Appendix H: Manual

Please refer to the following pages.

Portable Mesh Node

FAP4215-050

Installation and User Guide

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1. PORTABLE MESH NODE OVERVIEW

Innovative Wireless Technologies' Portable Mesh Node (PMN) is a transceiver designed for use in industrial mining applications.

The **FAP4215-050 Portable Mesh Node (PMN)** is a portable infrastructure device that acts as a repeater or router in an ad-hoc wireless communications network.

The mesh network supports voice communications, text messaging, and tracking capability of personnel. High reliability communications is inherent to the self-healing, self-configuring mesh network architecture by providing redundant communications paths from one device to another. In the event of any node failure, the system automatically re-routes signals to another device within radio frequency range.

Under normal operating conditions, the PMN is powered by an internal lead acid battery.

Some key features of the PMN:

- Supports simultaneous Voice/Data/Tracking
- High reliability communications in underground environments
- Supports peer-to-peer communications with other Portable Mesh Nodes
- High quality voice communications with minimal latency
- Intrinsically safe
- Mine Safety and Health Administration I.S. Evaluation No. 23-A-120008-0

2. SAFETY INFORMATION

IMPORTANT! READ BEFORE USING THE PORTABLE MESH NODE.

This section contains important information on the safe operation of the PMN.

2.1 PMN INSTALLED ABOVE GROUND

2.1.1 Part 15 of Federal Communications Commission (FCC) Rules Compliance

This device complies with Part 15 of FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation.

FCC ID: SP8-FAP4215-050

When operated above ground, PMN professional installation is required with the following antenna connected to the 900 MHz RF output port:

Laird Technologies Model No. OD9-5 or equivalent

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate RF energy which may cause harmful interference to radio communications if not installed and used in accordance with the instructions. It is important to note that proper installation does not guarantee interference will not occur. 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; or
- Consult the dealer or an experienced radio/TV technician for help.

2.1.2 FCC Allowable Limits for General RF Exposure

CAUTION! To ensure that exposure to RF electromagnetic energy is within the FCC allowable limits for general RF exposure, always adhere to the following guidelines:

- The antenna used for the PMN transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

- The PMN must be installed 20 cm or more from any personnel in order to comply with FCC exposure requirements.

2.2 PMN INSTALLED IN UNDERGROUND COAL MINES

The Mine Safety and Health Administration (MSHA) has evaluated this device per Title 30 Code of Federal Regulations Part 23.

MSHA Intrinsic Safety Evaluation Number: 23-A-120008-0

This product has been determined to be intrinsically safe under the following conditions:

- The PMN is installed with one of the following 900 MHz antennas:
    1. M-2 Antenna Systems, Inc. Model No. 902-5 or 902-5MA Yagi antenna.

    2. ASY-RAT-1000-018 antenna.

- When installed underground, the PMN may not be connected to line power.

- When installed underground in coal mines, the installed PMN is part of a MSHA approved system. Follow the PMN installation instructions described in Sections 5.0 and 6.0 as well as any instructions / documentation applicable to the specific MSHA approved system installation.

2.3 PROXIMITY TO BLASTING COMPONENTS

The PMN shall not be turned on or operated within 7.1 feet of explosives or blasting components. When used in the Commonwealth of Pennsylvania, the PMN shall not be turned on or operated within 35.5 feet of explosives or blasting circuits.

2.4 MODIFICATIONS

Changes or modifications to the PMN not expressly approved by Innovative Wireless Technologies, Inc., may void the user's authority to operate this equipment.

3. SPECIFICATIONS

(Typical unless otherwise specified)

Environmental	
Operating Temperature[1]	-10C to +50C
Storage Temperature	-40C to +80C
Dimensions	13.37" x 11.62" x 6.00"
Weight	13 lbs
Enclosure	IP5X

Power	
Main	
Connector	Souriau Circular MilL/Spec 10 Pin
Voltage	13V to 26VDC
Current w/ battery charging	0.30A avg, 0.37A peak @ 24VDC
Battery Only Voltage	5.9V to 7.2VDC
Current	.431 avg, @ 6.9VDC

Electrical	
Frequency Range	902 – 928 MHz
Receiver Sensitivity[2]	-100 dBm
RF Transmit Power (below ground)	+28 dBm
RF Transmit Power (above ground)	+13 dBm
RF input/output	50 ohms nominal (N connector)
Voice channels/PMN[3]	4 channels
Data channels/PMN	2 channels, 250 kbps

Note 1: Ambient temperature
Note 2: Conducted sensitivity measured at BER <2%
Note 3: Supports four simultaneous voice calls (TDMA)

4. USER INTERFACE DESCRIPTION

To begin using the PMN review the information below covering the basic information you need to know to get started.

