AEROCOMM

CL4424

Industrial 2.4GHz ConnexLink

User's Manual
Version 1.1

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For a period of one (1) year from the date of purchase, AᴇʀᴏCᴏᴍᴍ warrants the transceiver against defects in materials and workmanship. AᴇʀᴏCᴏᴍᴍ will not honor this warranty (and this warranty will be automatically void) if there has been any:

(1) Tampering, signs of tampering, or opening the transceiver's case.
(2) Use of AC power adapters and cables other than those originally supplied with the transceivers.
(3) Repair or attempt to repair by anyone other than an AᴇʀᴏCᴏᴍᴍ authorized technician.

This warranty does not cover and AᴇʀᴏCᴏᴍᴍ will not be liable for, any damage or failure caused by misuse, abuse, acts of God, accidents, electrical irregularity, or other causes beyond AᴇʀᴏCᴏᴍᴍ control, or claim by other than the original purchaser.

FCC Notice

⚠️ **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.

RF Exposure/Installation Instructions

⚠️ **WARNING:** To satisfy FCC RF exposure requirements for mobile transmitting devices, this equipment must be professionally installed such that the end user is prevented from replacing the antenna with a non-approved antenna. The end user should also be prevented from being within 20cm of the antenna during normal use with the exception of hands, feet, wrists and ankles.

The preceding statement must be included as a CAUTION statement in manuals for OEM products to alert users on FCC RF Exposure compliance.

Caution: Any change or modification not expressly approved by AeroComm could void the user's authority to operate the equipment.

Figures

Tables

1. CL4424 RF Transceiver

The CL4424 transceiver is a Frequency-Hopping Spread Spectrum (FHSS) radio designed for license-free operation in the 2.4GHz ISM band. Out-of-the box, the radio sustains a standard asynchronous serial data stream between two or more radios. Housed in a compact and rugged die-cast enclosure, the radio is equipped to replace thousands of meters of serial cable with its wireless link. The radio features an RS-232 or RS-485 interface for integration into legacy data systems.

Features

- ✓ Durable Industrial grade enclosure

- ✓ Transparent operation, supports any legacy system

- ✓ Transmits around corners, through walls

- ✓ Reliable communication up to 115.2Kbps

1.1 Overview

The CL4424 uses Frequency Hopping Spread Spectrum modulation, where the units "hop" from frequency to frequency many times per second using a specific hop pattern applied to all the transceivers in the same network. A distinct hopping pattern is provided for each Channel Number, thereby allowing multiple networks to co-exist in the same area without interference.

CL4424 transceivers operate in a Point-to-Point or Point-to-Multipoint, Client-Server or Peer-to-Peer architecture. One transceiver is configured as a Server and there can be one or many Clients. To establish synchronization between transceivers, the Server emits a beacon. Upon detecting a beacon, a Client transceiver informs its Host and a RF link is established.

CL4424s implement a proprietary communication protocol to provide secure data transmissions. Using FHSS technology, the data remains reliable over long distances. The use of license free frequency bands ensures that the units are ready to use with no further certification requirements.

Each unit is small and easily portable for use in mobile and temporary settings as well as for fixed installations. The CL4424 configuration software enables custom configurations based on unique application requirements.
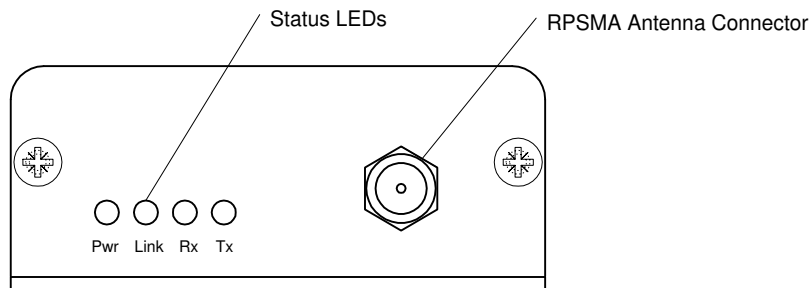
1.2   CL4424 Specification

