

# LD-G-10



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. 22-01-060

**Anleitung**

**Manual**

**Mode d'emploi**

**Handleiding**





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\* "Märklin" is a registered and protected trade mark of Gebr. Märklin & Co, Stuttgarter Straße, Göppingen, Germany.

\*\* "Intellibox" is a registered and protected trade mark of Uhlenbrock Elektronik GmbH, Bottrop, Germany.

## How to use this manual

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

### **Caution:**

Integrated circuits 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.

The module can be used according to the specifications of this manual in a model railway. Mounted in a model railway locomotive with d.c. motor it evaluates the Motorola II format data sent by the digital central unit to its address. The decoder controls the vehicle performance (velocity, direction of travel, acceleration) and switches two function outputs, which can be variously assigned to the functions keys.

The module is not suitable for 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.

## 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 55082-1, 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 and transmits it to the locomotive.

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.

### Driving of the motor

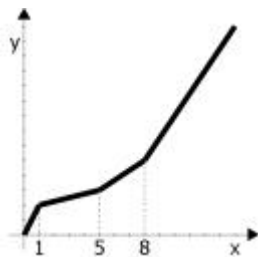
The motor is driven with a PWM of 32 kHz. This guarantees a soft and constant run of the motor. With that the decoder may be used with coreless (Faulhaber) motors as well.

### Load control

At constant motor voltage, additional loads (e.g. running up a gradient, coupled carriages) cause the locomotive to slow down or even come to a standstill. If the load control is active the motor voltage varies to keep the locomotive operating at constant velocity at a given speed level, independent of additional loads. When programming the decoder the load control can be switched on or off.

### 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.



x = speed grade  
y = motor voltage

## **Second velocity characteristic**

It is possible to program a second velocity characteristic (e.g. for shunting operation). You can switch between the two velocity characteristics by operating the function key F4.

## **Function speed level and direction of motion**

Based on 14 speed levels sent by the central unit the decoder can provide up to 27 speed levels. When changing the direction 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).

## **Acceleration and brake delay**

It is possible to program the acceleration and brake delay individually via the central unit. 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.

## **Automatic shuttle service**

If the automatic shuttle service is active the locomotive stops with the set brake delay as soon as the decoder detects a negative direct voltage on the track (Märklin\* braking route). Then the decoder changes internally the directions of motion „forwards“ and „backwards“. After the negative direct voltage on the track has been compensated the locomotive automatically starts with the set acceleration delay in the opposite direction.

During standard operation it is possible to drive the decoder as usual even if the automatic shuttle service is active. While the standard operation is interrupted the decoder maintains its present direction of travel.

## **Function outputs**

The decoder has two 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.

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. Function outputs that are assigned to the function key „function“ can be switched according to the direction of travel.

Example of use: The lighting of a shunting locomotive is assigned both to the function key „function“ as to the function key F1. In shunting operation you switch the lighting via F1 and in standard operation according to the direction on travel via „function“.

**Dimming:** The 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.

### **Check back of the address**

In the programming mode you can query the address. The address is transmitted coded by the flashing of the lighting of the locomotive.

### **Online-programming**

The address, the driving characteristics and all functions can be programmed online. This means:

- In order to start the programming mode and to set the desired (new) address, it is not necessary to enter the present address.
- 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).
- In the programming mode the function to be set is active. This makes it easier to assign the outputs to the function keys. The dimming function can be altered via the speed knob. As soon as it is set as desired, it can be saved directly (online).

## Restrictions in Motorola I format

In Motorola I Format the following settings can be made:

- address,
- starting and maximum velocity,
- assignment of the function outputs to „function“.

In Motorola I Format the load control is always active. It is not possible to perform a reset, to program the second velocity characteristic, the acceleration and brake delay and the parameters of the load control.

## Technical specifications

Data format	Motorola-I und -II
Supply voltage	12-18 Volt digital voltage
Current consumption (without connected loads)	approx. 10 mA
Max. current for motor	500 mA
Max. current per function output	100 mA
Max. total current	700 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. 9,2 x 11,7 x 2,7 mm
Weight	< 1 g

## Checking the package contents

Check the contents of the package for completeness immediately after unpacking:

- one decoder with soldered connecting wires or soldered NEM 651 interface connector, depending on the version.
- one manual.

## Required tools and consumables

Make sure you have the following tools, equipment 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 and wire stripper,
- a pair of tweezers,
- tin solder (0,5 mm. diameter),
- wire (diameter:  $\geq 0,05 \text{ mm}^2$  for all connections).

## 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**. If you have had training in soldering you can skip this chapter.

- 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.
- When soldering electronic circuits never use soldering-water or soldering grease. They contain acids that can corrode components and copper tracks.
- Only use tin solder SN 60 Pb (i.e. 60 % tin, 40 % lead) with rosin-based flux.
- 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. A glossy and perfect soldering spot should remain.
- 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

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 rail current collector if you have a locomotive with (electronic) change-over switch. The change-over switch is no longer necessary, you can remove it.

