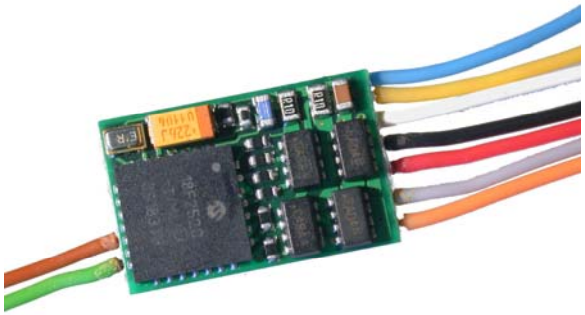
INSTRUCTION MANUAL

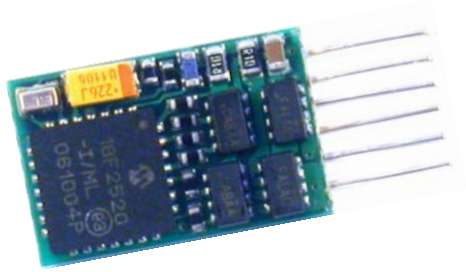


EDITION

Initial delivery (SW-Version 1) --- 2007 10 01
2008 02 15

FUNCTION - DECODER – Design as of October 2007

MX680, MX680N



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.

The current version may not yet be capable of all the functions mentioned in this manual. Where important, notes indicate whether a feature/function is valid for certain SW versions.
As with other computer programs, it is not possible for this 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 with MXDECUP!

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 service, see www.zimo.at !

1. Introduction

Function decoders are principally locomotive decoder 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 MX680 function decoder hardware is largely based on the miniature decoder MX620; it is just as small and is therefore ideal for all scales.

ZIMO decoders operate primarily in the standardized **NMRA DCC data format** as used by ZIMO DCC systems as well as DCC system of other manufacturers, but can also operate in the **MOTOROLA protocol** for use with Märklin systems and other MOTOROLA command stations.

A distinctive feature of the MX680 (as with its predecessor MX68) is the programmable **SECOND ADDRESS** (CV #640 to #68), which can be used as an alternative address for the car containing the function decoder and is commonly set to the same address as the loco pulling the train. When all coaches of a train are so equipped and all can be reached with a common address, it is the easiest form of a virtual **"TRAIN BUS"**, which will certainly play an essential role in future DCC developments.

2. Technical Information

Allowable Track voltage ..... 12 - 22 V
Maximum continuous power or function outputs *) 0.5A
Operating temperature ..... - 20 to 100 °C
Dimensions (L x B x H) .... 14 x 9 x 2.5 mm

*) The short circuit protection is carried out for the total current of all outputs. In the unlikely event that the outputs are turned off due to cold-start problems of light bulbs (power surge at turn-on leading to a short), the "soft-start" option should be utilized (see CV #125 = 52 etc.)!

DO–IT–YOURSELF SOFTWARE UPDATE

Beginning with production date September 2004, ZIMO DCC decoders are equipped to handle a software update by the user. A **ZIMO decoder update module (e.g. MXDECUP** or **MX31ZL),** a PC with Windows operating system, a serial port (or USB and converter) and the program **ZIMO Service Tool "ZST"** is required. The update module is used independent of the command station and can therefore be used with any DCC system!

There is **no need to remove the decoder or to open up the vehicle.** Just set it on a section of track connected to the update module and start the update with the computer.

See the **chapter "Software Update"** in this manual for more information on updating decoders or visit www.zimo.at

Note: Components in the vehicle that are connected directly to the track (that is, not powered by the decoder) can hinder the update process; likewise built-in energy packs unless they are wired according to the explanations in the chapter "Installation and wiring…". See under "Connection and control of an external energy source…".

OVERLOAD PROTECTION:

The motor and function outputs of ZIMO decoders are designed with lots of reserve capacities and are additionally protected against excessive current draw and short circuits. The affected output is turned off once an overload situation exists and subsequent load tests are performed by the decoder, which is often recognized as flashing headlights.

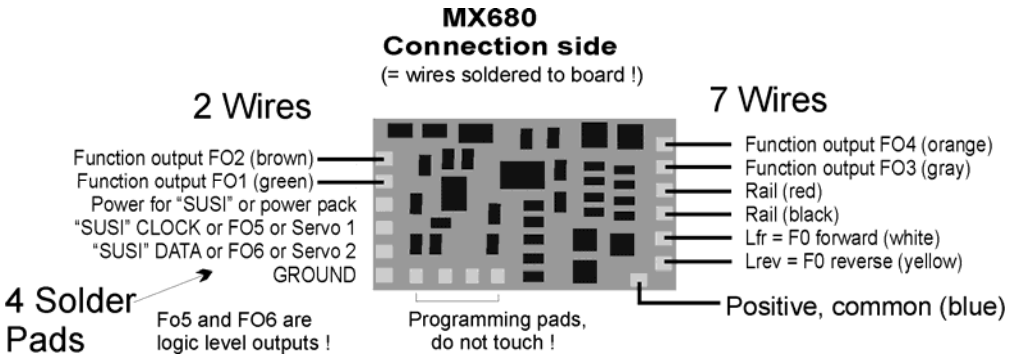
Even though the decoder is well protected, do not assume it is indestructible. Please pay attention to the following:

Faulty decoder hook-up, *connecting the motor leads to track power for instance or an overlooked connection between the motor brushes and rail pick-ups is not always recognized by the overload protection circuit and could lead to damage of the motor end stage or even a total destruction of the decoder.*

The end stages of loco decoders are not only at risk of high current but also ***voltage spikes,*** *which are generated by motors and other* ***inductive consumers.*** *Depending on track voltage, such spikes can reach several hundred volts and are absorbed by special protection circuits inside the decoder. Since the capacity and speed of such circuits is limited, the track voltage should not be selected unnecessarily high; that is not higher than recommended for the rolling stock in question. The full adjustable range of a Zimo command station (up to 24V) should only be utilized in special cases. Although ZIMO decoders are suitable for 24V operation, that may not be the case when interacting with some other equipment.*

THERMAL PROTECTION:

All ZIMO decoders have the ability to measure their own operating temperature. Power to the motor will be turned off once that temperature exceeds 100°C. The headlights start flashing rapidly, at about 5 Hz, to make this state visible to the operator. Motor control will resume automatically after a drop in temperature of about 20°C, typically in 30 to 60 seconds.



