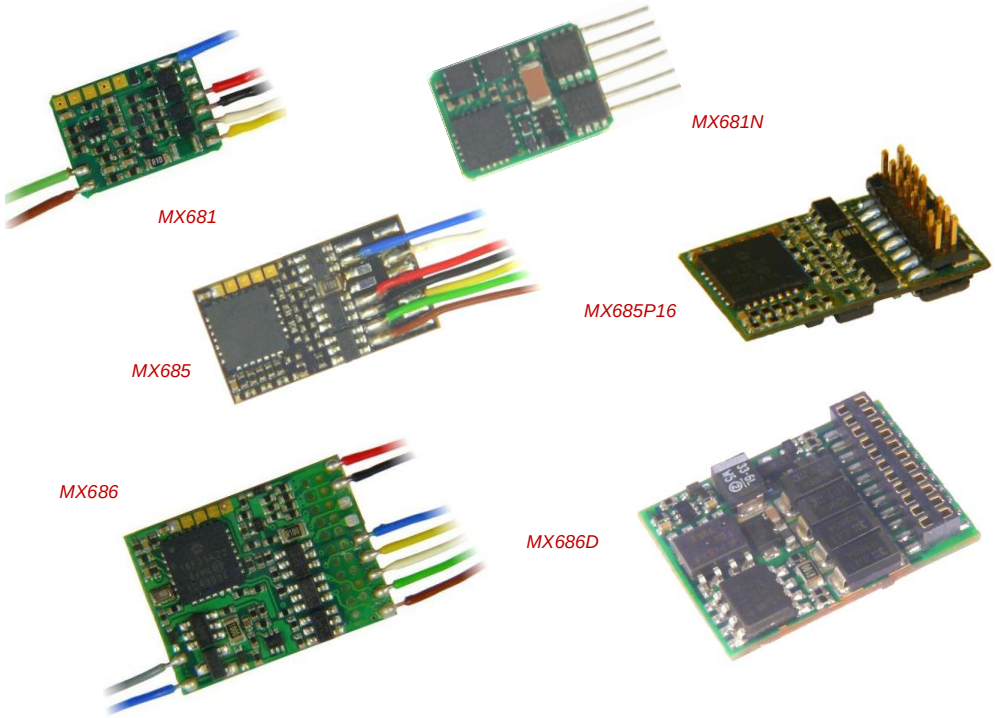
INSTRUCTION MANUAL



MINIATURE - FUNCTION - DECODER

MX681, MX681N

FUNCTION - DECODER

MX685, MX685P16

FUNCTION - DECODER with energy storage circuitry

MX686, MX686D

EDITION

First edition --- 2011 08 15

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NOTE:

ZIMO decoders contain an EPROM which stores software that determines its characteristics and functions. The software version can be read out form CV #7 and #65. The current version may not yet be capable of all the functions mentioned in this manual. As with other computer programs, it is also not possible for the manufacturer to thoroughly test this software with all the numerous possible applications. Installing new software versions later can add new functions or correct recognized errors. SW updates can be done by the end user for all ZIMO decoders since production date October 2004, see chapter “Software Update”! Software updates are available at no charge if performed by the end user (except for the purchase of a programming module); Updates and/or upgrades performed by ZIMO are not considered a warranty repair and are at the expense of the customer. The warranty covers hardware damage exclusively, provided such damage is not caused by the user or other equipment connected to the decoder. For update versions, see www.zimo.at.

1 Overview

Function decoders are **locomotive decoders for non-motorized vehicles** and are therefore not equipped with a motor end stage but do offer special features for use in coaches/cars usually belonging to a "block train" pulled by a locomotive.

The hardware of the MX685 function decoder is based on the loco decoder MX630 (board and hardware is almost identical), the MX686 on the MX631 and the miniature function decoder MX681 on the miniature decoder MX621. The dimensions and most features are identical to the decoder they are based on.

A distinctive feature of all ZIMO function decoders is the **programmable SECOND ADDRESS** (CV #64 to #68), which can be used as an alternative address for the coach containing the function decoder and is commonly set to the same address as the loco pulling the train. If all coaches of a train are equipped with such a decoder using the same (second) address, they can all be controlled simultaneously with a single key stroke (i.e. the interior light of all coaches are turned ON/OFF with a function key of the loco address, if that is the second address). With this, the simplest form of a **virtual "train bus"** becomes reality, which will certainly play a major role in future digital train technology.

*12 x 6.5 x 2 mm 0.7 A - 4 Fu-Outputs DCC and DC-Analog (**but not** MOTOROLA)*

MX681 *Family*	***Miniature-Function-Decoder***, with reduced ZIMO features; the software does not contain: MM (Motorola), Servos, SUSI, ZIMO spec. Function mapping.

MX681 plug configurations:

MX681	7 wires (120mm long) for power pick-up, 4 function outputs. Solder pads are available for further outputs.
MX681N	MX681 with **6-pin plug** as per NEM651 and NMRA RP 9.1.1., mounted to the circuit board.
(MX681R) ***(MX681F)***	(Versions with 8-pin plug as per NEM652 on 70mm wires or 6-pin plug on 70mm wires; special order only).

20 x 11 x 3.5 mm 1.0 A - 8 Fu-Outputs - 2 Servos - SUSI

MX685 *Family*	***Function-Decoder***, compact design for universal applications.

MX685 plug configurations:

MX685	7 wires (120mm long) for power pick-up, 4 function outputs. Solder pads are available for further outputs and for 2 servos or SUSI.
MX685P16	MX685 with **16-pin PluX connector** mounted on decoder board.
(MX685R) ***(MX685F)***	(Versions with 8-pin plug as per NEM652 on 70mm wires or 6-pin plug on 70mm wires; special order only).

20.5 x 15.5 x 4mm 1.2A - 8 Fu-Outputs - 2 Servos - SUSI

MX686 *Family*	***Function-Decoder***, high performance, with built-in **energy storage circuitry.**

MX686 plug configurations:

MX686	7 wires (120mm long) for power pick-up, 4 function outputs. Solder pads are available for further outputs as well as for servo or SUSI.
MX686D	MX686 with **21-pin "MTC" plug** mounted directly on decoder board.
(MX686R) ***(MX686F)***	(Versions with 8-pin plug as per NEM652 on 70mm wires or 6-pin plug on 70mm wires; special order only).

2 Technical Information

Allowable track voltage **) ..... min. 10 V
MX681 ..... max. 35 V
MX685, MX686 ..... DCC and DC-Analog operation ..... max. 35 V
MX685, MX686 ..... AC-Analog operation ..... max. power pulse 50 V

Maximum continuous motor current MX681 ..... 0.8 A
MX685 ..... 1.0 A
MX686 ..... 1.2 A

Operating temperature ..... - 20 to 100 °C

Dimensions (L x W x H) ..... MX681, MX681N ..... 12 x 8,5 x 2 mm
MX685, MX685P16 ..... 20 x 11 x 3,5 mm
MX686, MX686D ..... 20.5 x 15.5 x 4 mm

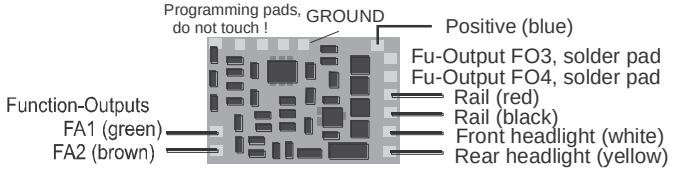
*) The short circuit protection is carried out for the total current of all outputs. Use the "soft start" option (i.e. CV #125 = 52) to prevent cold-start problems of light bulbs (in-rush current interpreted as a short circuit, which leads to the output being turned off)!

Software - Update:

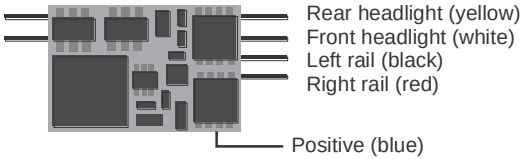
ZIMO DCC decoders are equipped to handle software updates by the user. An update device such as the ZIMO decoder update module **MXDECUP,** from 2011 **MXULF,** system-cab **MX31ZL** or **command station MX10)** is required. The update process is carried out by a USB stick (MXULF, MX31ZL / MX10) or by a PC with Windows operating system and the program "ZIMO Sound Programmer" **ZSP** or the "ZIMO Rail Center" **ZIRC** (MXDECUP).

There is **no need to remove the decoder or to open up the locomotive.** Just set the locomotive on a section of track connected to the update module and start the update with the computer or other equipment mentioned above.

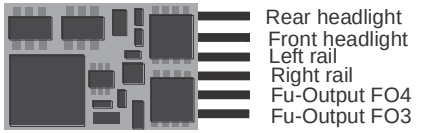
MX681, MX681R, MX681F
Connection side
(= wire side !)



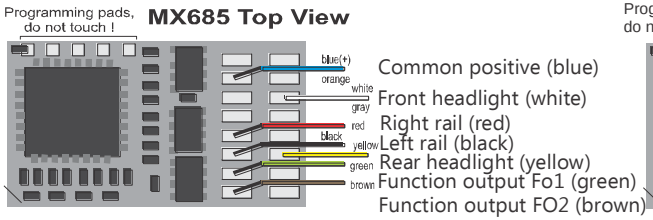
MX681, MX681R, MX681F
Controller side
(= **no** wires connected!)



