Digital plus
by Lenz
SILVER Decoder
Operating Manual
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Contents

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1 Important advice, please read first!

All features described here as well as advice given on programming and operation only apply to the SILVER decoder series. Other *Digital plus by Lenz* ® decoders may have identical or similar features, but they may be operated or programmed differently. Please use this manual only for decoders of the SILVER series.

Digital plus locomotive decoders are to be used only with *Digital plus by Lenz* ® or other standard digital control systems with an NMRA-conformance seal and on NEM-conform DC systems. If in doubt, ask the system supplier.

The current-carrying capacities noted in the technical data may not be exceeded as this could damage the decoder! Under no circumstances may the parts of the locomotive decoder be allowed to touch the metal components of the chassis or the body of the locomotive as this could cause a short-circuit within the locomotive decoder leading to damage.

Never wrap the locomotive decoder in insulating tape as this prevents the necessary air circulation around the decoder. Instead, use insulating tape or something similar around the metal components of the locomotive to avoid unintentional short-circuits without depriving the decoder of air. Use double-sided adhesive-tape to affix the decoder.

On two-wire layouts, locomotives equipped with Digital plus decoders must not be run using live overhead lines as this could subject the locomotive to double the voltage, if placed on the track in the wrong direction, and damage the decoder!

Before installing a Digital plus decoder, check the locomotive in normal DC operation to ensure that it works correctly before modifying it. Replace worn wheel contacts, motor brushes and blown bulbs. Only a locomotive that is mechanically OK will function properly with a locomotive decoder.

2 Features of the SILVER decoder

The following is a brief overview of the common features of the SILVER decoder series. For more detailed information as well as advice on how to use and alter these features, please read the following sections.

2.1 Motor control

The decoder has a high-frequency control (23kHz). To adapt it to the type of locomotive used, you can simply choose between different motor types. These individual motor types include parameter sets which have been specially adapted to the respective models. Moreover, it is also possible to carry out fine-tuning via various CVs.

Of course you can switch off both the high-frequency control as well as the control system itself.

The minimum, maximum and mid speed can be set; the decoder adapts the characteristic speed line dynamically to ensure a steady, smooth curve. Independently of this, it is also possible to program an individual characteristic speed line.

You can use up to 128 running notches.

2.2 Capacity

We have defined the continuous or maximum current-carrying capacities of the SILVER decoder motor outputs. The continuous load is achieved without special installation on cooling surfaces!

2.3 Overload protection

The decoders are protected against short circuits.

2.4 Starting and braking delay

The starting and braking delays can be set independently of each other. These delays can be enabled and disabled via a function by pressing the key of the digital system once.

2.5 Constant braking distance

A special feature of the SILVER decoder provides for a constant braking distance independent of the current speed of the locomotive. This feature is important for model railway operators who install automatic stopping sections in their layouts.

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2.6 Shunting speed

The shunting speed can be set via a function; it halves the speed.

2.7 ABC = simple signal stop and slow approach

You can carry out a particularly simple signal stop using the ABC braking module. Combined with the constant braking distance, precise on-the-spot stopping in front of red signals is not a problem.

The signal indication "Slow approach/Caution" does not pose a problem; the respective speed can be set via a CV in the decoder.

You can operate all functions during the signal stop or slow approach - you can even reverse away again from the red signal.

These special ABC modules BM3 can be used to assemble a block section of any desired length.

2.8 Push-pull train control

A push-pull train control can be set if the ABC braking module BM2 is used. There are two different options: push-pull operation with and without intermediate stops. The latter also takes slow-approach sections into account. The stopping time at the end of the track and at the intermediate stops is set at between 1 and 255 seconds via a CV.

2.9 Function outputs

The function outputs can be mapped to the functions of the digital system according to NMRA.

2.10 Lighting effects

Different lighting effects can be set at the four function outputs:

- Setting the brightness (dimming), can be switched via a function as desired
- Mars light
- Gyra light
- Strobe and double strobe
- Different settings for random flickering (ideal for a steam locomotive's fire box)
- Flashing

3   Setting (programming) the decoder

This section describes the basic setting of features. If you are already familiar with so-called "CVs" and their operation you may skip this section.

Unless stated otherwise in the detailed operating manuals, all settable features can be programmed both via "Programming in operational mode (*PoM*)" and "Programming on the programming track".

3.1   Variable decoder features - Configuration Variables (CV)

The number of the decoder's functional outputs cannot be altered since it is determined by its hardware. The maximum current load is also a feature that cannot be altered.

However there is a wide range of features which are not determined by the decoder's hardware but by its software. These features can be altered to a great extent. The most important of these features for normal operation are the locomotive address and the starting and braking delay.

There is a storage location for each feature within the decoder. A figure is stored in each storage location.

These storage locations are similar to cards in a index card box. Each decoder has a "card index box". Each "card" holds a feature of the locomotive decoder, for example on "card" number 1 the locomotive address, on "card" number 3 the starting delay. This means one card for each feature. Depending on the number of features available in the decoder, the size of the "index card box" varies.

This "index box" functions as a "command station" in the decoder. The information stored here largely defines the decoder's behaviour. For example, one of the "cards" determines whether the locomotive decoder also reacts to conventional DC.

If you imagine that these cards are written in pencil, it is possible for you to alter the entry by simply "erasing" and "rewriting" it. This is done while programming the locomotive decoder on the programming track. The comparison with the eraser is not completely correct, because there are no empty "cards". There is always something written on them, even if it is only 0. However this does <u>not necessarily</u> mean that the content is not interesting. And -the exception proves the rule- there are also cards whose

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content you can read but not delete, for example the version number and the manufacturer code.

On each "card" you will find a numerical value; the general range of values of each card is 0 to 255. Whether all possible numerical values of this range are sensible depends on the individual feature. And there are also "cards" on which the numerical value is presented in a different way in order to facilitate handling. This will be explained in more detail at a later stage.

Since you can alter the numerical values on the index cards (in these storage locations) at any time, they are often called variables. These variables are used to determine features; you use them to *configure*, and that is how the term "**Configuration Variable**", abbreviated to **CV,** developed (in the US)**.**

From now on we will not refer to index cards, but instead we shall use the correct term CV. CVs are used to determine the decoder's features or behaviour.

3.2   Standardisation in NMRA

The NMRA (**N**ational **M**odel **R**ailroad **A**ssociation; American association of model railway operators, the largest association of its kind worldwide) specified in one of its standards which CV determines which feature. This is an advantage for you since the same feature is always assigned to the same CV if the decoder you use was developed in accordance with the standard. Simply keep in mind which CVs are important for your operation and you will never be confused, even when working with several decoders.

There are certain CVs a decoder must have to fulfil the NMRA standardisation criteria. These CVs are a requirement of the "Conformance Seal". For the manufacturer of a decoder, this seal functions as a certificate confirming that the decoder was inspected by an independent NMRA body for compliance of its features with the standard.

The manufacturer may use other CVs in a decoder, although this is not imperative. However, if CVs are used, they must be designed in accordance with the standard.

Finally, there is another range of CVs which the manufacturer can specify freely.

