

Screw terminal boards, Relay output boards, connection cables



EMC-compliant selection of electromechanical components:

A complete range of products for safety!

In automation systems in which a PC has to undertake important controlling and regulating tasks, it must be guaranteed that data transfer is reliable. The interaction between all components determines the function safety of the whole system. The selection of each single component is therefore an important part of the interface structuring. Provided the PC enables data exchange with external devices through addition of plug-in boards, it can function as the central switching unit of a production process. Through the connection cables, interference is emitted and coupled, which largely influences the electronic properties of the extension boards and as a consequence the properties of the PC.

An interface board with a low-emission design and an adequate protection circuitry of the interface is a basic condition for the interaction of components. ADDI-DATA offers a large product range of EMC compliant boards. However, it also depends on the data transfer lines, whether the data exchange with external devices is disturbed and meets the requirements of the EMC specifications and EU directives or not.

Selecting the right cable

The connection cable as a mechanical device is not submitted to the EMC specifications, though it can affect the emission immunity of the devices to which it is connected. Therefore a thought-out conception requires connection cables with a braid shielding.

The selected connectors are to be connected to the cable shielding at low impedance to create earthing on both connector ends; This earthing is indispensable for shielding against electromagnetic fields. To this end the cable braid shielding has to be connected on both sides with the metallised plastic hoods of the connector.

Noise immunity of the board is additionally increased through the adapted pin assignment of the cables because the way the cable leads are twisted in pairs corresponds to the pin assignment of the boards.

Using pin-compatible screw terminals

Screw terminal boards are indispensable in most of the industrial applications. They dispatch to the sensors, tracers or control modules the numerous signals which are to be processed. If screw terminal boards are used to transmit the signals from the PC board, several conditions are to be considered: to avoid any connection errors, the screw terminal board should be pin-compatible with the PC board. The terminal board can thus lead the control signals in increasing order from the PC to the screw terminal which also corresponds to the bit set in the board. Besides the pin compatibility, the ADDI-DATA screw terminal boards have other advantages

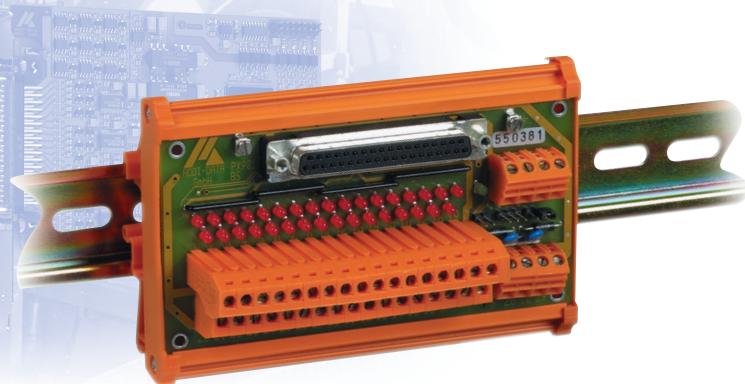
- Adaptability to the signal form: the screw terminal boards used for processing digital signals are equipped with status indicator LEDs. For the analog signals, diodes for overvoltage protection are mounted on the screw terminal board.
- Separate fuse protection: the digital 24 V extension boards require an external 24 V supply. To this end a separate 4-pin screw terminal is mounted on the terminal board for connecting the external supply voltage without additional installation. Varistors and diodes for overvoltage protection are connected to the screw terminals to prevent emissions from the external supply voltage.
- Earth connection terminal: the cable cannot be earthed on the SUB-D connector of the terminal board. Yet, a connection between housing and shield can be built through the ground connection terminal. An earthing on both sides is then created, reducing interference emissions and increasing noise immunity against electromagnetic radiation.

