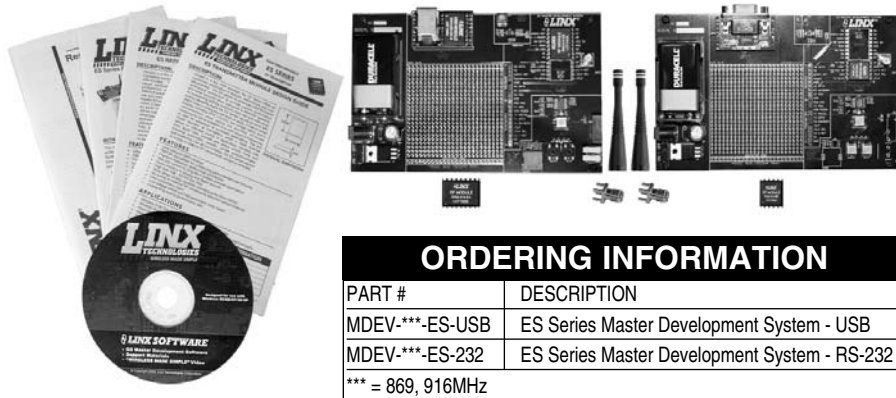


## ES Series Master Development System User's Guide



### ORDERING INFORMATION

PART #	DESCRIPTION
MDEV-***-ES-USB	ES Series Master Development System - USB
MDEV-***-ES-232	ES Series Master Development System - RS-232
*** = 869, 916MHz	

## INTRODUCTION

The Linx ES Series RF modules offer a simple, efficient, and cost-effective method of adding wireless communication capabilities to any product. The Master Development System is intended to give a designer all the tools necessary to correctly and legally incorporate the ES Series into an end product. The development boards themselves serve several important functions:

- **Rapid Module Evaluation** - The boards allow the performance of the Linx ES 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 may 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 header for easy connection to the designer's circuits.
- **Protocol Development** - The development system features an on-board RS-232 transceiver chip, which allows a designer to connect the development board to an RS-232 port. Linx Windows-based demonstration software is also included, which allows for a variety of tests.

The Master Development System includes 2 development boards, one set up for the transmitter and the other for the receiver, 2 ES Series transmitters\*, 2 ES Series receivers\*, two CW Series antennas, 2 9V batteries, and full documentation.

