User Manual

LokSound

for version V3.0
1st edition , July 2004

Contents

1. Introduction

Congratulations on purchasing a LokSound decoder. With LokSound your engines sound like the prototype. You will soon notice that your LokSound equipped engines are the center of attraction on any layout. Of course, you would like to install this decoder immediately, but first we kindly request you to read the following remarks:

> Please read this manual carefully before carrying out the installation!!! Although LokSound decoders are very robust, incorrect wiring may destroy the module!

Due to its factory settings your new LokSound decoder can generally be used as is. It offers a multitude of options to help you adjust your LokSound decoder even better to your model. Please familiarize yourself with the decoder before installing it and adjusting any parameters. Also note the recommendations regarding installation.

Important warning:

- LokSound decoders are designed for use in model railways only
- Avoid mechanical force or pressure on the decoder
- Do not expose to wet and humid conditions
- Do not remove the heat shrink sleeve on the decoder
- Never solder on the circuit board, extend cables if necessary
- Never wrap the decoder in insulation tape, since this may cause overheating
- Always disconnect the circuit when installing the decoder
- Make sure that neither the LokSound decoder nor any blank wire ends may come into contact with the engine chassis (risk of short circuit). Cover any blank ends of unused wires.
- Make sure that no wires are squeezed or cut by the model's transmission parts when reassembling the engine

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> Handle the speaker with extreme care: Do not touch the membrane or apply pressure! Solder speaker connections quickly and only at the intended contacts! Pay close attention to the instructions for installing the speaker!

If you adhere to these warnings your LokSound decoder will reward you with trouble-free operation and long life.

ESU GmbH & Co. KG, in July 2004

This manual has several chapters explaining step by step how to proceed:

Chapter 2 provides an overview of the characteristics of LokSound and LokSoundXL decoders.

Chapter 3 describes installation and connection. In chapter 3.1 installation of LokSound decoders for HO, TT, N and O gauge are explained while chapter 3.2 deals with the LokSoundXL for larger scale models (O, I, II,...).

LokSound decoders are suitable for most digital command control systems. Chapter 4 provides an overview on which digital and analogue systems may be used to operate LokSound decoders as well as some particularities with certain systems.

If you want to modify the preset running characteristics and/or sound effects we strongly recommend to read chapter 5. Here you will gain an insight regarding the many options and how to adjust various parameters. You will also learn how to reset the decoder to the factory settings. The ESU LokProgrammer (Art. No. 53450) makes setting any parameter of your LokSound decoder as easy as making a phone call or sending an email.

Chapter 6 contains the answers to Frequently Asked Questions.

In Chapter 7 a table provides all you need to know regarding the programming of decoder characteristics as outlined in chapter 5.

2. Characteristics of the LokSound decoders

The LokSound decoder is a universal electronic module for installation in model engines of most common scales. We recommend LokSound for all engines in TT, HO gauge as well as smaller engines in O gauge. LokSoundXL is best suited for larger scales such as O, I, II and G gauge. ESU LokSound decoders revolutionize any model train layout. They intelligently combine a sophisticated digital decoder and a digital sound module. With LokSound you can run your engine with load control and many auxiliary functions while enjoying the original sound of the prototype. Its unique features provide flexibility and safety in operation that you have come to expect from a state-of-the-art decoder. Even future standards are no problem for LokSound: its flash technology allows adaptation to the latest developments.

Multi-protocol operation: LokSound decoders und-erstand both, the commonly used Märklin® / Motorola® – format and the NMRA / DCC - system. Thus LokSound may be used with almost all currently available digital command control systems. Amongst others LokSound was tested with:

• Arnold Digital® (DCC system)

• Lenz Digital Plus®

• ROCO® digital is cool®

• Märklin® 6021

• Uhlenbrock® Intellibox (DCC + Motorola® system)

• ZIMO MX-1 (DCC-Betrieb)

• Fleischmann® Twin-Center

• LGB MZS Steuerung

Automatic change between all four operating modes during operation (AC analogue, DC analogue, DCC digital, Märklin® digital)

Universal motor connection: All types of motors commonly used for model trains may be connected to LokSound:

• DC motors (e.g. Bühler, Mabuchi)

• Coreless motors (e.g. Faulhaber, Maxxon)

• Alternating current

High motor pulse frequency: The pulse frequency of 32 kHz (!) assures absolutely smooth running. Thus the motor runs silently and without any whine, heat generation is minimized and lifetime is prolonged. Even coreless motors may be operated with LokSound decoders without any problem.

Motor control: LokSound offers fourth generation load control. It may be adapted to suit each individual motor and can be switched off. Suitable for DC motors and coreless motors. Therefor your engine will always travel at the selected speed, no matter how large the load is or whether the engine is traveling up or down gradients.

4 function outputs: In addition to the two lighting outputs, two more function outputs are available: switch on a smoke generator or the interior lighting or activate a digital coupler by pressing a button! Lighting effects and individually dimmable lamps help to make your models even more prototypical and you will have lots of fun.

Brake sections: LokSound decoders recognize (and respond to) the most common brake systems: besides the Lenz brake generator, the Märklin® brake track is also supported.

Circuit protection: the motor output and all function outputs are protected against short circuit.

> Please make sure that the total current does not exceed the maximum permitted current for the function outputs and avoid short circuits between the outputs: LokSound circuits are protected, but an external voltage at the terminals of a function output may destroy the circuitry.

Analogue operation: LokSound decoders may be operated on AC- and DC layouts without any problems.

Easy programming: Even with Märklin® 6021 all functions may be changed comfortably without opening the engine.

A digital, four-tone sound module with unique characteristics:

Prototype sounds: sounds of prototype engines were sampled using high fidelity microphones and recorded digitally on the flash memory module. Thus your engines sound exactly like the prototype!

With four independent channels your engine sounds even more realistic since you can simultaneously add 3 sound effects to the running sound. Pumps, power switches and squealing brakes can all be heard at the same time. The exhaust chuffs of steam engines vary with the revs of the drivers and the load. Now you can really hear your engine work. Diesel engines can now simulate the reduced revs of the diesel while the engine is coasting. The running sound and the sound

of the fans (blowers) in electric engines is now separate. Additional sound effects can be activated by pressing a function button (F1 – F12). Random sounds: sound effects such as air pump, water pump, shoveling coal, discharging compressed air, etc. are randomly triggered. Such sounds can be configured differently for stationary or moving engines.

3. Installation of LokSound decoders

3.1. Connecting LokSound decoders in HO, TT, N, O gauge models

3.1.1 Installation requirements

The engine must be in good mechanical condition: only an engine running smoothly in analogue mode should be modified for digital operation. An engine running poorly in analogue mode will not operate satisfactorily in digital mode – even with the best digital decoder. Check and clean or replace any wear and tear parts such as motor brushes, wheel contacts, lamps etc.

Always remove the engine from the track when doing maintenance work or modifications. Make sure that no voltage is applied – intentionally or accidentally – while you work on the model.

LokSound decoders have a certain size: make sure, that the decoder fits easily into the engine, that no pressure is applied when replacing the housing onto the chassis and that no wires are squeezed between other parts. Further, make certain that moving parts such as transmissions and trucks are not obstructed by wires.

Never pack a LokSound decoder in foam pads etc. The decoder heats up during operation; good heat dissipation is essential.

Electronic components are sensitive to electrostatic charges: always make sure that your work place is grounded. If necessary, use an earthed wristband.

When installing the decoder make sure that no metal part of the chassis touches any components of the decoder.

In conjunction with trained and experienced specialists ESU GmbH & Co. KG offers a conversion service (modification from analogue to digital).

Pin	Description	Colour code
1	motor terminal right	orange
2	back-up light	yellow
3	function F1	green
4	current pick-up 1	black
5	motor terminal left	grey
6	headlight	white
7	common (+pole)	blue
8	current pick-up 2	red
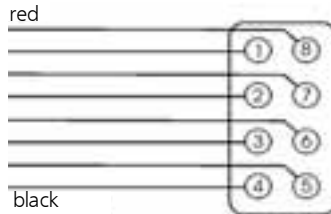
Figure 1: NEM 650/652 interface

3.1.2 Engines with DCC interface

LokSound is supplied with an 8-pin plug as per NEM 650/652 (NMRA S9.1/9.2) as shown in figure 1

Installation in engines with NEM socket is particularly easy:

- Remove the body! Follow the instructions in the manual of the engine!
- Remove the analogue plug or directional relay. Please keep the plug / relay for future use
- Insert the decoder plug with pin 1 (the side with the red/orange wire) into the side of the socket that is usually marked with *, +, • or 1. Take care not to bend any pins. Do not rely on the assumption that the wires have to lead in a certain direction, the marking is the only valid reference.
- Place the decoder in a suitable location within the engine and fasten it with double sided tape or a drop of hot glue.
- Now fix the speaker in a suitable place. See chapter 3.2.4

Figure 2: Wiring of engines with DC motor and isolated functions

Figure 3: Wiring of engines with DC motors and functions with the common pole connected to the chassis

3.1.3 Engines without interface

Not every engine has a digital interface and thus the wiring becomes more elaborate:

Disconnect any existing wires within the engine and any connection to the chassis. Both motor contacts must be isolated, make sure there isn't any connection to the chassis, the wheels or the pantographs. This may easily be overlooked particularly in Fleischmann® models!

After installing the decoder please check all connections with an Ohmmeter and look out for any short circuits between motor- and current pick-ups.

How to proceed depends on how the headlights and other functions are wired in the engine:

a) If headlights and functions are isolated from the engine chassis (free of any voltage) proceed as per figure 2.

b) Headlights and functions may be connected with their common to the track voltage (e.g. almost all Märklin® -engines and older Fleischmann® or ROCO® engines) as per figure 3

Don't get confused by the fact that both figure 2 and 3 show how to wire DC - and coreless motors. How to wire a universal motor (Märklin®) is shown in figure 5.

- Connect the red wire to the right rail pick-up (or centre pick-up in AC models), the black wire to the left rail pick-up (common rails in AC models).
- Connect the backup lights to the yellow wire, the headlights to the white wire.
- Connect the green wire to the function output AUX-1. Allocate the function button later.
- Connect the purple wire to the function output AUX-2. Allocate the function button later.
- Connect the speaker to the two dark-brown wires.
- If the headlights and functions are isolated from the chassis (see figure 2) connect all commons to the blue wire. Make sure the blue wire has no contact to the engine chassis.

3.1.3.1 Connecting DC motors

- Connect the orange wire with the motor terminal, that was originally wired to the right wheel pick-up (centre pick-up in AC models).
- The grey wire goes to the terminal, that was originally connected to the left wheel pick-up (common rails for AC models).
- Exchanging the wires changes direction of travel.
- Some engines with the Märklin® 5-pole high performance drive may have 3 RFI suppressors soldered to the motor shield.
- The two suppressors that connect the motor terminals with the motor chassis must be removed (see figure 4).
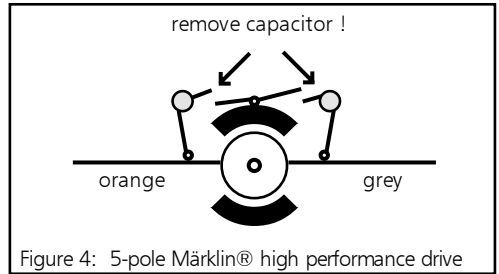
Figure 4: 5-pole Märklin® high performance drive

3.1.3.2 Connecting universal motors

Figure 5 shows how a universal motor (e.g. AC motor by Märklin®) is connected to a LokSound decoder:
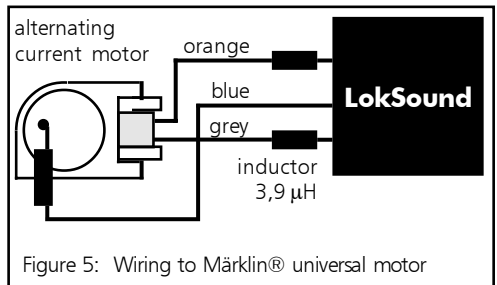
Figure 5: Wiring to Märklin® universal motor

- Connect the orange wire with the motor terminal that was originally connected with the center pick-up.
- Connect the grey wire to the motor terminal that was originally connected to the common / wheel pick-up.
- Exchanging the wires will change direction of travel.
- Solder an inductor (choke) with at least 3,9 mH to each motor terminal. They are available as spare parts from Märklin® under article number 516520.
- The RFI suppression inductor remains attached to the collector terminal of the motor and has to be soldered to the blue wire.

