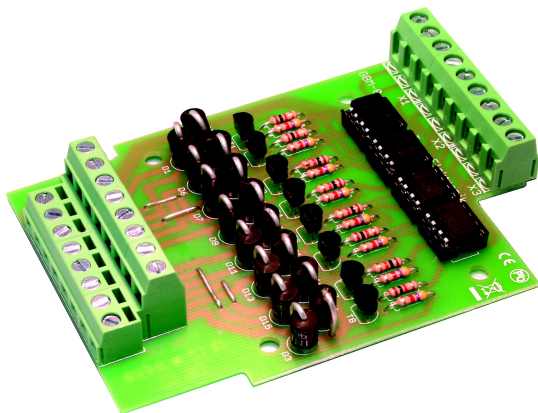


Manual

GBM-8

Item no. 52-01085 | 52-01086 | 52-01087



8-fold Track Busy Indicator

tams elektronik



Table of contents

1. Getting started.....	3
2. Safety instructions.....	5
3. Safe and correct soldering.....	7
4. Operation overview.....	9
5. Technical specifications.....	11
6. Assembling the kit.....	12
7. Performing a functional check.....	18
8. Connecting the GBM-8.....	20
9. Check list for troubleshooting.....	25
10. Guarantee bond.....	26
11. EU declaration of conformity.....	27
12. Declarations conforming to the WEEE directive.....	27

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The asterisks **

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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 track busy indicator GBM-8 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 GBM-8 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 track busy indicator GBM-8 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 14) and one PCB or
- one ready-built module or
- one ready-built module in a housing (complete unit);
- components for the auxiliary circuit for the functional test:
- 2 resistors 1 k Ω , 1 diode 1N4148, 1 LED;
- 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).

For testing the module you need an electric light bulb.

In order to connect the module you need wire. Recommended diameters: $\geq 0,25 \text{ mm}^2$ for all connections (e.g. item no. 73-1031x, x=0..9).

If you want to display the busy status you need LEDs and suitable series resistors.

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 track busy indicator GBM-8 can supervise a maximum of eight independent track sections. The GBM-8 is internally divided into four sections with two track busy indicators each, which can be connected to a maximum of four different booster or transformer sections.

Application

The track busy indicator GBM-8 is suitable for use in model railway layouts of all gauges:

- in analogue (d.c. or a.c.) layouts, e.g. as a part of a block signal control or an automated control or
- in digital layouts (with all digital formats), e.g. in combination with feedback modules reading in mass contacts (e.g. s88).

The GBM-8 has been optimised for use in digital layouts of gauges starting from TT:

- False reports occurring in digital operation due to interferences, are minimized on account of the comparatively low sensitivity of 6 mA.
- The in- and outputs of the GBM-8 are galvanically isolated from each other.
- The eight outputs of the GBM-8 are arranged so as to be connected directly to the inputs of the s88-feedback modules S88-3** oder S88-4**.

Voltage supply

The GBM-8 is supplied directly via the rails.

Detection of vehicles

The GBM-8 detects vehicles consuming at least 6 mA (e.g. locomotives and carriages with lighting) located in the connected section.

Hint: As a rule, the small current flowing after painting a carriage's axle with resistive lacquer is not high enough to be detected by the

GBM-8. For this application the fourfold track busy indicator GBM-1** can be used.

Due to technical principles, with (analogue) d.c. layouts the GBM-8 can only detect vehicles driving into the supervised track sections in a particular direction. In case the detection of vehicles from both directions is required, the track busy indicator GBM-1** can be used.

Electric consumers located in a switched off track section can be detected by the GBM-1 when

- an additional resistor is mounted in parallel to the switch between the switched off section and the associated input of the module and
- at the same time the supply voltage is applied to the not supervised rail sections.

Evaluation of the busy messages and transmission to digital feedback modules

As soon as the GBM-8 detects an electric current consumer in a connected track section, the linked output is internally connected to the output M. This way, the output of the GBM-8 works like a switch switching to earth.

Digital feedback modules (e.g. s88-feedback modules) can be connected directly to the outputs. The eight outputs of the GBM-8 are arranged so as to be connected directly to the inputs of the s88-feedback modules S88-3** oder S88-4**.

The in- and outputs of the GBM-8 are isolated from each other by opto-couplers. Consequently interferences are filtered out and hum loops and fault currents are prevented effectively.

Displaying the busy messages

Especially in analogue displays, you can display the busy messages with LEDs (together with suitable series resistors) connected to the outputs.

Outputs

The outputs of the GBM-8 are suitable for a load of maximum 50 mA each. For that reason they are not suitable for the connection of electric light bulbs, relays or subordinate circuits with a current consumption of more than 50 mA. For these applications the fourfold track busy indicator GBM-1** can be used.

