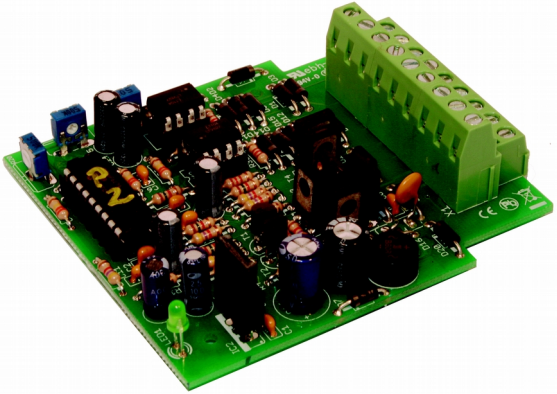
Manual

PZS-2

Item no. 51-02025 | 51-02026 | 51-02027



Shuttle-train control
for analogue d.c. model railway layouts

tams elektronik

Table of contents

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 shuttle-train control PZS-2 is designed to be operated according to the instructions in this manual in model building, especially with model railways. Any other use is inappropriate and invalidates any guarantees.

The PZS-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 PZS-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 (→ page 20) and one PCB or
- one ready-built module or
- one ready-built module in a housing (complete unit),
- a CD (containing the manual and further information).

Required materials

For assembling the kit you need:

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

For testing the module you need an electric light bulb.

In order to connect the module you need wire. Recommended diameters: $\geq$ 0.25 mm² for all connections.

It is recommended to connect two push-buttons when programming the module (e.g. push-buttons item no. 85-5212x, x=1,2,3,6,7).

When connecting points at terminus station 2, you need for switching the points:

- a bistable relay 12 V (e.g. item no. 84-61111) or
- a relay print RL-2 (e.g. 72-00055 as a kit or 72-00056 as a ready-built module).

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

2. Safety instructions

Mechanical hazards

Cut wires can have sharp ends and can cause serious injuries. Watch out for sharp edges when you pick up the PCB.

Visibly damaged parts can cause unpredictable danger. Do not use damaged parts: recycle and replace them with new ones.

Electrical hazards

- Touching powered, live components,
- touching conducting components which are live due to malfunction,
- short circuits and connecting the circuit to another voltage than specified,
- impermissibly high humidity and condensation build up

can cause serious injury due to electrical shock. Take the following precautions to prevent this danger:

- Never perform wiring on a powered module.
- Assembling and mounting the kit should only be done in closed, clean, dry rooms. Beware of humidity.
- Only use low power for this module as described in this manual and only use certified transformers.
- Connect transformers and soldering irons only in approved mains sockets installed by an authorised electrician.
- Observe cable diameter requirements.
- After condensation build up, allow a minimum of 2 hours for dispersion.
- Use only original spare parts if you have to repair the kit or the ready-built module.

Fire risk

Touching flammable material with a hot soldering iron can cause fire, which can result in injury or death through burns or suffocation. Connect your soldering iron or soldering station only when actually needed. Always keep the soldering iron away from inflammable materials. Use a suitable soldering iron stand. Never leave a hot soldering iron or station unattended.

Thermal danger

A hot soldering iron or liquid solder accidentally touching your skin can cause skin burns. As a precaution:

- use a heat-resistant mat during soldering,
- always put the hot soldering iron in the soldering iron stand,
- point the soldering iron tip carefully when soldering, and
- remove liquid solder with a thick wet rag or wet sponge from the soldering tip.

Dangerous environments

A working area that is too small or cramped is unsuitable and can cause accidents, fires and injury. Prevent this by working in a clean, dry room with enough freedom of movement.

Other dangers

Children can cause any of the accidents mentioned above because they are inattentive and not responsible enough. Children under the age of 14 should not be allowed to work with this kit or the ready-built module.

Caution:

Little children can swallow small components with sharp edges, with fatal results! Do not allow components to reach small children.

In schools, training centres, clubs and workshops, assembly must be supervised by qualified personnel.

In industrial institutions, health and safety regulations applying to electronic work must be adhered to.

3. Safe and correct soldering

⚠ Caution:
Incorrect soldering can cause dangers through fires and heat. Avoid these dangers by reading and following the directions given in the chapter **Safety instructions**.

- Use a small soldering iron with max. 30 Watt or a regulated soldering iron.
- Only use electronic tin solder with flux.
- When soldering electronic circuits never use soldering-water or soldering grease. They contain acids that can corrode components and copper tracks.
- Insert the component connecting pins into the PCB´s holes as far as possible without force. The components should be close to the PCB`s surface.
- Observe correct polarity orientation of the parts before soldering.
- Solder quickly: holding the iron on the joints longer than necessary can destroy components and can damage copper tracks or soldering eyes.
- Apply the soldering tip to the soldering spot in such a way that the part and the soldering eye are heated at the same time. Simultaneously add solder (not too much). As soon as the solder becomes liquid take it away. Hold the soldering tip at the spot for a few seconds so that the solder flows into the joint, then remove the soldering iron.
- Do not move the component for about 5 seconds after soldering.

