eMOTION LS
Sounddecoder

Version 2.2 - 01/09

! ATTENTION !

The factory setting of the light and function outputs is full track voltage!
Make sure that the outputs are set to the appropriate value according to the CV list (page 18 and on) before hooking up the lights or other units.
We cannot be held responsible for damages if this is disregarded.

Summary | **Page**

1. General and safety details

Congratulations on your purchase of an eMOTION LS Sound Decoder. The small eMOTION LS Sound 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 LS Sound Decoder.

Massoth Elektronik GmbH used the latest in technology in designing and manufacturing the eMOTION LS Sound 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 in the DCC standards are easily implemented in the eMOTION LS Sound Decoder by updating. The latest Flash-Technology is utilized in the eMOTION LS Sound Decoder to provide a safe and consumer-friendly operation during updating.

1.1. Layout of Terminals

eMOTION LS Decoder
Interface-cable for illumination + Function 1+2
Manual

2. Important information for the 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.

The functions may be triggered with serial pulse strings as well as with parallel data. In case your digital control system supports 28 speed steps CV29 must be set to "6". If you have only serial data processing set CV49 to "3".

Note: F13 to F16 are not available with serial data processing.

Properties of the eMOTION LS Sound Decoder

Decoder functions:
 • Loco decoder for digital and analog operation
 • Motor output max. 1,5 Amps
 • 3 light outputs with 300 mAmps each (front, rear, interior)
 • 6 function outputs (2 with 600 mAmps each (S1-2), 1 with 50 mAmps (S3) and 3 with 10mA each (S4,7+8))
 • Overload and excess temperature protection for motor and functions
 • Installation with plastic brackets and solder connections

Sound functions:
 • 6 channel play-back (6 sounds at the same time)
 • 1 Watt amplifier for 8 Ohms loudspeaker
 • Memory capacity for max. 150 sec of recorded sound
 • 4 driving sounds and 12 side noises selectable
 • Play-back frequency 10 kHz – 16 kHz
 • Pulse generator interface for synchronization and reed switch terminal for manual function triggering
 • Volume control by potentiometer or CV programming (also individual Sounds)
 • Sound functions usable in analog mode
 • Sounds and software changeable

Digital and analog properties:
 • 10239 programmable locomotive addresses
 • 4, 28, and 128 speed steps
 • Programmable driving curve
 • Adjustable start, mid, and max. speed

eMOTION LS Sounddecoder   4

- Adjustable acceleration and deceleration
- Adjustable motor frequency
- Load control for digital and analog mode (pat.pend.)
- 16 functions (selectable) NMRA compatible
- Switching speed and acceleration/deceleration selectable with F-key
- Parallel and serial control for all light outputs and function outputs, including triggering of parallel updated sound boards (LGB®)
- Comfortable function mapping (parallel and serial) with direction assignment
- Programmable flashing light and short term functions
- Dimmable light and function outputs, usable in analog mode
- Many settings may be used in analog mode
- Update feature
- Comprehensive reset functions for all Configuration Variables (CV's)
- Bus connector for SUSI interface and LGB-control (future use)
- BC-Connector (Buffer-Control) to control the Voltage- or Goldcapbuffer
- Adjustable follow-up time on buffer-mode with CV

2.1. Installation and Hook-Up

Installation of the eMOTION LS Sound Decoder is very basic and straightforward. The eMOTION LS Sound Decoder comes with a basic set of cables.

Please note the terminal assignments shown in the following illustrations and pay attention to the factory preset function outlet assignments of S1-S4, S7 and S8. These outlets need to be set according individually to your personal needs.
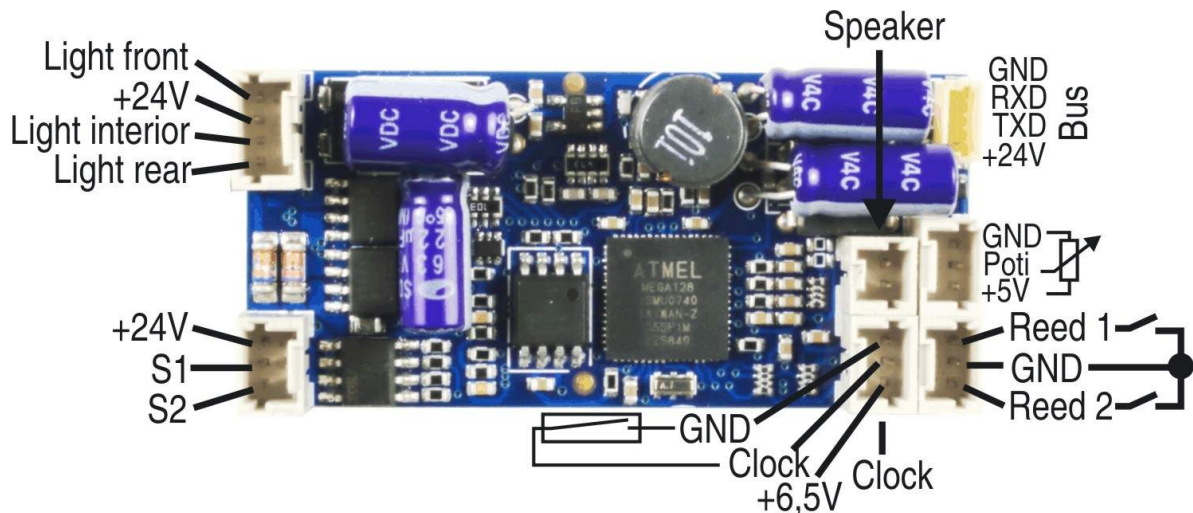
Illustration 1: Contact assignment of connectors

2.1.1. Connectors on the Upper Surface

The eMOTION LS Sound Decoder features seven additional connectors on the upper side (see illustration 1). The clock connector is the connector for an external pulse generator. These connectors are custom made for the connection with our pulse generator unit #8242030. Alternatively a reed contact may be utilized as pulse generator (see illustration 1). The Speaker connector connects a loudspeaker to the eMOTION LS Sound Decoder, and the POTI connector connects an external potentiometer (4.7K Ohms) to the decoder to facilitate manual volume control. A potentiometer board is available with the item # 8242010.

For connecting S1/S2 output use the S1/S2 connector.

The bus-connector is provided to control e.g. pantograph's or pulsed smoke generators. The bus connector may be programmed by Massoth control or, with an update, for SUSI interface.

The LS decoder comes with pre-manufactured cables that connect to the light output and the S1 and S2 output. In case you want to connect to other terminals too, we suggest to utilize the Massoth cable set #8312108.
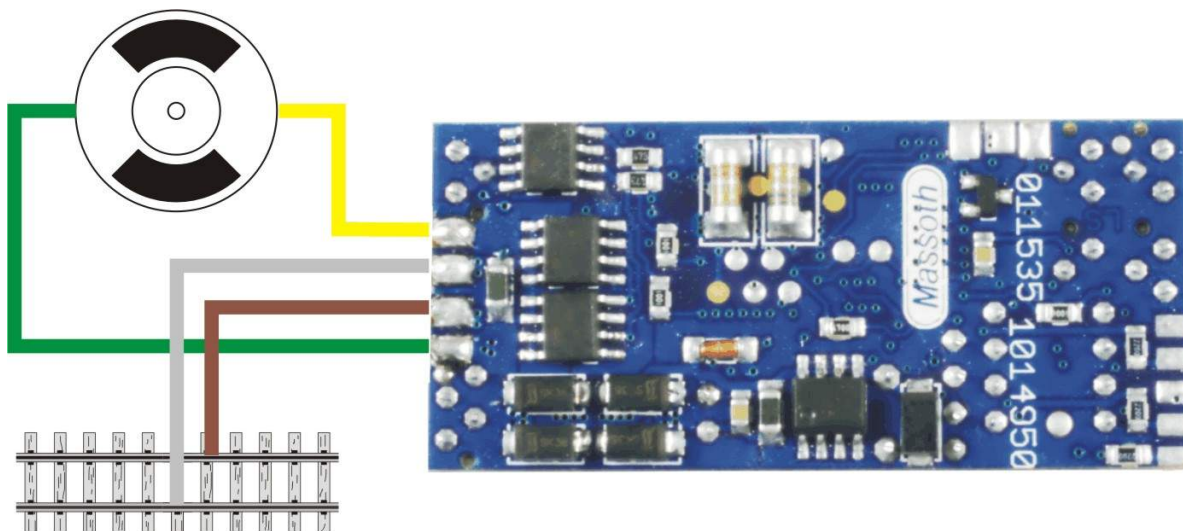
Illustration 2: Installation of the eMOTION LS Sound decoder

