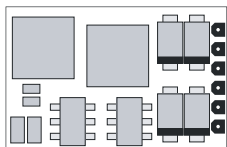
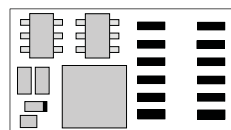


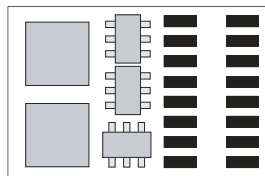
DH05C



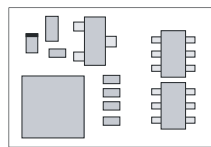
DH10C



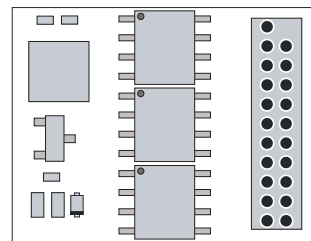
DH12A



DH16A



DH18A



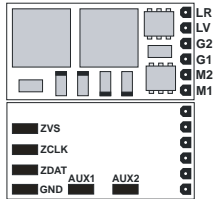
DH21A



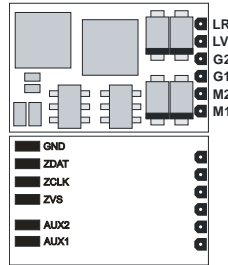
Doehler & Haass

LOCOMOTIVE DECODER

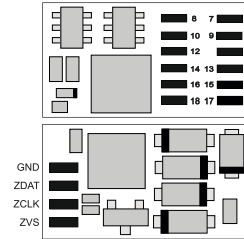
Loco Decoder DH05C



Loco Decoder DH10C



Loco Decoder DH12A



G1, G2 Track 1, 2
M1, M2 Motor 1, 2
LV Front light
LR Rear light
AUX1 ... AUX4 Additional functions 1 ... 4

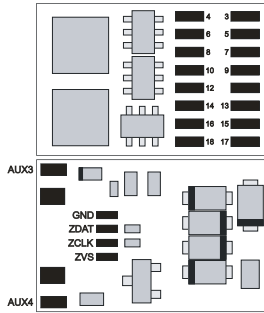
ZVS SUSI supply voltage
ZCLK SUSI clock (or AUX3 unamplified)
ZDAT SUSI data (or AUX4 unamplified)
GND SUSI ground

PluX12-interface

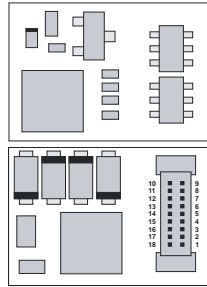
	1	2	
	3	4	
	5	6	
LV	7	8	M1
VS	9	10	M2
Index	11	12	G1
LR	13	14	G2
*) AUX3	15	16	AUX1
*) AUX4	17	18	AUX2
	19	20	
	21	22	

*) unamplified

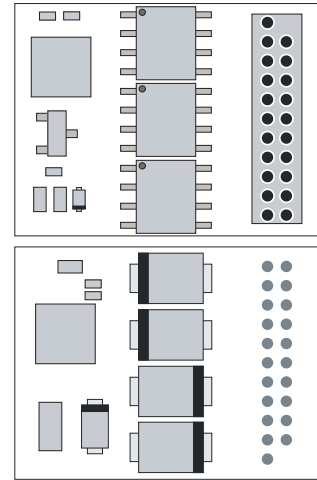
Loco Decoder DH16A



Loco Decoder DH18A



Loco Decoder DH21A



PluX16-interface

--	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
--	15	16	AUX1
--	17	18	AUX2
AUX4	19	20	AUX5
AUX6	21	22	AUX7

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
--	9	14	AUX2
--	10	13	AUX3
Index	11	12	VCC

