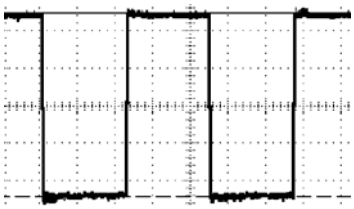

- Ultra clean DCC Track Power
- Adjustable DCC Track Voltage
- Opto-isolation and CE thermal protection for Safety
- Short and overload protection
- Designed to meet NMRA RP-9.1.2 Power Station Interface requirements
- Includes RP-9.3.1 cutout device

LV102
DCC Power Station

Art. No. 20102
July 2007
Version 5

Digital plus by Lenz®

Submitted for independent
NMRA C&I Testing

Contents

1 Welcome!

We would like to congratulate you on your acquisition of the LV102 ***Digital plus by Lenz***® power station/booster.

The purpose of this operating manual is to explain the use of the LV102 and how to connect it to your system. If you still have questions after reading this operating manual, for which you can not find the answers, please contact us. We will be happy to help. There are four different ways of contacting Lenz Elektronik GmbH:

	Europe	North America
Postal address:	Lenz Elektronik GmbH Huettenbergstrasse 29 D-35398 Giessen	Lenz Agency PO Box 143 Chelmsford, MA 01824
Phone	++49 (0) 6403 900 133	++1 978 250 1494
Fax	++49 (0) 6403 900 155	++1 978 455 LENZ
Email	info@digital-plus.de	support@lenz.com

Did you receive everything?

Please check, to ensure that all the components of the LV102 have been delivered:

LV102 –Power Station (Booster)

one 5- terminal, and one 3-terminal green connector attached to the rear of the LV102

operating manual (this booklet)

If an item is missing, please contact your retailer to have the missing item replaced.

If you have any problems with your LV102, just contact us, stating the following information together with a description of the problem and the following:

- DCC system being used
- Power Supply being used
- DCC track voltage

This will help our service department to resolve the problem. Thank you.

2 Important advice, please read first!

Your LV102 is a component of the ***Digital plus by Lenz***® system and was submitted to intensive testing before delivery. Lenz Elektronik GmbH guarantees fault-free operation provided you follow the advice given below:

The LV102 is only authorized for operation with other components of the *Digital plus by Lenz®* family or other NMRA DCC systems. Do not expose the LV102 to damp locations or direct sunlight.

The heat produced by the LV102 during operation is normal. You must provide sufficient air circulation around the LV102 in order to prevent the internal thermal protective system from reacting prematurely during normal operation.

WARNING!

Do not leave your model railway system unsupervised while in operation! If a short-circuit goes unnoticed, the heat produced creates a fire risk!

WARNING!

Do not connect an earth ground to your LV102 or to your model railroad. Earth grounds can pose significant safety concerns and such a connection is not necessary for the proper use of the LV102. All outlets in a room with an exposed earth ground should be protected by a ground fault interruption circuit.

3 Technical data of the LV102

The LV102 includes an powerful internal 5 amp power station. that 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.

Power supply (input voltage)	with AC:	min. 14 Volt, max. 19 Volt
	with DC:	min. 14 Volt, max. 24 Volt
	When powered with a DC power source, select an input voltage which is approx. 2-3 Volts higher than the selected DCC track voltage. When powered with an AC transformer, select an input voltage that is about the same or slightly lower then the selected DCC track voltage. This avoids unnecessary loss of heat in the device which in turn could lead to an early thermal switchdown.	
Output voltage (track voltage)	Settable between 11V and 22V in steps of 0.5V. Under load the actual DCC track voltage will be slightly lower. The factory voltage setting is 16V.	