Color code of the eMOTION LS Sound Decoder:

YELLOW	Motor +	(Motor in driving direction left)
WHITE	Track +	(Track in driving direction left)
BROWN	Track -	(Track in driving direction right)
GREEN	Motor -	(Motor in driving direction right)

2.1.2. Setup with a LGB® gear box

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 LS Sound Decoder according to the schematic below. **Very old LGB gear boxes have 3 contact pins only. These gear boxes need to be changed for digital operation. One pin is connected to the motor and the track. This must be disconnected as the motor and the track must be isolated for digital operation.**
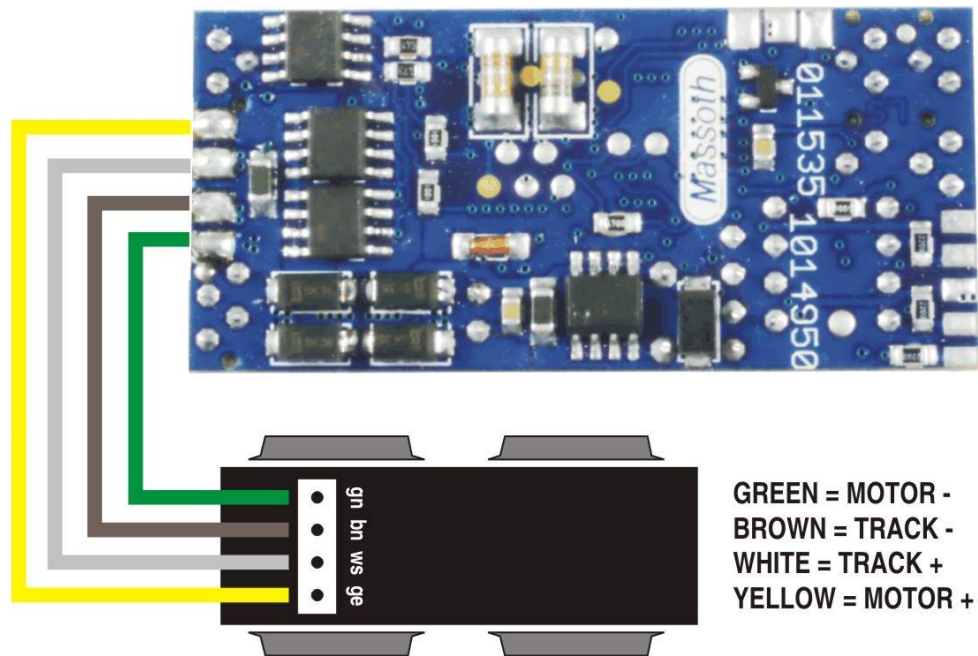
Illustration 3: Connection eMOTION LS Sound Decoder to a LGB Gear Box

GREEN = MOTOR -
BROWN = TRACK -
WHITE = TRACK +
YELLOW = MOTOR +

2.2. Manufacturer's settings of the eMOTION LS Sound Decoder:

These are the most important factory settings of the eMOTION LS Sound Decoder:

- **Loco address 3**
- **14 speed steps (compatible to MTS I, II and III)**
- **Light outputs deliver full voltage (for 19V/24V bulbs)**
- **Start locomotive engine/ engine shut down (Diesel/Electric) F5**
- **Cylinder side noises on/off F5 (Steam)**
- **Sound (amplifier) on/off F6**
- **Time delays on/off F16**
- **Switching speed on/off (half speed) F8**
- **Function output S1 (steam) on/off F7**
- **Function outputs S2 to S4 conform with function keys F2 to F4, function outputs S7 + S8 conform with F13 + F14**
- **If Functions in serial + parallel mode: F13 – F16 not usable**

2.3. Installation

To mount the eMOTION LS use our decoder bracket (# 8104010)

3. Advanced setup

Listed below you will find all other functions the eMOTION LS sound decoder features besides the basic functions already mentioned in chapter 2.2.

3.1. Connectors on the lower surface

Some more contacts are located on the lower side of the eMOTION LS Sound Decoder where function outputs (S3, S4, S7, S8) and the Goldcapbuffer (BC) may be connected.
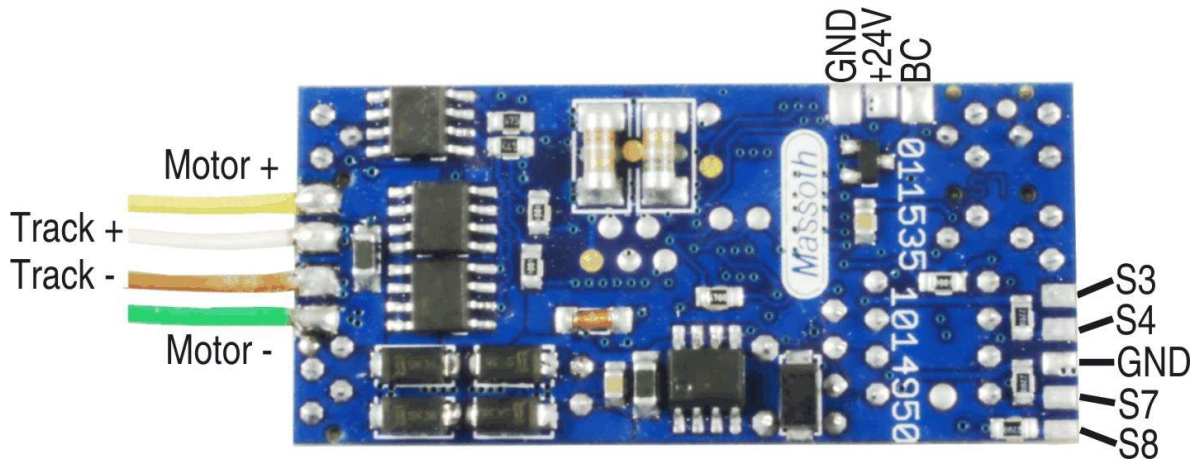
Illustration 4: Contact assignment of the solderable contacts (lower side)

