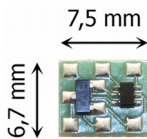


FI-1

Function inverter
for vehicle decoders

Manual



FI-1

Item number 70-02001-02



FI-Set

Item number 70-02000-02

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Printing the manual

The formatting is optimised for double-sided printing. The standard page size is DIN A5. If you prefer a larger display, printing on DIN A4 is recommended.

1. Getting started

The instructions will help you step by step with the safe and proper installation and use of your function inverter. Before you start to put the function inverter into operation, read this manual completely, especially the safety instructions and the section on possible errors and their elimination. You will then know what you have to pay attention to and thus avoid errors that sometimes can only be rectified with a lot of effort.

Keep the instructions in a safe place so that you can restore functionality later in the event of any malfunctions. If you pass the function inverter on to another person, also give the instructions with it.

1.1. Contents of the package

	FI-Set (70-02000-02)	FI-1 (70-02001-02)
Function inverters FI-1	2	2
Red-yellow dual LEDs	4	---
Yellow LEDs	2	---
Resistors (1,5 kOhm)	6	---

1.2. Required accessories

For mounting and connecting you need:

- a soldering iron with temperature control and a thin tip and a deposit stand or a controlled soldering station
- a scraper, rag or sponge
- a heat-resistant pad
- a small pair of side cutters and wire strippers
- tweezers and flat-nose pliers if necessary
- electronic solder (preferably 0.5 to 0.8 mm diameter)
- Stranded wires. If possible, use thin, flexible or highly flexible stranded wires that consist of several thin individual wires and can be easily laid in the vehicle.
Recommended cross-sections: $\geq 0,04 \text{ mm}^2$

1.3. Intended use

The function inverter is intended for use in model construction, especially in model railway layouts, according to the specifications in the manual. Any other use is not in accordance with the intended use and will result in the loss of the warranty claim. Intended use also includes reading, understanding and following all parts of the instructions. The function inverter is not intended to be used by children under the age of 14.

1.4. Safety instructions

Improper use and non-observance of the instructions can lead to incalculable hazards. Prevent these dangers by carrying out the following measures:

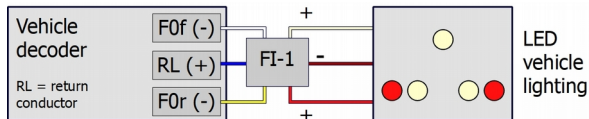
- Only carry out installation work when the module is de-energised. When carrying out soldering work, also observe the instructions in sections 3.1 and 3.2.
- Only carry out installation work in closed, clean and dry rooms. Avoid moisture, wetness and splashing water in your working environment.
- Supply the module only with extra-low voltage as specified in the technical data. Use only tested and approved transformers / power supply units.
- Only plug the mains plugs of transformers / power supply units into properly installed and fused earthed sockets.
- When making electrical connections, ensure that the cable cross-section is sufficient.
- Do not expose the module to high ambient temperatures or direct sunlight. Observe the information on the maximum operating temperature in the technical data.
- If you notice damage or malfunctions, switch off the supply voltage immediately. Send the function inverter in for inspection.

2. Operation overview

The function inverter has to be connected between the LED and the function output of the locomotive or function decoder and inverts the polarity of the decoder connections.

Example 1: Connection of a LED vehicle lighting

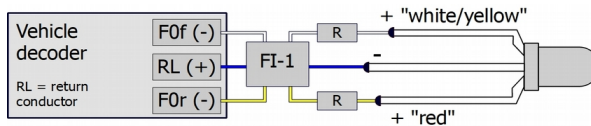
LED lighting in commercially available control cars is often wired so that the cathodes (-) are connected together to earth. They can therefore not be connected directly to the decoder when retrofitting a vehicle decoder. Instead of converting the diodes, a function inverter can be connected in between.



Functional principle. No connection diagram!

Example 2: Connection of dual-LEDs with common cathode

Red-yellow or red-white Duo-LEDs are suitable as front or rear lighting for model railway locomotives and carriages. However, some types only have a common cathode (-) for both colours. They can therefore not be connected directly to the function outputs of vehicle decoders, as the decoder return conductors have a positive polarity. These Duo-LEDs can be connected to the decoder outputs via the function inverter.



Functional principle. No connection diagram!

3. Connections

3.1. 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 and connecting the circuit to another voltage than specified,
- impermissibly high humidity and 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.
- Only install the module in closed, clean, dry rooms. Beware of humidity.
- Supply the module only with extra-low voltage as specified in the technical data. Use only tested and approved transformers.
- Connect transformers and soldering irons only in approved mains sockets installed by an authorised electrician.
- Observe cable diameter requirements.
- After condensation has formed, wait up to 2 hours for acclimatisation before working.

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 mount modules.

Caution:

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

In schools, training facilities, hobby and self-help workshops, the assembly, installation and operation of electronic modules must be supervised by trained personnel.

