LokSound V4.0

Instruction Manual
2. Edition, May 2011

LokSound V4.0
LokSound micro V4.0

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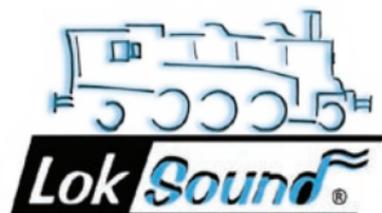
1. Declaration of Conformity

We, ESU electronic solutions ulm GmbH & Co KG, Industriestrasse 5, D-89081 Ulm, declare in sole responsibility that the products to which this declaration refers, namely

LokSound V4.0, LokSound micro V4.0

are in compliance with the following standards:

EN 71 1-3 : 1988 / 6 : 1994 – EN 50088 : 1996 – EN 55014, Teil 1 + Teil 2 : 1993

EN 61000-3-2 : 1995 – EN 60742 : 1995 – EN 61558-2-7 : 1998

according to the directive

88 / 378 / EWG – 89 / 336 / EWG – 73 / 23 / EWG

2. WEEE-Declaration

Disposal of obsolete electrical and electronic equipment (as practised in the European Union and other European countries with dedicated collection systems).

This mark on the product, the packaging or the relevant documentation indicates that this product must not be treated like household waste. Instead this product should be disposed of at a suitable collection point for recycling of electrical and electronic appliances. Thus you contribute to avoid negative impact on the environment and people's health that could be caused by inappropriate disposal. Recycling of materials contributes to preserve our natural resources. For more information regarding recycling of this product, please contact your local administration, your waste collection service or the dealer / shop where you purchased this product.

3. Important Notes – Please read this chapter first

We congratulate you to your purchase of an ESU LokSound decoder. This manual will guide you step by step through the features of your LokSound decoder.

Please read this manual carefully. Although the LokPilot has been design as a robust device an incorrect connection may lead to faults or even to the destruction of the device. Avoid any "costly" experiments.

- The LokSound is exclusively intended for use with model train layouts only. It may only be operated with the components listed here. Any other use is not permitted.
- Any wiring has to be carried out while power is disconnected. Please make sure that no voltage reaches the locomotive while converting it, above all not accidently.
- Avoid mechanical force or pressure on the decoder.
- Do not remove the heat shrink sleeve on 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.
- Never solder on the circuit board, extend cables if necessary.
- Never wrap the decoder in insulation tape, since this may cause overheating.
- Adhere to the wiring principles as outlined in this manual for wiring any external components. Other circuitry may cause damage to the LokSound.
- Make sure that no wires are squeezed or cut by the model's transmission parts when reassembling the engine.
- Any power supply must be protected by a fuse or circuit breaker to avoid any potential hazards such as burning cables in case of a short circuit. Only use transformers specifically desigend for model trains that bear the VDE/EN marks.
- Never operate the LokSound unattended. The LokSound is not a (children's) toy.
- Do not expose to wet and humid conditions.
- Handle the speaker with extreme care: Do not touch the membrane or apply pressure! Solder the speaker connections quickly and only at the intended contacts!

4. How this manual helps you

This manual is divided into several chapters that show you step-by-step how to install a LokSound decoder.

Chapter 5 provides an overview over the characteristics of each type of LokSound decoder.

Chapter 6 describes installation of the decoder in detail. Please make yourself familiar with the type of motor and the type of interface installed in your locomotive prior to working through chapters 6.2. to 6.7.

You can operate LokSound Decoders with most commercially available control systems for model trains.

Chapter 7 provides an overview which digital and analogue systems can drive LokSound decoders and which special issues to consider.

You will find the factory default settings for the function buttons in chapter 7.1.

You may adjust the default settings of your LokSound decoder as desired. Chapters 8 to 16 explain which parameters are adjustable and how to do it.

We recommend, that you at least read chapters 8 and 9 regarding address settings as well as chapter 11 concerning motor control in order to be able to adapt your LokSound decoder optimally to your model locomotive.

Chapter 20 lists all technical data as well as supported CVs and will assist you in case of questions.

If not stated otherwise all information refers to all types of the LokSound family. Should one particular decoder not support a specific function, then this is clearly mentioned.

5. Introduction – The LokSound Family

5.1. The Members of the LokSound Family

All LokSound V4.0 decoders have been completely redeveloped on the basis of their predecessors´ excellent properties and they are "better" in many respects. All decoders of the LokSound V4.0 family expand the capabilities of their forerunners by further functions. These developments further improve the driving characteristics, the operational reliability, the flexibility of the decoders as well as the sound functions. Compared to their predecessors, LokSound V4.0 Decoders ensure a far more realistic sound experience. Cobined with 8 (!) sound channels, the decoder makes a sound volume up to four times louder than before possible. The LokSound decoder is the first choice for any sophisticated model train enthusiast that places great value on excellent load control, outstanding driving characteristics at low speed and the best sound possible. LokSound decoders automatically detect the operating mode and are suitable for all commonly used motors. LokSound decoders of the fourth generation offer you flexibility and reliability that you would expect from a state-of-the-art decoder. Future standards do not represent a problem either: due to the flash technology, you can update the decoder at any time.

In order to suit the different scales and the related current draw of the model locomotives, all LokSound V4.0 decoders come in various options that we now would like to introduce to you.

5.1.2. LokSound V4.0

Der LokSound V4.0 revolutionises the authentic model railway operation. It combines a sound module as well as a multiprotocol decoder in an intelligent manner. The LokSound V4.0 is a multi-protocol decoder. It supports the Märklin® / Motorola® format, the DCC-format and Selectrix®.

It can also work on analogue DC or AC layouts. Thus, it is ideally suitable for mixed Motorola® / DCC environments.

5.1.1. An overview of the LokSound V4.0 decoders

	LokSound V4.0		LokSound micro V4.0		
DCC Operation	Ok		Ok		
Motorola® Operation	Ok		Ok		
M4 Operation (mfx® compatible)	-		-		
Selectrix® Operation	Ok		Ok		
Analogue DC Operation	Ok		Ok		
Analogue AC Operation	Ok		-		
DCC programming mode	Ok		Ok		
Programming with 6021, Mobile/ Central Station®	Ok		-		
M4 programming including automatic recognition	-		-		
RailCom® Plus	Ok		Ok		
ABC brake mode	Ok		Ok		
Continuous motor current	1,1A		0,75A		
Function output current	4/250 mA +2 Logic		2/150mA + 2 Logic		
Integrated PowerPack	-		-		
Optional connection for PowerPack buffer capacitor	Ok		Ok		
Connection type	NEM652	21MTC	NEM651	NEM652	Next18
	Harness	Direct	Harness	Harness	Direct
Article number	54400	54499	54800	54899	54898

Due to its manifold lighting and sound functions and its adaptability to different applications, it is the perfect all-rounder for your H0 locomotives.

5.1.3. LokSound micro V4.0

The LokSound micro V4.0 is a small power pack: Despite its small dimensions it supports beside DCC also Motorola® and Selectrix® and offers a maximum current draw of 0.75A. Thus it is ideal for the small scales with little room for decoders. The sound features are just as impressive as those of its "big brother".

5.2. General Properties of all Decoders

5.2.1. Operating Modes

All LokSound V4.0 decoders are true multi-protocol decoders with automatic detection of the operating mode „on-the-fly." The decoder analyses the track signal and filters out the part that is reserved for it. Changing from digital to analogue and back represents no problem whatsoever. This is important in case your e.g. fiddle yard still works in analogue mode. Furthermore, all LokSound decoders support the relevant brake modes such as ROCO®, Lenz® or Märklin® and stop as intended.

Especially the ABC brake sections are suitable for a simple stop in front of the signal. LokSound decoders achieve the maximum compatibility with the operating system in order to enable you to simulate even some unusual operational requirements.

The LokSound V4.0 supports and automatically detects the DCC protocol with 14, 28, or 128 speed steps. Of course, operation with the long 4-digit addresses is possible as well.

Contrary to the original Märklin®-decoders, LokSound V4.0 decoders support up to 255 addresses and 28 speed steps in Motorola® mode. With the appropriate command station such as the ESU ECoS, you can expand the system limits of the Motorola® system considerably.

Furthermore, all LokSound V4.0 decoder support RailComPlus®. A RailComPlus®-compatible command station immediately recognises a LokSound V4.0 decoder fully automatically. The decoder will transfer all of its important data to the command station. Finally, you will never have to look for a loco address once again or carry out any function mapping!

5.2.2. Motor Control

The most important function of digital decoders is motor control. All LokSound V4.0 decoders are designed for universal use and therefore can control all commonly available DC motors, regardless if they are by ROCO®, Fleischmann®, Brawa®, Mehano®, Bemo®, LGB®, Hübner®, Märklin® or others.

Coreless motors (such as Faulhaber® or Maxon®) also work fine

with LokSound. You may continue to use any universal motors provided you replace the stator coils with a permanent magnet. You will find more info on this topic in chapter 6.7.4.2.

Fifth-generation load compensation works with 20 resp. 40 kHz and assures extremely silent operation, particularly with coreless motors. Due to 10-bit technology, your locomotives will crawl at a snail's pace if so desired. Load compensation is easily adjustable to various motor and gear combinations (compare with chapter 11).

With Dynamic Drive Control (DCC), you can limit the influence of load control. Thus, you can control your locomotive in small throttle notches for instance in the yard or on turnouts while the locomotive responds like the prototype at high speed on the main line (for instance when climbing a gradient). In other words, if you do not change the throttle setting then the locomotive will slow down up the hill, as does the prototype. There is more info on this in chapter 11.4.

The minimum and maximum speed of the LokSound V4.0 is adjustable by setting three points or the speed table with 28 entries. The table is effective for all speed step ratings (14, 28, and 128 speed steps); many decoders by others do not offer this feature. Due to unique load compensation by ESU, there are no visible jerks between speed steps – even in 14-speed-step-mode.

5.2.3. Sound functions

LokSound V4.0 decoders inherit their reference for good sound from the successful LokSound family, introduced since 1999.

Compared to all its forerunners, the sound part of the fourth generation decoders has been significantly extended with the aim to offer you a much more prototypical sound experience. So all LokSound V4.0 decoders come with a 32MBit memory chip on which you are able to store twice as much sounds than before. All of the sounds saved are original sounds recorded from the real prototype loco.

ESU records the original sounds directly from the locos using the latest recording equipment. After recording, the sounds are digitally remastered for the best audio possible by ESU sound engineers before they are finally played on a decoder.

LokSound V4.0 decoders have a completely new designed audio amplifier concept. The new „Class D" last stage amplifier provides, in combination with new special 4 Ohms loudspeakers, a full sound which is up to 3 times (!) louder than usual. LokSound V4.0 decoders are able to play 8 sounds simultaneously, of which 3 channels are used for the simulation of the drive motor. This enables an authentic representation of the possibilities given by the prototype locos. Up to 28 additional sounds can be triggered via functions keys. With random sounds as well as wheel-synchron brake squealing your model railroad hobby grows more realistic than ever before.

5.2.3.1. Functions for Steam locomotives

All ESU LokSound decoders are distinctly audible: Steam locomotives reproduce changing chuffs. Those are coupled to motor control and are load-dependant. When accelerating, chuffs sound harsh, while, when the throttle is closed, only rod-clatter is discernible. The reproduction hereby is so faithful that you can differentiate between the rhythms of a two-, three, or four cylinder loco. The rhythm can either be triggered by an external sensor, absolutely r.p.m.- synchronous, or via back E.M.F (load compensation), speed step dependant.

5.2.3.2. Functions for Diesel locomotives

Diesel engines come in various designs, which are all correctly reproduced: Dieselhydraulic locos first rev up, before they start moving. Engine r.p.m.-sound is in ratio to speed. LokSound decoders allow your loco, prototype like, to move only when engine r.p.m is high enough. This is only possible through the entity of sound module and decoder. When accelerating or straining, the sound is more intensive, while, when you close the throttle, the prime mover revs down to idle. Diesel-electrical locos keep their prime mover r.p.m nearly constant, but you hear the soft whine of the electro motors.

5.2.3.3. Functions for Electric locomotives

But even Electric locomotives are a treat for the ears: Beside the fan noise, the compressors, or the oil coolers, you hear the whine of the electro motors, the cracks of main switches, or gear noises.

Beside these sound variations, you can activate sounds anytime per function key. Thus you can whistle, sound the horn or bell to your heart's content, in front of railroad crossings, or tunnels. Length of sound is up to you.

5.2.3.4. LokProgrammer

All sounds of the LokSound decoders can be exchanged, transferred and deleted with the help the ESU LokProgrammer. ESU already offers hundreds of pre-created sound projects free for download. This enables specialists to create their own sounds or even change available ESU projects.

5.2.4. Analogue Mode

Quite a few LokSound decoders replace analogue directional relays. Therefore, you can not only set the starting speed and the maximum speed as well as pre-select which functions should be active in analogue mode: even load compensation works in analogue mode!

5.2.5. Functions

Standard features for LokSound V4.0 decoders include the following features: acceleration and brake times can be separately adjusted and switched, and of course, you can switch the shunting mode. The brightness of all function outputs can be separately set and allocated to the desired function buttons (function mapping).

There is a wide range of options: dimmer, flickering firebox, gyro-light and mars-light, flash and double flash, blinker and alternate blinker as well as switch functions with timers (e.g.: for Telex) and a special coupler function for remote controlled couplers by Krois® and ROCO® including the automatic pushing and pulling.

The unique and once more improved ESU function mapping enables you to allocate every function to the function buttons F0 to F28; even multiple allocations are possible. You will find more info on this in chapter 12.

5.2.6. Programming

Where intended, LokSound decoders support all programming modes including POM (Programming-On-the-Main). You can use any NMRA-DCC compatible command station for this purpose. Even with the Märklin® central units 6020®, 6021®, Mobile Station® and Central Station® all settings are adjusted electronically. Most LokSound V4.0 decoders support a simple-to-use programming procedure.

Owners of the ESU ECoS enjoy an even more comfortable method of programming: you can read all possible settings in plain text on the large display and easily adjust them – even during operation!

5.2.7. Operational Reliability

LokSound decoders store the current operating status. Thanks to this data storage, the decoder will start again as quickly as possible after a service interruption. Some decoders also have an integral „PowerPack" that assures continuous power even in case of poor electrical contact or critically laid tracks.

5.2.8. Protection

All function outputs as well as the motor output have protection against overload and short circuit. We want you to enjoy your LokSound decoders for a long time.

5.2.9. Future built-in

All LokSound V4.0 decoders are suitable for firmware updates due to the flash memory. You may add new software functions at a later stage.

6. Installing the Decoder

6.1. Requirements for Installation

The locomotive must be in perfect operating condition prior to the conversion: Only a locomotive with faultless mechanical properties and smooth running characteristics in analogue mode is worth converting to digital. Check and replace all wear and tear parts such as motor brushes, wheel contacts, light bulbs etc., if necessary.

> Please take note of the remarks in chapter 3 in order to prevent possible damage of the decoder during installation!

6.2. Installing the Decoder

The components on the decoder must under no circumstances touch any metal parts of the locomotive since this could lead to short circuits and damage or even destruction of the decoder. Therefore, all LokSound decoders (with the exception of the ones with the 21MTC-interface) come with a protective shrink sleeve.

Never wrap the decoder in insulating tape. If there is no ventilation around the decoder, it may lead to a heat build-up and ultimately to the destruction of the decoder. Rather apply the insulating tape to the metal parts of the locomotive.

Mount the decoder at a suitable location. In most model locomotives, there is a dedicated space for the decoder. To hold the decoder in place use double sided adhesive tape or some (just a little) hot glue.

6.3. Locomotives with 8-pin NEM 652-Interface

Some LokSound V4.0 decoders are supplied with an 8-pin interface as per NEM 652 (refer to Fig 1). Installation in locomotives with this interface is particularly easy:

• Remove the locomotive body. Please observe the instructions in the manual of your locomotive!

• Remove the dummy plug from the socket and keep it in a suitable place for later use.

Pin	Description	Colour
1	Right motor terminal	orange
2	Rear light	yellow
3	Output AUX1	green
4	Left track connection	black
5	Left motor terminal	gray
6	Headlight	white
7	Common (+pole)	blue
8	Right track connection	red

Figure 1: LokSound V4.0 & LokSound micro V4.0 - NEM652

• Insert the plug of the decoder in such a way that pin 1 of the plug (this is the side with the red / orange wires) sits next to the corner of the socket that is usually marked with *, +, • or 1. Please make sure that the pins are straight when inserting the plug.

Do not rely on the assumption that the wires of the harness have to face in a certain direction: the only reliable reference is the marking of pin 1.

6.4. Locomotives with 6-pin NEM 651-Interface

Some LokSound V4.0 decoders have a 6-pin NEM 651 plug (as per Fig. 2). Installation in locomotives with this interface is particularly easy:

• Remove the locomotive body.
• Remove the dummy plug from the socket and keep it in a suitable place for later use
• Insert the plug of the decoder in such a way that pin 1 of the plug (this is the side with the red / orange wires) sits next to the corner of the socket that is usually marked with *, +, • or 1. Please make sure that the pins are straight when inserting the plug.

