Pivotal Commware Pivot 5G™
Installation Manual

Version 2022.1

Revision History

Version	Release date	Section	Revision Notes
v2022.1	March 16, 2022	IBMS Commissioning	Commissioning instructions and UI images updated to match updates to remote commissioning process and UI.
v2021.5	Nov 29, 2021	Installation	**Updated** pilot hole bit size to provide recommendations based on wood hardness
v2021.4	July 9, 2021	Installation	**Added** guidance for cable management
		IBMS Commissioning	**Updated** commissioning flow and UI **Added** guidance for Site ID (IBMS commissioning only)
		Parts List	**Added** additional Service Unit configurations and details.
v2021.3	Mar 1, 2021	All	Added: SU HBF guidance
		System Components	**Added:** Radial downtilt sticker as part of mounting kit
		Alarm list	**Added:** • ALM_UNSPECIFIED_ERROR **Removed:** • ALM_GAIN_DL_POWER_TOO_LOW: from Warning to Major • ALM_GAIN_UL_POWER_TOO_LOW from Warning to Major
v2021.2	Feb 1, 2021	Alarm List	**Alarm Severity Change**: • ALM_GAIN_PA_OUT_OF_SPEC: From Critical to Major • ALM_GAIN_DL_POWER_TOO_LOW: from Warning to Major • ALM_GAIN_UL_POWER_TOO_LOW from Warning to Major • ALM_WIFI_ENABLED_BY_ADMIN from Warning to Minor **Alarm Syntax Change**: • ALM_SIM_NOT_DETECTED changed to ALM_MODEM_SETUP_STATUS_ERROR • ALM_LTE_MODEM_COMMS_FAIL changed to ALM_MODEM_POWER_ON_ERROR **Removed**: • LTE ALM_LTE_MODEM_SETUP_NOT_SUCCESSFUL **Added**: • ALM_MODEM_OPERATOR_STATUS_ERROR • ALM_MODEM_REGISTRATION_ERROR • ALM_MODEM_IP_FAILED • ALM_MODEM_DISABLED (See Alarm List for severity level and descriptions)

Table of Contents

Safety and Regulatory Information

This manual should be read and used as a guideline for properly installing and operating the Pivot 5G device. This manual may be changed for system improvement, standardization, and other technical reasons without prior notice. Updated manuals are available at: https://pivotalcommware.com/Pivot5GUserManual.pdf.

For questions on the manual or their content, contact support@pivotalcommware.com.

FCC Industrial Signal Booster User Information

WARNING. This is NOT a CONSUMER device. It is designed for installation by FCC LICENSEES and QUALIFIED INSTALLERS. You MUST have an FCC LICENSE or express consent of an FCC Licensee to operate this device. Unauthorized use may result in significant forfeiture penalties, including penalties in excess of $100,000 for each continuing violation.

Modification of the device, cabling or antennas is prohibited and may violate your authority to operate the licensed device.

FCC Part 15 User Information

Pivot GA1 – Donor Unit and Narrow Beam Service Unit – FCC ID: **2AUVU-P28DUGA1**.

   This device contains FCC ID: **2AUVU-UBR410M** and **Z64-WL18SBMOD**

Pivot GA1 – Wide Beam Service Unit – FCC ID: **2AUVU-P28SUGA1**.

   This device contains FCC ID: **2AUVU-UBR410M** and **Z64-WL18SBMOD**

Pivot GA1 – Medium Beam Service Unit – FCC ID: **2AUVU-P28SUHMGA1**

   This device contains FCC ID: **2AUVU-UBR410M** and **Z64-WL18SBMOD**

Pursuant to part §15.21 of CFR Title 47, you are cautioned that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

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.

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a commercial 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.

FCC Radiation Exposure Statement

To ensure the safety of users, the FCC has established criteria for the amount of radio frequency energy various products may produce depending on their intended usage. This product has been evaluated to comply with the FCC's exposure criteria. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

The installation of the Pivot unit should allow at least 39 centimeters between the device and persons to be in compliance with FCC RF exposure guidelines. Use only Pivotal Commware approved power supplies and accessories that are specifically designed for your Pivot device.

Intellectual Property

All Intellectual Property, as defined below, owned by or which is otherwise the property of Pivotal Commware, Inc. ("Pivotal") or its respective suppliers relating to the Pivotal device, i.e., Pivot 5G, including but not limited to, accessories, parts, or software relating thereto (the "Pivot 5G"), is proprietary to Pivotal and protected under federal laws, state laws, and international treaty provisions. "Intellectual Property" means any Pivotal (or where applicable, Pivotal's supplier's) intellectual property including, but not limited to, inventions (patentable or unpatentable), patents, trade secrets, copyrights, software, computer programs, and related documentation and other works of authorship. You may not infringe or otherwise violate the rights secured by the Intellectual Property. Moreover, you agree that you will not (and will not attempt to) modify, prepare derivative works of, reverse engineer, decompile, disassemble, or otherwise attempt to create source code from the software. No title to or ownership in the Intellectual Property is transferred to you. All applicable rights of the Intellectual Property shall remain with Pivotal and its suppliers.

Disclaimer of Warranties; Exclusion of Liability

This document provides an introduction to features, functions, setup, and operation of Pivotal Commware's Pivot 5G. For more information, refer to the Warranty Information.

Contact Information

Headquarters:
10801 120th Ave NE #200
Kirkland, WA 98033 USA
www.pivotalcommware.com

Pivotal Commware Pivot 5G Technical Support:

- Phone – 1-855-956-2016
- Email – support@pivotalcommware.com
- File a Ticket – https://pivotalcommware.freshdesk.com/support/home
- Pivotal Support Resources: https://pivotalcommware.com/pivot-5g-installation-help/

Overview of Pivot 5G

The Pivot 5G is an outdoor network repeater that addresses mmWave coverage challenges by capturing and redirecting mmWave signals from the gNB around obstacles like buildings. By extending the range of gNBs, Pivot 5G, by virtue of its small size, easy permitting, low power consumption and no requirement for fiber, reduces gNB CAPEX, ongoing OPEX, siting costs and deployment time by minimizing the number of gNBs. Using Pivot 5Gs, network coverage can grow organically along with revenue.

Deploying Pivot 5Gs in conjunction with gNBs allows operators to reach indoor and outdoor coverage objectives more effectively than using gNBs alone.

Installation

Overview

The Pivot 5G is designed to be installed by a crew with experience installing pole- and building-mounted equipment. The following material provides guidance to perform a typical installation for both a Single Service Unit, Single Donor Unit deployment and a Dual Service Unit, Single Donor Unit deployment.

For installations where a Single Service, Single Donor deployment is upgraded to a Dual Service deployment there are special considerations noted.

While You Install

You will need the device serial numbers for the commissioning process. These are located on the bottom of each device and on the device packaging boxes.

Required Tools (Not Included with Pivot)

	Band-It® ½-inch stainless steel band C20499 Packaged in rolls of 100-feet.
	Band-It® ½-inch steel buckle C35499 Secures ends of band in place
	Band-It® Standard Banding Tool C00169 Tightens and cuts band
	Band-It® Band and Buckle Kit C27699 Includes all of the above Band-It® equipment
	8 in-lbs 2.92mm Torque Wrench Tightens the RF cable hex connectors to the proper torque
Additional Torque Wrenches	1. 18 ft-lbs, ½-inch Torque wrench (bracket arm screws) 2. 4-5 ft-lbs, 3/8-inch Torque wrench (bracket-to-unit screws)

General Configuration (1 Donor Unit, 1 or 2 Service Units)

The carrier will provide instructions that detail the angle at which the units should be separated around the pole.

Note: Only some deployments require a second Service Unit.
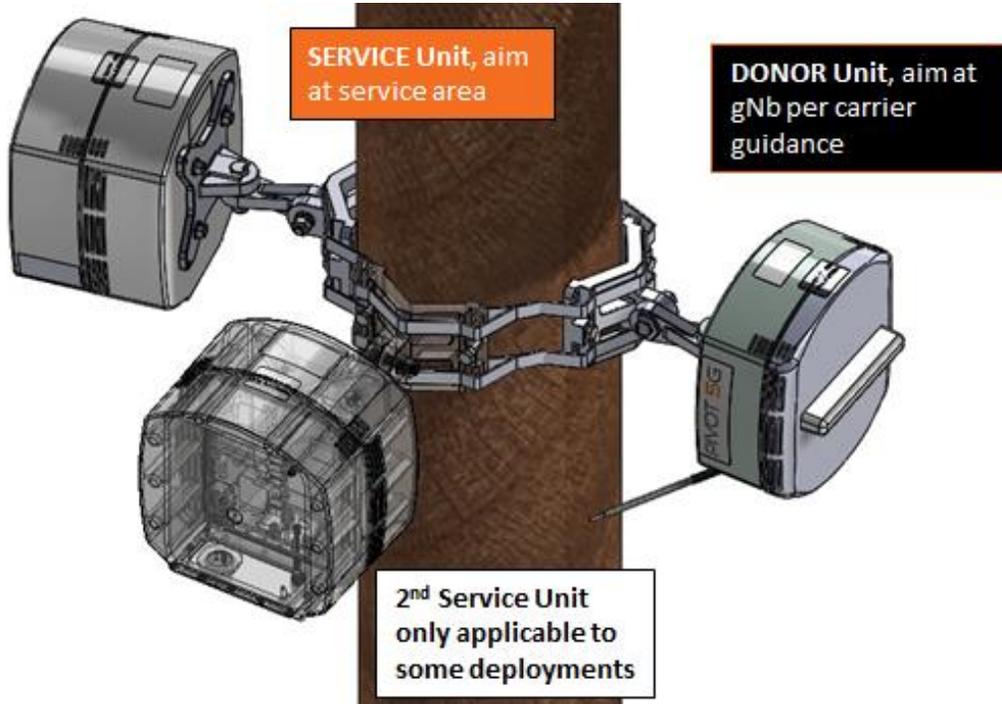
System Components

Units

Unit Types (Ships (1) per box with the below Accessories)			
Donor Unit (DU)	**Narrow Beam Service Unit (Service HBF)**	**Medium Beam Service Unit (SU)**	**Wide Beam Service Unit (SU)**
Beam Azimuth: 5° **Beam Elevation**: 25°	**Beam Azimuth:** 5° **Beam Elevation**: 25°	**Beam Azimuth:** 50° **Beam Elevation**: 30°	**Beam Azimuth:** 75° **Beam Elevation**: 45°
Pointed at the gNB to receive the 5G mmWave signal.	Contains 5° beam pointed towards the service area receiving 5G. Some deployments will utilize two (2) Service Units.	Contains 50° beam pointed towards the service area receiving 5G. Some deployments will utilize two (2) Service Units.	Contains 75° beam pointed towards the service area receiving 5G. Some deployments will utilize two (2) Service Units.
The Donor Unit and Narrow Beam Service Unit use the same case		The Medium Beam and Wide Beam Service Units use the same case	

Accessories

Each unit ships (1) per box with the below accessories.

