

## LD-G-14

Lastgeregelter Lokdecoder  
für Gleichstrommotoren  
Motorola-Format

Locomotive Decoder  
with load control for  
DC engines - Motorola format

Décodeur avec compensation de  
charge pour locomotive avec  
moteur continu - Format Motorola

Lastgeregelde Locdecoder  
voor gelijkstroommotoren  
Motorola-format

Art.-Nr. 22-01-081

**Anleitung**

**Manual**

**Mode d'emploi**

**Handleiding**





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## How to use this manual

Even if you have no specialist technical training, this manual gives step-by-step instructions for safe and correct fitting of the module, and operation. Before you start, we advise you to read the whole manual, particularly the chapter on safety instructions and the FAQ chapter. You will then know where to take care and how to prevent mistakes which take a lot of effort to correct.

Keep this manual safely so that you can solve problems in the future. If you pass the module on to another person, please pass on the manual with it.

## Intended use

The locomotive decoder is designed for mounting in a model train with DC motor. It evaluates the Motorola format data sent by the digital central unit to its address and controls the locomotive's motor and additional functions.

The module should not be mounted by children under the age of 14.

Reading, understanding and following the instructions in this manual are mandatory for the user.

Any other use is inappropriate and invalidates any guarantees.



### **Caution:**

Integrated circuits (ICs) are inserted on the decoder. They are very sensitive to static electricity. Do not touch components without first discharging yourself. Touching a radiator or other grounded metal part will discharge you.

## Safety instructions

### Mechanical hazards

Cut wires can have sharp ends and can cause serious injuries. Watch out for sharp edges when you pick up the PCB.

Visibly damaged parts can cause unpredictable danger. Do not use damaged parts: recycle and replace them with new ones.

### Electrical hazards

- Touching powered, live components,
- touching conducting components which are live due to malfunction,
- short circuits,
- connecting the circuit to another voltage than specified,
- impermissibly high humidity,
- condensation build up

can cause serious injury due to electrical shock. Take the following precautions to prevent this danger:

- Never perform wiring on a powered module.
- Mounting the module should only be done in closed, clean, dry rooms. Beware of humidity.
- Only use low power for this module as described in this manual and only use certified transformers.
- Connect transformers and soldering irons only in approved mains sockets installed by an authorised electrician.
- Observe cable diameter requirements.
- After condensation build up, allow a minimum of 2 hours for dispersion.
- Use only original spare parts if you have to repair the module.

## Fire risk

Touching flammable material with a hot soldering iron can cause fire, which can result in injury or death through burns or suffocation. Connect your soldering iron or soldering station only when actually needed. Always keep the soldering iron away from inflammable materials. Use a suitable soldering iron stand. Never leave a hot soldering iron or station unattended.

## Thermal danger

A hot soldering iron or liquid solder accidentally touching your skin can cause skin burns. As a precaution:

- use a heat-resistant mat during soldering,
- always put the hot soldering iron in the soldering iron stand,
- point the soldering iron tip carefully when soldering, and
- remove liquid solder with a thick wet rag or wet sponge from the soldering tip.

## Dangerous environments

A working area that is too small or cramped is unsuitable and can cause accidents, fires and injury. Prevent this by working in a clean, dry room with enough freedom of movement.

## Other dangers

Children can cause any of the accidents mentioned above because they are inattentive and not responsible enough. Children under the age of 14 should not be allowed to work with this module.

Little children can swallow small components with sharp edges, with fatal results! Do not allow components to reach small children.

In schools, training centres, clubs and workshops, assembly, mounting and operation must be supervised by qualified personnel.

In industrial institutions, health and safety regulations applying to electronic work must be adhered to.

## EMC declaration

This product is developed in accordance with the European standards EN 55014 and EN 50082-1, tested corresponding to the EC - directive 89/336/EEG (EMVG of 09/11/1992, electromagnetic tolerance) and meets legal requirements.

To guarantee the electromagnetic tolerance you must take the following precautions:

- Connect the transformer only to an approved mains socket installed by an authorised electrician.
- Make no changes to the original parts and accurately follow the instructions, print layout and circuit diagram included with this manual.
- Use only original spare parts if you have to repair the module.

## Operation overview

The decoder is designed for operation in Motorola II format and can be adjusted to one of 255 addresses. It evaluates the digital data sent by the central unit to its address. It controls the locomotive's motor and the driving characteristics. In addition, it switches four function outputs, which can for instance be used for the locomotive's lighting.

In Motorola I format it is possible to operate the decoder, but the programming of the parameters and the controlling of the functions is restricted.

### Automatic recognition of the analogue mode

The decoder can also be used in analogue model railway layouts run with an A.C. speed control. When putting the locomotive on the rails the decoder recognizes automatically if it is run in analogue or digital mode and sets the corresponding operation mode. The automatic recognition of the analogue mode can be switched off by programming the decoder accordingly.

