

B-4

Booster for digital model railway layouts

Item numbers:

40-19407 | 40-19417 | 40-19427 | 40-19437

Manual



B-4 without display. Item numbers 40-19407 | 40-19427



B-4 with display. Item numbers 40-19417 | 40-19437

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Valid for all hardware and software versions of Booster B-4.

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Printing the manual

The formatting is optimised for double-sided printing. The standard page size is DIN A5. If you prefer a larger display, printing on DIN A4 is recommended.

**** The asterisks**

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

- Power-Splitter | Item numbers 40-20106, 40-20107

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1. Getting started

This manual will help you step by step to install and use your booster B-4 safely and properly. Before you start using the booster, read through this manual completely, 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 booster on to another person, please pass on the manual with it.

1.1. Contents of the package

- Booster B-4
 - Standard version without display (item number 40-19407),
 - Standard version with display (item number 40-19417),
 - LocoNet version without display (item number 40-19427) or
 - LocoNet version with display (item number 40-19437)
- 1 plug-in connection terminal 3-pole, RM 3.81
- 1 plug-in connection terminal 4-pole, RM 3.81
- 5 short-circuit jumpers

1.2. Accessories

Connection cables

Connection to the digital control unit :	Stranded wire*, recommended cross-section $\geq 0.25\text{ mm}^2$
Connection to the power supply:	Stranded wire*, recommended cross-section: 0.75 mm^2 to 1.5 mm^2 (depending on the current).
Connection to the tracks:	Stranded wire*, recommended cross-section: 0.75 mm^2 to 1.5 mm^2 (depending on the current)

* The use of stranded wire is recommended for making the connections. Stranded wires consist of several thin individual wires and are therefore more flexible than rigid wires with the same copper cross-section.

Power supply

You will need a transformer or a power supply unit to provide power to the booster and the booster circuit. Only use tested and approved transformers or power supplies. Please note the background information on the following page.

Distribution of the booster current

In order to utilise the current of 5 A that the B-4 can provide, even with smaller nominal sizes, a power splitter** can be used. The power splitter distributes the current, e.g. to two booster sections with 2 A each.

Background information: Selecting the power supply

Determining the required output voltage of the power supply (‘Transformer voltage’):		
Desired track voltage	Recommended transformer voltage	
	AC voltage	DC voltage
10 – 12 V	12 V	Desired track voltage + 2V
12 – 15 V	15 V	
15 – 18 V	16 V	
18 – 22 V	18 V	
22 – 24 V	20 V	

Determining the minimum power of the power supply
(‘Minimum transformer power’):

Desired track voltage [V] x Desired interrupting current [A]
= Minimum transformer power [VA]

Example: 18 V x 3 A = 54 VA



Please note:

Use a transformer or a power supply unit with an output voltage not much higher than the desired track voltage. The power that is generated must otherwise be dissipated by the booster as heat. If this power is too high, the booster overheats and switches off due to overheating.

1.3. Intended use

The booster B-4 is intended for use in digital model railway layouts as specified in the instructions. Any other use is not in accordance with the intended use and will result in the loss of the warranty claim. Intended use also includes reading, understanding and following all parts of the instructions. The booster is not intended to be used by children under the age of 14.

1.4. Safety instructions

Improper use and non-observance of the instructions can lead to incalculable hazards. Prevent these dangers by carrying out the following measures:

- Use the booster only in closed, clean and dry rooms. Avoid humidity and splash water in the environment. After condensation has formed, wait two hours for acclimatisation before use.
- Disconnect the booster from the power supply before carrying out wiring work.
- Only supply the booster with extra-low voltage as specified in the technical data. Use only tested and approved transformers or power supply units for this purpose.
- Only plug the mains plug of the transformer / power supply unit into properly installed and fused earthed sockets.
- Heating of the booster and the transformer / power supply unit during operation is normal and harmless. Keep a distance of at least 20 cm between the sides, the top and the back to surrounding surfaces to allow unhindered air exchange and to prevent the units from overheating.
- Do not expose the units to high ambient temperatures or direct sunlight. Observe the information on the maximum operating temperature in the technical data.
- Regularly check the operational safety of the units, e.g. for damage to the connection cables or damage to the housing.
- If you notice damage or if malfunctions occur, switch off the supply voltage immediately. Send in the booster for inspection.

1.5. Care

Do not use any cleaning agents to clean the booster. Only wipe the unit dry. Disconnect the unit from the power supply before cleaning.

2. Your B-4

Boosters have three main tasks:

- 1. Supply the current needed to operate the digitally controlled locomotives and turnouts, but also other (digital) consumers.
- 2. Bring the voltage to the track so that the digital driving and switching commands arrive at all vehicle and accessory decoders.
- 3. In case of a short circuit on the layout (e.g. derailment of a vehicle), ensure that the current is switched off and damage to the rails and the vehicles is prevented.

In RailCom-monitored layouts, the booster also provides the so-called RailCom cutout, which is required for the transmission of the feedback data.

2.1. Track voltage

The Booster B-4 can provide 2 to 5 A of current at the track output, depending on the setting. The maximum output current set for the booster is identical to the cut-off current, when reached, the layout is switched off for safety reasons (e.g. in case of a short circuit). The switch-off current must be lower the smaller the nominal size (and the more filigree rails or vehicle parts such as wheel sliders are).

→ Recommendations for the settings on page 26

Division of the booster current

In order to utilise the current of 5 A that the B-4 can provide, even with smaller nominal sizes, a power splitter** can be used. The power splitter distributes the current, e.g. to two booster sections with 2 A each.

Connecting additional boosters

If the current requirement is higher than the current provided by the B-4, a corresponding number of further boosters must be connected to supply the digital model railway layout.

→ Section 3. Conception of the digital layout

Background information: Rough calculation of the current requirement	
1 locomotive nominal size N:	600 mA
1 locomotive nominal size H0:	800 mA
1 locomotive nominal size 0:	1,000 mA
Carriage interior lighting:	50 - 200 mA
one other consumer (e.g. sound module):	100 - 300 mA
Reserve for turnouts	10 % of the determined total

2.2. Anzeigen und Bedienung

Front side B-4

- 1 LED
- 2 7-segment display
(only for item numbers
40-19417 and 40-19437)



LED

The LED on the front of the booster lights up or flashes to indicate operating states or problems that have occurred:

- Operational readiness
- Short circuit at the track output
- Booster switched off by a turnout command
- Booster switched off after the Watchdog has been triggered
- Booster switched off after exceeding the maximum permissible temperature
- Missing signal from the control unit
- Programming start

Display (7-segment display)

The booster B-4 has a two-digit 7-segment display in the versions with display, on which additional information is displayed:

- during operation: current power consumption in the booster circuit [A]
- after a short circuit: the remaining seconds until it is switched back on

In addition, the current CV settings of the booster can be read and shown on the display.

