FD-6

Funktionsdecoder
DCC-Format

Function decoder
DCC format

Décodeur de fonctions
Format DCC

Functiedecoder
DCC-format

Anleitung

Manual

Mode d´emploi

Handleiding

Art.-Nr. 22-01-064

CE

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Technische Änderungen vorbehalten.

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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. It is designed for the mounting in a model railway locomotive or in a model railway carriage It evaluates the DCC format data sent by the digital central unit to its address. The decoder switches the four function outputs, which can be variously assigned to the functions keys.

The module should not be assembled or operated by children under the age of 14.

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

Any other use is inappropriate and invalidates any guarantees.

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/EWG (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.

Information: Speed mode

Digital control units for DCC format can send 14, 28 or 128 speed levels depending on the model and the settings. The number of speed levels sent by the digital control unit (= speed mode) must be set at the decoder as well. Otherwise the performance of the decoder may be incorrect.

Information: Configuration variables (CVs)

You can set the so-called configuration variables of the decoder from the central unit. The programming of the variables allows adjustment of the decoder to the particular demands of the vehicle and to the individual needs of the user.

The configuration variables are saved in the decoder and are also preserved if the decoder is switched off. Changing the configuration variables is possible at any time from the digital control unit.

The configuration variables for the DCC format are standarised. The variables that can be set depend on the decoder type.

Operation overview

The decoder FD-6 is designed for operation in DCC format and can be adjusted to one of 127 basic addresses or to one of 10.239 extended addresses. It is designed to be controlled from digital control units that are set on the 14-, 28 or the 128-speed mode.

The decoder can be programmed individually by setting the configuration variables. It is possible to set all configuration variables with central units which support the CV-programming. With central units which only support the so-called register-programming the number of the configuration variables that can be set is restricted.

The configuration variables of the FD-6

The following configuration variables (CVs) can be set from the digital control unit:

- Basic address (CV#1)
- Version (CV#7) – read only ***1**
- Manufacturer identification (CV#8) - read only
- Extended address (CV#17 und CV#18)
- Configuration data 1 (CV#29)
- Assignment of the outputs X5 to X8 to the function keys F5 to F8 (CV#39 to 42) ***1**
- Dimming of the outputs X5 to X8 (CV#50 to C53) ***1**
- Assignment of the outputs X5 to X8 to the function keys F0 to F4 (CV#55 to 58) ***1**
- Effects for the outputs X5 to X8 (CV#60 to 63) ***1**

***1** Not possible with central units with register programming!

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 F0 to F8. They are available to connect optional accessories (e.g. lighting, smoke generator, sound module, electric coupling).

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

Effects of the function outputs

It is possible to set the following effects for all function outputs individually:

- Irregular flickering. Example of use: Flickering of the boiler fire by steam engines.
- Strobe (flashing). Example of use: American locomotives with that kind of lighting.
- MARS light (swelling of the brightness). Example of use: American locomotives with that kind of lighting.
- Switching on and off depending on the direction of travel.
- Flashing with a frequency of 2 Hz with two phases which are out-of-phase by 180 degrees. Example of use: individual flash lights or alternating flash lights.
- Flashing with a frequency of 1 Hz.

Additional function output depending on the direction of travel

Beside the four function outputs to be switched there is another function output available that depends on the direction of travel but cannot be switched. This output can be connected directly to the base of a transistor, whose emitter is connected to the decoder. The output can be loaded with maximum 1 mA and therefore is not suitable for direct connection of auxiliary loads.

Depending on the direction of travel a voltage of 0 or 5 Volt is applied to this output. This allows the switching of a transistor depending on the direction of travel.

Technical specifications

Data format	DCC
Supply voltage	12-24 Volt digital voltage
Current consumption (without connected loads)	approx. 10 mA
Max. current per function output to be switched	1.500 mA
Max. total current	2.500 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	approx. 26 x 16,5 x 3,5 mm
Weight	approx. 2 g

Checking the package contents

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

- one decoder, with or without soldered connecting, depending on the version,
- one manual.

