

# LD-G-2

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**



**Manual**

**Mode d'emploi**

**Handleiding**

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(Pages I to II in the centre of this handbook are removeable.)

## 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. It is designed for the mounting 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 the four 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 of the kit 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

- Do not touch powered, live components.
- Do not touch conducting components which are live due to malfunction.
- Avoid short circuits.
- Do not connect the circuit to a higher voltage than designed.
- Impermissibly high humidity.
- Condensation building up can cause serious injury due to electrical shock.

Take the following precautions to prevent this danger:

- Never perform wiring on a powered module.
- Only use low power for this module as described in this manual and only use certified transformers.
- Connect transformers and soldering stations only in approved mains sockets installed by an authorised electrician.
- Observe cable diameter requirements.
- Assembling the kit should only be done in closed, clean, dry rooms. Beware of humidity.
- If the humidity in the room is too high, please do not start working until after a minimum of 2 hours of acclimatisation.
- Use only original spare parts if you have to repair the module.

## **Fire risk**

Touching flammable material with a hot soldering iron can cause life-threatening fire, burns and toxic smoke. Connect your soldering iron or soldering station only when actually needed. Use the correct soldering iron or station and 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.

## **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 kit or the ready-built module.

Little children can swallow small components with sharp edges. Life threatening! Do not allow components to reach small children.

In schools, training centres, clubs and workshops, assembly 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, circuit diagram and PCB layout included with this manual.
- Use only original spare parts if you have to repair the kit or the ready-built 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

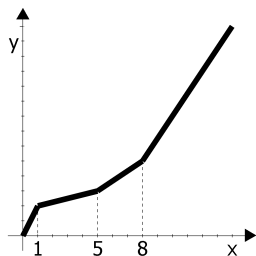
At constant motor voltage, additional loads (e.g. running up a gradient, coupled carriages) cause the locomotive to slow down or even come to a standstill. If the load control is active the motor voltage varies to keep the locomotive operating at constant velocity at a given speed level, independent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

## 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).

### 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.

### 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 it's present 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. 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:** 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.

**Kick function:** It is possible to set the function outputs so that they get the full voltage first for up to seven seconds and then are dimmed.

Example of use: For some types of electric couplings you need the full voltage for decoupling and the voltage then reduced to protect the couplings.

### **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 and the kick function can be altered via the speed knob. As soon as they are set as desired, they 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-II
Supply voltage	12-24 Volt digital voltage
Current consumption (without connected loads)	ca. 10 mA
Max. current for motor	1.000 mA
Max. current per function output	500 mA
Max. total current	1.500 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	ca. 28 x 17 x 6 mm
Weight	ca. 5 g

## Checking the package contents

Check the contents of the package for completeness:

- 1 module
- 1 manual

## Required tools and consumables

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

- a heat-resistant mat
- a soldering iron stand with tip-cleaning sponge
- a small side cutter and wire stripper
- an electronic soldering iron (max. 30 Watt) with a fine tip
- tin solder (0,5 mm. diameter)
- wire (diameter:  $\geq 0,05 \text{ mm}^2$ )

## Safe and correct soldering



### Caution:

Incorrect soldering can cause fires (through excessive heat). Avoid this danger by reading the chapter **Safety instructions** again and following the directions given.

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

- When soldering electronic circuits never use soldering-water or soldering grease. They contain acids that can corrode components and copper tracks.
- Only use electronic tin solder with flux.
- Solder fast: long soldering can destroy components and copper tracks, and damages through plated holes.
- 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.
- Apply the soldering tip to the soldering spot in such a way that the part and the soldering spot 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 tin solder finds its way, then remove the soldering iron.
- To make a good soldering joint you must 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.
- Do not move the component for about 5 seconds after soldering.

## Performing a visual check

Damaged materials can cause injury. Parts damaged during transit can also be dangerous. Check the module for damage, missing parts or poor soldering. If you find damage, return the module for exchange.

## Mounting the locomotive decoder

Open the locomotive housing. Locate the position for the decoder. Disconnect the motor from the rail current collector respectively the change-over switch from the motor and rail current collector if you have a locomotive with electronic change-over switch.

