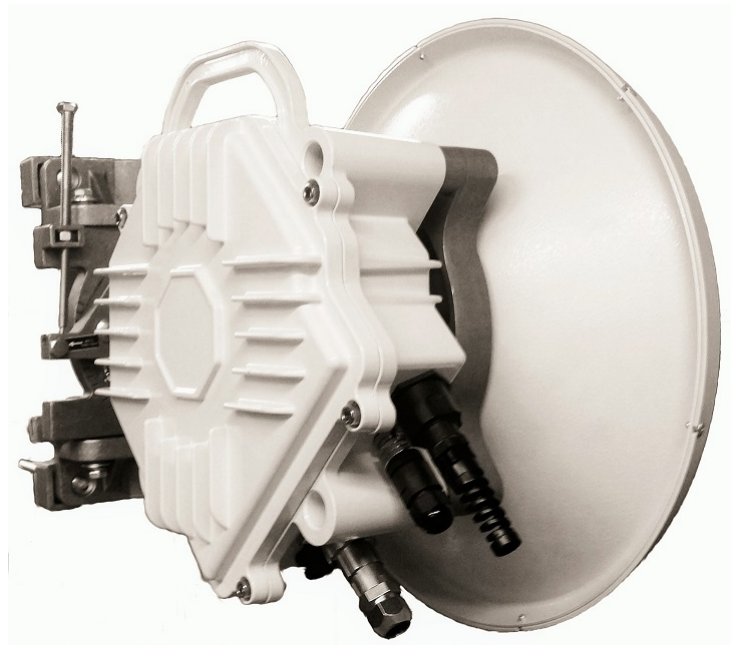


10 Gigabit Ethernet Wireless Link Point-to-Point Connectivity

PPC-10G

40.5 – 43.5 GHz
71-76/81-86 GHz



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1 Statement of Warranty



Elva-1 warrants each product sold by it to be free of defects in material and workmanship under conditions of normal use for twelve (12) months from date of receipt thereof to Buyer. Repair or, at Elva-1's option, replacement of defective parts shall be the sole and exclusive remedy under this limited warranty. All warranty replacement or repair of parts shall be limited to equipment malfunctions, which, in the sole opinion of Elva-1, are due or traceable to defects in original materials or workmanship.

In the event the Buyer believes that the Product is covered by the limited warranty of this Section, the Buyer shall pay for the shipping and insurance of such Product to Elva-1. If Elva-1 determines in its sole opinion that such Product does conform to the limited warranty, then Elva-1 shall pay for the shipping and insurance of repaired or replacement Product back to the Buyer. However, in the event that Elva-1 determines in its sole opinion that such Product is not covered by the limited warranty, Buyer shall pay for shipping and insurance of such Product back to the Buyer.

All obligations of Elva-1 under this limited warranty shall cease in the event of abuse, accident, alteration, misuse or neglect of the Product. In-warranty repaired or replaced parts are warranted only for the remaining unexpired portion of the original warranty period applicable to the repaired or replaced parts.

REASONABLE CARE MUST BE USED TO AVOID HAZARDS. ELVA-1 EXPRESSLY DISCLAIMS RESPONSIBILITY FOR LOSS OR DAMAGE CAUSED BY USE OF ITS PRODUCTS OTHER THAN IN ACCORDANCE WITH PROPER OPERATING PROCEDURES.

THE FOREGOING LIMITED WARRANTY FOR ELVA-1 PRODUCTS IS EXPRESSLY IN LIEU OF, AND EXCLUDES ALL OTHER EXPRESS OR IMPLIED WARRANTIES, INCLUDING BUT NOT LIMITED TO WARRANTIES OF MERCHANTABILITY AND OF FITNESS FOR PARTICULAR PURPOSE, USE OR APPLICATION, AND ALL OTHER OBLIGATIONS OR LIABILITIES ON THE PART OF ELVA-1 MILLIMETER WAVE DIVISION, UNLESS SUCH OTHER WARRANTIES, OBLIGATIONS OR LIABILITIES ARE EXPRESSLY AGREED TO IN WRITING BY ELVA-1.

Statements made by any person, including the representatives of Elva-1, which are inconsistent or in conflict with the terms of these warranties shall not be binding upon Elva-1 unless expressly reduced to writing and approved by CIO of Elva-1.