The decoder is not suitable for being operated in analogue model railway layouts run with an D.C. speed control. The decoder evaluates the data received in such layouts as "braking section", the locomotive therefore does not run.

In analogue mode the decoder reacts to the analogue changing direction signal. The lighting is always switched on according to the direction of travel. Switching on or off the lighting and the additional functions is not possible.

### **Driving of the motor**

The locomotive decoder drives the motor with a PWM of 16 kHz. This guarantees a soft and constant run of the motor, with which the decoder can also be used with coreless (Faulhaber) motors.

### **Load control**

The locomotive decoder has a load control. The load control influences the motor voltage to keep the locomotive at constant velocity, independent of additional loads (e.g. running up a gradient, coupled carriages).

The decoder chooses automatically the optimal values of the load control's parameters for the connected motor. The range of values from which the decoder chooses the optimal value can be altered by programming the decoder accordingly.

### **Direction of motion**

When changing the direction in digital operation the existing direction is saved and so retained, even if the central unit does not send absolute driving data (e.g. in Motorola I format).

In order to change the direction of travel in analogue operation a voltage impulse is applied to the rails which is distinctly higher than the normal driving voltage. Disturbances from the locomotive motor, tolerances in the connected components or voltage drops in the rails can release unintended changes of direction or hinder intended changes of direction. The voltage needed for a change of direction can be adjusted by programming the decoder accordingly.

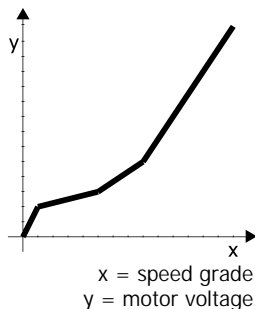


## Speed level

The decoder can drive 27 speed levels. Driving all 27 speed levels can be done only with central units which support this mode (e.g. MasterControl). With central units which only allow 14 speed levels only, it is only possible to select every second speed level.

## Velocity characteristic

The decoder can be adjusted to the individual driving characteristics of the motor and the characteristic speed of the locomotive type, by setting the starting velocity and the maximum velocity. From the starting velocity and the maximum velocity the decoder generates a velocity characteristic corresponding to the opposite figure. This characteristic allows a good fine tuning of the speed in the lower speed range.



## Shunting gear

The auxiliary function F4 allows you to switch into the shunting gear mode. In the shunting gear mode the velocity of all speed levels is reduced to ca. 25 % compared to the standard velocity.

## Acceleration and brake delay

It is possible to program the acceleration and brake delay individually. You can switch the acceleration and the brake delay on or off by operating the function key F3. Even if the acceleration and the brake delay are active you can actuate an emergency stop via the central unit by reversing the direction of travel.

## Function outputs

The decoder has four function outputs which can be switched on and off via the function keys „function“ and / or the auxiliary function keys F1 to F4. They are available to connect optional accessories (e.g. lighting, smoke generator, sound module, electric coupling).

The set states of the function outputs are saved. Even if the decoder is without current for a longer time, the states are set when the decoder is switched on again.

**Assignment:** You can assign the function keys to the function outputs freely. It is possible to assign several function keys to one function output.

Each function output can be programmed in such a way that it can be switched

- independent of the direction of travel with all function keys or
- dependent of the direction of travel with all function keys or
- dependent of the direction of travel with F0 („function“) and independent of the direction of travel with F1 to F4.

Example of use: The lighting of a shunting locomotive is assigned both to the function key „function“ as to the function key F4. In shunting operation you switch the lighting via F4 and in standard operation according to the direction on travel via „function“.

**Dimming:** All function outputs can be dimmed individually.

Example of use: The electric bulbs of older locomotives made for analogue operation can be dimmed and thus must not be exchanged after the mounting of the decoder.

Example of use: The front lighting is assigned to two different function outputs. Via one function key you can switch the standard lighting, via another the long distance lighting.

**Flash lights:** It is possible to program a flash light for all function outputs. Two flashing phases are available out-of-phase by 180 degrees. Example of use: individual flash lights or alternating flash lights.

## CV programming

Setting the address, the driving characteristics (starting and maximum velocity, acceleration and brake delay) and the velocity characteristic and adjusting the decoder to the particular locomotive motor (motor frequency, voltage for change of direction, load control parameters) as well as the definition of the function outputs´ characteristics is done by

programming the configuration variables (= CV). The CV programming has been laid down for DCC decoders in the NMRA guidelines. The CV programming for this Motorola decoder has been developed following these guidelines, but differs in some points, according to the differences between both formats. In particular programming the decoder on a DCC programming-track is not possible.

### Online programming

Alternatively to the CV programming it is possible to program the address and the driving characteristics "online". This means:

- Right after starting the programming mode you can enter the new address and directly save it.
- While programming the driving characteristics (starting and maximum velocity, acceleration and brake delay) the locomotive is running. By operating the speed knob the driving characteristics are altered. As soon as these are set as desired, they can be saved directly (online).

