

LokSound V4.0

Instruction manual Murphy Models «Class 201»



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Important Warnings:

- This LokSound decoder is designed for use in Murphy Models "Class 201" only.
- Do not expose to wet and humid conditions.
- Do not remove the heat shrink sleeve on the decoder.
- Always disconnect the circuit when installing the decoder. Please install the body shell before applying voltage.
- To avoid risk of short circuit, ensure that open ends of wires do not come into contact with any metal parts of the Locomotive.
- Make sure that no wires are squeezed or cut by the model's transmission parts when reassembling the locomotive.
- Handle the speaker with extreme care: Do not touch the membrane or apply pressure!

Introduction

1. Introduction

The LokSound V4.0 decoder by ESU is a versatile digital decoder integrating a full-featured, 8 channel sound system, various lighting outputs and a 1.1A motor controller. This key component of your newly acquired "Class 201" is responsible for all functions, such as motor control, control of all lighting functions and all sound and special sound functions.

LokSound V4.0 decoders are compatible with all NMRA DCC standards & RPs, support short and long addresses, advanced consisting, 14, 28, 128 speed steps and also support RailComPlus®. RailComPlus® allows the automatic recognition of locomotives by a DCC system, provided the command station supports RailComPlus®. LokSound V4.0 decoders also support Märklin® Motorola® and can be used on conventional AC and DC layouts as well.

The "Class 201" is preset at the factory for immediate operation. Nevertheless, we kindly ask you to first read these instructions before you set this locomotive onto a powered track.

1.1. Decoder features

The "Class 201" can be operated straight out of the box. The appropriate operating mode is selected automatically. You do not have to change any parameters.

Track Voltage	47 Volts maximum
Operation modes	DCC, Motorola, AC & DC
Steady state motor current	1.1A
Function output current	0.25A each
Number of function outputs	4 + 2 logic outputs
Total current of function outputs	0.5A
Audio amplifier	2W@40hms load
Speaker impedance	4–8 Ohms
Memory capacity	32 MBit
Number of Sound channels	8
Dimensions	30.0mm x 15.5mm x 4.5mm

2. Operation

2.1. Function assignments

Function Key	Effect
F0	Directional Headlights
F1	Sound on/off
F2	High pitched airhorn
F3	Low pitched airhorn
F4	High beam
F5	Compressor
F6	Acceleration / brake time, shunting mode / shunting speed
F7	Curve squeal
F8	Cab light
F9	Fan
F10	Conductor's signal
F11	Coupler
F12	Sand
F13	Brake release / brake set
F14	Short airhorn (high pitched)
F15	Short airhorn (low pitched)
F16	Open / close door
F17	Rail clank
F18	Valve
F19	Diesel manual notching (up)
F20	Diesel manual notching (down)
F21	

The default address for DCC operation is "03".

2.2. Using your LokSound decoder under DCC

The default address assigned to the LokSound decoder is 3. Simply set your controller to this locomotive number and place it on the mainline. If everything is set up properly, the “Class 201” should react as shown on the table 2.1.

If you use a DCC system which supports RailComPlus®, it will most likely ask you to change the locomotive address. All function button icons will be displayed correctly after the assignment of the new address.

2.3. Using your LokSound decoder under Märklin® Motorola®

The default address assigned to the LokSound decoder is 3. Simply set your command station to this locomotive address and place it on the main track. If everything is set up properly, the “Class 201” should react as shown on the table 2.1.

Usually, under a Motorola® system, you can only control the function buttons F0, F1 to F4. However, you can enable a special LokSound feature: Beside the normal locomotive address the decoder will also „listen“ for the next address. If you use this address with your 6021, you can activate the functions F5 to F8 by pressing F1 to F4. To enable the second Motorola® address, you may change CV49, Bit 3.

2.4. Using your LokSound decoder under DC or AC

Although we highly recommend the use of a DCC system in order to enjoy all features of the LokSound, you may also use your conventional DC or AC command station. You will be able to control the motor of the locomotive and will also hear the engine sounds. However, you cannot control any additional sound effects, such as the horn, since the function buttons are not available.

3. Decoder settings

The table starting on page 10 covers setting of the most important parameters of the LokSound decoder. A full list of CVs can be found in the respective manual available for download on our website www.esu.eu

3.1. Basics of DCC programming

The hardware determines some features such as the number of function outputs as well as the maximum permitted current of the motor output. Therefore they are not programmable. Nevertheless, there are plenty of possibilities to influence the behaviour of the LokSound decoder by adjusting the software-governed properties. Within the decoder there is at least one memory space reserved for each adjustable parameter in which numbers or letters can be stored.