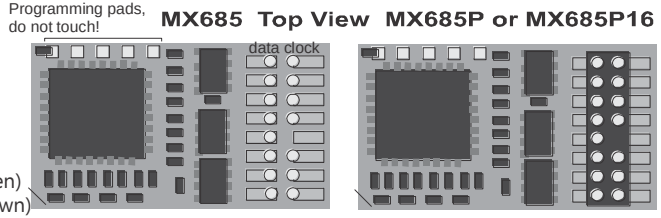
MX681N (MX681 with 6-pin plug on board)
Controller side
(this is also the proper plug-in position)



MX685 Top View

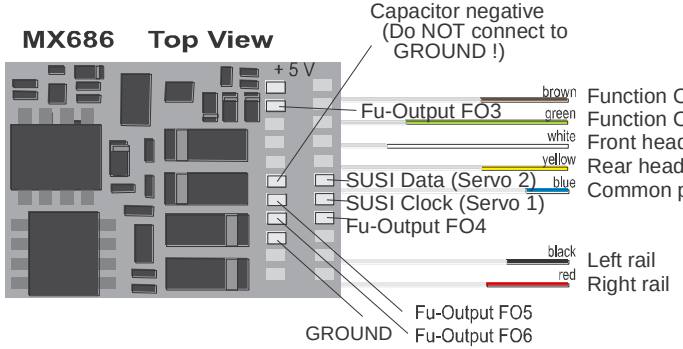


MX685 Top View **MX685P or MX685P16** **Solder pad layout**

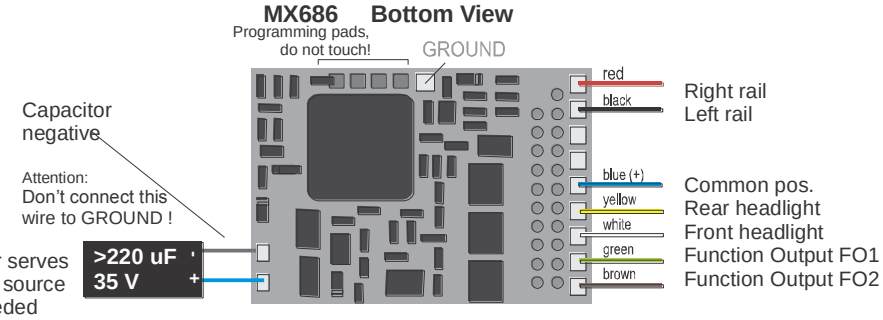


SUSI Data, Clock or Common pos. (+)	Servo's (2, 1) GROUND
Fu-Output FO5	Front headlight
Fu-Output FO6	Common pos. (+)
Right rail	– (Index)
Left rail	Rear headlight
Fu-Output FO1	FO3
Fu-Output FO2	FO4

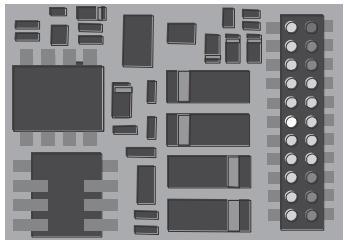
MX686 Top View



MX686 Bottom View

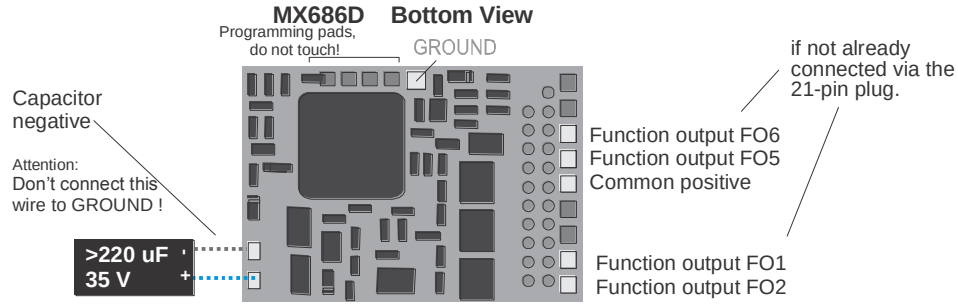


MX686D Top View



+ 5V	Index pin
Fu-Output FO3	n.c.
Fu-Output FO2	n.c.
Fu-Output FO1	Front headlight
Common positive	Rear headlight
Capacitor negative	SUSI Data (Servo 2)
Fu-Output FO5	SUSI Clock (Servo 1)
Fu-Output FO6	Function Output FO4
GROUND	n.c.
Left rail	n.c.
Right rail	n.c.

MX686D Bottom View



3 Adressing and Programming

ZIMO decoders can be programmed in

- **"Service Mode"** (on the **programming track**) for assigning a new address or reading and writing CV content, or in

- **"Operations Mode"** (a.k.a. "Programming on the main" or "PoM"), which is done on the main track; programming CV's "on the main" is always possible in operations mode. However, an acknowledgement of successful programming steps or reading out of CV's is only possible with a DCC system capable of **RailCom**.

Programming in "Service mode" (on the programming track)

Before programming is possible, it must be unlocked with

CV #144 = 0 or = 128 (the latter allows programming but prevents decoder updating).

This is normally the case but in many sound projects the programming lock is activated to prevent accidental changes. Therefore, it is useful to check that CV, especially when programming attempts have already failed.

The acknowledgments of successful programming steps on the programming track as well as CV read-outs are accomplished by power pulses, which the decoder generates by briefly engaging the motor and/or headlights. If the motor and/or headlights do not draw power (i.e. they are not conected) or don't draw enough power, acknowledgments for successful programming or CV read-outs are not possible.

To make acknowledgments possible in such cases activate CV #112 bit 1, which enables the decoder to use an alternate acknowledgment by sending high frequency pulses from the motor end stage. Whether this method is successful though depends on the DCC system used.

CV	Designation	Range	Default	Description
#144	Programming and Update Lock Note: The programming lock has no effect on CV #144, which is therefore always accessable for unlocking.	Bits 6, 7	0 oder 255	= 0: programming and update lock not active Bit 6 = 1: programming of the decoder in „Service Mode" is blocked as a protection against unwanted reprogramming. Note: Programming in "Operations Mode" is not locked because any such programming only applies to the active loco address and reprogramming the wrong locomotive is therefore not possible. Bit 7 = 1: Software updates via MXDECUP, MX31ZL or other means are locked.
#112	Special ZIMO configuration bits	0 - 255	4 = 00000100 also Bit 1 = 0 (normal)	Bit 1 = 0: Normal acknowledgment in "Service Mode"; motor and headlight pulses. = 1: High frequency pulses instead of normal acknowledgments from motor and headlights. Bit 2 = 0: Loco number ID is OFF etc.

3.1 Programming in "Operations mode" (a.k.a. on-the-main, "PoM")

According to the current NMRA DCC standards it is only possible to program and read CV's on the main track, but not assign new vehicle addresses. However, certain DCC systems (among them ZIMO beginning with the system generation MX10/MX32) will allow addresses to be modified on the main track with the help of bidirectional communication.

All ZIMO decoders are equipped with bidirectional communication (**"RailCom"**) and can therefore (with a corresponding DCC system such as ZIMO MX31ZL and all devices of the new MX10/MX32 generation) read, program and acknowledge successful CV programming steps in operations mode (on the main track). This requires RailCom to be activated, which is the case if the following CV's are set as:

CV # 29, Bit 3 = 1 AND CV # 28 = 3

This is usually the default setting, except in certain sound projects or OEM CV sets, in which they need to be set first.

CV	Designation	Range	Default	Description
#28	RailCom Configuration	0 - 3	**3**	Bit 0 - RailCom Channel 1 (Broadcast) 0 = OFF **1 = ON** Bit 1 - RailCom Channel 2 (Data) 0 = OFF **1 = ON**
#29	Basic settings	0 - 63	14 = 0000 **1**110 Bit 3 = 1 ("RailCom" is switched on)	Bit 0 - Train direction: 0 = normal, 1 = reversed Bit 1 - Number of speed steps: 0 = 14, 1 = 28 Bit 2 - DC operation (analog): *) 0 = disabled 1 = enabled Bit 3 - RailCom („bidirectional communication") 0 = deactivated **1 = activated** Bit 4 - Individual speed table: 0 = off, CV # 2, 5 and 6 are active. 1 = on, according to CV 's # 67 – 94 Bit 5 - Decoder address: 0 = primary address as per CV #1 1 = ext. address as per CV #17+18

