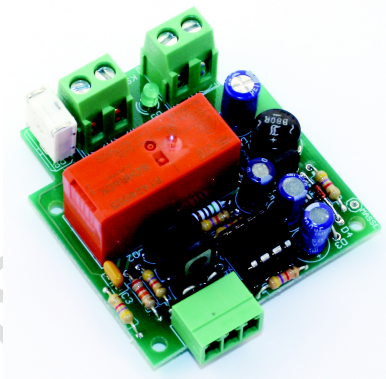


Manual

KSM-3

Item no. 49-01135 | 49-01136



Loop module
for digital model railroad layouts

tams elektronik



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Subject to technical modification.

1. Getting started

How to use this manual

This manual gives step-by-step instructions for safe and correct assembly of the kit and fitting and connecting of the ready-built module, and operation. Before you start, we advise you to read the whole manual, particularly the chapter on safety instructions and the checklist for trouble shooting. You will then know where to take care and how to prevent mistakes which take a lot of effort to correct.

Keep this manual safely so that you can solve problems in the future. If you pass the kit or the ready-built module on to another person, please pass on the manual with it.

Intended use

The loop module KSM-3 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-3 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-3 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 19) and one PCB or
- one ready-built module or
- one ready-built module 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:

- connection of the rails:
gauges Z and N: $\geq 0,75 \text{ mm}^2$
other gauges: $\geq 1,5 \text{ mm}^2$
- connection of the points: $\geq 0,25 \text{ mm}^2$

When using motor-run points, you need an additional adapter for motor-run points AMW-1 (item-no. 72-00076).

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 at the transition to the next booster section. Thus the problem would be dislocated only.

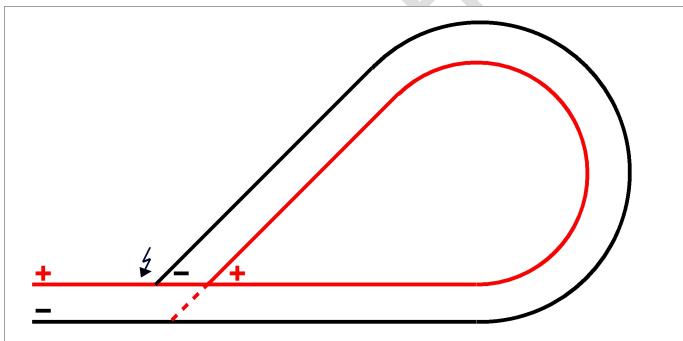


Fig. 1: Short circuit problem at the loop points

Mode of operation of the KSM-3

As soon as a locomotive bridges the sectioning point between differently poled sections inside and outside the loop, the KSM-3 changes the polarity within the terminal loop. The response time is extremely short, as the KSM-3 already detects the voltage drop at the switchover to a short-circuit. In consequence, the KSM-3 is able to react within milliseconds before the voltage breaks down due to the short circuit.

The sensitivity for the polarity reversal depends on the applied voltage and for that reason has to be set via a trimm-pot individually. In order to allow the precise setting a LED on the KSM-3 lights up as soon as the sensitivity has been set optimally (for the particular layout). That way you safely prevent wheels, current collectors and rails from damages and make sure locomotives pass the sectioning point without jerking.

Integrated switching of the points

The KSM-3 has an additional output for the connection of coil driven points. In order to connect motor-run points, you need an additional adapter for motor-run points AMW-1 (item-no. 72-00076).

The points are switched automatically as soon as the locomotive reaches one of the two sectioning points (simultaneously with altering the polarity). The two sectioning points are assigned to a particular correct position of points. That way externally switching the points does not interfere with the safe procedure.

Procedure

Phase 1: According to the current position of points the locomotive runs clockwise or counter-clockwise through the terminal loop. When the train is intended to run in a specific direction through the loop, the points can be set accordingly from the outside.

Phase 2: When the train running into the loop arrives at the sectioning point behind the points, the polarity within the loop is altered (if necessary).

Phase 3: When the train running out of the loop arrives at the sectioning point before the points, the polarity within the loop is altered and at the same time the points are set properly for the train to run out of the terminal loop.

