

# Class V60

## Instruction manual

2. Edition, October 2019



RailCom plus

M4

# Content

<b>1. Declaration of conformity</b> .....	<b>2</b>
<b>2. The prototype</b> .....	<b>3</b>
<b>3. The model</b> .....	<b>7</b>
3.1. Important remarks - please read this first .....	7
3.2. Unpacking the model .....	7
3.2.1. Mounting & removing the center pick-up .....	7
3.3. Outward appearance and special functions.....	8
<b>4. The technology of the ESU model</b> .....	<b>9</b>
4.1. Possible operating modes of the V60 .....	9
4.1.1. Analogue mode .....	9
4.1.2. Digital mode.....	9
4.1.2.1. Digital operation with DCC-systems.....	9
4.1.2.2. DCC with RailComPlus® .....	10
4.1.2.3. M4 registration.....	10
4.1.2.4. Digital operation with Märklin® Digital....	10
4.2. Your first ride.....	10
4.2.1. Lighting functions.....	10
4.2.2. Sound functions .....	11
4.2.3. Synchronised smoke generator .....	11
4.2.3.1. Filling the smoke generator holding tank .....	11
4.2.3.2. Operating the smoke generator.....	12
4.2.4. PowerPack energy storage .....	12
4.2.5. Shunting coupler.....	12
4.2.6. Shunting operation.....	13
4.2.7. „Heavy train“ operation .....	13
4.2.8. Independent brake .....	13
4.2.9. Train brake .....	13
<b>5. Decoder settings (Programming)</b> .....	<b>13</b>
5.1. Configuration Variables (CVs) .....	13
5.1.1. Standardization in the NMRA .....	13
5.1.2. Bits and Bytes .....	13
5.2. Programming the decoder .....	14
5.2.1. Programming with DCC Systems .....	14
5.2.2. Programming with Märklin® 6021 .....	14
5.2.2.1. Changing in the programming mode.....	14
5.2.2.2. Short mode .....	14
5.2.2.3. Long mode.....	15
5.2.3. Programming with Märklin® CS® & Mobile Station®	15
5.2.4. Programming with ESU LokProgrammer .....	15
5.3. Address settings .....	15
5.3.1. Short addresses in DCC mode .....	15
5.3.2. Long addresses in DCC mode .....	16
5.3.3. Motorola®-address .....	16
5.3.3.1 Consecutive addresses for more functions	16
5.4. Adapting the Driving characteristics .....	16
5.4.1. Acceleration Deceleration .....	16
5.4.2. Starting voltage, Vmax .....	17
5.5. Break sectors .....	17
5.5.1. DC break mode .....	17
5.5.2. Märklin® brake mode .....	17
5.5.3. Lenz® ABC brake mode .....	17
5.6. Adjusting the volume .....	18
5.6.1. Overall sound volume .....	18
5.6.2. Adjust individual sounds .....	18
5.7. PowerPack.....	18
5.8. Decoder reset .....	18
5.9. Brightness of the lighting.....	18
5.10. Selection of brake noise.....	19
5.11. Idling .....	19
5.12. Selection of rail joint noise .....	19
<b>6. Maintenance</b> .....	<b>19</b>
6.1. Removing the housing.....	19
6.2. Lubrication .....	19
6.3. Replacing traction tires .....	20
6.4. Changing height of coupler.....	20
<b>7. Technical support</b> .....	<b>21</b>
<b>9. Spare parts</b> .....	<b>21</b>
<b>10. List of all important CVs</b> .....	<b>22</b>
<b>11. Warranty Certificate</b> .....	<b>25</b>

## 1. Declaration of conformity

We, ESU electronic solutions ulm GmbH & Co. KG, Edisonallee 29, D-89231 Neu-Ulm, Germany, declare in sole responsibility that the product

Product description: V60, Part number: 31410 – 31419

complies with all relevant regulations of the Directive for Electromagnetic Compatibility (2004/108/EG).

The following harmonised standards have been applied:

EN 55014-1:2006 + A1:2009: Electromagnetic Compatibility - requirements for household appliances, electric tools, and similar apparatus - Part1: Emission - Product

EN 55014-2:1997 + A1:2001 + A2:2008: Electromagnetic Compatibility - Requirements for household appliances, electric tools, and similar apparatus - Part 2: Immunity - Product family standard.

## 2. The prototype

In the early 1950-ies the German state railways “Deutsche Bundesbahn” (DB) needed to renew its locomotive fleet. Besides mainline engines shunting locomotives were also put on the drawing boards. For light shunting duties there were about 500 locomotors type Kö/Köf. The most modern standard steam locomotives class 80 and 81 specially developed for light and medium shunting services were only available in very small numbers, namely 27 units altogether. Heavy shunting duties were taken on by downgraded mainline engines such as class 55 and 57 and the mostly Prussian class 94. About 25 class V20 and V36 diesel locomotives from the stocks for the armed services completed the range. Since many main lines and even more shunting yards were not equipped with catenary the procurement of diesel engines was paramount.

Since the 3-axle class V36, whose drivers were linked by rods, performed well, the intention was to develop another 3-axle locomotive for light shunting duty. To provide better visual conditions for the engineer the cab was to be located at the center.

1953 the manufacturers of rail vehicles Maschinenbau AG (MaK), Gmeinder, Henschel, Jung, Klöckner-Humboldt-Deutz, Krupp and Maschinenfabrik Esslingen joined their efforts under the supervision of the central authority of the German railways – the Bundesbahn-Zentralamt (BZA) – in Munich in order to develop the class V60 diesel locomotive for the DB (known as the consortium V60).