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

## ES SERIES TRANSMITTER DEVELOPMENT BOARD

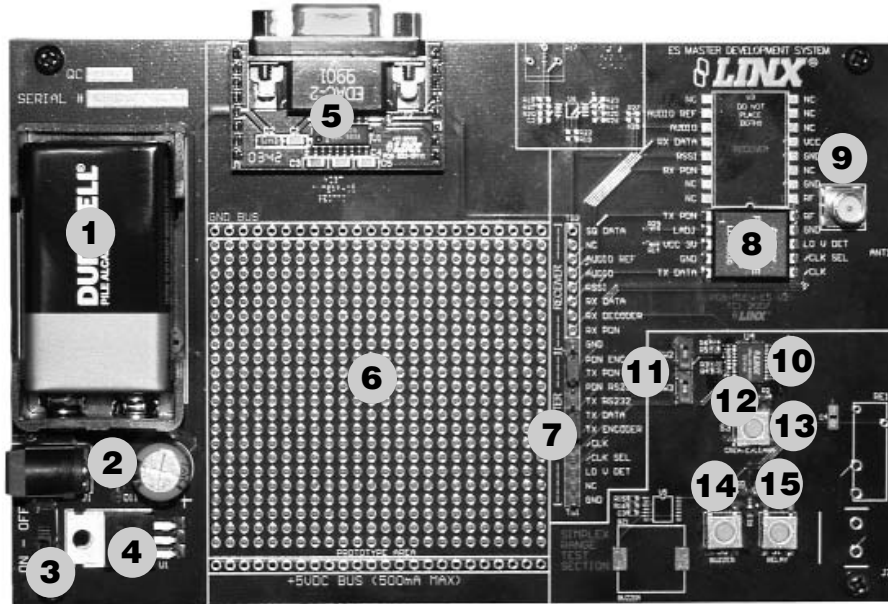


Figure 1: ES Series Transmitter Development Board

1. 9V Battery
2. DC Power Jack
3. On-Off Switch
4. Voltage Regulator
5. Host Interface Module
6. Prototype Area
7. Break-Out Header
8. ES Series Transmitter
9. RP-SMA Antenna Connector
10. MS Series Encoder
11. Baud Rate Selector Switches
12. MODE\_IND LED
13. CREATE button
14. Buzzer Button (S3)
15. Relay Button (S2)

## ES SERIES RECEIVER DEVELOPMENT BOARD

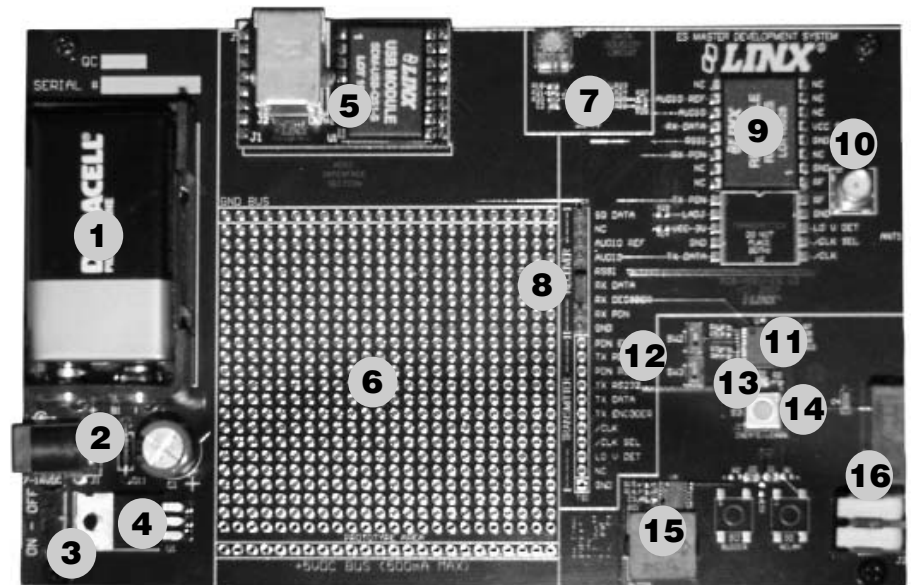


Figure 2: ES Series Receiver Development Board

1. 9V Battery
2. DC Power Jack
3. On-Off Switch
4. Voltage Regulator
5. Host Interface Module
6. Prototype Area
7. Data Squelch Circuit
8. Break-Out Header
9. ES Series Receiver
10. RP-SMA Antenna Connector
11. MS Series Decoder
12. Baud Rate Selector Switches
13. MODE\_IND LED
14. LEARN Button
15. Buzzer
16. Relay Output

## USING THE DEVELOPMENT BOARDS

All of the module's connections are made available to the designer via the wire-wrap header (TS1 / TS2). Jumper shunts have been provided. These shunts are placed across adjacent pins to control the routing of TX and RX data. After unpacking the development system, attach an antenna to each board, install the supplied 9V battery, and turn on the power switches. The development board is now ready for use.

## TROUBLESHOOTING

If the boards fail to work out of the box, then try the following:

- Check the battery to make sure it is not dead.
- Make sure that the antenna is connected.
- Make sure that the jumpers are set correctly.
- Ensure that the Baud Rate Selector switches are set the same on both boards.
- Create and learn a new address.

If all of these appear to be in order, then you can call 800-736-6677 or e-mail [techsupport@linxtechnologies.com](mailto:techsupport@linxtechnologies.com) for technical support.

## 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. The prototyping area is the same on both boards and contains a large area of plated through-holes so that external circuitry can be placed on the board. The holes are 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. This circuitry can be interfaced with the ES transmitter or receiver through the breakout header to the right. At the bottom of this area is a row connected to the 5V power supply and at the top is a row connected to ground.

