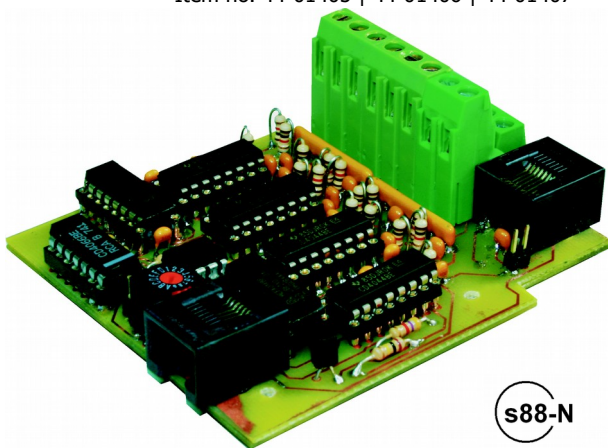


Manual

S88-4

Item no. 44-01405 | 44-01406 | 44-01407



s88-N

s88-Feedback Module
16-fold

tams elektronik
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Subject to technical modification.

1. Getting started

How to use this manual

This manual gives step-by-step instructions for safe and correct assembly of the kit and fitting and connecting of the ready-built module, and operation. Before you start, we advise you to read the whole manual, particularly the chapter on safety instructions and the checklist for trouble shooting. 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 kit or the ready-built module on to another person, please pass on the manual with it.

Intended use

The feedback module S88-4 is designed to be operated according to the instructions in this manual in model building, especially with model railways. Any other use is inappropriate and invalidates any guarantees.

The feedback module S88-4 should not be assembled or mounted by children under the age of 14.

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



Caution:

The S88-4 contains integrated circuits. These 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.

Checking the package contents

Please make sure that your package contains:

- one kit, containing the components listed in the parts list (→ page 15) and one PCB or
- one ready-built module or
- one ready-built module in a housing (complete unit),
- an Ethernet patch cable with RJ-45 connectors (length: 0.5 m)
- a CD (containing the manual and further information).

Required materials

For assembling the kit you need:

- an electronic soldering iron (max. 30 Watt) or a regulated soldering iron with a fine tip and a soldering iron stand,
- a tip-cleaning sponge,
- a heat-resistant mat,
- a small side cutter and wire stripper,
- as necessary a pair of tweezers and long nose pliers,
- electronic tin solder (0.5 mm diameter).

In order to connect the module to the rails you need wire.
Recommended diameter: $\geq 0.25 \text{ mm}^2$.

For the connection of the module to a device with a 6-pole s88 connector you need:

- an adapter S88-A (depending on the installation situation item no. 44-09100, 44-09110, 44-09200 or 44-09210).

2. 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.
- Assembling and mounting the kit 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 kit or the ready-built 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 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. 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**.

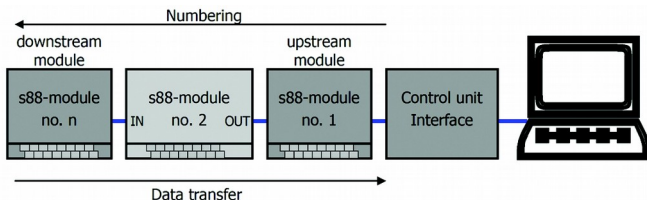
- Use a small soldering iron with max. 30 Watt or a regulated soldering iron.
- Only use electronic tin solder with flux.
- When soldering electronic circuits never use soldering-water or soldering grease. They contain acids that can corrode components and copper tracks.
- Insert the component connecting pins into the PCB's holes as far as possible without force. The components should be close to the PCB's surface.
- Observe correct polarity orientation of the parts before soldering.
- 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 part 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.
- Do not move the component for about 5 seconds after soldering.

- To make a good soldering joint you must use a clean and unoxidised soldering tip. Clean the soldering tip with a damp piece of cloth, a damp sponge or a piece of silicon cloth.
- Cut the wires after soldering directly above the soldering joint with a side cutter.
- After placing the parts, please double check for correct polarity. Check the PCB tracks for solder bridges and short circuits created by accident. This would cause faulty operation or, in the worst case, 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.