Follow the connection diagram fig. 1. Solder the red wire to the right rail current collector and the black wire to the left rail current collector (in direction of motion). Next solder the grey and the orange wires to the motor.

## Connecting the lighting and other accessories

Disconnect any existing diodes in the leads to the lamps. Follow the connection diagram fig. 1.

Connect the lamps and other accessories to the function outputs (white or yellow wires). The assignment of the function outputs to the function keys will be made when programming the decoder.

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

Front lighting: white wire

Back lighting: yellow wire

## Connections to the return conductor

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 X7).

 **Caution:**

If you connect the loads to the return conductor for all functions (point X7), the load must be insulated. The loads should not make contact with metal parts of the locomotive. Possible short circuit! The locomotive decoder will be damaged in operation.

 **Caution:**

The return conductor for all functions (point X7) 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 X7) instead of locomotive ground.

**Advice:** Before starting to program the locomotive decoder, you should connect a lamp to at least one of the function outputs, as the beginning of the programming mode as well as the entering of the set parameters is indicated by flashing the locomotive lighting.

**Advice:** Some accessories can not be checked for operation by switching on and off in short intervals. If you have connected accessories like these to the function outputs of the decoder it is recommended to connect a lamp in parallel to the accessory during the programming of the decoder.

## 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.

LEDs are available in many different models. There are LEDs with 2-5 mA, but also LEDs with 15-30 mA power consumption. The series resistor limits the current flow of the LED and will need to be calculated for each model. Ask for the max current rating when buying your LEDs.

You can connect up to 5 LEDs in parallel to each output. In this case every LED must have a series resistor of its own. If you connect several LEDs to one output in series, only one series resistor is needed. The number of LEDs connected in series to one output depends on the digital voltage.

You can determine the number of the LEDs that can be connected in series to one output from the following formula:

$$\boxed{(\text{number of LEDs} + 2) \times 1,5 < \text{digital voltage}}$$

### Fixing the locomotive decoder

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

## Programming the locomotive decoder

You can make the following adjustments from the central unit without intervention at the locomotive:

1. Locomotive address
2. Assignment of the function outputs to the function keys
3. Dimming the function outputs
4. Load control: active or inactive
5. Definition of the forward direction
6. Velocity at speed level 1 for velocity characteristic 1
7. Maximum speed for velocity characteristic 1
8. Velocity at speed level 1 for velocity characteristic 2
9. Maximum speed for velocity characteristic 2
10. Automatic shuttle service: active or inactive
11. Acceleration delay
12. Brake delay
13. Parameters of the load control

## Accessing the programming mode

Put the vehicle on to a programming track or on the layout and reset the central unit (by simultaneously pushing the buttons "stop" and "go" for some time). Enter the address "78" at the central unit. Set the function key "function" of the central unit to "off".



### Attention:

It does not matter if you have already saved another address. You always have to enter the address "78" to access the programming mode. If you put the vehicle for programming on the layout take off all other vehicles with decoders with online-programming. If not you programm these vehicles as well.

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) you are in the programming mode and can release the direction switch.

**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 address "78". As soon as the decoder is in the programming mode, the central unit must be set back to Motorola II format.

## Starting from this menu level you can:

Without any further inputs: Set the address and the functions.

After pushing the function key F1: Query the address.

After pushing the function key F2: Perform a decoder reset.

After pushing the function key F3: Set the driving characteristics.

After pushing the function key F4: Modify the parameters of the load control.

You can finish the programming mode at any time by disconnecting the locomotive (pushing the button „stop“ or taking the locomotive from the track).

## Setting the locomotive address

You are in the menu point „Setting the locomotive address“ when all lighting connected to the function outputs flash regularly. Enter the

desired address. You do not need to enter the old address. Confirm your setting by switching the function key „function“ on and off once. After the taking-over of the locomotive address the regular flashing of the connected lighting stops and the decoder proceeds immediately to the programming of the first function output.

### **Setting the function outputs**

Now the function outputs are programmed one after the other. The function keys are assigned in succession, and the dimming function is set for each output.

**Assigning the function keys:** While the programm continuously switches the output to be programmed on and off (and the lighting connected to the output flashes) switch on the functions key(s) F1 to F4 on your central unit with which you want to switch on the output in later operation. You can assign several function keys to one output of the decoder. Please notice that in operation the acceleration and brake delay is switched via F3 and the second velocity characteristic is activated via F4.

If you want to switch the function output in operation via „function“ you have to make the following settings:

Speed level 1 : Output will be switched on during backwards motion.

Speed level 2 : Output will be switched on during forward motion.

Speed level 3 : Output will be switched on independent of the direction of motion.

Advice: On the Märklin\* Central Unit 6021 the speed levels 1,2 and 3 correspond to the settings 20, 40 and 60.

Confirm your settings by switching the function key „function“ on and off once.

**Setting the dimming function:** The dimming function is set via the speed knob. If lamps are connected speed level 0 stands for minimal voltage at the output to be set and speed level 14 (250 on Märklin\* Control Unit 6021) maximal voltage. Confirm your setting by switching the function key „function“ on and off once.