Output current	The output current is limited to a maximum of 5A. Depending on the transformer used, as well as its voltage and the set track voltage, the long term continuous current, which the LV102 DCC Power Station of the LV102 can supply, varies. Example: When using the FCI FDA120-150-5000 transformer and a track voltage of 16V, the long term continuous current is approximately 4.4A.
Overload protection	Thermal overload protection. The switching off of the overload occurs after approx. 100ms in case of constant overcurrent (e.g. short-circuit).
Opto-isolated (Current) Interface Polarity	The LV102 uses the Opto-isolated (Current) Interface and consumes 10ma on the Power Station Interface. Per NMRA PR-9.1.2 The K terminal output and D terminal input represent the DCC positive polarity.
Dimensions	W 120mm x H 55mm x D 120mm

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 LV102 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 LV102 from accidentally sending out power to the track when the command station stops transmitting packets.

4 DCC Power Districts

As with conventionally operated systems and layouts, a sufficient supply of electricity to the system is a precondition for the sure and safe functioning of NMRA DCC powered layouts.

Locomotives, (passenger car) lights, turnouts, signals etc. are all power consumers. The LV102 DCC Power Stations supply this power and at the same time the DCC control information required by the decoders.

To find out whether the maximum current of the *NMRA DCC* system used is sufficient for the supply of your model railway system, simply add up the power consumption of all locomotives running at the same time as well as that of all other consumers. Use the following approximate values for your calculation:

- 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 2.5mA, illuminated approx. 50mA for each bulb.
- illuminated passenger cars - each bulb approx. 50mA.

If the calculated sum exceeds the maximum current available from the NMRA DCC system used, you will need to split your layout into multiple power districts and install an LV102 power station to provide power for each of these power districts.

5 Connecting the LV102

5.1 Power supply: terminals U,V

The LV102 is connected to the transformer via two wires at the terminals U and V. For selection of the correct transformer see . (⇨p. 11)

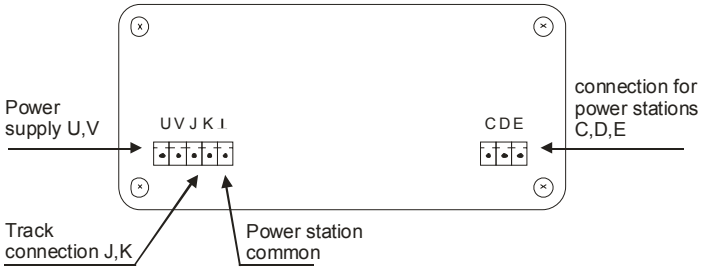

Fig. 1: The connections of the LV102

5.2 Track connection: terminals J,K

Connect the **J** and **K** wires to the track. The **K** wire represents the positive DCC polarity. Only use wires with sufficiently large cross-sections to connect the tracks and then twist this cable (we recommend 14-16 gauge wire). For best operation the **J/K** wires should be connected to your tracks at regular intervals.

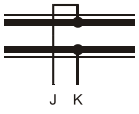

Fig. 2: Connection 2-wire tracks

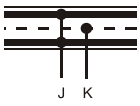

Fig. 3: Connection track with neutral wire

Note: No radio interference suppression capacitor may be installed in the track system. This capacitor, if used with the

Digital plus by Lenz ® system, will distort the data format and interfere with the fault-free transmission of data.

Important:
A mixed digital operation using overhead and track lines is not permitted. In this type of operational mode, the installed locomotive decoder can be destroyed by overvoltage if the locomotive is sitting on the track in the wrong direction (which might be the case e.g. after having driven through a terminal-loop)! We recommend operation using track pick-up, because the reliability of contact (and therefore the transmission of digital signals to the locomotive decoder) is substantially greater than it is when operating with overhead lines.

It is absolutely necessary that the electric circuits of all LV102 DCC Power Stations are of the same polarity. Thus, terminal J of one and terminal J of the next LV102 DCC Power Station must be connected to the same side of the track in question. Otherwise short-circuits will occur when driving over sectioning points.

If you have several supply areas on your model railway layout, you will have to set the track voltage (output voltage) for the LV102 DCC Power Stations in use to the same value (see Section 6).