4. Operation overview

The feedback module S88-4 is compatible with all components working with the s88-bus developed by the company Märklin**. It can read in 16 mass contacts. This information is transferred via the s88-bus to the upstream module or to the connected digital unit (interface, memory or central unit). The data transfer from one feedback module to the other one works on the principle of the bucket brigade device.

The number of feed back modules to be connected to one bus line depends on the interface, the memory or the control unit in use. Please follow the specifications of the device ´s manufacturer.



Specific features of the S88-4

According to the standard, the s88 feedback system is mounted by lining up the feedback modules, comparable to lining up pearls on a string. On this principle branching bus lines or a radial layout cannot be put into practice without using special attachments.

The addresses for the standard feedback modules are assigned automatically, according to the modules´ order. When mounting an additional standard module between two existing modules, the succeeding modules will be renumbered automatically. The effort involved to reprogram the control software in the PC can be considerable.

With the feedback module S88-4 you can assign an address directly. This minimizes the effort when adding a new module between existing modules. Addressing the feedback modules S88-4 directly is also the condition for installing branching bus lines and radial layouts.

It is possible to combine standard modules and S88-4 modules in one bus system. You have got to be aware that standard feedback modules can be used in linear data lines connected directly to the control unit or the interface only and not in branching data lines.



Standard s88-N

The S88-4 has RJ-45 connections according to the standard s88-N, which regulates the assignment of commercial Ethernet patch-cables for use in s88 feedback systems. Unlike the 6-conductor connecting cables frequently used, the patch-cables used in computer networks are screened against outside electric signals. Thus using patch-cables reduces the liability to interference considerably.

For the connection of digital devices or customary feedback modules with a 6-pole connector you need a special adapter (optional extra).

5. Technical specifications

Number of mass contacts	16
Feedback log	s88
Connections to the s88-bus (IN, OUT)	RJ-45 according to S88-N
Supply voltage	5 – 15 V d.c. voltage (provided by the s88-bus)
Protected to	IP 00
Ambient temperature in use	0 ... +60 °C
Ambient temperature in storage	-10 ... +80 °C
Comparative humidity allowed	max. 85 %
Dimensions of the PCB Dimensions including housing	approx. 72 x 82 mm approx. 100 x 90 x 35 mm
Weight of the assembled board Weight including housing	approx. 73 g approx. 121 g

6. Assembling the kit

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

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

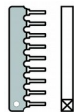


Resistors reduce current.

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:
220 Ω	red - red - brown (gold)
1 k Ω	brown - black - red (gold)
4,7 k Ω	yellow - violet - red (gold)
15 k Ω	brown - green - orange (gold)
100 k Ω	brown - black - yellow (gold)

Resistance networks



In resistance networks there are several resistors integrated. The number of the integrated resistors varies depending on the design. One side of the resistors is commonly taken out of the network, the other side separately for every resistor.

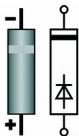
Ceramic capacitors



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.

Diodes and Zener diodes



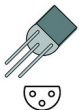
Diodes allow the current to pass through in one direction only (forward direction), simultaneously the voltage is reduced by 0,3 to 0,8 V. Exceeding of the limit voltage always will destroy the diode, and allow current to flow in the reverse direction.

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.

Transistors

Transistors are current amplifiers which convert low signals into stronger ones. There are several types in different package forms available. The type designation is printed on the component.

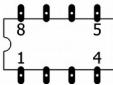


Transistors for a low power rating (e.g. BC types, BS types) have a package in form of a half cylinder (SOT-package). The three pins of bipolar transistors (e.g. BC, BD and BT types) are called basis, emitter and collector (abbreviated with the letters B, E, C in the circuit diagram).

Integrated circuits (ICs)



Depending on the type, ICs fulfil various tasks. The most common housing form is the so-called "DIP"-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.

Microcontrollers

Microcontrollers are ICs, which are individually programmed for the particular application. The programmed controllers are only available from the manufacturer of the circuit belonging to it.