- To make a good soldering joint you must use a clean and unoxidised soldering tip. Clean the soldering tip with a damp piece of cloth, a damp sponge or a piece of silicon cloth.
- Cut the wires after soldering directly above the soldering joint with a side cutter.
- After placing the parts, please double check for correct polarity. Check the PCB tracks for solder bridges and short circuits created by accident. This would cause faulty operation or, in the worst case, damage. You can remove excess solder by putting a clean soldering tip on the spot. The solder will become liquid again and flow from the soldering spot to the soldering tip.

4. Operation overview

Traffic between two terminus stations

The module controls the shuttle-train traffic between two terminus stations of an analogue d.c. model railway layout. At the second terminus station points can be connected. This allows the alternating traffic of two trains on the shuttle-train section. One additional stop can be added in each direction of traffic between the terminus stations.

The shuttle-train traffic runs automatically. The trains are slowed down before reaching the terminus sections or the two stops as soon as a track busy indicator integrated into the module indicates the train coming into the respective section. The further course (braking, halting and accelerating) is time controlled.

Extra halts

Independent of the automatically running shuttle-train traffic between the terminus sections (and the two stops), extra halts can be incorporated with external circuits at any time and place.

Settings for the automatic operation

The traffic

- between the terminus stations
- between the terminus stations and the stops
- between the terminus stations, the stops and/or the extra halts

always runs in four phases: acceleration, normal speed, braking and halt. The length of the phases acceleration, braking and halt can be programmed

- individually for each of the two terminus stations
- individually for each of the two stops
- jointly for all extra halts.

The length of the phases is adjusted at a trimmer, the settings are saved in an IC.

Manual operation

The halt at the terminus stations, the stops and the extra halts can be prolonged by connecting the corresponding input of the module to earth. Then the train stops at the next station, stop or halt as long as the input is connected to earth (at least so long as programmed for the particular halt). This allows intervention in the automatic shuttle-train traffic via a switch or an external extra circuit.

The already mentioned extra halts are released as soon as the corresponding input of the module is connected to earth. This can be done at any time, regardless in which position of the shuttle-train section the train is. There are a whole range of applications for this, e.g.:

- effectuating extra halts along the shuttle-train section or
- effectuating of signal stops or
- triggering exact halts at defined positions (e.g. at the end of a platform).

To trigger additional halts, several external circuits can be used, e.g. manually released swiches, couplings with reed contacts or light barriers or complex signal control circuits.

Overcurrent protection

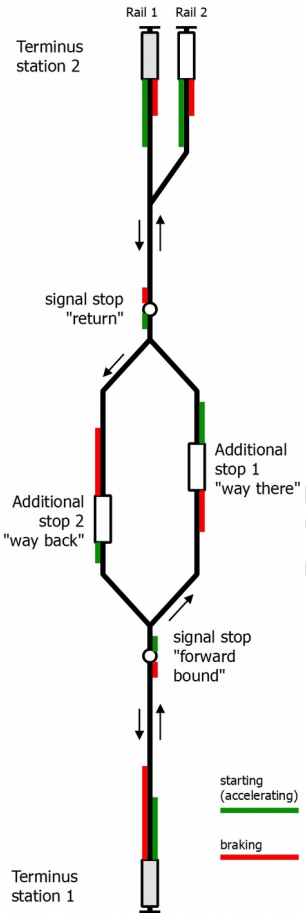
A fuse integrated in the PZS-2 interrupts the current circuit with overload or when a short circuit occurs on the rails and thus protects the module from damage. The fuse is designed as a self-closing fuse which heats with overload and re-activates the module automatically after cooling.

Power supply

The module has to be supplied via a transformer not in use as driving transformer. Note: Driving transformers providing an additional output for further accessories are not suitable to supply both rails and module, as they internally contain only one transformer. Note: It is possible to supply the module via a transformer used to supply other accessories as the rails (e.g. lighting).

When connecting the module to a transformer in use as driving transformer, short circuits occur within the PZS-2 which may damage it irreparably. The integrated fuse is without effect on these short circuits.

The seperate supply of module and rails has the advantage that the driving voltage can be set individually. E.g. the maximum driving voltage for the shuttle-train traffic (and the maximum speed with full speed) can be (pre-) set individually.



Example for a shuttle-train traffic controlled by a PZS-2

In order to use the PZS-2 it is sufficient to connect the two terminus stations. All other extensions are optional.

By connecting a second rail at terminus station 2 it is possible to run two trains alternatingly. In order to switch between the two rails an extra bistable relay (not included in the package) has to be mounted.

The additional stops 1 (outward bound) and 2 (return) are independent of each other. This allows a different routeing for outward and return journey (which is not obligatory).

Extra halts (e.g. at signals or further stops) can be mounted at any point of the route. To release the stop you need a switch or another external circuit switching against earth.

5. Technical specifications

Caution:
The PZS-2 must not be supplied via a transformer in use as a driving transformer! Further information see chapter 4. section "power supply".