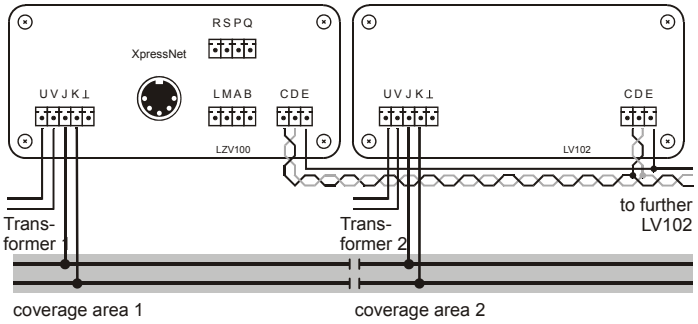

Fig. 4: Connecting an LV102 DCC Power Station to the LZV100.

5.3 Connection to the command station: terminals C,D,E

The LV102 DCC Power Station LV102 receives the data format from the command station via the terminals **C** and **D** (LZ100, LV102, compact). The terminals are connected to the terminals of the other LV102 DCC Power Stations, which have the same name. We recommend the use of a twisted cable.

If terminal **E** of the LV102 DCC Power Station is connected to terminal E of the command station, the LV102 DCC Power Station will communicate an overload or a short-circuit to the command station. The command station then switches off all other LV102

DCC Power Stations and communicates this to all connected input devices via the XpressNet.

5.4 Power Station Common ⊥ Connection

The connection labeled '⊥' on the power plug is the power station common. This connection can be used in 2 rail wiring schemes to form a common between power stations. (⇨p14)

6 Configuring the LV102

The DCC track voltage, Bi-Directional configuration and several additional parameters within the LV102 can be set using operations mode programming (POM). The command station and the LV102 DCC Power Station must be switched on and the LV102 must be connected to your DC Command station through terminals **C** and **D**.

Proceed as follows:

- Select any locomotive address on your handheld. (**Don't worry:** If a locomotive with the address used above is placed on a track while you are setting the voltage, its settings will not be affected, since CV7 is a read only Locomotive CV.
- Using POM (ops mode programming), program the value 50 into CV7. This switches the LV102 into configuration mode; the LED of the LV102 shows a double-flash.
- You have 15 seconds to program the value for the desired output voltage (compare below) into CV7. Once set, the LED will shine constantly and the track voltage is altered.

6.1 Reset and Version Number

The following table lists the values of CV7 used to determine the version Number and to reset the LZV100 to fact0ry default..

Write to CV7	Effect
CV7=50, CV7=96:	Displays version number – The led blinks a set number of times to display the version number. For example if the led blinks 5 times the LV102 is version 5.
CV7=50, CV7=99:	Return all parameters within the LV102 to factory default.

6.2 Setting the DCC Track Voltage Output

The LV102s DCC track voltage can be set by the user. Depending on the voltage and the capacity of the transformer supplying the power, the actual track voltage may be lower than the set value.

Depending on your modeling scale, changing the factory setting of the track voltage may be advantageous. Large Scale users often choose voltages between 18 and 22 volts DCC. N gauge users often prefer 14 volts DCC. If you desire to adjust the DCC track voltage, select a voltage where so that your slowest locomotive under full load travels at the desired top speed at full speed. If you desire 12 volts DC to the motor then you will need approximately 14 volts DCC at the track. Accounting for typical track wiring voltage loss this translates to a setting of 16 volts DCC (the factory default).

If your DCC track voltage is set lower then your transformer voltage you may experience a significant reduction in the amount of power that the LV102 power station can provide under load. The reason for this is that the excess voltage is turned into heat and to conform to the CE safety codes, we must ensure that the case temperature is less then 50°C.

If possible, the transformer voltage should be adjusted to the desired track voltage. A transformer voltage which is too high leads to an unnecessary loss of heat in the LV102 DCC Power Station which in turn leads to an early switch-off before the maximum output current is reached.

If you have several supply areas on your model railway layout, you should set the track voltage for all the LV102 DCC Power Stations in use to the same value. The following table contains the values you will have to program into CV7 in order to set the desired DCC track voltage.

