



Doehler & Haass

Locomotive decoder

Vehicle function decoder

Locomotive decoder

DH05C	DH24A
DH10C	DHSP10A
DH12A	PD05A
DH14B	PD06A
DH16A	PD12A
DH18A	PD18A
DH21A/B	PD21A
DH22A/B	

Vehicle function decoder

FH05B
FH16A
FH18A
FH22A



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1 Introduction

The locomotive decoders supports various data formats and operating modes:

Decoder	SX1, SX2	DCC	MM1, MM2	DC-analog	AC-analog
DH05C, DH10C, DH12A, DH14B, DH16A, DH18A, DH24A DHSP10A	X	X	X	X	
DH21A/B, DH22A/B	X	X	X	X	X
FH05B, FH16A, FH18A	X	X	X	X	
FH22A	X	X	X	X	X
PD05A	X	X			
PD06A	X	X		X	
PD12A, PD18A, PD21A		X		X	

Our decoders can be used for normal direct current motors as well for coreless motors.

The operation on alternating current supplied layouts with switching impulse is not allowed! The switching impulse destroys the decoder (exception: DH21A/B, DH22A/B and FH22A)!

The operation of inductive consumers (decouplers, relays, etc.) requires the connection of freewheeling diodes (see supplement 4).

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 or directly the producer (Doehler & Haass). The warranty period is two years from the data of purchase.

4 Support and help

In case you have any problems or questions please contact us by email: **technik@doehler-haass.de**

Usually you will get an answer within a few days.

5 Characteristics of the locomotive decoder

- Operation can be controlled either by conventional DC command stations or by digital command station supporting the formats SelectRIX 1 and 2, DCC format or MM1/MM2 standard
- Automatic switch over from conventional DC to 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
- State of art load regulation, in this way an especially smooth control mode
- Different control variants for an optimal adaption to the motor
- 127 internal speed steps
- Adjustable motor frequency (low frequency, 16 kHz, 32 kHz)
- Block section operation by simple diodes in digital operation
- Light and function outputs are (partly) dimmable and can be activated analogously
- Shunting gear
- Motor, light and track connections electronically changeable
- All function outputs are freely programmable
- Thermal protection
- Reset function for DCC and SX2
- Updateability of the decoder

The update (free software download from the internet) is possible in the installed state of the decoder on the track (no need to open the engine) and is done either via the FCC command station or the programmer. If no corresponding hardware is available, the company Doehler & Haass will provide a programmer on loan on request.

The locomotive decoders support braking with asymmetrical digital voltage (four diodes in series and one diode antiparallel, Lenz ABC), slow speed (with suitable brake modules) and bidirectional communication (locomotive address feedback in DCC mode, RailCom[®], reading CV values using POM, speed feedback, QoS feedback of the track signal quality).

6 Installation of the decoder

6.1 Preparation

Before installation check if the locomotive is in perfect electrical and mechanical condition. Defects and dirt must be eliminated first. Pay attention to the instructions of the locomotive producer.

Only locomotives running smoothly in analogue mode should be equipped with digital decoder. New locomotives should be run in at least 30 minutes in each driving direction.

Before starting installation, insulate the motor and all its terminals completely against track connections (sliders, chassis etc.).

Both motor connections must be disconnected from the ground!

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

Fix the decoder with a double sided adhesive tape.

6.1.1 Limitations of the PD series compared to our DH decoder series

The PD05A nano locomotive decoder is an especially small vehicle decoder for SX1, SX2 and DCC operation.

- No support for MM and DC-analog operation modes
- No support of SX1 programming (but SX1 operation is possible through SX2 parameter programming)
- No SUSI interface and no function outputs
- No extended function assignments (i.e.: no conditions, no initial mapping etc.)
- No automatic coupling process
- No brake ramp

The PD06A vehicle decoder for miniature motors is our particularly small vehicle decoder for SX1, SX2 and DCC operation.

- No support for MM mode
- No support of SX1 programming (but SX1 operation is possible through SX2 parameter programming)
- No SUSI interface
- No extended function assignments (i.e.: no conditions, no initial mapping etc.)
- No automatic coupling process
- No braking with asymmetrical digital voltage and no slow driving
- No brake ramp

The PD12A, PD18A and PD21A vehicle decoders are particularly inexpensive vehicle decoders for pure DCC operation and DC analog.

- No support of the operating modes SX1, SX2 and MM
- No SUSI interface and no unamplified function outputs
- No extended function assignments (i.e.: no conditions, no initial mapping etc.)
- No automatic coupling process (but timers for switching off AUX1 and AUX2 are available)

6.2 Connection of the decoder

Wired variants:

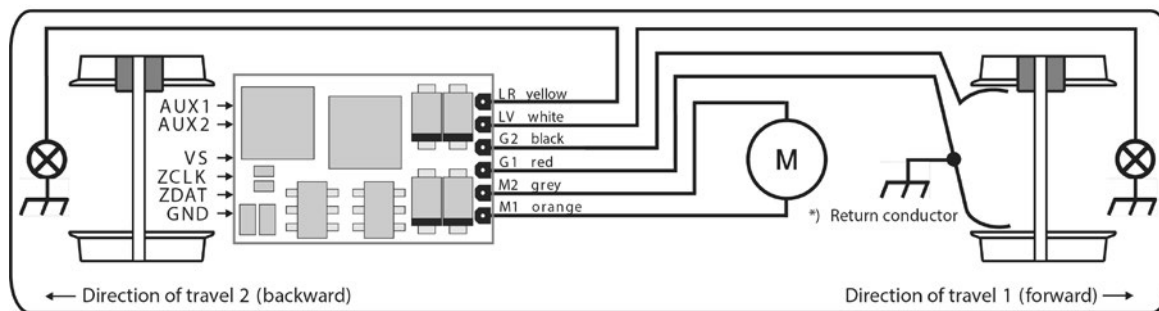
- 1 The decoders **DH05C-0**, **DH10C-0**, **DHSP10A-0**, **DH16A-0**, **DH21A-0**, **DH22B-0**, **PD05A-0**, **PD06A-0** and **PD12A-0**, should be used by experienced model railroaders only, as the connection wires must be soldered directly onto the decoder.
- 2 In case your locomotive is equipped with an interface according to NEM 651, you should take the decoder **DH05C-1**, **DH10C-1**, **DH10C-2**, **DH10C-4**, **DHSP10A-1**, **DHSP10A-2**, **DHSP10A-4** or **PD05A-1**. They have already the appropriate connections for this plug. Short the ribbon cable up to 5 mm and remove the rest of insulation. The decoder can be inserted into the interface without any problem now.
- 3 In case your locomotive is equipped with an interface according to NEM 652, you should take the decoder **DH16A-2**, **DH21A-2**, **DH22B-2** or **PD12A-2**. They have already the appropriate connections for this plug with an 8 pin plug. The decoder can be inserted into the interface without any problem now.
- 5 In case your locomotive is not equipped with an interface jack, the decoders must be wired individually. For this purpose you should use the decoders **DH05C-3**, **DH10C-3**, **DHSP10A-3**, **DH16A-3**, **DH21A-3**, **DH22B-3**, **PD05A-3**, **PD06A-3** or **PD12A-3** with flexible wires.

Variants with interfaces:

- 5 In case your locomotive is equipped with a 12 pin interface (PluX12), you should take the decoder DH12A or PD12A-**4**. They have 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 14 pin interface (mTc14), you should take the decoder DH14B. It has already the appropriate connection for this plug. The decoder can be inserted into the interface without any problem now.
- 7 In case your locomotive is equipped with a 16 pin interface (PluX16), you should take the decoder DH16A-**4**. It has already the appropriate connection for this plug. The decoder can be inserted into the interface without any problem now.
- 8 In case your locomotive is equipped with an 18 interface (Next18), you should take the decoder DH18A or PD18A. It has already the appropriate connection for this plug. The decoder can be inserted into the interface without any problem now.
- 9 In case your locomotive is equipped with a 21 pin interface (mtc21), you should take the decoder DH21A/B-**4**, DH21A/B-**5** or PD21A-**4**. It has already the appropriate connection for this plug. The decoder can be inserted into the interface without any problem now.
- 10 In case your locomotive is equipped with a 22 pin interface (PluX22), you should take the decoder DH22A/B-**4**. It has already the appropriate connection for this plug. The decoder can be inserted into the interface without any problem now.
- 11 In case your locomotive is equipped with a 24 pin interface (E24), you should use the DH24A decoder. The decoder can be inserted into the interface without any problem now.

For the wired variants connect the wires of the decoder according to the following diagram (see also graphic below)

- red wirewith the right track wire
- black wirewith the left track wire
- orange wire.....with the motor wire, which was connected to the right track wire
- gray wire.....with the motor wire, which was connected to the left track wire
- white wire.....with the front light in driving direction
- yellow wirewith the rear light in driving direction
- green wirefunction output AUX1 (only DH16A-**2/3**, DH21A-**2/3**, DH22B-**2/3**, DHSP10A-**3**, PD12A-**2/3** and PD06A-**3**)
- violet wire.....function output AUX2 (only DH16A-**3**, DH21A-**3**, DH22B-**2/3**, DHSP10A-**3**, PD12A-**3** and PD06A-**3**)
- pink wirefunction output AUX3 (only DHSP10A-**3**)
- turquoise wire.....function output AUX4 (only DHSP10A-**3**)
- blue wirecommon return, can carry up to 30 volts (+VS) (only DH16A-**2/3**, DH21A-**2/3**, DH22B-**2/3**, DHSP10A-**3**, PD12A-**2/3** and PD06A-**3**)
- white/black wireDecoder ground leads 0 Volt (GND) (only DHSP10A-**3** and PD06A-**3** (second black wire))



*) Depending on the manufacturer, the return conductor can be connected to wheel 1 or 2 (red or black) and to the locomotive chassis

The wires of an additionally connected SUSI module are connected according to the following scheme:

red wire SUSI supply voltage (ZVS) or supply voltage (VS) if no ZVS available
blue wire..... SUSI clock (ZCLK)
gray wire..... SUSI data (ZDAT)
black wire Ground (GND)

Function outputs:

The function outputs AUX* are possibly on the underside of the decoder and must be connected to the consumer with individual wires or – if unamplified – via appropriate amplifiers.

Notice:

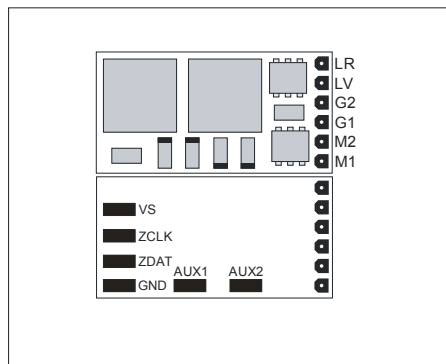
In case of an incorrect wiring of motor, lighting and track, there is no need to solder off the wires as the assignment can be interchanged electronically by programming (see setting options of the respective system format: CV51 or par031, par032, par033).

6.3 Check after installation

The first test should be made in programming mode (e.g. by reading out the address). If there is not correct check back signal to the central unit ("Error"), check again the mapping of the connection or the electrical separation of the motor from the chassis.

7 Locomotive decoder

DH05C 1st generation

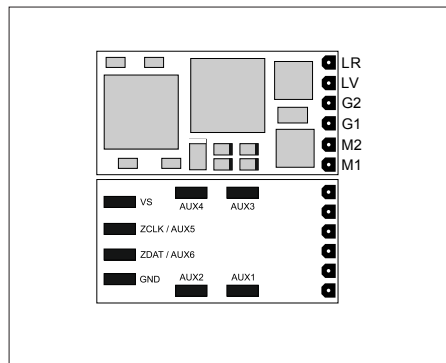


M1, M2 Motor connection 1, 2
G1, G2 Track connection 1, 2
LV, LR Front light, rear light (each 150 mA)
AUX1, AUX2 Additional function 1, 2 (each 300 mA)
VS Supply voltage (also for SUSI)
ZCLK SUSI clock (or AUX3 unamplified *)
ZDAT SUSI data (or AUX4 unamplified *)
GND Ground (0 V)

If necessary: Connect blue wire (common return conductor) to VS.
 You can connect a buffer capacitor to VS (+) and GND (-).
 An external charging circuit **is required** (see supplement 8).

Specifications	DH05C
Dimensions [mm]	13,2 x 6,8 x 1,4
Total load	0,5 A
Maximum motor current	0,5 A
Maximum operating voltage	18 V
Function outputs for light: LV, LR (dimnable)	each 150 mA
Function outputs: AUX1, AUX2 (dimnable)	each 300 mA
Function outputs: AUX3, AUX4 (dimnable)	unamplified *)
With SUSI interface (if AUX3/AUX4 deactivated)	X
Connecting options	
Without connection wires	DH05C-0
With ribbon cable for interface per NEM651	DH05C-1
With connection wires	DH05C-3

*) Unamplified function outputs: See supplement 3.

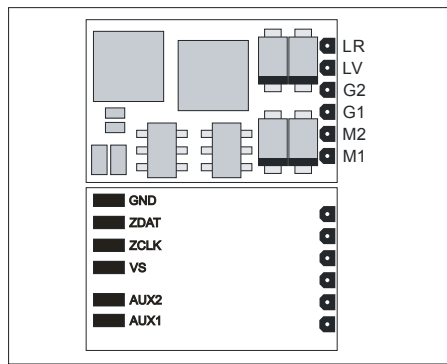
DH05C (2nd generation)

Specifications	DH05C
Dimensions [mm]	after publication
Total load	0,5 A
Maximum motor current	0,5 A
Maximum operating voltage	30 V
Function outputs for light: LV, LR (dimnable)	each 150 mA
Function outputs: AUX1, AUX2 (dimnable)	each 300 mA
Function outputs: AUX3, AUX4, AUX5, AUX6 (dimnable)	unamplified *)
With SUSI interface (if AUX5/AUX6 deactivated)	X
Connecting options	
Without connection wires	DH05C-0
With connection wires	DH05C-3

M1, M2.....Motor connection 1, 2
G1, G2.....Track connection 1, 2
LV, LRFront light, rear light (each 150 mA)
AUX1, AUX2.....Additional function 1, 2 (each 300 mA)
AUX3, AUX4.....Unamplified function 3, 4 *)
VS.....Supply voltage (also for SUSI)
ZCLK/AUX5.....SUSI clock (or AUX5 unamplified) *)
ZDAT/AUX6.....SUSI data (or AUX6 unamplified) *)
GNDGround (0 V)

*) Unamplified function outputs: See supplement 3.

If necessary: Connect blue wire (common return conductor) to VS.
 You can connect a buffer capacitor to VS (+) and GND (-).
 An external charging circuit **is required** (see supplement 8).

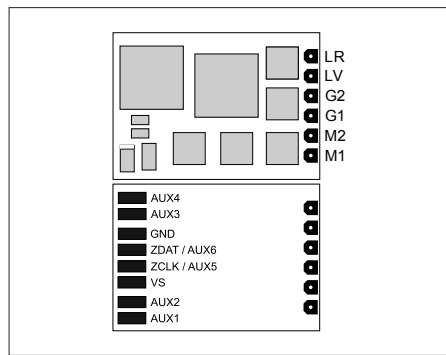
DH10C (1st generation)

M1, M2.....Motor connection 1, 2
G1, G2.....Track connection 1, 2
LV, LRFront light, rear light (each 150 mA)
AUX1, AUX2.....Additional function 1, 2 (each 300 mA)
VS.....Supply voltage (also for SUSI)
ZCLK.....SUSI clock (or AUX3 unamplified) *)
ZDATSUSI data (or AUX4 unamplified) *)
GNDGround (0 V)

If necessary: Connect blue wire (common return conductor) to VS.
 You can connect a buffer capacitor to VS (+) and GND (-).
 An external charging circuit **is required** (see supplement 8).

