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Certification Exhibit

FCC ID: R7PNG0R1S1
IC: 5294A-NG0R1S1

FCC Rule Part: 15.247
IC Radio Standards Specification: RSS-210

ACS Report Number: 08-300 - 15C

Manufacturer: Cellnet Technology Inc.
Model: Utilinet Modular SCADA/DA

Manual

UtiliNet SCADA
Single Board Radio
User Guide

Publication: 98-1546 Rev AA

Landis+Gyr

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UtiliNet SCADA Single Board Radio User Guide

Publication: 98-1546 Rev AA

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Product Overview

Introduction

The UtiliNet SCADA Single Board Radio (UtiliNet SBR) is for use by OEM vendors wanting to incorporate the UtiliNet SBR capability within their SCADA/DA and metering products.

The UtiliNet SBR is a self-contained 100 mW Integrated WanGate Radio (IWR) which includes voltage regulation, micro-processor, radio transmitter and receiver similar to the Series 3000 IWR.

This UtiliNet SBR, while a new design, is based upon existing UtiliNet IWR architecture. It is similar in construction to a Commercial and Industrial (C&I) endpoint, but with an optional on-board antenna. It has received Modular FCC approval when used with the approved cable and antenna.

The UtiliNet SBR provides two digital I/O ports and two analog input ports, which can also be configured as two general purpose I/O ports. One of the digital ports can also be configured as a counter by sensing either the rising end or trailing edge of the pulse or both.

The UtiliNet SBR in addition to the IWR functionality supports several General Purpose Digital and Analog interface connections. These interfaces are accessible via the UtiliNet Device Control Word (DCW) programming language.

The UtiliNet SBR has 2 DCW interpreters (one large and one small) like other Landis+Gyr AMR devices.

The design of the board allows integration with an OEM enclosure and interfacing with the customer's equipment via a 14-pin interface connector.The UtiliNet SBR is available in two versions (not interchangeable):

- On-Board Antenna, Part number 40-1119 (shown in Figure 1 - 1.)
- External Antenna (MCX connector), Part number 40- 1129 (shown in Figure 1 - 2.)

Both UtiliNet SBR models have the same internal circuitry except for the type of antenna/ connector and board size.

The On-Board antenna version is designed for customers seeking the lowest-cost solution. The on-board F-antenna exhibits nominal performance. The external antenna version is designed for customers who require enhanced performance (greater range).

Figure 1 - 1. UtiliNet SBR On-Board Antenna Version

Figure 1 - 2. UtiliNet SBR External Antenna Version

Electrical Interface

The electrical interface for power and control circuitry is provided via a connector located on the bottom (non-component) side of the board. The connector is a 14-pin keyed shrouded header connector as shown in Figure 1 - 3.

The UtiliNet SBR requires a nominal 5 VDC supply, with a total input range of 4 to 7 VDC. An onboard regulator will drop the voltage to 3.4 VDC for the circuitry.

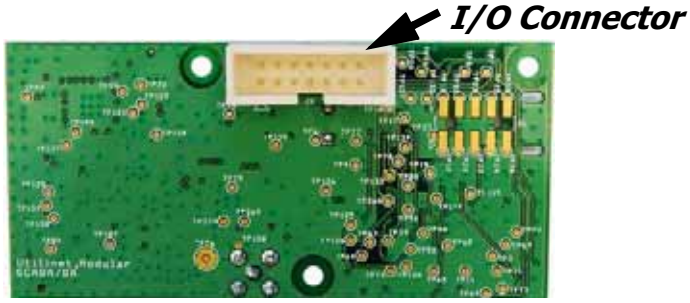


Figure 1 - 3. UtiliNet SBR (Reverse side)

The I/O connector provides interface connections as noted below:

- Power Supply
- LAN Packet Port (LPP)
- Transparent Port (TPP)
- Digital I/O signals
- Analog I/O signals
- Radio Enable/Disable control
- RF Power Control

Pin Functions

Pin Outs for the connector as described below are designed to interface with the developer's OEM board. When pins are connected to non developer boards or when standard interfaces are required without use of the USB cable (P/N 19-1220), appropriate design constraints (power and logic) must be adhered to (See "UtiliNet SBR Logic" on page 29).

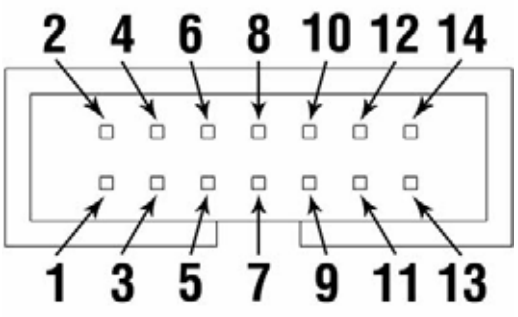


Figure 1 - 4. Pinout Diagram (as seen when viewing the board as shown in Figure 1 - 3.)

Table 1-1. I/O Connector Pin Functions and Acceptable Voltage Levels

Pin Number	Name	Function	Logic Level Low (VDC)	Logic Level High (VDC)
1	VIN	Main supply for the board.	0	4.0 ~ 7.0 Nominal = 5
2	LPP TX	This pin is an output from the device for connecting to Radioshop via the LAN Packet Port (LPP) interface.	0 ~ 0.5	2.8 ~ 3.4
3	LPP RX	This pin is an input to the device for connecting to Radioshop via the LAN Packet Port (LPP) interface.	0 ~ 0.6	2.6 ~ 3.4
4	DIGITAL_IO1	A general purpose Digital Input / Output Pin. The application-specific DCW can utilize this pin as desired.	0 ~ 0.6	2.6 ~ 3.4
5	ANALOG_IN1	An input to the device's A/D converter. The application-specific DCW can read the voltage on this pin. Note: This pin may be configured as a Digital I/O, if desired.	0 ~ 2.5	
6 and 7	GND	Common ground for both power and communications. These two pins are tied together on the device.	0	0
8	LOW_RF_POWER	Digital input used to select Low-Power Mode, an RF output power reduction of 6[dB].	0 ~ 0.6	2.6 ~ 3.4
9	PWR_DN	Digital input used to completely shut down the device.	0 ~ 0.5	2.8 ~ 7
10	ANALOG_IN2	An input to the device's A/D converter. The application-specific DCW can read the voltage on this pin. Note: This pin may be configured as a Digital I/O, if desired.	0 ~ 2.5	
11	DIGITAL_IO2	A general purpose Digital Input / Output Pin. The application-specific DCW can utilize this pin as desired.	0 ~ 0.6	2.6 ~ 3.4
12	TPP RX	This pin is an input to the Transparent Port (TPP) device.	0 ~ 0.6	2.6 ~ 3.4
13	TPP TX	This pin is an output from the Transparent Port (TPP) device.	0 ~ 0.5	2.8 ~ 3.4
14	NC	Not connected.	*N/A*	*N/A*

Pin 1 (VIN)

This pin must be supplied with DC voltage between 4.0 and 7.0 VDC with 5.0 VDC considered nominal.

The input voltage of 5.0 VDC is linearly regulated on the board to 3.4 VDC. While the linear regulation can remove some noise, its PSRR (Power Supply Rejection Ratio) varies with frequency. If the power source is particularly noisy, filtering may be required. Landis+Gyr engineering can assist in defining radio tests to determine if power supply noise is affecting radio performance.

The input voltage must be maintained between 4.0 VDC and 7.0 VDC during operation. The on-board electronics include fast-acting reset circuitry. If the voltage drops below 4.0 VDC, even transiently, the system will reboot once the voltage returns to normal range. If the voltage rises above 7.0 VDC, even transiently, the voltage-sensitive components could be damaged.

Upon power up, the on board processor and voltage regulator requires the supply voltage to have a minimum of 0.05 V/msec slew rate - which implies rising from 0 to 3.4 VDC in 68 msec max.

During normal receive mode, current consumption is 25 mA.

During the first 30 minutes and after an extended outage or initial power on, the on-board super-capacitor will be charging to prepare for outage notification (an RF function of the UtiliNet system). During this time, the total input current to the device will increase to 55 mA.

During RF transmission at 100 mW, the UtiliNet SBR current consumption is 200 mA maximum. The UtiliNet SBR uses a frequency hopping sequence transmission and, while typically rare, transmissions can be as long as 400 mS in duration, and can theoretically sustained at a 45% duty cycle.

The worst-case consumption profile, for a UtiliNet SBR that has just booted-up, charging its super-capacitor, and transmitting packets at the max possible rate would be approximately 255 mA. Typical current consumption is approximately 175 mA, drawn occasionally, for about 250 msec in duration, and 25 mA when not transmitting.

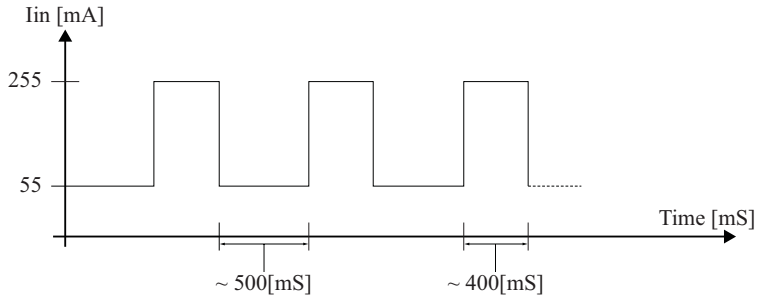


Figure 1 - 5. Worst-Case Current Consumption Profile

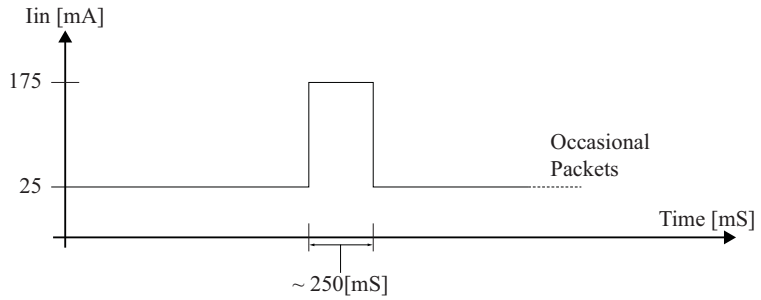


Figure 1 - 6. Typical Current Consumption Profile

Pin 2 (LPP TX) and Pin 3 (LPP RX)

These pins are used to interface with the device's LAN Packet Port. These pins are driven at TTL levels from 3.3 to 3.4 VDC.

Baud rates on this port default to 9600 bps, but using RadioShop are configurable up to 38,400 bps.

To reduce chances of electrical damage, a 10Kohm series resistor is placed in-series with the pin which limits the drive current capability of this pin.

Stray physical capacitance on this circuit should be kept below 250[pF].

These pins are NOT directly connected to an RS-232 interface on a computer, and where such a connection is necessary, the developer must purchase a TTL to RS-232 3.3 VDC converter which is powered externally and NOT via the pins or the RS-232 connection on the computer.

Pin 4 (DIGITAL_IO1) and Pin 11 (DIGITAL_IO2)

These pins are general purpose digital I/O lines and are driven at TTL levels from 3.3 to 3.4 VDC.

If not used, they should not be left unconnected and should be brought low connecting the pin to a common ground.

If used, these pins must be driven to a valid logic high or low and not left at intermediate voltages as this will result in indeterminate logic values and may damage the device.

Pin 5 (ANALOG_IN1) and Pin 10 (ANALOG_IN2)

These pins are analog inputs to the device. Voltages must be scaled to the 0 to 2.50 VDC range. The UtiliNet SBR returns the DC voltage as HEX values in the memory locations as described in “Analog Input Functionality” on page 31.

The value returned is shown in the table below.