3. Addressing and Programming

Every loco decoder requires a separate unique address with which the loco is controlled using a cab. **All NMRA-DCC compliant decoders have 3 as their factory default address** (NMRA standardized decoder address at delivery).

DECODER INSTALLATION:

After installing the new decoder (see chapter “Installation and wiring”), it can be tested with address #3.

THE ADDRESSING AND PROGRAMMING PROCEDURE:

The procedure for programming and reading of addresses and configuration variables is covered in detail in the instruction manual for the cab (MX21, MX31....). Consult the appropriate manual for systems of other manufacturers.

Programming a decoder with a PC and ADaPT software (by E.Sperrer, software developer) is a lot easier and more convenient!

Technical note to decoder acknowledgments during programming:

When programming a decoder with a cab or computer, every successful programming step will be made visible by the decoder. The same acknowledgment method is used when reading the configuration variables.

The acknowledgment is based on short power pulses that the decoder generates by briefly turning on the load connected to it, which the command station recognizes at the programming track. It follows that the acknowledgment and read out of a decoder is only successful if power consuming devices are connected to its outputs and the total current consumption is high enough.

HELPFUL HINTS FOR CV PROGRAMMING:

If you are familiar with CV programming please skip this section and go directly to the CV table below!

CV programming is not the same for all CV’s. While the programming procedure is the same for all CV’s, the calculation of the individual CV values varies.

For some CV’s it is obvious what the value is supposed to be and can easily be derived from the “Range” and “Description” column in the CV table. This kind of CV acts similar to a volume control. For instance, CV#60 is used to reduce the voltage on the function outputs (i.e. dimming):

CV	Designation	Range	Default	Description
#60	Reduced function output voltage (Dimming)	0 - 255	0	The actual function output voltage can be reduced by PWM. Useful to dim headlights, for example. Example values: # 60 = 0 or 255: full voltage # 60 = 170: 2/3 of full voltage. # 60 = 204: 80% of full voltage.

The “range” column suggests using a value between 1 and 255 and in the “description” column it is explained that the brightness of the light increases with the value.

Other CV’s are easier to understand if you think of them as a small switch board, where you can turn individual switches ON or OFF. Such a CV is made up of 8 “individual switches” called Bits and the group of Bits is known as a Byte (which is the CV itself or the switch board, if you will). On some CV’s you can change the setting of all 8 Bits (switches) and on others only a select few. The Bits (switches) are numbered from 0 to 7 and each has a specific value (**see the chapter “Converting binary to decimal”** for more on binary calculations). Each Bit is turned ON by adding its value to the CV and turned OFF by subtracting its value. Add the value of each Bit you want to turn ON and enter the total to the CV.

One such CV is CV #29:

CV	Designation	Range	Default	Description
#29	Basic configuration CV #29 is calculated by adding the value of the individual bits that are to be “on”: Values to turn “on”: Bit 0: 1 Bit 1: 2 Bit 2: 4 Bit 3: 8 Bit 4: 16 Bit 5: 32 Bit 6: 64 Bit 7: 128 ZIMO MX21, MX31… cabs also display the individual bits; calculating bit values is no longer necessary!	0 - 45	6	Bit 0 - Train direction: 0 = normal, 1 = reversed Bit 2 - DC operation (analog): *) 0 = off 1 = on Bit 3 - RailCom („bidirectional communication“) 0 = deactivated 1 = activated see CV #28! Bit 5 - Decoder address: 0 = primary address as per CV #1 1 = ext. address as per CV #17+18

You can only change the setting of Bit 0, 2, 3 and 5. Bits 1, 4, 6 and 7 have to remain OFF because they are not yet used for anything. To calculate the total CV value you have to first look at the description field of that CV and determine which Bit (switch) you want to have ON. Let’s say we want reverse the loco’s direction because it doesn’t agree with the cab’s direction indication and we want to activate RailCom. This means we have to have the Bits 0 and 3 turned ON (= 1). All other Bits can be OFF (= 0). In the “Designation” field it shows the value for each Bit: Bit 0 = 1, Bit 1 = 2, Bit 2 = 4, Bit 3 = 8, Bit 4 = 16, Bit 5 = 32, Bit 6 = 64, and Bit 7 = 128. If we want to have Bits 0 and 3 turned ON we add up the values for these Bits (1 + 8) and enter the total of 9 to CV #29.

Lastly there is a third kind of CV that sort of fits between the other two. Here you don't have to worry about Bits and their values. With those CV's the digit's position and value determines a specific action. Some of those digit positions act like a simple ON/OFF switch and others like a volume control.

