



EVAL-315-LT
EVAL-418-LT
EVAL-433-LT

LT SERIES BASIC EVALUATION KIT USER'S GUIDE



ORDERING INFORMATION

PART #	DESCRIPTION
EVAL-***-LT	LT Series Basic Evaluation Kit
*** = 315, 418 (Standard), 433MHz	

INTRODUCTION

Linx LT Series RF transceiver 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 LT Series modules into an end product. The development boards themselves serve several important functions:

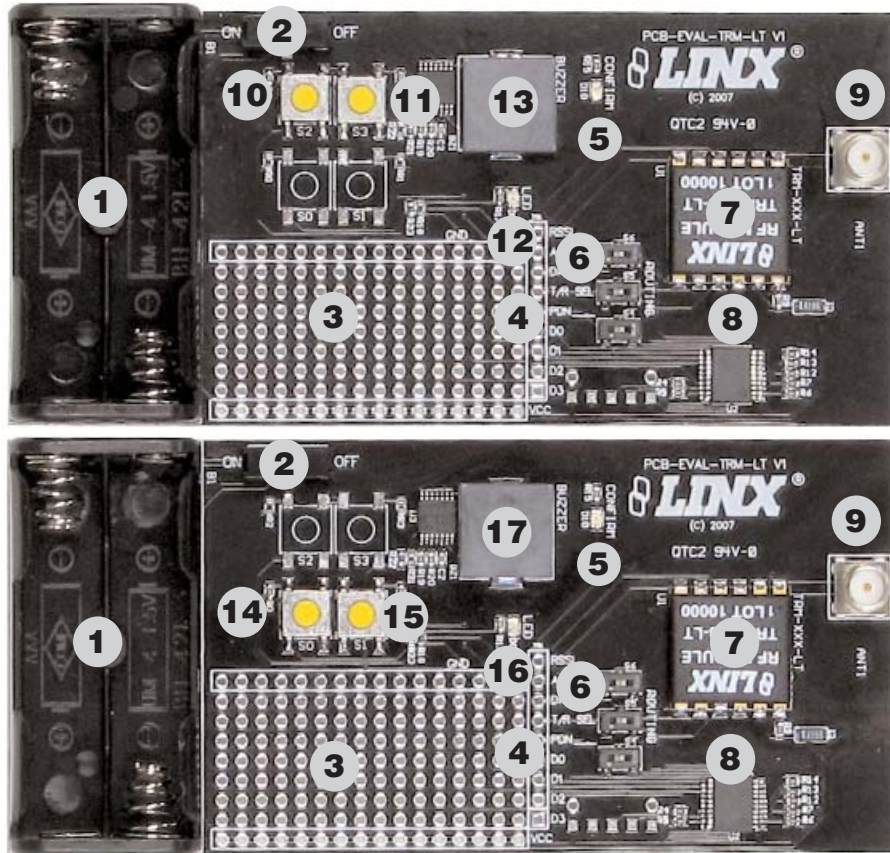
- **Rapid Module Evaluation** - The boards allow the performance of the Linx LT Series modules to be evaluated quickly in a user's environment.
- **Range Testing** - Using the on-board transcoders to generate a duplex transmission, a pair of development boards can be used to evaluate the range performance of the modules.
- **Design Benchmark** - During the design process of your product, the boards provide a known benchmark against which the performance of your own design can be judged.
- **Application Development** - An on-board prototyping area is provided to allow a designer to develop applications directly on the development board. All signal lines are available on a breakout header for easy connection to the designer's circuits.

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

This kit includes 4 LT Series transceivers*, 2 MT Series transcoders*, 2 extra PCB-mount RP-SMA connectors, 2 development boards, 2 CW Series antennas, 4 AAA batteries, and full documentation.

