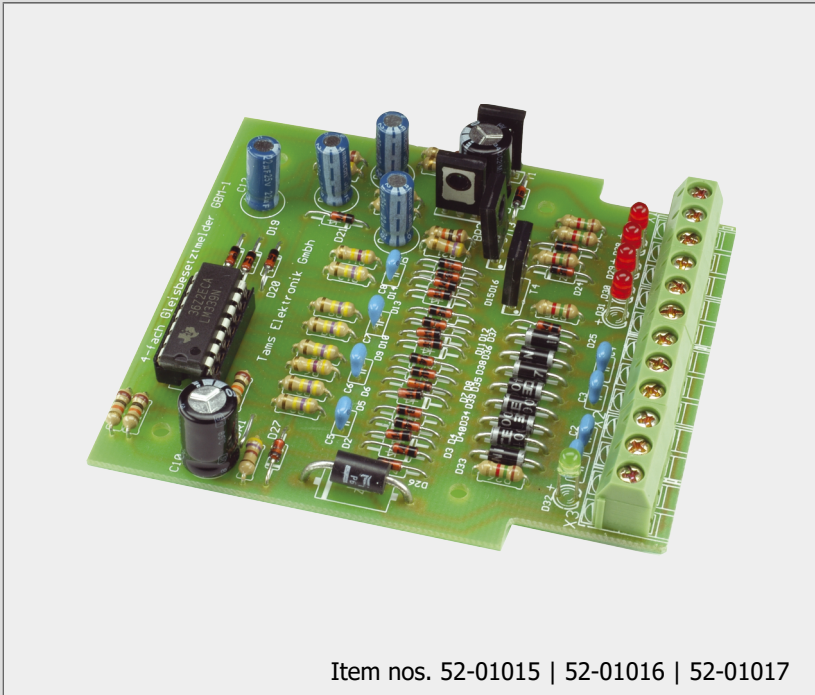


# GBM-1

## Track Occupancy Indicator 4-fold

## 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 asterisks indicate further products from the Tams Elektronik GmbH product range :

- Track occupancy indicator GBM-8 | Item numbers 52-01085, 52-01086 and 52-01087
- Track occupancy indicator GBM-8.2 | Item numbers 52-01186 and 52-01187

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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 track occupancy indicator. Before you start to assemble the kit or put the track occupancy indicator 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 track occupancy indicator on to another person, also give the instructions with it.

### 1.1. Contents of the package

1 kit GBM-1 (item no. 52-01015-01), containing the components listed in the parts list (→ section 3.4.) and one PCB or

1 ready-built and tested circuit board GBM-1 (item no. 52-01016-01) or

1 track occupancy indicator GBM-1 in housing (item no. 52-01017-01)

### 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 tracks:  $\geq 0.25 \text{ mm}^2$
- Connections to the power supply:  $\geq 0.75 \text{ mm}^2$
- Connections to the booster / the driving transformer:  $\geq 0.75 \text{ mm}^2$
- Connections to lamps, LEDs, relays or other downstream consumers: depending on the current consumption of the consumers

#### **Function test**

It is recommended to test the track occupancy indicator's functions before mounting it into the layout, especially if you have built the module from a kit. For this you need a light bulb.

### 1.3. Intended use

The track occupancy indicator 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 track occupancy indicator is not intended to be used by children under the age of 14.

### 1.4. Safety instructions

**Note:**

The track occupancy indicator 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 track occupancy indicator 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 track occupancy indicator from the power supply before carrying out wiring work.
- Supply the track occupancy indicator 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 track occupancy indicator during operation is normal and harmless.
- Do not expose the track occupancy indicator 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 track occupancy indicator, 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 track occupancy indicator in for inspection.

### 1.5. Care

Do not use any cleaning agents to clean the track occupancy indicator. Only wipe the module dry. Disconnect the track occupancy indicator from the power supply before cleaning.

## 2. Operation overview

The track busy indicator GBM-1 can monitor a maximum of four independent track sections. The four track sections have to be supplied by one common driving-transformer (in analogue layouts) or must be situated in one booster section (in digital layouts).

