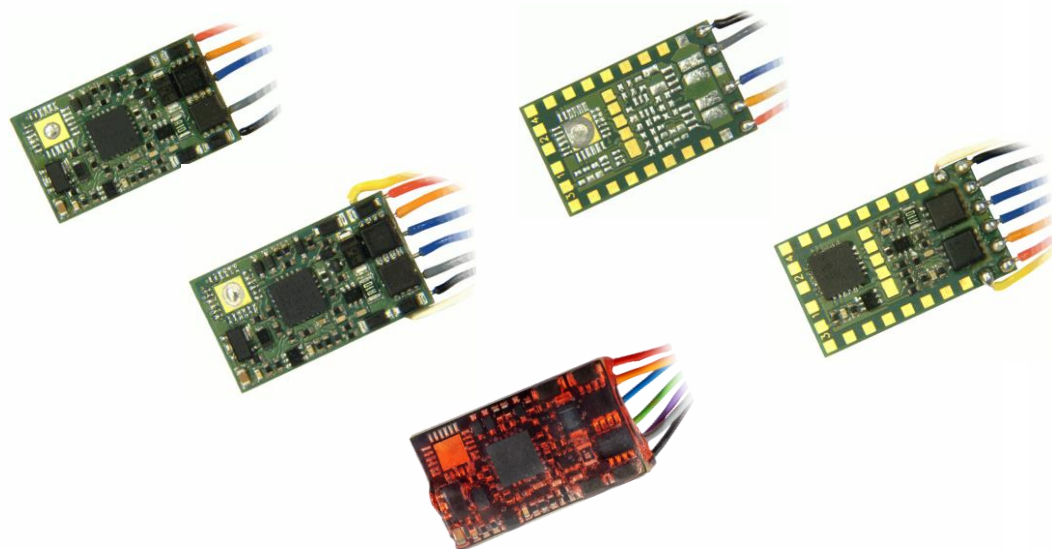


# OPERATING MANUAL



**ACCESSORY-DECODER**

**MX820E,  
MX820D,  
MX820V,  
MX820X,  
MX820Y,  
MX820Z**

## EDITIONS

Initial MX820 operating manual	---	2013 03 01
		2013 05 20
SW-Version 3	-	2013 08 20
		2013 09 25
		2013 11 11
		2013 12 17
		2014 04 06
SW-Version 4	-	2014 06 01
		2014 09 15
SW-Version 5	-	2020 08 01
		2024 03 07

SW-Version 2 contains (in addition to version 1): Synchronous update, decoder searching and address programming in "Operations Mode", only MX820X, -Y, -Z: „Light outputs“, control mode 0.  
SW-Version 3 also covers control mode 1 - 4.

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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. 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](http://www.zimo.at)!

## 1. Overview

The MX820 family of accessory decoders is used to operate and generate feedback from **turnouts, light and semaphore signals, magnetic uncouplers** and similar. The small size makes it possible to install them right in the roadbed or hide them inside turnout drives such as the ones manufactured by LGB. All currently available turnout and signal drive units are supported: double coil, DC motors, slow-motion switch machines and EPL motors.


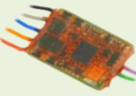


ZIMO accessory decoders operate according to the **standardized NMRA DCC data format**, which specifies that such decoders are accessed through accessory addresses.



**NOTE:** The MX820 accessory decoders DO NOT HAVE SERVO OUTPUTS, in contrast to the previous MX82 generation. The new MX821 decoder family will be especially designed for **servo drives**. A **separate operating manual** will be available later for the MX821 decoders.

19 x 11 x 2 mm (single-sided types like MX820E, MX820X) 19 x 11 x 3 mm

<b>MX820</b> Family	<b>Accessory Decoder</b> for turnout and semaphore signals ... with coil, motor or EPL-drives, for light signals and other lighting with LEDs or bulbs, BUT NOT for servo drives and NOT for multiplex signals.
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Various MX820 types:

<b>MX820E</b> 	For <b>1 turnout</b> with coil, motor or EPL drive or <b>2 signal bulbs (LEDs)</b> . Wires for track, common positive, coil or motor connections. Additional connections on solder pads... (Single sided, top side shown)
<b>MX820D</b> 	<b>Waterproof</b> version of MX820E (1 turnout). 7 Wires (Turnout and inputs for automatic switching).
<b>MX820V</b> 	For <b>2 turnouts</b> or <b>4 signal bulbs (LEDs)</b> . 7 connecting wires. (Double sided, top side shown)
<b>MX820X</b> 	MX820E (for 1 turnout), but with <b>8 additional light outputs</b> ("open collector", 100 mA each) for signal or other lights (LEDs, bulbs). (Single sided, bottom side shown)

<b>MX820Y</b> 	MX820V (for 2 turnouts), but with <b>16 additional light outputs</b> ("open collector", 100 mA each) for signal or other lights (LEDs, bulbs). (Double sided, bottom side shown)
<b>MX820Z</b> 	Version with <b>16 light outputs</b> but WITHOUT outputs for turnouts ("open collector", je 100 mA) for signal or other lights (LEDs, bulbs).

## 2. Technical Data, Schematics

Track voltage .....	12 - 40 V
Maximum output current in pulse mode (Turnouts) .....	3 A
Maximum output current in continuous operation (Lights, stall motors) .....	1 A
Switching times .....	0.1 to 25 sec
Idle current (Outputs deactivated) .....	max. 20 mA
Operating temperature .....	- 20 to 100 °C
Dimensions (L x W x H) .....	MX820E, MX820X (one-sided) 19 x 11 x 2 mm
	MX820D (sealed with shrink tube) 25 x 12 x 3 mm
	MX820V, MX820Y, MX820Z 19 x 11 x 3 mm

### OVERLOAD and THERMAL PROTECTION:

ZIMO decoders are designed with generous power reserves but equally important with protective components (current and heat sensors) to protect against short circuits, over-current and over-temperature. If an overload condition exists, the decoder initially turns its outputs off and then automatically tries to turn them back on (often resulting in flashing lights, as long as the problem is still present).

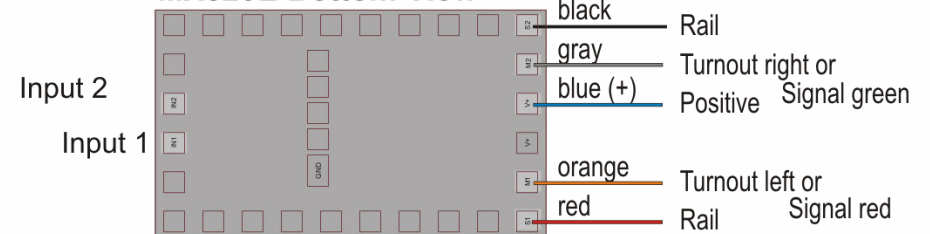
**Even though the decoder is well protected, do not assume it is indestructible! Please pay attention to the following:**

**Wrong 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 destruction of the decoder.

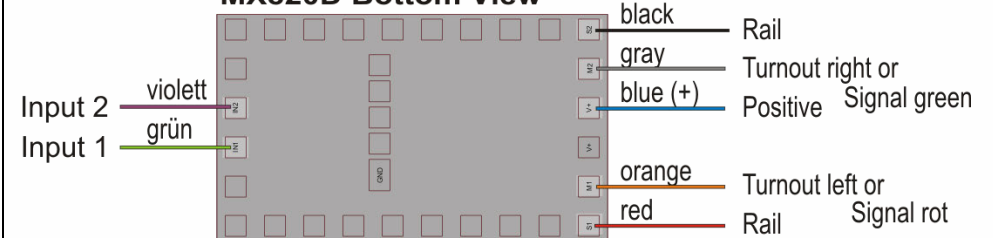
**Unfit or defective motors** (e.g. shorted windings or commutator) are not always recognized by their high current consumption, because these are often just short current spikes. Nevertheless, they can lead to decoder damage including damage to end stages due to long-term exposure.

The decoder end stages 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. The capacity and speed of these elements is limited and for this reason should the track voltage not be set higher than required by the vehicle. The available voltage range (24 V) offered by ZIMO command stations should only be utilized in exceptional cases.

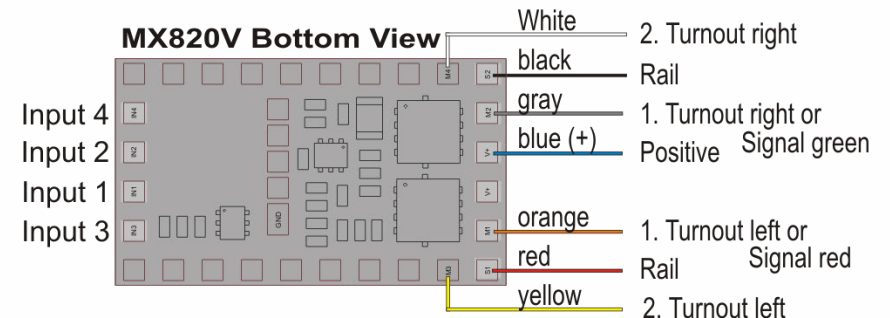
**MX820E Bottom View** (components only on this side)



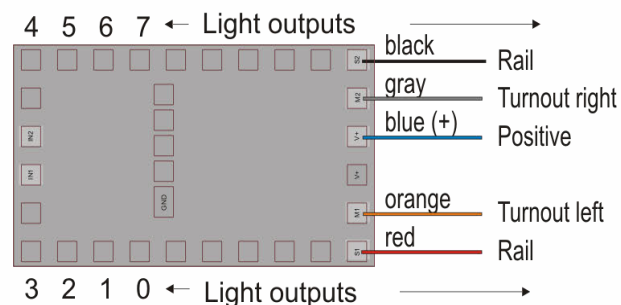
**MX820D Bottom View** (nur Unterseite ist bestückt)



