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PSS 3032

Programmable control systems PSS®

pilz

Installation Manual – Item No. 19 891

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Introduction

This installation manual contains all the information you need to install a PSS 3032 programmable safety system. It gives safety guidelines which should be followed during installation and also describes the installation procedure and measures which can be taken to ensure EMC compliance. Examples are also given to show how the on-board inputs and outputs should be connected.

Definition of symbols

Information in this manual which is of particular importance can be identified as follows:



DANGER!

This warning must be heeded! It warns of a **hazardous situation which poses an immediate threat of serious injury and death**, and indicates preventive measures which can be taken.



WARNING!

This warning must be heeded! It warns of a **hazardous situation which could lead to serious injury and death**, and indicates preventive measures which can be taken.



CAUTION!

This refers to a hazard which can lead to a less serious or minor injury plus material damage, and also provides information on preventive measures which can be taken.



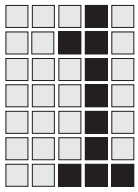
NOTICE

This describes a situation in which the unit(s) could be damaged and also provides information on preventive measures which can be taken.



INFORMATION

This gives advice on applications and provides information on special features, as well as highlighting areas within the text which are of particular importance.



Notes

Safety Regulations

To ensure that the PSS 3032 programmable safety system functions correctly, please follow the safety guidelines given below:

- Electrical connections should be made by a qualified electrical engineer who is familiar with the information in this manual as well as the relevant regulations concerning health and safety at work.
- Ensure VDE and local regulations are met, especially those relating to safety. The relevant safety regulations for the respective application must also be met.



- **CAUTION!**
  Electrostatic discharge can damage components on the PSS 3032. Ensure against discharge before touching the terminal strips, e.g. by touching an earthed, conductive surface or by wearing an earthed armband.
- Ensure all the requirements of the relevant trade associations or TÜV are met.
- Ensure the wiring instructions in Chapter 5 are followed.
- If the system is altered in any way, such as exchanging a component or carrying out soldering work, the guarantee, and any approval, will be rendered invalid.
- The date of manufacture can be found on the test label.

Supplying power to the PSS

- The safety system requires a 24 VDC supply.
  Check that the voltage supplied from the external power supply corresponds.
- The tolerance on the supply voltage for the system's power supply is +10 % or -15 % maximum. Safe operation cannot be guaranteed outside this range.
- Overvoltage and spikes of interference can damage the PSS power supply. If this occurs the unit will switch to a safe condition. Please refer to the relevant EMC-measures described in Chapter 3.
- To achieve the lowest possible residual ripple (< ± 1.2 V), we recommend that you install a three-phase bridge rectifier or regulated supply.

Safety Regulations

- The external power supply must be capable of supplying a current which is calculated as follows:
  Sum of all the inputs multiplied by 10 mA
  + Total current from the maximum number of outputs that can be driven simultaneously
  + 0.5 A quiescent current
  This must amount to 10 A maximum.
- The fuse between the external and the PSS power supply protects the external power supply. The size of the fuse will depend on the cable cross section and on local regulations.



- **WARNING!**
  Safe electrical isolation must be ensured for the external 24 V supply. Failure to do so could result in electric shock. Power supplies must conform to DIN VDE 0551 / EN 60 742 and DIN VDE 0160.
- Connect the external 24 V supply to the PSS power supply and the 0 V terminal to the inputs, as shown in the diagram below. (It is only necessary to connect one of the two 0 V terminals to the inputs.) The external supply should be earthed in accordance with local regulations. There must be no direct connection between “N” and the 0 V output on the external power supply.
  The 0 V connections on all the 24 V power supplies should be connected and the 0 V mains earthed at a single point. The connection of the 0 V supply to the central earth bar or earth fault monitor must be in accordance with the relevant national regulations (such as EN 60 204, VDE 0113, NFPA 79-1991:17-7, NEC: Article 250, for example).

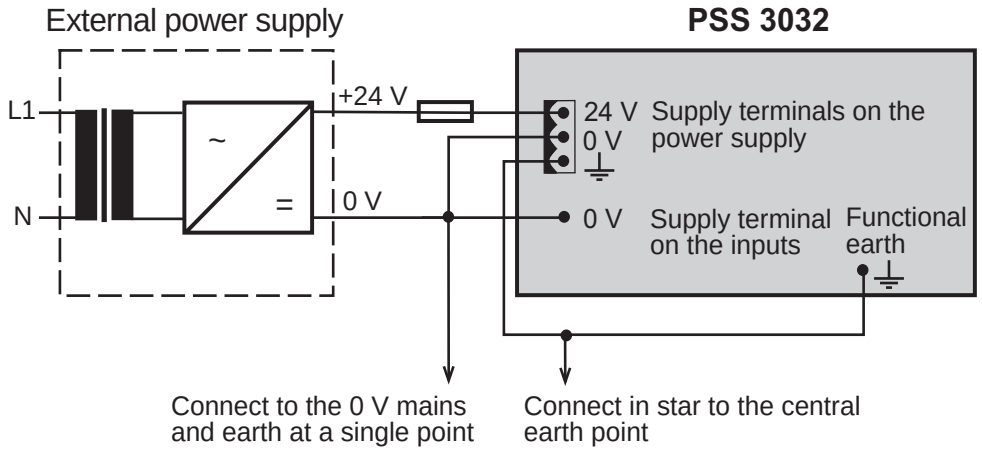
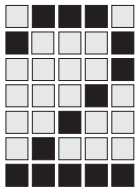


Fig. 2-1: Supplying the system

Installation

- The system should be installed in an enclosure (e.g. control cabinet) which conforms to the protection class required.
- When installing the unit in an enclosure such as a control cabinet, the technical specifications below must be taken into account:

Protection type (EN 60 529, 10/91)	IP 20
Protection class (DIN VDE 0106, Part 1/A1, 04/90)	1
Mounting position	Vertical
Ambient temperature (DIN IEC 68-2-14, 06/87)	0 ... 60 °C
Storage temperature (EN 60 068-2-1/-2, 03/93)	-25 ... +70 °C
Relative humidity (DIN IEC 68-2-30, 09/86)	Max. 95 % r.h.
Condensation	Not permitted
Vibration (EN 60 068-2-6, 04/95)	Frequency range: 10 ... 100 Hz Amplitude: 0.1 mm, max. 5g
Shock (DIN IEC 68-2-29)	30g, 11 ms/10g, 16 ms
EMC	EN 50 082-2, 03/95 EN 55 011 A, 08/96



- Ensure there is sufficient ventilation to prevent heat building up within the control cabinet.
- In extreme ambient conditions, additional measures may be required in order to keep within the prescribed value range (e.g. air-conditioning within the control cabinet).
- The PSS 3032 must be installed in such a way that buttons and switches cannot be operated unintentionally.

Connections

- Cable layout must meet the EMC-guidelines stated in Chapter 3.
- The current at each 24 V supply terminal should be 10 A maximum.
- Screened cables are not required for digital I/Os.
- Minimum ranges for cable cross sections on field connection terminals in mm^2, in accordance with EN 61 131-2, 08/94 and A11, 06/96:
  - Digital inputs: 0.5 (AWG20) ... 1.5 (AWG16)
  - Digital outputs: 0.5 (AWG20) ... 2.0 (AWG14)
  - Power supply: 1.5 (AWG16) ... 2.5 (AWG12)
  - Earth: 1.5 (AWG16) ... 2.5 (AWG12)
- If you are using a multi-stranded wire with a cross section of 1.5 mm^2 to connect the inputs and outputs, crimp ferrules in accordance with DIN 46 228 Part 1 and Part 2 0.5 ... 1.5 mm^2, type A or C are required, i.e. bootlace ferrules.
  To crimp the bootlace ferrules use a type A or C crimping tool, in accordance with EN 60 947-1 (e.g. PZ 1.5 or PZ 6.5 from Weidmüller).
- Use copper wiring.
- The torque setting on the connection terminals should be 0.5 ... 0.6 Nm.

