



MPU5

BASIC OPERATOR MANUAL

VERSION 2.11

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Rev. M



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READ MANUAL BEFORE OPERATION

DO NOT SWAP RF MODULES WHILE UNIT IS POWERED ON!

DO NOT POWER ON UNIT WITHOUT ANTENNAS ATTACHED!

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Issued: March 2020

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

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Persistent Systems Support & RMA

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

Persistent Systems Sales

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Persistent Systems Training

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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	36
Part II: Software Setup	40
Section A: Configuring the Management Computer	40
Parts List	40
Configuring the Management Computer (Windows)	42
Configuring the Management Computer (Linux)	48
Section B: Connecting the MPU5 to the Management Computer	49
Parts List	49
Section C: Accessing the Web Management Interface	52
Parts List	52
Section D: Basic Network Setup	60
Security Key	60
Assigning IP Address and Interface Names	62
Rebooting an Individual Node	65

Network Node List	66
Part III: Testing Connectivity	70
Check Neighbor Node Status	70
Perform a Throughput Test	72
Throughput Test Logging	74
Part IV: Using the Web Management Interface	76
View Individual Node Information	76
Configuring RF Settings for a Single Node	78
Upgrading Firmware	80
Creating a Configuration File	82
Loading Settings from a Configuration File	84
Reset Node to Factory Configuration	86
Check GPS Status	87
Network Status Tab	88
Network Visualization	90

Part V: Device Operation	94
Zeroize the Security Key	94
Connect a Camera to the MPU5	96
Configuring Video Settings	98
Video Kiosk Mode	108
Connect an EUD or Handheld Display to the MPU5	114
Connecting a Monitor or TV to the Wave Relay® MPU5	116
Connect USB Accessories to the MPU5	119
Install Android™ Apps on the MPU5	121
Using Android™ Screenshot	124
Network Configuration Tab	126
Connect a PTT Device to the MPU5	128
Configure PTT Settings	130
Enable Push-to-Talk	131
Set Earpiece Volume	131
Set Microphone Level	132

TABLE OF CONTENTS

Set Transmit Mode	133
Set Transmit or Receive Audible Checktone	134
Enable/Disable Low Battery Audible Notification	135
Selecting Channels	136
Customize a PTT Channel	136
Using Wave Relay® Push-to-Talk	138
Using Flash Override	139
Professional Installer – Compliance	140
Professional Installer - Compliance (USA)	140
Professional Installer - Compliance (Canada)	150
Professional Installer - Compliance (Japan)	160
Attachments	165



WAVE RELAY

L-BAND
1350-1390 MHz



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 enlevé. Cela peut augmenter les risques d'exposition aux radiofréquences et ou endommager l'équipement.

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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 définies 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, le saccage des batteries usagées est interdit et l'élimination peut être faite par les organisations à but non lucratif mandatées par les autorités locales ou organisées par des professionnels.
- ▶ L'incinération des cellules et batteries au lithium par les consommateurs est déconseillée. L'incinération devrait être faite 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

- ▶ **#1 Phillips Head Screwdriver:** Used to attach/detach RF module
- ▶ **TPI Kit:** Allows for antenna and RF cable matching
- ▶ **RF cable at various lengths (LMR-400):** Allows for flexibility in antenna setup
- ▶ **Ethernet Cables**
- ▶ **Ethernet Female-to-Female Extenders**
- ▶ **HD Screen or TV with HDMI input:** Displays Android™ computer interface and/or streaming video
- ▶ **Laptop with Administrator Access:** Used for device configuration
- ▶ **USB Thumb Drives:** Used for software configuration storage and loading

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

PHYSICAL SETUP: RF SETUP





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 2AG3J-RF2150.



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.



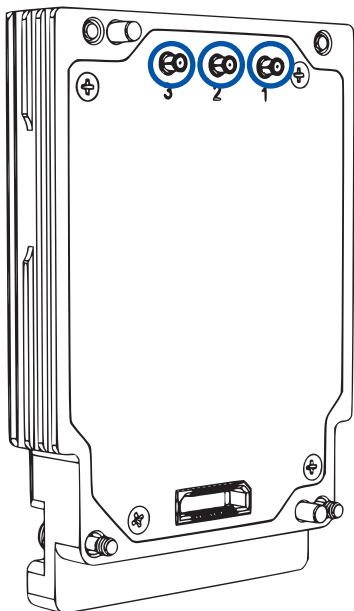
WARNING!: the MPU5 is not IP68 rated when the RF module is not attached. Ensure you are in a dry, dust-free environment before changing RF modules.

