CL4490

HARDWARE INTEGRATION GUIDE

VERSION 1.0

FCC Notice

CL4490 Hardware Integration Guide
Version 1.0

> **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 By
1.0	11 Dec 2013	Separated from User Guide. Initial Release	Chris Downey

CONTENTS

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CL4490 RF TRANSCEIVER

The CL4490 transceiver is a Frequency Hopping Spread Spectrum (FHSS) radio designed for license-free operation in the 900 MHz Industrial, Scientific, and Medical (ISM) unlicensed band. The radio sustains a standard asynchronous serial data stream between two or more radios out of the box. Housed in a compact and rugged die-cast enclosure, the radio is equipped to replace miles of serial cable using a CL4490 RS232, RS485, or USB interface.

This guide is for the CL4490 and CL4490-PRO. References to the CL4490 apply to the CL4490-PRO, unless otherwise specified.

Overview

The CL4490 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 coexist in the same area with limited interference.

CL4490 transceivers operate in a Point-to-Point or Point-to-Multipoint, client-server architecture. One transceiver is configured as a server and there can be one or many clients. To establish communication between transceivers, the server emits a beacon and upon detecting a beacon, a Radio Frequency (RF) link is established with the client(s).

CL4490s implement a proprietary communication protocol to provide secure data transmissions. Using 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.

Each unit is small and easily portable for use in mobile and temporary settings as well as fixed installations. The CL4490 configuration software enables custom configurations based on unique application requirements.

This document contains information about the hardware and software interface between a Laird CL4490 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 before the final product is sold that it meets all appropriate regulatory agency requirements listed herein.

Additionally, this document contains a list of Related Documents and Files.

Note: CL4490 modules are referred to as the "radio" or "transceiver". Individual naming is used to differentiate product-specific features. The host (PC, Microcontroller, or any device connected to the CL4490) is referred to as "OEM host".

Features

Networking and Security

- Retries and Acknowledgements
- API Commands to control packet routing and acknowledgement on a packet-by-packet basis
- Frequency Hopping Spread Spectrum for security and interference rejection
- Customizable RF Channel number and System ID
- Dynamic link analysis, remote radio discovery
- Low latency and high throughput

Easy to Use

- Continuous 76.8kbps RF data stream
- Software selectable interface baud rates from 1200bps to 115.2kbps
- Advanced configuration available using AT commands

Detailed Specifications

Table 1: CL4490 Specifications

INTERFACE	
Serial Interface Connector	**CL4490:** DB-9 Male (RS232), Terminal Block (RS485), Type B USB (USB) **CL4490-PRO:** DB-9 Female
RF Connector	50 Ohm RPSMA Connector
Serial Interface Data Rate	Baud rates from 1200 bps to 115.2 Kbps
Power Consumption	400 mA @ 12 VDC
Channels	CL4490-200: 56 channels on 3 channel sets CL4490-1000: 40 channels on 2 channel sets
Supported Network Topologies	Point-to-Point, Point-to-Multipoint
Security	One byte System ID. 56-bit DES encryption key
Interface Buffer Size	CL4490: Input/Output: 256 bytes each CL4490-PRO: Input/Output: 1600 bytes each

OPERATIONAL	
Frequency Band	902 – 928 MHz (US/Canada) 915 – 928 MHz (Australia, US/Canada)
RF Data Rate	76.8 Kbps fixed
Host Data Throughput	32 Kbps maximum
RF Technology	Frequency Hopping Spread Spectrum (FHSS)
EEPROM write cycles	20000
Hop period	20 ms
Output Power	**Conducted (no antenna)** **EIRP (3dBi gain antenna)** CL4490-200 100 mW typical 200 mW typical CL4490-1000/PRO 743 mW typical 1486 mW typical
Supply Voltage	CL4490-200: USB Supplied 5V/500 mA CL4490-1000: 7-18 VDC 400 mA PRO: 7-28 VDC 400 mA
Receiver Sensitivity	-100dBm typical @ 76.8 Kbps RF Data Rate
Range, Line of Sight (based on 3dBi gain antenna)	CL4490-200: Up to 4 miles CL4490-1000/PRO: Up to 20 miles

