

Information

LH100 Version 2.1

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_____plus

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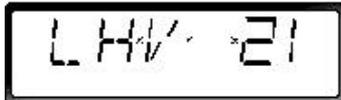
Introduction to the Hand Held LH100

The Hand Held LH100 is a universal input device for the DIGITAL plus system. You can

- control your motive power
- program the locomotive and accessory decoder as well as feedback encoder
- throw turnouts or set signals and activate uncoupling ramps
- determine and program the system properties
- display the information sent by feedback encoders and accessory decoders with feedback.

In this manual, all inputs on the keypad are shown on the left side, whereas the corresponding indications on the display after operating the keypad are shown on the right hand side. All steps require the LH100 to be connected to the DIGITAL plus system.

The software version 2.1



This manual describes the software version 2.1 for the Hand Held LH100. In this version, a couple of new features have been added. These features are listed below.

Naturally, the LH100 with version 2.1 works on command stations with older software, (e.g. version 1.5), but if you want to use the new features of version 2.1, the Command Station LZ100 has to be equipped with software version 2.1 or higher.

To prevent incorrect operation please use only this information booklet in conjunction with your new LH100.

The following new features of the DIGITAL plus system are supported by the new software version of the LH100.

Assigning the number of throttle notches to the locomotive address:

This is the most important of the new features. It allows you to save the number of throttle notches for each locomotive address in the Command Station LZ100.

The number of throttle notches depends on the locomotive decoder. All DIGITAL plus decoders can be used with 14 or 27 notches, depending on the decoder version. DIGITAL plus decoders of the newest generation conform to the recommended practice of the NMRA and also support 28 throttle notches.

If you are using other, compatible decoders check their manual or inquire with the manufacturer.

A detailed discussion is given in the section "Assigning the number of throttle notches to a locomotive address" on page 11.

Programming the decoder:

The operation of the LH100 during programming has also been improved.

The LH100 now automatically determines through the Command Station if the decoder connected to the programming track implements direct mode programming according to the NMRA-standard and if so the LH100 will automatically indicate the most important settings stored in the decoder. A description is given in the section "Programming and reading decoder properties" starting on page 25.

Language Preference:

In response to many requests from our customers, we have introduced the option of using either the German or the English language on the display.

As an example, the different displays for controlling a locomotive are shown:



The language is selected in the function SETUP, as described on page 48. The factory default is German.

Throughout this manual, the English language displays are shown. In some cases, the equivalent German is given in {} brackets in the text.

If you already own a Hand Held LH100

In order to adjust the address of the new LH100, please start by reading the section "Connecting several LH100's" on page 49 of this information.

Connecting the LH100

To connect the LH100 insert the connector into the 5-pole DIN socket labeled XBUS on the back of the Command Station LZ100 or into a socket on a connecting plate. If your system is switched on, the LH100 will indicate briefly "LH100" and is immediately ready for action.

If your system is set up for manual start, (see also the section "Selecting the start up mode of the system " on page 46.) the address and the data for the last locomotive assigned to the decoder are shown in the display. On the first operation of the LH100, address 03 will appear. (factory setting)

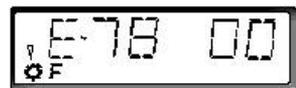
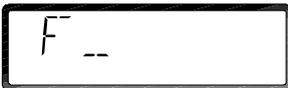
The LH100 is now in the mode *locomotive operation*.

Turning on the LZ100 Command Station

After an emergency stop, or a power fluctuation of the LV100 (if terminal E is connected to the LZ100), the command station stops transmitting information to the DCC decoders until the user tells the command station to restart transmissions. This allows the user to change events on the layout while it is in a stopped state. Please refer to the section on Emergency Stop later in this manual for more information on issuing instructions while the layout is off.

The sequence 'F' and '1' instructs the command station to resume operations. After resuming operations the LH100 display will show the speed and direction of the last locomotive controlled, which in this example is locomotive 78.

press the display shows then the display shows
press



Operating a locomotive with the LH100

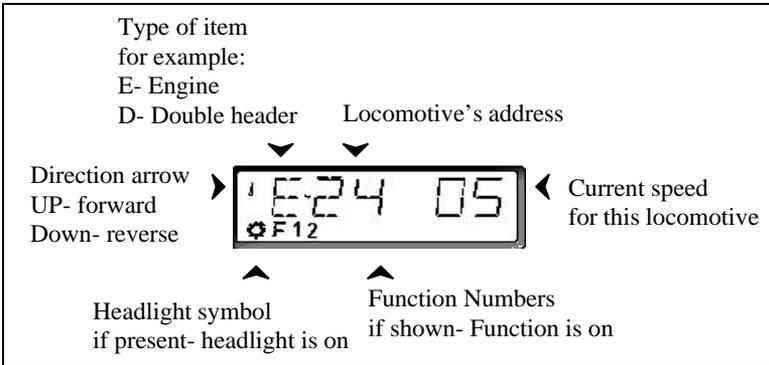


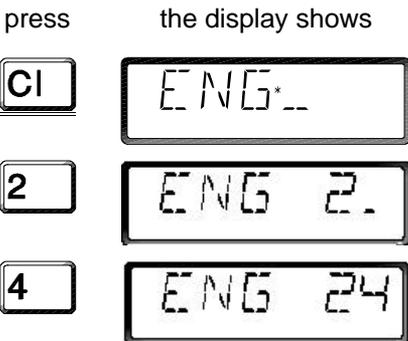
Figure 1 The display of the LH100 in Locomotive operation mode

Before you can operate a locomotive from your LH100, the locomotive has to be *selected*.

Selecting a locomotive

The address for the locomotive that you want to operate has to be entered on the keypad of the LH100. This *selects the locomotive*. All addresses from 0 to 99 are allowed. The address 0 is reserved for conventional locomotives. (locomotives without digital decoders)

Example: The LH100 is in the mode locomotive operation. You want to select the locomotive at address 24. The following steps are necessary:





The LH100 is now, again in the mode: locomotive operation. The display gives you the following information on the selected locomotive:

Direction forward, throttle setting 3, head light(s) (function 0) on.

If the display is blinking after selecting a locomotive, then it is already selected by another LH100. You can still override this locomotive from your LH100. This subject is covered in the section "Taking over a locomotive from another LH100 " on page 14.

Operating a locomotive

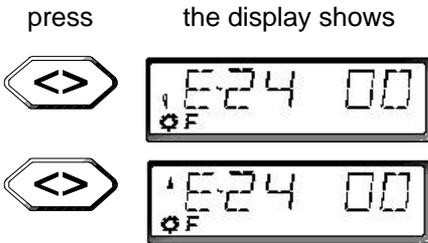
The speed and direction of the locomotive are changed with the following keys:

Pressing	will change the throttle at a maximum number of throttle notches of	
	14	27/28
	by	
	+1	+1
	+5	+8
	-1	-1
	-5	-8

Every time one of these keys is pressed, a command is sent to the locomotive. (Exception: If the display is blinking; the locomotive is selected by another device)

Momentum for acceleration and braking is a programmable feature of the DIGITAL plus locomotive decoder. Therefore, the throttle setting will not be incremented if the key is kept depressed.

