

Radio Unit Reference Guide

Installation and Configuration



- [1. Contents](#)
- [2. Specs](#)
- [3. Ports](#)
- [4. Modules](#)
- [5. Indicator](#)
- [6. Console](#)
- [7. Installation](#)
- [8. Serial Set](#)
- [9. SSH](#)
- [10. Out Band](#)
- [11. Fronthaul](#)
- [12. VLAN](#)
- [13. Frequency](#)
- [14. Phase](#)
- [15. Firmware](#)
- [16. Maintain](#)
- [17. Trouble](#)

PRECAUTIONS

- [1. Contents](#)
- [2. Specs](#)
- [3. Ports](#)
- [4. Modules](#)
- [5. Indicator](#)
- [6. Console](#)
- [7. Installation](#)
- [8. Serial Set](#)
- [9. SSH](#)
- [10. Out Band](#)
- [11. Fronthaul](#)
- [12. VLAN](#)
- [13. Frequency](#)
- [14. Phase](#)
- [15. Firmware](#)
- [16. Maintain](#)
- [17. Trouble](#)

SAFETY PRECAUTIONS

- Do not use the O-RAN where flammables or explosives are stored, for example, in a gas station, oil depot, or chemical plant. Otherwise, explosions or fires may occur. In addition, follow the instructions indicated in text or symbols in area used.
- Place the O-RAN on a stable surface.
- Keep the O-RAN far from electronic devices that generate strong magnetic or electric fields, such as microwave ovens, satellite dish antennas, or large appliances.
- Place the O-RAN in a cool and well-ventilated indoor area. Do not expose the device to direct sunlight.
- Do not use the O-RAN in an area under or over temperatures ranging from 0°C to 40°C.
- Do not cover the O-RAN. Reserve a minimum space of 10 cm around the O-RAN for heat dissipation.
- Before connecting and disconnecting cables, ensure that your hands are dry.
- To avoid electric shock, damage, and fire resulting from short-circuiting, do not use the product if wet, with wet hands, or while holding or drinking any liquids.
- Only insert relevant cables or devices into the ports, do not insert metal or other foreign objects.
- Do not place naked flame sources, such as lighted candles, on the O-RAN.
- Keep the O-RAN far from sources of heat and fire, such as a heater or a candle.
- Do not attempt to open the O-RAN, there are no user serviceable parts.
- Do not perform or attempt any customizing, adjustments, repair or maintenance on the O-RAN.
- Damage caused by user misuse or not following instructions are not covered by warranty.
- **Rated Voltage: 12V (DC Voltage)**
- **Rated Current: 7.5A**
- **POE: 42-57VDC / 1.7A**
- **Output power: 30.76 dBm (max)**
- **Max Operating Temps: 0°C to 40°C**
- **Operating humidity: 5% to 95%, (non-condensing)**

NOTICE

This O-RAN is suitable for usage and in compliance with the local regulatory laws in applicable countries.

PRECAUTIONS

1. Contents
2. Specs
3. Ports
4. Modules
5. Indicator
6. Console
7. Installation
8. Serial Set
9. SSH
10. Out Band
11. Fronthaul
12. VLAN
13. Frequency
14. Phase
15. Firmware
16. Maintain
17. Trouble

FEDERAL COMMUNICATIONS COMMISSION (FCC) STATEMENT

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

WARNING: Changes or modifications made to this device not expressly approved by the manufacturer may void the FCC authorization to operate this device.

PRECAUTIONS FOR USING WIRELESS DEVICES

When using this device, ensure that the antenna of the device is at least 20 cm away from all persons.

WARNING: Do not use this device where using wireless devices is prohibited or may cause interference or danger.

If you are using any electrical medical device, contact its manufacturer for the restrictions on the use of this device.

CAUTION: The EM radio waves generated by this device may interfere with the operation of electronic medical devices. Do not take this device into operating rooms, intensive care units (ICUs), or coronary care units (CCUs).

US CITIZENS BROADBAND RADIO SERVICE

CITIZENS BROADBAND RADIO SERVICE DEVICES

CBSDs are required to demonstrate compliance with the technical rules and the access requirements based on at least one Spectrum Access System (SAS), which authorizes and manages CBRS spectrum use. Similarly, End User Devices are required to demonstrate the capability to transmit on an in-band frequency only after receiving authorization from a CBSD.

Required data collection capabilities for CBSD

The following identifies one of several requirements for compliance with Part 96 rules. In cases where test procedures or test cases have not been specified, the application for certification must include a detailed description of how the device complies with the requirements.

Section 96.39 Geo-location requirements:

Devices must determine their location to an accuracy of ± 50 m horizontal and ± 3 m of elevation. Non-professionally installed devices must report any location changes exceeding ± 50 m horizontal and ± 3 m of elevation within 60 s.

