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SmartDecoder 4.1

#36125 PIKO SmartDecoder 4.1 G locomotive decoder for large railways multiprotocol

Description

This PIKO SmartDecoder 4.1 G is a compact, very powerful multi-protocol decoder. It can be used in DCC, Motorola® and mfx® digital systems and also runs in analogue operation with direct or alternating voltage.
The respective operating mode is recognized automatically, but it can also be set manually. The load-controlled decoder works with a motor frequency of 18.75 kHz and is therefore suitable not only for DC but also for bell-armature motors (e.g. Faulhaber, Maxon, Escap) up to to a continuous current consumption of 5 A. Short-term higher motor currents are well tolerated. Thanks to its large energy storage, the decoder is ideal for use in garden railway vehicles, as it can buffer dirty rail sections very well.

The PIKO SmartDecoder 4.1 G is RailCom® and RailCom Plus® capable and can handle both ABC braking and ABC slow travel. The motor characteristic curve is set using the minimum, average and maximum speed (simple characteristic curve), or via the extended characteristic curve with individual settings for 28 speed levels.
The decoder has two direction-dependent lighting outputs, as well as eleven additional special function outputs, three of which are equipped with logic levels.
It also offers four connections for standard model building servos. Decoder-internal processes can be called up automatically via the three inputs for reed contacts, for example. The maneuvering gear with an extended slow travel range and the three possible acceleration and braking delays can be switched using function keys.

Features •

Suitable for DC and bell-armature motors up to 5 A • Quiet motor running thanks to motor control at 18.75 kHz • 14, 27, 28, 128 speed levels, depending on data format • Short (1-127) and long (128-9999) addresses • NMRA compliant • RailCom® and RailCom Plus® • mfx® capable • Energy storage with adjustable start-up and supply time • Minimum, maximum and average speed adjustable • Extended speed characteristic curve adjustable • Additional starting characteristic curve can be activated for smooth starting • Shunting gear (half speed) can be switched • 3 adjustable acceleration and braking delays, each switchable via F0 - F28 • Direction-dependent light outputs, dimmable • 11 function outputs (3x logic), A1 -A7 dimmable, direction dependence adjustable • 4 servo outputs, two stopping positions each and speed adjustable • 3 inputs for reed contacts or Hall sensors for Triggering decoder-internal processes • Activation of the light and function outputs for analogue operation, adjustable • Second dimming for lighting, A1 to A7 adjustable, switchable • Simple function mapping, F0 - F12 for lighting, A1 to A7, acceleration, braking delay and maneuvering gear • Extended Function mapping, F0 - F44 for switching several outputs depending on linked conditions • The function keys F1 -F44 can be assigned directly to the outputs A8 -A11 • Train-side lighting can be switched off • Function outputs: flashing with variable on/off time • Function outputs: 2 phases for alternating flashers • Load-dependent smoke generator control • Firebox with setting parameters for brightness changes and flickering rhythm • Shunting clutch and shunting tango • Showing and hiding the light and function outputs, adjustable • Energy-saving lamp effect: achieving the maximum Brightness after an adjustable time • Fluorescent lamp switch-on effect with adjustable flash time and number • 8 PWM banks, each with 64 modulation entries for e.g. North American lighting effects such as Mars Light, Gyra Light, Strobe, etc. • With SUSI socket for corresponding PIKO sound modules and function decoders • Braking with DCC Braking signal, braking distances with DC voltage or ABC brakes • ABC slow travel distance • 2 adjustable braking distances in cm, can be activated via ABC, DC, DCC brake signal, as well as via speed level 0 with adjustable speed level threshold • 2 motor control types for precise motor control with many setting parameters • Motorola with 3 addresses for the functions F1 - F12 when used with Motorola control panels • All outputs protected against short circuits • Error memory for motor and function outputs, as well as temperature shutdown • Conventional direct and alternating current operation with automatic switching to the respective operating mode • All CVs have digital devices DCC and Motorola formats • Programmable in DCC mode via register, CV direct or page programming • Main track programming (DCC) • Decoder programming lock

Installation and connection of the PIKO SmartDecoder 4.1 G

You can attach the decoder to a suitable location in your vehicle using the appropriate screws. When installing, ensure that you do not pinch or damage any cables with the screw heads. When placing the module in the vehicle, make sure that there is no conductive connection anywhere. Connect the decoder as described in Figure 1. Only use suitable cable material with a sufficient cross-section for cabling. When using the screw terminals, make sure the screwdriver is the right size so that the screw terminals are not damaged. The assignment of the respective connections can be found in the following figures. The first commissioning should take place on the programming track with the control center in programming mode. When reading or programming, very small currents usually flow that do not damage the decoder in the event of a short circuit.

Special functions A1 to A11

The special function outputs A1 to A8 of the decoder are designed as a row of screw terminals on the right side of the decoder. The second connection for these consumers is labeled U+ in the same terminal row in Figure 1.

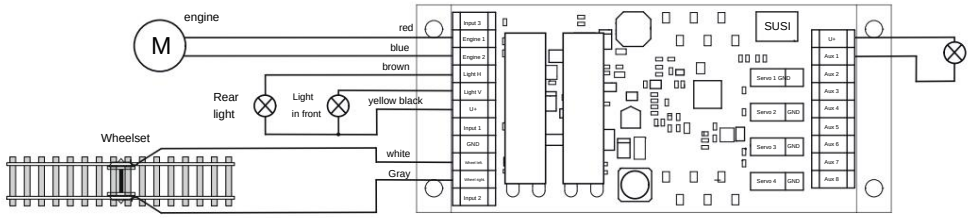

Figure 1: Connection of motor, front and rear lighting, wheelset

Connection of the function outputs

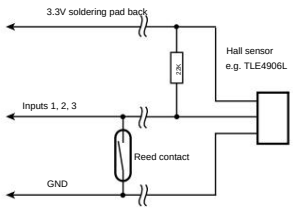

Figure 2: Connection of reed contact or Hall sensor

A11 logic output
A10 logic output
A9 logic output
3.3 volts

The terminals U+ and GND (-) required for connecting the logic outputs A9 - A11 are located on the screw terminal row on the front of the decoder.

The soldering pad marked 3.3V is used to connect a Hall sensor, which is connected as shown in Figure 2.

Figure 3: Connection pads on the back

ATTENTION: Soldering on the decoder and connecting electronic circuits should only be carried out by experienced specialists with the appropriate knowledge and appropriate tools. The warranty does not apply to decoders that have been damaged due to improper handling.

A short circuit in the area of the motor, lighting, grinder and wheelsets destroys the module and possibly the electronics of the locomotive!

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SUSI interface

Either a PIKO sound module with SUSI or a suitable function decoder can be connected to the SUSI interface of the PIKO SmartDecoder 4.1 G.
Please refer to the CV table to find out which CV needs to be programmed for the respective application. In the factory setting, the decoder outputs data for a PIKO sound module on the SUSI interface.

Commissioning the decoder (delivery status)

Enter address 3 on the control unit. Depending on which data format it was addressed with, the PIKO SmartDecoder 4.1 G runs in DCC mode with 28 speed levels or in Motorola mode. When using a RailCom Plus®- capable digital control center or an mfx®-capable digital control center, the decoder logs on automatically and can be operated immediately. If the decoder is used on conventional, analogue-operated systems, it can be controlled with a DC or AC drive unit. The operating mode is automatically recognized by the PIKO SmartDecoder 4.1 G.

NOTE: In DC voltage operation, your vehicle will only start at a higher voltage (speed controller turned up further) than you might be used to when operating analog vehicles. Please note that trouble-free operation with electronic speed controllers (PWM operation) cannot be guaranteed due to the large number of often unstable systems available on the market.

Function outputs in analogue operation

It is possible to set the decoder so that the function keys F0 - F12, as assigned in the function mapping, can also be switched on in analogue mode. To do this, CVs 13 & 14 must first be programmed using a digital control center. The corresponding values can be found in the CV table.

Motorola®

In order to be able to achieve the functions F1 - F12 when used with Motorola central units, the decoder has 3 Motorola® addresses, which are stored in CV47-49. These 3 addresses are also used for decoding. If an address is programmed decimal under CV1, the decoder automatically stores the trinary equivalent up to address 79 in CV47. For example, to use Motorola® locomotive addresses up to 255, CVs 47 - 49 must be programmed directly in decimal using the Motorola programming method.
These CVs can be read on the DCC programming track, but not programmed.
If the CV47 is programmed using the Motorola programming method, CV1 is not changed and the DCC data format in CV12 is therefore switched off so that the decoder cannot be accidentally addressed via two addresses.
If bit 5 is set in CV29 (DCC long address), the Motorola® data format is switched off except for the Motorola programming, so that the decoder cannot react to two addresses here either.

Configuration CVs

In addition to the decoder address, the configuration CVs of a locomotive decoder are certainly the most important CVs. For the PIKO SmartDecoder 4.1 G these are CVs 29, 50 and 51. A configuration CV usually contains various setting options for a decoder, which are represented in a maximum of 8 bits (0 - 7). The value of a CV to be entered is calculated from the respective CV table by adding the values of the desired functions. Below you can see the meaning and content of the configuration CVs, as well as an example calculation of the value:

bit	Configuration CV29	Value
0	Normal direction of travel Opposite direction of travel	0 1
1	14/27 speed levels 28/128 speed levels	0 2
2	Digital operation only Automatic analog/digital switching	0 4
3	RailCom® switched off RailCom® switched on	0 8
4	Speed levels via CV 2, 5 and 6 Use characteristic curve from CV 67-94	0 16
5	Short address (CV 1, register 1) Long address (CV 17 and 18)	0 32

bit	CV50 configuration	Value
0	Motorola 2. Do not use address Motorola 2. Use address	0 1
1	Motorola 3. Do not use address Motorola 3. Use address	0 2
2	Do not swap light outputs Swap light outputs	0 4
3	Frequency light, A1 to A8 = 156Hz Frequency light, A1 to A5 = 24KHz	0 8
7	Decoder internal automatic off Decoder internal automatic on	0 128

bit	Configuration CV 51	Value
0	Motor control off Motor control on	0 1
1	Motor control PID controller Motor control SX - controller	0 2
2	no dynamic period duration dynamic period duration	0 4
3	After power failure: Restore speed Restore speed	 0 8
4	After power failure: Restore functions 0 - 12 Restore functions 0 - 12	 0 16
7	additional starting characteristic curve additional starting characteristic curve	0 128

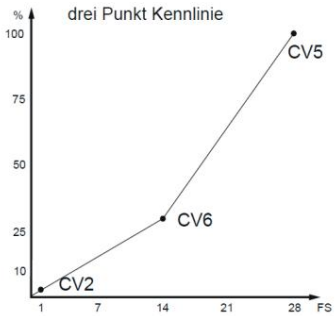
Example calculation (CV 29)

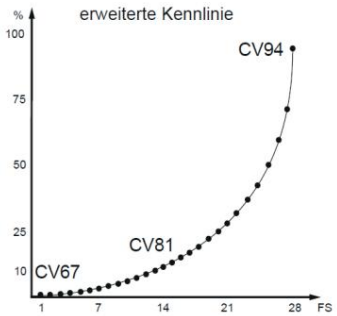
Normal direction of	Value = 0
travel 28 speed	Value = 2
levels automatic. Analog/digital	Value = 4
switching RailCom®	Value = 8
off/on speed levels via CV	Value = 0
2, 5, 6 Short address	Value = 0

The sum of all values is 14. This value is stored as a factory default in CV 29.