Specifications	DH10C
Dimensions [mm]	14,2 x 9,3 x 1,5
Total load	1,0 A
Maximum motor current	1,0 A
Maximum operating voltage	30 V
Function outputs for light: LV, LR (dimnable)	each 150 mA
Function outputs: AUX1, AUX2 (dimnable)	each 300 mA
Function outputs: AUX3, AUX4 (dimnable)	unamplified *)
With SUSI interface (if AUX3/AUX4 deactivated)	X
Connecting options	
Without connection wires	DH10C-0
With ribbon cable for interface per NEM651	DH10C-1
With connection wires	DH10C-3

*) Unamplified function outputs: See supplement 3.

DH10C (2nd generation)

M1, M2..... Motor connection 1, 2
G1, G2..... Track connection 1, 2
LV, LR..... Front light, rear light (each 150 mA)
AUX1, AUX2..... Additional function 1, 2 (each 300 mA)
AUX3, AUX4..... Unamplified function 3, 4 (each 1,0 A)
VS..... Supply voltage (also for SUSI)
ZCLK/AUX5..... SUSI clock (or AUX5 unamplified) *)
ZDAT/AUX6..... SUSI data (or AUX6 unamplified) *)
GND Ground (0 V)

If necessary: Connect blue wire (common return conductor) to VS.
 You can connect a buffer capacitor to VS (+) and GND (-).
 An external charging circuit **is required** (see supplement 8).

Specifications

DH10C

Dimensions [mm]	12,7 x 8,9 x 1,4
Total load	1,5 A
Maximum motor current	1,5 A
Maximum operating voltage	30 V
Function outputs for light: LV, LR (dimnable)	each 150 mA
Function outputs: AUX1, AUX2 (dimnable)	each 300 mA
Function outputs: AUX3, AUX4 (dimnable)	each 1,0 A
Function outputs: AUX5, AUX6 (dimnable)	unamplified *)
With SUSI interface (if AUX5/AUX6 deactivated)	X

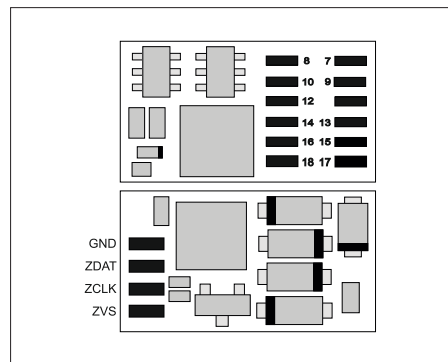
Connecting options

Without connection wires
 With ribbon cable for interface per NEM651
 With connection cable for interface per NEM651
 With connection wires
 6 pin connector for direct plugging (NEM651)

DH10C-0
 DH10C-1
 DH10C-2
 DH10C-3
 DH10C-4

*) Unamplified function outputs: See supplement 3.

DH12A



Specifications

Dimensions [mm]
 Total load
 Maximum motor current
 Maximum operating voltage
 Function outputs for light: LV, LR (dimnable)
 Function outputs: AUX1, AUX2 (dimnable)
 Function outputs: AUX3, AUX4, AUX5, AUX6 (dimnable)
 With SUSI interface (if AUX5/AUX6 deactivated)

DH12A

14,5 x 8,0 x 3,0
 1,5 A
 1,5 A
 30 V
 each 150 mA
 each 300 mA
 unamplified *)
 X

Connecting options

12 pin connector for direct plugging (PluX12)

DH12A

*) Unamplified function outputs: See supplement 3.

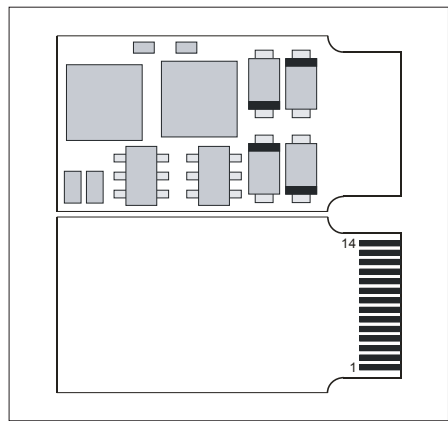
M1, M2.....Motor connection 1, 2
G1, G2.....Track connection 1, 2
LV, LR.....Front light, rear light (each 150 mA)
AUX1, AUX2.....Additional function 1, 2 (each 300 mA)
AUX3, AUX4.....Unamplified function 3, 4 *)
VS.....Supply voltage
ZVS.....SUSI supply voltage
ZCLK.....SUSI clock (or AUX5 unamplified) *)
ZDAT.....SUSI data (or AUX6 unamplified) *)
GND.....Ground (0 V)

If necessary: Connect blue wire (common return conductor) to VS.
 You can connect a buffer capacitor to ZVS (+) and GND (-).
 An external charging circuit **is required** (see supplement 8).

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	

DH14B



Specifications

Dimensions [mm]
 Total load
 Maximum motor current
 Maximum operating voltage
 Function outputs for light: LV, LR (dimnable)
 Function outputs: AUX1, AUX2 (dimnable)
 Function outputs: AUX3, AUX4 (dimnable)
 With SUSI interface (if AUX3/AUX4 deactivated)

DH14B

18,5 x 9,2 x 1,7
 1,0 A
 1,0 A
 30 V
 each 150 mA
 each 300 mA
 unamplified *)
 X

Connecting option

14 pole foil plug for direct plugging (mTc14)

DH14B

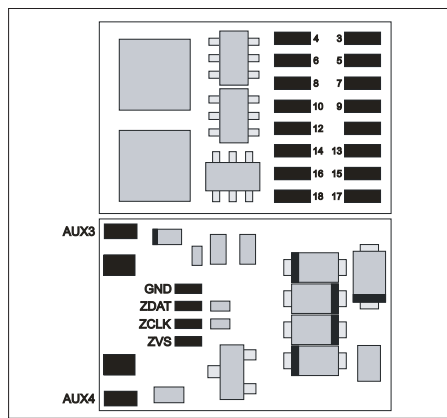
*) Unamplified function outputs: See supplement 3.

M1, M2 Motor connection 1, 2
G1, G2 Track connection 1, 2
LV, LR Front light, rear light (each 150 mA)
AUX1, AUX2 Additional function 1, 2 (each 300 mA)
ZCLK SUSI clock (or AUX3 unamplified) *)
ZDAT SUSI data (or AUX4 unamplified) *)
GND Ground (0 V)

mTc14 interface

1	2	3	4	5	6	7	8	9	10	11	12	13	14
G2	G2	LV	AUX2	ZDAT	GND	M2	M1	GND	ZCLK	AUX1	LR	G1	G1

There is no connection possibility (VS) for the common return conductor (blue wire) or a buffer capacitor.
 An external charging circuit **is required** (see supplement 8).

DH16A (1st generation)

- M1, M2** Motor connection 1, 2
G1, G2 Track connection 1, 2
LV, LR Front light, rear light (each 150 mA)
AUX1, AUX2 Additional function 1, 2 (each 300 mA)
AUX3, AUX4 Additional function 3, 4 (each 1,0 A)
VS Supply voltage
ZVS SUSI supply voltage
ZCLK SUSI clock (or AUX5 unamplified) *)
ZDAT SUSI data (or AUX6 unamplified) *)
GND Ground (0 V)

If necessary: Connect blue wire (common return conductor) to VS.

You can connect a buffer capacitor to ZVS (+) and GND (-).

An external charging circuit **is required** (see supplement 8).

Specifications

Dimensions [mm]
 Total load
 Maximum motor current
 Maximum operating voltage
 Function outputs for light: LV, LR (dimnable)
 Function outputs: AUX1, AUX2 (dimnable)
 Function outputs: AUX3, AUX4 (dimnable)
 Function outputs: AUX5, AUX6 (dimnable)
 With SUSI interface (if AUX5/AUX6 deactivated)

DH16A

16,7 x 10,9 x 2,8
 1,5 A
 1,5 A
 30 V
 each 150 mA
 each 300 mA
 each 1,0 A
 unamplified *)
 X

Connecting options

Without connection wires
 With connection cable for interface per NEM652
 With connection wires
 16 pin connector for direct plugging (PluX16)

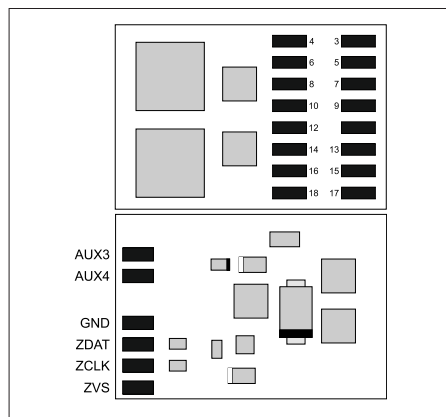
DH16A-0
 DH16A-2
 DH16A-3
 DH16A-4

*) Unamplified function outputs: See supplement 3.

PluX16 interface

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

DH16A (2nd generation)



M1, M2.....Motor connection 1, 2

G1, G2.....Track connection 1, 2

LV, LR Front light, rear light (each 150 mA)

AUX1, AUX2.....Additional function 1, 2 (each 300 mA)

AUX3, AUX4.....Additional function 3, 4 (each 1.0 A)

VS.....Supply voltage

ZVS SUSI supply voltage

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

ZDATSUSI data (or AUX6 unamplified) *)

GND Ground (0 V)

If necessary: Connect blue wire (common return conductor) to VS.

You can connect a buffer capacitor to ZVS (+) and GND (-).

An external charging circuit **is required** (see supplement 8).

Specifications

Dimensions [mm]	15,9 x 10,9 x 2,3
Total load	1,5 A
Maximum motor current	1,5 A
Maximum operating voltage	30 V
Function outputs for light: LV, LR (dimmbale)	each 150 mA
Function outputs: AUX1, AUX2 (dimmbale)	each 300 mA
Function outputs: AUX3, AUX4 (dimmbale)	each 1,0 A
Function outputs: AUX5, AUX6 (dimmbale)	unamplified *)
With SUSI interface (if AUX5/AUX6 deactivated)	X

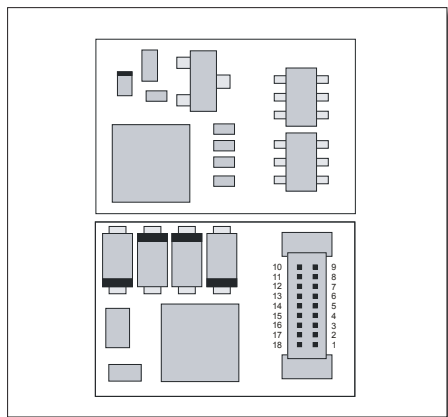
Connecting options

Without connection wires	DH16A-0
With connection cable for interface per NEM652	DH16A-2
With connection wires	DH16A-3
16 pin connector for direct plugging (PluX16)	DH16A-4

*) Unamplified function outputs: See supplement 3.

PluX16 interface

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

DH18A (1st generation)

Next18 interface

G1	LR	AUX5 *)	VS	GND	ZDAT	AUX2	M2	G2
18	17	16	15	14	13	12	11	10
1	2	3	4	5	6	7	8	9

G1 M1
AUX1
ZCLK
GND
VS
*) AUX6
LV
G2

Specifications

DH18A

Dimensions [mm]	13,5 x 9,0 x 2,8
Total load	1,0 A
Maximum motor current	1,0 A
Maximum operating voltage	30 V
Function outputs for light: LV, LR (dimnable)	each 150 mA
Function outputs: AUX1, AUX2 (dimnable)	each 300 mA
Function outputs: AUX3, AUX4, AUX5, AUX6 (dimnable)	unamplified *)
With SUSI interface (if AUX3/AUX4 deactivated)	X

Connecting option

18 pin connector for direct plugging (Next18)

DH18A

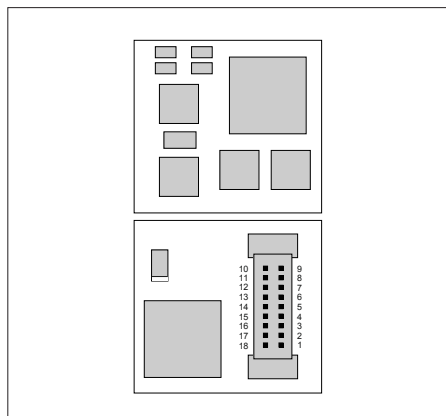
*) Unamplified function outputs: See supplement 3.

M1, M2.....Motor connection 1, 2**G1, G2**.....Track connection 1, 2**LV, LR**.....Front light, rear light (each 150 mA)**AUX1, AUX2**.....Additional function 1, 2 (each 300 mA)**AUX5, AUX6**.....Unamplified function 5, 6 *)**VS**.....Supply voltage (also for SUSI)**ZCLK**.....SUSI clock (or AUX3 unamplified) *)**ZDAT**.....SUSI data (or AUX4 unamplified) *)**GND**.....Ground (0 V)

If necessary: Connect blue wire (common return conductor) to VS.

You can connect a buffer capacitor to VS (+) and GND (-).

An external charging circuit **is required** (see supplement 8).

DH18A (2nd generation)

Next18 interface

G1	18	G1
LR	17	M1
AUX5 *)	16	AUX1
VS	15	ZCLK
GND	14	GND
ZDAT	13	VS
AUX2	12	*) AUX6
M2	11	LV
G2	10	G2
	9	
	8	
	7	
	6	
	5	
	4	
	3	
	2	
	1	

Specifications

Specifications	DH18A
Dimensions [mm]	9,7 x 8,9 x 2,8
Total load	1,5 A
Maximum motor current	1,5 A
Maximum operating voltage	30 V
Function outputs for light: LV, LR (dimnable)	each 150 mA
Function outputs: AUX1, AUX2 (dimnable)	each 300 mA
Function outputs: AUX3, AUX4, AUX5, AUX6 (dimnable)	unamplified *)
With SUSI interface (if AUX3/AUX4 deactivated)	X

Connecting option

18 pin connector for direct plugging (Next18)

DH18A

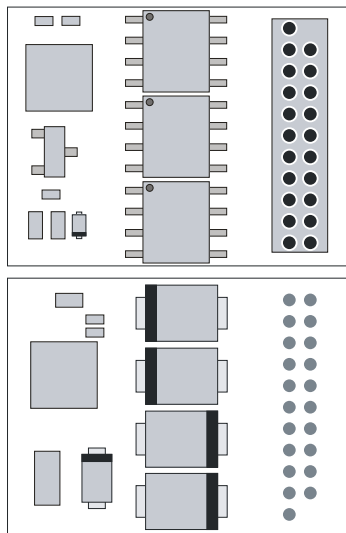
*) Unamplified function outputs: See supplement 3.

M1, M2.....Motor connection 1, 2**G1, G2**.....Track connection 1, 2**LV, LR**.....Front light, rear light (each 150 mA)**AUX1, AUX2**.....Additional function 1, 2 (each 300 mA)**AUX5, AUX6**.....Unamplified function 5, 6 *)**VS**.....Supply voltage (also for SUSI)**ZCLK**.....SUSI clock (or AUX3 unamplified) *)**ZDAT**.....SUSI data (or AUX4 unamplified) *)**GND**.....Ground (0 V)

If necessary: Connect blue wire (common return conductor) to VS.

