Uhlenbrock digital

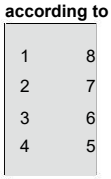
IntelliDrive 2 **Lokdecoder 74 320**

This decoder also includes the description and programming instructions of the Intelidrive 2 mini decoder

Connections of the locomotive decoder 74 320

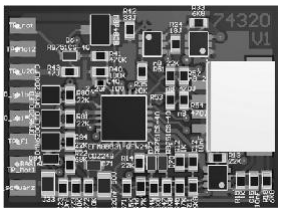
Remove the bridge connector from the interface socket your vehicle. In the same place, plug the plug of the locomotive decoder carefully into the interface socket. Is a contact on the interface socket in the vehicle with a 1" marked, then the pin on which the red cable is plugged in here. Fix the decoder in place with the included adhesive pad and make sure that also no short circuits can occur after closing the locomotive. The first commissioning should take place on the programming track when the programming mode of the control panel is called up. When reading or programming, very small currents usually flow, which do not damage the decoder in the event of a short circuit.

Pin assignment of the interface according to NEM 652 for DCC decoder



1 Motor connection (orange)
2 Rear lighting (yellow)
3 Special function A1 (green)
4 Power consumption left (black)
5 Motor connection (grey)
6 Lighting front (white)
7 gem. Positive pole lighting (blue)
8 Power consumption right (red)

red
orange
blue
yellow
weiß
green
grey
black



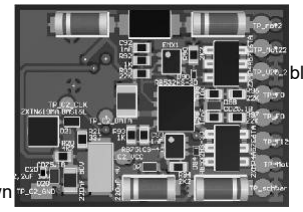
Connection of special functions

An additional special function such as smoke generator, automatic coupling or a cab lighting can be connected to the special function output A1 (green).

Connection of incandescent lamps

To adjust the operating voltage and to avoid very high inrush currents, we recommend a resistance of 68 ohms to the incandescent lamps in series.

Connection of energy storage device 71800



blue

brown

the energy store is labeled as in its instructions ben connected. The connection points of brown and blue line are shown on the sketch.

ATTENTION: Soldering on the decoder should only be carried out by experienced professionals with the appropriate tools. For decoders that have been damaged by improper handling, the warranty claim is void.

A short circuit in the area of motor, lighting and power consumption destroys the building block and possibly the electronics of the locomotive!

Commissioning of the decoder

Enter address 3 on the control unit. Depending on the data format used, the decoder works in DCC operation with 28 speed steps, in Selectrix® or in Motorola® operation. If the decoder is used on conventional systems, it can be controlled with a DC or AC drive device. The operating mode is automatically detected by the decoder. The state of the functions F0 - F1 can be set for analog operation via the CVs 13 and 14. Programming can be done in DCC and Motorola format.

Delivery status

The decoder is preset to address 03 and automatically switches between data formats and analog operation. In the factory setting, the outputs are set as follows.
F0 switches light front/rear depending on direction of travel
F1 switches A1

Technical data

Addresses: 1-9999 (long DCC address), 1-255 (Motorola®)
Load: 0.65 A (engine and total load)
0.4A (function outputs)
Größe: 19 x 14 x 3,5 mm

NOTE:

This product is not a toy and not suitable for children under 14 years. Any liability for damage of any kind caused by improper use, as well as by not following these instructions, is excluded.

Garantieerklärung

Each module is checked for its complete function before delivery. Should an error occur within the warranty period of 2 years, we will exchange the module free of charge upon presentation of the purchase receipt. The warranty does not apply if the damage was caused by improper handling.

EU-Konformitätserklärung

The EU declaration of conformity can be found on the Internet at:
www.uhlenbrock.de/de_DE/service/download/konformitätserklärung/index.htm

Our advantages for you:

If you have any questions, we are here for you!

Internet: FAQs can be found at www.uhlenbrock.de
E-Mail: service@uhlenbrock.de
Hotline: +49 (0)2045 8583-27
The times can be found on our service page (QR code)
Premium hotline: +49 (0)900 1858327 If it is urgent...
Chargeable (98cent/min dt.Festnetz, mobile considerably more expensive)
Service: In case of a defect, send the item with our repair form.
Scan QR code or www.uhlenbrock.de/de_DE/service/reparatu/index.htm.

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Motorola with 3 addresses for light effects such as Mars Light, • 8 Modulation curves • Fluorescent lamps • Energy-saving lamp effect • On and off of the light• Firebox with • Function outputs: - Programming device POM **2• Function outputs:** (DCC) Function outputs **Flashing outputs** Overload secures the **depending on • Extended function** functions F1 - Gyra Light, **mapping, • Simple function mapping, • Second dimming for • light and function output • 2 light outputs and one • 3 adjustable start-up, • shunting (half • Simple and extended • Short (1-127) and long • 14, 27, 28, 128 speed steps** strobe for example American switch-on effect and function outputs Setting parameters Phases for changeover links with variable time associated conditions F0 - F44 for several F0 - F12 lighting, A1 F12 for analog operation Special u.a. function output Brake deceleration speed) switchable Driving level characteristic (128-9999) addresses depending on data format

4<AODELQ=hedcaj>

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Made in Germany

Electronic devices do not belong in household waste.

Art.-Nr. 74 320

03.22

Uhlenbrock digital

IntelliDrive 2 **Mini-Lokdecoder** *73 300, 73 310, 73 340 73 406, 73 416*

Description

This manual describes in detail the entire range of functions of your new locomotive decoder. In order to enjoy it as much as possible, please read the instructions carefully and completely.

This locomotive decoder is a small, very powerful multi-protocol decoder. It can be used in DCC, Motorola and Selectrix digital systems. It also runs in analog mode with DC voltage. The respective operating mode is automatically detected, but it can also be set manually.

The decoder works with a frequency of 18.75 kHz and is therefore suitable not only for direct current, but also for Bell armature motors (e.g., Faulhaber, Maxon, Escap) up to a continuous current consumption of 0.8 A Motor currents up to 2 A are well tolerated.

The decoder is RailCom® and RailCom Plus® capable and masters both ABC braking and ABC slow-speed driving. The engine characteristic curve is set via the minimum, medium and maximum speed (simple characteristic curve), or via the extended characteristic curve with individual settings for 28 speed steps.

The decoder has two direction-dependent lighting outputs, as well as two additional special function outputs (not 73115). Its manoeuvring gear with extended low-speed range and the three possible starting and braking decelerations can be switched via function keys. Ideal for use in American locomotive models is the possibility to activate special, typical American light effects (Mars Light, Gyra Light, Strobe, etc.).

The assignment of switching tasks such as lighting, special function outputs (not 73115), shunting and switchable driving, braking deceleration (ABV) can be freely assigned to the function keys F0 - F12 of the digital control center (small function mapping). In addition, the decoder also supports extended function mapping. In the extended function mapping, simultaneous switching on or off of several outputs is possible depending on linked conditions (F-keys, direction of travel, loco stands / moves) with a function key assignment F0 - F44.

The decoder can be programmed via all Intelliboxes, DCC and Märklin controllers. All CVs can be programmed with all devices. To facilitate programming, especially for extended function mapping, the programming software "Lok-Tool" can be used, which is included with the digital programming and test station "DigiTest" from Uhlenbrock. This software is also available for free download on our website www.uhlenbrock.de.

As a further special feature, the decoder can be updated via the digital programming and test station "DigiTest" from Uhlenbrock. It can even remain in the closed vehicle. Even the installation of locomotive sounds on a connected IntelliSound 4 module can take place in this constellation in the installed state.

IMPORTANT: All information **about** the function outputs A1 & A2 in the user manual do not apply to the decoder 73115 with 6-pin NEM 651 interface.

Analog operation with DC voltage

The locomotive decoder is suitable for analog operation with DC voltage, which is detected independently. **ATTENTION:** Operation with AC voltage will destroy the decoder!

NOTE: In DC mode, your vehicle will only start at a higher voltage (throttle further turned up) than you might have been used to in operation with analog vehicles.

Function outputs in analog mode

It is possible to set the decoder so that the function keys F0 - F12, as assigned in the function mapping, can also be switched on in analog mode. For this purpose, the CVs 13 & 14 must first be programmed with a digital control center. The corresponding values can be found in the CV table.

Motor control

The motor control preset in the decoder is ideal for most motor types. If the driving behavior of your vehicle does not meet your expectations, because it jerks, for example, at low speed, you can change this standard setting of the engine control. Two control types are available for adjusting the motor control.

1. PID Regler
2. SX two-point controller

Within the CV51, the first three bits can be used to define whether a controller should be active, if yes, which controller should be active and whether a fixed or variable period is used (see Configuration CVs -> Table CV51, Bits 0 - 2).

CV51

Bit0 -> 0 = knob off, 1 = knob on
Bit1 -> 0 = PID-Regler, 1 = SX-Regler
Bit2 -> 0 = fixed period duration according to CV53, 1 = dynamic period duration CV53, 200, 201, 202
CV53 -> Period of motor control in 100µs steps
CV54 -> PID: P content
CV55 -> PID: I-component
CV56 -> PID: D content
CV57 -> PID: Regler Offset
CV58 -> Measuring gap for EMF measurement in 100µs steps

Speed-dependent (dynamic) period of the motor control CV200 minimum speed step (0-255) up to which the period duration = CV53 is set CV201 maximum speed step (0-255) from which the period duration = CV202 is set CV202 maximum period duration in 100µs steps

For the variable controller period, the period duration for internal speed steps smaller than CV200 is set to the value from CV53. Up to the speed step according to CV201, the period duration is linearly changed up to the value in CV202. For all driving levels above CV201, the period is set to the value of CV202.

