

Manual

# RCD-2

Item no. 45-01025 | 45-01026 | 45-01027



2-fold RailCom detector  
with integrated 2-fold track occupancy indicator  
and 8 switching outputs



tams elektronik



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## 1. Getting started

### How to use this manual

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

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

### Intended use

The RailCom detector RCD-2 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-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 RCD-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 and one PCB or
- one ready-built module or
- one ready-built module in a housing (complete unit),
- one jumper for programming the address,
- 3 distortion resistors (1 piece 120  $\Omega$ , 2 pieces 4,7 k $\Omega$ ),
- 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  $\text{mm}^2$ , red-brown, item no. 73-30037);
- connections to the rails and the booster:  $\geq 0,25 \text{ mm}^2$ ;
- connections to the integrated track occupancy indicator:  $\geq 0,1 \text{ mm}^2$ ;
- connection of downstream circuits to the switching outputs:  $\geq 0,1 \text{ mm}^2$
- connections to the detector's power supply:  $\geq 0,25 \text{ mm}^2$ .

As a power supply for the RCD-2 you **cannot** use the transformer supplying the digital control. It is recommended to use a separate transformer for the supply of all RailCom components on your layout (12 – 18 V d.c. or a.c. voltage.)

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**

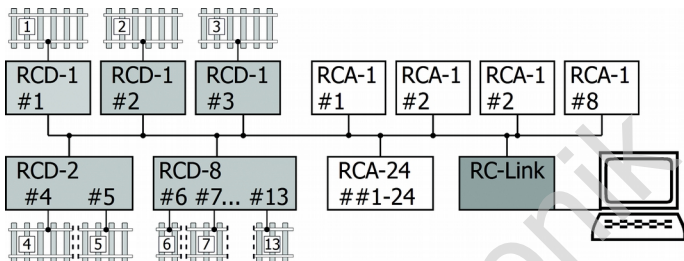
The RailCom standard is the basis of the communication between RailCom compatible decoders and RailCom detectors, which allows you to use detectors and decoders of different manufacturers together. On the other hand, a manufacturer specific data bus is used to communicate between detectors, display devices 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 mm<sup>2</sup> 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 mm<sup>2</sup>, 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-2

### **Supervising track sections with RailCom**

The RailCom detector RCD-2 picks up the RailCom signals from maximum two track sections 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-2. 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-2 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 for each of the two track sections of the RCD-2 which is able to detect also loads not sending a RailCom signal. 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.

The two outputs of the integrated track occupancy indicators have been carried to the outside and thus can be used for the connection of conventional feedback modules. This allows you to integrate the track sections into a conventional feedback system controlling only the busy condition of the track sections (e.g. s88).

### **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

### **Integrated switching outputs**

The RCD-2 has 8 switching outputs for the connection of downstream circuits which can be assigned to the controlled track sections according to your needs. This allows you to release switching operations depending on the locomotives' addresses pulling into a rail section. Examples are switching succeeding points or releasing announcements at the station for particular locomotive addresses.

## 6. Technical specifications

**Attention:** As a power supply for the RCD-2 you should **not** use the transformer supplying the digital control. If possible you should use a separate transformer supplying only the RailCom components on your layout.

Supply voltage	12 - 18 Volt d.c. or a.c. voltage
Digital format	DCC
Feedback log	RailCom
Number of sections controlled by RailCom	2
Number of outputs of track occupancy indicators max. current / output	2 100 mA
Number of switching outputs max. current / switching output max. Strom for switching outputs	8 300 mA 500 mA
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.) Dimensions including housing (approx.)	72 x 82 mm 100 x 90 x 35 mm
Weight of the assembled board (approx.) Weight including housing (approx. )	75 g 123 g

## 7. Assembling the kit

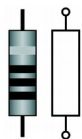
You can skip this part if you have purchased a ready-built module or device.

### 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

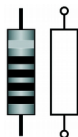


Resistors reduce current.

The value of resistors for smaller power ratings is indicated through colour rings. Every colour stands for another figure.

Carbon film resistors und einige Arten von Drahtwiderständen have 4 colour rings. The 4th ring (given in brackets here) indicates the tolerance of the resistor (gold = 5 %).

Value:	Colour rings:
220 $\Omega$	red - red - brown (gold)
560 $\Omega$	green - blue - brown (gold)
820 $\Omega$	grey - red - brown (gold)
1 k $\Omega$	brown - black - red (gold)
2,2 k $\Omega$	red - red - red (gold)
4,7 k $\Omega$	yellow - violet - red (gold)
10 k $\Omega$	brown - black - orange (gold)
33 k $\Omega$	orange - orange - orange (gold)
270 k $\Omega$	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  $\Omega$

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.