NO NDA REQUIRED

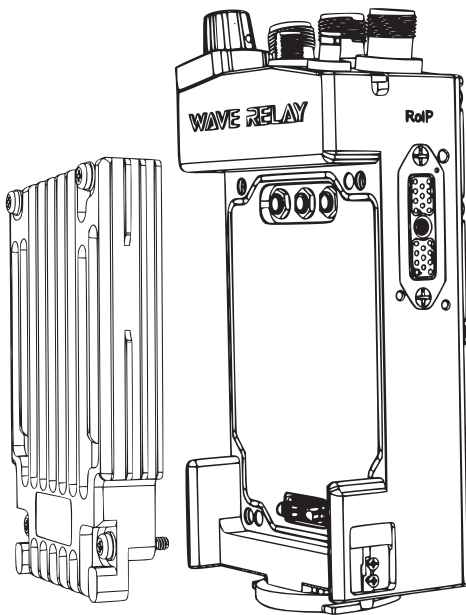
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Inserting the RF Module

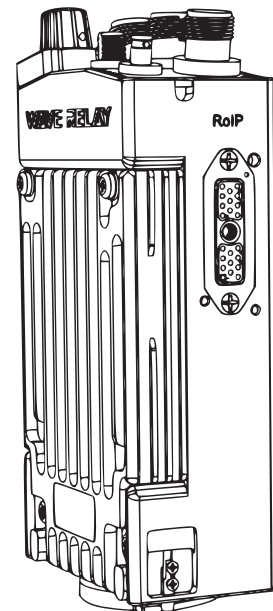
1 If there are **rubber caps** on the RF module contacts, **remove** them.



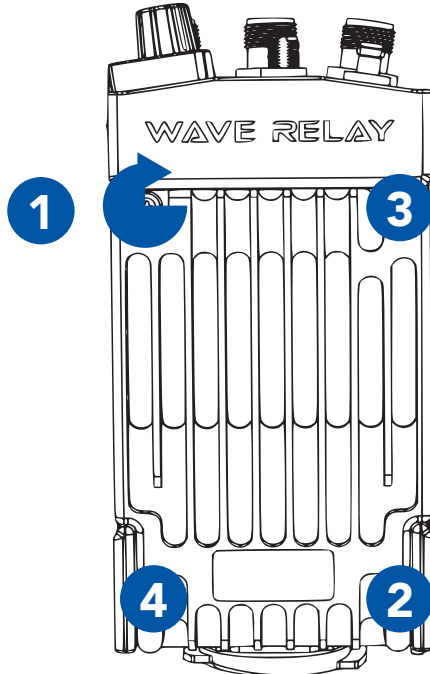
2 **Align** the RF module with the chassis.



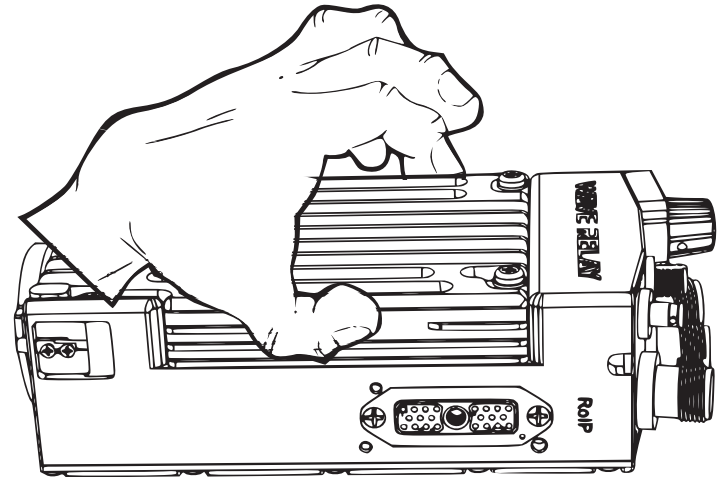
3 **Apply even force** and **press** the RF module into the chassis.



- 4** Tighten screws clockwise in **diagonal** order with a #1 Phillips Head screwdriver until they stop (min. **4 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.



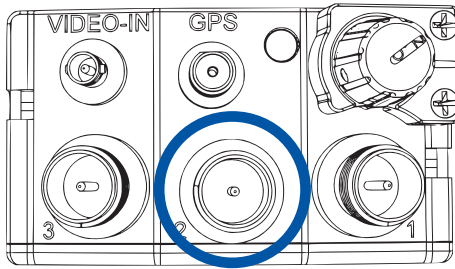
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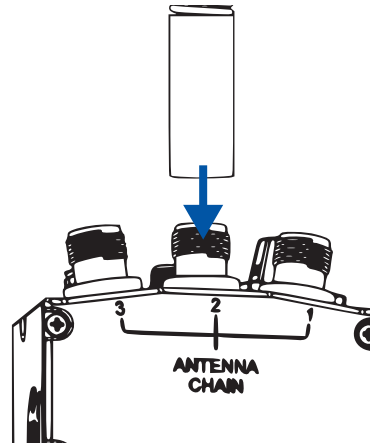
PHYSICAL SETUP: RF SETUP

Connecting Antennas

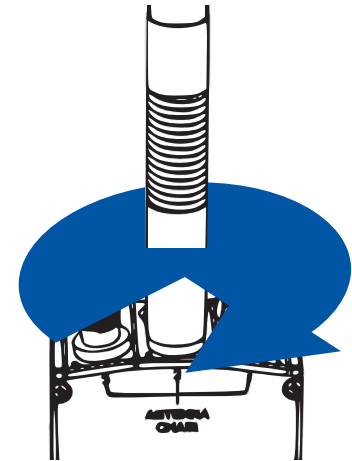
- 1 Start with the **middle** antenna port.



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



- 3 **Twist** the antenna clock-wise until it is fully mated.