Specifications	CL4424
TRANSCEIVER PERFORMANCE	
Output power (w/ 3dBi antenna)	100mW
Transmission range	Up to 500 feet (450m) indoors; Up to 1 mile (1.6 km) line-of-sight
Data rate	Up to 115.2 Kbps
RF Data Rate	576kbps fixed
Receiver Sensitivity	-100dBm typical @ 576kbps RF Data Rate
Power Consumption (@ 12 Vdc)	102mA (50% Transmit/Receive duty cycle)
Configuration software	Easy-to-use Windows based software
NETWORKING AND SECURITY	
Frequency band, RF Technology	2402 – 2478MHz, FHSS
Supported Network Topologies	Point-to-Point, Point-to-Multipoint
Channels	40 US/Canada/Europe, 20 France
Security	One byte System ID
ANTENNA	
RF Connector	RPSMA Jack
Type	1/2 Wave Dipole
ELECTRICAL	
Electrical requirements	Line voltage 100 – 120V (240V outside US);
Power supply	6-foot cable, AC power connector
ENVIRONMENTAL	
Environmental conditions	Operating temperature -40° to + 80°C; 10% to 90% humidity (non-condensing)
PHYSICAL	
Dimensions	4.4 x 2.7 x 1.4 inches
Weight	6 oz (170 g)
Serial Connector	DB-9 Male (RS-232), Terminal Block (RS-485)
Power Jack Dimensions	0.100" diameter pin with 0.250" diameter opening. Center positive.
Serial Cord length	6 feet (183 cm)

1.3   CL4424 Interface

CL4424 transceivers support RS-232/ RS-485 (2-wire Half Duplex) protocols. In a cabled environment, the RS-485 protocol can tolerate high noise and push signals over long cable lengths. RS-485 cabling can also communicate as far as 4000 feet (1200m) and offer multi-drop capability where up to 32 nodes can be connected. RS-232 cabling is suitable for distances less than 100 feet (30.5m) and only supports point-to-point communications. CL4424 transceivers offer performance improvements over a standard cabled link. Distance and multipoint communications are greatly enhanced. A selection of RS-232/RS-485 can be made when ordering the CL4424s.

Figure 1- RS-232/RS-485 CL4424 Front View

| CL4424 Status LEDs		
LED	Color	Description
Pwr	Green	On indicates that the unit is powered up.
Link	Red	On indicates the Client unit(s) and Server unit are in range of one another. Link LED remains activated on Server units. Client units activate the Link LED when in range of the Server unit.
Rx	Green	When flashing, LED indicates CL4424 unit is receiving data.
Tx	Red	When and flashing, LED indicates CL4424 unit is sending data.

RS-232 Pin Assignments

Figure 2- RS-232 CL4424 Back View

DB9 Male Connector   Power Connector
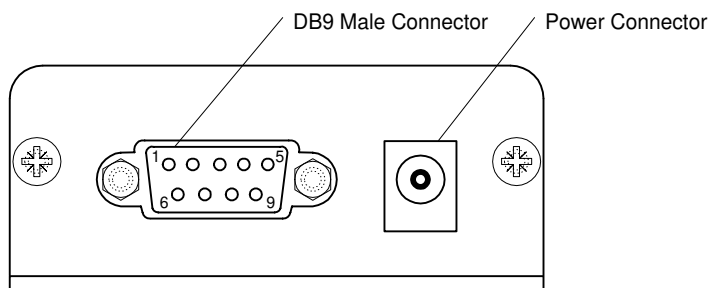
Pin	Description	Input / Output
1	DCD	O
2	TxD	O
3	RxD	I
4	DSR	O
5	GND	
6	DTR	I
7	CTS	O
8	RTS	I
9	RI	O

RS-485 (2-wire Half Duplex) Terminal Block Pin Assignments

Figure 3- RS-485 CL4424 Back View

Terminal Block
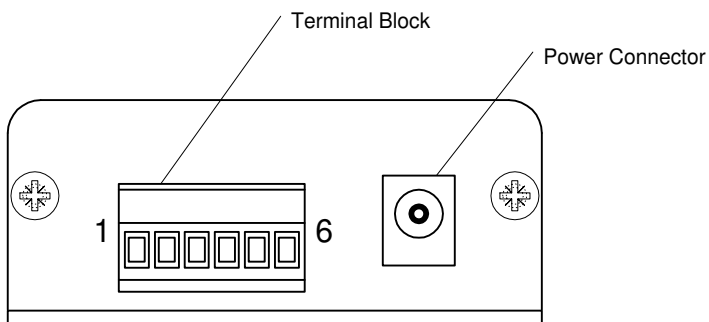
Power Connector

Pin	Description
1	VCC (6 –18V)(125 mA max)
2	485- (485B)
3	No Connect
4	No Connect
5	485+ (485A)
6	GND

Note: Standard power is applied through the power connector. Alternative power is available via the terminal block pins.