Do not install substitute parts or perform any unauthorized repair or modification to the equipment. Any repair, changes or modifications not expressly approved by Elva-1 void the Warranty on the equipment.

1.1 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 environment in which it will be used.

2 Safety Precautions



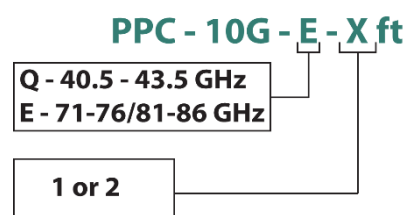
The following general safety precautions must be observed during all phases of operation and service of the ELVA-1 products. Elva-1 assumes no liability for the customer's failure to comply with these requirements.

- This product is not designed to withstand a direct lightning strike. It should be operated only with the protection of an external lightning rod.
- 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 #70, 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.
- This product is designed to withstand moisture conditions typically encountered when installed outdoors. This is not designed for operation under water.
- This product should be operated only from the type of power source indicated on the unit or in manual.

3 Product Code Format



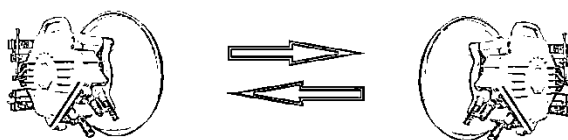
For example, PPC-10G link with 2ft antennas, 40.5 – 43.5 GHz frequency band has product code PPC-10G-Q-2ft.

4 PPC-10G Overview



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 restrictions for ground cable trenching, like national parks, rivers, lakes, airport/railway areas, private land, etc.



PPC-10G is available in either licensed 40.5-43.5 GHz (Q-band) or lightly licensed 71/86 GHz (E-band) 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(-50F) and +65°C(150F), 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.

4.1 PPC-10G Features

- Frequency band: 40.5-43.5 GHz or 71-76/81-86 GHz
- SNMP v.1; v.2; v.3; MIB-II and DOK Enterprise MIB; WEB
- True Full Duplex Operation
- Hitless adaptive bandwidth, coding and modulation
- IEEE 1588v2, SyncE
- Secure communication due to the difficulty of intercepting the link's laser-like beam transmission in free air without detection
- Solid reliability with Fiber-like Performance
- Easily installed, zero-footprint
- Compact Cassegrain type antennas
- Quasi-optical (laser-like) millimeter wave propagation
- EMI interference free

5 Package Contents

The PPC-10G equipment will arrive in 3 boxes (photo at left), the sizes of which will depend on requested antenna diameter.

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.).



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 (below, left photo) or be enclosed in the box as separate accessory package (below, right photo).



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.

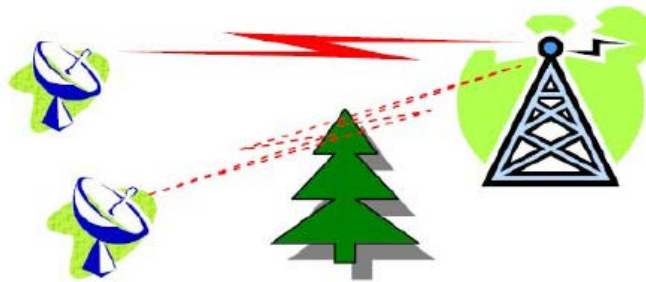
The box with transceivers contains 3 smaller boxes inside. Two of them contain transceivers (below, left photo) and one with doubled kit of power units, cables, sockets, tools, attenuation meter (below, right photo).



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.

6 Site Preparation

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).



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.



Because the link distances are usually within 10 km obstructions in the path can easily be identified using binoculars. It is important to understand that the Line-of-Sight is not just a thin line but more closely resembles a cone. To avoid signal degradation within the First Fresnel Zone, no obstacles should be located within a 1-4.5 meter (1.2-14.7 ft.) radius around the center axis of the Line-of-Sight.

6.1 Path planning

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

Contact your ELVA-1 representative to obtain the exact attenuation value for the transceiver distance obtained above. This value will be your “passport” reference value on the attenuation meters when conducting the final antenna alignment.