You can connect a buffer capacitor to VS (+) and GND (-).

An external charging circuit **is required** (see supplement 8).

DH21A (1st generation)**Specifications**

Dimensions [mm]
 Total load
 Maximum motor current
 Maximum operating voltage
 Switching voltage at AC analog:
 Max. 45 V peak = 30 V eff.
 Function outputs for light: LV, LR (dimnable)
 Function outputs: AUX1, AUX2 (dimnable)
 Function outputs: AUX3, AUX4 (dimnable)
 Function outputs: AUX5, AUX6 (dimnable)
 With SUSI interface
 (if AUX5/AUX6 deactivated)

Connecting option

21 pin socket board for direct plugging
 (Märklin/TRIX mtc21)

DH21A-4

20,7 x 15,8 x 5,2
 2,0 A
 2,0 A
 30 V
 X
 each 150 mA
 each 300 mA
 each 1,0 A
 unamplified *)
 X

DH21A-4

*) Unamplified function outputs: See supplement 3.

DH21A (1st generation)

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

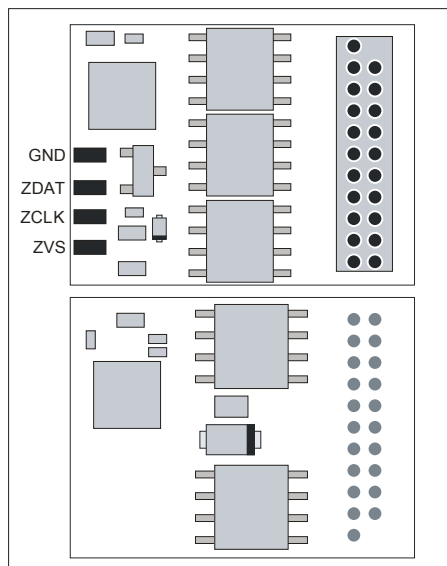
M1, M2..... Motor connection 1, 2**G1, G2**..... Track connection 1, 2**LV, LR**..... Front light, rear light (each 150 mA)**AUX1, AUX2**..... Additional function 1, 2 (each 300 mA)**AUX3, AUX4**..... Additional function 3, 4 (each 1,0 A)**VS**..... Supply voltage (also for SUSI)**ZCLK**..... SUSI clock (or AUX5 unamplified) *)**ZDAT**..... SUSI data (or AUX6 unamplified) *)**GND**..... Ground (0 V)**VCC**..... +5 V / max. 15 mA

*) Unamplified function outputs: See supplement 3.

If necessary: Connect blue wire (common return conductor) to VS.

You can connect a buffer capacitor to VS (+) and GND (-).

An external charging circuit **is required** (see supplement 8).

DH21A (2nd generation)

Specifications	DH21A-0/2/3/4	DH21A-5
Dimensions [mm]	20,7 x 15,8 x 5,2	20,7 x 15,8 x 5,2
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 eff.	X	X
Function outputs for light: LV, LR (dimnable)	each 150 mA	each 150 mA
Function outputs: AUX1, AUX2 (dimnable)	each 300 mA	each 300 mA
Function outputs: AUX3, AUX4 (dimnable)	each 1,0 A	each 300 mA unamplified *)
Function outputs: AUX5, AUX6 (dimnable)	unamplified *)	unamplified *)
Function output: AUX8	unamplified *)	unamplified *)
With SUSI interface (if AUX5/AUX6 deactivated)	X	X
Connecting options		
Without connection wire	DH21A-0	
With connection cable for interface per NEM652	DH21A-2	
With connection wires	DH21A-3	
21 pin socket board for direct plugging (Märklin/TRIX mtc21)	DH21A-4	
21 pin socket board for direct plugging (NEM660/RCN-121)		DH21A-5

*) Unamplified function outputs: See supplement 3.

DH21A (2nd generation)

21 pin interface

GPIO	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

M1, M2	Motor connection 1, 2
G1, G2	Track connection 1, 2
LV, LR	Front light, rear light (each 150 mA)
AUX1, AUX2	Additional function 1, 2 (each 300 mA)
AUX3, AUX4	Additional function 3, 4 †)
VS	Supply voltage
ZVS	SUSI supply voltage
ZCLK	SUSI clock (or AUX5 unamplified) *)
ZDAT	SUSI data (or AUX6 unamplified) *)
GND	Ground (0 V)
GPIO	General input / output (max. +5 V / max. 3 mA) or AUX8 unamplified *)
VCC	+5 V / max. 15 mA

*) Unamplified function outputs: See supplement 3.

†) The DH21A existists in two different hardware variants:

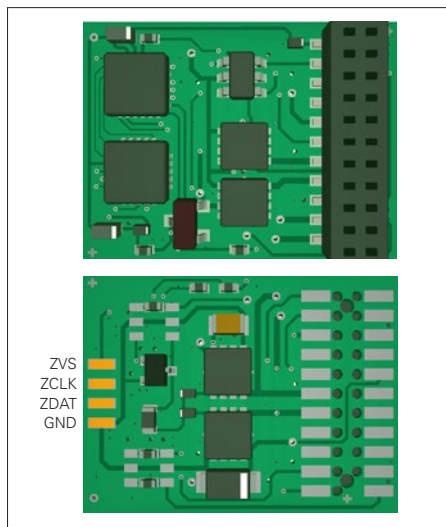
- Function outputs AUX3, AUX4: each 1,0 A (connecting option -0/-2/-3/-4)
- Function outputs AUX3, AUX4: unamplified *) (connecting option -5)

If necessary: Connect blue wire (common return conductor) to VS.

You can connect a buffer capacitor to ZVS (+) and GND (-).

An external charging circuit **is required** (see supplement 8).

DH21B-4



Specifications

DH21B-4

Dimensions [mm]	20,7 x 15,8 x 5,2
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 eff.	X
Function outputs for light: LV, LR (dimnable)	each 150 mA
Function outputs: AUX1, AUX2 (dimnable)	each 300 mA
Function outputs: AUX3, AUX4 (dimnable)	each 1,0 A
Function outputs: AUX5, AUX6 (dimnable)	unamplified *)
Function outputs: AUX7, AUX8	unamplified *)
Function outputs: AUX11, AUX12	unamplified *)
With SUSI interface (if AUX11/AUX12 deactivated)	X

Connecting option

21 pin socket board for direct plugging
(Märklin/TRIX mtc21)

DH21B-4

*) Unamplified function outputs: See supplement 3.

DH21B-4

21 pin interface

GPIO	1	22	G1
*) AUX7	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
–	9	14	AUX2
–	10	13	AUX3
Index	11	12	VCC

M1, M2..... Motor connection 1, 2**G1, G2**..... Track connection 1, 2**LV, LR** Front light, rear light (each 150 mA)**AUX1, AUX2**..... Additional function 1, 2 (each 300 mA)**AUX3, AUX4**..... Additional function 3, 4 (each 1,0 A)**AUX5 ... AUX7**.. Unamplified function *)**VS**..... Supply voltage**ZVS** SUSI supply voltage**ZCLK**..... SUSI clock (or AUX12 unamplified) *)**ZDAT** SUSI data (or AUX11 unamplified) *)**GND** Ground (0 V)**GPIO**..... General input / output (max. +5 V / max. 3 mA)
or AUX8 unamplified *)**VCC** +5 V / max. 15 mA

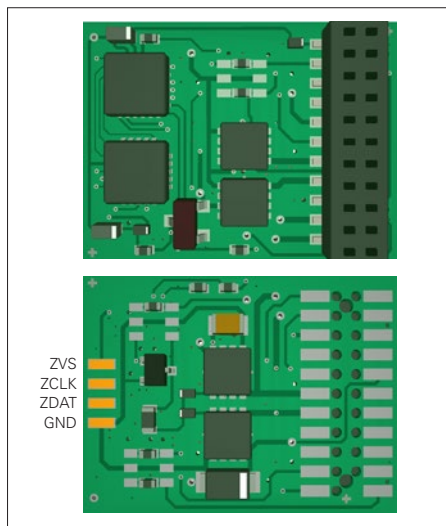
*) Unamplified function outputs: See supplement 3.

If necessary: Connect blue wire (common return conductor) to VS.

You can connect a buffer capacitor to ZVS (+) and GND (-).

An external charging circuit **is required** (see supplement 8).

DH21B-5



Specifications

Dimensions [mm]
 Total load
 Maximum motor current
 Maximum operating voltage
 Switching voltage at AC analog:
 Max. 45 V peak = 30 V eff.
 Function outputs for light: LV, LR (dimnable)
 Function outputs: AUX1, AUX2 (dimnable)
 Function outputs: AUX3, AUX4 (dimnable)
 Function outputs: AUX5, AUX6 (dimnable)
 Function outputs: AUX7, AUX8
 Function outputs: AUX11, AUX12
 With SUSI interface
 (if AUX11/AUX12 deactivated)

Connecting option

21 pin socket board for direct plugging
 (NEM660/RCN-121)

DH21B-5

20,7 x 15,8 x 5,2
 2,0 A
 2,0 A
 30 V
 X
 each 150 mA
 each 300 mA
 unamplified *)
 unamplified *)
 unamplified *)
 unamplified *)
 X

DH21B-5

*) Unamplified function outputs: See supplement 3.

21 pin interface

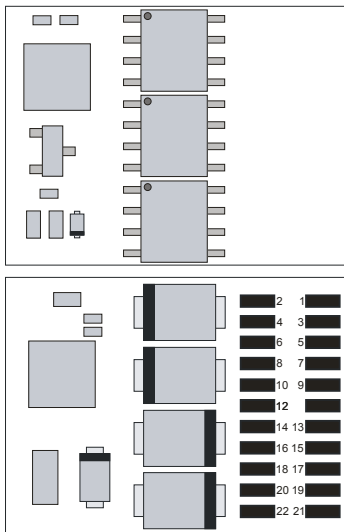
M1, M2	Motor connection 1, 2
G1, G2	Track connection 1, 2
LV, LR	Front light, rear light (each 150 mA)
AUX1, AUX2	Additional function 1, 2 (each 300 mA)
AUX3 ... AUX7 ..	Unamplified function *)
VS	Supply voltage
ZVS	SUSI supply voltage
ZCLK	SUSI clock (or AUX12 unamplified) *)
ZDAT	SUSI data (or AUX11 unamplified) *)
GND	Ground (0 V)
GPIO	General input / output (max. +5 V / max. 3 mA) or AUX8 unamplified *)
VCC	+5 V / max. 15 mA

*) Unamplified function outputs: See supplement 3.

If necessary: Connect blue wire (common return conductor) to VS.

You can connect a buffer capacitor to ZVS (+) and GND (-).

An external charging circuit **is required** (see supplement 8).

DH22A (1st generation)**Specifications**

Dimensions [mm]
 Total load
 Maximum motor current
 Maximum operating voltage
 Switching voltage at AC analog:
 Max. 45 V peak = 30 V eff.
 Function outputs for light: LV, LR (dimmmable)
 Function outputs: AUX1, AUX2 (dimmmable)
 Function outputs: AUX3, AUX4 (dimmmable)
 Function outputs: AUX5, AUX6 (dimmmable)
 Function output: AUX8
 With SUSI interface (if AUX5/AUX6 deactivated)

DH22A

20,7 x 15,8 x 5,2
 2,0 A
 2,0 A
 30 V
 X
 each 150 mA
 each 300 mA
 each 1,0 A
 unamplified *)
 unamplified *)
 X

Connecting option

22 pin connector for direct plugging (PluX22)

DH22A-4

*) Unamplified function outputs: See supplement 3.

DH22A (1st generation)

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
–	15	16	AUX1
–	17	18	AUX2
AUX4	19	20	–
–	21	22	–

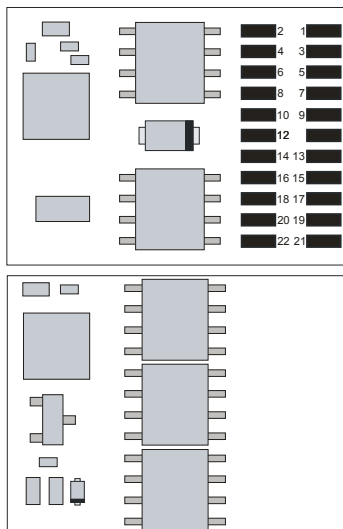
M1, M2	Motor connection 1, 2
G1, G2	Track connection 1, 2
LV, LR	Front light, rear light (each 150 mA)
AUX1, AUX2	Additional function 1, 2 (each 300 mA)
AUX3, AUX4	Unamplified function 3, 4 (each 1,0 A)
VS	Supply voltage
ZVS	SUSI supply voltage
ZCLK	SUSI clock (or AUX5 unamplified) *)
ZDAT	SUSI data (or AUX6 unamplified) *)
GND	Ground (0 V)
GPIO	General input / output (max. +5 V / max. 3 mA) or AUX8 unamplified *)

*) Unamplified function outputs: See supplement 3.

If necessary: Connect blue wire (common return conductor) to VS.

You can connect a buffer capacitor to ZVS (+) and GND (-).

An external charging circuit **is required** (see supplement 8).

DH22A (2nd generation)**Specifications**

Dimensions [mm]
 Total load
 Maximum motor current
 Maximum operating voltage
 Switching voltage at AC analog:
 Max. 45 V peak = 30 V eff.
 Function outputs for light: LV, LR (dimnable)
 Function outputs: AUX1, AUX2 (dimnable)
 Function outputs: AUX3, AUX4 (dimnable)
 Function outputs: AUX5, AUX6 (dimnable)
 Function output: AUX8
 With SUSI interface (if AUX5/AUX6 deactivated)

DH22A

20,7 x 15,8 x 5,2
 2,0 A
 2,0 A
 30 V
 X
 each 150 mA
 each 300 mA
 each 1,0 A
 unamplified *)
 unamplified *)
 X

Connecting option

22 pin connector for direct plugging (PluX22)

DH22A-4

*) Unamplified function outputs: See supplement 3.

DH22A (2nd generation)

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
–	15	16	AUX1
–	17	18	AUX2
AUX4	19	20	–
–	21	22	–

M1, M2..... Motor connection 1, 2**G1, G2**..... Track connection 1, 2**LV, LR**..... Front light, rear light (each 150 mA)**AUX1, AUX2**..... Additional function 1, 2 (each 300 mA)**AUX3, AUX4**..... Unamplified function 3, 4 (each 1,0 A)**VS**..... Supply voltage**ZVS**..... SUSI supply voltage**ZCLK**..... SUSI clock (or AUX5 unamplified *)**ZDAT**..... SUSI data (or AUX6 unamplified *)**GND**..... Ground (0 V)**GPIO**..... General input / output (max. +5 V / max. 3 mA)
or AUX8 unamplified *)

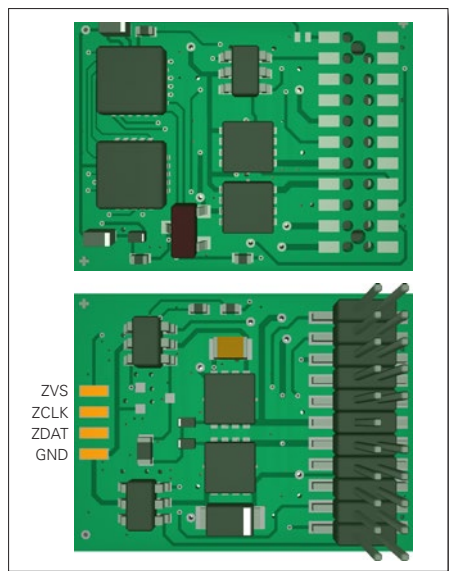
*) Unamplified function outputs: See supplement 3.

