Introduction
Linx OEM products combine Linx RF modules with remote control encoders and decoders in an enclosure. OEM products have been pre-approved for FCC, Industry Canada and European CE certifications (433.92MHz models). They can be quickly cosmetically customized, providing a rapid and inexpensive path to incorporate wireless remote control into OEM products.

In order for OEM products to work together, the encoders and decoders must be set correctly. This application note describes how to set the addresses and associate transmitters and receivers in each of Linx’s three OEM product lines.

The Holtek Family
Holtek is a popular brand of encoder and decoder known for its simplicity. The Linx Holtek-based OEM product family uses the HT640 encoder and HT658 decoder. The Holtek chips have ten address lines and eight data lines. The address lines are all tri-state (ground, Vcc or floating), giving 3\(^{10}\) or 59,049 individual addresses. The line is floating if it is not connected. Linx OEM products utilize only the ground and Vcc states.

The encoder data line inputs are also tri-state, but because the decoder outputs can only replicate two states, the floating state is interpreted by the encoder as a logic low.

During transmission, the encoder outputs a packet with the states of each of these lines. The decoder then looks at the received packet, compares the received address bits with the current states of its own address lines and, if they match, reproduces the received data bits on its data lines. If the addresses do not match, the decoder ignores the packet.

The Holtek family of OEM products are made with the LR Series transmitter and receiver modules. They are also compatible with the KH2 Series RF modules, which combine a Holtek IC with a Linx transmitter or receiver in a single surface-mount module.

Setting the Addresses
The Holtek ICs have ten address lines: A0 through A9. Some OEM products do not use all of the address lines. This note will look at each product and demonstrate how to set its address.
The chart below shows the possible settings for each address bit in each of the Holtek-based OEM products as well as the KH2 Series modules. Choose the transmitter and receiver you wish to use and find them in the chart. The address lines can be set to the states listed in each cell, but shaded cells cannot be changed. If one device has lines that cannot be changed, those lines on the other device must be set the same in order to communicate. The transmitter and receiver addresses must always match or the transmissions will not be recognized. When the addresses match, the transmitter and receiver will operate correctly.

<table>
<thead>
<tr>
<th>Address Bit</th>
<th>Transmitters</th>
<th>Receivers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CMD-HHTX</td>
<td>CMD-HHCP</td>
</tr>
<tr>
<td>A0</td>
<td>Float, Gnd</td>
<td>Float, Gnd</td>
</tr>
<tr>
<td>A1</td>
<td>Float, Gnd</td>
<td>Float, Gnd</td>
</tr>
<tr>
<td>A2</td>
<td>Float, Gnd</td>
<td>Float, Gnd</td>
</tr>
<tr>
<td>A3</td>
<td>Float, Gnd</td>
<td>Float, Gnd</td>
</tr>
<tr>
<td>A4</td>
<td>Float, Gnd</td>
<td>Float, Gnd</td>
</tr>
<tr>
<td>A5</td>
<td>Float, Gnd</td>
<td>Float, Gnd</td>
</tr>
<tr>
<td>A6</td>
<td>Float, Gnd</td>
<td>Float, Gnd</td>
</tr>
<tr>
<td>A7</td>
<td>Float, Gnd</td>
<td>Float, Gnd</td>
</tr>
<tr>
<td>A8</td>
<td>Float</td>
<td>Float, Gnd</td>
</tr>
<tr>
<td>A9</td>
<td>Float</td>
<td>Float, Gnd</td>
</tr>
</tbody>
</table>

Figure 1
Transmitters

Full-Size Handheld Transmitter
To set the address of the CMD-HHTX-***, remove the screw in the back of the case. Open the case and look for the DIP switch as shown in Figure 2.

![CMD-HHTX DIP Switches](image)

Switch number one is at the bottom and corresponds to address line A7 as shown in the figure. When the switch is on, the pin is connected to ground; otherwise, it is floating. **This transmitter does not use address lines A8 and A9, so the receiver/decoder must have these lines floating.**

Compact Handheld Transmitter
To set the address of the CMD-HHCP-***, remove the cover plate on the back of the case to reveal the DIP switch as shown in Figure 3.

![CMD-HHCP DIP Switches](image)

Switch number one is at the top and corresponds to address line A0 as shown in the figure. When the switch is on, the line is connected to ground; otherwise, it is floating.
Long-Range Handheld Transmitter

To set the address of the CMD-HHLR-***, remove the cover plate on the back of the case to reveal the DIP switch as shown in Figure 4.

Switch number one is at the top and corresponds to address line A0 as shown in the figure. When the switch is on, the line is connected to ground; otherwise, it is floating.

Keyfob Transmitter

To set the address of the CMD-KEYX-***, open the case at the seam. Look for the Holtek IC in the middle of the board above the battery. At the top of the IC, there are traces that run from the address lines to ground as shown in Figure 5.