**NOTE:** The on-board 5-volt regulator has approximately 500mA of headroom available for additional circuitry. If added circuitry requires a higher current, the user must add an additional regulator to the prototype area or power the board from an external supply.

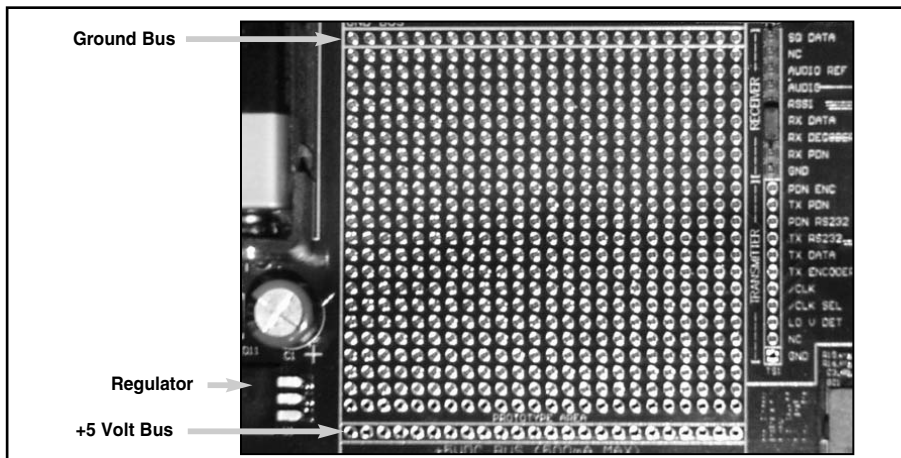


Figure 3: The Development Board Prototyping Area

## USING THE SIMPLEX ENCODER / DECODER SECTION

The transmitter board features an MS Series remote control encoder with two push buttons and the receiver board features a decoder with a relay output and a buzzer. When a button is pressed on the transmitter board, the status of both buttons is captured and encoded into a data stream for transmission. The data recovered by the receiver is decoded and the decoder's data lines are set to replicate the status of the encoder, driving either the buzzer or the relay.

To activate this area of the board, the module data line must be routed to the encoder / decoder. Configure the transmitter board for encoding and transmission by placing a jumper across TX DATA and ENCODER and across TX PDN and PDN ENC on header TS1. Configure the receiver board for reception and decoding by placing a jumper across RX DATA and DECODER on header TS2.

Once the boards have been configured, place the receiver board on a flat surface and turn it on. Turn on the transmitter board and press button S0. You should hear the buzzer on the receiver board sound. You may now walk away from the receiver to ascertain the useable range of the link in your environment.

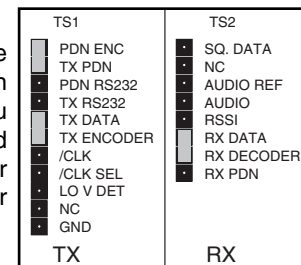


Figure 4: Jumper Configuration

Button S1 activates the relay on the receiver board. The relay's SPST contacts can be connected at J2. Any device up to 5A at 30VDC / 120VAC may be switched through the relay. Most commonly, an external siren or light would be connected to aid range testing if the on-board buzzer is not loud enough.

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 different times and phases. The areas in which this occurs are commonly called "nulls" and simply walking a little farther will often restore the signal.

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, 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.

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 R29 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, R29 can be changed according to the graph on Page 3 of the ES Series Transmitter Data Guide.

## USING THE DATA SQUELCH CIRCUIT

A data squelch circuit is provided on the receiver development board. This circuit is used to add both hysteresis and squelching capabilities as detailed in the ES Series Receiver Data Guide. Since the ES Series receiver output is not internally squelched, its output will continually hash when no transmission is present. This can cause interrupts and buffer overflows in external circuitry. A squelch circuit helps to eliminate hashing by providing a qualification threshold for incoming data based on signal strength. This circuit is not a substitute for robust protocol since squelch can be broken by unintended interference.

