PPC-10G
PPC-10G HIGH POWER
PPC-10G 2+0

FOR FREQUENCY BANDS
71–76/81–86 GHZ
40.5–43.5 GHZ

INSTALLATION AND USER MANUAL
10 Gigabit Ethernet Wireless Link

For any request regarding this Manual, ccontact us by E-mail: sales@elva-1.com

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1. COPYRIGHT AND STATEMENTS

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1.3 Other Vendor Product Compatibility

While every effort has been made to verify operation of this product with many different communications products and networks, ELVA-1 makes no claim of compatibility between its products and other vendors' equipment. It is assumed that users have thoroughly evaluated this product's performance in the communications and other engineering environment in which it will be used.

1.4 Installation and Operation Precautions

The following general safety precautions must be observed during all phases of operation and service of the products will fully violates standards of design, manufacture, and intended use of the product. Elva-1 Microwave HB assumes no liability for the customer's failure to comply with these requirements.

• Do not operate wireless equipment without an appropriate termination.

• Do not work directly in front of energized antenna.

Prior to working on the antenna or RF assembly, ensure that the RF assembly is not radiating energy. When power is applied to the RF assembly and antenna, power precautions must be taken to avoid placing any part of the human body in front of the antenna.

• The outdoor equipment must be properly grounded to provide protection against voltage surges and built-up static charges. In the event of a short circuit, grounding reduces the risk of electrical shock.

For installations in the USA, refer to Articles 810830 of the National Electrical Code, ANSI/NFPA, for information with respect to proper grounding and applicable lightning protection for DC cables.

For installations in all other countries, implement protection in accordance with the safety standards and regulatory requirements of the country where the equipment is to be installed.

• Do not install or operate this equipment in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

• Do not install substitute parts or perform any unauthorized modification to the equipment. Changes or modifications not expressly approved by ELVA-1 Microwave HB or ELVA-1 OU, will void the Warranty on the equipment.

• This product is designed to withstand moisture conditions typically encountered when installed outdoors. This is not designed for operation under water.

• This product is not designed to withstand direct thunderbolt. It should be operated only under protection of external lightning rod.

• The Ethernet port must be protected with Ethernet surge protector, such as the ETH-SP-G2 DS or similar model.

• This product should be operated only from the type of power source indicated on the equipment or in this manual.

2. INTRODUCTION

2.1 PPC-10G LINK APPLICATIONS

The PPC-10G wireless link is intended for full duplex 10 Gigabit Ethernet radio communication between two locations. It is comprised of two subscriber transceivers, each operating under line-of-sight conditions at working frequencies within the 71/86 GHz or 40.5-43.5GHz radio bands.

This link is intended for point-to-point digital communications applications such as 4G/LTE/5G Mobile Backhaul, Corporate Campus Networks, IPTV, and Wireless ISP backbones. It is designed to wirelessly interconnect WAN/LAN segments that are located at sites with no fixed line broadband connection. Such sites typically contain landscape or industrial barriers, or strict ecological, geographical or climate restrictions for ground cable trenching, like deep-frozen soil Arctic regions, national parks, rivers, lakes, airport/railway areas, private land, etc.

Fig. 1 PPC-10G link at the point of installation

PPC-10G is available in either lightly licensed 71-76/81-86 GHz (E-band) or licensed 40.5-43.5 GHz (Q-band) or frequency formats. The radios are equipped with 60 cm (2 ft.) antennas by default; however, smaller antenna sizes are also available. The PPC-10G is normally mounted in a rooftop or tower location, and contains slots for SFP/SFP+ modules to connect to a LAN/WAN network.

The ELVA-1 PPC-10G is a fully-outdoor radio link, designed for temperature variations between -50°C (-58°F) and +60°C (148°F), and humidity up to 100%. The reliable operating distance is up to 10 km (6 mi) for links equipped with 60 cm antennas. This distance is valid for regions like North

America or continental Europe. For regions with clear weather year-round, like the Middle East, the distance would be much longer.

2.2 PPC-10G FEATURES

- Frequency band: 71-76/81-86 GHz or 40.5-43.5 GHz
- SNMP v.2; MIB-II; IP-MIB; IF-MIB and Enterprise MIB; WEB
- True Full Duplex Operation
- Hitless adaptive bandwidth, coding and modulation
- IEEE 1588v2 (TC)
- Encryption AES-128 optionally
- Solid reliability with Fiber-like Performance
- Easily installed, zero-footprint
- Compact Cassegrain type antennas
- Quasi-optical (laser-like) millimetre wave propagation
- EMI interference free

2.3 PRODUCT CODE FORMAT

Wide choice of modification of the radio are available, including

1. Basic 10Gbps PPC-10G link,
2. PPC-10G link with high-power transmitter,
3. PPC-10G link with built-in L2+ switch (not covered in this Manual),
4. PPC-10G link for 2+0 aggregated channels 20 Gbps.

There is possibility of combining some of these features in one radio by customer order.

To order the right model by its product code, please use the following encoding schema:

Fig. 2 PPC-10G product code legend (mind L2 link is not covered in this Manual)

For example, basic PPC-10G link with 2ft antennas, 71-76/81-86 GHz band has code PPC-10G-E-2ft.

- To have L2+ switch option please add "L2" to code.
- To have HP (High Power) option please add "HP" to code
- To have 2+0 aggregation option please add "/2+0" to code

Notes: For HP (High Power) radio, its central frequency is factory preset (not tunable by user), please advise its value at order.

2.4 Regulatory Information

Links installed in the U.S. must be registered with the FCC according to product ID assigned by the FCC to identify this wireless product in the market. The FCC chooses 3 or 5 character "Grantee" codes to identify the business that created the product.

ELVA-1 grantee code is 2AIXT, for PPC-10G radios FCC ID: 2AIXT-PPC-10G-E. The remaining characters of the FCC ID, -PPC-10G-E, are associated with the product model. These letters are chosen by the applicant.

For use in EU countries ELVA-1 PPC-10G 70/80 GHz 10Gbps MMW Link has been examined for compliance to 2014/53/EU Radio Equipment Directive (RED) at Washington Laboratories, Ltd.

To download FCC Certificate and Declaration of Conformity to 2014/53/EU Radio Equipment Directive (RED) please visit ELVA-1 web site at http://www.elva-1.com/downloads.

2.5 Link Management

An operator could manage PPC-10G link of any modification using its web-based interface. Basic information on web-based interface to start the link at first time is available in this manual.

To understand all PPC-10G features and wide range of built-in indicators and diagnostic tools please refer to PPC-10G Web Interface Manual. It is available any time on request to support@elva-1.com.

2.6 User Manual Notes

This Manual covers PPC-10G, PPC-10G-HP and PPC-10G/2+0 links.

The PPC-10G and PPC-10G-HP are identical in dimensions, controls, delivery kit and other appearance. Read all chapters excluding "Chapter 7" for assembling, installation and IP setup of PPC-10G and PPC-10G-HP links.

For PPC-10G/2+0 links assembling, installation and IP setup read all chapters, then pay attention to Chapter 7 which is especially devoted to PPC-10G/2+0 link.

3. DELIVERY KIT

3.1 DELIVERY KIT OVERVIEW

The PPC-10G equipment will arrive in 3 or more boxes, the sizes of which will depend on antenna diameter.

For all modifications of radios excluding "2+0", two of the boxes will contain the antennas and mounting/alignment brackets, and the other box will contain two transceivers and accessories (cables, connectors, tools, etc.), see Fig. 3.

For "2+0"modification, there is one more box with two additional transceivers inside, see Chapter 7 for details.

Fig. 3. Delivery package (typical)

Each antenna box will contain one antenna, an antenna cover and a mounting/alignment bracket. Depending on the antenna configuration, the alignment bracket could already be mounted to the antenna as a complete unit (Fig.4, left photo) or be enclosed in the box as separate accessory package (Fig.4, right photo).

Fig. 4. Antenna package

If the alignment bracket is enclosed in a separate accessory package, it must be assembled and mounted to antenna in accordance with the printed manual that is enclosed in the box.

The box with transceivers contains 3 smaller boxes inside. Two of them contain transceivers (Fig.5, left photo) and one with doubled kit of power units, cables, sockets, tools, RSL meter (Fig.5, right photo).

Fig. 5. Transceivers and accessories boxes

The factory recommends that the shipping boxes and packing materials be retained by the customer at least for the length of the warranty (12 months), or longer.

Table 1. Packing list for radios

Description	Quantity
Transceiver module	2 (4*)
600** mm antenna with radio-transparent radome and mount	2
Power Supply unit	2 (4*)
Diplexer with 6x hex. bolts (for 2+0 modification only)	2
Mounting kit (tools, accessories)	2

* For PPC-10G 2+0 modification Delivery Kit includes 4x Transceiver modules and 4x Power Supply units.

** Antenna size is shipped according to the customer order, 600 mm antenna is basic, while there is other size of 300 mm in diameter for short-range application.

This User Manual and Manual for Web Interface are usually delivered to customer via the Internet in electronic format.

3.2 Tools and Accessories in Mounting Kit

There are connectors, tools and cables within Mounting kit to easily install PPC-10G link.

Table 2. ACCESSORIES list

Description	Quantity
RSL meter unit	2
SFP-Plus-LR.LC.10 module	2 (4*)
Cable to 110-240 VAC main for ESP-240-54 Power Supply unit	2 (4*)
106059-7700 Fibre Optic Connector LC SM	2
130057-0003 Sealed Ethernet, RJ-45, Cable Connector	2
120071-0036 Micro-Change (M12) 4 Contacts Connector for power in	2
Hexagon Socket Bolt DIN 912 M8	8
Lock Washer DIN6798J A2 M8	8
6mm Metric Allen Wrench Key (hex key)	2
17 Ring & Open Ended Wrench	2

* For PPC-10G 2+0 modification Mounting kit only.

4. PREPARING THE SITE OF INSTALLATION

ELVA-1 assumes that customer personnel has an understanding of mm-wave wireless technology and sufficient familiarity with configuring and operating LAN/WAN networking equipment. Preferably, the personnel installing PPC-10G fully read and understood the information covered in this manual before performing any actions with the PPC-10G.

Before starting installation procedure, it is recommended to get familiar with its general sequence:

- Unpacking the PPC-10G and examining Delivery Kit
- Preparing both sites of installation (at both ends of wireless link)
- Mounting the PPC-10G
- Connecting the cables
- Aligning the antenna (for both transceivers)
- Performing initial link setup by web-interface.

4.1 UNPACKING THE PPC-10G AND EXAMINING DELIVERY KIT

It is recommended to unpack PPC-10G at a clean indoor place and examine all parts of delivery for any mechanical damage during transportation. Report any damages to ELVA-1 or your dealer.

Please mind that hanks of DC power cable, twisted pair cable and optical cable are not included to delivery kit and have to be purchased from local supplier accordingly to required length.

4.2 EXAMINING THE SITE OF INSTALLATION

The PPC-10G mm-wave wireless link requires a clear Line-of-Sight (LOS) for proper operation. That means that no obstacles, such as trees, buildings, chimneys, etc. can obstruct the LOS path between the transceivers. Moreover, no obstacles should be located in the vicinity of the signal propagation line (inside the first Fresnel zone).

