SENTINEL-SENSE MPR-2010

MPR-2010AN Ver. 1.21N

DRAFT

Installation & Operation Manual - 007-04-A

Note: This manual is for Ethernet version only!
For RS-232 version, please refer to Manual-007-03-A

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FCC COMPLIANCE

This equipment has been tested and found to be in compliance with the limits for FCC Part 15, Class A digital device. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with instruction manual, may cause harmful interference with radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.
The users are prohibited from making any change or modification to this product, any modification to this product shall void the user's authority to operate under FCC Part 15 Subpart A Section 15.21 regulations.

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

INDUSTRY CANADA COMPLIANCE

Operation is subject to the following two conditions: (1) this device may not cause interference and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

CAUTION:
Reader should be positioned so that personnel in the area for prolonged periods may safely remain at least 23 cm (9 in) in an uncontrolled environment from the reader's surface. Observe FCC OET Bulletin 56 "Hazards of radio frequency and electromagnetic fields" and Bulletin 65 "Human exposure to radio frequency electromagnetic fields."

Table of Content

NOTE: READ AND USE THIS MANUAL.

FAILURE TO DO SO MAY RESULT IN POOR READER PERFORMANCE OR EVEN PERMANENT DAMAGE TO READER, WHICH COULD VOID THE READER WARRANTY.

FAILURE TO FOLLOW THE INSTALLATION (SET UP) GUIDE MAY RESULT IN POOR PERFORMANCE OR EVEN CAUSE PERMANENT DAMAGE TO THE READER, THUS VOIDS THE PRODUCT WARRANTY.

1. INTRODUCTION

AWID's Sentinel-Sense MPR-2010AN Ver. 1.21N is a long-range (12 to 15 feet) reader with TCP/IP interface and general purpose digital I/O (GP I/O - four (4) input four (4) outputs) that works with most leading passive UHF passive tags. This reader comes with a unique combination of long read range, small size, and low power consumption. MPR-2010 has an internal power converter, allowing it to work with a wide range of supply inputs without affecting its performance. Its primary applications are asset management and tracking, and fleet management applications.

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The MPR-2010 reader is delivered with the following components and accessories:

- MPR reader – MPR-2010AN or MPR-2010BN, Firmware Ver. 1.21N

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- Optional where PoE switch or router is not available:
  - Power supply – PS48-03A-SW, 50-60 Hz and 110 to 220 VAC.
  - Power Injector – PI-2000
  - RJ-45 Cable

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In order to control the MPR reader you will need the following:

- PC running Windows 98 or higher, CD-ROM drive Network connection
- Host software (AWID's demo software or your own custom software).
- RFID Tags (EPC Class 0, 1, ISO Type B or EM Micro)

1.1. GENERAL DESCRIPTION & THEORY OF OPERATION

This Radio Frequency Identification (RFID) reader uses radio frequency to identify, locate and track pallets and/or items that carry the appropriate RFID transponders. MPR-2010 readers work in non-line-of-sight situations and in darkness, bright sun-light, or through dirt, grime and smudges.

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A typical RFID system consists of three components – a reader (interrogator), a transponder (card or tag), and a data processing controller. MPR-2010 has an internal micro-controller section, a transmitter section, a receiver section, and a circular polarized transmit/receive antenna. Passive transponders (tags or labels) consist of an antenna and an RFID ASIC (Application Specific Integrated Circuits). During operation, the transmitter sends out an electromagnetic wave to establish a zone of surveillance. When a transponder enters this zone, the electromagnetic energy from the reader begins to energize the IC in the transponder. Once the IC is energized, it goes through an initialization process and is ready to accept further commands. Upon receiving a command that queries its identity, the RFID ASIC begins to broadcast its identity through a low-energy back-scattering process, which selectively reflects or "back-scatters" the electromagnetic energy back to the interrogator. The receiving circuits in the reader sense and decode this "back-scattered" signal and determine the identity of the transponder.

Passive tags are “beam powered”, which is the electromagnetic energy radiated by the transmitter section of the reader. Upon receiving a legitimated command, the tags will cause the matching of the tags antenna to vary from match to mismatch, thereby causing the tags to either absorb the RF energy or to reflect the RF energy. This absorption or reflection sequence is commanded by the tag’s internal memory and this is how the tag’s internal data are “conveyed” to the reader. The reader in turn monitors the perturbation of the RF energy field, and thereby receives the varying degree of signal reflected from the tag.