### Application

The track busy indicator GBM-1 is suitable for use in model railway layouts of all gauges (without gauge II / G):

- for visualisation of occupied track sections
- to switch on and off further consumers depending on the occupancy status of the track sections
- as part of an automated control system, e.g. a block control system

The GBM-1 has been optimised for use in analogue layouts:

- It is very sensitive and detects loads with a current of only 1 mA.
- In analogue d.c. layouts it detects vehicles driving into the monitored track sections independently of the direction of travel.
- The four outputs of the GBM-1 can be loaded with 500 mA each, which enables the direct connection of many consumers.

In principle, the GBM-1 can also be used in digital layouts with all digital formats, e.g. in combination with digital feedback devices (e.g. s88 feedback devices). Due to the high sensitivity of the GBM-1, interference voltages from the digital system can cause false alarms. Therefore, instead of a GBM-1, the track occupancy detectors GBM-8 or GBM-8.2\*\* are better suited for use in digital systems.

### Voltage supply

The GBM-1 must not be supplied by transformers or a digital boosters providing current for driving operation. In order to supply the GBM-1 transformers or boosters can be used which supply other track busy indicators or lighting modules as well.

### Detection of vehicles

The GBM-1 detects vehicles consuming at least 1 mA (e.g. locomotives and carriages with lighting) located in the connected section. In d.c. layouts the GBM-1 detects vehicles which axles are painted with resistive lacquer and which apart from that are not consuming current.

When switching off track sections with a switch mounted between the track section and the input of the GBM-1, the electric consumer located in the switched off track section can be detected when

- an additional resistor is mounted to bridge the switch and
- at the same time the supply voltage is applied to the rail sections not monitored.

**Evaluation of the busy signals and connection of subordinate consumers**

The evaluation of the track busy signals is done internally against ground. Thus, all consumers whose inputs switch to ground can be connected to the outputs of the GBM-1 and triggered depending on the occupancy status of the track sections.

Note: In principle, digital feedback modules that switch to ground (e.g. s88 feedback modules) can also be connected to the outputs of the GBM-1. However, due to the high sensitivity of the GBM-1, interference voltages from the digital system can cause false alarms.

The four outputs of the GBM-1 can be loaded with up to 500 mA. Many downstream circuits can therefore also be connected directly and switched on or off depending on the occupancy status of the track sections. Consumers that require a higher current must be switched via relays.

**Display of occupied messages**

When a connected track section is occupied, the assigned LED on the track occupancy indicator lights up. Additional lamps or LEDs (e.g. in a track diagram control panel) can be connected to the four outputs assigned to the signal sections.

Note: If consumers are connected downstream that operate with a higher voltage than the GBM, this can cause the LEDs on the module to light up dimly even though the connected track sections are not occupied.

### 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

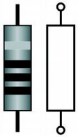
- Use a soldering iron with temperature control, which you set to approx. 300 °C.
- Only use electronic solder with a flux.
- Never use soldering water or soldering grease when soldering electronic circuits. These contain an acid that destroys components and conductor paths.
- Insert the connecting wires 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:
470 $\Omega$	yellow - violet - brown (gold)
1,5 k $\Omega$	brown - green - red (gold)
10 k $\Omega$	brown - black - orange (gold)
47 k $\Omega$	yellow - violet - orange (gold)
470 k $\Omega$	yellow - violet - yellow (gold)

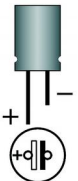
#### Ceramic capacitors



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.

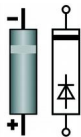
#### Electrolytic capacitors



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

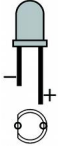


Diodes allow the current to pass through in one direction only (forward direction), simultaneously the voltage is reduced by 0,3 to 0,8 V. Exceeding of the limit voltage always will destroy the diode, and allow current to flow in the reverse direction.

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.

## Light emitting diodes (LEDs)

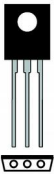


When operated in the forward direction the LEDs light. They are available in several different versions (differing in colour, size, form, luminosity, maximum current, voltage limits).

Light emitting diodes should always be connected via a series resistor which limits the current and prevents failure.