Item	Qty	Description
	1	**Mounting bracket (with radial downtilt sticker)** Connects both the Donor Unit and the Service Unit ((1) bracket per unit) to the pole
	2	**5" L hex screw** Connects the mounting bracket ((2) screws each) to the pole
	4	**½" L hex screw** Connects the mounting bracket to the Donor Unit or Service Unit
	1	**Power Cable**
	1	**Ground Cable**

Single Sector Cable Kit

Item & Description		Qty
	17-foot RF cables	**4** (Individually color coded)
	5" L hex screw Connects pole mount Velcro ((1) screw each) to the pole	**4**
	Pole Mount Velcro Wraps cables	**4**
	Wire Wrap Velcro Wraps cables and secures to pole	**6**
	COAX-SEAL packet Weatherproofs RF cable connectors	**2**
	Quick Start Guide Instructions for installation and cable connections	**1**

Dual Sector Cable Kit

Item & Description		1 DU, 2 SU Qty
	7-foot RF cables	**12** (Individually color-coded, 3 of each color)
	5" L hex screw Connects pole mount Velcro ((1) screw each) to the pole	**6**
	Wire Wrap Velcro Wraps cables	**9**
	Pole Mount Velcro Wraps cables and secures to pole	**6**
	Cable splitter Connects the 2 Service Units to the Donor Unit in dual-Service deployments	**4**
	COAX-SEAL packet Weatherproofs RF cable connectors	**5**
	Quick Start Guide Instructions for installation and cable connections	**1**

Optional

Item	Item ID	Description	Quantity
	Pivotal PN: 810-0086-01	**Cable box and accessories** • (3) Grommet plates • (3) Velcro straps • (3) Saddles for Velcro straps • (4) Wire Wraps	**1**
Additional Accessories	Pivotal PN: 438-0123-01	**Pole Mount Velcro** Wraps cables	**6**
	Pivotal PN: 438-0122-01	**Wire Wrap Velcro** Wraps cables and secures to pole	**9**
	Pivotal PN: 460-0162-01	**5" L hex screw** Mounts cable box	**2**
	Pivotal PN: 460-0164-01	**Hex-In Box Mounting Screw** Mounts cable box accessories (wire wraps) inside the box	**12**
	https://Delcity.net Item #1750 (75-foot roll) Item #1950 (300-foot roll)	**1-inch UV Resistant High-Temp Split Loom**	**75-foot or 300-foot rolls**

Mounting the Pivot 5G

Choosing the best location for mounting

The mounting location for the Pivot will be determined in part by site conditions and guidance from the carrier. However, there are some best practices that may dictate mounting location.

Mounting Best Practices

- Choose a mounting location where the hex screws will not back out of old or damaged wood.
- **Record your devices' serial numbers before mounting**. This can be found on the bottom of both the Donor and Service Unit and on the packaging boxes and will be needed for commissioning.

Mounting the Brackets (Wooden Pole Mount)

Note: The brackets come with instructions for proper assembly.

[1] Drill full 5-inch pilot holes into the mounting surface for the 5-inch screws where you wish to mount each bracket.

    a. Recommended bit size:

        i. Softwood: 3/32-inches

        ii. Hardwood: 3/16-inches

[2] Use bracket-to-pole screws to secure each bracket **without** an attached unit to the pole at center holes.

Note: There are **two** screws to mount each bracket to the pole. **Do not** use four screws for a bracket, or mount screws along the same side.
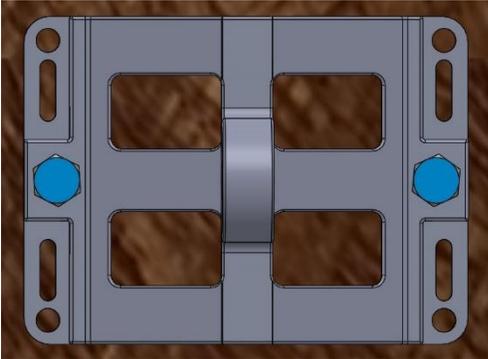
[3] Tighten hex nuts on bracket arm to 18 ft-lbs (216 in-lbs).
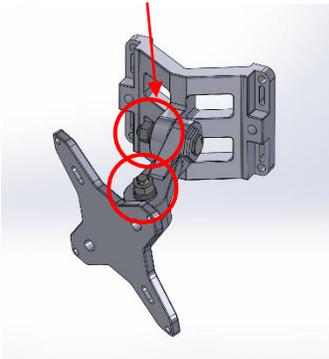
[4] Attach each unit and tighten bracket-to-unit hex nuts to 4-5 ft-lbs (48-60 in-lbs).
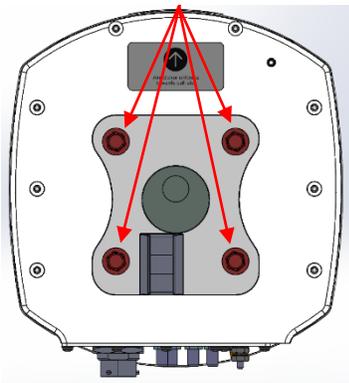
Using the Band-It® bands and tool

These are abbreviated instructions. For the full instructions from Band-It®, see Appendix B.

    [1] The required band length is **4.5x** the diameter of the pole.

    [2] Place the buckle with the ears pointing up on the right and slide the band through.
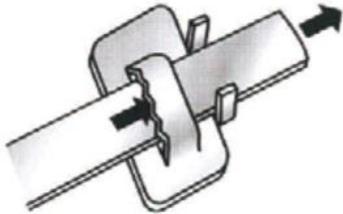
    [3] Bend at least 2-inches of the band beneath the buckle.
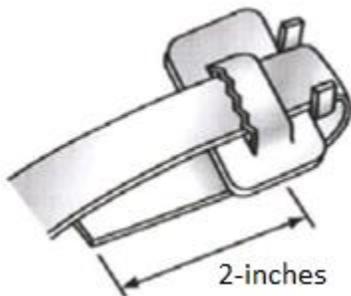
    [4] Squeeze the bend so that the band is flush to the buckle both above and beneath.
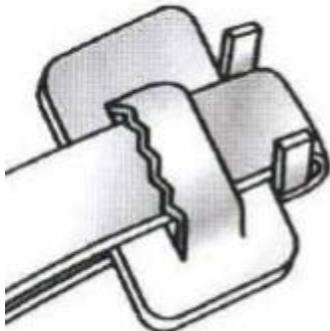
    [5] Loop the band around the pole and slide it back through the buckle with at least 6-inches of band past the buckle.
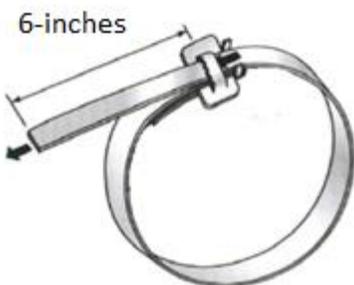
[6] Slide the 6-inches of band into the open slot of the tool nose and gripper block. Move into slot as far as possible. Turn the handle until the band stops moving through the buckle – this means maximum tension has been applied. **DO NOT OVER-TIGHTEN**.

[7] Roll tool nose over the buckle, relieving a slight amount of tension by backing off tension handle (1/2 to 1 turn) **DURING** this fold-over.

[8] Pull cutting handle to cut the band

[9] Hold clamp tail down between buckle ears while hammering ears down to hold band stub in place.

Assembling the Mounting Bracket

Parts List:

Item 1 Unit Bracket Qty: 1	**Item 2** Bracket Arm Qty: 1	**Item 3** Wall/Pole Bracket Qty: 1	**Item 4** Bolt M8x40 Qty: 4	**Item 5** Flat Washer M8 Qty: 4
Item 6 Spring Washer M8 Qty: 4	**Item 7** Nut M8 Qty: 2	**Item 8** Clamping Bracket Qty: 1	**Item 9** Bolt M8x70 Qty: 2	
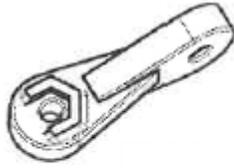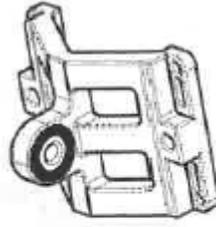
Notes:

- It is recommended to first secure mounting bracket *Item 3* to the pole **before** assembling the entire bracket.
- *Item 8* and *Item 9* are provided for installation on a small-diameter pole, but are not necessary for a wooden pole installation.
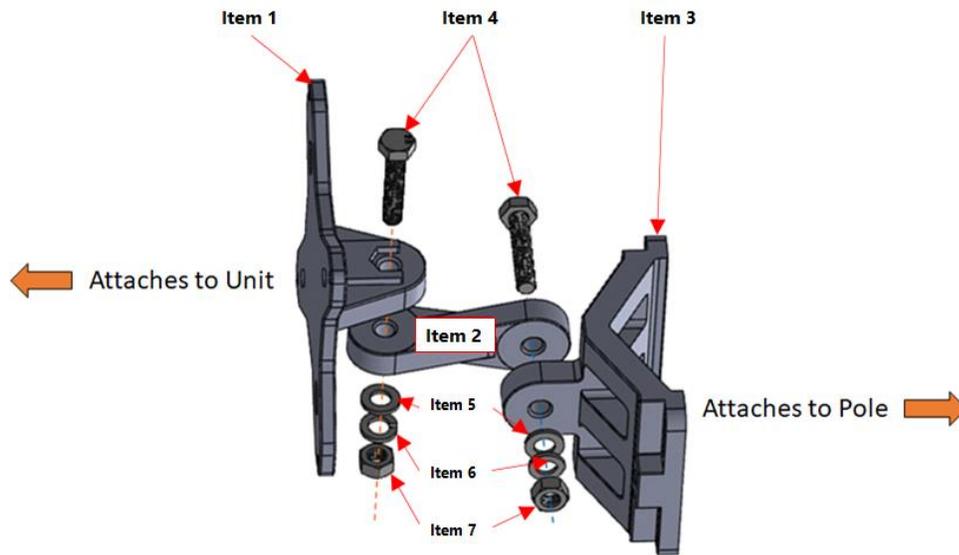
Tighten bolts to 18 ft-lbs (216 in-lbs*)*

Wiring for Pivot 5G

Wiring Guidelines

The Donor Unit and Service Unit must be wired together **properly** and the RF cables must be tightened to the **proper torque specifications**. Connect all four RF cables **before** connecting the power and ground cables.

