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■		
■		
■		
■	Deutsch	3
■	English	17
■	Français	31
■	Nederlands	45
■		
■		
■		
■	mit Stückliste 2016	
■	with parts list 2016	
■	avec nomenclature 2016	
■	met stuklijst 2016	
■		

## Table of contents

1. Getting started	18
2. Safety instructions	19
3. Safe and correct soldering	21
4. Operation overview	23
5. Technical specifications	23
6. Assembling the Booster-Link	24
7. Connecting the Booster-Link	28
8. Check list for troubleshooting	28
9. CE and Warranty	29
Parts list	I
Printed Circuit Board (PCB) layout (fig. 1)	II
Circuit diagram (fig. 2)	II
Connections diagram (fig. 3) and pin connections	III / IV

(Pages I to IV in the centre of this handbook are removeable.)

### The asterisks \*\*

This manual mentions the following company:

Gebr. MÄRKLIN\*\* & Cie. GmbH, Postfach 860, D-73008 Göppingen

**mfx**<sup>®</sup> RailCom<sup>®</sup> is the registered trademark of Gebr. MÄRKLIN\*\* & Cie. GmbH, Postfach 860, D-73008 Göppingen.

# 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 FAQ chapter. 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 Booster-Link is designed to be operated according to the instructions in this manual with a digital model railway controlled by an mfx<sup>®</sup> central unit. Any other use is inappropriate and invalidates any guarantees.

The kit and the module should not be assembled or fitted by children under the age of 14.

Reading, understanding and following the instructions in this manual are mandatory for the user.

### **Caution:**

The circuit 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, one ready-built module or one complete unit (ready-built module in a housing),
- one manual.

## Required materials

For assembling the kit you need:

- an electronic soldering iron (max. 30 Watt) with a fine tip,
- a soldering iron stand,
- a tip-cleaning sponge,
- a heat-resistant mat,
- a small side cutter and wire stripper,
- a pair of tweezers and long nose pliers,
- tin solder (0,5 mm. diameter),

In order to connect the module you need wire. Recommended diameters:  $\geq 0,14 \text{ mm}^2$  for the connections to the rails.

## 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,
- connecting the circuit to another voltage than specified,

- impermissibly high humidity,
- 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.

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. Keep the soldering tip clean so the heat of the soldering iron is applied to the solder point effectively.
- 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.
- Solder quickly: holding the iron on the joints longer than necessary can destroy components and can damage copper tracks or soldering eyes.

- Observe correct polarity orientation of semi-conductors, LEDs electrolytic capacitors and integrated circuits before soldering and ensure that the solder time does not exceed 5 seconds, otherwise components can be damaged.
- 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 PCB solder side with a side cutter.
- After placing the parts, please double check for correct polarity. Check the PCB tracks for solder bridges and short circuits created by accident. This would cause faulty operation or, in the worst case, damage. You can remove excess solder by putting a clean soldering tip on the spot. The solder will become liquid again and flow from the soldering spot to the soldering tip.



## 4. Operation overview

Standard boosters used in digital model railway layouts controlled by mfx<sup>®</sup>-central units (e.g. mobile station or central station of Maerklin\*\*), do not allow the transfer of the mfx<sup>®</sup>-feed back data across the isolation between the booster sections. For that reason vehicles that are in booster sections supplied by standard boosters cannot log in at the central unit.

The Booster-Link is used in combination with commercial standard boosters and transfers the mfx<sup>®</sup>-feed back data across the isolation between the booster sections. In layouts supplied by several boosters, you need one Booster-Link for each booster.

As usual in 3-rail systems the centre conductor has to be isolated between the booster sections when installing the Booster-Link. The outer conductors must not be isolated.

## 5. Technical specifications

Supply voltage	from the digital system
Current consumption	approx. 40 mA
Protected to	IP 00
Ambient temperature in use	0 - + 60 °C
Ambient temperature in storage	-10 - + 80 °C
Comparative humidity allowed	max. 85 %
Dimensions of the PCB	approx. 48 x 52 mm
Weight of the circuit	approx. 15,5 g

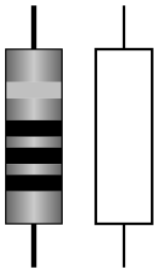
## 6. Assembling the Booster-Link

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 to prevent mistakes in assembling:

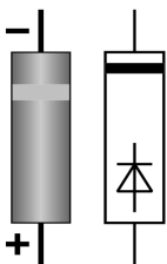
#### Resistors



Resistors reduce current. Their mounting orientation is of no importance. The value of resistors for smaller power ratings (under 5 W) is indicated through colour rings. Every colour stands for another figure. The colour ring in brackets indicates the tolerance of the resistor which here is of no importance.

