This CV list is an addition to the instruction manual for ZIMO driving decoders.
The left column shows the chapters of the ZIMO instruction manual (small decoders), where you can find further information on the CVs.

Following CVs are valid for driving- and sound decoders

Chap-ter	CV	Denomination	Area	Default	Description
3.4	#1	Primary address	1 – 127	3	The "short" (1-byte) vehicle address; This is active, if CV #29, Bit 5 = 0 (basic configuration)
3.6	#2	Start voltage	1 – 252	1	Internal speed step applied for lowest external speed (i.e. speed step 1). Only valid, if CV #29, Bit 4 = 0 (i.e. 3-point speed table according to CVs #2, 5, 6).
3.7	#3	Acceleration rate	0 – 255	2	Multiplied by 0.9 equals the time in sec from standstill to full speed.
3.7	#4	Deceleration rate	0 – 255	1	Multiplied by 0.9 equals the time in sec from full speed to standstill.
3.6	#5	Top speed	0 – 255	1 (=255)	Internal speed step applied for the highest external speed (speed step 14, 28 or 128 according to the adjustments in CV # 29); "0" and "1" = no effect. Only effective, if CV #29, Bit 4 = 0 (i.e. 3-point speed table according to CVs #2, 5, 6). As an elegant alternative use CV #57 (voltage reference).
3.6	#6	Medium speed	1, = about 1/3 of the value in CV #5	1	Internal speed step applied for medium external speed (= speed step 7,14 or 63 depending on the number of speed steps: 14, 28 or 128); "1" = Default-speed table (medium speed is a third of the maximum speed, so: if CV #5 = 255, then CV #6 = 85; or if CV #5 is lower, CV #6 is lowered correspondingly). The 3-point speed table according to CVs #2, 5, 6 is automatically smoothed out; this means no sharp bend in the middle. Only effective if CV #29, Bit 4 = 0. MS decoders: the medium speed is reached in the first third of the speed curve, as the speed curve is not linear.

3.3	#7 *	SW version number and special procedures for programming with Lokmaus 2 and other „low-level systems“. See annex of instruction manual “ZIMO decoders and competitor systems”. For special procedures to program CVs with higher numbers by “medium-level systems” – as Intellibox or Lenz; it is especially useful to select sound samples and sound CVs. For example to program CV #300 = 100	Read only! Reading out always shows SW version number. Combination with CV #65		This CV holds the number of the firmware version currently on the decoder. CV #7 number of main version – CV #65 number of sub-version **Pseudo-Programming** (”Pseudo” = programmed value is not saved) as preliminary action to program or read „higher“ CVs (# > 99) and/or higher values (> 99) with digital systems with limited range. **Ones digit** = 1: subsequent programming value +100 = 2: + 200. **Tens digit** = 1: subsequent CV number +100, = 2: + 200, = 3: + 300. = 4: + 400 … etc. **Hundreds digit** = 1: revaluation of CV number valid until power-off. = 2: ... until annulment by CV #7 = 0.
3.3	#8 *	Manufacturer ID and HARD RESET	Read only!	145 (ZIMO)	The number issued for ZIMO by the NMRA: “145” (”10010001”). **Pseudo-programming** (”Pseudo” = programmed value is not saved): **CV #8 = “8” ->** HARD RESET and SOUND RESET (Default values of the sound project). CV #8 = “9” -> HARD RESET for LGB operation (14 speed steps, pulse chain). **CV #8 = “0“** -> HARD RESET (Default values) CV #8 = “...” -> loading predefined or manufacturer’s CV sets of NON-sound decoders.

*****: those CVs are not used for programming, but to give information and RESET the decoder.

3.6	#9	Motor control frequency and total PWM period	0 = High frequency, medium sampling rate 01 – 99 = high frequency with modified sampling algorithm 255-176 = Low frequency Roco 5-pole motor = 95 / Fleischmann round motor = 89 / Faulhaber small = 51 / FH big = 11	0	= 0: Default motor control with high frequency (20/40 kHz) and EMF sampling rate that adjusts automatically between 200 Hz (low speed) and 50 Hz. • Tens digit 1 - 4: sampling rate lower than default (less noise!) • Tens digit 6 - 9: sampling rate higher than default (prevents juddering) • Ones digit 1 - 4: shorter EMF than default (good for coreless motors; less noise, more power) • Ones digit 5 - 9: longer EMF sampling rate than default (may be needed for round motors or similar) = 255 - 178: low frequency. Exemplary values for low frequency: #9 = 255: frequency at 30 Hz, #9 = 208: frequency at 80 Hz, #9 = 192: frequency at 120 Hz. MS decoders: recommended value: 97
3.6	#10	EMF Feedback Cutout	0 – 252	0	Internal speed step, on which back EMF intensity is reduced to the level defined in CV #113. CV #10, #58 and #113 define a back EMF curve. 0= default curve is valid (as defined in CV #58)
	#11	-			
	#12	Permissible operating modes MS-decoders only		117	Bit 0 - DC analog operation 0 = disabled / 1 = enabled Bit 2 - DCC always 1 = enabled Bit 4 - AC analog operation 0 = disabled / 1 = enabled Bit 5 - MM 0 = disabled / 1 = enabled Bit 6 - mfx 0 = disabled / 1 = enabled Programming CV # 12 = 0 (all bits 0) will NOT be executed (the decoder would become unresponsive)
3.5	#13	Analog functions Function Mapping remains active.	0 – 255	0	Select which functions shall be activated in analog operation; every Bit corresponds to a function (Bit 0 = F1, Bit 1 = F2, …, Bit 7 = F8).

3.5	#14	Analog functions Acceleration/deceleration Function Mapping remains active.	0 – 255	64 (Bit 6 =1)	Bits 5 to 0: Select the function (F12 – F9, FLr, FLv), which shall be activated in analog operation; every Bit corresponds to one function (Bit 0 = headlight, Bit 5 = F12). Bit 6 = 1: analog operation without acceleration/deceleration momentum as defined in CVs #3 & #4, so the loco reacts immediately; like in a classical analog operation. Bit 6 = 0: analog operation with momentum defined in CVs #3 & #4. Bit 7 = motor regulation (1=on, 0 = off).
	#15	MS decoder lock Starting FW 4.75			Prevents the unintentional entry into the update mode.
	#16	MS decoder lock Starting FW 4.75			Prevents the unintentional entry into the update mode.
3.4	#17	Extended address	128 – 10239	0	The „long“ address (2-byte): if an address higher than 127 is desired alternatively to the primary address in CV #1: The extended address is active if CV #29, Bit 5=1.
3.4	#18	Extended address Values are calculated automatically with MX2x and MX3x. [E]+[MAN] Address [F]	-„-	0	See above; calculation: Decimal address is transformed to binary (e.g. with Windows calculator), the first 8 Bits (from the right) are written into CV #18, the rest PLUS decimal 192 is written into CV #17. Example: Address = 1793; decimal 1793 = binary 111 00000001 CV17 CV18 Bin 0000 0111 Bin 0000 0001 Dec 7 Dec 1 So: CV17 = 7+192 = 199 CV18 = 1 CV29 -> Bit 5=1
3.4	#19	Consist address	0 – 127	0	Additional (short, till 127) loco address which is used to control several locos in consist. Value+128 = inverted driving direction.
3.4	#20	Extended consist address SW version 36.6 and higher	0 – 101	0	Multiply value with 100 and add to value in CV #19 = (long, > 127) address in consist operation (consist address) Bit 7 = send RailCom channel 2 from consist address.
3.4	#21	Consist functions F1 – F8 Function Mapping remains active	0 – 255	0	Select functions (F1-F8), which shall be activated in consist operation via consist address (Bit 0 = F1, Bit 1= F2, etc.). Each Bit = 0: fnct. output is controlled by primary address Each Bit = 1: function output is controlled by consist address

3.4	#22	functions F0 forw., rev. in consist Function Mapping remains active	0 -255	0	Select, whether functions shall be controlled by individual or consist address when in consist operation (Bit 0 for head-lights front, Bit 1 for headlights back; Bit 2 = F9…Bit 5= F12 Each Bit = 0: fnct. output is controlled by primary address. Each Bit = 1: fnct. output is controlled by consist address. Bit 6 = automatic consist (only valid after first departure): At standstill, every loco can be controlled individually via individual address or via consist address together with other locos. Change from consist to individual address. Functions according to CV #21 and #22. Bit 7 = F13-F28.
3.7	#23	Acceleration adjustment	0 – 255	0	Temporary adjustment of the acceleration rate, e.g. because of load or in consist. Bit 0 - 6: Value for the acceleration time, which is added to or subtracted from the value in CV #3. Bit 7 = 0: Add value = 1: subtract value
3.7	#24	Deceleration adjustment	0 – 255	0	Temporary adjustment of the deceleration rate, e.g. because of load or in consist. Bit 0 - 6: Value for the deceleration time, which is added to or subtracted from the value in CV #4. Bit 7 = 0: Add value = 1: subtract value
	#25	-			
	#26	-			
3.10	#27	Position dependent stopping („because of a red signal“) by an asymmetrical DC signal (method Lenz “ABC“) Also see CV #134!	0, 1, 2, 3	0	Activates the automatic position-dependent stopping by „asymmetrical DCC signal“ (Lenz ABC). Bit 0 = 1: loco stops, if voltage in right rail (in direction of travel is higher than in left rail. CV #27 = 1, USUAL APPLICATION for this feature (if decoder is wired correctly)! Bit 1 = 1: loco stops, if voltage in left rail (in direction of travel) is higher than in right rail. This means: if one of these bits is set, the stopping is direction dependent. Bit 0 and 1 = 1 (i.e. CV #27 = 3): the stopping is NOT direction dependent. Bit 6 = 1: activates the shuttle operation with ABC (see also CV #59 for waiting time).

3.2	#28	RailCom		3	Bit 0 - RailCom channel 1 (Broadcast) 0 = disabled 1 = enabled Bit 1 - RailCom channel 2 (Data) 0 = disabled 1 = enabled Bit 7: raises the RailCom current to approx.. 60 mA (only with MX699).
3.2	#29	Basic configuration The value for CV #29 is calculated by adding the singular bits, according to their values shown in the following table Bit 0: value 0 or 1 Bit 1: value 0 or 2 Bit 2: value 0 or 4 Bit 3: value 0 or 8 Bit 4: value 0 or 16 Bit 5: value 0 or 32 Bit 6: value 0 or 64 Bit 7: value 0 or 128 In ZIMO cabs MX21, MX31, …the CVs are also shown in bits, so a calculation of the values is no longer necessary.	0 – 63	14 Bit 1 = 1 Bit 2 = 1 Bit 3 = 1	Bit 0 – loco direction -> 0 = normal, 1 = reversed Bit 1 – speed steps -> 0 = 14, 1 = 28/128 speed steps Bit 2 – automatic conversion (analog operation) -> 0 = disabled, 1 = enabled Bit 3 – RailCom -> 0 = disabled, 1 = enabled (!!!CV #28 has to be 3!!!) Bit 4 – speed table -> 0 = 3-point characteristic according to CV # 2, #5, #6 1 = free characteristic according to CVs #67 – #94 Bit 5 – loco address: 0 = 1-byte address according to CV #1 1 = 2-byte address according to 17+18 Bits 6, 7 always 0 (Bit 7=1 in accessory decoders – defines decoder as accessory decoder in CV #541)! EXAMPLE: #29 = 2: normal loco direction, 28 speed steps, no analog operation, characteristic according to CVs # 2,5,6, primary address. #29 = 10 as above, but RailCom active #29 = 22: as above but with analog operation and individual speed table according to CVs # 67 - 94. #29 = 42: normal loco direction, 28 speed steps, no analog operation, RailCom active, characteristic according to CVs # 2, 5, 6, extended address. #29 = 0: 14 (instead of 28) speed steps (necessary for older systems of other manufacturers). ATTENTION: When using DC brake sections, which are polarity-dependent, CV #29, Bit 2 = 0 and CV #124, Bit 5 = 1 have to be set!
	#30	-			
	#31	-			
	#32	-			

3.14	#33	**Function Mapping F0**		1	“Function Mapping” for function outputs according to NMRA-DCC standard: #33 - 42 = 1, 2, 4, etc.: By default, the outputs are allocated to the function keys F0 to F12, i.e. (direction dependent) headlights are controlled by F0 (key 1 or L), all other outputs on one key each. See also CV #61 = 97.
3.14	#34	-„- F0		2	
3.14	#35	-„- F1		4	
3.14	#36	-„- F2		8	
3.14	#37	-„- F3		2	
3.14	#38	-„- F4		4	
3.14	#39	-„- F5		8	
3.14	#40	-„- F6		16	
3.14	#41	-„- F7		4	
3.14	#42	-„- F8		8	
3.14	#43	-„- F9		16	
3.14	#44	-„- F10		32	
3.14	#45	-„- F11		64	
3.14	#46	-„- F12		128	
	#47 #48	-			
3.9	#49	Signal controlled acceleration	0 – 255	0	Multiplied by 0.4 equals the time in sec from standstill to full speed, within the “ZIMO signal controlled speed influence“ (track section module MX9 or StEin) or when using DCC brake sections (= Lenz ABC).
3.9	#50	Signal controlled deceleration	0 – 255	0	Multiplied by 0.4 equals the time in sec from full speed to standstill, within the “ZIMO signal controlled speed influence“ (track section module MX9 or StEin) or when using DCC brake sections (=Lenz ABC).
3.9	#51	Signal controlled speed limits	0 – 252	20	For each of the 5 speed limits that can be defined via “ZIMO signal controlled speed influence”, an internal speed step is assigned. In case the “asymmetrical DCC signal” is extended, it can be applied on various speed limits.
3.9	#52	#52 for “U”, #54 for “L”, #51, 53, 55 for intermediate steps	-„-	40	
3.9	#53		-„-	70	
3.9	#54		-„-	110	
3.9	#55		-„-	180	

