

Class 66/77

Instruction manual

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RailCom
plus

M4



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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 „ESU HO-Diesellok Class 66/77“, 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 – Part 1: 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

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2. The prototype

Great tractive effort - robust – easy to maintain – competitively priced: These are the terms that appropriately characterize class 66 and class 77 diesel locomotives. By now about 650 units of both types travel European railway lines. But how did it happen that the big, heavy Canadian locomotive equipped with older but proven technology even became part of the DB rolling stock?

To explain this one must take a broader view: Due to the deregulation of the international rail freight traffic many railway undertakings (RU) sprang up like mushrooms and required powerful traction vehicles for handling the rail traffic taken away from the national railways. While diesel locomotives with medium to lower power (e.g.: DB and DR classes V100 and V60 as well as locomotors) were sold to private owners in considerable numbers, the DB did not establish a market for heavy diesel locomotives.

The comparatively low number of former national railway locomotives class 220 (DB and DR), 221, 228 (ex DR V 180), 231-241 (Ludmilla) that are travelling German rails today, were either sold in the 1990-ies by the DB to other countries and returned from there at a later stage, or were handed down to museums and collections, who meanwhile established their own railway undertakings (RU) and offer services in the field of track maintenance trains.

Therefore there was a lack of locomotives suitable for cost effective, heavy freight traffic in Germany at the turn of the millennium. New locomotives such as the DE AC33C by ADtranz Bombardier known as the Blue Tiger were quite expensive. Therefore only ten units were delivered to private railway undertakings. Relatively new second-hand locomotives such as the ones registered in the locomotive leasing pool, formerly Norwegian ME 26 manufactured by Siemens did not appear to be very reliable.

Then an attractive offer came indirectly from England. In 1993 the British government had initiated the step-by-step privatization of railways. The American Wisconsin Central RR (WC) founded the English, Welsh & Scottish Railway (EWS), which took over a large part of the freight service from the former national British Rail (BR). Since many of the old BR locomotives were reaching their end of life, the EWS wanted to order 250 new locomotives. Because EMD (Electro Motive Division) delivered a total of 15 JT 26 CW-66 locomotives to the British construction company Foster Yeoman starting in 1985, EWS decided to order a slimmed down, cheaper version of this class 59 from EMD, which subsequently was introduced as class 66.

This procedure contributed greatly to much faster approval formalities in England.



The Yeoman Highlander of the type JT 26 CW-66, classified by DB as 259 003, is the predecessor of the Class 66 and is in Seddin on September 28, 1997.

Picture: hof Wiemann

Prototype

Picture: Jochen Frickel



In contrast to DE 61, DE 62 of the HGK still carries the British headlamp unit with an external „position light“. Recording 08/24/2011 in Ulm Hbf.

The excellent experience with the Yeoman locomotives were prove of the technically mature design. The American SD40 family (5,550 units in total) provides the technical base for class 59 and later her replacements class 66/77. Class 59 locomotives built in 1990 and 1994 were already equipped with main headlights located next to each other just like class 66/77. In addition to the 15 class 59 about 650 units of class 66 were built commencing in 1998. The very first units were delivered to British railway undertakings. The nomination class 59 respectively class 66 originated in England, where these locomotives were integrated into the British numbering system. The actual ex works type design,

namely JT42CWR, would have been rather cumbersome for daily use. Since the DB acquired the construction company Foster Yeoman, the class 59 ended up in the DB rolling stock inventory. In 1997 the DB transferred the 59 003, built in 1985, to Germany for testing. After completion of the test runs the DB sold this locomotive to Heavy Haul Power International (HHPI), a construction material company. HGK was the first railway undertaking with the idea to import class 66 locomotives into Germany. Since the class 59 was already approved in Germany it was easy for HGK to get authorization for locomotives of similar construction. In 1999 HGK purchased two locomotives (DE 61 and DE 62) and undertook numerous tests. After successful completion of the tests, they leased more locomotives of the same type.

Picture: Rolf Wiemann



HGK DE64 promoted on the Geislinger Steige on July 22nd, 2004. a tank car block train.

Despite some deficiencies such as, for instance, the high interior noise level and the missing engine pre-heater, tractive effort and a competitive price/performance ratio were convincing. Almost at the same time the class 66 was introduced into other European countries. RUs, leasing or owning class 66 locomotives, have their registered offices in Germany, France, Belgium, the Netherlands, Luxembourg, Norway and Poland. Since most of the Benelux locomotives are equipped with the German train protection systems, they travel regularly as far as Berlin or Basle (Baden) Railway station.

Technology

The pure technical data foreshadow why this locomotive is so successful in Europe. The GM twelve cylinder two-stroke engine type 12N-710G3B-EC generates 3,194 HP (2,350 kW). The engine drives the DC generator AR8/CA6 providing the voltage for the D43 traction motors. The anti-skid protection keeps the wheels turning, even on greasy rails. The only other locomotive type capable of keeping up with the performance of the class 66/77 with a tractive force at starting of 409 kN and a continuous drawbar pull of 260 kN is the re-motorised class 241 (450/290 kN) owned by the DB. The latter, with 4.000 HP, is considerably more powerful but is limited to a maximum speed of 100 km/h. Class 241 appears to be not quite as reliable as the 232, which is the design base for the 241. Other locomotives with similar performance data are the electrics class 151 and 155 as well as the modern three-phase current locomotives.