POWER SETTINGS (Input Voltage: 12 v DC)				
Transmit – Full Duty Cycle	**Max Power Setting**	**Current (mA)**	**dBm**	**mW**
	Low	157	10	10
	Quarter	225	23	200
	Half	280	26	400
	Full	365	28	743
Receive – Transceiver in Idle	**Max Power Setting**	**Current (mA)**		
	Low	50		
	Quarter	50		
	Half	50		
	Full	50		

ENVIRONMENTAL	
Temperature (Operational)	-40° C to 80° 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	CL4490-200: KQLAC4490-100 CL4490-1000/PRO: KQLAC4490
Industry Canada (IC)	CL4490-200: 2268C-AC4490 CL4490-1000/PRO: 2268C-AC44901000

Caution! ESD Sensitive Component. You must 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.

SERIAL INTERFACE

This section details the CL4490's serial interface properties and th

- CL4490 Serial Interface
- CL4490-PRO Serial Interface
- Hardware Flow Control

The CL4490 supports the following protocols, which are separate products:
- RS232
- RS485
- USB

The CL4490-PRO supports the following protocols in one product:
- RS232
- RS485 (2-wire)
- RS485 (4-Wire) and RS422

Laird wireless solutions are not subject to the cabling restrictions for distance. All interfaces are available when ordering.

CL4490 Serial Interface

RS232
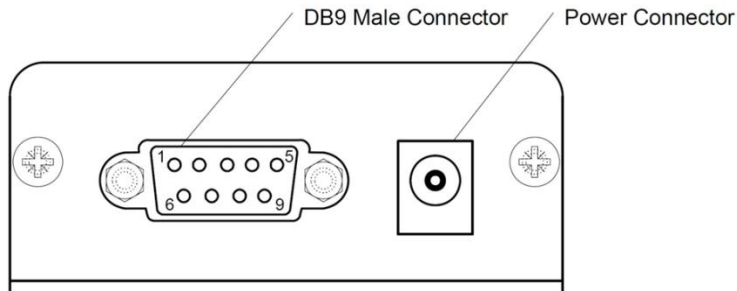
Figure 1: CL4490-RS232

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 2: CL4490 DB9 Male Connector Pinout (as defined in CL4490)

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 CL4490
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
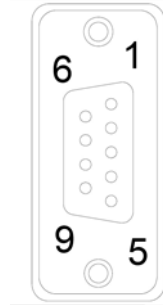
Interfacing to Other RS232 Equipment

The CL4490 is a DCE (Data Communications Equipment) device. Typically, devices like PCs are considered DTE (Data Terminal Equipment) devices. Peripheral devices are classified as DCE. A DCE device can interface to a DTE device using a straight-through serial cable. When interfacing two DCE (or two DTE) devices together, a null modem (or crossover) cable is required to swap pins and convert the signals accordingly.
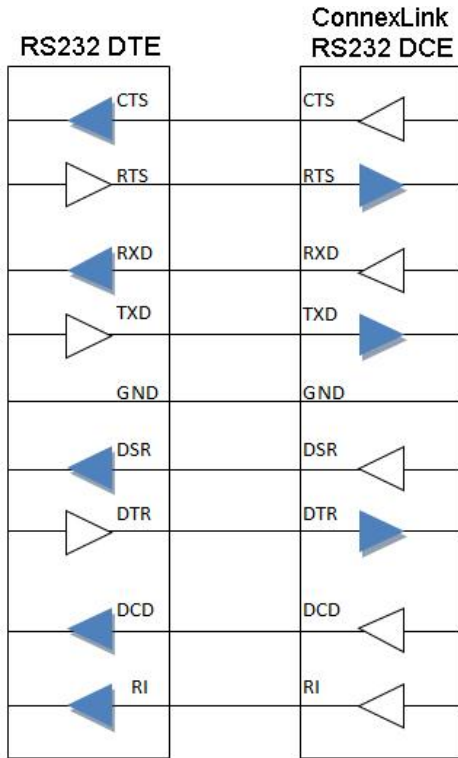

