eMOTION L
Decoder

Version1.0 - 02/08

Summary

1. General and Safety Details

Congratulations on your purchase of an eMOTION L Decoder. The eMOTION L Decoder is an exceptional, high-performance Digital Decoder designed for G-Scale by Massoth Elektronik GmbH, Germany. We highly recommend reading this manual and the documentation carefully and thoroughly before operating your eMOTION L Decoder.

Massoth Elektronik GmbH used the latest in technology in designing and manufacturing the eMOTION L Decoder. Excellent operation at all times is assured by the high safety standard in data processing and by delivering an exceptional power output and performance. Future alterations of the DCC standards are easily implemented into the eMOTION L Decoder by updating. The latest Flash-Technology is utilized in the eMOTION L Decoder to provide a safe and consumer-friendly operation during updating.

2. Important Information for Operation

Install your decoder in compliance with the connecting diagram in this manual. The decoder is protected against shorts and excessive loads. However, in case of a connection error e.g. a short between a light and the motor, this safety feature cannot work and the decoder will be destroyed subsequently.

The decoder is originally programmed on address #3 with 14 speed steps. In case you want to use a high address, you have to program CV17, CV18, and CV29 accordingly. If you want to use 28 speed steps you need to set CV29-Bit1 to "2". Otherwise the lights might not work or may flicker.

2.1.Properties of the eMOTION L Decoder

Decoder functions:
- Loco decoder for digital and analog Operation
- Motor output max. 1,8 Amps (1 motor)
- 2 Light outputs with max. 500mAmps each (front, rear)
- 6 Function outputs (2 with 500mAmps each (F1-2), 4 with 50mAmps each (F3-6))
- Overload and temperature protection for motor and functions
- Hook-up by cable, mini-connectors and soldering pads

Digital and Analog Features:
- 10239 loco addresses available
- 14, 28, 128 speed steps
- programmable driving curve
- Start-, mid-, and maximum speed adjustable
- Acceleration- and deceleration settings adjustable
- Motor frequency adjustable
- Back-EMF in digital and analog operation

- 16 selectable functions according to NMRA
- Switching speed and delay time selectable with function key
- Parallel and serial control of all light and function outputs
- Control of parallel updated modules (LGB®)
- Easy function mapping with direction assignment
- Programmable flashing light function and short term function
- Dimmable light and function outputs, activatable in analog
- Output for a RC-Servo
- Many settings may be used analog too
- Reset function for all CV-values
- Bus interface for MASSOTH and LGB® modules

2.2.General Hook-Up

Please note the colour code of the cables and the pin assignment in the illustration below:
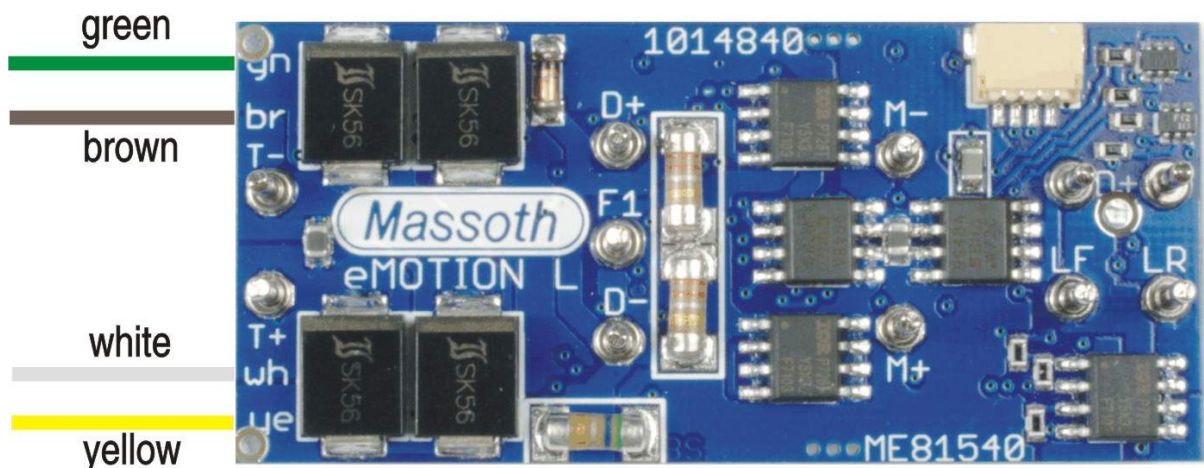
Illustration 1: eMOTION L Decoder hook-up

The colour coded cables connect as follows:

YELLOW	**= Motor +**	
WHITE	**= Track +**	(lh track in driving direction)
BROWN	**= Track -**	(rh track in driving direction)
GREEN	**= Motor -**	
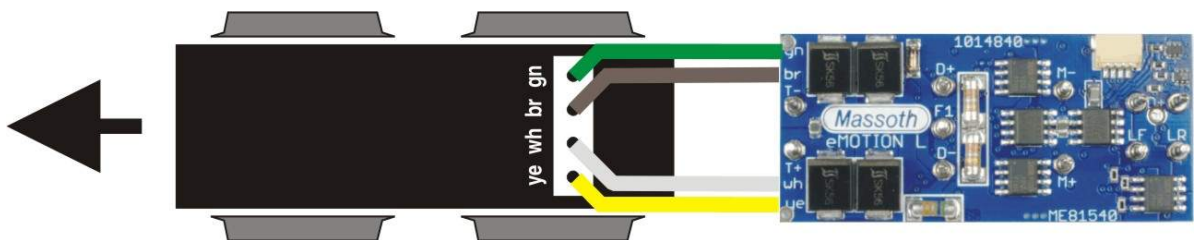
Illustration 2: eMOTION L hook-up to a LGB® gear box

2.2.1. Hook-Up to a LGB® gear box (Illustration 2)

All current LGB® gear boxes feature 4 contact pins on the upper side. To utilize these gear boxes for digital operation the pins must be connected to the eMOTION XLS Sound Decoder according to the schematic below. Older versions of LGB® gear boxes have only 3 contact pins. These gear boxes need to be changed for digital

operation. One pin is connected to the motor **and** the track. This connection needs to be disconnected as the motor and the track must be isolated for digital operation.

2.3.Pin Connectors on the Upper Surface

The eMOTION L decoder conforms to the pin arrangement of the LGB**®** 55021 decoder. Therefor the eMOTION L decoder may be installed in LGB**®** locomotives that are equipped with a direct-decoder interface. The cable 55026 may be utilized with older interfaces as well (Illustration 4).

