WRM2

Wireless Remote Monitoring System 2

iPAM-Tx - Base transceiver - MESH Repeater - External Transceiver – RAMSYS-TRX - iMUX - iMUX Area Monitor - Dive Repeater

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MIRION TECHNOLOGIES Health Physics Division

Revision Log

Revision #	Date	Revised Pages	Comments
0	07/31/2004	N/A	Original issue.
1	12/29/04	ALL	Added comments from KS/JK
2	6/2005	ALL	- Update, add Images - Modify Section 2.2.3, Radio Mode Selector positions and description - Minor reformatting - Add Appendix 2: Alternate network Adapter Programming
3	9/2005	13-14	Section 2.2.3 Radio & Network Adapter Configuration: - Modify Table 2 for description of Communication Mode Summary - Modify Figure 4 – Front Panel Changes made to reflect actual operation of rotary switch mode positions and description for WRM2 Base Transceiver
		26	Modify Table 3 to include baud rate settings for devices connected to the WRM2 External Transceiver
		ALL	General edits
4	9/2006	ALL	General edits
		27	Equipment to EXT Radio settings
		28-30	iMUX Description
		31-32	Dive MESH Repeater Description
		33-28	Component Specifications
5	3/2007		Removed “Only One MESH Repeater within Range of Base” and explain the algorithm in section 2.32. Added a note about the 5111 firmware version for the WRM2 radio 2.33 page 22 Added a CAUTION statement on the importance of upgrading the WRM2 radios in the ‘5111’ version of the radio firmware, page 5
6	10/2008		Added **RAMSYS transmitter** and Technical Characteristics, sections 2.7 and 3.7. Added newer logo.
7	06/13/2009	Page 8 Pages 12 and 42	Removed note containing “external power can be used to power dosimeter when in PAM-TRX” Added **iPAM-TX transmitter and IMUX Area Monitor with** technical characteristics sections
8	08/6/2009	Pages 13, 15, and 18	Added statement: AA battery needs to be removed when using an external power supplies for the iPAM-TX
9	02/090/2010	Page 3	Added Hardware Warning
10	04/16/2010	ALL	Added information to associate sections regarding the 2.4 GHz DM radio and other edits.

11	06/20/2011	38-41	Added information on Passive and Active Underwater Antennas
12	8/30/2011	Page 4, 9 and Section 3	Added statement about optional 900 MHz frequency changes (910.8 - 914.7 MHz). Removed statement about PAM-TX programming connector.
13	2/28/2012	All	Updated product names.
		7-8	Added information on optional iPAM-Tx external battery power.
		8	Changed iPAM-Tx buzzer volume. Added dead battery warning. Added average battery life and transmission range.
		7-13, 49	Deleted PAM TRX information.
		9-13	Added battery usage and replacement details.
		31	Added iMUX's average battery life and transmission range. Added clarification regarding reset tool's redundancy for later iMUX firmware versions.
		40	Added iMUX-AM's average battery life and transmission range.
		41-42	Added correct pictures of Q-TEMP Tx
		54-55	Added component part numbers.

Hardware Warning

WARNING: No user-serviceable parts inside equipment.

WRM2 FCC Compliance

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

Antenna Warning

WARNING: This device has been tested with Reverse Polarity SMA and MMCX connectors with the antennas that are supplied with the equipment. When integrated in the OEM product, these fixed antennas require installation preventing end users from replacing them with non-approved antennas. Any antennas not supplied by MGP Instruments must be tested to comply with FCC Section 15.203 for unique antenna connectors and section 15 emissions.

FCC Qualifications

Important: The WRM2 radio modules have been certified by the FCC for integration into OEM products without any further certifications (as per FCC section 2.1091). Changes not expressly approved by Mirion Technologies (MGPI), Inc. could void the user's authority to operate this equipment.

Frequencies and spacing hops:

900 MHz FHSS

- First Frequency: 910.5 MHz
- Last Frequency: 917.7 MHz
- Frequency Spacing: 300 KHz

900 MHz FHSS (Optional)

- First Frequency: 910.8 MHz
- Last Frequency: 914.7 MHz
- Frequency Spacing: 300 KHz

2.4 GHz FHSS 25 channels:

- First Frequency: 2450.15 GHz
- Last Frequency: 2459.75 GHz
- Frequency Spacing: 400 KHz

2.4 GHz DM ISM Band:

- Regulatory Approvals: FCC (USA) FCC ID: OUR-XBEE/OUR-XBEEPRO, IC (Canada) IC: 4214A-XBEE or IC: 4214A-XBEEPRO, ETSI CE Power output: 10 dBm (Europe), C-TICK (Australia)

Table of Contents

1. Introduction

1.1. The WRM2 telemetry system incorporates the features of multiple personnel devices into an integrated package. The WRM2 telemetry system components include: Compact Transmitter, Base Transceiver, MESH Repeater, External Transceiver and Intelligent Multiplexer.

1.2. The WRM2 Compact Transmitter, named “iPAM-Tx,” (Personal Alarm Module Transmitter) is a multi-functioning transmitter for the DMC-2000 electronic dosimeter with enhanced alarm notifications and options for various frequencies. Enhanced alarm notifications include directional audible speaker, LED’s (top and face), and vibration. The iPAM-Tx also has an optional connecter for an adapter battery power supply. Radio frequencies include frequency hopping spread spectrum (FHSS) 900 MHz, 2.4 GHz, or DHHS 2.4 GHz DM. All alarming functions are user selectable and all radio parameters, including transmission intervals, are programmable via the WRM configuration software.

1.3. The MESH Repeater and External Transceiver units are compact and easily deployable to further enhance the wireless remote monitoring activities.

1.4. The iMUX Multiplexer unit is capable of transmitting data from up to eight connected electronic dosimeters from a single transmitter. In addition the iMUX can be configured to multiplex area monitor data as well.

1.5. Related Documents:

Document No.	Title
15-00050	iMUX Quick Start Guide
15-00088	Quick Start Guide for the Active Dive Repeater and Active Dive Antenna
15-00094	PAM (iPAM-Tx and PAM-2) Quick Start Guide
16-00141	TeleView 2000 User’s Guide
16-00148	WinWRM2 User’s Guide
16-00165	WRM Configuration Studio

CAUTION: Only those power sources and power supplies recommended by Mirion Technologies should be used with WRM2 components. Non-approved power sources can result in component damage. Contact Mirion Technologies for additional information.

CAUTION: It is recommend that all WRM2 radios that are incorporated in the Base Transceivers, MESH Repeater, and External Transmitter be upgraded to the latest firmware, 5112 January 2007. Contact Mirion Technologies for additional information on upgrading the WRM2 radios firmware.

2. EQUIPMENT DESCRIPTION & OPERATION

2.1. iPAM-Tx (Intelligent Personal Alarm Module Transmitter)

2.1.1. **Features:**

- Compatible with ALL WRM2 900 MHz and 2.4 GHz DM systems.
- High volume buzzer, ≥85 dBA at 3100 ± 200 Hz
- Vibrator
- Self-testing
- Nine high intensity LED indicators. Three facing the user on top of the enclosure and three on the enclosure front to facilitate monitoring by other workers in the vicinity of the user are configurable using the iPAM-Tx configuration software.

  - The LED indications (see Table 1 for more details):
    - A GREEN indicator flashes to indicate data transmission and a slow GREEN flash to indicate a good battery when in the storage mode.
    - RED indicators for a local alarm triggered by the dosimeter.
    - A BLUE indicator will flash to indicate a received packet (also used for RF mapping applications).
    - A YELLOW LED to indicate low/dead battery.

- Firmware is upgradable and user configurable using the iPAM-Tx Configuration Studio.
- External 5 volt DC - 1500 mA supply via micro-USB connecter **with NO battery installed**.
- 900 MHz: Single AA battery that can provide over 100 hours of continuous operation (4 second transmission) with 15 minutes of continuous alarming.
- 900 MHz: Transmission range of 1.6 miles, line of sight.
- 2.4 GHz DM Radio (**not compatible with older 2.4 GHz radios**): Single AA Battery that can provide 60 hours of transmitter operation with 15 minutes of the LED, vibrator, and buzzer operating continuously. (60 hours of transmission achievable with A0B6 firmware. iPAM-Tx can transmit for up to 125 hours with A0B8 firmware. Contact Mirion Technologies with any questions.) Transmit Power output is selectable using the WRM Configuration Studio.
- 2.4 GHz: Transmission range of 1,150 feet (350 m), line of sight using 10 mW power.
- Optional connector for external power, supplied by two D batteries for long-term area monitoring.
- For the DMC-2000S and SOR/R electronic dosimeter
- Optional open detector window for the DMC-2000X and DMC-2000XB dosimeter. Contact Mirion Technologies for this option.

Selectable Operating Features using the iPAM-Tx Configuration Studio:

- Telemetry interval level – 2, 4, 8, 16, 32, and 64 seconds
- Transmit Battery level
- Enabling and disabling LED indicators
- Battery level settings
- Disabling and enabling the buzzer
- Disabling and enabling the vibrator
- Self-test mode settings
- Dose rate latch mode
- Battery Hysteresis
- WRM2 Radio settings
- Diagnostics software
- USB data output

The configuration software for the iPAM-Tx is intended for an appropriate experienced user to modify selectable parameters other than settings that are factory default values for the iPAM-Tx. These settings could be used where the iPAM-Tx is used as an area monitor, for example.

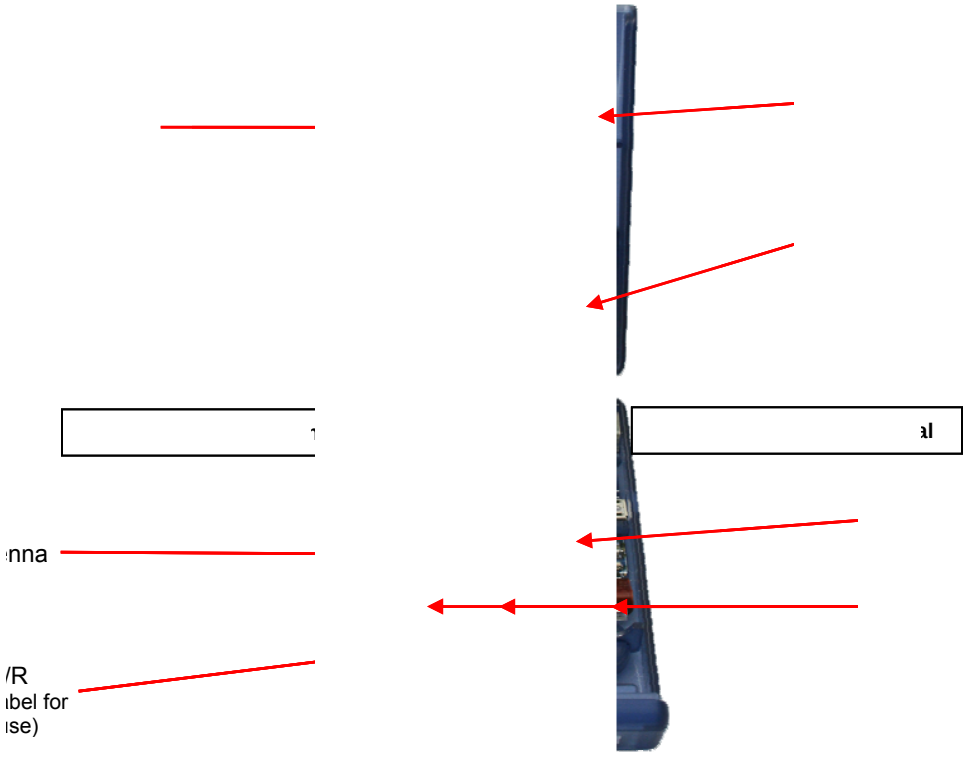
See the iPAM-Tx Configuration Studio manual for operation, use, and settings explanations.

The iPAM-Tx utilizes a micro-USB connector to connect to a PC and allow iPAM firmware upgrades, and user configuration, using the iPAM-Tx configuration software. The micro-USB connector is also used for external power (contact Mirion Technologies for the correct power adapters).

The battery shall be removed when upgrading the firmware or powering externally.

The pattern of the vibrator, audible, and visible LED indicator alarm signals are activated sequentially to conserve power and ensure transmission of the dosimeter data over-the-air. This sequence does not match the dosimeter's output alarms.

Opened View of iPAM-Tx



Front and Top View of iPAM-Tx

Figure 1: iPAM-Tx Complete Assembly

Note: The iPAM-Tx DOES NOT provide power to the dosimeter.

Note: Do not install an AA battery when powering the iPAM-Tx using an external power supply.

2.1.2. Operation

- The iPAM-Tx is designed to transmit the TTL RS-232 data packet from the dosimeter when the DMC-2000 or SOR/R is configured with transmission ON, 4800 BAUD, Triggered Externally.
- The iPAM-Tx transmitter is compatible with all WRM2 900 MHz and 2.4 GHz DM systems.
- The unit is compatible with the entire DMC-2000 family dosimeters data formats (DMC-2000S, X, XB, and SOR/R). The label on the iPAM-Tx located near the front cover center should be removed when using the SOR/R, see Figure 1 in this section.

Note: The iPAM-Tx is configurable using WRM Configuration Studio software. Contact Mirion Technologies for a software CD or downloadable link.

Note: For the DMC-2000XB an opening in the iPAM-Tx for the beta window can be provided as a factory option.

2.1.3. Preparation for use:

Note: Ensure the electronic dosimeter is configured for telemetry and the SPEAKER is enabled in DOSIMASS prior to use.

Step 1: Open the back case.

Step 2: Install a new AA battery, ensuring the correct polarity as indicated on the case. The iPAM-Tx will vibrate, all the LED indicators will flash, and the buzzer will sound briefly to verify all warnings/alarms are configured and working properly.

Step 3: The dosimeter must be installed with the display towards the top window face down with the dosimeter clip removed. Once inserted, close the back cover, ensuring the dosimeter is properly seated and aligned with the ISO connector. Use the DMC-2000 clip to lock the case.

Note: The iPAM-Tx does not come with its own clip, but uses the DMC-2000's clip to lock closed. Users need to buy a separate DMC-2000 clip if using the iPAM-Tx with SOR/R dosimeters.

Step 4: Turn the dosimeter ON. The iPAM-Tx will vibrate, all the LED indicators will flash, and the buzzer will sound briefly to ensure all warnings/alarms are configured and working properly.

Step 5: If the dosimeter alarms (e.g., dose or dose rate alarm), the enabled alarm functions in the iPAM-Tx will be triggered (buzzer, vibrator, and red LED indicators by factory default).

Note: Enhanced alarm capabilities of the iPAM-Tx is affected by the battery voltage and the type of battery used. Each site should determine the correct settings for their requirements and conditions.

Step 6: iPAM Low Battery and Dead Battery alarms are configurable with WRM configuration software. How they are set should be based on use. If enhanced alarm capability is priority, the Low Battery alarm may be set to 1.2 V and the Dead Battery alarm at 1.1 V. If telemetry is priority, the Low Battery alarm may be set at 1.1 and the Dead Battery alarm at 1.0 V.

FUNCTION	RED	GREEN	BLUE	YELLOW
Dose Alarm	Flash	Fast flash for transmitted data	NA	NA
Rate Alarm	Flash	Fast flash for transmitted data	NA	NA
Pre-Alarms (factory set at 4 cycles only)	Alt. Flash from **top** to **bottom**	Fast flash for transmitted data	NA	NA
Dosimeter 'Chirp' Feature ***Note: Will engage Rate alarm when using iPAM rate latching feature in the telemetry software.***	Flash	Fast flash for transmitted data	NA	NA
Battery Status (PAUSE) >8 hours	NA	Long green flash	NA	NA
Battery Status (PAUSE) < 8 hours Replace battery when possible.	NA	NA	NA	Long yellow flash
Battery Status (PAUSE) Needs immediate replacement.	NA	NA	NA	Steady ON
Battery Status (RUN) >8 hours	NA	Fast flash for transmitted data	NA	NA
Battery Status (RUN) < 8 hours Replace battery when possible.	NA	Fast flash for transmitted data	NA	Long yellow flash
Battery Status (RUN) Needs immediate replacement.	NA	Fast flash for transmitted data	NA	Steady
Transmitted Data	NA	Fast flash for transmitted data	NA	NA
Mapping Mode	NA	Fast flash for transmitted data	Fast flash for received data	NA
Fault: AC Power with Battery Installed	3 Flashes w/buzzer	NA	NA	NA

Table 1: Explanation of iPAM-Tx Light Emitting Diodes (LED) Functionally

2.1.4. Operational Test

Step 1: Ensure that a fresh (within the expiration date) AA alkaline or other appropriate type battery has been installed and that the iPAM-Tx powers ON when the battery is installed, ALL the LED indicators, Vibrator (if case is closed), and Speaker are activate for 1 second each.