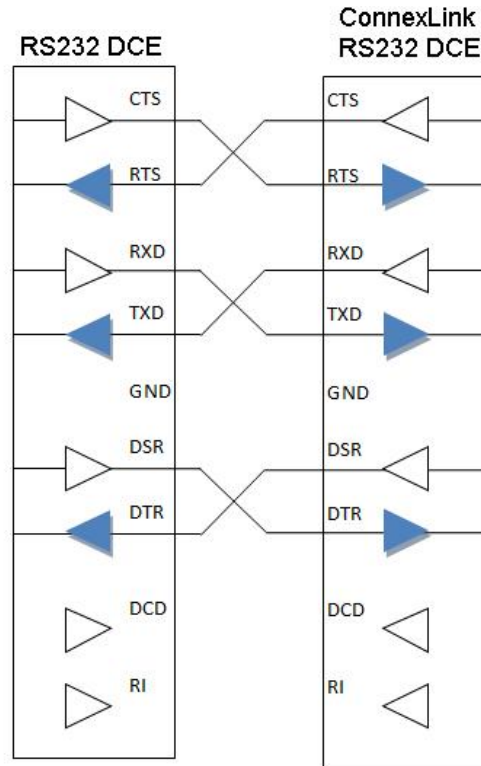*Figure 2: DTE to DCE interface (signals with respect to DTE)*

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

Note: When using a pair of CL4490s to connect a PC to a peripheral unit, if you previously used a straight-through serial cable to connect your PC to your peripheral device, you'll need to use a straight-through serial cable between the PC and the CL4490 and a null modem adapter, or cross-over cable, between the other CL4490 and the peripheral device.
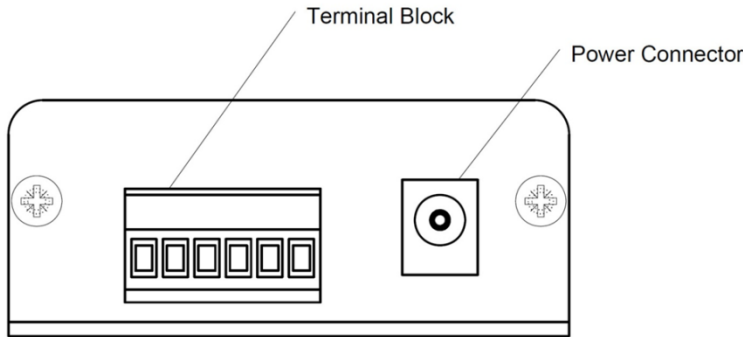
RS485

Figure 4: CL4490-RS485

The RS485 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 CL4490 uses a RS485 (2-wire Half Duplex) multi-drop interface. Typically, a RS485 bus consists of a master and several slaves. The nodes 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 CL4490 does not have an RS485 address; it transmits all RS485 traffic over the RF. Conversely, as soon as the CL4490 receives a packet over the RF, it transmits the packet over the RS485 bus.

Table 3: CL4490 Terminal Block Pinout

Terminal Block Pin	Signal Name	Description
1	VCC	6-18V (1.3A required)
2	485 -	485B
3	N/C	No Connect
4	N/C	No Connect
5	485 +	485A
6	GND	Ground

Note: When using RS485 (2-wire Half Duplex), a RS485 to RS232 converter is required to configure the unit. Laird recommends a B&B Electronics 4WSD9R converter to translate RS485 to RS232.
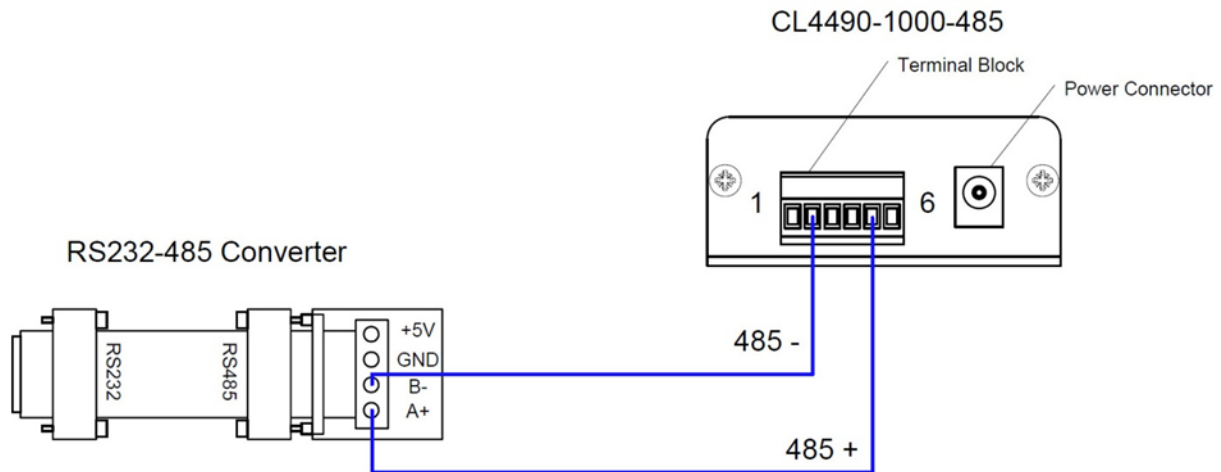