3.3   Different presentations of numerical values: "bits" in CVs

CV1 contains the basic address of the locomotive decoder. It is easiest if you are able to enter this address as a numerical value. However, it is also possible that several features are influenced in a CV. An example of this would be the switching on and off of the control or conventional operation.

It would be rather awkward here if you had to enter a certain numerical value for each possible combination.

It is easier for you if you image that there are 8 switches in the relevant CVs that can be switched on and off. We call these switches "bits". If the switch is switched on, we say "the bit is set" or "the bit is 1"; if the switch is switched off, we say "the bit is deleted" or "the bit is 0".

This is only a different way of writing numerical values, called **binary presentation**. In this system the numerical value is not shown using the figures 0,1,2,3,4,5,6,7,8,9, but using only the figures 0 and 1.

Example: binary presentation of CV29

A variety of settings are saved in this CV. Whether a certain setting is switched on or off, is determined by one of the 8 switches (bits):

Switch no.	Switched on (=bit set "1")	Switched off (=bit deleted "0")
1 (0)	Locomotive runs backward if direction switch points 'up'	Locomotive runs forward if direction switch points 'up'
2 (1)	Locomotive runs in 28/128 running-notches mode	Locomotive runs in 14/27 running- notches mode
3 (2)	Locomotive can also run analogue	Locomotive cannot run analogue
4 (3)	Not used	Not used
5 (4)	Decoder uses the set characteristic speed line	Decoder uses the default characteristic speed line
6 (5)	Locomotive controlled via extended address from CV17 and CV18	Locomotive controlled via basic address from CV1
7 (6)	Not used	Not used
8 (7)	Not used	Not used

Certain features are simply switched on and off by setting or deleting a bit in the CV.

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The setting and deleting of individual bits is particularly easy with the manual controls LH100 (from version 2 on), LH200 and LH90. These devices have a menu designed specifically for this purpose.

If you use a LH100 of a version smaller than 2, you will not be able to program in the binary mode. The same is true for the "*compact*" and possibly devices of other manufacturers. In this case you will have to enter a decimal number in the CV which corresponds to the set or deleted bits. For more information please refer to the Appendix, Section "Bits and bytes - conversion help".

3.3.1   Counting principles of bits

In the engineering field it is common to start counting bits from 0 onwards. Since this does not correspond to normal linguistic use, we start counting bits with 1 (you don't count the coaches of your train starting 0, 1, 2, do you?). This method applies to all Digital plus devices and decoders. When programming your decoders with devices of other manufacturers, you may have to start with 0, therefore we have put the number for the counting method starting from 0 in brackets behind the bit numbers. Example:

Bit 2 (1):   The number in front of the brackets represents the bit number for the counting method starting from 1; the number in brackets shows the bit number starting from 0.

4 Installation

4.1 Preparations and tests before installation

Before installing a Digital plus decoder, check the locomotive in normal DC operation to ensure that it works correctly before modifying it. Replace worn wheel contacts, motor brushes and blown bulbs. Only a locomotive that is mechanically OK will function properly with a locomotive decoder.

4.2 Affixing the decoder

Under no circumstances may the parts of the locomotive decoder be allowed to touch the metal components of the chassis or the body of the locomotive as this could cause a short-circuit within the locomotive decoder leading to damage.

Never wrap the locomotive decoder in insulating tape as this prevents the necessary air circulation around the decoder. Instead, use insulating tape or something similar around the metal components of the locomotive to avoid unintentional short-circuits without depriving the decoder of air. If a heat-shrink sleeve (insulating sleeve) is installed ex-works to protect components that are sensitive to contact, this sleeve may not be removed (warranty loss).
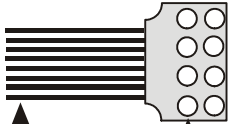
Use double-sided adhesive-tape to affix the decoder (enclosed with the product).

4.3 Locomotives with interface

Here, installation is particularly easy. The NEM652-conform interface plugs facilitate quick and easy conversion of locomotives.

Pull the strapping plug off the locomotive's interface and keep it in a safe place. Now, plug the decoder's connector onto the interface so that Pin 1 is placed at the position shown in the operating manual. When installing the plug, ensure that the pins are not bent or broken.

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Pin assignment of the NEM652 interface:

Pin	Meaning	
1	Motor connection 1	
2	Function output B (rear headlight)	Orange Pin 1
3	Function output C	The orange cable indicates the position of Pin 1 on the plug.
4	Left rail pickup	
5	Motor connection 2	
6	Function output A (front headlight)	
7	Function positive common	
8	Right rail pickup	

In the case of decoders that have more function outputs than A, B and C, these outputs are designed as loose cables to be soldered.

4.4   Locomotives without interface

Please note which motor connection is connected to the right rail pickups and which to the left. If you do this you will not have to try out which decoder cable needs to be soldered to which motor connection to achieve the desired direction of travel when connecting the decoder.

After removing the original connections to the motor brushes, the motor brushes must be potential-free. This means that they are not be connected in any way to the chassis or the rail pickups of the locomotive. This should be checked using a meter with a 'buzzer'.

Bear in mind that a such a connection is sometimes made only when the chassis is put back! Remove condensers which are connected across the motor brushes.

Please contact a service centre if you are in any doubt as to whether all necessary preconditions for the installation are fulfilled!

4.4.1　Cable colours

The cables of all SILVER decoders follow the same colour code. Having connected one decoder, you will know exactly what to do the next time.

Cable colour code:

red	Track connection, right-hand side
black	Track connection, left-hand side
orange	Motor, one connection
grey	Motor, the other connection
white	Function output A, lights at front for direction-dependent lighting
yellow	Function output B, lights at back for direction-dependent lighting
green	Function output C
purple	Function output D
blue	Function positive common

4.4.2　Motor and track connection

If you separate the track and motor connection while installing the locomotive decoder, please note which track connection belongs to which motor connection. Please wire as follows:

Red track connection belongs to the **orange** motor connection

Solder the red cable to the right track connection and the orange cable to the motor connection which was previously connected to the right track connection.

Black track connection belongs to the **grey** motor connection

Solder the black cable to the left track connection and the grey cable to the motor connection which was previously connected to the left track connection.

For the ABC module and the conventional operation to work properly, observe the following when connecting the track and motor:

If you are operating a steam locomotive and you are looking from the driver's cab to the smoke stack while the locomotive is moving **forward** (i.e. the smoke stack leads), the red cable of

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the decoder must be soldered to the **right-hand current collector**.

4.4.3   Function outputs

You can connect bulbs, LEDs, relays, smoke generators or even a remote coupling to the function outputs. Always ensure that the connected function does not consume more power than the respective function output of the decoder can supply. If this value is exceeded, the output will be damaged.

If you wish to connect LEDs to the function outputs, ensure that the function output is "negative". The LED's cathode must be connected to this function output via a voltage multiplier. The LED's anode must be connected to the blue cable, as this is the decoder's "positive" side.

There are two ways of connecting functions to function outputs:

1. One connection of the function is connected to the function output, the other to the decoder's blue cable.
   You must ensure that the functions inside the locomotive are potential-free, i.e. that their only live connections are to the decoder's function outputs.
   In this connection, the voltage at the function outputs (and thus at the functions) is approx. 1.5 V lower than the track voltage. The blue cable is the "positive pole" and the function output is the "negative pole". This and the voltage multiplier are particularly important when connecting LEDs.