In commercial facilities, the relevant accident prevention regulations must be observed.

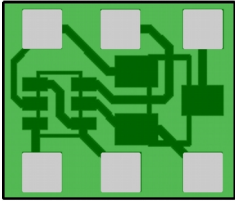
3.2. Safe and correct soldering

Caution:

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

- Use a soldering iron with temperature control, which you set to approx. 300 °C.
- Only use electronic solder with a flux.
- Never use soldering fluid or soldering grease when soldering electronic circuits. These contain an acid that destroys components and conductor paths.
- Solder quickly: Soldering for too long can detach solder pads or tracks or even destroy components.
- Hold the soldering tip on the soldering point so that it touches the wire and the pad at the same time. Add (not too much) solder simultaneously. As soon as the solder begins to flow, remove it from the soldering point. Then wait a moment for the solder to flow well before removing the soldering iron from the soldering joint.
- Do not move the created solder joint for about 5 seconds.
- A clean, non-oxidized soldering tip is essential for a perfect soldering joint and good soldering. Therefore, before each soldering, wipe off excess solder and dirt with a damp sponge, a thick damp cloth or a silicone wiper.
- After soldering, check (preferably with a magnifying glass) whether connections or tracks have been bridged with solder by mistake. This can lead to malfunction or destruction of components or, in the worst case, the complete circuit. You can re-liquefy excess solder with the clean hot soldering tip. The solder then flows from the board onto the soldering tip.

3.3. Connection assignment

Connecting point FI-1	Connection to	
 <p>The diagram shows a green PCB with six connection points labeled X1, X4, X6 at the top and X5, X3, X2 at the bottom. Internal traces connect these points to various components, including a decoder and LED drivers.</p>	X1 X2	Function outputs of the vehicle decoder X1: lighting forward direction X2: lighting backward direction
	X3	Return conductor for all outputs of the decoder
	X4	Anodes (+) of the yellow or white LEDs (of the dual-LEDs)
	X5	Anodes (+) of the red LEDs (of the dual-LEDs)
	X6	Cathodes (-) of the (dual-) LEDs

3.4. Connecting the LEDs

LEDs should always be connected to the function outputs of the vehicle decoder via a series resistor. If not operated via a series resistor they will be destroyed when put into operation. The value of the series resistor depends on the supply voltage.

Necessary value of the series resistor for a dual-LED with 15 mA current input:

Digital voltage on the rails *	12 V	14-16 V	18 V	20-22 V	24 V
Value of the series resistor	820 Ω	1,0 kΩ	1,2 kΩ	1,5 kΩ	1,8 kΩ

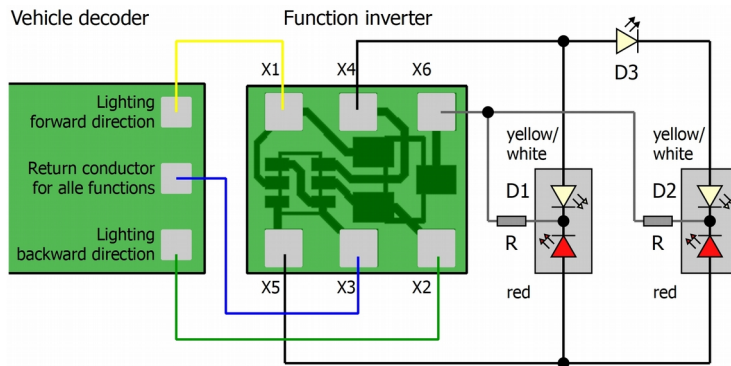
* **Advice:** When using a not regulated booster, the digital voltage on the rails is 1,4-fold as high as the nominal voltage of the transformer. Example:

Nominal voltage of the transformer: 18 V

→ Digital voltage on the rails: $1,4 \times 18 \text{ V} = 25,2 \text{ V}$

Example: Connecting dual-LEDs and a LED for the top light

The LEDs are connected that way the yellow or white parts light at forward motion. You can connect an additional yellow or white LED for the top light in series with one of the two dual-LEDs (yellow or white LED) to the function inverter.



Caution: If a component gets too hot, disconnect the module and power supply from the mains **immediately**. Possible short circuit!

3.5. Fixing the module

Mount the PCB in a suitable position in the carriage as required, using double sided adhesive tape for instance.

4. Checklist for troubleshooting and error correction



Warning:

If you notice a strong heat development, immediately disconnect the connection to the supply voltage. **Fire hazard!**

Possible causes:

- One or more connections are faulty. → Check the connections.
- The supply voltage is too high. → Reduce the supply voltage according to the specifications in the chapter "Technical specifications".
- The module is defective. → Return the module for testing/repair.

One or more LEDs do not light up.

Possible causes:

- None of the decoder outputs are active. → Check if at least one of the function outputs of the decoder is switched on.
- Possible cause: The connection to the power supply is interrupted. → Check the connections.

4.1. Technical Hotline

If you have any questions about the use of the function inverter, our technical hotline will help you (telephone number and e-mail address on the last page).