Supply voltage for the module	12 - 18 Volt d.c. or a.c. voltage
Supply voltage for the shuttle-train section	d.c. driving transformer
Current consumption of the module	approx. 30 mA
Max. current for the rails	1.000 mA
Predected to	IP 00
Ambient temperature in use	0 ... +60 °C
Ambient temperature in storage	-10 ... +80 °C
Comparative humidity allowed	max. 85 %
Dimensions of the PCB Dimensions including housing	approx. 72 x 82 mm approx. 100 x 90 x 35 mm
Weight of the assembled board Weight including housing	approx. 60 g approx. 108 g

6. Assembling the kit

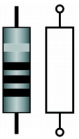
You can skip this part if you have purchased a ready-built module or device.

Preparation

Put the sorted components in front of you on your workbench.

The separate electronic components have the following special features you should take into account in assembling:

Resistors

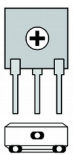


Resistors reduce current.

The value of resistors for smaller power ratings is indicated through colour rings. Every colour stands for another figure. Carbon film resistors have 4 colour rings. The 4th ring (given in brackets here) indicates the tolerance of the resistor (gold = 5 %).

Value:	Colour rings:
120 Ω	brown - red - brown (gold)
1,5 kΩ	brown - green - red (gold)
4,7 kΩ	yellow - violet - red (gold)
330 kΩ	orange - orange - yellow (gold)

Trimm-potentiometers



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

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

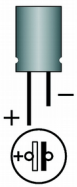
Ceramic capacitors

Among other things ceramic capacitors are used for filtering interference voltages or as frequency determining parts. Ceramic capacitors are not polarized.

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

The number 104 corresponds to the value 100 nF.

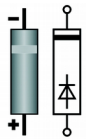
Electrolytic capacitors



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

Electrolytic capacitors are available with different voltage sustaining capabilities. Using an electrolytic capacitor with a voltage sustaining capability higher than required is always possible.

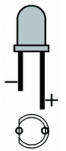
Diodes



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

The diode type is printed on the package.

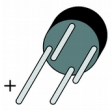
Light emitting diodes (LEDs)



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

Light emitting diodes should always be connected via a series resistor which limits the current and prevents failure. With circuits designed for the connection of LEDs the series resistors are often integrated on the circuit board.

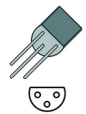
Rectifiers



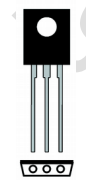
Rectifiers convert alternating into direct voltage. They have four pins: two for the input voltage (a.c. voltage) and two for the output voltage (d.c. voltage). The pins for the output voltage are polarized.

Transistors

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

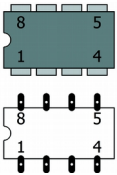


Transistors for a low power rating (e.g. BC types) have a package in form of a half zylinder (SOT-package). Transistors for a high power rating (e.g. BD types) have a flat package (TO-package), which is in use in different versions and sizes.



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).

Integrated circuits (ICs)



Depending on the type, ICs fulfil various tasks. The most common housing form is the so-called "DIL"-housing, from which 4, 6, 8, 14, 16, 18 or more "legs" (pins) are arranged along the long sides.

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

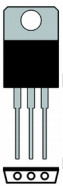
Microcontrollers

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

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 e.g. voltage regulators in flat TO packages.

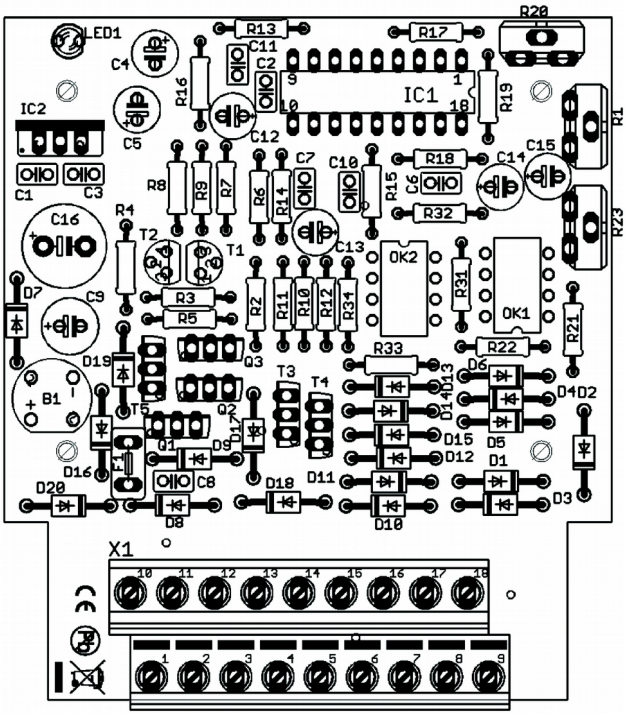
Fuses

Fuses interrupt a current circuit, when the current exceeds a certain strength of current for a set time. In this way they protect the circuit from damage due to overheating, resulting from an excess current flowing for a longer period. Excess current can be caused by overload or a short circuit.