Technical data

Manufacturer	Electro-Motive Division
Type	JT42CWR
Year of manufacture	1998
Number produced	ca. 650 units
Axle arrangement	Co'Co'
Power unit	Diesel-electric
Diesel engine	12 cylinder two-stroke turbo charger
Engine type	GM 12N-710G3B-EC
Power rating	3200 PS/2350 kW
Rpm range	235 - 900 U/min
Traction motors	EMD D43 TR (DC)
Starting / continuous tractive force	406/260 kN at 25,6 km/h
Tank capacity	6550 l
Range	ca. 1600 km
Operating weight	126 t (C77 130 t)
Maximum speed	120 km/h
Minimal curve radius	80 m

The class 66 locomotives with a maximum speed of 120 km/h keep up with other freight trains on even electrified mainlines. Therefore many class 66 units provide at least part of their service under overhead catenary. The reason for this is the fact that these locomotives haul their trains from the remote siding right into the factory (if necessary) without the need of changing traction.

One point criticized by the operators of class 66 locomotives is the missing pre-heating system. Therefore the cab drivers are advised to keep the engine running at exterior temperatures below 10°C, just like it has been a (deplorable) custom in America for decades. Only the class 77 units delivered as from 2006 are equipped with a pre-heating system. The two-stroke engine operating in the range from 235 to 900 rpm generates the characteristic sound.

The sound (or rather noise) is, however, more acceptable for people outside rather than for people inside the cab. Apparently the manufacturer economized on the sound proofing. This results in much higher noise levels in the interior compared to locomotives of the V160 and V300 families. Only a few locomotives are equipped with air conditioning.

Train drivers stationed in Mühldorf and Oberhausen, where the DB ECR locomotives are deployed, consider the A/C units as an advantage compared to all other DB freight service locomotives. There are two class 66 series employed in Europe. For easier differentiation the latest version is often described as class 77.

The current denomination of these locomotives is JT42CWRM. The "M" stands for "modified". Due to the shareholding in the French Euro Cargo Rail (ECR), the DB owns meanwhile a large number of class 66 engines. The units numbered 66 originate from England and were owned by EWS. Lacking the German train protection systems, these locomotives may only be operated in France. The new class 77 units in light grey livery are also approved in Germany.

There are only a few external differences such as a door to the engine compartment on the left side, the somewhat higher fan grills as well as a larger fan grill on the roof. In addition, the class 77 units have different cab windows on the sides.

Livery

The dominating colour for the chassis is jet black RAL 9005, the colour predominantly applied by the DB. Most locomotives deployed in Germany originate from the inventory by Beacon Rail Limited. The bodies are generally painted as per customer request or decorated with plastic film.

There is a yellow or white contrast field below the windows on the front and rear.

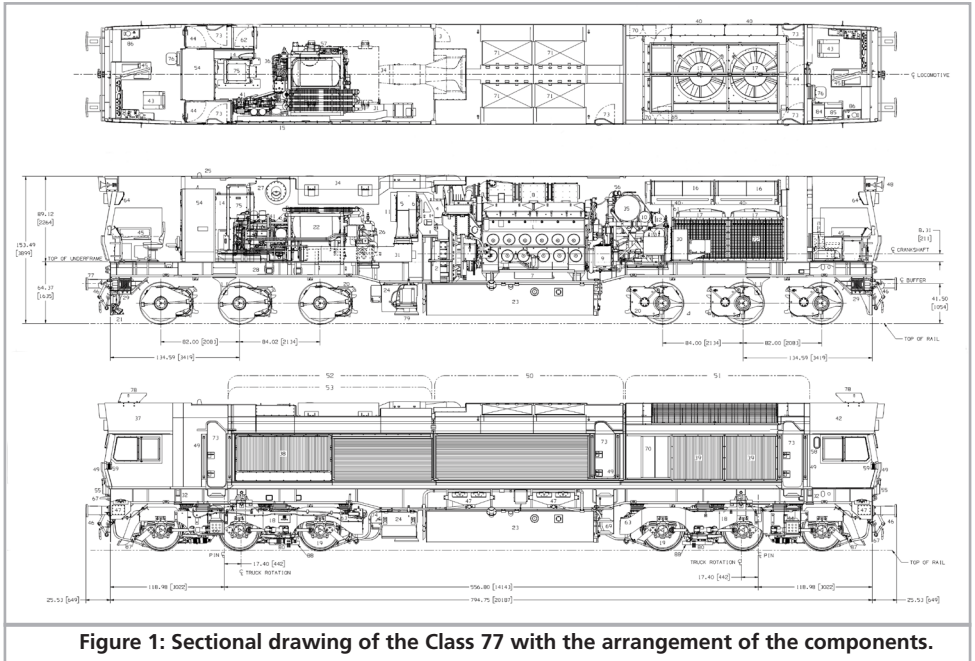


Figure 1: Sectional drawing of the Class 77 with the arrangement of the components.

