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

* "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. It is designed for the mounting in a model railway locomotive with d.c. motor (LD-G-3) or a.c. motor (LD-W-3).

It evaluates the Motorola 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 lighting.

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

- 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 I or 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.

Function speed level and direction of motion

The speed level set at the central unit and the change-direction command are transmitted to the locomotive by the decoder. At a direction change command, the current direction of travel is saved.

Velocity characteristics

By adjusting the starting and the maximum velocity an individual velocity characteristic can be programmed via the central unit. The adjustments set the actual motor voltage of the locomotive. The motor voltage has an immediate effect on the driving speed of the locomotive at a chosen speed level during the operation.

The operating voltage of the locomotive motor at speed level 1 is set by adjusting the starting velocity. Normally the motor voltage is adjusted so that the locomotive just starts to run at speed level 1.

The operating voltage of the locomotive motor at speed level 14 is set by adjusting the maximum velocity. The adjustment should be such that the locomotive reaches the desired maximum speed at speed level 14.

The operating voltages of the locomotive motor at speed levels 2 to 13 are linearly interpolated.

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. 50 % compared to the standard velocity.

Acceleration and brake delay

14 different steps are available for the acceleration and brake delay. The acceleration and brake delay can be switched off via the auxiliary function F3.

Function lighting

The lighting can be switched on and off according to the direction of travel from the central unit via the function "function".

Online-programming

The address and the driving characteristics 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).

Restrictions in Motorola I format

The auxiliary functions F3 and F4 are not available in Motorola I format.

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	800 mA
Max. current per function output	100 mA
Max. total current	1.000 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. 19 x 17 x 5 mm
Weight	approx. 1 g

Checking the package contents

Check the contents of the package for completeness:

- 1 module without or with soldered connecting wires, depending on the version,
- 1 manual.

Required tools and consumables

Make sure you have the following tools and consumables 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: > 0,05 mm² 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 with 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.
- 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 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!

Connecting the LD-G-3

Follow the connections diagrams (fig. 1)! Solder the connection to the slider at point X2, and the connection to the housing to point X3. These two connections can be exchanged without effecting functionality. Solder the connections to the motor at the points X10 and X11.

Connecting the LD-W-3

Follow the connections diagrams (fig. 2)! Solder the connection to the slider at point X2 and the connection to the housing to point X3. These two connections can be exchanged without effecting functionality. Solder the connections to the motor at the points X6, X10 and X11.

Connecting the lighting

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

Disconnect any existing diodes in the leads to the lamps. Connect the lamps for forward motion to X5 and the lamps for reverse to point X4. If the lamps are already connected with one side to locomotive ground, the connection is complete. If not, connect the second side of the lamps to the return conductor (point X1 or X6).

 **Caution:**

The return conductor for all functions (point X1 or X6) 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 X1 or X6) instead of locomotive ground.

 **Caution:**

If you connect the lamps to the return conductor for all functions (point point X1 or X6), 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.

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 several 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.

Fixing the locomotive decoder

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

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.

The list 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	X10
2	Lighting back (-)	yellow	X4
3	Not used or F1	green	---
4	Power supply left	black	X3
5	Motor connection 2	grey	X11
6	Lighting front (-)	white	X5
7	Common conductor for all functions (+)	blue	X6
8	Power supply right	red	X2

Programming the locomotive decoder

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

1. Locomotive address
2. Starting velocity
3. Maximum velocity
4. Acceleration and brake delay

The order of this list corresponds to the sequence of the single menu points in the programming mode.

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 the programming mode with the Mobile Station

When using the Märklin* Mobile Station it is not possible to access the programming mode with the method described before. In this case proceed as follows:

Delete all active locomotives from the data memory of the Mobile Station. Select a new locomotive with the current address of the decoder. Attention! Do not select a locomotive from the data base! In state of delivery the decoder has the address „78“.

Put the vehicle on to the track and switch off the lighting. Operate at least 16 times the direction switch (= red speed control knob). As soon as the lighting of the locomotive has flashed several times, the decoder is in the programming mode and you can continue according to the description below. Notice: Instead of operating the "function" button you have to switch on or off the lighting switch of the Mobile Station.

1. Programming the locomotive address

After accessing the programming mode enter the present or the new locomotive address. It is not necessary to enter the old address if you intend to enter a new locomotive address. Confirm the input by switching on the function "function". The locomotive confirms the input by flashing the front lamp once. Set the speed control knob to "0". To access the following menu point, switch off the function "function".

2. Programming the starting velocity

Turn the speed control knob. As soon as the locomotive is running with the starting velocity you want switch on the function "function". The locomotive confirms the input by flashing the front lamp twice. Set the speed control knob to "0". To access the following menu point, switch off the function "function".

3. Programming the maximum velocity

Turn the speed control knob. As soon as the locomotive is running with the maximum wanted velocity, switch on the the function "function". The locomotive confirms the input by flashing the front lamp three times. Set the speed control knob to "0". To access the following menu point, switch off the function "function".

