WILKERSON INSTRUMENT CO., INC.
www.wici.com

DR9050 / DR9051R

WIRELESS POLLING DATA ACQUISITION SYSTEM MODBUS RTU PROTOCOL

INSTALLATION & OPERATION MANUAL

BASIC SYSTEM DESCRIPTION

The DR9050 / DR9051R is a polling wireless data acquisition system. A single DR9050 provides a portal which allows a Modbus Master Controller (MMC) to interrogate from 1 to 247 DR9051R remote transmitters and report the requested data to the MMC using the RTU protocol.

The system requires only one DR9050 and at least one DR9051R remote transmitter. The DR9051R is an RF transmitter that will accept both analog and switch contact inputs. Analog data and switch status is transmitted upon request to the DR9050.

A query for data sent to the DR9050 by the MMC, forces the DR9050 to broadcast an RF transmission with a specific address of a DR9051R remote transmitter in its data packet. The DR9051R addressed receives the query and responds with a transmission back to the DR9050. The DR9050 sends the requested data to the MMC.

The physical layout of the system must be designed so the DR9050 RF transmission can be received by all DR9051R units in the system.

RF SYSTEM DESCRIPTION

The DR9050 and DR9051R have a plug-in RF transceiver module. Three different modules are available.

The system can be ordered as a 910 - 917MHz, 920 - 927MHz or 2.4GHz system. All three systems take advantage of the unlicensed ISM frequency bands. Both of the 900MHz systems have a transmit power of 100mW (20dBm) with a receive sensitivity of -110dBm. The 2.4GHz system has a transmit power of 50mW (17dBm) with a receive sensitivity of -105dBm.

The communication rate between the DR9050 and DR9051R is 9600 baud. The RF modules utilize spread spectrum, frequency hopping technology to allow reliable communications with a minimum of interference from other RF signals.

Spread spectrum, frequency hopping indicates the transmitter and receiver have the ability to hop between frequencies in a controlled sequence in a defined range of frequencies. The 3 modules available each have 7 hop sequences available that hops the frequency through 25 steps in the defined frequency band. For a given module, this allows up to 7 systems to operate in close proximity without interfering with each other. With all 3 modules available, up to 21 systems can be operated in close proximity without interfering with each other.

REPEATER CAPABILITY

The DR9051R remote transmitter has a repeater capability that is useful for data monitoring in areas where

the DR9050 cannot communicate directly with a DR9051R due to distance or obstructions in the transmission path.

A normal system has the DR9051R units and the DR9050 all set on the same hop sequence. The DR9050 transmits the address of the DR9051R of interest. The DR9051R responds with the desired data.

A DR9051R that can communicate with the DR9050 and is also able to communicate with the obstructed DR9051R is chosen as a Repeater. A dip switch in this DR9051R selects the Repeater mode and allows a hop sequence to be selected with a dip switch.

The obstructed DR9051R has its system hop sequence set at a value other than the DR9050 hop sequence (system value). The DR9051R Repeater has the same hop sequence set on the dip switch as the obstructed DR9051R has set in its memory.

When the DR9050 polls the obstructed DR9051R address, the DR9051R in the Repeater mode will rebroadcast the poll data on the hop sequence set on its dip switch.

The obstructed DR9051R will receive the addressed query from the Repeater and respond by transmitting the data. The DR9051R Repeater will receive the data, change its hop sequence to the system value and transmit the data which will be received by the DR9050.

The total number of Repeaters allowed in a system is large. Each Repeater has 6 hop sequences it can use, and also has the obstructed DR9051R's addresses as a further selection tool.

A simple straight line application would allow 7 DR9051R's to be used to collect data up to over 100 miles distance. The hop sequences would be set as shown below. This can be varied to fit the need.

DR9050 System Hop = 0

DR9051R #1 Hop = 0 - Repeater Hop = 1
DR9051R #2 Hop = 1 - Repeater Hop = 2
DR9051R #3 Hop = 2 - Repeater Hop = 3
DR9051R #4 Hop = 3 - Repeater Hop = 4
DR9051R #5 Hop = 4 - Repeater Hop = 5
DR9051R #6 Hop = 5 - Repeater Hop = 6
DR9051R #7 Hop = 6

This system could be expanded by repeating the above system. Once a DR9051R is out of the range of a DR9051R with the same hop sequences, the hop sequences can be repeated.

In the first example, the last DR9051R in the group would use hop sequence 6 to receive

and transmit. It could be set as a Repeater and retransmit on hop 0. Another string of 7 units could be used. This expansion process could be repeated until 247 DR9051R's are in the system.

A DR9051R Repeater changes its hop value to its system value as soon as it receives a response for the repeater query. If no response is received, the DR9051R times out and switches from its repeater hop value to its system hop value.