The decoder features two light outputs for front light and rear light which are activated according to the driving direction. Please observe the maximum current for each output: 500mAmps/output. Light bulbs and other consumer loads (e.g. smoke generator) are connected to Dec+ and the respective output (LF, LR or F1, see illustration 5). Light bulbs and smoke generators used must be suited for 24 Volts. In case 5Volt bulbs and smoke generators are used, please see in "Advanced Functions" (Chapter 3.3) for the correct output setting.
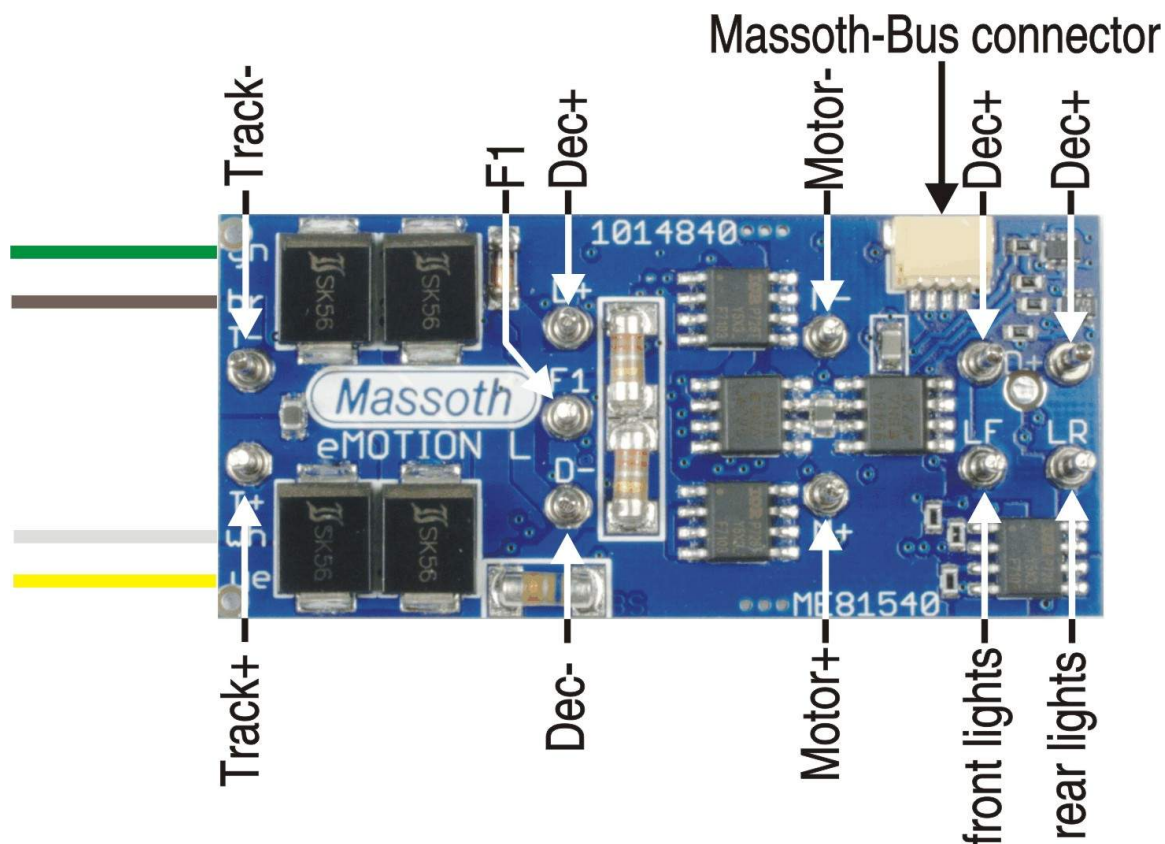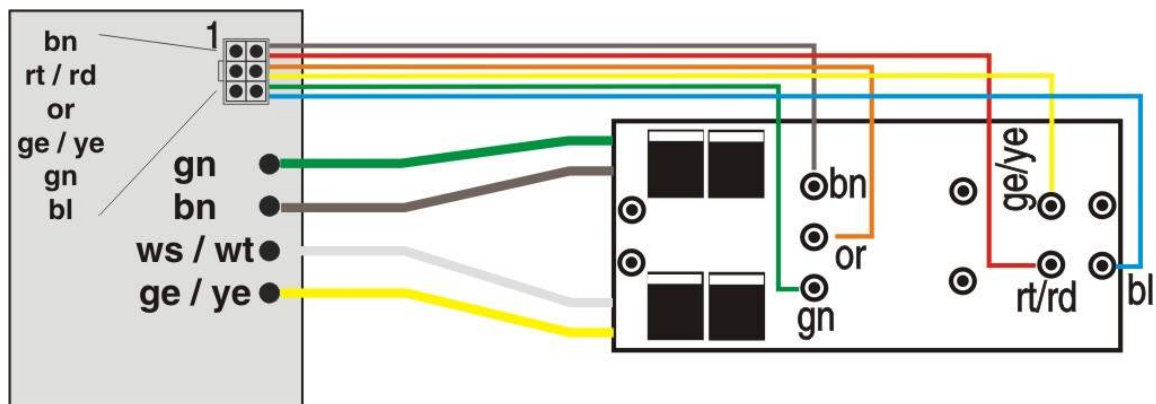
Illustration 3: Pin Assignment Upper Surface

Illustration 4: Hook-Up to a LGB®- Interface
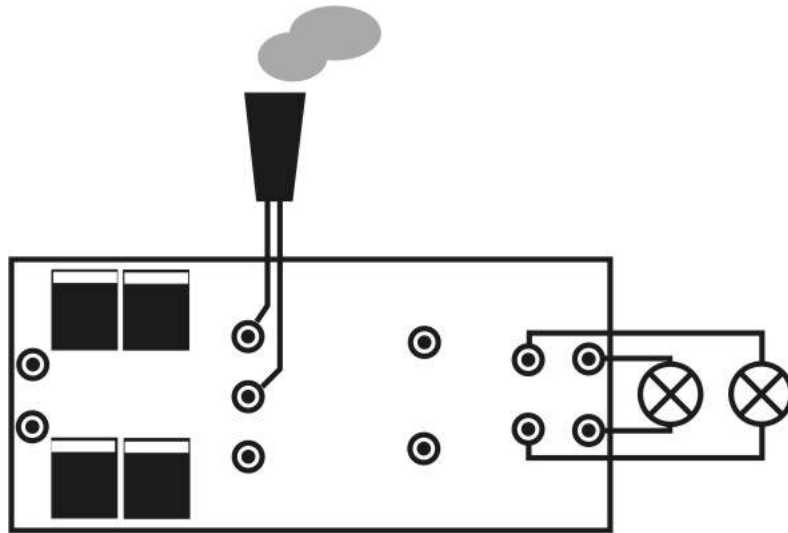
Illustration 5: Hook-Up of Light Bulbs and Smoke Generator