One of the unique design features for an RFID reader is that it must simultaneously transmit a strong CW signal, while at the same time, receives a weak reflected signal with little frequency separation. In a traditional design, such functions are implemented through the use of a circulator. As shown in Figure 1, there is a 3-port device between the Coupler and the band pass filter, which is called a circulator. A circulator is physically constructed by a permanent magnet, a Y junction on a high-dielectric ferromagnetic substrate, and a ferromagnetic enclosure to complete the flux field. A circulator permits flow of RF energy in one direction only, e.g. from port 1 to 2, 2 to 3, and 3 to 1. When one of the ports is terminated (matched condition), the other two are isolated in the reverse direction. Many fixed-site RFID readers use circulators to ensure that the power amplifier output flows from the amplifier (port 1) to the antenna (port 2), and the received signal flows from the antenna (port 2) to the receiver (port 3). When properly matched, a circulator can provide typically 15 to 18 dB of isolation between the power amplifier output (port 1) and the receiver input (port 3), thereby reducing any in-band interference from transmitter output to receiver input. MPR-2010 uses a similar circuit to accomplish the same function, but in a much smaller physical size.

It should be noted that some fixed-site reader designs use separate transmit and receive antennas to resolve this T/R signal isolation problem. Figure 2 is a block diagram of a dual-antenna RFID reader. On the surface, this design has the advantage of allowing a low-level design on the receive chain, which means lower compression point for mixers, lower saturation point for amplifiers, and the possibility of using a front-end amplifier to enhance receiver sensitivity. Such dual-antenna design becomes problematic in a mobile environment, where signal strength is not easily controlled. A well-designed dual-antenna reader can usually provide 25 to 30 dB of isolation between the two signal paths, reducing the unwanted signal in the receive chain to –20 dBm. However, when the RFID reader antenna is facing a tag placed on a large metallic object at a distance of 12 inches, the reflected transmitter signal at the receiver input can be as high as 13dBm, thereby eliminating any advantage of the dual-antenna design.

In actual circuit implementation, AWID developed a proprietary circuit to duplicate the functions of the circulator, with improved directivity and isolation.