- [1. Contents](#)
- [2. Specs](#)
- [3. Ports](#)
- [4. Modules](#)
- [5. Indicator](#)
- [6. Console](#)
- [7. Installation](#)
- [8. Serial Set](#)
- [9. SSH](#)
- [10. Out Band](#)
- [11. Fronthaul](#)
- [12. VLAN](#)
- [13. Frequency](#)
- [14. Phase](#)
- [15. Firmware](#)
- [16. Maintain](#)
- [17. Trouble](#)

US CITIZENS BROADBAND RADIO SERVICE

SETTING UP GEO-LOCATION FUNCTION IN THIS RU

Command to update CBRS configuration map and restart

```
kubectl patch configmaps/cbrs-agent-configmap -n pegatron --type merge -p '{"data":{"CBSD_LATITUDE":"25.127420","CBSD_LONGITUDE":"121.473720"}}'
```

Command to restart CBRS

```
kubectl rollout restart deployment/cbrs-agent -n pegatron
```

```
sysadmin@controller-0: ~/@storage/cbrs/1.3.0.1-DEV2$ kubectl patch configmaps/cbrs-agent-configmap -n pegatron --type merge -p '{"data":{"CBSD_LATITUDE":"25.127420","CBSD_LONGITUDE":"121.473720"}}'
configmap/cbrs-agent-configmap patched
sysadmin@controller-0: ~/@storage/cbrs/1.3.0.1-DEV2$ kubectl rollout restart deployment/cbrs-agent -n pegatron
deployment.apps/cbrs-agent restarted
sysadmin@controller-0: ~/@storage/cbrs/1.3.0.1-DEV2$
```

Command to check pod restart by the CBRS agent

```
kubectl get pods -n pegatron
```

```
sysadmin@controller-0: ~/@storage/cbrs/1.3.0.1-DEV2$ kubectl get pods -n pegatron
```

NAME	READY	STATUS	RESTARTS	AGE
cbrs-agent-645f4cc7b6-9ljcb New	1/1	Running	0	32s
cbrs-agent-6b84cbf7b9-b4qf7 Old	1/1	Terminating	0	14m
pega-gnb-cu248-6d6764758d-zqnbx	9/9	Running	0	30m
pega-gnb-cu248-du1-8d46897d4-7hprs	11/11	Running	0	30m
pega-gnb-debug-7784ffb789-l26jw	1/1	Running	0	30m

```
sysadmin@controller-0: ~/@storage/cbrs/1.3.0.1-DEV2$ kubectl get pods -n pegatron
```

NAME	READY	STATUS	RESTARTS	AGE
cbrs-agent-645f4cc7b6-9ljcb	1/1	Running	0	34s
pega-gnb-cu248-6d6764758d-zqnbx	9/9	Running	0	30m
pega-gnb-cu248-du1-8d46897d4-7hprs	11/11	Running	0	30m
pega-gnb-debug-7784ffb789-l26jw	1/1	Running	0	30m

```
sysadmin@controller-0: ~/@storage/cbrs/1.3.0.1-DEV2$
```

Command to check new location in CBRS agent configuration map

```
kubectl get configmaps/cbrs-agent-configmap -n pegatron -o yaml
```

```
sysadmin@controller-0: ~/@storage/cbrs/1.3.0.1-DEV2$ kubectl get configmaps/cbrs-agent-configmap -n pegatron -o yaml
apiVersion: v1
data:
  CBSD_LATITUDE: "25.127420"
  CBSD_LO_FREQ: "3600000000"
  CBSD_LONGITUDE: "121.473720"
  CBSD_MAC: 10:e8:a7:ef:8e:6f
  CBSD_MAX_BANDWIDTH: "40000000"
```

[1. Contents](#)

[2. Specs](#)

[3. Ports](#)

[4. Modules](#)

[5. Indicator](#)

[6. Console](#)

[7. Installation](#)

[8. Serial Set](#)

[9. SSH](#)

[10. Out Band](#)

[11. Fronthaul](#)

[12. VLAN](#)

[13. Frequency](#)

[14. Phase](#)





[15. Firmware](#)

[16. Maintain](#)

[17. Trouble](#)

CERTIFICATION LICENSES

1. Contents
2. Specs
3. Ports
4. Modules
5. Indicator
6. Console
7. Installation
8. Serial Set
9. SSH
10. Out Band
11. Fronthaul
12. VLAN
13. Frequency
14. Phase
15. Firmware
16. Maintain
17. Trouble

The 5G logo is a registered trademark of 3GPP alliance.	
The O-RAN logo is a registered trademark of O-RAN alliance.	
3GPP logo is a registered trademark of 3rd Generation Partnership Project (3GPP) Organizational Partners alliance.	
Hereby, Pegatron Corporation declares that this device is in compliance with the essential requirements and other relevant provisions of Directive 2014/53/EU. The full text of the EU declaration of conformity is available at: www.pegatroncorp.com The Wi-Fi frequency and the maximum transmitted power in EU are listed below:	

STATEMENTS FOR NCC

超過1.26W・10W以下 (微型基地臺)

