

**DR9011R  
WIRELESS REPEATER  
(Use With DR9011 and DR9021)**



A wireless system is very simple to setup and operate. To ensure optimal performance, please read and carefully follow the instructions in this manual.

**DESCRIPTION**

A Point to Point wireless data acquisition system utilizing the DR9011 transmitter and DR9021 receiver can provide reliable performance up to 20 miles. However, this performance is based on line of sight conditions between the 2 antennas in the system. When greater range is needed or a building, tank, mountain, or other obstruction must be overcome, a wireless repeater can be used to overcome these obstacles.

The DR9011R Repeater is used to provide a path from a DR9011 Transmitter to a DR9021 Receiver, when the path between the transmitter and receiver is obstructed or too far in distance. The DR9011R Repeater receives the signal transmitted by the DR9011 and retransmits it on a different Hop sequence for reception by the DR9021.

A different Hop value is used for reception and retransmission so there can be no partial reception of direct signals from the DR9011 to the DR9021.

Three radio modules are available for the DR9011 and DR9021, two 915MHz band versions with 7 Hop sequences each and a 2.4GHz band version with 7 Hop sequences. They use spread spectrum, frequency hopping technology. These choices provide 21 different Hop sequences that allow 21 systems to work in the same locale without interfering with each other. The DR9011R Repeater uses these same radio modules.

With proper antenna and cable selection and a 915MHz band version radio, the DR9011 Transmitter can transmit up to 20 miles to the DR9011R Repeater. The DR9011R Repeater can transmit up to 20 miles to the DR9021 Receiver. The 2.4GHz band version can transmit up to 10 miles from unit to unit.

A DIP Switch on the PC board is used to set the Hop sequence for reception and retransmitting. Screw terminal blocks that plug into the case allow easy wiring and removal of products. All of the DR Series of products provide transient protection to help eliminate damage from lightning and from other transients created on the power and signal leads.

Long coaxial cable runs to external antennas require a surge suppressor Type N bulkhead connector in the coaxial cable system

**ANTENNA SELECTION**

The geographical layout of the system will determine antenna types and heights. The antennas should be within line of sight of each other for best performance over long ranges. At short ranges, the 900MHz radios can have reliable communications through walls, floors, forests, etc. Performance will be dependent on material in the structures.

Since a DR9011R Repeater is being installed, either distance or an obstruction is being overcome.

The DR9011 transmitter installation will require an antenna with sufficient gain to communicate with the DR9011R Repeater. The Repeater antenna will probably have to be an omni-directional antenna in order to communicate in 2 directions. The DR9021 receiver will require an antenna with sufficient gain to receive the retransmitted signal from the Repeater. Antenna gain should provide a 20DB safety margin.

The receiving antenna and the transmitting antenna must have a clear path between the two. If any large obstruction is within close position of a line between the antennas, a reflected wave off the obstruction can arrive at the receiving antenna after traveling a longer distance than the straight line of sight signal.

The longer path makes the arriving signal have a different phase angle than the straight path. The 2 signals add in the receiving antenna and depending on the phase shift may create a gain or loss in signal level.

Obstructions in the path must be far enough away from the straight path so any reflected signals will pass behind the receiving antenna. The area which must be clear of obstructions is named the Fresnel Zone.

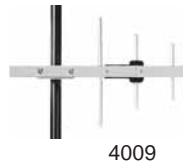
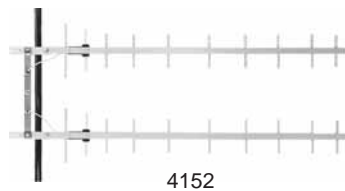
Large metal objects directly behind the receiving antenna can also reflect signals back into the receiving antenna.

Moving metal objects such as a large metal fan blade, metal door, or vehicles can cause reflections into the receiving antenna and make signal strength fluctuate.

The chart below shows distance in miles and kilometers for 2 antennas. Select an antenna in the vertical column and move across to the intersection of an antenna in the horizontal column.

The calculation of these ranges provide a 20dB safety margin in received signal strength. Calculations are based on a 100mW transmitter, a receiver threshold sensitivity of -110dBm, 1dB loss in each coaxial cable, and a clear line of sight between the antennas.

