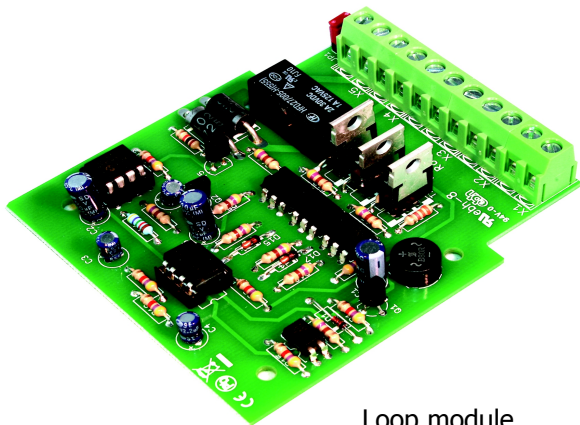


Manual

KSM-2

Item no. 49-01125 | 49-01126 | 49-01127



Loop module
for digital model railroad layouts

tams elektronik



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Subject to technical modification.

Remark: RailCom[®] is the registered trademark of the Lenz Elektronik GmbH, Hüttenbergstraße 29, D-35398 Gießen. To increase the text's readability we have refrained from referring to this point in each instance.

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 loop module KSM-2 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 KSM-2 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 KSM-2 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 18) and one PCB or
- one ready-built module with a jumper put onto JP1 or
- one ready-built module with a jumper put onto JP1 in a housing (complete unit),
- 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 you need wire. Recommended diameters: $\geq 0,25 \text{ mm}^2$ for all connections.

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

Loop problems

At the loop points in two-rail-systems, different polarities meet with each other. As soon as a vehicle bridges the differently polarized sections when driving in or out the terminal loop a short circuit occurs.

In digital layouts loop modules generally have to adapt the polarity within the terminal loop to the one outside. In case the polarity outside the terminal loop would be altered, different polarities would meet with each other at the transition to the next booster section. Thus the problem would be misaligned only.

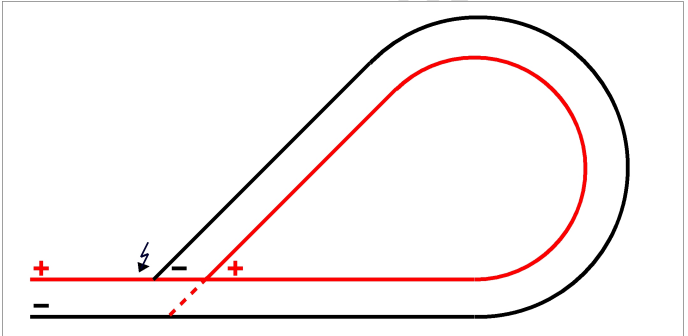


Fig. 1: Short circuit problem at the loop points

Mode of operation of the KSM-2

The loop module KSM-2 changes the polarity within the loop before a short circuit occurs – independently of the locomotive's direction of travel or the data format used to control the locomotive.

For that purpose transition zones are added between the layout and the inside of the terminal loop. Integrated track busy modules detect the direction of travel and position of the locomotive in the transition zones and in the section within the loop. As long as only one of the two track busy indicators in the transition zones detects "busy", the locomotive is about to drive into the loop. When the section within the loops detects "busy" as well, the locomotive is going to drive out of the loop.

Procedure

Phase 1: The two transition zones are switched currentless initially.

Phase 2: After a locomotive has come into one of the two transition zones, the integrated track busy indicator sends a busy message to a micro controller on the printed circuit board. The micro controller controls a relay which sets the "right" polarity within the loop. There is no short circuit occurring as the locomotive is within the transition zones which initially is currentless.

Phase 3: After having set the polarity within the loop "properly" the two interruptions at the initially currentless transition zone are closed by an integrated switch and the transition zone is supplied with current.

As a rule, the short interruption of the power supply at the locomotive's front axle when coming into the initially currentless transition zone has no visible effects on the locomotive's driving characteristics.

Phase 4: Shortly after the locomotive has left the transition zone (and there is not sent a "busy"-message from this zone any longer), the transition zone is switched currentless again.