Figure 5: RS232-485 Converter

Note: Many simple 2- or 4-wire converters do not provide hardware flow control capabilities and therefore require you to disable handshaking (Handshaking: None) in the Laird Configuration Utility to configure the radio. Check with your converter manufacturer for any specific requirements.
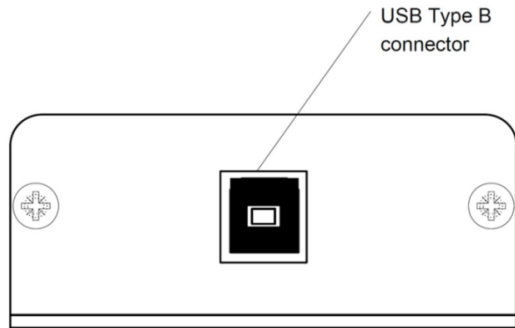

USB

Figure 6: CL4490 USB

The USB bus (of a master device, see USB Device Type for more information) supplies 5 V DC regulated power (maximum 500 mA) through each port on pins 1 and 4. Low power devices that might normally require a separate AC adapter can therefore be powered via the USB cable, eliminating the need for AC adaptors. The CL4490-USB draws its power directly from the USB bus and requires no external power supply.

Table 4: CL4490-USB Type B Point

TERMINAL BLOCK PIN	SIGNAL NAME	DESCRIPTION	CABLE COLOR
1	V_{BUS}	4.75 – 5.25 V	Red
2	D -	Transmit/Receive Data	White
3	D +	Transmit/Receive Data	Green
4	GND	Ground	Black
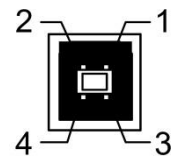
USB Device Type

There are two types of USB devices; masters and slaves. A USB master device is a host device (such as a PC) that supplies the USB drivers. A USB slave device (peripheral devices such as a keyboard, mouse, etc.) connects to a USB master device and uses the USB driver supplied by the host.

When a USB slave device connects to the host, the host prompts the device for the appropriate USB driver. Once the driver is located, the host loads and retains it for all subsequent connections of the slave device.

Note: The CL4490 is a USB slave device (peripheral) and cannot connect to another USB slave device.

USB Driver

The CL4490 is a stand-alone RF module that interfaces to a USB port on the host device. It uses a Virtual COM Port (VCP) driver that causes the device to appear as an additional COM port on a PC. Application software can then access the USB device in the same manner it would access a standard COM port.

The CL4490-USB is a plug-and-play device that the PC automatically detects upon connection. Once detected, the PC starts the *Add New Hardware* wizard and installs the USB driver.

Note: The Laird USB driver installs with the Configuration Utility. You may also install it manually:
1. Connect the CL4490-USB device to the PC using a USB cable.
2. Download WirelessSerialDeviceDriverInstall.zip from the USB Drivers link and unzip to local PC.

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3. Run Preinstaller.exe.
4. If a Windows logo testing dialog appears, click "Continue anyway."

Select **Finish** and reboot if prompted.

CL4490-PRO Serial Interface

DIP Switches

The CL4490-PRO DIP switches are located next to the Status LEDs and configure the serial interface and mode of the radio. The Figure 7 diagram also appears on the bottom of the metal casing of the CL4490-PRO for reference when configuring the radios.