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.

PCB layout and parts list



Resistors	R21, R22, R33, R34	120 Ω
	R3, R7, R12, R14, R15, R16	1,5 kΩ
	R2, R4, R5, R6, R8, R9, R10, R11, R13	4,7 kΩ
	R17, R18, R19, R31, R32	330 kΩ
Trimm-pots	R1, R29, R30	470 kΩ
Diodes	D1- D20	1N400x, x=2...7
LEDs	LED1	LED 3 mm
Rectifiers	B1	B80C800
Ceramic Capacitors	C1, C2, C3, C6, C7, C8, C10, C11	100 nF
Electrolytic capacitors	C12, C13, C14, C15	2,2 µF/25 V
	C4, C5	100 µF/25 V
	C9	220 µF/25 V
	C16	470 µF/25 V
Transistors	T1, T2	BC547
	Q3, T3, T4, T5	BD679
	Q1, Q2	BD680
ICs	IC1	PIC 16F627 A-I/P
Opto couplers	OK1, OK2	PC827
IC sockets	IC1	18-pol.
	OK1, OK2	8-pol.
Voltage regulators	IC2	7805
Fuses	F1	1 A
Terminal strips	X1	2 x 9 poles

Assembly

Proceed according to the order given in the list below. First solder the components on the solder side of the PCB and then cut the excess wires with the side cutter. Follow the instructions on soldering in section 3.

Caution:

Several components have to be mounted according to their polarity. When soldering these components the wrong way round, they can be damaged when you connect the power. In the worst case the whole circuit can be damaged. At the best, a wrongly connected part will not function.

1.	Resistors	Mounting orientation of no importance.
2.	Diodes	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.	IC sockets	Mount the sockets that way, the markings on the sockets show in the same direction as the markings on the PCB board.
5.	Fuse	Mounting orientation of no importance.
6.	Transistors	Observe the polarity! The cross section of transistors for a low power rating in SOT-packages is shown in the PCB layout. With transistors for a high power rating in TO packages (e.g. BD types) the unlabelled back side is marked in the PCB layout by a thick line.

7.	Rectifier	Observe the polarity! The pin connections are printed on the housing. The longer connecting pin is the positive pole.
8.	Electrolytic capacitors	Observe the polarity! One of the two leads (the shorter one) is marked with a minus sign.
9.	Voltage regulator	Observe the polarity! The cross section of voltage regulators in SOT-packages is shown in the PCB layout. With voltage regulators in TO-packages the unlabelled back side is marked in the PCB layout by a thick line.
10.	Trimm-potentiometers	The mounting orientation is preset by the layout of the three pins.
11.	Light emitting diode (LED)	Observe the polarity! With wired LEDs the longer lead is always the anode (positive pole).
12.	Terminal strips	Put together the terminal strips before mounting them.
13.	ICs and optocouplers in DIL-housing	Insert the ICs into the soldered socket. Do not touch the ICs without first discharging yourself by touching a radiator or other grounded metal parts. Do not bend the "legs" when inserting them into the sockets. Check that the markings on the PCB, the socket and the IC show to the same direction.

Performing a visual check

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

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

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

7. Functional test

It is recommended to test the basic functioning of the module before installing it into the layout.

- Connect a bulb to the connections 5 and 6 of the PZS-2.
- Connect the driving transformer to the module, namely
  the driving transformer´s earth connection to the connection 3 of the PZS-2 and
  the driving transformer´s "+" to the connection 11 of the PZS-2.
- Turn on the controller of the driving transformer.
- Connect the power supply for the shuttle-train control to the connections 1 and 10 of the PZS-2 and switch it on.

⚠ Do **not** use the driving transformer for supplying the PZS-2.

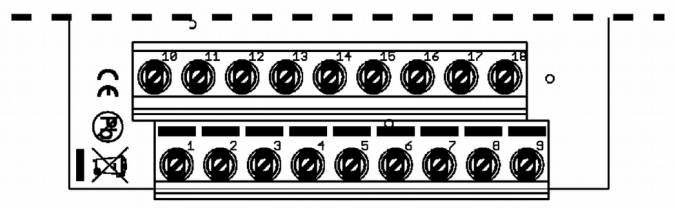
The lamps should start to light up slowly. With it, the functional test is completed. In case the lamp does not light up, check the connections.

⚠ **Caution:**

If a component gets too hot, disconnect the module from the power supply mmediately. Possible short circuit! Check the assembly!

8. Connecting the PZS-2

8.1. Schema



1	Supplying transformer PZS-2	10	Supplying transformer PZS-2
2	Points, return line	11	Driving transformer "+"
3	Driving transformer "⊥"	12	Switching input "extra halt(s)"
4	Earth for switching and programming inputs	13	Switching input "prolonging the halting time"
5	Terminus station 2	14	Programming input "save"
6	Terminus station 1	15	Programming input "select"
7	Points, switching contact 1	16	Stop 1 and 2
8	Points, switching contact 2	17	Stop 1 and 2
9	Terminus station 1	18	Terminus station 2

8.2. Dividing the shuttle-train section into parts

The halts at the terminus stations and the two stops are initiated when the train has come into the respective section and the accessory track busy indicator has indicated the train coming in. The division of the shuttle-train section should be done as follows:

- At least into the parts: terminus station 1 and terminus station 2.
- If neccessary into the additional parts: stop 1 and / or stop 2.

