



EVAL-\*\*\*-HHTX  
 EVAL-\*\*\*-HHCP  
 EVAL-\*\*\*-HHLR

## OEM TRANSMITTER EVALUATION KIT USER'S GUIDE



### ORDERING INFORMATION

PART #	DESCRIPTION
EVAL-***-HHCP	Compact Handheld Basic Evaluation Kit
EVAL-***-HHLR	Long-Range Handheld Basic Evaluation Kit
EVAL-***-HHTX	Full-Size Handheld Basic Evaluation Kit
EVAL-***-KEY#	Keyfob Basic Evaluation Kit
*** = 315, 418 (Standard), 433MHz	
# = Number of buttons: 1 to 5	

## INTRODUCTION

Linx OEM RF transmitters offer a simple, efficient, and cost-effective method of adding remote control and command capabilities to any product. The Basic Evaluation Kit is intended to give a designer all the tools necessary to correctly incorporate Linx OEM transmitters and receiver modules into a product. This guide will show how to take full advantage of the basic evaluation board that is included with the kit. The evaluation board serves several important functions:

- **Rapid Evaluation** - It allows the performance of the transmitters and receivers to be evaluated quickly in a user's environment.
- **Range Testing** - Using the OEM transmitter and the included development board, a simplex transmission is generated that can be used to evaluate the range performance of the products.
- **Design Benchmark** - During the design process of your product, the kit provides a known benchmark against which the performance of your own design may be judged.
- **Prototype Development** - An on-board prototyping area is provided, which allows for additional circuitry to be placed directly on the board so that it can act as the first prototype of the product. All of the signals are available on a breakout header for easy connection to external circuitry.

The kit includes 2 OEM transmitters, 2 KH2 Series receivers\*, 2 PCB-mount RP-SMA connectors\*, 1 development board, 1 CW Series antenna, 2 AAA batteries, and full documentation.

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

## OEM TRANSMITTER BUTTON ASSIGNMENTS

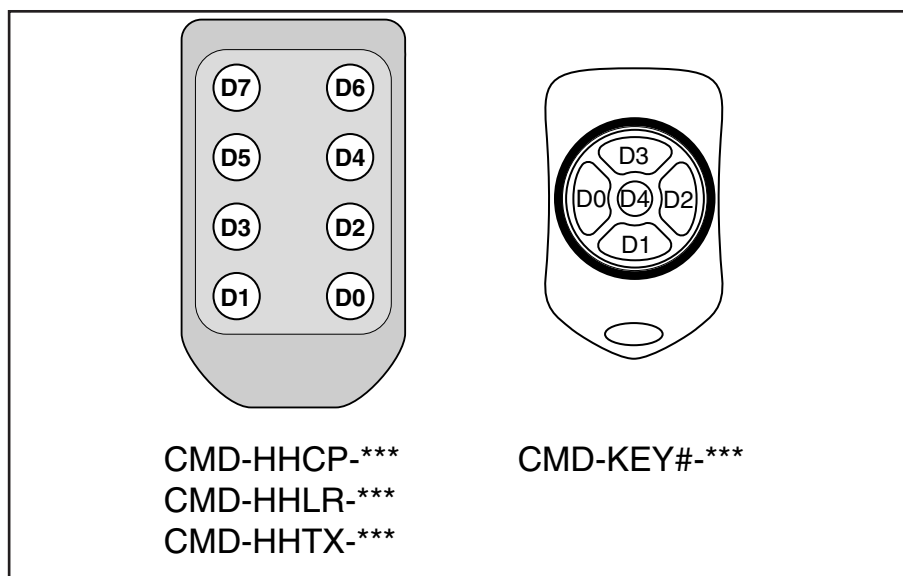
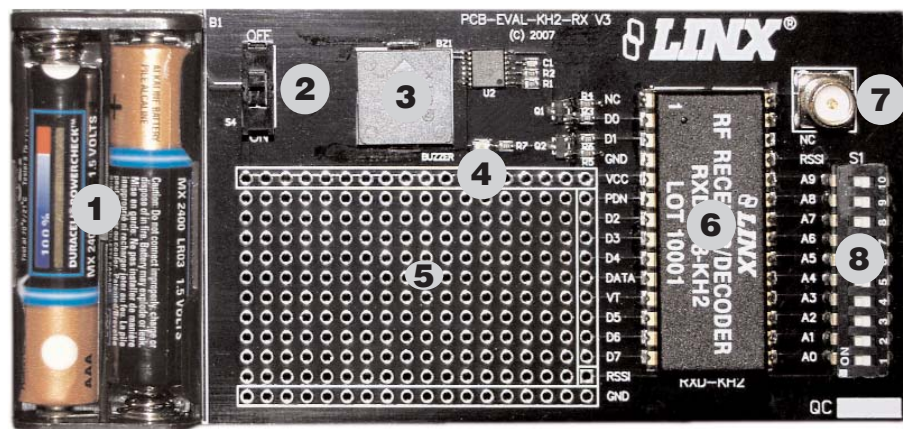


Figure 1: OEM Transmitter Button Assignments

## RECEIVER / DECODER BOARD



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

Figure 2: OEM Basic Evaluation Kit Receiver / Decoder Board

## THEORY OF OPERATION

### OEM TRANSMITTERS

Linx OEM transmitters are a great way to quickly bring a remote control product to market. They are fully assembled and certified, eliminating the need for design, tooling, and certification. Linx can also customize the transmitters with customer specific art, logos, or switch layouts.