Fig. 6. Examining LoS

Site planning should include an investigation into future construction that would block the LOS path, and other long term incremental obstructions such as growing trees.

However, it should be understood that due to the physics of the ray divergence process, the antenna radiation pattern is not an ideal thin straight line, but an elongated cone (with side lobes). Leaving practically from a point source (from the center of the antenna), the beam cone reaches a quite significant diameter to the opposite antenna about 30 m at a distance of 3 km, 60 m at 5

km and up to 100 m in diameter at a distance of 8 km and more. Accordingly, such a cone of the radiation pattern should also not touch any obstacles along the way by its edges.

Fig. 7. Antenna radiation pattern is an elongated cone with side lobes in reality

To ensure PPC-10G equipment is protected from vandalism and theft it must be mounted in a position that is accessible to only authorized personnel.

4.3 Path Planning

Use Google Maps or another geographical locating tool to obtain the distance between the proposed transceiver installation points.

Measurement of the link distance is important in calculating of the link availability and Receive Signal Level (RSL). The link distance measurement can be performed using Global Positioning System (GPS) device at proposed locations of the transceiver installation. Additionally GPS reading will be required in order to comply with the FCC registration process.

For estimated link availability and RSL value for your distance please refer to ELVA's online link budget calculator http://linkbudgetcalc.elva-1.com/. In case online calculator is not available, contact ELVA-1 or local dealer to obtain the exact attenuation value for distance between the transceiver. This value will be your "passport" reference value on the RSL meter device when conducting the final antenna alignment.

4.4 Minimal Clearance for Fresnel zone

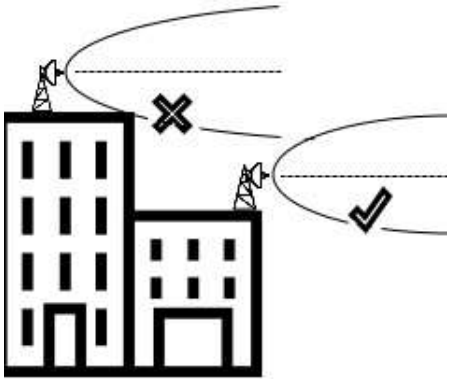


Fig. 8. Clearance in Fresnel zone

There must be no obstructions between the antenna and any on-site structure in the so-called first Fresnel zone. Any obstruction in the first Fresnel zone will corrupt the antenna pattern. In practice, the antenna should be mounted on the edge of a roof or on a mast, so it propagates the signal directly into free space.

Fresnel zones are series of concentric ellipsoids surrounding the straight-line path between two antennas. The radius of the Fresnel zone is greatest at midpoint in the signal path. Minimum Clearance (i.e., radius of the first Fresnel zone) for various bands is listed in the table.

Table 3. Fresnel zone min clearance

Path Length, miles/km	**Minimum Clearance for Fresnel zone**, ft/meters	
	Q-band 40.5-43.5 GHz	**E-band** 71-76/81-86 GHz
0,6 mi / 1 km	4,6 ft / 1,4 m	1,2 ft / 1 m
1,2 mi / 2 km	5,6 ft / 2 m	4,6 ft / 1,4 m
3,1 mi / 5 km	10,5 ft / 3,2 m	7,5 ft / 2,3 m
6,2 mi / 10 km	14,7 ft / 4,5 m	10,2 ft / 3,1 m

4.5 Supporting Structure for Transceiver

The radio should be fastened to a vertical support pole that is 51 to 114 mm in diameter and not less than 500 mm (20”) in vertical length. The design of the support structure is not specified, but its resistance to bending and torsion must be strong enough to prevent antenna movement in either azimuth or elevation by wind, snow cap or other natural force.

It is allowed to mount the radio to a horizontal pipe of 51 to 1114 mm diameter.

It is necessary to carefully monitor the polarization marks of the antenna, so that both transceivers are either in the vertical polarization or horizontal position.

Fig. 9. Photos of PPC-10G can be installed on vertical or horizontal pipe

4.6 Stationary Cabling on Installation Site

Before the transceivers with antennas can be installed, connecting cables must be run from the indoor network equipment (switch, for example) to the outdoor installation point at each site. Please mind the number of cables has to be doubled for 2+0 radio, see Chapter 7 for details.

A sample diagram of one transceiver installation layout is shown below. To avoid EMI noise, the low-voltage power supply and UTP data cables must be kept away from stationary 110-240 V AC

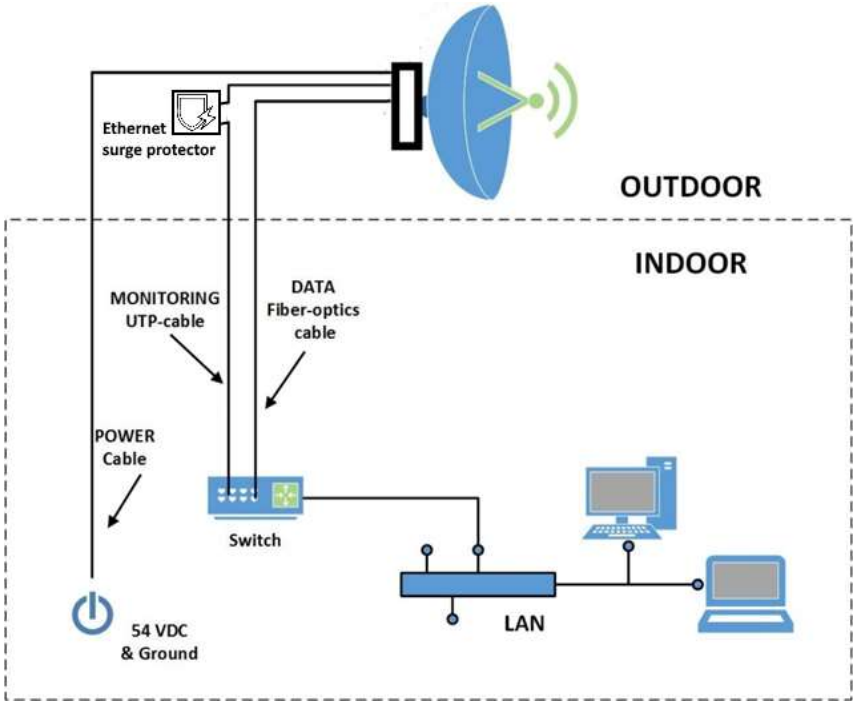


Fig. 10. Stationary cable layout diagram

The installation site should be inspected to determine the run paths for the fiber cable, twisted pair cable, DC power cable and grounding wire from the proposed radio location to the termination point. Locations for roof penetration should be identified. The routing and securing of all cables should conform to all applicable codes and requirements.

Cabling conduit may be required depending on the likelihood of damage due possible reasons. The maximum cable run length must not be exceeded as specified for type of the cable.

Unpack the Mounting Kit and get familiar yourself with connectors for each radio. They includes the following:

Fig. 11. Connectors in Mounting Kit for each PPC-10G radio (included to delivery)

1. RJ-45 Connector "MONITORING" for cable of WEB-monitoring
2. Power connector "POWER" for 36-60 V DC power cable
3. SFP/SFP + "DATA" connector for 10 Gbps data transmission cable

When installing cables outdoor, allow power and data cables with service loop for strain relief and proper fiber bend radius when determine the length of each cable.

TIP. It is possible to install a cross-connection box nearby of support pipe, install all stationary cables from indoor to this box, and then install short-length cables for power, UTP and fiber cables from this box to the transceiver. Please mind, the cross-connection box is not included to delivery and can be purchased locally.

Fig. 12. Cross-connection box with power, UTP and fiber cables to transceiver

- Install the power supply (PSU) in your chosen indoor location. Install 2-wire DC power cable from PSU directly to the radio or to cross-connection box (Fig.12).

- Connect the stationary DC power cable to the PSU

- Install supplied DC connector on the side of the radio for both radio positions. Use pin #1 or #2 for "+" red wire and pin #3 or #4 for "-" black wire. DC cable wire cross-section must be at least 1.5 mm2 (14 AWG). The normal PSU output voltage is 54 VDC. The voltage in DC cable at the port on the radio because of volt drop should be not less than level of 36 VDC.

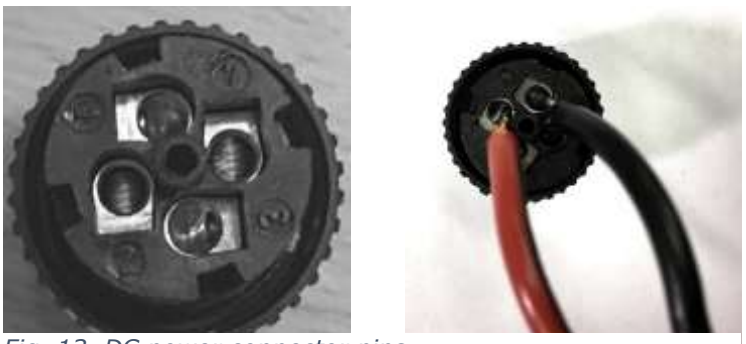


Fig. 13. DC power connector pins

- Install a 4-pair Twisted Pair cable from Indoor network equipment directly to the radio or to cross-connection box. Use water-proof connector from Mounting kit for last end of cable like on Fig. 12. Be sure that the UTP cable length from last active port to radio is less than 100 m.

- Install fibre optics cable from indoor network equipment directly to the radio or to cross-connection box. The radio is shipped with SFP+ module. Use water-proof connector from Mounting Kit like on Fig. 12.

- Install ground wire to the position of radio installation.

- Keep end of cables with installed connectors in a plastic bag or similar cover to prevent from dust and water before connecting them to radio transceiver sockets (see Fig.12, right photo).

Get familiar yourself with sockets on radio case.

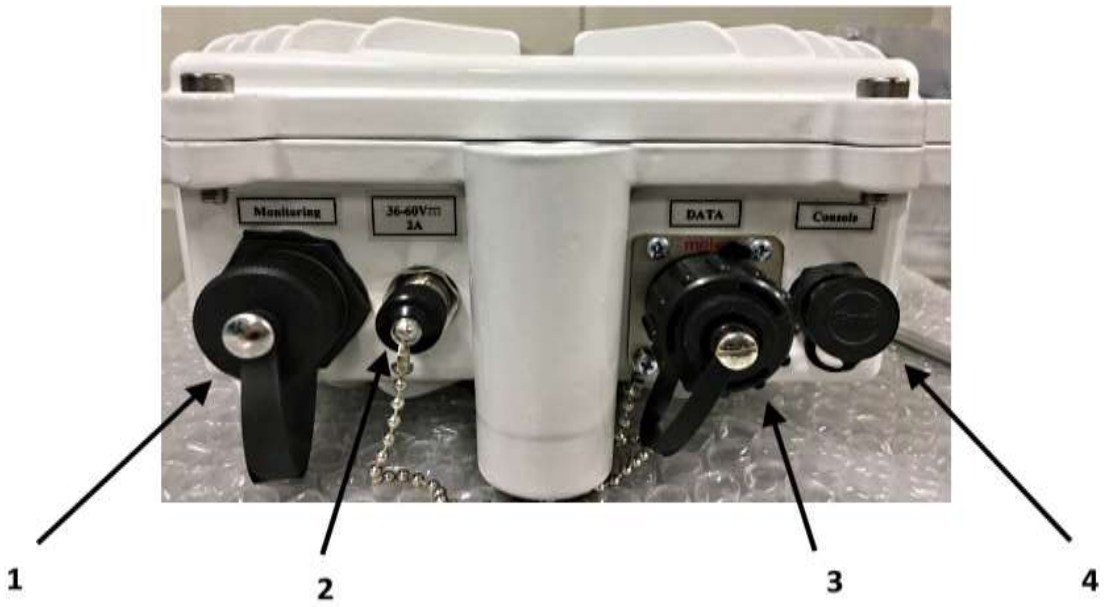


Fig. 14. Transceiver sockets (#1, #2, #3, #4)

1. RJ-45 socket "MONITORING" for UTP cable of WEB-monitoring
2. Socket for 36-60 V DC power cable
3. SFP/SFP + "DATA" socket for 10 Gbps data transmission cable
4. “CONSOLE” socket for RSL meter unit.

