

Size: Length = 1.1", Width = 0.7", Depth = 0.27"

Size: Length = 28mm, Width = 17mm, Depth = 7mm

User defined: Address (1-99); Starting Voltage; Acceleration Rate;

Deceleration Rate; Maximum Speed, Optional User Defined Speed

Tables; Adjustable Pulse Width Modulation; Analog Disable;

Directional Headlights with one Auxiliary Function or 3 Auxiliary

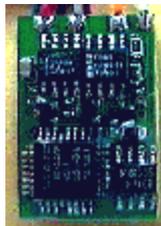
Functions: NMRA RP-9.1.1 2/4 plug (LE131 only)

Information LE130/131

Version 4.0

DIGITAL
_____plus

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Overview

The LE130 and LE131 are the newest Lenz decoders and the first DCC decoders featuring motor back EMF control. What this means is that the decoder senses the needs of the motor and adjusts the speed accordingly. Now before you turn up your pure modelers' nose consider this: It is very difficult to control locomotives so that they run steadily at very slow speeds. The LE130/131 constantly adjusts the voltage so that the perception is extremely smooth slow speed control. It features 14 speed step control (with averaging you can control 28 speeds) which is very smooth because of the back EMF control. In addition since you can adjust the maximum speed, you can set up the locomotive to operate within the speed range of the prototype. The LE130/131 features front and rear directional headlight control with one auxiliary function or can be configured to control 3 auxiliary functions. The LE131 comes with a NMRA RP-9.1.1 2/4 plug for easy installation. (The LE130 is the same decoder but without the plug).

Characteristics:

- Compatible with NMRA DCC Standards S-9.1 and S-9.2
- Operation on conventional DC layouts is possible. (This user may disabled this feature if desired)
- Provides 1A continuous motor current
- Motor output has thermal overload protection
- Three on/off function outputs, with a current rating of 300mA. These outputs have the option of being used in two modes: in the first mode, front and rear directional headlights are enabled and in addition one other function (F1). In the 2nd mode, three universal outputs are available, functions F1, F2, F3. User selects option according to needs of the installation.
- Programmable loco address, start speed, acceleration rate, braking momentum, maximum speed step, pulse rate frequency, and speed curve(1)
- 64 internal decoder speed steps, implements both NMRA 14 speed and 28 speed averaged modes.
- Compatible with all NMRA DCC systems (1)

- Size: 1.1" long 0.67" wide 0.28" High (28mm X 17mm X 7mm)
-

Preparing to Install the LE130/131 Decoder

The locomotive must be tested for excellent operation on normal DC power before installing the decoder. Clean any dirt or oxidation from the wheels and pickups, and make sure that electrical contact is smooth. Install extra pickup wipers if necessary. The decoder cannot correct for electrical pickup flaws! Take note which motor brush is connected to the right rail and which to the left; this information should be saved as it will be needed later on the installation process.

Make Sure Locomotive does not exceed decoder current Capability.

All of the decoder outputs are protected by internal current limiting circuitry, up to a maximum 1.2A permitted. It is never permitted for the total of the motor load plus all function outputs to exceed 1.2A. Of course, each individual load must be less than the total. For example- suppose the motor may require as much as 1.0A continuously. Then the function outputs combined must not exceed 0.2A. If the directional headlights each require 50mA, then function one (F1) load must not exceed 150mA.

- **Notice**
Although the LE130/131 has many internal safeguards to prevent damage, you must not allow any metal part of the locomotive to touch the surface components of the decoder. This could cause a direct internal short circuit and the decoder will be destroyed.
- **DO NOT WRAP decoder with electricians tape or shrink wrap!**
Doing so will impede air circulation and degrade the performance of the decoder. Instead, put electrician tape over any part of the locomotive frame or body that might touch the decoder. Take special note that metal contact might occur only when the loco body is reinstalled.

After disconnecting the wiring to the motor brushes, the brushes **MUST** be isolated from the rail pickup. Achieving isolation may require some different approaches on different locos, perhaps unsoldering wires, placing a thin piece of insulation plastic between brush terminal and contact spring, or whatever. In other words, after isolation there must be **NO** electrical contact between the motor and the rail pickup. If

you have a VOM, check for infinite resistance between the motor and all the wheels.

- **Caution**

The LE130/131 can not be set up for simultaneous use for 2-rail pickup and overhead catenary or trolley operation. If the loco is turned the wrong way, the decoder could get double-voltage which would destroy it!