3.2. Installation of the eMOTION LS with a LGB® interface

Using the LGB® decoder interface cable the eMOTION LS can be easily installed in LGB® locomotives with a decoder interface. The light and sound functions will be handled via this cable. The LGB® interface cable may be purchased as Massoth® item No. 8150602. Connect the wires to the eMOTION LS terminals according to the wiring diagram. **Mind the polarity! Do not mix-up the wires or short any wires!** Solder the gear box wires and the thin green wire to the respective soldering pads.
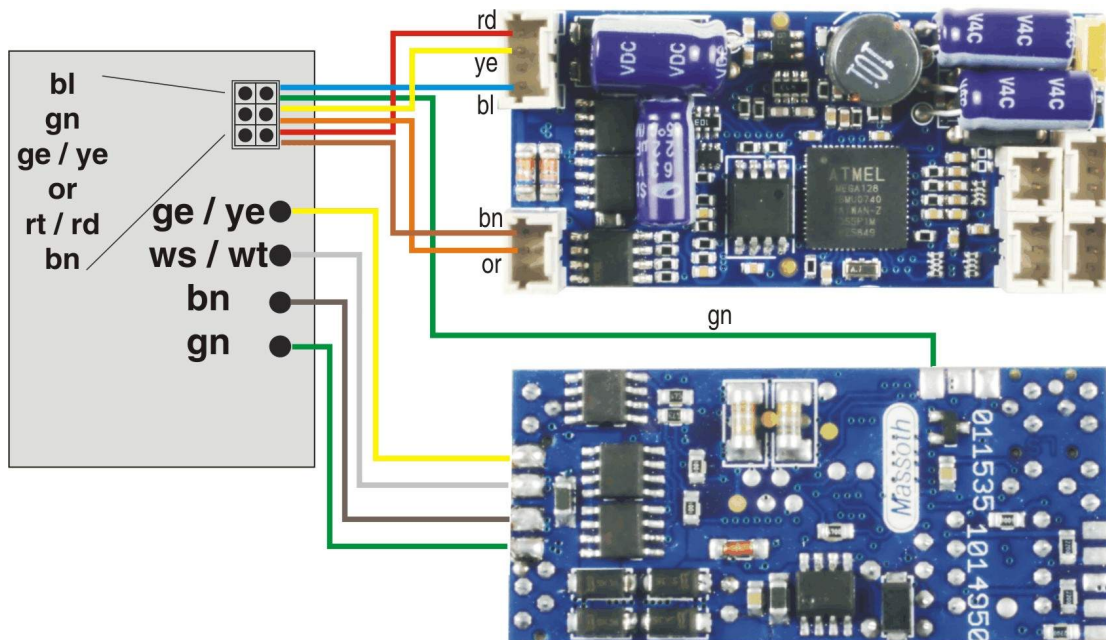
Illustration 5: Installation in a loco with LGB® decoder interface

3.3. Massoth bus interface

Components featuring a digital control function (e.g. the Massoth Pulse Smoke Generator) may be connected to the Massoth bus interface.

3.4. Light and function outputs

The eMOTION LS Sound Decoder features 3 light outputs, front light, rear light, and interior light. The front light and rear light are switched according to the driving direction, the front light output is "on" when driving forward, and the rear light is illuminated when driving in reverse. The interior light is steadily "on" when the lights are

switched "on". You may use this function to illuminate the interior of the cab of your locomotive or to illuminate the connecting rods of a steam locomotive or to implement the typical rear light of RhB locomotives because these lights are always "on".

Please observe the total current drain of the connected bulbs. The limit is 300 mAmps per output.
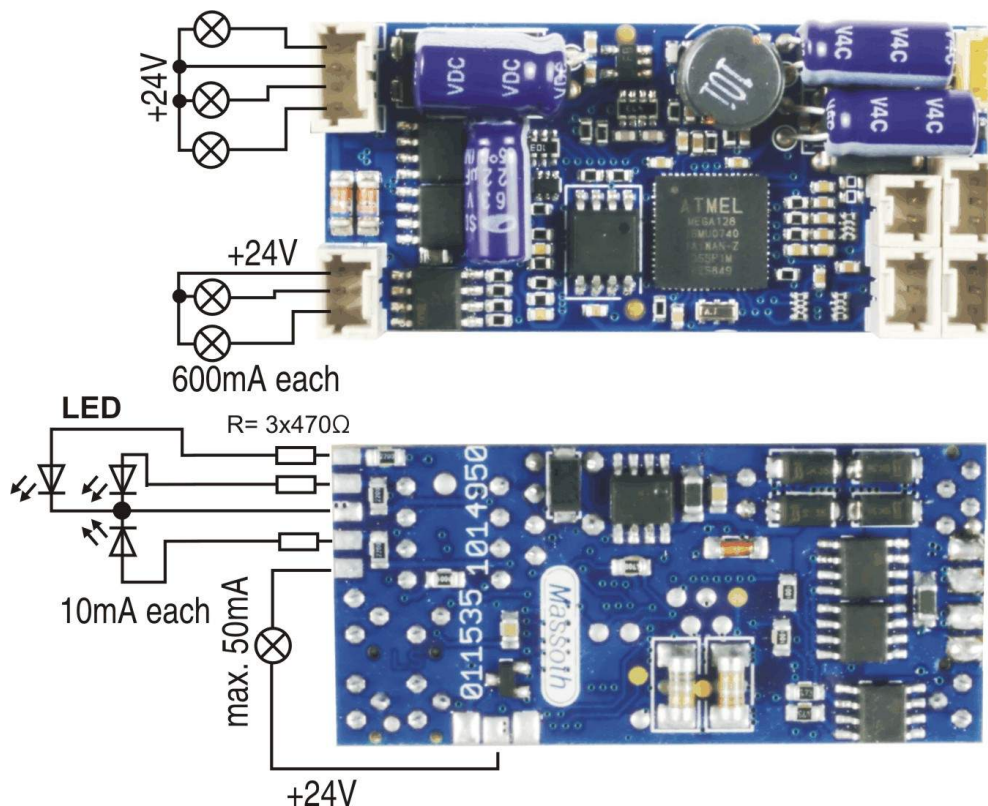
Illustration 6: Connection Scheme of the Light and Function Outputs

In addition to the 3 light outputs**,** the eMOTION LS Sound Decoder features 6 separate function outputs which may be used in different ways. Two outputs are located on the upper side on a jack (S1/S2) and four on the rear side as solderable contact (S3, S4, S7, S8).

The factory setting of the light and function outputs gives full track voltage to them. With 24 V on the track the outputs will deliver 24 V when activated. You can change the voltage with CV 50, 53, 112 (see CV-table). **The voltage supplied by the outputs 4, 7+8 is 5Volts, and the maximum allowable load is 10 mAmps.** The function (e.g. F-key assignment, light display according to driving direction, flashing and short term function) as well as the voltage of each output may be programmed by setting the respective CV's. For details please review the CV-table.

The outputs may be controlled by NMRA/DCC commands or with serial LGB® pulse strings. The light outputs and the outputs S1 to S4 are dimmable.

NOTE: The proper operation of the light functions depends on the selected speed steps. In case CV29 (speed steps) does not carry the same setting as the digital system the lights may flicker or might not work at all (not relevant for 128 speed steps)

3.5. Power buffer hook up

The eMOTION LS features a separate connector for power buffers (Massoth 8151001 + 8151501).

The power buffer bridges brief power interruptions caused by contaminated tracks or bad power supply on switches. The power buffer is to be connected to the connectors marked "+24V" (rt), "GND" (sw) and "BC" (ws)

on the decoder board. The maximum charging Amperage is 500mAmps.

The power buffer works in analog as well as in digital operation. In analog operation the power buffer works fully automatic. After the locomotive has stopped, the power buffer switches off the decoder after the standing noises were released.

The lag time of the sound may be set in digital operation in CV 129, in analog mode in CV 130.

3.6. Reed contacts to trigger bell and whistle by track magnets

You may utilize up to two reed contacts to trigger sounds with track magnets (Illustr. 1). The CV configuration (CV 190, 191) defines which sound is to be triggered by which reed contact. A special feature is the possibility to trigger a sound depending on the driving direction (to activate use CV149 Bit4).

3.7. Pulsed smoke generators

You can connect our pulsed smoke generator (8412101 or 8412201) to the eMOTION LS decoder. For details please see the pulsed smoke generator manual.