**One part is soldered to each board, two extras are for use on your first prototype boards.*

LT TRANSCEIVER EVALUATION BOARD



1. Battery - 3VDC
2. Power Switch
3. Prototyping Area
4. Breakout Header
5. Confirmation LED
6. Routing Switches
7. LT Series Transceiver Module
8. MT Series Transcoder
9. Reverse-Polarity SMA Antenna Connector
10. LED Button - D2
11. Buzzer Button - D3
12. LED - D0
13. Buzzer - D1
14. LED Button - D0
15. Buzzer Button - D1
16. LED - D2
17. Buzzer - D3

THEORY OF OPERATION

The two transceiver evaluation boards are identical, but they are populated slightly differently. The MT Series transcoder is both an encoder and a decoder, with the input or output nature of each line being determined by how the board is populated. One board will have buttons S0 and S1 populated, making those lines inputs. On the other board, those lines will be connected to the buzzer and LED, respectively. Conversely, the first board will have lines D2 and D3 connected to the buzzer and LED, while the second board has buttons S2 and S3 populated. This allows for bi-directional remote control. To use the kit, simply attach the antennas, turn on the power, and press one or both of the buttons on a board. When S0 or S2 is pressed, the buzzer will sound; when S1 or S3 is pressed, the LED will turn on.

Both boards have a confirmation LED. When one transcoder sends a command to the second transcoder, the second transcoder will send a confirmation back to the first transcoder indicating that the command was received and the action performed. When the first transcoder receives the confirmation, it will turn on the CONFIRM LED to indicate this. This feature offers the ability to range test without needing to be in visual or hearing range of both boards.

The MT Series Transcoder Data Guide goes into the many features of the transcoders in detail, but this is the only set-up required for operation of this kit.

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 bottom and ground at the top which can be used to power the added circuitry.

NOTE: If added circuitry requires a higher current, the on-board batteries 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.

All of the lines from the transceiver have been wired out to a row of plated holes on the right side of the prototyping area. Four of the data lines from the transcoder have also been wired out. This allows for easy access to connect external circuitry to the modules and the transcoder. Three lines from the transceiver (DATA, TR_SEL, and PDN) have been routed to switches. The switches connect the lines to either the transcoder or the prototyping area. This allows the transceiver to be conveniently switched between the transcoder and application circuitry during testing.

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.

Basic range testing can be performed with the transceiver evaluation boards. To prepare the board for range testing, turn it on by switching the power switch to the ON position. Pressing S0 or S2 will activate the buzzer on the receiver board, while S1 or S3 activates the LED. The CONFIRM LED provides an indication that the signal has traveled round trip, so only one person is needed to conduct range testing.

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 section has been attenuated 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 Output Power vs. LADJ Resistance graph in the LT Series Transceiver Data Guide.

To achieve maximum range, keep objects such as your hand away from the antenna and ensure that the antenna on the transmitting board has a clear and unobstructed line-of-sight path to the receiving board. Range performance is determined by many interdependent factors. If the range you are able to achieve is significantly less than what is 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 transceiver's RSSI voltage with the other transceiver 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 are HD Series (315MHz) or CW Series (418MHz and 433MHz) connectorized whip antennas 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 LT 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 1/4-wave antenna is employed, the ground plane is critical to serve as a counterpoise (you may wish to read Application Notes AN-00500 and AN-00501 for additional details on how a ground plane affects antenna function).

Second, a ground plane can help minimize 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 LT Series data guide or the calculator available on our website, www.linxtechnologies.com.

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. Our website is organized in an intuitive format to give you the answers you need. Day or night, the Linx website gives you instant access to the latest information regarding the products and services of Linx. It's all here: manual and software updates, application notes, a comprehensive knowledgebase, FCC information, and much more. If questions remain, call 541-471-6256 between 8AM and 4PM Pacific Time to speak with an application engineer.

Legal Notice

All Linx kits and modules are designed in keeping with high engineering standards; however, it is the responsibility of the user to ensure that the products are operated in a legal and appropriate manner. The purchaser understands that legal operation may require additional permits, approvals, or certifications prior to use, depending on the country of operation.

TRANSCIEVER EVALUATION BOARD

Power Supply Section

Power Supply Section Schematic:

- VCC is connected to a switch S8.
- Switch S8 is connected to a battery B1 (BAT-AAA).
- Battery B1 is connected to GND.
- VCC is also connected to a capacitor C1 (10uF).
- Capacitor C1 is connected to GND.