For example, CV #56 can be used for fine-tuning a motor:

CV	Designation	Range	Default	Description
#56	Back-EMF control P and I value	0 – 199 (See add. notes)	0 (is equal to 55, mid-range) But: default is not suitable for **coreless motors, i.e. MAXXON, FAULHABER!** Use "100" instead.	Back-EMF compensation is calculated by PID algorithm (Proportional/Integral - Differential); modifying these values may improve the compensation characteristics in certain cases. 0 - 99: for „normal" DC motors (LGB etc) 100 - 199: for coreless (MAXXON, Faulhaber, etc...) Tens digit: Proportional (P) value; by default (0) is set to mid value and automatic adjustment with the goal of jerk free running. Proportional effect can be modified with settings of 1 – 4 and 6 – 10 (instead of the default 0 = 5). Ones digit: Integral (I) value; is set by default to a mid value. The Integral effect can be modified with settings of 1 – 9 instead of the default 0 = 5).

As you can see in the "Range" field you can use any number between 0 and 199. However if you read the "Description" field it explains that each digit position controls a specific function. In this case, the hundredth digit (_xx) sets the decoder up for a coreless motor, the tens digit (x_x) modifies the proportional and the ones digit (xx_) the integral action. This hundredth digit acts just like a switch. If you use the hundredth digit (1__) the coreless motor function is turned ON. If you don't use it (_xx), the function is turned OFF. So for a normal DC motor you would only use the ones and tenth digit. With the tens digit (0 – 9) you can modify the proportional value and with the ones digit (0 – 9) the integral value.

Note: CV #56 is not used in the MX680. It serves as an example of how these kinds of CV's are to be understood and programmed.

THE CONFIGURATION VARIABLES:

The decoder address as well as a number of configuration variables can be defined with the help of programming procedures.

The meaning of the individual Configuration Variables (CV's) is in part standardized by the NMRA DCC RECOMMENDED PRACTICES, RP-9.2.2. There are however certain CV's that are for Zimo decoders only, in some cases exclusively for specific types of Zimo decoders.

Always use the specifications for the decoder in question, since the value range may differ between manufacturers, even with standardized CV's; in this case use the table below.

CV	Designation	Range	Default	Description
#1	Primary "short" address	1 – 127	3	The "short" (1-byte) loco addresses; Is active when Bit 5 in CV #29 is 0.
#3	Acceleration rate	0 - 255	1	Multiplied by 0.9 equals' acceleration time in seconds from stop to full speed. This CV in the function decoder is only relevant for direction changes, so that the point when the direction change occurs can be matched to the engine decoder (mostly function F0).
#4	Deceleration rate	0 - 255	1	Multiplied by 0.9 equals' deceleration time in seconds from full speed to complete stop. This CV in the function decoder is only relevant for direction changes, so that the point when the direction change occurs can be matched to the engine decoder (mostly function F0).
#7	Software version and temporary register when programming with a "Lokmaus 2" and similar low level systems. See section "Operation within other systems" in this manual!	Read only, all additional programming in case of Lokmaus 2 is pseudo only		This CV normally displays the decoder software version. **For user of Lokmaus 2 :** Pseudo-programming (because programmed value is not really stored) as an initial step for programming or read-out of a higher CV (>99) and/or a higher value (>99): **CV # 7 = „01", „02", „10", „11", „12" :** Tens digit = 1: The entered CV value will be increased by 100 during the actual programming. Tens digit = 2: ….increases by 200. Ones digit = 1: The entered CV value will be increased by 100 during the actual programming. Ones digit = 2: …increases by 200. **Also see other decoder manuals such as MX620 etc.**
#8	Manufacturer ID and HARD RESET with CV #8 = 8	Read only	145 (= ZIMO)	NMRA assigned manufacturer ID for Zimo is: 145 ("10010001") Pseudo-Programming ("Pseudo" = programmed value is not really stored):

CV	Designation	Range	Default	Description
				CV #8 = "8" -> HARD RESET (NMRA standard: all CV's reset to default values).
#13	Analog functions	0 - 255	0	Selects function outputs F1 to F8 that should be "on" in analog mode. Each bit equals one function; Bit 0 = F1, Bit 1 = F2, Bit 6 = F7, Bit 7 = F8.
#14	Analog functions	0 - 255	3	Selects function outputs F0v, F0r, and F9 to F12 that should be "on" in analog mode. Each bit equals one function (Bit 0 = F0 front, Bit 1 = F0 rear, Bit 2 = F9 … Bit 5 = F12). Bit 6 = 1: Acceleration and deceleration according to CV #3 and #4 is deactivated in analog operation.
#17 + #18	Extended address	128 - 10239	0	The long 5-digit primary address (>127). This address is only active when Bit 5 in CV #29=1. Otherwise address entered in CV #1 is active (<127).
#19	Consist address	0 - 127	0	An additional address that is used to operate several locos in a consist. If a consist address is assigned to this CV, commands for the primary and extended addresses (CV's #1 and #17/18) will be ignored by the decoder. This CV is seldom used within ZIMO systems, since it is more comfortable to build and control consists with the cab (using the "normal" single addresses).
#21	Consist functions for F1 - F8	0 - 255	0	Selected functions that should operate with the consist address. (Bit 0 for F1, Bit 1 for F2, Bit 2 for F3 ... Bit 7 for F8) Applicable Bits set to 0 = function controlled by single primary address. Applicable Bits set to 1 = function controlled by consist address.
, #22	Consist functions F0 forward, reverse and F9 – F12	0 - 3	0	Select whether the headlights are controlled with consist address or single address (Bit 0 for front headlight, Bit 1 for rear headlight): Bit 0 for front headlights, Bit 1 for rear headlights, Bit 2 for F9, Bit 3 for F10, Bit 4 for F11, Bit 5 for F12. Respective Bit = 0: function output controlled with single address Respective Bit = 1: function output controlled with consist address
#29	Basic configuration	0 - 63	6	Bit 0 - Train direction: 0 = normal, 1 = reversed Bit 2 - DC operation (analog): 0 = off 1 = on Bit 3 - RailCom („bidirectional communication") 0 = deactivated, 1 = activated