5. INSTALLATION OF TRANSCEIVER

- It is recommended to have 2 technicians at each site of transceiver installation with walkie-talkie radios or mobile phones.

- Binocular also is recommended for performing easy preliminary alignment of antennas.

- Windows-based laptop with RJ-45 port is recommended at each side for easy change between two modes of transceiver: Alignment or Operational during installation procedure (see section 5.3 and Chapter 6 for details).

- For installation of 2+0 radio please also read Chapter 7.

5.1 RADIO ASSEMBLING AND INSTALLATION SEQUENCE

- Bring the transceiver, antenna with alignment bracket, 4 mounting screws, allen wrench (hex key), metric open-end wrench and RSL meter to the outdoor points of installation at both sites of the link (see photo).

Fig. 15. Transceiver and tools at site of installation.

For quick radio installation, the following sequence of steps is recommended:

Fig. 16. It is more easy to put the antenna on top of the pipe than reassemble the mount to "hug" the pipe

• Make yourself familiar with the antenna alignment bracket (mount). It allows one to change the antenna's azimuth (horizontal) and elevation (vertical) angles. Use the printed manual to assemble the alignment bracket enclosed to the package onto the antenna, if necessary.

It is recommended that the threads of all bolts be lubricated upon assembly to protect them from corrosion and ease removal later.

• Install antenna with alignment bracket on the support pole, and point it to the approximate location of the opposite antenna. Use binoculars for performing more precise preliminary alignment of antennas.

It is possible to slide the alignment bracket over the top of the support pole (in case of vertical pipe), then tighten it in the appropriate position.

TIP. To prevent the mount with antenna from accidentally slipping down the vertical pipe and not getting antenna damaged, it is recommended to use a plastic tie strip, strongly tightening it on the pipe stand at the desired height below projected position of the mount. This tie strip will serve as an obstacle to move the mount down and will not allow it to slip below.

Fig. 17. A plastic tie strip tightening on the pipe stand will not allow the mount to slip down during installation procedure and thus prevents antenna from possible damage

- Remove protective tape from each transceiver and antenna waveguide slots. See photos below with red arrow pointing out to waveguide slots.

Fig. 18.. Remove protective tape waveguide hole on antenna and transceiver

- Check "H" and "V" polarization labels on antenna. "H" means horizontal polarization and "V" means vertical polarization. Check red label on the handle of the transceiver. This red label used

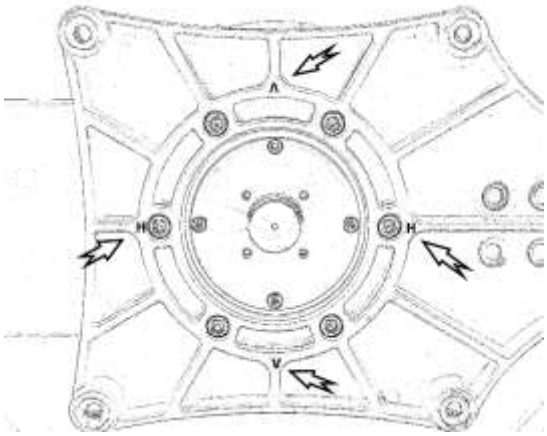


Fig. 19. Check for "H" and "V" polarization labels on antenna

to comply with chosen polarization. Red label has to be on top of mounted transceiver for vertical polarization and left or right side for horizontal polarization.

- When mounting transceiver to the antenna, choose "V" vertical polarization by default on both radios. In case of installing two parallel PPC-10G links from the same position, use vertical polarization on first link, and horizontal polarization on other link.

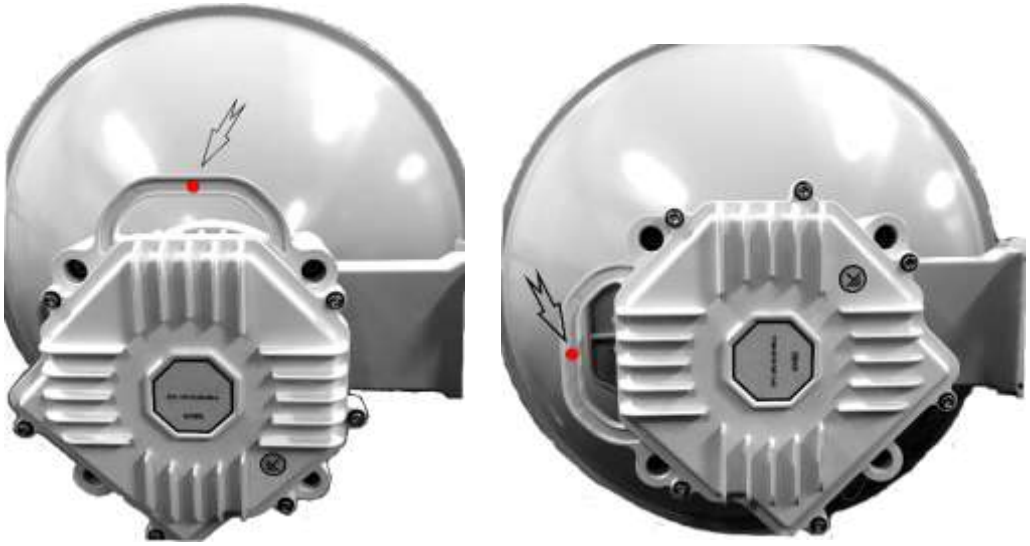


Fig. 20. Photo of V-polarization (left) and H-polarization (right) red label

- Mount each transceiver to its antenna with 4 mounting screws. Be sure that socket of radio are directed down, and not up. This is to get rain drops fall down from radio sockets easily.

TIP. Always be sure that socket of radio are directed down, and not up.

Fig. 21. Position of sockets to be directed down, not up

- Install grounding wire to the bolt nearby of the GROUND label as on photo.

Fig. 22. Grounding wire position

- Insert all connectors of power cable, UTP and Fiber optics cables into relevant sockets on transceiver marked as DC, MONITORING, DATA respectively. Insert RSL meter (aka attenuation meter) connector into CONSOLE socket on transceiver.

- Ask personnel at the indoor location to switch the 54 VDC power ON.

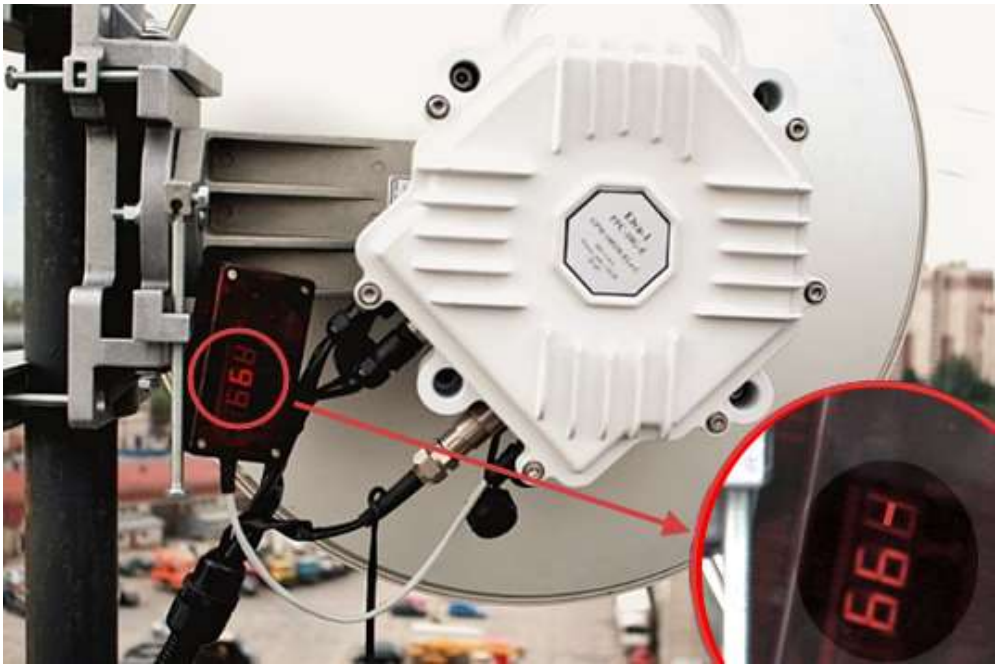


Fig. 23. RSL meter indicates -99.9 if the antenna is not aligned to opposite one

- Check if RSL meter is on. By default, it indicates "-99.9".

5.2 Final Antenna Alignment

For maximum throughput, the antennas must be aligned directly on the LOS. Please consider that antenna radiation pattern has main beam (central beam) and side lobes. The task is to aligned both antennas onto main beam, not side lobes (as throughput and operation distance at side lobes are low and unstable).

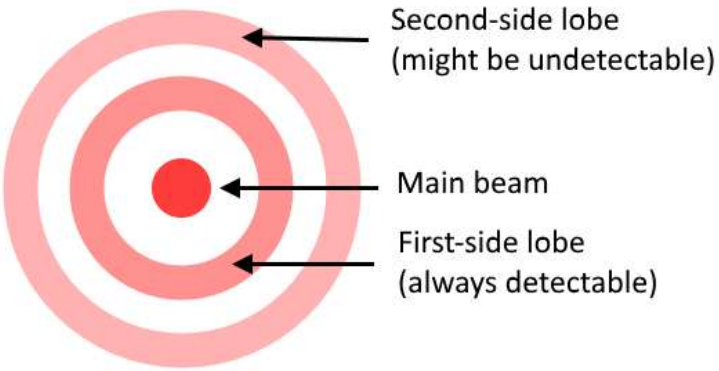


Fig. 24. Antenna radiation pattern has central beam and side lobes

Use the following procedures to accomplish this final alignment:

a. Place a technician with instructions on how to adjust antenna horizontal and vertical movement at each radio location, and designate the antenna at one location as A and the one at the other location as B. The technicians should have cell phone or other mobile communication availability to coordinate their antenna adjustments. Ideally, one person should also be in place at each radio's indoor power supply, with a means of communication to receive instructions to turn the power supply ON or OFF.

