



**LR Series**  
**Basic Evaluation Kit**  
**User's Guide**

**Wireless made simple<sup>®</sup>**



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Figure 1: LR Series Basic Evaluation Kit

## Introduction

LinX LR Series RF modules offer a simple, efficient, and cost-effective method of adding wireless communication capabilities to any product. The Basic Evaluation Kit is intended to give a designer all the tools necessary to correctly and legally incorporate the LR Series modules into an end product. The development boards themselves serve several important functions:

- **Rapid Module Evaluation:** The boards allow the performance of the LinX LR Series modules to be evaluated quickly in a user's environment.
- **Application Development:** An on-board prototyping area allows for the development of applications directly on the development board. All signal lines are available on a header for easy access.
- **Range Testing:** Using the on-board encoders and decoders to generate a simplex transmission, a pair of development boards can be used to evaluate the range performance of the modules.
- **Design Benchmark:** The boards provide a known benchmark against which the performance of a custom design may be judged.

The purpose of this guide is to show the designer how to take full advantage of the basic development boards included with the kit.

The kit includes 2 LR Series transmitters\*, 2 LR Series receivers\*, 2 extra PCB-mount RP-SMA connectors, 2 development boards, 2 CW Series antennas, 1 CR2032 battery, 2 AAA batteries and full documentation.

\* One part is soldered to the board, one extra for use on your first prototype board.

## Ordering Information

Ordering Information	
Part Number	Description
EVAL-***-LR	LR Series Basic Evaluation Kit
*** = 315, 418 (Standard), 433MHz	

Figure 2: Ordering Information

## LR Transmitter Evaluation Board

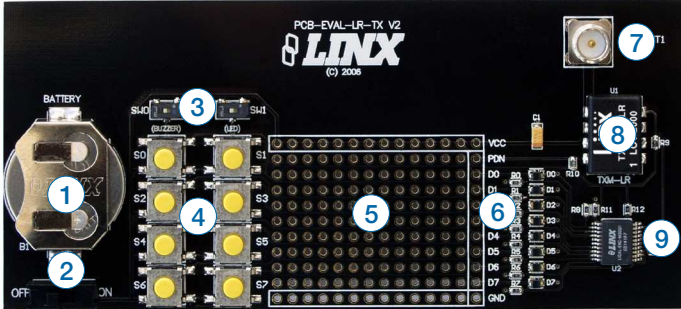


Figure 3: LR Transmitter Evaluation Board

1. Battery – 3VDC (use a CR2032-style battery only)
2. Power Switch
3. Continuous ON Switches
4. Momentary Pushbuttons
5. Prototyping Area
6. Breakout Header
7. Reverse-Polarity SMA Antenna Connector
8. LR Series Transmitter Module
9. MS Series Encoder

# LR Receiver Evaluation Board

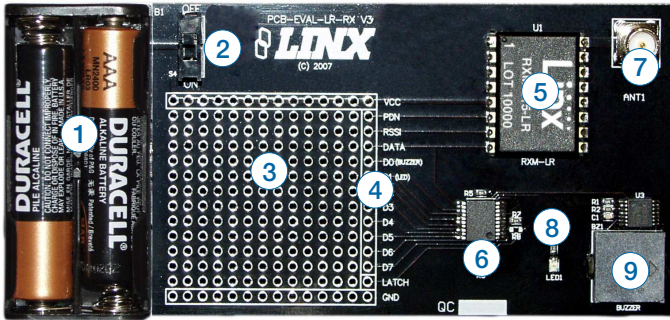


Figure 4: LR Receiver Evaluation Board

1. Batteries – 3VDC (use 2 AAA style batteries only)
2. Power Switch
3. Prototyping Area
4. Breakout Header
5. LR Series Receiver Module
6. MS Series Decoder
7. Reverse-Polarity SMA Antenna connector
8. LED – D1
9. Buzzer – D0

## Theory of Operation

### Transmitter Evaluation Board

The transmitter board is powered by an on-board 3V CR2032 lithium battery. It has eight SPST pushbutton switches, the state of which is encoded into a data stream using a Linx MS Series encoder. If a switch is closed, the transmitter will be enabled while the encoder captures the pushbutton states for encoding and transmission. The encoder will power down the transmitter when the button is released. Buttons S0 (D0) and S1 (D1) are used to activate the LED and buzzer on the receiver board. All of the data lines have been wired out to the header to the right of the prototyping area and can be accessed for use with other switches, contacts, or microcontrollers.