To use other pulsed smoke generators set CV114=30 and connect like illustr. 7
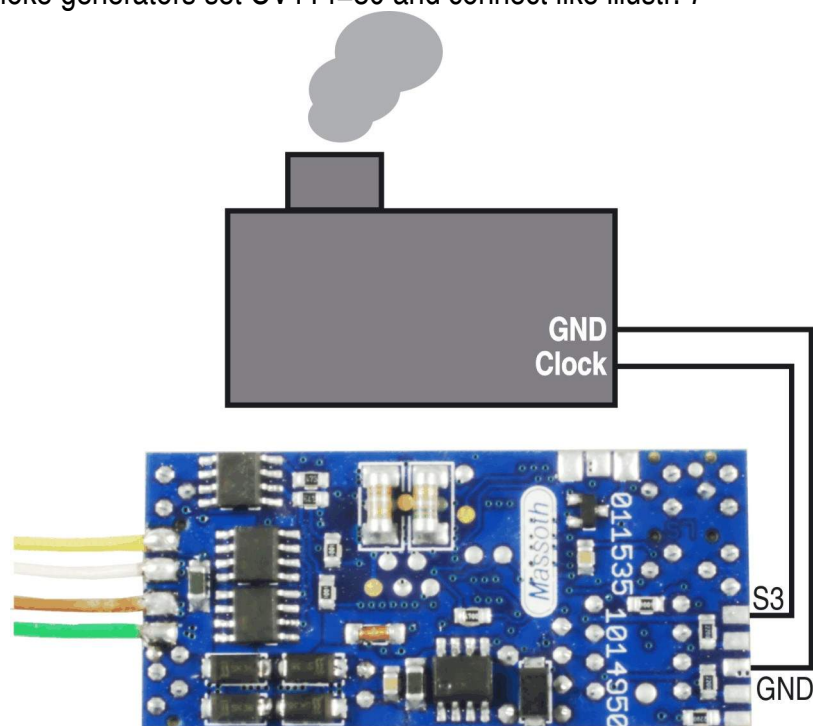
Illustration 7: Other pulsed smoke generators

3.8. Motor control

Depending on which the digital system you are utilizing different speed steps can be used. The more steps you use the smoother the throttle works. In garden G-Scale 14 speed steps are used and 28 speed steps are recommended when supported by the digital system.

- The direction of driving (including the direction related functions) can be defined 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 LS Sound Decoder with LGB® MTS I or II requires a 14 speed step setting. This is the

factory setting of the decoder.

Several CV settings in the eMOTION LS Sound Decoder influence the acceleration and deceleration characteristics of the locomotive. The acceleration/deceleration characteristic is defined by 2 CV's:
- 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 multiply your desired time delay with "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.
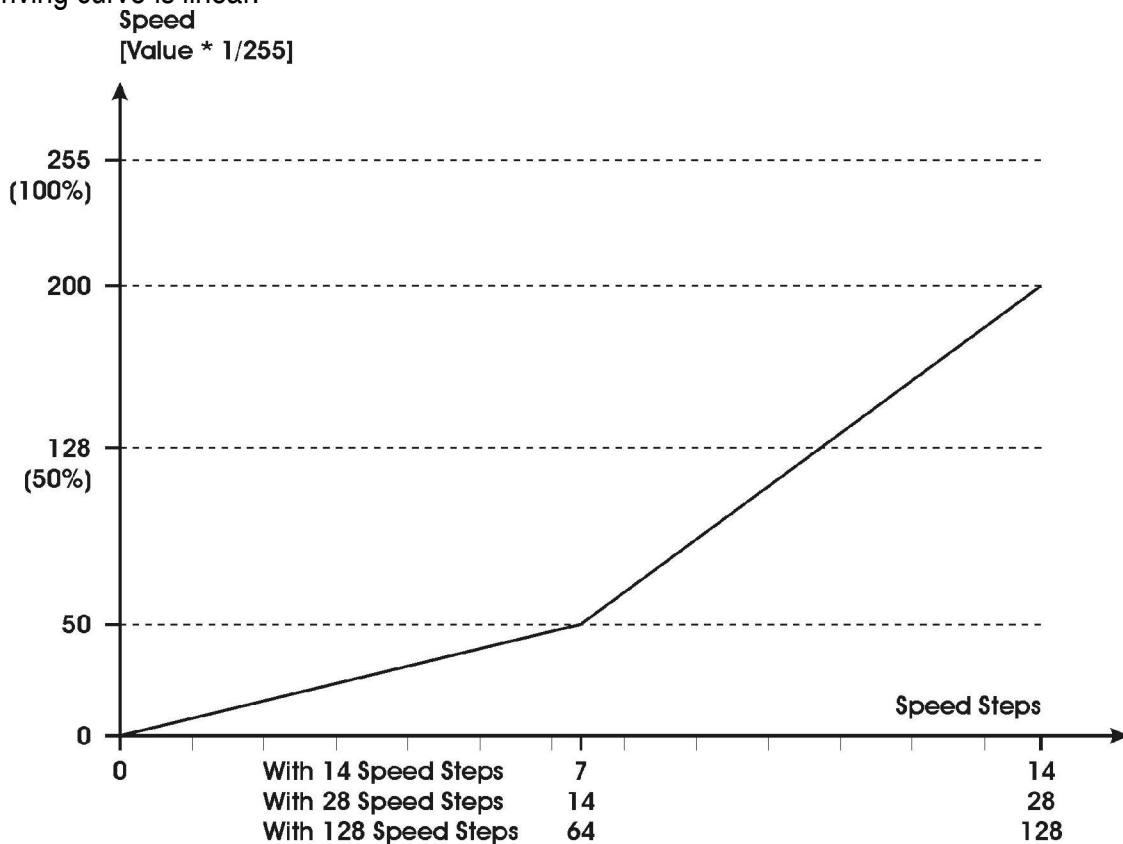
Illustration 8: Internal Driving Curve of the eMOTION LS Sound Decoder, Adjustable with CV2 (Starting Voltage), CV5 (Maximum Speed), CV6 (Mid Speed)

Recent decoders like the eMOTION LS Sound Decoder feature 3 CV's to define the speed parameters. The basic setting of the eMOTION LS Sound 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 the 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 extended.

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 CV's 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 motor 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 LS Sound Decoder is usable with all kinds of DC motors.

Load control

The eMOTION LS Sound 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 LS Sound 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,

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 over-control and tend to drive jerky during load changes.