3.6	#56	P and I value for BEMF motor regulation (MX decoders only)	0 – 199 Roco 5-pole motor = 33 / Fleischmann round motor = 91 / Faulhaber small = 133 / FH big = 111	0 (=55)	PID parameters (PID = Proportional/ Integral/ Differential): 0 - 99: „normal“ motors (LGB, etc.) 100 - 199: MAXON, Faulhaber, etc. Tens digit: • Proportional (P) - value; by default (0) it is set on a medium value and automatic adjustment for a judderfree driving experience • With 1 - 4 and 6 - 10 (instead of 0 (=5)) the proportional effect can be modified Ones digit: • Integral (I) - value; be default on a medium value • With 1 - 9 (instead of 0 (=5)) the integral value can be chosen individually. MS decoders: the I-value part is taken over by CV #147, the P-value part by CV #149. Please use these CVs.
3.6	#57	Voltage reference	0 – 252	0	Absolute voltage (1/10 of volts) applied to the motor at full speed. = 0: automatically adjusts to the track voltage (relative ref.).
3.6	#58	BEMF intensity	0 – 255	255	Intensity of Back-EMF control at the lowest speed step. If required, an “intensity curve“ can be achieved using CVs #10, #58 and #113 to reduce load regulation at higher speeds. EXAMPLE: = 0: no Back-EMF = 150-180: medium compensation = 255: maximum compensation MS decoders: recommended value: 200 MS decoders: recommended value: 200
3.9	#59	Signal controlled delay	0 – 255	5	Time in tenths of a second, after which acceleration is started after receiving a higher signal controlled speed limit. This CV is used in combination with the „ZIMO signal controlled speed influence“(MX9, StEin, TSE or “Lenz ABC“).
3.19	#60	Dimming (voltage reduction via PWM) for function outputs (also see CV #114 dimming mask 1 and CV #152 dimming mask 2)	0 – 255	0	Rate on function outputs when turned on; here you can reduce the intensity of the lamps as needed (e.g. high beam function). EXAMPLE: = 0: (as 255) full voltage / =1: dark = 125: half of full voltage = 170: 2/3 of full voltage

3.14	#61	ZIMO extended mapping	97	0	For applications that are not provided by the NMRA Function Mapping (CVs #33 - #46), for example Swiss locos (see Swiss Mapping, CVs #430ff) =97: ZIMO function mapping without left shift. See chapter Function Mapping in the instruction manual „small decoders“ **ATTENTION: NOT valid for function decoders MX680!**
3.22	#62	Modification of light effects (also see CVs #127- #132)	0 – 9	0	Changing the minimum dimming value
3.22	#63	Modification of light effects (CVs #127-#132) Or stop light OFF delay	0 – 99 0 – 255	52	Tens digit: changes the cycle time for the effect (0-9, default 5), or dims up (0-0.9 sec) Ones digit: extends off time of the brake lights (Code 001110xx in CV #125, 126 or 127…): afterglow in tenth of seconds (an area of 0 to 25 seconds) at standstill after stopping. MS decoders: CV #63 is ineffective in connection with effect "88", setting only by CVs #190 and 191.
3.22	#64	Modification of light effects (CV #127-#132)	0 – 9	5	Bit 3 - 0 (values 0-9): ditch Light follow-up time in sec. Bit 7 - 4 (values 16-128): define the Ditch Light key (function key+1)*16; therefore: 0=F2, 1=F0, 2=F1, ... 15=F14
3.3	#65	SW version / subversion			Number of SW version after the comma -> see also CV #7.
3.6	#66	Forward Trim	0 – 255	0	Multiply the current speed step with “n/128“ (n being the trimming value defined here) when traveling forward.
3.6	#67 to #94	Individual speed table	0 – 252		Internal speed step for every one of the 28 external speed steps (interpolation with 128 speed steps). Valid, if CV #29, Bit 4 = 1
3.6	#95	Reverse Trim	0 – 255	0	Multiply the current speed step with „n/128“ (n being the trimming value defined here) when driving backwards.
	#96	-			
	#97	Consist key	1 - 28	0	Activates the Consist address (F1 to F28), CVs #21 and 22 shall be at 0, automatic consist see CV #22 bit 6.
	#98	-			
	#99	-			
	#100 *	Read out current ABC asymmetry	0,1,255 or 5 – 15,241 – 251		Only for debugging! Values in entities of 0.1 Volt Pay close attention to the right polarity (value up to 10)!

	#101	Offset for ABC asymmetry If no asymmetry is wanted, the internal asymmetry can be changed			If in CV #100 a value >0 or <=255 is read out with ABC deactivated (with the same sign in both rail directions): Write value from CV #100 into CV #101. If you read +2 in one rerailing direction and -2 (= 254) in the other, there is an asymmetry on the rail of the system (e.g. Intellibox), ABC is then ineffective.
	#102	-			
	#103	-			
	#104	-			
	#105 *	User identification	0 – 255	0	Freely available for the user
	#106 *	User identification	0 – 255	0	Freely available for the user
3.16	#107	Light suppression cab side 1	0 – 255	0	>0: light is turned off when key is active (output F0f and definable output will be deactivated with definable key). Calculation: Output (1 for FO1, 2 for FO2,... to FO7) x 32 + function key (1-28 for F1-F28, with 0 only F0f/r is suppressed).
3.16	#108	Light suppression cab side 2	0 – 255	0	>0: light is turned off when key is active (output F0f and definable output will be deactivated with definable key).
3.16	#109	Further FO cab side 1	1 – 6	0	Function output is turned off together with CV #107 (1-6 for FO1-FO6). Bit 7 = 1: switch off all lighting on this cab side if in consist
3.16	#110	Further FO cab side 2	1 – 6	0	Function output is turned off together with CV #108 (1-6 for FO1-FO6). Bit 7 = 1: switch off all lighting on this cab side if in consist
	#111	Braking speed at emergency stop			Setting like CV #4, so the vehicles do not stop abruptly in case of an emergency stop / power off. Derailments are avoided.

<table>
<tr><td>3.1
3.6
3.11
3.21</td><td>#112</td><td>Special ZIMO configuration bits
Bit 0: value 0 or 1
Bit 1: value 0 or 2
Bit 2: value 0 or 4
Bit 3: value 0 or 8
Bit 4: value 0 or 16
Bit 5: value 0 or 32
Bit 6: value 0 or 64
Bit 7: value 0 or 128
In ZIMO cabs MX21, MX31, … the CVs are also shown in bits, so a calculation of the values is no longer necessary.</td><td>0 – 255</td><td>0</td><td>Bit 0 – normal (0) or load dependent (1) characteristic (sound) curve; curve itself defined in CVs #137, #138, #139.
Bit 1 = 1: High frequency acknowledgement (also if programmed without motor)
Bit 2 = 0: loco number recognition off;
=1: ZIMO loco number recognition on (useful to turn it off in case loco number recognition is not needed and cracking noises shall be prevented)
Bit 3 = 0: only reacts to the (new) NMRA-MAN-bit (12 functions);
= 1: reacts to old MAN bit (8 functions)
Bit 4 = 0: pulse chain recognition off;
=1: pulse chain recognition on when using LGB
Bit 5 = 0: 20 kHz motor control frequency;
= 1: 40 kHz
Bit 6 = 0: normal (also see CV #129);
= 1: DC brake mode direction dependent (“Märklin braking mode”)
Bit 7 = 0: no pulse chain generation;
= 1: pulse chain generation for LGB sound modules on FO1</td></tr>
<tr><td>3.6</td><td>#113</td><td>Compensation Cut-off</td><td>0 – 255</td><td>0</td><td>The BEMF intensity is reduced to this value at the speed step defined in CV #10 (builds a 3-point curve together with CV #10 and #58).
‘0’ means actual cut-off at speed step defined in CV #10.</td></tr>
<tr><td>3.19</td><td>#114</td><td>Dimming mask 1
Also see CV #152!</td><td>Bit 0 – 7</td><td>0</td><td>Bits 0 to 7 for one function output each (Bit 0 – headlight front, Bit 1 – headlight back, Bit 2 – FA1, etc.).
Each Bit = 0: output is dimmed to value defined in CV #60
Each Bit = 1: output is not dimmed</td></tr>
<tr><td>3.19
3.24</td><td>#115</td><td>CV #115 alternatively used as second dim value (by setting tens digit on ‘0’) from 0-90% (according to ones digits)</td><td>0 – 99</td><td>0</td><td>Valid, if function effect „Uncoupling” is activated in CVs #125 to #132 (equals ‘48’):
Tens digit (0-9): time in sec (according to the following table) in which the coupler receives full voltage:
<table>
<tr><td>Value</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr>
<tr><td>sec.</td><td>0</td><td>0.1</td><td>0.2</td><td>0.4</td><td>0.8</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
</table>
Ones digit (0-9): percentage (0-90%) of the track voltage, which the coupler receives while active.</td></tr>
</table>

3.24	#116	“Automatic uncoupling“ Not recommended if CV #273>5! (CV #273: Start-up delay, blow-off, etc.)	0 – 199	0	Tens digit (0-9): Time the loco should move away (disengage) from the train; coding as in CV #115. Ones digit (0-9) = x4: internal speed step for disengagement (acceleration according to CV #3) Hundreds digit: = 0: no unloading = 1: coupler unloading: engine moves towards train to relieve coupler tension.
3.20	#117	Flashing	0 – 99	0	Duty cycle for flasher function: Tens digit: off time (0 = 100 ms, …, 9 = 1 sec) Ones digit: on time
3.20	#118	Flashing mask	Bits 0 – 7	0	Bits 0 to 5 for one function output each (Bit 0 – headlight front, Bit 1 – headlight back, Bit 2 – FO1, etc.). Each Bit = 0: output shall not flash, Each Bit = 1: output shall flash Bit 6 = 1: FO2 shall flash inversely! Bit 7 = 1: FO4 shall flash inversely!
3.19	#119	Low beam mask F6	Bits 0 – 7	0	Bits 0 to 5 for one FO each (Bit 0 – headlight front, Bit 1 – headlight back, Bit 2 – FO1, etc.). Each Bit = 0: no low beam Each Bit = 1: output shall be dimmed to the value defined in CV #60 when activating F6. Bit 7 = 0: normal effect of F6 Bit 7 = 1: effect of F6 inverted: high beam function! Panto function see CV #154
3.19	#120	Low beam mask F7	Bits 0 – 7	0	As CV #119, but F7 as „low beam function“. Panto function see CV #154
3.7	#121	Exponential acceleration	0 – 99	00	Acceleration time (momentum) can be stretched in the lower speed range. Tens digit: percentage (0-90%) of the speed range where the curve shall be valid Ones digit: exponential curve (0-9).
3.7	#122	Exponential deceleration	0 – 99	00	Deceleration time (momentum) can be stretched in the lower speed range. Tens digit: percentage (0-90%) of the speed range where the curve shall be valid Ones digit: exponential curve (0-9).

3.7	#123	Adaptive acceleration and deceleration	0 – 99	0	Raising or lowering the speed to the next internal step occurs only if the preceding step is almost reached. CV #123 contains the distance between the speed steps which has to be reached (the smaller the value the softer the acceleration). Tens digit: 0 - 9 for acceleration Ones digit: 0 - 9 for deceleration 0: no adaptive acceleration/deceleration
3.13 **3.25**	#124	Shunting key functions Acceleration deactivation, half-speed and LGB ON-BOARD interface instead of SUSI on the plug (only MX69x) „Half speed“ means 0.625 of maximum speed (see CV #155 Bit 7 – 5)		0	Bits 0,1 = 00: key above has no function = 01: deactivates exponential and adaptive = 10: CV #3, 4 reduced to ¼ = 11: deactivates acceleration/deceleration momentum Bit 2 = 0: MAN-key for acceleration deactivation Bit 2 = 1: F4 for acceleration deactivation (in case you wish F3 instead of F4, see Bit 5) Bit 3 = 1: F7 as half-speed key Bit 4 = 1: F3 as half-speed key Bit 5 = 1: for ”DC-stopping” For polarity independent DC braking, also set CV #29, bit 2 = 0 (Basic Configuration) and CV #124, bit 5 = 1. Bit 6 = 1: F3 as acceleration deactivation (Bit 2 is irrelevant) Bit 7 = 1: (only MX69x) serial interface to an on-board LGB sound module via SUSI pin MX64x and MX658: FU-outputs instead of SUSI.

