DR-915L/LT Data Radio
USER'S GUIDE

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DR-915L/LT Data Radio

General Information

This DR-915L is a data transceiver operating in the 902-928 MHz ISM band. The DR-915LT is a transmit-only version. Both units are designed to operate under Part 15.249 of the FCC rules and regulations.

The unit operates on 62 discrete frequencies within the ISM band, each frequency about 400kHz apart. Using a frequency agile phase-locked loop synthesizer, the radio is able to operate on any of 62 non-interfering channels.

DR-915L/LT DATA RADIO
CONFIGURATION

Default Settings

Serial Baud.....9600 bits/second
Port..... UART
RX buffer size ..... 180 bytes*
TX buffer size ..... 180 bytes*
CTS assert..... 180 bytes*
CTS de-assert ..... 150 bytes*
TX assert.....180 bytes*/5 mS
Channel.....1
Source Address.....1
Destination Group.....1
Destination Address 1
Acknowledgement.....None
Power save..... Off

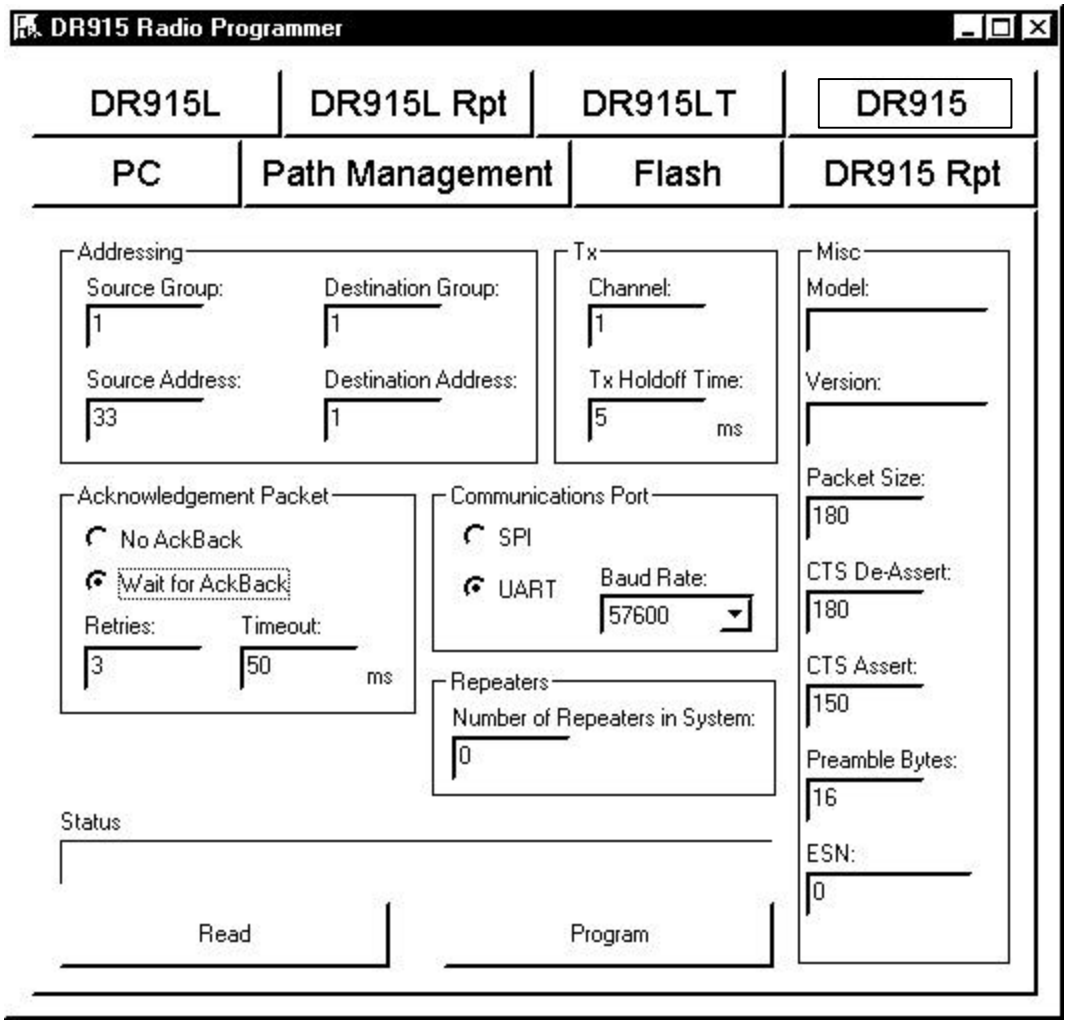
*Factory setting; cannot be changed.

DR-915L/LT DATA RADIO
CONFIGURATION

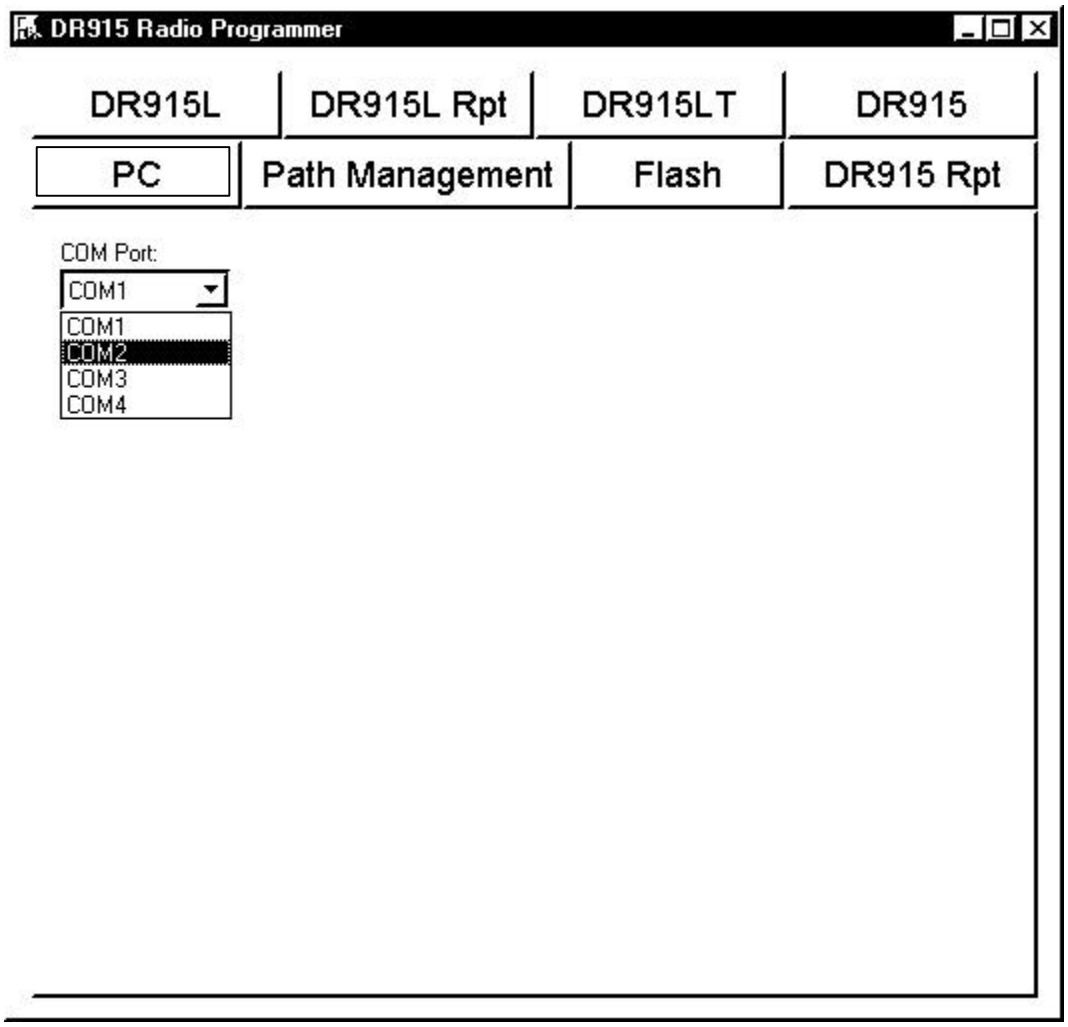
The DR-915L and DR-915LT are supplied with an easy-to-use Windows98™ configuration program. The configuration program allows the user to control the operation of their radio network.