Speed characteristic curve

The decoder is preset to a simple, 3-point characteristic curve that determines the minimum, medium and highest speed. However, it can also be switched to the extended speed characteristic for 28 speed steps (CV29, Bit4 = 1). This characteristic curve offers the possibility of setting a speed for each of the 28 speed levels. The settings are entered in CVs 67 to 94, with a CV reserved for each of the speed levels 1 - 28.





In addition, the PIKO SmartDecoder 4.1 G has a fixed starting characteristic curve. If this is activated via bit 7 of CV51, the decoder uses this very flat characteristic curve up to internal speed level 10. This setting leads to even smoother starting behavior in the lower gear range.

RailCom®, RailCom Plus®

The basis of the RailCom® technology developed by LENZ® is the transmission of data from the decoder into the specially prepared (CutOut) DCC digital signal on the track. There must be detectors on the track that evaluate this decoder data and, if necessary, forward it to the control center. Depending on the setting, the decoder sends out the decoder address and, when read out via the main track programming, CV values that can be displayed by the digital control center (depending on the detector and control center). In the decoder, the CV29 RailCom® can be switched on or off via bit 3 . Further RailCom® settings can be made in CV 28 . There is also, for example

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RailCom Plus® switched on via bit 7. If RailCom Plus® is switched on, the decoder automatically logs on to a RailCom Plus® capable control center (e.g. PIKO SmartControl) with its locomotive symbol, decoder name and its special function symbols. Thanks to this RailCom Plus® technology, no locomotive data has to be stored in the control center and no locomotive addresses have to be programmed into the decoder.

mfx®

The PIKO SmartDecoder 4.1 G supports the mfx® data format. If the digital control center used is mfx-capable, the decoder logs in automatically with its locomotive symbol, decoder name and special function symbols. Thanks to this mfx® technology, no locomotive data has to be stored in the control center and no locomotive addresses have to be programmed into the decoder.

Braking behavior

Märklin braking section

The decoder reacts to a Märklin braking section (brakes with analog direct voltage (DC) on the track) if CV29 bit 2 and CV27 bit 4 and/or bit 5 are set to 1 (factory setting 1 and 0).

CV27 Bit 4 = 1 -> DC with opposite direction of travel
CV27 Bit 5 = 1 -> DC with same direction of travel

ABC - brakes

If the decoder detects a lower amplitude of the digital voltage on one side of the track, a braking process begins.
The side of the rail on which the digital voltage should be more positive in order to activate the braking process can be set via CV27:
CV27 = 1, brake when right rail is more positive
CV27 = 2, brake when left rail is more positive
CV27 = 3, brake regardless of which rail is more positive
Bit 7 of CV27 can be used to set whether the vehicle should only react to the ABC braking distance in one direction of travel (forward or backward). However, only one of the bits 0 or 1 may be set. Regardless of the positions of bits 0 and 1 (at least one must be set to detect an ABC braking section), driving can be carried out in an activated ABC braking section if the maneuvering gear is switched on or the start-up braking delay is switched off.
In the CV97 you can set the voltage difference from which the decoder recognizes the ABC braking distance. The desired difference corresponds approximately to the CV value * 0.12 V.
If an ABC slow speed signal is detected according to a Lenz BM2 module, the decoder brakes to the internal speed level (0 - 255) that can be set in CV98.

Constant braking distance in cm

The decoder offers the option of two adjustable, constant braking distances in centimeters, true to scale.
The constant braking distances can be triggered by various events. These include the ABC brake signal, the brake signal of a DCC brake generator, the brake signal of a DC braking system, as well as speed level 0. When braking with speed level 0 (e.g. manual mode), it is possible to enter a speed level threshold above which the constant Braking distance is first carried out. If the internal speed level of the locomotive decoder is smaller than the entered speed level threshold, the vehicle stops at target speed level 0 with the set braking deceleration from CV4, or CV145, or CV147.

CV138 = 1 - 255 -> Current speed level above which braking takes place with a constant braking distance when the target speed level is set to zero.
CV meanings
CV139 = braking distance in cm
CV140 = alternative braking distance, can be activated via the CROSS bit (see “Extended Function Mapping”)
CV141 = maximum speed of the model locomotive in cm/s
CV142 = If the value determined for CV141 exceeds 255, the remainder is entered into CV142
CV143 = Activation of the constant braking distance by:
Bit 0 = 1 -> Target speed level = 0, with current internal speed level according to CV138 and greater Bit
1 = 1 -> ABC brakes
Bit 2 = 1 -> DC braking
Bit 3 = 1 -> DCC brake signal
CV143 = 0 -> no constant braking distance
If braking is initiated with a constant braking distance, the decoder only responds to driving commands again when the locomotive has come to a standstill. This process can be interrupted by switching on the maneuvering gear.

Determination of the maximum speed of the model locomotive

Program the CV of the maximum speed in the decoder to the maximum possible value (CV5 = 63, or if using the extended speed characteristic curve CV94 = 255)
Mark a starting point on a sufficiently long, straight section of track from which the vehicle can travel unhindered at the maximum possible speed for approximately 2 seconds. Place a sufficiently long tape measure at the marked starting point. Now drive into this section at top speed, i.e. with the speed controller set to the highest speed level. When you reach the starting point, start measuring the time for 2 seconds. After these 2 seconds have elapsed, note the position of the vehicle on the tape measure and read the value in cm. Divide this value by 2 and you get the speed traveled in cm/s. This value is now entered into CV141. In gauges 1 and IIm (G), the value determined may exceed 255 for very fast vehicles. In this case, please enter the value 255 in CV141 and the rest of the determined value in CV142.

After this measurement, the CV for the maximum speed (CV5 or CV94) can be set to the desired maximum speed for driving.

Function outputs

Simple function mapping

The following setting options for the decoder are only possible with simple function mapping (CV96 = 0).
In simple function mapping, the assignments of switching tasks such as lighting, special function outputs up to A11, maneuvering gear and switchable acceleration and braking delay can be freely assigned to the function keys F0 to F12 of the digital center. The value that is written into a CV of the function mapping determines the functions that can be switched via a function key assigned to the CV. CVs 33 to 46 are used for this purpose according to the following scheme.

Assignment of the function keys to the CVs	**Work value**
CV 33 Light function key F0 when driving forward	1
CV 34 Light function key F0 when reversing	2
CV 35 Function key F1	4
CV 36 Function key F2	8
CV 37 Function key F3	16
CV 38 Function key F4	32
CV 39 Function key F5	64
CV 40 Function key F6	128
CV 41 Function key F7	0

Assignment of the individual bits	**Value**
Bit 0 front light output	1
Bit 1 rear light output	2
Bit 2 function output A1	4
Bit 3 function output A2	8th
Bit 4 function output A3	16
Bit 5 function output A4	32
Bit 6 shunting gear	64
Bit 7 acceleration/braking delay	128

CV 42 function key F8 0
CV 43 function key F9 0
CV 44 Function key F10 0
CV 45 function key F11 0
CV 46 Function key F12 0

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Example 1: The rear light output should only be switched using the F5 function key.
The CV to be programmed is CV39 for the function key F5. The value 2 (rear light output) is programmed into this CV39. So that the rear light output is no longer switched backwards in the direction of travel via the function button F0, the CV34 must also be programmed to the value 0 for the function button F0 in the direction of travel backwards.

Example 2: The function output A1 and the shunting gear should be switched together with the function key F10.
The CV to be programmed is CV44 for the function key F10. The value 4 (function output A1) plus the value 64 (shunting gear), i.e. the value 68, is programmed into this CV44. So that the function output A1 is no longer switched via the function key F1 and the shunting gear is no longer switched via the function key F5, the CVs 35 for the function key F1 and 39 for the function key F5 must also be programmed to the value 0.

Function Mapping Shift
CVs 33 to 46 contain the function mapping. Since only 8 outputs (bits 0 - 7) can be activated with one CV, there are two further CVs with which the bit-by-bit meaning in CVs 33 to 46 can be changed.

CV100 changes the bitwise meaning in CVs 33-38 and CV101 in CVs 39-46. Each bit in CV100 / 101 changes the meaning of the bits in one of CVs 33-46. The following assignment applies here:

If the respective bit in CV100 / 101 is 0, the bits in one of the CVs 33-46 have the meaning from the table above.
If the respective bit in CV100 / 101 is 1, the bits in one of CVs 33-46 have the following meaning:

Assignment of the individual bits Value **Value**
Bit 0 Function output A2 1 Bit 1 Bit 4 acceleration/braking delay 16
Function output A3 2 Bit 2 Function Bit 5 function output A5 32
output A4 4 Bit 3 Jumper 8 Bit 6 function output A6 64
Assignment of bits in CV100 Bit0 = Bit 7 function output A7 128

Change of assignment in CV35	**Value**	**assignment of the bits in CV101**	**Value**
(F1)	1	Bit0 = Change of assignment in CV39 (F5)	1
Bit1 = Change of assignment in CV36 (F2)	2	Bit1 = Change of assignment in CV40 (F6)	2
Bit2 = Change of assignment in CV37 (F3)	4	Bit2 = Change of assignment in CV41 (F7)	4
Bit3 = Change of assignment in CV38 (F4)	8th	Bit3 = Change of assignment in CV42 (F8)	8th
Bit4 = Change of assignment in CV33 (F0v)	16	Bit4 = Change of assignment in CV43 (F9)	16
Bit5 = Change of assignment in CV34 (F0r)	32	Bit5 = Change of assignment in CV44 (F10)	32
		Bit6 = Change of assignment in CV45 (F11)	64
		Bit7 = Change of assignment in CV46 (F12) 128	

Example 3: The function output A6 should be switched with the function key F6.
The first CV to be programmed is CV40 for the F6 function key. The value 64 (A6) is programmed into this CV40. So that the value 64 does not switch the shunting gear (RG) but the output A6, bit 1 = 1 is set in CV 101 (change of the assignment in CV40), i.e. value 2 is programmed (assignment of the bits in CV 101).