Repeat the assignment of the function keys and the setting of the dimming function for the second function output. You can skip the

programming of an output that is not occupied by switching on and off the function key „function“ two times.

As soon as all functions are set the connected lighting flashes several times. You automatically proceed to the menu point „Setting the driving characteristics“. If you want to close the programming mode you just disconnect the locomotive.

### **Setting the driving characteristics - step 1**

You get to this menu point automatically from the menu point „Setting the address and the functions“ or by pushing the function key F3 when entering the top menu level.

**Setting the driving characteristic:** First select the velocity characteristic you want to set:

Characteristic 1: Function F4 off

Characteristic 2: Function F4 on

**Definition of the direction of travel:** Operate the speed knob and check the actual direction of travel. Check if the direction of travel of the locomotive corresponds to the direction of travel set at the central unit. If the actual and the set direction do not correspond operate the function key „F2“.

**Switching on or off the load control:** Set now if the load control is to be active or not in later operation.

Load control in later operation active: Function F1 off.

Load control in later operation inactive: Function F1 on.

**Setting the starting velocity:** Operate the speed knob. As soon as the locomotive moves with the desired starting velocity, you should switch the function key „function“ on and off once. The locomotive decoder confirms the taking-over of the starting velocity by flashing the front lighting of the locomotive once. Set the speed knob to "0".

**Setting the maximum velocity:** Operate the speed knob. As soon as the locomotive moves with the desired maximum velocity, you should switch the function key „function“ on and off once. The locomotive decoder confirms the taking-over of the maximum velocity by flashing the front lighting of the locomotive twice.

The program automatically goes back to the start of this programming step. You may change your settings or make the settings for the second velocity characteristic. In order to get to the next programming step you have to operate the direction switch.

### **Setting the driving characteristics - step 2**

During this programming step the locomotive continuously accelerates and brakes. Advice: The settings you make in the programming step 2 are valid for both velocity characteristics.

**Setting the automatic shuttle service:** Set if the automatic shuttle service is to be active or not in later operation.

Shuttle service in later operation active: Function F3 on.  
Shuttle service in later operation active: Function F3 off.

When the automatic shuttle service is activated the locomotive changes the direction of travel after the next braking operation and keeps up the shuttle service during the whole programming step.

**Setting the brake delay:** Switch off the auxiliary function F1. The locomotive accelerates with the acceleration delay set in state of delivery or in a former programming. Then it brakes with the brake delay set at the speed knob. You may modify the brake delay by operating the speed knob. Speed level 0 corresponds to no brake delay, speed level 14 (250 on the Märklin\* Control unit) to maximum brake delay. As soon as the brake delay is set as desired you have to confirm your setting by switching the function key „function“ on and off once.

**Setting the acceleration delay:** Now switch on the auxiliary function F1. The locomotive accelerates with the acceleration delay set at the speed knob and then brakes with the brake delay set before. Continue as described in section: „Setting the brake delay“. As soon as the acceleration delay is set as desired you have to confirm your setting by switching the function key „function“ on and off once.

During this programming step you may switch the automatic shuttle service on or off as required by operating F3 and also change between setting the brake or the acceleration delay by operating F1.

When all settings are made, you close the programming mode by disconnecting the decoder (pushing the button „stop“ or taking the locomotive from the track).

### **Querying the decoder address**

You get to this programming step only by operating the function key F1 on the top menu level after having started the programming mode. The lighting of the locomotive now starts to flash. Two flashing signals interrupted by a short stop transmit the coded address. After a longer pause the two flashing signals are repeated. You'll find the meaning of the flashing signals in the appendix. You get back to the standard operation by disconnecting the locomotive.

### **Performing a decoder reset**

You get to this programming step only by operating the function key F2 on the top menu level after having started the programming mode. By operating the function key F2 you restore the factory settings (and all other settings are deleted). Then the decoder continues automatically in standard operation.

### **Modifying the parameters of the load control**

You get to this programming step only by operating the function key F4 on the top menu level after having started the programming mode.



#### **Attention:**

For most locomotives you will achieve good driving characteristics with the factory settings. Incorrect of the load control parameter settings deteriorate the driving characteristics of the motor considerably. Therefore you should first check the locomotive with the preset values and modify the parameters of the load control only step-by-step. It is recommended to optimize the parameters of the load control before setting the other parameters. In case the modification of the of the load control parameters turn out to be unsuccessful and a reset is required, the other settings will not be lost.

**Parameters of the load control:** The load control is determined by three parameters which have to be coordinated in order to achieve optimal driving characteristics. Each of the load control parameters is

assigned to a function key. As soon as the concerning function is switched on, the parameter can be modified. The parameters are:

**KP** (function key F1): The proportional component of the load control ensures the difference between the set and the present value being as small as possible. It cannot have the value „0“ at any time.

**KI** (function key F2): The integral component of the load control ensures the remaining difference between the set and the present value being reduced to 0.