You could visualise the storage spaces as index cards in a large file box. In order to make sure you 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”. Just imagine you can write information onto these cards. Adjusting the settings means nothing else but erasing one entry and replacing it with another. Moreover, you are able to do that at any time. However, you cannot write onto every card: some bits of information such as 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.

3.1.1. Configuration variables (CV)

The 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.

3.1.2. Standardization 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 you 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 starting on page 10, showing the most important available CVs.

3.1.3. 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 on page 11: 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.

3.1.4. Programming methods

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”).

3.1.4.1. Programming on The Main

Programming on the Main (also called “Operations Mode programming”) enables you to program your decoders comfortably without having to remove the locomotive from 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 31”. Thus knowing the locomotive address is a precondition. Unfortunately, you cannot read CV values using this mode.

3.1.4.2. Service Mode Programming

This programming mode usually requires the locomotive to be placed on a special programming track output of the command station. CV's can only be read on the service track unless your DCC command stations supports RailCom®. 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 31”. Each decoder receiving this command will execute it.

In order to be able to read back the CV values from your decoder, the motor terminals must be properly connected to the motor. The motor is used to produce the “feedback” current pulse detected by the command station.

3.1.5. Programming procedure using various DCC systems

As each DCC system is different, the procedure for changing a CV will vary depending upon the system. We are very sorry that we are unable to provide detailed instructions to cover every system on the market. We need to assume that you are familiar with your system. Please consult your DCC system manual for detailed specification. We tested the LokSound with almost every DCC system available on the market (as of end of 2010), so there should not be any general problem.

3.1.6. Programming with the ESU LokProgrammer

The LokProgrammer 53451 offers the easiest and most comfortable way of setting the CVs of the LokSound decoders: simply by a few mouse clicks on an MS-Windows® computer. The computer

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helps you 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. You even can erase the sound and download a new soundpackage. Please see our website for more details.

3.2. Programming using Märklin® 6021

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.

3.2.1. 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 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 arrester 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“.

3.2.1.1. The 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).

3.2.1.2. 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).

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- 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 „Go“).

3.3. Setting up your LokSound

3.3.1. Address Settings

Each LokSound decoder requires a definite address to be addressable for the central unit. Depending on the type of decoder and the digital system, there are several possibilities how to allocate addresses. The LokSound may be setup to listen to either the primary address (also called “short” address), which provides a range of 1 to 127 or the extended (“long”) address, which has a range of up to 9999. Based on your preferences and your command station’s capabilities, you may select either the primary address or the extended address for usage. Be aware that some DCC systems do not support the full range of available addresses. Bit 5 in CV 29 switches between short and long address. The decoder can only respond to one address at a time.

If CV 29, Bit 5 is cleared, the decoder listens to the primary address stored in CV 1.

If CV 29, Bit 5 is set, the decoder listens to the extended address stored in CV 17 AND CV 18.

3.3.1.1. Primary Address

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.

Some digital systems (e.g.: ROCO® Lokmaus2, Lenz® digital plus, Lenz compact) only support the values 1 – 99 as short addresses.

3.3.1.2. Extended Address

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

If you want to use your LokSound with the extended address it is practical to program this address directly with your digital system: most modern digital systems 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.

Both the primary and the extended address may be changed at any time using service mode (on the programming track).

Some DCC systems (such as ESU ECoS, ESU Navigator) will allow the decoder address to be modified using Programming On The Main. LokSound will accept the programming commands, but the following restrictions apply:

- If the decoders primary address is enabled, the decoder will accept a new primary address and follow this immediately.
- If the decoders primary address is enabled, the decoder will accept a new secondary address (write of CV 17, 18).
- If the decoders extended address is enabled, the decoder will only accept a new primary address. You can not change an extended address to another number using Programming On The Main.

3.3.1.3. Motorola® Address

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

This address is identical to the short address in DCC mode. The LokSound decoder responds both to commands in DCC and in Motorola® mode at the same time.

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.

3.3.2. Configuring the decoders behaviour

3.3.2.1. Acceleration / Deceleration

Acceleration and brake time can be set independently of each other. Therefore, you could for instance program a short accelera-

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tion and a much longer brake time.

The time for accelerating from 0 to maximum speed 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.

3.3.2.2. Starting voltage, Max and Medium Speed

LokSound decoders know 255 speed steps internally. They can be adapted to the characteristic of the locomotive and allocated to the actual available speed steps (14, 28, or 128):

Motor characteristic via CV 2, 5, and 6: 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.

3.3.2.5. Shunting mode

The shunting mode reduces the speed to about 50%. Thus, you have smoother control of your locomotive in the lower speed ranges, which is important for shunting.