## Transistors

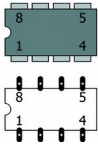
Transistors are current amplifiers which convert low signals into stronger ones. There are several types in different package forms available. The type designation is printed on the component.



Transistors for a high power rating (e.g. BD types) have a flat package (TO-package), which is in use in different versions and sizes.

The three pins of bipolar transistors (e.g. BD 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.

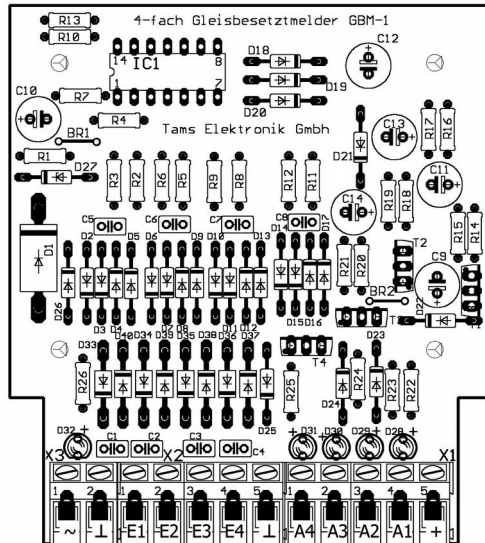
ICs are sensitive to damage during soldering (heat, electrostatic charging). For that reason in the place of the ICs IC sockets are soldered in, in which the ICs are inserted later.

## 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.

### 3.4. PCB layout and parts list

#### PCB layout



#### Parts list

Carbon film resistors	R1	470 $\Omega$
	R4, R7, R10, R13, R14, R16, R18, R20	10 k $\Omega$
	R2, R3, R5, R6, R8, R9, R11, R12	470 k $\Omega$
	R15, R17, R19, R21	47 k $\Omega$
	R22 - R26	1,5 k $\Omega$
Ceramic capacitors	C1 - C8	100 nF
Electrolytic capacitors	C9, C10	220 $\mu$ F $\geq$ 25 V
	C11 - C14	22 $\mu$ F $\geq$ 16 V
Diodes	D1	1N540x, x=2...7
	D2 - D26	1N4148
	D33 - D40	1N400x, x $\geq$ 1
Zener diodes	D27	ZD 12 V
LEDs	D28 - D31	3 mm, red
	D32	3 mm, green
Transistors	T1 - T4	BD679
ICs	IC1	LM 339 N
IC-sockets	IC1	14-pole
Terminal strips	X1 - X3	4 x 3-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.	Resistors	Mounting orientation of no importance.
2.	Wire bridges Br1 and Br2	Use the off-cut wires of the resistors.
3.	Diodes, Zener diodes	Observe the polarity! The negative end of the diodes is marked with a ring. This is shown in the PCB layout.
4.	IC sockets	Mount the sockets that way, the markings on the sockets show in the same direction as the markings on the PCB board.
5.	Ceramic Capacitors	Mounting orientation of no importance.
6.	Light emitting diodes (LEDs)	Observe the polarity! With wired LEDs the longer lead is always the anode (positive pole).
7.	Transistors	Observe the polarity! With transistors for a high power rating in TO packages (e.g. BD types) the unlabelled back side is marked in the PCB layout by a thick line.
8.	Electrolytic capacitors	Observe the polarity! One of the two leads (the shorter one) is marked with a minus sign.
9.	Terminal strips	Put together the terminal strips before mounting them.
10.	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.

### 3.6. Performing a visual check

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

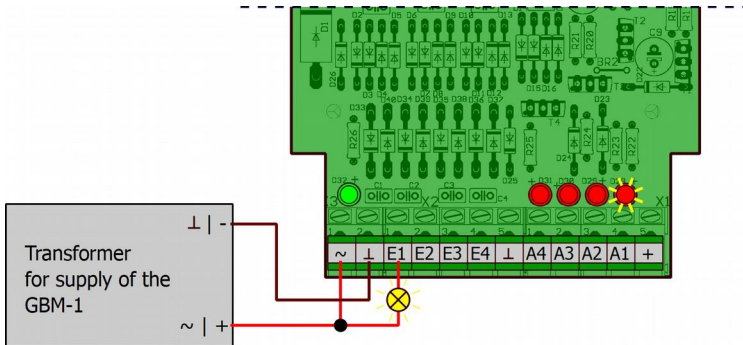
- Remove all loose parts, wire ends or drops of solder from the PCB. Remove all sharp wire ends.
- Check that solder contacts which are close to each other are not unintentionally connected to each other. Risk of short circuit!
- Check that all components are polarised correctly.