Wiring Options

With the LE131 you simply install the plug in the locomotives socket. The direction of the locomotive under digital control can be reversed by plugging in the plug in the other direction.

There are two important wiring options with the LE130, depending on how the locomotive is constructed. If the lamps are grounded to the frame, follow [diagram 1](#). If the lamps are isolated from the frame (or you make them isolated) then follow [diagram 2](#) which is the preferred installation approach.

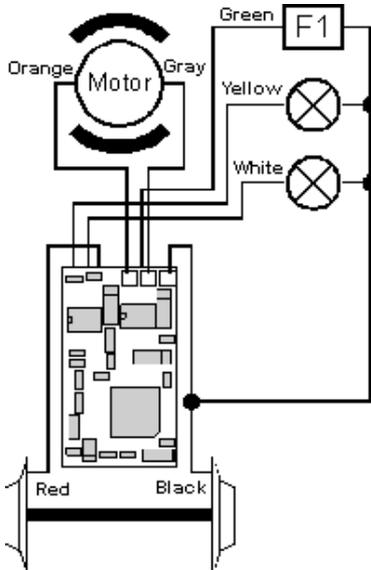


Figure 1

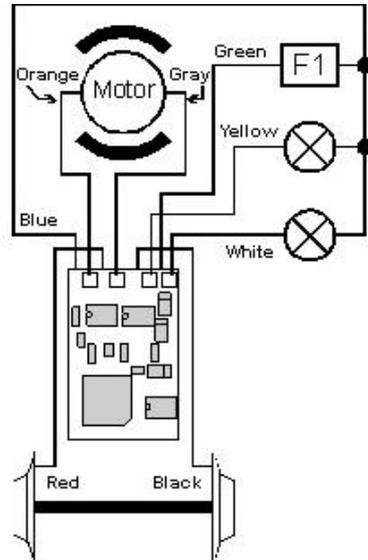


Figure 2

Step by Step Installation

The following example show the directional headlight option being used)

1. Connect the decoder to the track pickups thus:
 - Red wire to right rail pickup
 - Black wire to the left track pickup
2. Connect the decoder to the motor brush terminals thus:
 - Orange wire to the terminal which originally to the right rail
 - Gray wire to the terminal which was originally to the left rail
3. Now connect the headlights thus:
 - White wire to the forward headlight
If the bulb is isolated, then connect the Blue wire to the other bulb terminal.
 - Yellow wire to the rear headlight
If the bulb is isolated, then connect the blue wire similarly.

Check Your Installation

Place the loco on the programming track, with out the body, and read back the loco address from the decoder. If the decoder is properly installed, you will be able to read back the factory-set address 03. If you cannot read back the address then you will have to double-check the wiring.

With the LE110/LE111 and the LE130/131 (and only these decoders) you can use the self-diagnostic feature of the decoder. *Do not attempt this with any other type of decoder!* If no rear headlight is installed, temporarily solder a lamp to the yellow and blue wires. Place the loco on the running track and turn on the power. Select loco 03 with the LH100 and make sure the headlight is turned off (no headlight* on the LCD). compare the lamp behavior to the following table:

- LAMP Significance
OFF OK-continue test running

ON Motor brush-track shorted

Blinking Motor brushes shorted, or motor not connected

Take the loco off the track, correct the indicated problem, and re-test.

When the loco passes the test, you can connect the extra function, viz.:

- Green wire to the auxiliary function. If the aux. function is isolated, also connect the Blue wire. The aux. function is controlled with the 1 button on the LH100.

Now you are ready to program the loco address and begin test running.

Programming the LE130/LE131

(programming the LE130 and the LE131 is identical)

To program the decoder you will need the LH100 and the LZ100 properly wired to a programming track. The program values installed by the user are stored in "positions" internal to the decoder and will be saved even when the layout is switched off or the loco taken off the tracks. It is never necessary to take the loco apart to program or re-program it.

The LE130/131 has 128 storage positions. The higher positions can only be accessed by use of position 6 as a "gate" or "key". In fact, position 6 is a pointer register.

What is the pointer register?

Each of the positions has number, known as its address. For example, the position which holds the loco address is known as position 1, while the brake momentum is position 4. Now the pointer register behaves something like a treasure hunt!