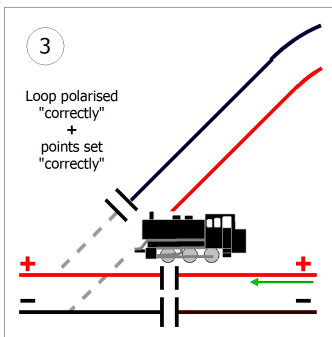
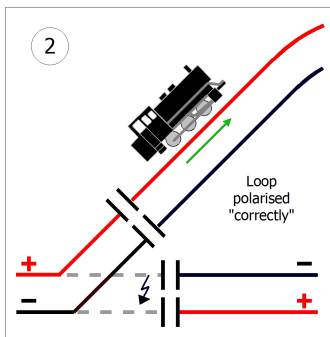
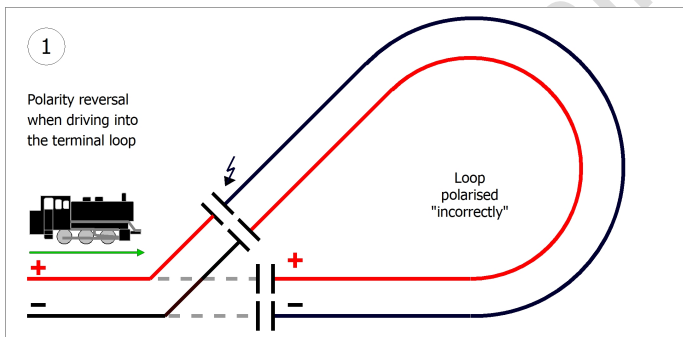


Fig. 2: Procedure

Designing a layout with the KSM-3

The rails in the loop's inside between the two sectioning points have to be at least as long as the longest train to pass the terminal loop.

The circuit also works properly when there are several trains within the loop at the same time provided that there are not two locomotives passing the sectioning points simultaneously. This allows branching rails within in terminal loop, for example.

The maximum current of all vehicles in the loop is 8 A (including motor current of the locomotive, carriage lighting, other accessories).

Use with a turntable

With turntables different polarities possibly meet at the transitions between bridge and the other parts of the layout after turning the bridge. The KSM-3 can solve this problem. For that purpose you have to connect the bridge like the loop's inside.

5. Technical specifications

Data format	all
Voltage supply	via the rails
Current consumption (without connected devices)	ca. 20 mA
Max. current of all vehicles in the loop	8 A
Additional outputs	1 (for the connection of coil driven points) Max. current: 1 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 Dimensions including housing	approx. 48 x 52 mm approx. 70 x 60 x 25 mm
Weight of the assembled board Weight including housing	approx. 37 g approx. 54 g

6. Assembling the kit

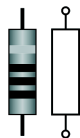
You can skip this part if you have purchased a ready-built module or device.

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



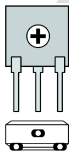
Resistors reduce current.

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:
150 Ω	brown - green - brown (gold)
4,7 k Ω	yellow - violet - red (gold)
22 k Ω	red - red - orange (gold)

Trimm-potentiometers



Trimm-potentiometers (abrv. "trimm-pots") are resistors which allow the value of resistance to be varied and that way to be adapted to the particular demands. In the middle they have a small slot into which a small screwdriver can be put in order to vary the value of resistance. The maximum value is printed on the housing.

Depending on the mounting situation trimmpots with a lying or a standing package are used.

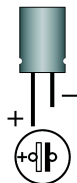
Ceramic capacitors



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 224 corresponds to the value 220 nF.

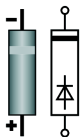
Electrolytic capacitors



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.

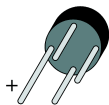
Light emitting diodes (LEDs)



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. With circuits designed for the connection of LEDs the series resistors are often integrated on the circuit board.

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.



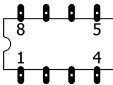
Transistors for a low power rating (e.g. BC types) have a package in form of a half cylinder (SOT-package). Transistors for a high power rating (e.g. BD types) have a flat package (TO-package), which is in use in different versions and sizes.

The three pins of bipolar transistors (e.g. 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 "DIL"-housing, from which 4, 6, 8, 14, 16, 18 or more "legs" (pins) are arranged along the long sides.



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

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.

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).

Plug-in units consist of a 2-, 3-, 4- or more pole box header to be soldered on the PCB and an appropriate plug-in part into which the connecting cables have to be inserted and screwed.