Value	Colour rings
120 $\Omega$	brown - red - brown (gold)
470 $\Omega$	yellow - violet - brown (gold)
2,7 k $\Omega$	red - violet - red (gold)
3,3 k $\Omega$	orange - orange - red (gold)
47 k $\Omega$	yellow - violet - orange (gold)
330 k $\Omega$	orange - orange - yellow (gold)

#### 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.

Diodes must be mounted in a given direction. The negative end is marked with a ring. This is shown in the PCB layout.

## Zener diodes

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

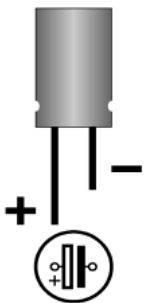
## Capacitors



Among other things capacitors are used for filtering interference voltages or as frequency determining parts. Ceramic capacitors are not polarized, for that reason their mounting orientation is of no importance. Normally they are marked with a three-digit number which indicates the value coded.

Value	Number
1 nF	102
100 nF	104

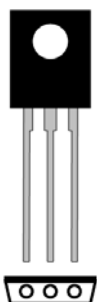
## Electrolytic capacitors



Electrolytic capacitors are often used to store energy. In contrast to ceramic capacitors they are polarized. One of the two leads is marked with a minus sign which indicates the mounting orientation. 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.

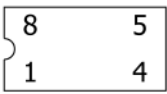
## Transistors



Transistors are current amplifiers which convert low signals into stronger ones. They have three contacts. As they are polarized, they have to be mounted in a certain direction.

The BD types have a flat housing (TO-housing) with the type designation printed on the front side. The metallic rear is unlabelled, on the PCB layout the rear is marked by a thick line.

## Integrated circuits (ICs)



Depending on the type, ICs fulfil various tasks. They are polarized and therefore have to be mounted in a certain direction. The most common housing form is the so-called "DIL"-housing, from which 4, 6, 8, 14, 16, 18 or more "legs" (pins) are arranged along the long sides. The mounting orientation is shown by a semicircular or circular marking at the end of the housing, which is also shown on the PCB layout.

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. The mounting orientation of the sockets is preset as well. The markings on the PCB, the socket and the IC must lie on top of each other after mounting.

### Micro-Controller

Micro-controllers are ICs, which are individually programmed for the particular application. When leaving the manufacturer, their memories are empty. The programmed controllers are normally only available from the circuit manufacturer.

### 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. When several terminal strips have to be mounted side by side, they have to be put together before mounting.

### Assembling the kit

Start the assembly with the resistors and the diodes. First solder the components on the solder side of the PCB and then cut the excess wires with the side cutter, as short as possible.

Next solder in the IC-socket. It has to be mounted according to the marking on the PCB.

Continue the assembly with the capacitors, the electrolytic capacitors and the transistor.

 **Caution:**

Diodes, ICs, electrolytic capacitors and transistors must be placed in the right direction! If you solder them the wrong way the affected parts can be damaged when you connect the power supply. In the worst case the whole circuit can be damaged. In any case, a wrongly connected part will not function.

Finally, solder in the terminal strip and insert the ICs into the soldered IC-socket.

 **Caution:**

Do not touch the ICs without first discharging yourself by touching a radiator or other grounded metal parts. Do not bend the "legs" of the ICs when inserting them into the sockets. Check that the markings on the PCB, the socket and the IC show to the same direction.

**Performing a visual check**

Perform a visual check after the assembly of the module and remove faults if necessary:

- Remove all loose parts, wire ends or drops of solder from the PCB. Remove all sharp wire ends.
- Check that solder contacts which are close to each other are not unintentionally connected to each other. Risk of short circuit!
- Check that all components are polarised correctly.

When you have remedied all faults, go on to the next part.

## 7. Connecting the Booster-Link

### Required number of Booster-Links

For each external booster supplying the mfx<sup>®</sup> layout you need one Booster-Link. In case one external booster supplies several booster sections one Booster-Link is sufficient.

### Performing the booster sectionings

Isolate the centre conductor at the sectioning between the booster sections (if not already done). Please note: The outer conductors must not be isolated.

### Connections

Make the connections according to the connections diagram (fig. 3) and the pin connections.

## 8. Check list for troubleshooting

- Parts are getting too hot and/or start to smoke.



**Switch off the digital system immediately !**

Possible cause: one or more components are soldered incorrectly.

→ In case you have mounted the module from a kit, perform a visual check (→ section 6.) and if necessary, remedy the faults. Otherwise send in the module for repair.