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	DH05C	DH10C	DH12A
Specifications			
Dimensions [mm]	13,2 x 6,8 x 1,4	14,2 x 9,3 x 1,5	14,5 x 8,0 x 3,0
Total load	0,5 A	1,0 A	1,5 A
Maximum motor current	0,5 A	1,0 A	1,5 A
Maximum operating voltage	18 V	30 V	30 V
Function outputs light: LV, LR (dimnable)	each 150 mA	each 150 mA	each 150 mA
Function outputs AUX1, AUX2 (dimnable)	each 300 mA	each 300 mA	each 300 mA
Function outputs AUX3, AUX4	not available	not available	unamplified
SUSI interface	available	available	available
Connection options			
Without connection wires	DH05C-0	DH10C-0	
With ribbon cable for interface per NEM651	DH05C-1	DH10C-1	
With connection wires	DH05C-3	DH10C-3	
12-pin connector for direct plug (PluX12)			DH12A

	DH16A	DH18A	DH21A
Specifications			
Dimensions [mm]	16,7 x 10,9 x 2,8	13,5 x 9,0 x 2,8	20,7 x 15,8 x 5,2
Total load	1,5 A	1,0 A	2,0 A
Maximum motor current	1,5 A	1,0 A	2,0 A
Maximum operating voltage	30 V	30 V	30 V
Function outputs light: LV, LR (dimnable)	each 150 mA	each 150 mA	each 150 mA
Function outputs AUX1, AUX2 (dimnable)	each 300 mA	each 300 mA	each 300 mA
Function outputs AUX3, AUX4	each 1,0 A	unamplified	each 1,0 A
SUSI interface	available	available	available
Connection options			
Without connection wires	DH16A-0		DH21A-0
With ribbon cable for interface per NEM652	DH16A-2		DH21A-2
With connection wires	DH16A-3		DH21A-3
16-pin connector for direct plug (PluX16)	DH16A-4		
18-pin connection for direct plug		DH18A	
21-pin socket board for direct plug			DH21A-4

1 Introduction

The locomotive decoder DH05C, DH10C, DH12A, DH16A, DH18A and DH21A are compatible with the protocols of SelecTRIX Standard SX1 and SX2 as well as with NMRA-DCC- and MM1/MM2-Standard. They can be controlled by every central unit working with one of these data formats. They can be used for normal direct current motors as well as for coreless motors.

**The operation on alternating current supplied layouts with switching impulse is not allowed!
The impulse excitation will destroy the decoder!
Exception: DH21A!**

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

The functioning of every decoder is fully tested before delivery. Should nevertheless a failure occur, please contact the dealer where you purchased the decoder respectively 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 or questions please contact us by E-mail under the address

doehler-haass@t-online.de

Normally you will get an answer within a few days.

5 Functions

- Operation can be controlled either by conventional DC command stations or by digital central units supporting the formats SelecTRIX 1 and 2, NMRA-Norm (DCC) or MM1/MM2-Standard
- Automatic switchover between conventional DC and digital operation
- In case of digital operation the last programmed system will be activated (no automatically 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 compensation state of art, that way an especially smooth regulation behavior
- Various regulation variants for an optimal adaptation to the motor
- 127 internal speed steps
- Adjustable motor frequency (low frequency, 16 kHz, 32 kHz)
- Block system operation by simple diodes (digital operating system)
- Light and functional outputs can be dimmed and activated analogically
- Shunting gear
- Electronic interchange ability of motor, lighting and track connections
- All function outputs freely programmable
- Thermal protection, insulation
- Reset function for DCC and SX2
- Decoder can be updated:
The update can be executed on the incorporated decoder when the loco is standing on track (no need to open the engine, the SW-Download can be downloaded from the Internet cost free)

6 Decoder-Installation

6.1 Preparation

Check if the locomotive is in perfect running order electrically and mechanically, prior to any mounting work. Defects or dirt must be eliminated first. Pay attention to the instructions of the locomotive producer. Only locomotives running smoothly in analog mode should be equipped with digital decoder. New locomotives should be run in at least 30 minutes in each direction of travel.

Before you start, insulate the motor and all its terminals completely against track connections (collector slipper, 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.

Fix the decoder with a double sided adhesive tape.

6.2 Check after the insertion

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.