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CONTENTS

PRECAUTIONS	Out-of-Band management 21
US CITIZENS BROADBAND RADIO SERVICE	Interface Configuration
CERTIFICATION LICENSES	Configuring fronthaul interface 22
1. PACKAGE & SPECIFICATIONS	Creating a VLAN sub-interface 23
Package contents	ORAN C/U Plane
Radio unit specifications.....	ORAN M Plane
2. HARDWARE INTRODUCTION	Deleting.....
PORTS	Changing Center Frequency..... 26
Bottom side	Symbol Phase Compensation..... 27
2. HARDWARE INTRODUCTION	Phase Compensation
TRANSCIVERS	Radio Transmit Power Level
Recommended modules.....	5. SYSTEM AND FIRMWARE
2. HARDWARE INTRODUCTION	Firmware upgrade..... 29
Powering the radio unit.....	6. SYSTEM MAINTENANCE
Single multi-colored LED	Factory Reset..... 32
Console connection	Save RU's Running Configuration.. 32
3. HARDWARE INSTALLATION	Reboot Device..... 32
Hardware installation flow	7. TROUBLESHOOTING
Mounting to flat surfaces	Show Version 33
Wall or ceiling.....	Show Platform 33
Mounting to poles or bars.....	Show Running Configuration 34
Horizontal or vertical	Show Interface Status 35
4. RU MANAGEMENT	Show PTP Clock..... 35
Command line system overview.....	Show Environment..... 36
Serial port setup	Show Radio Transport..... 37
SSH connection.....	Show Radio Counters..... 37
	Show Radio Delay Profile 38
	Show System Logs..... 38
	Show Server M-Plane / S-Plane 39

1. Contents
2. Specs
3. Ports
4. Modules
5. Indicator
6. Console
7. Installation
8. Serial Set
9. SSH
10. Out Band
11. Fronthaul
12. VLAN
13. Frequency
14. Phase
15. Firmware
16. Maintain
17. Trouble

1. Contents
2. Specs
3. Ports
4. Modules
5. Indicator
6. Console
7. Installation
8. Serial Set
9. SSH
10. Out Band
11. Fronthaul
12. VLAN
13. Frequency
14. Phase
15. Firmware
16. Maintain
17. Trouble

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1. PACKAGE & SPECIFICATIONS

Pegatron's radio unit is designed to provide 5G-NR Sub-6 GHz indoor coverage and optimal 5G network access at throughput speeds of over 1Gbps to satisfy the demands of enterprise, industrial, and commercial campuses. The radio unit is designed with a flexible vRAN solution that reduces costs and increases connection speeds via split 7-2x fronthaul network implementation. The radio unit can be mounted on walls, poles, or ceilings and utilizes internal (or optional external) 4T4R antennas to boost coverage and throughput.

This guide provides information and steps for installing the radio unit and its cables. The document is intended for installation trained personnel only.

PACKAGE CONTENTS

- **Radio Unit (5G NR O-RU)**

RADIO UNIT SPECIFICATIONS

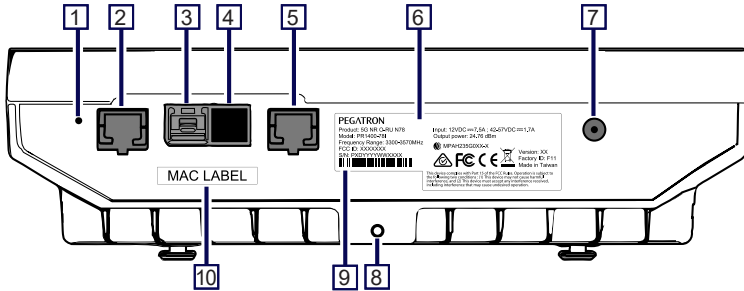
Item	Description
Model: PR1400 - 48I	5G NR O-RU N48 (3.55 – 3.70 GHz) internal antenna
Model: PR1400 - 77I	5G NR O-RU N77 (3.70 – 3.98 GHz) internal antenna
Model: PR1400 - 78I	5G NR O-RU N78 (3.30 – 3.60 GHz) internal antenna
Model: PR1400 - 79I	5G NR O-RU N79 (4.80 – 4.90 GHz) internal antenna
FPGA	Intel Arria 10
RF IC	ADI ADRV 9025
5G NR (n79)	TDD 4T4R / 100MHz bandwidth, 30KHz SCS
Fronthaul	O-RAN PHY split option 7.2 Cat A
TX power	24dBm per RF antenna chain
Max bandwidth	100MHz (OBW)
Antenna	Embedded or external (via SMA connectors)
Data interface	10Gbps SFP+
Synchronization	Supports IEEE 1588 PTPv2 & ITU-T G.8275.1 profiles
Holdover	1.5μs over 4 hours
M-plane	O-RAN compliant Netconf protocol & Yang model
Power supply	IEEE802.3bt PoE or DC 12V/7.5A
Dimensions	W250 x L250 x 66mm (W10" x L10" x D2.7")
Weight	3.5kg (7.72lbs)
Indoor IP rating	IP30
Operating temp	0°C to 40°C
Installation	Ceiling / Wall / Pole mount

