



MPU5 (WR-5100)

BASIC OPERATOR MANUAL

VERSION 3.2

03EN073
Rev. P



Copyright 2010 - 2025, Persistent Systems, LLC. All rights reserved. Wave Relay® is a registered trademark of Persistent Systems, LLC ("Persistent"). This Basic Operator Manual (the "Manual") contains information that is the sole property of Persistent Systems, LLC. Therefore, the Manual may not be excerpted, summarized, copied, distributed, or otherwise published, in whole or in part, without the prior written permission of Persistent Systems, LLC. All other product and service names, trademarks, logos, and brands are property of their respective owners. All non-Persistent company, product, and service names and all non-Persistent trademarks used in this Manual are for identification purposes only. Use of these non-Persistent names, trademarks, logos, and brands does not imply endorsement.

READ MANUAL BEFORE OPERATION

DO NOT SWAP RF MODULES WHILE UNIT IS POWERED ON!

DO NOT POWER ON UNIT WITHOUT ANTENNAS ATTACHED!



Copyright 2010 - 2025 Persistent Systems, LLC
Issued: November 2024

PERSISTENT SYSTEMS

Headquartered in New York City since 2007, Persistent Systems LLC is a global communications technology company that develops, manufactures, and integrates a patented and secure Mobile Ad Hoc Networking (MANET) system: the Wave Relay® MANET. The company's industry-leading R&D team has designed wireless networking protocols to support their cutting edge Wave Relay® system and has designed leading-edge tactical networking devices that allow the Wave Relay® MANET to achieve its highest potential. The Wave Relay® MANET is capable of running real-time data, video, voice, and other applications under the most difficult and unpredictable conditions. Their suite of products is field proven and utilized in Commercial, Military, Government, Industrial, Agriculture, Mining, Oil and Gas, Robotics, and Unmanned System markets.

THE MPU5

The MPU5 is the Next Generation Wave Relay® platform. Leveraging multiple leading edge technologies such as MIMO and Android™, the MPU5 is a tactical networking device that delivers increased performance, reliability, and capability to the end user in a small, cost-efficient package. Stream multiple HD Video feeds, run commercial and custom apps, view situational awareness, and communicate with high quality audio all with a single device and a minimal number of accessories.

WAVE RELAY® MANET

The Wave Relay® MANET is a peer-to-peer wireless MANET networking solution in which there is no master node. If any device fails, the rest of the devices continue to communicate using any remaining connectivity. By eliminating master nodes, gateways, access points, and central coordinators from the design, the Wave Relay® MANET delivers high levels of fault tolerance regardless of which nodes might fail. The network is designed to maximize the capacity of the radio frequency (RF) spectrum and to minimize the network overhead. While optimizing efficiency, the Wave Relay® MANET also implements techniques that increase multicast reliability. The advanced multicast functionality allows the system to support both multicast voice and video over IP.

The Wave Relay® MANET is designed to maintain high bandwidth connectivity among devices that are on the move. The system is scalable, enabling it to incorporate unlimited meshed devices into the wireless network, where the devices themselves form the communication infrastructure. Even in highly dynamic environments, the system is able to maintain connectivity by rapidly re-routing data as necessary. The Wave Relay® MANET is a self-forming and self-healing network where nodes can move freely within the network. Critical information flows reliably throughout the network while individual data paths are able to adapt at sub-second intervals. This unique approach creates an ideal environment for maximizing performance across the available communications medium. Customers leverage the Wave Relay® MANET's straightforward and effective architecture to enable a true "Plug and Play" capability. Deploying a Wave Relay® MANET is as simple as connecting a standard Ethernet cable; customers are immediately connected to everything on the network.

CONTACT PERSISTENT SYSTEMS

Persistent Systems

Tel: (212) 561-5895 | www.persistentsystems.com

Persistent Systems Support & RMA

<https://www.persistentsystems.com/ps-support/>

Persistent Systems Sales

Email: sales@persistentsystems.com

Persistent Systems Training

Email: training@persistentsystems.com



Table of Contents

Introduction	4
Persistent Systems	4
The MPU5	4
Wave Relay® MANET	4
Safety	12
Suggested Hardware	16
Part I: Physical Setup	17
Section A: RF Setup	17
Inserting the RF Module	20
Connecting Antennas	22
Section B: Power	26
Connecting Power	28
Removing Power	30
Powering On the Unit	32
Section C: Side Connector Cables	34

Parts List	35
Connecting a Cable to a Side Connector	35
Part II: Software Setup	38
Section A: Configuring the Management Computer	38
Parts List	38
Configuring the Management Computer (Windows)	40
Configuring the Management Computer (Linux)	45
Section B: Connecting the MPU5 to the Management Computer	46
Parts List	46
Section C: Accessing the Web Management Interface	49
Parts List	49
Section D: Basic Network Setup	57
Security Key	57
Assigning IP Address and Interface Names	59
Rebooting an Individual Node	62



Table of Contents

Managed Node List	63
Part III: Testing Connectivity	67
Check Neighbor Node Status	67
Perform a Throughput Test	69
Throughput Test Logging	71
Part IV: Using the Web Management Interface	73
View Individual Node Information	73
Configuring RF Settings for a Single Node	76
Upgrading Firmware	78
Creating a Configuration File	80
Loading Settings from a Configuration File	82
Reset Node to Factory Configuration	84
Check GPS Status	85
Network Status Tab	86
Network Visualization	88

Part V: Device Operation	92
Zeroize the Security Key	92
Connect a Camera to the MPU5	94
Configuring Video Settings	96
Connecting a Monitor or TV to the MPU5	106
Connect USB Accessories to the MPU5	109
Install Android™ Apps on the MPU5	111
Network Configuration Tab	114
Configure 3rd Party PTT Settings	116
Enable Push-to-Talk	117
Set Microphone Level	117
Set Earpiece Volume	118
Set Transmit Mode	119
Set Transmit or Receive Audible Checktone	120
Enable/Disable Low Battery Audible Notification	121
Selecting Channels	122



Table of Contents

Customize a PTT Channel	122
Using Wave Relay® Push-to-Talk	124
Using Flash Override	125
Professional Installer – Compliance	126
Professional Installer - Compliance (USA)	126
Professional Installer - Compliance (Canada)	141
Professional Installer - Compliance (Japan)	150
Attachments	155





Lire et comprendre les consignes de sécurité d'emploi et tout de l'opérateur avant d'utiliser cet équipement

SAFETY WARNINGS

Handle Safely:



- ▶ Falling while installing or removing equipment can cause serious injury.
- ▶ If installing on a tower or any other tall locations, use proper lifting techniques and wear proper protective equipment.
- ▶ Tomber lors de l'installation ou de retirer l'équipement peut causer des blessures graves.
- ▶ Si vous installez sur une tour ou d'autres endroits de hauteur, utiliser des techniques de levage appropriées et porter un équipement de protection approprié.

Electrical Shock and Fires:



- ▶ Understand and follow all local codes and regulations when installing electrical equipment.
- ▶ Only use approved battery and/or power supplies.
- ▶ Comprendre et respecter tous les codes et règlements locaux lors de l'installation des équipements électriques.
- ▶ Utilisez uniquement la batterie et les alimentations ou approuvée.

RF Exposure:



- ▶ Prevent injury from exposure to high frequency fields.
- ▶ See antenna separation instructions in the Compliance section of this manual.
- ▶ Do not operate with antenna removed. This can increase RF exposure risks and/or damage the equipment.
- ▶ Prévenir les blessures d'exposition aux champs de haute fréquence.
- ▶ Voir les instructions de séparation de l'antenne dans la section de la conformité de ce manuel.
- ▶ Ne pas faire fonctionner avec antenne enlevée. Cela peut augmenter les risques d'exposition aux radiofréquences et ou endommager l'équipement.

CAUTION
DEVICE UTILIZES LITHIUM ION BATTERY
RISK OF EXPLOSION IF BATTERY IS REPLACED BY AN INCORRECT TYPE.
DISPOSE OF USED BATTERIES ACCORDING TO THE INSTRUCTIONS

MISE EN GARDE
Dispositif utilise la batterie Ion Lithium
RISQUE D'EXPLOSION SI LA BATTERIE EST REMPLACÉ PAR UN TYPE INCORRECT.
Jetez les piles usagées selon
LES INSTRUCTIONS

Lithium Batteries Handling

- ▶ Lithium ion batteries are defined as Class 9 dangerous goods by the IATA Dangerous Goods Regulations.
- ▶ Handle with care.
- ▶ Do not use if package is damaged - it can cause fire.

Disposing of Used Batteries

- ▶ Disposal should be done in accordance with applicable regulations, which vary from country to country as well as by state and local governments. In most countries, trashing of used batteries is forbidden and disposal can be done through non-profit organizations mandated by local au-

thorities or organized by professionals.

- ▶ Incineration of lithium cells and batteries by consumers is not recommended. Incineration should be done at a properly permitted facility that can handle this waste.

Manipulation des batteries lithium

- ▶ Les batteries au lithium-ion sont définis comme Classe 9 marchandises dangereuses par le Règlement sur les marchandises dangereuses de l'IATA.
- ▶ Manipuler avec soin.
- ▶ Ne pas utiliser si l'emballage est dommage, il peut provoquer un incendie.

Mise au rebut des batteries usagées

- ▶ L'élimination doit être effectuée conformément aux réglementations applicables, qui varient d'un pays à l'autre ainsi que par les gouvernements d'État et locaux. Dans la plupart des pays saccage des batteries usagées est interdit et l'élimination peut être fait par les organisations à but non lucratif mandatés par les autorités locales ou organisées par des professionnels.
- ▶ Incinération des cellules et batteries au lithium par les consommateurs est déconseillée. Incinération devrait être fait dans une installation dûment autorisée qui peut gérer ces déchets.

See Attached Battery Spec Sheet, MSDS, and compliance document for more information



Suggested Additional Hardware

Suggested Additional Hardware

- ▶ **Torque Driver** calibrated to 4 to 12 in-lbs. (preferred)
- ▶ **#1 Phillips Head Screwdriver:** Used to attach/detach RF module
- ▶ **RF cable at various lengths:** Allows for flexibility in antenna setup; see **03EN063 MPU5 Product Catalog** for more information
- ▶ **Double-shielded Ethernet Cables with metal plug**
- ▶ **Ethernet Female-to-Female Extenders**
- ▶ **Rugged Display & Controller (RDC) or TV/Monitor with HDMI input:** Displays Android™ computer interface and/or streaming video
- ▶ **Laptop with Administrator Access & Ethernet port or USB-to-Ethernet adapter:** Used for device configuration
- ▶ **USB Thumb Drives:** Used for software configuration storage and loading
- ▶ **USB Mouse & Keyboard:** Used for interacting with the Android OS when using a TV/Monitor

Part I: Physical Setup

Section A: RF Setup

What Will I Learn?

- ▶ How to insert RF modules into the MPU5 chassis
- ▶ How to attach antennas to the MPU5

NO NDA REQUIRED

The export and/or the release of certain products, technology and software to non-US persons might be subject to export restrictions. Please refer to the US export laws & regulations for details.



 **WARNING!:** User **MUST** refer to the **Professional Installer – Compliance** Section of this manual for approved antenna types. This warning applies only to RF-2100 with the FCC ID 2AG3J-RF2100, RF-5100 with the FCC ID 2AG3J-RF5100, and RF-2150 with the FCC ID 2AG3JRF-2150.

How do I tell if my antennas and RF modules are compatible?

- 1 Find the part numbers on the antennas. Antenna part numbers are on a sticker wrapped around the base of the antenna.
- 2 Find the part number on the RF module. The RF module part number is on a sticker on the back of the RF module.
- 3 Each part number will begin with ANT- (antennas) or RF- (RF modules) followed by four (4) digits. The first digit references the RF band of the part. Make sure that the first digit of the antennas and RF module match.

 **WARNING!:** DO NOT use mismatched antennas and RF modules. This configuration will result in very poor performance and/or damage to the device. If you do not have matching antennas and RF modules, contact Persistent Systems.

 **WARNING!:** DO NOT switch RF modules while device is powered on. Power off device before changing RF modules.

 **WARNING!:** the MPU5 is not IP68 rated when the RF module is not attached. Ensure you are in a dry, dust-free environment before changing RF modules.

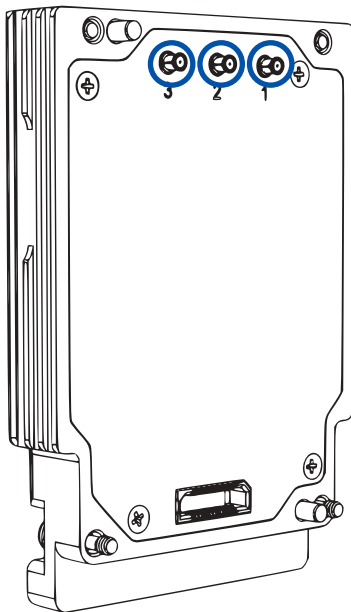


Physical Setup: RF Setup

Inserting the RF Module

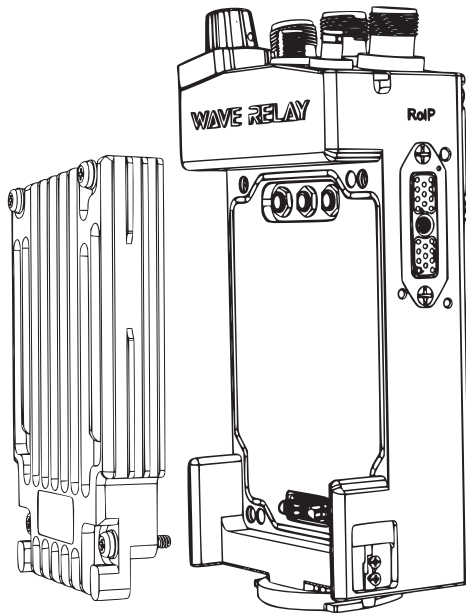
1

If there are **rubber caps** on the RF module contacts, **remove** them.



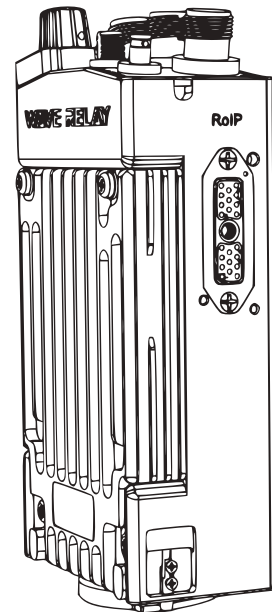
2

Align the RF module with the chassis.

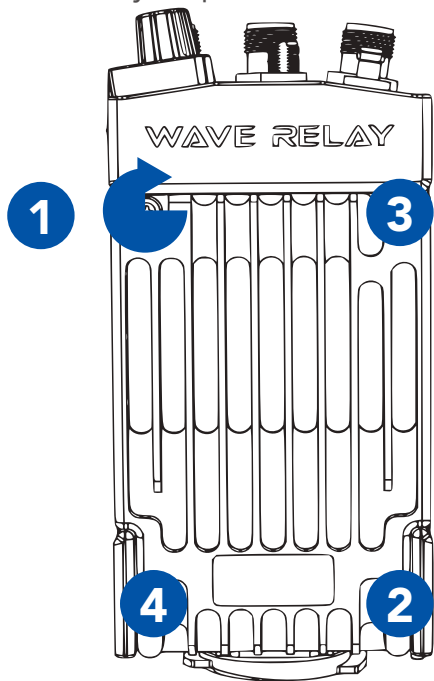


3

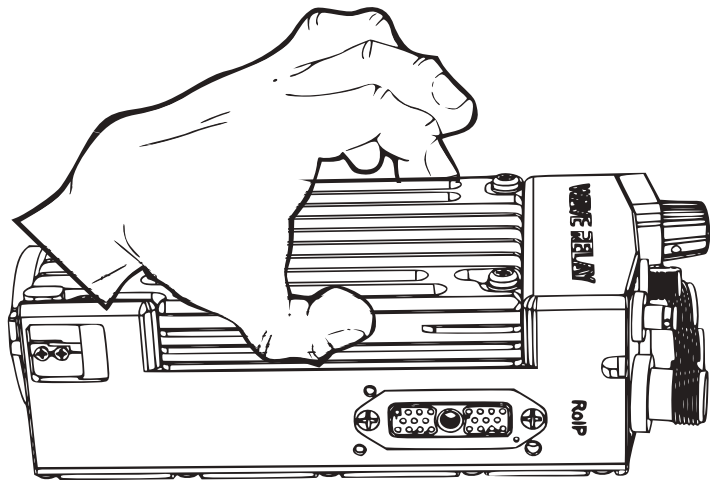
Apply even force and **press** the RF module into the chassis.



- 4** **Tighten** screws clockwise in **diagonal** order with a #1 Phillips Head screwdriver until they stop (**4 to 12 in-lbs.** of torque)



- 5** **Pull** on the RF module to verify that it is attached securely. Ensure there are no gaps in between the RF module and the MPU5 chassis.



NO NDA REQUIRED

The export and/or the release of certain products, technology and software to non-US persons might be subject to export restrictions. Please refer to the US export laws & regulations for details.

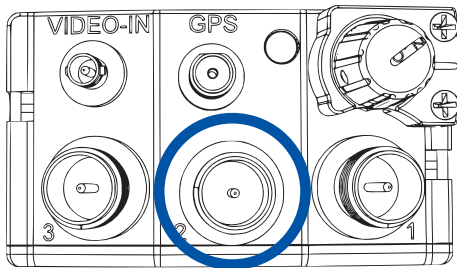


Physical Setup: RF Setup

Connecting Antennas

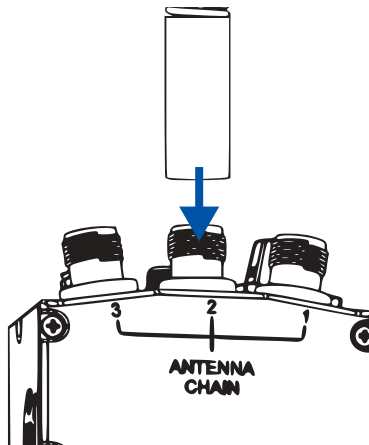
1

Start with the **middle** antenna port.



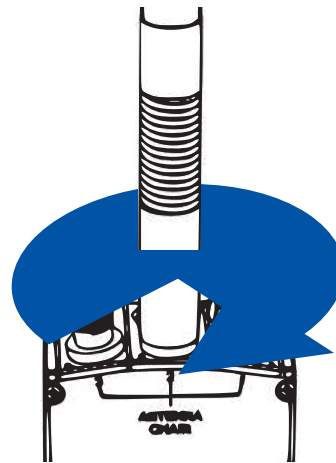
2

Align the **RF connector** on the antenna with the **RF connector** on the unit.



3

Twist the antenna clockwise until it is fully mated.



T

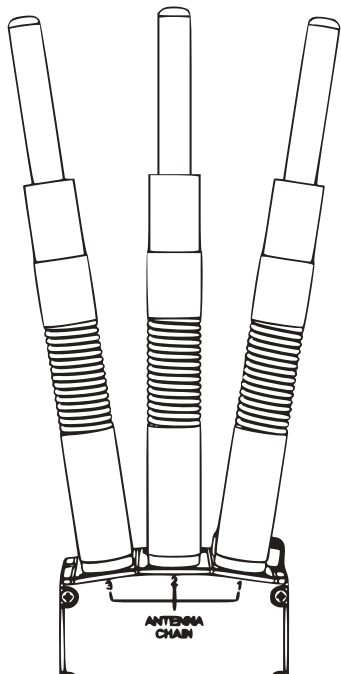
Tips & Tricks

- ▶ You can use a TPI Kit and/or extra LMR-400 RF Cables to remote antennas away from the unit. This setup is particularly useful for mounted or operations center configurations.
- ▶ To operate in SISO mode, you only need to attach an antenna to the antenna port for the chain you want to use.

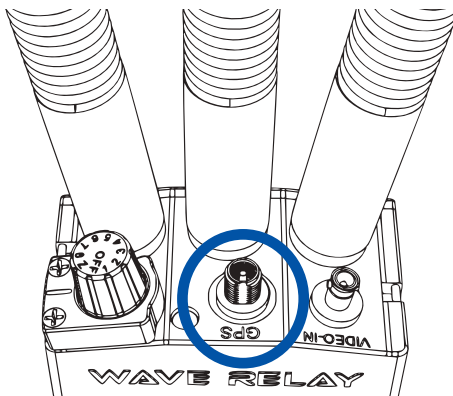


WARNING!: if you want to operate in SISO mode, unused antenna chains **MUST** be turned off (See p. 76).