Re-adjustment retardation (CV61)
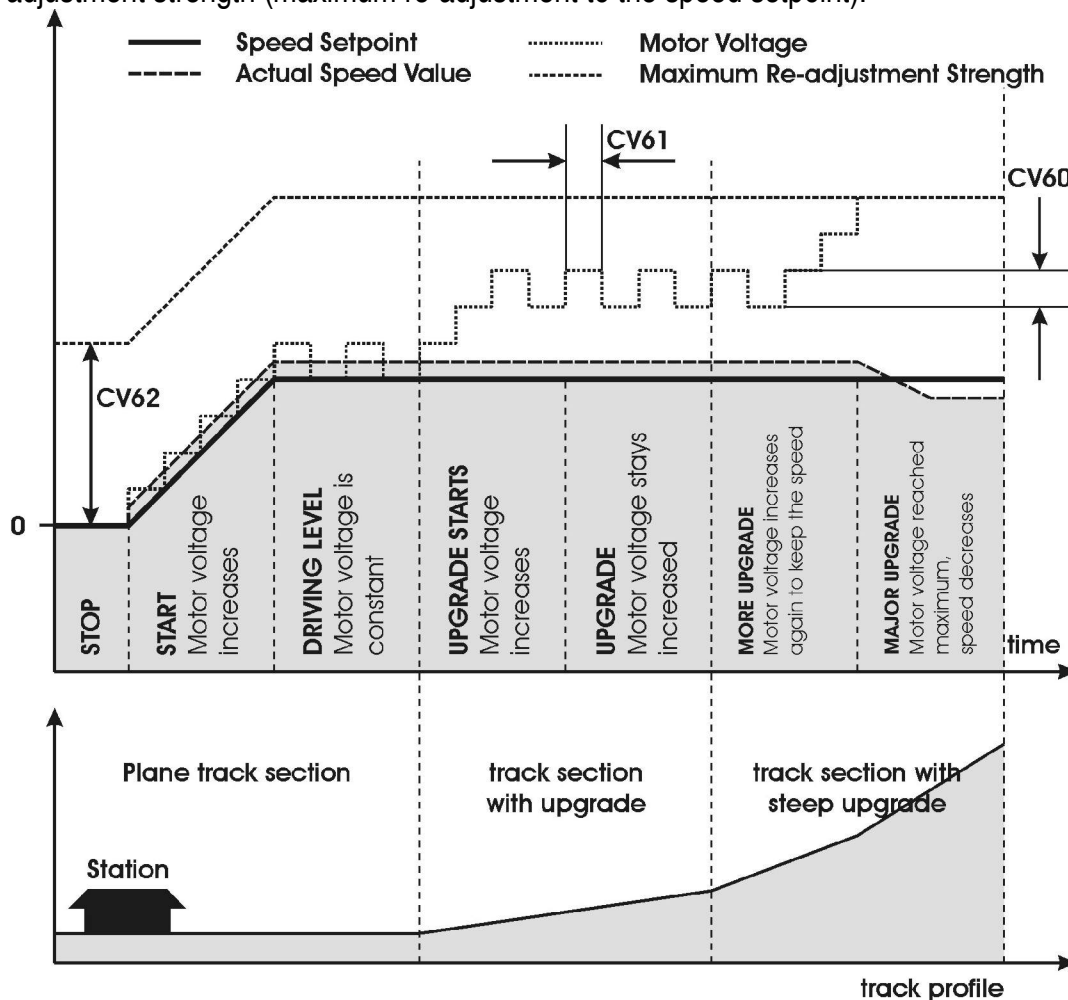The re-adjustment retardation defines how often the eMOTION LS Sound Decoder is allowed to re-adjust per second. Increasing the value means an increase of re-adjustments per second. The eMOTION LS Sound Decoder is able to perform up to 4000 adjustments per second. The basic setting is "60". This results 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 LS Sound Decoder is allowed to increase the motor voltage up to the track voltage if so required. If you lower this value you set a ceiling for the motor voltage which must not 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.

3.8.1. Special driving functions
Switching speed
The maximum speed is reduced by half to facilitate a more effective driving characteristic during switching. 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 basic setting is "8".

Disengageable 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 basic setting is "7".

Automatic Braking
There are two methods to stop a train in front of a stop signal automatically. The first method uses DCC brake signals produced by a booster with a breaking 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.

Starting Inhibit (since V2.2)
The Decoder possesses a starting check function in CV 150 for digital or analog mode that can be activated. If the appropriate bit is set, the locomotive starts only after the complete start-up phase is final in the sound. This function is adjustable only for E-Locos.

Electronic Parking Brake (since V2.1)

You may activate an electronic parking brake in CV49. This feature prevents a heavy train from moving once it is parked on a downhill track section. The brake is only set with the throttle (dial) in the "0" position. The brake is released automatically if the throttle is moved out of the "0" position. See attachment 2 (page 25).

Pausing time during shuttle operation

Programming a pausing time in a simple shuttle operation in analog and digital mode with stopping times can be achieved. With CV58=0 this function is deactivated, values between 1 and 255 define a waiting time in 1 to 255 seconds. 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.

3.9. Analog mode

In analog mode the eMOTION LS Sound Decoder is fully functional with as little as 5V track voltage. The operation in analog mode may be deactivated with CV29–Bit2. The eMOTION LS Sound 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. The Sound in the decoder

The eMOTION LS Sound Decoder contains a driving decoder as well as a full fledged digital power amplifier which reproduces all sounds and side noises of a locomotive in high quality and very realistically. The eMOTION LS Sound Decoder produces a locomotive's prototypical operating sound as well as an array of additional sounds which may be utilized according to your taste and needs. This allows you to individualize locomotives of the same type.

The eMOTION LS Sound Decoder manages up to 16 sound functions (F1 to F16 according to the latest NMRA/DCC standard). The memorized sounds are assigned to functions and function commands by CV programming. The CV settings of the eMOTION LS Sound Decoder may vary depending on the original locomotive and the sounds stored in the memory.

Sound and function assignment

Each locomotive displays certain sounds and side-noises which are characteristic for the respective type of engine. In addition to the basic sounds each eMOTION LS Sound Decoder carries sounds and side-noises which are individually assigned and therefore can not be listed in this table. Each eMOTION LS Sound Decoder carries up to 12 sounds and side-noises which are assigned to the F-keys. Besides the sounds other functions are assigned, e.g. sound on/off, accel./deceleration on/off, switching speed on/off. The sounds and the functions may be assigned to the 16 F-keys by CV-programming. You may alter the F-key assignment at any time according to your personal needs and move for example the braking sounds from F3 to F12. Or sounds may be switched off completely. In-depth information can be found in the CV-Tables as well as in the corresponding attachments, starting at page 18.

Important: In case the F-key assignment is greater than F12, CV49=Bit0 must be set to „"0" (only parallel data processing)

4.1. Driving sounds

The driving sound vary with the locomotive type: steam, diesel, or electric.

4.1.1. Steam locomotive:

Start up the locomotive

During the engine start up the noise of leaking steam is produced.

Standing noises

The noise of the leaking steam is produced in the background all the time. After a run the locomotive produces the programmed standing noises. These noises may contain an air pump, coal shuffling, pressure relieve valves or the generator. The noises will be produced only once, but with the use of the random generator these noises may be produced in random order.

Driving sounds

The steam sound varies with the speed of the locomotive, additionally the cylinder side noises are produced. This sound derives from leaking steam at the cylinders and it sounds like a hissing noise in sync with the chuff's.

Shut down of the locomotive

The steam noise stops.

4.1.2. Diesel locomotive:

Start up of the engine

First a compressor starts, thereafter the main engine starts.

Standing noise

The Diesel engine runs in idle as the locomotive rests. A compressor may start or excessive air pressure may be released depending on the programmed sounds.

Driving sound

The Diesel engine produces a sound depending on the speed of the locomotive.

Locomotive shut down

The Diesel engine is switched off and the sound of the engine running down is produced.

4.1.3. Electric locomotive:

Locomotive start up

If available the sound may start with the sound of the air valve. Thereafter the main switch is flipped and the compressor starts. The sequence is completed by the sound of the starting cooling fan.

Standing noises

The standing noises consist of the sound of the cooling fan only.

Driving sound

While driving, the sound of the driving motor is produced, depending on the speed of the locomotive.

Locomotive shut down

First the cooling fan stops, the the vacuum pump starts. The sequence is completed with the main switch.

4.2. Additional sounds

4.2.1. Sound selection, number of loops (endless loop) and volume

Additional sounds may be triggered by F-keys e.g. operational sounds of the locomotive, whistle, bell, generator, compressor, or station announcements. The allocation of these sounds is accomplished by CV settings (configuration variables).

The whistle, sound #1, is assigned to CV's 131, 151 and 201. The whistle with echo, sound #2, is assigned to CVs 132, 152 and 202, and so on.

The first CV contains the number of the F-key, which triggers the sound, in this case "1", which stands for F-key

1.
CV151 contains the number of loops (repetitions) of the sound. The sound will be repeated once if the CV contains a "1", twice if the CV contains a "2", and so on.
The sound may be repeated up to 15 times. In case "16" is set in CV 151, the sound is repeated endlessly. This means, the F-key switches the sound on and it will stop only after the F-key is switched off again.

The volume of each sound may be programmed separately in steps of four:
> 3 = max. volume
> 2 = ¾
> 1 = ½
> 0 = ¼

This value is set in CV201 for sound #1, in CV202 for sound #2, in CV203 for sound #3, etc.