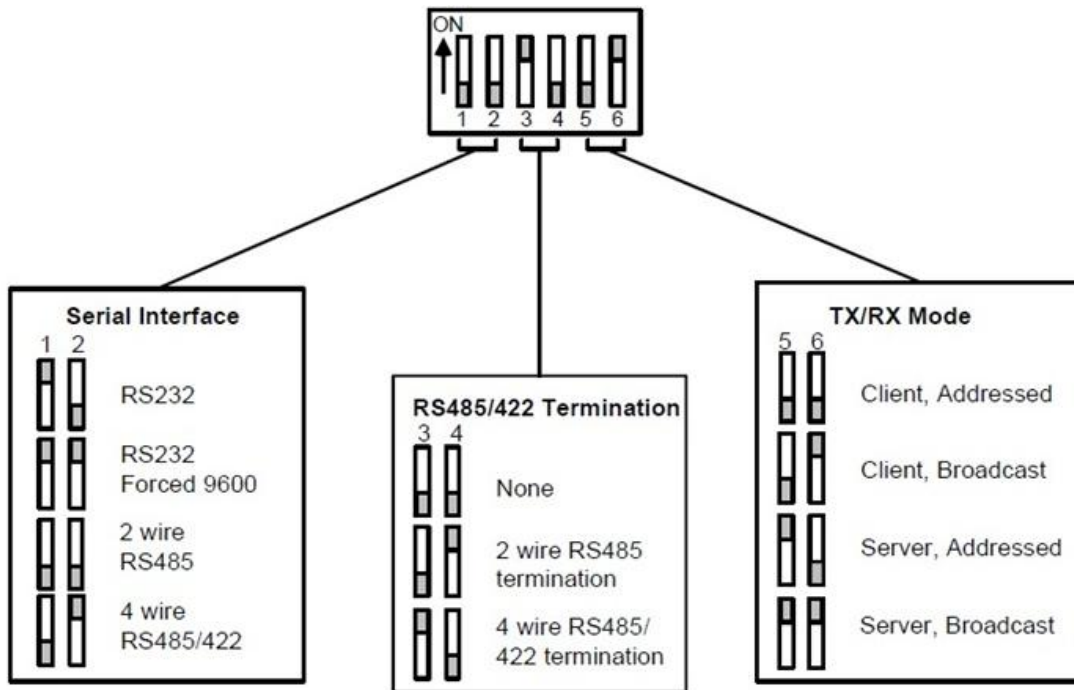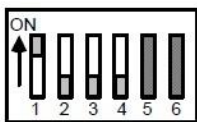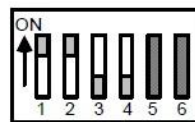

Figure 7: CL4490-PRO DIP Switch Settings

Note: The TX/RX Mode DIP switch settings override properties set with the Laird Configuration Utility.

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.

Figure 8: RS232 DIP Switch Settings (Only use Forced 9600 Mode to recover the radio when the state is unknown)

Table 5: CL4490-PRO RS232 Pinout (as defined in the CL4490-PRO)

DB9 female connector

DB9 Pin	Signal Name	I/O	Description	Details
1	DCD	O	Data Carrier Detect	Carrier Detect Signal. Connects to DSR (pin 6).
2	TXD (RXD with respect to DTE)	O	Transmitted Data	Serial Data (modem to host).
3	RXD (TXD with respect to DTE)	I	Received Data	Serial Data (host to modem).
4	DTR	I	Data Terminal Ready	Determines if modem is ready for operation.
5	GND	-	Ground	Ground
6	DSR	O	Data Set Ready	Connects to DCD (pin 1).
7	RTS	I	Request To Send	Provides RTS Flow Control.
8	CTS	O	Clear To Send	Provides CTS Flow Control.
9	NC	-	No Connect	No connect.

Note: Refer to Interfacing to Other RS232 Equipment for more information.

RS485 (2-wire)

The RS485 interface uses a Differential Data Transmission that helps nullify the effects of ground shifts and induced noise signals that can appear as common mode voltages on a network.

The CL4490-PRO implements a RS485 (2-wire Half Duplex) multi-drop interface. Typically, a RS485 bus consists of a master and several slaves. The nodes 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 CL4490-PRO does not have an RS485 address; therefore, it transmits all RS485 traffic over the RF. Conversely, as soon as a CL4490-PRO receives a packet over the RF, it transmits the packet over the RS485 bus.
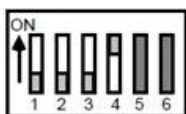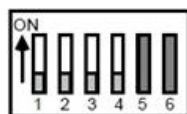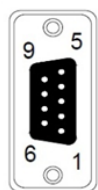