2.4.Basic Factory Settings:

- **CV1 = 3 (loco address)**
- **Light outputs adjusted to full track voltage** (for 19/24 Volt bulbs)
- **Switching Speed on/off by F8** (half speed)
- **Functions Outputs F1 to F6 mapped to Function Keys F1 to F6**
- **CV29 = 4 (to comply with 14 speed steps for MTS)** For 28 speed steps, CV29 must be set to "6".

Note: The light function depends on the selected speed step setting. In case the setting in CV29 is not identical to the setting of the digital control system, the lights may flicker or may not work at all. (Irrelevant when using 128 speed steps).

2.5.Installation
The decoder MUST NOT touch any metallic constructional elements. This may lead to short circuits and to the destruction of the decoder subsequently. Attach the decoder with double-sided tape to the locomotive body or utilize the MASSOTH decoder bracket #8104010.

3.   Advanced Settings
The eMOTION L decoder delivers a plentitude of functions when compared to the LGB® 55021 decoder : 5 additional function outputs, 1 output for the control of a RC servo, 1 bus interface and a great number of additional programming options.

3.1.Soldering Pads on the Lower Surface (Illustr. 6)
The lower surface of the eMOTION L decoder is fitted with 6 additional soldering pads for the function outputs F2, F3, F3S, F4, F5, and F6.
Please observe that the outputs F2, F3, F3S, F4, F5, and F6 are restricted to 50mAmps each.
F3S is reserved for RC servo control only. No other kind of consumer load must be connected to this output!

Illustration 6: Soldering Pads on the Lower Surface

3.2. MASSOTH Bus Interface
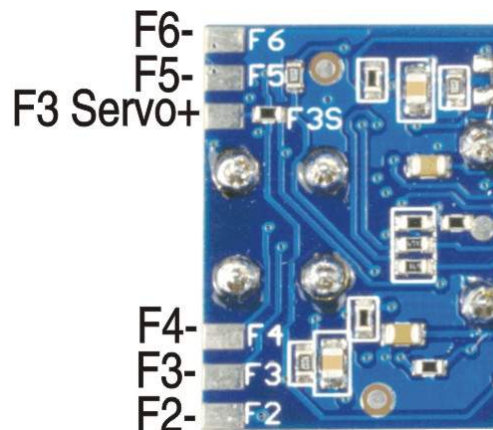
The MASSOTH bus interface connects to components with special digital control functions, e.g. the MASSOTH Pulse Smoke Generator.

3.3. Function Outputs

The eMOTION L Decoder is fitted with 1 function output on the upper surface (pin) and 5 additional soldering pads on the lower surface. All light outputs are set to 24Volts as default. This means, at 24Volts track voltage the function outputs 1 to 6 deliver 24Volts, if activated.

The outputs 3 to 6 are restricted to max. 50mAmps. The output voltage as well as the function of the light and function outputs may be set by programming (function key allocation, direction sensitivity, flashing function and short-term function). See the CV list for further details. The outputs may be controlled by NMRA-DCC commands as well as with serial LGB® pulse chain commands. The light outputs and the function outputs F1 to F4 are dimmable.

3.3.1. Serial Pulse Chain for LGB®- Interface

The factory default setting of the eMOTION L decoder provides serial and parallel data processing. Therefor the decoder may be utilized with all NMRA digital systems. The serial data processing mode may be deactivated, thus eliminating the brief waiting period of 0.5 secs with F1 (utilizing the mixed operation serial/parallel). The F1 function will be triggered instantly.

Special settings for serial pulse chain or parallel function data processing:

CV49 = 2 : Parallel function triggering only
CV49 = 3 : Serial and parallel function triggering
CV49 = 11 : Serial pulse chain on F1 for 6pole LGB®- Interface with sound module (Illustr. 4)
CV49 = 11 : Valid, too, for special P-Updates of LGB®- sound modules.

3.3.2. RC Servo Hook-Up (Illustr. 7)

The eMOTION L decoder is fitted with a special F3S output which is only usable for RC servo operation. This output is activated if F3 is programmed for RC operation. **In this case the F3 output cannot be utilized as a regular output.**

RC servos are especially suited for point-to-point movements (e.g. de-coupler, pantograph) or circular motions. The RC servo needs a 5Volt regulator additionally and the control commands of the decoder.

The end-positions are defined in CVs. In case the function is switched "ON", the servo is positioned in one of the end-positions, in case the function is "OFF", the servo will travel to the opposite end-position.

In addition the travel speed may be adjusted.
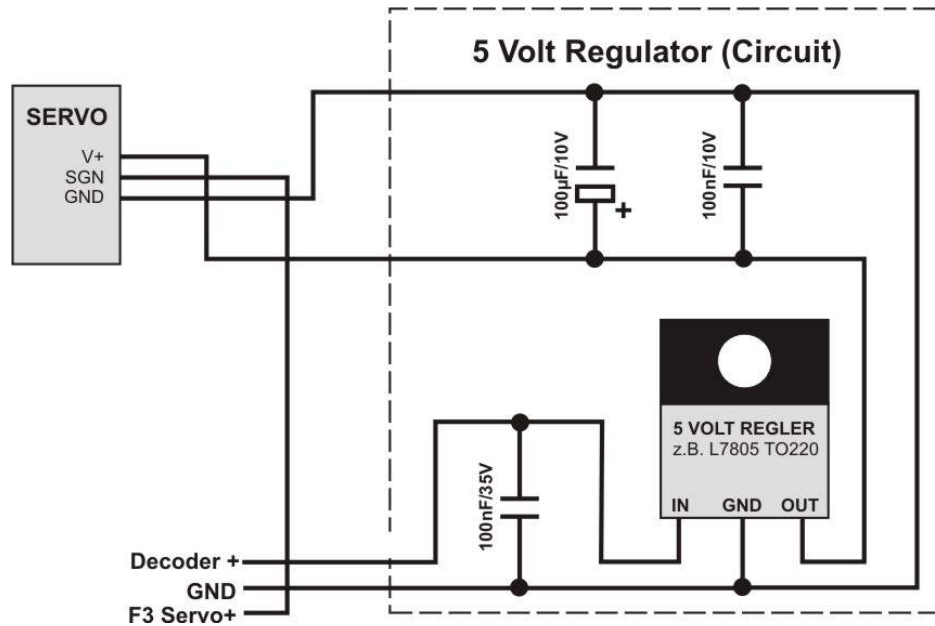
Illustration 7: Hook-Up of a RC Servo

