Table of the CVs (Configuration Variables)

CV	name	description	values	default
1	locomotive address	DCC / Motorola address of the locomotive	DCC: 1 - 127 Motorola: 1 - 80	03
2	minimum speed		1 - 63	03
3	acceleration	1 means that every 5ms the actual speed is increased by 1. If the internal maximum speed is set to 200 (CV5=50 or CV94=200), then the acceleration from 0 to Fmx is 1sec.	1 - 63	10
4	braking interia	(time factor like CV 3)	1 - 63	08
5	maximum speed	(must be greater than CV 2)	1 - 63	37
6	middle speed	(must be greater than CV2 and less than CV5)	1 - 63	12
7	software version	(the processor can be updated)	-	-
8	manufacturer ID	Reset, if CV 8 = 8	-	-
12	digital format	Bit0 = 0 data format DCC off Bit0 = 1 data format DCC on Bit1 = 0 Datenformat Motorola off Bit1 = 1 Datenformat Motorola on Note: If both formats are swichted off the decoder only can be programmed	1 - 2	03
13	function outputs in analogue operation	CV51=3: Bit0 - 7 = F0 to F7 CV51=7: Bit0 - 7: light outputs and A1 to A7; activate (bit =1), off (bit =0)	0-255	01
14	function outputs in analogue operation	CV51=3: Bit0 - 7 = F8 to F15 CV51=7: no function	-	-
17 18	long locomotive address	17 = high byte 18 = low byte	1 - 9999 192 - 231 0 - 255	2000 199 208
19	consist address (double traction)	0=Consist Adresse (CADR) is inactive; when bit7=1 the driving direction is reversed; The desired speed CADR + 128 = reverse direction	1 - 127	0
29	configuration for DCC	configuration for DCC Bit Function default 0 normal direction 0 reversed travel 1 1 14 speed steps 0 28 speed steps 1 2 only digital operation 0 automatic analogue / digital switching 1 3 RailCom® switched off 0 RailCom® switched on 1 4 speed steps from CV2, 5 and 6 0 speed characteristics from CV67 to 94 1 5 short address (CV1) 0 long address (CV 17/18) 1	0 - 255	14
47	speed correction forwards	adjust speed by percentage in direction "forward"	0 - 63	32
48	speed correction reverse	adjust speed by percentage in direction "reverse"	0 - 63	32
49	locomotive decoder configuration Bit 3=1, F24 - F28 to SUSI	locomotive decoder configuration Bit0=0 motor load regulation on Bit 0=1 motor load regulation off Bit Function default 2 brakes down to 0 in brake section 0 2 brakes to speed step in CV64 1 5 voltage devider load regulation EMF / 2 0 5 voltage devider load regulation EMF / 3 1 6 light outputs not swapped 0 6 light outputs swapped 1 7 brake only with brake signal 0 7 brake with analogue potential 1	0 - 255	0

CV	name	description	values	default
51	onfiguration of analogue operation	configuration of analogue operation 1 = only AC mode 2 = only DC mode Bit2 = 0 = analogue operation via checking transformer voltage output and speed step control like digital mode. Additionally control of a sound module possible, adjustable via CV102 to 104. Bit 2=1 -> direkt analogue operation without controlling sound module; motor will start with minimum voltage	1 - 3	03
52	presets for motor control-CVs		-	0
53	motor regulation repetition rate		1 - 63	55
54	motor regulation P constant for PID regulators		0 - 63	04
55	motor regulation I constant for PID regulators		0 - 63	13
56	regulation frequency		0 - 63	20
57	motor regulation D constant for PID regulators		0 - 63	02
58	time slot for AD transducer measurement		0 - 63	12
59	reset to factory defaults	when programming this CV to value "1" the decoder will be reset to factory defaults	-	0
60	short circuit monitoring	0 = inactive; 9 = active (do not change!)	0, 9	09
61	constant for over temperature shutdown	0 = temperature monitoring off	0 - 255	32
62	short circuit monitoring function outputs	0 = inactive; 249 = active (do not change!)	0 - 255	0
64	speed at end of brake section	valid if CV 49 Bit2=1 and Bit7=1	0 - 63	30
65	Motorola Offset Register	for CV programming with a Motorola center	0 - 255	0
66	Motorola Page Register	for CV programming with a Motorola center	0 - 255	0
67 - 94	characteristic curve for speed steps 1-28		0 - 255	-
102	hysteresis voltage	fluctuation of transformer output without changing the locomotives speed	0 - 255	30
103	analogue start up voltage		0 - 255	120
104	analogue voltage for maximum speed		0 - 255	160
109	assignment of blink generator to the function outputs	Bit 0-7 light and function outputs A1 to A7 on (bit=1), off (bit=0)	0 - 255	0
110	blink generator on time (x100ms)		0 - 255	05
111	blink generator off time (x100ms)		0 - 255	05
115	LISSY train category		1 - 4	01
116	PWN light (F0)	dimming of light	0 - 32	32
117	PWM A1	dimming of A1	0 - 32	32
118	PWM A2	dimming of A2	0 - 32	32
119	PWM A3	dimming of A3	0 - 32	32
120	PWM A4	dimming of A4	0 - 32	32
121	PWM A5	dimming of A5	0 - 32	32
122	PWM A6	dimming of A6	0 - 32	32
123	PWM A7	dimming of A7	0 - 32	32