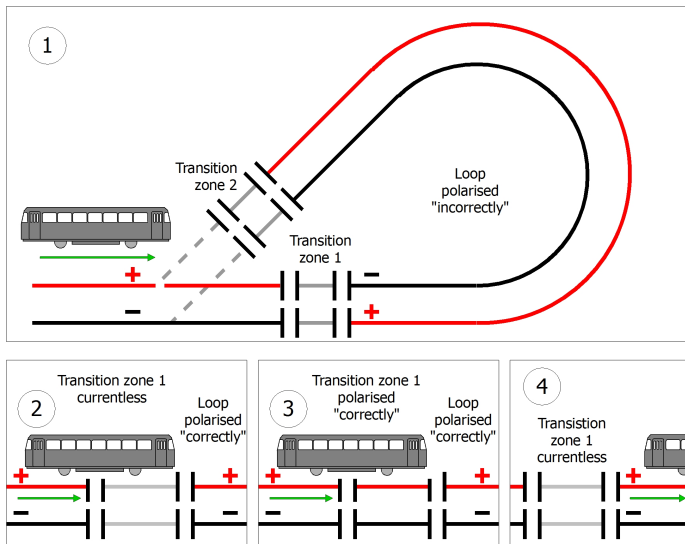


Fig. 2: Procedure

Track busy indicator conducted to the outside

The track busy indicator integrated into the KSM-2 which supervises the section within the loop, is conducted to the outside of the module and can be integrated into the rest of the layout's control system. As it is galvanically separated from the rest of the circuit, digital feed back modules (e.b. s88 modules) can be connected directly.

Using the KSM-2 in RailCom supervised layouts

It is impossible to connect a RailCom detector directly to the inside of the terminal loop. As the RailCom detector is an electric load, it would create a permanent busy indication when connected directly to the track section. This would invalidate the loop module's function.

The KSM-2 has a special connection for a RailCom detector which allows to link the terminal loop to a layout supervised by RailCom.

Designing a layout with the KSM-2

The rails in the loop's inside have to be at least as long as the longest train to pass the terminal loop. Additionally, two transition zones which are at least half as long as the longest locomotive have to be added between the points and the loop's inside.

Due to principle only one train is permitted to pass the terminal loop at once.


The maximum current of all vehicles in the loop is 3 A (including motor current of the locomotive, carriage lightings, other accessories).

Use with a turntable

With turntables different polarities possibly occur at the transitions between bridge and the other parts of the layout after turning the bridge. Loop modules can solve this problem.

However, loop modules of the type of the KSM-2 needing additional transition zones are **not** suitable for use with turntables.

5. Technical specifications

Data formats	all
Supply voltage	12 – 24 V a.c. or d.c. voltage
 Caution: The KSM-2 must not be supplied by a transformer in use to supply the digital system!	
Current consumption (without connected devices)	approx. 100 mA
Max. current of all vehicles in the loop	3 A
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	approx. 72 x 82 mm
Dimensions including housing	approx. 100 x 90 x 35 mm
Weight of the assembled board	approx. 57 g
Weight including housing	approx. 105 g

6. Assembling the kit

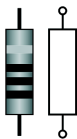
You can skip this part if you have purchased a ready-built module or device.

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



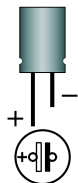
Resistors reduce current.

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:
330 Ω	orange – orange – black (gold)
470 Ω	yellow - violet - brown (gold)
1 k Ω	brown - black - red (gold)
2,2 k Ω	red - red - red (gold)
4,7 k Ω	yellow - violet - red (gold)
47 k Ω	yellow - violet - orange (gold)

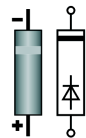
Electrolytic capacitors



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

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

Diodes and Zener diodes

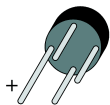


Diodes allow the current to pass through in one direction only (forward direction), simultaneously the voltage is reduced by 0,3 to 0,8 V. Exceeding of the limit voltage always will destroy the diode, and allow current to flow in the reverse direction.

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

The diode type is printed on the package.

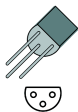
Rectifiers



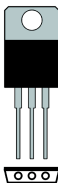
Rectifiers convert alternating into direct voltage. They have four pins: two for the input voltage (a.c. voltage) and two for the output voltage (d.c. voltage). The pins for the output voltage are polarized.

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.

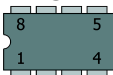


Transistors for a low power rating (e.g. BC types) have a package in form of a half cylinder (SOT-package). Transistors for a high power rating (e.g. BT types) have a flat package (TO-package), which is in use in different versions and sizes.

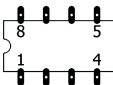


The three pins of bipolar transistors (e.g. BC and BT types) are called basis, emitter and collector (abbreviated with the letters B, E, C in the circuit diagram).

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.

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 DIL-housing with at least 4 pins.

Relays

Relays are electronic switches, depending on their position the one or other (internal) connection is closed. The mode of operation of monostable relays can be compared to that of a push-button switch, i.e. the connection is only closed as long as the voltage is applied. Bistable relays keep their status after switching – comparable to a switch.

Relays which combine two switches in one housing are common as well (shortly 2xUM). The switching between the two connections can be heard clearly because of the resulting clicking sound.

Screw terminals

Screw terminals provide a solder-free and safe connection of the cables to the circuit, which can still be separated any time.