2. One connection of the function is connected to the function output, the other to a track connection.
   This is how the lighting of many locomotives works. The bulbs are directly connected to the locomotive's chassis which in turn is connected to one side of the track. For functions connected like this, the blue cable remains unused. Thus, the wiring is a little easier, but the resulting voltage for the bulb is halved. This means the lighting is a little darker than is the case when the blue cable is used.
   In this type of connection, the lighting will still only work in one direction of travel in conventional operation. Which direction this is depends on which side of the track the chassis is connected to.

5 Setting the address

SILVER decoders can be operated both with the basic locomotive address in CV1 (range 1-127, the Digital plus system only uses addresses 1-99) as well as with the so-called extended locomotive address (range 100-9999), stored in CV17 and CV18.

For the locomotive decoder to know to which address it is to react, Bit 6 in CV29 serves as a switch between the two addresses. If this bit is deleted (0), the 2-digit address from CV1 will be used; if this bit is set (1), the 4-digit address from CV17 and CV18 will be used.

When using the Digital plus command stations *LZ100*[1] or *LZV100* together with a manual control LH100 or LH90 for the programming of the address, you will not have to pay attention to this division into the different CVs. Simply enter the desired address via the menu "Programming on the programming track". Enter the 2 or 4-digit address; the rest will be done automatically by the system.

When using a *compact* or LZ100 up to version 2.3, you will only use 2-digit addresses. In this case, you always enter the address in CV1.

If a valid address is entered in CV1, Bit 6 in CV29 is automatically deleted and the decoder set to operation with a 2-digit address.

Ex-works SILVER decoders are set to address 03.

If, by mistake, an address greater than 127 is entered in CV1, the SILVER decoder will automatically change the address to 03.

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[1] from version 3 on

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6   Setting the motor control

SILVER decoders are equipped with a control (load compensation). A set speed is thus held constant (so far as technically possible) independent of larger or smaller loads.

Since the different models are equipped with different motor types, the characteristic can be adjusted to the control.

6.1   Selecting the motor type

In order to also facilitate this adjustment for model railway operators who are not control engineering experts, we have combined different settings to so-called "motor types". It is thus possible to select between different types without having to pay attention to the precise setting of the control parameters.

If the control behaviour of the standard setting (motor type 0) is not ideal for your model, simply try a different motor type. Motor types 0 to 3 have set control parameters.

The motor type is set in CV50. Ex-works, CV50 is set to 0, i.e. motor type 0. If you wish to select a motor type 0 to 5, enter the respective value 0 to 5 in CV50.

Motor types 4 and 5 provide for 2 further CVs which make fine-tuning possible.

! ◆	Advice on how to proceed:
	First, set the motor types 0 to 3 one after the other and check the result. If you are unhappy with the result, try motor type 4. Then alter the value in CV113 and CV114 until you achieve the desired result. Never alter the motor type and the value in CV113 and CV114 simultaneously!

6.2   Switching the control on and off

If you wish to completely switch off the decoder's control, set Bit 7 in CV50. The previously selected motor type will no longer have an effect; the same is true for the EMF switch.

6.3   Switching off the high-frequency control

To keep the noise emission to a minimum, the control operates in a high-frequency range. Some models do not show satisfactory control behaviour when operated with the high-frequency control. In this case, you can switch to low-frequency control by setting Bit 8 in CV50 in addition to setting the motor type.

6.4   Activating the EMF switch

The decoder still has a so-called EMF switch which makes it possible to adjust the decoder to different motor types. Depending on the motor type used, it is possible that a digitally controlled locomotive cannot reach an adequate maximum speed compared to a locomotive in conventional operation. If this is the case, activate your EMF switch by setting Bit 6 in CV50. The locomotive will then reach a higher maximum speed while the minimum speed is also slightly increased.

6.5   Repeat rate

Another possibility for adjusting the control is to set the repeat rate in CV9. Depending on the motor type used, changes in this CV will be more or less apparent.

7 General settings

General settings for the SILVER decoder are carried out in CV29. Features in this CV are assigned to individual bits. This is why it is best to carry out changes in this CV in the binary mode of the manual controls LH100 and LH90.

When using devices that do not support the individual setting and deleting of bits, you must enter a decimal number in the CV that corresponds to the set or deleted bits. Further information can be found in the Appendix, Section "Bits and bytes - conversion help"

CV29:

Bit	Setting
1 (0)	Direction of travel
	0 normal: locomotive drives forward if the arrow on the manual control points up.
	1 interchanged: locomotive drives forward if the arrow on the manual control points down.
2 (1)	Running-notches mode:
	0 Operation with 14 or 27 running notches. This setting is chosen when using a decoder together with digital systems which do not support the 28/128 running-notches mode.
	1 Operation with 28 or 128 running notches. This setting is chosen when using a decoder together with digital systems which support the 28/128 running-notches mode.
3 (2)	Operational mode analogue / digital:
	0 Locomotive only runs in digital operation
	1 Locomotive runs both in digital and conventional operation, flying splice possible.
	Please find further information on the system change from analogue to digital operation further below in this section.
4 (3)	Not used
5 (4)	Characteristic speed line:
	0 Default characteristic speed line is used
	1 Self-programmed characteristic speed line is used. Please enter suitable values in CV67 to 94 before setting this bit. Please find further information on the characteristic speed line in the Section "Characteristic speed line", page 26.
6 (5)	Address used
	0 Decoder uses basic address (from CV1)
	1 Decoder uses extended address (from CV17 and CV18)
7-8(6-7)	Not used

7.1 System change during analogue operation

All SILVER decoders can be operated on conventional layouts with traditional DC devices. If Bit 3 is set in CV29, a locomotive equipped with a decoder will behave in conventional operation like a locomotive without a decoder. However, a starting delay programmed in the decoder can be used.

Even a flying splice between a digital and a conventional layout section is possible. Here, the locomotive will behave as follows:

7.1.1 Change from digital to conventional

During a change from a digital layout section to a conventional section, the locomotive decoder follows the polarity of the conventional section. If the polarity of the section (and the resulting direction of travel according to NEM) matches the direction of travel in the digital section, the locomotive will continue without stopping. However, because the speed depends on the voltage applied in the conventional section, variations in speed are possible.

If the polarity does not match the direction of travel, the locomotive will stop following the braking delay set in the locomotive decoder.

When the model railway is in operation, this behaviour can be an advantage when stopping in front of signals. Simply add a separate braking section in front of a signal, which is supplied with direct current if the signal is "red". The current's polarity in the direction of the signal is set so that the locomotive stops. If the signal is passed in the opposite direction, the locomotive will drive through despite the red signal. A disadvantage is the possible variation in speed which may occur during the change. To find out how this can be avoided, please refer to the Section "System change with switched-off analogue operation", page 20.

A relevant example is contained in the operating manual of the sectioning model LT100 which is necessary for the transition from digital to analogue operation and vice versa.