Switching on and off with a DCC turnout command

The track voltage at the output of the B-4 can be switched on and off via DCC turnout setting commands sent to an assigned turnout address.

Configuration

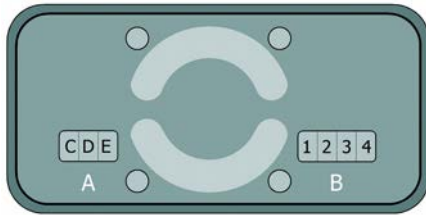
The B-4 booster can be adapted to individual requirements:

- via main track programming (POM) according to the RailCommunity standard RCN-226 ('DCC protocol | special values for configuration'), which, among other things, regulates the configuration of devices that do not have their own address and that cannot reasonably be connected to a programming track. For more information, see RailCommunity standard RCN-226 (at: www.railcommunity.org).
- or by setting short circuit plugs (jumpers) on the circuit board. Note: The setting options by setting jumpers are limited. This alternative should therefore only be used if the control unit used does not allow main track programming.

2.3. Interfaces of the B-4

Rear side B-4

- A Connections to the control unit and the following booster (DCC-compliant)
- B Connections to power supply and track



Power supply

The B-4 and the connected booster circuit are supplied with power via an AC transformer or a DC power supply. The output voltage of the power source must be selected according to the required track voltage and the required current.

→Background information: Selecting the power supply on page 6

Track connection

The B-4 provides a regulated, symmetrical track voltage that can be adjusted in 1 V steps to a value between 10 and 24 V. This makes it ideal for use with layouts of different nominal sizes. The track voltage is set to 18 V (standard versions) or 14 V (LocoNet versions) at delivery.

Setting the track voltage to a fixed value prevents the driving speeds of the locomotives and the brightness of the lighting from varying due to voltage fluctuations.

Background information: Output signal on page 11

Booster interface

The B-4 has a DCC-compliant booster interface (3-pole / 'CDE'): for connection to the DCC-compliant booster interface of a control unit or the track output of a control unit.

LocoNet socket

In the LocoNet version, the Booster B-4 has two LocoNet sockets (RJ12) connected in parallel. The values normally used by FREMO (Freundeskreis Europäischer Modellbahner – FREMO e. V.) are preset in the delivery state.

Background information: Output signal

Symmetrical output signal

The output signal is created by constantly reversing the polarity of the transformer voltage according to the specifications of the digital control signal from the central unit. Since the same voltage is always present at the output (alternately positive and negative), the output voltage at the booster output of the B-4 is 100 % symmetrical.

Use of the ABC braking method

This symmetrical output voltage is required for the use of the ABC braking method. The ABC braking method is based on the fact that, deviating from standard operation, asymmetrical voltages are generated at the two conductors in the braking sections.

Galvanic separation ↔ Continuous system ground

In digital layouts, the circuits supplying the tracks and the digital equipment can either be galvanically (i.e. electrically) separated from each other or connected to a common, continuous ground. Establishing a common, continuous ground is prone to errors in practice and therefore unreliable, especially in larger installations.

By using galvanically separated circuits, ground loops ('hum loops') and fault currents, which can cause malfunctions and in the worst case damage to the digital devices, can be reliably prevented.

The inputs and outputs of the B-4 are galvanically separated from each other by optocouplers. This means that there is no electrical connection between the digital control unit and the booster output.

Use with s88 feedback units

If a common system ground is required, e.g. when using the s88 feedback system, the ground connection of the s88 feedbacks must be connected to a rail. Just as with the use of ground-related boosters, it is also crucial with this variant that the ground connection is made to the 'correct' rail, i.e. always to the continuous rail.

2.4. Protocols

2.4.1. Digital formats

The Booster B-4 is multi-protocol capable, it can transmit data (via both the DCC compliant and LocoNet interfaces) in the following formats:

- DCC
- Motorola I and II
- m³ and mfx: The B-4 transmits control commands in m³ and mfx format, but no mfx feedback.

2.4.2. RailCom

RailCom cutout

The Booster B-4 can provide the so-called RailCom-Cutout, which enables the transmission of feedback data in RailCom-monitored sections.

When using the B-4 with central units that send a DCC signal and are not RailCom-capable, the RailCom-Cutout can lead to disturbances in the data transmission. Some older DCC vehicle decoders and some current DCC decoder types (especially from US manufacturers), which are not designed for use with RailCom, do not react correctly to run commands when RailCom cutout is switched on. With non-RailCom-capable DCC sound decoders, the sound reproduction can be disturbed.

Therefore, the B-4 offers the possibility to switch RailCom on or off (RailCom is switched on in the delivery state).

In the case of pure Motorola central units, interference with data transmission through the RailCom cutout is excluded due to the principle.

2.5. Safety devices

2.5.1. Short-circuit switch-off

Internal short-circuit switch-off

The Booster B-4 has an internal short-circuit switch-off, which automatically switches off the booster via an internal current limiter in the event of a short circuit at the track output. This prevents defects on the booster, the track and the vehicles.

The cut-off current in case of a short circuit (= maximum track current) can be set to a value between 2 and 5 A (in 1 A steps). In order to effectively prevent damage in the event of a short circuit, the cut-off current must not be set too high, especially for smaller nominal sizes.

→ Recommendations for the settings on page 26

Short-circuit feedback

How the digital control reacts when the maximum current at the track output of the booster is exceeded (e.g. a short circuit) depends on the connection of the booster:

- Connection of the short-circuit feedback line ('CDE') to a digital central unit via the DCC-compliant booster interface: The booster reports the exceeding of the maximum current to the control unit, which switches the complete layout to 'STOP'. This solution is useful for automated driving, for example.
- Connection to the track output of a central unit or omitting the connection of the short-circuit feedback line: If the maximum current is exceeded, the booster automatically switches off the track voltage for the connected booster circuit. Operation continues in further booster circuits. This solution is suitable for areas with independent operation, e.g. in the depot.

Automatic restart after a short circuit

If the digital control unit cannot receive a short-circuit feedback or is configured to ignore this message, the B-4 booster automatically switches the track signal back on at the output after a short circuit. The restart time after a short circuit can be set in 1-second increments to a value between 4 and 10 seconds. If the short circuit is still present, it switches the track signal off again immediately.

In the delivery state, the automatic switch-on is interrupted for one minute after the booster has switched itself on and off five times. This restart time after 5 short circuits can be individually set to an individual restart time between 0 and 90 seconds (adjustable in 10 sec. steps).

