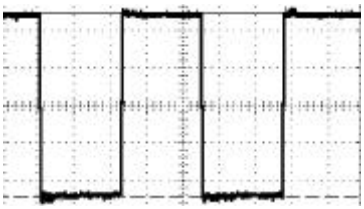


- 52 Volt/Amp DCC Power Station
- Adjustable DCC Track Voltages
- Opto-isolation for Safety
- Clean DCC Track Power
- Designed to meet NMRA Control Bus draft RP

Information

LV101

Art. No. 22101

DIGITAL plus

March 1998

The power station LV101

The DIGITAL plus LV101 Power Station is the “successor” of the previously available LV100. New features include user selectable DCC track voltages, a fault detection LED, and a new RJ-45 plug-in connector. This connector is provided now for new devices currently under development. This allows you to continue to use your LV101 in the future without modification.

The DIGITAL plus Power Station LV101 provides clean and safe DCC power to the track. New circuitry has been developed to reduce noise, which provides exceptionally clean power to operate your DCC equipped trains. Safety features include:

- Short/overload detection that turns off the power to the track whenever a short or overload condition is detected. This protects both your trains and the LV101 electronics.
- Opto-isolation to safely isolate your control bus wiring from your track wiring. This eliminates any possibility for hidden ground loops through your power station.
- Fail Safe runaway protection is provided by requiring a 7 volt signal on the DCC Control Bus (the C and D wires). This prevents the LV101 from accidentally sending out power to the track when the command station stops transmitting packets.

A new feature in the LV101 is a fault detection LED located on the front of the unit. When the power station is in use, the LED on the front is lit. In case of an overload of the power station, the LED will flash. In addition, the LED will also flash if no information is being transmitted over the Control Bus (connections **C** and **D**), or one of the wires in not connected.

The LV101 Power Station was designed to meet all NMRA Standards and RPs including the new the NMRA Control Bus draft RP. This allows maximum interchangeability for use with other conforming NRMA DCC systems. It has been submitted to the NMRA for full conformance testing. It has passed all the NMRA tests and the Conformance Warrant is pending.

Connecting the Power Station

The LV101 Power Station takes its energy from a user supplied AC transformer for model railroads. For maximum power, the LV101 should be located near the track being powered, so that the connection between the LV101 and the track is kept as short as possible. Connect the transformer to terminals **U** and **V**. For maximum output power, the transformer voltage should be selected to be close to the DCC track voltage. For HO scale and smaller, a 16V AC or DC transformer is ideal. In order for

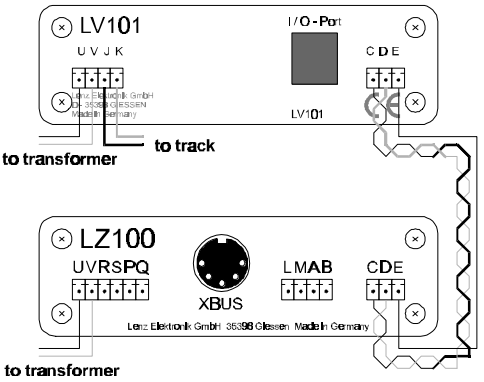
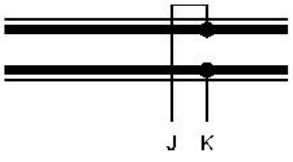


Figure 1 Connecting LV101 to Command Station LZ100

the Power Station to give off its full 3A current, the transformer also needs to be able to deliver a minimum of 4 amps. Use a suitable, UL listed transformer designed for model trains. The allowed maximum effective output voltage of the transformers must not exceed 18V AC or DC.

The track is connected to terminals **J** and **K** (see Figures 2 and 3). Use only wire of sufficient gauge to connect to the tracks (minimum 18 gauge) and either use parallel wires or twist the wires to reduce radio interference.



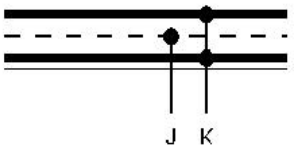


Figure 2 Connecting 2-rail track **Figure 3 Connecting 3-rail track**

The Power Station receives command information from the Command Station via terminals **C** and **D**. These terminals are connected to the corresponding terminals on Command Station LZ100 with a 2-wire cable. To reduce radio interface, these wires should be twisted (see Figure 1).