To get a better idea of the circuit's operation, clip an oscilloscope probe on both RX DATA and SQ. DATA (Squelch Data). With the transmitter off, the SQ. DATA line will be high (which means that the output is squelched) while RX DATA will be switching randomly. Squelching is accomplished by comparing RSSI with a voltage reference created by R17 (potentiometer), R18, and R21. When the RSSI falls below the voltage set by this reference, the output of the comparator (U6) will pull to ground. This will disable the data slicer created with the additional comparator contained within U6. It may be helpful to refer to the schematic contained later in this document in order to better understand the entire function of this circuit.

The squelch circuit will be at its factory default setting until the user adjusts it. Remember that setting a higher squelch threshold can have a severe impact on range. The squelch level affects only the threshold of the data going to the RS-232 serial port and the SQ DATA line on TS2.

To set squelch, verify that the transmitter is off and turn on the receiver. Place an oscilloscope probe on the SQ DATA line, and adjust R17 until SQ DATA remains high. Two resistors (R27 and R28) are used to connect the module to the squelch circuit. These may be removed to disconnect the squelch circuit and prevent it from slightly loading the AUDIO and AUDIO REF lines.

## USING THE ENCODER AND DECODER

The MS Series encoder and decoder use a 24-bit address to provide uniqueness to the transmission and to prevent unintended activation. The development boards come with a default address. To create a new address, press and hold the CREATE button on the transmitter board. The address is randomized for as long as the button is held down. Once released, the MODE\_IND LED begins flashing to indicate that the encoder is ready to accept Control Permissions. Press the Buzzer and/or Relay buttons to indicate to the encoder that they will be used. Press the Create button again to exit Create Mode, or let the encoder time out after 15 seconds.

On the decoder board, press the LEARN button and the MODE\_IND LED begins flashing to indicate that the decoder is ready to learn a new address. Press one of the authorized buttons on the transmitter board to send a signal. Press the LEARN button again to exit Learn Mode, or let the decoder time out after 17 seconds and the system is ready for use.

The encoder and decoder can operate on one of four different baud rates as set by the Baud Rate Selector switches. A faster baud rate will give a faster response time. Please see the encoder or decoder data guide for the correct settings. If the switch is up then it is connected to Vcc, if it is down then it is connected to GND.

## HOST INTERFACE MODULE

The ES Master Development System features a Host Interface socket, which allows the use of two different PC interface modules. The first is a USB interface module that uses a standard USB cable (not included) to connect to a PC's USB port or a USB hub. The second type of module is a RS-232 interface module that can be connected to a standard serial COM port on a PC using a straight-through 9-pin extension cable (not included). The evaluation board is considered a DCE device and as such is designed to be connected using a straight-thru serial extension cable. Do not use a null-modem cable as the boards will not function.

To install, select the module to be used and then line up the pins on the module with the headers on the board. Verify that the pin one polarity marks on the board and on the Host Interface Module match. The USB jack or the D-sub connector should face away from the board. Press firmly on the module so that it slides fully into the header.

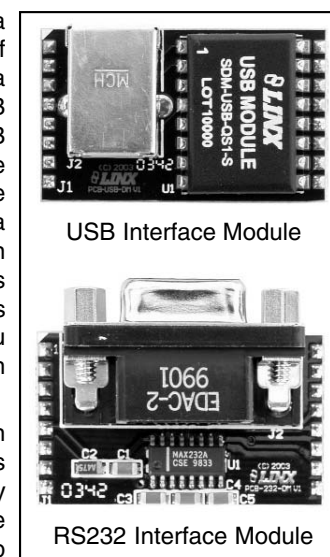


Figure 5: Host Interface Modules

The development system may be prepared for host operation with the supplied Linx software by setting the jumpers on the header as shown in the adjacent figure. This routes the module's data lines to the Host Interface Module. Despite being electrically interfaced, appropriate protocol must be employed to ensure reliable and error-free data transfer since the ES Series modules do not encode or packetize the data in any manner. It is important to understand that the development boards are transparent; that is, the user's software is entirely responsible for controlling the timing and error correction aspects of the link. The evaluation boards have no provision to check or qualify the incoming data. When designing a protocol to transfer data across a wireless link, it is very important to remember that interference is inevitable. The protocol must support error detection and correction if it is to be successful. A correctly designed protocol will provide optimum performance and throughput for product-specific applications while taking into account the timing and data-rate requirements of the module. For further information on protocol considerations please refer to Application Note AN-00160.