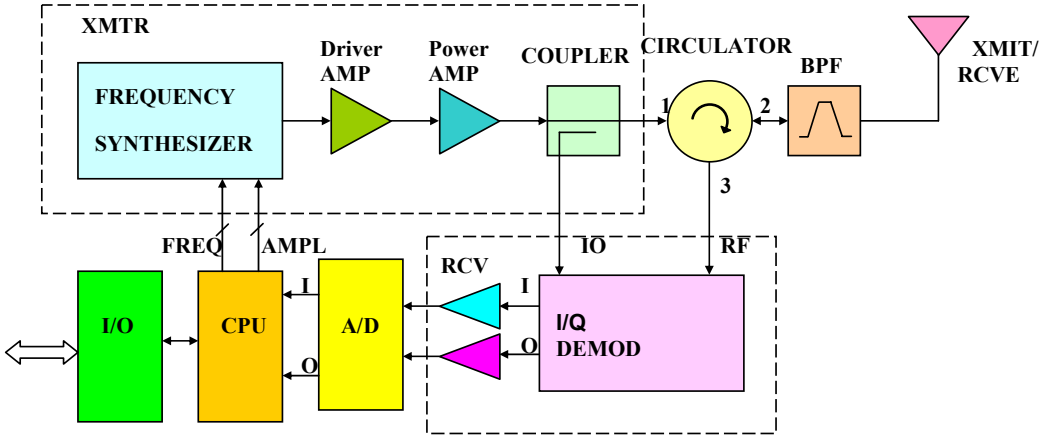

Figure 1 Block Diagram, Single-Antenna RFID Reader

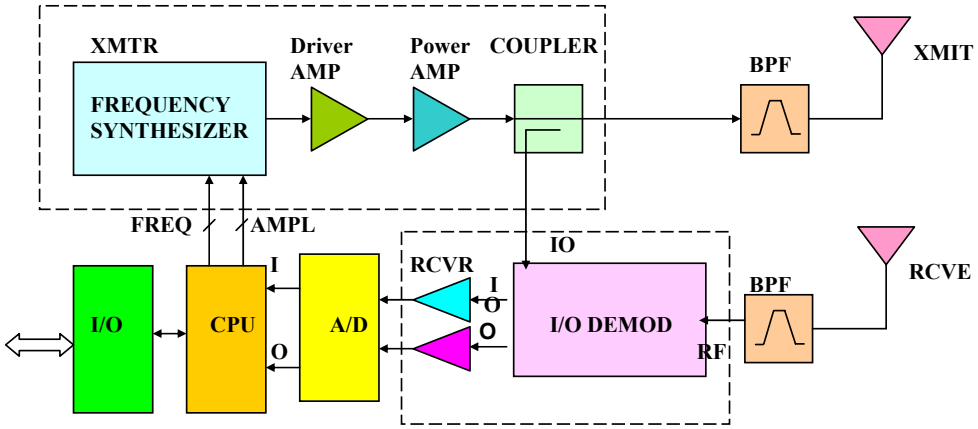

Figure 2 Block Diagram, Dual-Antenna RFID Reader

1.2. SPECIAL FEATURES

- Multi-Protocol:
  - Standard Version: ISO-18000-6 Type A/B, Dura-label, MH-10, AIAG
  - Version AN: EPC Class 1, EM Micro, ISO-18000-6 Type A/B, MH-10, AIAG
  - Version BN: EPC Class 1 & 0, EM Micro, ISO-18000-6 Type A/B, MH-10, AIAG

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- Thin passive tags with long-range performance
- High performance circular polarized antenna
- RS-232 outputs, with two optional peripheral drivers, one TTL input
- Splash proof design for indoor or outdoor applications
- UV stabilized housing

1.3. MODEL NUMBER ASSIGNMENT

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Part number description: A typical number is MPR-2010AN Ver. 2.21N

MPR – MPR – Multiple-protocol RFID
12#XZW– PC Card (PCMCIA) RFID readers
15#XZW– Handheld family of RFID readers
20#XZW– Integral reader/antenna design.
X – Antenna configuration: 0 – Internal antenna, 1 – external antenna
Z – Hardware version: A, B
W – Hardware version: R - RS-232, N - Ethernet, and I - IEEE RS-485.
Ver. X.XX signifies the firmware version in the reader

Examples:
MPR-2010AR (RS-232) – EPC C1, ISO & EM
915 MHz Integral RFID reader with RS-232 I/O interface, that complies with EPC Class 1, ISO-18000-6 Type B, EM Micro protocols.

MPR-2010AN (Ethernet) – EPC C1, ISO & EM
915 MHz Integral RFID reader with Ethernet I/O & PoE interface, that complies with EPC Class 1, ISO-18000-6 Type B, EM Micro[1].

MPR-2010BR (RS-232) – EPC C1, C0, ISO & EM
915 MHz Integral RFID reader with RS-232 I/O interface, that complies with EPC Class 0, Class 1, ISO-18000-6 Type B, EM Micro protocols.

MPR-2010BN (Ethernet) – EPC C1, C0, ISO & EM
915 MHz Integral RFID reader with Ethernet I/O & PoE interface, that complies with EPC Class 0, Class1, ISO-18000-6 Type B, EM Micro.

MPR-2080AR (RS-232)
866 MHz Integral RFID reader with RS-232 I/O interface, that complies with EPC Class 1, ISO-18000-6 Type B, EM Micro protocols.

MPR-2080AN (Ethernet)
866 MHz Integral RFID reader with Ethernet I/O & PoE interface, that complies with EPC Class 1, ISO-18000-6 Type B, EM Micro.

[1] Support of EPC C0 is also true for MPR-2010AN/AR except performance is not as good as with MPR-2010BN/BR due to HW difference.

MPR-1230
PC Card reader with internal antenna, 13.56 MHz RFID reader with EPC, ISO-15693, Tag-It, I-Code, Checkpoint, software version X.XX .