In order to define a new part you should cut the rail at that point where the coming-in train has to start braking. For the stop 1 and the terminus station 2 is the direction of travel "way there" and for the stop 2 and the terminus station 2 the direction of travel "way back" relevant.

Please regard the drawings in section 8.3 or 8.4.

- Layouts according to NEM 631 (= standard). The right rail in direction of travel is positive. → section 8.3
- Layouts not according to NEM 631 (= exception, e.g. LGB). The left rail in direction of travel is positive. → section 8.4

Caution:
Dismount anti-interference capacitors possibly mounted to the rails of the shuttle-train section. They can disturb the operation massively.

8.3. Connecting the shuttle-train (standard)

→ Layouts according to NEM 631

You must make at least the following connections (marked grey in the list):

- Supplying transformer for the PZS-2 (→ section 8.5)
- Driving transformer (→ section 8.5)
- Terminus station 1 and 2

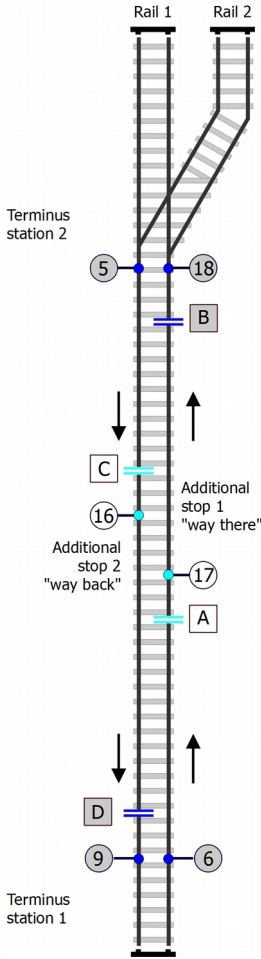
The other connections should be made only if required.

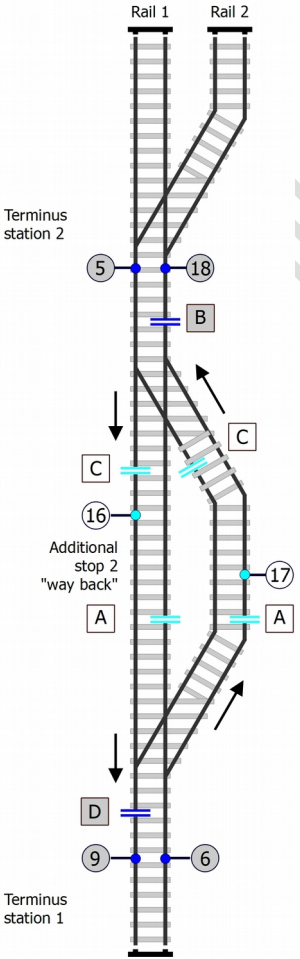
Connecting the shuttle-train section

N.B: The specifications "right" and "left" refer to the direction of travel"way there".	left	right	cutting points
Terminus station 1	9	6	D
Terminus station 2	5	18	B
Stop 1 and stop 2	16	17	A, C
Stop 1 only (without stop 2)	---	17	A
Stop 2 only (without stop 1)	16	---	C

Additional connections

Points at terminus station 2 In case you do not use stop-points you should connect an extra bistabile relais to the points (not included in the package). See section "Connecting points".	return line: 2 switching contacts: 7,8
Switching input "prolonging the halting time"	13, earth: 4
Switching input "extra halts"	12, earth: 4
Programming input "save"	14, earth: 4
Programming input "select"	15, earth: 4


Rail 1
Rail 2
Terminus station 2
5
18
B
C
16
Additional stop 1 "way there"
Additional stop 2 "way back"
17
A
D
9
6
Terminus station 1


Rail 1
Rail 2
Terminus station 2
5
18
B
C
C
16
Additional stop 2 "way back"
17
A
A
D
9
6
Terminus station 1

8.4. Connecting the shuttle-train (exception)

→ Layouts not according to NEM 631 (e.g. LGB)

You must make at least the following connections (marked grey in the list):

- Supplying transformer for the PZS-2 (→ section 8.5)
- Driving transformer (→ section 8.5)
- Terminus station 1 and 2

