Multi-Decoder MD-2

8-fold Servo Decoder and
4-fold Turnout Decoder

MM   DCC

Manual

Item numbers
43-03126
43-03127
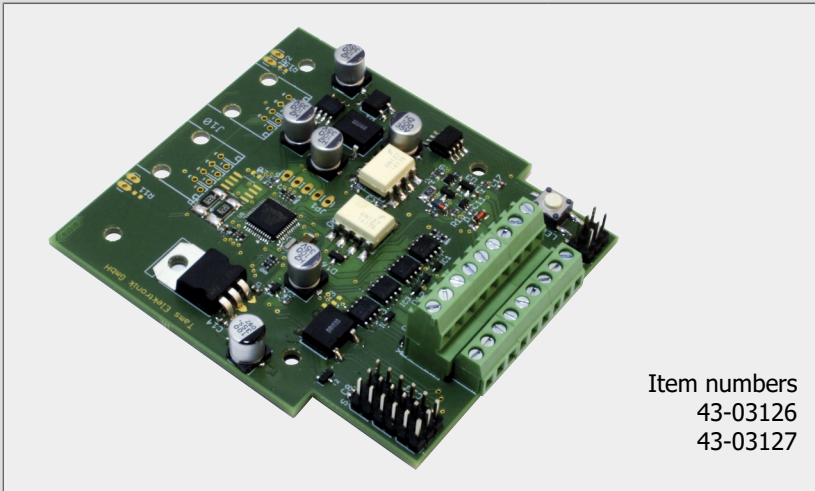
tams elektronik

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Printing the manual

The formatting is optimised for double-sided printing. The standard page size is DIN A5. If you prefer a larger display, printing on DIN A4 is recommended.

Notes on RailCom®

RailCom® is a German trademark registered in the name of Lenz Elektronik for class 9 "Electronic Controls" under number 301 16 303 and a trademark registered for classes 21, 23, 26, 36 and 38 "Electronic Controls for Model Railways" in U.S.A. under Reg.No. 2,746,080. To enhance the readability of the text, we have refrained from referring to the term each time it is used.

Contents

1. Getting started

The instructions will help you step by step with the safe and proper installation and use of your decoder. Before you start to put the decoder into operation, read this manual completely, especially the safety instructions and the section on possible errors and their elimination. You will then know what you have to pay attention to and thus avoid errors that sometimes can only be rectified with a lot of effort.

Keep the instructions in a safe place so that you can restore functionality later in the event of any malfunctions. If you pass the decoder on to another person, also give the instructions with it.

1.1. Contents of the package

- 1 ready-built and tested circuit board MD-2 (item no. 43-03116-01) or
  1 Multi-Decoder MD-2 in housing (item no. 43-03117-01)

1.2. Accessories

Connection cables

The use of stranded wire is recommended for making the connections. Stranded wires consist of several thin individual wires and are therefore more flexible than rigid wires with the same copper cross-section. Recommended cross-sections:

- connections of LEDs and push-buttons: $\geq$ 0.04 mm²
- all other connections: $\geq$ 0.25 mm²

Use of turnouts with motor drive

When using turnouts with motor drive you need an adapter AMW-2 (item-no. 72-00086).

1.3. Intended use

The decoder is intended for use in model construction, especially in model railway layouts, according to the specifications in the manual. Any other use is not in accordance with the intended use and will result in the loss of the warranty claim. Intended use also includes reading, understanding and following all parts of the instructions. The decoder is not intended to be used by children under the age of 14.

1.4. Safety instructions

> **⚠ Note:**
> The decoder contains integrated circuits (ICs). These are sensitive to electrostatic charging. Therefore, do not touch these components until you have "discharged" yourself. For this purpose, e.g. a grip on a radiator is sufficient.

Improper use and non-observance of the instructions can lead to incalculable hazards. Prevent these dangers by carrying out the following measures:

- Only use the decoder in closed, clean and dry rooms. Avoid moisture and splash water in the environment. After condensation has formed, wait two hours for acclimatisation before use.
- Disconnect the decoder from the power supply before carrying out wiring work.
- Supply the decoder only with extra-low voltage as specified in the technical data. Use only tested and approved transformers.
- Only plug the mains plugs of transformers into properly installed and fused earthed sockets.
- When making electrical connections, ensure that the cable cross-section is sufficient.
- Heating of the decoder during operation is normal and harmless.
- Do not expose the decoder to high ambient temperatures or direct sunlight. Observe the information on the maximum operating temperature in the technical data.
- Regularly check the operational safety of the decoder, e.g. for damage to the connection cables.
- If you notice damage or if malfunctions occur, disconnect the connection to the power supply immediately. Send the decoder in for inspection.

2. Operation overview

The MD-2 is a stationary decoder that controls up to 8 servos, e.g. for operating turnouts, semaphore signals, barriers or gates.

