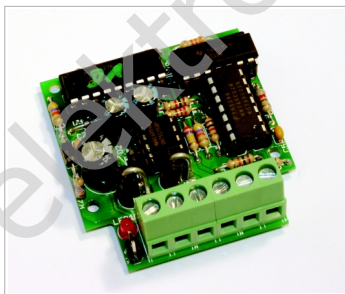


Manual

RCD-1

Item no. 45-01015 | 45-01016 | 45-01017



Single RailCom detector



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 RailCom detector RCD-1 is designed to be operated according to the instructions in this manual with digital model railways. Any other use is inappropriate and invalidates any guarantees.

The RCD-1 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 RCD-1 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 and one PCB or
- one ready-built module or
- one ready-built module in a housing (complete unit),
- one jumper for programming the address,
- 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:

- data bus: $\geq 0,1 \text{ mm}^2$. It is recommended to use twin wire (e.g. LiYz, 2x0,19 mm², red-brown, item no. 73-30037);
- connections to the rails and the booster: $\geq 0,25 \text{ mm}^2$.

If you intend to display and / or transfer the read-out data to a PC, you need external display devices resp. a PC interface, e.g.

- single display device RCA-1 (item no. 45-02016);
- 24-fold display device RCA-24 (item no. 45-02247);
- PC interface RC-Link (item no. 45-02257 with USB interface or 45-02267 with V24 interface).

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. Background information: RailCom

Feedback with RailCom

RailCom is a standard for bi-directional communication in digital model railway layouts controlled in DCC-format. It allows e.g. the feedback of the address and the CV values from RailCom decoders to the digital control unit or to special receivers (so-called detectors).

To transfer the RailCom messages special RailCom boosters supplying the so-called RailCom cutout have to be used.

Data transfer between RailCom components

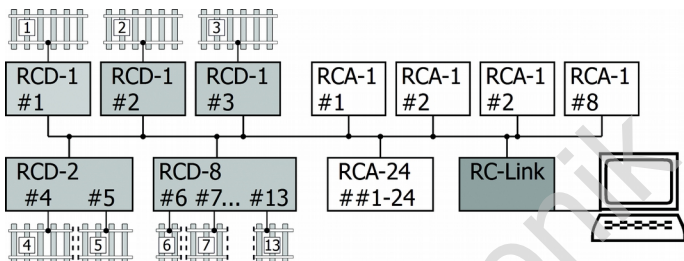
The RailCom standard is the basis of the communication between RailCom compatible decoders and RailCom detectors, which allows you to use detectors and decoders of different manufacturers together. On the other hand, a manufacturer specific data bus is used to communicate between detectors, display devices and PC interfaces. That is the reason why the use of detectors, display devices and PC interfaces of one manufacturer is mandatory.

The data bus used by Tams Elektronik for the communication between detectors, display devices and PC interfaces allows you

- to control up to 24 separate track sections and
- to connect up to 32 RailCom devices (detectors RCD-1, RCD-2 or RCD-8, display devices RCA-1 or RCA-24, PC interfaces RC-Link).

In order to assign the detectors, display devices and PC interfaces to each other, they get addresses between 1 and 24.

Example for the data transfer in the Tams specific data bus



There are five different detectors connected to the data bus, all together controlling 13 separate track sections. In order to display and exploit the data there are used:

- four single display devices RCA-1 displaying the data from one section each,
- one 24-fold display device RCA-24, displaying the data from all 13 track sections,
- one RailCom PC interface RC-Link.

Bus line

For technical reasons, there are two wires with a diameter of minimum 0,10 mm² mandatory as a bus line for the communication between detectors, display devices and PC interfaces (lines A and B). In order to minimise the vulnerability towards disturbances from other cables, the two wires should be twisted. It is recommended to use twin wire (e.g. LiYz, 2x0,19 mm², red-brown, item no. 73-30037)

The bus line has to be looped through from one to the other device. When connecting them the lines A and B always have to be assigned to the corresponding connection points A and B of the devices.