CV	Designation	Range	Default	Description
				Bit 5 - Decoder address: 0 = primary address as per CV #1 1 = ext. address as per CV #17+18
#33 #34 #35 #36 #37 #38 #39 #40 #41 #42 #43 #44 #45 #46	Function mapping	(See FUNCTION MAPPING)	1 2 4 8 2 4 8 16 0 0 0 0 0 0	Function mapping according to NMRA: #33 - 40 = 1, 2, 4... Outputs are set to F0 - F12 by default. Headlight switches with direction and can be turned on/off with F0 key (Key #1 or L on Zimo cab). Since the decoder only has 6 function outputs, the registers from #37 up are moved to the empty Bits on the right, which allows these outputs to be moved to higher function keys. See "NMRA function mapping" in next chapter.
#60	Reduced function output voltage (Dimming)	0 - 255	0	The actual function output voltage can be reduced by PWM. Useful to dim headlights, for example. Example values: #60 = 0 or 255: full voltage #60 = 170: 2/3 of full voltage. #60 = 204: 80% of full voltage.
#62	Light effects modifications	0 - 9	0	Change of minimum dimming value (FX_MIN_DIM); also see CV #125.
#63	Light effects modifications	0 - 99	51	Tens digit: sets cycle time for special effects (0 - 9, default 5), or start up time during soft start (0 - 0,9s) Ones digit: extends "off" time. Also see CV #125.
#64	Short SECONDARY ADDRESS	1 - 127	0	The "short" (1-byte) secondary address; It is active when Bit 5 in CV #112 = 0.
#67 + 68	Long SECONDARY ADDRESS	128 - 10239	0	The "long" (2-byte) secondary address; it is active when Bit 5 in CV #112 = 1. Note: In contrast to the "long" primary (extended) address in CV #17 + 18, the cab cannot automatically calculate these two CV's with the correct values. As a work around temporarily program this second address to the first address, then read out CV #17 + 18 and use these values in CV #67 + 68.
#69 - 82	Secondary address functions #69 for F0 front #70 for F0 rear #71 for F1 #72 for F2 #73 for F3 #74 for F4	 1 2 4 8 2 4		These 12 CV's form a matrix, which can be used to define the functions (function keys on cab) that should be active when operated with the secondary address.

CV	Designation	Range	Default	Description
	#75 for F5 #76 for F6 #77 for F7 #78 for F8 #79 for F9 #80 for F10 #81 for F11 #82 for F12	8 16 0 0 0 0 0 0		
#83	Light effects modifications	0 - 9	5	Ditch light off-time modification Note: This variable is identical to CV #64 in loco decoders.
#112	Special ZIMO configuration bits	0, 8, 32, 40	2	Bit 1 = 0: Normal "service mode" acknowledgement = 1: Special acknowledgement by means of "internal high frequency shorts", because typical LED's connected to the decoder don't draw enough current for normal acknowledgements. Bit 3 = 0: reacts only to the (new) NMRA-MAN-Bit, **12 function mode** = 1: reacts to old MAN bit also, **8 function mode** Bit 5 = 0: Select between "short" primary und = 1: "long" secondary address Only in MOTOROLA format: Bit 3 = 0: normal, 4 functions for each address = 1: next higher address is used to control 4 more functions, for a total of 8 functions.
#114	Dimming mask	Bits 0 - 5	0	Bit 0 to 5 for one function output each (Bit 0 = front headlight, Bit 1 = rear headlight, Bit 2 = function output F1, etc.) Bit value=0: Output dimmed to value defined in CV #60. Bit value=1: Output not dimmed.
#115	Uncoupler control (KROIS and ROCO) "Pull-in" time and "hold" voltage CV # 115 alternatively used for additional dim value (0-90% according to ones digit; set tens digit to 0)	0 – 99 See chapter 4	33	Active if "uncoupling" is selected (with value of 48) in CV #125.....132: Tens digit (0 – 9): Pull-in time (in seconds) that the coupler receives full voltage according to this table: Value: 0 1 2 3 4 5 6 7 8 9 Seconds: 0 .1 .2 .4 .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 (ROCO uncoupler or for general dim value)
#117	Flasher	0 – 99	0	Duty cycle for flasher function: Tens digit = on time (0 = 100msec…..9 = 1 sec) Ones digit = off time (0 = 100msec…..9 = 1 sec)
#118	Flasher Mask	Bits 0 – 7	0	Bit 0 to 5 for one function output each (Bit 0 = front headlight, Bit 1 = rear headlight, Bit 2 = function output FO1, etc.) Bit values = 0: no flasher Bit values = 1: output flashing Bit 6 = 1: output FO2 flashing inverse! Bit 7 = 1: output FO4 flashing inverse!
#119	Low beam mask for F6	Bits 0 - 7	0	Bit 0 to 5 for one function output each (Bit 0 = front headlight, Bit 1 = rear headlight, Bit 2 = function output FO1, etc.) Bit values = 0: no low beam function Bit values = 1: Low beam with key F6, brightness determined by value in CV #60. Bit 7 = 0: normal effect of F6. = 1: effect of F6 inverted.
#120	Low beam mask for F7	Bits 0 - 7	0	Same as in CV #119 but for F7 key.
#124	SUSI or Logic level outputs FO5, FO6		128 (that is Bit 7 = 1)	Bit 7 = 0: SUSI active. = 1: SUSI deactivated, solder pads can be used instead for logic level outputs FO5 + FO6. Note: The same pads can be used for Servo controls if activated with CV's 181 and 182!
#125[1]	**Special effects** American lighting effects, uncoupler function, "soft start" of function outputs at activation or automated ON/OFF with different criteria's. Operates with F0 in forward direction (front headlights) by default, unless assigned different through function mapping. Effects can be further adjusted and modified with CVs #62 - 64 and		0	Bits 0,1 value = 0: independent of direction =1:active in forward direction =2:active in reverse direction ATTENTION: change CV's #33, 34.... if direction is wrong! Bits 2 - 7 value = 4 Mars light = 8 Random Flicker = 12 Flashing headlight = 16 Single pulse strobe = 20 Double pulse strobe = 24 Rotary beacon simulation. = 28 Gyralite = 32 Ditch light type 1, right = 36 Ditch light type 1, left = 40 Ditch light type 2, right = 44 Ditch light type 2, left = 48 Uncoupler as in CV#115 = 52 Soft start up of function output = 56 Automatic stop lights for streetcars, see CV #63 = 60 Function output turns off automatically at speed >0 (i.e. turns off cab light at start).