Please note:

If a universal motor is connected LokSound will automatically deactivate Back EMF Control. The principle of Back EMF Control does not work with universal motors.

3.1.4 Connecting the speaker

LokSound decoders may only be used with the speakers supplied by ESU electronic solutions ulm GmbH & Co. KG. They have an impedance of 100 Ohm. The use of speakers by others may cause considerable distortion and in extreme cases even destroy the LokSound decoder.

The correct position of the speaker is crucial to achieve high quality sound. A speaker that is installed without a resonance chamber will not generate good sound. Therefore carefully select the location and sound chamber for the speaker.

The speaker must be installed in such a way that the sound waves are not unduly blocked.

> Please handle speakers with extreme care: don't apply pressure or touch the membrane! The speaker's magnets are very powerful! Keep all metal items away and secure the speaker firmly when soldering. The soldering iron may pull the speaker due the magnetic field and destroy it.

Connect the speaker to the 2 dark brown wires of the LokSound module. Make sure that you use a small soldering iron (max. 20 W) and only heat the marked spots as shown in the figure (close to the edge of the small contact plate). Polarity is not important

solder here!

An optimal sound effect is achieved by putting the speaker into a sound chamber, which is supplied with the speaker. This will increase the sound pressure and channel the sound in one direction. Without sound chamber the sound effect may be unsatisfactory. Feed the speaker wires through a small hole in the sound chamber.

speaker

chamber
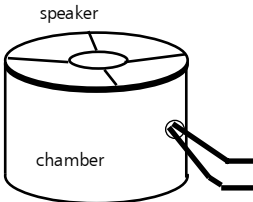
3.1.5 Connecting auxiliary function devices

Any load may be connected to the lighting and auxiliary function outputs as long as it doesn't exceed the maximum current (see technical data in the appendix of this manual). Note that the overload protection of the decoder reacts quickly and will switch off all functions immediately in case of an overload or short circuit.

> Therefore use only 16 V lamps (or a higher voltage) and a maximum nominal current of 50mA: incandescent lamps have a high starting current and may trigger the overload protection during switch-on.

Use only digital smoke generators (e.g. Seuthe No. 11) for engines whose lighting and auxiliary function outputs are connected as shown in figure 2. Other smoke generators draw too much current. There are smoke generators with more than 250mA nominal current on the market!

Engines that are wired as shown in figure 3 need an analogue smoke generator e.g. Seuthe No. 10.

> Make sure that the total current for the function outputs does not exceed the permitted current rating and avoid short circuits between outputs. Although the output circuits are protected, a high voltage on the terminals or a short circuit may cause damage.

3.1.6 Connecting a wheel sensor

To synchronize the exhaust chuffs with the revs of the drivers an external sensor can be (but does not have to be) used. The sensor input is described in figure 6.

LokSound decoders support reed contacts or mechanical contacts.

If a reed contact is to be used a miniature magnet (available at hobby shops) must be attached to the driving wheel axle in such a way that the magnet releases the reed contact once every turn. Miniature reed contacts have been proven to be very reliable. They are available at electronic specialist stores.

Suitable magnets may be bought at model train shops. (e.g. Mini-track magnets) which might have to be shaped to fit.

All double pole (mechanical) contacts that are isolated (not connected to the chassis) are suitable.

Before the wheel sensor will work various CVs have to be programmed. See chapter 5.2.4 on page 21.

drive wheel

miniature

reed contact   magnet

Figure 6: Connecting a wheel sensor
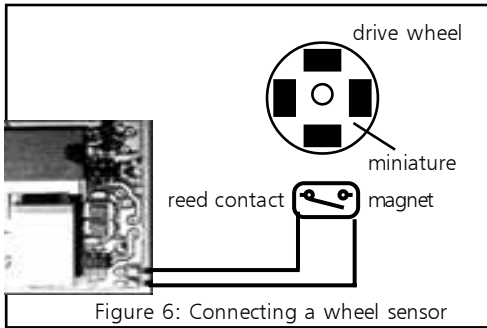
3.2. Connecting the LokSoundXL decoder

The LokSoundXL decoder is partly supplied as an open circuit board. Do not remove the shrink sleeve, as there will be no warranty. Like any electronic device handling the LokSoundXL requires some care:

Please make absolutely certain that the module does not have contact with any metal parts: risk of short circuits!

The LokSoundXL has a few more terminals required for the sound effects. LokSoundXL is supplied with screw terminals for easy wiring without soldering. Please note the following:

• LokSoundXL decoders have two screw terminal strips (No. 1 + No. 2):

• Please make sure, that you always use the correct terminal!

• Make certain, that the cable size is large enough for the terminals (min 0.20mm$^{2)}$

• Tinn the ends of the wires or use cable glands

• Take care to avoid short circuits while inserting the wires into the terminals.

• Use a suitable screw driver. Hold down the screw terminals while tightening the screws to avoid any mechanical force on the circuit board.

• Provide adequate RFI suppression of the motor: a 100 nF capacitor parallel to the motor terminals is the absolute minimum.

Please note, that RFI suppression may be achieved by different means. We recommend to leave the chokes supplied with the engine in the circuit.

3.2.1 General hints

When modifying an engine for digital operation please take note of the following:

Take care that no motor terminal is connected to the wheel pick-ups or pantographs, otherwise the decoder may be destroyed.

Separate all connections including possible electrical contact via the engine chassis.

The LokSoundXL has a certain size and requires adequate space. Take care, that the decoder fits easily into the engine, that no pressure is applied when replacing the housing onto the chassis and that no wires are squeezed between other parts. Further, make certain that moving parts such as transmissions and trucks are not obstructed by wires.

Fix the decoder with double sided adhesive tape, some hot glue or screws, but never pack it into foam pads, etc. The decoder heats up during operation and good heat dissipation is essential.

After installation please check all connections with an Ohmmeter and search for possible short circuits, particularly between the motor terminals and the wheel pick-ups.

3.2.2 Wiring diagram

Figures and 9 show the general wiring layout for LokSoundXL decoders:

The left terminal strip (No. 1) contains all connections required for running and sound. The right terminal strip (No. 2) is solely for auxiliary function outputs.

> Please make sure you do not confuse the terminals. Wrong wiring may cause damage or destruction of the decoder – despite the protective circuitry!

Connect the right wheel pick-up to terminal 1-1 and the left one to terminal 1-2. Terminals 1-3, 1-4 and 1-6 are reserved for the motor. For DC and coreless motors only terminals 1-3 and 1-6 are used. Details are described in chapter 3.2.3.1 and 3.2.3.2

A wheel sensor can be wired to terminals 1-4 and 1-5. Details are explained in chapter 3.2.6.1

The speaker is to be connected to terminals 1-8 and 1-9. Installation of the speaker is explained in chapter 3.2.4. Terminal strip 2 serves for the wiring of headlights and auxiliary functions only.

> Please note, that the common of all outputs is terminal 2-9 (positive voltage). Details are explained in chapter 3.2.5.2 and 3.2.5.3.

3.2.3.1 Connecting a DC- or coreless motor

According to the general wiring diagram on page 11. Please note, that any suppression chokes should remain in the motor leads. The parameters for load control vary depending on the type of motor (Bühler, Mabuchi, Faulhaber) and have to be adjusted accordingly. Also refer to chapter 5.2.1

When wiring the motor, please note that terminals 1-3 and 1-6 are used (the ones in between remain disconnected)!

3.2.3.2 Connecting an alternating current (with field coils)

To simplify the modification of older I gauge models with universal motors (with field coils) the motor can be wired straight to the LokSoundXL decoder:

The field coil is wired to the terminals 1-3 and 1-6. Swapping the terminals results in change of direction. The suppressor choke remains with one contact on the motor terminal. The other lead is wired to terminal 1-4 of the decoder. As soon as a universal motor is connected to LokSoundXL, load control is automatically switched off. Universal motors are not suitable for load control.
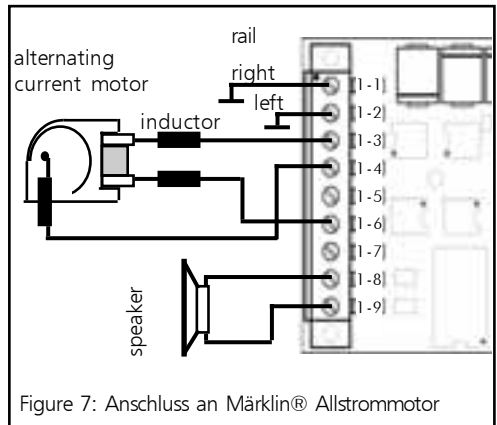
Figure 7: Anschluss an Märklin® Allstrommotor

3.2.4 Installing the speaker

You may only use the specially adapted speakers (1 Watt, 32 Ohm) provided by ESU electronic solutions ulm GmbH & Co. KG for LokSoundXL decoders.

Other speakers will distort the sound and may cause damage or destruction of the decoder.

We cannot recommend the use of speakers designed for HO decoders either.

The appropriate location within the model is crucial for excellent sound reproduction. A speaker without the sound chamber will never generate excellent sound. Therefor carefully select the space for the speaker and the sound chamber within the model.

The speaker must be installed in such a way that the sound waves are not unduly blocked.