5. Operating mode of the RCD-1

Supervising track sections with RailCom

The RailCom detector RCD-1 picks up the RailCom signals from one track section separated from each other. These are possibly:

- Addresses of the vehicle decoders in the rail section. The decoder's address is sent permanently.
- CV-values of the vehicle decoders in the rail section. The CV-values are sent only after a read out command (i.e. sent by the control unit).

Displaying and transferring the data

There is no display for the RailCom feedback signals integrated in the RCD-1. In order to display the received data special RailCom display devices have to be connected (e.g. single display device RCA-1 or 24-fold display device RCA-24). These display devices can be mounted in those places of the railway layout where needed.

In addition to display devices or instead of display devices, units passing on data to a PC (e.g. RC-Link) or to the digital control unit can be connected.

The RCD-1 verifies the signals it receives and sends the "clean" signals via a Tams specific databus to the downstream devices.

Integrated track occupancy indicator

There is an integrated track occupancy indicator which is able detecting also loads not sending a RailCom signal in the connected track sections. The messages "track occupied" are displayed in assigned display modules (e.g. RCA-1 or RCA-24) or transferred by an interface (e.g. RC-Link) to a PC.

Detection of the rerailing direction

In 2-rail systems the detector detects the direction in which the locomotive has been rerailed. This information is of importance e.g. when the locomotive's direction has to be detected in invisible sections or serves as a basis for a PC software. The rerailing direction is displayed in assigned display devices (e.g. RCA-1 or RCA-24) or transferred by an interface (e.g. RC-Link) to a PC.

6. Technical specifications

Supply voltage	Digital voltage of the control unit
Digital format	DCC
Feedback log	RailCom
Number of sections controlled by RailCom	1
Current consumption without connected loads approx.	100 mA
Protected to	IP 00
Ambient temperature in use	0 ... +60 °C
Ambient temperature in storage	-10 ... +80 °C
Comparative humidity allowed	max. 85 %
Dimensions of the PCB (approx.)	48 x 52 mm
Dimensions including housing (approx.)	60 x 70 x 25 mm
Weight of the assembled board (approx.)	30 g
Weight including housing (approx.)	47 g

7. Assembling the kit

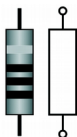
You can skip this part if you have purchased a ready-built module or device.

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:

220 Ω

Colour rings:

red - red - brown (gold)

820 Ω

grey - red - brown (gold)

1 k Ω

brown - black - red (gold)

10 k Ω

brown - black - orange (gold)

33 k Ω

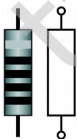
orange - orange - orange (gold)

47 k Ω

yellow - violet - orange (gold)

270 k Ω

red - violet - yellow (gold)



Metal film resistors have 5 colour rings. The 5th ring (given in brackets here) indicates the tolerance of the resistor (brown = 1 %).

Value:

1,5 Ω

Colour rings:

brown - green - black - silver (brown)

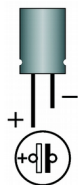
Ceramic capacitors



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 Zahl 104 corresponds to the value 100 nF.

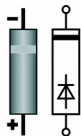
Electrolytic capacitors



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



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

Light emitting diodes (LEDs)



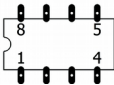
When operated in the forward direction the LEDs light. They are available in several different versions (differing in colour, size, form, luminosity, maximum current, voltage limits).

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

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.

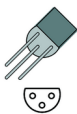


ICs are sensitive to damage during soldering (heat, electrostatic charging). For that reason in the place of the ICs IC sockets are soldered in, in which the ICs are inserted later.

Microcontrollers

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

Voltage regulators



Voltage regulators are ICs, which convert a variable, non regulated input voltage in a constant output voltage. They are produced in transistor packages with three connecting pins for input, output and earth.

The package forms of voltage regulators depend on their type. In use are voltage regulators in SOT packages (half cylinder shaped) and in flat TO packages.

Terminal strips

Terminal strips are solder-in screw-type terminals. They provide a solder-free and safe connection of the cables to the circuit, which can still be separated any time.