Fig. 25. The technicians should coordinate their antenna adjustments on both sides of the link

b. Using the vertical adjustment bolt on the radio mount, adjust Antenna A to an alignment that is noticeably below the LOS.

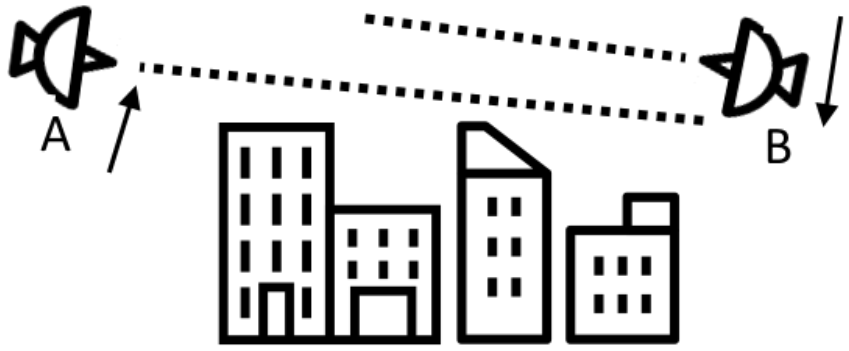


Fig. 26. Antennas A and B to an alignment that is above (B) and below (A) the LOS.

c. Using the same adjustment, adjust Antenna B to an alignment that is noticeably above the LOS.

Fig. 27. Check RSL meter indication when running alignment procedure

d. Turn power ON for both radios by turning on their indoor power supplies, and confirm that an RSL meter is connected to the CONSOLE socket of each radio and turned ON (initial meter reading should be -99.9),

Fig. 28. During antenna alignment, RSL indication should change from -99 to actual "RSL at alignment mode" value for your distance according Link Budget Calculator (see http://linkbudgetcalc.elva-1.com)

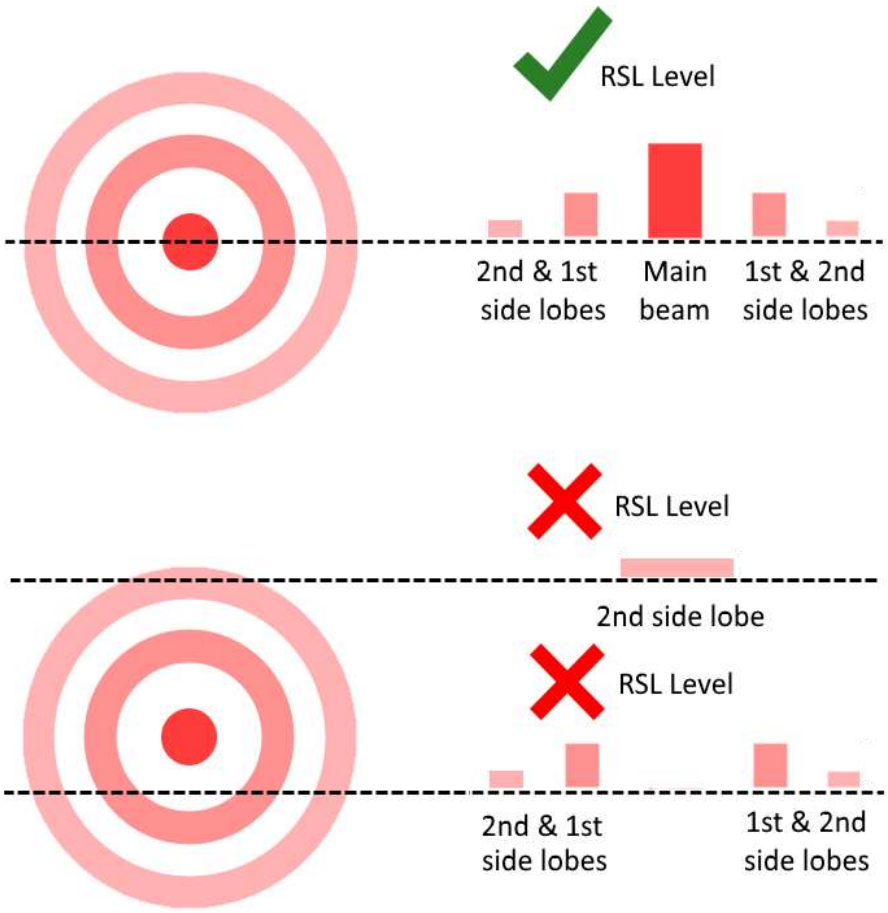


Fig. 29. Diagram for relevance of RSL meter indication to antenna side lobes

TIP. When make final antenna alignment, consider antenna radiation pattern has main beam (central beam) and side lobes as illustrated on Fig. 24, 29.

e. Using the vertical adjustment bolts, simultaneously move Antenna A up and Antenna B down in steps equivalent to one quarter-turn on their adjustment bolts. After each step, use the horizontal adjustment bolts to sweep Antenna A and Antenna B about 10° right and 10° left of the visual LOS center line. If a signal is noticed (a increase in the number on the RSL meters), stop the adjustment where the RSL meter number is highest. If no signal is detected, repeat Step "e" until the number increases on the RSL meter.

f. Adjust Antenna A horizontally and vertically to obtain the highest RSL meter number. See Fig.29 to understand how many RSL meter peaks could be seen on RSL meter.

g. After the initial signal acquisition, and best horizontal and vertical alignment (highest RSL meter number) on Antenna A, adjust Antenna B horizontally and vertically to obtain the highest RSL meter number for Antenna B.

h. Repeat Steps "f" and "g" to obtain the highest RSL meter numbers on both Antenna A and Antenna B.

i. At this point the expected RSL number should be displayed on both attenuation meters. If it is, lock both antennas in their final positions.

j. It is acceptable for the number displayed on the RSL meter to be as much as two points lower than the expected value. For example, if your expected RSL number is -45.0, but your RSL meter(s) displays -47.0 and you cannot achieve higher number of RSL, this is considered to be within normal tolerance.

k. Disconnect the RSL meters and cover the CONSOLE socket with the attached rubber cap. Confirm that all alignment bracket bolts are strongly secured in place. The outdoor link hardware is now ready for operation.

l. Check that all indoor connectors for UTP cable (MONITORING) and fiber optics cable (DATA) are plugged into relevant sockets of indoor network equipment such as a 10 Gigabit Ethernet Switch.

m. Flow Control (IEEE 802.3X) mode on 10 Gigabit Ethernet Switch must be enabled. **It is also required to switch the link from factory predefined Alignment mode to Operational mode (read Section 5.3 and Chapter 6)** to get the link ready for operation.

5.3 Understanding of Alignment and Operational Modes of Transceiver

All PPC-10G link modifications have adaptive to weather modulation feature implemented for better wireless channel availability. The PPC-10G link has two modes for signal transmitting, factory predefined Alignment mode and user defined Operational mode. At Alignment mode, link's adaptive modulation is **OFF** to help for antenna alignment procedure. At Operational mode link's adaptive modulation is **ON**. So, after the alignment procedure is complete, it is required to switch the link from factory predefined Alignment mode to Operational mode for normal operation of PPC-10G.

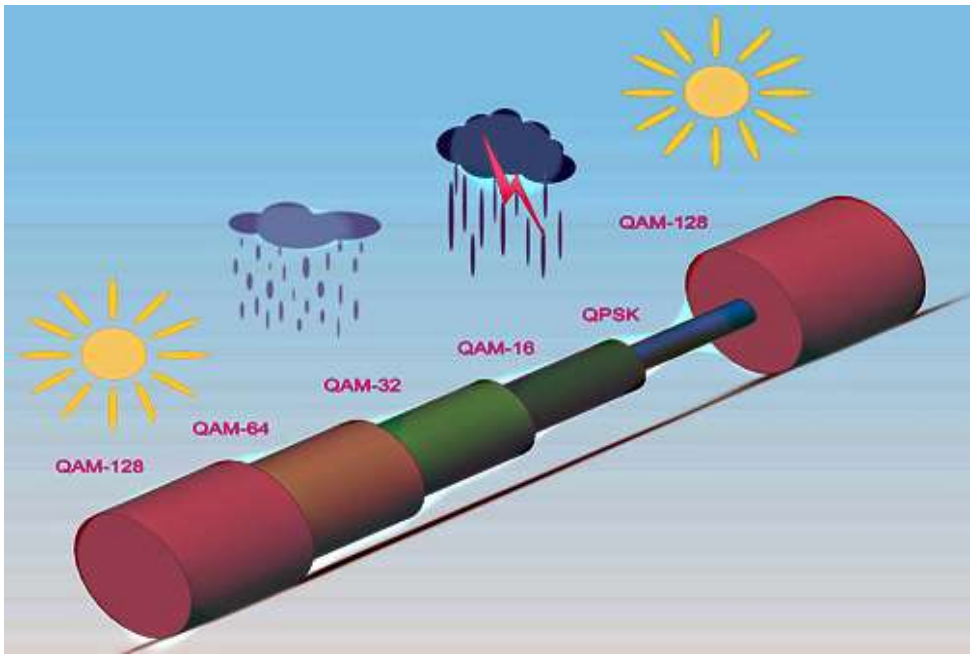


Fig. 30. Wireless channel throughput at different weather conditions for 70/80 GHz band when using adaptive modulation

During good weather conditions when the link's SNR (Signal to Noise Ratio) is high, operation at full capacity is enabled, reaching the maximum speed of 10Gbps. In case that the link`s SNR drops significantly (during heavy rain), the channel throughput will be reduced to keep the wireless channel connectivity alive.

6. Using Web Interface for First-Time Link Setup

6.1 Understanding Web Interface Connection to Radios

When PPC-10G transceivers are installed on both sides of the link, and cables from both radios are connected to LAN switch at each side of the link, PPC-10G radios can be accessed over LAN using the Web Interface by link's IP addresses (radios are GUI-enabled).

Any available web browser may be used, but Google Chrome is recommended. Desktop PCs, notebooks, tablets and smartphones are supported to get admin access to PPC-10G radios for either Windows, macOS/iOS and Android operating systems.

