CL024

HARDWARE INTEGRATION GUIDE
VERSION 2.0

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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 Laird could void the user's authority to operate the equipment.

Revision History

Version	Date	Changes	Approved
1.0	14 Aug 13	Initial Release	Chris Downey
1.1	19 Nov 13	Updated Appendix [Note: Now moved to HIG in v2.0]	Chris Downey
2.0	16 Dec 13	Separated into two separate docs (Hardware Integration Guide and User Guide). Added a Related Documents section.	Chris Downey

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CL024 RF TRANSCEIVER

The CL024 transceiver is a Frequency Hopping Spread Spectrum (FHSS) radio designed for license-free operation in the 2.4 GHz Industrial, Scientific, and Medical (ISM) unlicensed band. 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 miles of serial cable with its wireless link. The radio features an RS232 interface for integration into legacy data systems.

Overview

The CL024 uses Frequency Hopping Spread Spectrum technology, 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 with limited interference.

CL024 transceivers operate in a Server/Client architecture. The Server radio transmits a beacon at the beginning of every hop which Client radios utilize to synchronize their hopping. Communication between devices cannot occur until both devices are synchronized. While an unlimited number of clients can synchronize to the server's beacon, communication between devices is limited to the chosen RF rate (either 500kbps or 230kbps). The CL024 radios come with options for enabling Full Duplex communication to reserve slots for server and client transmissions and with Random-Backoff settings to ensure retransmissions don't collide.

CL024 radios implement a proprietary communication protocol to provide secure data transmissions. FHSS technology ensures data reliability over long distances. The license-free frequency bands ensure that the units are ready for use with no further certification requirements.

The CL024 transceivers use the 2.4 GHz ISM license free frequency band, which requires no additional certifications when designing into a new or legacy data system.

Each unit is small and easily portable for use in mobile and temporary settings as well as fixed installations. The CL024 configuration software enables custom configurations based on unique application requirements.

This document contains information about the hardware and software interface between a Laird CL024 transceiver and an OEM host. Information includes the theory of operation, specifications, serial interface definition, security information and mechanical drawings. The OEM is responsible for ensuring the final product meets all appropriate regulatory agency requirements listed herein before selling any product.

Note: CL024 modules are referred to as the "radio" or "transceiver". Individual naming differentiates product -specific features. The host (PC, Microcontroller or any connected device) is "OEM host."

Features

- Server/Client architecture, with an unlimited number of Clients in a network
- API commands to control packet routing and acknowledgement on a packet-by-packet basis
- Durable industrial-grade enclosure
- Transparent operation; supports any legacy system
- Transmits around corners and through walls
- Reliable communication with serial UART speeds up to 460.8 Kbps
- Point-to-Point and Point-to-Multipoint configurations

Detailed Specifications

Table 1: CL024-1000 Specifications

INTERFACE			
Serial Interface Connector	DB-9 Male (RS232)		
RF Connector	RPSMA Jack		
Serial Interface Data Rate	Serial UART to OEM host: Up to 460.8 Kbps		
Power Consumption	400 mA @ 12 VDC		
Channels	US/Canada: 43 or 79 channels		
Supported Network Topologies	Point-to-Point, Point-to-Multipoint		
OPERATIONAL			
Frequency Band	2400 – 2483.5 MHz (US/Canada)		
RF Data Rate	280 kbps or 500 kbps selectable		
Host Data Throughput	115 Kbps maximum		
RF Technology	Frequency Hopping Spread Spectrum (FHSS)		
EEPROM write cycles	1000 Write/Erase Cycles		
Hop Period	13.2 ms		
Output Power		**Conducted (no antenna)**	**EIRP (3dBi gain antenna)**
	CL024-100	125 mW typical	250 mW typical
Supply Voltage	CL024-1000: 7-18VDC; 400 mA		
Receiver Sensitivity	-100dBm typical @ 76.8 kbps RF Data Rate		
Range, Line of Sight (based on 3dBi gain antenna)	Max. 1300 feet (400 m) indoors; Max. 2.5 miles (km) line-of-sight		
ENVIRONMENTAL			
Temperature (Operational)	-40° C to +85° C		
Temperature (Storage)	-50° C to +85° C		
Humidity (Non-Condensing)	10% to 90%		
PHYSICAL			
Dimensions	4.4 x 2.7 x 1.4 inches		
Weight	6 oz. (170 g)		
CERTIFICATIONS			
FCC Part 15.247	CL024-100: KQL-RM024		
Industry Canada (IC)	CL024-100: 2268C-RM024		

Caution! ESD Sensitive Component. Use proper ESD precautions when handling this device to prevent permanent damage.

