6.5. ENCODER BOARD ES836 (SLOT A)

Board for incremental, bidirectional encoder to be used as a speed feedback for inverters of the SINUS PENTA series. The board is to be installed in SLOT A, described in paragraph 6.5.3

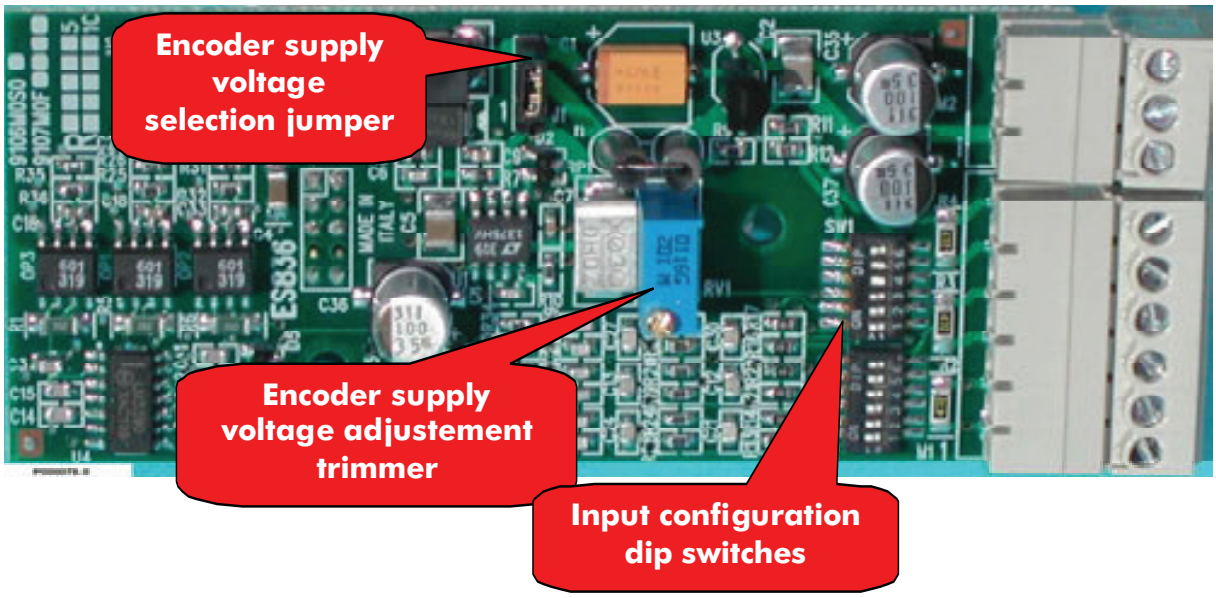

Fig. 66: Picture of the encoder board ES836

DESCRIPTION	ID NUMBER	COMPATIBLE ENCODERS	
		POWER SUPPLY	OUTPUT
Universal encoder acquisition board ES836	ZZ0095832	5 V, 12 V or 24 V	LINE DRIVER, PNP, NPN, PUSH-PULL

6.5.1. ENVIRONMENTAL REQUIREMENTS

Operating temperature:	0 to +50 °C ambient temperature (contact Elettronica Santerno for higher ambient temperatures)
Relative humidity:	5 to 95% (Non condensing)
Max. operating altitude	4000 m (a.s.l.)

6.5.2. ELECTRIC FEATURES

Connection to encoder	*Value*			
	Min	*Typ*	*Max*	*Unità*
Encoder supply current, + 24 V, protected with self-resetting fuse			200	mA
Electronically protected encoder supply current, + 12 V			350	mA
Electronically protected encoder supply current, + 5 V			900	mA
Adjustment range for encoder supply voltage (5 V mode)	4.4	5.0	7.3	V
Adjustment range for encoder supply voltage (12 V mode)	10.3	12.0	17.3	V
Input channels	Three channels: A, B and zero notch Z			
Voltage range for encoder input signals	Differential or single-ended			
Voltage range for encoder input signals	4		24	V
Pulse max. frequency with noise filter setting on	77kHz (1024imp @ 4500rpm)			
Pulse max. frequency with noise filter setting off	155kHz (1024imp @ 9000rpm)			
Input impedance in NPN or PNP mode (auxiliary pullup or pulldown resistors required)		15k		Ω
Input impedance in line driver mode or push-pull mode at maximum frequency		3600		Ω

ISOLATION:

The encoder supply line and inputs are galvanically isolated from the inverter control board grounding for a 500 VAC test voltage for 1 minute. Encoder supply grounding is in common with control board digital inputs available in the terminal board

6.5.3. INSTALLING THE ENCODER BOARD ON THE INVERTER (SLOT A)

1) Turn off the inverter and wait at least 5 minutes.
2) Remove the cover allowing to gain access to the inverter control terminals. The mounting columns for the encoder board and signal connector are located on the left.

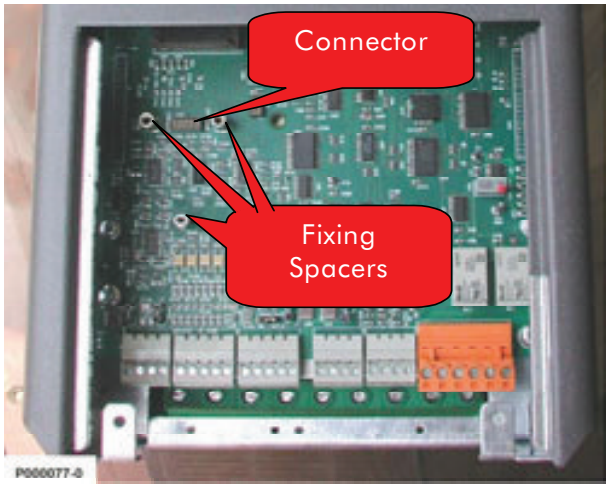

Fig.67: Position of the slot for the encoder board installation

3) Fit the encoder board and make sure that all contacts enter the relevant housing in the signal connector. Fasten the encoder board to the metal columns using the screws supplied.
4) Configure dip-switches and the jumper located on the encoder board based on the connected encoder; check that the supply voltage delivered to the terminal output is correct.
5) Turn on the inverter and set the parameters relating to the encoder feedback(see Programming Manual).

Fig.68: Encoder board fastened to its slot

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6.5.4. ENCODER BOARD TERMINALS

A 9-pole terminal board is located on the front side to perform connections to the encoder board.

Terminal board, pitch 3.81 mm in two separate extractable sections (6-pole and 3-pole sections)		
Terminal	Signal	Type and features
1	CHA	Encoder input channel A true polarity
2	CHA	Encoder input channel A inverse polarity
3	CHB	Encoder input channel B true polarity
4	CHB	Encoder input channel B inverse polarity
5	CHZ	Encoder input channel Z (zero notch) true polarity
6	CHZ	Encoder input channel Z (zero notch) inverse polarity
7	+VE	Encoder supply output 5 V/12 V/24 V
8	GNDE	Encoder supply grounding
9	GNDE	Encoder supply grounding

For the encoder connection to the encoder board, see wiring diagrams (following pages).