Special feature of the function key assignment for the outputs A8 - A11
The special function outputs A8 - A11 can be assigned directly to any function key F1 - F44. A CV is available for each of these outputs A8 - A11 in which the desired function key number is entered. If, for example, output A8 is to be switched with F12, CV191 is programmed with the value 12.
CV191 -> Output A8
CV192 -> Output A9 (logic)
CV193 -> Output A10 (logic)
CV194 -> Output A11 (logic)

Switch off train-side lighting at the front and rear (CV96 = 0)

The numbers of the special functions 1 - 12 can be entered in CV107 (front) and CV108 (rear), which switch off the white and red lighting at the front or rear.
You can also enter here which function outputs A1 to A7 the red rear train lighting is connected to.
The function numbers entered here must be set via function mapping so that they do not switch on other outputs. Furthermore, it must be ensured that the outputs used for the red lighting are not switched on or off via the function mapping of other function keys, ie the function mapping CV of the F keys used here must be set to zero. In order for the light to be switched off correctly, both CVs 107 and 108 must always be programmed as desired. If one of CVs 107 or 108 is programmed with the value 0, the function is considered deactivated.

The value for programming CVs 107 and 108 is made up of two conditions. On the one hand, to which of the outputs A1 to A7 the lighting to be switched off is connected and, on the other hand, which function key F1 to F12 is to be used to switch the lighting. Since a CV can only be described with one value, these conditions are combined into one value according to the following scheme:

Light assignment: A0v = white light at the front, A0h = white light at the back
CV107 for red lighting at the front
CV108 for red rear lighting
Calculation: Output * 16 + function key
Example: The red lighting at the front should be connected to A1 and switched with F5.
CV107 = 1 * 16 + 5 = 21
The red rear lighting should be connected to A2 and switched with F6.
CV108 = 2 * 16 + 6 = 38

Switch off function outputs depending on the direction of travel (CV96 = 0)

In CVs 113 (forward direction of travel) and 114 (reverse direction of travel) you can specify which function output A1 - A7 should be switched off. If such an output is switched on via a function button, it is automatically switched off in the desired direction of travel.

CV 113: Value Bit 1 A1 forward **CV 114:** **Value**
out 2 Bit 2 A2 forward out 4 Bit 1 A1 backwards from 2
Bit 3 A3 forward out 8 Bit 4 Bit 2 A2 backwards from 4
A4 forward out 16 Bit 5 A5 Bit 3 A3 backwards from 8
forward out 32 Bit 6 A6 forward Bit 4 A4 backwards from 16
out 64 Bit 7 A7 forward out 128 Bit 5 A5 backwards from 32
Bit 6 A6 backwards from 64
Bit 7 A7 backwards from 128

A combination (sum of the individual values) is possible in each case.

Simple and advanced function mapping

The following setting options for the light and function outputs up to A7 are possible with simple (CV96 = 0) and extended (CV96 = 1) function mapping.

Dimming of the light and function outputs
The light and function outputs A1 to A7 can be set to any dimming level. These settings are stored in CVs 116 (light) and 117 (A1) to 123 (A7).

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Softly show and hide light and function outputs

If the output is switched on or off, it will fade in or out smoothly.
In CV186 you can specify which output should receive this blending function.

CV 186:	**Value**	**Value**
Bit 0 light output. with blending function		Bit 4 A4 with blend function 16
Bit 1 A1 with blending function	1	Bit 5 A5 with blend function 32
Bit 2 A2 with blending function	2	Bit 6 A6 with blend function 64
Bit 3 A3 with blending function	4 8	Bit 7 A7 with blend function 128

A combination (sum of the individual values) is possible in each case.
The CV187 setting specifies how quickly the blending function should work. The step size is CV value * 10ms.

Flashing of the light and function outputs

The locomotive decoder has a flashing generator that can be assigned to the outputs. Both the switch-on time and the switch-off time of the flashing generator can be set separately.

In CV109 you can specify which output should use the flashing generator. Furthermore, the CV110 can be used to specify which output should use the flashing generator with the phase angle rotated by 180°. For example, an interchangeable indicator can be implemented.

CV 109: Value bit 0 light output. with flash generator	**CV 110: Value**
1 bit 1 A1 with flash generator 2 bit 2 A2 with	Bit 0 light output Flashing generator 180° 1
flash generator 4 bit 3 A3 with flash generator	Bit 1 A1 with flashing generator 180° 2
8 bit 4 A4 with flash generator 16 bit 5 A5 with	Bit 2 A2 with flashing generator 180° 4
flash generator 32 bit 6 A6 with flash generator	Bit 3 A3 with flashing generator 180° 8
64 bit 7 A7 with flash generator 128 A	Bit 4 A4 with flashing generator 180° 16
combination (sum of Individual values) is	Bit 5 A5 with flashing generator 180° 32
possible in each case.	Bit 6 A6 with flashing generator 180° 64
	Bit 7 A7 with flashing generator 180° 128

In the CV111 the switch-on time can be set in 100ms steps and in the CV112 the switch-off time can be set in 100ms steps.

Switch-on effect of a neon tube/fluorescent lamp

The switch-on effect of a defective fluorescent lamp can also be output at the light and function outputs. This effect consists of an adjustable maximum number of flashes (randomly one flash up to the maximum number of flashes set) and an adjustable flash time, i.e. how quickly the flashes should follow one another.

CV 188:	**Value**	**Value**
Bit 0 light output. with fluorescent lamp effect 1 Bit 1 A1		Bit 4 A4 with fluorescent lamp effect 16
with fluorescent lamp effect 2 Bit 2 A2 with fluorescent		Bit 5 A5 with fluorescent lamp effect 32
lamp effect 4 Bit 3 A3 with fluorescent lamp effect 8 A		Bit 6 A6 with fluorescent lamp effect 64
combination (sum of the individual values) is of course also		Bit 7 A7 with fluorescent lamp effect 128

possible here.
The flash time is set via CV 189 in 5ms steps. The maximum number of flashes in CV 190.

Energy saving lamp effect when switching on the light and function outputs

When you switch on an energy-saving lamp, it initially produces a basic brightness before slowly reaching its maximum brightness. This effect can be assigned to the outputs of the decoder as follows.

CV 183: Value Value

Bit 0 light output as an energy-saving lamp 1 Bit 4 A4 as an energy-saving lamp 16
Bit 1 A1 as energy-saving lamp 2 Bit 5 A5 as energy-saving lamp 32
Bit 2 A2 as energy-saving lamp 4 Bit 6 A6 as energy-saving lamp 64
Bit 3 A3 as energy-saving lamp 8 Bit 7 A7 as energy-saving lamp 128

A combination (sum of the individual values) is of course also possible here.

The basic brightness can be adjusted via the CV184. The setting of CV185 specifies how quickly the final brightness value (PWM1 in CVs 116 - 123) should be reached. The step width is CV value * 5ms.

Firebox flickering

A random flickering can be assigned to the light outputs A1 to A7. This effect is used, for example, for the flickering of a firebox.

CV 181: Value bit 0 light output. with	**Value**
flickering 1 Bit 1 A1 with flickering 2	Bit 4 A4 with flickering 16
Bit 2 A2 with flickering 4 Bit 3 A3 with	Bit 5 A5 with flickering 32
flickering 8	Bit 6 A6 with flickering 64
	Bit 7 A7 with flickering 128

A combination (sum of the individual values) is of course also possible here.

The settings for the flickering rhythm and the brightness change are entered in CV182:

Bits 0 - 3 change the flickering rhythm (value range 1 to 15).

Bits 4 - 6 change the brightness (value range 16, 32, 48, 64, 80, 96, 112).

With the value 128 the output is always bright, but can be combined with the value range 16 to 112.

Since only one value can be programmed in a CV, the flickering results from the sum of the individual values of the flickering rhythm plus the sum of the individual values of the brightness (sum of bits 0 - 3 plus sum of bits 4 - 6).

The combination of all bits leads to different, random flickering images. The rule here is: “try it out”.

Smoke generator control

A smoke generator can be connected to outputs A1 to A7, which is controlled by the decoder depending on the load. When stationary, the smoke outlet has the PWM according to CV133. When the locomotive starts moving, the output receives PWM=100%. The locomotive engine can be stopped for 0-15 seconds (start-up delay) so that the smoke generator heats up while stationary. After this time has elapsed, the locomotive starts moving. The output is then controlled at 100% for another time (start-up time). The smoke output then switches to the PWM in normal operation. If the load increases, the smoke output is activated again at 100% for the start-up time that has already been set. The required load increase (load threshold) can be set.

CV meanings:

CV130 determines which of the outputs A1 to A7 is controlled by the smoke generator control and which time should apply to the start-up delay. The value range 1-7 determines the output and the value range 16 - 240 determines the start-up delay in steps of 16, whereby a step of 16 means one second of start-up delay. The sum of the individual values results in the value for the CV130.

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Calculation: Start-up delay * 16 + output

The load threshold is entered into CV131 in a value range from 0 to 127. The larger the value in 0.1s increments, the slower the output reacts to a change in load.
The CV132 determines the PWM for normal travel and the CV133 determines the PWM when stationary. The start-up time is entered in CV134 in 0.1s increments.