3.3.2.6. Analogue mode

The LokSound can also be used on conventional layouts. By default, this option is enabled. If you don't want to use the LokSound on conventional layouts, please disable the analog mode by clearing bit 2 of CV 29. Disabling this mode is useful if you plan to use some automatic braking modes.

3.3.3. Brake Sectors

Brake sectors have the purpose to slow down the locomotive in-

dependently 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.

3.3.3.1. DC Brake Mode

In order to activate the DC brake mode you must set bit 3 in CV 27. The 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.

3.3.3.2. Märklin® Brake Mode

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 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.

3.3.3.3. Lenz® ABC Brake Mode

LokSound V4.0 decoder support the ABC braking technique introduced by Lenz®. In order to use this function a group of anti-parallel diodes will be soldered to one half of the track. The resulting voltage drop generates an asymmetrical DCC signal. LokSound decoders will detect the 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.

Programming table - List of most important CVs

CV	Name	Description	Range	Default																											
1	Locomotive address	DCC/Motorola® address of locomotive	1 - 127	03																											
2	Start voltage	Sets the minimum speed of the locomotive	0 - 255	03																											
3	Acceleration	This value multiplied by 0.25 is the time from stop to maximum speed.	0 - 255	65																											
4	Deceleration	This value multiplied by 0.25 is the time from maximum speed to stop.	0 - 255	65																											
5	Maximum speed	Maximum speed of locomotive	0 - 255	180																											
6	Vmid	Medium speed of locomotive	0 - 255	60																											
13	Analogue mode F1-F8	Status of functions F1 to F8 in analogue mode	0 - 255	01																											
		<table border="1"> <thead> <tr> <th>Bit</th> <th>Description</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Function F1</td> <td>1</td> </tr> <tr> <td>1</td> <td>Function F2</td> <td>2</td> </tr> <tr> <td>2</td> <td>Function F3</td> <td>4</td> </tr> <tr> <td>3</td> <td>Function F4</td> <td>8</td> </tr> <tr> <td>4</td> <td>Function F5</td> <td>16</td> </tr> <tr> <td>5</td> <td>Function F6</td> <td>32</td> </tr> <tr> <td>6</td> <td>Function F7</td> <td>64</td> </tr> <tr> <td>7</td> <td>Function F8</td> <td>128</td> </tr> </tbody> </table>	Bit	Description	Value	0	Function F1	1	1	Function F2	2	2	Function F3	4	3	Function F4	8	4	Function F5	16	5	Function F6	32	6	Function F7	64	7	Function F8	128		
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1	Function F2	2																													
2	Function F3	4																													
3	Function F4	8																													
4	Function F5	16																													
5	Function F6	32																													
6	Function F7	64																													
7	Function F8	128																													
17	Extended locomotive address	Long address of the loco. CV 17 contains byte with higher value, CV18 contains byte with lower value. Only active when function in CV 29 is switched on (see below).	192 - 9999	192 128																											
19	Consist Address	Address for consist operation. 1 – 127 consist address active, normal direction 129 – 255 consist address active reverse direction	0-255	0																											
27	Brake mode	Allowed brake modes		28																											
		<table border="1"> <thead> <tr> <th>Bit</th> <th>Function</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>ABC braking, voltage higher on the right hand side</td> <td>1</td> </tr> <tr> <td>1</td> <td>ABC braking, voltage higher on the left hand side</td> <td>2</td> </tr> <tr> <td>2</td> <td>ZIMO® HLU brakes active</td> <td>4</td> </tr> <tr> <td>3</td> <td>Brake on DC, if polarity against driving direction</td> <td>8</td> </tr> <tr> <td>4</td> <td>Brake on DC, wenn Polarität gleich wie Fahrtrichtung</td> <td>16</td> </tr> </tbody> </table>	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											
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28	RailCom® Configuration	Settings for RailCom®		131																											
		<table border="1"> <thead> <tr> <th>Bit</th> <th>Function</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Channel 1 Address broadcast disabled Channel 1 Address broadcast enabled</td> <td>0 1</td> </tr> <tr> <td>1</td> <td>No data transmission allowed on Channel 2 Data transmission allowed on Channel 2</td> <td>0 2</td> </tr> </tbody> </table>	Bit	Function	Value	0	Channel 1 Address broadcast disabled Channel 1 Address broadcast enabled	0 1	1	No data transmission allowed on Channel 2 Data transmission allowed on Channel 2	0 2																				
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Programming table - List of most important CVs