3.22	#125	**Special effects** Decoupling „Soft Start“ (=dimming up when starting the function outputs) or American light effects on FO „headlight front“, by default per F0 forw., possible change per “Function Mapping”. Adjustments and modification of the effects by CVs #62- 64 and CV #115 (coupling). SW 28.19 and higher: **Light effects** for FA7 and FA8: See CV #157 and CV #160 EXAMPLES: Mars light, only forw. - 00000101 = “5” Gyralite indep. of direction - 00011100 = “28” Ditch type 1 left, only forw . - 00100101 = “37” **Uncpoupler** - 00110000 **= “48”** Soft-Start for output - 00110100 = “52” Auto. **Brake light** - 00111000 **= „56“** Auto. **Cab light** off - 00111100 = „**60**“ speed./load dep. **Smoke generation. -** 01001000 **= „72“** speed./load dep. **Diesel-smoke -** 0101 0000 **= „80“** **slow dimming up/down -** 01011000 **= 88** **fluorescent light -** 01011100 **= 92** **flashes of light -** 01100000 **= 96**		0 88	The following description for the effects‘ coding is valid in the same way for CVs #125-132; as an example it is shown for CV #125, for FO “headlight front”, although in reality the effects are rarely used with this FO. Bits 1,0 = 00: direction dependent (always active) Bits 1,0 = 01: forward only Bits 1,0 = 10: reverse only ATTENTION: CVs # 33, 34 (“Function Mapping“ for F0) probably have to be adjusted, so there is no contradiction to the direction dependencies mentioned above. Bits 7, 6, 5, 4, 3, 2 (Bits 1, 0 see above) = 000001xx Mars light = 000010xx Random Flicker (= **value 8: fire chamber**) = 000011xx Flashing headlight = 000100xx Single pulse strobe = 000101xx Double pulse strobe = 000110xx Rotary beacon simulation = 000111xx Gyralite = 001000xx Ditch light type 1, right = 001001xx Ditch light type 1, left = 001010xx Ditch light type 2, right = 001011xx Ditch light type 2, left = 001100xx coupling according to CV#115 = 001101xx slow dimming up of FO (Soft-Start) = 001110xx automatic brake lights for streetcars, afterglow at standstill variable, see CV #63. = 001111xx automatic deactivation of the FO at speed step >0 (e.g. cab light while driving). = 010010xx speed or load dependent **smoke generation for steam locos** according to CVs #137 - 139 (pre-heating at standstill, thick smoke at high speed or load). Appropriate control of the smoke fan as defined in CV #133. = 010100xx driving state dependent **smoke generation for Diesel locos** according to CVs #137 - #139 (pre-heating at standstill, thick smoke when starting motor sounds and at acceleration). Appropriate control of the smoke fan as defined in CV #133, #351, #352. **=** 010110xx slow dimming up/down according to CVs #190/191 RPM for fan and smoke down time –> see CVs #351 – 353! Smoke effects only available and useful for sound decoders.

		NOTE to ditch lights: Ditch lights are only active when headlights and function F2 (#3 on ZIMO controller) are on, which is prototypical for North American railroads. The ditch lights will only be working if the applicable Bits in CVs #33 and #34 are on (the definition in #125 – 128 is not enough but a necessary addition). Example: If ditch lights are defined for FO1 and FO2, Bits 2, 3 in CVs #33, 34 have to be set accordingly (i.e. CV #33 = 00001101, CV #34 = 00001110).			
3.22	#126	Effects as CV #125 on function output "headlight rear" (default F0 rev.)		0 88	Bits 1,0 = 00: direction independent (always active) Bits 1,0 = 01: forward only Bits 1,0 = 10: reverse only
3.22	#127 to #132	effects as in CV #125 on FO1 (default F1; green cable) FO2 (default F2; brown cable) FO3 to FO6 (default F3 to F6)		0	as CV #125 / #126
3.23	#133	Activate smoke fan on FOx (rhythm of the smoke fan is defined in CV #267) Function output for heating element is defined in CVs #127-132, smoke fan in large-scale decoders on special pins, in small-scale decoders in FO4 – except MX646, there it is FO2!) Driving decoders (without sound): **MX695** has a special FO. NOTE in case CV #133 > 0 at **MX690**: The value defined here is not valid, but FO10 simulates the cam sensor that is used for the internal sound. **Valid for MX640/642/645:** CV #133 > 1: controls FO4 as described on the right, IF a smoke effect is assigned to a FO between FO1 and FO6 (CV #127ff). **MX646: FO2 used instead of FO4** **MX632:** If CV133= 20, or =40, FO2 is used for the pulses.	0 – 255 0 – 255	0 0	The function output (see explanation on the left) sends impulses, which can be connected to a sound module instead of a cam sensor to activate chuff sounds. = 0 (default): FO is used as a normal function output (controlled by F-key). = 1: FOx is fan-output, controlled by a (virtual) cam sensor (depending on value in CV #267). = 2: MX69x, activate second fan output on FO11. NOTE: on MX690 the fan is switched with FA10! = >1 FO is a virtual cam sensor; adjustment: smaller value in CV #133 equals higher frequency; lower value equals lower frequency of pulses. In case the smoke generator is defined in the effect CVs (#125 – 132, 159, 160), the ventilation will be: - turned on / off together with the smoke generator and - will be synchronized with the chuffs of a steam locomotive or - activated at start / is acceleration dependent during running of a diesel locomotive. The timing of the smoke at start is set in the sound file in ZSP using a Loop2 Marker. The fan's rpm is defined in CVs #351 and #352. = 4: inverts the polarity of Reed 3 input (= against +) = 8: inverts the polarity of Reed 2 input (= against +) = 16: inverts the polarity of Reed 1 input (= against +) = 32: inverts the polarity of Reed 3 input (= against +)

3.10	#134	Asymmetry thresholds for stopping with asymmetrical DCC-signal (Lenz ABC)	1 – 14 0.1 – 1.4 Volt	106	Hundreds digit: Sensitivity adjustment; this makes the asymmetry recognition more reliable (=slower) or faster. = 0: Fast recognition (higher risk for errors, therefore unreliable stopping) = 1: Normal recognition (about 0.5 sec), fairly reliable (default) = 2: slow recognition (about 1 sec), very reliable Tens and ones digit: asymmetry threshold in tenths of a volt. The voltage difference between the two half waves of the DCC signal defines the minimum required to be recognized as asymmetrical and starts the intended effect (usually braking and stopping a train). See CV #27! = 106 (default) means 0.6 V, This value has proven itself to be appropriate under normal conditions; by using 4 diodes to generate the asymmetry.
3.8	#135	km/h – speed regulation - activation, control and range definition / initiation of a calibration run	2 – 20	0 (1)	= 0: km/h – regulation turned off; the ‘normal‘ speed regulation is in effect. Pseudo programming (value is not saved!): **CV # 135 = 1 -> initiates a calibration run** = 2 to 20: speed steps / km/h – factor; e.g.: = 10: every step (1 to 126) represents 1 km/h: i.e. speed step 1 = 1 km/h, step 2 = 2 km/h, step 3 = 3 km/h, ... = 20: every speed step represents 2 km/h; i.e. step 1 = 2 km/h, step 2 = 4 km/h, up to speed step 126 = 253 km/h. = 5: every speed step represents 0.5 km/h; i.e. step 1 = 0.5 km/h, step 2 = 1 km/h, last step 126 = 63 km/h. **See chapter 4 in the manual, „km/h – speed regulation“** = 64: 9th bit of CV #136, extension of the km/h speed regulation. Adds 256 to the value in CV #136.
3.8	#136 *	km/h – speed regulation – control number read-out			A numeric value can be read out after a successful calibration run, which is used to calculate the speed. It should be independent of the used speed, this means that the value should remain unchanged (or vary slightly) even after multiple calibration runs. RailCom feedback factor: to adjust the speedometer of the MX32, see manual of the MX32.

3.23	#137	Characteristic PWM control of the heating element, if smoking effect is assigned to FOx. - Standstill	0 – 255	0	The values in CVs #137 - #139 define a smoke characteristic for the function outputs FO1-FO8. If Bit 0 in CV #112 = 0; characteristic is speed-dependent: • CV #137: PWM of Fox at standstill • CV #138: PWM of Fox driving without load • CV #139: PWM of Fox at full speed and acceleration If Bit 0 in CV #112 = 1; characteristic load-dependent: • CV #137: PWM of Fox at standstill and deceleration • CV #138: PWM of Fox driving without load • CV #139: PWM of Fox at full speed and acceleration, or high load … valid for the FO that has an “effect“ for smoke generation of a steam or Diesel loco defined, i.e. 010010xx or 010011xx in the corresponding CVs #127 - #132. Steam locos: PWM for heating element at blower.
3.23	#138	Characteristic PWM control of the heating element, if smoking effect is assigned to FOx. - Driving without load			
3.23	#139	Characteristic PWM control of the heating element, if smoking effect is assigned to FOx. - Driving with load			
3.12	#140	Distance controlled stopping – constant stopping distance Select a braking method and process	0,1, 2, 3,11,12,13	0	Activates distance controlled stopping as per CV #141 instead of time-constant braking, according to CV #4. = 1: automatic stops with ZIMO HLU (signal controlled speed influence) or ABC (asymmetrical DCC signal). Manual command is still possible. = 2: stops using a command software (Train Controller etc…). No manual command possible. = 3: automatic and SW stops. No manual command possible. The braking starts delayed in all cases shown above when the train travels at less than full speed to prevent unnecessary “creeping”. On the other hand: = 11, 12, 13: as above, but the braking starts immediately after entering the brake section.
3.12	#141	Distance controlled stopping – constant stopping distance	0 – 255	0	This value defines the constant stopping distance. The right value for the existing braking sections has to be determined by trial & error. Use this figures as a starting point: CV #141 = 255 is about 1 km for a real train (12 m in HO – 39.4 ft), CV # 141 = 50 about 200 m for a real train (2.4 m in HO – 7.9 ft). Further and finer adjustments of the braking distance including direction dependency: see CVs #830 – 833.

3.12	#142	Distance controlled stopping – constant stopping distance high speed correction for ABC	0 – 255	12	The delayed recognition (see CV #134), but also unreliable electrical contact between rails and wheels have a larger effect on a stopping point at higher speeds than at lower speeds. This effect is corrected with CV #142. = 12: Default, usually works fine with CV #134 = default.
3.12	#143	Compensation with HLU	0 – 255	0	The HLU method is more reliable than ABC; it usually does not require recognition delay. Default = 0
3.1	#144	Programming and Update lock	Bits 6 and 7	0, 64, 128	Prevents the wrong entry into the update mode. = 0: no programming and update lock. = 8: writing CV in POM (=OP PROG Mode) locked (except CV#144 itself). = 16: confirmation jingle for CV programming. = 32: read CV locked in SERV PROG mode (except CV#144 itself). = 64: write CV disabled in service mode. Protection against unintentional reprogramming and deletion of CVs. NOTE: Programming in "Operational mode" ("On-the-main") is not disabled in this case (because this is done in the operational process and an address is specifically addressed). = 128: Locking the software update via MXDECUP, MXULF, MX31ZL or other means. MS decoders: CV #144 is currently not implemented. See CVs #15 and 16.
3.6	#145	Alternate methods for motor control	0 , 1	0	= 0: normal motor control (DC-Motor, Faulhaber, Maxon, etc.) = 1: Special control for low-resistance DC-motors (often Maxon); this control allows connecting a capacitor (10 or 22 µF) to the positive pole/ground of the decoder; decoder and motor are stressed less.

3.7	#146	Compensation for gear backlash during direction changes in order to reduce start-up jolts	0 – 255	0	The transmission between motor and wheels often has blank cycles, especially when dealing with worm gears. Due to this, the motor spins a little until it moves the wheels, but already accelerates in this time; this produces an unpleasant jolt, which is prevented by that CV. = 0: no effect = 1 to 255: the motor spins at minimum rpm (according to CV #2), for a specific time and only starts to accelerate after this time has elapsed. How much time is required to overcome the backlash, depends on various circumstances and can only be determined by trial & error. Typical values: = 50: the motor turns about ½ revolution or a maximum of ½ sec at the minimum speed = 100: about 1 turn or max. 1 sec. = 200: about two turns or max. 2 sec. Important: CV #2 (minimal speed) has to be set correctly, so that the motor actually turns at the speed step defined as the lowest step in CV #2. Also, CV #146 is only useful if the load regulation is set to maximum or at least close to it (i.e. CV #58 = 200 - 255).
3.6	#147	EMK-sampling time	0 – 255	0	= 0: automatically / = 1 – 255: manually Useful initial value: 20. Too small a value leads to jerky behavior. Too large a value leads to poor regulation when driving slowly. MS decoders: recommended value: 65 - 80
3.6	#148	D-value	0 – 255	0	= 0: automatically / = 1 – 255: manually Useful initial value: 20; Too small a value leads to poor regulation (regulates too little, too slow, engine judders, …). Too large a value leads to overcompensation, the engine runs rough/vibrates. MS decoders: recommended value: 40 - 50
3.6	#149	Adaptive P-value	0,1	0	0 = automatic adjustment 1 = P-value is fixed as per CV #56 (tens digit) MS decoders: recommended value: 40 - 50

3.6	#150	Load compensation at top speed (also see CVs #10, #58, #113)	0 – 255	0	Load compensation at top speed is usually 0. This can be changed with this CV. Example: CV #58 = 200, CV #10 = 100, CV #113 = 80, CV #150 = 40 Result: Regulation at speed step 1=200 (of 255), Regulation at speed step 100 (of 252) = 80 (of 255), regulation at speed step 252 (top speed) = 40 (of 255).
3.5	#151	Engine brake	0 – 9	0	0 = no engine brake 1-8 = when speed 0 is reached by braking, the engine brake is activated slowly (distributed over 1, 2, … 8 seconds up to emergency braking by short circuits in the motor via power amplifier) 9 = immediate full engine brake, i.e. when speed 0 is reached, the power amplifier makes a short circuit at the motor. The tens digit reduces the gain (set value in CV #58) to 10% - 90%.
3.19	#152	Dimm-mask 2 like CV #114 (Bit 0-5) SW version 26.8 (MX690) and higher: direction Bits (Bits 6 and 7)	Bit 0 – 7		Bit 0 = FO7 …. Bit 5 =FO12 Each Bit = 0: output is dimmed on value defined in CV #60. Each Bit = 1: output will not be dimmed Bit 6 = 1 -> FO4 active when driving forward Bit 7 = 1 -> FO9 active when driving forward
	#153	Limiting driving along without data signal SW version 27.10 and higher	0 – 255	0	In case a vehicle has a capacitor, it continues to drive, even when contact to the tracks is lost. If the capacitor is very big (e.g. GoldCap), the distance after losing contact can be fairly long. This is why CV #153 was introduced; it prevents long driving along without external power supply. CV #153: time in tenths of seconds (i.e. 0 to 25 sec configurable), after which the vehicle stops after a data signal is „not received anymore“.

