Uhlenbrock Elektronik

Multi-protocol decoder 73 510
in Mini-format with 6 way NEM 651 plug

DIGITAL 2

For locomotives from Arnold, Bemo, Brava, Fleischmann, Kato, Roco, Tillig, Minitrix.

Features 73 510

- Regulated Multi-protocol decoder for DCC, Motorola and Selectrix
- Suitable for DC and Bell armature motors up to 500mA
- 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
- Minimum, maximum and middle speeds adjustable
- Speed step table for 14, 28 and 31 speed steps
- Main line programming (DCC)
- Shunting speed (half speed) switched with F3
- Direction dependent, dimmable lighting switched via F0
- Reacts to DCC brake signal (e.g. from Power 3) or Selectrix "Brake diode" or braking section in DC operation.
- Over heating protection
- All outputs have short circuit protection
- Conventional DC operation with automatic switching between DC and digital mode
- All CV's programmable by digital devices with DCC, Motorola and Selectrix formats
- Programmable via register, direct CV or page mode in DCC operation
- Updatable using Flash memory

Description

Locomotive decoder 73 510 a very small multi-protocol decoder. It can be operated in DCC, Motorola and Selectrix digital systems and also runs in DC analog mode.

The decoder operates with a frequency of 18.75KHz and is therefore well suited for DC and especially for Bell armature motors (e.g. Faulhaber, Maxon, Escap) up to a maximum power load of 500mA. Short burst start up currents are tolerated.

Motor characteristics can be controlled either by setting the minimum, maximum and middle speeds or via various CV's for individual speed steps.

Load regulation can be control via regulation parameters to a variety of individual motors.

The decoder provides two direction dependent lighting outputs. Using F3 and F4 a shunting mode for slow speeds and Start/braking inertia can be activated.

The decoder can be programmed with the Intellibox, DCC, Märklin and Selectrix controllers and Selectrix programming devices. CV's can be programmed with all devices.

In factory default the decoder automatically recognizes DCC and Märklin data formats. On a Selectrix layout the decoder must first its address programmed. The data format will then be automatically be switched to "Selectrix only" (CV49, Bit 4 = 1). The decoder can then only be switch to another data format by DCC programming.

If the decoder is to be used on a conventional DC layout the operating mode must be set up with the configuration variable. If the decoder set to "analog mode" is placed on to a digital layout it will automatically detects the digital signal and switches to digital mode.
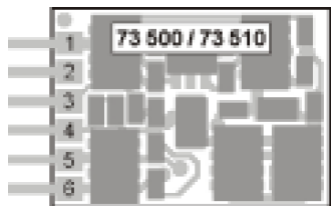
Installing a 73 510 locomotive decoder

Connecting the motor

Remove the bridging plug from the locomotive and push the plug from the decoder into the vacant socket.

If locomotive does not react then re-insert the decoder after turning it over 180°

Pin out for NEM 651 connector

1. Motor connection 1	(Orange)
2. Motor connection 1	(Grey)
3. Right Power pickup	(Red)
4. Left Power pickup	(Black/Chassis)
5. Front Light	(White)
6. Rear Light	(Yellow)

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!**

Starting up the decoder

DCC/Motorola

Select address 3 on the controller. The decoder will then react to the protocol with which it is addressed. In Motorola or DCC operation it will use 28 speed steps.

Selectrix

To read or program the Intellibox (selected Selectrix data format), a Selectrix controller or a Selectrix programming device can be used. The data format of the decoder will automatically switch to Selectrix when CV49 bit 4 = 1. The decoder can then be operated in Selectrix mode.

Programming

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

Programming with the Intellibox

Irrespective of the format to be driven later we recommend that the decoder be programmed via the programming menu for DCC decoders.

The Intellibox supports DCC programming with a simple input menu. Long addresses do not have to be laboriously calculated, them can be entered directly. The Intellibox automatically calculates the values for CV17 and CV18.

For the exact process please read the appropriate chapter in the Intellibox manual.

Programming with DCC devices

Use the programming menu in your DCC Centre, to program the decoder CV's in either register, direct CV or page programming mode. It is also possible to program the decoder on the main line using a DCC Centre.