6.5.5. DIP-SWITCH

Encoder board ES836 is provided with two dip-switch banks to be set up depending on the type of connected encoder. Dip-switches are located in the front left corner of encoder board ES836 and are adjusted as shown in the figure below:

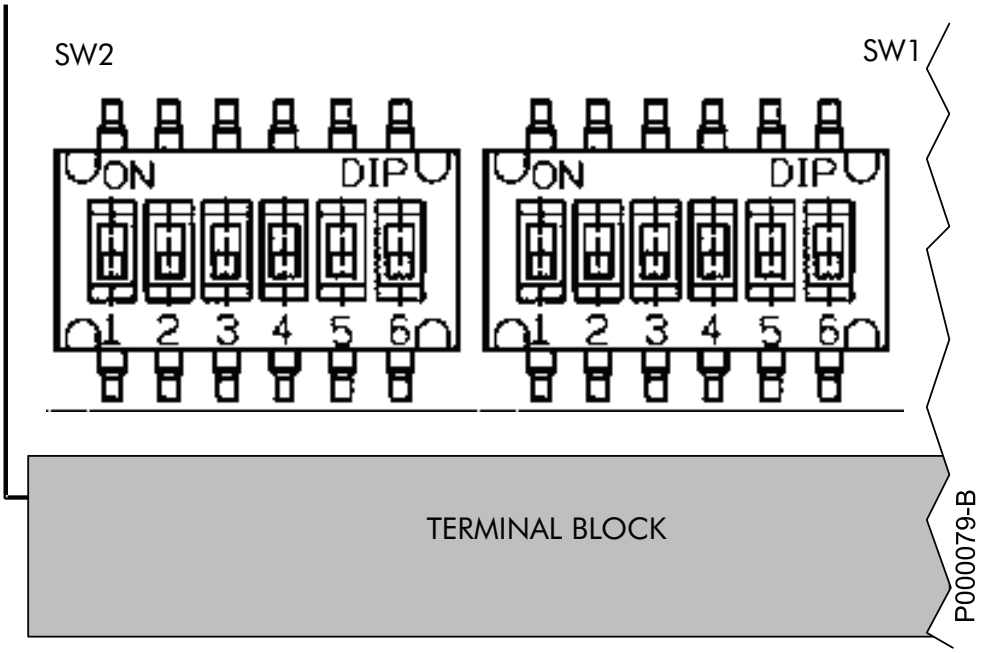

Fig.69: Position of dip-switches

Dip-switch functionality is detailed in the table below.

Switch	*OFF - open*	*ON - closed*
SW2 -1	Channel Z with no band limit	Channel Z with band limit
SW2 -2	Channel Z differential Line driver	Channel Z single-ended
SW2 -3	Channel Z type NPN or PNP	Channel Z Line driver or Push Pull
SW2 -4	Channel B with no band limit	Channel B with band limit
SW2 -5	Channel B differential Line driver	Channel B single-ended
SW2 -6	Channel B type NPN or PNP	Channel B Line driver or Push Pull
SW1 -1	Channel A with no band limit	Channel A with band limit
SW1 -2	Channel A differential Line driver	Channel A type single-ended
SW1 -3	Channel A type NPN or PNP	Channel A type Line driver or Push Pull
SW1 -4	Not used	Not used
SW1 -5	Not used	Not used
SW1 -6	Supply voltage 12 V	Supply voltage 5 V

6.5.6. JUMPER SELECTING THE TYPE OF ENCODER SUPPLY

Toggle jumper J1 installed on control board ES836 allows to set the encoder supply voltage. On position 1-2 the not adjusted supply voltage of 24V encoder has to be selected. On position 2-3 the adjusted supply voltage of 5/12V is selected. Supply values of 5 V or 12 V are to be set through dip-switch SW1-6 (see table).

6.5.7. TRIMMER

Trimmer RV1 installed on board ES836 allows to adjust the encoder supply voltage. This can compensate voltage drops in case of long distance between the encoder and the encoder board, or allows to feed an encoder with intermediate voltage values if compared to factory-set values.

Adjustment procedure:

1. put a tester on the encoder supply connector (encoder side of the connecting cable); make sure the encoder is on.
2. rotate the trimmer clockwise to increase supply voltage. Trimmer is factory set to deliver 5 V and 12 V (depending on the dip-switch selection) to the power supply termination lugs. For a power supply of 5 V, supply may range from 4.4 V to 7.3 V; for a power supply of 12 V, supply may range from 10.3 V to 17.3 V.

NOTE Output voltage cannot be adjusted by trimmer RV1 if 24 V power supply is delivered.

CAUTION: Power supply values exceeding the encoder ratings may damage the encoder. Always use a tester to check voltage delivered from board ES836 before wiring.

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6.5.8. ENCODER WIRING AND CONFIGURATION

The figures below show how to connect and configure the dip-switches for the most popular encoder types.

CAUTION: A wrong encoder-board connection may damage both the encoder and the board

NOTE In all the figures below, dip-switches SW2-1, SW2-4, and SW1-1 are in position ON, i.e. 77 kHz band limit is on. If a connected encoder requires a higher output frequency, set dip-switches to OFF.

NOTE The max. length of the encoder wire depends on the encoder outputs, not on encoder board ES836. See the encoder ratings.

NOTE Dip-switch SW1-6 is not shown in the figures because its setting depends on the supply voltage required by the encoder. See previous sections of this manual.

NOTE Zero notch connection is optional and is required only for particular software applications. However, for those applications that do not require any zero notch, its connection does not affect the inverter operation. See SINUS PENTA'S Programming Manual for any detail.