CL4424 Mechanical Diagram

Figure 4- CL4424 Mechanical Diagram

1.170

*Antenna Connector
SMA Jack, Reverse Polarity*

0.536

0.538

0.060
0.000

Side View

Label Recess, 3.5w x 2.0h

*0.150 dia. mounting holes
(4) places*

2.750

2.375

9 Pin Male D-Connector

J3

2.000

Status LEDs

*Power Jack w/ 0.100 dia. pin and
0.250 opening, pin is PWR.*

Pwr Link Rx Tx

J4

0.375

0.000

Top View

0.000   0.250   0.565

4.185   4.500   4.750

Note: All dimension in inches unless noted
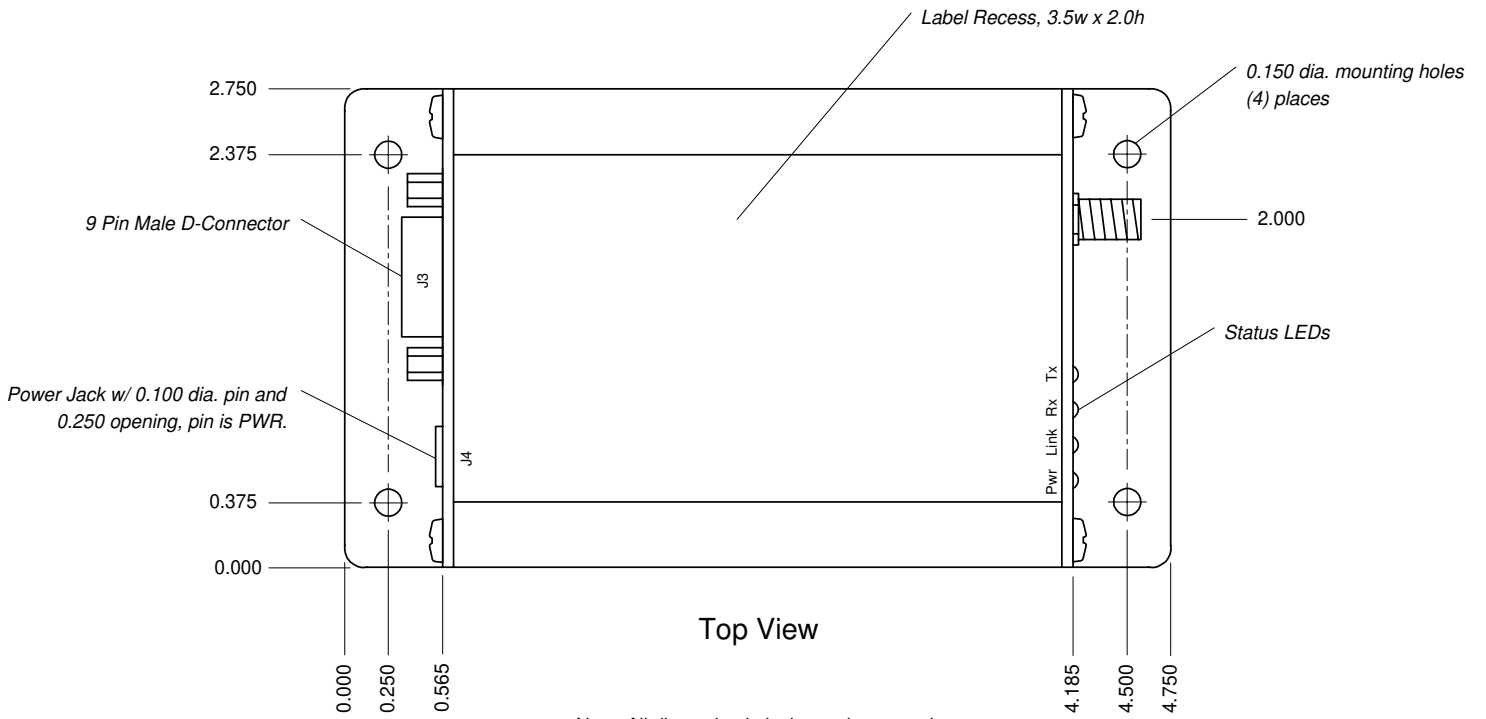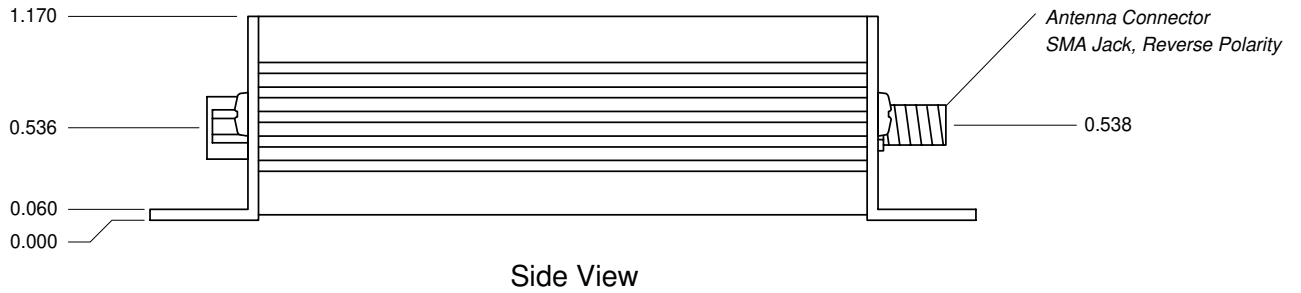
2. Interfacing Protocol

