Table of the CVs (Configuration Variables)

CV	Name	Description	Range	Value*
1	Decoder address	Address of the function decoder in the digital system	DCC 1-127 Mot 1-80	3
7	Version number			varies
8	Manufacturer ID			85
12	Operating modes	Bit 0=1 DC (Analog operation DC) on Bit 1=1 AC (Analog operation AC) on Bit 2=1 DCC data format on Bit 3=1 Motorola® data format on Attention: If all data formats are switched off, the decoder can only be programmed in digital mode. digital mode can only be programmed.	0 - 63	31
13	Analog mode F1 to F8	Activate function keys in analog mode Bit 0 - 7 -> F1 to F8; Bit = 0 Function off, Bit = 1 Function on	0 - 255	0
14	Analog mode F9 to F12	Activate function keys in analog mode Bit 0, 4 - 7 -> F0, F9 to F12; Bit = 0 Function off, Bit = 1 Function on	0 - 255	1
17 18	Long address 1-9999	17 = high byte 18 = low byte	192-231 / 0-255	2000 199/208
19	Consist Address (doubleheading)	0 = no consisting	1-127	0
28	RailCom® Configuration	Bit 0 = 1 -> Channel1 on Bit 1 = 1 -> Channel2 on Bit 7 = 1 -> RailCom Plus® on	0 - 131	131
29	Configuration per DCC-specification	Bit 0=0 normal direction 0 Bit 0=1 opposite direction 1 Bit 1=0 14 drive levels 0 Bit 1=1 28 drive 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 *8 Bit 4=0 drive levels about 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	1 = Fct. outputs error, 4 = Temperature exceedance		
31	CV banks	1. CV pointer for CV banks	0-1-8	0
32	CV banks	2. CV pointer for CV banks	0-5, 255	255
33 - 46	Simple mapping	Simple function mapping Assignment of the function outputs to the function keys	0-255	different
47	Motorola® F0 - F4	1. MM address (direct only with Motorola® programming method)	0-255	12
48	Motorola® F5 - F8	2. MM address (direct only with Motorola® programming method)	0-255	0
49	Motorola® F9 - F12	3. MM address (direct only with Motorola® programming method)	0-255	0
50	Decoder configuration	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 - A0v/A0h do not exchange *0 Bit 2 = 1 - A0v/A0h exchange 4 Bit 3 = 0 - Frequency A0 to A4 = 156Hz *0 Bit 3 = 1 - Frequency A0 to A4 = 24KHz 8	0-15	0
59	Reset	Reset to factory setting (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
96	Function mapping type	0 = simple function mapping, 1 = extended function mapping	0, 1	0

CV	Name	Description	Range	Value*
109	Blink generator phase 1	Bit 0-7 -> A0 to A7; Bit = 0 -> phase 1 off, Bit = 1 -> phase 1 on	0 - 255	0
110	Blink generator phase 2	Bit 0-7 -> A0 to A7; Bit = 0 -> phase 2 off, Bit = 1 -> Phase 2 on	0 - 255	0
111	Blink generator on	Blink generator switch on time in 100ms steps	0 - 255	5
112	Blink generator off	Blink generator switch off time in 100ms steps	0 - 255	5
113	A1 - A4 forward Off	Bit 1-4 -> A1 - A4; Bit = 0 -> output on, Bit = 1 -> output off	0 - 30	0
114	A1 - A4 backward Off	Bit 1-4 -> A1 - A4; Bit = 0 -> output on, Bit = 1 -> output off	0 - 30	0
116 - 121	Dimming A0 - A4	0 = output off, 63 = output 100%	0 - 255	63
124	electr. coupling	Coupling repetitions at A1 - A4 (0 = no coupling)	0 - 255	1
125	electr. coupling	Switch-on time of the clutch, value* 100ms (with PWM from CV117 - 121)	0 - 255	10
126	electr. coupling	Holding time of the coupling, value* 100ms	0 - 255	20
127	electr. coupling	Break time of the coupling, value* 100ms	0 - 255	10
128	electr. coupling	Holding PWM	0 - 255	30
129	electr. coupling	Assignment of outputs A1 - A4, bit 1-4 -> A1 - A4	0 - 255	0
150 - 155	Second dimming A0 - A4	Second dimming A0 - A4, 0 = off, 63 = 100%	0 - 255	10
170 - 175	PWM history	Assignment A0 - A4, course 1 - 8	0 - 255	0
178	PWM history	Period duration of the playback (value* 64ms)	0 - 255	15
179	PWM history, phase position	Bit 0-4 = 0 A0h - A4 -> phase position 0° Bit 0-4 = 1 A0h - A4 -> phase position 180°	0 - 255	0
181	Firebox flicker	Bit 0-4 -> A0 - A4; Bit = 0 -> flickering off, Bit = 1 -> flickering on	0 - 255	0
182	Firebox flicker	Bit 0-3 -> Change flicker 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 Bit 4-6)	0 - 255	0
183	Energy saving lamp effect	Bit 0-4 -> A0 - A4; 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	Bit 0-4 -> A0 - A4; Bit = 0 -> Blinding fct. off, Bit = 1 -> Blinding fct. on	0 - 255	0
187	Show and hide	Fade time (value* 10ms)	0 - 255	30
188	Neon lights switch on effect	Bit 0-4 -> A0 - A4; Bit = 0 -> effect off, Bit = 1 -> effect on	0 - 255	0
189	Neon lights switch on effect	Flash time (value* 5ms)	0 - 255	20
190	Neon lights switch on effect	maximum flash count	0 - 255	

