Uhlenbrock Elektronik

Multi-Protocol decoder 76 400

DIGITAL 2   SUSI

For locomotives with DC motors on digital layouts operating in the DCC- and Motorola data format.

Features

- Regulated multi-protocol decoder for DCC and Motorola
- Suitable for DC and bell armature motors to 1 A
- Quiet motor running by using 18.75 kHz control frequency
- 14, 27, 28, 128 speed steps, depending on data format
- Short addresses (1-127) and long addresses (for 128-9999)
- NMRA compliant
- Adjustable minimum, medium and maximum speeds
- Speed step tables for 14 and 28 speed step mode
- Main track programming (DCC)
- Shunting mode (half speed) toggled using F3
- Starting/brake inertia switched using F4
- Headlights switched using F0, dimmable
- 2 special function outputs switched using F1 and F2, dimmable
- With SUSI sound interface (4 pole mini socket) for the connection of sound modules or other modules controllable using auxiliary functions (f1 to f12)
- Produces the address identification for the control of the LISSY mini transmitter 68 400
- Reacts to DCC conforming brake signal or brake sections with DC voltage
- Overheating protection
- All outputs are short circuit protected
- Conventional DC or AC operation with automatic change-over to the respective operating mode
- All CV's are programmable with digital devices using DCC and/or Motorola formats
- In DCC layouts, programmable using register, CV direct or PAGE programming
- Updateable using Flash memory

Description

The locomotive decoder 76 400 is a small, efficient multi-protocol decoder. It can be used in DCC and Motorola systems and operates equally well in analog mode with DC or AC power and direction of travel change-over using high voltage pulse (Märklin system).

The decoder works with a frequency of 18.75 kHz and is not only suitable for DC motors and also for bell armature motors (e.g. Faulhaber, Maxon, Escap) up to a continuous power of 1 A. Short term higher switching on current are tolerated well.

The motor characteristics are setup either by means of the minimum, middle and maximum speeds or by different CV's for the individual speeds. The load control can be individually adapted to different locomotive motors by setting these control parameters.

The decoder has two travel direction dependent lighting outputs, as well as two additional special function outputs, which are switched using function keys f1 and f2. Function keys f3 and f4 can be used to switch a shunting mode with extended low-speed operating range and the starting/brake inertia. The allocation of the switching tasks such as lighting, special function outputs, shunting mode and adjustable starting/brake inertia can be freely assigned to the function keys of the digital center (Function Mapping). The decoder is programmable with the Intellibox, DCC-und Märklin controllers. All CV's are programmable with these devices.

In the default condition the decoder automatically recognizes the DCC and Motorola data formats, as well as the respective analog mode with DC or AC voltage. The desired operating mode can also be specified manually.

Installation of the locomotive decoder 76 400
Connection of the decoder
Connect the red decoder's red wire to the right power pickups and the black wire to the left. The decoder's black and orange wires are connected to the motor.

Test if the travel direction is correct. If it is not then swap the orange and grey wires

Important: the suppressor components remain connected.

Connection 76 400

### Connection of special functions

Connect the yellow wire to the rear and the white wire to the front light. The second pole of the lamps is connected either to the blue wire of the decoder or to the locomotive chassis. If the lamps do not light according to the driving direction, the travel direction of the motor must be changed, by swapping the orange and the grey wires to the motor.

For travel direction independent switching the outputs can be paralleled.

Note: If the driving direction of the locomotive does not agree with the indicator of your digital center, you can reverse it by changing bit 0 of CV 29.
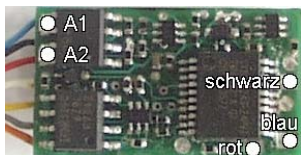
Additional special functions such as smoke generator, telex coupling or driver compartment lighting can be connected to the special function outputs A1 and A2. The feed to the device is soldered directly to the decoder circuit board. The return line is connected either to the blue wire of the decoder or the locomotive chassis.
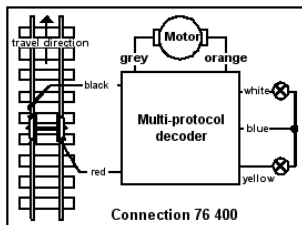
Connection of the LISSY mini transmitter 68 400

Insert the plug of the LISSY mini transmitter into the SUSI interface socket on the under side of the decoder. Then program bit 1 of CV 49 to the value 1, so that the decoder sends the identification address for the control of the LISSY mini transmitter to the SUSI interface.