Installing

The configuration software does not require an installation. Simply run it from the CD labeled "DR-915L/LT Tools" or copy it onto another drive. Start the program by locating and double clicking on the "Programmer" icon. This will launch the configuration program and display the screen below.

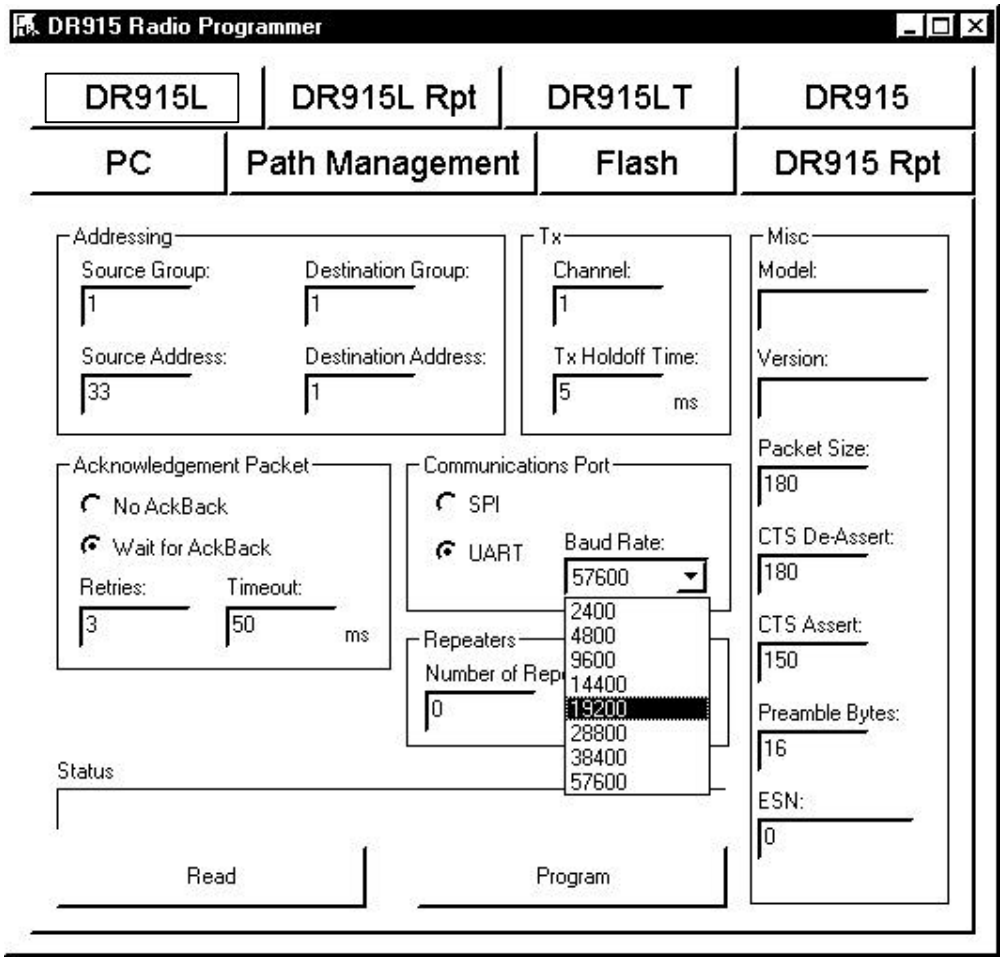


Click on the “PC Settings” tab, then select which COM port will be used to connect to the data radio. As shown below, COM1 thru COM4 are available. This setting will be retained the next time the configuration program is run.