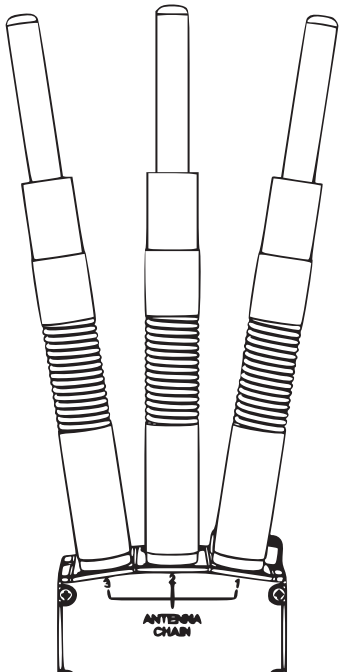


Tips & Tricks

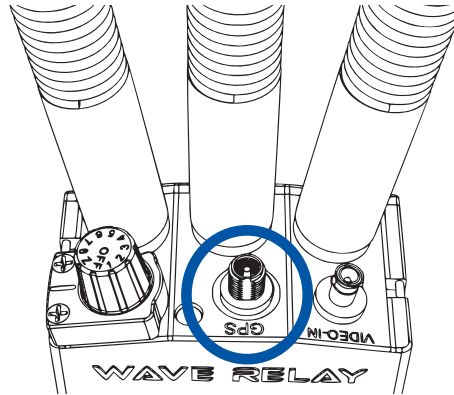
- ▶ You can use a TPI Kit and/or extra LMR-400 RF Cables to remote antennas away from the unit. This setup is particularly useful for mounted or operations center configurations.
- ▶ To operate in SISO mode, you only need to attach an antenna to the antenna port for the chain you want to use.

! **WARNING!** if you want to operate in SISO mode, unused antenna chains **MUST** be turned off (See p. 78).

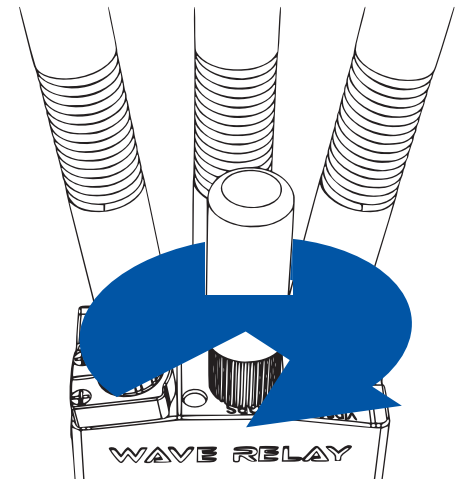
- 4** Repeat **Steps 1 - 3** for the remaining two RF antennas.



- 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.






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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 antennas won't screw onto the RF connectors?

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

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

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

How do I tell if the antennas are connected properly?

-  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

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.

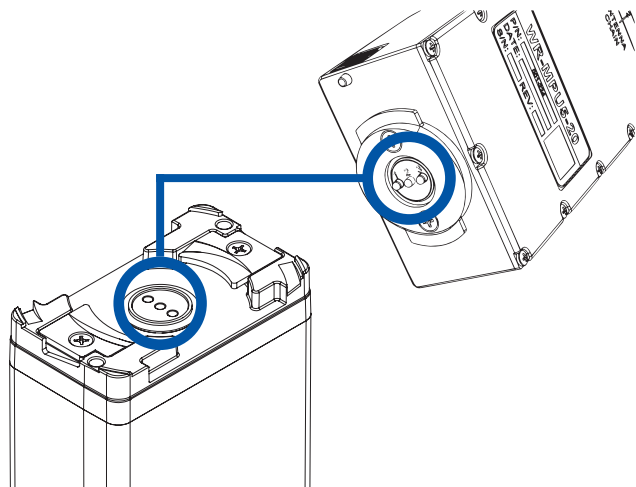


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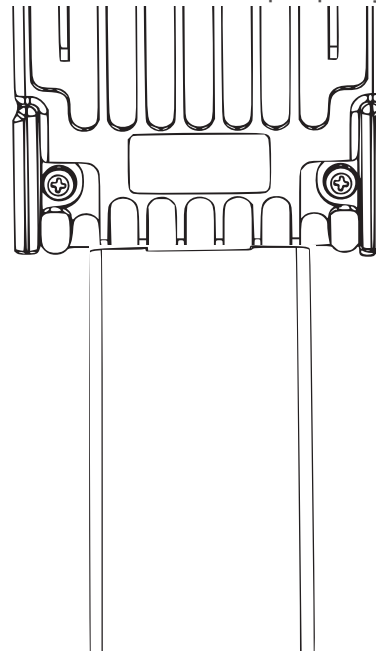
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Connecting Power

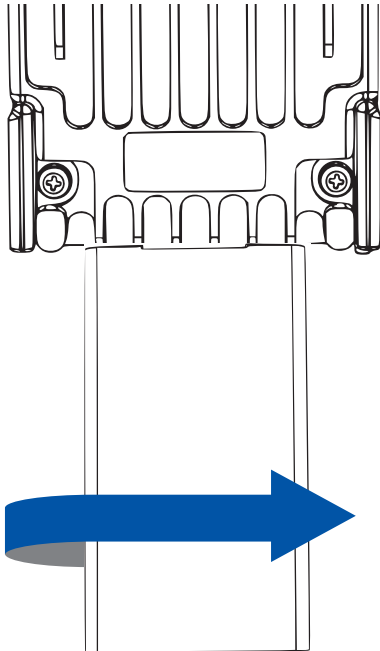
- 1 If you are using a battery, make sure that the battery is charged.
- 2 Align the **circular three pin connector** on the power source with the **circular three pin connector** on the bottom of the MPU5.