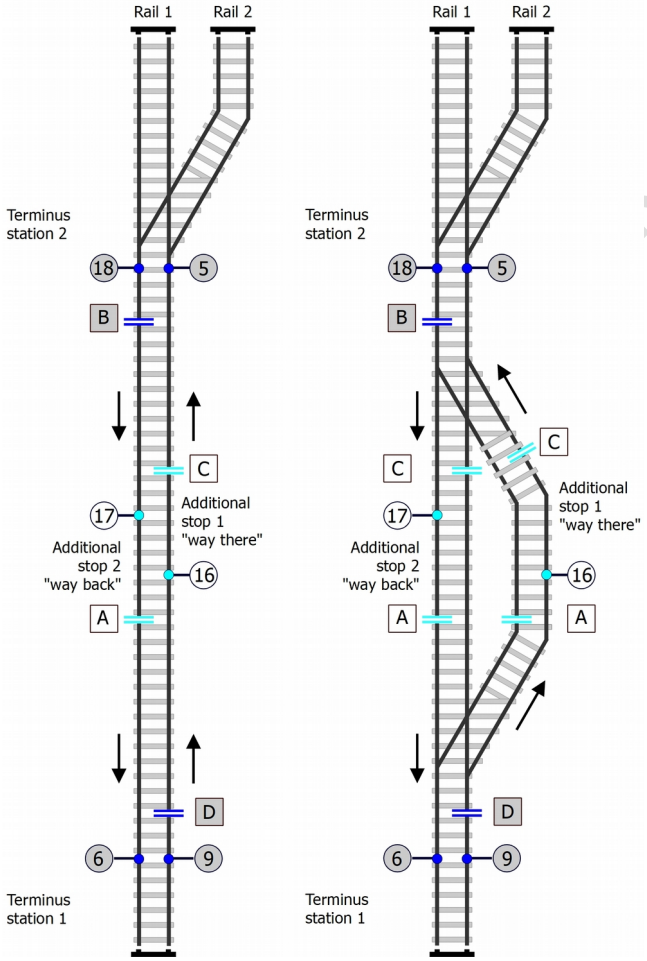
The other connections should be made only if required.

Connecting the shuttle-train section

N.B: The specifications "right" and "left" refer to the direction of travel"way there".	left	right	cutting points
Terminus station 1	6	9	D
Terminus station 2	18	5	B
Stop 1 and stop 2	17	16	A, C
Stop 1 only (without stop 2)	---	16	A
Stop 2 only (without stop 1)	17	---	C

Additional connections

Points at terminus station 2 In case you do not use stop-points you should connect an extra bistabile relais to the points (not included in the package). See section "Connecting points".	return line: 2 switching contacts: 7,8
Switching input "prolonging the halting time"	13, earth: 4
Switching input "extra halts"	12, earth: 4
Programming input "save"	14, earth: 4
Programming input "select"	15, earth: 4


Rail 1
Rail 2
Terminus station 2
18
5
B
C
17
Additional stop 1 "way there"
Additional stop 2 "way back"
16
A
D
6
9
Terminus station 1
Rail 1
Rail 2
Terminus station 2
18
5
B
C
C
17
Additional stop 1 "way there"
Additional stop 2 "way back"
16
A
A
D
6
9
Terminus station 1

8.5. Connecting the power supply

You can use a d.c. or an a.c. transformer with 12 to 18 V as a power supply for the PZS-2. The polarity is of no importance if you connect the PZC-2 only.

Caution:

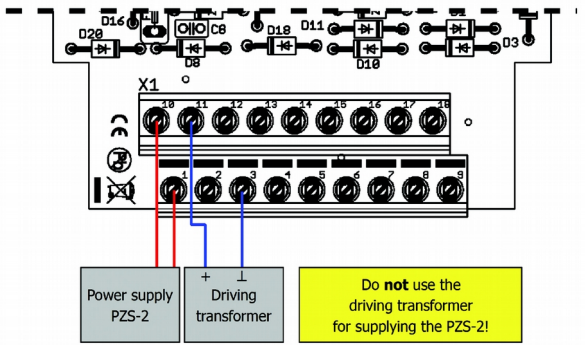
When connecting several devices to the same transformer, all connections have to be polarized the same way as a rule. Otherwise a short circuit could occur damaging connected devices.

Caution:

Do **not** use the driving transformer for supplying the PZS-2!

When supplying the circuit via a transformer used as a driving transformer as well, short circuits can occur and possibly damage the circuit irreparably. The integrated fuse is without effect against short circuits of this type.

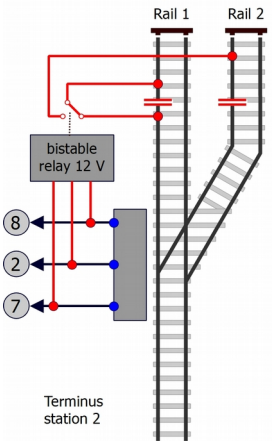
Hint: Driving transformers with an additional output for further accessories beside the driving controller are **not** suitable for supplying both rails and PZS, as they internally consist of one trafo only.