Each cable **must** be weatherproofed at both connectors after tightening to the required torque. For basic weatherproofing instructions see Cable Weatherproofing below.

While connecting cables, follow these guidelines:

RF CABLE GUIDELINES

- **DO NOT** use plastic tie wraps.
- **DO NOT** remove dust caps on cables or connectors until connecting.
- **DO NOT** get water or dirt in cable connectors.
- **DO NOT** leave connections exposed (without dust caps). Install cables **IMMEDIATELY** after mounting and removing caps.
- **DO NOT** power either unit on until all connections have been made and tightened to specifications.
- **DO NOT** loop power or ground cables in smaller than 6-inch diameter loops or RF cables in smaller than 3-inch diameter loops.
- **DO NOT** crimp, crush or tug on cables.
- Cables shall **NOT** be installed under tension or remain under tension once installed.
- Use the lines on the back of the Installation Guide for proper cable loop sizing.
- Cables **MUST** run uphill to **BOTH** units to create a drip loop between units.

Cable Management

To improve the aesthetics of the installation, cables may be enclosed in UV-rated cable sheathing. This sheathing can be used in combination with the provided Velcro wraps.

Recommended: 1-inch UV Resistant High-Temp Split Loom cable sheathing from Del City (https://delcity.net), Item #1750 (75-feet) or Item #1950 (300-feet)

Installation best practices:

- All four RF cables may be sheathed with the power and ground cables, or the power and ground cables may be sheathed separately in part or in whole.
- Velcro wraps may be used to keep sheathing closed or to keep the sheathing from slipping. **DO NOT** over-tighten Velcro.
- **DO NOT** allow sheathing to pinch cables.

If sheathing all cables together, cable sheathing must be at least six inches from unit to avoid over-bending the ground cable.

If sheathing the RF cables separately, the RF cable sheathing can begin closer to the unit (approximately 2-inches).

Velcro wraps can be used to keep sheathing closed or to help prevent sheathing from slipping down the cables.

RF Connection Guide: 1 Service Unit (or Narrow Beam Service Unit), 1 Donor Unit
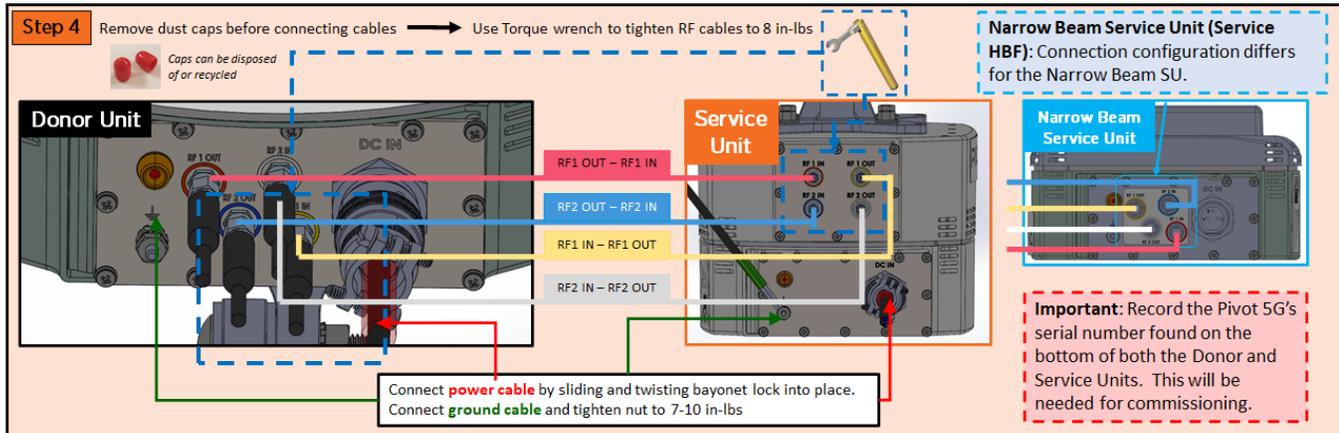
RF Connection Guide: 2 Service Units, 1 Donor Unit
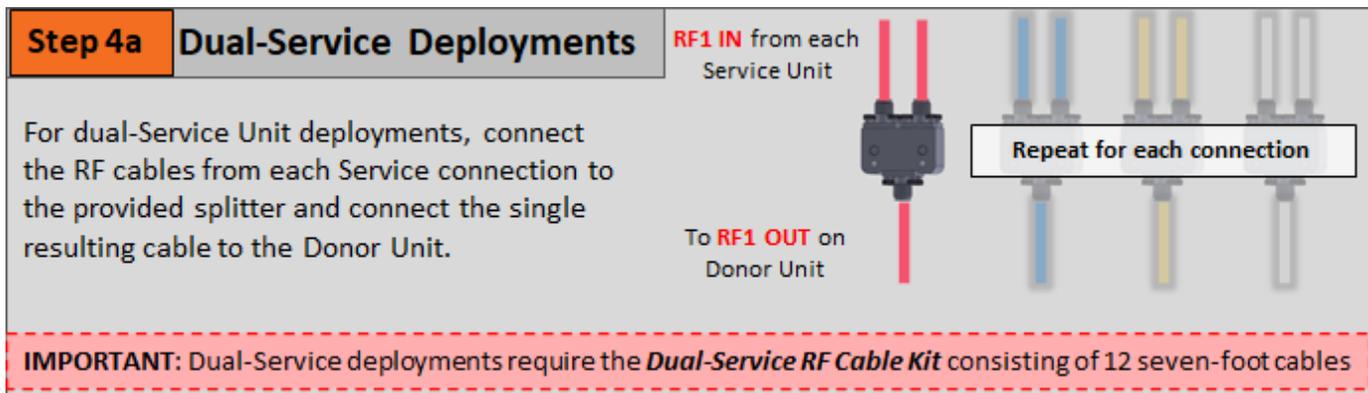
Connection Guidelines

Connection Guide			Connection Details	Cable bend radius	Max Tension
Donor Unit	to	Service Unit			
RF 1 OUT (V-DL)	—	**RF 1 IN** (V-DL)	Tighten to 8 in-lbs	Min 1.5" (Loops 3" dia. or larger)	**DO NOT** install RF cables under tension.
RF 2 IN (H-UL)	—	**RF 2 OUT** (H-UL)	Tighten to 8 in-lbs		
RF 1 IN (V-UL)	—	**RF 1 OUT** (V-UL)	Tighten to 8 in-lbs		
RF 2 OUT (H-DL)	—	**RF 2 IN** (H-DL)	Tighten to 8 in-lbs		
DC IN			Ensure bayonet lock is in place	10x cable dia. (Loops 6" dia. or larger) 6.0 twists per foot	25 lbs
Ground			Tighten nut to 7-10 in-lbs		

Cable Weatherproofing

Coax Weatherproofing

Step 1 — 1 to 1.5-inches of tape. Completely covers Connector

Step 2 — 1 to 1.5-inches of COAX-SEAL. Smooth for complete seal. Ok to run over tape

Step 3 — 1.5 to 2-inches of tape. Completely cover COAX-SEAL. Smooth for tight coverage

Make sure fittings are clean, dry, and connected to the proper torque.

1. Use 1 to 1.5-inches of 1/2 – inch wide electrical tape to cover the connector. Smooth tape for a tight seal over each side of the connector.

2. Use 1 to 1.5 inches of COAX-SEAL to create an air-tight seal over the tape and connector. It is okay to run over the tape. Smooth the COAX-SEAL to ensure complete airtight coverage.

3. Use 1.5 to 2-inches of tape to completely cover the COAX-SEAL. Smooth the entire coverage area to ensure an air-tight seal.

Cable Considerations When Rotating Unit 90 Degrees

Use the provided Velcro straps to route the cables away from the tilted unit in a near-linear path so that:

- No strain or weight is placed on the cables or connections.
- The cables exceed the 1.5-inch minimum bend radius. Best practice is to have as little bend radius as site conditions allow.
- Cables **MUST** run uphill to **BOTH** units to create a drip loop between units.

