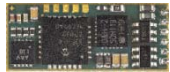




Doehler & Haass

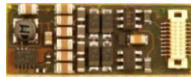
SOUND DECODER



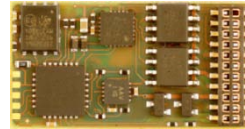
SD10A



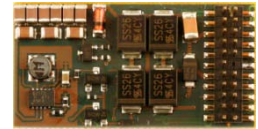
SD16A



SD18A



SD21A

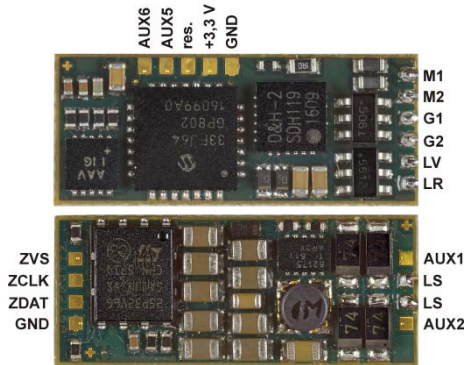


SD22A

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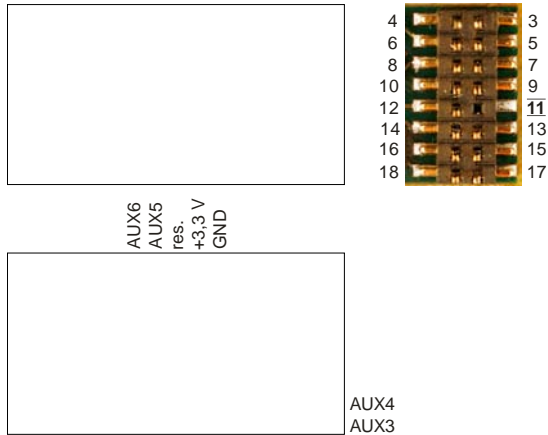
Sound decoder SD10A



ZVS	SUSI supply voltage	M1, M2	Motor connection 1, 2
ZCLK	SUSI clock (or AUX3 unamplified) *)	G1, G2	Track connection 1, 2
ZDAT	SUSI data (or AUX4 unamplified) *)	LV	Front light
GND	SUSI ground	LR	Rear light
		AUX1, AUX2	Additional functions 1, 2
		AUX5, AUX6	Unamplified additional functions 5, 6 *)
		LS	Speaker
		GND	Ground
		+3,3 V	Electronic supply voltage
		res.	Please do not connect anything!

*) Unamplified function outputs: see page 10

Sound decoder SD16A



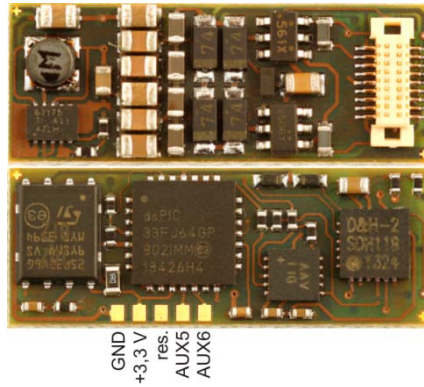
--	1	2	AUX3
ZCLK	3	4	ZDAT
GND	5	6	VS
LV	7	8	M1
VS	9	10	M2
Index	11	12	G1
LR	13	14	G2
LS	15	16	AUX1
LS	17	18	AUX2
AUX4	19	20	AUX5
AUX6	21	22	AUX7

AUX3, AUX4 Additional functions 3, 4
 AUX5, AUX6 Unamplified additional functions 5, 6 *)

GND Ground
 +3,3 V Electronic supply voltage
 res. Please do not connect anything!

*) Unamplified function outputs: see page 10

Sound decoder SD18A



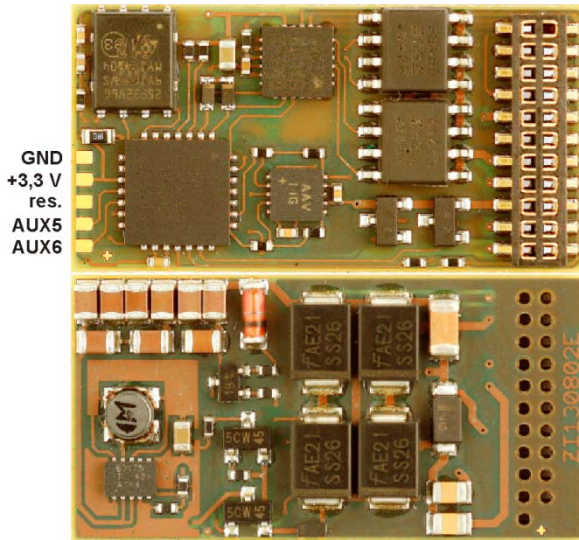
AUX5, AUX6 Unamplified additional functions 5, 6 *)

GND	Ground
+3,3 V	Electronic supply voltage
res.	Please do not connect anything!

*) Unamplified function outputs: see page 10

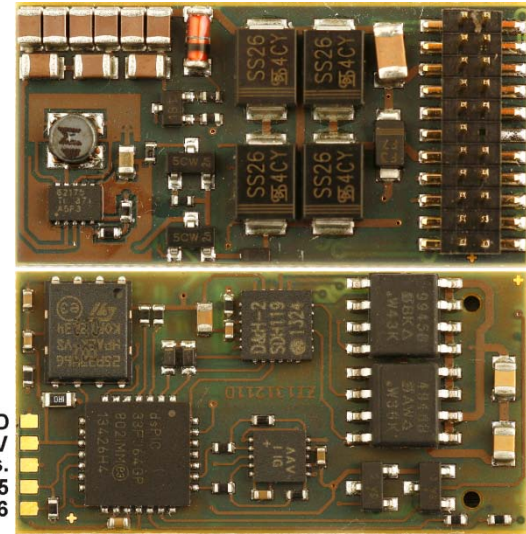
Specifications	SD10A	SD16A	SD18A
Dimensions [mm]	21,2 x 9,1 x 3,4	20,3 x 11 x 3,2	25,0 x 9,5 x 2,8
Driving characteristic values			
Operating mode SX1, SX2, DCC, MM, DC analog			
Total load	1,0 A	1,5 A	1,0 A
Maximum motor current	1,0 A	1,5 A	1,0 A
Maximum operating voltage	30 V	30 V	30 V
2 Light outputs, dimmable (LV, LR)	each 150 mA	each 150 mA	each 150 mA
2 Additional outputs, dimmable (AUX1, AUX2)	each 300 mA	each 300 mA	each 300 mA
2 Additional outputs (AUX3, AUX4)	---	each 1,0 A	---
2 Additional outputs (AUX5, AUX6)	unamplified	unamplified	unamplified
SUSI interface	available	available	available
Sound characteristic values			
Sampling rate	22 kHz	22 kHz	22 kHz
Independent sound channels	8	8	8
Memory size	32 Megabits	32 Megabits	32 Megabits
Memory period	ut to 190 s	up to 190 s	up to 190 s
Maximum output rating	1,4 W (4 Ω)	1,4 W (4 Ω)	1,4 W (4 Ω)
Connection options			
Without connection wires	SD10A-0		
With ribbon cable for standard plug NEM651	SD10A-1		
With connection wires	SD10A-3		
16 pin connector for direct plug (PluX16)		SD16A-4	
18 pin connection for direct plug (Next18)			SD18A

Sound decoder SD21A



GND
+3,3 V
res.
AUX5
AUX6

Sound decoder SD22A



GND
+3,3 V
res.
AUX5
AUX6

AUX5, AUX6 Unamplified additional functions 5, 6 *)

GND Ground
+3,3 V Electronic supply voltage
res. Please do not connect anything!

*) Unamplified function outputs: see page 10

21 pin interface

--	1	22	G1
--	2	21	G2
--	3	20	GND
AUX4	4	19	M1
ZCLK	5	18	M2
ZDAT	6	17	--
LR	7	16	VS
LV	8	15	AUX1
LS	9	14	AUX2
LS	10	13	AUX3
Index	11	12	VCC

PluX22 interface

--	1	2	AUX3
ZCLK	3	4	ZDAT
GND	5	6	VS
LV	7	8	M1
VS	9	10	M2
Index	11	12	G1
LR	13	14	G2
LS	15	16	AUX1
LS	17	18	AUX2
AUX4	19	20	AUX5
AUX6	21	22	AUX7

G1, G2	Track 1, 2
M1, M2	Motor 1, 2
LV	Front light
LR	Rear light
AUX1 - AUX4	Additional functions 1 – 4
LS	Speaker
VCC	+5 V / max. 15 mA
VS	Supply voltage (also for SUSI)
ZCLK	SUSI clock (or AUX3 or AUX5 unamplified*)
ZDAT	SUSI data (or AUX4 or AUX6 unamplified*)
GND	SUSI ground

*) Unamplified function outputs: see page 10

Specifications	SD21A	SD22A
Dimensions [mm]	30,2 x 15,8 x 5,2	30,2 x 15,8 x 5,2
Driving characteristic values		
Operating mode SX1, SX2, DCC, MM, DC/AC analog		
Total load	2,0 A	2,0 A
Maximum motor current	2,0 A	2,0 A
Maximum operating voltage	30 V	30 V
2 Light outputs, dimmable (LV, LR)	each 150 mA	each 150 mA
2 Additional outputs, dimmable (AUX1, AUX2)	each 300 mA	each 300 mA
2 Additional outputs (AUX3, AUX4)	each 1,0 A	each 1,0 A
2 Additional outputs (AUX5, AUX6)	unamplified	unamplified
SUSI interface	available	available
Sound characteristic values		
Sampling rate	22 kHz	22 kHz
Independent sound channels	8	8
Memory size	32 Megabits	32 Megabits
Memory period	up to 190 s	up to 190 s
Maximum output rating	1,4 W (4 Ω)	1,4 W (4 Ω)
Connecting options		
21 pin socket board for direct plug	SD21A-4	
22 pin connector for direct plug (PluX22)		SD22A-4

Unamplified function outputs AUX3 ... AUX6:

Since the unamplified function outputs AUX3 ... AUX6 (Logic level 0 V - 3,3 V, max. 20 mA) cannot switch higher load currents, it is absolutely necessary to connect the consumers via switching amplifiers (MOSFET, bipolar transistors or the like), if they need either a higher supply voltage ($> 3,3$ V) or a higher current (> 20 mA).