Screw terminal boards and relay output boards



	Description	Function display with LEDs	Overvoltage protection of the 24 V supply voltage	Available functions	Connection to	Page
PX 901	Terminal board for connecting up to 32 signal lines	PX 901-D: yes	through varistors and transorb diodes	PX 901-D: For digital boards with 32 LEDs for status display of the data lines PX 901-DG: Same as PX901-D with housing for DIN rail PX 901-A: For analog boards with transorb diodes for protecting the analog I/O against overvoltage PX 901-AG: Same as PX901-A with housing for DIN rail PX 901-ZG: For counter boards with housing for DIN rail	ADDI-DATA digital, analog or counter, boards	125
PX 9000	Terminal board for connecting up to 32 signal lines	for 24 V and sensor supply	through varistors and transorb diodes		All ADDI-DATA digital boards	126
PX 9200	Terminal board for connecting 22 signal lines and 4 analog channels	for 24 V and sensor supply	through varistors and transorb diodes		For multifunction board APCI-3122; and for analog board APCI-3504	127
PX 8500	Relay output board with 8 relays, cascadable to 16, 24 and 32 relays	for the relays and 24 V supply	through varistors and transorb diodes	PX 8500: Without varistors and with housing for DIN rail PX 8500-G: With housing for DIN rail PX 8500-V+G: With varistors and housing for DIN rail	APCI-1500, APCI-1516, APCI-1564, APCI-2016, APCI-2032, PA 1500, PA 2000, CPC-1500	128

Screw terminal board for DIN rail



The screw terminal board PX 901-xx is used for the connection of maximum 32 signal or signal-reference lines.

ADDI-DATA boards can be connected through 37-pin SUB-D female connector with our standard cables of the STxx series.

The housing of the female connector is connected with two ground terminals so that the board is additionally earthed for more security. All components of the board are enclosed in an earthing strip also connected to the ground terminals.

Each terminal is directly connected to one pin of the 37-pin SUB-D female connector. The designations on the terminals indicate the respective connections for the 37-pin SUB-D female connector.

The PX 901-D version is equipped with LEDs which are ideal for status display when working with ADDI-DATA digital 24 V I/O boards.

The PX901-A version is fitted with transil diodes for analog signals, but without LEDs.

An additional 4-pin terminal is available in order to be able to connect more than one 24 V operating voltage and ground line.

The 24 V or the ground terminal can be connected very easily through wire wrap to the 4-pin terminal.

The 24 V operating voltage lines are additionally protected against overvoltage through varistors and transil diodes.

Features

- Connection of up to 32 signal lines
- Separate ground connections
- Connection through screw terminals
- 2 rows of terminals
- Terminals can be labelled
- Additional 4-pin terminal for connecting the ground or the supply voltage
- With housing for mounting on a standard supporting rail
- All terminals intended for large conductor cross sections: up to 2.5 mm²

ADDIVARIOUS PX 901

Screw terminal board. Incl. technical description

Versions

PX 901-D: For digital boards, with status display through LEDs

PX 901-DG: same as PX 901-D, with housing for DIN rail mounting

PX 901-A: For analog boards, with transorb diodes

PX 901-AG: same as PX 901-A, for DIN rail mounting

PX 901

32 terminals for signal lines

LED indicator status for digital signals

Varistors for analog signals

DIN-rail mounting

Direct connection to ADDI-DATA boards

Safety features

- Overvoltage protection of the 24 V supply terminals through varistors and transil diodes

Applications

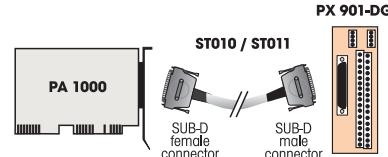
- Process control
- Industrial measuring
- Acquisition of sensor data
- Signal analysis

Specifications

Signal line terminals:	32 for the connection of peripherals
Additional terminals:	- 4 for feeding the external operating voltage (digital I/O) - 2 for the connection of ground lines
Status display:	32 LEDs for status display, 1 LED for the indicator status of the operating voltage (version D)
Safety features:	Varistors and transil diodes
Connector:	37-pin SUB-D female connector
Dimensions of the printed circuit: (L x W x H)	130 x 70 x 35 mm
Dimensions with housing:	(L x W x H) 132 x 87 x 70 mm
Temperature range:	0-70°C

Example

Connection of a digital input board through screw terminal board PX 901-DG



BESTELLINFORMATIONEN

PX 901-ZG: For the counting board PA1700-2 and for analog output boards with current outputs, and for connecting digital I/O on some ADDI-DATA boards.
With housing for DIN rail mounting

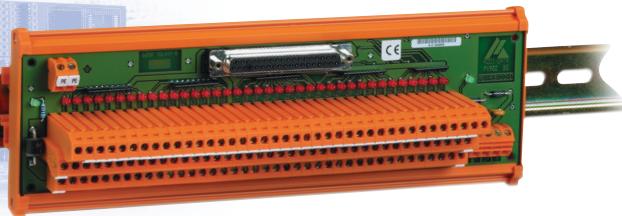
Connection

Not included with the board, please order separately!