6.3 Installation

There are following variants to connect the decoder:

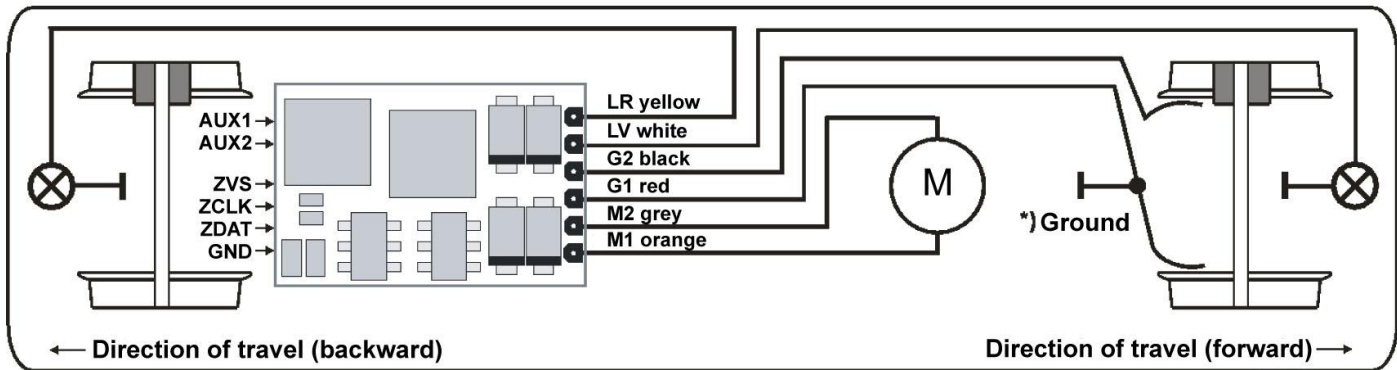
- 1 In case your locomotive is equipped with an interface (NEM 651), you should take the decoder DH05C-**1** respectively DH10C-**1**. They have already the appropriate connections for this plug. Short the ribbon cable up to approximately 5 mm and remove the rest of insulation. The decoder can be inserted into the interface without any problem now.
- 2 In case your locomotive is equipped with an interface (NEM 652), you should take the decoder DH16A-**2** / DH21A-**2**. They have already the appropriate connections for this plug. The decoder can be inserted into the interface without any problem now.
- 3 In case your locomotive is equipped with a 12-pin interface (PluX12), you should take the decoder DH12A. They have already the appropriate connections for this plug. The decoder can be inserted into the interface without any problem now.
- 4 In case your locomotive is equipped with a 16-pin interface (PluX16), you should take the decoder DH16A-**4**. It has already the appropriate connections for this plug. The decoder can be inserted into the interface without any problem now.
- 5 In case your locomotive is equipped with a 18-pin interface, you should take the decoder DH18A. It has already the appropriate connections for this plug. The decoder can be inserted into the interface without any problem now.
- 6 In case your locomotive is equipped with a 21-pin interface, you should take the decoder DH21A-**4**. It has already the appropriate connections for this plug. The decoder can be inserted into the interface without any problem now.
- 7 If the locomotive is not equipped with an interface jack, the decoder must be wired up individually. For this purpose you should use decoder with flexible wires. (DH05C-**3**, DH10C-**3**, DH16A-**3** respectively DH21A-**3**)
- 8 Decoders DH05C-**0**, DH10C-**0**, DH16A-**0** und DH21A-**0** should be used by experienced model railroaders only, as the connection wires must be soldered directly onto the decoder.

For the 7 variants above connect the decoder wires accordingly to following diagram:

red wire	with the right track wire (G1)
black wire	with the left track wire (G2)
orange wire	with the motor wire, which was connected to the right track (M1)
gray wire	with the motor wire, which was connected to the left track (M2)
white wire	with the front light (LV)
yellow wire	with the rear light (LR)
green wire	function output AUX1 (only DH16A- 2/3 and DH21A- 2/3)
violet wire	function output AUX2 (only DH16A- 3 and DH21A- 3)
blue wire	supply voltage up to 30 volts (+VS) (only DH16A- 2/3 and DH21A- 2/3)

In addition for SUSI interface (only if available):

red wire	SUSI supply voltage (ZVS)
blue wire	SUSI clock (ZCLK)
gray wire	SUSI data (ZDAT)
black wire	SUSI ground (GND)



*) The ground can either be connected to wheel 1 or 2, depending on the producer

Function outputs:

The function outputs AUX1 ... AUX4 (only if available) are on the underside of the decoder and must be connected to the consumers with individual wires (see illustration, pages 2 and 3).