The DCW that reads the memory location returns the HEX value, in the range of 0-03FF, from which the user must convert to decimal and then using the formula can obtain the voltage value.

Table 1-2. Voltage Conversion

Voltage = (Decimal value/1023) * 2.5

HEX Read	Actual Voltage
0000	0
0006	0.01
006B	0.25
0119	0.68
0253	1.44
0382	2.19
039F	2.26
03C7	2.36
03F1	2.46
03FD	2.49

The Analog I/O pins may be configured as Digital I/O pins or as General Purpose I/O pins, if desired.

Pins 6 and 7 (GND)

These pins are the ground connection for both power and communications. These two pins are tied together on the device.

Pin 8 (LOW_RF_POWER)

The purpose for this pin is to reduce the RF output power level to assure operation during development and OEM manufacturing process. A logic high on this pin leaves the device in its normal mode of operation with full rated RF transmitter power. A logic low reduces the RF power level to approximately 25 mW for use where high power is not required or maybe harmful. When the USB cable is used to power the board, the pin is brought low. This pin is a digital input, driven at TTL levels from 3.3 to 3.4 VDC.

This pin must be driven to a valid logic high or low as intermediate voltages will result in indeterminate logic values and may damage the device.

Pin 9 (PWR_DN)

This pin is used to enable or disable the device. This pin is a digital input and must be driven to a valid logic high or low, as intermediate voltages will result in indeterminate logic values and may damage the device.

A logic high enables the linear regulator, thus powering the device.

A logic low disables the linear regulator and turns off the device.

Prior to turning off the device, all interface signals must be driven low and logic voltage removed. This includes all Serial UART lines, digital and analog I/O lines.

When the device is turned off with this pin, total current consumption will be less than 2 µA.

When the board is not in use, voltage should not be applied to any interface as this may damage the device as destructive latch-up can result.

Pin 12 (TPP RX) and Pin 13 (TPP TX)

These pins are used to interface with the device's Transparent Port. These pins are driven at TTL levels from 3.3 to 3.4 VDC.

Baud rates on this port default to 9600 bps, but using RadioShop are configurable up to 38,400 bps.

To reduce chances of electrical damage, a 10Kohm series resistor is placed in-series with the pin which limits the drive current capability of this pin.

Stray physical capacitance on this circuit should be kept below 250[pF].

These pins are NOT direct connect to an RS-232 interface on a computer and where such a connection is necessary, the developer must purchase a TTL to RS-232 3.3 VDC converter which is powered external and NOT via the pins or the RS-232 connection on the computer.

USB Programming Cable

A USB Serial Interface programming cable (P/N 19-1220, shown in Figure 1 - 7) is available for developers to access the device via the I/O connector using RadioShop 4.0 or their own application.

The cable provides power (5 VDC) and a single emulated COM Port connection. The USB cable allows the OEM vendor to configure, load DCWs, and program the UtiliNet SBR.

Figure 1 - 7. USB Serial Interface programming cable

The cable uses the pins as shown in Figure 1 - 8.

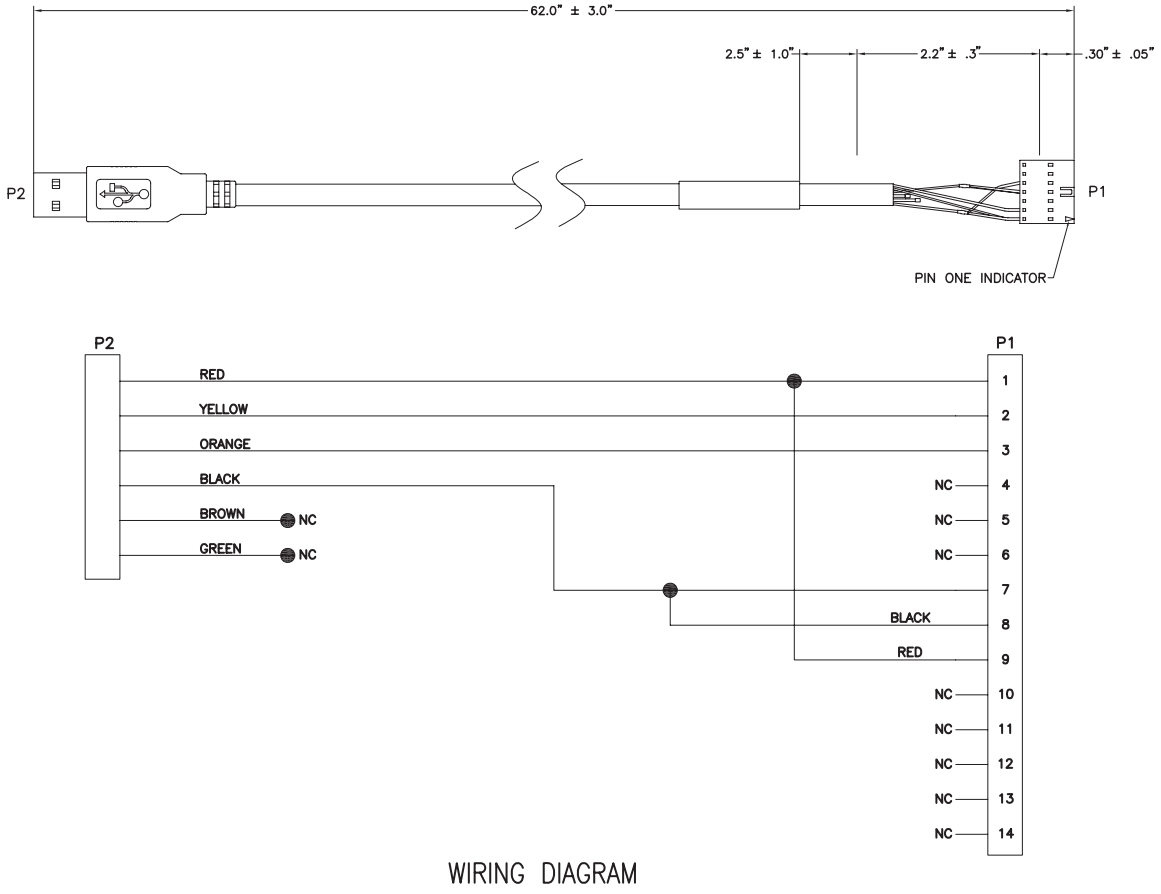


Figure 1 - 8. USB Serial Interface programming cable wiring diagram

The cable converts USB to Serial (TTL level) for connecting the TTL interfaces on the board to serial interfaces (COM Ports) via the USB interface. The cable is designed to allow for a fast, simple way to connect the board to the RS-232 COM Port on the PC, allowing the developer to access the board using RadioShop.

The entire USB protocol is handled by the USB Serial Interface cable when connected to the pc, thus no USB specific firmware programming is required.

Because most computer USB ports can only source 100 mA of current, the USB cable sets the device for RF Low Power Mode by grounding pin 8 of the I/O connector. This mode sets the output power level to approximately 25 mW. The USB is 2.0 Full Speed compatible thus providing for COM Port data rates between 300 to 38,200 BPS as required by the radio LPP port.

Table 1-3. USB Cable I/O Operating Parameters

Parameter	Description	Min	Type	Max	Unit	Conditions
VCC	Output Power Voltage	4.25	5.0	5.25	VDC	Dependant on the USB port that the TTL-232R-3V3 is connected to
I/O	Output Power Current	*N/A*	*N/A*	100	mA	*N/A*
T	Operating Temperature Range	-40	-	+85	°C	*N/A*

USB Cable Installation

Prior to connecting the USB cable the first time, make sure the PC is connected to the Internet.

Connect the device to a spare USB port on your PC. The Microsoft composite device driver is automatically loaded silently in the background. Once the composite driver has been installed Windows Found New Hardware Wizard will launch.

The installation process may continue by installing the USB Serial Converter driver for a second port of the USB Cable. The procedure for installing the second port is identical to that for installing the first port from the first screen of the **Found New Hardware Wizard**.

Antennas

As with any RF device, antenna-related decisions are critical and must be made early. The RF range of the final product will depend greatly on the choice of antenna and its placement. This module is available in two versions, selected at the time of order. The On-Board Antenna version is built and tuned to utilize an on-board F-antenna. The External Antenna version includes a 50-ohm MCX connector for RF co-ax connection to an external antenna.

External Antenna

An external antenna is connected to the board via an MCX Female coaxial RF connector.

The External Antenna used to qualify the board is a 5 dB whip (shown in Figure 1 - 9.), made by MMG. The MMG antenna part number is 16-1000-0. *MMG contact information is on page 35.*

Figure 1 - 9. Whip Antenna with N-type Male Reverse-Polarity Connector

See “External Antenna Specifications” on page 36 for Antenna technical specifications.

On-Board Antenna

The On-Board antenna design is an F-antenna. This design was chosen because its performance is more broad-band relative to a slot antenna, and its pattern is somewhat Omni-directional. This version of the product does not allow an external antenna in conjunction to the on-board antenna.

See “On-Board Antenna Specifications” on page 39 for Antenna technical specifications.

Specifications

Table 1-4. Physical Specifications

Category	Specification	Value(s) or Range(s)
Electrical	Supply Voltage	5.0 typical (4.0 min, 7.0 max)
	Current, Transmit Mode	200 mA maximum
	Current, Receive Mode	25 mA typical, 40 mA maximum
Networking	Number of Channels	240
	Channel Spacing	100 KHz
	Modulation Type	Direct 2-FSK
	RF Baud Rate	9600
	FCC Operation Certification	Part 15.247 Spread Spectrum
	Spreading Technique	Frequency Hopping
	Hopping Technique	Pseudo Random Asynchronous
	Hopping Patterns	65,536 (Unique per network)
	Network Address	Latitude / Longitude Coordinates
	Turn-Around Time	100[uS] max
Data/Programming	Programming Language	Device Control Word (DCW)
	Transparent Port	Serial Interface, DCW adjustable per specs below
	Serial Interface	TTL (adj. Reference)
	Data Rate	300, 600, 1200, 4800, 9600, 19200, or 38400
	Parity	Odd, Even, or None
	Data bits	7 or 8
	Stop bits	1 or 2
	Duplex	Full
	Protocol	Any asynchronous byte-oriented protocol
Environmental	Operating Temperature	-40°C to +85°C
	Storage Temperature	-40°C to +85°C
	Humidity	85C, 95% RH
Mechanical	Size	On-Board Antenna 3.5″ x 2.25″ x 1.0″
		External Antenna 3.5″ x 1.75″ x 1.0″

Table 1-5. RF Specifications

Category	Specification	Value(s) or Range(s)				
		Frequency (MHz)	**Condition**	**Minimum**	**Typical**	**Maximum**
Transmitter	RF Output	902.1~927.9	Max Power Mode Referenced to Antenna connector, CW	+18.0 dBm	+20.0 dBm	*N/A*
			Low Power Mode Reference to Antenna connector, CW	+12.0 dBm	+14.0 dBm	*N/A*
	Frequency Range	f_0	*N/A*	902.1 MHz	*N/A*	927.9 MHz
	Out-of-band Radiated Spurious	10~10000 $2*f_0$ $3*f_0$~$10*f_0$	1KHz RBW, TX on, CW, +20 dBm	*N/A*	*N/A*	-20 -45 -70
	Deviation	*N/A*	*N/A*	-5.5 kHz	*N/A*	+5.5 kHz
	Modulation Bandwidth	*N/A*	*N/A*	*N/A*	*N/A*	25 kHz
	Output Impedance	*N/A*	*N/A*	*N/A*	50 Ω	*N/A*
	Frequency Stability	f_0	-40°C ~ +85°C	-3 ppm	*N/A*	+3 ppm
	Conducted Spurious Emissions	902.1~927.9	$2*f_0$	*N/A*	*N/A*	-20 dBc
		902.1~927.9	$3*f_0$~$10*f_0$	*N/A*	*N/A*	-70 dBc
	Total Device Current	*N/A*	Max Power Mode Pout = +20.0 dBm, TX On, CW	*N/A*	150 mA	200 mA
			Low Power Mode Pout = +14 dBm, TX On, CW	*N/A*	80 mA	100 mA