3.3.3. Hook-Up of a Power Buffer

A power buffer may be installed to improve the operational reliability. The buffer connects to "Dec+" and "Dec-".
The charging current must not exceed 500 mAmps.

Analog operation must be disabled with a power buffer connected to the eMOTION L Decoder otherwise the decoder recognizes the power buffer as an analog power supply (CV29 bit2).

The power buffer must be switched off during programming.

The MASSOTH Power Buffers (#8151001 or #8151501) are switched off automatically during programming if you connect the white control line to "F5" with the power buffer control function activated in CV118 = 31. Then the F5 output cannot be used for other purposes.

3.4. Motor Output

Depending on which digital system utilized different speed steps may be used. The more steps are used the smoother the locomotive responds to the throttle. In Garden G-Scale 14 speed steps are used and 28 speed steps are recommended if supported by the digital system.

- The direction of driving (including the direction related functions) can be reversed by setting CV29 - bit0 accordingly.
- Three settings of speed control are available:
  14 speed steps (CV29 – bit1 = Off)
  28 speed steps (CV29 – bit1 = On)
  128 speed steps (is detected automatically)

  Using the eMOTION L with LGB® MTS I or II requires a 14 speed step setting. This is the factory default setting of the decoder.

Several CV settings in the eMOTION L Decoder influence the acceleration and deceleration characteristics of the locomotive. The acceleration/deceleration characteristic is defined by 2 CVs:

- Acceleration delay (CV3)
- Deceleration delay (CV4)

The time lag between speed 0 and the maximum speed (or reverse) is 0.5 sec if the setting is "1", maximum possible is 128 sec (setting "255"). Simply divide your desired time delay by "2" to acquire the respective CV setting.

Driving Curve
The speed characteristic of the locomotive is defined by the driving curve which is programmed by 3 CVs. The standard driving curve is linear.
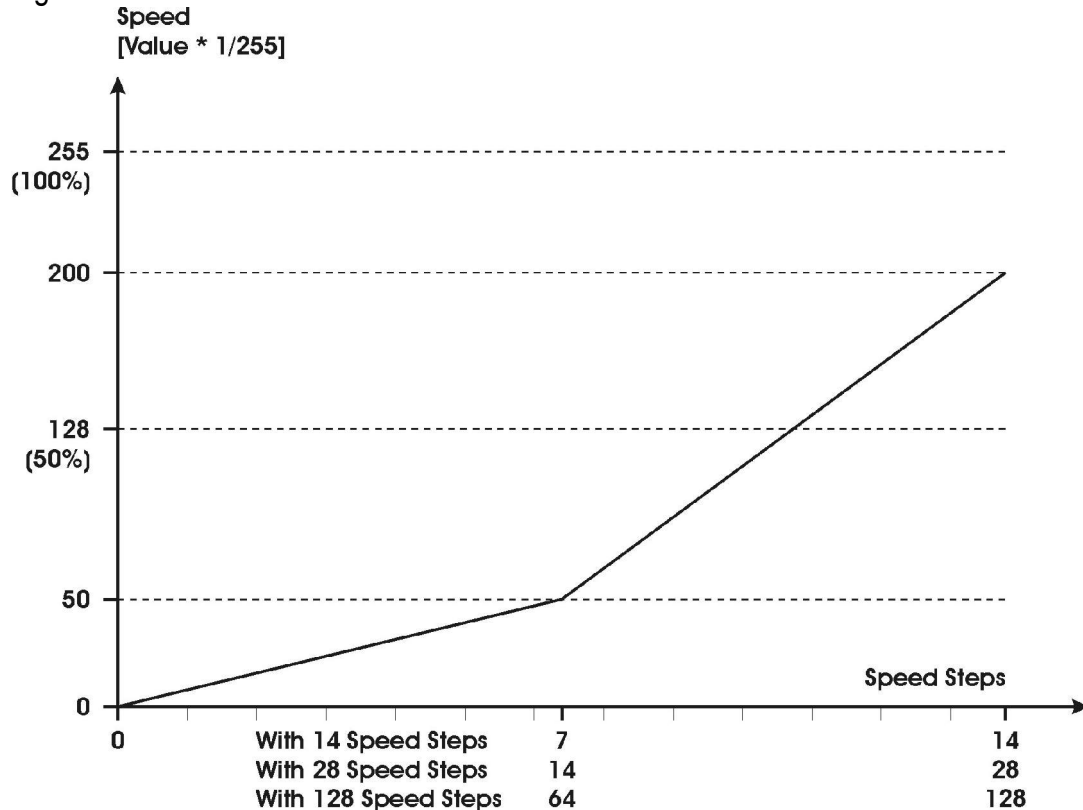
llustration 8: Internal Driving Curve of the eMOTION XLS Sound Decoder, Adjustable with CV2 (Starting Voltage), CV5 (Maximum Speed), CV6 (Mid Speed)

Recent decoders like the eMOTION L Decoder feature 3 CVs to define the speed parameters. The basic setting of the eMOTION L Decoder is shown in the illustration above.
- The start voltage (CV2) defines the driving voltage of speed step1. The smaller the voltage the slower the locomotive drives. If the PI-Load Control is "off" and the locomotive does not move in speed step 1, the start voltage should be increased.
- The maximum speed (CV5) may be reduced by inserting smaller values.
- The mid-speed (CV6) defines how many speed steps are available. In case CV6 is half of the value of CV5, all speed steps are distributed equally. In case CV6 is smaller than half the value of CV5 the locomotive will drive slower at mid-speed; the slow speed range will be stretched.