Utilizing the DR9050 Setup Software, system hop sequences can be ascertained and changed for the DR9050 and all of the DR9051R units in the system. The dip switch repeater hop value must be manually changed at the DR9051R.

ANTENNAS & COAXIAL CABLES

Reliable operation of a wireless system requires adequate signal strength from the transmitters arrive at the receivers. To insure adequate signal strength, consideration must be given to the site layout, the antennas, and the coaxial cable used.

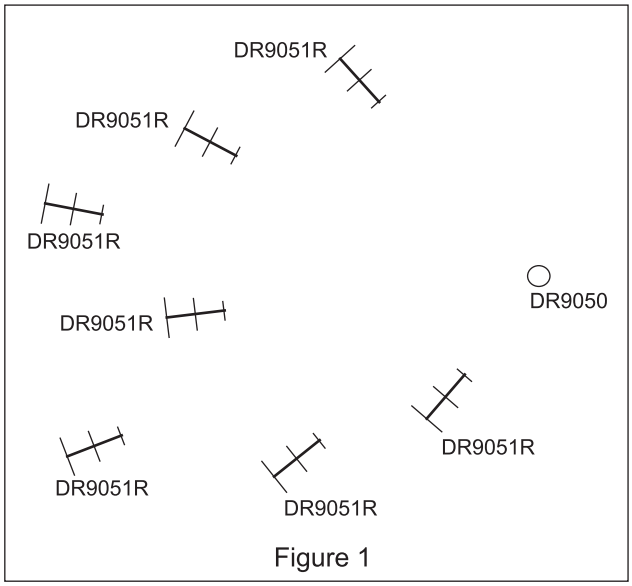


Figure 1

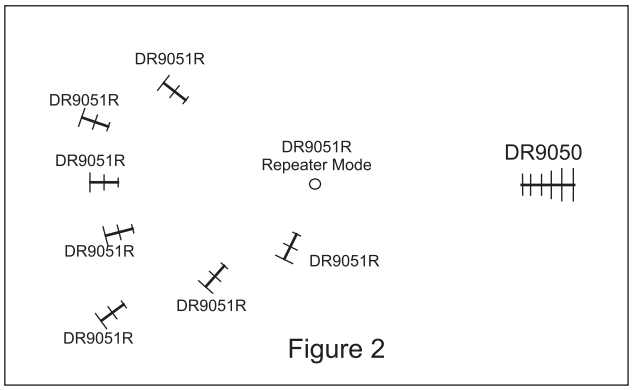


Figure 2

Site Layout

A polling system typically locates the DR9050 at a control center and the DR9051R remote transmitters at the different sites of data collection. The antenna used on the DR9050 is typically omnidirectional. It has a radiation pattern like a horizontal doughnut. The antennas used on the DR9051R's are usually low gain directional yagi antennas which are mounted, with the elements vertical, pointed at the omnidirectional antenna of the DR9050. The gain required is dependent on terrain and distances involved. The DR9050 omnidirectional antenna is required so all the DR9051R's are in the radiation pattern of the DR9050. See Fig. 1

Systems with data collection sites in close proximity can successfully use small vertical antennas (omnidirectional) on each DR9051R.

Different types of antennas can be used on the DR9051R's to meet the needs of signal strength.

If the distance between the points of data acquisition and the DR9050 is great, a high gain antenna can be used on the DR9050 and it communicates with a DR9051R in the Repeater mode. The Repeater DR9051R rebroadcasts data queries with an omnidirectional antenna. Each DR9051R responds through low gain antennas pointed at the Repeater DR9051R omnidirectional antenna. The Repeater then transmits to theDR9050. See Fig. 2.

Coaxial Cables

The DR9050 and DR9051R have small RF connectors to make the connection to the antenna. The units are usually mounted in an electrical enclosure and the coaxial cable must run from the small connector to the antenna. A short, small diameter cable is used from the DR products connector to a bulkhead connector mounted in the side of the electrical enclosure. A larger diameter cable is then used to complete the connection to the antenna.

The small cable allows small bend radiuses inside the enclosure for routing convenience. The large cable from the bulkhead connector to the antenna provides less signal loss.

A transient suppressor should be mounted at the bulkhead connector to protect the system from lightning.