Changing the direction is initiated by the hexagonal key. The change of direction will be displayed by the arrow indicating the direction. If the arrow is pointing up, the locomotive moves forward, if the arrow is pointing down, the locomotive is moving backwards.



The direction is locomotive specific. For example, a regular steam locomotive will move with the funnel to the front, independent of which direction the locomotive is pointing on the track.

If the locomotive is on throttle 00, the direction changes every time you press this key.

The hexagonal key has another function, too, it is a locomotive specific emergency stop.

If the locomotive runs at a throttle setting larger than 00, pressing the hexagonal key will lead to an emergency brake application for this locomotive.

Keep the key pressed until the locomotive starts to brake. At this point, release the key, and the locomotive will stop immediately without the programmed momentum.

The second keypress on this key will change the direction, as indicated in the display.

Using the accessory functions of the locomotive decoder

All DIGITAL plus decoder are equipped with a direction dependent accessory control, function 0. In most cases, this function will control the headlight(s) of the locomotive.

You can switch the function 0 on and off using the key '0'.

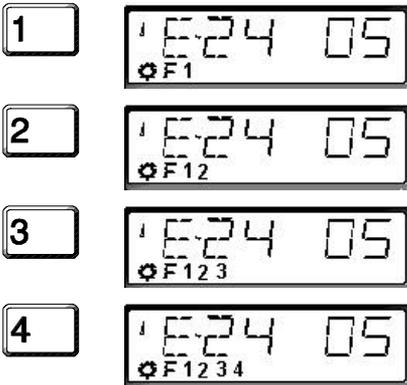
press the display shows



If the function 0 is on, the lamp symbol will show in the lower line of the display.

Some locomotive decoder are equipped with additional accessory controls, function 1 to 4. These functions are switched on or off by the keys '1', '2', '3', and '4'.

press the display shows



The function numbers will be shown in the lower line of the display, if the corresponding function is switched on.

Pressing one of the keys that activate the function will send a command to the locomotive.

Assigning the number of throttle notches to a locomotive address

The number of throttle notches is the number of steps from slowest to highest speed.

Using 27 notches allows for a finer division of possible locomotive velocities than 14 notches. The maximum velocity is reached at throttle 14 in one case, and at throttle 27 in the other case.

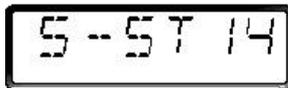
Select the locomotive address for which you want to set the number of notches. In this example, address 24 is used.

Set the throttle to 0, for example by pressing the hexagonal key.



If you want to see the number of throttle notches assigned to this locomotive, press the '+' key:

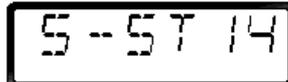
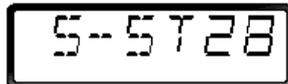
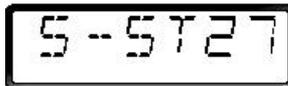
press the display shows



The display will show the number of throttle notches, in our example 14 for the address 24.

Repeated pressing of the '+' key will display the number of possible throttle notches:

press the display shows

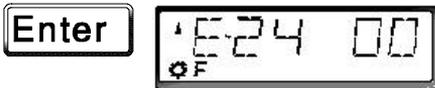




etc.

Press the 'Enter' key to assign a number of throttle notches to the locomotive address as it is being displayed.

press the display shows



The new number of notches will be stored in the Command Station and is immediately applicable. The setting is retained even after switching the system off.

If you do not want to change the current setting of throttle notches, press the 'ESC' key

IMPORTANT:

Please make sure that the decoder corresponding to the selected address can be operated with the selected number of throttle notches.

If the throttle setting is not 0, pressing the '+' key will display the actual throttle setting for this locomotive address. This setting cannot be changed.

Display for double headers:

If the selected address is part of a double header, pressing the '+' key will not display the throttle setting, but the address for the second locomotive in the double header.

Operating more than one locomotive from a LH100

After you have sent a command to e.g. locomotive 24 using the LH100, you can select another locomotive as described above.

The locomotive 24 is continuing according to the last command, which is stored in the decoder and the Command Station, until it is selected again and a different command is send.

After sending a command to the second locomotive, you can select a third one, etc..

This feature of the digital system enables you to operate up to 100 locomotives from one LH100. A second LH100 is only necessary if you want to operate several locomotives simultaneously. The number of locomotives running on your layout is independent from the number of LH100's.

Switching between two locomotive addresses

The Hand Held LH100 is equipped with two memory locations for locomotive addresses. The 'ESC' key toggles between these two memory locations and the addresses contained in them.

For example: You have selected the locomotive 24. The address for this locomotive is now stored in one of the two memory locations.

Pressing the 'ESC' key toggles the display to the second memory location, containing for example the address 22. If you now want to control the locomotive at address 78, press the 'CI' key, enter the address 78 and confirm by pressing 'Enter'.

The 'ESC' key will toggle between the addresses 24 and 78 from now on. When the 'CI' key is pressed, the address in the display will be erased, the second address will be retained.

Changing the content:	Toggle between memory 1 and 2:	Changing the content:
memory 1 old address		memory two old address
 Enter new address		 Enter new address
memory 1 new address		memory 2 new address

Taking over a locomotive from another LH100

A locomotive selected on one LH100 can be taken over by a second LH100. When the locomotive is selected on the second LH100, all the information on this locomotive will be blinking on the first LH display.

If you do not want to take control of this locomotive from the second LH100, but want to observe the current operational status, repeated pressing of the 'Enter' key will update the displayed information. If for example the throttle setting is changed from the first LH100, it will be shown on the second display.

You can take control of the locomotive to your LH100 by pressing one of the following keys:

The display stops blinking and shows the latest operational data. The display on the other LH100 starts blinking. Only the next command is actually sent to the locomotive, preventing unwanted sudden changes in operational characteristics.

Double Headers

The LH100 features a simple procedure for combining two locomotives into a double header, operating both locomotives as if they were one.

Requirements for a double header

- Both locomotives that you want to combine into a double header need to be selected by the same LH100.
- Each locomotive must have received a command (change in the throttle setting or activation of one of the accessory functions)
- The throttle setting for both locomotives must be 0.

It is not possible to assign a conventional locomotive (address 0) to a double header! In this case, you will receive an error message.

Combining two locomotives into a double header

Please select the first locomotive (for example, No. 24) and move it to the position on your layout where you want to build the double header.

Now select the second locomotive (for example, No. 78) and run it to the first locomotive.

This procedure ensures that both locomotives are selected on your LH100 and both have received a command.