The engine control can be adapted to the locomotive via the CVs 53 to 58 and 200 to 202.

In order for the decoder to use the dynamic period duration, it must be switched on via the CV51 bit 2.

Instructions for changing the controller parameters P, I, D:

Before changing the controller parameters, make sure that

1. The transmission is smooth running
2. The collector of the motor is not smeared
3. No capacitors from motor to chassis (ground) are present

Once these three points have been processed, you can start with the settings according to the following pattern.

) Enable PID control, bit 1 in CV51 = 0

) Set PID control offset CV57 = 0

) With the factory setting of the decoder CV2, 5 and 6 (min, max and medium speed) preset the motor control via CV54, 55 and 56.

) Set the CV55 and 56 to zero
) Set the CV54 so that the locomotive starts straight at speed 2
) Enlarge the CV55 so that the locomotive moves quickly from speed 0 to 1 and moves as desired at speed 1. The increment of the change should be 1.
) Compensate restless behavior when changing the speed steps with the CV56. The increment of the change should be 1.
) If necessary, adjust CV2, 5, 6 and start again from step 3.).

If a satisfactory result is not achieved, it may be necessary.
a) The period of the regulation in CV53 are changed.
b) The measuring gap for the EMF voltage in CV58 can be increased (For some motors, quiet operation at low speeds can only be achieved by this)
c) The slider Offset be changed.

Perform the respective changes in small increments and adjust the PID controller if necessary.

Motorola

In order to achieve the functions F1 - F12 when used with Motorola control panels (eg 6021), the decoder has 3 Motorola addresses, which are trinär stored in CV47-49. These 3 addresses are also used for decoding. If an address is programmed decimal under CV1, the decoder up to address 79 automatically stores the trinary equivalent in CV47. For example, to use Motorola loco addresses up to 255, the CVs 47 - 49 must be programmed directly decimal via Motorola programming (eg 6021 or Intellibox)
On the DCC programming track these CVs can be read, but not programmed.
If the CV47 is programmed by Motorola, the CV1 is not changed and therefore the DCC data format in CV12 is switched off so that the decoder can not be accidentally accessed via 2 addresses.
If the bit5 is set in the CV29 (DCC long address), the Motorola data format is turned off except for the Motorola programming, so that the decoder can not react to 2 addresses.

Konfigurations-CVs

In addition to the decoder address, the configuration CVs of a locomotive decoder are certainly the most important CVs. These are in the In-telliDrive 2 decoder the CVs 29, 50 and 51. A configuration CV usually contains various settings of a decoder, which are displayed in a maximum of 8 bits (0 - 7). The input value of a CV is calculated from the respective CV table by adding the values of the desired functions.
Below you can see the meaning and content of the configuration CVs, as well as an example calculation of the value:

Bit	Konfiguration CV 29	Wert
0	Normal direction of travel	0
	Opposite direction of travel	1
1	14 / 27 speed steps	0
	28 / 128 speed steps	2
2	only digital operation	0
	automatic analog/digital switching	4
3	RailCom from	0
	RailCom a	8
4	Speed steps via CV 2, CV 5, and CV 6	0
	Use characteristic curve from CV 67-94	16
5	Kurze Adresse (CV 1, Register 1)	0
	Long address (CV 17 and 18)	32

Example calculation (CV 29)

Normal direction of travel	Wert = 0
28 speed steps	Wert = 2
automatic analog/digital switching	Wert = 4
RailCom off/on	Wert = 8
Speed steps via CV 2, 5, 6	Wert = 0
Kurze Adresse	Wert = 0

The sum of all values is 14.

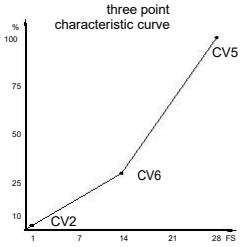
This value is stored as default in CV 29.

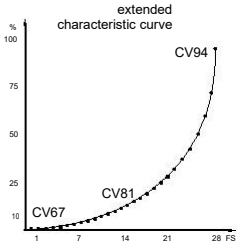
Bit	Konfiguration CV 50	Wert
0	Do not use Motorola 2nd address	0
	Motorola 2nd address use	1
1	Do not use Motorola 3rd address	0
	Motorola 3rd address use	2
2	Do not replace light outputs	0
	Replace light outputs	4
3	Frequency light, A1 and A2 = 156Hz	0
	Frequency light, A1 and A2 = 24KHz	8
4	SUSI = SUSI	0
	SUSI = A3/A4 Logikpegel	16

Bit	Konfiguration CV 51	Wert
0	Motor control from	0
	Motor control a	1
1	Motor control PID - Controller	0
	Motor control SX - controller	2
2	no dynamic period duration	0
	dynamic period duration	4
7	Light, A1/A2 PluX (73145)	0
	Light, A1/A2 cable/NEM (not 73145)	32

Driving stage characteristic curve

The decoder is preset to a simple, three-point characteristic curve, which determines the minimum, medium and highest speed. However, it can also be converted to the extended driving step characteristic for 28 speed steps (CV29, Bit4 = 1). This characteristic curve offers the possibility to set a speed for each of the 28 speed levels. The settings are entered in CVs 67 to 94, whereby a CV is reserved for each of the speed steps 1 - 28.





RailCom®, RailCom Plus®

The basis of the RailCom® technology developed by LENZ® is the transmission of data from the decoder to the specially prepared (CutOut) DCC digital signal on the track. Detectors must be located on the track, which evaluate these decoder data and, if necessary, forward them to the control center. The decoder transmits, depending on the setting, the decoder address and, when reading via the main track programming, CV values, which can be displayed by the digital control center (depending on the detector and control center). In the decoder, the CV29 RailCom® can be switched on or off via bit 3. Further RailCom® settings can be made in CV 28. There, for example, RailCom Plus® is also switched on via bit 7. If RailCom Plus® is switched on, the decoder automatically logs on to a RailCom Plus® capable control centre (e.g., PIKO SmartControl) with its locomotive symbol, decoder name and special radio symbols within a few seconds. This RailCom Plus® technology means that no locomotive data has to be stored in the control centre and no locomotive addresses have to be programmed into the decoders.

Braking behaviour

Märklin Brake Distance

The decoder responds to a Märklin brake path (brakes with analog DC voltage on the track) when CV29 bit 2 and CV27 bit 4 or bit 5 are set to 1 (factory setting 1 and 0).
CV27 bit 4 = 1 -> DC with opposite direction of travel
CV27 bit 5 = 1 -> DC with direction of travel equal

ABC - Brakes

If the decoder detects an ABC braking distance (not possible safely when using an Intellibox, or Power 3 - 8), a braking process begins. On which side of the rail the digital voltage should be more positive to activate the braking process can be set via the CV27:
CV27 Bit0 = 1, brake when right rail is more positive
CV27 Bit1 = 1, brake when left rail is more positive
CV27 Bit0 & Bit1 = 1, brake regardless of which rail is more positive
Bit 7 of the CV27 can be used to set whether the vehicle should only react to the ABC braking distance in one direction of travel (forward or backward). Only one of the bits 0 or 1 must be set for this. Regardless of the positions of bits 0 and 1 (one must be at least set to detect an ABC braking distance) can be driven in an activated ABC braking distance when the shunting gear is switched on or the starting braking deceleration is switched off. In the CV97, the voltage difference from which the decoder detects the ABC braking distance can be set. The desired difference corresponds approximately to the CV value * 0.12V. If an ABC slow-moving signal is detected according to a Lenz BM2 module, the decoder brakes on the internal speed step (0 - 255) adjustable in CV98.

Constant braking distance in cm

The decoder offers the possibility for two adjustable, constant braking distances in centimeters, true to scale.
The constant braking distances can be triggered by various events. This includes the ABC brake signal, the brake signal of a DCC brake generator, the brake signal of a DC brake section, as well as the speed step 0 When braking with the speed step 0 (eg manual operation, LISSY or MARCo) it is possible to enter a speed step threshold, above which the constant braking distance is only executed. If the internal speed of the locomotive decoder is smaller than the entered speed step threshold, the vehicle stops at setpoint speed 0 with the set brake delay from CV4, or CV145, or CV147.
CV138 = 1 - 255 -> Instantaneous speed above which is braked with constant braking distance when the setpoint speed is set to zero.

CV Meanings

CV139 = braking distance in cm
CV140 = alternative braking distance, can be activated via the CROSS bit (see "Extended Function Mapping")
CV141 = maximum speed of the model locomotive in cm/s
CV142 = If the value determined for the CV141 exceeds 255, the rest is entered in the CV142 (possibly track 1, IIm (G))
CV143 = constant braking distance activation by:
bit 0 = 1 -> setpoint speed = 0, with current internal speed according to CV138 and larger (manual operation, LISSY, MARCO)
bit 1 = 1 -> ABC brakes
Bit 2 = 1 -> DC Brakes
Bit 3 = 1 -> DCC brake signal
CV143 = 0 -> no constant braking distance
The meanings of CVs 141 and 142 described here are valid from software version 23 (CV7) of the decoder. For older software versions, the 1st edition of this description remains valid.
If braking is initiated with a constant braking distance, the decoder only responds to driving commands again when the locomotive has come to a standstill. This process can be interrupted by switching on the shunting gear.