SYSTEM CONTENTS

A system includes:

- This Installation / Operation manual
- DR9050 Setup Software CD
- DR9050 control unit
- DR9051R remote transmitters for each data collection site and stand alone repeater function
- DB9 connector to 4 pin plug-in terminal block cable adapter for computer RS232 connection
- CRC disable jumper (see below)

The following material must be defined and ordered

- Antennas and accessories for each DR product
- Coaxial cables for each DR product
- Bulkhead connectors as required
- Transient suppressors as required
- Coaxial cable for final run to antennas
- Any other accessories required for the completion of the system

The DR9050 Setup software requires a computer (PC or laptop) with an RS232 serial port, an RS232 cable and Windows 98, Windows XP, or Windows Vista operating system.

If a USB port is the only available port, a USB to RS232 adapter can be used to mate the computer to the DR9050. See PN4420 in the Wilkerson Instrument Company Wireless Catalog

The RS232 cable connects the computer to the DR9050 via the DB9 to plug-in terminal cable adapter. A jumper (supplied) is required for 2 of the DR9050 terminals. This jumper disables the Cyclical Redundancy Check (CRC) error checking used by the Modbus RTU protocol.

SYSTEM SETUP

Before the DR9050 can be used, it must have system addresses assigned to each DR9051R in the system. Each DR9051R is assigned a unit ID at the factory. The unit ID is on the DR9051R label and on its printed circuit board.

A list of the unit ID (nnn, nnn, nnn) and physical location (or application) of each DR9051R should be compiled to help with the assignment of the system addresses. A worksheet can be printed from the Address Editor in the DR9050 Setup software.

The Address Editor allows a System Address (1 - 247) to be assigned to each DR9051R. It also provides space for notes or comments for each system address. The address data can be saved for a project.

The Wilkerson supplied software is an editor that simplifies the assignment of system addresses to each DR9051R in the system. Install the software and read the Help files for detailed help on the process.

The Setup software also allows data to be read from each DR9051R in the system. System hop numbers can also be changed in the entire system from the DR9050 site.

CONNECTING TO THE DR9050

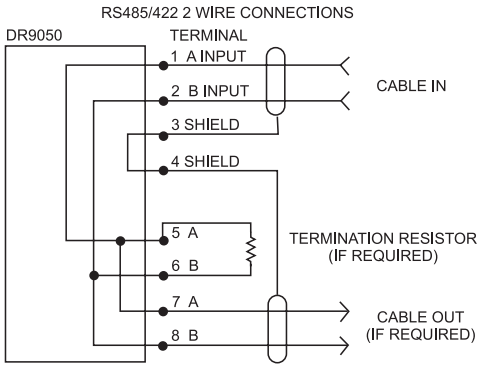
Serial Connection RS485/422

The DR9050 is a portal to 1 to 247 DR9051R remote transmitters. It only responds to queries received from a Modbus Master Controller (MMC) via the RS485/422 serial connections.

To query the DR9050 for data, a MMC must be connected to the RS485/422 terminals. The MMC can be a PLC, PC, Data logger, DCS, or any device that is capable of acting as a Modbus RTU master controller.

Use the controller's installation instructions along with the terminal locations identified in Figure 3 to determine the proper wiring of the communication cable.

The DR9050 can be part of a system that includes wireless data acquisition as well as hard wired instruments connected to the RS485/422 transmission line in parallel with the DR9050.



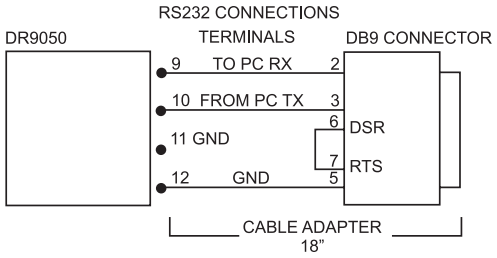
For MODBUS® RTU operation, the DR9050 requires serial communications of 9600 baud, 1 start bit, 8 data bits, no parity, and 2 stop bits.

Serial Connection RS232

The DR9050 RS232 port is designed primarily to allow the DR9050 set-up software to be used with a PC or laptop to control the set-up of the DR9050.

Custom software can be written that utilizes the RS232 port without using the MODBUS protocol.

A DB9 to 4 pin terminal cable adapter is provided for making connection to the RS232 port.

