American Hobby Helpful Hints

Lenz DCC System Hints &Tips

These notes are an evolving tip sheet on operation of Lenz DCC systems. The source of this information comes from customer questions, personal experience, the internet and the Lenz manuals and technical information. Some of the graphics have been copied from the Lenz manuals.

The Lenz Corporation

In the 1980's the NMRA was looking for a command control scheme that could become an NMRA standard. After looking at many different systems the Lenz approach looked the best. The Lenz method of data transmission became the NMRA standard we have today. Unlike earlier control systems using high frequence analog signals that could get lost in layout wiring the Lenz combined the power and digital signal into one power/command signal.

The Lenz DCC system is a product of German engineering and continues to come up with some very innovative products. One of these is the ability to continue to operate over dirty track with their new USP (Uninterruptible Signal Processing). This is a big step forward in the model railroad war against dirty track. The USP could eliminate "table thumpers" forever! The new Gold Series decoders from Lenz also features to control stopping distance and trigger stopping in front of a red signal.

The NMRA standard applies to the signals that are on the rails. In practice this means that it is up to the manufacturer to build a system to generate the signals. This is why you need to buy handheld controller, power stations (booster) and other components by the same maker. Since the DCC signal on the rails is standard any manufacturer's decoders must respond to this standard. This is why parts of a system may not be interchangeable, but you can use a mix decoders from any manufacturer.

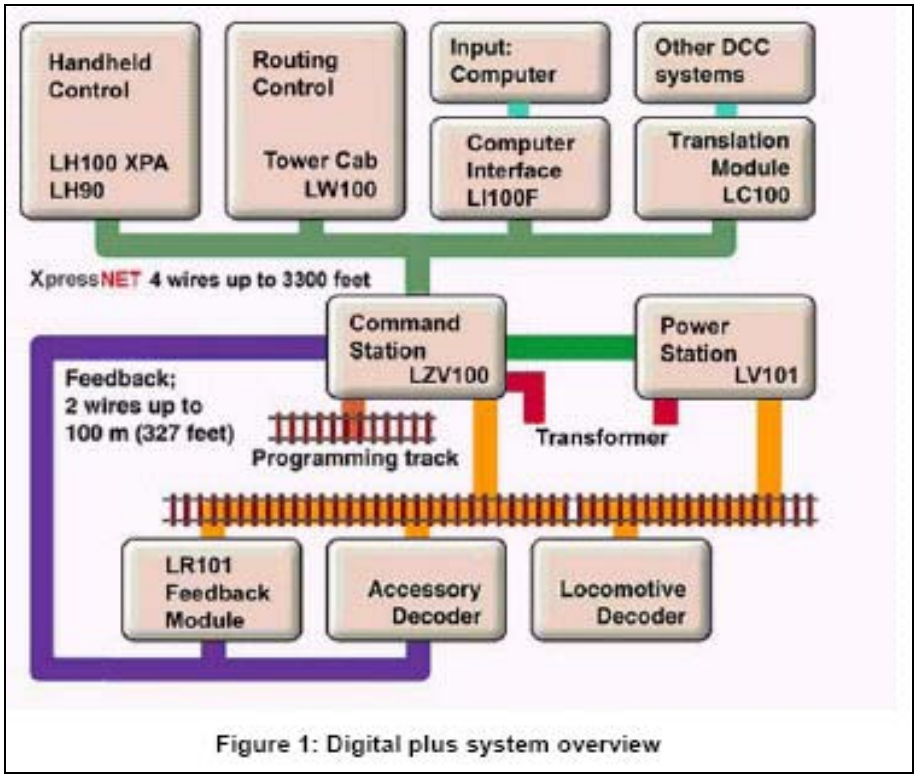


Figure 1: Digital plus system overview

Available DCC systems

There are two models of systems available from Lenz. Both models use the same command station and booster. The difference is in the hand control provided with the system. The system communicates with system devices over a network called XpressNET. This network has the capacity of 31 devices like handheld cabs, computer interfaces and the command station.