CV	Name	Description	Range	Default																																	
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.		14																																	
		<table border="1"> <thead> <tr> <th>Bit</th> <th>Function</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td rowspan="2">0</td> <td>Normal direction of travel</td> <td>0</td> </tr> <tr> <td>Reversed direction of travel</td> <td>1</td> </tr> <tr> <td rowspan="2">1</td> <td>14 speed steps DCC</td> <td>0</td> </tr> <tr> <td>28 or 128 speed steps DCC</td> <td>2</td> </tr> <tr> <td rowspan="2">2</td> <td>Disable analog operation</td> <td>0</td> </tr> <tr> <td>Enable analog operation</td> <td>4</td> </tr> <tr> <td rowspan="2">3</td> <td>Disable RailCom®</td> <td>0</td> </tr> <tr> <td>Enable RailCom®</td> <td>8</td> </tr> <tr> <td rowspan="2">4</td> <td>Speed curve through CV 2, 5, 6</td> <td>0</td> </tr> <tr> <td>Speed curve through CV 67 - 94</td> <td>16</td> </tr> <tr> <td rowspan="2">5</td> <td>Short addresses (CV 1) in DCC mode</td> <td>0</td> </tr> <tr> <td>Long addresses (CV 17 + 18) in DCC mode</td> <td>32</td> </tr> </tbody> </table>			Bit	Function	Value	0	Normal direction of travel	0	Reversed direction of travel	1	1	14 speed steps DCC	0	28 or 128 speed steps DCC	2	2	Disable analog operation	0	Enable analog operation	4	3	Disable RailCom®	0	Enable RailCom®	8	4	Speed curve through CV 2, 5, 6	0	Speed curve through CV 67 - 94	16	5	Short addresses (CV 1) in DCC mode	0	Long addresses (CV 17 + 18) in DCC mode	32
		Bit			Function	Value																															
		0			Normal direction of travel	0																															
					Reversed direction of travel	1																															
		1			14 speed steps DCC	0																															
					28 or 128 speed steps DCC	2																															
		2			Disable analog operation	0																															
					Enable analog operation	4																															
3	Disable RailCom®	0																																			
	Enable RailCom®	8																																			
4	Speed curve through CV 2, 5, 6	0																																			
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5	Short addresses (CV 1) in DCC mode	0																																			
	Long addresses (CV 17 + 18) in DCC mode	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																																	

Programming table - List of most important CVs

CV	Name	Description	Range	Default		
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	03		
		Bit			Function	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

Programming table - List of most important CVs

CV	Name	Description	Range	Default																											
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	100																											
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																											
63	Sound volume	0 = low, 192 = max. volume	1 - 192	128																											
124	Extended Configuration #2	Additional important settings for LokSound Decoders	-	20																											
		<table border="1"> <thead> <tr> <th>Bit</th> <th>Description</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Bi-directional bit: Enable driving direction when shifting direction</td> <td>1</td> </tr> <tr> <td></td> <td>Disable driving direction</td> <td>0</td> </tr> <tr> <td>1</td> <td>Disable decoder lock with CV 15 / 16</td> <td>0</td> </tr> <tr> <td></td> <td>Enable decoder lock with CV 15 / 16</td> <td>2</td> </tr> <tr> <td>3</td> <td>Disable serial protocol for C-Sinus</td> <td>0</td> </tr> <tr> <td></td> <td>Enable serial protocol for C-Sinus</td> <td>8</td> </tr> <tr> <td>4</td> <td>Adaptive regulation frequency</td> <td>0</td> </tr> <tr> <td></td> <td>Constant regulation frequency</td> <td>16</td> </tr> </tbody> </table>	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	3	Disable serial protocol for C-Sinus	0		Enable serial protocol for C-Sinus	8	4	Adaptive regulation frequency	0		Constant regulation frequency	16		
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																													
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		0-255	50																											
128	Maximum speed Analog AC		0-255	130																											

Programming long addresses

5. Appendix

5.1. Programming Long Addresses

As described in chapter 3.3.1.2. 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 the table on the right.

5.1.1. Write address

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

To programme the long address proceed as follows:

- First you determine the desired address, for instance 4007.
- Then you look for the appropriate address range in the table on the right. 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 your decoder is now programmed to address 4007.

5.1.2. Read out address

If you wish to read out the address of a locomotive 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 the table below. 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	to	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			

6. 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 or fax (don't forget to provide your own fax-no. or email address) 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:

Phone: ++49 (0) 731 - 1 84 78 - 106
Tuesday & Wednesday 10:00am - 12:00am
Fax: ++49 (0) 731 - 1 84 78 - 299
Email: www.esu.eu/en/forum
Mail: ESU GmbH & Co. KG
- Technischer Support -
Edisonallee 29
D-89231 Neu-Ulm

www.esu.eu

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