

S88-2

s88 Booster

Manual



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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.

**** The asterisks**

The following manufacturers and their products are mentioned in this manual:

Littfinski Daten Technik (LDT) | Ulmenstraße 43 | DE-15370 Fredersdorf

Gebr. Märklin** & Cie. GmbH | Stuttgarter Straße 55-57 | DE-73033 Göppingen

Viessmann Modelltechnik GmbH | Bahnhofstraße 2a | DE-35116 Hatzfeld-Reddighausen

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1. Getting started

The instructions will help you step by step with the safe and proper assembly of the kit and installation and use of your s88 booster. Before you start to assemble the kit or put the s88 booster 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 s88 booster on to another person, also give the instructions with it.

1.1. Contents of the package

- 1 one kit S88-2 (item no. 44-01205-01), containing the components listed in the parts list (see section 3.4.) and one PCB or
 - 1 ready-built and tested circuit board S88-2 (item no. 44-01206-01) or
 - 1 s88 booster S88-2 in housing (item no. 44-01207-01)
- 1 ribbon cable (6-pole) with cover caps (length: 15 cm)

1.2. Accessories

To assemble the kit you will 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)

Connection cables

The use of stranded wire is recommended for making the connections. Stranded wires consist of several thin individual wires and are therefore more flexible than rigid wires with the same copper cross-section. Recommended cross-sections:

- Connections to the transformer: $\geq 0.25 \text{ mm}^2$

1.3. Intended use

The s88 booster is intended for use in model railway layouts as specified in the instructions. 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 s88 booster is not intended to be used by children under the age of 14.

1.4. Safety instructions



Please note:

The s88 booster contains integrated circuits (ICs). These are sensitive to electrostatic charging. Therefore, do not touch these components until you have "discharged" yourself. For this purpose, e.g. a grip on a radiator is sufficient.

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

- Only use the s88 booster in closed, clean and dry rooms. Avoid moisture and splash water in the environment. After condensation has formed, wait two hours for acclimatisation before use.
- Disconnect the s88 booster from the power supply before carrying out wiring work.
- Supply the s88 booster only with extra-low voltage as specified in the technical data. Use only tested and approved transformers.
- Only plug the mains plugs of transformers into properly installed and fused earthed sockets.
- When making electrical connections, ensure that the cable cross-section is sufficient.
- Heating of the s88 booster during operation is normal and harmless.
- Do not expose the s88 booster to high ambient temperatures or direct sunlight. Observe the information on the maximum operating temperature in the technical data.
- Regularly check the operational safety of the s88 booster, e.g. for damage to the connection cables.
- If you notice damage or if malfunctions occur, disconnect the connection to the power supply immediately. Send the s88 booster in for inspection.

1.5. Care

Do not use any cleaning agents to clean the s88 booster. Only wipe the module dry. Disconnect the s88 booster from the power supply before cleaning.

2. Operation overview

The s88 booster reduces the interference that can occur during data transmission from the s88 feedback modules to the receiver (control unit, PC via interface or memory) when 6-core cables are used as bus lines. Interference is caused by external electrical signals such as:

- switching impulses for points or
- digital signals in data lines running in parallel to the bus lines.

This interference affects the data transfer and causes faulty input to the receiver.

Because it is standard to operate the s88-bus with a voltage of 5 V interference voltages of 2,5 V can cause interference in data transfer. The longer the s88-data lines are, the higher is the risk of interference.

The s88 booster is connected between receiver (control unit, PC via interface or memory) and s88-module(s) and heightens the s88-bus's supply voltage to 12 V. In consequence interference voltages of less than 6 V have non influence on the data transfer in the s88-bus.

Most commercial s88-feedback modules (e.g. from Littfinsky, Märklin, Viessmann, Tams) operate with this higher supply voltage.

**Please note:**

Before installing the s88 booster you must check if the s88-feedback modules used in your model railroad layout can operate with a supply voltage of 12 V. You can determine this by checking the IC-types used on the feedback modules.

Modules with ICs with a type designation starting with number "74": These modules are not suitable to use with the s88 booster. Highering the supply voltage to 12 V on the s88 booster would damage these modules.

Modules with ICs with a type designation containing the numbers "4014" and "4044": These modules are OK to use with the s88 booster.