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

### 3.7. Performing a functional test

It is recommended to perform a functional test before installing the assembled kit into the layout. You will need a light bulb for the function test.

There are terminal strips soldered to the module which are used to insert and screw on the connecting cables. Connect the bulb to the four inputs of the track busy indicator one after the other.



Light bulb	Connection to: Input E1 and ~ (not ⊥!) of the GBM-1
GBM-1 ~ and ⊥	Connection to: Transformer
→ Now the lamp and the LED at output A1 should light.	
→ Repeat the test for E2, E3 und E4.	

#### ⚠ Caution:

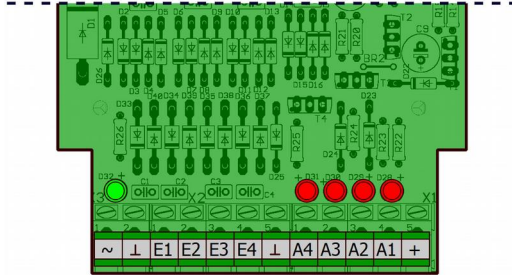
If a component gets too hot, disconnect the track busy indicator from the mains immediately. Possible short circuit! Check the assembly again.

After successful completion of the function test, disconnect the track occupancy detector from the supply voltage again and the light bulb from the input of the GBM.

## 4. Connecting the track busy indicator

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

### 4.1. Pin assignment



GBM-1	Connection to
E1 to E4	Isolated conductors of the monitored rail sections
A1 to A4	Downstream accessories or digital feedback modules
+	Return conductors of the downstream accessories
⊥	<p>⊥ - rail not monitored</p> <p>⊥ - or "-" connection of the transformer supplying the GBM-1</p> <p>⊥ - connection of the driving transformer / booster</p> <p>Notice: Internally, the two ground connections of the GBM-1 ⊥ are connected to each other, you can use them according to your needs.</p>
~	~ - or "+"- connection of the transformer supplying the GBM-1