3.2 Decoder-ID, Load -Code, Decoder-Type and SW-Version

CV	Designation	Range	Default	Description
#250, 251, 252, 253	Decoder-ID also contains a code (in CV #250) that identifies the decoder type	Read only	-	The decoder ID (serial number) is automatically entered during production: The first Byte (CV #250) denotes the decoder type; the three other Bytes contain the serial number. The decoder ID is primarily used for automatic address recognition when an engine is placed on the layout track (future function) as well is in conjunction with the "load code" for "coded" sound projects (see CV #260 - 263).
#8	Manufacturer ID and HARD RESET with CV #8 = „8" or CV #8 = 0 or ACTIVATION of special CV sets	Read only Reading out the decoder always shows "145", which is ZIMO's assigned number. For pseudo programming see "Description" column on the right.	145 (= ZIMO)	Reading out this CV always result in "145" ("10010001"), the number issued for ZIMO by the NMRA. This CV is also used to reset various events with the help of Pseudo-Programming. Pseudo-Programming means that the entered value is not really stored, but rather used to start a defined action. **CV #8 = "8" ➔ HARD RESET**(NMRA standard); all CV's reset to the last active **CV set,** or the default values listed in this CV table if no such set was active. CV #8 = "9" ➔ HARD RESET for old LGB-operation (14 speed steps, pulse chain commands). Further options: see chapter "CV Sets"!
#7	SW-Version Number Also see CV # 65 for Sub-Version Number and special procedures for programming with "Lokmaus-2" and other "low level" systems	Read only Pseudo-programm. see explanation to the right	-	This CV holds the firmware version number currently in the decoder. With the help of "Pseudo-programming" it also helps to program decoders with DCC systems of limited range: Ones digit = 1: Subsequent programming value + 100 = 2: ... + 200 Tens digit = 1: Subsequent CV number + 100 = 2: … + 200 etc. = 9: … + 900 Hundreds digit = 0: Revaluation applies only once = 1: Revaluation applies until power-off
#65	SW- Sub-Version Number Also see CV #7 for Version Number	Read only	-	This CV indicates a possible sub-version number of a main version noted in CV #7. The entire SW version number is thus composed of CV #7 and #65 (i.e. 28.15).

3.3 The (first) vehicle address

Decoders are usually delivered with **address 3** activated (**CV #1 = 3**), for the DCC as well as the MM (Märklin Motorola) format. All aspects of operation are possible with this address but it is recommended to change to a different address as soon as possible.

The address range in DCC mode exceeds the range of a single CV, in fact, goes up to 10239. Addresses higher than 127 are stored in CV #17 and #18. Bit 5 in CV #29 is used to select between the short address in CV #1 and the long address in CV's #17/18.

☞ Most digital systems (with the possible exception of very old or simple products) calculate the value for the CV's involved automatically and also set Bit 5 in CV # 29 to the proper value when writing the address, so that the user does not have to deal with the necessary coding.

CV	Designation	Range	Default	Description
#1	Short Address	DCC: 1 - 127 MM: 1 - 80	3	The "short" (1-byte) loco address (DCC,MM) In the case of DCC: The address in CV #1 is only valid if CV #29, Bit 5 = 0. Otherwise, if CV #29 Bit 5 = 1, the long address in CV #17 + #18 applies.
#17 + #18	Extended (long) address	128 - 10239	0	The long DCC address applies to addresses >127. It is only active if CV #29 Bit5 = 1.
#29	Basic Configuration	0 - 63	14 = 0000 1110 with Bit 5 = 0 (for short address)	Bit 0 - Train direction: 0 = normal, 1 = reversed Bit 1 - Number of speed steps: 0 = 14, 1 = 28 Bit 2 - DC operation (analog): *) 0 = disabled 1 = enabled Bit 3 - RailCom („bidirectional communication") 0 = deactivated 1 = activated Bit 4 - Individual speed table: 0 = off, CV # 2, 5 and 6 are active. 1 = on, according to CV 's # 67 – 94 Bit 5 - Decoder address selection: 0 = short address as per CV #1 1 = long address as per CV #17+18

Decoder-controlled consisting (a.k.a. "Advanced consisting")

Combined operation of two or more locomotives (consisting) can be organized by

- the DCC system (common practice with ZIMO systems, without changing any decoder CV's) or
- by the following CV's, which can be programmed manually or by DCC systems (often the case with American made systems).

This chapter covers only the latter; the decoder controlled consisting!

CV	Designation	Range	Default	Description
#19	Consist address	0 - 127	0	A common consist address for 2 or more engines can be entered in this CV to each loco of the same consist. If CV #19 > 0: Speed and direction is governed by this consist address (not the individual address in CV #1 or #17+18); functions are controlled by either the consist address or individual address, see CV's #21 + 22.
#21	Consist functions F1 - F8	0 - 255	0	Functions so defined here will be controlled by the consist address. Bit 0 = 0: F1 controlled by individual address = 1: …. by consist address Bit 1 = 0: F2 controlled by individual address = 1: …. by consist address ..... F3, F4, F5, F6, F7 Bit 7 = 0: F8 controlled by individual address = 1: …. by consist address
#22	Headlight control in a consist	0 - 3	0	Select whether the headlights are controlled with the consist address or individual address. Bit 0 = 0: F0 (forw.) controlled by individual address = 1: …. by consist address Bit 1 = 0: F0 (rev.) controlled by individual address = 1: …. by consist address Bit 2 = 0: F9 (forw.) controlled by individual address = 1: …. by consist address Bit 3 = 0: F10 (forw.) controlled by individual address = 1: …. by consist address Bit 4 = 0: F11 (forw.) controlled by individual address = 1: …. by consist address Bit 5 = 0: F12 (forw.) controlled by individual address = 1: …. by consist address

3.4 The second address in a function decoder

The second address in

CV #64 (short) or CV #67+68 (long)

is used as an alternative address for cars or coaches equipped with a function decoder. The second address is usually the decoder address of a locomotive. If all coaches of a train are quipped with function decoders using the loco address as the second address, the lights of all coaches for example can be turned ON/OFF with a single loco function key.

See chapter "Function mapping".
The "virtual motor control" follows the commands of the second address, if one is defined (value > 0).

CV	Designation	Range	Default	Description
#64	Short SECOND ADDRESS	1 - 127	0	The "short" (1-byte) second address; it is active when Bit 5 in CV #112 is set to 0.
#67 + 68	Long SECOND ADDRESS	128 - 10239	0	The "long" (1-byte) second address; it is active when Bit 5 in CV #112 is set to 1. Note: In contrast to the "first long address", the cab cannot calculate the proper CV values automatically. As a work around, program the desired second address temporarily as the first address. Then read out CV's #17/18 and enter these values in CV's #67/68. Program the first address back to the original address, if used.
#112	Special ZIMO configuration bits	0, 8, 32, 40	2	Bit 1 = 0: Normal "service mode" acknowledgement. = 1: Special "high frequency" acknowledgement; because LED's typically don't draw enough current for "service mode" acknowledgement. Bit 5 = 0: Select between "short" or = 1: "long" second address

3.5 Analog operation

All ZIMO decoders are capable of operating on conventional layouts operated with DC power packs, including PWM throttles, in **analog DC** as well as in **analog AC** (Marklin including the high voltage pulse for direction change).

To allow analog operation

CV #29, Bit 2 = 1

must be set.

The analog mode in the function decoder affects only the function outputs. Setting options are available for the function outputs similar to loco decoders.

CV	Designation	Range	Default	Description
#29	Basic configuration	0 - 63	14 = 0000 1110 includes Bit 2 = 1 (Analog operation enabled)	Bit 0 - Train direction: 0 = normal, 1 = reversed Bit 1 - Number of speed steps: 0 = 14, 1 = 28 Bit 2 – Automatic switchover to analog: 0 = disabled 1 = enabled Bit 3 - RailCom („bidirectional communication“) 0 = deactivated 1 = activated Bit 4 - Individual speed table: 0 = off, CV # 2, 5 and 6 are active. 1 = on, according to CV 's # 67 – 94 Bit 5 - Decoder address: 0 = primary address as per CV #1 1 = ext. address as per CV #17+18
#13	Functions F1 – F8 in analog mode	0 - 255	0	Select the functions that should be ON in analog operation. Bit 0 = 0: F1 OFF in analog mode = 1: …ON… Bit 1 = 0: F2 OFF in analog mode = 1: …ON… ..... F3, F4, F5, F6, F7 Bit 7 = 0: F8 OFF in analog mode = 1: …ON…
#14	Functions F0 (forward, reverse) and F9 – F12 in analog mode and acceleration, deceleration and motor control in analog	0 - 255	64 that is Bit 6 = 1	Select the functions that should be ON in analog operation. Bit 0 = 0: F0 (forward) OFF in analog mode = 1: …ON… Bit 1 = 0: F0 (reverse) OFF in analog mode = 1: …ON… Bit 2 = 0: F9 OFF in analog mode = 1: …ON… ..... F10, F11 Bit 5 = 0: F12 OFF in analog mode = 1: …ON… Bit 6 = 0: Analog operation with momentum as per CV's #3 + 4; often needed for sound = 1: Analog operation without momentum from CV #3 + 4; immediate response to track voltage similar to classic analog control. Bit 7 = 0: Analog operation **without** motor regulation. = 1: Analog operation **with** motor regulation.

3.6 "Virtual" motor control and momentum

Even though function decoders don't have an actual motor output, they can still be programmed with parameters for **"virtual motor control"**, in order to synchronize the actions of the function decoder with the loco decoder, provided the first or second address of the function decoder is identical with the loco decoder. This is especially important during accelerations or decelerations, for example, when activating the direction key without first stopping the train. It makes sense to use the same settings in these CV's as are used in the locomotive decoder.