CV	name	description	values	default
124	coupling configuration	number of repeats and assignment to a function output	0 - 255	0
125	PWN1 coupling	on time PWN1 of coupling	0 - 255	255
126	PWN2 coupling	hold time PWN2 of coupling	0 - 255	64
127	on time T1 x50ms	on time T1	0 - 255	05
128	hold time / on time T2 (x100ms)	on time T2 (x100ms)	0 - 255	20
129	hold time / on time T3 (x100ms)	on time T3 (x100ms)	0 - 255	20
130	dynamic smoke genrator control (A1 to A7)	bit 1 to 7 -> A1 to A7; 0 = no smoke generator	0 - 255	0
131	PWN1 start (delay)	start up delay in seconds (Bit 5-7)	0 - 255	127
132	PWN2 normal driving		0 - 255	16
133	PWM3 no load		0 - 255	08
134	start up time (x200ms)	time to reach maximum speed	0 - 255	05
135	speed step for shunting tango		0 - 255	0
136	"go to time" (coupling) in 0,05s		0 - 255	10
137	"go back time" (coupling) in 0,05s		0 - 255	10
150	ACK-pulse length (DCC programming)		0 - 255	28

Bit active	value for calculation		Bit active	value for calculation
Bit0=1	1		Bit4=1	16
Bit1=1	2		Bit5=1	32
Bit2=1	4		Bit6=1	64
Bit3=1	8		Bit7=1	128

The default values of each CV are a sum up of the values of each bit. Depending on what should be activated or not, the values of the bits have to be added together and this value has to be entered into the corresponding CV then.

Technical Data:

Decoder type: Multiprotocoll decoder 76590
Adress range: 1-9999 (extended DCC address)
Max. motor current: 1,2 A*
Ancillary outputs: 0,4 A each
Size: 22 x 15 x 3,8 mm
* Permanent load, may vary according to assembly.

Factory Default Settings
The factory settings are address 03, 28 speed steps, and the decoder automatically recognizes DCC- and Motorola**-formats.
In addition the decoder can be operated with a AC/DC throttle.

Hotline:
In case of questions,we are ready to answer them for you!
Directly contact our technician: (49) 2045 858327
Mo - Fr except Wed 14:00-16:00hrs CET, Wed 16:00 - 18:00hrs CET

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

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Motorola is a trade mark of Motorola Inc. Tempe-Phoenix (Arizona/USA)
RailCom® is a trade mark of Firma Lenz® Elektronik GmbH, Gießen.