- The mfx<sup>®</sup> central unit does not display the feedback data of the decoders in those sections supplied by external boosters.

Possible Cause: One or several connections of the Booster-Link have been interrupted or mixed up. → Check the three Booster-Link's connections.

Possible Cause: The Booster-Link is damaged. → In case you have mounted the module from a kit, perform a visual check (→ section 6.) and if necessary, remedy the faults. Otherwise send in the module for repair.


Possible Cause: The decoder does not send the mfx<sup>®</sup> feed back data to the central unit. → Check the decoder by setting the vehicle on to a rail section supplied by the booster integrated into the mfx<sup>®</sup> central unit.

## Hotline

If problems with your module occur, our hotline is pleased to help you. (address on the cover page).

## 9. CE and Warranty

### Certification (CE)

 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.

## Declarations conforming to the WEEE directive



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

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

## Conditions of warranty

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.



## Stückliste - Partslist - Nomenclature - Stuklijst

Widerstände - Resistors - Résistances - Weerstanden	R5, R6	120 $\Omega$
	R2, R3, R7	470 $\Omega$
	R4, R9, R10	2,7 k $\Omega$
	R1	3,3 k $\Omega$
	R8	100 k $\Omega$
	R11	330 k $\Omega$
Dioden - Diodes - Diode´s	D1, D4, D5, D6, D7	1N400x (x=2..7)
Zenerdioden - Zener diodes Diodes Zener - Zenerdiode´s	D2, D3	ZD 15 V
Kondensatoren - Capacitors - Condensateurs - Condensatoren	C8, C9, C10, C11	1 nF
	C5	10 nF
	C1, C2, C6, C7	100 nF
Elkos - Electrolytic capacitors - Condens. électrolytiques - Elco´s	C3, C4	100 $\mu$ F
Transistoren - Transistors - Transistors - Transistors	Q1	BD 679
ICs - CI	IC4	TL072P
IC-Sockel - IC sockets - Supports de CI - IC voetjes	IC4	8-pol.
Anreihklemmen - Terminal strips - Borniers - Printkroonstenen	X-1	3-pol.