5.7	#154	Special configuration SW version 27.10 and higher Individual Bits in this CV activate various special measures, which usually are only needed in special occasions	0 – 255	0 16	**Bit 0 = 1**: Panto; especially in use with ROCO BR110 with the ZIMO panto PCB (2010ff) and sound decoder MX634P22. Fu-outputs FO4, FO5, FO6, FO7 start the panto's movement together with the PCB's electronic. ATTENTION: CVs #119, #120 define the running time of the panto motors when moving upwards; range of values 0-20, default 10. Note: the movement downwards is stopped by end travel switches on the panto's PCB. **Bit 1 = 1**: The loco shall not start until the end of a sound loop at standstill. Note: Diesel locos "usually" wait until a loop of the standstill sound is played (about 1 to 2 sec) and afterwards a driving action (ordered meanwhile) is initiated; this guarantees a smooth sound transition. **Bit 2 = 1**: wait until sound is fully played, =0: do not wait/ start right away **Bit 3 = 1**: Use of „second Motorola-address" is deactivated This address is normally used to control 4 more functions. **Bit 4 = 1 activates special mode of random generator for 2-step air pump:** Z1 = fast air pump. Only after the train stopped. Define min and max values for Z1 intervals in ZSP; for how long the fast air pump must not be played after each other (set same values for min and max) Z2 = slow air pump to compensate pressure loss at standstill. Only at standstill. **Bit 5 = 1**: For ACK (Acknowledgement) when addressing in Service Mode (on the programming track), only motor-direction forward shall be used (if not, it changes and the loco moves). This is useful, if the motor "additionally" activated a slider switch; typically in Roco ICN. **Bit 6 = 1**: As Bit 5, but motor „reversed". **Bit 7 = 1**: Loco shall not drive until „starting whistle" is fully played. MOTOROLA format ONLY (from SW version 28.13): = 8: deactivates the 2nd Motorola address; this "subsequent address" switches the functions F5 - F8.

3.13	#155	Further selection of a function key for half speed (Shunting key I) SW version 27.10 and higher	0 – 19	0	In extension to the configurations in CV #124, if another key shall be the „half-speed key“ (instead F3 or F7): CV #155: Function key, with which half-speed (= highest speed step = half the speed) is activated. If CV #155 = 0, CV #124 is valid, if >0 = configuration in CV #124 is ignored. Additionally, half-speed is adjusted in 1/8 steps by Bits 5-7 Bit 7-5 = 000 = 0,625 of Vmax; = 001 = 0,125; … = 100 = 0,5; … = 111 = 0,875 of Vmax. „half-speed“ = 0,625 of Vmax.
3.13	#156	Further selection of a function key to deactivate acceleration and deceleration times and change of light (Shunting key II) SW version 34 and higher	0 – 19	0	In extension to the configurations in CV #124, if another key shall be defined (half-speed on F3, F4 or MAN): CV #156: Function key with which acceleration and deceleration times, which were defined in CVs #3, #4, #121, #122, shall be deactivated or reduced. The configurations in CV #124 of how deactivation or reduction are handled, are still valid. CV #124 = 3, to reach full deactivation (as far as no other Bits are set in CV #124). The configurations in CV #124 of how deactivation or reduction are handled, is still valid. The assignment of a key for the momentum deactivation is deactivated, if CV #156 > 0 (i.e. a key is defined). Bit 7 = automatic light change is suppressed when shunting key is active.
3.13	#157	Selecting a MAN-key = deactivation of „signal controlled speed influence“ HLU or of signal stops per ABC with function key SW version 27.10 and higher	0 – 19	0	The MAN function (or MAN key on the ZIMO controller) originally was a function designed especially for ZIMO, to suppress Halt and speed limits from HLU. But this function is also valid for the signal halt with “asymmetrical DCC signal“ (Lenz ABC). In case a ZIMO decoder is used with a system from another manufacturer, any key can be defined with CV #157 to deactivate the speed influence or signal stop.

4.0 **5.5** **5.7**	#158	FO1 as control wire for external capacitor charging/discharging circuitry if CV #158, Bit 0 is set. **BIT : 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0** **----------** **Value: 128|64|32|16| 8 | 4 | 2 | 1** ATTENTION: Some configurations can cause errors in consist.		0 8 24	**ONLY MX648**: **Bit 0=1** FO1 as control wire **Bit 1 = 1**: „Double clutch“ deactivated in special sound projects like VT61, Bully and others. **Bit 2 = 1**: RailCom km/h feedback active **Bit 3 = 1**: Looped driving sounds (standstill, F1, F2,...) are interrupted immediately when changing to another driving state to shorten the sound's reaction time. The transition is done at the sound's next rising zero crossing, so there is no crackling (if the sound designer makes sure that all sounds start with a zero crossing). **Bit 4 = 1**: Little elevation of the velocity of the chuff sounds at high speeds. **Bit 5 = 1**: Levelling down turboloader and diesel sounds by one step if the speed step was set one down on the controller. **Bit 6 = 1**: Thyristor sound may get louder when braking ONLY MX645: **Bit 7 = 1:** flashes of light at E-loco switchgear on FA7
3.22	#159	Light effect on FA7	Like CV #125ff		Effects coupling and smoke generator
3.22	#160	Light effect on FA8	Like CV #125ff		Effects coupling and smoke generator
3.26	#161	Servo outputs: protocol and ON/OFF	Bit 0 – 2	0	Bit 0 = 0: Servo protocol with positive pulses Bit 0 = 1: Servo protocol with negative pulses Bit 1 = 1: Servo output stays active (f. Smartservo!) Bit 1 = 0: Servo output will be turned off when reaching end position to avoid juddering Bit 2 = 0: In case of 2-key operation with middle position, if both functions are 0. Bit 2 = 1: In case of 2-key operation, servo is only active while operating those keys. Bit 4 = 1: Servo oscilates between the end points only when the loco runs forward Bit 5 = 1: the same but in backward direction
3.26	#162	Servo 1 end position left	0 – 255	49	Defines the usable part of the servo‘s total rotating area.
3.26	#163	Servo 1 end position right	0 – 255	205	Defines the usable part of the servo‘s total rotating area.
3.36	#164	Servo 1 central position	0 – 255	127	Defines the central position in case of a threefold division.
3.26	#165	Servo 1 cycle time	0 – 255	10	Rotating speed; time between the defined end positions in tenths of a second (up to 25 seconds). -> 10 = 1 second

3.26	#166 to #169	As above but for Servo 2			
3.26	#170 to #173	As above but for Servo 3			
3.26	#174 to #177	As above but for Servo 4			
	#180	Motor control EMF	0 – 255	0	
3.26	#181	Servo 1 – function assignment	0 – 204	0	= 0: Servo not in operation = 1: Single-key operation with F1 = 2: Single-key operation with F2 = 3: Single-key operation with F3 … = 28: Single-key operation with F28 = 90: Servo action depends on loco direction = 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 is moving; direction has no effect. = 101: two-key operation F1 + F2 = 102: two-key operation F2 + F3 etc. (each time left - right) = 111: two-key operation F11 + F12 = 112: two-key operation F3 + F6 = 113: two-key operation F4 + F7 = 114: two-key operation F5 + F8 = 201: Control by event 1 = 202/203/204: Control by event 2/3/4
3.26	#182	Servo 2 - function assignment	0 – 204	0	
3.26	#183	Servo 3 - function assignment	0 – 204	0	
3.26	#184	Servo 4 - function assignment	0 – 204	0	

3.26	#185	Special assignment for real steam locos	1, 2, 3	0	= 1: Steam engine operated with single servo; speed and direction controlled with speed regulator, stop is in center position. = 2: Servo 1 proportional to speed regulator, Servo 2 for direction. = 3: as in 2, but: direction servo is automatically in „neutral“ if speed is 0 and F1 = on; At speed step > 0: direction servo is engaged. NOTE regarding CV #185 = 2 or 3: Servo 1 is adjustable with CVs #162, #163 (end positions), with appropriate values the direction can also be reversed. Servo 2 is adjustable with CVs #166, #167.
3.26	#186 to #189	Panto 1 to 4	0 – 255	0	Bits 0 to 4: key to activate (00001 = F1; 00010 = F2; 00011 = F3; 00100 = F4) Bit 5 - 6: 00 = direction-independent 01 = only forward 10 = only backwards 11 = only if F-key deactivated Bit 7: 0 = not sound-dependent 1 = sound-dependent
3.22	#190	Fade-in time for effects (value 88, 89, 99) in CVs 125ff	0 – 255	0	value 0 = turned on immediately value 1 – 254 = approximate time in seconds value 255 = 326 sec. Note: depending on CV #63 (tens digit): if it is 0, the value in this CV is multiplied by 0.128, if CV #63 is 9, this CV is multiplied by 1.28. MS decoders: values: 0-100 = 0-1 s., 101-200 = 1-100 s., 201-255 = 100-320 seconds.
3.22	#191	Fade-in time for effect (value as above)	0 – 255	0	Values see CV #190 MS decoders: values see CV #190
	#193	ABC – shuttle train: stopping time	0 – 255	0	= 0: no ABC – train shuttle = 1 … 255: stopping time (in sec) in the ABC-stopping- (=return-) sections at the end of the shuttle circuit. MS decoders use only this CV.
	#194	ABC – shuttle train: stopping time MS decoders only	0 – 255	0	= 0: no ABC – train shuttle = 1 … 255: stopping time (in sec) in the ABC-stopping- sections at intermediary stations.

3.3	#250 to #253 *	Decoder ID and serial number SW version 26			The decoder ID (= serial number) is automatically entered during production: the first Byte (CV #250) denotes the decoder type; the three other Bytes contain the serial number. The decoder ID is primarily used for automatic address assignment when an engine is placed on the layout track (future function with RailComPlus) as well as in combination with the “load code” for “coded” sound projects (see CVs #260 to #263).
	#254 *	Sound project ID			Any number of the sound project.
	#255 *	Sound project ID			Any number of the sound project.
	#256 *	Sound project ID			Any sub-number of the sound project.

Decoder ID (value of CV #250):

197=MX617 | 199=MX600 | 200=MX82 | 201=MX620 | 202=MX62 | 203=MX63 | 204=MX64 | 205=MX64H | 206=MX64D | 207=MX680 | 208=MX690 | 209=MX69 | 210=MX640 | 211=MX630-P2520 | 212=MX632 | 213=MX631 | 214=MX642 | 215=MX643 | 216=MX647 | 217=MX646 | 218=MX630-P25K22 | 219=MX631-P25K22 | 220=MX632-P25K22 | 221=MX645 | 222=MX644 | 223=MX621 | 224=MX695-RevB | 225=MX648 | 226=MX685 | 227=MX695-RevC | 228=MX681 | 229=MX695N | 230=MX696 | 231=MX696N | 232=MX686 | 233=MX622 | 234=MX623 | 235=MX687 | 236=MX621-Fleischmann | 243=MX618 | 245=MX697 | 246=MX658N18 | 248=MX821 | 250=MX699 | 253=MX649 |

2=MS480 | 3=MS490 | 4=MS440 | 5=MS580 | 6=MS450 | 7=MS990 | 8 = MS500

Bit values:
Bit 0: value 0 or 1
Bit 1: value 0 or 2
Bit 2: value 0 or 4
Bit 3: value 0 or 8
Bit 4: value 0 or 16
Bit 5: value 0 or 32
Bit 6: value 0 or 64
Bit 7: value 0 or 128

CV – for sounddecoders

The following CVs are ONLY valid for sound decoders, large-scale decoders and MX633 (CV#400)!