Initially this working group has established that the motor power rating must be around 600 horse powers in order to meet the demand. This subsequently



Picture: Rolf Wiemann

**V60 815s paint scheme is an example for out of factory design of the V60 in the 1950s an 1960s.**

## Prototype

lead to the name V60 ("V" stands for "combustion engine" in German). The specification described a locomotive meeting most of the demands of light shunting duty. The concept of the diesel locomotives for mainline service class V80 and V200 with the articulated drive shaft has proven its reliability. However, due to little experience regarding a power train resting on three bearings it was decided to employ the principle known from the V36 with drive rods and jack shaft.

The driving and coupled axles should be dimensioned not to exceed an axle load limit of 16 tons. The intention was to employ this locomotive also on poorly maintained secondary lines and industrial spurs. In mainline gear this locomotive should reach a maximum speed of 60 km/h, which is the same speed that was standard for long distance freight trains also utilising the then given speed limit on branch lines. The client also insisted on fool-proof handling. At a driver diameter of 1250 mm the revolutions at 60 km/h were 255 rpm, which was well within the standard limits for rod coupled engines. From today's point of view it can be said that the engineers did not take any risks at all when developing the class V60.



Picture: Rolf Wiemann

Top view of an era III loco.

The coal fired furnace was part of the standard equipment (the so called Dofa furnace). It only served for keeping a parked engine warm and not for pre-heating the coaches of the train. Since the coal had to be loaded manually the DB modified the design as from the third series and equipped the locomotives with oil burning furnaces. Since the burner of the Dofa furnace was still utilised there is no outer hallmark differentiating locomotives of the third production run and earlier models. Locomotives of the fourth production run were equipped with an oil burning boiler with a circular cross section. Therefore these locos are clearly different to the previous models.



The first three series of V60 (left) were equipped with rectangular coal fired Dofa oven for keeping cooling water on temperature. Later series had a rounded oil oven (right).

During the 1990-ies the DB replaced the boilers with electrical heating devices powered by external sources for keeping the engines at the right temperature. Thus the furnaces located at the front underneath the right hand walk way were removed. Other changes visible from outside was the installation of Indusi magnets (inductive train safety system) starting in the mid-sixties as well as the upgrading with automatic couplers of most engines as from 1985. Following the five pre-production units delivered in 1955 another 937 locomotives were built in five production runs until 1964. The pre-production units re different form each other as well as form the later production runs where most locomotives looked pretty much the same.

The DB subdivided this class internally into light and heavy locomotives even though they look completely identical. The heavy type weighing 52 t has a reinforced chassis with somewhat larger dimensions compared to the light version weighing 48 t. Initially the light engines were marked with three-digit class numbers while the heavier type had four-digit numbers. With the introduction of the computer numbering system in 1968 the light engines were classified as class 260 and the heavy ones as class 261.

Until the early 1980-ies both types had to be operated by specially trained locomotive engineers. At the same time the small shunting locomotives type Kö could be operated by specially trained shunting personnel resulting in lower personnel cost. In 1987 the DB reclassified these locomotives to class 360 and 361 and thus to locomotors and created a new job description for the shunting personnel trained to operate locomotors known as "engine shunting driver". All locomotives equipped with automatic couplers (AK) and remote radio control were classified as class 364 (light version) and class 365 (heavy type).

The classes 362 and 363 were only established in 1992 and mark locomotives equipped with the Caterpillar engine 3412 DI-TA instead of the original Maybach GTO 6 / GTO 6A. Other engine types tested in some locomotives were not relevant in terms of their numbers. Meanwhile most engines have been operating for about 50 years proving the design of the V60 as quite successful. In the summer of 2012 a total of 405 engines of the classes 360 and 361 were still in service with the DB, some private operators or historical societies.

The main area of work has always been shunting service. Nevertheless they frequently operated local



Shunting some IC-Passenger cars in train station of Puttgarden at 1995-05-06.

## Prototype

services to nearby industries in and around their respective depots (Bw). Due to the lack of train heating equipment they were hardly used for passenger services since these services required suitable train heating. However, particularly in the 1960-ies there were quite a few railway authorities running their V60s in ahead of "Thunder Boxes" equipped with coal fired furnaces. Regular passenger services were conducted in the districts of Augsburg, Nuremberg, Essen and Wuppertal.

After German reunification in 1990 the so called "West V60s" were also relocated to the new provinces despite the fact that the DR had 4-axle shunting locomotives (class 105 and 106) with similar performance data. In the 1990-ies class 364 and 365 locomotives have been deployed in the regions of Schwerin (Stralsund depot, Rostock, Pasewalk, Neustrelitz), Berlin (Berlin-Pankow station, Seddin, Cottbus), Erfurt (Erfurt station), Halle (Leipzig Süd station), Dresden (Dresden station, Chemnitz, Reichenbach).



**365 105 pulls two cars with sliding doors out of switch yard of Darmstadt-Kranichstein.**

Some class V60s were delivered ex works to the Belgian railways (SNCB-NMBS), the Greek railways (CEH) as well as to the Turkish state railways (TCDD) and also to Israel. After their decommissioning in Germany these reliable locomotives were very popular export products. Some of them were put into service in Switzerland, Norway, Yugoslavia, Italy and Algeria.



**260 581 operates with a couple of cars on main line nearby Hengsen in October 1972.**

Picture: Rolf Wiemann

Picture: Rolf Wiemann

## 3. The model

### 3.1. Important remarks - please read this first

Congratulations to your purchase of the H0 diesel loco V60. Your H0 model offers various innovative functions. This manual provides a step by step insight into the features of the V60. Therefore we have one request:

Please read this manual prior to operating the model carefully. Although the model is quite robust, inappropriate handling could lead to injury of the operator or to damage of the locomotive. Do not indulge in "costly" experiments.

- This locomotive is not a toy and should only be operated under supervision.
- Please make sure that the room has adequate ventilation when operating the smoke generator continuously!
- Keep the smoke distillate away from children. It contains substances that may damage your health if consumed. In case of contact with your eyes consult a doctor immediately.
- Please return the pipette only into the packaging after you have emptied it completely. Otherwise you may risk draining the smoke distillate.
- Protect the model against wet conditions and humidity.
- When working on the locomotive (maintenance) always make sure there is no power connected to the model.
- Replace the housing on the chassis prior to operating the locomotive after maintenance work.
- Make sure that no wires are squeezed or that no short circuit may occur.