Step 2: Prior to use the iPAM-Tx shall be configured properly via the WRM configuration software.

Step 3: Verify that the dosimeter is installed, the dosimeter clip is installed on the iPAM-Tx case, and the dosimeter is turned ON and operational.

Step 4: When the dosimeter is in active in the RUN mode, the iPAM-Tx will activate ALL LED indicators will flash, vibrator, and the buzzer will sound briefly to ensure all warnings/alarms are configured and working properly.

Step 5: Verify the iPAM-Tx does not indicate low or dead battery. Additionally the iPAM-Tx battery voltage status can be viewed on the remote monitoring software.

Ensure dosimeter data is being displayed properly in the remote monitoring software.

2.1.5. **Usage**

Step 1: Perform an operational test before utilizing the unit (see Section 2.2.4).

CAUTION: Do NOT use the iPAM-Tx if it fails the operational test.

Note: Do not install an AA battery when powering the iPAM-Tx using an external power supply or when updating the firmware.

Step 2: The iPAM-Tx is designed for pocket use in a visible location as close as practical to the TLD badge. Follow all HP/RP recommendations/requirements for body placement.

CAUTION: The vibration alarm feature is only effective if the iPAM-Tx unit is in contact with the body.

2.1.6. **Battery Replacement**

Use only 1.5 VDC AA Energizer alkaline or Duracell alkaline batteries.

Step 1: Remove the DMC clip, if present, and open the back cover.

Step 2: Properly dispose of the battery.

Step 3: Install a new battery, ensuring correct polarity position (refer to Figure 2).

Step 4: Close the cover and insert the DMC-2000 dosimeter clip.

Step 5: Ensure the automatic operational test is performed once the battery is installed. Check the polarity of the batteries if the unit fails the test.

2.2. WRM2 Base Transceiver

2.2.1. **Features:**

- Compact size self-contained transceiver unit.
- Compatible with all available frequencies. CE compliant with FHSS 2.4 GHz radio.

- 2.4 GHz DM radio (not compatible with older 2.4 GHz radios), or 902-928 MHz FHSS for North America installed. Transmit Power output is selectable using the WRM Configuration Studio.
- Single or dual radios for streaming MESH Repeater applications.
- Simultaneous RS-232 AND TCP/IP outputs available.
- The selector switch allows normal operation, programming of two (2) radios, Network Adaptor from a single RS-232 serial port or in a stream MESH Repeater mode if fitted with 2 radios (optional).
- Internal jumper to select connection of the RS-232 to Radio 1 or Radio 2.
- Wide external power options, 10 to 15 VDC, 0.5A. Universal international wall power unit provided (100-250 VAC 50/60 Hz, 15 VDC output with interchangeable wall plug units).
- Built in top panel LED's to indicate power, transmitted and received data streams, battery and charger status, and Network adaptor status. Network adaptor with built in LED's to indicate network status.
- Internal battery back-up option for up to 2 hours of operation. Built in intelligent charger with low battery indication.
- Multiple attachment options provided (brackets for desk-top, wall mounting or magnetic mount).

Figure 2: WRM2 Base Transceiver (single radio)

2.2.2. **Operation**

Step 1: The WRM2 Base Transceiver is a simple device that, after factory configuration, requires no special configuration to operate. The single radio Base unit is pre-configured to operate with same frequency transmitters (normally delivered with the system). The network adapter must be set-up and configured for use on a user's facility local area network.

Step 2: The front panel of the base unit has the following components:

- **Power Switch:** Used to turn power ON and OFF.
- **Power Connector:** Used to connect external DC power to operate the base and to charge the internal back-up batteries. A specially designed switching regulator has been used to accept a large input voltage range (9 to 18 VDC) and a smart charger for the NiMH batteries. Optional POE (Power Over Ether network) configuration.
- **RS-232 Connector:** Used to monitor base data received from remote units and to access and configure the radios and network adaptor.
- **RJ-45 Connector:** Used to access the network for data broadcasting and network adaptor configuration.
- **Rotary Switch:** Mode switch used to select specific base operations.

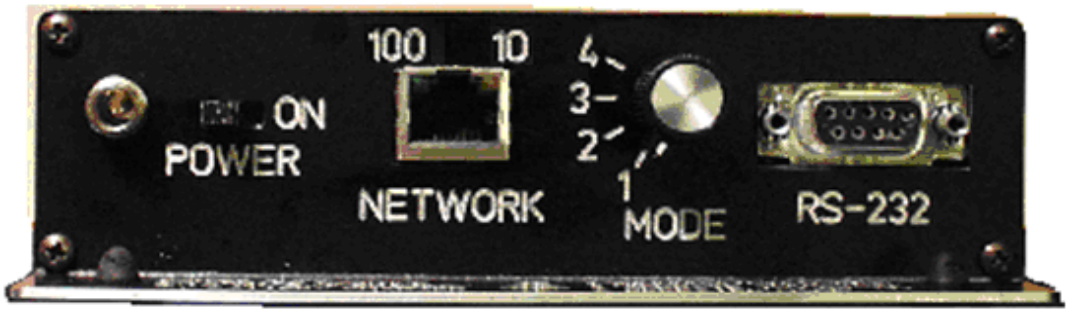


Figure 3 – Front Panel

Figure 4 – Antenna Panel (including 1 RPSMA connector)

Step 3: As soon as the power is turned ON, any RF data received by the radio is converted to RS-232 format and sent to the serial port (DB-9 connector if used) and the network adapter (RJ-45 connector if used) simultaneously. This means that the base can be connected to the network for the TeleView 2000 Software (Telecast Server) or other similar program to read the TCP/IP transmission from the network adaptor and, at the same time, a PC can be connected to the RS-232 port for local monitoring. Any RS-232 data from the host computer will be transmitted to all remote units or MESH Repeaters within range.

Step 4: Data to the serial port and network adapter is sent at by default at 19,200 BAUD, Parity NONE, 8 Data Bits, and 1 Stop Bit. All data is ASCII formatted, permitting use of any terminal program for inspection/troubleshooting.

Step 5: The data protocol of the output data is identical to the data going into the transmitter. No modifications are made to the data stream from the source device except for baud rate.

Step 6: The radios transmit data at 19,200 BAUD over the air and can be configured in a variety of ways to optimize the system for throughput, data reliability, and range. Contact Mirion Technologies for further information.

2.2.3. Radio and Network Adaptor Configuration

Step 1: The radios and network adaptor can be reconfigured using any terminal program, such as Windows HyperTerminal, to change parameters such as Serial Protocol, Network Address, Over-the-Air Radio Channel, etc. Refer to Section 2.2.3.3.3 and Appendix 2.

Step 2: The rotary switch on the front panel can be used to select the following functions (as depicted in Table 2 below):

Position	Mode	Description
1	**TX & RX NET, RX ONLY RS-232**	Operate Base, Transmit & Receive using Network, Receive Only using RS-232
2	**TX & RX RS-232, RX ONLY NET**	Operate Base, Transmit and Receive using RS-232 , Receive Only using Network; Configure Radio 1
3	**CONFIG NET OR RUN RADIO 2 RS-232**	Configure Network card, Operate Radio 2 using RS-232
4	**MESH REPEATER MODE WITH RS-232 MONITOR**	Operate Base in MESH Repeater Mode, monitor using RS-232

Table 2: Communication Mode Summary

2.2.3.1. Further description of the Communication Modes

Position 1: TX & RX NET, RX ONLY RS-232

- In this position, the base transceiver is configured to transmit and receive using the Network Interface Adapter (NIA) and/or receive using only the RS-232 port (no transmit capability via RS-232 port).

Note: The default LOCAL TCP PORT NUMBER for the network adapter is **4001**.

Position 2: TX & RX RS-232, RX ONLY NET

- In this position, the base transceiver is configured to transmit and receive using the RS-232 port, and/or receive using only the NIA (no transmit capability via the NIA). The radio can also be configured in this mode position and requires a specially designed software program.

CAUTION: The WRM2 radios are optimally configured for use with all WRM2 components and should not be modified. Contact Mirion Technologies for further information.

Position 3: CONFIGURE NET OR RUN RADIO 2 RS-232

- This is the same as for Radio 1 if the base has the optional second radio installed.
- In Position 3, the RS-232 serial connector Rx and Tx lines are connected to the network adaptor RS-232 serial lines. To configure the network adapter, **Windows HyperTerminal** is the preferred method and is described in this section (Refer to Appendix 2 for alternate programming software methods).

To program the network adapter perform the following steps:

Step 1: Power ON the WRM2 base unit.

Step 2: Set the Rotary Mode Selector to Position 3.

Step 3: Connect a straight RS-232 (9-pin Serial Cable) to the DB-9 connector of the Base unit and PC.

Step 4: Run Windows HyperTerminal (typically located in Start, Programs, Accessories, Communications of the windows desktop). The following window appears (Figure 6 below):

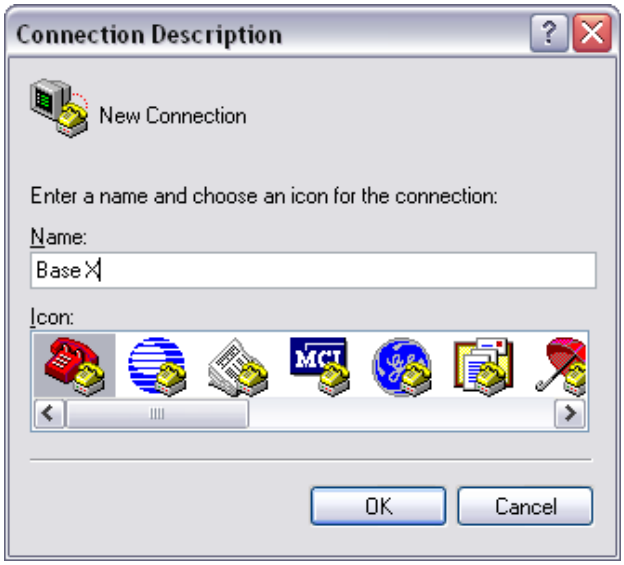


Figure 5: New Connection

Step 5: The Connection Description window opens. Provide a Name and click OK.

Step 6: The Connect To window will then be displayed (Figure 7 below).

Figure 6: Select COM Port

Step 7: Select the “Connect using” field to identify the available COM ports and select.

Step 8: Click OK.

Step 9: The Communication Settings should be set as depicted in Figure 8 below (change as necessary).

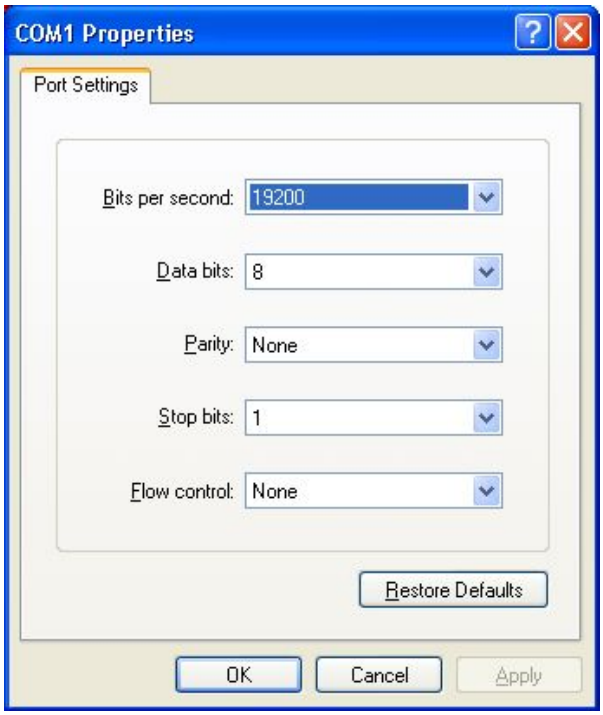


Figure 7: Port Settings

Step 10: Once HyperTerminal has established a connection to the Base unit, press any key on the PC keyboard to enter the configuration mode of the network adapter. The following screen is displayed:

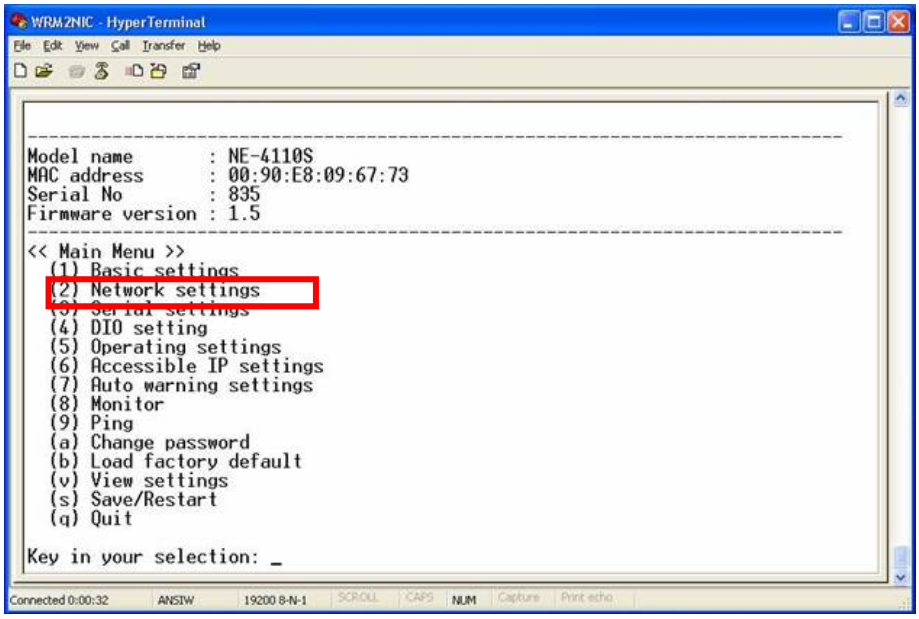


Figure 8: Network Configuration

Step 11: Select 2, then press ENTER. The following menu will appear (Figure 10 below):

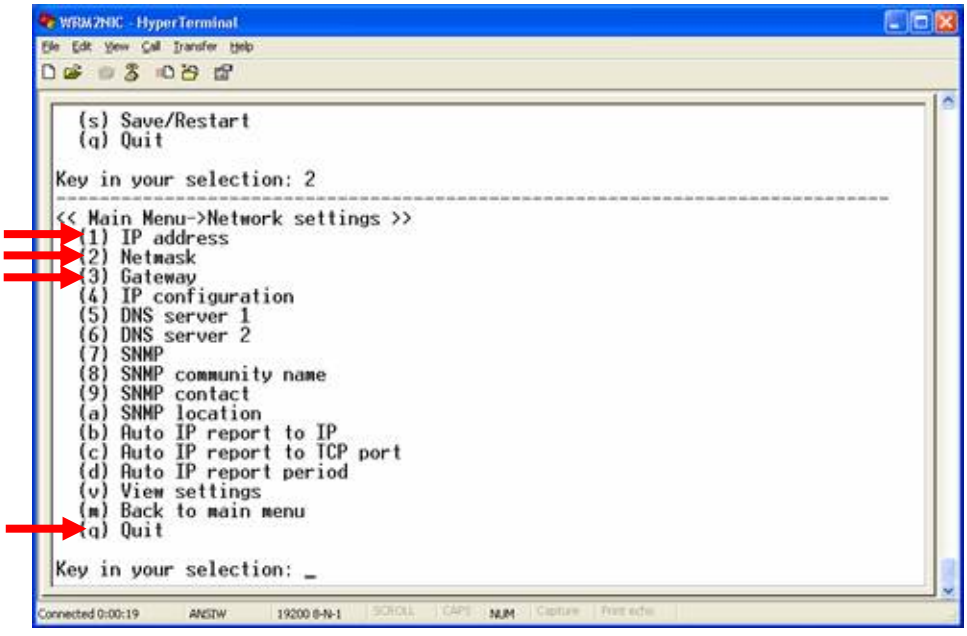


Figure 9: Network Configuration

Step 12: Select 1 and press ENTER.

- Change the IP Address (in accordance with the facility network scheme) and press ENTER.

Step 13: Perform changes, as appropriate, that meet specific network settings (as identified in Figure 10 above) for:

- IP Address
- Netmask
- Gateway

Step 14: Following completion of configuration, select “q” (Quit), and press ENTER.

