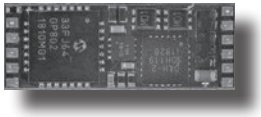
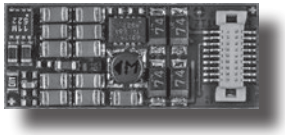
D&H

Doehler & Haass

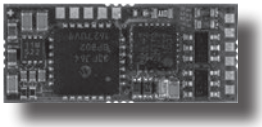
Sounddecoder



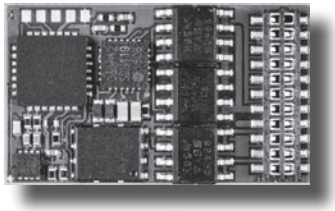
SD05A



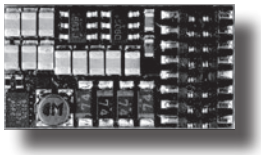
SD18A



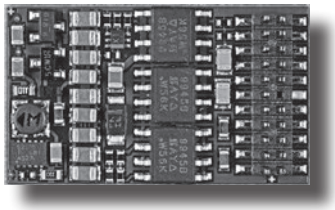
SD10A



SD21A



SD16A



SD22A

1 Introduction

The sounddecoders are compatible with the protocols of SelecTRIX standard SX1 and SX2 as well as with NMRA-DCC and MM1/MM2 standard. They and 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

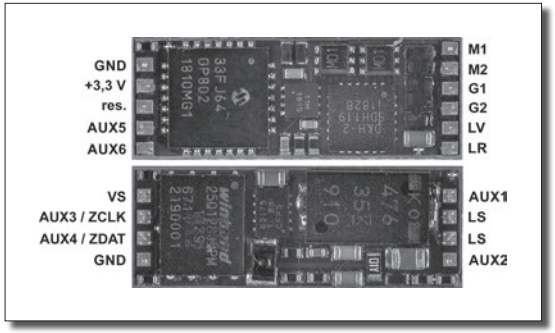
Every sounddecoder is fully tested before delivery. Should nevertheless a failure occur please contact the dealer where you purchased the decoder or directly the producer (Doehler & Haass enterprises). The warranty period is 24 month from the date of purchase.

4 Support and help

In case you have any problems please contact us by email: **technik@doehler-haass.de**
Normally you would get an answer within a few days.

5 Sounddecoder SD05A / SD10A / SD16A / SD18A / SD21A / SD22A

SD05A



VS Supply voltage (also for SUSI)
If necessary: Blue wire
(common return conductor) to VS

ZCLK SUSI clock
(or AUX3 unamplified or AUX5 unamplified) *)

ZDAT SUSI data
(or AUX4 unamplified or AUX6 unamplified) *)

GND SUSI ground

*) Unamplified function outputs: see supplement 3

M1, M2 Motor connection 1, 2

G1, G2 Track connection 1, 2

LV Front light

LR Rear light

AUX1, AUX2 Additional function 1, 2

AUX3, AUX4 Unamplified additional function 3, 4 *)

AUX5, AUX6 Unamplified additional function 5, 6 *)

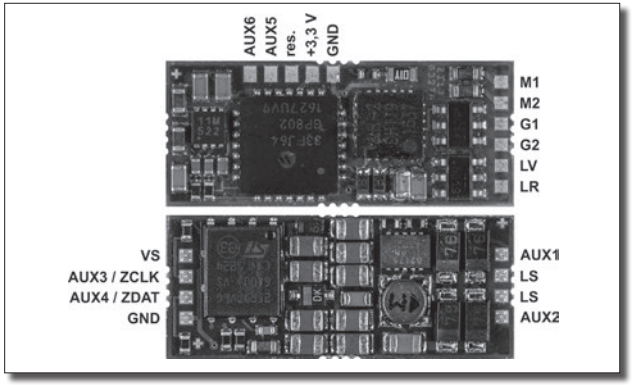
LS Speaker

GND Ground

+3,3 V Electronic supply voltage
(not for the user!)

res. Please do not connect anything!

SD10A



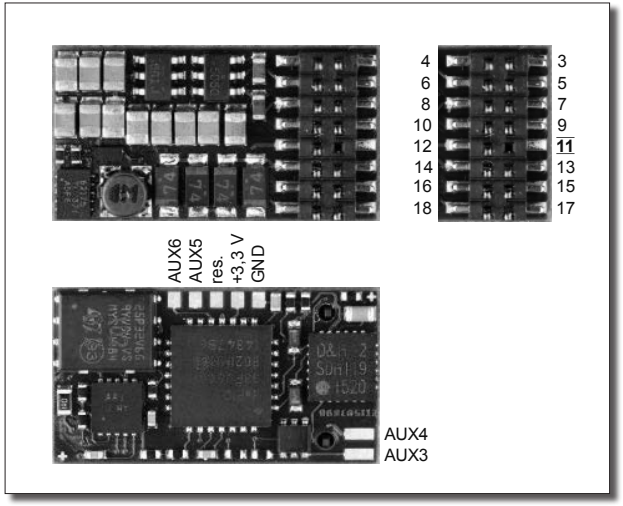
VS Supply voltage (also for SUSI)
If necessary: Blue wire
(common return conductor) to VS
ZCLK SUSI clock
(or AUX3 unamplified or AUX5 unamplified) *)
ZDAT SUSI data
(or AUX4 unamplified or AUX6 unamplified) *)
GND SUSI ground

*) Unamplified function outputs: see supplement 3

M1, M2 Motor connection 1, 2
G1, G2 Track connection 1, 2
LV Front light
LR Rear light
AUX1, AUX2 Additional function 1, 2
AUX3, AUX4 Unamplified additional function 3, 4 *)
AUX5, AUX6 Unamplified additional function 5, 6 *)
LS Speaker

GND Ground
+3,3 V Electronic supply voltage
(not for the user!)
res. Please do not connect anything!

SD16A



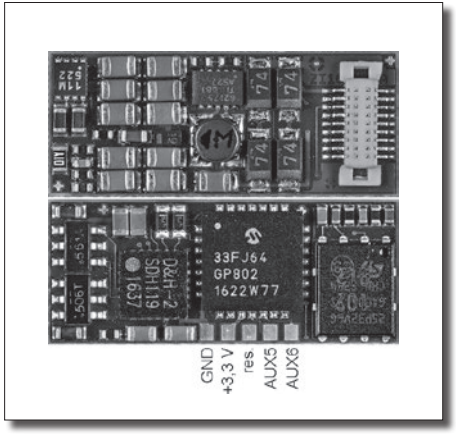
GPIO	1	2	AUX3
ZCLK	3	4	ZDAT
GND	5	6	VS
LV	7	8	M1
VS	9	10	M2
Index	11	12	G1
LR	13	14	G2
LS	15	16	AUX1
LS	17	18	AUX2
AUX4	19	20	AUX5
AUX6	21	22	AUX7

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

GND Ground
+3,3 V Electronic supply voltage (not for the user!)
res. Please do not connect anything!