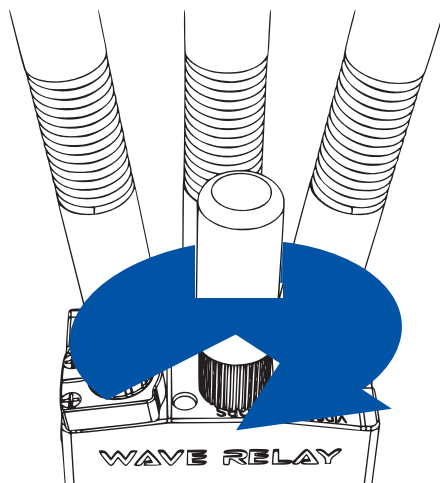
- 4** Repeat **Steps 1 - 3** for the remaining two RF antennas.



- 5** Align the **SMA connector** on the GPS antenna with the **SMA connector** on the unit.



- 6** **Twist** the antenna clockwise until it is fully mated.



NO NDA REQUIRED

The export and/or the release of certain products, technology and software to non-US persons might be subject to export restrictions. Please refer to the US export laws & regulations for details.



Physical Setup: RF Setup Troubleshooting



How do I ensure that the RF module is aligned properly?

The three RF connectors on the RF module will align with the three RF connectors on the chassis. When aligned properly, the engraved writing on the RF module will be facing the same direction as the writing on the chassis.



What do I do if the RF module won't insert into the chassis?

- 1 Ensure that the RF module is aligned properly.
- 2 Ensure that the connectors on the RF module are not bent.
- 3 Ensure that there are no foreign objects in any of the connectors, on the bottom of the RF module, or in the chassis well.



What do I do if the antennas won't screw onto the RF connectors?

- 1 Ensure that you are using antennas with RP-TNC Male connectors or an appropriate adapter
- 2 Ensure that the connectors on both the unit and antennas are not damaged.
- 3 Ensure that there are no foreign objects in any of the connectors.



How do I tell if the antennas are connected properly?

- 1 When an antenna is mated properly, the threads on the connector will not be visible. However, there may be a small space between the antenna and the chassis.



What Can I Do Now?

- ▶ Swap RF modules and antennas to change the RF band you are capable of operating on
- ▶ Swap out broken RF modules and antennas
- ▶ Setup hardware to receive GPS connectivity
- ▶ Remote antennas away from the unit

NO NDA REQUIRED

The export and/or the release of certain products, technology and software to non-US persons might be subject to export restrictions. Please refer to the US export laws & regulations for details.

03EN073 Rev. P

PAGE 25 OF 168



Section B: Power



What Will I Learn?

- ▶ How to connect a power source to the MPU5
- ▶ How to power on the MPU5



How can I use my old power accessories from previous Wave Relay products with my MPU5?

You can use your MPU4 twist locking battery pack or BB batteries with the MPU5. You CANNOT use old battery eliminators with the MPU5. Use only **CBL-PWR-0001** or **CBL-PWR-0002**. You CANNOT power the MPU5 via Power over Ethernet (PoE).



Will I lose all my settings if I remove power from my MPU5?

The MPU5 will retain settings if power is removed.



NO NDA REQUIRED

The export and/or the release of certain products, technology and software to non-US persons might be subject to export restrictions. Please refer to the US export laws & regulations for details.

03EN073 Rev. P

PAGE 27 OF 168

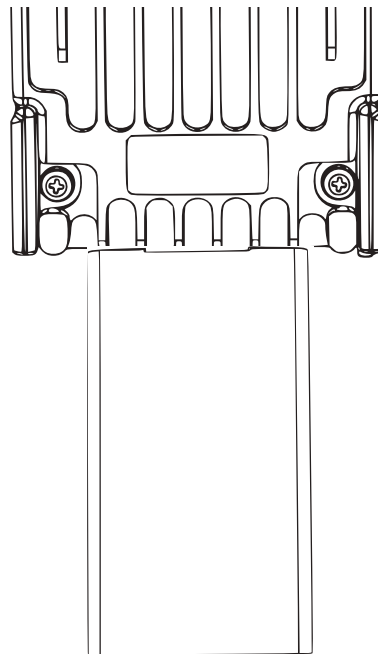
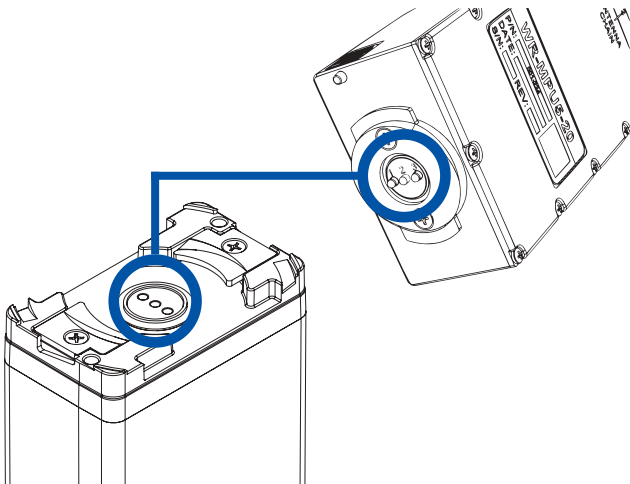
© 2010 - 2025 Persistent Systems, LLC – All Rights Reserved



Physical Setup: Power

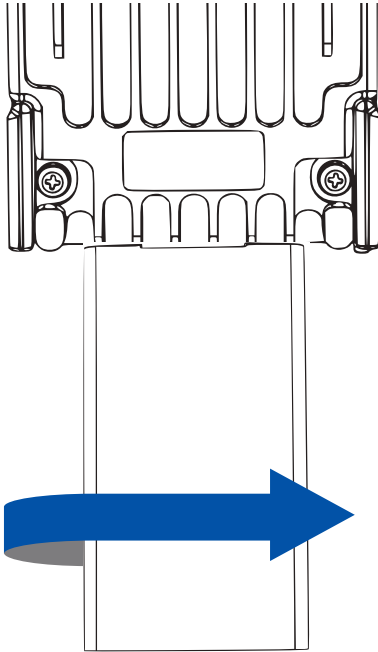
Connecting Power

- 1** If you are using a battery, make sure that the battery is charged.
- 2** Align the **circular three pin connector** on the power source with the **circular three pin connector** on the bottom of the MPU5.
- 3** **Push** the connectors together. Make sure the connector is seated properly.





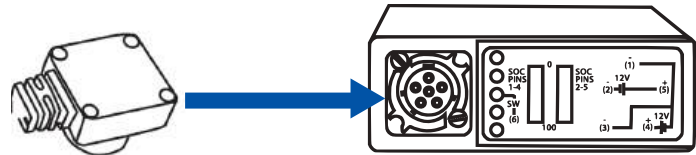
- 4** **Twist** clockwise 90°. You will hear a click when it is locked.



- 5** If you are using a Wall Battery Eliminator, plug the **standard wall plug** into a **standard wall outlet**.



- 6** If you are using a BB Battery Eliminator, plug the **BB plug** into a **BB Battery**.



NO NDA REQUIRED

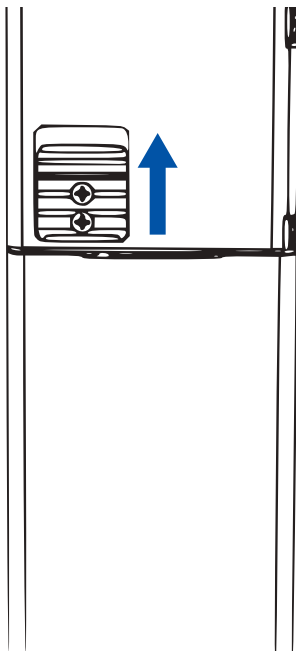
The export and/or the release of certain products, technology and software to non-US persons might be subject to export restrictions. Please refer to the US export laws & regulations for details.



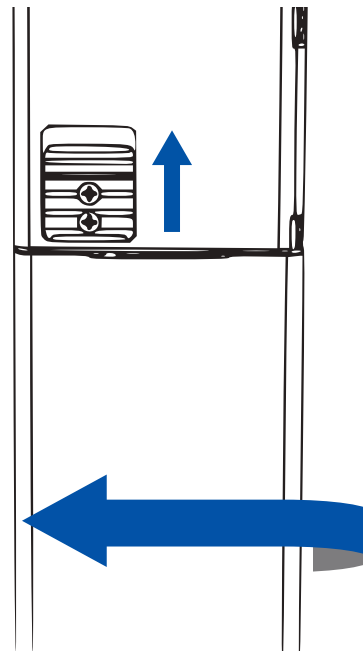
Physical Setup: Power

Removing Power

- 1 **Slide up** the battery latch on the side of the MPU5.



- 2 **Twist the battery** counterclockwise until it disconnects.





What do I do if my power accessory will not fit the battery connector?

- 1 Ensure that no parts (pins, plates, etc.) on either connector are bent or damaged.
- 2 Ensure that there are no foreign objects in either connector.



What do I do if my power accessory will not lock?

- 1 Ensure that the battery latch moves freely by sliding it up and down.
- 2 Ensure that the battery latch is not stuck in the unlocked position.



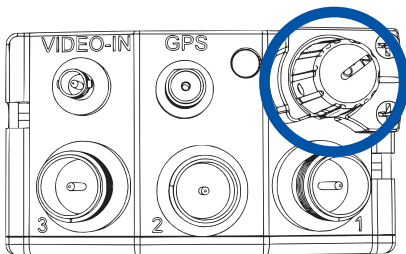
Physical Setup: Power

Powering On the Unit

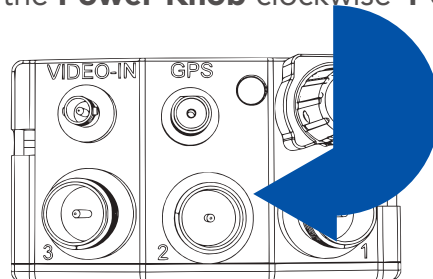
- 1 Ensure that **antennas**, a **RF module**, and an appropriate **power source** are connected.

! WARNING!: Antennas **MUST** be installed prior to powering on the unit.

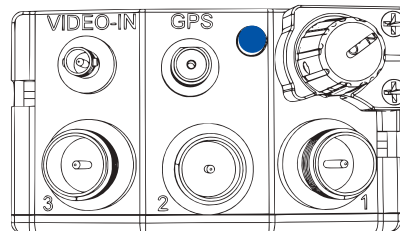
- 2 **Locate** the **Power Knob** on the top of the unit.



- 3 **Twist** the **Power Knob** clockwise **1 click**.



- 4 If the unit is powered and has turned on, the **LED** on the top of the unit will glow a color indicating unit status.



Quick Reference:

LED Color Unit Status

Blue	Booting
Yellow	Running, no neighbors
Green	Running, neighbors
Red	Crypto Fail (No key or FIPS)
Orange	Low Battery
Purple	Loading Firmware



What do I do if my Power Knob does not rotate?

- 1 Make sure that you are twisting it in the correct direction (clockwise).
- 2 Make sure that no foreign objects are blocking the rotation of the knob.
- 3 If the knob still does not rotate, it may be broken. Contact Persistent Systems Support.



What do I do if the Power Knob does not click when I twist it?

- 1 The Power Knob may be broken. Contact Persistent Systems Support.
- 2 Ensure that the battery latch is not stuck in the unlocked position.



Physical Setup: Side Connectors



What Can I Do Now?

- ▶ Provide power to an MPU5 via a battery or standard wall socket
- ▶ Power on/off the unit
- ▶ Replace dead batteries

Section C: Side Connector Cables

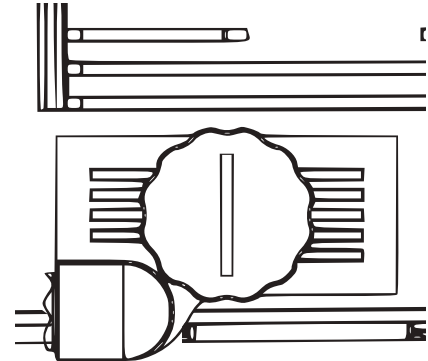
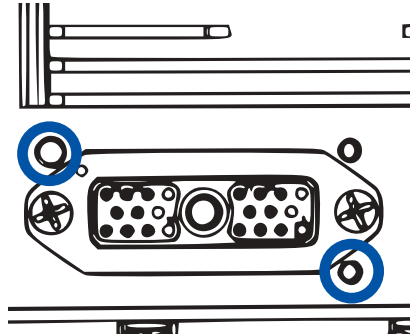
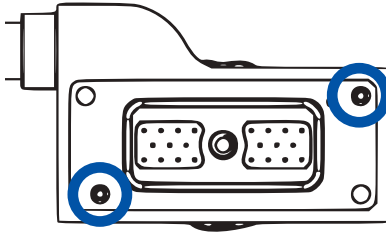


What Will I Learn?

- ▶ How to connect a cable to the MPU5 side connectors

Connecting a Cable to a Side Connector

- 1** The 22-Pin connector on every cable is keyed so that it will **only** attach to a compatible side connector. If a cable can attach to multiple side connectors, it is keyed (or not keyed) so that it will attach to all compatible side connectors.
- 2** To connect a cable to a side connector, **locate** the appropriate side connector.
- 3** **Align** the **key pins** on the **22-Pin connector** with the **key holes** on the case. **Push** the **key pins** into the **key holes**.



NO NDA REQUIRED

The export and/or the release of certain products, technology and software to non-US persons might be subject to export restrictions. Please refer to the US export laws & regulations for details.

03EN073 Rev. P

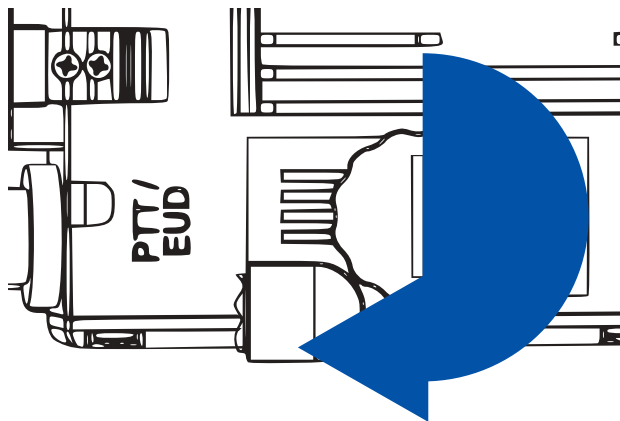
PAGE 35 OF 168



Physical Setup: Side Connectors

4

Twist the thumbscrew **clockwise** to attach the cable to the device.



5

Ensure that the cable is firmly attached and the connector is sitting flush with the case.



What do I do if the cable won't mate with the side connector?

- 1 Ensure that you are trying to connect the cable to the correct side connector.
- 2 Ensure that you are aligning the key pin properly and the cable is not upside down.
- 3 Ensure that no parts of the thumbscrew and the side connector are bent or damaged.
- 4 Ensure that there are no foreign objects in the thumbscrew or side connector.
- 5 Ensure that the cable connector is flush with the case.



What Can I Do Now?

- ▶ Identify which cable you need for your configuration
- ▶ Identify which side connector your cables attach to
- ▶ Connect a cable to a side connector

NO NDA REQUIRED

The export and/or the release of certain products, technology and software to non-US persons might be subject to export restrictions. Please refer to the US export laws & regulations for details.



Software Setup: Management Computer

Part II: Software Setup

Section A: Configuring the Management Computer



What Will I Learn?

- ▶ How to configure your computer to be able to communicate with an MPU5



Parts List



Management Computer with Administrator Access & Ethernet Port



IMPORTANT INFORMATION!:

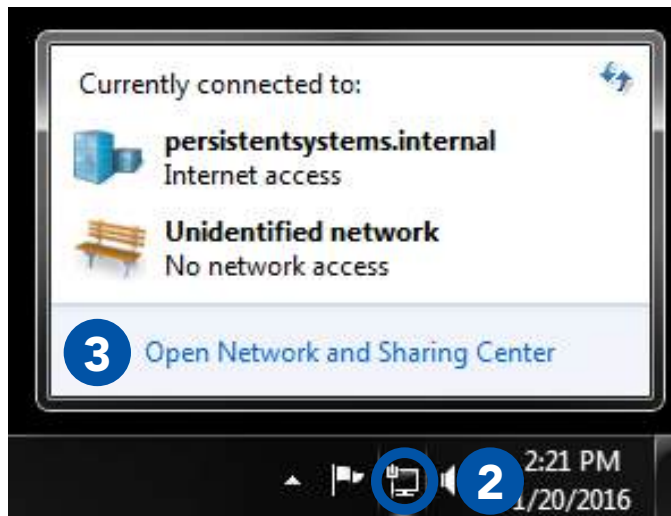
- ▶ To communicate with an MPU5, the computer must have an IP address in the same subnet mask as the MPU5's IP address.
- ▶ For example, with a subnet mask of 255.255.255.0, the computer and MPU5 will be able to communicate if they share the same first three numbers in their respective IP addresses (e.g. 10.3.1.10 and 10.3.1.254).
- ▶ If the computer and MPU5 do not share a subnet mask, the computer and MPU5 will not be able to communicate.
- ▶ If either the computer or MPU5 do not have an IP address in the same subnet mask, the computer and MPU5 device will not be able to communicate.



Software Setup: Management Computer

Configuring the Management Computer (Windows)

- 1** Locate the **Network** icon at the bottom right of the taskbar.
- 2** Right click the **Network** icon.
- 3** Click **Open Network and Sharing Center**.





4

Click **Local Area Connection 2**.

Control Panel Home

Change adapter settings
Change advanced sharing settings

View your basic network information and set up connections

WEDLE-NY1 (This computer) — Multiple networks — Internet [See full map](#)

View your active networks [Connect or disconnect](#)

 persistentsystems.internal Domain network	Access type: Internet Connections:  Local Area Connection
 Unidentified network Public network	Access type: No Internet access Connections:  Local Area Connection 2

Change your networking settings

-  [Set up a new connection or network](#)
Set up a wireless, broadband, dial-up, ad hoc, or VPN connection; or set up a router or access point.
-  [Connect to a network](#)
Connect or reconnect to a wireless, wired, dial-up, or VPN network connection.
-  [Choose homegroup and sharing options](#)
Access files and printers located on other network computers, or change sharing settings.

4

NO NDA REQUIRED

The export and/or the release of certain products, technology and software to non-US persons might be subject to export restrictions. Please refer to the US export laws & regulations for details.

03EN073 Rev. P

PAGE 41 OF 168

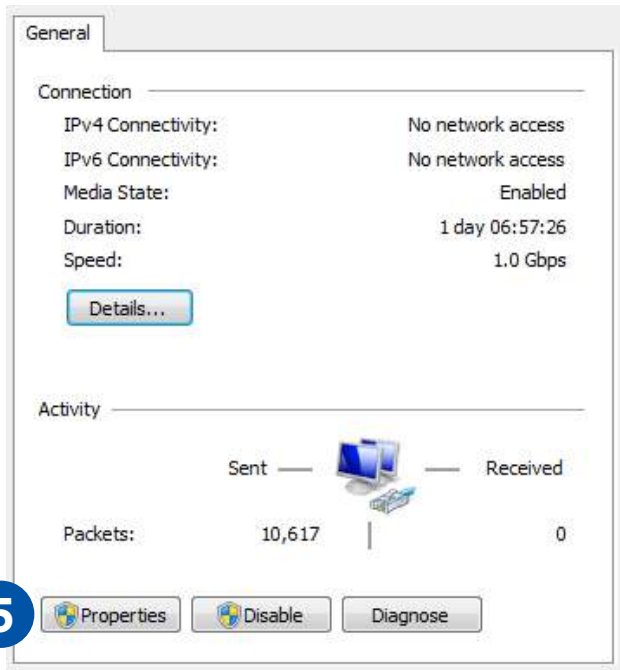
© 2010 - 2025 Persistent Systems, LLC – All Rights Reserved



Software Setup: Management Computer

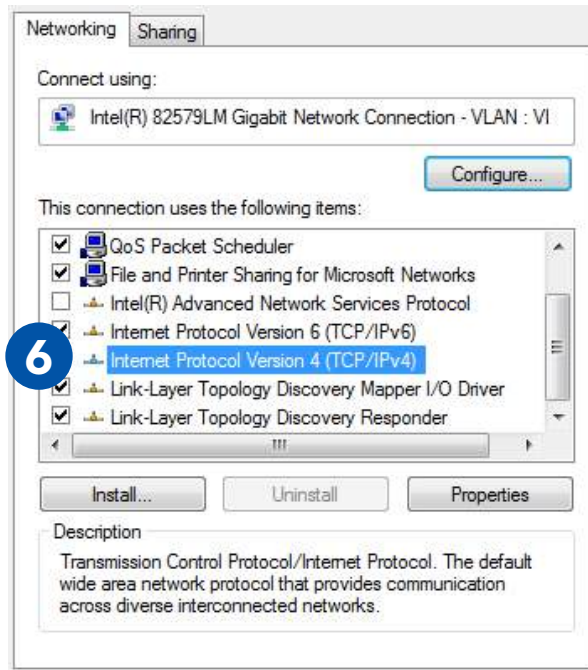
5

Click **Properties**.



