HS Series Master Development System User's Guide
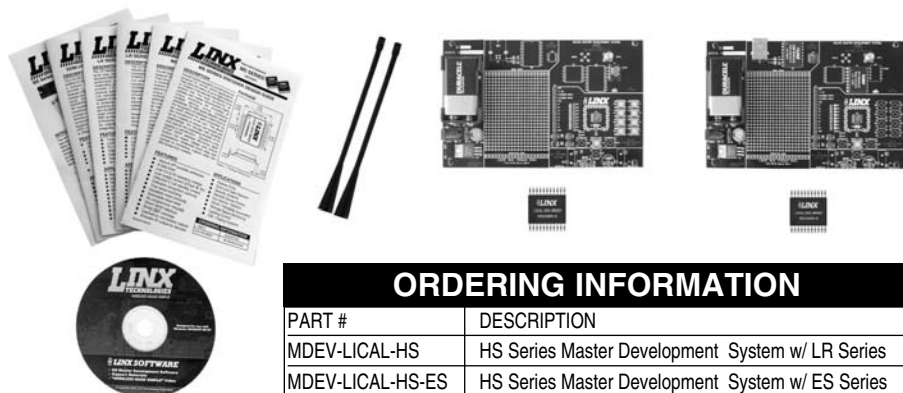
ORDERING INFORMATION

PART #	DESCRIPTION
MDEV-LICAL-HS	HS Series Master Development System w/ LR Series
MDEV-LICAL-HS-ES	HS Series Master Development System w/ ES Series

INTRODUCTION

The HS Series encoders and decoders are ideal for remote control and command, security, keyless entry, status monitoring, and a host of similar applications. They encode the status of up to eight buttons or contacts into a highly secure serial output intended for transmission via an RF or infrared link. The Master Development System is intended to give a designer all the tools necessary to incorporate the encoder and decoder into a product. This guide will show how to take full advantage of the development boards included with the system. Data Guides for the encoder and decoder are included with the system or may be downloaded from the Linx Technologies website at www.linxtechnologies.com. The Master Development System serves several important functions:

- Rapid Evaluation - It allows the performance and features of the HS Series encoder and decoder to be quickly evaluated.

- Design - It shows how to design with the encoder and decoder and how to interface with other components. It also demonstrates the overall system function, making it easy to develop the initial system design.

- Prototype Development - It 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 wire-wrap header for easy connection to external circuitry.

The Master Development System includes 2 development boards, one set up for the encoder and the other for the decoder, 2 HS Series encoders*, 2 HS Series decoders*, and two CW Series antennas. The boards may be populated with either the LR Series or the ES Series RF modules. The decoder board is also populated with 1 QS Series USB module.

*One part is soldered to the board, one extra is for use on your first prototype board.
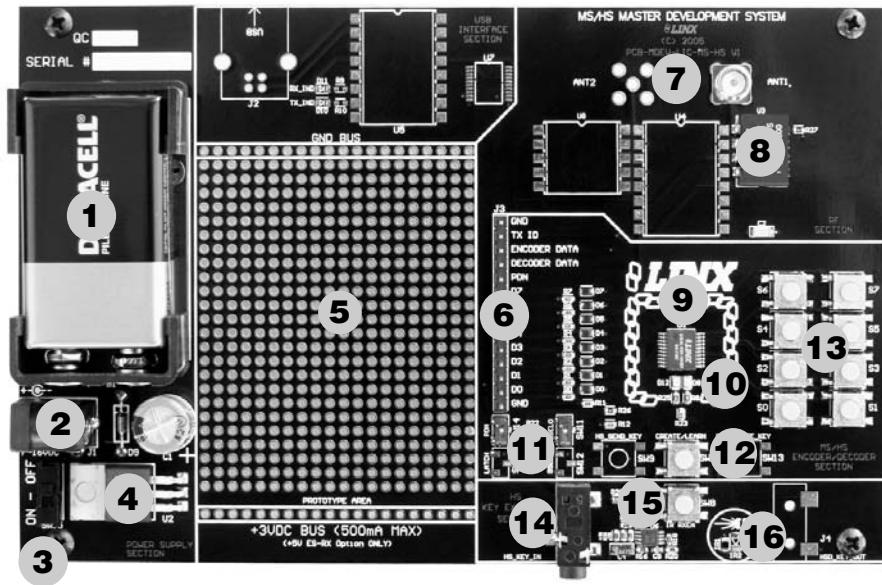
HS SERIES ENCODER DEVELOPMENT BOARD