Mounted to the motor there are interference suppression devices, consisting of capacitors and chokes. They must not be removed! If even one part is removed, it can cause extreme interference!

Follow the connection diagram fig. 1 and fig. 2. Solder the connections from the rail current collectors at the points X8 and X9 (back of the locomotive decoder). The assignment of the connecting wires is not important.

Next solder the connections from the motor at the points X6 and X7 (back of the locomotive decoder). Here too, the assignment of the connecting wires is not important.

### Connecting the lighting and other accessories

Disconnect any existing diodes in the leads to the lamps. Follow the connection diagram fig. 1 and fig. 2.

Connect the lamps and other accessories to the function outputs (X1 to X4) on the front of the decoder. The assignment of the function outputs to the function keys will be made when programming the decoder.

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 X5).

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

Front lighting: X4

Back lighting: X3

Accessory to be switched via F1: X1

Accessory to be switched via F2: X2

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 X4 and X3 respectively.

**Caution:**

If you connect the loads to the return conductor for all functions (point X5), 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 X5) 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 X5) instead of locomotive ground.

**Advice:** Before starting to program the locomotive decoder, you should connect a lamp to at least one function output, 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 (e.g. smoke generators). 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.

## Using a 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.

The list below shows how to connect the contacts of the interface connector to the connecting points of the locomotive decoder.

Contact	Connection	Colour of cable	Connecting points
1	Motor connection 1	orange	X7
2	Lighting back (-)	yellow	X3
3	Not used or F1	green	X1
4	Power supply left	black	X8
5	Motor connection 2	grey	X6
6	Lighting front (-)	white	X4
7	Common conductor for all functions (+)	blue	X5
8	Power supply right	red	X9

## 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. Kick function of the function outputs
5. Load control: active or inactive
6. Definition of the forward direction
7. Velocity at speed level 1 for velocity characteristic 1
8. Maximum speed for velocity characteristic 1
9. Velocity at speed level 1 for velocity characteristic 2
10. Maximum speed for velocity characteristic 2
11. Automatic shuttle service: active or inactive
12. Acceleration delay
13. Brake delay
14. Parameters of the load control



## Accessing the programming mode

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



### 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. 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".

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.

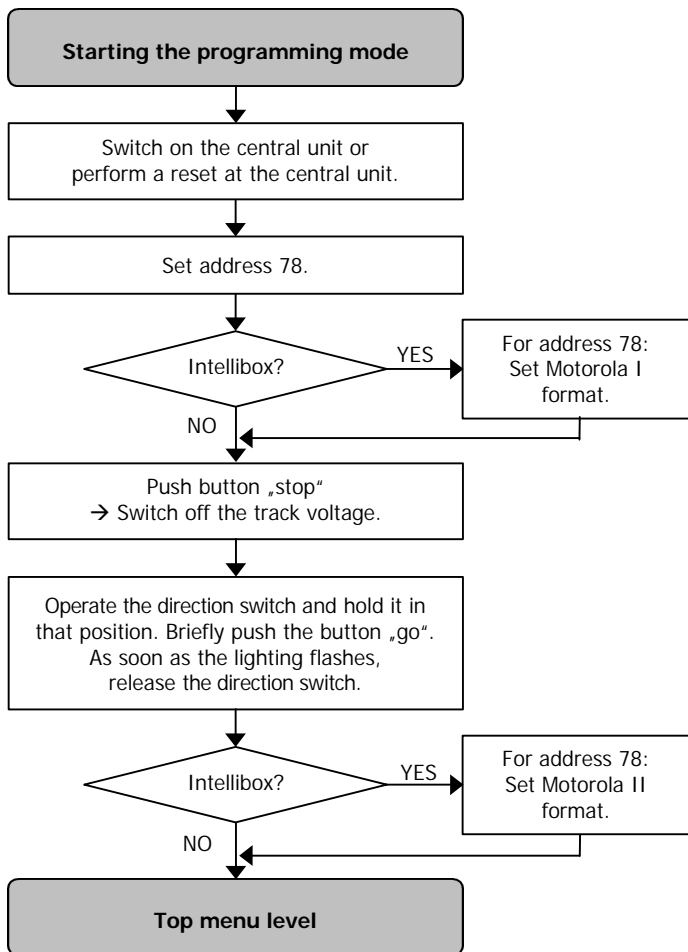
After pushing the function key F4: Modify the parameters of the load control.