Parts list

Resistors	R5	150 Ω
	R2, R3, R4, R6, R7, R9	4,7 k Ω
	R1	22 k Ω
Trim pots	R8	10 k Ω (standing)
Diodes	D1, D2, D3, D6, D7	1N400x, x=2...7
Zener diodes	D4	5V6
LEDs	D5	3 mm (green)
Rectifiers	D1-4	B80C1500 (or similar)
Capacitors	220 nF	C3
Electrolytic capacitors	C5	2,2 μ F / 25 V
	C1, C2	100 μ F / 25 V
	C4	220 μ F / 25 V
Transistors	Q2	BC337
	Q1	BC547B
	T1, T2	BD679
Micro-Controllers	IC1	PIC12F1571-I/P
IC-sockets	IC1	8-pole
Relais	K1	2xUm, 8 A, 5V monostable
Terminal strips	X1, X2	1x2-pole
Plug-in units	S2	3-pole box header
		3-pole plug-in part

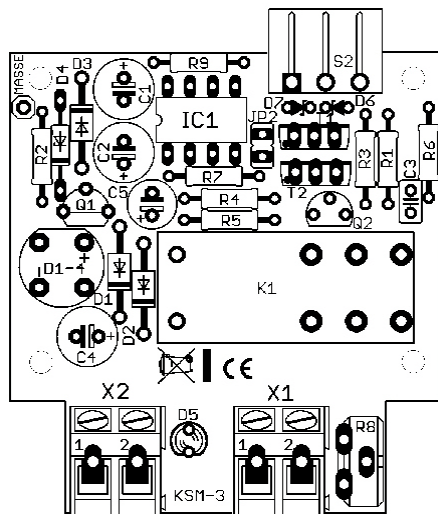


Fig. 3: PCB layout

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. Solder the diode D6 and D7 that way, their bodies are standing upright on the PCB.
3.	Ceramic Capacitors	Mounting orientation of no importance.
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.	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. BD types) the unlabelled back side is marked in the PCB layout by a thick line.
6.	Rectifiers	Observe the polarity! The pin connections are printed on the housing. The longer connecting pin is the positive pole.
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.	Light emitting diodes (LEDs)	Observe the polarity! With wired LEDs the longer lead is always the anode (positive pole).
10.	Srew terminals	Terminal strips and box header of the plug-in unit.
11.	Trimm-potentiometers	The mounting orientation is preset by the layout of the three pins.
12.	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-3

Isolating the terminal loop from the layout

First isolate the loop completely from the rest of the layout. Arrange the two isolating points as near to the points as possible.

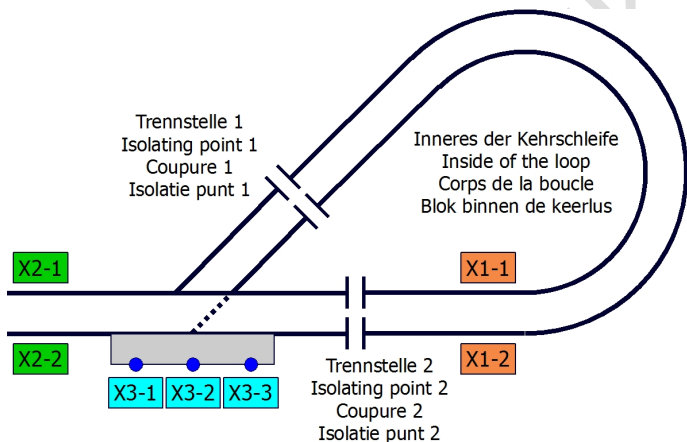


Fig. 4: Sections of the terminal loop

Connections

There are two terminal strips for the connection of the rails and a plug-in unit (consisting of a box header and an appropriate plug-in part) for the connection of the points soldered to the module which are used to insert and screw on the connecting wires.