1 Introduction

The sound decoders are compatible with the protocols of SelectRIX standard SX1 and SX2 as well as with NMRA-DCC and MM1/MM2 standard. They can be operated by every central unit supporting one of these data formats. They can be used for normal direct current motors as well as for coreless motors.

Operation on alternating current layouts with switching impulse is not allowed!

The switching impulse destroys the decoder!

Exception: SD21A and SD22A

2 Safety instructions

This product is not suitable for children under 14 years. It might be swallowed by children under 3 years! An improper use involves a risk of injury due to sharp edges and points!

3 Warranty

Every sound decoder is fully tested before delivery. Should nevertheless a failure occur please contact the dealer where you purchased the decoder or directly the producer (Doehler & Haass enterprises). The warranty period is 2 years from the date of purchase.

4 Support and help

In case you have any problems please contact us by email: doehler-haass@t-online.de

Normally you would get an answer within a few days.

5 Functions

5.1 Driving operation

- Operation can be controlled either by conventional DC command station or by digital central units supporting the formats SelectRIX 1 and 2, NMRA norm (DCC) or MM1/MM2 standard
- Automatic switchover between analog and digital operation
- In case of digital operation the last programmed system will be activated (no automatic switchover!)
- SelectRIX 1 31 speed steps, 100 addresses
- SelectRIX 2 127 speed steps, 10.000 addresses, 16 additional functions
- DCC Short addresses (1-127), long addresses (0001-9999), with 14, 28, 126 speed steps
- Load control state of the art, that way an especially smooth regulation behavior
- Various regulation variants for an optimal adaption of the motor
- 127 internal speed steps
- Adjustable motor frequency (low frequency, 16 kHz, 32 kHz)
- Block system operation with simple diodes in digital operation
- Asymmetric digital voltage brakes (four diodes connected in series and one diode anti parallel), Slow approach (with appropriate brake modules) and bidirectional communication (locomotive address feedback signal in DCC operation, RailCom®)
- Outputs for light and function dimmable and analogically activatable
- Shunting gear
- Electronic interchange ability for the connections of motor, light and track
- All function outputs are freely programmable
- Thermal protection
- Reset function for DCC and SX2
- Decoder can be updated (programmer is required):
Incorporated sound decoder can be updated when the locomotive is standing on track (no need to open the engine). SW download from D&H homepage for free.

5.2 Sound operation

- Originally designed sound projects for steam, diesel and electric locomotives (no "standard sounds")
- Realistic steam sound with synchronized wheel and overlapping exhaust whams. Pitch is depending on speed steps and independent from boiling sound
- Realistic diesel-hydraulic driving sound with pitch depending on speed steps, variable coasting speed drive and independent acceleration steps, turbocharger and dynamic brakes
- Realistic diesel-mechanic driving sound with several gears, coasting speed, several driving and acceleration steps and possible shift sound
- Realistic electric driving sound with traction motor and traction motor fan as well as upgrading sounds (pantograph, main switch etc.), switchgear sound and dynamic brakes
- Bell, horn, whistle, close doors etc. (according to the sound project) can be separately triggered at any time
- All sound procedures are freely configurable ("Function Mapping") and can be accidentally triggered
- Speaker connection protected from short circuit and overload
- Low heat generation through high tech
- Loading of the sound projects by programmer over SUSI interface (about 6 minutes). For this the locomotive has to be opened and the sound decoder has to be connected via SUSI interface with the programmer. For that appropriate connecting adapters may be necessary. The sound projects can be downloaded from the D&H homepage for free.

6 Sound decoder installation

6.1 Preparation

Check if the locomotive is in perfect condition electrically and mechanically before installation. Defects or dirt must be eliminated first. Pay attention to the instructions of the locomotive producer.

Only locomotives running smoothly in direct current mode should be equipped with the sound decoder. New locomotives should be run at least 30 minutes in each driving direction.

Before installing the sound decoder all connections between the motor and the track connections have to be removed (sliding contact, chassis, etc.).

Both motor connections must be disconnected from the ground!

Further on all capacitors have to be removed, particularly those associated to the connections of light and motor.

6.2 Installation

There are following variants to connect the sound decoder:

- 1 In case your locomotive is equipped with a 16/22 pin PluX interface:
The **SD16A-4** and the **SD22A-4** can be directly inserted into the interface.
- 2 In case your locomotive is equipped with a 18 pin/Next18 interface:
The **SD18A** can be directly inserted into the interface.
- 3 In case your locomotive is equipped with a 21 pin/MTC21 interface:
The **SD21A-4** can be directly inserted into the interface.
- 4 In case your locomotive is equipped with an interface corresponding to NEM 651:
The **SD10A-1** has already the appropriate connections for this plug. Short the ribbon cable up to approximately 5 mm and remove the rest of the insulation. The decoder can be now inserted into the interface without any problems.
For **SD18A** a N18-K-1 adapter is required. It has already the appropriate connections for this plug. Short the ribbon cable up to approximately 5 mm and remove the rest of the insulation. The adapter can be now inserted into the interface without any problems.
- 5 In case your locomotive is equipped with an interface corresponding to NEM 652:
For **SD18A** a N18-G-2 adapter is required.
For **SD21A-4** a M21-2 adapter is required.
They are equipped with the appropriate connection cable for this socket. You can connect the adapter with the interface without any problems.
- 6 If your locomotive is not equipped with an appropriate interface, the sound decoder must be wired individually.
For this you can either use **SD10A-3** or, when using other sound decoder, the adapter N18-K-3, N18-G-3, M21-3 and P22-3, according to the type of the sound decoder.
- 7 **SD10A-0** resp. the adapter N18-K-0, N18-G-0 and M21-0 should be used only by experienced model railroaders, as the connection wires must be soldered directly onto the adapter.

For fixing the adapter a double sided adhesive tape is recommended.

For installation variant 6 connect the wires of SD10A-3 or of the adapter according to the following diagram:

red wire	with the right track wire
black wire	with the left track wire
orange wire	with the motor wire, which was connected with the right track wire
gray wire	with the motor wire, which was connected with the left track wire
white wire	with the front light
yellow wire	with the rear light
green wire	function output AUX1 *)
violet wire	function output AUX2 *)
blue wire	common return, up to 30 Volt (+VS) *)

*) Only N18-G-3, M21-3 and P22-3

For installation variants 4 - 6 connect:

brown wires	with the speaker
-------------	------------------

6.3 Check after installation

The first test should be executed in the programming mode (e.g. by reading out the address). In case of an incorrect feedback (confirmation signal) to the central unit ("Error"), please check again the correct assignment of the connections, respectively if the motor is really disconnected from the chassis electrically.

7 Operating system SelecTRIX 1 (SX1)

Attention!

The locomotive sound decoder do not support SX1 programming.

You can adjust SX1 operation by SX2 parameter programming according the table in **point 7.2**.

7.1 Functions

Speed steps	31	
Speed steps (internal)	127	
Front light/rear light	yes	
Additional functions	2	
Additional channel available	8	(connectable with loco address + 1)
Operation by deceleration diode	yes	
Locomotive address output	yes	

7.2 SX1 operation by SX2 parameter programming

See also <http://doehler-haass.de/cms/pages/haeufige-fragen.php#a2bc> (only in German)

Setup SX1-programming	Characteristic value	Value range	Setup SX2 programming	par	Value range
Locomotive address	L	1 to 111	Address for SX1	003	1 to 111 *1
Maximum speed	V	1 to 7	Maximum speed	013	0 to 127
Starting delay/deceleration	A	1 to 7	Acceleration time	011	0 to 255
			Deceleration time	012	0 to 255
Impulse width (-duration)	I	1 to 4	Impulse width	053	0 to 3
Brake section	S	1-/2-part	Brake sections	021	0 or 1
Interchanging of connections	V	0 to 7	Interchanging track	031	0 or 1
			Interchanging motor	032	0 or 1
			Interchanging light	033	0 or 1
Efficiency of AFB and additional channel	A	1 to 7	Address for SX1, 1. Additional channel	004	0 to 255 *2
			Address for SX1, 2. Additional channel	005	0 to 255 *2
Regulation variant	I	1 to 4	Regulation variant	052	0 to 3

*1 For SX2 operation value 112 must be entered here.

*2 Enter here value 0, if you do not want to use the additional channel.

Value 1 means "Address for SX1" + 1, value 2 means "Address for SX1" + 2, etc.

If you proceed according to this mapping, you can simply write all characteristic values, which you would normally use for SX1 programming, into the corresponding SX2 parameter.

In this way you can adjust the maximum speed more precisely (value range from 0 to 127 instead of from 1 to 7) and also adjust starting delay and deceleration (AFB) separately and more precisely (value range from 0 to 255 separated for every parameter instead of 1 to 7 for the common characteristic value).

Notice:

Coreless motors should be operated with regulation variant 4 and impulse width 1.
Damages due to incorrect adjustments are excluded from warranty.

Also in SX1 operation through SX2 parameter programming the decoder assesses furthermore POM data packages, sent to its SX2 locomotive address. For driving enter please the SX1 locomotive address from parameter 003 in your manual controll and for POM the SX2 locomotive address from the parameters 001 and 002. All parameters except par001 and par002 can be changed during operation through "Programming on the Main (POM)".