### 3.2. Unpacking the model

out of the foam insert. In the box, you will find a hexagon spanner M3.

Now place the model on its side, hold the model and the plastic holder with one hand and release the two hexagon bolt with the other hand.

Please keep all parts of the packaging and this manual for later use. Only the original packaging guarantees proper protection against transport damage. Please fix the locomotive by means of the hexagonal bolts to the plastic holder and place it into the foam insert and put it into the carton and the transport box prior to shipment.

If you are an three-rail modeler using locos with center pick-up, you can put the V60 on the tracks and start immediately after entering the address 3.

The pick-up is responsible for the power consumption of the point contacts. The slide switch in the loco bottom right in front of the pick-up must point forward for AC operation.

If you are two-rail modeler, you must first disassemble the pick-up.

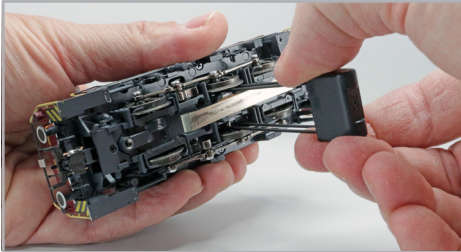
#### 3.2.1. Mounting & removing the center pick-up

Removal: Pull off the exhaust stack on the roof. Put the locomotive on its roof. Then you apply the tool in such a way that the ends of the four wire brackets fit into the four holes below the base plate of the center pick-up, than carefully(!) squeeze the tool and lever the center pick-up with a slight tug from its position.

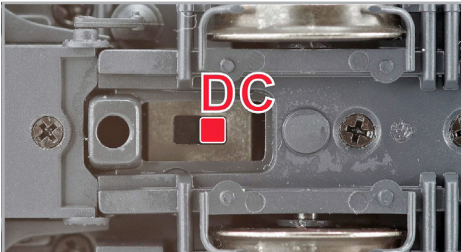
Now you have to slide the sliding switch in front of the first axis to the back. (Fig. 02\_3.2.2 Slide switch on two-rail operation). Now the locomotive is ready for two-rail operation.

Notes: If the switch is not moved to the rear position, a short circuit will be triggered.

## The Model

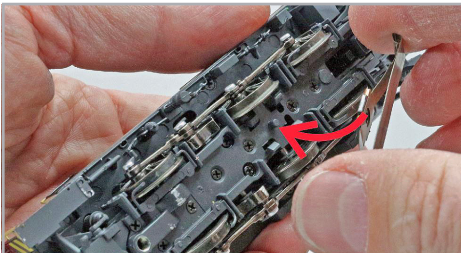


**Figure 1: Lever the center pick-up.**



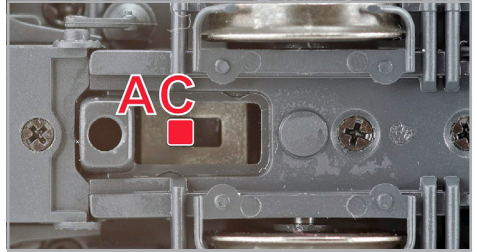
**Figure 2: Sliding switch at pos. for 2-rail operation**

Mounting: For re-converting your locomotive to a three-rail vehicle again hold the center pick-up between thumb and index finger and place it in the receptacle. Finally press the center pick-up until there is an audible “click”.



**Figure 3: Put center pick-up into receptacle**

Now you must slide the slide switch forwards towards the end of the loco (Fig. 04\_3.2.2. Set slide switch to AC operation).



**Figure 4: Sliding switch at pos. for 3-rail-operation**

### 3.3. Outward appearance and special functions

With your new V60 you can operate your model trains prototypically like never before. There are many separately applied detail parts on the metal housing as well as on the metal chassis. All grab irons are made off sturdy plastic or metal and are separately applied.

The two “sugarcube” speakers powered by the LokSound 5 decoder distributes its powerful sound through the cut-through radiator grills.

The ESU coreless motor with flywheel assure plenty of power and smooth running. All three axles are powered through the side-rods.

One traction tires assure considerable tractive effort. In order to assure perfect driving dynamics and excellent sound without interruptions due to dirty tracks the locomotive is equipped with a “PowerPack” energy storage module.

Your V60 is equipped with an automatic coupler plugged into the NEM shaft on both sides of the loco, which can be remotely controlled by the digital command station. In principle, all known bracket and universal couplings can be coupled. Remote uncoupling works only with counter-couplings, the brackets are made of a non-magnetic material. (See also chapter 4.6.2.).

In terms of its lighting the V60 is just as prototypically versatile as its original counterpart. Of course there is directional lighting generated by warm white LEDs that can be turned off at one end, wherever the train is coupled to the locomotive. During shun-

ting one white light at either end is switched on. In addition there is cab lighting as well as illuminated driver's cab-control panel. A working engine down-light is also available.

## 4. The technology of the ESU model

The LokSound 5 decoder is a central part of your new V60. Its circuitry is responsible for design and control of all running and sound functions of the V60:

- Driving forward and in reverse
- Lighting functions
- Sound functions
- Smoke generator

Besides M4 the LokSound 5 also supports DCC with RailComPlus®, Motorola® and Selectrix® and also be operated on analogue layouts. Programming can be done either with DCC command stations or with Märklin® central units, etc. the decoder automatically detects the mode of operation.

Therefore you do not have to set anything in this regard.

In case you wish to change any of the default settings of the locomotive (such as the address or the sound volume) we recommend to first reading chapter 5. This chapter lists the most important parameters of the LokSound 5 decoder and how to change them with the various command stations available on the market.