However, the 28-speed point curve is not available, only the three-point curve, because the relevant CV numbers are used for the second address. For this reason, Bit 4 in CV #29 is also not available. And of course, CV settings that relate to motor feedback are unnecessary.

For many applications though, the motor control CV's in function decoders are not important and setting CV #3 and #4 to match the CV's of the loco decoder is often good enough.

CV	Designation	Range	Default	Description
#2	Start Voltage Vstart with 3-step curve if CV #29, Bit 4 = 0	1 - 255	1	Internal speed step (1 … 255) applied as **lowest** external speed step (= speed step 1) (applies to 14, 28, or 128 speed step modes) = 1: lowest possible speed
#5	Top Speed Vhigh with 3-step curve if CV #29, Bit 4 = 0	0 - 255	1 or 255	Internal speed step (1 … 255) applied as **highest** external speed step (14, 25 or 128, depending on the speed step mode selected in CV # 29, Bit 1) = 1 (same as 255): fastest top speed possible.
#6	Medium Speed Vmid	1, ¼ to ½ of the value in CV #5	1 (= @ 1/3 of top speed)	Internal speed step (1 … 255) applied as **medium** external speed step (that is, speed step 7, 14 or 63 depending on the speed step mode selected in CV #29, Bit 1) "1" = default curve (Medium speed is set to one third of top speed. I.e., if CV #5 = 255 the curve is the same as if CV #6 would be programmed to 85). The speed curve resulting from CV #2, 5 and 6 is automatically smoothed out to prevent kinks.
#3	Acceleration rate	0 - 255	(2)	The value multiplied by 0.9 equals' acceleration time in seconds from stop to full speed. The effective default value for sound decoders is usually not the value given here, but is determined by the loaded sound project.
#4	Deceleration rate	0 - 255	(1)	The value multiplied by 0.9 equals' deceleration time in seconds from full speed to a complete stop. The effective default value for sound decoders is usually not the value given here, but is determined by the loaded sound project.
#23	Acceleration trimming	0 - 255	0	To temporarily adapt the acceleration rate to a new load or when used in a consist.

CV	Designation	Range	Default	Description
				Bit 0 - 6: entered value increases or decreases acceleration time in CV #3. Bit 7 = 0: adds above value to CV #3. = 1: subtracts above value from CV #3.
#24	Deceleration trimming	0 - 255	0	To temporarily adapt the acceleration rate to a new load or when used in a consist. Bit 0 - 6: entered value increases or decreases acceleration time in CV #4. Bit 7 = 0: adds above value to CV #4. = 1: subtracts above value from CV #4.
#121	Exponential acceleration	0 - 99	0	Acceleration time (momentum) can be stretched in the lower speed range: Tens digit: Percentage of speed range to be included (0 to 90%). Ones digit: Exponential curve (0 to 9). EXAMPLE: CV #121 = 11, 23 or 25 are typical initial test values.
#122	Exponential deceleration	0 - 99	0	Deceleration time (momentum) can be stretched in the lower speed range: Tens digit: Percentage of speed range to be included (0 to 90%). Ones digit: Exponential curve (0 to 9). EXAMPLE: CV #122 = 11, 23 or 25 are typical initial test values.
#49	Signal controlled (HLU) acceleration	0 - 255	0	ZIMO signal controlled speed influence (HLU) with ZIMO MX9 track section module or future module or when using the “asymmetrical DCC signal” stopping method (Lenz ABC). The content of this CV, multiplied by 0.4, equals the time in seconds for the acceleration event from standstill to full speed.
#50	Signal controlled (HLU) deceleration	0 - 255	0	ZIMO signal controlled speed influence (HLU) with ZIMO MX9 track section module or future module or when using the “asymmetrical DCC signal” stopping method (Lenz ABC). The content of this CV, multiplied by 0.4, equals the time in seconds for the deceleration event (braking) from full speed to standstill.
#51 #52 #53 #54 #55	Signal controlled (HLU) speed limits #52 for “U”, #54 for “L”, #51, 53, 55 for intermediate steps	0 - 255	20 40 (U) 70 110 (L) 180	ZIMO signal controlled speed influence (HLU) with ZIMO MX9 track section module or future module: Each of the 5 speed limits (CV’s #51 – 55) that can be applied with the ZIMO “signal controlled speed influence” can be defined with an internal speed step.
#59	Signal controlled (HLU)	0 - 255	5	ZIMO signal controlled speed influence (HLU) with ZIMO MX9 track section module or future module

CV	Designation	Range	Default	Description
	delay			or when using the “asymmetrical DCC signal” stopping method (Lenz ABC): Time in tenth of a second until the locomotive starts to accelerate after receiving a higher signal controlled speed limit command.
#27	Direction dependent stops with asymmetrical DCC signal (Lenz “ABC” method	0, 1, 2, 3	0	Bit 0 = 1: Stops are initiated if voltage in right rail is higher than left rail (in direction of travel). This setting, CV #27 = 1, IS THE COMMON APPLICTION for this feature (provided the decoder is wired to the rail correctly). Bit 1 = 1: Stops are initiated if voltage in left rail is higher than right rail (in direction of travel). Stopping is directional if only one of the two bits is set (not both). Traveling in the opposite direction will have no effect. Use the other bit In case the train stops in the wrong direction! Bit 0 and Bit 1 = 1 (CV #27 = 3): Stops in both directions, regardless of rail polarity.
#134	Asymmetrical threshold for stopping with asymmetrical DCC signal (Lenz ABC method).	1 - 14, 101 - 114, 201 - 214 = 0,1 - 1,4 V	106	Hundredths digit: Sensitivity adjustment, changes the speed with which the asymmetry is being recognized. = 0: fast recognition (but higher risk of errors, i.e. unreliable stopping). = 1: normal recognition (@ 0.5 sec.), pretty save results (default). = 2: slow recognition (@ 1 sec.), very reliable. Tenths and ones digit: Asymmetrical threshold in tenths of a volt. The voltage difference between the two half waves of the DCC signal defined here is the minimum required to be recognized as asymmetrical that starts the intended effect (usually braking and stopping of a train). = 106 (Default) therefore means normal recognition at 0.6 V asymmetry. This value has proven itself to be appropriate under normal conditions; by using 4 diodes to generate the asymmetry.
#29, #124, #112	Individual bits in these CV’s are responsible for the correct reaction to “DC” and “Marklin” brake sections.	-	-	Set the following CV’s for **polarity dependent DC brake sections:** CV #29, Bit 2 = 0 and CV #124, Bit 5 = 1. For polarity independent brake sections **(“Märklin-Brake sections”)** set them also to CV #29, Bit 2 = 0 and CV #124 , Bit 5 = 1 and additionally CV #112, Bit 6 = 1.
#124	Shunting key functions:	Bits 0 - 4, 6	0	Select a function key for LOW GEAR ACTIVATION: Bit 4 = 1 (and Bit 3 = 0): F3 as half-speed key

CV	Designation	Range	Default	Description
	Low gear (half speed) and Momentum reduction or deactivation NOTE: Extended shunting key selection in CV's #155, 156			Bit 3 = 1 (and Bit 4 = 0): F7 as half-speed key Select a function key for MOMENTUM DEACTIVATION: Bit 2 = 0 (and Bit 6 = 0): "MN" key for deactivation, Bit 2 = 1 (and Bit 6 = 0): F4 key for deactivation Bit 6 = 1 (Bit 2 is irrelevant): F3 for deactivation. Effect of above key (MN, F3 or F4) on MOMENTUM: Bit 1, 0 = 00: no effect on momentum = 01: removes momentum of CV #121 + #122 = 10: CV #3 + #4 reduced to ¼. = 11: removes all momentum above.
#155	Selecting a function key as half-speed key	0 - 19	0	Expanding on the settings of CV #124, if another key is required than F3 or F7: CV #155: Defines a function key for half-speed activation (= top speed cut in half). If a key is assigned through CV #155, a possible assignment through CV #124 is void. CV #155 = 0 doesn't mean that the F0 key is assigned but rather that the setting in CV #124 is active.
#156	Selecting a function key for deactivating momentum	0 - 19	0	Expanding on the settings of CV #124, if another key than F3, F4 or MAN is required for momentum deactivation: CV #156: Defines the function key that deactivates or reduces the acceleration and deceleration times in CV's #3, 4, 121 and 122. Whether the momentum is deactivated or reduced and by how much is still defined in CV #124, not CV #156: CV #124, Bit 1, 0: = 00: no effect on momentum = 01: removes momentum of CV #121 + #122 = 10: CV #3 + #4 reduced to ¼. = 11: removes all momentum. In order to deactivate all momentum, CV #124 is typically set to a value 3 (the value may be different if other Bits in CV #124 are also set). Assigning a key for momentum deactivation in CV #124 remains inactive if CV #156 > 0.
#157	Selecting a function key for the MAN function Only for non-ZIMO systems that don't have the MN key.	0 - 19	0	The MAN function (or MAN key on ZIMO cabs) was originally designed for ZIMO applications only, in order to cancel stop and speed limit commands applied by the signal controlled speed influence system (HLU).This function was expanded in later software versions to include "asymmetrical DCC signal stops" (Lenz ABC).If ZIMO decoders are used with non-ZIMO systems, a function key can now be assigned with CV #157 to cancel a signal controlled speed limit or stop command.