In addition, the decoder has eight connections which are used in operating mode 2 as inputs for push buttons to manually trigger the servo movements or in operating mode 1 as outputs for connecting solenoid accessories or other accessories.

Operating mode 1:

8-fold servo decoder

+ turnout- and/or switching decoder

Connecting area 1 (Pin headers)	8 servos (8-fold servo decoder)

Connecting area 2 (Terminal blocks)	4 solenoid accessories with twin coil drive (4-fold turnout decoder), e.g.
	
	     turnouts with twin coil drive (with or without limit switching)
	     semaphore signals with twin coil drive
	     decouplers
	
	or 8 other accessories (8-fold switching decoder)
	
	     2-term light signals between which switching takes place,
	     lights that are switched on and off
	
	or 4 motor driven turnouts (with an additional AMW-2 adapter per turnout)
	
	or combination of solenoid accessories and other accessories

Operating mode 2:

8-fold servo decoder
with push-buttons
for manual activation

Servo 1...6

Connecting Area 2

Servo 7...8

Connecting
Area 1

Connecting
Area 1
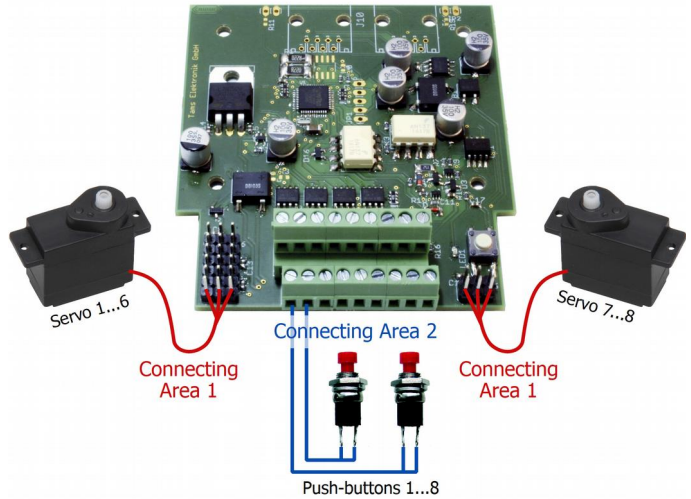
Push-buttons 1...8

Connecting area 1 (Pin headers)	8 servos[*1] (8-fold servo decoder)
Connecting area 2 (Terminal blocks)	8 push-buttons for toggling between the servos´ two end positions (as well suitable for purely analogue operation)

2.1. Movement curves

You can set separately for each of the 8 servos:

- Starting and end position
- Rotational speed
- Simple linear motion curve or linear motion curve with bobbing when reaching the end position

	Simple linear motion curve with constant velocity. It is not possible to break the motion sequence before the end position has been reached. When reaching an end position the motion sequence is stopped automatically.
	Linear motion with bobbing at the end positions (typical motion sequence of semaphore signals and railroad crossing gates). The bobbing motion has to be set separately for each direction of motion.

2.2. Programming and control

Driving the decoder via accessory decoder commands

Turnouts, servos or other accessories are operated via accessory decoder commands in DCC or Motorola format, sent from the control unit to the turnout addresses:

- operating mode 1: 12 turnout addresses
- operating mode 2: 8 turnout addresses

The decoder automatically recognizes the commands´data format. It is possible to switch the outputs via mixed DCC and Motorola commands as well as to operate one output alternately in DCC and Motorola format.

Use in analogue mode

When operating mode 2 is set (for connection of buttons in connecting area 2) the servos can be controlled either by turnout commands or by the connected buttons. This means that the MD-2 can also be used in pure analogue operation.

Programming

Using a DCC central unit, the decoder address and the decoder´s features can be defined by programming the configuration variables (CV). It is also possible to set the address by using a push-button switch.

When using a Motorola central unit the address has to be set with a push-button switch. Changing the other decoder´s features is not possible in layouts run in Motorola format only.

2.3. Feedback via RailCom (according to RCN-217)

The Multi-Decoder MD-2 is RailCom compatible, i.e. the decoder is able to pass the RailCom messages via the rails to special RailCom detectors. After a switching or setting command to its address the decoder sends:

- status message, e.g. "turnout is set right", "turnout has been switched" or "turnout still has to be switched" and / or
- time message, e.g. "another 2 seconds are required to carry out the switching or setting command" and/or
- error message, e.g. "turnout cannot be switched"

and, by this, confirms the recepton of the command.

2.4. Overload protection

In case the maximum current at one of the outputs or the total maximum current of one ot the two connecting areas has been exceeded, the decoder automatically switches off. Then, you have to switch the decoder currentless, to eliminate the overload and to switch on the decoder again.

> ⚠️ **Caution:**
>
> When connecting an in- or output to a live wire (e.g. to the power supply), a very high current occurs suddenly. In this case, the overload protection is ineffective, the decoder can be damaged irreparably.