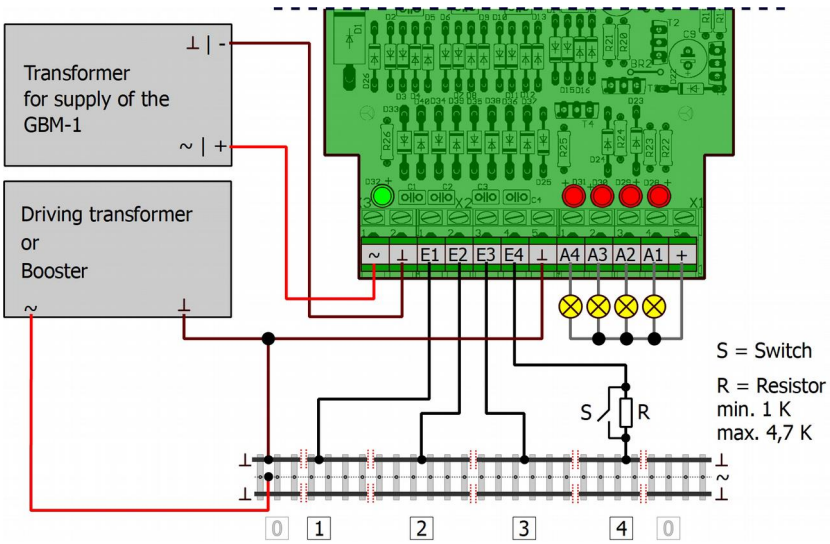
### 4.2. Connections

#### Isolation of the conductors

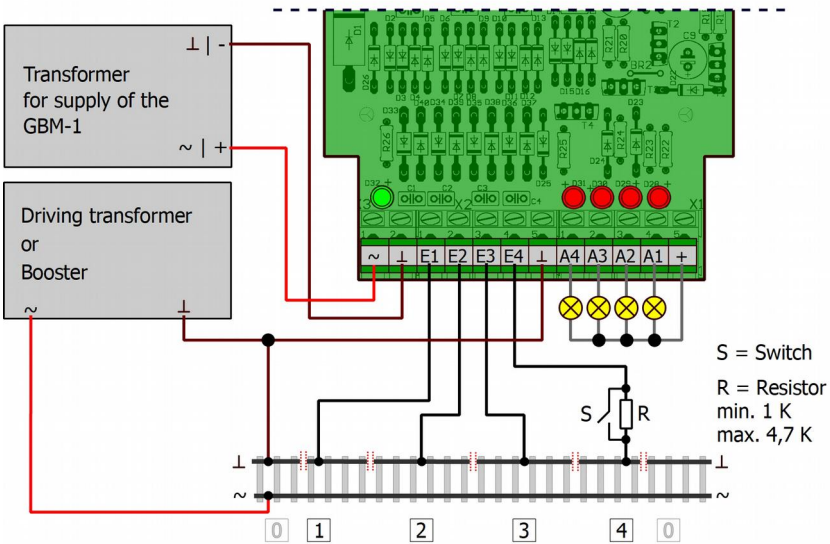
The busy status can only be reported trouble free, when with each monitored section one conductor is isolated at both ends:

- With centre conductor systems: both rails. When cutting the middle conductor instead of the two rails, it is impossible to connect digital feedback modules directly to the outputs A1 to A4.
- With 2-rail systems: one of the two rails.

**Connection to alternating current systems (centre conductor systems)**



**Connection to direct current systems (2- rail systems)**



0	Track section without monitoring
1 - 4	Report sections 1 - 4
4	Report section to be switched off (Example)



### 4.3. Connection of the track sections

Connect the isolated conductors of the monitored rail sections to the inputs (E1 to E4) of the GBM-1.

#### Monitoring switched off track sections

Track sections to be cut off in operation (e.g. in a shadow station) can also be monitored with the track busy indicator. For that purpose a resistor with a value between 1 k $\Omega$  und 4,7 k $\Omega$  has to be mounted in the wire leading to the concerned track section so that it shunts the switch when the track section is cut off (see connection diagrams on previous page, connection to E4).

### 4.4. Connection to the voltage supply

Connect the ground connections of the supply transformer for the GBM and the driving transformer to the ground connection of the track occupancy detector. The two ground connections of the GBM-1 ( $\perp$ ) are internally connected and can be used as required.

**Caution:**

The GBM-1 must not be supplied by transformers or a digital boosters providing current for driving operation. In order to supply the GBM-1 you can use transformers or boosters which supply other track busy indicators or lighting modules as well.

**Caution:**

If you use a d.c. transformer for the power supply of the GBM-1, you generally have to respect the polarity when connecting it. If using an a.c. transformer the polarity is of no importance first.

When connecting several outputs to circuits supplied by the same transformer, all connections have to be polarized the same way as a rule. Otherwise a short circuit could occur damaging connected devices.

**Caution:**

The ground of the driving transformer must not be connected to any of the four track sections to be monitored, as the busy status could not be reported then.

## 4.5. Connecting lamps or LEDs

Lamps are not polarised, thus the assignment of the connections to the outputs of the GBM-1 (A1 to A4) and to the return conductor for the outputs (+) is optional.

With LEDs you have to observe the polarity, otherwise they do not light. Connect the cathodes (-) to the outputs of the GBM-1 (A1 bis A4) and the anodes (+) to the return conductor for the outputs (+). With standard LEDs the longer connecting pin is the anode (+).

### Attention:

When using LEDs you always have to connect them via a series resistor as the LED will be damaged when put into operation or its duration of life will be reduced considerably.

The necessary value of the series resistor depends on the voltage supply to be available, the forward voltage of the LED (which depends on the colour) and the current.