Suppose on some occasion you came home, hoping to have coffee with your wife (or husband, or whoever puts up with your model railroad hobby). But you arrive home, and you wife (or husband, whatever...) is not there. Instead you find a note on the kitchen table which read "At Mom's, come have coffee there". This note points to where you can go to have your coffee.

Similarly, the pointer register in position 6 signifies a position where the desired thing can be found, just as the note does. In the decoder, it will point to the position of the speed table.

Programming the decoders configuration

In the following descriptions, the position numbers is shown on the left and the allowable values are shown on the right followed by an explanation of the purpose of the position.

1. Loco Address (Values: 1-99): The number for calling up this loco on your cab
(Caution: Never try to program the decoder with an address greater than 99)
2. Start Speed (Values: 1-15, or 65): This is the relative starting speed used for step 1 (Values: 1-15). If position 2 has the value 65 then the user installed [speed curve](#) will be used rather than the "standard" curve.
3. Acceleration Momentum (Values: 1-15): Relative momentum for acceleration; 1 being no momentum and 15 being maximum inertia.
4. Braking Momentum (Values: 1-15): Relative braking momentum; 1 being no momentum;, and 15 being maximum inertia.
5. Maximum Speed Step: Values 1-15): When Position 6 has a value of 0 or 1 (is not being used as a pointer) then position 5 is the maximum speed step. This works in the same way as the start speed in position 2. If set the entire speed curve is adjusted. Note that since the decoder is using the motor's back EMF to control the locomotive, the maximum speed step only effect the maximum speed of the locomotive's and not the locomotives power.
Speed Value (Values: 1-64): When position 6 is being used as a pointer, the value of position 5 will be stored into the position pointed at by the pointer register (position 6).
6. Pointer Register (Values: 0-128): Position 6 is only used during the process of [programming a speed curve](#) or setting the pulse rate frequency. The value of position 6 is a pointer to which position will accept the value in position 5.
NOTE- positions 5 and 6 are also used similarly during read back operations, position 6 pointing to the table position to be actually read, and position 5 accepting the readback value.
NOTE - whenever position 5 is written to, or readback, the value of the pointer will *automatically* be incremented by 1.

This makes it very easy to write (or read) the successive values in the speed curve table. Refer to the speed curve programming example further on in the instructions.

- 7: Function Options (Values: 0,2,4,6): The value in position 7 controls which options of the LE130/131 are selected. The options are determined by single bits as follows:
 - BIT setting Meaning
 - 1 - N/A not used
 - 2 - Off=0 DC Analog enabled
On=1 DC Analog disabled
 - 3 - Off=0 Directional lighting with F1, buttons 0,1
On=F1, F2, F3, buttons 1,2,3
 - 4 - N/A not used
 - With version 1.5 software in the LH100, these bits can be set directly. Alternatively, the following values can be entered in positions 7 to select options:
 - Options Desired Value
 - Directional lighting, F1 Enabled, DC Analog Enabled - Value: 0
 - Directional lighting, F1 Enabled, DC Analog Disabled - Value: 2
 - No Directional Lighting, F1, F2, F3 Enabled, DC Analog Enabled- Value: 4
 - No Directional Lighting, F1, F2, F3 Enabled, Analog Disabled - Value: 6
 - (Note: Refer to [Diagram 3](#) for wiring with three function option.)
- 9: (Value 0-15): The pulse rate frequency of the decoder is stored in position 9. The higher the number the higher the frequency. Normally this does not need to be adjusted, However if the frequency of the pulse rate is near the resonant frequency of the locomotive, then some noise will occur. This noise can be substantially reduced by adjusting this rate. To program position 9, the pointer register (Position 6) must indicate 9, and the value of the pulse rate is entered in position

5.

- 65-78 Speed Curve (Table Values: 1-64): These positions contain the loco speed values for the 14 speed steps of the LH100 cab. The speed step value for step 1 is in position 65, for step 2 in position 66, and so on up to the speed value for step 14 in position 78.

Factory Installed Standard Values

The LE130/131 is shipped from the factory with the following values set in the various positions.

1. Loco Address: Value: **03**
2. Start Speed: Value: **08**
3. Acceleration Inertia: Value: **01**
4. Braking Inertia: Value: **01**
5. Pointer not used, Max Speed **15**
6. Pointer Register: Value: **0**
7. Options: Value: **0**: (Directional Lighting, F1, DC enabled)
8. Pulse Rate Frequency: Value **04**

Notice that the values 1-15 in position 2 indicate that the standard speed curve will be used. This standard curve cannot be changed. This has the advantage that there will always be "fallback" in case of error or confusion. Simply place a value 1-15 in positions 2 to fallback to the standard speed curve.