56123
PIKO Loco Decoder
w/PluX22 Connector

PIKO MODELLBAHNEN & GEBÄUDEMODELLE

Description
The PIKO PluX22 decoder # 56123 is a small, efficient Multiprotocol decoder. It can be used in DCC and Motorola digital systems and runs equally as well in analogue mode with DC or AC current and travel direction changing by an over-voltage pulse (Märklin-System). The operating mode is automatically detected.
The Decoder is suitable for DC, and also bell armature motors (e.g. Faulhaber, Maxon, Escap) with continuous power consumption of 1.2 A. Higher switching currents are briefly tolerated.
Configuration of the motor characteristic curve is done either by setting the minimum, middle and maximum speed or via various CV's for the individual speed steps.
The load regulation can be adapted for the different locomotive motors. The decoder provides two travel direction dependent light outputs and 7 Special function outputs, which can be controlled by function keys f1 to f28 (function mapping). All outputs are connected to the 22-pole PluX-Interface on the designated pin.
They are dimmable and can blink at a programmable frequency. Four time switched outputs are available for operating electrical couplings. For dynamic smoke generation from a smoke generator, these can be operated depending on the speed step. Head and Tail light can be switched off depending on the travel direction.

Characterictics
• Regulated Multi-protocol decoder for DCC, Motorola
• for motors with up to 1,2 A
• Quiet motor running with 18.75KHz control frequency
• 14, 27, 28, 31 and 128 speed steps depending on the data format
• Short (1-127) and long (128-9999) addresses
• NMRA compatible
• RailCom
• analog sound possible in connection with IntelliSound 4 module
• function mapping up to F28
• motor presets for different locomotives available
• shunting tango, fully adjustable with all properties
• Minimum, maximum and middle speeds adjustable
• Speed step table for 14 and 28 Speed Step modes
• Mainline programming (DCC)
• Switchable shunting speed (half Speed)
• Switchable start/stop inertia
• Direction dependent, dimmable lighting switched via F0
• Switchable Train Lighting
• 7 special functions, dimmable, time switched
• Configurable blink generator for all Function outputs
• Four time switched function outputs for electric couplings
• Speed step dependent control for smoke units
• SUSI-Interface for connecting Sound modules or other modules for controlling switchable auxiliary functions (f1-f28) via the PluX-Interface
• reservation of F24 to F28 for SUSI possible (to connect function with sound)
• Generates the identification address for controlling the Uhlenbrock LISSY Mini-transmitter module 68400 via the PluX-Interface
• Reacts to DCC brake signal or braking section in DC operation
• Protected against overheating, all outputs have short circuit protection
• Conventional DC operation with automatic switching between DC and digital mode
• All CVs programmable by digital devices with DCC and Motorola formats
• Updatable using Flash memory

Installing the decoder # 56123

Connecting the Module
Remove the bridging plug from the locomotive and plug decoder interface plug into the vacant PluX22 socket (note the coding).

Connecting Special functions
The Special function outputs A1 to A7 are integrated into the 22-pole PluX-Interface. For PIKO locomotives, those outputs are also available on the mainboard as additional soldering pads.

Connecting a Sound module
A Sound module can only be connected if the locomotive is fitted with SUSI-Interface socket.
Insert the connector from the Sound module into the 4-way SUSI-socket.

Assignment of the 22-pole PluX interface:

Pin	PluX22-interface
1	Standard In/Output
2	Special function 3
3	SUSI - puls circuit
4	SUSI - data circuit
5	Decoder ground (behind rectifier)
6	20 V (behind rectifier)
7	Front light
8	Motor output 1
9	20 V (behind rectifier)
10	Motor output 2
11	n.n. = coding

Pin	PluX22-interface
12	2-rail: rail right / 3-rail: slider
13	Back light
14	2-rail: rail left / 3-rail: slider
15	Speaker connection A
16	Special function 1
17	Speaker connection B
18	Special function 2
19	Special function 4
20	Special function 5
21	Special function 6
22	Special function 7

PluX22 Decoder
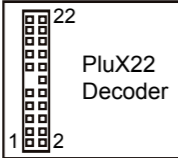
Digital and analogue Running
On digital layouts the decoder can be controlled with Motorola or DCC data formats. Enter address 3 on the control device. The decoder runs according to the data format with which it was programmed, in Motorola mode, or in DCC mode with 28 speed steps.
If the decoder is employed on conventional analogue layouts, then it can operate either with DC or AC transformer (System Märklin). All operating modes are automatically detected by the decoder.