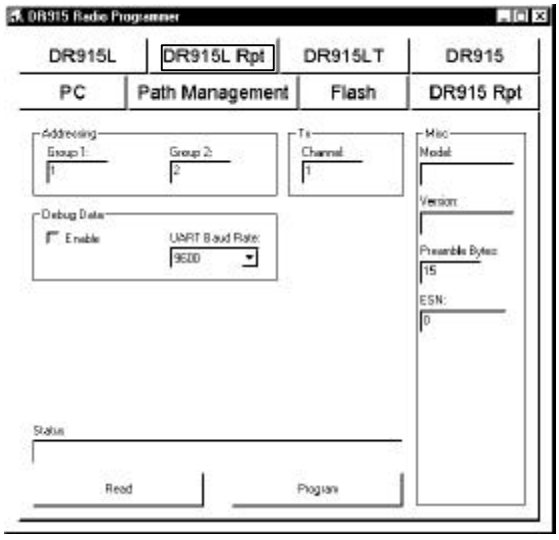


Getting Started

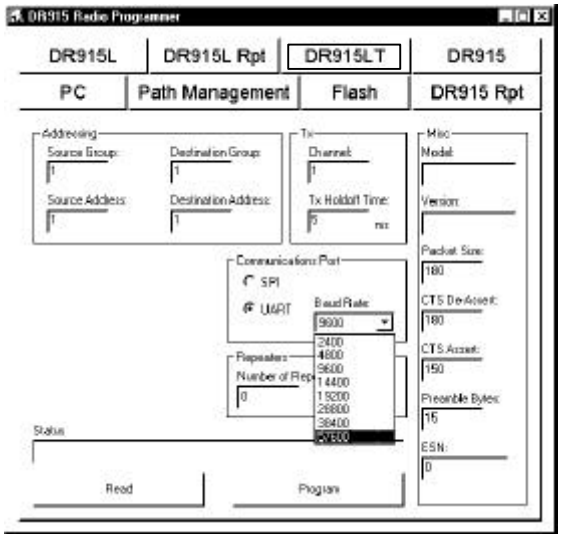
To configure the radio, click on appropriate tab to select the radio type being configured. Then select the radio Communications Port. The default setting is for asynchronous serial mode, UART (Universal Asynchronous Receiver/Transmitter). The default baud rate is 9600 bits per second. The interface baud rate can be set to standard values between 2400 and 57600 as shown on the following page. This mode supports 8 data bits, 1 stop bit and no parity.



DR-915L



DR-915L Repeater



DR-915LT

Addressing

The radio has been designed to be very versatile in its addressing functions. Each radio unit has its own identifier consisting of a group number and address number.

The Source Group specifies which group of radios the unit being configured belongs to. The Source Address specifies the address within that group that uniquely identifies this radio. The radio will decode packets containing a Destination Group and Address matching its own. With the exception of broadcast messages, all others will be ignored.

Broadcast messages are those messages where the destination address is 0 and the group is the same as the radio receiving it, or those messages where the destination address and group are both 0. When the destination group is set to 0, all radios in all groups will decode the packet.

Likewise, the Destination Group specifies which group of radios the transmissions will go to. The Destination Address specifies the individual radio within that group that will receive the message.

Channel

The Channel selects the frequency the radio will transmit and receive on. There are 62 channels available for the use of multiple networks or to avoid interference. Radios must be on the same channel to communicate.

TX Hold Off Time

TX Hold Off Time sets the amount of time that must elapse after the last byte to be transmitted is received by the radio before a transmit packet will be initiated. Setting this value higher will prevent numerous small packets from being sent when the transmit data is not continuous. The default setting will be adequate for most applications.

Acknowledgement (Ack-Back™)

The DR-915L has powerful, built-in path management features designed to make OEM integration quick and easy. Activating packet acknowledgement will virtually guarantee all data transmitted is received. Any packet transmitted by the DR-915L is then acknowledged by the receiving radio. If any packet is not acknowledged, the transmitting radio will resend the data. While reducing throughput, this feature also handles missed transmissions as well as performs path management, allowing full duplex communications.

The numeric value populated in the Retries field specifies the number of attempts the radio will make in trying to resend unacknowledged packets. The value in the Timeout field determines how long the radio will wait for the acknowledgement before resending. (See Hardware Timing for more information)

Number of Repeaters

The range of the DR-915L/LT may be extended by using repeaters. Repeater modules receive data packets on one group code and retransmit the packet on another group code. For example, a repeater configured with group codes 3 and 4 will translate the following packets and retransmit them as follows:

- A packet received with a destination group code of 3 will be received and retransmitted with a destination group of 4.

- A packet received with a destination group code of 4 will be received and retransmitted with a destination group of 3.

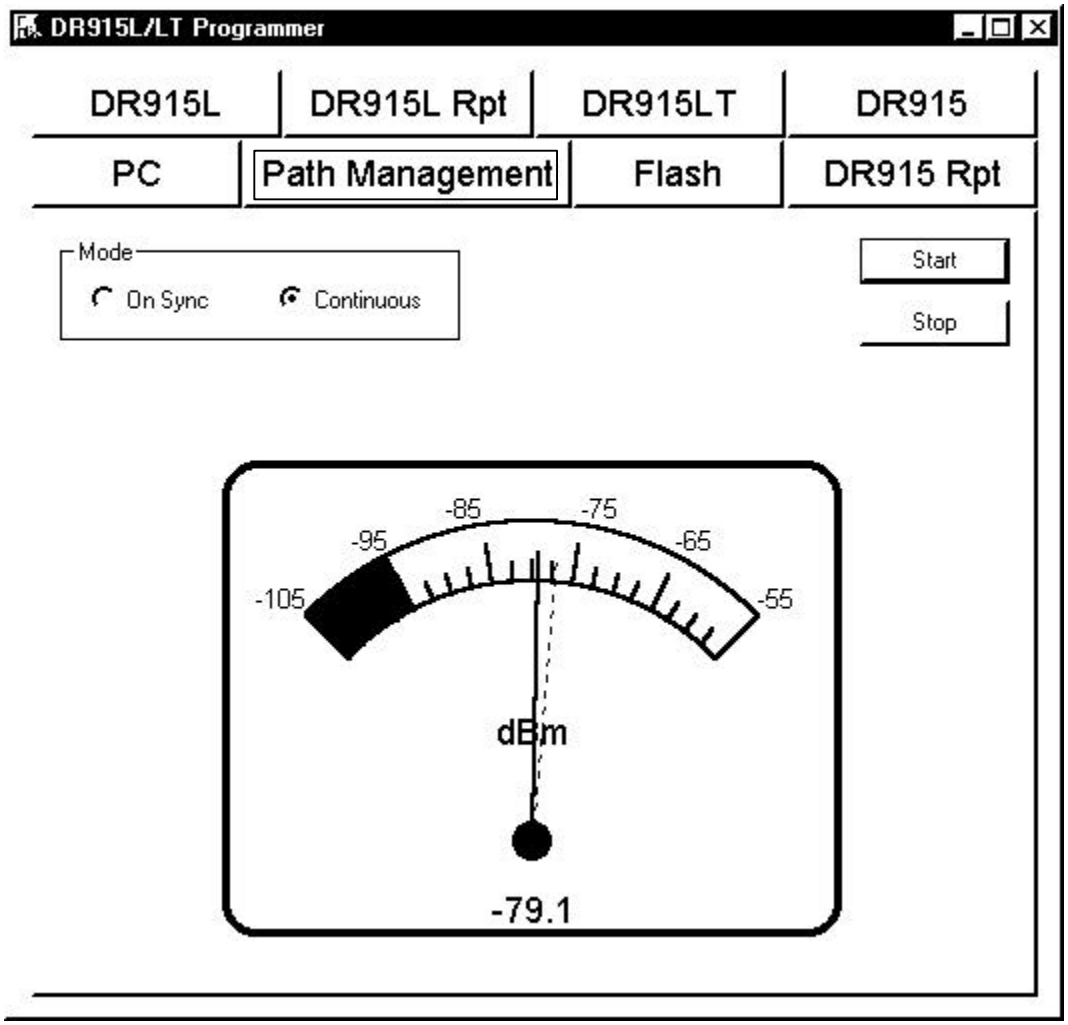
This method of group code translation guarantees that data is transferred through the repeater and not directly between radios.

