



EVAL-315-KH  
 EVAL-418-KH  
 EVAL-433-KH

## KH SERIES BASIC EVALUATION KIT USER'S GUIDE



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

### INTRODUCTION

Linx KH 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:

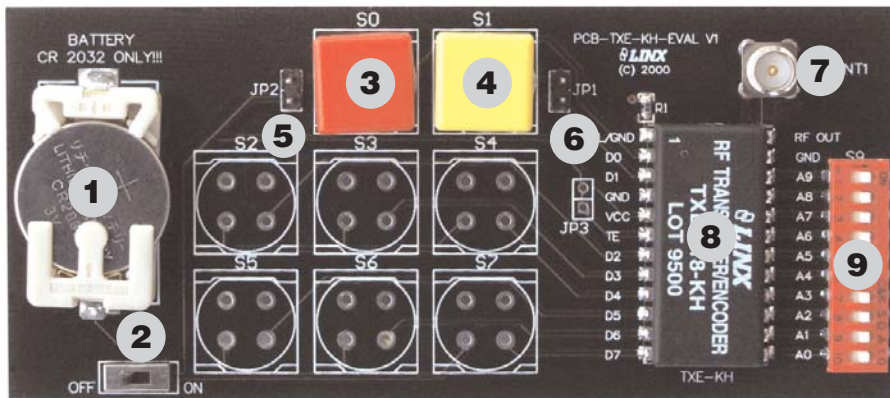
- **Rapid Module Evaluation** - The boards allow the performance of the Linx KH Series modules to be evaluated quickly in a user's environment.
- **Range Testing** - Using the on-board encoders and decoders to generate a simplex transmission, a pair of development boards can be used to evaluate the range performance of the modules.
- **Design Benchmark** - 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 development boards included with the kit.

The kit includes 2 KH Series transmitters\*, 2 KH2 Series receivers\*, 2 extra PCB-mount RP-SMA connectors, 2 development boards, 2 CW Series antennas, 2 CR2032 batteries, and full documentation.

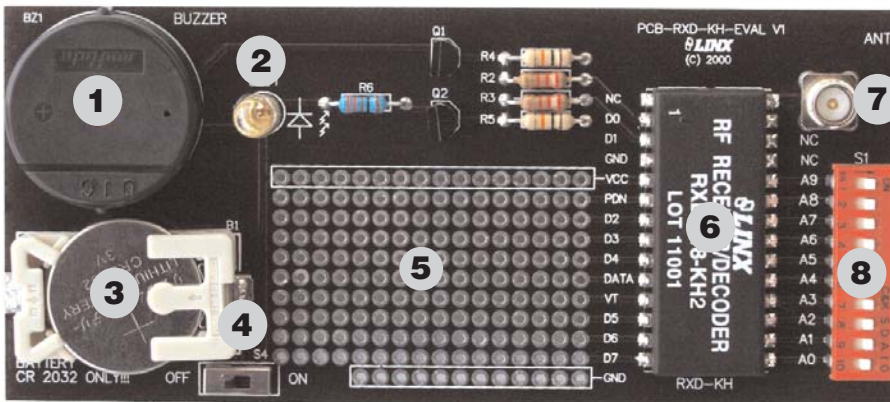
\*One part is soldered to the board, one extra for use on your first prototype board.

## KH TRANSMITTER EVALUATION BOARD



1. Battery - 3VDC (use a CR2032-style battery only)
2. Power Switch
3. Momentary Pushbutton - S0 (D0)
4. Momentary Pushbutton - S1 (D1)
5. Continuous Transmit Jumper
6. Transmit Enable Cut-Trace / Jumper (JP3)
7. Reverse-Polarity SMA Antenna Connector
8. KH Series Transmitter Module
9. 10-Position Address DIP Switch

## KH RECEIVER EVALUATION BOARD



1. Buzzer - D0
2. LED - D1
3. Battery - 3VDC (use a CR2032-style battery only)
4. Power Switch
5. Prototyping Area
6. KH2 Series Receiver Module
7. Reverse-Polarity SMA Antenna Connector
8. 10-Position Address DIP Switch

## THEORY OF OPERATION

### TRANSMITTER EVALUATION BOARD

The transmitter board is powered by an on-board 3V CR2032 lithium battery. It has two SPST pushbutton switches, the state of which is encoded into a data stream by the module. If a switch is closed, the module will capture the settings of the 10-position DIP switch address bits and pushbutton states for encoding and transmission. Only the two switches that control the LED and buzzer on the receiver board have been populated. The transmitter will transmit continuously when any switch is closed or when Transmit Enable (TE) is pulled high (default). If it is desired to control the TE line with external circuitry, then the trace marked by JP3 can be cut and additional circuitry added.