If the SUSI interface is occupied e.g. by a sound module, remove the interface plug of the LISSY mini transmitter and solder the three wires to the decoder circuit board as indicated below.

Note: For the operation of a sound module on the SUSI interface bit 1 of CV 49 must bit set to the value 0 (= factory setting).

Mounting the decoder in the locomotive

Use the enclosed double sided tape to fasten the decoder to any place in the locomotive. The sticking pad protects the decoder against conductive connections and holds it in place reliably.

Start-up

Examine the correct installation with a continuity tester or an ohm meter. Ensure that the unit is placed in the vehicle where a conducting connection cannot develop! Ensure that even after re-assembly of the locomotive no short-circuits occur from jammed wires.

> **A short-circuit in the area of the motor, lighting, pick-up and wheel contacts can destroy the component and electronics of the locomotive!**

Digital and analog Operation

On digital layouts the decoder can be controlled in the Motorola or DCC data format. For the DCC operation 28 speed steps are preset.

If the decoder is used on conventional layouts it can be controlled either with a DC or an AC controller (system Märklin). All operating modes are automatically recognized by the decoder.

Programming

The Configuration variables (CV's) form the basis of all possible operations of the decoder in accordance with the DCC standard. The decoder can be programmed with the Intellibox, DCC controllers and Motorola controllers.

Programming with the Intellibox

We recommend, that irrespective of the data format that will eventually be used, the decoder be programmed using the menu for DCC decoders.

The Intellibox supports DCC programming with a user friendly input menu. Long addresses do not have to be calculated laboriously, as they can be entered directly. The Intellibox calculates the values for CV 17 and CV 18 automatically.

For precise instructions please read the appropriate chapter in the Intellibox manual.

Special case locomotive addresses 80 to 255 in Motorola format

In Motorola format the Intellibox supports an address range to 255. Addresses 1 to 80 can also be programmed easily using DCC programming. However if locomotive addresses higher than 80 are to be used, the locomotive address must be programmed according to the chapter "Programming with a Märklin controller".

After programming is complete CV 1 has a value of 0 and the decoder uses the Motorola address larger than 80.

Programming with DCC devices

Use the programming menu of its DCC controller, to select and program the decoders CV's by register, CV directly or page mode programming. With a DCC controller it is also possible to be program the decoder using main line programming. For the exact procedure refer to the manual of controller the used.

Programming of long addresses without programming menu

If programming is to be done with controllers that do not support programming with an input menu, the values for CV 17 and CV 18 must be calculated. Here is a guide for programming of address 2000.

- Divide the address by 256 (2000/256 = 7 remainder of 208).
- Take the integer result (7) and add 192
- Program the result (199) into CV 17
- Program the remainder (208) into CV 18
- Important: Set bit 5 of CV 29 to 1, so that the decoder uses the long address.

Values for calculating the CV value

CV's 29 and 49 can be used to set the decoder into different modes.

The value to be programmed is calculated by using the CV and adding the values of the desired functions.

Example

Normal driving direction	value = 0
28 speed steps	value = 2
Auto Analog/digital change over	value = 4
Speed steps using CV 2, 5, 6	value = 0
Short address	value = 0

Bit	CV 29 function	Value
0	Normal driving direction	0
	Reverse driving direction	1
1	14/27 speed steps	0
	28/128 speed steps	2
2	Only digital operation	0
	Automatic analog/digital change over	4
4	Speed steps using CV2, CV5 and CV6	0
	Characteristics using CV67-CV94	16
5	Short address (CV1, register 1)	0
	Long address (CV17 and CV18)	32

The sum of all values is 6. CV 29 preset to this value ex factory.

