Table of the CVs (Configuration Variables)

CV	Name	Description	Range	Default
1	Decoder address		DCC 1-127 Mot 1-80	3
7	Version number			varies
8	Manufacturer ID			85
13	Functions F0 to F7 in analog mode	**Output state in analog mode** F0 - Bit 0 - Value 1 - Default *1 F1 - Bit 1 - Value 2 - Default *0 F2 - Bit 2 - Value 4 - Default *0 F3 - Bit 3 - Value 8 - Default *0 F4 - Bit 4 - Value 16 - Default *0 F5 - Bit 5 - Value 32 - Default *0 F6 - Bit 6 - Value 64 - Default *0 F7 - Bit 7 - Value 128 - Default *0	0 - 255	1
14	Functions F8 to F15 in analog mode	**Output state in analog mode** F7 - Bit 0 - Value 1 - Default *0 F8 - Bit 1 - Value 2 - Default *0 F9 - Bit 2 - Value 4 - Default *0 F10 - Bit 3 - Value 8 - Default *0 F11 - Bit 4 - Value 16 - Default *0 F12 - Bit 5 - Value 32 - Default *0 F13 - Bit 6 - Value 64 - Default *0 F14 - Bit 7 - Value 128 - Default *0	0 - 255	0
17 18	Extended decoder address	17 = high byte 18 = low byte	1-9999 192-231 / 0-255	2000 199/208
19	Consist Address (doubleheading)	0 = no consisting	1-127	0
29	Configuration per DCC-specification	Bit 1 = 0 14 Speed steps (Value 0) Bit 1 = 1 28 Speed steps (Value 2*) Bit 5 = 0 Short address (CV1) (Value 0*) Bit 5 = 1 Extended address (CV17, CV18) (Value 32)	0,2,32,34	6
35	Mapping output A1	high byte	0-128	128
36		low byte	0-255	0
37	Mapping output A2	high byte	0-128	128
38		low byte	0-255	0
39	Mapping output A3	high byte	0-128	128
40		low byte	0-255	1
41	Mapping output A4	high byte	0-128	128
42		low byte	0-255	2
49	Decoder configuration	Bit 0 = 1 DC Analog mode automatically - Value 1* Bit 0 = 0 DC Analog mode not automatically - Value 0 Bit 1 = 1 AC Analog mode automatically - Value 2* Bit 1 = 0 AC Analog modus not automatically - Value 0 Bit 3 = 1 Motorola** format off - Value 8 Bit 3 = 0 Motorola** on - Value 0* Bit 4 = 1 DCC offt - Value 16 Bit 4 = 0 DCC on - Value 0* Bit 6 = 1 lamp connection swapped - Value 64 Bit 6 = 0 lamp connection straight - Value 0* ***Notice:** when Motorola** and DCC are off, the decoder will not react to any input. It only can be programmed in this condition then.		3
	Conditions of the outputs A1 to A4			
52	Deactivate for forwards direction	Bit 0=0 - output A1 for forwards direction on - Value 0 Bit 0=1 - output A1 for forwards direction off - Value 1 Bit 1=0 - output A2 for forwards direction on - Value 0* Bit 1=1 - output A2 for forwards direction off - Value 2* Bit 2=0 - output A3 for forwards direction on - Value 0* Bit 2=1 - output A3 for forwards direction off - Value 4 Bit 3=0 - output A4 for forwards direction on - Value 0* Bit 3=1 - output A4 for forwards direction off - Value 8	0-15	2
53	Deactivate for reverse direction	Bit 0=0 - output A1 for reverse direction on - Value 0* Bit 0=1 - output A1 for reverse direction off - Value 1* Bit 1=0 - output A2 for reverse direction on - Value 0 Bit 1=1 - output A2 for reverse direction off - Value 2 Bit 2=0 - output A3 for reverse direction on - Value 0* Bit 2=1 - output A3 for reverse direction off - Value 4 Bit 3=0 - output A4 for reverse direction on - Value 0* Bit 3=1 - output A4 for reverse direction off - Value 8	0-15	1