Table 1-5. RF Specifications

Category	Specification	Value(s) or Range(s)				
		Frequency (MHz)	**Condition**	**Minimum**	**Typical**	**Maximum**
Receiver	Sensitivity	902.1~927.9	BER 5E-5	*N/A*	-108 dBm	-105 dBm
	Dynamic Range (Input Signal Level)	*N/A*	1X10-6 BER	-108 dBm	*N/A*	0 dBm
	Packet Error Rate	*N/A*	*N/A*	*N/A*	1x10-2 (1X10-6 BER)	*N/A*
	IF Selectivity	*N/A*	@ 25 kHz	39 dB	*N/A*	*N/A*
	Frequency Stability	f_0	-40°C ~ +85°C	-3 ppm	*N/A*	+3 ppm
	Total Device Current	*N/A*	RX On	*N/A*	*N/A*	40 mA
	IIP3	915	*N/A*	-25 dBm	*N/A*	*N/A*
	Adjacent Channel Rejection	*N/A*	*N/A*	35 dB	*N/A*	*N/A*
	Worst case Image Rejection	*N/A*	*N/A*	*N/A*	20 dB	*N/A*

UtiliNet SBR On-Board Antenna Dimensions

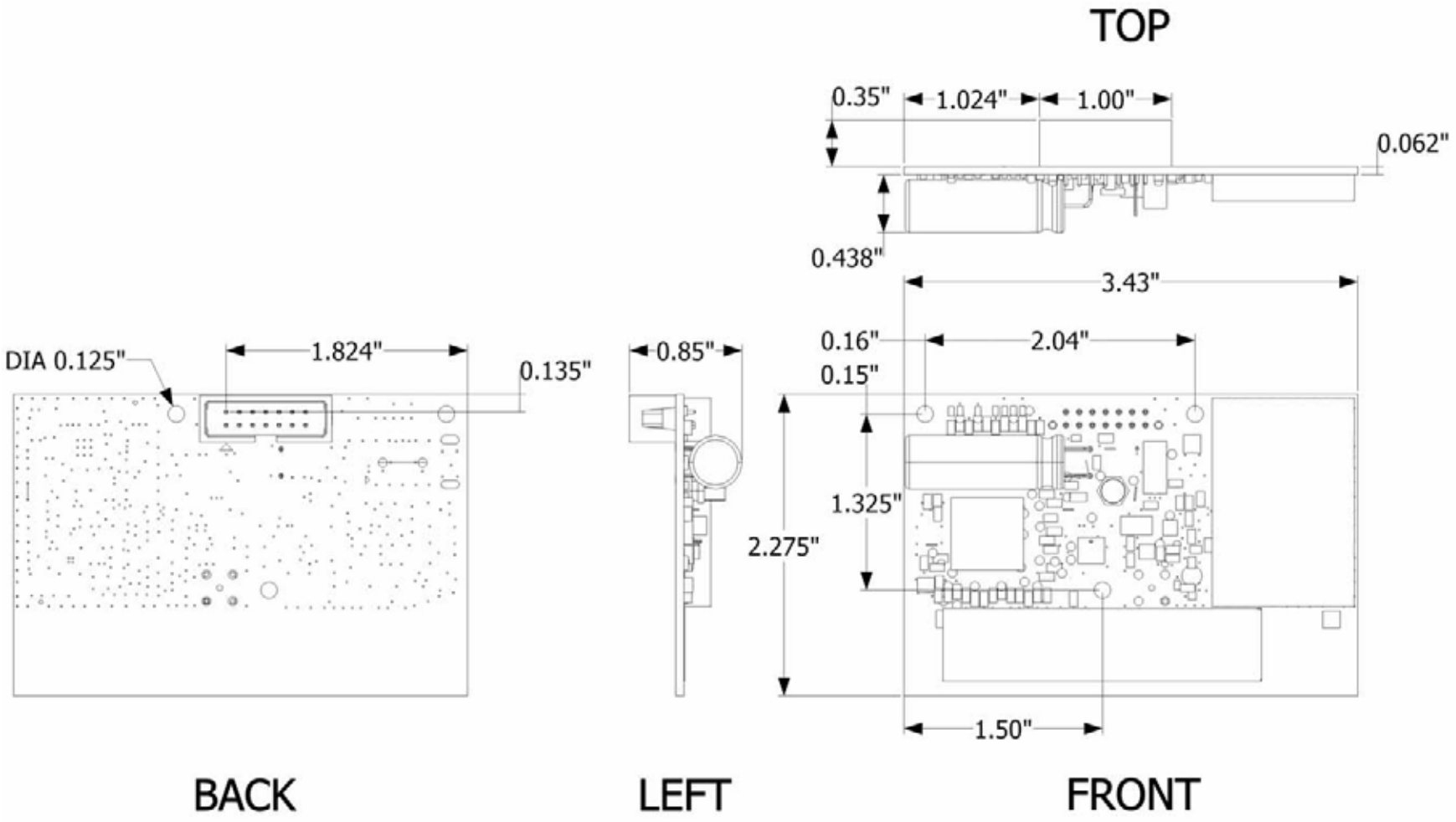


Figure 1 - 10. UtiliNet SBR On-Board Antenna Dimensions

UtiliNet SBR External Antenna Dimensions

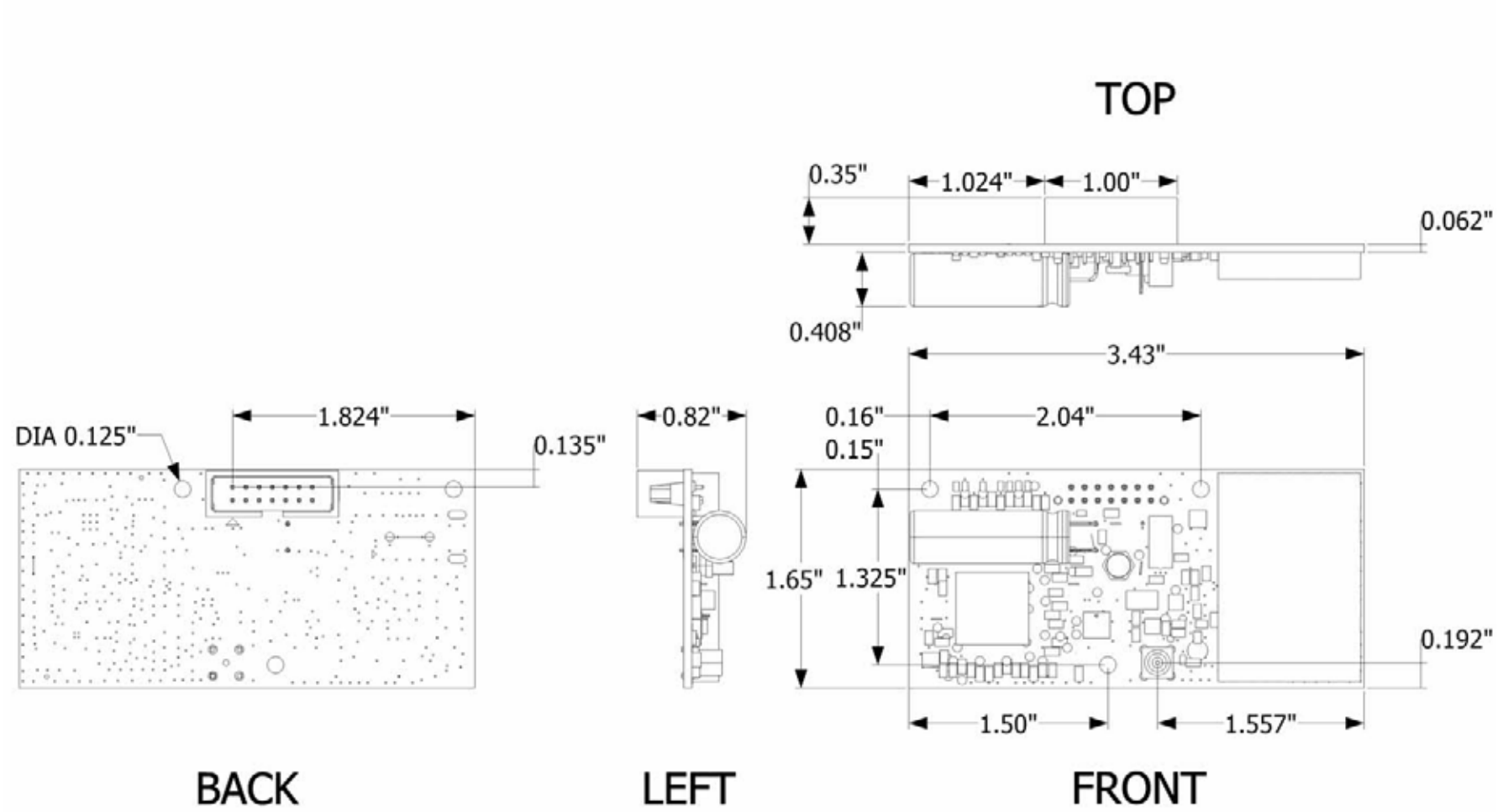


Figure 1 - 11. UtiliNet SBR External Antenna Dimensions

2
Configuration & Testing

Overview

The UtiliNet SCADA Single Board Radio is configured using the RadioShop 4.0 (or later) program only. Setup is similar to setting up and configuring any UtiliNet Radio.

Refer to the RadioShop 4.0 Getting Started Guide for further details about configuring the UtiliNet SBR.

RadioShop version number is subject to change. Refer to the latest version of the RadioShop Programming Guide for additional detail.

Connecting to a Radio using RadioShop 4.0

Connect the LAN Packet Protocol port of your IWR to your computer's serial port using a serial cable. Once the radio is powered up, you can launch RadioShop 4.0 on your computer. RadioShop will now connect to your local UtiliNet SBR card.

1. From RadioShop home select the **Head-End Mgmt** tab.
2. Click **Discover>Force Scan and Discover Entry Ports**.

When the **Select COM Ports for Discovery** window opens, select the COM port on your computer that is connected to the radio, and then click OK.

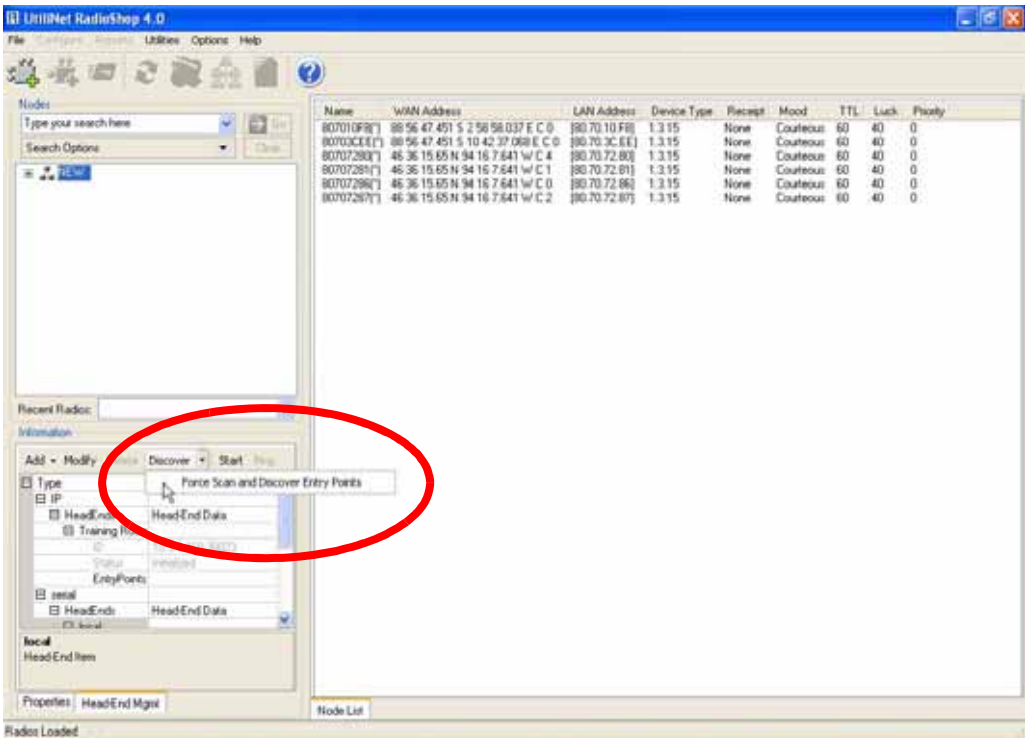


Figure 2 - 1. Connecting to Head-End Radio

Once connected, the local radio's LAN address will appear on the list at the top left-hand side of the screen, and a radio configuration report will be displayed in the main window (See Figure 2 - 2.). This radio can now be used to communicate with the UtiliNet SBR and configure it as needed.