With Termination [1]   Without Termination

Figure 9: RS485 Half Duplex and Termination DIP Switch Settings
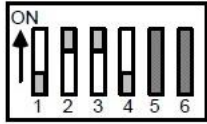
Table 6: CL4490-PRO RS485 Pinout

DB9 female connector

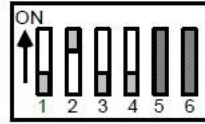| DB9 Pin	Signal Name	Description
1	-	No Connect
2	TR-	Serial Data transmitted to & received from radio
3	-	No Connect
4	-	No Connect
5	GND	Ground
6	-	No Connect
7	-	No Connect
8	TR+	Serial Data transmitted to and received from radio
9	Power	Optional Power Input[1]

1. *An internal jumper must be configured in order to use power over Pin 9.*
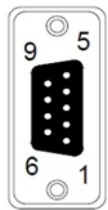
RS485 (4-Wire) and RS422

With Termination [1]

Without Termination

1. Termination is a 120 ohm resistor.

Figure 10: RS485 Full Duplex and Termination DIP Switch Settings

Table 7: CL4490-PRO RS422 Pinout

DB9 female connector

DB9 Pin	Signal Name	Description
1	-	No Connect
2	T-	Serial Data transmitted to radio
3	R-	Serial Data received by radio
4	-	No Connect
5	GND	Ground
6	-	No Connect
7	R+	Serial Data received by radio
8	T+	Serial Data transmitted to radio
9	Power	Optional Power Input[1]

1. An internal jumper must be configured in order to use power over Pin 9.

Hardware Flow Control

Flow control refers to the control of data flow between the host and the CL4490. It is the method used to handle data in the transmit/receive buffer of the CL4490 interface and it determines how data flow between the host and the CL4490 throttles. 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 CL4490 and its host *locally* (rather than over the air), one CL4490 cannot tell the other CL4490 to slow down or speed up.

The CL4490 sets the Clear to Send (CTS) line logic Low when it is able to accept data over the serial interface from the host, and alternately sets the CTS line logic High to signal that it is not ready to accept additional data from the host. By default the CTS signal on the CL4490 is always operational. When the *RTS Enable* option is selected through the Configuration Utility, the CL4490 checks the state of Ready to Send (RTS) before sending data over the serial interface to the host. If RTS is logic Low, the CL4490 sends data over the serial interface to its host. If RTS is logic High, it does not send data to its host. These signals send apart from the data itself on separate wires.

Note: CTS is always enabled by default. RS485 Interface does not support Hardware flow control.

RTS is high by default on the CL4490. If RTS Enable is enabled, the CL4490 will 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. CTS transitions logic High by the radio when its interface buffer is getting 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 need to 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