- The Main Menu will be displayed (Figure 11 below):

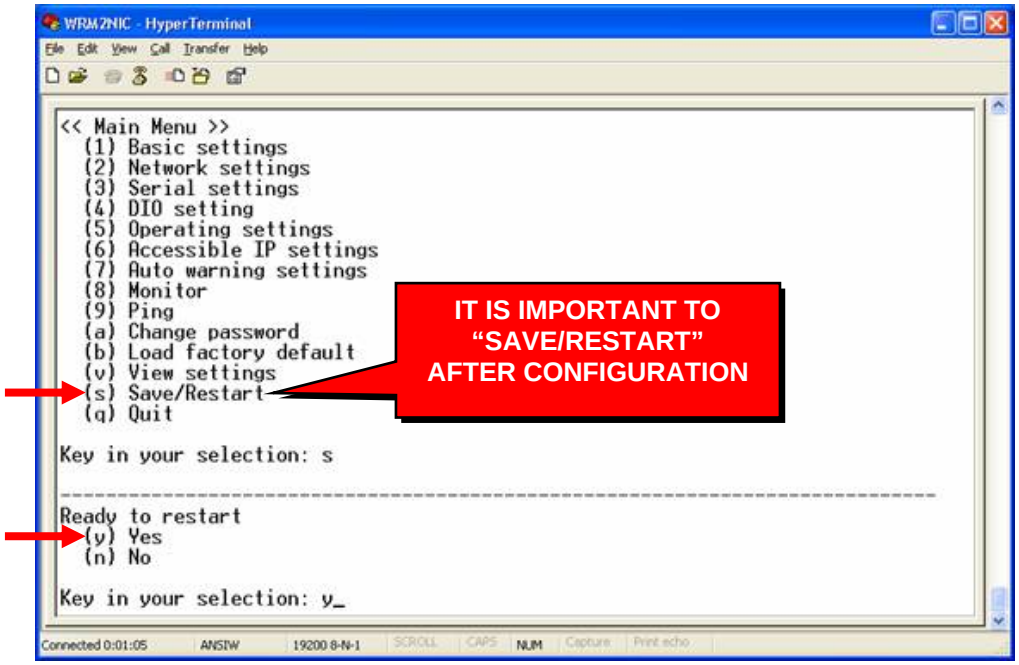


Figure 10: Main Menu

Step 15: Select “s” (Save/Restart) and press Enter.

- The prompt will display “Ready to restart.”

Step 16: Select “y” (Yes) and press Enter.

- The network adapter will restart with the saved parameters.
- The network adapter is now ready for connection.

Position 4: MESH REPEATER MODE WITH RS-232 MONITOR

- If the base has been optionally configured with 2 radios, in this position Radio 1 serial data output is connected to the Radio 2 serial input in order for Radio 2 to transmit any RF data received by Radio 1 at once. This configuration is used for a streaming MESH Repeater mode. The network adaptor and RS-232 lines are connected to monitor Radio 1 data for local monitoring.

Note: The MESH Repeater's configuration is factory set.

- The Base Transceiver, iPAM-Tx, DRM-1, and External Transmitter stations need DT and MK address command set so all MESH Repeaters are seen by the Base Transceivers and iPAM-Txs (Broadcast mode).
  - o Base Transceiver #1 = DT = "FFFF" MK = "0"
  - o Base Transceiver #2 = DT = "FFFF" MK = "0"
  - o Base Transceiver #3 = DT = "FFFF" MK = "0"

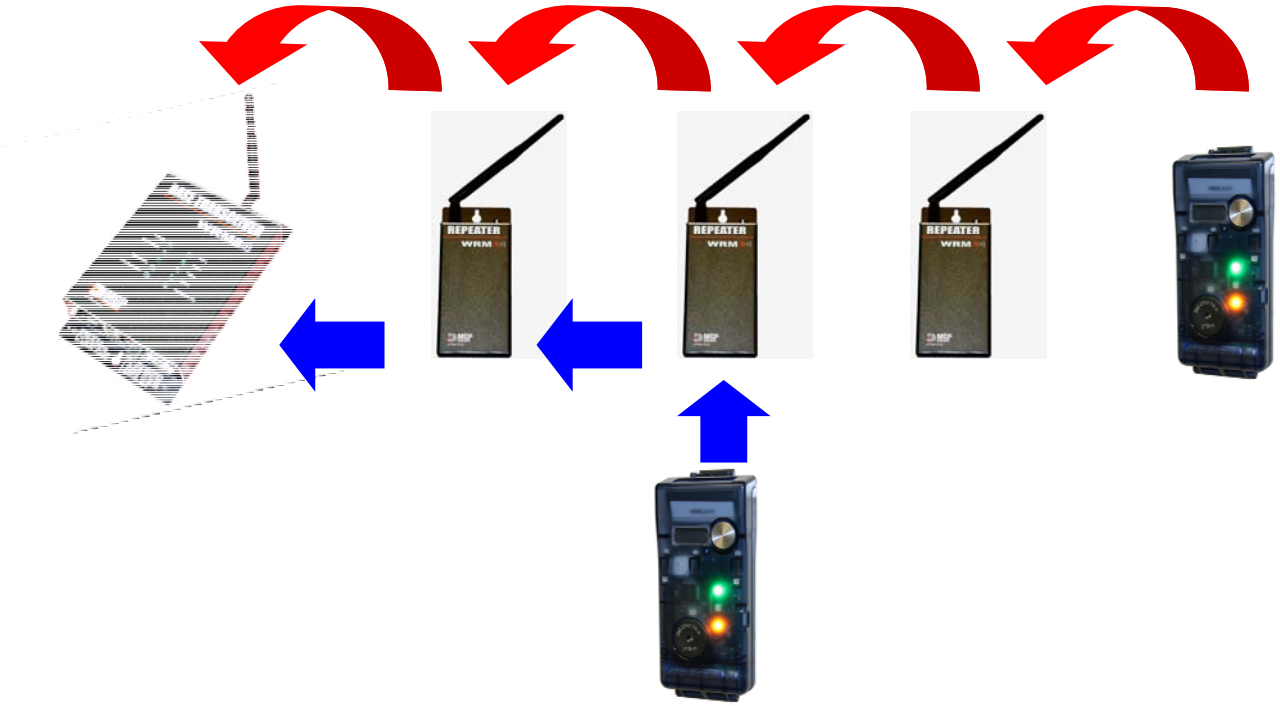


Figure 11: Base, MESH Repeater & Transmitter Signal Routing (example)

2.2.4. Batteries

- Eight (8) AAA NiMH batteries can power the WRM Base Transceiver for up to 4 hours when external power fails. The base circuitry is configured to charge the batteries and provide warning when the battery voltage is too low to properly operate the base.
- The battery shelf life is expected to be 7 to 10 years.

2.2.5. Operational Test

To test the base unit full functionality, perform the following steps:

Step 1: Turn ON an iPAM-Tx within range of the Base.

Step 2: Launch TeleView 2000 (TeleCast) or WinWRM2 software (refer to respective operating manuals). Ensure DMC data displays correctly.

2.2.6. **Usage**

Step 1: To use the Base Transceiver, ensure power is ON and that the Rotary function switch is set to Position 1 or Position 2 (if 2-way devices, such as the ABPM, are being monitored simultaneously).

Step 2: Connect a network cable to the RJ-45 connector or a straight DB9-M to DB9-F serial cable to the RS-232 port of a PC.

Step 3: Refer to the user manual of the monitoring software (like TeleView 2000 or WinWRM2) to ensure that data can be received and broadcasted over the network.

Step 4: Install an antenna for the appropriate frequency. If the base has dual antennas and the second radio is installed (optional), ensure the proper antenna is installed for each radio. See recommended spare parts for descriptions and part numbers.

2.3. WRM2 MESH Repeater

2.3.1. **Features:**

- Compact and rugged unit used to repeat signals to and from remote units when iPAM-Tx units are outside the normal reception range of the base unit.
- Uses the same radio modules as the Base Transceiver.
- External DC power and optional built in battery back-up for 2 hours with alkaline 9 VDC.
- Front panel LED's to indicate power and RF traffic.
- Protected power slide switch.
- Special cable for radio configuration connector (not included–contact Mirion Technologies for additional information).
- Case designed for desktop, wall or magnetic mounts.

Figure 12: WRM2 MESH Repeater

2.3.2. **Operation**

- The WRM2 MESH Repeater is a compact unit used to repeat signals to and from remote units when iPAM-Tx units must operate outside the normal range of the Base Transceiver and there are no network connection points between the remotes and the base.

  Note: The algorithm for the MESH Repeater's firmware provides complex calculations to eliminate double packets that the MESH Repeater might receive and pass on to the Base Transceiver(s). This helps reduce the "Bottle-Necking" of data from the base radio to the serial port or network adapter of the Base Transceiver.

  Note: The MESH Repeater is factory configured and ready to use.

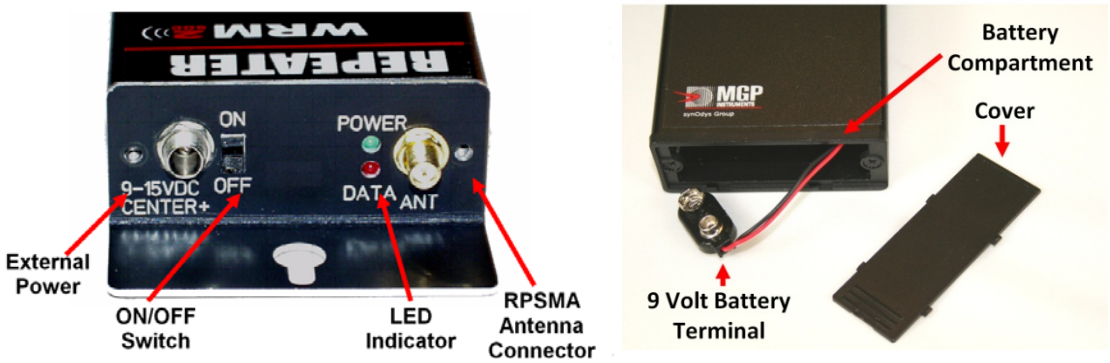


Figure 13: WRM2 MESH Repeater Front Panel and Battery Compartment

2.3.3. Settings

- Following factory configuration, no special settings are required to operate the MESH Repeater. The radio must be configured to operate in the same frequency and channel as the Base Transceiver and iPAM-Tx. The DT parameter is factory configured to the last four digits of the device serial number, e.g., 5xxx.

  Note: The 5112 firmware in the MESH Repeaters radio requires the setting called “My Address” to contain the four-digital serial number of the MESH Repeater.

- The unit is normally powered by an external DC power supply in the 7.0 to 15.0 DC, 0.5 Amps range. Mirion Technologies provides a specially designed power supply (the same as used for the base) with a lockable connector for improved reliability. However, a 9V DC battery provides for up to 2 hours of operation.

2.3.4. Operational Test

Step 1: Turn the unit ON using the front panel power switch. Ensure the power LED (green) is illuminated. Install the correct antenna for the proper frequency.

Step 2: Turn on an operating WRM2 Transmitter within range of the MESH Repeater and verify the Data light blinks when transmitter transmits.

2.3.5. Usage

Step 1: Once the MESH Repeater is turned ON, the radio is immediately enabled to receive RF signals provided:

- They are on the same frequency.
- The iPAM-Tx and Base Transceiver are on the same channel number.
- The iPAM-Tx and Base Transceiver are set in the broadcast mode correctly for DT and masking.
- The unit send and receive addresses are compatible with the network (if not in broadcast mode).

Step 2: If a good RF signal is detected, the radio checks the DT parameter and retransmits the packet with its own DT. Data that has already been repeated to the base is ignored to reduce over-the-air congestion and continuous loop transmission.

Step 3: The front panel red LED blinks for every packet of data received and the green LED blinks when the packet is transmitted.

2.3.6. **Battery**

- The MESH Repeater uses a standard 9 VDC alkaline battery. The battery is accessible by removing the back cover of the enclosure. Battery life is expected to be a minimum of 2 hours of continuous use with full transmitter load (approximately 70 PAM-TRX within range transmitting at 4 seconds interval).
- The unit continuously monitors the battery voltage. If a low battery condition is detected, the power LED will blink at approximately 1-second intervals to indicate the battery must be replaced (or recharged, if the option is installed).

2.4. WRM2 External Transmitter

2.4.1. **Features**

- Compact and rugged unit used to transmit signals to and from instruments fitted with RS-232 output capabilities like the AMP family survey meters, RAM-R200, RAM-ION, and CAM.
- Uses the same radio modules and enclosure as the MESH Repeater.
- External DC power and built in battery back-up for 2 hours with alkaline 9 VDC.
- Front panel LEDs to indicate power, receive and transmit data.
- Protected power slide switch.
- RJ-22 handset phone connector compatible with existing WRM devices.
- Case designed for desktop, wall or magnetic mount.

Figure 14: WRM2 External Transmitter

Note: Specially designed data cables may be needed for specific applications. Contact Mirion Technologies for further information.

2.4.2. **Operation**

- The WRM2 External Transmitter (or WRM2 EXT) is a compact unit used to transmit and/or receive serial data in TTL or standard RS-232 format from HP instruments to a WRM2 Base Transceiver and MESH Repeaters.
- Because of the open and flexible protocol used by the WRM2 EXT, any device with RS-232 capability can be connected to the WRM2 System such as body temperature or heart rate sensors, GPS monitors, and chemical or biological detection systems. In this case the software receiving the data from the Base Transceiver must be designed to properly identify and display this data.
- The WRM2 EXT can work on a request mode (strobe the device for data request) or in a continuous mode where the device accepts asynchronous data going into the EXT serial input and immediately transmits it over the air to a Base Transceiver and/or MESH Repeater in the same frequency and channel number.
- Normally the EXT outputs 5.0 VDC on pin 1 of the RJ-22 to power the DMC-family of dosimeters. The EXT board can be set-up internally (via dip switches) to change the function of pin 1 to standard RS-232 input.

- An adapter cable from RJ-22 to DB-9M/F is available to connect to standard RS-232 devices.
- Up to 75 WRM2 EXT connected to WRM compatible devices can be active on a single network at 4-second transmission interval with no loss contacts when the loss contact timer is set to 30 seconds. Higher numbers are possible if longer transmission intervals are selected. If other devices with longer data packets are used, the maximum number must be recalculated.
- The range of the unit is the same as the one for the MESH Repeater. For very long range coverage Mirion Technologies recommends the use of MESH Repeaters or high gain directional antennas.

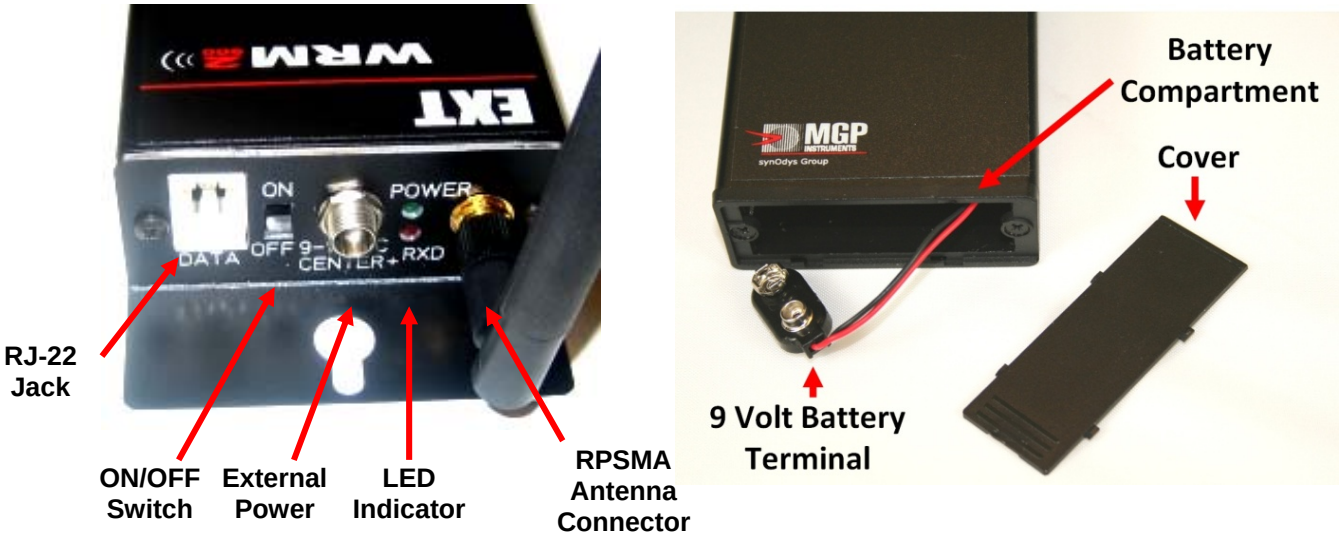


Figure 15: EXT Top Panel and Battery Compartment

2.4.3. Settings

- Baud Rate – The EXT radio must be set for the same baud rate as that used by the instrument. Range from 300 to 115,000 BPS are available (default 9600 Baud, N, 8, 1).
- Transmit Mode – The EXT radio must be configured in cyclic sleep mode to strobe the data from the external device or in no sleep for devices that output data at regular intervals.
- AMP family and other devices that send data only require that the Tx mode – the Receiver Control should be DISABLED; use the WRM2 Radio Configuration software for changes to the radio parameters.