### Restrictions in Motorola I format

The auxiliary functions F1, F2, F3 (switching on and off the acceleration and brake delay) and F4 (switching on and off the shunting gear) are not available in Motorola I format. Programming the decoder can only be done via CV programming.

## Technical specifications

Data format	Motorola I and II
Supply voltage	12-24 Volt digital voltage
Current consumption (without connected loads)	approx. 10 mA
Max. current for motor	3.000 mA
Max. current per function output	1.000 mA
Max. total current	3.000 mA
Protected to	IP 00
Ambient temperature in use	0 - + 60° C

Ambient temperature in storage	-10 - + 80° C
Comparative humidity allowed	max. 85 %
Dimensions	approx. 26 x 19 x 7,5 mm
Weight	approx. 3,5 g

## Checking the package contents

Check the contents of the package for completeness after unpacking:

- one decoder
- one manual

N.B. For technical reasons it is possible that the PCB is not completely inserted. This is not a fault.

## Required tools and consumables

Make sure you have the following tools and materials ready for use:

- an electronic soldering iron (max. 30 Watt) with a fine tip,
- a soldering iron stand,
- a tip-cleaning sponge,
- a heat-resistant mat,
- a small side cutter, a wire stripper and a pair of tweezers,
- wire, diameter:  $\geq 0,05 \text{ mm}^2$  up to a current of 1 A resp.  $\geq 0,14 \text{ mm}^2$  (from a current of more than 1 A),
- tin solder (0,5 mm. diameter).
- When the total current consumption is more than 1,5 A: a heat sink, e.g. a SMD heat sink with a base of 7 x 19 mm.

## Safe and correct soldering



### Caution:

Incorrect soldering can cause dangers through fires and heat. Avoid these dangers by reading and following the directions given in the chapter **Safety instructions**.

- Use a small soldering iron with max. 30 Watt. Keep the soldering tip clean so the heat of the soldering iron is applied to the solder point effectively.
- Only use electronic tin solder with flux.
- When soldering electronic circuits never use soldering-water or soldering grease. They contain acids that can corrode components and copper tracks.
- Solder quickly: holding the iron on the joints longer than necessary can destroy components and can damage copper tracks or soldering eyes.
- Apply the soldering tip to the soldering spot in such a way that the wire and the soldering eye are heated at the same time. Simultaneously add solder (not too much). As soon as the solder becomes liquid take it away. Hold the soldering tip at the spot for a few seconds so that the solder flows into the joint, then remove the soldering iron.
- The joint should be held still for about 5 seconds after soldering.
- To make a good soldering joint you should use a clean and unoxidised soldering tip. Clean the soldering tip with a damp piece of cloth, a damp sponge or a piece of silicon cloth.
- After soldering check (preferably with a magnifying glass) tracks for accidental solder bridges and short circuits. This would cause faulty operation or, in the worst case, permanent damage. You can remove excess solder by putting a clean soldering tip on the spot. The solder will become liquid again and flow from the soldering spot to the soldering tip.

## Mounting the locomotive decoder

Before mounting the decoder check if the locomotive motor's current is below the maximum permissible value of 3.000 mA. If it is above 3.000 mA the decoder is not suitable for mounting in this locomotive. It would be damaged when put into operation.

Follow the connections diagrams (fig. 1, 2 and 3)!

## Connecting the motor

Open the locomotive housing. Locate the position for the decoder. Disconnect the motor from the rail current collector or the change-over switch from the motor and rails if you have a locomotive with electronic change-over switch. The change-over switch is no longer necessary, you can remove it.



### Caution:

The interference suppression devices mounted to the motor or the connecting wire must not be removed! Motor and interference suppression devices are one unit. If even one part is removed, it can cause extreme interference!

Solder the connection to the slider at point X1, and the connection to the housing to point X2. These two connections can be exchanged without effecting functionality.

Solder the connections to the motor at the points X11 and X12. In case the locomotive's direction of motion does not match the direction of motion set at the central unit you should swap the connections at the points X11 and X12.

## Connecting the lighting and other accessories

Before connecting the accessories check if the current is below the maximum permissible value of 1.000 mA. If accessories with a current of more than 1.000 mA are connected the decoder will be damaged when put into operation. Please note that the maximum total current for motor and accessories should not exceed 3.000 mA.

Disconnect any existing diodes in the leads to the lamps.

Connect the lamps and other accessories to the function outputs (X4 to X7) on the front of the decoder. The assignment of the function outputs to the function keys can be altered by setting the configuration variables.

If the lamp or the accessory is already connected with one side to locomotive ground, the connection is complete. If not, connect the second side of the lamp or the accessory to the return conductor of the decoder (point X3).

If you want to use the decoder factory settings, you have to connect the lighting and the accessories as follows:


Front lighting: X5

Back lighting: X4

Accessory to be switched via F1: X7


Accessory to be switched via F2: X6

In case you want to operate the decoder in analogue mode and want to switch the lighting depending on the direction of travel, you have to connect the front and back lighting to the points X5 and X4 respectively.