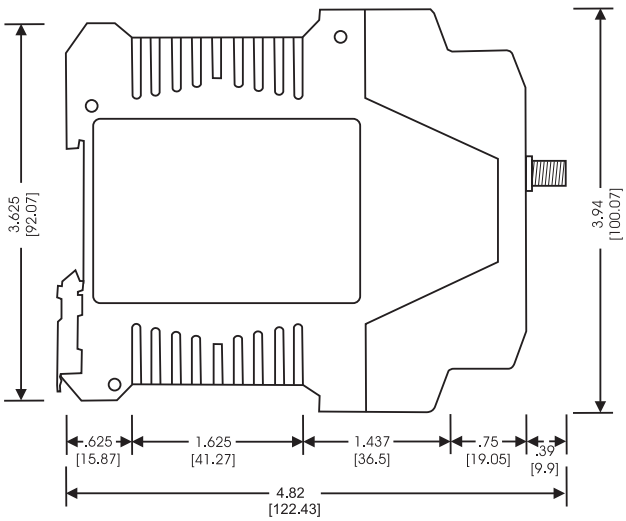


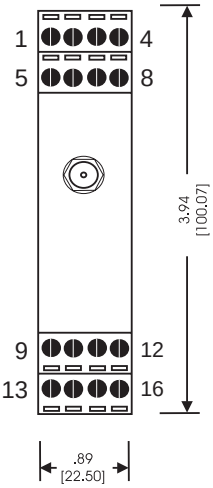
When using the RS232 port for set-up with the supplied Wilkerson set-up software, a jumper is required across TB pins 13 and 14. This disables the CRC error checking system used by MODBUS® RTU system.

RS485/422 and RS232 Interaction

When the RS485/422 port is used to implement a MODBUS® RTU system, the RS232 port mirrors the data sent, as an output, on the other port.

When the RS232 port is controlling the DR9050, the RS485/422 port mirrors the data sent out on the other port.





DR9050

TERMINAL	CONNECTION
1	RS485 Terminal A
2	RS485 Terminal B
3	RS485 Common/Shield
4	RS485 Common/Shield
5	RS485 Terminal A
6	RS485 Terminal B
7	RS485 Terminal A
8	RS485 Terminal B
9	RS232 RX
10	RS232 TX
11	RS232 Ground
12	RS232 Ground
13	CRC Bypass Jumper
14	CRC Bypass Jumper
15	AC L1 Power
16	AC L2 Power

Figure 3

DR9051R-01 Dual DC Input

TERMINAL	CONNECTION
1	DC Input 1 +
2	DC Input 1 -
3	DC Input 2 +
4	DC Input 2 -
5	Switch 1 +
6	Switch 1 -
7	Switch 2 +
8	Switch 2 -
9	Switch 3 +
10	Switch 3 -
11	Switch 4 +
12	Switch 4 -
13	No Connection
14	No Connection
15	DC Power +
16	DC Power -

DR9051R-02 Bridge Input

TERMINAL	CONNECTION
1	Input +
2	Input -
3	No Connection
4	Shield
5	Switch 1 +
6	Switch 1 -
7	Switch 2 +
8	Switch 2 -
9	Switch 3 +
10	Switch 3 -
11	Switch 4 +
12	Switch 4 -
13	10VDC Exc +
14	Exc -
15	DC Power +
16	DC Power -

DR9051R-03 RTD Input

TERMINAL	CONNECTION
1	RTD +
2	RTD Common
3	RTD Common
4	Shield
5	Switch 1 +
6	Switch 1 -
7	Switch 2 +
8	Switch 2 -
9	Switch 3 +
10	Switch 3 -
11	Switch 4 +
12	Switch 4 -
13	No Connection
14	No Connection
15	DC Power +
16	DC Power -

INSTALLATION

The DR Series products mount on standard 35mm DIN rails. Install by hooking the top of the case's latch onto the top of the DIN rail. Then push down on the case, letting it pivot on the DIN rail. The bottom slide of the mount will snap behind the rail and secure the product.

To remove, insert a screwdriver into the hole on the metal latch at the bottom of the case, and pull the latch down until it allows the front of the case to be lifted up.

The enclosure depth must be deep enough to accommodate the antenna connector and cable. See Figure 3 for details of the case dimensions.

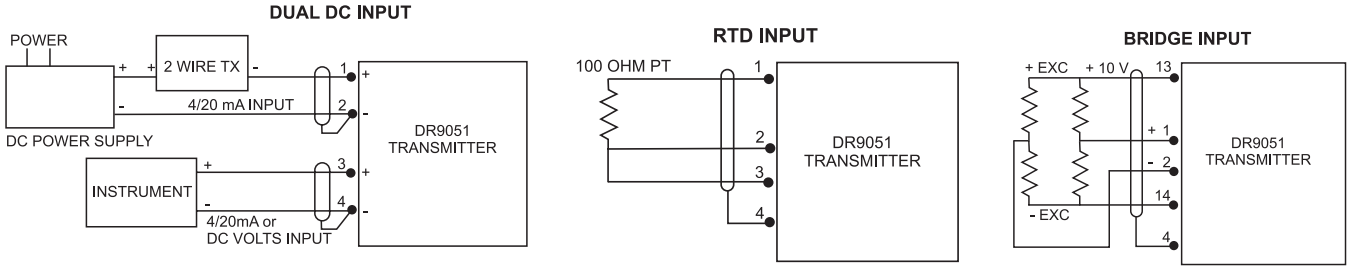
Note: Correctly identify the DR9050 and DR9051R and note power requirements before snapping onto the DIN Rail. Once installed the side label may not be visible.