ST010: Standard round cable, shielded, twisted pairs, 2 m

ST011: Standard round cable, shielded, twisted pairs, 5 m

Screw terminal board for DIN rail



The screw terminal board PX 9000 is intended for the connection of maximum 32 signal lines and the voltage supply for the external sensors/actuators. All components of the board are enclosed in an earthing strip which is also connected to the ground terminals.

On the 3x39-pin terminal block, all 37 contacts of the 37-pin female connector are assigned a contact on a row of terminals. Each signal line (terminal 1-32) is assigned a status LED.

Both other rows of terminals are intended for connecting the voltage supply for the sensors/actuators. These rows are protected against unintentional voltage reversal through a diode. A LED indicates when a voltage is applied.

These rows of terminals are equipped with 2 additional terminals, one on the right and one on the left side, for the easy connection of the voltage supply to a further terminal board.

4 further screw terminals are at disposal for the supply voltage of ADDI-DATA digital I/O boards: two for the connection of the 24 V operating voltage and two for the operating ground.

Both terminals for the operating voltage 24V are in addition protected against overvoltages through varistors and transorb diodes.

Features

- Connection of up to 32 signal lines through screw terminals
- 3 rows of terminals, terminals can be labelled
- LED indicator status

PX 9000

3-row screw terminal board

LED indicator status for digital signals

DIN-rail mounting

- Separate ground connection
- Additional 4-pin terminal for the direct connection of the ground and the 24 V supply voltage to ADDI-DATA boards
- With housing for mounting on a standard supporting rail
- All terminals intended for large conductor cross sections: up to 2.5 mm²
- 2 x 39 screw terminals to the distribution of the voltage supply e.g. on sensors and for cascading several PX9000

Safety features

- Overvoltage protection of the 24 V supply terminals through varistors and transil diodes

Specifications

Signal line terminals:	32 for the connection of peripherals
Supply voltage terminals:	2 rows of 39 terminals
Additional terminals:	- 4 terminals for the external voltage supply (digital I/O) - 2 for the connection of ground lines
Status display:	37 LEDs for status display, LEDs for the display of the operating voltage
Safety features:	Varistors and transil diodes, ground connection
Connector:	37-pin SUB-D female connector
Dimension of the board:	(L x W x H) 244 x 68 x 35 mm
Abmessungen with housing:	(L x W x H) 248 x 87 x 78 mm
Temperature range:	0-70°C

PX 8000

Screw terminal board, for DIN rail

Connection of 50 signal lines

Side elements with labels

- For conducting cross section of 1.5 mm²
- I/O test voltage: 2.5 kV, 50 Hz, 60 s
- Operating temperature range: - 20 °C to + 50 °C
- Dimensions (L x W x H): 155 x 45, 42 mm
- DIN rail mounting
- Current/voltage: 2.5 A / 125 V

ORDERING INFORMATION

ADDIVARIOUS PX 9000

Screw terminal board, with housing for DIN rail mounting, incl. technical description

ADDIVARIOUS PX 9000

Three-row screw terminal board, with housing for DIN rail mounting, incl. technical description

Connection please order separately!

ST010: Standard round cable, shielded, twisted pairs, 2 m

ST011: Standard round cable, shielded, twisted pairs, 5 m

ADDIVARIOUS PX 8000

Screw terminal board, with housing for DIN rail mounting.

Connection please order separately!

ST370-16: Standard round cable, shielded, twisted pairs, 2 m

ST8001: Cable for connecting APCI-8001 and OPMF 50-pin

Screw terminal board for DIN rail



The terminal board PX 9200 combines the connection of analog and digital signals. It features 2 separate cable connectors between the digital and the analog signals. Both signal types are driven through one own layer board and are protected between each other.

The two terminals blocks for the digital signals allow to connect 22 lines distributed as follows: 12 lines for digital output signals and 10 lines for digital input signals. The cable ST3122-D is used for digital data transfer to the ADDI-DATA boards and is equipped with a 26-pin SUB-D high-density female connector.