4. Programming the acceleration and brake delay

Operate the speed control knob. Now the locomotive accelerates and brakes alternately. By setting a low speed level you obtain a fast acceleration and brake delay, by setting a high speed level you obtain a slow acceleration and brake delay. While accelerating the front lamp of the locomotive is off, when braking it is on. Set the acceleration and brake delay required and switch on the function "function". The locomotive confirms the input by flashing the front lamp four times. Set the speed level to "0" while the lamp flashes, otherwise the locomotive will run with this speed level when the standard operation starts.

With that the programming is finished, the decoder automatically switches to standard operation.

Skipping single menu points

If you want to skip single menu points set the speed control knob to "0", and switch the function "function" on and off once. The decoder retains the driving characteristics that have already been saved. The decoder confirms the finishing of a menu point by flashing the front lamp of the locomotive. Depending on which menu point you finish, it flashes two, three or four times.

Reset

If you want to restore the data set in state of delivery you press the analogue driving transformer direction switch and hold it there until the light of the locomotive, after four flashes and a short break, starts to flash quickly. Please note that a reset is performed on all locomotives with this decoder type on the programming track.

If it is only the problem that a locomotive does not react on a certain address or you have forgotten the address, you do not need to perform a reset. As you do not have to enter the old address for programming you can just programm the address as described in the section "Programming the locomotive address".

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. 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

The shunting gear can be switched on and off via the auxiliary function F4. In the shunting gear mode the velocity of all speed levels is reduced to ca. 50 % compared to the standard velocity. The change of the setting takes effect immediately. 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 μF / > 35 V to the points X1 and X7 (see fig. 1 and 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. Do not hold the direction switch on too long, otherwise you perform a reset.

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.

- The locomotive lighting does not correspond to its direction of travel.
Possible cause: The forward and backward light connections have been exchanged. → Check the connections.
Possible cause: The connections of the motor to the points X10 and X11 have been exchanged. → Exchange the connections.
- 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 X1 or X6).
- The locomotive does not run in digital mode.
Possible cause: The locomotive address is not set correctly.
→ Programm the locomotive address again (see section "Programming the locomotive address").
- The locomotive does not run in analogue mode.
Possible cause: The locomotive is set to digital mode. → Change to analogue mode.

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.

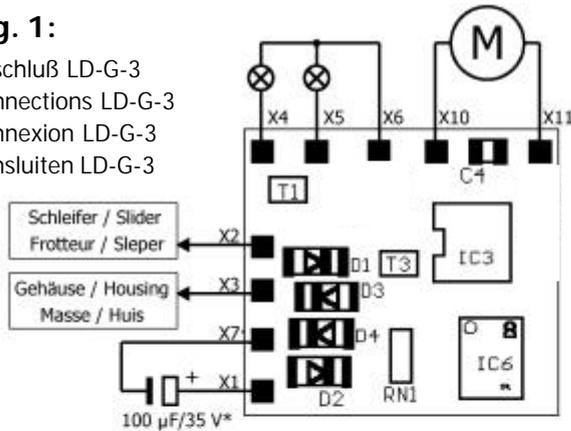
Other claims are excluded. By law, we are not responsible for damages or secondary damages in connection with this product. We retain the right to repair, make improvements, supply spare parts or return the purchase price.

The following invalidate the warranty:

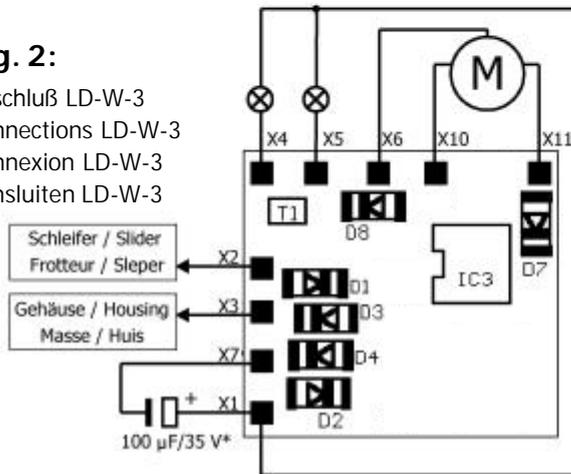
- using an unsuitable soldering iron, solder containing liquid acids or similar,
- if damage is caused by not following the instructions in this manual,
- if the module has been altered and repair attempts have failed,
- if arbitrary changes in the circuit are made,
- if additional components are added 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.