Electromagnetic Compatibility (EMC)

Overview

The PSS 3032 is designed to be installed within an electromagnetic industrial environment. To ensure electromagnetic compatibility the correct procedures must be carried out when installing the system.

A device is electromagnetically compatible if:

- It functions without error in a given electromagnetic environment.
- It does not adversely affect its own environment.

Electromagnetic interference reaches the system through:

- Radiated fields
- Power supply
- Earth cabling
- Bus
- Interfaces
- Input and output cables

The interference can be transferred from the source to the receiver (interference sink) via the coupling routes.

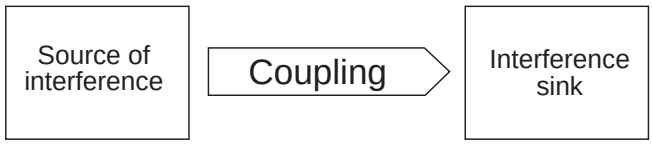


Fig. 3-1: Electromagnetic interference

Interference reaches the interference sink (e.g. PSS 3032) in various ways:

- DC coupling
  This occurs if the source and sink of interference have common cable connections. The common cable presents complex resistances, inducing potential differences. Possible sources of interference are switches/ relays, running motors or varying potentials for other systems on the same power supply.

- Capacitive (electrical) coupling
  A different potential between the source and interference sink (e.g. two cables) creates an electrical field. Cross-coupling is proportional to the rate of voltage change.
  Possible sources of interference are contactors, static discharge, parallel signal cables.
- Inductive (magnetic) coupling
  A live cable produces a magnetic field which surrounds both the live and neighbouring cables. Interference voltage is induced. Cross-coupling is proportional to the rate of current change.
  Possible sources of interference are mains cables running in parallel, live cables, high frequency cables, inductors, transformers, motors.
- Electromagnetic coupling
  A cable can emit a signal as a radio wave. This wave is then picked up by another cable.
  Possible sources of interference are transmitters such as radios, sparks from spark plugs, welding equipment etc.



NOTICE

Stronger HF transmitters should only be operated at a distance of more than 0.6 m.

- Static discharge
  Static discharge occurs where there are very high differences in potential between two points. If the two points are brought closer together or if the potential difference is increased, discharges can occur in the air gaps.
  Possible sources of interference are people who are statically charged from a synthetic carpet, for example.

Making the installation EMC-compatible

Connecting the earth cables

PSS safety systems all meet protection class 1 (DIN VDE 0106, Part 1/A1, 04/90). The prescribed earth points are designed for your safety and to guarantee compliance with noise resistance requirements.

- The housing should be connected to the earth conductor. A cable cross section of at least 2.5 mm^2 should be used. Connections should be kept as short as possible.
- Always connect the earth conductor to the central earth point in star form.
- The 0 V connections on all the 24 V power supplies should be connected and the 0 V mains earthed at a single point. The connection of the 0 V supply to the central earth bar or earth fault monitor must be in accordance with the relevant national regulations (such as EN 60 204, VDE 0113, NFPA 79-1991:17-7, NEC: Article 250, for example).
- Connections should be protected from corrosion.
- Flexible earthing straps should be used on moving earth parts (e.g. machine parts, gates). Ensure these earthing straps are as short and wide as possible.

Cabling

It is possible to differentiate between cables according to their function. The following groups exist:

- Group 1: Data and supply lines for DC voltages below 60 V and AC voltages below 25 V
- Group 2: Data and supply lines for DC voltages from 60 V to 400 V and AC voltages from 25 V to 400 V
- Group 3: Supply lines above 400 V

Cabling inside buildings:

- The cable groups listed above should be laid separately.
- Cables of the same group can be laid within the same cable duct.
- Lines from group 1 and group 2 should be laid in separate groups or in cable ducts which are at least 10 cm apart.
- Lines from group 1 and group 3 should be laid in separate groups or in cable ducts which are at least 50 cm apart.

- Data and signal lines should be laid as close as possible to an earthed surface.

Cabling to open air systems:

- As far as possible use metal conduits. These should be electrically connected and earthed.
- Ensure there is sufficient protection against lightning by:
  - Using metal conduits earthed at both ends, or concrete cable ducts with reinforcements connected across the joints.

Equipotential bonding

Potential differences can occur through potential connected couplings between the PSS and peripheral devices or cable shields, which are connected at either end and have different earth connections. In order to avoid interference, equipotential bonding cables must be installed. In doing so, you must ensure the following:

- Select a low impedance equipotential bonding cable.
- If the PSS and peripheral devices are connected with screened signal cables which are earthed at either end, the impedance is calculated as follows:

  Impedance equipotential bonding cable = 10% of screen impedance.
- Select the following as standard values for the cross section of the equipotential bonding cable:
  16 mm^2 for equipotential bonding cables up to 200 m in length.
  25 mm^2 for equipotential bonding cables over 200 m in length.
- Use copper or galvanised steel equipotential bonding cable.
- Connect equipotential bonding cables to the earth conductor over as wide a surface area as possible.
- As short a distance as possible should be kept between the equipotential bonding cable and signal cable.

Screened cables

Interference currents arising from electrical, magnetic or electromagnetic fields of interference must be diverted to cable screens via the earth bars connected to the enclosure. Please remember the following:

- Connect the screens with low impedence to the earth conductor.
- Use cables with braided screening, with a minimum cover area of 80%.
- For high frequency areas connect the screen at both ends.
- For low frequency areas connect the screen at one end; this is also valid when laying cables without equipotential bonding or using foil screens.
- Use metal or metallised plugs to connect cables for serial data transfer.
- The screen must have no connection to the connector housing if it is not located at the end of the cable.
- At the point where the cable enters the cabinet, connect the screen to the earth bar, without making a break in the cable. Use metal cable clamps which cover the screen over a wide surface area.
  Take the screen as far as the module, but do not lay it on top of the module

Suppression of inductive loads

Suppression should not be used to protect the semiconductor outputs.

Miscellaneous

Connecting the programming device

The programming device requires a mains connection in each cabinet. The mains connection must be connected to the same distributor as the earth conductor for the cabinet.

Electromagnetic Compatibility (EMC)

Lighting inside the cabinet

Use incandescent panel lighting as available from LINESTRA.



NOTICE
Fluorescent lamps should be avoided as they create interference fields. However, if it is absolutely necessary to use fluorescent lamps, the guidelines listed below should be followed:

- Place shield screening over the lamp.
- Used screened cable.
- Install a metal-sheathed switch.
- Use a mains filter or screened power supply cable.

Installing within an enclosure or wall-mounting

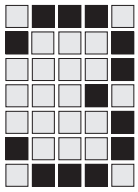
Care must be taken to avoid interference when installing the unit within an enclosure or wall-mounting:

- Shielding, earth conductor bars and the base module rack should be attached to metal parts in order to divert any coupled interference on to large metal areas. For wall-mounting we recommend that the overall potential surfaces are made of steel.
- For varnished or anodised metal parts you should use special contact plates or remove the protective coating.
- Install an earth bar for the cable screens.
- The earth bar can also be used as the ground conductor bar.
- Connect the earth bar to the mounting plate over a wide surface area and with low impedance.