Terminal strips are available as single or double row versions with 2 or 3 poles (resp. 2x2 or 2x3 poles). Connections with any number of poles can be created by linking several terminal strips. In order to fix them the connecting cables are inserted and screwed (similar to a lustre terminal).

Parts list

Resistors	R4, R7, R8	330 Ω
	R5, R9, R10, R11, R12, R13, R14, R17, R18	470 Ω
	R23	1 k Ω
	R2, R3, R15	2,2 k Ω
	R1, R6, R19, R20	4,7 k Ω
	R16	47 k Ω
	Diodes	D16
D15, D17		1N4148
D13, D14		1N540x
Zener diodes	D1	5V6
Rectifiers	D1-4	B80C
Electrolytic capacitors	C3, C4, C6	2,2 μ F / ≥ 10 V
	C1, C2, C5	100 μ F / ≥ 25 V
Transistors	T5, Q1, Q2	BC547B
	T1, T2, T3	BT136
Micro-Controllers	IC1	PIC12F508P
Opto couplers	OK1, OK2, OK3	MOC3012M
	OK4	PC817
	OK5	PC827
IC-sockets	OK1, OK2, OK3	6-pole
	OK5, IC1	8-pole
Relays	RL1	2xUm 5V monostable
Pin strips	JP1	2-pole
Jumper	JP1	2-pole
Terminal strips	X1 – X5	1x2-pole (1 unit) 1x3-pole (3 units)

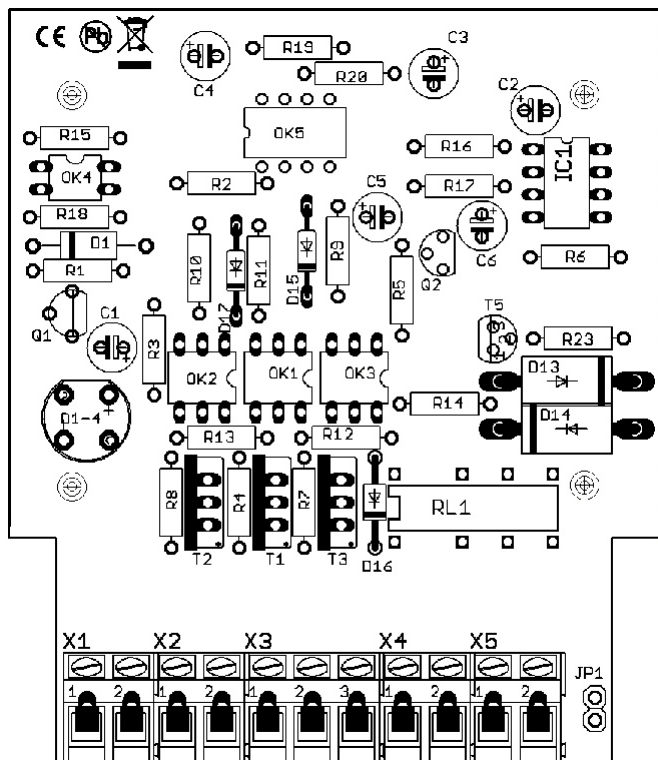


Fig. 3: PCB layout

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.	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.	Opto coupler	Solder the opto coupler OK4 directly onto the PCB (without socket).
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.	Rectifiers	Observe the polarity! The pin connections are printed on the housing. The longer connecting pin is the positive pole.

6.	Transistors	Observe the polarity! The cross section of transistors for a low power rating in SOT-packages is shown in the PCB layout. With transistors for a high power rating in TO packages (e.g. BT types) the unlabelled back side is marked in the PCB layout by a thick line.
7.	Electrolytic capacitors	Observe the polarity! One of the two leads (the shorter one) is marked with a minus sign.
8.	Relays	The mounting orientation is given by the layout of the pins.
9.	Terminal strips	Put together the terminal strips before mounting them.
10.	Pin strips	
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 KSM-2

Dividing the loop into sections

Divide the loop into three sections according to fig. 4:

- two transition zones near the points and
- the inner section of the loop.

Isolate both rails in each case. The transition zones should be about half as long as the longest locomotive, the inner section as long as the longest train. A train within the loop should never bridge the transition zones!