Due to its longevity the red colour of HGK is the most popular livery. Since this company, based in Cologne, usually enters into long term leasing contracts, the company livery is also applied to any locomotives earmarked for leasing resp. rental. Besides the two initial units DE 61 and DE 62, which are painted in a different, darker red, all HGK locomotives bear the yellow or white contrast field on front and rear. This is compulsory for locomotives travelling to the Benelux countries.

Deployment

Lacking any train heating devices, class 66 are only suitable for freight service. The type of trains hauled by these units is subject to the business area, in which the owner or lessee is active. The locomotives by Euro Cargo Rail offer currently the most versatile spectrum. A preposterous situation developed, once the DB purchased ECR, because only a small number of the 60 new locomotives could be deployed in France. This is due to the fact, that there was simply not enough freight traffic for these locomotives.

In 2009 DB Schenker Rail intended to decommission the long serving class 217 and 225 in the Mühldorf region as well as the class 232 in the Ruhr area. Without further ado the DB transferred six brand-new class 77 units from France to Mühldorf and a further six to Oberhausen. The adaptation to German requirements was accomplished in the DB Cottbus works. Since nobody in Cottbus, nor in Mühldorf or Oberhausen had any experience with the US heavyweights, it took almost a year until trouble-free operation could be achieved. The class 66 stationed in Mühldorf mainly haul heavy trains with tank cars. The units from Oberhausen haul trains for the steel industry. Other railway undertakings employ these locomotives mainly for the Multimodal Transport (also known as Combined Transport). Despite their rather rough tone these locomotives have gained an excellent reputation amongst the cab drivers. Particularly whenever heavy trains have to be moved on slippery tracks. Nevertheless, these locomotives are frequently employed to haul shorter trains as well. HGK employs the class 66 predominantly for unit trains, although with varying freight.

Picture: Jochen Frickel



The DE61 of the HGK, which is characterized by hard use, is only allowed to drive in Germany.

Picture: Rolf Wiemann



The 6603 waiting in Montzen, Belgium in 2011 has the latest CapTrain paintwork.

Picture: Slig-ESU



RailFeeding also rented two Class 66 Beacon Rail Limited.

Picture: Rolf Wiemann



The prototype of the ESU model in Montzen, Belgium.

Picture: Rolf Wiemann



Class 77 DE 6311 of the CrossRail runs through Neuwied station on the left-hand Rhine route.

Model

3. The model

3.1. Important remarks - please read this first

Congratulations to your purchase of the H0 diesel locomotive Class 66/77. Your H0 model offers various innovative functions. This manual provides a step by step insight into the features of the Class 66/77. 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.
- Make sure that no wires are squeezed or that no short circuit may occur.

Please note: All models shown are hand samples. Their design may differ from that of the series vehicles!

3.2. Unpacking the model

Pull the model screwed to the plastic holder with both hands out of the foam insert. In the box, you will find a hexagon spanner.



Figure 2: Unscrew the locomotive

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.

Now adapt your Class 66/77 to the operating mode on your system. If you are an AC modeler, i.e. need a locomotive with a center pick-up, you can place the Class 66/77 on the tracks and start driving immediately after entering address 3.

The pick-up shoe is responsible for the current consumption from the point contacts. The slide switch in the locomotive floor between the two air tanks must be set to AC for AC operation.

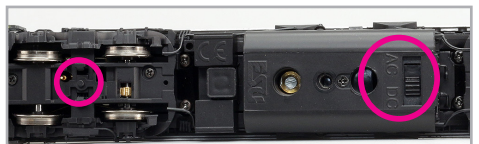


Figure 3: Grinder mount and slide switch

If you are a two-rail modeler, you must first dismantle the center pick-up.

3.2.2. Mounting & removing the centre pick-up

Removal: 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 in the base plate of the centre pick-up. Carefully (!) squeeze the tool and then lever the centre pick-up with a slight tug from its position.

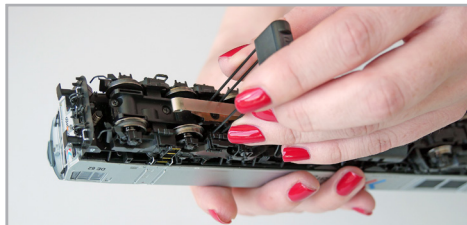


Figure 4: Remove the grinder

Now you have to slide the slide switch in front of the air containers into the DC position. The locomotive is now ready for operation on two-rail tracks.



Figure 6: DC-AC switch on Position „DC“

Notes: If you do not slide the switch to the DC position, a short circuit will be triggered.

Mounting: For re-converting your locomotive to a three-rail vehicle again hold the centre pick-up between thumb and index finger and place it in the receptacle. Please note that the grinder must be placed on bogie „1“. Finally press the centre pick-up until there is an audible “click”.