Short-circuit warning

The B-4 can send a short-circuit warning when a limit value below the set cut-off current is exceeded. This can be used as the basis for a PC-controlled booster management system. If there is a risk of a short circuit due to overloading, the PC control system can then switch off the carriage lighting in the overloaded booster circuit, for example.

The limit for the short-circuit warning can be set to a value that is 0 to 1.0 A lower than the set cut-off current. The short-circuit warning is sent in the form of a periodic switching on and off of the short-circuit signalling line at one-second intervals.

2.5.2. Switching off in case of overtemperature

In case of overheating, the booster automatically switches off the track voltage for safety reasons. Possible causes:

- Obstruction of the air flow through the ventilation slots on the top and back.
- Very high ambient temperature or direct sunlight in combination with high load.
- Significantly higher output voltage of the transformer / power supply than the set track voltage with simultaneous high current drain.

2.5.3. Watchdog function

The Watchdog is used in PC-controlled layouts to check whether the digital signals are transmitted in a booster circuit. For this purpose, the central unit (controlled by the PC software) sends a DCC turnout setting command to a turnout address assigned to the B-4 at intervals of max. 5 seconds. As soon as the B-4 no longer receives these commands, it automatically switches off the track voltage.

After switching on the B-4, the Watchdog function is initially inactive. It is activated by sending an adjustment command to the assigned turnout address. This makes it possible to control the layout without PC control without deactivating the Watchdog function.

3. Conception of the digital layout

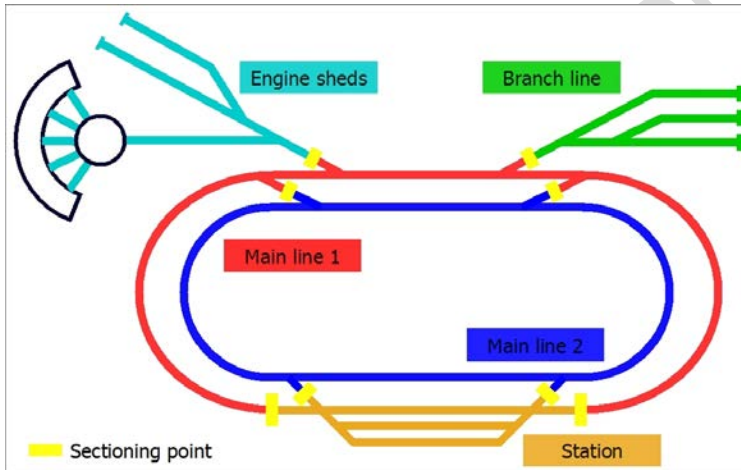
3.1. Dividing the layout

Divide your layout into individual, electrically separate sections (booster circuits), each supplied with its own booster. A maximum of three to five locomotives should run in each booster circuit at the same time. The following subdivisions are useful:

- station
- depot
- main line (if necessary in several sections)
- secondary line (if necessary in several sections)

Arrange the transitions between the booster circuits in such a way that

- they are crossed as little as possible
- in operation, never more than one crossing point between two booster circuits can be bridged by a (long) train (i.e. not two crossing points between three booster circuits).



Background information: Short circuit of the booster outputs

As soon as a vehicle bridges the separation point between two booster circuits, the track outputs of the two associated boosters are connected to each other. If this connection is only for a short time, the risk of this damaging the boosters is low. The situation is different if the vehicle stops at the separation point. If in this case the short-circuit disconnection does not react or reacts too late, the track outputs of the boosters can be damaged.

The risk of damage to the boosters increases significantly if a train is so long (or the separation points between several booster circuits are arranged so close together) that it connects more than two booster circuits and thus more than two boosters with each other when passing over them.

Cut the transitions between the booster circuits. Make sure that the sectioning points are permanently isolated!

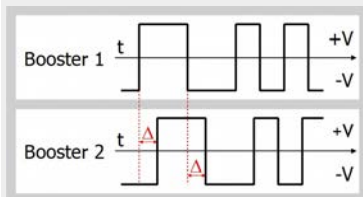
- For 2-conductor layouts: one rail. Make sure that you cut the same rail ('left' or 'right') in all booster circuits. In larger, unclear systems, it is recommended to cut both rails.
- In centre-conductor layouts: the centre conductor.

3.2. Supply with several boosters

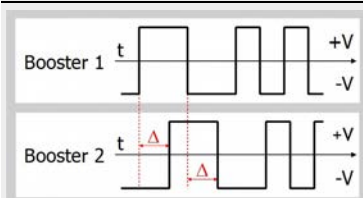
If possible, a layout should be supplied by identical boosters from the same manufacturer. If necessary, ask the manufacturer whether and, if so, which booster models can be combined with each other. Different booster models can be used on one layout if they are used for completely separate parts of the layout (e.g. standard gauge line and narrow gauge line) or separately for the tasks 'switching' and 'driving'.

If boosters are connected to a central unit or a small digital control unit via the track output, the integrated and external boosters should generally not be used together to supply the layout with traction current. The booster integrated in the central unit can be used sensibly for switching the accessory decoders in its own booster circuit.

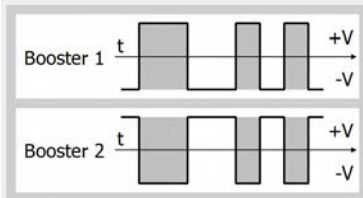
Background information: Track signals



The digital track signals that the boosters receive from the central unit need a certain amount of time to be processed and to get from the data input to the track output. This processing time is different for each booster due to its design. Even for boosters of the same design it differs due to component and manufacturing tolerances. A slight time shift of the voltage characteristics is therefore the normal state.



The more different the run-through time of the signals in the two boosters, the greater the time shift of the voltage curves. This can go so far that a positive voltage is already present at the output of one booster and a negative voltage is still present at the next booster, which is controlled by the same central unit.



If the two booster circuits are connected to the booster outputs with different polarity, opposite voltages will be present. If the isolating points between the booster circuits are bridged, the track voltage is twice the set maximum track voltage.

Equalising currents and double track voltage

When crossing the separation points, equalising currents occur between the (briefly differently polarised) booster circuits, even when using identical boosters from the same manufacturer. These currents are harmless for rails and vehicles and do not affect the operation.

The more different the voltage curve is in the two booster circuits, the higher the equalising currents are. High equalising currents can cause short circuits on boosters, rails, wheels and sliders.

In addition, the applied track voltage always doubles when opposite voltages are applied in the two booster circuits. The longer opposite voltages are present, the more serious the consequences.