Write to CV7	DCC Track Voltage
CV7=50, CV7=22	11
CV7=50, CV7=23	11.5
CV7=50, CV7=24	12
CV7=50, CV7=25	12.5
CV7=50, CV7=26	13
CV7=50, CV7=27	13.5
CV7=50, CV7=28	14
CV7=50, CV7=29	14.5

Write to CV7	DCC Track Voltage
CV7=50, CV7=30	15
CV7=50, CV7=31	15.5
CV7=50, CV7=32	16 **(Default)**
CV7=50, CV7=33	16.5
CV7=50, CV7=34	17
CV7=50, CV7=35	17.5
CV7=50, CV7=36	18
CV7=50, CV7=37	18.5

Write to CV7	DCC Track Voltage
CV7=50, CV7=38	19
CV7=50, CV7=39	19.5
CV7=50, CV7=40	20
CV7=50, CV7=41	20.5
CV7=50, CV7=42	21
CV7=50, CV7=43	21.5
CV7=50, CV7=44	22

6.3 Adjusting the Bi-Directional Cutout

Bi-directional communications requires a window for the decoder to communicative in. This window can be turned on or off.

Write to CV7	Effect	Explanation
CV7=50, CV7=93	Turn Bi-Directional **ON**	The LV102 creates the Bi-Directional communication window
CV7=50, CV7=92	Turn Bi-Directional **OFF** **(Default)**	The Default is that Bi Directional Communication is off

The following settings allow the creation of a smaller window for legacy command stations it is not needed for the LZV100..

Write to CV7	Effect	Explanation
CV7=50, CV7=94	Small Window	A small window allows limited communications and is only needed for legacy command stations
CV7=50, CV7=95	Full Feature Window **(Default)**	The default is for full support of Bi-Directional communications

The following settings are optional settings to configure the window for some legacy decoders that do not completely follow the NMRA standards. If you have problems with a decoder

working when Bi-Directional communications is enabled, consult the decoder manufacturer for the best setting.

Write to CV7	Effect	Explanation
CV7=50, CV7=88	Window ends next edge after 435us **(Default)**	Full length for small window (Default setting for small window)
CV7=50, CV7=89	NCE compatibility mode, window ends at 506us	Only needed for some NCE decoders which do not completely adhear to the NMRA standards.
CV7=50, CV7=70	decrement the window length by 6us	Fine tuning of the window length.
CV7=50, CV7=71	increment the window length by 6us	Fine tuning of the window length

7 Achieving the maximum LV102 DCC track power

For short term loads such as locomotive start up or slow speed operation the LV102 can deliver over 5 amps of DCC track power.

For long term loads, the LV102 can continuously deliver approximately 4.4 Amps at the DCC-voltage you set, as long as the difference between input and output voltage is low enough to prevent the LV102 from prematurely overheating. Otherwise the thermal overload protection will limit the power output and shut down the LV102.

☞ **You can achieve significantly more track current for running trains with a power supply that can deliver at least 5 amps and matches the set DCC track output.**

Over temperature is the most common reason that the LV102 shuts down before a short is detected. This shutdown is done for a CE safety concerns as we want to ensure that the case does not get hot to the touch. 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 LV102.

In order to achieve the desired output voltage, you must use a transformer with an output voltage that is matched as closely as possible to the desired DCC 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.

For the default DCC track voltage of 16 volts, you will need a transformer that delivers between 14 and 16V AC under load. Voltage that exceeds this is wasted in excess heat, which reduces the effective capacity of the unit. In order to make it possible for the LV102 power station to deliver its rated capacity the transformer also has to be able to deliver a amperage of at least **5A**. You can use a transformer that delivers less current, but then you will not be able to operate as many trains. The transformer's voltage must not exceed 19V AC voltage.