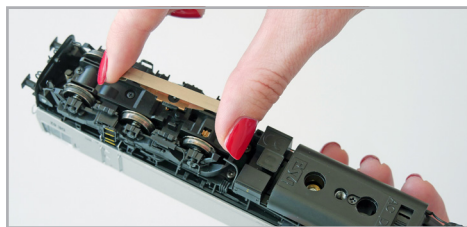


Figure 5: Attaching the grinder

Now you have to slide the switch into AC position.

3.3. Outward appearance and special functions

With your new Class 66/77 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. With the correct form changes for the respective locomotive number. All grab irons are made of sturdy plastic and are separately applied. You will find cables made of plastic on the bogie panels.

The two speakers powered by the LokSound 5 decoder distributes its powerful sound through the cut-through radiator grills in the roof. The curve sensor triggers the typical squeaking when driving through at low speeds.

A 5-pole ESU high-performance motor with a noise-optimized commutator and two centrifugal masses ensures a large amount of power with extremely smooth running. The drive acts on four axes.

Four 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 “Power-Pack” energy storage module.

A link-guided standard shaft according to NEM 362 ensures that the locomotive is always closely connected to its train.

The Class 66/77 also proves to be prototypically versatile in terms of lighting. Of course, the locomotive has a change of light depending on the direction of travel thanks to warm white LEDs, but the headlights on the train can be switched off if required. All three white headlamps are shunted under the lights on both sides. Direction-dependent driver's cab and driver's desk lighting complete the lighting functions.

Belgian, Dutch and French light functions can also be activated on the internationally used locomotives.

4. The technology of the ESU model

The LokSound 5 decoder is a central part of your new Class 66/77. Its circuitry is responsible for design and control of all running and sound functions of the loco:

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

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 Class 66/77

4.1.1. Analogue mode

The Class 66/77 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 function is not available in analog 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 Class 66/77 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 work) is:

„03“ (DCC aand 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 Class 66/77 can be operated with any DCC compliant system. Sounds and other functions of the Class 66/77 can be triggered with the function buttons F0 through F30.

Function mapping (ex work):

Button	Function
F0	Directional headlight
F1	Sound on/off
F2	High pitched airhorn
F3	Smoke generator on/off
F4	Directional cablights
F5	No lights at cab #1
F6	No lights at cab #2
F7	Directional headlight belgium/french
F8	Shunting illumination german/french/belgium
F9	Low pitched airhorn
F10	Emergency stop signal
F11	Station announcement #1
F12	Curve squeal off/on
F13	Coupler
F14	Directional dashboard illumination
F15	Shunting illumination dutch
F16	Compressor
F17	Station announcement #2
F18	Short high pitched airhorn
F19	Short low pitched airhorn
F20	Sanding
F21	Shunting mode
F22	Diesel manual notching up
F23	Diesel manual notching down
F24	Manual notching logic on/off
F25	Dynamic brake/brake fan
F26	Locomotive brake
F27	Release/set train-brake (automatically) off/on
F28	Radio conversation #1
F29	Radio conversation #2
F30	radio conversation #3 (shunting distance)

The number of functions actually available is determined by your command station or the handheld controller used. 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's address manually! Simply put the locomotive onto the track.

4.1.2.3. Requirements for RailComPlus®

RailComPlus® requires an appropriately equipped command station. You do not have to make any changes to your decoder. It will be recognized automatically.

Of course you can change the locomotive name, all function key symbols and the locomotive symbol as you wish and then write them back to your decoder. All of this happens fully automatically in the background.

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

4.1.2.4. 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®.

4.1.2.5. Digital operating with Märklin® Digital (6021)

You may operate the Class 66/77 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 switch on the light function with the light button. The Class 66/77 should then show a white front light in the direction of travel and a red rear light. If you wish, you can switch on the cabin lighting with F4 and thus better discover the interior.

If you also press the F14 key when the headlights are switched on (!), the driver's desk lighting will also be switched on. You can observe this through the side windows of the driver's cabs.

With the keys F5 and F6 you can switch one "end" of the locomotive completely dark. If your train is coupled to cab 1, you should press F5. In shunting operations without a train, you should use F8 to ensure the correct lighting.

Four LEDs mounted in the bogies are activated during braking and simulate the sparking of the brake blocks on the running surfaces of the wheels, as can be seen on the locomotives when heavy trains are decelerating.

4.2.2. Sound functions

After pressing F1 (preliminary lubrication and starting sequence) your V160/218 comes to life and continues with the typical sound of an idling diesel engine.

If you switch to the first speed step, the converter is filled and the locomotive starts moving without increasing the speed. The diesel engine only revs up when the second gear is engaged. When braking, the brake squeal sounds shortly before standstill.

With three new functions, driving operations are even more prototypical. With the function keys F22 and F23 you can increase or decrease the speed of the diesel engine and change the speed independently of the sound on the speed controller. Before doing this, you must allow the diesel speed step logic to be changed by pressing F24.

Sound functions

Then pressing F22 / F23 means switching one of the 8 continuous speed levels of the prototype locomotive.