Testing the EMC-compatibility of an installation

Use the following list to check that the PSS 3032 has been installed to conform with EMC-regulations.

Check	Action	Done
Before installation:		
Are there areas with a high probability of interference? (e.g. computers running, process control areas, distribution cabinets, cable casing, frequency converters, hand-held radios etc.)	Make detailed plans for EMC protection in these areas.	
Are areas where computers are running and areas such as process control rooms sufficiently shielded from electromagnetic coupling?	If necessary shield the whole area.	
Have you, or the installer, sufficient knowledge where cable layout is concerned?	Some important points: Lay cables close to earth, keep clear of other electrical equipment, keep cables in ducts separate from other parts of the installation, keep cables as short as possible.	
Is the supply voltage free of interference?	Build in a mains filter where interference may occur.	
EMC characteristics of individual units / all units once installed?	Test under operating conditions, e.g. while hand-held radios are in use, or HF frequency generators are close by. Test static discharge with operating personnel, test mutual interference between units under different operating conditions.	



Check	Action	Done
During installation:		
Earthed parts connected correctly?	Most important are the connections to base module racks, racking bars, earth conductors and earth bars. Inactive metal parts should be connected over a wide surface area and earthed to a central point. With insulated metal: Remove insulation or use special contact fixings. Protect the connection from corrosion. Connect the cabinet doors to the body of the cabinet using earthing straps.	
Are the cables laid correctly?	Separate cables into groups. Supply and signal leads must be laid separately.	
Are the shields connected correctly?	Use shielded cables for analogue and data leads. Use metallic plugs. Connect cable shields to earth bar at point of entry to cabinet. Connect cable shields over a wide surface area and with low impedance.	
Equipotential bonding carried out?	Equipotential bonding cables should be laid if the installation extends over a wide area.	
Are inductive loads switched?	Inductive loads not switched by the PSS 3032 must be wired with suppression elements.	
24 VDC power supply?	The power supply must conform to DIN VDE 0551 / EN 60 742 and DIN VDE 0160.	

Installing the PSS 3032

There are two ways to install the PSS 3032. Both are shown in Fig. 3-1. Drill 4 x M5 or M6 holes in the mounting plate of the control cabinet as shown in Fig. 3-1 (tolerance: +/-0.3 mm/0.012"). Screw the PSS 3032 to the mounting plate using washers.

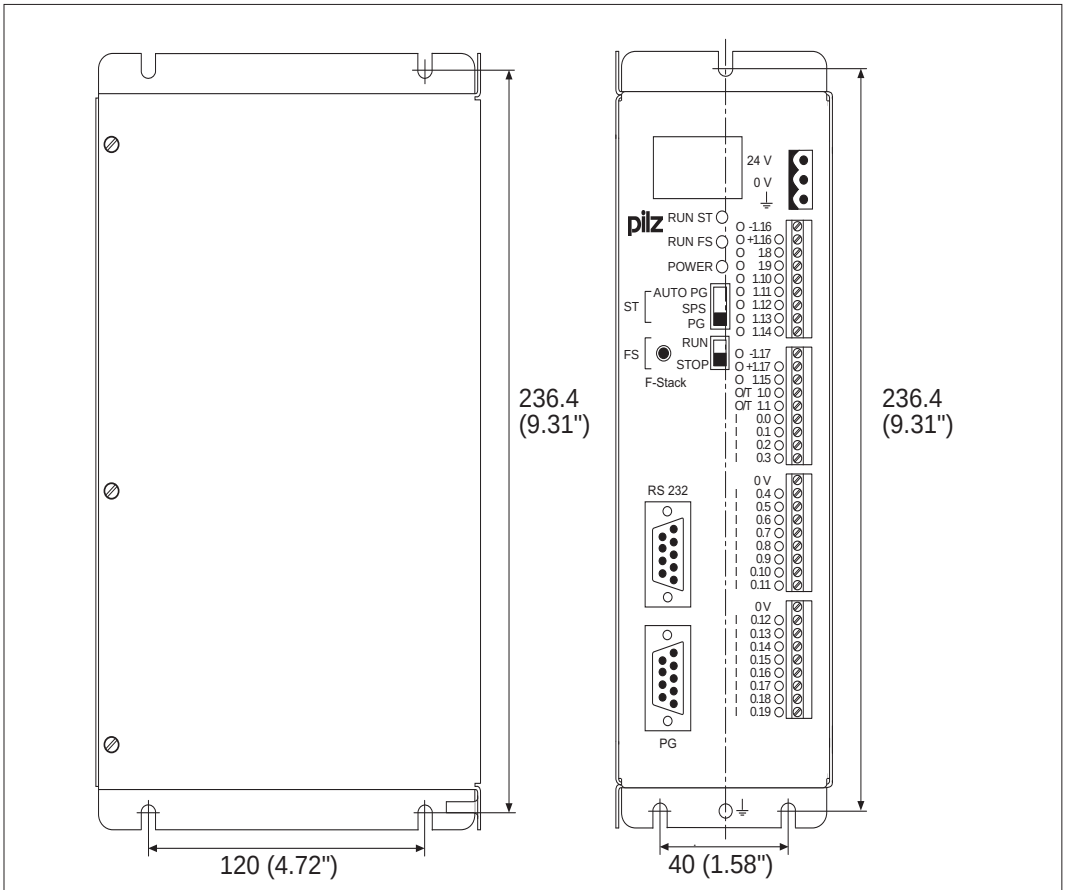


Fig. 4-1: Installing the PSS 3032, dimensions stated in mm (")

Dimensions in mm ("):
H x W x D: 246.4 x 74 x 161 (9.70" x 2.91" x 6.34")