Note: MP devices also require an RTM-9128 connector and LDM-6039 cable to work with the WRM2 EXT radio.

- Serial Protocol – The EXT TXD and RXD data lines must be configured for the proper serial protocol. Two modes are included, TTL serial (0 V – 3 to 5 VDC) or standards RS-232 (from -8 to -12 VDC to +8 to +12 VDC).
- Pin 1 can be configured for VDC output (5V or 7-15 VDC) or input (DMC/AMP connection) or for RXD for two-way communications.
- Slide (DIP) Switch configuration for the EXT is depicted in Table 3 below:

	SW 1		SW 2		SW 3		SW 4		SW 5		Baud Rate
Position	232	TTL	DATA	STROBE	232	TTL	IN	OUT	5V	15V	
	(Data Out)		(Data/Strobe)		(Data In)		(PWR In/Out)		(PWR Out)		
DMC-2000		X		X		X		X	X		4800
DMC100		X		X		X		X	X		300
AMP	X		X		X		X		NA	NA	AUT:04 9600[2]
PROGRAM RADIO	X		X		X						

Notes:
1: For other non-Mirion CAM's, refer to respective owner's manual for communication parameters and supported protocol (for example, CAM – Baud Rate: 19,200, RadNet protocol compliant in conjunction with cable WR2-6024).
2: Optional kits are available for the TelePole and Ram Ion instruments.

Table 3: WRM2 EXT Slide Switch & Baud Rate Parameters

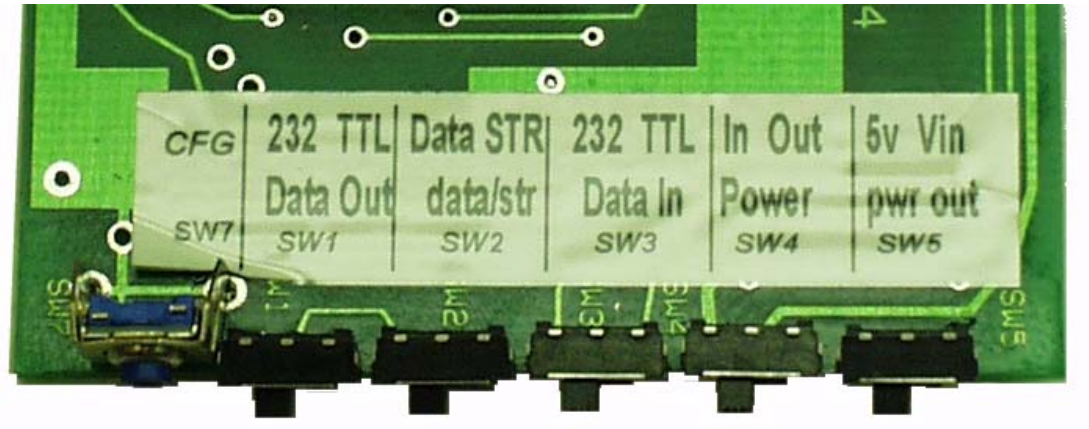


Figure 16: EXT Board – Slide Switch Configuration

2.4.4. Operational Test

Step 1: Turn the unit ON using the front panel power switch. Make sure the power LED (green) is lit.

Note: Install the correct antenna to ensure matching frequency.

Step 2: Connect to device that is within range of the Base Transceiver.

Step 3: Verify data is received on Televiewor other monitoring software.

2.4.5. **Usage**

- Once the EXT is turned ON, the radio is immediately enabled to strobe and/or transmits serial data from the device as RF signals to a Base Transceiver or MESH Repeater provided:
    - The EXT and the device have the same baud rate
    - The EXT and Base Transceiver or MESH Repeater are using the same frequency
    - The EXT and the Base Transceiver or MESH Repeater are using the same channel number
- If serial data is detected from the RJ-22 connector, the radio accepts the data in the RXD serial line and then transmits it over the air at 19,200 BPS.
- The front panel red/green LED blinks for every packet of data that is received or transmitted.

2.4.6. **Battery**

The EXT uses a standard 9 VDC Duracell alkaline battery. The battery is accessible removing the back cover of the enclosure. Battery life is expected to be a minimum of 2 hours of continuous use (no sleep). In the strobe mode, since the radio is in sleep mode at least 75% of the time, battery life is expected to be about 12 hours.

2.4.7. **Connection Cables used for the WRM2 External Transmitter.**

WR2-6002
- EXT Transmitter to PC, for programming radio

LDM-6039
- EXT Transmitter to AMP using RTM-9128 DB Connector

WR2-6024 - optional
- RadNet, to printer port on CAM or Polling, to computer connection on CAM

D20-1003 - optional
- DMC-2000 Interface adapter with RJ-22 connector

2.5. WRM2 iMUX – Intelligent Multiplexer

2.5.1. **Features**

- Intelligent detection of presence of a dosimeter.
- Verification of data packet integrity.
- Factory preset transmission cycle frequency (seven seconds minimum with eight data channels).
- Models compatible with both the CE compliant 2.4 GHz DM FHSS radio and the 902-928 MHz FHSS radio for North America.

- Intelligent low battery detection.
- Two (2) AA Alkaline batteries, Duracell or Energizer.
- 900 MHz: Battery life of 24 hours. Underwater transmission range of 12−24 in (30.5−70 cm).
- 2.4 GHz: Battery life of 24 hours. Underwater transmission range of 8 in (20.3 cm) using 10 mW power.
- Optional Bluetooth communication with Bluetooth enabled instrumentation or custom applications (Contact Mirion).
- A charger port is available for custom power options (Contact Mirion).

Figure 17: WRM2 iMUX

2.5.2. **Replacing Batteries**

Step 1: Remove the four (4) Phillips head screws.

Step 2: Remove the top cover.

Step 3: Inspect the gasket for cuts or tears. Replace if necessary.

Step 4: Remove the exhausted AA alkaline batteries.

Step 5: Replace with two (2) fresh AA alkaline batteries.

Step 6: Replace the cover in the correct position, ensuring the gasket is not pinched.

Step 7: Hand-tighten screws.

Figure 18: WRM2 iMUX with DMC-2000/Interface Clip

2.5.3. **Operation Use**

Step 1: The transmit cycle with 1 channel connected is 3 seconds and with all 8 channels connected is 6 seconds.

Step 2: When only 1 channel is plugged-in, the data will be transmitted twice (MESH Repeater configuration compatibility).

Step 3: The operation of an iMUX is possible with or without batteries when the charger is connected. However, batteries will prevent interruption of the transmission in case of power failure.

Step 4: When there is approximately 2−4 hours of battery life remaining, the Low Battery LED will start flashing and the Low Battery warning message will be transmitted inside a dosimeter packet and displayed as a Low Battery Warning in the telemetry software, for all dosimeters connected to the iMUX.

Step 5: If the iMUX is not functioning correctly, insert the reset tool into the reset port of the iMUX to reset the microprocessor. Wait five (5) seconds and remove.

Note: Later versions of the iMUX firmware do not require the reset tool to reset the device.

Figure 19: iMUX Reset Tool

2.5.4. **Storage**

- Remove the batteries and dosimeters for long-term storage.

2.6. WRM2 Dive Repeater – Underwater Dive Antenna

2.6.1. **Features**

- Compact size self-contained MESH Repeater/Transceiver unit for use with the iMUX.
- Compatible with 902−928 MHz FHSS for North America.
- Dual radio for streaming MESH Repeater and transmit applications for underwater diving operations.
- Internal jumper to select connection of the RS-232 for programming radios.
- Wide external power options, 9 to 18 VDC, 0.5A. Universal international wall power unit provided (110−250 VAC 50/60 Hz, 15 VDC output with interchangeable wall plug units).
- Built in top panel LEDs on repeater indicate power, transmitted and received data streams for both radios, and battery/charger status.
- Internal battery back-up option for up to 2 hours of operation. Built in intelligent charger with low battery indication.
- Multiple attachment options provided (brackets for desk-top, wall mounting or magnetic mount).

Figure 20: Dive Repeater

2.6.2. **Operation**

The WRM2 Dive Repeater is a simple device that, after factory configuration, requires no special configuration to operate. The Dive Repeater unit is pre-configured to operate with transmitters using the same frequency (normally delivered with the system). No configuration is required. Data is received by the iMUX/underwater antenna which is connected to Antenna 1. That data is then received by Radio 1 with the (MESH Repeater firmware installed) and transferred by electrical connection to Radio 2 running the normal external radio firmware. The data that Radio 2 receives is sent over-the-air to a Repeater or Base Transceiver.

Operational Note: The RXD-1 and TXD-2 LED will blink simultaneously when data is received in Radio 1 and then Radio 2 will transmit the data over-the-air.

Note: Contact Mirion for firmware upgrades to the radio(s).

The front panel of the base unit has the following components:

- **Power Switch:** Used to turn power ON and OFF.
- **Power Connector:** Used to connect external DC power to operate the base and charge the internal back-up batteries. A specially designed switching regulator has been used to accept a large input voltage range (9 to 18 VDC) and a smart charger for the NiMH batteries.

- **Radio(s) Baud Rate** 19,200 BPS
- **Antenna 1:** Used to connect the underwater antenna (RPSMA Connector) (optional).
- **Antenna 2**: Normal whip dipole antenna.

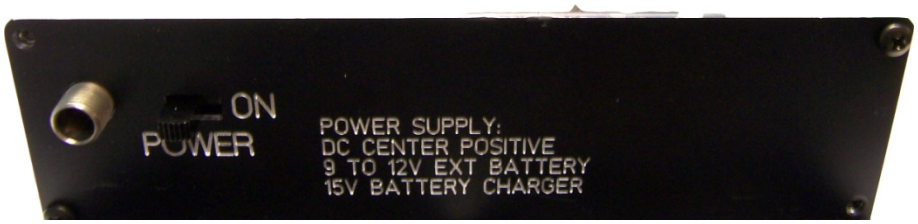


Figure 21: Front Panel with ON/OFF Switch and Power Connector

Figure 22: Back Panel with Antenna Connections

2.7. WRM2 Active Dive Repeater – Active Dive Antenna

2.7.1. Features

- Dual radio for streaming MESH Repeater and transmit applications for underwater diving operations. However, the second radio in this version is part of the Active Dive Antenna.
- The transmitter in the Active Dive Antenna system is encased in clear epoxy to make it waterproof and allow verification of the power and signals received (red and green LED's, respectively, located on the radio board).
- The Active Dive Antenna transmits data back via RS-232 to the Active Dive Repeater topside so there is no signal attenuation through the antenna cable.
- Power to the Active Dive Antenna is supplied from the Active Dive Repeater through the cable.
- Models compatible with both the CE compliant 2.4 GHz DM FHSS radio and the 902-928 MHz FHSS radio for North America.

- Internal jumpers in the Active Dive Repeater are labeled for the RS-232 connection to allow programming of both radios. **Note:** This connection is inside the Active Dive Repeater. Contact your Mirion representative for programming assistance if needed.
- Wide external power options, 9 to 18 VDC, 0.5A. Universal international wall power unit provided (110−250 VAC 50/60 Hz, 15 VDC output with interchangeable wall plug units).
- Built in top panel LEDs on Active Dive Repeater indicate power, transmitted and received data streams for both radios, and battery/charger status.

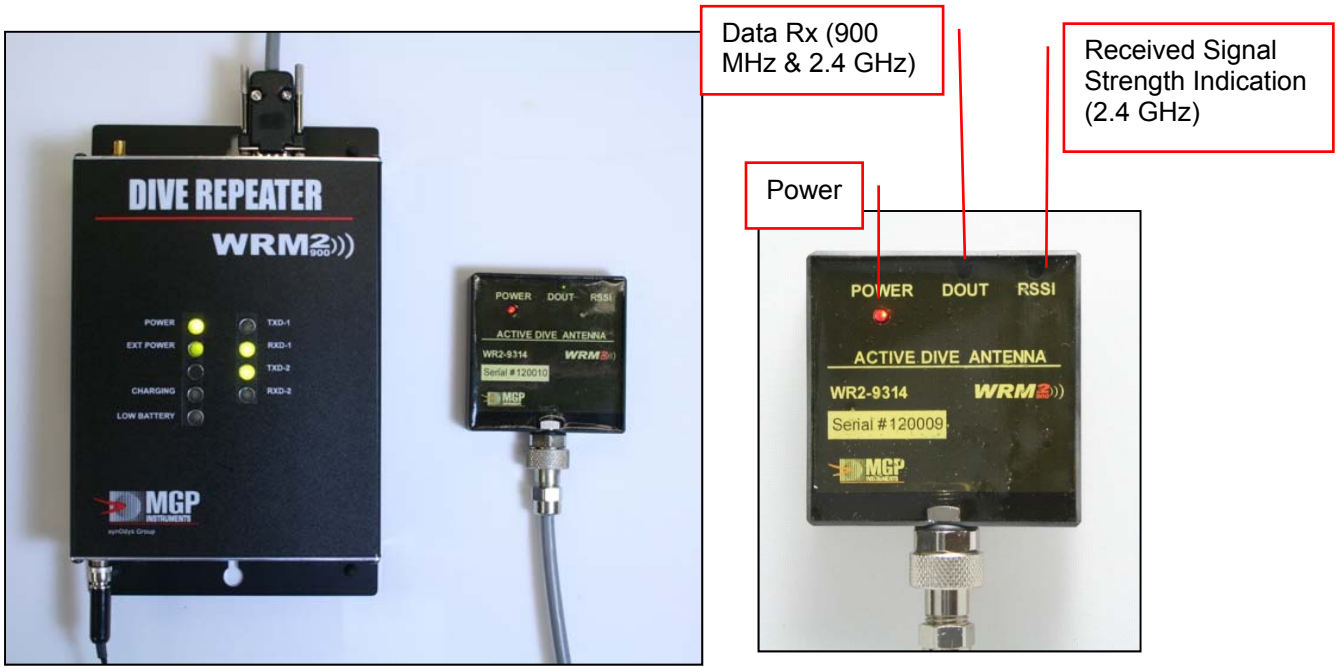


Figure 23: Active Dive Repeater with Active Dive Antenna

2.7.2. Operation

The WRM2 Active Dive Repeater is pre-configured to operate with the standard frequency group and should not require additional configuration. Data from the dosimeters is received by the iMUX which transmits to the Active Dive Antenna located outside the wet suit in close proximity to the iMUX. That data is transmitted from the Active Dive Antenna via RS-232 to the Active Dive Repeater. The data is then sent by the Active Dive Repeater over-the-air to a Base Transceiver or another Repeater.

Operational Notes:

- The RXD and TXD LEDs will blink simultaneously when data is received in Radio 1 and then Radio 2 transmits the data over-the-air.
- When connecting the cable to the Active Dive Antenna, utilize silicone grease on the o-ring, then align the pins and make the connection. Hand-tighten the connection then push the connector to the antenna to compress the rubber seal and retighten.

- DO NOT over tighten the connection to the Active Dive Antenna as this may cause damage to the connection or case.
- Ensure the DB-9 connection is tightly connected to the Active Dive Repeater and the Repeater is secured in place.
- Test only one unit at a time prior to diving. Ensure the Active Dive Antenna is tested underwater as the radios may repeat back to each other if in close proximity and cause a looping signal saturation condition.
- Baud Rate for both radios' serial connections are set at 19,200 BPS.

The front panel of the base unit has the following components:

- **Power Switch:** Used to turn power ON and OFF.
- **Power Connector:** Used to connect external DC power to operate the repeater and to charge the internal back-up batteries. A specially designed switching regulator has been used to accept a large input voltage range (9 to 18 VDC) and a smart charger for the NiMH batteries.
- **Antenna 1:** Used to connect the Active Dive Antenna (DB-9 Serial Connector).

