ADL RXO

Radio Module Integrator's Guide

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Cautions and Warnings

Throughout this manual this symbol is used to indicate caution or warning. Please pay particular attention to these items to assure safe and reliable operation of your radio module product.

License required prior to operation of radio communication equipment. Specifications are subject to change without notification.

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Introduction

This guide provides information concerning the integration of the Advanced Data Link (ADL) RXO radio modules - Model numbers ADLO-1 (390 to 430 MHz) and ADLO-2 (430 to 470 MHz) - into your product. This guide should be used in conjunction with the ADLCONF User's Guide – Dealer Version (PN M00800) that should be referenced for general information concerning the configuration of ADL radio modules, and also for detailed programming information.

The ADL RXO is a general-purpose receive-only radio module that is compatible with both the ADL and the Positioning Data Link (PDL) product families of radio modules. The ADL RXO module is designed specifically for integration into existing or new products requiring one-way wireless communications. Its small size, light weight and power efficient operation provide superior performance in embedded systems.

There are two variants of the ADL RXO: one covering the 390-430 MHz range and one for the 430-470 MHz range. Both variants include a CMOS data interface via a 20-pin connector. RS-232 variants are available upon request. The ADL Foundation transceiver module is described in a separate Integrator's Guide available from Pacific Crest.

Main Components

The ADL RXO Developer's Kit (P/N 82224) comprises the following:

ADL RXO module (CMOS 430-470MHz)	A02731
Test and Demo Board	A02599
2 screws to attach transceiver to I/O-test board	C02982
Power supply	TBD
Universal power cord adapter set	C02316
DB9 Male to DB9 Female Modem Cable	C02592
Flexible ¼ Wavelength Antennas	
420-450 MHz, 2.4 dB Gain	C02107
450-470 MHz, 2.4 dB Gain	C02108
Antenna Cable	A02650
Data/power test interface cable	A02720
ADLCONF (Dealer Version) USB Key	A02672

Getting Started

Caution: ADL RXO module must be handled with care during installation. Remove the transceiver from its protective bag only in an ESD safe area.

To set up the hardware components, follow these steps:

1. Plug the ADL RXO module into the I/O-test board's 20-pin connector
2. Secure the module to the I/O-test board using the provided screws
3. Attach the antenna cable to the ADL RXO module
4. Attach one of the two antennas (whichever matches your licensed frequency) to the antenna cable
5. Attach the PC interface cable to the I/O-test board's 9-pin UART connector (see diagram below)
6. Attach the PC interface cable to a serial port on your PC
7. Attach the wall cable to the AC/DC adapter and select the proper plug from the adapter kit
8. Attach the AD/DC adapter's tubular plug to the power jack on the I/O-test board
9. Plug in the ADLCONF (Dealer's Version) USB key on your PC
10. Download and run ADLCONF_setup.exe to install ADLCONF software. Do not launch the program yet.
11. Browse to C:\Program Files\Pacific Crest\ADLCONF and double-click "Sentinel System Driver Installer.exe" to install the USB key driver
12. Launch ADLCONF and refer to its user guide for instructions on connecting to the ADL RXO Module