Adjustable PWM frequency of light and function outputs

The output voltage of a function output is pulse width modulated (PWM) with a specified frequency.
The function outputs of the decoder work at a factory setting with a frequency of 156 Hz. This frequency can be increased to 24 kHz for the outputs A0 to A5. The frequency switching can be set in bit 3 of the CV50. Bit 3 = 0 -> 156Hz, Bit 3 = 1 -> 24KHz

Controlling an electric clutch

Electrical couplings are made from the finest copper wire windings. These usually react sensitively to constant current flow because they become relatively hot. With appropriate settings, the decoder can ensure that the function outputs switch off automatically after an adjustable time without the function button having to be switched off. The decoder can also ensure that the clutch is only activated for a short switch-on moment with an adjustable high PWM in order to safely raise the clutch. After this moment, less energy is required to keep the clutch up. This lower PWM and the required holding time can also be adjusted. If the couplings used do not uncouple safely on the first attempt, a number of coupling repetitions can also be set. When setting the clutch repetitions, the rule is “as many as necessary, as few as possible”. So that a permanent repetition does not lead to the destruction of the coupling windings, a switch-off time must be entered in 0.1s increments, which the decoder always waits for before carrying out another uncoupling process.

CV124 = Number of coupling processes
CV125 = switch-on time in 100ms steps with the PWM from CV117 (A1) to CV123 (A7)
CV126 = hold time in 100ms steps
CV127 = switch-off time in 100ms steps, (0=no clutch control)
CV128 = Hold PWM
CV129 = Electric clutch for A1 to A7

CV 129:	**Value**		**Value**
Bit 1 A1 for clutch	2	Bit 5 A5 for coupling	32
Bit 2 A2 for clutch	4	Bit 6 A6 for coupling	64
Bit 3 A3 for clutch	8	Bit 7 A7 for clutch	128
Bit 4 A4 for coupling	16		

Shunting tango, automatic uncoupling drive

A maneuvering tango can only be activated if the electric clutch control is activated via CV124-129.
A shunting tango is triggered by one of the clutch outputs when the decoder speed level = 0:

How a shunting tango works:
1. The locomotive moves with an adjustable speed level for an adjustable time (T1) against the current direction of travel (pressing)
2. Locomotive stops and switches direction
3. Uncoupling process and the locomotive runs at the same speed level for an adjustable time T2 (moving away)
4. Locomotive stops, now the locomotive has the original direction of travel again.

The CVs to be set are:

CV135 for the speed level of the shunting tango (1-255). The value 0 specifies that no shunting tango takes place.
CV136 for the pressing time T1 in 100ms steps
CV137 for the departure time T2 in 100ms steps

Shunting tango with automatic coupling and uncoupling

Change in functionality when two couplings are connected to two outputs:

1. In CV129 the lowest value output is always A1 to A7 for the front clutch, so if A1 and A2 are used, A1 should be used for the front clutch and A2 for the rear clutch. If more or less than 2 outputs are defined, there is no difference in the process in the different directions of travel (see automatic uncoupling travel).
2. If the front clutch is triggered via a function button and the direction of travel is forward at this point, the direction of travel is reversed automatically
   During the maneuvering process, the clutch is switched off (coupling process). If the rear clutch is released and the direction of travel is backwards at this point, the coupling process is also triggered now. In the other direction of travel, the clutch is controlled according to the settings for the automatic uncoupling travel.
3. The entire duration of the clutch control must be adapted to the times of the maneuvering tango in CVs 136 and 137 via CVs 124-127.
   The following applies: CV124 * (CV125 + CV126 + CV127) is larger than CV136 + CV137.
   Here, additions may have to be made on the right-hand side of the inequality, since in the shunting tango the decoder only reverses the direction of travel when it determines that the engine is actually stopped.

Servo control

On the PIKO SmartDecoder 4.1 G, up to four servos can be operated on the corresponding pin strips (see Figure 1). Please pay attention to the correct polarity when connecting the servo connectors. As a rule, the darkest cable of a commercial model building servo (usually black) is the GND cable. As can be seen in Figure 1, this must point in the direction of the adjacent row of clamps.

The settings of the breakpoints, the rotation time and the assignment to the desired function keys are stored in the following CVs.

CV160 Servo 1, position 1 (function key off)	CV163 Servo 2, position 1 (function key off)
CV161 Servo 1, position 2 (function key on)	CV164 Servo 2, position 2 (function key on)
CV162 Servo 1, rotation time in 100ms steps	CV165 Servo 2, rotation time in 100ms steps
CV166 Servo 1, function key number F0 - F28 CV168	CV167 Servo 2, function key number F0 - F28
Servo 1, assignment in extended function mapping CV210	CV169 Servo 2, assignment in extended function mapping
Servo 3, position 1 (function key off)	CV213 Servo 4, position 1 (function key off)
CV211 Servo 3, position 2 (function key on)	CV214 Servo 4, position 2 (function key on)
CV212 Servo 3, rotation time in 100ms steps	CV215 Servo 4, rotation time in 100ms steps
CV216 Servo 3, function key number F0 - F28 CV218	CV217 Servo 4, function key number F0 - F28
Servo 3, assignment in extended function mapping For	CV219 Servo 4, assignment in extended function mapping

assignment in extended function mapping, you will find a corresponding assignment table in the “Extended Function Mapping” chapter.

Decoder inputs for internal automatic processes

There are three decoder-internal automatic processes stored in the decoder. These can be started via the decoder inputs Inp.1 - Inp.3, provided bit 7 = 1 is set in CV50
Inp. 1 briefly switches on the special function F2, for example to call up a whistle (depending on the function mapping set) in front of a tunnel.
Inp. 2 switches on the special function F3 briefly, for example to switch on a train driver's greeting (depending on the function mapping set).
Inp. 3 switches on an automatic oscillation end point system, in which the vehicle stops, reverses the direction of travel after a waiting period of approx. 30 seconds and starts off again in the opposite direction at the original speed.

For these three decoder-internal processes, a reed contact (Figure 2) must be connected to the input mentioned and installed in a suitable location under the vehicle. A magnet must now be installed in the track at the desired location. If several processes are to be called up independently of one another, the reed contacts and the track magnets must be far away from each other so that false triggering due to crosstalk cannot occur.

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NOTE: The following two chapters require in-depth knowledge of CV programming. In order to be able to use these possibilities of the decoder even without the corresponding programming knowledge, we recommend that you use the testing and programming device PIKO SmartProgrammer (#56415) and PIKO SmartTester (#56416).

Modulation of the PWM output for the light and function outputs (for experts)

The brightness of the outputs can be modulated using 64 different brightness values, which are periodically output as PWM at the outputs. The playback period is adjustable. It results from the value of CV178 multiplied by 64ms.
Two banks (banks 3 & 4) with four PWM curves each are available for the 8 PWM curves, each with up to 64 individual values.
In total there are 8 available CV banks in the decoder, each with 256 CVs. This variety of possible combinations requires so many CVs that programming in the conventional CV frame 1 to 1024 is no longer possible. Therefore, a special division into CV banks of 256 CVs each (CV257 - 512) is necessary.
So CVs 257 - 512 can be used multiple times. Which of these CV banks should be programmed depends on the respective value of two “pointer CVs”, CVs 31 and 32. The values of these two CVs point to the corresponding CV bank, here banks 3 and 4. The values of the “pointer CVs” do not change the meaning of CVs 1 - 256 and are not relevant for driving.

Setting bank 3 for programming curves 1 to 4: CV31 = 8, CV32 = 3
Setting bank 4 for programming curves 5 to 8: CV31 = 8, CV32 = 4
In the factory setting, North American lighting effects for the following 8 PWM curves are stored here:
1 = Mars Light, 2 = Gyra Light, 3 = Osci. Headlight, 4 = Stakato, 5 = Ditch Light, 6 = rotary beacon, 7 = single strobe, 8 = double strobe
Since up to 64 brightness values can be entered in a gradient, 256 CVs are available for each bank. If a bank is selected for programming using pointers CVs 31 and 32, the individual values are written into CVs 257 - 512, with each course occupying 64 CVs as follows:

Bank 3 (CV31=8,CV32=3)	**Bank 4 (CV31=8,CV32=4)**
Course 1: CVs 257 - 320	Course 5: CVs 257 - 320
Course 2: CVs 321 - 384	Course 6: CVs 321 - 384
Course 3: CVs 385 - 448	Course 7: CVs 385 - 448
Course 4: CVs 449 - 512	History 8: CVs 449 - 512

The curves can be changed at any time or replaced with your own curves by changing the corresponding CVs in a value range from 0 - 63.
One of these 8 PWM curves can be assigned to outputs A0 to A7 via CVs 170 to 177 by entering the desired number 1 - 8 in the respective CV.
Each of the rear light and A1 to A7 outputs can be assigned one of 2 phase positions during playback. This means, for example, that two outputs can be created that flash in alternating cycles. The required settings are entered into CV179:

CV 179: Value Value

Bit 0 A0h, phase position 0° 0 0
Bit 0 A0h, phase angle 180° 1
Bit 1 A1, phase angle 0° 0 Bit 1 A1, phase angle 180° 2 Bit 2 A2, phase angle 0° 0 Bit 2 A2, phase angle 180° 4 Bit 3 A3, phase angle 0° 0 Bit 3 A3, phase position 180° 8 **degrees crossing**
Bit 4 A4, phase position 0°
Bit 4 A4, phase position 180° 16
Bit 5 A5, phase position 0° 0
Bit 5 A5, phase position 180° 32
Bit 6 A6, phase position 0° 0
Bit 6 A6, phase position 180° 64
Bit 7 A7, phase position 0° 0
Bit 7 A7, phase position 180° 128

If bit7 (value 128) of the respective CV170 - 177 is set, the modulated effect is only activated if the CROSS output bit is set via extended function mapping (see extended function mapping). If the CROSS output bit is not set, the output is constantly switched on. If the CROSS output bit is switched off again using extended function mapping, the effect activated in this way remains switched on until a hold time programmed in CV180 has expired. This holding time results from the value of CV 180 multiplied by 100ms.

To make programming easier, especially for modulating the PWM output, we recommend using the testing and programming device PIKO SmartProgrammer (# 56415) and PIKO SmartTester (#56416).