Determination of the maximum speed of the model locomotive

In the decoder, program the CV of the maximum speed to the maximum possible value (CV5 = 63, or when using the extended speed characteristic CV94 = 255)
Mark a starting point on a sufficiently long, straight track section, from which the vehicle approx. 2 seconds unhindered can drive at the maximum possible speed. Place a scale (ruler) at the marked starting point. Now you enter this section at maximum speed, that is, throttle set to the highest speed. When you reach the starting point, start the time measurement for 2 seconds. After these 2 seconds, remember the position of the vehicle on the folding rule and read the value in cm. Divide this value by 2 and you get the driven speed in cm/s. In the gauges 1 and IIm (G), the determined value may possibly exceed 255 for very fast vehicles. In this case, please enter the value 255 in the CV141 and the rest of the determined value in the CV142.
After this measurement, the CV for the maximum speed (CV5 or CV94) can be set to the desired maximum speed for driving operation.

Switchable starting and braking delays

In addition to the standard starting and braking deceleration (CVs 3 & 4) of the decoder, there are two alternative starting and braking delays, which can be activated with function keys. The function keys F0 - F28 for the alternative ABV sets can be stored by the values 0 - 28 in the respective CVs 148 and 149 (for simple function mapping, CV96 = 0). The value 255 disables the respective alternative ABV set.
CV144 = starting delay 2 as replacement for CV3
CV145 = brake delay 2 as replacement for CV4
CV146 = starting delay 3 as replacement for CV3
CV147 = Brake Deceleration 3 as replacement for CV4
CV148 = function key number for ABV 2 (0-12, 255=off)
CV149 = function key number for ABV 3 (0-12, 255=off)
In the extended function mapping (CV96 = 1), the alternative ABVs of the CVs 144 - 147 are activated via the possible conditions there (see "Extended function mapping").

Function outputs

Simple function mapping

The following settings of the decoder are only possible with the simple function mapping (CV 96 = 0).

In the simple function mapping, the assignments of the switching tasks such as lighting, special function outputs (not 73115), shunting and switchable starting and braking deceleration can be freely assigned to the function keys F0 to F12 of the digital control center. The value that is written to a CV of the function mapping determines the functions that can be switched via a function key assigned to the CV. For this purpose, the CVs 33 to 46 serve according to the following scheme.

Assignment of the function keys to the CVs		Factory value	Assignment of the individual bits		Wert
CV 33	Light function key F0 when driving forward	1	Bit 0	Front light output	1
CV 34	Light function key F0 when reversing	2	Bit 1	Rear light output	2
CV 35	Function key F1	4	Bit 2	Function output A1	4
CV 36	Function key F2	8	Bit 3	Function output A2	8
CV 37	Function key F3	16	Bit 4	Function output A3 (SUSI/logic)	16

CV 38	Function key F4	32	Bit 5	Function output A4 (SUSI/logic)	32
CV 39	Function key F5	64	Bit 6	Rangiergang	64
CV 40	Function key F6	128	Bit 7	Starting/braking deceleration	128
CV 41	Function key F7	0			
CV 42	Function key F8	0			
CV 43	Function key F9	0			
CV 44	Function key F10	0			
CV 45	Function key F11	0			
CV 46	Function key F12	0			

Example 1: The rear light output should only be switched with the function key F5.
The CV to be programmed is the CV39 for the function key F5 in which the value 2 (rear light output) is programmed. So that the rear light output is no longer switched backwards in the direction of travel via the function key F0, the CV34 for the function key F0 in the direction of travel must also be programmed backwards to the value 0.
Example 2: The function output A1 and the shunting ring should be switched together with the function key F10. The CV to be programmed is the CV44 for the function key F10. In this CV44 the value 4 (function output A1) plus the value 64 (shunting gear), ie the value 68 is programmed. So that the function output A1 is no longer switched via the function key F1 and the shunting lever no longer via the function key F5, the CVs 35 for the function key F1 and 39 for the function key F5 must also be programmed to the value 0.

Turn off front and rear train lights (CV96 = 0)

In CV107 (front) and CV108 (rear), the numbers of the special functions 1 - 12 can be entered, which switch off the white and red lights front or rear. Furthermore, it can be entered here to which function outputs A1 and A2 the red train terminal lighting is connected in each case.
The function numbers entered here must be set via the function mapping so that they do not switch on other outputs. Furthermore, it must be ensured that the outputs used for the red lighting are not switched off or switched off via the function mapping of other function keys. the Function Mapping CV of the F-keys used here must be set to zero. In order for the switching off of the light to work properly, both CVs 107 and 108 must always be programmed as desired. If one of the CVs 107 or 108 is programmed with the value 0, the function is considered deactivated.
The value for programming the CVs 107 and 108 consists of two conditions. On the one hand, to which the outputs A1 or A2 the switched off lighting is connected and on the other hand, with which function key F1 to F12 the lighting is to be switched. Since a CV can only be described with a value, these conditions are summarized into a value according to the following scheme:
Light assignment: A0v = white light front, A0h = white light rear
CV107 for red front lighting
CV108 for red rear lighting
Calculation: output * 16 + function key
Example: The red lighting at the front should be connected to A1 and switched with F5.
CV107=1*16+5=21
The rear red light should be connected to A2 and switched with F6.
CV108=2*16+6=38

Switch off function outputs depending on the direction of travel (CV96 = 0)

In the CVs 113 (forward direction) and 114 (backward direction) it can be defined which function output A1 - A4 (A3 & A4 logic on SUSI, CV50 bit 4 = 1) should be switched off. If such an output is switched on via a wireless button, it is automatically switched off in the desired direction of travel.
CV113 = 2 -> A1 forward from CV113 = 4 -> A2 forward from CV113 = 8 -> A3 forward from CV113 = 16 -> A4 forward from
CV114 = 2 -> A1 backwards from CV114 = 4 -> A2 backwards from CV114 = 8 -> A3 backwards from CV114 = 16 -> A4 backwards from
A combination (sum of the individual values) is possible.

Simple and advanced function mapping

The following settings of the decoder are possible with the simple (CV96 = 0) and with the extended (CV96 = 1) function mapping.

Dimming of light and function outputs

The light and function outputs A1 & A2 can be set to any dimming. These settings are stored in CVs 116 (light), 117 (A1) and 118 (A2).

Soft fade-in and fade-out of light and function outputs

If the output is switched on or off, it is softly switched on or off.
In the CV186 it can be defined which output should receive this glare function. CV186 = 1 -> light outputs with glare function, CV186 = 2 -> A1 with glare function, CV186 = 4 -> A2 with glare function. A combination (sum of the individual values) is of course also possible here.
The setting of the CV187 specifies how fast the glare function should work. The step size is CV value * 1ms.

Flashing of light and function outputs

The locomotive decoder has a flashing generator, which can be assigned to the outputs. Both the switch-on time and the switch-off time of the flashing generator are separately adjustable.
In the CV109 you can define which output should use the flashing generator. Furthermore, it can be defined in the CV110, which output should use the flashing generator with 180° rotated phase position. For example, a changeover line can be realized.
CV109 = 1 -> light outputs flash, CV109 = 2 -> A1 flashes, CV109 = 4 -> A2 flashes. A combination (sum of the individual values) is of course possible.
CV110 = 1 -> Light outputs flash with turned phase, CV110 = 2 -> A1 flashes with turned phase, CV110 = 4 -> A2 flashes with turned phase. Of course, a combination is also possible here.
In the CV111 the switch-on time is adjustable in 100ms steps and in the CV112 the switch-off time in 100ms steps.

Energy saving lamp effect when switching on the light and function outputs

When an energy-saving lamp is switched on, it first produces a basic brightness before it slowly reaches the maximum brightness. This effect can be assigned to the outputs of the decoder as follows. CV183 = 1 -> effect for light outputs, CV183 = 2 -> effect for A1, CV183 = 4 -> effect for A2.
A combination (sum of the individual values) is of course also possible here.
The basic brightness is adjustable via the CV184. The setting of the CV185 specifies how fast the final value of the brightness (PWM1 in CVs 116 - 118) should be reached. The step size is CV value * 5ms.

Switching on effect of a neon tube / fluorescent lamp

The switching effect of a defective neon tube can also be output at the light and function outputs. This effect consists of an adjustable, maximum number of flashes (random one flash up to the maximum number of flashes) and an adjustable flash time, so how fast the flashes should follow each other.
CV188 = 1 -> effect for light outputs, CV188 = 2 -> effect for A1, CV188 = 4 -> effect for A2.
A combination (sum of the individual values) is of course also possible here.
The flash time is set via the CV 189 in 5ms steps. The maximum number of flashes in CV 190.

Firebox Polishers

Random flickering can be assigned to the outputs light, A1 and A2. This effect is used, for example, for the flickering of a firebox.
CV181 = 1 -> flickering for light outputs, CV181 = 2 -> flickering for A1, CV181 = 4 -> flickering for A2.
A combination (sum of the individual values) is of course also possible here.
In the CV182 the settings for the flicker rhythm and for the brightness change are entered as follows:
Bits 0 - 3 change the flicker rhythm (value range 1 to 15).
Bits 4 - 6 change the brightness (value range 16, 32, 48, 64, 80, 96, 112).
With the value 128, the output is always bright, but can be combined with the value range 16 to 112.
Since only one value can be programmed in a CV, the flickering results from the sum of the individual values of the flicker rhythm plus the sum of the individual values of the brightness (sum of bits 0 -3 plus sum of bits 4 - 6). The combination of all bits leads to different, random flicker patterns. Here the rule is: "try".

Smoke generator control

At the outputs A1, A2 a smoke generator can be connected, which is controlled by the decoder load-dependent.
When stationary, the smoke output has the PWM according to CV133. If the locomotive starts, the output gets the PWM=100%.
The engine can be stopped for 0-15 seconds (starting delay), so that the smoke generator heats up when stationary. At the end of this time, the loco arrives, after which the output is controlled for another time (start-up time) with 100%. Then the smoke output goes to the PWM in normal travel. In case of a load increase, the smoke output is controlled again with 100% for the already defined start-up time. The necessary load increase (load threshold) can be set. For this purpose, the load variable is used, which is also output for an IntelliSound module on the SUSI interface.