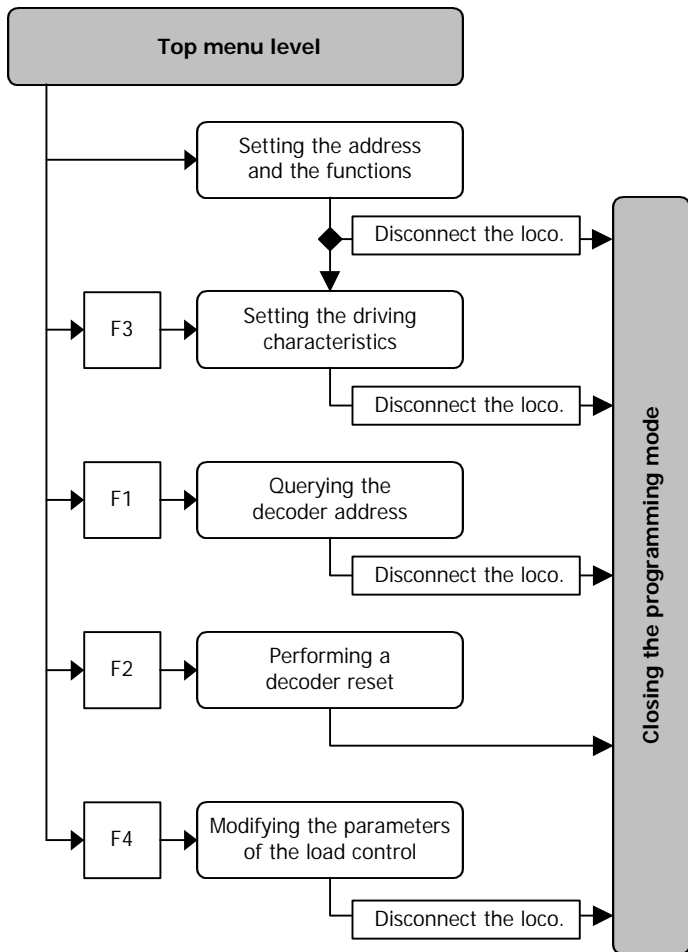


### Caution:

Incorrect setting of the load control parameters can 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.

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 and the functions

### 1. 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.

### 2. Setting the function outputs

Now the function outputs X4, X3, X1 and X2 are programmed one after the other. The function keys are assigned in succession, and the dimming and the kick function are 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 do not want to the function output in operation via „function“ set the speed level to “0”.

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.

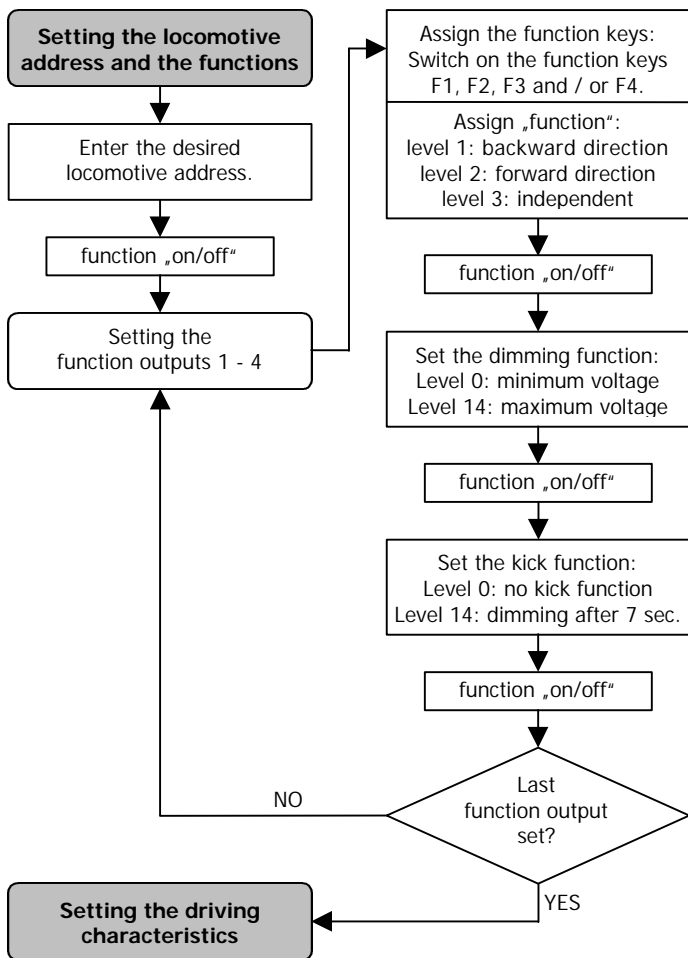
**Setting the dimming function:** The dimming function is set via the speed knob. If lamps are connected speed level 0 stands for minimal voltage at the output to be set and speed level 14 (250 on Märklin\* Control Unit 6021) maximal voltage. Confirm your setting by switching the function key „function“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