Note that the noise change is prototypically slow. If your locomotive is to pull the heavy train up the incline at walking speed with a roar, increase the speed with F22. By pressing the F24 key you leave the mode and the sound will revert to the speed assigned to the speed controller position. When your train has reached cruising speed and is maintaining its speed with momentum, reduce the speed with F23. After pressing F24 again, the driving noise is synchronized with the speed controller position.

By pressing F25 you activate the dynamic brake including the brake fan. Then the sound will idle. On the original, the traction motors now act as a generator, their power is destroyed in the braking resistors, the locomotive maintains its speed on downhill slopes or brakes on level ground. The speed of the diesel engine increases again when the brake resistor fan activates acoustically. If necessary, change the speed on the speed controller.

As soon as you turn the controller back, the locomotive decelerates more than set in CV4. After pressing F25 again, the sound adapts to the speed level set on the speed controller. How to change the values of F25 is described in Section 4.2.6.

With F26, the train and locomotive brake together, i.e. more heavily than with the value stored in CV4. At the same time the engine goes into idle acoustically. Now set the desired lower speed on the speed controller and your train decelerates more than set in CV4. If you switch F26 off again, the sound adapts to the speed set on the speed controller. Changing the values of F26 is described in Section 4.2.7.

You can call up various additional noises on your handheld controller (see table on page 10). The volume of each individual sound can be individually adapted to your needs. Read about this in section 5.6. after how it's done.

The platform announcements arranged by country are a specialty. Just write the following values in the given CV:

CV	Value	Language: Platform announcement
170	0	German
170	1	Dutch
170	2	French

4.2.3. Curve sensors

The Class 66/77 was equipped with an extensive sensor package in order to be able to reproduce prototypical noises even in curves.

Please take note of the following guidelines:

The curve sensor only works as long as the locomotive is running at low speed. As soon as the locomotive stops or drives faster than speed step 7 (from 28), no curve squeak is played.

The driving noise must be switched on, otherwise no curve noises will be played. The curve sensor works from a radius of approx. 80 cm. In the case of very large radii, the sensor system may not be able to detect the deflection. Unfortunately, certain mechanical tolerances cannot be avoided.

If you do not want to hear cornering noises, you can always switch off the function with the F12 key.

4.2.4. Synchronised smoke generator

The Class 66/77 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 loco and also comprehensively tested.

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

Only use the ESU smoke distillate part 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.

4.2.4.1. Filling the smoke generator holding tank

First take the pipette from the packaging of the model and pull about 0.4 - 0.5 ml smoke distillate into it. Please observe the index markers on the pipette in order to establish the appropriate quantity. Carefully inject the distillate into the large opening of the red-brown silencer.



Figure 7: Filling the system

Do not exceed the maximum quantity of the holding tank of 0.5 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.

4.2.4.2. Operating the smoke generator

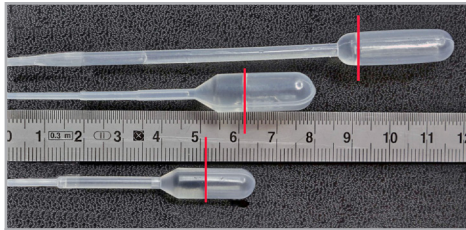


Figure 8: Maximum fluid level in pipette

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.

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.

Both the amount of smoke and the intensity can be adjusted to suit your needs. Section 5.10. gives more information.

4.2.5. PowerPack energy storage

The V160/218 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 5.8.).

4.2.6. Dynamic brake / brake fan (F25)

CV 181 (factory value: 240) indicates how much of CV 4 is removed when the dynamic brake is activated and the speed is reduced on the speed controller. If the locomotive is stationary while the function is active, it can only be started again after the function has been switched off.

4.2.7. Locomotive brake (F26)

CV 180 (factory value: 30) indicates how much of CV 4 is removed when the locomotive brake F26 is active. The higher the value, the more the locomotive brakes. If the locomotive is stationary while the function is active, it can only be started again after the function has been switched off.

Decoder settings

5. Decoder settings (Programming)

Chapter 5 is devoted to changing the most important settings of the LokSound decoder. The decoder in your Class 66/77 has been specially adapted to the model and offers many features that cannot all be listed here. We limit ourselves to the most common questions.

For each of these changeable properties there is one or more memory locations within the decoder in which numerical or letter values can be stored.

You can think of the individual memory locations as „index cards“ that are stored in a large file box: so that the individual index cards can be found again, they have a number or label with the property of the card, such as „locomotive address“ or „maximum speed“.

If you now imagine further that these index cards can be written on with a pencil; changes can be made at any time by „erasing and rewriting“.

Not all “cards” can be written on:

Some information such as the manufacturer ID for ESU is hard-coded.

You can determine the content of the memory locations and are read and taken into account by the decoder during operation. Using a procedure known as “programming”, you can fill these memory locations with the values you want.

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 9 show 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 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“). CV 29 is an good example:

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 63. 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).

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

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 arrestor until you hear a click sound), hold it in this position and then press the „Go“ button.

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

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).

5.2.2.3. Long programming mode

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

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

Decoder settings

- 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.