Notice:

In case of an incorrect wiring of motor, lighting and track, there is no need to solder off the wires as the assignment can be interchanged electronically by programming (see adjustment options of the respective operating system).

7 Operating System SelectRIX 1 (SX1)

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 with brake diodes	yes
Loco number output	yes

7.2 Setup features

All locomotive parameters can be varied by programming freely at any time. Please, take the information concerning the programming from the instructions of your programming device.

Basic setups

Loco address	01 ... 111	(01)	
Velocity	1 ... 7	(5)	1 = slow ... 7 = fast
Acceleration/Deceleration	1 ... 7	(3)	1 = low ... 7 = high
Impulse width (duration)	1 ... 4	(2)	
Signal-stopping section	1- / 2-part	(1)	

Extended setups

Interchange of connections	(V)	0 ... 7	(4)
Activation of AFB and additional channel	(A)	1 ... 7	(1)
Motor regulation variant	(I)	1 ... 4	(3)
Interchange of connections		0 ... 7	(4)
Interchange motor connections	1		
Interchange light connections	2		
Interchange track connections	4		

Activation of AFB (Automatically acceleration/deceleration control) and additional channel

Function	with AFB	without AFB
Without additional channel	1	2
With ZK*) without function mapping	3	4
With ZK*) with function mapping	5	6
Without ZK*) with function mapping	7	-

*) the additional channel ZK ("Zusatzkanal") has always the address: Loco address + 1

Motor regulation variant	1 ... 4
User defined by par056 ff.	1
Hard	2
Soft	3
Very soft	4

Reading out the extended characteristic values is executed by the entry of the character sequence

00-111

and a subsequently push on the programming key.

Writing of the extended characteristic values is executed by the entry of the character sequence

00=VAI

and a subsequently push on the programming key.

Notice:

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

Caution!

Reading out and entering extended characteristic values overwrites the default-values of the decoder. In case you have varied the extended characteristic values, the default characteristic values of the decoder must be entered anew.

Advice for decoder DH05C, DH10C, DH18A and DH21A:

For SX1-programming a connected SUSI sound module has to be removed. It is sufficient to interrupt the supply voltage (red wire) during the time of SX1-programming.

SX2- resp. DCC-programming and D&H-sound modules are not concerned. Decoders DH12A and DH16A support SX1-programming also with connected SUSI sound module.

7.3 Operation

Put the locomotive on the programming track und read out the programming parameters of the decoder. The default value should be 01-532. Program the desired locomotive address and start running the locomotive keeping the other 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 of the programming track. Never put such a locomotive into operation!

7.4 Explication of the signal-stopping sections

One-part signal-stopping section:

In front of the signal one track section is supplied by a diode. The decoder must be programmed for one-part stopping section (-). The locomotive will be braked to a halt.

Two-part signal-stopping section:

In front of the signal there are two track sections. The first one is supplied by a diode and the locomotive will be braked down to internal speed step 3 in this section. The second one is without supply and the locomotive will stop just in front of the signal. The decoder must be programmed for two-part stopping 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 (can be dimmed)	yes
Additional functions (can be dimmed)	2
Whole functions	28
Operation with brake diodes	yes
Operation with brake generators	yes
Consist mode	yes
Programming on the main (POM)	yes
Loco 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 by CV29/Bit5 makes that the decoder now just can only be operated by DCC. Then MM operation is no longer possible and MM-programming is also disabled. Attention, because "lock out" is possible.

8.2 Setup Features

The characteristics of a locomotive operated in the DCC-operating mode can be varied by programming the configuration variables (CV) freely at any time. The programming procedure is described in the instructions of your programming device.

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 respective information concerning your digital system.