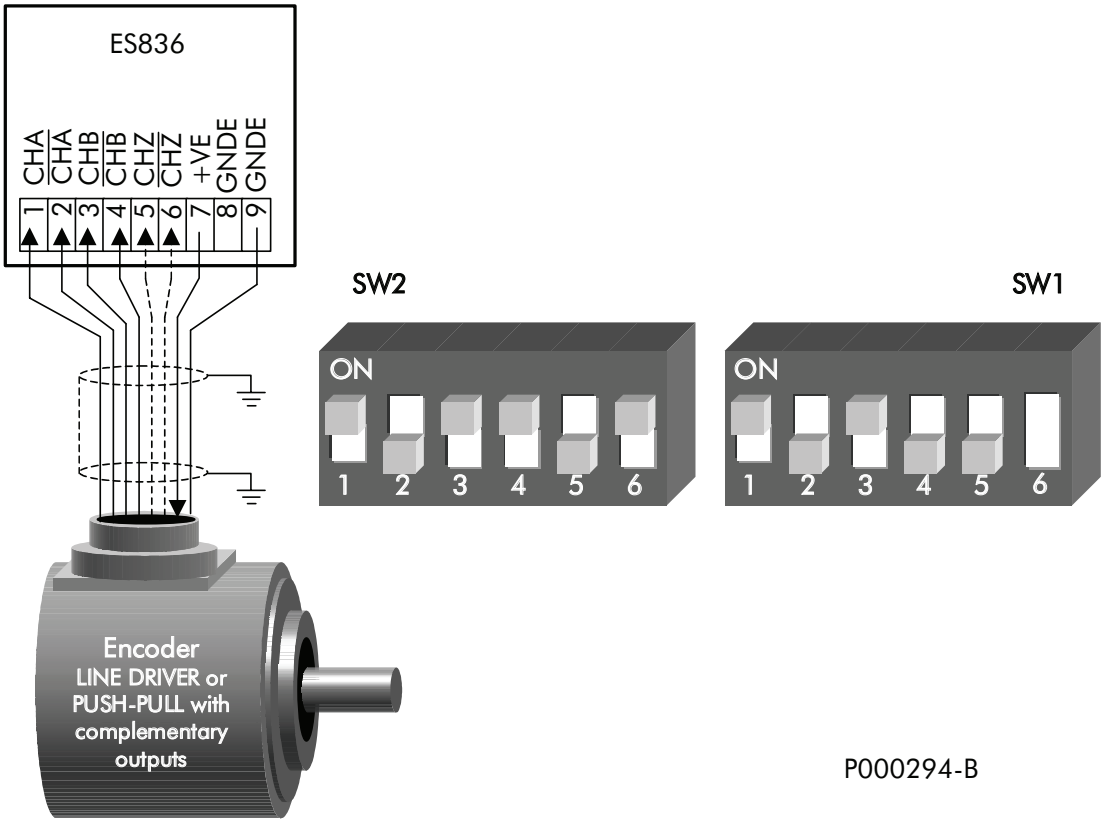

Fig.70: LINE DRIVER or PUSH-PULL encoder with complementary outputs

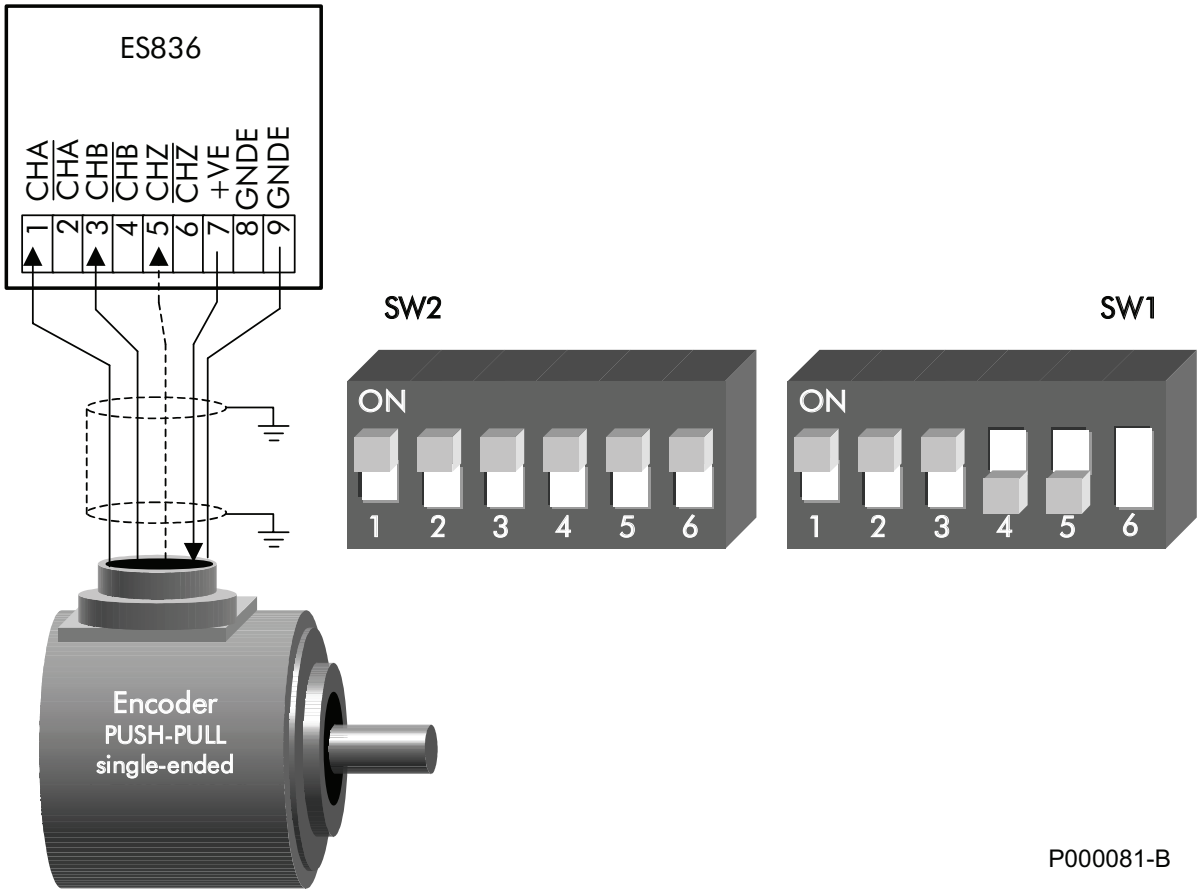

Fig.71: PUSH-PULL encoder with single-ended outputs

CAUTION

Because settings required for a single-ended encoder (dip-switches SW2-1, SW2-5, SW1-2 closed) deliver a reference voltage to terminals 2, 4, 6, the latter are not to be connected. Failures will occur if terminals 2, 4, 6 are connected to encoder conductors or to other conductors.

NOTE

Only push-pull, single-ended encoders may be used, with an output voltage equal to the supply voltage. Only differential encoders may be connected if their output voltage is lower than the supply voltage

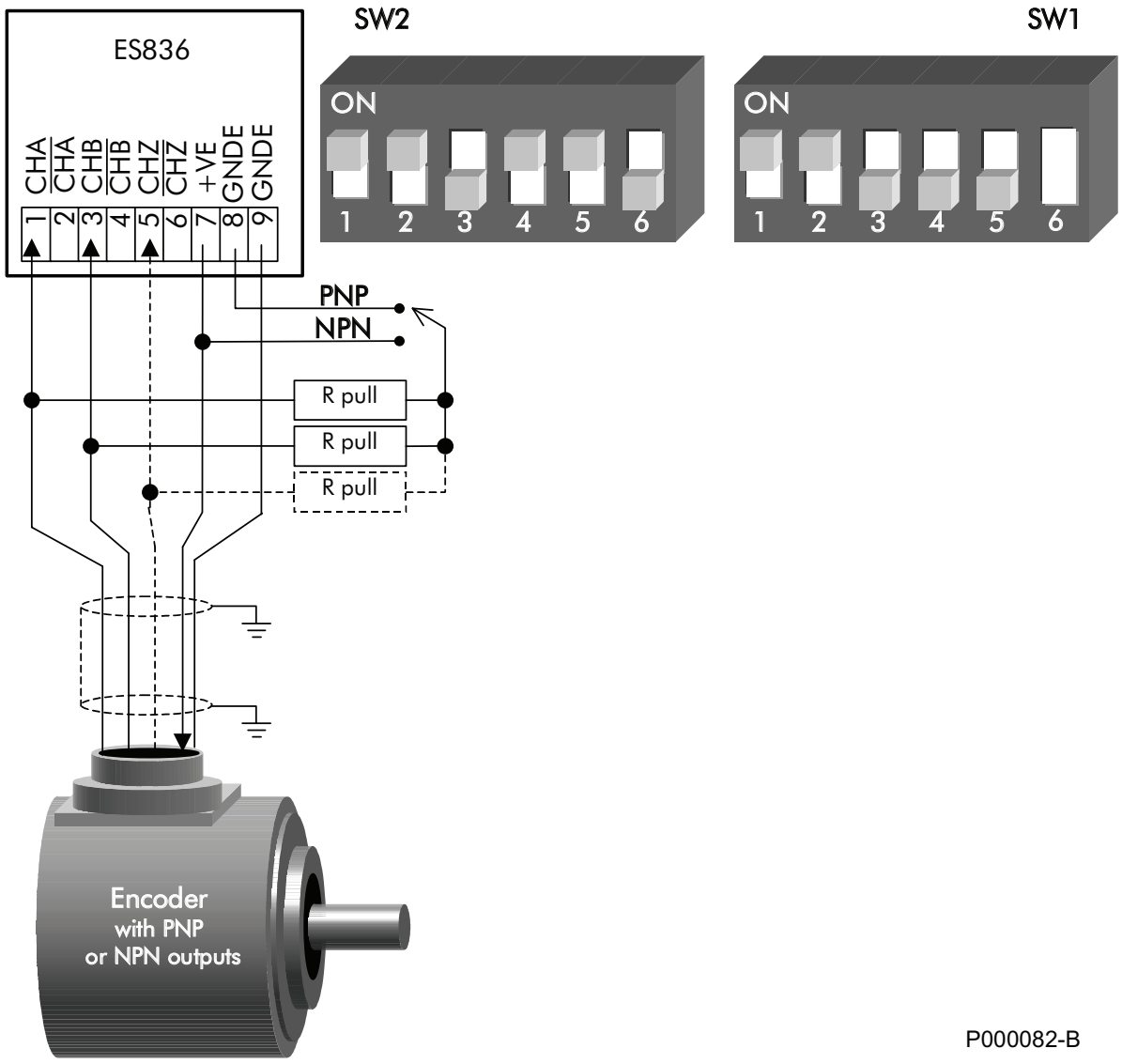

Fig.72: PNP or NPN encoder with single-ended outputs and load resistors with external wiring