The terminal block for the analog signals allow to connect 4 analog channels with a separated ground line. The cable ST3122-D is used for analog data transfer to the ADDI-DATA boards and is equipped with a 15-pin SUB-D high-density female connector.

All components of the layer board are included in an earthing strip which is itself connected to the earthing terminal.

The screw terminals are labelled to differentiate the different signals (analog/digital).

The PX 9200 is supplied with LEDs for status display of the digital signals.

The analog signals are protected against fast transients and the mechanical layout allows the separation from the digital signals. The voltage supply for the analog or digital functions are driven separately.

Features

- Max. connection of 22 digital signal lines and 4 analog channels with separated ground line
- Separate ground connection
- Connection through screw terminals
- Separated connection blocks for analog and digital channels
- Terminals can be labelled
- With housing for DIN rail mounting
- All terminals for screw terminals for large conductor cross sections: up to 2.5 mm²

ADDIVARIOUS PX 9200

Screw terminal board. Incl. technical description

Version

PX 9200: for multifunction board APCI-3122 and analog output board APCI-3504 with status display through LEDs

PX 9200

**Separate connectors digital I/O
and analog outputs**

LED status display for digital signals

Transil diodes for analog signals

DIN-rail mounting

Safety features

- Transil diodes on the analog channels
- separate lines for analog and digital channels

Applications

- Process control
- Industrial measurement
- Acquisition of sensor data
- Signal analysis

Specifications

Signal line terminals:	for connecting the peripheral
Status display:	22 LEDs for digital status display, incl.: - 12 yellow LEDs for digital outputs - 10 orange LEDs for digital inputs
Safety features:	One additional LED (green) for each voltage supply (analog and digital channels)
Connector:	Varistors and transil diodes
	26-pin SUB-D female connector, high-density (digital)
Dimensions:	15-pin SUB-D female connector, high-density (analog)
Temperature range:	(L x B x H) 132 x 87 x 65 mm 0-70 °C

ST3122, high-density round cable, 2m



ORDERING INFORMATION

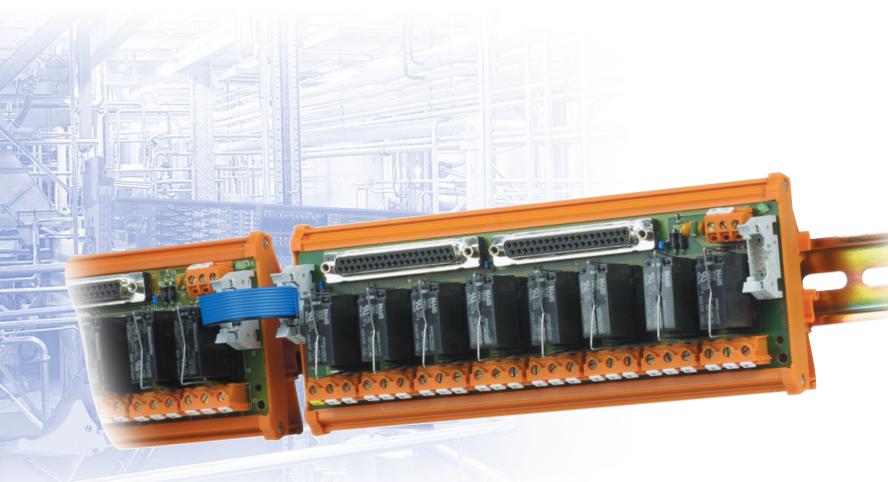
Connection

Please order separately!

ST3122-D: High-density round cable, 2 m, shielded, twisted pairs, for digital inputs/outputs

ST3122-A: High-density round cable, 2 m, shielded, twisted pairs, for analog outputs

8-channel relay output board



PX 8500

Cascadable to 16/24/32 relays

8 relays on sockets

DIN-rail mounting

30 VDC - 277 VAC

300 W - 2500 VA

10 A

The ADDIVARIOUS PX 8500 is an external 8-channel relay board for the connection of digital output boards. It can be cascaded in 16, 24 and 32 relays and is intended for mounting on DIN supporting rails. The board provides a convenient interface between an industrial process and the SUB-D connectors on ADDI-DATA boards.