3.7 The NMRA-DCC function mapping

ZIMO decoders have between 4 and 12 function outputs (FO). Items connected to these outputs (lights, smoke generator etc.) are switched ON and OFF with the function keys of the cab. Which function is to be controlled by which function key, can be defined with the NMRA function mapping.

CV's #33 to #46

constitute the NMRA function mapping table for the **first address;** unfortunately, this function mapping also has its restrictions (only one 8-Bit register is available for each function, which leaves only 8 outputs to select from) and the headlight is the only function that can be controlled by direction.

NMRA Function	CV	Number key on ZIMO cabs	Additional function outputs (Usually available on large-scale decoders only, but shown here for the sake of completeness.)						Function outputs; (The number of available outputs depends on the decoder type. Always available are the outputs "Front light" and "Rear light".)							
			FA12	FA11	FA10	FA9	FA8	FA7	FA6	FA5	FA4	FA3	FA2	FA1	Rear light	Front light
F0	#33	*1 (L) fw*							*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*●
F0	#34	*1 (L) re*							*7*	*6*	*5*	*4*	*3*	*2*	*1*●	*0*
F1	#35	*2*							*7*	*6*	*5*	*4*	*3*	*2*●	*1*	*0*
F2	#36	*3*							*7*	*6*	*5*	*4*	*3*●	*2*	*1*	*0*
F3	#37	*4*				*7*	*6*	*5*	*4*	*3*	*2*	*1*●	*0*			
F4	#38	*5*				*7*	*6*	*5*	*4*	*3*	●	*1*	*0*			
F5	#39	*6*				*7*	*6*	*5*	*4*	*3*●	*2*	*1*	*0*			
F6	#40	*7*				*7*	*6*	*5*	*4*●	*3*	*2*	*1*	*0*			
F7	#41	*8*	*7*	*6*	*5*	*4*	*3*	*2*●	*1*	*0*						
F8	#42	*(L-) 9*	*7*	*6*	*5*	*4*	*3*●	*2*	*1*	*0*						
F9	#43	*L- 1*	*7*	*6*	*5*	*4*●	*3*	*2*	*1*	*0*						
F10	#44	*L- 2*	*7*	*6*	*5*●	*4*	*3*	*2*	*1*	*0*						
F11	#45	*L- 3*	*7*	*6*●	*5*	*4*	*3*	*2*	*1*	*0*						
F12	#46	*L- 4*	*7*●	*6*	*5*	*4*	*3*	*2*	*1*	*0*						

The black dots in the table above indicate the default settings at the time of delivery, where each function key corresponds to the same numbered function output. Therefore, the following values were written to these CV's by default:

CV #33 = 1
CV #34 = 2
CV #35 = 4
CV #36 = 8
CV #37 = 2
CV #38 = 4
CV #39 = 8
CV #40 = 16
and so on..

EXAMPLE of a function mapping modification: The output #4 (FO4) should be switched in addition to output #2 (FO2) with the F2 key (ZIMO #3 key). Outputs #7 (FO7) and #8 (FO8) should be switched (not additionally but instead) with the F3 and F4 keys.

The new values to be entered are as follows:

CV #36=40
CV #37 = 32
CV #38 = 64

F2	3	#36						7	6	5●	4	3●	2	1	0
F3	4	#37			7	6	5●	4	3	2	1	0			
F4	5	#38			7	6●	5	4	3	2	1	0			

The *Function mapping for the **Second address*** is defined in the

CV's #69 to #82

The first address and the second address commands are read separately, and stored according to the respective "function mapping" and the desired states of the function outputs.

After power-on (system boot-up, longer track power interruption etc.), the decoder is first waiting for a SECOND ADDRESS command (provided the second address is not 0) and the outputs are set based on this secondary address command. First address commands are executed only when changes occur with respect to the functional states between successive first address commands. During continued operation the **"principle of the most recent changes"** between first and second address commands applies.

NMRA Function	CV	Number key on ZIMO cabs	Function outputs						Function outputs;							
			FA12	FA11	FA10	FA9	FA8	FA7	FA6	FA5	FA4	FA3	FA2	FA1	Rear light	Front light
F0	#69	1 (L) fw							7	6	5	4	3	2	1	0●
F0	#70	1 (L) re							7	6	5	4	3	2	1●	0
F1	#71	2							7	6	5	4	3	2●	1	0
F2	#72	3							7	6	5	4	3●	2	1	0
F3	#73	4				7	6	5	4	3	2	1●	0			
F4	#74	5				7	6	5	4	3	●	1	0			
F5	#75	6				7	6	5	4	3●	2	1	0			
F6	#76	7				7	6	5	4●	3	2	1	0			
F7	#77	8	7	6	5	4	3	2●	1	0						
F8	#78	9	7	6	5	4	3●	2	1	0						
F9	#79	0	7	6	5	4●	3	2	1	0						
F10	#80	↑1	7	6	5●	4	3	2	1	0						
F11	#81	↑2	7	6●	5	4	3	2	1	0						
F12	#82	↑3	7●	6	5	4	3	2	1	0						

Tip: Direction dependent taillights with special effect CV's:

With the NMRA function mapping it is only possible to have function F0 directional and was intended for the headlights, so they automatically switch between "front" and "rear" when changing direction. All other functions are controlled independent of direction.
The special effect CV's #125 … 132, #259 and #160 (see chapter "Special function output effects"), each assigned to a function output (up to FO8), make it possible to have more direction dependent functions. To utilize the directional capabilities of these CV's use only the directional Bits 0 and/or 1 without setting the actual effect CV's.

Example 1: A couple of **red taillights** are connected to function outputs FO1 and FO2 (front and rear of engine). Both are to be actuated with F1 but should also change with direction. This requires the following CV settings:

CV #35 = 12 (Bit 2 for FO1 and Bit 3 for FO2), as well as
CV #127 = 1 (for FO1) and CV #128 = 2 (for FO2).

Therefore FO1 is only activated in forward direction and FO2 only in reverse, and only if the function is turned ON with the function key F1.

Example 2: Contrary to example 1 where the red taillights were switched independent from the white headlights, in this example the headlights and taillights are switched ON/OFF together at the proper end of the locomotive with F0 or F1 (depending on which end the loco is coupled to the train).

This can be done as follows:
Connect: White front headlights connected to function output "front headlights"
Red front taillights to function output FO2
White rear headlights to function output FO1
Red rear taillights to function output "rear headlights" (!).

CV #33 = 1 and CV #34 = 8 front white headlights on F0forw and front red taillights on F0rev !)
CV #35 = 6 (both white headlights as well as red taillights in the rear on F1 !)
CV #126 = 1 / CV #127 = 2 (Direction dependence for rear white and red lights by means of "Special Effects" CV).

Alternative method: CV's #107, 108 for "One-sided light suppression", see below !

3.8 "One-sided Light Suppression"

This is a new feature, asked for by many users, that makes it possible to switch off all lighting on one side of a locomotive with the push of one function key (usually on the "train side", i.e. where cars are coupled to the locomotive).

CV	Designation	Range	Default	Description
#107	Light suppression (i.e. front headlights AND additionally defined function output) at cab side 1 (front)	0 - 255	0	The value of this CV is calculated as follows: The number of a function output (FO1…FO28) **x** 32 **+** number of a function key (F1, F2…F28) **=** Value of CV #107 Function Key: That key (F1…F28) which should turn off ALL lights on the cab side 1 (front side) AND Function Output: i.e. taillights on the same side.
#108	Cab side 2 (rear)	0 - 255	0	Same as CV #107 but for other locomotive side.

3.9 Dimming, Low beam and Direction Bits

Some functions are often not designed to operate with full track power, as is the case for example with 18V bulbs at 24V track voltage (quite common on large scale model railroads). Other times the brightness needs to be reduced simply because the light of the bulb is too bright.

The best solution in such cases is to connect the positive side of such devices to the low voltage supply of the decoder (see chapter “Installation and wiring”). Such low voltage outputs are by the way fully stabilized and the voltage will not fluctuate with changes in track voltage.

Alternatively or in addition to this (the dimming effect is not limited to devices connected to full track power but also works with low voltage), the PWM (pulse with modulation) voltage reduction is also available with

CV #60,

which defines the PWM duty cycle. Of course, this kind of voltage reduction is also interesting because it is easy to change at any time.

☞ NOTE: Bulbs with voltage ratings as low as 12V can be dimmed with this PWM dimming function without damage even if track voltages are considerably higher; but **not** bulbs rated below that such as 5V or 1.2V bulbs. These must be connected to one of the decoder’s low voltage supply pins instead of a normal positive pin (see chapter “Installation and Wiring”).

☞ LED’s, on the other hand, require a series resistor; if however, the resistor is designed to operate at 5 V, the PWM dimming is also sufficient at a track voltage of 25V. (in this case the setting would be CV #60 = 50, so a reduction by one fifth, 1/5th).

CV #60 generally affects all function outputs. The dimming function can be restricted to specific function outputs using the dim mask CV’s (see table).