TS1	TS2
<input checked="" type="checkbox"/> PDN ENC	<input checked="" type="checkbox"/> SQ. DATA
<input checked="" type="checkbox"/> TX PDN	<input checked="" type="checkbox"/> NC
<input checked="" type="checkbox"/> PDN RS232	<input checked="" type="checkbox"/> AUDIO REF
<input checked="" type="checkbox"/> TX RS232	<input checked="" type="checkbox"/> AUDIO
<input checked="" type="checkbox"/> TX DATA	<input checked="" type="checkbox"/> RSSI
<input checked="" type="checkbox"/> TX ENCODER	<input checked="" type="checkbox"/> RX DATA
<input checked="" type="checkbox"/> /CLK	<input checked="" type="checkbox"/> RX DECODER
<input checked="" type="checkbox"/> /CLK SEL	<input checked="" type="checkbox"/> RX PDN
<input checked="" type="checkbox"/> LO V DET	
<input checked="" type="checkbox"/> NC	
<input checked="" type="checkbox"/> GND	
<b>TX</b>	<b>RX</b>

Figure 6: Jumper Configuration

If the designer needs to develop protocols using a physical implementation other than an RS-232 or USB interface, the designer can build the custom interface circuitry in the prototyping area and route the module's data signals from the header to the prototyping area.



## MASTER DEVELOPMENT SOFTWARE

The development system is supplied with Windows-based software that facilitates communication with the development boards through the Host Interface Module. This software allows for testing and illustrates basic implementation of the modules as a wireless serial link. The user selects either a USB or RS232 connection and whether the connected board is the transmitter or receiver. The user can then send text, ASCII characters, and even a picture. Documentation for the software may be found by going to the 'Help' menu then 'Help File'.



Figure 7: Master Development Software

Terminal emulation programs, such as HyperTerminal, do not provide error correction; therefore, bit errors or data line hashing will be displayed as random characters. Some form of error detection should be employed when developing a protocol for wireless environments (please see Application Note AN-00160).

## USING THE BOARDS AS A DESIGN REFERENCE

The master development 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 HP3 mounting pads (SMD version) 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 HP3 Series Data Guides or the calculator available on the Linx Technologies website.

## 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 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.

## ONLINE RESOURCES



www.linxtechnologies.com

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



If you have questions regarding any Linx product and have Internet access, make 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!