RANGE - MILES & KM FOR 20DB MARGIN - 900 MHz				
ANTPN	4008	4023	4275	4241
PN 4008 INDOOR	4.5 MI 7 KM	4.5 MI 7 KM	7.5 MI 12 KM	10 MI 16 KM
PN 4023 OMNI	4.5 MI 7 KM	4.5 MI 7 KM	10 MI 16 KM	12 MI 19 KM
PN 4275 OMNI	7.5 MI 12 KM	7.5 MI 12 KM	10 MI 16 KM	15 MI 24 KM
PN 4241 OMNI	10 MI 16 KM	12 MI 19 KM	15 MI 24 KM	20 MI 32 KM
PN 4009 YAGI	10 MI 16 KM	10 MI 16 KM	15 MI 24 KM	29 MI 32 KM
PN 4078 YAGI	13 MI 21 KM	13 MI 21 KM	29 MI 32 KM	29 MI 32 KM
PN 4079 YAGI	15 MI 24 KM	15 MI 24 KM	29 MI 32 KM	29 MI 32 KM
PN 4025 YAGI	18 MI 30 KM	18 MI 30 KM	29 MI 32 KM	29 MI 32 KM
PN 4152 YAGI	29 MI 32 KM	29 MI 32 KM	29 MI 32 KM	29 MI 32 KM



**FCC regulations limit the maximum radiated power for these products to 36dBm**

**Transmitter power (20dBm) plus antenna gain minus cable losses must not exceed 36dBm.**

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

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

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)

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)

## HOP SEQUENCE SETTING

The DR9011R Repeater should be set to receive and transmit on different Hop values. If the DR9021 receiver can receive a signal from the DR9011 transmitter under any circumstances, it may scramble the signal arriving from the Repeater.

The Hop value is set in 2 steps. Storing the Hop value in the Repeater requires removing the power from the unit, setting the switches to the correct power and then applying power. Applying power writes the Hop value into non-volatile memory in the Repeater. This process must be done twice, once for the received Hop value and once for the transmit Hop value.

Turn off power to the DR9011R Repeater.

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.

Locate the 4 position DIP switch just inside of the front panel. (See Figure 1).

The switches work in binary.

Switch 1 = Binary 1 (HOP 1)

Switch 2 = Binary 2 (HOP 2)

Switch 3 = Binary 4 (HOP 4)

Switch 4 — A = Receive B = Transmit

To set the Receiver Hop Sequence set the switches as follows.

SW4 A (open)

(Other switches are open when on "0")

Set Switches For Desired Hop Value - Valid values are 0 to 6

Hop Value      Switch Settings  
For HOP SW 1, 2, 4

0	0,0,0
1	1,0,0
2	0,2,0
3	1,2,0
4	0,0,4
5	1,0,4
6	0,2,4

Apply power to the unit to store the switch values.

Turn off power to the unit.

Put SW 4 in B position (Transmit Hop)

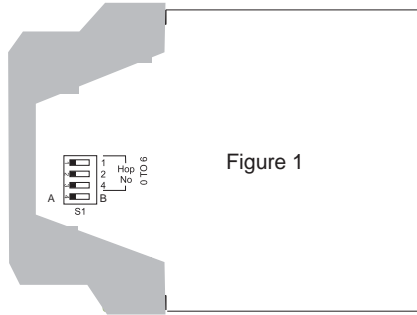
Set the Hop Value for transmitting on SW 1, 2 and 4

Turn on power to write Hop Value to the unit.

Leave the switches in this position.

Turn power off.

Replace unit into enclosure.



## INSTALLATION

The DR Series of products mount on standard 35 mm 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 on 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 2 for details of the case dimensions.

**Note:** Correctly identify the DR9011, DR9021, and DR9011R Repeater and note power requirements before snapping onto the DIN Rail. Once installed the side label may not be visible.

## TERMINAL CONNECTIONS

The only terminals available on the DR9011R Repeater are:

Terminal	Connection
13	No Connection
14	No Connection
15	Power + 10 to 30
16	Power -

Case Dimensions INCHES [mm]