The possible consequences of short circuits and doubled track voltages:

- damage to wheels, sliders and rails
- damage to the track outputs of the boosters involved

'Data salad'

Due to a shift in the voltage curves in the two booster circuits, the vehicle decoders receive information that differs from each other and may interpret it incorrectly. This can lead to the following phenomena, for example:

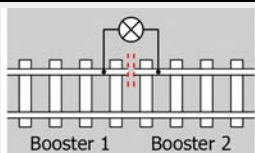
- Locomotive decoders understand the signal as an impulse to switch to analogue mode. However, since the locomotives are on the digital track, they race off at top speed.
- Locomotive decoders read out a run command for their address from the faulty data signal and set locomotives in motion as if by magic.
- Functions such as lighting or sound are switched on or off without the corresponding switching commands having been entered at the central unit.

The differences in the throughput time of the data are particularly large when the layout is jointly supplied with traction current by the booster integrated in the central unit and external boosters connected via the track output.

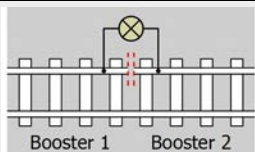
Tip: Detecting equalising currents

The question of whether or not dangerous equalising currents occur at a booster separation point can be detected relatively easily with the help of a model railway incandescent lamp connected to the rails or the centre conductors across the separation point.

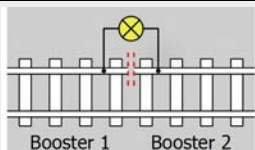
Note: For the test, use an incandescent lamp whose maximum voltage corresponds approximately to the set maximum track voltage. Suitable are e.g. bulbs with integrated cables or wire ends. LEDs are not suitable for this test!



Ideally, the lamp does not light up or only lights up very weakly. This case occurs when a power splitter** is used that distributes the output current of a booster to 2 or 3 booster sections or when using identical boosters from one manufacturer whose component and manufacturing tolerances are very small.

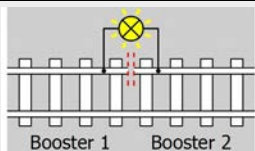


With well-matched, properly connected boosters, the lamp glows a little. When passing over the separation points, no damage to vehicles, tracks or boosters and no problems due to faulty data transmission are to be expected.



If the lamp glows visibly, it is not recommended to start operation. The two boosters should be checked in any case:

- Is the same output voltage set for both boosters?
- Is the RailCom gap switched on for the boosters? If yes, the test should be repeated with the RailCom switched off. If the lamp then only glows, operation with RailCom switched on can be started without hesitation.
- Boosters of different types / from different manufacturers may not fit together. It is advisable to check with the manufacturer.
- One of the two boosters is defective. A check by the manufacturer is recommended.

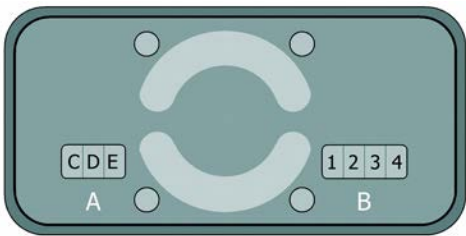


If the lamp lights up brightly, the start of operation can have fatal consequences for vehicles, tracks and the connected boosters! Either the two boosters are connected to the rail / centre conductor with different polarity or the two boosters do not fit together and should therefore not be used together.

4. Connections

**Avoid overheating the booster!**

Do not block the flow of air through the ventilation slits at the booster's top and back surface, otherwise the booster can overheat. **Risk of fire!** You should never cover the ventilation slits. When connecting the booster be sure to keep sufficient distance to other devices, walls, and the like.



Rear side of the B-4

A Connections to the control unit and following boosters		B Connections to the power supply and the tracks	
C	Data (+)	1	Power supply (Transformer / Power supply unit)
D	Earth / data (-)	2	
E	Short circuit feedback line	3	Outer conductor / Left rail
		4	Middle conductor / Right rail

Use the connector parts supplied (3- or 4-pole) for the connections. Insert the connection cables into the connector part, screw them tight and then insert the connector part into the socket on the rear of the booster so that the screws point upwards.

4.1. Connecting the power supply

Connect the transformer / power supply to the booster's transformer connection (pins 1 and 2 of connection B). The required voltage and the minimum power of the transformer / power supply depend on the desired track voltage and the desired cut-off current.

→Background information: Selecting the power supply on page 6

**Do not swap the connections for the power supply and rails!**

If you swap the connections for the rails and the power supply, the booster can be irreparably damaged when you switch it on.

4.2. Connecting the tracks

Connect the booster's track connection to the two rails (for 2-rail systems) or to one rail and the centre conductor (for 3-rail systems). T



Please note:

The resistances at the transitions between track sections are quite high. Therefore, the booster current must be fed into the track at short intervals (approx. 2 to 3 m) from a ring circuit. If the distances are too great, there may be problems with the power supply to the vehicles. In the worst case, the internal short-circuit cut-off and the short-circuit feedback will not work. **Fire hazard!**

Cable cross-sections

For the connection to the rails, use a cable with a cross-section sufficient for the load (recommended cross-section: > 0.75 to 1.5 mm^2).



Please note:

If the cross-section is too small, the overcurrent/short-circuit cut-off will not function reliably and the cable may become very warm. **Fire hazard!**

Assignment of the poles of the track connection to the rails

The assignment of the poles of the siding to the two rails (or the rail and the centre conductor) is initially arbitrary. However, this does not apply if you have already connected a booster to the layout. In this case you must ensure that all booster circuits have identical polarity!



Please note:

If the polarity of the two booster circuits is different, considerable disturbances in the data transmission and damage to the vehicles, rails and the track outputs of the boosters can occur when crossing the separation points!

4.3. Connecting the control unit

Use the 'CDE' booster connection (connections A) to connect the B-4 booster to the control unit:

- to the DCC-compliant booster connection of the control unit ('CDE') or
- if the control unit does not have a DCC booster output: to the track output of the control unit. In this case, only use connections C and D.

Make sure that the pin assignment of the booster interfaces of the control unit and the booster match.

Connecting the short-circuit feedback line ('E')

If you want the control unit to switch off the booster in the event of a short circuit, connect the short-circuit feedback (connection 'E'). If the short-circuit feedback line is not connected, the booster automatically switches off in the event of a short circuit and automatically switches back on after the set time.

4.4. Connecting an additional booster

In order to connect another booster connect an additional cable to each of the three connections 'CDE' (connections A) . Make sure that the pin assignment of the booster interfaces of both booster match.