### 4.1. Possible operating modes of the V60

#### 4.1.1. Analogue mode

The V60 may also be operated on conventional (=analogue) DC or AC model train layouts. The number of available functions is, however, quite limited:

- Driving forward and backwards
- Directional lighting
- Engine sounds (automatic)

The smoke generator cannot be turned on in analogue mode. The engine sound sets in at about 6.5 V track voltage. At 8.5 V the locomotive slowly starts moving. Both DC transformers and AC transformers are suitable for analogue operation. Please note, that due to the large number of different systems on the market you may not achieve trouble-free operation with electronic throttles employing PWM (pulse width modulation).

Attention: the V60 must have come to a complete standstill before you activate the change-of-direction command! Never switch to the opposite direction while the locomotive is moving.

#### 4.1.2. Digital mode

For prototypical operation we recommend using a digital command control system. The numerous functions are only available in digital mode.

The default address (ex. factory) is:

„03“ (DCC and Märklin® Motorola®)

14 speed steps with Märklin® Motorola®.

In DCC mode the decoder automatically detects the speed steps set in the command station.

##### 4.1.2.1. Digital operation with DCC-systems

The V60 can be operated with any DCC compliant system. Sounds and other functions of the V60 can be triggered with the function buttons F0 through F31.

## Light functions

### Function mapping (ex. factory):

Taste	Funktion
F0	Directional Headlights
F1	Prime mover sound On / Off
F2	Primary horn
F3	Smoke unit
F4	Digital coupler (automatic coupling sequence)
F5	Headlights off at Front side
F6	Headlights off at Reverse side
F7	Cab lights
F8	Shunting Operation
F9	Secondary horn
F10	Engine downlights
F11	Locomotive brake
F12	Radio transmission sound #1
F13	Heavy Train
F14	Dashboard lights
F15	Bell
F16	Set / Release train brake
F17	Set / Release hand brake
F18	Pre-heater
F19	INDUSI
F20	Sanding
F21	Compressor
F22	Frog squeal during running
F23	Track squeal during running
F24	Release air
F25	Fuel pump
F26	Curve squeal during running
F27	Conductor's whistle
F28	Radio transmission #3
F29	Radio transmission #4
F30	Soundfader
F31	Disable brake squeal

The number of functions actually available is determined by your digital command control or handset. Depending on the system, fewer function keys are available.

#### 4.1.2.2. DCC with RailComPlus®

The LokSound 5 supports RailComPlus®, which was jointly developed by Lenz® and ESU. This means that the decoder automatically reports to RailComPlus®

capable command stations. You will never ever have to change a locomotive address manually! Simply put the locomotive onto the track. If you do not wish to have the automatic recognition, you can switch it off by deleting CV 28, bit 7.

#### 4.1.2.3. M4 registration

If you use a Märklin® systems Central Station® or mobile station®, the locomotive will be automatically detected and registered by the system once you have put it onto the track. This process occurs completely automatically, you do not have to adjust any settings.

DCC with RailComPlus® has the highest priority when registering the locomotive. Therefore the decoder will always register with RailComPlus® and DCC on an ESU ECoS command station even when M4 is active. If RailComPlus® is not available then M4 will be treated as the second priority. Therefore the decoder will register with M4 on a Märklin

Central Station®. Based on the software version of your Central Station®, the number of available function buttons may be limited to 16.

#### 4.1.2.4. Digital operation with Märklin® Digital (6021)

You may operate the V60 with the Märklin® 6021 central unit without any problems. A special feature allows you to assign three more addresses besides the "actual locomotive address". They are known as following addresses. This enables you to access 16 functions with your 6021. Details on how to do this are described in chapter 5.3.3.1.

### 4.2. Your first ride

Most certainly you wish to test your new locomotive right away. We recommend going about this step by step. Put the locomotive onto the track call it up on your handheld throttle.

#### 4.2.1. Lighting functions

First turn on the lights by pressing F0. Then the white forward headlights as well as the red rear lights of the V60 should light up. If you wish you may

switch on the cab lighting with F6 in order to better see the cab interior.

If you now press F14 then the illuminated driver's cab-control panel will come to life. You will clearly see this through the side windows of the cab.

Using F10, you can enable the outside track downlights.

It is common practice to turn of the head and tail lights at the cab where a train is coupled to the locomotive. Press F5 if the train coupled to the long hood in order to switch off the head (tail) lights at that end. When shunting without any vehicle coupled to the locomotive you should press F8 in order to have prototypical lighting for shunting.

### 4.2.2. Sound functions

After pressing F1 (preliminary lubrication and starting sequence) your V60 comes to life and continues with the typical sound of an idling diesel engine.

You can simulate a cold start by quickly switching off and on again the function F1 during the pre-lubrication sound.

Once you go to speed step 1 the prime mover will rev up before the locomotive slowly starts moving. Shortly before coming to a standstill you will hear the squealing brakes.

With three new functions, driving is even more true to the original. The locomotive brake F11 slows down the locomotive more than the value stored in CV 4. At the same time the engine is acoustically in idle. The locomotive decelerates to standstill regardless of the throttle position. When the function is switched off, the locomotive accelerates again to the value corresponding to the throttle position. The change of the values of F11 is described in chapter 4.2.8.

When the train brake (F16) is applied, the locomotive brakes only when the speed control is taken back. See also chapter 4.2.9.

To simulate heavy load, switch to F13. This feature provides a one-step increase in engine speed and

extended acceleration and deceleration times while riding. You can read about the adaptation of the function in chapter 4.2.7.

Of course you may trigger various user sounds with your throttle (refer to the table on page 11). You may also adjust the volume of each individual sound sequence. How to do this is described in chapter 5.6.

### 4.2.3. Synchronised smoke generator

The V60 is equipped with a load dependent, synchronised smoke generator that can be controlled with your command station respectively handheld throttle. The system consists of a holding tank for the smoke distillate, an evaporator unit with temperature control and a blower that exhausts the smoke in a controlled manner.