5. Technical specifications

Voltage supply	via the rails
Current consumption (without connected devices)	approx. 15 mA
Number of monitored sections	8
Maximum current in the monitored sections	3.000 mA
Sensitivity	6 mA
Number of outputs	8
Max. current per output	50 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 of the PCB Dimensions including housing	approx. 72 x 95 mm approx. 100 x 98 x 35 mm
Weight of the assembled board Weight including housing	approx. 70 g approx. 110 g

6. Assembling the kit

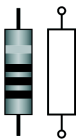
You can skip this part if you have purchased a ready-built module or device.

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



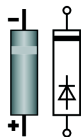
Resistors reduce current.

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:
1 k Ω	brown - black - red (gold)
4,7 k Ω	yellow - violet - red (gold)

Diodes and Zener diodes

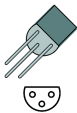


Diodes allow the current to pass through in one direction only (forward direction), simultaneously the voltage is reduced by 0,3 to 0,8 V. Exceeding of the limit voltage always will destroy the diode, and allow current to flow in the reverse direction.

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.



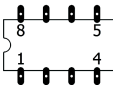
Transistors for a low power rating (e.g. BC types) have a package in form of a half cylinder (SOT-package).

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.

Opto couplers

Opto couplers are ICs, which work similar to laser beam switches. They combine in one housing a light emitting diode and a photo transistor. Their task is the transmission of information without galvanic connection. They are in a DIP-housing with at least 4 pins.

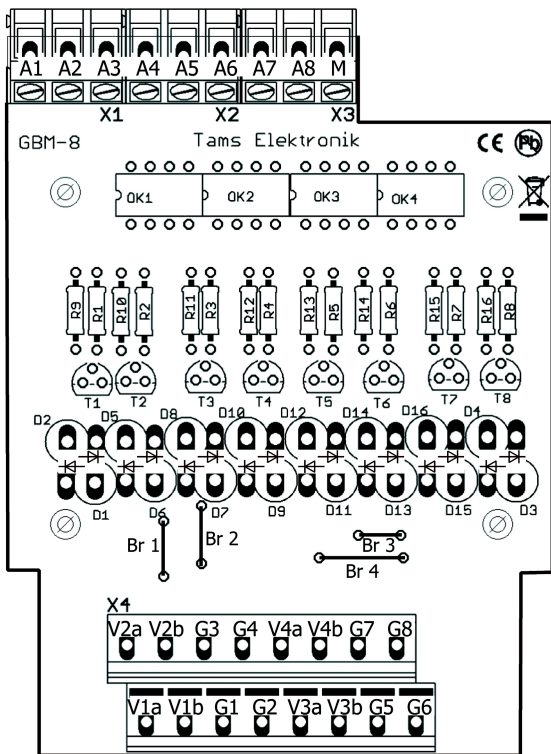
Terminal strips

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.

Parts list

Carbon film resistors	R9, R10, R11, R12, R13, R14, R15, R16	1 k Ω
	R1, R2, R3, R4, R5, R6, R7, R8	4,7 k Ω
Diodes	D1 - D16	1N540x, x \geq 2
Transistors	T1, T2, T3, T4, T5, T6, T7, T8	BC547B
Photocoupleurs	OK1, OK2, OK3, OK4	827 or 2 x 817
IC-sockets	OK1, OK2, OK3, OK4	8-pole
Terminal strips	X1 - X3	3 x 3-pole
Double terminal strips	X4	2 x 3-pole 1 x 2-pole

PCB layout



Assembly

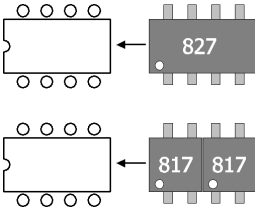
Proceed according to the order given in the list below. First solder the components on the solder side of the PCB and then cut the excess wires with the side cutter. Follow the instructions on soldering in section 3.



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	Mounting orientation of no importance.
2.	Wire bridges Br1 to Br4	Use the off-cut wires of the resistors.
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.	Transistors	Observe the polarity! The cross section of transistors for a low power rating in SOT-packages is shown in the PCB layout.
5.	Diodes	Observe the polarity! The negative end of the diodes is marked with a ring. This is shown in the PCB layout. Solder the diodes that way, their bodies are standing upright on the PCB.
6.	Terminal strips	Put together the terminal strips before mounting them.

7.	Photocouplers in DIL-housing	<p>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.</p> 
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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. Performing a functional check

It is recommended to perform a functional test before installing the GBM-8 into the layout. Test the module with a small auxiliary circuit. The required components are included in the package.