The CL4424 is a DCE (Data Communications Equipment). A DCE can be interfaced to a DTE using a straight through serial cable (the serial cable provided with the CL4424 is a straight through cable). Typically, PC's are defined as a DTE and peripherals are defined as DCE. To interface a DCE with another DCE, or a DTE with another DTE, a null modem (or a Crossover) cable is required. The null modem simply swaps pins to convert a DCE to a DTE and vice-versa. A null modem cable can be provided with the CL4424 on request.

The CL4424 transceivers support the following interface protocols

- RS-232

- RS-485 (2-wire) Half Duplex

Table 1 – DTE, DCE and Null Modem Signal Definitions

DCE Pin Number	DCE Signal Name	DCE Direction	DTE Pin Number	DTE Signal Name	DTE Direction	Null Modem Female DB9	Null Modem Male DB9
1	DCD	O	1	DCD	I	1	NC
2	TXD	O	2	RXD	I	2	3
3	RXD	I	3	TXD	O	3	2
4	DTR	I	4	DTR	O	4	6
5	GND		5	GND		5	5
6	DSR	O	6	DSR	I	6	4
7	RTS	I	7	RTS	O	7	8
8	CTS	O	8	CTS	I	8	7
9	RI	O	9	RI	I	9	NC

2.1   RS-232

RS-232 is a single ended data transmission protocol. The RS-232 signals are represented by voltage levels with respect to a system common (power / logic ground). The "idle" state (MARK) has the signal level negative with respect to common, and the "active" state (SPACE) has the signal level positive with respect to common. RS-232 has numerous handshaking lines (primarily used with modems), and also specifies a communications protocol.

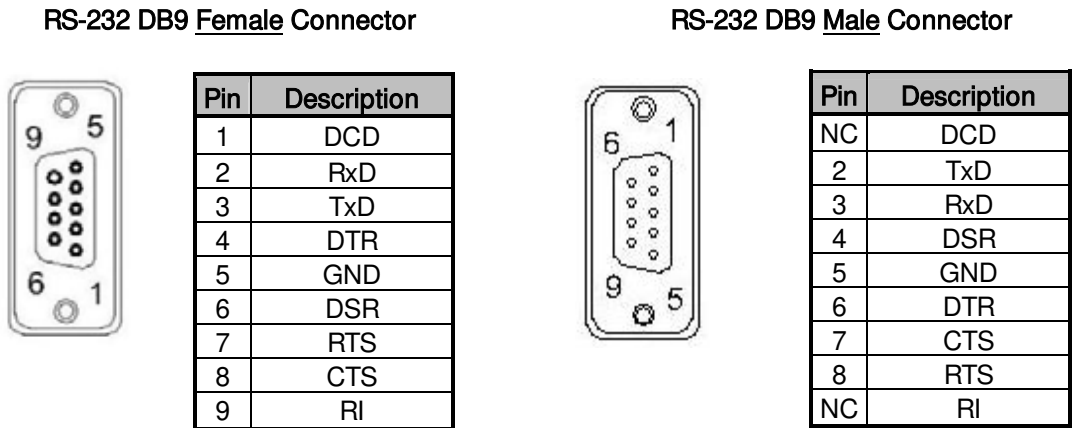**Figure 5- RS-232 Male/Female Connector Pin out**