3. Assembling the kit

You can skip this section if you have purchased a ready-built module or device.

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.

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 kit or the ready-built module.



Caution:

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 must be supervised by qualified personnel. In industrial institutions, health and safety regulations applying to electronic work must be adhered to.

3.2. Soldering properly

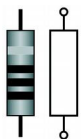
- Use a soldering iron with temperature control, which you set to approx. 300 °C.
- Only use electronic solder with a flux.
- Never use soldering water or soldering grease when soldering electronic circuits. These contain an acid that destroys components and conductor paths.
- Insert the connecting wires of the components as far as possible through the holes of the board without using force. The body of the component should be close above the board.
- Make sure that the polarity of the components is correct before soldering them.
- Solder quickly: soldering for too long can cause pads or tracks to become detached or even destroy components.
- Hold the soldering tip on the soldering point in such a way that it touches the component 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 component you have just soldered for about 5 seconds.
- A clean, non-oxidised (scale-free) 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, cut off the connecting wires directly above the soldering point with a side cutter.
- After assembly, always check each circuit again to ensure that all components are correctly inserted and polarised. Also check that no connections or tracks have been accidentally bridged with tin. This can lead not only to malfunction, but also to the destruction of expensive components. You can re-liquefy excess solder with the clean hot soldering tip. The solder then flows from the board to the soldering tip.

3.3. Preparation

Put the sorted components in front of you on your workbench.

The separate electronic components have the following special features you should take into account in assembling:

Resistors



Resistors reduce current.

The value of resistors for smaller power ratings is indicated through colour rings. Every colour stands for another figure. Carbon film resistors have 4 colour rings. The 4th ring (given in brackets here) indicates the tolerance of the resistor (gold = 5 %).

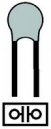
Value:

Colour rings:

1 k Ω

brown - black - red (gold)

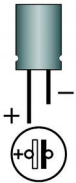
Ceramic capacitors



Among other things ceramic capacitors are used for filtering interference voltages or as frequency determining parts. Ceramic capacitors are not polarized.

Normally they are marked with a three-digit number which indicates the value coded. The number 104 corresponds to the value 100 nF.

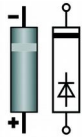
Electrolytic capacitors



Electrolytic capacitors are often used to store energy. In contrast to ceramic capacitors they are polarized. The value is given on the package.

Electrolytic capacitors are available with different voltage sustaining capabilities. Using an electrolytic capacitor with a voltage sustaining capability higher than required is always possible.

Diodes and Zener diodes

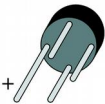


Diodes allow the current to pass through in one direction only (forward direction), simultaneously the voltage is reduced by 0,3 to 0,8 V. Exceeding of the limit voltage always will destroy the diode, and allow current to flow in the reverse direction.

Zener diodes are used for limiting voltages. In contrast to "normal" diodes they are not destroyed when the limit voltage is exceeded.

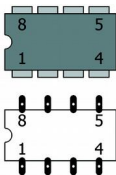
The diode type is printed on the package.

Rectifiers



Rectifiers convert alternating into direct voltage. They have four pins: two for the input voltage (a.c. voltage) and two for the output voltage (d.c. voltage). The pins for the output voltage are polarized.

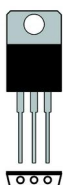
Integrated circuits (ICs)



Depending on the type, ICs fulfil various tasks. The most common housing form is the so-called "DIL"-housing, from which 4, 6, 8, 14, 16, 18 or more "legs" (pins) are arranged along the long sides.

ICs are sensitive to damage during soldering (heat, electrostatic charging). For that reason in the place of the ICs IC sockets are soldered in, in which the ICs are inserted later.

Voltage regulators



Voltage regulators are ICs, which convert a variable, non regulated input voltage in a constant output voltage. They are produced in transistor packages with three connecting pins for input, output and earth.