[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).

CV	Designation	Range	Default	Description
	CV #115 (for uncoupler).			= 64 Function output turns off automatically after 5 min. (i.e. to protect a smoke generator from overheating). = 68 Autom. Turns off after 10 minutes. <u>EXAMPLES</u> You want : — Program CV #125 to: Mars light forward only - 5 Gyralite independent of direction - 28 Ditch type 1 left, only forward - 37 **Uncoupler- 48** **Soft start of output- (i.e. headlights)- 52** **Automatic stop light- 56** Automatic cab lights OFF- 60 Automatic smoke OFF after 5 min.- 64
#126	**Special effects** for rear headlight (default F0 reverse)		0	Bits 0,1 value = 0: independent of direction =1: active in forward direction =2: active in reverse direction ATTENTION: change CV's #33, 34.... if direction is wrong! See CV #125 for details.
#127	**Special effects** for FO1 (default F1)		0	See CV #125 for details.
#128	**Special effects** for FO2 (default F2)		0	See CV #125 for details.
#129 - #130	**Special effects** for FO3, FO4 (default F3, F4)	MX62, MX63, MX64: from SW-Version 22 and up	0	See CV #125 for details. MX620: Only usable if outputs FO3 and FO4 are activated by deactivating the SUSI function (CV #124, Bit 7 = 1).
#131 - #132	**Special effects** for FO5, FO6 (default F5, F6)	MX63, MX64: from SW-Version 22 and up	0	See CV #125 for details. MX63, MX64, MX64H, and MX680: Only usable if outputs FO5 and FO6 are activated by deactivating the SUSI function (CV #124, Bit 7 = 1).
#144	Programming and update lock MX62, MX63, MX64: from SW-Version 32, MX620, MX64D from SW-Version 7.	Bits 6, 7	0	This CV was introduced to prevent unintentional decoder changes or loss of functions due to an inadvertent entry to the update mode. = <u>0</u>: Unrestricted CV programming, Bit 6 = 1: No programming possible in **service mode:** protection against unintentional programming. Note: "on-the-main" programming is still possible. Bit 7 = 1: Software updates normally executed with the MXDECUP, MX31ZL or future devices are blocked. (Unlock this CV with "on-the-main" programming)

CV	Designation	Range	Default	Description
#161	Protocol for all servo outputs	0 - 3	0	Bit 0 = 0: Servo protocol with positive pulses. = 1: Servo protocol with negative pulses. Bit 1 = <u>0</u>: Control wire active during movement = 1: … always active (consumes power, vibrates at times but holds position even under mechanical load).
#162	Servo 1 Left stop	0 - 255	49 = 1 ms pulse	Defines the servo's left stop position.
#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	10 = 1 sec	Rotating speed; Time between defined end stops in tenths of a second (total range of 25 sec). Value "30" = 3 sec.
#166 to #169	As above for servo 2			
#181 #182	Servo 1 Servo 2 Function assignment	0 - 13	0 0	= 0: Servo not in operation = 1: Single-key operation with F1 = 2: Single-key operation with F2 = 3: Single-key operation with F3 etc. = 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. Note: "left/right" is determined by the stop point settings with CV #162 and #163! = 101: Two-key operation F1 + F2 = 102: Two-key operation F2 + F3 etc. (left/right in each case) = 111: Two-key operation F11 + F12 = 112: Two-key operation F3 + F6 = 113: Two-key operation F4 + F7 = 114: Two-key operation F5 + F8

4. “Function mapping“

as per NMRA Standard; and ZIMO - Extensions

The allocation of function outputs (“function mapping”):

The configuration variables **#33 to #46 form the NMRA function mapping** according to their rules and regulations see table on the right.

A slightly modified function mapping that still conforms to the NMRA standard is used in the MX680 (as well as in the MX620) making use of the fact that the MX680 has a maximum of 8 function outputs (headlights, FO1, FO2, FO3, FO4 and with the SUSI interface deactivated additionally the logic level outputs FO5 and FO6), see table on next page!

The NMRA function mapping, including the modified version, limits the possibilities of a decoder in as much as the directional control of its outputs is intended for the headlights (F0...) only, but not for other functions (F1, F2 etc.).

That’s why ZIMO decoders offer the following solutions:

Directional functions through “lighting effects”:

The directional bits (0,1) in CV #125 to 132 (special effects) allow a directional function to be split into two direction specific functions, if at the same time bits 2 – 7 remain at “0”.

Example: Function output FO1 and FO2 (e.g. red taillights, front and rear) should change with direction but switched ON/OFF with F1. Program decoder as follows:
CV #35 = 12 (bit 2 and 3 for FO1 and FO2 in CV #35),
CV #36 = 0 (recommended, otherwise 2 function keys would act on FO2 by default)
CV #127 = 1 (“Special Effect” variable for FO1, CV #127 “active in forward direction”)
CV #128 = 2 (“Special Effect” variable for FO2, CV #127 “active in reverse direction”).