2.5. Power supply

The Multi-Decoder MD-2 and the connected servos and other consumers can be supplied

- either with digital voltage from the booster circuit, i.e. via the integrated booster of the digital central unit or a separate booster,
- or via its own transformer to relieve the digital circuit.

3. Connections

Make the connections one after the other to:

- servos (connecting area 1)
- push-buttons (connecting area 2, operating mode 2) **or**
- turnouts, other solenoid accessories and/or other accessories (connecting area 2, operating mode 1)
- central unit
- power supply

	Operating mode 1	**Operating mode 2**
Connecting area 1 (Pin headers)	8 servos (8-fold servo decoder)	8 servos (8-fold servo decoder)
Connecting area 2 (Terminal blocks)	4 solenoid accessories (4-fold turnout decoder) **or** 8 other accessories (8-fold switching decoder) **or** combination of turnouts and other accessories	8 push-buttons for toggling between the servos´ two end positions (suitable for purely analogue operation)

3.1. Connecting servos

The connecting area 1 with pin headers onto which you plug the connection sockets of a maximum of 8 servos directly. If you need to extend the connecting cables of servos, you should use 3-pole pin and socket connectors RM 2.54 mm (e.g. item no. 85-11103-10 or 85-11203-10).
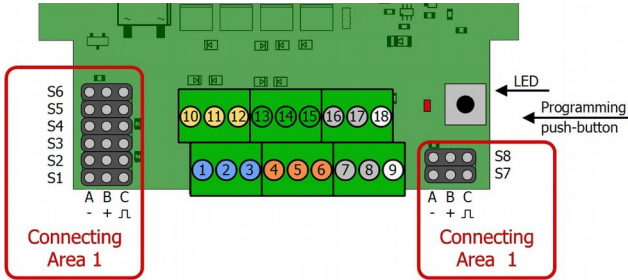
		A	**B**	**C**
S1	servo 1	GND (-)	VCC (+)	signal ⊓⌐
S2	servo 2	GND (-)	VCC (+)	signal ⊓⌐
...	...	...	...	...
S8	servo 8	GND (-)	VCC (+)	signal ⊓⌐

⚠ **Caution:** The maximum current for connecting area 1 as well as the maximum current per servo connection is 1,000 mA (see section 4. "Technical specifications"). With a too high current consumption of the connected accessories the decoder switches off automatically.

INFO: Servo connections

Connection	**Short term**	**Identification symbol**	**Colour of connecting wire** (deviations possible)
Voltage supply	"GND"	-	black or brown
	"VCC"	+	red
Impulse (signal)	"PW"	⊓⌐	white or orange

Tip: If the servo's connection socket is plugged onto the pin header the wrong way round, the servo will not be damaged during commissioning.

If the servo does not respond to keystrokes or digital switching commands, you can easily plug the socket in the other way round and thus test whether a connection socket plugged in the wrong way round is the cause of the malfunction.

3.2. Connecting push-buttons (→ Operating mode 2)

The connecting area 2 is equipped with terminals into which you plug and screw the connecting cables of the push-buttons.
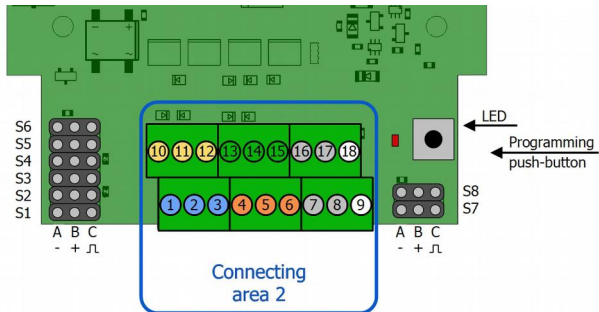
1 | 2	Push-button for servo 5
3 | 2	Push-button for servo 6
4 | 5	Push-button for servo 7
6 | 5	Push-button for servo 8
10 | 11	Push-button for servo 1
12 | 11	Push-button for servo 2
13 | 14	Push-button for servo 3
15 | 14	Push-button for servo 4

⚠ Caution: The push-buttons should be connected to the decoder only. A push-button connected to other components of the layout possibly causes a short-circuit and, as a consequence, irreparable damages at the connected items.

3.3. Connecting accessories (→ Operating mode 1)

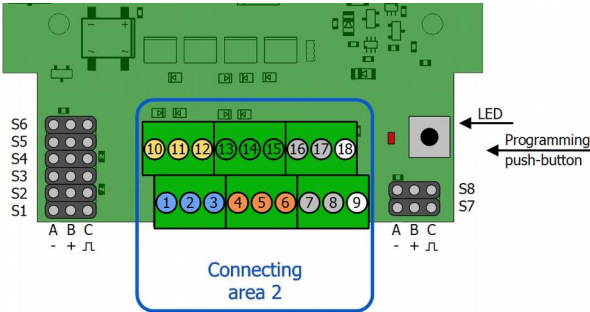The connecting area 2 is equipped with terminals into which you plug and screw the connecting cables of turnouts and other (solenoid) accessories. You can connect to each of the four output pairs either one solenoid accessory or two other accessories. A mixed use as turnout and switching decoder is possible.