4.1 INPUTS AND OUTPUTS

The following is an explanation of the PMN inputs and outputs as shown in Figures 1 and 2:

Main DC: Main power input. Souriau Circular MIL/Spec 10 pin connector receives input from AC/DC power supply (24 VDC, 3 Amps nominal). A dust cap is used when this connector is not in use.

LED: The blue power LED embedded in the switch indicates the status of the PMN and embedded battery via a designated blink pattern (refer to Section 7.0)

On-Off Switch: The push button switch allows the user to power the PMN on and off to conserve battery power.

RF Port: 900 MHz output port. Type-N connecter to connect coaxial cables, antennas, and RF accessories.

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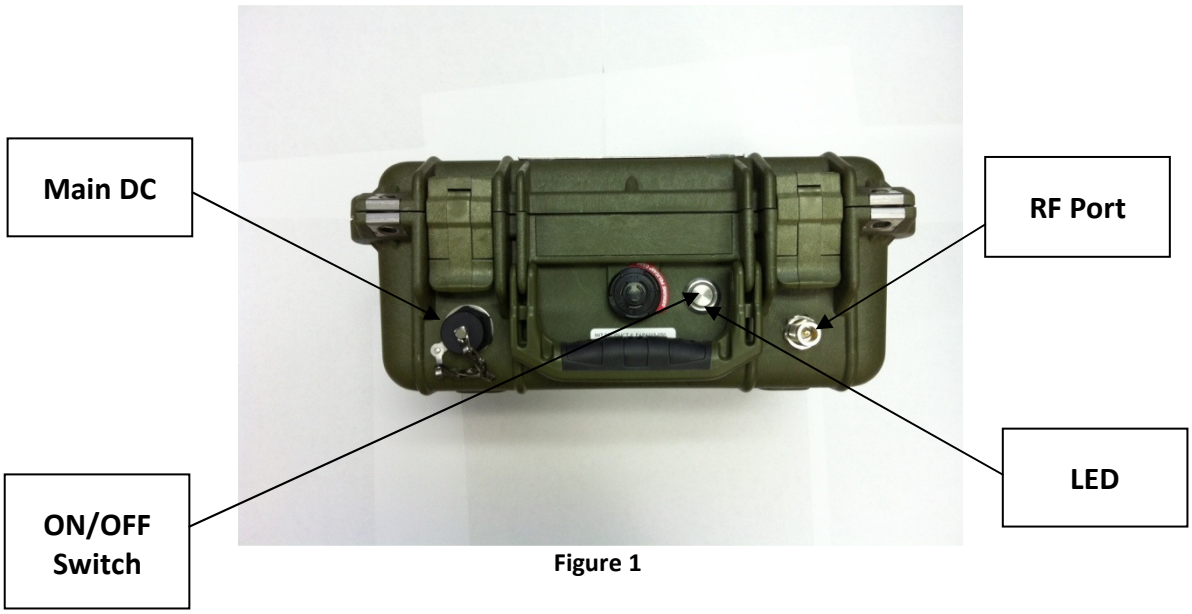

Figure 1

4.2 COMPONENTS NECESSARY FOR INSTALLATION

The PMN installation uses the following components and accessories (refer to Sections 5.0 and 6.0 for basic installation instructions):

Antenna (900 MHz):
The specific 900 MHz antenna connected to the PMN RF port depends on the location of the PMN.

For Above Ground (FCC Certified) use:
1. Laird Technologies OD9-5 or equivalent
2. Kent Model No. WA5VJB antenna

For Below Ground (MSHA Approved) use:
1. M-2 Antenna Systems, Inc. 902-5 or 902-5MA
2. Kent Model No. WA5VJB antenna

The PMN can only use the antenna models listed in applications that must meet FCC or MSHA requirements.

RF Power Splitters, Couplers, Attenuators:
The use of 2-way, 3-way, or 4-way power splitters and other RF accessories depends on the specific PMN system installation configuration. Refer to system installation drawings for approved configurations.

RF Cable:
The RF coaxial cable connecting the antenna port of the PMN to the 900 MHz antenna is an MSHA approved flame resistant cable with N-connectors.

5. PRIOR TO INSTALLATION

IMPORTANT! TRAINED PERSONNEL MUST PROFESSIONALLY INSTALL THE PMN.

5.1 SITE SURVEY

Conduct a survey to determine the appropriate sites to install the PMN from an RF perspective.

- Follow MSHA-approved system installation guidelines pertaining to the length of RF cables.
- Be sure that PMN antennas are installed an appropriate distance away from any blasting circuits (refer to Section 2.3).

5.2 VISUAL INSPECTION

Each PMN should be visually inspected to ensure the following:

- The enclosure is free from damage and defects.

- The enclosure has all connectors installed.
- The DC input connector has the proper dust cap installed.
- Properly secure the enclosure lid with the 2 latches.