Parts list

Carbon film resistors	R1, R6, R13	220 Ω
	R10	820 Ω
	R2, R4, R14, R16	1 k Ω
	R12, R17	10 k Ω
	R8	33 k Ω
	R11, R15	47 k Ω
	R9	270 k Ω
Metal film resistors	R3	1,5 Ω
Capacitors	C6	not assembled
	C5, C7	100 nF
Electrolytic capacitors	C1	220 μ F / 35 V
	C2, C4	100 μ F / 25 V
Diodes	D1, D2, D3	1N400x, x=2..7
	D4, D5	1N540x, x \geq 1
LEDs	LED1	3 mm
ICs and microcontrollers	IC1	74HC02N
	IC2	LM339N
	IC4	PIC16F627P
	IC5	SN75176
IC-sockets	IC1, IC2	14-pole
	IC4	18-pole
	IC5	8-pole
Voltage regulators	IC3	78L05Z
Solder pins	JP1	2-pole
Terminal strips	X1 - X3	6-pole

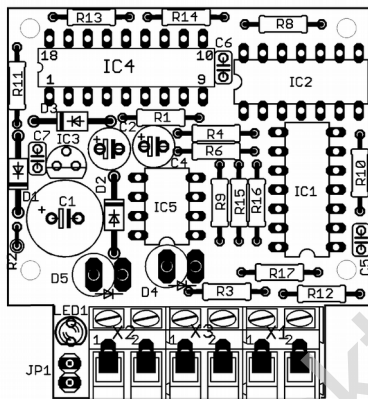


Fig. 2: PCB layout

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 (except R2)	Mounting orientation of no importance.
2.	Diodes (except D4 and D5)	Observe the polarity! The negative end of the diodes is marked with a ring. This is shown in the PCB layout.

3.	Light emitting diodes (LEDs)	Observe the polarity! With wired LEDs the longer lead is always the anode (positive pole).
4.	Resistor R2 and diodes D4 and D5	Solder the resistor and diodes that way, their bodies are standing upright on the PCB. Observe the diodes' polarity!
5.	Terminal strips	Put together the terminal strips before mounting them.
6.	Voltage regulators	Observe the polarity! The cross section of voltage regulators in SOT-packages is shown in the PCB layout.
7.	Ceramic Capacitors	Mounting orientation of no importance.
8.	Electrolytic capacitors	Observe the polarity! One of the two leads (the shorter one) is marked with a minus sign.
9.	Solder pins	
10.	IC sockets	Mount the sockets that way, the marking on the sockets show in the same direction as the markings on the PCB board.
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.

8. Connecting the RCD-1

Separating the controlled track section

The track section controlled by the RCD-1 has to be separated from the remaining tracks. For that purpose

- one conductor with 2-rail systems or
- the middle conductor with 3-rail systems

has to be cut through at both ends of the track section. When connecting several rail sections to RailCom detectors be sure to always cut the same conductor.



Attention:

If you don't cut the same conductor in layouts controlled by several RailCom detectors, a short circuit is going to occur as soon as the cut-off point is traversed. Normally, the layout will be switched off automatically in these cases.

Connecting the RCD-1

There are terminal strips soldered to the modules' connecting points which allow you to insert and screw the connecting cables.

Connecting the booster and the track sections

Mount the RCD-1 into the feed line from the booster to the track section. Check the right assignment to the continuous and the interrupted conductors.

U1	Track connection of the booster continuous conductor (earth)
U2	Track connection of the booster interrupted conductor
S1-1	Track section continuous conductor (earth)
S1-2	Track section interrupted conductor

Connecting RailCom display devices

You can connect display devices (e.g. RCA-1 or RCA-24) or a PC interface (e.g. RC-Link) to the RCD-1 according to your needs. As the data transfer between the detectors on the one side and the display devices and PC interfaces on the other side is run on a Tams specific data bus, you cannot connect devices from other manufacturers to the data bus.

Loop through the bus lines A and B from one device to the other. When connecting the lines A and B always be sure to assign them to the corresponding connection points A and B of the devices.

A	Tams specific RailCom bus line A
B	Tams specific RailCom bus line B

Hint: You assign the display devices to the RCD-1 by programming the address (see section 10).