Cables **MUST** run uphill to **BOTH** units to create a drip loop between units

Velcro strap ensures cables exceed 1.5-inch minimum bend radius

Velcro strap ensures no load is placed on cables
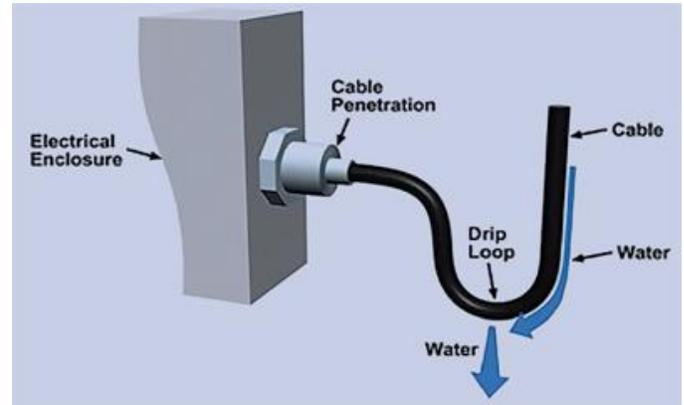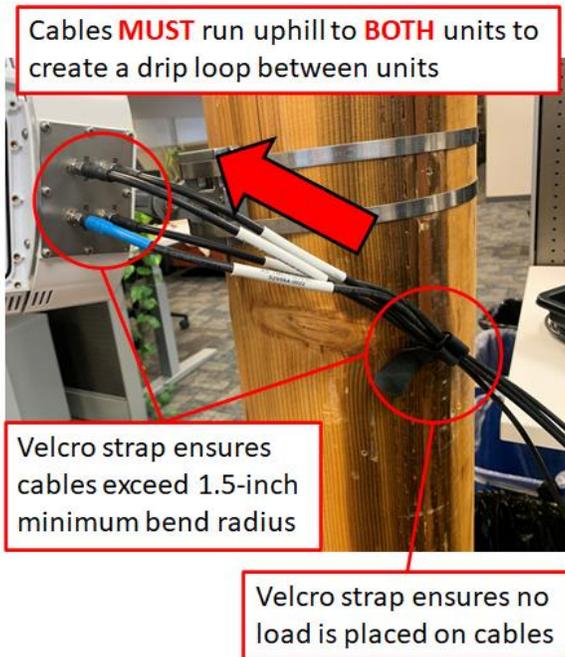
Power and Ground Wiring

Power Cable Guidelines

The **red** wire on the power cable is labeled **+** and should be connected to the positive 48V terminal of the power source. The **black** wire is labeled **–** and should be connected to the negative 48V terminal of the power source.

Pivot 5G is designed to be powered from either a "Neg 48V" power source (with the + terminal connected to ground) or from an "isolated 48V" power source (with both terminals isolated from ground).

Pivot 5G **SHOULD NOT** be powered from a "Pos 48V" power source (with the – terminal connected to ground).

Ground Cable Guidelines

- **DO NOT** route cable over unit. Route cable **AWAY** from the unit (down or left in orientation shown in photos).
- **DO NOT** bend ground cable ring more than 30°.
- Cables **MUST** run uphill to **BOTH** units to create a drip loop between units.

Donor	
Service	
DO NOT route ground cable over repeater.	
DO NOT bend cable at connection point more than 30°.	
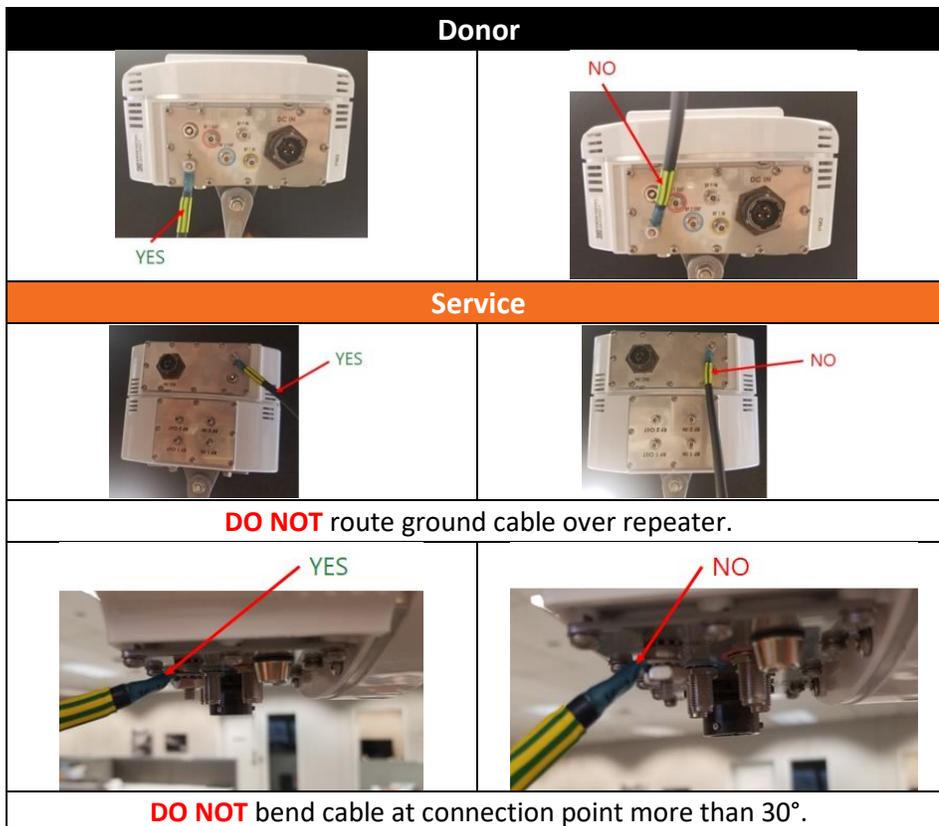
A video of the installation steps is available at: https://vimeo.com/486599212
Password: 5GisPivotal

Setup & Commissioning

Overview

The commissioning process is how the Pivot is set up for use. **Do not try to activate or connect to the Pivot from multiple devices (e.g., phone and laptop) simultaneously**. This will prevent the Pivot from being commissioned properly.

Below is a high-level overview of both Remote (IBMS) and Local Commissioning.

Remote (IBMS) Commissioning → Log onto IBMS → Search for and select Donor Unit → Select **Commission**

After this point Remote Commissioning follows the same steps as Local Commissioning

Local Commissioning → Connect to the Pivot via Wi-Fi → Enter Donor Unit IP into Web Browser → Connect Service Unit → Initiate raster scan → Select and optimize a beam → Run continuous traffic through Pivot (needed for next two steps) → Set up Donor Unit → Set up Service Unit → Complete

Prerequisites for Commissioning

Installation

- Pivot Donor and Service Units installed with all cables connected properly and power on
- Pivot Donor and Service Unit and device used for commissioning are all on the same Wi-Fi network (for Local Commissioning only)

Connectivity

- (Recommended for Local Commissioning): Wireless Access Point configured to the SSID (Pivot5G-install) and Password (InstallNow!) of the units
- Customer-premises equipment supporting mmWave 5G

Information

- Pivot Donor and Service Unit Serial Numbers (on bottom of both Units and packaging box for either Unit)
- **Local Commissioning Only**: Pivot Donor and Service Unit IP Addresses (acquired when connected)

Local Commissioning

Connect via Wi-Fi® and Determine Device IP Addresses

> Using an Access Point is **strongly recommended**. This allows for further distance between Pivot, the AP and PC during commissioning.

[1] Connect to Pivot using either a hotspot created from a PC or an Access Point
   a. Create a hotspot from PC
      i. Search **Mobile Hotspot Settings and configure as follows:**
      ii. *Share my Internet connection with other devices* should be set to **On**
      iii. *Share my connection from* should be set to **Wi-Fi**
      iv. *Network name / SSID* should be **Pivot5G-Install**
      v. *Network password* should be **InstallNow!**
      vi. *Network band* should be set to **2.4 GHz**

      Note: Windows will not allow the creation of a hotspot unless the PC has an Internet connection through a wired interface or second wireless interface. In this case there are apps available that may allow a hotspot outside of the Windows settings.

Mobile hotspot

Share my Internet connection with other devices

On

Share my Internet connection from

Pivotal.local

Share my Internet connection over

Wi-Fi

Bluetooth

Network name: Pivot5G-Install
Network password: InstallNow!
Network band: 2.4 GHz

Edit

Devices connected: 2 of 8

Device name	IP address	Physical address (MAC)
Pivot5G-DU-2002...	192.168.137.125	d8:a9:8b:c1:57:c3
Pivot5G-SU-100043	192.168.137.141	d8:a9:8b:c2:b7:07

The DU and SU indicate which device is the Donor Unit and which device is the Service Unit

    b.   Connect using an Access Point
        i.   Configure AP to the correct SSID/Password and connect
       ii.   The system will appear as '*Pivot5G-DU*-[partial serial number]' in the AP menu along with the IP. (Refresh the AP menu if Pivots do not immediately appear.)
    c.   Record the IP addresses. (These are needed for commissioning.)

Connect to Donor Unit

[2] Connect to the Donor Unit
    a.   Open a web browser (supported: Firefox, Chrome) and enter the **Donor Unit's IP address** into the URL field.
    b.   To confirm which device is connected, use the Flicker LED button in the *Control* tab at the top of the screen to flash the LED on the connected unit. This can also be used if multiple Pivots are in range to confirm connection to the correct unit.

Connect the Service Unit(s).

Welcome to Pivot 5G Donor Unit Setup

Connect Service Unit

IP:

add device

Start

[3] Enter the **Service Unit's IP address** then select **add device** and wait for the Donor Unit to query for the Service Unit. When this is finished the full Service Unit ID will appear above the connection pane along with the service unit type.

    a. Add the second Service Unit if a second Service Unit is being deployed. This will also appear above the connection pane.

    b. If you have added a Service Unit by mistake, you can remove the added unit via the **X** to the left.

Welcome to Pivot 5G Donor Unit Setup

❌ Service Unit 1 URL: http://192.168.1.246/
Service Unit 1 ID: 89000170101203100000
Service Unit 1 Type: SERVICE_HORN_WIDE

Connect Service Unit

IP:

add device

[4] Select **Start** to initiate the raster scan.

Raster Scan

The Raster Scan is the process where the Pivot Donor Unit's Holographic Beamforming Antenna takes measurements across its field of view to determine the best beam direction to choose. This may take several seconds as the Pivot scans for beams.

[5] *Raster Complete* will appear when the scan is finished. This shows the results of the raster scan as well as the top three beam choices ranked based on received power.

[6] The Pivot will select the strongest beam and make that the active beam. Selecting any of the other beams in the list below will change that beam selection to *active* and place a crosshair over that beam.

Raster Complete

Select beams from the list below and perform gain optimization. At least one beam must be optimized to complete the setup process.