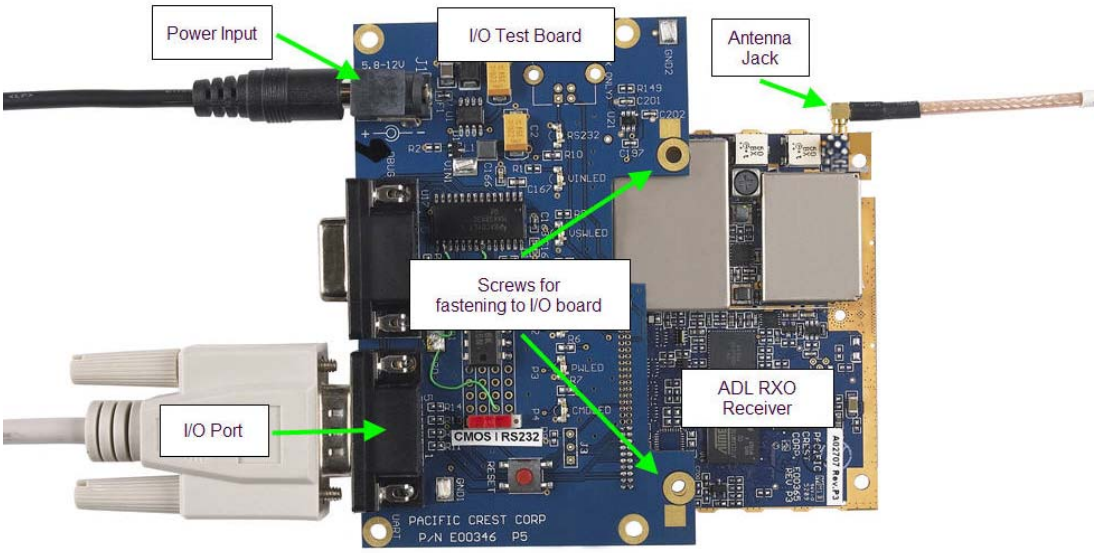

Figure 1 – ADL RXO Developer's Kit

Interface Port Pin Out

The standard ADL RXO module comprises a 20-pin port for power, data and interfacing with other electronic devices. The following signals are available on the 20-pin connector:

Pin	Name	Description
1	GND	GROUND FOR SIGNAL AND POWER
2	GND	GROUND FOR SIGNAL AND POWER
3	PWR IN	DC POWER INPUT, +3.3V to +5V
4	PWR IN	DC POWER INPUT, +3.3V to +5V
5	TX1	TX DATA, DTE SERIAL PORT 1, RS232 OR 3V CMOS (3.3V COMPATIBLE)
6	RX1	RX DATA, DTE SERIAL PORT 1, RS232 OR 3V CMOS (3.3V COMPATIBLE)
7	NC	NO CONNECTION AND INTERNALLY OPEN
8	GND	GROUND FOR SIGNAL AND POWER
9	PWRLED	POWER LED DRIVER, 3V CMOS OUTPUT W/ 470 RESISTOR IN SERIES
10	-	FACTORY USE ONLY, PLEASE LEAVE NO CONNECTION
11	RXLED	RADIO RECEIVE LED DRIVER, 3V CMOS OUTPUT W/ 470 RESISTOR IN SERIES
12	-	FACTORY USE ONLY, PLEASE LEAVE NO CONNECTION
13	-	FACTORY USE ONLY, PLEASE LEAVE NO CONNECTION
14	-	FACTORY USE ONLY, PLEASE LEAVE NO CONNECTION
15	CMDLED	PROGRAMMABLE LED DRIVER, 3V CMOS OUTPUT W/ 470 RESISTOR IN SERIES
16	-	FACTORY USE ONLY, PLEASE LEAVE NO CONNECTION
17	NC	FACTORY USE ONLY, PLEASE LEAVE NO CONNECTION
18	TEST1	FACTORY USE ONLY, PLEASE LEAVE NO CONNECTION
19	TEST2	FACTORY USE ONLY, PLEASE LEAVE NO CONNECTION
20	GND	GROUND FOR SIGNAL AND POWER

TX and RX Pins

Pin 5 is used to receive data into the radio from an external device (a PC, GPS receiver, etc). Pin 6 is used to send data out of the radio to the external device. The external device is transmitting data to the ADL RXO on Pin 5, so according to the DTE naming convention, Pin 5 is called the TX pin. The external device receives data from the ADL RXO's Pin 6 so this is called the RX pin.

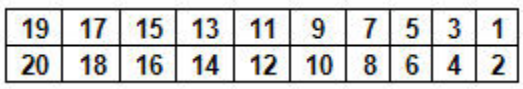

Figure 2 – Pin Orientation

Antenna Port

A coaxial antenna port is provided for connecting the antenna system to the ADL RXO module. The antenna connector is a 50-Ohm MMCX-style female type. Appendix B provides part numbers and manufacturer information for compatible interface and RF connectors. Pacific Crest also provides custom manufactured cables designed to your specific needs. Contact us for a quotation for your specific cabling requirements.