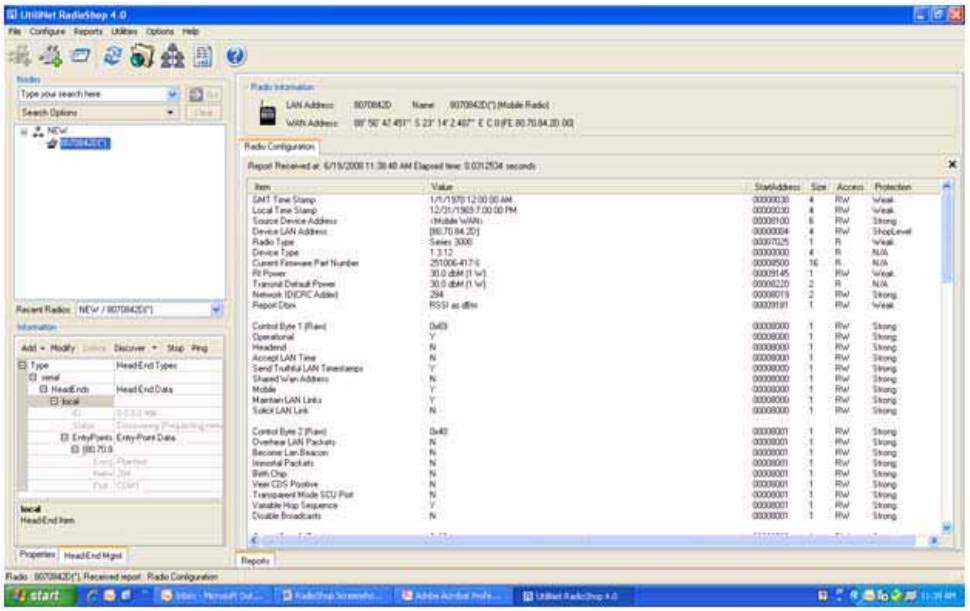


Figure 2 - 2. Radio Configuration Report for Head-End Radio

All RF Mesh radios ship with a default network ID, or CRC, of 670. In order to communicate with the UtiliNet SBR, your local radio will have to be re-configured to match the network ID (670) of the UtiliNet SBR. After re-configuring the UtiliNet SBR to match the customer's unique network ID, the local radio will need to be reset to it's original network ID. See "Assign the Network ID (CRC) of the UtiliNet SBR" on page 21 or see "Assigning a New Network ID to a Radio" on page 22., for steps to re-configure the local radio.

Assign the Network ID (CRC) of the UtiliNet SBR

All UtiliNet SBRs ship with a default network ID, or CRC, of 670. In order to communicate with other radios in a customer's network, the UtiliNet SBR will have to be re-configured to match the customer's unique network ID.

Network ID or CRC are usually assigned for each customer. Please call Customer Service at 888-390-5733 if you require a Network ID or CRC.

1. From RadioShop home, select **Configure>Change Network ID (CRC)**. The **Network ID Wizard** dialog box will open, as shown in Figure 2 - 3
2. Select **Use an Existing Network**, and click **Next** to continue.

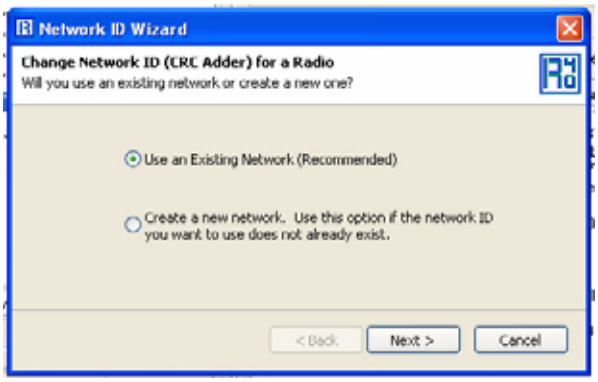


Figure 2 - 3. Network ID Wizard

The Choose an Existing Network dialog is displayed

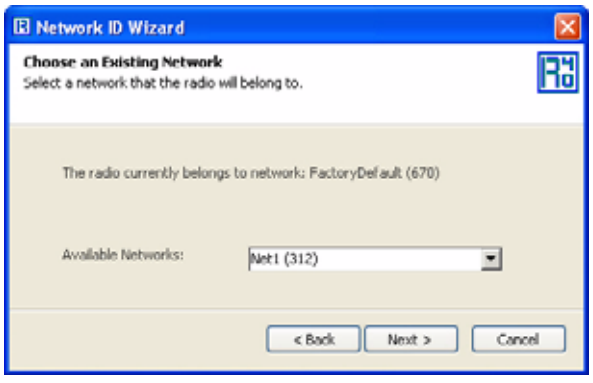


Figure 2 - 4. Choose an Existing Network

3. Choose a **Network ID** from the **Available Networks** drop-down list, and click **Next** to continue.

The Final Confirmation dialog is displayed

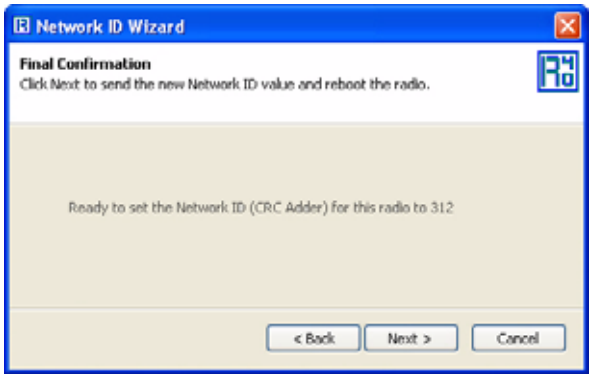


Figure 2 - 5. Final Confirmation dialog box

4. Click **Next** to change the Network ID for the radio.

   A confirmation message verifies that the Network ID has been changed.

Radio will reboot.

Assigning a New Network ID to a Radio

Important:

Assign a new Network ID only if the ID you want to use does not exist already.

Valid values range from 1 to 65535. If 0 is displayed at startup, call customer support.

To assign a new Network ID to a radio, perform the following steps.

1. Select **Configure > Network Id (CRC)**. The first dialog of the Network ID Wizard is displayed.
2. Select **Create a New Network**, and then click **Next**.

   The Specify New Network dialog is displayed

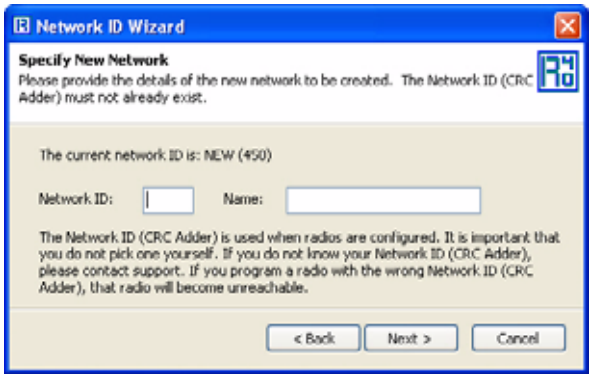


Figure 2 - 6. Specify New Network

3. Specify the **Network ID** and **Name** of the new network you want to assign, and click **Next** to continue.

Do not use spaces in the Name field.

The Final Confirmation dialog is displayed.

4. Click **Next** to create the Network ID for the radio. A confirmation message verifies that the new Network ID has been assigned to the radio.

Adding New Radios to RadioShop

You can now add the UtiliNet SBR to the RadioShop database.

1. Make sure your local radio is highlighted on the **Nodes Pane**.
2. Click **Generate WAN Nodes Report**.
3. From RadioShop home click **Utilities > Radio > Discover Neighbors**. See Figure 2 - 7.

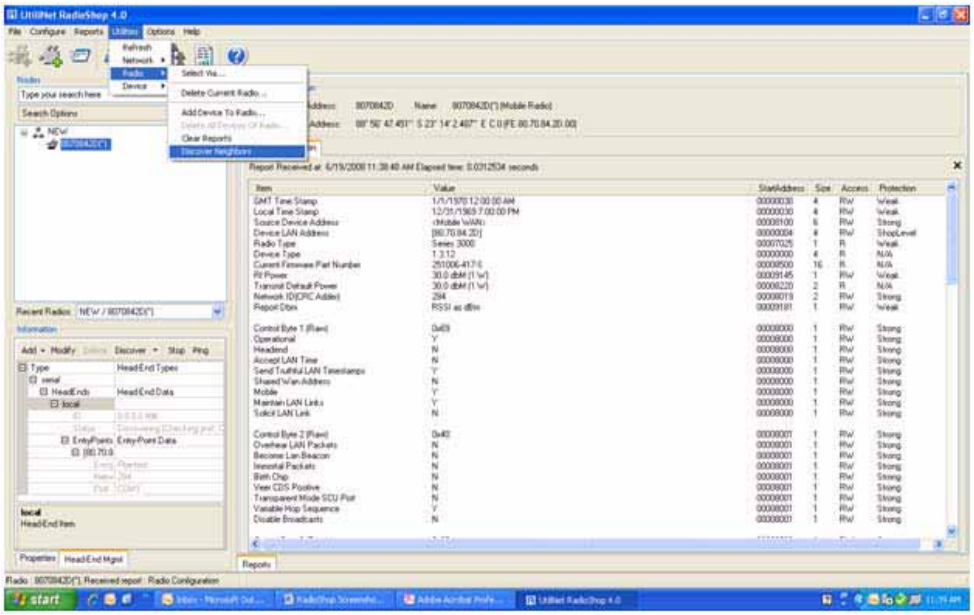


Figure 2 - 7. Discovering Neighbors

4. Once discovered, the UtiliNet SBR's LAN Address will show up on the **Nodes** pane, as shown in Figure 2 - 8.

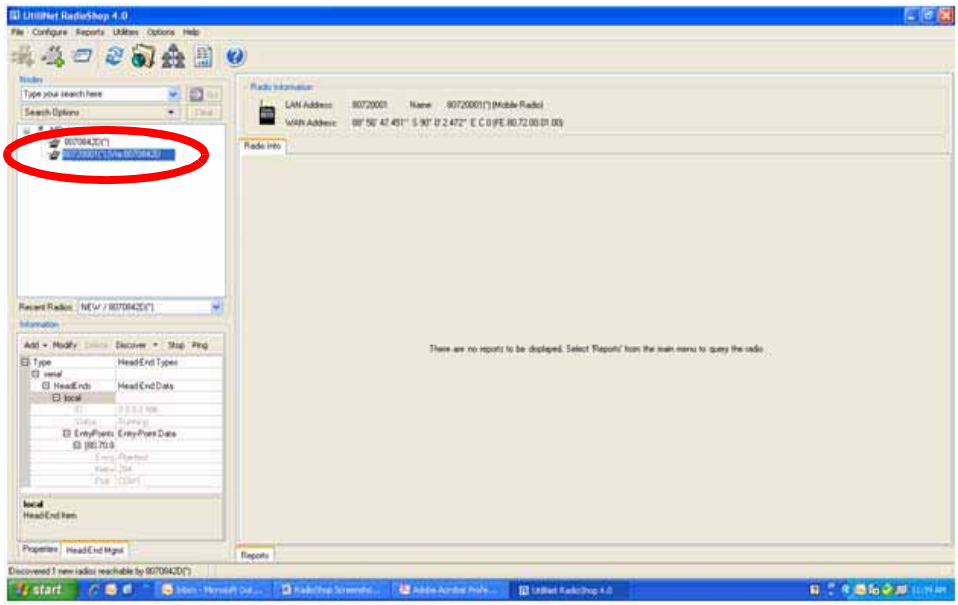


Figure 2 - 8. RMFM is added to Nodes Pane

5. Highlight the new UtiliNet SBR, Figure 2 - 8, and click **Reports > Configuration > Radio** to verify that you can communicate with the UtiliNet SBR
6. On the report, you can verify the firmware version and current network ID.