- 3 **Push** the connectors together. Make sure the connector is seated properly.



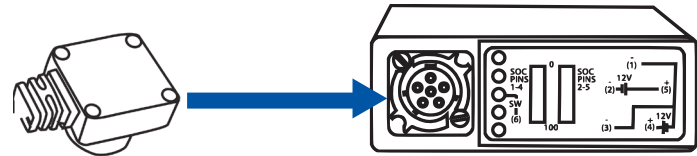
- 4** **Twist** clockwise 90°. You will hear a click when it is locked.



- 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**.

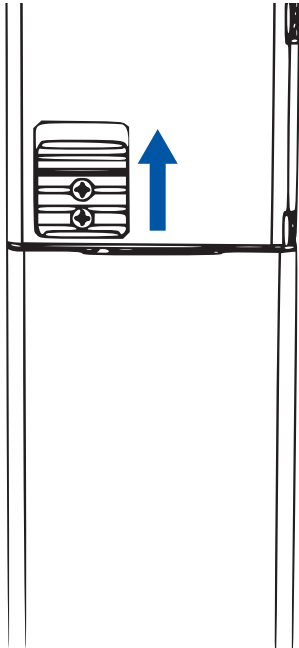


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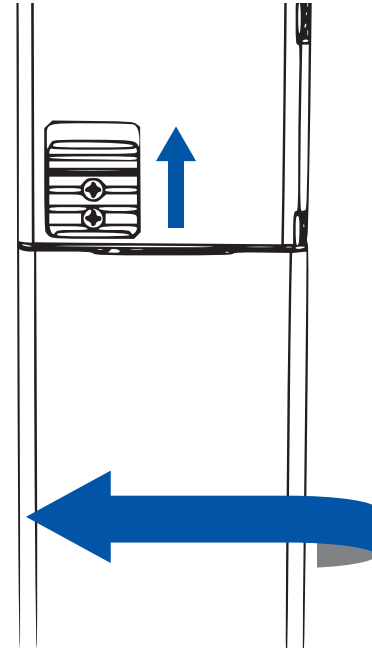
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Removing Power

- 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.

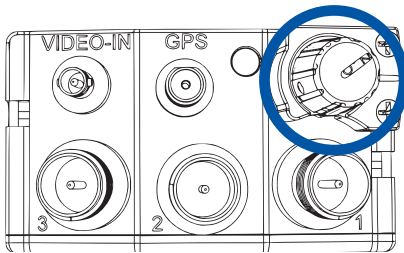
PHYSICAL SETUP: POWER

Powering On the Unit

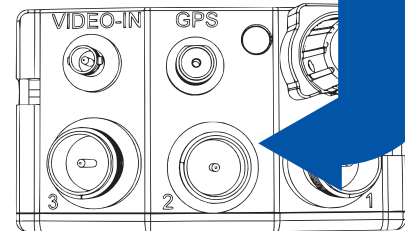
1 Ensure that **antennas**, a **RF module**, and an appropriate **power source** are connected.

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

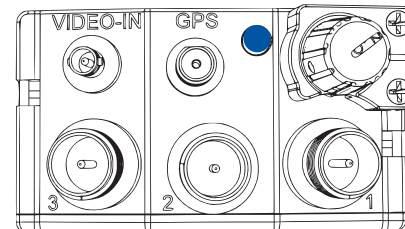
2 **Locate** the **Power Knob** on the top of the unit.



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.



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

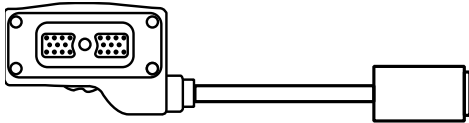
Section C: Side Connector Cables



What Will I Learn?

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

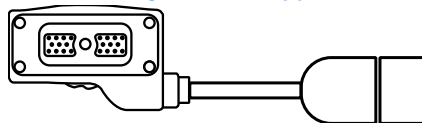
Parts List



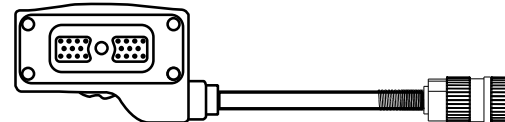
22-Pin to RJ45 Receptacle
CBL-DATA-2001



22-Pin to U94
CBL-AUD-0003



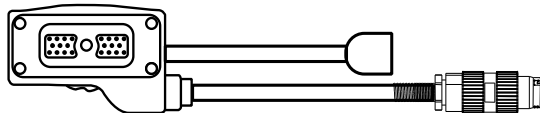
22-Pin to USB 2.0 Type A Receptacle
CBL-DATA-2003