 **Caution:**

The return conductor for all functions (point X3) must under no circumstances be connected to locomotive ground. Possible short circuit! The locomotive decoder will be damaged in operation.


**Tip:** If the second side of the lamps is connected to locomotive ground the lamps often flicker in operation. You can avoid the flickering of the lamps if you connect the second side to the return conductor (point X3) instead of locomotive ground.

 **Caution:**

If you connect the lamps to the return conductor for all functions (point X3), the lamps must be insulated. The lamps must not make contact with metal parts of the locomotive. Possible short circuit! The locomotive decoder will be damaged in operation.

### Connecting the LEDs

The function outputs of the locomotive decoder switch against decoder ground. For that reason you must connect the cathode (-) of the LED to the output of the relevant function.

 **Caution:**

If you use light-emitting diodes (LEDs) you must always operate them via a series resistor. The series resistors differ depending on the current and the model. Calculate the proper value or ask for it when purchasing the LED.

You can connect several LEDs each with a series resistor of it´s own in parallel to one output. If you connect several LEDs to one output in series, only one series resistor is needed.

### Fixing the locomotive decoder

After completing all connections fix the locomotive decoder with double-sided adhesive tape, for example.



#### Caution:

The locomotive decoder can get warm during operation. For that reason it should not be covered with shrinking hose or hot adhesive.



#### Caution:

When the total current consumption is more than 1,5 A you should cool the decoder. As a heat sink you could use a SMD heat sink with a base of 7 x 19 mm. Fix the heat sink on the diodes D1 to D4, using an appropriate glue ( e.g. super glue ). Take care that the heat sink does not contact the adjoining IC1. Risk of short circuit!

### Using an NEM 652 interface connector

Some locomotives already have an NEM 652 interface connector mounted. Using a convenient connecting plug you save disconnecting the connections and you do not need to solder at the locomotive.

Contact	Connection	Colour of cable	Connecting points
1	Motor connection 1	orange	X12
2	Lighting back (-)	yellow	X4
3	Not used or F1	green	X7
4	Power supply left	black	X2
5	Motor connection 2	grey	X11
6	Lighting front (-)	white	X5
7	Common conductor for all functions (+)	blue	X3
8	Power supply right	red	X1



## Programming the locomotive decoder

With the most digital control units supporting the Motorola II format (e.g. Tams MasterControl, Märklin\* Control Unit, Uhlenbrock\* Intellibox) you can choose between two methods of programming after having started the programming mode:

1. CV programming
2. Online programming

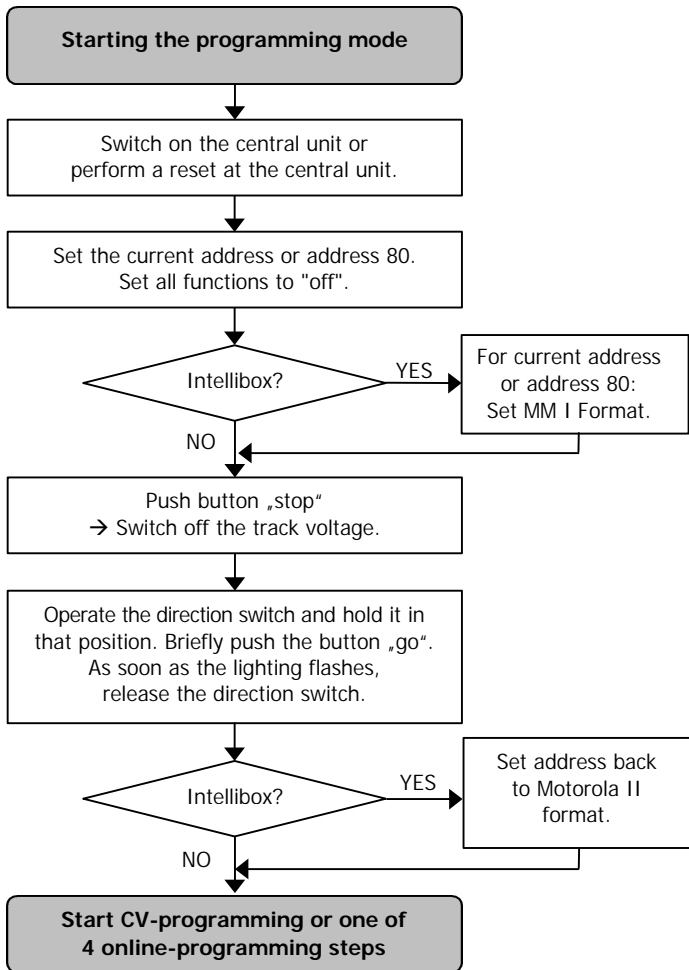
With the Central Station or the Mobile Station of Märklin\* you can program the address, the maximum speed and the acceleration and brake delay. Select the article no. 29750 from the locomotive database and program the decoder as described for this article in the Central Station´s or Mobile Station´s manual.