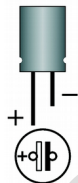
Normally they are marked with a three-digit number which indicates the value coded.

Value:                      Number:

10 nF                      103

100 nF                    104

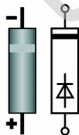
### Electrolytic capacitors



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

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 body.



## Light emitting diodes (LEDs)

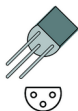


When operated in the forward direction the LEDs light. They are available in several different versions (differing in colour, size, form, luminosity, maximum current, voltage limits).

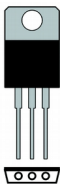
Light emitting diodes should always be connected via a series resistor which limits the current and prevents failure.

## Transistors

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



Transistors for a low power rating (e.g. BC and BS 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.

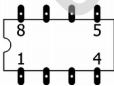


The three pins of bipolar transistors (e.g. BC and BD types) are called basis, emitter and collector (abbreviated with the letters B, E, C in the circuit diagram). The three pins of the field effect transistors (e.g. BS types) are called "source", "gate" and "drain" (abbreviated with the letters S, G, D 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.

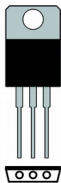
## Microcontrollers

Microcontrollers are ICs, which are individually programmed for the particular application. The programmed controller 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.

## 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	R13, R21	220 $\Omega$
	R10, R15, R24, R26	560 $\Omega$
	R22	820 $\Omega$
	R3, R11, R12, R14, R17	1 k $\Omega$
	R1, R4	2,2 k $\Omega$
	R5, R7, R8, R16	4,7 k $\Omega$
	R6, R9, R19, R20, R27, R28	10 k $\Omega$
	R31	33 k $\Omega$
	R23	270 k $\Omega$
Metal film resistors	R2, R25	1,5 $\Omega$
Capacitors	C1	10 nF
	C3, C5, C6, C7, C15, C16, C34	100 nF
Electrolytic capacitors	C2, C4	100 $\mu$ F
	C14	220 $\mu$ F
	C17	470 $\mu$ F
Diodes	D4, D5, D6, D7, D14	1N400x, x=2..7
	D3, D8, D9, D11	1N540x, x $\geq$ 1
LEDs	LED1	3 mm
Transistors for a low power rating	Q1, Q5, Q9, Q10	BC547B
	Q7, Q8	BC557B
	Q4, Q6, T1, T2	BS170
Transistors for a high power rating	Q3	BD679
ICs	IC2	SN75176
	IC3	ULN2004AN
	IC9	LM339N

Micro-Controller	IC1	MEGA162P
Photocoupleurs	OK2	PC827
IC-sockets	IC1	40-pole
	IC2, OK2	8-pole
	IC3	16-pole
	IC9	14-pole
Voltage regulators	IC 4	7805
Terminal strips	X3	1 x 3-pole
Double terminal strips	X1, X2, X5	2 x 9-pole
Solder pin	JP1	2-pole
Not assembled	R18, C12, C13, Q2, SV1, SV3, X4	

Distortion resistors	RS1	120 $\Omega$
	RS2, RS3	4,7 k $\Omega$

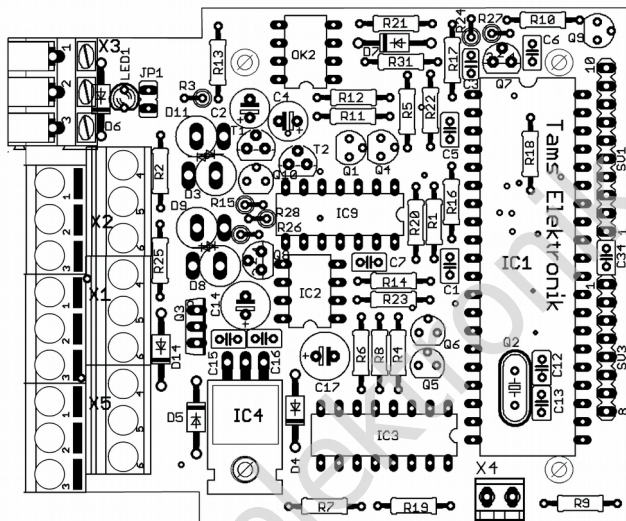


Fig. 2: PCB layout

## 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 R3, R15, R24, R26, R27 and R28)	Mounting orientation of no importance.
2.	Diodes 1N400x	Observe the polarity! The negative end of the diodes is marked with a ring. This is shown in the PCB layout.
3.	Ceramic Capacitors	Mounting orientation of no importance.
4.	Voltage regulators	Observe the polarity! Before soldering, bend the voltage regulator's pins to 90 degrees, so that you can solder it in corresponding to the PCB layout with the labelled front side facing upwards.
5.	IC sockets	Mount the sockets that way, the marking on the sockets show in the same direction as the markings on the PCB board.
6.	Transistors (except Q3)	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.
7.	Solder pin	
8.	Resistors R3, R15, R24, R26, R27 and R28	Solder the resistors that way, their bodies are standing upright on the PCB.
9.	Electrolytic capacitors	Observe the polarity! One of the two leads (the shorter one) is marked with a minus sign.