Ensure that both locomotives are moving in the same direction.

The arrows indicating the direction on the display might still be pointing in different directions, since the direction is referenced to the locomotive, which might be coupled back-to-back or front-to-front.

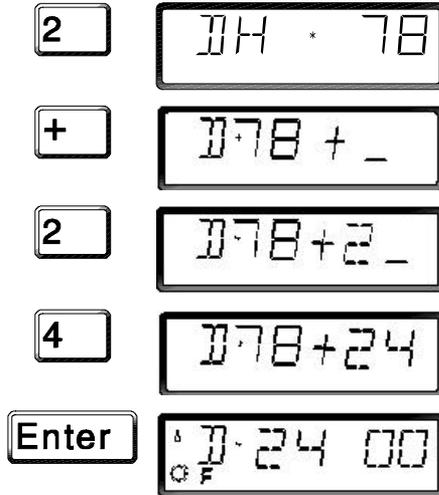
Proceed as follows:

press



the display shows





In case you make an error entering the locomotive address, you can clear the last entry by pressing the 'C' key. Confirm your entry by pressing the 'Enter' key.

Operating a double header will be indicated by the letter 'D' instead of 'L' {'E'} on the display. The letter is followed by the address of the last locomotive entered. The last two digits indicate the throttle setting for the double header. The direction arrow and the indication of the accessory functions is similar to a single locomotive.

The double header can now be operated like a single locomotive using the appropriate keys.

While operating a double header, the keys for the *throttle setting* and the *direction* work on both locomotives *simultaneously*. The *function* keys will *only operate on the locomotive address* shown in the display.

If you want to activate a function in the second locomotive of the double header, you have to select this locomotive first. Only then can a function be activated or deactivated on this locomotive.

If you want to find out which is the second locomotive address belonging to a double header while operating it, press the '+' key. As long as the '+' key is pressed down, the LH100 will display

the address of the second locomotive instead of the throttle setting.

press the display shows



Combining locomotives with an unequal number of throttle notches into a double header

Locomotives with an unequal number of throttle notches can be combined into a double header. The throttle setting shown corresponds to the velocity.

Example:

The locomotive with address 24 has 14 throttle notches; the locomotive with address 78 has 28 throttle notches. If you see throttle setting 14 displayed for address 14, then, after selecting address 78, the throttle setting 28 will be displayed, since this is the corresponding setting.

Error messages while setting up a double header



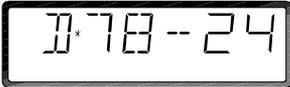
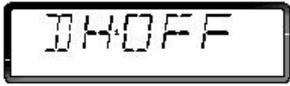
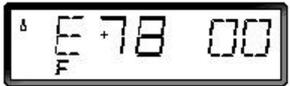
If you make a mistake setting up the double header, one of the following error messages will appear in the display:

ERR 20:	The locomotive was not selected or no command was sent prior to setting up the double header. You have attempted to use a conventional locomotive (address 0) in a double header.
ERR 21:	One of the two locomotives of the double header is already selected on another LH100.
ERR 22:	One of the two locomotives is already part of another double header.
ERR 23:	One of the two locomotives was not at throttle 0 as you were combining them.

Please press the 'Cl' key to return to locomotive operation.

Dissolving the double header

Select one of the two locomotives of the double header on your LH100 and enter the following commands:

press	the display shows
	
	
	
	

You can stop this process at any time by pressing the 'ESC' key.

After dissolving the double header, the letter 'L' {'E'} will be displayed in front of the address.

IMPORTANT:

A double header can be dissolved even if the throttle setting is not 0!

Emergency STOP/Emergency shutdown (OFF)

In the event of an emergency, for example an impending collision, all trains can be stopped by calling an emergency STOP. In this case, the power supply, the track voltage, and the data transmission within the DIGITAL plus system will remain switched on. Calling an emergency shutdown (OFF {AUS}) will switch off the track voltage.

press	the display shows
	

app. 2 seconds



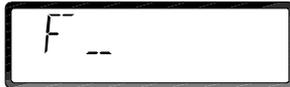
app. 1 second



All locomotives will be stopped without a delay, but the track voltage remains on. The display will show the "Off/On" message. These three message will continue to cycle through the display. Now you have two choices:

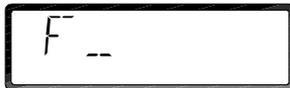
The sequence 'F' and '1' resets the emergency STOP condition, all locomotives will resume at their original throttle setting and direction.

press the display shows



Or you can activate an emergency shutdown (OFF {AUS}) with the sequence 'F' and '0'. In this case, the track voltage will be switched off. This might be useful for rereiling a locomotive.

press the display shows



The display will continue to show the emergency shutdown (Off/On) message:

app. 2 seconds



app. 1 second



These two messages will be displayed alternatively.

'OFF' {'AUS} indicates that the track voltage is switched off. 'ON F1' {'EIN F1'} indicates the key sequence to reset the emergency condition. All locomotives will resume at their original throttle setting and direction.

The message "Off/On" appears on all connected LH100's after calling an emergency STOP or shutdown. A shutdown of a Power Station due to excessive current draw will also be indicated by the emergency STOP message. It might take up to three seconds for the LH100's to return to locomotive operation after resetting an emergency condition on one of the LH100s.

The locomotive operation mode during an emergency condition

You can send commands to a locomotive during an emergency condition.

Press the 'ESC' key while the "Off/On" message is displayed. The LH100 will switch to the locomotive operation mode and the display will switch to the last locomotive selected. You can now change all operational data of that locomotive, or select a different locomotive. Every time you are pressing the 'ESC' key while the emergency condition has not been reset, the message will "Off/On" appear as a reminder.

The accessory function during an emergency condition

The track voltage is on during an emergency STOP condition. Therefore, you have full control over all accessories.

First select the locomotive operation mode by pressing the 'ESC' key. You can now change to the *accessory* function as described in the next section.

The Accessory Function

The accessory function gives the Hand Held LH100 access to throw turnouts, signals, or relays. These devices have to be connected to the accessory decoder LS100/110/120/130 of the DIGITAL plus system, or to the decoder k87 (Märklin); k87N (Arnold); CO87 (Cordes) or other NMRA DCC accessory decoder.

Selecting the accessory function

press	the display shows
F	FUNC* _
5	5/T*_

Enter the number (address) of the turnout or signal that you want to send a command to. The address can have up to three digits.

press	the display shows
1	5/T+1_
6	5/T+16_
Enter	70 16 +

You can use the 'C' key to correct your input and you have to confirm by pressing 'Enter'.

Allowed addresses are 1 to 256. If you are entering a smaller or larger number, the display will briefly blink



and ask you to re-enter a valid address.

A '+' or '-' sign will appear behind the address of the turnout (or signal) to indicate the turnout's position.

Using the keys



and



the status of the output on the accessory decoder can be changed, throwing the turnout or setting a signal.