When you connect terminal **E** with the corresponding terminal on the Command Station LZ100, the Command Station will receive feedback in case of a Power Station overload. This information is then passed on to all handheld controllers. The display on Handheld Controller LH100 will show "OFF" (AUS) followed by “ON F1” (EIN F1). Once the short or overload is removed, the system can be restarted by pressing the "F" key followed by the "1" key and then "Enter".

If you have connected additional Power Stations to the Command Station, they will turn off their layout sections as well. You can turn the power supply for the layout back on via the handheld controller (see LH100 section "Emergency Stop/Emergency-Off"). A push button switch connecting terminal **D** with the command station's terminal **E** can be located at strategic places around the layout for emergency power interruption to all power stations.

If you do not connect the LV101's terminal **E** with the Command Station, then an overload will only turn off track power to the layout section that the LV101 is connected to and the overload will not affect the command station nor any other power station. After a certain time (when the Power Station has cooled down again) the Power Station automatically turns the power supply back on. If the overload still is present, it will turn off again after an additional short time.

The output current of the Power Station is limited by an electronic fuse circuit to approximately 3A.

Six-Pin I/O - Port

The new six-pin phone type jack located on the rear of the LV101 is provided for future use. Lenz GmbH is planning ahead for future development. The wire connections for this I/O port are shown in Figure 4.

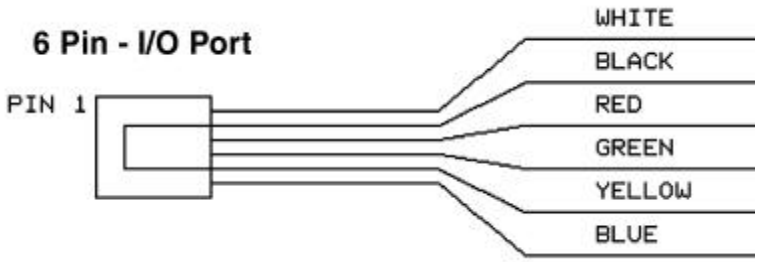


Figure 4: Wire connections for the LV101 6 pin -I/O port

Pin #	Color	Description
Pin 1	White	"**C**" Control Bus Connection
Pin 2	Black	Ground
Pin 3	Red	- RS-485
Pin 4	Green	+ RS-485
Pin 5	Yellow	+12 volts
Pin 6	Blue	"**D**" Control Bus Connection

Installation considerations

There must not be a capacitor connected to the track for interference control. A capacitor is only needed for conventional operations to prevent radio interference. In DCC operation a capacitor corrupts the data format and the error free data transfer is disturbed.

It is normal for the Power Station to get warm during operation. Ensure sufficient airflow around the Power Station to prevent the internal safety circuit from activating during normal operations.

Never allow your layout to operate without supervision! If there is an unnoticed short, the heat build-up could present a fire hazard!

Commom Rail Wiring

Normally both rails are gapped between power stations. This provides complete isolation. However, in some scales there exist locomotives that have pickups that are offset from each other. For example many steam locomotives have power pickup from one rail in the locomotive and the other rail in the tender.

When such a locomotive bridges the gap between isolated power stations, the locomotive will stall. The solution to this problem is to provide a common wire between all the power stations. All systems of command control need to have a such a common provided, if offset pickup locomotives are to be operated.

Lenz has chosen to leave the option of the location of the common up to the individual operator. The LV101 is completely opto-isolated. This allows you to use one of the rails (called common rail) for your common. Common rail wiring is also compatible with many existing signaling systems. While common rail is the preferred place for a common, you may rather connect all the power station **U** or **V** wires together. This is called common power supply wiring.

Caution: If you decide to install a common, it is important that you only have a single common. Multiple commons (such as common rail and common transformer) should be avoided.

Mixing Digital and Analog Operations

Conventional and digital track sections must be consistently separated from each other by using isolating tracks or isolating rail connectors between the digital and conventional (DC=) track sections (double gapping).

At the gap dividing digital from analog operation, you must take steps to prevent interference between the 2 systems when a locomotive crosses the gap. One approach is to use a Digital Circuit Breaker such as the LT130. If a locomotive bridges the insulated gap, the module immediately interrupts the analog power supply.

Warning:

Mixed digital/analog operations using both rails and catenary (overhead wire) is not allowed. In this mode of operation, if the locomotive is on the track in the wrong direction (for instance after going through a loop), the built-in locomotive decoder could be destroyed by excessive voltage! We suggest you operate with current pickup from the rails (wheel pickups), since that contact is more reliable (and thereby the transmission of the digital signals to the locomotive decoder) than with catenary.