### Receiver Evaluation Board

The receiver board is powered by two AAA batteries. The LR Series receiver exhibits a sensitivity of greater than  $-112\text{dBm}$ , so under optimum line-of-sight conditions, the transmitter / receiver link can operate over distances of up to 3,000 feet. The data recovered by the LR Series receiver is decoded by a MS Series decoder, and the data lines are updated to match the state of the data lines (or pushbuttons) on the transmitter board. To demonstrate this, one data line is used to drive a LED while another is used to activate a buzzer. This board also has a prototyping area with all of the receiver and decoder lines brought out to a header.

## Using the Kit

Using the kit is straightforward. Simply attach the antennas, turn on the power, and press one or both of the buttons on the transmitter board. When S0 is pressed, the buzzer will sound; when S1 is pressed, the LED will turn on. When any button (S0–S7) is pressed on the transmitter board, the corresponding decoder output (D0–D7) will be active high ( $V_{CC}$ ) on the prototyping header.



## Development Using the Prototyping Area

In addition to their evaluation functions, the boards may also be used for actual product development. They feature a prototyping area to facilitate the addition of application-specific circuitry. This area has a connection to  $V_{CC}$  at the top and ground at the bottom that can be used to power the added circuitry.

**Note:** The CR2032-style battery on the transmitter board has very low current capacity with, only about 3mA available for external circuitry. If added circuitry requires a higher current, the battery must be removed and the board powered from an external source.

The holes are plated and set at 0.100" on center with a 0.040" diameter, making it easy to add most industry-standard SIP and DIP packages to the board.

On the transmitter board, the data lines from the encoder and the PDN line from the transmitter have been wired out to a row of plated holes on the right side of the prototyping area. On the receiver board, the data lines from the decoder plus the RSSI, PDN, and DATA lines from the receiver have been wired out. This allows for easy access to connect external circuitry to the modules, the encoder, and the decoder. Data line D0 is connected to the buzzer and D1 is connected to the LED.

## Range Testing

Several complex mathematical models exist for determining path loss in many environments. These models vary as the transmitter and receiver are moved from indoor operation to outdoor operation. Although these models can provide an estimation of range performance in the field, the most reliable method is to simply perform range tests using the transmitter and receiver in the intended operational environment.

Simple range testing can be performed with the transmitter and receiver evaluation boards. To prepare the board for range testing, simply turn it on by switching the power switch to the ON position. Pressing S0 on the transmitter will activate the buzzer on the receiver board, while S1 activates the LED. Switches SW0 and SW1 have been provided to jumper the buttons and continuously transmit. This will allow the designer to turn on the transmitter and walk with the receiver.

As you near the maximum range of the link in your area, it is not uncommon for the signal to cut in and out as you move. This is normal and can result from other interfering sources or fluctuating signal levels due to multipath effects. This results in cancellation of the transmitted signal as direct and reflected signals arrive at the receiver at differing times and phases. The areas in which this occurs are commonly called “nulls” and simply walking a little farther will usually restore the signal.

Since the evaluation boards are intended for use by design engineers, they are not FCC certified. The transmitter has been set to approximate legal limits by resistor R9 so that the range test results will approximate the results from a well-designed, certified product. For applications where Part 15 limits are not applicable or output levels can be legally raised due to protocol duty cycle, R9 can be changed according to the graph on Page 3 of the LR Series Transmitter Data Guide.

To achieve maximum range, keep objects such as your hand away from the antenna and ensure that the antenna on the transmitter has a clear and unobstructed line-of-sight path to the receiver board. Range performance is determined by many interdependent factors. If the range you are able to achieve is significantly less than specified by Linx for the products you are testing, then there is likely a problem with either the board or the ambient RF environment in which the board is operating. First, check the battery,

switch positions, and antenna connection. Next, measure the receiver's RSSI voltage with the transmitter turned off to determine if ambient interference is present. If this fails to resolve the issue, please contact Linx technical support.

## About Antennas

The choice of antennas is one of the most critical and often overlooked design considerations. The range, performance, and legality of an RF link are critically dependent upon the type of antenna employed. Linx offers a variety of antenna styles that you may wish to consider for your design. Included with your kit is a Linx CW Series connectorized whip antenna that should be connected prior to using the kit. Despite the fact that the antenna is not centered on the board's ground plane, it exhibits a VSWR of  $<1.7$  and suitably demonstrates the module's best practical performance.