If necessary: Connect blue wire (common return conductor) to VS.

You can connect a buffer capacitor to ZVS (+) and GND (-).

An external charging circuit **is required** (see supplement 8).

DH22B



Specifications

DH22B

Dimensions [mm]	20,7 x 15,8 x 5,2
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 eff.	X
Function outputs for light: LV, LR (dimnable)	each 150 mA
Function outputs: AUX1, AUX2 (dimnable)	each 300 mA
Function outputs: AUX3, AUX4, AUX5, AUX6 (dimnable)	each 1,0 A
Function output: AUX7	1,0 A
Function output: AUX8	unamplified *)
Function outputs: AUX11, AUX12	unamplified *)
With SUSI interface (if AUX11/AUX12 deactivated)	X

Connecting options

Without connection wire	DH22B-0
With connection cable for interface per NEM652	DH22B-2
With connection wires	DH22B-3
22 pin connector for direct plugging (PluX22)	DH22B-4

*) Unamplified function outputs: See supplement 3.

DH22B

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

M1, M2	Motor connection 1, 2
G1, G2	Track connection 1, 2
LV, LR	Front light, rear light (each 150 mA)
AUX1, AUX2	Additional function 1, 2 (each 300 mA)
AUX3 ... AUX7	Additional function 3 ... 7 (each 1,0 A)
VS	Supply voltage
ZVS	SUSI supply voltage
ZCLK	SUSI clock (or AUX12 unamplified) *)
ZDAT	SUSI data (or AUX11 unamplified) *)
GND	Ground (0 V)
GPIO	General input / output (max. +5 V / max. 3 mA) or AUX8 unamplified *)

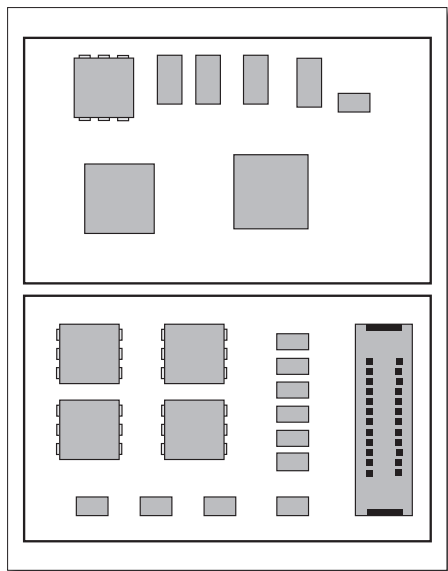
*) Unamplified function outputs: See supplement 3.

If necessary: Connect blue wire (common return conductor) to VS.

You can connect a buffer capacitor to ZVS (+) and GND (-).

An external charging circuit **is required** (see supplement 8).

DH24A



Specifications

Dimensions [mm] (with reservation)
 Total load (short-term)
 Continuous motor current
 Maximum operating voltage
 Function outputs for light: LV, LR (dimnable)
 Function outputs: AUX1, AUX2 (dimnable)
 Function outputs: AUX3, AUX4 (dimnable)
 Function outputs: AUX5, AUX6 (dimnable)
 Function outputs: AUX7, AUX8
 Function outputs: AUX10, AUX11, AUX12
 With SUSI interface
 (if AUX11/AUX12 deactivated)
 Direct capacitor connection

DH24A

14,0 x 8,4 x 2,8
 1,5 A
 0,7 A
 30 V
 each 150 mA
 each 300 mA
 unamplified *)
 each 0,5 A
 each 0,5 A
 unamplified *)
 X
 max. +15 V / 100 mA

Connecting options

24 pin connector for direct plugging (E24)

DH24A

*) Unamplified function outputs: See supplement 3.

DH24A

E24-Interface

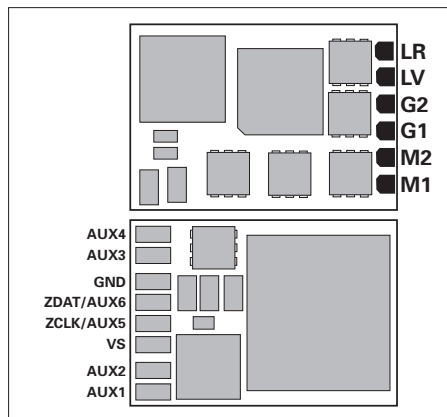
G2	X1		G2
–	1	24	ZDAT *)
–	2	23	ZCLK *)
GND	3	22	GND
M2	4	21	AUX3 *)
M2	5	20	AUX4 *)
M1	6	19	GPIO *)
M1	7	18	VCC
VCAP	8	17	VS
LV	9	16	AUX5
LR	10	15	AUX6
AUX1	11	14	AUX7
AUX2	12	13	AUX8
G1	X2		G1

M1, M2	Motor connection 1, 2
G1, G2	Track connection 1, 2
LV, LR	Front light, rear light (each 150 mA)
AUX1, AUX2	Additional function 1, 2 (each 300 mA)
AUX3, AUX4	Unamplified additional function 3, 4 *)
AUX5 ... AUX8	Additional function 5 ... 8 (each 500 mA)
VS	Supply voltage
ZCLK	SUSI clock (or AUX12 unamplified) *)
ZDAT	SUSI data (or AUX11 unamplified) *)
GND	Ground (0 V)
GPIO	General input / output (max. +5 V / max. 3 mA) or AUX10 unamplified *)
VCC	+5 V / max. 15 mA
VCAP	Direct capacitor connection (max. +15 V / max. 100 mA)

*) Unamplified function outputs: See supplement 3.

If necessary: Connect blue wire (common return conductor) to VS.
You can connect a buffer capacitor to VCAP (+) and GND (-).
An external charging circuit **is not required** (see supplement 8).

DHSP10A



Specifications

Dimensions [mm] (with reservation)
 Total load (short-term)
 Continuous motor current
 Maximum operating voltage
 Function outputs for light: LV, LR (dimnable)
 Function outputs: AUX1, AUX2 (dimnable)
 Function outputs: AUX3, AUX4 (dimnable)
 Function outputs: AUX5, AUX6
 With SUSI interface (if AUX5/AUX6 deactivated)
 Capacitor voltage
 Capacitor capacitance

DHSP10A

12,7 x 8,9 x 3,6
 1,5 A
 0,7 A
 30 V
 je 150 mA
 je 300 mA
 je 1,0 A
 unamplified *)
 X
 16 V
 470 μ F

Connecting options

Without connection wires
 With ribbon cable for interface per NEM651
 With connection cable for interface per NEM651
 With connection wires
 6 pin connector for direct plugging (NEM651)

DHSP10A-0
 DHSP10A-1
 DHSP10A-2
 DHSP10A-3
 DHSP10A-4

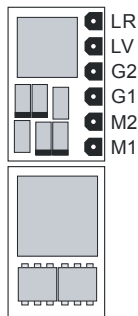
*) Unamplified function outputs: See supplement 3.

DHSP10A

M1, M2..... Motor connection 1, 2
G1, G2..... Track connection 1, 2
LV, LR Front light, rear light (each 150 mA)
AUX1, AUX2..... Additional function 1, 2 (each 300 mA)
AUX3, AUX4..... Additional function 3, 4 (je 1,0 A)
VS..... Supply voltage (also for SUSI)
ZCLK/AUX5..... SUSI clock (or AUX5 unamplified) *)
ZDAT/AUX6..... SUSI data (or AUX6 unamplified) *)
GND Ground (0 V)

If necessary: Connect blue wire (common return conductor) to VS.

A buffer capacitor is integrated in the decoder.

PD05A (1st generation)

M1, M2 Motor connection 1, 2
G1, G2 Track connection 1, 2
LV, LR Front light, rear light (each 150 mA)

There is no connection possibility (VS) for the common return conductor (blue wire) or a buffer capacitor.
 An external charging circuit **is required** (see supplement 8).

Specifications

Dimensions [mm]
 Total load
 Maximum motor current
 Maximum operating voltage
 Function outputs for light: LV, LR (dimnable)

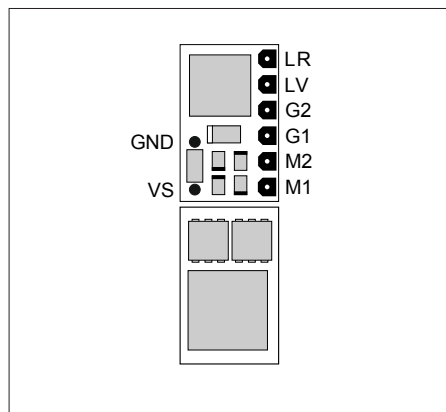
PD05A

5,0 x 7,9 x 2,5
 0,5 A
 0,5 A
18 V
 each 150 mA

Connecting options

Without connection wires
 With ribbon cable for interface per NEM651
 With connection wires

PD05A-0
 PD05A-1
 PD05A-3

PD05A (2nd generation)

Specifications

PD05A

Dimensions [mm]	5,2 x 8,0 x 2,5
Total load	0,5 A
Maximum motor current	0,5 A
Maximum operating voltage	30 V
Function outputs for light: LV, LR (dimnable)	each 150 mA

Connecting options

Without connection wires	PD05A-0
With ribbon cable for interface per NEM651	PD05A-1
With connection wires	PD05A-3
6 pin connector for direct plugging (NEM651)	PD05A-4

M1, M2..... Motor connection 1, 2

G1, G2..... Track connection 1, 2

LV, LR Front light, rear light (each 150 mA)

VS..... Supply voltage

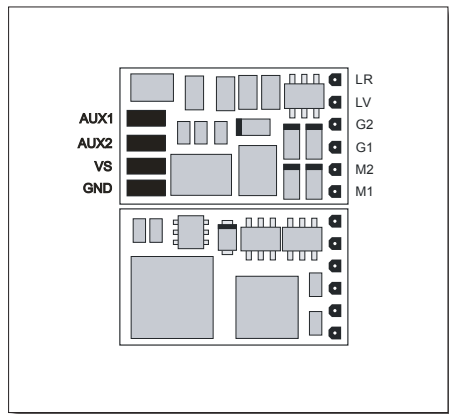
GND Ground (0 V)

If necessary: Connect blue wire (common return conductor) to VS.

You can connect a buffer capacitor to VS (+) and GND (-).

An external charging circuit **is required** (see supplement 8).

PD06A



Specifications

PD06A

Dimensions [mm]	6,8 x 11,4 x 2,8
Total load	0,5 A
Motor voltage	6 V
Maximum motor current	0,2 A
Maximum operating voltage	18 V
Function outputs for light: LV, LR (dimnable)	each 150 mA
Function outputs: AUX1, AUX2 (dimnable)	each 300 mA

Connecting options

Without connection wires
With connection wires

PD06A-0
PD06A-3

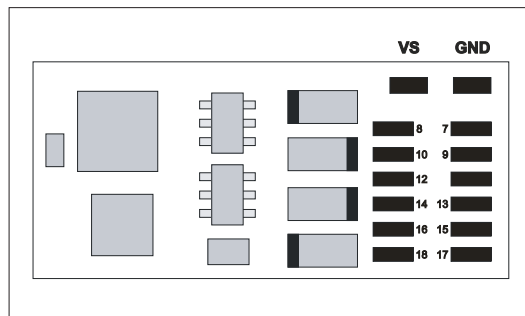
- M1, M2** Motor connection 1, 2
G1, G2 Track connection 1, 2
LV, LR Front light, rear light (each 150 mA)
AUX1, AUX2 Additional function 1, 2 (each 300 mA)
VS Supply voltage
GND Ground (0 V)

If necessary: Connect blue wire (common return conductor) to VS.

You can connect a buffer capacitor to VS (+) and GND (-).

An external charging circuit **is required** (see supplement 8).

PD12A



M1, M2.....Motor connection 1, 2
G1, G2.....Track connection 1, 2
LV, LRFront light, rear light (each 150 mA)
AUX1, AUX2.....Additional function 1, 2 (each 300 mA)
VS.....Supply voltage
GNDGround (0 V)

If necessary: Connect blue wire (common return conductor) to VS.
 You can connect a buffer capacitor to VS (+) and GND (-).
 An external charging circuit **is required** (see supplement 8).

Specifications

PD12A

Dimensions [mm]	24,2 x 11,0 x 2,4
Total load	1,0 A
Maximum motor current	1,0 A
Maximum operating voltage	30 V
Function outputs for light: LV, LR (dimnable)	each 150 mA
Function outputs: AUX1, AUX2 (dimnable)	each 300 mA

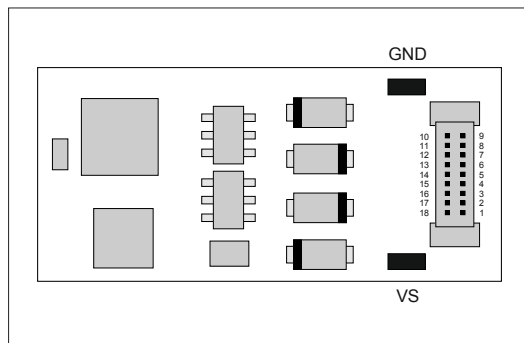
Connecting options

Without connection wires	PD12A-0
With connection cable for interface per NEM652	PD12A-2
With connection wires	PD12A-3
12 pin connector for direct plugging (PluX12)	PD12A-4

PluX12-Interface

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

PD18A



Specifications

Dimensions [mm]
 Total load
 Maximum motor current
 Maximum operating voltage
 Function outputs for light: LV, LR (dimnable)
 Function outputs: AUX1, AUX2 (dimnable)

PD18A

23,8 x 10,8 x 2,0
 1,0 A
 1,0 A
 30 V
 each 150 mA
 each 300 mA

Connecting option

18 pin connector for direct plugging (Next18)

PD18A

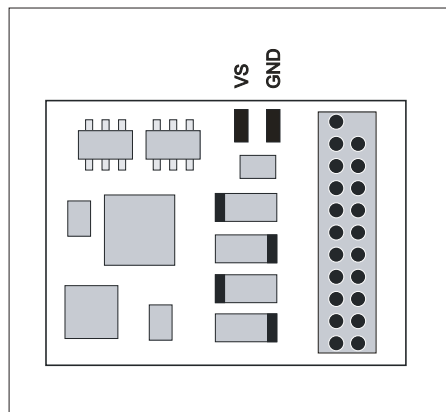
M1, M2.....Motor connection 1, 2
G1, G2.....Track connection 1, 2
LV, LRFront light, rear light (each 150 mA)
AUX1, AUX2.....Additional function 1, 2 (each 300 mA)
VS.....Supply voltage
GNDGround (0 V)

If necessary: Connect blue wire (common return conductor) to VS.
 You can connect a buffer capacitor to VS (+) and GND (-).
 An external charging circuit **is required** (see supplement 8).

Next18 interface

G1	1	18	G1
M1	2	17	LR
AUX1	3	16	–
–	4	15	VS
GND	5	14	GND
VS	6	13	–
–	7	12	AUX2
LV	8	11	M2
G2	9	10	G2

PD21A



M1, M2..... Motor connection 1, 2
G1, G2..... Track connection 1, 2
LV, LR..... Front light, rear light (each 150 mA)
AUX1, AUX2..... Additional function 1, 2 (each 300 mA)
VS..... Supply voltage
GND Ground (0 V)

If necessary: Connect blue wire (common return conductor) to VS.