⚠ Caution:

Be sure not to connect the in- and outputs by accident to a live wire. The extreme overload suddenly occurring can damage the decoder irreparably.

1	Output pair 1 (T1)	Solenoid accessory / turnout 1 or switching contact 1	Turnout 1 "diverging" (1r)
2		Return conductor for T(urnout)1	
3		Solenoid accessory / turnout 1 or switching contact 2	Turnout 1 "straight" (1g)
4	Output pair 3 (T3)	Solenoid accessory / turnout 3 or switching contact 5	Turnout 3 "diverging" (3r)
5		Return conductor for T(urnout)3	
6		Solenoid accessory / turnout 3 or switching contact 6	Turnout 3 "straight" (3g)
10	Output pair 2 (T2)	Solenoid accessory / turnout 2 or switching contact 3	Turnout 2 "diverging" (2r)
11		Return conductor for T(urnout)2	
12		Solenoid accessory / turnout 2 or switching contact 4	Turnout 2 "straight" (2g)
13	Output pair 4 (T4)	Solenoid accessory / turnout 4 or switching contact 7	Turnout 4 "diverging" (4r)
14		Return conductor for T(urnout)4	
15		Solenoid accessory / turnout 4 or switching contact 8	Turnout 4 "straight" (4g)

⚠ Caution: The maximum current for connecting area 2 as well as the maximum continuous current per output is 1,000 mA (see section 4. "Technical specifications"). With a too high current consumption of the connected accessories the decoder switches off automatically.
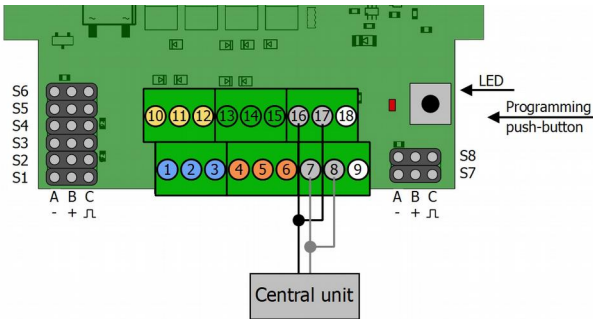
3.4. Connection to the power supply

You can supply the decoder and the connected servos and other consumers

- either with the digital voltage from the booster circuit, i.e. via the integrated booster of the digital central unit or a separate booster,
- or if you want to relieve the digital circuit, via your own transformer.

7	Power supply / transformer (~)	⚠ **Caution:**
8	Input DCC signal	If a component gets too hot, disconnect the decoder and the power supply from the mains **immediately**. Possible short circuit! Check the assembly!
9	not in use	
16	Power supply / transformer (~)	
17	Input DCC signal / central unit	
18	not in use	

Power supply via central unit

⚠ **Caution:**

Switch off the control unit before connecting the decoder.

Power supply via separate transformer
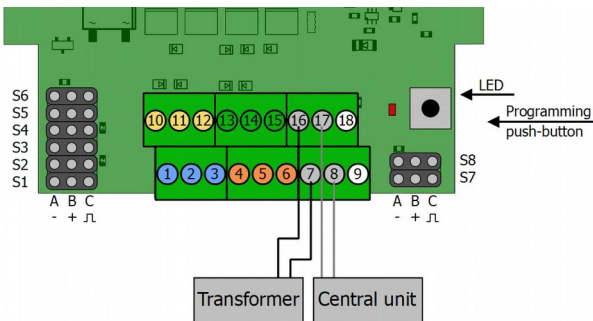
⚠ **Caution:**

When connecting several devices to the same voltage supply, generally all connections have to be polarised identically. Otherwise a short circuit will occur, possibly damaging connected devices.

3.5. Connection examples

Connecting twin coil driven turnouts

Example: Connection to terminal blocks 4 to 6 (connection pair 3 / turnout 3)
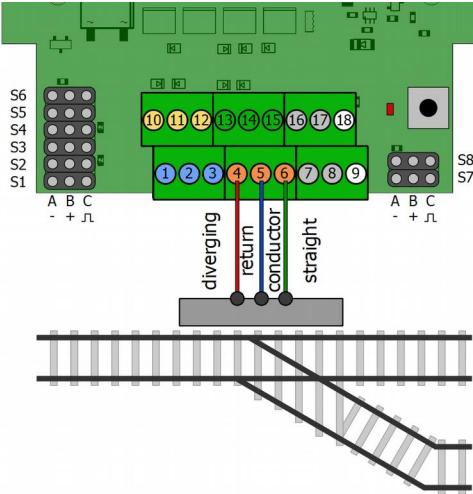
Connecting decouplers

Example: Connection to terminal blocks 4 to 6 (connection pair 3)
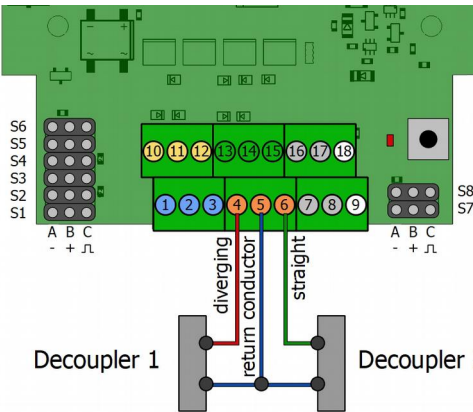
4. Settings

You can program the configuration variables (CV) using a DCC digital central unit. See the chapter in the manual of your central unit where the byte wise programming of configuration variables (CVs) is explained.