The number above the trace corresponds to the address line: trace 0 to bit A0, trace 1 to bit A1, etc. To set the address, use a hobby knife or razor blade to cut the traces on the board. If the trace is intact, the line is connected to ground; otherwise, it is floating.
**KH2 Series Transmitter**

The pin diagram for the TXE-***-KH2 transmitter is shown in Figure 6.

**TOP VIEW**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Pin Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GND/LVL</td>
</tr>
<tr>
<td>2</td>
<td>D0</td>
</tr>
<tr>
<td>3</td>
<td>D1</td>
</tr>
<tr>
<td>4</td>
<td>GND</td>
</tr>
<tr>
<td>5</td>
<td>VCC</td>
</tr>
<tr>
<td>6</td>
<td>TE</td>
</tr>
<tr>
<td>7</td>
<td>D2</td>
</tr>
<tr>
<td>8</td>
<td>D3</td>
</tr>
<tr>
<td>9</td>
<td>D4</td>
</tr>
<tr>
<td>10</td>
<td>D5</td>
</tr>
<tr>
<td>11</td>
<td>D6</td>
</tr>
<tr>
<td>12</td>
<td>D7</td>
</tr>
</tbody>
</table>

Figure 6: KH2 Series Transmitter Pin-Out

The address lines A0 through A9 are shown on the bottom right of the diagram. These lines are tri-state (ground, V_{CC} or floating), but if this module is used with one of the OEM receivers, only the ground or floating states will be used. If a KH2 receiver or LR receiver and decoder chip are used, then the option to use all three states exists, giving $3^{10}$ or 59,049 individual addresses.

**LC Series TX and a Holtek Encoder**

The KH2 Series transmitter is essentially an LC Series transmitter that is connected to a Holtek encoder and put into a single package. If desired, the designer could purchase these parts separately and connect them as shown in the figure below. The addressing and data out would work the same as for the KH2 Series transmitter.

Figure 7: LC Series Transmitter with Holtek Encoder
LR Series TX and a Holtek Encoder

The LR Series transmitter is also compatible with the OEM products and offers some performance advantages over the LC Series transmitter. Its use is similar to the LC Series transmitter.

Receivers

AC Function Module

The DIP switches for the FCTN-WALL-*** are located on the side that plugs into the outlet as shown in Figure 9.

This module only uses address lines A0 through A3, so the encoder must have A4 through A9 floating. When the switch is on, the line is connected to ground; otherwise, it is floating. The other four switches determine which button pairs on the transmitter control this module. The data guide describes this feature in more detail and it is described briefly at the end of this note.
Relay Function Module

The address switches on the FCTN-RLY4-***-2 can be found on one end of the case as shown on the right side of Figure 10.

![Figure 10: FCTN-RLY4 DIP Switches](image)

This module does not make use of address lines A8 and A9, so the transmitter must have these lines floating. When the switch is on the line it is connected to ground; otherwise, it is floating.

KH2 Series Receiver

The pin diagram for the RXD-***-KH2 receiver is shown in Figure 11.

![Figure 11: KH2 Series Receiver Pin-Out](image)

The address lines A0 through A9 are shown on the bottom right of the diagram. These lines are tri-state (ground, \( V_{CC} \) or floating), but if this module is used with one of the OEM transmitters, only the ground or floating states will be used. If a KH2 Series transmitter/encoder or an LC or LR Series transmitter and a Holtek encoder chip are used, then the option to use all three states exists, giving \( 3^{10} \) or 59,049 individual addresses. When correctly addressed and a data line is pulled high on the transmitter, the corresponding data line goes high on the receiver. The output is momentary, going high for only as long as the button is pressed, so if a latched output is needed then an external circuit or microcontroller will need to be used.
LR Series RX and a Holtek Decoder

The KH2 Series receiver is an LR Series receiver that is connected to a Holtek decoder and put into a single package. If desired, the designer could purchase these parts separately and connect them as shown in the figure below. The addressing and data out would work the same as for the KH2 Series receiver.

Data Line Connections

Another important consideration when choosing OEM products is the way each product uses the data lines. Figure 13 shows the relationship between the button locations and the encoder data lines for the handheld transmitters.
Figure 14 shows the relationship between the button locations and the encoder data lines for the keyfob transmitter.

The relay function module uses one data line to activate each relay and another one to deactivate each relay. This means that the four relays use all eight data lines as shown in Figure 15.

![Figure 14: Keyfob Transmitter Data Line Buttons](image)

<table>
<thead>
<tr>
<th>Relay</th>
<th>Data Lines</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>D7 D6</td>
</tr>
<tr>
<td>2</td>
<td>D5 D4</td>
</tr>
<tr>
<td>3</td>
<td>D3 D2</td>
</tr>
<tr>
<td>4</td>
<td>D1 D0</td>
</tr>
</tbody>
</table>

The relay function module uses all eight data lines when in latched mode and only the data lines that turn the relays on in momentary mode. This means that the keyfob transmitter can only control relays 3 and 4 in latched mode and relays 2, 3 and 4 in momentary mode.