Or: Output FO5 and FO6 operated with F5 key and directional control:

CV #39 = 24 (Bits 3, 4), CV #131 = 1 (forward), CV #132 = 2 (reverse).

Another option: Direction-dependent functions with special pseudo programming procedure; see CV #61 = 98 on next page.

*The configuration variables **CV #33 to #46** refer to the function keys (F...) of the cab; the single bits to the function outputs (FO...) of the decoder (whereby, due to the „left shift“ of the higher CV’s (CV37 and up), different function output bits are contained in those CV’s). The function keys are matched to the function outputs by setting the appropriate bits (indicated in the table below with ●). Multiple assignments are permissible.*

Because the miniature MX680 have a maximum of 8 function outputs (headlights, FO1, FO2, FO3, FO4, FO5 and FO6), the “left over” bits of the NMRA conforming registers from #37are moved “to the front” and allow the lower numbered outputs (e.g. headlights) to be reached with higher numbered function keys (F3 and up), which would be impossible with the NMRA function mapping.

***Therefore:** NMRA standard (dark grey fields) with “turned over” bits“ (light gray):*

NMRA Functions	CV Primary address	CV Secondary address	Number key on ZIMO Cabs		MX680 Function Outputs							
					FA6	FA5	FA4	FA3	FA2	FA1	Rear light	Front light
F0	# 33	# 69	1 (L) for		7	6	5	4	3	2	1	0 ●
F0	# 34	# 70	1 (L) rev		7	6	5	4	3	2	1●	0
F1	# 35	# 71	2		7	6	5	4	3	2●	1	0
F2	# 36	# 72	3		7	6	5	4	3 ●	2	1	0
F3	# 37	# 73	4		4	3	2	1●	0	7	6	5
F4	# 38	# 74	5		4	3	2 ●	1	0	7	6	5
F5	# 39	# 75	6		4	3 ●	2	1	0	7	6	5
F6	# 40	# 76	7		4 ●	3	2	1	0	7	6	5
F7	# 41	# 77	8		1	0	7	6	5	4	3	2
F8	# 42	# 78	(↓) 9		1	0	7	6	5	4	3	2
F9	# 43	# 79	↓ 1		1	0	7	6	5	4	3	2
F10	# 44	# 80	↓ 2		1	0	7	6	5	4	3	2
F11	# 45	# 81	↓ 3		1	0	7	6	5	4	3	2
F12	# 46	# 82	↓ 4		1	0	7	6	5	4	3	2

ZIMO – Special function mapping: Function mapping procedure with CV #61 = 98:

This procedure allows free allocation of function outputs to function keys (on the cab) that is not possible by setting fixed values in configuration variables.

To carry out this procedure requires a bit more time and attention from the user.

*** Preparation:** The loco must be on the main track (not on the programming track); the whole procedure is performed with operations mode programming. Set the loco direction to "forward", all functions off.

*** CV #61 = 98** Writing value "98" to CV #61 (in operations mode) starts the actual allocation procedure.

The decoder is now in a special programming mode, which will not end until the whole programming procedure is completed or the loco is lifted from the track for a few seconds.

***** The decoder is now ready to accept the first function output allocation, starting with function output **F0 in forward direction.**

The function outputs (as many as desired) to be assigned to F0 in forward direction, are now actuated with the corresponding function keys (i.e. FLf, FLr, F1…F12).

Because only one function key (F0) is available for FLf and FLr (headlights), it is necessary to press F0 repeatedly to select the desired configuration (which alternately actuates the front and rear headlights).

The assignment must be confirmed by pressing the **direction's key.**

***** The decoder is now ready to accept the next output assignment for **F0 but now for "reverse".**

Continue as above!

Again, once a selection is made press the **direction's key** to apply.

*** Continue in the same fashion for all function keys** (28 function-direction-combinations)**!**

***** After the last function key (F12 "reverse") has been assigned, the function outputs FLf and FLr (both headlights) are turned on to indicate the end of this programming procedure.

Confirm again by actuating **the direction key.**

***** After confirmation, the finished allocations are **automatically activated** and CV #61 is set to "99"**.**

Deactivation:

CV # 61 = 0 ... 97 (any value except 98 and 99) deactivates the function assignment and again activates the function mapping according to CV #33 to #46 or CV #61, if a value between 1and 7 is entered. The assignment defined during this procedure though remains stored in the decoder.

Reactivating already stored data:

CV # 61 = 99 reactivates the defined output allocations.

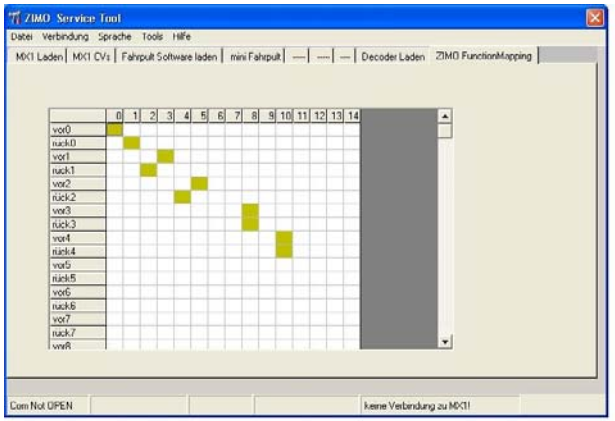
NOTES:

The special effects (US-lighting, uncoupler, soft-start etc) can also be assigned using above procedure. CV's #125, 126 etc. always refer to actual outputs!