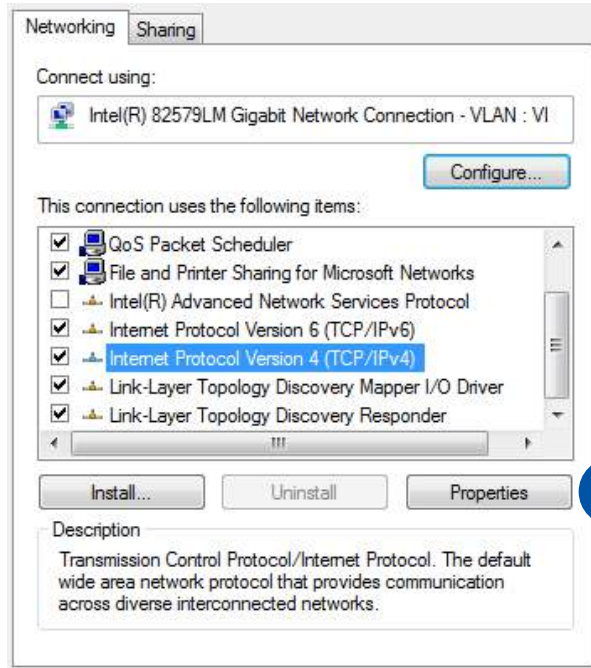
6

Select **Internet Protocol Version 4 (TCP/IPv4)** and ensure that it is highlighted as pictured.

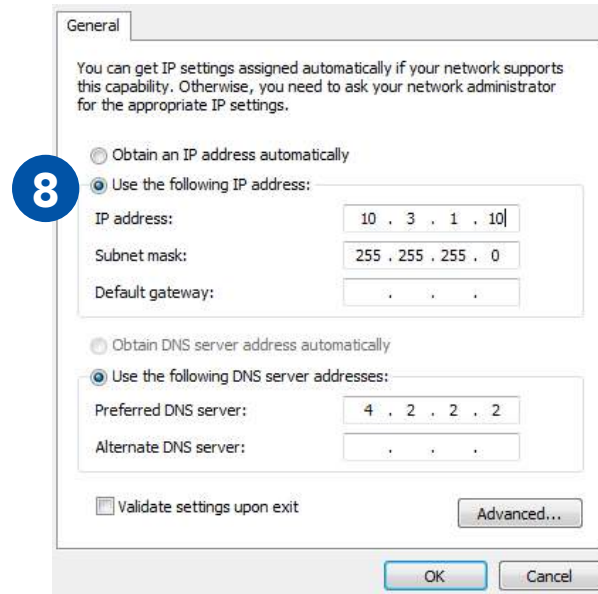




7 Click **Properties**.



8 Click **Use the following IP address**.



NO NDA REQUIRED

The export and/or the release of certain products, technology and software to non-US persons might be subject to export restrictions. Please refer to the US export laws & regulations for details.



Software Setup: Management Computer

- 9 Enter **10.3.1.10** into the **IP address** field.
- 10 Enter **255.255.255.0** into the **Subnet mask** field.
- 11 Click **OK**.
- 12 Your computer is now properly configured to connect to the MPU5.

General

You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.

☐ Obtain an IP address automatically

☒ Use the following IP address:

IP address: 10 . 3 . 1 . 10

Subnet mask: 255 . 255 . 255 . 0

Default gateway: . . .

☐ Obtain DNS server address automatically

☒ Use the following DNS server addresses:

Preferred DNS server: 4 . 2 . 2 . 2

Alternate DNS server: . . .

☐ Validate settings upon exit

Advanced...

OK Cancel



Configuring the Management Computer (Linux)

- 1 Open the **command line**.
- 2 **Type:**
`sudo ifconfig eth0 10.4.1.10/24`
- 3 **Type:**
`sudo ip addr add 10.3.1.10/24 dev eth0`

What Can I Do Now?

- ▶ Configure computers to be able to communicate with Wave Relay® devices.
- ▶ Have a computer that is able to configure a Wave Relay® device.



Software Setup: Management Computer

Section B: Connecting the MPU5 to the Management Computer

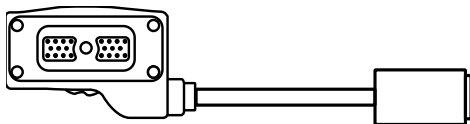


What Will I Learn?

- ▶ How to physically connect the MPU5 to the Management Computer



Parts List



22-Pin to RJ45 Receptacle
CBL-DATA-2001



Standard RJ45 Ethernet Cable

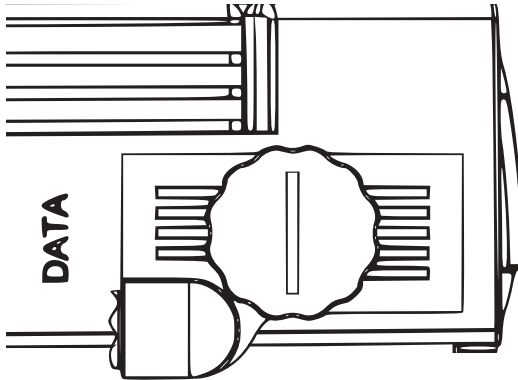


Properly Configured Management Computer with Ethernet Port



1

Connect **CBL-DATA-2001** to the **DATA** side connector on the MPU5.



2

Plug one end of the standard RJ45 Ethernet cable into the **Ethernet receptacle** on **CBL-DATA-2001**.



NO NDA REQUIRED

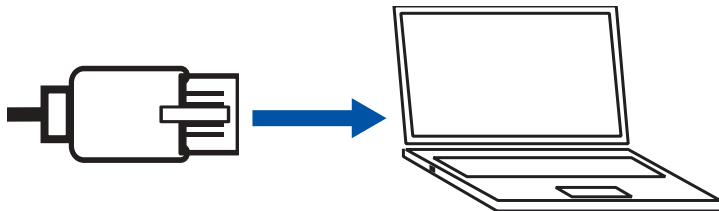
The export and/or the release of certain products, technology and software to non-US persons might be subject to export restrictions. Please refer to the US export laws & regulations for details.



Software Setup: Management Computer

3

Plug the other end of the standard RJ45 Ethernet cable into an **Ethernet port** on the Management Computer.



What Can I Do Now?

- ▶ Connect an MPU5 to a computer for configuration

Section C: Accessing the Web Management Interface

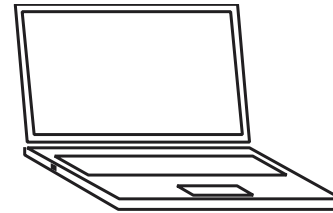
What Will I Learn?

- ▶ How to access the Web Management Interface to configure the MPU5

Parts List



Web Browser (Microsoft Edge, Firefox 3+, or Chrome)



Management Computer with properly configured IP address and subnet mask & Ethernet Port

NO NDA REQUIRED

The export and/or the release of certain products, technology and software to non-US persons might be subject to export restrictions. Please refer to the US export laws & regulations for details.

03EN073 Rev. P

PAGE 49 OF 168



Software Setup: Web Management Interface

1 Open the web browser



Microsoft Edge

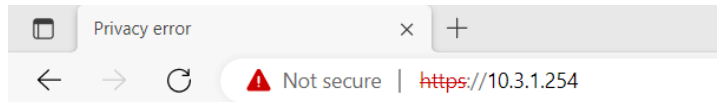


Google Chrome

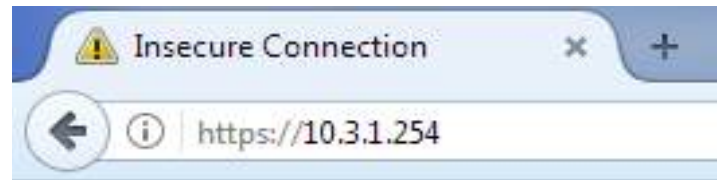


Mozilla Firefox 3+

2 In the address bar, type **https://10.3.1.254** then press the **Enter** key.



Microsoft Edge



Mozilla Firefox 3+

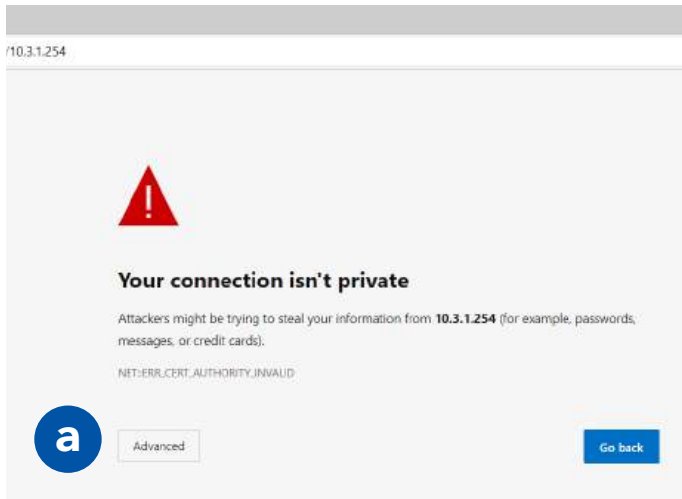


Google Chrome

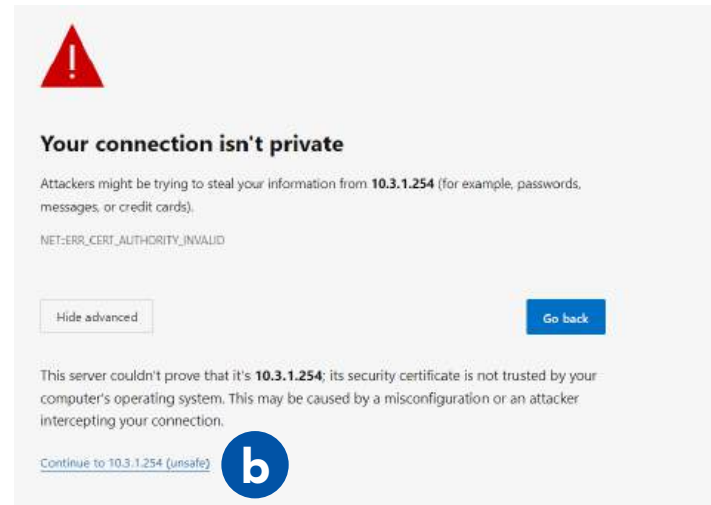


3 The web browser will ask you to accept a security certificate.

In Edge:



a Click **Advanced**



b Click Continue to 10.3.1.143 (unsafe)

NO NDA REQUIRED

The export and/or the release of certain products, technology and software to non-US persons might be subject to export restrictions. Please refer to the US export laws & regulations for details.



Software Setup: Web Management Interface

In Firefox:



Click **I Understand the Risks**



10.3.1.254 uses an invalid security certificate.

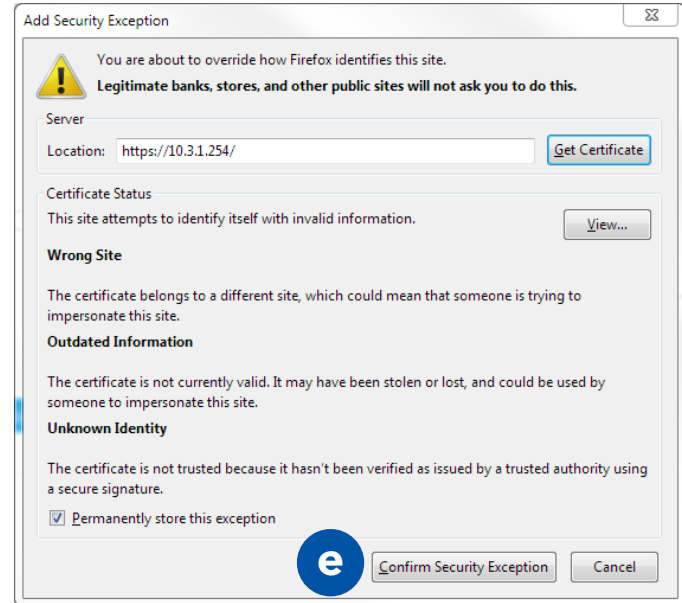
The certificate is not trusted because the issuer certificate is unknown.
The server might not be sending the appropriate intermediate certificates.
An additional root certificate may need to be imported.
The certificate is not valid for the name 10.3.1.254.
The certificate expired on January 1, 1971 at 7:00 PM. The current time is June 22, 2017 at 4:28 PM.

Error code: [SEC_ERROR_UNKNOWN_ISSUER](#)

Add Exception...



Click **Add Exception**



Click **Confirm Security Exception**

NO NDA REQUIRED

The export and/or the release of certain products, technology and software to non-US persons might be subject to export restrictions. Please refer to the US export laws & regulations for details.

03EN073 Rev. P

PAGE 53 OF 168

© 2010 - 2025 Persistent Systems, LLC – All Rights Reserved



Software Setup: Web Management Interface

In Chrome:



Your connection is not private

Attackers might be trying to steal your information from **10.3.1.254** (for example, passwords, messages, or credit cards). NET::ERR_CERT_AUTHORITY_INVALID

☐ [Automatically report](#) details of possible security incidents to Google. [Privacy policy](#)

ADVANCED 

[Back to safety](#)



Click **Advanced**

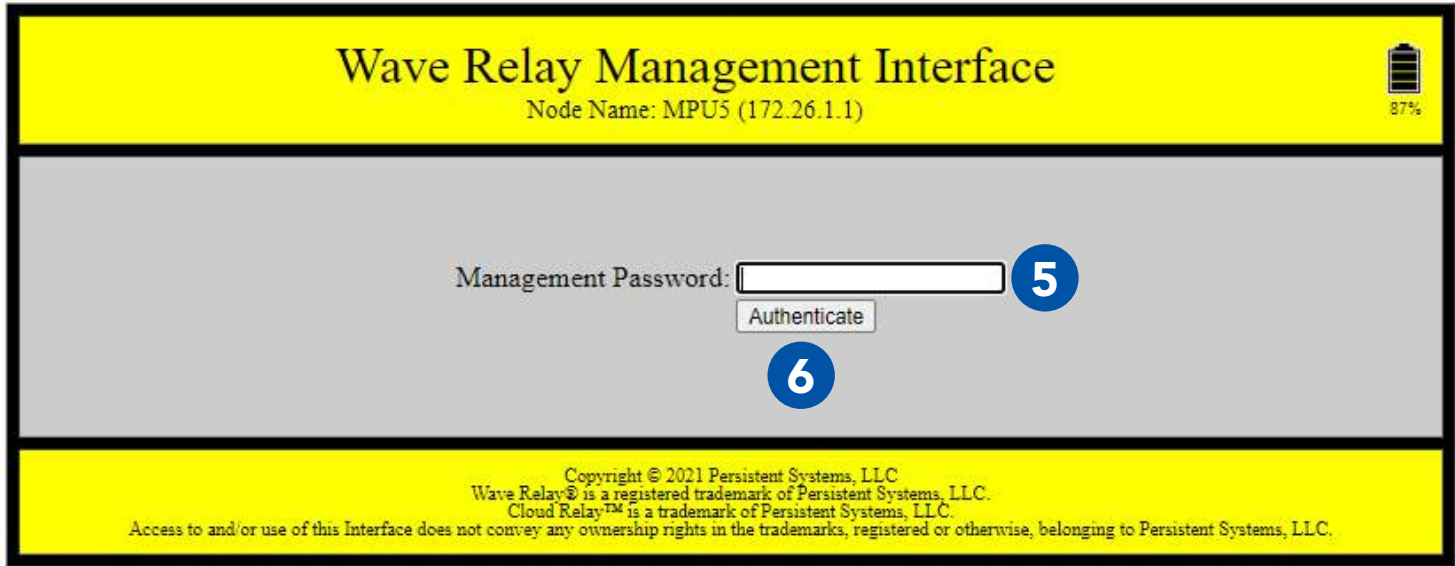
This server could not prove that it is **10.3.1.254**; its security certificate is not trusted by your computer's operating system. This may be caused by a misconfiguration or an attacker intercepting your connection. [Learn more.](#)

[Proceed to 10.3.1.254 \(unsafe\)](#) 



Click **Proceed to 10.3.1.254 (unsafe)**

- 4 Wait for the Web Management Interface page to load
- 5 In the **Management Password** field, type **password**
- 6 Click **Authenticate**.



Wave Relay Management Interface

Node Name: MPU5 (172.26.1.1)

87%

Management Password:

Authenticate

Copyright © 2021 Persistent Systems, LLC
Wave Relay® is a registered trademark of Persistent Systems, LLC.
Cloud Relay™ is a trademark of Persistent Systems, LLC.
Access to and/or use of this Interface does not convey any ownership rights in the trademarks, registered or otherwise, belonging to Persistent Systems, LLC.

NO NDA REQUIRED

The export and/or the release of certain products, technology and software to non-US persons might be subject to export restrictions. Please refer to the US export laws & regulations for details.

03EN073 Rev. P

PAGE 55 OF 168

© 2010 - 2025 Persistent Systems, LLC – All Rights Reserved



Software Setup: Web Management Interface



Why does the Security Exception Page or the Web Management Interface page not load?

- 1 Verify that you configured the Management Computer IP address and subnet mask properly.
- 2 Ensure that all cables are connected properly
- 3 Ensure that you are accessing the correct management IP address (10.3.1.254).
- 4 Ensure that you are using a compatible web browser.
- 5 Reboot the node.



What Can I Do Now?

- ▶ Access the Web Management Interface for any node you connect to your computer.

Section D: Basic Network Setup

Security Key

What Will I Learn?

- ▶ How to set the security key and crypto mode on an MPU5

- 1 Click the **Security** tab.
- 2 Expand the **Set Key** box
- 3 In the **Set Key** section, locate the **Update** drop down menu. Select **Node**.
- 4 In the **Crypto Mode** drop down menu, select the desired **Crypto Mode**.
Note: All nodes must have the same Crypto Mode in order to communicate.
- 5 In the **Enter key** field, click the **Generate** button to generate a random key. Only keys generated by a Wave Relay node are valid.
- 6 **Copy** and **paste** the security key to a text file in a secure place on the Management Computer.
- 7 Click the **Set** button to set the key for the node.



Software Setup: Security Key

Node Status	Node Configuration	Network Status	Network Configuration	Security 1	Log Out
-----------------------------	------------------------------------	--------------------------------	---------------------------------------	-----------------------------------	-------------------------

Security Help

Status ▶

2 Set Key ▼

Update: **3** Node

Crypto Mode: Recommended: 256-bit AES-GCM with HMAC-SHA-256 (Suite-B) **4**

Enter key:

7 (in hex with optional whitespace between bytes)

Random key: **5**



What Can I Do Now?

- ▶ Set or change the security key and crypto mode for a single node
- ▶ Generate a random security key
- ▶ Save a security key in a text file to copy to other nodes

Assigning IP Address and Interface Names



What Will I Learn?

- ▶ How to set and change the Node Name and IP Address of a node

NO NDA REQUIRED

The export and/or the release of certain products, technology and software to non-US persons might be subject to export restrictions. Please refer to the US export laws & regulations for details.



Software Setup: Assigning IP Address and Interface Names

1

Click the **Node Configuration** tab.

2

Click the **Node Configuration** button.

Node Status	Node Configuration	Network Status	Network Configuration	Security	Help	Log Out						
Node Configuration												
<table><tr><td>Node Configuration</td><td>Setup the node configuration.</td></tr><tr><td>Audio Configuration</td><td>PTT, Radio over IP (RoIP), and Intercom Audio Configuration.</td></tr><tr><td>Config Management</td><td>Store, Load, Quick Config, Factory Reset, and Rapid Configuration Tool (RCT)</td></tr></table>							Node Configuration	Setup the node configuration.	Audio Configuration	PTT, Radio over IP (RoIP), and Intercom Audio Configuration.	Config Management	Store, Load, Quick Config, Factory Reset, and Rapid Configuration Tool (RCT)
Node Configuration	Setup the node configuration.											
Audio Configuration	PTT, Radio over IP (RoIP), and Intercom Audio Configuration.											
Config Management	Store, Load, Quick Config, Factory Reset, and Rapid Configuration Tool (RCT)											

Software Setup: Assigning IP Address and Interface Names



- 3 In the **Management** section, find the **Node Name** field and enter the desired Node Name.
- 4 In the **IP Address** field, enter the desired IP Address.
- 5 Enter a **Netmask** and **Gateway**, if required. Otherwise, **check the Factory Default** box.
- 6 Scroll to the bottom of the page and click the **Save & Reconfigure Unit** button.
- 7 Wait for the page to reload.