7.1.2 Change from conventional to digital

If a locomotive changes from the conventional layout section back to the digitally controlled area, the locomotive decoder will again be able to receive digital information. As in the case of the example above, different reactions of the locomotive are possible:

If the direction of travel transmitted by the *Digital plus by Lenz* [®]

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command station matches the locomotive's present direction of travel, the locomotive will also take over the speed transmitted by the command station and thus continue driving.

If the actual direction of travel does not match the direction of travel transmitted by the command station, the locomotive will stop with the set braking delay, change its direction of travel and continue in the opposite direction, i.e. return to the conventional section. There, it will stop.

If the locomotive is not called up in the digital layout section, the address of the decoder will also not be sent. In any such case, the locomotive will continue.

7.1.3   Why does the speed change during a system change?

The motor at the decoder output is operated with a so-called pulse-width control. Here, the voltage is not altered depending on the speed (low speed = low voltage; high speed = high voltage), but the motor is charged with full voltage, if not for the whole time. The rule that is applicable here is: low speed = short turn-on time and long turn-off time; high speed = long turn-on time and short turn-off time.

If the decoder-fitted locomotive now changes from digital to analogue, it is possible that a low running notch (speed) is set. The decoder recognises the analogue section and has to adjust the pulse width to the maximum value so that the motor can again be controlled analogue to the level of the track voltage. This means that the locomotive speeds up if the conventional voltage is as high as the digital voltage. If the conventional voltage is lower than the digital voltage, the locomotive will first slow down (since only little power is transmitted to the motor via the pulse width) and then accelerate until the desired speed is reached.

7.2   System change with switched-off analogue operation

You can avoid the disadvantage of the speed matching during the transition from digital to conventional by switching off the decoder's conventional operation (delete Bit 3 in CV29). You will no longer be able to operate the locomotive conventionally, but its reaction during the system change will improve.

If you let the decoder change from the digital to the conventional section when the conventional operation is switched off, the locomotive will stop with the set braking delay.

8   Overload protection

SILVER decoders are protected against short circuits.

When the decoder is activated (i.e. the track voltage is switched on), a check for short-circuits will be carried out. If the decoder detects a short-circuit, the affected output will not be activated.

If the decoder detects a short-circuit at the motor output, the lighting will start flashing.

In case of a fault, a corresponding bit is set in CV30 which will inform you about the type of fault which has occurred. This bit can be deleted via programming; it will be reset if another fault occurs.

Bit	Fault
1	Light short-circuit
3	Motor short-circuit

9   Starting and braking delay

The starting and the braking delay can be set independently of each other. Thus it is possible to set a short starting delay and a long braking delay.

The starting delay is set in CV3 and the braking delay is set in CV4. The permitted range of values for both CVs is 0 (no delay) to 255 (long delay).

These delays are direction-dependent:
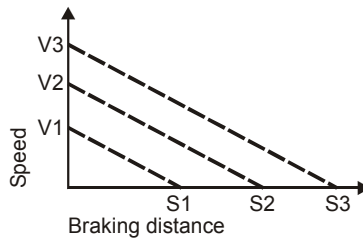
If, for example, you wish to brake the locomotive from the maximum speed V3 to a complete standstill, the resulting braking distance will be S3.

If you brake the locomotive from speed V1 to a complete standstill, the locomotive will cover the shorter braking distance of S1.

9.1   Switching off the starting and the braking delay

You can switch off the starting and the braking delay via a function of the digital system. This makes it possible to carry out shunting moves in the train station without delays. If the locomotive pulls a heavy train out of the train station, the starting delay will ensure life-like starting.

The function of the digital system, which switches off the starting and the braking delay, is set in CV59. If this function is active in the digital system, the delay is switched off.

Each bit of this CV stands for a function of the digital system: Bit 1(0) for function 1, Bit 2(1) for function 2 and so on up to Bit 8(7) for function 8. If you want to use one of these functions to switch off the delays, you will have to set the corresponding bit. Bit 4 is set ex-works for function 4.

Bit:	1	2	3	4	5	6	7	8
CV59	F1	F2	F3	F4	F5	F6	F7	F8

Example:

If Bit 4 is set in CV59, the delay is switched on and off with function 4.

If both Bit 4 and Bit 7 are set in CV59, the delay can be switched off both with function 4 and function 7.

For information on how to set or delete individual bits, please refer to the LH100 and LH90 operating manuals.

10 Minimum, maximum and mid speed

The minimum speed is set in CV2, the mid speed is set in CV6 and the maximum speed is set in CV5. Permissible values for all three CVs range from 0 to 255. The decoder automatically calculates a steady, smooth speed line from these three values.

Two examples:
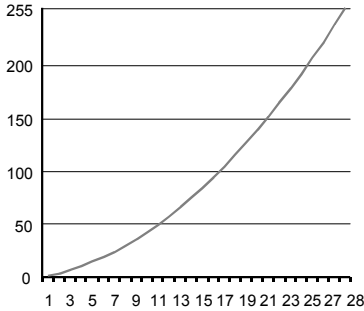
Speed line with default settings:
CV2 = 0
CV5 = 255
CV6 = 60
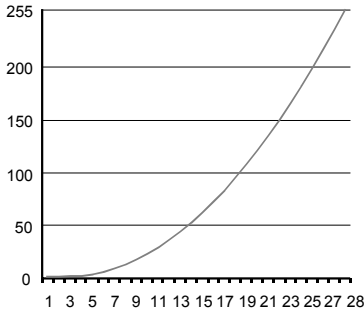
Altered setting with reduced mid speed:
CV2 = 0
CV5 = 255
CV6 = 30
This setting results in smaller changes in the lower range of running notches
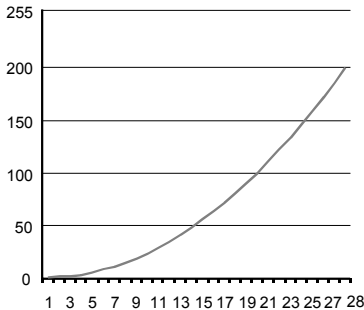
Altered setting with reduced maximum speed:
CV2 = 0
CV5 = 200
CV6 = 60

The values of the minimum, mid and maximum speed are dependent on each other.
If you choose a minimum speed that is lower than the mid speed, the locomotive will be slower in the average range of running notches than in the lower range.
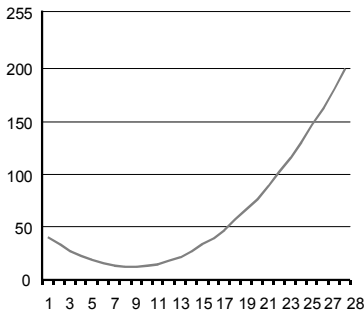
Example for an unfavourable mid speed value:

CV2 = 40

CV5 = 200

CV6 = 1
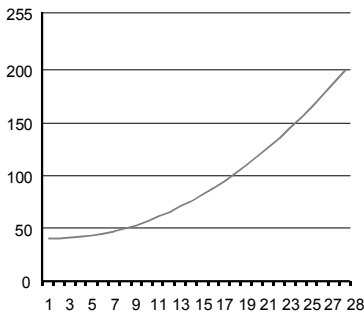
Correct by increasing the mid speed value:

CV2 = 40

CV5 = 200

CV6 = 70

For running notch 1, the value 255 in CV2 results in the maximum speed.