Refer to the manual for your control centre for full instructions on the process.

Programming of long Addresses without the Programming Menu

For programming 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

With CV29 and CV49 various characteristics of the decoder be established.

The required values are easily calculated using the CV table and simply addition.

Example:

Normal travel direction	Value = 0
28 speed steps	Value = 2
Speed steps via CV 2, 5, 6	Value = 0
Short address	Value = 0

The total value is 2.

This value is factory default for CV29.

Bit	Function CV29	Value
0	Normal travel direction Reverse travel direction	0 1
1	14/27 speed steps 28/128 speed steps	0 2
4	Speed steps in CV2, CV5 and CV6 Characteristics read from CV67-94	0 16
5	Short address (CV1, Register 1) Long address (CV17 and CV18)	0 32

Table of individual CV's (Configuarion Variables)

CV	Description	Value range	Factory default
1	Locomotive address	DCC 1-127 Mot 1-80 SX: 1-111	3
2	Minimum speed value	1-63	1
3	Start Inertia 1 means every 5ms the speed will be increased by 1 Sets the internal maximum speed e.g. 200 (CV5=50 or CV94=200) then starts the locomotive from 0 to Fmax in 1sec	1-63	2
4	Braking inertia (time factor like CV3)	1-63	2
5	Maximum speed (must be lager than CV2)	1-63	48
6	Middle speed	1-63	24
7	Software version (The processor used can be updated)	-	8
8	Manufacturer ID	-	85
17,18	Long address	1-9999	2000
17	Long address high byte	192-231	199
18	Long address low byte	0-255	208
19	Consist address (Multi-traction) 0 = Consist address is inactive When Bit 7=1 the driving direction is reversed So the desired CADR + 128 = driving direction reversed	1-127	0

			0-255	2
29	**Configuration DCC Standard** Value Bit 0=0 Normal driving direction 0 * Bit 0=1 Reversed driving direction 1 Bit 1=0 14 speed steps 0 Bit 1=1 28 speed steps 2 * Bit 2/3 not used - Bit 4=0 Speed steps from CV2, CV5 and CV6 0 * Bit 4=1 Characteristics read from CV67 to CV94 16 Bit 5=0 Short Address (CV 1) 0 * Bit 5=1 Long Address (CV 17/18) 32 Bit 6/7 not used -		0-255	2
49	**Decoder Configuration** Value Bit 0=0 Load regulation on 0 * Bit 0=1 Load regulation off 1 Bit 1 Not used - Bit 2=0 Brake down to Zero in a brake section 0 * Bit 2=1 Brakes to speed step in CV52 4 Bit 3=0 SX programming off 0 Bit 3=1 SX programming on 8 " Bit 4=0 Data format Motorola and DCC 0 * Bit 4=1 Data format Selectrix 16 Bit 5=0 Motorola Data format off 0 Bit 5=1 Motorola Data format on 32 * Bit 6=0 Don't swap light outputs 0 * Bit 6=1 Swap light outputs 64 Bit 7=0 Brake only with brake signal 0 * Bit 7=1 Brake with analog voltage 128 *Note*: When Selectrix program is enabled by Bit 3 or Motorola data format by Bit 5 and the decoder can only be programmed by a DCC device.		0-255	40
50	Dimming of the function outputs		0-63	32
51	Switching between analog and digital operation 0=Digital operation, 1=Analog operation		0,1	0
52	Speed at the end of a braking section Relevant when CV49 Bit 2=1 and Bit 7=1		0-255	30
53	Repetition rate of load regulation (CV49, Bit 0=1) Rate=Value * 53us		0-255	80
54	Load regulation: increase motor voltage		0-255	2
55	Load regulation: decrease motor voltage		0-255	2
56	AD transducer correction (Do Not Change)		0-255	1
57	SX operation using speed set table (CV29 Bit 4=1): For speed steps 29, 30, 31 which are not in the speed step table CV67-94 the values are added linearly		0-255	5
58	Time slot for AD transducer measurement		0-255	14
59	Reset to Factory default. If this CV is set to 1 the decoder is reset to factory settings *Note: After a reset definitely program CV61 and CV21*		0, 1	0
60	Short circuit guard (Do Not Change)		0, 82	82
61	Switch off temperature °C (90°C) 0=Temperature monitoring is switched off		0-255	Varies between decoders
62	This CV is used when the decoder is programmed using SX programming		0-255	0
63	Offset register for CV programming with a Motorola digital controller		0-255	0
64	Page register, used in DCC page mode		0-255	0
67-94	Speed step curve		0-255	5, 7, 10, 12, 15, 32, 20, 22, 25, 27, 30, 32, 35, 37, 42, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100, 105, 110