Use identical boosters

If you are using a layout with several booster circuits, and the separation points are regularly passed over during operation, then use only boosters from the same manufacturer and of the same type to avoid problems such as:

- Interference in the data transmission to the decoders.
- Leakage currents that set locomotives in motion as if by magic when other locomotives pass over transitions between two booster sections.
- Short circuits when passing over the transitions between the booster sections.

→ Section 3.2. Supply with several boosters

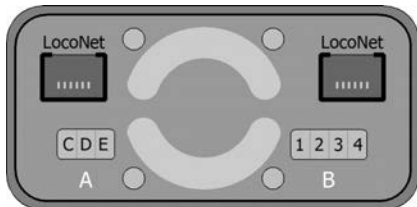


Tightly insulate the separation points!

Set up the separation points so that the booster circuits are permanently isolated from each other! Otherwise, short circuits may occur that can damage the track outputs of the boosters.

4.5. Connecting LocoNet devices

You can connect LocoNet devices (e.g. digital control unit, digital manual control units, additional boosters) according to your requirements to both LocoNet-connectors.



**Rear side of the B-4
Version "LocoNet"**



Caution:

You must not use connections A ('CDE') **and** a LocoNet socket for connecting digital control units at the same time. Doing so may damage the booster and the devices in question!

5. Settings / Configuration

The booster B-4 can be set to individual requirements by programming on main (POM) or by inserting short-circuit terminations (jumpers).

Function	Possible settings	Pre-settings		Settings with jumpers
		Default values	Version "LocoNet"	
Track voltage	10 – 24 V to be set in 1 V-steps	18 V	14 V	yes 16 – 22 V
Autostarting time after a short circuit	4 – 10 seconds to be set in 1 sec.-steps	4 sec.	4 sec.	4 sec. or 10 sec.
Max. track current (interrupting current after a short circuit)	2 – 5 A to be set in 1 A-steps	5 A	3 A	yes
RailCom	active or inactive	active	inactive	no
Switching off with a DCC turnout switching command	active or inactive / assignment of the turnout address	inactive	inactive	no
Watchdog	active or inactive / assignment of the turnout address	inactive	inactive	no
Limiting value for short circuit warning	0,2 – 1 A to be set in 0.2 A-steps	0 A inactive	0 A inactive	no
Autostarting time after 5 short circuits	10 – 100 sec.	60 sec.	0 sec.	no

5.1. Programming on main (POM)

The booster B-4 is set by programming on main (POM). This is possible only with control units supporting this programming mode.

In order to start programming the booster, input the value "62" for CV 7 of any DCC locomotive address. Proceed as described in the manual of your control unit. This input has no effect on a decoder with the chosen address, as locomotive decoders do not allow setting a value for CV 7 (= version).

After having started the programming mode (input the value "62" for CV 7), the LED flashes quickly with a yellow light. You can now alter the booster's settings by choosing CV 7 again and inputting a value from the following list.

If you do not input a value for CV 7 within 30 seconds, the programming mode will be switched off. After setting the value the programming mode is ended automatically. If you want to alter further settings, you have to start the programming mode again by inputting the value "62" for CV 7.

Function	Default value	Value for CV 7	Settings / Remarks
Reset		8	Reset. Sets the values back to the default values.
Track voltage (output value)	18 V	10	10 V
		11	11 V
		...	12 ... 23 V
		24	24 V
Autostarting time after a short circuit	4 seconds	34	4 seconds
		35	5 seconds
		...	6 ... 9 seconds
		40	10 seconds
Max. track current (interrupting current)	5 A	42	2 A
		43	3 A
		44	4 A
		45	5 A
RailCom → 2.4.2	active	51	active
		52	inactive

Function	Default value	Value for CV 7	Settings / Remarks
Switching off with a DCC turnout switching command	inactive	71	active
		72	inactive
		73	Change over into the progr. mode. When within 30 sec. a DCC turnout switching command is set, the B-4 takes over the corresponding points address to release the switching off function. Condition: Switching off function = "active".
Watchdog	inactive	74	active
		75	inactive
		76	Change over into the programming mode. When within 30 sec. a DCC turnout switching command is set, the B-4 takes over the corresponding turnout address to release the Watchdog function. Condition: Watchdog function = "active".
Limiting value for short circuit warning	0 A	81	0 A
		82	0.2 A
		83	0.4 A
		84	0.6 A
		85	0.8 A
		86	1.0 A
Autostarting time after 5 short circuits	60 seconds	100	0 seconds
		101	10 seconds
		102	20 seconds
		...	30 - 80 seconds
		109	90 seconds

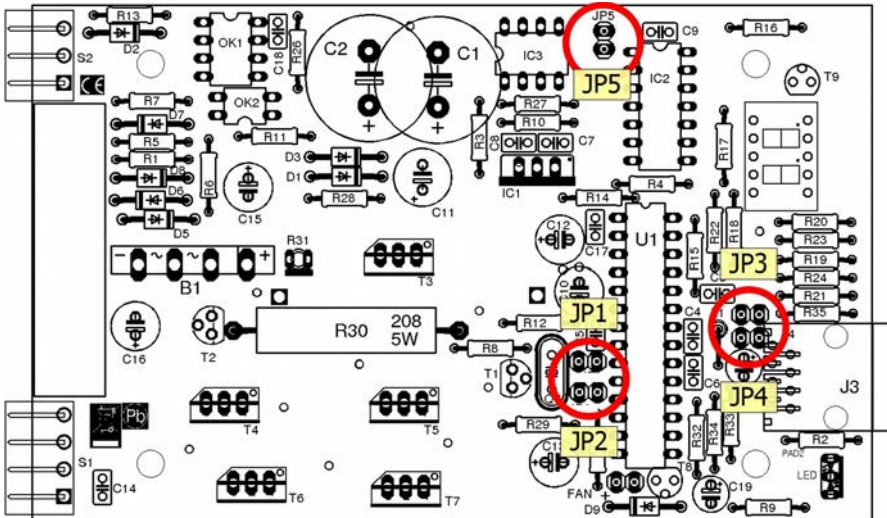
5.2. Setting the B-4 with jumpers

With control units not supporting programming on main (POM) the booster B-4 can be set by inserting short-circuit terminations (jumpers). Please note: It is not possible to set the whole range of values by inserting jumpers.