4.2. Repairs

You can send us a defective function inverter for inspection / repair (address on the last page). Please do not send us your return freight collect. In the event of a warranty or guarantee claim, we will reimburse you for the regular shipping costs.

Please enclose the following with your shipment

- proof of purchase as evidence of any warranty or guarantee claim
- a brief description of the defect
- the address to which we should return the product(s)
- your email address and/or a telephone number where we can reach you in case of queries

Costs

The inspection of returned products is free of charge for you. In the event of a warranty or guarantee claim, the repair and return are also free of charge for you.

If there is no warranty or guarantee case, we will charge you the costs of the repair and the costs of the return. We charge a maximum of 50% of the new price for the repair according to our valid price list.

Carrying out the repair(s)

By sending in the product(s), you give us the order to inspect and repair it. We reserve the right to refuse the repair if it is technically impossible or uneconomical. In the event of a warranty or guarantee claim, you will then receive a replacement free of charge.

Cost estimates

Repairs for which we charge less than € 25.00 per item plus shipping costs will be carried out without further consultation with you. If the repair costs are higher, we will contact you and carry out the repair only after you have confirmed the repair order.

5. Technical data

Inputs and outputs

Inputs	2 for connection to the outputs of vehicle decoders
Outputs	2 for connecting LEDs

Electrical properties

Supply voltage	Digital voltage of the decoder
Current consumption	approx. 0.1 mA (without LEDs)
Maximum total current	30 mA

Protection

Protection class	IP 00 Meaning: No protection against solid foreign bodies. No protection against water.
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Environment



For use in closed rooms

Ambient temperature during operation	0 ~ + 30 °C
Permissible relative humidity during operation	10 ~ 85% (non-condensing)
Ambient temperature during storage	- 10 ~ + 40 °C
Permissible relative humidity during storage	10 ~ 85% (non-condensing)

Other features

Dimensions of the PCB	approx. 7.5 x 6.5 x 2 mm
Weight of the PCB	approx. 0.1 g

6. Warranty, EU conformity & WEEE

6.1. Guarantee bond

For this product we issue voluntarily a guarantee of 2 years from the date of purchase by the first customer, but in maximum 3 years after the end of series production. The first customer is the consumer first purchasing the product from us, a dealer or another natural or juristic person reselling or mounting the product on the basis of self-employment. The guarantee exists supplementary to the legal warranty of merchantability due to the consumer by the seller.


The warranty includes the free correction of faults which can be proved to be due to material failure or factory flaw. With kits we guarantee the completeness and quality of the components as well as the function of the parts according to the parameters in not mounted state. We guarantee the adherence to the technical specifications when the kit has been assembled and the ready-built circuit connected according to the manual and when start and mode of operation follow the instructions.

We retain the right to repair, make improvements, to deliver spares or to return the purchase price. Other claims are excluded. Claims for secondary damages or product liability consist only according to legal requirements.

Condition for this guarantee to be valid, is the adherence to the manual. In addition, the guarantee claim is excluded in the following cases:

- if arbitrary changes in the circuit are made,
- if repair attempts have failed with a ready-made module or device,
- if damaged by other persons,
- if damaged by faulty operation or by careless use or abuse.

6.2. EU Declaration of Conformity

 This product fulfils the requirements of the following EU directives and therefore bears the CE marking.

2001/95/EU Product Safety Directive

2015/863/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)

2014/30/EU on electromagnetic compatibility (EMC Directive). Underlying standards:

DIN-EN 55014-1 and 55014-2: Electromagnetic compatibility - Requirements for household appliances, electric tools and similar electrical appliances. Part 1: Emitted interference, Part 2: Immunity to interference

To maintain electromagnetic compatibility during operation, observe the following measures:

Only connect the supply transformer to a professionally installed and fused earthed socket.

Do not make any changes to the original components and follow the instructions, connection and assembly diagrams in this manual exactly.

Only use original spare parts for repair work.

6.3. Declarations on the WEEE Directive

This product is subject to the requirements of the EU Directive 2012/19/EC on Waste Electrical and Electronic Equipment (WEEE), i.e. the manufacturer, distributor or seller of the product must contribute to the proper disposal and treatment of waste equipment in accordance with EU and national law. This obligation includes

- registration with the registering authorities ("registers") in the country where WEEE is distributed or sold
- the regular reporting of the amount of EEE sold
- the organisation or financing of collection, treatment, recycling and recovery of the products
- for distributors, the establishment of a take-back service where customers can return WEEE free of charge
- for producers, compliance with the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) Directive.



The "crossed-out wheeled bin" symbol means that you are legally obliged to recycle the marked equipment at the end of its life. The appliances must not be disposed of with (unsorted) household waste or packaging waste. Dispose of the appliances at special collection and return points, e.g. at recycling centres or at dealers who offer a corresponding take-back service.

Further Information and Tips:
<http://www.tams-online.de>

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