Figure 8:
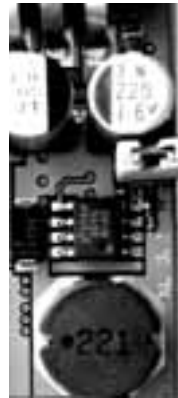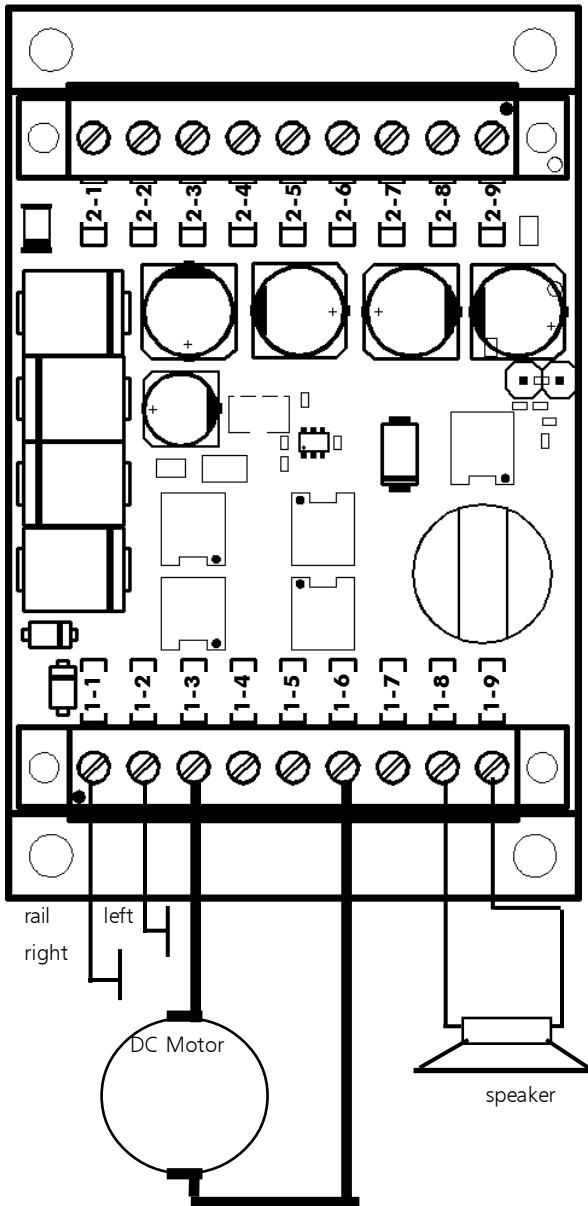
Figure 8a: Setting for 8 - 16 Ohm
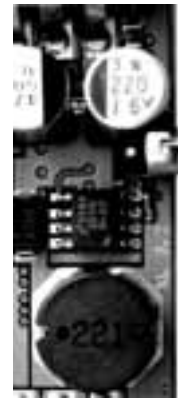
Figure 8b: Setting for 16 - 32 Ohm
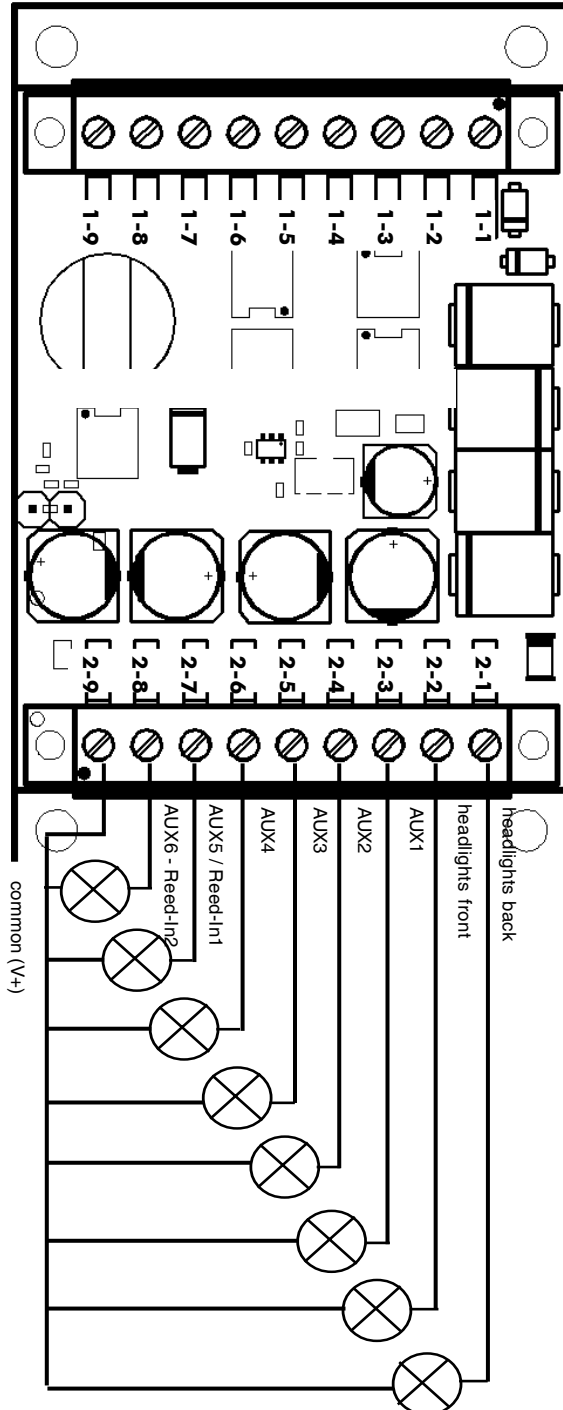
rail

left

right

DC Motor

speaker

Figure 9:

Please handle speakers with extreme care: don't apply pressure or touch the membrane! The speaker's magnets are very powerful! Keep all metal items away and secure the speaker firmly when soldering.

Connect the speaker to the terminals 1-8 and 1-9 of the LokSoundXL module. Make sure that you use a small soldering iron (max. 20 W) and only heat the marked spots as shown in the figure (close to the edge of the small contact plate). Polarity is not important. Make sure no solder drips on the membrane.
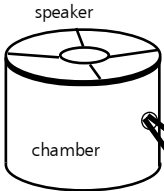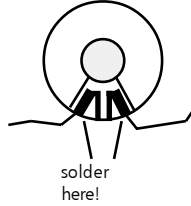
solder here!

An optimal sound effect is achieved by putting the speaker into a sound chamber, which is supplied with the speaker. This will increase the sound pressure and channel the direction of sound. Without sound chamber the sound effect may be unsatisfactory. Feed the speaker wires through a small hole in the sound chamber.

speaker

chamber

3.2.5.1 Auxiliary function outputs

LokSoundXL has 8 (!) function outputs, two of which are reserved for headlights. The remaining 6 (AUX 1 through AUX 6) can be used for lighting, smoke generators, couplers, etc.

However, before you can use these outputs you have to activate them as described in chapter 5.2.3.

The brightness of the outputs can be adjusted individually in 15 steps for each output. Each function output can also be programmed to provide certain lighting effects (blinking, etc.).

3.2.5.2 Connecting headlights

Headlights and back-up lights are to be wired to terminal block 2 as per figure 3.

Generally the outputs will have the full track voltage (between 14 and 25 Volts, depending on the power supply). Therefor you should equip your engine with lamps suitable for that voltage. In older models the lamps may be connected to the chassis (e.g. Märklin). In this case you may not wire the return from the lamp to the terminal 2-9. Thus the lamp works against the common return (chassis).

In many models LEDs or 1.5 Volt lamps are used. They can also be operated with LokSoundXL decoders, but not without some preparation: use a 100 Ohm / 0.5 Watt resistor in series with each LED or 1.5 Volt lamp. You also have to reduce the output voltage to 1,5 V by setting the appropriate CV as per chapter 5.2.3.

When using 1.5 Volt lamps it is not sufficient to reduce the brightness (dimming level) via the CV. Due to the PWM-mechanism the full voltage will be applied for short intervals. The lamps have to be replaced by others that are suitable for 19 Volts.

3.2.5.3 Connecting auxiliary functions

The function outputs AUX 1 to AUX 6 can be used for many different purposes, such as switching a smoke generator, interior lights, automatic change of headlights according to the rules of the Swiss Railways (SBB), etc. Please note, that the outputs are intended for resistive loads such as lamps, smoke generators, relays, etc. The direct connection of a motor is not recommended due to its inductive peaks. Use a relay to switch the motor.

Each output can be wired against terminal 2-9 or against the common return (chassis).

3.3.6.1 Connecting a wheel sensor

To synchronize the exhaust chuffs with the revs of the drivers an external sensor can be used. The sensor input is available on terminal 1-7.

The LokSoundXL decoder supports reed contacts, mechanical contacts or Hall sensors. Many models (e.g. Bachmann or Märklin®) are supplied complete with mechanical contacts.

3.2.6.2 Connecting a reed contact with magnet

If a reed contact is to be used one miniature magnet (available at hobby shops) for each exhaust chuff must be attached to the driving wheel axle in such a way that the magnet triggers the reed contact once every turn.

Miniature reed contacts have been proven to be very reliable. They are available at electronic specialist stores. Suitable magnets may be purchased at model train shops. (e.g. mini-track magnets).

Figure 10a
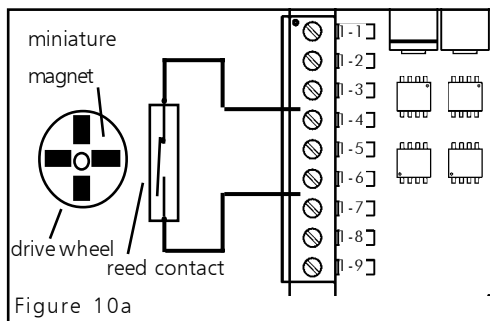
3.2.6.3 Connecting a mechanical contact

Many models are supplied complete with a mechanical contact. It has to be connected in the same way as a reed contact, namely to terminals 1-4 and 1-7.

All double pole (mechanical) contacts that are isolated from the chassis may be used.

3.2.6.4 Connecting a Hall sensor

A Hall sensor is an electronic circuit that responds to an alternating magnetic field similar to a reed contact. It is, however, far more precise than a reed contact.

Hall sensors are easier to adjust since the distance between sensor and magnet is not critical. A commonly used hall sensor, that can be purchased via mail order is the TLE4905 by Siemens / Infineon.

The terminal Vs of the TLE4905 has to be wired to terminal 1-4, GND to terminal 1-5 and the Pin Output to terminal 1-7.

Figure 10b: Connecting a Hall sensor
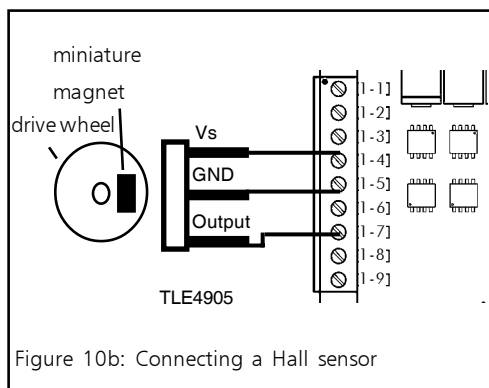
3.2.7 Connecting additional reed contacts

LokSoundXL decoders from version 2.0 have two additional inputs that can trigger various functions. The main purpose of these inputs is to trigger sounds by means of track magnets. A reed sensor has to be wired to one of these inputs and a magnet is to be placed at the appropriate location on the layout. Every time the engines passes that spot a sound effect will be triggered.

With the aid of these sensors users of the LGB MZS with Lokmaus can also trigger the many sound effects of the LokSoundXL decoder.

The inputs REED-IN1 and REED-IN2 share the terminals 2-7 and 2-8 with the auxiliary function outputs AUX 5 and AUX 6. Therefor AUX 5 and AUX 6 are not available if you use these inputs.

Figure10c: Connecting extern Reed contact

4. Set Up and installation of the decoder

After successful installation you may now operate the decoder.

The following will outline how you can check if you have installed the decoder correctly. Chapter 4.1 describes analogue operation. In chapter 4.2 you learn how to operate LokSound with various digital systems.

Before changing any decoder settings (e.g. engine address, sound volume) we recommend to read chapter 5. There you find out which parameters are available and how they may be adjusted with the most common DCC command stations.

After installation you may test the LokSound decoder as follows.

Please check all connections carefully using an Ohmmeter: Are there any short circuits between the motor terminals and the wheel pick-ups? Are all connections between motor terminals and the chassis isolated? Are lamps connected properly and isolated from the chassis? Is the decoder installed safely to avoid contact with the chassis? Is there sufficient space around the LokSound decoder to allow for heat dissipation? Could the LokSound decoder or any of the wires be squeezed when refitting the housing? Is the speaker installed in such a way that sound can emit from the engine without obstruction?

After you have checked above points you may switch on the power.

We strongly recommend to carry out this initial check on a track section with overload protection. Programming tracks of modern digital systems offer this protection. Our LokProgrammer (part Number 53450) also offers extremely reliable overload protection.

> The pre-set engine address is 03.

Does the engine travel in both directions?

Turn the lights on: are they operating correctly? If the LokSound decoder was built into an engine with NEM / DCC interface: check if the plug has been inserted correctly.

4.1 Analogue operation

4.1.1 DC operation

Operation using a conventional DC controller is possible without any problems but there is one limitation. The engine will only start moving when the track voltage reaches 7–8 Volts. Maximum speed will be reached when turning the controller to the limit. This is absolutely normal and is due to the minimum voltage the LokSound decoder requires for operation. Running sounds are available in this operating mode but not additional sound effects.

4.1.2 AC operation with conventional Märklin® controller

Operation with conventional Märklin® controllers works as you know it from other models. Speed is controlled by turning the knob.

To change direction the knob has to be turned to the left beyond the stop position.

Please note:

The engine must have completely stopped before changing direction. Never change direction while the engine is moving!

4.2 Digital operation

4.2.1 Using Märklin® 6021

LokSound decoders may be used with all Märklin® control devices or compatible systems. The functions F1 to F4, however, can only be activated with the „new Motorola® format". To activate this format put DIP switch 2 of the 6021 to the upper („On") position.