The change-over contacts of the relay are controlled through 24 V signals. The 24 V voltage supply is protected through varistors and transil diodes.

The board is intended for the use with 220 V supply. The creeping distance (acc. to DIN VDE0110) and the connector cross sections allows high-power switching (up to 2,500 VA).

The board has a female SUB-D connector for connecting an ADDI-DATA digital 24 V output board through a standard I/O cable ST010. The red LEDs display the state of the relays (open/closed). A green LED displays the ON/OFF of the operating voltage.

The 37-pin cable shielded can be grounded on both sides for the protection against high-frequency EMI.

Features

- Relay output board with 8 relays, cascadable in 16, 24 and 32 relays
- Max. switching voltage: 30 VDC/277 VAC
- Max. switching current: 10 A
- All terminals intended for large conductor cross sections up to 2.5 mm²
- Operating voltage display through green LED
- Relay state display through red LED
- Relays mounted on sockets
- High switching capacity
- Long-lasting life

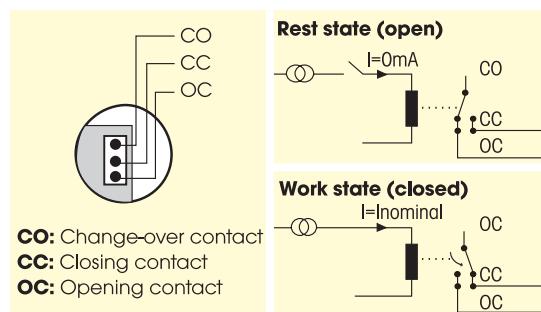
Safety features

- Overvoltage protection of the 24 V supply voltage through varistors and transil diodes
- Contact protection of the relays through varistors (Option Vt)
- 4 mm creeping distance between change-over, closer and opening contact
- 6 mm creeping distance between change-over contact and closer of adjoining relay
- Free-wheeling diode in the coil circuit
- With housing for mounting on a standard DIN rail, (option G)
- Operating safety tested according to the low-voltage directive: 73/23/EEC

Applications

- Industrial digital I/O control
- Automatic test equipment
- External high power relay control
- Alarm monitoring
- Test automation
- Alarm monitoring
- Digital monitoring
- ON/OFF monitoring of motors, lights ...
- ...

Function principle of the relays



8-channel relay output board

PX 8500

Specifications

Noise immunity test level

Electric strength of the relays	
At open contact:	1000 Veff
Contact coil:	5000 Veff
Isolation structure of the board according to VDE0110:	Group C/250VAC/300VAC

Contact side

Type of contacts:	8 change-over contacts
Max. switching voltage:	30 VDC - 277 VAC
Max. switching capacity:	300 W - 2500 VA
Max. switching current:	10 A
Contact resistance:	<100 mW
Response time:	15 ms
Release time:	5 ms
Mechanical life:	5,000,000 operations
Operating time at max. switching capacity:	100,000 operations

Control side

Switching behaviour:	Monostable
Operating voltage:	24 VAC
Operating efficiency:	533 mW
Switching frequ. at max. load:	20 switchings/minute
Threshold voltage at +20°C:	16.8 V
Release voltage at +20°C:	2.4 V

Physical and environmental conditions

Operating voltage:	+ 24 V
Current consumption:	210 mA typ.
Dimensions (L x W x H):	210 x 68 x 42 mm
Dimensions (L x W x H):	With housing 212 x 87 x 72 mm
Connector:	2 x 37-pin SUB-D female connector
X1:	For the connection to the PC
X2:	For cascading the PX 8500 in max. 32 relays, for example for the digital output board PA 2000. In this case digital output signal 1 corresponds to the 24 V control signal of the relay 1, output 2 to relay 2, etc ...
Temperature range:	0-70°C
Humidity:	30-95 %

Standard round cable ST010



ADDIVARIOUS PX 8500

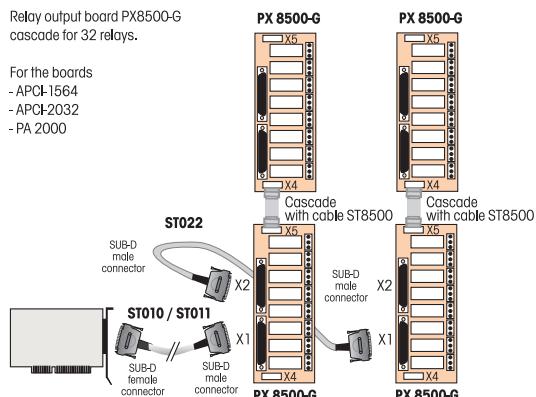
8-channel relay output board. Incl. technical description