Chapter	CV	Denomination	Range	INC-step	Default	Description
The **"incremental programming"** is a special process of the "operational mode" programming with the following fundamental principle: the CV's are not programmed with an absolute value (as is normally the case) but rather the current value of a CV is being incremented or decremented by a fixed value (defined in the decoder for each CV). This is the value in the row "INC-step".						
3.3	#260 to #263	Load code	0 – 255		0	Knowing the decoder ID (CV #250-253) the user gets a load code if needed, which is valid for certain ("coded") sound projects.
	#264	Low voltage on MX635V, MX636V …				Used to adjust the low voltage connection of the decoder. This adjustment can be done alternatively by solder bridges, but not both at the same time! Bit = 0: 1,5V | = 1: 3V | = 2: 5V | 3: 6,5V | = 4: 12V = 5: 14V | = 6: 16V | = 7: 17V MS decoders: low voltage for large scale decoders linearly adjustable (0.1V steps])
5.	#265	Selection between sound for STEAM and DIESEL-locos or: selection of DIESEL loco type	1 – 32 101-132		1 - 32 = steam 101 - 132 = diesel	With CV 265=X the respective sound project can be changed, which is switching between existing sound sets (see ZSP, first tab "Samples")
5.4	#266	Ovrall volume	0 – 255	5	64 (30)	The value "64" represents the (calculated) loudest possible playback without distortions; nevertheless, a value up to 100 is useful without strongly audible distortions. Additionally, the aptitude of the sound depends on the sound sample NOTE: Oversteered sounds damage the speakers! As a safety measure, the sound samples below 100 Hz are also trimmed by means of a high-pass filter. Further general volume CVs: CV #275, 276, 283, 286, 376, 377, 395, 514ff

5.5	#267	Steam chuffs' frequency Corresponding to a "virtual cam sensor"	0 – 255	1	70	This CV is only valid, if **CV #268 = 0:** Chuff sounds are activated by a "virtual cam sensor", no real cam sensor has to be connected. The default „70" equals to 4 to 6 to 8 chuff sounds per turn of the wheels, depending on the chosen chuff set. Because of the strong dependency between motor and transmission, another individual alignment should be done, to get to the exact chuff sound's frequency. This is what CV #267 does: **Lowering the value causes higher chuff-sound frequency (and vice-versa)** See also CV #354: Adjusting the steam chuff frequency at extreme slow speed. See also CV #393 Bit 6: Extension of the value range of CV #267 for large scale models.
5.5	#268	Changing to real cam sensor and trigger count for chuff rate	0 – 255	1	0	= 0: "virtual" cam sensor active (adjustable in CV #267, see above). = 1: Real cam sensor (connected to „In3" of the decoder) is active, each negative spike results in a chuff. = 2, 3, 4, … real cam sensor, various triggers after one another (2, 3, 4, …) result in one chuff. Bit 6 = 1: for „articulated" locos when only one chuff set shall be used… this sounds unnatural, because the same samples overlap each other. Bit 7 = 1 -> for „articulated" locos (2 engines). Usage with virtual cam sensor: CV #268 = 128 In this mode the second engine runs a little slower than the first one in order to achieve the characteristic "floating" sound. When using 2 cam sensors (In3 for first and In2 for second engine) CV #268 = 129 (1 + Bit 7=1). The sound samples for the second engine must be attributed to "Set+1" in ZSP.

5.5	#269	Accentuated lead-chuff	0 – 255	10	0	A typical sound signature of a passing steam engine is that one chuff out of a group of 4 or 6 chuffs is louder than the rest; this effect is already part of the chuff set but can be amplified with this CV.
5.5	#270	Longer chuff length at very low speeds	0 – 255	10	x	**PROJECT (not yet implemented):** The chuff sounds of a real engine are extended when driving very slowly due to the mechanical valve control. This effect can be more or less accentuated with this CV.
5.5	#271	Overlapping effect at high speed	0 – 255	1	16	The individual steam chuffs of a real engine overlap at high speed. Because the frequency of the chuffs increases but won't shorten to the same extent, they will eventually blend into a weakly modulated swoosh. This is not always desired in model railroading because it doesn't sound that attractive, hence this CV, with which an adjustment is possible to have the chuffs accentuated at high speed or rather fade away.
5.5	#272	Blow-off duration	0 – 255	10	50	An automated blow-off at start-up is more suitable in model railroading; CV #272 defines how long after the start-up the blow-off sound should be played. Value = time in tenths of a second (50 = 5 sec)! Opening the cylinder valves on a prototype steam engine to drain water is entirely up to the engineer. Note: If the blow-off sound is also allocated to a function key, the automated blow-off sound can be shortened or extended with the relevant function key (see CV #300). Automated blow-off and function key blow-off are inevitably the same sound (as per selection/allocation) **= 0**: no blow-off sound CV #272 shall be 0 at Diesel projects.

5.5	#273	Start-up delay Steam – blow-off Diesel – First start motor sound and then loco moves with delay E-Loco – first switching/controlling contactors	0 – 255	1	0 15-20	Opening the cylinder valves and with it the related blow-off sound on a real steam engine mostly starts before the engine even starts to move. This can be imitated with CV #273 by automatically delaying the start of the locomotive. The start-up delay is not valid, if shunting with acceleration deactivation is activated (see allocation of F3/F4 in CV #124) = 0: no start-up delay = 1: Special setting for blow-off via speed regulator; no start-up delay, but setting the speed to the lowest speed step causes the blow-off sound to be played without powering the motor (only possible with 128 speed steps). = 2 .. : start up delay in tenths of a second
5.5	#274	Blow-off schedule start-up whistle schedule	0 – 255	10	30	Constant opening and closing of the cylinder valves is usually prevented in real shunting operations, which often requires many short trips with associated idle times. This CV causes the blow-off sound to be suppressed if the engine wasn't standing still for the time defined here. Value in tenths of a second. NOTE: If shunting shall be done with a permanently open valve, this can be done by a function key for the blow-off (define functions with CV #312 = 2, 3, 4, …) CV #274 shall be 0 at Diesel projects.
5.6	#275	Chuff sound volume at low speed and no-load	0 – 255	10	60	Usually, but not necessarily, the perfect value for CV #275 is found by trial and error (via „incremental programming") when driving slowly. It is not necessary to keep an exact speed (at about 1/10 of the top speed), because the volume of the chuff sounds is interpolated between CV #275 and #277, depending on the actual speed. During this adjustment, CV #277 stays "0" (default), so the adjustments for „no-load" are not influenced by load factors.

To adjust the load dependency, the following steps have to be carried out in this order:

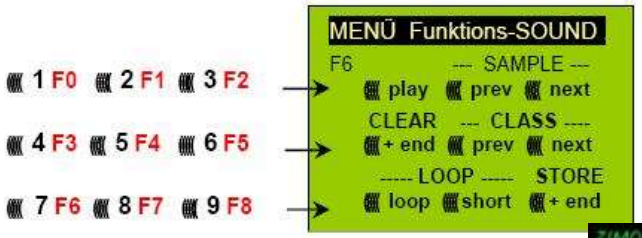
- Automatic calibration run to determine the motor's minimum load" with CV #302 = 75 and maybe 76;
- Configuration and control with CVs #275 and #276.

• Configuring CV #277 (up until now this should have been 0). • If necessary configure CV #278 and #279. • CV #275 defines the volume of the chuff sounds at base load (i.e. same conditions as in the calibration run) at about 1/10 of the top speed.						
5.6	#276	Volume at high speed and no-load	0 – 255	10	220	Same procedure as above (CV #275) but for high speed. This CV defines the minimum load chuff sound volume at full speed. Set the speed regulator to maximum during this set-up.
5.6	#277	Chuff volume changes according to load	0 – 255	10	0	When deviating from the minimum load (according to the automatic calibration run to determine the motor's minimum load, the chuff beat volume should be increasing (on inclines) and decreasing (on declines, or even muted). This CV defines the degree of change, which must be set to the proper value by trial 6 error.
5.6	#278	Load change threshold	0 – 255	10	0	With this CV, a change in volume because of small load changes can be suppressed (e.g. in curves) in order to prevent chaotic sound impressions. Suitable settings can only be determined by trial.
5.6	#279	Reaction speed when load changes	0 – 255	1	0	This CV determines how quick the sound reacts to load changes, whereby the factor is not just time, but rather "load-change dependent time" (=the bigger the change, the faster the effect). This CV is also used to suppress chaotic sound changes. Suitable settings can only be determined by trial (CV #278 and #279 together).
5.7	#280	Diesel engine, load influence	0 – 255	10	0	This CV determines the reaction of the diesel sound to load, acceleration & inclination: Diesel-hydraulic engines – higher and lower rpm's and notches Diesel-electric engines – cruise/idle rpm Diesel-mechanical – shift points =0: no influence, motor speed-dependent =255: maximum influence **Note: It is highly recommended to perform the automatic test run with CV #302 = 75 first.**

5.6	#281	Threshold for acceleration sound	0 – 255	1	1	More powerful and louder chuff sounds should be played back indicating increased power requirements during accelerations. To realize that, the prototypes get louder before the acceleration even starts (because the motor moves faster due to more steam), it is useful to activate the acceleration sound already at one speed step higher (unnoticeable for the eye), to be able to activate an appropriate sound-acceleration-sequence. This way, the engineer can adjust the driving sound according to an oncoming inclination. =1: acceleration sound (steam chuffs) in full volume, already when elevating 1 speed step. =2, 3…: acceleration sound on full volume when elevating the number of steps defined here, before that it is proportional.
5.6	#282	Duration of acceleration sound	0 – 255	10	30	After elevating the speed, the acceleration sound is played back for a little longer (if not, one would hear every speed step which would be unrealistic). Value in CV #282 = time in tenths of a second
5.6	#283	Chuff sound volume during full acceleration	0 – 255	10	255	Defines the volume of steam chuffs at maximum acceleration (default 255 = full volume). If CV #281 = 1 (acceleration threshold set to 1 speed step), the volume defined here is applied with each speed increase, even if it is just 1 step.
5.6	#284	Threshold for deceleration sound	0 – 255	1	1	Steam chuffs should be played back at less volume (or muted) signifying the reduced power requirement during deceleration. The sound reduction logic is analog to a reversed acceleration (per CVs #281 to #283). = 1: reduces sound to a minimum (as per CV #286) when speed is reduced by just 1 step. = 2, 3, ... sound reduced to a minimum after lowering speed by this number of steps.
5.6	#285	Duration of deceleration sound	0 – 255	10	30	After the speed has been reduced, the sound should remain quiet for a specific time (analog to the acceleration case). Value = time in tenths of a second

5.6	#286	Chuff sound volume during deceleration	0 – 255	10	20	Defines the chuff volume during deceleration (default 20 = rather quiet) If CV #284 = 1 (deceleration threshold set to 1 speed step), the volume defined here is applied with every reduction in speed (even if decreased by just 1 step).
5.4	#287	Brake squeal threshold	0 – 255	10	20	The brake squeal should start when the speed drops below a specific speed step. It will be stopped automatically or faded out slowly at speed 0 (based on back-EMF results)
5.4	#288	Minimum driving time before brake squeals	0 – 255	10	50	The brake squeal is to be suppressed when an engine is driven for a short time only which is usually a shunting run and often without any cars (in reality it is mostly the cars that are squealing, not the engine itself). Note: Brake squeal sounds can also be assigned to a function key (see allocation procedure per CV #300), with which the brake squeal can be started and stopped manually.
5.7	#289	Thyristor control, Stepping effect for ELECTRIC engines	1 - 255	10	1	The pitch of the thyristor sound of many engines (typical example: Taurus) does not ascend evenly but rather in steps (scale). = 1: no steps, ascends evenly = 2 - 255: ascending scale according to the corresponding speed step interval.
5.7	#290	Thyristor sound, “slow“ pitch increase for ELECTRIC engines	0 – 100	10	40	Percentage the thyristor pitch shall be higher at medium speed than at standstill. “Medium speed” as defined in CV #292. = 0: no change (concerning pitch) = 1- 99: corresponding change of the pitch = 100: double pitch already at “medium speed”.
5.7	#291	Thyristor sound, maximum pitch for ELECTRIC engines	0 – 100	10	100	Percentage the thyristor pitch shall be higher at maximum speed than at standstill. = 0: no change (concerning pitch) = 1- 99: corresponding change of the pitch = 100: double pitch

5.7	#292	Thyristor control, speed step for medium speed for ELECTRIC engines	0 – 255	10	100	Internal speed step which is defined as “medium speed“ for the sound pitch in CV #290. The CVs #290 to #292 define a three-point characteristic for the thyristor sound pitch on the basis of standstill, where the original sample is played back at any time.
5.7	#293	Thyristor control, volume at steady speed for ELECTRIC engines.	0 – 255	10	30	Volume of the thyristor control sound at no-load (no acceleration or deceleration) Note: load dependency is regulated via CV #277, but not yet with SW version 4.
5.7	#294	Thyristor control, volume during acceleration for ELECTRIC engines	0 – 255	10	100	Volume during considerable acceleration; for logical reasons, the value in CV #294 should be higher than in CV #293 (so the loco gets louder when accelerating). For smaller accelerations a lower volume is used.
5.7	#295	Thyristor control, volume during deceleration for ELECTRIC engines	0 – 255	10	50	Volume at heavier deceleration (braking); a higher or lower value compared to CV #293 can be defined here, depending on if the thyristor is affected by power regeneration (higher volume) or not (lower volume).
5.7	#296	ELECTRIC motor: maximum volume	0 – 255	10	100	Maximum volume of the motor sound, which is reached at full speed, or at the speed defined in CV #298.
5.7	#297	ELECTRIC motor: minimum volume	0 – 255	10	30	Internal speed step at which the motor sound can be first heard; at this speed step it starts quietly and reaches the maximum volume per CV #296.
5.7	#298	ELECTRIC motor: volume increase per speed step	0 – 255	10	128	Degree of increase in volume per speed step. The higher the value in this CV, the faster the increase. =255: one speed step increases volume to maximum
5.7	#299	ELECTRIC motor: pitch dependency on velocity	0 – 255 (> CV #297!)	10	100	The pitch of the motor sound rises at faster pace, if the speed increases. = 0: pitch (play back frequency) does not rise, = 1 .. 100: intermediate values = 100: double pitch, > 100: at the moment like 100; spare for SW-upgrading.