It is possible to store and selectively re-activate several function output allocations with the help of the "CV-set" feature!

For a better understanding, the function keys or, more accurately, the function-direction-combinations are listed here in the sequence in which they are defined:

1. F0 forward
2. F0 reverse
3. F1 forward
4. F1 reverse
5. F2 forward
6. F2 reverse
7. F3 forward
8. F3 reverse
9. F4 forward
10. F4 reverse
11. F5 forward
12. F5 reverse
13. F6 forward
14. F6 reverse
15. F7 forward
16. F7 reverse
17. F8 forward
18. F8 reverse
19. F9 forward
20. F9 reverse
21. F10 forward
22. F10 reverse
23. F11 forward
24. F11 reverse
25. F12 forward
26. F12 reverse



In the fall of 2007 an easy to work with tool that replaces the "CV #61 = 98" procedure will become available as part of the ***"ZIMO Service Tool " ZST,*** where the desired functions can be "mapped" into a table and the procedure described above will be carried out automatically!

Output switching logic of the MX680 using PRIMARY and SECONDARY address:

The PRIMARY and SECONDARY ADDRESS commands are read separately and the desired output states are stored according to the respective function mapping.

After the system is turned on (or after loss of track power) it looks first for a SECONDARY address command (unless set to 0) and the outputs will be set accordingly. PRIMARY address commands are only executed if the values have changed between consecutive PRIMARY address commands.

After that, the **"last command received is the one executed"** principle applies to consecutively received PRIMARY or SECONDARY addresses.

5. RailCom - “Bidirectional communication”

“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 and status information are being received from decoders.

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

With the help of RailCom® ***= bidirectional communication, it will***

RailCom is a trademark of Lenz GmbH.

be possible that the decoder can acknowledge received commands,

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

“global” information from decoders is sent to the command station

e.g. “real” 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, system cab MX31ZL and successors;

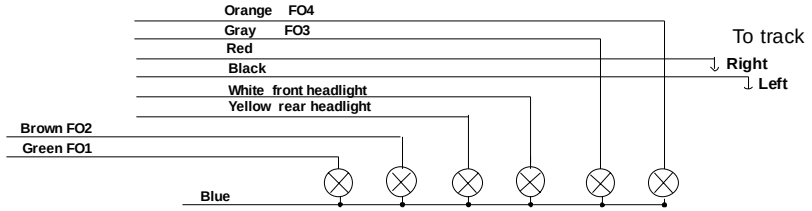
NOTE:

The speedy address recognition through “local RailCom detectors” (i.e. Lenz LRC120) with the help of “RailCom” broadcasts, as used for loco decoders, is not intended for the MX680 function decoder. That would not be possible because only one vehicle may be in a track section with this broadcast technique.

RailCom will be further developed over the coming years and will bring new applications, which of course require new software updates in decoders and other equipment.

The RailCom function is activated with CV #29, Bit 3 (see chapter 3 and CV list).

6. Installation and wiring



Bulbs connected to the white and yellow wire (or to the Lfr and Lr pins of the MX680N) correspond to the headlights of loco decoders, that is they are both by default switchable with function F0 and directional and are often used for head/taillights of pilot cars.

The other connections are single functions and by default assigned as follows:

green … with F1 / brown … with F2 / gray … with F3 / orange ... with F4,

for other assignments see chapter “Function mapping”.

Connecting an electric uncoupler (System “Krois”):

In order to prevent damage to the delicate core of an uncoupler from continuous power, appropriate adjustments can be made with special CV’s for one or several function outputs.

First, write the value “48” to the CV that is assigned to the same output the uncoupler is connected to (e.g. CV #127 for output #1, CV #128 for output #2 etc.)

Next define the uncoupler activation time limit in CV #115 (see CV-table).

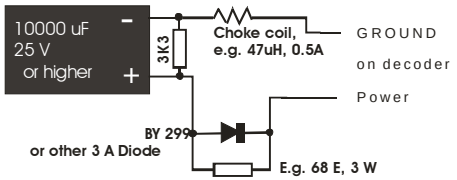
Connection and control of an external energy source (capacitor) for uninterrupted driving on dead track sections:

With the help of an electrolytic capacitor (or Gold cap) or a battery the

- flickering of lights can be reduced.

The energy storage increases with the capacity of a condenser and from 100uF (Microfarad) onwards an effect will be noticed. 1000uF to 10’000uF are recommended if the necessary space is available. The required voltage strength of the capacitor is given by the track voltage; 25V is suitable for all cases. Smaller 16V capacitors should only be used if track voltage will never be higher than that.

The capacitor is connected between ground (available on all ZIMO decoders as solder pad) and power (blue wire or SUSI-POWER) of the decoder. Note polarity!



Use the above schematic if you want to build this circuit yourself. The 100 ohm resistor is required to prevent a short circuit when booting up the system, due to the large in-rush current caused by a large number of capacitor-equipped locos on the track. The diode (e.g. 1N4007) allows the resistor to be bypassed when a quick discharge is required.