Node Configuration

Hide Advanced Fields

Management

3	Node Name	MPU5	☐ Factory Default
	IP Address	172.26.1.1	☐ Factory Default
	Netmask	255.255.192.0	☒ Network Default
5	Gateway	172.26.63.254	☒ Network Default

4

NO NDA REQUIRED

The export and/or the release of certain products, technology and software to non-US persons might be subject to export restrictions. Please refer to the US export laws & regulations for details.

03EN073 Rev. P

PAGE 61 OF 168

© 2010 - 2025 Persistent Systems, LLC – All Rights Reserved



Software Setup: Rebooting an Individual Node



What Can I Do Now?

- ▶ Access the Node Configuration page for an individual node
- ▶ Set the Node Name and IP Address of a node to fit the node into your IP scheme and identify the node in status functions

Rebooting an Individual Node

1

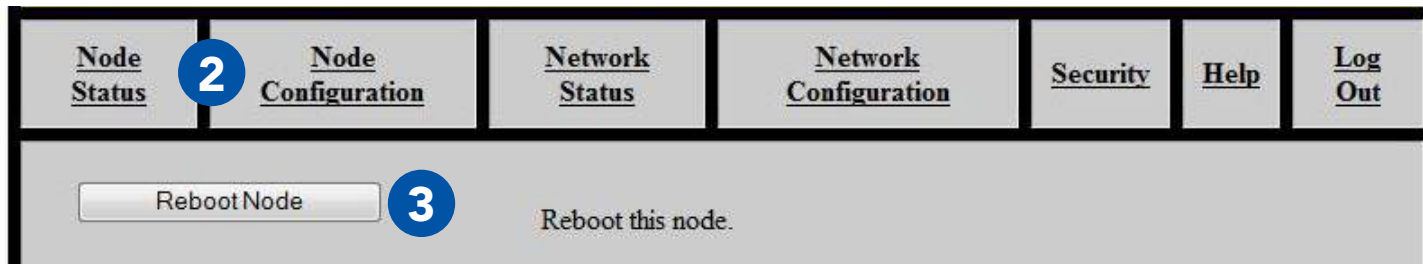
Log into the node.

3

Scroll down and click the **Reboot Node** button.

2

Click the **Node Configuration** tab.



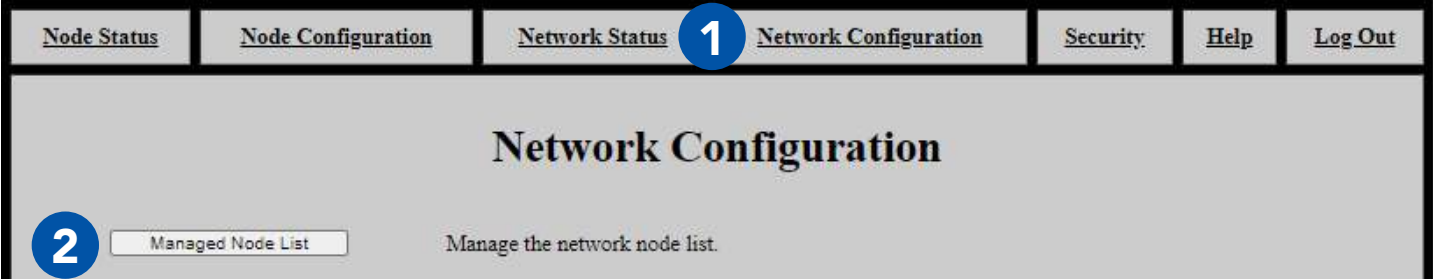
Managed Node List

What Will I Learn?

- ▶ How to add and remove nodes from the Managed Node List
- ▶ How to push the Managed Node List to all nodes in your network

1 Click the **Network Configuration** tab.

2 Click **Managed Node List**.





Software Setup: Managed Node List

The **Managed Node List** creates a list of nodes for **Network Status** and **Network Configuration** functions. Those functions will **ONLY** operate on nodes that are in the Managed Node List.

Adding Nodes to the Managed Node List

- 1 Ensure that all your nodes are powered on and that you have configured their IP addresses and node names. These will appear in the **Other Nodes on Network** box.
- 2 Click **Refresh** if all nodes do not appear.
- 3 Click **All** to add all nodes in the box to the Managed Node List. Alternatively, select one or more nodes and click **Selected IPs** to add those nodes to the Network Node List. Hold the **shift** key or **ctrl** key while clicking to select multiple nodes.
- 4 Nodes can be added manually as well. Enter a comma separated list of all IP addresses to add in the **Manually Add IP(s)** box, then click **Add**.

Other Nodes on Network

Refresh

Add to Managed Node List

Selected IPs All Clear Nodes

172.26.1.2 - DUT

172.26.1.1 - GOLDEN

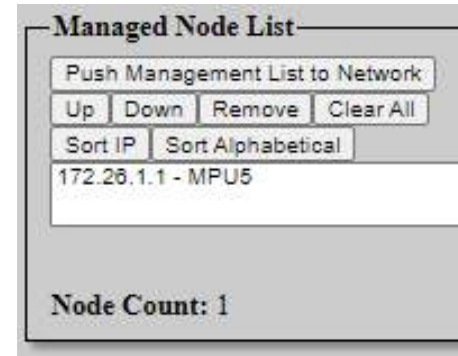
Manually Add IP(s)

Add

(comma separated list)

Managing the Managed Node List

- 1 After you add nodes to the Managed Node List, they will appear in the box on the left of the page.
- 2 Use the **Up**, **Down**, **Remove**, **Clear All**, and **Sort** buttons to reorder or delete nodes from the Managed Node List.
- 3 Click **Push Management List to Network** to copy the Managed Node List to all the nodes in the Managed Node List. This will ensure that Network Status and Network Configuration functions will work properly on all nodes in the network.



Note: ensure that all nodes are turned on and have the same RF settings (i.e. they are able to be contacted). If nodes are not able to be contacted, they will not receive the Managed Node List.

Note: remember to add new nodes to the Managed Node List when you are expanding your network.



Software Setup: Managed Node List



What Can I Do Now?

- ▶ Add new nodes to the Managed Node List
- ▶ Remove nodes from the Managed Node List
- ▶ Synchronize the Managed Node List between all nodes on your network

Part III: Testing Connectivity

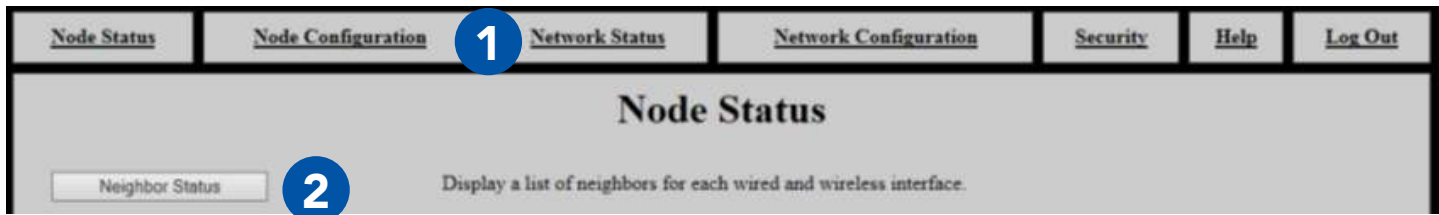
What Will I Learn?

- ▶ How to tell if nodes are connected
- ▶ How to see the connection strength between Neighbor Nodes
 - ▶ Neighbor Nodes are nodes connected without hops through other nodes
- ▶ How to test bandwidth between nodes

Check Neighbor Node Status

1 Click the **Network Status** tab.

2 Click the **Neighbor Status** button.





Testing Connectivity: Neighbor Node Status

3

Verify that all nodes are communicating with the network.

Notes:

- ▶ This table only displays Neighbor Nodes (nodes directly connected without hops through other nodes. If you spread nodes apart, they may disappear from the Neighbor Nodes Status page when they become connected via a hop.
 - ▶ The Neighbor Nodes status page displays:
 - ▶ Interface: how nodes are connected to this node (RF or Ethernet)
 - ▶ Neighbor IP/Name: IP address and name of connected nodes
 - ▶ Receive SNR: signal-to-noise ratio - combined (NOT average) and per chain
 - ▶ Distance: if GPS is available, will display distance of the neighbor node in relation to this node

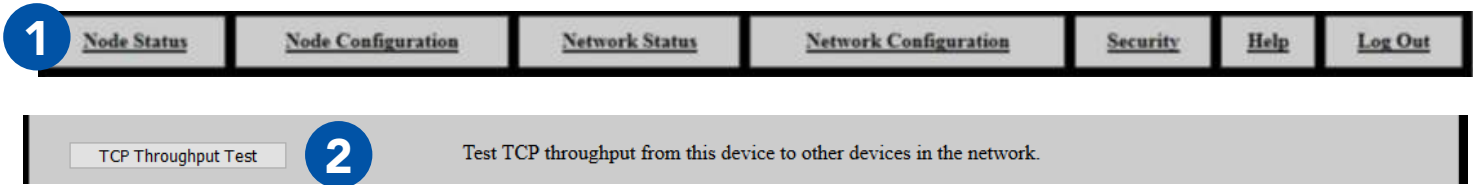
Interface *	Neighbor IP *	Neighbor Name *	Receive SNR (dB) *				Distance *
			Combined *	Chain 1 *	Chain 2 *	Chain 3 *	
Radio 1	172.26.35.50	MAC-05	52	44	40	51	
Radio 1	172.26.35.40	MAC-04	50	41	46	47	
Radio 1	172.26.35.30	MAC-03	53	40	50	49	
Radio 1	172.26.35.20	MAC-02	49	40	44	46	
Radio 1	172.26.35.10	MAC-01	62	53	59	56	
Radio 1	172.26.35.70	MAC-07	49	44	37	46	
Radio 1	172.26.35.60	MAC-06	49	44	41	45	
Radio 1	172.26.35.202	MAC-INSTR2	52	42	44	50	

[Return to Menu](#) [MANET Monitor](#)

Perform a Throughput Test

1 Click the **Node Status** tab.

2 Click the **TCP Throughput Test** button.



NO NDA REQUIRED

The export and/or the release of certain products, technology and software to non-US persons might be subject to export restrictions. Please refer to the US export laws & regulations for details.

03EN073 Rev. P

PAGE 69 OF 168



Testing Connectivity: Throughput Test

- 3 Select a **destination node** for the throughput test from the **Neighbors** drop-down menu. This menu is populated from the Managed Node List.
- 4 Enter the desired **test duration (in seconds)** in the **Total Test Time** field. EACH node will upload for this duration. **Note:** Persistent Systems recommends the test duration to be set to a minimum of 5 seconds.
- 5 Check or uncheck the **Upload only test** box. If this box is checked, only upload speed to the destination node will be tested.
- 6 Click **Start** and wait for the test to complete.
- 7 The page will display the upload speed to and download speed from the destination node.

The screenshot shows a web interface for configuring and running a throughput test. On the left, the 'Test Configuration' section contains a 'Neighbors' dropdown menu (callout 3) showing '172.26.35.20 - MAC-02', a 'Total Test Time' input field set to '5' seconds (callout 4), an 'Upload (Tx) only' checkbox (callout 5) which is currently unchecked, and a 'Start' button (callout 6). On the right, the 'Test Result' section (callout 7) displays two columns: 'Upload/TX' and 'Download/RX', which are currently empty.



WARNING!: During long duration tests, data will continue to be sent for the full specified duration even if a different data flow is started or the web browser is exited.

Throughput Test Logging

- 1

Click the **Enable Logging** button.
- 2

When the throughput test is run, data will be collected in a table at the bottom of the page.

Enable Logging

1

Clear

Download CSV

Download KML

2

Time	SNR(dB)	Chain1(dB)	Chain2(dB)	Chain3(dB)	Tx Rate	Dist(km)	Remote Name	Local Name	Rx(%) Duty C
Thu Dec 08 16:30:06 2022	85	77	82	81		0.02	Tech Sup Cam 210	Tech Support 101	3
Thu Dec 08 16:30:07 2022	86	77	83	81		0.02	Tech Sup Cam 210	Tech Support 101	4
Thu Dec 08 16:30:07 2022	86	77	83	81		0.02	Tech Sup Cam 210	Tech Support 101	4
Thu Dec 08 16:30:09 2022	86	78	83	81		0.02	Tech Sup Cam 210	Tech Support 101	81
Thu Dec 08 16:30:10 2022	86	77	83	81		0.02	Tech Sup Cam 210	Tech Support 101	82

- 3

Use the scroll bar at the bottom of the table to view more data

Wed May 03 18:43:48 2023	75	70	71	70		15.02	Tech Support 93	Tech Support 101	48



Testing Connectivity: Throughput Test

Position Status: displays GPS status information for the current node. See the Check GPS Status section for an explanation of these fields.

Clear: clears all data from the table

Note: If Clear is not pressed before beginning a test, the new throughput test data will be appended sequentially to the existing table of data.

Download CSV: downloads all throughput test data in the table as a CSV file

Download KML: downloads all throughput test data in the table as a KML file

Time: date and time for each line of test data

SNR (dB): Signal-to-Noise Ratio at which the destination node is heard

Chain 1/2/3 (dB): Signal-to-Noise Ratio for each chain on the source node

Tx Rate: MIMO or SISO rate used to communicate between nodes in the format **MIMO|SISO [Rate]:[Number of streams]**.

Dist (km): distance between nodes, in meters, if available

Remote Name: Node Name of the destination node

Local Name: Node Name of the source node

Rx(%) Duty Cycle: percentage of the channel used to receive

Tx(%) Duty Cycle: percentage of the channel used to transmit

Channel(%) Duty Cycle: percentage of the channel used

Interference: noise level of the channel

Bw Tx (Mbps): Upload Bandwidth, in Mbps

Bw Rx (Mbps): Download Bandwidth, in Mbps

Interval (s): time interval of the throughput test for each line of throughput test data

Rem Lat/Lon/Alt/Speed/Addr: location, speed and IP address of remote node

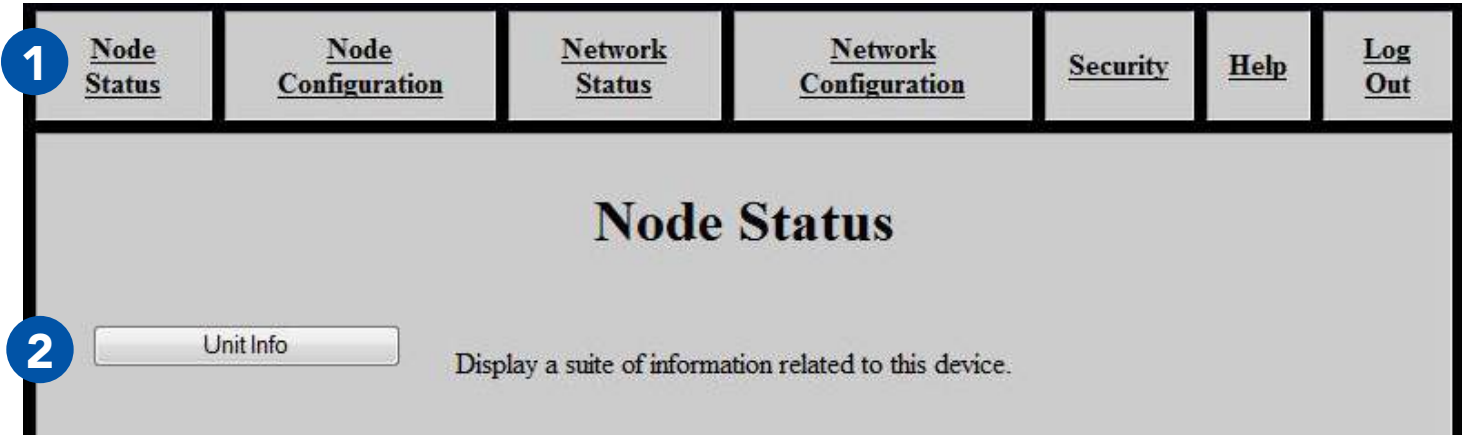
Lcl Lat/Lon/Alt/Speed/Addr: location, speed and IP address of local node

Part IV: Using the Web Management Interface

View Individual Node Information

1 Click the **Node Status** tab.

2 Click the **Unit Info** button.





Using the Web Management Interface: Individual Node Info

3

The page will display:

Firmware Version: Wave Relay® firmware version loaded on the node

User App Install: Ability to install apps on node

Wave Relay Model: Device model

Serial No.: Serial number of the node

Uptime: Operating time since the node was last powered on or rebooted

Temperature: Temperature of the power board, main board CPU, and all three RF chains

Input Power Voltage: Voltage supplied to node

Battery Status: Battery percentage remaining

Battery Temperature: Appx. temperature of battery

Real Time Clock Battery: Voltage of real-time-clock keep-alive battery (on units with RTC)

Current System Time: Current system time of the node (in both UTC and current time zone if not UTC)

Node Information

Show Advanced Fields

Firmware Version: 19.7.0-dev.59

User App Install: Enabled

Wave Relay Model: MPU5

Serial No: 00016686

Uptime: 8 minutes, 54 seconds

Temperature: Power Board: 31.625 C

Main Board CPU: 30.317 C

MIMO Radio Chain 1: 26.187 C

MIMO Radio Chain 2: 26.187 C

MIMO Radio Chain 3: 26.375 C

Input Power Voltage: 12.067 Volts

Real Time Clock Battery: 4.658 Volts

Current System Time: Local Time: Fri Nov 4 16:23:51 EDT 2022
UTC Time: Fri Nov 4 20:23:51 GMT 2022

Refresh



4

Advanced:

Management HW MAC Address: MAC Address for the management hardware of the node

Ethernet 1 HW MAC Address: MAC Address for the Ethernet port in the node

Radio 1 HW MAC Address: MAC Address and frequency band for the RF module installed in the node

Radio Module HW Version: hardware version for the RF module installed in the node

Micro Firmware Version: Micro firmware version

RDC Firmware Version: Version of RDC firmware, if RDC is attached

RDC Serial Number: Serial number of RDC, if attached

Advanced	
Management HW MAC Address:	00:18:a6:00:41:2e
Ethernet 1 HW MAC Address:	00:18:A6:E0:00:DB
Radio 1 HW MAC Address:	00:18:A6:A0:00:8B (RF-2100 S-BAND (2200-2500 MHz))
Radio Module HW Version:	PS2W2400
Micro Firmware Version:	18
RDC Firmware Version:	Display Not Attached.
RDC Serial Number:	Display Not Attached.



Using the Web Management Interface: RF Configuration

Configuring RF Settings for a Single Node

- 1 Click the **Node Configuration** tab.
- 2 Click the **Node Configuration** button.
- 3 Scroll to the **RF Configuration** section

Radio 1

Radio Enable	Enable - Manual Configuration	▼
Radio Name	Radio 1	☒ Factory Default
Frequency	2.277 GHz	▼
Bandwidth	20MHz	▼
Max Link Distance	3.0 mi - 4.8 km	▼
Channel Density	Low: 2 Nodes	▼
Radio Preference	None	▼
Chain Select	Auto - Chains 1, 2, & 3	▼
Max Transmit Power/Chain	16.5 dBm - 45 mW	▼ ---> Total Power: 21.3dBm - 134mW
MAC address	00:18:A6:A0:00:8B	☒ Factory Default



4 Configure settings if needed.

Note: changing these settings may cause poor performance or loss of connectivity.

Radio Name: Assign a name - check the **Factory Default** box to use the factory default name.

Frequency: Assign a frequency to operate on. Nodes must be operating on the same frequency to communicate. Ensure that the frequency is set to match the RF module installed in the unit.



WARNING!: User **MUST** refer to the **Professional Installer – Compliance** Section of this manual for approved power levels and approved channels. This warning applies only to RF-2100 with the FCC ID 2AG3J-RF2100, RF-5100 with the FCC ID 2AG3J-RF5100, and RF-2150 with the FCC ID 2AG3JRF-2150.

Bandwidth: Assign a bandwidth to operate on. Nodes must be set to the same bandwidth to communicate. Bandwidth should be increased for shorter distances and decreased for longer distances.

Max Link Distance: Set Max Link Distance to the maximum distance any individual link between nodes in the network may need to be. All nodes on the network must be set to the same Max Link Distance.

Channel Density: Select the menu item that corresponds to the number of nodes in the network.

Radio Preference: Increasing radio preference will make the routing protocol more likely to choose this node when routing traffic in the network. **It is not recommended to change this setting.**

Max Transmit Power/Chain: Adjust transmit power of the node - this setting is per chain. The total power is shown to the right of the drop down menu.



WARNING!: User **MUST** refer to the **Professional Installer – Compliance** Section of this manual for approved power levels and approved channels. This warning applies only to RF-2100 with the FCC ID 2AG3J-RF2100, RF-5100 with the FCC ID 2AG3J-RF5100, and RF-2150 with the FCC ID FCC ID 2AG3JRF-2150.