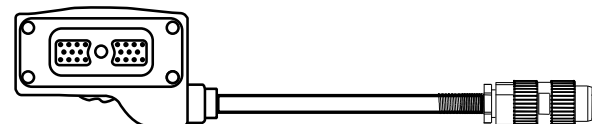
22-Pin to U-329
CBL-AUD-0001



22-Pin to 6-Pin Push Pull USB Tether
CBL-DATA-2004



22-Pin to Audio and Video Out
CBL-DATA-3002



22-Pin to U-328
CBL-AUD-0002

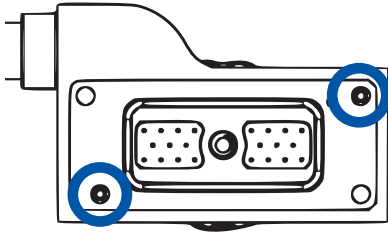
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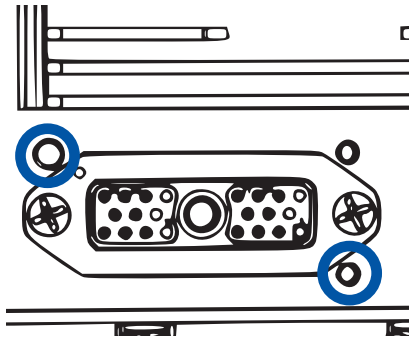
PHYSICAL SETUP: SIDE CONNECTORS

Connecting a Cable to a Side Connector

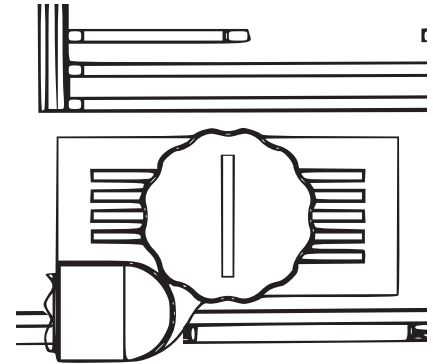
1 The 22-Pin connector on every cable is keyed so that it will **only** attach to a compatible side connector. If a cable can attach to multiple side connectors, it is keyed (or not keyed) so that it will attach to all compatible side connectors.



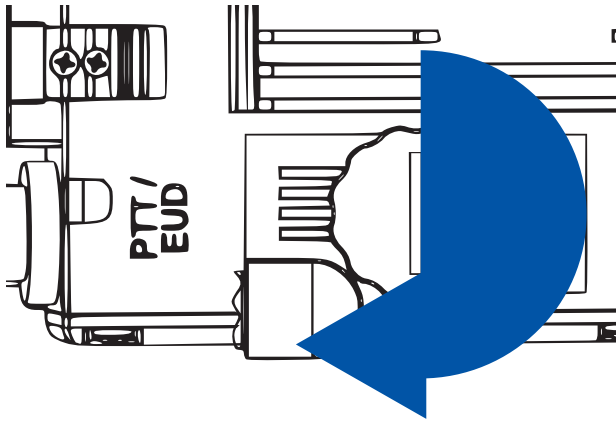
2 To connect a cable to a side connector, **locate** the appropriate side connector.



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**.



- 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.

PHYSICAL SETUP: SIDE CONNECTORS

Quick Reference:

Part Number	Description	Side Connector(s)	Uses
CBL-DATA-2001	22-Pin to RJ45 Receptacle	DATA	Connects to a standard RJ45 Ethernet cable. Use this cable to connect the unit to a computer for configuration.
CBL-DATA-2003	22-Pin to USB 2.0 Type A Female	PTT/EUD, DATA, RoIP	Connects USB accessories via a standard USB A port.
CBL-DATA-2004	22-Pin to 6-Pin Push Pull Android™ USB	PTT/EUD, DATA, RoIP	Connects an Android™ EUD or Screen
CBL-DATA-2005	22-Pin to DB9 Serial Socket	PTT/EUD, DATA, RoIP	Connects serial devices via a DB9 socket
CBL-DATA-2007	22-Pin to RJ45 Receptacle and USB 2.0 Type A Male	DATA	Connects to USB devices via a standard USB A plug and to a standard RJ45 Ethernet cable
CBL-DATA-2009	22-Pin to RJ45 Flying Leads	DATA	Flying leads for custom Ethernet integration (72")
CBL-DATA-2010	22-Pin to RJ45 Flying Leads	DATA	Flying leads for custom Ethernet integration (18")
CBL-DATA-3002	22-Pin to Audio and Video Out	PTT/EUD	Connects to a standard HDMI cable to display video on a TV or Monitor and connects to a speaker box or headset.
CBL-AUD-0001	22-Pin to U-329	RoIP	Connect the unit to a Legacy Radio via a U-329 connector.

CBL-AUD-0002	22-Pin to U-328	PTT/EUD	Connects to a headset via a U-328 connector.
CBL-AUD-0007	22-Pin to Audio and USB 2.0 Type A Female	PTT/EUD	Connects USB accessories via a standard USB A port and an audio accessory via a U-328 connector
CBL-AUD-2009	22-Pin to Audio and 6-Pin Push Pull Android™ USB	PTT/EUD	Connects an Android™ EUD or Screen and an audio accessory via a U-328 connector

Refer to the MPU5 Product Catalog for more information on MPU5 cables. If you still have questions, contact Persistent Systems.