As an alternative you may program the driving curve individually in 28 speed steps (CV67 - CV94). This driving curve is activated by CV29- bit4. In this case the CVs 2, 5, and 6 are deactivated!

Motor Control Frequency
Basically the motor runs quieter and smoother when the control frequency is increased. The motor control frequency is defined in 4 steps by CV9. At 24 kHz the motor is operated at its optimum and runs very quiet. A

few types of motors may require a lower setting if they do not run smoothly or get hot. The integrated load control works only with 24 kHz. The eMOTION L Decoder is usable with all kinds of DC motors.

Load Control

The eMOTION L Decoder monitors the driving performance of the locomotive and regulates the driving voltage. The load control governs the speed of the locomotive regardless of up or down grades or the length of the train. This means the decoder delivers more voltage to the motor(s) if the locomotive is running uphill in order to keep the speed constant. The eMOTION L Decoder is equipped with a state-of-art integrated PI-Load Control (proportional-integral) that can be programmed efficiently by 3 CVs. These 3 CVs define the characteristics of the PI-Load Control by the following parameters: maximum re-adjustment factor (allowed readjustment per adjustment interval), re-adjustment retardation (frequency of the adjustment intervals), and maximum re-adjustment strength (maximum re-adjustment to the speed setpoint).
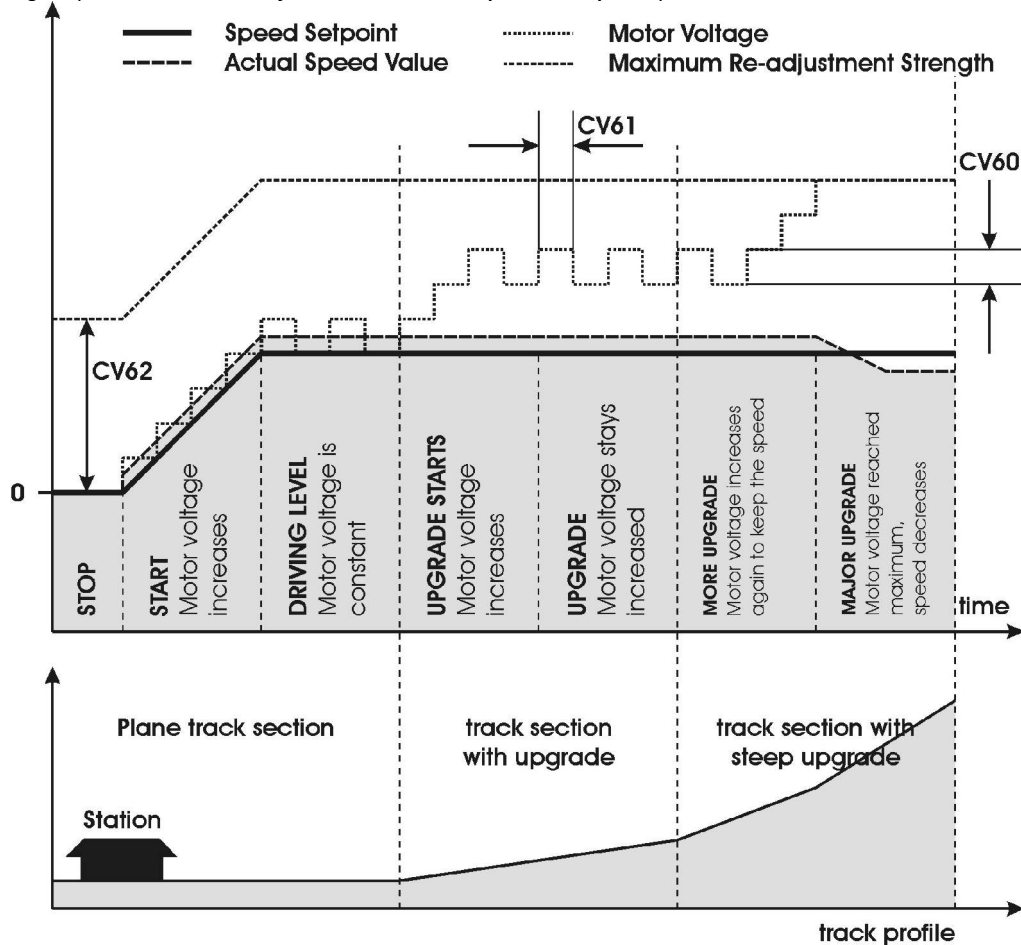
Illustration 9: Operating Modes of the PI-Load Control

Maximum Re-Adjustment Factor (CV60)

The maximum re-adjustment factor sets the range of change per re-adjustment interval for the motor voltage (see CV61), input range is 0 … 255. The larger the value the more aggressive the decoder will react to load changes. In the most extreme cases the locomotive will overcontrol and tend to drive jerky during load changes.

Re-Adjustment Retardation (CV61)

The re-adjustment retardation defines how often the eMOTION L Decoder is allowed to re-adjust per second. Increasing the value means an increase of re-adjustments per second. The eMOTION L Decoder is able to perform up to 4000 adjustments per second. The basic setting is "60". This results in a leisurely and realistic control characteristic. Formula: 4000/(CV-value) = Number of adjustments per second.

Re-Adjustment Strength (CV62)
An example will explain this matter best: The motor voltage is insufficient to keep the speed as the load increases. The PI-load control kicks in and regulates (increases) the motor voltage accordingly to make sure the locomotive continues with the same speed. The re-adjustment strength is the maximum allowable voltage to achieve the required speed. The selectable value range is 0…255. The basic setting is "255", the maximum strength. This means the eMOTION L Decoder is allowed to increase the motor voltage up to the track voltage if so required. Lowering this value sets a ceiling for the motor voltage which cannot be exceeded. This might meet reality closely as the power reserve of real locomotives is not unlimited. Entering a track segment with an upgrade the locomotive will be only partially able to cope with the new power demand and will decrease the speed at some point. With the setting at "128" the readjustment is limited to 50%. In case the locomotive reaches this limit, a speed decrease will occur under an increased load.
The basic setting of the PI-load control is set to "fast". This enables fast speed changes but may result in over-regulating and thus to bucking. The PI-load control may be switched off in CV49.

3.4.1. Special Driving Functions
Shunting Speed
The maximum speed is reduced by half to facilitate a more effective driving characteristic during shunting. This feature may be set on any programmable function key. With CV59 = 0 the function is "off". Values between 1… 16 define the number of the function key. The standard F-key setting is "8".