5.1	#300 *	Allocation of function keys (“CV #300 procedure”) MX31  MX32 				Pseudo programming – is activated with CV #300 = 100 -> select a chuff set = 128 -> boiling sound = 129 -> change of direction = 130 -> brake squeal = 132 -> starting whistle = 133 -> blow-off sound = 1 sound allocated on F1 = 2 sound allocated on F2 etc. = 20 sound allocated on F0 = 101 sound for random generator Z1 = 102 sound for random generator Z2 = 103 sound for random generator Z3 etc. (to Z8) = 111 sound for switch input S1 = 112 sound for switch input S2 = 113 sound for switch input S3 **See chapter “allocation of sound samples“!**
5.2	#301 *	Incremental programming of sound CVs	0,66		0	Function keys on MX31, MX32 convert to inc / dec keys in case of value 66.
5.3	#302 *	Automatic calibration run	75, 76		0	Initiated by pseudo programming CV #302 = 75 activates an automatic run to measure the minimum load in direction forward; ATTENTION: The loco (or the train) is moved automatically, therefore it is necessary to have a track that is 1.5 m (HO) to 5m (LGB) long, without inclination/slope and possibly without (tight) curves. CV # 302 = 76 Starts a calibration run in reverse direction, in case the vehicle’s construction may lead to differences in the minimum load (if not, driving backwards is handled like driving forward).
	#303	Key to activate IN1	0 - 240		0	= 1 – 16: Number of the key that activates IN1 = 32: inverts the f-key: sound on when key is off = 64: sound is looped when f-key is on = 128: sound is shortened when f-key is turned off
	#304	Key to activate IN2	0 - 240		0	See CV #303
	#305	Key to activate IN3	0 - 240		0	See CV #303
	#306	Key to activate IN4	0 - 240		0	See CV #303

5.4	#307	Entry for curve squeal	0 – 15, 128 – 143		0	The CV defines the input for the "curve squeal" sound. Value 1 to 15 (bit 0 to 3): "Reed" input 1 to 4 Value 128 (Bit 7): A function key activates the sound.
5.4	#308	Curve squeal key	0 – 255		0	Value = key that triggers the curve squeal.
3.7	#309	Braking key	1 – 28		0	Number of F-key as braking key (see CV #349 concerning braking value instead of CV #4).
5.4	#310	ON/OFF-key for driving and random sounds	0 – 29, 255		8	Select a function key that switches on/off driving sounds (chuff sounds, boiling, automatic blow-off, brake squeals) and random sounds (air pump, coal shoveling, …); at delivery this is F8. = 255: driving and random sounds are always switched on = 0: no key defined (select, if keys are needed otherwise), i.e. always active. =29: F0
5.4	#311	General ON/OFF key for function sounds	0 – 28		0	Select a key which switches those sounds on/off which are allocated to function keys (e.g. F2 – whistle, F6 – bell); at delivery this is not active. = 0: does not mean F0, but that the sounds are always active. = (#310), i.e. same value as in CV #310: with the assigned function key, all sounds are activated/deactivated completely. = 1 … 28: ON/OFF key for function sounds (independent of CV #310) Depends on the actual sound project! Default = like CV #310 for steam, = 0 for diesel

5.4	#312	Blow-off key	0 – 29		0 / 10	Select a function key which activates the blow-off sound, e.g. for shunting with “open valves”. = 0: no key assigned (select, if keys are needed otherwise) =29 -> F0 Depends on the actual sound project Default = 10 for steam, Default = 0 for diesel. NOTE: The sound should last for at least 2-3 seconds (see CV #272). It loops automatically.
	#313	Mute key	0 – 28 101 – 129		8	Fade in/out all sounds 0= no mute key 1= no mute if F1 activated, 2= no mute if F2 activated, etc. 101= mute if F1 activated, etc.
5.4	#314	Mute fade in/out time	0 – 255		0	Range in 1/10 seconds 0 = immediately; 10 (=1 sec); practical: value 45
5.8	#315	Random generator Z1 minimum interval NOTE: Random generator Z1 is optimized for air pumps, starting shortly after the train stopped. Set CV #315 and 316 to the same value (i.e. 30) and CV #154 bit 4 “on”.	0 – 255		60	The random generator randomly generates internal impulses, which activate random sounds assigned to this generator. This CV defines the smallest possible interval between two consecutive impulses. The assignment of sound samples to the random generator Z1 is done by CV #300 = 101. At delivery (default), Z1 activates the air pump at standstill.
5.8	#316	Random generator Z1 maximum interval	0 – 255		120	This CV defines the biggest possible interval between two consecutive impulses of the random generator Z1 (usually the start of the air pump at standstill); between the values of #315 and #316, the impulses are evenly distributed.
5.8	#317	Random generator Z1 duration (time in sec)	0 – 255		5	Defines the playback duration of the random sound assigned to Z1. = 0: play sample 1 time (as stored in the memory).
5.8	#318 #319 #320	As above, but for random generator Z2	0 – 255 -„- -„-		80 110 6	At delivery for STEAM, Z2 activates “coal shoveling“ at standstill.
5.8	#321 #322 #323	As above, but for random generator Z3	0 – 255 -„- -„-		40 80 5	At delivery for STEAM, Z2 activates “water pump“ at standstill.

5.8	#324 #325 #326	As above, but for random generator Z4	0 – 255 -„- -„-		40 80 5	At delivery this random generator is not used.
5.8	#327 #328 #329	As above, but for random generator Z5	0 – 255 -„- -„-		40 80 5	At delivery this random generator is not used.
5.8	#330 #331 #332	As above, but for random generator Z6	0 – 255 -„- -„-		40 80 5	At delivery this random generator is not used.
5.8	#333 #334 #335	As above, but for random generator Z7	0 – 255 -„- -„-		40 80 5	At delivery this random generator is not used.
5.8	#336 #337 #338	As above, but for random generator Z8	0 – 255 -„- -„-		40 80 5	At delivery this random generator is not used.
5.7	#339	Key to manually rising the diesel step (sound)	0 – 28		0	Function key that rises the motor sound of the diesel loco the minimum value defined in CV #340 (e.g. train heating)
5.7	#340	Diesel steps to be risen and possibly required function keys.	0 – 10		0	Thereby, every F-key corresponds to one speed step. Minimum step that the diesel sound is risen to with the function key defined in CV #339. If various keys are defined: minimum step + (16*(Number of keys – 1)).
5.8	#341	Switch input 1 sound duration	0 – 255		0	Sound sample assigned to S1 shall be played back for the duration defined here. = 0: play sample once (as saved in memory).
5.8	#342	Switch input 2 sound duration	0 – 255		0	As above for S2
5.8	#343	Switch input 3 sound duration	0 – 255		0	As above for S3
5.7	#344	Follow-up time for (motor) sound after stopping the train	0 – 255		0	After stopping the train, the fan (for example) shall run on a little longer = 0: no follow-up = 1 … 255: Follow-up 1 … 25.5 sec.
5.7	#345	Fast-switching key (F1 – F28) For the sound of POLYSYSTEM locos	1 – 19		0	Switching is possible between the first two sound sets i.e. set 1 and set 2 (solo driving loco).

5.7	#346	Kind of switching sound set	0 – 2		0	=0 -> switching set only when sound OFF =1 -> switching set when sound at standstill =2 -> switching set when sound at standstill and cruising
5.7	#347	Key “loco cruising” (1-28)	0 – 28		0	Defined function key for “loco cruising”
5.7	#348	Behavioral definition for loco cruising	0 – 31		0	When driving solo (Function key as per CV #347 is ON), the… Bit 0 = 1: Diesel sound should rev up unhindered to maximum rpm (or limited in relation to speed step as per CV #389). Bit 1 = 1: acceleration and deceleration times in CV #3 and 4 should be reduced by the amount defined in CV #390. Bit 2 = 1: motor’s idle sound should be played-back when driving at low speeds, wherein the highest speed step still playing idle sound is set in CV #391. Bit 3 = 1: deactivate 2nd smoke fan and heating element with this key (diesel loco with two engines only drives with one). Deactivate 2nd smoke fan and heating element on the each time higher output if this key is ON Bit 4 = 1: braking squeal is suppressed with this key
3.7	#349	Braking time for braking key SW version 33.25 and higher (braking key see CV #309)	0 – 255		0	Set CV #4 on a high value (50 – 254), then set CV #349 to a „usual“ braking value (like normally in CV #4). So a “sliding” of the loco can be simulated, whereby the slider is set to 0 and the loco is braked quickly with a key or with “braking thrusts”. With this, the sound of the main braking valve shall be played.
5.7	#350	Delay of tap changer sound after starting for ELECTRIC locos	0 – 255		0	The tap changer shall not be heard immediately after starting, but after a time defined here. = 0: tap changer is heard immediately at starting. = 1 … 255: switch-gear is heard 0.1 … 25.5 sec, after starting
3.23	#351	Rotating speed fan while cruising (only diesel)	0 – 255		0	PWM fan medium (255 = 100%) (cruising)

3.23	#352	Rotating speed fan when starting; SW 30.22 and higher: PWM for additional fan	0 – 255		0	PWM fan strong (255 = 100%) (load/start-up)
3.22	#353	Switch-off time of heating element of smoke generator	0 – 255		0	Switch-off time [25s] (24 = ~10min) (must be at least 1 min)
5.5	#354	Chuff sound frequency when driving slowly SW version 26.8 and higher	1 – 255			Only in combination with CV #267 (steam chuff frequency)! It balances the speed measurement (which is non-linear) for the virtual cam sensor: while CV #267 should be adjusted with speed step 10 or higher (i.e. slow, but not very slow), CV #354 corrects the steam chuff frequency for speed step 1 (i.e. very slow). = 0: no effect (frequency linear according to CV #267) = 1 .. 127: steam chuffs at speed step 1 (and extremly slow velocities) higher than in CV # 267 = 255 .. 128: steam chuffs less frequent.
3.23	#355	Fan speed at standstill SW version 26.8 and higher	0 – 255		0	Fan PWM at standstill (255 = 100%)
	#356	Speed Lock	0 – 28		0	If the key is active, the speed controller can be used to control the sound without changing the speed of the locomotive.
5.7	#357	Thyristor control Lowering volume when driving faster in ELECTRIC-locos	0 – 255		0	Internal speed step with which thyristor sound shall be quieter
5.7	#358	Thyristor control Characteristic curve of lowered thyristor sound at high speed in ELECTRIC-locos	0 – 255		0	Curve that defines how the thyristor sound is getting lower starting with CV #357. = 0: not at all = 10: about 3% softer per speed step = 255: stops at the speed step defined in CV #257.
5.7	#359	Tap changer sound duration of playback of the switchgear sound when changing speed for ELECTRIC locos	0 – 255		30	Time in seconds (0 to 25) for how long the tap changer sound shall be audible after switching steps. High-speed tap changer: max. number of steps which are played directly one after the other when switching up. After that a pause is inserted according to CV #361 before switching up further.

5.7	#360	Tap changer sound Duration of playback of the switchgear sound after the train stopped for ELECTRIC locos	0 – 255		0	Time in seconds (0 to 25) how long the tap changer sound shall be played back after the train stopped. = 0: not at all
5.7	#361	Tap changer sound Time between two playbacks for ELECTRIC locos	0 – 255		20	In case the speed is changed very often in little time, the sound would be played back too often. Minimum waiting time (0 to 25 sec) between the tap changer sounds
5.7	#362	Thyristor control Threshold when switching to a second sound for ELECTRIC locos	0 – 255		0	Speed step, at which the sound switches to the second thyristor for higher velocities = 0: no second thyristor sound
5.7	#363	Tap changer sound Number of switching steps for ELECTRIC locos	0 – 255		0	Number of switching steps over the complete range (standstill to full speed), e.g. if 10 steps are defined, the tap changer sound will be played back 10 times (internal speed steps 20, 50, 75, …) = 0: equals 5; i.e. 5 switching steps over the complete driving range
5.7	#364	Speed drop during upshifts Diesel engines with mechanical transmission	0 – 100		0	Diesel engines with mechanical transmission, this CV defines a typical drop in rpm when shifting up
5.7	#365	Upshift rpm Diesel engines with mechanical transmission	0 – 100		0	For diesel engines with mechanical transmission, defines highest rpm before shifting up
5.7	#366	Maximum sound volume of turboloader SW version 30.x and higher	0 – 64		64	
5.7	#367	Frequency dependency on driving speed	0 – 255		100	
5.7	#368	Frequency dependency on acceleration	0 – 255		100	
5.7	#369	Minimum load for turboloader to be audible	0 – 255		100	
5.7	#370	How fast the turboloader rises the frequency	0 – 255		100	
5.7	#371	How fast the turboloader lowers the frequency	0 – 255		100	
5.7	#372	Electric motor sound, volume at acceleration	0 – 255		100	
5.7	#373	Electric motor sound, volume at deceleration	0 – 255		100	
5.7	#374	Coasting key	0 – 28		0	Key that forces the sound to a specific speed, independent of the current driving situation
5.7	#375	Speed step, to which the coasting key switches the sound	0 – 10 / 255		0	0 = not active 1-10 = speed step 255 = acceleration is possible with active coasting (ONLY for diesel engines with mechanical transmission)