Required tools and materials

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: $\geq$ 0,1 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.
- Only use tin solder SN 60 Pb (i.e. 60 % tin, 40 % lead) with rosin-based flux.
- When soldering electronic circuits never use soldering-water or soldering grease. They contain acids that can corrode components and copper tracks.
- Solder quickly: holding the iron on the joints longer than necessary can destroy components and can damage copper tracks or soldering eyes.
- Apply the soldering tip to the soldering spot in such a way that the wire and the soldering eye are heated at the same time. Simultaneously add solder (not too much). As soon as the solder becomes liquid take it away. Hold the soldering tip at the spot for a few seconds so that the solder flows into the joint, then remove the soldering iron.
- The joint should be held still for about 5 seconds after soldering. 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 function decoder

Open the vehicle housing. Locate the position for the decoder. Follow the connection diagram fig. 1. Solder the connections from the rail current collectors at the points X1 and X2. 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. Connect the lamps and other accessories to the function outputs (X5 to X8) on 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 vehicle ground, the connection is complete. If not, connect the second side of the lamp or the accessory to the return conductor of the decoder (point X3 or X4).

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

Front lighting: X8

Back lighting: X5

Accessory to be switched via F1: X6

Accessory to be switched via F2: X7

Caution:

If you connect the loads to the return conductor for all functions (point X3 or X4), the load must be insulated. The loads should not make contact with metal parts of the vehicle. Possible short circuit! The function decoder will be damaged in operation.

Caution:

The return conductor for all functions (point X3 or X4) must under no circumstances be connected to vehicle ground. Possible short circuit! The function decoder will be damaged in operation.

Tip: There is a confirmation signal from the central unit only when enough current can flow. For that reason you should connect to at least one output a load with a high current consumption, before starting to program the decoder. See the manual of your central unit for the required minimum value for the current consumption.

Connecting the LEDs

The function outputs of the function 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. 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:

(number of LEDs + 2) x 1,5 < digital voltage

Connecting a transistor stage

You can connect a transistor stage to the function outputs X9 and X10 which e.g. allows a change-over between the current collectors to be realised. Connect the base of the transistor to point X 9 and the emitter to point X10.

Attention:

The output X9 can be charged with maximum 1 mA. Therfore it is not suitable for the direct connection of auxiliary loads.

Fixing the function decoder

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

Programming the function decoder

The function decoder is programmed from the digtial central. See chapter in the manual of your digital control unit where the programming of configuration variables (CVs) is explained.

You can programm resp. read out the following decoder variables:

NB. With central units with register-programming it is only possible to program the variables CV#1 and CV#29 (= register1 and 5).

*[2] Tip: You program the configuration variables CV#29, CV#39 to 42, CV#55 to 58 and CV#60 to 63 by entering the sum of the numerical values which are assigned to the desired parameters.

CV-name	CV-no.	Input value / (State of delivery)	Remarks
Basic address	1	1 ... 127 (3)	
Version	7	---	Read only!
Manufacturer	8	---	Read only!
Reset	8	0 ... 255	Any value restores the settings in state of delivery.
Extended adress	17 18	1 ... 10239 (-)	
Configuration data 1	29	(2)	Numerical value *2 Direction "standard" 0 Reverse direction 1 14 speed levels 0 28 or 128 speed levels 2 Basic adress 0 Extended adress 32
Assignment F5 – F8 to the outputs:		0 ... 15 (0)	Numerical value *2 Operation with:
X5	39		--- 0 function key F5 1
X6	40		function key F6 2
X7	41		function key F7 4
X8	42		function key F8 8
Dimming of the outputs:		0 ... 63 (63)	= The voltage that is applied to the output. The value "1" corresponds to the minimum, „63“ to the maximum voltage.
X5	50		
X6	51		
X7	52		
X8	53		

CV-name	CV-no.	Input value / (State of delivery)	Remarks	
Assignment F0 – F4 to the outputs:		0 … 31 (0)	Numerical value *2 Operation with:	
			---	0
			function key F1	1
X5	55		function key F2	2
X6	56		function key F3	4
X7	57		function key F4	8
X8	58		function key F0	16
Effects for the outputs:		0 … 255 (0)	Numerical value *2	
			Flickering active	1
			Strobe active	2
			MARS light active	4
			at backward motion inactive	8
X5	60		at forward motion inactive	16
X6	61		Flashing 2 Hz phase A	32
X7	62		Flashing 2 Hz phase B	64
X8	63		Flashing 1 Hz	128