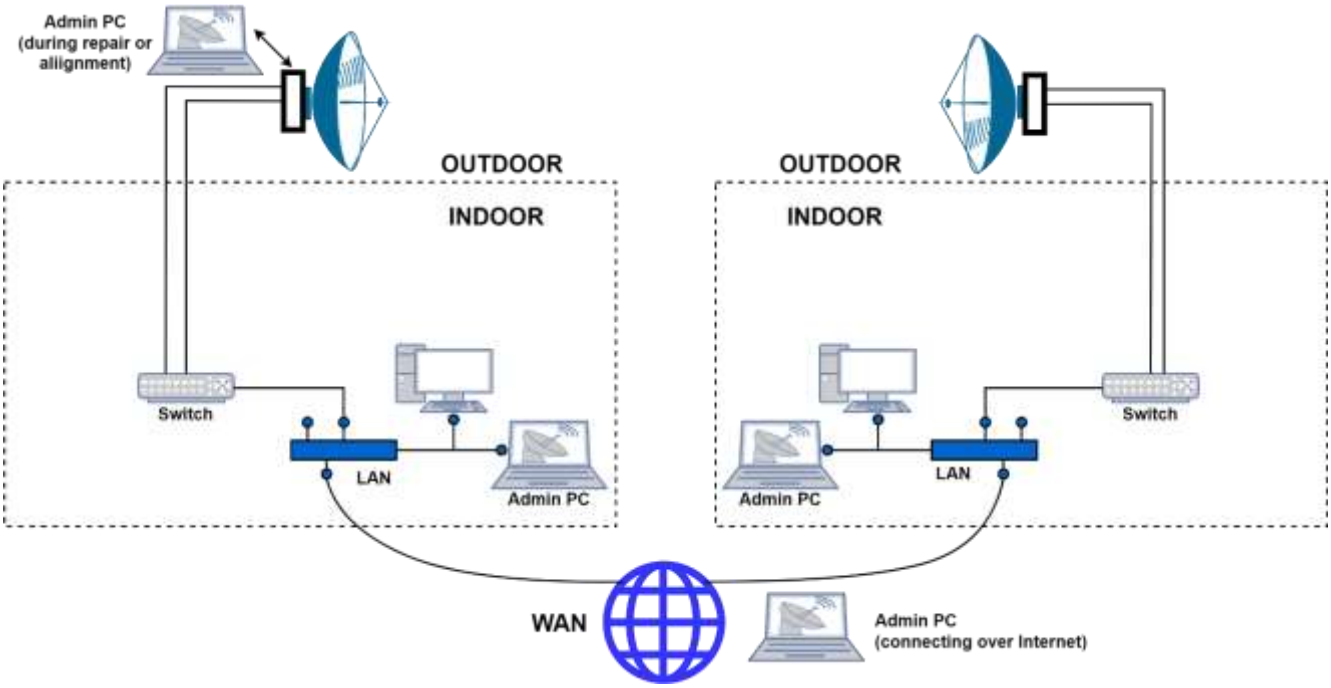


Fig. 31. PPC-10G radios LAN / WAN web access connectivity – over LAN at each side or over the Internet

By factory default, each transceiver has IP address for Web Interface access. These IP addresses are different – the transceiver named **Hi** has internal IP address 192.168.127.254, while **Lo** - 192.168.127.253.

What are Hi or Lo symbols mean? One radio of the link works in the higher part of the allocated frequency band and is called **Hi**, while another radio works in lower band and called **Lo**. There is label on the back of radio body with **Hi** or **Lo** symbols in the link abbreviation (see illustration below). To review which radio is Hi and which one is Lo, check label on the radio's body.

Fig. 32. Example of PPC-10G label with Hi symbols on the back of the radio body

The system administrator (aka Admin) could connect to each radio by its IP address in 3 ways:

1. Connect from Admin PC (PC, notebook or mobile device) to the radio while are in the same LAN segment as this radio.

2. Connect from Admin PC (PC, notebook or mobile device) to the radio over WAN (over the Internet). In this case Hi and Lo radios have to have static IP addresses accessed globally. Otherwise, Virtual Desktop technology could also be used for remote connection from Internet to a computer inside LAN, then running web browser on this computer and do all works as within LAN.

3. Directly connect from Admin PC (notebook with Ethernet port) to the radio by UTP cable from indoor (by a stationary UTP cable) or outdoor (by a temporary UTP cable). This way usually used only in some situations of initial installation of the link or at link repair works.

For way #3, can use UTP cable with RJ-45 connector that come from radio to indoor switch, just unplug it from switch and connect it to your notebook. You can also connect notebook to #1 MONITORING socket on the radio directly at place of installation (roof, tower, etc), using temporary twisted pair cable with RJ-45 connectors if needed (be sure radio's external Power Supply is ON to get access). Remember, default IP addresses are 192.168.127.254 for Hi radio, while Lo - 192.168.127.253.

6.2 First Time Connection to Radios at Both Sides of the Link

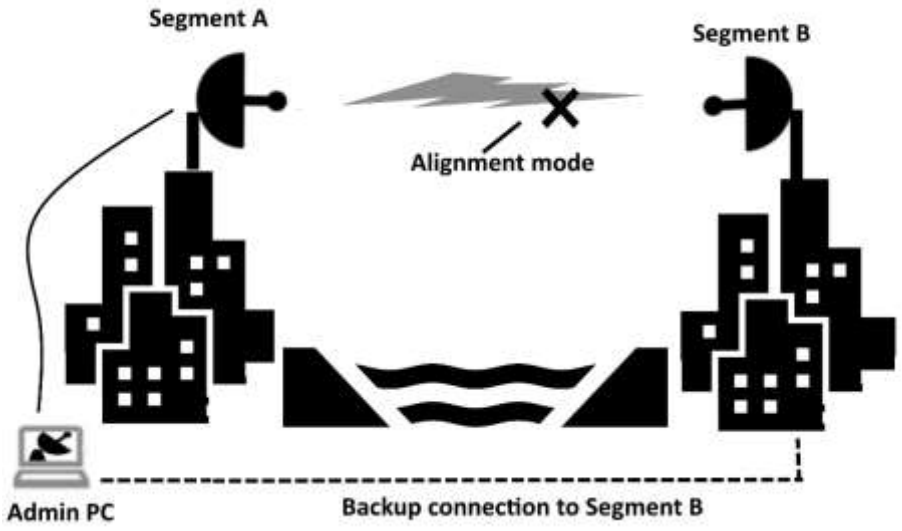


Fig. 33. Case of admin connection to both radios with backup channel

Please mind, until you switched both radios from Alignment mode to Operational mode using Web Interface, there will be NO wireless connection between radios in network segments A and B (see Fig.33). This means that Admin can get access to the radio on remote site only if there is any backup connection to LAN segment at remote site.

Otherwise, Admin required to personally come to the site of Segment B and connect to those radio at Segment B locally (Fig.34). This is "first time login" situation only. Later, with switched both radios into Operational mode and wireless connection between radios will be active, it is possible to connect to any radio from any point of LAN or WAN (including over the Internet).

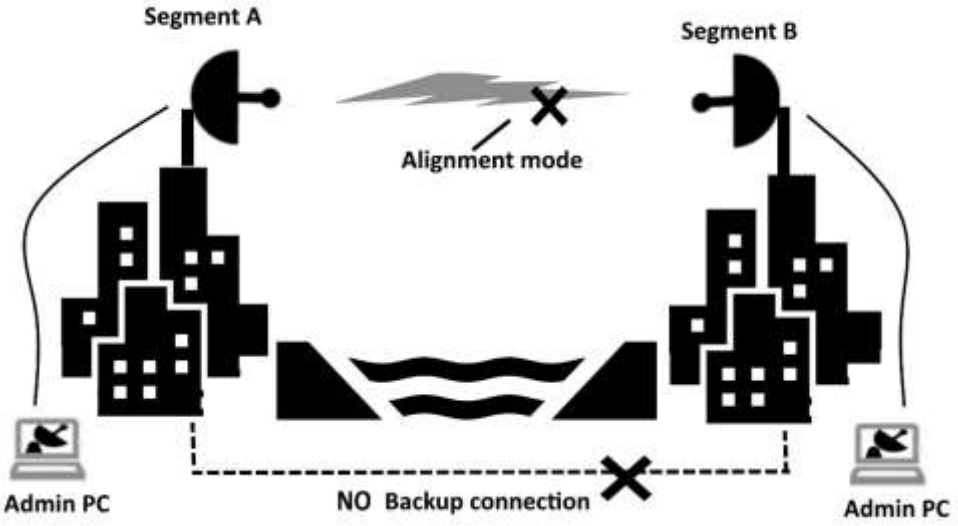


Fig. 34. Case of admin connection to each radio while there is NO backup channel

Be sure 192.168.127.254, 192.168.127.253 addresses are not occupied in your network by any other devices before first-time connection to radios by web interface. Otherwise, release these IP addresses temporary for the "first time login" to radios. In case if releasing of addresses is not possible, bring Admin notebook equipped with Ethernet RJ-45 port to nearby of LAN switch with MONITORING cable coming from the radio. Disconnect MONITORING cable from the switch and insert this cable RJ-45 jack into notebook's Ethernet port. Start web browser on the notebook and proceed as described below.

6.3 Login to Radios and Initial Setup

To connect to radio Hi and Lo by its IP address, enter it in browser's address line. Any available web browser may be used, but Google Chrome is recommended.

The factory default PPC-10G IP addresses are:
Hi Radio - 192.168.127.254, Lo radio – 192.168.127.253.

When you arrive at the web page, proceed as follows (Fig.35):
- Choose **Installer** from drop-down menu as the Access Level
- Enter the default password: **111111**

Installer is an Admin level access, and has rights to change parameters.
User is a reader level access, and has rights to only view parameters.

Please mind **Auto-Logout** because on Web Interface inactivity after 10 min.

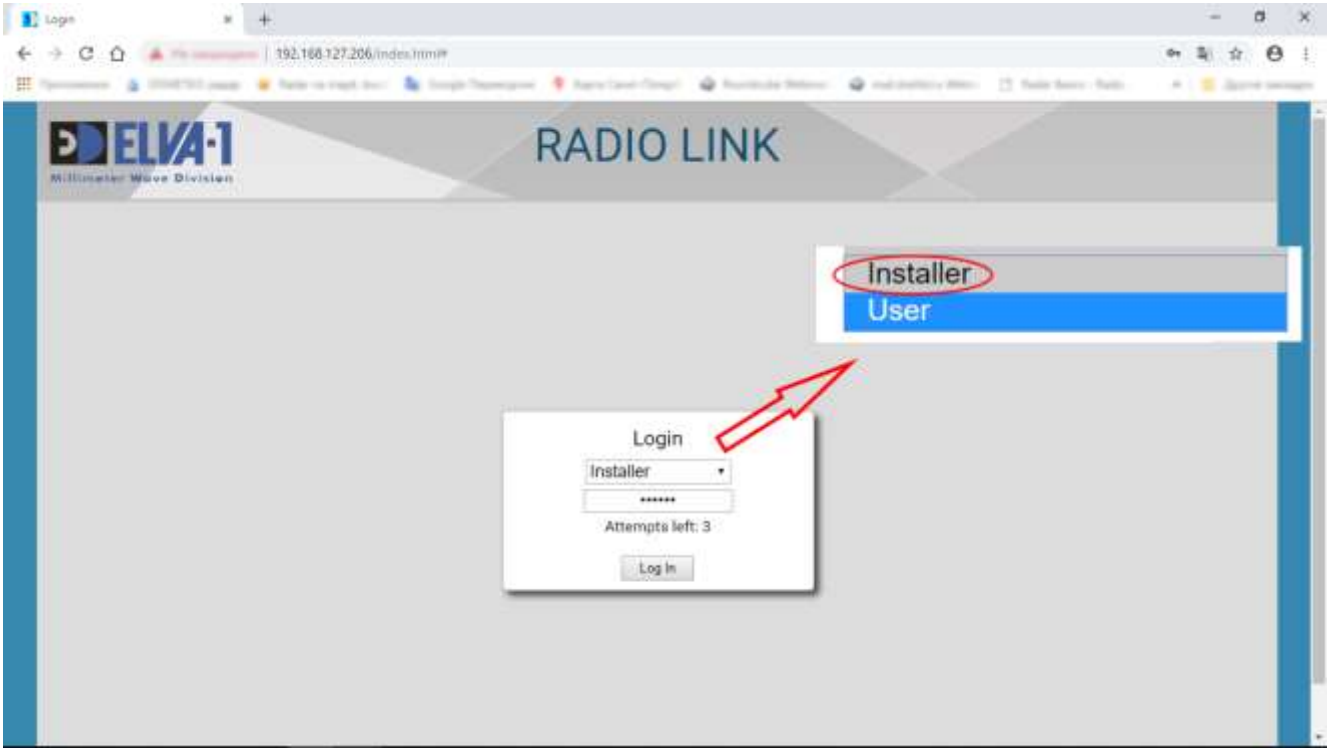


Fig. 35. Login as Installer with default password 111111

- When enter to the radio Web Interface page (Fig.33), press the **Operational** radio button in the window. Then press the **Save and Reboot** button and wait until the transceiver restarts. The normal wireless data transmission mode is now activated, but only for this radio – to fully activate main data channel, you need to repeat this procedure for second transceiver as well.