### Starting the programming mode

Put the locomotive on a track oval. If you want to program the decoder via CV programming it is sufficient to put the locomotive on a track section. Please note: You must connect the track oval or track section to the control unit´s track output and not to control unit´s output for the DCC programming track

Reset the central unit (by simultaneously pushing the buttons "stop" and "go" for some time) or quickly switch f the central unit on and off. First enter the current address or the address "80" (e.g. if you do not know the current address). Manufacturers setting is "78". Set all functions (function, f1 to f4) to "off".

Push the "stop" button at the central unit. Next, operate the direction switch and hold it in that position while briefly pushing the "go" button. As soon as the lamps of the locomotive flash (after approx. 2 seconds) the decoder is in the programming mode and you an release the direction switch. Now you can programm the decoder either by setting the configuration variables (CV) or "online".



**Notice:** Some types of central units do not allow you to access to the programming mode when the Motorola II format is set (e.g. Intellibox from Uhlenbrock\*). These central units must be set to Motorola I format for the current address or the address "80". As soon as the decoder is in the programming mode, the central unit must be set back to Motorola II format.

## CV programming

This programming method follows the standards for the DCC format by the NMRA. Please note: It is not possible to program this Motorola Decoder via the DCC programming track!

After having started the programming mode (and when the locomotive's lighting flashes) you can program the configuration variables (CV) as follows:

1. Choose the CV you want to program by setting the CV's number as Motorola locomotive address at your central unit.
2. Operate the direction switch. The locomotive's lighting stops flashing.
3. Set the desired value of the CV by setting the CV's value as Motorola locomotive address at your central unit.
4. Operate the direction switch again. The locomotive's lighting starts flashing again.

Repeat the steps 1 to 4 for all CVs you want to program. In order to choose a variable for programming or to enter a value for a variable you have to confirm the entered number like selecting a Motorola locomotive address. Please note: If you have a multi protol control you have to define the Motorola format for the particular address. The locomotive's lighting shows which kind of entry the decoder expects:

- locomotive's lighting flashes → entry of a CV's number
- locomotive's lighting stops to flash → entry of a CV's value

In order to stop the programming mode push "stop".

CV-name	CV-no.	Input value / (State of delivery)	Remarks
Address	1	1, 2, 3 ... 255 (78)	
Starting velocity	2	1, 2, 3 ... 80 (16)	=The voltage to be output to the motor at speed level 1. The value "0" corresponds to 0 Volt, the value "80" to the max. voltage.
Acceleration delay	3	1, 2, 3 ... 80 (5)	= Length of the delay before the switching to the next higher speed level when the locomotive is accelerating.
Braking delay	4	1, 2, 3 ... 80 (5)	= Length of the delay before the switching to the next lower speed level when the locomotive is braking.
Maximum velocity	5	1, 2, 3 ... 63 (54)	= The voltage to be output to the motor at the highest speed level.
Analogue mode	6	2, 3 (3)	2=on, 3=off
	7	---	Only internal importance. Do not enter new values for this CV.
Reset	8	1, 2, 3 ... 255 (---)	Any value restores the settings in state of delivery.

CV-name	CV-no.	Input value / (State of delivery)	Remarks
Analogue switching voltage	9	100 ... 200 (150)	= The voltage needed for change of direction.
Dimming output 1	10	1, 2, 3 ... 7 (6)	Dimming of the outputs. = The voltage that is applied to the output. The value "1" corresponds to the minimum, „7“ to the maximum voltage.
Dimming output 2	11	1, 2, 3 ... 7 (6)	
Dimming output 3	12	1, 2, 3 ... 7 (7)	
Dimming output 4	13	1, 2, 3 ... 7 (7)	
	14-15		Not used
Speed level 0	16	0 (0)	Only internal importance. Do not enter new values for this CV.
Individual velocity characteristic	17-43	0 ... 255	Velocity table for velocity characteristic. You can assign an individual motor voltage to each of the 27 speed levels.
	44-47		Not used
Lowest value of load control parameters	48	1, 2, 3 ... 80 (64)	Proceed in small steps when altering the CV#8, #48 und #49. For most motors the factory settings meet the optimum.
Highest value of load control parameters	49	48, 49 ... 255 (160)	

CV-name	CV-no.	Input value / (State of delivery)	Remarks
Assignment F0 – F4 to the outputs:		0 ... 31	Numerical value*
			Operation with:
			function key F0                    1
X5	50	(1)	function key F1                    2
X4	52	(1)	function key F2                    4
X7	54	(2)	function key F3                    8
X6	56	(4)	function key F4                    16
Effects for the outputs:		0 ... 31	Numerical value*
			at forward motion active            1
			at backward motion active        2
X5	51	(17)	Flashing phase A                    4
X4	53	(18)	Flashing phase B                    8
X7	55	(3)	Independent of direction of travel „on“ with F1 to F4    16
X6	57	(3)	
<p>Setting the numerical value: You program the configuration variables 50 to 57 by entering the sum of the numerical values which are assigned to the desired parameters.</p> <p>Values in state of delivery: In state of delivery the values are set so that the front and back lighting are switched depending on the direction of travel with F0.</p>			

## Online-programming

After having started the programming mode (and when the locomotive's lighting flashes) you can perform one of four online programming steps:

- directly entering the locomotive address,
- performing a decoder reset,
- setting the acceleration and braking delay and verifying the settings during driving operation,
- setting the starting and the maximum velocity and verifying the settings during driving operation.