[1. Contents](#)[2. Specs](#)[3. Ports](#)[4. Modules](#)[5. Indicator](#)[6. Console](#)[7. Installation](#)[8. Serial Set](#)[9. SSH](#)[10. Out Band](#)[11. Fronthaul](#)[12. VLAN](#)[13. Frequency](#)[14. Phase](#)[15. Firmware](#)[16. Maintain](#)[17. Trouble](#)

2. HARDWARE INTRODUCTION

PORTS

BOTTOM SIDE



Parts description:

#	Item	Description
1	Reset (push button)	System reset
2	Console (RJ45)	Debug port (baud: 115200)
3	SFP+1 (for user installed SFP+ transceiver module)	Data transmission via fiber cable
4	SFP+0 (not available)	(reserved)
5	PoE eth0 / Management (RJ45)	1G + 802.3bt PoE (telnet/SSH)
6	Product label	Model, Freq, SN, Voltages, Ver
7	12V DC input jack (optional)	DC power in (optional)
8	Screw hole	For included bracket mount & screw
9	MAC address label	Each RU are programmed with 2 MAC

Note: Make sure your PoE Ethernet cable is connected to the MGMT (eth) interface. If you connect the PoE cable to the console port, there is a risk that unqualified PoE PSE may force output power and cause permanent damage to your RU.

2. HARDWARE INTRODUCTION

[1. Contents](#)

[2. Specs](#)

[3. Ports](#)

[4. Modules](#)

[5. Indicator](#)

[6. Console](#)

[7. Installation](#)

[8. Serial Set](#)

[9. SSH](#)

[10. Out Band](#)

[11. Fronthaul](#)

[12. VLAN](#)

[13. Frequency](#)

[14. Phase](#)

[15. Firmware](#)

[16. Maintain](#)

[17. Trouble](#)

TRANSCEIVERS

RECOMMENDED MODULES

List of transceivers that are recommended to be used with the radio unit.

Vendor	Part number	Description
INTEL	FTLX 857 1D3BCL	Short Range: Ethernet SFP+ SR Optics
DELL	LTF 850 2-BC+-DEN	
Eoptolink	EOLP- 8596 -02-I	
FINISAR	FTLX 857 1D3BCL	
LUXSHARE	LUXSHARE-ICT	
Cisco	SFP+10G- SR (C)	
JPC (Dell type)	TNP 199007 A00038- 7	
JPC (Intel type)	TNP 199007 A00038- A	
CZT (Dell type)	YV02-C 01 -HS 01	
CZT (Intel type)	YV02-C 01 -HS 02	
FINISAR	FTLX 147 1D3BCL	Long Range: Ethernet SFP+ LR Optics
LUXSHARE	PGN1SSD01-NC-T	
Eoptolink	EOLP- 1396 -10	
Cisco	SFP+10G- LR (C)	
JPC (Dell type)	TNP 14200103 A009- 7	
JPC (Intel type)	TNP 14200103 A009- A	
CZT (Dell type)	YV02-C 02 -HS 01	
CZT (Intel type)	YV02-C 02 -HS 02	

2. HARDWARE INTRODUCTION

POWERING THE RADIO UNIT

The radio unit can be powered via a PSE^[1] or a DC adaptor. If both are available, choose the DC adaptor over the PSE. Please make sure your PSE device can support “802.3bt”, as the radio unit’s full loading power consumption will exceed “802.3at” specifications.

The steps below describe ways of powering on the radio unit.

Scenario	Power source
RJ45 Ethernet cable is connected to a “PSE” device.	The radio unit will be powered by the PSE.
RJ45 Ethernet cable is connected to a “non-PSE” device.	Insert the radio unit’s DC power connector.
Both PSE and DC adaptor are connected.	The radio unit will use the DC power adaptor as the first priority.

^[1] PSE: Power Sourcing Equipment - Using power over Ethernet (PoE)

2. HARDWARE INTRODUCTION

[1. Contents](#)

[2. Specs](#)

[3. Ports](#)

[4. Modules](#)

[5. Indicator](#)

[6. Console](#)

[7. Installation](#)

[8. Serial Set](#)

[9. SSH](#)

[10. Out Band](#)

[11. Fronthaul](#)

[12. VLAN](#)

[13. Frequency](#)

[14. Phase](#)

[15. Firmware](#)

[16. Maintain](#)

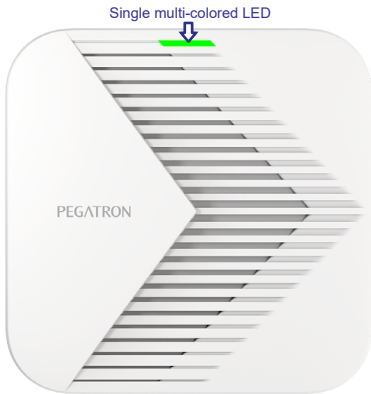
[17. Trouble](#)

INDICATOR

SINGLE MULTI-COLORED LED

Location

There is one multi-color LED on the top cover of the RU. The table below summarizes the LED color definitions.