CONNECTING TO THE DR9051R TRANSMITTER

Analog Inputs

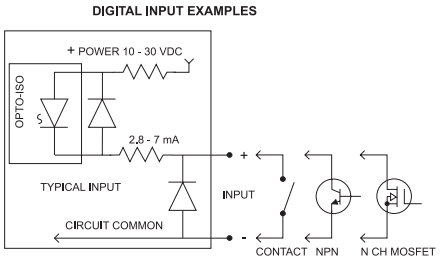
The DR9051R accepts dual DC, single RTD or single bridge analog inputs as noted on the right side of the product. Refer to this label to determine the input type and range that the product is configured to receive.

Figure 3 shows the terminal connections for the DR9051R. The following diagrams show typical configurations for wiring the analog input channels.



When wiring the input signal to the DR9051R, certain precautions need to be made to insure a clean signal is provided. Twisted and shielded wire is recommended from the sensor or instrument output to the input of the DR9051R transmitter. The twisting of the leads provided resistance to magnetic coupling which can occur if signal leads are run too close to conductors carrying AC currents. Shielding prevents capacitive coupling interference from devices such as SCR Drives, relay coils, and equipment such as welding machines. Connection of the shield should be only at the DR9051R end and never at the sensor or ground.

Switch Inputs



The DR9051R accepts four discrete inputs. Refer to Figure 3 for location of the terminal connections. These are dry contacts or open collectors that require no external supply voltage. The DR9051R supplies voltage across the switch inputs equal to the power supply voltage. Applying external voltage across the switch inputs will result in damage to the DR9051R and will void the warranty.

Connecting Power to the DR9050 and DR9051R

WARNING: Before connecting power to either unit please read the label to ensure the correct power is being supplied. The DR9050 is AC powered. Applying the wrong power will damage the unit.

Once the proper power requirement is determined for each unit, connect the power leads to the terminal connections as shown in Figure 3. The DR9050 and DR9051R do not have power LED's and no response is expected from the units once they are powered. The LED's on the units only respond when the units are queried. The power leads should always be tested before attempting to access the units and/or removing the terminal blocks.

Terminal Connections

Once wired, the terminal blocks can be unplugged as necessary for maintenance, eliminating the need for disconnecting all wiring. To remove the terminal blocks, simply pry the blocks off their connector pins using a small screwdriver inserted under the front edge of each terminal block.

Calibration

The system was factory calibrated and does not require field calibration.

Connecting the Antenna to the DR9050 and DR9051R

The antenna connects to the Reverse Polarity SMA (RPSMA) connector on the front panel of the DR9050 and DR9051R. Large cable sizes (400, 600 size cable) should not be directly connected to the product unless the cable can be connected with no stress/strain on the front panel connector.

Small diameter cables are available to connect the RF unit to a bulkhead connector. Larger cable can then be used from the bulkhead connector to the antenna.

When connecting the cable to the front panel connector, the connection should be hand tight. Ensure that the connection is tight, but use of a wrench to tighten beyond hand tight may damage the connector.

IMPORTANT

Lightning is also a primary consideration when attaching outdoor antennas to the DR products. A grounded surge arrestor must be connected in the coax line between the antenna and the transmitter. Using an outdoor antenna without a surge suppressor will void the warranty.

Setup and Operation of the Wireless Polling System

If possible, the wireless polling system should be bench tested to ensure all setup options and programming is correct.

Use the following steps as a guide for setting up the DR9050 and verifying communications with the DR9051.

Determine the MODBUS address to be assigned to each DR9051R in the system. Each DR9051R will need to be assigned a different MODBUS Address between 1 and 247. Note the Unit ID on the side label of each DR9051R.

Install the DR9050 setup software shipped with the DR9050 on a PC with a serial port.

Jumper Terminals 13 and 14 of the DR9050. This jumper sets the DR9050 in a mode to allow it to communicate with the user setup software.

Determine the type of PC serial connection to be used with the user setup software (RS232 or RS485). Disconnect any power that is being applied to the DR9050. Open the DR9050, and set the RS485/RS232 switch to the proper position. To open the DR9050 squeeze the two tabs that hold the case front section to the rear section and pull the case apart. The circuit board is attached to the front section and will slide out of the case.

Close the case and connect the DR9050 to a PC serial port via a standard RS232 connection and the supplied cable adapter or via a RS485 Converter (See CONNECTING TO THE DR9050 MCU (Pages 4 - 5 and Figure 3).