The operation of the OEM transmitter is straightforward. When a button(s) is pressed on the OEM transmitter, the states of D0 to D7 are formatted into secure packets by an on-board encoder IC. These encoded packets are sent to a Linx transmitter that, through the antenna, conveys the data into free space.

### RECEIVER / DECODER EVALUATION BOARD

The receiver board is powered by two AAA batteries. A Linx KH2 Series receiver is used for reception of the transmitted signal. This receiver provides exceptional sensitivity, allowing the transmitter and receiver to operate at distances of up to 1,000 feet (depending on TX model and signal conditions). 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, the data lines are updated to match the state of the buttons on the OEM transmitter. To demonstrate this, one data line on the evaluation board is used to drive a LED while another is used to activate a buzzer. Transistors are used as drive buffers since the KH2 receiver cannot directly source enough current for these devices.

## USING THE KIT

Attach the antenna to the board, set the address on the transmitter and on the board, turn on the power to the board, and press a button on the transmitter.

## SETTING THE ADDRESS

The Holtek encoder and decoder each have ten address lines that **must** match in order for the transmitter and receiver to talk to each other. If they do not match, then the decoder will ignore any transmission and take no action.

The address lines are tri-state, meaning that  $V_{CC}$ , ground, and floating are separate and valid states for the address. The OEM transmitters only make use of the ground and floating states, so the receiver board is designed to match.

To set the address on the receiver evaluation board, note the A0 - A9 labels on the board and turn the DIP switches on or off as desired. If a switch is on, the address line is connected to ground. If it is off, then the address line is floating.

The four OEM transmitters have different ways of setting their address lines. For your convenience, a brief explanation follows; however, the OEM transmitter manual or Application Note AN-00300 should be referenced for complete details.

The HHTX has an eight-position DIP switch accessed by opening the case. Switch number 8 corresponds to A0 and number 1 corresponds to A7. A8 and A9 are floating on the transmitter and must be left off on the receiver board.

The HHCP and HHLR utilize a ten-position DIP switch that is accessed by a cover on the back of the remote. The switch numbers match the address lines with switch number 1 corresponding to A0 and number 10 to A9.

The Keyfob has ten internal cut traces numbered 0 to 9 to match A0 to A9. If the trace is intact, it is connected to ground; when cut, it is floating.

## RANGE TESTING

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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 usage environment.

Simple range testing can be performed with the transmitter and receiver evaluation board. To prepare the board for range testing, simply turn it on by switching the power switch to the ON position. Pressing D0 on the transmitter will activate the buzzer on the receiver board, while D1 activates the LED.

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. Multipath 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 further will usually restore the signal. If this does not restore the signal, then the maximum effective range of the link has been reached.

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 what is specified by Linx for the products you are testing, then there is likely a problem either with the board or the ambient RF environment in which the board is operating. First, check the battery, switch positions, address settings, 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.

## DEVELOPMENT USING THE PROTOTYPING AREA

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In addition to evaluation functions, the boards may also be used for product development. The receiver board features a prototyping area for the addition of application-specific circuitry. This area has connections to  $V_{CC}$  at the top and to ground at the bottom that can be used to power any circuitry that is added.

**NOTE:** *If added circuitry requires a higher current than can be provided by the batteries, the batteries must be removed and the board powered from an external source.*

The holes are all plated and are set at 0.100” on center with a 0.040” diameter, making it easy to add industry-standard SIP and DIP packages to the board. The data line outputs, RSSI, PDN, and DATA line from the receiver have been wired out to a header row to the right of the prototyping area. This makes it easy to connect external circuitry to the module and decoder. Data lines D0 and D1 are connected to the buzzer and LED, but can be accessed by removing the resistors next to the D0 and D1 labels.

## USING THE BOARDS AS A DESIGN REFERENCE

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Since the OEM transmitters are a finished product, most of the designer's work will be incorporating the receiver into their design product. The basic evaluation board included in this kit is very simple, yet illustrates some important techniques that you may wish to incorporate into your own board layout. You will observe that the receiver's 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 KH2 Series Receiver Data Guide or the calculator available on our website.

## 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 connectorized whip antenna that should be connected prior to using the kit. Despite the fact the antenna is not centered on the board's ground-plane, it exhibits an outstanding VSWR of <1.7 and suitably demonstrates the module's best practical performance.