Advanced Function Mapping (for experts)

The following setting options for the decoder are only possible with extended function mapping **(CV 96 = 1) .**
In the extended function mapping, it is possible to simultaneously switch on or off several outputs, acceleration and braking delays, maneuvering gear, second dimming of the function outputs, servos, transfer of the function keys F22 to F28 to SUSI, as well as setting the CROSS bit.
These functions can be switched depending on linked conditions, such as function keys F0 to F44 switched on or off, direction of travel of the locomotive, and locomotive stationary or moving. These combinations are stored in two CV banks.
In total there are 8 available CV banks in the decoder, each with 256 CVs. This variety of possible combinations requires so many CVs that programming in the conventional CV frame 1 to 1024 is no longer possible. Therefore, a special division into CV banks of 256 CVs each (CV257 - 512) is necessary.
So CVs 257 - 512 can be used multiple times.
Which of these CV banks should be programmed depends on the respective value of two “pointer CVs”, CVs 31 and 32. The values of these two CVs point to the corresponding CV bank, here 1 and 2. The values of the “pointer CVs” do not change the meaning of CVs 1 - 256 and are not relevant for driving.

Each CV bank of the extended function mapping consists of 16 lines with 16 entries. These 16 entries then form the combination of switching condition and output.
Since two CV banks are available for the extended function mapping, a total of 32 possible combinations for switching conditions and outputs can be implemented.
TIP: Before programming CVs 257 - 512, you should program pointers CVs 31 and 32 for the desired CV bank. It is advisable to read out these two “pointer CVs” before programming so that incorrect CV banks are not accidentally programmed.
The CV programming of the extended function mapping in detail:
Pointer CVs:
CV31 = 8, CV32 = 0 for lines 1 - 16 (bank 1) and CV31 = 8, CV32 = 1 for lines 17 - 32 (bank 2)
Each line consists of 16 entries (bytes) with the following meaning:
Entries (bytes) 1 - 6 define the functions that must be switched on for the condition to be met.
Entries (bytes) 7 - 12 specify the functions that must be switched off for the condition to be met.
Entries (bytes) 13 - 16 determine the outputs that are switched on when the condition is met.

Each entry (byte) consists of a combination of 8 individual conditions (bits)

Bits 0 - 7 in the respective entries (bytes) for the switching conditions "On" (Bytes 1 - 6) and "Off" (Bytes 7 - 12) have the following meaning:

bit / **byte** **On off**	**0**	**1**	**2 6**	**3**	**4**	**5**		**7**
1/7	F1	F2	F3	F4	F0	nb	Drive.	Prev.
2 / 8 F5		Q6	Q7	Q8	Q9	F10	F11	F12
3 / 9 F13		F14	F15	F16	F17	F18	F19	F20
4 / 10 F21		F22	F23	F24	F25	F26	F27	F28
5 / 11 Q29		F30	F31	F32	F33	F34	F35	F36
6 / 12 F37		F38	F39	F40	F41	F42	F43	F44

Drive. Locomotive drives

Forward Direction of travel Forward
nb not used

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The bits in the respective entries (bytes) 13 - 16 for the output have the following meaning:

bit / byte	0	1	2	3	4	5	6	7
13	A1	A2	A3	A4	A5	A6	A7	A8
14	A0v	A0h	A9	A10	ABV **ABV2** ABV3 RG			
15	A0-P2 A1-P2 A2-P2 A3-P2				A4-P2	A5-P2 A6-P2 A7-P2		
16	Cross S-F22 S-F23 S-F24 S-F25/A11 S-F26 S-F27 S-F28							

A0v — Front light output
A0h — Rear light output
A1 to A11 — Function outputs 1 - 11 (A9 - A11 logic)
ABV — Switch off acceleration and braking delay 1
ABV2 — Switch on acceleration and braking delay 2
ABV3 — Switch on acceleration and braking delay 3
RG — shunting aisle
A0-P2 to A7-P2 — Light and function outputs 1 - 7, 2nd dimming
Cross — CROSS bit for PWM modulated outputs
S-F22 to S-F28 — Switch functions F22 - F28 on or off on the SUSI interface, depending on the result of the conditions set in bytes 1 - 12.
The status of these functions, as transmitted by the digital center, is then no longer transferred to the SUSI interface.
CV159 must be set accordingly for transfer of F22 - F28 to SUSI.

The CV number to be programmed is calculated **for lines 1 - 16:**
basic value 256 plus (line number minus 1) multiplied by 16 plus the byte number.

Formula: 256 + (line - 1) * 16 + byte The

for lines 17 - 32:
Base value 256
plus (line number minus 17) multiplied by 16
plus the number of the byte.

Formula: 256 + (row - 17) * 16 + bytes

bit structure and the corresponding values to be programmed in the CVs are comparable to the configuration CVs of the decoder. This means that there is a fixed value for each bit set. If the bit is not set, the value for this bit remains 0. The sum of the desired values results in the value for the CV.

Bit	**Value**
Bit 0	1
Bit 1	2
Bit 2	4
Bit 3	8
Bit 4	16
Bit 5	32
Bit 6	64
Bit 7	128
Total	255

The values for the individual CVs can now be derived from the information mentioned.

Examples:

1. The output **A1** should be switched on when the function key **F1** is switched on.
Bank 1, line 1 -> CV31 = 8, CV32 = 0
There are two CVs to program
First CV for the switch-on condition (F1 on), second CV for the output (A1 on)
F1 key switched on -> CV number = 256 + (1 - 1) * 16 + 1= 257
F1 key switched on -> Byte 1, Bit 0 = 1 -> CV 257 = 1
Output **A1** switched on -> CV number = 256 + (1 - 1) * 16 + 13 = 269
Output **A1** switched on -> Byte 13, Bit 0 = 1 -> CV269 = 1

2. The front light output **(A0v)** should be switched on when the function key **F0** is switched on and the **locomotive is running.**
Bank 1, line 2 -> CV31 = 8, CV32 = 0
There are two CVs to program
F0 key switched on + **driving->** CV number = 256 + (2 - 1) * 16 +1 = 273
F0 button switched on + **drive.** -> Byte 1, Bit 4 = 1 + Bit 6 = 1-> CV 273 = 16 + 64 = 80
Output **A0v** switched on -> CV number = 256 + (2 - 1) * 16 + 14 = 286
Output **A0v** switched on -> Byte 14, Bit 0 = 1 -> CV286 = 1

Servos 1 - 4 can be assigned to any position in the output table (bytes 13 - 16) via the corresponding CVs 168, 169, 218 and 219. This does not delete the original output function, but rather outputs it additionally.

Values of the CVs related to the position in the output table above

0	16	32	48	64	80	96	112
1	17	33	49	65	**81**	97	113
2	18	34	50	66	82	98	114
3	19	35	51	67	83	99	115

Example: Servo 2 should be placed at the output position of ABV2.
The output position of ABV2 is in the output table at the coordinates “Byte14” (line 2) and “Bit 5” (column 6). At this position in the servo programming table there is the value 81 (line 2, column 6)

CV169 must therefore be programmed with the value 81 for servo 2.

To make programming easier, especially for extended function mapping, we recommend that you use the testing and programming device PIKO SmartProgrammer (# 56415) and PIKO SmartTester (#56416).

Second dimming of the light and function outputs (CV96 = 1)
The light and function outputs can be set to an alternative, i.e. second, dimming (e.g. for a high beam). The settings of the values for the alternative dimming are stored in CVs 150 to 157 for A0 to A7. In the extended function mapping (CV96 = 1), the alternative dimmings of CVs 150 - 157 are activated using the possible conditions there (see “Extended function mapping).

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Resetting to factory settings (Reset)

DANGER! When the decoder is reset, all specific settings programmed at the factory are overwritten! Please only perform a reset in really urgent emergencies. If you still perform a reset, factory-programmed functions may no longer work and you will have to reprogram the individual function mapping (see FAQ)!

To return the decoder to factory settings, two CVs (CV8, CV59) can be used in DCC programming and one CV (CV59) can be used in Motorola programming.
In order not to rewrite all available areas, you can decide which areas should be set to factory settings.

The value 1-5 to be programmed sets the following CVs in the factory setting:

1 = CV0 - 256, and CV257 - 512 (RailCom® Bank 7)	CV31=0, CV32=255
2 = CV257 - 512 (RailCom Plus® banks 5 & 6)	CV31=1, CV32=0 and CV31=1, CV32=1
3 = CV257 - 512 (extended function mapping banks 1 & 2)	CV31=8, CV32=0 and CV31=8, CV32=1
4 = CV257 - 512 (PWM modulation function outputs banks 3 & 4)	CV31=8, CV32=3 and CV31=8, CV32=4

programming

The configuration variables (CVs) form the basis of all setting options for the decoder. The decoder can be programmed with the digital control centers PIKO SmartControl, PIKO SmartControl Light, or other DCC control centers, as well as with Motorola control centers.

TIP: If it is possible with the digital center used, we recommend the DCC CV programming method via a programming track, as all CVs can be read and written using this!

Programming with DCC devices

Use the programming menu of your DCC control center to read and program the decoder CVs via register, CV direct or page programming.
It is also possible to program the decoder via the main track programming (POM) of a DCC digital control center.
Please refer to the manual for the control panel used for the exact procedure.

Programming of long addresses without a programming menu

If the programming is carried out with control panels that do not support the programming of long addresses with an input menu, the value for CV 17 and CV 18 must be calculated.

Here are the example instructions for programming the address 2000.
• Divide the address value by 256 (2000:256 = 7 remainder 208).
• Take the integer result (7) and add 192.
• Enter the result (199) as a value in CV 17.
• Enter the remainder (208) as a value in CV 18.
• Important: Set bit 5 of CV 29 to 1 so that the decoder also uses the long address.

Programming lock (decoder programming lock)

The decoder programming lock is used on multiple decoders in a vehicle to change CVs in only one of the decoders with the same base address (CV1) or long address (CV17 and CV18). To do this, CV16 must be programmed to a different number (index number) in each decoder before the decoders are installed in the vehicle.
To change or read the value of a CV in one of the installed decoders, program the corresponding index number in CV15 and then program the CVs of the selected decoder. The decoders compare the values in CV15 and CV16 and if both values match, access to the CVs is enabled. If the comparison fails, access to the CVs of this decoder is not possible.

The following index numbers are recommended:
1 for motor decoders, 2 for sound decoders, 3 or higher for functional and other types of decoders.

Programming with a Märklin control center (e.g. 6021)

With a Märklin control center, all CVs can be programmed, but not read. The decoder can be put into programming mode and then programmed in two ways (a and b, depending on the control panel).