CV Meanings

The CV130 defines which of the two outputs A1, A2 is controlled with the smoke generator control and which time should apply to the start-up delay. The value range 1-3 (1 = A1, 2 = A2, 3 = A1 & A2) defines the output and the value range 16 - 240 in steps of 16 the starting delay, whereby a 16 step means one second starting delay. The sum of the individual values gives the value for the CV130.
Calculation: Start delay * 16 + output
The load threshold is entered in the CV131 in a value range from 0 to 127. The higher the value in 0.1s steps, the more the output reacts to a load change.
The CV132 determines the PWM for the normal drive and the CV133 the PWM at the standstill.

Adjustable PWM - frequency of light and function outputs

The output voltage of a function output is pulse width modulated (PWM) with a predetermined frequency.
The function outputs of the decoder work in factory setting with a frequency of 156 Hz. This frequency can be increased to 24 kHz for all outputs A0 to A2. A typical application is the electrical coupling from ROCO. Only with the higher frequency do these couplings no longer "flutter".
The frequency switching is adjustable in the CV50 in bit 3. Bit 3 = 0 -> 156Hz, Bit 3 = 1 -> 24KHz

Control of an electrical coupling

Electrical couplings consist of the finest copper wire windings. These usually react sensitively to permanent current flow, because they become relatively hot. With appropriate settings, the decoder can ensure that the function outputs switch off automatically after an adjustable time without having to switch off the function key. Furthermore, the decoder can ensure that the coupling is only actuated for a short switch-on moment with an adjustable high PWM to safely lift the coupling. After this moment, less energy is required to keep the clutch up. This, lower PWM, as well as the required holding time are also adjustable. If the used couplings do not disengage safely during the first attempt, a number of coupling repetitions can also be set. When adjusting the clutch repetitions, "as many as necessary, as few as possible" applies. So that a permanent repetition does not lead to the destruction of the coupling windings, an off time must be entered in 0.1s steps, which the decoder always waits before performing another uncoupling process.
CV124 = Number of repetitions
CV125 = Switch-on time in 100ms steps with the PWM from CV117 (A1) or CV118 (A2)
CV126 = holding time in 100ms steps
CV127 = switch-off time in 100ms steps, (0=no clutch control)
CV128 = Hold PWM
CV129 = 2 -> Coupling for A1, CV129 = 4 -> Coupling for A2, CV129 = 6 -> Coupling for A1 & A2

Shunting ango, automatic uncoupling

A shunting line can only be activated if the electrical clutch control is activated via CV124-129. A shunting line is triggered by one of the coupling outputs if the decoder level = 0: Function of a shunting line:
1. Locomotive moves with adjustable speed for an adjustable time (T1) against the current direction of travel (pressing)
2. Locomotive stops and changes direction
3. Uncoupling process and loco moves with the same speed step for an adjustable time T2 (back off)
4. Locomotive stops, now the locomotive has the original direction of travel again.

The CVs to be set are:
CV135 for the speed step of the shunting line (1-255). The value 0 specifies that no shunting ango takes place.
CV136 for the pressing time T1 in 100ms steps
CV137 for the rest time T2 in 100ms steps

Modulation of the PWM - output for the light and function outputs

The brightness of the outputs can be modulated by means of 64 different brightness values, which are periodically output as PWM at the outputs. The period of playback is adjustable. It results from the value of CV178 multiplied by 64ms.
For the 8 PWM paths with up to 64 individual values, two banks (banks 3 & 4) á four PWM paths are available. In total, there are 7 available CV banks in the decoder, each with 256 CVs. For this variety of combination possibilities, so many CVs are necessary that programming in the conventional CV frame 1 to 1024 is no longer possible. Therefore, a special splitting into CV banks of 256 CVs (CV257 - 512) is necessary.
Thus, the CVs 257 - 512 can be used multiple times. A similar procedure for handling CV banks already exists in our IntelliSound modules. If you have already made settings there, you will certainly find your way around quickly.
Which of these CV banks should be programmed depends on the respective value of two "pointer CVs", the CVs 31 and 32.
The values of these two CVs point to the corresponding CV bank, here banks 3 and 4.The values of the "pointers CVs do not change the meaning of CVs 1 - 256 and are not relevant for driving.
Setting of Bank 3 for programming the courses 1 to 4: CV31=8,CV32=3 Setting of Bank 4 for programming the courses 5 to 8: CV31=8,CV32=4 The following 8 PWM courses are stored in the factory setting:
1 = Mars Light, 2 = Gyra Light, 3 = Oszi. Headlight, 4 = Stakato, 5 = Ditch Light, 6 = rotary Beacon, 7 = single Strobe, 8 = double Strobe

Since up to 64 brightness values can be entered in a gradient, 256 CVs are available for each bank. If a bank is selected for programming via the CVs 31 and 32, the individual values are written to the CVs 257 - 512, with each course 64 CVs as follows:

Bank 3 (CV31=8,CV32=3)	**Bank 4 (CV31=8,CV32=4)**
History 1: CVs 257 - 320	History 5: CVs 257 - 320
Course 2: CVs 321 - 384	History 6: CVs 321 - 384
Course 3: CVs 385 - 448	History 7: CVs 385 - 448
History 4: CVs 449 - 512	History 8: CVs 449 - 512

The gradients can be changed at any time, or replaced by your own gradients by changing the corresponding CVs in a value range of 0 - 63.
The CVs 170 to 172 can be assigned to the outputs A0 to A2 one of these 8 PWM curves by entering the desired number 1 - 8 in the respective CV.
Each of the outputs light rear, A1 and A2 can be assigned one of 2 phase positions during playback. Thus, two outputs can be generated, which flash in the changing clock. The required settings shall be entered in CV179:

Bit	**Phase position of the outputs CV179**	**Wert**
0	A0h, phase 0°	0
	A0h, phase 180°	1
1	A1, phase 0°	0
	A1, phase position 180°	2
2	A2, phase 0°	0
	A2, phase position 180°	4

Grade Crossing
If the bit7 (value 128) of the respective CV170 - 172 is set, the modulated effect is only activated if the CROSS output bit is set via function mapping (see extended function mapping). If the CROSS output bit is not set, the output is constantly switched on. If the CROSS output bit is switched off again via function mapping, the effect thus activated remains on until a hold time programmed in CV180 has expired. This holding time results from the value of CV 180 multiplied by 100ms.

Servo control

The use of a servo on the decoder requires electronic expertise.
If a 1 is entered in CV166 and a function key number F0 - F28 is entered in CV167 (Servo1) and/or 168 (Servo2), a control signal for a model user is output via the SUSI interface (Servo1 = Data, Servo2 = CLK, see graphic "Servo circuit for operating a servo on SUSI or solder pads")
The servo positions and the rotation time can be set with the following CVs:
CV160 Servo 1 position 1 (function key off)
CV161 Servo 1 position 2 (function key on)
CV162 Servo 1 rotation time in 100ms steps
CV163 Servo 2 position 1 (function key off)
CV164 Servo 2 position 2 (function key on)
CV165 Servo 2 rotation time in 100ms steps

Advanced function mapping

The following settings of the decoder are only possible with the extended function mapping (CV 96 = 1).

The decoder supports advanced function mapping. In the extended function mapping, the simultaneous switching on or off of several outputs, starting and braking delays, shunting, second dimming of the function outputs, SUSI as logic level output, transfer of the function keys F22 to F28 to SUSI, as well as the setting of the CROSS-bit possible. These functions can be switched on or off depending on linked conditions, such as function keys F0 to F44, direction of travel of the locomotive, as well as loco stands or moves. These combinations are stored in two CV banks. In total, there are 7 available CV banks in the decoder, each with 256 CVs. For this variety of combination possibilities, so many CVs are necessary that programming in the conventional CV frame 1 to 1024 is no longer possible. Therefore, a special splitting into CV banks of 256 CVs (CV257 - 512) is necessary.
Thus, the CVs 257 - 512 can be used multiple times. A similar procedure for handling CV banks already exists in our IntelliSound modules. If you have already made settings there, you will certainly find your way around quickly.
Which of these CV banks should be programmed depends on the respective value of two "pointer CVs", the CVs 31 and 32. The values of the "pointer CVs" do not change the meaning of the CVs 1 - 256 and are not relevant for driving operation.
Each CV bank of the extended function mapping consists of 16 lines with 16 entries. These 16 entries then form the combination of switching condition and output. Since two CV banks are available for the extended function mapping, a total of 32 possible combinations for switching conditions and outputs can be realized.
TIP: Before each programming process of the CVs 257 - 512, you should program the CVs 31 and 32 for the desired CV bank. It is recommended to read these two "pointer CVs" before programming, so that wrong CV banks are not accidentally programmed.
To facilitate programming, especially for extended function mapping, the programming software "Lok-Tool" can be used, which is included with the digital programming and test station "DigiTest" from Uhlenbrock. This software is also available for free download on our website www.uhlenbrock.de.
The CV programming of the extended function mapping in detail:
Pointer CVs:
CV31 = 8, CV32 = 0 for line 1 - 16 (Bank 1)
CV31 = 8, CV32 = 1 for lines 17 - 32 (Bank 2)
Each line consists of 16 entries (bytes) with the following meaning:
Entries (bytes) 1 - 6 specify the functions that must be **turned on** for the condition to be met.
Entries (bytes) 7 - 12 specify the functions that must be **turned off** for the condition to be met.
Entries (bytes) 13 - 16 specify **the outputs that** are turned on when the condition is met.
Each entry (byte) consists of a combination of 8 individual conditions (bits)
The bits 0 - 7 in the respective entries (bytes) for **the switching conditions On (bytes** 1 - 6) and Off (**bytes 7** - 12) have the following meaning:

Byte / Bit / From	0	1	2	3	4	5	6	7
1 / 7	F1	F2	F3	F4	F0	n.b.	Fahr.	Vorw.
2 / 8	F5	F6	F7	F8	F9	F10	F11	F12
3 / 9	F13	F14	F15	F16	F17	F18	F19	F20
4 / 10	F21	F22	F23	F24	F25	F26	F27	F28
5 / 11	F29	F30	F31	F32	F33	F34	F35	F36
6 / 12	F37	F38	F39	F40	F41	F42	F43	F44

Fahr. Lok fährt Driving direction
Vorw. forward
n.b. unused

The bits in the respective entries (bytes) 13 - 16 for the output have the following meaning:

Byte / Bit	0	1	2	3	4	5	6	7
13	A1	A2						
14	A0v	A0h	S-CLK	S-Data	ABV	ABV2	ABV3	RG
15	A0-P2	A1-P2	A2-P2					
16	Cross	S-F22	S-F23	S-F24	S-F25	S-F26	S-F27	S-F28

A0v Front light output
A0h Rear light output
S-CLK Output SUSI CLK: (enable A4 logic, CV50 bit4 = 1) or (enable servo1, CV166 bit0 = 1)
S-Data Output SUSI Data: (enable A3 logic, CV50 Bit4 = 1) or (enable servo2, CV166 Bit0 = 1)
ABV Starting and braking deceleration 1
ABV2 Starting, braking deceleration 2
ABV3 Starting, braking deceleration 3
RG Rangiergang
A0-P2 Light outputs, 2nd dimming
A1-P2 Function out1, 2nd dimming
A2-P2 Function out2, 2nd dimming
Cross CROSS-Bit für PWM-modulierte Ausgänge
S-F22 - S-F28 functions F22 - F28 on the SUSI interface on or off, depending on the result of the conditions set in bytes 1 - 12. The state of these functions, as it is transmitted by the digital control center, is then no longer transferred to the SUSI interface.
The CV159 must be set accordingly for transfer of F22 - F28 to SUSI.

The CV number to be programmed is calculated from the

for lines 1 - 16
Base value 256
plus (line number minus 1) multiplied by 16
plus the number of the byte.

Formula: 256 + (line - 1) * 16 + bytes

for lines 17 - 32
Base value 256
plus (line number minus 17) multiplied by 16
plus the number of the byte.

Formula: 256 + (line - 17) * 16 + bytes

The bit structure and the values to be programmed accordingly in the CVs are comparable to the configuration CVs of the decoder. This means that there is a fixed value per bit set. If the bit is not set, the value for this bit remains 0.

Bit	**Wert**
Bit 0	1
Bit 1	2
Bit 2	4
Bit 3	8
Bit 4	16
Bit 5	32
Bit 6	64
Bit 7	128
Summe	255

The values for the individual CVs can now be derived from the above-mentioned information.

Examples:

The output A1 should **be switched on** when the function key **F1 is** switched on.
Bank 1, line 1 -> CV31 = 8, CV32 = 0
There are two CVs to program
First CV for the power condition (F1 on), second CV for the output (A1 on)
F1 key **on** -> CV number = 256 + (1 - 1) * 16 + 1 = 257
F1 key **on** -> byte 1, bit 0 = 1 -> CV 257 = 1
Output **A1 switched on** -> CV number = 256 + (1 - 1) * 16 + 13 = 269
Output **A1 switched on** -> byte 13, bit 0 = 1 -> CV269 = 1

The light output at the front (A0v) **should be switched on** when the function key **F0 is** switched on **and the** locomotive is moving. Bank 1, line 2 -> CV31 = 8, CV32 = 0
There are two CVs to program
Key **F0 on** + **drive ->** CV number = 256 + (2 - 1) * 16 +1 = 273
Key **F0 on** + **drive ->** byte 1, bit 4 = 1 + bit 6 = 1-> CV 273 = 16 + 64 = 80
Output **A0v switched on** -> CV number = 256 + (2 - 1) * 16 + 14 = 286
Output **A0v turned on** -> byte 14, bit 0 = 1 -> CV286 = 1

The starting, braking deceleration 2 (ABV2) and the output **A2 are to** be switched on **when the locomotive** moves forward (previous) (driving), not **stationary and** the function F6 is switched on.
Bank 1, line 3 -> CV31 = 8, CV32 = 0
There are four CVs to program
Fahr. + Vorw. -> CV-Nummer = 256 + (3 - 1) * 16 +1 = 289
Fahr. + Vorw. -> Byte 1, Bit 6 = 1 + Bit 7 = 1-> CV 289 = 64 + 128 = 192
Key F6 on **->** CV number = 256 + (3 - 1) * 16 +2 = 290
Key **F6 switched on** -> byte 2, bit 1 = 1 -> CV 290 = 2
A2 switched on -> CV number = 256 + (3 - 1) * 16 + 13 = 301
A2 switched on -> byte 13, bit 1 = 1 -> CV301 = 2
ABV2 switched on -> CV number = 256 + (3 - 1) * 16 + 14 = 302
ABV2 turned on -> byte 14, bit 5 = 1 -> CV302 = 32

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The output A0v should **be switched off** and **the outputs** A1 and **A2 should** be switched on. Furthermore, **the second dimming for A2 (A2-P2) should** be **switched on** and the CROSS **bit** should **be** set.
These outputs should only be activated if the loco moves backwards (**Drive.), the** function key **F14** is switched on **and the** function key F0 is switched off
Bank 2, line 17 -> CV31 = 8, **CV32 = 1**

Four CVs for output and three CVs for conditions to program
Lok fährt (**Fahr.**) -> CV-Nummer = 256 + (17 - 17) * 16
+ 1 = 257 Lok fährt (**Fahr.**) -> Byte 1, Bit 6 = 1 -> CV
257 = 64
F14 key **on** > CV number = 256 + (17 - 17) * 16 + 3 = 259 key
F14 on -> byte 3, bit 1 = 1 -> CV 259 = 2
Key **F0 switched off** + loco reverse (previous) switched off **->** CV number = 256 + (17 - 17) * 16 + 7 = 263
Key **F0 switched off** + loco reverse (previous) switched off **->** byte 7, bit 4 = 1 + bit 7 = 1-> CV 263 = 16 + 128 = 144
A0v should be switched off **->** CV number = 256 + (17 - 17) * 16 + 14 = 270
A0v should be switched off **->** byte 14, bit 0 = 0 -> CV 270 = 0
A1 + A2 **switched on ->** CV number = 256 + (17 - 17) * 16 + 13 = 269
A1 + A2 **switched on ->** byte 13, bit 0 = 1 + bit 1 = 1-> CV 269 = 1 + 2 = 3
A2-P2 switched on -> CV number = 256 + (17 - 17) * 16 + 15 = 271
A2-P2 switched on -> byte 15, bit 2 = 1 -> CV 271 = 4
CROSS bit **set ->** CV number = 256 + (17 - 17) * 16 + 16 = 272
CROSS-bit **set ->** byte 16, bit 0 = 1 -> CV 272 = 1

To facilitate programming, especially for extended function mapping, the programming software "Lok-Tool" can be used, which is included with the digital programming and test station "DigiTest" from Uhlenbrock. This software is also available for free download on our website www.uhlenbrock.de.

Second dimming of light and function outputs

The light and function outputs can be set to an alternative, ie second dimming (eg for a high beam). The settings of the values for the alternative dimming are stored in the CVs 150 (light), 151 (A1) and 152 (A2). In the extended function mapping (CV96 = 1), the alternative dimming of the CVs 150 - 152 is activated via the possible conditions there (see "Extended function mapping).

Reset to factory setting (Reset)

To bring the decoder back to factory settings, two (CV8, CV59) can be used in the DCC programming, in the Motorola programming a CV (CV59). In order to not rewrite all available areas, you can decide which areas should be brought into factory settings. The value 1-4 to be programmed sets the following CVs to factory settings:

1 = CV0 - 256, and CV257 - 512 (RailCom® Bank 7)	CV31=0, CV32=255
2 = CV257 - 512 (RailCom Plus® Banken 5 & 6)	CV31=1, CV32=0 and CV31=1, CV32=1
3 = CV257 - 512 (extended function mapping banks 1 & 2)	CV31=8, CV32=0 and CV31=8, CV32=1
4 = CV257 - 512 (PWM modulation function outputs banks 3 & 4)	CV31=8, CV32=3 and CV31=8, CV32=4

Uhlenbrock digital

IntelliDrive 2 ***Mini-Lokdecoder 73*** *300, 73 310, 73 340, 73 406, 73 416* **Programming**

The configuration variables (CVs) form the basis of all settings of the decoder. The decoder can be programmed with the Intellibox, DCC control panels and Motorola control panels.

Programming with the Intellibox

We recommend programming the decoder via the programming menu for DCC decoders, regardless of the format to be used later.

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

Special case loco addresses 80 to 255 in Motorola data format

The Intellibox supports an address range up to 255 in the Motorola data format. For the first Motorola address, addresses 1 to 80 can also be easily programmed via DCC programming. However, if locomotive addresses larger than 80 are to be used, the address must be programmed in any case as in the chapter "Programming with a Märklin central station". After this programming, the CV 1 contains the value 0 and the decoder uses the Motorola address greater than 80.

Programming with DCC devices

Use the programming menu of your DCC control panel to read and program the decoder CVs via register, CV directly or page programming. It is also possible to program the decoder by main track programming with a DCC digital control center.
The exact procedure can be found in the manual of the used control unit.