List of supported CV:

CV	Name and definition	Range
01	Short address	0 – 127 (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 (Read only) 97 = Doehler & Haass (Decoder Reset with "8")	
09	Motor frequency 0 = 32 kHz, 1 = 16 kHz, 2 = low-frequency	0 – 2 (1)

12	Motorola-setups Bit 0, Bit 1: 0 = deactivated 1 = without additional addresses 2 = with one additional address 3 = with two additional addresses Bit 2: Internal use only (Driving direction when using MM1/AC-analog)	0 – 7 (1)																														
13	Analog mode F1 – F8 <table border="0" style="margin-left: auto; margin-right: auto;"> <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" style="margin-left: auto; margin-right: auto;"> <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 CV17 contains the most significant byte, CV18 contains the least significant byte, Only if activated by CV29	0 – 255 (192)																														
18		0 – 255 (0)																														
19	Consist address Several compound locos run under this address 0 = deactivated Value + 128 = inverse direction	0 – 127 (0)																														

21	Consist mode F1 – F8						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						0 – 63 (0)
	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					
27	Brake setups						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		
28	Feedback setups						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	Inverse direction		1
	1	14 ↔ 28/126 speed steps		2
	2	Analog operation permitted		4
	3	Feedback allowed		8
	5	Long 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) If CV35 is written, CV47 will be set to the same value	(See supplement 1)	0 – 255 (4)	
36	Function mapping F2(f+r) If CV36 is written, CV64 will be set 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)	
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) In case CV47 should have another value than CV35, you have to set CV35 first and then CV47	(See supplement 1)	0 – 255 (4)	

48	Characteristic diagram Response curve, 0 = linear ... 7 = logarithmic	(See supplement 2)	0 – 7	(5)											
49	Impulse width 0 = 1 ms, 1 = 2 ms, 2 = 4 ms, 3 = 8 ms		0 – 3	(1)											
50	Regulation variant 0 = User defined by CV56 ff., 1 = Hard, 2 = Soft, 3 = Very soft		0 – 3	(2)											
51	Interchange of connections		0 – 7	(0)											
	<table border="0"> <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>Motor connections</td> <td>1</td> </tr> <tr> <td>1</td> <td>Light connections</td> <td>2</td> </tr> <tr> <td>2</td> <td>Track connections</td> <td>4</td> </tr> </tbody> </table>	Bit	Function	Value	0	Motor connections	1	1	Light connections	2	2	Track connections	4		
Bit	Function	Value													
0	Motor connections	1													
1	Light connections	2													
2	Track connections	4													
52	Dimming light „normal“ 0 = off ... 31 = full brightness		0 – 31	(31)											
53	Dimming light „alternative“ 0 = off ... 31 = full brightness		0 – 31	(15)											
54	Dimming AUX1 0 = off ... 31 = full brightness		0 – 31	(31)											
55	Dimming AUX2 0 = off ... 31 = full brightness		0 – 31	(31)											
56	Motor proportional controller Only if CV50 = 0, see www.doehler-haass.de / "frequent questions"		0 – 7	(3)											
57	Motor integral controller	(See CV56)	0 – 3	(3)											
58	Motor measurement period	(See CV56)	0 – 3	(1)											
59	Motor impulse width	(See CV56)	0 – 7	(3)											
60	Signal-stopping section 1 or 2		0, 1	(0)											

61	Shunting gear speed (See CV05)	0 – 127 (63)
62	Shunting gear deceleration (See CV03)	0 – 255 (1)
63	Start delay speed step1 each 100 ms, 0 = deactivated (See CV124)	0 – 250 (0)
64	Function mapping F2(r) In case CV64 should have another value than CV36, you have to set CV36 first and then CV64 (See supplement 1)	0 – 255 (8)
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 identifier 1	0 – 255 (0)
106	User identifier 2	0 – 255 (0)
112	Speed reduction analog 0 = small reduction ... 31 = strong reduction	0 – 31 (15)
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 clear AUX1 Each 100 ms, 0 = deactivated	0 – 250 (0)