Programming with a Märklin Center

With a Märklin center all CV's can be programmed, but not read.

1. Switch Center off and on.
2. Select the address of the decoder and switch the light on.

3. Operate the direction change-over 5 times in quick succession with the stationary locomotive (speed step 0), until the light turns off.

4. Set the speed controller to "zero". The rear light now flashes slowly 4 times.

5. Enter the number of the CV that is to be programmed.

6. Briefly operate the direction change-over. The rear light flashes fast 4 times.

7. Enter the desired value for CV e.g. a locomotive address.

8. Briefly operate the direction change-over. The rear light flashes slowly 4 times.

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

If programming is to be terminated switch the center to "STOP" or set the address to "80" and briefly operate the direction change-over.

Since a Motorola digital center from Märklin only accepts inputs of 01 to 80, the value "0" must be entered by entering the address as "80".

Page-Register for inputting CV-Numbers greater than 79

CV addresses larger than 79 can only be programmed with the help of the page register, CV66. If CV66 has a value higher than 0, then the contents of CV66 times 64 will be added to every address entered. The entered value must lie in the range 1 to 64. When leaving Motorola programming mode the page register (CV66) is set automatically reset to zero.

Example

If CV82 is to be programmed with a value of 15, then CV66 must first be programmed with a value of 1. Subsequently, CV18 can be programmed with a value of 15. The decoder places the value 15 into CV82, which is derived from the multiplying the contents of the CV66 (in the example 1) by 64 (thus 64) and then adding the entered CV address (18).

Offset-Register for entering CV values greater than 79

CV values larger 79 can be programmed only with the help of the offset register. The offset register is CV65. If CV65 contains a value > 0, then all following programmed valued are calculated by multiplying the contents of CV65 by 4 and adding the result to the entered value. When leaving Motorola programming mode the offset register (CV65) is automatically reset to zero.

Example

CV49 is to be programmed with a value of 157, then CV65 must first be programmed with the value of 25. Subsequently, CV49 can be programmed with a value of 57. The decoder places the value 4 * 25 + 57 into CV49.

Note: When programming CV65 and CV66 the contents of the offset and page registers have no effect.

Märklin braking section

The decoder reacts to a Märklin brake section (brakes with analog power on the track), if CV29 bit 2 and CV49 bit 7 are set to 1 (factory setting 1 and 0).

Technical Data

Addresses:	1-9999 (long DCC address)
Max. current consumption:	1 A
Function outputs:	1 A each
Size:	22 x 12.5 x 5.5 mm

The decoders is preset to address 03, and 28 speed step mode and can be used and programmed in DCC and Motorola data format.

Factory defaults

The factory setting places the decoder in DCC/Motorola operating mode. It automatically switches between both formats. Additionally the decoder can operate on conventional analog layouts with a DC or AC controller (Märklin system).

Table of CVs (Configuration Variables)