6.2 Minimum Clearance for Fresnel zone

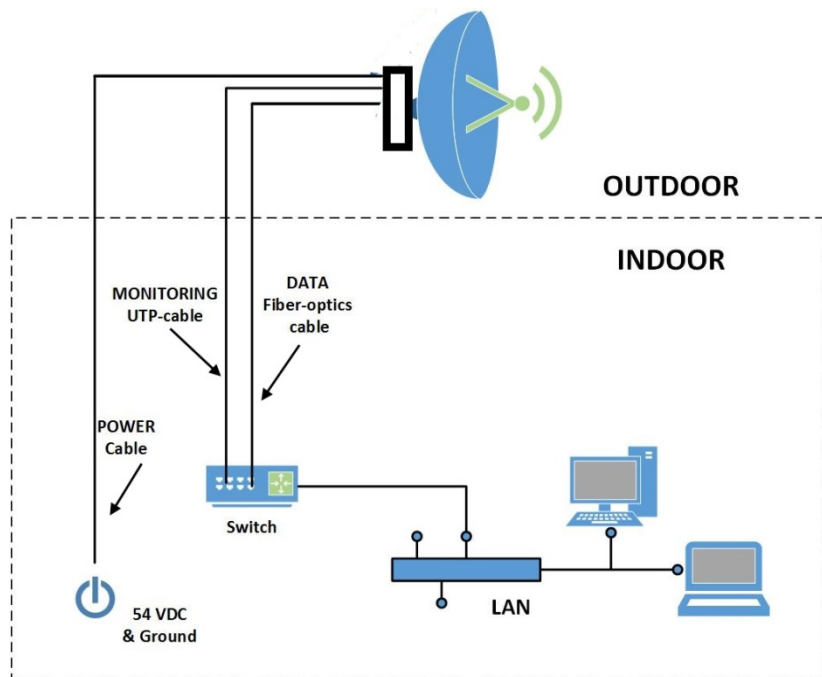
There must be no obstructions between the antennas in the so-called first Fresnel zone. Any obstruction in the first Fresnel zone will corrupt the antenna pattern. In practice, the antenna should be mounted on the edge of a roof or on a mast, so it propagates the signal directly into free space.

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 below.

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

6.3 PPC-10G System Diagram

Before the transceivers can be installed, connecting cables must be run from the indoor control room to the outdoor installation point at each site.



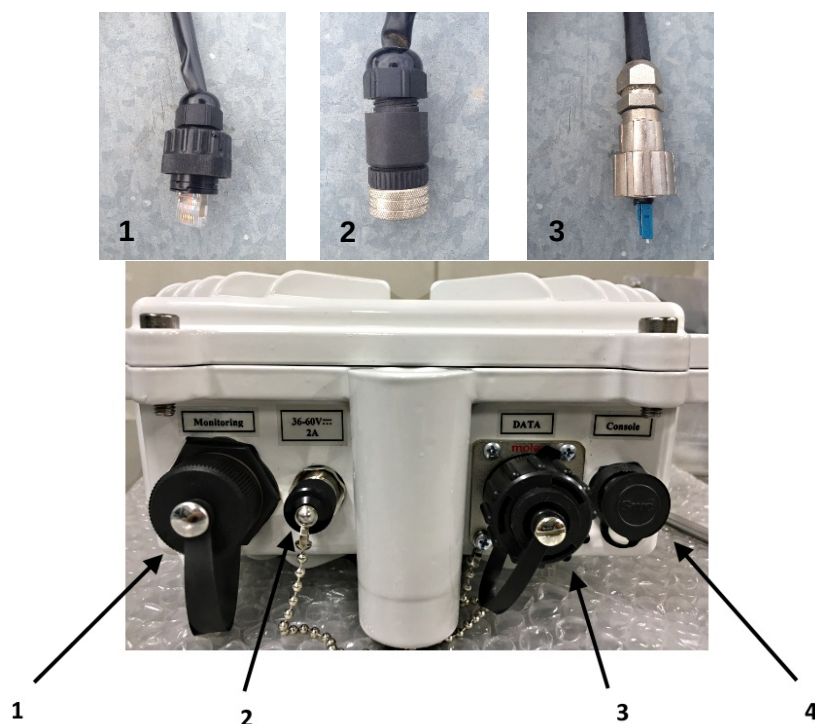
A sample diagram of one transceiver installation layout is shown below. To avoid EMI noise, the low-voltage power supply and UTP data cables must be kept away from building power cables.

The radio should be fastened to a vertical support pole that is 80 to 130 mm (3.2" to 5.12") in diameter and not less than 500 mm (20") in vertical length. The design of the support is not specified, but its resistance to bending and torsion must be strong enough to prevent antenna movement in either azimuth or elevation.