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Loudspeaker #1 --
right motor terminal --
left motor terminal --
right track connection --
left track connection --
headlight --
rearlight --
common (+pole) --

AUX1 --
Loudspeaker #2 --

AUX2
AUX3
AUX4

decoder back

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right track	1	18	right track
motor +	2	17	rearlight
AUX1	3	16	loudspeaker +
AUX3 / Trainbus Clk	4	15	common (+)
GND	5	14	GND
common (+)	6	13	AUX4/Trainbus DTA
loudspeaker -	7	12	AUX2
headlight	8	11	motor -
left track	9	10	left track
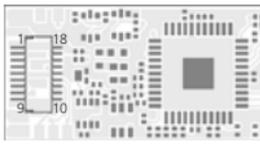
Next18 interface (decoder back)

Pin	Description	Colour
1	Right motor terminal	orange
2	Left motor terminal	grey
3	Right track connection	red
4	Left track connection	black
5	Headlight	white
6	Rearlight	yellow
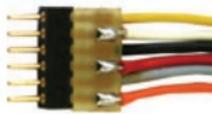
Figure 2: LokSound micro V4.0 - NEM651 & Next18

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Radsensor	1	22	Gleis rechts
n.c.	2	21	Gleis links
n.c.	3	20	GND
AUX4	4	19	Motor rechts
ZBCLK	5	18	Motor links
ZBDTA	6	17	n.c.
Licht hinten	7	16	U+ (+ Pol)
Licht vorne	8	15	AUX1
Lautspr. #1	9	14	AUX2
Lautspr. #2	10	13	AUX3
Indexpin	11	12	VCC

How to connect the decoder:

locomotive pcb
(Side view)

Insertion of the decoder with **connector to the top** (e.g. Liliput, ESU, HAG, Märklin)

locomotive pcb
(Side view)

Insertion of the decoder with **connector to the bottom** (e.g. Brawa)

Figure 3: LokSound V4.0 - 21MTC

6.5. Locomotives with 21MTC Interface

Some LokSound decoders are available with a variant of the 21MTC interface as per Fig. 3. Installation in locomotives with this interface is particularly easy since the plug-socket connector facilitates the mechanical fixing as well.

⚠ Please make sure that the impendance of the installed loudspeakers is really 4 or 8 Ohms! Some locomotives have installed 100 Ohms loudspeakers which have originally been created for LokSound V3.5 decoders.

- Remove the locomotive body. Please observe the instructions in the manual of your locomotive!
- Remove the dummy plug from the socket and keep it in a suitable place for later use
- Search for the missing pin in the plug on the circuit board of the locomotive. The missing pin serves as the marker. Memorise its location.
- You can insert the decoder in two ways: either the pins are put through the decoder; the socket of the decoder remains visible after installation (mounting on top) or the decoder is inserted in such a way that the pins go straight into the socket. Once the decoder sits in the socket, the socket is hidden from view. This method is common for Brawa locomotives.
- Which of the two mounting positions is the correct one depends solely on the locomotive. The position of the marker-pin is the crucial indicator.
- Plug the decoder into the socket in such a way that the locomotive interface corresponds with the decoder.
- Do not apply too much pressure when inserting the plug. The decoder must go in without force.
- Check if the decoder sits correctly.

6.5.1. Connecting C-Sine motors („SoftDrive-Sinus")

The LokSound decoder cannot drive the newer Märklin® models with C-Sine motors (also called „SoftDrive-Sinus") directly. To facilitate this, a circuit board supplied ex works with the locomotive is required. This circuit board will be controlled by a LokSound decoder. Märklin® uses the 21MTC interface installed on this circuit board and thus utilises the normal motor commands form the decoder for the exchange of information.

The LokSound V4.0 with the 21MTC interface is suitable for controlling the C-Sine control electronics provided some parameters are set accordingly. Chapter 11.5. explains the necessary steps.

⚠ Some Trix® locomotives have the same C-Sine motor; however, the control electronics in Trix® locomotives communicate in a different manner with the decoder.

All of the LokSound V4.0 decoders send the necessary commands to ensure that the respective locomotives work with the decoder. Unfortunately Trix® changed the interface too often in the past, therefore we are not able to garantuee you a proper function. In case of doubt, trying might just help.

ⓘ The serial protocol can be switched on with the help of CV 124, Bit 3.

6.6. Locomotives with Next18 Interface

Some LokSound micro decoders are shipped with a Next18. More information about how to install the decoder is given in chapter 6.5.

6.7. Locomotives without Interface

All LokSound decoders have an interface (plug). There is no „wires-only" version. Please remove the plug at the end of the harness should this become necessary.

ⓘ Please do not extend any wires at the decoder end. If necessary use an extension harness (also refer to chapter 17).

6.7.1. Wiring Diagram for LokSound
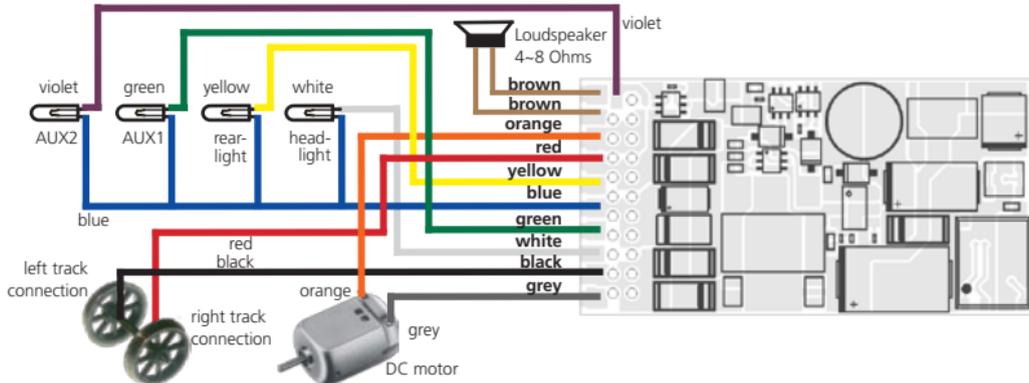
Figure 4: Wiring Diagram for LokSound V4.0 (wiring example)
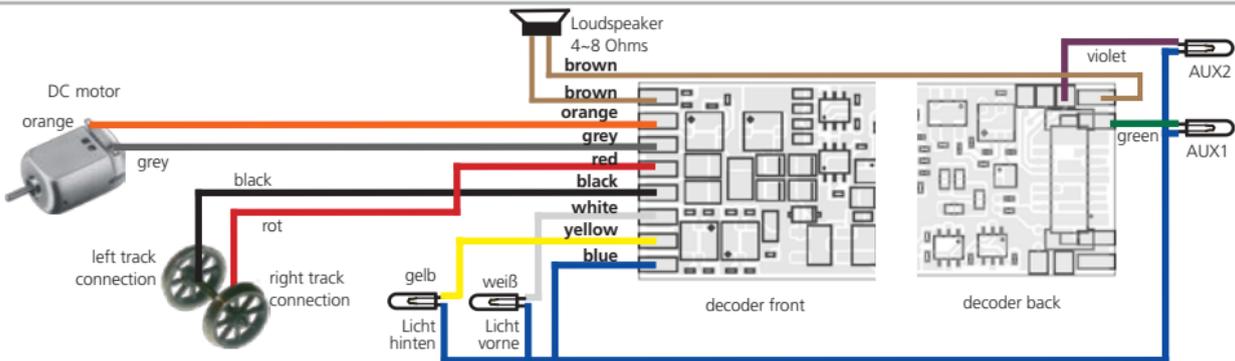
Figure 5: Wiring Diagram for LokSound micro V4.0 (wiring example)

(no content for the present)

6.7.3. Colour Coding by Märklin®

Märklin® uses a different colour coding system compared to the DCC colours. Please refer to fig. 8 for more information.

6.7.4. Motor and Track Connections

Firstly, please cut all wires installed in the locomotive. Take special care to remove any connections to the chassis (ground): the motor leads must be positively potential-free, in other words they may not have any contact to the chassis or body or the wheels and wheel contacts.

It is particularly easy to overlook such connections in Fleischmann® locomotives.

Make notes of which motor lead connects the motor with the right and the left wheel contact.

This avoids mistakes and assures that your locomotive runs in the right direction.

⚠ Please check all connections with an Ohmmeter. Search for short circuits, particularly between the motor leads and the wheel contacts.

- Connect the red wire to the right rail pickup or the centre pick up in AC models.
- Connect the black wire to the left rail pickup or the chassis in AC models.
- Connect the orange wire with the motor terminal, which originally lead to the right wheel pick up (centre pick up in AC models).
- The grey wire goes to the terminal, which originally connected to the left rail (chassis for AC models).

6.7.4.1. Connecting DC and Coreless Motors

You may use all DC motors commonly used for model trains provided they do not exceed the current limit of the decoder.

In some cases with the 5-pole High Performance Drive by Märklin®, you may find three anti-interference capacitors.

The two capacitors connected directly to the motor leads and the motor housing MUST be removed (also refer to Fig. 9 on the following page).

Description	Märklin® colour	ESU colour (according to NMRA DCC standard)
AC: Power pick up show («Schleifer») (Center rail) DC: Right track connection	red	red
AC: Outside rails DC: Left track connection	brown	black
Left motor terminal	blue	orange
Right motor terminal	green	grey
Common (rectified track voltage) (+Pole) for function outputs	orange	blue
Function output rear lights	yellow	yellow
Function output head lights	grey	white
Function output AUX1	brown/red	green
Function output AUX2	brown/green	violet
Function output AUX3	brown/yellow	-
Function output AUX4	brown/white	-
Figure 8: Colour coding by Märklin® in contrast to the DCC wiring code		

6.7.4.2. Connecting Universal Motors with HAMO-Conversions

Do not wire universal motors installed in many older Märklin® locomotives (also known as AC motors) directly to LokSound decoders. You must modify the motor by first installing permanent magnets – so called HAMO magnets. You may purchase these magnets from your ESU dealer.

We supply three types of magnets. Please refer to chapter 18.2. for more information regarding motor conversions with permanent magnets.

6.8. Connecting the Speaker

Every LokSound V4.0 decoder is shipped with an appropriate loudspeaker that is connected with both the dark brown braids. Firstly, you need to unsolder the speaker before you install it into the locomotive. It 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.

For LokSound V4.0 decoders you can use loudspeakers (also combinations) with a total impendance of 4 – 16 Ohms. We recommend to use the 4 Ohms impendance by ESU as they are tuned to LokSound V4.0 decoders. However, we advise against using the previous 100 Ohm impedance speakers since the sound volume would be too low.

Make sure that you use a small soldering iron (max. 20W) and only heat the marked contact spots of the speaker. Polarity is not important. The correct position of the speaker is crucial to achieve high quality sound. A speaker that is installed without a sound chamber will not generate good sound. Therefore carefully select the location and sound chamber for the speaker.

6.8.1. Connecting several speakers

When wiring several speakers, the speaker polarity is important. If a speaker is wired "backwards" compared to another speaker, each speaker´s membrane will move in phase opposition. This will lead to a sound wave cancellation resulting in a very poor and extremely low sound volume!

As some speakers do not provide any polarity mark, you need to test the phase position before the final installation of the speaker!
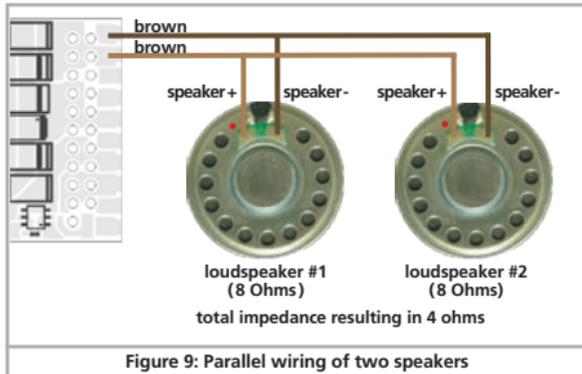
Figure 9: Parallel wiring of two speakers

6.9. Connecting Additional Functions

You can wire any kind of load such as light bulbs, LEDs (light emitting diodes), smoke generators or similar devices to the function outputs provided the maximum current draw is less than that of the decoder output.

ℹ️ The permitted maximum current draw per function output is listed in chapter 20 under „Technical Data."

⚠ ⚡ Please make sure that the load does not exceed the permitted maximum current and there are no short circuits. The outputs of the LokSound have protection but if an external voltage is applied, the outputs may suffer damage or destruction.

Remove capacitors!

orange   grey

Figure 10: 5-pole Märklin® motor
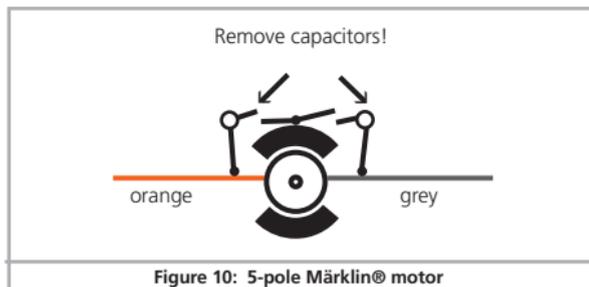
6.9.1. Overload Protection of Function Outputs (Blinking)

The function outputs of LokSound decoders have electronic protection against overload and short circuit. The decoder keeps checking the sum of all function output currents. If the current is too high, the decoder will switch off the outputs. After about 1 second, the decoder tries to switch them on again. Should the current still be too high – perhaps due to a short circuit – the same procedure starts again.

When using light bulbs (incandescent lamps) please note the following: they draw a very high „inrush current" when they are switched on, that becomes lower after a few moments. Therefore, it can happen with 12V bulbs that the headlights „flash" briefly during switch-on and then extinguish due to the overload protection of the decoder. The lights will be shortly switch on and off again in a one-second cycle. This results from a much too high inrush current of the bulbs; the decoder is not able to distinguish between the bulbs´ high inrush current and an overload. Therefore it is important to install the correct bulbs.

6.9.1.1. Suitable Light Bulbs

ℹ Only install bulbs rated 16V or higher and with a nominal current draw, that does not exceed 50 mA.

⚠ Many older models by ROCO® and Fleischmann® have 12V bulbs installed. They draw a high current, become very hot, and may cause damage to the locomotive. Replace them with 16V bulbs.

6.9.2. Using LEDs

If you like to use LEDs, then a resistor must be wired in series with the LEDs. It should have a rating between 470 Ohms and 2.2 kOhms. Running the LEDs without this resistor will lead to their immediate destruction! Unlike lightbulbs, LEDs are polarity-sensitive. The minus (cathode) end of the LED is connected to the function output, the plus (anode) end is connected to the blue (function common) wire.

Figure 11: wiring LED to output AUX1, AUX2
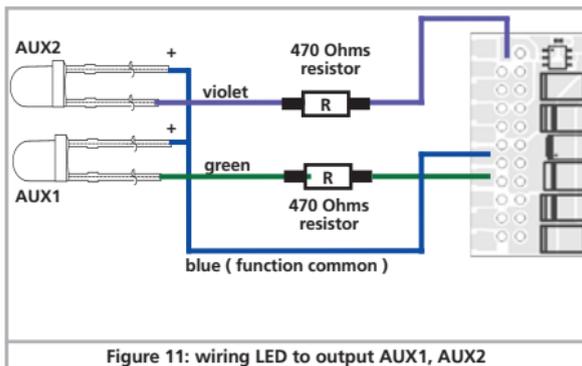
ℹ Please to not forget to switch the respective function output to LED mode. This will ensure a prototypical presentation of all light effects. Please refer to chapter 12.3. for more details.

6.9.3. Connecting the Light Outputs as well as AUX1 and AUX2

This procedure depends on the wiring of the lights and auxiliary functions in the locomotive:

a) The lamps / function outputs are insulated from the common pole (ground) (i.e.: the locomotive chassis); therefore they are potential free. Fig. 11 shows the correct wiring for the outputs AUX1 and AUX2. The functions of the locomotive must be potential-free, in other words there may not be any other connection to the function besides the wires from the decoder. The voltage at these outputs is about 1.5V lower than the track voltage. The blue wire is the „plus-pole"; the function output the „minus-pole".

If LEDs are installed (also refer to Fig. 11), then a resistor must be wired in series with the LEDs. It should have a rating of between 470 Ohms and 2.2 kOhms. Running the LEDs without this resistor will lead to their destruction!

b) The lamps / function outputs are wired (together) against the chassis of the locomotive (as in most locomotives by Märklin® as well as in most older locomotives by Fleischmann® and ROCO®).

The wiring is simpler but the available voltage is about half.

This type of connection is not suitable for multi-protocol operation.

Both M4 and Motorola® packets are asymmetrical. Therefore, the function outputs do not have continuous power. This leads to a rhythmic flicker of the headlights (pulsing) that becomes particularly obvious with LEDs.

Furthermore, the headlights will only work in one direction in analogue DC mode. Whether it will be the forward lights or the backup lights depends on which way you have placed your locomotive on the track.

• Solder the backup lights to the yellow wire, the headlights to the white one.

• The green wire connects to the function output AUX1.

• The voilet wire goes to the function output AUX2.

If your locomotive is wired according to option b), then it is ready for use. Otherwise, you must connect the remaining wires of all bulbs and functions together to the blue wire. This pole may not have any connection to the chassis!

As shown in Fig. 4 it is possible to use both options in the same locomotive.

6.9.4. Purpose of AUX3 and AUX4

6.9.4.1. LokSound with 21MTC Interface

LokSound decoders with 21MTC interface have two additional outputs besides the 4 standard outputs, namely AUX3 and AUX4. Since they are pure „logic-outputs," it is not possible to connect any external loads directly. External power transistors are required. Connect AUX3 and AUX4 via the interface; there are no wire leads. In terms of their functionality, AUX3 and AUX4 are equal to the other outputs. ESU offers an appropriate adapater board (art. no. 51968) with transistors.

6.9.5. Suitable Smoke Generators

Unfortunately, it is not an easy task to find the right smoke generator for each locomotive. The amount of smoke generated depends on the following factors:

a) Track voltage
The track voltage varies depending on the command station. Therefore, it is possible that a locomotive generates smoke when driven by one digital system but does not generate any smoke with another system. Even 1V variation makes a big difference.

b) Type and tolerance of the Seuthe smoke generator and the smoke distillate
Seuthe smoke generators have considerable production tolerances. Therefore, it is possible that one unit works perfectly well while another does not. Type of distillate and filling level have an influence as well.

c) Setting the decoder output

For correct smoking action you should set the AUX output to „Dimmer" as well as full „Brightness." More info in chapter 12.

d) Connecting the smoke generator

Most smoke generators are wired against the chassis (ground). Therefore the smoke generator only receives current in every second half cycle. How much power gets to the smoke generator depends on your command station and the digital protocol. Generally, Seuthe type 11 is recommended, but it does not get enough power and therefore does not smoke satisfactorily.