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11 Characteristic speed line

An alternative to setting the minimum, mid and maximum speed is the programming of an individual characteristic speed line.

When this is set, the settings of CV2, CV5 and CV6 have no effect.

R N	CV	Value
1	CV67	1
2	CV68	10
3	CV69	20
4	CV70	29
5	CV71	39
6	CV72	48
7	CV73	57
8	CV74	67
9	CV75	76
10	CV76	86
11	CV77	95
12	CV78	104
13	CV79	114
14	CV80	123
15	CV81	133
16	CV82	142
17	CV83	152
18	CV84	161
19	CV85	170
20	CV86	180
21	CV87	189
22	CV88	199
23	CV89	208
24	CV90	217
25	CV91	227
26	CV92	236
27	CV93	246
28	CV94	255

The self-programmed characteristic speed line is stored in CV67 to CV94. The value in CV67 determines the speed for running notch 1, the value in CV68 determines the speed for running notch 2 and so on up to CV94 whose value determines the speed for running notch 28.

The table on the left shows the default settings for CV67 to CV94.

This table also applies to the operation with 128 running notches. In this case, CV67 corresponds to running notch 1 and CV94 to running notch 128. The remaining running notches are distributed evenly; the decoder automatically calculates the intermediate values required for operation.

Set Bit 5 in CV29 to activate the self-programmed characteristic speed line.

12 Constant braking distance

The constant braking distance functions differently to the time-controlled braking delay (CV4):

During the transition from one running notch to running notch 0 (e.g. by moving the turning-knob of the manual control to the left limit-stop), the locomotive/train covers a settable, defined braking distance. This braking distance does not depend on the speed of the locomotive/train.

The length of the covered braking distance is set in CV52. The braking distance differs depending on the value set in this CV.

A low value in CV52 will result in a short braking distance (S1), independent of the speed (V1, V2, V3).	A high value in CV52 will result in a long braking distance (S2), independent of the speed (V1, V2, V3).
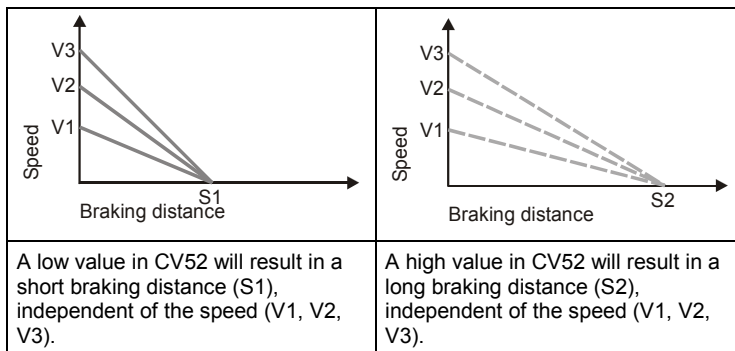
Set Bit 1(0) in CV51 to activate the constant braking distance.

12.1 Setting the constant braking distance:

The braking distance is defined by the value set in CV52. Since the motors and gear ratios of locomotives vary, the braking distance differs from locomotive to locomotive even if the same value is set in CV52.

1. Use a short test section to measure how long your locomotive's braking distance will be with a given value set in CV52. Start with the default value in CV52.

2. Enable the constant braking distance function. This requires setting Bit 1(0) in CV50. If this bit is not set, the decoder will use the speed-dependent braking delay.

3. Accelerate your locomotive until it has reached mid speed.

4. At a chosen point in time, set the running notch to 0. This requires moving the turning-knob of the manual controls LH30, LH90 or the *compact* to the left limit-stop; if you are

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using the LH100, keep pressing the key ▼ until the running notch is set to 0 or until the locomotive address is displayed. (If using the LH100, do not press key ⬯! This results in a locomotive-specific emergency stop (*Nothalt*) where the delays in the locomotive decoder will not be enabled!).

5. Measure the covered braking distance.

6. Increase or decrease the value in CV52 in steps of 10 and carry out another measurement. In this way, you will create a table which will show the braking distances in relation to the values set in CV52.

Further important advice:

The constant braking distance is only effective if the running notch is altered to 0. If the running notch is decreased from e.g. 28 to 10, the speed-dependent delay from CV3 becomes effective.

While the shunting speed is enabled (default setting F3), the constant braking distance is disabled and the delay from CV3 becomes effective.

The constant braking distance is also disabled if the delays set in the decoder are switched off via the corresponding function (default setting F4).

The two latter features can also be used sensibly if you wish to interrupt a braking process prematurely.

The constant braking distance is not effective if the locomotive brakes in DC mode.

13 Shunting speed

The shunting speed halves the speed. This facilitates particularly sensitive control of the shunting process. Use function 3 (default setting, can be altered in CV58) to enable and disable the shunting speed. If the shunting speed is enabled, the constant braking distance is disabled. The shunting speed is enabled as long as the function is active.

13.1 Mapping the shunting speed to a function

The function of the digital system used to switch the shunting speed is set in CV58.

Each bit of this CV stands for a function of the digital system: Bit 1(0) for function 1, Bit 2(1) for function 2 and so on up to Bit 8(7) for function 8. If you want to use one of these functions to switch the shunting speed, you will have to set the corresponding bit.

Example:

If Bit 4 is set in CV58, the shunting speed is switched on and off with function 4.

If both Bit 4 and Bit 7 are set in CV58, the shunting speed can be switched both with function 4 and function 7.

For information on how to set or delete individual bits, please refer to the LH100, LH90 and the *compact* operating manuals.

14 Setting the function outputs

14.1 Function mapping of function outputs

By mapping functions you determine which function key of your digital system is used to switch the individual functions of the SILVER decoder on and off.

This applies both to the switching on and off of a function output which you have connected to, for example, the front lighting (physical function) as well as to the switching on and off of the shunting speed (logical function).

Double-mapping is possible and permitted: If, for example, you map function 3 both to function output C as well as the shunting speed, switching on function 3 will activate both function output C as well as the shunting speed.

This section describes only the mapping of functions to function outputs. To learn more about how to map other features (such as the shunting speed) to certain functions, please refer to the sections covering these functions. The number of function outputs available is stated in the operating manuals of the respective SILVER decoders.

It is easy to map functions to function outputs:

Each CV of the SILVER decoder is responsible for a function F0 to F12 of the digital system. CV33 is responsible for the function F0 forward, CV34 is responsible for the function F0 backward, CV35 is responsible for function F1 and so on up to CV46 which is responsible for the function F12.

The value in this CV determines which function output will react to a certain function.

Example: The value 64 in CV36 determines that function output D will react to function 2. If 32 is entered in CV36, function output C will react to function 3.