When the DR-915L is in Ack-Back™ mode and there are repeaters in the system, the amount of time needed to receive packet acknowledgements increases. By specifying the number of repeaters in the Configuration program, this delay is calculated and the radio is updated correctly. Always populate this field with the maximum number of chained repeaters in the system.

Path Management

The DR-915L/LT has powerful path management tools to help ensure successful field installations. The Path Management window has two modes, Continuous and On Sync.

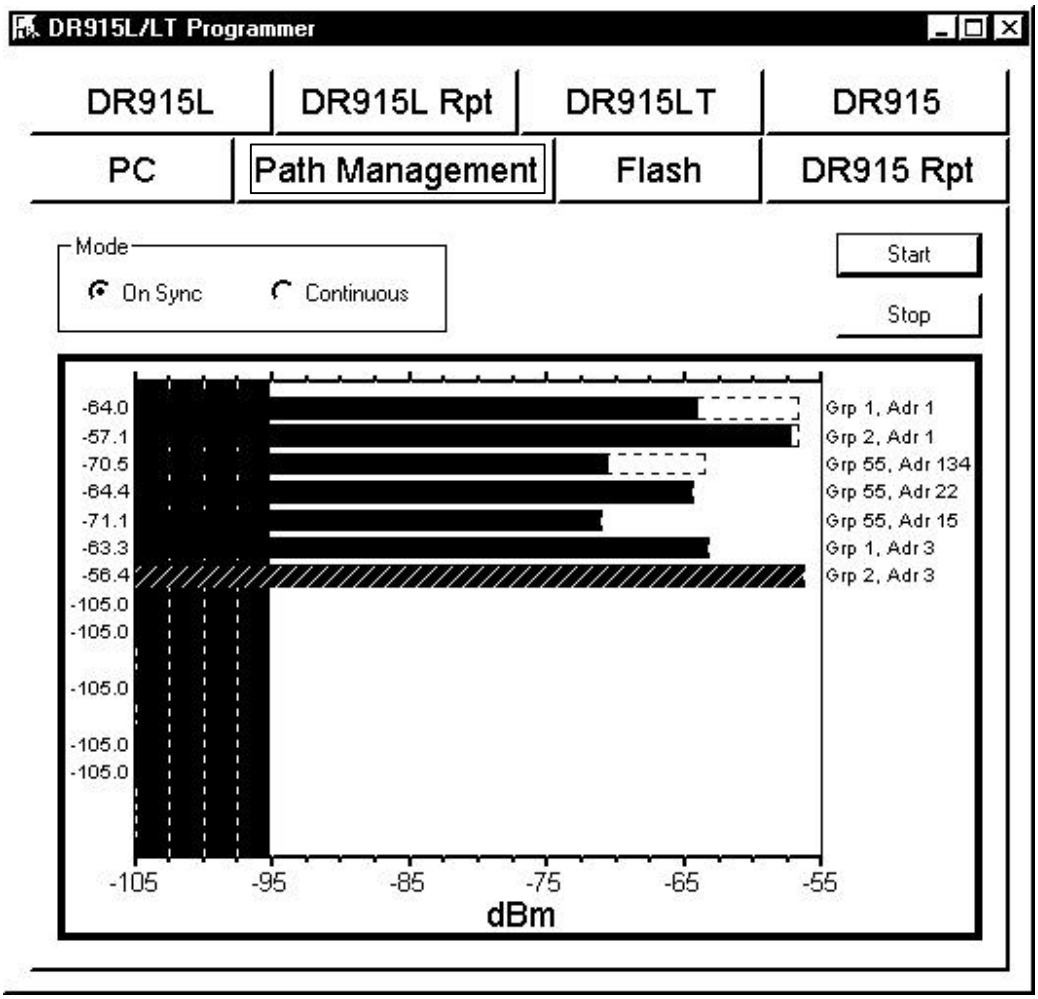
The Continuous mode allows the installer to look at competing signals on the radio's channel and determine if there is a potential interference problem. Running in this mode for an extended period of time will show the installer the level of the strongest signal seen by the radio. The solid indicator needle indicates the current signal level being received while the dashed indicator needle shows the strongest signal received. Clicking the Stop button will reset the dashed indicator.



Continuous Mode Signal Monitoring

The On-Sync mode allows the installer to look only at radio transmissions for DR-915L or DR-915LT radios. When packets are received, the transmission's current and maximum signal strength is displayed along with the packets' source group code and address. This allows the installer to ensure there is adequate signal strength with enough fade margin to guarantee reliable operation. Signals in the green area are considered very reliable, the yellow area are marginally reliable and the red area are considered not reliable.

The graph will display information for a maximum of 16 radio addresses. As new addresses are received, they will replace the oldest ones in the graph. The signal received last is indicated by a cross hatch in the bar. Clicking on the Stop button will reset the graph information.



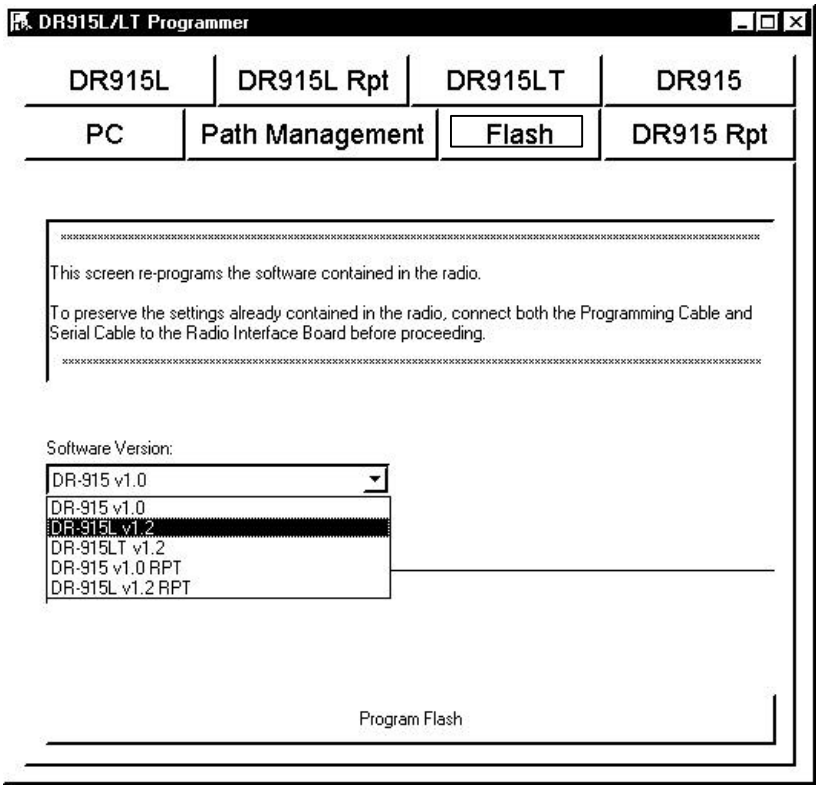
On-Sync Signal Monitoring

Code Upgrading

The DR-915L and DR-915LT have been designed for easy field upgrades. Using the RS-232 Serial Adapter board, a DR915 Programming cable, a standard Serial Configuration cable and a current version of the DR-915L/LT Configuration program running on the user's PC, the radio can be re-flashed with new operating code. Special customer code can also be loaded in this manner.