Optimize Beam

-15dBm   -7.5dBm   0dBm

Beam Rankings

Rank	Beam(Az/El)	Selection	Optimized
1	6 / -5	(active)	no
2	6 / -30	select	no
3	6 / 10	select	no

HBF SU Beam Direction

Parameter	Value	New Value
SU 1 Azimuth	0	
SU 1 Elevation	0	

Apply Changes

A video of the previous steps:
1. Connect to Pivot via WiFi
2. Add Service Unit
3. Raster & Select Beam.

Is available at https://vimeo.com/486592084
Password: 5GisPivotal

Optimizing Beam Candidates

[7] After choosing the desired beam, select **Optimize Beam**. The display will change to read *Mitigating oscillation before setup...*.

    a. Optimizing a beam is a process in which Pivot will walk through setting up the Donor Unit and Service Unit for the best gain and performance.

    b. Pivot will display *Mitigating oscillation before setup…* and a progress bar. This is the initial check to determine a good starting oscillation point.
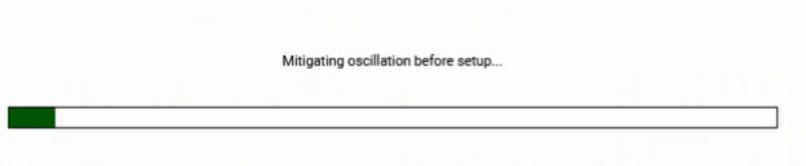
[8] The dB and dBm values below will adjust for the Donor and Service Units as oscillation completes. Note that the Donor Unit value on the left is lined up with the corresponding Service Unit value on the right.
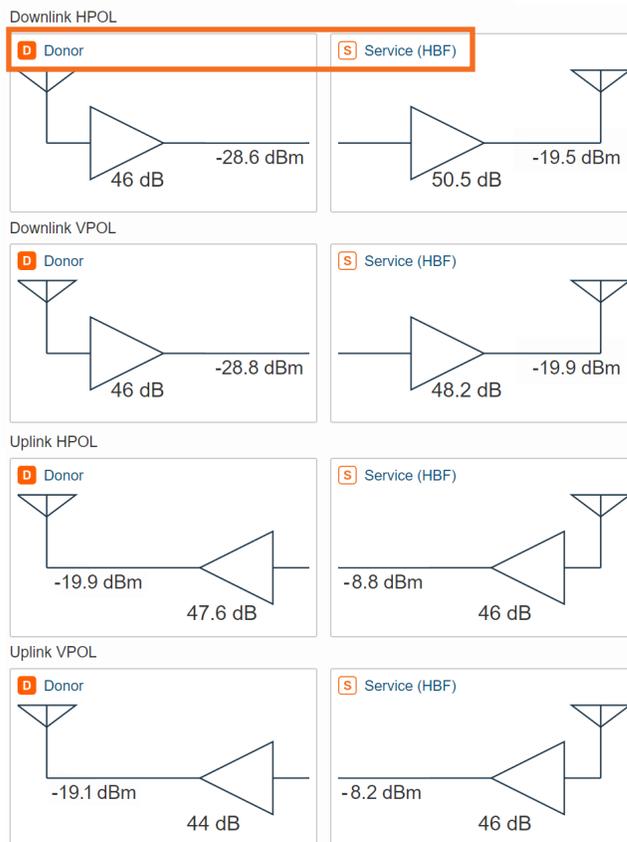
Setting up the Donor Unit

[9] Then set up the Donor Unit which will populate values for power targets.

    a. **During Donor Unit setup the gNB needs to be transmitting traffic continuously.** The Fast.com speed test app can be setup for long duration tests (300s) of downlink traffic.

        i. Go to fast.com and run an initial test.

ii.   Select **Show more info**
iii. Set the duration of the test (300s or longer)

To ensure Pivot is in its optimal configuration after commissioning is complete, continuous traffic must run through the Pivot during DU setup to simulate the maximum power the repeater will ever receive from the gNB (or as close as is possible using UE). AGC can handle a small amount of additional power without a user noticing much change. (See Automatic Gain Control)

There are two ways to ensure proper Pivot setup for this part of the commissioning process:

1. **At the Base of the Pole** – Stand at the base of the pole, below the Pivot Donor Unit if the UE is served by the same beam that would serve Pivot.

2. **In the Pivot Service Area** – Standing in the Pivot service area is a good choice if there is uncertainty of the beam that serves the donor antenna, standing below Pivot is not possible due to the terrain or if there is no service directly below Pivot (e.g., where there is a building between the UE and the gNB allowing Pivot but preventing the UE from having line of sight). Do not change any power targets unless explicitly instructed.

*If the UE is in the service area do not worry about throughput at this point as it may be lower than expected because the Service Unit has not been optimized.

[10] Select **Start DU Setup** while the speed test is running.

> **To calibrate gains, 5G traffic must be present.**
> Begin a speed test on a 5G device, change power detect targets if necessary, then with the speed test running click start to begin Donor Unit gain calibration
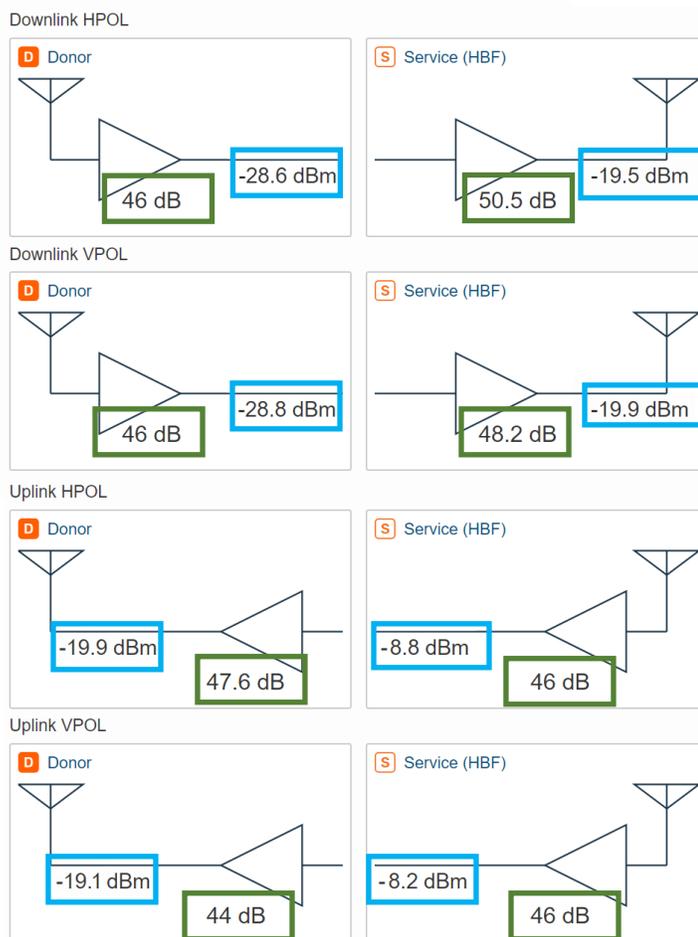> If you cannot get a 5G connection, you should abort and try a different beam.

Start DU Setup

Set Power Targets   refresh

Parameter	Value	New Value
DU downlink (dBm)	3	
DU uplink (dBm)	20	
SU downlink (dBm)	20	
SU uplink (dBm)	10	

Set Targets

a. In the diagram below, the amplifier gain is shown in the green boxes, while the power detector value is shown in the blue boxes.


b. Pivot has two functions which will automatically adjust gain.
    i. Oscillation Self-Detection (OSD)

- OSD continuously monitors for oscillation and will reduce the gain to ensure the repeater does not stay in oscillation. This function creates a "ceiling" for the repeater gain.
    ii.   Automatic Gain Control (AGC)
- AGC adjusts the repeater gain to achieve a specific power target measured at the power detectors and set during Donor Unit setup.
  c.   With traffic continuously running, the gain and power levels will adjust over time (**this may take 3-6 minutes depending on how many changes are needed**).
    iv.   Once the Donor Unit DL Power Detectors reach their target of approximately **3 dBm** click the green **Stop** button
  d.   The image below shows the end state of the Donor Unit optimization. The Donor Unit DL power detectors are reading approximately 3dBm which is the Donor Unit DL target.
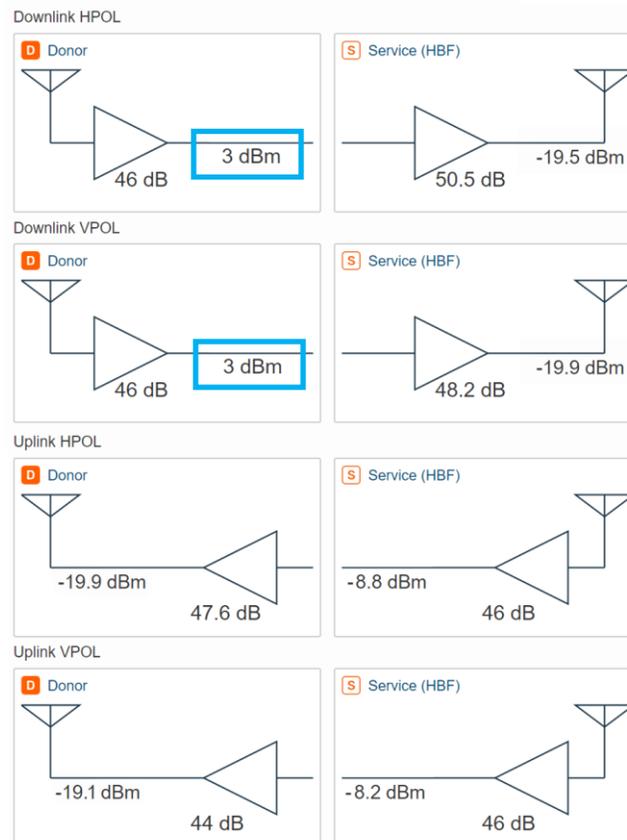
e. Another oscillation mitigation message will appear. This time Pivot will use the specific Donor Unit gains and determine the maximum gain it is able to apply on the Service Unit.