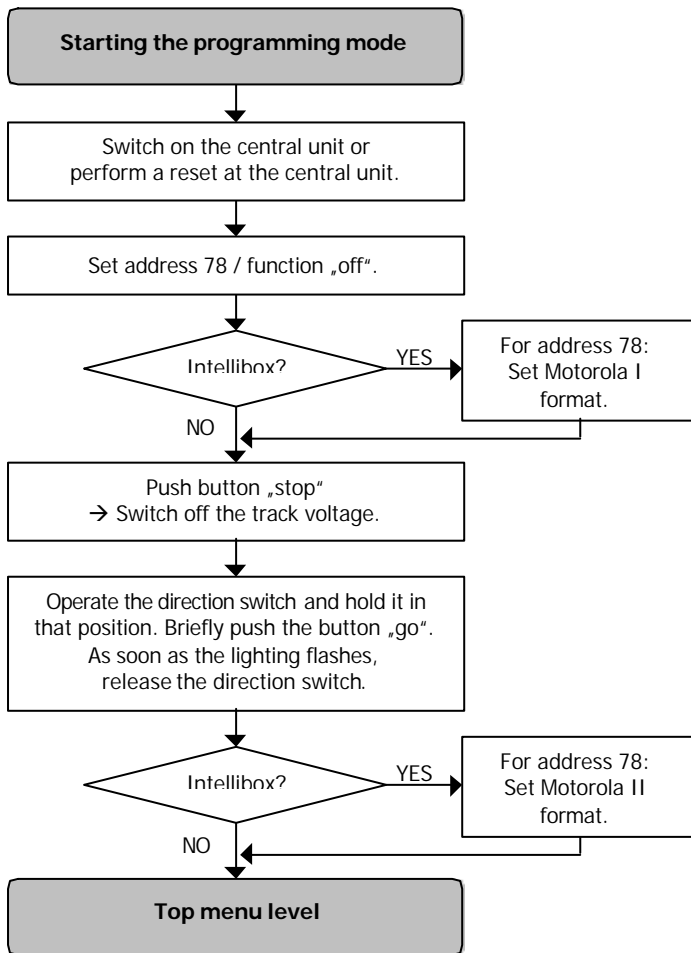
**KD** (function key F3): The differential component of the load control ensures that the control is not converted too quickly. Shaking and vibrating would be the consequence.

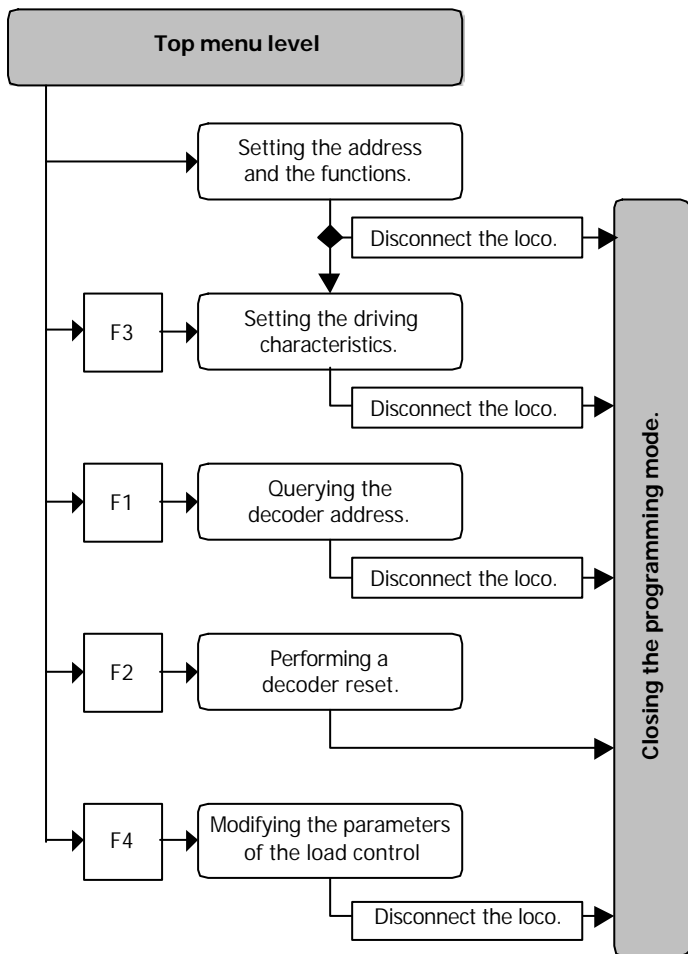
**Setting the parameters of the load control:** First switch off all auxiliary functions. Then switch on the function F4 and start the standard operation. Find the speed level where the locomotive shakes. Keep the setting of the speed knob and switch off the function F4. The locomotive continues to drive, but you cannot influence the speed from the speed knob.