You can connect a buffer capacitor to VS (+) and GND (-).

An external charging circuit **is required** (see supplement 8).

Specifications

Dimensions [mm]
 Total load
 Maximum motor current
 Maximum operating voltage
 Function outputs for light: LV, LR (dimnable)
 Function outputs: AUX1, AUX2 (dimnable)

PD21A

21,2 x 15,5 x 2,9
 1,0 A
 1,0 A
 30 V
 each 150 mA
 each 300 mA

Connecting option

21 pin socket board for direct plugging (mTc21)

PD21A-4

21 pin interface

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

8 Characteristics of the vehicle function decoder

- Operation can be controlled either by conventional DC command stations or by digital command station supporting the formats SelectRIX 1 and 2, DCC format or MM1/MM2 standard
- Automatic switch over from conventional DC to 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
- 127 internal speed steps
- Block section operation by simple diodes in digital operation
- Light and function outputs are (partly) dimmable and can be activated analogously
- Shunting gear
- Light and track connections electronically changeable
- All function outputs are freely programmable
- Thermal protection
- Reset function for DCC and SX2
- Updateability of the decoder

The update (the firmware download from the Internet is free of charge) is possible while the decoder is installed on the track (no need to open the engine) and is done either via the FCC digital control center or the programmer. If no appropriate hardware is available, the company Doehler & Haass will provide a programmer on loan on request.

The vehicle function decoder support braking system with asymmetric digital voltage (four diodes connected in series and one antiparallel diode), slow approach (with appropriate brake modules) and the bidirectional communication (locomotive address check back signal in DCC operation, RailCom®).

The vehicle function decoders correspond completely to the vehicle decoders in terms of function, only those properties that are directly related to the motor control are missing. This is indicated in the setting options for the corresponding operating modes.

9 Installation of the decoder

9.1 Preparation

In general, the instructions under point 6.1 apply.

9.2 Connection of the vehicle function decoder

Wired variants:

- 1 The FH05B-**0** decoder should only be used by experienced model railroaders, as the connecting wires must be soldered directly onto the decoder.
- 2 In case your model is equipped with an interface according to NEM 651, you should take the decoder FH05B-**1**. It has already the appropriate connections for this plug. Short the ribbon cable up to 5 mm and remove the rest of insulation. The decoder can be inserted into the interface without any problem now.
- 3 In case your model is not equipped with an interface jack, the decoder must be wired individually. For this purpose you should use the decoder FH05B-**3** with flexible wires.

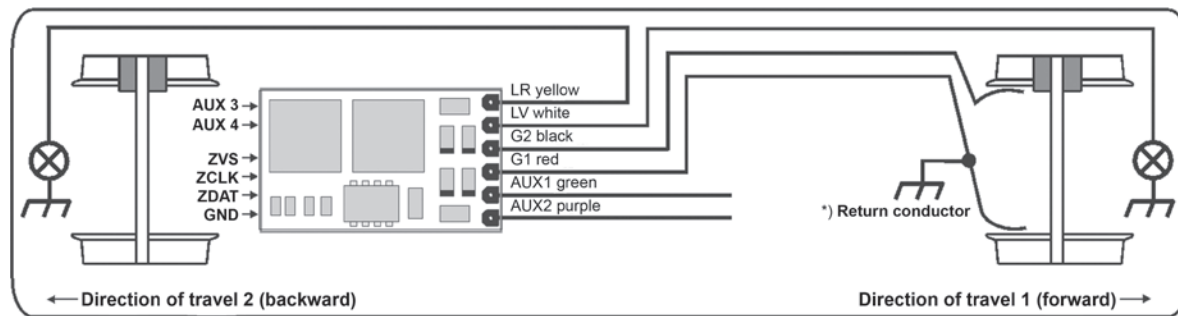
Variants with interfaces:

- 4 In case your model is equipped with a 16 pin interface (PluX16), you should take the decoder FH16A-**4**. It has already the appropriate connection for this plug. The decoder can be inserted into the interface without any problem now.
- 5 In case your model is equipped with an 18 interface (Next18), you should take the decoder FH18A. It has already the appropriate connection for this plug. The decoder can be inserted into the interface without any problem now.

- 6 In case your model is equipped with a 22 pin interface (PluX22), you should take the decoder FH22A-4. It has already the appropriate connection for this plug. The decoder can be inserted into the interface without any problem now.

For the wired versions, connect the wires of the decoder according to the following diagram (see also graphic below):

red wire with the right track wire
 black wire with the left track wire
 white wire..... with the front light in driving direction
 yellow wire with the rear light in driving direction
 green wire function output AUX1
 violet wire function output AUX2



*) Depending on the manufacturer, the return conductor can be connected to wheel 1 or 2 (red or black) and to the locomotive chassis.

The wires of an additionally connected SUSI module are connected according to the following scheme:

red wire SUSI supply voltage (ZVS) or supply voltage (VS) if no ZVS available
blue wire..... SUSI clock (ZCLK)
gray wire..... SUSI data (ZDAT)
black wire Ground (GND)

Function outputs:

The function outputs AUX* are possibly on the underside of the decoder and must be connected to the consumer with individual wires or – if unamplified – via appropriate amplifiers.

Notice:

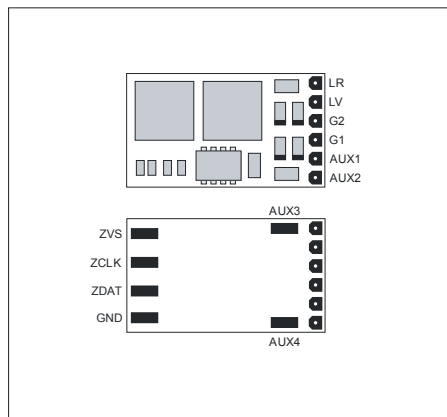
In case of an incorrect wiring of motor, lighting and track, there is no need to solder off the wires as the assignment can be interchanged electronically by programming (see setting options of the respective system format: CV51 or par031, par032, par033).

9.3 Check after installation

The first test should be made in programming mode (e.g. by reading out the address). If there is not correct check back signal to the central unit ("Error"), check again the mapping of the connection or the electrical separation of the motor from the chassis.

10 Vehicle function decoder

FH05B (1st generation)



- G1, G2** Track connection 1, 2
LV, LR Front light, rear light (each 150 mA)
AUX1, AUX2 Additional function 1, 2 (each 300 mA)
AUX3, AUX4 Unamplified function 3, 4 *)
ZVS SUSI supply voltage
ZCLK SUSI clock (or AUX5 unamplified) *)
ZDAT SUSI data (or AUX6 unamplified) *)
GND Ground (0 V)

Specifications	FH05B
Dimensions [mm]	13,7 x 7,8 x 1,5
Total load	0,5 A
Maximum operating voltage	30 V
Function outputs for light: LV, LR (dimnable)	each 150 mA
Function outputs: AUX1, AUX2 (dimnable)	each 300 mA
Function outputs: AUX3, AUX4, AUX5, AUX6 (dimnable)	unamplified *)
With SUSI interface (if AUX5/AUX6 deactivated)	X
Connecting options	
Without connection wires	FH05B-0
With ribbon cable for interface per NEM651	FH05B-1
With connection wires	FH05B-3

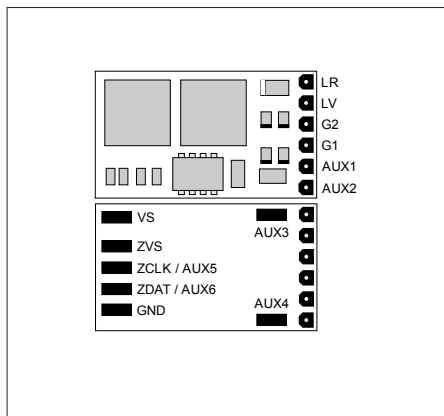
*) Unamplified function outputs: See supplement 3.

If necessary: Connect blue wire (common return conductor) to ZVS.

You can connect a buffer capacitor to ZVS (+) and GND (-).

An external charging circuit **is required** (see supplement 8).

Please note that the ZVS connection does not carry voltage in analog mode.

FH05B (2nd generation)

G1, G2 Track connection 1, 2
LV, LR Front light, rear light (each 150 mA)
AUX1, AUX2 Additional function 1, 2 (each 300 mA)
AUX3, AUX4 Unamplified function 3, 4 *)
ZVS SUSI supply voltage
ZCLK/AUX5 SUSI clock (or AUX5 unamplified) *)
ZDAT/AUX6 SUSI data (or AUX6 unamplified) *)
GND Ground (0 V)

Specifications

Dimensions [mm]
 Total load
 Maximum operating voltage
 Function outputs for light: LV, LR (dimnable)
 Function outputs: AUX1, AUX2 (dimnable)
 Function outputs: AUX3, AUX4, AUX5, AUX6 (dimnable)
 With SUSI interface (if AUX5/AUX6 deactivated)

FH05B

13,4 x 7,8 x 1,7
 0,5 A
 30 V
 each 150 mA
 each 300 mA
 unamplified *)
 X

Connecting options

Without connection wires
 With ribbon cable for interface per NEM651
 With connection wires

FH05B-0
 FH05B-1
 FH05B-3

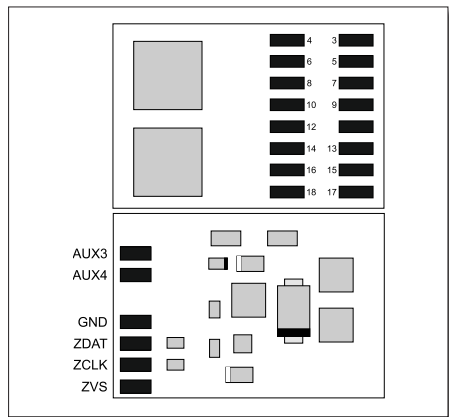
*) Unamplified function outputs: See supplement 3.

If necessary: Connect blue wire (common return conductor) to VS.

You can connect a buffer capacitor to ZVS (+) and GND (-).

An external charging circuit **is required** (see supplement 8).

FH16A



Specifications

Dimensions [mm]	15,9 x 10,9 x 2,3
Total load	1,5 A
Maximum operating voltage	30 V
Function outputs for light: LV, LR (dimmbale)	each 150 mA
Function outputs: AUX1, AUX2 (dimmbale)	each 300 mA
Function outputs: AUX3, AUX4 (dimmbale)	each 1,0 A
Function outputs: AUX5, AUX6 (dimmbale)	unamplified *)
With SUSI interface (if AUX5/AUX6 deactivated)	X

Connecting option

16 pin connector for direct plugging (PluX16)	FH16A-4
---	---------

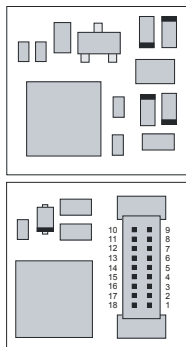
*) Unamplified function outputs: See supplement 3.

G1, G2	Track connection 1, 2
LV, LR	Front light, rear light (each 150 mA)
AUX1, AUX2	Additional function 1, 2 (each 300 mA)
AUX3, AUX4	Additional function 3, 4 (each 1,0 A)
VS	Supply voltage
ZVS	SUSI supply voltage
ZCLK	SUSI clock (or AUX5 unamplified) *)
ZDAT	SUSI data (or AUX6 unamplified) *)
GND	Ground (0 V)

If necessary: Connect blue wire (common return conductor) to VS.
You can connect a buffer capacitor to ZVS (+) and GND (-).
An external charging circuit **is required** (see supplement 8).

PluX16 interface

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

FH18A (1st generation)

Specifications

Dimensions [mm]	10,4 x 9,7 x 3,2
Total load	1,0 A
Maximum operating voltage	30 V
Function outputs for light: LV, LR (dimnable)	each 150 mA
Function outputs: AUX1, AUX2 (dimnable)	each 300 mA
Function outputs: AUX3, AUX4, AUX5, AUX6 (dimnable)	unamplified *)
With SUSI interface (if AUX3/AUX4 deactivated)	X

Connecting option

18 pin connector for direct plugging (Next18)

FH18A

*) Unamplified function outputs: See supplement 3.

Next18 interface

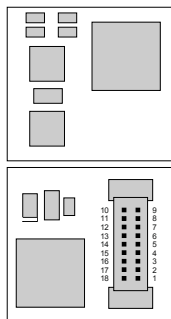
G1	1	18	G1
–	2	17	LR
AUX1	3	16	AUX5 *)
ZCLK	4	15	VS
GND	5	14	GND
VS	6	13	ZDAT
*) AUX6	7	12	AUX2
LV	8	11	–
G2	9	10	G2

G1, G2 Track connection 1, 2**LV, LR** Front light, rear light (each 150 mA)**AUX1, AUX2** Additional function 1, 2 (each 300 mA)**AUX5, AUX6** Unamplified function 5, 6 *)**VS** Supply voltage (also for SUSI)**ZCLK** SUSI clock (or AUX3 unamplified) *)**ZDAT** SUSI data (or AUX4 unamplified) *)**GND** Ground (0 V)

If necessary: Connect blue wire (common return conductor) to VS.

You can connect a buffer capacitor to VS (+) and GND (-).

An external charging circuit **is required** (see supplement 8).

FH18A (2nd generation)

Specifications

Dimensions [mm]	9,7 x 8,9 x 2,8
Total load	1,5 A
Maximum operating voltage	30 V
Function outputs for light: LV, LR (dimnable)	each 150 mA
Function outputs: AUX1, AUX2 (dimnable)	each 300 mA
Function outputs: AUX3, AUX4, AUX5, AUX6 (dimnable)	unamplified *)
With SUSI interface (if AUX3/AUX4 deactivated)	X

Connecting option

18 pin connector for direct plugging (Next18)

FH18A

FH18A

*) Unamplified function outputs: See supplement 3.

Next18 interface

G1	1	18	G1
–	2	17	LR
AUX1	3	16	AUX5 *)
ZCLK	4	15	VS
GND	5	14	GND
VS	6	13	ZDAT
*) AUX6	7	12	AUX2
LV	8	11	–
G2	9	10	G2

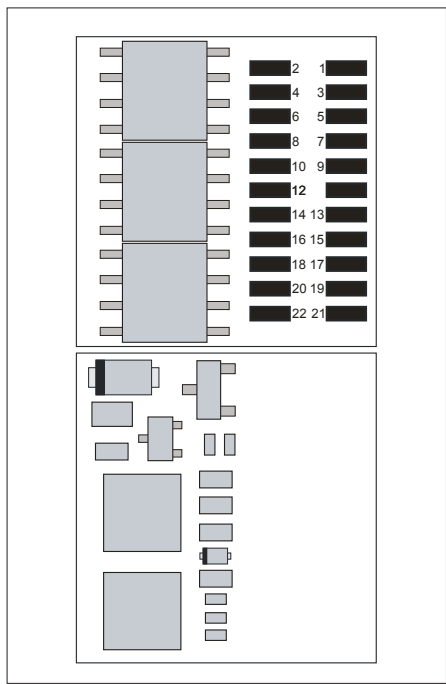
G1, G2 Track connection 1, 2**LV, LR** Front light, rear light (each 150 mA)**AUX1, AUX2** Additional function 1, 2 (each 300 mA)**AUX5, AUX6** Unamplified function 5, 6 *)**VS** Supply voltage (also for SUSI)**ZCLK** SUSI clock (or AUX3 unamplified) *)**ZDAT** SUSI data (or AUX4 unamplified) *)**GND** Ground (0 V)

If necessary: Connect blue wire (common return conductor) to VS.