*The factory set values are marked with *.*

NOTE: This product is not a toy and is not suitable for children under the age of 14. Any liability for damage of any kind caused by improper use or failure to observe these instructions is excluded.

Service:
Internet: www.piko.de
E-Mail:info@piko.de
Hotline: Di + Do 16-18 Uhr, Tel.: +49 3675 897255

In the event of a defective decoder, please return the decoder module to PIKO along with proof of purchase, the decoder address, and a short description of the problem.

Warranty Statement
Each decoder module is fully tested before shipment. Nevertheless, should a malfunction occur within the 2-year warranty period, we will repair the module free of charge on presentation of the proof of purchase. This warranty is voided if the unit has been damaged by improper use. Please note that, according to the German Electromagnetic Compatibility Law (EMV-Gesetz), the decoder module may only be used inside models bearing the CE mark.

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96515 Sonneberg
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56126
Multi-protocoll function decoder for DCC with RailCom+® and Motorola®

Properties

- 14, 28, 128 speed steps, depending on data format
- Short (1-127) and long (DCC 128-9999) addresses
- RailCom® and RailCom® Plus capable
- Total load 0.6A
- All 6 outputs adjustable depending on direction of travel
- Light and function outputs for analog operation
- Second dimming switchable for all outputs
- Simple function mapping, F0 - F12
- Extended function mapping, F0 - F68
- Function outputs: flashing with variable time
- Function outputs: 2 phases for alternating flashers
- Firebox with setting parameters
- Fade in, fade out of light and function outputs
- Energy saving lamp effect
- Fluorescent lamp switch-on effect
- 8 modulation sequences for e.g. American light effects like Mars Light, Gyra Light, etc.
- Motorola with 3 addresses for functions F1 - F12
- All outputs protected against overload
- Error memory for function outputs
- DCC CV programming, Motorola programming
- Main track programming POM (DCC)
- Decoder programming lock

Description
The function decoder is a small efficient Multi-protocol decoder. It can be used with in DCC and Motorola Digital systems or on Analog layouts with DC or AC voltage. The respective operating mode is automatically detected. The decoder is RailCom® and RailCom Plus® capable. It has two direction-dependent lighting outputs and four additional special function outputs. The assignment of the special function outputs can be freely assigned to the function keys F0 - F12 of the digital command station (small function mapping). In Motorola format, these can be switched via three addresses. In addition, the decoder also masters the extended function mapping. In the extended function mapping the simultaneous switching on or off of several outputs is possible depending on linked conditions (F keys, direction of travel, locomotive stopped / moving) with a function key assignment F0 - F68. The decoder is programmable via DCC and Märklin controllers. All CVs can be programmed with all devices. In factory default state the decoder automatically recognizes the DCC and Motorola data formats as well as analog operation. The operation type can also be set up manually.

