APPLIED WIRELESS ID

SENTINEL-SENSE 2.6 EA

Installation & Operation Manual-041320

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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 voids 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."

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NOTE: READ AND USE THIS MANUAL.

NOTE: FAILURE TO FOLLOW THE INSTALLATION 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 2.6 EA is a long-range (12 to 15 feet) Radio Frequency IDentification (RFID) reader module with RS-232 I/O interface that works with most leading passive UHF passive tags. The reader module comes with a unique combination of long read range, small size, and low power consumption. The reader module 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.

- The 2.6 EA reader modules are delivered with firmware version 2.xxM

In order to operate an 2.6 EA you will need the following:

- PC running Windows[1] 98 or higher, CD-ROM drive and one RS-232 serial port.
- Host software (AWID's demo software or your own custom software)

1.1 GENERAL DESCRIPTION & THEORY OF OPERATION

This reader module uses radio frequency to identify, locate and track pallets and/or items that carry the appropriate RFID transponders. It works in non-line-of-sight situations and in darkness, bright sun-light, or through dirt, grime and smudges.

A typical RFID system consists of three components – a reader (interrogator), a transponder (card or tag), and a data processing controller. The reader consists of a module such as 2.6 EA (that 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 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 tags' internal memory and this is how the tags' internal data are "conveyed" to the reader. The reader in turn monitors

[1] Though 2.6 EA can also be controlled from a non-Windows programming platform, AWID demo and FW upgrade programs are applications to run in Windows.

the perturbation of the RF energy field, and thereby receives the varying degree of signal reflected from the tags.

One of the unique design features for an RFID reader is that it must simultaneously transmit a strong CW signal and at the same time, receive 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. AWID's reader consisting of 2.6 EA uses a similar circuit to accomplish the same function, but in a much smaller physical size.

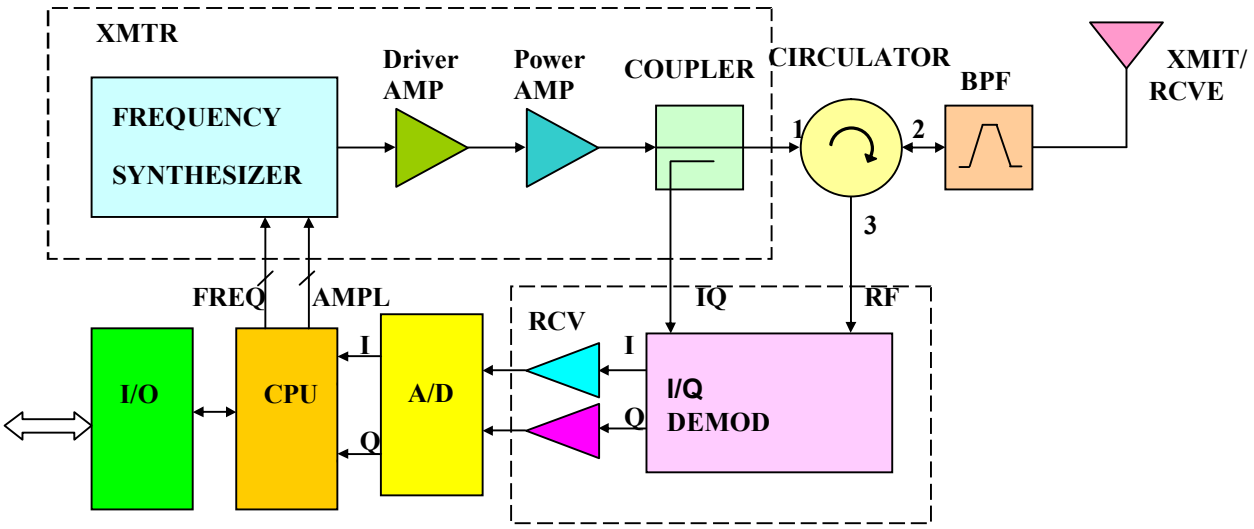


Figure 1 Block Diagram, Single-Antenna RFID Reader

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.