4.2.2 Using DCC (Lenz, Intellibox, etc)

LokSound may be operated with any DCC compatible system. The automatic speed step detection was tested with the following command stations: Roco® Lok-maus2, Uhlenbrock® Intellibox, Lenz digital plus version 3.0, Zimo MX1. When using Lenz digital plus version 3.0 the auto-detect function does not work with 14 speed steps. Set 28/128 speed steps at all times. The auto-detect function is activated every time the decoder receives power (when turning on power to the layout) or when you switch on the headlights. During this process the headlights have to be switched on and you have to turn the control knob (or slide control) until the lights burn steadily. Should you change the speed step setting during operation you have to interrupt power to the decoder shortly in order to re-activate the auto-detect function.

4.3 Resetting to factory pre-set values

You may reprogram the factory pre-set values at any time. Write value 08 in CV 08. A reset of the sound files is only possible with the aid of the LokProgrammer 53450.

5. Adjusting decoder parameters

Chapter 5 provides information on how to change the settings of LokSound decoders. Please take your time to read and understand the somewhat complex explanations. After the introduction into the world of decoder parameters (called CVs) in chapter 5.1, you will find in chapter 5.2 all you want to know about which CVs have what kind of effect on the properties of LokSound decoders.

Chapter 5.3 explains how CVs may be set with various DCC command stations as well as the Märklin® command stations. You find a complete list of all CVs in chapter 7.1.

5.1 CVs of LokSound decoders

LokSound decoders are compatible with the NRMA / DCC standard. That means, that all parameters controlling the properties of LokSound decoders, are stored in so called CVs (Configuration Variables). LokSound decoders support 230 variables. This large number of CVs indicates the multitude of possibilities available with LokSound decoders. In order to get the best out of your decoder and to easily manage this large number of settings we recommend the use of our LokProgrammer, part no. 53450.

With LokProgrammer all CVs may be programmed easily and comfortably on your PC. Please note that CVs that are not programmed properly could impede the performance of the decoder. The LokProgrammer part no. 50450 is not suitable for programming this decoder.

All CVs may be programmed without the LokProgrammer by using any DCC system that is NMRA / DCC compatible or with Märklin® 6021.

Chapter 5.3 explains, how it works.

In each CV values from 0 to 255 may be stored.

The properties of the decoder vary depending on the stored value. If you have a look at the list of CVs in chapter 7.1 you will notice that most CVs have numerical values.

For example CV 1 contains the engine address. This may vary between 1 and 127 (see range of values). The factory setting is 3.

Please note that not all CVs have factory pre-set values:

Some CV values vary depending on the type of sound effect. While most CVs expect numerical values, others represent storage locations that manage various functions simultaneously (mostly switching on or off). CVs 29 and 49 are good examples: for these CVs the value has to be calculated individually, depending on the parameters you want to adjust:

First you decide which options should to be turned on or off. In the column „value" you find 2 numbers for each option. The value 0 indicates the option is switched off, otherwise the value may range from 1 to 128. Add all values of the individual options to get the total value to be written into the CV.

Example 1:

Let's assume, you want to use the Intellibox DCC with 128 speed steps and analogue detection should be active (because you want to control some locos in analogue mode). All other options are turned off. CV 29 shows the value 6 (0 + 2 + 4 + 0 = 6).

Example 2:

You want to turn the volume of the decoder down. Set CV 63 to a value between 1 and 64, let's say 25.

5.2 Important settings of LokSound

Details of the most important CVs may be found in chapter 5.2. Please study these instructions carefully before you do any program changes.

Careful deliberation will help you to find the optimal settings to achieve the desired effects with your LokSound decoder.

5.2.1 Back EMF control (load control)

LokSound decoders utilize fourth generation load control assuring constant speed regardless of the actual load, when using DC motors. Load control was optimized and tested with motors from:

• ROCO®,

• Bachmann (Liliput),

• BRAWA®,

• Märklin®,

• LGB,

• Bühler,

• Mabuchi.

Load control may be deactivated (if so desired).

Please note that load control is always turned off when using AC motors – no matter what settings are used.

AC motors are not suitable for load control

How to switch on load control

Set the first bit of CV 49. Read out the CV: load control is deactivated if the value is 0 or 2. To activate it, just add 1 to the actual value and enter. Example: CV 49 reads 2. To activate load control set CV 49 to 3.

You find a detailed description of all possible values for CV 49 in chapter 7.1.

Parameters of Back EMF control

The internally used PI-control algorithm of Back EMF control depends on 3 parameters: the control reference voltage is stored in CV 53, the control parameters are in CVs 54 and 55.

Reference voltage:

In CV 53 you set the voltage that should come back from the motor.

This value depends on the track voltage and the coefficient of utilization of the motor. A coefficient of 75 % and a track voltage of 16 Volts adds up to a voltage of 16 V * 75 % = 12 Volts. That value has to be written into CV 56. The voltage (here: 12 V) may be entered in 0.25V-increments. This results in a value of 30 (12V * 2.5) for CV 53. If you don't know the exact motor coefficient you may obtain the value experimentally as follows:

Check, if the engine really reaches top speed at the highest speed step or if you cannot detect any speed changes at the maximum speed step. In the latter case you have to reduce the value for CV 56, in the first case increase the value. The internal PI-regulation of LokSound can be adjusted with CV 54 and CV 55. Depending on the type of motor the parameters may have to be adjusted to achieve optimal running performance.

LokSound decoders are factory pre-set for the use with ROCO®-, Brawa®- or Kato motors.

Parameter 'K", stored in CV 54, influences how strongly load control will effect the driving performance. The higher the value, the more load control will respond to any changes. Adjust this value with care, because too high values could lead to irregular and „hard" driving performance. If you prefer smooth running try to reduce the value step by step until you reach an optimum.

Parameter „I", stored in CV 55 provides important information to the LokSound decoder regarding the motor type used: certain electric motors respond differently to adjustments of the rpm's. The longer a motor takes to respond the lower the value in CV 55. However, it is not easy to recognize the degree of inertia. In general: the more poles a motor has and the bigger it is, the more fly wheels it has, the slower it is and the lower the value should be set in CV 55.

For optimal programming proceed as follows:

Read out the value in CV 53 as described above. Leave the value of CV 55 (parameter I .I.) for the time being and test the engine. Now change the value of CV 54 in steps of 5 downwards or upwards and monitor the running properties of the engine. If there is no improvement leave the value of CV 54 and change the value of CV 55 (intensity of control) in steps of 5 until an optimum is reached.

Please note, that incorrectly set parameters may impede the effect of Back EMF control to the point that the motor may stop altogether. Refer to our website http://www.loksound.de for suggested values for commonly used motor / drive combinations such as:

Parameters for Fleischmann® motors

Engines with the traditional Fleischmann® motor should be programmed as follows:

CV 54 = ca. 14 – 18

CV 55 = 20

Parameters for Märklin® high performance motor

The 5-pole high performance motor from Märklin® (series 37xxx) is well suited for the LokSound decoder when programmed as follows:

CV 54 = ca. 20 – 25

CV 55 = 38

5.2.2 Speed Curve

LokSound decoders recognize 256 internal speed steps. They may be adapted to the characteristics of each engine and assigned to the available speed steps (14, 28 or 128). NMRA allows two choices:

Speed curve via CV 2, 5 and 6 (figure 10).

Set the starting voltage in CV 2 and the maximum speed with CV 5. CV 6 represents the medium speed.

You may define the shape of the curve (straight or with two different gradients). This mode is activated via CV 29 (see chapter 7.1).

Figure 11: Speed curve with CV2, 6, 5
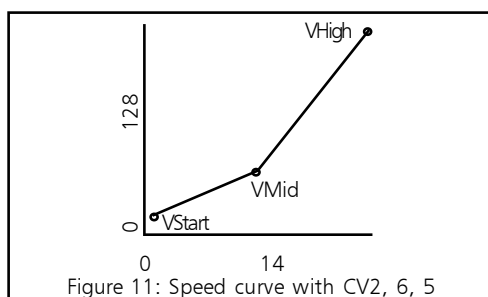
You may also define an individual speed curve:

Store the speed curve values in CVs 67 to 94 (as per figure 8). Those 28 values will determine the 256 speed steps. This method permits to optimize the running performance. This mode is also activated via CV 29. We recommend the use of the ESU LokProgrammer and its software for easy calculation and programming.

Figure 12: Speed curve with CV 67 - 90
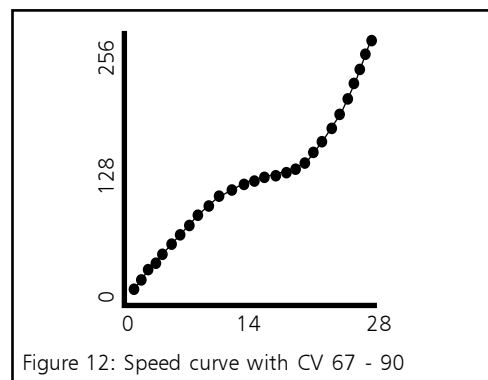
5.2.3 Auxiliary function outputs

LokSound decoders have 4 physical function outputs, two for directional lighting, two for auxiliary loads.

A further 10 functions may be activated by pressing a button to trigger various sound effects.

If you do not want to use the physical function outputs AUX 1 and AUX 2 you may control another two sound effects (12 in total).

In addition the functions „sound on / off" and „acceleration on / off" are available. The latter turns off the acceleration- and deceleration rate and is often used for precise control of the engines particularly while shunting. In „shunting mode" the speed is halved.

Assignment of function buttons

The outputs may be assigned to the available function buttons. Each function button is linked to a CV in which any number of events may be combined. Figure 14 on page 25 shows the different possible combinations and also the ex-factory setting.

Please note:

- Some functions are directional.
- Your DCC command station may not have all necessary function buttons.
- Each of the function outputs must be turned on or off separately.

The value that has to be entered into each individual control-CV is calculated as follows:

Switching on function outputs

Each of the function outputs can / must be turned on, before it can be used.

You may program any of eight available lighting effects for each output:

- Dimmer: normal, continuous power to load
- Blinking light: the output blinks with an adjustable frequency
- Inverse blinking light: the output blinks as usual but in opposite sequence. This permits to activate alternately blinking lights.
- Strobe
- Double Strobe
- Random, fire box

- Smoke, for controlling the intensity of the smoke generator
- Zoom
- Mars light
- Gyra light

There is a CV (CV 113 - 120) for each output, in which the desired mode may be stored. Please note that you may deactivate each output with „0" if it is not needed. CVs 117 – 120 are only available on LokSoundXL.

The lighting outputs are factory pre-set to „on". In steam engines this is also true for the AUX 1 output that is assigned to the headlight button.

Dimming of lamps

With LokSound you may dim the lamps in 15 steps to adapt the brightness optimally to your model. The lamps are pulsed, i.e.: they are continuously switched on and off. The brightness of each output may be adjusted separately. The desired dimming value (0 to 15) has to be added to the value of the corresponding control-CV (113 - 120) that defines the function mode.

Blinking frequency and duration of „bright period"

If a function output has been set to „blinking" or „inverse blinking", the duration of the „bright period" (defines blinking frequency) and the on / off ratio have to be taken from CV 112 (see chapter 7.1).

The „bright period" is adjustable in 33 steps. It is always a multiple of 65.5 milliseconds. The On / Off ratio is adjustable in 16 steps from 1/16 to 16/16. A ratio of 8/16 indicates that the light output remains „on" for the same period as it is „off". The value to be entered into the control-CV 113 is calculated as follows:

Duration of „On" period (value: 0 – 15) * 16 + On / Off ratio

Examples

• Example 1: smoke generator on AUX 1 and F5.

Let's assume you want to control a smoke generator with function button F5 that should be connected to output AUX 1. Please refer to the installation instructions in chapter 2.5. The output AUX 1 must be activated and assigned to the F5 button:

First we activate the output. In this example we want to use the dimming function (the output must be active continuously) and set at 100% brightness. CV 115 controls output AUX 1 (see paragraph 7.1).

The value to be entered into CV 115 is calculated as follows: 16 (for dimming function) + 15 (for maximum brightness) = 31.