2. SPECIFICATIONS

Input voltage .....RS-232 Version: +6.5 VDC to +15 VDC
.....Ethernet Version: +37 VDC to +56 VDC
Input current.....RS-232: 1.0 A (6.5 V) to 0.40 A (15 V), typical
.....Ethernet Version: 300 mA, Max
Protocol language
- 2010: ISO-18000-6 Type A/B, Dura-label, MH-10, AIA
- 2010A: ..... EPC Class 1, EM Micro, ISO-18000-6 Type A/B, MH-10, AIAG
- 2010B: ..... EPC Class 1 & 0, EM Micro, ISO-18000-6 Type A/B, MH-10, AIAG

Read range .....Depends on type & size of labels used
Output power .....1.0 Watt into 6 dB antenna
Transmit frequency .....902-928 MHz
Receiver frequency.....902-928 MHz (Amplitude Modulated)
Hopping channels .....50 Channels
Channel spacing .....500 kHz
Hopping sequence.....Pseudo random
Operating temperature range .....-30° C to +65° C (-22° F to 149° F)
Color .....Beige
Output data formats .....RS-232 Version:
.....Ethernet Version: TCP/IP
GP I/O Input.....RS-232 Version: 1-input, 2-output
.....Ethernet Version: 2-input, 2-output
GP I/O Connector .....RS-232 Version: DB-9 connector
.....Ethernet Version: RJ-45 & terminal block
Dimension .....8X9.5X1.125 inches (20X24X2.86 cm)
Weight.....1,100 g (2.4 lb)

2.1. INPUT AND OUTPUT INTERFACES & CONNECTOR PIN ASSIGNMENT

MPR-2010AN and MPR-2010BN are equipped Power over Ethernet (PoE) circuit that complies with Carrier Sense Multiple Access with Collision Detection (CSMA/CD) access method and physical layer specifications standards (IEEE 802.af). MPR-2010AN and BN can work with the following different PoE configurations, power through spare pairs or power through data lines with automatic polarity sensing.

2.1.1. Power through spare wires

Ethernet connector (RJ45) Power through Spare Pairs

Pin #	Function description		
1	TX+	5	-48V RTN
2	TX-	6	RX-
3	RX+	7	-48V
4	-48V RTN	8	-48V

2.1.2. Power through data wires.

Ethernet connector (RJ45) Power through Data Pairs

Pin #	Function description		
1	TX+	5	Spare+
2	TX-	6	RX-
3	RX+	7	Spare-
4	Spare+	8	Spare-

2.1.3. General Purpose Input/Output

Terminal block – 4 inputs & 4 outputs (optically isolated)

Pin #	Function description (Pin 10 near LED)		
1	Input 1	6	Output Common
2	Input 2	7	Output 4
3	Input 3	8	Output 3
4	Input 4	9	Output 2
5	Input Common	10	Output 1

The four general-purpose inputs that use photo diodes are used to accept TTL input commands. Each input require 15 mA and 5V to activate. The four outputs are solid-state relays, with 0.03 uA off-state leakage current and the ability to sink 120 mA at a breakdown voltage of 400V DC. All outputs are protected with reverse clamping diodes, and ready to drive inductive loads. The floating arrangement eliminates any ground loop considerations.

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Deleted: 1 RTN
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Deleted: Input 2 RTN
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2.2. MEASURING READ DISTANCE

Make sure you know the tag types. For certain readers and tags, the user must also be mindful of the tag's orientation and the reader's antenna orientation, what mounting surface the tags are designed for and how the tags are supposed to be mounted. Any departure from its intended purpose will drastically affect the reader's ability to energize the tag and its read range.

When measuring the reader's read range, make sure that the tag is properly oriented to the reader antenna, and for optimum performance, be sure the operator's finger is not within three (3) inches of the tag's antenna surface.

3. INSTALLATION PROCEDURE

This section provides installation and operation information for MPR readers.

Verify that all items listed below are present before starting the installation.

3.1. PARTS LIST

a. Set Up Guide (Reference I, packed inside Reader carton) Qty=1

b. Sentinel-Sense MPR-2010, P/N: 007-20-A Qty=1

c. Demo Program CD Qty=1

d. LRMB – Reader mounting bracket (Optional)

3.2. PREPARATION FOR INSTALLATION

3.2.1. Bench Top Verification

It is always a good idea to verify system operation before committing to a full-scale installation (e.g., as shown in Figure 4, page 18). The following are the necessary steps to test reader's operation in a static environment.