RS-232 DB9 <u>Female</u> Connector

Pin	Description
1	DCD
2	RxD
3	TxD
4	DTR
5	GND
6	DSR
7	RTS
8	CTS
9	RI

RS-232 DB9 <u>Male</u> Connector

Pin	Description
NC	DCD
2	TxD
3	RxD
4	DSR
5	GND
6	DTR
7	CTS
8	RTS
NC	RI

Figure 6- DCE to DTE Interface

OEM Host/PC — CL4424 Modem

CTS ← CTS
RTS → RTS
RXD ← TXD
TXD → RXD
GND — GND
DCD ← DCD
DSR ← DSR
DTR → DTR

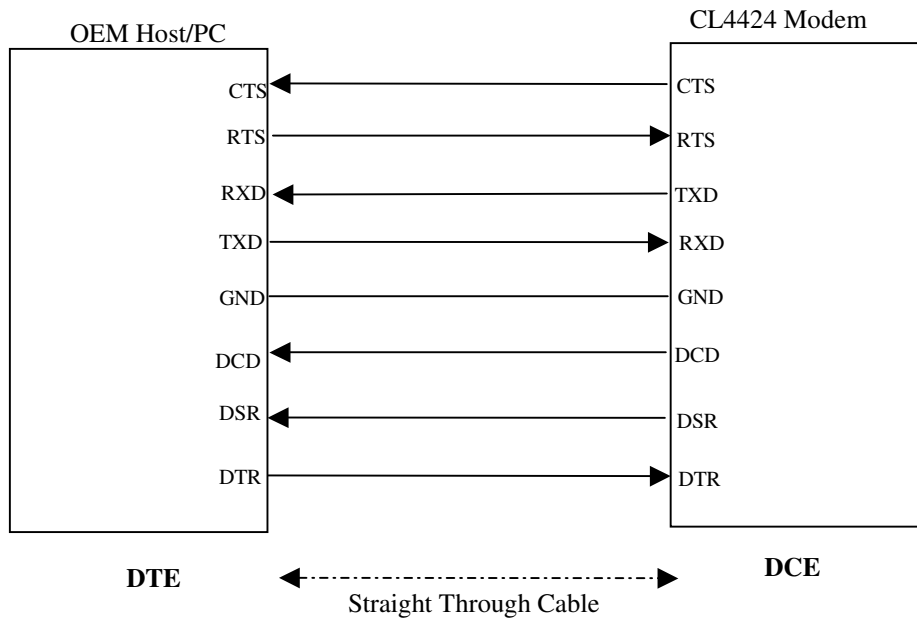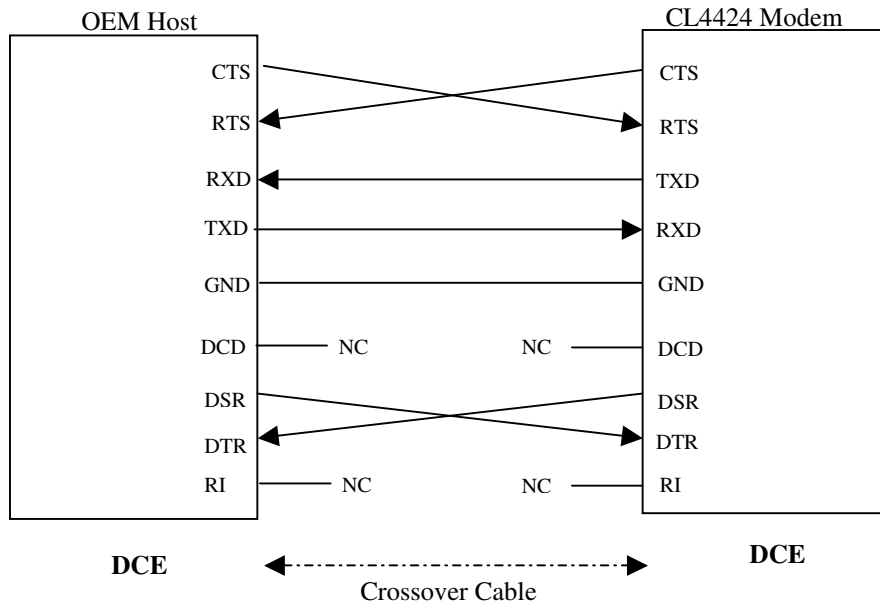**DTE**   **DCE**
Straight Through Cable