*) Unamplified function outputs: see supplement 3

SD18A



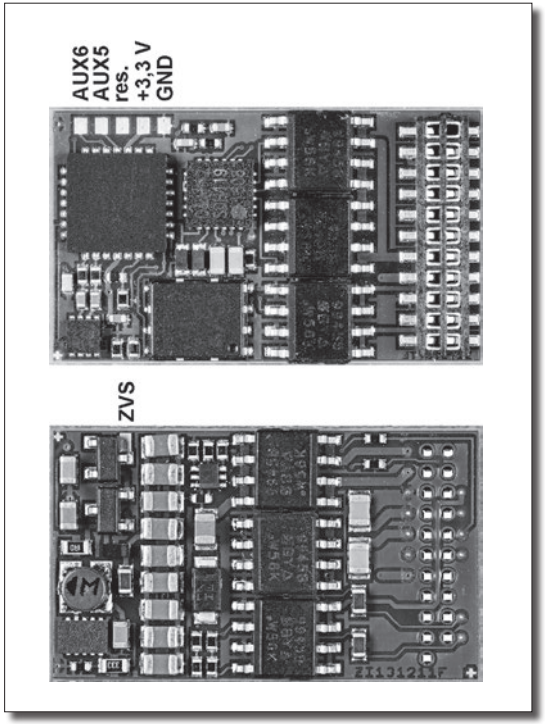
AUX5, AUX6 Unamplified additional function 5, 6 *)

GND Ground
+3,3 V Electronic supply voltage (not for the user!)
res. Please do not connect anything!

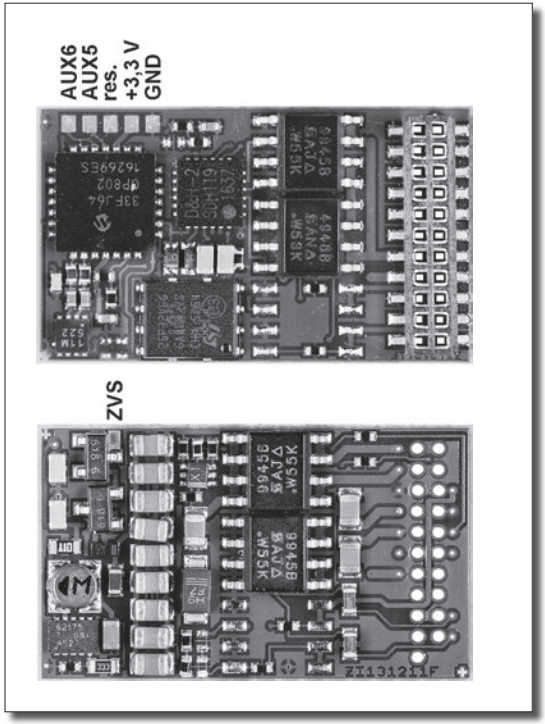
*) Unamplified function outputs: see supplement 3

Specifications	SD05A	SD10A	SD16A	SD18A
Dimensions [mm]	20,0 x 7,6 x 3,0	21,2 x 9,1 x 3,4	20,2 x 10,5 x 3,0	21,4 x 9,0 x 3,2
Driving characteristic values				
Operating mode SX1, SX2, DCC, MM, DC analog				
Total load	0,5 A	1,0 A	1,5 A	1,0 A
Maximum motor current	0,5 A	1,0 A	1,5 A	1,0 A
Maximum operating voltage	**18 V**	30 V	30 V	30 V
2 Light outputs: LV, LR (dimmable)	each 150 mA	each 150 mA	each 150 mA	each 150 mA
2 Additional outputs: AUX1, AUX2 (dimmable)	each 150 mA	each 300 mA	each 300 mA	each 300 mA
2 Additional outputs: AUX3, AUX4	unamplified	unamplified	each 1,0 A	unamplified
2 Additional outputs: AUX5, AUX6	unamplified	unamplified	unamplified	unamplified
SUSI interface	available (if AUX3/AUX4 deactivated)	available (if AUX3/AUX4 deactivated)	available	available (if AUX3/AUX4 deactivated)
Sound characteristic values				
Sampling rate	22 kHz	22 kHz	22 kHz	22 kHz
Independent sound channels	8	8	8	8
Memory size	128 Megabits	128 Megabits	128 Megabits	128 Megabits
Memory period	up to 760 s	up to 760 s	up to 760 s	up to 760 s
Maximum output rating	1,6 W (8 Ω)	2,6/1,6 W (4/8 Ω)	2,6/1,6 W (4/8 Ω)	2,6/1,6 W (4/8 Ω)
Connecting options				
Without connection wires	SD05A-0	SD10A-0	SD16A-0	
With ribbon cable for standard plug NEM651	SD05A-1	SD10A-1		
With connection cable for interface per NEM652			SD16A-2	
With connection wires	SD05A-3	SD10A-3	SD16A-3	
16 pin connector for direct plugging (PluX16)			SD16A-4	
18 pin connection for direct plugging (Next18)				SD18A

SD21A-4

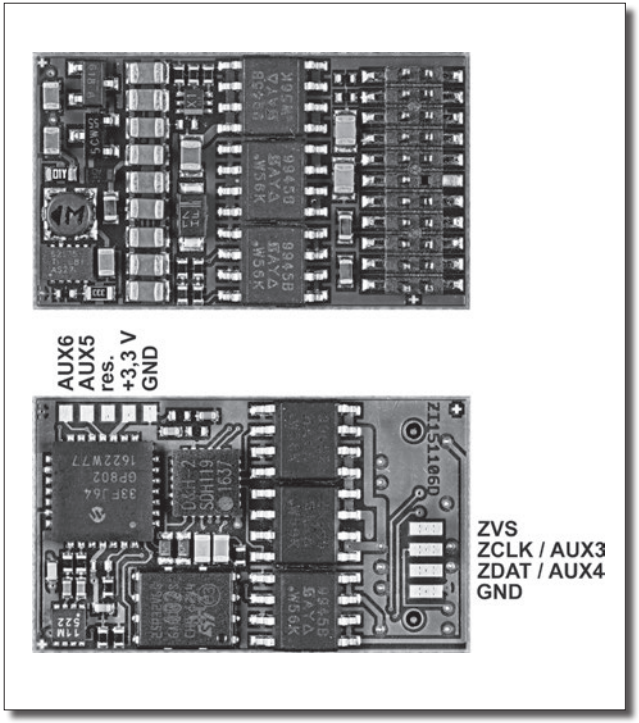


SD21A-5



AUX5, AUX6 Unamplified additional function 5, 6 *) *) Unamplified function outputs: see supplement 3
ZVS SUSI supply voltage (also suitable for connecting capacitors)
GND Ground
+3,3 V Electronic supply voltage (not for the user!)
res. Please do not connect anything!

SD22A



AUX5, AUX6	Unamplified additional function 5, 6 *)
ZVS	SUSI supply voltage (also suitable for connecting capacitors)
GND	Ground
+3,3 V	Electronic supply voltage (not for the user!)
res.	Please do not connect anything!

*) Unamplified function outputs: see supplement 3

21 pin interface

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

PluX22 interface

GPIO	1	2	AUX3
ZCLK	3	4	ZDAT
GND	5	6	ZVS
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

GPIO General input/output (max. +5 V / max. 3 mA)
G1, G2 Track 1, 2
M1, M2 Motor 1, 2
LV Front light
LR Rear rückwärts
AUX1-AUX6 Additional function 1-6
LS Speaker

VCC +5 V / max. 15 mA
VS Supply voltage
ZVS SUSI supply voltage (also suitable for connecting capacitors)
ZCLK SUSI clock (or AUX3 unamplified or AUX5 unamplified *)
ZDAT SUSI data (or AUX4 unamplified or AUX6 unamplified *)
GND SUSI ground

*) Unamplified function outputs: see supplement 3

Specifications	**SD21A-4**	**SD21A-5**
Dimensions [mm]	26,6 x 15,8 x 4,0	26,6 x 15,8 x 4,0
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
Switching voltage at AC-analog: max. 45 V peak = 30 V effective		
Function outputs for light: dimmable LV, LR (dimmable)	each 150 mA	each 150 mA
Function outputs: AUX1, AUX2 (dimmable)	each 300 mA	each 300 mA
Function outputs: AUX3, AUX4, AUX5, AUX6	each 1,0 A	unamplified
SUSI interface	available	available
Sound characteristic values		
Sampling rate	22 kHz	22 kHz
Independent sound channels	8	8
Memory size	128 Megabits	128 Megabits
Memory period	up to 760 s	up to 760 s
Maximum output rating	2,6/1,6 W (4/8 Ω)	2,6/1,6 W (4/8 Ω)
Connecting options		
21 pin socket board for direct plugging (mTc21)	SD21A-4	SD21A-5