Figure 1: HS Series Encoder Development Board

1. 9V Battery
2. Power Jack
3. On-Off Switch
4. Voltage Regulator
5. Prototype Area
6. Break-Out Header
7. RP-SMA Antenna Connector
8. LR Series Transmitter
9. HS Series Encoder
10. Indicator LEDs
11. Function Switches
12. CREATE Button
13. Data Line Buttons
14. Key Input Jack
15. IR Receiver Enable Button
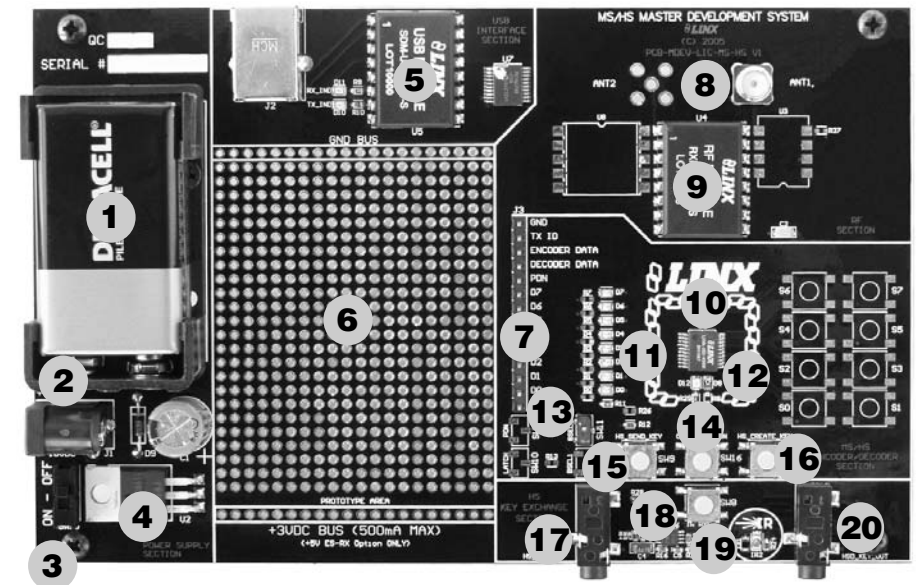16. IR Key Transfer Phototransistor

HS SERIES DECODER DEVELOPMENT BOARD

Figure 2: HS Series Decoder Development Board

1. 9V Battery
2. Power Jack
3. On-Off Switch
4. Voltage Regulator
5. QS Series USB Module
6. Prototype Area
7. Break-Out Header
8. RP-SMA Antenna Connector
9. LR Series Receiver
10. HS Series Decoder
11. Data Line LEDs
12. Indicator LEDs
13. Function Switch
14. LEARN Button
15. SEND_KEY Button
16. CREATE_KEY Button
17. Key Input Jack
18. IR Receiver Enable Button
19. IR Key Transfer Phototransistor and Diode
20. Key Output Jack

USING THE DEVELOPMENT BOARDS

After unpacking the development system, attach an antenna to each board, install the supplied 9V battery, and turn on the power switches. The encoder and decoder will be set at the factory and will work straight out of the box. To create a new operational setup, follow these steps:

1. On the decoder board, press the LEARN button and then the CREATE_KEY button to enter Create Key Mode. Release the LEARN button and press the CREATE_KEY button ten times to generate the KEY.

2. To use the infrared key transfer, press the IR_RXEN button on the encoder board to activate the infrared receiver. Hold the encoder and decoder boards close until the MODE_IND LEDs on both boards light up.

3. To set Control Permissions, press the LEARN button on the decoder board.

4. While the decoder's MODE_IND line is flashing, press each data line button on the encoder that is needed for the application.

5. After all the desired data lines have been transmitted, press the LEARN button again, or wait until the 15 second time-out occurs. The permissions will now be saved in the decoder.

6. Transmit with one or all the data lines held high to confirm that the learn process was successful.

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 baud rate switches are set the same on both boards.

- Make sure that the antenna is connected.

- Check to see if the PDN switch is on, placing the encoder and decoder into Power Down Mode. In most cases, the encoder PDN switch should be on.

- Make sure that you set the Encryption Key correctly. This key is created by the decoder and needs to be sent to the encoder before they will communicate.

- Make sure that you set your Control Permissions correctly. If you have not set the encoder to use a particular line, then when you press a button on the encoder board, the MODE_IND LED on the decoder board will light up, but the data line LED will not light up.

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

THE PROTOTYPING AREA

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. This circuitry can be interfaced with the HS encoder or decoder through the breakout header to the right. At the bottom of this area is a row connected to the 3V power supply and at the top is a row connected to ground.