Calculating the series resistor:

$$\text{necessary } R_V [\text{Ohm}] = ( U_B [\text{V}] - U_F [\text{V}] ) / ( I_F [\text{mA}] \times 0,001 )$$

$U_B$  = operating voltage

$U_F$  = forward voltage of the LED

$I_F$  = current with max. luminosity

For red and green LEDs you can take 2 V as a basis for the forward voltage. The luminosity depends on the current draw, with standard LEDs the difference between 10 and 20 mA is not visible.

Connection to a.c. voltage			Connection to d.c. voltage		
Note: The operating voltage of an a.c. transformer is approx. 1,4 fold the nominal voltage given.			Note: With d.c. Power packs the operating voltage corresponds to the nominal voltage given.		
Nominal voltage	Necessary series resistor with current draw		Nominal voltage	Necessary series resistor with current draw	
	10 mA	20 mA		10 mA	20 mA
12 V ~	1,5 kΩ	820 Ω	16 V =	1,5 kΩ	820 Ω
14V ~	1,8 kΩ	820 Ω	18 V =	1,5 kΩ	820 Ω
16 V ~	2,2 kΩ	1 kΩ	20 V =	1,8 kΩ	1 kΩ
18 V ~	2,2 kΩ	1,2 kΩ	22 V =	2,2 kΩ	1 kΩ

## 5. Connecting subordinate circuits

Consumers with a current consumption of up to 500 mA can be connected directly to the outputs A1 to A4 of the GBM-1 and switched on and off depending on the occupancy status.

The GBM-1 evaluates the income signals against earth. Thus you can connect the outputs of the GBM-1 to:

- the inputs of downstream electronic circuits that switch to ground and consume a current of max. 500 mA;
- relays to switch the inputs of subordinate electronic circuits with a current consumption of more than 500 mA or to switch circuits requiring to be galvanically isolated;
- relays to switch the current at the outputs of subordinate modules.

### 5.1. Connection of digital feedback modules

In principle, it is possible to connect the inputs of digital feedback modules (e.g. s88 modules) to the outputs of the GBM-1.

Due to the high sensitivity of the GBM-1, interference voltages from the digital system can generate false occupancy messages. Therefore, instead of a GBM-1, the GBM-8 and GBM-8.2\*\* track occupancy detectors optimised for digital operation are more suitable for use in combination with digital feedback devices.

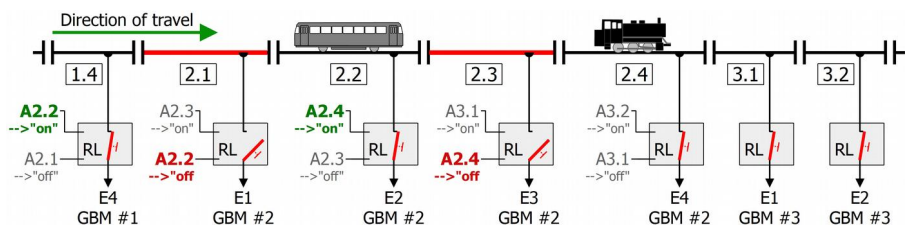
### 5.2. Application example: Block section control

#### Functional principle

In the block section, the section behind the occupied section (seen in the direction of travel) must be blocked for the entry of a following vehicle and the section behind it must be released again.

With track occupancy detectors and one bistable relay (RL) per section, a block section control can be realised. The relays are connected between the inputs E1...E4 of the GBM and the corresponding track sections and function as switches for switching the track voltage in the relevant sections on and off.