Specifications	SD22A
Dimensions [mm]	26,6 x 15,8 x 4,0
Driving characteristic values	
Operating mode SX1, SX2, DCC, MM, DC/AC analog	
Total load	2,0 A
Maximum motor current	2,0 A
Maximum operating voltage	30 V
Switching voltage at AC-analog: max. 45 V peak = 30 V effective	
Function outputs for light: LV, LR (dimmable)	each 150 mA
Function outputs: AUX1, AUX2 (dimmable)	each 300 mA
Function outputs: AUX3, AUX4, AUX5, AUX6	each 1,0 A
SUSI interface	available
Sound characteristic values	
Sampling rate	22 kHz
Independent sound channels	8
Memory size	128 Megabits
Memory period	up to 760 s
Maximum output rating	2,6/1,6 W (4/8 Ω)
Connecting option	
Without connection wires	SD22A-0
With connection cable for interface per NEM652	SD22A-2
With connection wires	SD22A-3
22 pin socket board for direct plugging (PluX22)	SD22A-4

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. Automatic switching into a certain operating mode is not possible because of the multiprotocol operation. For switching a parameter (e.g. locomotive address) is to be readout and must be written again in the required operating mode. Thus the switching to the required track protocol is completed.
- 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
- Outputs for light and function dimmable and can be activated analogously
- 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 sounddecoder can be updated when the locomotive is standing on track (no need to open the engine).
  SW can be downloaded from D&H homepage for free.
- 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®).

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 sounddecoder 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 Installation of the sounddecoder

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 smoothely in direct current mode should be equipped with the sounddecoder. New locomotives should be run at least 30 minutes in each driving direction.

Before installing the sounddecoder 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.

For fixing the decoder we recommend a double-sided adhesive tape.

With sound decoders, always solder the speaker first.
Carry out all soldering work in a de-energized state.
Avoid test drives with stripped unsoldered cable ends.

6.2 Installation

There are following variants to connect the sounddecoder:

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 **SD05A-1** or 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 rib-bon 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 in-terface without any problems.
6 If your locomotive is not equipped with an appropriate interface, the sounddecoder must be wired individually. For this you can either use **SD05A-3** or the **SD10A-3** or, when using other sounddecoder, the adapter N18-K-3, N18-G-3, M21-3 and P22-3, according to the type of the sounddecoder.
7 **SD05A-0** or the **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 we recommend a double sided adhesive tape.

For installation variant 6 connect the wires of SD05A-3, 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, resepectively if the motor is really disconnected from the chassis electrically.

7 Operating system SelecTRIX 1 (SX1)

Attention!

The locomotive sounddecoder do not support SX1 programming.

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

7.1 Functions

Speed steps.....31
Speed steps (internal).....127
Front light/rear light .....yes
Additional functions.....2
Functions in additional channel .....8 (connectable with loco address + 1)
Operation with deceleration diodes.....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)

Setting SX1-programming	Para-meter	Value range	Setting 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 sections	S	1-/2-teilig	Brake sections	021	0 oder 1
Interchanging of connections	V	0 to 7	Interchanging track	031	0 oder 1
			Interchanging motor	032	0 oder 1
			Interchanging light	033	0 oder 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 readout the programming parameters of the decoder. Program the desired locomotive address and start running the locomotive with those parameter values. After the first check you can vary the parameters of the engine freels 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 for connecting the programming track. **Never put such a locomotive into operation!**

7.4 Explanation of the brake sections

1 part brake section:

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

2 part brake section:

In front of the signal there are two track sections. The first one is controlled by a diode. The locomotive decelerates to internal speed step 3 in this section. The second one is without supply, thus the locomotive stops just in front of the signal. In this case the decoder must be programmed on 2 part brake 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 (dimmable).....yes
Additional functions (dimmable) 2
Whole functions 28
Operation with brake diodes .....yes
Operation with brake generators.....yes
Consist.....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-CV01, operating MM values from 1 to 255 are allowed. Values from 128 on lead to restricting the decoder operation only to MM, 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 Setting options

The characteristics of a locomotive designed in DCC operation can be varied by programming the "Configuration Variables" (CV) at any time. Pleas 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)

All programmable CVs can be changed during operation (POM / "**P**rogramming **O**n The **M**ain" / main track programming).

The given default values can be overwritten depending on the sound project!

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 information concerning your digital system.

8.2.1 List of supported CV for driving operation

CV	Name and definition	Range	Standard
01	**Address** Addresses greater than 127 are only useable in MM operation	**1-255**	**3**
02	**Starting voltage**	**0-15**	**0**
03	**Acceleration time** The value corresponds to the time in seconds from start to maximum speed and should be set to at least 8 (see note in chapter 8.3).	**0-255**	**3**
04	**Deceleration time** The value corresponds to the time in seconds from the maximum speed to stop and should be set to at least 8 (see note in section 8.3).	**0-255**	**3**
05	**Maximum speed** (see supplement 2)	**0-127**	**92**
07	**Version number** (read only)		
08	**Manufacturer identification** (read only) 97 = Doehler & Haass (Decoder reset with "8")		
09	**Motor frequency** **Bit Function Value** 0.....0 = 32 kHz, 1 = 16 kHz.....1 1.....0 = 16/32 kHz, 1 = low frequency.....2 2.....proportional part limitation.....4 3.....Switch off short circuit protection.....8	**0-15**	**1**

CV	Name and definition	Range	Standard
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** This setting is also valid for MM1 operation **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**
14	**Analog Mode F0, F9-F12** This setting is also valid for MM1 operation **Bit Function Value** **Bit Function Value** 0.....F0 (f) ..... 1 4.....F11 .....16 1.....F0 (r) ..... 2 5.....F12 .....32 2.....F9 ..... 4 3.....F10 8	**0-63**	**3**
17 **18**	**Long address** CV17 contains the most significant byte; CV18 contains the least significant byte. Only if activated by CV29/Bit 5=1.	**0-255** **0-255**	**192** **0**

CV	Name and definition	Range	Standard
19	**Consist address** Several locomotives in compound under this address (1-127) 0, 128 = inactiv Value **+ 128** = inverse direction	**0-255**	**0**
21	**Consist mode F1-F8** **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**
22	**Consist mode F0, F9-F12** **Bit Function Value** **Bit Function Value** 0.....F0 (f) ..... 1 4.....F11 ..... 16 1.....F0 (r) ..... 2 5.....F12 ..... 32 2.....F9 ..... 4 3.....F10 8	**0-63**	**0**
27	**Brake settings** (*Bit 2: see CV161-CV165) **Bit Function Value** **Bit Function Value** 0.....Asymmetrie normal..... 1 4.....Negative voltage .....16 1.....Asymmetrie inverse ..... 2 5.....Positive voltage .....32 2.....ZIMO HLU * ..... 4 6.....Brake diode normal .....64 3.....Currently without function.. 8 7.....Brake diode inverse.....128	**0-247**	**64**
28	**Feedback settings** **Bit Function Value** 0..... Loknummernausgabe erlaubt ..... 1 1..... POM-Auslesen erlaubt..... 2	**0-3**	**3**

