

## IntelliDrive Comfort 76 320

### Multi-protocol decoder with Load regulation for DC and Faulhaber motors

#### Features

- Regulated Multi-protocol decoder for DCC, Motorola
- Suitable for DC and Bell armature motors up to 1A
- Quiet motor running with 18.75KHz control frequency
- 14, 27, 28, 128 speed steps depending on the data format
- Short (1-127) and long (128-9999) addresses
- NMRA compatible
- Minimum, maximum and middle speeds adjustable
- Main line programming (DCC)
- Shunting speed (half speed) switched with F3
- Direction dependent, dimmable lighting switched via F0
- Reacts to DCC brake signal 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 and Motorola formats
- Programmable via register, direct CV or page mode in DCC operation
- Updatable using Flash memory
- Fitted with 8 pole NEM 652 plug

#### Description

Locomotive decoder 76 320 is a very small powerful multi-protocol decoder. It can be operated in DCC and Motorola digital systems and also runs in analog mode with DC current or with AC current using the Märklin reversing pulse switching mechanism. The operating mode is automatically detected and can also be locked manually.

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 1A. 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 and Märklin controllers. CV's can be programmed with all devices.

# Installing a 76 320 locomotive decoder

## Connecting the device

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 degrees.

**Note:** If the travel of the locomotive does not coincide with the indication on the control centre you can change the value of CV29 bit to 0 to reverse the direction.

## Fastening the decoder in the Vehicle

Using the double sided adhesive pad provided affix 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 into contact with any conducting surfaces in the vehicle! Also ensure that a short circuit cannot occur when the locomotive is close and that the wire is not cinched.

### Pin outs of the NEM 652 connector

1	●	●	8
2	●	●	7
3	●	●	6
4	●	●	5

- 1 Motor (orange)
- 2 Rear Light (yellow)
- 3 Auxiliary (green)
- 4 Track left (black)
- 5 Motor (grey)
- 6 Front Light (white)
- 7 + common lights (blue)
- 8 Track right (red)

**A short circuit with the Motor, lighting, third rail pickup and wheels can destroy the device and eventually the locomotive's Electronics!**

## Starting up the decoder

Select address 3 on your controller. The will operate in which ever data format it is addressed, in Motorola or in DCC operation with 28 speed step.

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

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 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, they 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.

## 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 freely 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 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 may 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

Auto Analog/digital change over Value = 4

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

## 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 values 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 set 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:	1A
Function outputs:	1A each
Size:	19 x 16 x 5 mm

## Factory defaults

The decoder has a preset address of 03 and can operated in DC format with 28 speed steps and in Motorola format and programmed. It automatically switches between both formats.

Additionally the decoder is able to operate with DC controller or AC controller (Märklin system) on analog 2 or 3 rail layouts.

## Table of individual CV's (Configuration Variables)

CV	Description	Value range	Factory default
1	<b>Locomotive address</b>	DCC 1-127 Mot 1-80	3
2	<b>Minimum speed</b> value	1-63	1
3	<b>Start Inertia</b> 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	<b>Braking inertia</b> (time factor like CV3)	1-63	2
5	<b>Maximum speed</b> (must be larger than CV2)	1-63	63
6	<b>Middle speed</b>	1-63	30
7	<b>Software version</b> (The processor used can be updated)	-	varies
8	<b>Manufacturer ID</b>	-	85
17	<b>Long address</b>	1-9999	2000
18	17 = Long address high byte / 18 = Long address low byte	192-231 / 0-255	199 / 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
29	<b>Configuration DCC Standard</b> Bit 0=0 Normal driving direction Bit 0=1 Reversed driving direction Bit 1=0 14 speed steps Bit 1=1 28 speed steps Bit 2=0 only Digital operation Bit 2=1 automatic Analog/Digital switching Bit 3 not used Bit 4 not used Bit 5=0 Short Address (CV 1) Bit 5=1 Long Address (CV 17/18) Bit 6/7 not used	Value 0 * 1 0 2 * 0 4 * - - 0 * 32 -	0-255 6
49	<b>Decoder Configuration</b> Bit 0=0 Load regulation on Bit 0=1 Load regulation off Bit 3=0 Data format Motorola and DCC Bit 3=1 Data format DCC Bit 4=0 Data format Motorola and DCC Bit 4=1 Data format Motorola Bit 6=0 Don't swap light outputs Bit 6=1 Swap light outputs Bit 7=0 Brake only with brake signal Bit 7=1 Brake with analog voltage <i>Note: 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.</i>	Value 0 * 1 0 8 * 0 * 16 0 * 64 0 * 128	0-255 0
50	<b>Dimming</b> of the function outputs	0-31	16
51	<b>Configuration of analog operation</b> 1 = only AC operation, 2 = only DC operation 3 = AC and DC operation with automatic recognition	1-3	3
53	<b>Motor regulation repetition rate</b> Lower the value if the locomotive is not running smoothly	0-255	40
54	<b>Decoder Configuration</b> Connected to 12V motor Connected to 14V motor Connected to 16V motor Motor regulation repetition rate constant Motor regulation repetition rate depending on speed step with large speed steps <i>Bit 3-7 must not be changed</i>	Value 0 * 1 3 0 4 *	0-255 132
58	<b>Time slot for AD transducer measurement</b> 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	8
59	<b>Reset to factory defaults</b> If this CV is set to 1, the decoder will be returned to factory setting. <i>Note: After a reset definitely program CV61 and CV21</i>	0, 1	0

CV	Description	Value range	Factory default
60	<b>Short circuit monitoring</b> 0 = inactive, 250 = active (do not change)	0, 35	35
65	<b>Offset-Register</b> For CV Programming with a Motorola center	0-255	0 0
66	<b>Page Register</b> For CV Programming with a Motorola center	0-255	0
100	<b>Error memory</b> 0 = no error (reset error memory) 1 = Motor Short circuit 2 = Light Short circuit	0-2	0

The factory default values in CV29 and CV49 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.

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 **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



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