Chain Select: Choose which RF chains to use - you may select one, two, or three chains. The Auto setting will instruct the MPU5 to select Transmit Chains on its own.

MAC Address: If desired, define a custom MAC address

5

Scroll to the bottom of the page and click **Save & Reconfigure Unit**.



Using the Web Management Interface: Upgrading Firmware

Upgrading Firmware

- 1 Click the **Node Configuration** tab.
- 2 Click the **Firmware Upgrade** button.
- 3 Click **Choose File**, then navigate to and select the firmware file you wish to load.
- 4 Click **Upload**.

! **WARNING!:** A firmware upgrade will cause the node to be reconfigured, an operation that causes a period of downtime. Do not perform a firmware upgrade during mission critical operations that cannot tolerate such disruptions. Perform firmware upgrades only during scheduled maintenance or other appropriate times.

! **WARNING!:** when upgrading or downgrading a node's firmware, the LED will turn purple. Do not unnecessarily disturb devices during an upgrade. Loss of power during the upgrade can permanently damage the device.

Note: when new firmware is available for the MPU5, you will receive an email with the new firmware file to upgrade your units.

Note: MPU5 firmware will NOT load on legacy Wave Relay® devices (MPU4, MPU3, QUAD).



<u>Node Status</u>	1 <u>Node Configuration</u>	<u>Network Status</u>	<u>Network Configuration</u>
------------------------------------	--	---------------------------------------	--

Node Configuration

Firmware Upgrade

2

Install a firmware upgrade on only this node.

Node Firmware Upgrade

Upgrade this device:

Upgrade file to install: No file chosen **3** **4**

There will be a 20 to 90 second delay when Upload button is pressed.

Erase Data Partition ▼

UPGRADE STATUS

Current Firmware Version:19.7.0



Using the Web Management Interface: Configuration Files

Creating a Configuration File

- 1 Click the **Node Configuration** tab.
- 2 Click the **Config Management** button.
- 3 Expand the **Store Configuration** box.
- 4 Click **Store**.
- 5 A prompt will appear to choose where to save the configuration file.

Note: this file contains settings (both Network Configuration and Node Configuration settings) for the current node only.

Note: do not save configuration files from nodes without a RF module installed.



[Node Status](#)

1
[Node Configuration](#)

[Network Status](#)

[Network Configuration](#)

Node Configuration

Config Management

2

Store, Load, Quick Config, Factory Reset.

Configuration Management

Help

Load Configuration ▶

3

Store Configuration ▼

Stores all current node and network configuration information for this device into a configuration file. Store this file where you can access it later with 'Quick Setup' or 'Load Configuration from File'.

Store

4

NO NDA REQUIRED

The export and/or the release of certain products, technology and software to non-US persons might be subject to export restrictions. Please refer to the US export laws & regulations for details.

03EN073 Rev. P

PAGE 81 OF 168

© 2010 - 2025 Persistent Systems, LLC – All Rights Reserved



Using the Web Management Interface: Configuration Files

Loading Settings from a Configuration File

- 1 Click the **Node Configuration** tab.
- 2 Click the **Config Management** button.
- 3 Click **Load Configuration**.
- 4 Configure **Node Name and Management IP configuration (IP, Netmask, Gateway) source**.
 - Keep Current Settings:** Node Name, Management IP, Netmask, and Gateway will not change after the configuration file is loaded.
 - Pull from Config File:** Node Name, Management IP, Netmask, and Gateway will be set to the values in the Config File you are loading.
 - Quick Setup:** A box will appear that will allow you to enter a Node Name and Management IP Address to be set when the Config File is loaded.
- 5 Click **Choose File**. Navigate to the desired configuration file to load.

Note: the configuration file should be from a device with the same firmware version and RF hardware configuration as the device being configured.

Note: do not load configuration files that have been saved from nodes with no RF module installed.
- 6 Click **Load**.



Configuration Management

Help

3

Load Configuration ▼

For network configuration: [Network Configure](#)

Load a configuration file to node:

Node Name and Management IP configuration (IP, Netmask, Gateway) source

4Keep Current Settings ▼

Configuration File:

5Choose File

 No file chosen

6Load



Using the Web Management Interface: Factory Reset

Reset Node to Factory Configuration

- 1 Click the **Node Configuration** tab.
- 2 Click **Config Management**.
- 3 Expand the **Reset to Factory Configuration** box
- 4 Configure **Node Name and Management IP configuration (IP, Netmask, Gateway)**.
Keep Current Settings: Node Name, Management IP, Netmask, and Gateway will not change after the node is reset to factory configuration.
Full Factory Reset: All settings will be reset to factory configuration.
- 5 When you are ready to remove all custom configuration and restore the node to factory settings, click the **Factory Reset** button.

3 **Reset to Factory Configuration** ▼

Clears user configuration and resets node and network configuration to factory settings.

Note: this does not zeroize security keys or reset management password (instead see [security configuration](#) and [password configuration](#) respectively.)

Factory Reset Options:

Node Name and Management IP configuration (IP, Netmask, Gateway)

Keep Current Settings ▼ 4

Factory Reset 5



Check GPS Status

1 Click the **Node Status** tab.

2 Click the **GPS Status** button.

3 The page will display:

Source: GPS information source

Latitude: Current latitude of the node

Longitude: Current longitude of the node

Altitude: Current altitude of the node as MSL (above sea level) and HAE (above ellipsoid)

Position Status

```
Source:           Internal GPS
Latitude:         +40.75184 deg
Longitude:        -74.00753 deg
Altitude (HAE):   -6 m
Altitude (MSL):   26 m
Time:             2023-03-30T19:03:20.00Z
Speed:            0.1 m/s  0.4 km/h  0.2 mph
Climb:            0.0 m/s  0.0 km/h  0.0 mph
Track:            0 deg True
Satellites Used:  6
Satellites Visible: 18
Satellite ID/PRN: 1 3 6 7 14 17 19 21 22 24 30 131 133 135 138 193 194 197
Satellite SNR:    24 0 0 0 31 40 36 18 0 24 0 38 35 0 0 0 0 0 dB
```

System Clock Status

GPS set system clock to UTC time at 03/30/2023 14:44:56 EDT

[Return to Menu](#)



Using the Web Management Interface: Network Status

Network Status Tab

The **Network Status** tab allows you to view information about every node in the Managed Node List at the same time. Besides MANET Monitor, Network Visualization, and Channel Plan, each page displays the same information as its counterpart on the Node Status page, but for every node in the network.

Unit Info: general node information for every node in the network

Power Status: supply voltage and battery percent for all Wave Relay nodes in the network as well as tethered, Advanced-RoIP-capable radios.

Channel Plan: channel setting for each node

MANET Monitor: number of nodes in the network, serial number, node name, IP address, velocity and direction, altitude, neighbors, battery percentage remaining, SNR for every node in the network

GPS Status: GPS information for every node in the network

Video Encoder Status: Video settings and status for every node

Intercom Audio Status: Intercom Audio status for every node

IP Tether Status: IP tether status for every node

Video Kiosk Status: Video kiosk settings and status for every node

Network Traffic Load: traffic load information for every node in the network

IP Flow List: IP flows on the network

IP Multicast Status: IGMP & IP multicast routing status on which groups are joined

RoIP Status: RoIP status for all nodes

Network Default Check: lists configuration settings for each node that are NOT set to a Network Default value

Network Visualization: view the network in Google Earth

Using the Web Management Interface: Network Status



Unit Info	The operational time since last power on or reboot, firmware version, system temperature, voltages, and date.
Power Status	Supply voltages and battery status.
Channel Plan	The channel setting for every radio.
MANET Monitor	Monitors active nodes heard on the MANET.
GPS Status	The current GPS position.
Video Encoder Status	Video settings and status for every radio.
Intercom Audio Status	Intercom Audio status for every radio.
IP Tether Status	IP Tether status for every radio.
Video Kiosk Status	Video kiosk settings and status for every radio.
Network Traffic Load	Monitor and analyze wireless medium and bridged interface traffic loads.
IP Flow List	List IP flows passing through node sorted by measured throughput.
IP Multicast Status	IGMP & IP multicast routing status on which groups are joined.
RoIP Status	RoIP status for every radio.
Cloud Relay™ Status	Cloud Relay™ status for every radio.
Network Default Check	List configuration settings for each node that are NOT set to a Network Default value
Network Visualization	Display <u>Network Visualization</u> in Google Earth Refresh every: 2 seconds ▼

NO NDA REQUIRED

The export and/or the release of certain products, technology and software to non-US persons might be subject to export restrictions. Please refer to the US export laws & regulations for details.

03EN073 Rev. P

PAGE 87 OF 168

© 2010 - 2025 Persistent Systems, LLC – All Rights Reserved



Using the Web Management Interface: Network Visualization

Configuring Visualization Settings

- 1 Click the **Node Configuration** tab.
- 2 Click **Node Configuration**.
- 3 Scroll to the **Wave Relay SA** box.
- 4 Configure Wave Relay Situational Awareness settings:

Enable/Disable WRSA Packets: select Enabled to enable Wave Relay SA

WRSA Multicast Address: defines the multicast address for sending and receiving Wave Relay SA packets - uncheck the Factory Default box to modify this field.

SA Neighbor Info: enables or disabled SA Neighbor info - if disabled, Google Earth will not display SNR lines, and SNR will not appear in the MANET monitor. Disable this setting to reduce network overhead and improve scalability and performance of high density networks.

Visualization Icon: select an icon to represent the node in Google Earth.



Node Status

1 Node Configuration

Network Status

Network Configuration

Node Configuration

2

Setup the node configuration.

3 Wave Relay SA

Enable/Disable WRSA packets

Network Default (Enabled) ▼

Update Interval

Network Default (Dynamic) ▼

WRSA Multicast Address

239.23.212.229

☒ Network Default

SA Neighbor Info

Network Default (Auto) ▼

Visualization Icon














NO NDA REQUIRED

The export and/or the release of certain products, technology and software to non-US persons might be subject to export restrictions. Please refer to the US export laws & regulations for details.

03EN073 Rev. P

PAGE 89 OF 168

© 2010 - 2025 Persistent Systems, LLC – All Rights Reserved



Using the Web Management Interface: Network Visualization

Viewing Network Visualization

- 1 Click the **Network Status** tab.
- 2 Scroll to **Network Visualization**.
- 3 Select a refresh rate from the drop-down menu. Faster refresh rates will use more bandwidth.
- 4 Click Network Visualization. A file named node-monitor.kml will download.
- 5 Open this file in Google Earth to view network visualization.

Note: this is a network tool and may not accurately show position (especially elevation) in Google Earth. TAK may be desired for accurate positioning or operational picture.

Using the Web Management Interface: Network Visualization



4

Node Status

Node Configuration

1

Network Status

Network Configuration

Security

Help

Log Out

Network Visualization

Display Network Visualization in Google Earth

Refresh every: 2 seconds

3

5

Google Earth

Search

Get Directions History

Places

My Places

Sightseeing Tour

PS Office

Receptor 1

Temporary Places

Layers

Earth Gallery

Primary Database

Coming soon

Buildings and Labels

Photos

Roads

3D Buildings

Ocean

Weather

Gallery

Global Awareness

More

Wave 150

Wave 160

Wave 192

Wave 209

Wave 170

Wave 171

Wave 167

Wave 180

Wave 177

Wave 165

Wave 190

Google Earth

Imagery Date: 6/20/2014

Lat: 40.746011° N, Lon: -73.975663° W, Elev: 14.7m, Zoom: 15.66 km

NO NDA REQUIRED

The export and/or the release of certain products, technology and software to non-US persons might be subject to export restrictions. Please refer to the US export laws & regulations for details.

03EN073 Rev. P

PAGE 91 OF 168

© 2010 - 2025 Persistent Systems, LLC – All Rights Reserved



Device Operation: Zeroize the Security Key

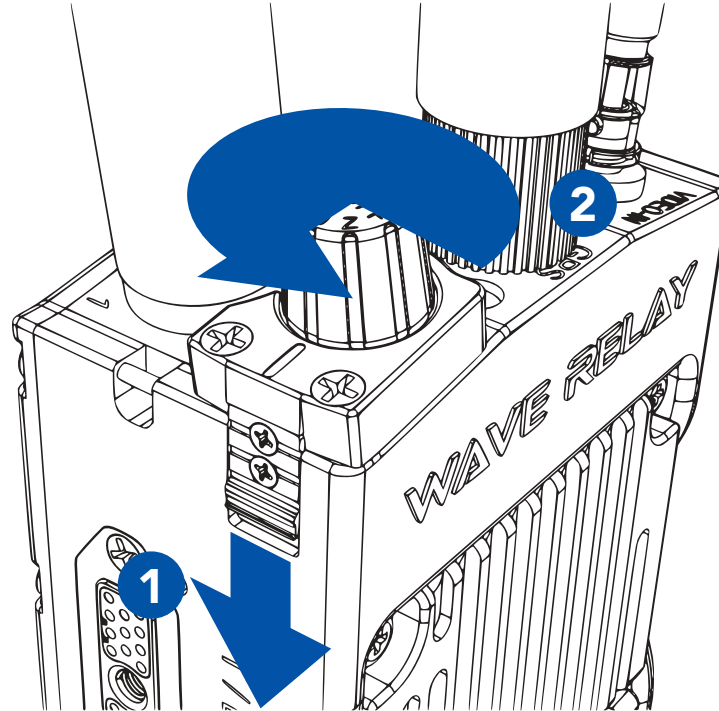
Part V: Device Operation

Zeroize the Security Key

Zeroizing the node will erase the security key, reset the management password, and disable Cloud Relay™.

- 1** Pull down the **zeroize latch** on the top of the unit.
- 2** With the zeroize latch held down, **twist** the **Power Knob** counterclockwise from the **OFF** position to the **Z** position.

Note: the status indicator LED will blink red once when the key is zeroized.



NO NDA REQUIRED

The export and/or the release of certain products, technology and software to non-US persons might be subject to export restrictions. Please refer to the US export laws & regulations for details.

03EN073 Rev. P

PAGE 93 OF 168



Device Operation: Connecting a Camera

Connect a Camera to the MPU5

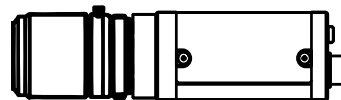


Parts List

For HD-SDI Connection:



HD-BNC to BNC Cable
CBL-VID-2001

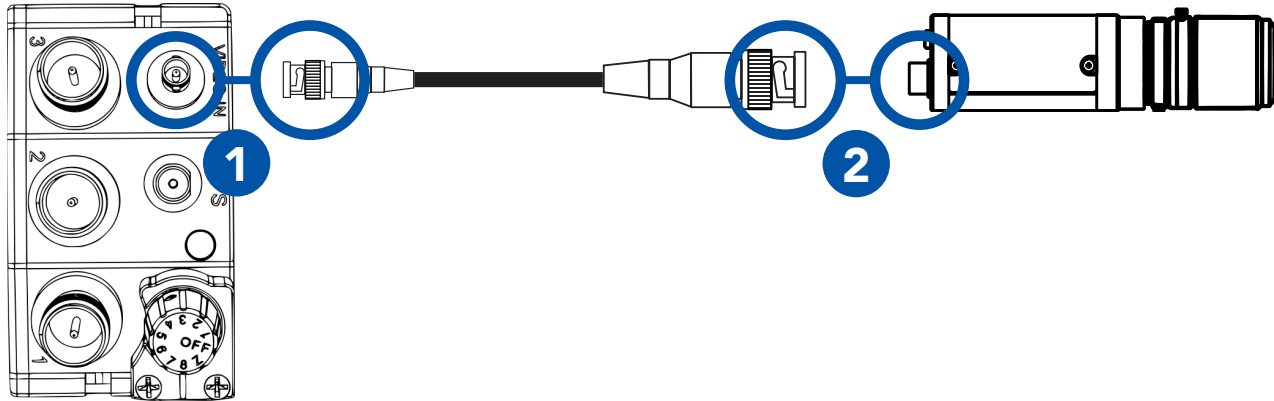


Camera with BNC output



- 1 Connect the **HD-BNC** end of **CBL-VID-2001** to the **HD-BNC** connector on the top of the MPU5.

- 2 Connect the **BNC** end of **CBL-VID-2001** to the **BNC** connector on the camera.



Note: the Video In connector does not supply power to the camera. Ensure that your camera is properly powered via another source.

NO NDA REQUIRED

The export and/or the release of certain products, technology and software to non-US persons might be subject to export restrictions. Please refer to the US export laws & regulations for details.

03EN073 Rev. P

PAGE 95 OF 168

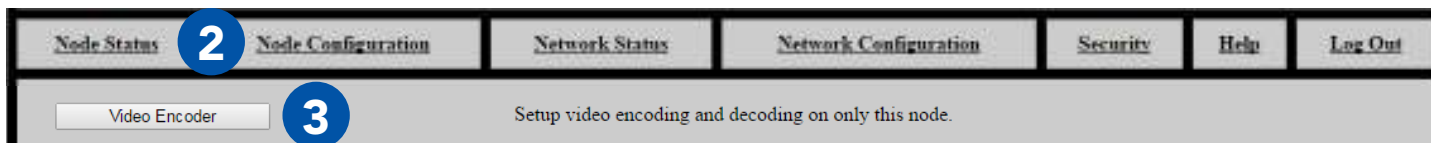
© 2010 - 2025 Persistent Systems, LLC – All Rights Reserved



Device Operation: Configuring Video Settings

Configuring Video Settings

- 1 Connect the MPU5 to the Management Computer and log into the Web Management Interface.
- 2 Click the **Node Configuration** tab.
- 3 Click the **Video Configuration** button.



Check Camera Input Status

- 1** The left column displays status information for the camera connected to the MPU5. Use this status information to verify that the connected camera is configured and working properly.

Overall Input Status: displays Yes if a camera is connected; displays No otherwise.

Scan Mode: scan mode setting of the connected camera, if available

Video Data Format: output format setting of the connected camera, if available

Input Resolution: resolution setting of the connected camera, if available

Input Frames/Sec: frame rate setting of the connected camera, if available

Audio Present: audio status from the connected camera, if available

Input Status	
Overall Input Status:	Yes
Scan Mode:	---
Video Data Format:	NTSC
Input Resolution:	NTSC
Input Frames/Sec:	30
Audio Present:	None

NO NDA REQUIRED

The export and/or the release of certain products, technology and software to non-US persons might be subject to export restrictions. Please refer to the US export laws & regulations for details.



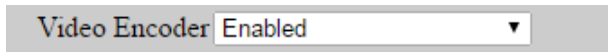
Device Operation: Configuring Video Settings

Encoder Configuration

The center column displays configuration settings for the MPU5's onboard video encoder.

Enable/Disable Video Encoding

- 1 In the **Enable/Disable** drop-down menu, select **Enabled**.

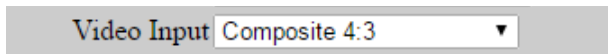


A screenshot of a configuration interface showing a dropdown menu labeled 'Video Encoder' with 'Enabled' selected. The dropdown is open, showing the selected option.

- 2 To disable Video, select **Disabled**.

Select Video Input

- 1 Select the video source that corresponds to your camera from the **Video Input** drop-down menu.



A screenshot of a configuration interface showing a dropdown menu labeled 'Video Input' with 'Composite 4:3' selected. The dropdown is open, showing the selected option.

3G-SDI: 3G-SDI input via the **Video In** connector on the top of the MPU5

Composite 4:3: Composite input with a 4:3 aspect ratio via the **Video In** connector on the top of the MPU5

Composite 16:9: Composite input with a 16:9 aspect ratio via the **Video In** connector on the top of the MPU5

Note: you **MUST** manually configure the correct input source. If the correct input source is not selected, input status will show no camera detected.

Configure Video Output IP Address and Port

Video Output IP	239.23.212.200	☒ Factory Default
Video Output Port	9722	☒ Factory Default

- 1 Enter an IP address for the video in the **Video Output IP** field. Pick a unique IP address. Uncheck the **Factory Default** box to make changes to this field. Check the **Factory Default** box to use the Factory Default Video Output IP.

Note: it is recommended to change this setting from the factory default to avoid IP conflicts. Only valid Multicast addresses can be used (224.0.0.0 through 239.255.255.255)

- 2 Enter a port for the video stream in the **Video Output Port** field. Uncheck the **Factory Default** box to make changes to this field. Check the **Factory Default** box to use the Factory Default Video Output Port.



Device Operation: Configuring Video Settings

Advanced Video Configuration Options

- 1 Click **Show/Hide Advanced Settings**. This will show or hide drop-down menus for **I-Frame Interval**, **IDR-Frame Interval**, and **Protocol**.