Figure 7- DCE to DCE Interface

Note: The Straight Through Cable provided with the CL4424 has female connectors on both ends and the Crossover cable has a male connector at one end and a female connector at the other end. Please use a male-to-male adapter or female-to-female adapter wherever required. Using a null modem adapter with a Crossover cable is equivalent to using a Straight Through cable.

2.2 RS-485 (2-wire Half Duplex)

The RS-485 interface uses a Differential Data Transmission that can help nullify the effects of ground shifts and induced noise signals that can appear as common mode voltages on a network.

The CL4424 implements a RS-485 (2-wire Half Duplex) multi-drop interface. Typically, a RS-485 bus will consist of a master and several slaves. The nodes will have unique addresses and can send addressed packets to specific nodes. Because the bus is half duplex, no two nodes should try to talk at the same time. The CL4424 does not have a RS-485 address, therefore, it will transmit all RS-485 traffic over the RF. Conversely, as soon as a CL4424 receives a packet over the RF, it will transmit the packet over the RS-485 bus.

Note: When using RS-485 (2-wire Half Duplex), a RS-485 to RS-232 converter is required to configure the unit. AeroComm recommends a B&B Electronics 4WSD9R converter to translate RS-485 to RS-232.

2.3   Hardware Flow Control

Often, the host device can send data to the CL4424 faster than it can be sent over the RF. The CL4424 has a 256 byte buffer to store data before sending it over the RF. If the host device is sending data faster than the CL4424 can send it out, eventually, the buffer will fill up. If the host device continues to send data while the CL4424 buffer is full, that data will be discarded. To avoid this situation, the CL4424 will de-assert CTS as a warning that the buffer is filling. The host device should stop sending data. When the CL4424 is able to free some buffer space, it will assert CTS and the host device can continue sending data. Similarly, if RTS is enabled in the CL4424, the host device can throttle the CL4424 by de-asserting RTS. **Note: CTS is always enabled by default. RS-485 Interface does not support Hardware flow control and RTS mode should not be enabled on a RS-485 CL4424.**

3. Network Topologies

Topology refers to the shape of a network, or the network's layout. How different nodes in a network are connected to each other and how they communicate is determined by the network's topology. The CL4424s support a Point-to-Point and a Point-to-Multipoint network topology.

3.1   Point-to-Point

A point-to-point system is a simple arrangement consisting of just two CL4424s - a Server and a Client. Sometimes referred to as a wireless bridge, a point-to-point link replaces a single communications cable. A point-to-point link might be used to connect a PLC to a remote monitoring station.

Figure 8- Point-to-Point Network
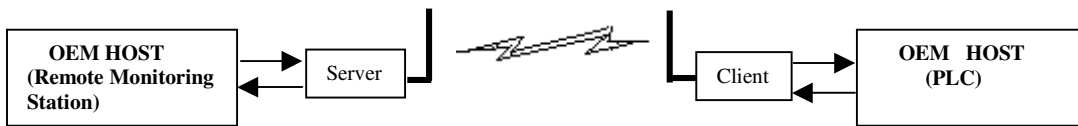
3.2   Point-to-Multipoint

Point-to-Multipoint systems have one base station, or access point, that controls communications with all of the other wireless nodes in the network. This allows for the creation of a wireless network consisting of multiple nodes. By programming each CL4424 with a network specific Channel Number and System ID multiple networks can be created as shown below.

