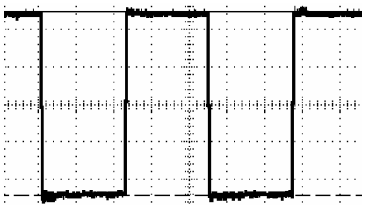


Ultra clean DCC Track Power
Adjustable DCC Track Voltage
Opto-isolation interface for Safety
Short and overload protection
Designed to meet Proposed NMRA Power Station Interface RP

LV101
DCC Power Station

Art. No. 22101
June 2002

Digital plus by Lenz ™

The LV101 power station

The Digital plus LV101 Power Station is the power station of choice for most ***Digital plus by Lenz***® users. Features include 8 user settable DCC track voltages to allow for the user to customize the operation of the LV101 to their individual needs, a fault detection LED to assist the user in troubleshooting problems, and a RJ-45 plug-in I/O port. This I/O port is provided for use with Set-02 or for providing additional **X**press**Net** power.

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:

Both short and 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 power station interface 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.

The LV101 has 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. If the power is on but no information is being received over the Power Station Interface (connections **C** and **D**), the LED will blink. The LED will also blink when the LV101 has detected a short or experienced a thermal overload.

The LV101 Power Station was designed to meet all NMRA Standards and RPs including the new proposed NMRA Power Station Interface RP. This allows maximum interchangeability for use with other conforming NRMA DCC systems. The LV101 was submitted to the NMRA along with the LZ100 for full conformance testing and has received an NMRA C&I Warrant.

Achieving the maximum LV101 DCC track power

There are several protection circuits inside the LV101. These are designed to shut down the track output when a short or overload occurs. If an LV101 has been shut down due to detecting a short or overload, it will check to see if the overload condition has been corrected and restart after a short delay.

1. The fast acting current limiting circuit designed to very quickly shut down the LV101 track output if a short is detected. This circuit activates at over 5 Amps.

2. Thermal overload protection. The LV101 has a long term thermal overload circuit designed to shut down if its temperature exceeds its rated capacity or value.

How does this translate to the output power you can expect?

For short term loads such as locomotive start up or slow speed operation the LV101 can deliver over 5 amps of DCC track power.

For long term loads, the LV101 can continuously deliver between 4 and 5 Amps at the DCC-voltage you set as long as the difference between input and output voltage is low enough to prevent the LV101 from prematurely overheating. Otherwise the thermal overload protection will limit the power output and shut down the LV101.

That means you can achieve significantly more track current for running trains with a power supply that matches best to the LV101s potential.

Over temperature is the most common reason that the LV101 shuts down before a short is detected. To maximize the DCC track output current, you need to have a transformer that puts out a voltage that is close to the DCC track voltage under load because any voltage above the regulated track voltage generates heat. It is normally this heat that limits the output power of the LV101.

Installing the LV101 Power Station

The LV101 Power Station takes its energy from a user supplied AC or DC transformer that is designed for model railroads. To avoid wiring power loss, 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 LV101 output power, the transformer voltage should be selected to be close to the DCC track voltage. For HO scale and smaller, a 15 or 16V AC or DC transformer is ideal. In order for the LV101 Power

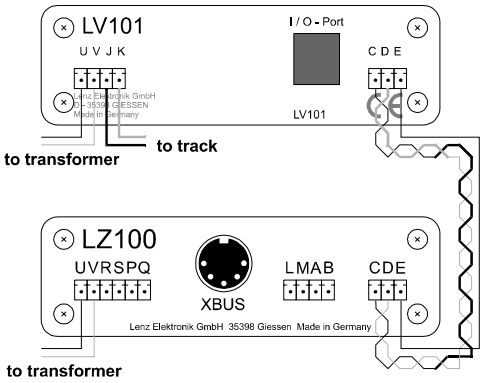
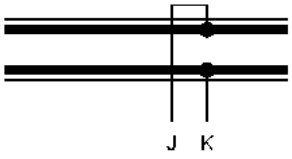


Figure 1 Connecting LV101 to Command Station LZ100

Station to deliver its full rated capacity, the transformer also needs to be able to deliver a minimum of 65 VA. 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.