**Setting the kick function:** The kick function is set via the speed knob as well. Speed level 0 stands for „kick function off“, the output always receives the voltage set during the setting of the dimming function. By operating the speed knob you can set how long the full voltage is applied until the voltage is adjusted to the dimmed value. The period is extended for approx. half a second with each speed level. Accordingly, when setting the speed level 14, the full voltage is applied for approx. 7 seconds before the chosen dimmed value is set. 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 and the kick function for the other three function outputs. You can skip the programming of an output that is not occupied by switching on and off the function key „function“ three 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.



## 1. 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.

## 2. 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.

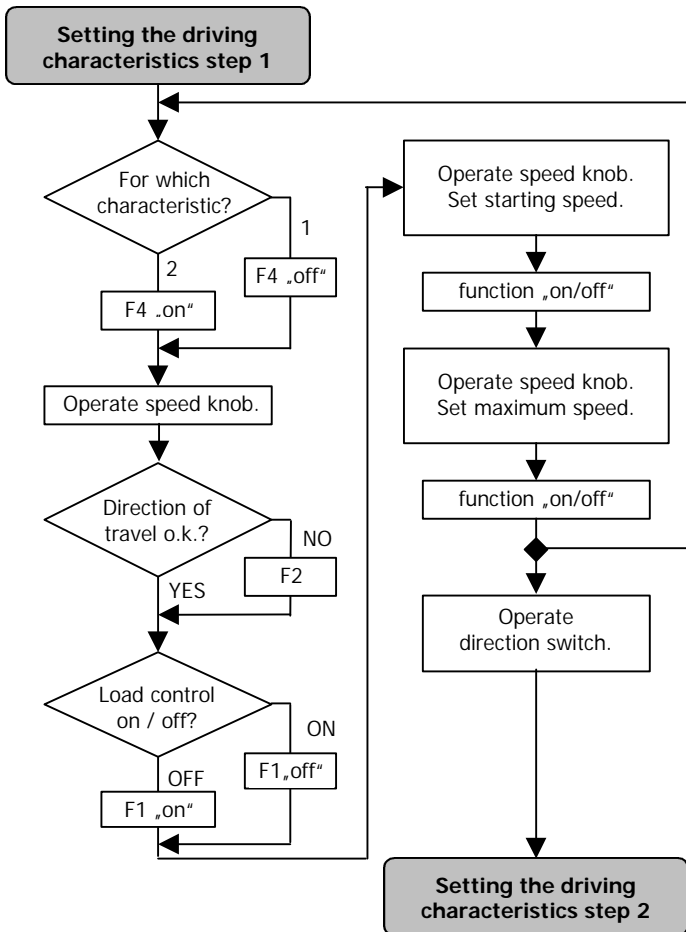
**Setting the brake delay:** Switch off the auxiliary function F1. The locomotive accelerates with the acceleration delay set in state of delivery or in a former programming. Then it brakes with the brake delay set at the speed knob. You may modify the brake delay by operating the speed knob. Speed level 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.