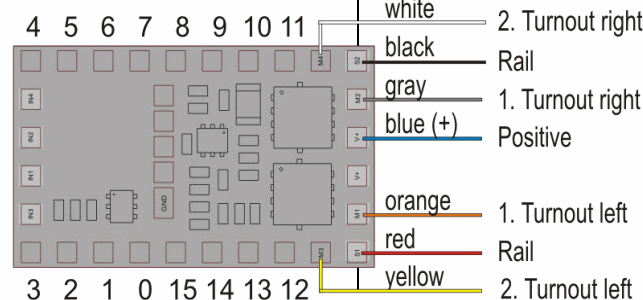
**MX820V Bottom View**



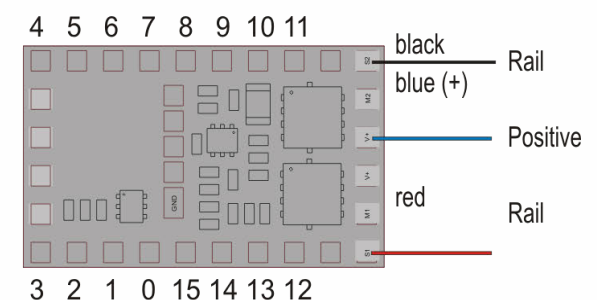
**MX820X Bottom View**



**MX820Y Bottom View**



**MX820Z Bottom View**



### 3. Address Programming

Accessory decoders MX820 require an **accessory address**, sometimes even several addresses. According to NMRA DCC standards, such addresses are intended for 4 turnouts (or 8 single functions). A **sub-address** identifies the 4 turnouts (or 8 single functions) that is, it determines with which **function key (F0, F1, F2, or F3)** the switch in question is operated with. The MX820V requires 2 sub-addresses because it can operate 2 turnouts.

#### 3.1. The "normal" addressing in "Service mode"

The address programming (= allocation of the desired accessory address 1...511) is normally done with **"service mode"** programming at the command station's programming track output, which allows only one decoder to be connected at the time!

*Prerequisite for programming an address in "service mode":*

*Accessory decoders (MX820, MX821 etc.) must be programmed with an address before they are installed in the layout and connected to the track or power bus (where several accessory decoders will be connected in parallel). This is the only way that each accessory decoder receives its unique address and can be operated individually.*

*Alternatively, the method "Search and program decoder in Operations Mode" can be used: in this case, the decoders can be connected to the layout even though they all have the same (delivery) address. The assignment of the final unique address takes place with a specific procedure (see below, chapter 1.2).*

**RECOMMENDATION:** Activate "Service mode" programming lock CV #611 = 1 to protect the decoder from accidental address reprogramming!

The exact programming procedure depends on the DCC system used. There may be a special address programming procedure available (i.e. ZIMO cabs automatically determine and enter the values for the two address CVs – see below) or the addressing is carried out using simple programming steps (the user must calculate and enter each CV value).

The address (1 – 511) divided in 6 low bits and 3 high bits is, depending on the system, either automatically or manually entered to the CVs #513 (6 bit) and #521 (3 bit); alternatively accessible with CV #1 and #9. Addresses 1 – 63 require only the 6 bits in CV #513 (or #1) while CV #513 (or #9) can remain at zero.

#### 3.2. Search and program decoder in "Operations mode"

This is a new feature of ZIMO accessory decoders introduced in 2013 (which includes the MX820, MX821...with software versions from September 2013). The predecessor (MX82) cannot use this method.

Searching for and programming an address in Operations Mode ("OP MODE") helps to eliminate a long-standing problem, namely the problem of multiple used addresses. Until now, decoders with the same address had to be removed from the layout or worse from switch motors (if mounted inside) and reprogrammed individually. This is typical when decoders get installed without first changing the delivery address 3 to a unique address, which happens quite frequently.

A frequently used remedy (by the competition) is the installation of a programming button on the decoder, but that would be contrary to the miniaturized construction of ZIMO decoders. Also once the decoder is installed in the layout, the access to the programming button is often difficult.

**"Decoder search" and "address programming" procedure:**

1. First, start a pseudo-programming (will not save the programmed value) **for the repeatedly used (undesired) address** (i.e. address #3) with

**CV #81 = 0**

followed immediately by an additional pseudo-programming with

**CV #81 = x,**

where the value x is supposed to be about two to three times as large as the approximate number of decoders with the repeatedly used address. All decoders now enter a special "address search mode" and calculate internal random numbers, which are of no interest to the user, but will be needed in the following steps to "separate" the decoders.

2. Now send (still on the undesired address) repeated

**switch commands with F0** ((#1 key on ZIMO cabs, other system may call this "turnout 1"),

that is, operate a turnout or similar back and forth, whereupon in the "ideal case" only one single decoder operates a turnout based on the calculated random number (namely when the number of switch commands coincides with the random number), which is an indication to the user that this decoder is now ready for CV programming.

In regards to "non-ideal" cases causing an **address conflict** (i.e. when multiple decoders switch simultaneously or, if you are not sure whether it was actually just one decoder): see below, switching commands by pressing F1, F2, etc.!

3. A new address can now be programmed into this decoder (still on the undesired address) with operations mode CV programming, in this order:

**ATTENTION** – only addresses from 1 to 63 can be used (but NOT 64 – 511),

"DCC experts" may first write the high bits into CV #521 and thereby use the full address range.

– use only CV #513 and #514 (NOT #1 and #33).

This is true at least for Zimo systems, if a third-party system cannot program the "high" CVs try #1 and #33 anyway.

**f i r s t:** if applicable, enter a new sub-address or sub-address combination in CV #545,  
**a n d t h e n:** the actual address in CV #513.

4. The decoder exits the special "address search" mode and is now fully functioning with the newly assigned address (according to the CV #513 programming).

Corrective measures in "non-ideal cases", especially with **"address conflicts"**,

when the procedure described above causes several decoders to respond instead of only one (because they generated the same random number), or when you are not sure if only one decoder responded, try the following:

**Switch commands with F1** (other systems may call this "Turnout 2") instead of F0 while in the undesired address: This repeats the same result as with F0 but won't advance to the next step in order for you to verify (look more closely!) whether one, two or even more turnouts are thrown.

**Switch commands with F2** (other systems may call this "Turnout 3"):

After address conflict, when two or more turnouts operated: Splits the previously generated random number into individual numbers by applying a 25 – 50% random decision.

**Switch commands with F3** (other systems may call this "Turnout 4"):

Go back one step in the switching sequence ("undo");

**ATTENTION:** only one step is possible.

Cancel the procedure is possible with **CV #81 = 0**.



**Example: 5 decoders with the same address 3 should receive their own unique address, 37 and 38 for the first two and sub-addresses for functions F2, F3 or F1:**

1. Activate accessory address 3 in OP MODE (Operations mode) programming and enter

**CV #81 = 0** followed by **CV #81 = 10**,

the 5 decoders now enter the "address search" mode and each calculates an internal random number between 1 - 10 (For example, the first MX820 may generate random number 5, the second MX820 the number 8 etc., which is not visible to the user).

2. Send repeated switch commands on address 3 with function key F0 (ZIMO cab: #1 key): after the fifth command sent (because of random number 5), the first MX820 reacts by operating the turnout connected to it. At the same time, the decoder enters a special sub-state within the address search mode where it can receive programming commands on the multiple-used address (#3), while all other decoders (in this case 4 decoder) are being locked in this regard.

3. A new address can now be programmed into this decoder (the cab is already active on address 3 and all that is needed is to switch to operations mode programming), by entering  
CV #545 = 32 for the new sub-addresses (F2 and F3) and  
CV #513 = 37 for the new main address.

4. This decoder now exits the "address search" mode and is ready for operation at address 37.

5. Continue to send switch commands with F0 on address 3; after the third time the next MX820 reacts (because of random number 8) and operates its turnout.

6. Program this second decoder with a new address, by entering

CV #545 = 01 for the new sub-address (F1 - for a MX820E for example) and  
CV #513 = 38 for the new main address.

7. and so on for decoders 3 - 5.

... in cases where **several decoders** reacted **simultaneously** (because they generated the same random number):

1. ...

2. ... after the fifth command sent: two MX820 react at the same time (conflict!) and throw their respective turnouts. The following steps (address-programming under point 3) can therefore NOT proceed as described above.

2a. Continue sending switch commands on address 3 but use the F2 key, which causes these two decoders to enter a special "address search" mode that separates them. With a certain probability, only one of the two decoders in conflict will respond and operate its turnout;

2b. but if not, continue pressing F2 on address 3 until only one decoder reacts by operating its turnout and entering into the special state where it can receive programming commands on the common address 3.

3. Enter a new address (as above with CV #545 ..., CV #513 ...),

3a. Continue sending switch commands on address 3 (with F2 key), change the address on single-responding decoders until all "collided" decoders have their unique address.

4. With this, the affected decoders will exit the "address search" mode (as above with F0 commands).

5. Continue sending switch commands on address 3, with F0 key...

6 ...

The procedure described above can be applied with any digital system but there could be differences in numbering and terminology.

The ZIMO devices (especially the MX32 cab) will of course support the "decoder search and address procedure in operations mode" with a user-friendly interface.

NOTE to the *Synchronous-Update*:

This has nothing to do with "addressing and programming" (that is, with this chapter), but has certain similarities: the installed decoder should be able to remain on the layout if a new software version is being uploaded. The decoder update device MXULF is connected in place of the DCC command station and sends the new software to all accessory decoders simultaneously.

See separate chapter "Software Update" in this manual!



### 3.3. Table of Configuration Variables (CVs)

The meaning of Configuration Variables (CVs) is in part standardized by the NMRA DCC RECOMMENDED PRACTICES, RP-9.2.2. There are however certain CVs 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 CVs; in this case use the table below.

**CV-Numbers:** the CVs for accessory decoders can either be programmed with high numbers from #513 on or low numbers from #1 and up. For this reason, you will find both high and low numbers in the CV column in the tables below.