1a. Switch the control panel off and on

1b. Set the central unit to “Motorola old” (6021 DIP 2 = off), switch the central unit off and on
2a. Select the address of the decoder and switch on the light

2 B. Set the control center to “stop” and select address 80
3a. With the locomotive stationary (speed level 0), press the direction switch 5-8 times in a row until the lighting flashes
3b. When the locomotive is stationary, press and hold the direction switch, set the control center to “go” and wait approx. 12 seconds
4. Enter the number of the CV to be programmed at the control center like a locomotive address
5. Briefly activate the direction switch (5a and 5b). Now the rear lighting flashes 4 times quickly (only 5a)
6. Enter the desired value for the CV like a locomotive address at the control center
7. Briefly activate the direction switch (7a and 7b). Now the rear lighting flashes 4 times slowly (only 7a)
If further CVs are to be programmed, repeat points 4-7

If you want to end the programming, switch the control center to “stop” or enter the address “80” and briefly press the direction switch.
Since entries from 01 to 80 are only possible when programming with a Motorola digital center from Märklin, the value “0” must be entered via the address as “80”.

Page register for entering CV numbers greater than 79

CV numbers greater than 79 can only be programmed using the page register. This page register is CV64. If the CV64 is written with a value greater than 0, the contents of the CV64 are added times 64 to each subsequent address value entered during all subsequent programming processes. The value entered must be in the range 1 to 64.

After successful programming of all CVs greater than 79, the page register (CV64) must be set to zero again.

For example, if CV82 is to be programmed with the value 15, CV64 must first be programmed with the value 1. CV18 can then be programmed with the value 15. In the decoder, the value 15 is now stored in the CV number 82, which results from adding the contents of CV64 (in the example 1) multiplied by 64 (i.e. 64) and the CV number entered at the control center (18).

Offset register for entering CV values greater than 79

CV values greater than 79 can only be programmed using the offset register. This offset register is CV65. If the CV65 is written with a value > 0, the contents of the CV65 will be multiplied by 4 for all subsequent programming, added to each subsequently programmed CV value and stored in the corresponding CV.

After successful programming of all CV values greater than 79, the offset register (CV65) must be set to zero again.

For example, if CV49 is to be programmed with the value 157, CV65 must first be programmed with the value 25. CV49 can then be programmed with the value 57. The value 4 is now displayed in the decoder. Note: When programming the * 25 + 57 filed.

CV64 and CV65, the contents of the offset and page registers are not taken into account.

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Programming with Mobile Station 1, 2 & 3

Mobile Station 1: The programming menu is only available in the locomotive menu for certain locomotives. A locomotive that has a programmable decoder must be selected from the database. Proceed as follows:

1. Create a new locomotive and select the item number. 36330 from the database. The Ee 3/3 locomotive can be seen on the display.
2. Press the “MENU/ESC” button and select the “CHANGE LOCATION” section. Here you will find the last function, among other things, the programming register called “REG”. Use this function to change the CVs of the decoder. You can only write the CVs with this function.
3. Enter the CV number and confirm it with the switch button.
4. Then enter the value of the CV and confirm it with the switch button. The mobile station now programs the CV with the desired value.

Mobile Station 2 & 3: To program please use the DCC CV programming menu.
Attention: Before programming, remove all locomotives from the track that are not to be programmed!

Table of CVs (Configuration Variables) of the decoder

CV	Description	Area	Value*
1	**Address of the locomotive**	DCC: 1 - 127 Motorola: 1 - 80	3
2	**Minimum speed** (change until the locomotive starts at speed level 1)	1-63	1
3	**start-up delay,** 1 means that the current internal speed is increased by 1 every 5 ms For example, if the internal maximum speed is 200 (CV 5 = 50 or CV 94 = 200), then the start-up time from 0 to Vmax is 1 second	0-255	10
4	**Braking delay** (time factor like CV 3)	0-255	0
5	**Maximum speed** (must be greater than CV 2)	1-63	48
6	**Medium speed** (must be greater than CV 2 and less than CV 5)	1-63	24
7	**Software version** (The processor used can be updated)	-	U.N- tersh.
8th	**Manufacturer identification** decoder reset, values as in CV 59	-	162
12	**operating modes** Value bit 0=1 DC (analog operation direct current). 1* Bit 1=1 AC (analog operation alternating current) on 2* Bit 2=1 DCC data format on 4* Bit 3=1 Motorola data format on 8th* Bit 4=1 Selectrix data format on 16* Bit 5=1 data format mfx on (only mfx® variants) 32* *Attention: If all data formats are switched off, the decoder can only be programmed in digital mode.*	0-63, 255	255
13	**Activate function keys in analogue mode** Bit 0-7 -> F1 to F8; Bit = 0 function off, bit = 1 function on	0-255	0
14	**Activate function keys in analogue mode** Bit 0 and Bit 4-7 -> F0 and F9 to F12; Bit = 0 function off, bit = 1 function on	0-255	1
15	**decoder programming lock**	0-255	1
16	**decoder programming lock index number**	0-255	1
17 18	**Long locomotive address** 17 = Higher Byte 18 = Low Byte	128 - 9999 192 - 231 0 - 255	2000 199 208
19	**Consist address (double traction)** 0 = Consist address (CADR) is not active If bit 7 = 1 the direction of travel is reversed, So desired CADR + 128 = reversal of direction	1-127	0
27	**Brake signal settings (automatic hold)** Value Bit 0 = 1 -> ABC right rail more positive 1 Bit 1 = 1 -> ABC left rail more positive 2 Bit 4 = 1 -> DC with opposite direction of travel 16 Bit 5 = 1 -> DC with the same direction of travel 32 Bit 7 = 0 -> ABC only forward direction if bit 0 = 1 or bit 1 = 1 0 Bit 7 = 1 -> ABC only reverse travel direction if bit 0 = 1 or bit 1 = 1 128	0-130	0
28	**RailCom® configuration** Value Bit 0 = 1 -> Channel1 on 1* Bit 1 = 1 -> Channel2 on 2* Bit 7 = 1 -> RailCom Plus® on 128*	0-131	131
29	**Configuration according to DCC standard** Value Bit 0=0 Normal direction of travel 0 Bit 0=1 Opposite direction of travel 1 Bit 1=0 14 speed levels 0 Bit 1=1 28 speed levels 2* Bit 2=0 Digital operation only 0 Bit 2=1 Automatic analog/digital switching 4* Bit 3=0 RailCom® switched off 0 Bit 3=1 RailCom® switched on 8th* Bit 4=0 speed levels via CV 2, 5 and 6 0 Bit 4=1 Use characteristic curve from CV 67 - 94 16 Bit 5=0 Short address (CV 1) 0 Bit 5=1 Long address (CV 17/18) 32	0-63	14
30	**Error memory for function outputs, motor and temperature monitoring** 1 = error function outputs, 2 = error motor, 4 = temperature exceeded	0-7	0
31	1. Pointer CV for CV banks 2.	0, 1, 8	0
32	Pointer CV for CV banks	0,1,3,4,5,255	255

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CV	Description		Area	Value*
33-46	**Simple function mapping**		0-255	
	Assignment of the function outputs to the CVs of the function keys F0 - F12			
	CV 33 Light function button (F0) when driving forward			1
	CV 34 Light function button (F0) when reversing			2
	CV 35 function key F1			4
	CV 36 Function key F2			8th
	CV 37 Function key F3			16
	CV 38 Function key F4			32
	CV 39 function key F5			32
	CV 40 function key F6			64
	CV 41 Function key F7			128
	CV 42 function key F8			64
	CV 43 Function key F9			128
	CV 44 function key F10			0
	CV 45 function key F11			0
	CV 46 Function key F12			0
	Assignment of the individual bits (for CV100/101 bit x = 0, standard)	Value		
	Bit 0 front light output	1		
	Bit 1 rear light output	2		
	Bit 2 Function output A1 Bit 3	4		
	Function output A2 Bit 4 Function	8th		
	output A3 Bit 5 Function output	16		
	A4	32		
	Bit 6 shunting gear	64		
	Bit 7 acceleration/braking delay	128		
	Assignment of the individual bits (for CV100/101 bit x = 1, fkt mapping shift)	Value		
	Bit 0 function output A2	1		
	Bit 1 Function output A3 Bit 2	2		
	Function output A4	4		
	Bit 3 shunting gear	8th		
	Bit 4 acceleration/braking delay Bit 5	16		
	function output A5 Bit 6 function	32		
	output A6	64		
	Bit 7 Function output A7	128		
47	**Motorola 1st trinary address** (only with Motorola programming method)		0-255	12
48	**Motorola 2nd trinary address** (only with Motorola programming method)		0-255	0
49	**Motorola 3rd trinary address** (only with Motorola programming method)		0-255	0
50	**decoder configuration 1**	Value	0-143	0
	Bit 0=0 Motorola 2. Do not use address	0		
	Bit 0=1 Motorola 2. Use address	1		
	Bit 1=0 Motorola 3. Do not use address	0		
	Bit 1=1 Motorola 3. Use address	2		
	Bit 2=0 Do not swap light outputs	0		
	Bit 2=1 Swap light outputs	4		
	Bit 3=0 frequency light, A1 to A8 = 156Hz	0		
	Bit 3=1 frequency light, A1 to A5 = 24KHz (A6 - A8 156Hz)	8th		
	Bit 7=0 Decoder internal automatic off	0		
	Bit 7=0 Decoder internal automatic on	128		
51	**Decoder configuration 2**	Value	0-159	3
	Bit 0=0 Motor control off	0		
	Bit 0=1 Motor control on	1*		
	Bit 1=0 Motor control PID controller	0		
	Bit 1=1 Motor control SX - controller	2*		
	Bit 2=0 no dynamic period duration of the motor control	0		
	Bit 2=1 dynamic period duration of the motor control	4		
	Bit 3=0 After power failure: Restore speed off	0		
	Bit 3=1 After power failure: Restore speed on	8th		
	Bit 4=0 After power failure: Restore functions 0 - 12 off	0		
	Bit 4=1 After power failure: Restore functions 0 - 12	16		
	Bit 7=0 additional starting characteristic curve	0		
	Bit 7=1 additional starting characteristic	128		
53	Motor control period in 100ÿs steps		0-255	40
54	Motor control P constant of the PID controller		0-255	100
55	Motor control I constant of the PID controller 56		0-255	40
	Motor control D constant of the PID controller		0-255	32
57	Controller offset		0-255	6
58	Measuring gap for EMF measurement in 100ÿs steps		0-255	8th
59	**Reset to factory settings** (also possible via CV8) 1 = CV 0 - 256, as well as CV257 - 512 (RailCom® Bank 7) 2 = CV 257 - 512 (RailCom Plus® banks 5 & 6) 3 = CV 257 - 512 (extended function mapping banks 1 & 2) 4 = CV 257 - 512 (PWM modulation function outputs banks 3 & 4)		0 - 4	0
60	**Short-circuit monitoring motor, function outputs, temperature monitoring** Switched on (do not change)		-	-
61	Constant for temperature shutdown Constant for		-	-
62	short-circuit detection of the function outputs (do not change)		-	-
63	Motor output short-circuit detection constant (do not change)		-	-
64	**Page Registers** for CV programming with a Motorola central unit		0-255	0
65	**Offset register** for CV programming with a Motorola central unit		0-255	0