Layout Power Requirements

Lenz gives has a choice of three power stations current ratings. They have a 4, 5 and 10 amp units. The 4 or 5 amp rating is ample power for most small to medium size layouts in N thru S scales The 5 amp unit is the more popular of the two. This will even work well with newer O scale locomotives. (I've run 2 newer O scale locomotives on a 2.5 amp system.)The power boosters are connected to a separate bus. The bus between the command station and the power station (power booster) can feed an almost unlimited number of power stations. For **older** O scale and G scale the 10 amp unit should be used.

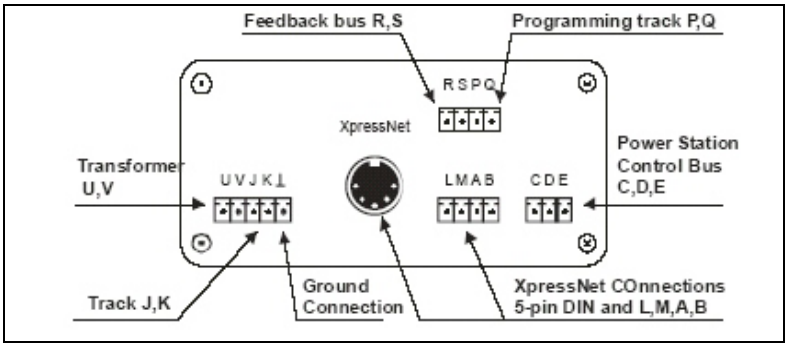
The 5 amp power station should handle the requirements of most layouts. To determine if you will need additional power here are some currents that Lenz suggests. If you have a consist, add the number of powered locomotives in the consist.

To find out whether the maximum current is sufficient for your layout, simply add up the power consumption of all locomotives running at the same time as well as that of all other accessories. Use the following approximate values for your calculation: (1000mA = 1 amp)
Running locomotives - depending on gauge and attached load, the power consumption ranges from 200mA to 2000mA. Calculate per locomotive 300mA for N gauge, 600mA for HO gauge and 2000mA for larger gauges. This ensures that you still have some reserve left.
Standing locomotives - not illuminated 5mA, illuminated approx. 50mA for each bulb. 20mA for each LED
illuminated passenger cars - each bulb approx. 50mA.
If the calculated sum exceeds the maximum current available from a single Power Station system you need to split your layout into multiple power districts and install additional power stations to power for each of the power districts. Remember to plan for the future.

The three power stations available are the **LV101**- 4 Amp Power Station, **LV102**- 5 Amp Power Station and the **LV200** - 10 Amp Power Station. The 4 amp works best with N scale. The 10 amp Power Station should be reserved for G and O scales.

The Lenz Power Stations have a programable output voltage. They can be adjusted from 11 to 22 voltage. This lets you adjust the voltage to match your scale. The default setting is 16 volts.. It can be lowered for N scale and higher for G scales. The best choice is the *lowest voltage that works satisfactorily with your layout*. Most of the new O scale locomotives have 12 volt motors and the HO setting should work.

Transformer Requirements
The command station and power stations need be powered by a transformer. If a transformer is used that has a rating less than the output of the Power Station there may not be enough power to trip the over-current protection. The transformer should also have a voltage rating that is slightly higher than the output voltage you have selected for your scale. (The Power Station puts out a regulated voltage and must dissipate any excess voltage in the form of heat.) For most applications a 16 to 18 volts ac transformer works.



The Digital Plus by Lenz family includes a command station/ power station combination and three power stations models depending on the current needs and scale of your railroad.

POWER STATION (Booster)
LZV100 - 5 Amp Command Station / Power Station
LV101 - 4 Amp Power Station
LV102 - 5 Amp Power Station 6Amp for HO to On3
LV200 - 10 Amp Power Station Amp for O and G scale

SUGGESTED TRANSFORMER
MF615 16VAC 6Amp
MF615 16VAC 6Amp for HO to On3
MF615 16VAC
XFR12 18VAC 12

Layout Wiring and System Setup

Layout Wire
Wire has resistance and the longer the wire the higher the resistance. Smaller wire has more resistance per foot. Resistance can cause a loss of voltage. More current equals higher voltage loss resulting in a loss in train speed and dimming lights. It is best to keep the voltage loss to under one volt. To add to the loss in wiring, nickel-silver rail is not a good electrical conductor. Feed wire should be installed in parallel to the rails and a drop from the rails to the wiring at least every 6 to 10 feet. The wire from the rails to the feed