Now we have to assign function button F5 to output AUX 1: refer to figure 13: control-CV 171 controls the F5 button (third column). In CV 171 we enter those functions that should be switched with the F5 button. We look at the table in figure 13, locate the intersection of the row for F5 and column AUX 1 and find the number (in this case 4). Once we enter this value in CV 171 the F5 button controls the output AUX 1. In order to also switch AUX 1 with F5 when reversing the same value has to be entered in CV 174.

• Example 2: blinking light on AUX 2 and F6

We want to connect a „blinking light" to AUX and control it via the F6 function button. The brightness should be set to 6/15 of the maximum value. The „bright period" and the „On / Off" ratio are set as described in paragraph 5.2.3.3.

First we have to activate output AUX 2 and set it to „blinking". We achieve this by entering 32 (for blinking) + 5 (= 6/15 of maximum brightness) = 37 in CV 116.

Next we assign output AUX 2 to the F6 button. We enter the functions to be controlled via F6 into control-CV 177. Again we consult the table in figure 13, find the intersection between row F6 (forward) and column AUX 2 and enter the number (in this case 8) from the table in CV 177. Now the F6 „forward" button controls the output AUX 2. To program the same for reversing enter value 8 in CV 183.

• Example 3: Deceleration on / off with F5

Here we want to activate / deactivate the acceleration / deceleration with F5. This function represents a „logical" function and not a „physical" output and thus does not have to be configured. We only have to assign the function „deactivate deceleration" to the F5 key by entering value 1 in CV 172 (see figure 13). If the same effect should work while reversing enter 1 in CV 175. We recommend a PC and LokProgrammer for programming function outputs:

LokSound decoders offer so many possible combinations that it is recommended to use the LokProgrammer (part no. 53450) in conjunction with a personal computer.

5.2.4 Sound adaptation

LokSound decoders offer many possibilities to adjust sound effects. All parameters are stored in CVs that, like all others, may be modified. Adaptation of revolutions for diesel and pitch for steam exhaust chuffs. The revolutions of a diesel motor may be modified with 2 CVs:

Enter the revolutions of the idling diesel motor in CV 59. The standard value of 32 permits reproduction of the sound at original speed, while value 16 reduces this to half speed.

Enter the revolutions at maximum speed (respectively maximum revs) in CV 60:

Value 255 means double the original speed. Use the same parameters when adapting the pitch of the exhaust chuffs for steam engines:

The interval of the exhaust chuffs should be shorter and vary in pitch with increasing speed.

Specific settings for steam engines

To simulate a steam engine you have to synchronize the exhaust chuffs with the revolutions of the drivers. There are 2 ways to achieve this:

• With an external wheel sensor

• Speed step dependent

Depending on the method selected, certain CVs have to be set accordingly. LokSound is factory pre-set to speed step dependent adjustment.

Using a wheel sensor

The wheel sensor must be connected as described in chapter 3.1.6 and 3.2.6. Then two more parameters have to be adjusted:

Set CV 57 to value 0 and enter a value > =1 in CV 58. CV 58 defines after how many pulses by the sensor the next exhaust chuff will be reproduced. Normally one exhaust chuff per pulse should be played.

Speed step dependent method

With this method the interval between exhaust chuffs is set with CV 57 and CV 58. This method is recommended if an external wheel sensor cannot be used.

The adaptation of this variable to the wheel / gearbox combination may require some experiments. It pays to spend some time in order to achieve an optimal result. This feature works best with Back EMF control.

With Märklin® engines with universal motor (Back EMF is always switched off) only a compromise can be reached.

In this case we recommend the use of an external wheel sensor. For CV adaptation proceed as follows:

• Set CV 57 to 10 and CV 58 to 110.

• Put the engine onto the track and drive it with speed step 1 (sound is switched on).

• Measure the time in seconds it takes the driver to complete one turn at this speed.

• Divide the time by 0,064.

• Enter a rounded value without decimal points in CV 57, e.g. 0.9 seconds / 0.064 = 14-5= Value 9.

• Increase the speed and check whether the exhaust chuffs match the turns of the drivers. If the exhaust chuffs are too fast, increase the value in CV 58 gradually, if they are too slow, decrease the value in CV 58.

Adjusting the volume

The volume of LokSound decoders may be adapted gradually. Enter the desired value in CV 63. Permitted values are: 0 (quiet) to 64 (loud).

Random sound effects

CV 61 and CV 62 define the frequency of random sounds that are played while a steam engine is stationary. CV 61 contains the minimal time between 2 random sounds, CV 62 the maximum. Both represent an interval in which LokSound randomly selects and plays sounds. The unit of both CVs is 1.0 second.

Example: the minimum interval in CV 61 should be 8 seconds. Enter 8 into CV 61. The maximum interval in CV 62 should be 30 seconds. Enter 30 in CV 62.

5.2.5 Brake sections

LokSound decoders respond to the most commonly used brake generators on the market:

• Lenz-brake generator in DCC operation

• Märklin® brake track

• Signal dependent train control by ZIMO

As soon as the LokSound decoder recognizes a brake command it brakes with the deceleration set in CV 4. After this forced stop (once the signal aspect has changed) the engine begins to move again and accelerates according to the value set in CV 3. In order to support this function some CVs have to be programmed. This feature is activated in CV 51.

Lenz brake generator

The Lenz brake generator LG 100 uses the mechanisms recommended by the NMRA standards and is supported by LokSound decoders. Write value 8 in CV 51.

Märklin® brake track

Instead of digital signals the Märklin® brake track supplies a DC voltage to the tracks. To activate this you must write 1 in CV 51. Do not activate the Märklin® brake track and the analogue DC operation at the same time, because the DC supplied by the Märklin® brake track could be interpreted as analogue DC. With CV 50 you can switch off the analogue mode (see paragraph 7.1).

Signal dependent train control by ZIMO

LokSound detects and responds to the H, L, U-signals transmitted by the ZIMO MXHLU modules and the MX9 modules. Write value 2 in CV 51.

5.2.6. Märklin® address

In order to be able to use functions F5 to F9 with the Märklin® 6021 command station LokSound decoders have a second Märklin® address. It is always the following number to the actual address. Set bit 3 in CV 49.

5.3 Adjusting CVs

After having been introduced to the effects controlled by CVs in chapters 5.1 and 5.2 we now need to clarify how to set the CVs. In principle there are 3 possibilities:

• With a PC and LokProgrammer (article no. 53450)

• With a DCC compatible digital command station (e.g. Intellibox, Lenz digital plus)

• With Märklin® 6021

Depending on the system used the procedure varies.

5.3.1 Using LokProgrammer

The LokProgrammer by ESU electronic solutions ulm GmbH & Co. KG offers the easiest method to adjust CVs of LokSound decoders:

It is done with a mouse click on your MS-Windows® computer. The PC saves you searching for various CV numbers and values. With the LokProgrammer you can also modify the sounds of LokSound decoders and you may also create your own sound effects.

You may purchase the LokProgrammer (article no. 53450) at model train outlets complete with detailed operating instructions.

The LokProgrammer part no. 50450 is not suitable for programming LokSound decoders version 3.0.

5.3.2 Using DCC systems

There is no „one fits all" instruction for programming of CVs with various DCC systems. There are too many differences between the popular DCC systems. Whenever possible you should use the DCC direct mode (CV programming by setting individual bytes with Uhlenbrock®) or DCC paged mode. Refer to chapter 9 „programming" of the user manual for the Intellibox. In particular read chapter 9.5 „programming of DCC decoders" very carefully. Programming should be done in the „CV-programming byte-wise" mode.

Lenz digital plus

There are various software versions available of the Lenz digital plus command station. You need firmware version 2.3 or 3.0 in order to program LokSound decoders. Contact Lenz for more details regarding upgrades of older versions.

Use „paged CV" mode for programming. Depending on the firmware version the „CV mode" might cause problems.

Older command stations such as „Digital plus", „Lenz compact" and „Arnold Digital" create another phenomenon:

Programming is not possible.

The Lenz command station displays „err02", the Arnold command station „short circuit":

This is caused by the very sensitive overload protection of the digital system. The LokSound decoder with the built in audio amplifier uses a higher current than other decoders and thus triggers the overload protection. To rectify this, solder a 47 Ohm (0,5 Watt) resistor in one of the two wires connecting the digital command station with the programming track. See figure 13.

program track

resistor 47Ω

central unit
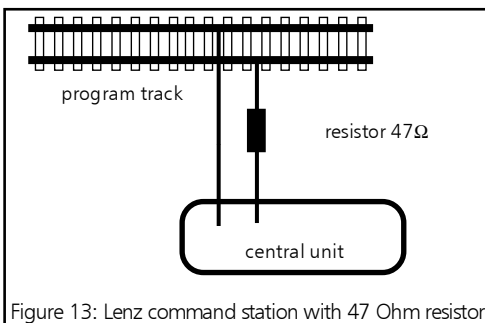
Figure 13: Lenz command station with 47 Ohm resistor

5.3.3 Using Märklin® 6021

With the Märklin® command station you cannot modify standard CVs as it does not comply with the NMRA DCC standards. However, the most important CVs of LokSound decoders may be changed with a specific programming mode. Please note this applies only to CVs from 1 to 79, and only for values from 1 to 79.

Programming mode for 6021:

Set the drive control knob to 0. Remove any other engines from the track. Observe the blinking signals of the engine! Press the „stop"- and „go" button of the 6021 simultaneously until a reset has been triggered. Alternately you can remove the power plug for a moment. Press the „stop" button in order to switch off the track voltage. Enter the current decoder address (alternately: 80).

- Confirm by activating change of direction (turning the control knob beyond the stop position towards the left) and hold the knob, then press the „go" button.
- The LokSound decoder is now in programming mode (headlights are blinking). Now enter the number of the parameter (CV) you want to change (two digit number).
- Confirm by activating change of direction (double blinking headlights).
- Now enter the new value for the CV (2 digits).
- Confirm by activating change of direction (headlights light up for about 1 second, then continue blinking).
- Now you can continue with other CVs in the same manner.
- To exit the programming mode select CV 80 or switch off the track voltage for a moment (press „stop" button followed by „go" button on 6021). Please note that 6021 only permits entries from 01 to 80. There is no value „0", instead always enter 80.

6. Frequently asked questions (FAQ)

Usually there is no fault in the LokSound decoder if it does not work as desired but very likely some CVs are set incorrectly. Here are some examples of what may happen and how to solve them:

- Headlights and sound work, write CVs as well, but the engine does not move.

A short circuit on the motor terminals or a high current draw may trigger the overload protection.

Perhaps the motor is not fully insulated against the chassis. To eliminate this as the cause of the malfunction remove the motor and test-run it while outside the engine.

If load control is deactivated the starting voltage may be too low (CV 2).

- The engine jerks and runs very uneven at low speed with activated load control.

Deactivate load control and check if the problem remains (refer to chapter 5.2.1). If the problem disappears then the parameters for load control have to be adjusted (as per 5.2.1).

- The engine runs perfectly, but there is no sound.

Check the wires to the speaker.

With the Märklin® 6021 the new Motorola format has to be used, otherwise the F1 button does not work (refer to chapter 4.2.1). If the format is set correctly, the speaker may be damaged.

- The engine runs perfectly, but the headlights do not work or switch on and off depending on the speed step.

If you have an engine with DCC socket check if the plug has been inserted in the correct position (refer to chapter 3.2).

- If you operate LokSound in DCC mode please refer to chapter 4.2.2 where the solution to this problem is described.
- I would like to reset the LokSound decoder to the factory settings. What do I have to do?

With the aid of a PC and the LokProgrammer software a reset is easily achieved. If you only want to reset the CVs write value 8 in CV 8.

• I have read the instruction carefully but still have problems. What can I do?

If you have further questions regarding LokSound decoders please contact our Technical Customer Service.

Contact details are listed in chapter 8 on the last page of this Manual.

Should you have come to the conclusion you do not want to install decoders yourself we can offer you another solution:

ESU electronic solutions ulm GmbH & Co. KG offers an installation service in conjunction with experienced specialists.