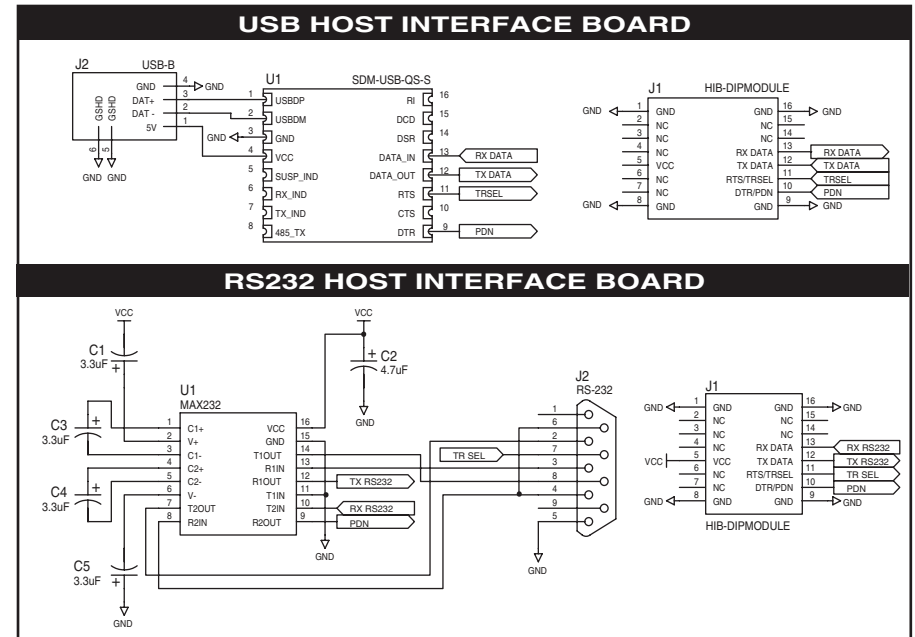
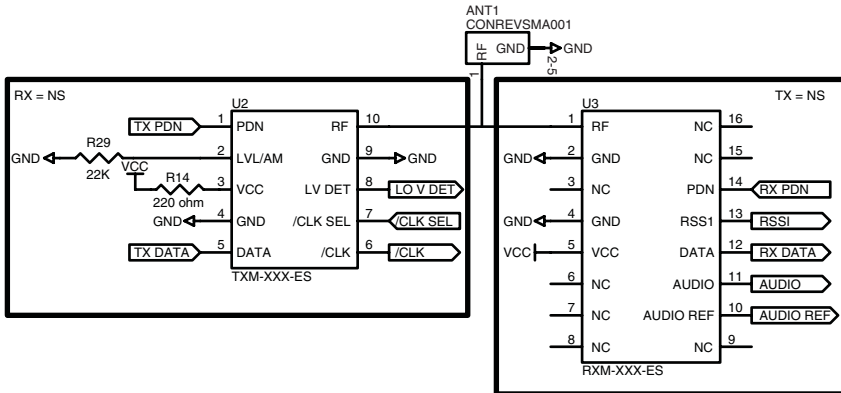
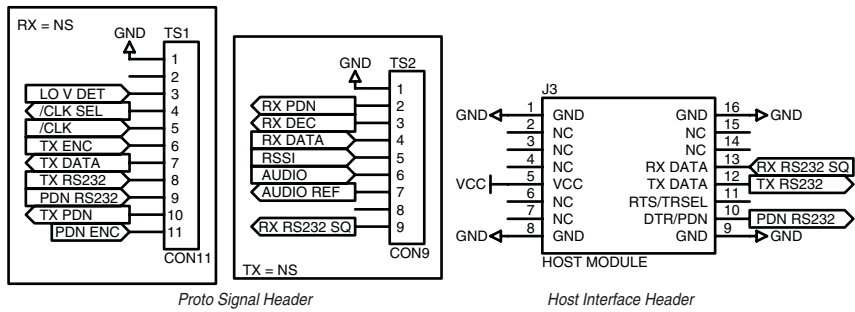