6. BASIC INSTALLATION INSTRUCTIONS

6.1 INSTALLATIONS BELOW GROUND

IMPORTANT! TRAINED PERSONNEL MUST PROFESSIONALLY INSTALL THE PMN.

IMPORTANT! WHEN USED IN AN UNDERGROUND COAL MINING APPLICATION, THE PMN INSTALLATION MUST BE PART OF A MSHA APPROVED SYSTEM. INSTALLATION OF THE PMN MUST BE PER REQUIREMENTS SPECIFIC TO THE APPROVED SYSTEM INCLUDING CABLE LENGTHS AND CABLE TYPES.

At each of the sites determined by the survey described in 5.1:

Antenna Placement

Determine the placements for the 900 MHz antennas to ensure proper RF propagation. The PMN may connect to multiple 900 MHz antennas via RF power splitters connected to the output of the unit. For units installed in coal mines below ground, mount the antennas to roof bolts or on the PMN's magnetic accessory plate using the magnetic antenna mount. Select locations that ensure proper RF communication. Antenna location should not present a safety hazard or opportunity for damage to occur.

PMN Enclosure and RF Splitter Placement

Locate a place to emplace or mount the PMN enclosure and RF power splitter. Choose the appropriate splitter (2-way, 3-way, or 4-way) for a given PMN antenna configuration. The PMN and splitter installation should be in a convenient central location in order to minimize the amount of RF cable needed to connect the splitter box to the antennas. The PMN mounts on a wall, the ceiling or can be placed on the mine floor. The PMN enclosure orientation is not relevant.

PMN/RF Splitter/Antenna Connection

Connect the PMN 900 MHz output to the splitter and antennas. The PMN connects to the splitter box with coaxial cable. Connect one end of the cable to the RF output port on the PMN and the other end to the side of the splitter with only one connector. Connect each of the remaining splitter connections to an antenna using coaxial cable.

Applying Power to the System

Before pressing the ON/OFF button, re-check all appropriate clearance distances to blasting circuits (refer to Section 2.3). If blasting must be done near a PMN, be sure to power the device down. Install dust caps on exposed battery connector.

Press the ON/OFF button. The power LED on the PMN will start out solid as the PMN boots up.

Verify the power indicator LED on the PMN is indicating a Discharging Battery (ON—10%, OFF—90%). It may take up to one (1) minute to indicate a Discharging Battery.

IMPORTANT SAFETY WARNINGS!

- **CONTENTS OF THE PMN ASSEMBLY INCLUDE A NONSPILLABLE SEALED LEAD ACID BATTERY.**
- **DO NOT BLOCK THE VENT OPENING NEAR THE HANDLE OF THE ASSEMBLY ENCLOSURE.**
- **DO NOT CHARGE BATTERY IN INVERTED POSITION (WITH ENCLOSURE HANDLE FACING DOWNWARD).**
- **AVOID EXPOSURE OF BATTERY ASSEMBLY TO HEAT. DO NOT PLACE IN CLOSE PROXIMITY TO HEAT SOURCE WITHOUT PROPER VENTILATION.**

6.2 INSTALLATIONS ABOVE GROUND

IMPORTANT! TRAINED PERSONNEL MUST PROFESSIONALLY INSTALL THE PMN.

At each of the sites determined by the survey described in 5.1:

Follow installation instructions of 6.1. Equipment above ground should be located so it does not present a safety hazard or cause damage. Secure all equipment using the proper hardware.

PMNs installed above ground are not required to be part of a MSHA approved system. MSHA-specific system restrictions on cable lengths, gauges, and power supplies may not apply.

Follow all FCC guidelines listed in Section 2.0.

7. OPERATING AND MAINTENANCE INSTRUCTIONS

The PMN does not have any direct user interface.
The status of the PMN and its connected backup battery may be monitored by observing the blink pattern of the indicator LED mounted on the outside of the enclosure:

SOLID ON:	Main DC Power ON / Bad or missing battery (Also solid during initial power up of device)
BLINK (ON—50%, OFF—50%):	Main DC Power ON / Battery Charging (Charging condition)

WINK (ON—10%, OFF—90%): Main DC Power OFF / Battery Discharging (Normal Use condition)

OFF: PMN Power Set to off

The PMN requires little routine maintenance. Inspect each box periodically every month to ensure that the box remains free of damage and defects. It is important that the box remains dust tight. Replace defective boxes immediately. Do not continue to use any boxes that may have had their dust seal compromised.

The PMN may be shut down and disconnected from antennas during maintenance or while being moved to a new location. When removing PMN power or RF connections, place dust caps on all exposed connectors.

8. WARRANTY INFORMATION

Disassembling the PMN will void the warranty. If a PMN is damaged, discontinue use.