### RECEIVER EVALUATION BOARD

The receiver board is also powered by a 3V CR2032 lithium battery. The KH2 Series receiver exhibits a sensitivity of greater than -112dBm, 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 KH2 Series receiver is internally decoded. If the settings of the 10-position DIP switch on the receiver board match the address setting of the transmitter board, 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. Switching transistors are used as drive buffers because the KH2 receiver cannot directly source the current necessary to operate these devices. This board has a prototyping area with all of the receiver lines brought out to a header for easy access by external circuitry.

## 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.

## DEVELOPMENT USING THE PROTOTYPING AREA

In addition to its evaluation functions, the receiver board may also be used for actual product development. It features 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 board has very low current capacity, with only about 3mA available for external circuitry. If added circuitry requires a higher current, the on-board 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, locations S2 to S7 are available for population of switches or direct interface of logic level inputs. On the receiver board, the data lines from the decoder plus the 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**

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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, ensure that JP3 is closed on the transmitter board and that the address line DIP switches on both boards are identically set. Turn on the boards 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. Placing a jumper across JP1 or JP2 will cause the transmitter to 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 R1 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, R1 can be changed according to the graph on Page 3 of the KH 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, jumper routing, and antenna connections. 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**

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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**

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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 KH 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 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 KH Series data guides or the calculator available on our website.

## **IN CLOSING**

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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 541-471-6256 between 9AM and 4PM Pacific Time to speak with an application engineer.

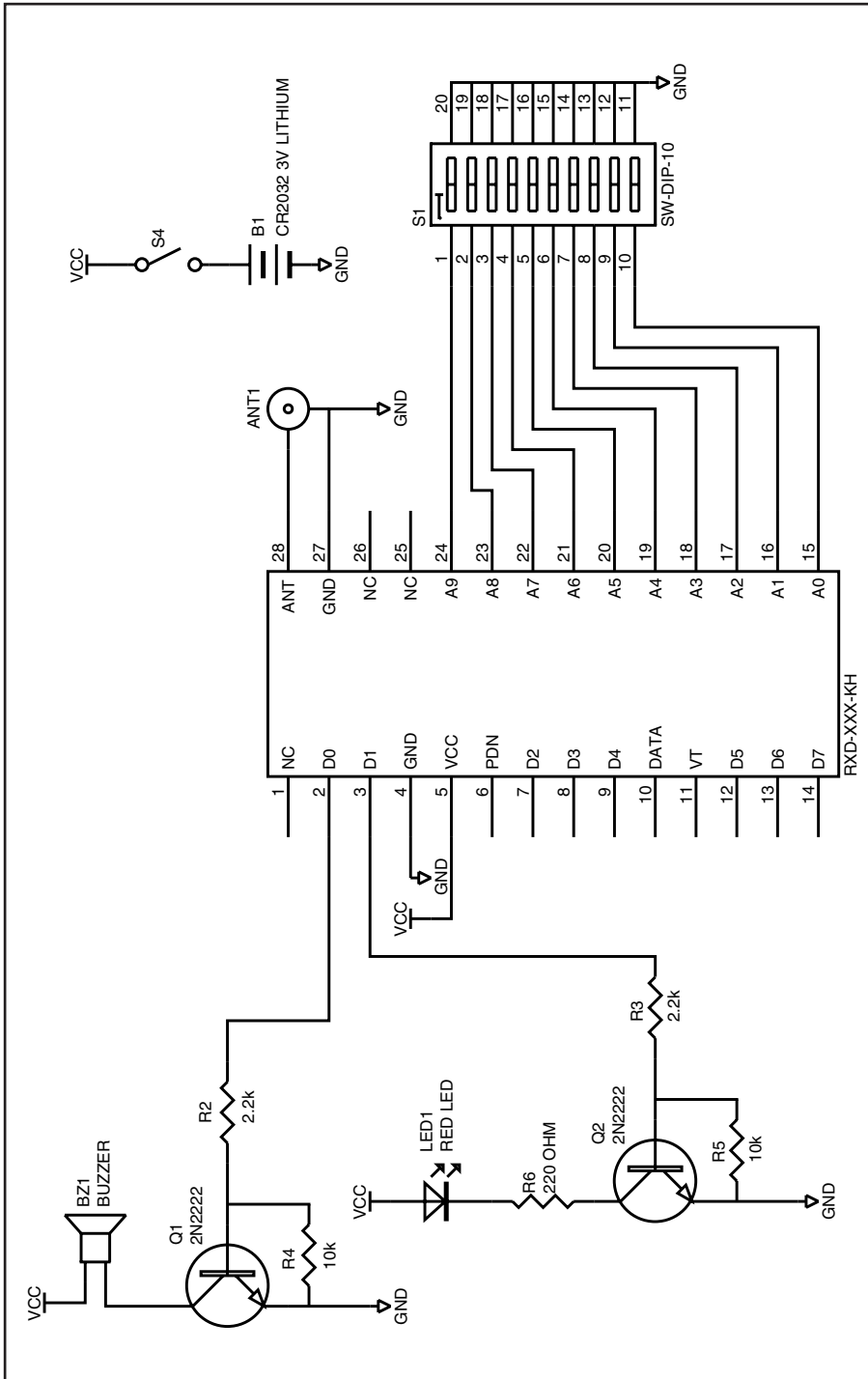
### **Legal Notice**

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.