Ask your dealer for the new ESU service pack: We arrange for installation of your decoder: comfortable and without risk for you!

7. List of all supported CVs

The following pages provide a list of all CVs of LokSound decoders. Please refer to the remarks regarding the concept of CVs in chapter 5.1.

> Change CVs only if you have a clear understanding of the implications. Incorrect settings may lead to malfunctioning decoders.

(Function Mapping)

Function button	Description	Control CV A	Headlight (1)	Back-up lights (2)	AUX 1 (4)	AUX 2 (8)	AUX 3 only LokSoundXL (16)	AUX 4 only LokSoundXL (32)	AUX 5 only LokSoundXL (64)	AUX 6 only LokSoundXL (128)	Control CV B	Acceleration on / off (1)	Shunting mode on / off (2)	Sound on / off (4)	Shift mode (8)	Blower (16)	Control CV C	Sound slot 1-16
	value	value	1	2	4	8	16	32	64	128	value	1	2	4	8	16	value	0, 1-16
	stand forward	129									130						131	
	stand backward	132									133						134	
	drive forward	135									136						137	
	drive backward	138									139						140	
F0	light forward	141	1								142						143	
F0	light backward	144		2							145						146	
F1	key F1 forward	147									148						149	
F1	key F1 backward	150			4						151			4			152	1
F2	key F2 forward	153			4						154			4			155	1
F2	key F2 backward	156									157		2				158	
F3	key F3 forward	159									160		2				161	
F3	key F3 backward	162									163						164	
F4	key F4 forward	165									166	1					167	2
F4	key F4 backward	168									169	1					170	2
F5	key F5 forward	171									172						173	3
F5	key F5 backward	174									175						176	3
F6	key F6 forward	177									178						179	4
F6	key F6 backward	180									181						182	4
F7	key F7 forward	183									184						185	5
F7	key F7 backward	186									187						188	5
F8	key F8 forward	189									190						191	6
F8	key F8 backward	192									193						194	6
F9	key F9 forward	195									196						197	7
F9	key F9 backward	198									199						200	7
F10	key F10 forward	201									202						203	8
F10	key F10 backward	204									205						206	8
F11	key F11 forward	207									208						209	9
F11	key F11 backward	210									211						212	9
F12	key F12 forward	213									214						215	
F12	key F12 backward	216									217						218	
	sensor 1 forward	219									220						221	
	sensor 1 backward	222									223						224	
	sensor 2 forward	225									226						227	
	sensor 2 backward	228									229						230	

List of all supported CVs

CV	name	description	range	default
1	Engine address	Address of engine	1-127	3
2	Start voltage	Sets the minimum speed of the engine	1-75	3
3	Acceleration	This value multiplied by 0.869 is the time from stop to maximum speed	0-64	8
4	Deceleration	This value multiplied by 0.869 is the time from maximum speed to stop	0-64	6
5	Maximum speed	Maximum speed of engine	0-64	64
6	Medium speed	Medium speed of engine	0-64	22
7	Version number	Internal software version of LokSound decoder		
8	Manufacturer's ID	Manufacturer's ID - ESU – Writing value 8 in this CV triggers a reset to factory values		151
13	Analogue mode F1-F8	Status of functions F1 to F8 in analogue mode	0-255	0

Bit	Description	value
0	function F1	1
1	function F2	2
2	function F3	4
3	function F4	8
4	function F5	16
5	function F6	32
6	function F7	64
0	function F8	128

CV	name	description	range	default
14	Analogue mode FL, F9-F12	Status of functions FL, F9 to F12 in analogue mode	0-255	3

Bit	Description	value
0	function FL (f)	1
1	function FL (r)	2
2	function F9 (f)	4
3	function F10 (f)	8
4	function F11	16
5	function F12	32
6	function F9 (r)	64
0	function F10 (r)	128

CV	name	description	range	default
17 18	Extended engine address	long address of engine CV17 contains byte with higher value (bit 6 and 9999, bit 6 and bit 7 must always be active), CV18 contains byte with lower value. Only active when function is switched on in CV 29(see below).		

List of all supported CVs

CV	name	description	range	default
19	Consist address	Additional address for consist value 0 or 128 means: consist address deactivated 1-127 consist address, normal direction 129-255 consist address, reverse direction	0-127	0
29	Configuration register	The most complex CV within the DCC standards. This register contains important information, which is only relevant in DCC mode.		4

		Bit	function	value
		0	Reverse direction of travel (forward becomes reverse) normal direction reversed direction	 0 1
		1	speed steps (only for DCC mode) 14 speed steps 28 or 128 speed steps	 0 2
		2	analogue operation analogue operation off analogue operation on	 0 4
		4	selection of speed curve speed curve through CV 2,5, 6 speed curve through CV 67 – 96	 0 16
		5	selection of engine address (only for DCC operation) short addresses (CV 1) in DCC mode long addresses (CV 17 + 18) in DCC mode	 0 32

CV	name	description	range	default
49	Extended configuration	Activate support for brake sections or switch off Back EMF control		19

		Bit	description	value
		0	load control off load control activated	0 1
		1	DC motor PWM frequency 15 kHz pulse frequency 30 kHz pulse frequency	 0 2
		2	Märklin® delta mode Delta mode off Delta mode on	 0 4
		3	Märklin® second address second address off second address on	 0 8
		4	Automatic speed step detection DCC speed step detection off DCC speed step detection on	 0 16
		5	LGB function button mode LGB mode off LGB mode on	 0 32
		6	Zimo manual function Zimo manual function off Zimo manual function on	 0 64

List of all supported CVs

CV	name	description		range	default
50	Analogue mode	Selection of desired analogue mode		0-3	3
		bit	description / value		
		0	AC analogue mode AC analogue mode off — 0 AC analogue mode on — 1		
		1	DC analogue mode DC analogue mode off — 0 DC analogue mode on — 2		
51	Brake mode	Selection of desired brake mode			
		Bit	description / value		
		0	Märklin® brake mode Märklin® brake mode off — 0 Märklin® brake mode on — 1		
		1	Zimo brake mode Zimo brake mode off — 0 Zimo brake mode on — 2		
		2	not used		
		3	Lenz DC brake mode Lenz brake mode off — 0 Lenz brake mode on — 1		
53	Control reference	Defines the Back EMF voltage, which the motor should generate at maximum speed. The higher the efficiency of the motor, the higher this value may be set. If the engine does not reach maximum speed, reduce this parameter.		0-80	50
54	Load control parameter K	K-component of internal PI-controller Defines the effect of load control. The higher the value, the stronger the effect of Back EMF control		0-80	32
55	Load control parameter I	„I"-component of internal PI-controller Defines momentum (inertia) of motor. The higher the momentum of the motor (large flywheel or bigger diameter motor) the lower this value has to be set (see chapter 5.2.1)		0-80	24
56	Operating range of load control	0 – 100% Defines up to which speed in % load control will be active. A value of 32 indicates that load control will be effective up to half speed.		1-64	64
57	Sound mode 1	Multiplied by 0,64 is the time in seconds between two chuff sounds at speed step 1. Value 0 indicates that period between exhaust chuffs is controlled by a wheel sensor		0-127	LokSound Steam: 20 Diesel: 0 LokSoundXL Steam: 50 Diesel: 0

List of all supported CVs

CV	name	description	range	default
58	Sound mode 2	Value defines the gradual decrease of intervals of exhaust chuffs with increasing speed. A higher value indicates a more rapid decrease, a lower value a slower decrease. If exhaust chuffs are triggered by a wheel sensor (if CV 57 = 0), this value specifies the number of trigger pulses required for one exhaust chuff.	0-127	LokSound Steam: 115 Diesel: 0 Electric:: 0 LokSoundXL Steam: 95
59	Sound	Divided by 32 this will yield the factor for reproducing the sound at the slowest speed step. Values < 32 are slower, values > 32 are faster than original speed.	0-64	32
60	Sound	Divided by 32 this will yield the factor for reproducing the sound at the fastest speed step values < 32 are slower, values > 32 are faster than original speed.	0-64	55
61	Random sound min	Multiplied by 1 is the time in seconds for the shortest random sound interval. These values represent the interval between random sounds.	0-64	30
62	Random sound max	Multiplied by 1 is the time in seconds for the longest interval between random sounds. These values represent the interval between random sounds. Playing of random sounds is deactivated when CV 61 and CV 62 = 0	0-64	50
63	Sound volume	volume of running and additional sounds	0-64	64
64	Brake sound threshold	Specifies when the decoder starts the braking noises. The higher the value, the sooner it will start. If CV 64= 0, the braking sound is only played once the engine has stopped.	0-64	7
66	Forward trim	Divided by 128 is the factor used to multiply the motor voltage when driving forward. Value 0 deactivates the trim.	0-255	0
67-94	Speed table	Defines motor voltage for speed steps. The values „in between" will be interpolated.	0-255	-
95	Reverse trim	Divided by 128 is the factor used to multiply the motor voltage when driving backwards. Value 0 deactivates the trim	0-255	0
112	Blinking light	Blinking frequency of Strobe effects. Always a multiple of 65.536 milliseconds	4-64	33

List of all supported CVs

CV	name	description		range	default
113	Headlight configuration	configuration of headlights		0-255	15
		description	value		
		continuous (dimmer)	Vol		
		blinking (phase 1)	Vol + 16		
		blinking (phase 2)	Vol + 32		
		Strobe light	Vol +48		
		Double Strobe light	Vol + 64		
		Fire box	Vol +80		
		Smoke generator	Vol +96		
		Headlight bright/dim	Vol +128		
		Mars light	Vol + 144		
		Gyra light	Vol + 160		
		Vol = brightness. Range 0 (dark) – 15 (maximum)			
114	Back-up light configuration	configuration of back-up lights		0-255	15
		description	value		
		continuous (dimmer)	Vol		
		blinking (phase 1)	Vol + 16		
		blinking (phase 2)	Vol + 32		
		Strobe light	Vol +48		
		Double Strobe light	Vol + 64		
		Fire box	Vol +80		
		Smoke generator	Vol +96		
		Headlight bright/dim	Vol +128		
		Mars light	Vol + 144		
		Gyra light	Vol + 160		
		Vol = brightness. Range 0 (dark) – 15 (maximum)			
115	AUX 1 configuration	configuration of output AUX 1		0-255	15
		description	value		
		continuous (dimmer)	Vol		
		blinking (phase 1)	Vol + 16		
		blinking (phase 2)	Vol + 32		
		Strobe light	Vol +48		
		Double Strobe light	Vol + 64		
		Fire box	Vol +80		
		Smoke generator	Vol +96		
		Headlight bright/dim	Vol +128		
		Mars light	Vol + 144		
		Gyra light	Vol + 160		
		Vol = brightness. Range 0 (dark) – 15 (maximum)			

List of all supported CVs

CV	name	description		range	default
116	AUX 2 configuration	configuration of output AUX 2		0-255	15
		description	value		
		continuous (dimmer)	Vol		
		blinking (phase 1)	Vol + 16		
		blinking (phase 2)	Vol + 32		
		Strobe light	Vol +48		
		Double Strobe light	Vol + 64		
		Fire box	Vol +80		
		Smoke generator	Vol +96		
		Headlight bright/dim	Vol +128		
		Mars light	Vol + 144		
		Gyra light	Vol + 160		
		Vol = brightness. Range 0 (dark) – 15 (maximum)			
117	AUX 3 configuration	configuration of output AUX 3		0-255	0
		description	value		
		continuous (dimmer)	Vol		
		blinking (phase 1)	Vol + 16		
		blinking (phase 2)	Vol + 32		
		Strobe light	Vol +48		
		Double Strobe light	Vol + 64		
		Fire box	Vol +80		
		Smoke generator	Vol +96		
		Headlight bright/dim	Vol +128		
		Mars light	Vol + 144		
		Gyra light	Vol + 160		
		Vol = brightness. Range 0 (dark) – 15 (maximum)			
118	AUX 4 configuration LokSoundXL only	configuration of output AUX 4		0-255	0
		description	value		
		continuous (dimmer)	Vol		
		blinking (phase 1)	Vol + 16		
		blinking (phase 2)	Vol + 32		
		Strobe light	Vol +48		
		Double Strobe light	Vol + 64		
		Fire box	Vol +80		
		Smoke generator	Vol +96		
		Headlight bright/dim	Vol +128		
		Mars light	Vol + 144		
		Gyra light	Vol + 160		
		Vol = brightness. Range 0 (dark) – 15 (maximum)			