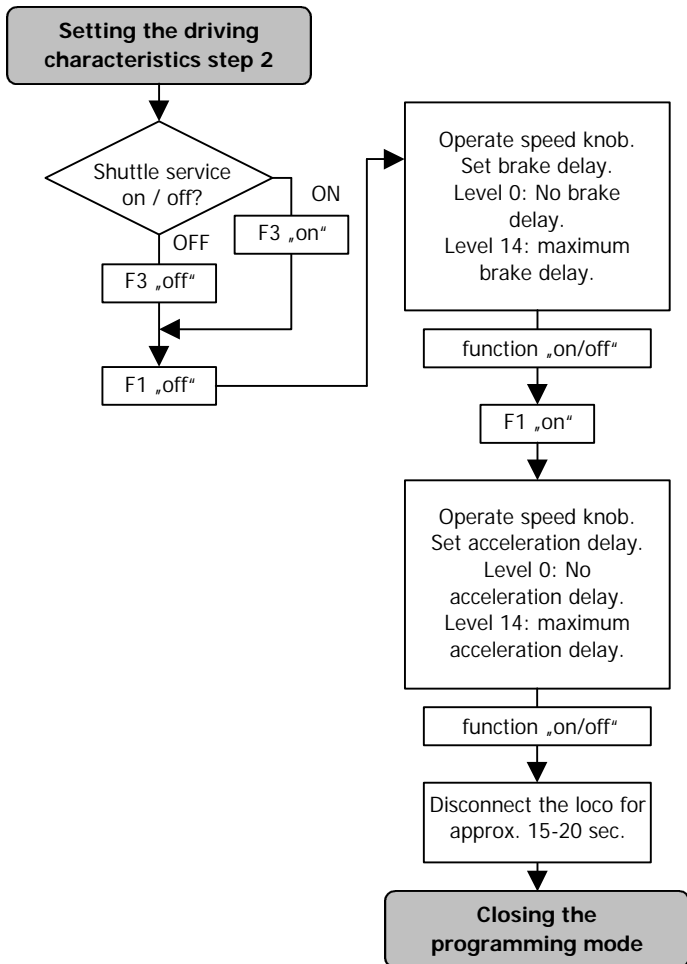
**Setting the acceleration delay:** Now switch on the auxiliary function F1. The locomotive accelerates with the acceleration delay set at the speed knob and then brakes with the brake delay set before. Continue as described in section: „Setting the brake delay“. As soon as the acceleration delay is 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 .

## 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. You can improve the locomotive performance by soldering a capacitor 100  $\mu$ F / 35 V between X10 and X11 (see fig. 2).

## Analogue mode

In analogue mode the decoder can be run like a change-over switch. This means the decoder reacts with a change of direction on the shift impulse of the speed control knob, as usual. In analogue mode the lighting is always switched on. It is switched depending on the direction of travel.

You access the analogue mode by pressing the direction switch of the analogue driving transformer until the light of the locomotive starts flashing. To get back into the digital mode, press the direction switch of the analogue driving transformer again until the light of the locomotive starts to flash.

## 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 X5).

- 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 builds this kit or brings the circuit into operation is the manufacturer of the product. If he sells the product to another person he is responsible for passing on all the relevant papers. Domestic appliances assembled from a kit are deemed industrial products and must comply with health and safety regulations.

## Certification

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

## Conditional warranty

This product is guaranteed for two years. The warranty includes free repair if the problem is due to material failure or incorrect assembly of the module by us. We guarantee the quality of the components.

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 points 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 or the connection diagram,
- if the circuit has been altered and repair attempts have failed,
- if arbitrary changes in the circuit are made,
- if components are exchanged for other types, or the circuit is altered in any way at all.
- if the copper tracks or soldering points are damaged,
- when connections have been connected with reverse polarity resulting in damage to this product and other connected components.
- if damage occurs due to an overload of the circuit,
- if the wrong power or current is connected,
- if damaged by other persons,
- if damaged by the wrong use or abuse of the circuit,
- if parts are damaged due to static because they were touched before a discharge is performed.