Which values you have to enter in the CVs in order to map functions to function outputs is shown in the table below:

CV		Function output							
		H	G	F	E	D	C	B	A
33	F0 forward				128	64	32	16	**8**
34	F0 backward				128	64	32	**16**	8
35	Function 1				128	64	**32**	16	8
36	Function 2				128	**64**	32	16	8
37	Function 3				**128**	64	32	16	8
38	Function 4	128	64	**32**	16	8	4	2	1
39	Function 5	128	**64**	32	16	8	4	2	1
40	Function 6	**128**	64	32	16	8	4	2	1
41	Function 7	128	64	32	16	8	4	2	1
42	Function 8	128	64	32	16	8	4	2	1
43	Function 9	16	8	4	2	1			
44	Function 10	16	8	4	2	1			
45	Function 11	16	8	4	2	1			
46	Function 12	16	8	4	2	1			

Table 14-1

To map a function of the digital system to a function output, look for the section where

- the row of the desired function

intersects with

- the column of the desired function output.

Enter the number found in the respective CV.

For the purpose of clarification, the table above shows the default settings in bold print.

Example 1:

Let us return to the above example: "The value 64 in CV36 determines that function output D will react to function 2".

	CV		H	G	F	E	Column: function output D	C	B	A
	33	F0 forward				128	64	32	16	**8**
	34	F0 backward				128	64	32	**16**	8
	35	Function 1				128	64	**32**	16	8
Row: function	36	Function 2				128	**64**	32	16	8

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Where the row for CV36/function 2 intersects with the column for function output D (in a bold frame), we find the value 64.

Example 2:

Let us reverse the task: "Function output C is to be switched with function 3".

Where the row for CV37/function 3 intersects with the column for function output C, we find the value 32.

CV		H	G	F	E	D	C	B	A
					Function output
33	F0 forward				128	64	32	16	8
34	F0 backward				128	64	32	16	8
35	Function 1				128	64	32	16	8
36	Function 2				128	64	32	16	8
37	Function 3				128	64	**32**	16	8

Example 3:

Both function outputs C and D are to be switched with function 1.

CV		H	G	F	E	D	C	B	A
					Function output
33	F0 forward				128	64	32	16	8
34	F0 backward				128	64	32	16	8
35	Function 1				128	**64**	**32**	16	8

In this case, you will have to add up the two values found where the row for CV35/function 1 intersects with the columns for function outputs D and C and enter the result in CV35:

$$64+32=\textbf{96}.$$

There is a basic rule: If a function is to be mapped to several function outputs, the values found where the respective row intersects with the respective columns must be added up and the result entered in the respective CV.

Example 4:

Function output A is to be activated with F0 when driving forward and, in addition, with F4:

CV		Function output							A
		H	G	F	E	D	C	B	A
33	F0 forward				128	64	32	16	**8**
34	F0 backward				128	64	32	16	8
35	Function 1				128	64	32	16	8
36	Function 2				128	64	32	16	8
37	Function 3				128	64	32	16	8
38	Function 4	128	64	32	16	8	4	2	**1**

In this case, you will also find two intersections, one where the row for CV33/F0 intersects with the column for function output A and the other where the row for CV38/F4 intersects with the column for function output A.

Here, 8 has to be entered in CV33/F0 forward and 1 has to be entered in CV38/F4.

The parts of Table 14-1 highlighted grey indicate impossible mappings. Thus, the functions 0 to 3 cannot be mapped to function outputs F,G and H and the functions 9 to 12 cannot be mapped to function outputs A,B and C.

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15   Effects at function outputs

When connecting lights or LEDs to function outputs of the SILVER decoder, you can set a variety of lighting effects.

15.1   Setting the brightness (dimming)

The brightness for function outputs A and C is set in CV55; the brightness for function outputs B and D is set in CV56.

Permissible values range from 0 to 255. Maximum brightness is achieved when 255 is set, zero brightness is achieved when 0 is set; in the latter case, the output is not active.

> Technically, the brightness is set via a so-called pulse-width control, i.e. **the voltage at the output is not reduced**. This is why setting the brightness is no adequate way of adapting to low-volt bulbs!

If you only wish to set the brightness of function outputs A and C, it is sufficient to set the suitable value in CV55. The brightness set here will always be activated together with the function output.

If you wish to switch between full and low brightness, i.e. dim the lighting, you will have to define a function of the digital system responsible for the dimming.

This setting is carried out in CV57. Whenever the set function is activated, the function output will change from maximum brightness to the set brightness.

Each bit in CV57 stands for a function of the digital system: Bit 1 for function 1, Bit 2 for function 2 and so on up to Bit 8 for function 8.

Bit:	1	2	3	4	5	6	7	8
CV57	F1	F2	F3	F4	F5	F6	F7	F8

If you wish to map a function to the dimming, you will have to set the corresponding bit.

Bit:	1	2	3	4	5	6	7	8
CV57	F1	F2	F3	F4	F5	F6	F7	F8
	0	0	0	1	0	0	0	0

In the above example, the dimming function is switched on and off with F4.

Here, you can also set several bits and thus use several functions to switch the dimming function on and off.

15.2 Effects at outputs A and B

The settings for the effects at function outputs A and B are carried out in CV60. The following rule applies:

- The units digit determines the effect for output A
- The tens digit determines the effect for output B

The set effect always works for the function output, unless you have mapped functions in CV61.

CV60:

The following effects are available:	Output B Tens =	Output A Units =
No effect	0	0
Mars light	1	1
Gyra light	2	2
Strobe (flash)	3	3
Double strobe (double flash)	4	4

Examples:

Enter the following values in CV60:

"00" results in no effect at outputs A and B.

"01" results in Mars light at output A and no effect at output B.

"23" results in Gyra light at output B and strobe at output A.

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15.2.1 Function mapping for effects at outputs A and B

The function mapping for the effects at function outputs A and B is carried out in CV61. If no mapping has been specified, the effect set in CV60 is always active. If mapping has been specified, the effect is switched on and off with the selected function.

Each bit of CV61 stands for a function of the digital system: Bit 1 for function 1, Bit 2 for function 2 and so on up to Bit 8 for function 8.

Bit:	1	2	3	4	5	6	7	8
CV61	F1	F2	F3	F4	F5	F6	F7	F8

If you want to map a function to the effect set in CV60, you will have to set the corresponding bit.

Bit:	1	2	3	4	5	6	7	8
CV61	F1	F2	F3	F4	F5	F6	F7	F8
	0	0	0	1	0	0	0	0

In the above example, the effect set in CV60 is switched on and off with F4.

Here, you can also set several bits and thus use several functions to switch the effect on and off.

15.3   Effects at outputs C and D

The settings for the effects at function outputs C and D are carried out in CV62. The following rule applies:

- The units digit determines the effect for output C
- The tens digit determines the effect for output D

The set effect always works for the function output, unless you have mapped functions in CV64.

Effects Output D	Output D Tens =	Output C Units =	Effects Output C
No effect	0	0	No effect
Flashing at same time as function output C	1	1	Flashing
Flashing alternately to function output C	2	2	Flickering type 1 (smooth)
Flickering type 2 (less smooth)	3	3	Dimming with value from CV55
Flickering type 3 (excitedly)	4	4	
Dimming with value from CV56	5	5	

Examples:

"00" results in no effect at outputs C and D.

"01" results in flashing at output C and no effect at output D.

"23" results in dimming at output C and flashing at output D.