Rotary code switches

Rotary code switches can be set to 10 or 16 switching positions with a small screwdriver, depending on the version.

Terminal strips

Terminal strips 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.

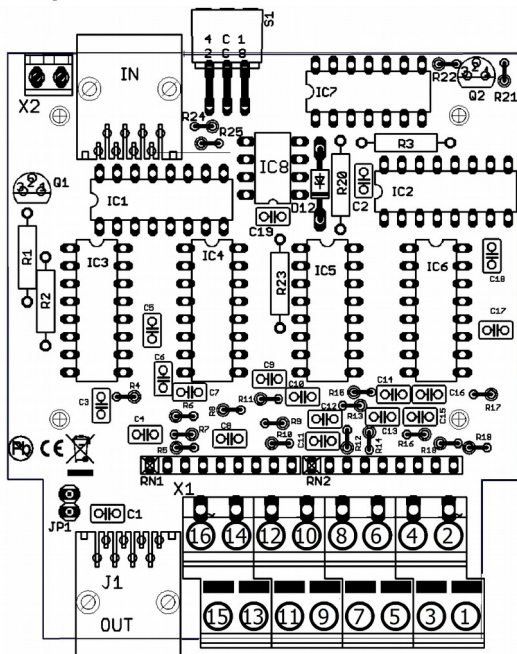
RJ-45 sockets

The RJ-45 sockets are standardized and are made to connect commercial Ethernet patch-cables (or RJ-45 cables).

Parts list

Carbon film resistors	R20	220 Ω
	R4, R5, R6, R7, R8, R9, R10, R11, R12, R13, R14, R15, R16, R17, R18, R19	1 k Ω
	R2, R3, R21, R24, R25	4,7 k Ω
	R23	15 k Ω
	R1, R22	100 k Ω
Resistance networks	RN1, RN2	47 k Ω
Ceramic capacitors	C1 bis C19	100 nF
Zener diodes	D12	6V2
Transistors for a low power rating	Q1, Q2	BC547B
Integrated circuits (ICs)	IC1, IC2	4014N
	IC3, IC4, IC5, IC6	4044N
	IC7	4066N
Microcontrollers	IC8	PIC12F508P
IC-sockets	IC1, IC2, IC3, IC4, IC5, IC6	16-pole
	IC7	14-pole
	IC8	8-pole
Terminal strips	X1	8-pole
Rotary code switches	S1	
RJ-45 sockets	IN, OUT	

PCB layout



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.



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.	Resistors R1, R2, R3, R20, R23	Mounting orientation of no importance.
2.	Diodes, Zener diodes	Observe the polarity! The negative end of the diodes is marked with a ring. This is shown in the PCB layout.
3.	IC sockets	Mount the sockets that way, the markings on the sockets show in the same direction as the markings on the PCB board.
4.	Resistors R4 to R19, R21, R22, R24, R25	Solder the resistor that way, their bodies are standing upright on the PCB. Mounting orientation of no importance.
5.	Resistance networks	Observe the mounting orientation! The common connection is marked which is also shown on the PCB print.
6.	Ceramic Capacitors	Mounting orientation of no importance.

7.	Transistors	Observe the polarity! The cross section of transistors for a low power rating in SOT-packages is shown in the PCB layout.
8.	Terminal strips	Put together the double terminal strips before mounting them.
9.	Rotary code switch	Solder in the code switch so that you can adjust it from the outside after mounting it.
10.	RJ-45 sockets	
11.	ICs in DIL-housing	Insert the ICs into the soldered socket. Do not touch the ICs without first discharging yourself by touching a radiator or other grounded metal parts. Do not bend the "legs" when inserting them into the sockets. Check that the markings on the PCB, the socket and the IC show to the same direction.

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.

7. Connecting the S88-4

The S88-4 has two RJ-45 sockets (IN, OUT) to connect commercial Ethernet patch-cables (RJ-45 cables), which allow an interference free connection to other feedback modules or digital devices. Use an adapter S88-A (optional extra) for the connection of digital devices or customary feedback modules with 6-pole connector.