54	Time delayed Outputs	Bit 0=0 - output A1 no delay - Value 0* Bit 0=1 - output A1 with time delay - Value 1 Bit 1=0 - output A2 no delay - Value 0* Bit 1=1 - output A2 with time delay - Value 2 Bit 2=0 - output A3 no delay - Value 0* Bit 2=1 - output A3 with time delay - Value 4 Bit 3=0 - output A4 no delay - Value 0* Bit 3=1 - output A4 with time delay - Value 8	0-15	0
55	Delay time in 0.5 sec.	Time before desired outputs will be deactivated again	0-255	4
56	Blinking on / off	Bit 0=0 - output A1 no blinking - Value 0* Bit 0=1 - output A1 blinking - Value 1 Bit 1=0 - output A2 no blinking - Value 0* Bit 1=1 - output A2 blinking - Value 2 Bit 2=0 - output A3 no blinking - Value 0* Bit 2=1 - output A3 blinking - Value 4 Bit 3=0 - output A4 no blinking - Value 0* Bit 3=1 - output A4 blinking - Value 8	0-15	0
57	Blinking time: ON (time constante 50ms)	on-time of „blinking“	0-255	10
58	Blinking time: OFF (time constante 50ms)	off-time of „blinking“	0-255	10
59	Reset to factory default	reset of all CV-Values to Default	0,1	0
60	Dimming for A1	dimming of function outputs (f.e. dim lights); (63 = no dimming, 0 = maximum dimming)	0-63	63
61	Dimming for A2			63
62	Dimming for A3			63
63	Dimming for A4			63
65	Offset Register	for CV-progr. using a Motorola** central unit	0-255	0
66	Page Register	for CV-progr. using a Motorola** central unit	0-255	0
Dimming of the outputs (MASTER)		setup which function should be dimmed		
107	Function number Alternative dimming Output A1	higher byte	0-128	0
108		low byte	0-255	0
109	Function number Alternative dimming Output A2	higher byte	0-128	0
110		low byte	0-255	0
111	Function number Alternative dimming Output A3	higher byte	0-128	0
112		low byte	0-255	0
113	Function number Alternative dimming Output A4	higher byte	0-128	0
114		low byte	0-255	0
	Alternative PWM value for dimming	setup in which brightness the light should shine „after dimming“ with these values		32
115	A1	alternative value for output-PWM when using function „dimming“	0-64	32
116	A2			32
117	A3			32
118	A4			
	Function numbers A5 to A8			255
119	A5	0-28 Function numbers; 29-255 off	0-255	255
120	A6			255
121	A7			255
122	A8			255
123	Fade-in / fade-out for function outputs	Bit 0=0 - output A1 no fade-in - Value 0* Bit 0=1 - output A1 fade-in - Value 1 Bit 1=0 - output A2 no fade-in - Value 0* Bit 1=1 - output A2 fade-in - Value 2 Bit 2=0 - output A3 no fade-in - Value 0* Bit 2=1 - output A3 fade-in - Value 4 Bit 3=0 - output A4 no fade-in - Value 0* Bit 3=1 - output A4 fade-in - Value 8	0-15	0
124	Fading time	time constant = 0,005s (for all outputs, when choosesn)	0-255	0
125	Light effect: neon bulb	With help of this function light outputs can simulate the typical „flickering“ of a neon bulb. Each start will make a random “flickering”. Bit 0=0 - output A1 no effect - Value 0* Bit 0=1 - output A1 with effect - Value 1 Bit 1=0 - output A2 no effect - Value 0* Bit 1=1 - output A2 mit effect - Value 2 Bit 2=0 - output A3 no effect - Value 0* Bit 2=1 - output A3 mit effect - Value 4 Bit 3=0 - output A4 no effect - Value 0* Bit 3=1 - output A4 mit effect - Value 8	0-15	0
126	Maximum flashing time for neon bulb (single flashes)	time constant = 0,005s (* the total activation time will remain random)	0-255	0
127	Number of flash-repititions	number of maximum flash-repititions that should be repeated during the “flickering startup”	0-255	0