Length	Feet	for 1/2 volt Drop		
Wire Size	1 Amp	4 Amps	5 Amps	10 Amps
8	796	199	159	80
10	501	125	100	50
12	314	79	63	31
14	198	50	40	20
16	124	31	25	12
18	78	20	16	8
20	50	12	10	5

This chart shows voltage drop for 1/2 volt. The figures would equal 1 volt for a two way path.

wire can be a small gage wire like 20 to 24 gage. Solid wire works well in this application. Some modelers use a drop wire on every section of rail. The wires should be soldered for best reliability. This minimizes the problem with poor connections due to rail joiners. Here is a chart listing wire size, currents and lengths. A good source of wire is the *speaker wire* from Radio Shack. Stranded wire works best for block feed lines and solid for the drop down wires.

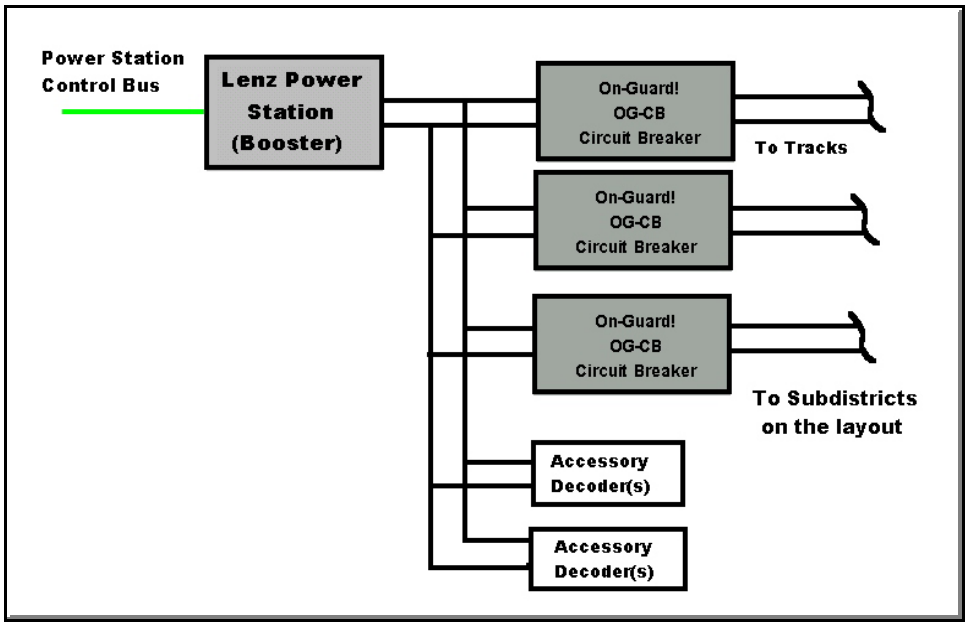
To determine the voltage drop of an existing layout wiring you can use an RRampMeter. Put one end of the meter on the rails and put a load on the other end to get a reading under load. You can make a simple load from an automotive lamp. Measure the voltage with the load and then without the load to determine the amount of loss. The 1156 lamp will give little over a 2 amp load. a 1141 is about 1.5 amps and the 912 lamp near 1 amp. The RRampMeter is a handy tool to have for testing and monitoring the electrical system of a layout.


Checking voltage drop with an RRampMeter. Auto lamp used as a load.

Blocking the Layout

With only two wires connected to the main track connection a single short will shut down the layout. To prevent a single short from shutting down the entire layou the layout should be divided into blocks. With DCC these blocks are called districts and subdistricts . A ***district*** is a section of the layout that is powered by a single Power Station. A ***subdistrict*** is a section of track or block that has a separate circuit breaker. Another type of block or subdistrict is a reversing loop or reversing section like a turning wye.

