




**HS Series**  
**Master Development System**  
**User's Guide**

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 **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”).

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# HS Series Master Development System

## User's Guide

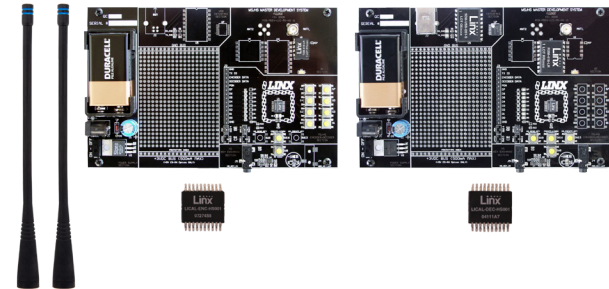


Figure 1: HS Series Master Development System

### 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 eight buttons into a highly secure serial output for transmission via a wireless link. The Master Development System gives a designer all the tools necessary to incorporate the encoder and decoder into a product. This guide shows how to take full advantage of the development boards included with the system. 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 HS Series 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.

This kit includes 2 development boards, 2 HS Series encoders\*, 2 HS Series decoders\*, and two CW Series antennas, 1 LR or ES Series transmitter, 1 LR or ES Series receiver, full documentation and batteries. The decoder board is populated with 1 QS Series USB module.

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

## Ordering Information

Ordering Information	
Part Number	Description
MDEV-LICAL-HS	HS Series Master Development System with LR Series
MDEV-LICAL-HS-ES	HS Series Master Development System with ES Series