External ESD protection is required to protect this device from damage as required to pass IEC 61000-4-2 or ISO 10605 based on end system application.

Status LEDs

CL024

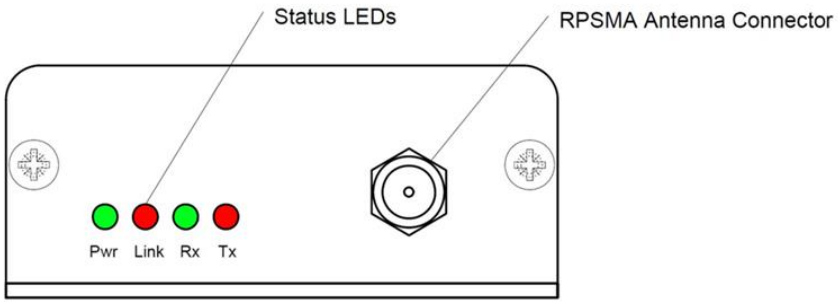


Figure 1: CL024 Status LEDs

Table 2 describes each of the CL024 Status LEDs.

Table 2: CL024 Status LEDs

LED	COLOR	DESCRIPTION
Pwr	Green	On. Indicates the unit is powered up.
Link	Red	On. Indicates the CL024 is synchronized. Note for a Server the Link will always be on
RXD	Green	When flashing, indicates the CL024 is receiving data.
TXD	Red	When flashing, indicates the CL024 is transmitting data.

Serial Interface

- CL024 Serial Interface
- Hardware Flow Control

The CL024 supports the following protocols:

- RS232

CL024 Serial Interface

RS232

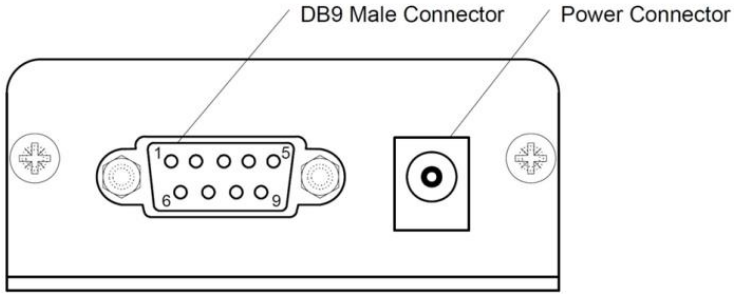
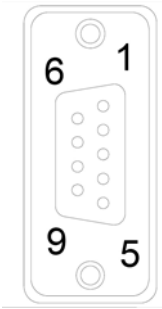


Figure 2: CL024-RS232

RS232 is a single-ended data transmission protocol. The RS232 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.

Table 3: CL024 DB9 Male Connector Pinout

DB9 Pin	Signal Name	Description	Direction
1	DCD	Data Carrier Detect	Out
2	TXD (RXD with respect to DTE)	Transmit Data	Data Out to Host
3	RXD (TXD with respect to DTE)	Receive Data	Data In to CL024
4	DTR	Data Terminal Ready	In
5	GND	Ground	-
6	DSR	Data Set Ready	Out
7	RTS	Request to Send	In
8	CTS	Clear to Send	Out
9	RI	Ring Indicator	Out



Interfacing to Other RS232 Equipment

The CL024 is a DCE (Data Communications Equipment) device. Typically, devices like PCs are considered DTE (Data Terminal Equipment) devices while peripheral devices are classified as DCE. A DCE device can interface to a DTE device using a straight-through serial cable (Figure 3). When interfacing two DCE (or two DTE) devices together, a null modem cable (or crossover cable) is required to swap the pins and convert the signals accordingly (Figure 4).