Installing the PSS 3032 in a control cabinet

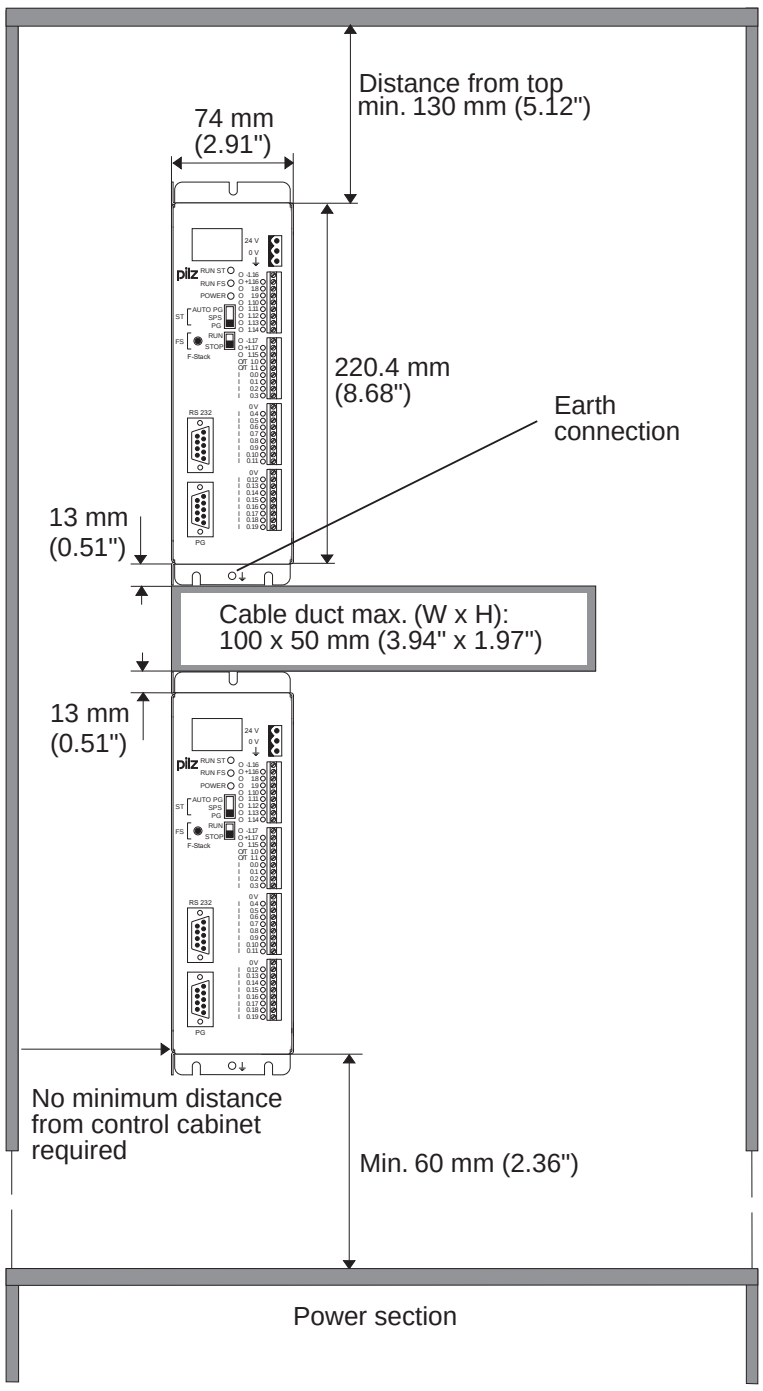
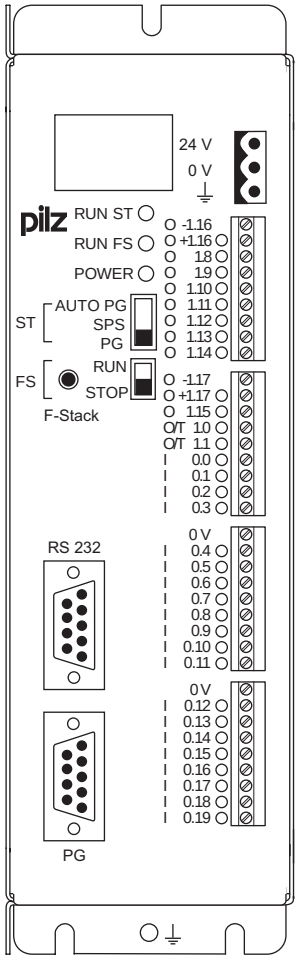


Fig. 4-2: Installing the PSS 3032 in a control cabinet, dimensions stated in mm (")

Configuration of the screw terminals and connector description



Connector description:

X0

X4

X1

X2

X3

Fig. 5-1: Terminal configuration on the PSS 3032

Connecting the Inputs and Outputs

Notes on wiring

Where safety-relevant applications are concerned, it is essential that short circuits and line breaks are unable to cause a hazardous condition within a plant.

The way in which this is done will depend on the degree of hazard within the plant itself, the switching frequency of the input devices and the level of safety of the input devices and actuators. These points must be assessed in conjunction with the relevant standards or approvals body (e.g. BG or TÜV).

The following terms are important:

- Test pulses
  These are signals which change status on several occasions within a period of time.
- Single-channel safe input devices
  These are positively-driven normally-closed contacts which open on actuation (failsafe principle).
- Elimination of short circuits between signals
  This is possible within electrically-enclosed areas and also outside electrically-enclosed areas for signals conducted in different multicore cables. However, all components must meet the relevant regulations in accordance with EN, DIN and VDE.
- In principle, the possibility of earth faults and line breaks occurring cannot be eliminated.

If a dual-pole switching output on the PSS 3032 is used to drive the actuators, a test for short circuits and line breaks will automatically be carried out during each cycle. For this purpose the actuator will be switched off for approximately 100 µs. When using single-pole outputs or test pulses, a switch-off test will not be carried out in each cycle. The test time will depend on the test slices designed into the self-check.

With multi-channel pulsed input devices, short circuits and line breaks can be detected via feasibility checks in the control program.

The input test on the PSS 3032 uses test pulses to enable the system's operating program to carry out a test to detect short circuits and line breaks. The following pages contain details of connection examples which may be of use when wiring the unit.

Notes

Connecting the Inputs and Outputs

Digital inputs

Features:

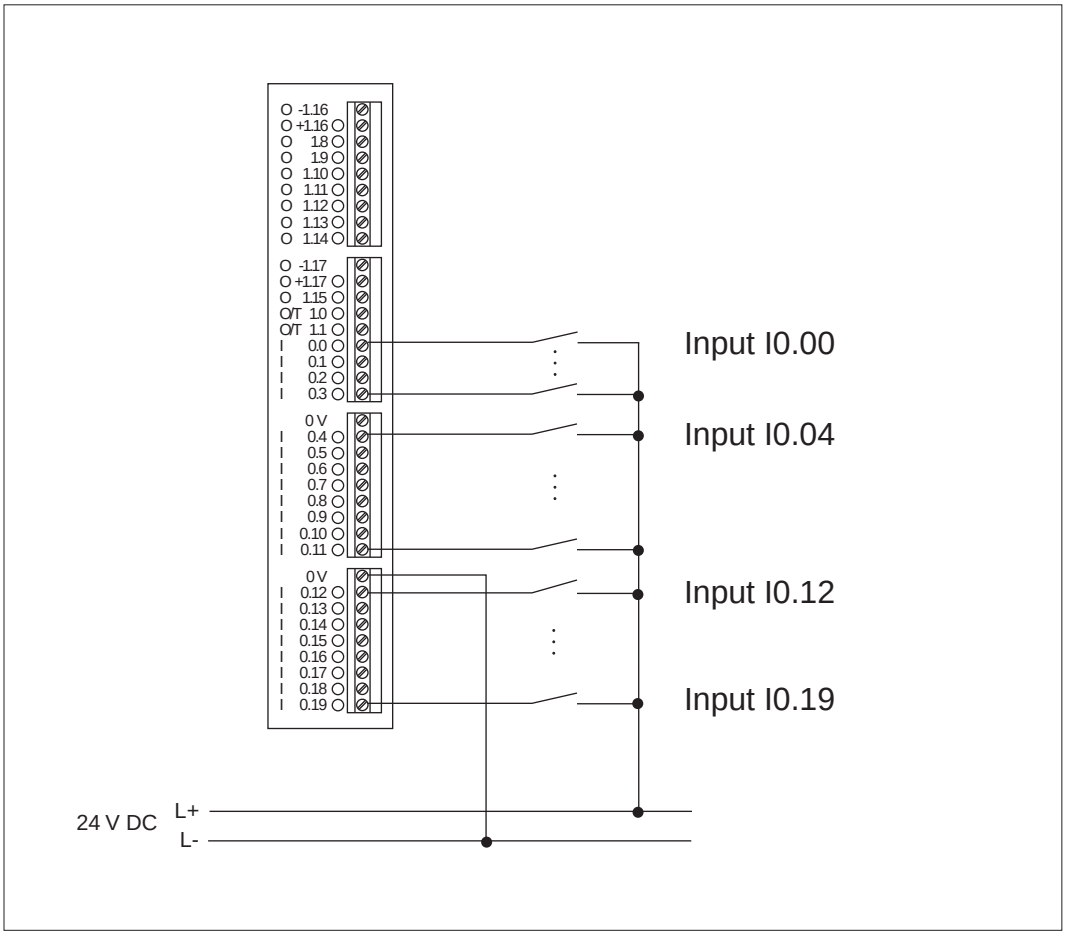
- 20 digital inputs I0.00 ... I0.19
- Only one 0 V terminal needs to be connected.
- Only input signals which operate in accordance with the zero signal principle (on switching off) are permitted for safety-related applications.
- Signals may be connected using unscreened cables.