Programming of long addresses without programming menu

If programming is performed with control panels that do not support programming with an input menu, the value for CV 17 and CV 18 must be calculated. Here the instructions for programming the address 2000.

- Divide the address value by 256 (2000:256 = 7 Rest 208).
- Take the integer result (7) and add 192.
- Enter the result (199) as a value in CV 17.
- Enter the remainder (208) as a value in CV 18.
- Important: Set bit 5 from CV 29 to 1 so that the decoder uses the long address.

Programming lock (decoder programming lock)

The decoder programming lock is used for several decoders in a vehicle to change CVs in only one of the decoders with the same basic address (CV1) or long address (CV17 and CV18). For this purpose, each decoder CV16 must be programmed to a different number (index number) before the decoders are installed in the vehicle. To change or read the value of a CV in one of the installed decoders, program the corresponding index number in CV15 and then program the CVs of the selected decoder. The decoders compare the values in CV15 and CV16 and if both values match, access to the CVs is released. If the comparison fails, the CVs of this decoder cannot be accessed.
The following index numbers are recommended: 1 for motor decoders, 2 for sound decoders, 3 or higher for function and other types of decoders.

Programming with a Märklin control unit (eg 6021)

With a Märklin control panel, all CVs can be programmed, but not read out. The decoder can be put into programming mode in two ways (a and b, depending on the control panel) and then programmed.

Switch off and on the control panel

Set control panel to "Motorola old" (6021 DIP 2 = off), switch control panel off and on

Select address of decoder and turn on light

Set central to "stop" and dial address 80

When the locomotive is stationary (speed level 0), press the direction switch 5-8 times in a row until the lighting flashes

Press and hold the change of direction when the locomotive is stationary, set the central unit to "go" and wait about 12 seconds

4. Enter the number of the CV to be programmed as a loco address at the control panel
5. Briefly press the direction switch (5a and 5b). Now the rear light flashes 4 x fast (only 5a)
6. Enter the desired value for the CV like a loco address at the central office
7. Briefly press the direction switch (7a and 7b). Now the rear light flashes 4 x slowly (only 7a)

If further CVs are to be programmed repeat point 4-7

If the programming is to be stopped, switch the control panel to "stop", or enter the address 80 and briefly press the direction switch.

Since only inputs from 01 to 80 are possible when programming with a Motorola digital control center from Märklin, the value 0" must be entered via the address as 80".

Page register for entering CV numbers greater than 79

CV numbers greater than 79 can only be programmed using the Page tab. This page register is the CV64. If the CV64 is described with a value greater than 0, the content of the CV64 times 64 is added to each subsequent, entered address value in all subsequent programming operations. The entered value must be in the range 1 to 64.

After successful programming of all CVs greater than 79, the page register (CV64) must be reset to zero.

If, for example, the CV82 is to be programmed with the value 15, the CV64 must first be programmed with the value 1. Then the CV18 can be programmed with the value 15. In the decoder, the value 15 is now stored in the CV number 82, which results from the addition of the content of the CV64 (in example 1) multiplied by 64 (ie 64) and the entered CV number at the control panel (18).

Offset register for entering CV values greater than 79

CV values greater than 79 can only be programmed using the offset register. This offset register is the CV65. If the CV65 is described with a value > 0, the content of the CV65 is multiplied by 4 for all subsequent programming operations, added to each CV value programmed below and stored in the corresponding CV.

After successful programming of all CV values greater than 79, the offset register (CV65) must be reset to zero.

For example, if the CV49 is to be programmed with the value 157, the CV65 must first be programmed with the value 25.
Then the CV49 can be programmed with the value 57. The value 4* 25 + 57 is now stored in the decoder.

Note: When programming the CV64 and the CV65, the content of the offset and page registers is not taken into account.

Programming with the Mobile Station 1 & 2

Mobile Station 1: The programming menu in the locomotive menu is only available for certain locomotives. A locomotive with a programmable decoder must be selected from the database. Proceed as follows:

1. Create a new locomotive and select the item 36330 from the database.The display shows the locomotive Ee 3/3.
2. Press the "MENU/ESC" button and select the "CHANGE LOCO" section. Here you will find the last function Programming tab labeled "REG". Use this function to change the CVs of the decoder. You can only write the CVs with this function.
3. Enter the CV number and confirm it with the switch button.
4. Then enter the value of the CV and confirm it with the switch button. The Mobile Station now programs the CV with the desired value.

Mobile Station 2: For programming please use the DCC CV programming menu.

Caution: Before programming, remove all locomotives from the track that should not be programmed!

Table of CVs (Configuration Variables) of the decoder

IMPORTANT: All outputs A1 & A2 specified in the table do not apply to **decoder 73115**

CV	Description		Value range	Value ex works
1	Lokadresse		DCC 1-127 Mot 1-80	3
2	Minimum speed (change until the locomotive moves straight at speed 1)		1-63	1
3	**start-up delay,** 1 means that the current internal speed is increased by 1 every 5 ms For example, if the internal maximum speed is 200 (CV 5 = 50 or CV 94 = 200), then the start-up time from 0 to Fmax is 1 second		0-255	5
4	**Braking deceleration (time factor** like CV 3)		0-255	5
5	**Maximum speed** (must be greater than CV 2)		1-63	48
6	**Average speed** (must be greater than CV 2 and less than CV 5)		1-63	24
7	**Software version** (The processor used can be updated)		-	under.
8	**Decoder** set, values as in CV 59		various	85
12	**Operating modes** Bit 0=0 DC (analog operation direct current) off Bit 0=1 DC (analog operation direct current) on Bit 2=0 Data format DCC from Bit 2=1 Data format DCC a Bit 3=0 Data format Motorola from Bit 3=1 Data format Motorola a Bit 4=0 Data format Selectrix from Bit 4=1 Data format Selectrix a	Wert 0 1* 0 4* 0 8* 0 16*	0-29, 255	255
13	**Activate function keys in analog mode** bit 0-7 -> F1 to F8; bit = 0 function off, bit = 1 function on		0-255	0
14	**Activate function keys in analog mode** bit 0 and bit 4-7 -> F0 and F9 to F12; bit = 0 function off, bit = 1 function on		0-255	1
15	**Decoder programming lock**		0-255	1
16	**Decoder Programming lock Index number**		0-255	1
17,18	**Lange Lokadresse** 17 = Higher value byte 18 = Low-valued byte		128-9999 192-231 0-255	2000 199 208
19	**Consist address** (double traction) 0 = Consist address (CADR) is not active If bit 7 = 1 the direction of travel is reversed, so desired CADR + 128 = reversal of direction		1-127	0
27	**Settings Brake signal (automatic stop)** bit 0 = 1 -> ABC right rail positive bit 1 = 1 -> ABC left rail positive bit 4 = 1 -> DC with opposite direction of travel Bit 5 = 1 -> DC with direction of travel equal Bit 7 = 0 -> ABC only forward direction when bit 0 = 1 or bit 1 = 1 Bit 7 = 1 -> ABC only reverse direction if bit 0 = 1 or bit 1 = 1	Wert 1 2 16 32 0 128	0-179	0
28	**RailCom® Konfiguration** Bit 0 = 1 -> Channel 1 on Bit 1 = 1 -> Channel 2 on Bit 7 = 1 -> RailCom Plus®a	Wert 1 2 128	0-131	131
29	**Configuration according to DCC standard** Bit 0=0 Normal direction of travel Bit 0=1 Opposite direction of travel 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=0 RailCom® switched off Bit 3=1 RailCom® switched on Bit 4=0 Speed steps via CV 2, 5 and 6 Bit 4=1 Use characteristic curve from CV 67 - 94 Bit 5=0 Kurze Adresse (CV 1) Bit 5=1 Lange Adresse (CV 17/18)	Wert 0* 1 0 2* 0 4* 0* 8* 0* 16 0* 32	0-63	14
30	**Fault memory for function outputs, motor and temperature monitoring** 1 = Error FKT outputs, 2 = Error motor, 4 = Temperature exceeding		0-7	0