Figure 2: Ordering Information

## HS Series Encoder Development Board

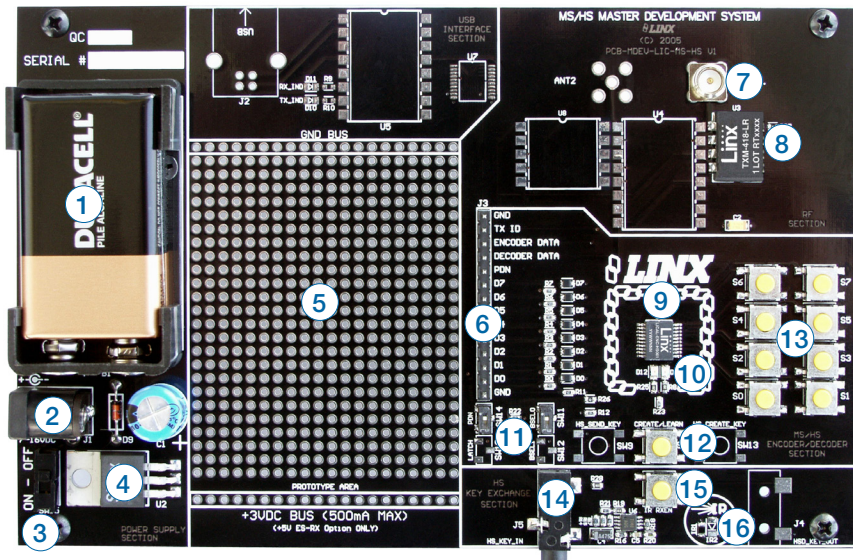


Figure 3: HS Series Encoder Development Board

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

## HS Series Decoder Development Board

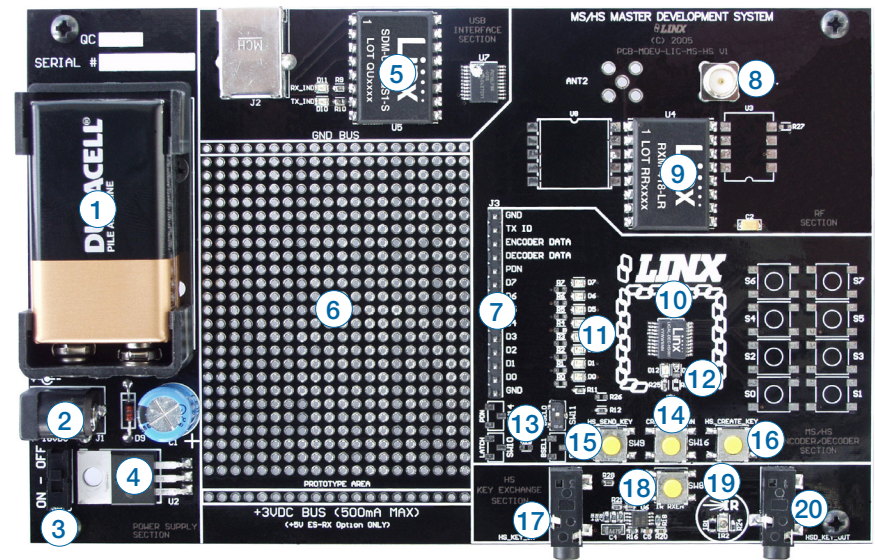


Figure 4: HS Series Decoder Development Board

- |   |   |
|---|---|
| 1. 9V Battery                             | 11. Data Line LEDs                            |
| 2. Power Jack                             | 12. Indicator LEDs                            |
| 3. On-Off Switch                          | 13. Function Switches                         |
| 4. Voltage Regulator                      | 14. LEARN Button                              |
| 5. QS Series USB Module                   | 15. SEND_KEY Button                           |
| 6. Prototype Area                         | 16. CREATE_KEY Button                         |
| 7. Break-Out Header                       | 17. Key Input Jack                            |
| 8. Reverse-Polarity SMA Antenna Connector | 18. IR Receiver Enable Button                 |
| 9. LR Series Transmitter Module           | 19. IR Key Transfer Phototransistor and Diode |
| 10. HS Series Decoder                     | 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 are set at the factory and work straight out of the box. To create a new operational setup, follow these steps:

1. On the decoder board, hold the LEARN button and press 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 IR sections of 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 LED 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 are now 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 and has the correct polarity connector.
- 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 in the up position.
- Make sure that the Encryption Key is set correctly. This key is created by the decoder and needs to be sent to the encoder before they will communicate.

- Make sure that the Control Permissions are set correctly. If the encoder is not set to use a particular line, then when the button on the encoder board is pressed, the MODE\_IND LED on the decoder board lights up, but the data line LED does not light up.

If all of these appear to be in order, then call +1 800 736 6677 or email [techsupport@linxtechnologies.com](mailto: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 Series 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.

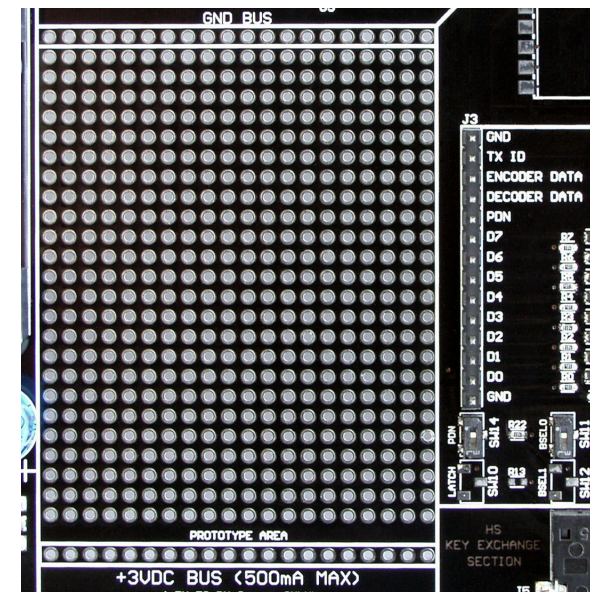


Figure 5: The Prototyping Area and Power Supply

## The Power Supply

The power supply is the same on both boards and consists of a 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 needs more than this, then the designer must add an external supply. If the circuit consistently draws 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 is 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

Figure 6 shows the encoder area of the development board.

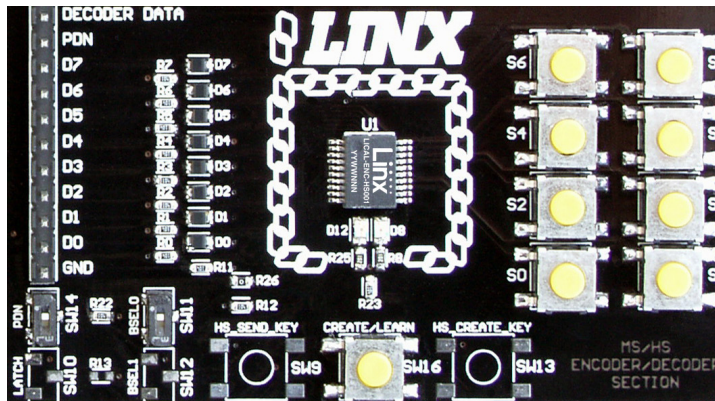


Figure 6: The Encoder Area

The encoder is located in the center beneath the Linx logo. To the right are buttons that 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 lights up as described in the HS Encoder Data Guide. D8 is connected to the TX\_CNTL line and provides 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 Figure 7.