6.4 Stationary Cabling on Installation Site

Following are the recommended rules for laying the cables.

- Select an indoor location with easy cable routing to the radio position. Get yourself familiar with connectors on the radio.



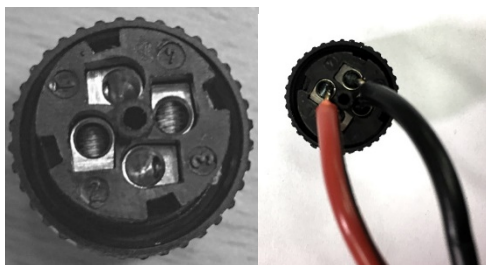
1. RJ-45 Connector "MONITORING" for cable of WEB-monitoring

2. Power connector "POWER" for 36-60 V DC power cable

3. SFP/SFP + "DATA" connector for 10 Gbps data transmission cable

4. "CONSOLE" connector for tuning panel

- Install the power supply (PSU) in your chosen location. Install DC power cable from PSU directly to the radio.
- Connect the stationary DC power cable to the PSU
- Install supplied DC connectors 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. 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 or higher.



- Install a 4-pair Twisted Pair cable from Indoor equipment directly to the radio. Use water-proof connector from shipment kit for it. Be sure that the UTP cable length from last active port to radio is less than 100 m.
- Install fiber optics cable from indoor host equipment directly to the radio. The radio is shipped with SFP+ module (LC, 1310nm). Use water-proof connector from shipment kit for fiber optics cable to the radio.
- Install ground wire to the position of radio installation.
- Keep end of cables with installed connectors in a plastic bag to prevent from dust and water before connecting them to radio transceiver sockets.

6.5 Switching radios to installation mode

Prepare each radio electronic components for installation using WEB-interface to radio.



- Connect power cable into #2 POWER socket.
- Take laptop with some aux twisted pair cable with RJ-45 sockets to the site of the radio. Connect this twisted pair cable to Ethernet port of the computer and to #1 socket of radio directly. Turn ON the power of the radio on PSU.
- Start the Web browser and type radio default address in the address bar of your browser (for Hi - 192.168.127.254, for Lo - 192.168.127.253). This will open a web page with a menu to access to the parameters of the transceiver. To review which radio is **Hi** and which one is **Lo**, check label on the radio
- Go to the reading section 9 to review the WEB-interface. Use the default username and password specified there.
- When enter to the radio WEB-interface, press the Alignment button in the bottom left of the window. Then the APPLY button and wait until the transceiver restarts. Alignment button (Set up) becomes blue (ie, the alignment mode will be active). Next, press the Exit button (Exit). This transceiver is now in the installation mode.
- Repeat this for second radio. Close the browser window. Turn the power OFF and disconnect aux twisted pair cable from the transceiver.
- Connect stationary twisted pair cable from indoor location to the #1 MONITORING socket.

7 Transceiver Installation on Site

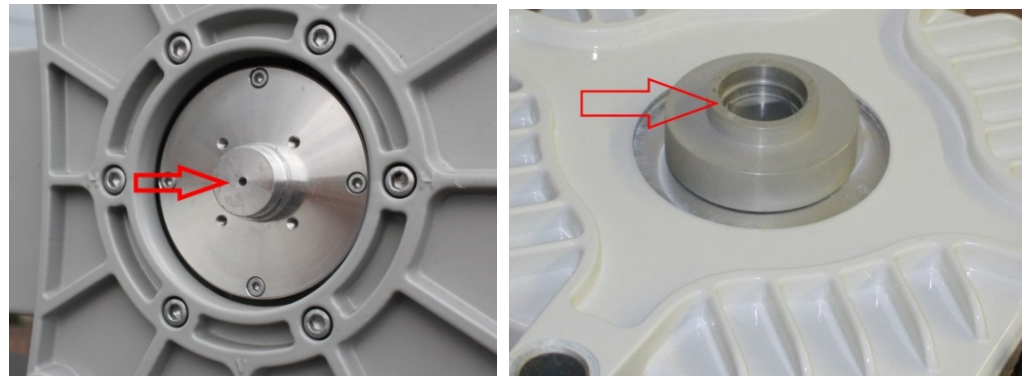
- It is recommended to have 2 technicians at each transceiver site.
- Bring the transceiver, antenna with alignment bracket, 4 mounting screws, Allen wrench (hex key), metric open-end wrench and attenuation meter to the outdoor points of installation at both sites of the link (see photo).