After having entered a new address or performing a decoder reset the decoder automatically returns to standard driving operation.

After having set and saved the acceleration and braking delay or the starting and the maximum velocity the decoder first remains in the programming mode and you can alter and save your settings again. The programming step is not finished until pushing "stop". Then the decoder returns to standard driving operation.

Connect your central unit to a track oval for online-programming of the driving characteristics. Please do not place other vehicles on the track oval with a decoder while online programming, because they will possibly be programmed as well.

## Setting the locomotive's address

Start the programming mode (see above)	The locomotive's lighting flashes regularly.
	Enter the desired locomotive's address.
Switch on and off "function" (f0) once	The entered address is saved.
	After having saved the locomotive's address the lighting stops to flash and the decoder automatically returns to standard driving operation.

### Performing a decoder reset

Start the programming mode (see above)	The locomotive's lighting flashes regularly.
Switch on function F2.	The factory settings are restored, all other settings are deleted.
	The decoder automatically returns to standard driving operation.

### Setting the acceleration and braking delay

Start the programming mode (see above)	The locomotive's lighting flashes regularly.
Switch on function F1. Tip: With the online programming it is not possible to set the acceleration and the braking delay individually. This can be done with the CV programming only.	The locomotive's lighting flashes intermittently. Switch off the function F1. The locomotive accelerates and brakes continuously. By turning the speed control knob you can alter the acceleration and braking delay. Speed level 0 → no delay Highest speed level → maximum delay
Switch on and off "function" (f 0) once	The settings are saved. The locomotive's lighting flashes regularly.
Push "Stop"	The programming mode is finished.

### Setting the starting and the maximum velocity

Start the programming mode (see above)	The locomotive's lighting flashes regularly.
Funktion F3 einschalten	The locomotive's lighting flashes intermittently. Do <b>not</b> switch off the function F3. Turn the speed control knob until the locomotive drives with the desired starting velocity.
Switch on and off "function" (f0) once	The settings are saved and the locomotive's lighting flashes some times. The decoder changes to the setting of the maximum velocity (the locomotive drives faster).



	Turn the speed control knob until the locomotive drives with the desired maximum velocity.
Switch on and off "function" (f0) once	The settings are saved and the locomotive's lighting flashes intermittently. The decoder changes to the setting of the starting velocity (the locomotive runs slower).
Push "Stop"	The programming mode is finished.

## Operation

### Acceleration and brake delay

In Motorola II format the acceleration and brake delay is switched alternately on or off by switching on the function F3. F3 "off": delay active. The change of the setting takes effect immediately. If the acceleration and brake delay is switched off during braking the locomotive immediately runs with the speed level set at the central unit.

In Motorola I format the acceleration and brake delay is always active.

An emergency stop during acceleration and brake delay can be performed from the central unit by changing the direction of travel.


### Switching the shunting gear

In Motorola II format the shunting gear can be switched on and off via the auxiliary function F4. In Motorola I format the shunting gear cannot be activated.

### Improvement of the driving characteristics

Locomotives with especially high current consumption or track sections with bad contacts (e.g. some types of points) may give an unsatisfactory performance after the mounting of the locomotive decoder. You can improve the locomotive performance by soldering a capacitor 100  $\mu\text{F}$  / > 35 V to the points X8 and X15 (see fig. 1 and 3).

## FAQ

- Parts are getting too hot and/or start to smoke.  
Tip: The decoder may warm up to 45 °C in operation. This does not affect the functioning of the decoder.  
 **Disconnect the system from the mains immediately!**  
Possible cause: One or more connections are soldered incorrectly.  
→ Check the connections.  
Possible cause: The connection of the motor is connected to locomotive ground. → Disconnect the connection from locomotive ground.
- A lamp flickers (this is not a defect).  
Possible cause: The lamp is connected with one side to locomotive ground.  
→ If you do not want the lamp to flicker, disconnect it from locomotive ground, insulate it and connect it to the return conductor (point X3).
- The locomotive runs too fast or too slow.  
Possible cause: Different locomotives drive differently with the same decoder settings. → Adjust the decoder settings to the individual driving characteristics of the locomotive.
- The locomotive does not react to F3 or F4.  
Possible cause: The central unit is set to Motorola I format. → Set the central unit to Motorola-II format.
- The locomotive does not run in analogue mode.  
Possible cause: The analogue mode is switched off. → Alter the value for CV #6.  
Possible cause: The analogue model railway layout is run with a D.C. speed control; the analogue mode however is only possible with A.C. speed controls.
- After programming the decoder the locomotive does not run or runs badly.  
Possible cause: The set values for the CV are inconsistent.  
→ Perform a decoder reset and program the decoder anew.