Installation of the Function decoder

Connecting the wires

When the decoder is installed a vehicle the black wire is connected to the left pickup (2-rail) or to the vehicle chassis (3-rail). The red wire is connected to the right pickup (2-rail) or to the vehicle third rail pickup (3-rail). The loads are soldered directly to the circuit board of the decoder. For this purpose, the consumers to be connected are connected with one pole to the function output and with the second pole either to the blue cable for the 20V feedback or to the black cable (vehicle ground). When connecting LEDs, the correct series resistor and polarity must be ensured. When connecting incandescent lamps, we recommend connecting a resistor of 68 ohms in series to each incandescent lamp to adapt the operating voltage and to avoid very high inrush currents.

Attaching the decoders in the Vehicle

Use the provided double sided adhesive pad to fix the decoder to the desired location in the locomotive. The adhesive pad protects the decoder from contacting conducting surfaces and holds it in place.

Double check the correct installation with a continuity tester or an Ohmmeter. When placing the device make sure it does not come in contact with any conducting surfaces in the vehicle! Also ensure that a shot circuit cannot occur when the locomotive is close and that the wire is not cinched.

A short circuit with the Motor, lighting, third rail pickup and wheels can destroy the device and eventually the locomotive electronics!

Digital operating

Commissioning the decoder

Enter address 3 on the control unit. Depending on the data format used to address it, the decoder operates in DCC mode with 28 speed steps or in Motorola® mode. If the decoder is used on conventional layouts, it can be controlled with a DC or AC traction unit. The operating mode is automatically recognized by the decoder. The state of the functions F0 - F12 can be set for analog operation via CVs 13 and 14. Programming can be done in DCC and Motorola format.

Delivery state

The decoder is preset to address 3. It automatically switches between the data formats and analog operation. In the factory setting the outputs are set as follows.
F0 switches A0v and A0h, direction-dependent
F1 switches A1
F2 switches A2
F3 switches A3
F4 switches A4

Function outputs

Simple function mapping

The following setting options of the decoder are only possible with simple function mapping (CV96=0). In the simple function mapping the assignments of the switching tasks like lighting, special function outputs can be freely assigned to the function keys F0 to F12 of the digital center. The value, which is written into a CV of the function mapping, determines the functions, which 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 function keys to CVs	Factory value	Assignment of individual bits	value
CV 33 Light function key F0 during forward travel	1	Bit 0 - Function output A0v	1
CV 34 Light function key F0 during reverse travel	2	Bit 1 - Function output A0h	2
CV 35 Function key F1	4	Bit 2 - Function output A1	4
CV 36 Function key F2	8	Bit 3 - Function output A2	8
CV 37 Function key F3	16	Bit 4 - Function output A3	16
CV 38 Function key F4	32	Bit 5 - Function output A4	32
CV 39 Function key F5	0		
CV 40 Function key F6	0		
CV 41 Function key F7	0		
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		

Direction-dependent outputs A1 - A4

In CVs 113 (direction of travel forward) and 114 (direction of travel backward) you can define which function output A1 - A4 is to be switched off in each case. If such an output is switched on via a function key, it is automatically switched off in the desired direction of travel.

CV113 = 2 -> A1 forward off	CV114 = 2 -> A1 backwards off
CV113 = 4 -> A2 forward off	CV114 = 4 -> A2 backwards off
CV113 = 8 -> A3 forward off	CV114 = 8 -> A3 backwards off
CV113 = 16 -> A4 forward off	CV114 = 16 -> A4 backwards off

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

Dim outputs

The function outputs A0 to A4 can be set to any dimming. These settings are stored in CVs 116 (A0v/A0h), 117 (A1), 118 (A2), 119 (A3) and 120 (A4).

Show and hide outputs

If the output is switched on or off, it will be faded in or out softly.
In CV186 you can define which output should get this fade function.
CV186 = 1 -> fade function for A0v/A0h
CV186 = 2 -> fade function for A1
CV186 = 4 -> fade function for A2
CV186 = 8 -> fade function for A3
CV186 = 16 -> fade function for A4
A combination (sum of the individual values) is possible.
The setting of CV187 specifies how fast the blend function should work. The step size is CV value * 1ms.