Setting the Latitude & Longitude

1. From RadioShop home click **Configure > Wan Address**.
2. The **Configure WAN Address** window, specify the new coordinates and click **OK**.

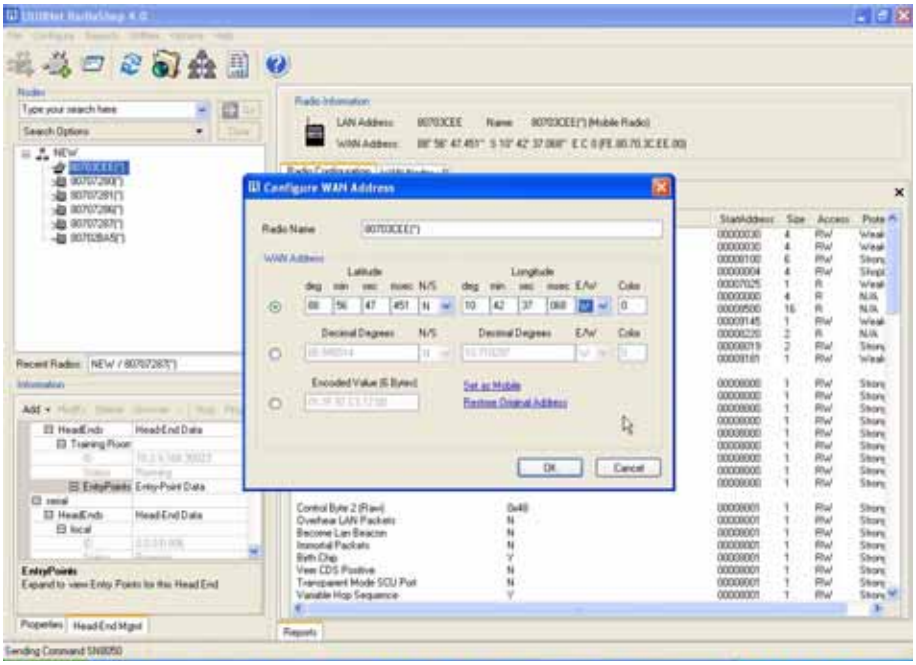


Figure 2 - 9. Configuring the WAN Address

A message will appear indicating that the radio was successfully programmed.

Troubleshooting

The UtiliNet SBR has been designed as a Field Replaceable Unit. As such, there are no serviceable parts in the unit.

If you suspect parts within the UtiliNet SBR have failed:

1. Perform a visual inspection to determine if there is any visual indications of damage to the unit.
2. Verify that AC power is being supplied to the unit. If there is power then proceed to step 3.
3. Try to connect with a locally connected Series III IWR configured the same as the UtiliNet SBR. If after 5 minutes, the locally connected Series III IWR does not acquire the UtiliNet SBR in its neighbors list, the UtiliNet SBR should be replaced.

For additional assistance for this product, contact Technical Support toll-free at 1-888-390-5733 or support@landisgyr.com.

3
Development Environment

UtiliNet SCADA Single Board Radio Interface Board

This section provides instruction for the usage of the UtiliNet IWR Single Board Radio interface board, a simple prototype board wired to interface a UtiliNet IWR Single Board Radio to a PC.

The drawings provided in this section are for design reference purposes only. No interface board is available for purchase from Landis+Gyr.

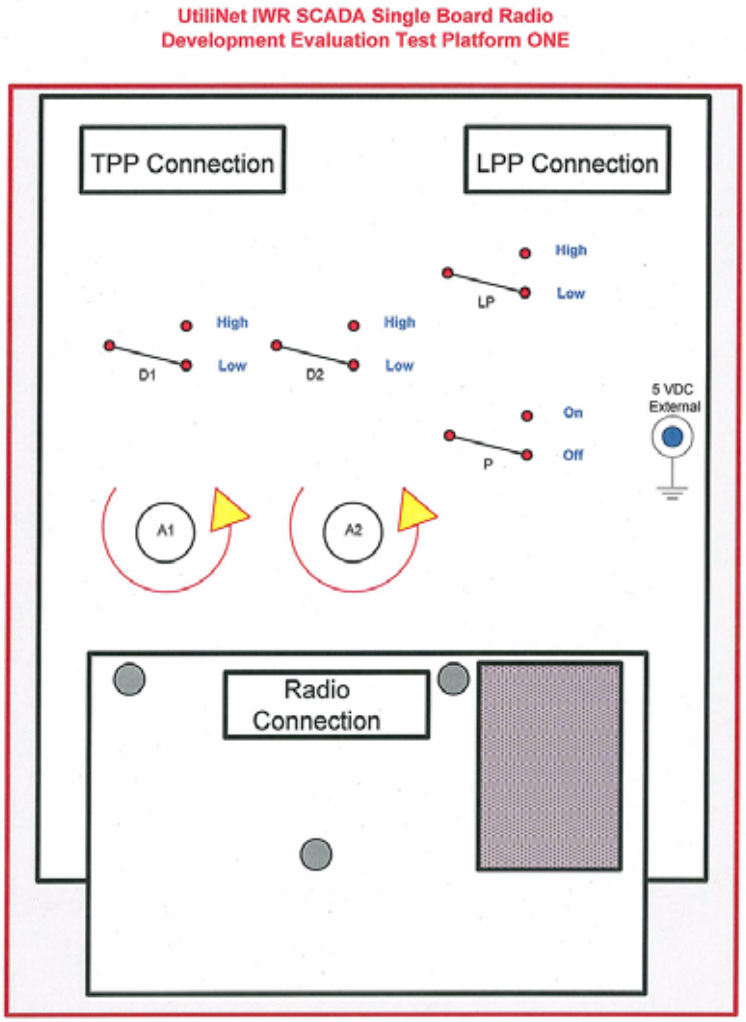


Figure 3 - 1. Board Component Layout with On-Board Antenna

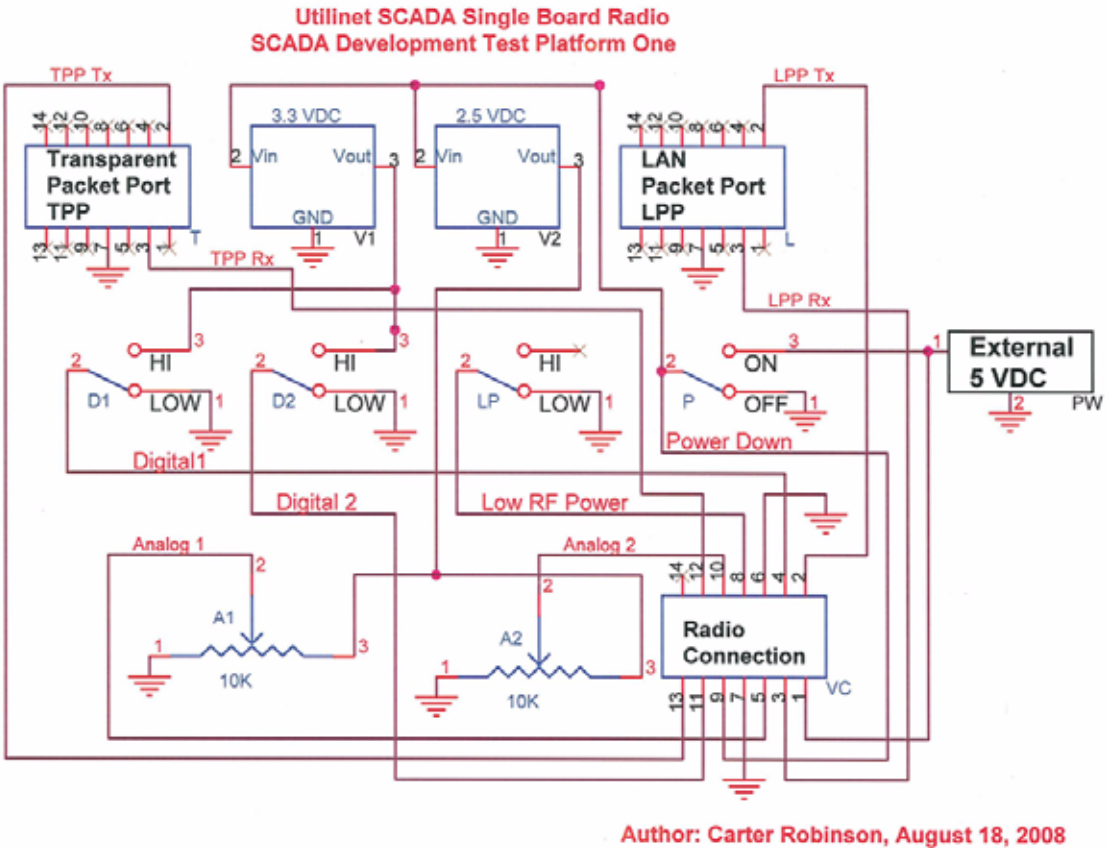


Figure 3 - 2. Board Component Schematic

Transparent Port Connection

This connector is used to establish connection to the UtiliNet SBR through the transparent port. When communication through the transparent port is desired, connect the USB cable to this connector.

LAN Packet Port Connection

This connector is used to establish connection to the UtiliNet SBR through the LAN packet port. When communication through the LAN packet port (RadioShop) is desired, connect the USB cable to this connector.

Onboard Regulator

The UtiliNet SBR interface board is equipped with an onboard 3.4 VDC regulator. This regulator takes a 4 ~ 7 VDC input from a main power source and regulates it at 3.4 VDC for the device's electronics.

Digital Input

Digital input to UtiliNet SBR can be tested by toggling the two switches on the test board that correspond to DIGITAL_IO1 and DIGITAL_IO2. The switch will toggle between 0V and 3.3VDC.

This interface board does not have function to test the digital output of the UtiliNet SBR, with the digital input switch tying the digital I/O pin on the UtiliNet SBR to either 0V or 3.3VDC. It is recommended to NOT configure the digital I/O pin when the UtiliNet SBR is connected to the test interface board.

Analog Input

Analog input to the UtiliNet SBR can be tested by tuning the two potentiometers on the test board that correspond to ANALOG_IN1 and ANALOG_IN2. The input voltage should lie between 0 VDC and 2.5 VDC.