Function outputs in Analogue operation
Prior programming with a digital center determines which function outputs, light to A7 are active in analogue mode. For this CV 13 must be programmed according to the appropriate CV-table. Each output has a corresponding Bit 0 to 7 which must be set.
If, for example, only the light (Bit 0 = 1) and function output A1 (Bit 1 = 1) are to be on then Bits 0 and 1 must be set. So a value of 3 must be programmed into CV 13.

Shunting speed
By default, shunting speed can only be activated from driving step 2 and higher. Set CV12, bit 7 to 1 to activate shunting speed for driving step 1, too.

Function Mapping
All function outputs can be mapped to a function button via "function mapping". In the overview for function mapping you will see, which CV value is necessary to connect an output with a function button. It's not just possible to activate one function – it is also possible to activate several outputs at once, including special rules like direction or other outputs (active or not).
As the function mapping for this decoder is very complicated, please see our WebShop page for item 56123.
There you will find an excel file. Just choose your desired function button, output to activate and may be some rules and the document will show you which CV has to be changed to the corresponding value.
To combine a function with a sound, it is possible to assign functions F24 to F28 to the SUSI interface. This can be done by CV49, bit 3 =1.

F0	Light, direction of travel red / white	F10	empty (AUX3)	F20	empty (AUX7)
F1	(Placeholder motor sound)	F11	empty (AUX4)	F21	ABV / start- and brake delay
F2	(Placeholder horn 1)	F12	(Placeholder Sound N° x)	F22	(Placeholder Sound N° x)
F3	(Placeholder coupling noise)	F13	(Placeholder depart station)	F23	(Placeholder Sound N° x)
F4	(Placeholder horn 2)	F14	(Placeholder Coal / glose door)	F24	(Placeholder Sound N° x)
F5	(Placeholder Warning whistle short + F1)	F15	(Placeholder air compressor)	F25	(Placeholder Sound N° x)
F6	logic function: shunting mode	F16	(Placeholder whistle long)	F26	(Placeholder Sound N° x)
F7	empty (AUX1 / ZSBel FR v)	F17	(Placeholder venting)	F27	(Function: half volume / night mode)
F8	empty (AUX2 / ZSBel FR r)	F18	empty (AUX5)	F28	(Placeholder Sound fader)
F9	(Placeholder whistle short)	F19	empty (AUX6)		

Blink generator for all Function Outputs
The On and Off time of the blink generator is configurable. The light outputs and outputs A1-A7 can be connected with the blink generator.
CV109: Blink assignment Bit 0-7 = light, A1-A7
CV110: Blink generator Off time in 100ms steps
CV111: Blink generator On time in 100ms steps

Dimming of the Function Outputs
Each output can be configured via various PWM values (Pulse width modulation). The PWM values amount to 0 (0%) to 12 (100%). The PWM frequency is around 52 Hz.
The dimming for light upto A7 is configured with CV's 116 (light) to 123 (A7).

Setup of function outputs A1-A4 for electric coupling
One or two electric couplings can be connected to each output A1 to A4. When the corresponding output is switched on it is first fed with PWM1 for a time of T1 and after that for a time period of T2 with PWM2. Subsequently the output is turned off for a period of T3. The sequence can be repeated up to 16 times.
Setup via:
CV124 - coupling repetitions and outputs   0=no coupling   values 0-255
1 = A1 / 2 = A2 / 3=A2 & A1 / 4=A3 / 5=A3 & A1 / 6=A3 & A2 / 7=A4 / 8=A4 & A1 / 9=A4 & A2 / 10 = A4 & A3 / 11-15 no function
If CV124 is set to an higher value (1 to 10) then the coupling will be activated once, per default. To activate the coupling more often, the repetitions quantity minus 1 has to be added to the CV value.
Example: outputs A1 and A2 should make 3 repetitions:
CV124=(3-1) * 16 + 3 = 35

CV125 - coupling-PWM1	switch on-PWM	0-255
CV126 - coupling-PWM2	Halt-PWM	0-255
CV127 - coupling time T1 x 50ms	on time	0-255
CV128 - coupling time T2 x 0.1s	hold time	0-255
CV129 - coupling time T3 x 0.1s	pause time	0-255

Please take care whichh outputs are available at your locomotive. May be you need to move an existing function to another output via soldering, to use an electric coupupling on A1 to A4
Notice: Keep the quantity of repetitions as small as possible, to conserve the couplings.