Blinking outputs

The function decoder has a flash generator that can be assigned to the outputs. Both the on-time and the off-time of the blink generator can be set separately. In CV109 you can define which output should use the blink generator. CV110 can also be used to specify which output should use the flash generator with the phase rotated by 180°. So e.g. an alternating flasher can be realized.

CV109 = 1 -> A0v/A0h blink	CV110 = 1 -> A0v/A0h blink with rotated phase
CV109 = 2 -> A1 blink	CV110 = 2 -> A1 blink with rotated phase
CV109 = 4 -> A2 blink	CV110 = 4 -> A2 blink with rotated phase
CV109 = 8 -> A3 blink	CV110 = 8 -> A3 blink with rotated phase
CV109 = 16 -> A4 blink	CV110 = 16 -> A4 blink with rotated phase

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

Energy saving lamp effect when switching on the function outputs

When an energy-saving lamp is switched on, it first generates a basic brightness before slowly reaching maximum brightness. This effect can be assigned to the outputs of the decoder as follows.
In CV 183 you can define which output should get this effect.
CV183 = 1 -> effect for A0v/A0h
CV183 = 2 -> effect for A1
CV183 = 4 -> effect for A2
CV183 = 8 -> effect for A3
CV183 = 16 -> effect for A4
A combination (sum of the individual values) is possible.

Outputs with switch-on effect of a fluorescent lamp

The switch-on effect of a neon tube can also be output at the function outputs. This effect consists of an adjustable maximum number of flashes (randomly one flash to maximum set number of flashes) and an adjustable flash time, i.e. how fast the flashes should follow each other. In CV 188 you can define which output should receive this effect.
CV188 = 1 -> effect for A0v/A0h
CV188 = 2 -> effect for A1
CV188 = 4 -> effect for A2
CV188 = 8 -> effect for A3
CV188 = 16 -> effect for A4
A combination (sum of the individual values) is possible.
The flash time is set via CV 189 in 5ms steps. The maximum number of flashes in CV 190.
The basic brightness is adjustable via CV184. The setting of CV185 specifies how fast the final brightness value (PWM1 in CVs 116 - 120) should be reached. The step size is CV value * 5ms.

Adjustable PWM frequency function outputs

The output voltage of a function output is pulse width modulated (PWM) with a preset frequency. The function outputs of the decoder operate with a frequency of 156 Hz in the factory setting. This frequency can be increased to 24 kHz for all outputs A0 to A4. A typical application can be an electrical coupling. Only with the higher frequency these couplings do not "flutter" any more. The frequency switching can be set in CV50 in bit3.
Bit 3 = 0 -> 156Hz, Bit 3 = 1 -> 24KHz

Firebox flickering

A random flickering can be assigned to the outputs A0v/A0h, A1 to A4. This effect is used e.g. for the flickering of a firebox. CV 181 can be used to define which output should receive this effect.
CV181 = 1 -> effect for A0v/A0h
CV181 = 2 -> effect for A1
CV181 = 4 -> effect for A2
CV181 = 8 -> effect for A3
CV181 = 16 -> effect for A4
A combination (sum of the individual values) is possible.
In CV182 the settings for the flicker rhythm, as well as for the brightness change are entered as follows.
Bits 0 - 3 change the flicker rhythm (value range 1 to 15).
Bits 4 - 6 change 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 single values of the flickering rhythm plus the sum of the single values of the brightness (sum of bits 0 -3 plus sum of bits 4 - 6). The combination of all bits results in different, random flicker images.

Control of an electric Coupling

Electrical couplings consist of extremely fine copper wire windings. These usually react sensitively to continuous current flow because they become relatively hot as a result. With the appropriate settings, the decoder can ensure that the function outputs switch off automatically after an adjustable time without having to switch off the function key. Furthermore, the decoder can ensure that the clutch is only controlled for a short switch-on moment with an adjustable high PWM in order to lift the clutch safely. After this moment, less energy is needed to keep the clutch up. Also this, lower PWM, as well as the required holding time are adjustable. If the used clutches do not disengage safely on the first try, a number of clutch 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 steps, which the decoder always waits for before carrying out another uncoupling process.
Translated with www.DeepL.com/Translator (free version).
CV124 = Number of coupling repetitions
CV125 = Switch-on time in 100ms steps with the PWM from CV117 (A1) to CV120 (A4)
CV126 = Hold time in 100ms steps
CV127 = Switch-off time in 100ms steps, (0=no clutch control)
CV128 = Hold PWM
CV129 = 2 -> Coupling for A1
CV129 = 4 -> Coupling for A2
CV129 = 8 -> Coupling for A3
CV129 = 16 -> Coupling for A4