You can connect a buffer capacitor to VS (+) and GND (-).

An external charging circuit **is required** (see supplement 8).

FH22A



Specifications

Dimensions [mm]
 Total load
 Maximum operating voltage
 Switching voltage at AC analog:
 Max. 45 V peak = 30 V eff.
 Function outputs for light: LV, LR (dimnable)
 Function outputs: AUX1, AUX2 (dimnable)
 Function outputs: AUX3, AUX4 (dimnable)
 Function outputs: AUX5, AUX6 (dimnable)
 Function output: AUX8
 With SUSI interface (if AUX5/AUX6 deactivated)

FH22A

16,1 x 15,8 x 3,3
 2,0 A
 30 V
 X
 each 150 mA
 each 300 mA
 each 1,0 A
 unamplified *)
 unamplified *)
 X

Connecting option

22 pin connector for direct plugging (PluX22)

FH22A-4

*) Unamplified function outputs: See supplement 3.

FH22A

PluX22 interface

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

G1, G2	Track connection 1, 2
LV, LR	Front light, rear light (each 150 mA)
AUX1, AUX2	Additional function 1, 2 (each 300 mA)
AUX3, AUX4	Additional function 3, 4 (each 1,0 A)
VS	Supply voltage
ZVS	SUSI supply voltage
ZCLK	SUSI clock (or AUX5 unamplified) *)
ZDAT	SUSI data (or AUX6 unamplified) *)
GND	Ground (0 V)
GPIO	General input / output (max. +5 V / max. 3 mA) or AUX6 unamplified *)

*) Unamplified function outputs: See supplement 3.

If necessary: Connect blue wire (common return conductor) to VS.

You can connect a buffer capacitor to ZVS (+) and GND (-).

An external charging circuit **is required** (see supplement 8).

11 System formate SelecTRIX 1 (SX1)

11.1 Functions

Speed steps.....	31
Speed steps (internal).....	127
Front lighth/rear light	yes
Additional functions.....	2
Functions in additional channel.....	8 (connectable with locomotive address + 1)
Operation with brake diodes	yes
Locomotive number output.....	yes

11.2 Setting options

All locomotive parameters can be varied by programming freely at any time. Please take the programming informations out of the instructions of your programming device.

Instructions for "Function Mapping" by default see Doehler & Haass website:

<https://doehler-haass.de/cms/pages/haeufige-fragen.php>

Wie sieht das standardmäßige „Function Mapping“ aus? (only in German)

Basic settings

Locomotive address	01 ... 111	(01)	
Maximum speed.....	1 ... 7	(5)	1 = slow ... 7 = fast
Acceleration/Deceleration.....	1 ... 7	(3)	1 = low 7 = high
Impulse width (duration).....	1 ... 4	(2)	Not relevant to FH05B/FH16A/FH18A/FH22A
Brake sections	1 / 2 part	(1)	

Extended settings

Interchange of connections	(V)	0 ... 7	(4)	
Activation of AFB and additional channel	(A)	1 ... 7	(1)	
Motor control variant	(I)	1 ... 4	(3)	
Interchange of connections		0 ... 7	(4)	
Interchange motor connections	1			Not relevant to FH05B/FH16A/FH18A/FH22A
Interchange light connections	2			
Interchange track connections	4			

Activation of AFB (Automatic 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) has always the address: Locomotive address + 1

Motor control variant	1 ... 4	Not relevant to FH05B/FH16A/FH18A/FH22A
Setting 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 by pressing the programming key. Writing of the extended characteristic values is executed by the entry of the character sequence **00=VAI** and by pressing the programming key.

Notice: Coreless motors should be operated with regulation variant 4 and pulse width 1.
No warranty for damages due to incorrect adjustments.

Caution!

Reading out and entering extended characteristic values overwrite the default values of the decoder. In case you have varied the extended characteristic values; the default characteristic value of the decoder must be entered again.

Note for connected SUSI modules:

The supply voltage of the SUSI module (red wire) is connected to the ZVS connection of the decoder:
Nothing else needs to be observed.

The supply voltage of the SUSI module (red wire) is connected to the VS terminal of the decoder:

For SX1 programming, a connected SUSI module must be removed. It is sufficient to disconnect the supply voltage of the SUSI module (red wire) for the time of SX1 programming. D&H sound modules (such as SH05A, SH10A etc.) are not affected by this.

11.3 Operation

Put the locomotive on the programming track and readout the programming parameters of the decoder. The default value should be 01-532. 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!**

11.4 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 (=).

12 System format DCC

12.1 Functions

Short address	1-127
Long address	1-10239
Speed steps.....	14, 28, 126
Speed steps (internal).....	127
Front light/rear light (dimmmable).....	yes
Additional functions (dimmmable)	2
Functions total	28
Operation with brake diodes	yes
Operation with brake generators.....	yes
Consist mode	yes
Programming On The Main	yes
Locomotive number output.....	yes

Notice to address range:

DCC operation allows only address values from 1 to 127 for DCC-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.

12.2 Setting options

The features 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.

Instructions for “Function Mapping” by default see Doehler & Haass website:

<https://doehler-haass.de/cms/pages/haeufige-fragen.php>

Wie sieht das standardmäßige „Function Mapping“ aus? (only in German)

Notice:

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

12.2.1 List of supported CV

The abbreviation **FH*** refers to the decoder types **FH05B, FH16A, FH18A** and **FH22A**.

The abbreviation **PD*** refers to decoder types **PD05A, PD06A, PD12A, PD18A** and **PD21A**.

CV	Name and definition	Range	Standard
01	Address (not relevant to PD*) Addresses higher than 127 are only usable in MM-operation	1-255	3
02	Offset for counter-EMF setpoint at speed level 1 This can be used to specify a higher speed for speed level 1	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 the maximum speed to stop	0-255	3
05	Control reference counter EMF (see supplement 2) The reference value for the control of the back-EMF is set of the motor at highest speed level ("0" corresponds to about 1.2V, "127" corresponds to about 10V back-EMF), for shunting speed see CV61	0-127	92
07	Version number (read only) 3 = 3.00.092, 3.01.023, 3.02.053, 3.02.073 oder 3.03.014 (only distinguishable by par106), 15 = 3.05.015, 16 = 3.15.016, 26 = 3.06.026, 27 = 3.08.027, 48 = 3.10.048, 50 = 3.12.050, 53 = 3.13.053, 54 = 3.04.054, 66 = 3.07.066, 95 = 3.14.095, 98 = 3.11.098, 104 = 3.05.104, 114 = 3.05.114, 117 = 3.09.117		
08	Manufacturer identification (read only) 97 = Doehler & Haass (Decoder reset with "8")		

CV	Name and definition			Range	Standard			
09	Motor frequency (not relevant to FH*)			0-15	1			
	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					
12	MM settings (not relevant to PD*)			0-15	1			
	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 = decoder internal use: driving direction at MM1/AC analog							
13	Analog mode F1-F8 (not relevant to PD05A)			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
	This setting is also valid for MM1 operation.							

CV	Name and definition						Range	Standard
14	Analog mode F0, F9-F12 (not relevant to PD05A)						0-63	3
	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					
	This setting is also valid for MM1 operation.							
17	Extended address						0-255	195
18	CV17 contains the most significant byte; CV18 contains the least significant byte. Only, if activated by CV29/Bit 5=1.						0-255	232
19	Consist address Several compound locomotives run under this address (1-127) 0, 128 = deactivated Value + 128 = inverse direction						0-255	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 F0, F9-F12						0-63	0
	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					

CV	Name and definition						Range	Standard
27	Brake settings						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.....	SX Brake diode normal.....	64		
	3.....	Currently without function..	8	7.....	SX Brake diode inverse ...	128		
	28	Check-back settings						
Bit		Function	Value					
0.....		Channel 1 (Locomotive address) allowed.....	1					
1.....		Channel 2 (POM readout etc.) allowed	2					
2.....		Dynamic channel utilization	4					
29	Configuration register						0-255	14
	Bit	Function	Value					
	0.....	Inverse direction	1					
	1.....	14 speed steps	0					
		28/126 speed steps	2					
	2.....	Analog operation allowed	4 (not relevant to PD05A)					
	3.....	Check back allowed.....	8 (disabled by default on FH*)					
5.....	Locomotive address by CV17/18.....	32						
33	Function mapping F0(f) (see supplement 1)						0-255	1
34	Function mapping F0(r) (see supplement 1)						0-255	2
35	Function mapping F1(f+r) (see supplement 1) If CV35 is written, CV47 will be set to the same value						0-255	4
36	Function mapping F2(f+r) (see supplement 1) If CV36 is written, CV64 will be set to the same value						0-255	8

CV	Name and definition	Range	Standard
37	Function mapping F3 (see supplement 1)	0-255	16
38	Function mapping F4 (see supplement 1)	0-255	128
39	Function mapping F5 (see supplement 1)	0-255	32
40	Function mapping F6 (see supplement 1)	0-255	0
41	Function mapping F7 (see supplement 1)	0-255	0
42	Function mapping F8 (see supplement 1)	0-255	64
43	Function mapping F9 (see supplement 1)	0-255	0
44	Function mapping F10 (see supplement 1)	0-255	0
45	Function mapping F11 (see supplement 1)	0-255	0
46	Function mapping F12 (see supplement 1)	0-255	0
47	Function mapping F1 (r) (see supplement 1) In case CV47 should have a different value than CV35, you have to set CV35 first and then CV47	0-255	4
48	Characteristic curve for back EMF (see supplement 2) Deflection of speed step characteristic, 0 = straight ... 7 = strongly curved	0-7	5
49	Impulse width (not relevant to FH*) 0 = 1 ms, 1 = 2 ms, 2 = 4 ms, 3 = 8 ms	0-3	1
50	Control variant (not relevant to FH*) 0 = defined by CV56 - CV59, 1 = hard, 2 = soft, 3 = very soft	0-3	2

CV	Name and definition	Range	Standard
51	Interchange of connections Bit Function Value 0..... Motor connections 1 (not relevant to FH*) 1..... Light connections 2 2..... Track connections 4	0-7	0
52	Dimming LV/LR 0 = dark ... 31 = full brightness	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 (not relevant to FH*) Only if CV50 = 0, see: www.doehler-haass.de/ „Häufige Fragen“ (only in German)	0-7	3
57	Motor control integral (as CV56)	0-3	3
58	Motor control measurement period (as CV56)	0-3	1
59	Motor control impulse width (as CV56)	0-7	3

CV	Name and definition	Range	Standard
60	Setting Bit Function Value 0.....0 = single-section SX brake sections..... 1 1 = two-section SX brake sections (see CV65) Only for SX brake diode (CV27 bits 6 and 7) 1.....Minimum speed level for brake ramp active (see CV65) 2 2:3.....Shuttle mode deactivated 0 Shuttle mode without intermediate stop (see CV63) 4 (Stop leads to reversal of direction, slow speed leads to slow speed) Shuttle mode with manual intermediate stop (see CV63)..... 8 (Stop leads to hold until canceled, slow speed leads to reversal of direction) Shuttle mode with automatic intermediate stops (see CV63)..... 12 (Stop leads to stop with restart, slow speed to reversal of direction) Only with suitable asymmetry brake modules (CV27 bits 0 and 1)	0-15	0
61	Shunting speed Control reference counter EMF (see supplement 2) The reference value for the control of the back EMF of the motor is set of the motor at the highest speed level in shunting mode ("0" corresponds to approx. 1.2V, "127" corresponds to about 10V back-EMF), see CV05	0-127	63
62	Shunting gear deceleration (as CV03)	0-255	1
63	Start delay/delay time (see CV160) Depending on whether shuttle mode is active, the following is set (CV60 bits 2 and 3) an additional waiting time before the decoder starts moving (100 ms each) see CV124) or the dwell time before the decoder changes direction (1 s each) and the dwell time before the decoder starts moving again (0.5 s each)	0-250	0

CV	Name and definition	Range	Standard
64	Function mapping F2 (r) (see supplement 1) In case CV64 should have a different value than CV36, you must set CV36 first and then CV64	0-255	8
65	Drive stage in brake sections (see CV60) Depending on whether the braking ramp is active (CV60 bit 1), the maximum drive stage in two-part SX braking sections (see CV27 bits 6 and 7 and CV60 bit 0) or the minimum drive stage at which the braking ramp becomes active (see CV154/ CV155) is set.	0-127	12
66	Forward trim 0 = deactivated, smaller 128 = reduction, higher 128 = enhancement of the speed	0-255	0
95	Backward trim (see CV66)	0-255	0
98	Function mapping AUX7 (only relevant to DH21B/DH22B/DH24A) 0 = deactivated, 1 ... 28 = F1 ... F28, 29 = F0 (light)	0-29	10
99	Function mapping AUX8 (as CV98)	0-29	11
101	Function mapping AUX10 (as CV98)	0-29	12
102	Function mapping AUX11 (as CV98)	0-29	13
99	Function mapping AUX12 (as CV98)	0-29	14
105	User identification 1	0-255	0
106	User identification 2	0-255	0
112	Speed reduction analog (not relevant to FH*/PD05A) 0 = small reduction ... 127 = strong reduction	0-127	15

CV	Name and definition	Range	Standard
113	Switch off function for LV Bit 0 = F1 ... Bit 7 = F8	0-255	0
114	Switch off function for LR Bit 0 = F1 ... Bit 7 = F8	0-255	0
115	Switch off function for AUX1 Bit 0 = F1 ... Bit 7 = F8	0-255	0
116	Switch off function for AUX2 Bit 0 = F1 ... Bit 7 = F8	0-255	0
117	Timer for switch off AUX1 Each 100 ms, 0 = deactivated	0-250	0
118	Timer for switch off AUX2 Each 100 ms, 0 = deactivated	0-250	0
119	Timer for switch off AUX3 Each 100 ms, 0 = deactivated	0-250	0
120	Timer for switch off AUX4 Each 100 ms, 0 = deactivated	0-250	0
121	Function mapping LV+LR on / AUX1+AUX2 off Bit 0 = F1 ... Bit 7 = F8 Only with F0 (light) on	0-255	0
122	Function mapping AUX1+AUX2 on / LV+LR off Bit 0 = F1 ... Bit 7 = F8 Only with F0 (light) off	0-255	0
123	Slow approach speed Only with suitable asymmetry brake modules (CV27 bits 0 and 1)	(see CV27) 0-127	63

CV	Name and definition	Range	Standard
124	Function mapping starting delay Bit 0 = F1 ... Bit 7 = F8 (see CV63)	0-255	0
125	Switch off function for AUX3 Bit 0 = F1 ... Bit 7 = F8	0-255	0
126	Switch off function for AUX4 Bit 0 = F1 ... Bit 7 = F8	0-255	0
127	Switch off function for AUX5 Bit 0 = F1 ... Bit 7 = F8	0-255	0
128	Switch off function for AUX6 Bit 0 = F1 ... Bit 7 = F8	0-255	0
129	Timer for switch off AUX5 Each 100 ms, 0 = deactivated	0-250	0
130	Timer for switch off AUX6 Each 100 ms, 0 = deactivated	0-250	0
131	Function mapping low beam light 0 = deactivated, 1 ... 28 = F1 ... F28, 29 = F0 (light) Only valid if CV137/Bit 4=1 (not relevant to PD*)	0-29	8
132	Function mapping shunting gear (as CV131)	0-29	4
133	Function mapping deceleration off (as CV131)	0-29	9
134	Decision threshold for asymmetry 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 higher 6 on demand. (see CV27)	0-15	6
135	Multiplication speed check back signal 0 = deactivated	0-255	0