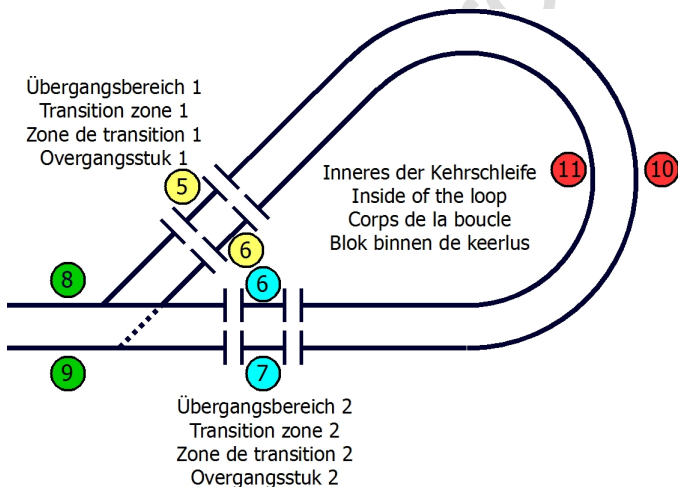




Fig. 4: Sections of the terminal loop

Assignment of the connections

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

1 2	<p>Outputs of the integrated track busy indicator</p> <p>1 → Record input of the digital feedback module</p> <p>2 → Mass connection of the digital feedback module (optional connection)</p>
3 4	<p>Voltage supply (transformer)</p> <p>The polarity is of no importance.</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p> Caution: Do not connect the KSM-2 to the power supply of the digital system. The occurring fault current can damage the module irreparably!</p> </div>
5 6	<p>Transition zone 1</p> <p>5 → outer rail</p> <p>6 → inner rail (together with inner rail of transition zone 2)</p>
7 6	<p>Transition zone 2</p> <p>7 → outer rail</p> <p>6 → inner rail (together with inner rail of transition zone 1)</p>
8 9	<p>Rails outside the loop</p>
10 11	<p>Inner section of the loop</p> <p>10 → outer rail</p> <p>11 → inner rail</p>
JP1	<p>RailCom detector</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p> Please note: In case there is no RailCom detector to be connected, the connecting pins JP1 have to be bridged, e.g. with the short-circuit termination (jumper) included in the package</p> </div>

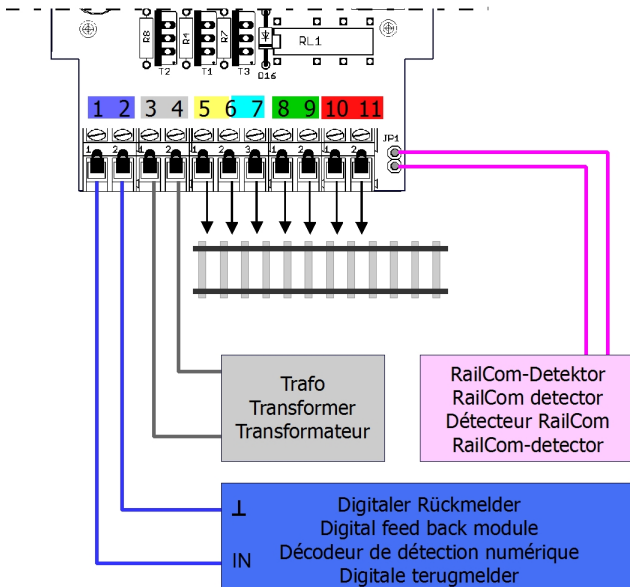


Fig. 5: Connections

Connection of the track busy indicator to the layout

The track busy indicator integrated into the KSM-2 which supervises the section within the loop, is conducted to the outside of the module via the connection points 1 and 2 and can be integrated into the rest of the layout's control system. The galvanic separation enables the direct connection to digital feed back modules (e.g. s88 modules)

Connect the connecting point 1 of the KSM-2 (= record output) to the input of the feed back module and the connecting point 2 to the mass connection of the feed back module.

Connection of a RailCom detector

As a RailCom detector is an electric load, it would create a permanent busy indication when connected directly to the rails within the loop. The loop module would not work, in consequence.

The RailCom detector supervising the inner section of the loop has to be looped in between internal track busy indicator and loop module via the connections JP1.

As at the time of printing this manual only a few RailCom detectors are available and future developments are pending we have refrained from describing the connection of RailCom detectors in detail. Please contact our technical hotline (address on the cover page) and tell us which RailCom detector (manufacture, type) you intend to connect. You will receive free information on connecting it then.

8. 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 loop module does not work as intended.

Possible cause: There is no RailCom detector connected and the connection points JP1 are not bridged. In consequence there are no track busy messages to be sent from the inside of the loop. □ Bridge the connections JP1, e.g. with the short circuit termination (jumper) included in the package.

- When coming into one of the transition zone a short circuit occurs.

Possible cause: The connecting points 5, 6 and 7 are not connected to the rails of the transition zones the right way. □ Check the connections, especially if the inner rails of both transition zones are connected to connecting point 6.

- When coming into a transition zone the locomotive stops.

Possible cause: The connecting points 5, 6 and 7 are not properly connected to the rails of the transition zones. □ Check the connections.

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.

9. 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.

10. 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.

11. 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.

tams elektronik

Information and tips:

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

Warranty and service:

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