Dis-Engageable Acceleration/Deceleration Times
Disabling acceleration value and braking value: the programmed values of CV3 and CV4 may be reduced to a minimum by a single keystroke. With CV64 = 0 the function is "off". Values between 1…16 define the number of the function key. The standard F-key setting is "7".

Automatic Braking (V1.3 and up)
There are two methods to stop a train automatically in front of a stop signal. The first method uses DCC brake signals produced by a booster with a braking module (Broadcast), the second method utilizes a DC signal (Brake-On-DC). For both methods a track portion in front of the signal must be totally isolated and powered by the respective signal.
For Brake-On-DC the option for analog operation must be blocked (CV 29, Bit2). Please check your DCC system manual for further information.

Pausing Time during Shuttle Operation
You may program a pausing time in a simple shuttle operation in analog and digital mode. Values between 1 and 255 define a waiting time in 1 to 255 seconds, with CV58=0 this function is deactivated. The activated pausing time is executed only if the driving direction is reversed during operation, e.g. by an analog electronic shuttle control. In case the locomotive is stopped and started in the same direction, the pausing time will not be executed.

3.5. Analog Operation
In analog mode the eMOTION L Decoder is fully functional with as little as 5Volts of track voltage. The operation in analog mode may be de-activated with CV29–Bit2. The eMOTION L Decoder features an internal motor characteristic curve which enables a smooth operation by measuring the track voltage. An analog load control (pat.pend.) may be activated (CV49-Bit2). The 3 light outputs are always activated according to the driving direction. The 6 function outputs (CV13) may be activated in analog mode also, including the dimming and flashing features.

4. CV - Table

This table shows the default settings of the eMOTION L Decoder.

An = Analog

CV	Description	Default	An	Value	Note
1	Loco Address (Standard Short)	3		1 - 127	
2	Starting Voltage	2		1 - 255	CV2 x (1/255 track voltage)
3	Acceleration Time	3	√	1 - 255	CV3 x 2ms x (1/255 track voltage)
4	Braking Time	3	√	1 - 255	CV4 x 2ms x (1/255 track voltage)
5	Top Speed	255	√	1 - 255	CV5 x (1/255 track voltage)
6	Mid Speed	64		1 - 255	CV6 x (1/255 track voltage)
5+6	Programming in Register Mode: Register 6 = CV No. Register 5 = Value	---		---	CV5 and CV6 are not affected
7	Software Version	1.2		---	read only
7	Decoder Reset Functions (3 Ranges available)	---		55 66 77	reset basic setting reset motor setting reset lights and functions
8	Manufacturer ID	123		---	read only
9	Motor Frequency	0	√	0 ... 3	0=16 kHz, 1=2 kHz, 2=250 Hz, 3= 60 Hz
13	Function Outputs in Analog Mode (on if Value Set)	3	√	0 ... 255	F1 = 1, F2 = 2; F3 = 4, F4 = 8; F5 = 16, F6 = 32; F7 = 64, F8 = 128 add the values of the desired functions!
17	Long Loco Address (high byte)	128		128 ... 10239	high loco address active, if CV29-Bit5 = 1
18	Long Loco Address (low byte)				
29	Configuration Table NMRA	4	√		see attachment 1
49	Configuration Table MASSOTH	3	√		see attachment 2
50	Light: Dimming Value (PMW)	32	√	1 ... 32	32 = full track voltage
51	Front Light: Command Allocation	128			see attachment 3
52	Rear Light: Command Allocation	64			see attachment 3
53	F1 + F2 Dimming Value	0	√		see attachment 4
54	F1: Command Allocation	1			see attachment 3
55	F1: Special Function	0	√		see attachment 5
56	F2: Command Allocation	2			see attachment 3
57	F2: Special Function	0	√		see attachment 5 + 5a
58	Pause Time for Stop with Reversing	0	√	0 ... 255	0.5 sec per value

CV	Description	Default	An	Value	Note
59	Shunting Speed (Half Speed) Command Allocation	8		0 ... 16	0 = Off, 1...16 = F-key
60	PI-Load Control: Maximum Readjustment Factor	2	√	1 ... 255	large value = strong readjustment
61	PI-Load Control: Readjustment Retardation	60	√	1 ... 255	large value = slow readjustment
62	PI-Load Control: Readjustment Strength	255	√	1 ... 255	1 = fast limitation 254 = slow limitation 255 = no limitation
64	PI-Load Control On/Off: Command Allocation	7		0 ... 16	0=Off, 1…16: No. of function key
67 ... 94	Freely Programmable Driving Curves in 28 Steps	1 ... 255		1 ... 255	see attachment 6 (if CV29-bit4=16)
112	F3+F4 Dimming Value	0	√		see attachment 4
113	F3: Command Allocation	3			see attachment 3
114	F3: Special Function	0	√		see attachment 5
115	F4: Command Allocation	4			see attachment 3
116	F4: Special Function	0	√		see attachment 5 + 5a
117	F5: Command Allocation	5			see attachment 3
118	F5: Special Function	0	√		see attachment 5 + 5a
119	F6: Command Allocation	6			see attachment 3
120	F6: Special Function	0			see attachment 5 + 5a
121	RC Servo Configuration	0		0,1	0=F3 standard output function 1=F3 RC servo operation
122	Lower End Position	16		5...50	Adjust to RC servo
123	Upper End Position	32		5...50	Adjust to RC servo
127	RC Servo Time Base	1		1...16	1 Unit = 10 msec

4.1. Attachments to the CV-Table

Attachment 1: (CV29) - NMRA-Configuration

Bit	Off (Value=0) Application On		Value	Note
0	Standard Driving Direction	Reverse Driving Direction	1	
1	14 Speed Steps	28 Speed Steps	2	automatic recognition of 128 speed steps
2	Digital Operation Only	Digital + Analog Operation	4	
3	Not Used			
4	Internal Driving Curve	Programmable Driving Curve	16	CV 67 - 94
5	Short Address (CV1)	Long Address (stored in CV17+18)	32	
6	not used			
7	not used			

Attachment 2: (CV49) - Massoth-Configuration

Bit	Off (Value=0) Application On		Value	Note
0	Parallel Data Transfer Only	Seriell + Parallel Data Transfer	1	automatic detection of seriell/parallel
1	Digital Load Control = Off	Digital Load Control = On	2	
2	Analog Load Control = Off	Analog Load Control = On	4	
3	F1-Output Standard Function	Fast Pulse String (P-Update) on F1	8	Bit3 "on" only with Bit0 "on"
4	Not Used			
5	Not Used			
6	Not Used			
7	Not Used			