Automatic Coupling / "shunting tango"
It only will be active, if CV124 to 129 are setup for coupling and driving step is "0".
Sequence:
-loco drives in momentary direction with adjustable speed for adjustable time T1
-loco stops and changes direction
-loco drives with same speed for adjustable time T2
-loco stops

CV135 = driving step for shunting tango (1-255); 0 = no shunting tango
CV136 = "go to" time T1
CV137 = "go back" T2

Dynamic Smoke Generator control
A Smoke generator can be connected to any output A1 to A7. On departure the output for the smoke unit is fed with PWM1 for a programmable time T1.
After the timeout the output is switched over to PWM2, for as long as the speed step is larger than 0. If the Motor speed step is 0, it is switched to PWM3 (idle running).
Configuration via:
CV130 – Bit 1 to 7 -> A1 to A7; 0 = no smoke generator,
CV131 – PWM1 Starting (bit 5-7 start delay motor in seconds / bit value = time in seconds; bit 0-4 PWM start 0-31)
CV132 – PWM2 Normal operation (wanted speed step)
CV133 – PWM3 idle (stationary)

CV134 - bit 0-5 start time x0,2s - time for PWM1, after that PWM2

RailCom
If the locomotive decoder is to operate with RailCom Bit 3 of CV 29 must be set. Additionally the Motorola Format in CV 12 must be switched off. CV29 - bit3 = 0 no RailCom

Märklin Braking section
The decoder reacts to a Märklin Braking section (Braking with an analogue voltage on the track), if CV 29 Bit 2 and CV 49 Bit 7 are set to 1 (Default 1 and 0).

Programming
In factory default state, all decoder options are changed using configuration variables (CVs) according to the DCC standard. The decoders can be programmed by an Intellibox, DCC Centre and Motorola Centre.

Programming with the Intellibox
We recommend programming the decoder using the programming menu for DCC decoders irrespective of the format in which it is to be driven later.
The Intellibox supports DCC programming with a user friendly input menu. Long addresses do not have to be laboriously calculated and can be entered directly. The Intellibox calculates the values for CV 17 and CV 18 automatically. In addition it sets 5 of CV29 to 1, so that the decoder also uses the long address.
For the exact approach please read the appropriate chapter in the Intellibox manual.
Special case Locomotive addresses 80 to 255 in Motorola Data format In the Motorola data format the Intellibox supports an address range to 255. Addresses 1 to 80 can also be programmed using DCC programming. However if locomotive addresses larger than 80 are to be used the address must be programmed as in chapter "Programming with a Märklin center".
After this programming is completed the CV1 has the value 0 and the decoder uses the Motorola address larger than 80.

Programming with DCC devices
Use the programming menu of your DCC center to select and program the decoders CV's by register, direct CV or Page programming. It is likewise possible to program the decoder by main line programming with a DCC digital center.
For the exact approach please refer to the manual for your center.
Programming of long Addresses without Programming menu If programming is to be done with a center which does not support programming with an input menu, the value for CV17 and CV18 must be calculated.
Here is a guide for programming address 2000.
• Divide the address by 256 (2000/256 = 7 remainder 208).
• Take the integer value (7) and add it to 192.
• Enter the result (199) as the value for CV 17.
• Enter the remainder (208) as the value for CV 18.
Important: Set bit 5 of CV 29 to 1, so that the decoder uses the long address.
Calculation of the Configuration Variable values CVs 29 and 49 are to be used for defining different modes for the decoder. The value to be entered is calculated by the CV-table by adding the values of the desired functions.
Example:
Normal driving direction Value = 0
28 Speed steps Value = 2
Auto. Analog/Digital detection Value = 4
RailCom switched off Value = 0
Speed steps using CV 2, 5, 6 Value = 0
Short address Value = 0
The sum of all the values is 6.
This value is set to CV29 as Factory default value.