Compliance

The ADL RXO radio module is designed to be compliant with worldwide regulatory requirements, including FCC part 90, ETS 300-113-2, IC RSS 119 and others.

Compatibility

The ADL RXO module is compatible with most modes of operation supported by the ADL and PDL product families of radio modules. See the Protocols and Modes of Operation section for an overview of the protocols and modes that are supported with the ADL RXO radio module. The compatibility also extends to ADLCONF configuration software and the ADL Test application that are supplied as part of the ADL RXO Developer's Kit.

Protocols and Modes of Operation

The ADL RXO radio module is completely configurable using ADLCONF software. Configuration parameters define the DTE interface and the over-the-air protocol. Depending on the application you may need to change the factory default settings. The following table shows the factory default configuration of the ADL RXO module.

Parameter	Default
Channel	0
Baud Rate	38400
Parity	None
Soft Break Disable	On
Mode	Transparent EOT Timeout
EOT	50 ms
Link Rate	9600 bps
Modulation Type	GMSK

Retries	10
FEC	On
Scrambling	On
Sensitivity	High
Local Address	0
Destination Address	255

Table 1 - ADL RXO Factory Default Settings

Up to 32 frequencies are stored in the configuration memory called the channel table. The selection of channel is subject to proper licensing of the corresponding frequencies by the appropriate governmental agency. Please refer to the ADLCONF User's Guide for instructions in creating and uploading channel tables into the ADL RXO module.

The ADL RXO module supports multiple protocols and modes of operation including:

- Transparent with EOT Timeout
- Transparent with EOT Character
- Transparent FST
- Packet Switched
- TRIMTALK™ 450S
- TRIMTALK II/IIE
- TT450S HW)
- TRIMMARK™ 3
- SATEL®

Refer to the ADLCONF User's Guide for a detailed description.

Electrical Considerations

Power Supply

The ADL RXO module has a power supply connection on both Pin 3 and Pin 4 of the interface connector. Pins 1, 2, 8 and 20 are connections to both power ground and RS-232 interface signal grounds. Note that these pins are tied to a common point on the ADL RXO module.

ADL RXO modules are designed to operate with unregulated DC voltage levels between +3.3V to +5V. The power supply must be capable of sourcing 0.16A. (Zero-point-one-six-A)

Data Interface

The ADL RXO module provides one serial port, which is a simple 3-wire CMOS electrical interface for communicating data to and from the module. This CMOS data interface is designed to work at 3.0-3.3 V maximum signal levels. Do not connect the data interface to 5V CMOS input levels. It is possible to request ADL RXO variants with RS-232 instead of CMOS.

Note: We define this data interface as a DTE port. In other words, an external device transmits data to the radio on the TX pin (Pin 5) and receives data from the radio on the RX pin (Pin 6).

Caution: The ADL RXO's CMOS port is designed only for internal access by the system integrator's product. It must not be connected to any port accessible from outside.

LED Drivers

The ADL RXO module's 20-pin connector provides access to three function-specific LED drivers. Table 2 shows the pin-out and function of the three LED drivers.

Pin	Function	Description
9	PWR LED	Power LED Driver
11	RX LED	Radio Receive LED driver
15	CMD LED	Programmable LED driver

Table 2 - Pin-outs for the LED driver port

The LED drivers are designed to provide approximately 2 mA. This drive level requires that only high-efficiency LEDs be used with the drivers.

Error Codes

The ADL RXO module performs a variety of power-up and run-time tests to assure optimal operation. Tests include environmental as well as electrical measurements designed to avoid damage to the unit while maintaining adequate operation. In the event of an error condition, an error code is flashed on the ADL RXO's LED lines, but only if they are connected to LED drivers. The number of times the LED(s) flash equals the number of the error code. Table 3 lists the possible error conditions.