There are two options on how to solve this problem:

Solution 1: Using the Seuthe No. 10. This type is intended for analogue operation and draws a relatively high current. Subject to its tolerance levels, it may trigger the overload protection of the decoder. In this case, you must wire a relay (ESU No. 51963) into the circuit or you slightly reduce the „Brightness" of the output.

Solution 2: Using the Seuthe No. 11. Do not wire it against the chassis (ground) but rather use the blue wire for the second pole („U+"). This prevents the asymmetric track signal from interfering with the smoke generator. It represents the best solution but is sometimes a bit difficult in terms of wiring.

6.9.6. Connecting a wheel sensor

If you want to synchronise the stem exhaust chuff using a sensor, you have a little work to do. LokSound decoders support several types of sensors: Hall sensors, reed switches and mechanical wipers. The most accurate result you will get when using a hall sensor IC in combination with (up to) four magnets.

If you want to use an external sensor, you need to configure the LokSound in such a way that it will use the sensor input. The LokSound is setup ex works to use the computed exhaust chuff.
Set CV 57 to 0 in order to tell the LokSound to use the external sensor.
Using CV 58, you can define how many sensor pulses the decoder has to receive before it generates a steam chuff. Set CV 58 = 1 to get a triggered chuff on each pulse the decoder receives from the sensor. Based on the type of sensor IC you use, this may result in double the amount of steam chuffs you want to have. In this case, set CV 58 = 2. For values of 2 and more, every trigger pulse the decoder counts will result in one steam chuff. This is useful for geared locomotives.

6.9.6.1. HALL Sensor IC

A Hall sensor is an electronic circuit that responds to an alternating magnetic field similar to a reed switch. 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. There are also many compatible devices on the market. The terminals have to be wired to the LokSound as shown in figure 12.

Place four miniature magnets on the inner side of the driving wheel in such a way that the magnet will trigger the HALL IC each time it will pass the sensor IC.

For 3-cylinder locomotives, you may even need 6 or 8 magnets, depending on the cylinder configuration.

Figure 12: HALL IC wiring to a LokSound decoder
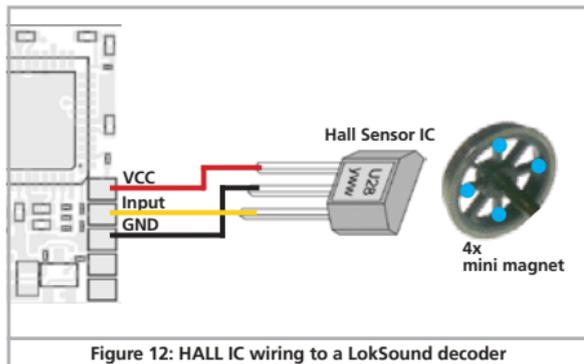
6.9.6.2. Reed switch sensor

If you have trouble obtaining a hall sensor IC, you may also use a subminiature reed switch. They are connected to the decoder with two pins only.

However, their sensitivity is not as good as hall IC sensors and

Figure 13: Reed switch wiring to the LokSound
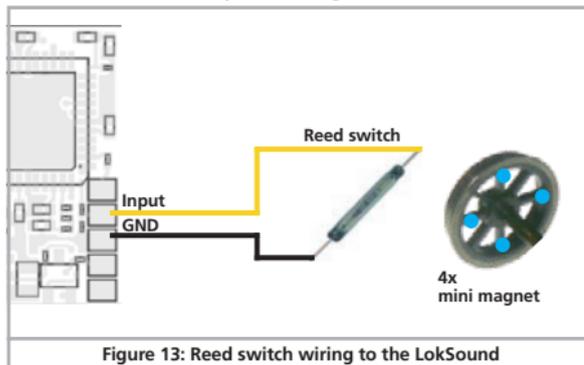
stronger magnets may be needed in order to trigger these reed switches correctly. Furthermore the position of the reed switches needs to be considered.

6.10. Connecting Capacitors

On many older layouts, current pick up of locomotives is not very reliable. Therefore, power interruptions may cause a stop or jerky movement when the locomotive travels over turnouts at low speeds. This can be overcome with buffer capacitors (100 mF / 25V or higher show the desired results). If desired you may connect them to the LokSound decoders.

> ⚠ Soldering wires onto a decoder requires quality soldering equipment and experience. Our warranty does not cover damage caused by inappropriate soldering. Consider carefully if you really need that capacitor.

6.10.1. All LokSound decoders

You can connect two larger capacitors as per the circuit in the upper half of figure 14.

The capacitor is charged via a resistor (100 Ohms) thus preventing the digital system from interpreting the charging current as short circuit at the time of switch-on. The diode makes sure that the energy of the capacitor is fully available when required.

> ⚡ However, you may not run this locomotive on AC layouts anymore. Risk of destruction!

> ⚠ Disconnect / remove the capacitor prior to programming with the ESU LokProgrammer!

6.10.2. Optional "PowerPack"

You can solder a powerful energy buffer to all LokSound V4.0 H0 decoders. In the lower half of figure 14 we show you how to do it. This „PowerPack" allows your locomotive to keep running for 2 seconds without power.

- The PowerPack only operates in digital mode. It automatically turns off on analogue layouts.
- It may take up to two minutes to fully charge the capacitor („GoldCap"). Therefore, the time bridged with the energy buffer depends on the current draw of your locomotive and the charge-up time.
- Futher information about how to use the PowerPack module is to be found in the "PowerPack module" manual.
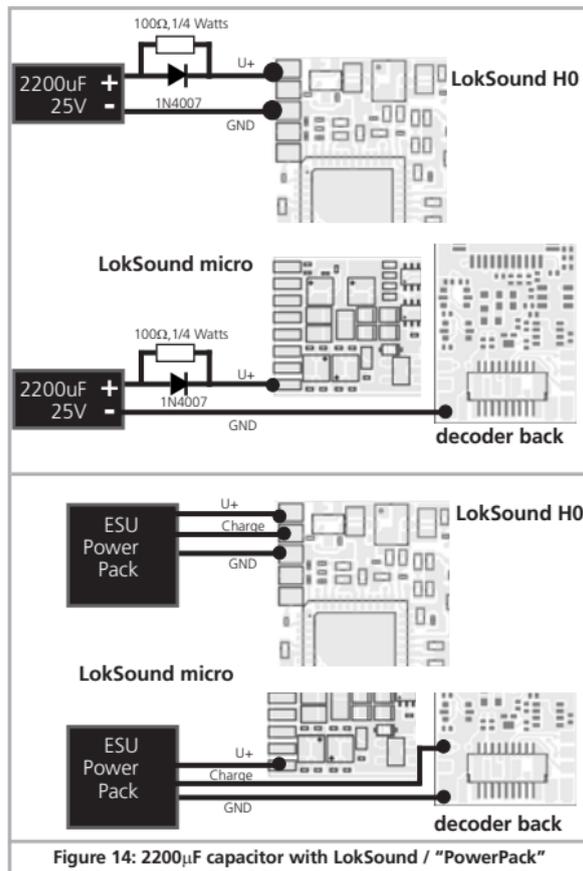
Figure 14: 2200μF capacitor with LokSound / "PowerPack"

7. Initial Operation

7.1. Factory Default Values

The address is set to 03 with 14 speed steps.

LokSound V4.0		

F1 switches the sound on/off
F2 switches the whistle/signal horn

The remaining function keys are used differently depending on the prototype. On our website you will find an appropriate function key assignment for every sound.

• Does the locomotive move in both directions?
• Does the indicated direction of travel correspond with the actual one? If not, are the motor leads swapped or is the 8-pin plug inserted the wrong way round?
• Switch on the lights: do they work properly? If you have installed a LokSound with an 8-pin plug, check if the plug sits in the socket correctly.

7.2. Digital Operating Modes

In the following chapters, we describe the operation of the LokSound with different digital systems.

ⓘ Since not every LokSound supports all digital systems, we state which chapter is applicable for which type..

7.2.1. DCC operation

LokSound V4.0		
LokSound micro V4.0		

ⓘ Remove any capacitors that are wired into the track feeders (e.g. ROCO® feeder track). This could impair the functionality of the decoder.

The LokSound works with any DCC system. Unfortunately, the DCC protocol also brings some difficulties into the game. One of them occurs so often that we deal with it right away.

7.2.1.1. DCC Speed Steps („flashing lights")

„Lights do not work" with DCC systems: DCC locomotives run with 14, 28, or 128 speed steps. The decoder offers all of the three options and needs to „know" with which option the the command station operates the decoder. The command station must be able to operate with this mode and must be set accordingly. If this is not the case, the following problems may occur:

• You cannot switch the lights with F0 at all.
• The lights keep switching on and off dependent on the speed step. On and Off again, and On again, and Off again etc.

In this case, make sure that the speed step settings of decoder and command station are the same.

7.2.1.2. Auto-detection of DCC Speed Steps

LokSound decoders implement auto-detection to avoid the above problem. We have tested this with the following systems:

• ESU ECoS®
• Bachmann E-Z-Command® Dynamis®
• ROCO® Lokmaus2 and Lokmaus3
• Uhlenbrock® Intellibox
• Lenz® Digital plus V2.3
• ZIMO® MX1

When operating with Lenz® digital plus V3.0 the auto-detect feature does not work at 14 speed steps. Select 28 / 128 speed steps instead.

The LokSound tries to establish the speed step setting every time it receives power (i.e.: after switching on the power on your layout or the track sector where your locomotive is located) and the lights are switched on. This process requires that you switch on the lights and turn the throttle until the lights light up continuously.

Should you change the speed step setting during operation then you must interrupt the power to the decoder for a short moment in order to activate the auto-detection.

This auto-detect feature can be turned off with bit 4 in CV 49 (also refer to the CV table in chapter 21.1). Then you have to set the correct speed step with bit 1 in CV 29.

7.2.2. Motorola® Mode

LokSound V4.0		

LokSound micro V4.0	

The LokSound works with all Märklin® devices and compatible systems that are in the market until now. The functions F1 to F4 can only be activated with the so-called „new Motorola® format." In order to activate this you must set the DIP-switch 2 on your 6021 to the upper position („On").

LokSound decoders support two special features in Motorola® mode:

7.2.2.1. 28 Speed Steps

While the original Motorola® system used by the following central units, namely Märklin® central unit 6021, Delta® and Mobile Station®, only supports 14 speed steps, the LokSound decoder can also handle the 28-speed step mode. In conjunction with suitable command stations (e.g.: ESU ECoS, in „Motorola® 28" mode) this leads to smoother control of your locomotives. No changes are required on the decoder.

7.2.2.2. Extended Motorola® Address Range

While the original Motorola® format only knows the addresses from 01 to 80, the LokSound offers the following range of addresses:

LokSound V4.0	01 - 255

Chapter 9 explains how to set the address.

7.2.3. Selectrix® Mode

LokSound V4.0		
LokSound micro V4.0		

You may operate the LokSound with any Selectrix® compatible command station with access to the functions „lights" and F1.

⚠️ For programming any parameters, you must use the DCC programming mode. It is not possible to program it with a „pure" Selectrix® system. Any changes programmed in DCC are also valid for operation with Selectrix® command stations.

As soon as a decoder receives commands in Motorola® or DCC format (whenever it receives a signal packet with information addressed to it), the Selectrix® receiver switches off automatically. This allows trouble-free mixed operation with Selectrix® / DCC / Motorola®. The Selectrix® receiver turns on again as soon as the decoder detects a power interruption.

7.3. Analogue Mode

All LokSound decoders are set ex factory to operate in analogue mode as well.

ℹ️ Please take note of the remarks in chapter 10.4 if the decoder should move repeatedly from analogue into digital sectors and back.

7.3.1. Analogue DC operation

LokSound V4.0		
LokSound micro V4.0		

LokSound decoders work on conventional DC layouts. From the factory, load compensation is active. This provides smooth control of your locomotives even at low speeds (in DC mode as well).

Since load compensation requires about 3 – 4 Volts as „base voltage" you must turn the throttle further than normal (=locomotives without decoder) before the locomotive starts moving.

7.3.2. Analogue AC Operation

LokSound V4.0		

⚠️🔔 Other LokSound decoders than the ones mentioned above are not suitable for analogue AC mode. AC will definitely lead to the destruction of the decoder!

Where intended, LokSound decoders support operation with AC transformers. Therefore, the LokSound decoder can simply replace the old directional relay. Load compensation is active (similar to DC mode) and provides smooth control and slow-speed-performance you have never seen before. The LokSound V4.0 recognised the pulse for changing direction as usual. Just wait until the locomotive has stopped prior to changing direction.

⚠️ Never issue the „Change of Direction" command to a moving locomotive! This could lead to damaged gears!

⚠️🔔 We cannot recommend the use of the old (blue) Märklin® transformers that where originally designed for 220 Volt. Depending on their age and their tolerance range, the pulse for changing direction could be too high in case of increased mains voltage and therefore destroy the LokSound decoder.

Do yourself and your locomotives a favour and purchase a suitable Märklin® transformer No. 6647 – your locomotives and decoders will thank you with longer product life!

8. Decoder Settings (Programming)

Chapter 8 covers setting various parameters of the LokSound decoder. Should you not be familiar with the handling of CVs please take the time to read these occasionally quite complex instructions.

After an introduction into the world of parameters in chapter 8.1, we explain in the following section 8.2 how to change various parameters in DCC mode and with Märklin® central units.

The chapters 9 to 16 explain which parameters have what kind of influence on the behaviour of the LokSound decoder.

8.1. Adjustable Properties of Decoders

The hardware determines some features such as the number of function outputs as well as the maximum permitted current of the motor output and therefore they are not programmable. Nevertheless, there are plenty of possibilities to influence the behaviour of the LokSound decoder by adjusting software-governed properties.

There is at least one memory space within the decoder reserved for each adjustable parameter where numbers or letters can be stored.

You could visualise the storage spaces as index cards in a large file box. In order to enable you to find the right card again, they all have numbers and / or names outlining the properties of this particular card such as „locomotive address" or „maximum speed."

Then imagine that you can write information onto these cards. Adjusting the settings means nothing else but erasing one entry and replacing it with another. Moreover, you could do that at any time. However, you cannot write onto every card: some bits of information like the manufacturer's code are firmly encoded.

Thus, you can determine the content of the storage spaces in the decoder even during operation and of course, the decoder will follow the instructions. Via the procedure known as „Programming," you can enter the desired data into the storage spaces.

8.1.1. Configuration Variables (CVs)

LokSound V4.0

LokSound micro V4.0

LokSound decoders follow the CV concept developed in the US. CV stands for „Configuration Variable" and indicates that the storage cells described above are not only variable but they also determine the behaviour of the decoder.

8.1.1.1. Standardisation in the NMRA

The NMRA (National Model Railroad Association) has defined which CVs determine certain parameters of a decoder. The DCC standard allocates fixed numbers for certain CVs (adherence is obligatory). This greatly simplifies things for the user since decoders of most manufacturers comply with this standard and therefore dealing with CVs requires the same process with the same CV-numbers regardless of the manufacturer.

The DCC concept permits to enter numbers ranging from 0 to 255 into CVs. Each CV carries only one number.

While the position number is predetermined, the range of values may vary. Not all CVs must accept values ranging from 0 to 255.

The permitted values for LokSound decoders are listed in the table in chapter 20.1. showing all available CVs.

8.1.1.2. Bits and Bytes

Most CVs contain numbers: CV 1 for instance contains the locomotive address. This can be any number between 1 and 127. While most CVs expect numbers to be entered, some others are rather like a „collection point" of various „switches", that administer different functions in one CV (mainly „on" or „off): CVs 29 and 49 are good examples: you must calculate the value for these CVs yourself. The value depends on which settings you want to program:

Have a look at the explanations for CV 29 in the table in chapter 20.1.: firstly, decide which options should be active. The column „Value" has two numbers for each option. If the option is switched off, the value is 0. Otherwise, it is a number between 1 and 128. Add all the values for the respective options to arrive at the correct value for this CV.

Example: Let us assume you want to run trains with the ECoS in DCC mode with 128 speed steps. Analogue detection should be active (because you also want to drive your locomotive in analogue mode). All other options are not active.

Therefore you must write the value 6 in CV 29 (0 + 2 + 4 +0 = 6).

8.2. Programming with popular Digital Systems

As already explained it is not possible to program every type of LokSound with every command station in the market. This chapter explains which options are available.

8.2.1. Programming with DCC Systems

LokSound V4.0		
LokSound micro V4.0		

LokSound decoders support all NMRA programming modes as there are the programming track modes (Direct Mode, Register Mode, Paged Mode) and the mode for the main („POM", „Programming on the Main").

Programming on the Main enables you to program your decoders comfortably without having to remove the locomotive form the layout. In this case, the command station talks directly to the decoder by using its locomotive address, for instance: „Locomotive number 50, write the value 7 into CV 3!". Thus knowing the locomotive address is a precondition. Unfortunately, you cannot read CV values.

ⓘ However, with RailCom® you can read CV values on the main. More on this topic in chapter 15.

Assuming you have a suitable DCC system you can read CV values on the programming track. You can also reprogram the locomotive address without knowing the old address since the command station simply transmits the command „Write value 7 in CV 3!". Each decoder receiving this command will execute it.

ⓘ ESU counts the bits from 0 to 7 as laid out in the standards while others (e.g.: Lenz®) count the bits from 1 to 8.

8.2.2. Programming with the ESU ECoS

LokSound V4.0		

LokSound micro V4.0		

The owners of an ESU ECoS can comfortably program LokSound decoders. ECoS has a library of „Decoder Profiles" that help you to program decoders with the graphic display. All CVs are stored in the decoder profile thus enabling the ECoS to read them and to display them on the screen. Chapter 16.5. of the ECoS manual provides more information on this topic.