- In digital mode the locomotive suddenly runs very fast.  
Possible cause: Interfering signals from the layout have switched the decoder to analogue mode. → So long as the interfering signals' origin cannot be found it is advisable to switch off the automatic recognition of the analogue mode during digital operation.

If you cannot find the problem, please return the decoder for repair (address on the cover page).

## Manufacturer's note

According to DIN VDE 0869, the person who brings the circuit into operation by extension or mounting into a housing is the manufacturer of the product. If he sells the product to another person he is responsible for passing on all the relevant papers and to give his name and address.

## Certification

This product conforms with the EC- directive 89/336/EWG on electromagnetic radiation and is therefore CE certified.

## Conditions of warranty

This product is guaranteed for two years. The warranty includes the correction of faults which can be proved to be due to material failure or factory flaw. We guarantee the adherence to the technical specifications of the circuit when assembled and connected according to the manual.

Other claims are excluded. By law, we are not responsible for damages or secondary damages in connection with this product. We retain the right to repair, make improvements, supply spare parts or return the purchase price.

The following invalidate the warranty:

- using an unsuitable soldering iron, solder containing liquid acids or similar,
- if damage is caused by not following the instructions in this manual,
- if the module has been altered and repair attempts have failed,
- if arbitrary changes in the circuit are made,
- if additional components are added which are not described in the manual,
- if the copper tracks or soldering eyes are damaged,
- if damage occurs due to an overload of the module,
- if connected to a incorrect voltage or current,
- if damaged by other persons,
- if damaged by faulty operation or if damaged by careless use or abuse,
- if damaged by touching components before electrostatic discharging of the hands.

\* The following manufacturers and their products are mentioned in this manual:

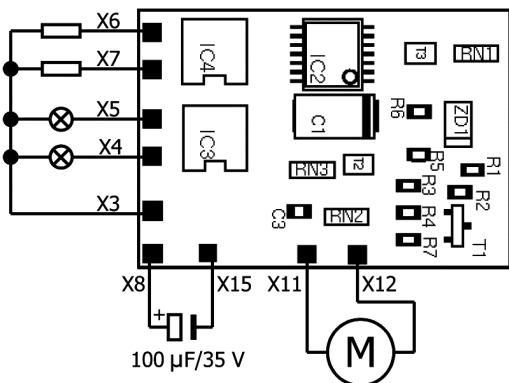
Märklin & Cie. GmbH, Goeppingen, Germany

Uhlenbrock Elektronik GmbH, Bottrop, Germany

**Fig. 1:**

Anschluß LD-G-14 / Connections LD-G-14

Connexion LD-G-14 / Aansluiten LD-G-14

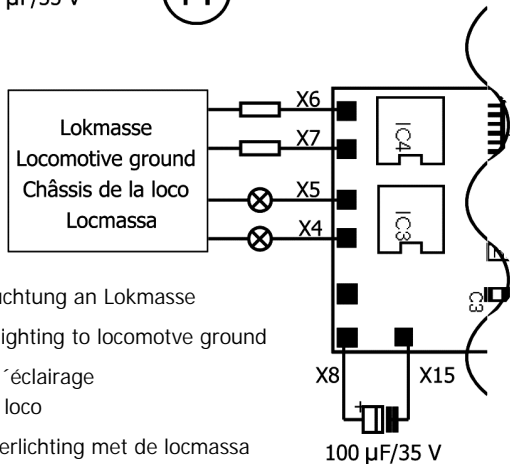
**Fig. 3:**

Anschluß der Beleuchtung an Lokmasse

Connection of the lighting to locomotive ground

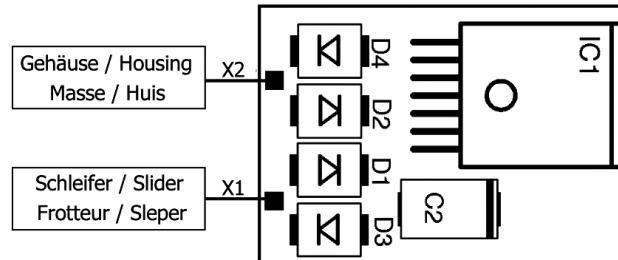
Raccordement de l'éclairage  
via le châssis de la loco