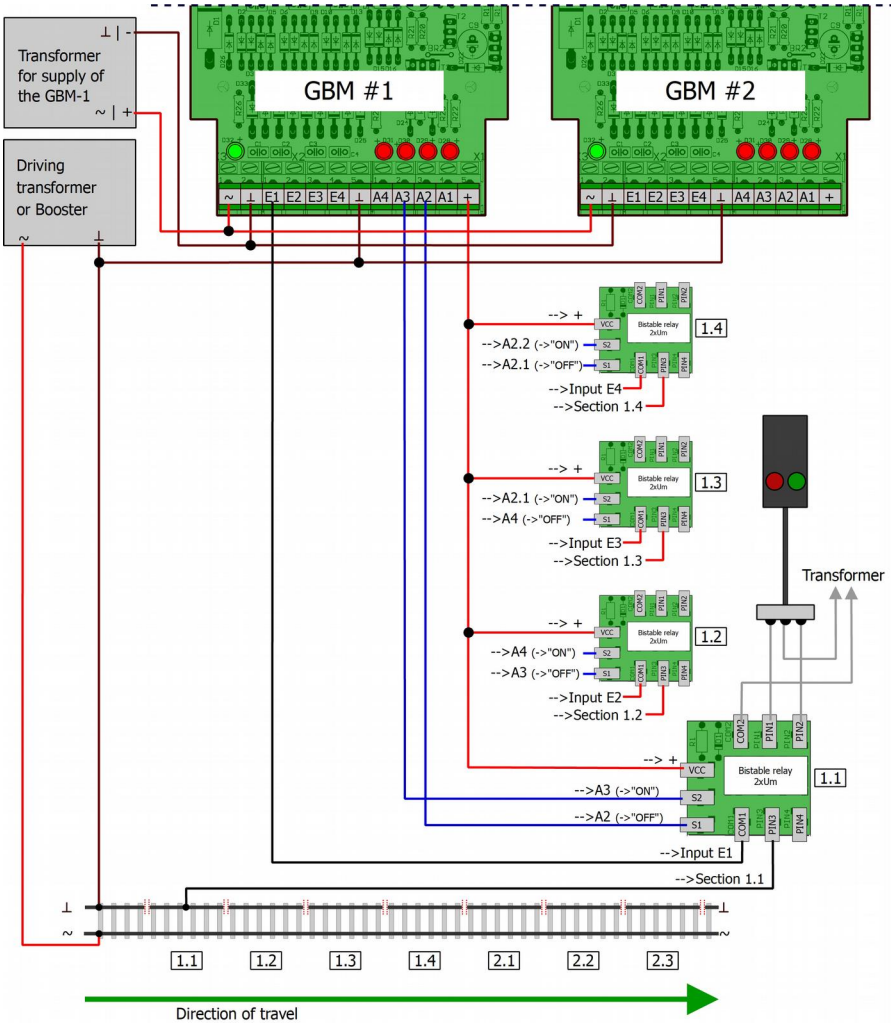
The control connections of the relay are controlled via the two outputs of the GBM, which are assigned to the two sections **ahead**. If the section ahead is occupied, the relay's normally open contact is opened and the section is thus de-energised (see track sections 2.1 and 2.3 in the illustration). If the section ahead is vacant again, the contact of the relay is closed again and the section is thus supplied with current again (see track section 1.4 and 2.2 of the illustration). If neither of the two sections ahead is occupied, the contact of the relay remains closed and the section is supplied with power.



### Connection example

For an automatic block section control you need

- one GBM- 1 track occupancy detector for up to 4 sections each
- one bistable relay or one relay board RL-2 (item numbers 72-00055 or 72-0056) for each section



### Notes on the connection example

- The connection to direct current systems is shown. The connection to AC systems is analogous to the connection diagram in section 4.2.
- In order to increase clarity, only the connection of the relay board for section 1 of the track occupancy detector number 1 is shown in full (designated as "1.1" in the connection diagram). The connection of the relay boards for the other track sections is done accordingly.
- The number of sections in the block section can be extended as desired with further track occupancy detectors and relays.
- The relay board RL-2 is equipped with a relay 2xUm, so it has two change-over switches. Only one of these can be used to switch a track section (COM1 and pin 3 or 4 or COM2 and pin 1 or 2). The free change-over switch can be used, for example, to connect a light signal that is switched at the same time as the track section.

### Pin assignment

Due to the large number of connections required, the connection of the block section quickly becomes confusing. It is therefore recommended to create a table with the required connections and to execute the connections based on this table.