- PX 8500:** Basic board with 8 relays
- PX 8500-G:** with housing for mounting on DIN rail
- PX 8500-Vt:** PX 8500 with varistors
- PX 8500-VtG:** PX 8500 with varistors and housing for mounting on DIN rail

PX 8500 cascaded in 32 relays

Relay output board PX8500-G cascade for 32 relays.

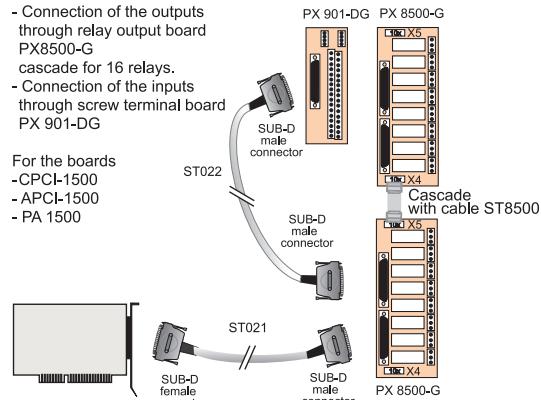
- For the boards
- APCI-1564
- APCI-2032
- PA 2000



PX 8500 cascaded in 16 relays

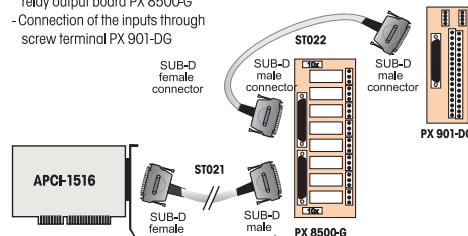
- Connection of the outputs through relay output board PX8500-G cascade for 16 relays.
- Connection of the inputs through screw terminal board PX 901-DG

- For the boards
- CPCI-1500
- APCI-1500
- PA 1500



Connection example for the board APCI-1516

- Connection of the outputs through relay output board PX 8500-G
- Connection of the inputs through screw terminal PX 901-DG