15.3.1 Function mapping for effects at outputs C and D

The function mapping for the effects at function outputs C and D is carried out in CV64. If no mapping has been specified, the effect set in CV24 is always active. If mapping has been specified, the effect is switched on and off with the selected function.

Each bit of CV61 stands for a function of the digital system: Bit 1 for function 1, Bit 2 for function 2 and so on up to Bit 8 for function 8.

Bit:	1	2	3	4	5	6	7	8
CV64	F1	F2	F3	F4	F5	F6	F7	F8

If you want to map a function to the effect set CV24, you will have to set the corresponding bit.

Bit:	1	2	3	4	5	6	7	8
CV64	F1	F2	F3	F4	F5	F6	F7	F8
	0	0	0	1	0	0	0	0

In the above example, the effect set in CV64 is switched on and off with F4.

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Here, you can also set several bits and thus use several functions to switch the effect on and off.

15.3.2   Setting the flashing frequency

The flashing frequency for function outputs C and D is set in CV63. Permissible values range from 0 to 255; this corresponds to a frequency range of approx. 33Hz to 0.13Hz. Low values thus result in high frequency and high values in low frequency.

The precise formula for the frequency is:

$$f = \frac{1}{0{,}03 \times (1 + CV63)}$$

Here, "*f*" is the frequency which results from the value between 0 and 255 entered in "*CV63*".

If you set a certain frequency and you want to know the corresponding value that needs to be entered in CV63, please use the following adjusted formula:

$$CV63 = \frac{1}{f \times 0{,}03} - 1$$

Here, "CV63" is the value which results when you enter the desired frequency in "f".

Here are some values which have already been calculated for CV63:

CV63=	0	1	2	5	10	15	32	66	133	255
Frequency(Hz) =	33	16	11	5.5	3	2	1	0.5	0.25	0.13

The default setting is CV=32; this results in a frequency of approx. 1Hz.

16   ABC – simple signal stop

With little effort, ABC manages to enable exactly what model railway enthusiasts crave: exact stopping in front of signals and passage in the opposite direction.

By means of the simple modules BM1 (art. no. 22600) and BM2 (art. no. 22610) which supply the braking section in front of the signal, the locomotive decoder receives the signal status information *depending on the direction of travel!*

Here, two different pieces of information are transmitted:

- Stopping
- Slow approach

If none of this information is available, the decoder will not react and the train will continue unimpeded.

During a stop in front of a signal, you can still address the locomotive (the decoder). You can operate all functions during the signal stop; of course, the locomotive's front light remains switched on. If you change the direction of travel, you can reverse away again from the red signal.

Thus, combined with the constant braking distance, precise on-the-spot stopping in front of red signals is not a problem.

If the decoder receives the information "Slow approach/Caution", the current speed will be reduced to a slow speed that can be set in the decoder. Of course, this is only the case if the current speed is faster than the set slow speed. If the current speed is slower than the set slow speed, the locomotive will continue unimpeded.

The information "Stop" and "Slow approach/Caution" is always stored in the track that is on the right depending on the direction of travel. This is why a signal installed for the opposite direction can be ignored.

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16.1 Activating ABC

Bit 2 in CV51 is used to activate the ABC feature.

We recommend the simultaneous use of the constant braking distance which is activated by setting Bit 1 in CV51.

16.2 Setting the slow speed

CV53 contains the value for the slow speed. Permissible values range from 0 to 255. Here, 255 corresponds to the maximum speed and 1 to the minimum speed. If you enter 0 the locomotive will come to a standstill.

16.3 Important advice on ABC

If the shunting speed is activated (ex-works it is switched on with function 3), the ABC feature is switched off. In this way, you can drive past a signal indicating "Stop" when using a shunting locomotive.

When using tracks with neutral wires, the direction-dependency of the ABC feature no longer works. In this case, switch off the direction-dependency by setting Bit 3 in CV51.

17 Push-pull (shuttle) train control

In combination with the ABC modules, a convenient push-pull operation is possible. Here, the decoders make extended use of the ABC feature described above.

You can choose between two variants:

1. Push-pull operation without intermediate stop.
   The stopping time at the end points of the track can be set.
2. Push-pull operation with intermediate stop.
   Here you can set up further intermediate stops between the end points of the track.

> The push-pull control integrated in the SILVER series requires the use of the ABC module BM1 or BM2 (for rear-powered trains).

Recommendation:

Activate the function "Constant braking distance" so that your train will come to a standstill in the stopping section independent of the current speed.

17.1 Push-pull operation without intermediate stop

The procedure is simple:

A ══════════════════════════════════════ B

1. The train drives to stop "A" and stops there with the set delay.
2. When the set stopping time has elapsed, the train will automatically start moving into the opposite direction.
3. The train comes to a standstill at stop "B" with the set delay, waits until the stopping time has elapsed and starts moving again in the opposite direction, back towards stop "A".

17.1.1 Functioning of the push-pull operation without intermediate stop

The information "Stop" created by means of the BM1 / BM2 is used in two ways. If the decoder detects this information, the stopping procedure will be activated first; afterwards, the

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decoder will change the direction of travel and set the locomotive in motion after the set stopping time has elapsed.

If you have set up slow speed sections between the end points of the track, the decoder will reduce the speed in these sections to the value set in CV53.

17.1.2   Prerequisites for the push-pull operation without intermediate stop

For each end point of the push-pull section you need a BM1 or BM2 module (for rear-powered trains). Wire the driving and the stopping sections as described in the BM1 / BM2 operating manuals.

17.1.3   Activating the push-pull operation without intermediate stop:

First, activate the ABC function by setting Bit 2 in CV51. Then, activate the push-pull operation by setting Bit 4 in CV51.

Afterwards, set the desired stopping time for the end points in CV54. The value range for this CV is 0 to 255, which corresponds to a time frame of 1 to 256 seconds. The default setting is 4 seconds.

17.2   Push-pull operation with intermediate stop

The procedure of the push-pull operation with intermediate stop is as follows:

1.   The train drives to stop "A" and stops there with the set delay.
2.   When the set stopping time has elapsed, the train will automatically start moving into the opposite direction.
3.   You can set up intermediate stops "Z" on the layout. Here, the train can be stopped by means of further BM1 / BM2 modules, depending on the signal position, and then set into motion manually.
4.   At stop "B", the train comes to a standstill with the set delay, waits until the stopping time has elapsed and starts moving again in the opposite direction, back towards stop "A".

17.2.1 Functioning of the push-pull operation with intermediate stop

At the end points of the push-pull section, the information "Slow approach/Caution" will be fed into the stopping section by means of a BM2 module. Wire the BM2 so that the information "Slow approach/Caution" is applied to the track.

The decoder set to "Push-pull operation with intermediate stop" will interpret this information as a "Stop" command and activate the braking procedure. Then, it will change the direction of travel and set the locomotive in motion after the set stopping time has elapsed.

The information "Stop" of the BM1 / BM2 module is used for the intermediate stops. Here, the train will stop as long as the information "Stop" is applied to the track (signal is red). When this information changes (signal turns green) the locomotive will start moving again.

Please note that the ABC function is dependent on the direction of travel: If you set up an intermediate stop on the layout, you must use a BM1 / BM2 module both for the train's initial journey as well as its return journey.