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CV	Description	Area	Value*
66	Forward speed correction	0-255	0
67-94	**Extended speed level characteristic for speed levels 1 - 28**	0-255 each	un-different.
95	Reverse speed correction	0-255	0
96	**Type of function mapping** 0 = simple function mapping, 1 = extended function mapping	0, 1	0
97	**ABC brakes** Voltage difference for diode path is approx. CV value * 0.12V	0-255	8th
98	Speed in the ABC slow travel route 100 **Function Mapping**	0-255	30
Shift (F0 - F4)	Value Bit 0 Change of assignment in CV35 (F1) 1 Bit 1 Change of assignment in CV36 (F2) 2 Bit 2 Change of assignment in CV37 (F3) 4 Bit 3 Change of assignment in CV38 (F4) 8th Bit 4 Change of assignment in CV33 (F0v) 16 Bit 5 Change of assignment in CV34 (F0r) 32	0-63	0
101 **Function Mapping Shift (F5 - F12)**	Value Bit 0 Change of assignment in CV39 (F5) 1* Bit 1 Change of assignment in CV40 (F6) 2* Bit 2 Change of assignment in CV41 (F7) 4* Bit 3 Change of assignment in CV42 (F8) 8th Bit 4 Change of assignment in CV43 (F9) 16 Bit 5 Change of assignment in CV44 (F10) 32 Bit 6 Change of assignment in CV45 (F11) 64 Bit 7 Change of assignment in CV46 (F12) 128	0-255	7
102 **Analogue operation configuration**	Value Bit 0/1 00 = max. speed no regulation 0 01 = max. speed like CV106 1 10 = transformer voltage measure and use CV103 and CV104 2* Bit 2 0 = controller OFF, 1 = controller ON 4* Bit 3 0 = PID controller, 1 = SX controller 8th* Bit 4 1 = dynamic repetition rate 16*	0-31	30
103 **Analogue:** minimum transformer voltage for Vsoll = 0		0-255	150
104 **Analog:** maximum transformer voltage for Vsoll = Vmax		0-255	180
105 **Analog:** Hysteresis		0-255	30
106 **Analogue:** Vmax		0-255	200
107 Switch off front lighting		0-124	0
108 Switch off rear lighting		0-124	0
109 **Flashing generator, assignment of phase 1 to the outputs** Bit 0-7 -> A0 to A7; Bit = 0 -> flashing phase 1 off, bit = 1 -> flashing phase 1 on		0-255	0
110 **Flashing generator, assignment of phase 2 to the outputs** Bit 0-7 -> A0 to A7; Bit = 0 -> flashing phase 2 off, bit = 1 -> flashing phase 2 on		0-255	0
111	Blink generator switch-on time in 100ms steps	0-255	5
112 flash generator switch-off time in 100ms steps		0-255	5
113 **Switching off the function outputs A1 - A7 in the forward direction of travel** Bit 1-7 -> A1 - A7; Bit = 0 -> output on, bit = 1 -> output off		0-254	0
114 **Switching off the function outputs A1 - A7 in the reverse direction of travel** Bit 1-7 -> A1 - A7; Bit = 0 -> output on, bit = 1 -> output off		0-254	0
116-123	**Dimming of the light and function outputs A1 - A7** 0 = output off, 63 = output 100%	0-63	63
124 **clutch repetitions for electric clutches on A1 - A7** 0 = no clutch		0-255	1
125 **Clutch switch-on time,** value * 100ms (with PWM from CV117 - 123)		0-255	10
126 **Clutch holding time,** value * 100ms		0-255	20
127 **Clutch pause time,** value * 100ms		0-255	10
128 **hold PWM**		0-255	30
129 **Assignment of outputs A1 - A7 electrical couplings** (0 = no coupling) Bits 1-7 -> A1 - A7		0-254	0
130 **Dynamic smoke generator control on A1 - A7** 0 = no smoke generator operation Bit 0-3 -> 1=A1, 2=A2, 3=A3, 4=A4, 5=A5, 6=A6, 7=A7 Bit 4-7 = 1 -> start-up time = value * 200ms	Value 0 1-7 16-240	0-247	0
131 Dynamic smoke generator control, load threshold		0-255	5
132 Dynamic smoke generator control, PWM normal operation		0-63	16
133 Dynamic smoke generator control, PWM idle (status)		0-63	2
134 Dynamic smoke generator control, start-up time in 100ms steps		0-255	30
135 **Shunting tango** (automatic uncoupling drive), speed level (0 = off)		0-255	0
136 **shunting tango,** pressing time T1 * 100ms		0-255	10
137 **shunting tango,** departure time T2 * 100ms		0-255	10
138 **Constant braking distance** in cm, speed level threshold Only above this level is braking with a constant braking distance (0 = off)		0-255	0
139 **Constant braking distance** in cm, first braking distance		0-255	50
140 **Constant braking distance** in cm, alternative braking distance (activated by cross-bit)		0-255	25
141 **Constant braking distance** in cm, maximum speed of the model locomotive in cm/s 142		0-255	40
Constant braking distance in cm, residual value of the determined maximum speed 143 **Constant**		0-255	0
braking distance in cm, activated by (0 = off): Bit 0 = 1 -> target speed = 0 Bit 1 = 1 -> ABC brakes Bit 2 = 1 -> DC braking Bit 3 = 1 -> DCC brake signal		15	0

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CV	Description	Area	Value*
144	**Start-up delay 2** (as a replacement for CV3)	0-255	12
145	**Braking delay** 2, (as a replacement for CV4)	0-255	12
146	**Start-up delay 3** (as a replacement for CV3)	0-255	24
147	**Braking delay** 3, (as a replacement for CV4)	0-255	24
148	Function key number for ABV 2 (255=off)	0-28	255
149	Function key number for ABV 3 (255=off)	0-28	255
150-157	**Second dimming of the light and function outputs A1 - A7** 0 = off, 63 = 100%	0-63	10
159	Identification of functions F22 - F28 for transfer to SUSI Bits 0-6; Bit = 1 --> F22 - F28 is passed to SUSI	0-127	0
160	Servo control, servo 1 position 1 (function key off)	0-255	20
161	Servo control, servo 1 position 2 (function key on)	0-255	200
162	servo control, servo 1 rotation time in 100ms steps	0-255	30
163	Servo control, servo 2 position 1 (function key off)	0-255	20
164	Servo control, servo 2 position 2 (function key on)	0-255	200
165	servo control, servo 2 rotation time in 100ms steps	0-255	30
166	Function key number for servo 1	0-28	9
167	Function key number for servo 2	0-28	10
168	Servo 1: Output value from extended function mapping	0-115	0
169	Servo 2: Output value from extended function mapping	0-115	0
170-177	**Assignment of PWM curve for light output, A1 - A7** History 1 - 8, Bit 7 = 1 -> History only active if CROSS output bit set	0-8 129-136	0
178	**PWM history,** playback period (value * 64ms)	0-255	15
179	**PWM curve,** phase position of the outputs Bit 0-7 = 0 A0h - A7 -> phase position 0° Bit 0-7 = 1 A0h - A7 -> phase position 180°	0-255	0
180	**PWM history,** hold time, after CROSS output bit off (value * 100ms)	0-255	0
181	**Firebox flickering of the light and function outputs A1 - A7** Bit 0-7 -> A0 - A7; Bit = 0 -> flickering off, bit = 1 -> flickering on	0-255	0
182	**firebox flickering, flickering settings** Bit 0-3 -> Change flickering rhythm (value range 1 to 15) Bit 4-6 -> Change brightness (value range 16, 32, 48, 64, 80, 96, 112) Bit 7 = 1 -> Output always bright (can be combined with bits 4-6)	0-255	0
183	**energy saving lamp effect of the light and function outputs A1 - A7** Bit 0-7 -> A0 - A7; Bit = 0 -> Effect off, Bit = 1 -> Effect on	0-255	0
184	**energy saving lamp effect,** basic brightness	0-63	10
185	**energy saving lamp effect,** time until maximum brightness is reached (value * 5ms)	0-255	100
186	**Show and hide the light and function outputs A1 - A7** Bit 0-7 -> A0 - A7; Bit = 0 -> Blending function off, Bit = 1 -> Blending function on	0-255	0
187	**Fade in and out,** fade time (value * 10ms)	0-255	30
188	**neon tubes switching effect of the light and function outputs A1 - A7** Bit 0-7 -> A0 - A7; Bit = 0 -> Effect off, Bit = 1 -> Effect on	0-255	0
189	**neon tubes switch-on effect,** flash time (value * 5ms)	0-255	20
190	**neon tubes switch-on effect,** maximum number of flashes	0-255	20
191	A8 function key assignment (simple function mapping)	1-44	11
192	A9 function key assignment (simple function mapping)	1-44	12
193	A10 Function key assignment (simple function mapping)	1-44	13
194	A11 Function key assignment (simple function mapping)	1-44	14
200	**motor control, speed dependent period** Minimum speed level up to which the period = CV53 is set	0-255	10
201	maximum speed level from which the period duration = CV202 is set 202	0-255	150
	maximum period duration in 100ÿs steps (min=CV53)	0-255	250
208	Energy storage: StartUp time until charging begins in seconds increments	0-255	3
209	Energy storage: Maximum supply time in 100ms steps	0-255	20
210	Servo control, servo 3 position 1 (function key off)	0-255	20
211	Servo control, servo 3 position 2 (function key on)	0-255	200
212	servo control, servo 3 rotation time in 100ms steps	0-255	30
213	Servo control, servo 4 position 1 (function key off)	0-255	20
214	Servo control, servo 4 position 2 (function key on)	0-255	200
215	servo control, servo 4 rotation time in 100ms steps	0-255	30
216	Function key number for servo 3	0-28	27
217	Function key number for servo 4	0-28	18
218	Servo 3: Output value from extended function mapping	0-115	0
219	Servo 4: Output value from extended function mapping	0-115	0