All of the data lines are connected to a wire-wrap header to the right, allowing easy access from the prototyping area. The DATA_IN, DATA_OUT, and TX_ID lines are also available on the header, as well as the PDN lines from the RF modules. This allows complete control of the entire system from the prototyping area, giving the designer a great deal of flexibility in using the boards.
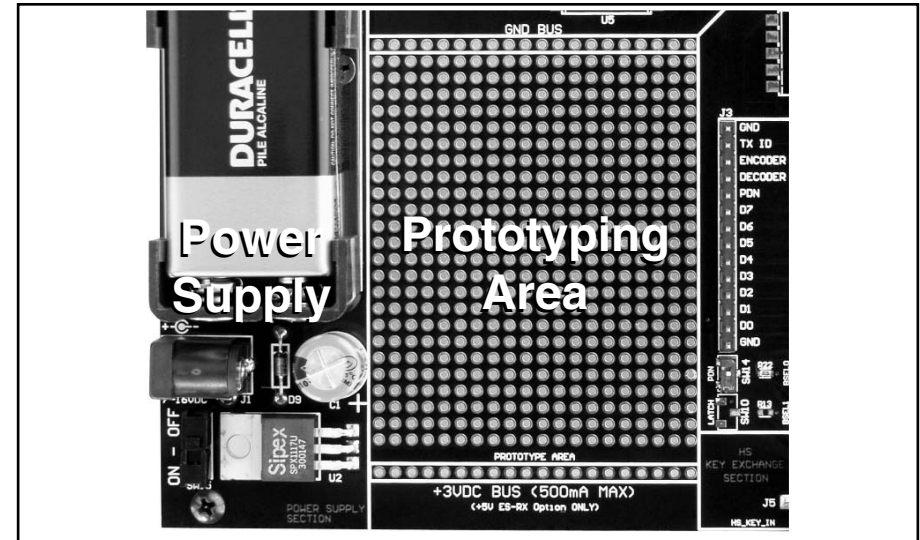

Figure 3: The Prototyping Area and Power Supply

THE POWER SUPPLY

The power supply is the same on both boards and consists of a standard 9V battery and a power jack connected to a 3.0V voltage regulator. The regulator can provide approximately 500mA of current to the prototyping area. If the added circuitry will need more than this, then the designer must add an external supply. If the circuit will consistently draw more than 100mA of current, it might be better to use the power jack, as the battery may run down fairly quickly, reducing testing and development time.

The jack accepts a standard 5.5mm plug with the tip ground and the outer shell 7 to 16VDC positive supply. A reverse voltage protection diode has been included on the board to protect the circuitry in case the voltage on the plug is reversed, but it is still a good idea to double-check the polarity.

THE ENCODER BOARD

The encoder board has three sections that are of primary interest: the encoder area, the transmitter area, and the key exchange area.

The Encoder Area

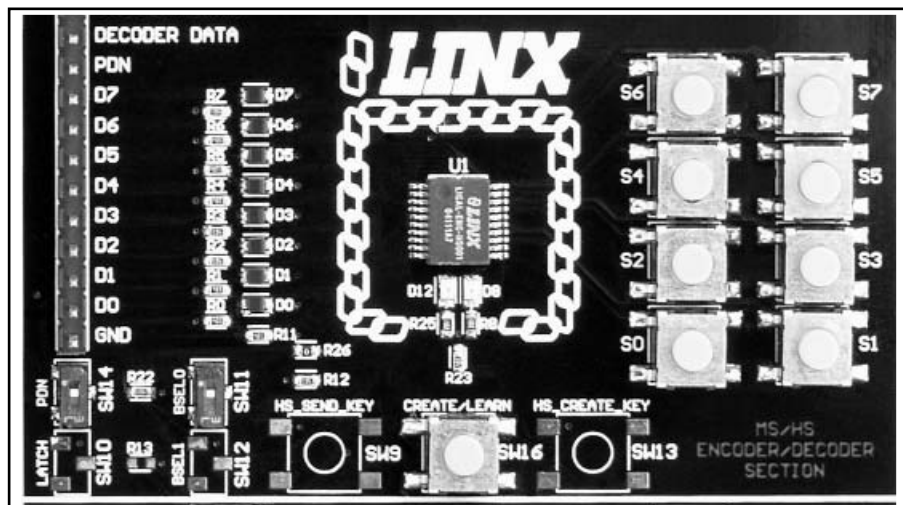The figure below shows the encoder area of the development board.

Figure 4: The Encoder Area

The encoder is located in the center beneath the Linx logo. To the right are buttons that will pull the encoder data lines high when pressed. Button S0 corresponds to data line D0, button S1 to data line D1 and so forth.

The diodes to the left isolate the data lines from each other while allowing any line to activate the SEND line.

Beneath the encoder are two LEDs. D12 is connected to the MODE_IND line and will light up as described in the HS Encoder Data Guide. D8 is connected to the TX_CNTL line and will provide visual feedback by lighting up when the encoder sends a word.

Beneath the LEDs is a button that is connected to the CREATE line. This button is used to create a PIN as described in the HS Series Encoder Data Guide.

There are two function switches to the left of the CREATE button. BSEL0 is used to set the baud rate of the encoder as described in the adjacent table. *Important* The decoder board must be set to the same baud rate in order for the signal to be received correctly.

BSEL0	Baud Rate (bps)
0	4,800
1	28,800

Table 1: Baud Rate Selection Table

The maximum baud rate for the LR Series is 10,000bps, so only 4,800bps can be used on boards with these modules. The ES Series can use both baud rates.

The PDN switch will connect the TX_CNTL line of the encoder to the PDN line of the transmitter so that the TX Control Mode of the encoder can be tested. This mode is described in the HS Series Encoder Data Guide.

THE ENCODER BOARD (CONT.)