Apply power to the DR9050 and run the DR9050.exe application. Select “Edit System Address” from the top menu. Then select “Load Memory List”. A text box on the right hand side of the screen should begin to populate with System Addresses, and Unit Id’s of every DR9051 programmed into the DR9050’s memory. If no units are programmed all “0” will fill the box. If the information does not load then check the serial connection and jumper to ensure your connection is correct.

Follow on-screen help to assign a system address to every DR9051 in the polling system. Verify that the addresses assigned are correct.

Select “Query Data” from the top menu. Enter the System Address of each DR9051 in the system and click “Query” to verify communication with the proper DR9051. If one or more DR9051’s do not respond to the queries verify and set the hop sequence as needed.

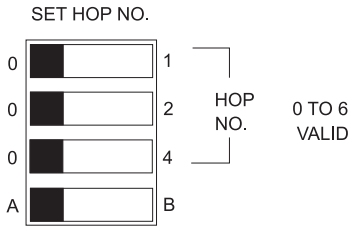
Remove power from the DR9050. Remove the jumper between Terminals 13 and 14. Confirm that theRS232/ RS485 switch is in the RS485 position for connecting to the MODBUS master controller.

Connect the DR9050 to the MODBUS master controller and reapply power.

If a DR9051 is to be used in the repeater mode, set the DIP switch to the desired positions and program the proper HOP value into memory on the obstructed DR9051.

Set Repeater Mode

Set position 4 to B - Repeater Mode



Set desired HOP value on other 3 positions. The HOP value is equal to the sum of the selected switch positions. Example - A value of 3 requires positions 1 and 2 to be on.

The obstructed DR9051R must have its memory hop value set equal to the switch. This is accomplished with the DR9050 Software.

Register Location of Data (All values are decimal values)

Input Coils (Switch Status)
Registers 10001-10004

Example Queries:	Start at SW 1, Read 1	Start at SW 2, Read 3
Slave Address	(1-247)	(1-247)
Function	02	02
Starting Address Hi byte	00	00
Starting Address Lo byte	01	02
No. of Points Hi byte	00	00
No. of Points Lo byte	01	03
CRC	—	—
CRC	—	—

A 1 bit indicates a closed switch; a 0 bit indicates an open switch. A byte is returned. The decimal value of the byte indicates the status of the switch(es) queried.

Analog Data Channels
Registers 30006 - 30008

Analog data is a 12 bit binary value. The Hi byte is the 4 msb and the Lo byte is the 8 lsb.
The value of the two is: (256 X Hi value) + Lo value
Zero Scale = 100, Full Scale = 4000

Channel 1		Channel 2		Channel 1 & 2	
Function	04	Function	04	Function	04
Starting Address Hi byte	00	Starting Address Hi byte	00	Starting Address Hi byte	00
Starting Address Lo byte	07	Starting Address Lo byte	08	Starting Address Lo byte	07
No. of Points Hi byte	00	No. of Points Hi byte	00	No. of Points Hi byte	00
No. of Points Lo byte	01	No. of Points Lo byte	01	No. of Points Lo byte	02
CRC	—	CRC	—	CRC	—
CRC	—	CRC	—	CRC	—

Register 6 is a special case. It is not true Modbus protocol, but many MMC, especially PLC's have the ability to use the features of this special case. It can also be used to write custom software for the DR9050.

This single query of Register 6 for 5 data points returns all the data the DR9051R and DR9050 can provide. It includes all switches, all analog, and the signal strength at the DR9051R and DR9050. (10 data bytes)

All Data - Single Query	
Function	04
Starting Address Hi byte	00
Starting Address Lo byte	06
No. of Points Hi byte	00
No. of Points Lo byte	05
CRC	—
CRC	—

DR9050 Response Decimal Values All Data	
Slave Address	2
Function	4
Bytes Received	10
Switch Data Hi Byte	0
Switch Data Lo Byte	6
Analog CH1 Hi Byte	15
Analog CH1 Lo Byte	255
Analog CH1 Hi Byte	15
Analog CH1 Lo Byte	255
DR9051R SS Hi Byte	0
DR9051R SS L Byte	25
DR9050 SS Hi Byte	0
DR90510 SS L Byte	51
CRC Lo Byte	--
CRC Hi Byte	--

TESTING THE RF LINK

Once all DR9051R's are installed and powered the RF signal strength can be tested to ensure reliable operation.

With all antennas connected and installed, use the following steps as a guide for testing the RF signal strength.

Apply power to all units in the area. Remove the communication cable from the DR9050. Monitor the DR9050 and all DR9051R's associated with the polling system to ensure that the green RX LED is not flashing. If the RX LED is flashing, change HOP Sequences on all units and repeat this step.