- You must first check to see if your network switch or router is equipped with PoE (Power over Ethernet).
  - If switch is PoE, connect network cable to just one (1) MPR-2010AN/BN unit. Skip the next two steps unless the IP address of connected unit cannot be obtained.
- If your network is not equipped with PoE, obtain a power injector (PI-2000), and 48V DC wall plug power supply and a short network RJ-45 cable (all available from AWID under part number PI-2000, PS48-03A and RJ-45 cable).
- Connect the RJ-45 cable between the reader and "READER" port of PI-2000, connect the wall plug power supply to POWER port of PI-2000 and connect the Ethernet (RJ-45) cable from the Ethernet Hub (if in use) to "HUB or SWITCH" port of PI-2000 or in the case where there is no such hub, connect from PC to the port using a Crossover CAT5 cable.
  - Power up computer
  - Follow instructions on Local Set Up (Figure 6 or Figure 7) of an MPR-2010AN.
- Load the demo program CD onto (installation) PC and launch the demo program. Try Connect after filling in the IP address of reader and then some commands once connected.

3.2.2. Aiming of Antenna

Antenna Pattern for MPR-2010

MPR-2010 comes with a circular polarized antenna, to ensure reading tag with random orientation. Most circular polarized antenna has a horizontal to vertical differential of up to 3 dB, this will cause the antenna pattern to deviate from a true circle. AWID's antenna

has a horizontal to vertical differential of typically less than 0.5 dB, making its antenna pattern as near to a circle as possible.

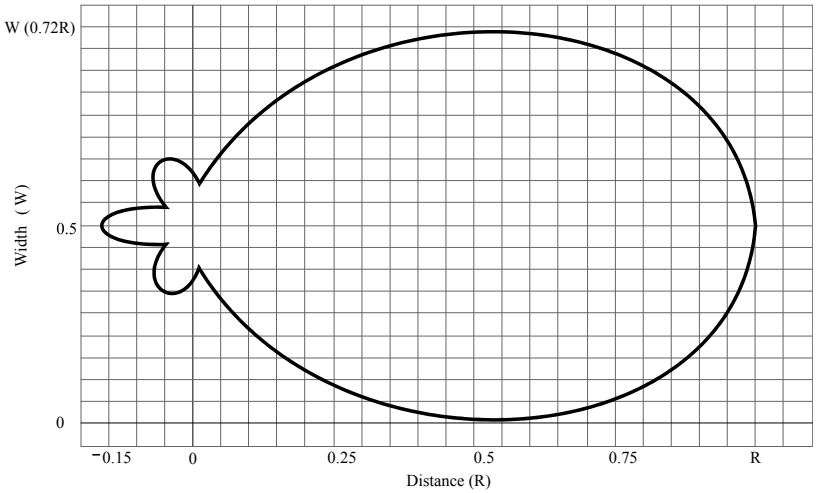

Figure 3 MPR-2010 Antenna Pattern

- Antenna pattern measurements represent both horizontal and vertical polarized planes of the read area transmitted by the reader.
- In the drawing above, R = approximately 12 feet to 15 feet for MPR-2010 with Alien free space tags.
- Antenna pattern can be affected by RFI[2] and other environmental conditions.

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3.2.3. Mounting Considerations

Antenna Mounting Bracket

Also available from AWID is an optional antenna-mounting bracket (part # LRMB) that provides antenna tilt adjustment and pan adjustment. Photo at right shows how the reader is mounted onto the LRMB. (Ignore the wire that does not apply to MPR-2010AN/BN. This was photographed from an MPR-2010AR.)

[2] Radio Frequency Interference

3.3. INSTALLATION STEPS

- Check to ensure that all connections are secure. Make sure all wires through the cable clamps are anchored properly; avoid dangling wires that may become safety hazard.
- Mount the Reader using the two recessed threaded holes to fasten to reader on the desired mounting surface. Please note that the threaded inserts are closed ended, user must select screws with exact length to ensure proper tightening of the mounting screws. In cases where the reader aiming is critical, please order antenna-mounting bracket (P/N LRMB) from AWID. This mounting bracket provides pan/tilt adjustment for the reader. User can also drill holes through the plate as required at the desired distance from the Reader.

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4. Notes on Software Programming and System Operation

4.1. SET UP AND SYSTEM OPERATION

4.1.1. Setting Up MPR-2010AN or BN

Refer to the *Set Up Procedure for MPR-2010AN/BN* document.