Attachment 3: Switching Output Commands (CV51, 52, 54, 56, 113, 115, 117, 119)

Value	Application	Note
0 ... 16	0 = Switch Function with Light Key, 1...16 = Switch Function with F-Key No. 1-16	
+ 64	Switching Output "on" in Reverse Only	additional value must be added
+ 128	Switching Output "on" in Standard Driving Direction Only	additional value must be added

Attachment 4: Dimming Values (CV53, 112)

Value	Application	Note
1 ... 32	Voltage in Percent of Track Voltage on Output	1 Unit = approx. 3% of track voltage 1 = 3% of track voltage (0.75V) 32 = 100% track voltage (24V)
+ 64	F1 resp. F3 Is Dimmed Only	F1 = value in CV53 F3 = value in CV112*
+ 128	F2 resp. F4 Is Dimmed Only	F2 = value in CV53 F4 = value in CV112*
+ 192	Both Outputs are Dimmed	*

* = Command Allocation Value must be added to Voltage Value

Attachment 5: Special Function F1 + F2 + F3 + F4 + F5 (CV55, 57, 114, 116, 118)

Value	Application	Note
0	0 = Steady "On" (Standard Operation)	
1 ... 15	Flashing symmetrical (Time Base 0.25 sec/value)	symmetric flashing
(1 ... 15) + 64	Short Term Function (Monoflop) (Time Base 0.25 sec/value)	output switches off after time out
(1 ... 15) + 128	Asymmetric Flashing (1/3 on, 2/3 off)	short "on", long "off" additional value must be added
(1 ... 15) + 192	Asymmetric Flashing (2/3 on, 1/3 off)	long "on", short "off" additional value must be added

Attachment 5a: Expanded Special Functions F2 + F4 + F5 + F6 (CV57, 116, 118, 120)

Value	Application	Note
16	Inverse Coupling with Output F1, resp. F3 or F5 Alternating Flashing	CV57 (F2 with F1) CV116 (F4 with F3) CV120 (F6 with F5)
31	Charging Control of Voltage Buffer in Programming Mode (only F5)	only in CV118: buffer controlled by F5

Attachment 6: Basic Values of Freely Programmable Driving Curve (CV67...CV94)

The programmable driving curve is set to the setting below as basic setting. This setting is not subject to the reset functions.

Basic values of freely programmable driving curve (CV + Value)

67=6, 68=8, 69=10, 70=13, 71=16, 72=19, 73=22, 74=26, 75=31, 76=36, 77=42, 78=48, 79=54, 80=60, 81=68, 82=76, 83=84, 84=92, 85=102, 86=112, 87=124, 88=136, 89=152, 90=168, 91=188, 92=208, 93=228, 94=232

4.2. Reset Functions

In case the settings of your eMOTION L Decoder are messed up or obscure, you may reset the decoder to the manufacturer's settings by using specific CV values. A distinctive feature of the eMOTION L Decoder is that you can reset a specific part of the decoder without changing the remaining parts. The CVs are combined to function groups and reset as a group. You may reset the basic settings (address, switching speed and driving characteristics) or the light functions (F-key assignment and brightness) separately. Please find detailed information about the reset functions of the eMOTION L Decoder in the CV-table.

Attachment 7: CV 7 Default Settings at Resets

Write the desired reset value into CV7 (software version of the decoder) to reset the decoder settings to the basic factory settings.

RESET	CV-Values on Reset Programing
55	1=3, 17=0, 18=128, 29=4, 49=2, 58=0, 59=8
66	2=2, 3=3, 4=3, 5=255, 6=64, 9=0, 60=4, 61=60, 62=255, 64=9
77	13=0, 50=32, 51=128, 52=64, 53=32, 54=1, 55=0, 56=2, 57=0, 112=32, 113=3, 114=0, 115=4, 116=0, 117=5, 118=0, 119=6, 120=0, 121=0

4.3. Address Programming

Each locomotive operated by the NMRA/DCC standard needs a digital address to receive its specific command.

- The NMRA standard provides two kinds of addresses:
  - Low (short) addresses (1…127)
  - High (long) addresses (128…10239)
- The address must be stored in the decoder to enable the decoder to recognize the commands that are meant for it.
- The low address is stored in CV 1. The maximum value is "127". In addition bit5 in CV 29 must be "off" (value 0).
- The high address is divided into two values and is stored in CV17 and CV18. In addition bit5 in CV29 must be set to "on".

The long address must be calculated as follows:
CV17 = address / 256 (store only the whole-numbered value)
CV18 = address – (CV17 x 256)

In case you want to calculate the locomotive address "3005", please proceed as follows:
Step 1: 3005 / 256 = 11.74 , so CV17 will be "11"
Step 2: 3005 – (11 x 256) = 3005 – 2816 = "189"
Consequently you have to program CV17 with "11" and CV18 with "189".

Current digital systems (e.g. the DiMAX-System) offer a comfortable programming method of the addresses. **All CVs including CV29 are being calculated automatically and programmed at the same time when using the function "Loco Address Programming".** The original address setting of the eMOTION L Decoder is "3". In case of a decoder reset the address will be reset to this value.

5 Programming Methods

The eMOTION L Decoder supports all programming methods in accordance with the latest NMRA/DCC standards. Please note that not all of the DCC systems currently available can be programmed according to this

standard. The manufacturer of your DCC system should give you in-depth information. Choose the programming method applicable to your digital system. The eMOTION L Decoder confirms every successful programming cycle with a short bucking of the engine. This ensures the correct reception and accomplishment of the programming command.

5.1 Reading Configuration Variables (Cvs)

The readout of CV parameters shall not be mistaken for a programming procedure. However, it is essential for checking the programmed settings. The eMOTION L Decoder provides this function and the readout can be easily accomplished with a hand held controller. After inserting the desired CV No. the controller will display the value of the respective variable.

5.2 Writing Configuration Variables (CVs)

Programming (writing) the CV values is the easiest way of programming the decoder. This method is utilized by most of the DCC systems. Using your hand held controller, the central station, or the PC - you select the desired CV parameter and insert your desired value. Programming is done on a separate programming track or a piece of track that is used as programming track, depending on the digital system. Please check the manual of your central station.