\* **Märklin** is the registered trademark of Gebr. Märklin & Cie. GmbH, Göppingen , Germany.

\* **Intellibox** is the registered trademark of Uhlenbrock Elektronik GmbH, Bottrop , Germany.



**Check back of the address****Indication de l'adresse du décodeur****Terugmelding van het decoderadres**

Flash 1 *	Flash 2 *	Address Adresse Adres
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

Flash 1 *	Flash 2 *	Address Adresse Adres
2	15	88
2	16	22
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

Flash 1 *	Flash 2 *	Address Adresse Adres
4	13	12
4	14	14
4	15	96
4	16	13
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

Flash 1 *	Flash 2 *	Address Adresse Adres
6	15	104
6	16	76
7	1	194
7	2	202
7	3	105
7	4	198
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

Flash 1 *	Flash 2 *	Address Adresse Adres
9	1	229
9	2	231
9	3	113
9	4	230
9	5	235
9	6	237
9	7	114
9	8	236
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

Flash 1 *	Flash 2 *	Address Adresse Adres
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
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

Flash 1 *	Flash 2 *	Address Adresse Adres
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
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

Flash 1 *	Flash 2 *	Address Adresse Adres
15	3	137
15	4	200
15	5	220
15	6	228
15	7	138
15	8	224
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

\* Number of flashing signals / Nombre des clignotements / Aantal knipperingen

Flash 1: before the short stop / avant la courte pause / voor de korte pauze

Flash 2: after the short stop / après la courte pause / na de korte pauze

## Fig. 1 / Fig. 2: Connction Diagrams - Schémas de connexion - Aansluitplannen

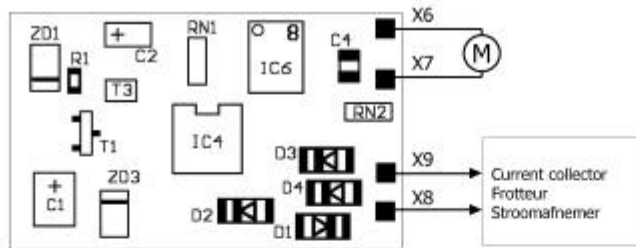


Fig. 1:

Rear of the locomotive decoder

Face arrière du décodeur - Achterzijde van de locdecoder

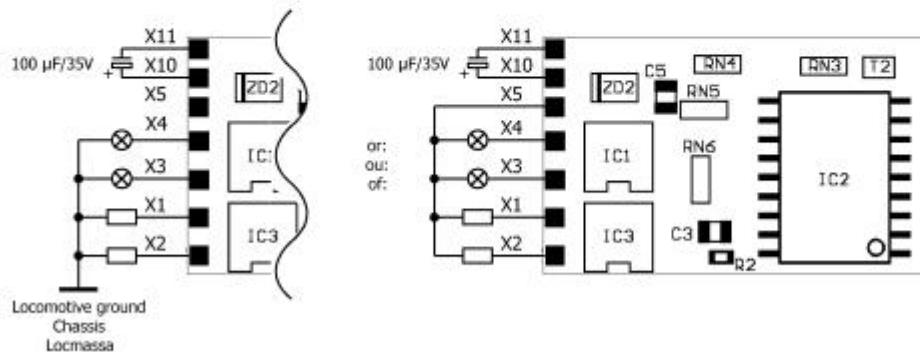


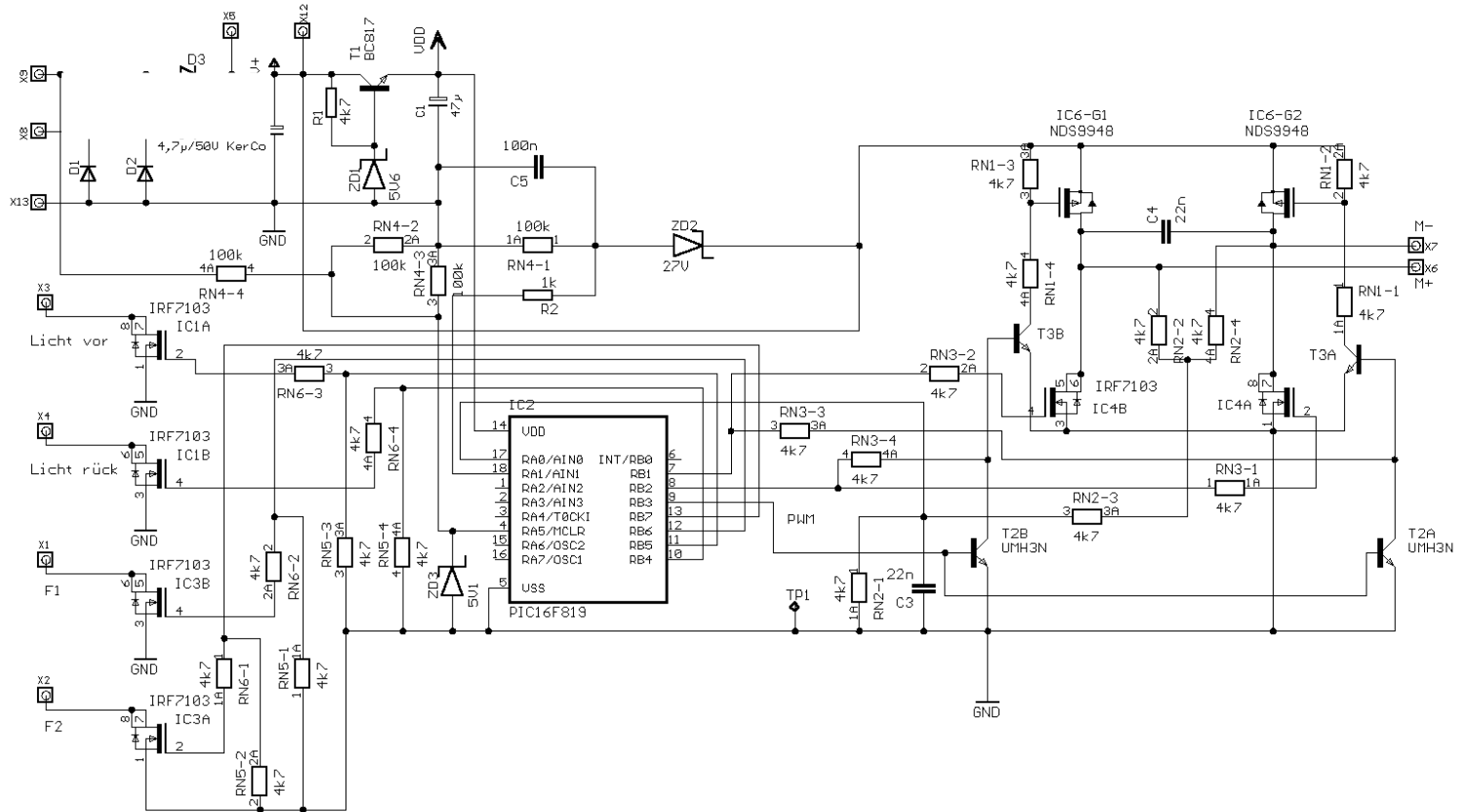
Fig. 2:

Front of the locomotive decoder

Face avant du décodeur - Frontzijde van de locdecoder

X1 - X4	Optional accessories Consommateurs quelconques Gewenste verbruikers
Connections for decoder factory settings: Occupation pour réglage d'origine: Plaatsing voor de fabrieksmatige instelling:	
X1	F1
X2	F2
X3	Lighting backward direction Feux marche arrière Verlichting achteruitrijden
X4	Lighting forward direction Feux marche avant Verlichting vooruitrijden
X5	Return conductor for all functions Pole commun des fonctions Retourleiding voor alle functies
X6, X7	Motor - Moteur
X8, X9	Current collector Frotteur Stroomafnemer
X10, X11	Capacitor, if necessary Condensateur, si nécessaire Eico, indien noodzakelijk

Fig. 3: Circuit Diagram - Schéma de principe - Schakelplan



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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