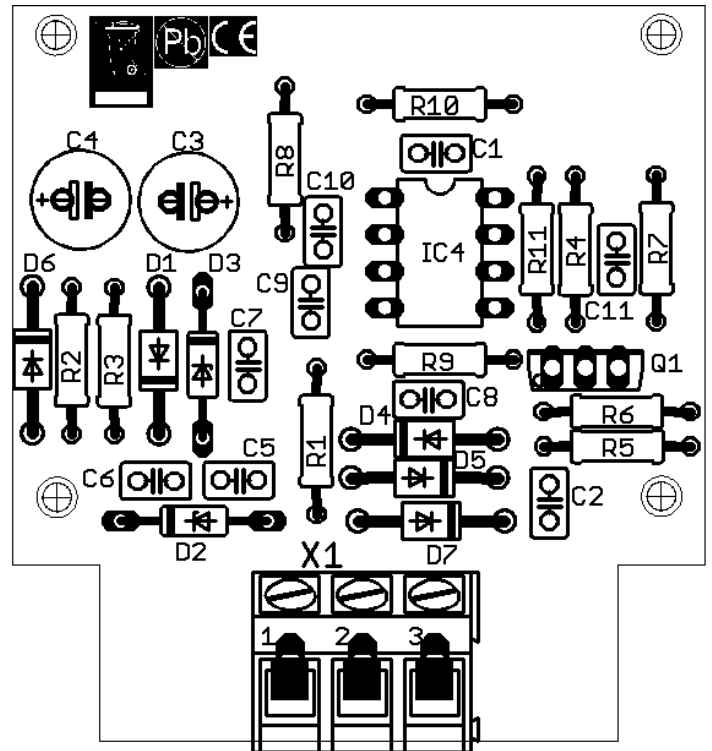
**Fig. 1:**

**Bestückungsplan**

**PCB layout**

**Plan d'implantation**

**Printplan**



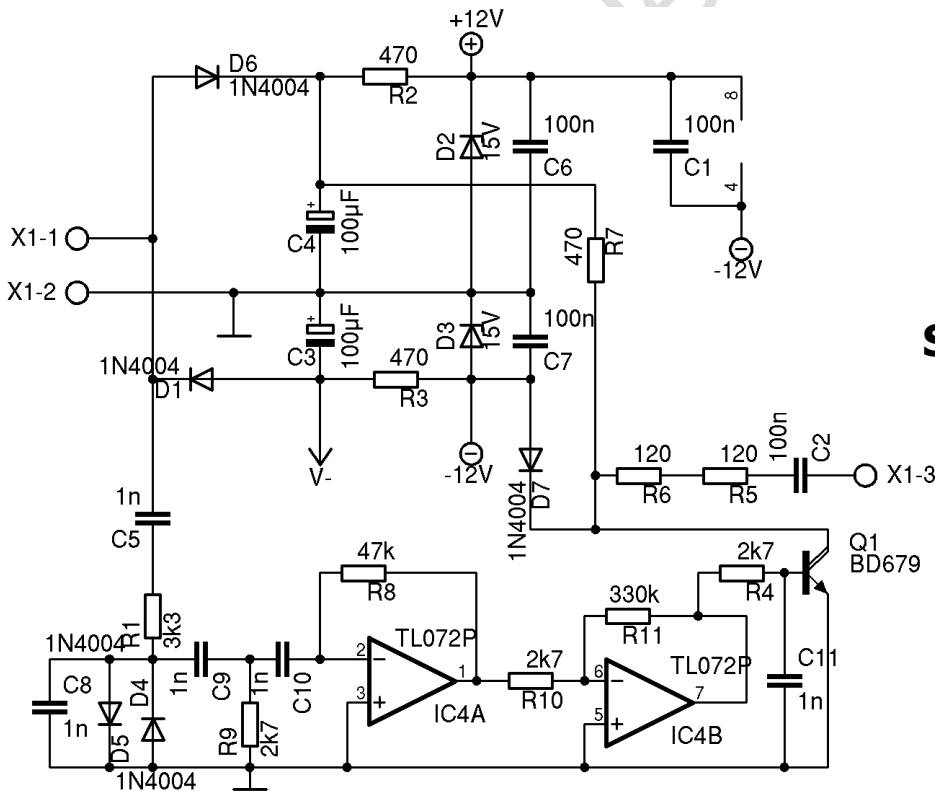
**Fig. 2:**

**Schaltplan**

**Circuit diagram**

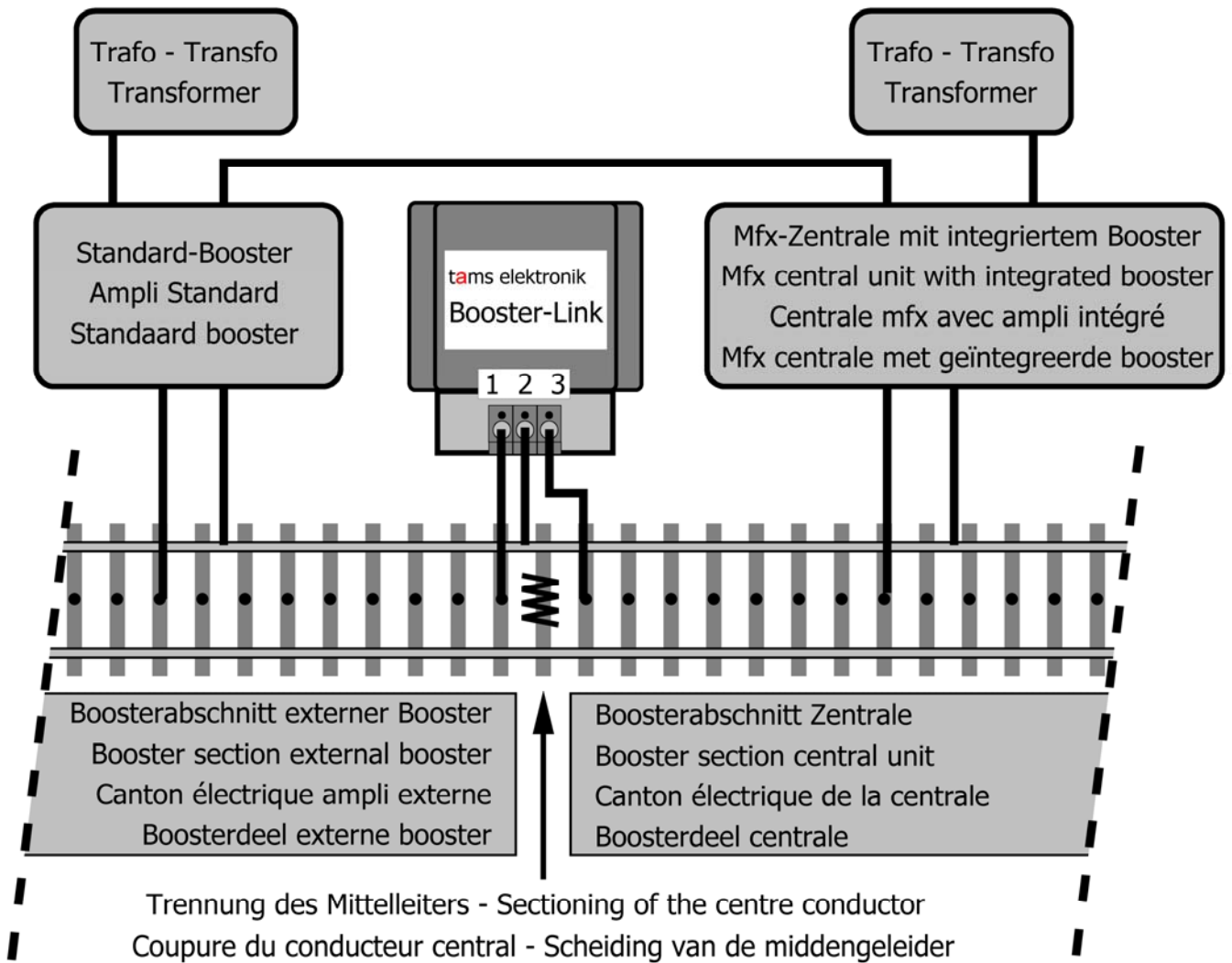
**Schéma de principe**

**Schakelschema**



**Fig. 3:**

**Anschlußplan - Connections - Raccordements - Aansluit plan**



**Anschlussbelegung:**

1	Mittelleiter im Boosterabschnitt des externen Standard-Boosters. Versorgt ein Booster mehrere Abschnitte, ist es ausreichend, wenn der Booster-Link mit dem Mittelleiter in einem der Abschnitte verbunden wird.
2	Außenleiter, an den auch die Booster zur Versorgung der Anlage angeschlossen sind.
3	Mittelleiter im Boosterabschnitt, der über den in der Zentrale integrierten Booster versorgt wird. Beachten Sie: Verbinden Sie diesen Anschluss nicht mit dem Mittelleiter eines Boosterabschnittes, der durch einen weiteren externen Booster versorgt wird. Eine sichere Datenübertragung ist dann nicht gewährleistet. Wenn der Booster, der in der Zentrale integriert ist, nicht zur Versorgung der Anlage eingesetzt wird, verbinden Sie den Anschluss direkt mit dem Boosterausgang der Zentrale (Mittelleiter).

**Pin connections:**

1	Centre conductor in the booster section supplied by the external standard booster. In case one external booster supplies several booster sections it is sufficient to connect the Booster-Link to the centre conductor in one of the sections.
2	Outer conductor used for the connection of all boosters supplying the layout.
3	Centre conductor in the booster section supplied by the booster integrated into the central unit. Please note: Do not connect this connection to the centre conductor in a booster section supplied by another external booster. A safe data transfer cannot be guaranteed in this case. In case the booster integrated into the central unit is not in use to supply the layout, connect the connection directly to the booster output of the central unit (centre conductor).