This system can adjust both the amount and the intensity of the smoke discharged subject to the operating conditions and thus assures prototypical performance. This system has been especially tuned for the V60 and also comprehensively tested.

Please bear in mind the following remarks in order to assure safe operation:

Only use the ESU smoke distillate item No. 51990. Other liquids may lead to damage of the paint finish, choking the system or a faulty heating unit due to unwanted deposits. Only activate the smoke generator while observing the model and in a well ventilated room.

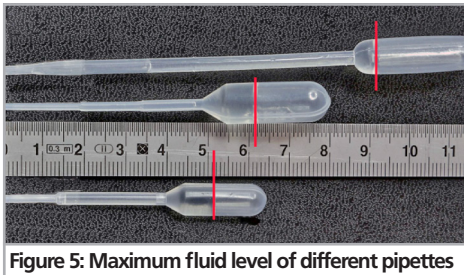
#### 4.2.3.1. Filling the smoke generator holding tank

First take the pipette from the packaging of the model and pull about 0.3 ml smoke distillate into it. Please observe the index markers on the pipette (see figure 5) in order to establish the appropriate quantity. Then carefully inject the distillate into the silver-colour opening of the exhaust.

After filling, blow short but strong into the mantle to remove any bubbles.



## Smoke unit



**Figure 5: Maximum fluid level of different pipettes**

Do not exceed the maximum quantity of the holding tank of 0.3 ml. If in doubt rather put less liquid into the system! Due to the integral temperature sensor the smoke generator will not be damaged even if there is no liquid in the system!

Fill the smoke system only while the locomotive is on a horizontal sector but never on a gradient. Do not turn the locomotive with liquid in the tank sideways or upside down! This avoids the drainage of the distillate.

### 4.2.3.2. Operating the smoke generator

The smoke generator only works in conjunction with the sound. Smoke without sound is not possible. First activate the smoke generator with the function button F3. As long as the engine (prime mover) is not running nothing happens just like with the prototype. After pressing F1 you will hear the sounds of the starter motor. As soon as the prime mover

is firing acoustically the diesel locomotive blows a strong cloud of smoke from the exhaust into the "model sky". Like with the prototype the intensity of the smoke from the exhaust is reduced as soon as the prime mover begins to idle.

More intense smoke will be emitted during acceleration and, of course, there is no smoke when the locomotive slows down.

In order to protect the model the smoke generator is turned off automatically after 6 minutes. Thus overheating is avoided in case there is no distillate in the holding tank. Switch off the F3 button and

then on again in order to reactivate the smoke function.

The maximum capacity of the holding tank is 0.3 ml and is sufficient for about 10 to 15 minutes operation.

In some instances it may happen that the system is clogged up due to an excessive amount of distillate in the holding tank. Simply blow some air through the exhaust opening in order to remove the drops of condensation.

The smoke generator system as well as the entire locomotive gets quite warm. Let the model cool down before putting it back into its packaging.

### 4.2.4. PowerPack energy storage

The V60 is equipped with a maintenance free "PowerPack" energy storage module. This facilitates uninterrupted power supply even on dirty tracks. The PowerPack is only active in digital mode. In analogue mode it will be automatically switched off. After turning on the power supply the "PowerPack" must first be charged. This may take up to 60 seconds. Only then the full capacity will be available. The system supplies power to the lighting, the motor and the sound functions. The maximum time that the system should cover can be set (also refer to chapter 5.7.)

### 4.2.5. Shunting coupler

Your V60 is equipped with an automatic coupler plugged into the NEM shaft and remotely controlled by the digital control unit. In principle, all known bracket and universal couplings can be coupled. Remote uncoupling works only with counter-couplings, the brackets are made of a non-magnetic material. Since this is not the case with the popular Märklin® short coupling, you will find two pieces of suitable ESU universal couplers for replacement in the accessory bag. Further universal couplings can be obtained from your dealer under item number 41000.

When pressing the function key F4, the rear clutch in the direction of travel is activated: The locomotive

first presses the train lightly, the clutch is activated, and the locomotive advances a few millimeters and leaves the cars. The process is referred to as model railroaders call coupler waltz. During the coupling phase, the clutch vibrates. This is intentional and not a malfunction.

#### 4.2.6. Shunting operation

Switch to shunting mode with the help of the F8 key: The shunting light also indicates this immediately visually. CV 181 (factory value: 60) indicates how much of CV 4 will be taken away when the shunting operation is active. The greater the value, the faster the locomotive accelerates and brakes.

CV 103 (factory setting: 96) sets the maximum speed achieved in shunting operations. The factory locomotive reaches 75% of its normal maximum speed.

#### 4.2.7. „Heavy train“ operation

With F13 you can switch to the „Heavy train“ mode to increase the simulated load for the decoder. On the one hand the engine speed increases (also in the state), on the other hand doubles the braking and acceleration time.

#### 4.2.8. Independent brake

CV 179 (factory value: 80) indicates how much of CV 4 is taken away when the locomotive brake (F11) is active. The larger the value, the more the engine slows down. The vehicle can decelerate to standstill (speed 0).

#### 4.2.9. Train brake

CV 180 (factory value: 60) indicates how much of CV 4 is removed when the train brake (F16) is active. The larger the value, the more the locomotive decelerates. However, the locomotive does not brake immediately when the train brake is active, but only as soon as the controller has been turned to „0“.

## 5. Decoder settings (Programming)

Chapter 5 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 5.1, we explain in the following section

5.2 how to change various parameters in DCC mode and with Märklin® central units. The following chapters explain which parameters have what kind of influence on the behavior of the LokSound decoder.

### 5.1. Configuration Variables (CVs)

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 behavior of the decoder.

#### 5.1.1. 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 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 10.1. showing all available CVs.

#### 5.1.2. 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

## Decoder settings

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 10: 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 ( $0 + 2 + 4 + 0 = 6$ ).