CV	Name and definition		Range	Standard
29	**Konfigurationsregister** **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		**0-255**	**6**
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)** If CV35 is written, CV47 will be set up to the same value	(see supplement 1)	**0-255**	**4**
36	**Function mapping F2(f+r)** If CV36 is written, CV64 will be set up to the same value	(see supplement 1)	**0-255**	**8**
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**

CV	Name and definition	Range	Standard
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) In case CV47 should have another value as CV35, you have to set CV35 first and then CV47.	**0-255**	**4**
48	**Kennlinie** (see supplement 2) Response curve, 0 = linear ... 7 = strongly curved	**0-7**	**5**
51	**Interchange of connections** **Bit Function Value** 0..... Motor connections ..... 1 1..... Light connections ..... 2 2..... Track connections 4	**0-7**	**0**
52	**Dimming LV/LR** 0 = dark … 31 = volle Helligkeit	**0-31**	**31**
53	**Dimming low beam light** (see CV156) 0 = dark … 31 = full brightness	**0-31**	**15**
54	**Dimming AUX1** 0 = dark … 31 = full brightness	**0-31**	**31**
55	**Dimming AUX2** 0 = dark … 31 = full brightness	**0-31**	**31**
56	**Motor control proportional** see: www.doehler-haass.de / „Häufige Fragen“ (FAQ) (only in German)	**0-7**	**3**
57	**Motor control integral** (as CV56)	**0-3**	**3**

CV	Name and definition	Range	Standard
58	**Motor control measurement period** (as CV56)	**0-3**	**1**
59	**Motor control impulse width** (as CV56)	**0-7**	**3**
60	**Brake sections** 1 or 2	**0, 1**	**0**
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) In case CV64 should have another value as CV36, you have to set CV36 first and then CV64.	**0-255**	**8**
65	**Maximum speed step in two-part braking sections** (as CV60) Only with brake diode	**0-127**	**12**
66	**Forward trim** 0 = disconnected, smaller 128 = reduction, greater 128 = enhancement of the speed	**0-255**	**0**
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**

CV	Name and definition	Range	Standard
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 speed** (see CV27) Only with 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**

CV	Name and definition	Range	Standard
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 low beam light** 0 = deactivated, 1 … 28 = F1 … F28, 29 = F0 (light) Only valid, if CV137/bit 4=1	**0-29**	**8**
132	**Function mapping shunting gear** (as CV131)	**0-29**	**4**
133	**Function mapping delays off** (as CV131)	**0-29**	**9**
134	**Decision threshold for asymmetry** (see CV27) Default value 6 corresponds approximately to 0.7 V asymmetry and thus to the forward voltage of a silicon diode. Values less than 3 do not make sense, values greater than 6 on demand.	**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**

CV	Name and definition	Range	Standard
137	**Settings** **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.....16 (see CV131 and CV137/Bit 5) 5.....0 = AUX3 and AUX4 to ZCLK and ZDAT .....32 1 = AUX5 and AUX6 to ZCLK and ZDAT (only valid, if CV137/bit 0=1 and bit 4=1) **Explanations to Bit 0, Bit 4 and Bit 5: see end of the table**	**0-63**	**0**
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 step for driving up**	**0-127**	**12**
142	**Speed step for driving away**	**0-127**	**12**
143	**Settings** **Bit Function Value** 6.....Coupling process and timer deactivated .....64 7.....Coupling process only in shunting gear.....128	**0-255**	**0**

CV	Name and definition	Range	Standard
144	**Settings** **Bit Function Value** 0.....Dynamic channel use .....1 1.....Immediate starting after current interruption .....2 2.....Special bit for lightning in analog operation.....4 3.....Brake section output to "GPIO" .....8 (→ 1 = no braking distance detected, 0 = braking) (only relevant for SD21A / SD22A) 4.....Braking with "GPIO" (1 = driving, 0 = braking).....16 (only relevant for SD21A / SD22A)	**0-31**	**0**
145	**Conditions for LV** **Function Value** Default value (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 in shunting gear +81 Ignore driving/stand in shunting gear +108 Ignore direction and driving/stand in shunting gear +135 **Always only one number of each definite range may be added up!**	**0-161**	**0**

CV	Name and definition	Range	Standard
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** **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 These function outputs are active as soon as the decoder is addressed (without active function key). Thus, for example, the switchover of the sliding contacts can be realized in connection with the conditions.	**0-255**	**0**
154	**Brake ramp forward and backward** (see CV27) Recommended for constant braking distance: CV48 = 0, 0 = deactivated If maximum speed step braking time is adjusted in seconds times 8, at smaller speed steps the decoder generates the brake ramp independently.	**0-255**	**0**
155	**Brake ramp backward** (see CV154) 0 = value from CV154 is used Alows different brake times forward and backward	**0-255**	**0**

CV	Name and definition	Range	Standard
156	**Dimming mask for low beam light** (see CV53) **Bit Function Value Bit Function Value** 0.....LV.....1 4.....Currently without function .....16 1.....LR .....2 5.....Currently without function .....32 2.....AUX1 .....4 6.....Currently without function .....64 3.....AUX2 .....8 7.....Currently without function 128	**0-15**	**3**
157	**Conditions for low beam light** (see CV145)	**0-161**	**0**
161	**ZIMO HLU 1/6** (siehe CV27/Bit2) Only relevant for users of the ZIMO digital system	**0-127**	**21**
162	**ZIMO HLU 1/3 (U)** (see CV161) Only relevant for users of the ZIMO digital system	**0-127**	**42**
163	**ZIMO HLU 1/2** (see CV161) Only relevant for users of the ZIMO digital system	**0-127**	**63**
164	**ZIMO HLU 2/3 (L)** (see CV161) Only relevant for users of the ZIMO digital system	**0-127**	**84**
165	**ZIMO HLU 5/6** (see CV161) Only relevant for users of the ZIMO digital system	**0-127**	**105**
260	**Manufacturer indentification** (read only) 97=Doehler & Haass		
261	**Decoder number** (read only) SD05A = 205, SD10A = 210, SD16A = 216, SD18A = 218, SD21A = 221, SD22A = 222 Complete table see: www.doehler-haass.de / „Häufige Fragen“ (only in German)		
262	**Version number** (read only)		

CV	Name and definition	Range	Standard
263	**Date** (read only)		
264	**Revision number** (read only)		
265	**Date** (read only)		

The CV's 311-379 for sound operation can be found in a separate list in chapter 8.2.2

390	**Function mapping brake button** (see CV391) 0 = deactivated, 1 … 28 = F1 … F28, 29 = F0 (light) Bit 7 = 0: Brake button delay is activated only if the brake button is pressed. Bit 7 = 1 (add value 128 to the value of F1 … F28 or F0): Brake button delay is also active when speed step is on 0. When the corresponding function key is pressed, the value from CV391 is used instead of the value from CV04. **Not valid for shunting gear and for emergency stop.**	**0-255**	**0**
391	**Deceleration time with brake button** (see CV390) The value corresponds to the time in seconds from maximum speed to stop	**0-255**	**3**
401	**Function interchange F1** 0 = deactivated, 1 … 28 = F1 … F28, 29 = F0 (light) 30 = deactivated, 31 = gear sound, 32 = brake sound 33 … 46 = sound flow 3 … 16	**0-46**	**1**
402	**Function interchange F2** (as CV401)	**0-46**	**2**
403	**Function interchange F3** (as CV401)	**0-46**	**3**