Bit	Function CV29		default
0	normal direction		0
	reversed travel		1
1	14 / 27 speed steps		0
	28 / 128 speed steps		2
2	only digital operation		0
	automatic analogue / digital switching		4
3	RailCom® switched off		0
	RailCom® switched on		8
4	speed steps from CV2, 5 and 6		0
	speed characteristics from CV67 to 94		16
5	short address (CV1)		0
	long address (CV 17/18)		32

Programming with a Mobile Station
The programming menu is available under the Mobile Station Locomotive menu for particular locomotives. A locomotive which has a programmable decoder must be selected from the database. Proceed as follows:
1. Enter a new locomotive and select Part No. 36330. The display indicates the Locomotive Ee 3/3.
2. Press the "MENU/ESC" key and select the entry "LOK ANDERN". Here you will find among other things the last item Register Programming with the designation "REG". Use this function to change CV's in the decoder. The CV's can only be written with this function.
3. Enter the CV number and confirm with the reversing button.
4. Afterwards enter the new value for the CV and press the reversing button. The Mobile Station now programs CV with the desired value.
Note: Before programming, remove All locomotives which are not to be programmed from the track!

Programming with PIKO SmartControl
programming of single CV's:
Put your locomotive on the track which has to be conneted with the "PROG" output of the PIKO SmartBox. Then start the App "SmartControl" and choose the menu "read and write CVs". Here you easily can enter your desired CV whichh should be changed. In the next line you can enter the new value. Now just touch "Write" and the programming will start. programming long DCC addresses:
By the help of PIKO SmartControl long addresses can be entered easily. Just choose the menu "DCC Address". Enter the new address and touch "write". The app will automatically calculate the values for CV17 and CV18 and also change bit 5 in CV29, to make the decoder use the long address.

Motor Regulation
The motor regulation can be fitted to locomotives with CV's 53 to 58. The individual CV's have the following meaning:
CV53 Regulation Repetition rate
CV54 P-constant for the PID Regulator
CV55 I-constant for the PID Regulator
CV56 Regulator frequency
CV57 D-constant for the PID Regulator
CV58 Length of time slot for measuring the EMF voltage

Guide for changing the regulation parameters P, I, D:
1.) Preset the decoders CV 2, 5 and 6 (min., max. and middle speed.) the Motor regulation in CV54, 55 and 57 to factory default.
2.) Set CV55 and 57 to zero
3.) Set CV54 so that the locomotive just starts to move on speed step 2.
4.) Increase CV55 so that the locomotive starts to run during the change from speed step 0 to 1 and runs as desired on speed step 1. (The incremental change should be 1.)
5.) Jerkiness at a speed step can be compensated in CV57. (The incremental change should be 1.)
6.) If necessary adjust CV2 and start the setup again from step 2.). If you don't get a satisfactory result, then try:
a) Changing the regulation repetition rate CV53.
b) Increasing the measuring time of the EMF voltage CV58. (With some Motors smooth running at low speeds can only be achieved this way)
c) Decrease the regulation frequency in CV56. (Applies when the locomotive already runs at top speed when it is set to a speed step lower than the maximum and after which the speed no longer changes)
Apply the various changes to CV 53, 57, 58 in small steps and if necessary repeat the settings to the PID regulation, as in points 1.) to 6.).

To make it more simple for you, we already have setup some defaults for different motor types. In the following schedule you can see which value of CV52 can fit to a motor type. Please note that for some items it may be necessary to adjust the topspeed again, as these settings are universal standard defaults.

CV52	CV53	CV54	CV55	CV56	CV57	CV58	suitable for
0	55	4	13	20	2	12	CV53 tuntil CV58 variable / factory setting / BR118GFK / BR147-187 / BR245 / T669 / V200.1-221 / Z2
1	55	4	13	20	2	12	BR103 / BR130 / BR150 / E41 / BR102.1-312 / BR112-143 / Rh28 / EP07 / Su45
2	30	10	3	32	1	12	V200 / V15-23
3	35	20	10	32	2	12	BR197 + Roco, Fleischmann
4	32	15	20	32	5	12	V15-23
5	35	20	10	32	2	12	for example: Roco

By default CV52 is set to „0". For this case you can change CV's 53 to 58 manually. If a value different to "0" is entered then the values from above standing schedule will be used. Changes in CV53 to 58 will not be taken into account then.