CAUTION!

The connection shown overleaf is only approved for non-safety applications. The connection of safe input devices for safety-relevant applications is described later in the chapter.

Configuration



Please ensure safety regulations and EMC guidelines are observed!

Example: Single-channel, failsafe input device, unchecked

Features:

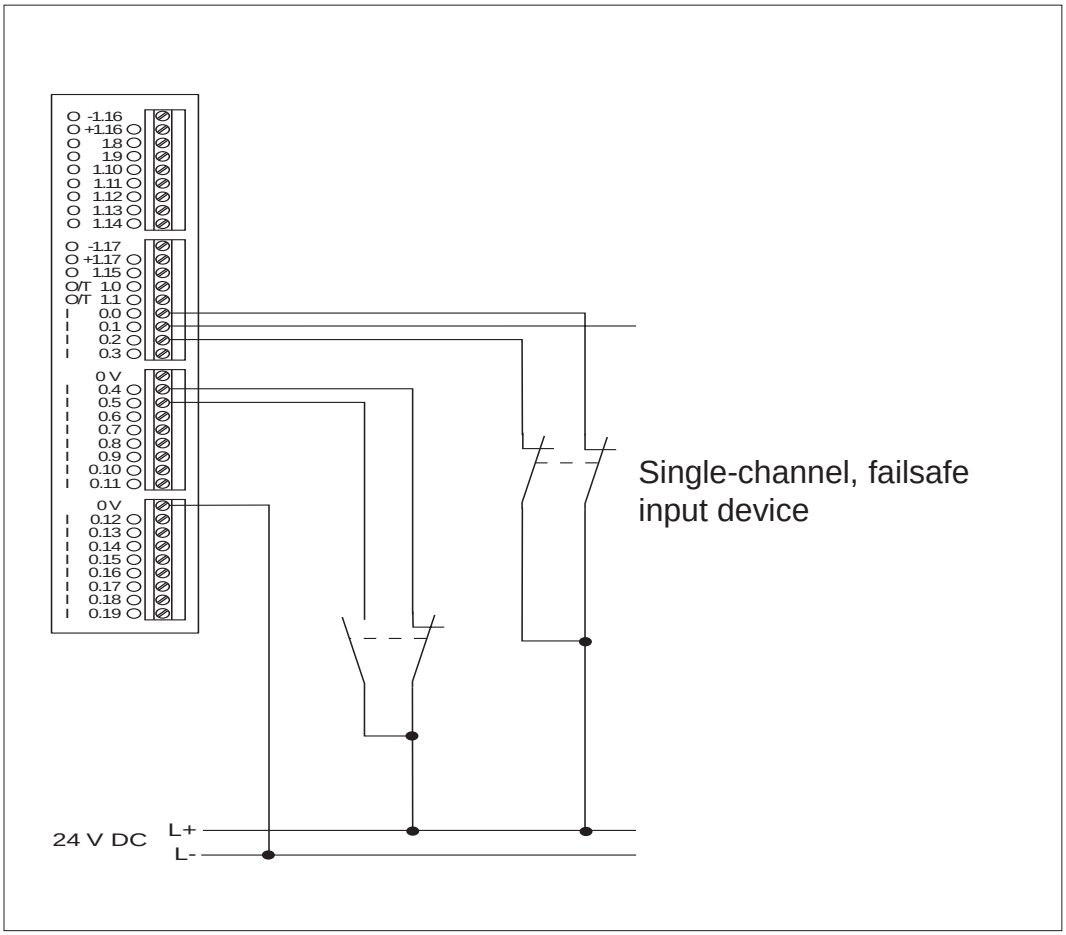
- The input device must be approved for failsafe applications.
- Please read the instructions provided with the input device.



CAUTION!

It will not be possible to detect a short circuit in the cable between the input device/input and the L+ line, nor a short circuit between several input devices. Depending on the type of input device connected, this could create a risk to both personnel and machinery (e.g. emergency stop). You should always ensure that the unit is suitably wired to eliminate the risk of short circuits.

Example: Single-channel, failsafe input device, unchecked



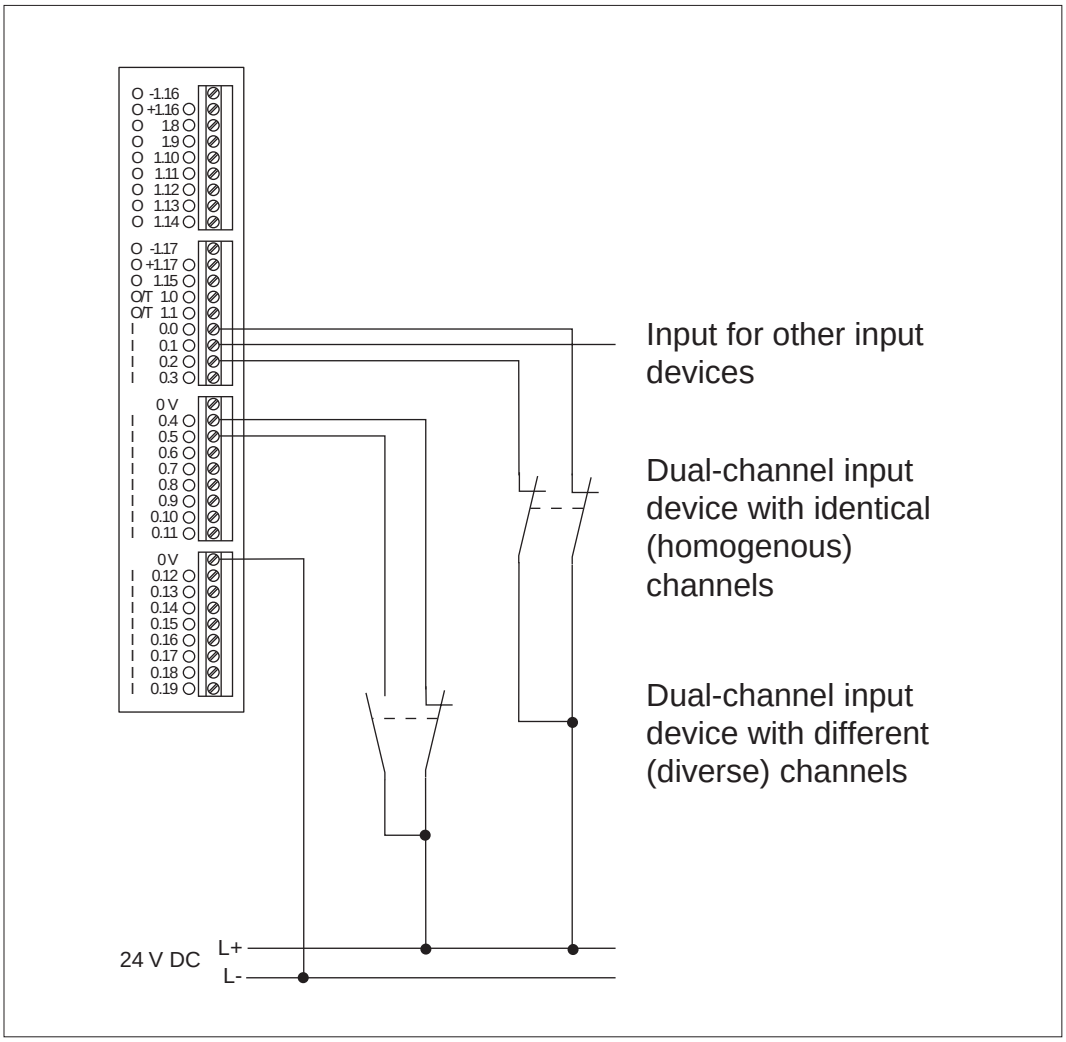
Please ensure safety regulations and EMC guidelines are observed!