7.3 Operation

Put the locomotive on the programming track and read out the programming parameters of the decoder. Program the desired locomotive address and put the locomotive in operation keeping these setting values. After the first check you can vary the parameters of the locomotive according to your requirements.

In case your programming device indicates "Error", please check again the correct wiring of the locomotive and pay attention to the wiring instructions of the programming track. Never put such a locomotive into operation!

7.4 Explanation of the brake sections

1-part stopping section:

In front of the signal one track section is controlled by a diode. The decoder must be programmed on a 1-part section. The locomotive decelerates until stop.

2-part stopping section:

There are two track sections in front of the signal. The first one is controlled by a diode. In this section the locomotive will be decelerated to speed step 3. The second section is without supply, thus stops the locomotive just in front of the signal. In this case the decoder must be programmed onto the 2-part section (=).

8 Operating system DCC

8.1 Functions

Short addresses	1 – 127
Long addresses	0001 – 9999
Speed steps	14, 28, 126
Speed steps (internal)	127
Front light/rear light (dimnable)	yes
Additional functions (dimnable)	2
Whole functions	28
Operation with brake diodes	yes
Operation with brake generators	yes
Consist mode	yes
Programming on the main	yes
Locomotive number output	yes

Notice to address range:

DCC operation allows only address values from 1 to 127 for DCC. In MM operation values from 1 to 255 are allowed. Values from 128 on lead to restricting the decoder for MM operation only, i.e. DCC operation is no longer possible. DCC "service mode" is of course still possible.

Activating the long DCC address through CV29/Bit5 makes vice versa that the decoder can be operated by DCC just now. MM operation is no longer possible then. MM programming is also disabled. Attention "lock out" is possible.

8.2 Setup features

The characteristics of a locomotive designed in DCC operation can be varied by programming the "Configuration Variables" (CV) at any time. Please learn the programming of the CV from the instructions of your programming device.

You can find notices for standard "Function Mapping" on the Doehler & Haass website:

<http://doehler-haass.de/cms/pages/haeufige-fragen.php>: Wie sieht das standardmäßige "Function Mapping" aus? (only in German)

Notice:

In case the speed steps programmed on the decoder differ from those of the control device, malfunctions may occur. Please pay attention to the informations concerning your digital system.

List of supported CV for driving operation:

CV	Name and definition	Range
01	Address Addresses greater than 127 are only useable in MM operation	0 – 255 (3)
02	Starting voltage	0 – 15 (0)
03	Acceleration time The value corresponds to the time in seconds from start to maximum speed	0 – 255 (3)
04	Deceleration time The value corresponds to the time in seconds from maximum speed to stop	0 – 255 (3)
05	Maximum speed (See supplement 2)	0 – 127 (92)
07	Version number (Read only)	

08	Manufacturer identification 97 = Doehler & Haass (Decoder Reset with "8")	(Read only)																															
09	Motor frequency 0 = 32 kHz, 1 = 16 kHz, 2 = low frequency Bit 2 = proportional part limitation		0 – 7 (1)																														
12	MM-settings Bit 0 – 2: 0 = MM operation deactivated 1 = MM operation without additional address 2 = MM operation with one additional address 3 = MM operation with two additional addresses 4 = MM operation with three additional addresses 5 = MM operation with four additional addresses 6 = MM operation with five additional addresses 7 = MM operation with six additional addresses Bit 3 = For decoder internal use: driving direction at MM1/AC analog		0 – 15 (1)																														
13	Analog Mode F1 – F8 <table border="0"> <thead> <tr> <th>Bit</th> <th>Function</th> <th>Value</th> <th>Bit</th> <th>Function</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>F1</td> <td>1</td> <td>4</td> <td>F5</td> <td>16</td> </tr> <tr> <td>1</td> <td>F2</td> <td>2</td> <td>5</td> <td>F6</td> <td>32</td> </tr> <tr> <td>2</td> <td>F3</td> <td>4</td> <td>6</td> <td>F7</td> <td>64</td> </tr> <tr> <td>3</td> <td>F4</td> <td>8</td> <td>7</td> <td>F8</td> <td>128</td> </tr> </tbody> </table>	Bit	Function	Value	Bit	Function	Value	0	F1	1	4	F5	16	1	F2	2	5	F6	32	2	F3	4	6	F7	64	3	F4	8	7	F8	128		0 – 255 (1)
Bit	Function	Value	Bit	Function	Value																												
0	F1	1	4	F5	16																												
1	F2	2	5	F6	32																												
2	F3	4	6	F7	64																												
3	F4	8	7	F8	128																												
14	Analog Mode FL, F9 – F12 <table border="0"> <thead> <tr> <th>Bit</th> <th>Function</th> <th>Value</th> <th>Bit</th> <th>Function</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>FL(f)</td> <td>1</td> <td>4</td> <td>F11</td> <td>16</td> </tr> <tr> <td>1</td> <td>FL(r)</td> <td>2</td> <td>5</td> <td>F12</td> <td>32</td> </tr> <tr> <td>2</td> <td>F9</td> <td>4</td> <td></td> <td></td> <td></td> </tr> <tr> <td>3</td> <td>F10</td> <td>8</td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	Bit	Function	Value	Bit	Function	Value	0	FL(f)	1	4	F11	16	1	FL(r)	2	5	F12	32	2	F9	4				3	F10	8					0 – 63 (3)
Bit	Function	Value	Bit	Function	Value																												
0	FL(f)	1	4	F11	16																												
1	FL(r)	2	5	F12	32																												
2	F9	4																															
3	F10	8																															

17	Long address	0 – 255 (192)																														
18	CV17 contains the most significant byte, CV18 contains the least significant byte. Only if activated by CV29/Bit 5=1	0 – 255 (0)																														
19	Consist address Several locomotives in compound under this address 0 = inactive Value + 128 = inverse direction	0 – 127 (0)																														
21	Consist mode F1 – F8 <table border="0"> <thead> <tr> <th>Bit</th> <th>Function</th> <th>Value</th> <th>Bit</th> <th>Function</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>F1</td> <td>1</td> <td>4</td> <td>F5</td> <td>16</td> </tr> <tr> <td>1</td> <td>F2</td> <td>2</td> <td>5</td> <td>F6</td> <td>32</td> </tr> <tr> <td>2</td> <td>F3</td> <td>4</td> <td>6</td> <td>F7</td> <td>64</td> </tr> <tr> <td>3</td> <td>F4</td> <td>8</td> <td>7</td> <td>F8</td> <td>128</td> </tr> </tbody> </table>	Bit	Function	Value	Bit	Function	Value	0	F1	1	4	F5	16	1	F2	2	5	F6	32	2	F3	4	6	F7	64	3	F4	8	7	F8	128	0 – 255 (0)
Bit	Function	Value	Bit	Function	Value																											
0	F1	1	4	F5	16																											
1	F2	2	5	F6	32																											
2	F3	4	6	F7	64																											
3	F4	8	7	F8	128																											
22	Consist mode FL, F9 – F12 <table border="0"> <thead> <tr> <th>Bit</th> <th>Function</th> <th>Value</th> <th>Bit</th> <th>Function</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>FL(f)</td> <td>1</td> <td>4</td> <td>F11</td> <td>16</td> </tr> <tr> <td>1</td> <td>FL(r)</td> <td>2</td> <td>5</td> <td>F12</td> <td>32</td> </tr> <tr> <td>2</td> <td>F9</td> <td>4</td> <td></td> <td></td> <td></td> </tr> <tr> <td>3</td> <td>F10</td> <td>8</td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	Bit	Function	Value	Bit	Function	Value	0	FL(f)	1	4	F11	16	1	FL(r)	2	5	F12	32	2	F9	4				3	F10	8				0 – 63 (0)
Bit	Function	Value	Bit	Function	Value																											
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27	Brake settings <table border="0"> <thead> <tr> <th>Bit</th> <th>Function</th> <th>Value</th> <th>Bit</th> <th>Function</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Asymmetry normal</td> <td>1</td> <td>4</td> <td>Negative voltage</td> <td>16</td> </tr> <tr> <td>1</td> <td>Asymmetry inverse</td> <td>2</td> <td>5</td> <td>Positive voltage</td> <td>32</td> </tr> <tr> <td>2</td> <td>Currently without function</td> <td>4</td> <td>6</td> <td>Brake diode normal</td> <td>64</td> </tr> <tr> <td>3</td> <td>Currently without function</td> <td>8</td> <td>7</td> <td>Brake diode invers</td> <td>128</td> </tr> </tbody> </table>	Bit	Function	Value	Bit	Function	Value	0	Asymmetry normal	1	4	Negative voltage	16	1	Asymmetry inverse	2	5	Positive voltage	32	2	Currently without function	4	6	Brake diode normal	64	3	Currently without function	8	7	Brake diode invers	128	0 – 243 (64)
Bit	Function	Value	Bit	Function	Value																											
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28	Feedback settings <table border="0"> <thead> <tr> <th>Bit</th> <th>Function</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Locomotive number output allowed</td> <td>1</td> </tr> <tr> <td>1</td> <td>POM read out allowed</td> <td>2</td> </tr> </tbody> </table>	Bit	Function	Value	0	Locomotive number output allowed	1	1	POM read out allowed	2	0 – 3 (3)																					
Bit	Function	Value																														
0	Locomotive number output allowed	1																														
1	POM read out allowed	2																														