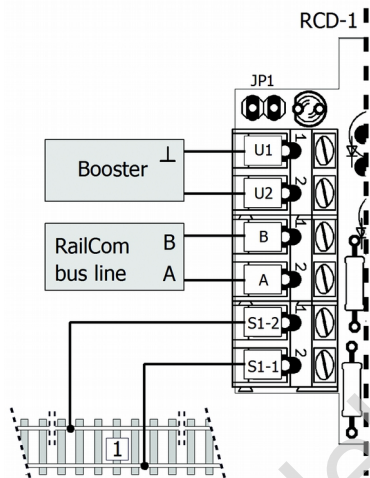


Fig. 3:
Connections diagram

9. LED-display of the RCD-1

The LED on the RCD-1 shows, if the device receives signals and which type they are.

LED	Received signals
on	DCC-signal received and RailCom-Cutout detected.
out or flashes	No DCC-signal received. When using a multiple protocol control unit you have to drive at least one decoder on the layout in DCC format.
	DCC-signal received, but no RailCom-Cutout detected. The RailCom-Cutout is supplied by the booster and is indispensable for feeding back data with RailCom. That is the reason why the booster supplying the respective rail section has to be RailCom-compatible.

10. Programming the RCD-1

By giving an identical address between 1 and 24 to the detector and the accessory display device (or devices) you assign the devices to each other. This enables the connection of several detectors and display devices to one common databus line (and to minimize the cabling) and the changing of the assignments any time.

Starting the programming of the detector

The desired detector's address has to be input at the accessory display device. In order to assign the address properly make sure that during the programming process only the detector to be programmed and the accessory display device are connected by the lines A-A and B-B. You achieve this by:

- disconnecting the detector from the databus line (in connection with other detectors) during the programming process and making a temporary connection directly from the detector to the accessory display device or
- disconnecting all other detectors from the power supply during the programming process.

Programming the RCD-1's address

- Disconnect the RCD-1 to be programmed from the power supply. In case there are other detectors connected to the same databus line you have to disconnect these from the power supply as well.
- Program the address of the accessory display device as described in the display device's manual.
- Bridge the two pins of the RCD-1's programming connector JP1, e.g. by putting on the jumper included in the package. Restore the connection from the detector to the power supply. The LED on the RCD-1 flashes. Be sure that the other detectors connected to the same databus line are not connected to the power supply yet.

- Program the RCD-1's address at the accessory display device as described in the display device's manual. As soon as the LED goes out, the RCD-1 has received the address.

Finishing the programming

- After the LED goes out, disconnect the RCD-1 from the power supply and take away the bridge on the two pins of the RCD-1's programming connector JP1.
- If necessary disconnect the temporary connection between the RCD-1 just programmed and the accessory display device. Restore the connection from the RCD-1 (and, if necessary, other detectors connected to the same databus line) to the power supply.

11. 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 7.) and if necessary, remedy the faults. Otherwise send in the module for repair.

- When passing the sectioning point between two booster sections a short circuit occurs.

Possible cause: The two connections of the detector to the rail (interrupted conductor / continuous conductor) have been reversed. → Check and alter the connections.

Possible cause: The two connections of the booster / the detectors (interrupted conductor / continuous conductor) are not consistent. → Check and alter the connections.

- An accessory display device assigned to the RCD-1 does not show data.

Possible cause: The RCD-1 and the display device have not been programmed to the same address. → Program the addresses of the two devices anew.

Possible cause: The connection A of the RCD1 is connected to the connection B of the display device (or the other way round). → Exchange the connections A and B at one of the devices.

Possible cause: The booster connected to the controlled rail section is switched off or does not supply the RailCom cutout. → Check the booster.

Possible cause: The vehicle decoder in the supervised rail section does not send a RailCom message, e.g. when in the corresponding CV the RailCom function is set to off. → Check the vehicle decoder.

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.

12. 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.

13. 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.

14. Declarations conforming to the WEEE directive

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



DE 37847206

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

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

Information and tips:

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

Warranty and service:

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DE 37847206