118	Timer for clear AUX2 Each 100 ms, 0 = deactivated		0 – 250	(0)														
119	Timer for clear AUX3 Each 100 ms, 0 = deactivated		0 – 250	(0)														
120	Timer for clear AUX4 Each 100 ms, 0 = deactivated		0 – 250	(0)														
121	Function mapping LV+LR on Bit 0 = F1 ... Bit 7 = F8		0 – 255	(0)														
122	Function mapping AUX1+AUX2 on Bit 0 = F1 ... Bit 7 = F8		0 – 255	(0)														
123	Slow approach speed step Only at asymmetry and suitable brake module	(See CV27)	0 – 127	(63)														
124	Function mapping start delay Bit 0 = F1 ... Bit 7 = F8	(See CV63)	0 – 255	(0)														
134	Decision threshold for asymmetry 0 = small asymmetry ... 15 = strong asymmetry	(See CV27)	0 – 15	(6)														
135	Multiplication speed feedback 0 = disconnected		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	Setups		0 – 15	(0)														
	<table border="0"> <thead> <tr> <th>Bit</th> <th>Function</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>AUX3 and AUX4 instead of ZCLK and ZDAT</td> <td>1</td> </tr> <tr> <td>1</td> <td>Switch off energy saving mode</td> <td>2</td> </tr> <tr> <td>2</td> <td>Invert SUSI driving direction</td> <td>4</td> </tr> <tr> <td>3</td> <td>Switch off SUSI start delay</td> <td>8</td> </tr> </tbody> </table>	Bit	Function	Value	0	AUX3 and AUX4 instead of ZCLK and ZDAT	1	1	Switch off energy saving mode	2	2	Invert SUSI driving direction	4	3	Switch off SUSI start delay	8		
Bit	Function	Value																
0	AUX3 and AUX4 instead of ZCLK and ZDAT	1																
1	Switch off energy saving mode	2																
2	Invert SUSI driving direction	4																
3	Switch off SUSI start delay	8																

8.3 Operation

Put the locomotive on the programming track and read out the short locomotive address of decoder (CV01). The default value should be 3. Program the desired locomotive address and start running the locomotive keeping the other adjustment 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 of the programming track.
Never put such a locomotive into operation!

Notice:

Operation with asymmetry in the block section 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".

Block section operation in the DC operating mode is not possible with the factory settings.
If this feature is requested, CV27 / Bit 4 and/or Bit 5 must be set to "1".

9 Operating System Märklin-Motorola (MM)

9.1 Functions

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

Notice to 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 lead to operating the decoder only by MM, i.e. DCC-operation is no longer possible. DCC-"service mode" is still possible.

On the other hand activating the long DCC-address by CV29/Bit5 leads that operating the decoder can only done by DCC. Then 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 just setup parameter < 80 can be changed, if 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. As the display of 6020/6021 allows only binary values, the inserting values have to be divided and entered in two steps.
- 3 Programming SUSI parameter.

Please notice, that 6021/6020 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. There may not be other locomotives on the layout. Notice the flashing signal of the locomotive!
- Push STOP- and GO-button of 6021 simultaneously until reset will be triggered (alternatively: disconnect for a moment the short plug of the transformer). Push STOP-button for disconnecting the 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 GO-button.
- After about 1 second the lights of the engine 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 slowly and periodically.
- 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 the CV, e.g. 15 (double-digit).
- Activate the reversion of the driving direction for confirmation.
- The lighting flashes.
- You may now enter further values, which are going to be changed.

The programming mode is going to be 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 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, which you want to change. Example: CV124 shall 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 and short (periodically). The decoder waits now for entering the CV-value.

- Enter now the hundreds- and tens digit of the new CV-values.
Example: the value 135 shall be written: Enter '13'.
- Activate the reversion of the driving direction for confirmation. The lighting flashes long and short-short-short (periodically).
- Enter now the unit-place of the CV in double-digit. See example: '05'.
- Activate the reversion of the driving direction for confirmation.
Then the locomotive is flashing again.
- You may now enter further CVs, which are going to be changed in long-mode.

The long-mode can be quitted by disconnecting and connecting the track power or over STOP.

SUSI-Mode

You gain the SUSI-mode, by writing value 09 in CV09 in short-mode.
The decoder confirms that by slow flashing.

Enter CVs resp. the related values as in short-mode and reduce all CVs at 900. Thus changes CV903 to 003. Notice please, you are operating in SUSI-mode, which is programmed according to the long-mode.

Notice:

More simple is to program under DCC.
Thus programmed values are also valid for MM-format.