Code	Description
01	External voltage too high
02	External voltage too low
08	Unit temperature is too high

11	Config memory C/S error during initialization
12	RAM error during initialization
16	RX Synthesizer Lock Error
99	Unknown error

Table 3 – ADL RXO Error Codes

A 50Ω impedance coaxial MMCX style RF connector is provided for attachment to an external antenna system. The MMCX connector offers a positive friction locking mechanism that is very reliable. In some circumstances, it may be required to provide a physical stop to prevent the MMCX plug from becoming disconnected due to extreme shock or vibration.

The ADL RXO module requires an antenna and feed cable system that is impedance- matched to 50Ω. We recommend that high quality RG-178 or equivalent coaxial cable be used for internal wiring of the RF signal from the MMCX to the panel connector. We also suggest the selection of an antenna that has a low VSWR (less than 1.5:1) and that has been tuned for operation in the band of the ADL RXO module.

Caution: Improper impedance matching of the antenna, connectors or cable will degrade the performance of the ADL RXO module.

Shielding Considerations

The ADL RXO module is designed to operate in proximity to noise generating circuitry. However, certain radiated or conducted frequencies may degrade the performance of the ADL RXO module or render it inoperable. When possible, provide well-grounded shielding between circuits that radiate, such as power supplies, voltage-controlled oscillators, crystal oscillators and the ADL RXO module.

Frequency Planning

The ADL RXO module contains a very sensitive, dual-conversion super-heterodyne receiver.

Caution: Radiated and conducted signals to and from the ADL RXO module may cause problems due to interference. Proper attention to frequency planning may reduce interference from radiated or conducted frequencies that fall within the pass-bands of the filters at the IF frequencies.

We recommend the use of upfront analysis of the product frequency plan (including harmonics) and then the use of a spectrum analyzer to determine the potential for interference within the pass-bands of the various front-end and band pass filters.

The following table indicates the frequencies and band pass filter characteristics that are areas of potential interference.

Circuit	Center Frequency (MHz)	Bandwidth (MHz)
RF front-end	410 or 450 (depending on model)	40
First IF	54.45	0.015
Second IF	0.450	0.010

Table 4 - ADL RXO Frequency Plan

Mechanical Considerations

EMI interferers

The ADL RXO module is easily mounted inside new and existing products. The ADL RXO module is specifically designed for operation in harsh environments. For best performance, mount the radio away from potential EMI radiators and route RF signals apart from digital signals.

Caution: We do not recommend the bundling of the antenna interface cable with other signal cables internal to your product.

Shock and Vibration

Sensitive radio modules, such as the ADL RXO module, are susceptible to interference due to mechanical shock and vibration. To reduce the potential for electromechanical interference, a robust mounting scheme must be used when being integrated into other systems. A thin damping pad between the mounting surface and the ADL RXO module may be required. We recommend the use of damping pads made of PORON$^{(R)}$ or a similar material.

Mounting

Refer to Appendix A for mounting diagrams and specification.

Materials

The ADL RXO module is electrically connected to the ground and signal ground pins.

Service and Support

Philosophy

Pacific Crest is dedicated to providing the very best service and support possible. We recognize that the success of our business is directly related to the success our customers have in using our products. For this reason, we provide easy access with our toll free number, which we encourage our customers to use if they are experiencing difficulties or problems with the products we supply.

Let us know what you think. A cornerstone of our business philosophy is to evolve our product lines to match the needs of our customers. Your input allows us to better determine what we need to do to keep our product and support offerings in alignment with your needs.

Phone/Internet Support

Phone support is available during our business hours, Monday through Friday (7 a.m. to 4 p.m. Pacific Standard Time). Call 1-800-795-1001 (U.S. and Canada), +1-408-481-8070 (International), +1-408-481-8984 (Fax). You can contact the support group via our web site, www.PacificCrest.com or send an e-mail to support@pacificcrest.com

Warranty

One-Year Limited Warranty

This warranty gives you specific legal rights. You may also have other rights which vary from state to state or province to province.