CV	Description	Value range	Default value
1	**Locomotive address**	DCC 1-127 Mot 1-80	3
2	**Minimum Speed**	1-63	1
3	**Acceleration** 1 means that every 5 ms the actual speed is increased by 1 If the internal maximum speed is set to 200 (CV5=50 or CV94 = 200), then acceleration time from 0 to Fmax is 1sec.	1-63	2
4	**Braking inertia** (time factor CV3)	1-63	2
5	**Maximum speed** (must be greater than CV2)	1-63	48
6	**Middle speed** (must be greater than CV2 and less than CV5)	1-63	24
7	**Software version** (The processor can be updated)	-	varies
8	**Manufacturer ID**	-	85
17 18	**Long locomotive address** 17 = high byte / 18 = low byte	1-9999 199-231/0-255	2000 199/208
19	**Consist address** (double traction) 0 = Consist address inactive When bit 7=1 the driving direction is reversed The desired speed CADR + 128 = reverse direction	1-127	0
29	**Configuration for DCC** Value Bit 0=0 Normal direction 0 * Bit 0=1 reversed travel 1 Bit 1=0 14 speed steps 0 Bit 1=1 28 speed steps 2 * Bit 2=0 Only digital operation 0 Bit 2=1 automatic analog/digital switching 4 * Bit 3 Not used - Bit 4=0 Speed steps using CV 2, CV 5, and CV 6 0 * Bit 4=1 Characteristics using CV 67 to CV 94 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	6
33-40	**Allocation of the function outputs, which are to be activated with function keys like light and special functions** CV33 Light operation forwards CV34 Light operation backwards CV35 Function key f1 CV36 Function key f2 CV37 Function key f3 CV38 Function key f4 CV39 Function key f5 CV40 Function key f6 **Bit Assignment** Bit 0 Light output front 1 Bit 1 Light output back 2 Bit 2 Special function A1 4 Bit 3 Special function A2 8 Bit 4 Shunting mode 16 Bit 5 Start/brake inertia 32	0-63	 1 2 4 8 16 32 0 0
49	**Locomotive decoder configuration** Value Bit 0=0 Motor load regulation On 0 * Bit 0=1 Motor load regulation Off 1 Bit 1=0 SUSI configured for Sound module 0 * Bit 1=1 SUSI configured for LISSY Mini transmitter 2 Bit 2=0 brakes to 0 in brake section 0 * Bit 2=1 brakes to speed step in CV52 4 Bit 3=0 Data format DCC and Motorola 0 * Bit 3=1 Data format only DCC 8 Bit 4=0 Data format DCC and Motorola 0 * Bit 4=1 Data format only Motorola 16 Bit 5=0 Dimming for A1 and A2 Off 0 * Bit 5=1 Dimming for A1 and A2 On 32 Bit 6=0 Light outputs not swapped 0 * Bit 6=1 Light outputs swapped 64 Bit 7=0 Brake only with brake signal 0 * Bit 7=1 Brake with analog potential 128 *Attention: When the Motorola data format is selected by Bit 3 and the DCC data format by Bit 4, the decoder no longer receives speed commands and can only be programmed.*	0-255	32
50	**Dimming of Function outputs A1, A2 and Light outputs**	0-63	32

CV	Description	Value range	Default value
51	**Configuration of analog operation** 1 = only AC operation, 2 = only DC operation 3 = AC and DC operation with automatic recognition	1-3	3
52	**Final speed in a braking section** Effective when CV49 Bit 2=1 and Bit 7=1	0-255	30
53	**Motor regulation repetition rate** Lower the value if the locomotive is not running smoothly	60-255	120
56	**Reference rule** Lower the value, if the top speed is too small Increase the value, if locomotive runs too fast at speed step 1	0-127	64
58	**Time slot for AD transducer measurement** Increase the value, if locomotive run roughly at slow speeds Lower the value, if CV 53 is reduced the maximum speed of the locomotive is too low	0-255	10
59	**Reset to factory defaults** If this CV is set to 1, the decoder will be returned to factory setting.	0, 1	0
60	**Short circuit monitoring** 0 = inactive, 250 = active (do not change)	0, 250	250
61	**Shutdown temperature in °C (90°C)** 0 = Temperature monitoring Off	0-255	varies
64	**Speed correction forwards** Correction factor = value from CV 64/128	0-255	128
65	**Offset-Register** For CV Programming with a Motorola center	0-255	0 0
66	**Page Register** For CV Programming with a Motorola center	0-255	varies
67-94	**Characteristic curve for speed steps 1-28**	0-255	128
95	**Speed correction reverse** Correction factor = value from CV 64/128	0-255	1
115	LISSY Train catagory	1-4	3

*Ex-factory values are marked with *.*

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.

The trade names mentioned are registered trade marks of the respective companies.