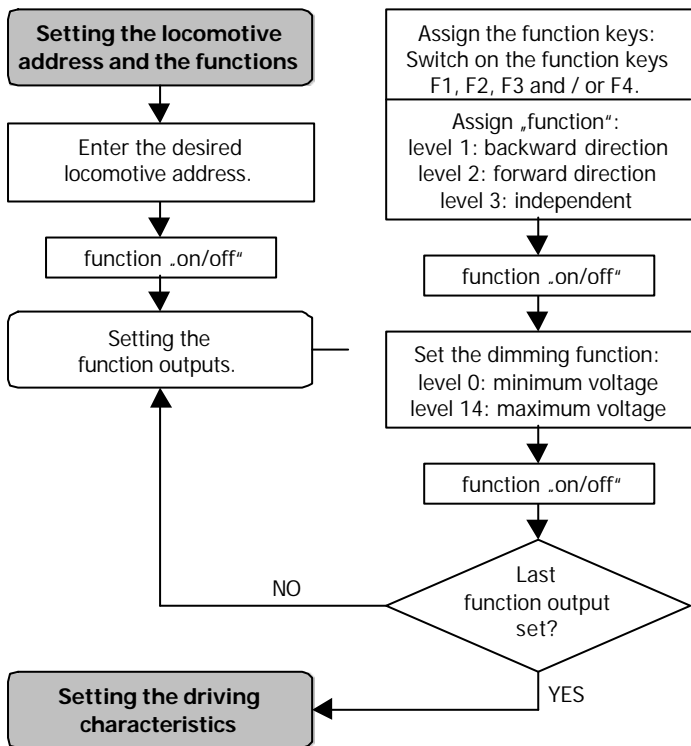
Next you have to set the speed knob to speed level 7 (120 on the Märklin\* Central Unit 6021). Select the parameter you want to modify by switching on the assigned function key.

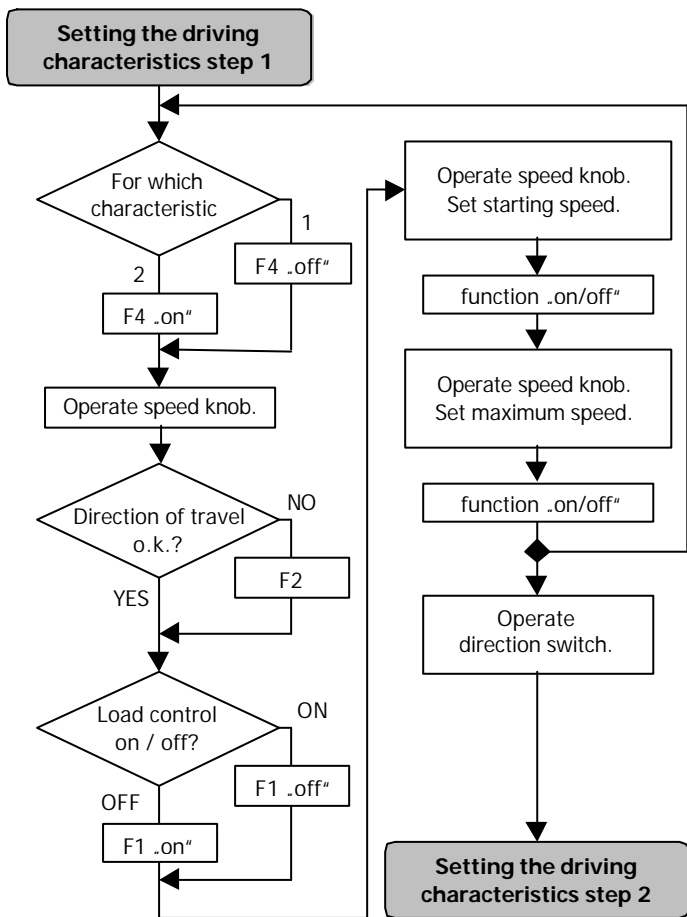
For all parameters is valid that: Speed level 7 is equivalent to the saved value of the parameter. By setting a lower speed level the value of the parameter is reduced, by setting a higher speed level it is enlarged. The set value takes effect immediately and therefore can be checked directly on the driving locomotive. As soon as the parameter is set as desired, confirm your setting by switching the function key „function“ on and off once.

