Linx TECHNOLOGIES

DS Series
Basic 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.

Table of Contents

DS Series Basic Evaluation Kit

User´s Guide

Figure 1: DS Series Basic Evaluation Kit

Introduction

The DS Series encoder / decoder offers a simple, efficient and cost-effective method of adding wireless remote control capabilities to any product. The Basic Evaluation Kit gives a designer all the tools necessary to correctly and legally incorporate the DS Series encoder / decoder into an end product. This guide shows how to take full advantage of the development boards included with the system. The evaluation kit serves several important functions:

- Rapid Evaluation: The boards allow the performance of the DS Series encoder / decoder to be evaluated quickly in a user's environment.
- Prototype 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.

This kit includes 4 DS Series encoders / decoders*, 2 LR Series transmitters*, 2 LR Series receivers*, 2 development boards, 2 CW Series antennas, 1 CR2032 battery, 2 AAA batteries and full documentation.

*Two DS Series encoders / decoders, 1 LR Series transmitter and 1 LR Series receiver are soldered to the boards, the rest are for use on prototypes.

Ordering Information

Ordering Information	
Part Number	**Description**
EVAL-xxx-DS	DS Series Basic Evaluation Kit
LICAL-EDC-DS001	DS Series Encoder/Decoder

xxx = 315, 418 (Standard), 433MHz

Figure 2: Ordering Information

DS Series Encoder Evaluation Board

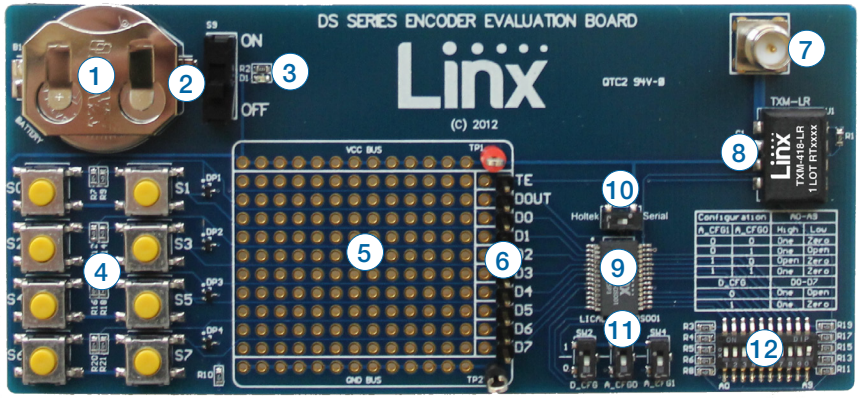

Figure 3: DS Series Encoder Evaluation Board

1. Battery – 3VDC (use a CR2032-style battery only)
2. Power Switch
3. Power On Indicator LED
4. Momentary Pushbuttons
5. Prototyping Area
6. Breakout Header
7. Reverse-Polarity SMA Antenna Connector
8. LR Series Transmitter Module
9. DS Series Encoder / Decoder
10. Protocol Select Switch
11. Holtek Protocol Configuration Switches
12. Address Configuration DIP Switch

DS Series Decoder Evaluation Board

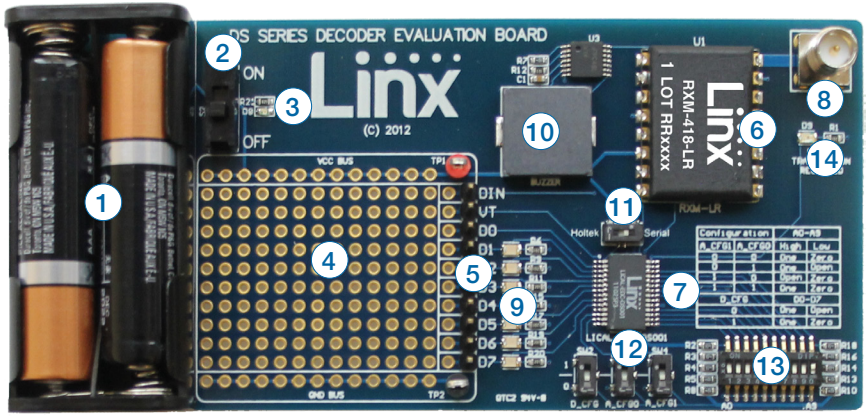

Figure 4: DS Series Decoder Evaluation Board

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 Select Switch
12. Holtek Configuration Switches
13. Address Configuration DIP Switch
14. Valid Transmission Received LED

Theory of Operation

Encoder Evaluation Board

The transmitter board is powered by an on-board 3V CR2032 lithium battery. It has eight SPST pushbutton switches, the states of which are encoded into a data stream using the DS Series as an encoder. If a switch is closed, the transmitter is enabled while the encoder captures the pushbutton states for encoding and transmission. Buttons S0 (D0) is used to activate a buzzer on the receiver board while the rest of the buttons activate LEDs. All of the data lines are wired out to the header to the right of the prototyping area and can be accessed for use with other switches, contacts or microcontrollers.