10.	Transistors Q3	Observe the polarity!
11.	Diodes 1N540x	Solder diodes that way, their bodies are standing upright on the PCB. Observe the diodes' polarity!
12.	Terminal strip X3	Put together the terminal strips before mounting them.
13.	Light emitting diodes (LEDs)	Observe the polarity! With wired LEDs the longer lead is always the anode (positive pole).
14.	Double terminal strips	Put together the terminal strips before mounting them.
15.	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-2

### Separating the controlled track sections

The track sections (maximum 2) controlled by the RCD-2, have 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-2

There are terminal strips soldered to the modules' connecting points which allow you to insert and screw the connecting cables. Follow the connection diagram fig. 3.

### Connecting the booster and the track sections

Mount the RCD-2 into the feed line from the booster to the track sections. 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	Track section 1   interrupted conductor
S2	Track section 2   interrupted conductor



## Connecting the power supply

**⚠ Attention:** As a power supply for the RCD-2 you should **not** use the transformer supplying the digital control. If possible you should use a separate transformer supplying only the RailCom components on your layout.

If you use a d.c. transformer for the power supply of the RCD-2, you have to regard the polarity when connecting it, if using an a.c. transformer the polarity is of no importance. If you supply several RailCom components by one a.c. transformer you have to be careful to connect all devices with the same polarity.

**⚠ Attention:** If you supply several RailCom components by one a.c. transformer, the connections of all devices have to be polarized in the same way. Otherwise a short circuit will occur which possibly can damage the connected devices.

~/+	Voltage supply. With d.c. transformers: +
~/-	Voltage supply. With d.c. transformers: -

## Connecting the switching outputs

The RCD-2 has 8 switching outputs for the connection of additional devices according to your needs. You can switch these additional devices when a particular locomotive (with a particular address) is pulling into a rail section. The assignment of the switching outputs to the locomotive addresses and the rail sections is done by CV programming.

V+	Return conductor for switching outputs X1 to X8
X1	switching output 1 / additional device 1
X2	switching output 2 / additional device 2
...	
X8	switching output 3 / additional device 8

### Connecting the integrated track occupancy indicator

In order to integrate the RCD-2 into conventional feedback systems controlling nothing but the busy condition of the track sections, you can connect the two integrated track occupancy indicators to the inputs of external feedback modules (e.g. s88).

T1	output 1 of the integrated track occupancy indicators (e.g. to input 1 of an external s88 feedback module)
T2	output 2 of the integrated track occupancy indicators
⊥	Earth connection for the integrated track occupancy indicator and external feedback modules

### 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-2 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-2 by programming the address (see section 9).

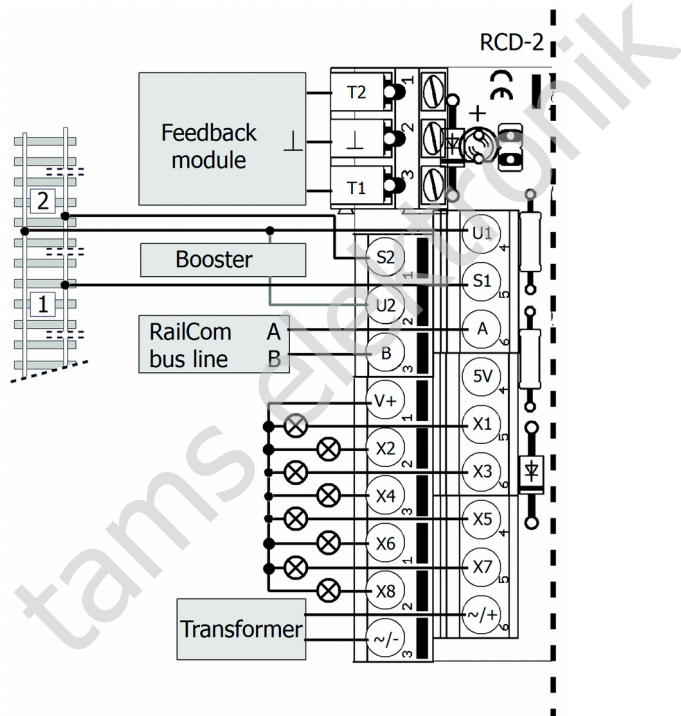


Fig. 3: Connection diagram

## Connecting distortion resistors

With the RCD-2 interferences in the RailCom data bus can result in an incorrect transfer of the RailCom messages to the connected display devices or in a very slow data transfer. In this case you should connect additional resistors (included in the package) according to fig. ? as an interference suppression.