There are terminal strips soldered to the inputs and to the earth connection of the S88-4 which are used to insert and screw on the connecting wires.

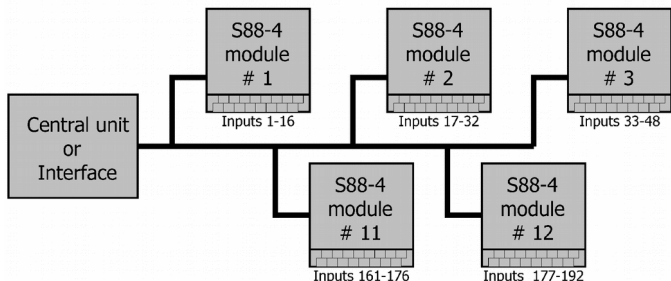
Functional test

First connect the output "OUT" of the S88-4 to the central unit, the memory or the interface for a functional test. Fix a connecting cable to the module's earth connection X2 and connect it one after the other to all 16 inputs. Check if the correct status message is shown for all inputs.

Connection to the s88 bus

After successfully terminating the functional test mount the S88-4 at the desired place in your layout. Connect the inputs 1 to 16 to the mass contacts, the output OUT to the control unit, the interface or another feedback module and the input IN to another feedback module, if necessary.

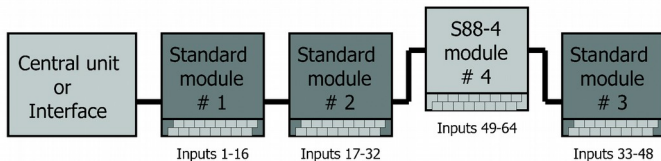
Unlike with standard feedback modules you can install branching lines with the S88-4 modules. There are no limits for the layout of the data lines, everything is possible, from simple branch lines up to radial layouts. Use special RJ-45 terminal boxes (optional extra) for the branch connections.



Example for a s88 bus system with branching data lines.

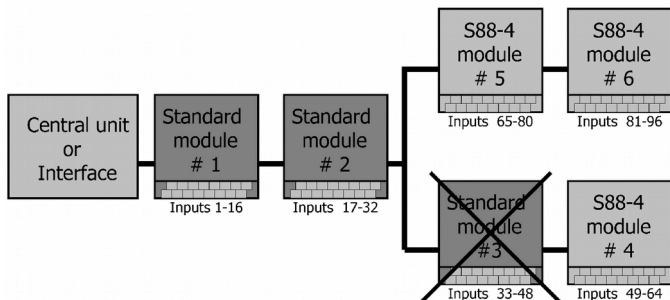
Combination with standard feedback modules

You can combine the S88-4 module with standard feedback modules in a data line directly connected to the control unit or the interface. In this way you can mount a S88-4 module between existing standard modules. e.g.



Example for mounting an additional S88-4 module between standard modules. The standard modules keep the addresses 1 to 3 assigned automatically. The S88-4 module gets the address 4. When adding a standard module between the modules 2 and 3, this would get the address 3 automatically, all following modules would be renumbered.

After branch connections of a data line, seen from the control unit or the interface, you can use S88-4 modules only.



Example for the combination of standard modules and S88-4 modules in one bus system. The standard modules can be used in data lines directly connected to the control unit or the interface only and not in branching data lines.