10 Operating system SelectRIX 2 (SX2)

10.1 Functions

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

10.2 Setup features

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

List of supported parameters:

par	Name and definition	Range
001	Loco address unit position	0 – 99 (1)
002	Loco address hundred position	0 – 99 (10)
003	Loco address for SX1 If > 111 = deactivated	0 – 255 (112)
004	Additional channel 1 for SX1 Functions F1 – F8	0 – 255 (1)
005	Additional channel 2 for SX1 Functions F9 – F16	0 – 255 (0)
006	Loco address output 1 = activated	0, 1 (1)
007	Effectiveness additional channels 0 = relative: Additional channel 1 = par003 + par004 Additional channel 2 = par003 + par005 1 = absolute	0, 1 (0)
008	Consist address unit position Reserved	
009	Consist address hundred position Reserved	
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 speed step (See par091) Only at asymmetry and suitable brake module.	0 – 127 (63)
016	Start delay speed step 1 (See par095) Each 100 ms, 0 = deactivated	0 – 250 (0)
017	Speed decrease analog 0 = slight decrease ... 31 = strong decrease	0 – 31 (15)
018	Shunting gear speed (See par013)	0 – 127 (63)
019	Shunting gear deceleration (See par011)	0 – 255 (1)
021	Signal-stopping section 1 or 2	0, 1 (0)
022	Consist mode F1 – F8 Reserved	
023	Consist mode FL, F9 – F12 Reserved	
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 style="margin-left: auto; margin-right: auto;"> <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																											
029	Analog mode FL, F9 – F12 <table style="margin-left: auto; margin-right: auto;"> <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																														
031	Interchange of track connections 0 = normal, 1 = inverted	0, 1 (0)																														
032	Interchange of motor connections 0 = normal, 1 = inverted	0, 1 (0)																														
033	Interchange of light connections 0 = normal, 1 = inverted	0, 1 (0)																														
051	Characteristic diagram (See supplement 2) Response curve, 0 = linear ... 7 = logarithmic	0 – 7 (5)																														
052	Regulation variant 0 = User defined by par056 ff., 1 = Hard, 2 = Soft, 3 = Very soft	0 – 3 (2)																														
053	Impulse width 0 = 1 ms, 1 = 2 ms, 2 = 4 ms, 3 = 8 ms	0 – 3 (1)																														

054	Motor frequency 0 = 32 kHz, 1 = 16 kHz, 2 = low-frequency		0 – 2	(1)
056	Motor proportional controller Only if par052 = 0, see www.doehler-haass.de / "Frequent questions"		0 – 7	(3)
057	Motor integral controller	(See par056)	0 – 3	(3)
058	Motor measurement period	(See par056)	0 – 3	(1)
059	Motor impulse width	(See 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) 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) If 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 clear AUX1 Each 100 ms, 0 = deactivated	0 – 250 (0)
077	Timer for clear AUX2 Each 100 ms, 0 = deactivated	0 – 250 (0)
078	Timer for clear AUX3 Each 100 ms, 0 = deactivated	0 – 250 (0)
079	Timer for clear 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 Bit 0 = F1 ... Bit 7 = F8	0 – 255 (0)
087	Function mapping AUX1+AUX2 on Bit 0 = F1 ... Bit 7 = F8	0 – 255 (0)

088	Setups					0 – 15	(0)
		Bit	Function		Value		
		0	AUX3 and AUX4 instead of ZCLK and ZDAT		1		
		1	Switch off energy saving mode		2		
		2	Invert SUSI driving direction		4		
		3	Switch off SUSI start delay		8		
091	Brake adjustment					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	At present without function	4	6	Brake diode normal	64
		3	At present without function	8	7	Brake diode inverse	128
092	Decision threshold for asymmetry					0 – 15	(6)
	0 = small asymmetry ... 15 = strong asymmetry				(See par091)		
093	Forward-trim					0 – 255	(0)
	0 = deactivated, < 128 = reducing speed, > 128 = increasing speed						
094	Backward-trim					0 – 255	(0)
					(As par093)		
095	Function mapping start delay					0 – 255	(0)
	(See par016)						
	Bit 0 = F1 ... Bit 7 = F8						
098	User identifier 1					0 – 255	(0)
099	User identifier 2					0 – 255	(0)
101	Manufacturer identification						
	97 = Doehler & Haass (Decoder Reset by „101“)				(Read only)		
102	Decoder identifier						
	DH05C = 52, DH10C = 102, DH12A = 120, DH16A = 160, DH18A = 180, DH21A = 200				(Read only)		

103	Version number	(Read only)	
104	Date	(Read only)	
105	Revision number	(Read only)	
106	Date	(Read only)	

10.3 Operation

Put the locomotive on the programming track und 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 the other parameters 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 of the programming track. Never put such a locomotive into operation!