29	Configuration register		0 – 255	(6)
	Bit	Function	Value	
	0	Invert direction	1	
	1	14 ↔ 28/126 speed steps	2	
	2	Analog operation allowed	4	
	3	Feedback allowed	8	
	5	Locomotive address by CV17/18	32	
33	Function mapping F0(f)	(See supplement 1)	0 – 255	(1)
34	Function mapping F0(r)	(See supplement 1)	0 – 255	(2)
35	Function mapping F1(f+r)	(See supplement 1)	0 – 255	(4)
	If CV35 is written, CV47 will be set up to the same value			
36	Function mapping F2(f+r)	(See supplement 1)	0 – 255	(8)
	If CV36 is written, CV64 will be set up to the same value			
37	Function mapping F3	(See supplement 1)	0 – 255	(16)
38	Function mapping F4	(See supplement 1)	0 – 255	(128)
39	Function mapping F5	(See supplement 1)	0 – 255	(32)
40	Function mapping F6	(See supplement 1)	0 – 255	(0)
41	Function mapping F7	(See supplement 1)	0 – 255	(0)
42	Function mapping F8	(See supplement 1)	0 – 255	(64)
43	Function mapping F9	(See supplement 1)	0 – 255	(0)
44	Function mapping F10	(See supplement 1)	0 – 255	(0)
45	Function mapping F11	(See supplement 1)	0 – 255	(0)
46	Function mapping F12	(See supplement 1)	0 – 255	(0)
47	Function mapping F1(r)	(See supplement 1)	0 – 255	(4)
	In case CV47 should have another value as CV35, you have to set CV35 first and then CV47			
48	Characteristic diagram	(See supplement 2)	0 – 7	(5)
	Response curve, 0 = linear ... 7 = strongly curved			

51	Interchange of connections		0 – 7	(0)	
	Bit	Function			Value
	0	Motor connections			1
	1	Light connections			2
	2	Track connections	4		
52	Dimming light "normal"		0 – 31	(31)	
	0 = off ... 31 = full brightness				
53	Dimming light "alternative"		0 – 31	(15)	
	0 = off ... 31 = full brightness				
54	Dimming AUX1		0 – 31	(31)	
	0 = off ... 31 = full brightness				
55	Dimming AUX2		0 – 31	(31)	
	0 = off ... 31 = full brightness				
56	Motor proportional controller		0 – 7	(3)	
	See www.doehler-haass.de / "Häufige Fragen" (FAQ) (only in German)				
57	Motor integral controller	(As CV56)	0 – 3	(3)	
58	Motor measurement period	(As CV56)	0 – 3	(1)	
59	Motor impulse width	(As CV56)	0 – 7	(3)	
60	Brake sections		0, 1	(0)	
	1 or 2				
61	Shunting gear speed	(As CV05)	0 – 127	(63)	
62	Shunting gear deceleration time	(As CV03)	0 – 255	(1)	
64	Function mapping F2(r)	(See supplement 1)	0 – 255	(8)	
	In case CV64 should have another value as CV36, you have to set CV36 first and then CV64				
66	Forward-trim		0 – 255	(0)	
	0 = disconnected, smaller 128 = reduction, greater 128 = enhancement of the speed				

95	Backward-trim (As CV66)	0 – 255	(0)
105	User identification 1	0 – 255	(0)
106	User identification 2	0 – 255	(0)
113	Switch-off function for LV Bit 0 = F1 ... Bit 7 = F8	0 – 255	(0)
114	Switch-off function for LR Bit 0 = F1 ... Bit 7 = F8	0 – 255	(0)
115	Switch-off function for AUX1 Bit 0 = F1 ... Bit 7 = F8	0 – 255	(0)
116	Switch-off function for AUX2 Bit 0 = F1 ... Bit 7 = F8	0 – 255	(0)
117	Timer for switch off AUX1 Each 100 ms, 0 = deactivated	0 – 250	(0)
118	Timer for switch off AUX2 Each 100 ms, 0 = deactivated	0 – 250	(0)
119	Timer for switch off AUX3 Each 100 ms, 0 = deactivated	0 – 250	(0)
120	Timer for switch off AUX4 Each 100 ms, 0 = deactivated	0 – 250	(0)
121	Function mapping LV+LR on / AUX1+AUX2 off Bit 0 = F1 ... Bit 7 = F8	0 – 255	(0)
122	Function mapping AUX1+AUX2 on / LV+LR off Bit 0 = F1 ... Bit 7 = F8	0 – 255	(0)
123	Slow approach (See CV27) Only at asymmetry and suitable brake modules	0 – 127	(63)
125	Switch-off function for AUX3 Bit 0 = F1 ... Bit 7 = F8	0 – 255	(0)

126	Switch-off function for AUX4 Bit 0 = F1 ... Bit 7 = F8		0 – 255	(0)
127	Switch-off function for AUX5 Bit 0 = F1 ... Bit 7 = F8		0 – 255	(0)
128	Switch-off function for AUX6 Bit 0 = F1 ... Bit 7 = F8		0 – 255	(0)
129	Timer for switch off AUX5 Each 100 ms, 0 = deactivated		0 – 250	(0)
130	Timer for switch off AUX6 Each 100 ms, 0 = deactivated		0 – 250	(0)
131	Function mapping dim light 0 = deactivated, 1 ... 28 = F1 ... F28, 29 = F0 (light) Only valid, if CV137/bit 4=1		0 – 29	(1)
132	Function mapping shunting gear	(As CV131)	0 – 29	(1)
133	Function mapping delays off	(As CV131)	0 – 29	(1)
134	Decision threshold for asymmetry 0 = small asymmetry ... 15 = strong asymmetry	(See CV27)	0 – 15	(6)
135	Multiplication speed feedback 0 = deactivated		0 – 255	(0)
136	Division speed feedback 0 = /1, 1 = /2, 2 = /4, 3 = /8, 4 = /16, 5 = /32, 6 = /64		0 – 6	(0)

137	Settings		0 – 63	(0)	
	Bit	Function			Value
	0	Unamplified function outputs instead of ZCLK and ZDAT			1
	1	Energy saving mode out			2
	2	Invert SUSI driving direction			4
	3	Currently without function			
4	Extended function mapping activated (see CV131 and CV137/Bit 5)	16			
5	0 = AUX3 and AUX4 to ZCLK and ZDAT 1 = AUX5 and AUX6 to ZCLK and ZDAT (Only valid, if CV137/bit 0=1 and bit 4=1)	32			
Notes to Bit 0, Bit 4 and Bit 5: see end of the table					
138	Timer for driving up Each 100 ms, 0 = no driving up		0 – 250	(0)	
139	Timer for waiting Each 100 ms, 0 = no waiting		0 – 250	(0)	
140	Timer for driving away Each 100 ms, 0 = no driving away		0 – 250	(0)	
141	Speed steps for driving up		0 – 127	(12)	
142	Speed steps for driving away		0 – 127	(12)	
143	Settings		0 – 255	(0)	
	Bit	Function			Value
	6	Coupling process and timer deactivated			64
	7	Coupling process only in shunting gear			128
144	Settings		0 – 1	(0)	
	Bit	Function			Value
	0	Dynamic channel usage (BiDi)	1		

145	Conditions for LV		0 – 161	(0)
	Function	Value		
	Initial state (always on, if function key on)	0		
	Only forward	+1		
	Only backward	+2		
	Only while standing	+3		
	Only while driving	+6		
	Only at F0 (light) off	+9		
	Only at F0 (light) on	+18		
	Not in shunting gear	+27		
	Only in shunting gear	+54		
	Ignore direction using shunting gear	+81		
	Ignore drive/stand using shunting gear	+108		
Ignore direction and drive/stand using shunting gear	+135			
It is allowed to add up only one number from every definite range!				
146	Conditions for LR	(See CV145)	0 – 161	(0)
147	Conditions for AUX1	(See CV145)	0 – 161	(0)
148	Conditions for AUX2	(See CV145)	0 – 161	(0)
149	Conditions for AUX3	(See CV145)	0 – 161	(0)
150	Conditions for AUX4	(See CV145)	0 – 161	(0)
151	Conditions for AUX5	(See CV145)	0 – 161	(0)
152	Conditions for AUX6	(See CV145)	0 – 161	(0)

153	Initial mapping					0 – 255 (0)	
	Bit	Function	Value	Bit	Function		Value
	0	LV	1	4	AUX3		16
	1	LR	2	5	AUX4		32
	2	AUX1	4	6	AUX5		64
	3	AUX2	8	7	AUX6		128
<p>These function outputs are activated as soon as the decoder is addressed (without active function key). Thus, in connection with the conditions, the switching of the sliding contact can be realized for example.</p>							
154	Brake ramp forward and backward				(See CV27)	0 – 255 (0)	
<p>Only at asymmetry and CV48 = 0 0 = deactivated Deceleration time will be adjusted in the highest speed step in seconds, at smaller speed steps the decoder is calculating the brake ramp independently</p>							
155	Brake ramp backward				(See CV154)	0 – 255 (0)	
<p>0 = the value from CV154 is used Enables different deceleration times forward and backward</p>							
260	Manufacturer identification				(Read only)		
<p>97 = Doehler & Haass (Decoder reset with "101")</p>							
261	Decoder code				(Read only)		
<p>SD10A = 210, SD16A = 216, SD18A = 218, SD21A = 221, SD22A = 222</p>							
262	Version number						
263	Date						
264	Revision number						
265	Date						

Explanation to CV137:

Activation SUSI pins: Bit 0 = 0 / Bit 4 = equal / Bit 5 = equal

Activation AUX3/AUX4: Bit 0 = 1 / Bit 4 = equal / Bit 5 = 0

Activation AUX5/AUX6: Bit 0 = 1 / Bit 4 = 1 / Bit 5 = 1

List of the supported CV for sound operation:

311	Function mapping driving sound 0 = deactivated, 1 ... 28 = F1 ... F28, 29 = F0 (light) Traction motor at electric locomotives, chuffs at steam locomotives, etc.		0 – 29	(1)
312	Function mapping secondary driving sound (As CV311) Traction motor fan at electric locomotives, boiling sound at steam locomotives, etc.		0 – 29	(1)
313	Function mapping gear sound (As CV311)		0 – 29	(0)
314	Function mapping brake sound (As CV311)		0 – 29	(7)
315	Function mapping sound flow 3 (As CV311)		0 – 29	(2)
316	Function mapping sound flow 4 (As CV311)		0 – 29	(3)
317	Function mapping sound flow 5 (As CV311)		0 – 29	(4)
318	Function mapping sound flow 6 (As CV311)		0 – 29	(5)
319	Function mapping sound flow 7 (As CV311)		0 – 29	(6)
320	Function mapping sound flow 8 (As CV311)		0 – 29	(9)
321	Function mapping sound flow 9 (As CV311)		0 – 29	(10)
322	Function mapping sound flow 10 (As CV311)		0 – 29	(11)
323	Function mapping sound flow 11 (As CV311)		0 – 29	(12)
324	Function mapping sound flow 12 (As CV311)		0 – 29	(13)
325	Function mapping sound flow 13 (As CV311)		0 – 29	(14)

326	Function mapping sound flow 14	(As CV311)	0 – 29	(15)
327	Function mapping sound flow 15	(As CV311)	0 – 29	(16)
328	Function mapping sound flow 16	(As CV311)	0 – 29	(17)
329	Function mapping fade-out effect	(As CV311)	0 – 29	(8)
330	Total volume 0 ... 255 = 0% ... 100%		0 – 255	(64)
331	Volume driving sound 0 ... 128 ... 255 = 0% ... 100% ...200% Value higher 100% can lead to overload!		0 – 255	(128)
332	Volume secondary driving sound	(As CV331)	0 – 255	(128)
333	Volume gear sound	(As CV331)	0 – 255	(128)
334	Volume brake sound	(As CV331)	0 – 255	(128)
335	Volume sound flow 3	(As CV331)	0 – 255	(128)
336	Volume sound flow 4	(As CV331)	0 – 255	(128)
337	Volume sound flow 5	(As CV331)	0 – 255	(128)
338	Volume sound flow 6	(As CV331)	0 – 255	(128)
339	Volume sound flow 7	(As CV331)	0 – 255	(128)
340	Volume sound flow 8	(As CV331)	0 – 255	(128)
341	Volume sound flow 9	(As CV331)	0 – 255	(128)
342	Volume sound flow 10	(As CV331)	0 – 255	(128)
343	Volume sound flow 11	(As CV331)	0 – 255	(128)
344	Volume sound flow 12	(As CV331)	0 – 255	(128)
345	Volume sound flow 13	(As CV331)	0 – 255	(128)
346	Volume sound flow 14	(As CV331)	0 – 255	(128)
347	Volume sound flow 15	(As CV331)	0 – 255	(128)
348	Volume sound flow 16	(As CV331)	0 – 255	(128)
349	Volume fade-out effect	(As CV330)	0 – 255	(0)

350	Coasting delay time The value corresponds to the time in 100 ms steps until the compulsory change from driving sound to coasting. 0 = deactivated	0 – 255	(0)
353	Chuffs at speed step 1 The value corresponds to the time in 64 ms steps between the chuffs at speed step 1	0 – 255	(120)
354	Chuffs at higher speed steps The value determines the time of reduction between the chuffs at higher speed steps	0 – 255	(20)
355	Brake squeal at minimal speed step The minimum speed step that must be reached, before brake squeal is starting	0 – 127	(20)
356	Brake squeal at initial speed step The minimum speed step that must be reached, before brake squeal is starting	0 – 127	(13)
357	Secondary driving sound modulation The value determines to which extent the speed step influences the pitch 0 = deactivated	0 – 255	(0)
358	Driving sound modulation (As CV357)	0 – 255	(11)
359	Timer for fade-out effect The value corresponds to the time in seconds from the adjusted total volume to silence	0 – 255	(8)
360	Write protection Flash-ROM Must be "0" for sound operation (is operated during the loading process)	0, 1	(0)
361	Threshold value ZVS The value corresponds to about the supply voltage in volt. At that voltage it will be changed in the energy saving mode (small values induces resetting the sound module and great values cause a „stuttering“ sound)	0 – 14	(7)

362	Chuffs at speed step 127 The value corresponds to the minimum time in 1 ms steps between the chuffs at speed step 127, which must not be undercut	0 – 255	(0)												
364	Brake squeal at final speed step The speed step, where the brake squeal changes into the final sequence of the sound flow (actual end at speed step 0 at the latest)	0 – 127	(6)												
365	Brake squeal at deceleration time The value corresponds to the time in 8 ms steps, which may pass by between two speed step reductions, in order that brake squeal is still possible	0 – 255	(3)												
366	Brake squeal at minimum delay The value corresponds to the number of speed steps, which must run through within the deceleration time at least, in order that brake squeal is still possible	0 – 127	(0)												
367	Random sounds <table border="0" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Bit</th> <th style="text-align: left;">Function</th> <th style="text-align: left;">Value</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Random sounds allowed while standing</td> <td>1</td> </tr> <tr> <td>1</td> <td>Random sounds allowed while running</td> <td>2</td> </tr> <tr> <td>2</td> <td>Transfer random sounds to SUSI interface</td> <td>4</td> </tr> </tbody> </table>	Bit	Function	Value	0	Random sounds allowed while standing	1	1	Random sounds allowed while running	2	2	Transfer random sounds to SUSI interface	4	0 – 7	(3)
Bit	Function	Value													
0	Random sounds allowed while standing	1													
1	Random sounds allowed while running	2													
2	Transfer random sounds to SUSI interface	4													
368	Volume dynamic sound	(As CV331)	0 – 255 (128)												
369	Volume turbo charger	(As CV331)	0 – 255 (128)												
370	Modulation dynamic brake	(As CV357)	0 – 255 (0)												
371	Modulation dynamic drive	(As CV357)	0 – 255 (0)												
372	Modulation turbo charger proportional part	(As CV357)	0 – 255 (0)												
373	Modulation turbo charger integral part	(As CV357)	0 – 255 (0)												
374	Function mapping volume reduction With every keystroke (on/off) the total volume will be permanently reduced	(As CV311)	0 – 29 (0)												
375	Function mapping volume enhancement With every keystroke (on/off) the total volume will be permanently enhanced	(As CV311)	0 – 29 (0)												

376	Function mapping brake squeal deactivation (As CV311) If the corresponding function key is pushed, no brake squeal will be represented, even if the conditions are fulfilled.	0 – 29	(0)
377	Function mapping compulsory coasting (As CV311) If the corresponding function key is pushed, the driving sound remains also during the coasting acceleration	0 – 29	(0)

All programmable CVs can be changed during the current operation (POM / "Programming on the Main" / main track programming).

Stated default values can be overwritten according to the sound project!

8.3 Operation

Put the locomotive on the programming track and read out the locomotive address of the decoder (CV01). The default value should be 3. Program the desired locomotive address and start running the locomotive keeping these setup values. After the first check you can vary the parameters of the locomotive according to your requirements.

In case your programming device indicates "Error", please check again the correct wiring of the locomotive and pay attention to the notices for connecting the programming track. Never put such a locomotive into operation!

Notice:

Block section operation with asymmetry in the direct current operating mode is not possible with the factory settings. In case you want this option, you must set CV27 / bit 0 and/or bit 1 to "1". Operation with direct current voltage in block section is not possible with the factory settings. If this feature is requested, CV27 / bit 4 and/or bit 5 must be set to "1".

Acceleration time CV03 and deceleration time CV04 of the sound decoder should be adjusted to value 8 at the minimum. Too small adjusted time leads to the skipping of several sound flows and they could not be displayed! If required the values can be enhanced step by step for fine tuning.

Please take the mapping, which sound flow corresponds to which sound, from the instruction of the particular sound project.

Not all sound flows from 1 to 16 (CV313 – CV328) must contain sounds.

9 Operating system Märklin-Motorola (MM)

9.1 Functions

Addresses	1 – 255
Speed steps	14, 28
Speed steps (internal)	127
Front light/rear light (dimnable)	yes
Additional functions (dimnable)	2
Functions total (only MM2)	12
Operation with MM brake section	yes

You can find notices for standard "Function Mapping" on the Doehler & Haass-website:

<http://doehler-haass.de/cms/pages/haeufige-fragen.php>: Wie sieht das standardmäßige "Function Mapping" aus? (only in German)

Notice for address range:

In MM operation address values from 1 to 255 are allowed. In DCC operation are for DCC-CV01 only values from 1 to 127 allowed. Values from 128 on lead to operating the decoder only in MM, i.e. DCC operation is no longer possible. DCC "service mode" is still possible.

Vice versa activating the long DCC address by CV29/Bit5 induces, that the decoder can now be operated only by DCC. MM operation is no longer possible and MM programming is also disabled.

Attention, because „lock out“ is possible.

9.2 Programming with Märklin central unit 6020/6021

- 1 **Short** programming allows entering figures between 0 and 79, i.e. in short mode only setup parameters with a number < 80 can be changed, in case the desired value should also be < 80.
- 2 **Long** programming allows entering figures between 0 and 255, i.e. in long mode all setup parameters with values from 0 to 255 can be changed. Because the display of the 6020/6021s allows only binary values, the values to be entered must be entered in two steps.
- 3 Programming of SUSI parameter

Please notice, that the 6021/6020s allows only entering values from 01 to 80. Value 0 is missing. **Instead of '0' always '80' must be entered.**

Changing in programming mode

- The driving controller must display 0. No other locomotives are allowed to be on the layout. Notice the flashing signals of the locomotive!
- Push the STOP- and GO button of the 6021s simultaneously until reset is triggered (alternatively: disconnect for a moment the plug of the transformer). Push the STOP button for disconnecting track power.
- Enter the current decoder address. If you do not know the address, enter '80'.
- Revert the driving direction with the driving controller (turn the driving controller to the left beyond the keystroke until you hear a click), hold the controller and push the GO button.
- After about 1 second the engine lights are flashing, the decoder is now in programming mode.