I-Frame Interval	Factory Default (2 Seconds) ▼
IDR-Frame Interval	2 Seconds ▼
Protocol	Factory Default (MPEG-TS/UDP) ▼

I-Frame Interval (Advanced): Sets the time between I-Frames (in seconds). The shorter amount of time between I-Frames, the better video quality will be, but the video stream will use more bandwidth. It is not recommended for non-advanced users to change this setting.

IDR-Frame Interval (Advanced): Sets the time between IDR-Frames (in seconds). Increasing IDR-Frame interval will decrease the bandwidth used by the stream, but it may reduce video quality. It is not recommended for non-advanced users to change this setting.

Note: Available IDR-Frame Interval options change based on the selected I-Frame interval. If you change I-Frame Interval and the selected IDR-Frame Interval setting is available for that I-Frame Interval, the IDR-Frame Interval will not change. If you change I-Frame Interval and the selected IDR-Frame Interval setting is not available for that I-Frame Interval, IDR-Frame Interval will be set to the factory default setting for that I-Frame Interval.

Protocol (Advanced): Selects the streaming protocol for the video stream. Options are: **MPEG-TS/UDP** or **RTP/UDP**.



Select Video Encoding Settings

- 1 Select a resolution from the Resolution drop-down menu. This setting selects the resolution at which video will be encoded. Options are:
- 2 Select a frame rate from the Frame Rate drop-down menu. This setting selects the frame rate at which video will be encoded.
- 3 Select a bit rate from the Bit Rate drop-down menu. This setting selects the bit rate at which video will be encoded.

Resolution Factory Default (720 P) ▼
Frames/Sec Factory Default (30 fps) ▼
Bit Rate 1.00Mbps ▼

Note: Available frame rate and bit rate options change based on the selected resolution. If you change resolution and the selected frame rate and bit rate settings are available for that resolution, they will not change. If you change resolution and the selected frame rate or bit rates settings are not available for that resolution, frame rate and bit rate will be set to the factory default setting for that resolution.

- 4 If you wish to encode audio with the video stream, select **Yes** from the **Audio** drop-down menu. Otherwise, select **No**.

Audio Factory Default (No) ▼

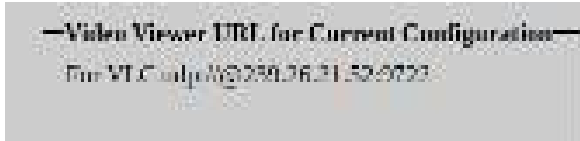


Device Operation: Configuring Video Settings



When you are finished configuring settings, click **Save & Reconfigure Unit**.

Video Viewer URL



The **Video View URL** box will display the URL below the Video Configuration settings. To pull video from this node, enter the **For VLC** URL into VLC.

Note: if you change **Video Output IP** or **Video Output Port** on the **Video Configuration** page, these URLs will change as well.



Device Operation: Configuring Video Settings

Video Encoding Status

The center column displays configuration settings for the MPU5's onboard video encoder.

Overall Encoder Status: displays whether this node is encoding video or not.

Subscribers: displays whether there are users on the network subscribing to the video from this node.

Note: if no one is subscribed to the video from this node, the node will not encode video.

Output Resolution: displays the resolution of the encoded video being output

Output Frames/Sec: displays frame rate of the encoded video being output

Audio Encoded: displays whether audio is being encoded with the video stream or not

Video Configuration Status: will green if good, and will show errors, if they occur

Encoder Output Status	
Overall Encoder Status: Encoding Video	
Subscribers:	Subscribers Present
Output Resolution:	1080x1080
Output Frames/Sec:	30
Audio Encoded:	Not Present
Video Configuration Status:	



What do I do if video is not being encoded?

- 1 Ensure that the camera is powered and all cables are connected securely to the correct connectors.
- 2 Ensure Video Encoding is enabled on the node. You must click the Save & Reconfigure Unit button for settings to take effect.
- 3 Ensure that the correct video input is selected on the Video Encoding Configuration page.
- 4 If there are no subscribers to the video, video will not be encoded. Check if video is being encoded when a subscriber is present.
- 5 Ensure the correct Video Viewer URL is entered into your video viewer.

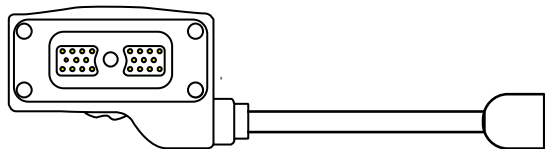


Device Operation: Connecting a Monitor or TV

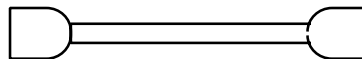
Connect a Monitor or TV to the MPU5



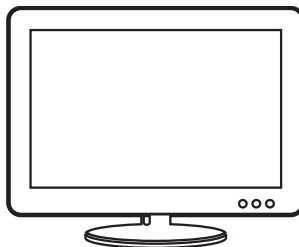
Parts List



22-Pin to Video Out
CBL-DATA-3003



HDMI Cable

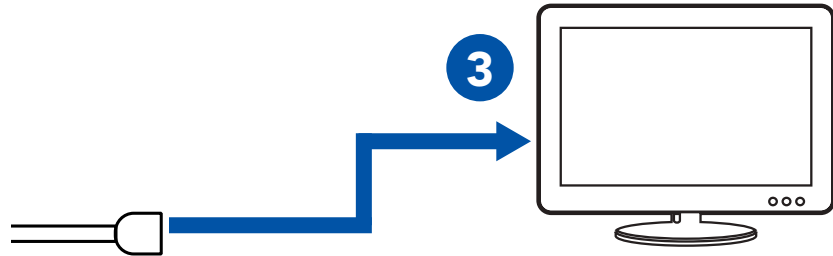
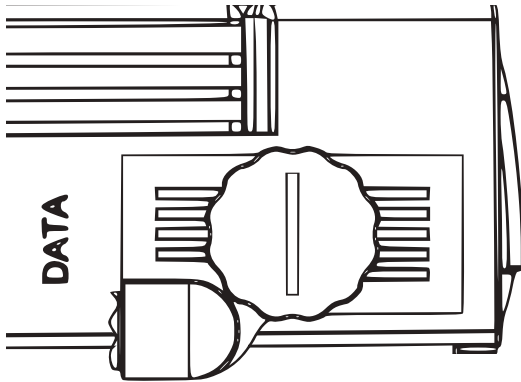


Monitor or TV with HDMI Input

Device Operation: Connecting a Monitor or TV



- 1 Connect **CBL-DATA-3003** to the **DATA** side connector on the MPU5.
- 2 Connect an **HDMI cable** to the HDMI output on **CBL-DATA-3003**.
- 3 Connect the **HDMI cable** to the **HDMI Input** on the monitor or TV.



NO NDA REQUIRED

The export and/or the release of certain products, technology and software to non-US persons might be subject to export restrictions. Please refer to the US export laws & regulations for details.

03EN073 Rev. P

PAGE 107 OF 168

© 2010 - 2025 Persistent Systems, LLC – All Rights Reserved



Device Operation: Connecting a Monitor or TV



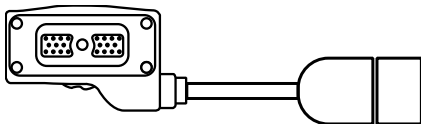
Why can't I see video on my Monitor or TV?

- 1 Ensure that the Monitor or TV is powered on.
- 2 Ensure that all cables are connected properly.
- 3 Ensure that the Monitor or TV is set to the correct HDMI input.
- 4 Reboot the node.

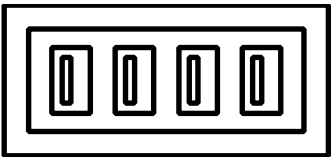


Connect USB Accessories to the MPU5

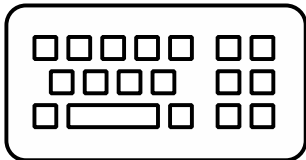
Parts List



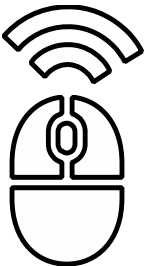
22-Pin to Type A Female USB 2.0 Receptacle
CBL-DATA-2003



USB Hub
(Optional)



USB Keyboard
(Optional)



USB Mouse
(Optional)

NO NDA REQUIRED

The export and/or the release of certain products, technology and software to non-US persons might be subject to export restrictions. Please refer to the US export laws & regulations for details.



Device Operation: Connecting USB Accessories

1

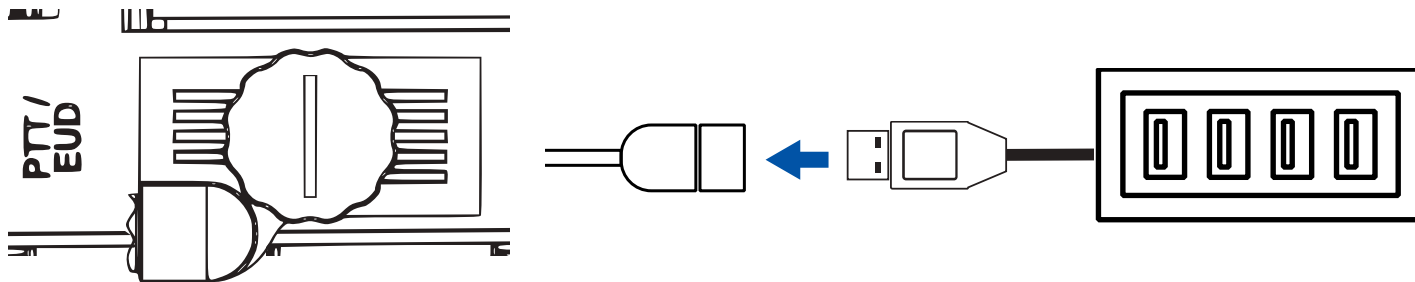
Connect **CBL-DATA-2003** to an unused side connector on the MPU5.

2

Connect the USB Hub or one USB accessory to the **USB receptacle** on the end of CBL-DATA-2003.

3

If you are using a USB Hub, connect USB accessories to the USB receptacles in the USB Hub.



?

Why don't my USB accessories work?

1

Ensure all cables are connected properly.

2

Ensure that all wireless accessories (keyboards/mice/etc.) are powered (i.e. batteries are not dead)

3

If you are using a USB Hub, connect the USB accessory directly to CBL-DATA-2003. If the accessory works, replace the USB hub.

4

If available, test a different CBL-DATA-2003. If the accessory works, the original CBL-DATA-2003 may be defective.

5

Reboot the node.

4

Your USB accessory may not be compatible. Contact Persistent Systems support.

Install Android™ Apps on the MPU5



Parts List



.apk file for Android™ App(s)



Management Computer

Note: the Operating System on the MPU5 is Android™ version 5.0 (Lollipop). Ensure that the app you wish to install is compatible with this version of the Android™ OS.

NO NDA REQUIRED

The export and/or the release of certain products, technology and software to non-US persons might be subject to export restrictions. Please refer to the US export laws & regulations for details.



Device Operation: Installing Android™ Apps

- 1 Connect the MPU5 to the Management Computer and log into the Web Management Interface.
- 2 Click the **Node Configuration** tab.
- 3 Click **APK Install**.



4 Click **Choose File** and navigate to the .apk file you wish to install.

5 Click **Upload** and wait for the on-screen prompt to say Node APK Install Succeeded. The page will then reload.

Node APK Install

Install APK on this node:

APK file to install: No file chosen

4

5

APK Install Status

Started APK Install.

127.0.0.1: Connected to node

127.0.0.1: APK file transferred

127.0.0.1: Ready for APK install

127.0.0.1: APK install successful

Node APK Install Succeeded

Stand by. Preparing to reload



Network Configuration Tab

The **Network Configuration** tab allows you to perform actions on all nodes in the managed node list.

Managed Node List: manage the Managed Node List

Network Defaults: manage network default settings

Network Upgrade: upgrade firmware on all nodes in the managed node list

Network Password: change the Management Password for all nodes in the managed node list

Network APK Install: install an APK on all nodes in the network

Config Management: push a config file to all nodes in the network

Reboot Network: reboot all nodes in the network

Each action on this tab is the same as the corresponding action on the Node Configuration tab.

This switch controls behavior when an error occurs.

On Error/Dropout Continue Install



Halt Install

Continue Install: function will skip the node with the error and continue installation on the rest of the node list.

Halt Install: function will stop installation when an error occurs.



Network Configuration

Managed Node List

Manage the network node list.

Network Defaults

Configure the network defaults for the network

Network Upgrade

Upgrade the firmware on all of the nodes in the network in a single step.

Network Password

Change the management interface password.

Network APK Install

Install an APK on all of the nodes in the network in a single step.

Config Management

Send a configuration file to all nodes on the network

Reboot Network

Reboot all of the nodes in the network.

NO NDA REQUIRED

The export and/or the release of certain products, technology and software to non-US persons might be subject to export restrictions. Please refer to the US export laws & regulations for details.

03EN073 Rev. P

PAGE 115 OF 168

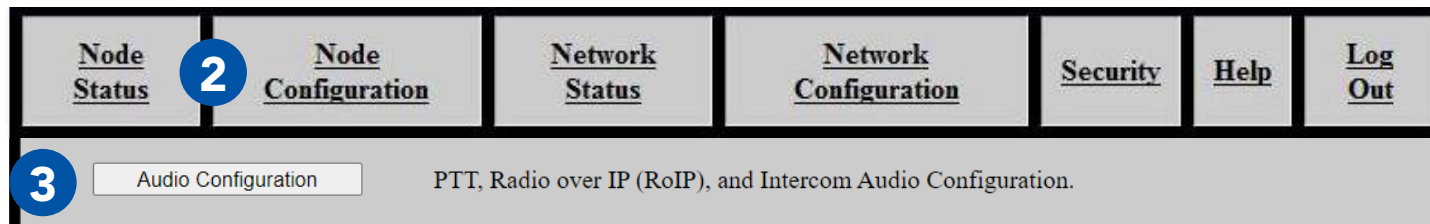
© 2010 - 2025 Persistent Systems, LLC – All Rights Reserved



Device Operation: Configuring 3rd Party PTT Settings

Configure 3rd Party PTT Settings

- 1 Connect the MPU5 to the Management Computer and log into the Web Management Interface.
- 2 Click the **Node Configuration** tab.
- 3 Click the **Audio Configuration** button.





Enable Push-to-Talk

- 1 In the **PTT Audio** drop-down menu, select **Enabled**.

PTT Audio Network Default (Enabled) ▼

- 2 To disable Push-to-Talk, select **Disabled**.

Set Microphone Level

- 1 Next to Microphone Level, **check** the **Auto/AGC (Network Default)** box to use automatic gain control (recommended).

Microphone Level [0, 31] auto ☒ Auto/AGC (Network Default)

- 2 To customize microphone level, **uncheck** the **Network Default** box.

- 3 In the **Microphone Level** field, enter a value:
0 - 31: valid microphone level volumes



Device Operation: Configuring 3rd Party PTT Settings

Set Earpiece Volume

- 1 Next to Volume, **check** the **Network Default** box to use the Network Default earpiece volume.
- 2 To customize earpiece volume, **uncheck** the **Network Default** box.
- 3 In the **Volume** field, select **1 - 8**.



Set Transmit Mode

- 1 Select a setting from the **Transmit Mode** drop-down menu:

Transmit Mode Network Default (On Key Press) ▼

OnKeyPress: audio is transmitted only when the PTT button is pressed on the headset

Continuous: audio is continuously transmitted.

Note: other nodes may monitor the channel only. Selected Channel audio transmissions will interrupt monitored continuously transmitted audio.



Device Operation: Configuring 3rd Party PTT Settings

Set Transmit or Receive Audible Checktone

1

From the **Tones on Transmit** and **Tones on Receive** drop down menus, select:

Quiet: no audible checktone

Beep: audible checktone will be set to a beep

Voice: audible checktone will be a vocalized "one"

Network Default: audible checktone will be set to the network default setting

Transmit Tones Network Default (Beep) ▼

Receive Tones Network Default (Beep) ▼



Enable/Disable Low Battery Audible Notification

1

Select a setting in the **Low Battery** drop-down menu:

Enabled: when the battery is depleted to 5%, the node will play an audible notification every 5 minutes.

Disabled: no low battery audible notification will occur.

Network Default: network default setting

Audible Low Battery Notify Network Default (Enabled) ▼



Device Operation: Configuring 3rd Party PTT Settings

Selecting Channels

- 1 In the **Selected** column, click the circle for the channel(s) you wish to transmit on.
- 2 In the **Monitor** column, check the box for each channel you wish to monitor. You will be able to hear PTT audio on the monitored channel.

Pro Tip: you may select any number of channels to monitor. In the Monitor column, check the box for each channel you wish to monitor. You will NOT be able to transmit PTT audio on channels other than the one you selected in Step 3.

Customize a PTT Channel

- 3 In the **Channel** field, uncheck the **Network Default** box and enter the desired channel name.
- 4 In the **Multicast Address** field, uncheck the **Network Default** box and enter the desired multicast address and multicast port in the form <multicast address>:<multicast port>.

Note: valid multicast address values are in the range **224.0.0.0 - 239.255.255.255**

Note: valid multicast port values are in the range **1 - 65534**

Note: each channel **MUST** have a unique multicast address and multicast port.

- 5 Scroll to the bottom of the page and click **Save & Reconfigure Unit**.

Device Operation: Configuring 3rd Party PTT Settings



Talk Group Configuration

Audio Codec: Network Default (Opus)

PTT A

SELECTED	MONITORED	Name	Multicast Address
☒	☐	Flash Override	239.192.60.0:60000
☐	☐	Talk Group 1	239.192.60.1:60001
☐	☐	Talk Group 2	239.192.60.2:60002
☐	☐	Talk Group 3	239.192.60.3:60003
☐	☒	Talk Group 4	239.192.60.4:60004
☐	☐	Talk Group 5	239.192.60.5:60005
☐	☐	Talk Group 6	239.192.60.6:60006
☐	☐	Talk Group 7	239.192.60.7:60007
☐	☐	Talk Group 8	239.192.60.8:60008
☐	☐	Talk Group 9	239.192.60.9:60009
☐	☐	Talk Group 10	239.192.60.10:60010
☐	☐	Talk Group 11	239.192.60.11:60011
☐	☐	Talk Group 12	239.192.60.12:60012
☐	☐	Talk Group 13	239.192.60.13:60013
☐	☐	Talk Group 14	239.192.60.14:60014
☐	☐	Talk Group 15	239.192.60.15:60015
☐	☐	Talk Group 16	239.192.60.16:60016

Save & Reconfigure Unit

NO NDA REQUIRED

The export and/or the release of certain products, technology and software to non-US persons might be subject to export restrictions. Please refer to the US export laws & regulations for details.

03EN073 Rev. P

PAGE 123 OF 168

© 2010 - 2025 Persistent Systems, LLC – All Rights Reserved



Device Operation: Configuring 3rd Party PTT Settings

Using Wave Relay® Push-to-Talk

- 1 Ensure that your PTT device is connected and channel settings have been configured properly and as desired.
 - 2 **Press and hold** the PTT button on the PTT device.
 - 3 Wait to hear a single beep.
 - 4 Talk.
 - 5 **Release** the PTT button when you are finished talking.
- ▶ You may talk or listen, but you may not do both simultaneously.
 - ▶ Transmissions from an individual user are broadcast to all other users on the network using the same channel.
 - ▶ Only one person may talk on a channel at one time. If you try to PTT while another user is transmitting, you will hear a busy signal.
 - ▶ Selected Channel audio will interrupt Monitored Channel audio.
 - ▶ Flash Override audio will interrupt both Selected Channel and Monitored Channel audio.



Using Flash Override

Flash Override is a feature that allows a user to transmit audio to all nodes on the network regardless of which channel they are operating on.

Flash Override audio will interrupt all audio on all channels.

- 1 To activate Flash Override, **"tap-tap-hold"** the PTT button (**press and release** the PTT button quickly in succession, then **press and hold** the PTT button for the duration of the transmission)
- 2 The transmitting user and all receiving users will hear three beeps.
- 3 Talk.
- 4 **Release** the PTT button when you are finished talking.



PROFESSIONAL INSTALLER - COMPLIANCE

USA

The following notes refer to these part numbers:

Persistent Systems P/N	Description	FCC ID
RF-2100	S-Band RF Module	2AG3J-RF2100
RF-5100	Upper C-Band RF Module	2AG3J-RF5100
RF-2150	10W S-Band RF Module	2AG3JRF-2150

This device complies with part 15 of the FCC rules. Operation is Subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

NO NDA REQUIRED

The export and/or the release of certain products, technology and software to non-US persons might be subject to export restrictions. Please refer to the US export laws & regulations for details.