The total number of CVs is divided into two blocks (one table for each block):

- 1) CVs for the **"main outputs"**, i.e. a single turnout (MX820E) or two turnouts (MX820V) or up to 4 signal light bulbs; these outputs and their CVs correspond largely to the MX82 decoder (predecessor of the MX820).
- 2) CVs for **"light outputs"**, which are only available with the types MX820X, ...Y or ...Z in addition to or instead of the "main outputs".

#### Main Output CVs:

CV	Designation	Range	Default	Description
#1, #9 or #513, #521	Decoder-Address ("Main address")  This address controls the "main outputs" (not the "light outputs") as well as the programming and reading of CVs.	1 - 511	3	The address for accessory decoders is 9 Bits long and spreads over two CVs. The calculation of these two CVs is performed automatically by the ZIMO cab; the user only sees the complete address as a value between 1 - 511.  A sub address (see CV #545) is also required to fully identify which accessory item is to be controlled and how,  <b>except:</b> it is an "extended" accessory format, which does not use sub addresses, but instead controls up to 32 signal aspects.
#2 or #514	Turnout actuated by switch inputs	0 - 15	0	Bit 0 = 0: Input 1 not active. = 1: Input 1 active for "1. turnout, left". Bit 1 = 0: Input 2 not active. = 1: Input 2 active for "1. turnout, right". Bit 2 = 0: Input 3 not active. = 1: Input 3 active for "2. turnout, left" (MX820V only). Bit 3 = 0: Input 4 not active. = 1: Input 4 active for "2. turnout, right" (MX820V only).

CV	Designation	Range	Default	Description
#33 or #545	Sub address(es) for outputs on top side of MX820E, MX820D and MX820V)  and for outputs on bottom side of MX820V	MX820E, MX820D: 0, 1, 2, 3, 9 operates turnout with  F0, F1, F2, or F3  MX820V,Y: 0 - 32, <i>Ones and tens digit must have different values!!</i> 99	MX820E, MX820D: 10 Turnout operates with F0  MX820V, ...X, ...Y: 10 F0 for turnout connected to top and F1 connected to bottom of decoder	Sub address(es); determine with which of the 4 function keys, F0 - F3, the accessories are actuated.  ONES DIGIT: for top outputs (this is already the total CV value required for the <b>MX820E</b> and <b>MX820D</b> ) = 0: F0 (#1 with Zimo cab) = 1: F1 (#2 with Zimo cab) = 2: F2 (#3 with Zimo cab) = 3: F3 (#4 with Zimo cab) = 9: Top outputs turned off.  TENS DIGIT: (for bottom outputs, <b>MX820V</b> only): = 0: F0 (#1 with Zimo cab) = 1: F1 (#2 with Zimo cab) = 2: F2 (#3 with Zimo cab) = 3: F3 (#4 with Zimo cab) = 9: bottom outputs turned off.  Example: = 21: F1 for "upper" turnout, F2 for "lower" turnout.
#3, #4, #5, #6 or  #515, #516, #517, #518	Switch time	0 - 255 corresponds to 0 - 25 sec	1 1 1 1	The time in 1/10 of a second the accessory is powered (max. 25 sec. Default value "2" = 0.2 sec).  The CV to be used here is the one that correlates with the sub-address in CV #545. For the <b>MX820E</b> : if CV #545 = 0: use CV #515; if CV #545 = 1: use CV #516; if CV #545 = 2: use CV #517; if CV #545 = 3: use CV #518.  For the <b>MX820V, MX820Y</b> : if CV #545 = 10: use CV #515 and #516; if CV #545 = 32: use CV #517 and #518; and so on.  Possible values for the relevant CV: = 0: permanently ON (mostly for signal light bulbs). = 1 - 255: Switch time settings between 0.1 sec and 25.5 sec (Default value "1" = 0.1 sec).
#7 or #519	Software Version	Read only		Displays currently loaded software version.
#8 or #520	Manufacturer ID and HARD RESET with CV #8 = 8	Read only  (except for Hard Reset CV #8 = 8)	145	The NMRA issues a specific number to each registered manufacturer; for ZIMO it is "145".  HARD RESET by means of „Pseudo-Programming“ (that is, the entered value is not saved) of CV #8 to the value "8":  All CVs will be set back to default, which is identical to values at time of delivery.

CV	Designation	Range	Default	Description
#28 or #540	RailCom Configuration	0 - 3	2	Use of RailCom channels (only active if RailCom is selected with CV #29, Bit 3): Bit 0 = 1: Channel 1 (broadcast channel) for "service request" Bit 1 = 1: Channel 2 for RailCom Data
#29 or #541	Decoder ID and RailCom ON/OFF	Only Bit 3 can be overwritten	136	Bit 7 = 1: this bit identifies the MX820 as an accessory decoder. The value of this bit cannot be changed. Bit 3 - RailCom ("bidirectional communication") = 0: OFF = 1: ON
#34 or #546	Light-up time (Only when "permanently ON" is selected, as in CV #515, 516, 517 or 518 = 0)	0 - 255 equals 0 - 25 sec	10	<u>Only valid for decoders "main outputs".</u> (separate CVs for LED outputs on supplementary address) For prototypical signal control: Time in tenth of a second until the bulb reaches full brightness. = 0: Full brightness reached instantly. = 10: Default - short light-up time (@ 1 sec)
#35 or #547	Light-up delay (Only when "Permanently ON" is selected, as in CV #515, 516, 517 or 518 = 0)	0 - 255 equals 0 - 25 sec	0	<u>Only valid for decoders "main outputs".</u> (separate CVs for LED outputs on supplementary address) For prototypical signal control: Time delay in tenth of a second until the bulb gets turned on. Together with CV #548 a smooth transition between lighting aspects can be achieved. = 0: No delay.
#36 or #548	Dimming time (Only when "Permanently ON" is selected, as in CV #515, 516, 517 or 518 = 0)	0 - 255 equals 0 - 25 sec	10	<u>Only valid for decoders "main outputs".</u> (separate CVs for LED outputs on supplementary address) For prototypical signal control: Time in tenth of a second until the bulb is completely dark. = 0: Full darkness reached instantly. = 10: Default - short dim time (@ 1 sec)
#37 or #549	Initial pulse (Does <b>not</b> apply when "permanently ON" is selected)	0 - 255 equals 0 - 25 sec	0	Time in 1/10 of a second until a switch command is sent after booting up the system or after connecting an MX820. Value= 0: No initial pulse.
#38 or #550	Reverse directions	0 - 3	0 normal	Bit 0 = 0: Top output normal. = 1: Reverse direction of top outputs. Bit 1 = 0: Bottom output (only MX82V) normal. = 1: Reverse direction of bottom outputs.
#39 or #551	Dimming (Only when "Permanently ON" is selected, as in CV #515, #516, #517, #518 = 0)	0 - 255	255 full brightness	The brightness of the bulb is controlled by pulse width modulation. If a light-up time is defined (CV #546), the brightness is reached after the light-up phase. = 0 - 255: Variable settings for all outputs. = 255: full brightness

CV	Designation	Range	Default	Description
#40 or #552	Operating mode: Paired function/ Single function and Position recognition (ON/OFF)	MX820E, MX820D: 0, 1, 4, 5  MX820V: 0 - 7	0 applies to MX820E, MX820D: 1 turnout  MX820V: 2 turnouts	"Paired function": One function key on the cab switches one turnout (right - left) or a two-aspect signal (red - green). "Single function": One function key on the cab turns one bulb or uncoupler ON or OFF. Bit 0 = 0: Top outputs for 1 paired function. = 1: Top outputs for 2 single functions. Bit 1 = 0: Bottom outputs for 1 paired function. = 1: Bottom outputs for 2 single functions. Bit 2 = 0: Position recognition OFF. = 1: Position recognition ON.
#43 or #555	Motor acceleration	0 - 255 equals 0 - 25 sec	0	Slow start-up phase for motor drives (not valid when permanently ON when CV #515 ...-> 0) Value divided by 10 equals time in seconds until the motor reaches its full speed (as per CV #557).
#44 or #556	Motor deceleration	0 - 255 equals 0 - 25 sec	0	Slow deceleration of motor drives (not valid when permanently ON when CV #515 ...-> 0) Value divided by 10 equals time in seconds until the motor comes to a full stop.
#45 or #557	Motor speed	0 - 255	255	Maximum speed the motor reaches after acceleration phase. = 0 - 254: reduced speed. = 255: highest possible speed.
#71 or #583	Operating mode for switch inputs (Assigned to switch inputs with CV #2)	0, 1, 2 / 0, 1, 2	0	The switch inputs for turnout control can be used in different ways, depending on application (i.e. forced switching by approaching train). Ones digit: for 1 <sup>st</sup> turnout; Tens digit: for 2 <sup>nd</sup> turnout (MX820V, -Y only) = 0 (as MX82): Turnout will be held in forced position as long as the input is active. = 1: the turnout is operated with a positive pulse; after that, the decoder is ready to accept all DCC commands. = 2: the turnout is also operated with a positive pulse but the turnout remains locked after that until confirmed by the operator by repeating the same switch command (= unlock) with the cab.
#72, #73 or #584, #585	Day/Night Address	1 - 511	0	Signals can be dimmed according to the settings in CV #586 (#74), by sending switch-over commands to the Day / Night address (Sub-address 0). The same address can be used on any number of decoders (collective dimming).
#74 or #586	Day/Night dimming	0 - 255	63	Dimming factor "at night". =63 (Default): for LEDs @ 50% of normal.
#75 or #587	Limiting successive forced switching's	0 - 9 / 0 - 9	0	Ones digit: max. number of forced switch pulses = 0: no limits (to the same position) Tens digit: Min. time between pulses (0.5 s ea.)