A video of Donor Unit optimization is available at
https://vimeo.com/486593567
Password: 5GisPivotal

Setting up the Service Unit

[11]   When ready select **Start SU Setup**.

[12]   Pivot will now optimize the Service Unit. As with the Donor Unit previously, the gain and power detector values will adjust. When the Service Unit DL Power detectors are at the set point of **20 dBm**, select the green **Stop** button.

[13]   After each setup for the Donor Unit and Service Unit, the Pivot will store beam data on the devices. Once this is complete the interface will show **Gain optimization complete** and give the option to return to the beam selection screen. If a different beam is selected, the above steps (beginning at step 7) will need to be followed again.

Finish Commissioning

[14]   The other beams can now be optimized. Doing this extra work now has advantages:
a. The other beams can be checked to see if they give better performance.
b. Pivot will save the settings and beams can be toggled remotely if there is a network outage or to switch to a less busy gNB during a particularly congested time.

[15]   Once finished you **MUST** select **Finish Setup** to save the beam optimization and Donor and Service Unit setup.

> **IMPORTANT**: If you do not select **Finish Setup** to save the beam optimization and Donor and Service Unit setup, the Pivot system will not operate efficiently.

[16]   Commissioning is now complete.

   a.   After commissioning, values for yaw, pitch and roll can be added to record these deployment details of the Donor or Service Unit. See Entering or Collecting Data after Commissioning for more details.

Note: If the Donor Unit or Service Unit need to be re-optimized, the entire process must be redone starting at Optimizing Beam Candidates above.

> A video of Service Unit Optimization and entering deployment details is available at
> https://vimeo.com/486594139

For a full list of videos see Appendix D – Commissioning Videos.

Post-Commissioning Closeout

Overview

Once commissioning is complete and the user has selected **Finish Setup**, information about the site may be entered or recorded before selecting **Save Configuration** to save the setup.

IMPORTANT: Even if no data is entered, the user **MUST** select **Save Configuration** or they will have to redo the entire commissioning process.

The post-installation data is split into two categories: 5G Information and Location Information.

Record 5G Information

The following 5G data may be recorded by entering the requisite data and selecting **Record Info**.

IMPORTANT: The user **MUST ALSO** select **Save Configuration** to save the information that has been entered.

- **PCID** – Physical Cell ID
- **RSRP** – Referenced Signal Received Power
- **SINR** – Signal to Interference plus Noise Ratio
- **ARFCN** – Absolute Radio Frequency Radio Number

Information about the installation can be recorded below. Make sure to click the save button to record changes to installation info.

Record 5G Info

Parameter	Value	New Value
5G PCID	5G PCID_RC1	
5G RSRP	5G RSRP_RC1	
5G SINR	5G SINR_RC1	
5G ARFCN	5G ARFCN_RC1	

Record Info

Record Location Information

The following location data may be recorded by entering the requisite data and selecting **Record Info**.

IMPORTANT: You **MUST ALSO** select **Save Configuration** to save the information that has been entered.

- **DU Location**
- **DU Orientation**
  - **Yaw**
  - **Pitch**
  - **Roll**
- **SU Location**
- **SU Orientation**
  - **Yaw**
  - **Pitch**
  - **Roll**

Record Location

Parameter	Value	New Value
DU Location	DU_LOCATION_RC1	
DU Orientation - Yaw	DU_YAW_RC1	
DU Orientation - Pitch	DU_PITCH_RC1	
DU Orientation - Roll	DU_ROLL_RC1	
SU Location		
SU Orientation - Yaw		
SU Orientation - Pitch		
SU Orientation - Roll		

Record Info

Save Configuration

IBMS Commissioning

[1] Log into IBMS at https://ibms-ui-prod.azurewebsites.net/.
  a. **Note**: This is a generic URL, use your customer-specific IBMS URL.

[2] Open the Actions Menu via the lightning bolt on the left sidebar. Select the **Commission Pivot** button at the top left.
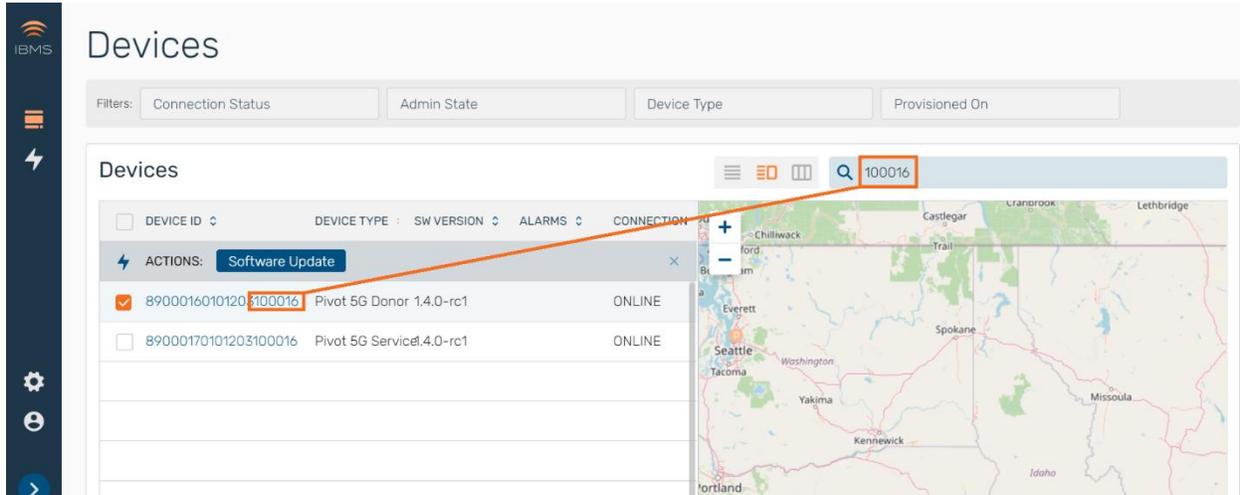
[3] You will be prompted to *Create a Pivot* by adding the Donor Unit serial number and Service Unit serial number. If your Donor Unit is associated with a Pivot System (as in a Donor Unit and its associated Service Unit(s)), then the Service Unit serial number(s) will fill automatically.

[4] Enter the Donor Unit serial number and the serial numbers for the one or two connected Service Units. If you do not have a second Service Unit, this field can be left blank. You can also use the Donor Unit and Service Unit(s) names or existing Pivot System name (both as previously assigned by the customer or installer).

[5] When finished, select **Next**.

    a.   **Note**: If you are recommissioning a Pivot System, an additional window will pop up now that confirms that you are recommissioning. If you are commissioning for the first time, the dialogue will proceed to the next step.

[6] Setting a Site ID as part of a POD

    a. Software versions 2.0.0 and later require the user to bundle a Donor Unit and Service Unit (or dual Service Units) under a POD (Pivotal Operational Device) when commissioning with IBMS. A *Site ID* is required to complete the *POD code and name*. Only alpha-numeric characters (including underscores and spaces) may be entered.

[7] Once a user has entered a Site ID (and latitude and longitude if desired), they should select **Ready to commission**.

Create a POD

    Selected devices for the Pivot

    D Donor   89000160101203100013

    S Service   89000170101203100043

    POD code and name

    POD code   Site ID (Required)

    POD_00115   5643 S Kirkland - Pole A

    Location

    Latitude: Longitude:

    47.480   -124.134

    Advanced settings   Cancel   Ready to commission

[8] The Pivot will then scan for signal sources and provide an estimated time remaining.
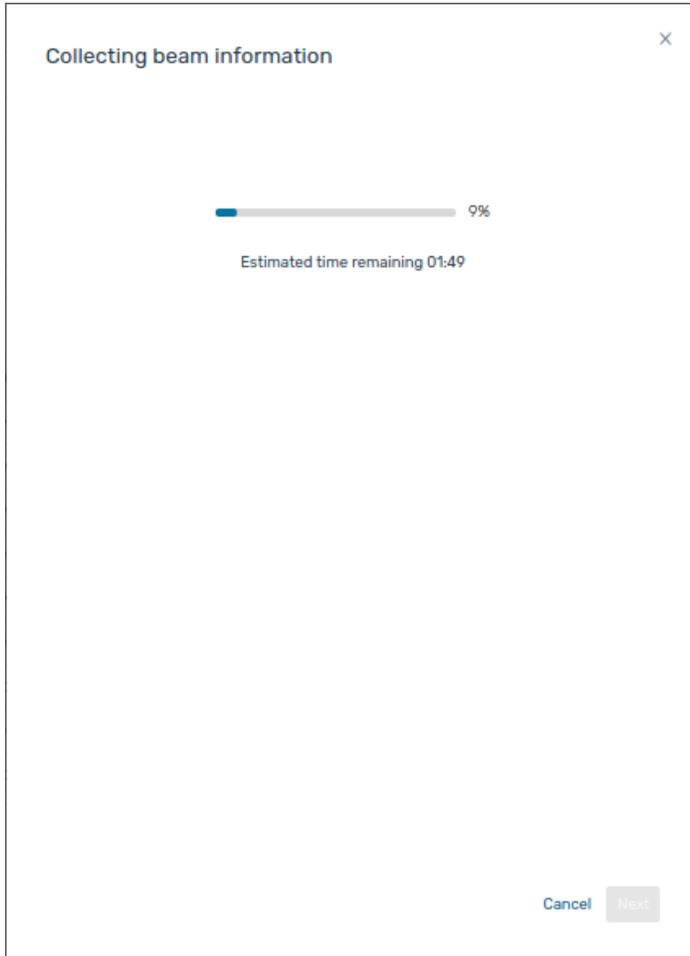
[9] Once scanning is complete IBMS will display the found beam(s) with the top beam selected.
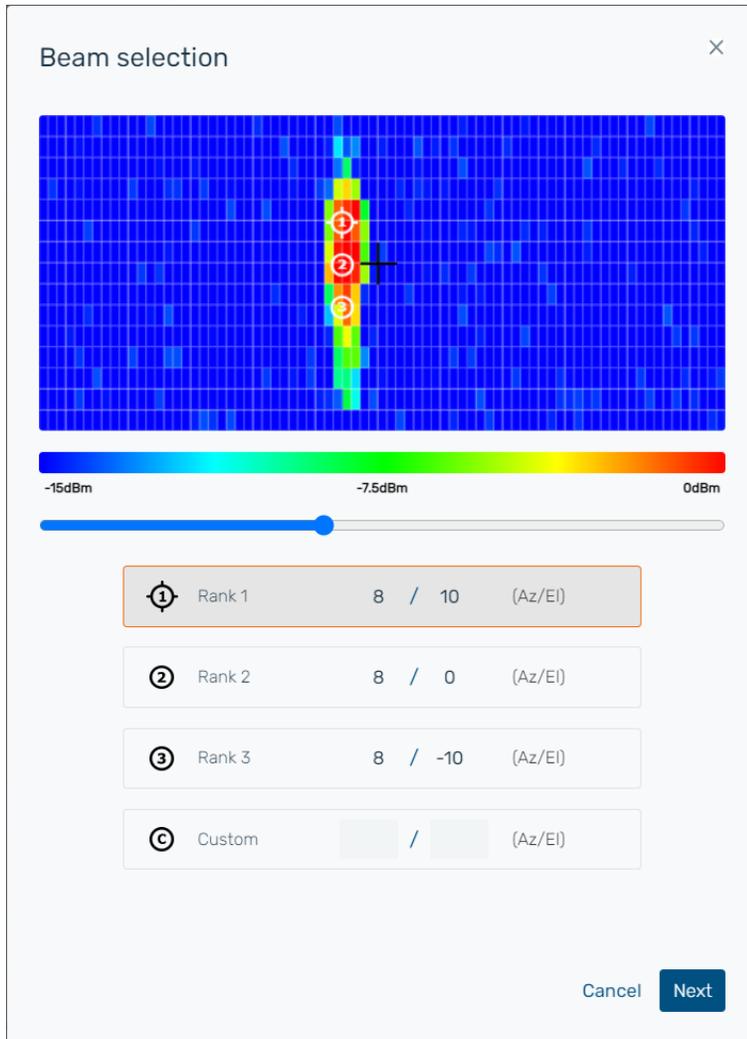
[10] Select the desired beam and select **Next**.