If you want to throw another turnout, press the 'C' key and enter the number of the turnout (or signal) that you want to select.

Display of the turnout setting

Using the accessory decoder LS100 with feedback, it is possible to receive an indication of the real position of the turnout after selecting it.

For example, the turnout No. 18 is powered down and correctly connected to an accessory decoder LS100. Enter the number of the turnout. The LH100 receives a message from the Command Station that the decoder is set up for feedback and displays the following:



The 'R' on the left side informs you that the accessory decoder for this turnout number is in feedback mode.

After selecting the turnout, the position '+' is displayed. After pressing the '-' key to throw the turnout, the display is only going to change to '-' after the turnout is in its end position. Otherwise, the original indication will remain. Therefore, you will be able to see immediately, if the turnout has been thrown or not. The indication will change after throwing the turnout by hand, too.

HINT: The time between giving the command and receiving the new indication will depend on the time that the turnout needs to reach its end position.

Further information on wiring the feedback bus is given in the manual for the decoder with feedback.

If the turnouts are not enabled for feedback or are connected to an accessory decoder without feedback from the Märklin or Arnold system (e.g. k87 or k87N), no feedback will be given to the LH100. In this case, the LH100 will show the position according to the last command sent to the decoder ('+' or '-'). Furthermore, the indication will change immediately after the command is sent.

If you see the following display after selecting, for example, the address 118, then the address does not correspond to an accessory decoder but a feedback encoder LR100.



In this case, the keys '+' and '-' are without function. Pressing the 'CI' key allows you to enter a different address, pressing the 'ESC' key selects the mode locomotive operation. More information on reading a feedback encoder is given in the chapter "The Feedback Display Function" on page 24.

Operating locomotives while in the accessory function

While the display is showing the address of an accessory and its status, you can still use the keypad to operate the locomotive selected before entering the accessory function.

While pressing one of the operational keys, the locomotive address will appear in the display. The direction arrow and the status of the locomotive accessory functions will be displayed continuously. Therefore, it is very convenient to operate a selected locomotive while setting turnouts or signals, e.g. throwing a turnout during a switching move.

The Feedback Display Function

This function of the Hand Held LH100 allows you to display the status of the inputs of the Feedback Encoder LR100.

Selecting the feedback display function:

press	the display shows
	
	

Assume you want to display the 8 inputs at the feedback address 39.

press	the display shows
	
	
	

As discussed in previous sections, the 'Cl' key allows you to clear an erroneous key stroke.

After confirming the command by pressing 'Enter', the LH100 inquires the status of the feedback encoder at the Command Station and displays the result.

The top line of the display shows 'RM' {'OD'} for feedback and the selected address.

The bottom line shows a 'b' (for binary display) and the status of the 8 input lines. For example, the display 1 3 4 6 8 means, that

the inputs 1, 3, 4, 6, and 8 are active. (a negative potential was detected on these inputs of the LR100)

If you want to display the status for a different feedback address, press 'Cl' and enter the new address.

If you enter an address that is not assigned to a feedback encoder, the display shows '-' behind the address. No binary display is given.

The allowed address range for feedback encoder is 1 to 127. If you enter an address outside of this range, the display will blink 'ERR 10' and ask you to enter another address.

Programming and Reading Decoder Properties

The specific features of a locomotive decoder, an accessory decoder or a feedback encoder in the DIGITAL plus System can be customized by the user. These features can be read, displayed and/or changed by the LH100 as often as you want and once changed they retain their new value until changed again. The reason this is possible is that each of these settings is stored in the decoder in its internal memory. Customizing a particular decoder is called *programming*. The specific decoders memory locations, that can be set or read by the user, are called *Configuration Variables*, or CVs. This section will describe methods for using the LH100 to read and write these decoder CVs.

In 1996 the National Model Railroad Association completed a Recommended Practice that describes how DCC Command Stations should program decoders. The DIGITAL plus System Version 2.2 is the first commercial system that fully implements all aspects of this RP and has earned the NMRA Conformance Warrant.

Digital plus System Version 2.2 also implements *Safe Programming*. Safe Programming means that low current power is only applied to the programming track when you are actually performing a programming operation. At other times no power is

sent to the programming track. This is a much safer form of programming because if you have mistakenly wired your decoder, Safe Programming will normally protect your decoder from being harmed. For this reason we always recommend you take all locomotives to the programming track to check them out each time you alter the decoder installation.

The combination of Safe Programming and compliance to RP-9.2.3 means that you will be able to program all NMRA DCC decoders from any manufacturer with your DIGITAL plus version 2.2 system.

Setup

Before you can program a decoder the decoder has to be connected to the programming output of the Command Station LZ100 (terminals P and Q). Please check the manual of your Command Station for further information on proper installation of your programming track.

Sending the Command Station LZ100 into programming mode will stop all operations on your model train layout!

What is a CV - Configuration Variable ?

The NMRA (**N**ational **M**odel **R**ailroad **A**ssociation) is an organization of model railroaders, mainly based in North America, and is the largest organization of its kind world wide. Independent expert members of the NMRA developed Standards and Recommended Practices for DCC, based on an early version of the DIGITAL plus System. Among other features, this Recommended Practice advises on the use of different memory locations in locomotive decoders. These memory locations store the properties of the locomotive decoder. (For example the address or the momentum setting) In this recommended practice, the memory locations are called "**C**onfiguration **V**ariable, CV". For example, the address of the locomotive decoder is stored in CV 1, the momentum setting in CV 3. More information on specific CV assignments is given in the manuals supplied with the decoder.

IMPORTANT:

On the LH100 you can program all memory locations to values from 0 to 255. These values will be programmed into the decoder. Ensure that the value you are using is within the range of allowed values for the decoder! This information can be found in the information for the decoder. For example, you could program a locomotive decoder for the address 127. Subsequently, you will not be able to address that locomotive decoder anymore, since the range of allowed addresses for a locomotive decoder using the DIGITAL plus System is only 0 to 99 !

If you try to program the decoders address (CV#1) to a value larger than 99, the display will show



Pressing the 'ESC' key aborts the operation and allows you to enter a different value.

If you want to program a decoder to a value larger than 99 in this memory location, (for example an accessory decoder) confirm the operation by pressing 'Enter'. The new value will be stored in the decoders memory location as indicated.

Programming methods

Your DIGITAL plus System implements many different methods to program your decoder. This was done to allow you to program ALL decoders on the market. The various forms are Direct CV mode, Register Mode, and Paging Mode. If your decoder supports indexing, this can be accomplished using Register Mode (see your decoder manual for details).

In order to make programming as convenient as possible to the user, your Digital plus System will automatically convert from Direct CV mode to Register mode for the most common CVs. For this reason we suggest you start with direct CV mode if you are uncertain which mode your decoder supports.