### CVs for "Light Outputs" (MX820X, -Y, -Z only):

**NOTE:** programming of these CVs is carried out on the decoder's "main address" (see CVs #513, #521 or #1, #9), just like the CVs for the main outputs. This also applies for decoders that don't have any main outputs (i.e. the type MX820Z).

Light outputs are controlled in two groups: 0 – 7 and 8 – 15 (the latter only in MX820Y and –Z versions) in one of 5 possible "control modes", which is set up individually for each group in CV #70 or #582 (ones and tens digits, see the following table).

Control mode = 0 (according to the ones or tens digit setting in CV #70 or #582):

The 8 light outputs of one group (0 – 7 or 8 – 15) form a signal light, for which the possible signal aspects are stored in the associated 8 CVs (#157 – #150 and #158 – #165). An MX820X decoder can control one signal with up to 8 bulbs and 8 aspects while an MX820Y or –Z can control two signals with 8 bulbs and 8 aspects each.

Typical signals are stored by default in some signal aspect CVs (#150, ...); see table. For schematics go to chapter 4 "Application examples".

The stored (programmed) signal aspects are turned ON/OFF with the corresponding accessory commands at the relevant supplementary address (as per CV #578 etc.), the respective sub address and left/right bits:

Command with sub address 0, left: signal aspect 1 (as per CV #150),  
Command with sub address 0, right: signal aspect 2 (as per CV #151),  
Command with sub address 1, left: signal aspect 3 (as per CV #152), and so on.

With a ZIMO cab MX31 or MX32 (also MX2 and MX21), activate the "supplementary address" of the MX820X, -Y or -Z (see the following table) and after setting the cab up for "8 single functions" and "momentary action" select the desired signal aspect with the 8 number keys.

Control mode = 1 (according to the ones or tens digit setting in CV #70 or #582):

The light outputs in this mode are arranged in pairs that is, 4 (MX820X) or 8 MX280Y/Z) red-green signals. The signal aspect CVs are not needed. Each signal is controlled with its "supplementary address" and sub address (same as a turnout).

Control mode = 2 (according to the ones or tens digit setting in CV #70 or #582):

Predefined signals or signal aspects are not available in this case. Each output is controlled with a corresponding accessory command at the relevant supplementary address (as per CV #578 etc.), the respective sub address and left/right bits.

With a ZIMO cab MX31 or MX32 (also MX2 and MX21), activate the "supplementary address" of the MX820X, -Y or -Z (see the following table) and after setting the cab up for "8 single functions" and "momentary action" switch the bulbs/LEDs ON/OFF individually with the 8 number keys.

Control mode = 3 (for the "extended" accessory command format as per NMRA):

32 signal aspects are available (in CVs #150 – #213) for the 8 light outputs of each group (0 – 7 or 8 – 15). They are controlled with the "extended" accessory commands.

Control mode = 4 → NOT part of the following table. See description AFTER this table!

THIS table contains the control modes 0 and 3;  
mode 1 and 2 do not require any special CVs and for mode 4 there is a dedicated table further down.

CV	Designation	Range	Default	Description
#66, #67 or #578, #579	Supplementary address for light outputs 0 – 7 only for MX820X, MX820Y, MX830Z	1 – 511	4  (a new MX820X, Y or Z therefore comes with main address 3 and supplementary address 4 and 5.	This supplementary address (9-bits long) is spread over two CVs; the ZIMO cab calculates the necessary values. The user sees the address as one number between 1 and 511.  The 8 light outputs (0 – 7) are switched with this address (each bit = one output)  <b>Or:</b> If it is an "extended" address, then there are no sub-addresses, but the main address controls 8 signal bulbs/LEDs or 32 signal aspects.
#68, #69 or #580, #581	Supplementary address for light outputs 8 – 15 only for MX820Y, MX830Z	1 – 511	5	This supplementary address (9-bits long) is spread over two CVs; the ZIMO cab calculates the necessary values. The user sees the address as one number between 1 and 511.  The 8 light outputs (8 – 15) are switched with this address (each bit = one output)  <b>Or:</b> If it is an "extended" address, then there are no sub-addresses, but the main address controls 8 signal bulbs/LEDs or 32 signal aspects.
#70 or #582	Light output control mode	0 – 3 / 0 – 3, (44)	0	Ones digit 0 – 3: Controls light outputs 0 – 7, (MX820X, -Y, -Z)  Tens digit 0 – 3: Controls light outputs 8 – 15, (MX820Y, -Z only)  Mode 4 controls either all 16 outputs (i.e. ones and tens digit = 4) or none (therefore settings other than 44, such as 04, 40 or 42 ... are not valid).
#128 ... ... #143 or #640 ... ... #655	Brightness settings for light outputs 0 – 15	0 – 255	255 (full)	To compensate for the different efficiency of the connected lights (LEDs or bulbs), mostly color-dependent efficiency, the intensity can be reduced here for each light output (PWM – pulse width modulation).  CV #128: Light output 0 #129: Light output 1 and so forth.
#144 or #656	Programming and Update Lock  Note: the programming lock does not lock CV #144 and cancelling the programming lock is therefore possible.	Bits 6, 7	0	= 0: Programming or updating is not locked Bit 6 = 1: the decoder cannot be programmed in "Service mode" as a protection against unintentional programming or deletion. Note: Programming in "Operations Mode" is not locked because this is done during layout operation and only a specific address is affected. Bit 7 = 1: Locks software updates via MXDECUP, MX31ZL or other devices.
#145, #146 or	LED / Bulb selection for	0 – 255	0	If a signal contains bulbs instead of the now usual LEDs, the appropriate bits should be set to adapt the brightness according to the CVs #128 – #143.



CV	Designation	Range	Default	Description
#657, #658	Light outputs 0 - 15			Bit value = 0: LED = 1: Light bulbs
#147 or #659	Light-up time	0 - 255 equals 0 - 25 sec	4	<u>Only valid for the decoder's "light outputs".</u> (controlled by the supplementary addresses) For prototypical signal control: Time in tenth of a second until the bulb reaches full brightness. = 0: Full brightness reached instantly. = 4: Default - short light-up time (@ 0.4 sec)
#148 or #660	Light-up delay	0 - 255 equals 0 - 25 sec	1	<u>Only valid for the decoders "light outputs".</u> (controlled by the supplementary addresses) For prototypical signal control: Time delay in tenth of a second until the bulb gets turned on. Together with CV #576 a harmonious transition between lighting aspects can be achieved. = 0: No delay. = 1: Short light-up delay (0.1 sec).
#149 or #661	Dimming time	0 - 255 equals 0 - 25 sec	4	<u>Only valid for the decoder's "light outputs".</u> (controlled by the supplementary addresses) Time in tenth of a second until the bulb is completely dark. = 0: Full darkness reached instantly. = 4: Default - short dim time (@ 0.4 sec)
#150 ... ... #157 or #662... ... #669	Signal aspects No. 1 - 8 for light outputs 0 - 7	0 - 255		CV #150 = 01000100 = 68 (HP00/Stop) CV #151 = 0000010 = 2 (HP1/Go) CV #152 = 0010010 = 34 HP2/Slow) CV #153 = 0101000 = 80 (SH1/Shun.)  In control mode 0 or 3 (as per CV #70): Each CV stores a possible signal aspect, that is the on / off state of the 8 light outputs (one bit for each output), which can be activated with a corresponding accessory command. ← This is a typical main signal (default setting) with 4 possible aspects using 5 light outputs: 0 -, 1 green, 2 red, 3 -, 4 white, 5 yellow, 6 red, 7 -
#158... ... #165 or #670 ... ... #667	Signal aspects No. 1 - 8 for light outputs 8 - 15	0 - 255		CV #159 = 00000101 = 5 (VR0/Stop) CV #160 = 0001010 = 10 (VR1/Go) CV #161 = 0000110 = 34 VR2/Slow) CV #162 = 0000000 = 0 (dark)  In control mode 0 or 3: Each CV stores a possible signal aspect, that is the on / off state of the 8 light outputs (one bit for each output), which can be activated with a corresponding accessory command. ← This is a typical main signal (default setting) with 4 possible aspects using 4 light outputs: 0 yellow, 1 green, 2 yellow2, 3 green2, 4 -, 5 -, 6 -, 7 -

CV	Designation	Range	Default	Description
#166... ... #173 or #668 ... ... #675	Signal aspects No. 9 -16 for light outputs 0 - 7	0 - 255	0	In control mode 0: not used In control mode 3: Each CV stores a possible signal aspect, that is the on / off state of the 8 light outputs (one bit for each output), which can be activated with an "extended" accessory command.
#174... ... #181 or #676 ... ... #683	Signal aspects No. 9 -16 for light outputs 8 - 15	0 - 255	0	In control mode 0: not used In control mode 3: Each CV stores a possible signal aspect, that is the on / off state of the 8 light outputs (one bit for each output), which can be activated with an "extended" accessory command.
#182... ... #189 or #684 ... ... #691	Signal aspects No. 17 -24 for light outputs 0 - 7	0 - 255	0	In control mode 0: not used In control mode 3: Each CV stores a possible signal aspect, that is the on / off state of the 8 light outputs (one bit for each output), which can be activated with an "extended" accessory command.
#190... ... #197 or #692 ... ... #699	Signal aspects No. 17 -24 for light outputs 8 - 15	0 - 255	0	In control mode 0: not used In control mode 3: Each CV stores a possible signal aspect, that is the on / off state of the 8 light outputs (one bit for each output), which can be activated with an "extended" accessory command.
#198... ... #205 or #700 ... ... #707	Signal aspects No. 25 -32 for light outputs 0 - 7	0 - 255	0	In control mode 0: not used In control mode 3: Each CV stores a possible signal aspect, that is the on / off state of the 8 light outputs (one bit for each output), which can be activated with an "extended" accessory command.
#206... ... #213 or #708 ... ... #715	Signal aspects No. 25 -32 for light outputs 8 - 15	0 - 255	0	In control mode 0: not used In control mode 3: Each CV stores a possible signal aspect, that is the on / off state of the 8 light outputs (one bit for each output), which can be activated with an "extended" accessory command.