CV	Name and definition		Range	Standard
404	**Function interchange F4**	(as CV401)	**0-46**	**4**
405	**Function interchange F5**	(as CV401)	**0-46**	**5**
406	**Function interchange F6**	(as CV401)	**0-46**	**6**
407	**Function interchange F7**	(as CV401)	**0-46**	**7**
408	**Function interchange F8**	(as CV401)	**0-46**	**8**
409	**Function interchange F9**	(as CV401)	**0-46**	**9**
410	**Function interchange F10**	(as CV401)	**0-46**	**10**
411	**Function interchange F11**	(as CV401)	**0-46**	**11**
412	**Function interchange F12**	(as CV401)	**0-46**	**12**
460	**Effect for AUX3** 0 = no effect, 1 = dim, 2 = fade in, 3 = fade out, 4 = Fade in and out, 5 = **"**Marslight", 6 = **"**Gyralight", 7 = **"**Strobe", 8 = **"**double strobe", 9 = dynamic smoke generator, 10 = firebox (red), 11 = Firebox (orange)		**0-255**	**0**
461	**Parameter for AUX3** 0 = lowest ... 255 = highest		**0-255**	**255**
462	**Effect for AUX4**	(as CV460)	**0-255**	**0**
463	**Parameter for AUX4**	(as CV461)	**0-255**	**255**

CV	Name and definition		Range	Standard
464	**Effect for AUX5**		**0-255**	**0**
465	**Parameter for AUX5**		**0-255**	**255**
466	**Effect for AUX6**	(as CV460)	**0-255**	**0**
467	**Parameter for AUX6**	(as CV461)	**0-255**	**255**

Notes to CV137:
Activation SUSI pins: Bit 0 = 0 / Bit 4 = don‘t care / Bit 5 = don‘t care
Activation AUX3/AUX4: Bit 0 = 1 / Bit 4 = don‘t care / Bit 5 = 0
Activation AUX5/AUX6: Bit 0 = 1 / Bit 4 = 1 / Bit 5 = 1

8.2.1 List of supported CV for sound operation

CV	Name and definition	Range	Standard
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**

CV	Name and definition		Range	Standard
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**

CV	Name and definition	Range	Standard
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, to make brake squeal possible	**0-127**	**20**
356	**Brake squeal at initial speed step** The speed step at which brake squeal begins when the vehicle stops	**0-127**	**13**
357	**Secondary driving sound modulation** The value determines how strongly the speed level influences the pitch. 0 = deactivated	**0-255**	**0**

CV	Name and definition	Range	Standard
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 to 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

CV	Name and definition	Range	Standard
367	**Random sounds** **Bit Function Value** 0.....Random sounds allowed while standing.....1 1.....Random sounds allowed while running .....2 2.....Forward random sounds to SUSI interface 4	**0-7**	**3**
368	**Volume dynamic sound** (as CV331)	**0-255**	**128**
369	**Volume turbo sound** (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 sound proportional part** (as CV357)	**0-255**	**0**
373	**Modulation turbo sound integral part** (as CV357)	**0-255**	**0**
374	**Function mapping volume reduction** (as CV311) With every keystroke (on/off) the total volume will be permanently reduced	**0-29**	**0**
375	**Function mapping volume enhancement** (as CV311) With every keystroke (on/off) the total volume will be permanently enhanced	**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 should actually be fulfilled for it	**0-29**	**0**
377	**Function mapping forced coasting** (as CV311) If the corresponding function key is pushed, the driving sound remains coasting even during acceleration	**0-29**	**0**

CV	Name and definition	Range	Standard
378	**Function assignment automatic idle** (as CV331) When the corresponding function key is pressed, the automatic idling after the time period from CV350 has elapsed. If no function key is assigned, the automatic idle is always effective.	**0-29**	**0**
379	**Function assignment forced acceleration** (as CV331) When the corresponding function key is pressed, the driving noise even during a deceleration in acceleration.	**0-29**	**0**

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 re-quested, 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 (dimmable)..... yes
Additional functions (dimmable) 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 for DCC-CV01 only values from 1 to 127 are allowed. Values from 128 on lead to the fact that the decoder can be operated only with 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 numbers 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 numbers 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 (two 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 (two 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 is left by selection of CV80 or by turning off and on the track power (push STOP button and then again GO button).

Long mode

- You get the longe mode by entering in short mode value 07 in CV07 at first.
  The decoder confirms changing in long mode by slow fashing of the lighting.
- Enter now then hundredth and ten‘s digit of the CV, which you want to change.
  Example: CV124 should be changed: Enter ‘12‘.
- Activate the reversion of the driving direction for confirmation. The lighting flashes long and short (periodically).
- Enter now the unit place of the CV in double digit. See example: ‘04‘.
- Activate the reversion of the driving direction for confirmation. The lighting flashes long - short - short (periodically).
  The decoder waits now for entering the CV value.
- Enter now the hundredth and ten‘s digit of the new CV value.
  Example: Value 135 is to be written: Enter ‘13‘.
- Activate the reversion of the driving direction for confirmation. The lighting flashes long - short - short – short (periodically)

- Enter now the unit place of the new CV in double digit. Example: Enter ‘05‘.
- Activate the reversion of the driving direction for confirmation.
  Then the locomotive is flashing again.
- You may now enter further CVs in long mode which you want to change

The long mode can be left by switching the track voltage off and on again or by STOP.

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

10 System format SelecTRIX 2 (SX2)

10.1 Functions

Speed steps..... 127
Speed steps (internal)..... 127
Front light/rear light (dimmable)..... yes
Additional functions (dimmable) 2
Functions total 16
Operation with brake diodes ..... yes
Programming On The Main ..... yes

10.2 Setting options

The characteristics of a locomotive designed in SX2 operation can be varied by programming the "parameters" (par) at any time. Pleas learn the programming of the par from the instructions of your programming device.

Information on the standard "Function Mapping" can be found on the Doehler & Haass website:
http://doehler-haass.de/cms/pages/haeufige-fragen.php: **Wie sieht das standardmäßige „Function Mapping" aus?**
(only in German).

All programmable par can be changed during operation (POM / "**P**rogramming **O**n The **M**ain" / main track programming).

The given default values can be overwritten depending on the sound project!

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 information concerning your digital system.

10.2.1 List of supported parameters

par	Name and definition	Range	Standard
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** 1 = activated (if suitable occupancy detectors, power packs/boosters and central units are available)	**0-1**	**0**
007	**Mode of operation additional channel** 0 = relativ: 1. Additional channel = par003 + par004 2. Additional channel = par003 + par005 1 = absolute	**0-1**	**0**
008	**Consist address unit place** Currently without function		
009	**Consist address hundreds digit** Currently without function		

par	Name and definition	Range	Standard
011	**Acceleration time** The value corresponds to the time in seconds from start to maximum speed and should be set to at least 8 (s. notice in chapter 10.3)	0-255	3
012	**Deceleration time** The value corresponds to the time in seconds from the maximum speed to stop and should be set to at least 8 (s. notice in chapter 10.3)	0-255	3
013	**Maximum speed** (see supplement 2)	0-127	92
014	**Starting voltage**	0-15	0
015	**Slow approach speed step** (see par091) Only with suitable brake modules	0-127	63
018	**Shunting gear speed** (as par013)	0-127	63
019	**Shunting gear delay time** (as par011)	0-255	1
021	**Brake sections** 1 or 2	0, 1	0
022	**Consist mode F1-F8** Currently without function		
023	**Consist mode F0, 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

par	Name and definition	Range	Standard
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** **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**
029	**Analog mode F0, F9-F12** **Bit Function Value** **Bit Function Value** 0..... F0 (f)..... 1 4.....F11 .....16 1..... F0 (r)..... 2 5.....F12 .....32 2..... F9 ..... 4 3..... F10 8	**0-63**	**3**
031	**Interchange of track connections** 0 = normal, 1 = interchanged	**0, 1**	**0**
032	**Interchange of motor connections** 0 = normal, 1 = interchanged	**0, 1**	**0**
033	**Interchange of light connections** 0 = normal, 1 = interchanged	**0, 1**	**0**