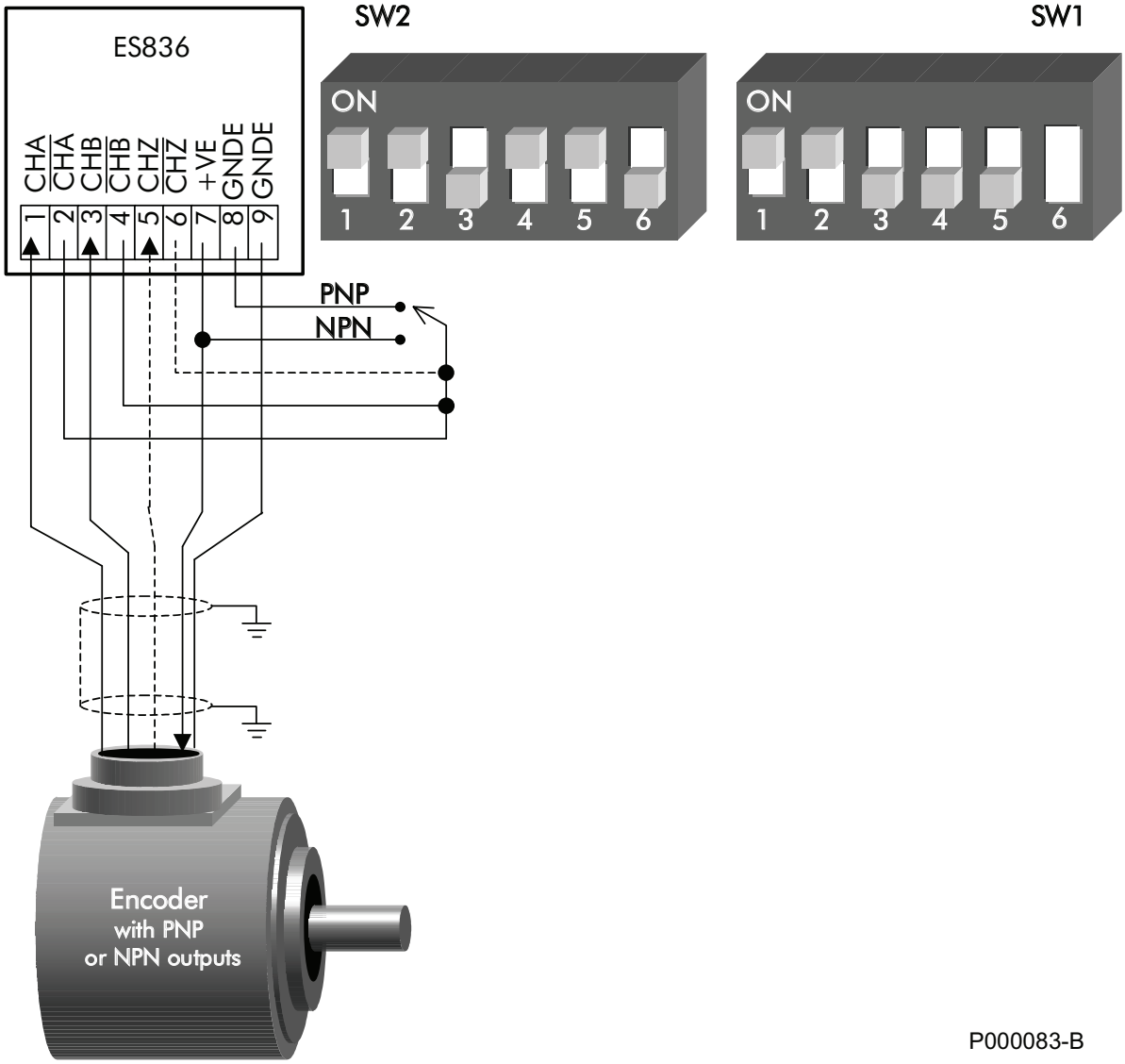

Fig.73: PNP or NPN encoder with single-ended outputs and load resistors with internal wiring

NOTE

NPN or PNP encoders are provided with outputs requiring a resistive, pull-up or pull-down load towards the power supply or the common. Load resistors are to be externally connected because their ratings are defined by the encoder manufacturer. Connect the resistor common to the mains for a NPN encoder or to the common for a PNP encoder.
Incorporated load resistors may be used only if the encoder can operate with 4700Ω resistors; their wiring is shown in Fig. 4.18.

NOTE

NPN or PNP encoders cause pulse distortions because ramps up and ramps down are different. Distortion depends on the load resistors ratings and the wire stray capacitance. PNP or NPN encoders should not be used for applications with an encoder output frequency exceeding a few kHz dozens. For such applications, use encoders with Push-Pull outputs, or better with a differential line driver output.

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6.5.9. WIRING THE CABLE

Use a screened cable to connect the encoder to the control board; screening should be grounded to both ends of the cable. Use the special clamp to fasten the encoder wire and ground the cable screening to the inverter.

Fig.74: Wiring the encoder cable

Do not stretch the encoder wire along with the motor supply cable.
Connect the encoder directly to the inverter using a cable with no intermediate devices, such as terminals or connectors.
Use a model of encoder suitable for your application (as for connection length and max. rev number).
Preferably use encoder models with complementary LINE-DRIVER or PUSH-PULL outputs. Non-complementary PUSH-PULL, PNP or NPN open collector outputs offer a lower immunity to noise.
The encoder electrical noise occurs as a difficult speed adjustment or uneven operation of the inverter; in the worst cases, it can lead to the inverter stop due to overcurrent conditions.

6.6. ISOLATED SERIAL BOARD ES822 (SLOT B)

Isolated serial board RS 232/485 controlling SINUS PENTA and SINUS K inverters allows to connect a computer through interface RS232 or allows a multidrop connection of modbus devices through interface RS485. Provides galvanic isolation of interface signals relating to both the control board ground and the terminal board common of the control board.