4.1.2. Running a Custom Software Application or the AWID Demo Program

If AWID Demo Program is not used, it is expected user will launch a Custom Software Application developed using the MPR_2010AN/BN TCP/IP Interface to send commands as specified to the reader.

4.1.3. Operating Modes

Typical operating modes for MPR-2010 can be grouped into the following modes:

Search Mode – This mode is used when operator or user is not certain which family of tags is placed on the items to be tracked. Since most tags are deterministic in nature, the reader must cycle through each and every protocol, issue a protocol specific inquiry, to hail and to wait for a response from tags of that specific protocol. Therefore, if there are many different protocols, for an untrained observer, the reader response will become sluggish.

Mixed Mode:
This mode assumes the user is aware of the types of protocol in use, and furthermore, the user made a determined effort to operate the reader in a mixed protocol mode. In this mode, the user can decide how many and which specific protocols to be selected. Once Mix Protocol Mode is selected, the reader will routinely cycle through each protocol, dwell long enough for the reader to wait for a response and then move onto the next protocol. It should be noted that in a mixed protocol mode, the tag must have sufficient time to respond to the reader, and therefore, it can only be used on a conveyor belt arrangement, with specific speed restrictions.

Single Protocol Mode
Single protocol is the normal mode of operation, where the protocol type is known and many tags are expected to pass through the readers.

Interactive Read Mode
TBD

Autonomous Read Mode[3]
When the reader is in autonomous mode, the reader is placed under the control of its two sensing inputs, which will most likely be in the form of photo sensors, ground loop sensors, weight triggering mechanism or simple remote command. Upon receiving the sensing input, the reader will switch to a pre-programmed single-protocol, multi-protocol and in the case of a conveyor installation, fast-read mode and start reading functions. Upon intercept of a RFID tag, the reader will automatically output the tag ID and after a

[3] Not yet available in 1.21N.

pre-programmed period of in-activity, the reader will switch to stand-by and wait for input from the sensing commands.

4.2. USERS NOTE

For System Integrators and/or Software Developers
System Integrators and/or Software developers should get familiar with the MPR-2010 TCPIP Interface (Reference II) specifications for developing applications that control MPR-2010AN or BN readers.

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For Custom System Users
For custom system user, please refer to your host software user guide for information regarding system and software operations

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For Demo Software Users
If you are using the AWID RFID demonstration software application which is .NET based with easy-to-follow GUI operations, simply fill in the IP address of MPR-2010AN/BN installed then click “Connect” should get you started.

5. Reference

I. Set Up Procedure for MPR-2010AN/BN – 007-04-B
II. MPR-2010 TCP/IP Interface – 007-04-D

6. Appendix

Shown in this Appendix section are diagrams for some possible Set Up scenarios of MPR-2010AN/BN.

6.1. NETWORK SET UP DIAGRAM

Multiple MPR-2010AN/BN units can be networked using either Power Injector units from AWID (PI-2000) or a Power-Over-Ethernet (PoE) Switch/Router as depicted below.