When using a Motorola central unit you can set the address with a programming push-button. Changing the other decoder´s features is impossible with Motorola central units.

4.1. Setting the addresses

Addresses of the Multi-Decoder MD-2

Depending on the set operating mode, two or three consecutive quadruple accessory decoder address blocks are assigned to each decoder address.

|	Connecting area 1	Connecting area 2	Number of accessory decoder address blocks
Mode 1 "Servos + turnouts"	8 servos	4 solenoid accessories or 8 other accessories	3 blocks (= 12 addresses)
Mode 2 "Servos + push-buttons"	8 servos	8 push-buttons	2 blocks (= 8 addresses)

Setting the address with the push-button
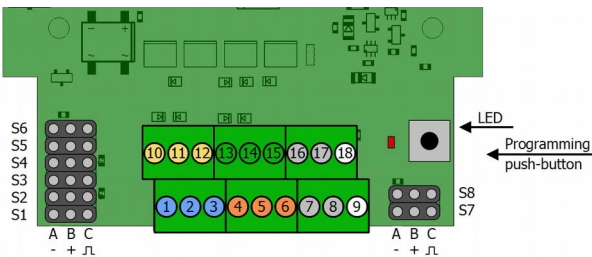
The easiest way to program the addresses is using the programming push-button. With Motorola central units the addresses can be set via the programming push-button only.

In order to set the address via the programming push-button perform the following steps:

1. Push the programming push-button on the PCB. The LED flashes.
2. Set one of the addresses from the **first** quadruple accessory decoder address block you want to use for switching the connected accessories at the central unit (e.g. address "10" from the quadruple accessory decoder address block 9 – 12). Perform a switching command for the chosen address.
3. As soon as the LED goes out, the decoder has taken over the new address.

The reqiured addresses are set automatically for the decoder, depending on the operating mode:

- operating mode 1: addresses 9 – 20 (= 3 consecutive address blocks)
- operating mode 2: addresses 9 – 16 (= 2 consecutive address blocks)

Setting the decoder address via CVs

Instead of setting the address using the programming button, you can alternatively set it by programming the CVs with a DCC control unit. The turnout addresses, via which the switching commands are sent, result as follows:

Decoder address x 4 = highest address of the quadruple accessory decoder address block

Note: For the control of the decoder in Motorola format "255" is the highest decoder address (= turnout address 1020).

Note: With some control units the numbering of the turnout addresses does not start with "1" but with "0". The addresses assigned to an address block are shifted accordingly.

CV	No.	Input value (Default)	Remarks and tips
Decoder address "Base value	9	0, 1, 2, 3, ... 7 (0)	The "base value" of the decoder address results from multiplying the input value by 256.
Decoder address "Additional value	1	1, 2, 3, ... 63 (1)	The decoder address results from the addition of the "additional value" to the "basic value".

Value in CV9	0	1	2	3	4	5	6	7
→ Base value	0	64	128	192	256	320	384	448

Value in CV1	1...63	0...63	0...63	0...63	0...63	0...63	0...63	0...62
→ Adress	1 ... 63	64 ... 127	128 ... 191	192 ... 255	256 ... 319	320 ... 383	384 ... 447	448 ... 510

4.2. Overview: Setting options and default values

CV	Meaning	Default value
Operation mode (CV39)	Operation mode 1 ("servos + turnouts") Operation mode 2 (" servos + push-buttons")	Operation mode 1
RailCom (CV28 / CV29)	Channel 1 and/or 2 on / off RailCom on / off	RailCom on Channel 1 and 2 on

Settings for connecting area 1

CV	Meaning	Default value
Servo control in rest (CV65)	Servo control commands are switched off or sent further. (to be set individually for each servo)	For all 8 servos: servo signals are switched off as soon as the servo has reached its rest position.
Servo settings (CV40...63f)	left / right stop, servo velocity (to be set individually for each servo)	
Follow-up time of servos (CV67)	0 ... 25,2 s (to be set in common for all servos)	500 ms
Bobbing (CV68 / CV69)	Especially for semaphore signals or railroad crossing gates: yes/no (to be set individually for each servo and each direction of motion)	no bobbing
Velocity of bobbing (CV70...77)	To be set individually for each servo, together for both directions of movement of a servo.	