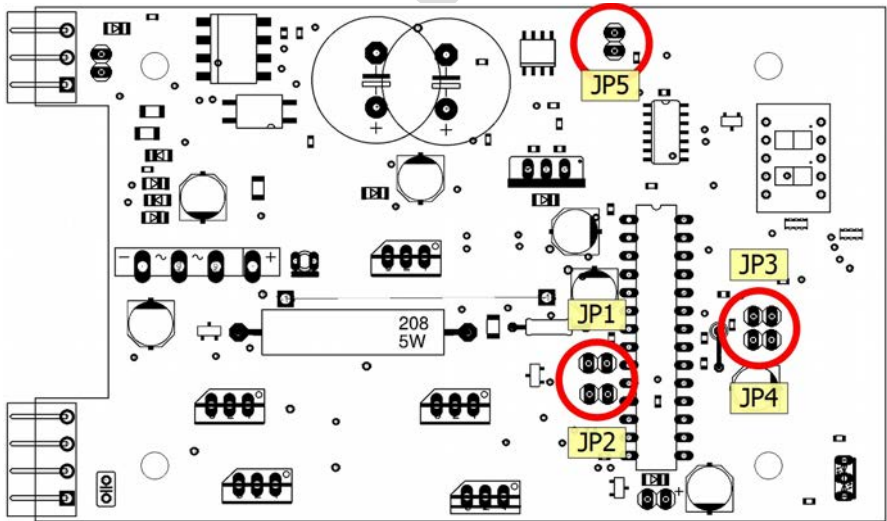
Before inserting the jumpers you have to open the booster's housing. In order to release the clips bolting the two red half shells of the housing, press in the housing on it's side above / underneath the ventilations slits. It is recommend to release the clips on one side first and then on the opposite side.

Set the jumpers on the PCB is shown in the figure. When no jumper is inserted the programmed values are set.

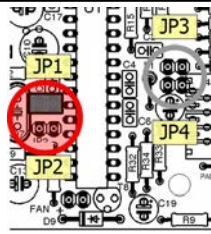
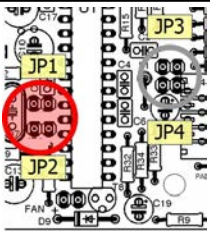
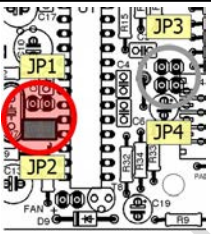
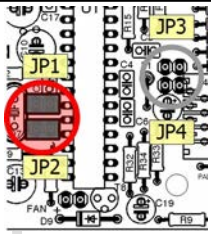
Assignment of the programming jumpers (THT version of the B-4)



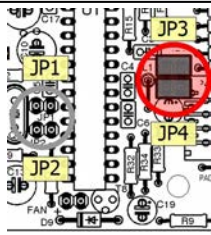
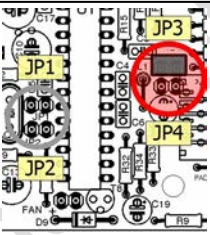
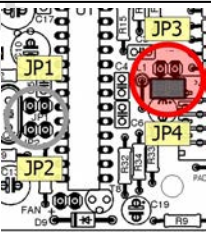
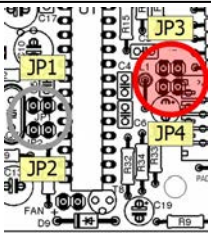
Assignment of the programming jumpers (SMD version of the B-4)



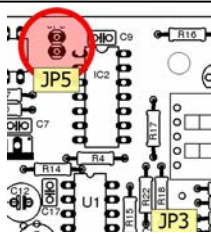
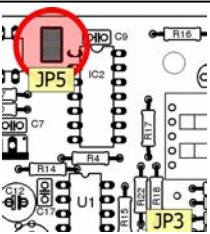
Setting the track voltage

16 V	18 V or the last programmed value	20 V	22 V
			
JP1 inserted JP2 open	JP1 open JP2 open	JP1 open JP2 inserted	JP1 inserted JP2 inserted

Setting the maximum track current (cut-off current)

2 A	3 A	4 A	5 A or the last programmed value
			
JP3 inserted JP4 inserted	JP3 inserted JP4 open	JP3 open JP4 inserted	JP3 open JP4 open

Setting the restart time after a short circuit

4 seconds or the last programmed value	10 seconds
	
JP5 open	JP5 inserted

Note:

To be able to place the jumper on JP5, you must first carefully bend the electrolytic capacitor upwards.

Recommendations for the settings

Track voltage

Locomotive motors are - depending on the nominal size - designed for operation with a certain track voltage. If they are driven with a track voltage significantly higher than the recommended one, the motors will be more heavily loaded and the carbons more worn, HF interference and brush fires will be increased.

Locomotive decoders are usually designed for a maximum track voltage of 24 V, some mini decoders only for a track voltage of 18 V. A slight exceeding of the maximum permissible voltage by 1 to 2 V usually does not cause damage to the locomotive decoder, but in any case leads to significant heating. In case of an unfavourable installation situation with poor heat dissipation, damage to the adjacent plastic parts of the locomotive can be the (undesirable) consequence.

Nominal size	Z	N and TT	H0	0, I and II
Recommended track voltage	10 - 12 V	14 V	18 V	20 - 24 V

Maximum track current (cut-off current in case of short circuit)

The idea of using the current of 5 A, which the Booster B-4 can provide, to supply large sections or even the complete layout is obvious. This solution, which at first glance appears to be cost-effective, promises minimised installation effort and avoids problems that can arise when crossing separation points between booster circuits. This idea has only one decisive catch: in order to be able to utilise the high output current of the booster, the cut-off current, when reached, the layout is switched off for safety reasons (e.g. in case of a short circuit) is also increased.

The smaller the nominal size (and the more filigree rails or vehicle parts such as wheel sliders are), the lower the cut-off current must be..

Nominal size	Z and N	TT and H0	0, I and II
Recommended maximum track current	2 A	3 A	≥ 4 A

Tip: Utilise the total booster current with smaller nominal sizes

With small nominal sizes, the current in the booster circuit is limited to 2 A in order to protect rails and vehicles from damage in the event of a short circuit. By using a power splitter**, the entire output current of the booster B-4 can be utilised even with smaller nominal sizes. The power splitter is connected between the booster's track output and the tracks and splits the booster's power into two sections with a maximum current of 2 A.

6. Operation

6.1. Display of operating states

6.1.1. LED display

The LED on the front of the booster lights up or flashes to indicate operating states or problems that have occurred.

LED			Meaning
	red	steady light	There is a short circuit at the track output.
	red	fast flashing	The booster has been switched off after exceeding the permissible maximum temperature.
	yellow	steady light	The booster is in operation.
	yellow	slow flashing (approx. 1-second cycle)	There is no signal from the control unit.
	yellow	fast flashing	Programming has been initiated.
	yellow	2 flashes...pause...2 flashes...	The booster has been switched off by a accessory decoder command.
	red	2 flashes...pause...2 flashes...	The Watchdog was triggered and the booster was switched off as a result.