CV	Name and definition	Range	Standard																																				
136	Division speed check back signal 0 = /1, 1 = /2, 2 = /4, 3 = /8, 4 = /16, 5 = /32, 6 = /64	0-6	0																																				
137	Settings <table><thead><tr><th>Bit</th><th>Function</th><th>Value</th></tr></thead><tbody><tr><td>0.....</td><td>Unamplified function outputs instead of ZCLK and ZDAT *)</td><td>1</td></tr><tr><td>1.....</td><td>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 starting delay *).....</td><td>8</td></tr><tr><td>4.....</td><td>Activate extended function mapping *).....</td><td>16</td></tr><tr><td colspan="3">(see CV131 and CV137/Bit 5)</td></tr><tr><td>5.....</td><td>0 = AUX3 and AUX4 on ZCLK and ZDAT *).....</td><td>32</td></tr><tr><td></td><td>1 = AUX5 and AUX6 on ZCLK and ZDAT *)</td><td></td></tr><tr><td colspan="3">(Only valid if CV137/Bit 0=1)</td></tr><tr><td>6.....</td><td>Adopt function interchanges (CV401ff.) for SUSI F1-F12.....</td><td>64</td></tr><tr><td colspan="3">*) (not relevant to PD*)</td></tr></tbody></table>	Bit	Function	Value	0.....	Unamplified function outputs instead of ZCLK and ZDAT *)	1	1.....	Switch off energy saving mode.....	2	2.....	Invert SUSI driving direction *).....	4	3.....	Switch off SUSI starting delay *).....	8	4.....	Activate extended function mapping *).....	16	(see CV131 and CV137/Bit 5)			5.....	0 = AUX3 and AUX4 on ZCLK and ZDAT *).....	32		1 = AUX5 and AUX6 on ZCLK and ZDAT *)		(Only valid if CV137/Bit 0=1)			6.....	Adopt function interchanges (CV401ff.) for SUSI F1-F12.....	64	*) (not relevant to PD*)			0-127	0
Bit	Function	Value																																					
0.....	Unamplified function outputs instead of ZCLK and ZDAT *)	1																																					
1.....	Switch off energy saving mode.....	2																																					
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5.....	0 = AUX3 and AUX4 on ZCLK and ZDAT *).....	32																																					
	1 = AUX5 and AUX6 on ZCLK and ZDAT *)																																						
(Only valid if CV137/Bit 0=1)																																							
6.....	Adopt function interchanges (CV401ff.) for SUSI F1-F12.....	64																																					
) (not relevant to PD)																																							
138	Timer for approach (not relevant to PD*) Each 100 ms, 0 = no driving away	0-250	0																																				
139	Timer for waiting (not relevant to PD*) Each 100 ms, 0 = no waiting	0-250	0																																				
140	Timer for driving away (not relevant to PD*) Each 100 ms, 0 = no driving away	0-250	0																																				
141	Speed step for approach (not relevant to PD*)	0-127	12																																				
142	Speed step for driving away (not relevant to PD*)	0-127	12																																				

CV	Name and definition	Range	Standard
143	Settings (not relevant to PD*) Bit Function Value 6.....Deactivate coupling process and timer64 7.....Coupling process only in shunting gear.....128	0-255	0
144	Settings Bit Function Value 0.....Dynamic channel usage1 1.....Immediate starting after current interruption2 2.....Special bit for lighting in analog operation.....4 3.....Brake section output to "GPIO"8 (only relevant for DH21A/DH21B/DH22A/DH22B/DH24A/FH22A) 4.....Brake with "GPIO"16 (only relevant for DH21A/DH21B/DH22A/DH22B/DH24A/FH22A) 5.....Deactivate temporary data storage32	0-63	0

CV	Name and definition	Range	Standard
145	Conditions for LV Function (not relevant to PD*) 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
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

CV	Name and definition						Range	Standard
153	Initial mapping (not relevant to PD*)						0-255	0
	Bit	Function	Value	Bit	Function	Value		
	0.....	LV.....	1	4.....	AUX3	16		
	1.....	LR	2	5.....	AUX4	32		
	2.....	AUX1	4	6.....	AUX5	64		
	3.....	AUX2	8	7.....	AUX6.....	128		
	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.							
154	Brake ramp forward and backward (see CV27, not relevant to PD05A/PD06A)						0-255	0
	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							
155	Brake ramp backward (see CV154)						0-255	0
	0 = value from CV154 is used, allows different brake times forward and backward							
156	Dimming mask for low beam light (see CV53)						0-255	3
	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		
157	Conditions for low beam light (see CV145)						0-161	0
158	Conditions for AUX7 (see CV145) (only relevant for DH21B/DH22B/DH24A)						0-161	0

CV	Name and definition	Range	Standard
159	Conditions for AUX8 (see CV158)	0-161	0
260	Manufacturer indentification (read only) 97 = Doehler & Haass (Decoder reset with "101")		
261	Decoder number (read only) DH05C=52, DH10C=102, DH12A=120, DH14B=141, DH16A=160, DH18A=180, DH21A=200, DH21B=201, DH22A=202, DH22B=203, DH24A=204, DHSP10A=110, FH05B=41, FH16A=150, FH18A=170, FH22A=192, PD05A=131, PD06A=132, PD12A=130, PD18A=134, PD21A=133 Complete table see: www.doehler-haass.de/ „Häufige Fragen“ (only in German)		
262	Version number (read only)		
263	Date (read only)		
264	Revision number (read only)		
265	Date (read only)		
401	Function interchange F1 (not relevant to PD*) 0 = deactivated, 1 ... 28 = F1 ... F28, 29 = F0 (light)	0-29	1
402	Function interchange F2 (as CV401)	0-29	2
403	Function interchange F3 (as CV401)	0-29	3
404	Function interchange F4 (as CV401)	0-29	4
405	Function interchange F5 (as CV401)	0-29	5
406	Function interchange F6 (as CV401)	0-29	6
407	Function interchange F7 (as CV401)	0-29	7
408	Function interchange F8 (as CV401)	0-29	8

CV	Name and definition	Range	Standard
409	Function interchange F9 (as CV401)	0-29	9
410	Function interchange F10 (as CV401)	0-29	10
411	Function interchange F11 (as CV401)	0-29	11
412	Function interchange F12 (as CV401)	0-29	12
461	Dimming AUX3 (not relevant for PD*) 0 = dark ... 31 = full brightness (Not every AUX can be dimmed independently on every decoder)	0-31	31
463	Dimming AUX4 (as CV461)	0-31	31
465	Dimming AUX5 (as CV461)	0-31	31
467	Dimming AUX6 (as CV461)	0-31	31

12.3 Operation

Put the locomotive on the programming track and readout the locomotive address (CV01). The default value should be 3. Program the desired locomotive address and start running the locomotive keeping these setting 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:

Operation with asymmetry in the brake section is not possible with the factory settings.

In case you want this option, CV27 / bit 0 and/or bit 1 must be set to "1".

Brake section operation in direct current operating mode is not possible with the factory settings.

In case you want this option, CV27 / bit 4 and/or bit 5 must be set to "1".

13 Operationsform Märklin-Motorola (MM)

13.1 Functions

Addresses.....	1-255
Speed steps.....	14, 28
Speed steps (internal).....	127
Front light/rear light (dimmable).....	yes
Functions total (only MM2).....	28 (can be switched on with locomotive address + 1 ff.)
Operation with MM brake section.....	yes

Instructions for "Function Mapping" by default see: Doehler & Haass website:

<https://doehler-haass.de/cms/pages/haeufige-fragen.php>

Wie sieht das standardmäßige „Function Mapping“ aus? (only in German)

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

Conversely, activating the long DCC address with CV29/Bit5 means that the decoder can only be operated with DCC. Then MM operation is no longer possible and MM programming is also disabled. Attention, because "Lock out" is possible.

13.2 Programming with Märklin central unit 6020/6021

- 1 **,Short'** programming allows entering figures between 0 and 79, i.e. in short mode just setup parameters with values from < 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 must be divided and entered in two steps.
- 3 Programming of SUSI parameters Programming of SUSI parameters.

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 to 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 plug of the transformer). Push STOP button for disconnecting the track power.
- Enter the current decoder address. If you don't 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 one 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 CV values 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 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 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

You gain the SUSI mode by writing value 09 in CV09 in short mode.

The decoder confirms that by slow flashing.

Enter CVs respective the related values as in long mode and reduce all CVs about 900.

Thus changes CV903 to 003 for example.

Notice please that you are operating in SUSI mode, which is programmed according to the long mode.

Notice:

It is easier to do the programming under DCC.

Thus programmed values are also valid for MM format.

14 System format SelectRIX 2 (SX2)

14.1 Functions

Speed steps.....	127
Speed steps (internal).....	127
Front light/rear light (dimnable).....	yes
Functions total	32
Operation with brake diodes	yes
Programming On The Main	yes

14.2 Setting options

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

Information on the standard „Function Mapping“ can be found on the Doehler & Haass website:

<https://doehler-haass.de/cms/pages/haeufige-fragen.php>

Wie sieht das standardmäßige „Function Mapping“ aus? (only in German)

14.2.1 List of supported parameters

The abbreviation **FH*** refers to the decoder types **FH05B, FH16A, FH18A** and **FH22A**.

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	0-255	3
012	Deceleration time The value corresponds to the time in seconds from the maximum speed to stop	0-255	3
013	Regulatory reference Counter-EMF (see supplement 2) The reference value for controlling the back EMF of the motor at the highest speed level is set ("0" corresponds to approx. 1.2V, "127" corresponds to approx. 10V back EMF), for shunting gear see par018	0-127	92
014	Offset for setpoint counter-EMF at speed level 1 This can be used to specify a higher speed for speed level 1	0-15	0
015	Slow approach speed step (see par091) Only with suitable brake modules (par091 Bits 0 und 1)	0-127	63
016	Start delay speed step 1 (see par021) Depending on whether shuttle mode is active (par021 bits 2 and 3), an additional waiting time is set before the decoder starts moving (100 ms each) (see par095) or the dwell time before the decoder changes direction (1 s each) and the dwell time before the decoder starts moving again (0.5 s each).	0-250	0
017	Speed reduction analog (not relevant to FH*/PD05A) 0 = small reduction ... 31 = strong reduction	0-127	15
018	Shunting gear Control reference Counter EMF (as par013) The reference value for controlling the back EMF of the motor at the highest speed level in shunting gear is set ("0" corresponds to approx. 1.2V, "127" corresponds to approx. 10V back EMF), see par013	0-127	63

par	Name and definition	Range	Standard
019	Shunting gear delay time (as par011)	0-255	1
021	Setting Bit.....FunctionWert 0 0 = single-section SX brake sections..... 1 1 = two-section SX brake sections (see par055) Only for SX brake diode (par091 bits 6 and 7) 1 Minimum speed level for brake ramp active (see par055) 2 2:3 Shuttle mode deactivated 0 Shuttle mode without intermediate stop (see par016)..... 4 (Stop leads to reversal of direction, slow speed to slow speed) Shuttle mode with manual intermediate stop (see par016) 8 (Stop leads to hold until canceled, slow speed to reversal of direction) Shuttle mode with automatic intermediate stops (see par016) 12 (Stop leads to stop with restart, slow speed to reversal of direction) Only with suitable asymmetry brake modules (par091 bits 0 and 1)	0-15	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
026	Switch off function for AUX1 Bit 0 = F1 ... Bit 7 = F8	0-255	0

par	Name and definition	Range	Standard	
027	Switch off function for AUX2 Bit 0 = F1 ... Bit 7 = F8	0-255	0	
028	Analog mode F1-F8	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 F0, F9-F12	0-63	3	
	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			
031	Interchange of track connections 0 = normal, 1 = interchanged	0, 1	0	
032	Interchange of motor connections 0 = normal, 1 = interchanged	(not relevant to FH*) 0, 1	0	
033	Interchange of light connections 0 = normal, 1 = interchanged	0, 1	0	

par	Name and definition	Range	Standard
043	Settings	0-63	0
	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	
	(only relevant to DH21A/DH21B/DH22A/DH22B/DH24A/FH22A)		
	4..... Brake with "GPIO" (1 = driving, 0 = braking)	16	
	(only relevant to DH21A/DH21B/DH22A/DH22B/DH24A/FH22A)		
	5..... Deactivate temporary data storage	32	
045	Function mapping AUX7 (only relevant to DH21B/DH22B, DH24A) 0 = deactivated, 1 ... 28 = F1 ... F28, 29 = F0 (light)	0-29	10
046	Conditions for AUX7 (see par161) (Only relevant to DH21B/DH22B, DH24A)	0-161	0
047	Function mapping AUX8 (as par045)	0-29	11
048	Conditions for AUX8 (see par046)	0-161	0
051	Characteristic curve for back EMF (see supplement 2) Deflection of the characteristic curve, 0 = linear ... 7 = strongly curved	0-7	5
052	Control variant (not relevant to FH*) 0 = defined by par056 ff, 1 = hard, 2 = soft, 3 = very soft	0-3	2
053	Impulse width (not relevant to FH*) 0 = 1 ms, 1 = 2 ms, 2 = 4 ms, 3 = 8 ms	0-3	1

par	Name and definition	Range	Standard
054	Motor frequency (not relevant to FH*) 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	Travel speed in braking sections (see par021) Depending on whether the braking ramp is active (par021 bit 1) the following is set: the maximum drive stage in two-part SX braking sections (see par091 bits 6 and 7 and par021 bit 0) or the minimum drive stage at which the braking ramp becomes active (see par096/par097)	0-127	12
056	Motor control proportional (not relevant to FH*) 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
061	Function mapping F0(f) (see supplement 1)	0-255	1
062	Function mapping F0(r) (see supplement 1)	0-255	2
063	Function mapping F1(f+r) (see supplement 1) If par063 is written, par075 will be set to the same value	0-255	4
064	Function mapping F2(f+r) (see supplement 1) If par064 is written, par085 will be set to the same value	0-255	8
065	Function mapping F3 (see supplement 1)	0-255	16

par	Name and definition	Range	Standard
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
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

par	Name and definition	Range	Standard
082	Dimming low beam light 0 = dark ... 31 = full brightness (see par089)	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) In case par085 should have a different value than par064, you must set par064 first and then par085 (see supplement 1)	0-255	8
086	Function mapping LV+LR on / AUX1+AUX2 off Bit 0 = F1 ... Bit 7 = F8 Only with F0 (light) on	0-255	0
087	Function mapping AUX1+AUX2 on / LV+LR off Bit 0 = F1 ... Bit 7 = F8 Only with F0 (light) off	0-255	0

par	Name and definition				Range	Standard		
088	Settings				0-127	0		
	Bit	Function	Value					
	0	Unamplified function outputs instead of ZCLK and ZDAT *)	1					
	(Enabled by default on DH18A / FH18A)							
	1	Switch off energy saving mode	2					
	2	Invert SUSI driving direction *)	4					
	3	Switch off SUSI starting delay *)	8					
	4	Activate extended function mapping *)	16					
	5	0 = AUX3 and AUX4 on ZCLK and ZDAT *)	32					
	1 = AUX5 and AUX6 on ZCLK and ZDAT *)							
(Not applicable to PD/DH21B/DH22B/DH24A)								
6	Adopt function interchanges (par401ff.) for SUSI F1-F12		64					
*) not relevant to PD05A / PD06A								
089	Dimming mask for low beam light (see par082)				0-15	3		
	Bit	Function	Value	Bit			Function	Value
	0	LV	1	4			AUX3	6
	1	LR	2	5			AUX4	32
	2	AUX1	4	6			AUX5	64
	3	AUX2	8	7			AUX6	128
091	Brake settings				0-243	64		
	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