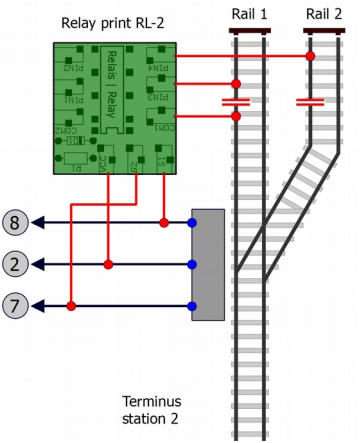


Supplying transformer (= power supply of the module) ⚠ Do not power the transformer yet!	1 and 10
Driving transformer (= power supply for the shuttle-train section)	earth-connection: 3 connection "+": 11

8.6. Connecting coil driven points

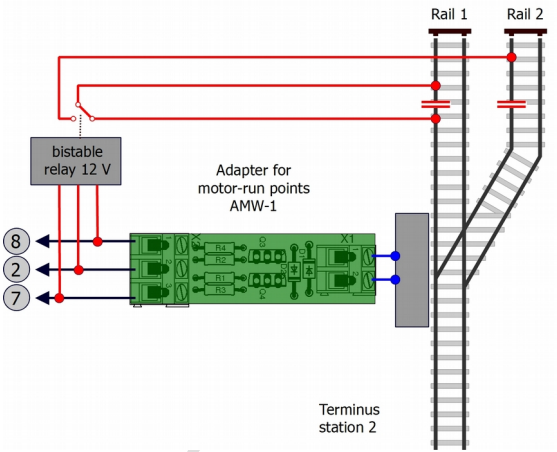
In case you do not use stop-points you should connect an extra bistabile relais 12 V (or a relay circuit board RL-2) to the points. The bistable relais switches on the power supply for the one rail in terminus station 2 while switching off the power supply for the other rail. If neither stop-points nor a bistabile relais are connected both rails are constantly supplied with power.





8.7. Connecting motor-run points

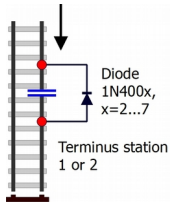
When using motor-run points, you must connect an additional adapter for motor-run points AMW-1 between points and relay (or relay print RL-2).



8.8. Connecting stop diodes

In order to prevent trains running beyond the end of the rails in the terminus stations 1 and 2, you can install extra stop diodes.

Connect them to the right rail – seen in the train´s direction of travel. Cut the rail that way that all current collectors driving the motor have passed the cut-off before the train reaches the end of the rails.



9. Operation

Caution:
The maximum current of a train in the shuttle-train section should not exceed 1 000 mA (including all loads as e.g. carriage lightings). When exceeding the maximum current, the integrated fuse switches off the circuit. In the worst case components on the circuit can be damaged.

Run

Immediately after switching on the power supply for the module, the shuttle-train traffic starts with a train starting from the terminus station 1 in direction of travel "way there".

Between the halts the shuttle-train traffic always runs in four phases: acceleration, normal speed, braking and halt. As soon as a braking phase has been triggered (i.e. the locomotive has run into the respective section) the phases braking, halt and acceleration are time controlled. During the phase "normal speed" the train is supplied with the voltage set at the driving transformer. The phase "normal speed" is interupted by releasing a new braking phase.

Traffic with one train

Caution: When switching on the shuttle-train control, the train should be standing in the terminus station 1. If it is standing in the terminus station 2 it runs in direction of travel "way there" against the buffers.

Traffic with two trains

Caution: When switching on the shuttle-train control one train should be standing in the terminus station 1. Check before switching on the shuttle-train control if the points are set so that the train is runs freely into the terminus station 2.

It is possible that the train starting at terminus station 1, after switching on the shuttle-train control, runs back from terminus station 2 after the

set halting time, and not the train standing in terminus station 2. After another "way there" of this train, the normal alternating traffic begins.

The points are switched automatically so that the trains alternatingly start from rails 1 and 2.

Caution: The points´ position and the "track busy"-status of the two rails in terminus station 2 are not controlled by the module. In case the points´position is altered externally a coming-in train possibly runs into occupied rails.

Prolonging the halting time

The halting phases for all stops can be prolonged individually by connecting the switching input "prolonging the halting time" to earth. The switching input can be connected either to a switch or an extra circuit. Closing the earth contact affects the stop to be performed next or the stop that actually is performed.

N.B: The halt at a terminus station, a stop or an extra halt takes at least as long as programmed for the stop, even if the connection to earth is interrupted earlier for the switching input.

Extra halts

By connecting the switching input "extra halts" to earth an extra halt is released immediately and independent of the place where the train momentarily is. In order to close the earth contact you can use switches or external circuits (e.g. signal control circuits).

N.B: The length of the phases accelerating, halt and braking is set jointly for all extra halts.

10. Programming the PZS-2

Programming the length of the phases is done the same way for the five different stops (two terminus stations, two stops, all extra halts). Carry out the programming steps 1 to 3 for all stops you want to program.

Programming step 1: Choosing a stop

Intermittently earth the programming input "select" (15) to point (4). The LED on the module flashes and thus indicates the 1st stop is ready to be programmed. By connecting the programming input once again to earth you switch to the programming of the next stop. The number of flashlights between the pauses indicates the one of the five stops ready to be programmed.

If you do not want to program a stop you can skip this halt by connecting the programming input once again to earth.

If you connect the programming input once again to earth after having reached the programming of the 5th stop the module automatically returns to standard operation.