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

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Part II: Software Setup

Section A: Configuring the Management Computer

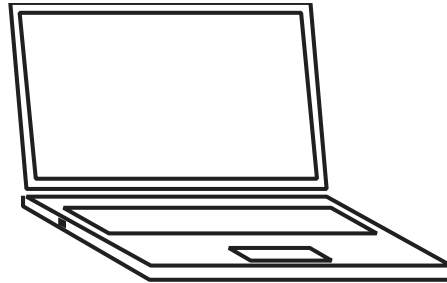


What Will I Learn?

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



Parts List



Management Computer with Administrator Access & Ethernet Port

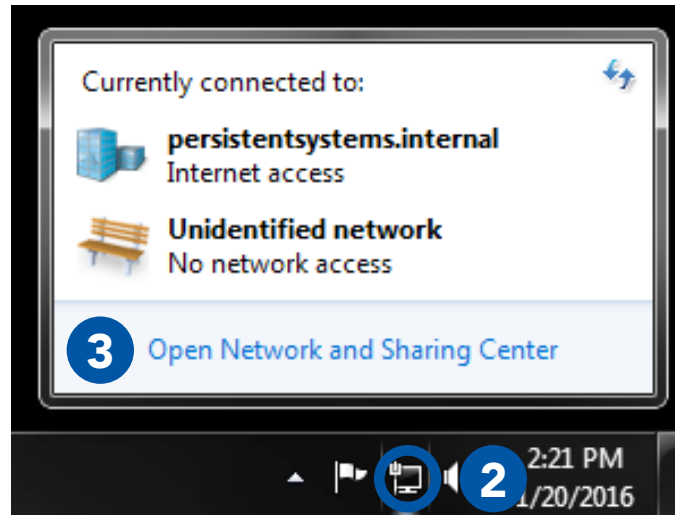


IMPORTANT INFORMATION!:

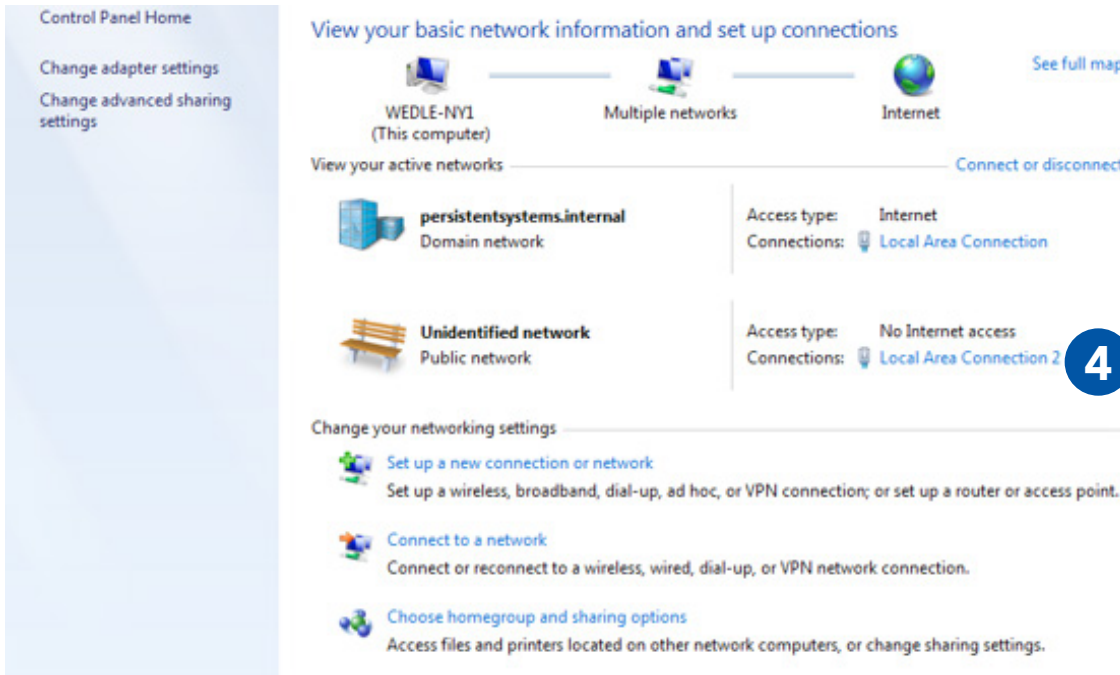
- ▶ To communicate with an MPU5, the computer must have an IP address in the same subnet mask as the MPU5's IP address.
- ▶ For example, with a subnet mask of 255.255.255.0, the computer and MPU5 will be able to communicate if they share the same first three numbers in their respective IP addresses (e.g. 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.

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**.