Pacific Crest warrants its ADL RXO radio Module products against defects in materials and workmanship for a period of one year from receipt by the end user. During the warranty period, Pacific Crest will, at its option, either repair or replace products that prove to be defective.

Exclusions

Should Pacific Crest be unable to repair or replace the product within a reasonable amount of time, a refund of purchase price may be given upon return of the product.

The warranty on your ADL RXO radio Module shall not apply to defects resulting from:

- Improper or inadequate maintenance by the customer
- Unauthorized modification or misuse
- Operation outside of the environmental specifications for the product
- Negligence or misuse

Warranty Limitations

The warranty set forth above is exclusive and no other warranty, whether written or oral, is expressed or implied. Pacific Crest specifically disclaims the implied warranties of merchantability and fitness for a particular purpose.

Appendix A - Mounting Guide

Standard Enclosure

Figure A1 below shows mounting holes locations and overall dimensions for the ADL RXO module.

Caution: Screws used to mount the ADL RXO module to a mounting plate must not penetrate the mounting surface of the ADL RXO module by more than 0.20 inches. Screws that penetrate beyond this distance may cause damage.

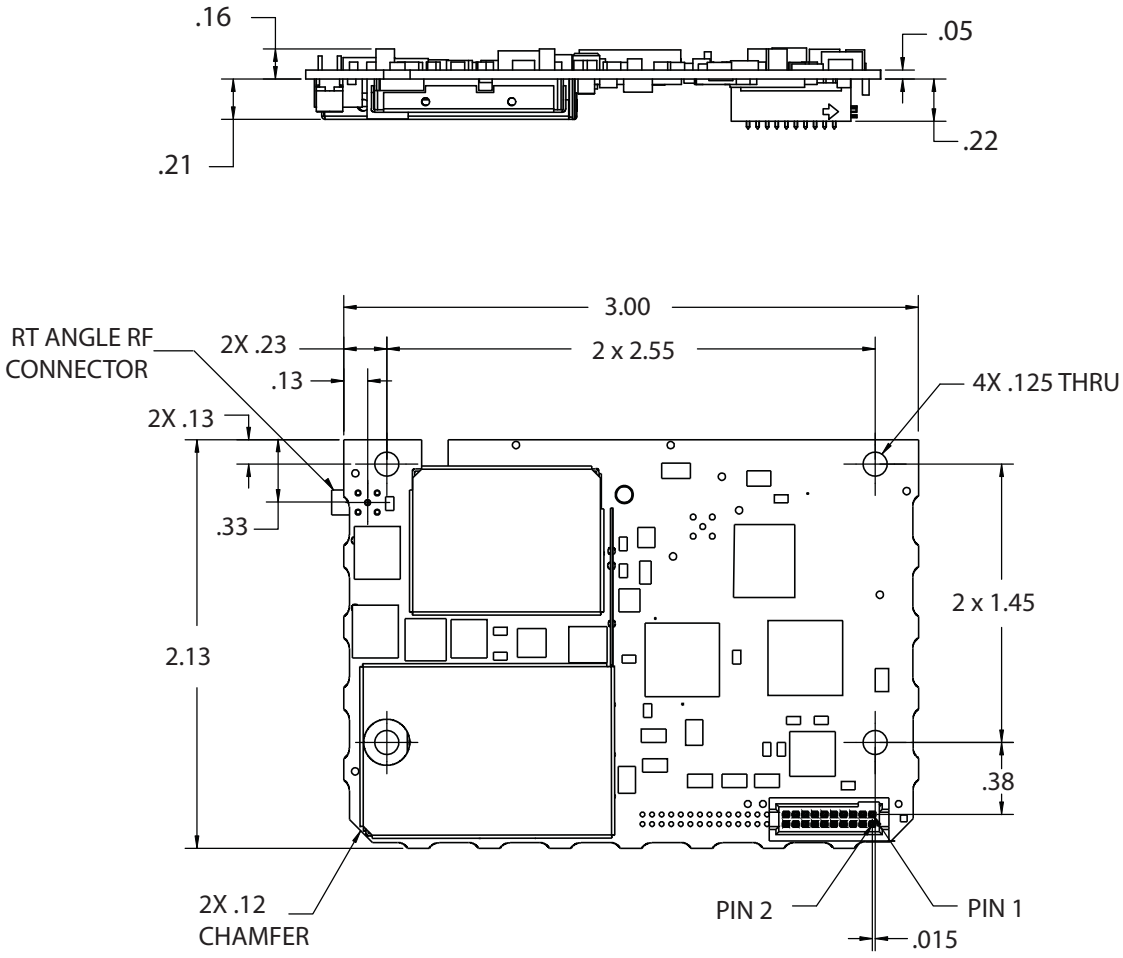

Figure A1 - ADL RXO Mounting Template

Appendix B - Cables and Connectors

Value-Added Cable Products

Pacific Crest manufactures a wide variety of high-quality custom cables in support of its OEM customers. Contact your Pacific Crest sales representative to discuss your custom cable requirements.

Interface Connector

The 20-pin data/power header is a Samtec TFM series housing a standard-configuration connector, Samtec part number TFM-110-01-S-D. The mating Samtec connector is part number SFM-110-01-S-D for a board-to-board interface that is coincident with the mounting hardware and heat sink (.25" mating height). See Samtec website www.samtec.com for other mating connector options.

RF Connector