If BSEL0 is up, then the line is high (1, V_{CC}); if down, then the line is low (0, GND). If the PDN switch is up, then the encoder's TX_CNTL line is connected to the transmitter's PDN line; if down, it is not connected and the LR Series transmitter will not be activated unless the PDN line is pulled high externally. The ES Series transmitter has an internal pull-up, so will be active unless pulled low.

The Encoder Board RF Area

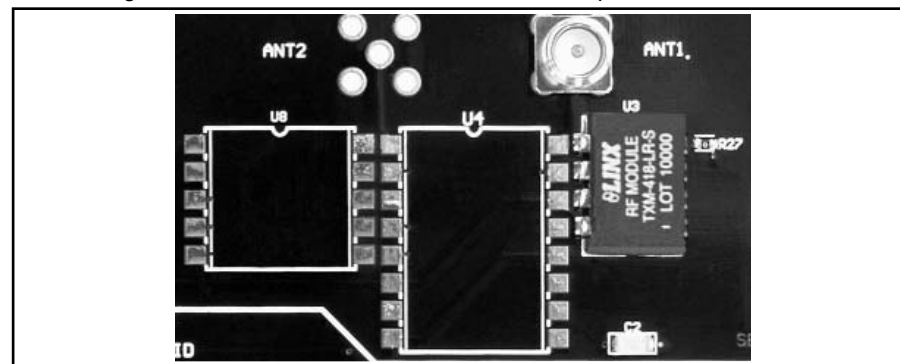The figure below shows the RF area of the development board.

Figure 5: The Encoder Board RF Area

This board can be populated with either the LR Series transmitter (as shown) or the ES Series transmitter. The LR Series transmitter will be placed on the right side and the ANT1 connector will be populated. The ES Series transmitter will be placed on the left and the ANT2 connector will be populated. R27 is connected to the LADJ line of the LR transmitter to reduce the output power to approximately 0dBm. The LR Series transmitter is capable of producing more output power than may be legally acceptable, so by reducing the output power, the range experienced with the evaluation kit will more closely resemble the range that can be achieved with a final certified product.

The Encoder Board Key Exchange Area

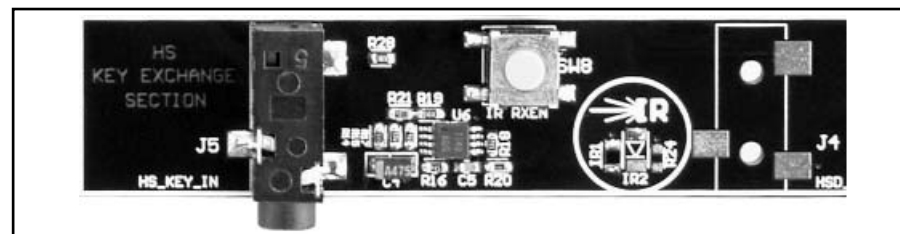The figure below shows the key exchange area of the development board.

Figure 6: The Encoder Board Key Exchange Area

This section allows for both a wire and infrared transfer of the Encryption Key. The encoder can only receive a key, so only the infrared receiver and KEY_IN jack are populated. The jack is simply connected directly to the KEY_IN line on the encoder. The infrared receiver is more complex. A schematic diagram of this circuit is shown in Figure 7.
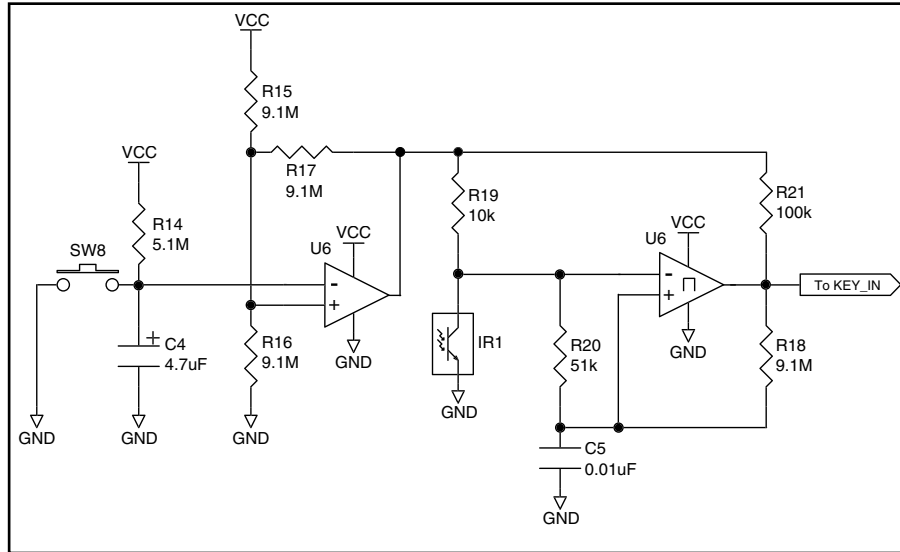
THE ENCODER BOARD (CONT.)

Figure 7: The Infrared Receiver Circuit

The left side of the circuit consists of an op-amp that is set up as a timer to feed current into the phototransistor for a specific amount of time after the button is pressed. Since the phototransistor can pick up infrared radiation from many sources, including lights, this keeps the output from randomly switching and keeping the encoder awake. This circuit will keep the phototransistor from constantly pulling current and will allow the encoder to enter sleep mode, preventing it from also constantly pulling full current.