Circuit breakers provide the benefits of short circuit protection without the cost of adding additional Power Stations. **On-Guard** has easy to wire circuit beakers available

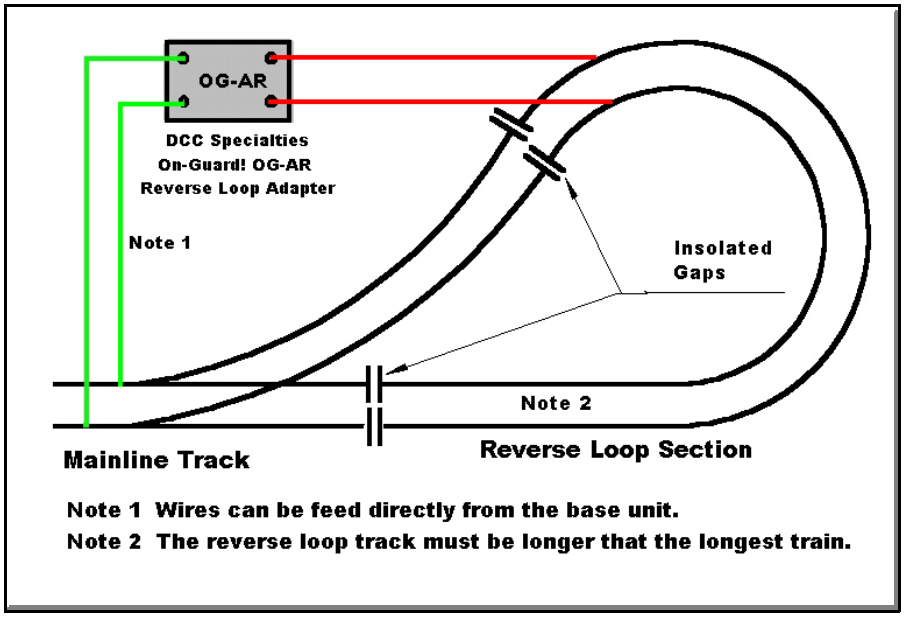


Circuit Breakers and Accessory Decoder Wiring

One of the most common causes of short circuits is running into a turnout that is set the wrong way. If you power an accessory decoder from the rails the short will cut the power to the decoder and you can not throw the switch the clear the short. This situation can be avoided by wiring the power directly from the power booster to the accessory decoder. A short circuit will trip the circuit breaker while the accessory decoder continues to receive power via the power station and allows you can throw the switch and clear the short.

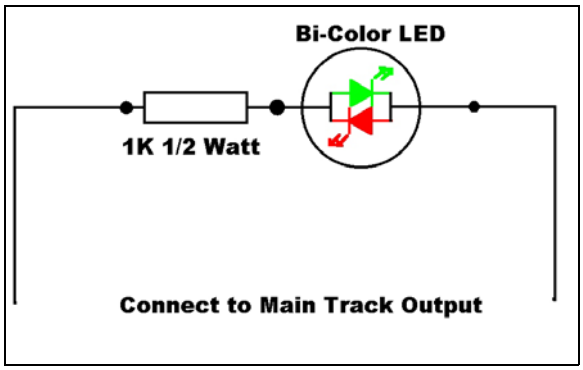
Even without accessory decoder(s) using circuit breakers will allow sections of the layout to continue to operate with a short circuit in one of the other subdistricts There is also an On-Guard model OG-AR for reverse loops which also has a integrated circuit breaker.

Reversing Loops
A reversing loop is a section of track that allow the train to turn around and reverse directions. Reverse loop wiring and operation is much simpler with DCC than dc. On dc the reverse loop was wired so the you could flip the polarity of the mainline while the train was in the loop. On DCC it is done in the opposite way. With DCC the polarity of the train can be reversed under the train while it is in the loop. Polarity can be automated with a reverse loop adapter.



The On-Guard OG-AR is a solid state electronic device. Two wires are connected to the mainline or base unit and the other two wires to the isolated loop. When the metal wheels cause a short either entering or leaving the loop the adapter automatically switches the loop polarity. The OG-AR has an integrated circuit breaker.

Output Status Light.
You can use a bicolor LED to monitor the status of the track power. Here is a simple circuit that will give you the information. Normally it is a ***yellow/amber***, a distinct ***red*** or ***green*** indicates a DC output bias and may be indication of a malfunction. When using the 0 address feature for a non-decoder equipped locomotive this LED may shift to red or green depending on speed or direction of the locomotive.