## Using the Boards as a Design Reference

The basic evaluation boards included in this kit are very simple, yet they illustrate some important techniques that you may wish to incorporate into your own board layout. You will observe that the LR mounting pads extend slightly past the edge of the part. This eases hand assembly and allows for better heat conduction under the part if rework is necessary. Next, observe the use of a full ground plane fill on the lower side of the board. This ground plane serves three important purposes:

First, since a quarter-wave antenna is employed, the ground plane is critical to serve as a counterpoise (you may wish to read Application Note AN-00500 Antennas: Design, Application, and Performance for additional details on how a ground plane affects antenna function).

Second, a ground plane will suppress the transfer of noise between stages of a product, as well as unintentional radiation of noise into free space.

Third, a ground plane allows for the implementation of a microstrip feed to the antenna. The term microstrip refers to a PCB trace running over a ground plane that is designed to serve as a 50-ohm transmission line between the module and the antenna. A microstrip is implemented on this evaluation board. If you are unfamiliar with microstrip calculations, you may wish to refer to the LR Series data guides or the calculator available on our website.

## In Closing

Here at Linx, “Wireless Made Simple” is more than just our motto, it is our commitment. A commitment to the highest caliber of product, service, and support. That is why, should you have questions or encounter any difficulties using the evaluation kit, you’ll be glad to know many resources are available to assist you. First, check carefully for the obvious, then visit our website at [www.linxtechnologies.com](http://www.linxtechnologies.com) or call +1 541 471 6256 between 7AM and 5PM Pacific Time to speak with an application engineer.

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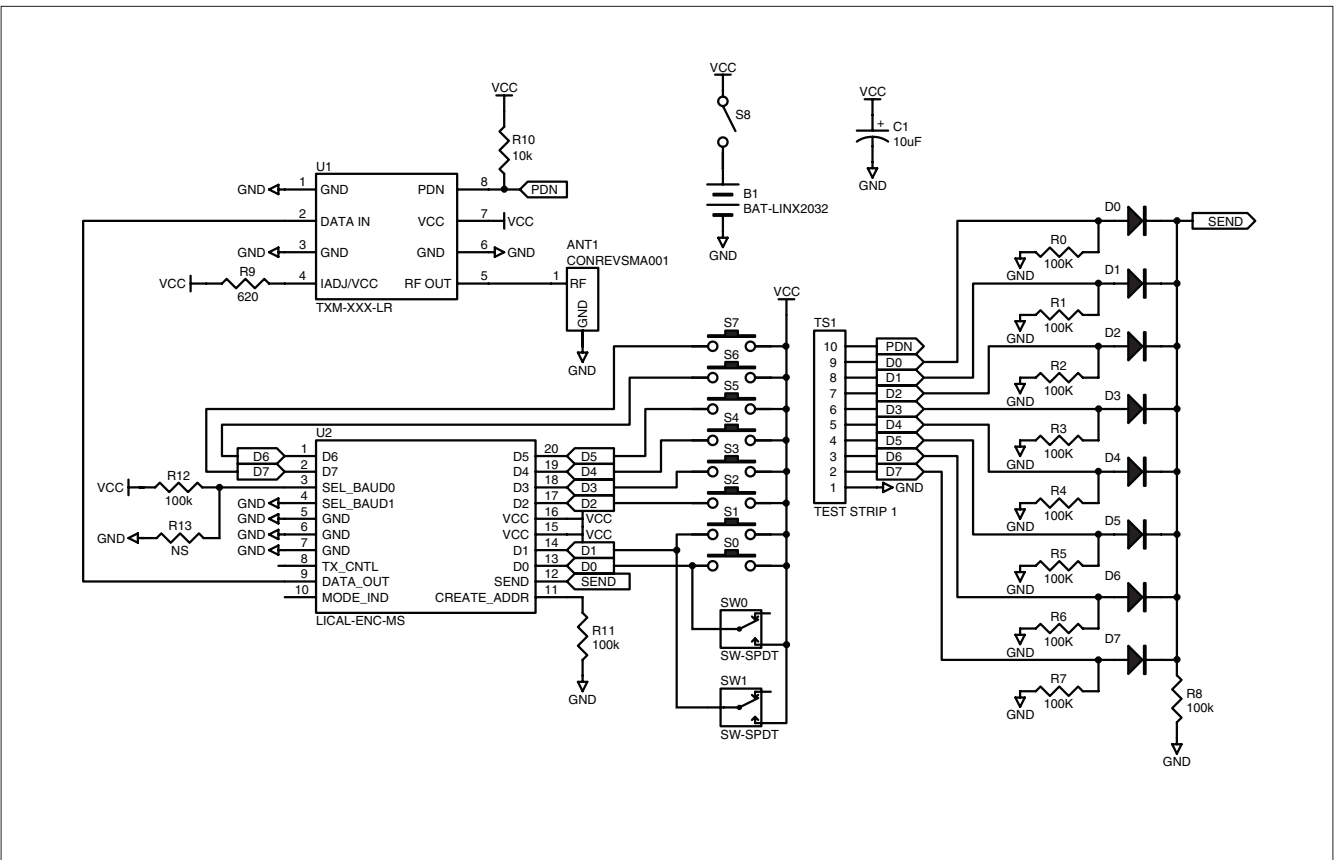