With the radio mounted on an RS232 Serial Adapter board, connect a program upgrade cable from the programming connector, J4, on the Adapter board to the parallel port on the PC. Connect a standard DB9 male-to-female serial cable from the Adapter board's DB9, J2, and to the serial port on the PC. Power the Adapter board using the supplied 12-volt wall module connected to the Adapter board's power jack, P8.

Using the DR-915L/LT Configuration program, click on the Flash tab. Select the software version from the Software Version drop-down box and then press the Program Flash button. The Configuration program will then read the setup information from the radio, upgrade the radio code and reload the original configuration.



Flash Upgrade Tab

DR-915L/LT DATA RADIO
SPECIFICATIONS

Overall

Frequency ..... 902-928 MHz
Frequency Control.....PLL Synthesizer
Transport ..... Transparent, Point-to-Point Guaranteed
Data Interface .....Asynchronous TTL, Synchronous Serial (SPI)
Channels 62
Configuration.....Windows98™ Application using PC Serial Port
Duty Cycle.....100% all modes of operation
Data Interface Rate.....2400,4800,9600,19.2k,28.8,*38.4,*56k bps (N,8,1)
Temperature..... -30 to +70 °C
Range .....up to 3000 feet depending on conditions
Data Encoding ..... Proprietary Method
Receiver Sensitivity .....-101 dBm usable
Modulation ..... Direct FM (FSK)
RF Data Rate .....50 kbps
Data Flow Control .....Hardware using CTS
Transmitter Output 1mW
Error Detection .....16 bit CRC

Power Requirements

Input Voltage..... 7.5 – 15 VDC
Input Current.....70 mA Receive Mode
50 mA Transmit Mode
tbd mA Power Save Mode