FAQ

- Parts are getting very 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: Short circuit. The decoder is connected to locomotive or carriage ground. → Check the connections. A short circuit can result in irreparable damage.
- The lighting does not correspond to the direction of travel.
  Possible cause: The configuration data (CV29) of the locomotive decoder in the train vary from the configuration data programmed in the function decoder. → Change the programming or the function or the locomotive deocder.
- The lighting goes on and off when the speed levels are turned up or the lighting cannot be switched on or off.
  Possible cause: The speed mode of the decoder and the digital control unit do not correspond. Example: The central is set to the mode 28 speed levels, but the decoder to the mode 14 speed levels. → Change the speed mode at the central and / or at the decoder.

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 resp. 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

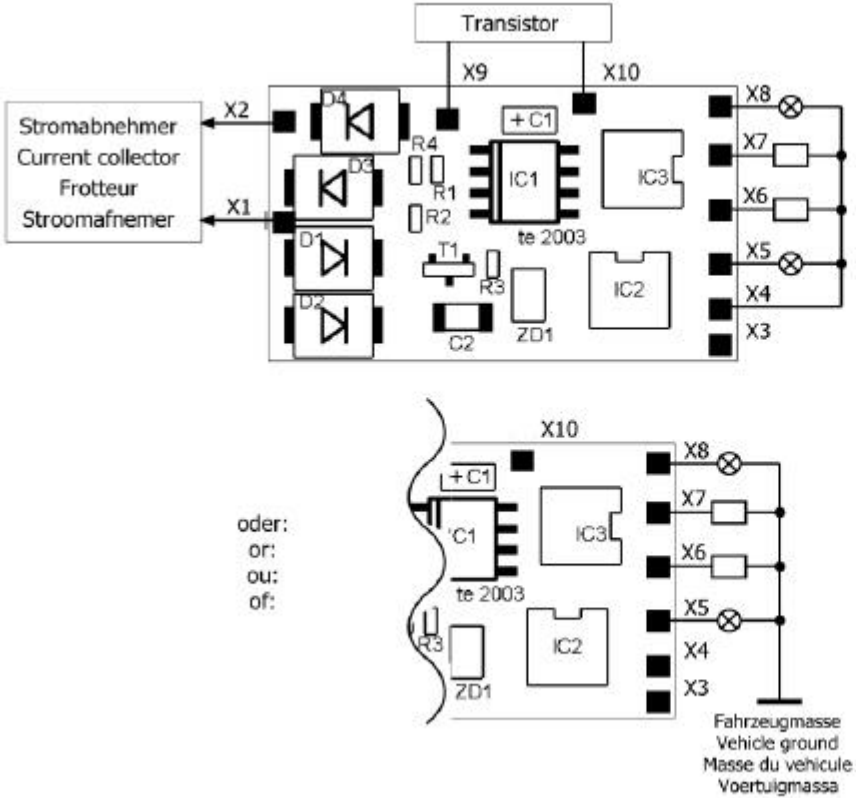
This product is guaranteed for two years. The warranty includes the correction of faults which can be proved to be due to material failure or factory flaw. We guarantee the adherence to the technical specifications of the circuit when assembled and connected according to the manual.

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:

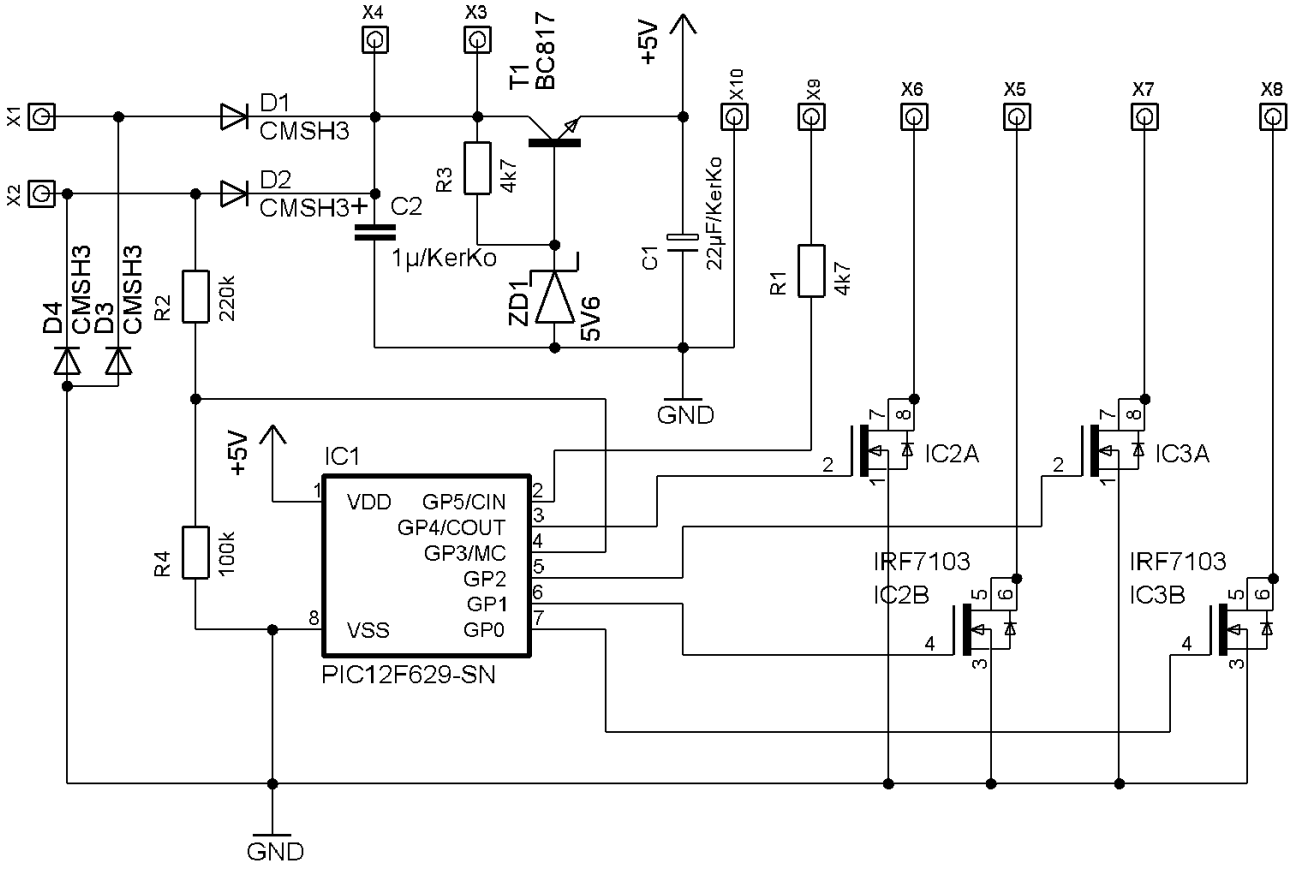
- using an unsuitable soldering iron, solder containing liquid acids or similar,
- if damage is caused by not following the instructions in this manual,
- if the module has been altered and repair attempts have failed,
- if arbitrary changes in the circuit are made,
- if additional components are added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



X5 - X8	Beliebige Verbraucher Optional accessories Consommateurs quelconques Gewenste verbruikers
Anschlüsse für werkseitige Einstellung: Connections for decoder factory settings: Occupation pour réglage d'origine: Plaatsing voor de fabrieksmatige instelling:	
X5	Beleuchtung Rückwärtsfahrt Lighting backward direction Feux marche arrière Verlichting achteruitrijden
X6	F1
X7	F2
X8	Beleuchtung Vorwärtsfahrt Lighting forward direction Feux marche avant Verlichting vooruitrijden
X4, X3	Rückleiter für alle Funktionen Return conductor for all functions Pole commun des fonctions Retourleiding voor alle functies
X1, X2	Stromabnehmer Current collector Frotteur Stroomafnemer
X9, X10	Transistorstufe Transistor stage Transistor Transistortrap

Fig. 2: Schaltplan - Circuit Diagram - Schéma de principe - Schakelplan



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