With an on-board reference of 2.5 VDC, the highest analog input the UtiliNet SBR may sense is 2.5 VDC. Although the processor on the UtiliNet SBR may withstand 3.3 VDC analog input, it is advised to not exceed 2.5 VDC.

General Usage Instruction

Depending on the desired port to establish communication, connect a main cable to either the transparent port connection or the LAN packet port connection.

To provide power to the UtiliNet SBR test Platform, the power input must be supplied externally (as shown). Therefore the USB Cable when connected to the TPP or LPP connector does not provide power for the test board.

When connecting the USB cable directly to the Utilinet SBR power is provided by the USB port on the computer.

Set the USB power input to an appropriate level (recommended: 5V). Toggle the switch controlling the signal *PWR_DN to LOW position.

Connect the UtiliNet SBR to the test board through the board-to-board I/O connector.

Toggle the switch controlling the signal *PWR_DN to HIGH position to turn the UtiliNet SBR ON.

The switch controlling *LOW_RF_POWER may be toggled to set the transmit level of the UtiliNet SBR under test: whether to transmit with limited or full power and power consumption.

UtiliNet SBR Logic

Developers desiring to use the UtiliNet SCADA Single Board Radio in their SCADA equipment to monitor equipment should be aware of the logic of the setting when writing a DCW program. The following describes the logic for reading and writing at Control Registers 1 and 2 located at memory locations 7700h and 7700h in the radio using a DCW.

Control Register 1

D1-Input

Pin D1 at 7700h (Bits 0-3), if 7700h (Bit 0 = "0") Input then read Control at 7700h (Bits 2-3)

- If Control = "00" - General Purpose => Read state at 7700h (Bit 1) and report

- If Control = "01" - Rising Edge => Read count at 7706h (four bytes) and report
- If Control = "10" - Falling Edge => Read count at 7706h (four bytes) and report
- If Control = "11" - Either Edge => Read count at 7706h (four bytes) and report

D1-Output

Pin D1 at 7700h (Bits 0-3), if 7700h (Bit 4 = "0") Output then verify Control = "00"

- If NOT "00" => Report Error in configuration
- If "00" General Purpose => Set state at 7700 (Bit 1) and report

D2-Input

Pin D2 at 7700h (Bits 4-5), if 7700h (Bit 4 = "0") Input then read state at 7700 (Bit 5) and report

D2-Output

Pin D2 at 7700h (Bits 4-5), if 7700h (Bit 4 = "1") Output then set state at 7700 (Bit 5) and report

Control Register 2

A1-Input

Pin A1 at 7701h (Bits 0-2), if 7701 (Bit 0 = "0") Input then read Control at 7701h (Bit 2)

- If Control = "0" - General Purpose => Read state at 7701h (Bit 1) and report
- If Control = "1" - Analog to Digital Channel => Read channel at 7702h (two bytes) and report

A1-Output

Pin A1 at 7701h (Bits 0-2), if 7701 (Bit 0 = "1") Output then read Control at 7701h (Bit 2)

- If Control = "0" - General Purpose => Set state at 7701h (Bit 1) and report
- If Control = "1" - Analog to Digital Channel => Report Error in configuration

A2-Input

Pin A2 at 7701h (Bits 4-6), if 7701 (Bit 4 = "0") Input then read Control at 7701h (Bit 6)

- If Control = "0" - General Purpose => Read state at 7701h (Bit 5) and report
- If Control = "1" - Analog to Digital Channel => Read channel at 7704h (two bytes) and report

A2-Output

Pin A2 at 7701h (Bits 4-6), if 7701 (Bit 0 = "1") Output then read Control at 7701h (Bit 6)

- If Control = "0" - General Purpose => Set state at 7701h (Bit 5) and report
- If Control = "1" - Analog to Digital Channel => Report Error in configuration

Digital I/O Functionality

This device provides two general purpose digital I/O lines. These are controllable through the DCW programming language. It is outside the scope of this document to describe that language, but in brief, there are mechanisms by which each line can be independently configured as input or output. The state of inputs can be read, and the state of outputs can be set. The DCW code execution is a virtual environment and as such, is not fast. Users should understand the speed limitations associated with the use of these digital I/O pins.

The register below can be used to control either of the two general purpose I/O pins (D1 & D2).

Table 3-1. Control Register 1

Bit	Feature	Description	Dflt.
0	Pin D1 Direction	0: Input 1: Output	0
1	Pin D1 State	When D1, bit 0 is "0" and bit 2-3 is "00", then bit 1 returns current state as "0" or "1". When D1, bit 0 is "0" and bit 2-3 is not "00", then read location 7706-7709 which returns the count of the as defined in bit 2-3. When D1, bit 0 is "1" then the value can be read or set.	0
2-3	Pin D1 Control	00: General Purpose I/O 01: Count interrupts on rising edge 10: Count interrupts on falling edge 11: Count interrupts on either edge	0
4	Pin D2 Direction	0: Input 1: Output	0
5	Pin D2 State	When D2, bit 4 is "0" then bit 5 returns current state as "0" or "1". When D2, bit 4 is "1" then the value can be read or set.	0
6-7	Reserved	*N/A*	0

Analog Input Functionality

This device provides two general purpose analog inputs. These are filtered and connected to a 10-bit A/D converter.

The voltage reference for this A/D converter is 2.5 VDC +/- 60[mVDC] across the operating temperature range.

This A/D converter has the following specifications:

Table 3-2.

A/D characteristic	Specification
Resolution	10 bit
INL	+/-5 LSB
Absolute Accuracy	+/-5 LSB
DNL	+/-1 LSB
Offset Error	+/-3 LSB
Gain Error	+/-3 LSB

The actual sampling time is 0.25 µS and the conversion time is 2.75 µS, but the rate at which signals on these inputs can be sampled in-practice is limited by the DCW execution. It is recommended that these channels be used only for DC voltage measurement, and that the sampling rate can not exceed 100 mS.

The register below can be used to control either of the two general purpose Analog pins (A1 & A2).

Table 3-3. Control Register 2

Bit	Feature	Description	Dflt.
0	Pin A1 Direction	0: Input 1: Output	0
1	Pin A1 State	When A1, bit 0 is "0" and bit 2 is "0", then bit 1 returns current state as "0" or "1". When A1, bit 0 is "0" and bit 2 is "1", then read location 7702-7703 which returns the Hex value of the sampled voltage between 0-2.5 VDC. When A1, bit 0 is "1", then the value of bit 1 can be set.	0
2	Pin A1 Control	0: General Purpose I/O 1: Analog to Digital Channel (Bit 0 = "0" only)	0
3	Reserved	Not Used	0
4	Pin A2 Direction	0: Input 1: Output	0
5	Pin A2 State	When A2, bit 4 is "0" and bit 6 is "0", then bit 5 returns current state as "0" or "1". When A2, bit 4 is "0" and bit 6 is "1", then read location 7704-7705 which returns the Hex value of the sampled voltage between 0-2.5 VDC. When A2, bit 4 is "1", then the value of bit 5 can be set.	0
6	Pin A2 Control	0: General Purpose I/O 1: Analog to Digital Channel (Bit 0 = "0" only)	0
7	Reserved	Not Used	0

Memory Location

[7702-7703h] Analog to Digital Channel A1.

When A1 is set to "Analog to Digital" (Bit 2) this location will contain a 10-bit reading. The scale on this board is from 0 to 2.5 volts. Voltages greater than 2.5 VDC will be reported as 2.5 VDC.

[7704-7705h] Analog to Digital Channel A2.

When A2 is set to "Analog to Digital" (Bit 6) this location will contain a 10-bit reading. The scale on this board is from 0 to 2.5 volts. Voltages greater than 2.5 VDC will be reported as 2.5 VDC.

[7706-7709h] D1 Interrupt Counter.

If D1 is configured as an interrupt (bit 2-3) then this location will count the number of interrupts that have been detected.

The interrupt counter is cleared each time interrupts are enabled.

A
External Antenna

Manufacturer Contact Information

Manufacturers Marketing Group, Inc.
922-C Merchants Walk
Huntsville, AL 35801
Phone: 256-519-2455
Fax: 256-519-9299
Website: www.mmg-inc.com

Contact:
Sharon Tow
Inside Sales Manager
Ph: 256-519-2455
Fax: 256-519-9299
E-mail: sales@mmg-inc.com

RF External Antenna Cable Specifications

An external antenna is connected to the board via an RF coaxial cable as shown in Figure A - 1. See page 46 for product data sheet.

Figure A - 1. RF coaxial cable

The cable has a Reverse-Polarity N-Type Female/Jack connector on one end and an MCX Male connector on the other. This cable is available from MMG in lengths of 6", 12", and 18".

The MMG part numbers and typical insertion loss for these cables are shown in Table A-1:

Table A-1.

Length (inches)	Part number	Insertion Loss
6	21-1000-0	0.23 dB
12	21-1001-0	0.40 dB
18	21-1002-0	0.54 dB

External Antenna Specifications

The External Antenna used to qualify the board is a 5 dB whip (shown in Figure A - 2), made by MMG. The MMG antenna part number is 16-1000-0. See page 45 for product data sheet.

Figure A - 2. Whip Antenna with N-type Male Reverse-Polarity Connector

Ground Plane Specifications

Please note this antenna requires a ground plane. The ground plane needs to be at least 6" in diameter. See Figure A - 3.

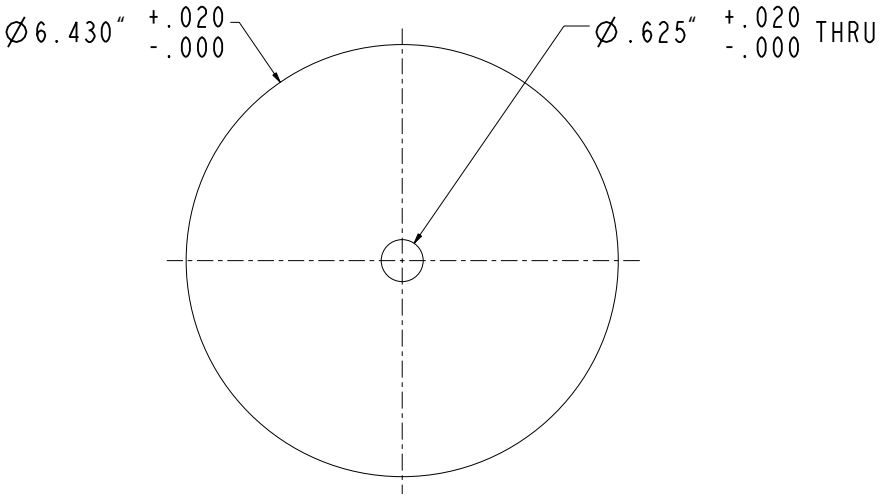


Figure A - 3. Ground Plane Specification

If the enclosure for the board is metal and at least 6" across, and the antenna is connected directly to the enclosure, no ground plane is required, as the enclosure is the ground plane. The radiation pattern of the approved antenna is of a traditional dipole (RF pattern as a donut). The orientation of the antenna should be in the vertical position (straight up or straight down), such that the RF pattern is Omni-directional in the horizontal plane.

This antenna's maximum gain is 5 dB and its efficiency is 80%.

Antenna Radiation Pattern

The antenna's radiation pattern is shown in Figure A - 4 and Figure A - 5.