Example: Dual-channel input devices, unchecked

Features:

- This type of connection is mainly used for signal inputs with frequent operation.
- The functionality of both input device channels should be monitored in the user program via feasibility checks (see example in the Programming Manual).
- The possibility of short circuits occurring between adjacent connector terminals cannot be eliminated. For this reason, the two identical (homogenous) channels on an input device must **not** be connected to adjacent inputs.
- If you are using input devices with different (diverse) channels, adjacent inputs may be used. Short circuits will be detected in the application program via the feasibility check (see example in the Programming Manual).

Example: Dual-channel input devices, unchecked



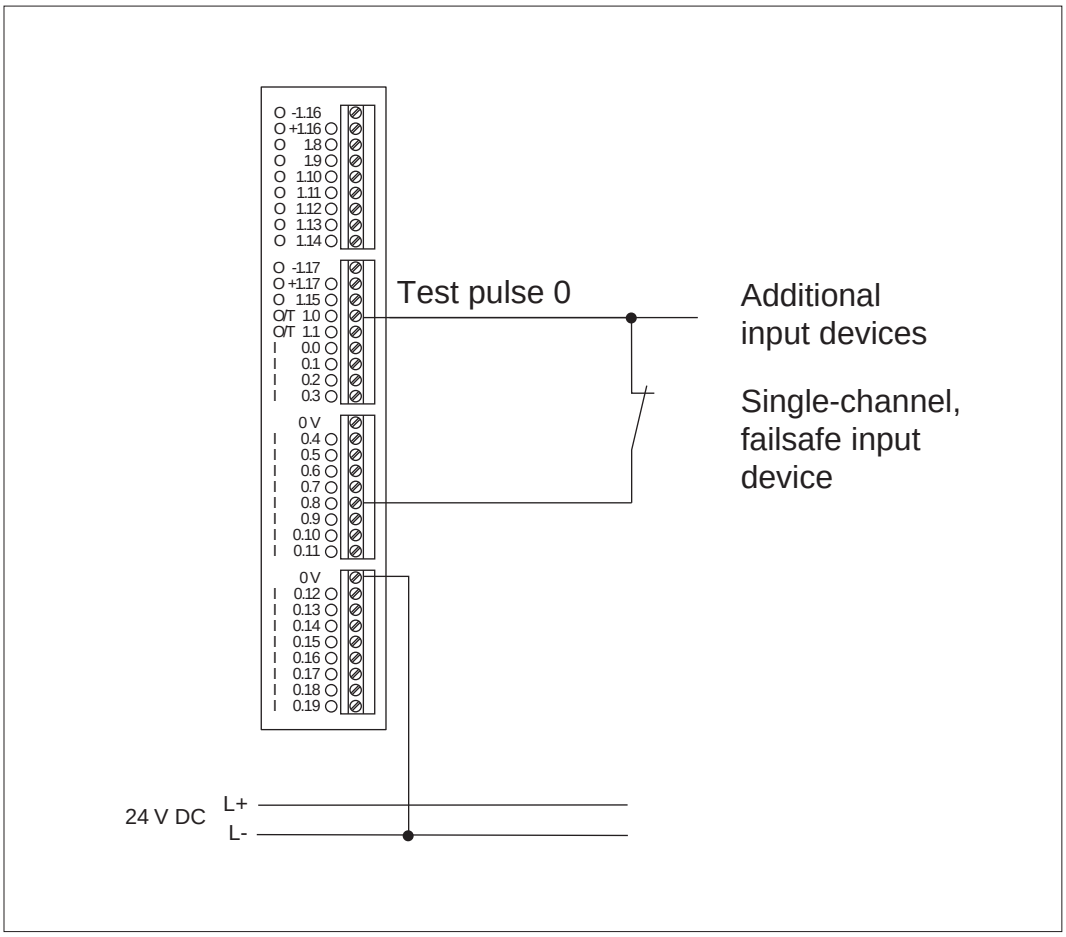
Please ensure safety regulations and EMC guidelines are observed!

Example: Single-channel, failsafe input device, with test pulse

Features:

- The input device must be approved for failsafe applications.
- Please read the instructions provided with the input device.
- The test pulse must be allocated to the input via the configurator on the programming device (see Programming Manual).
- Testing will detect short circuits between lines L+ and L-, and also between the pulsed outputs.
- Short circuits between the cable from the signal to the input device and the cable from the input device to the input will **not** be detected.
- Only input devices with N/C contacts can be tested.

Example: Single-channel, failsafe input device, with test pulse



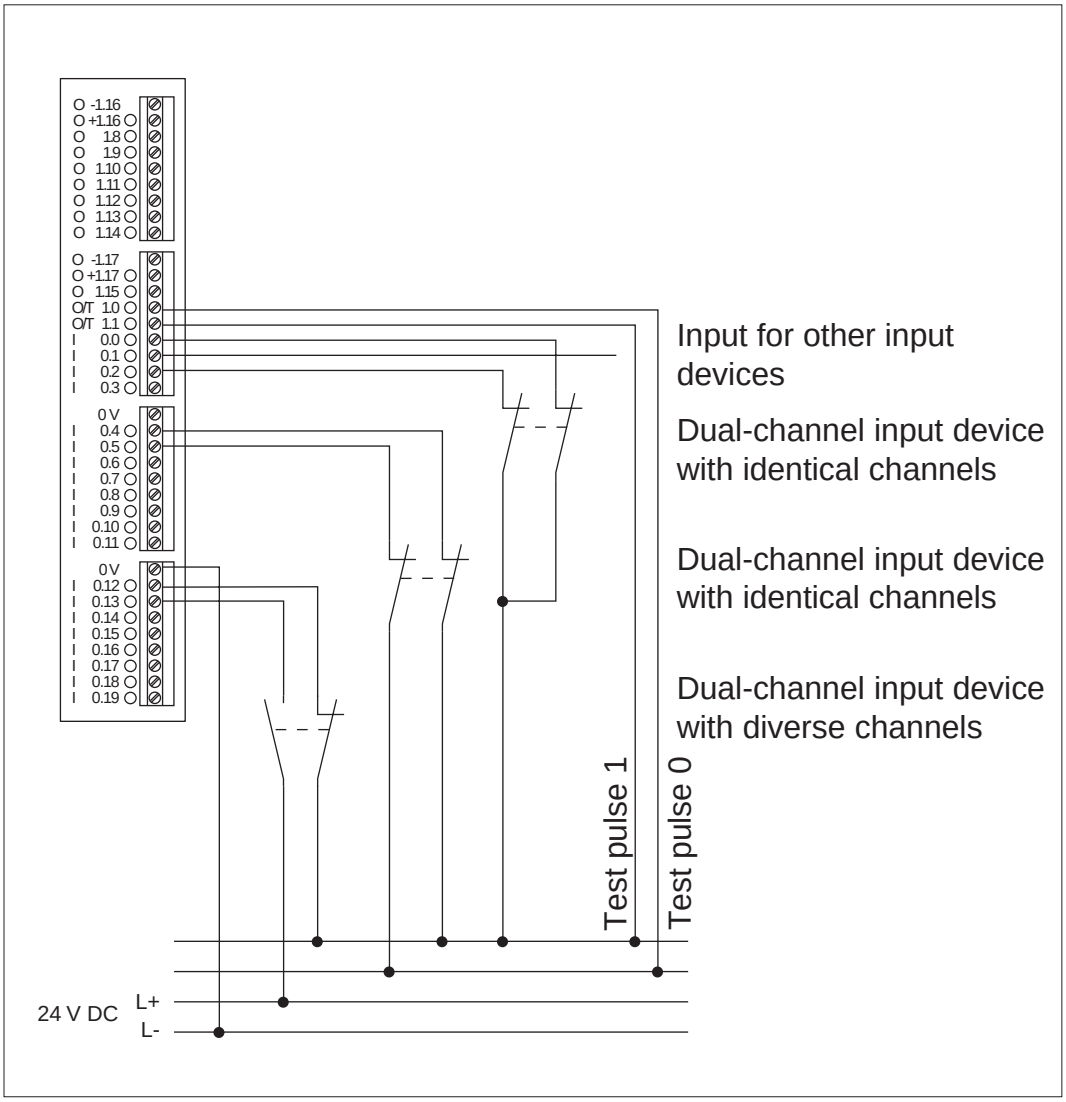
Please ensure safety regulations and EMC guidelines are observed!