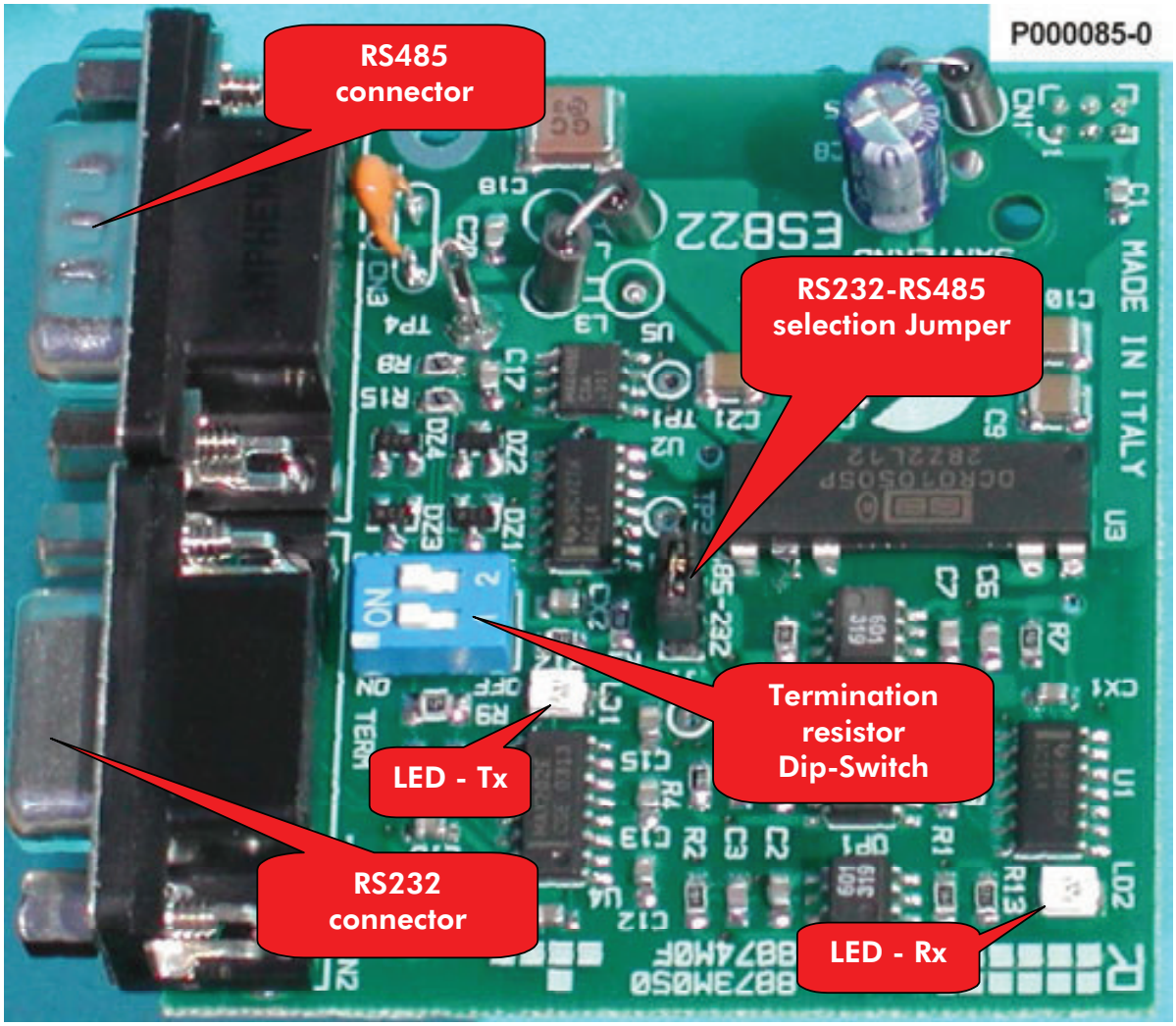

Fig.75: Picture of Board ES822

DESCRIPTION	ID NUMBER
Isolated serial board RS 232/485	ZZ0095850

6.6.1. ENVIRONMENTAL REQUIREMENTS

Operating temperature:	0 to +50 °C ambient temperature (contact Elettronica Santerno for higher ambient temperatures)
Relative humidity:	5 to 95% (Non condensing)
Max. operating altitude	4000 m (a.s.l.)

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6.6.2. ELECTRIC FEATURES

WIRING:

Once board ES822 is fitted, connector RS-485 installed on the inverter will automatically disable; D-type, 9-pole male connector (RS- 485) or female connector activate depending on the position of J1.
(RS-232-DTE) on ES 822 board.

Contacts of CN3, D-type, 9-pole male connector (RS-485) are as follows

PIN	FUNCTION
1 – 3	(TX/RX A) Differential input/output A (bidirectional) according to standard RS485. Positive polarity with respect to pins 2 – 4 for one MARK.
2 – 4	(TX/RX B) Differential input/output B (bidirectional) according to standard RS485. Negative polarity with respect to pins 1 – 3 for one MARK.
5	(GND) control board zero volt
6 - 7	not connected
8	(GND) control board zero volt
9	+ 5 V, max 100 mA for the power supply of an auxiliary converter RS-485/RS-232 (if any)

Contacts of CN2, D-type, 9-pole female connector (RS-232-DCE) are as follows

PIN	FUNCTION
1, ~~4~~ 9	not connected
2	(TX A) Output according to standard RS232
3	(RX A) Input according to standard RS232
5	(GND) zero volt
4-6	to be connected together for loopback DTR-DSR
7-8	to be connected together for loopback RTS-CTS

6.6.3. INSTALLING THE ES822 BOARD ON THE INVERTER (SLOT B)

1. Turn off the inverter and wait at least 5 minutes.
2. Remove the cover allowing to gain access to the inverter control terminals. The mounting columns for the encoder board and signal connector are located on the right.

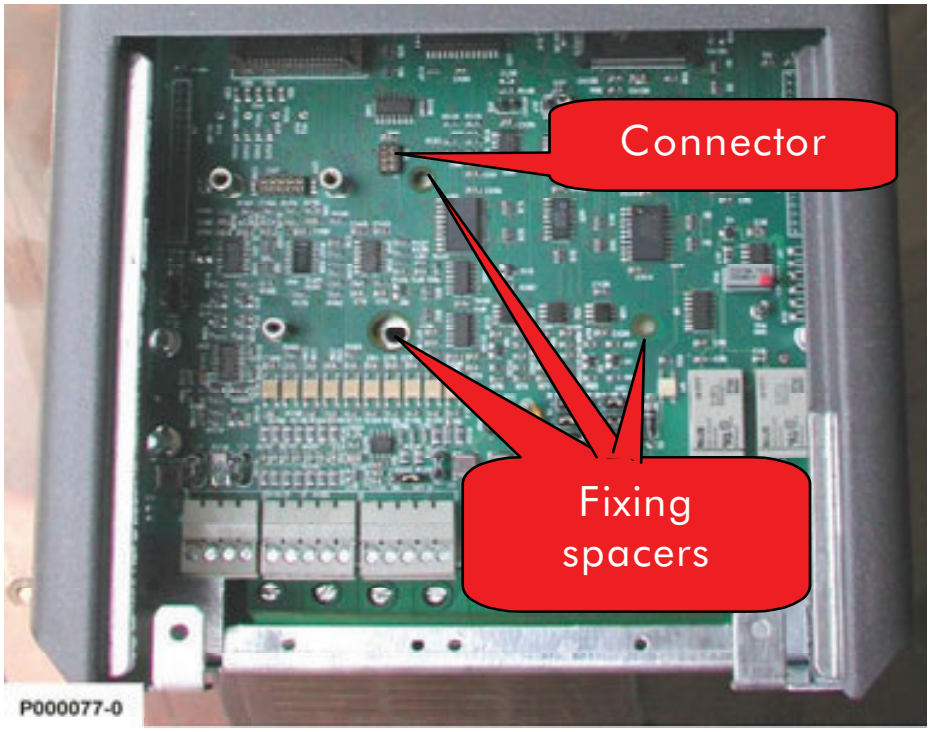

Fig.76: Position of the slot for the serial isolated board installation

3. Fit encoder board ES822 and make sure that all contacts enter the relevant housing in the signal connector. Fasten the encoder board to the metal columns using the screws supplied.
4. Configure dip-switches and the jumper located on the encoder board based on the connected encoder.

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6.6.4. BOARD SETTING

6.6.4.1. JUMPER FOR RS232 / RS485 SELECTION

Jumper J1 allows to set board ES822 to operate as interface RS-485 or as interface RS-232. All the relevant positions may be found on the board.
Jumper between pin 1-2 CN3-(RS-485) is enabled
Jumper between pin 2-3 CN2-(RS-232) is enabled)