⚠ **Note: DO NOT connect a computer to the Antenna 1 connection as this may damage the Active Dive Repeater.**

- **Antenna 2:** Normal whip dipole antenna supplied (900MHz or 2.4GHz DM).

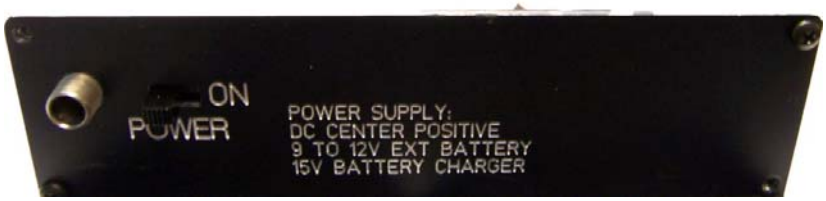


Figure 24: Front Panel with ON/OFF Switch and Power Connector

Figure 25: Back Panel Antenna Connections

2.8. WRM2 RAMSYS TRANSMITTER

2.8.1. Features

- Compact size self-contained transmitter for all RAMSYS processing equipment.
- Compatible with all available frequencies. CE compliant with FHSS 2.4 GHz radio installed.
- 902−928 MHz FHSS for North America
- 2.4 GHz DM ISM Band: Regulatory Approvals: FCC (USA), IC (Canada), ETSI (Europe), and C-TICK (Australia).
- Plug and play (RAMSYS device must be configured with a unique address, 1−254).
- Wide external power options, 9 to 18 VDC, 0.5A. Universal international wall power unit provided (110−250 VAC 50/60 Hz, 15 VDC output with interchangeable wall plugs).
- One blue LED for indication of power, connection and data transmission.
- Transmitter interval: 10 seconds
- Compatibility list of RAMSYS devices (short list):
  - ABPM 201L
  - ABPM 201M
  - ABPM 201S
  - ABPM 203M
  - IM 201L
  - IM 201M
  - NGM 209M
  - NGM 203S
  - PING

Figure 26: WRM2 RAMSYS Transmitter

2.8.2. Operation

The WRM2 RAMSYS Transmitter is an intelligent device that, after factory configuration, requires no special configuration to operate, plug and play. Once powered-up the RAMSYS-TRX will scan for the connected device. When the device is found the transmitter will request the first four channels (Channels A−D) and any status flags. The data is enveloped into a WRM2 Modbus packet and transmitted over-the-air to a base transceiver which is connected to TeleView 2000 or third party's telemetry software.

Operational Note: Channels A-D are displayed in the telemetry software and each RAMSYS device must have its own unique address, 1−254. Addresses and the four channels are configurable using the MASS2 configuration software.

Note: Contact Mirion Technologies for firmware upgrades to the microprocessor board or radio(s).

The front panel of the base unit has the following components:

- **Power Switch:** None
- **Power Connector:** A specially designed switching regulator has been used to accept a large input voltage range (9 to 18 VDC) baud rate of 38,400 BPS for the RAMSYS devices.
- **Antenna**: Normal dipole antenna

Figure 27: Front Panel with blue LED and power connection

2.9. WRM2 iMUX AM – Intelligent Multiplexer Area Monitor

2.9.1. Features

The iMUX Area Monitor is designed to transmit the TTL RS-232 data packet from the dosimeter when the DMC-2000 is configured with transmission ON, 4800 BAUD, Triggered. The unit is compatible with all the DMC family gamma dosimeters data formats (DMC-2000S, X and SOR/R).

- Intelligent detection of a presence of a dosimeter, DMC-2000 or SOR/R (Dosimeters Only).
- Intelligent detection of a presence of AMP 50/100/200 Area Monitors.
- Verification of data packet integrity.

- Factory preset transmission cycle frequency (seven seconds minimum with eight data channels).
- RJ-45 cable to DMC Interface Back (part number: D20-1003).
- RJ-45 to RJ-22 (part number: WR2-4020).
- WRM2 radio−900 MHz.
- 900 MHz: Battery life of 24 hours. Transmission range of 1.6 miles (2.6 km), line of sight.
- 2.4 GHz: Battery life of 24 hours. Transmission range of 1,150 feet (350 m), line of sight, using 10 mW power.
- 8−30 VDC External Power.
- Supplied with a 15 VDC External 120 VAC power supply (WR2-A000).
- Magnets for quick mount.
- WR2-4020 Adapter RJ22/RJ45.
- D20-1017-50 iMUX Area Monitor cable, 50 feet.

Figure 28: iMUX AM Multiplexer Area Monitor

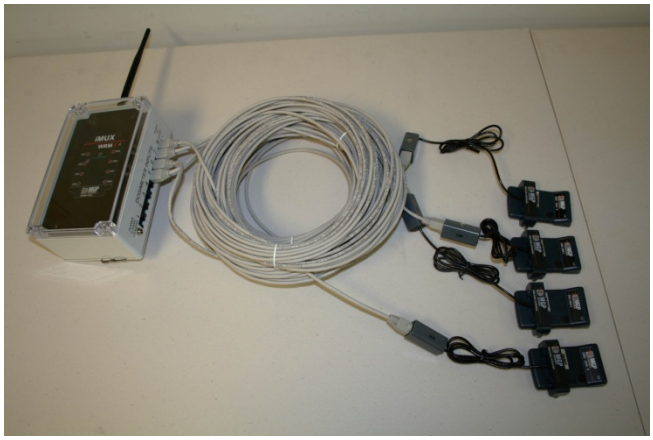


Figure 29: iMUX AM with dosimeters connected

2.9.2. **Operation Use**

iMUX AM WAKE UP:

The iMUX AM will detect the presence of a dosimeter and immediately start transmitting data over-the-air once the unit is powered and the dosimeter is turned ON with the correct telemetry settings using DOSIMASS (4800 BPS, Triggered Externally, and ON).

Note: A special firmware was designed to handle the AMP devices or the DMC-2000. The Reset button is the only way the device is turned ON when AMPs or Dosimeters are plugged in.

2.9.3. **OPERATION**

Note: The operation of an iMUX AM requires external power.

Step 1: Attach configured dosimeters using an RJ-45 cable and DMC interface back with barrel connector.

Step 2: The transmit cycle with 1 channel connected is 3 seconds and with all 8 channels is 6 seconds.

Step 3: Ensure the dosimeter data is being displayed properly in the remote monitoring software.

Step 4: RESET will re-start the iMUX AM microprocessor.

Note: The iMUX AM DOES NOT provide power to the dosimeter.

2.10. WRM2 Q-TEMP TRANSMITTER

2.10.1. **Features**

- Compact self-contained transmitter for Quest Technologies' Temperature Monitoring equipment.

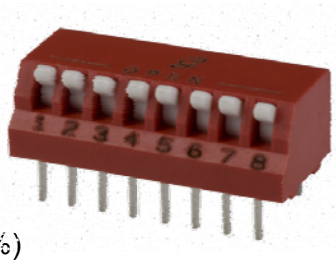
- Compatible with all available frequencies. CE compliant with FHSS 2.4 GHz radio installed.
- 902-928 MHz FHSS for North America.
- 2.4 GHz DM ISM Band: Regulatory Approvals: FCC (USA), IC (Canada), ETSI (Europe), and C-TICK (Australia).
- Plug and play (Quest Tech supplied communication cable).
- Wide external power options, 9 to 18 VDC, 0.5A. Universal international wall power unit provided (110-250 VAC 50/60 Hz, 15 VDC output with interchangeable wall plugs).
- One blue LED for indication of power, connection and data transmission.
- Transmitter interval: 10 seconds.
- Compatibility list of Quest Tech Temperature devices:
  - QuestTemp 32 Portable Monitor
  - QuestTemp 34 Portable Monitor
  - QuestTemp 36 Portable Monitor
  - QuestTemp 44 Portable Monitor
  - QuestTemp 46 Portable Monitor

Figure 30: Q-TEMP Transmitter

2.10.2. **Operation**

The WRM2 Q-TEMP Transmitter is an intelligent device that, after factory configuration, requires no special configuration to operate, plug and play. Once powered-up the Q-TEMP Transmitter scans for the connected device. The data is enveloped into a WRM2 packet and transmitted over-the-air to a base unit which is connected to telemetry software. The device temperature transmission data is viewed as a dose rate reading (e.g., "40 mR/h" is 40°F).

Note: The WRM2 Q-TEMP Transmitter can be configured for the following output; only one selection can be transmitted at a time with device.



- 0 = Wet Bulb when **all of the dip switches are down**
- 1 = Dry Bulb
- 2 = Globe
- 3= WBGT in
- 4= WBGT out
- 5= WBGT Custom
- 6= Humidity (transmitted in percentage e.g., "40 mR/h" is 40%)
- 7= Heat Index / Humidex
- 8= Wind Speed - **not implemented / reserved**

Note: Contact Mirion Technologies for firmware upgrades to the microprocessor board or radio(s).

The front panel of the base unit has the following components:

- **Power Switch:** None
- **Power Connector:** A specially designed switching regulator has been used to accept a large input voltage range (9 to 18 VDC) baud rate of 9600 BPS for the Q-TEMP Transmitter.
- **Antenna**: Normal dipole antenna, supplied.

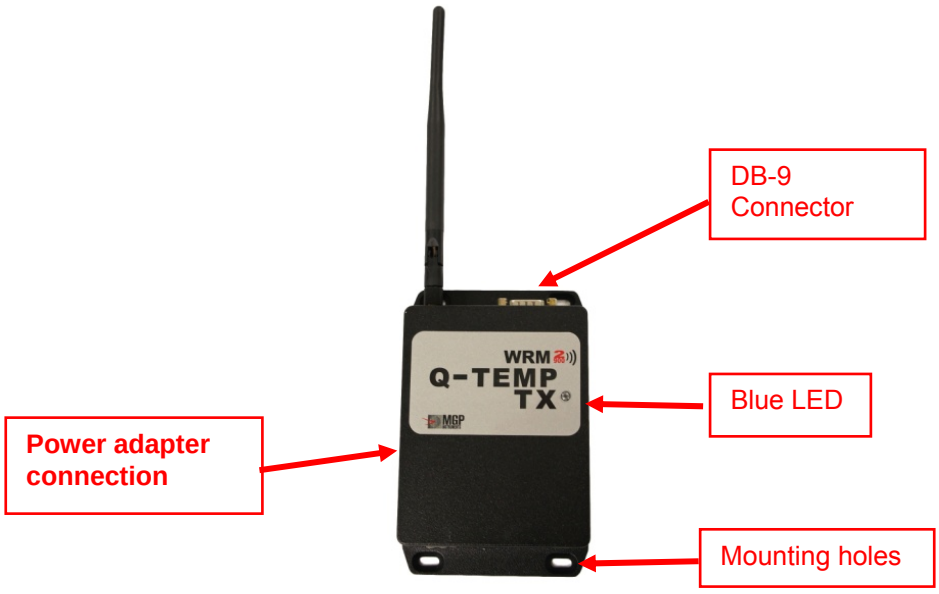


Figure 31: Front Panel with blue LED and power connection

3. Technical Characteristics

3.1. iPAM Tx

3.1.1. Transmitter Characteristics

900 MHz

- Transmit power output is ~100 mW (900 MHz).
- Wired antenna
- Radio sensitivity -110 dBm (900 MHz)
- 900 MHz spread spectrum hopping (FHSS)
- Frequency Range: 910-917 MHz (900 MHz), 910.8 - 914.7 MHz (optional)
- Range for the 900 MHz unit 1500 ft (500 m) indoors-industrial environment, 2 miles (3.2 km) outdoors RF line-of-sight with standard dipole antenna, up to 20 miles (32 km) with high gain directional antenna.
- Over the air data stream at 19,200 Baud Per Second
- Addressable from 0 to 65,000
- Regulatory Approvals: FCC and IC Certified

2.4 GHz DM – not compatible with older 2.4 GHz radios

- Transmit power output is configurable, 10 mW, 16 mW, 25 mW, 16 mW, 40 mW, or 63 mW. Factory set at 10mW.
- CE marked.
- Wired antenna
- Radio sensitivity -100 dBm at 63 mW (2.4 GHz)
- GHz ISM Band
- Frequency Range: 2.400–2.500 GHz
- Range for the 2.4 GHz unit 300 ft (90 m) indoors-industrial environment, 5280 ft (1.6 km) outdoors RF line-of-sight with standard dipole antenna and utilizing the highest power setting.
- Over the air data stream at 256,000 Baud Per Second
- Addressable from 0 to 65,000
- Regulatory Approvals: FCC (USA), IC (Canada), ETSI (Europe), and C-TICK (Australia)

3.1.2. Physical Characteristics

• Buzzer frequency:	3100±200 Hz.
• Buzzer sound level:	90+ dB @ 30 cm
• RED LED viewing angle:	top, front, and sides (transparent case)
• Vibrator:	Standard mobile phone type
• Case material:	Polycarbonate
• Ruggedness:	6 drops on concrete from 1.5 m

3.1.3. Mechanical Characteristics

• Height:	4.8 in (121 mm).
• Width:	2.3 in (58 mm).
• Thickness (including clip):	.98 in (25 mm).
• Weight (including batteries and dosimeter):	6.0 oz. (170 g).

3.1.4. Electrical Characteristics

• Battery type:	1.5 VDC AA Energizer M Alkaline battery
• Battery life:	900 Mhz Radio: > 24 hours of transmitter operation with 15 minutes of the LED, vibrator, and buzzer operating continuously. GHz DM Radio: > 12 hours of transmitter operation with 15 minutes of the LED, vibrator, and buzzer operating continuously.
• Connector to iPAM-Tx:	Micro-USB connector (Remove battery when programming.)
• External Power Supply:	5 VDC - 1500 mA- with micro USB connector 100 - 220 VAC with USA and Euro Adapter (**Remove battery when using external AC power.**)

3.1.5. Environmental Characteristics

- Operating Temperature: -10°C to 50°C (or 14°F to 122°F)
- Relative Humidity: less than 99% (without condensation)

3.2. WRM2 Base Transceiver

3.2.1. Base Characteristics

- Transmit power output 100 mW (900 MHz) or 50 mW (2.4 GHz)
- RPSMA Antenna connector
- Receiver sensitivity -110 dBm (900 MHz) and -105 dBm (2.4 GHz).
- 900 MHz or 2.4 GHz spread spectrum hopping (FHSS)
- Frequency Range: 910-917 MHz (900 MHz), 910.8-914.7 MHz (optional), 2.4000-2.4835 GHz (2.4 GHz
- Radio module is FCC approved, IC Certified, 2.4 GHz is CE marked.
- Front panel controls and connectors
- RS-232 and RJ-45 TCP/IP outputs for radio 1
- Rotary switch selector for internal device configuration (Network adaptor and radios)
- Wide range power supply (110 to 250 VAC input) with interchangeable AC plugs
- Standard locking type DC connector, wide range input 10 maximum of 24 VDC, coaxial connector with center + pin.
- Top mounted LED array to indicate power input, power ON, charging, battery status, network status and RX/TX data traffic for both radios (if installed)
- Dual radio capable for streaming MESH Repeater function
- Internal battery backup for up to 4 hours of operation (8 AAA NiMH batteries installed).

2.4 GHz DM - not compatible with older 2.4 GHz radios

- Transmit power output is configurable, 10 mW, 16 mW, 25 mW, 16 mW, 40 mW, or 63 mW. Factory set at 10mW.
- CE marked.
- RPSMA Antenna connector
- Radio sensitivity -100 dBm at 63 mW (2.4 GHz)
- GHz ISM Band
- Frequency Range: 2.400–2.500 GHz
- Range for the 2.4 GHz unit 300 ft (90 m) indoors-industrial environment, 5280ft (1.6 km) outdoors RF line-of-sight with standard dipole antenna and utilizing the highest power setting.
- Over the air data stream at 256,000 Baud Per Second
- Addressable from 0 to 65,000
- Regulatory Approvals: FCC (USA), IC (Canada), ETSI (Europe), and C-TICK (Australia)

3.2.2. Physical Characteristics

- Front panel controls: clearly labeled, protected from inadvertent operation
- Ruggedness: 2 drops on concrete from 1.0 m
- Attachments: feet for desktop, wall mount or magnetic mount

3.2.3. Mechanical Characteristics

- Height: 1.5 in (40 mm)
- Width: 5.5 in (140 mm)
- Depth: 9.5 in (235 mm) including antenna and switch knob.
- Weight (including batteries): 1 lb, 14 oz (850 g)

3.2.4. Electrical Characteristics

- External Power Supply: Wall pack power adaptor 110 to 250 VAC input, 15 VDC 1 A coaxial power jack with center + pin. The base will operate with a 7 to 15 VDC power supply but it will not charge the batteries. Threaded locking type plug.
- Power switch: Front panel slide type.
- Battery type: 8 x 1.5 VDC AAA NiMH rechargeable types.
- Battery life: At least 4 hours of full operation.
- Connectors to PC/network: DB-9F for RS-232, 10/100 RJ-45 for network
- Mode selection: 4 position rotary switch.