The AC function module is also turned on with one data line and turned off with another. This module allows the user to choose which button pairs operate the module. The top four DIP switches are labeled “Button 1” through “Button 4” and correspond to the data line pairs as shown in Figure 16.

![Figure 15](image)

![Figure 16](image)
If the DIP switch labeled “Button 1” is set to the ON position, then data line D6 will turn the module on and data line D7 will turn the module off. If the switches labeled “Button 1” and “Button 2” are both on, lines D4 and D6 will turn the module on and lines D5 and D7 will turn it off. Likewise, if all of the DIP switches are on, all of the data lines will work with the module according to the table above.

The MS Family
The MS Family is based on the MS Series encoder and decoder from Linx Technologies. Instead of using DIP switches to set an address, the MS Series randomizes the address based on the length of time a line is held high on the encoder, normally with a button press. The decoder is then placed into a Learn Mode to learn the address and the association is complete.

Transmitters
All of the transmitters follow the same procedure. They have a hole in the back of the enclosure that allows access to a CREATE button.
Use a paper clip or probe to press the CREATE button on the board through the hole in the back of the case. Press the button and a LED will light up in the MODE_IND window indicating that the address is being created. The address will be randomized for as long as the button is held down. Release the button and the randomized address will be saved.

The LED will begin flashing to indicate that the Control Permissions may now be set. Press the buttons on the front of the transmitter that it will have the authority to access.

Press the CREATE button with the paper clip again or wait 17 seconds for it to time out. The address and Control Permissions are now set. The decoder will need to learn the address before it will accept any transmissions.

**Receivers**

An example application circuit for a MS-based receiver is shown in Figure 21.

**Figure 20: MS Family Transmitters**

**Figure 21: LR Receiver and MS Decoder Schematic**
To learn an address, the button connected to the LEARN line is pressed, placing the decoder into Learn Mode. The LED connected to the MODE_IND line will start flashing, indicating that the decoder is ready to accept an address. Any of the authorized buttons on the front of the transmitter are pressed to send a transmission to the decoder. Press the LEARN button again to exit Learn Mode. Otherwise, the decoder will time out after 17 seconds. The units are now associated and will operate together.

When the decoder receives a valid transmission, it will turn on the MODE_IND LED. If the LED is turning on when a transmission is sent but the data line is not, check the Control Permissions settings. That line was likely not authorized for use when the address was created.

The HS Family
The HS Family is based on the HS Series encoder and decoder from Linx Technologies. The HS Series utilizes CipherLinx®, an encrypted remote control technology that provides a very high level of security. In this family, the user creates a key in the decoder and transfers the key to the encoder. The transmission can only be decrypted if both sides use the same key.

Creating and Transferring a Key
Creating a key begins with the decoder. A typical application circuit is shown in Figure 22.

![Figure 22: LR Receiver and HS Decoder Schematic](image-url)
A key is created by placing the decoder into Create Mode. This is done by taking the CREATE_KEY line high while the LEARN line is high, so press and hold the LEARN button then press the CREATE_KEY button. When the MODE_IND LED turns on, release both buttons. Press the CREATE_KEY button ten times to generate a key. The MODE_IND LED will turn off after the 10th press to indicate that the key has been created. The decoder will then automatically output the key on the KEY_OUT line. This line is connected to a 900nm infrared (IR) diode for short-range wireless transmission. The key is output for 17 seconds.

Now the transmitter’s IR receiver circuit needs to be activated. This is done by using a paper clip or probe to press the GET_KEY button on the back of the transmitter.

Once the button is pressed, the IR circuit will be activated for approximately 15 seconds. Hold the MODE_IND window near the decoder’s IR diode. The MODE_IND LED on both the transmitter and receiver will light up for one second when the key transfer is successful. Again, the key will be output from the decoder for 17 seconds and the IR receiver circuit on the transmitter will be active for 15 seconds.

Once the key has been transferred, Control Permissions must be created. The decoder is placed into Learn Mode by pressing the LEARN button. The MODE_IND LED will start flashing to indicate the decoder is ready to accept control permissions. Press the buttons on the transmitter that are to be authorized. Press the LEARN button on the decoder again to exit Learn Mode or wait for the decoder to time out after 17 seconds. The buttons on the transmitter that were pressed should now activate the appropriate decoder data lines.
When the decoder receives a valid transmission, it will turn on the MODE_IND LED. If the LED is turning on when a transmission is sent but the data line is not, check the Control Permissions settings. That line was likely not authorized for use when the permissions were set.

**Summary**

Linx OEM products provide a rapid and cost effective way to add wireless functionality to a wide variety of end applications. Correctly setting the product’s address is necessary for proper functionality. After reviewing this application note, it is our hope that you are now able to correctly perform this important function. If you have any additional questions, please contact Linx technical support at +1 800 756 6677 (+1 541 471 6256 if outside the United States).