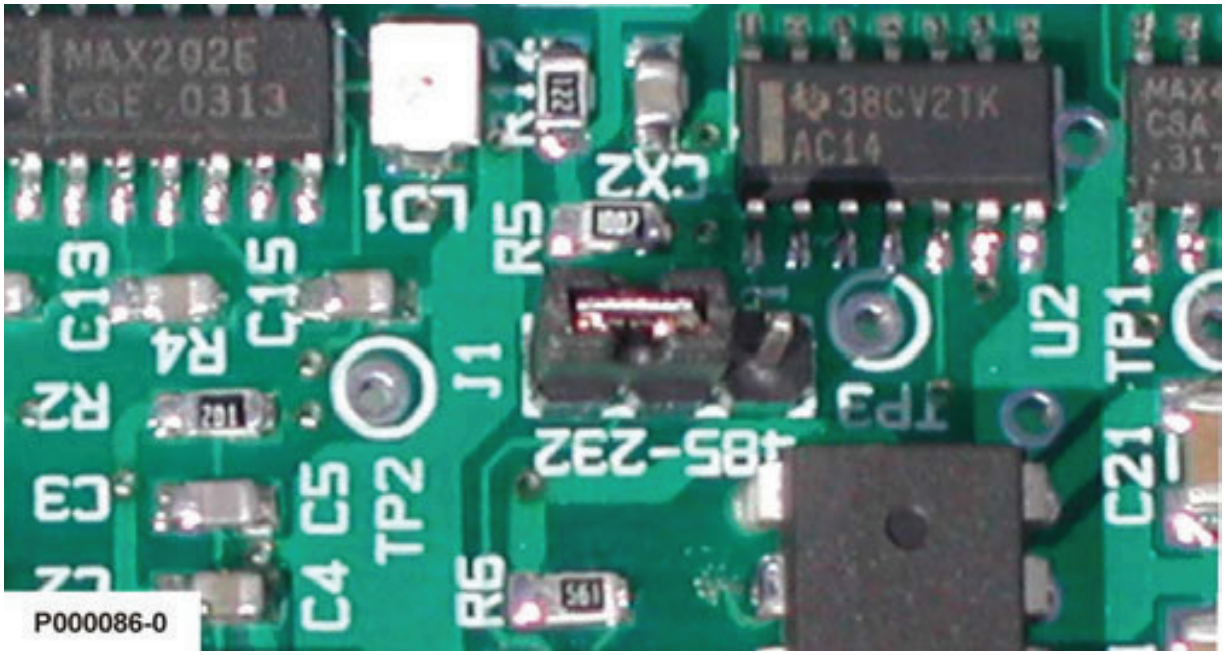

Fig.77: Jumper setting RS232/RS485

6.6.4.2. DIP-SWITCH FOR TERMINATOR RS-485

Please refer to the Serial Communications section 1.7:
For serial line RS-485 in control board ES822, the line terminator is selected through dip-switch SW1 as shown in the figure below.
When the line master (computer) is located at the beginning or at the end of the serial link, the line terminator of the farthest inverter from the master computer (or the only inverter in case of direct connection to the master computer) shall be enabled.
Line terminator enables by setting selector switches 1 and 2 to ON in dip-switch SW1. The line terminator of the other inverters in intermediate positions shall be disabled, dip switch SW1, selector switches 1 and 2 in position OFF (default setting).
To use line RS-232-DTE, no adjustment of dip-switch SW1 is required.

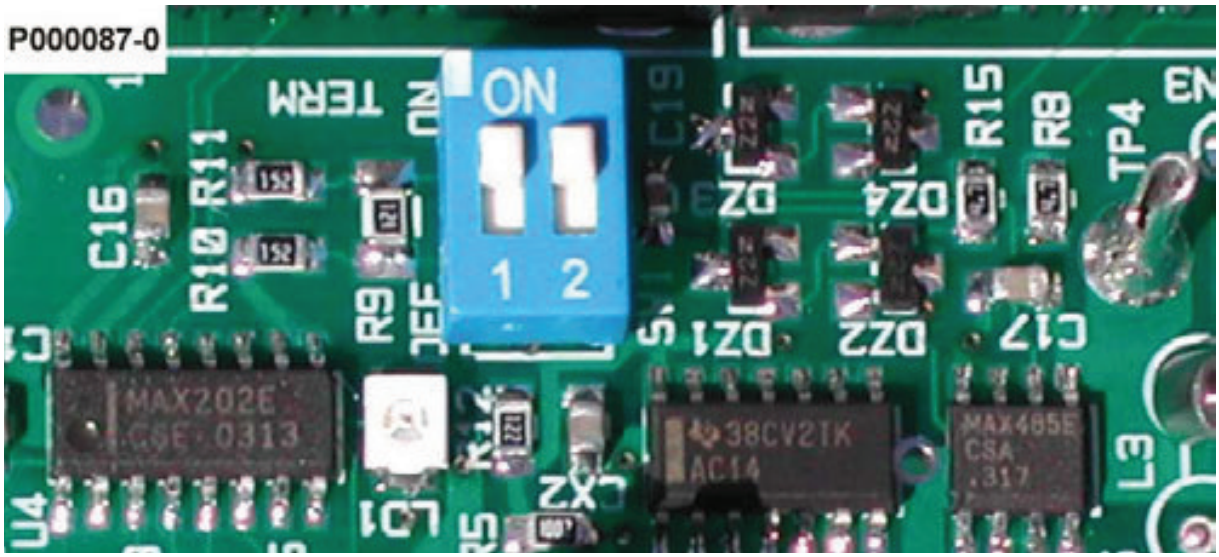

Fig.78: Setting up the dip terminator switch for line RS485

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6.7. IO ES847 EXPANSION BOARD

6.7.1. SIGNAL CONDITIONING AND ADDITIONAL I/O ES847 BOARD

ES847 board allows extension of the I/O set of any PENTA line products. Board additional functions are the following:

- four analog inputs with "fast" sampling 12 bit ±10V f.s.,
- three analog inputs with "fast" sampling, 12 bit, for alternate current measure or for 0-20mA measure with 8 bit resolutions,
- four inputs with "slow" sampling, 12 bit, to be programmed as 0-10V f.s., 0-20 mA f.s., 0-100 mV f.s., temperature acquisition with two-wire PT100,
- two analog inputs with "slow" sampling 12 bit 0-10V f.s.,
- eight digital multifunction inputs 24V, PNP type; two of them characterized by fast propagation time and may also be used for the acquisition of PUSH-PULL 24V encoders,
- six digital multifunction outputs, o.c. type and free from potential to be used both as PNP and as NPN Vomax=48V Iomax=50mA with short circuit protection through self-resetting fuse.

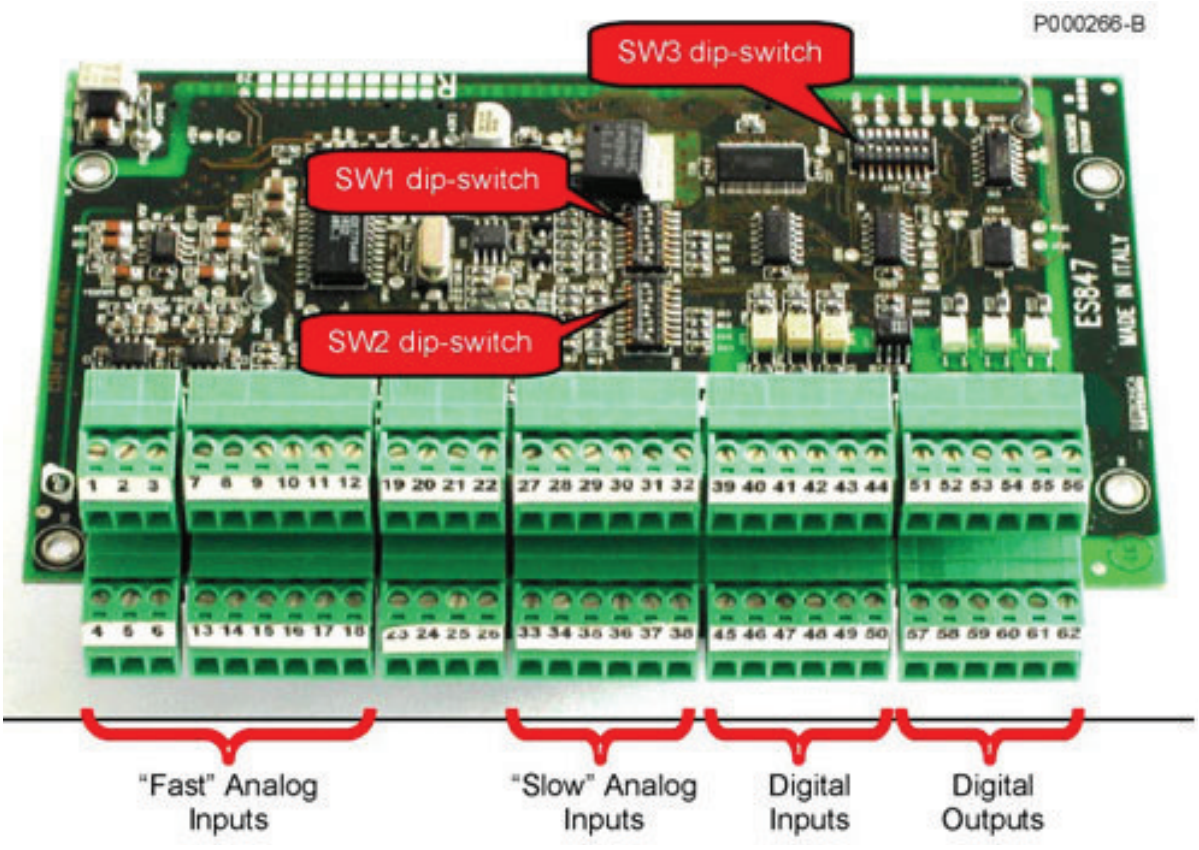


Fig.79: Signal and additional I/O ES847 conditioner board

6.7.2. IDENTIFICATION DATA

Description	*Ordering code*	*Compatibility*
Additional I/O PENTA ES847 board	ZZ0101810	All the inverters of Sinus "PENTA"