Verbinding van de verlichting met de locmassa

**Fig. 2:**

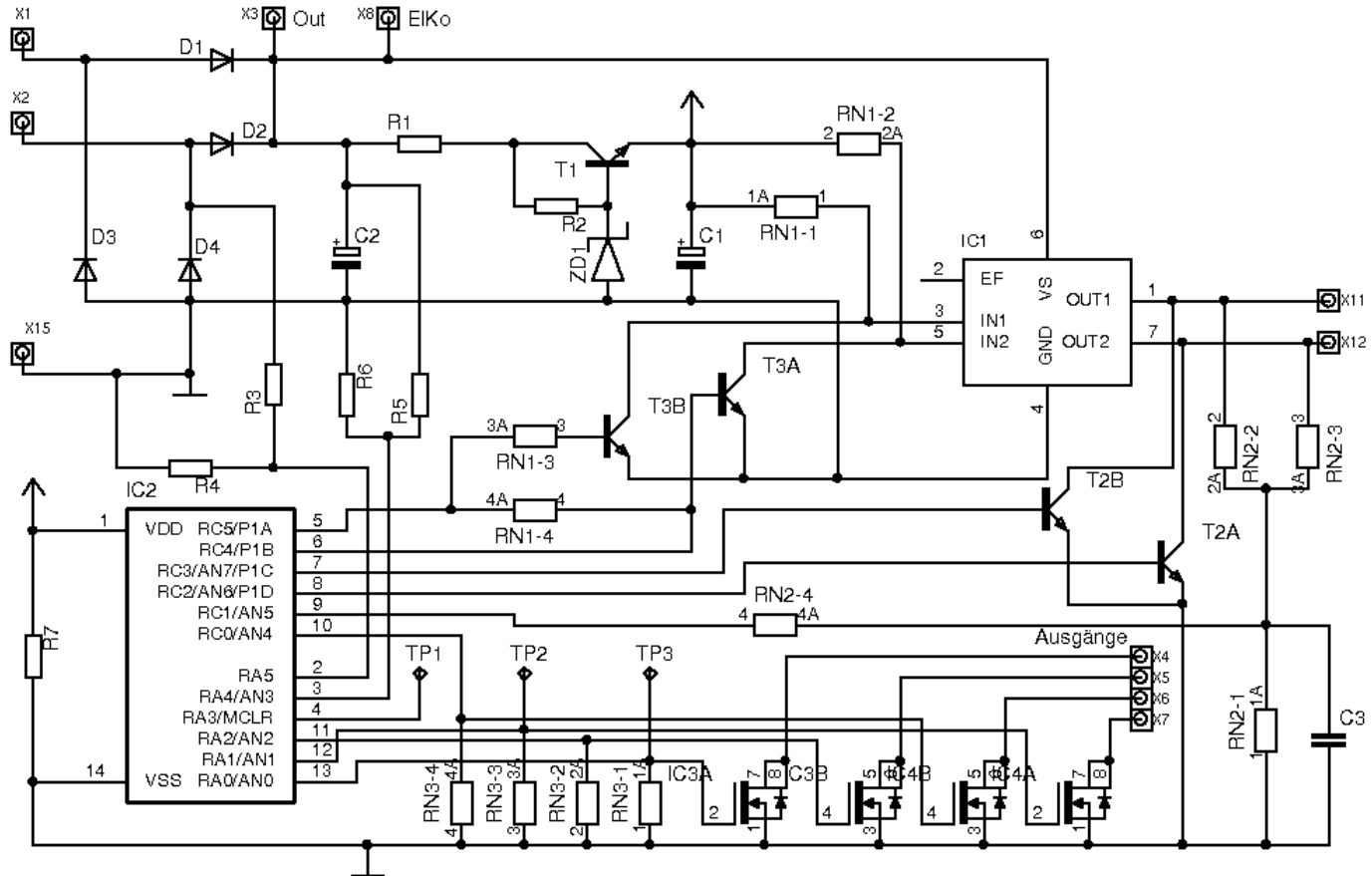
Anschluß LD-G-14 / Connections LD-G-14

Connexion LD-G-14 / Aansluiten LD-G-14



X1	Schleifer / Slider / Frotteur / Sleper
X2	Gehäuse / Housing / Masse / Huis
X3	Rückleiter für alle Funktionen / Return conductor for all functions Pole commun des fonctions / Retourleiding voor alle functie
X4	Beleuchtung Rückwärtsfahrt / Lighting reverse direction Feux marche arrière / Verlichting achteruitrijden
X5	Beleuchtung Vorwärtsfahrt / Lighting forward direction Feux marche avant / Verlichting vooruitrijden
X6	F2
X7	F1
X8 / 15	falls erforderlich / if necessary si nécessaire / indien noodzakelijk
X11/X12	Motor / Moteur

**Fig. 4:** Schaltplan - Circuit diagram - Schéma de principe - Schakelschema



Aktuelle Informationen und Tipps:

Information and tips:

Informations et conseils:

Actuele informatie en tips:

**<http://www.tams-online.de>**

Garantie und Service:

Warranty and service:

Garantie et service:

Garantie en service:

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