Control mode = 4:

Only in this mode (for which the NMRA or VHDM standards have nothing similar, it is a ZIMO specialty) are the available light outputs utilized particularly well, by defining how many light outputs are used for each signal. Depending on the requirements, it is possible to define 2 to 8 signals, each with 1 – 8 light outputs ("1" defines a single light) and up to 8 signal aspects.

The configuration is not address-oriented (as usual), but rather object-oriented: a quota of 12 CVs is available for each signal object, see the following table. There, each signal is defined for the following: the accessory address for THIS signal (the decoder can in this way have up to 8 "object addresses"), the number of light outputs, a possible dependence to a distant signal, and the number of up to 8 signal aspects.

Signals defined that way are controlled with switch commands ("left", "right") to the four sub-addresses of their object address (and therefore up to 8 signal aspects).

*THIS table deals exclusively with the control mode 4 (CV #70 = 44):*

CV	Designation	Range	Default	Description
(#578, #579)	(Supplementary address for light outputs)	(1 – 511)	( 4 )	These supplementary addresses are NOT RELEVANT for control mode 4! (Only used with control mode 0, 1, 2 or 3) "Object addresses" apply in control mode 4.
( #580, #581)	(Supplementary address for light outputs)	(1 – 511)	( 5 )	
#70 Or #582	Light output control mode	(0-3 / 0-3) <b>44</b>	( 0 )	THIS table deals exclusively with the <b>control mode 4</b> . It <b>always applies to BOTH groups</b> of light outputs (i.e. 0 – 15), therefore "44"; a combination with other modes is not allowed.
#128 ... #143 or #640 ... #655	Brightness settings for light outputs 0 – 15	0 – 255	255	For CV description see previous table! Default setting: full brightness (255).
#147 or #659	Light-up time	0 – 255 equals 0 – 25 sec	4	<u>Only valid for the decoder's "light outputs"</u> . (That are controlled by the "supplementary" or "object" addresses) For CV description see previous table!
#148 or #660	Light-up delay	0 – 255 equals 0 – 25 sec	1	<u>Only valid for the decoder's "light outputs"</u> . (That are controlled by the "supplementary" or "object" addresses) For CV description see previous table!
#149 or #661	Dimming time	0 – 255 equals 0 – 25 sec	4	<u>Only valid for the decoder's "light outputs"</u> . (That are controlled by the "supplementary" or "object" addresses) For CV description see previous table!
#150... ... #151 or #662 ... ... #663	Object address for Signal 1 ("first CV": #150, "second CV": #151) This address is valid for this signal object.	0 – 511		The object address is 9 bits long and spread over the two CVs (same coding scheme as all accessory addresses, i.e. a main address in CVs #1 and #9) that is, the lowest 6 bits in the first CV and 3 bits in the second CV. If the first signal aspect (No.1) should not be driven by the sub-address 0 (because several signals are on

CV	Designation	Range	Default	Description															
				<p>the same object address), the correct sub-address must be specified for controlling the first signal aspect in Bit 7 and 6 of the second CV as follows:</p> <table><tr><th>Sub-address</th><th>Bit 7</th><th>Bit 6</th></tr><tr><td>0</td><td>0</td><td>0</td></tr><tr><td>1</td><td>0</td><td>1</td></tr><tr><td>2</td><td>1</td><td>0</td></tr><tr><td>3</td><td>1</td><td>1</td></tr></table>	Sub-address	Bit 7	Bit 6	0	0	0	1	0	1	2	1	0	3	1	1
Sub-address	Bit 7	Bit 6																	
0	0	0																	
1	0	1																	
2	1	0																	
3	1	1																	
#152 or #664	Bit mask for signal 1	0 - 255		<p>The bit mask stores the bits valid for the signal aspects of this signal: Bit = "1": the corresponding light output (0-7) is used in the signal aspect. The number of "1-bits" defines those light outputs that are used by this signal aspect. The remaining light outputs can be used by another signal, if necessary.</p>															
#153 or #665	Number of signal aspects for signal 1 and distant signal dependence		0	<p>Ones digit: Number of signal aspects = 1: this signal contains a single light = 2 - 8: up to 8 aspects possible Tens digit: = 0: this signal is not a distant signal = 1 - 8: this signal is a distant signal mounted on the mast of the main signal 1- 8 and shall remain dark if main signal shows "Stop" ("Stop" is always the first aspect!)</p>															
#154... ... #161 or #666 ... ... #673	Signal aspects Nr. 1 - 8 for signal 1		0	<p>Each CV contains a possible signal aspect, that is the On / Off state of the 8 light outputs (one bit for each output, as provided in the above bit mask), which can be activated by an appropriate accessory command. The signal aspect <u>No.1</u> should ALWAYS show "<u>Stop</u>"</p>															
#162... ... #173 or #674 ... ... #685	Object address, bit mask, number/distant signal and signal aspects for signal 2		0	<p>These 12 CVs contain the information for the Signal 2 (in control mode 4) in the same sequence as described above for Signal 1</p>															
#174 ... or #686 ... #186 ... or #698 ... #198 ... or #710 ... #210 ... or #722 ... #222 ... or #734 ...	for signal aspect 3 for signal aspect 4 for signal aspect 5 for signal aspect 6 for signal aspect 7			<p>12 CVs for each of the signals 3, 4, 5... (Starting with the specified address) <b>ATTENTION:</b> For the signals 5, 6, 7 and 8, the bit mask for light outputs 8 - 15 is valid (not for 0-7)</p>															
#234 ... ... #245 or #746 ... ... #757	Object address, bit mask, number/distant signal and signal aspects for signal 8		0	<p>These 12 CVs contain the information for the Signal 8 (in control mode 4) in the same sequence as described above for Signal 1</p>															

### 3.4. Flashing:

The following CVs can be used to define whether and which stop signals should flash.

CV	Designation		Description
#47	Flashing speed		Upper 4 Bit=dimming time on 0 to 15 = 0,1 to 1,6s, lower 4 Bit= time off 0 to 15 = 0,1 to 1,6 seconds so #47 = (dimming time on [0,1s] - 1) * 16 + (time off [0,1s] - 1)
#257 to #288	Flashing mask		Defines which outputs should flash. #257=output 0-7 Signal aspect 1 or mode 1, 2 #258=output 8-15 Signal aspect 1 or mode 1, 2  #259=output 0-7 Signal aspect 2 #260=output 8-15 Signal aspect 2 ... #287=output 0-7 Signal aspect 16 #288=output 8-15 Signal aspect 16

In control modes 1 and 2, there are no signal aspects, so only CVs #257 and #258 are needed there.

In control modes 0 and 4, there are up to 8 signal aspects, so CVs #257 to #272 are required there.

In control mode 3, there are up to 32 signal aspects, but only the first 16 signal aspects support flashing outputs.

General:

Bits 7 to 0 = Outputs 7 to 0 or outputs 15 to 8

Bit value 0=Output permanently on, 1=Output flashing on

## 4. Application notes and examples

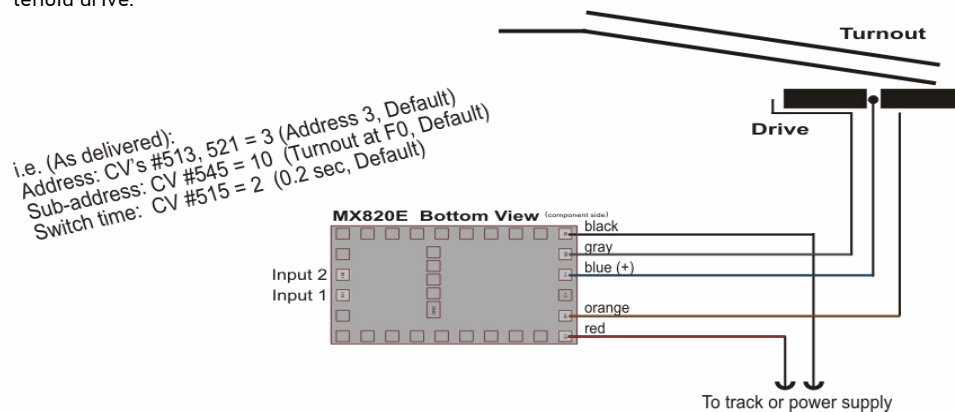
### TURNOUTS OR SEMAPHORE SIGNALS ... (paired functions)

MX820E, MX820D, MX820V, MX820X, MX820Y (on "main outputs" not "light outputs")

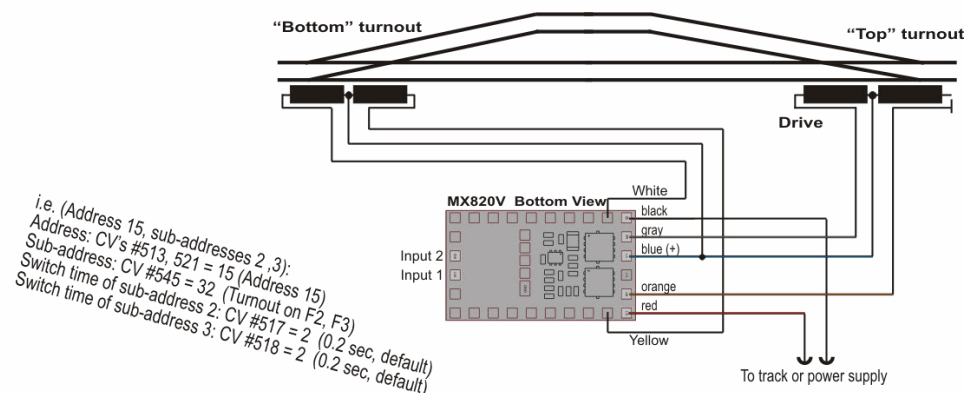
The CVs **as delivered** (or after a hard reset with CV #8 = 8) are set for **normal operation of one** (solenoid operated) **turnout** (or two in case of an MX820V), see drawing.