Fig. 36. Press the Operational radio button

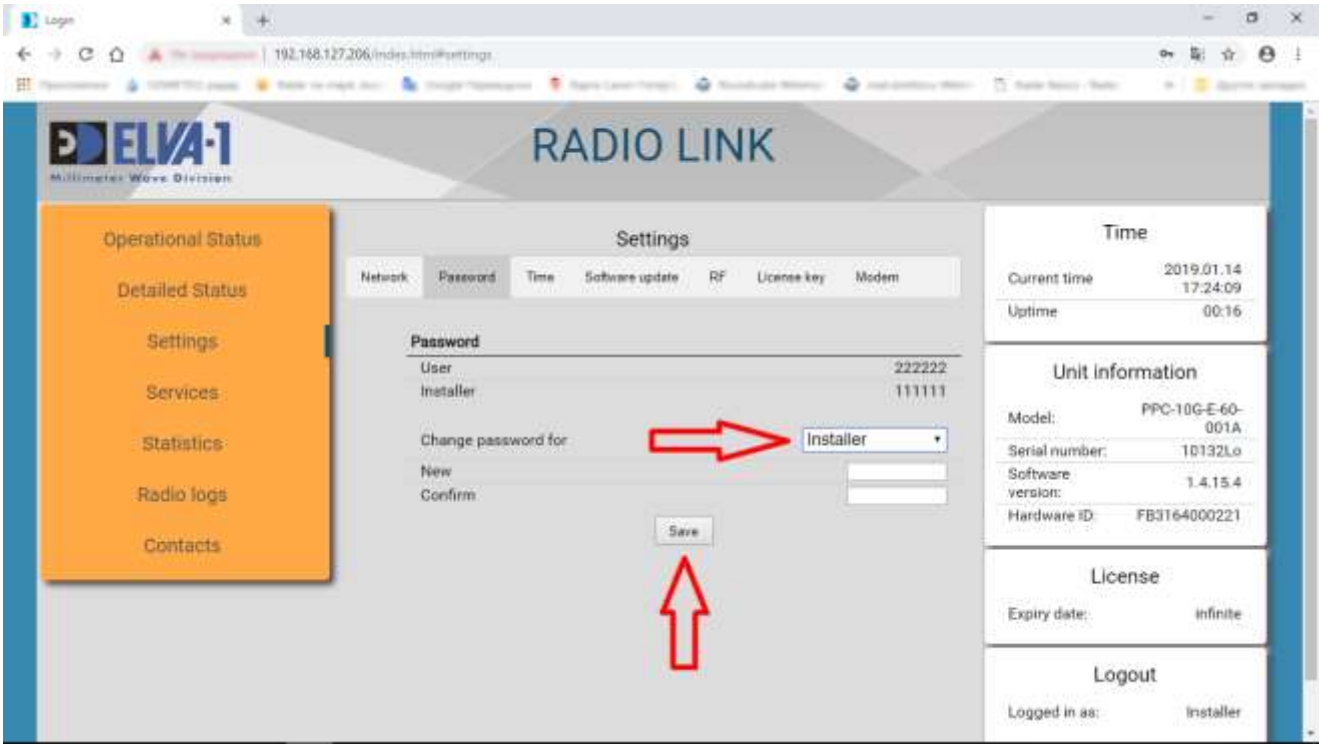


Fig. 37.Change password for Web Interface access to this radio

- Change password for Web Interface access to this radio (Fig.37). For this, choose **Settings** on left menu, then **Password** tab at top. Enter new password, retype it, then click **Save and Reboot** button. Use only Latin characters and digits, 6 - 20 symbols long.
It is possible to change password for both **Installer** and **User** roles here.

- Save new password in a protected local file or cloud storage, otherwise just write down on the paper book. Don't forget to mark this password is valid for Hi or Lo radio.

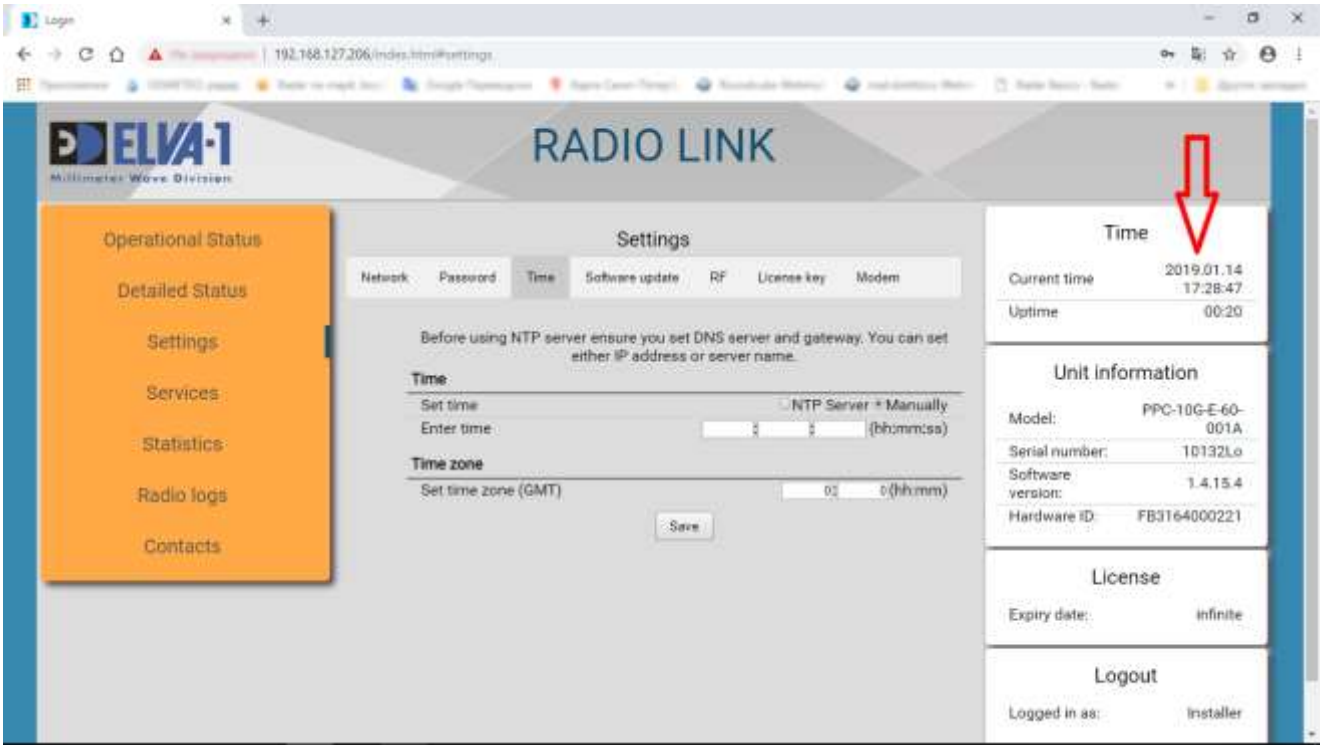


Fig. 38. Check and if necessary adjust actual time settings for the radio

- Set the time for radio to actual local time. You can set time manually or from NTP Server (NTP server requires setting DNS and Gateway at IP Settings tab). By default, "UTC 0" time zone is used. For this, choose **Settings** on left menu, then **Time** tab at top. Adjust hours and minutes to local time, then click **Save** button (Fig.38).

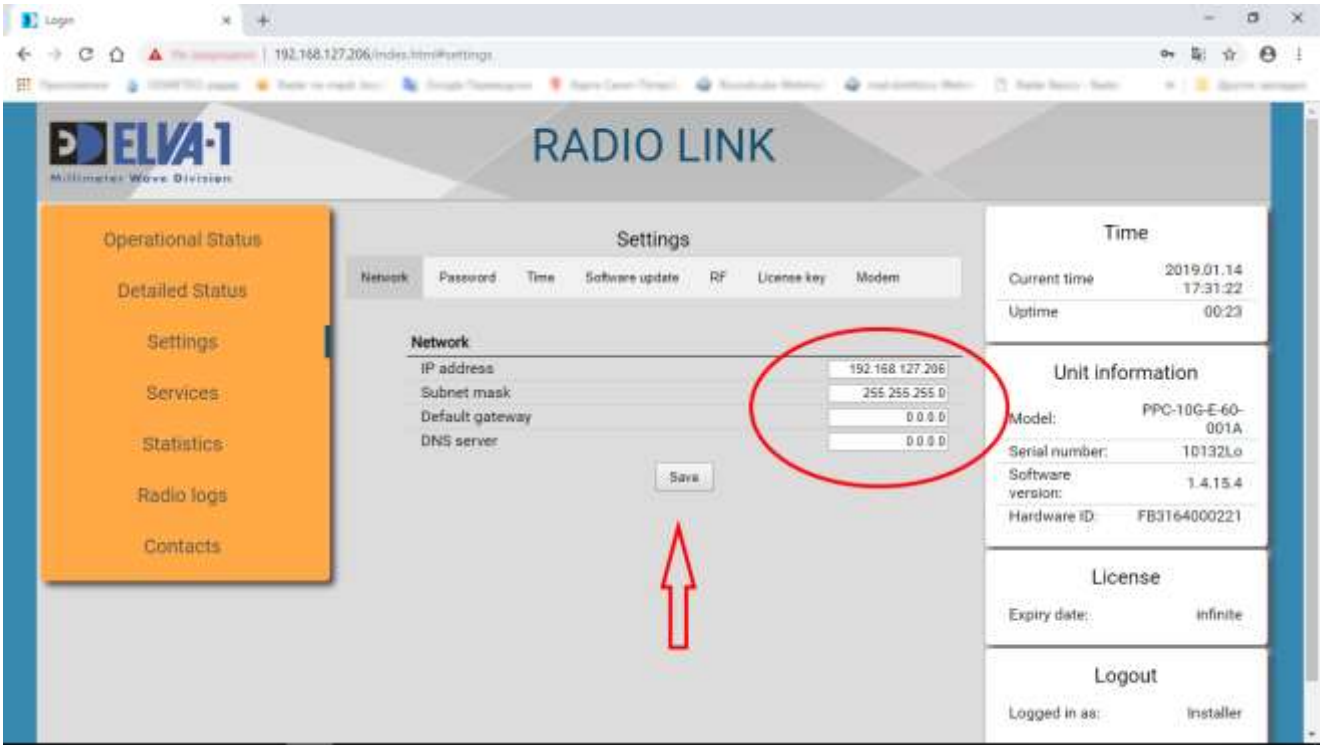


Fig. 39. Change IP address of the radio from default to actual one

- Change IP address of this radio from default to actual one. For this, choose **Settings** on left menu and **Network** tab at top (Fig.39). Enter the IP parameters of your choice (could use default Mask 255.255.255.0 and default Gateway 0.0.0.0). Click **Save** button.