CV	Designation	Range	Default	Description
#60	Reduced function output voltage (Dimming). Affects all function outputs.	0 - 255	0	Reduction of function output voltage with PWM (pulse-with modulation). Useful for headlight dimming for example. Example values: CV #60 = 0 or 255: full voltage CV #60 = 170: 2/3 of full voltage. CV #60 = 204: 80% of full voltage.
#114	Dim Mask 1 = Excludes certain function outputs from dimming per CV #60. For higher function outputs go to CV #152.	Bits 0 - 7	0	Enter function outputs that are **not** to be **dimmed** as per CV #60. These outputs will use the full voltage available from the decoder’s positive pin. Bit 0 - front headlight, Bit 1 - rear headlight, Bit 2 - function output FO1, Bit 3 - FO2, Bit 4 - function output FO3, Bit 5 - FO4 Bit 6 - function output FO5, Bit 7 - FO6 Bit value = 0: Output will be dimmed to the value defined in CV #60. Bit value = 1: Output will not be dimmed. EXAMPLE: CV #114 = 60: FO1, FO2, FO3 and FO4 will not be dimmed; front and rear headlights will be dimmed according to CV #60.
#152	Excluding specific function outputs from dimming as per CV #60 This is a continuation of Dim Mask 1 in CV #114 and FO3, FO4 as direction bit mapping	Bits 0 - 5 and Bit 6, Bit 7	0 0	… continuation of CV #114. Bit 0 - function output FO7, Bit 1 - function output FO8, Bit 2 - function output FO9, Bit 3 - function output FO10, Bit 4 - function output FO11, Bit 5 - function output FO12. Bit 6 = 0: „normal“ = 1: Direction bit mapped to FO3 and FO4 that is, FO3 is switched on when driving in reverse and FO4 when driving forward (normal mapping for FO3 and FO4 is invalid when this Bit is set).

Low/high beam with the help of the low beam mask

One of the function keys, F6 (CV #119) or F7 (CV #120) can be defined as a low beam key. As required, specific function outputs can be dimmed whit the output turned ON or OFF (inverted action with Bit 7).

CV	Designation	Range	Default	Description
#119	Low beam mask for F6 - Output assignment for (example) low/high beam headlights ATTENTION: Certain settings in CV #154 (Special output configurations) change the meaning of CV’s #119 and #120 and therefore will no longer work as a low-beam mask.	Bits 0 - 7	0	Selected function outputs will dim with F6 key, according to dim value in CV #60. Typical application: Low/high beam Bit 0 - front headlight, Bit 1 - rear headlight, Bit 2 - function output FO1, Bit 3 - function output FO2, Bit 4 - function output FO3, Bit 5 - function output FO4. Bit value = 0: Output will not be dimmed, Bit value = 1: Output will be dimmed with F6 to value defined in CV #60. Bit 7 = 0: normal action of F6. = 1: inverted action of F6. EXAMPLE: CV #119 = 131: Function key F6 toggles headlights between low and high beam.
#120	Low beam mask for F7	Bits 0 - 7		Same as CV #119 but with F7 as low beam key.

A "second dim value" with the help of the uncoupler CV

If more function outputs need to be dimmed than CV #60 allows or if some function outputs require a different voltage and the uncoupler function is not needed on the same vehicle then

CV #115

can be used for an alternative low voltage supply. The respective function outputs must be defined as "uncoupler output" in the corresponding

CV's #125…#132, #159 and #160
(see "Special effects for function outputs).

CV	Designation	Range	Default	Description
#115	Uncoupler control or Second dim value	0 - 9	0	Only active as uncoupler if "uncoupler" function is selected (value 48) in CV #125 …132, 159 or 160: Tens digit = 0: used for dimming. Ones digit (0 to 9): PWM – voltage reduction (0 to 90%)
#127 - #132 #159 #160	Effects on FO1, FO2, FO3, FO4, FO5, FO6 on FO7 on FO8		0 0	Value = 48 for dimming application #127 → FO1 #128 → FO2 #129 → FO3 #130 → FO4 #131 → FO5 #132 → FO6 #159 → FO7 #160 → FO8

3.10 The Flasher Effect

Flashing is actually a lighting effect just like all the others that are summarized in the CV's starting with #125; but for historical reasons are listed in their own CV's #117 and #118.

CV	Designation	Range	Default	Description
#117	Flasher functions Outputs are assigned in CV #118.	0 - 99	0	Duty cycle for flasher function: Tens digit = ON time Ones digit = OFF time (0 = 100msec, 1 = 200msec…..9 = 1 sec) Example: CV #117 = 55: Flashes evenly at 1 a second interval.
# 118	Flashing mask - Defines which outputs operate as flashers according to programmed in CV #117	Bits 0 - 7	0	Selected function outputs will flash when turned ON. Bit 0 - front headlights Bit 1 - rear headlights Bit 2 - function output FO1, Bit 3 - …FO2 Bit 4 - …FO3, Bit 5 - function output FO4. Bit value = 0: No flasher Bit value = 1: Output flashes when turned ON.
				Bit 6 = 1: FO2 flashes inverse! Bit 7 = 1: FO4 flashes inverse! (for alternate flashing, i.e. wig-wag) EXAMPLE: CV #118 = 12: FO1 and FO2 are defined as flashers. CV #118 = 168: Alternate flashing of FO2 and FO4.

3.11 F1- Pulse Chains (Only for old LGB products)

#112	Special ZIMO configuration Bits	0 - 255	4 = 00000100 (Bits 4 and 7 = 0)	…. Bit 3 = 0: **12-Function mode** = 1: **8-Function mode** Bit 4 = 0: Pulse chain recognition OFF = 1: P Pulse chain recognition ON (use with old LGB systems) … Bit 7 = 0: no pulse chain generation = 1: Generates pulse chain commands for LGB sound modules.

3.12 Special Effects for Function Outputs

(US and other lighting effects, Smoke generator, Uncoupler…)

Special effects can be assigned to a total of 10 function outputs with

CV's #125, #126, #127 … #132, #159, #160

for F0fr., F0rear, FO1 ..... FO6 , FO7 , FO8

The values for these special effect CV's contain the

actual *6-Bit – special effects code* *and the* *2-Bit directions code*

Bits 1,0 = 00: bidirectional (active in both directions)
= 01: active in forward direction only (+ 1)
= 10: active in reverse direction only (+ 2)

Bits 7 ... 2 = 000000xx No effect, except for direction = **(0), 1, 2** (bidirectional, forward, reverse)
= 000001xx Mars light + direction = **4, 5, 6** (bidirectional, forward, reverse)
= 000010xx Random flicker + direction = **8, 9, 10** (ditto, ditto, ditto)
= 000011xx Flashing headlight + direction = **12, 13, 14** …
= 000100xx Single pulse strobe + direction = **16, 17, 18**
= 000101xx Double pulse strobe + direction = **20, 21, 22**
= 000110xx Rotary beacon + direction = **24, 25, 26**
= 000111xx Gyralite + direction = **28, 29, 30**
= 001000xx Ditch light type 1, right + direction = **32, 33, 34**
= 001001xx Ditch light type 1, left + direction = **36, 37, 38**
= 001010xx Ditch light type 2, right + direction = **40, 41, 42**
= 001011xx Ditch light type 2, left. + direction = **44, 45, 46**
= 001100xx Uncoupler as defined in CV #115 = **48, 49, 50**
automatic disengagement in CV #116

= 001101xx "Soft start" = slow power-up of function output = **52, 53, 54**

= 001110xx Automatic stoplights for street cars, stoplight-off delay, see CV #63. = **56, 57, 58**

= 001111xx Function output turns itself off at speed >0 (i.e. turns off cab light when driving). = **60, 61, 62**

= 010000xx Function output turns itself off after 5 minutes (i.e. to protect smoke generators form overheating). = **64, 65, 66**

= 010001xx As above, but after 10 minutes = **68, 69, 70**

= 010010xx Speed or load dependent **smoke generation** for **steam engines** as per CV's 137 – 139 (i.e. pre-heating at stand still, heavy smoke at high speed or high load). Smoke turns itself off as per CV #353; function key has to be pressed to reactivate smoke. = **72, 73, 75**

= 010100xx Driving state-dependent **smoke generation** for **diesel engines** as per CV's #137 – 139 (i.e. pre-heating at stand still, heavy smoke during motor start-up sound and acceleration). Synchronized control of fan connected to the fan output. Smoke turns itself off as per CV #353; function key must be pressed to reactivate smoke. = **80, 81, 82**

☞ The effect CV's are also suitable **without using a special effect** (with effect code 000000), for

direction dependent function outputs.

EXAMPLE: CV #127 = 1, CV #128 = 2, CV #35 = 12 (FO1, FO2 operate in both directions, ON/OFF with F1 key).