17.2.2 Prerequisites for the push-pull operation with intermediate stop

You need a BM2 module for each end point of the push-pull section as well as for each intermediate stop. Wire the driving and the stopping sections as described in the BM2 operating manual.

17.2.3 Activating the push-pull operation with intermediate stop:

First, activate the ABC function by setting Bit 2 in CV51. Then, activate the push-pull operation by setting Bit 5 in CV5, thus deleting Bit 4.

Afterwards, set the desired stopping time for the end points and intermediate stops in CV54. The value range for this CV is 0 to 255 which corresponds to a time frame of 1 to 256 seconds. The default setting is 4 seconds.

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17.3 Important advice on the push-pull control:

You can choose the speed of the push-pull train freely. If you set the speed to 0 while the train is stopping at an end point, the train will only start moving again when the stopping time has elapsed and you increase the speed.

If you wish to interrupt the stopping time prematurely, simply set the stopping time in CV54 to 0. The train will immediately start moving. As soon as the entire train has left the stopping section, set CV54 again to the desired value. In the same way, you can also extend the stopping time while in push-pull operation.

18   Resetting the decoder

If you wish to reset all the decoder CVs to their default settings, enter value 33 in CV8. Doing so does not affect the characteristic speed line; however, please note that Bit 5 is deleted in CV29 which means that the decoder is set to using the default speed line.

The CVs of a connected S.U.S.I. module are not reset!

19 Appendix

19.1 Programming and reading out of decoder features

Basically two different methods are available:

"**Programming and reading out on the programming track**" and "**Programming in operational mode (*PoM*)".**

With *PoM* you can alter features in the CVs without having to place the locomotive on a separate programming track. However, reading out of programmed values is only possible on the programming track.

During *PoM* the locomotive receives a command that can be described as follows:

"Locomotive number 1234, enter value 15 in CV4!"

Only the locomotive with address 1234 will execute this command.

For "Programming on the programming track" it is not necessary to know the address of the decoder. During this procedure the decoder receives the command:

"Enter value 15 in CV4!"

Every decoder which receives this command will execute it.

19.1.1 Programming in operational mode

Which features can be altered with *PoM*?

All of a decoder's CVs can be altered with *PoM* except for the basic address in CV1 and the extended address in CV17 and CV18. In practice, you will probably alter the CVs for the starting and the braking delay most often.

19.1.1.1 Which devices are required for *PoM*?

PoM is possible with the LZV100 or the LZ100 (from version 3 on) in combination with the manual control LH90 or LH100 as well as SET02.

The step-by-step procedure is described in the operating manuals of the devices listed above.

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19.1.2   Programming on the programming track

This programming method requires a special track, the so-called programming track. A programming track is a part of the track which is electronically isolated from the rest of the track system and which is connected to the programming output of the command station (LZ100, LZV100, *compact*). Decoder settings can be read out and altered on this special track.

The step-by-step procedure depends on the devices used. Please refer to the operating manuals of the respective devices.

19.2   Advice on programming the extended locomotive address with other systems

If you want to operate your *Digital plus by Lenz* ® decoder together with a system that supports the extended address but does not automatically carry out the division into CV 17&18 as well as the setting of CV29, you will have to do this manually. The corresponding procedure is described in the section below.

19.3   Dividing the extended locomotive address into CV17 & CV18

CV17 contains the higher-order byte of the address. This byte determines the range in which the extended address will be located. If, for example, CV17 reads 192, the extended address can have values ranging from 0 to 255. If CV17 reads 193, the extended address can have values ranging from 256 to 511. This can be continued up to 231 in CV17, in which case the extended address can have values ranging from 9984 to 10239. The table below contains a complete list of all possible ranges.
Do not forget to set Bit 6 in CV29 if you wish to operate a decoder with the extended address.

19.3.1   How do I determine the higher and the lower-order byte of a 4-digit locomotive address?

First, determine the desired address, e.g. 1234.

Then, select the relevant "range of addresses" from the "Table of extended locomotive addresses" further below. In the column to the right, next to the range of addresses, you will find the value that needs to be entered in CV17. In our example we use 196.

To establish the required value for CV18, calculate as follows:

		In numbers:	1234
minus	First address in established range of addresses	**-**	1024
equals	Value for CV18	**=**	**210**

In this case, 210 is the value that needs to be entered in CV18. Your decoder is now programmed to address 1234.

When reading out the address of a locomotive, read CV17 and then CV18 and proceed further in reverse order:

Let us assume that you have read out the following: CV17 = 228; CV18 = 145. First, look at column CV17 and establish the respective range of addresses. The first possible address of this range is 9216.

Now all you have to do is add the value from CV18 and you will know the locomotive address:

9216	or in order to quote the example of the locomotive address 1234 again:		1024
145		**+**	210
9361		**=**	**1234**

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Table of extended locomotive addresses

Range of addresses			Range of addresses			Range of addresses		
from	to	CV 17	from	to	CV 17	from	to	CV 17
0	255	192	3584	3839	206	7168	7423	220
256	511	193	3840	4095	207	7424	7679	221
512	767	194	4096	4351	208	7680	7935	222
768	1023	195	4352	4607	209	7936	8191	223
1024	1279	196	4608	4863	210	8192	8447	224
1280	1535	197	4864	5119	211	8448	8703	225
1536	1791	198	5120	5375	212	8704	8959	226
1792	2047	199	5376	5631	213	8960	9215	227
2048	2303	200	5632	5887	214	9216	9471	228
2304	2559	201	5888	6143	215	9472	9727	229
2560	2815	202	6144	6399	216	9728	9983	230
2816	3071	203	6400	6655	217	9984	10239	231
3072	3327	204	6656	6911	218			
3328	3583	205	6912	7167	219			

19.4   Bits and bytes – conversion help

Setting and deleting of bits in a CV

Many of the decoders' CVs use individual bits rather than numerical values. If you wish to program a decoder that does not support the individual setting and deleting of bits or if you use a system that does not permit programming using bits, you will have to program the appropriate decimal number for whichever bits you want to set or delete in the CVs.

Ask yourself:

"Which decimal numbers do I have to enter in order to set or delete which bits?"

Each bit that is set represents a number, a value. Simply write all bits which are to be set in a CV underneath one another and add them up. See table on the right. Each bit that is not set and therefore deleted, is '0'.

Bit	Value
1 (0)	1
2 (1)	2
3 (2)	4
4 (3)	8
5 (4)	16
6 (5)	32
7 (6)	64
8 (7)	128

If Bit 1 and Bit 5 are to be set, the values of these bits must be added up:

Bit	Value
1	1
5	16
Sum:	17

The decimal number which you have to enter in the CV is '17' if you wish to set bits 1 and 5.

19.5   Brake generator

Naturally, SILVER decoders can also be used together with the brake generator. If you control brake sections in front of signals with the brake generator, locomotives equipped with SILVER decoders will stop here.

Near to a brake generator, the lighting will retain its last status, i.e. it will remain switched on or off.

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We reserve the right to make changes in line with technical progress, product maintenance or changes in production methods.

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Please keep this operation manual for future reference!