Example: Dual-channel, failsafe input device, with test pulse

Features:

- This type of connection is mainly used for signal inputs with infrequent operation.
- The test pulse must be allocated to the input via the configurator on the programming device (see Programming Manual).
- Only input devices with N/C contacts can be tested (in the case of diverse channels, only the N/C contact).
- On input devices with identical channels, each channel should be given a separate signal, where possible. This will ensure that all short circuits are detected, with the exception of short circuits which short out the input device (cable from the signal to the input device and cable from the input device to the input).
- If the input device has only one signal, a short circuit between the cables from the input device to the inputs will **not** be detected. You should always ensure that the unit is suitably wired to avoid the risk of this type of short circuit.

Example: Dual-channel, failsafe input device, with test pulse



Please ensure safety regulations and EMC guidelines are observed!

Connecting the Inputs and Outputs

Single-pole 0.5 A outputs/test pulses

Features:

- 8 single-pole 0.5 A outputs O1.8 ... O1.15 and 2 single-pole 0.5 A outputs, which can also be used as test pulse outputs O/T 1.0 and O/T 1.1
- The test pulse outputs are push-pull outputs. Do not use the push-pull level to drive a load to L+, otherwise the switch off test will detect a connection to L+ and will register an error.



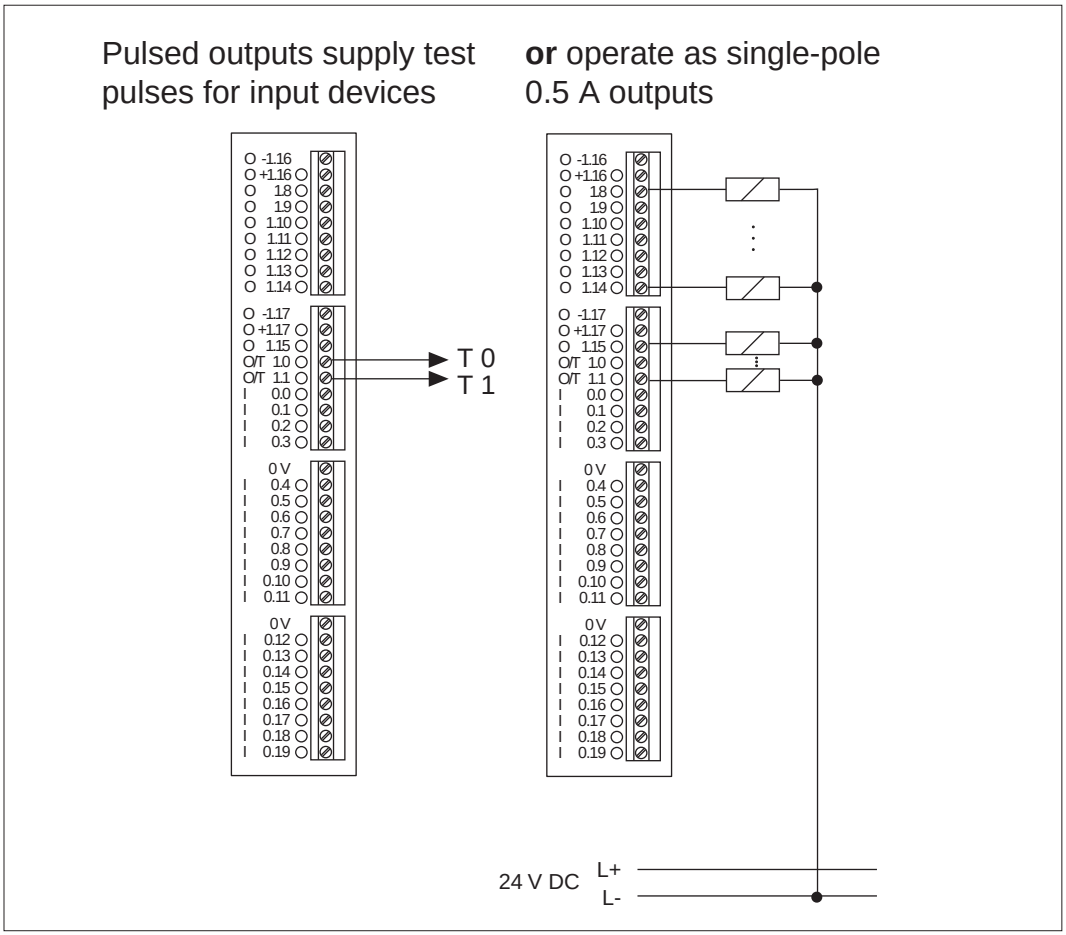
IMPORTANT
When using single-pole outputs, always ensure that line or cable breaks and short circuits between lines can be detected (e.g. by staggering the outputs as they switch on), or ensure they cannot occur by using appropriate wiring methods.

- The two outputs can only be configured jointly as test pulse outputs or as single-pole 0.5 A outputs (see Programming Manual). The configuration is set automatically, depending on the number of test pulses configured in the programming device:
  Number $\leq$ 2: T1.0 and T1.1 are test pulse outputs
  Number = 0: T1.0 and T1.1 are single-pole 0.5 A outputs
- If only one test pulse is required, the second test pulse output must remain unwired.
- Outputs configured as 0.5 A outputs have monitoring inputs available under the same address. These can be used for feasibility checks.
- If cable runs are greater than 0.5 km, the functionality of the feasibility check must be tested by simulating a short circuit.
- Each output is protected against short circuit, overload and overtemperature. Outputs are designed for resistive and inductive loads.
- All outputs have a common second shutdown route. This means that the PSS 3032 can be used for single-channel operation in applications conforming to EN 954-1 (11/94), up to safety category 3. Please note that the second shutdown route is only tested when the system switches from STOP to RUN and that a feedback control loop must be used with single-channel operation.