The RF connector is compatible with an MMCX-style coaxial plug. Plugs are available from many sources and in many configurations. We use plugs manufactured by Radiall. Radiall MMCX right-angle plug for use with RG-178 cable is part number R110 172 100. Radiall MMCX straight plug for use with RG-178 cable is part number R110 083 120.

Appendix C - Technical Specifications

General

Interface

DTE - DCE Interface	RS-232 or CMOS, 115.2 kbps maximum

Power Requirements

Input	3.3 VDC to 5.0 VDC +/- 0.1 VDC
During RX	0.5 W @ 3.3 VDC; 0.7 W @ 5.0 VDC

Radio Specifications

Frequency Bands

390-430 MHz

430-470 MHz

Frequency Control

Synthesized 12.5 kHz tuning resolution

Frequency stability +/- 1PPM

Channel Spacing

Channel spacing 12.5/25 kHz (user-selectable)

Sensitivity

-110 dBm BER = 1×10^{-5}

Adjacent Channel Selectivity

>55dB

Type Certification

All models are type accepted and certified for operation in the U.S., Europe, Australia and Canada

FCC, IC, EU, NZ, Australia ETS300-113-2

Module

Link Rate/Modulation

4FSK: 9600, 19,200 bps

GMSK: 4800, 8000, 9600, 16,000, 19,200 bps

Link Protocols

Transparent EOT/EOC, Transparent FST" Packet-switched, Trimble®, SATEL®, OEM-specific

Forward Error Correction

Yes

Environmental

Shock and Vibration

Per MIL-STD-810F

Temperature Range

Operating Temperature (Receiver):	-40˚ to +85˚ C	(-40˚ to +185˚ F)
Storage Temperature (Receiver/Transmitter):	-55˚ to +85˚ C	(-67˚ to +185˚ F)

Mechanical

Dimensions

7.6 cm W x 5.6 cm D x 1.1 cm H (3.0”W x 2.2”D x 0.4”H)

Weight

70 grams (2.5 oz.)

Data/Power Connector

20 Pin: Samtec

Appendix D – API Commands

A description of the ADL RXO module Application Programmer Interface is available to qualified Pacific Crest development partners. Please contact sales@PacificCrest.com.

Appendix E – ADL Test Software

Description:

The ADL Test application is used to perform functional radio tests on Pacific Crest ADL radios.

Usage

Set radio to command mode:

Start application

Select Serial Port + Data Rate to connect to radio

Select Soft Break (Put radio into command mode, default behavior for ADL radio is that it is in data mode.)

Run test:

Select Link Rate

Select Modulation

Select Channel

Select Transmit Test

Select Adjust Frequency Error

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