The circuit works in the following way: when SW8 is pressed, capacitor C4 will discharge and pull the negative input of the op amp low. This will make the output of the op amp go high and supply current to the phototransistor (IR1). C4 will begin to recharge through R14 as soon as SW8 is released. At 5.1MΩ, it will take approximately 20 seconds for the voltage to get high enough to make the output of the op amp go low and deactivate IR1.

The right half of the circuit uses a comparator as a data slicer to make the output of the phototransistor into a square wave that is easier for the encoder to read. The output of the comparator is then connected to the KEY_IN line on the encoder. The Master Development board has a 10kΩ resistor in series to prevent the jack from shorting the comparator out, but it may not be necessary in a custom design.

THE DECODER BOARD

The decoder board has four main sections of interest: the decoder area, the receiver area, the USB area, and the key exchange area.

The Decoder Area

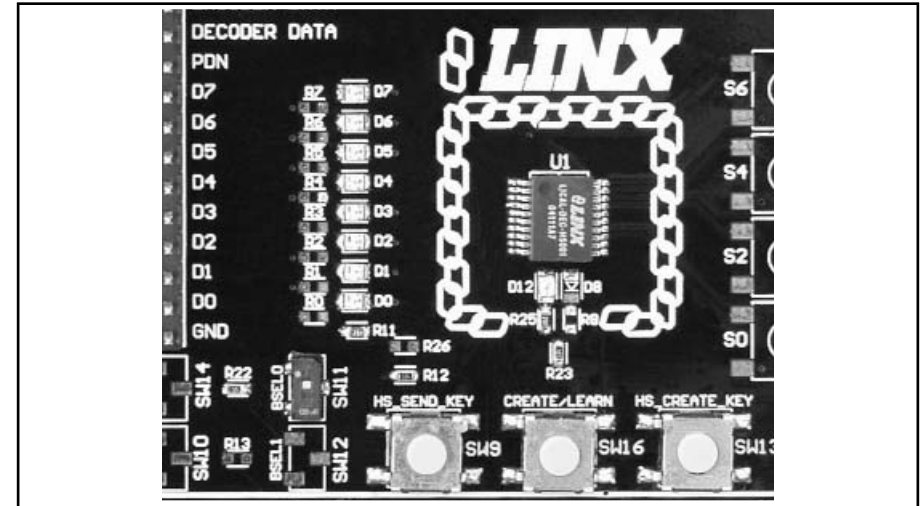The figure below shows the decoder area of the development board.

Figure 8: The Decoder Area

The decoder is located in the center beneath the Linx logo. To the left are LEDs that are connected to the decoder data lines. These will light up when the decoder receives a signal from the encoder to take the data line high. LED D0 corresponds to data line D0, and so forth.

Beneath the decoder is an LED that is connected to the MODE_IND line. This will light up as described in the HS Series Decoder Data Guide.

Beneath the LED are three buttons. The one on the left labeled HS_SEND_KEY is connected to the SEND_COPY line on the decoder. The one in the middle is connected to the LEARN line, and the one on the right is connected to the CREATE_KEY line. The HS_SEND_KEY button will cause the decoder to begin sending a copy of its User Data when pressed at the same time as the LEARN button. The LEARN button is used to learn the Code Word from the encoder and, with the other two buttons, to make the decoder enter special modes. The CREATE_KEY button will cause the decoder to create a new key when pressed at the same time as the LEARN button. All of these functions are described in detail in the HS Series Decoder Data Guide.

There is one function switch to the left of the CREATE button. BSEL0 is used to set the baud rate of the decoder as described in Table 1. *Important* The encoder board must be set to the same baud rate in order for the signal to be received correctly. The maximum baud rate for the LR Series is 10,000bps, so only 4,800bps can be used on boards populated with these modules. The ES Series receiver can use both baud rates. If the switch is up, then the line is high; if it is down, then the line is low.

The Decoder Board RF Area

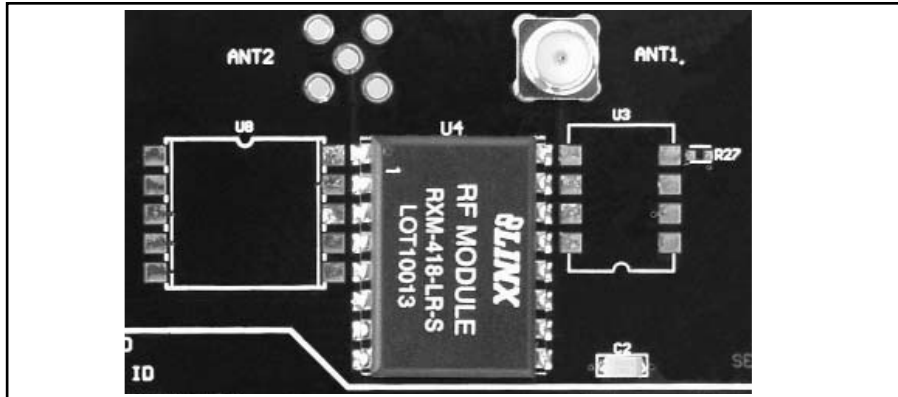The figure below shows the RF area of the development board.