To achieve category 4, dual actuators must be connected to two different outputs.

- If a short circuit occurs between the lead from the output to the load and the 24 VDC supply lead, it will no longer be possible to switch off the load. The following remedies are possible:
  - Eliminate the possibility of an error by using separate multicore cable for the 24 VDC
  - Use dual actuators for safety
  - Use an additional shutdown device such as a main contactor.

Configuration



Please ensure safety regulations and EMC guidelines are observed!

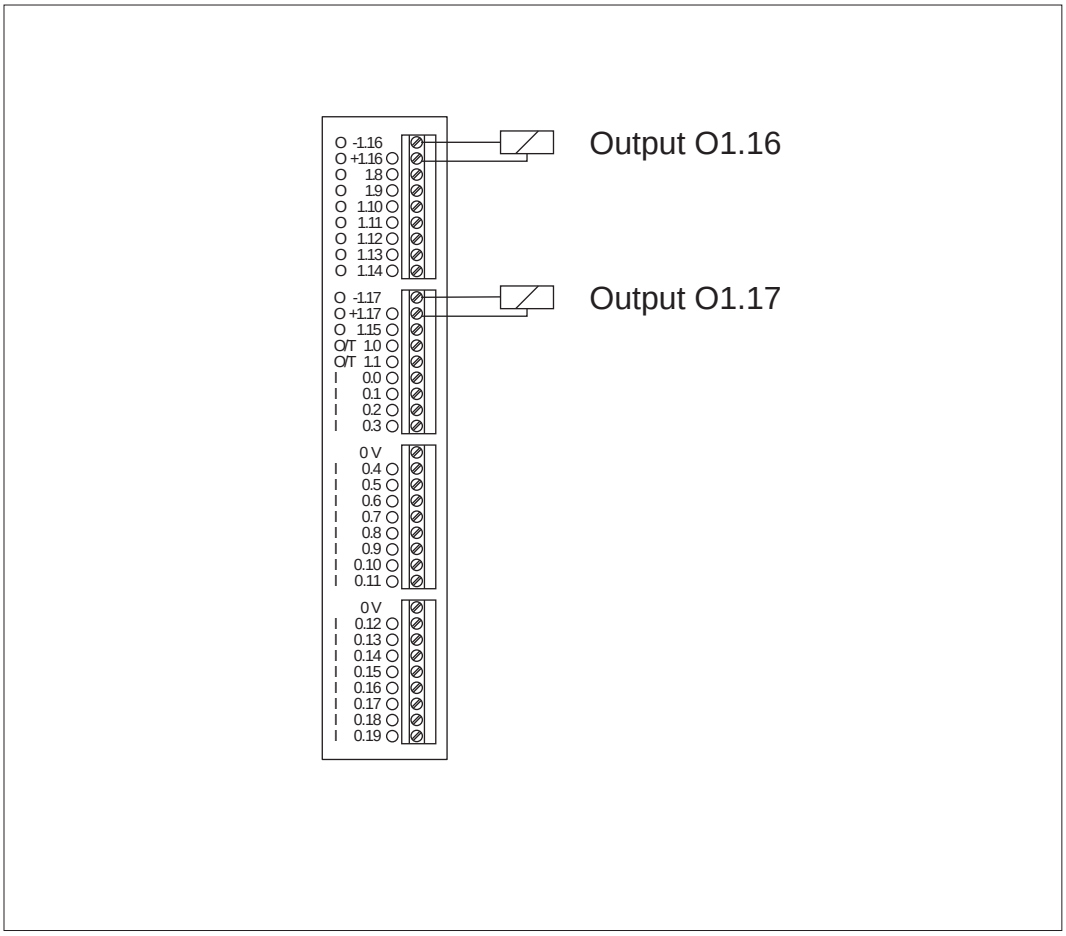
Connecting the Inputs and Outputs

Dual-pole 2 A outputs

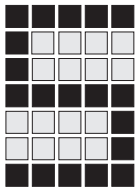
Features:

- 2 dual-pole outputs, O1.16 and O1.17
- The outputs are dual-pole switching 2 A outputs.
- The PSS 3032 operating system tests the outputs during each cycle. Any short circuits or open circuits to the load will be detected.
- During testing, the load is isolated from the supply for 100 ... 200 µs in each cycle (depending on the load and the line length). The load must not switch off during this time.
- Error messages can occur when testing outputs on which the contactors are smaller than the recommended load. The error messages are triggered by too high an inductance on the contactors. In this case it helps to have a 1 kOhm resistor connected in parallel to the contactor coil.
- Each output is protected against short circuit, overload and overtemperature. Outputs are designed for resistive and inductive loads.

Configuration



Please ensure safety regulations and EMC guidelines are observed!



Notes

Interfaces

PG programming interface

The programming interface is an RS 485 interface, enabling communication between the programming device and the PSS safety system.

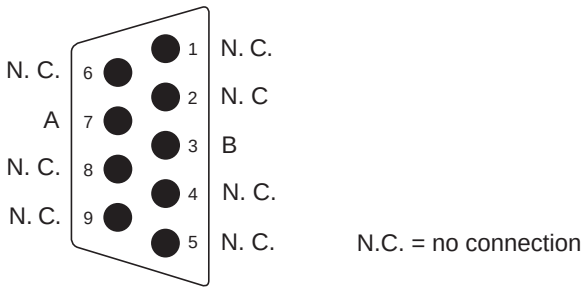


Fig. 6-1: Configuration of the programming interface

RS 232 user interface

The user interface operates to the RS 232C standard and can be individually configured. A detailed description of the interface can be found in the “FS System Description” and “ST System Description” which form part of the “PSS-Range System Manual”.

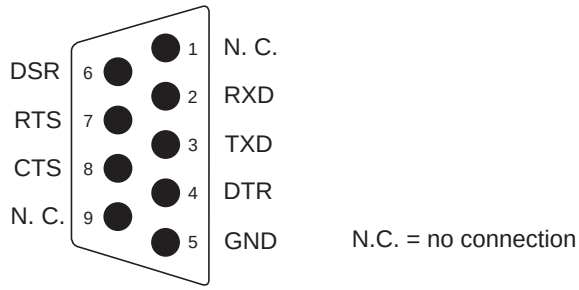
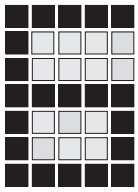


Fig. 6-2: Configuration of the user interface



Notes

Appendix

Changes to the Installation Manual

Changes from version III to version IV

Old page	New page	Change
1 ff.	2 ff.	Chapter entitled “Safety Regulations” was restructured and the contents corrected
2-2	3-2	Description: “Connecting the earth cables” was amended
2-3	3-3	Section entitled “Cabling” was amended
2-5	3-5	Section entitled “Suppression of inductive loads” was amended
2-5	3-5	Section entitled “EN 61 000-4-5” was deleted
2-8	3-8	The standards the power supply must meet were added
-	5-1	Connector description added
-	6-1	Interface configuration added

Changes from version IV to version V

Old page	New page	Change
2-3	2-3	Environmental data: Condensation is not permitted.
2-4	2-4	The use of wiring which can withstand insulation temperatures of 75° C is no longer specified.

Changes from version V to version VI

Old page	New page	Change
5-14	5-14	Do not use the test pulse outputs to drive a load to L+.
5-14	5-14	Warning: Exemple inserted

Notes

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