Figure 8: Host Interface Module Schematics

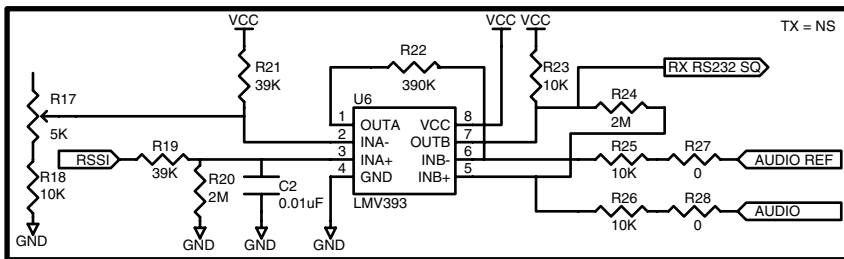
## RF SECTION



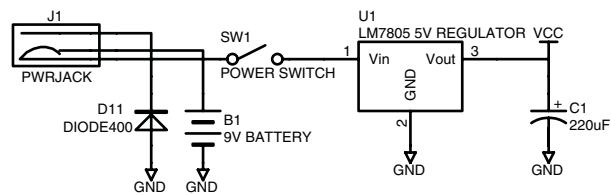
## HEADER SECTION



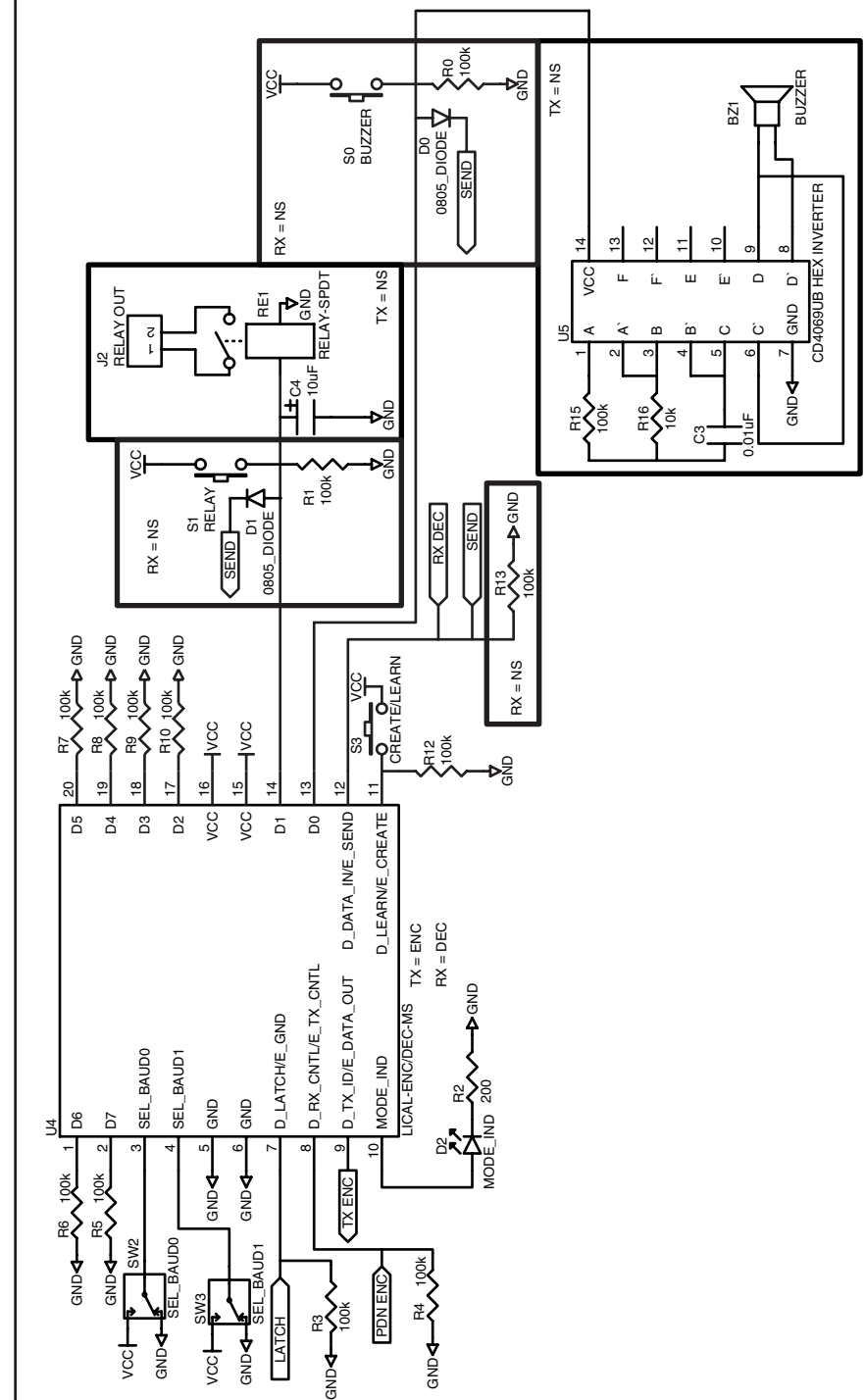
## SQUELCH CIRCUIT



## POWER SUPPLY SECTION



## ENCODER/DECODER SECTION





## U.S. CORPORATE HEADQUARTERS

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