Entering programming mode

press the display shows

F

FUNC*

8

PRGG*

Enter

OFF

(blinking)

'OFF' {'AUS'} blinks as a reminder that the operation of the layout is stopped while programming. Confirm by pressing 'Enter'. (the 'ESC' key returns to the mode locomotive operation).

press the display shows

Enter

CV

At this point you can begin programming in Direct CV mode or using the '+' key you can switch to an alternate programming mode (Paging or Register). If the last time you were programming you used Register or Paging mode, the display will indicate this value instead. Using the '+' key you can switch back to CV mode.

Note only one LH100 may be in programming mode at a time
Once you begin programming all other LH100 displays will display

FM

Entering Direct CV Programming Mode

You can enter Direct CV mode by pressing 'ENTER' any time the LH100 display has 'CV' on it.

Each time you enter direct CV programming mode from the 'PROG' display, your DIGITAL plus System will attempt to read the most common CVs from the decoder. This can take approximately 12 seconds.

press the display shows



The display is now blinking 'SEARCH' {'SUCHE'}. The Command Station is reading the decoder connected to the programming output and checks for a manufacturers code.

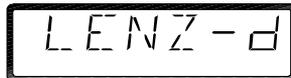
There are two possibilities:



The Decoder did not respond with a manufacturer's code. Normally this means that the decoder is an older decoder that does not support direct CV mode. In this case, the programming has to be done using Register or Paging modes, as described in the section "Programming using the Register Mode", or "Programming using Paging starting on page 34. If you press 'ENTER' at this point the DIGITAL' plus System will automatically enter Register Mode Programming.



The Decoder implements the NMRA direct CV mode programming. The manufacturer's code will be displayed as a number, for a DIGITAL plus decoder, the display will show:

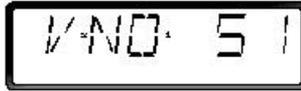


If a manufacturer's code is read, all the important status information of the decoder will be read simultaneously. CV 29 (read automatically) identifies the decoder as a locomotive or accessory decoder. If the decoder is a locomotive decoder, the version number, address, starting voltage, acceleration and

brake momentum, and value of CV 29 are displayed. Press any key except 'Cl', (this key allows you to skip the display of the properties) and you will see:

press and the display shows

any key



any key



any key



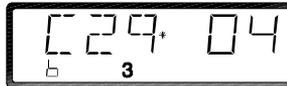
any key



any key



any key



In this example, the decoder has the following properties:

Version number (VNO)	51
Starting voltage (STV)	05
Acceleration (ACC)	09
Brake momentum (DEC)	03
CV 29	04

The last value (CV 29) will be shown both as a number and as a binary representation. (For information on the binary mode, see page 41.)

any key



At this point you have entered Direct CV mode and you can read or write any CV directly.

Programming a decoder using direct CV mode.

This method of programming requires a Command Station version 2.1 or higher and a decoder that implements the NMRA recommended practice for direct CV mode.

IMPORTANT:

Only decoders that implement Direct CV Programming according to the NMRA Recommended Practices can be programmed with this method. Please consult the decoder manual if you are unsure about the capabilities of your decoder. If you try to program a decoder that does not implement this method you will get an 'ERR 02' on the display. Your DIGITAL plus System will automatically convert to Register mode if you try to read or write any of the first 4 CVs and your decoder does not support Direct CV mode.

After completing the search function or if you entered this mode after programming in another mode, you can read or program any CV. Please enter the CV that you want to read or reprogram. In the following example, CV#1, the address of the decoder is programmed.

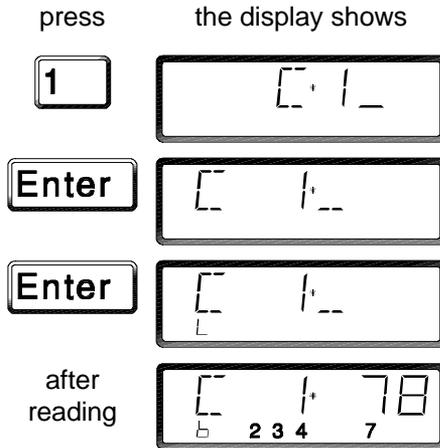
Information on the properties of each CV can be found in the manuals for these components or in the recommended practice of the NMRA.

Reading the address (CV#1) of a locomotive in Direct CV mode:

The display will show:



Press the key '1' to select CV 1 and start the request by pressing 'Enter'.



Reading the memory location might take a moment. During this time, the letter 'L' is displayed on the bottom line.

After reading the CV, the display will show its value to the right of the CV in the top line of the display. In this example, it is CV 1, address 78.

The bottom line of the display will show a lower case 'b' and to the right a *binary representation* of the value. More information on this subject is given in the section "Programming a value in *binary mode*" on page 41 and in the manual for the decoder.

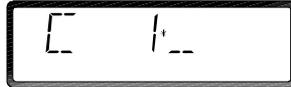
If the decoder could not be read, an error message will appear. A table of possible error messages is given in the section "Error messages while programming or reading a decoder" on page 45.

This display can be cleared by pressing 'Cl'.

Programming the address (CV 1) of a locomotive in Direct CV mode:

Directly after reading an address, it can be reprogrammed. Clear the display of the current address by pressing 'Cl'.

The display shows



Enter the address you want to program into the decoder:

press the display shows



Ensure that you stay within the allowed range of values for the decoder. If you are unsure about the range of allowed values for the decoder, please read the manual of the decoder. An incorrect input can be cleared by pressing 'Cl'.

Confirm the programming by pressing 'Enter'.

press the display shows



The newly programmed address is shown on the right hand side of the top line.

The bottom line of the display will show again the binary representation of this value. More information on entering values in binary mode is given in the section "Programming a value in *binary mode*" on page 41 and in the manual for the decoder.

Programming the other properties of the locomotive is performed in similar manner. Instead of using CV 1 for the address, you could for example program the brake momentum at CV 4.

Programming using Register Mode

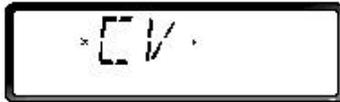
Register mode is entered by pressing the 'ENTER' key when 'REG' is displayed on the screen. (after entering programming mode)

The display will show:



press

the display shows



Now enter the number of the memory location or register you want to read or program. The assignment of memory location to each feature is described in the manual of the decoder. It will also give the correct range of values for that memory location.

In the following example, you will learn how to read the locomotive address and program it to a different value. Programming the other properties follows along the same steps.

Reading a locomotive address using Register Mode:

Press the key '1' to select the memory location for the locomotive address, and start the inquiry by pressing 'Enter'.

The display will show:



press the display shows

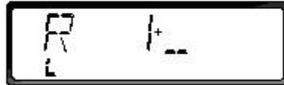
1



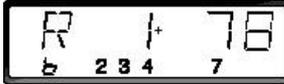
Enter



Enter



after
reading



Reading the memory location might take a moment. During this time, the letter 'L' is displayed on the bottom line.