5.4	#376	Driving sound volume	0 – 255		255	
	#377	Only for LARGE SCALE : Overrides volume manually adjusted per potentiometer	0 – 255		0	= 0: manually adjusted value of potentiometer is valid > 0: value defined here overrides manual value on potentiometer
	#378	Switchgear sparks at acceleration	0 – 255		0	Probability of switchgear sparks at acceleration (0= always, 1= very rarely, 255= very often)
	#379	Switchgear sparks at deceleration	0 – 255		0	Probability of switchgear sparks at deceleration (0= always, 1= very rarely, 255= very often)
5.7	#380	Defining key for electric brake SW version 32.3 and higher	1 – 28		0	F1 – F28.
5.7	#381	Minimum speed step for electric brake	0 – 255		0	Below that speed step, the sound is stopped or does not start
5.7	#382	Maximum speed step for electric brake	0 – 255		0	Sound is not played back above that speed step
5.7	#383	Electric brake, sound pitch dependency of driving speed	0 – 255		0	(0 = none, 1-255=rise playback speed).
5.7	#384	Electric brake, minimum number of speed steps, that have to be reduced (scaled to 255 steps) for sound to be played back	0 – 255		0	
5.7	#385	Electric brake, activation threshold by negative engine load	0 – 255		0	0 = deactivated (only works after calibration run CV #302 = 75) 255 = 100% negative engine load (will never happen in reality), 128 = 50%, 64 = 25%, 30 = 10% etc.
5.7	#386	Electric brake	0 – 7, 8		0	Bit 3=1: play sound until the end without fading Bit 2-0 = prolongation of duration (0-7=0-7s).
5.7	#387	Diesel sound acceleration	0 – 255		0	Influence of acceleration on diesel sound steps. Defines, how a change on the controller influences the pre-running of the motor acceleration time.
5.7	#388	Diesel sound deceleration	0 – 255		0	Influence of deceleration on diesel sound step. Like CV #387, but for deceleration
5.7	#389	Driving sound loop asynchrony (= diesel sound is faster at acceleration)	0 – 255		0	Restricts, how far the diesel sound can run away at acceleration from the current speed = 0: synchronously to CV #3 / CV #4 = 255: immediately highest speed step

5.7	#390	Reduces delay times	0 – 255		0	Reduces CV#3, CV#4 if loco driving key is activated (CV #348 = 2): = 0: no reduction = 64: reduction to ¼ = 128: reduction to ½
5.7	#391	Speed threshold	0 – 255		0	Threshold up to which the diesel sound stays on ‘standstill‘ if loco driving key is active. Adds this value to all thresholds. With CV #348, Bit 2 = 0, change is always active, regardless of the loco driving key.
	#392	Sound playback duration (only MX699; also see CV #671 and #672)	0 – 255		0	Playback duration of sound activated by Reed 4
3.22 3.25 5.7	#393	ZIMO configuration 5 SW version 36.1 and higher				1 = bell activates ditchlight 2 = horn activates ditchlight 4 = high speed switchgear, sound samples are played back one after the other, not always sample 1 8 = high speed switchgear, skip beginning and end of sound sample (when looping) also at start-up, only play middle part. 16 = thyristor 2, do not rise pitch. 32 = switch SUSI to Reed input 64 = enlarges the scale of CV #267 in case of large scale models 128 = start of smoke generator diesel with 2 separate generators (only MX699). Starting sample in ZSP: set 4 pointers
3.25	#394	ZIMO configuration 4 SW version 33.14 and higher	0 – 128		0	1 = switchgear sparks on ELECTRIC locos on FO6. 2 = turn Beilhack Schneeschleuder on FO2 4 = I2C on SUSI output. 8 = deactivate stay-alive unit with GPIOC on MX645. 16 = acceleration depends on range between current and target state 32 = fade steam chuffs 64 = inhibit acceleration when braking key is active 128 = thyristor sound starts before departure

	#395	Maximum volume	0 – 255			Maximum volume for key defined in CV #396 / #397.
	#396	Key for softer volume	1 – 28			Key number
	#397	Key for louder volume	1 – 28			Key number
5.7	#398	Coasting idle number of speed steps (‘automatic coasting‘)	0 – 255		0	Define the number of speed steps (of 255) that have to be reduced in a relatively short period (about 0.5 sec) at deceleration, so the diesel sound is reduced to ‚idle/standstill‘. When reducing the speed slowly, this function is not active. The diesel engine stays ‘idle/standstill’ until acceleration.
3.17	#399	„Rule 17“	0 – 255		0	0= no function 1 – 255 = speed step at and above which the lights shall switch to high beam. See CV #430 and following!
3.17	#430	“F-key” Swiss Mapping group 1 SW 32.0 „Swiss lighting mapping”	0, 1 – 29		0	If this key is activated, the outputs defined in A1, A2 are activated. 1-28 for keys F1-F28, 29 for F0 Bit 7 = 1: invert function of F-key
3.18	#400	Input Mapping for internal F0, which F-key switches F0 SW version 30.1 and higher	0 1 – 28 29 30 – 58 59 – 87 and 101 – 128 129 130 – 158 159 – 187		0	= 0: Function key (from the DCC package) is forwarded directly to the internal function – no mapping necessary! = 1: key F1 is forwarded to internal F0. = 2: key F2 is forwarded to internal F0. …. = 28: key F28 is forwarded to internal F0. = 29: key F0 is forwarded to internal F0. = 30: key F1 to F0, only when driving forward = 31: key F2 to F0, only when driving forward …. = 59: key F0 to F0, only when driving backwards Inverting key = value + 100 (SW 30.6 and higher)
3.18	#401 … #428	Input Mapping for internal functions F1 to F28 SW 30.6 and higher	As CV #400		0	As above. If 100 is added to the values defined here, the function is inverted -> function key pressed = function off, function key not pressed = function on.
3.17	#430	“F-key”; Swiss Mapping Function key group 1 SW 32.0 and higher	0, 1 – 29		0	When this key is on, the outputs defined at A1, A2 are switched on. = 1 - 29: for key F1-F28, 29 for F0. = 128: inverts function of F-key.

3.17	#431	„M-key“; Swiss Mapping Master (global lighting key) group 1 SW 34 / 35 and higher	1 – 29 129 – 157, 255	0	If defined, the outputs of the ‚M-key‘ are not activated if the F-key is activated 0=not defined,1-28 for key F1-F28, 29 for F0. Bit 5 = 1: direction backwards, outputs of M-key on if F-key on Bit 6 = 1: direction forward, outputs of M-key on if F-key on. Bit 7 = 1: outputs of F-key only on if M-key on value 157: if F0=M-key and Bit7=1: F0 is general ON/OFF key value 255: high beam function for random F-key – ONLY if output is on and dimmed (per CV #60, CV #114, CV #152)! Dependency on CV #399: high beam from speed step defined in CV #399.
3.17	#432	A1 Fw; Swiss Mapping group 1	0, 1 – 12 14 – 15	0	First output that shall be activated in direction forward, if F-key (and M-key, only if Bit 7=1) is activated. 0=no output, 1-12=FO1-FO12, 14=FO0v, 15=FO0r. Bits 7, 6, 5 (7 possible values and 0): number of used „dimming CV“: „1“ (bit 5 = 1) = dimming according to CV #508 etc. (Dimming for Swiss Mapping)
3.17	#433	A2 Fw; Swiss Mapping group 1	0, 1 – 12 14 – 15	0	Second output that shall be activated in direction forward (the rest is like CV #432)
3.17	#434	A1 Bw; Swiss Mapping group 1	0, 1 – 12 14 – 15	0	First output that shall be activated in direction backwards (the rest is like CV #432)
3.17	#435	A2 Bw; Schweizer Mapping Gruppe 1	0, 1 – 12 14 – 15	0	Second output that shall be activated in direction backwards (the rest is like CV #432)
3.17	#436 … #441	Swiss Mapping group 2 (F-, M-key, A1 Fw, A2 Fw, A1 Bw, A2 Bw)	….	0	All 6 CVs of group 2 are adjustable like group 1
3.17	#442 … #447	Swiss Mapping group 3 (F-, M-key, A1 Fw, A2 Fw, A1 Bw, A2 Bw)	….	0	All 6 CVs of group 3 are adjustable like group 1
3.17	#448 … #453	Swiss Mapping group 4 (F-, M-key, A1 Fw, A2 Fw, A1 Bw, A2 Bw)	….	0	All 6 CVs of group 4 are adjustable like group 1

3.17	#454 … #459	Swiss Mapping group 5 (F-, M-key, A1 Fw, A2 Fw, A1 Bw, A2 Bw)	….	0	All 6 CVs of group 5 are adjustable like group 1
3.17	#460 … #465	Swiss Mapping group 6 (F-, M-key, A1 Fw, A2 Fw, A1 Bw, A2 Bw)	….	0	All 6 CVs of group 6 are adjustable like group 1
3.17	#466 … #471	Swiss Mapping group 7 (F-, M-key, A1 Fw, A2 Fw, A1 Bw, A2 Bw)	….	0	All 6 CVs of group 7 are adjustable like group 1
3.17	#472 … #477	Swiss Mapping group 8 (F-, M-key, A1 Fw, A2 Fw, A1 Bw, A2 Bw)	….	0	All 6 CVs of group 8 are adjustable like group 1
3.17	#478 … #483	Swiss Mapping group 9 (F-, M-key, A1 Fw, A2 Fw, A1 Bw, A2 Bw)	….	0	All 6 CVs of group 9 are adjustable like group 1
3.17	#484 … #489	Swiss Mapping group 10 (F-, M-key, A1 Fw, A2 Fw, A1 Bw, A2 Bw)	….	0	All 6 CVs of group 10 are adjustable like group 1
3.17	#490 … #495	Swiss Mapping group 11 (F-, M-key, A1 Fw, A2 Fw, A1 Bw, A2 Bw)	….	0	All 6 CVs of group 11 are adjustable like group 1
3.17	#496 … #501	Swiss Mapping group 12 (F-, M-key, A1 Fw, A2 Fw, A1 Bw, A2 Bw)	….	0	All 6 CVs of group 12 are adjustable like group 1
3.17	#502 … #507	Swiss Mapping group 13 (F-, M-key, A1 Fw, A2 Fw, A1 Bw, A2 Bw)	….	0	All 6 CVs of group 13 are adjustable like group 1
	#508 … #512	Dimming- (PWM)-values for Swiss Mapping SW 36.1 / 37 and higher	(0 – 31)*8 only Bits 7…3		Valid for function outputs FO0 to FO13 Bit 0 = 1: suppresses light effect Bit 1 = 1: flashing effect Bit 2 = 1: inverted flashing effect Bit 3 = 1: 32 PWM (dimming) steps
	#513	Sound number F1			Sample number of function sound on F1
5.4	#514	Function sound F1	0 – 255		**Volume setting**
	#515	Loop Info F1			Loop parameter of function sound on F1; Loop = 8; short = 64
	#516	Sound number F2			Sample number of function sound on F2
5.4	#517	Function sound F2	0 – 255		**Volume setting**
	#518	Loop Info F2			Loop parameter of function sound on F2

	#519	Sound number F3			Sample number of function sound on F3
5.4	#520	Function sound F3	0 – 255		**Volume setting**
	#521	Loop Info F3			Loop parameter of function sound on F3
	#522	Sound number F4			Sample number of function sound on F4
5.4	#523	Function sound F4	0 – 255		**Volume setting**
	#524	Loop Info F4			Loop parameter of function sound on F4
	#525	Sound number F5			Sample number of function sound on F5
5.4	#526	Function sound F5	0 – 255		**Volume setting**
	#527	Loop Info F5			Loop parameter of function sound on F5
	#528	Sound number F6			Sample number of function sound on F6
5.4	#529	Function sound F6	0 – 255		**Volume setting**
	#530	Loop Info F6			Loop parameter of function sound on F6
	#531	Sound number F7			Sample number of function sound on F7
5.4	#532	Function sound F7	0 – 255		**Volume setting**
	#533	Loop Info F7			Loop parameter of function sound on F7
	#534	Sound number F8			Sample number of function sound on F8
5.4	#535	Function sound F8	0 – 255		**Volume setting**
	#536	Loop Info F8			Loop parameter of function sound on F8
	#537	Sound number F9			Sample number of function sound on F9
5.4	#538	Function sound F9	0 – 255		**Volume setting**
	#539	Loop Info F9			Loop parameter of function sound on F9
	#540	Sound number F10			Sample number of function sound on F10
5.4	#541	Function sound F10	0 – 255		**Volume setting**
	#542	Loop Info F10			Loop parameter of function sound on F10
	#543	Sound number F11			Sample number of function sound on F11
5.4	#544	Function sound F11	0 – 255		**Volume setting**
	#545	Loop Info F11			Loop parameter of function sound on F11
	#546	Sound number F12			Sample number of function sound on F12
5.4	#547	Function sound F12	0 – 255		**Volume setting**
	#548	Loop Info F12			Loop parameter of function sound on F12
	#549	Sound number F13			Sample number of function sound on F13
5.4	#550	Function sound F13	0 – 255		**Volume setting**

	#551	Loop Info F13			Loop parameter of function sound on F13
	#552	Sound number F14			Sample number of function sound on F14
5.4	#553	Function sound F14	0 – 255		**Volume setting**
	#554	Loop Info F14			Loop parameter of function sound on F14
	#555	Sound number F15			Sample number of function sound on F15
5.4	#556	Function sound F15	0 – 255		**Volume setting**
	#557	Loop Info F15			Loop parameter of function sound on F15
	#558	Sound number F16			Sample number of function sound on F16
5.4	#559	Function sound F16	0 – 255		**Volume setting**
	#560	Loop Info F16			Loop parameter of function sound on F16
	#561	Sound number F17			Sample number of function sound on F17
5.4	#562	Function sound F17	0 – 255		**Volume setting**
	#563	Loop Info F17			Loop parameter of function sound on F17
	#564	Sound number F18			Sample number of function sound on F18
5.4	#565	Function sound F18	0 – 255		**Volume setting**
	#566	Loop Info F18			Loop parameter of function sound on F18
	#567	Sound number F19			Sample number of function sound on F19
5.4	#568	Function sound F19	0 – 255		**Volume setting**
	#569	Loop Info F19			Loop parameter of function sound on F19
	#570	Sound number F0			Sample number
5.4	#571	Function sound F0	0 – 255		**Volume setting**
5.4	#573	Sound number boiling			Sample number
5.4	#574	Boiling	0 – 255		**Volume setting**
5.4	#575	Sound number change of direction			Sample number
5.4	#576	Change of direction	0 – 255		**Volume setting**
5.4	#577	Sound number brake squeal			Sample number
5.4	#578	Brake sqeal	0 – 255		**Volume setting**
5.4	#579	Sound number thyristor sound			Sample number
5.4	#580	Thyristor sound	0 – 255		**Volume setting**
5.4	#581	Sound number starting whistle			Sample number
5.4	#582	Starting whistle	0 – 255		**Volume setting**
5.4	#583	Sound number blow-off			Sample number

