Fixed Mesh Node

FAP4213-025

Gateway Node

FAP2213-011

Product Manual

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1. FIXED MESH NODE / GATEWAY NODE OVERVIEW

Innovative Wireless Technologies' Fixed Mesh Node (FMN) and Gateway Node (GWN) are transceivers designed primarily for use in industrial mining applications.

The **FAP4213-025 Fixed Mesh Node (FMN)** is a fixed 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 are 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 the radio frequency range.

Under normal operating conditions, the FMN is powered by an AC/DC power supply. The FMN has a backup battery option to ensure communications when main power is lost.

The **FAP2213-011 Gateway Node (GWN)** is electrically and mechanically identical to the FMN but contains the addition of an Ethernet port. The GWN Ethernet port provides a gateway to a wired network for system management.

Some key features of the FMN / GWN:

- Supports simultaneous Voice/Data/Tracking
- High reliability communications in underground environments
- Supports peer-to-peer communications with other Fixed Mesh Nodes
- High quality voice communications with minimal latency
- Battery backup option (IWT Product No: FAP9100-002 or FAP9100-010)
- Intrinsically safe
- Mine Safety and Health Administration I.S. Evaluation No. 23-ISA080005-0

2. SAFETY INFORMATION

IMPORTANT! READ BEFORE USING THE FIXED MESH NODE OR GATEWAY NODE.

This section contains important information on the safe operation of the FMN and GWN.

2.1 DEVICES INSTALLED ABOVE GROUND (FMN OR GWN)

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-FAP2213-001 ***for both the FMN and GWN**

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 FMN/GWN transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.
- The FMN or GWN must be installed 20 cm or more from any personnel in order to comply with FCC exposure requirements.

2.1.3 Acceptable Antennas and Power Level above ground

For Above Ground (FCC Certified) use configure the FMN/GWN as an above ground unit and limit the transmit power to the antenna to be the maximum listed below for the specific type of antenna.

Use the following antennas with the FMN/GWN:

1. ZDA Communications LLC Model ZDADJ928-11YG (Yagi 11 dBi): Max power: 10 dBm
2. Hana Wireless Model HW-OD9-5-NF (Omni 6 dBi): Max power: 9 dBm
3. Ventev T09170P1000690 (Sector 17 dBi): Max power: 9 dBm

2.2 DEVICES INSTALLED IN UNDERGROUND COAL MINES (FMN ONLY)

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-ISA080005-0

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

- When the FMN connects to a non-intrinsically safe AC/DC power supply, its installation is ONLY in areas where permissible equipment is not required.
- The FMN is installed with one of the following intrinsically safe backup battery assemblies:
    1. Innovative Wireless Technologies FAP9100-002 (36Ahr SLA battery)
    2. Innovative Wireless Technologies FAP9100-010 (58Ahr SLA battery)

- The FMN 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. IWT FAA9100-017
    3. IWT FAA9100-068
    4. Antenna Factor ANT-916-CW-HWR use with SMA to Type-N connector adapter
    5. Antenna Factor ANT-916-CW-HW use with SMA to Type-N connector adapter
    6. PULSE Model No. MSU900FME Omni antenna with modified cable assembly (per IWT drawing FAA9100-009).
- When installed, power cables (AC or DC) must not be intermingled or bundled with RF coaxial cables used to connect the antenna to the FMN.
- When installed underground in coal mines, the installed FMN is part of a MSHA approved system. Follow the FMN 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 FMN/GWN shall not be turned on or operated within 7.1 feet of explosives or blasting components. When used in the Commonwealth of Pennsylvania, the FMN/GWN shall not be turned on or operated within 35.5 feet of explosives or blasting circuits.

