Linx TECHNOLOGIES

DS Keyfob Transmitter Evaluation Kit

User´s Guide

Wireless made simple®

Warning: Some customers may want Linx radio frequency ("RF") products to control machinery or devices remotely, including machinery or devices that can cause death, bodily injuries, and/or property damage if improperly or inadvertently triggered, particularly in industrial settings or other applications implicating life-safety concerns ("Life and Property Safety Situations").

NO OEM LINX REMOTE CONTROL OR FUNCTION MODULE SHOULD EVER BE USED IN LIFE AND PROPERTY SAFETY SITUATIONS. No OEM Linx Remote Control or Function Module should be modified for Life and Property Safety Situations. Such modification cannot provide sufficient safety and will void the product's regulatory certification and warranty.

Customers may use our (non-Function) Modules, Antenna and Connectors as part of other systems in Life Safety Situations, but only with necessary and industry appropriate redundancies and in compliance with applicable safety standards, including without limitation, ANSI and NFPA standards. It is solely the responsibility of any Linx customer who uses one or more of these products to incorporate appropriate redundancies and safety standards for the Life and Property Safety Situation application.

Do not use this or any Linx product to trigger an action directly from the data line or RSSI lines without a protocol or encoder/ decoder to validate the data. Without validation, any signal from another unrelated transmitter in the environment received by the module could inadvertently trigger the action.

All RF products are susceptible to RF interference that can prevent communication. RF products without frequency agility or hopping implemented are more subject to interference. This module does not have a frequency hopping protocol built in.

Do not use any Linx product over the limits in this data guide. Excessive voltage or extended operation at the maximum voltage could cause product failure. Exceeding the reflow temperature profile could cause product failure which is not immediately evident.

Do not make any physical or electrical modifications to any Linx product. This will void the warranty and regulatory and UL certifications and may cause product failure which is not immediately evident.

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DS Keyfob Transmitter Basic Evaluation Kit

User´s Guide

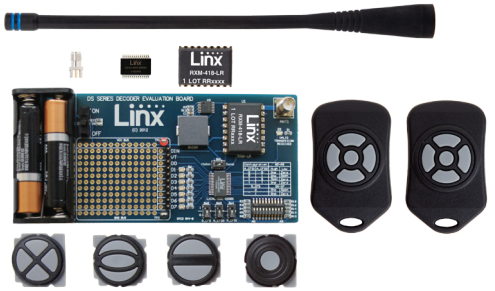


Figure 1: DS Keyfob Transmitter Basic Evaluation Kit

Introduction

Linx DS keyfob transmitters offer a simple, efficient and cost-effective method of adding remote control and command capabilities to any product. The Basic Evaluation Kit provides a designer all the tools necessary to correctly incorporate the keyfob and receiver modules into a product. 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 transmitter and the included development board, a simplex transmission is generated that can be used to evaluate the range performance of the products.
- Prototype Development: An on-board prototyping area allows for additional circuitry to be placed directly on the evaluation board. All signal lines are available on a breakout header for easy access.
- Design Benchmark: The boards provide a known benchmark against which the performance of a custom design may be judged.

The kit includes 2 DS Keyfob transmitters, 2 DS Series encoder / decoders*, 2 LR Series receivers*, 2 PCB-mount RP-SMA connectors*, 1 evaluation board, 1 CW Series antenna, 2 AAA batteries and full documentation.

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

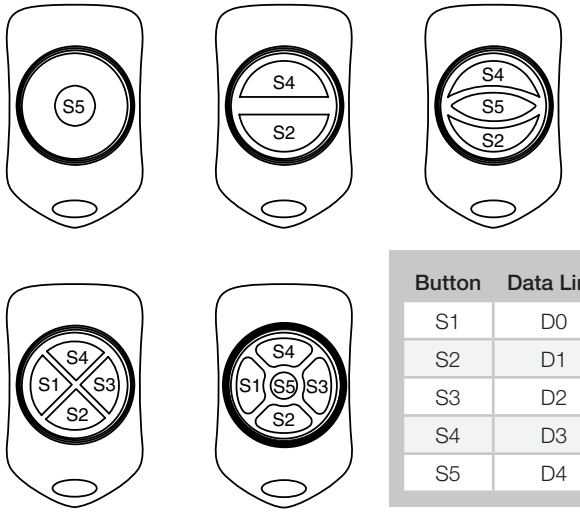
Ordering Information

Ordering Information	
Part Number	**Description**
EVAL-***-HH-KF-DS	DS Keyfob Basic Evaluation Kit