Professional Installer - Compliance

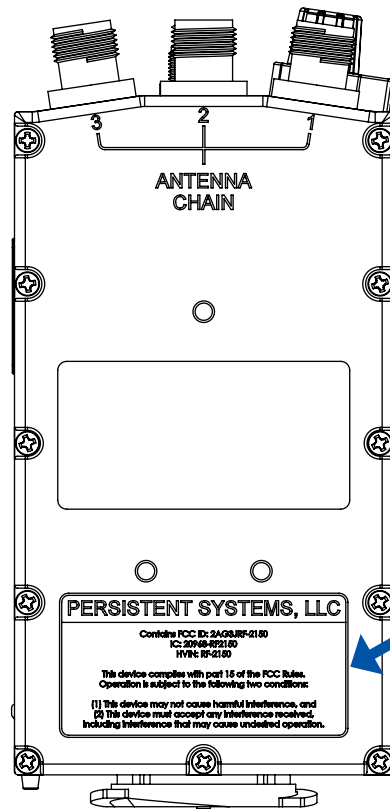
NOTE: THE MANUFACTURER IS NOT RESPONSIBLE FOR ANY RADIO OR TV INTERFERENCE CAUSED BY UNAUTHORIZED MODIFICATIONS TO THIS EQUIPMENT. SUCH MODIFICATIONS COULD VOID THE USER'S AUTHORITY TO OPERATE THE EQUIPMENT.

NOTE II: 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:

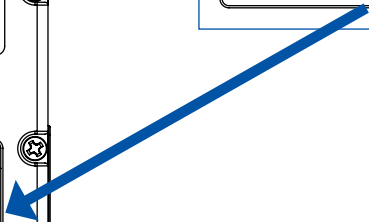
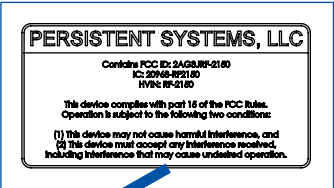
- ▶ Reorient or relocate the receiving antenna.
- ▶ Increase the separation between the equipment and receiver.
- ▶ Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- ▶ Consult the dealer or an experienced radio/TV technician for help.

OPERATING FREQUENCY: Operating frequency is determined by the installer. It is important that the frequency configured meets local regulations.

NOTE III: Please note that if the FCC identification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following: "Contains FCC ID: XXX" where XXX = the radio module's FCC ID. Any similar wording that expresses the same meaning may be used.



When the MPU5 is paired with RF-2150, professional installer is responsible for attaching included label to the MPU5 in this location. Label is included with the RF module.





FCC Part 15

Test Plan for Host Compliance - FCC Part 15

The modular transmitter is authorized under FCC Part 15 Subpart C (§15.247). The certification is for a Limited Module Approval (LMA) with the only limitation being that the radio module cannot be tested in a stand-alone configuration. This requires additional testing to be performed (as outlined below) with the module installed in a new host, and for the module grantee to file for a Class II Permissive Change for each new specific host.

The following testing or evaluation should be performed on each new host product in which the limited module is installed, to demonstrate continued compliance:

- Radiated Spurious Emissions on the lowest, middle and highest channels in all supported data modes (this is to be done in accordance with FCC Rule Parts 15.247, 15.205 and 15.209, and following the procedures given in ANSI C63.10)
- RF Exposure assessment based on the intended use case configuration(s) of the new host (this is to be done in accordance with FCC Rule Parts 1.1310, 2.1091 or 2.1093 as applicable)



The limited module has already been tested and approved for use in the following host:

- MPU5 (**WR-5100**)

The host listed above is manufactured by Persistent Systems, LLC, and the radio module will be installed in the host only by professional installers. The module is intended to be used only in the grantee's equipment and is not offered for sale to the public or OEMs other than the grantee.

Additional testing for host products:

The modular transmitter is only FCC authorized for the specific rule parts listed on the grant, and the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host. The final host product requires Part 15 Subpart B compliance testing with the modular transmitter installed.

NO NDA REQUIRED

The export and/or the release of certain products, technology and software to non-US persons might be subject to export restrictions. Please refer to the US export laws & regulations for details.



Professional Installer - Compliance

P/N: RF-2100

FCC ID: 2AG3J-RF2100

US Power Limits						
Mode:	SISO: Only One Port Active		MIMO (2x2): 2 Ports Active Power Setting / Port		MIMO (3x3): All 3 Ports Active Power Setting / Port	
CHANNEL:	Max. Power Setting Approved (dBm)	Max. EIRP (dBm)	Max. Power Setting Approved (dBm)	Max. EIRP (dBm)	Max. Power Setting Approved (dBm)	Max. EIRP (dBm)
1	28	32	26	31	24.5	31
2	30	35	26	32	24.5	31
3	30	36	26	32	24.5	31
4	30	36	26	32	24.5	31
5	30	36	26	32	24.5	31
6	30	36	26	32	24.5	31
7	30	36	26	32	24.5	31
8	30	36	26	32	24.5	31
9	30	36	26	32	24.5	31
10	30	33	26	32	24.5	31
11	29	32	26	31	24.5	31

P/N: RF-2150
FCC ID: 2AG3JRF-2150

US Power Limits 2.15 dBi Omnidirectional Antenna							
Mode:		SISO: Only One Port Active		MIMO (2x2): 2 Ports Active Power Setting / Port		MIMO (3x3): All 3 Ports Active Power Setting / Port	
CHANNEL:	Channel Width (MHz)	Max. Power Setting Approved (dBm)	Max. EIRP (dBm)	Max. Power Setting Approved (dBm)	Max. EIRP (dBm)	Max. Power Setting Approved (dBm)	Max. EIRP (dBm)
1	20	14.0	17.0	12.5	21.5	9.5	22.4
2	20	17.5	20.2	17.0	26.1	15.5	28.2
3	20	18.5	21.6	18.0	27.0	16.0	29.2
4	20	19.5	22.6	18.5	28.1	17.5	30.8
5	20	23.0	25.6	21.0	29.7	19.5	32.0
6	20	23.5	26.1	22.5	31.6	21.0	33.0
7	20	23.5	26.1	23.0	32.0	21.5	33.1
8	20	22.0	24.6	21.0	30.0	20.0	32.1
9	20	21.0	23.5	19.0	28.2	17.5	30.6
10	20	19.5	22.0	17.0	26.3	16.5	29.3
11	20	14.5	17.6	13.0	22.1	10.0	22.7



Professional Installer - Compliance

P/N: RF-2150

FCC ID: 2AG3JRF-2150

US Power Limits 4 dBi Omnidirectional Antenna							
Mode:		SISO: Only One Port Active		MIMO (2x2): 2 Ports Active Power Setting / Port		MIMO (3x3): All 3 Ports Active Power Setting / Port	
CHANNEL:	Channel Width (MHz)	Max. Power Setting Approved (dBm)	Max. EIRP (dBm)	Max. Power Setting Approved (dBm)	Max. EIRP (dBm)	Max. Power Setting Approved (dBm)	Max. EIRP (dBm)
1	20	12.5	17.8	11	22.3	9	24.3
2	20	17	22	15.5	26.8	14.5	29.3
3	20	18	23.2	17.5	28.7	16	31.4
4	20	19.5	24.7	18	29.9	17	32.5
5	20	22	26.2	20.5	31.5	19	33.6
6	20	22.5	26.9	22	32.9	20.5	34.6
7	20	23	27.5	22.5	33.1	21	34.8
8	20	21.5	25.9	21	31.9	19.5	33.8
9	20	20	24.7	19	30.1	17	32.1
10	20	18	23	17	28.2	16	30.8
11	20	14	19.2	12.5	23.4	9.5	24.3

P/N: RF-2150
FCC ID: 2AG3JRF-2150

US Power Limits 8.5 dBi Omnidirectional Antenna							
Mode:		SISO: Only One Port Active		MIMO (2x2): 2 Ports Active Power Setting / Port		MIMO (3x3): All 3 Ports Active Power Setting / Port	
CHANNEL:	Channel Width (MHz)	Max. Power Setting Approved (dBm)	Max. EIRP (dBm)	Max. Power Setting Approved (dBm)	Max. EIRP (dBm)	Max. Power Setting Approved (dBm)	Max. EIRP (dBm)
1	20	10.0	20.1	9.0	24.4	7.0	26.6
2	20	16.0	25.0	14.5	29.9	14.0	33.0
3	20	16.5	26.1	16.0	31.4	14.5	33.5
4	20	19.0	28.4	16.5	32.1	15.0	34.1
5	20	20.0	28.9	18.5	33.9	15.0	34.0
6	20	21.0	29.8	20.0	35.8	15.5	34.9
7	20	21.5	30.2	20.0	34.9	15.5	34.6
8	20	21.0	29.8	16.5	31.8	15.0	34.3
9	20	18.0	27.9	16.0	31.4	15.0	34.6
10	20	16.5	25.7	15.5	30.9	14.5	33.4
11	20	12.5	21.6	9.5	24.8	8.0	27.6



Professional Installer - Compliance

P/N: RF-5100

FCC ID: 2AG3J-RF5100

Antenna Type and Gain (dBi): Omnidirectional / 3.5 dBi

USA

Freq (MHz)	Channel (WLAN)	Channel Width (MHz)	SISO Max. Power Setting Approved (dBm)	2x2 Max. Power Setting Approved (dBm)	3x3 Max. Power Setting Approved (dBm)	Max. EIRP Approved (dBm)
5180	36	20	17.0	14.0	11.5	21
5200	44	20	17.0	14.0	11.5	21
5240	48	20	17.0	14.0	12.0	21
5745	149	20	29.5	26.5	24	36
5787	157	20	29.5	26.5	24	36
5825	165	20	29.5	26.5	24	36

Operations outside of the FCC grant will require special licensing.

Approved Antennas:

The radio transmitters listed in the table below have been approved by the FCC to operate with the antenna types listed below with the maximum permissible gain indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Part Number	FCC ID	FCC Part	Antenna Type	Max. Gain Approved (dBi)
RF-2100	2AG3J-RF2100	15	Omni	7.4
RF-5100	2AG3J-RF5100	15	Omni	3.5
RF-2150	2AG3JRF-2150	15	Omni	8.5

EIRP (Isotropic Radiated Power) = Power Setting + Antenna Gain - Cable Loss

National regulations may require that operations may be limited to portions of the frequency range shown in the channel selection page of the interface.

Radios operated in a portable configuration can be attached to dismount users using a holster via a MOLLE attachment method. As required by ANSI C95.1 Specific Absorption Rate, all portable configurations, using 2.15dBi antennas, are required to maintain a separation distance of 5cm from the body.

NO NDA REQUIRED

The export and/or the release of certain products, technology and software to non-US persons might be subject to export restrictions. Please refer to the US export laws & regulations for details.



Professional Installer - Compliance

Minimum Safe Distance (MSD)			
	Antenna Gain (dBi)	*Occupational Exposure Distance (cm)	Non Occupational Exposure Distance (cm)
Dipole (Omnidirectional)	2.1	7.0	20.0
	3.5	7.0	20.0
	4.0	8.0	20.0
	7.4	**11.0	**25
	8.5	10	24

In addressing the MSD for operation of the RF-2100 S-Band (2200 MHz – 2500 MHz) RF module with **FCC ID 2AG3J-RF2100**, the RF-5100 Upper C-Band (5100 MHz – 6000 MHz) RF module with **FCC ID 2AG3J-RF5100**, and the RF-2150 10W S-Band (2200 MHz – 2500 MHz) RF module with **FCC ID 2AG3JRF-2150**, the applicable Maximum Permissible Exposure (MPE) limits were obtained IAW the FCC rules for radio frequency radiation exposure limits under **FCC Title 47, Chapter 1 Subpart 1 Article 1.1310**.

For compliance information, contact Persistent Systems’ Quality Management Department.

(212)-561-5895
support@persistentsystems.com



FCC Part 90

Test Plan for Host Compliance - FCC Part 90

The modular transmitter is authorized under FCC Part 90 Subpart I. The certification is for a Limited Module Approval (LMA) with the only limitation being that the radio module cannot be tested in a stand-alone configuration. This requires additional testing to be performed (as outlined below) with the module installed in a new host, and for the module grantee to file for a Class II Permissive Change for each new specific host.

The following testing or evaluation should be performed on each new host product in which the limited module is installed, to demonstrate continued compliance:

- Radiated Spurious Emissions on the lowest, middle and highest channels in all supported data modes (this is to be done in accordance with FCC Rule Parts 2.1055 and 90.210, and following the procedures given in ANSI C63.26)
- RF Exposure assessment based on the intended use case configuration(s) of the new host (this is to be done in accordance with FCC Rule Parts 1.1310, 2.1091 or 2.1093 as applicable)

NO NDA REQUIRED

The export and/or the release of certain products, technology and software to non-US persons might be subject to export restrictions. Please refer to the US export laws & regulations for details.



Professional Installer - Compliance

The limited module has already been tested and approved for use in the following three hosts:

- MPU5 (**WR-5100**)
- Aircraft Kit (**WR-AIR-SYS-1-02**)
- S-Band Integrated Sector Antenna (**WR-INT-ANT-01**)

The hosts listed above are manufactured by Persistent Systems, LLC, and the radio modules will be installed in the hosts only by professional installers. The module is intended to be used only in the grantee's equipment and is not offered for sale to the public or OEMs other than the grantee.

Additional testing for host products:

The modular transmitter is only FCC authorized for the specific rule parts listed on the grant, and the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host. The final host product requires Part 15 Subpart B compliance testing with the modular transmitter installed.

P/N: RF-2150 & RF-2151
FCC ID: 2AG3JRF-2150

US Power Limits							
Mode:		SISO: Only One Port Active		MIMO (2x2): 2 Ports Active Power Setting / Port		MIMO (3x3): All 3 Ports Active Power Setting / Port	
Frequency	Channel Width (MHz)	Max. Power Setting Approved (dBm)	Max. Conducted Power (dBm)	Max. Power Setting Approved (dBm)	Max. Conducted Power (dBm)	Max. Power Setting Approved (dBm)	Max. Conducted Power (dBm)
2457	5	35	35	33	37	31	36.5
2457	10	35	35	33	37	31	36.5
2457	20	N/A	N/A	N/A	N/A	N/A	N/A
2462	5	35	35	33	37	31	36
2462	10	35	35	33	36.5	31	36
2462	20	35	35	33	36.5	31	37
2467	5	35	36.5	33	37	31	36
2467	10	35	35	33	37	31	36
2467	20	35	35.5	33	37	31	36.5
2472	5	35	35	33	37	31	36.5
2472	10	35	35	33	37	31	36
2472	20	35	35	33	37	31	36.5

*Please note these are values of output power at the port not EIRP



Professional Installer - Compliance

Operations outside of the FCC grant will require special licensing.

Approved Antennas:

The radio transmitters listed in the table below have been approved by the FCC to operate with the antenna types listed below with the maximum permissible gain indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Part Number	FCC ID	FCC Part	Antenna Type	Max. Gain Approved (dBi)
RF-2150	2AG3JRF-2150	90	Omni	3.0
RF-2151	2AG3JRF-2150	90	Sector	12.0

EIRP (Isotropic Radiated Power) = Power Setting + Antenna Gain - Cable Loss

National regulations may require that operations may be limited to portions of the frequency range shown in the channel selection page of the interface.

Radios operated in a portable/dismount configuration can be attached to dismount users using a holster via a MOLLE attachment method. As required by ANSI C95.1 Specific Absorption Rate, all portable configurations, using 2.15dBi antennas, are required to maintain a separation distance of 5cm from the body.

Minimum Safe Distance (MSD)			
	Antenna Gain (dBi)	*Occupational Exposure Distance (cm)	Non Occupational Exposure Distance (cm)
Dipole (Omnidirectional)	3 (Aircraft Kit)	20	22
	12 (Sector Antenna)	36	80

In addressing the MSD for operation of the the RF-2150 10W S-Band (2200 MHz – 2500 MHz) RF module with **FCC ID 2AG-3JRF-2150**, the applicable Maximum Permissible Exposure (MPE) limits were obtained IAW the FCC rules for radio frequency radiation exposure limits under **FCC Title 47, Chapter 1 Subpart 1 Article 1.1310**.

For compliance information, contact Persistent Systems’ Quality Management Department.

(212)-561-5895
support@persistentsystems.com



PROFESSIONAL INSTALLER - COMPLIANCE

CANADA

The following notes refer to these part numbers:

Persistent Systems P/N	Description	IC ID
RF-2100	S-Band RF Module	20968-RF2100
RF-5100	Upper C-Band RF Module	20968-RF5100
RF-2150	10W S-Band Radio	20968-RF2150

This device complies with Industry Canada license-exempt RSS standard(s). Operation is Subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

OPERATING FREQUENCY: Operating frequency is determined by the installer. It is important that the frequency configured meets local regulations.

NO NDA REQUIRED

The export and/or the release of certain products, technology and software to non-US persons might be subject to export restrictions. Please refer to the US export laws & regulations for details.



Professional Installer - Compliance

P/N: RF-2100

IC ID: 20968-RF2100

Canada Power Limits						
Mode:	SISO: Only One Port Active		MIMO (2x2): 2 Ports Active Power Setting / Port		MIMO (3x3): All 3 Ports Active Power Setting / Port	
CHANNEL:	Max. Power Setting Approved (dBm)	Max. EIRP (dBm)	Max. Power Setting Approved (dBm)	Max. EIRP (dBm)	Max. Power Setting Approved (dBm)	Max. EIRP (dBm)
1	28	32	26	31	24.5	31
2	30	35	26	32	24.5	31
3	30	36	26	32	24.5	31
4	30	36	26	32	24.5	31
5	30	36	26	32	24.5	31
6	30	36	26	32	24.5	31
7	30	36	26	32	24.5	31
8	30	36	26	32	24.5	31
9	30	36	26	32	24.5	31
10	30	33	26	32	24.5	31
11	29	32	26	31	24.5	31

P/N: RF-2150
IC ID: 20968-RF2150

Canada Power Limits 2.15 dBi Omnidirectional Antenna						
Mode:	SISO: Only One Port Active		MIMO (2x2): 2 Ports Active Power Setting / Port		MIMO (3x3): All 3 Ports Active Power Setting / Port	
CHANNEL:	Max. Power Setting Approved (dBm)	Max. EIRP (dBm)	Max. Power Setting Approved (dBm)	Max. EIRP (dBm)	Max. Power Setting Approved (dBm)	Max. EIRP (dBm)
1	14.0	17.0	12.5	21.5	9.5	22.4
2	17.5	20.2	17.0	26.1	15.5	28.2
3	18.5	21.6	18.0	27.0	16.0	29.2
4	19.5	22.6	18.5	28.1	17.5	30.8
5	23.0	25.6	21.0	29.7	19.5	32.0
6	23.5	26.1	22.5	31.6	21.0	33.0
7	23.5	26.1	23.0	32.0	21.5	33.1
8	22.0	24.6	21.0	30.0	20.0	32.1
9	21.0	23.5	19.0	28.2	17.5	30.6
10	19.5	22.0	17.0	26.3	16.5	29.3
11	14.5	17.6	13.0	22.1	10.0	22.7



Professional Installer - Compliance

P/N: RF-2150

IC ID: 20968-RF2150

Canada Power Limits 4 dBi Omnidirectional Antenna						
Mode:	SISO: Only One Port Active		MIMO (2x2): 2 Ports Active Power Setting / Port		MIMO (3x3): All 3 Ports Active Power Setting / Port	
CHANNEL:	Max. Power Setting Approved (dBm)	Max. EIRP (dBm)	Max. Power Setting Approved (dBm)	Max. EIRP (dBm)	Max. Power Setting Approved (dBm)	Max. EIRP (dBm)
1	12.5	17.8	11	22.3	9	24.3
2	17	22	15.5	26.8	14.5	29.3
3	18	23.2	17.5	28.7	16	31.4
4	19.5	24.7	18	29.9	17	32.5
5	22	26.2	20.5	31.5	19	33.6
6	22.5	26.9	22	32.9	20.5	34.6
7	23	27.5	22.5	33.1	21	34.8
8	21.5	25.9	21	31.9	19.5	33.8
9	20	24.7	19	30.1	17	32.1
10	18	23	17	28.2	16	30.8
11	14	19.2	12.5	23.4	9.5	24.3

P/N: RF-2150
IC ID: 20968-RF2150

Canada Power Limits 8.5 dBi Omnidirectional Antenna						
Mode:	SISO: Only One Port Active		MIMO (2x2): 2 Ports Active Power Setting / Port		MIMO (3x3): All 3 Ports Active Power Setting / Port	
CHANNEL:	Max. Power Setting Approved (dBm)	Max. EIRP (dBm)	Max. Power Setting Approved (dBm)	Max. EIRP (dBm)	Max. Power Setting Approved (dBm)	Max. EIRP (dBm)
1	10.0	20.1	9.0	24.4	7.0	26.6
2	16.0	25.0	14.5	29.9	14.0	33.0
3	16.5	26.1	16.0	31.4	14.5	33.5
4	19.0	28.4	16.5	32.1	15.0	34.1
5	20.0	28.9	18.5	33.9	15.0	34.0
6	21.0	29.8	20.0	35.8	15.5	34.9
7	21.5	30.2	20.0	34.9	15.5	34.6
8	21.0	29.8	16.5	31.8	15.0	34.3
9	18.0	27.9	16.0	31.4	15.0	34.6
10	16.5	25.7	15.5	30.9	14.5	33.4
11	12.5	21.6	9.5	24.8	8.0	27.6



Professional Installer - Compliance

P/N: RF-5100

IC ID: 20968-RF5100

Antenna Type and Gain (dBi): Omnidirectional / 3.5 dBi

Canada

Freq (MHz)	Channel (WLAN)	Channel Width (MHz)	SISO Max. Power Approved (dBm)	2x2 Max. Power Approved (dBm)	3x3 Max. Power Approved (dBm)	Max. EIRP Approved (dBm)
5180	36	20	n/a	n/a	n/a	n/a
5200	44	20	n/a	n/a	n/a	n/a
5240	48	20	n/a	n/a	n/a	n/a
5745	149	20	29.5	26.5	24	36
5787	157	20	29.5	26.5	24	36
5825	165	20	29.5	26.5	24	36

Operations outside of the IC Technical Acceptance Certificate (TAC) will require special licensing.