CV	Description			Value range	Value ex works
31	Pointer CV for CV banks			0,1,8	0
32	2nd pointer CV for CV banks			0, 1, 3, 4, 5, 255	255
33-46	**Simple function mapping**			0-255	
	Assignment of the function outputs to the CVs				
	CV 33	Light function button (F0) when driving forward			1
	CV 34	Light function key (F0) when reversing			2
	CV 35	Function key F1			4
	CV 36	Function key F2			8
	CV 37	Function key F3			16
	CV 38	Function key F4			32
	CV 39	Function key F5			64
	CV 40	Function key F6			128
	CV 41	Function key F7			0
	CV 42	Function key F8			0
	CV 43	Function key F9			0
	CV 44	Function key F10			0
	CV 45	Function key F11			0
	CV 46	Function key F12			0
	Assignment of the individual bits		Wert		
	Bit 0	Front light output	1		
	Bit 1	Rear light output	2		
	Bit 2	Function output A1	4		
	Bit 3	Function output A2	8		
	Bit 4	Function output A3 (SUSI/logic)	16		
	Bit 5	Function output A4 (SUSI/logic)	32		
	Bit 6	Rangiergang	64		
	Bit 7	Starting/braking deceleration	128		
47	**Motorola 1st trinary address (directly** only with Motorola programming method)			0-255	12
48	**Motorola 2nd trinary address (only** with Motorola programming method)			0-255	0
49	**Motorola 3rd trinary address (only** with Motorola programming method)			0-255	0
50	**Decoder Konfiguration 1**		Wert	0-63	0
	Bit 0=0	Do not use Motorola 2nd address	0*		
	Bit 0=1	Motorola 2nd address use	1		
	Bit 1=0	Do not use Motorola 3rd address	0*		
	Bit 1=1	Motorola 3rd address use	2		
	Bit 2=0	Do not replace light outputs	0*		
	Bit 2=1	Replace light outputs	4		
	Bit 3=0	Frequency light, A1 and A2 = 156Hz	0*		
	Bit 3=1	Frequency light, A1 and A2 = 24KHz	8		
	Bit 4=0	SUSI = SUSI	0*		
	Bit 4=1	SUSI = A3/A4 output function mapping table	16		
51	**Decoder Konfiguration 2**		Wert	0-135	3, 131
	Bit 0=0	Motor control from	0		
	Bit 0=1	Motor control a	1*		
	Bit 1=0	Motor control PID - Controller	0		
	Bit 1=1	Motor control SX - controller	2*		
	Bit 2=0	no dynamic period of motor control	0		
	Bit 2=1	Dynamic period of motor control	4		
	Bit 7=0	Light, A1/A2 PluX12 decoder (73145)	0		
	Bit 7=1	Light, A1/A2 cable/NEM decoder (not 73145)	128		
53	Period of motor control in 100µs steps			0-255	40
54	Motor control P-constant of the PID controller			0-255	100
55	Motor control I-constant of the PID controller			0-255	40
56	Motor control D-constant of the PID controller			0-255	32
57	Regler Offset			0-255	6
58	Measuring gap for EMF measurement in 100µs steps			0-255	8
59	**Factory reset** (also possible via CV8) 1 = CV 0 - 256, and CV257 - 512 (RailCom® Bank 7) 2 = CV 257 - 512 (RailCom Plus® Banken 5 & 6) 3 = CV 257 - 512 (extended function mapping banks 1 & 2) 4 = CV 257 - 512 (PWM modulation function outputs banks 3 & 4)			0-4	0
60	**Short-circuit monitoring Motor, function outputs, temperature control.** Switched on (do not change)			-	-
61	Constant for the temperature shutdown			-	-
62	Constant of short-circuit detection of the FKT outputs (do not change)			-	-
63	Constant of short-circuit detection of motor output (do not change)			-	-
64	**Page Register** for CV programming with a Motorola control unit			0-255	0
65	**Offset-Register** for CV programming with a Motorola control unit			0-255	0
66	Speed correction forward			0-255	0
67-94	**Extended speed step characteristic curve for speed steps 1 - 28**			0-255 each	under.
95	Reverse speed correction			0-255	0

CV	Description	Value range	Value ex works
96	**Type of function mapping** 0 = simple function mapping, 1 = extended function mapping	0-1	0
97	**ABC brakes** Voltage difference for diode range is about CV value * 0.12V	0-255	8
98	Speed in the ABC slow-speed route	0-255	30
107	Turn off front lights	0-44	0
108	Turn off rear lighting	0-44	0
109	**Flashing generator, assignment of phase 1 to the outputs** bit 0-2 -> A0 to A2; bit = 0 flashing phase 1 off, bit = 1 flashing phase 1 on	0-7	0
110	**Flashing generator, assignment of phase 2 to the outputs** bit 0-2 -> A0 to A2; bit = 0 flashing phase 2 off, bit = 1 flashing phase 2 on	0-7	0
111	Blink generator switch-on time in 100ms steps	0-255	5
112	Turn-off time in 100ms steps	0-255	5
113	**Switching off the function outputs A1 - A4 forward in the direction of travel** Bit 1-4 -> A1 - A4; Bit = 0 output on, bit = 1 output off	0-31	0
114	**Switching off function outputs A1 & A2 in reverse direction** Bit 1-4 -> A1 - A4; Bit = 0 output on, bit = 1 output off	0-31	0
115	Adjustment of the train category for LISSY	1-4	1
116-118	**Dimming of light and function outputs A1 & A2** 0=off, 63 = 100%	0-63	63
124	**Coupling repetitions for electrical couplings on A1 & A2** 0=no coupling	0-255	1
125	**Coupling** start-up time, value * 100ms	0-255	10
126	**Clutch holding time, value** * 100ms	0-255	20
127	**Break time of the clutch,** value * 100ms	0-255	10
128	**Holding PWM**	0-255	30
129	**Assignment of outputs A1 & A2 electrical couplings (0=no couplings**) Bit 1-2 -> A1 & A2	0-6	0
130	**Dynamic smoke generator control on A1 & A2** Wert 0=no smoke generator operation 0* bit 0=1 -> A1=smoke generator operation, 1 bit 1=1 -> A2=smoke generator operation 2 bit 4-7 = 1 -> start time = value * 200ms 16-240	0-243	0
131	Dynamic smoke generator control, load threshold	0-255	5
132	Dynamic smoke generator control, PWM normal operation	0-63	16
133	Dynamic smoke generator control, PWM idle (stand)	0-63	2
134	Dynamic smoke generator control, start-up time in 100ms steps	0-255	30
135	**Shunting** Ango (automatic uncoupling drive), speed (0 = off)	0-255	0
136	**Shunting ango,** pressing time T1 * 100ms	0-255	10
137	**Shunting Ango,** Deceleration Time T2 * 100ms	0-255	10
138	**Constant braking distance in cm,** speed level threshold Only above is braking with constant braking distance (0 = off)	0-255	0
139	Constant braking distance in cm, first braking distance	0-255	50
140	**Constant braking distance in cm,** alternative braking distance	0-255	25
141	**Constant braking distance in cm,** maximum speed of the prototype locomotive in km/h	0-255	40
142	**Constant braking distance in cm,** residual value of the determined maximum speed	0-255	0
143	**Constant braking distance in cm,** activated by: bit 0 = 1 -> setpoint speed = 0 bit 1 = 1 -> ABC brakes Bit 2 = 1 -> DC Brakes Bit 3 = 1 -> DCC brake signal	0-15	0
144	**Starting delay 2 (as** replacement for CV3)	0-255	12
145	**Brake Deceleration 2, (as** replacement for CV4)	0-255	12
146	**Starting delay 3 (as** replacement for CV3)	0-255	24
147	**Brake Deceleration 3, (as** replacement for CV4)	0-255	24
148	Function key number for ABV 2 (255=off)	0-28	255
149	Function key number for ABV 3 (255=off)	0-28	255
150 - 152	**Second dimming of light and function outputs A1 & A2** 0 = off, 63 = 100%	0-63	10
159	Marking of functions F22 - F28 for transfer to SUSI Bit 0-6; Bit = 1 --> F22 - F28 is passed to SUSI	0-127	0
160	Servo control, Servo 1 position 1 (function key off)	0-255	20
161	Servo control, Servo 1 position 2 (function key on)	0-255	200
162	Servo control, Servo 1 rotation time in 100ms steps	0-255	30
163	Servo control, Servo 2 position 1 (function key off)	0-255	20

164	Servo control, Servo 2 position 2 (function key on)	0-255	200

CV	Description		Value range	Value ex works
165	Servo control, servo 2 rotation time in 100ms steps		0-255	30
166	Servo control via SUSI, 1 = on, 0 = off		0, 1	0
167	Function key number for Servo 1 SUSI-Data		0-28	7
168	Function key number for Servo 2 SUSI-CLK		0-28	8
170	**Assignment PWM curve for light output** History 1 - 8, bit 7 = 1 -> History only active if CROSS output bit is set		0-8 129-136	0
171	**Assignment PWM curve for function output A1** History 1 - 8, bit 7 = 1 -> History only active if CROSS output bit is set		0-8 129-136	0
172	**Assignment PWM curve for function output A2** History 1 - 8, bit 7 = 1 -> History only active if CROSS output bit is set		0-8 129-136	0
178	**PWM history,** period of playback (value * 64ms)		0-255	15
179	**PWM curve,** phase position of the outputs Bit 0 = 0 A0h -> Phase position 0° Bit 0 = 1 A0h -> phase position 180° Bit 1 = 0 A1 -> phase position 0° Bit 1 = 1 A1 -> phase position 180° Bit 2 = 0 A2 -> phase position 0° Bit 2 = 1 A2 -> phase position 180°	Wert 0* 1 0* 2 0* 4	0-7	0
180	**PWM** curve, hold time, after the CROSS output bit off (value * 100ms)		0-255	0
181	**Firebox varnishes of light and function outputs A1 & A2** bit 0-2 -> A0 to A2; bit = 0 flickering, bit = 1 flickering		0-7	0
182	**Firebox Polishers, Flicker Settings** Bit 0-3 -> Change flicker rhythm (value range 1 to 15) Bit 4-6 -> Change brightness (value range 16, 32, 48, 64, 80, 96, 112) bit 7 = 1 -> output always bright (combinable with bit 4-6)		0-255	0
183	**Energy saving lamp effect of light and function outputs A1 & A2** bit 0-2 -> A0 to A2; Bit = 0 effect off, bit = 1 effect on		0-7	0
184	**Energy** saving lamp effect, basic brightness		0-63	10
185	**Energy** saving lamp effect, time until maximum brightness is reached (value * 5ms)		0-255	100
186	**Fade-in and fade-out of light and function outputs A1 & A2** bit 0-2 -> A0 to A2; Bit = 0 blend function off, bit = 1 blend function on		0-7	0
187	**Fade in and fade out, fade** time (value * 1ms)		0-255	30
188	**Neon tubes Switching on effect of light and function outputs A1 & A2** bit 0-2 -> A0 to A2; Bit = 0 effect off, bit = 1 effect on		0-7	0
189	**Neon tubes turn on** effect, flash time (value * 5ms)		0-255	20
190	**Neon tubes turn on** effect, maximum flash count		0-255	20
200	**Motor control, speed-dependent period** minimum speed up to which the period duration = CV53 is set		0-255	10
201	maximum speed from which the period = CV202 is set		0-255	150
202	maximum period duration in 100µs steps (min=CV53)		0-255	250