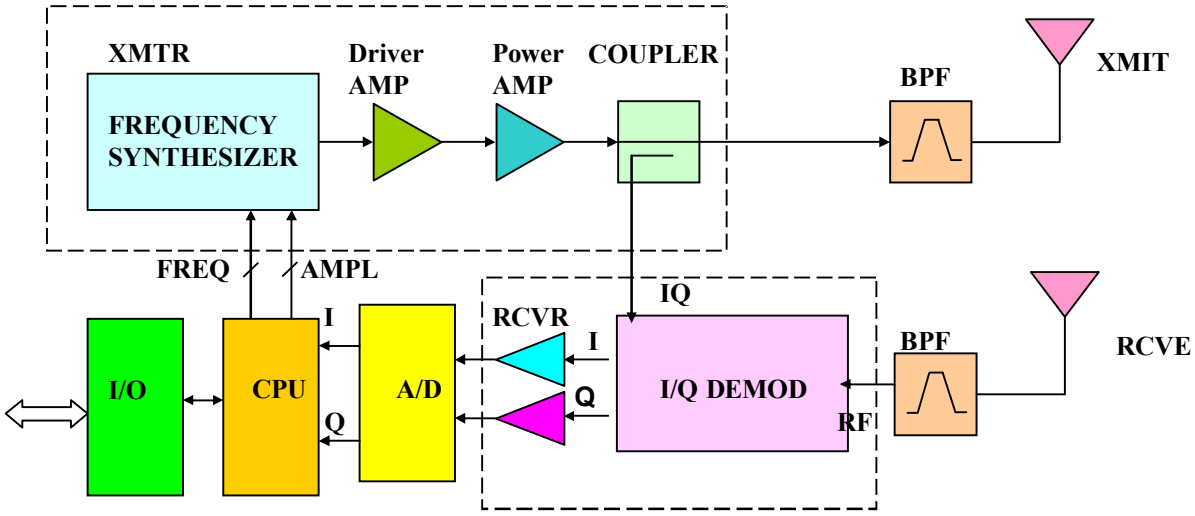


Figure 2 Block Diagram, Dual-Antenna RFID Reader

1.2 SPECIAL FEATURES

- Multi-Protocol: ISO-18000-6 Type B, EPC Class 1[2] Gen 1 & 2, EM Micro, EPC Class 0[3], EPC V1.19 Rev.2
- Thin passive tags with long-range performance
- RS-232 outputs

[2] Both 64- and 96-bit
[3] Both 64- and 96-bit

2 SPECIFICATIONS

Input voltage	+7.0 VDC to +15 VDC
Input current	1.0 A (7.0 V) to 0.40 A (15 V) typical
Protocol language	ISO Type B, EPC Class 1 Gen 1 & 2, EM Micro, EPC Class 0, EPC V1.19 Rev.2
Read range	Depends on type & size of labels used
Output power	+30 dBm max
Transmit frequency	903.14-927.26 MHz
Receiver frequency	903.14-927.26 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)
Output data formats	RS-232
I/O Connector	DB-9 connector
Dimension	3”x5”x0.25”

2.1 CHANNEL FREQUENCY TABLE

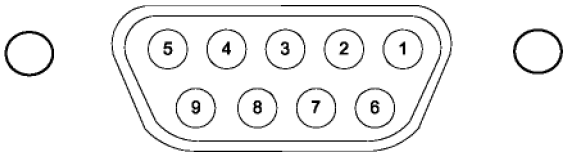
Frequency range: 903.14 ~ 927.26 MHz

Minimum number of frequency channels: 50

CH	902~928	MHz	CH	902~928	MHz	CH	902~928	MHz	CH	902~928	MHz	CH	902~928	MHz
0	903.14	MHz	20	908.06	MHz	40	912.98	MHz	60	917.91	MHz	80	922.83	MHz
2	903.63	MHz	22	908.55	MHz	42	913.48	MHz	62	918.40	MHz	82	923.32	MHz
4	904.12	MHz	24	909.05	MHz	44	913.97	MHz	64	918.89	MHz	84	923.82	MHz
6	904.62	MHz	26	909.54	MHz	46	914.46	MHz	66	919.38	MHz	86	924.31	MHz
8	905.11	MHz	28	910.03	MHz	48	914.95	MHz	68	919.88	MHz	88	924.80	MHz
10	905.60	MHz	30	910.52	MHz	50	915.45	MHz	70	920.37	MHz	90	925.29	MHz
12	906.09	MHz	32	911.02	MHz	52	915.94	MHz	72	920.86	MHz	92	925.78	MHz
14	906.58	MHz	34	911.51	MHz	54	916.43	MHz	74	921.35	MHz	94	926.28	MHz
16	907.08	MHz	36	912.00	MHz	56	916.92	MHz	76	921.85	MHz	96	926.77	MHz
18	907.57	MHz	38	912.49	MHz	58	917.42	MHz	78	922.34	MHz	98	927.26	MHz

Table 1 Channel Frequency Table for 2.6 EA

2.2 INPUT AND OUTPUT INTERFACES & CONNECTOR PIN ASSIGNMENT



Pin	Function	Pin	Function
1	Ground	6	+7V/+15V
2	RS232 Tx	7	+7V/+15V
3	RS232 Rx	8	Data 0
4	Enable RFID	9	Data 1
5	Ground	10	Ext Data in

2.3 MEASURING READ DISTANCE

Make sure you know the tag types. For certain readers and tags, 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 & OPERATION GUIDELINES

3.1 GENERAL WIRING REQUIREMENTS

All the MPR reader wiring should be continuously shielded. AWID recommends using #24 AWG up to #22 AWG, longer distances and higher current consumption on the power supply line will require larger gauge wires.