RF Module Section

RF Module Section Schematic:

- ANT1 CONREVSMA001 is connected to RF pin 1 of U1.
- RF pin 2 of U1 is connected to GND.
- RF pin 3 of U1 is connected to NC.
- RF pin 4 of U1 is connected to RSSI.
- RF pin 5 of U1 is connected to A REF.
- RF pin 6 of U1 is connected to ANALOG.
- RF pin 12 of U1 is connected to LADJ.
- RF pin 11 of U1 is connected to VCC.
- RF pin 10 of U1 is connected to GND.
- RF pin 9 of U1 is connected to PDN.
- RF pin 8 of U1 is connected to T/R SEL.
- RF pin 7 of U1 is connected to DATA.
- RF pin 6 of U1 is connected to TRM-XXX-LT.
- LADJ pin 12 of U1 is connected to R9 (750 ohm) and then to VCC.
- VCC pin 11 of U1 is connected to VCC.
- GND pin 10 of U1 is connected to GND.
- PDN pin 9 of U1 is connected to SW-SPDT S4.
- T/R SEL pin 8 of U1 is connected to SW-SPDT S5.
- DATA pin 7 of U1 is connected to SW-SPDT S6.
- SW-SPDT S4 is connected to PDMNT and PDN.
- SW-SPDT S5 is connected to TRSELMT and TRSEL.
- SW-SPDT S6 is connected to DATAMT and DATA.

Header Section

Header Section Schematic:

- TS1 Test Strip 1 is connected to RSSI, A REF, DATA, TRSEL, PDN, D0, D1, D2, and D3.
- RSSI is connected to R0 (100K) and then to GND.
- A REF is connected to R0 (100K) and then to GND.
- DATA is connected to R0 (100K) and then to GND.
- TRSEL is connected to R0 (100K) and then to GND.
- PDN is connected to R0 (100K) and then to GND.
- D0 is connected to R0 (100K) and then to GND.
- D1 is connected to R0 (100K) and then to GND.
- D2 is connected to R0 (100K) and then to GND.
- D3 is connected to R0 (100K) and then to GND.
- R0 (100K) is connected to S0 (switch) and then to VCC.
- R0 (100K) is connected to R23 (0 ohm) and then to LED.
- R0 (100K) is connected to R1 (100K) and then to GND.
- R1 (100K) is connected to S1 (switch) and then to VCC.
- R1 (100K) is connected to R21 (0 ohm) and then to BUZZER.
- R1 (100K) is connected to R2 (100K) and then to GND.
- R2 (100K) is connected to S2 (switch) and then to VCC.
- R2 (100K) is connected to R18 (0 ohm) and then to LED.
- R2 (100K) is connected to R3 (100K) and then to GND.
- R3 (100K) is connected to S3 (switch) and then to VCC.
- R3 (100K) is connected to R22 (0 ohm) and then to BUZZER.

TRANSCIEVER EVALUATION BOARD

Duplex Range Test Section

The schematic diagram illustrates the Duplex Range Test Section of the Transciever Evaluation Board. It features two primary integrated circuits: U2 (LICAL-TRC-MT) and U3 (CD4069UB HEX INVERTER).

U2 (LICAL-TRC-MT) Connections:

- Inputs:** R6 (100K) to GND, R7 (100K) to GND, R12 (100k) to GND, R13 (100K) to GND, R14 (100K) to GND, R15 (200 ohm) to GND, and D10 (LED0805) to GND.
- Outputs:** D5 to GND, D4 to GND, D3 to D3 (LED), D2 to D2 (LED), D1 to D1 (LED), and D0 to D0 (LED).
- Other Connections:** VCC to VCC, GND to GND, and a 0.01uF capacitor (C2) connected to the input of U3.

U3 (CD4069UB HEX INVERTER) Connections:

- Inputs:** A (1), A' (2), B (3), B' (4), C (5), and C' (6).
- Outputs:** VCC (14), F (13), F' (12), E (11), E' (10), D (9), and D' (8).
- Other Connections:** GND to GND, and a buzzer (BZ1) connected to the output of U3.



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