List of all supported CVs

CV	name	description		range	default
119	AUX 5 configuration LokSoundXL only	configuration of output AUX 5		0-255	15
		description	value		
		continuous (dimmer)	Vol		
		blinking (phase 1)	Vol + 16		
		blinking (phase 2)	Vol + 32		
		Strobe light	Vol +48		
		Double Strobe light	Vol + 64		
		Fire box	Vol +80		
		Smoke generator	Vol +96		
		Headlight bright/dim	Vol +128		
		Mars light	Vol + 144		
		Gyra light	Vol + 160		
		Vol = brightness. Range 0 (dark) – 15 (maximum)			
120	AUX 6 configuration LokSoundXL only	configuration of output AUX 6		0-255	15
		description	value		
		continuous (dimmer)	Vol		
		blinking (phase 1)	Vol + 16		
		blinking (phase 2)	Vol + 32		
		Strobe light	Vol +48		
		Double Strobe light	Vol + 64		
		Fire box	Vol +80		
		Smoke generator	Vol +96		
		Headlight bright/dim	Vol +128		
		Mars light	Vol + 144		
		Gyra light	Vol + 160		
		Vol = brightness. Range 0 (dark) – 15 (maximum)			
125		Start voltage of engine in DC mode		0-127	110
126		maximum speed of engine in DC mode		0-127	127
127		Start voltage of engine in AC mode		0-127	50
128		maximum speed of engine in AC mode		0-127	127

List of all supported CVs

CV	name	description		range	default
129	Assignment of function button „stop" forward A	Assignment of function outputs that are activated in status „stop – forward"		0-255	0
		bit	description	value		
		0	headlights	1		
		1	back-up lights	2		
		2	function output AUX 1	4		
		3	function output AUX 2	8		
		4	function output AUX 3 (XL only)	16		
		5	function output AUX 4 (XL only)	32		
		6	function output AUX 5 (XL only)	64		
		7	function output AUX 6 (XL only)	128		
130	Assignment of function button „stop" forward B	Assignment of function outputs that are activated in status „stop – forward"		0-255	0
		bit	description	value		
		0	acceleration on / off	1		
		1	shunting mode on / off	2		
		2	sound on / off	4		
		3	shift mode	8		
		4	blower sound	16		
131	Assignment of function button „stop" forward C	Defines, which sound will be activated with the given function button 0= no sound, 1-16= No. of sound slot		0, 1-16	0
132	Assignment of function button „stop" back-up A	Assignment of function outputs that are activated in status „stop – back-up"		0-255	0
		bit	description	value		
		0	headlights	1		
		1	back-up lights	2		
		2	function output AUX 1	4		
		3	function output AUX 2	8		
		4	function output AUX 3 (XL only)	16		
		5	function output AUX 4 (XL only)	32		
		6	function output AUX 5 (XL only)	64		
		7	function output AUX 6 (XL only)	128		

List of all supported CVs

CV	name	description			range	default
133	Assignment of function button „stop" back-up B	Assignment of function outputs that are activated in status „stop – back-up"			0-255	0
		bit	description	value		
		0	acceleration on / off	1		
		1	shunting mode on / off	2		
		2	sound on / off	4		
		3	shift mode	8		
		4	blower sound	16		
134	Assignment of function button „stop" back-up C	Defines, which sound will be activated with the given function button. 0= no sound, 1-16= No. of sound slot			0, 1-16	0
135	Assignment of function button „running" forward A	Assignment of function outputs that are activated in status „running – forward"			0-255	0
		bit	description	value		
		0	headlights	1		
		1	back-up lights	2		
		2	function output AUX 1	4		
		3	function output AUX 2	8		
		4	function output AUX 3 (XL only)	16		
		5	function output AUX 4 (XL only)	32		
		6	function output AUX 5 (XL only)	64		
		7	function output AUX 6 (XL only)	128		
136	Assignment of function button „running" forward B	Assignment of function outputs that are activated in status „running – forward"			0-255	0
		bit	description	value		
		0	acceleration on / off	1		
		1	shunting mode on / off	2		
		2	sound on / off	4		
		3	shift mode	8		
		4	blower sound	16		
137	Assignment of function button „running" forward C	Defines, which sound will be activated with the given function button in status „running – forward" 0= no sound, 1-16= No. of sound slot			0, 1-16	0

List of all supported CVs

CV	name	description		range	default
138	Assignment of function button „running" back-up A	Assignment of function outputs that are activated in status „running – back-up"		0-255	0
		bit description	**value**		
		0 headlights	1		
		1 back-up lights	2		
		2 function output AUX 1	4		
		3 function output AUX 2	8		
		4 function output AUX 3 (XL only)	16		
		5 function output AUX 4 (XL only)	32		
		6 function output AUX 5 (XL only)	64		
		7 function output AUX 6 (XL only)	128		
139	Assignment of function button „running" back-up B	Assignment of function outputs that are activated in status „running – back-up"	0-255	0	
		bit description	**value**		
		0 acceleration on / off	1		
		1 shunting mode on / off	2		
		2 sound on / off	4		
		3 shift mode	8		
		4 blower sound	16		
140	Assignment of function button „running" back-up C	Defines, which sound will be activated with the given function button in status „running – back-up" 0= no sound, 1-16= No. of sound slot	0, 1-16	0	
141	Assignment of function button headlight forward A	Assignment of function outputs that are activated in status „headlight – forward"	0-255	0	
		bit description	**value**		
		0 headlights	1		
		1 back-up lights	2		
		2 function output AUX 1	4		
		3 function output AUX 2	8		
		4 function output AUX 3 (XL only)	16		
		5 function output AUX 4 (XL only)	32		
		6 function output AUX 5 (XL only)	64		
		7 function output AUX 6 (XL only)	128		

CV	name	description		range	default
142	Assignment of function button headlight forward B	Assignment of function outputs that are activated in status „headlight – forward"		0-255	0
		bit	description	value		
		0	acceleration on / off	1		
		1	shunting mode on / off	2		
		2	sound on / off	4		
		3	shift mode	8		
		4	blower sound	16		
143	Assignment of function button headlight forward C	Defines, which sound will be activated with the given function button in status „ headlight – forward" 0= no sound, 1-16= No. of sound slot		0, 1-16	0
144	Assignment of function button headlight reverse A	Assignment of function outputs that are activated in status „headlight – reverse"		0-255	0
		bit	description	value		
		0	headlights	1		
		1	back-up lights	2		
		2	function output AUX 1	4		
		3	function output AUX 2	8		
		4	function output AUX 3 (XL only)	16		
		5	function output AUX 4 (XL only)	32		
		6	function output AUX 5 (XL only)	64		
		7	function output AUX 6 (XL only)	128		
145	Assignment of function button headlight reverse B	Assignment of function outputs that are activated in status „headlight – reverse"		0-255	0
		bit	description	value		
		0	acceleration on / off	1		
		1	shunting mode on / off	2		
		2	sound on / off	4		
		3	shift mode	8		
		4	blower sound	16		
146	Assignment of function button headlight reverse C	Defines, which sound will be activated with the given function button in status „ headlight – reverse" 0= no sound, 1-16= No. of sound slot		0, 1-16	0

CV	name	description		range	default
147	Assignment of function button F1 forward A	Assignment of function outputs that are activated with „F1 - forward"		0-255	0
		bit	description / value		
		0	headlights / 1		
		1	back-up lights / 2		
		2	function output AUX 1 / 4		
		3	function output AUX 2 / 8		
		4	function output AUX 3 (XL only) / 16		
		5	function output AUX 4 (XL only) / 32		
		6	function output AUX 5 (XL only) / 64		
		7	function output AUX 6 (XL only) / 128		
148	Assignment of function button F1 forward B	Assignment of function outputs that are activated with „F1 - forward"		0-255	0
		bit	description / value		
		0	acceleration on / off / 1		
		1	shunting mode on / off / 2		
		2	sound on / off / 4		
		3	shift mode / 8		
		4	blower sound / 16		
149	Assignment of function button F1 forward C	Defines, which sound will be activated with the given function button 0= no sound, 1-16= No. of sound slot		0, 1-16	0
150	Assignment of function button F1 reverse A	Assignment of function outputs that are activated with „F1 - reverse"		0-255	0
		bit	description / value		
		0	headlights / 1		
		1	back-up lights / 2		
		2	function output AUX 1 / 4		
		3	function output AUX 2 / 8		
		4	function output AUX 3 (XL only) / 16		
		5	function output AUX 4 (XL only) / 32		
		6	function output AUX 5 (XL only) / 64		
		7	function output AUX 6 (XL only) / 128		

CV	name	description		range	default
151	Assignment of function button F1 reverse B	Assignment of function outputs that are activated with „F1 - reverse"		0-255	0
		bit	description	value		
		0	acceleration on / off	1		
		1	shunting mode on / off	2		
		2	sound on / off	4		
		3	shift mode	8		
		4	blower sound	16		
152	Assignment of function button F1 reverse C	Defines, which sound will be activated with the given function button 0= no sound, 1-16= No. of sound slot		0, 1-16	0
153	Assignment of function button F2 forward A	Assignment of function outputs that are activated with „F2 - forward" description refer to CV 147		0-255	0
154	Assignment of function button F2 forward B	Assignment of function outputs that are activated with „F2 - forward" description refer to CV 148		0-255	0
155	Assignment of function button F2 forward C	Defines, which sound will be activated with the given function button 0= no sound, 1-16= No. of sound slot		0, 1-16	0
156	Assignment of function button F2 reverse A	Assignment of function outputs that are activated with „F2 - reverse" description refer to CV 150		0-255	0
157	Assignment of function button F2 reverse B	Assignment of function outputs that are activated with „F2 - reverse" description refer to CV 151		0-255	0
158	Assignment of function button F2 reverse C	Defines, which sound will be activated with the given function button 0= no sound, 1-16= No. of sound slot		0, 1-16	0
159	Assignment of function button F3 forward A	Assignment of function outputs that are activated with „F3 - forward" description refer to CV 147		0-255	0
160	Assignment of function button F3 forward B	Assignment of function outputs that are activated with „F3 - forward" description refer to CV 148		0-255	0

List of all supported CVs

CV	name	description	range	default
161	Assignment of function button F3 forward C	Defines, which sound will be activated with the given function button 0= no sound, 1-16= No. of sound slot	0, 1-16	0
162	Assignment of function button F3 reverse A	Assignment of function outputs that are activated with „F3 - reverse" description refer to CV 150	0-255	0
163	Assignment of function button F3 reverse B	Assignment of function outputs that are activated with „F3 - reverse" description refer to CV 151	0-255	0
164	Assignment of function button F3 reverse C	Defines, which sound will be activated with the given function button 0= no sound, 1-16= No. of sound slot	0, 1-16	0
165	Assignment of function button F4 forward A	Assignment of function outputs that are activated with „F4 - forward" description refer to CV 147	0-255	0
166	Assignment of function button F4 forward B	Assignment of function outputs that are activated with „F4 - forward" description refer to CV 148	0-255	0
167	Assignment of function button F4 forward C	Defines, which sound will be activated with the given function button 0= no sound, 1-16= No. of sound slot	0, 1-16	0
168	Assignment of function button F4 reverse A	Assignment of function outputs that are activated with „F4 - reverse" description refer to CV 150	0-255	0
169	Assignment of function button F4 reverse B	Assignment of function outputs that are activated with „F4 - reverse" description refer to CV 151	0-255	0
170	Assignment of function button F4 reverse C	Defines, which sound will be activated with the given function button 0= no sound, 1-16= No. of sound slot	0, 1-16	0
171	Assignment of function button F5 forward A	Assignment of function outputs that are activated with „F5 - forward" description refer to CV 147	0-255	0