After reading the locomotive address, the display will show it to the right of the memory location in the top line of the display. In this example, it is location 1, address 78.

The bottom line of the display will show a lower case 'b' and to the right a *binary representation* of the value. More information on this subject is given in the section "Programming a value in *binary mode*" on page 41 and in the manual for the decoder.

If the decoder could not be read, an error message will appear. A table of possible error messages is given in the section "Error messages while programming or reading a decoder" on page 45.

This display can be cleared by pressing 'Cl'.

Programming the locomotive address in Register mode:

Directly after reading an address, it can be reprogrammed. Clear the display of the current address by pressing 'Cl'.

If you have not read the address yet, and your LH100 is still in the mode locomotive operation, select the function programming and reading decoder properties as described above. Enter the memory location for the address. (key '1', 'Enter')

The display shows



Enter the address you want to program into the decoder for the example we use address 78:

press the display shows

7



8

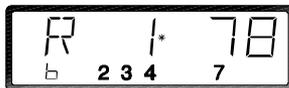


Ensure that you stay within the allowed range of values for the decoder. If you are unsure about the range of allowed values for the decoder, please read the manual of the decoder. An incorrect input can be cleared by pressing 'Cl'.

Confirm the programming by pressing 'Enter'.

press the display shows

Enter



The newly programmed address is shown on the right hand side of the top line.

The bottom line of the display will show again the binary representation of this value. More information on entering values in binary mode is given in the section "Programming a value in *binary mode*" on page 41 and in the manual for the decoder.

Programming the other properties of the locomotive is performed in similar manner. Instead of using the memory location 1 for the

address, you could for example program the brake momentum at memory location (Register) 4.

Programming and reading of memory locations on accessory decoders and feedback encoders is similar to programming the locomotive address. Information on the properties of each memory location can be found in the manuals for these components.

Programming using Paged Mode

Many older decoders implement paged mode rather than direct mode for programming. Your Digital plus System fully supports page mode so that you can successfully program these decoders. However, many other decoders do not implement paging. If paging is done on these decoders unexpected results can occur. It is recommended you consult your decoder manual before using Paged Programming Mode to program a decoder.

Paged mode is similar to Direct CV mode in that you enter the actual CV# to read or write a CV. It differs in that it actually uses a form of Register mode. As such, the operation is somewhat slower. Care should be taken not to remove the locomotive from the programming track while paged mode is working as the decoder may be left in a state that some command stations may have difficulty in subsequent programming.

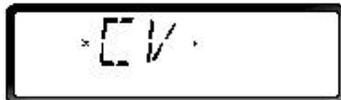
Paged mode is entered by pressing the 'ENTER' key when 'PAG' is displayed on the screen. (after entering programming mode)

The display will show:



press

the display shows





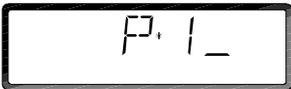
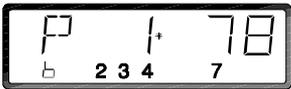


Now enter the number of the CV you want to read or program. The assignment of CVs to each feature is described in the manual of the decoder. It will also give the correct range of values for that memory CV#.

In the following example, you will learn how to read the locomotive address and program it to a different value. Programming the other properties follows along the same steps.

Reading a locomotive address using Paged Mode:

Press the key '1' to select the memory location for the locomotive address, and start the inquiry by pressing 'Enter'.

press	the display shows
	
	
	
after reading	

Reading the memory location might take a moment. During this time, the letter 'L' is displayed on the bottom line.

After reading the locomotive address, the display will show it to the right of the memory location in the top line of the display. In this example, it is location 1, address 78.

The bottom line of the display will show a lower case 'b' and to the right a *binary representation* of the value. More information

on this subject is given in the section "Programming a value in *binary mode*" on page 41 and in the manual for the decoder.

If the decoder could not be read, an error message will appear. A table of possible error messages is given in the section "Error messages while programming or reading a decoder" on page 45.

This display can be cleared by pressing 'C'.

Programming the locomotive address using Paged Mode:

Directly after reading an address, it can be reprogrammed. Clear the display of the current address by pressing 'C'.

If you have not read the address yet, and your LH100 is still in the mode locomotive operation, select the function programming and reading decoder properties as described above. Enter the memory location for the address. (key '1', 'Enter')

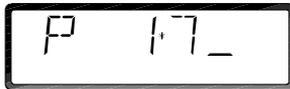
The display shows



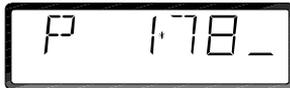
Enter the address you want to program into the decoder for the example we use address 78:

press the display shows

7



8



Ensure that you stay within the allowed range of values for the decoder. If you are unsure about the range of allowed values for the decoder, please read the manual of the decoder. An incorrect input can be cleared by pressing 'C'.

Confirm the programming by pressing 'Enter'.

press the display shows



The newly programmed address is shown on the right hand side of the top line.

The bottom line of the display will show again the binary representation of this value. More information on entering values in binary mode is given in the section "Programming a value in *binary mode*" on page 41 and in the manual for the decoder.

Programming the other properties of the locomotive is performed in similar manner. Instead of entering a '1' (CV#1) to select the address, you could for example program the brake momentum (CV#4) by entering a '4' at this same step. Information on the properties of which CVs can be used in paging mode can be found in the manuals for these components.

Changing between CV, Register and Paged programming modes

As the LH100 is waiting for the input of a memory location or a CV, the method of programming can be changed.

You do not have to leave the programming mode. Simply press the '+' key if your display is waiting for which CV or Register you wish to program or press the 'ESC' key once first if you are in the middle of programming.

press or press



The display now shows one of the three programming modes. Press the '+' key. With each key press, the display will change as follows:



(Programming using Direct CV Mode)

or



(Programming using Paged Mode)

or



(Programming using Register mode)

Select the method you want to use and press 'Enter'. If you do not want to change the current selection, abort by pressing 'ESC'.

IMPORTANT:

You can always change the method while you are programming. Remember to only select the 'PAG' method of programming if the decoder manual indicates that your decoder allows this. You can also only use the 'CV' mode if your decoder supports this. If you try to program the first four CVs in Direct CV mode and your decoder does not support this mode, the DIGITAL plus System will automatically convert to Register mode.

Programming a value in binary mode

After reading the memory location of a decoder, it can be reprogrammed using the binary mode. This mode is useful for certain decoders, where only some bits at the memory location should be changed.

In this case, it does not matter which programming mode you are using.

More on bits and bytes:

The memory locations on the decoder store *decimal* numbers in *binary* representation. This is just a different way of writing a decimal number. In the binary representation, the numerals 0 and 1 are used instead of the numerals 0 to 9. Therefore, the binary representation needs more numerals to express a given number. The number "5" is written "101" in binary representation.