*** = 418 (Standard) or 433MHz

Figure 2: Ordering Information

Keyfob Transmitter Button Assignments



Button	Data Line
S1	D0
S2	D1
S3	D2
S4	D3
S5	D4

Figure 3: OTX-***-HH-KF#-DS Button Assignments

DS Series Receiver / Decoder Evaluation Board

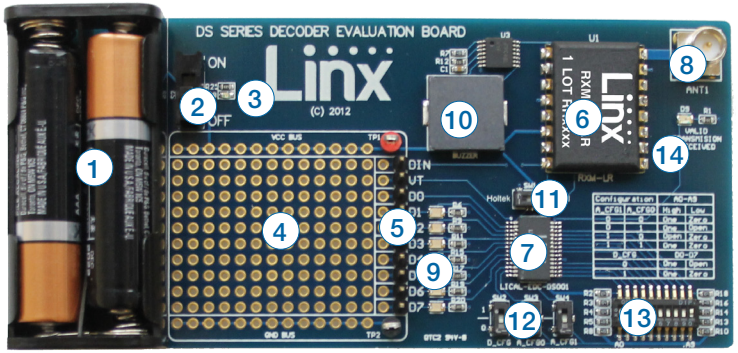


Figure 4: DS Series Decoder Evaluation Board

1. Battery – 3VDC (use 2 AAA style batteries)
2. Power Switch
3. Power On Indicator LED
4. Prototyping Area
5. Breakout Header
6. LR Series Receiver Module
7. DS Series Encoder / Decoder
8. Reverse-Polarity SMA Antenna Connector
9. LEDs – D1–D7
10. Buzzer – D0
11. Protocol Selection Switch
12. Data and Address Line Interpretation Configuration Switches
13. Address Configuration DIP Switch
14. Valid Transmission Received LED

Theory of Operation

DS Keyfob Transmitters

DS Keyfob 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 on the case and buttons.

The operation of the transmitter is straightforward. When a button(s) is pressed on the transmitter, the states of D0 to D4 are formatted into packets by an on-board encoder IC. These encoded packets are sent to a 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 LR 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 750 feet (depending on signal conditions). The data recovered by the receiver is decoded by the DS Series set as a decoder. If the settings of the 10-position DIP switch on the receiver board match the address setting of the transmitter, the data line outputs are updated to match the states of the buttons on the transmitter. To demonstrate this, one data line on the evaluation board is used to drive a buzzer while the other lines activate LEDs. The 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 antenna to the board and install the batteries. Set the address on the transmitter and on the board to the same settings, turn on the power to the board, and press a button on the transmitter. When D0 is pressed, the buzzer sounds; when S1–S4 are pressed, the LEDs turn on. When any button (D0–D4) is pressed on the transmitter, the corresponding decoder output (D0–D4) is active high (V_{CC}) on the prototyping header.

> Note: All switches (address, protocol select and interpretation configuration) must match on both the transmitter and the decoder / receiver board.

Setting the Address

The transmitter 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 ignores the transmission and takes no action.

To set the address on the 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, the line is pulled to VCC.

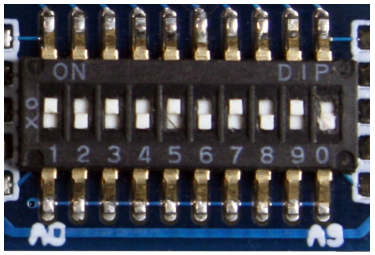


Figure 5: The Evaluation Board Address DIP Switch

Setting the keyfob address is accomplished by cutting the address traces. The traces are accessed by removing the rear cover. There are ten 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 pulled to VCC.