Decoder Evaluation Board

The receiver board is powered by two AAA batteries. The data recovered by the LR Series receiver is decoded using the DS Series as a decoder, and the data line outputs are updated to match the states of the data line inputs (or pushbuttons) on the transmitter board. To demonstrate this, one data line is used to activate a buzzer while the other seven are used to drive LEDs. 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 buttons on the transmitter board. When S0 is pressed, the buzzer sounds; when S1–S7 are pressed, the LEDs turn on. When any button (S0–S7) is pressed on the transmitter board, the corresponding decoder output (D0–D7) is active high (V_{CC}) on the prototyping header.

Note: All switches (address, protocol select and Holtek configuration) must match on both the encoder and decoder boards.

Selecting the Protocol

The DS Series encoder / decoder offers two over-the-air protocols. The Holtek selection is used when communicating with other Holtek devices. The serial selection offers a much more reliable protocol to allow better range and response time. See the DS Series Data Guide for more details.

Setting the Address

The address is made of ten inputs from the DIP switch, resulting in 1,022 ($2^{10} – 2$) possible combinations. It's important to remember that all switches placed on or off are not valid addresses and are ignored. At least one input must be different from the rest. Both the encoder and decoder board must have matching addresses.

Warning: When designing remote control applications, it is very important to use unique addressing between devices. This eliminates opportunities for accidental triggering of unintentional devices within range. For example, if next door neighbors have matching addresses for their garage doors, each person would open both garage doors when transmitting from a single remote controller. Likewise, suppose a person shouts "John" in a room full of people. Each person named John will respond. However, if the person shouts "John Smith", only people with the first same and last name will respond. For this reason it is very important to set the address to a unique configuration.

Note: The DS Series has 10 address inputs which can be set to over a thousand combinations. It is extremely important to mix up the address logic, making the address more likely to be unique. Simple addressing schemes, such as the first 9 address pins set to the same logic and the 10th address pin being inverted is NOT recommended.

Configuring the Holtek Protocol

The Holtek configuration switches are only necessary when using the Holtek protocol; they can be ignored when using the Serial protocol. These switches determine the Data and Address bit types for the Holtek protocol. It's important that the encoder and decoder boards have matching configurations. See the DS Series Data Guide for further details.

Development Using the Prototyping Area

In addition to their evaluation functions, the boards may also be used for 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 any circuitry that is added.

> 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 0.1" on center with a 0.04" diameter, making it easy to add most industry-standard SIP and DIP packages to the board.

On the encoder board, the Transmit Enable (TE), Data Output (DOUT) and data lines (D0–D7) from the encoder have been wired out to a row of plated holes on the right side of the prototyping area. On the receiver board, the Data In (DIN), the Valid Transmission (VT) and the data lines (D0–D7) from the decoder have been wired out. This allows easy access to connect external circuitry to the encoder and decoder. Data line D0 is connected to the buzzer; D1–D7 and VT are connected to LEDs.

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 transmitter and receiver evaluation boards. To prepare the board for range testing, turn it on by switching the power switch to the ON position. Pressing S0 on the transmitter activates the buzzer on the receiver board. For continuous transmit, connect D0 to V_{CC}. This allows the designer to turn on the transmitter and walk with the receiver.

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.

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 Output Power vs. LADJ Resistance graph in the LR Series Transmitter Module 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 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.

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 should be incorporated into the board layout. The module'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 data guide or the calculator available on our website for details on microstrip calculations.

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 your kit are CW Series 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.

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 7AM and 5PM Pacific Time to speak with an application engineer.

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.