6.7.3. INSTALLING THE ES847 BOARD ON THE INVERTER (SLOT C)

1) Turn off the inverter and wait at least 5 minutes.
2) To facilitate the board installation, remove inverter cover by loosening the four hexagonal screws situated on the bottom and upper part of the inverter. In this way the four metal columns fixing board ES847 and signal connector (Slot C) may be reached. (Fig. 78)

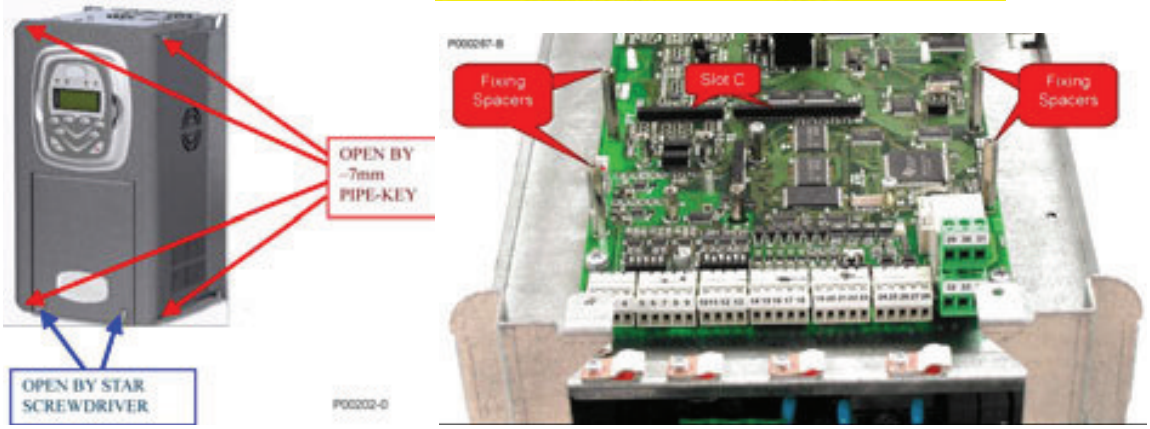


Fig. 80: Disassembly of inverter cover, slot C position

3) Fit both contact strips supplied on the lower side of ES847 board paying attention that all contacts are properly fixed inside the connector seats. Fit encoder board ES847 on the inverter PENTA control board and make sure that all contacts enter the relevant housing in the signal connector. Fasten the encoder board to the metal columns using the screws supplied. (Fig. 79)

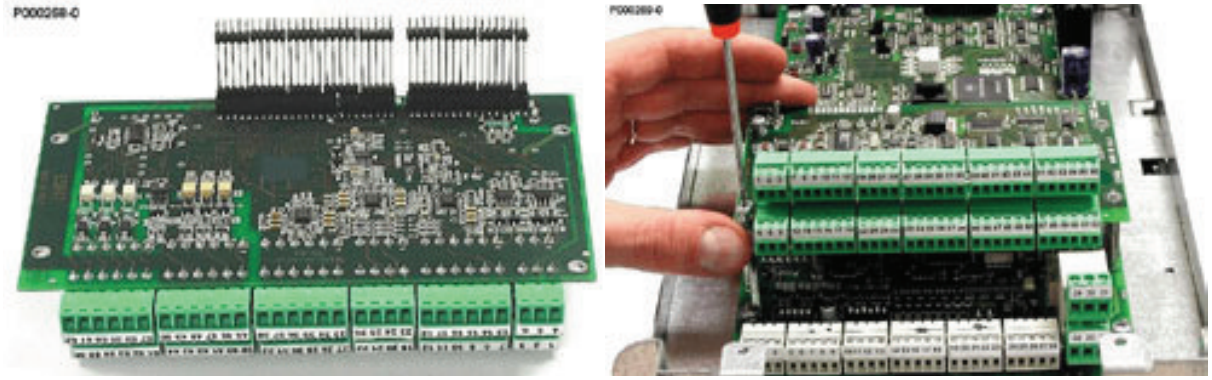


Fig. 81: Fitting the strips inside ES847 board and fixing the board on slot C

4) Configure dip switches of the board according to the type of signals to be acquired; refer to the relevant section.
5) Carry out electrical connections on terminal board by following the provisions detailed in the mentioned section.
6) Turn on the inverter and set the parameters relating to the ES847 board use (see Programming Manual of inverter).

DANGER:

CAUTION:

NOTE:

Before gaining access to the components inside the inverter, remove voltage from the inverter and wait at least 5 minutes. Wait for a complete discharge of the internal components to avoid any electrical shock hazard.
Do not connect or disconnect signal terminals or power terminals when the inverter is on. Beyond the hazard of electric shock, here is also the risk of damaging the inverter.
All fastening screws for removable parts (terminal cover, serial interface connector, cable path plates, etc.) are black, rounded-head, cross-headed screws. Only these screws may be removed when connecting the equipment. If other screws or bolts are removed, the product guarantee will be no longer valid.

6.7.4. BOARD ES847 TERMINALS

Screwable terminal board in twelve extractable sections suitable for cross-sections 0.08÷1.5mm² (AWG 28-16)