### 5.2. Programming the decoder

In this paragraph we explain how you can program the decoder with the most commonly available digital systems.

#### 5.2.1. Programming with DCC Systems

LokSound decoders support all NMRA programming modes. Programming on the Main 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 3!“. Thus knowing the locomotive address is a precondition.

Using RailCom® you can read CV values on the main. This function is enabled by default (CV 28 = 3). 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.

#### 5.2.2. Programming with 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.

##### 5.2.2.1. Changing in the programming mode

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 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“.

##### 5.2.2.2. 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).
- 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).

### 5.2.3. Programming with Märklin® central station® & Mobile Station®

LokSound 5 decoders can be programmed with all mfx® compatible command stations. However, most likely not all configuration options will be shown. This is because there are different versions of mfx® command stations available. Please refer to the instruction manual of your mfx® command station how to program decoders. Our decoders do follow the original Märklin® engines typically.

#### 5.2.2.3. 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 (the lights light up for about one second).

#### 5.2.4. Programming with ESU LokProgrammer

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. For the V60, please make sure you are using software version 5.0.0 or later which is available for download from our website.

### 5.3. 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.

#### 5.3.1. Short addresses in DCC mode

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® Lokmaus II, Lenz® digital plus, Lenz® compact) only support the values 1 – 99 as short address.

## Decoder settings

### 5.3.2. Long addresses in DCC mode

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 decoder 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 Command® Dynamis®, ESU CabControl) 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.

### 5.3.3. Motorola®-address

You can also operate many 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 as described in chapter 5.3.1. 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.

#### 5.3.3.1 Consecutive addresses for more functions

The extended Motorola®-Format covered only the lighting function (F0) and the auxiliary function F1 to F4. Of course, this is far too few for the many functions of the V60. Therefore one can assign up to three additional addresses (4 addresses in total). The so called consecutive addresses follow immediately after the actual address stored in CV 1 and serve to trigger functions. Motor control is solely accomplished via the base address in CV 1.

Example: select address 66 for a class V60 locomotive. You want to set 3 consecutive addresses. They are 67, 68 and 69. They will then switch the consecutive functions whenever you callup these addresses on your 6021:

Name	Example Address	Functions
Base address	66	F0, F1 – F4
Consecutive 1	67 (66+1)	F5 – F8
Consecutive 2	68 (66+2)	F9 – F12
Consecutive 2	69 (66+3)	F13 – F16

Please make sure that no other vehicle is programmed to any of the consecutive addresses. Otherwise you will inadvertently run several vehicles at the same time!

The consecutive addresses are activated with bits 3 and 7 in CV 49. For reasons of compatibility they are not next to each other.

The relationship is as follows:

Bit 7	Bit 3	Description	Value to be added to CV 49
0	0	No consecutive addr.	0
0	1	1 consecutive addr.	8
1	0	2 consecutive addr.	128
1	1	3 consecutive addr.	136

First read out the value in CV 49 (default value: CV 49 = 1) and the value shown in column 4. If, for instance, you wish to activate 3 consecutive addresses then you must write the value  $136 + 1 = 137$  into CV 49. Consecutive addresses are only active in Motorola® mode.

## 5.4. Adapting the Driving characteristics

### 5.4.1. Acceleration 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 255.

The times set in these CVs work speed dependent. 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.

#### 5.4.2. Starting voltage, Vmax

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).

Enter the start voltage in CV 2 and the maximum speed in CV5.

The values of the start and maximum speed are dependent on each other. Selecting a maximum speed that is lower than the start speed could lead to some erratic driving performance. Therefore always adhere to the principle: start voltage < maximum speed.

#### 5.5. Break 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.

##### 5.5.1. DC brake mode

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.

##### 5.5.2. 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 possibly 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.

##### 5.5.3. Lenz® ABC brake mode

LokSound 5 decoders support the ABC braking technique introduced by Lenz®. In order to use this function a group of antiparallel diodes will be soldered to one half of the track. The resulting fall of voltage generates an asymmetrical 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 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® guarantee 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 diodes are also installed on the left side), set bit 2 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 diodes are also installed on the right side), set bit 1 in CV 27.

## Decoder settings

- If you want to stop the decoder no matter in which half of the track the diodes are set, please set bit 2 and bit 1 in CV 27 (CV 27 = 3).

### 5.6. Adjusting the volume

The volume of all individual sounds of the V60 can be independently adjusted. This enables you to tune the model optimally according to your preferences.

#### 5.6.1. Overall sound volume

If you wish to reduce the overall volume simply enter a lower value in CV 63 (master volume). All sounds will be adapted in the correct ratio.

#### 5.6.2. Adjust individual sounds

If you wish to adjust the volume of individual sounds you must set the volume for each individual sound by changing the value of its corresponding CV. In order to enable the decoder to describe these CVs correctly you must assure that the so-called "index CV" CV 32 has the correct value.

Before you change any volume CV please make sure that CV 32 = 1.

The CVs for the sounds are defined as follows:

CV	Function	Default value
259	Prime mover	128
427		
275	Primary signal horn	108
283	Secondary signal horn	128
291	Set / Release loco brake	64
299	Compressor	128
307	Bell	128
315	Coupler sounds	90
331	Conductor's whistle	80
339	Sanding	50
347	Set / Release Train brake	64
355	INUDSI	80
395	Set / Release Hand brake	100

403	Track squeal	80
419	Shunting gear shift	100
467	Radio transmission #1	100
459	Radio transmission #3	100
435	Radio transmission #4	100
411	Air release	80
387	Fuel pump	50
475	Curve squeal	128
259	Brake squeal	110

If you wish not to hear a certain sound (for instance, no sanding) then you set the corresponding CV to the value of "0".