List of all supported CVs

CV	name	description	range	default
172	Assignment of function button F5 forward B	Assignment of function outputs that are activated with „F5 - forward" description refer to CV 148	0-255	0
173	Assignment of function button F5 forward C	Defines, which sound will be activated with the given function button 0= no sound, 1-16= No. of sound slot 1	0, 1-16	
174	Assignment of function button F5 reverse A	Assignment of function outputs that are activated with „F5 - reverse" description refer to CV 150	0-255	0
175	Assignment of function button F5 reverse B	Assignment of function outputs that are activated with „F5 - reverse" description refer to CV 151	0-255	0
176	Assignment of function button F5 reverse C	Defines, which sound will be activated with the given function button 0= no sound, 1-16= No. of sound slot	0, 1-16	
177	Assignment of function button F6 forward A	Assignment of function outputs that are activated with „F6 - forward" description refer to CV 147	0-255	0
178	Assignment of function button F6 forward B	Assignment of function outputs that are activated with „F6 - forward" description refer to CV 148	0-255	0
179	Assignment of function button F6 forward C	Defines, which sound will be activated with the given function button 0= no sound, 1-16= No. of sound slot	0, 1-16	0
180	Assignment of function button F6 reverse A	Assignment of function outputs that are activated with „F6 - reverse" description refer to CV 150	0-255	0
181	Assignment of function button F6 reverse B	Assignment of function outputs that are activated with „F6 - reverse" description refer to CV 151	0-255	0
182	Assignment of function button F6 reverse C	Defines, which sound will be activated with the given function button 0= no sound, 1-16= No. of sound slot	0, 1-16	0

CV	name	description	range	default
183	Assignment of function button F7 forward A	Assignment of function outputs that are activated with „F7 - forward" description refer to CV 147	0-255	0
184	Assignment of function button F7 forward B	Assignment of function outputs that are activated with „F7 - forward" description refer to CV 148	0-255	0
185	Assignment of function button F7 forward C	Defines, which sound will be activated with the given function button 0= no sound, 1-16= No. of sound slot	0, 1-16	0
186	Assignment of function button F7 reverse A	Assignment of function outputs that are activated with „F7 - reverse" description refer to CV 150	0-255	0
187	Assignment of function button F7 reverse B	Assignment of function outputs that are activated with „F7 - reverse" description refer to CV 151	0-255	0
188	Assignment of function button F7 reverse C	Defines, which sound will be activated with the given function button 0= no sound, 1-16= No. of sound slot	0, 1-16	0
189	Assignment of function button F8 forward A	Assignment of function outputs that are activated with „F8 - forward" description refer to CV 147	0-255	0
190	Assignment of function button F8 forward B	Assignment of function outputs that are activated with „F8 - forward" description refer to CV 148	0-255	0
191	Assignment of function button F8 forward C	Defines, which sound will be activated with the given function button 0= no sound, 1-16= No. of sound slot	0, 1-16	0
192	Assignment of function button F8 reverse A	Assignment of function outputs that are activated with „F8 - reverse" description refer to CV 150	0-255	0
193	Assignment of function button F8 reverse B	Assignment of function outputs that are activated with „F8 - reverse" description refer to CV 151	0-255	0

CV	name	description	range	default
194	Assignment of function button F8 reverse C	Defines, which sound will be activated with the given function button 0= no sound, 1-16= No. of sound slot	0, 1-16	0

195	Assignment of function button F9 forward A	Assignment of function outputs that are activated with „F9 - forward"
		  description
		    refer to CV 147
			0-255	0

196	Assignment of function button F9 forward B	Assignment of function outputs that are activated with „F9 - forward"
		  description
		    refer to CV 148
			0-255	0

197	Assignment of function button F9 forward C	Defines, which sound will be activated with the given function button 0= no sound, 1-16= No. of sound slot	0, 1-16	0

198	Assignment of function button F9 reverse A	Assignment of function outputs that are activated with „F9 - reverse"
		  description
		    refer to CV 150
			0-255	0

199	Assignment of function button F9 reverse B	Assignment of function outputs that are activated with „F9 - reverse"
		  description
		    refer to CV 151
			0-255	0

200	Assignment of function button F9 reverse C	Defines, which sound will be activated with the given function button 0= no sound, 1-16= No. of sound slot	0, 1-16	0

201	Assignment of function button F10 forward A	Assignment of function outputs that are activated with „F10 - forward"
		  description
		    refer to CV 147
			0-255	0

202	Assignment of function button F10 forward B	Assignment of function outputs that are activated with „F10 - forward"
		  description
		    refer to CV 148
			0-255	0

203	Assignment of function button F10 forward C	Defines, which sound will be activated with the given function button 0= no sound, 1-16= No. of sound slot	0, 1-16	0

204	Assignment of function button F10 reverse A	Assignment of function outputs that are activated with „F10 - reverse"
		  description
		    refer to CV 150
			0-255	0

CV	name	description	range	default
205	Assignment of function button F10 reverse B	Assignment of function outputs that are activated with „F10 - reverse" description refer to CV 151	0-255	0
206	Assignment of function button F10 reverse C	Defines, which sound will be activated with the given function button 0= no sound, 1-16= No. of sound slot	0, 1-16	0
207	Assignment of function button F11 forward A	Assignment of function outputs that are activated with „F11 - forward" description refer to CV 147	0-255	0
208	Assignment of function button F11 forward B	Assignment of function outputs that are activated with „F11 - forward" description refer to CV 148	0-255	0
209	Assignment of function button F11 forward C	Defines, which sound will be activated with the given function button 0= no sound, 1-16= No. of sound slot	0, 1-16	0
210	Assignment of function button F11 reverse A	Assignment of function outputs that are activated with „F11 - reverse" description refer to CV 150	0-255	0
211	Assignment of function button F11 reverse B	Assignment of function outputs that are activated with „F11 - reverse" description refer to CV 151	0-255	0
212	Assignment of function button F11 reverse C	Defines, which sound will be activated with the given function button 0= no sound, 1-16= No. of sound slot	0, 1-16	0
213	Assignment of function button F12 forward A	Assignment of function outputs that are activated with „F12 - forward" description refer to CV 147	0-255	0
214	Assignment of function button F12 forward B	Assignment of function outputs that are activated with „F12 - forward" description refer to CV 148	0-255	0
215	Assignment of function button F12 forward C	Defines, which sound will be activated with the given function button 0= no sound, 1-16= No. of sound slot	0, 1-16	0

List of all supported CVs

CV	name	description	range	default
216	Assignment of function button F12 reverse A	Assignment of function outputs that are activated with „F12 - reverse" description refer to CV 150	0-255	0
217	Assignment of function button F12 reverse B	Assignment of function outputs that are activated with „F12 - reverse" description refer to CV 151	0-255	0
218	Assignment of function button F12 reverse C	Defines, which sound will be activated with the given function button 0= no sound, 1-16= No. of sound slot	0, 1-16	0
219	Assignment of function button sensor 1 forward A	Assignment of function outputs that are activated with „sensor 1 - forward" description refer to CV 147	0-255	0
220	Assignment of function button sensor 1 forward B	Assignment of function outputs that are activated with „sensor 1 - forward" description refer to CV 148	0-255	0
221	Assignment of function button sensor 1 forward C	Defines, which sound will be activated with the given function button 0= no sound, 1-16= No. of sound slot	0, 1-16	0
222	Assignment of function button sensor 1 reverse A	Assignment of function outputs that are activated with „sensor 1 - reverse" description refer to CV 150	0-255	0
223	Assignment of function button sensor 1 reverse B	Assignment of function outputs that are activated with „sensor 1 - reverse" description refer to CV 151	0-255	0
224	Assignment of function button F12 sensor 1 reverse C	Defines, which sound will be activated with the given function button 0= no sound, 1-16= No. of sound slot	0, 1-16	0
225	Assignment of function button sensor 2 forward A	Assignment of function outputs that are activated with „sensor 2 - forward" description refer to CV 147	0-255	0
226	Assignment of function button sensor 2 forward B	Assignment of function outputs that are activated with „sensor 2 - forward" description refer to CV 148	0-255	0

CV	name	description	range	default
227	Assignment of function button sensor 2 forward C	Defines, which sound will be activated with the given function button 0= no sound, 1-16= No. of sound slot	0, 1-16	0

228	Assignment of function button
	
	sensor 2 reverse A
		Assignment of function outputs that are activated with „sensor 2 - reverse"
		
		   description
		   refer to CV 150
			0-255	0

229	Assignment of function button
	
	sensor 2 reverse B
		Assignment of function outputs that are activated with „sensor 2 - reverse"
		
		   description
		   refer to CV 151
			0-255	0

230	Assignment of function button F12 sensor 2 reverse C	Defines, which sound will be activated with the given function button 0= no sound, 1-16= No. of sound slot	0, 1-16	0

8. LokSound Version 3.0 - Technical data

Dimensions:	34,5mm x 15,5mm x 6,5mm
Supported protocols:	NMRA / DCC with 14, 28, 128 speed steps. 2- and 4-digit addresses. Digital Märklin® / Motorola® (old and new). Analogue DC and AC (can be switched off). Automatic detection of operating mode. Auto-detect function for DCC speed steps. Supports Lenz LG 100, Märklin®, Roco® and ZIMO® HLU brake modules. Intelligent ESU brake mode.
Motor control:	Max load 1.1A continuous. Suitable for DC-, AC- and coreless motors (auto-detect feature). Silent drive 32 kHz pulse frequency. Overload protection of motor output. Fourth generation Back EMF control (may be switched off).
Function outputs:	4 outputs, 2 of which may be used for lighting. 250 mA load per output. Total current of function outputs 0.5 A. Function Mapping for F1 to F12. Outputs are short circuit protected.
Sound part:	Four (!) independent channels. High performance amplifier with ca. 0,6 Watts. Sound data in flash memory can be modified. Mode for steam engines, diesel-hydraulic and diesel-electric engines, electric engines. 8 Mbit memory (for up to 65 seconds).

8.1 LokSoundXL Version 3.0 - Technical data

Dimensions:	51 mm x 40 mm x 14 mm
Supported protocols:	NMRA / DCC with 14, 28, 128 speed steps. 2- and 4-digit addresses. Digital Märklin® / Motorola® (old and new). Analogue DC and AC (can be switched off). Automatic detection of operating mode. Auto-detect function for DCC speed steps. Supports Lenz LG 100, Märklin®, Roco® and ZIMO® HLU brake modules. Intelligent ESU brake mode.
Motor control:	3.0A continuous. Suitable for DC-, AC- and coreless motors (auto-detect feature). Silent drive 32 kHz pulse frequency. Overload protection of motor output. Fourth generation Back EMF control (may be switched off).
Function outputs:	8 outputs, 2 of which may be used for lighting. 600 mA load per output. Total current of function outputs 2.0 A. Function Mapping for F1 to F12.
Sound part:	Four (!) independent channels. High performance amplifier with ca. 1,5 Watts. Sound data in flash memory can be modified. Mode for steam engines, diesel-hydraulic and diesel-electric engines, electric engines. 8 Mbit memory (for up to 65 seconds).

notice:

9. Service-Support and assistance

Your model train or hobby shop is your competent partner for all questions regarding LokSound decoders.

You may also contact us directly. For enquiries please use either email or fax (don't forget to provide your own fax-no.) and we will reply within a few days.

Please call our hotline only in case of complex enquiries that can't be dealt with by email or fax. The hotline is often very busy and you may encounter delays.

Also check our website for more information. You will find many hints regarding FAQ and even feed back from other users.

Hotline:	+49 (0) 700 - 56576863 *
	(0)700 - LOKSOUND
	Tuesday and Wednesday
	10.00 Uhr - 12.00 Uhr
Fax:	+49 (0) 700- 37872537 *
Email:	support@loksound.de
Post:	ESU GmbH & Co. KG
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Internet:	www.loksound.de
* 0,12 EUR / min	

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