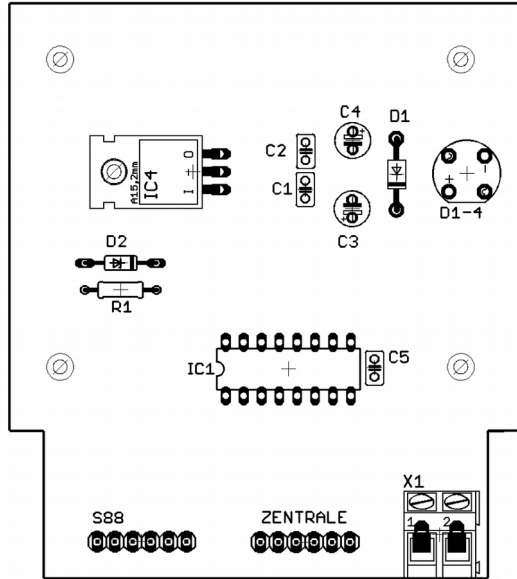
The package forms of voltage regulators depend on their type. In use are voltage regulators in SOT packages (half cylinder shaped) and in flat TO packages.

Modular terminals

Modular terminals are solder-in screw-type terminals. They provide a solder-free and safe connection of the cables to the circuit, which can still be separated any time.

3.4. PCB layout and parts list

PCB layout



Parts list

Carbon film resistors	R1	1 k Ω
Ceramic capacitors	C1, C2, C5	100 nF
Electrolytic capacitors	C3, C4	100 μ F/25 V
Diodes	D1	1N400x, x = 2..7
Zener diodes	D2	5V1
Rectifiers	D1-4	B80C800 or similar
Integrated circuits (ICs)	IC1	4104
IC sockets	IC1	16-pole
Voltage regulators	IC4	7812
Terminal strips	X1	2-pole
Pin headers	S88, ZEN	6-pole

3.5. Assembly

Proceed according to the order given in the list below. First solder the components on the solder side of the PCB and then cut the excess wires with the side cutter. Follow the instructions on soldering in section 3.2.



Caution:

Several components have to be mounted according to their polarity. When soldering these components the wrong way round, they can be damaged when you connect the power. In the worst case the whole circuit can be damaged. At the best, a wrongly connected part will not function.

1.	Resistor	Mounting orientation of no importance.
2.	Diode and Zener diode	Observe the polarity! The negative end of the diodes is marked with a ring. This is shown in the PCB layout.
3.	IC socket	Mount the socket that way, the markings on the socket show in the same direction as the markings on the PCB board.
4.	Rectifier	Observe the polarity! The pin connections are printed on the housing. The longer connecting pin is the positive pole.
5.	Ceramic capacitors	Mounting orientation of no importance.
6.	Voltage regulator	Observe the polarity! With voltage regulators in TO-packages the unlabelled back side is marked in the PCB layout by a thick line. Before soldering, bend the voltage regulator's pins to 90 degrees, so that you can solder it in corresponding to the PCB layout with the labelled front side facing upwards.
7.	Electrolytic capacitors	Observe the polarity! One of the two leads (the shorter one) is marked with a minus sign.
8.	Terminal strip and pin headers	
9.	IC in DIL-housing	Insert the IC into the soldered socket. Do not touch the IC without first discharging yourself by touching a radiator or other grounded metal parts. Do not bend the "legs" when inserting it into the socket. Check that the markings on the PCB, the socket and the IC show to the same direction.

3.6. Performing a visual check

Perform a visual check after the assembly of the module and remove faults if necessary:

- Remove all loose parts, wire ends or drops of solder from the PCB. Remove all sharp wire ends.
- Check that solder contacts which are close to each other are not unintentionally connected to each other. Risk of short circuit!
- Check that all components are polarised correctly.

When you have remedied all faults, go on to the next part.

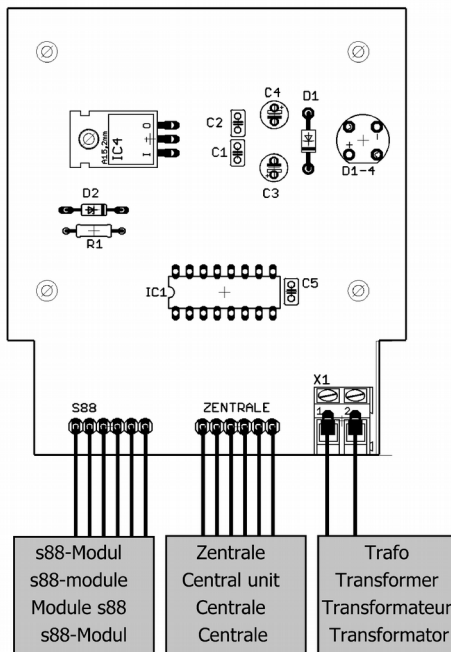
4. Connecting the s88 booster

Checking the s88-feedback modules

You should check if the s88-feedback modules are working properly before connecting them to s88 booster. See the manual for the s88-feedback modules. That way you can prevent faults occuring after installing the s88 booster due to the s88-feedback modules. Avoid interference caused by external electrical signals during the funtional test.