Baud Rate Selection Table	
SEL_BAUD0	Baud Rate (bps)
0	4,800
1	28,800

Figure 7: Baud Rate Selection Table

**Note:** The decoder 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 transmitter 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 PDN switch connects 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.

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 is not be activated unless the PDN line is pulled high externally. The ES Series transmitter has an internal pull-up, so is active unless pulled low.

## The Encoder Board RF Area

Figure 8 shows the RF area of the development board.

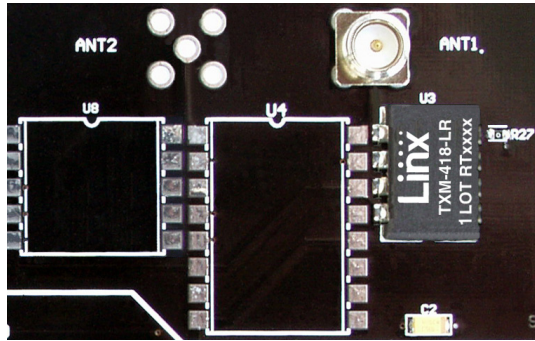


Figure 8: The Encoder Board RF Area

This board can be populated with either the LR Series transmitter (as shown) or the ES Series transmitter. The LR Series transmitter is placed on the right side and the ANT1 connector is populated. The ES Series transmitter is placed on the left and the ANT2 connector is 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

Figure 9 shows the key exchange area of the development board.

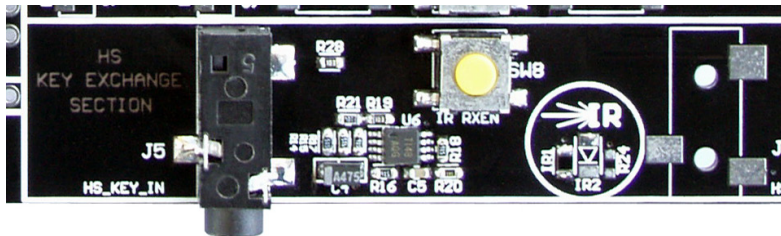


Figure 9: The Encoder Board Key Exchange Area

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 10.

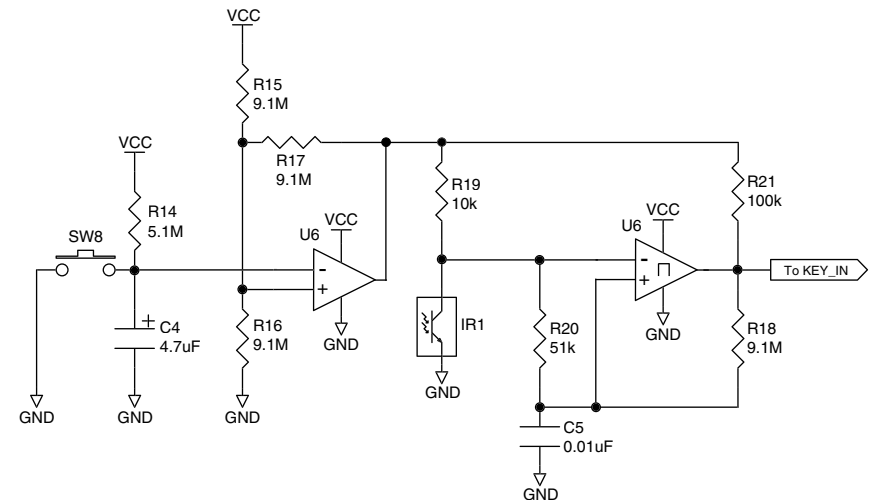


Figure 10: The Infrared Receiver Circuit

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 keeps the phototransistor from constantly pulling current and allows 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 discharges and pulls the negative input of the op amp low. This makes the output of the op amp go high and supplies current to the phototransistor (IR1). C4 begins to recharge through R14 as soon as SW8 is released. At 5.1M $\Omega$ , it takes 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 10k $\Omega$  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

Figure 11 shows the decoder area of the development board.