Technical Data

Addresses: 1-9999 (long DCC address)
Total maximum load: 1,0 A
Function outputs: each 650 mA
Size: 22 x 12,5 x 2,5 mm

The decoder is preset to address 03, operating with 28 speed steps 28 and can be operated or programmable in DCC and Motorola data format.

Factory settings

In factory default setting the decoder is in DCC/Motorola mode. It automatically switches between both formats. Additionally the decoder will operate with DC or AC (Märklin System) transformers

Decoder-Typ: Multi-protocoll decoder 76900_2

Warranty Statement

Every item is fully tested for functioning before shipment. If a defect occurs within two years after purchase, the item will be repaired free of charge against presentation of purchase proof.
Please send it to Uhlenbrock Elektronik GmbH • Mercatorstr. 6 • 46244 Bottrop • Germany
Damages caused by overload or improper treatment are not covered by this warranty.

For EU only: Please note that decoders may only used in models carrying the EC conformance label.

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56126
Multi-protocoll function decoder for DCC- and Motorola II

Properties

- Multi-protocol function decoder for DCC und Motorola IIa II
- AC und DC Analog mode with automatic directional change
- Suitable for the new DCC protocol for Function decoders, with up to 32000 special functions
- Total 8 function outputs:
  - 4 Function output with up to 650 MA capacity
  - 4 non-powered processor outputs / logic level for more functions
- All outputs can be individually configured for:
  - direction independent outputs
  - delayed outputs
  - blinking outputs
  - fade-in and fade-out function for lights / outputs
- The outputs, when used in pairs, can be dimmed using PWM
- Simulation of neon bulb for lights
- If choosen, light outputs can be high-beam or low-beam lights via function button (2nd PWM)
- Programming with a DCC or Motorola** Digital center
- In DCC operation can be programmed by Register, CV or Page programming
- Use of electrical couplings possible, for example for automatic coupling of cab cars

Description

The function decoder is a small efficient Multi-protocol decoder. It can be used with in DCC and Motorola-II Digital systems and on Analog layouts as well.

The decoder cannot be used as a function decoder with the old Motorola data format.

The outputs can be configured individually. Each output can be activated for only one travel direction. It can be programmed to switch on after a set time or switched on and off bit a blink generator. In analog operation you can determine which outputs are to switched on. Direction dependent outputs are toggled by the DC power on the track

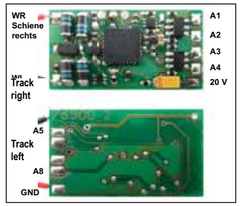
Furthermore, with an amplifying circuit four additonal function outputs can be used. More informations in our webpage.

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. As you can see in the diagram one side of the loads is connected to a function output and the other side to either the black wire (vehicle chassis) or the solder pad for 20V return.
When connecting LEDs, the correct resistance and polarity must be observed



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.
Start-up
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 operation

Allocation of the special functions to the switching outputs via CV35 to 42
In each case 2 CV's serve to allocate a function to an output.
All functions from 0 (light) to 32767 can be used (Motorola**: 0-4, DCC: 0-32767). CV's 35, 37, 39 and 41 contain the high order byte and the CV's 36, 38, 40 and 42 the low order byte of the function code.
Calculation:
Function number = high order byte x 256 + low order byte
If an output is to be switched by Functions 0-28, the high order byte must have the value of 128.
Example 1:
Special function f12 is to switch output A1. CV35 = 128 (factory setting) CV36 = 12 For higher Functions the high order byte receives the appropriate CV.
Example 2:
Special function 2000 is to switch output A1.
• Divide the address value by 256 (2000/256 = 7 remainder 208).
• Enter the result (7) into CV35.
• Enter the remainder value (208) into CV36.
For Experts:
The decoder controls all functions which are defined in the newest version of the NMRA DCC standard. Only the CV's 35 to 42 deviating from the NMRA DCC standard. There are the functions 0-28, as well as two further possible switching functions for transfer to a vehicle decoder which is marked with Binary State control (BSC). If CV's 35, 37, 39 or 41 (High byte) are given a value of 128 then the matching outputs of the decoder are controlled by the DCC special function commands (0-28). If CV's 35, 37, 39 or 41 have a value smaller than 128 the matching output of the decoder is controlled via BSC and function numbers 0-32767 can be used. In this case (CV's 35, 37, 39 or 41 = 0) the outputs are also controlled via BSC if function numbers 0-28 are used.

Direction dependent Outputs
In CV's 52 and 53 you can specify if the state an output is to depend on the travel direction or not.
If the Bit for the respective output is set to "1" the output matching this CV direction sensing is turned off.
CV52 is for the forward direction and CV53 is for the reverse direction.
In CV54 you can specify if an output activation is to be delayed or not.

Delayed Outputs
If the Bit for the respective output is set to "1" the output will be switch with a delay. The delay can be specified in CV55 in 0.5sec intervals. This delay is common to all outputs activated in CV54

Blinking Outputs
In CV56 you can specify if an output that is switch on is to operate on a blinking cycle or not e.g. for a blinking light. If the Bit for the respective output is set to "1" then it will blink. CV 57 includes the on-time. With CV58 the off time can be defined separately. The time constant is 0,05s.
The time constants apply to all outputs that are set to blinking type in CV56.

Dimmed Headlights / Low – and High Beam of the headlights
In order to create even more realistic scenarios on the layout, the function decoder got a high- and low beam function for the headlights (dimming).
By the help of that function you can use a function button to reduce the brightness of a light by 50% (or the related PWM value you choose).
The first PWM is stored in CV60 to 63. This value acts as "100% brightness".
If now the function for low beam is activated then the PWM is reduced by 50% (or the value you desired).

Fade in and fade out of light
To simulate the slow light up of old bulbs or lights there is now the possibility to fade in the light.
Via CV123 the desired outputs are choosen. Via CV124 the fade in and fade out time can be setup in 0,005s steps. By default this function is not activated.

Effect neon bulb
Light outputs can also be assigned with a neon bulb effect. Depending on the output this function can be activated via CV125. It's possible to setup the number of single flashes and the timing of the flashes. The total flashing time and the frequency cannot be influenced. They are random per each start.