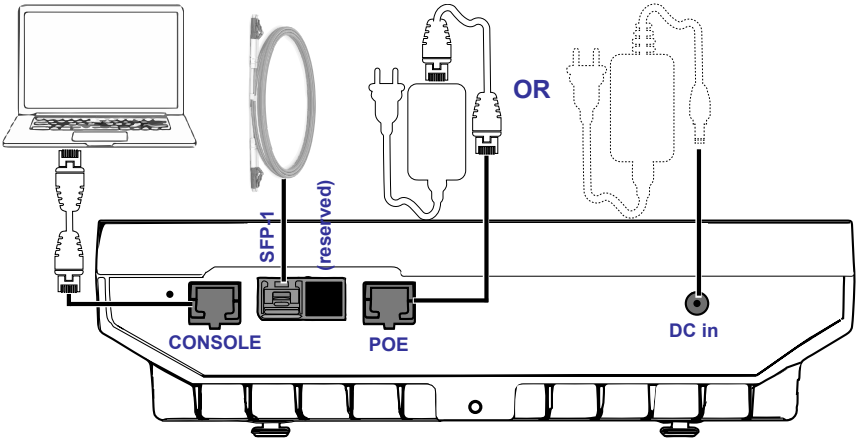
LED	Item	Description
Off	Solid	System is powered off.
Green	Solid	System is powered on but not ready for service.
	Slow blinking	1. System is powered on but not ready for service. 2. Correct synchronization messages are received but not locked yet.
	Fast blinking	1. System is powered on but not ready for service. 2. C/U plane eCPRI messages are received.
Violet	Solid	System is in service.
	Slow blinking	1. System is in service. 2. Correct synchronization messages are received but not locked yet.
	Fast blinking	1. System is in service. 2. C/U plane eCPRI messages are received.
Yellow	Solid	System is in service but performance issues were found.
	Slow blinking	1. System is in service but performance issues were found. 2. Correct synchronization messages are received but not locked yet.
	Fast blinking	1. System is in service but performance issues were found. 2. C/U plane eCPRI messages are received.
Red	Solid	A fatal system issue was detected. (FH linkdown or overheating)

2. HARDWARE INTRODUCTION

- 1. Contents
- 2. Specs
- 3. Ports
- 4. Modules
- 5. Indicator
- 6. Console
- 7. Installation
- 8. Serial Set
- 9. SSH
- 10. Out Band
- 11. Fronthaul
- 12. VLAN
- 13. Frequency
- 14. Phase
- 15. Firmware
- 16. Maintain
- 17. Trouble

CONSOLE CONNECTION

You need an RJ-45 to DB-9 female cable, which is compatible with a Cisco management cable. You also need a USB port for the RS232 DB-9 male adapter. The console cabling example is shown below. On the management PC, you can use a terminal emulator, such as putty, Tera Terminal, etc for console connection.



PC IP settings

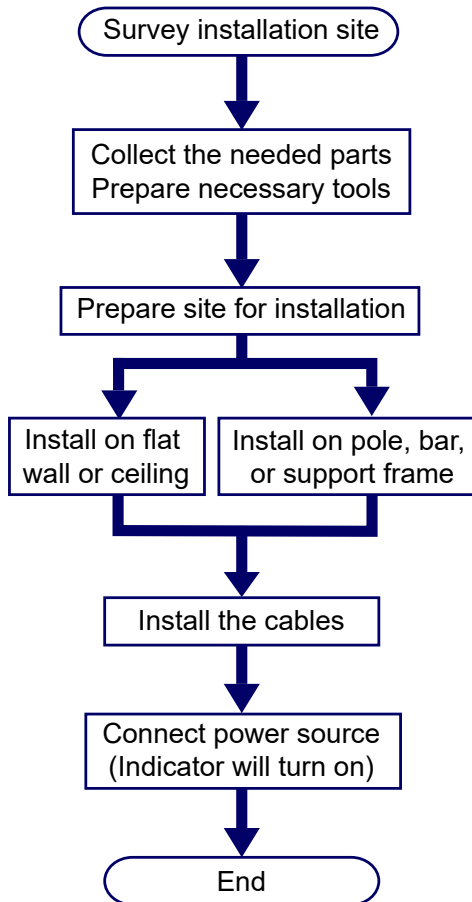
Properties	Value
IP address	192.168.1.201
Subnet mask	255.255.255.0

Terminal emulator settings

Properties	Value	Properties	Value
Baud Rate/Speed	115200	Stop-bits	1-bit
Data	8-bit	Flow control	none
Parity	None		

3. HARDWARE INSTALLATION

HARDWARE INSTALLATION FLOW



[1. Contents](#)

[2. Specs](#)

[3. Ports](#)

[4. Modules](#)

[5. Indicator](#)

[6. Console](#)

[7. Installation](#)

[8. Serial Set](#)

[9. SSH](#)

[10. Out Band](#)