Speed Curves

Understanding the Speed Curve

All Lenz Digital locomotives decoders have 64 internal speed values to control the actual loco speed. The LH100 (version 1.5) provides 14 speed steps for control. A speed curve (internal to every decoder) defines what locomotive speed will be used for each speed step. In contrast to other decoders the LE130/131 allows the user to determine the speed curve that works best for a particular locomotive. Consider the chart shown:

The dotted line speed curve spreads the speed values evenly over the 14 speed steps; the solid line shows a speed curve that allows a wider

range of slow speed values suitable for a switching locomotive for example.

The speed curve is really a table of values stored internally which specifies for every speed step, 1-14, what the associated loco speed should be. So, for example, step 7 on the dotted line specifies speed value 32, while the step on the solid line calls for speed value 10. When changing speed steps with the LH100, the decoder's momentum feature will automatically make the transitions through all the intermediate speed values, yielding smooth operation. Thus any jerky operation is prevented.

Example of Programming a Speed Curve

Write, for working purposes, a speed table similar to the example shown below which you would like to install in your decoder. The table is merely for illustrative purposes and is probably not "ideal" for any given locomotive.

The decoder must be properly installed and tested, and the loco must be on the programming track with the power on. We assume you are familiar with the general process of programming. Items in **Bold** are LH100 key strokes.

- Change to programming mode (**F8 Enter Enter**) and select position 6 (**6 Enter**) the pointer register. Program the value 65 into position 6 (**65 Enter**). The pointer register is now pointing at the first position of the speed curve table.
- Now select position 5 (**Esc 5 Enter**). In this position we will enter the successive values of the speed table one by one. Enter the value 8 (for the first speed step) and press Enter to initiate programming (**8 Enter**). The 1st speed value will now be placed in position 65 and the pointer register will automatically be moved up to point 66.
- Now enter the 2nd speed value (in this case 12) and then again press Enter to initiate programming (**Cl 12 Enter**).
- Continue to enter speed table entries until all of the values have been entered (**CL 14 Enter**).
- Now select position 2 and enter and program the value 65 (**Esc 2 Enter 65 Enter**).
- You are Done!

Important

After you have written, or read back, the speed curve values, program the value 0 or 1 into position 6 so that in the future you will not accidentally program some unwanted values into the speed curve table **(Esc 6 Enter 0 Enter)!**

Footnotes:

[\(1\)](#) Digitrax command stations can not currently program the speed curves or other advanced features of this decoder. Contact your dealer for assistance.

Warranty

Lenz GmbH does everything it can do to ensure that its products are free from defects and will operate for the life of your model railroad equipment. From time to time even the best engineered products fail either due to a faulty part or from accidental mistakes in installation. To protect your investment in Digital Plus products, Lenz GmbH offers a very aggressive 10 year Limited Warranty.

This warranty is not valid if the user has altered, intentionally misused the Digital Plus product, or removed the product's protection, for example the heat shrink from decoders and other devices. In this case a service charge will be applied for all repairs or replacements. Should the user desire to alter a Digital Plus Product, they should contact Lenz GmbH for prior authorization.

Year One: A full repair or replacement will be provided to the original purchaser for any item that that has failed due to manufacturer defects or failures caused by accidental user installation problems. Should the item no longer be produced and the item is not repairable, a similar item will be substituted at the manufacturers discretion. The user must pay for shipping to an authorized Lenz GmbH warranty center.

Year 2 and 3: A full replacement for any item will be provided that has failed due to manufacturer defects. If the failure was caused by accidental user installation or use, a minimal service charge may be imposed. Should the item no longer be produced and the item is not repairable, a similar item will be substituted at the manufacturers discretion. The user must pay shipping to and from the authorized Lenz GmbH warranty center during this portion of the warranty period.

Year 4-10: A minimal service charge will be placed on each item that has failed due to manufacturer defects and/or accidental user installation problems. Should the item no longer be produced and the item is not repairable, a similar item will be substituted at the manufacturers discretion. The user must pay shipping to and from the authorized Lenz GmbH warranty center during this portion of the

warranty period.

Please contact your dealer or authorized Lenz GmbH warranty center for specific instructions and current service charges prior to returning any equipment for repair



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This equipment complies with Part 15 of FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

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