Each memory location has room for 8 numerals, called 'bits'. Each bit can be "0" or "1". Writing a "1" to a bit is called *setting* the bit, writing a "0" to a bit is called *erasing* the bit.

A byte is a collection of 8 bits. Therefore, each memory location is a byte. With 8 bits, the numbers from 0 to 255 can be represented.

Each bit has a value, the bits are "numbered".

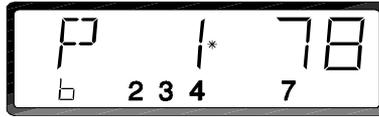
The bit with the lowest value is written to the left, and the bit with the highest value on the right. This definition is somewhat arbitrary, we could define it just the other way around, too. Since the bit numbering may differ between manufacturers, please consult your decoder manual for more information. The number 78 is represented in DIGITAL plus as follows:



Writing the address 78 to a memory location of a locomotive decoder will erase bit 0, set bit 1, etc.

As mentioned before, after reading a memory location, its value

will be displayed in binary representation on the bottom line of the display. This enables you to see which bit is set or erased. Only the value for the set bits will be displayed in the bottom line.



As you can see, for the address 78 the bits 2, 3, 4, and 7 are set for memory location 1.

You can now erase or set the bits by pressing the keys 1 to 8. The decimal value will be automatically shown in the top of the display.

press the display shows



Pressing the 'Enter' key writes the value to this memory location or CV.

Ensure that the resulting value lies within the range of allowed values for this location.

More information on the influence of setting and erasing certain bits is given in the manual for the decoder.

Display on all other connected LH100's

While the Command Station is in the programming mode, the displays of all other LH100's will show:



You cannot use the other LH100's for input while the Command Station is in the programming mode, since no information is moving over the XBUS. Therefore, do not disconnect any device from the XBUS while the Command Station is in programming mode! The programming mode can only be ended from the LH100 that it was started from. If you accidentally disconnect a device, please refer to the "Trouble Shooting Guide" to end the programming mode.

Ending the programming mode

At any time during the programming, you are able to go back to the beginning of the programming.

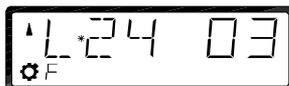
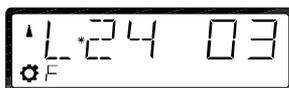
press the display shows



You can now select another decoder for programming or reading.

To exit the programming mode and return to the mode locomotive operation, press the 'ESC' key again. The display will return to the last address and status information before entering the programming mode:

press the display shows



In this example, it was the locomotive at address 24.

The layout will resume operation.

Error messages while programming or reading a decoder

While programming or reading decoder properties, the following error messages may appear on the LH100:

ERR 01:	A short circuit was detected during programming or accessing a decoder. Ensure that the decoder is wired correctly and is not defective.
ERR 02	No information was found during programming or accessing of a decoder. Ensure that the decoder is correctly connected to the programming output of the Command Station LZ100. (e.g. the digital locomotive might be derailed)
ERR 10:	The user pressed the 'ENTER' key when LH100 is expecting a user entry such as the value of the CV to read or program.

Repeat the programming sequence. If the error message remains after several attempts, try to program a different memory location. If you are successful, try to program the original location. If it is still not possible, a defect on the decoder might have occurred.

The Setup Function

The setup function allows the setting of device specific properties, e. g. the device address of the LH100, or the behavior of the DIGITAL plus system upon powering up the system. Furthermore, you can display the software version of the LH100.

Selecting the setup function

press the display shows





Press the key 'F' followed by '9'. Now you can select the device properties by pressing '1' to '9'.

Display the software version of the LH100 and the Command Station

As you know from the DIGITAL plus information, all the properties of the DIGITAL plus system components are determined by the software, a program that runs inside these components. Each piece of software has a version, which will tell you which properties a device has and which devices will work together at which level of functionality.

Display the software version of the LH100:

Select the function setup as described above. Proceed as follows:

press the display shows

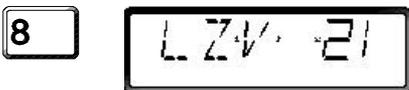


The software version of the Hand Held LH100 will be displayed, in the example version 2.1.

Display the software version of the Command Station:

Select the function setup as described above. Proceed as follows:

press the display shows



The software version of the Command Station LZ100 will be displayed, in the example version 2.1.

Selecting the start up mode of the system

The function setup allows you to select the start up mode of your system. You can select to have your locomotives

continue with the previous settings	Start up mode AUTO
or	
be manually selected	Start up mode MAN

Display the start up mode:

Select the function setup as described above. Proceed as follows:

press the display shows

1

545 _

1

MAN

In this example, the mode MAN is displayed.

Changing the start up mode:

Begin by displaying the current start up mode. If the automatic mode is selected, AUTO will be displayed. If the manual mode is selected, MAN will be displayed.

You can now toggle between the start up mode MAN and AUTO:

press the display shows

+

AUTO

+

MAN

Confirm your selection by pressing 'Enter'. the new setting will be stored in the Command Station.

If you select the start up mode AUTO for your system (locomotives will continue at their previous settings), the LH100 will display the message AUTO after switching the system on. At this point, you have the choice to either continue with the automatic start or to select manual start.

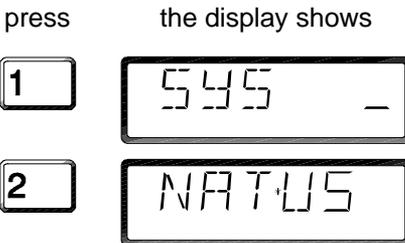
Pressing the 'Enter' key will start your locomotives with their old settings.

Pressing the '-' key changes the display to MAN. if you press 'Enter' now, the throttle setting for all locomotives will be set to 0, the locomotives will not start to roll. In both case the LH100 will be in the mode locomotive operation.

Language preference

For the LH100, you can select between display in German or English(American) language.

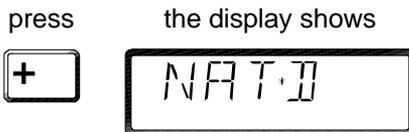
Select the function setup as described above. Proceed as follows:



In this example, the language preference is English.

Changing the language preference:

You can now select between display in German or English.





Confirm your selection by pressing 'Enter'. The selection will be stored in the Command Station. Pressing the 'ESC' key exits the function SYS.

The table on page 52 compares important displays in the two languages.

Connecting several LH100's

All devices connected to the XBUS have to have their own *device address* to allow an orderly transfer of commands and information. You have to ensure that all devices connected to the XBUS have an unique address. The maximum number of device that can be connected to the XBUS is 30, therefore the address range is 1 to 30. Every LH100 is factory pre set for address 01. If you want to use two or more LH100's, their device addresses need to be changed.