4.3.Automatic sounds

4.3.1.Starting signal
The engineer gives a warning signal with the whistle shortly before the train starts moving. The sound for this stating signal is defined in CV 188/189. No sound is produced if this CV contains a "0". The factory setting of the eMOTION LS sound decoder defines a 30 sec. Pause between two starting signals. This means, the locomotive has to rest at least 30 sec. To trigger the next starting signal. The pause time may be deactivated in CV149 by subtracting 64.

4.3.2. Operational noises
During acceleration a multiple contact switch is operated in an electric locomotive. The sound used is defined in CV234. The speed at which this sound is produced is set in CV229 and CV233. These values are for digital mode. The decoder computes the stages for the analog mode, as an offset is added of 80.

4.3.3. Braking noise
This sound is produced automatically when the locomotive is slowing down for stopping. This feature is activated per factory setting. The activation of the braking noise is achieved by setting CV149 to "32". Two threshold values may be set for this feature: CV168 (factory setting "64") is the unblocking threshold. A locomotive has to accelerate to a predefined speed to enable the braking noise when slowing down. Next the locomotive has to fall below a predefined speed to trigger the braking noise (trigger threshold) CV169 (factory setting "30"). The braking sound is produced until the locomotive stops or until it accelerates again. These thresholds have a programmable range of 0...255, 255 being the maximum speed. In case a locomotive is generally operated at very low speeds, CV168 may be lowered to e.g. "32".

4.3.4. Random generator
The random generator handles a maximum of 4 sounds. The number of the sounds are set in CV180 to CV183, the number of loops are set in CV184 to CV187. The frequency of occurrence is set in CV179, 1 = frequent occurrence to 3 = infrequent occurrence.
The random generator is activated by adding "1" to the CV149 setting (to set Bit 0).

4.3.5. Standing noises
The standing noises is a series of max. 4 sounds which are produced after the locomotive has stopped. These sounds are activated by adding "2" to the CV149 setting (to set Bit 1). The sounds are defined in CV171 to CV174 and the loops in CV175 to 178.

4.4.Loudspeaker + external volume control
4.4.1. Total volume
The total volume of the sound is set in CV200, range 0...64. The factory setting is "32".

4.4.2.External volume control
The total volume of the eMOTION LS sound decoder may be controlled by an external potentiometer. CV200 must be set to "255" to activate the external volume control.

4.4.3.Loudspeaker specifications
The power amplifier of the eMOTION LS Sound Decoder delivers 1 Watt with a loudspeaker of 8 Ohms impedance. 8 Ohms impedance is a must for all loudspeakers used with the decoder to ensure proper operation and a long-life cycle. Use only loudspeakers with at least 1 Watt capacity. The basic rule says: the play back quality of a loudspeaker grows with the capacity.

4.5. RPM control, control in- and outputs
The synchronization of the sound with the rotation of the wheels can be achieved with a pulse generator or by speed steps. CV195 defines the method used. Setting CV195 to "0" defines the speed steps to be the controlling parameter for the sound.
Recommendable a hall sensor is to be used as master clocks. This is switched by a magnet. Therefore it must be indicated in the register of the wheel sensor (CV 195) how many magnets are necessary around a steam impact to produce.

Steam locomotives:
0 = Control by speed steps
1 = one chuff per magnet
2 = one chuff per two magnets
4 = one chuff per four magnets

Diesel locomotives and Electric locomotives:
0 = Control by speed steps
1 = Control by pulse generator (wheel sensor)
CV196 and CV198 apply for steam locomotives only. CV196 sets the duration of the steam chuff, range 0 to 32. This relates to a time frame between 32 msec to 1.28 sec. CV198 defines the pause time between steam chuff's (in relation to the duration of the chuff's).
In addition track magnets may trigger sounds. The sound assignment is set in CV's 190 and 191.

5. Explanation of basic CV settings

5.1. Locomotive address
As mentioned in " A brief introduction into digital control" above, 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)
   - Multiple Unit addresses (Consist addresses) (1…99)
 • 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 Multiple Unit address (Consist address) (CV 19) is programmed automatically, if Lenz Digitalsystem multiple traction is called. In normal operation CV must be 19= 0. If the driving direction is to be reversed, a value of 128 must be added to CV 19

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 CV's 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 LS Sound Decoder is "3". In case of a decoder reset the address will be reset to this value.

5.2. Serial and Parallel Data Transfer

The factory setting of the eMOTION LS Sound Decoder enables both serial and parallel data transfer making the decoder compatible to all NMRA/DCC systems. The serial data transfer may be disabled to eliminate the short waiting time of about ½ second when using F1. The F1 function will be triggered instantly.
Pulse generator (sound synchronization with the wheel cycle)
The eMOTION LS Sound Decoder may be synchronized directly with the revolutions of the locomotive wheels. The installation of the pulse generator in the model varies with the type of model and may be done on different axles. Three CV's are utilized to define the synchronization setting.

5.3. Reset functions

In case the settings of your eMOTION LS Sound 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 LS Sound Decoder is that you can reset a specific part of the decoder without changing the remaining parts. The CV's are combined to function groups and reset as a group. You may reset the driving characteristics, the light functions, or sound settings separately. Please find detailed information about the reset functions of the eMOTION LS Sound Decoder in the CV-table.

6. CV - table (drive-settings)

This table shows the standard settings of eMOTION LS Sound Decoders. 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)**

CV	Description	Default	An	Value	Note
4	Braking Time	3	√	1 - 255	CV4 x 2ms x (1/255 track voltage)
5	Top Speed	200	√	1 - 255	CV5 x (1/255 track voltage)
6	Mid Speed	50		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	22		---	read only
7	Decoder Reset Functions (5 Ranges Available)	---		55 66 77 111 122 133	reset basic setting reset motor setting reset lights and functions reset CV131 - CV167 reset CV171 - CV199 reset CV200 - CV212 see attachment 6
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	S1 = 1, S2 = 2; S3 = 4, S4 = 8; S7 = 64, S8 = 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)				
19	Multiple Unit Address (Consist Address)	0		0 ... 99 +128	Address to drive in multiple traction +128 = reverse direction
29	Configuration Table NMRA	4	√		see attachment 1
49	Configuration Table Massoth	2	√		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	S1 + S2 Dimming Value	32	√		see attachment 4
54	S1: Command Allocation	7			see attachment 3
55	S1: Special Function	0	√		see attachment 5
56	S2: Command Allocation	2			see attachment 3
57	S2: 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	Switching 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	16		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 7 (if CV29-Bit4=16)
105	Type of Sound	*		---	read only
106	ID for Decoder Type (Only Needed for Software Update)	202		---	read only
112	S3+S4 Dimming Value	32	√		see attachment 4
113	S3: Command Allocation	3			see attachment 3
114	S3: Special Function	0	√		see attachment 5 + 5a
115	S4: Command Allocation	4			see attachment 3
116	S4: Special Function	0	√		see attachment 5 + 5a
121	S7: Switching Function	13		0 ... 16	0=light, 1…16 = F-key
123	S8: Switching Function	14		0 ... 16	0=light, 1…16 = F-key
129	Lag time with power buffer, digital operation	0		2 ... 255	Only use Goldcap buffer
130	Lag time with power buffer, analog operation	0	√	2 ... 255	Only use Goldcap buffer

7. CV - table (sound settings)

The sound settings vary with the sound programmed in the decoder therefore the settings are not listed.