## 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.

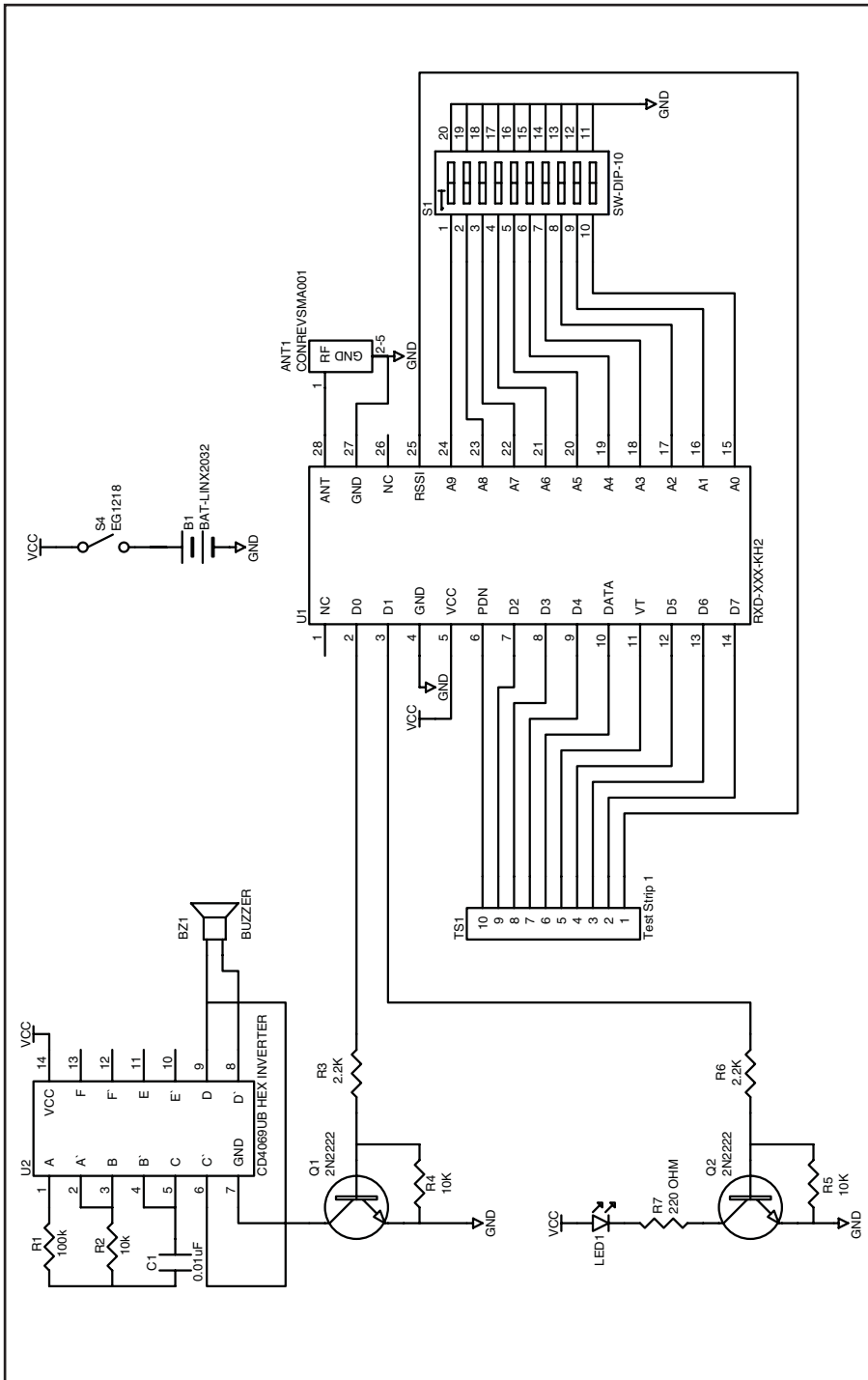


Figure 3: OEM Basic Evaluation Kit Receiver / Decoder Board Schematic

## ONLINE RESOURCES



[www.linxtechnologies.com](http://www.linxtechnologies.com)

- Latest News
- Data Guides
- Application Notes
- Knowledgebase
- Software Updates



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 immediately 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!



[www.antennafactor.com](http://www.antennafactor.com)

The Antenna Factor division of Linx offers a diverse array of antenna styles, many of which are optimized for use with our RF modules. From innovative embeddable antennas to low-cost whips, domes to Yagis, and even GPS, Antenna Factor likely has an antenna for you, or can design one to meet your requirements.



[www.connectorcity.com](http://www.connectorcity.com)

Through its Connector City division, Linx offers a wide selection of high-quality RF connectors, including FCC-compliant types such as RP-SMAs that are an ideal match for our modules and antennas. Connector City focuses on high-volume OEM requirements, which allows standard and custom RF connectors to be offered at a remarkably low cost.





## U.S. CORPORATE HEADQUARTERS

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