- Save new IP address in the protected file or cloud storage, otherwise just write down on the paper. Don't forget to mark this address valid for Hi or Lo radio.

After you entered new IP address, this Web Interface session will be finished with "Not found" page. To login to the radio next time, use new actual IP address in the browser address bar and new actual password.

TIP. If you have backup network connection to LAN segment where another radio is installed (Fig.33), repeat right now all steps you did in this section, login to and setup another radio. Otherwise come to another LAN segment (Fig. 34) or delegate this task to another admin and repeat all steps there. The main data channel will be automatically ON when both radios will be switched into **Operational** mode.

In case of forgotten password please contact your supplier's technical support. They will restore factory default password, so you can change it to actual one again. Letter of Authorization may be required from your CEO or CIO to confirm this request for password recovery.

From now, the initial PPC-10G setup is complete. To get familiar with all Web Interface menus and tabs, proceed to another document, called Web Interface Manual.

7. 2+0 Link Assembling, Installing and Setup

7.1 PPC-10G 2+0 Unpacking

PPC-10G 2+0 equipment will arrive in 4 boxes. The first two boxes contain transceivers of the upper and low frequency ranges and accessories (cables, connectors, tools, etc.). The each box contains 3 smaller boxes inside with transceivers and one small box with doubled Mounting Kit of power units, cables, sockets, tools, RSL meter.

Fig. 40. 2+0 package with transceivers and accessories

Fig. 41. 2+0 package with antenna and dual polarization adapter

As for other PPC-10G link modification, it is recommended to store packaging materials for 12 month of link warranty.

For list of components in delivery package see Table 1 and Table 2.

For information on transceiver sockets and connectors see Fig.11 – Fig.14.

7.2 Assembling and Installation of 2+0 Link

Mind 2+0 link is a combination of two independed transceivers which share the same antenna. It is strongly recommended to read Chapters 5 and 6 of this Manual before starting any works on installation of PPC-10G 2+0 link.

- Get yourself familiar with all parts in 2+0 delivery. Assemble transmitter and receiver with diplexer (dual polarisation adapter, DPA). Use 4 mounting screws and hex key. Attach the blocks so that the sockets on transceivers are pointing down. Look at arrow "UP" label like on Fig.42.

- Make two such assemblies. Be careful when assembling transceivers to dual polarisation adapter, it is necessary to observe polarization. Look at "<-V H->" label like on Fig.43.

Fig. 42. Two transceivers assembled with dual polarisation adapter

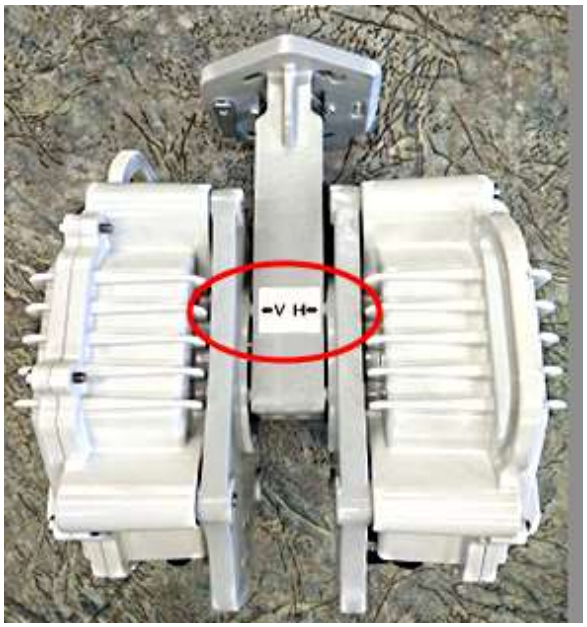


Fig. 43. Mind polarisation label on DPA

- Install doubled number of stationary cables (see. Section 4.6) as 2x power cables, 2x UTP and 2x fiber optics cables at each side of the link.

- Install antenna with mount on the supporting pipe as described in Chapter 5 and point it to the approximate location of the opposite antenna. Use binoculars for performing more precise preliminary alignment of antennas.

Fig. 44. Install 3 bolts on positions of "5, 15 and 35 minutes" on the antenna flange

- Install 3 bolts on positions of "5, 15 and 35 minutes" on the antenna flange (Fig. 44). Do not screw them strongly into antenna flange. These bolts will serve like hooks for diplexer.

- Put on the diplexer with pre-screwed two transceivers on 3 bolts like on hooks and rotate to prevent diplexer from fall down.

- Install other 3 bolts with washers on positions "25, 45 and 55 minutes" on the antenna flange. Now there are all 6 bolts with washers on place.

Do not allow the appearance of an uneven gap between the antenna and the diplexer.

Fig. 45. Use 6 bolts to screw diplexer to antenna flange

Fig. 46. Do not allow the appearance of an uneven gap between the antenna and the diplexer

The diplexer must be connected to the antenna without twisting. See the marks in the photo Fig.47 (are indicated with arrows.). If required, adjust the diplexer rotation using the element marked by red oval.

Fig. 47. Adjust the diplexer rotation using the element marked by red oval

Strongly tighten all 6x mounting bolts between antenna and diplexer.

7.3 ANTENNA ALIGNMENT FOR 2+0 LINK

- Insert all cables to both transceivers at both sides of the link, switch the power ON for all four transceivers.

- Insert RSL meter to transceiver with vertical (V) polarisation at both sides of the link.

- Proceed antenna alignment like in Section 5.2.

- Disconnect the RSL meter from "V" transceiver at both sides of the link and cover the CONSOLE socket with the attached rubber caps.

- Insert RSL meter to transceiver with horizontal (H) polarisation at both sides of the link. Check RSL meter indication. It should be about the same as RSL meter indication for "V" transceiver that seen before. If it is not, check the bolts and marks for rotation of the diplexer relatively to antenna flange.

- Disconnect the RSL meter from "H" transceiver at both sides of the link and cover the CONSOLE socket with the attached rubber caps.

The installation and alignment procedure is now complete.

7.4 LOGIN TO 2+0 RADIOS AND INITIAL SETUP

Mind 2+0 link as a combination of two 1+0 links which just share the same antenna, so run IP setup for each pair of transceivers (pair in "V" polarisation and pair in "H" polarisation) independently.

Use the following IP addresses:

Hi Radio #1 - 192.168.127.254,
Lo Radio #1 – 192.168.127.253

Hi Radio #2 - 192.168.127.254,
Lo Radio #2 – 192.168.127.253.

- Login to first pair of radios (does not matter - pair in "V" polarisation or pair in "H" polarisation) and run initial setup as described in Section 6.3.

- Release 192.168.127.254, 192.168.127.253 to make them not occupied for setup of second pair of radios, and repeat setup procedure as described in Section 6.3 for second pair of radios.

8. MAINTENANCE AND TROUBLESHOOTING

PPC-10G has been designed to require practically zero periodic maintenance. However, each radio of the link should be periodically inspected for visible damage or excessive accumulation of dirt. Use a brush or sponge with water to clean antenna and transceiver. When run cleaning procedure, do not stand in front of the energized antenna if transceiver power is ON.

In case of a complete or partial communication failure, please perform the following checklist:

1. Make a visual inspection of the radios for mechanical integrity of and between the transceiver and antenna, and check to be sure that the cable joints are reliable and no unauthorized objects are on the antennas. Remove dust or snow from antennas if necessary.

2. Check the signal propagation line (LOS) to be sure that no obstacles like buildings, cranes, electric lines, trees have appeared in it or its vicinity. If necessary, remove the obstacle or change the radio position.

3. Make sure of that the radio is receiving power from the power supply:

- Measure voltage at radio end of power cable while PSU is on.
- The power supply voltage should be between 36 and 60 VDC. If it is not, clear the fault of the power supply source or use a thicker gauge wire for a smaller voltage drop.

4. Make sure of that the UTP and optical cables are transporting data to/from the radios.

5. Connect RSL meter, and check the value. The RSL should correspond to the value given in the calculation for actual distance. If it does not, find and correct the cause.

Possible causes of low RSL reading:

- Precipitation along the signal propagation line. Wait until the clear weather and repeat the measurements.
- Obstacles on the signal propagation line. Remove them or change the position of the radio.
- Alignment disturbance (could happen occasionally after very strong wind or because of ice buildup during winter). Re-align the antennas.
- Transceiver failure.

If the radio still does not operate properly, measure and write down RSL, make WEB screenshots and copy last log files, then contact your supplier.

ELVA-1 Service Center email:

support@elva-1.com or sales@elva-1.com

9. APPENDIX A

9.1 PPC-10G SPECIFICATIONS

Model	PPC-10G-E	PPC-10G-Q
Frequency range	71-76/81-86 GHz (E-band)	40.5-43.5 GHz (Q-band)
Throughput	Up to 10 Gbps Full duplex	Up to 7.2 Gbps Full duplex
Channel Bandwidths Available	250/ 500/ 750 / 1000 / 1250 / @E-band 1500 / 2000 MHz	
Modulation	QAM-256 to BPSK Adaptive to weather with hitless adaptive bandwidth, coding and modulation	
MTBF	150 000 hours	
Central frequency	Tunable 71-76GHz for Hi ODU, 81-86GHz for Low ODU at 125 MHz /31.25 MHz steps	
Max Distance at max throughput	up to 20.0 km (12.4 miles) with 2ft antennas at clear sky	up to 20.0 km (12.4 miles) with 2ft antennas at clear sky
Max output power	17 dBm (50 mW) at QAM 128 / 20 dBm (100 mW) at QPSK/BPSK	
Link budget with 2ft antennas BPSK/QPSK modulation @ 10^{-9} BER	200 / 197dB @250MHz 197 / 194dB @500MHz 195 / 192dB @750MHz 194 / 191dB @1000MHz 193 / 190dB @1250MHz 192 / 189dB @1500MHz 191 / 188dB @2000MHz	186 / 183dB @250MHz 183 / 180dB @500MHz 181 / 178dB @750MHz 180 / 177dB @1000MHz 179 / 176dB @1250MHz

Max throughput	1330Mbps @250MHz	2660Mbps @500MHz	3750Mbps @750MHz	5200Mbps @1000MHz	7200Mbps @1250MHz	7630Mbps @1500MHz	9980Mbps @2000MHz