Figure 9- Multiple Networks of Point-to-Multipoint CL4424s

Example: Channel Number = 23
          System ID = 123

Example: Channel Number = 25
          System ID = 256

4. CL4424 Configuration Utility Software

AeroComm provides the easy to use CL4424 Utility Software for programming the CL4424. The software is compatible with Microsoft® Windows 95, 98, 2000, Me, NT and XP. CL4424s are plug-and-play devices that work with minimal or no configuration.

Advanced users may refer to the AC4424 User's Manual for more details about the radio's operation and additional configuration options. The SDK Software can be used to enable and demonstrate these options. The SDK Software and AC4424 User's manual can be found on the Connex Tools and Literature CD or on the website at http://www.aerocomm.com/.

4.1   Installation

1. Locate the **CL4424 Configuration Utility, 900 MHz** link in the Software section of the Connex Tools & Literature CD. This software is also available at
    http://www.aerocomm.com/Software/ConnexLink_4424.zip.
2. When prompted, select the directory where the program files will be installed.
3. When finished, a window will be displayed indicating a successful installation. Click **OK**.

4.2   CL4424 Settings

The CL4424 **Settings** Page is shown below, as it will appear the first time the program is run.

4.2.1   ConnexLink Settings

Client/Server: Designates CL4424 type. In each network, there must be only one Server. All other CL4424 units must be programmed as Clients. The number of Clients in the network is not limited; however, if performance diminishes due to the number of CL4424s that need to access the network, consider additional RF Networks.

Interface Baud Rate: This defines the baud rate used for communicating with the CL4424 over the serial interface. The RF baud rate is fixed at 576kbps and is independent of the Interface Baud Rate. The default baud rate setting is 115,200 bps unless the units have been pre-configured by AeroComm. **The Interface Baud Rate setting of the CL4424 must match the Baud Rate setting of its host device.**

Random Back Off: In an asynchronous network where any node can talk at any time, the CL4424 can be programmed to use Random Back Off to mitigate the RF Link. If two nodes try to send packets at the same time, the packets will collide over the RF and will not be received by the destination node. If Random Back Off is enabled when this occurs, both radios will generate a random amount of time (in 8ms increments) to wait before retrying.

Channel Number: The CL4424 is a frequency hopping transceiver. Each Channel Number designates a unique hopping sequence and constitutes an independent network of CL4424 units. Up to 40 independent networks can be created (up to 20 in France). Multiple Servers operating in the same coverage area must be programmed with different Channel Numbers to prevent inoperability of the networks. The valid range of values for this field is 0 to 39.

Table 1 – US and International RF Channel Number Settings

Channel Set	RF Channel Number Range	Frequency Range	Countries
1	0 – 19	2406 – 2435MHz	US,Canada, Europe, France
2	20 – 39	2444 – 2472MHz	US, Canada, Europe

Max Transmit Retries (For all Clients and for Servers in Point-to-Point networks): This value represents the maximum number of times a particular data packet will be transmitted unsuccessfully, or without an acknowledgement, before the CL4424 discards the packet. The default value is 16 attempts. If communication is lost and the Client's **Link** LED is on, try increasing this value in small increments until communication is reestablished. The valid range of values for this field is 0 to 255.

Broadcast Attempts (For Servers in Point-to-Multipoint networks): This value represents the number of times a data packet will be transmitted by the Point-to-Multipoint Server. The default value is 4 attempts. If communication is lost and the Clients' **Link** LED is on, try increasing this value in small increments until communication is reestablished. The valid range of values for this field is 0 to 255.

System Identification: A number from 0 to 256 that provides added security to each independent network of CL4424 units. The System ID serves as an RF password to maintain secure transfers of data. The System ID will not prevent inoperability that occurs from locating multiple Servers with the same Channel Number in the same coverage area.

Important Note: **Collocated CL4424 networks must operate on different Channel Numbers. All units in a given CL4424 network must have identical Channel Numbers and System IDs.**

Destination Address: Programmed in the Point-to-Point Server, Destination Address is the MAC Address of the CL4424 Client. Used to optimize Point-to-Point communications by utilizing RF Acknowledgement.

RF Delivery: Shows if the CL4424 is configured in Broadcast mode or Addressed mode. This is controlled by the System Config selection that was made when the CL4424 was configured.