Earth connection

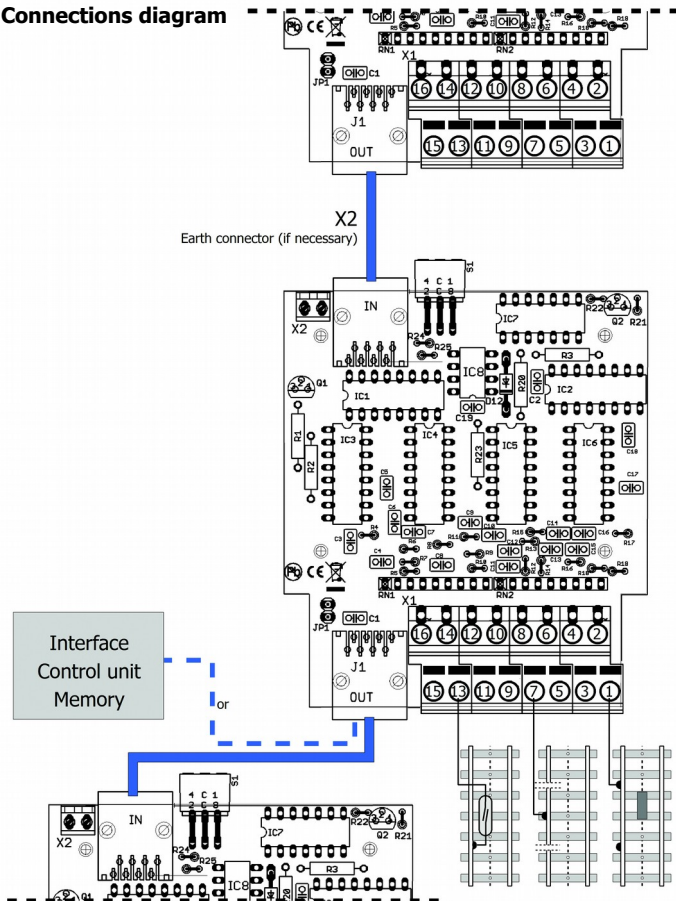
In systems with continuous mass (e.g. 3 rail systems fed with boosters with continuous mass) the earth connection between s88 feedback module and other components is made via the earth line in the s88 bus cable.

In digital layouts with boosters galvanically separated, the earth connection X2 of the S88-4 module has to be connected to a separate earth line or to mass of the rails. This applies especially to layouts with DCC conform boosters, but as well to layouts controlled by the central station of Märklin** or the Ecos of ESU**.

Pin assignment

IN	RJ-45 socket for the connection of a downstream s88 module
OUT	RJ-45 socket or 6-pole connector for the connection of an upstream s88 module or digital device
1 ... 16	Inputs for mass contacts
1	Example: Connection to a switching rail
7	Example: Connection to a contact rail
13	Example: Connection to a reed contact
X2	Earth connection (if necessary)

Connections diagram



8. Assigning an address to the S88-4

According to principle, the standard feedback modules in the s88 bus get an address automatically according to their position in the data line. Thus you have to assign addresses to the S88-4 modules which are higher as the highest address of a standard module. It is up to you to assign the addresses to the S88-4 modules. The addresses do not have to be appointed in ascending or descending order. It is possible to leave addresses unused.

When assigning the addresses be careful not to appoint addresses already used. In case two modules have the same address only the data of the module next to the control unit or the interface will be transmitted.

Take into account how many s88 modules your control unit or interface supports.

The address of a S88-4 module is set by two parameters:

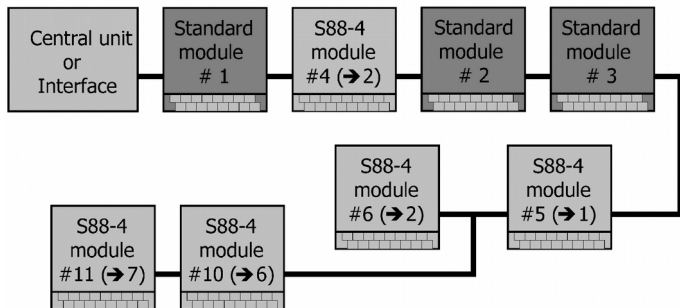
1. The position of the code switch, set by turning the arrow with a small screwdriver. The settings 0 to 9 and A to F correspond to the numerical values 1 to 16 (see list below).
2. The number of standard modules preceding the S88-4 module (not the total number of standard modules in the s88 bus).

The particular address results from the address of the last standard module before the S88-4 module plus the numerical value corresponding to the setting of the code switch.

In consequence, the addresses you can assign to a S88-4 module are restricted:

1. The lowest possible address is by 1 higher than the number of standard modules in the s88 bus.
2. The highest possible address is by 16 higher than the number of standard modules preceding the S88-4 module.