6.1.2. Display

The booster B-4 in the versions with item numbers 40-19417 and 40-1943x (x = 1...7) has a two-digit 7-segment display. During operation, the following is displayed:

- the current power consumption in the booster circuit [A]
- after a short circuit: the remaining seconds until the circuit is switched back on

Im Display werden außerdem folgende Betriebszustände angezeigt:

Display	Meaning
--	The track voltage is switched off.
-- --	The booster was switched off by a turnout command.
-- --	The Watchdog was triggered and the booster was switched off as a result.

Display of current settings

The B-4 versions with display also have the option of reading out and displaying the booster's current settings. To read out the settings, enter the value '62' for CV 7 of any DCC locomotive address. To do this, proceed as described in the instructions for your control unit for the main track programming (POM) of locomotive decoders.

After you have selected CV 7 again and entered a value from the following table, the current setting is displayed.

Value for CV 7	Currently set value
91	Autostarting time after 5 short circuits [sec.]
92	Limiting value for short circuit warning [A]
93	Watchdog: "ON" = active, "OF" = inactive
94	Switching off command: "ON" = active, "OF" = inactive
95	Software release
96	Autostarting time after a short circuit [sec.]
97	Railcom. "ON" = active, "OF" = inactive
98	Track voltage [V]
99	Maximum track current (interrupting current) [A]

6.2. Activating the Watchdog

In the delivery state, the Watchdog is inactive and no turnout address is assigned to the Booster B-4 for switching the Watchdog on and off. To use the function, you must therefore

- activate the Watchdog function (value for CV 7 = 74) and
- assign the B-4 a turnout address for switching the Watchdog on and off.

→ Section 5.1. Programming on main (POM)

You can then switch the Watchdog on and off using a turnout setting command to the turnout address that you have assigned to the booster for this function.

- Turnout "straight": Watchdog active
- Turnout "diverging": Watchdog inactive

6.3. Switching the track voltage on and off

6.3.1. Switching on and off with turnout setting commands

In the delivery state, this function is inactive and no turnout address is assigned to the B-4 booster for switching the track voltage on and off. To use the function, you must therefore

- activate the function (value for CV 7 = 71) and
- assign a turnout address to the B-4 for switching the track voltage on and off.

→ Section 5.1. Programming on main (POM)

You can then switch the track voltage on and off via a turnout setting command to the turnout address that you have assigned to the booster for this function.

- turnout "straight": track voltage on
- turnout "diverging": track voltage off

6.3.2. Automatic switching off of the track voltage

The booster B-4 automatically switches off the track voltage at the output in the following cases to prevent damage to the booster, connected digital devices, vehicles and/or tracks:

Short circuit on the tracks

The internal short-circuit cut-off ensures that the track voltage at the track output is automatically switched off in the event of a short circuit on the tracks. The short circuit is indicated by the LED lighting up red continuously.

After a short circuit, the B-4 automatically switches back on after 4 to 10 seconds. If the short circuit is still present, it switches off immediately. In the delivery state, the automatic switch-on is interrupted for one minute after the booster has switched on and off five times.

You have the following setting options → Section 5.1. Programming on main (POM):

- Restart time after short circuit: 4... 10 seconds (input values for CV 7: 34... 40)
- Maximum track current (cut-off current): 2... 5 A (input values for CV 7: 42... 45)
To effectively prevent damage in the event of a short circuit, the short-circuit sensitivity must not be set too high (→ Recommendations for the settings)
- Reclosing time after 5 short circuits: 0... 90 seconds (input values for CV 7: 100... 109)

If the short circuit feedback line is connected, the B-4 sends a short circuit feedback message to the DCC control unit, which then switches off the track voltage at the booster output (and any other boosters) in the event of a short circuit.

Overheating of the booster ("overtemperatur")

The booster can overheat if it cannot dissipate the heat generated during operation to the environment. Therefore, maintain a distance of at least 20 cm between the sides, top and back to surrounding surfaces. Also, make sure that the booster is not exposed to very high ambient temperatures or direct sunlight.

The booster can also overheat if the output voltage of the power supply (transformer, power supply unit) is significantly higher than the track voltage set for the booster. In this case, the power that is generated must be dissipated by the booster as heat. If it is too high, the booster overheats and switches off due to overheating.

Triggering the Watchdog

When the Watchdog is activated, the control unit (usually controlled by PC software) sends a DCC turnout setting command to a turnout address assigned to the B-4 at intervals of about 5 seconds. As soon as the booster stops receiving these commands, it automatically switches off the track voltage.

6.4. Reset

To reset all CV settings to the factory settings (default values), you must perform a reset using main track programming (POM) (→ Section 5.1., input value for CV 7: 8).

Please note: After a reset, the 'LocoNet' version of the B-4 also sets the default values and not the LocoNet settings.

6.5. Driving operation

Make sure that locomotives or trains do not bridge separation points between two booster circuits for a long time. This would connect the outputs of the two associated boosters and the boosters could be damaged. A short circuit message does not usually occur in this situation.

7. Checklist for troubleshooting and error correction

The LED on the front indicates the operating status and the occurrence of problems.

→ Section 6.1.1. LED display

7.1. Excessive heat

 **Warning:** If you notice a strong heat development or if the booster has switched off the track voltage due to overtemperature, disconnect the B-4 from the supply voltage immediately. **Fire hazard!**

- Possible cause: Overheating of the booster due to obstruction of the air exchange, exposure to sunlight, use of an unsuitable power supply. The LED flashes quickly in red.
→ Disconnect the booster from the power supply and let it cool down. Eliminate these external influences.
- Possible cause: Power supply and track connections mixed up.
→ Check the connections and change them if necessary. It cannot be ruled out that the booster was damaged by the wrong connection. Send the B-4 in for testing.

7.2. Automatic shutdown

The voltage at the booster's track output is switched off, the LED flashes or glows red.

- Possible cause: The booster has switched off the voltage at the track output due to a short circuit or overtemperature. → Section 6.1.1. LED display

After a turnout command, the voltage at the track output of the booster is switched off.

- Possible cause: The turnout address in question has been assigned to the function "Switch off with DCC turnout command".
→ Avoid using the turnout address in question or assign another turnout address to the function.
- Possible cause: The turnout address in question has been assigned to the 'Watchdog' function, but no PC control with a corresponding function is used. In this case, the LED flashes red.
→ Switch the function inactive or avoid using the turnout address in question.

7.3. No short circuit switch-off

The control unit does not switch off in case of a short circuit although the short circuit feedback of the booster is connected.