Short mode

- After changing in programming mode the decoder is in short mode.
The engine lighting flashes periodically slow.
- Enter now the number of the CV, you want to change, e.g. 01 (double-digit).
- Activate the reversion of the driving direction for confirmation. Lighting is now flashing shortly two times.
- Enter now the new value for CV, e.g. 15 (double-digit).
- Activate the reversion of the driving direction for confirmation.
The lighting flashes.
- You may now enter further CVs, which you want to change.

The programming mode will be left by selection of CV80 or by turning off and on the track power (push STOP button and then again the GO button).

Long mode

- You get the long mode by entering in short mode value 07 in CV07 at first.
The decoder confirms changing in long mode by slow flashing of the lighting.
- Enter now the hundreds- and tens digit of the CV you want to change.
Example: CV124 shall be changed: Enter '12'.
- Activate the reversion of the driving direction for confirmation. The lighting flashes periodically long and short.
- Enter now the unit of the CV in double-digit. See example: '04'.
- Activate the reversion of the driving direction for confirmation. The lighting flashes periodically long-short-short. The decoder awaits now the entering of the CV value.

- Enter now the hundreds- and tens digit of the new CV value.
Example: Value 135 shall be written: Enter '13'.
- Activate the reversion of the driving direction for confirmation. The lighting flashes periodically long-short-short.
- Enter now the unit position of the CV in double-digit. See example '05'.
- Activate the reversion of the driving direction for confirmation.
The lighting flashes again.
- You may now enter further CVs in long mode, which you want to change.

The long mode can be quitted by turning off and on the track power or pushing the STOP button.

SUSI mode

The sound decoder does not support SUSI mode at MM programming.

10 Operating system SelecTRIX 2 (SX2)

10.1 Functions

Speed steps	127
Speed steps (internal)	127
Front light/rear light (ca be dimmed)	yes
Additional functions (dimmable)	2
Functions total	16
Operation with brake diodes	yes
Programming on the main	yes

10.2 Setup features

The characteristics of the locomotive operating in SX2 can be varied by programming the parameter (par) freely at any time. The programming of the parameter is described in the instructions of your programming device.

You can find notices for standard "Function Mapping" on the Doehler & Haass-website:

<http://doehler-haass.de/cms/pages/haeufige-fragen.php>: Wie sieht das standardmäßige "Function Mapping" aus? (only in German)

List of supported parameters for driving operation:

par	Name and definition	Range
001	Address unit position	0 – 99 (1)
002	Address hundreds digit	0 – 99 (10)
003	Address for SX1 If > 111 deactivated	0 – 255 (112)
004	Address for SX1, 1. Additional channel Functions F1 – F8	0 – 255 (1)
005	Address for SX1, 2. Additional channel Functions F9 – F16	0 – 255 (0)
006	Locomotive address output Activated = 1	0 – 1 (1)
007	Mode of action additional channel 0 = relative: 1. Additional channel = par003 + par004 2. Additional channel = par003 + par005 1 = absolute	0 – 1 (0)
008	Compound address unit position Currently without function	
009	Compound address hundreds digit Currently without function	
011	Acceleration time The value corresponds to the time in seconds from start to maximum speed	0 – 255 (3)
012	Deceleration time The value corresponds to the time in seconds from maximum speed to stop	0 – 255 (3)
013	Maximum speed (See supplement 2)	0 – 127 (92)
014	Starting voltage	0 – 15 (0)

015	Slow approach Only at asymmetry and suitable brake modules	(As par091)	0 – 127	(63)																														
018	Shunting gear speed	(As par013)	0 – 127	(63)																														
019	Shunting gear deceleration time	(As par011)	0 – 255	(1)																														
021	Brake sections 1 or 2		0, 1	(0)																														
022	Compound mode F1 – F8 Currently without function																																	
023	Compound mode FL, F9 – F12 Currently without function																																	
024	Switch-off function for LV Bit 0 = F1 ... Bit 7 = F8		0 – 255	(0)																														
025	Switch-off function for LR Bit 0 = F1 ... Bit 7 = F8		0 – 255	(0)																														
026	Switch-off function for AUX1 Bit 0 = F1 ... Bit 7 = F8		0 – 255	(0)																														
027	Switch-off function for AUX2 Bit 0 = F1 ... Bit 7 = F8		0 – 255	(0)																														
028	Analog mode F1 – F8 <table border="0" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Bit</th> <th style="text-align: left;">Function</th> <th style="text-align: left;">Value</th> <th style="text-align: left;">Bit</th> <th style="text-align: left;">Function</th> <th style="text-align: left;">Value</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>F1</td> <td>1</td> <td>4</td> <td>F5</td> <td>16</td> </tr> <tr> <td>1</td> <td>F2</td> <td>2</td> <td>5</td> <td>F6</td> <td>32</td> </tr> <tr> <td>2</td> <td>F3</td> <td>4</td> <td>6</td> <td>F7</td> <td>64</td> </tr> <tr> <td>3</td> <td>F4</td> <td>8</td> <td>7</td> <td>F8</td> <td>128</td> </tr> </tbody> </table>	Bit	Function	Value	Bit	Function	Value	0	F1	1	4	F5	16	1	F2	2	5	F6	32	2	F3	4	6	F7	64	3	F4	8	7	F8	128		0 – 255	(1)
Bit	Function	Value	Bit	Function	Value																													
0	F1	1	4	F5	16																													
1	F2	2	5	F6	32																													
2	F3	4	6	F7	64																													
3	F4	8	7	F8	128																													

029	Analog mode FL, F9 – F12						0 – 63	(3)
	Bit	Function	Value	Bit	Function	Value		
	0	FL(f)	1	4	F11	16		
	1	FL(r)	2	5	F12	32		
	2	F9	4					
3	F10	8						
031	Interchange of track connection 0 = normal, 1 = inversed						0, 1	(0)
032	Interchange of motor connection 0 = normal, 1 = inversed						0, 1	(0)
033	Interchange of light connection 0 = normal, 1 = inversed						0, 1	(0)
051	Characteristic diagram (See supplement 2) Deflection of the characteristic, 0 = linear ... 7 = strongly curved						0 – 7	(5)
054	Motor frequency 0 = 32 kHz, 1 = 16 kHz, 2 = low-frequency Bit 2 = Proportional part limitation						0 – 7	(1)
056	Motor proportional controller See www.doehler-haass.de / "Häufige Fragen" (only in German)						0 – 7	(3)
057	Motor integral controller (As par056)						0 – 3	(3)
058	Motor measurement period (As par056)						0 – 3	(1)
059	Motor impulse width (As par056)						0 – 7	(3)
061	Function mapping F0(f) (See supplement 1)						0 – 255	(1)
062	Function mapping F0(r) (See supplement 1)						0 – 255	(2)
063	Function mapping F1(f+r) (See supplement 1) If par063 is written, par075 will be set up to the same value						0 – 255	(4)
064	Function mapping F2(f+r) (See supplement 1) If par064 is written, par085 will be set up to the same value						0 – 255	(8)

065	Function mapping F3	(See supplement 1)	0 – 255	(16)
066	Function mapping F4	(See supplement 1)	0 – 255	(128)
067	Function mapping F5	(See supplement 1)	0 – 255	(32)
068	Function mapping F6	(See supplement 1)	0 – 255	(0)
069	Function mapping F7	(See supplement 1)	0 – 255	(0)
070	Function mapping F8	(See supplement 1)	0 – 255	(64)
071	Function mapping F9	(See supplement 1)	0 – 255	(0)
072	Function mapping F10	(See supplement 1)	0 – 255	(0)
073	Function mapping F11	(See supplement 1)	0 – 255	(0)
074	Function mapping F12	(See supplement 1)	0 – 255	(0)
075	Function mapping F1(r) In case par075 should have another value than par063, you have to set par063 first and then par075	(See supplement 1)	0 – 255	(4)
076	Timer for switch off AUX1 Each 100 ms, 0 = deactivated		0 – 250	(0)
077	Timer for switch off AUX2 Each 100 ms, 0 = deactivated		0 – 250	(0)
078	Timer for switch off AUX3 Each 100 ms, 0 = deactivated		0 – 250	(0)
079	Timer for switch off AUX4 Each 100 ms, 0 = deactivated		0 – 250	(0)
081	Dimming light „normal“ 0 = off ... 31 = full brightness		0 – 31	(31)
082	Dimming light „alternative“ 0 = off ... 31 = full brightness		0 – 31	(15)
083	Dimming AUX1 0 = off ... 31 = full brightness		0 – 31	(31)