### 5.7. PowerPack

The PowerPack energy storage module continues to provide electric current to the decoder in case of a power interruption. Should you have installed isolate track sectors ahead of signal where the sector is disconnected from the power source if the signal aspect shows "red", the locomotive will still be powered by the "PowerPack" and will therefore continue to run. Of course, in such a situation this may be undesirable.

Therefore it is possible to adjust the buffer time in CV 113 as a multiple of 0.016384 seconds. The default value facilitates about 2.9 seconds. For smooth running the time should not be set to any value lower than 0.3 seconds.

### 5.8. Decoder reset

You may reset the decoder to default values at any time.

### Simply write the value 8 in CV 8.

### 5.9. Brightness of the lighting

The brightness of all LEDs of the V60 can be changed. The range is from value 31 (maximum brightness, default value) down to the value 0 (lights are almost off, very dark).

Please change the following CV values:

Description	Output	Index CV/32	CV	De-fault
Light white in the lower left corner	Light reverse[1]	0	270	31
Red light behind	AUX1[1]	0	278	31
Light white in the lower right corner	AUX2[1]	0	286	31
Light white front top	AUX5	0	310	31
Cab light	AUX6	0	318	31
Driver's desk light	AUX7	0	326	31
Light white in the back above	AUX13	0	374	31
Light white front lower right	AUX14	0	382	31
Front coupling	AUX15	0	390	31
Engine Lighting	AUX16	0	398	31
Red light in front	AUX17	0	406	31
Light white front lower left	AUX18	0	414	31

### 5.10. Selection of brake noise

With CV 165 one of 4 brake sounds can be selected. Possible values are 0 - 3, the factory value is 0.

### 5.11. Idling

Using the CV 166, you can set the time in quarter of a second until the idle mode is automatically exited when regressing (roll time). When this time has elapsed or the controller has been turned up, the engine resumes „drive“. The factory value is 120.

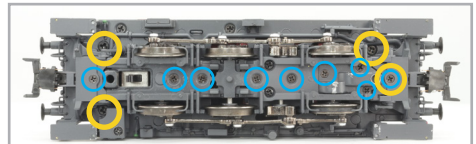
### 5.12. Selection of rail joint noise

CV 164 selects the desired noise for the rail joints. Possible values are 0-3, the factory value is 0.

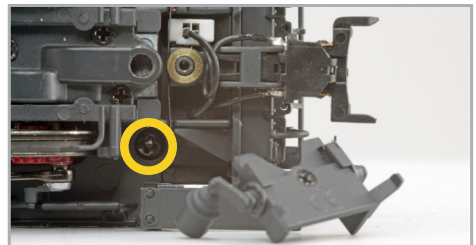
## 6. Maintenance

### 6.1. Removing the housing

Put the model on its roof. You will find four Phillips Screws at the bottom of the chassis. You can find one of them under the rear clutch cover, which is first unscrewed. Then you solve all four housing screws and put the model back on its wheels. Now you can easily remove the housing. The yellow circles point to the screws to be removed in order to take off the housing.



**Figure 6: Screws for remove of housing and for change of traction tires**



**Figure 6a: Remove housing - Release screw under clutch cover**

### 6.2. Lubrication

We have equipped the V60 with durable mechanical components. All moving parts have been permanently lubricated with durable grease and oil. Additional lubrication of these individual components is therefore usually not required.

## Maintenance

### 6.3. Replacing traction tires

Traction tires do age and must be replaced when worn out. If mounted, remove the AC pickup first.

Using a Phillips screwdriver, loosen the four screws holding the locomotive bottom, the two screws above the coupling shaft, and the two three screws that hold the gear cover at the height of the rear axle. The total 9 screws are circled in picture 06 blue. Then lift off the gearbox cover.

Now pull the crank pin on both sides of the wheel set with the traction tire and lift the wheel set out. Use a pair of tweezers or a thin flat-head screwdriver. Now you can with a thin tweezers remove the damaged traction tire.

Please make sure that the traction tires are put onto the wheel uniformly and without any tension in order to avoid out-of-round running characteristics of the model. It has proven quite useful to place the traction tires prior to mounting into some low surface tension water (a drop of dishwashing liquid is sufficient).

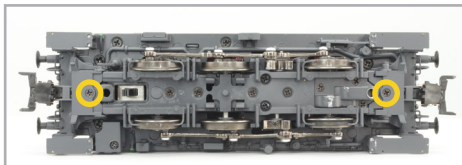
Please note when reinserting the crankpin that it has a square cross-section and should therefore not be twisted in the wheel.

The assembly takes place in reverse order.

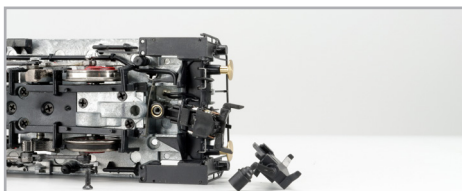
### 6.4. Changing height of coupler

Out of factory, we deliver the model in such a way that the height of the coupler matches that of the standard two-rail and modern Märklin® cars. If you use mostly older Märklin® material, it may be advisable to change the position of the coupler.

To do this, unscrew the cover of the coupler in the locomotive bottom.

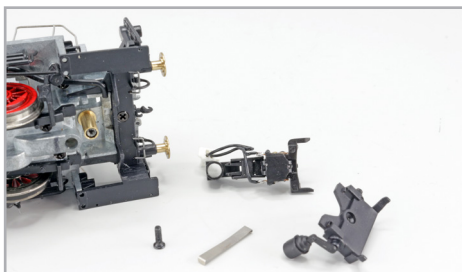


**Figure 7: Position of screws for elevation of coupler**



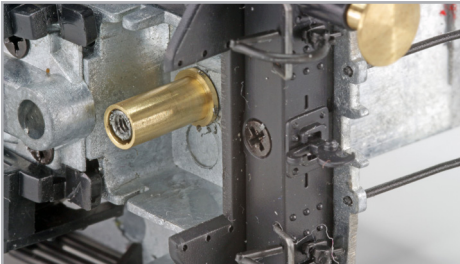
**Figure 8: Elevation of coupler: Remove cover**

Then carefully pull the electrical coupler out of the NEM shaft.