2.4 MODIFICATIONS

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

3. SPECIFICATIONS FOR FAP4213-025 / FAP2213-011

(Typical unless otherwise specified)

3.1 Environmental	
Operating Temperature[1]	-20C to +60C
Storage Temperature	-40C to +80C
Dimensions	11.8” x 11” x 4.25”
Weight	11.4 lbs
Enclosure	IP54

3.2 Power	
Main	
Connector	Universal Mate-N-Lock (keyed)
Voltage	13V to 26VDC
Current	0.15A avg, 0.37A peak @ 24VDC
Current w/ battery charging	0.30A avg, 0.37A peak @ 24VDC
IS Battery (Optional)	
Connector	Universal Mate-N-Lock (keyed)
Voltage	5.9V to 7.2VDC
Current	1.2A avg, 3.5A peak @ 6.9VDC

3.3 Electrical	
Frequency Range	902 – 928 MHz
Receiver Sensitivity[2]	-100 dBm
RF Transmit Power (below ground)	+28 dBm
RF Transmit Power (above ground)	Antenna dependent (section 2.1.3)
RF input/output	50 ohms nominal (N connector)
Voice channels/FMN[3]	4 channels
Data channels/FMN	2 channels, 250 kbps

Note 1: Ambient temperature
Note 2: Conducted sensitivity measured at BER <2%
Note 3: Supports 4 simultaneous voice calls (TDMA)

4. FMN / GWN DESCRIPTION

To begin using the FMN or GWN, 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 FMN / GWN inputs and outputs as shown in Figures 1 and 2:

Main DC: Main power input. Four-pin Universal Mate-n-Lok 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.

Battery: Backup battery input. Four-pin Universal Mate-n-Lok connector receives input from 6V battery assembly. IWT FAP9100-002 or FAP9100-010 intrinsically safe backup battery assembly must be used for applications where MSHA approval is required. A dust connector is used when the Battery connector is not in use.

LED: The blue power LED indicates the status of the FMN/GWN and connected backup battery via a designated blink pattern (refer to Section 7.0)

Ethernet: Ethernet connector for Gateway Nodes (GWN ONLY)

RF Port : 900 MHz output port. Type-N connecter for connections to coaxial cable, antennas, and RF accessories.

RS-232: RS-232 connector. This connector is not used on the FMN or GWN. A dust cap must be on this connector at all times.