3.2.5. Environmental Characteristics

- Operating Temperature: -10°C to 50°C (or 14°F to 122°F)
- Relative Humidity: less than 95% RH (without condensation)

3.3. WRM2 MESH Repeater

3.3.1. MESH Repeater Characteristics

- Transmit power output 100 mW (900 MHz) or 50 mW (2.4 GHz)
- Receiver sensitivity -110 dBm (900 MHz) and -105 dBm (2.4 GHz)
- 900 MHz or 2.4 GHz spread spectrum hopping (FHSS)
- Frequency Range: 910-917 MHz (900 MHz), 910.8-914.7 MHz (optional), 2.4000-2.4835 GHz (2.4 GHz
- Radio module is FCC approved, IC Certified, 2.4 GHz is CE marked.
- Front panel controls and connectors
- Custom cable front panel RS-232 for radio configuration. The unit returns to repeat mode automatically when the serial cable is disconnected.
- Wide range power supply (110 to 250 VAC input) with interchangeable AC plugs
- Standard locking type DC connector, wide range input 9 to 24 VDC, coaxial connector with center + pin.
- Front mounted LED's to indicate power and RX/TX data traffic.
- Internal battery back-up for up to 2 hours of operation.

2.4 GHz DM - not compatible with older 2.4 GHz radios

- Transmit power output is configurable, 10 mW, 16 mW, 25 mW, 16 mW, 40 mW, or 63 mW. Factory set at 10mW.
- CE marked
- RPSMA Antenna connector
- Radio sensitivity -100 dBm at 63 mW (2.4 GHz)
- GHz ISM Band
- Frequency Range: 2.400–2.500 GHz
- Range for the 2.4 GHz unit 300 ft (90 m) indoors-industrial environment, 5280 ft (1.6 km) outdoors RF line-of-sight with standard dipole antenna and utilizing the highest power setting.
- Over the air data stream at 256,000 Baud Per Second
- Addressable from 0 to 65,000
- Regulatory Approvals: FCC (USA), IC (Canada), ETSI (Europe), and C-TICK (Australia)

3.3.2. Physical Characteristics

- Front panel controls: clearly labeled, protected from inadvertent operation
- Configuration cable: Custom made RS-232 cable
- Ruggedness: 2 drops on concrete from 1.0 m with antenna attached.
- Attachments: feet for desktop, wall mount or magnetic mount

3.3.3. Mechanical Characteristics

- Height: 1.2 in (30 mm)
- Width: 2.75 in (70 mm)
- Depth: 5.5 in (140 mm)
- Weight (including batteries): 11 oz (310 g) with antenna

3.3.4. Electrical Characteristics

- External Power Supply: Wall pack power adaptor 110 to 250 VAC input, 15 VDC 1 A coaxial power jack with center + pin. Threaded locking type plug.
- Power switch: Front panel slide type.
- Battery type: 9 VDC alkaline
- Battery life: At least 2 hours of full operation with alkaline.
- Connectors to PC/network: Custom cable stereo plug to DB-9F for RS-232 connection to PC for radio configuration.
- Mode selection: Automatically switched to MESH Repeater mode when the configuration cable is removed.

3.3.5. Environmental Characteristics

- Operating Temperature: -10°C to 50°C (14°F to 122°F)
- Relative Humidity: less than 95% RH (without condensation)

3.4. WRM2 External Transmitter

3.4.1. External Transmitter Characteristics

- Transmit power output 100 mW (900 MHz) or 50 mW (2.4 GHz)
- Receiver sensitivity -110 dBm (900 MHz) and -105 dBm (2.4 GHz)
- 900 MHz or 2.4 GHz spread spectrum hopping (FHSS)
- Frequency Range Frequency Range: 910-917 MHz (900 MHz), 910.8-914.7 MHz (optional), 2.4000-2.4835 GHz (2.4 GHz)
- Radio module is FCC approved, IC Certified, 2.4 GHz is CE marked.
- Front panel controls and connectors
- Standard RJ-22 phone handset connector for RS-232 TXD/RXD
- WRM device compatible with 3.3 DVC power output
- Configurable for two way RS-232 communications by converting pin 1 to RXD.
- TTL/CMOS or standard RS-232 serial levels
- Wide range power supply (110 to 250 VAC input) with interchangeable AC plugs
- Standard locking type DC connector, wide range input 9 to 18 VAC, coaxial connector with center + pin
- Front panel mounted LED's to indicate power and RX/TX data traffic.

GHz DM - not compatible with older 2.4 GHz radios

- Transmit power output is configurable, 10 mW, 16 mW, 25 mW, 16 mW, 40 mW, or 63 mW. Factory set at 10mW
- CE marked.
- RPSMA Antenna connector
- Radio sensitivity -100 dBm at 63 mW (2.4 GHz)
- GHz ISM Band
- Frequency Range: 2.400–2.500 GHz
- Range for the 2.4 GHz unit 300 ft (90 m) indoors-industrial environment, 5280 ft' (1.6 km) outdoors RF line-of-sight with standard dipole antenna and utilizing the highest power setting.
- Over the air data stream at 256,000 Baud Per Second
- Addressable from 0 to 65,000
- Regulatory Approvals: FCC (USA), IC (Canada), ETSI (Europe), and C-TICK (Australia)

3.4.2. Physical Characteristics

- Front panel controls: clearly labeled, protected from inadvertent operation
- Configuration cable: Standard WRM phone RS-232 cable or custom made RS-232 cable for other devices with serial data output capability.
- Ruggedness: 2 drops on concrete from 1.0 m with antenna attached.
- Attachments: feet for desktop, wall mount or magnetic mount

3.4.3. Mechanical Characteristics

- Height: 1.2 in (30 mm)
- Width: 2.75 in (70 mm)
- Depth: 5.5 in (140 mm)
- Weight (including batteries): 11 oz (310 g) with antenna

3.4.4. Electrical Characteristics

- External Power Supply: Wall pack power adaptor 110 to 250 VAC input, 15 VDC 1 A coaxial power jack with center + pin. Threaded locking type plug.
- Power switch: Front panel slide type.
- Battery type: 9 VDC alkaline.
- Battery life: At least 4 hours of full operation with alkaline. Up to 12 hours of operation for strobe type devices with radio sleep mode enabled.
- Connectors to PC/network: Standard phone handset WRM cable or custom cable RJ-22 to DB-9F for RS-232 connection to PC for radio configuration and external device connection.
- Mode selection: TTL/CMOS or standard RS-232 selected via slide (DIP) switches on board.

3.4.5. Environmental Characteristics

- Operating Temperature: -10°C to 50°C (14°F to 122°F)
- Relative Humidity: less than 95% RH (without condensation)

3.5. WRM2 iMUX - Multiplexer

3.5.1. Multiplexer Characteristics

- Eight wired and one optional Bluetooth wireless channel for custom applications
- Transmit power output 100 mW (900 MHz), 50 mW (2.4 GHz)
- Receiver sensitivity -107 dBm (900 MHz) and -102 dBm (2.4 GHz)
- Spread Spectrum Frequency Hopping, Wide Band FM Modulator
- Frequency Range: 910-917 MHz (900 MHz), 910.8 - 914.7 MHz (optional), 2.4000-2.4835 GHz (2.4 GHz)
- FCC approved, IC Certified, 2.4 GHz is CE and ETSI Certified.
- Front panel rugged LEMO connectors, and front panel LED indicators
- Optional output power to dosimeter
- Standard TTL/CMOS RS-232 Levels
- Wide range power supply (110 to 250 VAC input)
- Standard MUX connector modified to supply 5V DC to charging circuitry
- Front panel mounted LEDs to indicate power, low battery, charging, and RX/TX data traffic.
- Internal standard NiMH rechargeable batteries for up to 24 hours of continuous operation

2.4 GHz DM - not compatible with older 2.4 GHz radios

- Transmit power output is configurable, 10 mW, 16 mW, 25 mW, 16 mW, 40 mW, or 63 mW. Factory set at 10mW.
- CE marked
- RPSMA Antenna connector
- Radio sensitivity -100 dBm at 63 mW (2.4 GHz)
- GHz ISM Band
- Frequency Range: 2.400–2.500 GHz
- Range for the 2.4 GHz unit 300 ft (90 m) indoors-industrial environment, 5280 ft (1.6 km) outdoors RF line-of-sight with standard dipole antenna and utilizing the highest power setting.
- Over the air data stream at 256,000 Baud Per Second
- Addressable from 0 to 65,000
- Regulatory Approvals: FCC (USA), IC (Canada), ETSI (Europe), and C-TICK (Australia)

3.5.2. Physical Characteristics

- Enclosure: NEMA 4X Enclosure, IP65
- Dosimeter cable: Standard MUX cable in 4 ft and 6 ft length
- Ruggedness: 2 drops on concrete
- Attachments: Optional steel spring clip

3.5.3. Mechanical Characteristics

- Height: 4.53 in (115 mm)
- Width: 2.56 in (65 mm)
- Depth: 1.58 in (40 mm) without optional clip
- Weight (including batteries): 12 oz (340 g)

3.5.4. Electrical Characteristics

- External Power Supply: Wall power adaptor 110 to 250 VAC input, 5V DC 2.5A MUX Connector

- Power switch: Auto turn on when Dosimeter detected
- Battery type: Two AA 1.2V NiMH rechargeable battery, or Alkaline w/o recharging
- Battery life: At least 24 hours of full operation. 14 days of standby operation
- Mode selection: Automatic mode selection, no user intervention required.
- PC Connectivity: Built in wireless WRM2 radio. Optional wireless Bluetooth connectivity

3.5.5. Environmental Characteristics

- Operating Temperature: -10°C to 50°C (14°F to 122°F)
- Recommended Temperature: 0°C to 20°C (32°F to 68°F)
- Relative Humidity: less than 95% RH (without condensation)
- Environmental Resistance: Splash proof, air tight, dust tight (on the inside of the enclosure)

3.6. WRM2 Dive MESH Repeater (Passive and Active Dive Antennas)

3.6.1. Dive MESH Repeater Characteristics

- Transmit power output 100 mW (900 MHz) or 50 mW (2.4 GHz)
- Receiver sensitivity -110 dBm (900 MHz) and -105 dBm (2.4 GHz)
- 900 MHz or 2.4 GHz spread spectrum hopping (FHSS)
- Frequency Range: 910-917 MHz (900 MHz), 910.8 - 914.7 MHz (optional), 2.4000-2.4835 GHz (2.4 GHz)
- Radio module is FCC approved; IC Certified, 2.4 GHz is CE marked.
- Front panel controls and connectors
- RS-232 internal for programming radios
- Wide range power supply (110 to 250 VAC input) with interchangeable AC plugs
- Standard locking type DC connector, wide range input 9 maximum of 24 VDC, coaxial connector with center + pin.
- Top mounted LED array to indicate power input, power ON, charging, battery status
- Dual radio for streaming MESH Repeater and transmit applications for underwater diving operations
- Internal battery backup for up to 2 hours of operation (8 AAA NiMH batteries installed).

2.4 GHz DM - not compatible with older 2.4 GHz radios

- Transmit power output is configurable, 10 mW, 16 mW, 25 mW, 16 mW, 40 mW, or 63 mW. Factory set at 10mW.
- CE marked.
- RPSMA Antenna connector
- Radio sensitivity -100 dBm at 63 mW (2.4 GHz)
- GHz ISM Band
- Frequency Range: 2.400–2.500 GHz
- Range for the 2.4 GHz unit 300’ (90 m) indoors-industrial environment, 5280’ (1.6 km) outdoors RF line-of-sight with standard dipole antenna and utilizing the highest power setting.
- Over the air data stream at 256,000 Baud Per Second
- Addressable from 0 to 65,000
- Regulatory Approvals: FCC (USA), IC (Canada), ETSI (Europe), C-TICK (Australia)

3.6.2. Physical Characteristics

- Front panel controls: clearly labeled, protected from inadvertent operation
- Ruggedness: 2 drops on concrete from 1.0 m
- Attachments: rubber feet for desktop, wall mount or magnetic mount

3.6.3. Mechanical Characteristics

- Height: 1.5” (40 mm)
- Width: 5.5” (140 mm)
- Depth: 9.5” (235 mm) including antenna and switch knob.
- Weight (including batteries): 1 lb 14 oz (850 g)

3.6.4. Electrical Characteristics

- External Power Supply: Wall pack power adaptor 110 to 250 VAC input, 15 VDC 1 A coaxial power jack with center + pin. The base will operate with a 7 to 15 VDC power supply but it will not charge the batteries. Threaded locking type plug.
- Power switch: Front panel slide type.
- Battery type: 8 x 1.5 VDC AAA NiMH rechargeable types.
- Battery life: At least 2 hours of full operation (somewhat less for Active Dive Antenna model).
- Connectors to PC/network: Internal DB9 connector for programming radios
- Connection to Dive Antennas (RPSMA for Passive Antenna and DB9 for Active Dive Antenna)

3.6.5. Environmental Characteristics

- Operating Temperature: -10°C to 50°C (or 14°F to 122°F)
- Relative Humidity: less than 95% RH (without condensation)

3.7. WRM2 RAMSYS TRANSMITTER

3.7.1. RAMSYS Transmitter Characteristics

- Transmit power output 100 mW (900 MHz) or 50 mW (2.4 GHz)
- Receiver sensitivity -110 dBm (900 MHz) and -105 dBm (2.4 GHz)
- 900 MHz or 2.4 GHz spread spectrum hopping (FHSS)
- Frequency Range: 910-917 MHz (900 MHz), 910.8 - 914.7 MHz (optional), 2.4000-2.4835 GHz (2.4 GHz)
- Radio module is FCC approved, IC Certified, 2.4 GHz is CE marked.
- Short DB9 male-to-male RS-232 cable for connection to transmitter and device
- Standard DC connector, wide range input (9 to 15 VDC), coaxial connector with center + pin.
- Front mounted blue LED to indicate power, connection and data traffic.
- RAMSYS Channels A−D data transmitted

GHz DM - not compatible with older 2.4 GHz radios

- Transmit power output is configurable, 10 mW, 16 mW, 25 mW, 16 mW, 40 mW, or 63 mW. Factory set at 10 mW.

- CE marked.
- RPSMA Antenna connector
- Radio sensitivity -100 dBm at 63 mW (2.4 GHz)
- GHz ISM Band
- Frequency Range: 2.400–2.500 GHz
- Range for the 2.4 GHz unit 300 ft (90 m) indoors-industrial environment, 5280 ft (1.6 km) outdoors RF line-of-sight with standard dipole antenna and utilizing the highest power setting.
- Over the air data stream at 256,000 Baud Per Second
- Addressable from 0 to 65,000
- Regulatory Approvals: FCC (USA), IC (Canada), ETSI (Europe), and C-TICK (Australia)

3.7.2. Physical Characteristics

- Front panel controls: none
- LED: Front mounted blue LED to indicate power, connection and data traffic.
- Configuration and operational cable: RS-232 cable
- Ruggedness: 2 drops on concrete from 1.0 m with antenna attached.

3.7.3. Mechanical Characteristics

- Height: 5.8 in (143mm)
- Width: 1.4 in (36mm)
- Depth: 3.7 in (94mm)
- Weight (including batteries): 7.7 oz (220 g) with antenna
- Case material: Cast Aluminum

3.7.4. Electrical Characteristics

- External Power Supply: Wall pack power adaptor 110 to 250 VAC input, 15 VDC 1 A coaxial power jack with center + pin. 2.2mm plug
- Power switch: none
- Connectors to RAMSYS Devices: Male-to-Male DB-9 for RS-232 connection

3.7.5. Environmental Characteristics

- Operating Temperature: -10°C to 50°C (14°F to 122°F)
- Relative Humidity: less than 95% RH (without condensation)

3.8. WRM2 iMUX – Intelligent Multiplexer Area Monitor

3.8.1. Multiplexer Characteristics

- Eight wired channels
- Transmit power output 100 mW (900 MHz), 50 mW (2.4 GHz)
- Receiver sensitivity -107 dBm (900 MHz) and -102 dBm (2.4 GHz)
- Spread Spectrum Frequency Hopping, Wide Band FM Modulator
- Frequency Range: 910-917 MHz (900 MHz), 910.8 - 914.7 MHz (optional), 2.4000-2.4835 GHz (2.4 GHz)
- FCC approved, IC Certified, 2.4 GHz is CE and ETSI Certified.