Connection table for the connection example shown:

Relay Board no.	COM 1 <i>or</i>	PIN 3 or 4 <i>or</i>	S1 ("off")	S2 ("on")
	COM 2	PIN 1 or 2		
	→ Input GBM*	→ Track section	→ Output GBM*	→ Output GBM*
<b>1.1</b>	E1.1	1.1	A1.2	A1.3
<b>1.2</b>	E1.2	1.2	A1.3	A1.4
<b>1.3</b>	E1.3	1.3	A1.4	A2.1
<b>1.4</b>	E1.4	1.4	A2.1	A2.2
<b>2.1</b>	E2.1	2.1	A2.2	A2.3
<b>2.2</b>	E2.2	2.2	A2.3	A2.4
<b>2.3</b>	E2.3	2.3	A2.4	A3.1
...	...	...	...	...

\*The numbers of the inputs and outputs result as follows:

Number of the track occupancy detector + number of the input/output according to the connection diagram of the GBM.

Example: 2.3 = track occupancy detector no. 2 / input or output 3

## 6. 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 track occupancy detector is defective. → Send the detector in for inspection.

### **Faulty occupancy indications on the integrated LEDs**

The LEDs light up dimly although the track sections are not occupied.

Possible cause:

- A consumer is connected to the outputs of the GBM which operates with a higher voltage than the GBM. → Remove the LEDs on the track occupancy indicator.

One or more LEDs do not light up although the associated track sections are occupied.

Possible cause:

- The GBM is not correctly connected to the track sections, its power supply and/or the driving transformer. → Check the connections.
- There is a connection between the monitored section and the earth connection of the driving transformer. → Check the connections.

### **Faulty occupancy indications on external lamps or LEDs**

Possible causes:

- The voltage supply has been interrupted. → Check the connection from the module to the transformer.
- One or more lamps are defective. → Check the lamps by connecting them directly to the power supply.
- "Kit" version: The diode D1 is soldered in the wrong direction. → Change the mounting direction!

### **Unreliable occupancy signals in combination with digital feedback devices**

Possible cause:

- The LEDs on the track busy indicator create external voltages which affect the digital feedback module. → Demount the LEDs from the track busy indicator.
- Interference voltages from the digital system generate (false) occupancy signals. The GBM-1 is obviously not suitable for this application due to its high sensitivity. → Replace the GBM-1 with a less track occupancy detector optimised for use in digital systems (e.g. GBM-8 or GBM-8.2\*\*).

## 6.1. Technical Hotline

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

## 6.2. Repairs

You can send us a defective track occupancy detector 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.


## 7. Technical data

Number of monitored sections	maximum 4
Evaluation of the occupancy messages	against earth of the downstream components

### Inputs and outputs

Inputs	4 inputs for the connection of the monitored track sections
Outputs	4 outputs for the connection of <ul style="list-style-type: none"> <li>▪ external indicator LEDs or lamps</li> <li>▪ subordinate circuits</li> <li>▪ the inputs of digital feedback devices</li> </ul>

### Electrical characteristics

Power supply	12 – 18 Volt a.c. or d.c. voltage
 The GBM-1 must not be supplied by transformers or a digital boosters providing current for driving operation.	
Current consumption (without connected loads)	approx. 15 mA
Maximum current in the monitored sections	1 200 mA
Max. current per output	500 mA
Max. total current of the outputs	2 000 mA
Sensitivity	1 mA

### 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 <math>\geq 12.5</math> mm and access with a finger. No protection against water.</p>
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**Environment**

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For use in closed rooms

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Ambient temperature during operation      0 ~ + 30 °C

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Permissible relative humidity during operation      10 ~ 85% (non-condensing)

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Ambient temperature during storage      - 10 ~ + 40 °C

---

Permissible relative humidity during storage      10 ~ 85% (non-condensing)

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**Other features**

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Dimensions (approx.)      Circuit board: 63 x 97 mm  
Ready device including housing: 100 x 98 x 35 mm

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Weight (approx.)      Assembled board (ready-made module): 49 g  
Ready device including housing: 97 g

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## 8. Warranty, EU conformity & WEEE

### 8.1. 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.

## 8.2. 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.

## 8.3. 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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