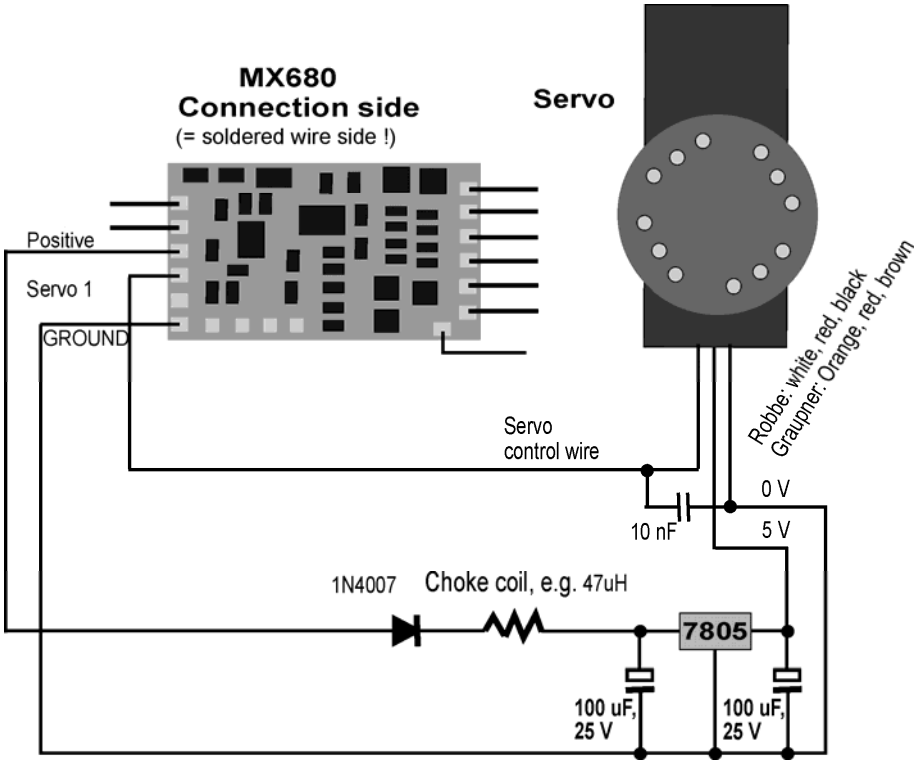
The purpose of the resistor 3K3 shown in the drawing above (not necessarily required) is:
Even though a large condenser supplies the motor and lights for just a few tenths of a second (1000uF) or a few seconds (e.g. 10,000uF) the remaining power, although at a voltage level below what is required by the motor and lights, is sufficient power to keep the decoders memory alive for quite some time. This is sometimes a rather undesired effect. For example: If a running loco is taken from the track and the speed then set to zero, the loco would briefly run at the previous speed when it is set back on the track after about a minute. Using the above-mentioned resistor would erase the memory after just a few seconds.

Connecting servo motors:

Two control outputs are available on the MX680 function decoder. The same solder pads are used, which can alternatively be used for SUSI connections or FO5 and FO6 outputs. These outputs can be activated for servo control duty with CV #181 and #182.

The 5V power of servos must be supplied by external means, typically with a commercially available voltage regulator (7805, LM317 etc.) and connected as shown in the diagram below.

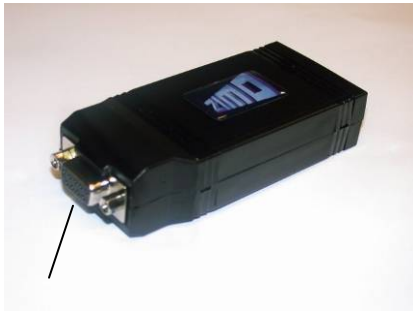
The 10 n capacitor shown is recommended to suppress interference in the control wires.



7. Software Update with MXDECUP

Like all ZIMO loco decoders, the MX680 ZIMO function decoder can also be updated by the user with new firmware with the help of the decoder update module MXDECUP (or MXDECUPU = with USB converter).

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.
The ZIMO Service Tool (ZST from version 1.4) is also required for the update procedure. This software can also be downloaded at no charge from www.zimo.at.



RS-232 – DSUB-9-connector

To update track
Control LED
behind connector

Socket
for
power supply

The update module comes with a power supply, an RS-232 connecting cable and a USB converter (in case of MXDECUPU). Power supplies (12V DC, 300mA minimum, unregulated), serial cable with two 9-pin sub-D connectors (1:1) and commercially available USB converters (USB to serial) can also be acquired locally if for some reason only the MXDECUP is at hand.

Implementation and operation:

A **section of track** is used as "update track" and connected to the 2-pin screw terminal of the MXDECUP. 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...

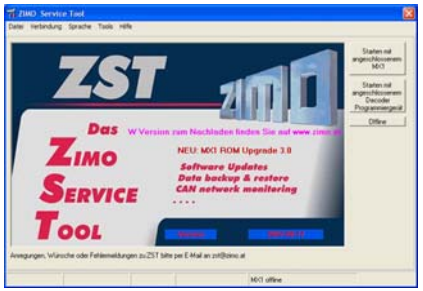
Electrical loads in the loco that are not connected to the decoder may potentially present a problem (since the decoder cannot turn the load off), because of the 150mA power limit of the MXDECUP. The update process may fail in such cases and the relevant loads must first be removed or remove the decoder 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 ZST that operates without acknowledgements, its use is not really recommended.

First, 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.

The actual update process is started and controlled with the ***"ZIMO Service Tool"*** (***ZST***, always use the latest version:

We can't offer a detailed description here regarding the update process; since ZST will often be modified and expanded (this software performs a number of other tasks within the ZIMO system). In any case, there is a button on the original ZST main page named: "start with MXDECUP online". English speaking users should start the ZST extension, which opens the COM PORT selection page. All further steps, such as selecting the right COM port, the update software file (one file contains all current software versions for all ZIMO decoders), starting, control and terminating the update process are self-explanatory on screen or can be obtained from the help file.



The two LED's at the MXDECUP are flickering very rapidly during the update process (red and green). This indicates that data packets are sent to and acknowledgments received from the decoder. The LED's remain dark once the update process is finished.

If for any reason the update is unsuccessful (indicated by ZST), another update can be started after a waiting period of 5 seconds!