Regulatory

United States..... 15.249 Approved
Canada.....RSS210 Compliant

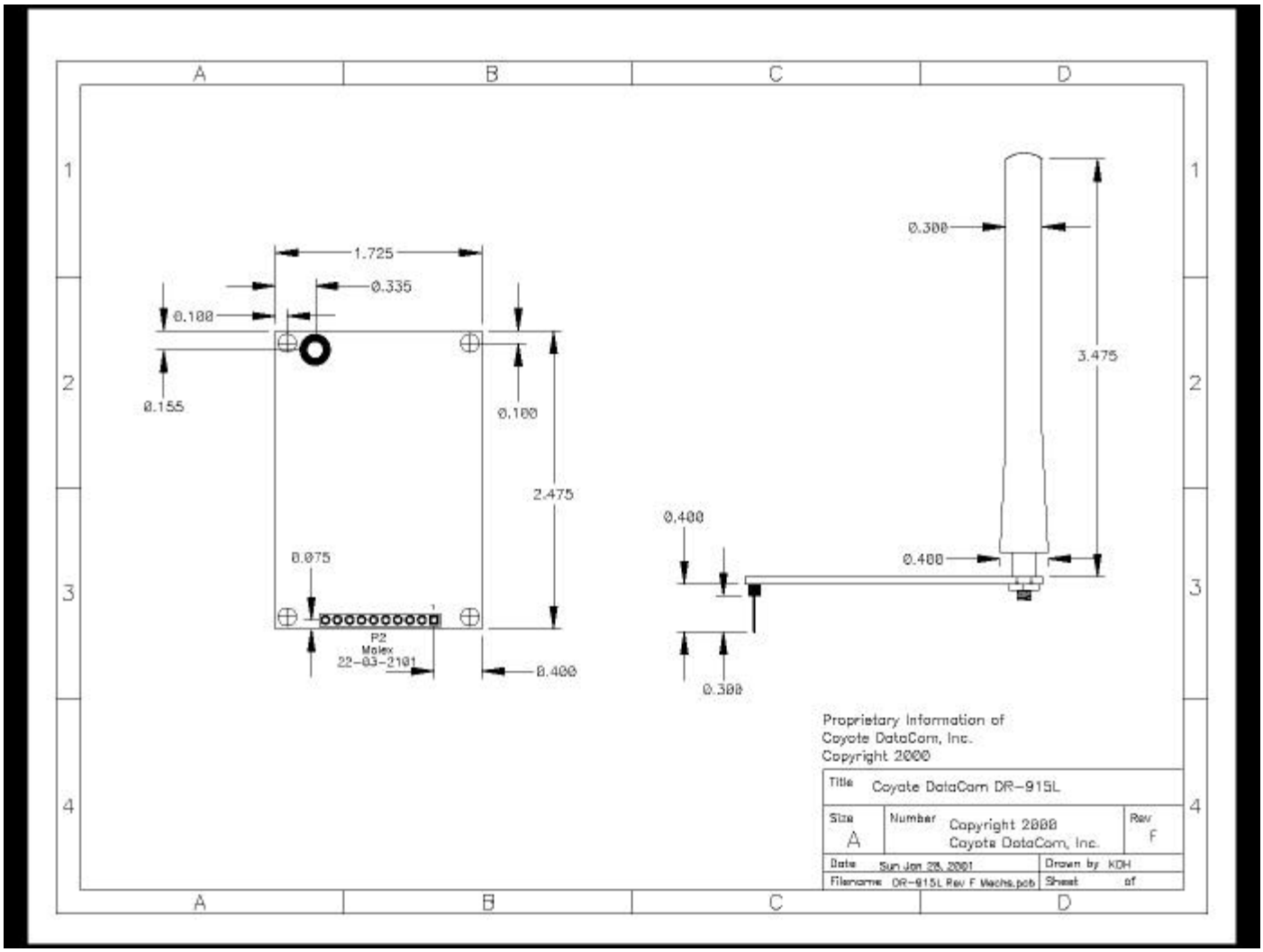
Mechanical

Size.....1.75” x 2.5”
Antenna Connector .....Fixed Mount, Remote

*38.4k not available on the DR-915L, 57.6k not available on the DR-915LT

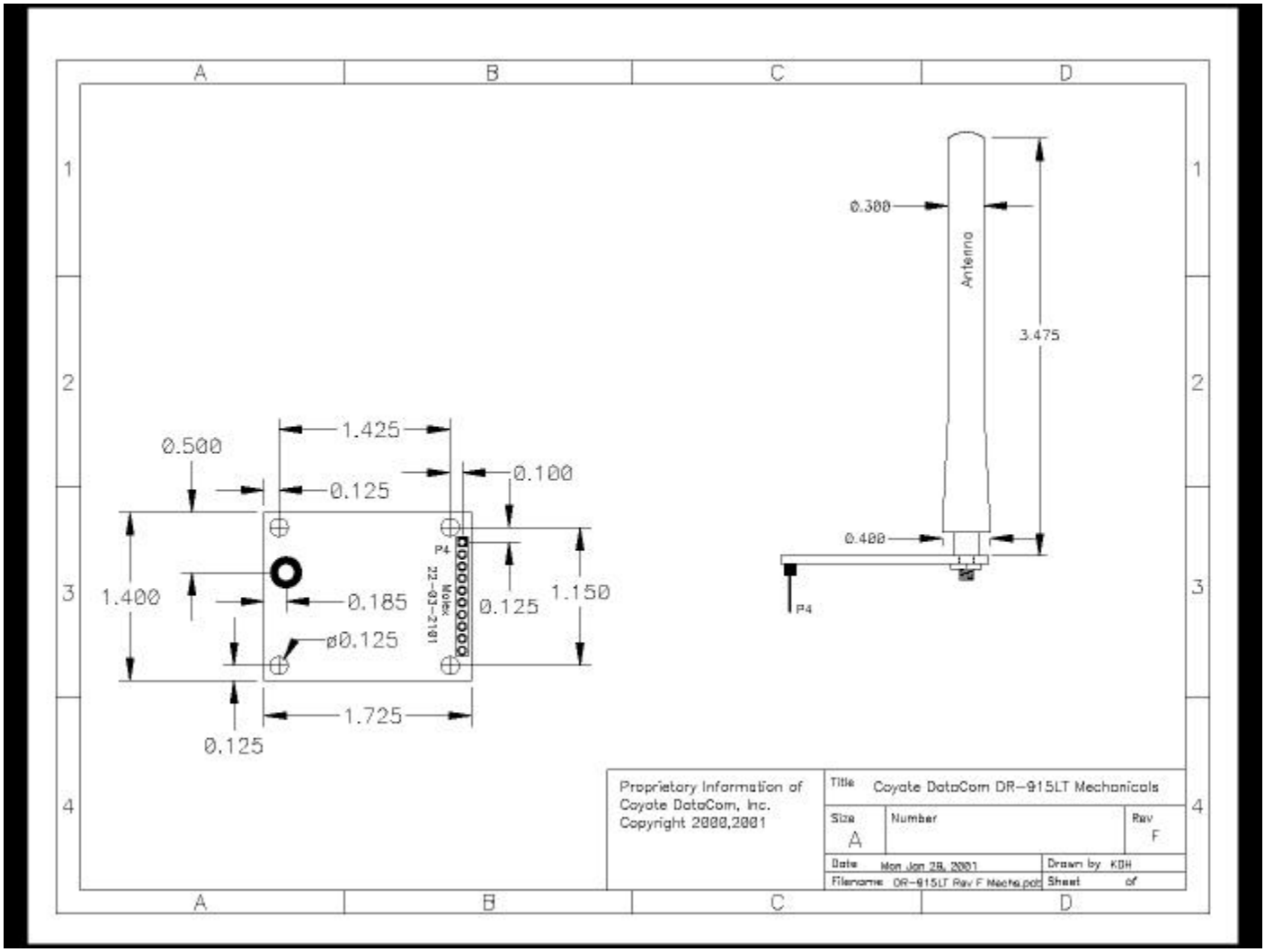
DR-915L/LT Data Radio
RADIO HARDWARE INTERFACE

DR-915L Mechanical Overview



DR-915L/LT DATA RADIO
RADIO HARDWARE INTERFACE

DR-915LT Mechanical Overview



DR-915L/LT DATA RADIO
HARDWARE INTERFACE

Pin Definitions for Connector P2 (915L) and P4 (915LT)

PIN	FUNCTION
1	Ground
2	CTS
3	DTR
4	Receive Data
5	Transmit Data
6	Reset
7	SPI Clock
8	SPI MISO/Fail
9	SPI MOSI/Sending
10	VCC

PIN 1 – Ground

Power and signal ground for the data radio.

PIN 2 – CTS

Clear to Send. This line will be low when the radio is ready to accept data to transmit. When the radio raises this line, the user application must cease sending data to the radio or a buffer overflow may occur, resulting in a loss of data.

PIN 3 – DTR

Data Terminal Ready. This line is used to place the radio into configuration mode. It should be held low for normal operation.

PIN 4 – Receive Data

This is data received by the radio and sent out to the user device. The data format is a standard, asynchronous stream at the user-set baud rate with one start bit (low) followed by eight data bits and one stop bit (high). This is a TTL-

level interface. Applications requiring RS-232 must use an appropriate interface circuit or a DR-915L RS-232 interface board.

PIN 5 – Transmit Data

This is the data sent by the user device for the radio to transmit. The data format is a standard asynchronous stream at the user-set baud rate with one start bit (low) followed by eight data bits and at least one stop bit (high). This is a TTL-level interface. Applications requiring RS-232 must use an appropriate interface circuit or a DR-915L RS-232 interface board.

PIN 6 – Reset

Taking this pin low will reset the radio's microcontroller. For normal operation, this pin should be left open.

PIN 7 – SPI Clock

This is the SPI clock signal. Data is clocked into and out of the DR-915L on the rising edge. This pin is also used for updating the code in the radio.

PIN 8 – SPI MISO

This is the SPI data from the radio to the host when in SPI mode. This pin also indicates a failure to complete an transmission while in Ack-Back™ mode. This pin is also used for updating the code in the radio.

PIN 9 – SPI MOSI

This is the SPI data to the radio from the host when in SPI mode. This pin also indicates the radio is attempting a transmission while in Ack-Back™ mode. This pin is also used for updating the code in the radio.