Dim outputs (first dimming)
With the CVs 60 - 63 the outputs A1 to A4 can be dimmed. The PWM set here is only effective if the second dimming (see next section) is not switched on.

Switch outputs to a second dimming (e.g. darker lighting or high beam)
CVs 115 - 118 can be used to set a second dimming for outputs A1 to A4. The assignment to the desired function keys takes place via CVs 107 - 114 according to the same pattern as already described in chapter "Assignment of special functions to the switching outputs via CV35 to 42". If both CVs of an assignment are set to the value "0", the second dimming is switched off (factory setting). The second dimming can only be switched if the corresponding output is already switched on via a special function from CVs 35 to 42.

Logic outputs A5 - A8
The four solder pads of the logic outputs A5 - A8 are located on the back of the board. With the CVs 119 - 122 the function numbers F0 - F28 can be assigned to the logic outputs.
IMPORTANT:
These outputs are not loadable. They are only used to control amplifier circuits!

Analog mode
For Analog mode CV13 and Cv14 can be used to determine which outputs should be activated. Outputs that are programmed to be direction dependent in CV52 und CV53 will be switched independently of the direction in DC analog operation. AC and DC Analog mode are supported.

Programming

Note:
If the decoder should be programmed with Motorola** format A1 has to be connected with a load. A Led is sufficient.
If you want to program in DCC it's not necessary anymore to connect a load to any output. The decoder can confirm the instructions of the programming directly. So it doesn't need to be disassembled for programming!

Programming with PIKO SmartControl®
With the PIKO SmartControl® app there is a very comfortable possibility for programming.
Simply start the app on the PIKO SmartController® an enter the menu "Read and Write CVs".
In the first line you can enter the CV which should be checked or changed. In the second line you can enter a new value. Then, by choosing "Read" or "Write" you can check a CV value or change it.

Special case locomotive addresses 80 to 255 in Motorola data format
Some Motorola control panels support an address range of up to 255. Addresses 1 to 80 can also be easily programmed via DCC programming. If, however, decoder addresses larger than 80 are to be used, the decoder address must always be programmed as described in the chapter "Programming with a Märklin central station". After this programming, the CV 1 contains the value 0 and the decoder is used.
the Motorola address is greater than 80.

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.

Calculating the CV value
If several different settings on the decoder are to be changed in a particular CV the value which is to be entered is calculated using the CV table and the values of the desired functions are simply added.
Example:
Outputs A1 and A4 are to blink
Output A1 blinks Value = 1
Output A2 does not blink Value = 0
Output A3 does not blink Value = 0
Output A4 blinks Value = 8
The total value is 9.
This value is programmed into CV56.

Bit	Function CV 68	Value
0	A1 does not blink A1 blinks	0 1
1	A2 does not blink A2 blinks	0 2
2	A3 does not blink A3 blinks	0 4
3	A4 does not blink A4 blinks	0 8

Programming by a Märklin* Central Unit

All CV's can be programmed with a Märklin Central unit but they cannot be read.
1. Turn the centre on and off
2. Select the decoders address and turn the light on.
3. With stationery locomotive (speed step 0) switch the direction 5 times in a row until the light turns on.
4. Set the speed control to "Zero". The rear lamp will blink 4 times slowly.
5. Enter the number of the CV to be programmed (as for the locomotive address).
6. Quickly switch the direction. This time the rear light will blink quickly 4 times.
7. Enter the desired value for the CV (like the locomotive address).
8. Quickly switch the direction. The rear lamp will blink 4 times slowly. If more CV's are to be programmed, repeat points 5-8.

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".

Page Register for entering a CV number greater then 79
CV addresses above 79 can only be programmed with the help of the page register.
The page register is CV66. If CV66 is set to a value greater than 0 then the following programming values have 64 added to them. The entered value must be between 1 and 64.
When leaving Motorola** programming mode then page register (CV66) is automatically reset to Zero.
Example
If CV82 is to be programmed with the value 15, CV66 must first be set to a value of 1. Subsequently CV18 can be programmed with the value 15. A value of 15 will now be programmed to decoder CV address 82 (which is obtained from the addition of the contents of CV66 (in Example 1) multiplied by 64 and adding the entered CV address (18).

Offset Register for entering CV values above 79
CV values greater than 79 can only be programmed with the help of offset register.
CV65 is the offset register.
If CV65 is set to a value > 0 the following programmed values are multiplied by 4 and added to the value entered for the CV.
When leaving Motorola** programming mode then offset register (CV65) is automatically reset to Zero.
Example
If CV49 is to be programmed with a value 157, CV65 must first be programmed with a value of 25.
Subsequently CV49 can be programmed with a value of 57.
The decoder will now be programmed to value 4 * 25 + 57.
Note: When programming CV65 and CV66 contents of the offset and page registers are ignored