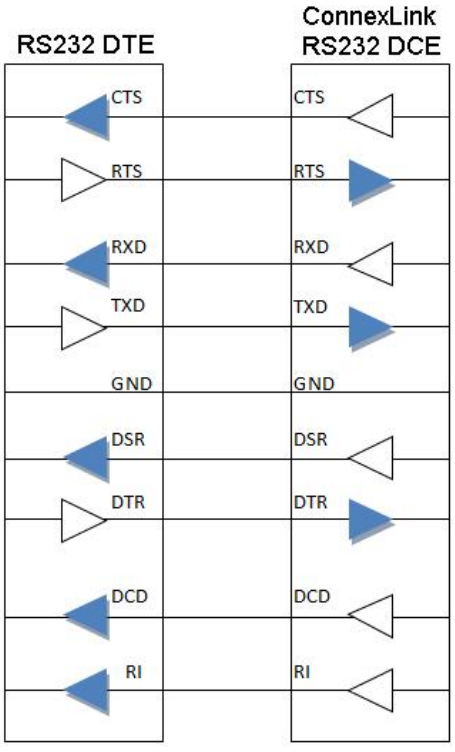


Figure 3: DTE to DCE interface (all signals with respect to DTE)

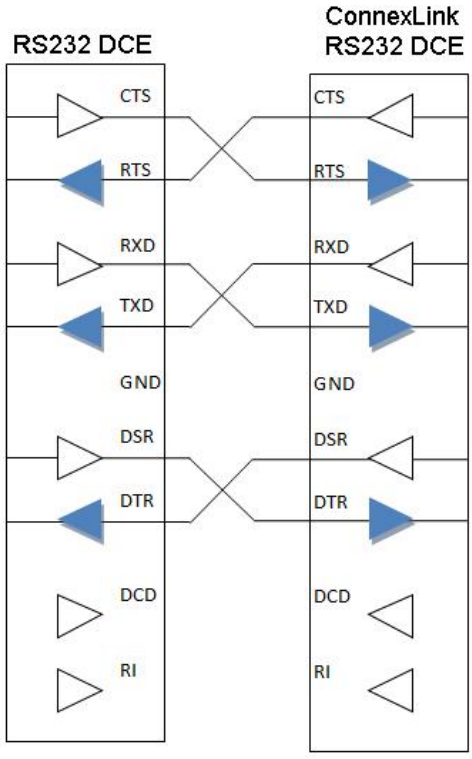


Figure 4: DCE to DCE interface (all signals with respect to DTE)

Note: If you previously used a straight-through cable to connect your PC to your device, you'll need to use a null modem cable or adapter to connect the CL024 to that device. Please refer to www.lairdtech.com/wireless for more information.

Hardware Flow Control

Flow control refers to the control of data flow between the host and the CL024. It is the means of handling data in the transmit/receive buffer of the CL024 interface and it determines the throttling of data flow between the host and the CL024. Often in serial communication, one device is capable of sending data much faster than the other can receive. Flow control allows the slower device to tell the faster device to pause and resume data transmission. Because flow control signals CTS and RTS are used by the CL024 and its host *locally* (rather than over the air), one CL024 cannot tell the other CL024 to slow down or speed up.

The CL024 controls the Clear to Send (CTS) output to the OEM host. The state of the CTS pin is based on the amount of data in the interface buffer. If the buffer is below the maximum limit, the transceiver holds CTS logic Low to signal to the OEM host that data can be accepted over the serial interface safely. If the buffer is full, then CTS transitions logic High to signal to the OEM host that additional data sent over the serial bus has the potential to be lost due to buffer overflow.

Ready to Send (RTS) is an input to the CL024 from the OEM host. When the RTS Enable option is selected in the software configuration of the CL024, the transceiver checks the status of RTS before attempting to send received RF data to the OEM host. If RTS is logic Low, the transceiver sends data to the OEM host. If RTS is logic High, the CL024 does not send data to the host.

Note: CTS is always enabled by default.

RTS is high by default on the CL024. If RTS Enable is enabled, the CL024 does not transmit data out the serial interface unless the RTS line is driven low by the OEM host.

Tip

Can I implement a design using just Txd, Rxd and Gnd (Three-wire Interface)?

Yes. However, Laird strongly recommends that your hardware monitor the CTS pin of the radio. The radio signals CTS logic High when its interface buffer is nearly full. Your hardware should stop sending data over the serial interface at this point to avoid a buffer overrun (and subsequent loss of data).

You can perform a successful design without monitoring CTS. However, you must take into account the amount of latency the radio adds to the system, any additional latency caused by Transmit Retries or Broadcast Attempts, how often you send data, non-delivery network timeouts, and interface data rate. Polled type networks, where a centralized host requests data from the surrounding hosts and the surrounding hosts respond, are good candidates for avoiding the use of CTS. This is because no one transceiver can monopolize the RF link. Asynchronous type networks, where any radio can send to another radio at any point in time, are much more difficult to implement without the use of CTS.