a. You can also manually select a beam by mousing over the raster map to the desired location and **left-clicking** or by filling in the fields for azimuth and elevation under the custom beam at the end of the list. You can only enter numeric values between the Pivot scanning ranges of +/- 76 for azimuth and +/- 35 for elevation for a custom beam.

[11]　　You have completed the Pivot 5G setup. The Pivot will make further adjustments over the next 24 hours to optimize for prevailing traffic. You can visit the *Actions* page for a status update.
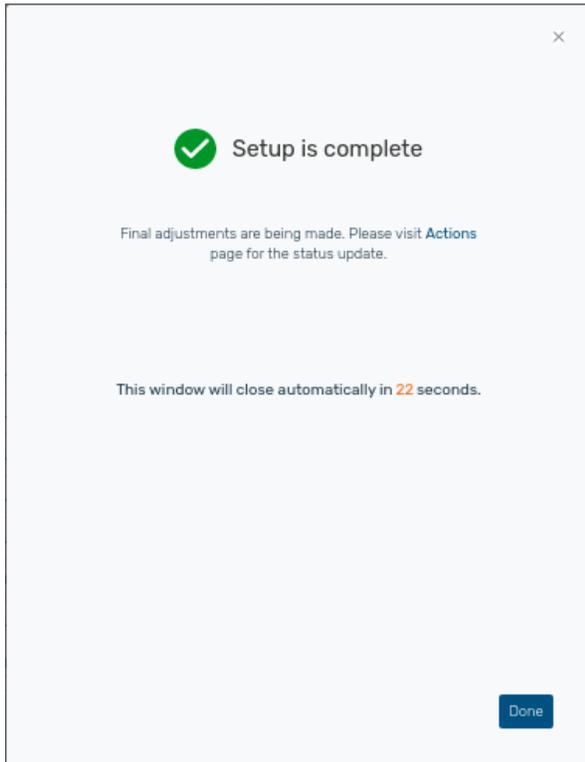
Changing from a Single Service to Dual Service Deployment

Overview

There are additional considerations when changing a single Donor Unit, single Service Unit deployment to a dual Service Unit deployment that do not need to be considered when you are deploying two Service Units from the start.

Mounting

It is not critical to mount the second Service Unit on the same plane as the first Service Unit. We recommend mounting the second Service Unit just below the first Service Unit vertically. The carrier will help determine the angle from the other Units at which to place the second Service Unit.

DO NOT mount the second Service Unit on top of the banding from the first Service Unit.
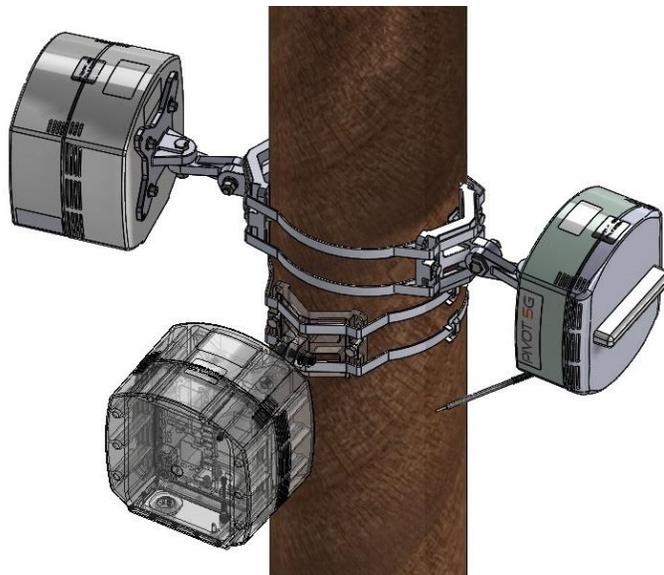
Second Service Unit added below initial Service Unit

Commissioning

You **MUST** redo the **ENTIRE** commissioning process.

When you reach the point in the commissioning process where you connect to the Service Unit(s) you will need to add **BOTH** service units.

The Service Unit setup will perform for both service units simultaneously. You will not need to do setup for each Service Unit.

A commissioning video with two Service Units is available at
https://vimeo.com/486597860
Password: 5GisPivotal

Management and Troubleshooting

LED Behavior

LED Behavior

Before Commissioning

Solid Yellow – Initial power-up sequence

Blinking Yellow – Device is ready to Commission

After Commissioning

Blinking Red and Green – Identifying Device

Solid Green or Yellow (temporary, prior to no light) – Strong or medium signal from gNB

Solid Red – Weak signal from gNB

No light – Ready for use

Blinking red – Error

Notes:

Signal Strength

- The solid yellow or green LED color will remain for 20 seconds before changing to the "ready for use" status (no light).
- A solid red LED indicating a weak signal will remain until the signal gets stronger.
- The LED may cycle between green and yellow or yellow and red if the signal strength is right between strong and medium or medium and weak.

Errors – A blinking red LED indicating an error will remain until the error is cleared.

FAQ

The page loads slowly when I type in the DU's IP.

Clear your browser cache and enter the IP address again.

What if I don't see the unit in IBMS?

It can take several minutes for the device to appear in IBMS.

What if my last saved data does not appear?

Wait a few seconds after saving to ensure the unit has time to save data.

Getting Technical Assistance

Pivotal Commware is dedicated to the success of your Pivot 5G installation and operation. Feel free to contact us with any questions or concerns.

Before calling, gather the following details about your Pivot 5G:

- Serial Number (located on the bottom of each unit and on the packaging box)

Pivotal Commware Pivot 5G Technical Support:

- Phone – 1-855-956-2016
- Email – support@pivotalcommware.com
- File a Ticket – https://pivotalcommware.freshdesk.com/support/home
- Pivotal Support Resources: https://pivotalcommware.com/pivot-5g-installation-help/

10801 120th Ave NE, #200
Kirkland, WA 98033 USA

(425) 365-0408
pivotalcommware.com

Appendix A – Resources

Commissioning Videos

	Title	Description	Link	Length
1	Pivot 5G Commissioning Part 1	1. Connecting to WiFi 2. Raster Scanning 3. Beam Selection	https://vimeo.com/486592084	7:17
2	Pivot 5G Commissioning Part 2	Optimizing the Donor Unit	https://vimeo.com/486593567	2:48
3	Pivot 5G Commissioning Part 3	Optimizing the Service Unit	https://vimeo.com/486594139	4:53
4	Pivot 5G Commissioning with Two Service Units		https://vimeo.com/486597860	11:21
5	Pivot 5G Web GUI	User Interface, system status, and alarms	https://vimeo.com/486595043	5:36
6	Installing Pivot 5G on a Pole	How to install Pivot on a wooden utility pole	https://vimeo.com/643726220	12:26

Password for all videos: 5GisPivotal

Pivot 5G Specifications

Pivot 5G specifications can be found in the Pivot5G datasheet: https://pivotalcommware.com/wp-content/uploads/2021/01/Pivot-5G-Datasheet-28-GHz-v2021.1.pdf

Appendix B – Full Band-It® Instructions

Forming a Band Clamp and Operating a C00169 Tool
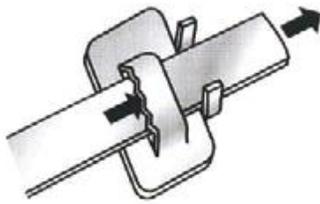
[1] Pull appropriate length of band from BAND-IT tote (approx. 4-1/2 times the diameter of the pole or mastarm for a single-wrapped clamp and seven times the diameter for a double-wrapped clamp. Add 6-8 inches for both single-wrapped and double-wrapped clamps to accommodate the tail and bracket design.) Cut the band using one of the BAND-IT tools with built-in cutter.
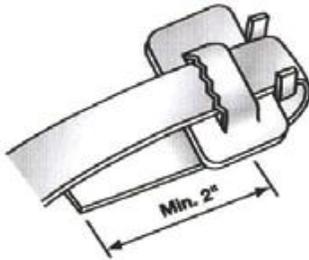
[2] Holding the buckle in one hand, with ears pointing upward and to the right as shown, insert the band through the buckle "bridge", past the ears and bend so that at least 2 inches are underneath the buckle.
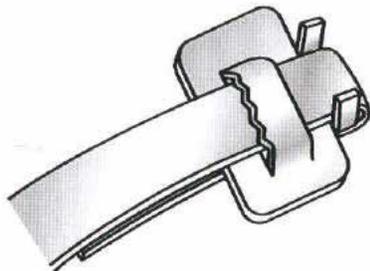
[3] Squeeze this "buckle wrap" to flatten the bend preventing "pull-out" during tensioning

[4] Wrap band through hardware as needed and around the pole, mastarm or hose and thread through bridge as shown.
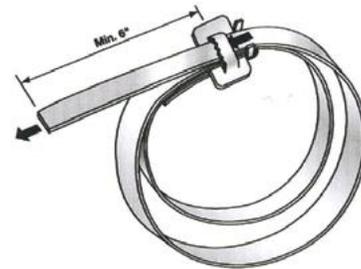
[5] Repeat a second wrap of band through the bracket and buckle for a continuous double-wrap application. Double-wrapping develops greater clamp tightness than single-wrapping clamps and more than doubles the holding strength for heavy objects and high wind loads.