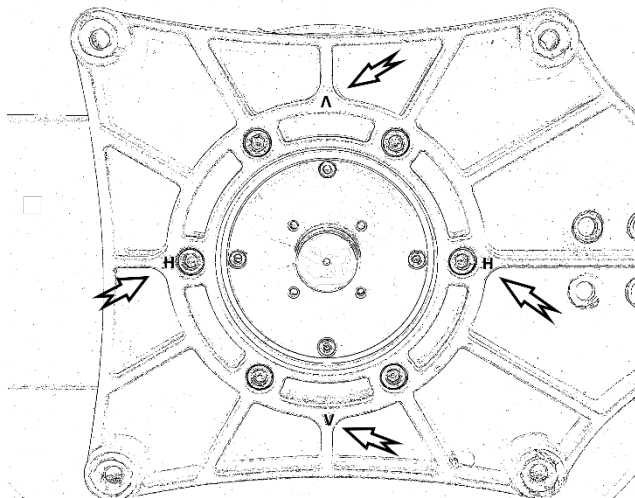
- Make yourself familiar with the antenna alignment bracket (mount). It allows one to change the antenna's azimuth (horizontal) and elevation (vertical) angles. Use the enclosed manual to assemble the alignment bracket enclosed to the package onto the antenna, if necessary. It is recommended that the 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. It is possible to slide the alignment bracket over the top of the support pole, then tighten it in the appropriate position.



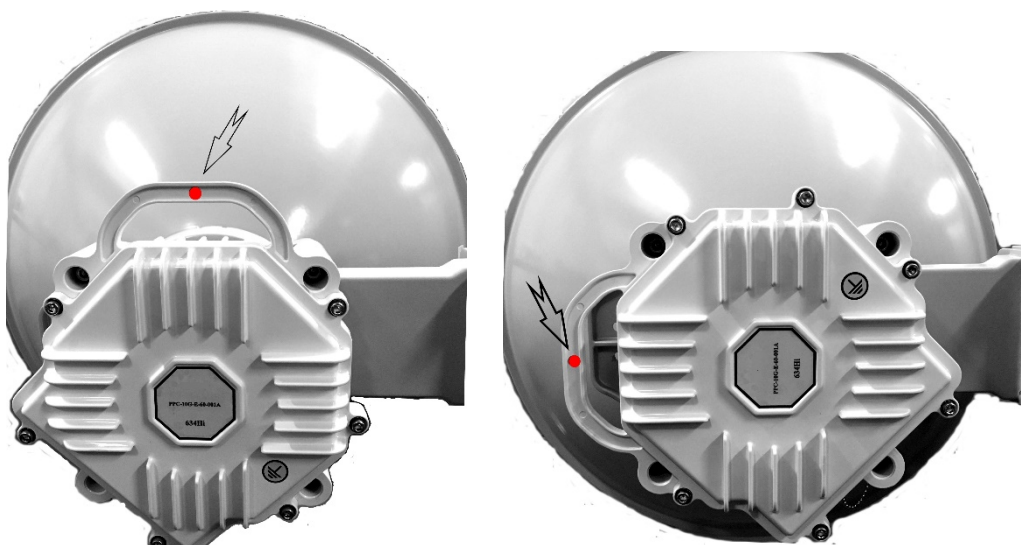
- Remove protective tape from each transceiver and antenna waveguide slots. See photos below with red arrow pointing out to waveguide slots.



- 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 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 (as for channel aggregation), use vertical polarization on first link, and horizontal polarization on second link.



See photo of V-polarization left and H-polarization right.

Be sure that socket of radio are directed down, and not up to get rain drops fall down from radio sockets easily.

- Mount each transceiver to its antenna with 4 mounting screws.
- Install grounding wire to the bolt nearby of the GROUND label as on photo.