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
095	Function mapping starting delay (see par016) Bit 0 = F1 ... Bit 7 = F8	0-255	0
096	Brake ramp forward and backward (see par091, not relevant to PD05A/PD06A) 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 par096 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")		

par	Name and definition	Range	Standard
102	Decoder number (read only) DH05C=52, DH10C=102, DH12A=120, DH14B=141, DH16A=160, DH18A=180, DH21A=200, DH21B=201, DH22A=202, DH22B=203, DH24A=204, DHSP10A=110, FH05B=41, FH16A=150, FH18A=170, FH22A=192, PD05A=131, PD06A=132, PD12A=130, PD18A=134, PD21A=133 Complete table see: www.doehler-haass.de/ „Häufige Fragen“ (only in German)		
103	Version number (read only)		
104	Date (read only)		
105	Revision number (read only)		
106	Date (read only)		
141	Switch-off function for AUX3 Bit 0 = F1 ... Bit 7 = F8	0-255	0
142	Switch off function for AUX4 Bit 0 = F1 ... Bit 7 = F8	0-255	0
143	Switch off function for AUX5 Bit 0 = F1 ... Bit 7 = F8	0-255	0
144	Switch off function for AUX6 Bit 0 = F1 ... Bit 7 = F8	0-255	0
145	Timer for switch off AUX5 Each 100 ms, 0 = deactivated	0-250	0
146	Timer for switch off AUX6 Each 100 ms, 0 = deactivated	0-250	0

par	Name and definition	Range	Standard
147	Function mapping low beam light (not relevant to PD05A/PD06A) 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 (not relevant to PD05A/PD06A) Each 100 ms, 0 = no approach	0-250	0
152	Timer for waiting (not relevant to PD05A/PD06A) Each 100 ms, 0 = no waiting	0-250	0
153	Timer für driving away (not relevant to PD05A/PD06A) Each 100 ms, 0 = no driving away	0-250	0
154	Speed steps for approach (not relevant to PD05A/PD06A)	0-127	12
155	Speed steps for driving away (not relevant to PD05A/PD06A)	0-127	12
156	Settings (not relevant to PD05A/PD06A) Bit Function		

par	Name and definition	Range	Standard
161	Conditions for LV Function (not relevant to PD05A/PD06A) 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
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)	0-250	0
167	Conditions for AUX5 (see par161)	0-127	0
168	Conditions for AUX6 (see par161)	0-127	0

par	Name and definition						Range	Standard
169	Initial mapping (not relevant to PD05A/PD06A)						0-255	0
	Bit	Function	Value	Bit	Function	Value		
	0.....	LV	1	4.....	AUX3.....	16		
	1.....	LR.....	2	5.....	AUX4.....	32		
	2.....	AUX1	4	6.....	AUX5.....	64		
	3.....	AUX2	8	7.....	AUX6.....	128		
	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.							
401	Function interchange F1 0 = deactivated, 1 ... 28 = F1 ... F28, 29 = F0 (light)						0-29	1
402	Function interchange F2 (as par401)						0-29	2
403	Function interchange F3 (as par401)						0-29	3
404	Function interchange F4 (as par401)						0-29	4
405	Function interchange F5 (as par401)						0-29	5
406	Function interchange F6 (as par401)						0-29	6
407	Function interchange F7 (as par401)						0-29	7
408	Function interchange F8 (as par401)						0-29	8
409	Function interchange F9 (as par401)						0-29	9
410	Function interchange F10 (as par401)						0-29	10
411	Function interchange F11 (as par401)						0-29	11
412	Function interchange F12 (as par401)						0-29	12

par	Name and definition	Range	Standard
461	Dimming AUX3 (not relevant for PD*) 0 = dunkel ... 31 = volle Helligkeit (Nicht jeder AUX ist bei jedem Decoder unabhängig dimmbar)	0-31	31
463	Dimming AUX4 (as par461)	0-31	31
465	Dimming AUX5 (as par461)	0-31	31
467	Dimming AUX6 (as par461)	0-31	31

14.3 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!**

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 simultaneously 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 | par066.

Notice:

If CV137 | par088 Bit4 is not active (normal mapping):
Value 128 operates the shunting gear, value 64 operates the low beam.
AUX6 and AUX5 are not usable in this case and CV132-134 | par147-149 have no meaning.

If CV137 | par088 bit4 is active (extended mapping):
Value 128 operates AUX6, value 64 operates AUX5.
The shunting mode is controlled by CV132 | par147, the low beam is controlled by CV133 | par148.
With CV133 | par149 the delays (CV03, 04 | par011, 012) can be switched off.

Timer function

Value = 0

The timer is switched off (continuous function)

Value = 1...250

The timer is activated, the corresponding output will be disconnected after the time of:
entered value x 0.1 [sec].

Switch off function (CV113-116, CV125-128, par024-027, par141-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

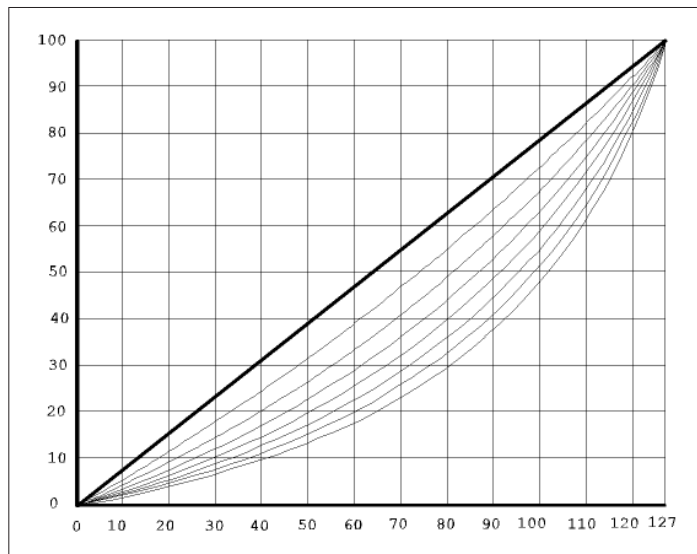
F3 Switches the rear ligh off

CV	par	Function	RG/ AUX6	ABL/ AUX5	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		

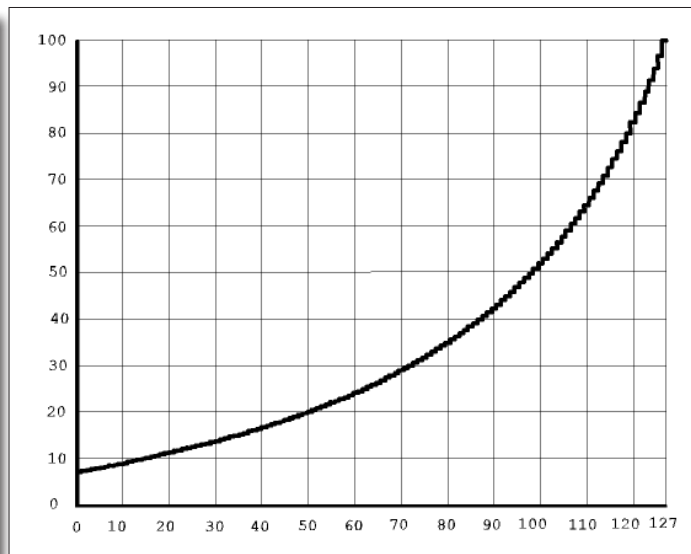
LV Front light white | **LR** Rear light white | **AUX1** Front light red | **AUX2** Rear light red

Supplement 2: Speed characteristics



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

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



Maximum speed characteristic
(see CV05 / par013)
in shunting gear
(see CV61 / par018)

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

Supplement 3: Unamplified function outputs

As in case the unamplified function outputs (logic level 0 V - 5 V, max. 20 mA) cannot switch higher 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).

The SUSI connectors ZCLK and ZDAT can, if available, alternatively always be used as unamplified function outputs:

Explanation for CV137 par088	Bit 5	Bit 4	Bit 0	Value
Activation SUSI interface without extended mapping	0 (or 1)	0	0	0 (or 32)
Activation SUSI interface with extended mapping*	0 (or 1)	1	0	16 (or 48)
ZCLK and ZDAT as unamplified outputs AUX3 and AUX 4 without extended mapping	0	0	1	1
ZCLK and ZDAT as unamplified outputs AUX3 and AUX 4 with extended mapping*	0	1	1	17
ZCLK and ZDAT as unamplified outputs AUX5 and AUX 6 with extended mapping*	1	1	1	49
Deactivation of SUSI interface without extended mapping	1	0	1	33

* See supplement 1

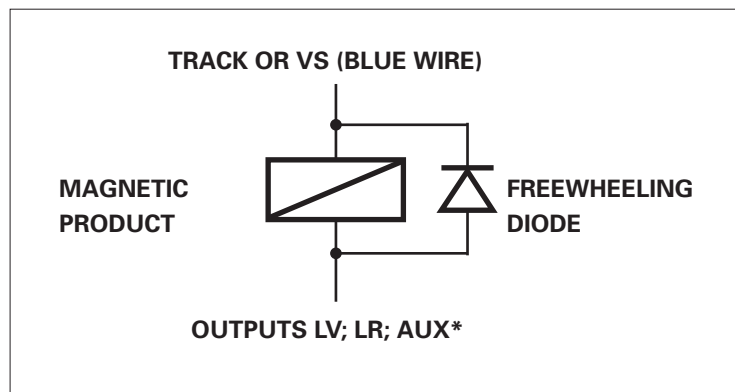
Please note that it does not matter here whether the decoder also offers these function outputs on other solder pads or interfaces! The additional activation of the connectors ZCLK and ZDAT does not change anything on these solder pads or interfaces. If a decoder offers for example AUX3 and AUX4 amplified on corresponding solder pads resp. interfaces, these outputs are additionally available unamplified at the connections ZCLK and ZDAT, if CV137 | par088 is set accordingly.

Supplement 4: Electric coupling / Freewheeling diode

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

When switching 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 automatic coupling procedure.

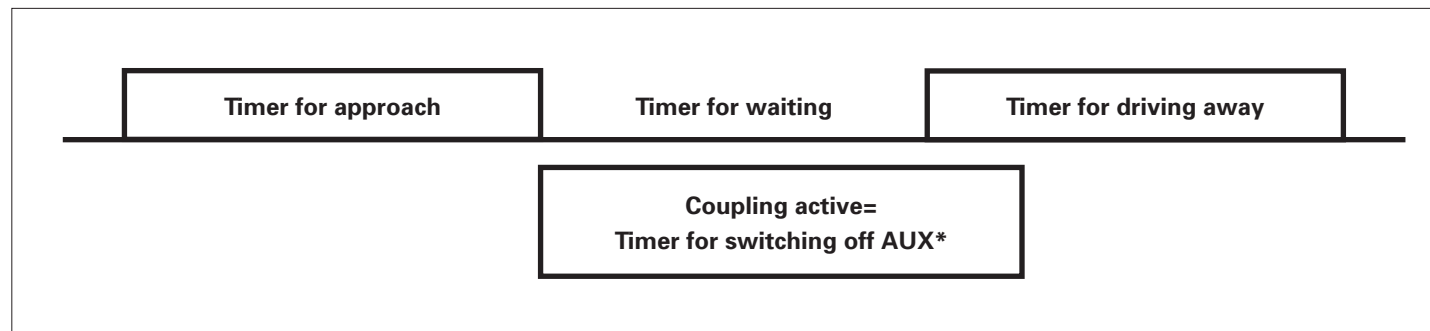
Automatic coupling procedure ("coupling waltz")

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

Supplement 5: Constant braking distance

Function of the “braking ramp”

Set the desired braking method in CV27 / par91. Set in CV48 / par051 the linear characteristic (value = 0).

Make sure that CV154 / par096 contains the value 0. Before proceeding, please check if the model reaches a reasonable top speed with the highest speed step. If it is slower, please increase the value in CV05 / par013. If it is faster, please reduce the value in CV05 / par013.

Note the current value from CV04 / par012. Let the model enter the braking section with the highest speed step. If the model stops too early, please increase the value in CV04 / par012. If the model stops too late (drives through), please reduce the value in CV04 / par012. Repeat the entry into the braking section until the most suitable value for CV04 / par012 is found.

Now set the determined value for CV04 / par012 multiplied by 8 in CV154 / par096.

If you want a fine tuning, you can vary the value in CV154 / par096 in the range of -7 to +7.

Reset CV04 / par012 to the noted value.

The decoder now automatically calculates the necessary “braking ramp” for all other speed steps when entering the braking section.

For pushed reversing trains etc. a separate value for reverse direction is available with CV155 / par097. If CV155 / par097 contains the value “0”, CV154 / par096 is valid for both driving directions. If CV155 / par097 contains a value higher than “0”, CV154 / par096 is only valid for forward direction.

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.

Supplement 7: Speed feedback

The decoders are able to report their current speed in km/h to the digital system by means of bidirectional communication (RailCom®). For this purpose, it is necessary to enter the measured model speed at the highest speed step in km/h (determined, for example, by measuring cars, the time span between two track points of known distance, etc.) into CV135 and CV136.

The formula for this is:
$$\text{Speed} = \frac{\text{speed step} \times \text{CV135}}{2 \text{ CV136}}$$

Here are some exemplary values:

km/h	CV135	CV136
none	0	no matter
5	3	6
10	5	6
15	8	6
20	10	6
25	13	6
30	15	6
35	18	6
40	20	6
45	23	6
50	25	6
60	30	6
70	35	6
80	40	6
90	45	6

km/h	CV135	CV136
100	50	6
110	55	6
120	60	6
130	66	6
140	71	6
160	81	6
150	76	6
170	86	6
180	91	6
190	96	6
200	101	6
210	106	6
220	111	6
230	116	6
240	121	6

Supplement 8: Charging circuit

Depending on the installation situation, we recommend our energy storage unit SP05A or our storage circuit SP16A. Please observe the setting instructions in the description of the respective product.

You must also observe the setting instructions for self-built storage circuits.

Operation with D&H decoder without sound

When operating with a D&H decoder without sound, CV137 = 2 must be set if the light is to remain switched on in the de-energised section.

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Dieses Produkt darf am Ende seiner Nutzungsdauer nicht über den normalen Hausmüll entsorgt werden. Bitte benutzen Sie die Entsorgungsstelle Ihrer Gemeinde.

This product must not be disposed off with normal household waste at the end of its useful life. Please use the disposal point in your municipality.

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.

WEEE-Reg.-Nr.: DE 28016265



Achtung: Nicht für Kinder unter 36 Monaten geeignet wegen verschluckbarer Kleinteile, Erstickungsgefahr.

Caution: Not suitable for children under 36 months due to small parts which may be swallowed, choking hazard.

Attention : ne convient pas aux enfants de moins de 36 mois en raison de petites pièces pouvant être avalées, risque d'étouffement.



Company Stamp

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