084	Dimming AUX2 0 = off ... 31 = full brightness	0 – 31	(31)																														
085	Function mapping F2(r) (See supplement 1) In case par085 should have another value than par064, you have to set par064 first and then par085	0 – 255	(8)																														
086	Function mapping LV+LR on / AUX1+AUX2 off Bit 0 = F1 ... Bit 7 = F8	0 – 255	(0)																														
087	Function mapping AUX1+AUX2 on / LV+LR off Bit 0 = F1 ... Bit 7 = F8	0 – 255	(0)																														
088	Settings <table border="0"> <thead> <tr> <th>Bit</th> <th>Function</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Unamplified function outputs instead of ZCLK and ZDAT</td> <td>1</td> </tr> <tr> <td>1</td> <td>Energy saving mode out</td> <td>2</td> </tr> <tr> <td>2</td> <td>Invert SUSI-driving direction</td> <td>4</td> </tr> <tr> <td>3</td> <td>Currently without function</td> <td></td> </tr> <tr> <td>4</td> <td>Extended function mapping activated (see par088/bit 5 and par147)</td> <td>16</td> </tr> <tr> <td>5</td> <td>0 = AUX3 and AUX4 to ZCLK and ZDAT 1 = AUX5 and AUX6 to ZCLK and ZDAT (Only valid, if par088/bit 0=1 and bit 4=1)</td> <td>32</td> </tr> </tbody> </table> Notes to Bit 0, Bit 4 and Bit 5: see end of the table	Bit	Function	Value	0	Unamplified function outputs instead of ZCLK and ZDAT	1	1	Energy saving mode out	2	2	Invert SUSI-driving direction	4	3	Currently without function		4	Extended function mapping activated (see par088/bit 5 and par147)	16	5	0 = AUX3 and AUX4 to ZCLK and ZDAT 1 = AUX5 and AUX6 to ZCLK and ZDAT (Only valid, if par088/bit 0=1 and bit 4=1)	32	0 – 63	(0)									
Bit	Function	Value																															
0	Unamplified function outputs instead of ZCLK and ZDAT	1																															
1	Energy saving mode out	2																															
2	Invert SUSI-driving direction	4																															
3	Currently without function																																
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091	Brake settings <table border="0"> <thead> <tr> <th>Bit</th> <th>Function</th> <th>Value</th> <th>Bit</th> <th>Function</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Asymmetry normal</td> <td>1</td> <td>4</td> <td>Negative voltage</td> <td>16</td> </tr> <tr> <td>1</td> <td>Asymmetry inverse</td> <td>2</td> <td>5</td> <td>Positive voltage</td> <td>32</td> </tr> <tr> <td>2</td> <td>Currently without function</td> <td>4</td> <td>6</td> <td>Brake diode normal</td> <td>64</td> </tr> <tr> <td>3</td> <td>Currently without function</td> <td>8</td> <td>7</td> <td>Brake diode inverse</td> <td>128</td> </tr> </tbody> </table>	Bit	Function	Value	Bit	Function	Value	0	Asymmetry normal	1	4	Negative voltage	16	1	Asymmetry inverse	2	5	Positive voltage	32	2	Currently without function	4	6	Brake diode normal	64	3	Currently without function	8	7	Brake diode inverse	128	0 – 243	(64)
Bit	Function	Value	Bit	Function	Value																												
0	Asymmetry normal	1	4	Negative voltage	16																												
1	Asymmetry inverse	2	5	Positive voltage	32																												
2	Currently without function	4	6	Brake diode normal	64																												
3	Currently without function	8	7	Brake diode inverse	128																												

092	Decision threshold for asymmetry 0 = small asymmetry ... 15 = strong asymmetry	(As par091)	0 – 15	(6)
093	Forward-trim 0 = deactivated, smaller 128 = reduction, greater 128 = increasing speed		0 – 255	(0)
094	Backward-trim	(As par093)	0 – 255	(0)
096	Brake ramp forward and backward Only at asymmetry and par051 = 0 0 = deactivated Deceleration time will be adjusted in the highest speed step in seconds, at smaller speed steps the decoder is calculating the brake ramp independently	(As par091)	0 – 255	(0)
097	Brake ramp backward 0 = the value from CV154 is used Enables different deceleration times forward and backward	(As par096)	0 – 255	(0)
098	User identification 1		0 – 255	(0)
099	User identification 2		0 – 255	(0)
101	Manufacturer identification 97 = Doehler & Haass (Decoder reset with "101")	(Read only)		
102	Decoder number SD10A = 210, SD16A = 216, SD18A = 218, SD21A = 221, SD22A = 222	(Read only)		
103	Version number	(Read only)		
104	Date	(Read only)		
105	Revision number	(Read only)		
106	Date	(Read only)		
141	Switch-off function for AUX3 Bit 0 = F1 ... Bit 7 = F8		0 – 255	(0)
142	Switch-off function for AUX4 Bit 0 = F1 ... Bit 7 = F8		0 – 255	(0)

143	Switch-off function for AUX5 Bit 0 = F1 ... Bit 7 = F8	0 – 255	(0)									
144	Switch-off function for AUX6 Bit 0 = F1 ... Bit 7 = F8	0 – 255	(0)									
145	Timer for switch off AUX5 Each 100 ms, 0 = deactivated	0 – 250	(0)									
146	Timer for switch off AUX6 Each 100 ms, 0 = deactivated	0 – 250	(0)									
147	Function mapping dimmed headlight 0 = deactivated, 1 ... 28 = F1 ... F28, 29 = F0 (light) Only valid, if par088/Bit 4=1	0 – 29	(1)									
148	Function mapping shunting gear	(As par147)	0 – 29 (1)									
149	Function mapping decelerations off	(As par147)	0 – 29 (1)									
151	Timer for driving up Each 100 ms, 0 = no driving up	0 – 250	(0)									
152	Timer for waiting Each 100 ms, 0 = no waiting	0 – 250	(0)									
153	Timer for driving away Each 100 ms, 0 = no driving away	0 – 250	(0)									
154	Speed steps for driving up	0 – 127	(12)									
155	Speed steps for driving away	0 – 127	(12)									
156	Settings	0 – 255	(0)									
	<table border="0"> <thead> <tr> <th>Bit</th> <th>Function</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>6</td> <td>Deactivate coupling process and timer</td> <td>64</td> </tr> <tr> <td>7</td> <td>Coupling process only in shunting gear</td> <td>128</td> </tr> </tbody> </table>	Bit	Function	Value	6	Deactivate coupling process and timer	64	7	Coupling process only in shunting gear	128		
Bit	Function	Value										
6	Deactivate coupling process and timer	64										
7	Coupling process only in shunting gear	128										

161	Conditions for LV		0 – 161 (0)
	Function	Value	
	Initial state (always on, if function key on)	0	
	Only forward	+1	
	Only backward	+2	
	Only while standing	+3	
	Only while driving	+6	
	Only at F0 (light) off	+9	
	Only at F0 (light) on	+18	
	Not in shunting gear	+27	
	Only in shunting gear	+54	
	Ignore direction using shunting gear	+81	
	Ignore drive/stand using shunting gear	+108	
Ignore direction and drive/stand using shunting gear	+135		
It is allowed to add up only one number from every definite range!			
162	Conditions for LR	(See par161)	0 – 161 (0)
163	Conditions for AUX1	(See par161)	0 – 161 (0)
164	Conditions for AUX2	(See par161)	0 – 161 (0)
165	Conditions for AUX3	(See par161)	0 – 161 (0)
166	Conditions for AUX4	(See par161)	0 – 161 (0)
167	Conditions for AUX5	(See par161)	0 – 161 (0)
168	Conditions for AUX6	(See par161)	0 – 161 (0)

169	Initial mapping						0 – 255	(0)
	Bit	Function	Value	Bit	Function	Value		
	0	LV	1	4	AUX3	16		
	1	LR	2	5	AUX4	32		
	2	AUX1	4	6	AUX5	64		
	3	AUX2	8	7	AUX6	128		
<p>These function outputs are activated as soon as the decoder is addressed (without active function key). Thus, in connection with the conditions, the switching of the sliding contact can be realized for example.</p>								

Explanation to par088:

Activation SUSI pins: Bit 0 = 0 / Bit 4 = equal / Bit 5 = equal

Activation AUX3/AUX4: Bit 0 = 1 / Bit 4 = equal / Bit 5 = 0

Activation AUX5/AUX6: Bit 0 = 1 / Bit 4 = 1 / Bit 5 = 1

List of supported parameter for sound operation:

311	Function mapping driving sound 0 = deactivated, 1 ... 28 = F1 ... F28, 29 = F0 (light) Traction motor at electric locomotives, chuffs at steam locomotives, etc.	0 – 29	(1)
312	Function mapping secondary driving sound (As par311) Traction motor fan at electric locomotives, boiling sound at steam locomotives, etc.	0 – 29	(1)
313	Function mapping gear sound (As par311)	0 – 29	(0)
314	Function mapping brake sound (As par311)	0 – 29	(7)
315	Function mapping sound flow 3 (As par311)	0 – 29	(2)

316	Function mapping sound flow 4	(As par311)	0 – 29	(3)
317	Function mapping Sound flow 5	(As par311)	0 – 29	(4)
318	Function mapping sound flow 6	(As par311)	0 – 29	(5)
319	Function mapping sound flow 7	(As par311)	0 – 29	(6)
320	Function mapping sound flow 8	(As par311)	0 – 29	(9)
321	Function mapping sound flow 9	(As par311)	0 – 29	(10)
322	Function mapping sound flow 10	(As par311)	0 – 29	(11)
323	Function mapping sound flow 11	(As par311)	0 – 29	(12)
324	Function mapping sound flow 12	(As par311)	0 – 29	(13)
325	Function mapping sound flow 13	(As par311)	0 – 29	(14)
326	Function mapping sound flow 14	(As par311)	0 – 29	(15)
327	Function mapping sound flow 15	(As par311)	0 – 29	(16)
328	Function mapping sound flow 16	(As par311)	0 – 29	(17)
329	Function mapping fade-out effect	(As par311)	0 – 29	(8)
330	Total volume 0 ... 255 = 0% ... 100%		0 – 255	(64)
331	Volume driving sound 0 ... 128 ... 255 = 0% ... 100% ...200% Values greater 100% can lead to overload!		0 – 255	(128)
332	Volume secondary driving sound	(As par331)	0 – 255	(128)
333	Volume gear sound	(As par331)	0 – 255	(128)
334	Volume brake sound	(As par331)	0 – 255	(128)
335	Volume sound flow 3	(As par331)	0 – 255	(128)
336	Volume sound flow 4	(As par331)	0 – 255	(128)
337	Volume sound flow 5	(As par331)	0 – 255	(128)
338	Volume sound flow 6	(As par331)	0 – 255	(128)
339	Volume sound flow 7	(As par331)	0 – 255	(128)