The screenshot shows the Windows Network and Sharing Center. On the left, there is a sidebar with links: "Control Panel Home", "Change adapter settings", and "Change advanced sharing settings". The main area is titled "View your basic network information and set up connections" and includes a "See full map" link. Below this, there are three network status icons: "WEDLE-NY1 (This computer)", "Multiple networks", and "Internet". A section titled "View your active networks" contains two network entries:

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

A blue circle with the number "4" is overlaid on the "Local Area Connection 2" link in the second row. Below the active networks, there is a section titled "Change your networking settings" with three options:

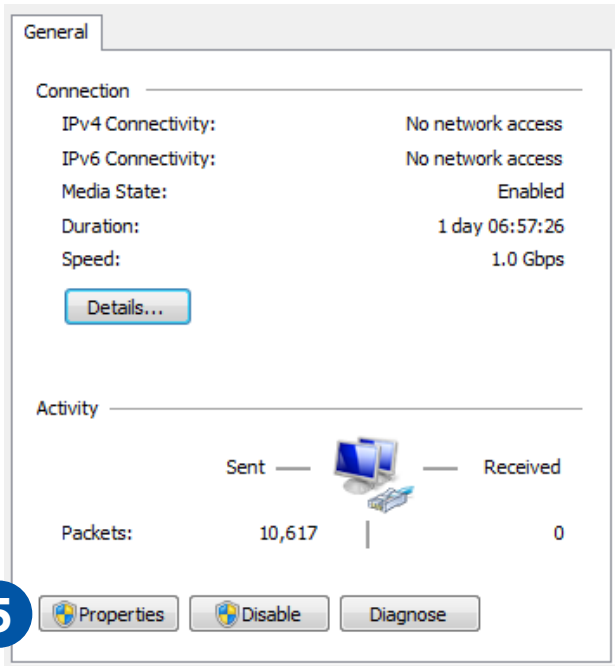
- Set up a new connection or network**: Set up a wireless, broadband, dial-up, ad hoc, or VPN connection; or set up a router or access point.
- Connect to a network**: Connect or reconnect to a wireless, wired, dial-up, or VPN network connection.
- Choose homegroup and sharing options**: Access files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

NO NDA REQUIRED

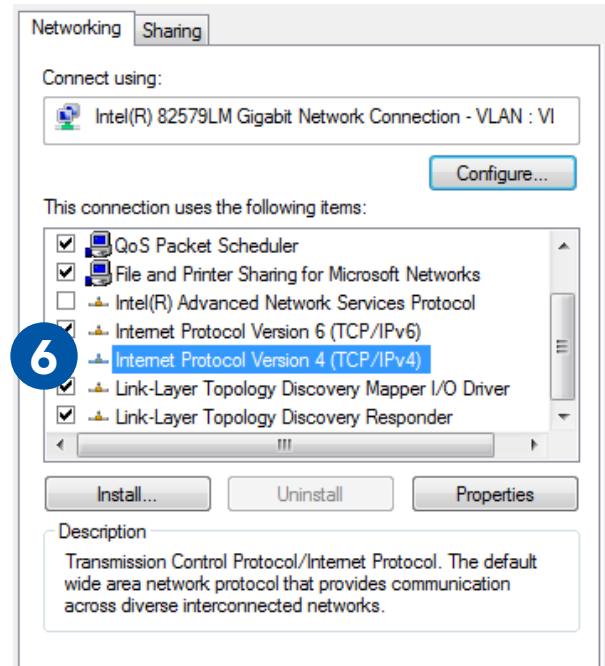
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SOFTWARE SETUP: MANAGEMENT COMPUTER

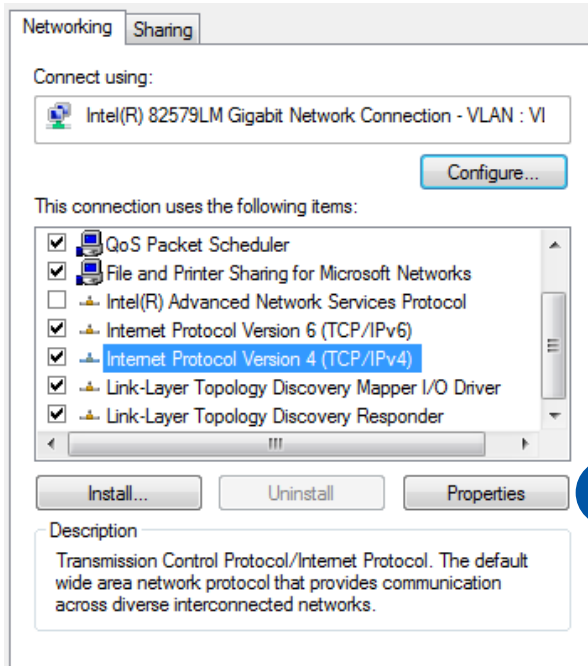
5 Click **Properties**.