Supplying power to a large model train layout

As in conventionally operated layouts, a sufficient power supply is prerequisite for the safe function of a digital layout.

Locomotives, interior lights in rolling stock, turnouts, signals etc. all get their power from the Power Station, along with their commands. If the devices you have connected to an LV101 together require more than 3.0A, the safety circuit of the LV101 will activate. You will have an overload situation as described in the section "Connecting the Power Station" above.
The current use of your layout is the sum of the following:

- locomotives in operation: depending on scale and load .2 Amps to 2 Amps. In N-scale, calculate ½ Amp, for H0 scale estimate 1 Amp and for larger scales 2 Amps per locomotive, and you will normally have some reserves.
- standing locomotives: without lights 1.5mA, with lights approximately 50mA per light bulb
- rolling stock with lights: per light bulb approximately 50mA

If the output of a single LV101 is not enough to supply the layout, then divide the layout into several power districts. Additional LV101 units then will supply those areas with approximately 3.0A each (one LV per power district)

In the supply area of one LV101, the current load of all simultaneously operating locomotives must not exceed 3.0A (including the current used for lighting in rolling stock).

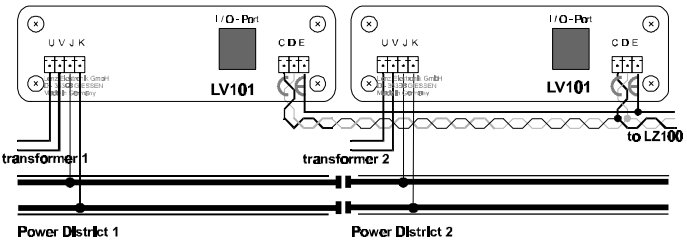


Figure 4 Connecting track voltage when using 2 LV101

The command signals reach additional LV101s through terminals **C** and **D** of the first one. Each LV101 must be connected to its own transformer. The number of transformer/Power Station combinations needed for the layout thus depends on the power

needs of your layout.

The power blocks of several LV101 must necessarily have the same polarity. Terminal J of one and terminal J of the next LV101 must therefore be connected to the same rail. Otherwise there will be a short when passing a dividing gap. (See Figure 1)

Setting the track voltage

As previously mentioned, LV101 provides the ability to adjust the track voltage level. This adjustment is useful if you for instance want a lower output voltage for an N scale layout. You can select an area between 11.5V and 22V.

To adjust the track voltage, you must open the LV101.

On the circuit board you find a DIP-switch.

DCC Track Voltage	SW 1	SW 2	SW 3	SW 4
11.5 Volts	On	On	On	N/A
13 Volts	Off	On	On	N/A
14.5 Volts	On	Off	On	N/A
16 Volts	Off	Off	On	N/A
17.5 Volts	On	On	Off	N/A
19 Volts	Off	On	Off	N/A
20.5 Volts	On	Off	Off	N/A
22 Volts	Off	Off	Off	N/A

Depending on the position of each of the 4 switches on this DIP-switch, you get a different output voltage at terminals J and K.

The switch positions necessary to get a particular voltage are also printed on LV101's circuit board.

In order to reach the desired output voltage, you must use a transformer with an output voltage that is as high as the desired track voltage. But do not overdo it: The transformer voltage should be matched as closely as possible to the desired track voltage. Too high of a transformer voltage just generates unnecessary heat loss in the power station, and this will lead to premature triggering of the overload fuse, before the maximum

power output is reached.

Combining LV101s for larger output capacity

If your locomotives need a higher current than the 3.0A available from the Power Station, you can connect two Power Stations in parallel. Each Power Station is connected to its own transformer. In this case you connect terminals **J** and terminals **K** on both Power Stations with each other (Figure 5). You will then have 6.0A current available to power your trains.

Warning: If you wire your LV101s as in Figure 5 the shorting current is also 6.0A. This could in some cases lead to damage to vehicle wheels or tracks, especially in the smaller scales.

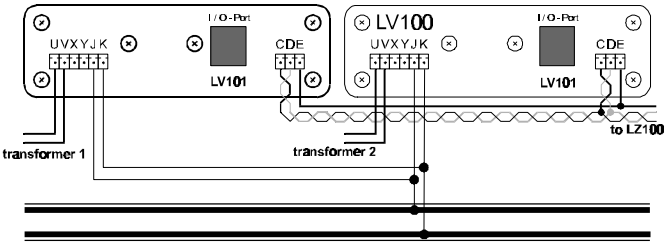


Figure 5 Connecting track voltage for large scale railroads

Connecting a reverse loop

Lenz GmbH produces an automatic reversing module (LK100) which can be used to easily wire complex automatic reversing sections. While these units are invaluable in some cases they are not absolutely needed for DCC operations. Following is an example on how a very simple reversing section can be built.

