, 39
 DIN rail, 38
 IP52, 41

O

ordering code, 21

P

part number, 21
product
 code, 21
 conformity
 CE, 69
 EU, 70
 IP51, 72

Q

quick guide, 6

R

radio
 parameters, 50
reset, 19
RipEX Hot Standby, 22
RipEX2 RD, 23
RipEX2-RS, 24
RoHS and WEEE, 64

S

safety, 62
 distance, 62
sensitivity, 49
sleep, 47
supply
 connection, 13, 15, 43
 consumption, 47

T

technical parameters, 45

U

USB adapter, 25