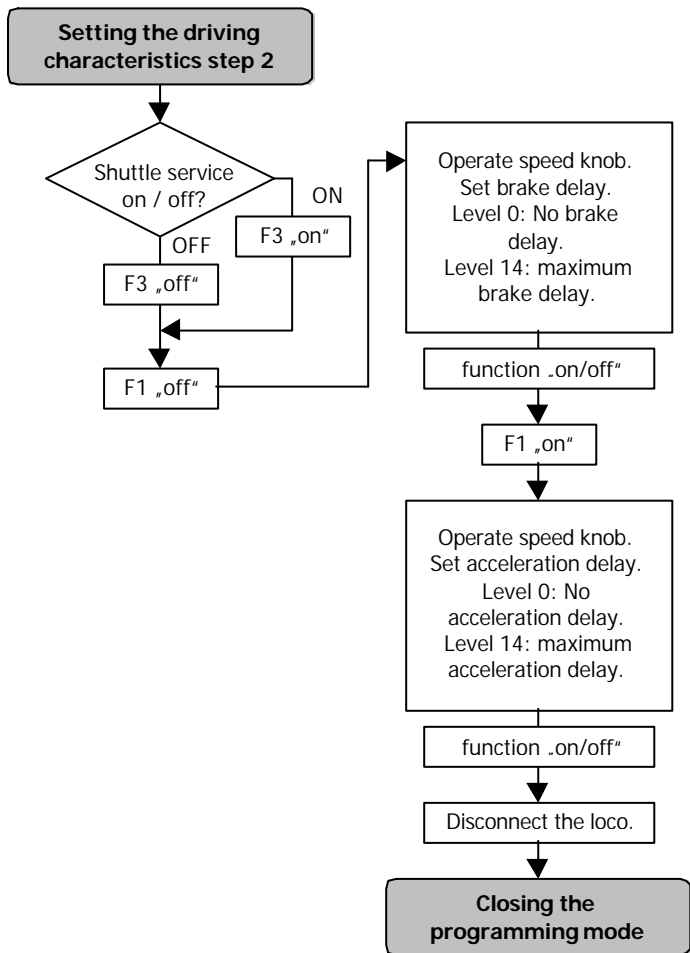
Set the speed knob to speed level 7 in order to set the value of the parameter saved before. Switch off the assigned function and continue with modifying the next parameter of the load control if necessary. As soon as all modifications are made, you can close the programming mode by disconnecting the locomotive.











## Operation

### Speed level regulation

Based on the 14 speed levels sent by the central unit the decoder can provide up to 27 speed levels. The 13 additional speed levels are "half" speed levels between the speed levels set at the central unit. They are selected if you switch to a higher speed level followed by a lower grade, or if you reduce the speed level and then switch to a higher grade.

Example:	Raising from 3 to 4	→ speed level 4
	Raising from 4 to 5	→ speed level 5
	Raising from 5 to 6	→ speed level 6
	Reducing from 6 to 5	→ speed level 5,5
	Reducing from 5 to 4	→ speed level 4,5
	Raising from 4 to 5	→ speed level 5

### Acceleration and brake delay


In Motorola II format the acceleration and brake delay is switched on and off via the function button F3 and takes effect immediately. If the acceleration and brake delay is switched off during the acceleration and brake process, the locomotive immediately runs with the speed level set at the central unit.

In Motorola I format the acceleration and brake delay cannot be switched on or off. An emergency stop can be made via the central unit by reversing the direction.

### Velocity characteristic

In Motorola II format you can change between the two velocity characteristics via the auxiliary function F4. This function is not available in Motorola I Format.

## FAQ

- Parts are getting too hot and/or start to smoke.  
 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 X7).
  - The locomotive runs too slowly or too fast.  
Possible cause: Different locomotives react in different ways to identical programmings. → Adapt the programming to the individual characteristics of the locomotive.
  - The locomotive does not react to F3 and F4.  
Possible cause: Instead of Motorola II format, Motorola I format is set at the central unit. → Set Motorola II format.
- 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.

**Anhang: Rückmeldung der Decoderadresse****Appendix: Check back of the address****Tableau : Indiquation de l'adresse du décodeur****Tabel: Terugmelding van het decoderadres**

Flash 1 *	Flash 2 *	Ad. **
1	1	80
1	2	2
1	3	81
1	4	1
1	5	6
1	6	8
1	7	82
1	8	7
1	9	145
1	10	177
1	11	191
1	12	161
1	13	3
1	14	5
1	15	84
1	16	4
2	1	18
2	2	20
2	3	85
2	4	19
2	5	24
2	6	26
2	7	86
2	8	25
2	9	146
2	10	178
2	11	87
2	12	162
2	13	21
2	14	23
2	15	88
2	16	22

Flash 1 *	Flash 2 *	Ad. **
3	1	193
3	2	201
3	3	89
3	4	197
3	5	217
3	6	225
3	7	90
3	8	221
3	9	147
3	10	179
3	11	91
3	12	163
3	13	205
3	14	213
3	15	92
3	16	209
4	1	9
4	2	11
4	3	93
4	4	10
4	5	15
4	6	17
4	7	94
4	8	16
4	9	148
4	10	180
4	11	95
4	12	164
4	13	12
4	14	14
4	15	96
4	16	13

Flash 1 *	Flash 2 *	Ad. **
5	1	54
5	2	56
5	3	97
5	4	55
5	5	60
5	6	62
5	7	98
5	8	61
5	9	149
5	10	181
5	11	99
5	12	165
5	13	57
5	14	59
5	15	100
5	16	58
6	1	72
6	2	74
6	3	101
6	4	73
6	5	78
6	6	---
6	7	102
6	8	79
6	9	150
6	10	182
6	11	103
6	12	166
6	13	75
6	14	77
6	15	104
6	16	76
7	1	194
7	2	202
7	3	105
7	4	198