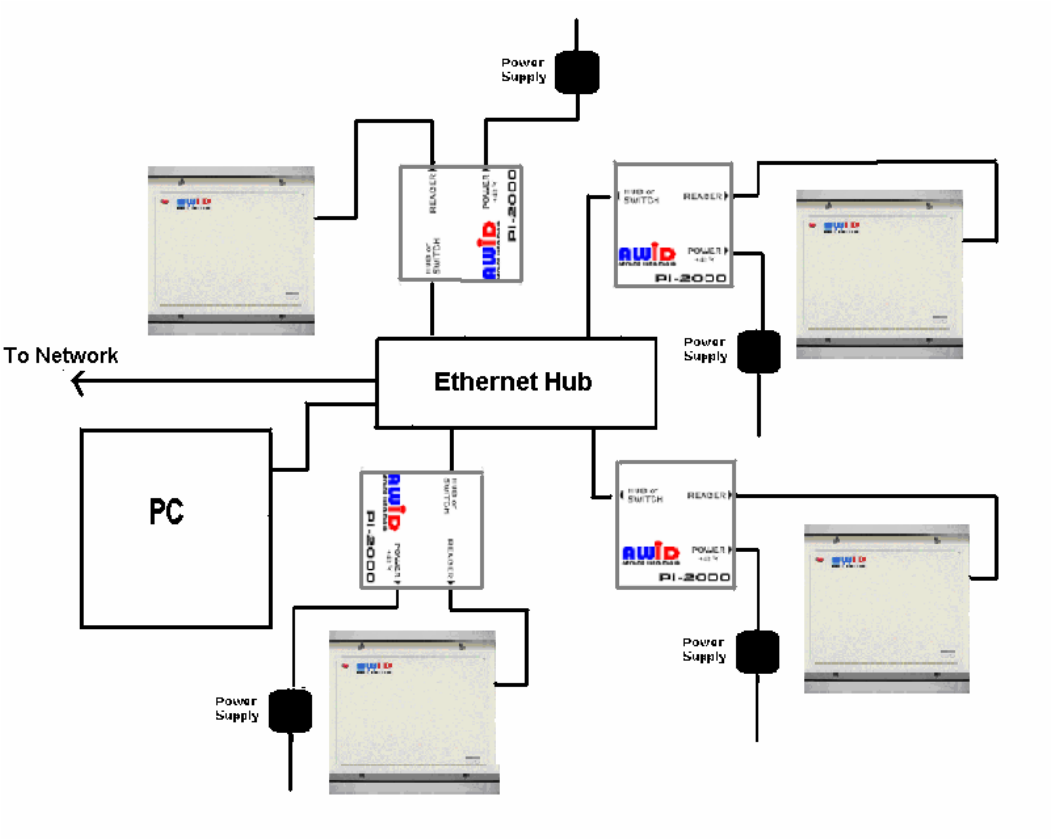

Figure 4 Four MPR-2010AN/BN Networked via PI-2000

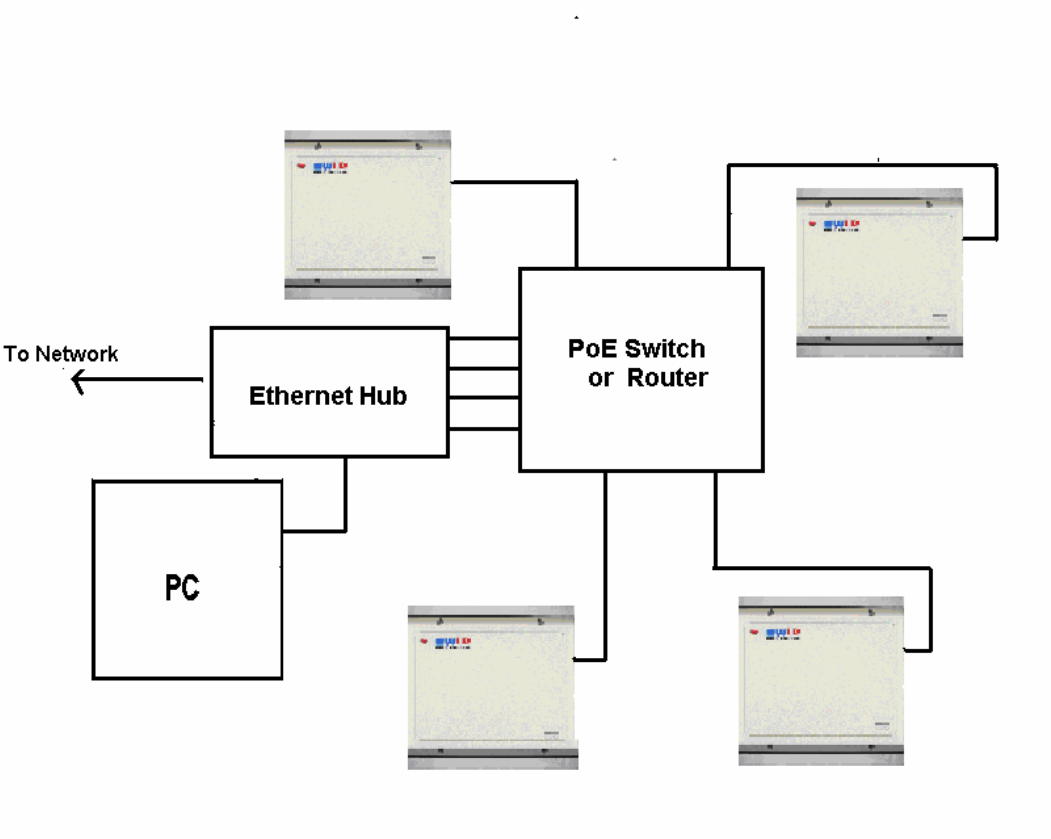

Figure 5 Four MPR-2010AN/BN Networked via PoE Switch/Router