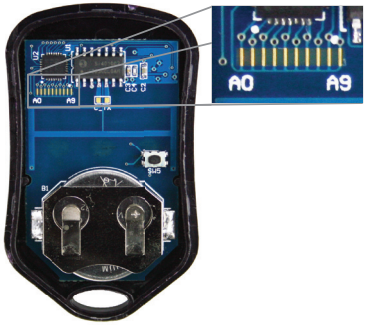


Figure 6: Address Traces

Application Note AN-00300 describes in detail how to set the address to match any of the receivers offered by Linx. This note can be found in the Support section of the Linx website, www.linxtechnologies.com.

> Note: All address switches ON and all switches OFF are not valid states and are not recognized by the decoder. At least one switch must be set differently from the rest.

Input Interpretation Selection Switches

The DS Series was designed to replace an encoder and decoder from Holtek. These parts had tri-state lines, so the address and data lines could be high, low or floating. The DS can only be high or low, so these selection switches are included for backwards compatibility.

In the case of the DS Keyfob transmitter, these lines are ignored and can be set to any position.

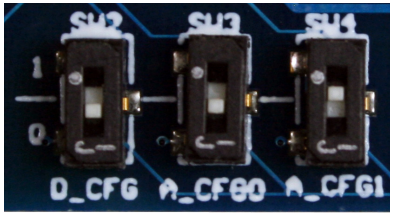


Figure 7: The Evaluation Board Input Interpretation Selection Switches

Selecting the Protocol

The DS Series encoder / decoder offers two over-the-air protocols: Holtek and serial. The Holtek selection is used when communicating with other Holtek devices. This is a legacy protocol that provides backwards compatibility with older products.

The DS Keyfob uses the serial protocol, which is a much more reliable protocol that offers better range and response time. The protocols are not interoperable, so the evaluation board must be set to use the serial protocol. The protocol is selected by the Protocol Select Switch on the evaluation board, as shown in Figure 8.

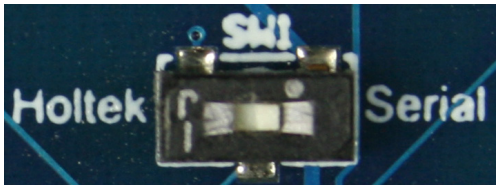


Figure 8: The Evaluation Board Protocol Selection Switch

Development Using the Prototyping Area

In addition to evaluation functions, the boards may also be used for product development. The evaluation 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 plated and set at 0.1" on center with a 0.04" diameter, accommodating industry-standard SIP and DIP packages. The data line outputs, Valid Transmission (VT) and the DATA line from the receiver (DIN) have been wired out to a header row to the right of the prototyping area. This allows easy access for connection to external circuitry. Data line D0 is connected to a buzzer, D1 to D7 and VT are connected to LEDs.

Using the Boards as a Design Reference

Since the OEM transmitters are a finished product, most of the designer's work will be incorporating the receiver into the end product. The basic evaluation board included in this kit is very simple, yet illustrates some important techniques that should be incorporated into the board layout. 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. A full ground plane fill is placed on the bottom 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 (please see Application Note AN-00500 "Antennas: Design, Application, and Performance" for details on how a ground plane affects antenna function).

Second, a ground plane suppresses 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 between the module and 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. See the LR Series receiver data guide or the calculator available on our website for details on microstrip calculations.

Range Testing

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 activates the buzzer on the receiver board, while D1 activates the LED.

As the maximum range of the link in an area is approached, it is not uncommon for the signal to cut in and out as the transmitter moves. 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 usually restores 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 for the products being tested, 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.

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 can be considered for a design. Included with the 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

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 or call +1 541 471 6256 between 8AM and 4PM Pacific Time to speak with an application engineer.

Legal Notice: All Linx kits 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 the legal operation may require additional permits, approvals, or certifications prior to use, depending on the country and operation.