CV	Designation	Range	Default	Description
#125[1]	**Special effects** American lighting effects as well as others such as uncoupler, smoke generator and more on function output F0 (front headlight) Effects can be further adjusted and modified with CV's #62 - 64 and CV #115 (for uncoupler).		0	Bits 1, 0 = 00: bidirectional (active in both directions) = 01: only active in forward direction = 10: only active in reverse direction ATTENTION in case of CV #125 and #126: change CV's #33, 34.... if direction is wrong! Bits 7, 6, 5, 4, 3, 2 = Effekt-Code EXAMPLES You want : Program CV #125 to: Mars light forward only - 00000101 = 5 Gyralite independent of direction - 00011100 = 28 Ditch type 1 left, only forward - 00100101 = 37 **Uncoupler - 00110000 = 48** **Soft start of output - 00110100 = 52** **Automatic stop light - 00111000 = 56** Automatic cab light OFF - 00111100 = 60 Auto. smoke OFF after 5 min – 01000000 = 64 Auto. smoke OFF after 10 min – 01000100 = 68 Speed/load depen. smoke - 01001000 = 72 Speed/load depen. diesel smoke - 01010000 = 80
#126	Special effects for rear headlight		0	See CV #125 for details.

[1] Note to ditch lights: Ditch lights are only active when headlights and function F2 (#3 on Zimo cab) are on, which is prototypical for North American railroads. The ditch lights will only be working if the applicable bits in CV #33 and 34 are on (the definition in CV #125 - 128 in itself is not enough but a necessary addition). Example: If ditch lights are defined for F1 and F2, the bits #2 and 3 in CV #33 and 34 have to be set accordingly (i.e. CV # 33 = 13 (00001101), CV #34 = 14 (00001110).

	(default F0 reverse)			
#127 - #132	Special effects for FO1, FO2, FO3, FO4, FO5, FO6		0	See CV #125 for details #127 → FO1 #128 → FO2 #129 → FO3 #130 → FO4 #131 → FO5 #132 → FO6
#159, #160	Special effects for FO7, FO8		0	See CV #125 for details #159 → FO7 #160 → FO8
#62	Light effects modifications	0 - 9	0	Change of minimum dimming value
#63	Light effects modifications or Stop light OFF delay	0 - 99 0 - 255	51	Tens digit: sets cycle time (0 - 9, default 5), or start-up time during soft start with 001101 (0 - 0,9s) Ones digit: extends OFF time For stop light OFF delay (001110xx in CV #125, 126 or 127): Time in tenths of a second the stop lights remain ON after the street car comes to a full stop (range: 0 – 25 sec.).
#64	Light effects modifications	0 - 9	5	Ditch light OFF time modification
#353	Automatic smoke generator shut-down	0 - 255 = 0 - 106 min	0	For special effect codes "010010xx" or "010100xx" (smoke generator): Overheat protection: turns OFF from ½ min – about 2 hours. = 0: Won't turn off automatically. = 1 … 252: Switches off automatically after 25 seconds/unit. Maximum time therefore is about 6300 sec. = 105 min.

3.13 Configuration of Electric Uncouplers

"System KROIS" and "System ROCO"

When one or two of the function outputs **FO1…FO6** (but not FO7 or FO8) are assigned to the uncoupler function (CV #127 for FO1 etc.), the control of the couplers as well as the entire uncoupling process is defined by the settings in

CV #115 and CV #116.

These CV's limit the pull-in time (to prevent overheating), define a hold-in voltage if required (i.e. System "Roco") as well as the automated coupler unloading and train disengagement.

It is recommended to use the following settings for the **Krois system: CV #115 = 60, 70 or 80;** these settings will limit the pull-in voltage (full track power) to 2, 3 or 4 seconds respectively. A hold-in voltage is not required for the Krois coupler and the ones digit can therefore remain at "0".

CV	Designation	Range	Default	Description
#115	Uncoupler control "Pull-in" time and "hold" voltage or use CV # 115 for an alternative second dim value (dimming 0-90% using ones digit; tens digit must be 0)	0 - 99	0	Uncoupler function is only active if "uncoupler" is selected (value 48) in one of the CV's #125…132: Tens digit (0 – 9): Time in seconds the coupler receives full voltage (pull-in time): Spannung angesteuert wird: Value: 0 1 2 3 4 5 6 7 8 9 **seconds: 0 0,1 0,2 0,4 0,8 1 2 3 4** 5 Ones digit (0 to 9): hold-in power in percent of track voltage, 0 - 90%. Applied after the pull-in time elapsed (necessary for ROCO coupler, not needed for KROIS coupler).

3.14 SUSI-Interface and Logic-Level Output

All decoders described in this manual (except for the MX621) have outputs that can either be used as a SUSI interface, as logic level outputs or for servo control. These outputs are available at solder pads or on the decoder plug (MTC or PluX), see the various decoder pinouts starting on page 5.

These outputs are active by default as SUSI interface. They can be switched for the alternative applications with *CV #124* (Bit 7) or *CV's #181 and #182* (see next chapter "Servo configuration).

CV	Designation	Range	Default	Description
#124	Shunting key functions: Changing SUSI outputs	Bits 0 - 4, 6	0	Bits 0 - 4, 6: Shunting key selection and HALF-SPEED ACTIVATON **Bit 5 = 1:** " DC stopping" Bit 7 = 0: SUSI active instead of normal functions = 1: Normal function outputs instead of SUSI

3.15 Servo Configuration

CV	Designation	Range	Default	Description
#161	Servo outputs: Protocol	0 - 3 0 Note: CV #161 must be set to "2" for **Smart Servo RC-1!**	0	Bit 0 = 0: Servo protocol with positive pulses. = 1: Servo protocol with negative pulses. Bit 1 = 0: Control wire only active during movement = 1: … always active (consumes power, vibrates at times but holds position even under mechanical load) – this setting is also required for **SmartServo RC-1** (with memory wire)! Bit 2 = 0: Moves to center position, if defined for two-key operation (see CV #181/182), when both function keys are OFF. = 1: Servo runs only if function keys are pressed when in two-key operating mode (see CV #181/182).
#162	Servo 1 - Left stop	0 - 255	49 = 1 ms pulse	Defines the servo's left stop position. "Left" may become the right stop, depending on values used.
#163	Servo 1 - Right stop	0 - 255	205	Defines the servo's right stop position.
#164	Servo 1 - Center position	0 - 255	127	Defines a center position, if three positions are used.
#165	Servo 1 - Rotating speed	0 - 255	30 = 3 sec	Rotating speed; Time between defined end stops in tenths of a second (total range of 25 sec, default 3 sec.).
#166 - 169	As above but for Servo 2			
#181 #182	Servo 1 Servo 2 Function assignment	0 - 28 90 - 93 101-114	0 0 0 0	= 0: Servo not in operation = 1: Single-key operation with F1 = 2: Single-key operation with F2 and so on to = 28: Single-key operation with F28 = 90: Servo action depends on loco direction: forward = turns left; reverse = turns right = 91: Servo action depends on loco stop and direction: turns right when stopped and direction is forward, otherwise turns left. = 92: Servo action depends on loco stop and direction: turns right when stopped and direction is reverse, otherwise turns left. = 93: Servo action depends on loco movement: turns right when loco stopped, left when loco moving; direction makes no difference. = 101: Two-key operation F1 + F2 = 102: Two-key operation F2 + F3 and so on to =127: Two-key operation F27 + F28 = 111: Two-key operation F11 + F12 = 112: Two-key operation F3 + F6 = 113: Two-key operation F4 + F7 = 114: Two-key operation F5 + F8 (Two-key mode operates as defined with CV #161, Bit 2)

Connecting servos to decoder: *see loco decoder manual !*

4 Feedback - "Bidirectional communication"

All ZIMO decoder types have been equipped with a type of feedback ever since DCC was formed, which has always been a major difference to competitor products:

- the ***ZIMO loco number identification*** is part of ZIMO DCC decoders since 1997 and as far back as 1990 with ZIMO's own data format (which is no longer in use today). It can only be used with ZIMO DCC systems (MX1…MX10, MX31ZL, MX32ZL…) and together with ZIMO track section modules (MX9 and successors): The decoder sends acknowledgment pulses after receiving DCC packets, which will be utilized to identify and locate the decoder in the respective section of track.
- the ***"bidirectional communication"*** according to ***"RailCom"*** is installed in all ZIMO decoders since 2004; in the large-scale decoders MX695, MX696 and MX697 operational since the beginning (basic functions and ongoing extensions).

"Bidirectional" means that the information transfer within the DCC protocol is not only flowing towards the decoder but also in the opposite direction; that is not just driving, function and switch commands are being sent to decoders but also messages such as acknowledgements, actual speed, other status information and CV read-outs are being received from decoders.

The functioning principle of RailCom is based on the introduction of short cut-outs (max. 500 micro seconds) to the otherwise continuously sent DCC signal by the command station. These cut-outs provide the time and opportunity for the decoders to send a few bytes of data to locally mounted detectors.

RailCom is defined by the "RailCom working group" (Lenz, Kühn, Tams and ZIMO) with the goal of a uniform platform for RailCom applications. The same was first pursued by the NMRA RP's 9.3.1 and 9.3.2 for bidirectional communication but failed, largely due to the self-dissolution of the NMRA "DCC working group".

Just now in 2011 (the year this manual is published), the future of RailCom uncertain because the manufacturer ESU (after loss of key OEM supplier contracts) is working intensively since 2010 to use the RailCom method for expanding its own market position.

By taking advantage of a patent by Lenz (who entered into close cooperation with ESU), it is tried to keep other market participants away from using RailCom altogether, or to force compliance through controls and sanctions to the specifications issued by ESU (based on what their own command stations require).