Connect the DR9050 to a PC and run the DR9050 Setup software in the "Setup - Non-CRC" mode. Under the menu heading "Query Data" query each DR9051R and note the RSSI (received signal strength). If the DR9051R does not respond or if the RSSI value is less than -85 dBm the antennas, cables, and connectors for both the DR9050 and DR9051R may need to be adjusted, changed or repaired.

Verify that all antenna cables and connectors are continuous and not shorted. This includes any pigtail cables, bulkhead adapters, lightning surge arrestors, and extension cables.

Inspect the antennas for damage. Note: Some antennas are shorted across the center pin to shield and some are open. Unless the antenna configuration is known, measuring resistances across the antenna is not useful.

Verify that the antennas are mounted and aimed correctly. Omni antennas should be vertical and mounted above and free of obstructions. Yagi antennas should be pointed at the target antenna, with the elements vertical. Yagi antennas need to be aimed in both the horizontal and vertical planes. Use of topographical maps and satellite imaginary can be very helpful when aiming antennas.

Verify that the signal path is clear. Any obstructions in the signal's Fresnel zone can reduce the signal strength. Often the signal can pass through or around trees, building, and machinery. All of these do reduce the signal strength and excessive obstruction will result in a weak signal. The signal will not penetrate earth. If the ground level rises up into and obstructs the Fresnel zone, the height of the antennas will need to be increased.

The DR9051R repeater capability may be of value if communicating with an obstructed DR9051R.

Verify you have selected the proper antenna for the application. For help with antenna selection see the Appendix.

Open Sensor Input

The DR9051R is design for an up scale burn out. If the analog inputs of the DR9051R become open, the analog data values will read 4095 (Hi byte = 15, Lo byte = 255).

Applications

The DR9050 and DR9051R have numerous applications where an analog signal and/or an alarm contact needs to be monitored and the installation of signal wire between the locations is not practical or cost prohibitive. This system has been successfully installed in many application where a signal needs to be transmitted a short distance between machinery as well as longer range application where signals are transmitted up to 20 miles.

Visit http://www.wici.com or call Wilkerson Instrument Company, Inc. for more information on successful applications using the sensoRad™ Wireless products.

FCC WARNING

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.

The maximum power the FCC allows the radio transmitters to radiate is 36dBm. The transmitters have an output of 20dBm. To meet this FCC requirement, the antenna gain minus cable losses connected to a unit cannot exceed 16dB.

WARRANTY

The DR9050 and DR9051R carry a limited 5 year warranty (1 year on the radio module). In the event of a failure due to defective material or workmanship, the unit will be repaired or replaced at no charge.

SPECIFICATIONS

DR9051R REMOTE TRANSMITTER INPUTS

Dual DC Voltage or Current

Current	Voltage
Min Span = 1mA	Min Span = 100 mV
Max Span = 50mA	Max Span = 150 V

Accuracy	Linearity
±0.1% of span	±0.05% of span

Common Mode Rejection = 100 dB, DC to 60 Hz

RTD Input – 100 ohm Pt
- Min Span = 50°C
- Max Span = RTD Limit
- Linearity vs Temperature = 0.005%/10°C of span
- Accuracy = ±0.1% of span

Bridge Input
- Min Span = 0.5mV/V (10V excitation)
- Max Span = 100mV/V
- Linearity = ±0.05% of span (referenced to V in)

Excitation Supply = 10.00V, 125mA max
(Drive four 330 ohm bridges in parallel)

Switch Input
- Open Circuit Voltage
  - 10 to 30 VDC (V = primary power input)
- Closed Circuit Current
  - 3 to 9 mA

DR9050 MCU OUTPUT

MODBUS® RTU
- RS485/422
  - 9600 bps
  - 1 Start Bit
  - 8 Data Bits
  - 1 Stop Bit

RS232 Port
- Setup Software connection and Custom Software use
- 9600 bps
- 1 Start Bit
- 8 Data Bits
- 1 Stop Bit

I/O Data Rate TX to RX = 9600 bps

AMBIENT TEMPERATURE RANGE
-13°F to 167°F / -25°C to 75°C

TEMPERATURE STABILITY
± (0.01% of span)/°C max

POWER
DR9050
- 85 to 240 VAC, 2.0 VA Max

DR9051R
- 10 to 30 VDC, 1.5 Watts Max

RADIO

Frequency

910 - 917 MHz (Standard)
920 - 927 MHz (Optional)
2.4000 - 2.4835 GHz

Transmit Output Power

915 and 923MHZ

100mW (20dBm)

2.4GHZ

50mW (17dBm)

Receiver Sensitivity

915 and 923MHZ

-110dBm

2.4GHZ

-105dBm

Spread Spectrum Type,

Frequency Hopping, Direct FM

7 Hop Sequences per Frequency

Range (Line of Sight)

900MHz —

Up to 20 Mi. with high gain antennas

2.4GHz —

Up to 10 Mi. with high gain antennas

Antenna Connector

Reverse Polarity SMA Female

CERTIFICATIONS

RF Module — FCC Part 15.247
DR9050 and DR9051R — UL/cUL Recognized

SUPPORT

Wilkerson Instrument Company, Inc. wants to help you get the most from your system. If there is anything we can do, please call or fax us.