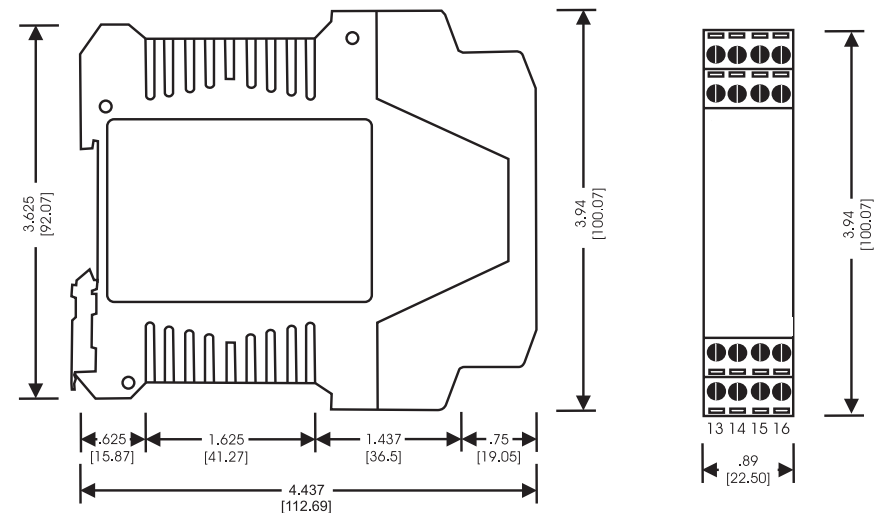


Figure 2

## TESTING THE SYSTEM

It is recommended that the 3 wireless products be tested in close proximity before field installation. This will verify Hop values are correct. They can be tested without any antenna connections if placed 2 or 3 feet apart.

Power the DR9011 transmitter and note the red TX LED is flashing. It flashes at 6.5/S and indicates the transmitter is sending data.

Power the DR9021 receiver. If the green LED flashes, the 2 units are on the same Hop sequence. One should be changed.

If the green LED does not flash, power the DR9011R Repeater. If the green LED flashes, it is receiving the signal from the transmitter. The red LED should also be flashing indicating the Repeater is transmitting.

The DR9021 receiver green LED should be flashing. If it is not, the Repeater transmitter Hop value and receiver Hop value are not the same.

Factory default values are DR9011 transmitter Hop = 0. DR9011R Repeater receive Hop = 0. DR9011R Repeater transmit Hop = 1. DR9021 receiver Hop = 1.

## SETTING UP THE RF LINK

The DR9011R Repeater will probably have an omni-directional antenna attached because it has to send and receive in 2 different directions. If the DR9011 transmitter or the DR9021 receiver has a directive antenna, it must be pointed at the Repeater antenna.

If the Repeater antenna can be seen from the transmitter and receiver site, a person at the transmitter can point the antenna toward the Repeater antenna. A person at the receiver site can accurately point the antenna at the Repeater by observing the green LED on the receiver. Slowly rotate the antenna in 1 direction until the green LED does not flash. Mark the position of the antenna (or mast). Rotate the antenna in the other direction through the receiving position until the green LED stops flashing. Mark this position. Position the antenna exactly half way between the 2 marks.

The person at the receiver site can now talk the person at the transmitter site through the same procedure to point the transmitter antenna accurately.

If the antennas are a long distance apart, a person may have to do this process from the Repeater site to get the transmitter antenna pointed. Then the receiver antenna can be pointed.

## SPECIFICATIONS

### RADIO

Frequency

908 MHz (Standard)  
922 MHz (Optional)  
2.4000 - 2.4835 GHz

Transmit Output Power

908 and 922 MHz  
100mW (20dBm)  
2.4 GHz  
50mW (17dBm)

Receiver Sensitivity

908 and 922 MHz  
-110dBm  
2.4 GHz  
-105dBm

Spread Spectrum Type,  
Frequency Hopping, Direct FM  
7 Hop Sequences per Frequency

Range (Line of Sight)

900 MHz  
Up to 20 Mi.  
with high gain antennas  
2.4GHz  
Up to 10 Mi.  
with high gain antennas

Antenna Connector

Reverse Polarity SMA Female  
(RPSMA)

### CERTIFICATIONS

RF Module  
FCC Part 15.247  
DR9011R Repeater  
UL/cUL Recognized

### OPERATING TEMPERATURE

-13°F to 167°F  
-25°C to 75°C

### POWER

DR9011R Repeater  
10 to 30 VDC  
1.5 Watts Max

### 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

Or, you can email us: [sales@wici.com](mailto:sales@wici.com)

Or you can visit our website:

[www.wici.com](http://www.wici.com)

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

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2915 Parkway Street  
Lakeland, FL 33811-1391 · USA

800-234-1343

Tel: 863-647-2000 · Fax: 863-644-5318  
[www.wici.com](http://www.wici.com) · E-mail: [sales@wici.com](mailto:sales@wici.com)