5.2.4. 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 Class 66/77, please make sure you are using software version 5.0.14 or later which is available for download from our website.

5.3. Address settings

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

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 V160/218. 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 Class 66/77 locomotive. You want to set 3 consecutive addresses. They are 67, 68 and 69. They will then switch the consecutive functions whenever you call up 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 #3	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 address	0
0	1	1 consecutive addr. active	8
1	0	2 consecutive addr. active	128
1	1	3 consecutive addr. active	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 and deceleration

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

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

5.4.1.1. Shunting mode

The shunting gear can be switched on ex works with F21. It cuts the speed in half at each speed step. This means that you can drive more sensitively in the lower speed range, which is very useful for maneuvering, especially in 14-speed mode.

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 CV 5.

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 stop then. 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

Decoder settings

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 exactly 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 0 in CV 27.
- If you wish to stop the LokSound decoder when the track signal is stronger on the left side than on the right side (and the diodes are also installed on the right side), set bit 1 in CV 27.
- If you want to stop the decoder no matter in which half of the track the diodes are set, please set bit 0 and bit 1 in CV 27 (CV 27 = 3).

5.5.3.1. ABC recognition threshold

In some operating cases it can happen that the LokSound decoder does not recognize the ABC braking section. This can be due to the cabling or the boosters or brake diodes used. The detection sensitivity can be influenced with the help of CV 134. Change the factory setting (8) step by step and test until the result is OK.

5.6. Adjusting the volume

The volume of all individual sounds of the Class 66/77 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 CVs" CV 31 and CV 32 have the correct values:

Before you change any volume CV please make sure that CV 31 = 16 and CV 32 = 1.

The CVs for the sounds are defined as follows:

CV	Function	Value
259	Drive sound	128
291	Airhorn	128
299	Compressor	40
307	Station announcement #1	120
315	Coupler	40
323	Airhorn short (low)	128
339	Sanding	45
363	Station announcement #2	120
371	Curve squeal	98
379	Airhorn short (high)	128

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 of 60 facilitates about 1 second. 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 Class 66/77 LEDs can be individually adjusted. The settings go from value 31 (very bright, factory setting) down to value 0 (light almost switched off, very dark). Please change the following CV values (all versions except CargoNet and HectorRail):

Description (* for cNet,TGOJ,CFL)	Decoder output	Index CV/32	CV	Value
Lower right FS1 (*außen)	Front light [1]	0	262	31
Lower right FS1 (blinkend)	Front light [2]	0	358	31
Lower right FS2 (*außen)	Back light [1]	0	270	31
Lower right FS2 (blinkend)	Back light [2]	0	366	31
Lower left FS1 (* & rechts)	AUX1[1]	0	278	31
Lower left FS1 (blinkend)	AUX1[2]	0	374	31
Lower left FS2 (* & rechts)	AUX2[1]	0	286	31
Lower left FS2 (blinkend)	AUX2[2]	0	382	31
Above FS1	AUX3	0	294	31
Above FS2	AUX4	0	302	31
Cab light FS1	AUX5	0	310	31
Cab light FS2	AUX6	0	318	31
Red FS1	AUX7	0	326	31
Driver's desk FS1 und FS2	AUX8	0	334	31
Brake light	AUX9	0	342	15
Red FS2	AUX10	0	350	31

5.10. Smoke generator

The smoke generator can also be adapted to your needs.

5.10.1. Fan speed

The fan speed can be adapted to your wishes using CV 138 (factory value: 128). A higher value results in a higher speed and thus a larger smoke plume, but also means a higher „consumption“ and lower density of the smoke.

5.10.2. Heating temperature

The temperature of the heating element can be adapted to the application with CV 139 (factory setting: 128). Increase the value just a little to avoid excessive wear and tear on the smoke generator. The settings of CV 138 and CV 139 depend on each other and should be changed together.

6. Maintenance

6.1. Removal of the housing

Place the locomotive model on the roof. In the locomotive floor you will find a total of four Phillips screws between the bogies and the tank. You loosen this and put the model back on its wheels. The housing can then simply be lifted off. The pink circles point to the screws that must be loosened to remove the case.



Figure 9: Seat of the housing screws

6.2. Lubrication work

We have equipped the Class 66/77 with durable mechanical components. All moving parts are permanently lubricated with high-quality greases and oils. Additional greasing of the individual components is therefore not necessary.

6.3. Exchange of wheelsets

Replacing the wheel sets: If fitted, first use the tool to pull off the center grinder (see section 3.2.2.). Use a Phillips screwdriver to loosen the three screws in the base of the bogie (circled in pink) and lift off the gearbox cover.

Lift off the unscrewed bogie cover and take out the wheel set.

Insert the new set of wheels and make sure that the power take-off plates are on the inside of the wheels.

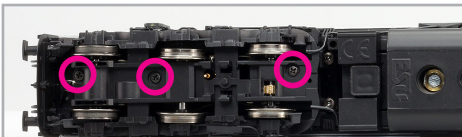


Figure 10: Loosen the bogie screws

6.4. Traction tire exchange

Traction tires age and must be replaced when they wear out. ESU delivers suitable traction tires with every locomotive. To change the traction tires, you must unscrew the bogie cover (see section 6.3.).