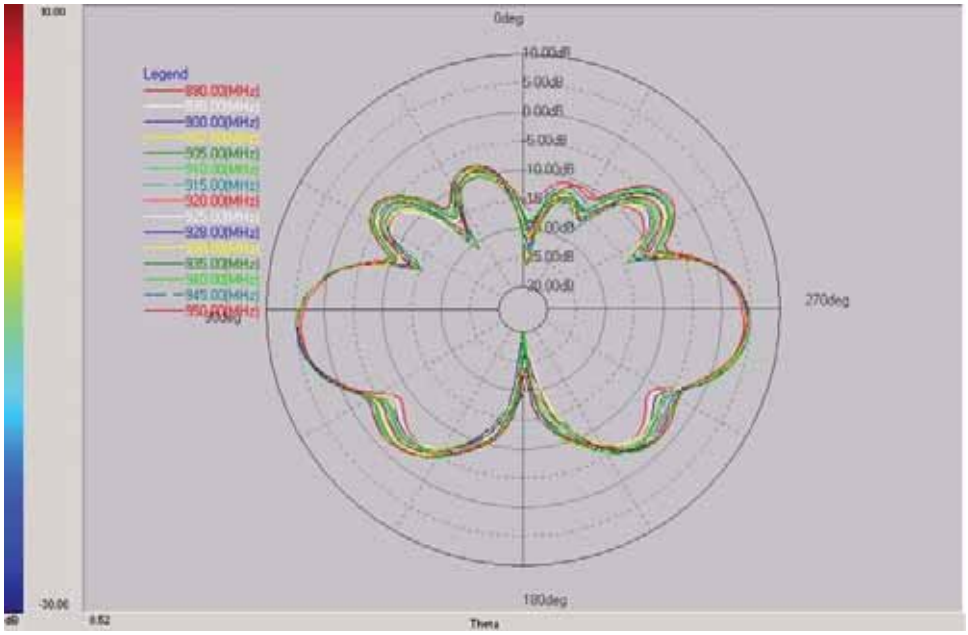


Figure A - 4. External Antenna Radiation Pattern, Side View

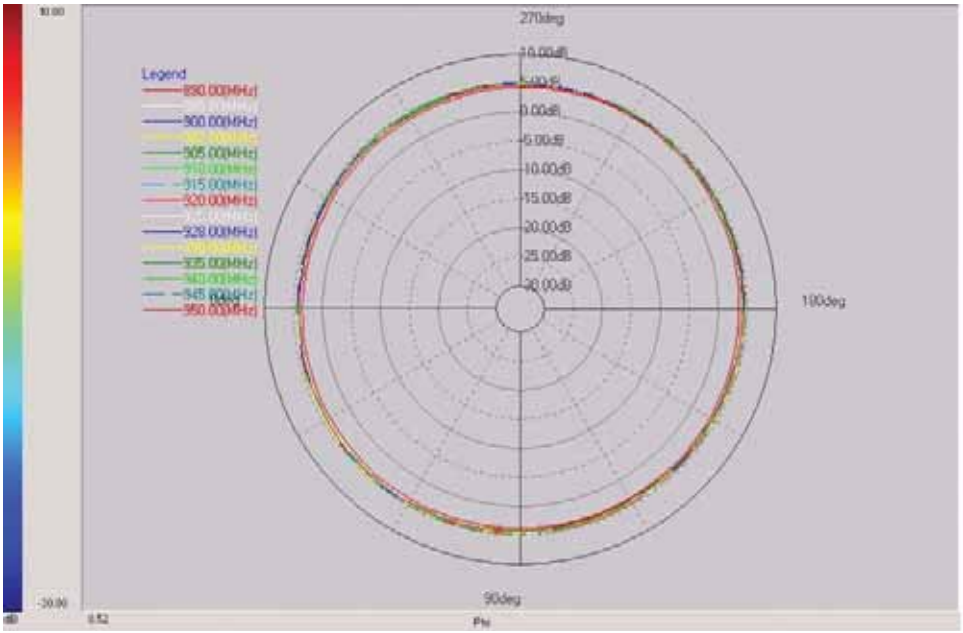


Figure A - 5. External Antenna Radiation Pattern, Top View

Identifying a Reverse-Polarized Connector

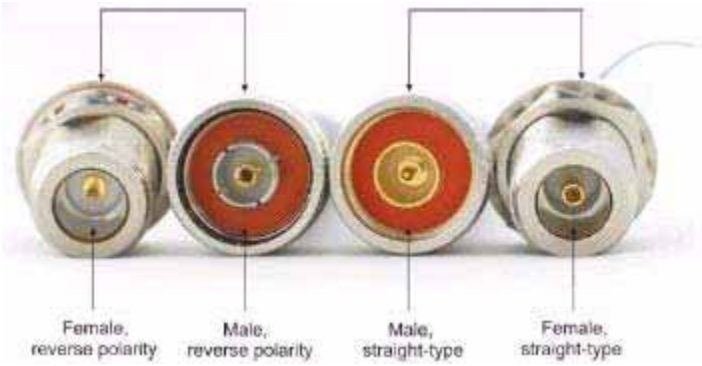


Figure A - 6. Reverse Polarity and Straight connectors

A reverse polarized coaxial connector alters the standard connector interface by utilizing a male pin center conductor in a female threaded coupling mechanism and a female basket center conductor in a male threaded coupling nut mechanism.

This prevents mating with a standard non-polarized connector. This type of connector is required by FCC part 15.203 rules for modular approval. See Appendix C on page 43.

B

On-Board Antenna

On-Board Antenna Specifications

The On-Board antenna design is an F-antenna. This design was chosen because its performance is more broad-band relative to a slot antenna, and its pattern is somewhat Omni-directional. This antenna's maximum gain is 0 dB and its efficiency is 45%. This version of the product does not allow an external antenna in conjunction to the on-board antenna.

Using the On-Board antenna, the recommended placement of the radio board is at the edge of the OEM board, with the antenna-side edge of the board extending beyond the edge of the board, hanging out in free space and facing up as shown below in Figure 1 - 8. If the antenna on the board does not extend out in free space, then the customer's board will load the antenna and affect the radiation pattern.

Also, an RF-transparent enclosure must be used (plastic or similar). Do not enclose the board within a metal box. If a metal box is required to house the assembly, then the external antenna version of the product should be considered.

The on-board F-antenna's radiation pattern in free space is nearly Omni-directional, but has nulls in the direction of the 14-pin I/O connector. The best way to visualize the antenna's radiation pattern is a semi-sphere about the antenna-side edge of the board.

The main radiating element is the long trace running the length of the board. The length of this trace sets the resonant frequency of the antenna. The thicker F element, parallel to the feed element, is the return path to ground. The length of the feed element and size of the gap between the feed and ground elements dictate the match of the antenna.

Figure B - 1. Recommended Board Orientation for Optimal Antenna Performance

Using the orientation of the antenna as described above, the antenna's radiation pattern is shown in the following figures.

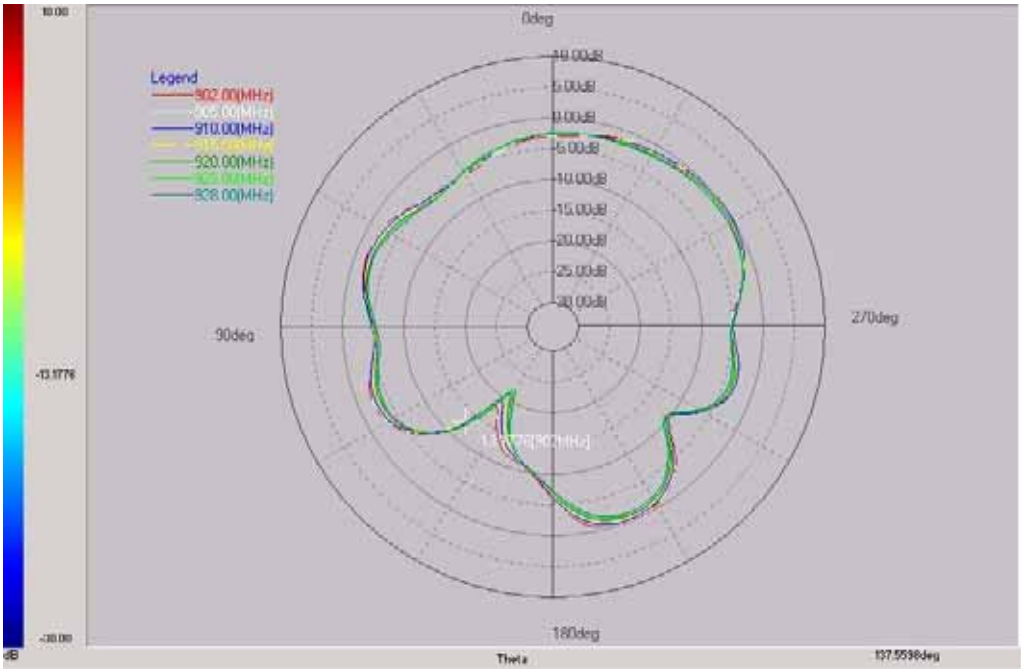


Figure B - 2. On-Board Antenna Radiation Pattern, Side View, Looking At the Components

Rotating the board 90° on the Z-axis, relative to the above plot (so the antenna is still up), the antenna's radiation pattern is shown in Figure B - 3.

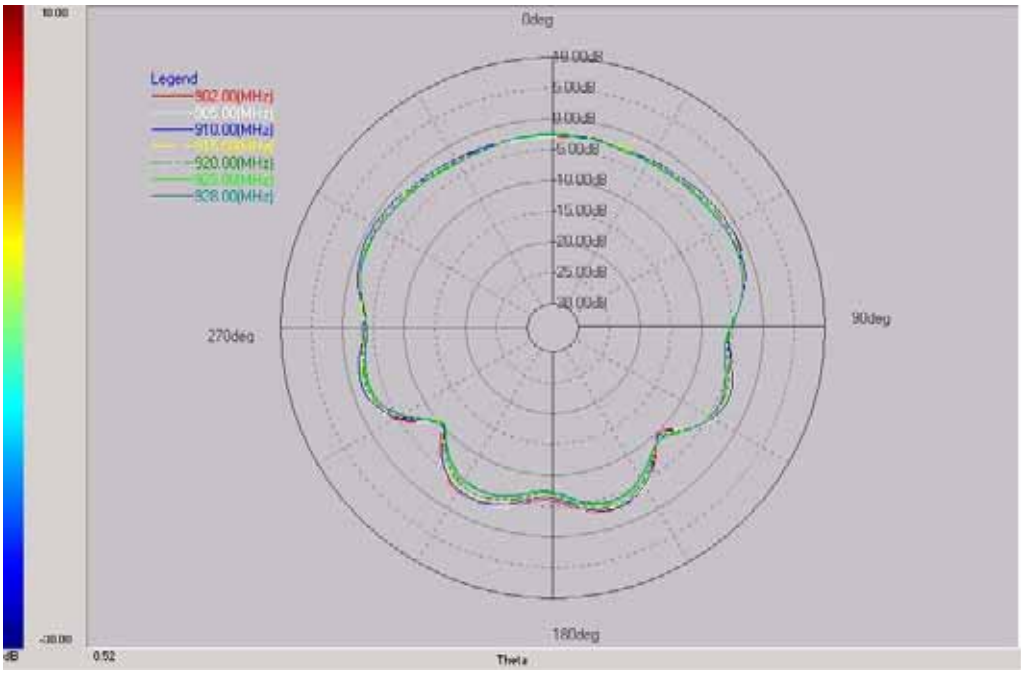


Figure B - 3. On-Board Antenna Radiation Pattern, Side View, Looking At the Edge of the Board

The Top View of the antenna's radiation pattern is shown in Figure B - 4.