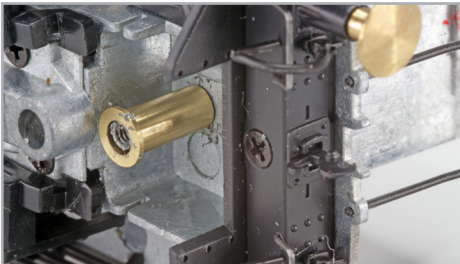


**Figure 9: Elevation of coupler: View at brass hull**

Now pull the NEM shaft downwards out of the holder and turn the brass sleeve over so that it no longer looks at the top, but at the bottom of the standard shaft.



**Figure 10: Elevation of coupler: Position low**



**Figure 11: Elevation of coupler: Position high**

The assembly is done in reverse order, the coupler is now about 0.5 mm higher than before.

## 7. Technical support

Should you have questions regarding your V60 to which you have not found the right answer in this manual please first contact your hobby shop. The people there are your competent contact for all questions relating to model trains.

Should you not be able to get an answer to your question look up our homepage in the internet. We continuously publish topical questions and answers as well as the latest versions of manuals. Of course you will also find our postal address as well as our phone number on our site.

[www.esu.eu](http://www.esu.eu)

## 9. Spare parts

Due to the large number of parts built into your V60 we have divided the spare parts in to component groups. Some parts belonging to large parts groups are also included in smaller groups. You can download the current spare part list from our website.

Please bear in mind that only the spare parts listed in the supplied spare part list are available ex works as spare parts. Enquiries for individual parts are pointless.

Should you require a spare part you must first identify the spare part group containing the needed part. For rarely needed parts you may have to purchase a larger component group. You must state the listed ESU part number when ordering spare parts from your hobby shop.

## Important CVs

### 10. List of all important CVs

CV	Name	Description	Range	Value
1	Loco address	Address of the loco	1 - 127	3
2	Start voltage	Sets the minimum speed of the engine	1 - 75	2
3	Acceleration	This value multiplied by 0.25 is the time from stop to maximum speed	0 - 255	60
4	Deceleration	This value multiplied by 0.25 is the time from maximum speed to stop	0 - 255	60
5	Maximum speed	Maximum speed of the engine	0 - 255	130
8	Manufacturer's ID	Manufacturers's ID ESU - Writing value 8 in this CV triggers a reset to factory default values	-	151
9	Motor Pulsfrequenz (PWM)	Hersteller-Nummer (ID) der ESU – Das Schreiben des Werts 8 bewirkt ein zurücksetzen aller CVs auf die Werkseinstellung	10 - 50	40
17	Long address of the loco	Long address of engine CV 17 contains the high byte (Bit 6 and 7 must always be enabled), CV18 contains the Lowbyte. Active only if enabled in CV 29 (see below).	128 -	192
18			9999	128
19	Consist Address	Additional address for consist operation. Value 0 or 128 means: consist address is disabled	0-255	0
27	Brake mode	Allowed brake modes		0
		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, if polarity like driving direction	16	
28	RailCom® Configuration	Settings for RailCom®		131
		Bit	Function	Value
		0	Channel 1 Address broadcast not enabled	0
			Channel1 Address broadcast enabled	1
		1	Data transmission not allowed on Channel 2	0
			Data transmission allowed on Channel 2	2
		2	Command Acknowledgement on Channel 1 not allowed	0
			Command Acknowledgement on Channel 1 allowed	4
	7	RailComPlus® automatic loco recognition not active	0	
		RailComPlus® automatic loco recognition active	128	
29	Configuration register	This register contains important information, some of which are only relevant for DCC operation.		30
		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	-	0	
			16	
	5	Short addresses (CV 1) in DCC mode	0	
		Long addresses (CV 17 + 18) in DCC mode	32	



## Important CVs

CV	Name	Description	Range	Value
139	Smoke generator - Heating temperature	Adaption of the heating temperature of the smoke generator. The bigger the value, the higher the heating temperature	0 - 255	128
179	Brake function 1 delay	The value entered here (1/3 of it) is subtracted from the CV 3, if brake function 1 is active	0 - 255	30
180	Brake function 2 delay	The value entered here (1/3 of it) is subtracted from the CV 3, if brake function 2 is active	0 - 255	20
181	Brake function 3 delay	The value entered here (1/3 of it) is subtracted from the CV 3, if brake function 3 is active	0 - 255	20
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 braking distance forward	A value > 0 determines the way of brake distance it adheres to, independent from speed	0 - 255	0

Copyright 1998 - 2019 by ESU electronic solutions ulm GmbH & Co KG. Electrical characteristics and dimensions are subject to change without prior notice. All rights reserved. ESU might not be held responsible for any damage or consequential loss or damage caused by inappropriate use of the product, abnormal operating conditions, unauthorized modifications to the products etc...

Not suitable for children under 14 years of age. Inappropriate use may result in injury due to sharp points and edges.

Märklin® and mfx® is a registered trademark of the company Gebr. Märklin® and Cie. GmbH, Göppingen, Germany. RailCom is a registered trademark of the company Lenz Elektronik GmbH, Giessen, Germany.

All the other trade marks are owned by their respective right holders.

ESU electronic solutions ulm GmbH & Co. KG continues to develop the products according to the company's politics. Therefore, ESU reserves the right to carry out changes and improvements on the products listed in this manual at any time and without any advanced note.

Duplications and reproductions of this documentation are strictly forbidden and need to be allowed by ESU in writing.

## 11. Warranty Certificate

### 24 months warranty from 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:

Information on service processing can be found on our homepage [www.esu.eu](http://www.esu.eu)







ESU P/N 03518-20253