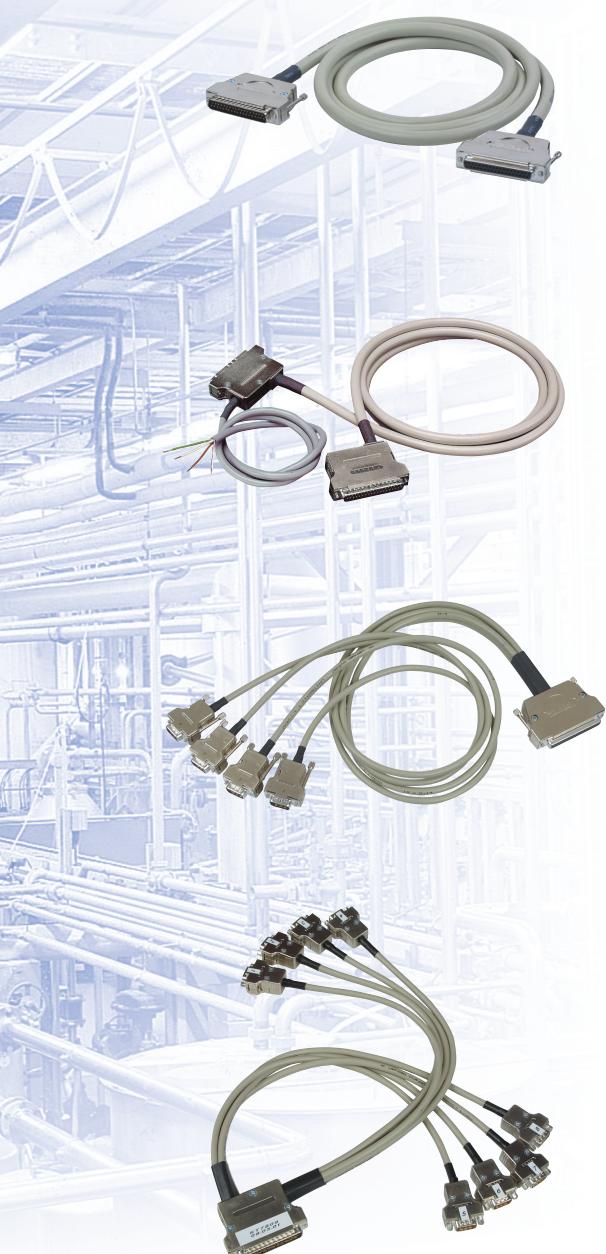


ORDERING INFORMATION

Connection

- ST8500:** Ribbon cable for cascading the board to 16, 24 or 32 relays
- ST021:** Standard round cable, shielded, for connecting the APCI-1500, PA 1500, APCI-1516
- ST022:** Standard round cable, shielded, for cascading two PX 8500
- ST010:** Standard round cable, shielded, twisted pairs, 2 m, for connecting the PA 2000, APCI-2032, APCI-1564
- ST011:** Same as ST010, 5 m

Shielded cables for industrial applications



Standard round cables, shielded

ST010, ST011

- Standard round cable, shielded, 2 or 5 m for digital, analog and counter boards
- Twisted pairs
- 37-pin SUB-D female connection to 37-pin SUB-D male connector
- Metallized hoods
- Other length on request

ST010-S, ST011-S

- Standard round cable, shielded, for high current, 2 or 5 m
- For digital output boards
- Twisted pairs
- 37-pin SUB-D female connector to 37-pin SUB-D male connector
- Metallized hoods
- Other length on request

Connection cable for serial interfaces, shielded

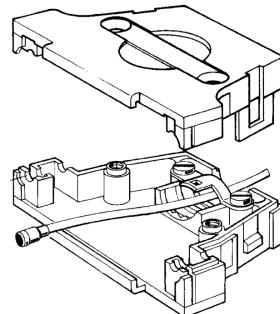
ST074, ST075

- Standard round cable, shielded, for 4-port serial interfaces.
- Twisted pairs
- 37-pin SUB-D female connector to 4 x 25-pin SUB-D male connector (ST074) or 25-pin SUB-D male connector to 4 x 9-pin (ST075)
- Metallized hoods
- Length 35 cm, other length on request

ST7809, ST7825

- Standard round cable, shielded, 35 cm, for 8-port serial interfaces.
- Twisted pairs
- 78-pin SUB-D male connector to 8 x 9-pin SUB-D male connector (ST7809) or to 9 x 25-pin SUB-D male connector (ST7825) (78-pin to board, 9-pin, 25-pin to peripheral)
- Metallized hoods

Shielded metallized hoods with strain relief



Application:

Suitable for use as control or signal cables in noisy environment, for indoor or outdoor applications.

The tight braid reduces the emissions. The copperbraid is used as "ground". Twisted pairs provide protection against crosstalk and external interference.

Construction of the cable

- Plain copper conductor, fine-strand according to VDE 0295 class 5
- Special PVC conductor insulation
- Twisted-pair conductors
- Core identification according to DIN 47100
- Conductors laid up in layers
- Paper tape
- Tinned copper braid shielding
- Covering grade approx. 85%
- Special outer sheath, grey PVC
- Oil and petrol resistant according to VDE 0250 and 04772
- Self-extinguishing (SE) and flame-retardant, B test according to VDE 0472 part 804 and IEC 332-1

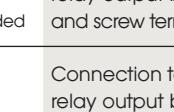
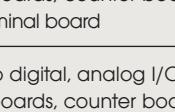
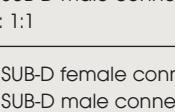
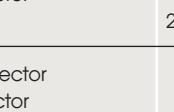
Specifications of the cable

Specifications:	Special PVC data line for electronic control tasks according to VDE 0812 and 0814
Temperature range:	-5°C to +80°C
Nominal voltage:	350 V
Test voltage:	2000 V
Insulation resistance:	± 20 MW/km
Inductance:	Approx. 0,65 mH/km
Impedance:	Approx. 78 W
Capacitive coupling:	Approx. 300 pF/100m
Connector cross section:	0.14 mm ² (ST010-S and ST011-S with a connector cross section of 0.25 mm ²)
Material and finish:	ABS, flame-retardant to UL 94 V-0, plastic with nickel finish over Cu.
Temperature range:	-35°C to +95°C
Attenuation factor:	> 40 dB between 300 and 900 MHz
Construction:	The cable screen is screwed low-impedance over strain relief on both sides of the housing hood with locking screws, the connections are crimped.