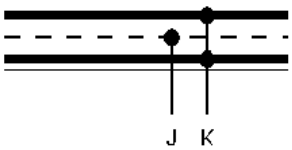


Figure 2 Connecting 2-rail track Figure 3 Connecting 3-rail track

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

A connection to terminal **E** is optional. When you connect terminal **E** with the corresponding terminal on a LZ100 Command Station, the Command Station will receive feedback in case of a Power Station shutdown. This information is then passed on to all handheld controllers. The display on each handheld will flash "OFF". Once the short or overload is removed, the system can be restarted by pressing the emergency stop key on any handheld.

If additional Power Stations are connected to the Command Station, they will also turn off power to their layout sections when a terminal **E** fault is detected. 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 a power station shutdown will only affect the power to the layout section that the LV101 is connected to and the overload will not affect the command station or any other power station. After the fault has been corrected, the Power Station automatically turns the power supply back on. If the fault is still present, the LV101 will again turn itself off.

Setting the DCC track voltage

As previously mentioned, LV101 provides the ability to adjust the track voltage level. This adjustment is useful if you desire a lower output voltage. A lower output voltage may be useful if your slowest locomotive operated faster than desired at full speed. You can select a DCC output voltage of between 11.5V and 22V.

To adjust the track voltage, you must first open the LV101. On the LV101 circuit board you will find a 4 position DIP-switch. The position of the 4 switches on this DIP-switch, will determine the DCC track voltage output you receive at terminals **J** and **K**.

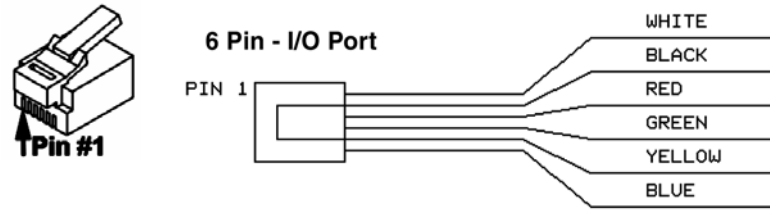
DCC Track Voltage	SW 1	SW 2	SW 3	SW 4
11.5 Volts	On	On	On	N/A
13 Volts	Off	On	On	N/A
14.5 Volts	On	Off	On	N/A
16 Volts	Off	Off	On	N/A
17.5 Volts	On	On	Off	N/A
19 Volts	Off	On	Off	N/A
20.5 Volts	On	Off	Off	N/A
22 Volts	Off	Off	Off	N/A

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

In order to achieve 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 thermal overload circuit, before the maximum output power is achieved.

The Six-Pin I/O - Port

The six-pin phone type jack located on the rear of the LV101 is provided for use with Set-02 or for use in providing auxiliary power to an **X**pres**Net**. The wire connections for this I/O port are shown in Figure 4.



Pin #	I/O Port	Description
Pin 1	White	"**C**" Control Bus Connection
Pin 2	Black	Ground "**M**"
Pin 3	Red	- RS-485 "**B**"
Pin 4	Green	+ RS-485 "**A**"
Pin 5	Yellow	+12 volts "**L**"
Pin 6	Blue	"**D**" Control Bus Connection

Operation considerations

Before use, remove all capacitors (if present) that are connected to the track intended 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 circuits 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!

Supplying power to a large model train layout

Providing sufficient power is a prerequisite for the proper function of a digital layout. The number of transformer/Power Station combinations needed for the layout depends on the power needs of your layout.

Locomotives, interior lights in rolling stock, turnouts, signals etc. all get their power, along with their commands, from the Power Station. If all the devices you have connected to an LV101 together continuously require more than 4 amps, the thermal safety circuit within the LV101 will activate. This will result in an overload situation and the LV101 will shut down for a brief period to cool down.

The current required by your layout is the sum of the following:

Operating locomotives: each operating locomotive can consume between 0.2 Amps and 2 Amps depending on scale and load. For a good estimate per locomotive, use 0.3 amps for N-scale, 0.5 Amp for H0 scale and 2 Amps for O and Large Scales. This will normally provide you with plenty of reserve capacity.