Supplement 1 Explanation for function mapping

If you want to activate a function enter the value to the corresponding output according to the following table. In case you want to activate several functions simultaneously you must add up their specific values.

Output's values:

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

RG = Shunting gear ABL = dimmed headlights

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 | par66.

Notice: AUX3 and AUX4 are not available in the decoder DH05C and DH10C.

Timer function (CV117 - 120, par076 - 079)

Value = 0 The timer is switched off (permanent function)

Value = 1...250 The timer is activated, the correspondent output will be disconnected after the set time of: entered value x 0.1 sec.

Switch-off function (CV113 - 116, par024 - 027)

This function gives you the option to deactivate a function associated to an output partly (e.g. drivers cab light in front dark), though this output is switched on (e.g. LV by function F0).

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

- F0 switches on the light (white or red in dependency of the direction of travel)
- F2 switches off the front light
- F3 switches off the rear light

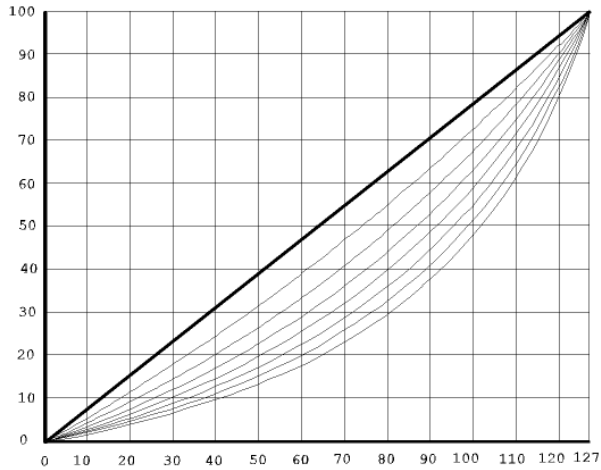
CV	par	Function	RG	ABL	AUX4	AUX3	AUX2	AUX1	LR	LV
33	061	F0(f)					x			x
34	062	F0(r)						x	x	

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

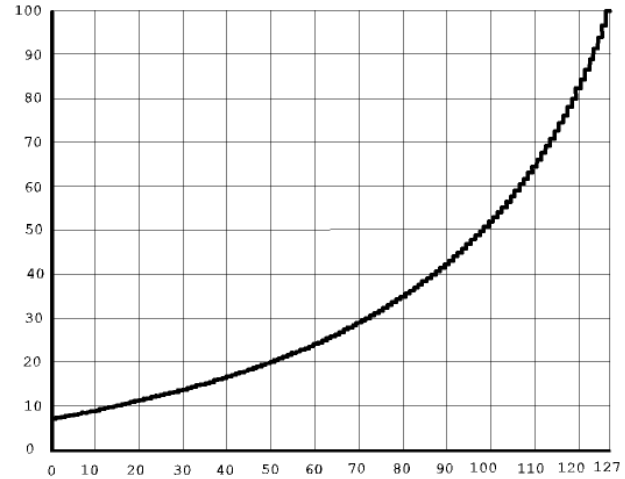
LR Rear light white
 AUX2 Rear light red

Supplement 2 Characteristic diagrams



Speed step characteristics *)

(see CV48/par051)



Maximum speed characteristic

(see CV05/par013)

characteristic speed step diagram:

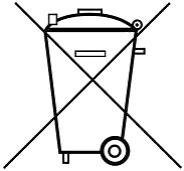
Linear	0
Logarithmic	7

*) The curve 5 of the speed step characteristics corresponds with the DHL loco decoder 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. They might swallow it! Risk of injury due to sharp edged-parts!

Ne convient pas aux enfants en dessous de 3 ans. Danger d'avaler et de violation par bords tranchants!

Company stamp

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Modifications and errors expected.

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