CV	Description	Default	Value	Note
131	Add. Sound 1 : Switching Command	*	0 ... 16	0=deactivated: sound can not be triggered by F-key
132	Add. Sound 2 : Switching Command	*	0 ... 16	
133	Add. Sound 3 : Switching Command	*	0 ... 16	
134	Add. Sound 4 : Switching Command	*	0 ... 16	1…12 = F-key assignment: sound will be triggered by the respective F-key
135	Add. Sound 5 : Switching Command	*	0 ... 16	
136	Add. Sound 6 : Switching Command	*	0 ... 16	
137	Add. Sound 7 : Switching Command	*	0 ... 16	
138	Add. Sound 8 : Switching Command	*	0 ... 16	
139	Add. Sound 9 : Switching Command	*	0 ... 16	
140	Add. Sound 10 : Switching Command	*	0 ... 16	
141	Add. Sound 11 : Switching Command	*	0 ... 16	
142	Add. Sound 12 : Switching Command	*	0 ... 16	
147	Amplifier (Sound) Off/On : Switching Comand	6	0 ... 16	
148	Loco Start up/Shut down, resp. Cylinder Sound (Steam Engine)	5	0 ... 16	
149	Configuration Register Massoth-Sound	2	0 ... 255	see attachment 8
150	Starting Inhibit between starting-phase	0	0 ... 3	0=Off 1=Digital on 2=Analog on 3=Digital + Analog on If on, loco starts after starting-phase
151	Add. Sound 1 : Number of Loops	*	0 ... 16	0= no sound repetition: the sound will be triggered only once
152	Add. Sound 2 : Number of Loops	*	0 ... 16	
153	Add. Sound 3 : Number of Loops	*	0 ... 16	
154	Add. Sound 4 : Number of Loops	*	0 ... 16	1…15: number of repetitions: e.g. the number of bell rings or the blow of a whistle
155	Add. Sound 5 : Number of Loops	*	0 ... 16	
156	Add. Sound 6 : Number of Loops	*	0 ... 16	
157	Add. Sound 7 : Number of Loops	*	0 ... 16	
158	Add. Sound 8 : Number of Loops	*	0 ... 16	16: sound steady on: the sound is started with a F-key and repeated until the F-function is switched off
159	Add. Sound 9 : Number of Loops	*	0 ... 16	
160	Add. Sound 10 : Number of Loops	*	0 ... 16	
161	Add. Sound 11 : Number of Loops	*	0 ... 16	
162	Add. Sound 12 : Number of Loops	*	0 ... 16	
167	Control Register: Type of Sound (Do Not Change!!)	*	---	read only 1=Steam, 2=Diesel, 6=Electric

CV	Description	Default	Value	Note
168	Release Threshold: Brake	64	0 ... 255	
169	Trigger Threshold: Brake	30	0 ... 255	
171	1. Standing Noise : Sound Assignment	*	0 ... 12	0= no standing noise
172	2. Standing Noise : Sound Assignment	*	0 ... 12	1…12= assignment of additional
173	3. Standing Noise : Sound Assignment	*	0 ... 12	sounds the sounds selected are
174	4. Standing Noise : Sound Assignment	*	0 ... 12	played in the order 1-4 while the loco holds
175	1. Standing Noise : Number of Loops	*	0 ... 15	0= no sound repetition:
176	2. Standing Noise : Number of Loops	*	0 ... 15	the sound will be triggered only
177	3. Standing Noise : Number of Loops	*	0 ... 15	once
178	4. Standing Noise : Number of Loops	*	0 ... 15	1…15: number of repetitions: e.g. the number of air pump sounds
179	Time Value of Random Generator	3	1 ... 3	1= frequent triggering, 3=infrequent triggering
180	1. Random Sound: Sound Allocation	*	0 ... 12	0= no random sound
181	2. Random Sound: Sound Allocation	*	0 ... 12	1…12= assignment of additional
182	3. Random Sound: Sound Allocation	*	0 ... 12	sounds:
183	4. Random Sound: Sound Allocation	*	0 ... 12	the sounds selected are triggered randomly
184	1. Random Sound: Number of Loops	*	0 ... 15	0= no sound repetition:
185	2. Random Sound: Number of Loops	*	0 ... 15	the sound will be triggered only
186	3. Random Sound: Number of Loops	*	0 ... 15	once
187	4. Random Sound: Number of Loops	*	0 ... 15	1…15= number of repetitions: e.g. number of air pump sounds
188	Warning Signal Moving Forward: Sound Allocation	*	0 ... 12	0= no sound allocated 1…12= allocation of the
189	Warning Signal Moving Backward: Sound Allocation	*	0 ... 12	additional sounds:
190	(Reed) Contact 1: Sound Allocation	*	0 ... 12	The sound selected will be
191	(Reed) Contact 2: Sound Allocation	*	0 ... 12	presented depending on the operational status of the
192	Brake Application: Sound Allocation	*	0 ... 12	locomotive
193	Trigger Threshold: Sound Output in Analog Mode	*	0 ... 255	alignment of the sound to the motor RPM when starting to
194	Trigger Threshold: Sound Output in Digital Mode	*	0 ... 255	move
195	Pulse Generator: Control Register	0	0 ... 4	0= no external pulse generator 1…4= number of magnet poles per each steam chuff
196	Duration of a Steam Chuff	28	0 ... 32	0…32= duration of a steam chuff

CV	Description	Default	Value	Note
198	Spacing Between Steam Chuff	1	0 ... 16	0...16 pause time between steam chuff's (only active if CV195 is set to "0")
200	Total Volume Level	32	1 ... 63 oder 255	1= low, 63= loud, 255= ext. potentiometer
201	Add. Sound 1: Individual Volume Level	*	0 ... 3	0= 25% volume level 1= 50% volume level 2= 75% volume level 3= 100% maximum volume
202	Add. Sound 2: Individual Volume Level	*	0 ... 3	
203	Add. Sound 3: Individual Volume Level	*	0 ... 3	
204	Add. Sound 4: Individual Volume Level	*	0 ... 3	
205	Add. Sound 5: Individual Volume Level	*	0 ... 3	
206	Add. Sound 6: Individual Volume Level	*	0 ... 3	
207	Add. Sound 7: Individual Volume Level	*	0 ... 3	
208	Add. Sound 8: Individual Volume Level	*	0 ... 3	
209	Add. Sound 9: Individual Volume Level	*	0 ... 3	
210	Add. Sound 10: Individual Volume Level	*	0 ... 3	
211	Add. Sound 11: Individual Volume Level	*	0 ... 3	
212	Add. Sound 12: Individual Volume Level	*	0 ... 3	
217	Volume Turn-on phase	*	0 ... 3	
218	Volume Standing phase	*	0 ... 3	
219	Volume Turn-off phase	*	0 ... 3	
220	Volume Driving phase	*	0 ... 3	
229	Trigger Threshold 1: Multiple-contact switch digital mode	16	0 ... 255	
230	Trigger Threshold 2: Multiple-contact switch digital mode	32	0 ... 255	
231	Trigger Threshold 3: Multiple-contact switch digital mode	48	0 ... 255	
232	Trigger Threshold 4: Multiple-contact switch digital mode	112	0 ... 255	
233	Trigger Threshold 5: Multiple-contact switch digital mode	160	0 ... 255	
234	Sound on accelerate, Multiple-contact switch	11	0 ... 255	

Values marked with „*" : see the respective locomotive manual.

7.1. Sound assignment

The settings for the sound in the eMOTION LS Sound Decoder start at CV131. In this section specific sounds and noises may be assigned to desired F-keys. In addition a triggered sound may be looped for a prolonged play-back; you may arrange the sounds of your locomotive to your own needs, tastes and ideas.

7.2. Standing sounds and noises (CV171 to CV178)

During the standing phase a locomotive produces several different sounds from various functions and places on the locomotive. The origins of these sounds can be air pumps, valves, pressure reducers, compressors, hydraulic pumps, generators, and other components. The frequency of occurrence and the allocation of the sounds may be changed at any time.