That means: the connected turnout (on orange-gray-blue wires) is operational on address 3 with function key F0 (#1 key on a ZIMO cab). The switch time is set by default to 0.2 seconds, which is suitable for the commonly found double-solenoid or EPL drives.

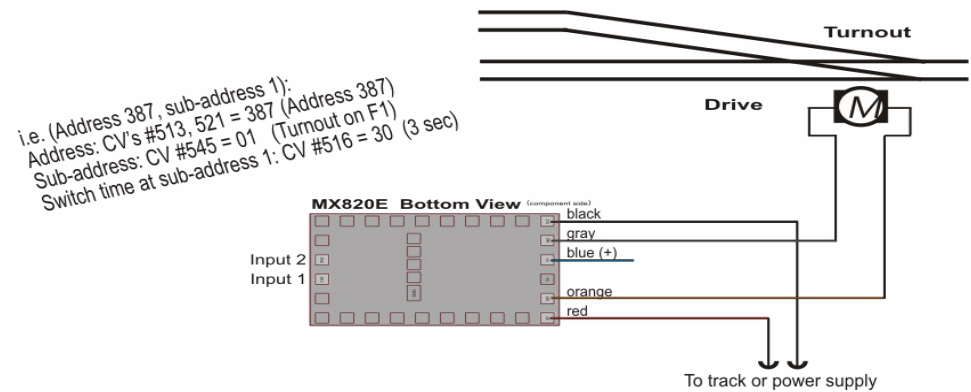
Note regarding **EPL drives** (LGB turnouts and similar): these are connected the same way as a turnout equipped with a DC motor (see further down), but require a short switch pulse like a solenoid drive.



For a **MX820V** or **MX820Y** (decoders for 2 turnouts): the second turnout connected to the yellow-white-blue wires operates also on address 3 but with function key F1 (#2 key on ZIMO cab).



For MX820s used with **motorized turnouts** (instead of solenoid or EPL drives), the switch time (in CV #515, #516, #517 or #518, according to the sub-address 0, 1, 2 or 3 in CV #545) must be adjusted accordingly. For example: If the switch time is to be 3 seconds for sub-address 0 (#545 = 0), set CV #515 = 30. If required, the motor's characteristics' (starts, stops) can be modified with the help of CVs #555 to #557, see CV table in chapter 3.



The switch time CV #515 is only appropriate for the sub address 0 (CV # 545 = 0) and therefore the switch is operated with function key F0.

On the other hand, if the sub-address 1 (CV #545 = 1) is used, use CV #516 for the switch time setting, for sub-address CV #545 = 2 use CV #517 and if CV #545 = 3 use the CV #518.

The purpose for this "peculiar" classification is the fail-safe programming, when multiple **accessory decoders** are used at the same address but with different sub-addresses: This gives each decoder its "own" CV for switch time settings (i.e. one decoder uses #515, the next #516 etc.), which prevents accidental programming of the wrong decoder.

MX820V for two motorized turnouts: *both* associated switch time CVs must be set, i.e. if CV #545 = 10 (= sub-addresses 0 and 1), the CVs #515 and #516 must both be set to 30 (for 3 second switch times).

**Several MX820 or MX820V** may be set to a **common address** (CVs #513, #521), each with different sub-addresses, so that all 4 functions F0 – F3 can be utilized. Here an example with 3 decoders sharing address 25:

First decoder – a MX820E: Address CV #513, #521 = 25, sub-address CV #545 = 0 (F0 key)

Second decoder – a MX820V: Address CV #513, #521 = 25, sub-address CV #545 = 21 (F1/F2 key)

Third decoder – a MX820E: Address CV #513, #521 = 25, sub-address CV #545 = 3 (F3 key)

The switch times are set as follows (for this example: 2 sec for motorized turnouts):

First decoder – a MX820E: Switch time CV #515 = 20

Second decoder – a MX820V: Switch time CV #516 = 20 and CV #517 = 20

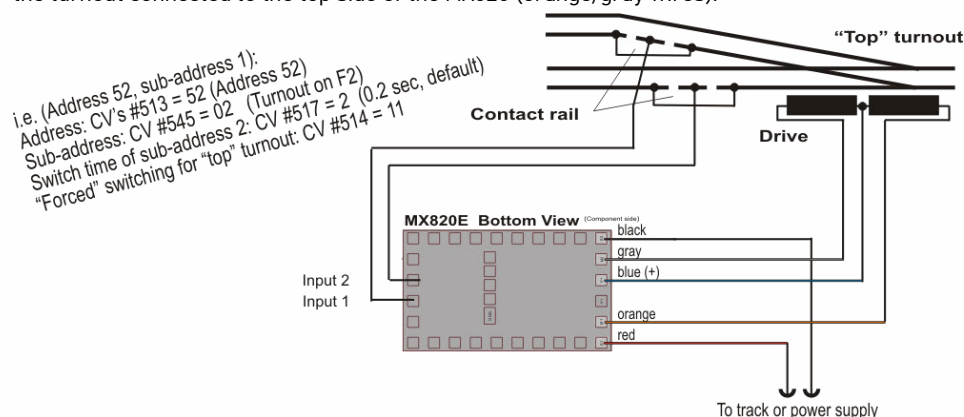
Third decoder – a MX820E: Switch time CV #518 = 20

**Forced turnout switching using the MX820 switch inputs:**

MX820E, MX820D, MX820V, MX820X, MX820Y

The switch inputs of the MX820 can be used to automatically switch the turnout to the appropriate position using switch contacts (or reed switches etc.) to prevent a short circuit situation by an approaching train. They can also be used to operate the turnout with facia mounted push-button switches.

The inputs have to be activated first with CV #514, which uses a dedicated Bit for each input (see CV table). For example: CV #515 = 3 activates input 1 and 2, which are assigned automatically to the turnout connected to the top side of the MX820 (orange/gray wires).



**NOTE:** For the switch inputs to work, they must be “pulled up” towards a positive voltage (from 5 V to track voltage), not to ground! In contrast to the predecessor MX82, the MX820 no longer requires pull-down resistors or other suppression capacitors.

**LIGHT SIGNALS****(Paired or single functions)**

MX820E, MX820D, MX820V, MX820X, MX820Y (connected to “main outputs”, not “light outputs”)

**Red-green signal** operation: is very similar to operating turnouts (see above) because there are also just two positions (**paired function**). For signals though, the switch time must be set to “continuous” that is, CV #515 = 0 for a signal on sub address 0, CV #516 = 0 for sub address 1, CV #517 = 0 for sub address 2 and CV #518 = 0 for sub address 3.

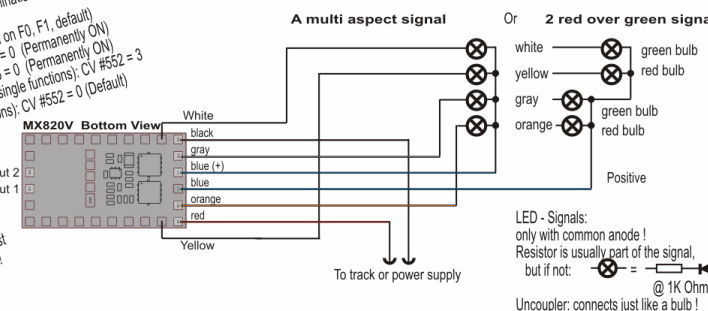
If prototypical **slow illumination and dimming** is desired use CVs #546 – #548 for setting the dimming time (i.e. value 20 = 2 seconds). The settings are equally valid for all bulbs connected to the MX820 regardless to which sub address they belong to.

**Multi-aspect signal** operation: multi-aspect signals have more than two bulbs and can therefore not be handled by a paired function. Each bulb of the signal must be controlled as a **single function**. This application is only useful with the MX820V (but not with the MX820E or MX820D), since more than 2 bulbs are required to be considered multi-aspect.

The decoder is set to single function with Bit 0 and 1 in CV #552 (CV #552 = 3).

i.e. (Address 20, sub-addresses 0, 1, slow illumination and dimming of @ 2 sec):  
Address: CV's #513 = 20 (Address 20)  
Sub-addresses: CV #545 = 10 (2 bulbs each on F0, F1, default)  
Switched time of sub-address 0: CV #515 = 0 (Permanently ON)  
Switched time of sub-address 1: CV #516 = 0 (Permanently ON)  
For multi-aspect signal (all outputs set as single functions): CV #552 = 3  
For red over green signal (paired functions): CV #552 = 0 (Default)  
For red over green signal: CV #546 = 20  
Light-up time: CV #547 = 20  
Light-up delay: CV #547 = 20  
Dimming time: CV #548 = 20

**NOTE:** In case of multi aspect signals: the function keys on the cab must also be set for “single function”!

**Solenoid operated UNCOUPLER****(Single function)**

Uncouplers are handled as single functions, similar to multi-aspect light bulbs. Program CV #552 = 1 if two uncouplers are connected to a MX820E or CV #552 = 3 if four uncouplers are connected to a MX820V.