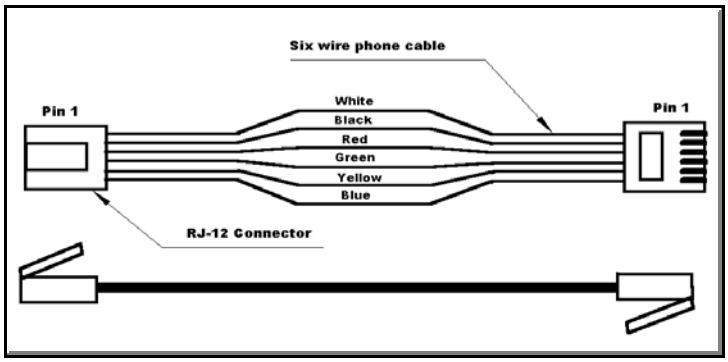
XPA Wireless "Phone" Cab
Lenz is a wold wide supplier of DCC products and getting a wireless cab approved for all the countries would be very expensive. Lenz used a very novel approach low cost to a wireless cab. They developed an adapter to the XpressNet that connects to a standard wireless telephone. The tones generated by the phone are translated to DCC commands over the net. The distance of the link between the phone and base is determined by the wireless phone used in this application. Address selection, speed, direction, turnout control, function and more are all controlled with the phone keyboard. There are even some tones used as feed back to the phone for status. The wireless phone requirement is that it generates the standard DTMF dialing tones.

Computer Connections

Most computer connections to a DCC system are done using the RS-232 serial connection. The Lenz LI101F-232 works with the RS-232 connection. Most new laptop and many of the desktop computers no longer have the RS-232 connection, but instead have a USB (Universal Serial Bus) connector. LI101-USB has been release to meet the needs of computers with USB ports only. Both the LI101-232 and LI101-USB interface to the XpressNet.

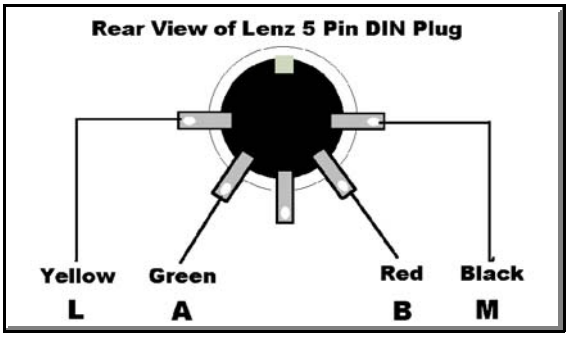
Many of the computer programs that control DCC will work with the Lenz system. **Decoder Pro** is one and is free over the internet.

System Cab Cables
The Lenz cabs use a 5 pin DIN connector for the ExpressNet connections. The modular plugs can be used in place of the 5 pin DIN connectors. If you need to make or buy modular they should be correctly wired. Correct wiring has the same wire connected to the same pin on both ends of the cable. Either 4 or 6 pin connectors can be used. If you buy cables be sure they are the type with pin 1 to pin1. (See drawing) If you make your own be sure to



use a *good* quality crimper on the connectors. Some cheap crimpers don't apply enough pressure to adequately connect the wires to the pins. (The cost of a good tool is soon forgotten, but the problems of a cheap tool linger on!)

You should not connect the **command station or power station** to any device even if other devices use the same connectors, . The fact that the connectors are similar does not automatically mean that the device is designed to work with the Lenz system. This is true even if you are dealing with other model railroad DCC control systems..

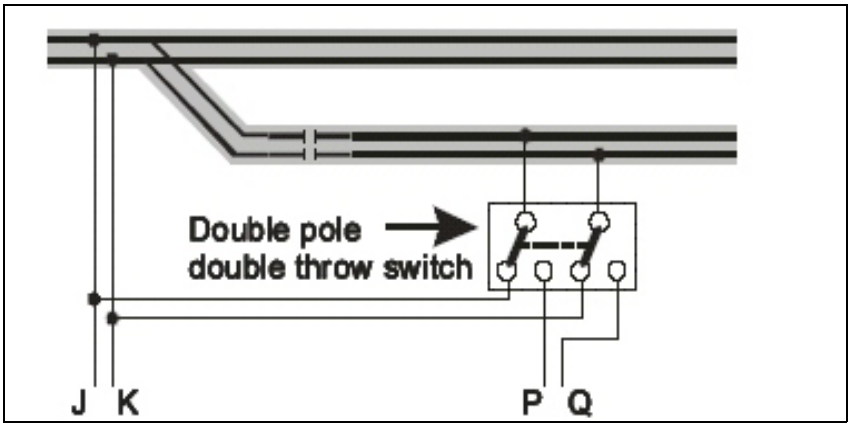


Programing with the Lenz System

Program Track

When using the program track be sure no wheels bridge the rail gap as the main track power is still on when using the program track.