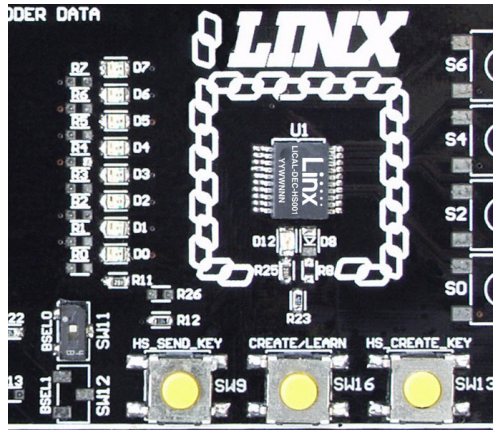


Figure 11: The Decoder Area

The decoder is placed in the center beneath the Linx logo. To the left are LEDs that are connected to the decoder data lines. These 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 lights 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 causes 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 set Control Permissions and, with the other two buttons, to make the decoder enter special modes. The CREATE\_KEY button causes 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 Figure 7.

**Note:** 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

Figure 12 below shows the RF area of the development board.

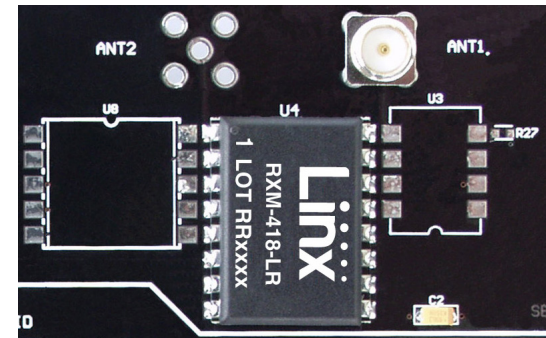


Figure 12: The Decoder Board RF Area

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 is populated for the LR receiver and the ANT2 connector is populated for the ES receiver.



### The Decoder Board USB Area

The decoder development board has a Linx SDM-USB-QS1-S USB interface module for use with the included development software. This module is powered by the USB bus so does not pull any current from the battery. Figure 13 shows this section.

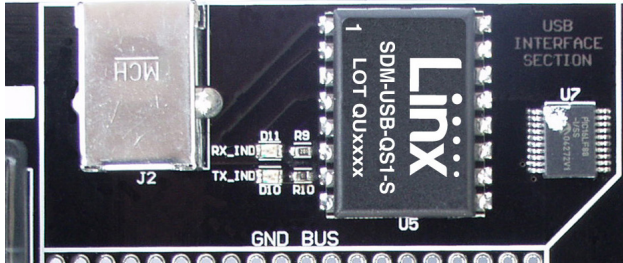


Figure 13: The Decoder Board USB Area

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 flashes to indicate that data is being received from the PC, and the TX\_IND line flashes to indicate that the module is sending data to the PC.

### The Decoder Board Key Exchange Area

Figure 14 shows the key exchange area of the development board.

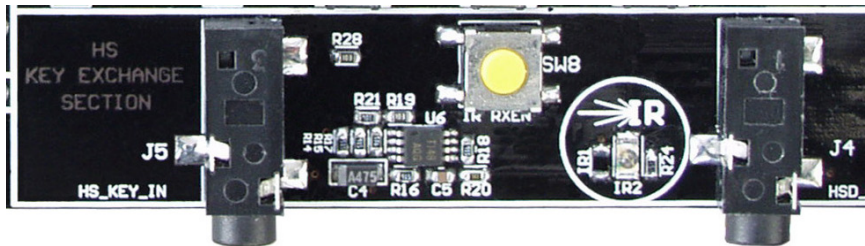


Figure 14: The Decoder Board Key Exchange Area

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 begins 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 of showing 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 sends a command to the computer to control the functions in the software.



Figure 15: The HS Series Master Development Software

Clicking the Help label at the top of the window opens the guide for using the development software. Please see this document for details on operation of the software.

## Installing the Software and Drivers

The first time a QS module is plugged into a computer, Windows displays the Found New Hardware Wizard, which guides the installation of the drivers. The drivers are included on the CD, so point the wizard to the CD when prompted. The drivers have not gone through Microsoft's verification process, so a message may appear warning of this. Click "Continue Anyway" to finish the installation process.

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 automatically starts when the CD is inserted and the player in Figure 16 appears.



Figure 16: Software Installer

The View Documentation button shows a list of the application notes and manuals related to the HS Series. Selecting one of these opens the file in Adobe Acrobat. The Play Movie button plays a short video about Linx in the Player Screen, which can be controlled with the Selection Keypad. Clicking the button on the bottom right of the player opens 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, and Flash, which may be required if the Linx video does not play correctly.

Clicking the Install Software button starts the Installation Wizard, which guides the installation of the development software. The installer places the software application, MS Series documentation, and USB drivers at the installed location on the computer's hard drive.

## Resources

### Support

For technical support, product documentation, application notes, regulatory guidelines and software updates, visit [www.linxtechnologies.com](http://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.

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