Follow the connections diagram "Testing layout" and the list "Assignment of the booster sections or transformers and the rail sections to the GBM-8" in section 8. There are terminal strips soldered to the module which are used to insert and screw on the connecting cables.

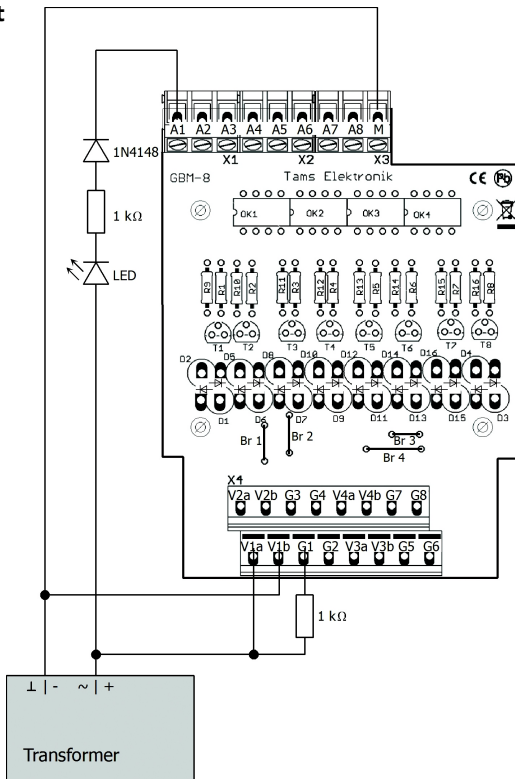
Test for rail section 1

GBM-8	Connection to
V1a, V1b and M	Transformer
A1	Auxiliary circuit made of: LED, series resistor 1 k Ω and damping diode. Observe the polarity of the LED and the damping diode! With wired LEDs the longer lead is always the anode (positive pole). The negative end of the damping diode is marked with a ring.
G1 and V1a	Resistor 1 k Ω → simulation of a load in the supervised rail section 1

After connecting the transformer with the power supply, the LED should light. Disconnect the connection between G1 and the resistor, the LED should go out.


Repeat the test for all other track sections. Be sure to connect the connections for the power supply, the rails and the output, which are assigned to each other (e.g. V3a, V3b, G5 and A5).

Testing layout



⚠ Caution: Never connect electric light bulbs to the outputs as these consume more than 50 mA current, as a rule. The outputs which are designed for a maximum current of 50 mA would be destroyed when putting them into operation.

If the functional test is not successful for one or several outputs, check if the opto-couplers and the diodes have been mounted polarized correctly. Follow the hints in section 9, as well.

 **Caution:** When a component gets too hot, disconnect the module immediately from the power supply. Risk of short circuit! Check the assembly.

After performing a successful function test, disconnect the track busy indicator from the voltage supply and continue with the connection of the module.

8. Connecting the GBM-8

There are terminal strips soldered to the module which are used to insert and screw on the connecting cables.

Assignment of the booster sections or transformers and the rail sections to the GBM-8


Booster section or transformer	Rail section	GBM-8		
		Supply voltage	Rail	Output
1	1	V1a and V1b	G1	A1
	2		G2	A2
2	3	V2a and V2b	G3	A3
	4		G4	A4
3	5	V3a and V3b	G5	A5
	6		G6	A6
4	7	V4a and V4b	G7	A7
	8		G8	A8

Connecting the power supply

Each pair of connections for the rails is assigned to one connection for the power supply.

Connect the connections for the power supply of the GBM-8 (V1a and V1b or V2a and V2b etc.) to the rail outputs of the driving transformer (in analogue layouts) or the rail outputs of the boosters (in digital layouts).

As the need arises, you can connect the connections for the power supply (V1, V2, V3, V4) either in parallel to the rail outputs of one booster or transformer or to maximum four different transformers or boosters.

 **Caution:** If you use a d.c. transformer as a driving transformer, you generally have to respect the polarity when connecting it. If using an a.c. transformer the polarity is of no importance.