Settings for connecting area 2 (operating mode 1)

CV	Meaning	Default value
On-Time (CV31...38)	0 ... 25,5 s (to be set individually for each pair of outputs)	for alle 4 pairs of outputs: 0,3 s
Hint: Setting the value "0" for the on-time allows the use as a changeover switch (switching decoder).		

4.3. Basic settings

CV	No.	Input value (Default)	Remarks and tips
Version	7	---	Read only!
Manufacturer	8	(62)	Read only!
Reset	8	0 ... 255	Any input value restores the settings in state of delivery.

Choosing the operation mode

CV	No.	Input value (Default)	Operation mode no.	Value of the CV
Operation mode	39	0, 1 (0)	1 ("servos + turnouts")	0
			2 ("servos + push-buttons"	1

Settings for RailCom

CV	No.	Input value (Default)	Remarks and tips	
RailCom channel	28	0, 1, 2, 3 (3)	RailCom in channel 1 off | on	0 | 1
			RailCom in channel 2 off | on	0 | 2
RailCom on / off	29	128, 136 (136)	RailCom off	128
			RailCom on	136
Hint: When not using RailCom with a DCC-central unit, it is recommended to switch it off in CV29.				

4.4. Settings for connecting area 1 (servos)

CV	No.	Input value (Default)	Signal for	is sent further *	is switched off **
Servo control in rest	65	0, 1, 2, 3, 4, 5, 6, ... 255 (255)	servo 1	0	1
			servo 2	0	2
			servo 3	0	4
			servo 4	0	8
			servo 5	0	16
			servo 6	0	32
			servo 7	0	64
			servo 8	0	128

* The servo control signals are sent continuously, the decoder controls the servo in rest. Please note: With this setting snarling noises can occur.
** The servo control signals are switched off as soon as the servo is in rest. The servo keeps its position internally.

CV	No.	Input value (Default)	Remarks and tips
Settings for servo 1	40	0...255 (100)	LS = left stop each step = 100 µs (0,1 msec)
	41	0...255 (150)	RS = right stop each step = 100 µs (0,1 msec)
	42	0...255 (10)	V = velocity
	68*	0,1,2,3 (0)	bobbing / direction 0 = no bobbing 1 = bobbing left 2 = bobbing right 3 = bobbing on both sides
	70	0...255 (40)	bobbing / velocity (for both directions of motion) Each step changes the velocity of bobbing by 100 µs (0.1 msec).
Settings for servo 2	43	0...255 (100)	LS = left stop
	44	0...255 (150)	RS = right stop
	45	0...255 (10)	V = velocity
	68*	0,4,8,12 (0)	bobbing / direction 0 = no bobbing 4 = bobbing left 8 = bobbing right 12 = bobbing on both sides
	71	0...255 (40)	bobbing / velocity (for both directions of motion)

CV	No.	Input value (Default)	Remarks and tips
Settings for servo 3	46	0.255 (100)	LS = left stop
	47	0...255 (150)	RS = right stop
	48	0...255 (10)	V = velocity
	68*	0,16,32,48 (0)	bobbing / direction 0 = no bobbing 16 = bobbing left 32 = bobbing right 48 = bobbing on both sides
	72	0...255 (40)	bobbing / velocity (for both directions of motion)
Settings for servo 4	49	0...255 (100)	LS = left stop
	50	0...255 (150)	RS = right stop
	51	0...255 (10)	V = velocity
	68*	0,64,128,192 (0)	bobbing / direction 0 = no bobbing 64 = bobbing left 128 = bobbing right 192 = bobbing on both sides
	73	0...255 (40)	bobbing / velocity (for both directions of motion)
Settings for servo 5	52	0...255 (100)	LS = left stop
	53	0...255 (150)	RS = right stop
	54	0...255 (10)	V = velocity
	69*	0,1,2,3 (0)	bobbing / direction 0 = no bobbing 1 = bobbing left 2 = bobbing right 3 = bobbing on both sides
	74	0...255 (40)	bobbing / velocity
Settings for servo 6	55	0.255 (100)	LS = left stop
	56	0...255 (150)	RS = right stop
	57	0...255 (10)	V = velocity
	69*	0,4,8,12 (0)	bobbing / direction 0 = no bobbing 4 = bobbing left 8 = bobbing right 12 = bobbing on both sides
	75	0...255 (40)	bobbing / velocity (for both directions of motion)

CV	No.	Input value (Default)	Remarks and tips
Settings for servo 7	58	0.255 (100)	LS = left stop
	59	0...255 (150)	RS = right stop
	60	0...255 (10)	V = velocity
	69*	0,16,32,48 (0)	bobbing / direction 0 = no bobbing 16 = bobbing left 32 = bobbing right 48 = bobbing on both sides
	76	0...255 (40)	SW-V = Velocity of bobbing
Settings for servo 8	61	0.255 (100)	LS = left stop
	62	0...255 (150)	RS = right stop
	63	0...255 (10)	V = velocity
	69*	0,64,128,192 (0)	bobbing / direction 0 = no bobbing 64 = bobbing left 128 = bobbing right 192 = bobbing on both sides
	77	0...255 (40)	bobbing / velocity (for both directions of motion)

*Note on CV68 and 69: You have to add up the setting values for servos 1 to 4 and 5 to 8 in CV68 and 69.