7.1 Suitable transformers for your LV102

The following transformers are suitable for the LV102:

- Digital plus TR100 (order-no. 26000) (220 volts)
- FCI FDA120-150-5000 transformer Output: 5 amps 15 volts (120 volts)
- NCE P515 Power supply, Output: 5 amps 15 volts (120 volts)
- Digitrax PS515 Power supply, Output: 5 amps 15 volts AC, (120 volts)
- Atlas Generator, Item #335, 16 volts AC, 45-watt, (120 Volt)
- DCC Specialties Magna Force MF615, Output: 6 amps 15 volts AC, Note do not connect the ground wire to the LV102, (120 volts)
- Lionel 6-12866 135-Watt PowerHouse™ Power Supply 18 volts AC, 135-watt, (120 volts)
- Lionel 6-22983 180-Watt PowerHouse™ Power Supply (UL Listed) 18 volts AC, 180-watt, (120 volts)
- MRC AD515, AH800, 18 volts AC, 65-watt, (120 volts)

If you wish to use a different transformer, please note that it should be a Class 2 SELV model railroad transformer with a 'UL, 'GS' or 'CE' symbol.

8 Layout Wiring considerations

There are many different wiring approaches used within model railroads. The basic difference between these wiring styles is in how the common is wired. In order to simplify the conversion to DCC, the LV102 has been designed to support all the popular model railroading wiring approaches.

> ☞ 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.

What is a Common?

In some scales there exist locomotives that have pickups that are offset from each other. For example most brass 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 because the circuit is not complete. The solution to this problem is to provide a common wire between all the power stations. All DCC command control systems need to have 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 LV102 is completely opto-isolated. There are no built in hidden commons. This allows you to select which common approach works best for you.

> ☞ For safety reasons the model railroad track common should never be connected to earth ground. Such a connection unnecessary and is specifically prohibited by most electrical safety codes unless all outlets in a room have ground fault interruption circuits..

8.1 Common Rail Wiring

In common rail wiring one rail has the same polarity around the entire layout. If you are using such an approach it is best to have a single common point where all the commons are tied together. For best results and to prevent any possibility of double voltages connect the positive polarity **J** wires on all connected power stations together and then connect this **J** common to the rail common in a single location.

8.2 Two rail wiring (Direct Home Wiring)

In two rail wiring, both rails are gapped between power districts. Because there is no rail common, a power station common can be used. The LV102 has the terminal marked '⊥' that can be used for this purpose.

8.3 Common transformer

In common transformer wiring a single larger transformer is used to power the command station and all the power stations. If using common transformer wiring connect all the power station **U** or **V** wires together and then connect the transformer to this common wire at a single point. If using a common power supply it must be sized to meet the needs of all the connected components.

9 The LED display

The various operating states of the LV102 are indicated by the LEDs on the front plate:

LED shines constantly	Everything ok, device in normal operation
LED flashes slowly	Terminals C and D are not connected
	Emergency stop, track voltage switched off at an operating device
	The command station is not in normal operation mode
LED flashes quickly	Emergency stop, track voltage switched off
	Overheating of LV102 DCC Power Station
	Transformer is not connected to U,V (correct) but to J,K (incorrect). *The LED will also flash quickly when the LV102 is switched off, this is normal.*
LED double-flashes:	A LV102 configuration procedure was started by means of PoM (see section "6")

10 Help in case of problems

Fault	Possible cause	Elimination of problem
LV102 is not ready for operation (LED does not shine)	Electric power supply is interrupted. Transformer mains-plug not plugged in.	Check wiring between transformer and LV102, plug in transformer mains-plug.
LED flashes slowly.		
	There has been a short-circuit on the track system.	Deal with the short-circuit.
	The J/K output is overloaded..	Divide the system into several coverage areas and supply them with additional LV102 DCC Power Stations / transformers.
	The J/K output is overloaded..	The transformer being used has a voltage greater then the DCC track voltage and is causing a premature shutdown
LV102 is ready for operation (LED shines), locomotives do not run, turnouts and signals can not be switched.	The connection of the LV102 DCC Power Station and the track and / or the switch decoders is interrupted (terminals J and K not connected).	Check and correct the connections.

11 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 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. A minimal service charge for shipping and handling costs will 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.

Year 4-10: A service charge to include repair, shipping and handling 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.

A return authorization number is necessary for warranty service. Please contact a Lenz Service Center to receive this number and give the required information.

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info@digital-plus.de

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Warning: This product contains chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

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!