The factory default values in CV29 and CV49 are marked with *.

Programming with Selectrix Devices

In Selectrix data format only 5 parameters are programmable. As opposed to DCC format this makes only restricted programming possible.

Selectrix Description	Value range of Selectrix Centre	CV	Programming Value for the decoder CV
Locomotive address	1-111	1	1-111
Top speed	0 1-7	59 5	1 (analog operation) 56, 88,120, 152, 184, 216, 248
Start/brake inertia	1-7	3 and 4	1, 5, 9, 13, 17, 21, 25
Pulse width	1-4	2	1, 3, 5, 7
Signal stop section	1 or 2	CV49 – Bit 1	0, 1

Table 1: Cross reference between the input on a Selectrix programming device and programmed CV's

CV programming with Selectrix Devices

In order to also program all the CV with Selectrix devices we use the following method:

We use a special programming mode which employs the memory locations for 'Signal stop section', 'Top speed', 'Start/brake inertia' to specify to the decoder, the CV number, the memory for the 'address' and 'pulse width' to program this CV.
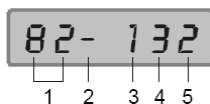
1 – Address
2 – Signal brake section (BS)
3 – Top Speed (TS)
4 – Start/brake inertia (SB)
5 – Pulse width

Assignment of functions on the display in Selectrix programming mode

Step 1.

You enter the special programming mode by entering an address value of 0 and pulse width value of 4.
Note: Because address 0 is used to place the decoder into programming mode it cannot be used as a normal address.
Now tell the decoder which CV you wish to call up. Look for particular values for Signal brake section (BS), Top Speed (TS) and Start/brake inertia (SB), in the programming table and program the decoder.
After the programming the decoder will be in CV programming mode and desired CV can be read or programmed.

Step 2.

The decoder can now be read with the programming device, the CV value can be determined from the contents of 'Address' and 'Pulse Width':
CV contents = Address display + (Pulse width display - 1) * 100

Step 3.

If the CV is to be changed then the value for 'address' and 'pulse width' must be changed in the programming device.
Note: The value for 'Signal brake section' (BS), 'Top Speed' (TS) and 'Start/brake inertia' (SB), which specify the CV number must not be changed or the programming will not be completed.
It means:
CV contents = Address display + (Pulse width display - 1) * 100
Where the 'Address' value is between 0 and 99 and the 'pulse width' between 1 and 3.

If the values have been changed on the programming device they will be written to the decoder. The programming of the CV can be verified by reading the decoder.

Step 4.

CV programming mode is terminated by entering the following values from the programming device:
'Address' = 0
'Pulse width' = 4
'Signal brake section' = 1
'Top Speed' = 1
'Start/brake inertia' = 1
Following this a further programming step must be carried out.