Please make sure that you always use the latest ECoS firmware version. Whenever we expand the range of the LokSound family, only an update will add the required decoder profile.

8.2.3. Programming with Märklin® 6021

LokSound V4.0		

LokSound micro V4.0		

The Märklin® central unit 6021 works differently: Since it does not comply with the NMRA DCC standards, LokSound decoders start a special, obligatory programming procedure. Reading of values is not permitted.

There are two modes:

In the short mode, parameters with a number below 80 can be set provided the desired value is also lower than 80.

In the long mode, all parameters with values from 0 to 255 are adjustable. Since the display of the 6020 /6021 is limited to two-digit numbers, values must be split and entered in two separate steps.

8.2.3.1. Changing the Programming Mode

Enter the programming mode with the 6020/6021:

The throttle must be set to „0". No other locomotives may be on on the layout. Watch out for flashing signals of the locomotive!

- Press the „Stop" and „Go" buttons of the 6021 simultaneously until a reset has been triggered (alternately pull the mains plug of the transformer). Press the „Stop" button in order to switch off the track voltage. Enter the current decoder address. If you do not know the current address, simply enter „80".
- Activate the change-of-direction button (turn the throttle knob to the left beyond the arrestor until you hear a click sound), hold it in this position and then press the „Go" button.

Please bear in mind that the 6020/6021 only permits you to enter values from 1 to 80. The value 0 is missing. Always enter „80" instead of „0".

8.2.3.2. Short Mode

The decoder is in the short mode (the headlights flash periodically in brief intervals).

- Now enter the number of the CV that you want to adjust e.g.: „01". Always enter this number with two digits.
- For confirmation activate the change-of-direction routine (now the lights flash twice very quickly).
- Now enter the new value for the desired CV, e.g.: 15 (two digits).
- For confirmation activate the change-of-direction routine (now the lights light up for about one second).
- Then you can enter other CVs as desired.
- Selecting „80" allows you to exit the programming mode. Alternately you can switch off the track voltage and then on again (press the „Stop" button on the 6021, then the „Go" button).

8.2.3.3. Long Mode

You access the long mode by entering the value 07 in CV 07 while in the short mode. The decoder confirms the change to the long mode by slowly flashing lights.

- Enter the hundred-digit and the ten-digit (decade) of the CV that you want to change. Example: If you want to adjust CV 124, you enter „12".
- For confirmation activate the change-of-direction routine (now the lights flash periodically: long – short – long – short - etc.)
- Now enter the unit of the CV („04" in this example).
- For confirmation activate the change-of-direction routine. Now the decoder expects the entry of the CV value. The lights flash periodically: long – short – short).
- Now enter the hundred-digit and the ten-digit (decade) of the new CV value (as a two-digit number). Example: You want to write the value 135. Therefore, you enter „13".
- For confirmation activate the change-of-direction routine. Now the lights flash periodically: long – short – short – short).
- Now enter the unit of the new CV value as a two-digit number („05" in this example).
- For confirmation activate the change-of-direction routine (now the lights light up for about one second).
- Now you can adjust more CVs in long mode.
- Exit the long mode by switching off the track voltage and then on again (press the „Stop" button on the 6021, then the „Go" button).

8.2.4. Programming with the Märklin® Mobile Station®

LokSound V4.0		
LokSound micro V4.0		

With the Mobile Station®, you can also adjust some of the CVs. Use the Register Programming Menu to facilitate this.

As with the 6021, you can only enter values between 1 and 80. The possible CV values are also limited to that range from 1 to 80.

You will find the programming menu in the locomotive menu of the Mobile Station®. It is only available for certain locomotives. Of course, this works only for a programmable locomotive.

Proceed as follows:

- Enter a new locomotive in the database. How you do this is explained in the manual for the Mobile Station®.
- Select locomotive 36330. The locomotive Ex 3/3 is shown as active on the display.
- By pressing the „MENU / ESC" button you can now change any of the settings such as name, address, etc. in the heading „CHANGE LOCOMOTIVE". The last function shown is „Register Programming" (REG). Select this for writing CVs.
- Then select the CV (called „REG" on the Mobile Station®) and then the desired value and confirm by pressing the change-of-direction button.
- The Mobile Station® will program the new value into the decoder.

Please remove all other locomotives prior to programming!

8.2.5. Programming with the Märklin® Central Station

LokSound V4.0		
LokSound micro V4.0		

With the Central Station®, you can program the CVs 1 to 80 via the Motorola® programming menu. Unfortunately, you can only enter values between 1 and 80. Find more information regarding this programming mode in chapter 8 of the manual of the Central Station®.

8.2.6. Programming with the ESU LokProgrammer

LokSound V4.0		
LokSound micro V4.0		

The LokProgrammer 53451 offers the easiest and most comfortable way of setting the CVs of LokSound decoders: simply by a few mouse clicks on an MS-Windows® computer. The computer saves you to look for the various CV numbers and values. More information is contained in the manual for the LokProgrammer.

You can access all properties of ESU decoders with the LokProgrammer. Since this works independently form the data format it also works for mfx® decoders.

ℹ Please use the software version from V4.0 onwards for the LokSound V4.0 decoder. The software is available for download on our website!

8.2.7. Programming with the ROCO® Multimaus

LokSound V4.0		
LokSound micro V4.0		

Unfortunately the ROCO® Multimaus® is not able to programm any CVs via number 255 due to an error in the current (State: Dec. 2010) firmware version 1.02. To make, however, a proper programming procedure possible, we implemented an assistance tool. This helps to write the number of the CVs desired temporarily into two assisting CVs (so-called address registers), since the usual CVs cannot be reached. Afterwards the value of the CV desired will be programmed into another assisting CV (so-called value register). When the value register is written, the content will be copied to the actual desired position and the assisting CV will be set back.

Consequently, 3 CVs have to be programmed to write one CV.

These 3 CVs mean the following:

CV	Name	Description	Value range
96	Address offset	Saves the CV number that should be actually programmed in hundreds	0 – 9
97	Address	Saves the CV number that should be actually programmed in units and tens	0-99
99	Value	Saves the value of the CV that should be actually programmed	0-255

Example: You wish to programm CV 317 with value 120.

Proceed as follows:

• Programm the value of the CV number in hundreds in CV 96. In this example: CV 96 = 3.

• Programm the value of the CV number in units and tens in CV 97. In our example: CV 97 = 17

• Programm the desired value in CV 99. In our example: CV 99 = 120

As soon as you have programmed CV 99, the value of CV 99 will be transferred into CV 317. Is the programming finished, CVs 96, 97 and 99 will be set back automatically.

8.2.8. Programming with the ROCO® LokMaus II

LokSound V4.0

LokSound micro V4.0

The ROCO® LokMaus II is generally one of the most successful DCC command stations. However, as an affordable system designed for beginners it only allows the writing of two-digit CV numbers as well as CV values.

Similarly as with the MultiMaus® the problem can be solved via an assistance procedure. This helps to porgramm the number of the CVs desired temporarily into two assisting CVs (so-called address registers) instead of programming the actual CV. Afterwards the value desired will be separated into two parts and programmed into two further assisting CVs (so-called value registers). When the last value register is written, the content will be copied to the respective desired position and all assisting CVs will be set back.

Consequently, 4 CVs have to be programmed to write one CV.

These 4 CVs mean the following:

CV	Name	Description	Value range
96	Address offset	Saves the CV number that should be actually programmed in hundreds	0 – 9
97	Address	Saves the CV number that should be actually programmed in units and tens	0-99
98	Value offset	Saves the value that should be actually programmed into hundreds.	0-9
99	Value	Saves the value of the CV that sould be actually programmed in untis and tens	0-99

<u>Example:</u> You wish to programm CV 317 with value 120.

Proceed as follows:

• Programm the value of the CV number in hundreds in CV 96. In this example: CV 96 = 3

• Programm the value of the CV number in units and tens in CV 97. In our example: CV 97 = 17

• Program the CV value in hundreds in CV 98. In our example: CV 98 = 1

• Programm the CV value in untis and tens in CV 99. In our example: CV 99 = 20

As soon as you have programmed CV 99, the value of CV 99 will be transferred into CV 317. Is the programming finished, CVs 96, 97,98 and 99 will be set back automatically.

9. Address Settings

Each LokSound decoder requires a definite address to be address-able for the central unit. Depending on the type of decoder and the digital system, there are several possibilities how to allocate addresses.

9.1. Short Addresses in DCC Mode

LokSound V4.0		
LokSound micro V4.0		

Normally you would control LokSound decoders with the short address that is stored in CV 1. In DCC mode, the permitted values range from 1 to 127. In order to enable the decoder to „listen" to the short address you must delete bit 5 in CV 29.

ℹ Some digital systems (e.g. ROCO® Lokmouse2, Lenz® digital plus, Lenz® compact) only support the values 1 – 99 as short address.

9.2. Long Addresses in DCC Mode

LokSound V4.0		
LokSound micro V4.0		

You can operate LokSound decoders also with long addresses (4-digit addresses). The supported values range from 128 – 10239. The long address is stored in the CVs 17 and 18. You must activate the long address by setting bit 5 in CV 29.

⚠ Bit 5 in CV 29 switches between short and long address. The de-coder can only respond to one address at a time.

If you want to use your LokSound with the long address it is practical to program this address directly with your digital system: most modern digital systems (e.g. ESU ECoS, Bachmann E-Z Com-mand® Dynamis®) have a menu for programming long addresses.

The command station not only programs CV 29 correctly but also assures the correct storage of the values for the long address in CV 17 and 18.

If you want to enter the long address manually in CV 17 and 18 please refer to chapter 22.1.

9.3. Motorola® Address

You can also operate many LokSound decoders with the Mo-torola® format. The address for this operating mode is stored in CV 1.

LokSound V4.0		
LokSound micro V4.0		

This address is identical to the short address in DCC mode as de-scribed in chapter 9.1. The LokSound decoder responds both to commands in DCC and in Motorola® mode at the same time. The permitted values are listed in chapter 7.2.2.2.

ℹ Märklin® digital devices (6020, 6021, Delta®) can only work with addresses from 1 to 80. Should you have entered a higher value in CV 1 you will not be able to drive this locomotive with these central units.

10. Adapting the Driving Characteristics

10.1. Acceleration and Deceleration

Acceleration and brake time can be set independently from each other. Therefore, you could for instance program a short acceleration and a much longer brake time.

The time for accelerating is adjusted in CV 3 while deceleration is set in CV 4. Permitted values are 0 (no delay) to 63.

The times set in these CVs work speed dependant. Therefore, the acceleration distance and the brake distance are longer at high speeds. In other words, the faster the locomotive moves, the longer is the distance until it stops.

ⓘ For information on how to set a brake distance independently of the speed refer to chapter 10.6.

10.1.1. Switching Acceleration / Deceleration

LokSound decoders can deactivate acceleration and deceleration by the push of a button. This is particularly handy for shunting since your locomotive responds directly to the throttle.
The default setting for this function is function button F4.

10.1.2. Shunting Mode

The default setting for the shunting mode is F3. It reduces the speed to about 50%. Thus, you have smoother control of your locomotive in the lower speed ranges, which is important for shunting, particularly in the 14-speed-step mode.

10.2. Starting Voltage, Maximum and Medium Speed

LokSound V4.0		
LokSound micro V4.0		

LokSound decoders know internally 256 speed steps. They can be adapted to the characteristic of the locomotive and allocated to the actually available speed steps (14, 28, or 128).

The NMRA defined two options to facilitate this:

Motor characteristic via CV 2, 5, and 6 (Fig. 15): Enter the start voltage in CV 2 and the maximum speed in CV 5. CV 6 corresponds with the speed at a medium speed step. Thus, you can define a "kink" in the speed curve. This mode is active if bit 4 = 0 in CV 29.

ⓘ The values of the start, mid and maximum speed are dependent on each other. Selecting a mid speed that is lower than the start speed or higher than the maximum speed could lead to some erratic driving performance. Therefore always adhere to the principle: start voltage < mid speed < maximum speed.
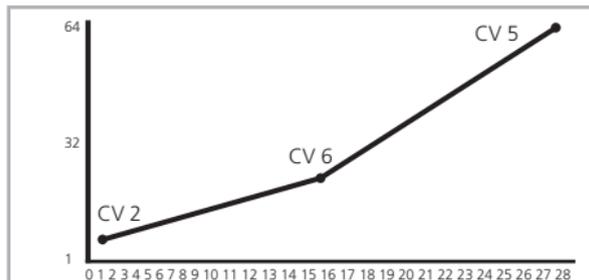
Figure 15: Speed settings using CV 2, 6, 5

10.3. Speed Curve

LokSound V4.0		
LokSound micro V4.0		

You may also define your own speed curve: simply enter the desired values in the CVs 67 to 94 (also refer to Fig. 16). The decoder will superimpose these 28 values onto the real speed steps. Thus, you can adapt the driving performance optimally to your locomotive. This mode is only active if bit 4 in CV 29 is set.

We recommend using the ESU LokProgrammer for easy and comfortable programming.

ℹ️ When this mode is active, the settings in CV 2, CV 5, and CV 6 have no influence.

10.4. Changing between Operating Modes

You may change from a digital to an analogue sector of your layout „on-the-fly" at any time.

The locomotive behaves as follows:
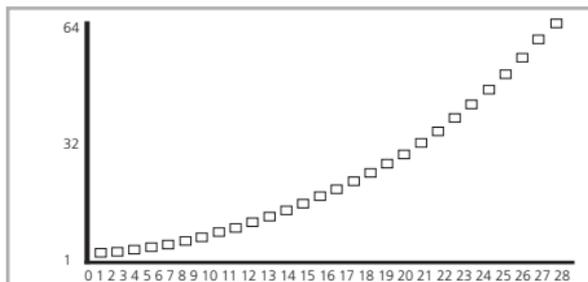
Figure 16: Free speed curve

10.4.1. Changing from Digital to Analogue DC

When the decoder enters the analogue DC sector, it monitors the polarity of the track voltage. If the polarity (and the resulting direction of travel as per NEM) matches the the direction of travel in digital mode the locomotive will continue without stopping at the speed that corresponds to the analogue voltage.

If the polarity does not match than the behaviour depends on the settings in CV 27:

If the DC brake mode is active in CV 27 then the locomotive will slow down to a stop with the programmed deceleration, if not, then the locomotive will change the direction and back out of the analogue sector. Chapter 10.5 provides detailed info about brake sectors and the appropriate settings.

10.4.2. Changing from Digital to Analogue AC

If a locomotive travels into an analogue AC sector, it will continue onwards in the same direction at a speed corresponding to the analogue track voltage.

This mode is not available for the LokSound micro V4.0!

10.4.3. Changing from Analogue to Digital (directional bit)

When entering the digital sector the locomotive compares the current direction of movement with the digital signals arriving via the track: If the actual direction matches the one as per digital signal, the locomotive continues onwards at a speed corresponding with the digital signals.

Does the direction not match the commands from the digital system, then the behaviour depends on the settings in the „directional bit" (also refer to chapter 15.1. for more details):

If the directional bit has been set, then the decoder ignores the directional commands from the central unit, the locomotive continues in the same direction; only the speed will be adjusted according to the commands from the central unit. Therefore, the actual direction of movement does not match the direction as intended by the central unit for the time being; however, this changes once a change-of-direction-command is activated at the central unit.

If the directional bit has not been set, then the locomotive slows down and stops according to the programmed deceleration, changes its direction and returns to the conventional sector. What happens next is described in chapter 10.4.1 resp. 10.4.2.

10.4.4. Changing from Digital to Digital

LokSound V4.0		
LokSound micro V4.0		

Travelling between sectors with different digital protocols, namely Motorola® and DCC is possible at any time. The LokSound decoder interprets each valid data package from the command station.

LokSound V4.0		
LokSound micro V4.0		

Travelling from Selectrix® to DCC or Motorola® is only possible after a short power interruption (also refer to chapter 7.2.3).

10.4.5. Changing modes with Analogue Mode turned off

LokSound V4.0		
LokSound micro V4.0		

Perhaps you have disabled analogue mode on your decoder (bit 2 in CV 29 is deleted). When the locomotive moves from the digital sector into the analogue one, the locomotive will continue with the set speed and direction. However, you cannot issue any commands to that locomotive until is back in a digital sector.

Under certain circumstances, the decoder interprets the analogue DC voltage as brake sector and slows down to a stop; please refer to chapter 10.5.

10.5. Brake Sectors

Brake sectors have the purpose to slow down the locomotive independently from the commands issued by the command station. Frequently, this function serves for stopping a train in front of a red signal. If a LokSound detects a brake command, it will slow down with the programmed deceleration and then stop. After this enforced stop, the locomotive will accelerate again as per the programmed values in CV 3.

Depending on the type of digital system, there are several options on how to influence the decoder so that it stops the train.

10.5.1. DC Brake Mode

LokSound V4.0		
LokSound micro V4.0		

In order to activate the DC brake mode you must set bit 3 in CV 27. The LokSound decoder will start brake once it moves from a digital sector into a DC sector provided the brake mode is active and the polarity of the track voltage does NOT match the current direction of travel. The locomotive will stop taking into account the programmed deceleration.

10.5.2. Märklin® Brake Mode

LokSound V4.0		
LokSound micro V4.0		

In principle, the Märklin® modules 72441 / 72442 apply a DC voltage to the track instead of the digital signals. Provided bit 3

and bit 4 in CV 27 is set, then LokSound decoders detect this voltage and will stop the train (CV 27 = Value 24).

⚠️ The signal generated by these modules looks the same as DC from conventional DC-transformers. The LokSound could possible misinterpret this and switch to the analogue mode instead of brake.

⚠️ If you wish to control the LokSound decoder with DCC signals and keep your Märklin® brake sectors then you should switch off the DC analogue mode by deleting bit 1 in CV 50. The LokSound will stop as desired.