5 V	Internal voltage supply. For the connection of distortion resistors if necessary.
-----	---

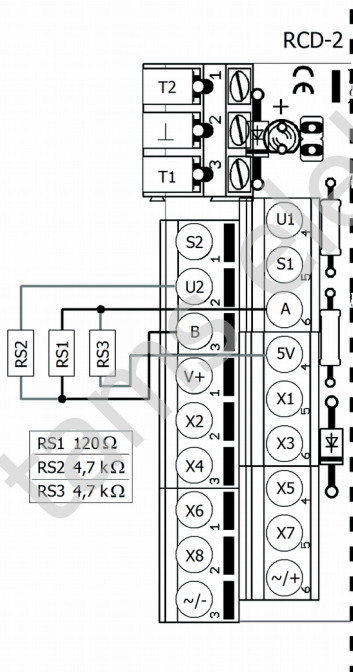


Fig. 4: Connection of distortion resistors

## LED-display

When the LED on the RCD-2 is illuminated, the detector is ready for operation. When changing into the programming mode the LED starts flashing continuously.

## 9. Programming the RCD-2

By programming the configuration variables (CVs) you set separately for the two detectors of the RCD-2:

- their addresses;
- which locomotive addresses release a switching operation in the controlled rail section and
- which of the 8 outputs is switched with a particular locomotive address.

Here you have to program on main (POM) for the RCD-2, according to the programming of locomotive decoders. With control units not supporting programming on main, you cannot program the RCD-2.

Choose any DCC locomotive address on your control unit and perform the programming for this address. Make sure not to use an address of a locomotive on the layout.

In order to change into the programming mode insert the jumper included in the package onto the 2-pole solder pin beside the LED. The LED which was illuminated till then starts continuously flashing.

In the following list you find all configuration variables to be set. The default values are the values in state of delivery which are restored after a reset.

Please note: With some control units it is not possible to program the configuration variables CV#1 and CV#17 by POM. With these control units use the listed alternative CVs.

### Programming the detectors' addresses

Name of CVs	CV no.	Input value (Default value)	Remarks and tips
Address detector 1	1 or 9	1 ... 24 (1)	Address of detector 1 in the RailCom data bus. CV#9 = alternative CV
Address detector 2	2	1 ... 24 (2)	Address of detector 2 in the RailCom data bus

### Reading-out the CVs of the RCD-2

Name of CVs	CV no.	Input value (Default value)	Remarks and tips
CV-request for CV #1-199	6	1 ... 199	The set CV values can be shown only when the detector(s) has / have been assigned to a display module. In CV#6 you can enter directly the CV numbers between 1 and 199 to be read out.
CV-request for CV #200-289	7	0 ... 89	For the CV numbers between 200 and 289 enter in CV #7 the number without the hundred-value (e.g. for # 248 value 48)

### Performing a reset

Name of CVs	CV no.	Input value (Default value)	Remarks and tips
Reset	8	1 ... 255	By entering any value all settings are restored to the values in state of delivery.

## Assigning the locomotive addresses to the detectors

You can assign up to 13 locomotive address groups to each of the two detectors. In one group is possible:

- a single locomotive address,
- several locomotive addresses between a lowest and a highest address

Notice: You can invert the locomotive address groups when assigning the switching outputs. Then the output will be switched only when locomotives not included in the assigned address group are pulling into the section.

You can enter locomotive addresses up to 9999. In generally, each locomotive address group is defined by four CVs (even groups with only one locomotive address):

- 1st CV: thousand and hundred digit of the lowest locomotive address
- 2nd CV: ten and one digit of the lowest locomotive address
- 3rd CV: thousand and hundred digit of the highest locomotive address
- 4th CV: ten and one digit of the highest locomotive address