Coding table for CV numbers for Selectrix

CV	BS	TS	SB	CV	BS	TS	SB	CV	BS	TS	SB
1	1	2	1	33	1	6	5	65	2	3	3
2	1	3	1	34	1	7	5	66	2	4	3
3	1	4	1	35	1	1	6	67	2	5	3
4	1	5	1	36	1	2	6	68	2	6	3
5	1	6	1	37	1	3	6	69	2	7	3
6	1	7	1	38	1	4	6	70	2	1	4
7	1	1	2	39	1	5	6	71	2	2	4
8	1	2	2	40	1	6	6	72	2	3	4
9	1	3	2	41	1	7	6	73	2	4	4
10	1	4	2	42	1	1	7	74	2	5	4
11	1	5	2	43	1	2	7	75	2	6	4
12	1	6	2	44	1	3	7	76	2	7	4
13	1	7	2	45	1	4	7	77	2	1	5
14	1	1	3	46	1	5	7	78	2	2	5
15	1	2	3	47	1	6	7	79	2	3	5
16	1	3	3	48	1	7	7	80	2	4	5
17	1	4	3	49	2	1	1	81	2	5	5
18	1	5	3	50	2	2	1	82	2	6	5
19	1	6	3	51	2	3	1	83	2	7	5
20	1	7	3	52	2	4	1	84	2	1	6
21	1	1	4	53	2	5	1	85	2	2	6
22	1	2	4	54	2	6	1	86	2	3	6
23	1	3	4	55	2	7	1	87	2	4	6
24	1	4	4	56	2	1	2	88	2	5	6
25	1	5	4	57	2	2	2	89	2	6	6
26	1	6	4	58	2	3	2	90	2	7	6
27	1	7	4	59	2	4	2	91	2	1	7
28	1	1	5	60	2	5	2	92	2	2	7
29	1	2	5	61	2	6	2	93	2	3	7
30	1	3	5	62	2	7	2	94	2	4	7
31	1	4	5	63	2	1	3	95	2	5	7
32	1	5	5	64	2	2	3	96	2	6	7

Programming with a Märklin Centre

All CV's can be programmed with a Märklin Centre, but they cannot be read.

- Turn the centre off and on
- Select the decoders address and turn the light on
- Keep changing the driving direction for about 10 seconds until the lights are blinking
- Set the speed control to "zero". Now the rear light will blink 4 times slowly.
- Enter the number of the CV that is to be programmed such as a locomotive address.
- Quickly change the driving direction. Now the rear light will quickly blink 4 times.
- Enter the desired value for the CV such as a locomotive address.
- Quickly change the driving direction. Now the rear light will slowly blink 4 times.

If further CV's are to be programmed repeat steps 5-8.

When all programming is done switch the centre to "Stop" or enter address "80" and quickly change driving direction.

Seeing a Motorola digital centre can only program values from 01 to 80, a value of "0" must be given as address "80".

CV values greater than 79 can only be entered with the help of the "Offset register". The offset register is CV63. If a value > 0 is contained by CV63 the CV's will be programmed using the value in CV63 multiplied by 4 plus entered CV value.

Example

CV49 is to be programmed with a value of 157. CV63 must first be programmed with a value of 25. After this, CV49 is programmed with a value of 57. The decoder will calculate the CV value as 4 * 25 + 57. Following programming CV63 should be set back to zero, so that following value smaller than 79 are not incorrectly programmed.

Technical Data

Addresses:	1-9999 (long DCC Address)
Max. Motor current:	0.5A
Function outputs:	0.5A each
Total Load:	0.5A
Size:	8.6 x 12.0 x 3.7 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 Selectrix programming mode is enabled. Therefore every time power is applied a short impulse is sent to the motor output. This can be suppress by programming CV49.

www.uhlenbrock.de

Visit our website for up-to-date information about the Intellibox, a Price or Dealer list or to download various publications.

Guarantee declaration

Each component is tested for its complete functionality before distribution. If a fault should arise within the guarantee period of 2 years, we will repair the component free of charge upon production of proof of purchase. The warranty claim is void, if the damage was caused by inappropriate treatment.

Please note that, according to EMV regulation the component may only be installed in vehicles, which carry the CE logo.

⒃ Uhlenbrock Elektronik

Our contact Details:
Service
In the event of a defect or failure send the unit together with the invoice and a short description of the fault back to us for repair.

Hotline
We are available if you have any questions!
Your direct line to a technician: **0 20 45 - 85 83 27**
Mon - Tue - Thu – Fri, 14:00~16:00 and Wed 16:00~18:00

Uhlenbrock Elektronik GmbH
Mercatorstr. 6
D-46244 Bottrop
Made in Germany

CE

Part No. 73 510