Fig. 1:

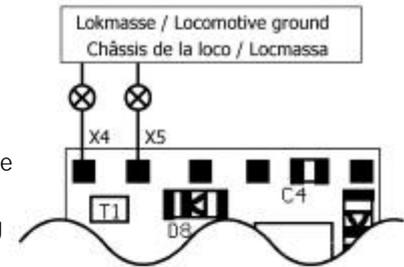
Anschluß LD-G-3
Connections LD-G-3
Connexion LD-G-3
Aansluiten LD-G-3

**Fig. 2:**

Anschluß LD-W-3
Connections LD-W-3
Connexion LD-W-3
Aansluiten LD-W-3

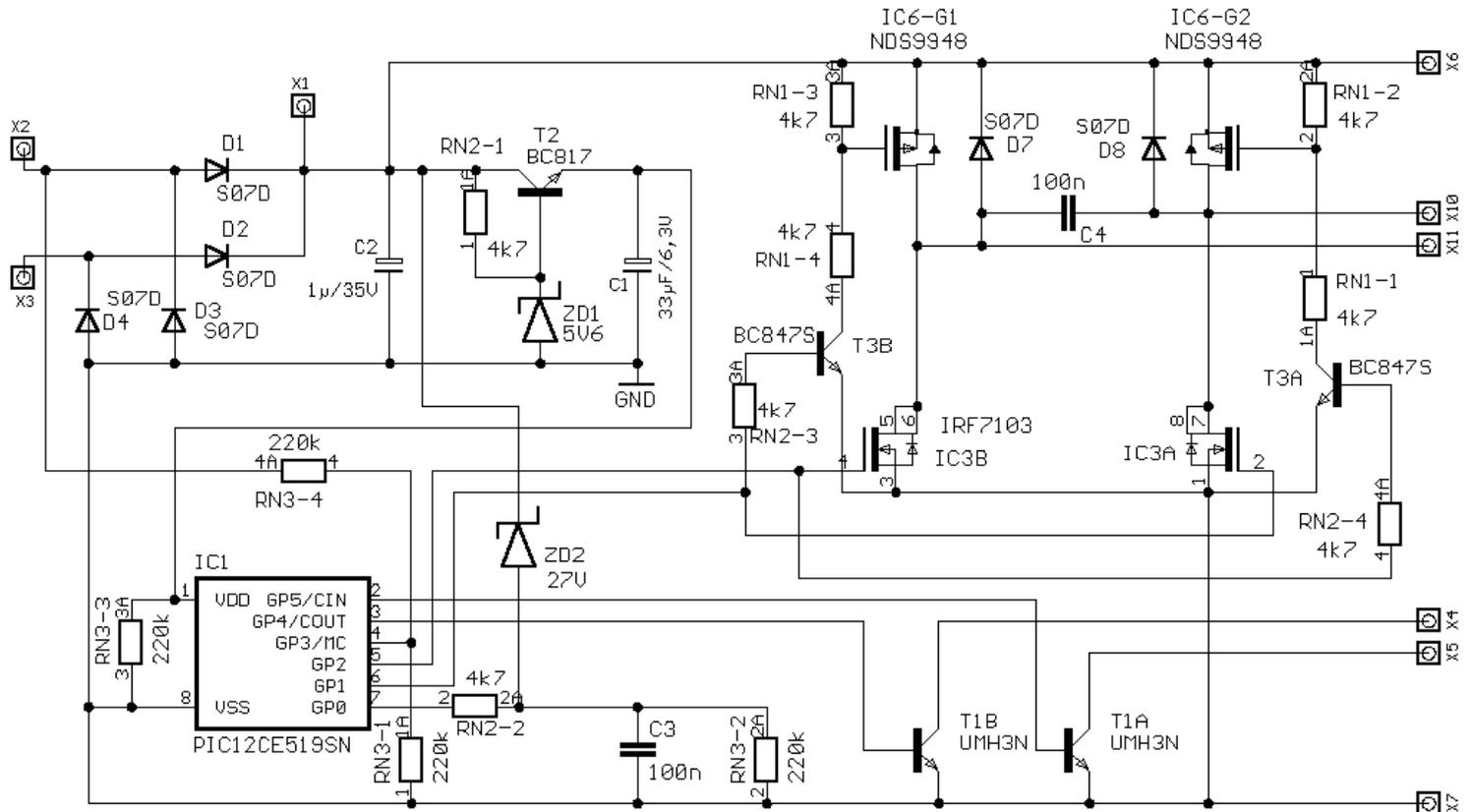
**Fig. 3:**

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



- | | |
|-----|--|
| X1 | LD-W-3: 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 | LD-G-3: Rückleiter für alle Funktionen / Return conductor for all functions / Pole commun des fonctions / Retourleiding voor alle functie
LD-W-3: Rückleiter des Motors (schwarzes Kabel) / Return conductor of the motor (black cable) / Retour du moteur (fil noir) / Retourleiding van de motor (zwarte draad) |
| X10 | Feldwicklung "zurück" des Motors / "Backwards" field winding of the motor / Bobinage d'induit "marche arrière" du moteur / Veldwikkling "terug" van de motor |
| X11 | Feldwicklung "vor" des Motors / "Forwards" field winding of the motor / Bobinage d'induit "marche avant" du moteur / Veldwikkling "heen" van de motor |
| * | falls erforderlich / if necessary / si necessaire / indien noodzakelijk |

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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