**Mixed applications are also possible with the MX820V; for example: turnouts connected to the top side and uncouplers to the bottom side of the MX820V.**



## Connecting LIGHT SIGNALS to the LIGHT OUTPUTS of the types MX820X, MX820Y, MX820Z

**MX820X, MX820Y, MX820Z (connected to the "light outputs", Control mode = 0)**

The signals in the following example are wired according to the default signal aspects in the CVs #159 - #161 (see CV-Table for control mode 0)

Example: Connecting a main signal  
(matching the default signal aspect in CV #150...153 with  
control mode = 0):

Light output 0 is not used  
Light output 1 to green LED  
Light output 2 to (first) red LED  
Light output 3 not used  
Light output 4 to white LEDs (Shunting signal)  
Light output 5 to yellow LED  
Light output 6 to (second) red LED

Signal aspects in the CVs #150 ... 157:

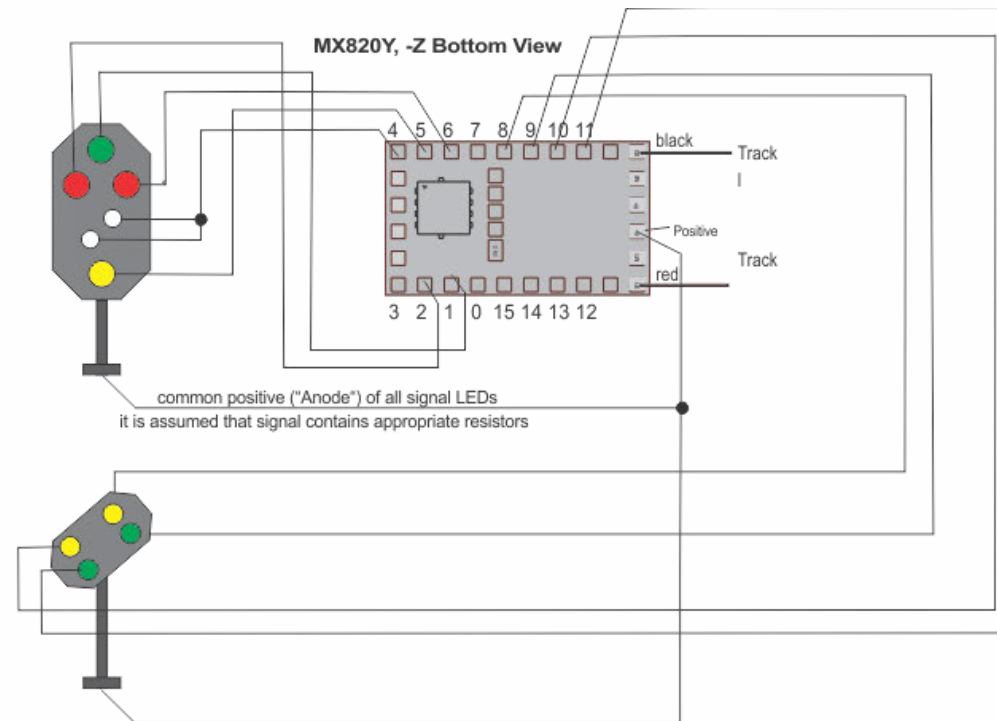
Hp00 = 01000100 = 68 (= both red LEDs ON)  
Hp1 = 00000010 = 2 (= green LED)  
Hp2 = 00100010 = 34 (= green and yellow LEDs)  
SH1 = 01010000 = 80 (= one red and white LED)

Example: Connecting a distant signal to the same decoder  
(matching the default signal aspects in CV #159...161 with  
control mode = 0):

Light output 8 to top yellow light  
Light output 9 to top green light  
Light output 10 to bottom yellow light  
Light output 11 to bottom green light

Signal aspects in the CVs #158...161:

VR0 (Stop) = 00000101 = 5 (= both yellow LEDs)  
VR1 (Clear) = 00001010 = 10 (= both green LEDs)  
VR2 (Approach) = 00001100 = 12 (= green and yellow LED)  
Dark = 00000000 = 0



## SIGNAL APPLICATION for, MX820X, -Y, -Z

MX820X, MX820Y, MX820Z (at the "light outputs", Control mode = 4)

### Example 1:

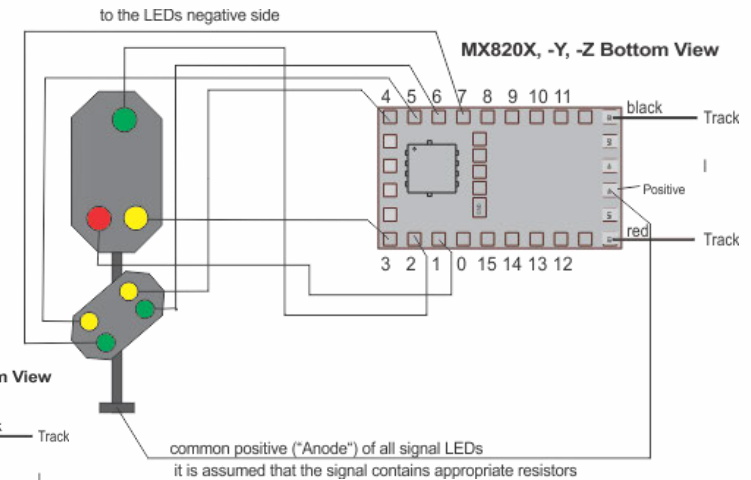
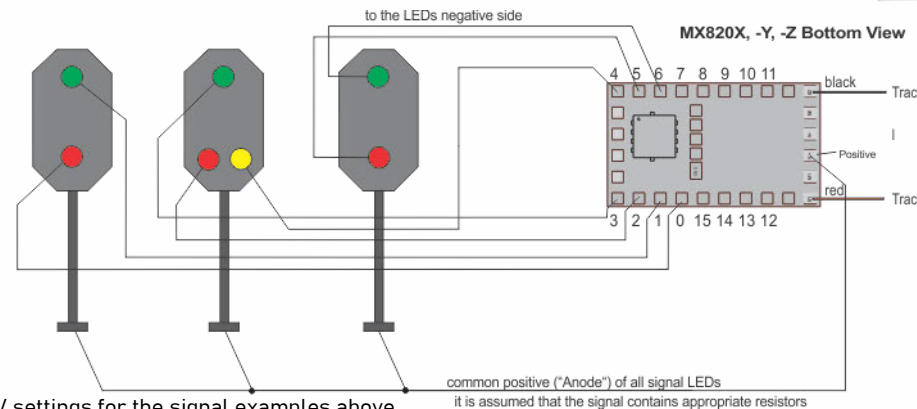
Typical connection of a main signal AND a distant signal mounted to the main signal (Control mode = 4):

Light-Output 0, not used  
 Light-Output 1 main signal, red LED  
 Light-Output 2 main signal, green LED  
 Light-Output 3 main signal, yellow LED  
 Light-Output 4 distant signal, top yellow LED  
 Light-Output 5 distant signal, bottom yellow LED  
 Light-Output 6 distant signal, top green LED  
 Light-Output 7 distant signal, bottom green LED

### Example 2:

Typical connection of a block signal AND entry signal AND additional block signal (Control mode = 4):

Light-Output 0, first block signal, red  
 Light-Output 1, first block signal, green  
 Light-Output 2, entry signal, red  
 Light-Output 3, entry signal, green  
 Light-Output 4, entry signal, yellow  
 Light-Output 5, second block signal, red  
 Light-Output 6, second block signal, green  
 Light-Output 7, not used



The following tables show the necessary CV settings for the signal examples above.  
 For all examples:

CV-Numbers	CV-Function	Value	Explanation
CV #66 - #69	Supplementary addresses	--- (Not relevant for Mode 44)	These addresses are not used in Mode 4, instead all signal objects have their own addresses
CV #70	Mode	44 (decimal)	Mode 4 must always be activated for both groups of outputs
CV #150 - #161, CV #162 - #173, CV #174 - #185, CV #186 - #197, CV #198 - #209, CV #210 - #221, CV #222 - #233, CV #234 - #245	Signal objects	0 (decimal), when object is not needed	The CVs of unused signal objects should be set to '0' (this is also the default value after a CV reset except for signal object 1), to prevent an unintended activation and unexpected behavior due to possible overlaps with other signal objects. This can also be achieved by setting the CV for the number of signal aspects for each unused signal to zero (CV #153, #165, #177, #189, #201, #213, #225, #237 = 0). The signal objects are thus effectively disabled.

### Example 1: DB Entry signal (Hp 0 = stop, Hp 1 = clear, Hp 2 = approach) and distant signal (Vr 0 = expect stop, Vr 1 = expect clear, Vr 2 = expect approach)

Allocation: Entry signal 3 outputs -> Output 1 - 3, Distant signal 4 outputs -> Output 4 - 7

Assignment: 0 = free, 1 = Main signal red, 2 = Main signal green, 3 = Main signal yellow, 4 = Distant signal yellow 1 (top), 5 = Distant signal yellow 2 (bottom), 6 = Distant signal green 1 (top), 7 = Distant signal green 2 (bottom) Controlled with: Main signal with address 5, Distant signal with address 100

### Example 2: Two block signals (Hp 0/Hp 1 = stop/clear) and one DB Entry signal (Hp 0 = stop, Hp 1 = clear, Hp 2 = approach)

Allocation: First block signal 2 outputs -> Output 0.1, Entry signal 3 outputs -> Output 2..4, Second block signal 2 outputs -> Output 5..6

Assignment: 0 = First block signal red, 1 = First block signal green, 2 = Entry signal red, 3 = Entry signal green, 4 = Entry signal yellow, 5 = Second block signal red, 6 = Second block signal green, 7 = free Controlled with: First block signal with address 4 (Sub address 0 = F0), Entry signal with address 20, second block signal with address 4 (Sub address 1 = F1)

**Example 1: DB Entry signal (Hp 0 = stop, Hp 1 = clear, Hp 2 = approach) and distant signal (Vr 0 = expect stop, Vr 1 = expect clear, Vr 2 = expect approach)**