par	Name and definition	Range	Standard
043	**Settings** **Bit Function Value** 0.....Dynamic channel usage (not relevant to SX1/SX2) .....1 1.....Immediate starting after current interruption.....2 2.....Special bit for lighting in analog operation.....4 3.....Brake section output to "GPIO" .....8 (→ 1 = no brake section detected, 0 = braking) (only relevant to SD21A/SD22A) 4.....Brake with "GPIO" (1 = driving, 0 = braking).....16 (only relevant to SD21A/SD22A)	**0-31**	**0**
051	**Speed step characteristic** (see supplement 2) Deflection of the characteristic curve, 0 = linear ... 7 = strongly curved	**0-7**	**5**
054	**Motor frequency** **Bit Function Value** 0.....0 = 32 kHz, 1 = 16 kHz.....1 1.....0 = 16/32 kHz, 1 = low frequency.....2 2.....proportional part limitation.....4 3.....Switch off short circuit protection 8	**0-15**	**1**
055	**Maximum speed step in two part brake sections** (see par021) Only with brake diode	**0-127**	**12**
056	**Motor control proportional** Only if par052 = 0, see: www.doehler-haass.de / „Häufige Fragen" (only in German)	**0-7**	**3**
057	**Motor control integral** (as par056)	**0-3**	**3**
058	**Motor control measurement period** (as par056)	**0-3**	**1**
059	**Motor control impulse width** (as par056)	**0-7**	**3**

par	Name and definition		Range	Standard
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)** If par063 is written, par075 will be set to the same value	(see supplement 1)	**0-255**	**4**
064	**Function mapping F2(f+r)** If par064 is written, par085 will be set to the same value	(see supplement 1)	**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 a different value than par063, you must 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**

par	Name and definition	Range	Standard
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 LV/LR** 0 = dark … 31 = full brightness	0-31	31
082	**Dimming low beam light** (see par089) 0 = dark … 31 = full brightness	0-31	15
083	**Dimming AUX1** 0 = dark … 31 = full brightness	0-31	31
084	**Dimming AUX2** 0 = dark … 31 = full brightness	0-31	31
085	**Function mapping F2(r)** (see supplement 1) In case par085 should have a different value than par064, you must 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

par	Name and definition	Range	Standard
088	**Settings** **Bit Function Value** 0.....Unampliefied function outputs instead of ZCLK and ZDAT *) .....1 1.....Switch off energy saving mode.....2 2.....Invert SUSI driving direction *).....4 3.....Currently without function..... 4.....Activate extended function mapping *).....16 (see par088/Bit 5 and par147) 5.....0 = AUX3 and AUX4 on ZCLK und ZDAT.....32 1 = AUX5 and AUX6 on ZCLK und ZDAT (only valid if par088/bit 0=1 and bit 4=1) **Explanations to bit 0, bit 4 and bit 5: see page 66**	**0-63**	**0**
089	**Dimming mask for low beam light** (see par082) **Bit Function Value Bit Function Value** 0.....LV ..... 1 4.....Currently without function ..... 16 1.....LR..... 2 5.....Currently without function ..... 32 2.....AUX1 ..... 4 6.....Currently without function ..... 64 3.....AUX2 ..... 8 7.....Currently without function ... 128	**0-15**	**3**
091	**Brake settings** **Bit Function Value Bit Function Value** 0.....Asymmetry normal.....1 4 ..... Negative voltage ..... 16 1.....Asymmetry invers .....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	**0-255**	**64**

par	Name and definition	Range	Standard
092	**Decision threshold for asymmetry** (see par091) Default value 6 corresponds approximately to 0.7 volt asymmetry and thus to the forward voltage of a silicon diode. Values smaller 3 are not useful, values greater 6 on demand.	**0-15**	**6**
093	**Forward trim** 0 = deactivated, smaller 128 = reduction, greater 128 = increasing speed	**0-255**	**0**
094	**Backward trim** (see par093)	**0-255**	**0**
096	**Brake ramp forward and backward** (see par091) Recommended for constant braking distance: par051 = 0 0 = deactivated If maximum speed step braking time is adjusted in seconds 8 times, at smaller speed steps the decoder generates the brake ramp independently	**0-255**	**0**
097	**Brake ramp backward** (see par096) 0 = value from CV154 is used Allows different brake times forward and backward	**0-255**	**0**
098	**User identification 1**	**0-255**	**0**
099	**User identification 2**	**0-255**	**0**
101	**Manufacturer number** (read only) 97 = Doehler & Haass (Decoder reset with "101"		
102	**Decoder number** (read only) SD05A = 205, SD10A = 210, SD16A = 216, SD18A = 218, SD21A = 221, SD22A = 222 Complete table see: www.doehler-haass.de / „Häufige Fragen" (only in German)		
103	**Version number** (read only)		
104	**Date** (read only)		

par	Name and definition	Range	Standard
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 low beam light** 0 = deactivated, 1 … 28 = F1 … F28, 29 = F0 (light) Only valid if par088/Bit 4=1	**0-29**	**8**
148	**Function mapping shunting gear** (as par147)	**0-29**	**4**
149	**Function mapping deceleration off** (as par147)	**0-29**	**9**
151	**Timer for approach** Each 100 ms, 0 = no approach	**0-250**	**0**
152	**Timer for waiting** Each 100 ms, 0 = no waiting	**0-250**	**0**

par	Name and definition	Range	Standard
153	**Timer for driving away** Each 100 ms, 0 = no driving away	**0-250**	**0**
154	**Speed steps for approach**	**0-127**	**12**
155	**Speed steps for driving away**	**0-127**	**12**
156	**Settings** **Bit Function Value** 6.....Coupling process and timer deactivated .....64 7.....Coupling process only in shunting gear.....128	**0-255**	**0**
160	**Conditions for low beam light** (see par161)	**0-161**	**0**
161	**Conditions for LV** **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 in shunting gear +81 Ignore driving/stand in shunting gear +108 Ignore direction and driving/stand in shunting gear +135 **Always only one number of each definite range may be added up!**	**0-161**	**0**
162	**Conditions for LR** (see par161)	**0-161**	**0**

par	Name and definition	Range	Standard
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** **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 These function outputs are active as soon as the decoder is addressed (without active function key). Thus, for example, the switchover of the sliding contacts can be realized, in connection with the conditions.	**0-255**	**0**

The parameter 311-379 for sound operation can be found in a separate list in chapter 10.2.2.

par	Name and definition	Range	Standard
390	**Function mapping brake button** (see CV391) 0 = deactivated, 1 … 28 = F1 … F28, 29 = F0 (light) Bit 7 = 0: Brake button delay is activated only if the brake button is pressed. Bit 7 = 1 (add value 128 to the value of F1 … F28 or F0): Brake button delay is also active when speed step is on 0. When the corresponding function key is pressed, the value from CV391 is used instead of the value from CV04. **Not valid for shunting gear and for emergency stop.**	**0-255**	**0**
391	**Deceleration time with brake button** (see CV390) The value corresponds to the time in seconds from maximum speed to stop	**0-255**	**3**
401	**Function interchange F1** 0 = deactivated, 1 … 28 = F1 … F28, 29 = F0 (light) 30 = deactivated, 31 = gear sound, 32 = brake sound 33 … 46 = sound flow 3 … 16	**0-46**	**1**
402	**Function interchange F2** (as CV401)	**0-46**	**2**
403	**Function interchange F3** (as CV401)	**0-46**	**3**
404	**Function interchange F4** (as par401)	**0-46**	**4**
405	**Function interchange F5** (as par401)	**0-46**	**5**
406	**Function interchange F6** (as par401)	**0-46**	**6**
407	**Function interchange F7** (as par401)	**0-46**	**7**
408	**Function interchange F8** (as par401)	**0-46**	**8**
409	**Function interchange F9** (as par401)	**0-46**	**9**