340	Volume sound flow 8	(As par331)	0 – 255 (128)
341	Volume sound flow 9	(As par331)	0 – 255 (128)
342	Volume sound flow 10	(As par331)	0 – 255 (128)
343	Volume sound flow 11	(As par331)	0 – 255 (128)
344	Volume sound flow 12	(As par331)	0 – 255 (128)
345	Volume sound flow 13	(As par331)	0 – 255 (128)
346	Volume sound flow 14	(As par331)	0 – 255 (128)
347	Volume sound flow 15	(As par331)	0 – 255 (128)
348	Volume sound flow 16	(As par331)	0 – 255 (128)
349	Volume fade-out effect	(As par330)	0 – 255 (0)
350	Coasting delay time The value corresponds to the time in 100 ms steps until the compulsory change from driving sound to coasting. 0 = deactivated		0 – 255 (0)
353	Chuffs at speed step 1 The value corresponds to the time in 64 ms steps between the chuffs at speed step 1		0 – 255 (120)
354	Chuffs at higher speed steps The value determines the time of reduction between the chuffs at higher speed steps		0 – 255 (20)
355	Brake squeal at minimal speed step The minimum speed step that must be reached, before brake squeal is starting		0 – 127 (20)
356	Brake squeal at initial speed step The minimum speed step that must be reached, before brake squeal is starting		0 – 127 (13)
357	Secondary driving sound modulation The value determines to which extent the speed step influences the pitch. 0 = deactivated		0 – 255 (0)
358	Driving sound modulation	(As par357)	0 – 255 (11)

359	Timer for fade-out effect The value corresponds to the time in seconds from the adjusted total volume to silence	0 – 255	(8)												
360	Write protection Flash-ROM Must be "0" for sound operation (is operated during the loading process)	0, 1	(0)												
361	Threshold value ZVS The value corresponds to about the supply voltage in volt. At that voltage it will be changed in the energy saving mode (small values induces resetting the sound module and great values cause a „stuttering“ sound)	0 – 14	(7)												
362	Chuffs at speed step 127 The value corresponds to the minimum time in 1 ms steps between the chuffs at speed step 127, which must not be undercut	0 – 255	(0)												
364	Brake squeal at final speed step The speed step, where the brake squeal changes into the final sequence of the sound flow (actual end at speed step 0 at the latest)	0 – 127	(6)												
365	Brake squeal at deceleration time The value corresponds to the time in 8 ms steps, which may pass by between two speed step reductions, in order that brake squeal is still possible	0 – 255	(3)												
366	Brake squeal at minimum delay The value corresponds to the number of speed steps, which must be run through within the deceleration time at least, in order that brake squeal is still possible	0 – 127	(0)												
367	Random sounds <table border="0" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Bit</th> <th style="text-align: left;">Function</th> <th style="text-align: left;">Value</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Random sounds allowed while standing</td> <td>1</td> </tr> <tr> <td>1</td> <td>Random sounds allowed while running</td> <td>2</td> </tr> <tr> <td>2</td> <td>Transfer random sounds to SUSI interface</td> <td>4</td> </tr> </tbody> </table>	Bit	Function	Value	0	Random sounds allowed while standing	1	1	Random sounds allowed while running	2	2	Transfer random sounds to SUSI interface	4	0 – 7	(3)
Bit	Function	Value													
0	Random sounds allowed while standing	1													
1	Random sounds allowed while running	2													
2	Transfer random sounds to SUSI interface	4													
368	Volume dynamic sound flow	(As par331)	0 – 255 (128)												

369	Volume turbo charger	(As par331)	0 – 255	(128)
370	Modulation dynamic brake	(As par357)	0 – 255	(0)
371	Modulation dynamic drive	(As par357)	0 – 255	(0)
372	Modulation turbo sound proportional part	(As par357)	0 – 255	(0)
373	Modulation turbo sound integral part	(As par357)	0 – 255	(0)
374	Function mapping volume reducing With every keystroke (on/off) the total volume will be permanently reduced	(As par311)	0 – 29	(0)
375	Function mapping volume enhancing With every keystroke (on/off) the total volume will be permanently enhanced.	(As par311)	0 – 29	(0)
376	Function mapping brake squeal deactivating If the corresponding function key is pushed, no brake squeal will be represented, even if the conditions are fulfilled.	(AS par311)	0 – 29	(0)
377	Function mapping forced coasting If the corresponding function key is pushed, the driving sound remains in coasting, even during acceleration	(As par311)	0 – 29	(0)

All programmable CVs can be changed during the current operation (POM / "Programming on the Main" / main track programming).

Stated default values can be overwritten according to the sound project!

10.3 Operation

Put the locomotive on the programming track and read out the locomotive address of the decoder (par001+par002). The default value should be 1001. Program the desired locomotive address and start running the locomotive keeping these setup values. After the first check you can vary the parameters of the locomotive according to your requirements.

In case your programming device indicates "Error", please check again the correct wiring of the locomotive and pay attention to the notices for connecting the programming track. Never put such a locomotive into operation!

Notice:

Acceleration time par011 and deceleration time par012 of the sound decoder should be adjusted to value 8 at the minimum. Too small adjusted time lead to the skipping of several sound flows and they could not be displayed! If required the values can be enhanced step by step for fine tuning.

Please take the mapping, which sound flow corresponds to which sound, from the instruction of the particular sound project.

Not all sound flows from 1 to 16 (par313 – par328) must contain sounds.

Supplement 1 Declaration for function mapping

For activating a function enter the value of the output according to the following table. In case you want to activate several different functions by one and the same output, you must add up their specific values.

Value of the outputs:

	RG / AUX6	ABL / AUX5	AUX4	AUX3	AUX2	AUX1	LR	LV
Value	128	64	32	16	8	4	2	1

RG = Shunting gear ABL = dimmed headlight

Example: F4 should activate the shunting gear and turn on the outputs LV and LR:
LV=1, LR=2, RG=128: Value 131 must also be entered in CV38 | par066.

Notice: AUX3 and AUX4 are not available in all decoders in an amplified implementation - alternatively to ZCLK and ZDAT however always available in an unamplified implementation

AUX5 and AUX6 are not available in all decoders (generally only unamplified), alternatively to ZCLK und ZDAT however always available in an unamplified implementation

Timer function (CV117 – 120, 129, 130 / par076 – 079, 145, 146)

Value = 0 Timer is turned off (continuous function)

Value = 1...250 Timer is activated; the corresponding output will be disconnected after the time of:
Entered value x 0.1 [sec].

Switch-off function (CV113 – 116, CV125 – 128 / par024 – 027, par141 – 144)

This function gives you the option to turn off an output (e.g. drivers cab light in front dark), although it is activated (e.g. LV by function F0).

Example: A typical situation where to apply this function is the pus-pull operation. The front lightning pointing at the waggons must be switched off, but the other lights must be reversed in the driving direction (white ↔ red).

- F0 turns the light on (depending on the driving direction white or red)
- F2 turns off the front light
- F3 turns off the rear light

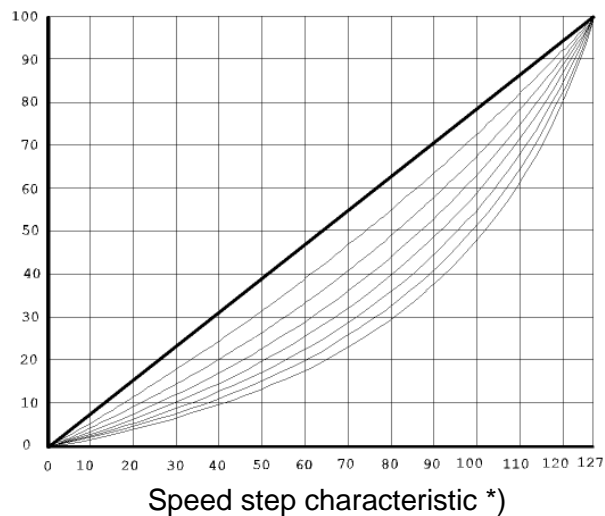
CV	par	Function	RG	ABL	AUX4	AUX3	AUX2	AUX1	LR	LV
33	061	F0(f)					x			x
34	062	F0(r)						x	x	

CV	par	Function	F8	F7	F6	F5	F4	F3	F2	F1
113	024	LV off							x	
114	025	LR off						x		
115	026	AUX1 off							x	
116	027	AUX2 off						x		

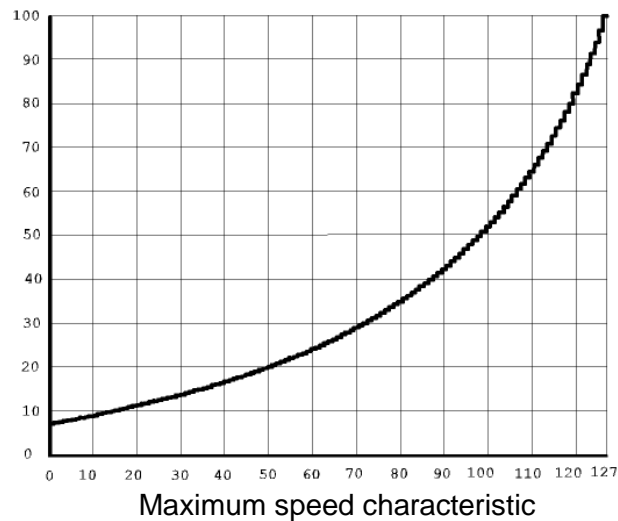
LV Front light white
 AUX1 Front light red

LR Rear light white
 AUX2 Rear light red

Supplement 2 Speed characteristics



(see CV48/par051)



(see CV05/par013)

Speed step characteristic:

Linear	0
Strongly curved	7

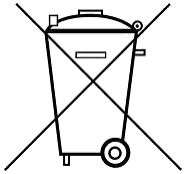
*) The curve of the characteristic 5 corresponds with the decoders of the DHL-series.

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This product must not be disposed at the end of its service life in normal household waste. Please use the recycling depot of your community.



Nicht geeignet für Kinder unter 3 Jahren wegen der Gefahr des Verschluckens sowie der Verletzung durch scharfkantige Teile!

Not suitable for children under 3 years because of the danger of swallowing the product and of injuries due to sharp-edged parts.

Ne convient pas aux enfants au-dessous de 3 ans, dus au risque d'avaler le produit ou bien d'être blessés par des pièces à arêtes vives!

Company stamp

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