- Possible cause: Connections C, D and E are connected to the booster and/or control unit interface in the wrong order.
→ Check the connections and change them if necessary.

7.4. Problems with the Watchdog Function

The Watchdog function is not active after switching on the booster, although a switch address has been assigned to it.

- Possible cause: The Watchdog function is only activated after switching on when the setting command "turnout straight ahead" has been sent for the assigned turnout address.

7.5. Technical Hotline

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

7.6. Repairs

You can send us a defective B-4 for inspection / repair (address on the last page). Please do not send us your return freight collect. In the event of a warranty or guarantee claim, we will reimburse you for the regular shipping costs.

Please enclose the following with your shipment

- proof of purchase as evidence of any warranty or guarantee claim
- a brief description of the defect
- the address to which we should return the product(s)
- your email address and/or a telephone number where we can reach you in case of queries.

Costs

The inspection of returned products is free of charge for you. In the event of a warranty or guarantee claim, the repair and return are also free of charge for you.

If there is no warranty or guarantee case, we will charge you the costs of the repair and the costs of the return. We charge a maximum of 50% of the new price for the repair according to our valid price list.

Carrying out the repair(s)

By sending in the product(s), you give us the order to inspect and repair it. We reserve the right to refuse the repair if it is technically impossible or uneconomical. In the event of a warranty or guarantee claim, you will then receive a replacement free of charge.

Cost estimates

Repairs for which we charge less than € 25.00 per item plus shipping costs will be carried out without further consultation with you. If the repair costs are higher, we will contact you and carry out the repair only after you have confirmed the repair order.

8. Technical data

Digital protocols

Data formats	Motorola-I and -II DCC (according to NMRA and RCN standard) m3 and mfx (limited to the control of mfx decoders)
Feedback format	RailCom (RailCom cutout can be switched off)

Interfaces

For the connection the digital central unit or further boosters	DCC-compliant ('CDE')
Track output	Main track

Electrical properties

Power supply	12 – 20 V AC voltage or 12 – 26 V DC voltage
Maximum output current	2.0 to 5.0 A adjustable in 1 A steps
Current consumption (without consumer)	max. 30 mA
Output voltage	10 to 24 volts digital voltage (regulated) adjustable in 1 V steps
Output signal	symmetrical
Power consumption	max. 120 watts

Protection

Protection class	IP 20 Meaning: Protected against solid foreign bodies with a diameter ≥ 12.5 mm and access with a finger. No protection against water.
Overload Short-circuit cut-off	100 ~ 110% of the rated output power Protection: Switching off the voltage at the track output
Overtemperature	Switching off the voltage at the track output

Environment

	For use in closed rooms Note: To allow unhindered air exchange and to protect the unit from overheating, a distance of at least 20 cm must be maintained between the side, top and rear surfaces and surrounding surfaces.
Ambient temperature during operation	0 ~ + 60 °C
Permissible relative humidity during operation	10 ~ 85% (non-condensing)
Ambient temperature during storage	- 10 ~ + 80 °C
Permissible relative humidity during storage	10 ~ 85% (non-condensing)

Other features

Dimensions (approx.)	95 x 135 x 45 mm
Weights (approx.) Standard version	Standard version (THT): without display (item no. 40-19407): 240 g with display (item no. 40-19417): 255 g Standard version (SMD): without display (item no. 40-19407): 249 g with display (item no. 40-19417): 264 g
Weights (approx.) LocoNet version	LocoNet version (THT): without display (item no. 40-19427): 240 g with display (item no. 40-19437): 243 g LocoNet version (SMD): without display (item no. 40-19427): 249 g with display (item no. 40-19437): 252 g

9. Warranty, EU conformity & WEEE

9.1. Guarantee bond

For this product we issue voluntarily a guarantee of 2 years from the date of purchase by the first customer, but in maximum 3 years after the end of series production. The first customer is the consumer first purchasing the product from us, a dealer or another natural or juristic person reselling or mounting the product on the basis of self-employment. The guarantee exists supplementary to the legal warranty of merchantability due to the consumer by the seller.

The warranty includes the free correction of faults which can be proved to be due to material failure or factory flaw. With kits we guarantee the completeness and quality of the components as well as the function of the parts according to the parameters in not mounted state. We guarantee the adherence to the technical specifications when the kit has been assembled and the ready-built circuit connected according to the manual and when start and mode of operation follow the instructions.

We retain the right to repair, make improvements, to deliver spares or to return the purchase price. Other claims are excluded. Claims for secondary damages or product liability consist only according to legal requirements.

Condition for this guarantee to be valid, is the adherence to the manual. In addition, the guarantee claim is excluded in the following cases:

- if arbitrary changes in the circuit are made,
- if repair attempts have failed with a ready-made module or device,
- if damaged by other persons,
- if damaged by faulty operation or by careless use or abuse.

9.2. EU Declaration of Conformity



This product fulfils the requirements of the following EU directives and therefore bears the CE marking.

2001/95/EU Product Safety Directive

2015/863/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)

2014/30/EU on electromagnetic compatibility (EMC Directive). Underlying standards:

DIN-EN 55014-1 and 55014-2: Electromagnetic compatibility - Requirements for household appliances, electric tools and similar electrical appliances. Part 1: Emitted interference, Part 2: Immunity to interference

To maintain electromagnetic compatibility during operation, observe the following measures:

Only connect the supply transformer to a professionally installed and fused earthed socket.

Do not make any changes to the original components and follow the instructions, connection and assembly diagrams in this manual exactly.

Only use original spare parts for repair work.

9.3. Declarations on the WEEE Directive

This product is subject to the requirements of the EU Directive 2012/19/EC on Waste Electrical and Electronic Equipment (WEEE), i.e. the manufacturer, distributor or seller of the product must contribute to the proper disposal and treatment of waste equipment in accordance with EU and national law. This obligation includes

- registration with the registering authorities ("registers") in the country where WEEE is distributed or sold
- the regular reporting of the amount of EEE sold
- the organisation or financing of collection, treatment, recycling and recovery of the products
- for distributors, the establishment of a take-back service where customers can return WEEE free of charge
- for producers, compliance with the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) Directive.



The "crossed-out wheeled bin" symbol means that you are legally obliged to recycle the marked equipment at the end of its life. The appliances must not be disposed of with (unsorted) household waste or packaging waste. Dispose of the appliances at special collection and return points, e.g. at recycling centres or at dealers who offer a corresponding take-back service.

tams elektronik

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Further Information and Tips:
<http://www.tams-online.de>

Warranty and Service:
tams elektronik GmbH

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