par	Name and definition		Range	Standard
410	**Function interchange F10**	(as par401)	**0-46**	**10**
411	**Function interchange F11**	(as par401)	**0-46**	**11**
412	**Function interchange F12**	(as par401)	**0-46**	**12**
460	**Effect for AUX3** 0 = no effect, 1 = dim, 2 = fade in, 3 = fade out, 4 = Fade in and out, 5 = **"**Marslight", 6 = **"**Gyralight", 7 = **"**Strobe", 8 = **"**double strobe", 9 = dynamic smoke generator, 10 = firebox (red), 11 = Firebox (orange)		**0-255**	**0**
461	**Parameter for AUX3** 0 = lowest ... 255 = highest		**0-255**	**255**
462	**Effect for AUX4**	(as par460)	**0-255**	**0**
463	**Parameter for AUX4**	(as par461)	**0-255**	**255**
464	**Effect for AUX5**		**0-255**	**0**
465	**Parameter for AUX5**		**0-255**	**255**
466	**Effect for AUX6**	(as par460)	**0-255**	**0**
467	**Parameter for AUX6**	(as par461)	**0-255**	**255**

Notes to par088:

Activation SUSI pins: Bit 0 = 0 / Bit 4 = don't care / Bit 5 = don't care
Activation AUX3/AUX4: Bit 0 = 1 / Bit 4 = don't care / Bit 5 = 0
Activation AUX5/AUX6: Bit 0 = 1 / Bit 4 = 1 / Bit 5 = 1

10.2.2 List of supported parameters for sound operation

par	Name and definition	Range	Standard
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**

par	Name and definition		Range	Standard
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**
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**

par	Name and definition	Range	Standard
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**

par	Name and definition	Range	Standard
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** **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**
368	**Volume dynamic sound flow** (as par331)	**0-255**	**128**

par	Name and definition	Range	Standard
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** (as par311) With every keystroke (on/off) the total volume will be permanently reduced	**0-29**	**0**
375	**Function mapping volume enhancing** (as par311) With every keystroke (on/off) the total volume will be permanently enhanced	**0-29**	**0**
376	**Function mapping brake squeal deactivating** (as par311) If the corresponding function key is pushed, no brake squeal will be represented, even if the conditions are fulfilled	**0-29**	**0**
378	**Function assignment automatic idle** (as par331) When the corresponding function key is pressed, the automatic idling after the time period from CV350 has elapsed. If no function key is assigned, the automatic idle is always effective.	**0-29**	**0**
379	**Function assignment forced acceleration** (as par331) When the corresponding function key is pressed, the driving noise even during a deceleration in acceleration.	**0-29**	**0**

10.3 Operation

Put the locomotive on the programming track and readout the locomotive address of the decoder (par001+par002). The ground value should be 1001. Program the desired locomotive address and start running the locomotive keeping these parameter values. After the first check you can vary the parameters of the engine freely 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 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: Notes to Function Mapping

If you want to activate a function enter the value of the corresponding output according to the following table. In case you want to activate several different functions simultanously you must add up the related values.

Output values:

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

RG = shunting gear ABL = low beam light

Example: F4 should activate the shunting gear and switch on the outputs LV and LR:
LV=1, LR=2, RG=128: so you must enter the value 131 in CV38 I par066.

Notice: AUX3 and AUX4 are not available in all decoders as amplified ones, however always alternatively available to ZCLK and ZDAT as unampliefied ones.

AUX5 and AUX6 are not in all decoders available (generally only unamplified), however always alternatively available to ZCLK and ZDAT as unamplified ones.

Timer function (CV117-120, 129, 130, par076-079, 145, 146)
Value = 0 The timer is switched off (continuous function)
Value = 1…250 The timer is activated, the coressponding output will be disconnected after the time of:
entered value x 0.1 [sec].

Switch off function (CV113-116, CV125-128, par024-027, par141-par144)
This function gives you the option for deactivating the output (e.g. frontal driving cab light off), despite of activated output (e.g. LV by function F0).

Example: A typical situation where to apply the switch off function is the push pull operation.
The front lightning pointing to the waggon must be switched off, but the other lights must be reversed according to the driving direction (white ↔ red).

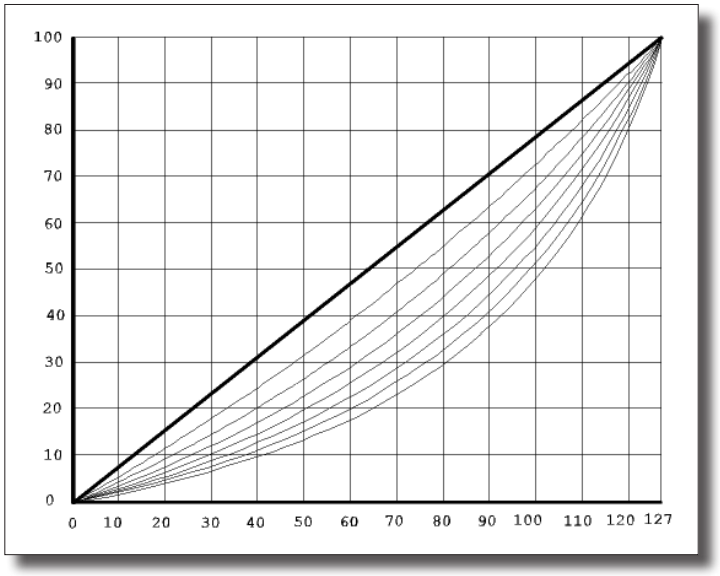
F0 Switches the light on (white or red according to the driving direction)
F2 Switches the font light off
F3 Switches the rear ligth off

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

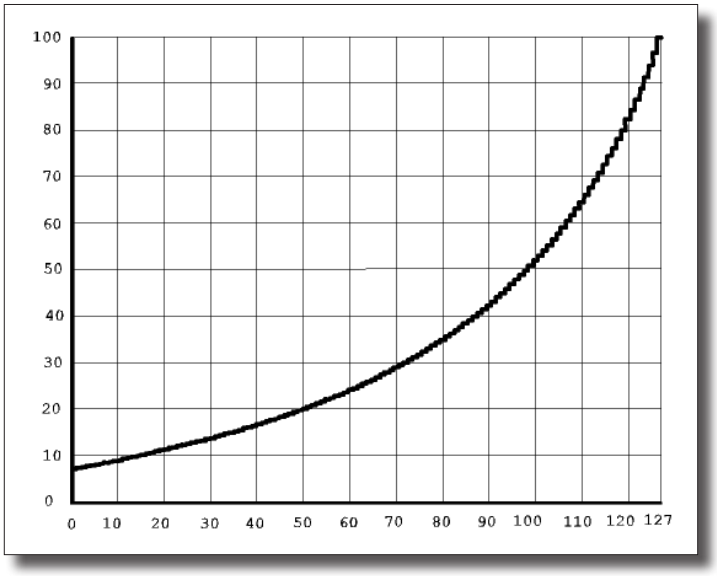
CV	par	Function	F8	F7	F6	F5	F4	F3	F2	F1
113	024	LV off							x	
114	025	LR off						x		
115	026	AUX1 off							x	
116	027	AUX2 off						x		

LV Front light white
AUX1 Front light red
LR Rear light white
AUX2 Rear light red

Supplement 2: Speed characteristics



Speed step characteristic *),
(see CV48 / par051)



Maximum speed characteristic
(see CV05 / par013)

Linear..... 0
Strongly curved..... 7

*) The curvature of the speed step characteristic corresponds with the DHL locomotive decoder series.