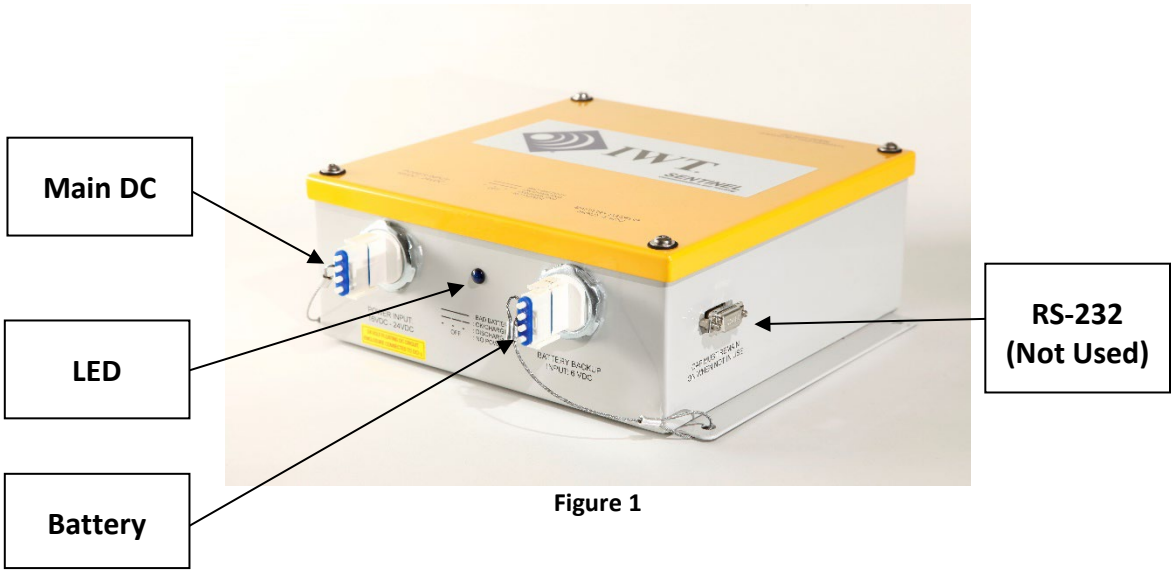

Figure 1

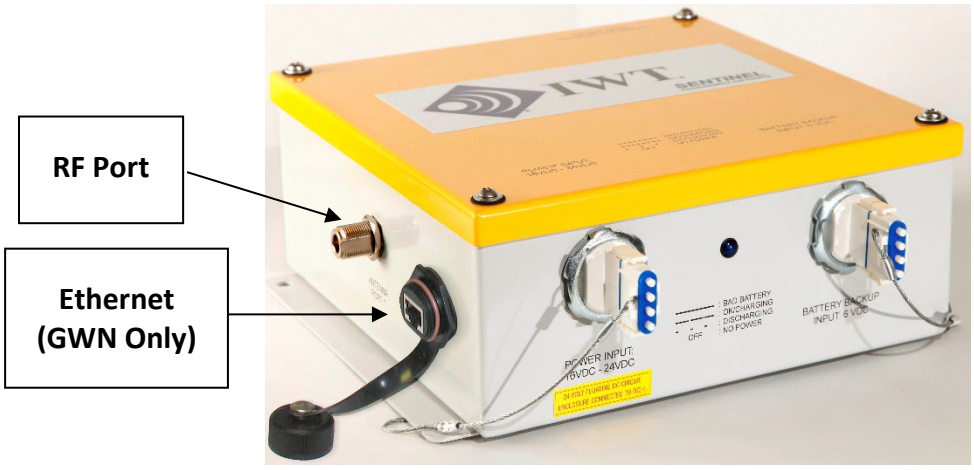

Figure 2

4.2 COMPONENTS NECESSARY FOR INSTALLATION

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

Power Cable (IWT P/N: FAA4200-007*):*
The power cable for the AC/DC supply input is an 8 foot, 2-conductor, 18 AWG MSHA approved flame-resistant cable with a 4-pin Universal Mate-n-Lok connector.

Power Supply:
The specific power supply used to power the FMNs and GWNs will depend on the requirements of the approved system installation.

Backup Battery Assembly (IWT P/N: FAP9100-002 / FAP9100-010):
The FMN/GWN backup battery is a 6V sealed lead acid battery housed in a rugged plastic enclosure. The battery assembly connects to the FMN via an MSHA approved flame-resistant cable with Universal Mate-n-Lok connector. The battery supplies a 6V intrinsically safe input to the FMN. The FAP9100-002 contains a 36Ahr SLA battery. The FAP9100-010 contains a 58Ahr SLA battery.

Antenna (900 MHz):
The specific 900 MHz antenna connected to the FMN or GWN RF port depends on the location of the FMN or GWN. The FMN or GWN can only use the antenna models listed in applications that must meet FCC or MSHA requirements.
For above ground use see section 2.1.3
For below ground use see section 2.2

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 FMN or GWN system installation configuration. Refer to system installation drawings for approved configurations.

RF Cable:
The RF coaxial cable connecting the antenna port of the FMN 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 FMN and GWN.

5.1 SITE SURVEY

Conduct a survey to determine the appropriate sites to install the FMN / GWN from an RF and power perspective.

- FMNs / GWNs may be supplied with a Main DC voltage between 13 VDC and 26 VDC.
- Follow MSHA-approved system installation guidelines pertaining to the length of both power and RF cables.
- Be sure that FMN / GWN antennas are installed an appropriate distance away from any blasting circuits (refer to Section 2.3).

5.2 VISUAL INSPECTION

Each FMN or GWN should be visually inspected to ensure the following:

- The enclosure is free from corrosion and defects.
- The enclosure has all connectors installed.
- The RS232 port has a proper dust cap installed.
- If not used, the main DC and battery input connectors have the proper dust cap installed.
- Properly secure the enclosure lid with 4 screws.

6. BASIC INSTALLATION INSTRUCTIONS

6.1 INSTALLATIONS BELOW GROUND (FMN ONLY)

IMPORTANT! TRAINED PERSONNEL MUST PROFESSIONALLY INSTALL THE FMN AND GWN.

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

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 FMN 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 (FMN only), mount the antennas to roof bolts 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.