CV	No.	Input value (Default)	Remarks and tips
Servo follow-up time	67	0...255 (5)	each step = 100 msec (0.1 sec)

By setting a servo follow-up time you can avoid that the servo signal is switched off immediately after the regulating time calculated by the deocder has elapsed und thus the servo movement is interrupted before reaching the stop e.g. after a unscheduled slow run.

4.5. Settings for connecting area 2 (operation mode 1)

CV	No.	Input value (Default)	Remarks and tips
On-time of the outputs			Defines how long the switching impulse is applied / the output is switched on.
Turnout 1r	31	For use as a switching decoder: 0	Output remains switched on until the next switching impulse to the same turnout address 0
Turnout 1g	32		
Turnout 2r	33	For use as a turnout decoder::	
Turnout 2g	34	1, 2 ... 255 (3)	100 milliseconds (msec) 1
Turnout 3r	35		200 milliseconds (msec) 2
Turnout 3g	36		300 milliseconds (msec) 3
Turnout 4r	37		...
Turnout 4g	38		25,5 seconds (sec) 255

⚠️ **Caution:**
When connecting turnouts, the set on-time has to be greater than 0! Otherwise the turnouts possibly burn through.

5. Checklist for troubleshooting and error correction

> ⚠️ **Warning:**
>
> If you notice a strong heat development, immediately disconnect the connection to the supply voltage. **Fire hazard!**

Possible causes:

- One or more connections are faulty. → Check the connections.
- "The decoder is defective. → Send the decoder in for inspection.

Connected consumers do not react to switching commands

Possible causes:

- The connection of the decoder to the control unit and / or the power supply is interrupted. → Check the connections.
- The connection of the decoder to the consumer is interrupted. → Check the connections.
- The control unit is not in operation. → Check whether the control unit is ready for operation.
- The consumer is defective. → Check the consumer.
- Another operation mode is set than expected. → Check the operation mode.

After programming the decoder does not react as desired.

Possible causes:

- The values entered for the configuration variables are inconsistent. → Perform a decoder reset and test the decoder with the default values first. Then reprogram the decoder.
- Another operating mode is set than assumed. → Check the operating mode.
- When programming via CVs, the decoder address is assigned. For switching the decoder, however, turnout addresses are used. → Enter the turnout address for switching. Note: The decoder address multiplied by 4 results in the highest address from the block of 4 turnout addresses.
  Example: Decoder address = 10 → associated turnout addresses: 37 to 40

When programming with servos connected, the control unit sends an error message.

Possible cause: Some servos have such a high inrush current that the control unit detects an error when the decoder is switched on briefly while the programming command is being sent. → Disconnect the servo's connector plug during programming and test the settings in normal operation.

The decoder switches off when sending switching commands to a connected accessory.

Possible cause: The accessory's current consumption exceeds the maximum values. → Check the accessory's current consumption. If necessary, use an external voltage supply for servos or a relay to switch accessories.

The decoder switches off connected accessories some time after having sent switching commands to the accessory.

Possible cause: For the output the on-time is set to a value greater than "0" (CV31...38). → Check the settings and alter them.

The decoder does not switch off a connected turnout.

Possible cause: For the output the on-time is set to the value "0" (CV31...38). → Check the settings and alter them. Please note: Possibly the coil of the turnout is burnt through.

5.1. Technical Hotline

If you have any questions about the use of the decoder, our technical hotline will help you (telephone number and e-mail address on the last page).

5.2. Repairs

You can send us a defective decoder for inspection / repair (address on the last page). Please do not send us your return freight collect. In the event of a warranty or guarantee claim, we will reimburse you for the regular shipping costs.

Please enclose the following with your shipment

- proof of purchase as evidence of any warranty or guarantee claim
- a brief description of the defect
- the address to which we should return the product(s)
- your email address and/or a telephone number where we can reach you in case of queries.

Costs

The inspection of returned products is free of charge for you. In the event of a warranty or guarantee claim, the repair and return are also free of charge for you.

If there is no warranty or guarantee case, we will charge you the costs of the repair and the costs of the return. We charge a maximum of 50% of the new price for the repair according to our valid price list.

Carrying out the repair(s)

By sending in the product(s), you give us the order to inspect and repair it. We reserve the right to refuse the repair if it is technically impossible or uneconomical. In the event of a warranty or guarantee claim, you will then receive a replacement free of charge.

Cost estimates

Repairs for which we charge less than € 25.00 per item plus shipping costs will be carried out without further consultation with you. If the repair costs are higher, we will contact you and carry out the repair only after you have confirmed the repair order.