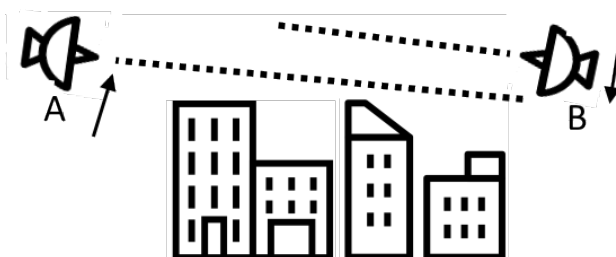
- Insert all connectors of power cable, UTP and Fiber optics cables into relevant sockets on transceiver marked as DC, MONITORING, DATA respectively. Insert attenuation meter connector into CONSOLE socket on transceiver.
- Ask personnel at the indoor location to switch the 54 VDC power ON.
- Check if Attenuation meter is on. By default, it indicates "99".



8 Final Antenna Alignment

For maximum throughput, the antennas must be aligned directly on the LOS. 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.
- b. Using the vertical adjustment bolt on the radio mount, adjust Antenna A to an alignment that is noticeably below the LOS.
- c. Using the same adjustment, adjust Antenna B to an alignment that is noticeably above the LOS.



- d. Power ON both radios by turning on their indoor power supplies, and confirm that an attenuation meter is connected to the CONSOLE socket of each radio and turned ON (meter reading should be 99),
- 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 centerline. If a signal is noticed (a decrease in the number on the tuning meters), stop the adjustment where the attenuation meter number is lowest. If no signal is detected, repeat Step e until the number decreases on the attenuation meter.
- f. Adjust Antenna A horizontally and vertically to obtain the lowest attenuation meter number.
- g. After the initial signal acquisition, and best horizontal and vertical alignment (lowest meter number) on Antenna A, adjust Antenna B horizontally and vertically to obtain the lowest attenuation meter number.
- h. Repeat Steps f and g to obtain the lowest attenuation meter numbers on Antenna A and Antenna B.

- i. At this point the expected passport attenuation 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 attenuation meter to be as much as two points higher than the expected passport value. For example, if your passport attenuation number is 45, but your meter(s) displays 47, this is considered to be within normal tolerance.
- Disconnect the attenuation meters (aka tuning panels) and cover the CONSOLE socket with the attached rubber cap. Confirm that all alignment bracket bolts are secured in place. The outdoor link hardware is now ready for operation.
- Connect indoor connectors for UTP cable (MONITORING) and fiber optics cable (DATA) into relevant sockets of indoor network equipment such as a 10 Gigabit Ethernet Switch. Flow Control (IEEE 802.3X) mode must be enabled. The complete link is now ready for operation.

9 Using WEB Monitoring

WEB Monitoring is a convenience installed to check and modify network parameters, get logs, etc.

PPC-10G link immediately begins operating after the power supply is switched ON. However, firstly, it is required to switch the link from Alignment mode to Operational mode using WEB monitoring.

Each PPC-10G link is shipped as GUI-enabled and can be monitored using WEB browser online. The GUI feature is independent from the data channel, and does not directly affect the link's ability to transmit and receive data through its main data channel. Without the GUI feature enabled, the link performs exactly like an unmonitored cable.

To use monitoring, connect to the PPC-10G's IP address by entering the address in your browser's address line. Any available web browser may be used, but Google Chrome is recommended.

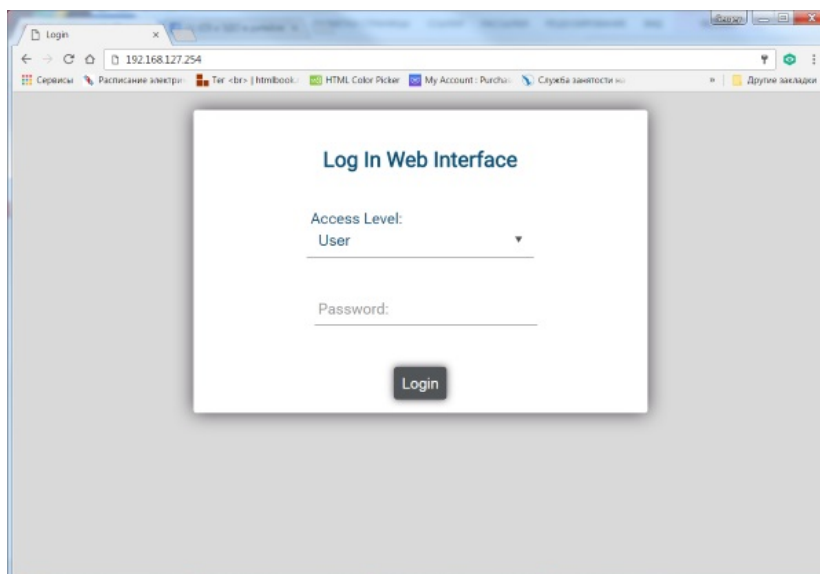
The default PPC-10G IP addresses are:

Hi Radio - **192.168.127.254**, Lo radio – **192.168.127.253**. When you arrive at the web page, proceed as follows:

- Choose **Installer** as the Access Level and enter the default password: **111111**

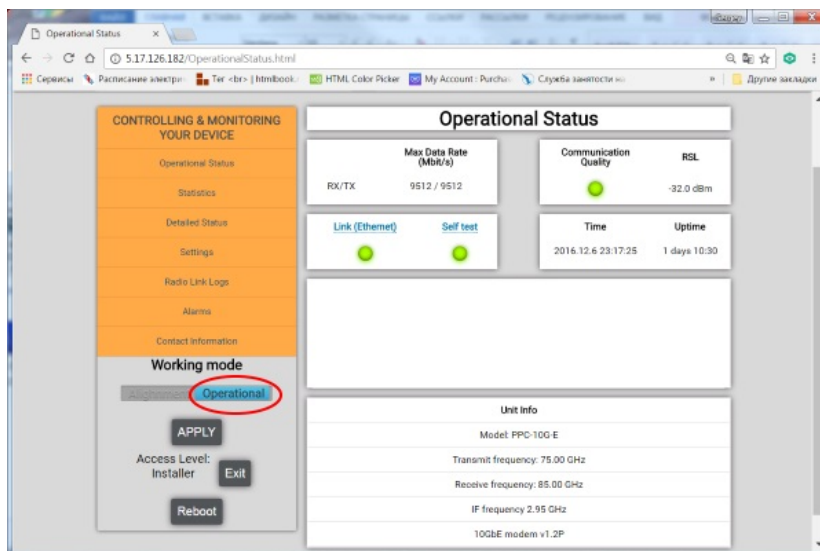
Installer is an admin level access, and has rights to change parameters

User is a reader level access, and has rights to only view parameters.

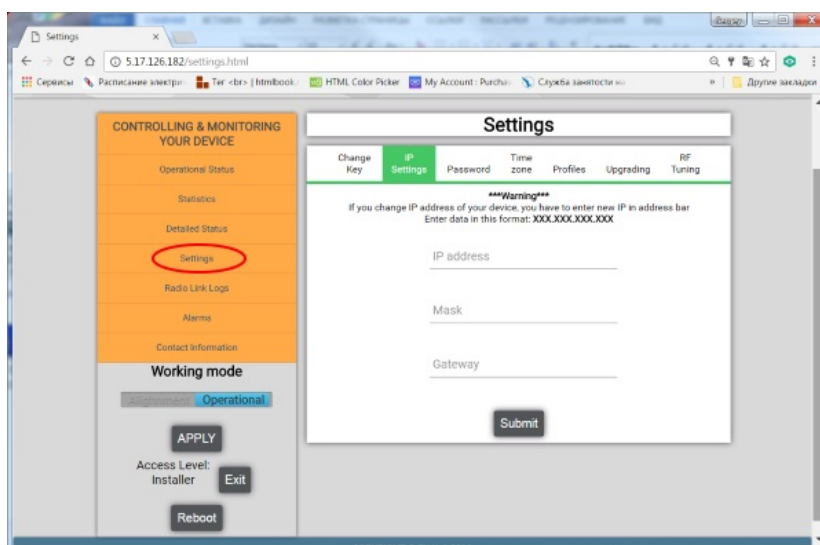


Upon your first Installer access, you should switch the link from Alignment mode to Operational mode, then change the default IP address and password to your preference.

- When enter to the radio WEB-interface, press the **Operational** button in the bottom left of the window. Then press the **APPLY** button and wait until the transceiver restarts. **Operational** button become blue (ie, the normal data transmission mode is active).
- Open another tab in the browser and repeat this for second radio.