[11. Fronthaul](#)

[12. VLAN](#)

[13. Frequency](#)

[14. Phase](#)

[15. Firmware](#)

[16. Maintain](#)

[17. Trouble](#)

3. HARDWARE INSTALLATION

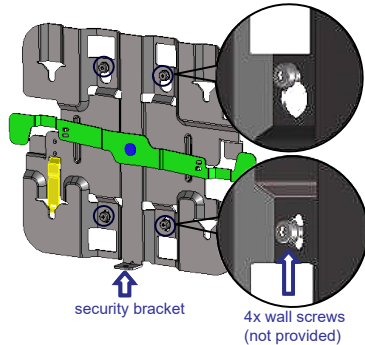
1. Contents
2. Specs
3. Ports
4. Modules
5. Indicator
6. Console
7. Installation
8. Serial Set
9. SSH
10. Out Band
11. Fronthaul
12. VLAN
13. Frequency
14. Phase
15. Firmware
16. Maintain
17. Trouble

MOUNTING TO FLAT SURFACES

WALL OR CEILING

1. Install four screws (not provided) at the marked positions. Use expansion anchors if screwing into masonry or drywall.

The “security bracket” should be facing down and out.



2. Align the four “studs” on the backside of the radio unit into the four “slots” on the bracket.

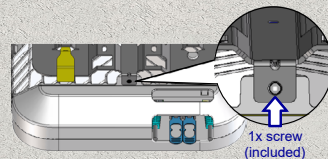
Push down against the security bracket until it stops against it.

NOTE: To remove the RU, push the “stopper” inwards (away from RU) before sliding the “stud” out of the “slot”.



3. Install the security “screw” here to secure the radio unit from sliding out.

NOTE: The screw is very small so a phillips screw driver with a magnetic bit is recommended.



3. HARDWARE INSTALLATION

[1. Contents](#)

[2. Specs](#)

[3. Ports](#)

[4. Modules](#)

[5. Indicator](#)

[6. Console](#)

[7. Installation](#)

[8. Serial Set](#)

[9. SSH](#)

[10. Out Band](#)

[11. Fronthaul](#)

[12. VLAN](#)

[13. Frequency](#)

[14. Phase](#)

[15. Firmware](#)

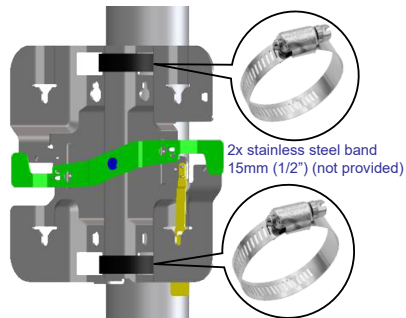
[16. Maintain](#)

[17. Trouble](#)

MOUNTING TO POLES OR BARS

HORIZONTAL OR VERTICAL

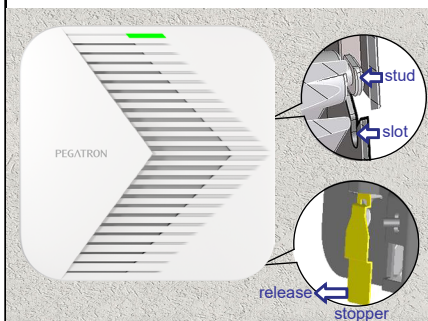
For horizontal or vertical mount to square or round objects, use two stainless steel band of about 12-15mm (about 1/2").



2. Align the four “studs” on the backside of the radio unit into the four “slots” on the bracket.

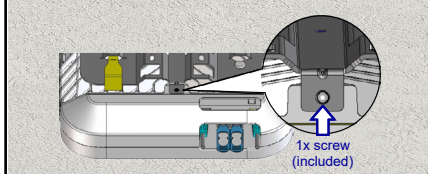
Push down against the security bracket until it stops against it.

NOTE: To remove the RU, push the “stopper” inwards (away from RU) before sliding the “stud” out of the “slot”.



3. Install the security “screw” here to secure the radio unit from sliding out.

NOTE: The screw is very small so a phillips screw driver with a magnetic bit is recommended.