5.3 Writing the Configuration Variables (CVs) bit by bit

Some of the CV (e.g. CV29, CV49) parameters consist of multiple binary values. This means that several values are combined in one value. Each function has a bit and a value. Programming a CV of this kind requires that all values of all functions controlled by this CV need to be summed up. A deactivated function always is "0", an active function must be programmed with the respective value according to the CV-table. The sum represents the value of the CV and must be written into the CV parameter. All known programming methods may be used.

> Let's look at the NMRA configuration register for example (CV 29). You intend to program "normal driving direction, 28 speed steps, digital and analog operation, internal driving curve, and a short locomotive address". This sums up to 2+4=6 according to the attachment list #1. So CV should be programmed with "6".

5.4 Register Programming / Writing CVs Indirectly

Register programming was the first method of CV programming. The eMOTION XLS Sound Decoder supports this programming method. The CV value is to be entered into an intermediate variable. The decoder thereafter does the real programming. The input into register 5 and 6 is accomplished with the hand held controller. The CVs 1 to 4 are entered directly; all other CVs with higher numbers are programmed indirectly.

> Let's assume you want to set the light output voltage (CV 50) to "10". The first step is to go into the register programming mode, insert "6" thereafter "50". If this was successful, program register "5" with "10". Now your light output is set to "10".

5.5 PoM Programming on Main (main track)

The PoM method is the only procedure to accomplish programming on the main track. All of the CV programming can be done except CV1, 17+18 (address) with the eMOTION XLS Sound Decoder. **PoM programming should only be performed when the locomotive is not in motion.**

6. Properties of the eMOTION L

The eMOTION L Decoder is a compact and small-sized driving and function decoder designed for the G-Scale garden railroad operation. The decoder features an output for one electric motor and 8 programmable function outputs.

The eMOTION L Decoder has exceptional driving characteristics in both digital and analog operation. The performance in analog is outstanding and delivers steady operation from 7 to 8 Volts and up. Optional an additional power buffer may be used which eliminates power interruptions on contaminated tracks in digital and analog operation.

On which type of layout is the L Decoder to be used?

The eMOTION L Decoder supports the operation on all digitally controlled layouts according to the NMRA standards, irrespective of the manufacturer. The use of the internationally accepted standard of the National Model Railroad Association (NMRA) ensures that the eMOTION L Decoder works with all NMRA/DCC compatible digital central stations. The eMOTION L Decoder may be utilized according to NMRA/DCC as well as with regular analog DC.

6.1. General Information Regarding DCC Systems

In analog operation the speed of the locomotive is controlled by the level of the track voltage. All locomotives connected to the throttle will drive with the same speed and direction. Multiple train operation can only be accomplished by separated track sections with separate power supplies.

A digitally controlled layout, however, is powered by a steady track voltage. This track voltage is supplied by an overlay of digital signals which carry digital commands for speed and switch commands. All locomotives and switches have a decoder with a programmed address, comparable to a phone number. Thus multiple locomotives may be controlled independently to each other although they a located on the same track. In addition light and other functions may be operated comfortably. The most popular digital systems are NMRA/DCC and Motorola. These systems are not compatible because they use different commands.

This means, a locomotive with a Motorola decoder may not be used on a NMRA/DCC layout and vice versa. In G-Scale generally the NMRA/DCC system is used (e.g. LGB® MTS). In addition there are some niche products as Selectrix (Trix) or FMZ (Fleischmann). Basically decoders by different manufacturers utilizing the same DCC system may be operated jointly. All functions like driving, light or switch commands are identical. Many systems however may feature functions additional to the DCC standard which may only be used with decoders of the same manufacturer.

To ensure the proper operation of the decoders, the decoders need to be individually programmed according to the CV-table. CV stands for configuration variables and the table holds the individual data for the properties of a decoder. CV1 holds the address of the decoder; others define the maximum speed, the brightness of a light bulb or the braking characteristics of the locomotive.

Please find the explicit list of all CVs at the end of this manual.

6.2. Operation with LGB® MTS-I, MTS-II and MTS-III

The LGB® MTS digital systems I and II basically work with 14 speed steps. The third generation of LGB® MTS supports 28 speed steps, however only in connection with the DiMAX Navigator. The eMOTION L Decoder's factory default setting is 14 speed steps to ensure flawless operation with LGB® MTS and other digital systems. In case you use a LGB® MTS III central station in connection with a DiMAX Navigator or in case a digital system is used which supports 28 speed steps, the eMOTION L Decoder may be set to 28 speed steps by changing CV29 accordingly.

In addition you may have to change the decoder settings for serial or parallel function data processing (see chapter 3.3.1)

LGB® Programming Modules may be limited in the programming range of CVs. Utilizing the register programming method (see chapter 5.5) may solve this problem. With this method you may change all CV settings.

7. Technical Specifications
Power Supply: 0-24 Volts DC/DCC (in peaks max. 27Volts)
Current: 30-2000 mAmps (Motor + Functions)
Maximum Motor Current: 1,8 Amps
Maximum Function Outlet Current: 1 Amp (max. 500 mAmps/output)
Temperature Range: -4°F to +113°F
Measurements: 55 x 25 x 14 mm (L x W x H)

Note: If you intend to utilize this decoder below freezing temperatures, make sure it was stored before in a heated environment before operation to prevent the generation of condensed water. The heat generated during operation is sufficient to prevent condensed water.

CE	This Decoder conforms to the CE Standards
RoHS	This Decoder is manufactured according to the latest EG Standards for lead free manufacturing conforming to RoHS Standard.
	Please dispose of according to your State regulations.
	Do not dispose of in open fire.

8. Warranty
MASSOTH ELECTRONICS USA warrants this product for 1 year from the original date of purchase. This product is warranted against defects in materials and workmanship. Peripheral component damage is not covered by this warranty. Normal wear and tear, consumer modifications as well as improper use or installation are not covered. Errors and changes excepted.

8.1. Warranty Claims:
Valid Warranty Claims will be serviced without charge within the warranty period. To initiate a warranty claim, please contact your dealer or MASSOTH ELECTRONICS USA for an RMA (Return Merchandise Authorization). MASSOTH ELECTRONICS USA cannot be responsible for return shipping charges to our repair facility. Please include your Proof of Purchase with the returned goods.

8.2.Support:

For support and technical questions contact: sales@massoth.com

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