FMN Enclosure and RF Splitter Placement

Locate a place to mount the FMN enclosure and RF power splitter. Choose the appropriate splitter (2-way, 3-way, or 4-way) for a given FMN antenna configuration. The FMN and splitter installation should be in a convenient central location to minimize the amount of RF cable needed to connect the splitter box to the antennas. The FMN mounts on a wall or the ceiling. If the FMN mounts on the wall, the enclosure orientation is not relevant. If the FMN mounts on the ceiling, be sure that the lid of the enclosure faces up. This will prevent water from accumulating in the lip of the lid.

FMN/RF Splitter/Antenna Connection

Connect the FMN 900 MHz output to the splitter and antennas. The FMN connects to the splitter box with coaxial cable. Connect one end of the cable to the RF output port on the FMN 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.

FMN/Junction Box or Power Supply Connection

The FMN connects to a junction box or power supply with a FAA4200-007 cable. The cable has a Universal Mate-n-Lok connecter on one end and spade lugs on the other. Install the Mate-n-Lok to the main DC power input of the FMN.

The connector will not fit properly into the wrong mate. Do not force the connector in. The connector should mate smoothly and lock in place with an audible click. If the connector does not mate properly, check for obstructions and try again.

Connect the other end of the cable to the terminal strip inside of a junction box or power supply via the attached spade lugs. Connect the BLACK wire (ground) to the terminal screws marked with a "- ". Connect the other wire (typically WHITE) to the terminal screws marked with a "+". Secure the cable so that it does not present a safety hazard or damage to occur.

Applying Power to the System

Before applying power to the system, recheck all appropriate clearance distances to blasting circuits. Refer to Section 2.3.

Backup Battery Installation

If a backup battery is required for the node installation, determine a place to mount the FAP9100-002 or FAP9200-010 battery enclosure. Inspect the enclosure for damage and ensure the latch is closed. Make sure that the mounting does not interfere with proper venting of the battery enclosure (vent hole is located near the handle of battery enclosure).

Before installing the battery enclosure, remove the dust cap from the FMN battery connector and recheck all appropriate clearance distances to blasting circuits (refer to Section 2.3). Remember a system with a battery installed will continue to run after line power is removed and may still be a hazard to nearby blasting. If blasting must be done near a node with a battery installed, be sure to unplug the battery and de-energize the main system power. Install dust caps on exposed battery connector.

Connect the battery enclosure to the FMN with a FAA4200-008 battery cable that is part of the FAP9100-002 / FAP9100-010 battery assembly. It will only fit into the FMN battery power connector. Do not force the connector in. The connector should mate smoothly and lock in place with an audible click. If the connector does not mate properly with the FMN battery input connector, check for obstructions and try again. Properly secure the cable.

Verify the power indicator LED on the FMN is indicating a Charging Battery (ON—50%, OFF—50%). It may take up to one (1) minute to indicate a Charging Battery.

Disconnect the main power cable (AC/DC supply input) and verify the power indicator on the FMN is indicating a Discharging Battery (ON—10%, OFF—90%). Reconnect the main power cable and verify the FMN is indicating a Charging Battery. It can take up to one (1) minute to indicate a Charging Battery.

IMPORTANT SAFETY WARNINGS!

- **CONTENTS OF THE FMN BATTERY 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 (FMN or GWN)

IMPORTANT! TRAINED PERSONNEL MUST PROFESSIONALLY INSTALL THE FMN AND GWN.

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

- Follow installation instructions described in 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.

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

- Follow all FCC guidelines listed in Section 2.

For proper operation and to meet FCC certification requirements it is critical that the installer properly set the “Above Ground” / “Below Ground” configuration parameter in the network configuration tool.

7. OPERATING AND MAINTENANCE INSTRUCTIONS

The FMN and GWN do not have any direct user interface.
The status of the FMN / GWN 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 (Normal use condition)
WINK (ON—10%, OFF—90%):	Main DC Power OFF / Battery Discharging
OFF:	No Power to FMN / GWN

The FMN and GWN require little routine maintenance. Inspect each box periodically every 3-6 months to ensure that the box remains free of corrosion 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 FMN and GWN may be disconnected from power, backup battery, or antennas during maintenance or while being moved to a new location. When removing FMN / GWN power or RF connections, place dust caps on all exposed connectors.

8. WARRANTY INFORMATION

Never disassemble the FMN or GWN. Doing so will void your warranty. If an FMN or GWN is damaged, do not use it.