Approved Antennas:

The radio transmitters listed in the table below have been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Part Number	IC ID	Antenna Type	Max. Gain Approved (dBi)
RF-2100	20968-RF2100	Omni	7.4
RF-5100	20968-RF5100	Omni	3.5
RF-2150	20968-RF2150	Omni	8.5

EIRP (Isotropic Radiated Power) = Power Setting + Antenna Gain - Cable Loss

National regulations may require that operations may be limited to portions of the frequency range shown in the channel selection page of the interface.

Radios operated in a portable configuration can be attached to dismount users using a holster via a MOLLE attachment method. As required by ANSI C95.1 Specific Absorption Rate, all portable configurations, using 2.15dBi antennas, are required to maintain a separation distance of 5cm from the body.



Professional Installer - Compliance

Minimum Safe Distance (MSD)			
	Antenna Gain (dBi)	*Occupational Exposure Distance (cm)	Non Occupational Exposure Distance (cm)
Dipole (Omnidirectional)	2.1	7.0	20.0
	3.5	7.0	20.0
	4.0	8.0	20.0
	7.4	**11.0	**25
	8.5	10	24

In addressing the MSD for operation of the RF-2100 S-Band (2200 MHz – 2500 MHz) RF module with **IC ID 20968-RF2100**, the RF-5100 Upper C-Band (5100 MHz – 6000 MHz) RF module with **IC ID 20968-RF5100**, and the RF-2150 10W S-Band (2200 MHz – 2500 MHz) radio with **IC ID 20968-RF2150**, the applicable Maximum Permissible Exposure (MPE) limits were obtained IAW the IC rules for radio frequency radiation exposure limits under **Industrial Canada RSS-102, Section 2.6**.

En abordant la MSD pour le fonctionnement des RF-2100 S-Band (2200 MHz - 2500 MHz) radio avec **IC ID 20968-RF2100**, et RF-5100 Upper C-Band (5100 MHz – 6000 MHz) radio avec **IC ID 20968-RF5100**, et RF-2150 10W S-Band (2200 MHz - 2500 MHz) radio avec **IC ID 20968-RF2150**, l'exposition maximale admissible applicable (MPE) limites ont été obtenus conformément à la IC règles pour les limites d'exposition aux radiations de fréquences radio sous **industriel Canada RSS-102, Section 2.6**.

For compliance information, contact Persistent Systems' Quality Management Department.

Pour plus d'informations de conformité, le service de qualité contact Persistent Systems.

(212)-561-5895

support@persistentsystems.com

PROFESSIONAL INSTALLER - COMPLIANCE

JAPAN

NO NDA REQUIRED

The export and/or the release of certain products, technology and software to non-US persons might be subject to export restrictions. Please refer to the US export laws & regulations for details.

03EN073 Rev. P

PAGE 153 OF 168



Professional Installer - Compliance

Notes:

* Occupational/controlled exposure limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when a person is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure. The phrase *fully aware* in the context of applying these exposure limits means that an exposed person has received written and/or verbal information fully explaining the potential for RF exposure resulting from his or her employment. With the exception of *transient* persons, this phrase also means that an exposed person has received appropriate training regarding work practices relating to controlling or mitigating his or her exposure. Such training is not required for *transient* persons, but they must receive written and/or verbal information and notification (for example, using signs) concerning their exposure potential and appropriate means available to mitigate their exposure. The phrase *exercise control* means that an exposed person is allowed to and knows how to reduce or avoid exposure by administrative or engineering controls and work practices, such as use of personal protective equipment or time averaging of exposure.

** Cable loss is the minimum cable loss that may exist between the antenna port and the 7.4dBi antenna. 0.50dB cable loss was taken into consideration when calculating minimum distance.



Radio P/N: RF-5100 Japan ID:

Country: Japan (Government) ㊦㊧ 209-J00294

Mode of Operation: MIMO 3x3

Antenna Types and Gain (dBi)

Antenna 1: Omnidirectional / 3.5 dBi Antenna 2: Blade / 9 dBi Antenna 3: Patch 4x4 / 13 dBi

Japan Power Limits

Channel (MHz)	Channel Width (MHz)	Antenna 1		Antenna 2		Antenna 3	
		Max. Power Approved (dBm)	Max. EIRP Approved (dBm)	Max. Power Approved (dBm)	Max. EIRP Approved (dBm)	Max. Power Approved (dBm)	Max. EIRP Approved (dBm)
5660	20	25.2	36	22.2	36	18.2	36
5655	10	25.2	36	22.2	36	18.2	36
5665	10	25.2	36	22.2	36	18.2	36
5675	10	25.2	36	22.2	36	18.2	36
5680	20	25.2	36	22.2	36	18.2	36
5685	10	25.2	36	22.2	36	18.2	36
5695	10	25.2	36	22.2	36	18.2	36
5700	20	25.2	36	22.2	36	18.2	36
5705	10	25.2	36	22.2	36	18.2	36
5715	10	25.2	36	22.2	36	18.2	36
5720	20	25.2	36	22.2	36	18.2	36
5725	10	25.2	36	22.2	36	18.2	36
5740	10	25.2	36	22.2	36	18.2	36
5745	20	25.2	36	22.2	36	18.2	36
5750	10	25.2	36	22.2	36	18.2	36

NO NDA REQUIRED

The export and/or the release of certain products, technology and software to non-US persons might be subject to export restrictions. Please refer to the US export laws & regulations for details.



Professional Installer - Compliance

Radio P/N: RF-2150 Japan ID:

Country: Japan (Government)  209-J00337

Mode of Operation: MIMO 2x2

Antenna Types and Gain (dBi)

Antenna 1:	Omnidirectional / 3 dBi Total EIRP = 13 dBm/MHz	Antenna 2:	Omnidirectional / 2.15 dBi Total EIRP = 12.15 dBm/MHz	Antenna 3:	Omnidirectional / 0 dBi Total EIRP = 10 dBm/MHz
-------------------	--	-------------------	--	-------------------	--

Japan Power Limits (same for all antenna types)

Channel (MHz)	Channel Width (MHz)	Amplitude Measured (dBm/MHz)	Max. Output Power Level Per Chain (dBm)
2407	5	7	13.4
2407	10	7	16.4
2412	5	7	13.4
2412	10	7	16.4
2412	20	7	19.7
2417	5	7	13.4
2417	10	7	16.4
2417	20	7	19.7
2422	5	7	13.4
2422	10	7	16.4
2422	20	7	19.7
2427	5	7	13.4
2427	10	7	16.4
2427	20	7	19.7
2432	5	7	13.4
2432	10	7	16.4

Japan Power Limits (same for all antenna types) [continued]



Channel (MHz)	Channel Width (MHz)	Amplitude Measured (dBm/MHz)	Max. Output Power Level Per Chain (dBm)
2432	20	7	19.7
2437	5	7	13.4
2437	10	7	16.4
2437	20	7	19.7
2442	5	7	13.4
2442	10	7	16.4
2442	20	7	19.7
2447	5	7	13.4
2447	10	7	16.4
2447	20	7	19.7
2452	5	7	13.4
2452	10	7	16.4
2452	20	7	19.7
2457	5	7	13.4
2457	10	7	16.4
2457	20	7	19.7
2462	5	7	13.4
2462	10	7	16.4
2462	20	7	19.7
2467	5	7	13.4
2467	10	7	16.4
2472	5	7	13.4

NO NDA REQUIRED

The export and/or the release of certain products, technology and software to non-US persons might be subject to export restrictions. Please refer to the US export laws & regulations for details.

03EN073 Rev. P

PAGE 157 OF 168

BAT-06 Technical Datasheet

Rechargeable, Lithium-Ion Battery

Features

- Communicates using a Single Wire DQ interface.
- UN/DOT 38.3 Rating: 73Wh
- Comparable to: BT-70716BE

Typical Applications

- Wave Relay System
- AN/PRC-148
- TRC-9110

Recommended Charging Platforms

Charger Part Number	Required Adapter Part Number
BTC-70801	BTA-70810
BTC-70844	BTA-70810
BTC-70819, -1, -3	BTA-70810
BTC-70836	BTA-70830, BTA-70830-1
BTC-70870, -1, -3	BTA-70830, BTA-70830-2
BTC-70824-1	BTA-70810S
BTC-70663	BTA-70810S
BTC-70716-1	Not Required

Technical Specifications

National Stock Number	Pending
BT Part Number	BT-70716BG
Dimensions	Length: 2.8 in. (71 mm) Width: 1.6 in. (41 mm)
	Height: 3.4 in. (86 mm)
Weight	0.75 lbs (0.34 kg)
Nominal Voltage	10.8V
Maximum Voltage	12.6V
Capacity	7.0Ah
Discharge	6A Max Continuous
Pulse Discharge	40A ≤ 1 ms
Operating Temperature	-30°C to +60°C (-22°F to +140°F)
Recommended Storage Temperature	-40°C to +40°C (-40°F to +104°F)
Connector	Flat Contacts (bottom), Fly Wheel Connection (top)
State of Charge Indicator	Not Applicable
Disposal	Check local regulations (Contains 0% Mercury or Cadmium)



PRODUCT INFORMATION SHEET

From: Bren-Tronics Inc.
10 Brayton Court
Commack, N.Y. 11725

Telephone: 631-499-5155
Fax: 631-499-5504
www.bren-tronics.com

Emergency Telephone: If no answer above, contact Chem-Tel Corporation at 1-800-255-3924 or
1-813-248-0585

P/N: BT-70716

Effective Date: 10 Jan 2020

[Alternate P/N's: BT-70716B, BT-70716BE, BT-70716BE-PS, or -TB, or -TG, or -TT;
BT-70716BV, BT-70716BG, BT-70716BG -PS, or -TG, or -TT; ALI 130]

1. Product Identification

Product Name: Lithium-Ion Battery

Chemical System: Li-Ion

NSN: n/a

Nominal Weight: 0.84 lbs., (0.38kg)

Nominal Voltage: 10.8V

Max Energy of Alternates: 76Wh

2. Composition/Information on Ingredients

Although the chemical composition of the various cell manufacturers is proprietary, the following is typical of the chemistry. Per-centages could vary between specific anode-cathode designs.

Hazardous Components (Specific Chemical Identity; Common Name(s))	%	CAS Number	LD ₅₀ (mg/kg) (oral-rat)	LC (mg/L)
Aluminum foil	0.1-1 w/w	7429-90-5	N/AV	A/AV
Biphenyl (BP)	0 -0.3 w/w	92-52-4	2400	N/AV
Copper foil	0.1 -0.3 w/w	7440-50-8	3.5(ipr-mouse)	N/AV
Dioxathiolane 2,2-Dioxide (DTD)	0 -3 w/w	1072-53-3	1600	N/AV
Linear and Cyclic Carbonic Solvents (See other information)	5 -17 w/w	N/APP	≈11000 (weighted avg)	N/AV
Graphite Powder	10-30 w/w	7440-44-0	440 (ivn-mouse)	N/AV
Lithium Carbonate	0 -0.3 w/w	554-13-2	525	N/APP
Lithium cobaltite (LiCoO ₂)	01-3- w/w	12190-79-3	N/AV	N/AV
Lithium hexafluorophosphate (LiPF ₆)	1-5 w/w	21324-40-3	1702	Rat: >20
Poly (vinylidene fluoride) (PVDF)	0.1 -1 w/w	24937-79-9	N/AV	N/AV
Propane Sultone (PS)	0-3 w/w	1120-71-4	100	N/AV
Steel, nickel and inert polymer	Balance	N/APP	N/APP	N/APP

These chemicals and metals are contained in a sealed can.

NO NDA REQUIRED

The export and/or the release of certain products, technology and software to non-US persons might be subject to export restrictions. Please refer to the US export laws & regulations for details.



3. Hazards Identification

Routes of Entry:

Inhalation? Not anticipated. Respiratory (and eye) irritation may occur if fumes are released due to heat or an abundance of leaking batteries.

Skin? Yes

Ingestion? Yes

Potential Health Effects:

These chemicals are contained in a sealed can. Risk of exposure occurs only if the battery is mechanically or electrically abused. The most likely risk is acute exposure when a cell vents. Propylene Carbonate is mildly irritating upon eye and skin contact.

Contact of electrolyte and extruded lithium with skin and eyes should be avoided.

Inhalation or ingestion of lithium trifluoromethane sulfonate may be harmful.

Signs/Symptoms of Exposure:

Skin and eye irritation may occur following exposure to a leaking battery.

Medical Conditions Generally Aggravated by Exposure:

An acute exposure will not generally aggravate any medical condition.

Elevated temperatures can result in reduced performance or overheating and ignition. See also Para 7.

4. First Aid Measures

Emergency & First Aid Procedures:

If battery is leaking and material contacts eyes, flush with copious amounts of clear, tepid water for thirty (30) minutes, exposed skin for at least fifteen (15) minutes.

Contact Physician at once. Leaking contents may be irritating to respiratory passages.

Remove to fresh air. Contact physician if irritation persists. If ingested, rinse mouth and surrounding area with clear, tepid water for at least fifteen (15) minutes.

Consult physician immediately for treatment and to rule out involvement of the esophagus and other tissues.

5. Fire Fighting Measures

Extinguishing Media:

Water spray, Carbon Dioxide, dry chemical powder or appropriate foam. Use agent appropriate for surrounding materials

Special Fire Fighting Procedures:

In burning, wear self-contained breathing apparatus and protective clothing to prevent contact with skin and eyes.

Unusual Fire and Explosion Hazards:

Organic components will burn if cell incinerated. Combustion of cell contents will cause evolution of extremely corrosive Hydrogen Fluoride gas.

6. Accidental Release Measures

Ventilation:

None under normal use conditions.

Protective Gloves:

None under normal use conditions. Use butyl gloves when handling leaking batteries.

Eye Protection:

None under normal use conditions. Wear safety glasses when handling leaking batteries.



7. Handling and Storage

Precautions to be taken in Handling and Storage:

For best service life, store batteries in a cool, below 70°F (21°C), dry area that is subject to minimal temperature changes. Do not place near fire, heating equipment, nor expose to direct sunlight for long periods. Elevated temperatures can result in reduced performance and/or battery service life. Temperatures above typically 90°C (194°F) can cause battery to overheat or ignite.

Other Precautions:

Do not disassemble battery or battery pack. Do not puncture, crush or dispose of in fire.

8. Exposure Controls/Personal Protection

Steps to be Taken in Case Material is Released or Spilled:

Notify safety personnel of large spills. Evacuate the area and allow vapors to dissipate. Increase ventilation. Avoid eye or skin contact. **DO NOT** inhale vapors. Clean up personnel should wear appropriate protective gear. Remove spilled liquid with absorbent and contain for disposal.

Transport containers outdoors. Hold burned cells and fire cleanup solids for disposal as potential hazardous waste. Unburned cells are not hazardous waste. A fire with over 100 kg of burned cells will likely require reporting to environmental offices. Always consult and obey all international, federal and local environmental laws.

9. Physical and Chemical Properties

Appearance:

Rectangular box shape

10. Stability and Reactivity

Stability:

Stable

Conditions to Avoid:

Do not heat, crush, disassemble, or short-circuit.

Hazardous Decomposition or By-products:

Thermal degradation may produce hazardous fumes of manganese and lithium; hydrofluoric acid; oxides of carbon and sulfur and other toxic by-products.

Hazardous Polymerization:

Will not occur.

Incompatible Materials:

Contents incompatible with strong oxidizing agents.

11. Toxicological Information

Carcinogenicity:	NTP?	IARC Monograph?	OSHA Regulated?
	No	No	No

12. Ecological Information

N/A

13. Disposal Considerations

- Batteries must be completely discharged prior to disposal and/or the terminals must be taped or capped to prevent short circuit.
- Disposal of large quantities of batteries containing lithium cells may be subject to Federal, State or local regulations.



Attachments

14. Transportation Information: This lithium ion battery is regulated as a Class 9 Miscellaneous hazardous material (dangerous goods). The UN number is UN 3480. **The Watt-hour rating is 76 Wh max.** The battery and component cells conform to the requirements of Section 38.3 of the UN Manual of Tests and Criteria (T1-T8 tests). The battery is subject to the transport regulations listed below.

A. Domestic Transportation within U.S. by Highway and Rail. See 49 CFR 173.185(c)(1) – (c)(3)

“Excepted” from the U.S. Hazardous Materials Regulations if the following requirements are met: Battery must be packaged in a manner to prevent short circuits and packed in a strong outer packaging. Package must be marked with the lithium battery handling marking shown on the right. Shipment must be accompanied with a document indicating that the package contains a lithium ion battery; the package must be handled with care and that a flammable hazard exists if the package is damaged; special procedures must be followed in the event the package is damaged, to include inspection and repacking, if necessary; and a telephone number for additional information. Package must be capable of passing a 1.2 meter drop test and the gross weight of package may not exceed 30 kg (66 lbs).



**Lithium Battery
Handling Marking**

B. Domestic and International Transportation by Air. See 49 CFR 173.185(c)(1) – (c)(4); and IATA Dangerous Goods Regulations / ICAO Technical Instructions, Packing Instruction 965, Sections II and IB.

NOTE – Effective 01 Apr 2016, for air transport, all Li-Ion batteries can only be charged to 30% max, shipped cargo aircraft only, and have CAO label on package. Shipping on passenger aircraft is forbidden.

- **49 CFR 173.185(c)(1) – (c)(3) and IATA / ICAO PI 965, Section II.** “Excepted” from air transport regulations if there are no more than 2 batteries per package. Shipper must comply with packaging, documentation and marking requirements described in paragraph A. above. In addition, if an air waybill is used, each shipment must include an indication on the air waybill that the shipment contains lithium ion batteries and an indication of compliance with 49 CFR 173.185(c)(1) – (c)(3) or Packing Instruction 965, Section II of the ICAO Technical Instructions (if shipping internationally). Packages must *not* be “overpacked” effective 01 Apr 2016.
- Employees must receive “adequate instructions” on the requirements associated with the applicable regulations.
- **49 CFR 173.185(c)(4) and IATA / ICAO PI 965, Section IB.** If more than 2 batteries per package, shipment is not “excepted” from transport regulations and must be offered as fully-regulated Class 9 dangerous goods. Shipper must comply with packaging, documentation and marking requirements described in paragraph A. above. Package also must include Class 9 hazard label shown on the right and be accompanied by a Shipper’s Declaration for Dangerous Goods. Net weight of batteries in package may not exceed 10 kg (22 lbs). Employees must receive hazardous materials/dangerous goods training in accordance with applicable regulations.



C. International Transportation by Sea or by Motor Vehicle or Rail in Europe. See IMDG Code, Special Provision 188 and European Road and Rail Regulations (ADR/RID), Special Provision 188.

Shipper must comply with packaging, documentation and marking requirements as described in paragraph A. above.

15. Regulatory Information

Batteries are considered to be “articles” and thus are exempt from TSCA regulation.

16. Other Information

Avoid mechanical or electrical abuse. **DO NOT** short circuit or install incorrectly. Batteries may explode, pyrolize or vent if disassembled, crushed, recharged incorrectly or exposed to high temperatures. Install batteries in accordance with equipment instructions.

This information and recommendations set forth are made in good faith and believed to be accurate as of the date of preparation. Bren-Tronics Inc. makes no warranty, expressed or implied, regarding the accuracy of the data or the results to be obtained from the use thereof.

MPU5
BASIC OPERATOR MANUAL
VERSION 3.2



www.persistentsystems.com