⚠ Please note:
 Before installing the s88 booster you should check if the s88-feedback modules used in your model railroad layout are compatible with a voltage supply of 12 V and so with the s88 booster. Please note the section 2 ("Operation overview")!

Connections



s88	First s88 feedback in the s88 bus
Zentrale	Receiver (central unit, interface, memory)
X1	Transformer

Connection to the s88 bus

Disconnect the first s88-feedback module from the receiver (central unit, interface, memory). Next connect the s88 booster to the receiver and the first s88-feedback module.

 **Caution:**

You must not interchange the connections to the receiver and the s88 feedback module! If the connections are swapped, damage to the connected devices can occur during commissioning!

Connection to the power supply

Connect the s88 booster to the supply voltage.

 **Caution:**

The s88 booster must be supplied by a transformer of it's own. In case the s88 booster is connected to a transformer that also supplies other parts of the layout, short-circuits and damages at the s88 booster cannot be excluded.

Then test the connected s88 feedback devices.

5. 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.
- "Kit" version: one or more components are soldered incorrectly. → Carry out a visual inspection (→ section 3.5.) and eliminate the faults, if necessary.
- The s88 booster is defective. → Send the s88 booster in for inspection.

No data transmission to the receiver

The receiver (central unit, interface, memory) does not receive any data from the connected s88 feedback modules.

Possible causes:

- The power supply of the s88 booster has been interrupted. → Check the connection.
- The connections of the receiver and the s88-feedback modules have been mixed up. → Check the connections. In this case it is possible the connected devices having been damaged. Check these without connecting them to the s88 booster.
- "Kit" version: The IC on the s88 booster's PCB has been mounted the wrong way about. → Check the polarity.

5.1. Technical Hotline

If you have any questions about the use of your s88 booster, our technical hotline will help you (telephone number and e-mail address on the last page).

5.2. Repairs

You can send us a defective s88 booster for repair (address on the last page). In the event of a warranty or guarantee claim, the repair is free of charge for you. As proof of any warranty or guarantee claim, please enclose the proof of purchase with your return.

If there is no warranty or guarantee claim, we are entitled to charge you the costs of the repair and the costs of the return shipment. We charge a maximum of 50% of the new price for the repair according to our valid price list. We reserve the right to refuse the repair if it is technically impossible or uneconomical.


If you want to clarify whether a repair is possible or economical before sending it in, please contact our Technical Hotline (telephone number and email address on the last page).

Please do not send us repair shipments freight collect. In the event of a warranty or guarantee claim, we will reimburse you for the regular shipping costs.

6. Technical data

Feedback log	s88
Connections to the s88-bus	OUT: 6-pole plug connector IN: 6-pole plug connector


Electrical characteristics

Power supply of the s88 booster	12 - 18 V AC voltage (own transformer required)
	<div style="border: 1px solid black; padding: 5px;">  Warning: If the s88 booster is connected to a transformer that also supplies other parts of the digital system, short circuits may occur and damage the s88 booster. </div>
Power supply of the connected s88 modules	12 V DC voltage
Current consumption	maximum 500 mA (depending on the number of connected s88 feedback modules)

Protection

Protection class	<p>Ready-made module (without housing): IP 00 Meaning: No protection against foreign bodies, contact and water.</p> <p>Ready device (in housing): IP 20 Meaning: Protected against solid foreign bodies with diameter ≥ 12.5 mm and access with a finger. No protection against water.</p>
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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 (approx.)	Circuit board: 73 x 80 mm Ready device including housing: 100 x 90 x 35 mm
Weight (approx.)	Assembled board (ready-made module): 26 g Ready device including housing: 72 g

7. Warranty, EU conformity & WEEE

7.1. 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.

7.2. 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.

7.3. 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>

Warranty and Service:

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