Flash 1 *	Flash 2 *	Ad. **
7	5	218
7	6	226
7	7	106
7	8	222
7	9	151
7	10	183
7	11	107
7	12	167
7	13	206
7	14	214
7	15	108
7	16	210
8	1	63
8	2	65
8	3	109
8	4	64
8	5	69
8	6	71
8	7	110
8	8	70
8	9	152
8	10	184
8	11	111
8	12	168
8	13	66
8	14	68
8	15	112
8	16	67
9	1	229
9	2	231
9	3	113
9	4	230
9	5	235
9	6	237
9	7	114
9	8	236

Flash 1 *	Flash 2 *	Ad. **
9	9	153
9	10	185
9	11	115
9	12	169
9	13	232
9	14	234
9	15	116
9	16	233
10	1	247
10	2	249
10	3	117
10	4	248
10	5	253
10	6	255
10	7	118
10	8	254
10	9	154
10	10	186
10	11	119
10	12	170
10	13	250
10	14	252
10	15	120
10	16	251
11	1	195
11	2	203
11	3	121
11	4	199
11	5	219
11	6	227
11	7	122
11	8	223
11	9	155
11	10	187
11	11	192
11	12	171

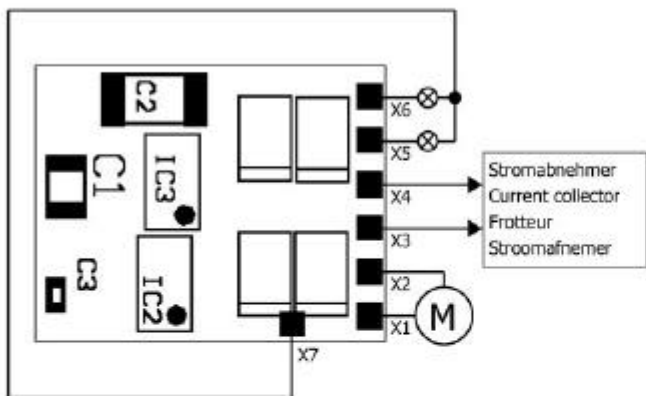
Flash 1 *	Flash 2 *	Ad. **
11	13	207
11	14	215
11	15	124
11	16	211
12	1	238
12	2	240
12	3	125
12	4	239
12	5	244
12	6	246
12	7	126
12	8	245
12	9	156
12	10	188
12	11	127
12	12	172
12	13	241
12	14	243
12	15	128
12	16	242
13	1	27
13	2	29
13	3	129
13	4	28
13	5	33
13	6	35
13	7	130
13	8	34
13	9	157
13	10	189
13	11	131
13	12	173
13	13	30
13	14	32
13	15	132
13	16	31

Flash 1 *	Flash 2 *	Ad. **
14	1	45
14	2	47
14	3	133
14	4	46
14	5	51
14	6	53
14	7	134
14	8	52
14	9	158
14	10	190
14	11	135
14	12	174
14	13	48
14	14	50
14	15	136
14	16	49
15	1	196
15	2	204
15	3	137
15	4	200
15	5	220
15	6	228
15	7	138
15	8	224

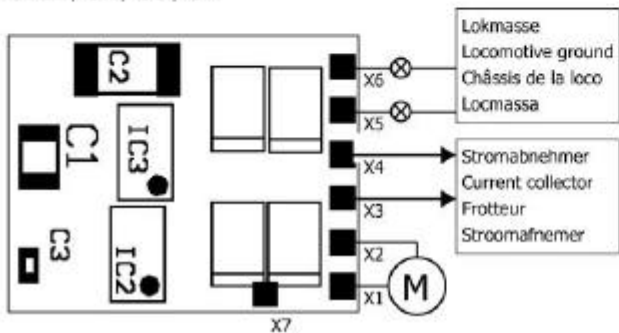
Flash 1 *	Flash 2 *	Ad. **
15	9	159
15	10	83
15	11	139
15	12	175
15	13	208
15	14	216
15	15	140
15	16	212
16	1	36
16	2	38
16	3	141
16	4	37
16	5	42
16	6	44
16	7	142
16	8	43
16	9	160
16	10	123
16	11	143
16	12	176
16	13	39
16	14	41
16	15	144
16	16	40

- \* Anzahl der Blinkzeichen / Number of flashing signals  
Flash 1: vor der kurzen Pause / before the short stop  
Flash 2: nach der kurzen Pause / after the short stop
- \* Nombre des clignotements / Aantal knipperingen  
Flash 1: avant la courte pause / voor de korte pauze  
Flash 2: après la courte pause / na de korte pauze
- \*\* Adresse / address / adresse / adres