6.2. LOCAL SET UP DIAGRAM

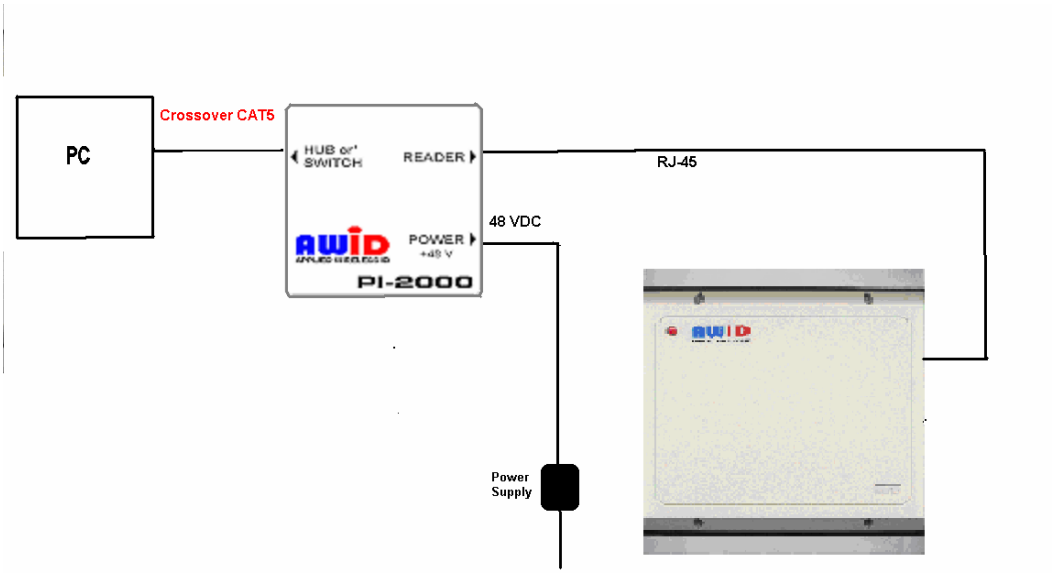

Figure 6 Local Set Up without Ethernet Hub

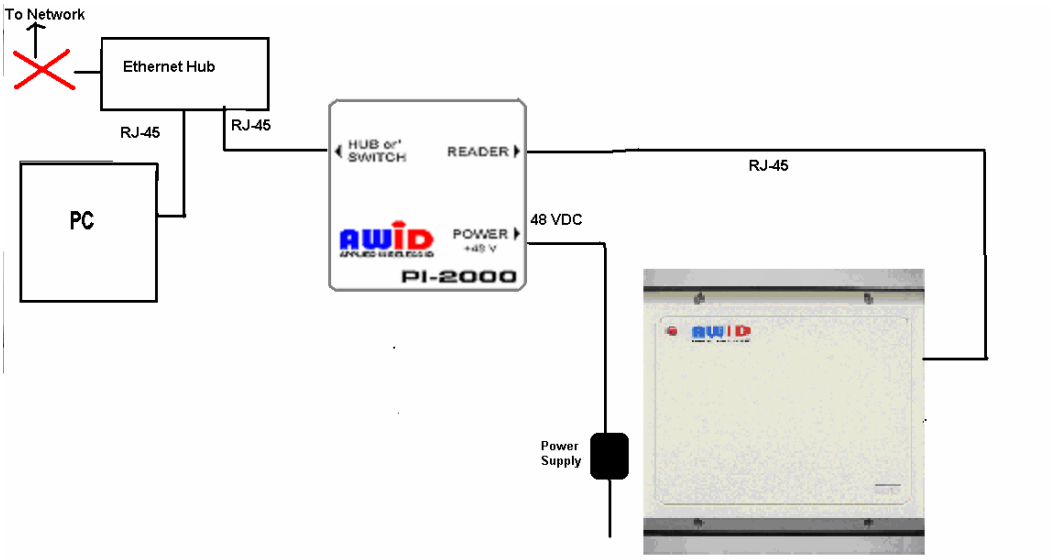

Figure 7 Local Set Up with an Ethernet Hub