* Factory set values

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CV table for programming banks 1 - 4

CV	Bank 1, extended function mapping, lines 1 - 16 (CV31=8,CV32=0), factory values range	
257-272	Condition ON: 144, 0, 0, 0, 0, 0, Condition OFF: 0, 0, 0, 0, 0, 0, Output: 0, 1, 0, 0,	0 - 255 each
273-288	Condition ON: 16, 0, 0, 0, 0, 0, Condition OFF: 128, 0, 0, 0, 0, 0, Output: 0, 2, 0, 0, 0 - 255 each	
289-304	Condition ON: 1, 0, 0, 0, 0, 0, Condition OFF: 0, 0, 0, 0, 0, 0, Output: 1, 0, 0, 0,	0 - 255 each
305-320	Condition ON: 2, 0, 0, 0, 0, 0, Condition OFF: 0, 0, 0, 0, 0, 0, Output: 2, 0, 0, 0,	0 - 255 each.
321-336	Condition ON: 0, 0, 0, 0, 0, 0, Condition OFF: 0, 0, 0, 0, 0, 0, Output: 0, 0, 0, 0,	0 - 255 each
337-352	Condition ON: 0, 0, 0, 0, 0, 0, Condition OFF: 0, 0, 0, 0, 0, 0, Output: 0, 0, 0, 0,	0 - 255 each
353-368	Condition ON: 0, 0, 0, 0, 0, 0, Condition OFF: 0, 0, 0, 0, 0, 0, Output: 0, 0, 0, 0,	0 - 255 each
369-384	Condition ON: 0, 0, 0, 0, 0, 0, Condition OFF: 0, 0, 0, 0, 0, 0, Output: 0, 0, 0, 0,	0 - 255 each
385-400	Condition ON: 0, 0, 0, 0, 0, 0, Condition OFF: 0, 0, 0, 0, 0, 0, Output: 0, 0, 0, 0,	0 - 255 each
401-416	Condition ON: 0, 0, 0, 0, 0, 0, Condition OFF: 0, 0, 0, 0, 0, 0, Output: 0, 0, 0, 0,	0 - 255 each
417-432	Condition ON: 0, 0, 0, 0, 0, 0, Condition OFF: 0, 0, 0, 0, 0, 0, Output: 0, 0, 0, 0,	0 - 255 each
433-448	Condition ON: 0, 0, 0, 0, 0, 0, Condition OFF: 0, 0, 0, 0, 0, 0, Output: 0, 0, 0, 0,	0 - 255 each
449-464	Condition ON: 0, 0, 0, 0, 0, 0, Condition OFF: 0, 0, 0, 0, 0, 0, Output: 0, 0, 0, 0,	0 - 255 each
465-480	Condition ON: 0, 0, 0, 0, 0, 0, Condition OFF: 0, 0, 0, 0, 0, 0, Output: 0, 0, 0, 0,	0 - 255 each
481-496	Condition ON: 0, 0, 0, 0, 0, 0, Condition OFF: 0, 0, 0, 0, 0, 0, Output: 0, 0, 0, 0,,	0 - 255 each
497-512	Condition ON: 0, 0, 0, 0, 0, 0, Condition OFF: 0, 0, 0, 0, 0, 0, Output: 0, 0, 0, 0,	0 - 255 each
	Bank 2, extended function mapping, lines 17 - 32, (CV31=8,CV32=1), factory values	
257-272	Condition ON: 0, 0, 0, 0, 0, 0, Condition OFF: 0, 0, 0, 0, 0, 0, Output: 0, 0, 0, 0,	0 - 255 each
273-288	Condition ON: 0, 0, 0, 0, 0, 0, Condition OFF: 0, 0, 0, 0, 0, 0, Output: 0, 0, 0, 0,	0 - 255 each
289-304	Condition ON: 0, 0, 0, 0, 0, 0, Condition OFF: 0, 0, 0, 0, 0, 0, Output: 0, 0, 0, 0,	0 - 255 each
305-320	Condition ON: 0, 0, 0, 0, 0, 0, Condition OFF: 0, 0, 0, 0, 0, 0, Output: 0, 0, 0, 0,	0 - 255 each
321-336	Condition ON: 0, 0, 0, 0, 0, 0, Condition OFF: 0, 0, 0, 0, 0, 0, Output: 0, 0, 0, 0,	0 - 255 each
337-352	Condition ON: 0, 0, 0, 0, 0, 0, Condition OFF: 0, 0, 0, 0, 0, 0, Output: 0, 0, 0, 0,	0 - 255 each
353-368	Condition ON: 0, 0, 0, 0, 0, 0, Condition OFF: 0, 0, 0, 0, 0, 0, Output: 0, 0, 0, 0,	0 - 255 each
369-384	Condition ON: 0, 0, 0, 0, 0, 0, Condition OFF: 0, 0, 0, 0, 0, 0, Output: 0, 0, 0, 0,	0 - 255 each
385-400	Condition ON: 0, 0, 0, 0, 0, 0, Condition OFF: 0, 0, 0, 0, 0, 0, Output: 0, 0, 0, 0,	0 - 255 each
401-416	Condition ON: 0, 0, 0, 0, 0, 0, Condition OFF: 0, 0, 0, 0, 0, 0, Output: 0, 0, 0, 0,	0 - 255 each
417-432	Condition ON: 0, 0, 0, 0, 0, 0, Condition OFF: 0, 0, 0, 0, 0, 0, Output: 0, 0, 0, 0,	0 - 255 each
433-448	Condition ON: 0, 0, 0, 0, 0, 0, Condition OFF: 0, 0, 0, 0, 0, 0, Output: 0, 0, 0, 0,	0 - 255 each
449-464	Condition ON: 0, 0, 0, 0, 0, 0, Condition OFF: 0, 0, 0, 0, 0, 0, Output: 0, 0, 0, 0,	0 - 255 each
465-480	Condition ON: 0, 0, 0, 0, 0, 0, Condition OFF: 0, 0, 0, 0, 0, 0, Output: 0, 0, 0, 0,	0 - 255 each
481-496	Condition ON: 0, 0, 0, 0, 0, 0, Condition OFF: 0, 0, 0, 0, 0, 0, Output: 0, 0, 0, 0,	0 - 255 each
497-512	Condition ON: 0, 0, 0, 0, 0, 0, Condition OFF: 0, 0, 0, 0, 0, 0, Output: 0, 0, 0, 0,	0 - 255 each
	Bank 3, PWM modulations, course 1 - 4, (CV31=8,CV32=3), factory values	
257 until 320	3, 8, 16, 24, 32, 48, 63, 63, 63, 63, 48, 32, 24, 16, 8, 3, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 3, 8, 16, 24, 32, 48, 63, 63, 63, 63, 48, 32, 24, 16, 8, 3, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,	each 0 - 63 each 0 - 63 each 0 - 63 each 0 - 63
321 until 384	3, 8, 16, 24, 32, 48, 63, 63, 63, 63, 48, 32, 24, 16, 8, 3, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,, 3, 8, 11, 14, 22, 28, 32, 32, 32, 32, 28, 22, 14, 11, 8, 3, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,	each 0 - 63 each 0 - 63 each 0 - 63 each 0 - 63
385 until 448	5, 15, 25, 35, 45, 55, 63, 63, 63, 55, 45, 35, 25, 15, 5, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,	each 0 - 63 each 0 - 63 each 0 - 63 each 0 - 63
449 until 512	8, 8, 8, 8, 8, 8, 8, 8, 8, 8, 8, 8, 8, 8, 8, 8, 32, 32, 32, 32, 32, 32, 32, 32, 32, 32, 32, 32, 32, 32, 32, 32, 63, 63, 63, 63, 63, 63, 63, 63, 63, 63, 63, 63, 63, 63, 63, 63, 48, 48, 48, 48, 48, 48, 48, 48, 48, 48, 48, 48, 48, 48, 48, 48,	each 0 - 63 each 0 - 63 each 0 - 63 each 0 - 63
	Bank 4, PWM modulations, course 5 - 8, (CV31=8,CV32=4), factory values	
257 until 320	3, 8, 16, 24, 32, 40, 48, 56, 63, 63, 63, 63, 63, 63, 63, 63, 56, 50, 44, 40, 36, 33, 29, 26, 23, 21, 19, 17, 14, 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,	each 0 - 63 each 0 - 63 each 0 - 63 each 0 - 63
321 until 384	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 63, 63, 63, 63, 63, 63, 63, 63, 16, 15, 14, 13, 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,	each 0 - 63 each 0 - 63 each 0 - 63 each 0 - 63
385 until 448	63, 63, 63, 63, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,	each 0 - 63 each 0 - 63 each 0 - 63 each 0 - 63
449 until 512	63, 63, 63, 63, 0, 0, 0, 0, 63, 63, 63, 63, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,	each 0 - 63 each 0 - 63 each 0 - 63 each 0 - 63

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Technical data

Addresses:	1-9999 (long DCC address)
Max. motor current / total load: Function	5 A*
outputs: Sound	1 A each
connection: Size:	SUSI
	73x30x11mm

*
Continuous load, can vary depending on the installation situation

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NOTE: This product is not a toy and is not suitable for children under 14 years of age. Any liability for Damage of all kinds caused by improper use or failure to follow these instructions are, is excluded.

If you have any questions, we are here for you!

Internet: www.piko.de
Email: info@piko.de
Hotline: Tue + Thu 4 p.m. - 6 p.m., Tel.: 03675 897255

Service: If there is a defect, please send us the module with the proof of purchase, a short one Description of the error and the decoder address.

Warranty Statement

Each component is checked for complete functionality before delivery. Should be within the warranty period If an error occurs after 2 years, we will replace the module free of charge upon presentation of proof of purchase maintained. The guarantee does not apply if the damage was caused by improper handling. Please Please note that, according to EMC law, the module may only be operated in vehicles that have the CE mark carry.

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