6. Technical data

Digital protocols

Data formats	Motorola
	DCC (according to NMRA and RCN standard)
Adress range Hint: The adress range to be used also depends from the control unit.	MM: 1020 turnout addresses DCC: 2040 turnout addresses
Feedback format	RailCom (according to RCN standard)

Inputs and outputs

Connecting area 1 (Pin headers)	8 outputs for the connection of servos
Connecting area 2 (Terminal blocks)	Operating mode 1: 8 outputs (4 output pairs) for the connection of solenoid accessories and/or other accessories
	Operating mode 2: 8 inputs for the connection of push-buttons

Electrical properties

Power supply	Digital voltage of the booster circuit (12 - 24 volts)
	or 14 – 20 V a.c. voltage
Current consumption	approx. 40 mA (without connected devices)
Maximum total current	Connecting area 1: 1,000 mA (continuous)
	Connecting area 2: 1,000 mA (continuous)
Maximum current per output	Connecting area 1: 1,000 mA

	Connecting area 2
	  up to 2 seconds: 1,500 mA
	  continuous: 1,000 mA

Protection

Protection class	Ready-made module (without housing): IP 00 Meaning: No protection against foreign bodies, contact and water.
	Ready device (in housing): IP 20 Meaning: Protected against solid foreign bodies with diameter ≥ 12.5 mm and access with a finger. No protection against water.

Environment

	For use in closed rooms
Ambient temperature during operation	0 ~ + 30 °C
Permissible relative humidity during operation	10 ~ 85% (non-condensing)
Ambient temperature during storage	- 10 ~ + 40 °C
Permissible relative humidity during storage	10 ~ 85% (non-condensing)

Other features

Dimensions (approx.)	Circuit board: 72 x 82 mm Ready device including housing: 100 x 90 x 35 mm
Weight (approx.)	Assembled board (ready-made module): 40 g Ready device including housing: 88 g

7. Warranty, EU conformity & WEEE

7.1. Guarantee bond

For this product we issue voluntarily a guarantee of 2 years from the date of purchase by the first customer, but in maximum 3 years after the end of series production. The first customer is the consumer first purchasing the product from us, a dealer or another natural or juristic person reselling or mounting the product on the basis of self-employment. The guarantee exists supplementary to the legal warranty of merchantability due to the consumer by the seller.

The warranty includes the free correction of faults which can be proved to be due to material failure or factory flaw. With kits we guarantee the completeness and quality of the components as well as the function of the parts according to the parameters in not mounted state. We guarantee the adherence to the technical specifications when the kit has been assembled and the ready-built circuit connected according to the manual and when start and mode of operation follow the instructions.

We retain the right to repair, make improvements, to deliver spares or to return the purchase price. Other claims are excluded. Claims for secondary damages or product liability consist only according to legal requirements.

Condition for this guarantee to be valid, is the adherence to the manual. In addition, the guarantee claim is excluded in the following cases:

- if arbitrary changes in the circuit are made,
- if repair attempts have failed with a ready-made module or device,
- if damaged by other persons,
- if damaged by faulty operation or by careless use or abuse.

7.2. EU Declaration of Conformity

CE   This product fulfils the requirements of the following EU directives and therefore bears the CE marking.

2001/95/EU Product Safety Directive

2015/863/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)

2014/30/EU on electromagnetic compatibility (EMC Directive). Underlying standards:

DIN-EN 55014-1 and 55014-2: Electromagnetic compatibility - Requirements for household appliances, electric tools and similar electrical appliances. Part 1: Emitted interference, Part 2: Immunity to interference

> To maintain electromagnetic compatibility during operation, observe the following measures:
>
> Only connect the supply transformer to a professionally installed and fused earthed socket.
>
> Do not make any changes to the original components and follow the instructions, connection and assembly diagrams in this manual exactly.
>
> Only use original spare parts for repair work.

7.3. Declarations on the WEEE Directive

This product is subject to the requirements of the EU Directive 2012/19/EC on Waste Electrical and Electronic Equipment (WEEE), i.e. the manufacturer, distributor or seller of the product must contribute to the proper disposal and treatment of waste equipment in accordance with EU and national law. This obligation includes

- registration with the registering authorities ("registers") in the country where WEEE is distributed or sold
- the regular reporting of the amount of EEE sold
- the organisation or financing of collection, treatment, recycling and recovery of the products
- for distributors, the establishment of a take-back service where customers can return WEEE free of charge
- for producers, compliance with the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) Directive.

> The "crossed-out wheeled bin" symbol means that you are legally obliged to recycle the marked equipment at the end of its life. The appliances must not be disposed of with (unsorted) household waste or packaging waste. Dispose of the appliances at special collection and return points, e.g. at recycling centres or at dealers who offer a corresponding take-back service.

Further Information and Tips:

http://www.tams-online.de

Warranty and Service:

tams elektronik GmbH

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