Therefore, ZIMO is preparing (in collaboration with other ESU damaged companies) an alternative method, which currently (June 2011) is still nameless:

- The ***alternative method*** to RailCom is based on the above mentioned ZIMO loco number identification, which is realized by using that basic idea together with current technological means for a comprehensive feedback system. The scope of performance will be similar, or even greater than that of RailCom. From the users perspective who does not see the physical level of data transmission, but only the logical structure of data transmitted, the difference to RailCom will not be that big. That's why the following description is valid for both, RailCom as well as the alternative method.

„RailCom" is a registered trademark of Lenz Elektronik GmbH.

With the help of ***bidirection communication*** according to RailCom or the alternative future method it will possible that

decoders can acknowledge received commands -

- which increases operational reliability and the bandwidth of DCC systems because already acknowledged commands don't need to be sent repeatedly;

up-to-date information is sent to the command station ("global detector") -

- e.g. "real" (measured) train speed, motor load, routing and position codes, "fuel reserves", current CV values on demand from decoders to command station or more precisely, to a **global detector** in the command station;

decoder addresses are recognized by "local" detectors -

- the actual loco positions are determined by local detectors connected to individual track sections (integrated in future MX9 track section modules), which has been possible with ZIMO's own loco number recognition for over two decades without bidirectional communication; but only with ZIMO components.

RailCom and/or the alternative method will be further developed over the coming years and add new applications, which of course require new software updates in decoders and other equipment. ZIMO decoders as of 2009 are able to send their own loco address from an isolated section of track (with a so called broadcast method, very fast, although only for one loco inside that section), send CV content on demand along with some decoder data such as actual speed in km/h, load and decoder temperature.

In 2011, ZIMO will deliver the new MX10 command stations with integrated detectors for RailCom and the alternative method. The MX32 cab (released early in 2011) uses feedback functions from the start (speed indicator, CV-reading), but until the appearance of the MX10 is accessible only in connection with the MX31ZL.

RailCom in ZIMO Decoders is activated with

CV #29, Bit 3 = 1 *AND* *CV #28 = 3*

These are usually default settings on a new decoder, but RailCom is turned off by default in many sound projects or OEM CV sets and must therefore be activated first with above CV's.

5 Operating with Märklin MOTOROLA Systems

See loco decoder manual!

6 ZIMO Decoder - Software Update

All current ZIMO decoders can be updated with new firmware by the end user with the help of the update module MXDECUP or MXDECUPU (with USB converter), the MX31ZL or with the new MX10 command station.
New software versions can be downloaded at no charge from ZIMO's web site: www.zimo.at (under "UPDATE") and add new features, improvements and corrections to the decoder firmware.

First download a so-called **"Decoder Software Collection File"** from the UPDATE pages at the zimo web site: www.zimo.at. , usually the one marked ***aktuell*** (the last line in the update list). It contains the latest firmware **for all ZIMO decoders.** The correct file for the decoder at hand will be automatically selected during the update process.

The update itself can be done in different ways:

- With the **decoder update module MXDECUP** via a **computer,**

  using the serial port of the MXDECUP or
  the USB-serial convertor with the MXDECUPU.

The MXDECUP(U) is connected with the computer, power supply and a section of track. Set the engine on this "update" track. Start the program **"ZIMO Rail Center" (ZIRC)** on the computer. ZIRC selects the proper software from the "decoder software collection file" and installs it in the decoder when prompted to do so.

The **"ZIMO Sound Program" (ZSP)** can also be used instead of ZIRC. As the name implies, this program is used for editing and installing sound projects to ZIMO sound decoders but can also be used to update decoder firmware in all ZIMO decoders (sound, non-sound and accessory decoders).

The programs **ZIRC** and **ZSP** can also be downloaded at no charge from www.zimo.at

- With the **system cab MX31ZL** and a **computer**

  using the USB interface of the MX31ZL.

  The MX31ZL is used in this case just like an MXDECUP (see above) and the procedure is also controlled by the PC with **ZIRC** or **ZSP**.
  This is of advantage especially to the ZIMO system user, since the cost of a MX31ZL is about the same as a MX31 with MXDECUPU. The MX31ZL can also be used for updates without a computer (see below) and most of all; it is also a complete DCC system.

- With a **USB stick** and a **MX31ZL,**

In this case, the "decoder software collection file" is first loaded onto the USB stick. Plug the stick to the MX31ZL (with the help of the adapter that comes with the MX31ZL) and use the MX31ZL to proceed with updating as many decoders as desired (but of course, only ZIMO decoders). This process doesn't require a computer and no direct connection to one (see MX31ZL instruction manual).

- With a **USB-Stick** and a **MX10 command station,**

Similar procedure as with the MX31ZL; more information follows when the MX10 becomes available.

MXDECUP

RS-232 – DSUB-9-Plug

Connector for update track control LED's behind socket

Socket for power supply

MX31ZL with USB-Stick

The update module MXDECUP(U) is shipped with a power supply, a RS-232 cable and a USB converter (with MXDECUPU).

MXDECUP Implementation and operation:

A **section of track** is used as "update track" and connected to the 2-pin screw terminal of the MXDECUP(U). Set the engine with the decoder that is to be updated on the track. The decoder can of course be connected with its red and black wires directly to the track connector of the module instead.

In contrast to the CV-programming procedure, the update procedure with the corresponding acknowledgment does not depend on the load connected to the decoder (such loads are neither necessary nor hindering).

Please note...

Electrical loads in the loco that are not connected to the decoder may potentially present a problem (since the decoder cannot turn the load off), because of the 150mA power limit of the MXDECUP. The update process may fail in such cases and the relevant loads must first be removed or remove the decoder from the locomotive.

Make sure the choke coil recommended in chapter 17 is actually installed, if **external buffer circuits** (capacitors) are used to maintain power to the decoder on dirty track sections. Acknowledgments from the decoder to the MXDECUP are otherwise not possible.
Although there is a "blind update option" available in ZSP that operates without acknowledgements, its use is not really recommended.

Now, plug-in the ***power supply*** at the MXDECUP. The green LED, visible in the connector recess, should now be lit. Next, connect the MXDECUP with the ***computer*** using either the RS-232 cable or the RS-232 cable with USB converter. The green LED now turns off again (both LED's are dark).

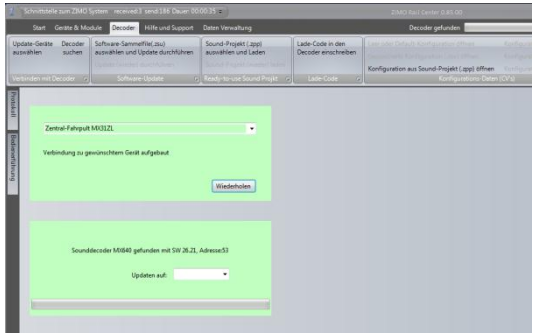
Consult the cab manual for details about the computer during the update.

Using the "ZIMO Rail Center" ZIRC for software updates and loading of sound:

The program ZIRC is used together with the MXDECUP or MX31ZL; for MXDECUP hook-up and operations see above; for MX31ZL, see operating manual.

Note: The MX31ZL can be used in two ways for decoder updates: with a computer and ZIRC as described here (where the MX31ZL behaves like a MXDECUP), or with a USB stick without using a computer during the update process, which is not described here (see MX31 instruction manual).

ZIMO Decoder Software Update



Die Vorgangsweise (Kurzdarstellung):

ZIRC is used together with either a MXDECUP update module, MX31ZL, MX32ZL or MX10 command station.

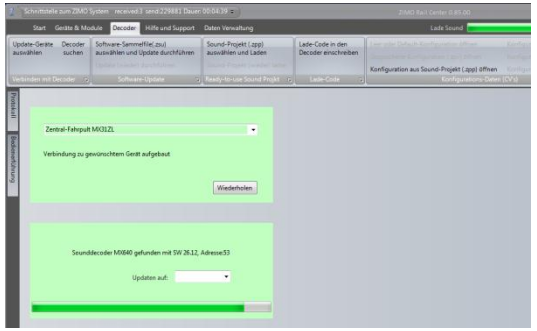
- Select **“Decoder”** on the welcome.

- Then the user selects either,
  - to prepare data (CV editing, see above) or
  - to apply SW-Updates immediately, or load "Ready-to-use“ sound projects (under "Decoder suchen").

- Click on “Update Gerät auswählen”, select your update device from the list and click on “Verbinden”.

ZIRC establishes a connection to the update-devices (MX31ZL, MXDECUP, MX10...) and displays them on the **Produckt-Panel**. It then identifies any decoders connected to these devices (displayed in **Decoder-Panel**).

In the Decoder-Panel select the task to be performed, either **"Decoder-Update"** or "**Sound-Projekt-Laden"** (not both at the same time!).

The software update is performed with the assistance of a Wizard, the decoder software can be automatically downloaded from the ZIMO website (if an Internet connection is present) or it can be saved on a PC (or USB stick) and used from there.

To load a "Ready-to-Use” sound project, the desired .zpp file must first be found and selected. Select "Öffnen" and the file will be loaded into the decoder.