**Connexions:**

1	Conducteur central du canton électrique alimenté par l'ampli standard externe. Si un ampli alimente plusieurs cantons, il suffit de connecter le Booster-Link au conducteur central de l'un des cantons.
2	Conducteur extérieur auquel sont connectés tous les amplis du réseau.
3	Conducteur central du canton électrique alimenté par l'ampli intégré de la centrale. Attention : ne reliez pas cette borne au conducteur central d'un canton alimenté par un autre ampli externe, la transmission des données en serait affectée. Si l'ampli de la centrale n'est pas utilisé pour alimenter la voie, reliez cette borne directement à la sortie (conducteur centrale) de l'ampli de la centrale.

**Aansluitingen:**

1	Middengeleider in boosterdeel van de externe standaard booster. Versterkt de booster meerdere delen, dan is het voldoende wanneer de booster link wordt verbonden met de middengeleider van één van de delen.
2	Buitenste geleiders, waaraan ook de boosters voor de versterking van de modelspoorweg zijn aangesloten.
3	Middengeleider in het boosterdeel, dat via de in de centrale geïntegreerde booster wordt versterkt. Let op: verbind deze aansluiting niet met de middengeleider van een boosterdeel, dat door andere boosters wordt versterkt. Een goede dataoverdracht is in dit geval niet gegarandeerd. Wanneer de booster, die in de centrale is geïntegreerd, niet voor de versterking van de modelspoorweg wordt gebruikt, verbindt u de aansluitingen direct met de boosteruitgang van de centrale (middengeleider).

Aktuelle Informationen und Tipps:  
Information and tips:  
Informations et conseils:  
Actuele informatie en tips:

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

Garantie und Service:  
Warranty and service:  
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