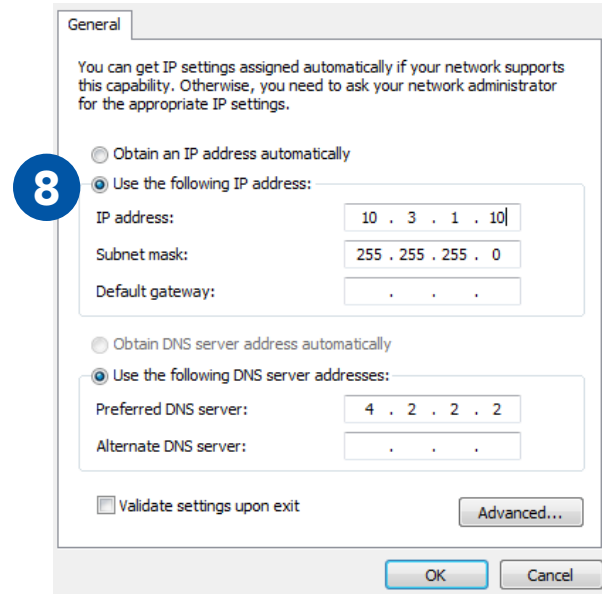
6 Select **Internet Protocol Version 4 (TCP/IPv4)** and ensure that it is highlighted as pictured.



7 Click **Properties**.



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



NO NDA REQUIRED

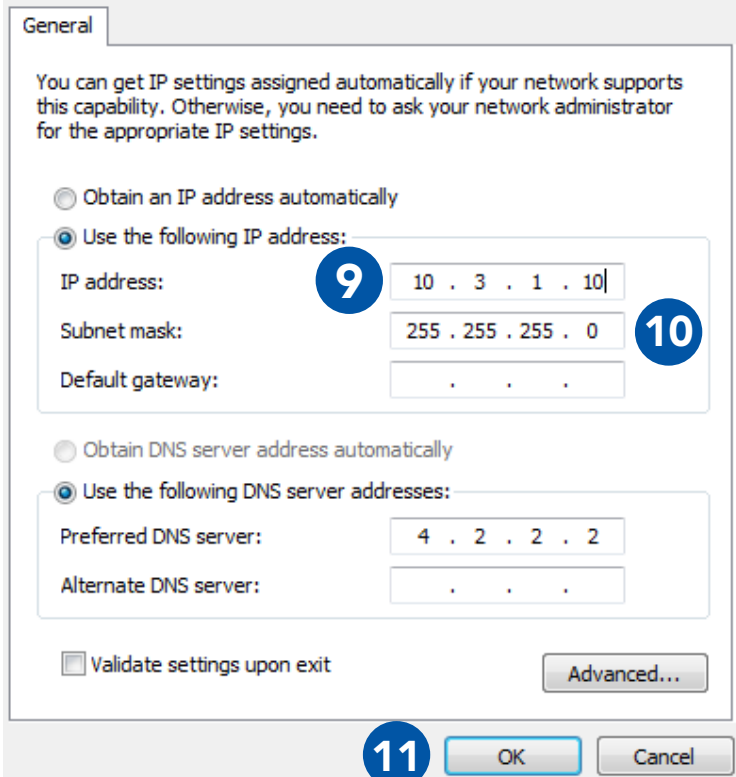
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SOFTWARE SETUP: MANAGEMENT COMPUTER

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**.



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:

Subnet mask:

Default gateway:

Obtain DNS server address automatically

Use the following DNS server addresses:

Preferred DNS server:

Alternate DNS server:

Validate settings upon exit

Advanced...

11 OK Cancel

12 Your computer is now properly configured to connect to the MPU5.

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?

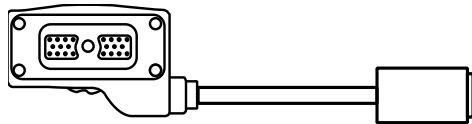
- ▶ Configure computers to be able to communicate with Wave Relay[®] devices.
- ▶ Have a computer that is able to configure a Wave Relay[®] device.

Section B: Connecting the MPU5 to the Management Computer

What Will I Learn?

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

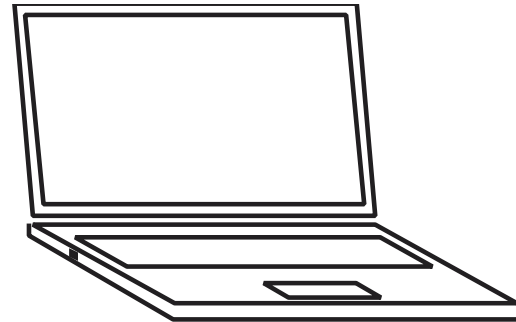
Parts List



22-Pin to RJ45 Receptacle
CBL-DATA-2001



Standard RJ45 Ethernet Cable



Properly Configured Management Computer with Ethernet Port

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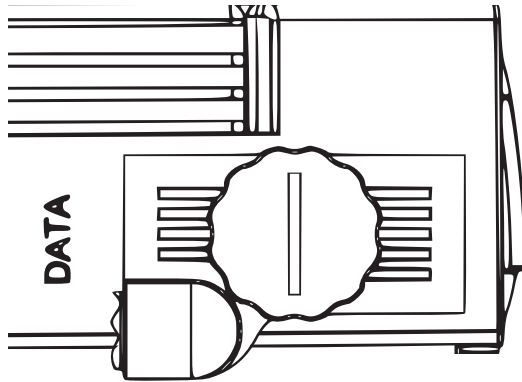
03EN073 Rev. M

PAGE 49 OF 176

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SOFTWARE SETUP: MANAGEMENT COMPUTER

- 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**.