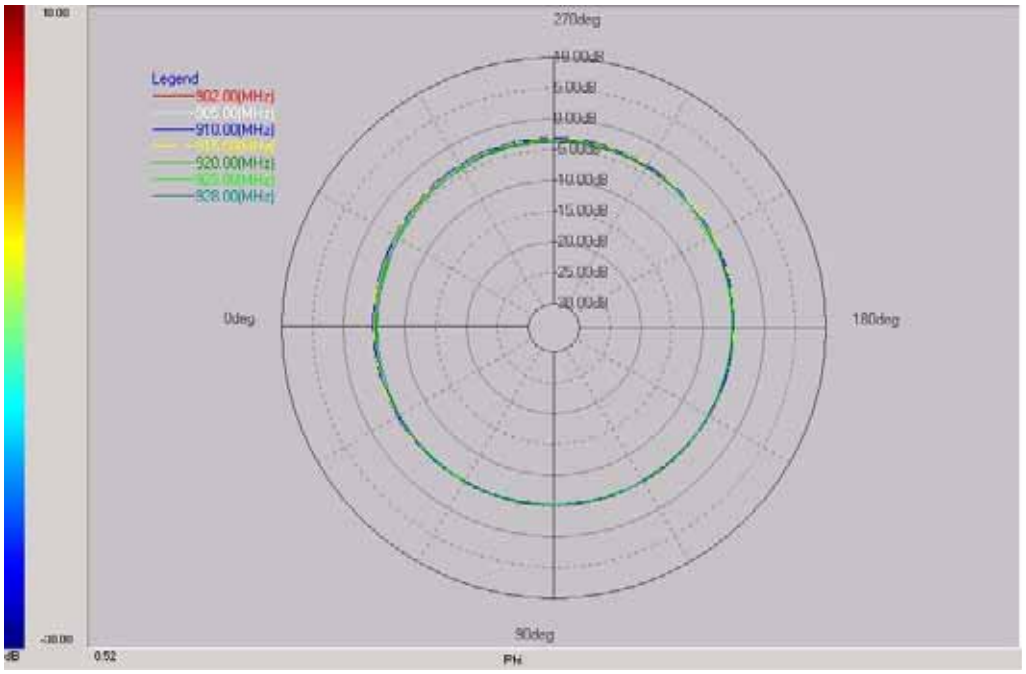


Figure B - 4. On-Board Antenna Radiation Pattern, Top View

C

Regulatory Compliance

The endpoint module has been designed to meet the following standards:

- FCC - CFR Part 15.247 - Radio Frequency Devices, Subparts A-General and B-Unintentional Radiators (testing is done at a module level for Modular Approval)
- Industry Canada

FCC - CFR Part 15.247

Both versions of this product are certified with Modular Approval under the same FCC ID number. Modular Approval is used because the product may be used in a variety of customer assemblies and configurations. Modular Approval avoids the need to qualify each individual end-product assembly. However, the customer must adhere to certain rules in order to stay compliant.

For customers using the Internal Antenna version, an FCC ID sticker must be affixed to the outside of the end-product assembly, stating this Modular SCADA/DA Utilinet board is contained within.

For customers using the External Antenna version, the end-product assembly must also have an FCC ID sticker stating this Modular SCADA/DA Utilinet board is contained within. In addition, though, special rules apply to the antenna:

- The antenna (and any associated RF cables connecting the antenna to the board) must be exactly the same as the one used for certification OR the same type antenna and equal or less gain than the antenna used for certification.
- The antenna (and associated RF cables) must have unique connectors, so that an end user cannot connect a non-approved antenna.

The point is that the FCC does not want a customer to attach an antenna with more gain and thereby possibly exceed the radiated output power and spurious limits. Landis+Gyr chose to use a 5 dB whip antenna made by MMG (Manufacturer's Marketing Group) to qualify this product. More information about this specific antenna is found in “External Antenna” on page 35.

This antenna was chosen due to its good performance, availability, relatively low cost, and comprehensiveness (qualification with this antenna should cover most other antennas available on the market that could potentially and realistically be used with this product).

If a customer wants to use a different antenna, they are welcome to do so. If the alternate antenna is the same type (whip) and equal or less gain (5 dB), then it falls under Modular Approval and no further action is required. However, if the antenna is a different type or more than 5 dB gain, the customer must re-qualify the assembly for compliance.

The requirement for unique connectors is satisfied by using an MCX Female connector on the Modular SCADA/DA Utilinet board and a Reverse-Polarity N-Type Male/Plug connector on the 5 dB whip antenna from MMG. MMG also makes the RF coaxial cable to connect this antenna to the

board. The RF cable has a Reverse-Polarity N-Type Female/Jack connector on one end and an MCX Male connector on the other. More information about this RF cable is found in “External Antenna” on page 35.

For Class B Devices:

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.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the Instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Consult Landis+Gyr or an experienced radio technician for help.

Changes or modifications to this device not expressly approved by Landis+Gyr could void the user's authority to operate the equipment.

RF Exposure

In accordance with FCC requirements of human exposure to radio frequency fields, the radiating element shall be installed such that a minimum separation distance of 20 centimeters will be maintained.

Industry Canada

This Class B digital apparatus meets all requirements of the Canadian Interference Causing Equipment Regulations. 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.

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that permitted for successful communication.

This device has been designed to operate with an antenna having a maximum gain of 5 dBi. Antennas with a gain greater than 5 dBi are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.

Cet appareillage numérique de la classe B répond à toutes les exigences de l'interférence canadienne causant des règlements d'équipement. L'opération est sujette aux deux conditions suivantes: (1) ce dispositif peut ne pas causer l'interférence nocive, et (2) ce dispositif doit accepter n'importe quelle interférence reçue, y compris l'interférence qui peut causer l'opération peu désirée.

Pour réduire le risque d'interférer avec d'autres utilisateurs, le type d'antenne et son gain doivent être choisis de telle sorte que la Puissance Isotrope Rayonnée Equivalente (P.I.R.E) ne soit pas supérieure à celle autorisée pour une communication réussie.

Cet appareil a été conçu pour opérer avec des antenne ayant un gain maximum de 2dBi. Les antennes n’ayant pas un gain supérieur à 2 dBi sont strictement interdites pour une utilisation avec cet appareil. L'impédance d'antenne requise est de 50 ohms.

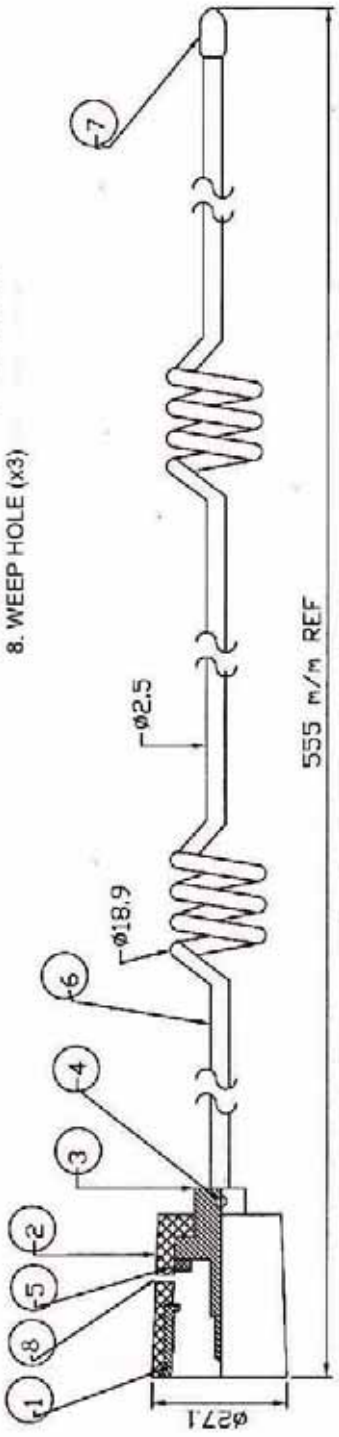
Whip Antenna P/N 16-1000-0

MANUFACTURERS MARKETING GROUP, INC.
www.MMG-Inc.com
ph 256.519.2455
fx 256.519.9299
(send PO's to Sales@MMG-Inc.com)

MMG Part # 16-1000-0

MATERIAL/ FINISH

1. GROUND BODY:	BRASS / NICKEL
2. OUTER SHELL:	UV POLYCARBONATE / BLACK
3. CONTACT:	BRASS / NICKEL
4. SCREW:	STAINLESS/ NATURE
5. O-RING:	RUBBER/ BLACK
6. WHIP:	STAINLESS/ BLACK CHROME
7. TOP:	PVC/ BLACK
8. WEEP HOLE (x3)	



Antenna Base
(Reverse-Polarity N-type Male/Plug)

ELECTRICAL SPECIFICATIONS

Frequency	920 MHz
Frequency Range	920 +/- 50 MHz
Gain (nominal)	5 dB
Return Loss	<-18 dB
V.S.W.R.	<1.5
Impedance	50 Ω
Connector	Reverse-Polarity N-type Male/Plug

This drawing is for information purposes only.

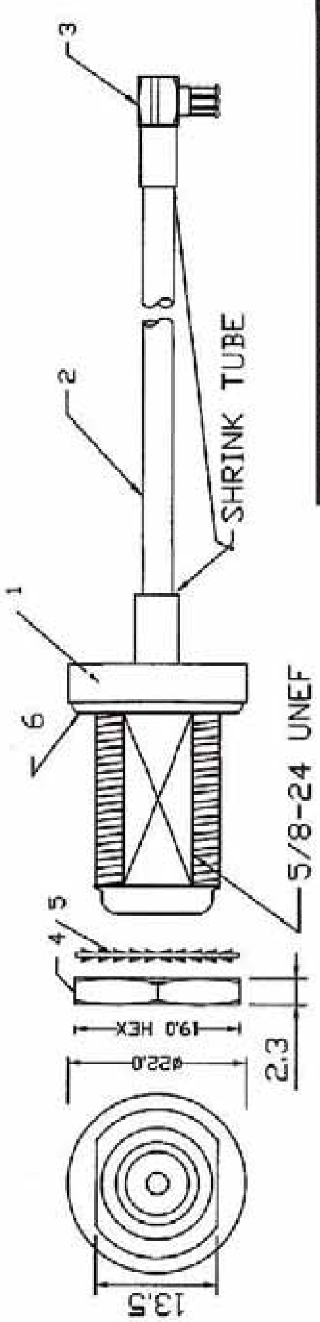
MCX RF Connector P/N 21-1000-0

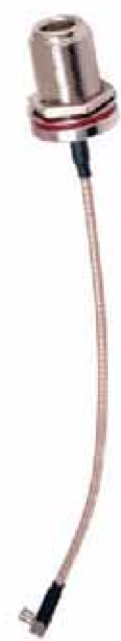
MANUFACTURERS MARKETING GROUP, INC.
www.MMG-Inc.com
ph 256.519.2455
fx 256.519.9299
(send PO's to Sales@MMG-Inc.com)

MMG Part # 21-1000-0 (6 inch coax)
MMG Part # 21-1001-0 (12 inch coax)
MMG Part # 21-1002-0 (18 inch coax)

MATERIAL/ FINISH

1. N CONNECTOR:
   - BODY: BRASS / NICKEL
   - CONTACT: BRASS / GOLD PLATED
   - INSULATION: TEFLON / NATURE
2. CABLE: RG-316U
3. MCX CONNECTOR:
   - BODY: BRASS / NICKEL
   - CONTACT: BRASS / GOLD PLATED
   - INSULATION: TEFLON / NATURE
4. NUT: BRASS / NICKEL
5. SPRING WASHER: IRON / NICKEL
6. O-RING: SILICON RUBBER / RED





ELECTRICAL SPECIFICATIONS

	6 inch	12 inch	18 inch
Frequency	900 MHz	900 MHz	900 MHz
Insertion Loss (typical)	-.23 db	-.40 db	-.54 db
V.S.W.R. (typical)	1.12	1.06	1.13
Impedance	50 Ω	50 Ω	50 Ω
Connectors	R/A MCX Male, Reverse-Polarity N-type Female/Jack		

This drawing is for information purposes only.