Supplement 3: Unamplified function outputs AUX3 … AUX6

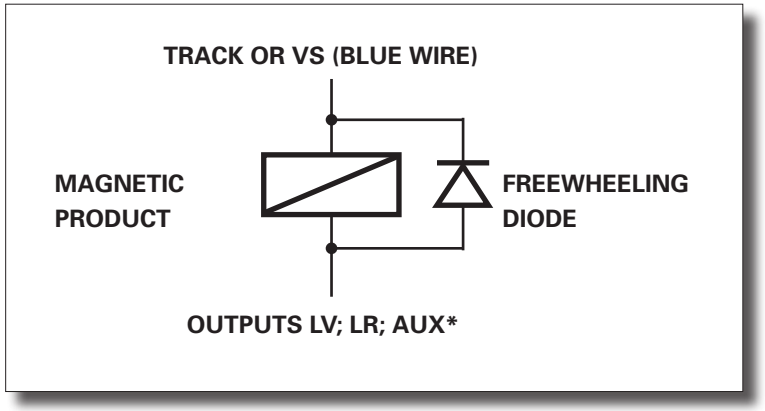
As in case the unamplified function outputs AUX3 … AUX6 (logic level 0 V - 5 V, max. 20 mA) cannot switch greater loads, switching amplifiers (MOSFET, bipolar transistors or the like) must be provided for consumers, which either require a higher supply voltage (> 5 V) or a higher current (> 20 mA).

Supplement 4: Electric coupling / Freewheeling diode

Electric couplings – i.e. couplings, which can automatically uncouple remotely — are magnetic articles and therefore inductive consumers.

When switiching off the current they may generate by the coil of the magnetic product a high voltage with opposite polarity (up to several hundred volts) by self induction. By exceeding the maximum cut off voltage of the function outputs of the most sensitive MOSFET output drivers, they can be destroyed irreparably!

It is therefore imperative to close shortly these voltages by freewheeling diodes:



Please make sure that the function output you have chosen for connecting the electric coupling has a sufficiently high capacity! We recommend the connections AUX3 and AUX4 of our decoders, which are designed for currents up to 1 A.

Hint:
Use the coupling functions of our decoders (timer for switching off AUX*) to make sure that the function output will be switched off in any case according to a maximum activation time specified by you. Otherwise the destruction of the electric coupling is possible.

Refer to supplement 5.

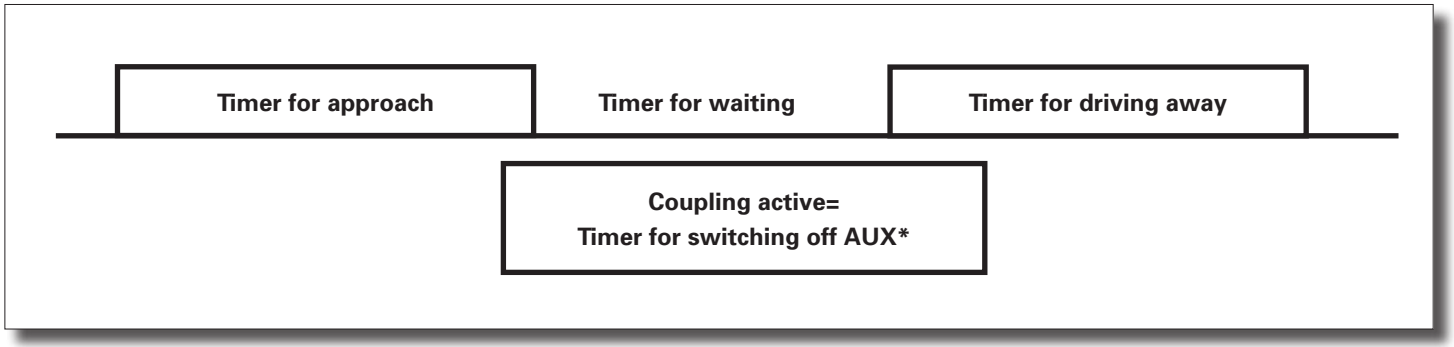
Supplement 5: Automatic coupling procedure (“coupling waltz“)

Principle function

If a locomotive with attached wagon train has been driven into the station in forward driving and now the wagon train should be uncoupled, the locomotive must approach the wagon train backwards to relieve the coupling. Then the coupling must be activated by relaxed towing hook. Now the locomotive is driving away with activated coupling a bit, until the coupling is in rest position.

“Coupling waltz“ is not assigned to a function; it is automatically available, as long as it is activated by CV143 Bit 6 = 0.

The time procedure is defined by CVs (see chart):



CV138 Timer for approach
CV139 Timer for waiting
CV140 Timer for driving away

Using the coupling function of our decoder it must be ensured that the function output will be switched off in any case according to a maximum activation time specified by you. Otherwise the destruction of the electric coupling is possible

The time, while coupling is activated, is defined by the switching off function:
CV117 Timer for switching off AUX1
CV118 Timer for switching off AUX2
CV119 Timer for switching off AUX3
CV120 Timer for switching off AUX4
CV129 Timer for switching off AUX5
CV130 Timer for switching off AUX6

Please proceed as follows:
For function output AUX1 please use CV 117 (par076)
For function output AUX2 please use CV 118 (par077)
For function output AUX3 please use CV 119 (par078)
For function output AUX4 please use CV 120 (par079)
For function output AUX5 please use CV 129 (par145)
For function output AUX6 please use CV 130 (par146)

The adjusted value is internal multiplied by 100 milliseconds. If you want for example to achieve a maximum activation time of one second, please program the value 10.
Value 0 means no coupling function.

That a coupling waltz should be executed the decoder recognizes by the fact that a value unevenly 0 is entered at different times.

Operating the couplings with 2 function keys
Should the couplings be connected for example to AUX3 (in front) and AUX4 (at the rear), times are to be entered at AUX3 and AUX4. The mapping of the function keys (which function key should control which coupling), is set by the normale function mapping (see next page).

For example F3 = AUX3 and F4 = AUX4 should be assigned:
CV37 Function mapping F3 (in the example = 16 for AUX3)
CV38 Function mapping F4 (in the example = 32 for AUX4)

Operating the couplings with 1 function key

Should the couplings be connected for example to AUX3 (in front) and AUX4 (at the rear), times are to be entered at AUX3 and AUX4. The corresponding function key must now be assigned to both couplings.

For example shall F4 = AUX3 and AUX4 operate:
CV38 Function mapping F4 (in example = 16 + 32 = 48 for AUX3 + AUX4)

Which coupling should react must be defined by a condition.
In the example AUX3 should that be for forward and AUX4 for backward:
CV149 Condition for AUX3: forward only = 1
CV150 Condition for AUX4: backward only = 2

Notes to function mapping

If you want to activate a function enter the value of the corresponding output according to the following table. In case you want to activate several different functions simultanously you must add up the related values.

Outputs values:

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

RG = shunting gear ABL = low beam light

Supplement 6: Decoder detection

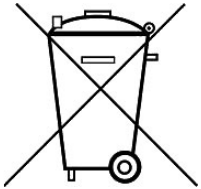
Which decoder is it?

Please read out the CV261. You can determine the decoder by the read out value with the help of the listing of the CV261 in the CV table of this description.

How do I recognize the firmware version of the decoder?

Please read out the CV264. The read out value must be at least as big as the value after the dot in the above firmware version bar next to our logo.

If this should not be the case, an older description is required for your decoder.



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Ce produit ne doit pas être éliminé avec les déchets ménagers normaux à la fin de sa vie utile. Veuillez utiliser le point d'élimination de votre autorité locale.

CE

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

Not suitable for children under 36 month 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!

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