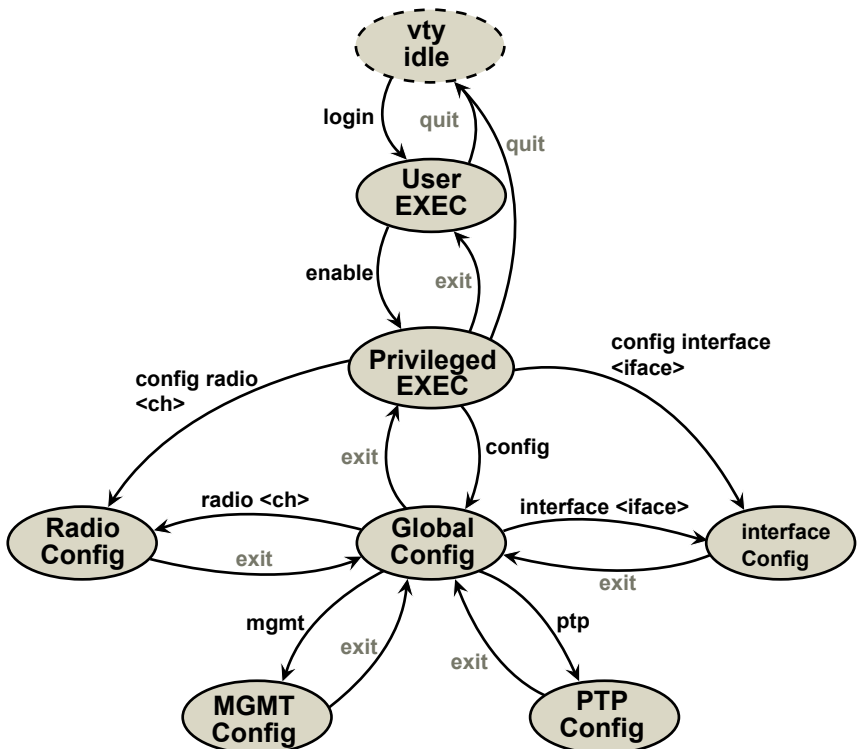


4. RU MANAGEMENT

COMMAND LINE SYSTEM OVERVIEW

A command-line interface (CLI) is a text-based user interface (UI) used to run programs, manage computer files, and interact with the computer. Command-line interfaces are also called command-line user interfaces.

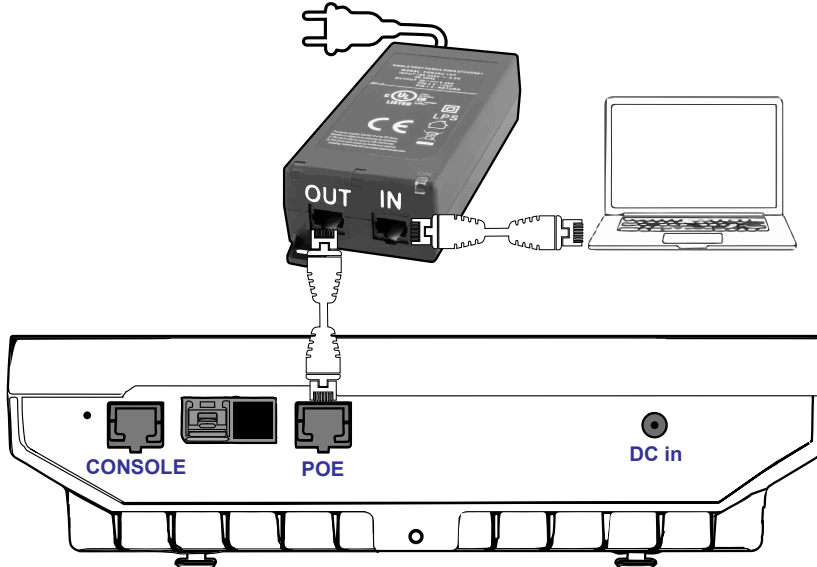
There are 6 CLI system modes. The transition of modes is shown in the figure below.



4. RU MANAGEMENT

You need an RJ-45 to DB-9 female cable, which is compatible with a Cisco management cable. You also need a USB port for the RS232 DB-9 male adapter. The console cabling example is shown below. On the management PC, you can use a terminal emulator, such as putty, Tera Terminal, etc for console connection.

SERIAL PORT SETUP



PC IP settings

Properties	Value
IP address	192.168.1.201
Subnet mask	255.255.255.0

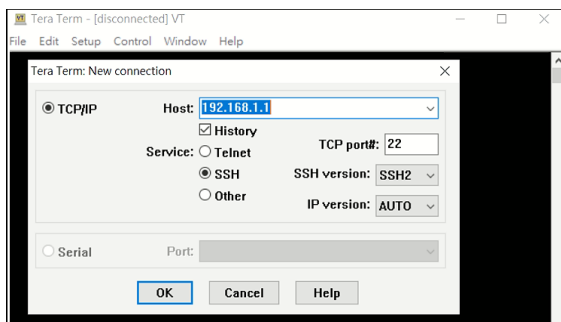
- [1. Contents](#)
- [2. Specs](#)
- [3. Ports](#)
- [4. Modules](#)
- [5. Indicator](#)
- [6. Console](#)
- [7. Installation](#)
- [8. Serial Set](#)
- [9. SSH](#)
- [10. Out Band](#)
- [11. Fronthaul](#)
- [12. VLAN](#)
- [13. Frequency](#)
- [14. Phase](#)
- [15. Firmware](#)
- [16. Maintain](#)
- [17. Trouble](#)