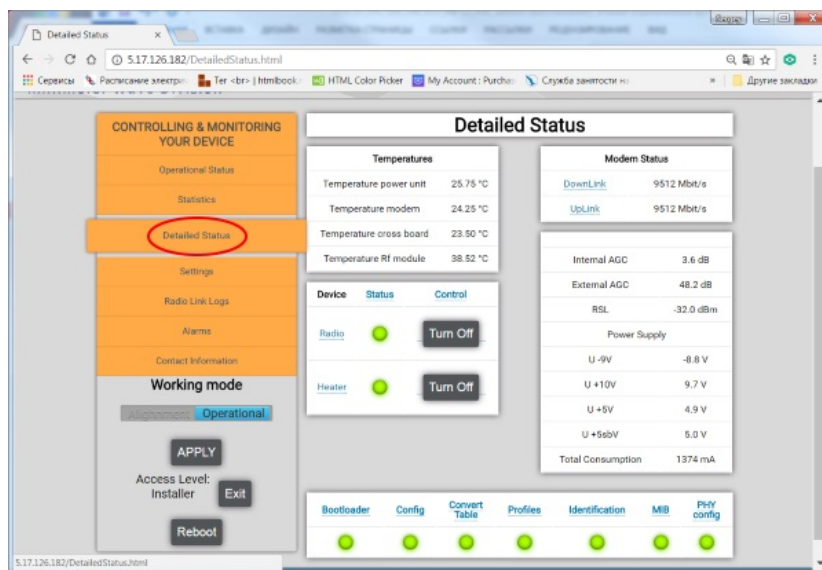
- To change IP address, choose **Settings** on left menu and **IP Settings** tab at top. Enter the IP parameters of your choice. Click **Submit** button.



- To change password, choose **Password** tab at top. Enter new password, then click **Submit** button. Save the password in the protected file or just write down on the paper.

In case the password get lost, contact your supplier for remotely rebooting the link to default password value. The written proof of authority from the link owner must be send to supplier in such case.

- Click **Operational Status** and **Detailed Status** in left menu to check status of link principal parameters. Be sure all marks are green. Orange color means attention, and red color indicates error (for Heater red color indicates switched off).



- Familiarize yourself with other menus and tabs. Please mind **Change Key** tab at Settings is intended only for customers who loan the link.
- Use **Reboot** button to restart the link if needed. Please mind all previous settings of the link will be saved and not be changed after rebooting.

10 Maintenance and Troubleshooting

PPC-10G has been designed to require no 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. Do not stand in front of the 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 SNMP and optical cables are transporting data to the radios.

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

Possible causes of high attenuation 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). Re-align the antennas.
- Transceiver failure.

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

ELVA-1 Service Center email:

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

11 Specifications and Drawing

Frequency range	71-76/81-86 GHz (E-band)				40.5-43.5 GHz (Q-band)			
Throughput	Up to 10Gbps Full duplex, license keys upgradeable							
Channel Bandwidths Available	250/ 500/ 750 / 1000 / 1250 / 1500/ 2000 MHz							
Modulation	from BPSK to QAM-256							
Adaptive rate	Hitless adaptive bandwidth, coding and modulation							
Max Distance with 2ft antennas in clear sky	Up to 20km (12 mile)							
Link budget with 2ft antennas BPSK/QPSK modulation	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 (E&Q band)	1350Mbps @250MHz	2700Mbps @500MHz	4050Mbps @750MHz	5400Mbps @1000MHz	6700Mbps @1250MHz	8150Mbps @1500MHz	10Gbps @2000MHz	
Management	SNMP v.1; v.2; v.3; MIB-II and DOK Enterprise MIB; WEB GUI							
Ethernet Interface	1 × SFP/SFP+ slot (1000Base-X, 10GBase-LR/ER)							
Ethernet	Transparent for Ethernet services, Flow Control 802.3x Optionally: L2 switch built-in with IEEE1588v2 and SyncE, CPRI up to 9.8Gbps							
Management Port	100 Base-Tx (RJ – 45)							
Forward Error Correction	LDPC; Reed Solomon							
Polarization	Vertical / Horizontal							

Antenna Type	Cassegrain type antenna with radome	
Antenna Gain/Beamwidth		
1ft antenna	45 dB/0.7°	38 dB/1.5°
2ft antenna	51 dB/0.35°	44 dB/0.7°

Power Supply AC	Input 88-132 / 176-264 Volts, 50/60 Hz
Transceiver Power Consumption	35 W (+60 W when heater is switched on)
DC Power	36 to 60 Volts DC
Power Connection Ethernet / Power connector	IP-65 [optional IP-68]
Operational Temperature	-50°C to +60°C / -58°F to 140°F
Humidity	Any Rate

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