10.5.3. Selectrix® Diode Brake Sector

LokSound V4.0		
LokSound micro V4.0		

LokSound decoders also detect the Selectrix®-diode brake sector and stop as desired.

10.5.4. Lenz® ABC Brake Mode

LokSound V4.0		
LokSound micro V4.0		

As a new function the LokSound V4.0 decoder supports the ABC braking technique introduced by Lenz®. In order to use this function a group of anti-parallel diods will be be soldered to one half of the track. The resulting fall of voltage generates an assymetrical DCC signal. LokSound decoders are able to detect the potential difference between the left and right half of the signal. If desired, the decoder will be stopped.

To be able to use the ABC technique you also need, beside the adequate LokSound V4.0 decoder, an appropriate brake module. The ABC technique can only be operated with boosters offering an exact symmetrical output. All command stations and boosters by ESU and Lenz® garantuee a symmetrical output. We don´t recommend to use other boosters for the ABC technique.

• If you wish to stop the LokSound decoder when the track signal is stronger on the right side than on the left side (and the diods are also installed on the left side), set bit 0 in CV 27.

• If you wish to stop the LokSound decoder when the track signal is stronger on the left side than on the right side (and the diods are also installed on the right side), set bit 1 in CV 27.

• If you want to stopp the decoder no matter in which half of the track the diods are set, please set bit 0 and bit 1 in CV 27 (CV 27 = 3).

10.6. Constant Brake Distance

LokSound V4.0		
LokSound micro V4.0		

An attractive function hides behind CV 254 (ESU brake mode): Here you can set a constant distance for braking the train, from the beginning of the brake sector to the stopping point. Thus, it is possible to stop the train right in front of a red signal regardless of the speed. The LokSound simply calculates the required brake effect.

The higher the value in CV 254, the longer is the brake distance. Simply make some trials on a test track in order to find the values best suited to your locomotive.

If CV 254 is set to 0, then the normal time mode according to chapter 10.1. will automatically turn on.

The constant brake distance is only active in brake sectors. When you turn the throttle back to 0, the locomotive will slow down as per the value in CV 4.

Via CV253 you can chose how the LokSound should decelerate.

10.6.1. Linear Braking Distance

CV253=0: The loco starts immediately to stop linearly after receiving the braking command. The brake effort is determined by the decoder so that, independent from the starting speed, the loco will stopp after reaching the way defined in CV254. The dashed line in Figure 17 shows the relation.

10.6.2. Constant Linear Braking Distance

CV253>0: Is the value in CV253 higher than 0, the locomotive continues to drive ahead for some time when entering the braking section to finally brake within the braking time indicated in CV253. The effort of the braking effect is now constant as set in CV253. The decoder changes the brake timing accordingly so that the locomotive stopps at the correct position in the end. Figure 17 shows this quite clearly.
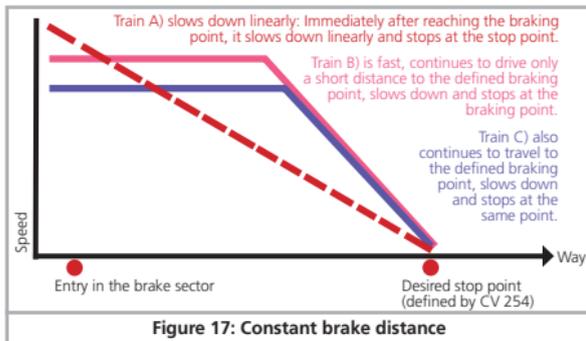
10.7. Settings for Analogue Operation

You can adjust the acceleration and maximum speed of the LokSound separately for analogue DC and AC mode. Thus, you can adapt the speed of your locomotive also to analogue operations.

You will have to determine suitable values by trial and error since they depend on the type of transformer (throttle) and the drive system of your locomotive.

Please note that load compensation is always active ex works, even in analogue mode. This gives you smooth control even at very low speeds.

10.7.1. DC Analogue Operation

LokSound V4.0		
LokSound micro V4.0		

In DC analogue mode you can adjust the starting speed with CV 125 and the maximum speed with CV126.

10.7.2. AC Analogue Operation

LokSound V4.0		

In AC analogue mode you can adjust the starting speed with CV 127 and the maximum speed with CV 128.

Train A) slows down linearly: Immediately after reaching the braking point, it slows down linearly and stops at the stop point.

Train B) is fast, continues to drive only a short distance to the defined braking point, slows down and stops at the braking point.

Train C) also continues to travel to the defined braking point, slows down and stops at the same point.

Speed

Way

Entry in the brake sector

Desired stop point (defined by CV 254)

Figure 17: Constant brake distance

11. Motor Control

LokSound V4.0		
LokSound micro V4.0		

5th generation load compensation enables LokSound decoders to execute precise motor control. Even with the default settings, most locomotives run perfectly.

11.1. Adjusting Load Compensation

Should you find after programming and doing the initial test that the locomotive does not run smoothly particularly at low speed or that the locomotive jerks a little after having stopped or if your are simply unsatisfied with the driving performance, then you should adjust the load compensation of your LokSound decoder.

Due to the large number of different types of motors and drive systems there is no single setting that suits all. Load compensation can be influenced with 5 CVs.

Firstly, check if the irregular performance is due to any mechanical faults. Bent driving rods are one common cause. When you turn off load compensation (set CV56 to 0) and the problem persists then it is likely there is a mechanical fault.

11.1.1. Parameter for frequently used Motors

We have listed the correct settings for the most common motors in table fig. 18. If a motor is missing, it means either that the default settings produce good results or that we have not yet sufficient experience about these motors.

Set the suitable values and test-drive your locomotive.

11.1.2. Adjustments for other Motors / „Fine Tuning"

Unfortunately, the motors available in the market have considerable variations due to tolerances. This is even true for the same type. Therefore, LokSound decoders enable you to adapt load compensation to the motor with CVs 53, 54 and 55. If the recommended values above do not lead to acceptable results, you can further optimise them.

Especially for the slow driving sector (speed step 1) the LokSound V4.0 with CV 52 to change the gain control. This helps to avoid any jerking while driving extremely slowly.

However, before doing this you must make sure that there are no capacitors wired between the motor terminals and the chassis. The commutator of the motor must be clean and the drive system should run freely. The wheel contacts and other contact plates of the locomotive must also be clean and make reliable contact.

11.1.2.1. Parameter „K"

Parameter „K", stored in CV 54, influences how strongly load control will affect the driving performance. The higher the value, the more load control will respond to any changes and try to adjust the revs of the motor.

Parameter „K" needs adjustment if the locomotive runs unevenly (jerks).

Reduce the value of CV 54 by 5 and test-run the locomotive to see if there are any improvements. Reat these steps until the locomotive runs smoothly at speed step 1.

11.1.2.2. Parameter „I"

Parameter „I", stored in CV 55, provides important information to the decoder on how much inertia the motor has. Motors with large flywheels naturally have more inertia than smaller ones or coreless motors.

Adjust parameter „I" if the locomotive jerks somewhat just before it stops or „jumps" at lower speeds (lower third of the speed step range) or simply does not run smoothly.

- Increase the value by 5 starting with the default value for motors with very small or no flywheels.
- Reduce the value by 5 starting with the default value for motors with large flywheels.

Test again and repeat this procedure until you arrive at the desired result.

11.1.2.3. Reference Voltage

In CV 53, you set the EMF reference voltage generated by the motor at maximum revs. This parameter may have to be adapted subject to the track voltage and the efficiency of the motor.

If the locomotive reaches maximum speed when the throttle is set to about three-quarter and the top third of the throttle has no influence on the speed, then you should reduce the value of CV 53. Reduce the value by 5 – 8 and test the locomotive again. Repeat this process until the locomotive just reaches its maximum speed when the throttle is fully open.

11.1.2.4. Parameter "K slow"

Together with the LokSound V4.0 decoder an additional CV 52 has been introduced which seperately determines the gain control considerably for the whole slow driving sector in speed step 1.

If you are not satisfied with the driving behaviour when the locomotive drives slowly or starts, while everthing is fine with the medium and high speed steps, you should increase the value of CV 52 by ca. 5 - 10 than the value set in CV 54.

11.1.2.5 Adaptive Regulation Frequency

The decoder operates ex works with a mutable (adaptive) regulation frequency to drive the motor as precisely as possible. However, as a result some motors might show a nasty buzzing noise.

For such motors you are able to set the regulation frequency on a constant value. Set bit 4 to "1" in CV 124.

Type of motor	Remarks	CV 2	CV 52	CV 53	CV 54	CV 55	CV 56
Fleischmann® round motor		4	32	120	80	50	255
Märklin® SFCM small «Scheibenkollektormotor»	with magnet 51961	4	30	50	40	175	200
Märklin® SFCM big «Scheibenkollektormotor»	with magnet 51960	4	30	50	40	175	200
Märklin® DCM «Trommelkollektormotor»	with magnet 51962	4	30	50	40	175	200
Märklin® 5*-high-performance motor		3	32	120	60	95	255
Märklin® Locomotives with Maxon Motor		3	16	140	48	20	255
HAG® motors		4	15	100	40	175	200
Trix® Locomotives with Maxon Motor	Remove the motor EMC capacitors from the main board!	3	16	140	48	20	255
Faulhaber® motors		4	32	140	80	50	255
Piko® Motor		3	20	80	30	30	255
Figure 18: Chart of BACK-EMF settings for widely used motors							

11.2. Turning off Load Compensation

LokSound V4.0		
LokSound micro V4.0		

You can also switch off load compensation by writing the value 0 in CV 56 („Control Influence").

⚠ With load control turned off, the starting voltage in CV 2 should be increased until the locomotive starts moving at speed step 1 or 2.

11.3. Adapting Load Control Frequency

LokSound V4.0		
LokSound micro V4.0		

In the LokSound decoders load control works normally with 40 kHz. Sometimes it can be useful to reduce this frequency by half:

• For motors with little power due to high inductivity.
• If suppressors (such as capacitors, chokes, etc.) disturb load control but cannot be removed (e.g. some older Gützold® locos).
Delete bit 1 in CV 49 in order to set the PWM frequency from 40 KHz to about 20 kHz.

11.4. Dynamic Drive Control: Up and Down the Hill

LokSound V4.0		
LokSound micro V4.0		

Dynamic Drive Control of your LokSound decoder enables you to adapt load control, as you may desire. Full control over the entire speed range (constant speed, if enough power is available) is not always prototypical. Therefore you can set the degree to which load control will be effective between 0 (no load control) and 100% (load compensation over the full range).

At low speeds it is advisable to have 100% load compensation in order to prevent the locomotive form „getting stuck" or from „running away" without any load. The impact of load control should recede with increasing speed in order to have the full „un-harnessed" power of the motor available when the throttle is fully open. Thus, the locomotive will respond to certain changes in the main line such as gradients. The locomotive will run faster down-hill and become slower climbing the hill.

The desired degree of load control influence is set in CV 56.

ℹ It is particularly meaningful to reduce the influence of load control whenever you run consists. This allows for better driving proper-ties of all locomotives in the consist.

11.5. Settings for the C-Sinus Motor

LokSound decoders with the 21MTC interface can drive the new C-Sinus motors indirectly via the circuit board installed in the loco-motive. The LokSound can generate all necessary signals provided you readjust certain settings:

Load compensation must be turned off as described in chapter 11.2.

The control electronics of the motor also need a switched logic voltage provided by the LokSound on output AUX4. AUX4 must therefore be active while the locomotive is stopped and while it is moving (in both directions!).

LokSound V4.0		
LokSound micro V4.0		

Write the values below into the respective CVs.

⚠️ Make sure that CV 31 contains the value 16 and CV 32 the value 2.

CV	Value
CV 266	32
CV 282	32
CV 298	32
CV 314	32

Use the LokProgrammer alternatively in order to activate AUX4 for the stationary locomotive and for the moving locomotive in both directions as shown in figure19.
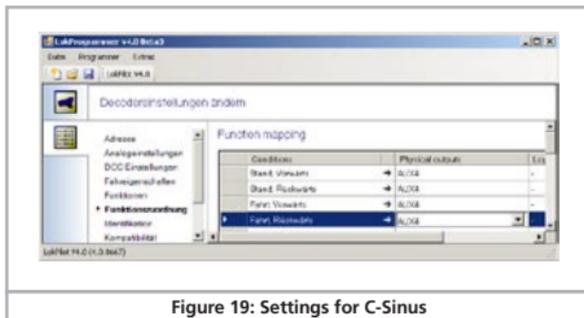
Figure 19: Settings for C-Sinus

12. Function outputs

12.1. Physical function outputs

LokSound decoders have up to 6 physical function outputs. „Head lights" and „Rear lights" are used for lighting, the remaining ones (AUX1 to AUX4) are freely available. Other functions include „Shunting Mode", „Acceleration / Deceleration On/Off" as well as virtual functions like „Sound On/Off". We explain the importance of the latter in chapter 14.

The function buttons („F buttons") of your command station or throttle activate the function outputs.

Generally, F0 is the lighting button, while we count the remaining buttons from F1 upwards.

12.2. Allocation of Function Buttons (Function Mapping)

LokSound V4.0		
LokSound micro V4.0		

You can allocate the functions freely to any function button. ESU uses the so-called and once more extended „Mapping" for the LokSound V4.0 decoder. It has the advantage that you can link each output to any button. Furthermore, the allocation can vary between forward and reverse as well. It is also possible to switch several functions simultaneously. Unfortunately this kind of flexibility requires a large amount of CVs. The solution of this problem is called "Index CV access".

12.2.1. Index CV access

The CVs ranging from 257 – 511 are "indexed". This means that the meaning of any of these CVs can change depending on the value of the so-called "Index register".

If you change the value of the index register, the meaning and the value of the CV itself will be also changed. This method allows

to use every CV between 257–511 several times and solves the problem regarding CV shortage.

CV 32, which is also so-called "index register", determines the meaning of CV 257–511 as well. If you change both the CVs 31 and 32, you simultaneously change the meaning and the values of CV 257–511.

The meaning of all other CVs (1–256) is not influenced by the value of the index register.

So should you ever change any of the CVs located in the range of 257–511, please make sure first that the index registers CV31 and CV32 have the indicated values.

12.2.2. Function Mapping Chart

Please refer to the chart on page 40/41 to get an overview of the possible options. Each function key can control more than one output. There are different types of "outputs":

- Physical outputs: There are six real outputs on the LokSound Select decoder. You can use them for lighting effects, smoke units or couplers etc.
- Logical functions: Such as Dynamic "shunting mode", "start and braking mode" and so on. These functions have a direct influence on the decoders behavior.
- Sound functions: every triggered sound is assigned to a sound slot. You are able to determine which of the sound slots (also several simultaneously) should be triggered with the key.
- Modifier functions: Functions such as "Full brightness" are used in combination with other functions.

Each output can also be controlled by more than one function key. The keys are logical OR linked. This means that every key is able to turn switch an output on, however, all function keys have to be turned off, to deactivate the function.

To determine the correct CV values, go ahead as follows:
- Find the column in the chart corresponding to the function output you wish to control.
- Identify the line corresponding to the function key you wish to use for the selected output.
- Note the numbers at the intersection of the line and the column you have selected.
- Program the Control CV listed left aside the noted number. Before you write this CV, make sure the index registers CV31 and CV 32 have the value shown left aside the Control CV number.

For each function key, there are 3 control CVs. Each function key exists twice, one for driving forwards and one for driving backwards. You sould set the unneeded CVs to zero to avoid an unexpected behaviour of the decoder.

Example: Switch AUX3 with F8.

You want to switch AUX3 with the F8 key, either when you drive forwards and backwards. With the help of the ESU adapter board 51968 you added a light bulb to AUX3.

We can see from the chart, that CV 330 must be set to the value 16 to switch AUX3 via F8 to drive forward. In addition to this, CV 346 must be also set to the value 16 to switch AUX3 via F8 to drive backwards.

12.2.3. Allocation of Function Keys with the LokProgrammer

The LokSound V4.0 can, if used with the ESU LokProgrammer and its new software version 4.1, be programmed more flexibly. It is e.g. possible to use several function keys at the same time as entry and thus allows to realise very specific wishes. However, it is widely impossible to make certain entries with the digital command station only. We therefore recommend to use our LokProgrammer, if your expectations exceed to the possibilities described in this manual.

Especially to operate the function keys F14 - F28 you have to use the LokProgrammer.

12.3. Special Effects on Function Outputs

12.3.1. Switching on Outputs and Different Options

Each function output can / must be unlocked prior to using it. Furthermore, each output offers the choice of a lighting effect or can be additionally occupied with logical functions such as "Grade Crossing" or "High beam".

The following lighting effects are available:

• Dimmable light: A normal continuous output. The brightness will be reduced to about 50% if the dimmer function is on.

• Dimmable headlight with "fade in/out": Here the output is switched on slowly and immitates the slow glowing of oil lamps or very old light bulbs. The brightness will be reduced to about 50% if the dimmer function is on.

• Firebox: Simulates a normal fire box lighting effect.

• Intelligent firebox: Simulates an "intelligent" fire box lighting effect, whose itensity changes relating to the driving conditions.

• Single Strobe: This is a single strobe light (short flashing) output. The frequency can be adjusted.

• Double Strobe: This will result in two short flashes. The frequency can be adjusted.

• Rotary Beacon: This effect should simulate a revolving reflector and bulb assignment of a very popular warning beacon atop many diesels of the 60's and 70's.

• Prime Stratolight: This is the more modern version of the Rotary beacon.

• Ditch Light Type1: The ditch light type 1 will revert to a steady On state when it is not flashing.

• Ditch Light Type 2: The ditch light type 2 will revert to Off state when it is not flashing.

• Blinklicht: This is the "classical" flashing light. The frequency can be adjusted..

• Mars Light: This effect simulates the sweeping pattern of this well-known warning beacon in the USA.

• Gyra Light: The Gyra Light is similar to the Mars Light, but is slower in motion.

• Coupler function: You can use this function to control Krois® or ROCO® couplers, also in connection with automatic pushing/re-moving.