4. RU MANAGEMENT

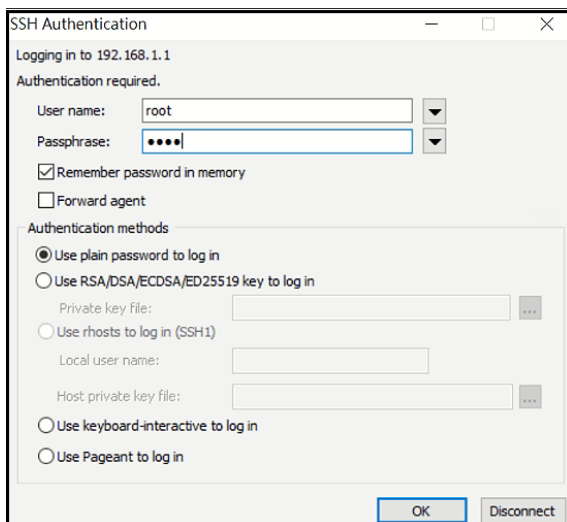
- 1. Contents
- 2. Specs
- 3. Ports
- 4. Modules
- 5. Indicator
- 6. Console
- 7. Installation
- 8. Serial Set
- 9. SSH
- 10. Out Band
- 11. Fronthaul
- 12. VLAN
- 13. Frequency
- 14. Phase
- 15. Firmware
- 16. Maintain
- 17. Trouble

SSH CONNECTION

The IN port on the PoE adapter is the RU's management port. Default IP address is 192.168.1.1/24. Please configure your management laptop within the same subnet 192.168.1.* /24. (e.g. 192.168.1.201/24) You can setup the SSH connection via Tera Term. Refer to the image below and type in the Host address with the RU's management IP address. For Service, select SSH protocol. Click on OK to start the SSH session.



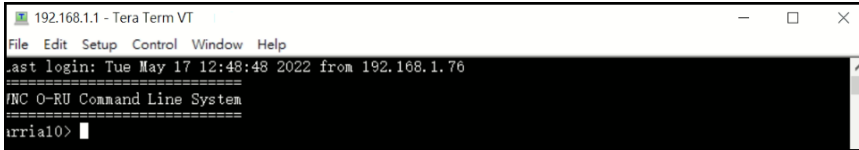
Type in the credentials here using the RU's default User name and Password: **root / root**.



4. RU MANAGEMENT

SSH CONNECTION (CONT.)

After log in, you will see the RU's welcome message.



```
192.168.1.1 - Tera Term VT
File Edit Setup Control Window Help
Last login: Tue May 17 12:48:48 2022 from 192.168.1.76
=====  
/NC O-RU Command Line System  
=====  
arria10>
```

OUT-OF-BAND MANAGEMENT

INTERFACE CONFIGURATION

OOB MGMT interface, eth0 is a gigabits Ethernet network port with PoE PD capability. While the system is powered by PoE, you can connect this interface by using a direct Cat.5e cable to PoE PSE “IN” port.

To configure the OOB MGMT interface, follow the steps, beginning in privileged EXEC mode.

OOB management interface

Step	Command	Purpose
1	config ru# config	Entering global configuration mode
2	interface <ifname> Example: ru(config)# interface eth0 ru(config-if eth0)#	Entering interface configuration mode Note: OOB MGMT interface name is eth0
3	ip address <ipv4/prefix-len> Example: ru(config-if eth0)# ip address 192.168.1.25/24	Sets the IP address and prefix length for the OOB MGMT interface. Note: OOB MGMT default IP is 192.168.1.1/24
4	no shutdown Example: ru(config-if eth0)# no shutdown ru(config-if eth0)#	Enables the MGMT interface, changing its state to administration up.

[1. Contents](#)[2. Specs](#)[3. Ports](#)[4. Modules](#)[5. Indicator](#)[6. Console](#)[7. Installation](#)[8. Serial Set](#)[9. SSH](#)[10. Out Band](#)[11. Fronthaul](#)[12. VLAN](#)[13. Frequency](#)[14. Phase](#)[15. Firmware](#)[16. Maintain](#)[17. Trouble](#)

4. RU MANAGEMENT

CONFIGURING FRONTHAUL INTERFACE

Fronthaul interfaces are 10-gigabits Ethernet ports which are used to connect the O-DU server or the fronthaul gateway. All in-band traffic, such as eCPRI, PTP, NETCONF packets, are transmitted and received by fronthaul interfaces. You can use the SFP+ fiber or DAC to connect to the fronthaul interface.

To configure the fronthaul interface, follow these steps, beginning in privileged EXEC mode.

Fronthaul interface

Step	Command	Purpose
1	config ru# config	Entering global configuration mode
2	interface Example: ru(config)# interface eth1 ru(config-if eth1)#	Entering interface configuration mode Note: primary fronthaul interface name is eth1
3	ip address <ipv4/prefix-len> Example: ru(config-if eth1)# ip address 192.168.2.25/24	Sets the IP address and prefix length for the OOB MGMT interface. Note: primary fronthaul interface default IP is 192.168.2.1/24
4	no shutdown Example: ru(config-if eth1)# no shutdown ru(config-if eth1)#	Enables the fronthaul interface, changing its state to administration up.

Note: Only primary fronthaul interface is available in v0.5.x firmware.