Figure 5: LR Transmitter Board Schematic

# LR Receiver Evaluation Board Schematic

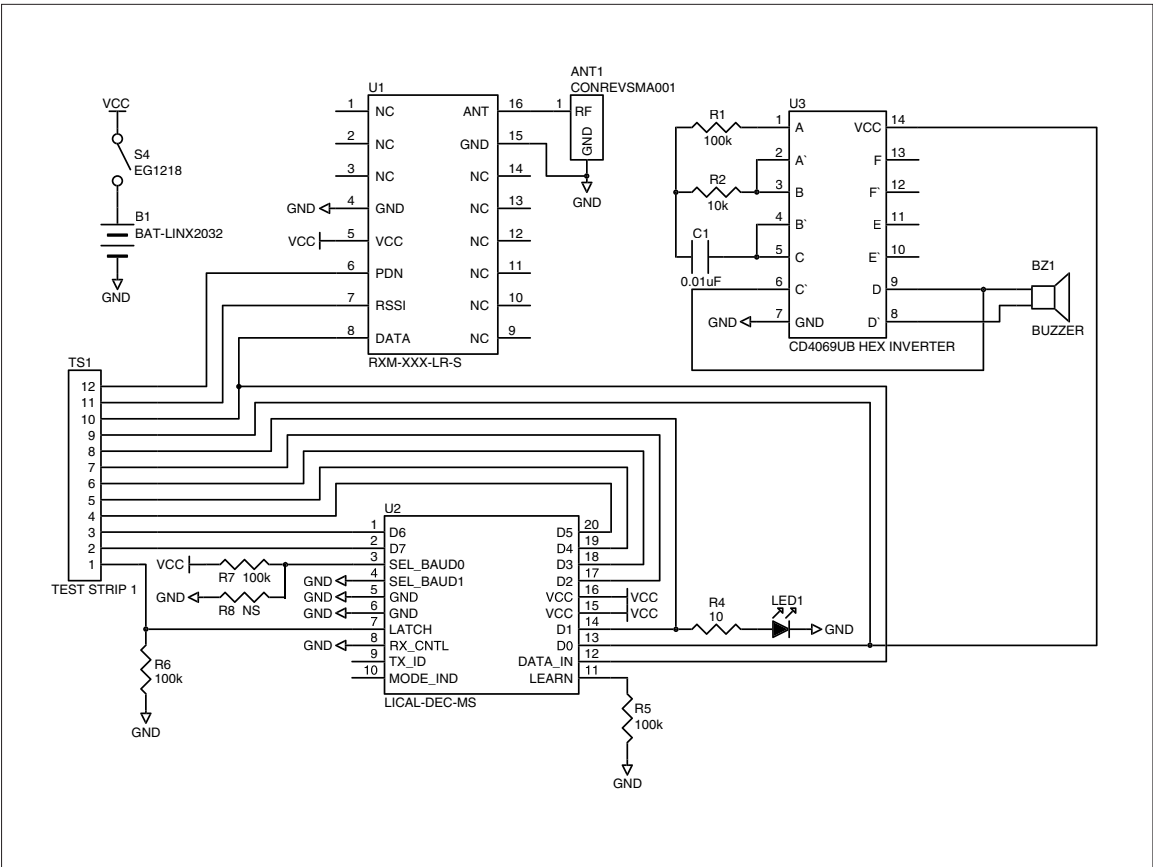


Figure 6: LR Receiver Board Schematic



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