CV-Number	CV-Function	Value	Explanation
<b>Main signal:</b>			
CV #150	Signal object 1, Address Part 1	5 (decimal)	Address 5 (decimal) = binary 0 0000 0101 (9 Bit address range), therefore part 1 = lowest 6 Bits = 000101 binary = 5 decimal
CV #151	Signal object 1, Address Part 2	0 (decimal)	Address 5 (decimal) = binary 0 0000 0101 (9 Bit address range), therefore part 2 = highest 3 Bits = 000 binary = 0 decimal
CV #152	Bit mask for signal 1	14 (decimal)	Outputs 1 - 3 are used for Signal 1 = Bits 1..3 set = binary 00001110 = 14 decimal
CV #153	Number of signal aspects for Signal 1 and distant signal dependence	3 (decimal)	Ones digit: Number of signal aspects used for this signal = 3, tens digit: distance signal dependence = none = 0 (This signal is always displayed and never dimmed in dependence of another)
CV #154	Signal aspect 1 for signal 1	2 (decimal)	The first signal aspect of any main signal must always be STOP. Hp 0 (Stop) = red, therefore only output 1 active: binary 00000010 = 2 decimal
CV #155	Signal aspect 2 for signal 1	4 (decimal)	Hp 1 (Clear) = green, therefore only output 2 active: binary 00000100 = 4 decimal
CV #156	Signal aspect 3 for signal 1	12 (decimal)	Hp 2 (Approach) = green + yellow, therefore output 2 + 3 active: binary 00001100 = 12 decimal
CV #157 – CV #161	Signal aspects 4 ... 8 for signal 1	--- (content is not relevant)	
<b>Vorsignal:</b>			
CV #162	Signal object 2 Address Part 1	36 (decimal)	Address 100 (decimal) = binary 0 0110 0100 (9 Bit address range), therefore part 1 = lowest 6 Bits = 100100 binary = 36 decimal
CV #163	Signal object 2 Address Part 2	1 (decimal)	Address 100 (decimal) = binary 0 0110 0100 (9 Bit address range), therefore part 2 = highest 3 Bits = 001 binary = 1 decimal
CV #164	Bit mask for signal 2	240 (decimal)	Outputs 4..7 are used for Signal 2 = Bits 4..7 set = binary 11110000 = 240 decimal
CV #165	Number of signal aspects for Signal 2 and distant signal dependence	13 (decimal)	Ones digit: Number of signal aspects used for this signal = 3, tens digit: distance signal dependence = Depends on signal object 1 = 1 (this distance signal will be dimmed when main signal 1 shows STOP (Hp 0))
CV #166	Signal aspect 1 for signal 2	48 (decimal)	Vr 0 (expect STOP) = yellow + yellow, therefore output 4 + 5 active: binary 00110000 = 48 decimal
CV #167	Signal aspect 2 for signal 2	192 (decimal)	Vr 1 (Clear) = green + green, therefore output 6 + 7 active: binary 11000000 = 192 decimal
CV #168	Signal aspect 3 for signal 2	96 (decimal)	Vr 2 (expect approach) = green top + yellow bottom, therefore output 5 + 6 active: binary 01100000 = 96 decimal
CV #169 – CV #173	Signal aspects 4 ... 8 for signal 2	--- (content is not relevant)	

**Example 2: Two block signals (Hp 0/Hp 1 = stop/clear) and one DB Entry signal (Hp 0 = stop, Hp 1 = clear, Hp 2 = approach)**

CV-Number	CV-Function	Value	Explanation
<b>First block signal:</b>			
CV #150	Signal object 1, Address Part 1	4 (decimal)	Address 4 (decimal) = binary 0 0000 0100 (9 Bit address range), therefore part 1 = lowest 6 Bits = 000100 binary = 4 decimal
CV #151	Signal object 1, Address Part 2	0 (decimal)	Address 4 (decimal) = binary 0 0000 0100 (9 Bit address range), therefore part 2 = highest 3 Bits = 000 binary = 0 decimal
CV #152	Bit mask for Signal 1	3 (decimal)	Outputs 0..1 are used for Signal 1 = Bits 0..1 set = binary 00000011 = 3 decimal
CV #153	Number of signal aspects for Signal 1 and distant signal dependence	2 (decimal)	Ones digit: Number of signal aspects used for this signal = 2, tens digit: distance signal dependence = none = 0 (This signal is always displayed and never dimmed in dependence of another)
CV #154	Signal aspect 1 for signal 1	1 (decimal)	The first signal aspect of any main signal must always be STOP. Hp 0 (Stop) = red, therefore only output 0 active: binary 00000001 = 1 decimal
CV #155	Signal aspect 2 for signal 1	2 (decimal)	Hp 1 (Clear) = green, therefore output 1 active: binary 00000010 = 2 decimal
CV #156 – CV #161	Signal aspects 3 ... 8 for signal 1	--- (content is not relevant)	
<b>Entry signal:</b>			
CV #162	Signal object 2 Address Part 1	20 (decimal)	Address 20 (decimal) = binary 0 0001 0100 (9 Bit address range), therefore part 1 = lowest 6 Bits = 010100 binary = 20 decimal
CV #163	Signal object 2 Address Part 2	0 (decimal)	Address 20 (decimal) = binary 0 0001 0100 (9 Bit address range), therefore part 2 = highest 3 Bits = 000 binary = 0 decimal
CV #164	Bit mask for Signal 2	28 (decimal)	Outputs 2..4 are used for Signal 2 = Bits 2..4 set = binary 00011100 = 28 decimal
CV #165	Number of signal aspects for Signal 2 and distant signal dependence	3 (decimal)	Ones digit: Number of signal aspects used for this signal = 3, tens digit: distance signal dependence = none = 0 (This signal is always displayed and never dimmed in dependence of another)
CV #166	Signal aspect 1 for signal 2	4 (decimal)	The first signal aspect of any main signal must always be STOP. Hp 0 (Stop) = red, therefore only output 2 active: binary 00000100 = 4 decimal
CV #167	Signal aspect 2 for signal 2	8 (decimal)	Hp 1 (Clear) = green, therefore output 3 active: binary 00001000 = 8 decimal
CV #168	Signal aspect 3 for signal 2	24 (decimal)	Hp 2 (Approach) = green + yellow, therefore output 3 + 4 active: binary 00011000 = 24 decimal
CV #169 - CV #173	Signal aspects 4 ... 8 for signal 2	--- (content is not relevant)	
<b>Second block signal:</b>			
CV #174	Signal object 3 Address Part 1	4 (decimal)	Address 4 (decimal) = binary 0 0000 0100 (9 Bit address range), therefore part 1 = lowest 6 Bits = 000100 binary = 4 decimal
CV #175	Signal object 3 Address Part 2	64 (decimal)	Address 4 (decimal) = binary 0 0000 0100 (9 Bit address range), therefore part 2 = highest 3 Bits = 000 binary, additionally Bit 6 is set for sub-address 1: 01000000 binary = 64 decimal
CV #176	Bit mask for Signal 3	96 (decimal)	Outputs 5..6 are used for Signal 3 = Bits 5..6 set = binary 01100000 = 96 decimal
CV #177	Number of signal aspects for Signal 3 and distant signal dependence	2 (decimal)	Ones digit: Number of signal aspects used for this signal = 2, tens digit: distance signal dependence = none = 0 (This signal is always displayed and never dimmed in dependence of another)
CV #178	Signal aspect 1 for signal 3	32 (decimal)	The first signal aspect of any main signal must always be STOP. Hp 0 (Stop) = red, therefore only output 5 active: binary 00100000 = 32 decimal
CV #179	Signal aspect 2 for signal 3	64 (decimal)	Hp 1 (Clear) = green, therefore output 6 active: binary 01000000 = 64 decimal
CV #180 - CV #185	Signal aspects 3 ... 8 for signal 3	--- (content is not relevant)	

## 5. MX820 with other DCC systems

MX820 accessory decoders operate according to the NMRA-DCC standard and can therefore be used with other DCC systems adhering to the same standard.

However, instead of using addresses and sub addresses to reach individual turnouts, other systems (i.e. Lenz, LGB, Uhlenbrock...) often number them consecutively. The following allocation table can be used with such systems:

Turnout 1	program the MX820 to	Address CV #1 = 1, Sub Address CV #33 = 0
Turnout 2	program the MX820 to	Address CV #1 = 1, Sub Address CV #33 = 1
Turnout 3	program the MX820 to	Address CV #1 = 1, Sub Address CV #33 = 2
Turnout 4	program the MX820 to	Address CV #1 = 1, Sub Address CV #33 = 3
Turnout 5	program the MX820 to	Address CV #1 = 2, Sub Address CV #33 = 0
Turnout 6	program the MX820 to	Address CV #1 = 2, Sub Address CV #33 = 1
...		
Turnout 9	program the MX820 to	Default (!) Addr CV #1 = 3, Sub Address CV #33 = 0
Turnout 10	program the MX820 to	Addr CV #1 = 3, Sub Address CV #33 = 1
and so on.		

## 6. Software-Update (and Synchronous-Update)

As is the case with all ZIMO decoders, the accessory decoder too can be updated with new firmware by the end user. This is accomplished with decoder update modules such as the MXDCUP, MX31ZL, MXULF(A) or a DCC command station MX10; see the respective operating manual.

However, a distinctive feature of the accessory decoder is the **synchronous update**, which takes into account that accessory decoders are usually installed permanently in the layout and should preferably remain there during the update. The problem is that there is no direct connection to a single decoder, instead, all decoders are connected in parallel to the track (power bus), and the software update would be sent to all decoders simultaneously.

For the synchronous (simultaneous) update of all decoders, connect the decoder update module MXULFA to the track (power bus) in place of the DCC command station and start the special synchronous software update procedure. Vehicles may remain on the track but higher and longer inrush currents caused by energy storage devices (capacitors etc.) may cause problems...

Check the MXULF operating manual for detailed description; the following is a short excerpt:

At first, the update module searches for any accessory decoders (suitable for the synchronous update) and displays them all organized by decoder family.

Decoder-Family search in progress	→	MX820 SEARCH 3
Search completed	→	● MX820 FOUND 7
Update progress is shown	→	● MX820 SY-UP 68%
Update successful (Updated decoders; total numbers of decoders FOUND) Of course, all decoders should normally update successfully.	→	MX820 OK 6( 7)