Figure 9: The Decoder Board RF Area

This board can be populated with either the LR Series receiver (as shown) or the ES Series receiver. Both modules can be placed on the same pads in the center of the section, but the ANT1 connector will be populated for the LR receiver and the ANT2 connector will be populated for the ES receiver.

The Decoder Board USB Area

The decoder development board has a Linx SDM-USB-QS-S module for use with the included development software. This module is powered by the USB bus, so it will not pull any current from the battery. The figure below shows the USB area on the decoder board.
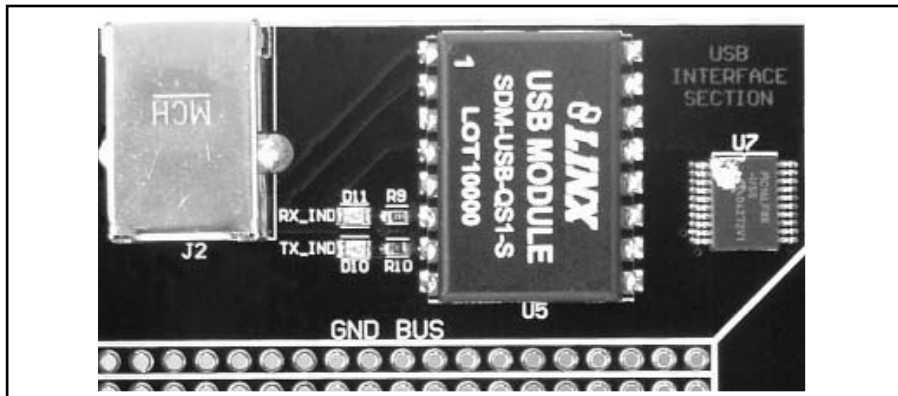

Figure 10: The Decoder Board USB Area

The microcontroller on the right monitors the decoder data lines and generates commands that are sent to the development software on the PC via the QS Series USB module. The RX_IND LED to the left of the module will flash to indicate that data is being received from the microcontroller.

The Decoder Board Key Exchange Area

The figure below shows the key exchange area of the development board.
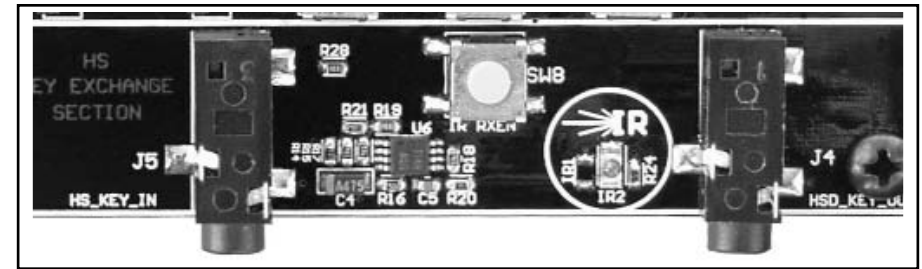

Figure 11: The Decoder Board Key Exchange Area

The KEY_IN jack and the IR receiver circuit are identical to the encoder board. Since the decoder must also send a key to an encoder and / or another decoder, the KEY_OUT jack is populated. The infrared portion consists of an infrared diode (IR2) that is modulated by the KEY_OUT line of the decoder. When the SEND_KEY and LEARN buttons are pressed and released, the decoder will begin sending the key to the jack and diode. Simply plug a wire into the KEY_OUT jack on the decoder board and the KEY_IN jack on the encoder board or activate the infrared receiver on the encoder board to send the key across.

HS SERIES MASTER DEVELOPMENT SYSTEM SOFTWARE

The HS Series Master Development System software can be used in one of two modes. The default mode is as a simulation of the system. This is a good way to show how the HS Series can work in a system for activating lights and doors.

The second mode is for use with the development system. When the decoder board is plugged into the USB port, the kit can be used to activate the features in the software. When a data line goes high on the decoder, the microcontroller will send a command to the computer to control the functions in the software. Please see the documentation included with the software for details.

Figure 12: The HS Series Master Development Software

INSTALLING THE SOFTWARE AND DRIVERS

The software included with the Master Development System uses the QS Series Direct Drivers and cannot be used with the Virtual COM Port Drivers. For this reason, only the Direct Drivers are included on the CD with the software.

The first time a QS module is plugged into a computer, Windows will display the Found New Hardware Wizard, which will guide you through installing the drivers. Application Note AN-00201 "Installing the SDM-USB-QS-S Drivers" describes the installation of the drivers in detail. The drivers should be installed before running the development software.