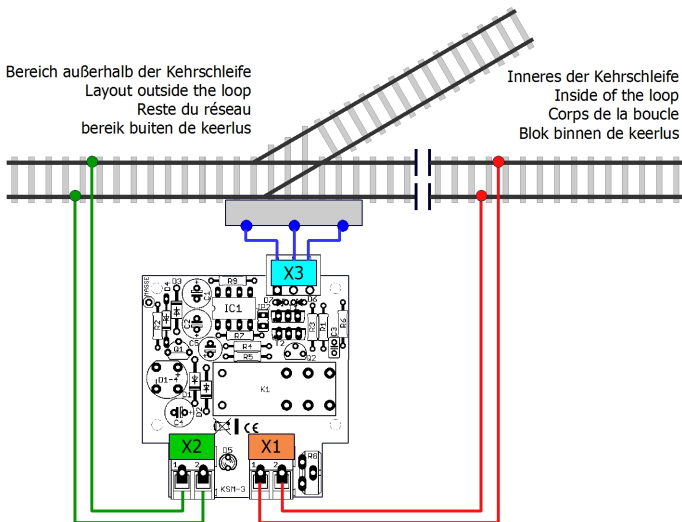


Fig. 5: Connections

X1	Inside of the loop 1 → inner rails 2 → outer rails
X2	Layout outside the loop 1 → inner rails 2 → outer rails
X3	Optional: coil driven points (or motor-run points plus AMW-1) 1 → Position of points 1 2 → voltage supply 3 → Position of points 2

Connecting points

Connecting points to the KSM-3 is optional. You can do without when you do not intend to switch the points automatically.

Each of the two isolating points is assigned firmly to one position of points. If the position is "branch" or "straight" depends on the particular mounting situation.

For that reason you have to check after having connected them if the points switch "correctly", when the locomotive passes the isolating points on its way out of the loop. If not, you have to interchange the connections of the points (X3-1 and X3-3).

Setting the sensitivity for the polarity reversal

Proceed accurately when setting the sensitivity for the polarity reversal in order to make sure the KSM-3 already reacts at the beginning of the voltage drop and alters the polarity within the loop as quickly as possible. If the inevitably occurring short circuit lasts too long, wheels, rails and current collectors possibly corrode or locomotives passing the sectioning point possibly jerk. With a very high current the short circuit interruption of the booster possibly reacts.

First set the trimm-pot by use of a small screwdriver as far to the left as possible. Then turn it

1. slowly to the right, until the LED lights up or flashes
2. further to the right, until the LED goes out or the relay switches (audible by a clicking sound)
3. carefully back to the left, until the LED lights up or flashes again or the relay stops to switch

Connecting a turntable

You can use the KSM-3 in combination with a turntable.

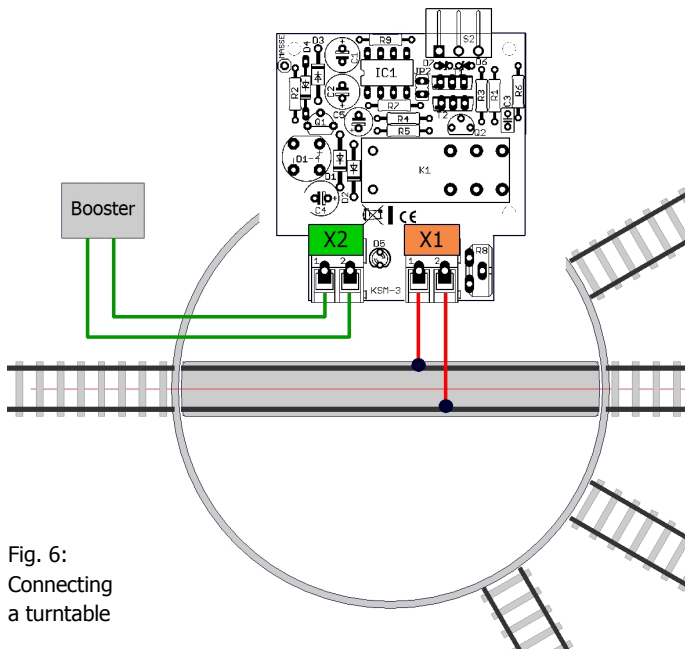


Fig. 6:
Connecting
a turntable

X1	Rails of the bridge. The assignment of the connections 1 and 2 is of no importance.
X2	Rail output of the booster 1 → connection for "inner" rails 2 → connection for "outer" rails

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.

- When setting the trimming pot the relay does not switch.

Possible cause: one or more components are soldered incorrectly.
→ Perform a visual check.

Possible cause: The IC has been inserted into the IC-socket in the wrong direction. → The IC has consequently been destroyed and must be replaced. (The programmed IC can only be purchased directly from Tams Elektronik!)

- During the testing run the central unit switches off.

Possible cause: one or more components are soldered incorrectly.
→ Perform a visual check.

Possible cause: The trimming pot is set incorrectly. → Set the trimming pot according to the section "Setting the operating point" and repeat the test.

- When the train is driving out of the loop the points are switched incorrectly.

Possible cause: The connections X3-1 and X3-3 have been assigned incorrectly. → Interchange 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.

Information and tips:

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

Warranty and service:

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