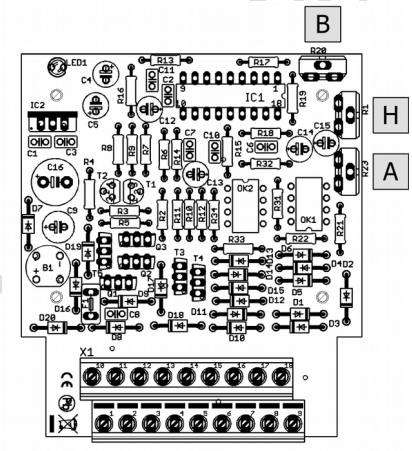
Stop	Number of flashlights	Stop ready to be programmed
1	1	Terminus station 1
2	2	Stop 1
3	3	Terminus station 2 (both rails)
4	4	Stop 2
5	5	Extra halt(s)

Programming step 2: Setting the phases´length

By adjusting the trimmer you set the length of the phases accelerating, halt and braking for the 5 stops. In state of delivery the phases are set to the shortest possible length. Test the module with these settings first. Choose the stop you want to program (see programming step 1) and prolong the phases by turning the adjusting screw to the right.

N.B: The settings only take effect if you save them before choosing the next stop for programming (see programming step 3).

Trimmer		Phase	Length (approx.)
Trimmer A	R23	Accelerating	> 1 sec.
Trimmer B	R20	Braking	> 1 sec.
Trimmer H	R1	Halt	5 - 150 sec.



Programming step 3: Saving the settings

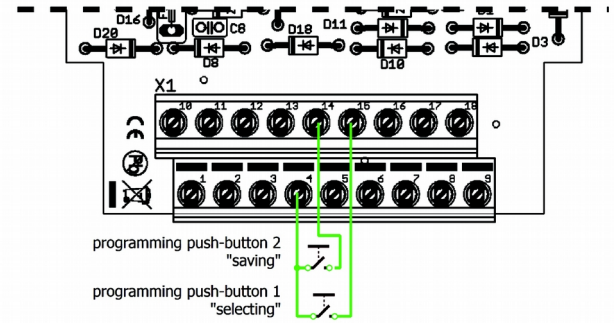
After having set the phases´ length for a stop at the trimmer, connect the programming input "save" (14) to earth (4) intermittently.

N.B: Before closing the earth contact make sure the LED on the module flashes. If it does not the module is not in the programming mode and you cannot save any settings. The number of the light pulses between the pauses indicates for which stop the settings at the trimmer are saved.

As long as the connection to earth is held the LED lights and indicates that the settings are saved.

Tip

Especially if you use all possible connections of the module we advise you to mount 2 push-button switches (not included in the package) into the connections between the programming inputs and the earth connection.



11. Check list for troubleshooting

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

⚠ Disconnect the system from the mains immediately!

Possible cause: one or more components are soldered incorrectly. →·In case you have mounted the module from a kit, perform a visual check (→ section 6.) and if necessary, remedy the faults. Otherwise send in the module for repair.

- The train stops, restarts, stops again, and so forth.

Possible cause: The overload protection consistently switches on and off the current circuit, due to overload or a short circuit. → Check if there is a short circuit on the rails or if the locomotive´s current consumption exceeds 1.000 mA.

- The train does not run. / Functional test: The lamp does not light.

Possible cause: The driving transformer has not been connected or has been connected the wrong way around (connections "earth" and "+" exchanged.) → Check the connections.

- The settings of the trimmer do not take any effect on phase length of a stop.

Possible cause: The settings of the trimmer have not been saved or have been saved for another stop. → Program the phase length anew for the stop concerned. See information on the programming steps 1 and 3.

- The train does not stop at a station or a stop.

Possible cause: The cuts are placed badly or the sections are connected the wrong way. → Check the placing of the cuts and the connections of the sections.

- In a terminus station the train runs against a buffer.
  Possible cause: The cuts are placed badly or the sections are connected the wrong way. → Check the placing of the cuts and the connections of the sections.
  Possible cause: When switching on the shuttle-train control the train (or both trains) was (were) standing in terminus station 2.

Hotline

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

Repairs

You can send in a defective module for repair (address on the last page). In case of guarantee the repair is free of charge for you. With damages not covered by guarantee, the maximum fee for the repair is the difference between the price for the ready-built module and the kit according to our valid price list. We reserve the right to reject the repairing of a module when the repair is impossible for technical or economic reasons.

Please do not send in modules for repair charged to us. In case of warranty we will reimburse the forwarding expenses up to the flat rate we charge according to our valid price list for the delivery of the product. With repairs not covered by guarantee you have to bear the expenses for sending back and forth.

12. Guarantee bond

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

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

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

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

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

13. EU declaration of conformity

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.

14. Declarations conforming to the WEEE directive

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

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

Don´t dispose of this product in the house refuse, bring it to the next recycling bay.

Information and tips:

http://www.tams-online.de

Warranty and service:

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e-mail: modellbahn@tams-online.de

CE

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