The HS Series Master Development System Software will automatically start when the CD is inserted and the player in the figure below will appear.
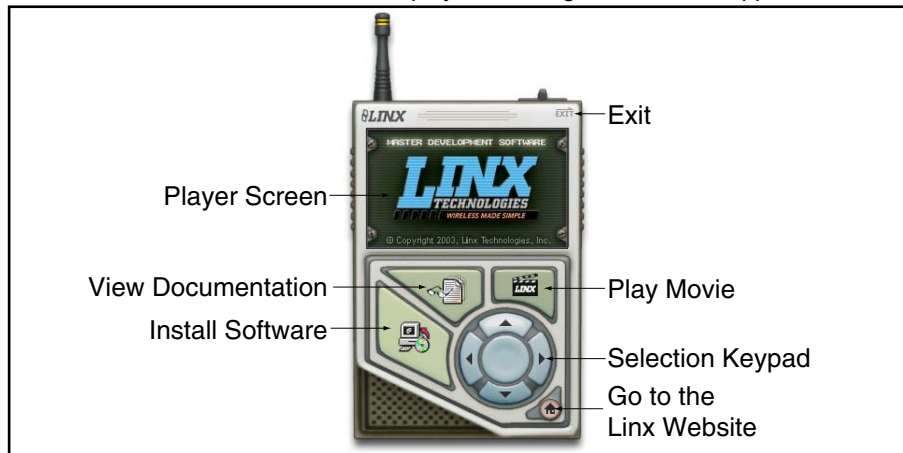

Figure 13: Software Installer

Pressing the Install Software button will start the Installation Wizard, which will guide you through the installation of the development software. The View Documentation button will show a list of the application notes and manuals related to the HS Series. Selecting one of these will open the file in Adobe Acrobat. The Play Movie button will play a short video about Linx on the Player Screen, which can be controlled with the Selection Keypad. Clicking the button on the bottom right of the player will open the Linx Technologies homepage in the computer's default browser.

The View Documentation list also allows for the installation of Adobe Acrobat Reader so that the documents may be viewed. There is also the option of installing Flash, which may be required if the Linx video does not play correctly.

The Read Me file found in the View Documentation list will have extra information on the software that may not be in the software documentation, so it is a good idea to read this file before using the software.

ONLINE RESOURCES

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 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

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.

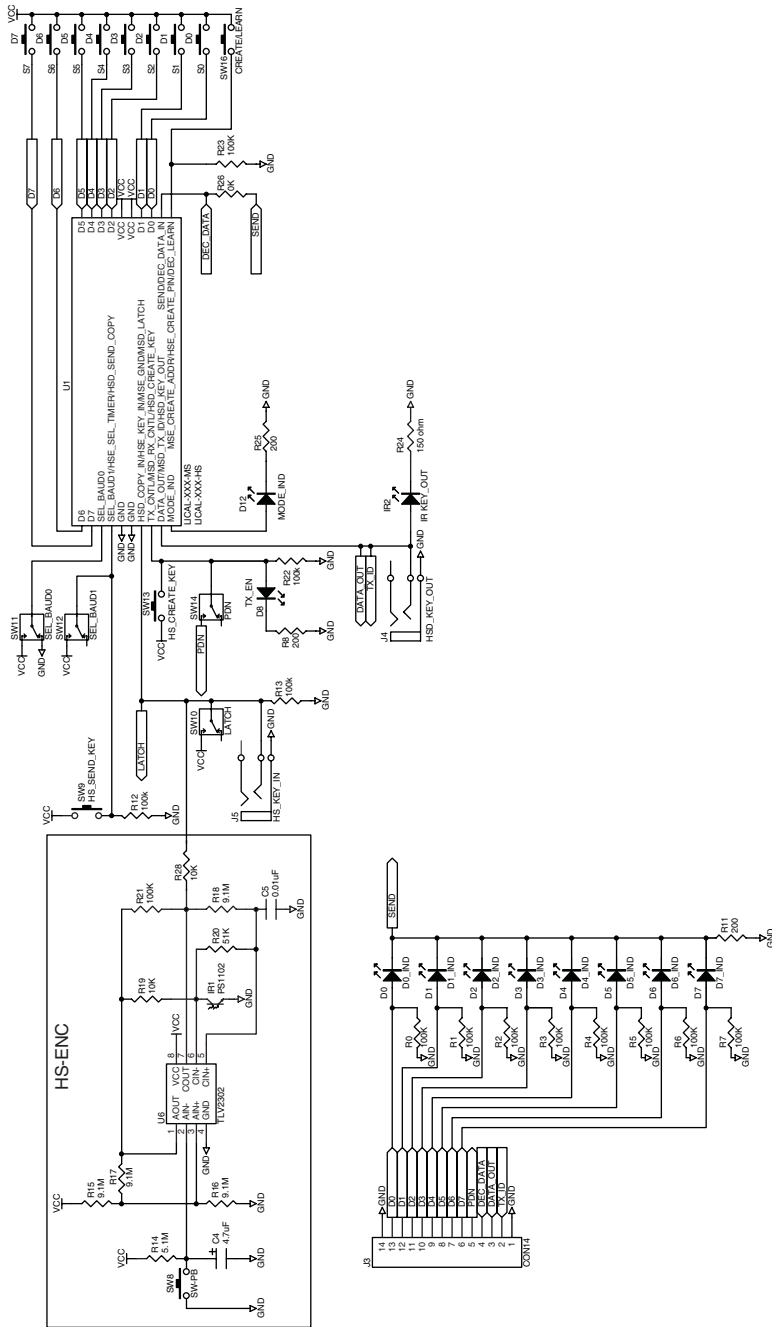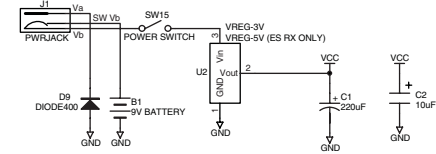**www.connectorcity.com**