Note: Overall dimensions apply to both the CL4490 and CL4490-PRO.
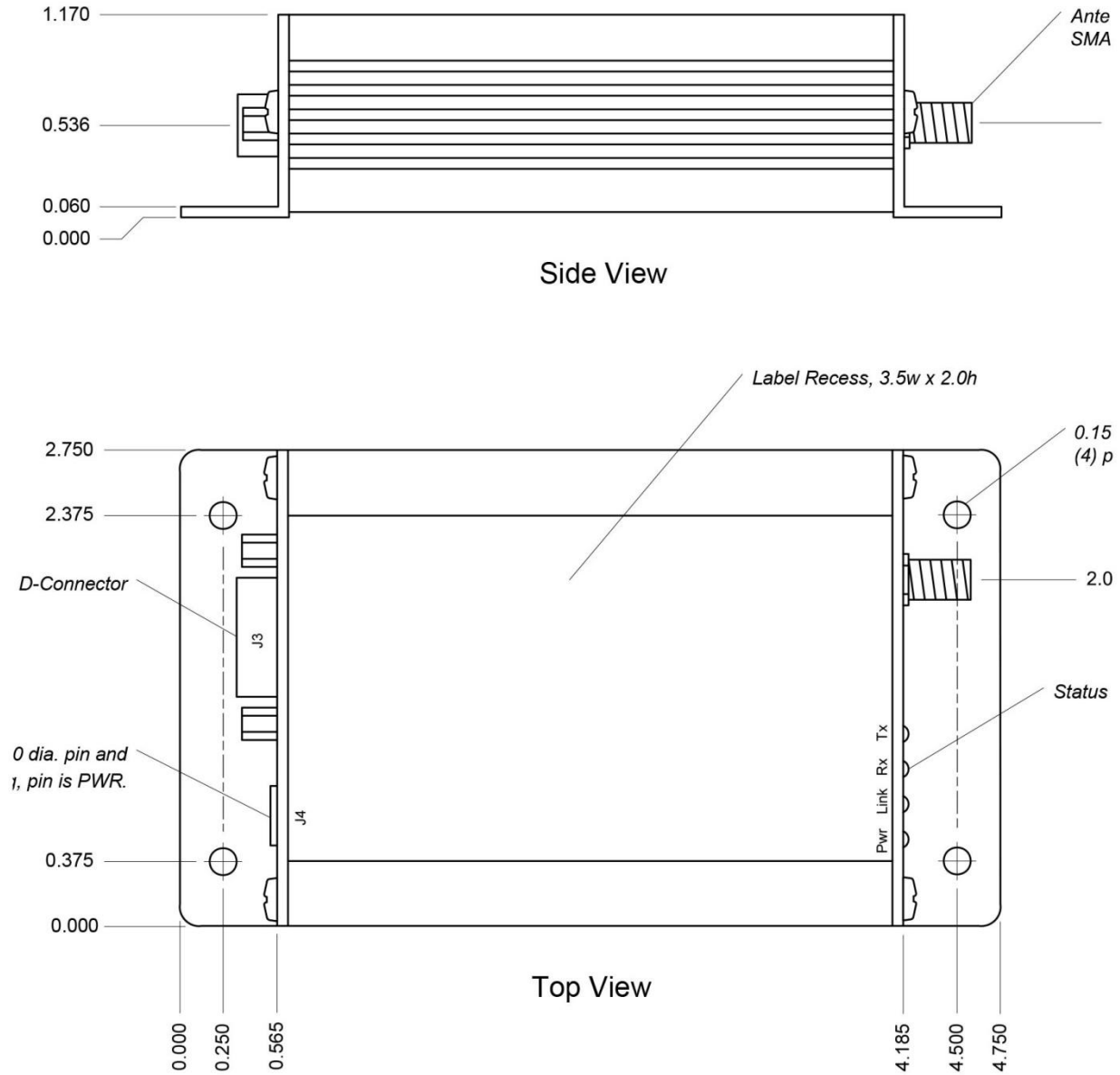

Figure 11: CL4490 Mechanical

Approved Antenna List

Table 8: CL4490 approved antennas

Laird Part Number	Manufacturer Part Number	Manufacturer	Type	Gain (dBI)	CL4490-200	CL4490-1000/PRO
0600-00019	S467FL-5-RMM-915S	Nearson	1/2 Wave Dipole	2	X	X
0600-00025	S467FL-5-RMM-915	Nearson	1/2 Wave Dipole	2	X	X
0600-00024	S467AH-915	Nearson	1/2 Wave Dipole	2	X	X
0600-00027	S467AH-915R	Nearson	1/2 Wave Dipole	2	X	X
0600-00028	S161AH-915R	Nearson	1/2 Wave Dipole	2.5	X	X
0600-00029	S161AH-915	Nearson	1/2 Wave Dipole	2.5	X	X
0600-00030	S331AH-915	Nearson	1/4 Wave Dipole	1	X	X
-	1020B5812-04 Flavus	gigaAnt	Microstrip	-0.5	-	-
-	Y2283[1]	Comtelco	Yagi	6dBd	X	X
-	Y2283A-915-10RP	Comtelco	Yagi	6dBd	X	X
-	SG101N915[2]	Nearson	Omni	5	X	X
-	SG101NT-915	Nearson	Omni	5	X	X
-	GM113	V.Torch	Omni	3.5	X	-
-	PC8910NRTN	Laird	Yagi	11dBd	-	-
-	ANT-DB1-RMS	Ant. Factor	Monopole	3	X	-

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 in the table above.**

RELATED DOCUMENTS AND FILES

The following additional CL4490 technical documents are also available from the RAMP page under the Product Information tab in the row labelled ConnexLink - Wireless Cable Replacement System:

- ConnexLink Product Brief
- CL4490 User GUide
- Statement of Compliance to EU WEEE Directive and RoHS Directive
- ConnexLink™ Product Line

The following downloads are also available from the RAMP Product Information tab:

- Laird Configuration Utility
- USB Drivers