Management	SNMP v.1; v.2; MIB-II and proprietary MIB; WEB GUI; Telnet; CLI
Ethernet Interface	1 × SFP/SFP+ slot (1000Base-X, 10GBase-LR/SR)
Encryption	AES 128 Optionally
Ethernet	Transparent for Ethernet services, Flow Control 802.3x PTP IEEE 1588v2 (TC) support
Management Port	100 Base-Tx (RJ – 45)
Forward Error Correction	LDPC; Reed Solomon
Polarization	Vertical / Horizontal

Antenna

Antenna Type	Cassegrain type antenna with radio-transparent radome	
Antenna Gain/Beamwidth	71-76/81-86 GHz (E-band)	40.5-43.5 GHz (Q-band)
- 1ft antenna	45 dB/0.7°	38 dB/1.5°
- 2ft antenna	51 dB/0.35°	44 dB/0.7^0

Power / Environment

Power Supply AC	Input 88-132 / 176-264 Volts, 50/60 Hz
Transceiver Power Consumption (for one radio)	45 W (+60 W when heater is switched on)
DC Power	36 to 60 Volts DC
Power Connection	IP-67
Operational Temperature	-50^{0}C to +60^{0}C / -58^{0}F to 140^{0}F
Humidity	Up to 100%

Physical dimensions

Outdoor unit size w/o antenna	246 x 246 x 110mm
Weight (ODU w/o antenna)	4 kg max
Complete set	2 radios with antennas + 2 indoor power supplies

9.2 PPC-10G-HP SPECIFICATIONS

Model	**PPC-10G-E-HP**	**PPC-10G-Q-HP**
Frequency range	71-76/81-86 GHz (E-band)	40.5-43.5 GHz (Q-band)
Throughput	Up to 10 Gbps Full duplex	
Channel Bandwidths Available	250/ 500/ 750 /1000 /1250 /1500 /2000 MHz	
Modulation	QAM-256 to BPSK Adaptive to weather with hitless adaptive bandwidth, coding and modulation	
MTBF	150 000 hours	
Max distance at max throughput	up to 24.0 km (15 miles) at clear sky with 2ft antennas	
Max output power	24.7 dBm (295 mW) at QPSK/BPSK	
Link budget with 2ft antennas, BPSK modulation @ 10^{-9} BER	208 dB @250 MHz 205 dB @500 MHz 203 dB @750 MHz 202 dB @1000 MHz 201 dB @1250 MHz 200 dB @1500 MHz 199 dB @2000 MHz	190 dB @250 MHz 187 dB @500 MHz 185 dB @750 MHz 184 dB @1000 MHz 183 dB @1250 MHz

Max throughput	1330Mbps @250MHz	2660Mbps @500MHz	3750Mbps @750MHz	5200Mbps @1000MHz	7200Mbps @1250MHz	7630Mbps @1500MHz	9980Mbps @2000MHz

Management	SNMP v.1; v.2; SNMPv2-MIB and proprietary MIB; WEB GUI; Telnet; CLI
Encryption	AES 128 Optionally
Ethernet Interface	1 × SFP/SFP+ slot (1000Base-X, 10GBase-LR/SR)
Ethernet	Transparent for Ethernet services, Flow Control 802.3x PTP IEEE 1588v2 (TC) support
Management Port	100 Base-Tx (RJ – 45)
Forward Error Correction	LDPC; Reed Solomon
Polarization	Vertical / Horizontal

Antenna

Antenna Type	Cassegrain type antenna with radio-transparent radome	
Antenna Gain/Beamwidth	71-76/81-86 GHz (E-band)	40.5-43.5 GHz (Q-band)
- 1ft antenna	45 dB/0.7°	38 dB/1.5°
- 2ft antenna	51 dB/0.35°	44 dB/0.7^0

Power / Environment

Power Supply AC	Input 88-132 / 176-264 Volts, 50/60 Hz
Transceiver Power Consumption (for one radio)	45 W (+60 W when heater is switched ON)
DC Power	36 to 60 Volts DC
Power Connection	IP-67
Operational Temperature	-50^0C to $+60^0$C / -58^0F to 140^0F
Humidity	Up to 100%

Physical dimensions

Outdoor unit size w/o antenna	246 x 246 x 110mm
Weight (ODU w/o antenna)	4 kg max
Delivery set	2 radios with antennas + 2 indoor power supplies

9.3 PPC-10G /2+0 SPECIFICATIONS

Model	**PPC-10G-E 2+0**	**PPC-10G-E-HP 2+0**
Frequency range	71-76/81-86 GHz (E-band)	
Throughput	2x 10 Gbps Full duplex	
Channel Bandwidths Available	250/500/750/1000/1250/1500/2000 MHz	
Modulation	QAM-256 to BPSK Adaptive to weather with hitless adaptive bandwidth, coding and modulation	
MTBF	150 000 hours	
Central frequency	Tunable 71-76GHz for Hi ODU, 81-86GHz for Low ODU at 125 MHz /31.25 MHz steps	
Max Distance @10Gbps at clear sky	up to 20.0 km (12.4 miles)	Up to 24.0 km (15 miles)
Max output power	17dBm (50 mW) at QAM 128 20 dBm (100 mW) at QPSK/BPSK	24.7dBm (295 mW) at QPSK/BPSK
Link budget with 2ft antennas BPSK/QPSK modulation @ 10^{-9} BER	200 dB @250 MHz 197 dB @500 MHz 195 dB @750 MHz 194 dB @1000 MHz 193 dB @1250 MHz 192 dB @1500 MHz 191 dB @2000 MHz	206 dB @250 MHz 203 dB @500 MHz 201 dB @750 MHz 200 dB @1000 MHz 199 dB @1250 MHz 198 dB @1500 MHz 197 dB @2000 MHz

Max throughput	1330Mbps @250MHz	2660Mbps @500MHz	3750Mbps @750MHz	5200Mbps @1000MHz	7200Mbps @1250MHz	7630Mbps @1500MHz	9980Mbps @2000MHz

Management	SNMP v.1; v.2; SNMPv2-MIB and proprietary MIB; WEB GUI; Telnet; CLI
Encryption	AES 128 Optionally
Ethernet Interface	2x (1x SFP/SFP+ 1x slot 1000Base-X, 10GBase-LR/SR)
Ethernet	Transparent for Ethernet services, Flow Control 802.3x PTP IEEE 1588v2 (TC) support
Management Port	100 Base-Tx (RJ – 45)
Forward Error Correction	LDPC; Reed Solomon
Polarization	Vertical / Horizontal

Antenna

Antenna Type	Cassegrain type antenna with radio-transparent radome	
Antenna Gain/Beamwidth	71-76/81-86 GHz (E-band)	40.5-43.5 GHz (Q-band)
- 1ft antenna	45 dB/0.7°	38 dB/1.5°
- 2ft antenna	51 dB/0.35°	44 dB/0.7^0

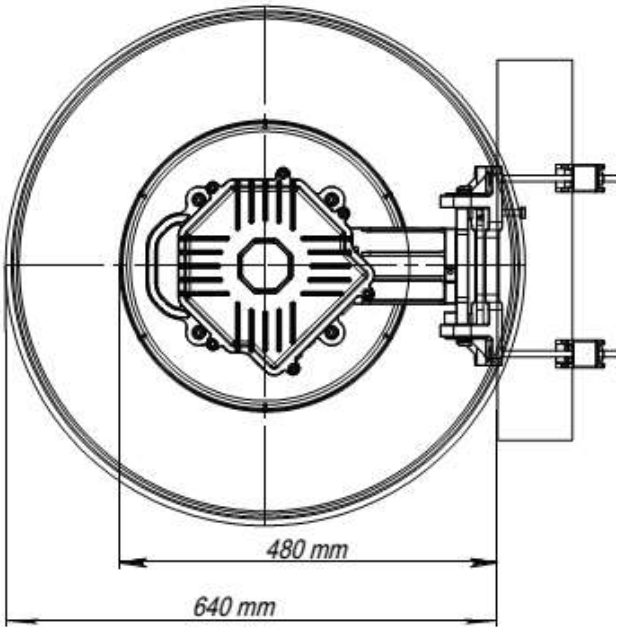
Power / Environment

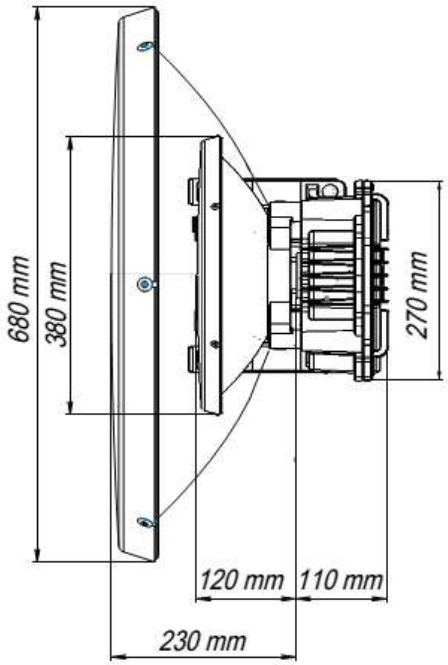
Power Supply AC	Input 88-132 / 176-264 Volts, 50/60 Hz
Transceiver Power Consumption (for two radios at one side of the link)	90 W (+120 W when heater is switched on)
DC Power	36 to 60 Volts DC
Power Connection	IP-67
Operational Temperature	-50^{0}C to +60^{0}C / -58^{0}F to 140^{0}F
Humidity	Up to 100%

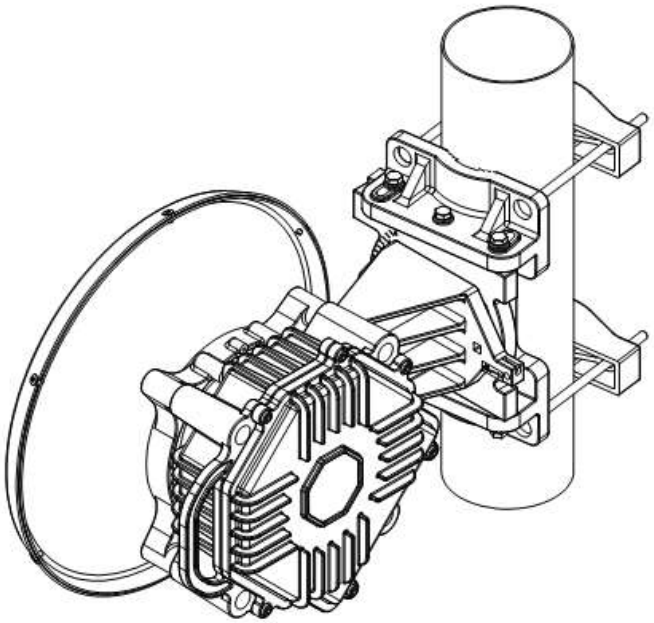
Physical dimensions

Outdoor unit size w/o antenna	246 x 246 x 110mm
Weight (ODU w/o antenna)	8 kg
Complete set	4 radios with 2 antennas + 2 indoor power supplies

9.4 PPC-10G / PPC-10G-HP DRAWING







9.5 PPC-10G / 2+0 DRAWING