5.4	#584	Blow-off	0 – 255		**Volume setting**
5.4	#585	Sound number E-motor			Sample number
5.4	#586	E-motor	0 – 255		**Volume setting**
5.4	#587	Sound number rolling sound			Sample number
5.4	#588	Rolling sound	0 – 255		**Volume setting**
5.4	#589	Sound number switchgear			Sample number
5.4	#590	Switchgear	0 – 255		**Volume setting**
5.4	#591	Sound number thyristor 2			Sample number
5.4	#592	Thyristor 2	0 – 255		**Volume setting**
5.4	#593	Sound number panto up			Sample number
5.4	#594	Panto up	0 – 255		**Volume setting**
5.4	#595	Sound number panto down			Sample number
5.4	#596	Panto down	0 – 255		**Volume setting**
5.4	#597	Sound number panto hitting fork			Sample number
5.4	#598	Panto hitting fork	0 – 255		**Volume setting**
5.4	#599	Sound number turbo			Sample number
5.4	#600	Turboloader	0 – 255		**Volume setting**
5.4	#601	Sound number Dynamic Break			Sample number
5.4	#602	Dynamic Break	0 – 255		**Volume setting**
5.4	#603	Sound number curve squeal			Sample number
5.4	#604	Curve squeal	0 – 255		**Volume setting**
5.4	#671	Sample number Reed 4 (**only MX699**; playback duration see CV #392)			Sample number of the sound that shall be played back by Reed 4
5.4	#672	Reed 4 Sound (**only MX699**)			**Volume setting**
5.4	#673	Sound number F20			Sample number of function sound on F20
5.4	#674	Function sound F20	0 – 255		**Volume setting**
5.4	#675	Loop Info F20			Loop parameter of function sound on F20
5.4	#676	Sound number F21			Sample number of function sound on F21
5.4	#677	Function sound F21	0 – 255		**Volume setting**
5.4	#678	Loop Info F21			Loop parameter of function sound on F21
5.4	#679	Sound number F22			Sample number of function sound on F22
5.4	#680	Function sound F2	0 – 255		**Volume setting**

5.4	#681	Loop Info F22			Loop parameter of function sound on F22
5.4	#682	Sound number F23			Sample number of function sound on F23
5.4	#683	Function sound F23	0 – 255		**Volume setting**
5.4	#684	Loop Info F23			Loop parameter of function sound on F23
5.4	#685	Sound number F24			Sample number of function sound on F24
5.4	#686	Function sound F24	0 – 255		**Volume setting**
5.4	#687	Loop Info F24			Loop parameter of function sound on F24
5.4	#688	Sound number F25			Sample number of function sound on F25
5.4	#689	Function sound F25	0 – 255		**Volume setting**
5.4	#690	Loop Info F25			Loop parameter of function sound on F25
5.4	#691	Sound number F26			Sample number of function sound on F26
5.4	#692	Function sound F26	0 – 255		**Volume setting**
5.4	#693	Loop Info F26			Loop parameter of function sound on F26
5.4	#694	Sound number F27			Sample number of function sound on F27
5.4	#695	Function sound F27	0 – 255		**Volume setting**
5.4	#696	Loop Info F27			Loop parameter of function sound on F27
5.4	#697	Sound number F28			Sample number of function sound on F28
5.4	#698	Function sound F28	0 – 255		**Volume setting**
5.4	#699	Loop Info F28			Loop parameter of function sound on F28
	#724	Set of the high speed tap changer SW 37.26 and higher			Swap between higspeed tap changer set (like between sound sets with CV #265)
5.4	#726	Trigger Sound …	0 – 255		Sound number for connection 1
	#727	… on FO			Function output for connection 1: 1=FO0v,2=FO0r, 3=FO1, 4=FO2…14=FO12 and 255=additional fan for smoke generator).
	#728	Trigger Sound …	0 – 255		Sound number for connection 2
	#729	… on FO			Function output for connection 2 (values see CV #727)
	#730	Trigger Sound …	0 – 255		Sound number for connection 3
	#731	… on FO			Function output for connection 3 (values see CV #727)
	#732	Trigger Sound …	0 – 255		Sound number for connection 4

	#733	… on FO			Function output for connection 4 (values see CV #727)
	#734	Trigger Sound …	0 – 255		Sound number for connection 5
	#735	… on FO			Function output for connection 5 (values see CV #727)
	#736	Trigger Sound …	0 – 255		Sound number for connection 6
	#737	… on FO			Function output for connection 6 (values see CV #727)
	#738	Sample number			Sample number according to sample information, for switch input S1
5.4	#739	Sound switch input S1	0 – 255		**Volume setting**
	#740	Sample number			Sample number for S2
5.4	#741	Sound switch input S2	0 – 255		**Volume setting**
	#742	Sample number			Sample number for S3
5.4	#743	Sound switch input S3	0 – 255		**Volume setting**
	#744	Sample number			Sample number according to sample information for random sound Z1
5.4	#745	Random sound Z1 (most of the time air pump / compressor)	0 – 255		**Volume setting**
	#746	Random sound Z1 – Loop Info			Loop parameters of random sound Z1; Loop = 8; short = 64
	#747	Sample number			Sample number for Z2
5.4	#748	Random sound Z2	0 – 255		**Volume setting**
	#749	Random sound Z2 – Loop Info			Loop parameters of random sound Z2
	#750	Sample number			Sample number for Z3
5.4	#751	Random sound Z3	0 – 255		**Volume setting**
	#752	Random sound Z3 – Loop Info			Loop parameters of random sound Z3
	#753	Sample number			Sample number for Z4
5.4	#754	Random sound Z4	0 – 255		**Volume setting**
	#755	Random sound Z4 – Loop Info			Loop parameters of random sound Z4
	#756	Sample number			Sample number for Z5
5.4	#757	Random sound Z5	0 – 255		**Volume setting**
	#758	Random sound Z5 – Loop Info			Loop parameters of random sound Z5
	#759	Sample number			Sample number for Z6

5.4	#760	Random sound Z6	0 – 255		**Volume setting**
	#761	Random sound Z6 – Loop Info			Loop parameters of random sound Z6
	#762	Sample number			Sample number for Z7
5.4	#763	Random sound Z7	0 – 255		**Volume setting**
	#764	Random sound Z7 – Loop Info			Loop parameters of random sound Z7
	#765	Sample number			Sample number for Z8
5.4	#766	Random sound Z8	0 – 255		**Volume setting**
	#767	Random sound Z8 – Loop Info			Loop parameters of random sound Z8
5.3	#777	Results of the clibration run			PWM slowly forward
5.3	#778	Results of the measuring run			PWM fast forward
5.3	#779	Results of the measuring run			PWM slowly backward
5.3	#780	Results of the measuring run			PWM fast backward
3.17	#800 … #805	Swiss Mapping group 14 (F-, M-key, A1 Fw, A2 Fw, A1 Bw, A2 Bw)	….	0	All 6 CVs of group 14 are adjustable like group 1
3.17	#806 … #811	Swiss Mapping group 15 (F-, M-key, A1 Fw, A2 Fw, A1 Bw, A2 Bw)	….	0	All 6 CVs of group 15 are adjustable like group 1
3.17	#812 … #817	Swiss Mapping group 16 (F-, M-key, A1 Fw, A2 Fw, A1 Bw, A2 Bw)	….	0	All 6 CVs of group 16 are adjustable like group 1
3.17	#818 … #823	Swiss Mapping group 17 (F-, M-key, A1 Fw, A2 Fw, A1 Bw, A2 Bw)	….	0	All 6 CVs of group 17 are adjustable like group 1
	#824	Key that is inverted by IN1			IN1 inverts the function of the key (key itself can invert the function)
	#825	Key that is inverted by IN2			IN2
	#826	Key that is inverted by IN3			IN3
	#827	Key that is inverted by IN4			IN4
	#828	Steam chuff cycle for set+1			Steam chuff cycle as in CV #267 but for set+1
	#830	Braking distance forward high			Braking distance with HLU, ABC, DC: value 1 for driving forward
	#831	Braking distance forward low			Same as above, but for value 2
	#832	Braking distance backward high			Braking distance with HLU, ABC, DC: value 1 for driving backward

	#833	Braking distance backward low			Same as above, but for value 2
	#834	Turbo dependence on acceleration	0 – 28	0	Reduces the dependence of the turbo sound on the acceleration (less loud).
	#835	Number of sets + key	0 -		Number of all set switching keys. These keys are always sorted one after the other, starting with the key defined in CV #345.
	#836	Sound configuration SW 37.16 and higher	0		Bit 0 = Locomotive should not start as long as the „Stand“ Sound has not been played yet.
	#837	Deactivate Scripts SW 37.16 and higher			Bit 0 = deactivates script 1; Bit 1 = deactivates script 2; Bit 2 = deactivates script 3; Bit 3 = deactivates script 4 …
	#840	Functions in analog modus			Selection of the function keys (F13 - F20) that shall be switched on in analog mode. For F1 - F12 see CVs #13 and 14.
	#841	Functions in analog modus			Selection of the function keys (F21 - F28) that shall be switched on in analog mode.
	#980 ... #1019	Script CVs, siehe Changelog ZSP			Values of these CVs are read by scripts. So values can be changed in scripts loaded in the decoder.

CVs for switching decoders

Some CVs of the switching decoders have a different meaning than in driving decoders!

CV	Denomination	Area	Default	Description
# 33 # 34 # 35 # 36 # 37 # 38 # 39 # 40 # 41 # 42 # 43 # 44 # 45 # 46	Function Mapping		1 2 4 8 2 4 8 16 0 0 0 0 0 0	“Function mapping” according to NMRA-DCC standard: # 33 - 42 = 1, 2, 4, ... : By default, the outputs are set to F0 etc., i.e. headlights are direction dependent and can be activated by pressing F0 (key 1 or L); further outputs on one key each. At the most, 6 function outputs are available, and the “free” bits on the left are added on the right side starting with CV #37. Therefore “lower” outputs can be reached by higher functions. See table “NMRA function mapping”
#61				NO effect!
#64	Short SECOND ADDRESS	1 - 127	0	The “short“ (1-byte) second address; it is active, if CV #112, Bit 5 = 0.
#67 + #68	Extended SECOND ADDRESS	128 - 10239	0	The “extended“ (2-byte) second address; it is active, if CV #112, Bit 5 = 1 NOTE: Contrary to the long first address in CVs #17 & 18, the second address is not calculated automatically by the controller. Alternatively, the second address can be programmed into CVs #17&18, and then transferred to CVs #67&68.
#69 to #82	Function Mapping for the second address # 69 for F0 front # 70 for F0 back # 71 for F1 # 72 for F2 # 73 for F3 # 74 for F4 # 75 for F5 # 76 for F6 # 77 for F7		 1 2 4 8 2 4 8 16 0	These 12 CVs form a matrix which defines which function (function key on the controller) is addressed in case the decoder is operated via the singular function outputs of the decoder.

	# 78 for F8 # 79 for F9 # 80 for F10 # 81 for F11 # 82 for F12		0 0 0 0 0	
#83	Modification of light effects	0 - 9	5	Ditch lights modification of turn-off times
#112	Special ZIMO configuration bits	0,8,323,40	2	Bit 1 and Bit 3 as driving decoders Bit 5 = 0: selection between „short“ and = 1: „long“ address

Bit 0: value 0 or 1
Bit 1: value 0 or 2
Bit 2: value 0 or 4
Bit 3: value 0 or 8
Bit 4: value 0 or 16
Bit 5: value 0 or 32
Bit 6: value 0 or 64
Bit 7: value 0 or 128

NMRA Standard (dark grey) and “turned over bits“ (light grey):

NMRA function	CV first address	CV second address	Function outputs of MX68x								
			FA6	FA5	FA4	FA3	FA2	FA1	Stirn hinten	Stirn vorne	
			7	*6*	*5*	*4*	*3*	*2*	*1*	*0*	*BIT*
F0	# 33	*# 69*	128	64	32	16	8	4	2	1	WERT
F0	# 34	*# 70*	128	64	32	16	8	4	2	1	WERT
F1	# 35	*# 71*	128	64	32	16	8	4	2	1	WERT
F2	# 36	*# 72*	128	64	32	16	8	4	2	1	WERT
F3	# 37	*# 73*	16	8	4	2	1	128	64	32	WERT
F4	# 38	*# 74*	16	8	4	2	1	128	64	32	WERT
F5	# 39	*# 75*	16	8	4	2	1	128	64	32	WERT
F6	# 40	*# 76*	16	8	4	2	1	128	64	32	WERT
F7	# 41	*# 77*	2	1	128	64	32	16	8	4	WERT
F8	# 42	*# 78*	2	1	128	64	32	16	8	4	WERT
F9	# 43	*# 79*	2	1	128	64	32	16	8	4	WERT
F10	# 44	*# 80*	2	1	128	64	32	16	8	4	WERT
F11	# 45	*# 81*	2	1	128	64	32	16	8	4	WERT
F12	#46	*#82*	2	1	128	64	32	16	8	4	WERT