DS Series Decoder Evaluation Board Schematic

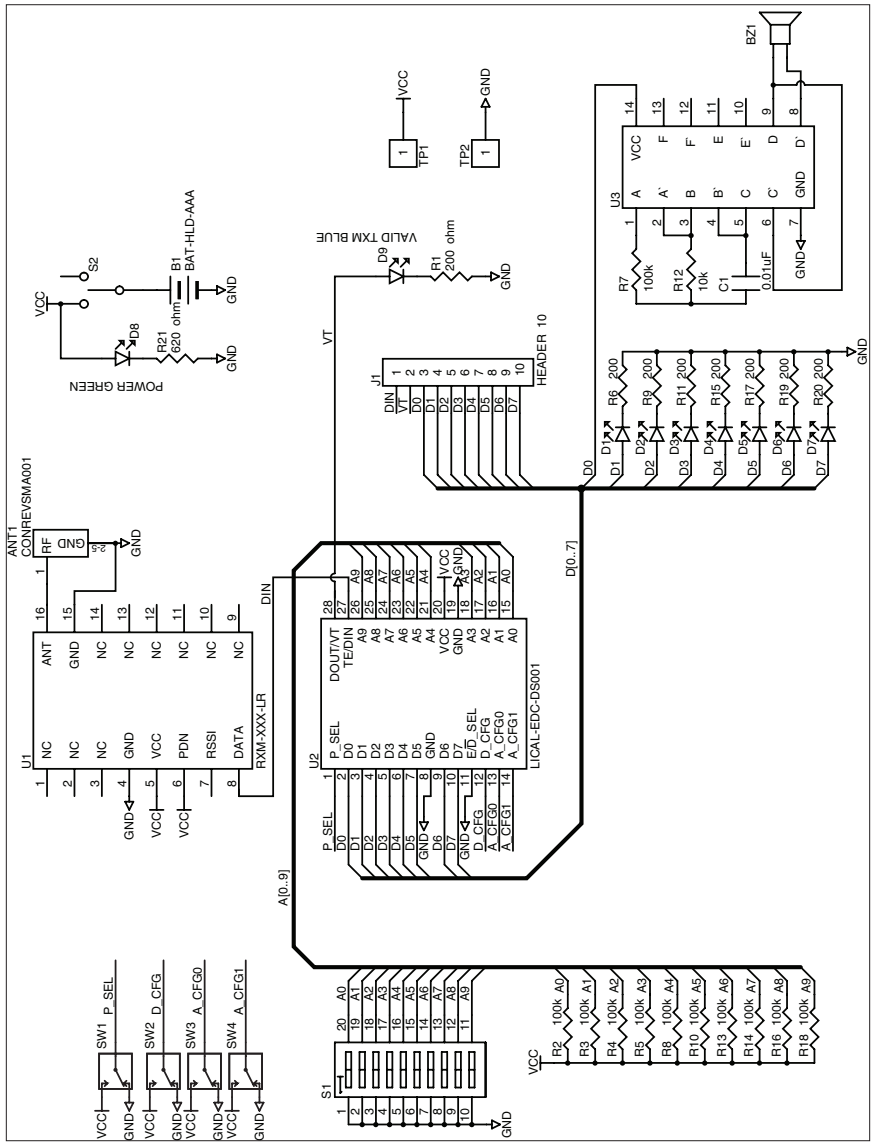


Figure 9: DS Series Decoder Board Schematic

Resources

Support

For technical support, product documentation, application notes, regulatory guidelines and software updates, visit www.linxtechnologies.com

RF Design Services

For customers who need help implementing Linx modules, Linx offers design services including board layout assistance, programming, certification advice and packaging design. For more complex RF solutions, Apex Wireless, a division of Linx Technologies, creates optimized designs with RF components and firmware selected for the customer's application. Call +1 800 736 6677 (+1 541 471 6256 if outside the United States) for more information.

Antenna Factor Antennas

Linx's Antenna Factor division has the industry's broadest selection of antennas for a wide variety of applications. For customers with specialized needs, custom antennas and design services are available along with simulations of antenna performance to speed development. Learn more at www.linxtechnologies.com.

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