* Factory set values

CV table for programming the banks 1 - 4

CV	Bank 1, extended mapping, lines 1 - 16 (CV31=8,CV32=0), values ex works	Value range
257-272	Condition ON: 144, 0, 0, 0, 0, 0, 0, condition OFF: 0, 0, 0, 0, 0, 0, output: 0, 1, 0, 0,	0 - 255 each
273-288	Condition ON: 16, 0, 0, 0, 0, 0, 0, condition OFF: 128, 0, 0, 0, 0, 0, output: 0, 2, 0, 0,	0 - 255 each
289-304	Condition ON: 1, 0, 0, 0, 0, 0, 0, Condition OFF: 0, 0, 0, 0, 0, 0, output: 1, 0, 0, 0,	0 - 255 each
305-320	Condition ON: 2, 0, 0, 0, 0, 0, 0, Condition OFF: 0, 0, 0, 0, 0, 0, output: 2, 0, 0, 0,	0 - 255 each
321-336	Condition ON: 0, 0, 0, 0, 0, 0, 0, condition OFF: 0, 0, 0, 0, 0, 0, output: 0, 0, 0, 0,	0 - 255 each
337-352	Condition ON: 0, 0, 0, 0, 0, 0, 0, condition OFF: 0, 0, 0, 0, 0, 0, output: 0, 0, 0, 0,	0 - 255 each
353-368	Condition ON: 0, 0, 0, 0, 0, 0, 0, condition OFF: 0, 0, 0, 0, 0, 0, output: 0, 0, 0, 0,	0 - 255 each
369-384	Condition ON: 0, 0, 0, 0, 0, 0, 0, condition OFF: 0, 0, 0, 0, 0, 0, output: 0, 0, 0, 0,	0 - 255 each
385-400	Condition ON: 0, 0, 0, 0, 0, 0, 0, condition OFF: 0, 0, 0, 0, 0, 0, output: 0, 0, 0, 0,	0 - 255 each
401-416	Condition ON: 0, 0, 0, 0, 0, 0, 0, condition OFF: 0, 0, 0, 0, 0, 0, output: 0, 0, 0, 0,	0 - 255 each
417-432	Condition ON: 0, 0, 0, 0, 0, 0, 0, condition OFF: 0, 0, 0, 0, 0, 0, output: 0, 0, 0, 0,	0 - 255 each
433-448	Condition ON: 0, 0, 0, 0, 0, 0, 0, condition OFF: 0, 0, 0, 0, 0, 0, output: 0, 0, 0, 0,	0 - 255 each
449-464	Condition ON: 0, 0, 0, 0, 0, 0, 0, condition OFF: 0, 0, 0, 0, 0, 0, output: 0, 0, 0, 0,	0 - 255 each
465-480	Condition ON: 0, 0, 0, 0, 0, 0, 0, condition OFF: 0, 0, 0, 0, 0, 0, output: 0, 0, 0, 0,	0 - 255 each
481-496	Condition ON: 0, 0, 0, 0, 0, 0, 0, condition OFF: 0, 0, 0, 0, 0, 0, output: 0, 0, 0, 0,	0 - 255 each
497-512	Condition ON: 0, 0, 0, 0, 0, 0, 0, condition OFF: 0, 0, 0, 0, 0, 0, output: 0, 0, 0, 0,	0 - 255 each

CV	Bank 2, extended mapping, lines 17 - 32, (CV31=8,CV32=1), values ex works	Value range
257-272	Condition ON: 0, 0, 0, 0, 0, 0, 0, condition OFF: 0, 0, 0, 0, 0, 0, output: 0, 0, 0, 0,	0 - 255 each
273-288	Condition ON: 0, 0, 0, 0, 0, 0, 0, condition OFF: 0, 0, 0, 0, 0, 0, output: 0, 0, 0, 0,	0 - 255 each
289-304	Condition ON: 0, 0, 0, 0, 0, 0, 0, condition OFF: 0, 0, 0, 0, 0, 0, output: 0, 0, 0, 0,	0 - 255 each
305-320	Condition ON: 0, 0, 0, 0, 0, 0, 0, condition OFF: 0, 0, 0, 0, 0, 0, output: 0, 0, 0, 0,	0 - 255 each
321-336	Condition ON: 0, 0, 0, 0, 0, 0, 0, condition OFF: 0, 0, 0, 0, 0, 0, output: 0, 0, 0, 0,	0 - 255 each
337-352	Condition ON: 0, 0, 0, 0, 0, 0, 0, condition OFF: 0, 0, 0, 0, 0, 0, output: 0, 0, 0, 0,	0 - 255 each
353-368	Condition ON: 0, 0, 0, 0, 0, 0, 0, condition OFF: 0, 0, 0, 0, 0, 0, output: 0, 0, 0, 0,	0 - 255 each
369-384	Condition ON: 0, 0, 0, 0, 0, 0, 0, condition OFF: 0, 0, 0, 0, 0, 0, output: 0, 0, 0, 0,	0 - 255 each
385-400	Condition ON: 0, 0, 0, 0, 0, 0, 0, condition OFF: 0, 0, 0, 0, 0, 0, output: 0, 0, 0, 0,	0 - 255 each
401-416	Condition ON: 0, 0, 0, 0, 0, 0, 0, condition OFF: 0, 0, 0, 0, 0, 0, output: 0, 0, 0, 0,	0 - 255 each
417-432	Condition ON: 0, 0, 0, 0, 0, 0, 0, condition OFF: 0, 0, 0, 0, 0, 0, output: 0, 0, 0, 0,	0 - 255 each
433-448	Condition ON: 0, 0, 0, 0, 0, 0, 0, condition OFF: 0, 0, 0, 0, 0, 0, output: 0, 0, 0, 0,	0 - 255 each
449-464	Condition ON: 0, 0, 0, 0, 0, 0, 0, condition OFF: 0, 0, 0, 0, 0, 0, output: 0, 0, 0, 0,	0 - 255 each
465-480	Condition ON: 0, 0, 0, 0, 0, 0, 0, condition OFF: 0, 0, 0, 0, 0, 0, output: 0, 0, 0, 0,	0 - 255 each
481-496	Condition ON: 0, 0, 0, 0, 0, 0, 0, condition OFF: 0, 0, 0, 0, 0, 0, output: 0, 0, 0, 0,	0 - 255 each
497-512	Condition ON: 0, 0, 0, 0, 0, 0, 0, condition OFF: 0, 0, 0, 0, 0, 0, output: 0, 0, 0, 0,	0 - 255 each
	Bank 3, PWM modulations, gradient 1 - 4, (CV31=8,CV32=3), values ex works	
257 until 320	3, 8, 16, 24, 32, 48, 63, 63, 63, 63, 48, 32, 24, 16, 8, 3,	0 - 63 each
	0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,	0 - 63 each
	3, 8, 16, 24, 32, 48, 63, 63, 63, 63, 48, 32, 24, 16, 8, 3,	0 - 63 each
	0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,	0 - 63 each
321 until 384	3, 8, 16, 24, 32, 48, 63, 63, 63, 63, 48, 32, 24, 16, 8, 3,	0 - 63 each
	0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,	0 - 63 each
	3, 8, 11, 14, 22, 28, 32, 32, 32, 32, 28, 22, 14, 11, 8, 3,	0 - 63 each
	0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,	0 - 63 each
385 until 448	5, 15, 25, 35, 45, 55, 63, 63, 63, 55, 45, 35, 25, 15, 5, 0,	0 - 63 each
	0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,	0 - 63 each
	0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,	0 - 63 each
	0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,	0 - 63 each
449 until 512	8, 8, 8, 8, 8, 8, 8, 8, 8, 8, 8, 8, 8, 8, 8, 8,	0 - 63 each
	32, 32, 32, 32, 32, 32, 32, 32, 32, 32, 32, 32, 32, 32, 32, 32,	0 - 63 each
	63, 63, 63, 63, 63, 63, 63, 63, 63, 63, 63, 63, 63, 63, 63, 63,	0 - 63 each
	48, 48, 48, 48, 48, 48, 48, 48, 48, 48, 48, 48, 48, 48, 48, 48,	0 - 63 each
	Bank 4, PWM modulations, gradient 5 - 8, (CV31=8,CV32=4), values ex works	
257 until 320	3, 8, 16, 24, 32, 40, 48, 56, 63, 63, 63, 63, 63, 63, 63, 63,	0 - 63 each
	56, 50, 44, 40, 36, 33, 29, 26, 23, 21, 19, 17, 14, 12, 11, 10,	0 - 63 each
	9, 8, 7, 6, 5, 4, 3, 2, 0, 0, 0, 0, 0, 0, 0, 0,	0 - 63 each
	0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,	0 - 63 each
321 until 384	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16,	0 - 63 each
	63, 63, 63, 63, 63, 63, 63, 63, 16, 15, 14, 13, 12, 11, 10, 9,	0 - 63 each
	8, 7, 6, 5, 4, 3, 2, 1, 0, 0, 0, 0, 0, 0, 0, 0,	0 - 63 each
	0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,	0 - 63 each
385 until 448	63, 63, 63, 63, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,	0 - 63 each
	0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,	0 - 63 each
	0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,	0 - 63 each
	0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,	0 - 63 each
449 until 512	63, 63, 63, 63, 0, 0, 0, 0, 63, 63, 63, 63, 0, 0, 0, 0,	0 - 63 each
	0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,	0 - 63 each
	0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,	0 - 63 each
	0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,	0 - 63 each