### Assigning locomotive address group 1 to the detectors

Name of CVs	CV no.	Input value (Default value)	Remarks and tips
locomotive address group 1 for detector 1	30	0 ... 99 (0)	Thousand and hundred digits of the lowest locomotive address
	31	0 ... 99 (0)	Ten and one digits of the lowest locomotive address
	32	0 ... 99 (0)	Thousand and hundred digits of the highest locomotive address
	33	0 ... 99 (0)	Ten and one digits of the highest locomotive address
locomotive address group 1 for detector 2	40	0 ... 99 (0)	Thousand and hundred digits of the lowest locomotive address
	41	0 ... 99 (0)	Ten and one digits of the lowest locomotive address
	42	0 ... 99 (0)	Thousand and hundred digits of the highest locomotive address
	43	0 ... 99 (0)	Ten and one digits of the highest locomotive address

Examples	CV#30	CV#31	CV#32	CV#33
Locomotive address 41	0	41	0	41
Locomotive address 153	1	53	1	53
Locomotive address 3 to 11	0	3	0	11
Locomotive address 9732 to 9733	97	32	97	33



### Assigning further locomotive addresses to the detectors

In order to assign further locomotive address groups to the detectors proceed as described in the section before.

Name of CVs	CV no.	Remarks and tips
Detector 1	50 to 53	locomotive address group 2
Detector 2	60 to 63	locomotive address group 2
Detector 1	70 to 73	locomotive address group 3
Detector 2	80 to 83	locomotive address group 3
...	...	...
Detector 1	270 to 273	locomotive address group 13
Detector 2	280 to 283	locomotive address group 13

### Allocating the outputs to the detectors and the locomotive addresses

You allocate the 8 outputs of the RCD-2 to the two detectors and the assigned locomotive address groups according to your needs. When a locomotive from an assigned address group pulls into the connected rail section, the allocated output will be switched. When inverting the allocation the chosen outputs are switched when a locomotive not belonging to the address group pulls into the section.

Determine the input values by adding the values corresponding to the desired settings.

Name of CVs	CV no.	Input value (Default value)	Remarks and tips
Allocation of the outputs to detector 1 and locomotive address group 1	34	0 ... 255 (0)	Allocation of the outputs 1 - 8
	36	0 ... 255 (0)	Inverted allocation of the outputs 1 - 8
			output 1 1
			output 2 2
			output 3 4
			output 4 8
			output 5 16
			output 6 32
			output 7 64
		output 8 128	

Example 1: Output 1, 5 and 7 are switched as soon as a locomotive belonging to address group 1 (detector 1) is pulling into track section 1.  
 $CV\#34 = 1+16+64 = 81$  |  $CV\#36 = 0$

Example 2: Output 1, 5 and 7 are switched as soon as a locomotive not belonging to address group 1 (detector 1) is pulling into track section 1.  
 $CV\#34 = 0$  |  $CV\#36 = 1+16+64 = 81$

### Allocation of the outputs to further locomotive addresses

In order to allocate further outputs to the detectors and the locomotive address groups proceed as described in the section before.

Name of CVs	CV no.	Remarks and tips
Allocation of the outputs to the detectors and locomotive addresses	44 and 46	Detector 2 / locomotive address group 1
	54 and 56	Detector 1 / locomotive address group 2
	64 and 66	Detector 2 / locomotive address group 2
	...	...
	274 and 276	Detector 1 / locomotive address group 13
	284 and 286	Detector 2 / locomotive address group 13

### Setting the switching times of the outputs

Name of CVs	CV no.	Input value (Default value)	Remarks and tips
Switching times of the outputs	By setting the switching time you determine how long the output is supplied with current. Increasing the input value by 1 prolongs the switching time by 65,5 msec. The longest switching time to be set is 16,5 sec.		
	10	1 ... 255 (4)	output 1
	11	1 ... 255 (4)	output 2
	12	1 ... 255 (4)	output 3
	...		...
	17 or 3	1 ... 255 (4)	output 8 CV#3 = alternative CV

## 10. 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.

- The RailCom messages are displayed incorrectly and / or very slowly at the connected display devices.

Possible cause: Interferences in the RailCom data bus. → Connect the distortion resistors according to fig. 4 to the detector.

- An accessory display device assigned to the RCD-2 does not show data.

Possible cause: The RCD-2 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 RCD-2 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.

- When a locomotive pulls into a connected track section the outputs always switch, independent of the locomotive address.  
Check the assignment of the outputs to the locomotive addresses. Possibly a group of locomotive addresses has been programmed to a regular assignment as well as to an inverted assignment. If you cannot find the fault in programming, perform a reset.
- Downstream loads are not switched as intended when particular locomotives are pulling into the track section.  
→ Check the assignment of the outputs to the locomotive addresses. If you cannot find the fault in programming, perform a reset.  
→ Check the switching times for the concerned outputs and alter them, if necessary.

**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.

## 11. 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.

## 12. 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.

## 13. Declarations conforming to the WEEE directive

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



DE 37847206

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

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

Information and tips:

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

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