During assembly, make sure that the traction tires are pulled on evenly and without tension in order to prevent the model from running out of round. It is helpful to first bathe the unmounted traction tires in relaxed water (a drop of detergent is enough) before they are mounted.

6.5. Assembly of a coupling

We deliver the model from the factory with a model coupling on the driver's cab side 2. At the other end of the locomotive, the apron is closed and prototypical hose couplings are fitted. The installation of a model coupling takes about two minutes. You will find the necessary components in the packaging. Small flat-nose pliers or tweezers and a thin screwdriver are sufficient as tools.

Remove the coupling shaft and the coupling from the accessory bag.

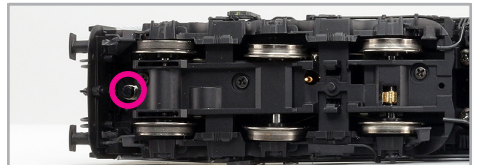


Figure 11: Coupling socket

The spring-loaded socket for the coupling shaft is located between the front apron and the front of the bogie.

Use tweezers / flat-nosed pliers to pull off the hose couplings and the original coupling and then press the apron insert inwards.

Since the insert is sometimes quite tight, move the thin screwdriver next to the retaining lug between the apron and the insert.

Place the coupling shaft on the socket in such a way that the front "in the direction of travel" points to the left.

Then press the shaft down and turn it 90 degrees until it protrudes from the front of the apron.

Now plug in the bracket coupling.

The first locking position of the coupling may be necessary to avoid overbuffering with the first car when heavy trains are to be pushed through tight curves. Normally, however, you push the coupling into its end position.

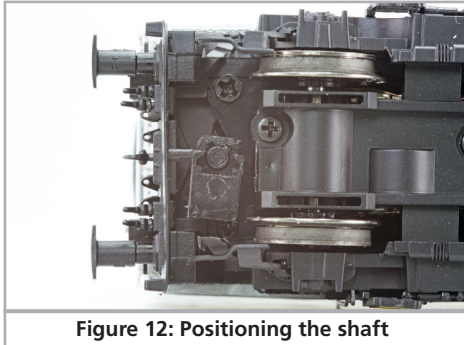


Figure 12: Positioning the shaft

7. Accessories included

The model comes with parts for installing a second model coupling and parts for replicating a closed apron including accessories.

8. Technical support

If you have any questions about your Class 66/77 that are not answered here, it is best to contact your specialist dealer first. He is your competent contact for all matters relating to model railways.

If this does not know the answer either, it is best to visit our website on the Internet. We always publish current information and the latest versions of the documentation there. You can also check our address and telephone numbers there at any time.

www.esu.eu

9. Spare parts

Because of the large number of parts in your Class 66/77, we have divided the spare parts into assemblies. Some parts belonging to a large assembly are also available in smaller assemblies.

Please note that only the parts listed in the spare parts sheet available on the ESU website are available as spare parts ex works. You can call up the spare parts sheet at: <http://www.esu.eu/download/betriebsanleitungen/esu-engineering-edition/>.

Requests for individual parts are pointless.

If you need a spare part, you must first identify the spare parts group that contains the part. In the case of seldom used parts, you may need to purchase a very large assembly. The ESU article number mentioned must be specified when ordering spare parts from your dealer.