DS Series Encoder Evaluation Board Schematic

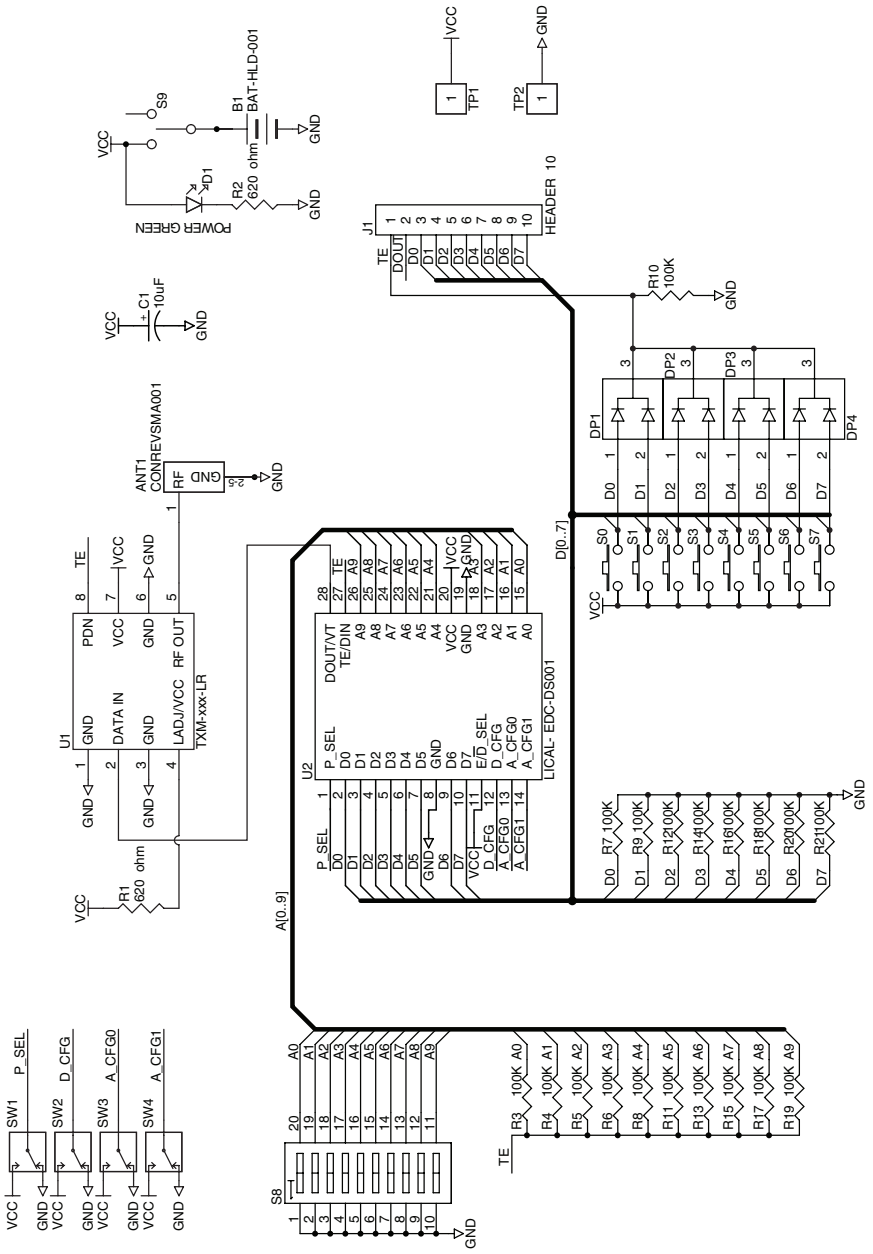

Figure 5: DS Series Encoder Board Schematic

DS Series Decoder Evaluation Board Schematic

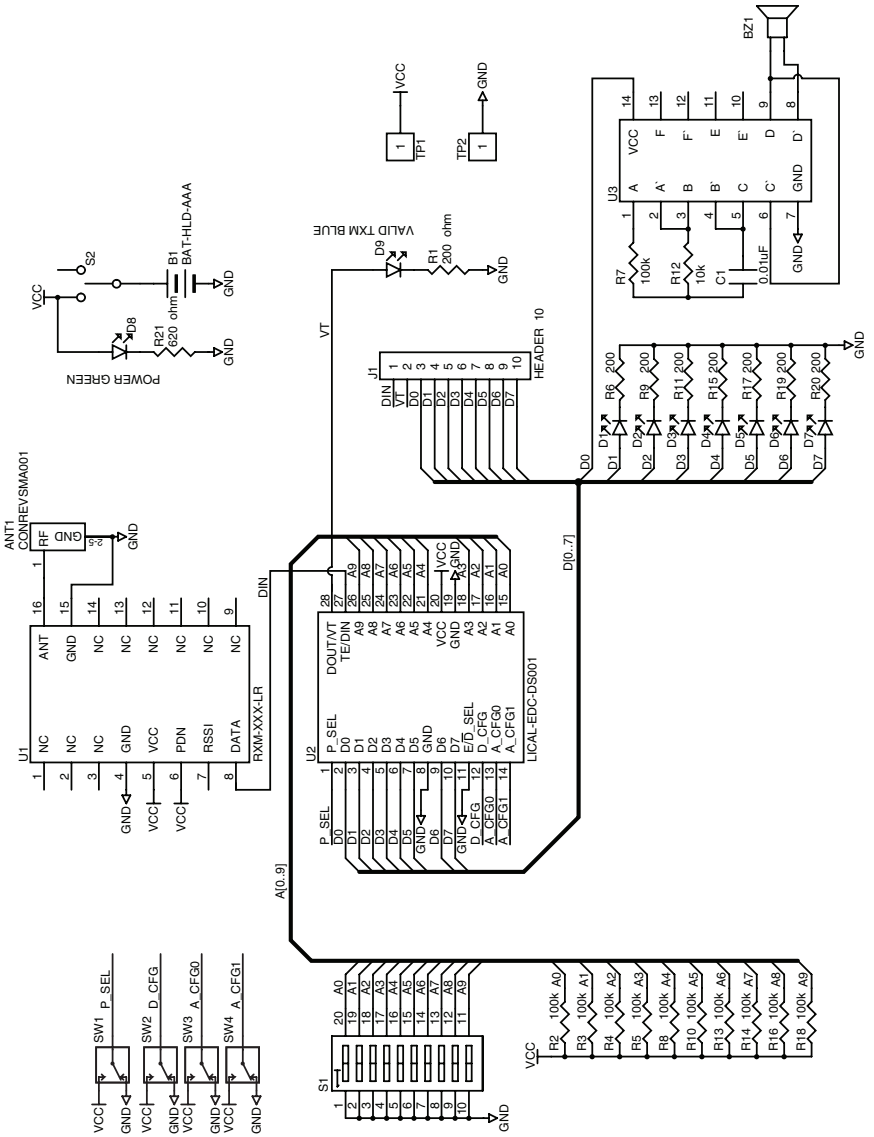

Figure 6: DS Series Decoder Board Schematic

Linx Technologies
159 Ort Lane
Merlin, OR, US 97532

Phone: +1 541 471 6256
Fax: +1 541 471 6251

www.linxtechnologies.com

Disclaimer

Linx Technologies is continually striving to improve the quality and function of its products. For this reason, we reserve the right to make changes to our products without notice. The information contained in this Data Guide is believed to be accurate as of the time of publication. Specifications are based on representative lot samples. Values may vary from lot-to-lot and are not guaranteed. "Typical" parameters can and do vary over lots and application. Linx Technologies makes no guarantee, warranty, or representation regarding the suitability of any product for use in any specific application. It is the customer's responsibility to verify the suitability of the part for the intended application. NO LINX PRODUCT IS INTENDED FOR USE IN ANY APPLICATION WHERE THE SAFETY OF LIFE OR PROPERTY IS AT RISK.

Linx Technologies DISCLAIMS ALL WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL LINX TECHNOLOGIES BE LIABLE FOR ANY OF CUSTOMER'S INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING IN ANY WAY FROM ANY DEFECTIVE OR NON-CONFORMING PRODUCTS OR FOR ANY OTHER BREACH OF CONTRACT BY LINX TECHNOLOGIES. The limitations on Linx Technologies' liability are applicable to any and all claims or theories of recovery asserted by Customer, including, without limitation, breach of contract, breach of warranty, strict liability, or negligence. Customer assumes all liability (including, without limitation, liability for injury to person or property, economic loss, or business interruption) for all claims, including claims from third parties, arising from the use of the Products. The Customer will indemnify, defend, protect, and hold harmless Linx Technologies and its officers, employees, subsidiaries, affiliates, distributors, and representatives from and against all claims, damages, actions, suits, proceedings, demands, assessments, adjustments, costs, and expenses incurred by Linx Technologies as a result of or arising from any Products sold by Linx Technologies to Customer. Under no conditions will Linx Technologies be responsible for losses arising from the use or failure of the device in any application, other than the repair, replacement, or refund limited to the original product purchase price. Devices described in this publication may contain proprietary, patented, or copyrighted techniques, components, or materials. Under no circumstances shall any user be conveyed any license or right to the use or ownership of such items.

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

Linx Technologies:

EVAL-418-DS