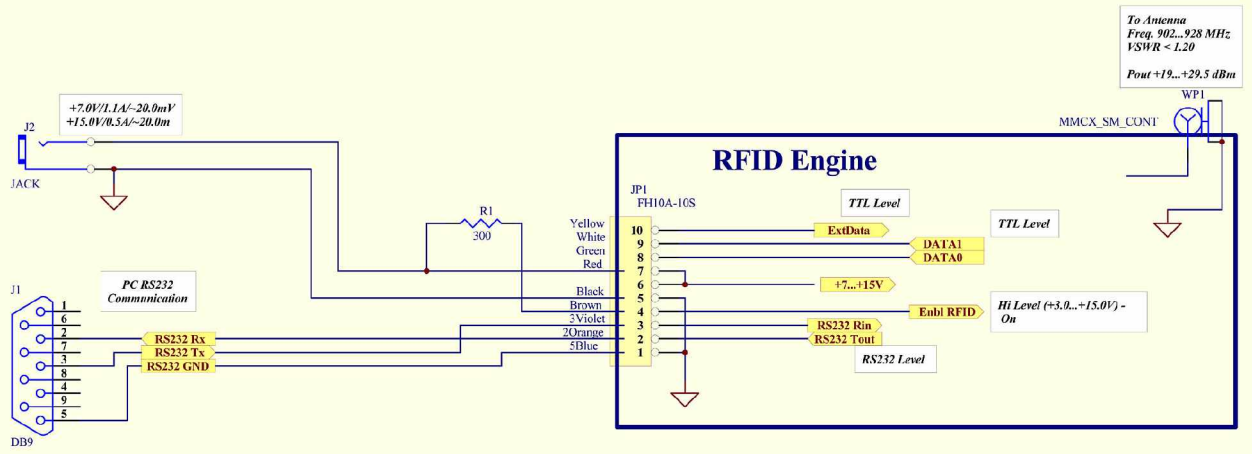
TABLE 3.4-1: Data Line's Wiring Requirement

WIRE SIZE	#22 AWG (0.6 mm Dia.)	#24 AWG (0.5 mm Dia.)
RS-232	50 ft (15 meters)	50 ft (15 meters)

3.2 WIRING DIAGRAMS

See section 2.1 for pin assignment for the RS-232 connector of a 2.6 EA.

The MPR RS-232 interface is a short distance serial interface, a full command set for the standard serial interface is not necessary, therefore only transmit, receive and ground wires are used. Sense input is an enable input, which is traditionally used to activate the RF energy of the reader and to start the read functions.



4 INSTALLATION PROCEDURE

This section provides installation and operation information for 2.6 EA reader modules.

4.1 PARTS LIST

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

- Sentinel-Sense 2.6 EA Qty=1
- Documentation and command demo program CD Qty=1

4.2 PREPARATION FOR INSTALLATION

Familiarize yourself with the connectors and pin out assignment of each I/O connectors.

4.2.1 Bench Top Verification

It is always a good idea to verify system operation before committing to a full-scale installation. The following are the necessary steps to test the reader's operation in a static environment.

- Connect 2.6 EA to the RS-232 port of a PC
- Connect the power jack from the wall plug power supply to reader module
- Power up PC
- Install demo software on PC
- Activate demo software and verify performance of the reader.
- Select COM port 1 on top page then click "Connect". Follow with some system commands.

5 SOFTWARE PROGRAMMING AND SYSTEM OPERATION NOTES

5.1 SYSTEM OPERATION

5.1.1 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 Serial Communication Protocol to issue commands to the MPR reader/module as specified.

5.1.2 Operating Modes

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

Search Mode
This mode is used when operator or user is not certain what family of tags is placed on the items to be tracked. Since most tags are deterministic in nature, MPR 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 appear 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 on to 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.

5.2 USERS NOTE

For System Integrators and/or Software Developers
System Integrators and/or software developers should get familiar with the MPR Serial Communication Protocol specifications for developing applications that control a 2.6 EA.

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

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 select the COM port for which the 2.6 EA is configured then click “Connect” should get you started.

6 MPR SERIAL COMMUNICATION PROTOCOL

See MPR Serial Communication Protocol Manual - 041304