Example:

Using isolated track contacts and a twin-coil relay, the polarity inside a reverse loop is switched such that when crossing the gaps, there is no short. For example; consider Figure 6 when the train travel is in clockwise direction (turnout is set to diverging route).

When passing track contact b1, the polarity of the loop is set to allow the train to cross the gap without a short. As the reverse loop is traversed, track contact 2 will switch the polarity in the loop, and the adjoining gap can be crossed safely. Since in

digital operations the direction of travel is dependent on the locomotive and not track polarity, the locomotive will not change its direction of travel when the polarity within the reverse loop is changed.

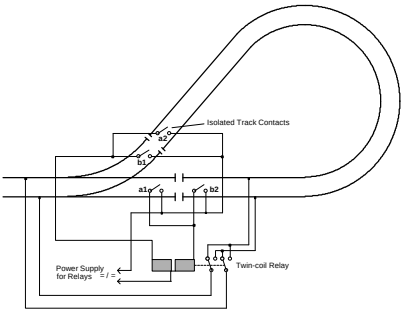


Figure 6: Wiring of Reverse Loops

Traveling the reverse loop counter-clockwise is done in a similar manner, now contacts a1 and a2 ensure that proper polarity is set.

Notes:

The distance between track contacts a2 and b2 must be longer than the longest train that travels the reverse loop.

If the reverse loop is only traversed in one direction, then either contacts a1 and a2 or contacts b1 and b2 are not needed.

The track contacts used in this example can actually be auxiliary contacts set by the switch machine for the switch.

If you wish to traverse the reverse loop with a locomotive without a decoder (analog locomotive), proceed as follows:

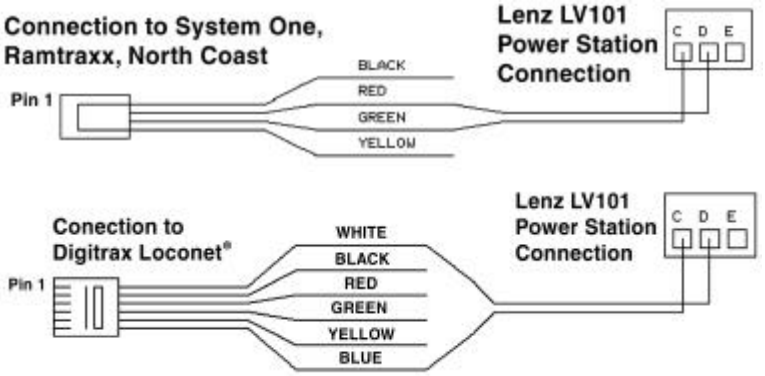
- drive the entire train into the reverse loop (the train must be between contacts a2 and b2)
- stop the train and change direction with your handheld (LH100).
- now manually change the polarity in the reverse loop (for example by using push buttons connected in parallel with track contacts a2 and b2)
- continue driving the train through the reverse loop.

You must use this sequence with analog locomotives (non-

decoder equipped), since their direction of travel is dependent on track polarity.

Connecting the LV101 to Other DCC Systems

The LV101 has been designed to be used with a broad range of NMRA DCC systems. Following are diagrams to assist you in connecting the LV101.



Troubleshooting the LV101

Problem	Cause	Solution
LV101 is not operational LED does not light up)	Power supply is interrupted, power plug of transformer is not in outlet or "**U**", "**V**" wires are not connected to the transformer.	Ensure that the transformer is on, has not overloaded or shut off, check wiring from transformer to LV101
LED flashes	There is a short circuit on the layout.	Remove the cause of the short circuit.
	There is a power overload.	Divide the layout into several supply sections and power these with additional power stations/transformers.
	The connection between LV101 and command station LZ100 is broken , or there is a short circuit (terminals C and D)	Check and correct these connections.
	The command station is not transmitting packets.	Exit programming mode or press **F** followed by **1**
LV101 is operational (LED lights), but locomotives do not run	The connection from Power Station to track is broken (terminals J and K).	Test and correct connections.
	The command station off	Press **F** followed by **1**

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.