Firmware Version: Displays the CL4424's firmware version.

MAC Address: A unique 6 Byte, IEEE 802.3 Ethernet address assigned by AeroComm to each CL4424.

4.2.2   Optional Settings

RTS Enable: Enables the Request To Send control line. When enabled, enables Hardware Flow Control. Refer to **Section 2.3 Hardware Flow Control**.

Full Duplex: This mode restricts Client radios to transmitting on odd numbered frequency hop bins and the Server to even numbered frequency hop bins. Though the RF hardware is still technically half duplex, it makes the transceiver seem full duplex. This can cause overall throughputs to be cut in half. **Note: All transceivers on the same network must have the same setting for Full Duplex.**

4.2.3   PC Settings

Port: On startup, the software will search the Windows Registry to locate all serial communications ports. It will designate each port it finds by displaying the full Windows identifier for the port. Select the port that is connected to the CL4424 unit.

Baud Rate: Must be equal to the Interface Baud Rate setting of the CL4424 unit that is to be configured.

System Config: Type of CL4424 network to be configured. Valid choices are **Point-to-Point** (one Server and one Client) or **Point-to-Multipoint** (one Server and multiple Clients).

Attention: When setting up a Point-to-Point network the Server's Destination address must be programmed with the Client's MAC Address.

4.2.4   Additional Features

Show Defaults: When this button is clicked, the default values will be shown for all the ConnexLink Settings parameters.

Save File: This will save all the ConnexLink Settings parameters to a file.

Load File: This will load a previously saved file and put all the values from that file into the ConnexLink Settings parameters.

4.3   Programming The CL4424 units

1. Connect a CL4424 unit to the serial communications port on the PC.

2. Connect the power supply to the CL4424 unit. Make sure the **Pwr** LED is on.

3. Start the CL4424 Configuration Utility.

4. Select the COM Port that is connected to the CL4424 unit on the PC Settings section.

5. Select the Interface Baud Rate of the CL4424 unit. All CL4424 units are shipped with a default rate of 115,200 bps (unless units have been pre-configured to match specific serial settings). If the Interface Baud Rate of the CL4424 unit is changed as described in **Section 4.2 Changing CL4424 Settings,** then PC Setting Baud Rate must be set to the same Baud Rate to allow proper programming of the units.

6. Select the System Configuration for the CL4424 network, **Point-to-Point** (one Server and one Client) or **Point-to-Multipoint** (one Server and multiple Clients).

7. Select **Read Radio** to display the current settings of the CL4424 unit.

8. Change desired settings.

9. After all changes have been made, select **Write Radio** to save the changes.

10. Cycle Power to the unit after all changes has been saved. This will set the CL4424 unit to its normal mode of operation.

5. Troubleshooting

Problem	Solution
Read Radio displays error message: "Radio not responding."	1. Verify the PC Settings. See **Section 4.2.3 PC Settings.** 2. Make sure the CL4424 unit uses the right serial cable. Refer to **Section 2.1 RS-232**. 3. If any other program is running and is using the same COM port as the CL4424, close that program and try to read the radio again. 4. Reset the radio by cycling power after each unsuccessful Read.
Write Radio displays error message: "Radio not responding."	1. Cycle power to the radio. 2. Read the radio and make desired changes and then Write the radio.
Garbled **Data** received.	1. Verify that the baud rate of the CL4424 matches that of the CL4424 host device.
Client's **Link** LED does not come on.	1. Make sure the unit is connected to power. 2. Cycle power to the radio. 3. Verify the Channel Number and System ID settings.
Link LED is on, but data does not get transmitted or received.	1. Make sure the CL4424 unit(s) is connected to the correct COM Port. 2. Check the COM port settings for correct **Baud Rate**. Units can have transmission errors with **Flow Control** set to **Xon/Xoff**. 3. Try increasing the **Maximum Transmit Attempts** (for Clients) and/or **Broadcast Attempts** (for Servers) values in small increments until communication is established. 4. Connect a **Null Modem** adapter between the Client and its host device. 5. Check the Destination Address setting.

If these troubleshooting tips do not resolve the problem, please call our toll free number at: (800) 492-2320, extension 207. Technical support hours are Monday through Friday, 8:00 am to 5:00 pm Central Standard Time.