12.3.2. Adjusting the Lighting Effects

The LokSound V4.0 provides 3 CVs for each physical output, which defines their behavior.

Mode Select:	Defines which effect you want to have for the output.
Brightness:	Defines the brightness of each individual function output in 32 steps (0 to 31).
Special functions:	Defines some further modes for each function output..

Have a look at the chart figure 20 to see how this works.

The CV for special functions needs to be explained in more detail. The special functions are additional functions you could add to each output.

Phase Select:	Alters the timing of the effect so that it is 180 degree out of phase with other effects. This allows you to create alternate blinking. It is used for ditch lights mainly.
Grade Crossing:	Causes the lighting effect to become active only when the global flag "Grade crossing enable" is set AND the corresponding function key is ON. Grade crossing logic can be used with any of the light effects. Grade Crossing can be used with most of the lighting effects.
Rule 17 Forward:	Applicable only if the output is set to either "Dimmable headlight" or "Dimmable headlight with fade in / out". Causes the effect to be dimmed to around 60% of the set brightness, if the locomotive is stopped. When the engine is running forward, the output will be increased to a 100%.

Rule 17 Reverse: Like Rule 17 Forward, but the brightness will be increased to a 100% when the locomotive drives backwards.

Dimmer: Causes the output to be dimmed to around 60% of the defined brightness, if the global flag "Dimmer" is set. With this function you are able to realise a full beam very easily by setting the the global function "Dimmer" with a function key.

LED mode: The outputs are pre-set to be used with incandescent bulbs. If you wire LEDs on the output, you should set the LED compensation mode bit in order to get satisfying characteristics. The light effects will be accordingly adjusted, so that the result will look more realistic again.

For each physical output, the three controlling CVs are defined as follows:

Function output	Mode Select CV	Brightness CV	Automat. Switch off	Special function CV
Head light	259	262	261	263
Rear light	267	270	269	271
AUX1	275	278	277	279
AUX2	283	286	285	287
AUX3	291	294	293	295
AUX4	299	302	301	303

⚠ Please set index register CV 31 to 16 and CV 32 to 0 before changing any of the above-mentioned CVs.

Light effect	Mode Select	Brightness	Special function					
			Phase select	Grade XING	Rule 17 Fw	Rule 17 Rev	Dimmer	LED mode
Dimmable headlight	1	0–31	1	2	4	8	16	128
Dimmable headlight (fade in/out)	2	0–31	1	2	4	8	16	128
Fire box	3	0 - 31	1	2			16	128
Intelligent fire box	4	0 - 31	1	2			16	128
Single Strobe	3	0–31	1	2	4	8	16	128
Double Strobe	4	0–31	1	2			16	128
Rotary Beacon	7	0–31	1	2			16	128
Strato Light	8	0–31	1	2			16	128
Ditch light Type 1	9	0–31	1	2			16	128
Ditch light Type 2	10	0–31	1	2			16	128
Flash light	12	0–31	1	2			16	128
Mars light	13	0–31	1	2			16	128
Gyra light	14	0–31	1	2			16	128
Coupler function	28	0 - 31	1	2			16	128

Figure 20: Light effects for function outputs and the according special functions

Function Button	Description	CV 32	Control CV	Physical function outputs								CV 32	Control CV	Logic functions 1								CV32	Control CV
				Headlight	Rearlight	AUX1	AUX2	(AUX3)	(AUX4)	(AUX5)	(AUX6)			ABV On/Off	Shunting mode	Dynamic brake	Reserved	Reserved	Reserved	Dimmer	Grade Crossing		
FS(f)	Stand forward	2	266	1	2	4	8	16	32	64	128	2	268	1	2	4	8	16	32	64	128	2	269
FS(r)	Stand backward	2	282	1	2	4	8	16	32	64	128	2	284	1	2	4	8	16	32	64	128	2	285
FF(f)	Drive forward	2	298	1	2	4	8	16	32	64	128	2	300	1	2	4	8	16	32	64	128	2	301
FF(r)	Drive backward	2	314	1	2	4	8	16	32	64	128	2	316	1	2	4	8	16	32	64	128	2	317
F0(f)	Light forward	2	330	1	2	4	8	16	32	64	128	2	332	1	2	4	8	16	32	64	128	2	333
F0(r)	Light backward	2	346	1	2	4	8	16	32	64	128	2	348	1	2	4	8	16	32	64	128	2	349
F1	Function key F1	2	362	1	2	4	8	16	32	64	128	2	364	1	2	4	8	16	32	64	128	2	365
F2	Function key F2	2	378	1	2	4	8	16	32	64	128	2	380	1	2	4	8	16	32	64	128	2	381
F3	Function key F3	2	394	1	2	4	8	16	32	64	128	2	396	1	2	4	8	16	32	64	128	2	397
F4	Function key F4	2	410	1	2	4	8	16	32	64	128	2	412	1	2	4	8	16	32	64	128	2	413
F5	Function key F5	2	426	1	2	4	8	16	32	64	128	2	428	1	2	4	8	16	32	64	128	2	429
F6	Function key F6	2	442	1	2	4	8	16	32	64	128	2	444	1	2	4	8	16	32	64	128	2	445
F7	Function key F7	2	458	1	2	4	8	16	32	64	128	2	460	1	2	4	8	16	32	64	128	2	461
F8	Function key F8	2	474	1	2	4	8	16	32	64	128	2	476	1	2	4	8	16	32	64	128	2	477
F9	Function key F9	2	490	1	2	4	8	16	32	64	128	2	492	1	2	4	8	16	32	64	128	2	493
F10	Function key F10	2	506	1	2	4	8	16	32	64	128	2	508	1	2	4	8	16	32	64	128	2	509
F11	Function key F11	3	266	1	2	4	8	16	32	64	128	3	268	1	2	4	8	16	32	64	128	3	269
F12	Function key F12	3	282	1	2	4	8	16	32	64	128	3	284	1	2	4	8	16	32	64	128	3	285
F13	Function key F13	3	298	1	2	4	8	16	32	64	128	3	300	1	2	4	8	16	32	64	128	3	301
F14	Function key F14	3	314	1	2	4	8	16	32	64	128	3	316	1	2	4	8	16	32	64	128	3	317
F15	Function key F15	3	330	1	2	4	8	16	32	64	128	3	332	1	2	4	8	16	32	64	128	3	333
F16	Function key F16	3	346	1	2	4	8	16	32	64	128	3	348	1	2	4	8	16	32	64	128	3	349
F17	Function key F17	3	362	1	2	4	8	16	32	64	128	3	364	1	2	4	8	16	32	64	128	3	365
F18	Function key F18	3	378	1	2	4	8	16	32	64	128	3	380	1	2	4	8	16	32	64	128	3	381
F19	Function key F19	3	394	1	2	4	8	16	32	64	128	3	396	1	2	4	8	16	32	64	128	3	397
F20	Function key F20	3	410	1	2	4	8	16	32	64	128	3	412	1	2	4	8	16	32	64	128	3	413
F21	Function key F21	3	426	1	2	4	8	16	32	64	128	3	428	1	2	4	8	16	32	64	128	3	429
F22	Function key F22	3	442	1	2	4	8	16	32	64	128	3	444	1	2	4	8	16	32	64	128	3	445
F23	Function key F23	3	458	1	2	4	8	16	32	64	128	3	460	1	2	4	8	16	32	64	128	3	461
F24	Function key F24	3	474	1	2	4	8	16	32	64	128	3	476	1	2	4	8	16	32	64	128	3	477
F25	Function key F25	3	490	1	2	4	8	16	32	64	128	3	492	1	2	4	8	16	32	64	128	3	493
F26	Function key F26	3	506	1	2	4	8	16	32	64	128	3	508	1	2	4	8	16	32	64	128	3	509

Logic functions 2 / Sound functions 1 / Sound functions 2 / Sound functions 3

Reserved	Reserved	Reserved	Reserved	Manual Diesel step	Doppler	Reserved	Shift Mode	CV32	Control CV	Sound on/off	Sound slot 2	Sound slot 3	Sound slot 4	Sound slot 5	Sound slot 6	Sound slot 7	Sound slot 8	CV32	Control CV	Sound slot 9	Sound slot 10	Sound slot 11	Sound slot 12	Sound slot 13	Sound slot 14	Sound slot 15	Sound slot 16	CV32	Control CV	Sound slot 17	Sound slot 18	Sound slot 19	Sound slot 20	Sound slot 21	Sound slot 22	Sound slot 23	Sound slot 24
1	2	4	8	16	32	64	128	2	270	1	2	4	8	16	32	64	128	2	271	1	2	4	8	16	32	64	128	2	272	1	2	4	8	16	32	64	128
1	2	4	8	16	32	64	128	2	286	1	2	4	8	16	32	64	128	2	287	1	2	4	8	16	32	64	128	2	288	1	2	4	8	16	32	64	128
1	2	4	8	16	32	64	128	2	302	1	2	4	8	16	32	64	128	2	303	1	2	4	8	16	32	64	128	2	304	1	2	4	8	16	32	64	128
1	2	4	8	16	32	64	128	2	318	1	2	4	8	16	32	64	128	2	319	1	2	4	8	16	32	64	128	2	320	1	2	4	8	16	32	64	128
1	2	4	8	16	32	64	128	2	334	1	2	4	8	16	32	64	128	2	335	1	2	4	8	16	32	64	128	2	336	1	2	4	8	16	32	64	128
1	2	4	8	16	32	64	128	2	350	1	2	4	8	16	32	64	128	2	351	1	2	4	8	16	32	64	128	2	352	1	2	4	8	16	32	64	128
1	2	4	8	16	32	64	128	2	366	1	2	4	8	16	32	64	128	2	367	1	2	4	8	16	32	64	128	2	368	1	2	4	8	16	32	64	128
1	2	4	8	16	32	64	128	2	382	1	2	4	8	16	32	64	128	2	383	1	2	4	8	16	32	64	128	2	384	1	2	4	8	16	32	64	128
1	2	4	8	16	32	64	128	2	398	1	2	4	8	16	32	64	128	2	399	1	2	4	8	16	32	64	128	2	400	1	2	4	8	16	32	64	128
1	2	4	8	16	32	64	128	2	414	1	2	4	8	16	32	64	128	2	415	1	2	4	8	16	32	64	128	2	416	1	2	4	8	16	32	64	128
1	2	4	8	16	32	64	128	2	430	1	2	4	8	16	32	64	128	2	431	1	2	4	8	16	32	64	128	2	432	1	2	4	8	16	32	64	128
1	2	4	8	16	32	64	128	2	446	1	2	4	8	16	32	64	128	2	447	1	2	4	8	16	32	64	128	2	448	1	2	4	8	16	32	64	128
1	2	4	8	16	32	64	128	2	462	1	2	4	8	16	32	64	128	2	463	1	2	4	8	16	32	64	128	2	464	1	2	4	8	16	32	64	128
1	2	4	8	16	32	64	128	2	478	1	2	4	8	16	32	64	128	2	479	1	2	4	8	16	32	64	128	2	480	1	2	4	8	16	32	64	128
1	2	4	8	16	32	64	128	2	494	1	2	4	8	16	32	64	128	2	495	1	2	4	8	16	32	64	128	2	496	1	2	4	8	16	32	64	128
1	2	4	8	16	32	64	128	2	510	1	2	4	8	16	32	64	128	2	511	1	2	4	8	16	32	64	128	2	512	1	2	4	8	16	32	64	128
1	2	4	8	16	32	64	128	3	270	1	2	4	8	16	32	64	128	3	271	1	2	4	8	16	32	64	128	3	272	1	2	4	8	16	32	64	128
1	2	4	8	16	32	64	128	3	286	1	2	4	8	16	32	64	128	3	287	1	2	4	8	16	32	64	128	3	288	1	2	4	8	16	32	64	128
1	2	4	8	16	32	64	128	3	302	1	2	4	8	16	32	64	128	3	303	1	2	4	8	16	32	64	128	3	304	1	2	4	8	16	32	64	128
1	2	4	8	16	32	64	128	3	318	1	2	4	8	16	32	64	128	3	319	1	2	4	8	16	32	64	128	3	320	1	2	4	8	16	32	64	128
1	2	4	8	16	32	64	128	3	334	1	2	4	8	16	32	64	128	3	335	1	2	4	8	16	32	64	128	3	336	1	2	4	8	16	32	64	128
1	2	4	8	16	32	64	128	3	350	1	2	4	8	16	32	64	128	3	351	1	2	4	8	16	32	64	128	3	352	1	2	4	8	16	32	64	128
1	2	4	8	16	32	64	128	3	366	1	2	4	8	16	32	64	128	3	367	1	2	4	8	16	32	64	128	3	368	1	2	4	8	16	32	64	128
1	2	4	8	16	32	64	128	3	382	1	2	4	8	16	32	64	128	3	383	1	2	4	8	16	32	64	128	3	384	1	2	4	8	16	32	64	128
1	2	4	8	16	32	64	128	3	398	1	2	4	8	16	32	64	128	3	399	1	2	4	8	16	32	64	128	3	400	1	2	4	8	16	32	64	128
1	2	4	8	16	32	64	128	3	414	1	2	4	8	16	32	64	128	3	415	1	2	4	8	16	32	64	128	3	416	1	2	4	8	16	32	64	128
1	2	4	8	16	32	64	128	3	430	1	2	4	8	16	32	64	128	3	431	1	2	4	8	16	32	64	128	3	432	1	2	4	8	16	32	64	128
1	2	4	8	16	32	64	128	3	446	1	2	4	8	16	32	64	128	3	447	1	2	4	8	16	32	64	128	3	448	1	2	4	8	16	32	64	128
1	2	4	8	16	32	64	128	3	462	1	2	4	8	16	32	64	128	3	463	1	2	4	8	16	32	64	128	3	464	1	2	4	8	16	32	64	128
1	2	4	8	16	32	64	128	3	478	1	2	4	8	16	32	64	128	3	479	1	2	4	8	16	32	64	128	3	480	1	2	4	8	16	32	64	128
1	2	4	8	16	32	64	128	3	494	1	2	4	8	16	32	64	128	3	495	1	2	4	8	16	32	64	128	3	496	1	2	4	8	16	32	64	128
1	2	4	8	16	32	64	128	3	510	1	2	4	8	16	32	64	128	3	511	1	2	4	8	16	32	64	128	3	512	1	2	4	8	16	32	64	128

In order to set each output, you should proceed as follows:

1. From the chart fig. 20 on the previous page, select the value for the Mode Select CV.
2. Compute the value for the Special Function CV by adding the values you can find in the chart figure 20 below the corresponding special function.
3. Define the value for the desired brightness.
4. Write the values into the CV corresponding to the appropriate function output.

Repeat these steps for all 6 function outputs you want to configure.

Example: Double Strobe with LEDs on AUX4.
We want to set up AUX4 to create a Double strobe output. We want to use an LED.

1. Using figure 20, we find that the Mode Selection CV must be set to 5.
2. We find out that for LED compensation mode, we should set the Special function CV to 128.
3. We want to have a brightness level of 25.
4. Using the table on the left side, we find that the Mode Select CV for AUX4 is 299. We set CV 299 = 5. We also find that the brightness CV is 302 and set it to 25. Finally, the Special function CV for AUX4 is 303 and needs to be set to 128.

12.3.3. Grade Crossing holding time

You can define the for time the global grade crossing function as you like. By doing so, the "Grade Crossing" will remain active, also after switching off the function key. This will create a very interesting game effect. The desired value will be stored in CV 132. The value of CV 132 multiplied with 0.065 seconds defines the time. The default value 80 results in 5.2 seconds.

12.3.4. Flash Rate

You can also set the flash rate for all lighting effects globally. All effects will flash or strobe at the same rate. The desired value should be stored in CV 112. The value of CV 112 multiplied with 0.065536 seconds (65,536ms) defines the flash rate. The default value 30 results in 1.97 seconds.

12.3.5. Automatic Switch-off

Each output usually switches off when the corresponding key is deactivated. However, sometimes the output has to be "forced" to switch off after a certain period of time to aviod damages.

Digital couplers by ROCO® e.g. cannot handle permanent control. Via the automatic switch-off function you are able to determine for every output when it should be switched off automatically - no matter if the function key is still activated.

Just write the time, after which the output should be switched off, into the corresponding CV according to the above-mentioned table on page 45. The unit is 0.4 seconds. The default value „0" deactivates this function.

12.3.6. Digital Couplers

LokSound V4.0		
LokSound micro V4.0		

Some LokSound decoders can directly control digital couplers. Subject to the type of coupler, you must adjust certain settings.

12.3.6.1. „Coupler" Mode

Krois® and ROCO® couplers need a special high frequency PWM signal to avoid burning the copper windings of the coil. This special function „Coupler" provides this type of signal. In this mode, the output switches on at 100% for 250 ms and then reduces the output power by switching to the PWM-signal. The ratio between Off and On time can be set by adjusting the „Brightness Value" from 0 (completely off) to 31 (connected through = 100% output).

This coupler mode should also be used for modern Telex®-couplers.

12.3.6.2. Automatic Coupler Function (Removing/Pushing)

The LokSound V4.0 decoder is able to do the automatic decoupling. When you push the function button the loco drives backwards against the train and then removes from it again. This procedure can be influenced via three CVs.

In CV246 the speed that moves the loco will be stored (or defined) (0-255). If this value is 0, the automatic coupler function is not active.
In CV247 the time of removing is to be entered.
In CV248 the time of pushing is to be entered.

The time of removing should be higher than the time of pushing to make sure that the loco stops in a safe distance away from the train.

⚠️ The function output of the options „pulse" or „coupler" needs to be configured correctly to make the automatic decoupling work.

12.4. Analogue Settings

LokSound V4.0		
LokSound micro V4.0		

With the CVs 13 and 14, you can predetermine which function buttons should be switched in analogue mode. Thus, you „simulate" pressing an F button. The ex works default settings switch on the directional headlights (F0 is on!) as well as F1 (ex works allocated to AUX1).