PIN 10 – VCC

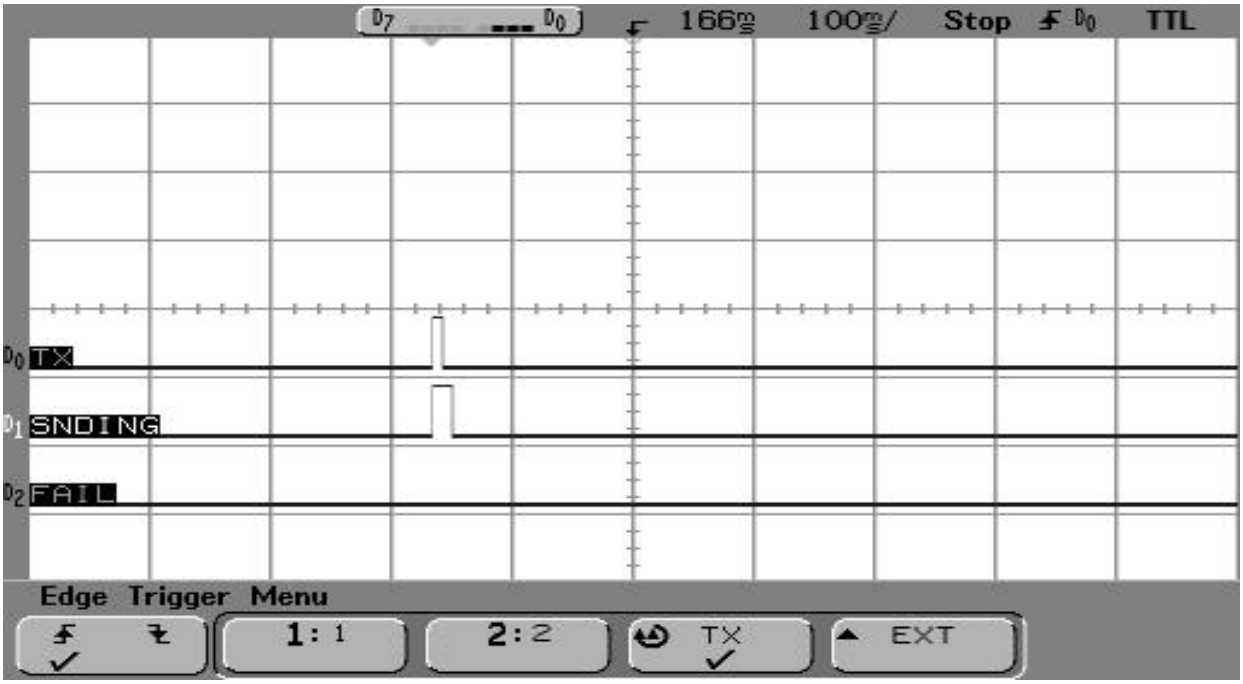
This is power to the radio. It should be 7.5 to 15 vdc.

DR-915L/LT DATA RADIO
HARDWARE TIMING

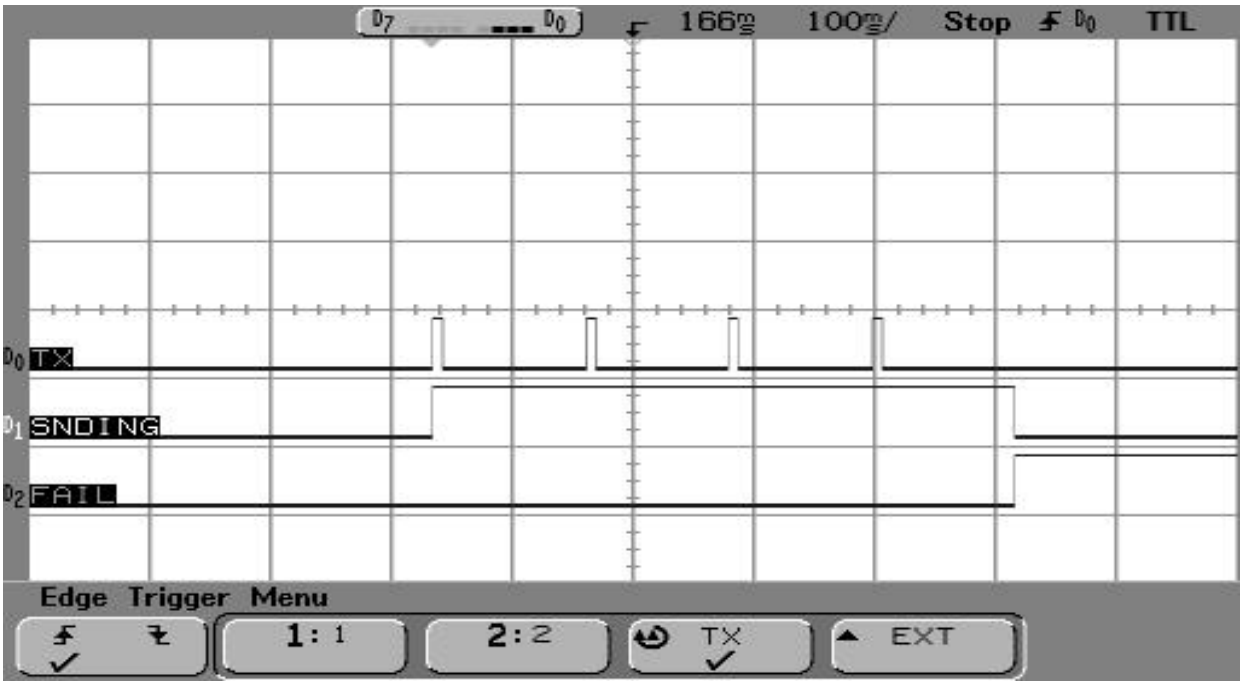
Ack-Back™ Handshaking

When configured for Ack-Back™ mode, the radio will attempt to resend packets that are not acknowledged as received by the destination radio. While this virtually guarantees that data will be correctly transmitted, there is still the possibility that the destination radio is unavailable. Because of this, the DR-915 supplies hardware indication of the success or failure of Ack-Back™ packets. (See Radio Hardware Interface for pin definitions)

Shown below is an example of the hardware handshaking for a successful Ack-Back™ transmission. The **TX** trace identifies the actual transmission attempt and is internal to the radio. The **SNDING** trace is the handshake signal on Pin 9 of P2. This signal goes high when the transmit attempt is made and stays high until the acknowledgement packet is received from the destination radio.



If and acknowledgement is not received within the **Ack-Back™ Timeout** time, the radio will resend the packet up to the **Ack-Back™ Retries** setting. If an acknowledgment is received during one of the retries, the **SNDING** signal will return low, indicating a successful transmission. If there is no acknowledgement after all retry attempts, the **SNDING** line will return low and the **FAIL** line will go high to indicate a transmission failure



Failed Ack-Back™ Transmission
After 3 Retries

DR-915 DATA RADIO
IN-SYSTEM CONFIGURATION

The DR-915 may be reconfigured while in a host system. This allows the users system to change the source or destination address and group codes on-the-fly, adding great versatility to the Ack-Back™ delivery mode.