HARDWARE

Mechanical Drawing

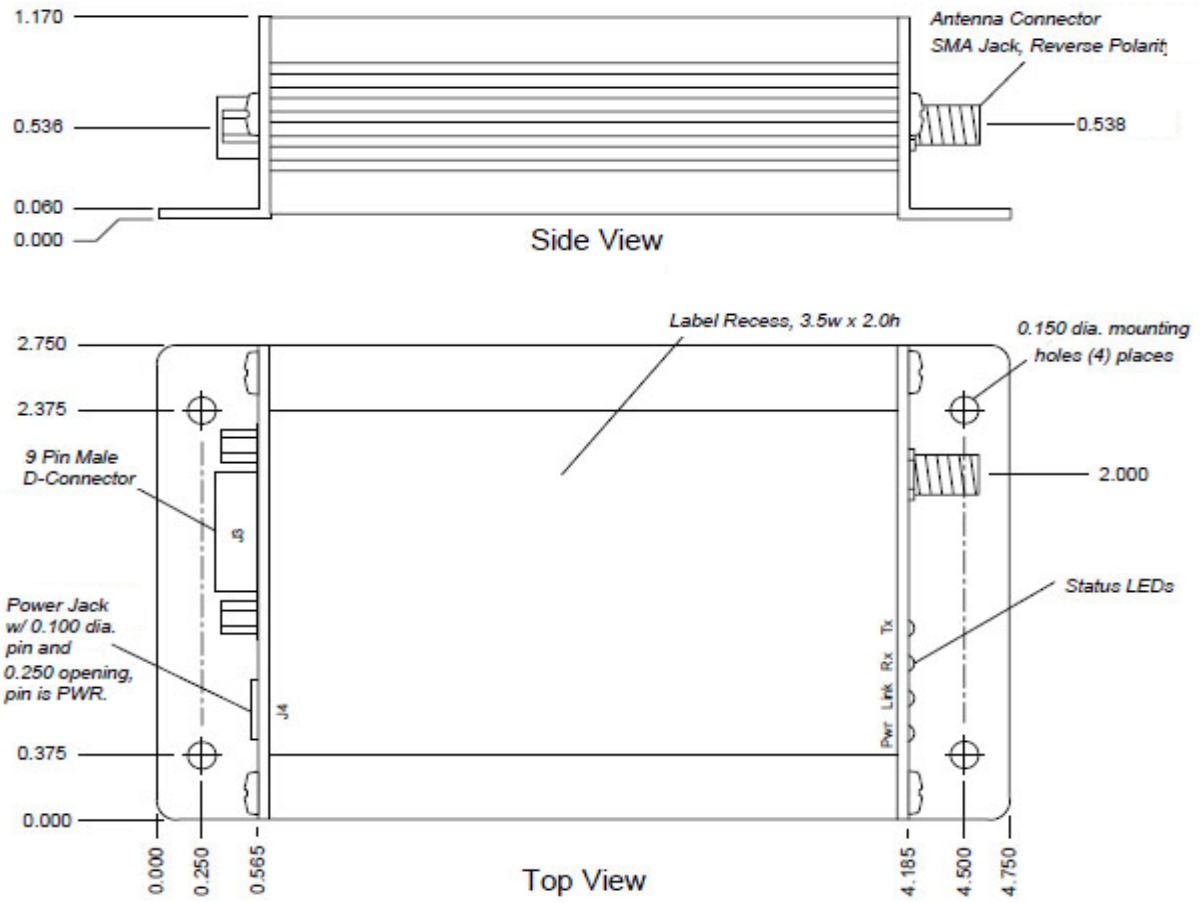


Figure 5: Mechanical Drawing

Approved Antenna List

Table 4: CL024 approved antennas

Item	Part Number	Mfg.	Type	Gain (dBi)
1	ID2450-RS36	Laird Technologies	Panel	9
2	IG2450-RS36	Laird Technologies	Omni	6
3	S151-6-PX-2450S	Nearson	Dipole	5

1. *Strictly requires professional installation*

Note: You may use different antenna manufacturers as long as the antenna is of like type and equal or lesser gain to one of the antennas listed in the table above.

Related Documents and Files

The following additional CL024 technical documents are also available from the Laird RM024 product page under the Documentation tab:

- ConnexLink Product Brief
- CL024 User Guide

The following downloads are also available from the Laird CL024 product page:

- Configuration Utility
- USB Drivers