Telephone: 863-647-2000
Fax: 863-644-5318
email us: sales@wici.com

visit our website: www.sensorad.com or www.wici.com

On the website you'll find application notes, product manuals, engineering manuals, and a complete listing of our products.

2915 Parkway Street
Lakeland, FL 33811-1391 · USA
800-234-1343
Tel: 863-647-2000 · Fax: 863-644-5318
www.sensorad.com · E-mail: sales@sensorad.com

APPENDIX

The RF system must insure adequate signal strength is available at the receiver. Assume a minimum of 20dB safety margin in signal strength is required at the receiver.

The antennas must have a clear line of sight to each other and the Fresnel Zone must be clear. (See chart below)

The system gain is :

TX output + TX antenna gain - TX cable loss + RX antenna gain - RX cable loss + Abs Value RX sensitivity

Available signal at the RX is System Gain - Space Loss. For a 20 dB safety margin, the system gain must be 20 dB greater than the Space Loss

915MHz System Gain Calculation
TX Power Out = 20dbm (100mW)
TX antenna gain = _____ (see chart below)
TX cable loss = _____ (see chart below)

RX antenna gain = _____ (see chart below)
RX cable loss = _____ (see chart below)
Abs Value RX Sensitivity = 110dBm

2.4GHz System Gain Calculation
TX Power Out = 17dbm (50mW)
TX antenna gain = _____ (see chart below)
TX cable loss = _____ (see chart below)

RX antenna gain = _____ (see chart below)
RX cable loss = _____ (see chart below)
Abs Value RX Sensitivity = 105dBm

Example: 8 mile range and 8dBi gain yagi antennas on the TX and RX with 50ft of WBC400 coax at each antenna

TX Power = 20dBm
TX antenna gain = 8dBi
TX cable loss = 2dB
RX antenna gain = 8dBi
RX cable loss = 2dB
RX sensitivity = 110dBm

System gain = 20 + 8 - 2 + 8 - 2 + 110 = 142dB
System gain - Space Loss = 142dB - 114dB = 28dB safety margin. A very viable system.

FCC regulations limit the maximum radiated power for these products to 36dBm
Transmitter power plus antenna gain minus cable losses must not exceed 36dBm

COAXIAL CABLE LOSS DATA

Cable Type	dB Loss / ft 915MHz	dB Loss/ft 2.4GHz
WBC195	0.111	0.186
WBC400	0.039	0.066
WBC600	0.025	0.043

Cable Loss = Feet X dB/Ft = _____ dB

(Connector loss is insignificant)

SPACE LOSS DATA

Distance Miles	Space Loss 915MHz - dB	Space Loss 2.4GHz - dB
0.25	84	92
0.5	90	98
1	96	104
2	102	110
4	108	116
8	114	122
16	120	128
32	126	

ANTENNA SELECTION DATA

Model	Type	Gain
	900MHz Band	
4008	Vertical Indoor	2.1dBi
4023	Vertical Outdoor	2.1dBi
4275	Omnidirectional	6dBi
4241	Omnidirectional	8.5dBi
4009	Yagi	8dBi
4078	Yagi	11dBi
4079	Yagi	12dBi
4025	Yagi	14dBi
4152	Dual Stacked Yagi	17dBi
	2.4GHz Band	
4007	Vertical Indoor	2dBi
4023	Vertical Outdoor	2.1dBi
4063	Yagi	14dBi

The diameter of the Fresnel zone is a function of the frequency and the distance between the antennas.

Fresnel Zone Table

Distance between antennas	900 MHz Fresnel Zone diameter	2.4 GHz Fresnel Zone diameter
1000 ft (300 m)	16 ft (7 m)	11 ft (5.4 m)
1 Mile (1.6 km)	32 ft (12 m)	21 ft (8.4 m)
5 Miles (8 km)	68 ft (23 m)	43 ft (15.2 m)
10 Miles (16 km)	95 ft (31 m)	59 ft (20 m)
20 Miles (32 km)	138 ft (42 m)	87 ft (27 m)