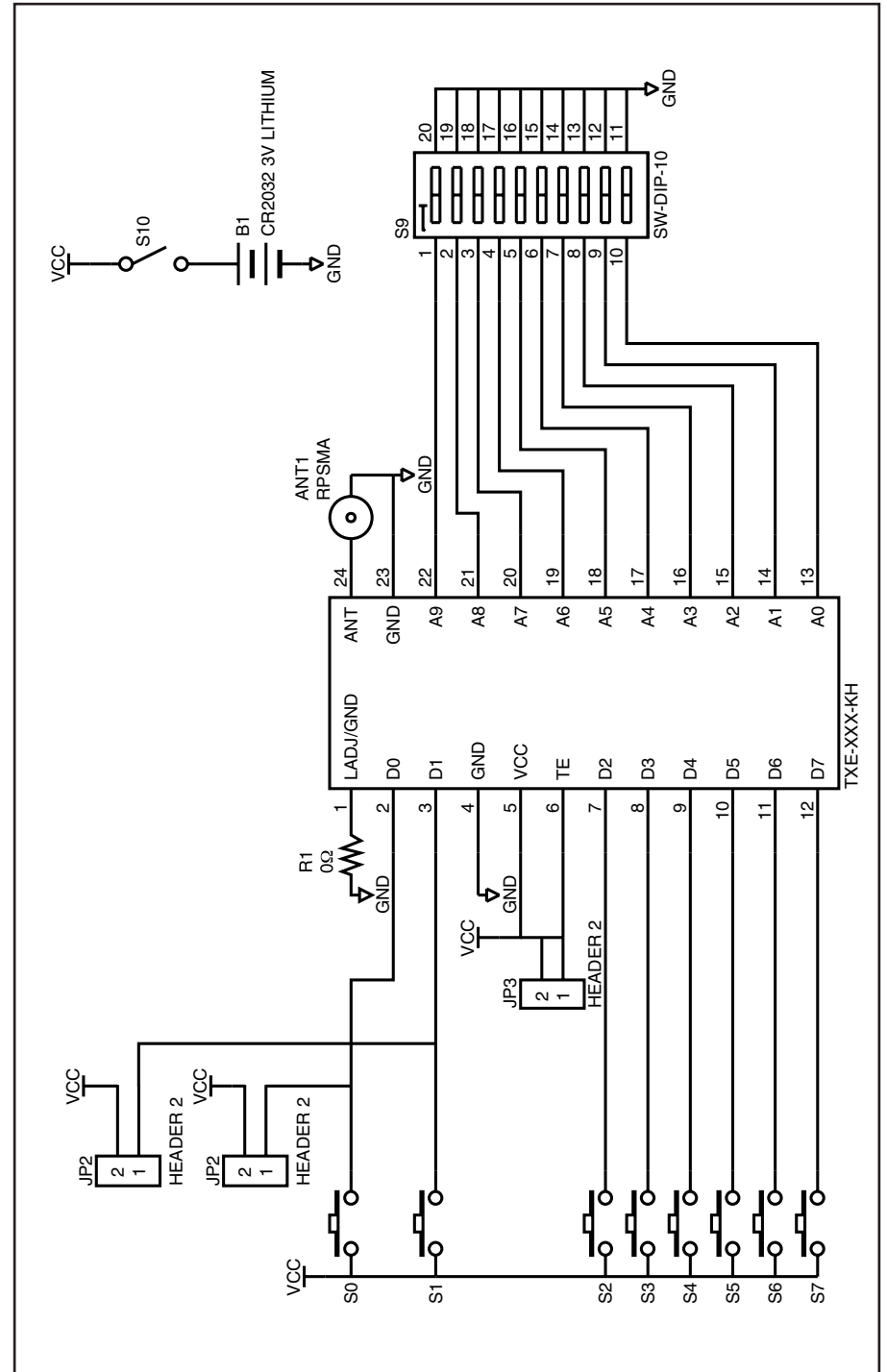
## **ONLINE RESOURCES**

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If you have questions regarding any Linx product and have Internet access, make [www.linxtechnologies.com](http://www.linxtechnologies.com) your first stop. 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. Be sure to visit often!



EVAL-\*\*\*-KH Receiver Board Schematic



EVAL-\*\*\*-KH Transmitter Board Schematic



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