Setting	Tallies numerical value	Address by number of preceding standard modules							
		=1	=2	=3	=4	=5	=6	=7	=n
0	1	2	3	4	5	6	7	8	n+1
1	2	3	4	5	6	7	8	9	n+2
2	3	4	5	6	7	8	9	10	n+3
3	4	5	6	7	8	9	10	11	n+4
4	5	6	7	8	9	10	11	12	n+5
5	6	7	8	9	10	11	12	13	n+6
6	7	8	9	10	11	12	13	14	n+7
7	8	9	10	11	12	13	14	15	n+8
8	9	10	11	12	13	14	15	16	n+9
9	10	11	12	13	14	15	16	17	n+10
A	11	12	13	14	15	16	17	18	n+11
B	12	13	14	15	16	17	18	19	n+12
C	13	14	15	16	17	18	19	20	n+13
D	14	15	16	17	18	19	20	21	n+14
E	15	16	17	18	19	20	21	22	n+15
F	16	17	18	19	20	21	22	23	n+16



Example for numbering the S88-4 modules. The numbers behind the arrows correspond to the setting of the code switch.

The S88-4 module with the address 4 cannot get a lower address, as the addresses 1 to 3 are used by standard modules. The code switch has to be set to "2" as one standard module is preceding.

The S88-4 modules with the addresses 5, 6, 10 and 11 are preceded by three standard modules. The address 7, 8 and 9 are not in use in the shown system, which does not influence the mode of operation.

9. Check list for troubleshooting

- Parts are getting too hot and/or start to smoke.



Disconnect the system from the mains immediately!

Possible cause: one or more components are soldered incorrectly.
→ In case you have mounted the module from a kit, perform a visual check (→ section 6.) and if necessary, remedy the faults. Otherwise send in the module for repair.

- The central unit, the memory or the interface do not show the proper status.

Possible cause: The connection(s) between the feedback module and feedback modules connected in series or the digital device are interrupted. → Check the connections. When using a ribbon cable, check as well, if the connecting socket of the ribbon cable is put on in the right direction.

Possible cause: The connection between the input and the mass contact is interrupted. → Check the connections.

- The control unit / the memory / the interface always displays in a specific situation the same false status.

Possible cause: You have assigned another address to the S88-4 module than required. → Check the address.

- The control unit / the memory / the interface display does not display the status of one module.

Possible cause: You have assigned an address to a S88-4 module that is occupied by another S88-4 module or a standard module. → Check the addresses.

Hotline

If problems with your module occur, our hotline is pleased to help you (mail address on the last page).

Repairs

You can send in a defective module for repair (address on the last page). In case of guarantee the repair is free of charge for you. With damages not covered by guarantee, the maximum fee for the repair is the difference between the price for the ready-built module and the kit according to our valid price list. We reserve the right to reject the repairing of a module when the repair is impossible for technical or economic reasons.

Please do not send in modules for repair charged to us. In case of warranty we will reimburse the forwarding expenses up to the flat rate we charge according to our valid price list for the delivery of the product. With repairs not covered by guarantee you have to bear the expenses for sending back and forth.

10. 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-built module or device,
- if damaged by other persons,
- if damaged by faulty operation or by careless use or abuse.

11. EU declaration of conformity

 This product conforms with the EC-directives mentioned below and is therefore CE certified.

2004/108/EG on electromagnetic. Underlying standards: EN 55014-1 and EN 61000-6-3. To guarantee the electromagnetic tolerance in operation 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, connection diagrams and PCB layout included with this manual.
- Use only original spare parts for repairs.

2011/65/EG on the restriction of the use of certain hazardous substances in electrical and electronic equipment (ROHS). Underlying standard: EN 50581.

12. Declarations conforming to the WEEE directive



This product conforms with the EC-directive 2012/19/EG on waste electrical and electronic equipment (WEEE).

Don't dispose of this product in the house refuse, bring it to the next recycling bay.

Information and tips:

<http://www.tams-online.de>

Warranty and service:

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