- Front panel RJ-45 connectors
- Standard TTL/CMOS RS-232 Levels
- Wide range power supply (110 to 250 VAC input)
- Standard MUX connector modified to supply 8−30 V DC
- Front panel mounted LEDs to indicate power and RX/TX data traffic.

2.4 GHz DM - not compatible with older 2.4 GHz radios

- Eight wired channels
- Transmit power output is configurable, 10 mW, 16 mW, 25 mW, 16 mW, 40 mW, or 63 mW. Factory set at 10 mW.
- CE marked.
- RPSMA Antenna connector
- Radio sensitivity -100 dBm at 63 mW (2.4 GHz)
- GHz ISM Band
- Frequency Range: 2.400–2.500 GHz
- Range for the 2.4 GHz unit 300 in (90 m) indoors-industrial environment, 5280 in (1.6 km) outdoors RF line-of-sight with standard dipole antenna and utilizing the highest power setting.
- Over the air data stream at 256,000 Baud Per Second
- Addressable from 0 to 65,000
- Regulatory Approvals: FCC (USA), IC (Canada), ETSI (Europe), and C-TICK (Australia)

3.8.2. Physical Characteristics

- Enclosure: NEMA 4X Enclosure, IP65
- Dosimeter cable: Standard DMC interface back cable – 6 ft in length
- RJ-45 cable 10−200 feet
- Ruggedness: 2 drops on concrete
- Attachments: magnetic or permanent mounts

3.8.3. Mechanical Characteristics

- Height: 7.53 in (191 mm)
- Width: 5.56 in (141 mm)
- Depth: 4.58 in (116 mm) with magnets

3.8.4. Electrical Characteristics

- External Power Supply: Wall power adaptor 110 to 250 VAC input, 8−30 V DC
- Power switch: Auto turn on when Dosimeter detected
- Mode selection: Automatic mode selection, no user intervention required

3.8.5. Environmental Characteristics

- Operating Temperature: -10°C to 50°C (14°F to 122°F)
- Recommended Temperature: 0°C to 20°C (32°F to 68°F)
- Relative Humidity: less than 95% RH (without condensation)
- Environmental Resistance: Splash proof and dust tight (on the inside of the enclosure)

4. Recommended Spare Parts List

4.1. iPAM-Tx Transceiver

WR2-A015 (900 MHz)

Quantity	Description/Manufacturer/Part Number	Comments
1	WRM2 Radio Module 900 MHz/WR2-7013	MIRION VID number only. Wired antenna type
1	WRM2 Radio Module 2.4 GHz DM/WR2-7014	MIRION VID number only. Wired antenna type
1	Electronic Micro-controller board/WR2-4025	MIRION
1	Front and Back Case/WR2-1209	MIRION - Transparent blue
1	SS pan head Phillips screw/9177A267	McMaster-Carr
1	Pushbutton/162109	MIRION
1	Soft 0-Ring/24181T113	McMaster-Carr
1	Push button retaining ring/98541A112	McMaster-Carr
1	Vibrator with rubber boot/WR2-1200	MIRION
1	All Labels 900 MHz/WR2-3042	MIRION
1	Micro-Controller Cover/WR2-3043	MIRION
3	Zinc-PTD STL Phillips, 2-32 thrd, 3/16 L/90056A075	McMaster-Carr
1	Positive battery contact/WR2-1211	MIRION
1	Negative battery contact/WR2-1212	MIRION
1	Adapter for iPAM-Tx Battery Pack/WR2-A031	Optional
1	Holder, Battery D-Pack with Wire/WRM-4029	Optional

4.2. iPAM-Tx Transceiver

WR2-A020 (2.4 GHz DM)

Quantity	Description/Manufacturer/Part Number	Comments
1	WRM2 Radio Module 2.4 GHz DM/WR2-7014	MIRION VID number only. Commercial version will not work on the WRM2 system. Wired antenna type
1	Electronic Micro-controller board/WR2-4025	MIRION
1	Front and Back Case/WR2-1209	MIRION - Transparent blue
1	SS pan head Phillips screw/9177A267	McMaster-Carr
1	Pushbutton/162109	MIRION
1	Soft 0-Ring/24181T113	McMaster-Carr
1	Push button retaining ring/98541A112	McMaster-Carr
1	Vibrator with rubber boot/WR2-1200	MIRION
1	All Labels 2.4 GHz DM	MIRION
1	Micro-Controller Cover/WR2-3043	MIRION
3	Zinc-PTD STL Phillips, 2-32 thrd, 3/16 L/90056A075	McMaster-Carr
1	Positive battery contact/WR2-1211	MIRION
1	Negative battery contact/WR2-1212	MIRION
1	Adapter for iPAM-Tx Battery Pack/WR2-A031	Optional
1	Holder, Battery D-Pack with Wire/WRM-4029	Optional

4.3. WRM2 Base Transceiver

WR2-9001 (900 MHz), WR2-9101 (2.4 GHz), or WR2-9109 (2.4 GHz) DM

Quantity	Description/Manufacturer/Part Number	Comments
1	Radio Module 900 MHz – WR2-7001 2.4 GHz – WR2-7003	RPSMA connector
1	Antenna 900 MHz – WR2-4005 2.4 GHz – WR2-4006	2.1 dBA Dipole
1	Radio Module 2.4 GHz DM – WR2-7015	
1	2.4 GHz DM Adapter Cable – WR2-7016	RPSMA to U.FL
1	Network Adapter MOXA NE-4110S DAS-6016	Set to 192.168.1.21
8	Battery AAA 1.2 V NiMH, WR2-2001	
1	RS-232 cable, LDM-6000	6 ft (2 m) long For longer cable contact MIRION
1	Network Cable w/RJ-45 connectors	3 ft (1 m) long For longer cable contact MIRION
1	Power Supply WR2-A000 (USA plug), WR2-A001 European plug.	15 VDC, 1A, 100-250 VAC
1	High Gain Antenna, 6 dBA 900 MHz – WR2-4008 2.4 GHz – WR2-4009	N Type connector, requires N type to RPSMA adapter
1	Antenna adapter N type to RPSMA	

4.4. WRM2 MESH Repeater

WR2-9002 (900 MHz), WR2-9102 (2.4 GHz), or WR2-9110 (2.4 GHz) DM

Quantity	Description/Manufacturer/Part Number	Comments
1	Radio Module 900 MHz – WR2-2002 2.4 GHz – WR2-7003	RPSMA Connector
1	Antenna 900 MHz – WR2-4005 2.4 GHz – WR2-4006	2.1 dBA dipole
1	Power Supply WR2-A000 (USA plug), WR2-A001 European plug	15 VDC, 1A, 100−250 VAC
1	Radio Module 2.4 GHz DM – WR2-7015	
1	2.4 GHz DM Adapter Cable – WR2-7016	RPSMA to U.FL
1	Battery 9 VDC Alkaline CCC-2003	9 VDC alkaline
1	RS-232 DB-9 Female to Stereo jack configuration cable, WR2-6003	3 ft (1 m) long

4.5. WRM2 External Transmitter

WR2-9003 (900 MHz), WR2-9103 (2.4 GHz), or WR2-9111 (2.4 GHz DM)

Quantity	Description/Manufacturer/Part Number	Comments
1	Radio Module 900 MHz – WR2-2002 2.4 GHz – WR2-7003	RPSMA Connector
1	Antenna 900 MHz – WR2-4005 2.4 GHz – WR2-4006	2.1 dBA dipole
1	Radio Module 2.4 GHz DM – WR2-7015	
1	2.4 GHz DM Adapter Cable – WR2-7016	RPSMA to U.FL
1	Power Supply WR2-A000 (USA plug), WR2-A001 European plug	15 VDC, 1A, 100-250 VAC
1	Battery 9 VDC Alkaline CCC-2003	9 VDC alkaline
1	RS-232 Male DB-9 to RJ-22 PC Interface Cable, WR2-6002	3 ft (1 m) long
1	RS-232 Female DB-9 to RJ-22 AMS-4, WR2-6024	3 ft (1 m) long
1	RS-232 Female DB-9 to RJ-, AMP Devices LDM-6039	3 ft (1 m) long

4.6. WRM2 iMUX

WR2-A003 (900 MHz), WR2-A026 (2.4 GHz)

Quantity	Description/Manufacturer/Part Number	Comments
1	Radio Module 900 MHz – WR2-1003 2.4 GHz – WR2-1004 2.4 GHz DM – WR2-9113	Wired Antenna
1	Antenna 900 MHz – WR2-4005 2.4 GHz – WR2-4006	Wired Antenna
1	Power Supply WR2-A000 (USA plug), WR2-A007 European plug.	15 VDC, 1A, 100-250 VAC
1	Battery AA VDC Alkaline CCC-1000	1.5 VDC alkaline
1	RESET Key, WR2-3023	LEMO Connector – Special
1	DMC Interface Back /D20-1003	MIRION

4.7. WRM2 Dive Repeater – Underwater Dive Antenna
WRM2 Active Dive Repeater – Active Dive Antenna

WR2-9207 (900 MHz), WR2-9036 (2.4 GHz)

Quantity	Description/Manufacturer/Part Number	Comments
1	Passive Repeater 900 MHz – WR2-7001	RPSMA Connector
1	Passive Antenna 900 MHz – WR2-4005 2.4 GHz – WR2-4006	2.1 dBA dipole
1	Power Supply WR2-A000	15 VDC, 1.5A, 100-250 VAC
1	Active Dive Antenna 900 MHz – WR2-9314 2.4GHz – WR2-9315	
1	Active Dive Repeater 900 MHz – WR2-9316 2.4GHz DM – WR2-9306	

4.8. WRM2 iMUX Area Monitor

WR2-9303 (900 MHz), WR2-9313 (2.4 GHz)

Quantity	Description/Manufacturer/Part Number	Comments
1	Radio Module 900 MHz – WR2-1003 2.4 GHz – WR2-1004	RPSMA Connector
1	Antenna 900 MHz – WR2-4005 2.4 GHz – WR2-4006	0 dBA dipole
1	Power Supply: WR2-A000 (USA plug) WR2-A007 European plug.	15 VDC, 1A, 100-250 VAC
1	DMC Interface Back /D20-1003	MIRION

APPENDIX 1

Dosimeter Data Protocol

This document describes the data exchange protocol used between a DMC series dosimeter in 4800 BAUD and a PAM-TRX sent to a Base or MESH Repeater.

Dosimeter Settings

The correct dosimeter settings for the dosimeter are as follows:

Status word 5 (accessible from Message 11)

Bit 0 ⟶	set to 1	tele-transmission allowed
Bit 2	set to 1	transmit on request mode
Bit 3	Set to 1	transmit in 4800 BAUD (DMC-2000 only)

This means that the dosimeter transmits data immediately following a strobe signal and the data is transmitted using the dosimeter internal clock in ASCII format, 8 bits with bit 8 set to 0, and 1 stop bit.

Figure A1 below depicts a timing diagram of the data stream.

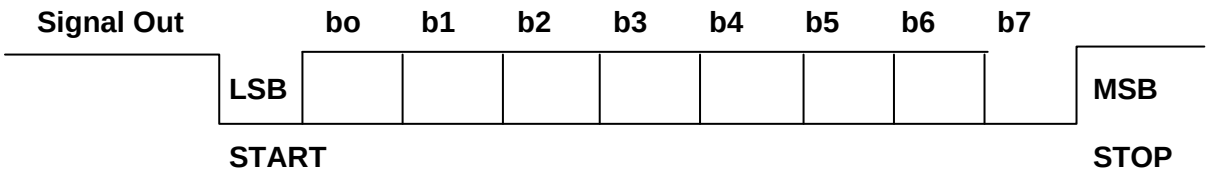


Figure A1-1: Data Stream Timing Diagram

The ASCII format of the data is as shown in Table 1 below. The dosimeter data consists of 13 characters, each consisting of two bytes representing an ASCII character or a set of 4 status bits. The data starts with a Line Feed (LF) and ends with a checksum CKS. A Carriage Return (CR) is transmitted after the checksum.

The data sent is the following:

- Dosimeter serial number
- Cumulated Dose
- Current value of the Dose Rate
- Dosimeter Status

The check sum is calculated such that the modulo 256 sum of all 26 bytes is equal to 0.

Table A1-1: Data Format

1	LF	Line Feed
2	N5	Dosimeter Serial Number N5N4N3N2N1N0
3	N4	
4	N3	
5	N2	
6	N1	
7	N0	
8	Status 1 MSB	Dosimeter's dose and dose rate alarms and status.
9	Status 1 LSB	
10	D5	Accumulated Dose D5D4D3D2D1D0.D-1 mrem
11	D4	
12	D3	
13	D2	
14	D1	
15	D0	
16	D-1	
17	0	iPAM-TX battery voltage
18	STATUS 5 (MSB)	Configuration Parameters
19	STATUS 5 (LSB)	
20	X_1	Gamma Dose rate X,YZ * 10^T mrem/h
21	Y_1	
22	Z_1	
23	T_1	
24	Status 3 MSB	Dosimeter dose and dose rate warning alarms and status
25	Status 3 LSB	
26	READER # (MSB)	Last reader seen in marker mode
27	READER # (LSB)	
28	LIM 0	Limit for Zone 0
29	LIM 1	Limit for zone 1
30	STATUS 10 (MSB)	Dosimeter configuration for secondary measurement
31	STATUS 10 (LSB)	
32	COUNTS (MSB)	
33	COUNTS (LSB)	
34	D5	Accumulated beta dose if enabled. D5D4D3D2D1D0.D-1 mrem
35	D4	
36	D3	
37	D2	
38	D1	
39	D0	
40	D-1	
41	0	Not used
42	X_2	Beta Dose rate X,YZ * 10^T mrem/h
43	Y_2	
44	Z_2	
45	T_2	
46	CKS MSB	Checksum
47	CKS LSB	
48	CR	Carriage Return

APPENDIX 2

Alternate Network Adapter Configuration: Network Enabler Software Operation

1. Install the Moxa Network Enabler Administrator.
2. Power up the WRM2 base transceiver.
3. Connect the network cable to the RJ 45 connector on the WRM2 and to a network hub.
4. Launch the Network Enabler Administrator software.
5. Click on “Configuration,” then “Broadcast Search” to find the factory default IP address.
6. The network adaptor with MAC address appears, as depicted in **Figure A2-1** below:

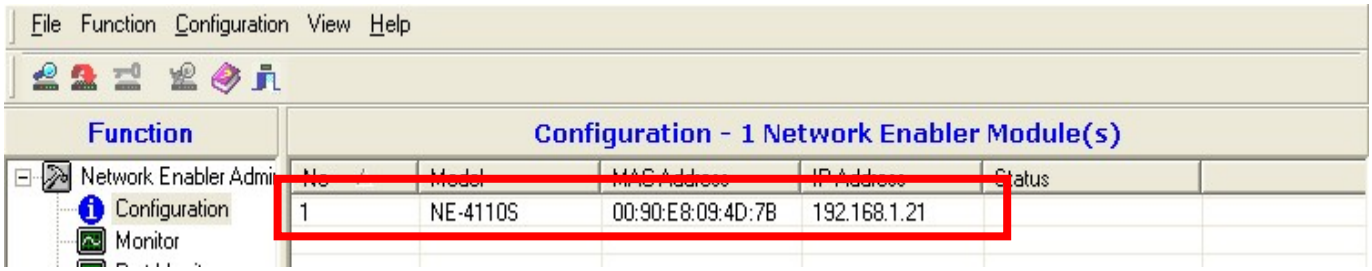


Figure A2-1: Network Enabler Software Configuration

7. Double Click on the device for programming and the following window is displayed (Figure A2-2 below):

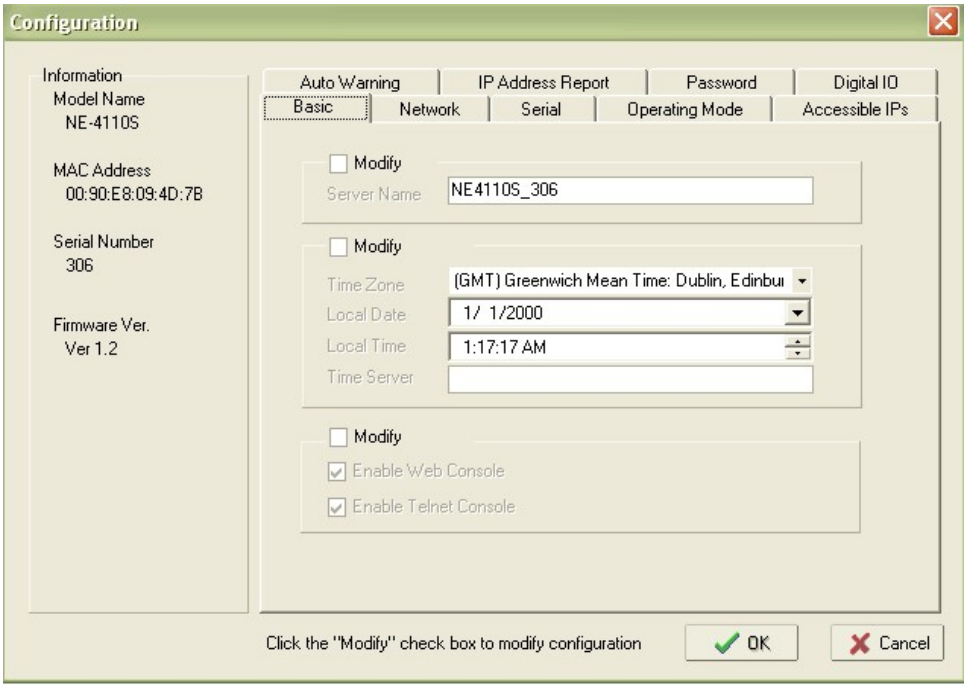


Figure A2-2: Network Enabler Software Programming

8. Click on the network tab and check the “Modify” box to edit parameter settings that meet your network settings (Figure A2-3 below):