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

Switch outputs to a second dimming (e.g. darker lighting or high beam)

The 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 (A0v/A0h), 151 (A1), 152 (A2), 153 (A3) and 154 (A4). In the extended function mapping (CV96 = 1) the alternative dimmings of CVs 150 - 154 are activated via the conditions possible there (see "Extended function mapping).

Note:

For further information about the setting options of the extended mapping and the modulations of the PWM outputs (North American light effects), please refer to the detailed user manual, which you can find in our webshop as PDF on the page of the respective item.

Analog mode

CVs 13 and 14 can be used to define which function numbers F0 - F12 are switched on in analog mode. In CVs 13 and 14 not the outputs but the function numbers are stored, which are entered in CVs 33 - 46 for the respective outputs.

Reset to factory setting (Reset)

ATTENTION! When resetting the decoder, all specific settings programmed ex works will be overwritten! Therefore, please perform a reset only in really urgent emergencies. If you nevertheless perform a reset, factory-programmed functions may no longer work and you will have to reprogram the individual FunctionMapping (see FAQ)!

To reset the decoder to factory settings, two CVs (CV8, CV59) can be used in DCC programming, one CV (CV59) in Motorola programming. In order not to rewrite all available ranges, it can be decided which ranges should be brought into factory setting.
The value 1-4 to be programmed sets the following CVs to factory setting:

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

Programming

The basis of all setting possibilities of the decoder are the configuration variables (CV's) according to the DCC standard. The decoder can be programmed with the PIKO SmartControl, PIKO SmartControl$_{light^{4}}$ as well as DCC and Motorola command stations.

Programming with DCC devices

Use the programming menu of your DCC control panel to set the decoder CVs by register, CV directly or CV directly. Page programming to read and program. It is also possible to program the decoder by main track programming with a DCC digital panel.

Programming of long addresses without the programming menu

If programming is to done with a centre which does not support programming with an input menu, the value for CV17 and CV18 must be calculated. Here is an example for programming the address 2000
• Divide the addresses by 256 (2000:256 = 7 remainder 208).
• Take the result (7) and add it to 192.
• Program this value (199) into CV17.
• Program the remainder (208) into CV18.
Important: Set Bit 5 of CV 29 to 1, so the decoder uses the long address

Programming by a Märklin® Central Unit (e.g. 6021)

With a Märklin® command station all CVs can be programmed but not read out. The decoder can be set to programming mode and then programmed in two ways (a and b, depending on the command station).
1a. Turn the central unit on and off
1b. Set the central unit to "Motorola old" (6021 DIP 2 = off), switch the control unit off and on
2a. Select the decoders address and turn the light on
2b. Set central unit to "stop" and dial address 80
3a. With stationery locomotive (speed step 0) switch the direction 5-8 times in a row until the light turns on
3b. With stationery locomotive, press and hold the direction switch, set the control unit to "go" and wait approx. 12 seconds
4. Enter the number of the CV to be programmed (as for the locomotive address)
5. Operate the direction of travel switch (5a and 5b). The rear lighting flashes 4 x quickly (5a only)
6. Enter the desired value for the CV (like the locomotive address)
7. Quickly switch the direction (7a and 7b). The rear lamp will blink 4 times slowly (only 7a)
If further CVs are to be programmed repeat point 4-7.
When programming is complete set the Centre to “STOP” or enter address “80” and quickly switch direction.
Seeing a Motorola® digital centre can only program vaules from 01 to 80, a value of “0” must be given as address “80”.

Technical Data

Addresses: 1-9999 (long DCC Adresse), 1-255 (Motorola®)
Total maximum load: 0.6 A Total load, per output max. 0.3 A,
(A0h, A1, A4 together. 0.3A and A0v, A2, A3 together 0.3 A)
Size: 20 x 12 x 2,2 mm