General Structure

The general structure of the protocol for programming the DR915L/LT radios is as follows:

[0xAA] [command] [checksum] [0x55]

where *command consists of byte #1, byte #2, byte #3, ..., byte #n as defined below, and*

where *the checksum is an 8-bit checksum (a simple unsigned 8-bit addition of bytes) of data bytes 1 thru n, 0x55, and*

where *the checksum does not include the beginning 0xAA, itself, or the ending 0x55.*

Numbers preceded by "0x" are hexadecimal. All others are decimal.

The DTR pin must be raised prior to sending any commands to the radio. Once a complete command has been sent to the radio, the DTR pin should be immediately lowered. If a read command of some sort was issued, the device should be ready to receive the information immediately. If a Write Command was issued, the device must allow 250 milliseconds for the radio to reboot itself with the new values before any other commands can be issued.

As bytes are sent to the radio, each byte will be immediately echoed back to the sender for confirmation that the radio received the byte.

When any data is being read from the radio, the device should simply read in the data without echoing the bytes back to the radio.

Command Structure

The format of the data bytes for sending a command to the radios is as follows:

Read command:

- 0x01 (1 byte)
- memory select (1 byte) (0 = read from EEPROM, 1 = read from RAM)
- beginning address (high byte) (1 byte)
- beginning address (low byte) (1 byte)
- number of bytes to be read (1 byte)

Write Command:

- 0x02 (1 byte)
- memory select (1 byte) (0 = write to EEPROM, 1 = write to RAM)
- beginning address (1 byte)
- number of bytes to be written (1 byte)
- byte #1 to be written
- byte #2 to be written
- byte #3 to be written
- byte #n to be written

Path Management:
-0x03 (1 byte)
-mode (1 byte) (0 = off, 1 = every 250ms & on sync, 2 = on sync)
This command returns a series of packets 6 bytes long. The packet structure is as follows:
-0xAA (1 byte)
-counter (high byte) (1 byte)
-counter (low byte) (1 byte)
-source group (1 byte)
-source address (1 byte)
-0x55 (1 byte)

Read Model Command:

- 0x04 (1 byte)
This command returns an ASCII string 15 bytes long.

Read Software Version Command:

- 0x05 (1 byte)
This command returns an ASCII string 15 bytes long.

Read Serial Number Command:

- 0x06 (1 byte)
This command returns 4 bytes with the least significant byte first.

Addresses of Settings

CAUTION! *The radio software performs no validation of settings. Great care should be taken when programming any of these settings.*

DR915L Address Map:

0x0001 = Channel (Valid range = 0 – 63)

0x0002 = Tx Holdoff (Valid range = 5 - 255. Default = 5.)

0x0003 = Preamble Bytes (high byte) (Valid range = 16 - 1000. Default = 16. A value of less than 16 will cause improper operation.)

0x0004 = Preamble Bytes (low byte))

0x0005 = Destination Group (Valid range = 0 - 255 where 0 is broadcast group)

0x0006 = Destination Address (Valid range = 0 - 255 where 0 is broadcast address)

0x0007 = Source Group (Valid range = 1 - 255. A value of 0 must not be used.)

0x0008 = Source Address (Valid range = 1 - 255. A value of 0 must not be used.)

0x0009 = Packet Length (Valid range = 1 - 177. Default = 177.)

0x000A = CTS Deassert Limit (Valid range = 1 - 178. Default = 178. This value should be greater than the CTS Assert Limit.)

0x000B = CTS Assert Limit (Valid range = 1 - 177. Default = 89. This value should be less than the CTS Deassert Limit.)

0x000C = Baud Rate (*see below for proper settings)

0x000D = Ack-Back™ Enable (Valid range = 1 is enabled, 0 is disabled.)

0x000E = Ack-Back™ Retries (Valid Range = 0 - 255.)

0x000F = Ack-Back™ Timeout (Valid Range = 50 - 255.)

0x0010 = Communications Port (Valid range = 0 is SPI port, 1 is UART)

0x0011 = Number of Repeaters in System (Valid range = 0 - 255.)

DR915L Repeater Address Map:

0x0001 = Channel (Valid range = 0 – 63)

0x0002 = Preamble Bytes (high byte) (Valid range = 16 - 1000. Default = 16. A value of less than 16 will cause improper operation.)

0x0003 = Preamble Bytes (low byte)

0x0004 = Group 1 (Valid range = 0 - 255)

0x0005 = Group 2 (Valid range = 0 - 255)

0x0006 = Baud Rate (*see below for proper settings)

0x0007 = Debug Enable (Valid range = 1 is enabled, 0 is disabled.)

DR915LT Address Map:

0x0001 = Channel (Valid range = 0 – 63)

0x0002 = Tx Holdoff (Valid range = 5 - 255. Default = 5.)

0x0003 = Preamble Bytes (high byte) (Valid range = 16 - 1000. Default = 16. A value of less than 16 will cause improper operation.)

0x0004 = Preamble Bytes (low byte))

0x0005 = Destination Group (Valid range = 0 - 255 where 0 is broadcast group)

0x0006 = Destination Address (Valid range = 0 - 255 where 0 is broadcast address)

0x0007 = Source Group (Valid range = 1 - 255. A value of 0 must not be used.)

0x0008 = Source Address (Valid range = 1 - 255. A value of 0 must not be used.)

0x0009 = Packet Length (Valid range = 1 - 177. Default = 177.)

0x000A = CTS Deassert Limit (Valid range = 1 - 178. Default = 178. This value should be greater than the CTS Assert Limit.)

0x000B = CTS Assert Limit (Valid range = 1 - 177. Default = 89. This value should be less than the CTS Deassert Limit.)

0x000C = Baud Rate (*see below for proper settings)

0x000D = Communications Port (Valid range = 0 is SPI port, 1 is UART)

0x000E = Number of Repeaters in System (Valid range = 0 - 255.)

***Baud Rate settings for the DR915L and Repeater are as follows:**

2400 baud = 215
4800 baud = 107
9600 baud = 53 (default)
14400 baud = 35
19200 baud = 26
28800 baud = 17
38400 baud = 12 (not recommended for use)
57600 baud = 8

***Baud Rate settings for the DR915LT are as follows:**

2400 baud = 207
4800 baud = 103
9600 baud = 51 (default)
14400 baud = 34
19200 baud = 25
28800 baud = 16
38400 baud = 12
57600 baud = 8 (not recommended for use)

DR-915L/LT DATA RADIO
REGULATORY

FCC Compliance Warning

Changes or modifications to the DR-915L/LT not expressly approved by Coyote DataCom, Inc. could void the user's authority to operate this product.

Note: 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 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.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.