[6] Place band in open slot of tool nose and gripper block. Move into slot as far as possible to prevent buckle from sliding into tool nose. With thumb on band gripper lever, apply tension by turning handle of tool. After tension is created, it is no longer necessary to hold the band gripper lever as it locks itself under tension. When band stops moving through buckle, maximum tension has been applied. Stop turning the handle.

[7] To set the lock and cut off band, roll tool nose over buckle, relieving a slight amount of tension by backing off tension handle **during** this fold over operation. Failure to back off tension handle throughout the entire course of roll over may result in breaking band. On the other hand, releasing too much tension may result in a loose clamp. We suggest 1/2 to 1 full turn of the spin handle during release.
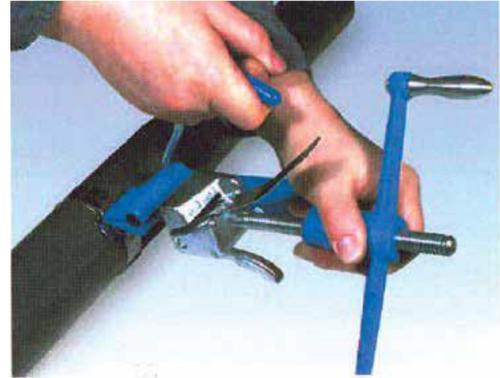
[8] Pull cutting handle to cut the band.

[9] Remove tool, holding stub of band down with thumb.

[10] Hold clamp tail down between ears while hammering the buckle ears down to hold band stub in place. This completes the secure BAND-IT clamp.

Top View

Fluted Pole Applications

When tensioning a conventional clamp over a fluted pole, it is necessary to extend the length of the "buckle wrap" several inches to assure contact with 2 or 3 flute ridges. Also, buckle placement over a ridge is important to provide support for the lock and prevent the "lip wrap" from shifting.

Appendix C – Full Warranty Information

Your Pivotal Commware, Inc. ("Pivotal") Pivot 5G has been designed to provide reliable, worry-free service. If for any reason you have a problem with your equipment, please refer to the manufacturer's warranty in this section.

Standard Limited Warranty

What is Covered and For How Long?

Pivotal warrants to the original purchaser ("Purchaser" or "You") that the Pivotal Pivot 5G and accessories ("Products") included in this package are free from defects in material and workmanship under normal use and service for the period commencing upon the date of purchase and continuing for the following specified period of time after that date: All components carry a one-year warranty.

What is Not Covered?

This Limited Warranty is conditioned upon proper use of Product by Purchaser. This Limited Warranty does not cover: (a) defects or damage resulting from accident, misuse, abuse, neglect, unusual physical, electrical or electromechanical stress, or modification of any part of Product, including antenna, or cosmetic damage; (b) equipment that has the serial number removed or made illegible; (c) any plastic surfaces or other externally exposed parts that are scratched or damaged due to normal use; (d) malfunctions resulting from the use of Product in conjunction with accessories, products, or ancillary/peripheral equipment not furnished or approved by Pivotal; (e) defects or damage from improper testing, operation, maintenance, installation, or adjustment; (f) installation, maintenance, and service of Product, or (g) Product used or purchased outside the United States.

There are no user-serviceable parts in any Pivot unit. If a unit is believed to not be functioning properly, the user must contact Pivotal Commware for Returned Material Authorization.

What are Pivotal's Obligations?

During the applicable warranty period, Pivotal will repair or replace, at Pivotal's sole option, without charge to Purchaser, any defective component part of Product. To obtain service under this Limited Warranty, Purchaser must return Product to an authorized service facility in an adequate container for shipping, accompanied by Purchaser's sales receipt or comparable substitute proof of sale showing the date of purchase, the serial number of Product and the seller's name and address. To obtain assistance on where to deliver the Product, call Verizon Customer Care at (800) 922-0204. Upon receipt, Pivotal will promptly repair or replace the defective Product. Pivotal may, at Pivotal's sole option, use rebuilt, reconditioned, or new parts or components when repairing any Product or replace Product with a rebuilt, reconditioned or new Product. All other repaired/replaced Product will be warranted for a period equal to the remainder of the original Limited Warranty on the original Product or for 90 days, whichever is longer. All replaced parts, components, boards and equipment shall become the property of Pivotal. If Pivotal determines that any Product is not covered by this Limited Warranty, Purchaser must pay all parts, shipping, and labor charges for the repair or return of such Product.

WHAT ARE THE LIMITS ON PIVOTAL'S WARRANTY/LIABILITY?

EXCEPT AS SET FORTH IN THE LIMITED WARRANTY CONTAINED HEREIN, PURCHASER TAKES THE PRODUCT "AS IS," AND PIVOTAL MAKES NO WARRANTY OR REPRESENTATION AND THERE ARE NO CONDITIONS, EXPRESS OR IMPLIED, STATUTORY OR OTHERWISE, OF ANY KIND WHATSOEVER WITH RESPECT TO THE PRODUCT, INCLUDING BUT NOT LIMITED TO:

THE MERCHANTABILITY OF THE PRODUCT OR ITS FITNESS FOR ANY PARTICULAR PURPOSE OR USE;

WARRANTIES OF TITLE OR NON-INFRINGEMENT;

DESIGN, CONDITION, QUALITY, OR PERFORMANCE OF THE PRODUCT;

THE WORKMANSHIP OF THE PRODUCT OR THE COMPONENTS CONTAINED THEREIN; OR

COMPLIANCE OF THE PRODUCT WITH THE REQUIREMENTS OF ANY LAW, RULE, SPECIFICATION OR CONTRACT PERTAINING THERETO.

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Appendix D - Glossary

Term	Definition
3GPP LTE	LTE protocol per "3rd Generation Partnership Project," a mobile telephone standards org.
5G-NR	The 5G radio system
5G NSA	Non-Stand-Alone flavor of 3GPP 5G-NR ... requiring concurrent 4G capability to function (currently typical)
5G SA	Stand-Alone flavor of 3GPP 5G-NR ... able to work without 4G capability (eventually, future)
AGC	Automatic Gain Control
Az, AZ, Azimuth	The "left-to-right" angle direction relative to nearby gNB location
BW	Bandwidth
CAPEX	Capital Expenditure, the money an organization uses to maintain fixed assets such as infrastructure.
Commissioning	(Pivot 5G) Installation and initial setup, which tunes the system to optimal functionality
CPE, Customer Premises Equip.	Typically: End-user obtained transceiver that distributes FWA broadband internet to devices within the home via WLAN (Wi-Fi). Effectively replaces cable/DSL internet
dB, decibel	A relative unit of power, used to express change in value as in "increase of 3 dB" -- presented on a logarithmic scale
dBm	A unit of level, indicating a power ratio expressed in decibels (dB) with reference to one milliwatt (mW)
DL, Downlink	Data/information transmitted in the direction from gNB to CPE/UE
DU, Donor Unit	The Pivot unit that receives service from the gNb
KPI	Key performance indicators: set of useful parameters that are tracked through IBMS.
EIRP	Equivalent Isotropic Radiated Power, a measure of Transmit power
El, EL, Elevation	The "up-to-down" angle direction relative to distant gNB location
EVM	Error Vector Magnitude, a measure of quality of received signal
FWA	Fixed Wireless Access.
Gigabit speed	A term of user-perceived throughput, as in Gigabits/second
gNodeB, gNB	5G NR base station
HBF	Pivotal Commware's Holographic Beam Forming technology that enables Gigabit speeds beyond the reach of cable and DSL
IBMS	Intelligent Beam Management System, software to help operators maximize efficiency, capacity, and coverage.
LTE	Long-term Evolution, generally referring to technology path toward 4G speeds
LTE Cat M1	A flavor of IoT (internet of things) technology under 3GPP LTE umbrella
MAC Address	Media Access Control address, a unique identifier assigned to a network interface controller
Millimeter wave frequencies	Wavelength spectrum that correlates to ~24 GHz frequencies and higher
mmWave	Millimeter Wave
OAM, OA&M	Operations, Administration & Management/Maintenance – the necessary processes for setting up and running a system
OPEX	Operating Expenditure, the cost for a business to run an ongoing service or system.
OSD	Oscillation Self-Detection

Term	Definition
Pivot, Pivot 5G, Pivot System	A Pivot consisting of one Donor Unit and one or two Service Units
POD	Pivotal Operational Device
RF	Radio Frequency
RSRP	Reference Signal Reserve Power, the received power level in a network.
SU, Service Unit	The Pivot unit that distributes the signal to users.
SSID	Service Set Identifier, the technical term for a network name
UE	User Equipment – typically CPE or a mobile device/smartphone
UL, Uplink	Data/information transmitted in the direction from CPE/UE towards gNB