The program track can be a piece of isolated track on the layout. (See program track wiring drawing) This section of track MUST BE ISOLATED with gaps on both rails. A temporary way to wire the program track is to use a piece of track that is not connected to the layout. Simply run two wires from the track to the Program Track output (P Q)of the command station. If you use a center off toggle switch the section of track can be used to put new equipment on the rails without shorting out the system.



The new BLI locomotives with the QSI sound decoders require more startup power to charge the capacitors. This can cause a problem programing on the program track. If you have a problem the PowerPax from DCC Specialties can fix it. The PowerPax is an adapter that is wired in between the command station and the program track.

Decimal Binary or Hex

The Lenz system uses decimal to display numeric values. Not all of the decoders manuals you read are in decimal only. A knowledge of the hex, (hexadecimal) binary and decimal numbering system is a big help when you start setting up some of the special lighting or sound settings CVs. The values stored in a CV runs from 0 to 255 decimal. There are conversion charts available to convert from one numbering system to any of the other number systems.

DCC or dc Settings

CV-29 Bit 2 permits some decoders operate when dc in on the rails. This bit should be left *off* unless you have a real need to switch between DCC and dc operation. Leaving this bit *off* can reduce the possibility runaways. Some decoder do not support dc operation. One dc, non-decoder equipped, locomotive can be operated with the Lenz system. This feature is activated by selecting an address of 0 for the locomotive. This feature is an NMRA requirement, but not recommended by some manufactures.

CV-29 Settings Here is a chart showing the standard decoder functions of CV-29.

Bit	Weight	Function (When *on*)	Purpose
0	1	Normal Direction of Travel (NDOT)	To correct direction problems so forward is forward. Reverses the normal direction of travel.

1	2	14 or 28/128 speed steps	Sets use of 14 or 28/128 Speed Steps. Should be on unless you have an old decoder(14 speed step is obsolete and rarely used)
2	4	Power Source Conversion	Allows the decoder to operate on dc or DCC. Not supported by all decoders. Best left off.
3	8	Advance Decoder Acknowledgment	This is a feature in some newer decoders Leave this bit off unless you have the function.
4	16	Use Speed Alternate Table	Used for speed matching. Leave off unless you set up the speed table at CV67 to CV94.
5	32	4 Digit Address (Off for 2 digit)	Sets 4 digit addressing. (2 Digit in CV-3 and 4 digit in CV-17 & 18.)
6	64	Reserved for Future use	Not used at the present time.
7	128	Defines Accessory Decoders	On if an accessory decoder/Off for mobile decoder.

Addressing VS. Other systems.
There are two different address types used with DCC , the older 2 digit address and the newer 4 digit addresses Normally the two digit is address 1 to 127 and four digit is 128 to 9999. Some DCC systems use four digit as 0001 to 9999. Some releases of the Lenz system defines 2 digit as 1 to 99 and four digit as 100 to 9999. You need to check your systems manual to verify how your level of software handles the 2 and 4 digit addressing. Some of the Lenz systems do not setup 4 digit addresses. Four digit addresses use two CVs to give the range of up to an address of 9999. Four digit addresses use CV-17 & 18. CV-17 hold the upper part and CV18 the lower part. One confusing thing is the top bits of CV-17 are on by default which adds 192 to this part of the address.