Connecting the rail sections

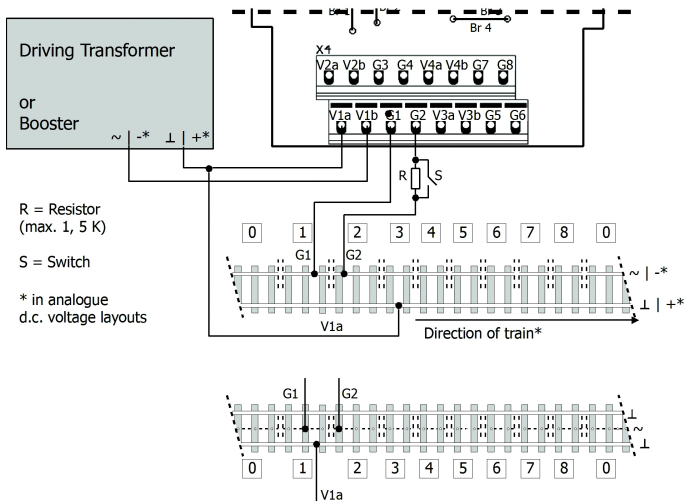
The busy status can only be reported trouble free, when with each supervised section one conductor is isolated at both ends:

- 3-rail systems: middle conductor or both rails;
- 2-rail systems (analogue): "-"-rail;
- 2-rail systems (digital): one of the two rails.

Pay attention to the fact that, due to technical principles, in analogue 2-rail systems only vehicles driving into the track section in one particular direction are detected.

GBM-8	Connection to
G1, G2, G3, ... G8	isolated conductor of the supervised rail sections
V1a, V2a, V3a, V4a	rail conductor which has not been isolated
Be sure to use the connections for the power supply and the rails which are assigned to each other (e.g. V3a and G5 and G6).	

Connection diagram 1: Connecting the power supply and the track sections



0	Track section without monitoring
1-8	Report sections 1-8
2	Report section to be switched off

Supervising switched off rail sections

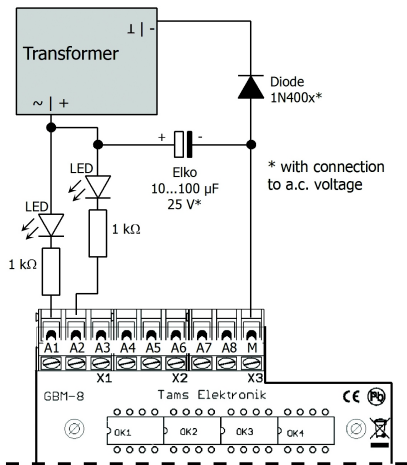
Rail sections to be switched off during operation (e.g. in a shadow station) can be supervised with the track busy indicator, as well. For that purpose you have to mount a resistor of $\leq 1,5 \text{ k}\Omega$ into the lead-in wire of the rail section concerned so that it bridges the switch when the

rail section is switched off (see connection diagram 1, connection to G2).

Connecting LEDs

In order to display the busy status (e.g. in analogue displays), connect the cathodes (-) of the LEDs (with series resistors, e.g. 1 k Ω) to the outputs of the GBM-8.

Connection diagram 2: Connecting LEDs



! Caution: Never use LEDs without series resistors, as in this case the LEDs will be destroyed quickly.

! Caution: Do not use the driving transformer for the power supply of the LEDs but a separate transformer, for instance one used to supply other lighting circuits. The arising stray electric currents could possibly damage connected components.

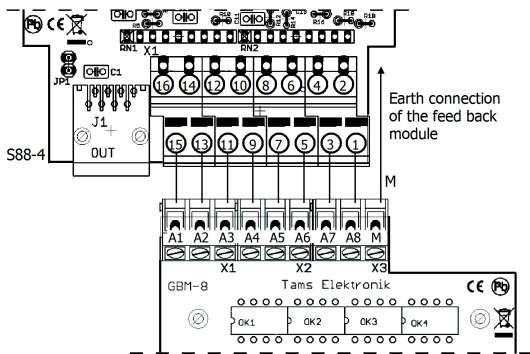
When connecting the LEDs to an a.c. transformer, you should mount an additional damping diode (e.g. 1N400x, x=2...7) and a capacitor with a value between 10 and 100 μF and an electrical strength of minimum 25 V according to connection diagram 2.

! Caution: Never connect electric light bulbs to the outputs as these consume more than 50 mA current, as a rule. The outputs which are designed for a maximum current of 50 mA would be destroyed when putting them into operation.

Connection to digital feed back modules

You can connect the inputs of digital feed back modules (e.g. s88-modules) directly to the outputs of the GBM-8. Connect the earth output of the feed back module to the connection M of the GBM-8 according to connection diagram 3.

Connection diagram 3: Connecting digital feed back modules



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 LEDs connected to the module do not light.

Possible cause: The voltage supply has been interrupted. → Check the connection from the module to the transformer.

Possible cause: One or more LEDs are defective. → Check the LEDs by connecting them directly (via a series resistor) to the power supply.

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).



DE 37847206

The Tams Elektronik GmbH is registered with the WEEE-no. DE 37847206, according to. § 6 sect. 2 of the German electro regulations from the responsible authority for the disposal of used electro equipment.

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>

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