Analog Function Control 1							
CV #	F1	F2	F3	F4	F5	F6	F7	F8
13	1	2	4	8	16	32	64	128

Analog Function Control 2							
CV #	F0(f)	F0(r)	F9	F10	F11	F12		
14	1	2	4	8	16	32		

12.5. LGB® Pulse Sequence Mode

LokSound V4.0		
LokSound micro V4.0	

It is possible to switch to pulse sequence mode for operations with the LGB® command station and the Roco® Lokmaus I. To do so, set bit 5 in CV 49. From now on decoder counts the number of times the F1 button is pressed in order to activate the desired function. Thus, it is possible to reach all function buttons by repeated pushing of the F1 button.

12.6. Swiss Headlight Mode

LokSound V4.0		

Function mapping enables you to set many different configurations. The Swiss headlight mode is a good example. We need a


Figure 22: Swiss headlight mode
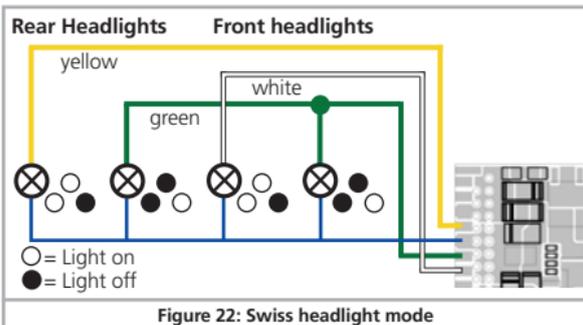
third lighting circuit that switches the left lower headlight of the „A"- headlight configuration whenever the lights are turned on. This third circuit must work independently form the direction of travel.

Figure 22 shows one option of how to wire this arrangement with AUX1 (green wire) being used for the third circuit. All you have to do now is to program the decoder in such a way that it always switches on that third circuit when the lighting function is active.

In order to do so enter value 5 in CV 330 and value 6 in CV 346. (Don´t forget to firstly set the index register CV 31 to value 16 and CV 32 to value 2!). That´s it!.

13. Adjusting the Sound Effects

The LokSound V4.0 allows you to adjust the sound in a way that suit your preferences for your locomotives. You are able to change the volume of each sound individually, influence the frequency of random sounds or even use an extern wheel sensor. Allow yourself some time to adjust your modell perfectly!

13.1. Adjust the sound volume

The LokSound V4.0 allows the individual volume control of each sound. Every sound has its own CV.

13.1.1. Adjusting the master volume

Function	Sound slot	CV	Range	Factory default
Master volume		63	0 – 192	180

The master volume control controls all sound effects. A value of „0" would mute the decoder completely. The resulting sound volume for each individual sound effect therefore is a mixture of the master volume control settings and the individual volume control sliders.

13.1.2. Single sounds tables

All single sounds are subdivied in so-called sound slots. Each sound slot controls a certain sound and its volume can be individually adjusted. The following charts show how the CVs are allocated to each sound slot.

Please note that all the single sound projects are likely to have a different sound allocation. Thus you will find notes about the corresponding functions keys and soundslots to all sound projects available in the download area of our website. This information will help you to find the appropriate CV volume very easily.

Adjusting the Sound Effects

Steam sound table

Function	Sound slot	CV	Range	Default
Sound on/off	1	259	0 – 128	99
Sound on/off	2	267	0 – 128	99
Whistle (playable)	3	275	0 – 128	128
Bell	4	283	0 – 128	128
Coal shovelling / Oil burner (AUX2 Firebox)	5	291	0 – 128	128
Air pump	6	299	0 – 128	128
Station announcement #1	7	307	0 – 128	128
Coupler sound	8	315	0 – 128	128
Cylinder blow	9	323	0 – 128	128
Conductor whistle	10	331	0 – 128	128
Sanding valve	11	339	0 – 128	128
Safety valve	12	347	0 – 128	128
Brake Set / Brake Release (automatic)	13	355	0 – 128	128
Drain valve	14	363	0 – 128	128
Curve squeal	15	371	0 – 128	128
Short whistle	16	379	0 – 128	128
Rail joints	17	387	0 – 128	128
Rail joints	18	395	0 – 128	128
	19	403	0 – 128	128
	20	411	0 – 128	128
	21	419	0 – 128	128
	22	427	0 – 128	128
	23	435	0 – 128	128
Boiler noise	24	443	0 – 128	128

Diesel sound table

Function	Sound slot	CV	Range	Default
Sound on/off	1	259	0 – 128	99
Sound on/off	2	267	0 – 128	99
Signal horn #1 (playable)	3	275	0 – 128	128
Signal horn #2 or bell	4	283	0 – 128	128
Fan motor (AUX 2)	5	291	0 – 128	128
Compressor	6	299	0 – 128	128
Station announcement #1	7	307	0 – 128	128
Coupler sound	8	315	0 – 128	128
Air outlet valve (Line free)	9	323	0 – 128	128
Conductor whistle	10	331	0 – 128	128
Sanding valve	11	339	0 – 128	128
Close/Open doors	12	347	0 – 128	128
Brake Set / Brake Release (automatic)	13	355	0 – 128	128
Station announcement #2	14	363	0 – 128	128
Curve squeal	15	371	0 – 128	128
Short whistle	16	379	0 – 128	128
Rail joints	17	387	0 – 128	128
Rail joints	18	395	0 – 128	128
	19	403	0 – 128	128
	20	411	0 – 128	128
	21	419	0 – 128	128
	22	427	0 – 128	128
	23	435	0 – 128	128
	24	443	0 – 128	128

Electric sound table

Function	Sound slot	CV	Range	Default
Sound on/off	1	259	0 – 128	99
Sound on/off	2	267	0 – 128	99
Signal horn #1 (playable)	3	275	0 – 128	128
Signal horn #2 or bell	4	283	0 – 128	128
Fan motor (AUX 2)	5	291	0 – 128	128
Compressor	6	299	0 – 128	128
Station announcement #1	7	307	0 – 128	128
Coupler sound	8	315	0 – 128	128
Air outlet valve (Line free)	9	323	0 – 128	128
Conductor whistle	10	331	0 – 128	128
Sanding valve	11	339	0 – 128	128
Close/Open doors	12	347	0 – 128	128
Brake Set / Brake Release (automatic)	13	355	0 – 128	128
Station announcement #2	14	363	0 – 128	128
Curve squeal	15	371	0 – 128	128
Short whistle	16	379	0 – 128	128
Rail joints	17	387	0 – 128	128
Rail joints	18	395	0 – 128	128
	19	403	0 – 128	128
	20	411	0 – 128	128
	21	419	0 – 128	128
	22	427	0 – 128	128
	23	435	0 – 128	128
	24	443	0 – 128	128

Special sound table

Function	Sound slot	CV	Range	Default
Random sounds	-	451	0 – 128	128
Brake sound	-	459	0 – 128	128
Camshaft contactors (for electric locos)		467	0 – 128	128

Before you change any of the volume control CVs, please make sure that the CV 32 is set to 1! As explained earlier, CV 32 is used as an index selection register to distinguish between the real function of CV 257 – 512.

When you adjust the volume levels, please keep in mind that you should not exceed the maximum mixer levels to avoid a condition called "clipping" which occurs when the sum of two or more signals exceeds the capacity of the output channel.

Clipping can be identified by clicking or popping sounds. To avoid this situation, consider which sounds are likely to be played at the same time and take care that their corresponding volume levels are not set too high.

13.2. Prime mover startup delay

Usually, when the LokSound V4.0 sound is idling and you turn up the throttle, the locomotives begins to move only after the Diesel engine has reached notch 1. A steam loco will even release its brakes first and fill the cylinders. Although this behavior is very prototypically, one might not like it because it causes some delay.

You can disable this startup delay by simply deleting bit 3 of CV 124. This will cause the LokSound V4.0 decoder to immediately start moving when the throttle is turned up. However, the start up sound will not be synchon with the motion anymore.

13.3. Manual notching (Diesel locomotives only)

Usually, the LokSound V4.0 decoder automatically selects the diesel speed notch appropriate for the desired speed. However, in some cases where the train has to pull heavy loads, you may want to "shift gears" manually to get higher overall engine RPM.

The LokSound V4.0 offers a feature we call "Manual notching". However, this feature does not mean that you have to manually adjust all speed steps every time. This would cause a lot of user action.

Instead, if you enable the function key in some of the LokSound sound projects, the decoder will automatically increase an "offset" to the current diesel notch. This offset will automatically increase as you crank up the throttle resulting in a general higher engine RPM. This will result in a much easier operation while maintaining the possibility to increase the diesel RPM when needed (e.g. hill starts).

Manual notching works only while the train is moving. While idling, the function key has no influence on the diesel notch.

You can define how many notches will be increased after pressing the function key. The value is set in CV 131. It can comprise a value between 0 and 255. The default value of 50 results in an increase of 2 diesel notches. The higher the value stored in CV 131, the more diesel notches will be increased.

13.4. Synchronising the steam chuff (Steam locomotives only)

To synchronise the steam chuff with the wheel revolutions, you may use an external cam as described in chapter 6.9. However, most users prefer not do such massive changes on their valuable locomotives and prefer to use the automatic exhaust mode of the LokSound V4.0 decoder. Because of the excellent Back-EMF function, the synchronisation will be satisfying most users.

To enable this function (and disable any external cam at the same time), CV 57 and CV 58 are used. All you need is a stop-watch and a little time. It pays to spend some time in order to achive an optimal result. Please make sure that the load control is perfectly adjusted to your loco and set the maximum / mimimum speed according to your wishes. After doing so, you should start to synchronise the steam chuff.

In CV 57, the distance between two steam chuffs at the lowest possible speed (at speed step 1) is defined. The unit of CV 57 is a multiple of 32 ms (Milliseconds). In CV 58, you need to give the LokSound V.40 some information about the gearing of your engine.

Please proceed as follows:

1. Put the engine onto the track and drive it with speed step 1 and switch the sound on.
2. Using the stop-watch, measure the time in seconds it takes the driver to complete one turn at this speed.
3. Divide the time by 0.128 (assuming you are using a 2 cylinder or 4-cylinder locomotive)
4. Enter a rounded value without decimal point in CV 57. We recommend to use POM to be able to observe the result immediately.
5. Observe the locomotive and check if now 4 steam chuffs will be reproduced per revolution. If needed, adjust the value of CV 57 gradually by increasing or decreasing the value one by one.
6. If you are satisfied, increase the speed of your locomotive to speed step 4 (of 28).
7. Try to observe, if still four steam chuffs per revolution can be heard. If you find that there are too many steam chuffs, increase the value of CV 58 (defaults to 43). If they are too slow,

decrease the value of CV 58. This procedure will oaken the gear factor of the LokSound V4.0 decoder.

13.4.1. Minimum distance of steam chuffs

Quite small driving wheel diameters are likely to make the steam chuffs sound very good at small and medium speeds; however during high speed it sounds strangely distorted and ticked off. This has often to do with an excessive terminal speed that isn´t prototypical at all. The minimum distance, which two steam chuffs need to have, can be set with the help of CV 249T to reach a satisfactory sound. A unit of 1 ms allows a quite exact adjustment.

If you are still not satisfied with the sound during high speed, you should increase CV 249 gradually while the sound is switched on, until the sound gets more natural since the steam chuffs are set further apart.

13.5. Random sounds

LokSound decoders offer some random sounds, such as air compressor, air outlet valve, coal shovelling or similar sounds, which makes the scene more realistic. This sound will be played-back in random intervals. You can adjust the "rate" for these sounds.

In CV 61, you need to set the minimum delay between two random sounds. The unit is 0.25 seconds. The default value of 75 results in 18.75 seconds.

In CV 62, you can set the maximum delay between two random sounds. At the end of the programmed time, another random sound will be played. The unit is 0.25 seconds. The default value of 200 results in 50 seconds.

If you don't like random sounds, simply set CV 61 = 0 and CV 62 = 0 to disable this feature.

13.6. Adjusting the braking sound threshold

The LokSound decoder is able to play a wheel-synchron brake sound. To play a brake sound, Damit das Bremsgeräusch abgespielt wird, there are several conditions necessary:

• The braking time in CV 4 is set sufficiently high (at least value 20 or higher).
• The loco drives with high speed at the time of the braking command.
• The loco receives the driving command "Speed step 0".

The LokSound decoder will now start to play the braking sound at the time determined in CV 65. The higher the value in CV 64 is, the sooner the braking sound will be played. The default value 100 is approximately equivalent to speed step 48 of128.

The braking sound should and when the loco stopps. You are able to do some "finetuning" with CV 65, if the loco stopps too early.

14. Decoder Reset

You can reset decoder to the default settings at any time.

14.1. With DCC Systems or 6020/6021

Enter the value 08 in CV 08.

14.2. With Märklin® systems (mfx® decoders)

Mfx® decoders can be reset to factory default values with the Central Station® or the Mobile Station® via the reset command in the locomotive menu.

14.3. With the ESU LokProgrammer

(From software 2.7.3.): In the menu „Programmer", select option „Reset decoder" and follow the instructions on the screen.

15. Special Functions

You may not yet be aware of some other highly specialised functions offered by LokSound decoders.

15.1. Directional Bit

The directional bit determines the driving behaviour when transiting from an analogue into a digital sector (also refer to chapter 10.4.3.). If you want to set this directional bit, then bit 0 in CV 124 must be set.

16. RailCom®

LokSound V4.0		
LokSound micro V4.0		

RailCom® was developed by Lenz® Elektronik, Giessen, Germany, and is a technology for transmitting information from the decoder back to the command station. Until now DCC systems could only transmit data from the command station to the decoder but could never be sure if the decoder actually received the commands.

The locomotive can send the following information to the command station:

Locomotive address: The decoder transmits its address on request by „Broadcast". Detectors in a certain track sector can detect this command. Thus, the command station can find out the location of that particular locomotive.

CV information: The decoder can provide feedback about all CV values to the command station per RailCom®. In future, a programming track will not be necessary any more.

Meta data: The decoder can transmit status information such as motor load, current draw of the motor, temperature etc. to the command station.

In order for RailCom® to work all decoders and the command station must be equipped accordingly. LokSound decoders are RailCom®-ready in terms of their hardware. However, it may be necessary to carry out a firmware update in order to activate it.

Prior to use RailCom® must be unlocked by setting bit 3 in CV 29. CV 28 offers further options. Ex works, RailCom® is active in ESU LokSound V4.0 decoders.

16.1. RailCom® Plus

LokSound V4.0 decoders support RailComPlus®, an absolute world novelty developed by Lenz® in collaboration with ESU.

Decoders equipped with RailComPlus® will be automatically recognised by a RailComPlus®-compatible command station.You will never ever have to change the locomotive address of a new locomotive by hand! Just put the locomotive on the tracks and it will be recognised automatically.

Also the Besides the name of the locomotive, the functional key symbols as well as the kind of the functions (long-term function and moment function) will be transferred. And all that happens within less seconds, you don´t have to wait anymore.

16.1.1. Prerequisites for RailCom® Plus

RailComPlus® implies an accordingly equipped digital command station. The ESU ECoS command station supports RailComPlus®-capable decoders from software 3.4. You don´t need to change anything about the decoder settings. It will be automatically recognised.

Of course you can change the locomotive name, all functional key and locomotive symbols and after that write it back on your decoder. This happens automatically in the background.

If you do not wish to have the automatic recognition, you can switch it off by deleting CV 28, bit 7.

17. Firmware Update

You can update LokSound decoders with new operating software (so-called firmware) at any time. This is useful for fixing bugs and implementing new functions.

You can carry out the update yourself for free without having to remove the decoder from the locomotive. All you need is the ESU LokProgrammer. The software of the LokProgrammer will keep your LokSound decoder up-to-date. A seperate download is therefore not necessary.

Updates which are carried out by our service department will not be treated as a case of warranty. Therefore we will charge you for this service.

18. Accessories

You will get detailed information regarding accessories at your dealer or on our homepage.

18.1. Switching the Centre pick-up

The circuit board 51966 for switching the centre pick-up only for the decoder with the 21MTC interface is intended for vehicles with two pick-ups. Thus, you can activate the forward pick-up in the direction of movement. This is ideal for block control!

18.2. HAMO Magnets

One cannot drive the universal motors in many Märklin® models directly with a LokSound decoder. Firstly, you must replace the stator coil with a permanent magnet. ESU supplies the following magnets:

51960	Permanent magnet as 220560, for rotor 217450, D=24.5mm, for motor plate 216730, 211990, 228500
51961	Permanent magnet as 220450, for rotor 200680, D=18.0mm, for motor plate 204900
51962	Permanent magnet as 235690, for rotor 231440, D=19.1mm, for motor plate 231350

18.3. Wire Harnesses with 8-pole or 6-pole Socket

If the locomotive you want to convert does not have an interface and you do not want to remove the plug from the decoder then you can use the harness 51950 or 51951: First install the suitable harness and then plug in the decoder.

18.4. Mounting Adapter 21MTC

If you wish to convert a locomotive with a LokSound decoder with the 21MTC interface, the adapter plate 51967 comes in handy: it has a socket for plugging in the LokSound but also has solder points for connecting the original wiring of the locomotive. This is ideal for converting Märklin® locomotives.

With article no. 51968 we offer an adapter board which amplifies both the outputs AUX3 and AUX4 through a transistor and are therefore accessable. Ideal for complex conversions!

19. Support and Assistance

Your model train dealer or hobby shop is your competent partner for all questions regarding your LokSound decoder. In fact he is your competent partner for all questions around model trains.

There are many ways to get in touch with us. For enquiries please use either email, fax (please provide your fax-no. or email address) or go to **www.esu.eu/en/forum** 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. Rather send an email or fax and also check our website for more information. You will find many hints under "Support / FAQ" and even feedback from other users that may help you with your particular question.