**Fig. 1: Anschlußplan - Connection Diagram  
Schéma de connexion - Aansluitplan**

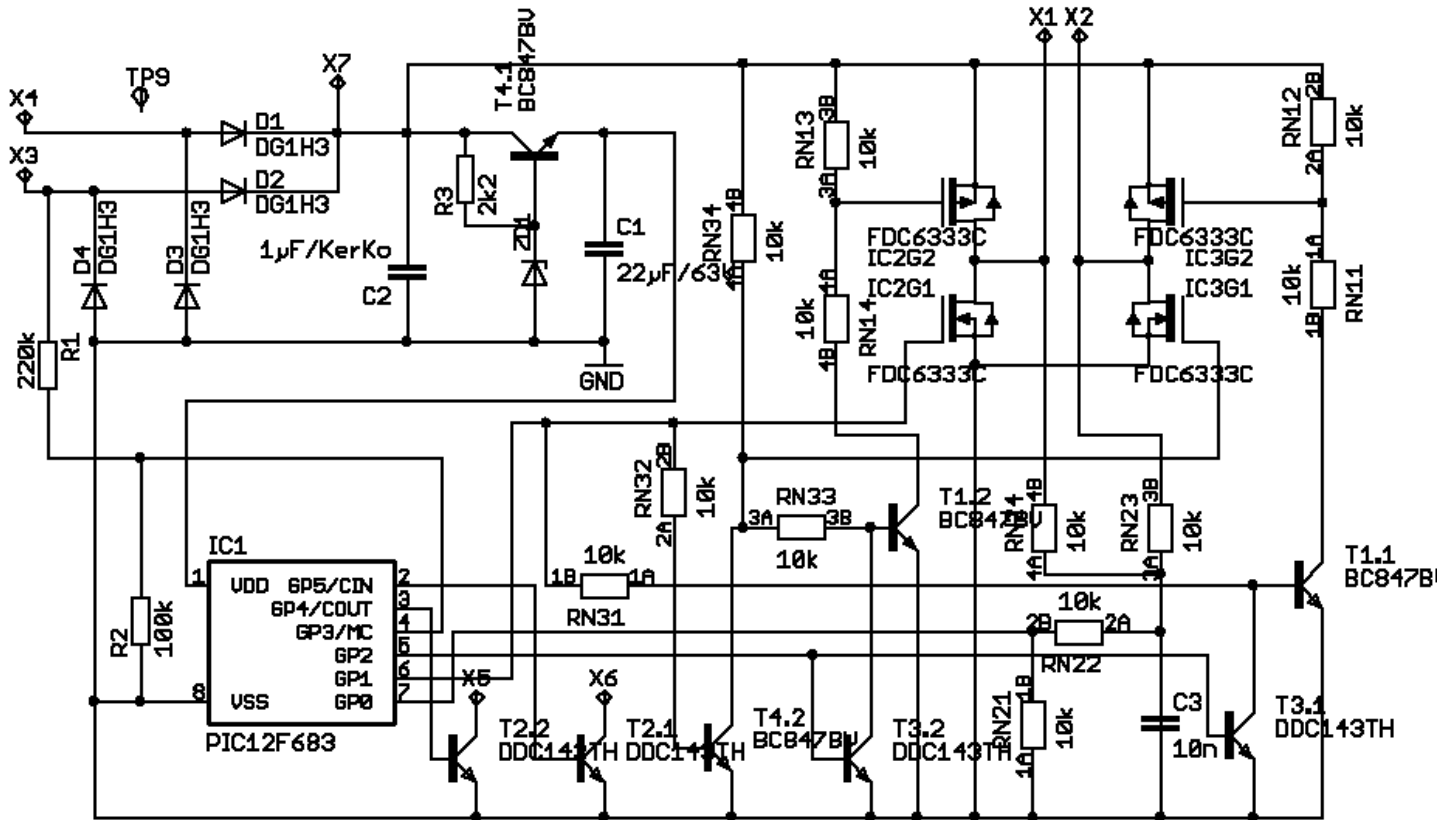


ODER / OR / OU / OF:



- X1 grau / grey / gris / grijs:  
Motoranschluß 2 / Motor connection 2  
Connexion moteur 2 / Motoraansluiting 2
- X2 orange / orange / orange / oranje:  
Motoranschluß 1 / Motor connection 1  
Connexion moteur 1 / Motoraansluiting 1
- X3 schwarz / black / noir / zwart:  
Schienenabnehmer links / Current collector left side  
Frotteur gauche / Stroomafnemer linkerhand
- X4 rot / red / rouge / rood:  
Schienenabnehmer rechts / Current collector right side  
Frotteur droite / Stroomafnemer rechterhand
- X5 gelb / yellow / jaune / geel:  
Beleuchtung hinten / Back lighting  
Feux arrière / Verlichting achter  
oder / or / ou / of:  
Beliebiger Verbraucher / Optional accessory  
Consommateur quelconque / Gewenste verbruiker
- X6 weiß / white / blanc / wit:  
Beleuchtung vorne / Front lighting  
Feux avant / Verlichting voor  
oder / or / ou / of:  
Beliebiger Verbraucher / Optional accessory  
Consommateur quelconque / Gewenste verbruiker
- X7 Rückleiter für alle Funktionen  
Return conductor for all functions  
Pole commun des fonctions  
Retourleiding voor alle functies

Fig. 2: 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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