Four Digit Addressing
If your system does not automatically setup 4 digit addressing here is a way to do it manually. The basic idea for this came from a QSI manual.
The following way uses a calculator.
A. Start with the locomotive address and divide it by 256. *Sample 4449 ÷ 256 = 17.3789....*
B. Take the whole number (17) and add it to 192. *Sample 17 + 192 = 207*
C. Program the value (207) in step B is into **CV-17.**
D. Multiply the whole number from step A by 256. *Sample 17 X 256 = 4352*
E. Subtract the locomotive address from the computed value in step D. *Sample 4449 – 4352= 97.*
F. Program the value (97) in step E is into **CV-18.**
G. To activate 4 digit addressing a value of 32 (bit 5) needs to be added to **CV-29**.

Programming on the Main Track
Lenz uses the term "PoM" in the display for Programming on the Main. This mode is also called the "OPS Mode Programming". This allows you to change the value in a CV while out on the mainline. Functions like lighting, sound levels, acceleration/deceleration rates can be changed on-the-fly while operating a locomotive. The change will only apply to the address shown in the display. With a little practice you will appreciate what this feature can do for you and the operation of a train. The value in a CV can not be read back in this mode.

Operation with the Lenz System

Language
The Lenz system is multi language. When you start up be sure to select your language preference.

Accessory Control
The system allows you to control either separate accessory decoders. Accessory decoder are controlled with the pressing the "F" key followed by the "5" key. Then enter the accessory address. The + and – key are used to throw the turnout.

Emergency Stop

The “St” key is programed to stop all locomotives and leave track power on. With track power on you can still operate accessory decoders to clear a turnout set the wrong way. The “St” key can be programed for other functions. See the throttle manual for more information.

Function Keys
The cab has function keys F0 to F9 that can be entered directly. With the explosion of newer sound equipped locomotive these extra function keys become very useful! The new SoundTraxx Tsunami and QSI sound decoder use the function keys higher than F8. Below is a sample of the function keys and actions.

If your throttle does not have function keys for some of the higher numbered function there is a way to re-map the functions. Functions can be re-mapped to your available function keys. Some Lenz decoders do not conform to the NMRA function mapping practice. The new Gold Series decoders do conform.

Function Key	Typical Function	Tsunami Steam*	Tsunami Diesel*	QSI Steam*	QSI Diesel*
F0	Head/Backup Light	Head/Backup Light	Head/Backup Light	Head/Backup Light	Head/Backup Light
F1	Bell	Bell	Bell	Bell	Bell
F2	Horn /Whistle	Whistle	Horn	Whistle	Horn
F3		Short Whistle	Short Horn	Coupler Sound	Coupler Sound
F4		Steam Release	Dynamic Brake	Steam Blower	Fans
F5		Function F5	Function F5		Dynamic Brake
F6		Function F6	Function F6	Doppler/Startup	Doppler/Startup
F7		Light Dimmer	Light Dimmer	Brake Squeal	Brake Squeal
F8	Sound Mute	Sound Mute	Sound Mute	Sound Mute	Sound Mute
F9		Water Stop Sound	RPM +	Cruise/Shutdown	Cruise/Shutdown
F10		Dynamo	RPM --	Short Air Let Off/ Pop Off	Speed Read out
F11		Brake Squeal	Brake Squeal	Short Air Let Off/ Boiler Blow Down	Number Board
F12		Coupler Sound	Coupler Sound	Short Air Let off	Hazard/Cab Light

* **Note--** The above chart is subject to change depending on the type of locomotive or decoder.

Consisting
Consisting or MUing (multiple unit)is the ability to run more than one locomotive together as a single unit. Two methods are available with the Lenz system. They have a setup for Double Heading or for Multi-unit consists. The Multi-unit consisting requires a software of version 3 or later. Check the throttle manual for more information on setting up either of these consist.

DCC Documents
DCC system and decoders all come with manuals or information sheets. When you buy DCC products you get a receipt from the supplier. **All of these documents should be retained**. You may need a receipt to prove when you bought a device when getting something repaired under warrantee. Manuals are needed for reference, like when a decoder gets amnesia and needs to be reprogrammed. It is a good idea to write down the programing of a decoder’s CVs and keep the information with the decoder manuals. Even though many of the manuals are now available over the internet in time they get obsoleted and can get removed. Lenz does a good job of keeping manuals of obsolete equipment on their website, many others do not.

Getting Help

There is a Yahoo Chat Group for Lenz with over 1200 members. Questions posted here should get a quick answer. There are a number of ways of contacting Lenz Elektronik GmbH:

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