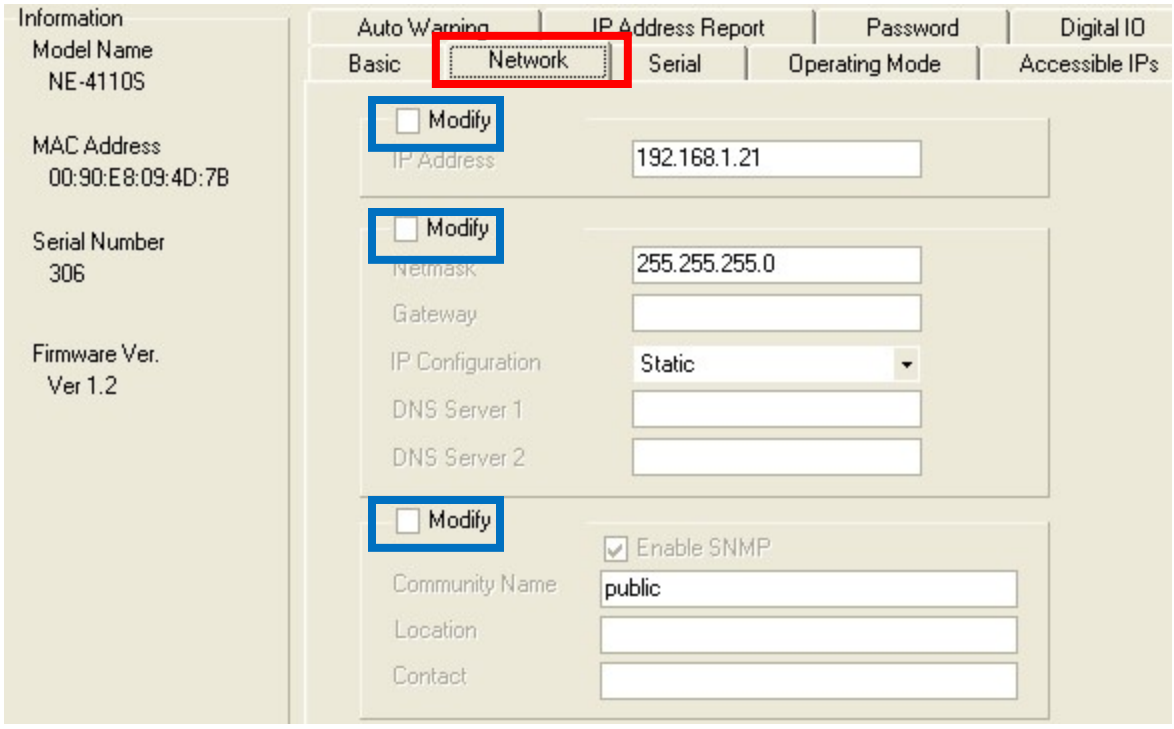


Figure A2-3: Network Parameters

9. Once the network TCP/IP is set, configure the serial port. Select the serial screen and highlight the port.

10. Click on the Modify box and go to the Settings as shown in Figure A2-3

11. In the Serial Settings tab set the port as shown in Figure A2-4. These are the default settings of the radio.

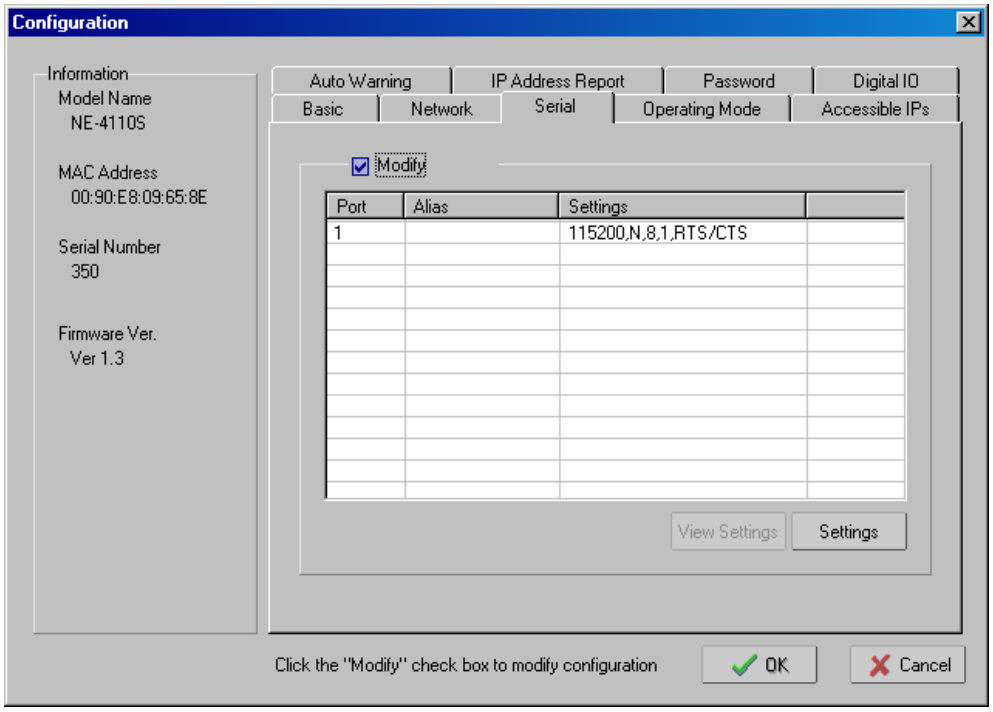


Figure A2-4 Serial Configuration

12. Serial Port Configuration

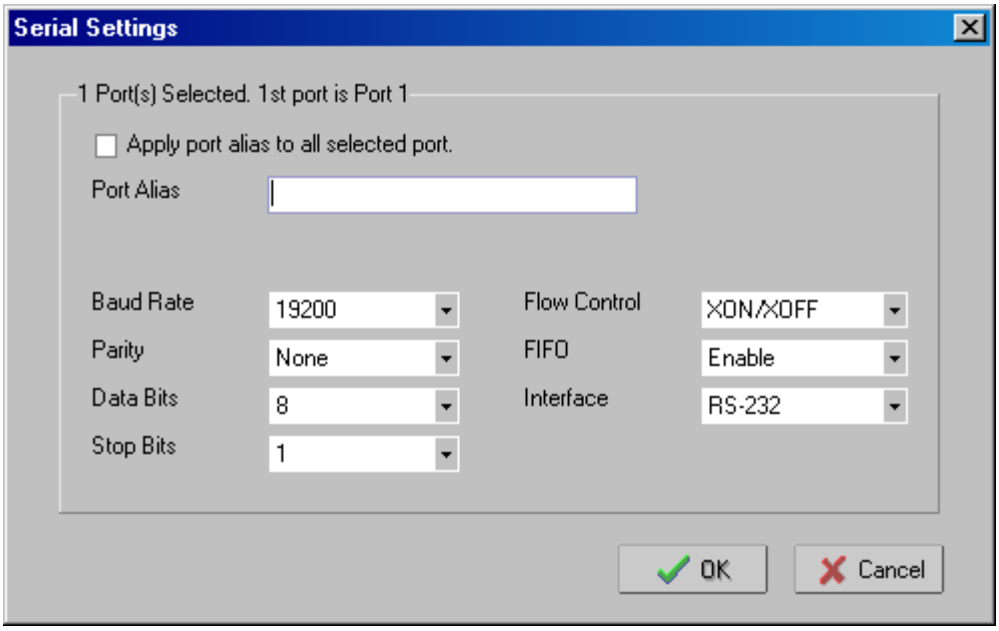


Figure A2-5: Serial Port Settings

13. Once the network adapter is configured with the correct IP address (in accordance with facility Information Technology organizations), the network configurations can be accessed using Internet browser running JAVA. To access the web configuration, type in the IP

address of the device in the address bar and click GO to view the data (Figure A2-6, below).

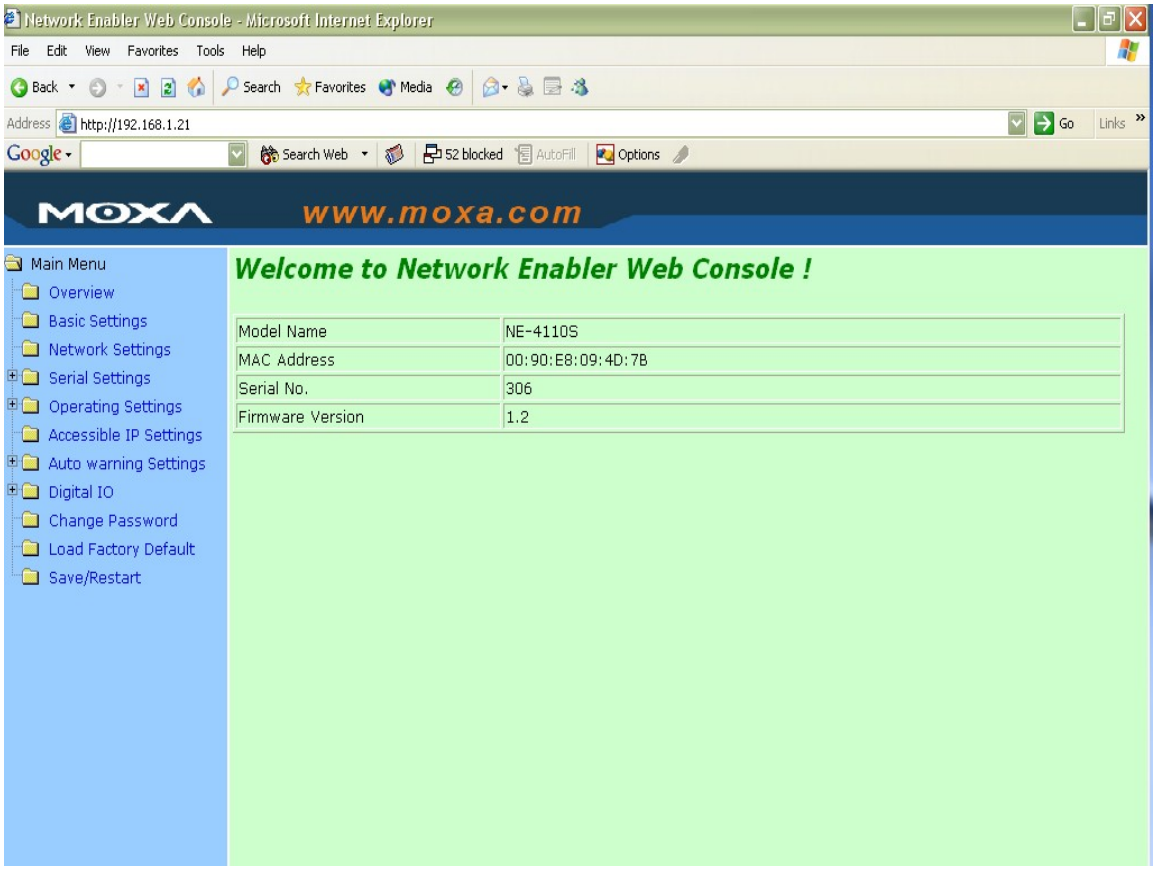


Figure A2-6: Web Console for Network Enabler Software

14. From this screen go to Operating Settings, Port 1 and set the Max Connection to 4 as shown in Figure A2-7 and select the Local TCP Port to be used in WinWRM2 or Telecast configuration. The default value is 4001.

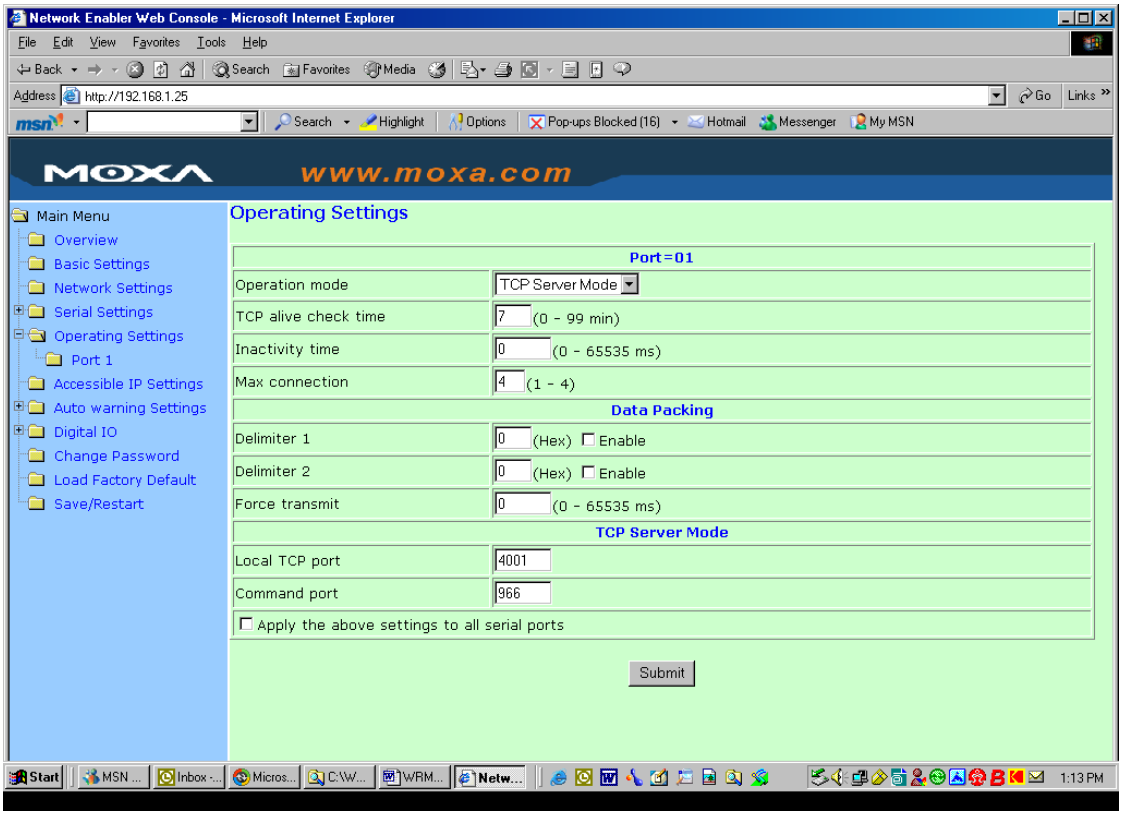


Figure A2-7: Operating Settings (Web Console)

APPENDIX 3

WRM2 TelePole WR and RAM ION Chamber

- The TelePole WR and RAM ION have WRM2 radio kits that are powered by the instrument's power supply and turn ON the WRM2 radios when the instrument is turned ON.
- To change the internal radio transmission interval level for these instruments the Meter View configuration software (downloadable at www.synodys.com) and cable RTM-600 are needed for this setting.
- The baud rate for the TelePole and RAM ION is defaulted to 19,200 BPS for the instruments and 19,200 for the WRM2 radios.
- The interval levels are defaulted to four (4) seconds for the radio transmission.

WRM2

Operating Manual

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