Changing the device address on the LH100

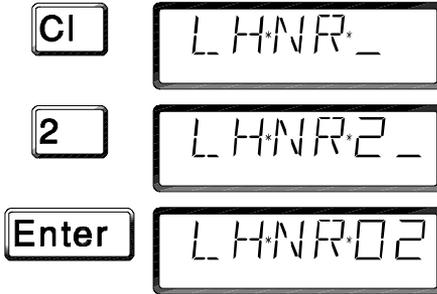
Select the function setup as described above. Proceed as follows:

press the display shows



The LH100 will now display its current device address, in this example the address 01. (factory default) If another LH100 is using this address, you have to change the device address, for example to address 02:

press the display shows



Any mistakes in entering this sequence can be corrected using the 'CI' key. After entering the correct sequence, confirm by pressing the 'Enter' key.

The new device address will be stored in the LH100. It will be preserved even when the LH100 is switched off. (disconnected from the XBUS)

The display will show 'SET_'. To return to the mode locomotive operation, you have to press the 'ESC' key.

Disconnecting the LH100 during Operation

The cable on the LH100 is limited in length. During operation, you can disconnect the LH100 from one connector plate, move to the next one, and reconnect. The LH100 will be immediately operational and, after briefly showing the LH100 message, display the locomotive selected before.

Important:

Do not remove any LH100 while the Command Station is in programming mode! If you accidentally disconnect a LH100 while the Command Station is in programming mode, please check the "Trouble Shooting Guide" for help.

Error Messages on the LH100

This section will give you an overview over the various error messages that might appear in the display after a mistake, or if a selected function cannot be executed. Error messages that do not blink have to be cleared with the 'C' key.

ERR 01:	A short circuit was detected during programming or accessing of a decoder. Ensure that the decoder is wired correctly and not defect.
ERR 02:	No information was found during programming or accessing of a decoder. Ensure that the decoder is correctly connected to the programming output of the Command Station LZ100. (e.g. the digital locomotive might be derailed)
ERR 10:	The last number entered was out of the permissible range. This message will blink for a short time, it does not need to be cleared using the 'C' key.
ERR 20:	The locomotive was not selected or no command was sent prior to setting up the double header. You have attempted to use a conventional locomotive (address 0) in a double header.
ERR 21:	One of the two locomotives of the double header is already selected on another LH100.
ERR 22:	One of the two locomotives is already part of another double header.
ERR 23:	One of the two locomotives was not at throttle 0 as you were combining them.

ERR 97:	An error occurred during data processing. All information about throttle settings, directions and accessory functions for all locomotives and about the status of turnouts and signals were erased. The battery in the Command Station might be drained, if this error occurs repeatedly. This battery powers the memory for data storage after powering down the system. Please contact your dealer of Lenz to replace the battery.
ERR 98:	The command send by the LH100 is not recognized by the Command Station. The Command Station uses a different software version than the LH100, which does support this command. Please read out the software version of your command station and contact your dealer or Lenz.
ERR 99:	General system fault. The LH100 did not receive the expected reply after sending a command or a request to the Command Station. This fault might be caused by a problem on the XBUS. Please check all connections and ensure that the cables are laid out as twisted pairs according to the manual. The Command Station or the LH100 might be defective. Please contact your dealer or Lenz.

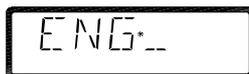
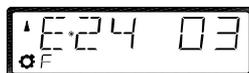
Table of language displays

The following table compares the most important displays for the different language versions.

"German"



"English"



"German"

F--ST 14

FKT. _

DTR. 78

DTRAUS

AUS

AUS. FO

EIN. FI

S/W..

√W0 16 +
F

RM. _

RM:39
b 1 3 4 6 8

SUCHE

HST. 99

"English"

S--ST 14

FUNC. _

DH . 78

DHOFF

OFF

OFF. FO

ON. FI

S/T..

√T0 16 +
F

DD. _

DD:39
b 1 3 4 6 8

SEARCH

MF. 99

Trouble shooting guide

Fault	Problem	Solution
LH100 not working. (Display does not come on after plugging in)	The wires L and M on the connector are not wired or exchanged.	Check the wiring on the female connector.
The LH100 displays repeatedly 'LH100' after plugging it in.	The wires A and B are exchanged or shorted out.	Check the wiring of cable A and B.
	The device address for the LH100 is already used by another device.	Change the device address.
	The Command Station is in programming mode.	<p>End the programming mode using the LH100 that it was started from. If it is the LH100 you are using at this point, proceed as follows:</p> <p>Remove the LH100 from the connector. Press the 'F' key while you reconnect the LH100. After the message 'LH100', the display will show 'F_'. Press '0'. This will abort the programming mode, the locomotive address used last will be shown in the display.</p>
The messages on the display do not correspond to the ones shown in this manual.	The language preference is set incorrectly.	Change the language preference as explained on page 48.
The message **PM** blinks on the display.	The Command Station was set into the programming mode from another LH100.	Stop the programming mode from the LH100 that started it.
The display on the LH100 blinks after entering an Locomotive address.	The locomotive is already selected by a different input device.	Input a command to takeover the locomotive or select a different locomotive.

Fault	Problem	Solution
The display alternates between 'STOP', AUS F0', and 'EIN F1'	An emergency STOP was caused from another LH100.	Reset the emergency condition by pressing 'F' and '1'.
The display alternates between 'OFF' and 'ON F1'.	An emergency shutdown was caused from another LH100.	Reset the emergency condition by pressing 'F' and '1'.
	The Power Station caused the shutdown because of a short circuit or to high current draw.	Remove the short circuit. If the current draw is too high, divide the layout into several sections with independent Power Stations. Please read the section 'Supplying Power to a large model train layout' in the manual for the Power Station LV100.
Locomotive does not react to commands.	Wrong locomotive address.	Select the correct locomotive address. If necessary, read back the locomotive address to find the correct one.
	The connection between the Command Station and the Power Station, or between the Power Station and the track is broken.	Check all connections and correct any problems.
The headlights of the locomotive come on for even throttle settings, go out for odd throttle settings, and cannot be changed at throttle '0'.	The locomotive decoder is set up for 14/27 throttle notches, but the Command Station has stored 28 throttle notches for this address.	Change the assignment of throttle notches to this address to 14 or 27.
The headlights cannot be switched on or off with the '0' key.	The locomotive decoder is set up for 28 throttle notches, but the Command Station has stored 14/27 throttle notches for this address.	Change the assignment of throttle notches to this address to 28.

Fault	Problem	Solution
Turnout is not throwing.	Wrong turnout address.	Select the correct turnout address.
	The connection between the Command Station and the Power Station, or between the Power Station and the accessory decoder is broken.	Check and repair the connections.
	There is no accessory decoder at the address entered, but a feedback encoder LR100. This can be seen from the two horizontal lines behind the address in the display, for example:	Select the correct turnout address.



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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.