7.3. Random generator (CV179 to CV189)

Depending on the prototype of the locomotive, the standing sounds and noises are allocated and played back realistically randomly. If required the sounds and noises may be changed or substituted by other sounds.

7.4. Signals before start (CV188, CV189)

Sounds to signal the imminent start of a locomotive may be allocated depending of the direction of the movement.

7.5. Sound allocation for reed contacts (CV190, CV191)

Allocate sounds of your choice to the reed contacts (contact 1 and contact 2). Please note that you may choose between basic reed contact triggering or direction related triggering which may be done with CV149.

7.6. Total volume level (CV200) and individual volume level (CV201 to CV212)

The eMOTION LS Sound Decoder features volume control by CV-programming. The volume of the sound may be changed by PoM programming at any time while operating a locomotive. In addition you may change the volume of each and every sound and noise individually.

7.7. Volume Control Driving Sound (CV217 – CV220)

- **Effect of the CV's in an Electric Locomotive:**

  During the start of the operation of an electric locomotive the main switch, the pantograph's or the compressor are switched on before the cooling fan starts running. The volume of these sounds is controlled by CV217. The cooling fan volume is set with CV218. The shut-down sound of the cooling fan is controlled by CV219. The volume of the driving sound is adjusted by CV220.

- **Effect of the CV's in a Diesel Locomotive:**

  Before the main diesel engine is started auxiliary units are switched on, e.g. the auxiliary diesel or the oil pump. The volume of the auxiliary units is controlled by CV217. The idle volume of the main diesel engine is set with CV218, the driving sound volume is adjusted with CV220. The volume of the shut-down sound is controlled by CV219.

- **Effect of the CV's in a Steam Locomotive:**

  The volume of the standing noise of a steam locomotive is set with CV218. The volume of the cylinder side noise is controlled by CV219 and the volume of the main sound is adjusted with CV220.

8. 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				

8.1. Attachment 2: (CV49) - Massoth-Configuration

Bit	Off (Value=0)	Application	On	Value	Note
0	Parallel Data Transfer Only		Serial + Parallel Data Transfer	1	automatic detection of serial/parallel
1	Digital Load Control = Off		Digital Load Control = On	2	
2	Analog Load Control = Off		Analog Load Control = On	4	
3	S1-Output Standard Function		Fast Pulse String (P-Update) on S1	8	Bit3 "on" only with Bit0 "on"
4	Electronic parking brake OFF		Electronic parking brake ON	16	Only active on halt of loco
5	Not Used				
6	Not Used				
7	Not Used				

8.2. Attachment 3: Switching Output Commands (CV51, 52, 54, 56, 113, 115)

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

8.3. Attachment 4: Dimming Values (CV53, 112)

Value	Application	Note
1 ... 32	**Voltage in Percent of Track Voltage on Output (Both outputs dimmed)**	1 Unit = approx. 3% of track voltage 1 = 3% of track voltage (0.75V) 32 = 100% track voltage (24V)
+ 64	**S1 resp. S3 is dimmed only**	S1 = value in CV53 S3 = value in CV112*
+ 128	**S2 resp. S4 is dimmed only**	S2 = value in CV53 S4 = value in CV112*

* = Command Allocation Value must be added to Voltage Value

8.4. Attachment 5: Special Function S1 + S2 + S3 + S4 (CV55, 57, 114, 116)

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**

8.5. Attachment 5a: Expanded Special Functions S2 + S3 + S4 (CV57, 114, 116)

Value	Application	Note
16	**Inverse Coupling with Output S1, resp. S3 or S5 Alternating Flashing**	**CV57 (S2 with S1)** **CV116 (S4 with S3)**
30	**Pulse simulation for the pulsed smoke generator (Only S3)**	**CV 114**

8.6. Attachment 6: 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 settings. The reset values 111 and 122 reset the sound settings of the sound decoder. These values vary with the sound version and are therefore not listed.

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=200, 6=50, 9=0, 60=2, 61=60, 62=255, 64=16
77	13=3, 50=32, 51=128, 52=64, 53=32, 54=7, 55=0, 56=2, 57=0, 112=32, 113=3, 114=0, 115=4, 116=0, 117=5, 118=0, 119=6, 120=0
111	CV131 - CV167 Reset of Sound Functions (values vary with sound type)
122	CV171 - CV199 Reset Standing Phase Sounds (values vary with sound type)
133	CV200 - CV220 Reset Volume Settings

8.7.Attachment 7: 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

8.8. Attachment 8: (CV149) – Massoth-Sound-Configuration

Bit	Off (Value=0)	Application On	Value	Note
0	Random Generator Off	Random Generator Active	1	
1	Standing Phase Noise Off	Standing Phase Noise Active	2	
2	Standard Driving Sound	Load-Dependent Sound	4	rolling noise during coasting
3	Cylinder Valves Closed	Cylinder Valves Open	8	only steam locos during start of movement
4	Contacts Standard	Reed Contact Inputs Direction Sensitive	16	
5	Automatic Side Noises Off	Automatic Side Noises Active	32	
6	Start Signal Delay Off	Start Signal Delay On	64	
7	Not Used			

9. Decoder programming + update

The eMOTION LS Sound 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 LS Sound Decoder confirms every successful programming cycle with a short beep via the loudspeaker. This ensures the correct reception and accomplishment of the programming command.

9.1. Reading Configuration Variables (CV's)

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

9.2. Writing Configuration Variables (CV's)

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.

9.3. Writing the Configuration Variables (CV's) 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".

9.4. Register programming / writing CV's indirectly

Register programming was the first method of CV programming. The eMOTION LS 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 CV's 1 to 4 are entered directly; all other CV's with higher numbers are programmed indirectly.

> Let's assume you want to set the total volume (CV 200) to "10". The first step is to go into the register programming mode, insert "6" thereafter "200". If this was successful you have to program "5" with "10". Now your volume is set to "10".

9.5. 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 LS Sound Decoder. **PoM programming should only be performed when the locomotive is not in motion.**

9.6. Software and Sound Update

The software of the decoder may be updated utilizing the Massoth PC-Module (DiMAX 100A, 8175001). In addition the decoder may be reprogrammed with other sounds. Programming must be accomplished via the programming track terminal of the PC-Module. Thus the decoder may be updated even if it is installed in a locomotive.

NOTE: The data volume transferred is tremendous. An optimum track contact during this procedure is a must. We recommend to utilize the loco's power socket if available or the Massoth Rolling Road. The update procedure starts with an extensive test of the communication line. In case the update shuts down prematurely, a better contact must be provided.

10. 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.

10.1. 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.

10.2. Technical specifications:

Power supply: 0-24 Volts DC/DCC (in peaks max. 27Volts)
Current: 30-500 mAmps (depending on sound, w/o motor + functions)
Maximum Motor current: 1,5Amps
Maximum function current: 1,2Amps (max. 100 mAmps on S3, max. 10mAmps on S7+S8)
Loudspeaker: 8 Ohm (at least 1,5W)
Temperature range: -4°F to 113°F
Measurements: 53,5 x 25 x 15 mm (L x W x H)

Important notice regarding temperature: The accumulation of condensed water must be avoided at all times. If you intend to operate the electronic unit in temperatures below or close to freezing, make sure to have it stored in a heated environment before operation. The heat resulting from the normal operation is sufficient to prevent condensation.

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.

11. Support

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

11.1. Manufacturer

Massoth Elektronik GmbH
Frankensteiner Str. 28
D-64342 Seeheim-Malchen
GERMANY

For technical support contact:
Massoth Electronics USA
6585 Remington Dr. Suite 200
Cumming, GA 30040

Hotline hours USA: 9:00 a.m. to 4:00 p.m. EST Mo thru Fr

Ph. 770-886-6670
Fax 770-889-6837

Email sales@massoth.com

Internet www.massoth.com