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	3																																										
3	Acceleration	This value multiplied by 0.25 is the time from stop to maximum speed	0 - 255	80																																										
4	Deceleration	This value multiplied by 0.25 is the time from maximum speed to stop	0 - 255	45																																										
5	Maximum speed	Maximum speed of the engine	0 - 255	120																																										
8	Manufacturer's ID	Manufacturers's ID ESU - Writing value 8 in this CV triggers a reset to factory default values	-	151																																										
17	Long address of the loco	Long address of engine	128 - 9999	192																																										
18		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																																										
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		24																																										
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28	RailCom® Configuration	Settings for RailCom®		131																																										
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29	Configuration register	This register contains important information, some of which are only relevant for DCC operation.		30																																										
		<table border="1"> <thead> <tr> <th>Bit</th> <th>Function</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Normal direction of travel</td> <td>0</td> </tr> <tr> <td></td> <td>Reversed direction of travel</td> <td>1</td> </tr> <tr> <td>1</td> <td>14 speed steps DCC</td> <td>0</td> </tr> <tr> <td></td> <td>28 or 128 speed steps DCC</td> <td>2</td> </tr> <tr> <td>2</td> <td>Disable analog operation</td> <td>0</td> </tr> <tr> <td></td> <td>Enable analog operation</td> <td>4</td> </tr> <tr> <td>3</td> <td>Disable RailCom®</td> <td>0</td> </tr> <tr> <td></td> <td>Enable RailCom®</td> <td>8</td> </tr> <tr> <td>4</td> <td>-</td> <td>0</td> </tr> <tr> <td></td> <td></td> <td>16</td> </tr> <tr> <td>5</td> <td>Short addresses (CV 1) in DCC mode</td> <td>0</td> </tr> <tr> <td></td> <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	-	0			16	5	Short addresses (CV 1) in DCC mode	0		Long addresses (CV 17 + 18) in DCC mode	32					
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48	Language selection	CV selects the language of the station announcement. See chapter 4.2.2.	0 - 255	0																																										
49	Extended Configuration	More important adjustments for the decoder	0 - 255	17																																										
		<table border="1"> <thead> <tr> <th>Bit</th> <th>Description</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Enable Load control</td> <td>1</td> </tr> <tr> <td></td> <td>Disable Load control</td> <td>0</td> </tr> <tr> <td>1</td> <td>Reserved</td> <td>2</td> </tr> <tr> <td>2</td> <td>Reserved</td> <td>4</td> </tr> <tr> <td>3</td> <td>Märklin® Consecutive addresses, „low“-Bit“</td> <td>0</td> </tr> <tr> <td></td> <td></td> <td>8</td> </tr> <tr> <td>4</td> <td>Disable automatic DCC speed step detection</td> <td>0</td> </tr> <tr> <td></td> <td>Enable automatic DCC speed step detection</td> <td>16</td> </tr> <tr> <td>5</td> <td>Disable LGB® function button mode</td> <td>0</td> </tr> <tr> <td></td> <td>Enable LGB® function button mode</td> <td>32</td> </tr> <tr> <td>6</td> <td>Reserved</td> <td>64</td> </tr> <tr> <td>7</td> <td>Märklin® Consecutive addresses, „high“-Bit</td> <td>0</td> </tr> <tr> <td></td> <td>Please note chapter 5.3.3.1. for explanation Bit 3, 7</td> <td>128</td> </tr> </tbody> </table>	Bit	Description	Value	0	Enable Load control	1		Disable Load control	0	1	Reserved	2	2	Reserved	4	3	Märklin® Consecutive addresses, „low“-Bit“	0			8	4	Disable automatic DCC speed step detection	0		Enable automatic DCC speed step detection	16	5	Disable LGB® function button mode	0		Enable LGB® function button mode	32	6	Reserved	64	7	Märklin® Consecutive addresses, „high“-Bit	0		Please note chapter 5.3.3.1. for explanation Bit 3, 7	128		
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CV	Name	Description	Range	Value		
50	Analogue mode	Selection of allowed analogue modes	0 - 3	3		
		Bit			Function	Value
		0			Disable AC Analogue Mode Enable AC Analogue Mode	0 1
		1			Disable DC Analogue Mode Enable DC Analogue Mode	0 2
51	„K Slow“ Cutoff	Internal gear up to which the „K slow“ value set in CV 52 is used	0 - 255	20		
52	Load control parameter „K slow“	„K“-component of the internal PI-controller for lower speed steps	0 - 255	20		
53	Control Reference voltage	Defines the Back EMF voltage, which the motor should generate at maximum speed. The higher the efficiency of the motor, the higher this value may be set. If the engine does not reach maximum speed, reduce this parameter.	0 - 255	140		
54	Load control parameter „K“	„K“-component of the internal PI-controller. Defines the effect of load control. The higher the value, the stronger the effect of Back EMF control.	0 - 255	25		
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 higher this value has to be set.	0 - 255	40		
56	Operating range of load control	0 – 100 % Defines up to which speed in % load control will be active.	0 - 255	255		
63	Sound volume «Master»	Master volume for all sounds	0 - 192	192		
67-94	Speed table	Defines motor voltage for speed steps. The values „in between“ will be interpolated.	0 - 255	-		
113	Power Fail Bypass	The time that the decoder bridges via the PowerPack after an interruption of voltage. Unit: A multiple of 0.016384 sec.	0 - 255	50		
125	Starting voltage Analogue DC		0 - 255	90		
126	Maximum speed Analogue DC		0 - 255	130		
127	Starting voltage Analogue AC		0 - 255	90		
128	Maximum speed Analogue AC		0 - 255	130		
134	ABC mode „sensitivity“	Response threshold from which asymmetry ABC should be recognized.	4 - 32	8		
138	Smoke generator - Blower	Adjusting the fan speed. The higher the value, the faster operates the fan and the more smoke will be ejected.	0 - 255	128		
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	Braking function 1	Value indicates how much of CV 4 is removed when the function is activated and the speed is reduced on the speed controller.	0 - 255	20		
180	Braking function 2	Value indicates how much of CV 4 is removed when the function is activated and the speed is reduced on the speed controller.	0 - 255	30		
181	Braking function 3	Value indicates how much of CV 4 is removed when the function is activated and the speed is reduced on the speed controller.	0 - 255	240		
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		

12. Warranty

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 authorized 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 authorized dealer.

No claims will be accepted without proof of purchase. We recommend keeping the receipt.

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 receipt of purchase and fault description directly to ESU electronic solutions ulm GmbH & Co. KG.

If you want to know the details how to handle warranty returns, please refer to our website www.esu.eu