Of course we will always assist you; please contact us at:

USA & Canada (English support), please contact:

Phone:	+1 (570) 649-5048
	Tuesday & Thursday 9:00am - 3:00pm (CT)
Fax:	+1 (866) 591-6440
Email:	support@loksound.com
Mail:	ESU LLC
	477 Knopp Drive
	US-PA-17756 Muncy

Germany and all other countries, please contact:

Fax:	++49 (0) 731 - 1 84 78 - 299
Email:	www.esu.eu/en/forum
Mail:	ESU GmbH & Co. KG
	- Technical support -
	Edisonallee 29
	D-89231 Neu-Ulm

www.esu.eu

	LokSound V4.0	LokSound micro V4.0
Operation Voltage	5 – 40V	5 – 21V
DCC operation using 14/28/128 Fahrstufen, 2-digit and 4-digit addresses; automatic recognition of operational mode	Ok	Ok
Digital Motorola®, with 14/28 speed steps, address range for Motorola®-mode	Ok 255	Ok 255
M4-operation with automatic recognition	-	-
Selectrix® operation	Ok	Ok
Analog DC Operation	Ok	Ok
Analog AC Operation	Ok	-
DCC programming	Ok	Ok
Motorola®-Programming mode using 6021, Mobile Station or Central Station possible	Ok	Ok
Mfx® programming procedure	-	-
Märklin® brake section	Ok	Ok
Brake on DC, Roco® brake section	Ok	Ok
Selectrix® brake mode (with diodes)	Ok	Ok
Lenz® ABC brake mode	Ok	Ok
Shunting mode/Starting - braking times switchable	Ok	Ok
RailCom® Plus	Ok	Ok
Continuous motor load	1,1A	0,75A
5th generation back-EMF control, overload protected	20/40 kHz	20/40 kHz
Function outputs	4/250 mA	2/150mA
Total load of all function outputs	280mA	280mA
Logic outputs Bus systems	2 Logic outputs as well as serial train bus (21MTC), „Susi" interface for C-Sinus motor control	2 Logic outputs as well as serial train bus (with Next18 interface)
Supported function keys	F0 – F28	F0-F28
Integrated PowerPack backup capacitor	-	-
Integrated PowerPack backup capacitor	Ok	Ok
Audio part	8 sound channels, priority-controlled, 12 Bit dynamic range, 32 MBit flash memory, high-performance audio amplifier «class D», 3W power modes für steam, Diesel, electric sounds	8 sound channels, priority-controlled, 12 Bit dynamic range, 32 MBit flash memory, high-performance audio amplifier «class D», 3W power modes für steam, Diesel, electric sounds
Dimensions in mm:	30.3x15.5x5.5	25.3x10.6x3.8

21. List of all supported CVs

21.1. LokSound decoders

On the following pages, we have listed all CVs of LokSound decoders in a chart. Please refer to the CV concept as outlined in chapter 5.1. Please only change CVs if you are certain about their purpose and the impact of your action. Wrong CV settings can lead to impaired performance or may cause your LokSound not to respond at all.

CV	Name	Description	Range	Value
1	Loco address	Address of engine (For LokSound V4.0: Range 1 - 255)	1 - 127	3
2	Start voltage	Sets the minimum speed of the engine	1 - 255	3
3	Acceleration	This value multiplied by 0.25 is the time from stop to maximum speed	0 - 255	32
4	Deceleration	This value multiplied by 0.25 is the time from maximum speed to stop	0 - 255	24
5	Maximum speed	Maximum speed of the engine	0 - 64	64
6	Medium speed	Medium speed of engine	0 - 64	22
7	Version number	Internal software version of decoder	-	-
8	Manufacturer's ID	Manufacturers's ID ESU - Writing value 8 in this CV triggers a reset to factory default values	151	-
13	Analogue mode F1-F8	Status of functions F1 to F8 in analogue mode (see chapter 12.4)	0-255	1
14	Analogue mode FL, F9-F12	Status of function F0, F9 to F12 in analogue mode (see chapter 12.4)	0-63	3
17 18	Extended engine address	Long address of engine (see chapter 9.2)	128 - 9999	192
19	Consist Address	Additional address for consist operation. Value 0 or 128 means: consist address is disabled 1 – 127 consist address active, normal direction 129 – 255 consist address active reverse direction	0-255	0
21	Consist mode F1-F8	Status of functions F1 to F8 in Consist mode Meaning of the bits as in CV 13 (see chapter 12.4)	0-255	0
22	Consist Mode FL, F9-F12	Status of functions FL, F9 to F12 in Consist mode Meaning of the bits as in CV 14 (see chapter 12.4)	0-63	0

CV	Name	Description			Range	Value
27	Brake mode	Allowed brake modes				28
		Bit	Function	Value		
		0	ABC braking, voltage higher on the right hand side	1		
		1	ABC braking, voltage higher on the left hand side	2		
		2	ZIMO® HLU brakes active	4		
		3	Brake on DC, if polarity against driving direction	8		
		4	Brake on DC, wenn Polarität gleich wie Fahrtrichtung	16		
28	RailCom® Configuration	Settings for RailCom®				131
		Bit	Function	Value		
		0	Channel 1 Address broadcast enabled	1		
		1	Data transmission allowed on Channel 2	2		
		7	RailCom® Plus automatic loco recognition active	128		
29	Configuration register	The most complex CV within the DCC standards. This register contains important information, some of which are only relevant for DCC operation.				12
		Bit	Function	Value		
		0	Normal direction of travel Reversed direction of travel	0 1		
		1	14 speed steps DCC 28 or 128 speed steps DCC	0 2		
		2	Disable analog operation Enable analog operation	0 4		
		3	Disable RailCom® Enable RailCom®	0 8		
		4	Speed curve through CV 2, 5, 6 Speed curve through CV 67 - 94	0 16		
		5	Short addresses (CV 1) in DCC mode Long addresses (CV 17 + 18) in DCC mode	0 32		
31	Index register H	Selection page for CV257-512			16	16
32	Index register L	Selection page for CV257-512			0,1,2,3	0

CV	Name	Description			Range	Value
49	Extended Configuration #1	Additional important settings for LokSound Decoders			0 - 255	19
		Bit	**Description**	**Value**		
		0	Enable Load control (Back-EMF) Disable Load control (Back-EMF)	1 0		
		1	DC Motor PWM frequency 20kHz motor pulse frequency 40 kHz motor pulse frequency	 0 2		
		2	Märklin® Delta Mode Disable Märklin® Delta Mode Enable Märklin® Delta Mode	 0 4		
		3	Märklin® 2nd address Disable Märklin® 2nd address Enable Märklin® 2nd address	 0 8		
		4	Automatic DCC speed step detection Disable DCC speed step detection Enable DCC speed step detection	 0 16		
		5	LGB® function button mode Disable LGB® function button mode Enable LGB® function button mode	 0 32		
		6	Zimo® Manual Function Disable Zimo® Manual Function Enable Zimo® Manual Function	 0 64		
		7	Reserved	0 128		
50	Analogue mode	Selection of allowed analogue modes			0 - 3	3
		Bit	**Description**	**Value**		
		0	AC Analogue Mode (if implemented, refer to section 7.3.) Disable AC Analog Mode Enable AC Analog Mode	 0 1		
		1	DC Analogue mode Disable DC Analogue mode Enable DC Analogue Mode	 0 2		

CV	Name	Description	Range	Value
52	Load control parameter «K» for slow driving	„K"-component of the internal PI-controller for the low speed steps. Defines the effect of load control. The higher the value, the stronger the effect of Back EMF control.	0 - 255	32
53	Control Reference voltage	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 - 255	140
54	Load control parameter „K"	„K"-component of the internal PI-controller. Defines the effect of load control. The higher the value, the stronger the effect of Back EMF control.	0 - 255	48
55	Load control parameter „I"	„I"-component of the internal PI-controller. Defines the momentum (inertia) of the motor. The higher the momentum of the motor (large flywheel or bigger motor diameter, the lower this value has to be set	0 - 255	32
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 - 255	255
57	Steam chuff synchronisation #1	Defines the steam chuff synchronisation. See chapter 12.4.	1 - 255	0
58	Steam chuff synchronisation #2	Defines the steam chuff synchronisation. See chapter 12.4.	1 - 255	0
59	Driving sound «min»	Divided by 128 this will yield the value for reproducing the sound at the slowest speed step. Values < 128 are slower, values > 128 are faster than original speed. Meant for «Pitch-Shifting».	1 - 255	128
60	Driving sound «max»	Divided by 128 this will yield the value for reproducing the sound at the fastest speed step. Values < 128 are slower, values > 128 are faster than original speed. Meant for «Pitch-Shifting».	1 - 255	128
61	Random sound «min»	Multiplied by 0.25 it is the time in seconds for the shortest random sound interval. Find more information in chapter 13.5.	0 - 255	120
62	Random sound «max»	Multiplied by 0.25 it is the time in seconds for the longest random sound interval. Find more information in chapter 13.5.	0 - 255	200
63	Sound volume «Master»	Master volume for all sounds.	0 - 192	192
64	Brake sound threshold «Brake On»	If the actual loco speed step is smaller than or equals the value indicated here, the brake sound is triggered. Compare chapter 13.6.	0 - 255	100

CV	Name	Description			Range	Value
65	Brake sound threshold «Brake Off»	If the actual loco speed step is smaller than the one indicated here (up to 255) , the brake sound will be switched off again. Compare chapter 13.6.			0 - 255	25
66	Forward Trimm	Divided by 128 is the factor used to multiply the motor voltage when driving forward. The value 0 deactivates the trim.			0 - 255	128
67-94	Speed table	Defines motor voltage for speed steps. The values „in between" will be interpolated.			0 - 255	-
95	Reverse Trimm	Divided by 128 is the factor used to multiply the motor voltage when driving backwards. Value 0 deactivates the trim.			0 - 255	128
112	Blinking light	Blinking frequency of Strobe effects. Always a multiple of 0.065536 seconds.			4 - 64	30
105	User CV #1	Free CV. Here you are able to save what ever you want.			0 - 255	0
106	User CV #2	Free CV. Here you are able to save what ever you want.			0 - 255	0
113	Power Fail Bypass	The time that the decoder bridges via the PowerPack after an interruption of voltage. Unit: A multiple of 0.016384 sec.			0 - 255	50
124	Extended Configuration #2	Additional important settings for decoders			-	24
		Bit	**Description**	**Value**		
		0	Bi-directional bit: Enable driving direction when shifting direction	1		
			Disable driving direction	0		
		1	Disable decoder lock with CV 15 / 16	0		
			Enable decoder lock with CV 15 / 16	2		
		2	Disable prime mover startup delay	0		
			Enable prime mover startup delay	4		
		3	Disable serial protocol for C-Sinus	0		
			Enable serial protocol for C-Sinus	8		
		4	Adaptive regulation frequency	0		
			Constant regulation frequency	16		
125	Starting voltage Analog DC				0-255	30
126	Maximum speed Analog DC				0-255	130
127	Starting voltage AC	(not for LokSound micro V4.0)			0-255	50
128	Maximum speed Analog AC	(not for LokSound micro V4.0)			0-255	150

CV	Name	Description	Range	Value
131	Manual Notching «Offset»	The value determines the number of speed steps to which the motor revolution will be increased («notch up»). See chapter	0 - 255	50
132	Grade Crossing Hold Time	Grade Crossing holding time. See chapter 12.3.3		
246	Automatic decoupling Driving speed	Speed of the loco while decoupling; the higher the value, the faster the loco. Value 0 switches the automatic coupler off. Automatic decoupling is only active if the function output is adjusted to „pulse" or „coupler".	0 - 255	0
247	Decoupling - Removing time	This value multiplied with 0.016 defines the time the loco needs for moving away from the train (automatic decoupling).	0 – 255	0
248	Decoupling - Pushing time	This value multiplied with 0.016 defines the time the loco needs for pushing against the train (automatic decoupling).	0 – 255	0
249	Minimum steam chuff distance	Minimum distance of two steam chuffs, independant from sensor data. Compage chapter13.4.1.	0 - 255	0
253	Constant brake mode	Determines the constant brake mode. Only active, if CV254 >0	0 – 255	0
		Function		
		CV 253 = 0: Decoder stops linearly CV 253 > 0: Decoder stops constantly linear		
254	Constant stopping distance	A value > 0 determines the way of brake distance it adheres to, independent from speed.	0 – 255	0

(no content for the present)

22. Appendix

22.1. Programming Long Addresses

As described in chapter 9.2. the long address is split into two CVs. The byte with the higher value of the address is in CV 17. This byte determines the range in which the extended address will be located. For instance, if you enter the value 192 in CV 17 then the extended address may be between 0 and 255. If 193 is written into CV 17 then the extended address will be between 256 and 511. You can continue this up to addresses with values of 9984 and 10239. The possible values are shown in figure 23.

22.1.1. Write address

To programm a long address you first of all need to calculate the values for CV 17 and CV 18 and then programm it. Please note that it is not possible to programm addresses via the programming mode "POM".

To programm the long address proceed as follows:
• First you determine the desired address, for instance 4007.
• Then you look for the appropriate address range in Fig. 23. The value to be entered into CV 17 can be found in the column on the right. In our example, it is 207.

The value for CV 18 is established as follows:

	desired address	4007
minus	first address in the address range -	3840
	================================	====
equals	value for CV 18	167

• 167 is therefore the value to be entered in CV 18. Thus you decoder is now programmed to address 4007.

22.1.2. Read out addess

If you wish to read out a loco address please read the values of CV 17 and CV 18 one after another and proceed then in reverse order:

Let's assume you have read:

CV 17 = 196; CV 18 = 147. Look up the corresponding address range in Fig. 23. The first possible address within this range is 1024. Then you have to add the value from CV 18 and you arrive at the locomotive address:

	1024
+	147
	====
=	1171

Address range			Address range			Address range		
from	bis	CV17	from	to	CV17	from	to	CV17
0	255	192	3584	3839	206	7168	7423	220
256	511	193	3840	4095	207	7424	7679	221
512	767	194	4096	4351	208	7680	7935	222
768	1023	195	4352	4607	209	7936	8191	223
1024	1279	196	4608	4863	210	8192	8447	224
1280	1535	197	4864	5119	211	8448	8703	225
1536	1791	198	5120	5375	212	8704	8959	226
1792	2047	199	5376	5631	213	8960	9215	227
2048	2303	200	5632	5887	214	9216	9471	228
2304	2559	201	5888	6143	215	9472	9727	229
2560	2815	202	6144	6399	216	9728	9983	230
2816	3071	203	6400	6655	217	9984	10239	231
3072	3327	204	6656	6911	218			
3328	3583	205	6912	7167	219			

Figure 23: Chart of extended loco addresses

23. Warranty Certificate

24 months warranty form date of purchase

Dear customer,

Congratulations on purchasing this ESU product. This quality product was manufactured applying the most advanced production methods and processes and was subjected to stringent quality checks and tests.

Therefore ESU electronic solutions ulm GmbH & Co. KG grants you a warranty for the purchase of ESU products that far exceeds the national warranty as governed by legislation in your country and beyond the warranty from your authorised ESU dealer. ESU grants an extended

manufacturer´s warranty of 24 months from date of purchase.

Warranty conditions:

- This warranty is valid for all ESU products that have been purchased from an authorised dealer.
- No claims will be accepted without proof of purchase. The filled in warranty certificate together with your ESU dealer´s receipt serves as proof of purchase. We recommend keeping the warranty certificate together with the receipt.
- In case of claim please fill in the enclosed fault description as detailed and precise as possible and return it with your faulty product.

Extend of warranty / exclusions:

This warranty covers free of charge repair or replacement of the faulty part, provided the failure is demonstrably due to faulty design, manufacturing, material or transport. Please use the appropriate postage stamps when shipping the decoder to ESU. Any further claims are excluded.

The warranty expires:

1. In case of wear and tear due to normal use
2. In case of conversions of ESU - products with parts not approved by the manufacturer.
3. In case of modifications of parts, particularly missing shrink sleeves, or wires directly extended on the decoder.
4. In case of inappropriate use (different to the intended use as specified by the manufacturer).
5. If the instructions as laid down in the user manual by ESU electronic solutions ulm GmbH & Co. KG were not adhere to.

Due to liability reasons any inspections or repairs can only be carried out on products that are not installed in a locomotive or carriage. Any locomotive sent to ESU for inspection will be returned without even touching it. There is no extension of the warranty period due to any repairs or replacements carried out by ESU.

You may submit your warranty claims either at your retailer or by shipping the product in question with the warranty certificate, the receipt of purchase and fault description directly to ESU electronic solutions ulm GmbH & Co. KG:

ESU GmbH & Co. KG
- Warranty department -
Edisonallee 29
D-89231 Neu-Ulm
GERMANY

Trouble shooting sheet

1. Personal data   **(Please write in block letters)**

Name: ....

Street: ....

ZIP/City: .... | | | | | |

Country: ....

Email:...................

Phone: ....

Date:....................

Signature: ....

2. Product details and system enviroment (use extra page if needed)

Art.No.: _____ Purchase Date: _____ Address: _____

Operation Mode: ☐ AC Analogue   ☐ AC Digital   ☐ DC Analog   ☐ DC Digital (DCC)
Digital system: ☐ ESU ECoS   ☐ Märklin® 6012   ☐ ROCO® Digital   ☐ LGB® Digital   ☐ LGB® MZS
☐ Intellibox®   ☐ Lenz® Digital   ☐ Others:

3. Error description

☐ Headlight output front
☐ Headlight output rear
☐ Motor output
☐ Programming

☐ No Sound
☐ Wrong Sound
☐ Short circuit
☐ AUX output

☐ Cable
☐ Change direction probl
☐ Without any function (DOA)
☐ Other problems:

4. Receipt - Proof of purchase (Please enclose this document!)

Please enclose your receipt / invoice. Otherwise no warranty possible!

5. Additional information: **6. Your retailer:**

Retailer´s stamp or address