Stopped locomotives: without lights 1.5mA, with lights approximately 50mA per light bulb

Rolling stock with lights: per light bulb approximately 50mA

The sum of all the current loads for extended periods should not exceed 5 amps per LV101

If the output of a single LV101 is not powerful enough to supply the complete layout, then divide the layout into several power districts. Additional LV101 units then will supply those areas with approximately 4 amps each (one LV per power district)

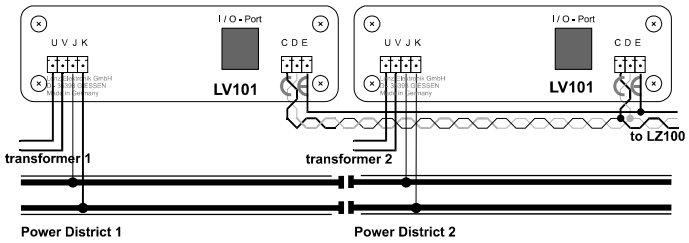


Figure 4 Connecting track voltage when using 2 LV101

To use multiple LV101s, connect them so that terminals **C** and **D** are all connected together. Connections to terminal **E** are optional. Next connect the **J** and **K** connections to the Track. The power districts of all LV101s must have the same polarity. Terminal **J** of one LV101 must be connected to the same rail as terminal **J** of all other LV101s. Otherwise there will be a short when a locomotive crosses the dividing gap. (See Figure 4)

Common 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 DCC command control systems 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

instead 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 LT100. 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.

Connecting a reverse loop

Lenz GmbH produces an automatic reversing module (LK100) that 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 can be controlled to ensure that there is no short when crossing the gaps. Figure 5 illustrates an example of how this can be performed.

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 b2 will switch the polarity in the loop, and the adjoining gap can be crossed safely. This works because In digital operations the direction of travel is determined by the decoder and not by track polarity.

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

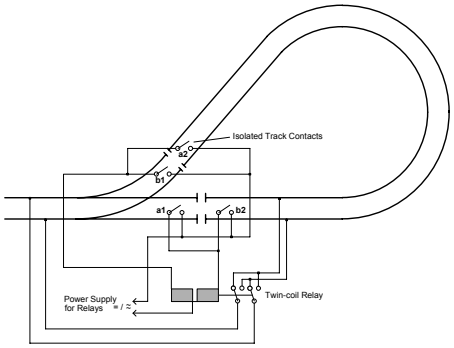


Figure 5: Wiring of Reverse Loops

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), then you must use the following sequence since the direction of travel for locomotives without a decoder is dependent on track polarity.

move 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).

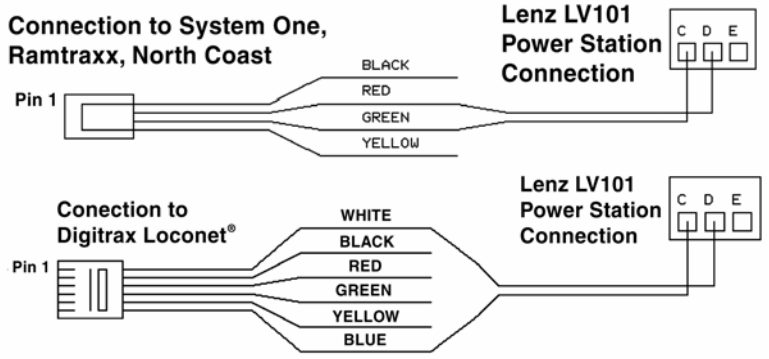
now manually change the polarity in the reverse loop (for example by using push buttons connected in parallel with track contacts a2 and b2) or by throwing the turnout.

you can now move the train through the reverse loop.

Connecting the LV101 to Other DCC Systems

The LV101 has been designed to be used with a broad range of NMRA DCC systems. The LV101 **C D** interface provides a load of 10 milliamps at 12 volts.

Following are diagrams to assist you in connecting the LV101.



Troubleshooting the LV101

Problem	Cause	Solution
LV101 is not operational (LED does not light)	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
The LV101 LED flashes	There is a short circuit on the layout.	Remove the cause of the short circuit.
	There is a short.	Correct the short on the layout
	There is a power overload.	Divide the layout into several power districts and power each district 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 the emergency stop key
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.

North American 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 use. 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 or use. Should the item no longer be produced and the item is not repairable, a similar item will be substituted at the manufacturer's 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 manufacturer's 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 manufacturer's 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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FC 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.

CE Please save this manual for future reference!