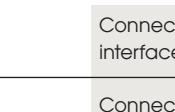
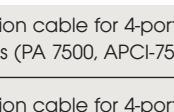


Shielded cables for industrial applications



Cable designation	Application	Connections	Length
Shielded standard round cable, twisted pairs and with metallized hoods			
 ST010 Connector cross section 0.14 mm ² twisted pairs, shielded	Connection to digital, analog I/O boards, relay output boards, counter boards and screw terminal board	37-pin SUB-D female connector 37-pin SUB-D male connector Wiring: 1:1	2 m
 ST011	Connection to digital, analog I/O boards, relay output boards, counter boards and screw terminal board	37-pin SUB-D female connector 37-pin SUB-D male connector Wiring: 1:1	5 m
 ST010-S and ST011-S Connector cross section 0.25 mm ² for data line 0.752 mm ² (for external supply)	Connection to digital boards intended for higher currents CPCI-1500, APCI-1500, APCI-1564, APCI-2032, PA1500, PA 1508, PA 2000	same as ST010 and ST011 Wiring: 1:1	2 m, 5 m
 ST021	Connection cable between CPCI-1500, APCI-1500, APCI-1516, PA1500, and relay output board PX 8500	37-pin SUB-D male connector 37-pin SUB-D female connector	2 m
 ST022	Connection cable between - 2 relay output boards PX 8500 - PX 8500 and PX 901-D or PX 9000	2 x 37-pin SUB-D male connector Wiring: 1:1	2 m
 ST3122-A ST3122-D	Connection cable between APCI-3122/APCI-3504 and PX9200 analog outputs APCI-3122 and PX9200 digital inputs/outputs	2 x 26-pin SUB-D HD male connector 2 x 15-pin SUB-D HD male connector	2 m 2 m
 ST3701	Connection cable between APCI-3701 and PX 3701-8	50-pin SUB-D male connector 50-pin SUB-D female connector	2 m
 ST370-8	Connection cable between PA 370-8 and PX 371-8	50-pin SUB-D male connector 50-pin SUB-D female connector	2 m
 ST370-16	Connection cable between - PA 370-16 and PX 371-16 - PA 2200 and PX 8000 - APCI/CPCI-1710 and PX 8000	50-pin SUB-D male connector 50-pin SUB-D female connector	
ST8001	- PA 8000 or APCI-8001 and PX 8000		2 m

Other length on request

Cable designation	Application	Connections	Length
Connection cable, twisted pairs and with metallized hoods for the communication boards ADDICOM			
 ST074	Connection cable for 4-port serial interfaces (PA 7500, APCI-7500)	1 x 37-pin SUB-D female connector 4 x 25-pin SUB-D male connector	35 cm
 ST075	Connection cable for 4-port serial interfaces (PA 7500, APCI-7500)	1 x 37-pin SUB-D female connector 4 x 9-pin SUB-D male connector	35 cm
 ST7809	Connection cable for 8-port serial interfaces (APCI-7800)	1 x 78-pin SUB-D male connector 8 x 9-pin SUB-D male connector	35 cm
 ST7825	Connection cable for 8-port serial interfaces (APCI-7800)	1 x 78-pin SUB-D male connector 8 x 25-pin SUB-D male connector	35 cm

Cable designation	Application	Connections	Length
Ribbon cable			
FB2200-1/FB1700	Ribbon cable for PA 2200-8-8 and PA 2200-16-8 or PA 1700-2	1 x 34-pin female connector 1 x 37-pin SUB-D male conn. with bracket	20 cm
FB3000	Ribbon cable for PA 3000, PA 3500, APCI-3120, APCI-3501, APCI-3001	1 x 16-pin female connector 1 x 37-pin SUB-D male conn. with bracket	25 cm
FB311	Ribbon cable for PA 311 oder PA 3100	1 x 26-pin female connector 1 x 37-pin SUB-D male conn. with bracket	35 cm