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.
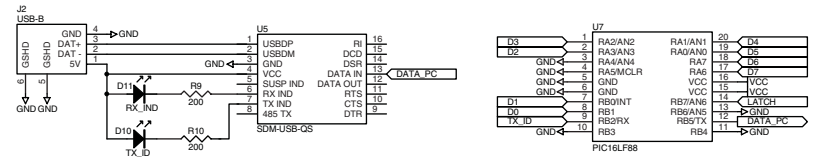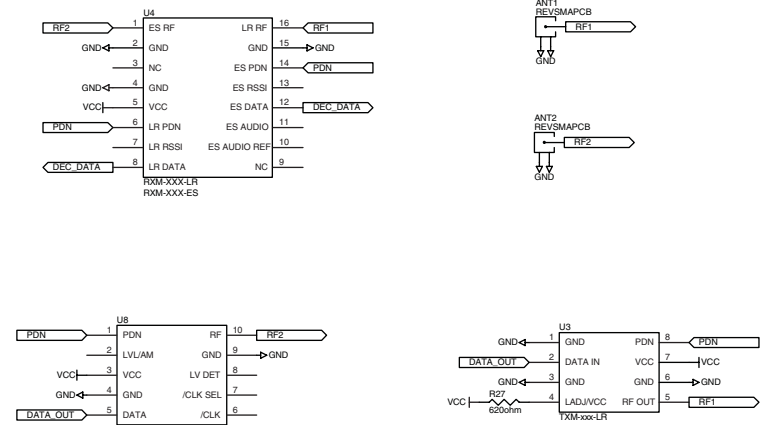
ENCODER / DECODER SECTION

POWER SUPPLY SECTION

J1 PWRJACK
Va / Vb
SW Vb
SW15 POWER SWITCH
VREG-3V
VREG-5V (ES RX ONLY)
U2 GND Vin Vout
VCC
VCC
D9 DIODE400
B1 9V BATTERY
+ C1 220uF
+ C2 10uF
GND

USB SECTION

J2 USB-B
GND / DAT+ / DAT- / 5V
GSHD GSHD
GND GND
U5 SDM-USB-QS
USBDP / USBDM / VCC / SUSP IND / RX IND / TX IND / 485 TX
RI / DCD / DSR / DATA IN / DATA OUT / RTS / CTS / DTR
DATA_PC
D11 RX_IND R9 200
D10 TX_ID R10 200

U7 PIC16LF88
RA2/AN2 / RA3/AN3 / RA4/AN4 / RA5/MCLR / GND / VCC / RB0INT / RB1 / RB2RX / RB3
RA1/AN1 / RA0/AN0 / RA7 / RA6 / VCC / VCC / RB7/AN6 / RB6/AN5 / RB5/TX / RB4
D3 / D2 / GND / GND / GND / D1 / D0 / TX_ID / GND
D4 / D5 / D6 / D7 / VCC / LATCH / GND / DATA_PC / GND

RF SECTION

U4 RXM-XXX-LR / RXM-XXX-ES
ES RF / GND / NC / GND / VCC / LR PDN / LR RSSI / LR DATA
LR RF / GND / ES PDN / ES RSSI / ES DATA / ES AUDIO / ES AUDIO REF / NC
RF2 / GND / GND / VCC / PDN / DEC_DATA
RF1 / GND / PDN / DEC_DATA

ANT1 REVSMAPCB / RF1 / GND
ANT2 REVSMAPCB / RF2 / GND

U8 TXM-xxx-ES
PDN / LVL/AM / VCC / GND / DATA
RF / GND / LV DET / /CLK SEL / /CLK
PDN / VCC / GND / DATA_OUT
RF2 / GND / RF1

U3 TXM-xxx-LR
GND / DATA IN / GND / LADJ/VCC
PDN / VCC / GND / RF OUT
GND / DATA_OUT / VCC / R27 620ohm
PDN / VCC / GND / RF1

HS-ENC
U6 TLV2302
AOUT / AIN- / AIN+ / GND
VCC / COUT / CIN- / CIN+
R15 9.1M / R17 9.1M / R16 9.1M / R14 5.1M / C4 4.7uF / SW8 SW-PB
R21 100K / R28 10K / R18 9.1M / R19 10K / R20 51K / R1 PS1102 / C5 0.01uF

J3 CONN14

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