No.	Name	Description	I/O Features	Dip Switch/Note
1-2	XAIN1+ XAIN1 -	Analog differential auxiliary input ±10V f.s., "fast", number 1	Vfs = ±10V, Rin= 10k Ω; Resolution: 12 bits	
3	CMA	0V analog inputs (common terminal with 0V control)	Control board zero volt	
4-5	+15VM- 15VM	Two-pole supply output, stabilized and protected against short circuit for external sensors.	+15V, -15V Iout max: 100mA	
6	CMA	0V analog inputs (common terminal with 0V control)	Control board zero volt	
7-8	XAIN2+ XAIN2 -	Analog differential auxiliary input ±10V f.s., "fast", number 2	Vfs = ±10V, Rin= 10k Ω; Resolution: 12 bits	
9-10	XAIN3+ XAIN3 -	Analog differential auxiliary input ±10V f.s., "fast", number 3	Vfs = ±10V, Rin= 10k Ω; Resolution: 12 bits	
11-12	XAIN4+ XAIN4 -	Analog differential auxiliary input ±10V f.s., "fast", number 4	Vfs = ±10V, Rin= 10k Ω; Resolution: 12 bits	
13	XAIN5	Auxiliary analog input in "fast" current, number 5	Ifs = ±160mA, Rin= 33.33 Ω; Resolution: 12 bits	
14	CMA	0V analog inputs set up for XAIN5 return	Control board zero volt	
15	XAIN6	Auxiliary analog input in "fast" current, number 6	Ifs = ±160mA, Rin= 33.33 Ω; Resolution: 12 bits	
16	CMA	0V analog inputs set up for XAIN6 return	Control board zero volt	
17	XAIN7	Auxiliary analog input in "fast" current, number 7	Ifs = ±160mA, Rin= 33.33 Ω; Resolution: 12 bits	
18	CMA	0V analog inputs set up for XAIN7 return	Control board zero volt	
19-26	N.C.	**Engaged terminal - Do not use**		
27	XAIN8/T1+	Auxiliary analog "slow" input, to be set, number 8	Vfs = 10V, Rin = 30k Ω	SW1.3 = ON SW1.1-2-4 = OFF
			Vfs = 100mV, Rin = 1M Ω	SW1.4 = ON SW1.1-2-3 = OFF
			Ifs = 20mA, Rin = 124,5 Ω	SW1.2 = ON SW1.1-3-4 = OFF
		Thermistor number 1 temperature measure	Misura temperatura PT100	SW1.1-4 = ON SW1.2-3 = OFF
28	CMA/T1-	0V analog inputs set up for XAIN8 return	Control board zero volt	
29	XAIN9/T2+	Auxiliary analog "slow" input, to be set, number 9	Vfs = 10V, Rin = 30k Ω	SW1.7 = ON SW1.5-6-8 = OFF
			Vfs = 100mV, Rin = 1M Ω	SW1.8 = ON SW1.5-6-7 = OFF
			Ifs = 20mA, Rin = 124.5 Ω	SW1.6 = ON SW1.5-7-8 = OFF
		Thermistor number 2 temperature measure	PT100 temperature measure	SW1.5-8 = ON SW1.6-7 = OFF
30	CMA/T2-	0V analog inputs set up for XAIN9 return	Control board zero volt	
31	XAIN10/T3+	Auxiliary analog "slow" input, to be set, number 10	Vfs = 10V, Rin = 30k Ω	SW2.3 = ON SW2.1-2-4 = OFF
			Vfs = 100mV, Rin = 1M Ω	SW2.4 = ON SW2.1-2-3 = OFF
			Ifs = 20mA, Rin = 124.5 Ω	SW2.2 = ON SW2.1-3-4 = OFF
		Thermistor number 3 temperature measure	PT100 temperature measure	SW2.1-4 = ON SW2.2-3 = OFF
32	CMA/T3-	0V analog inputs set up for XAIN10 return	Control board zero volt	
33	XAIN11/T4+	Auxiliary analog "slow" input, to be set, number 11	Vfs = 10V, Rin = 30k Ω	SW2.7 = ON SW2.5-6-8 = OFF
			Vfs = 100mV, Rin = 1M Ω	SW2.8 = ON SW2.5-6-7 = OFF
			Ifs = 20mA, Rin = 124.5 Ω	SW2.6 = ON SW2.5-7-8 = OFF
		Thermistor number 4 temperature measure	PT100 temperature measure	SW2.5-8 = ON SW2.6-7 = OFF
34	CMA/T4-	0V analog inputs set up for XAIN11 return	Control board zero volt	
35	XAIN12	Auxiliary analog input 10V f.s. "slow" type, number 12	Fs = 10V; Rin= 30k Ω;	
36	CMA	0V analog inputs set up for XAIN12 return	Control board zero volt	
37	XAIN13	Auxiliary analog input 10V f.s. "slow" type, number 13	Fs = 10V; Rin= 30k Ω;	
38	CMA	0V analog inputs set up for XAIN12 return	Control board zero volt	

39	XMDI1	Multifunction auxiliary digital input 1	Optoisolated digital inputs 24Vcc; positive logic (PNP type): active with high signal with respect to CMD (terminals 43 and 50). Complying with EN 61131-2 as type-1 digital inputs with rated voltage equal to 24Vcc.	Max. response time to processor 500 μs
40	XMDI2	Multifunction auxiliary digital input 2		
41	XMDI3	Multifunction auxiliary digital input 3		
42	XMDI4	Multifunction auxiliary digital input 4		
43	CMD	0 V digital input isolated to control 0 V		
44	+24V	Auxiliary supply output for optoisolated multifunction digital inputs		
45	XMDI5	Multifunction digital input 5		Max. response time to processor 600 μs
46	XMDI6	Multifunction digital input 6		
47	XMDI7	Multifunction digital input 7		
48	XMDI8	Multifunction digital input 8		
49	+24V	Auxiliary supply output for optoisolated multifunction digital inputs	+24V±15% ; Imax: 200mA Protect with resetting fuse	
50	CMD	0 V digital input isolated to control 0 V	Optoisolated digital input zero volt	
51	XMDO1	Multifunction auxiliary digital output 1 (collector)	Isolated digital outputs, open collector, Vomax = 48V; Iomax = 50mA	
52	CMDO1	Multifunction auxiliary digital output 1 (emitter)		
53	XMDO2	Multifunction auxiliary digital output 2 (collector)		
54	CMDO2	Multifunction auxiliary digital output 2 (emitter)		
55	XMDO3	Multifunction auxiliary digital output 3 (collector)		
56	CMDO3	Multifunction auxiliary digital output 3 (emitter)		
57	XMDO4	Multifunction auxiliary digital output 4 (collector)		
58	CMDO4	Multifunction auxiliary digital output 4 (emitter)		
59	XMDO5	Multifunction auxiliary digital output 5 (collector)		
60	CMDO5	Multifunction auxiliary digital output 5 (emitter)		
61	XMDO6	Multifunction auxiliary digital output 6 (collector)		
62	CMDO6	Multifunction auxiliary digital output 6 (emitter)		

NOTE:

All digital outputs are in a rest condition (inactive mode) in the following cases:
- inverter off
- inverter initialization after startup
- inverter in emergency mode (see Programming Manual)

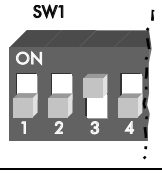
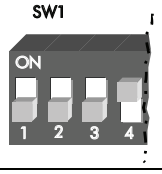
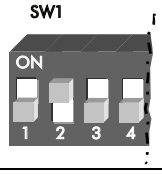
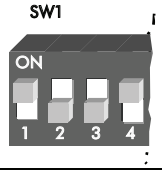
This condition should be considered as for the specific application to be used for the inverter

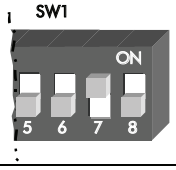
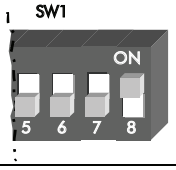
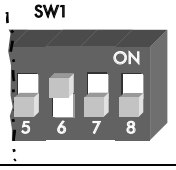
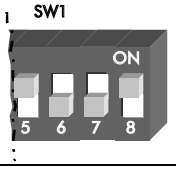
6.7.5. SETUP DIP-SWITCH

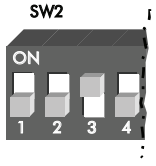
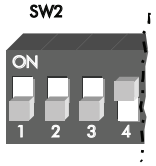
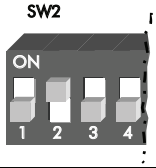
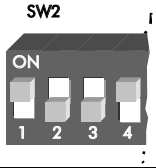
The ES847 board includes three set up dip-switches (see figure 1.1) allowing setting up of operating mode (see table).

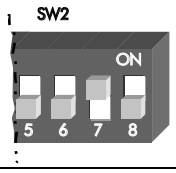
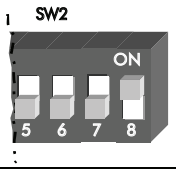
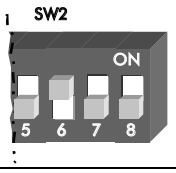
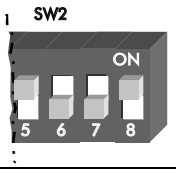
SW1	Setting up of "slow" analog inputs XAIN8 and XAIN9 operating mode
SW2	Setting up of "slow" analog inputs XAIN10 and XAIN11 operating mode
SW3	Factory setting up SW3.2=ON, SW3.5=ON, the other devices OFF – not to be changed –

6.7.6. THE FOLLOWING TABLES SHOW THE POSSIBLE SETTING UP OF DIP-SWITCHES SW1 AND SW2 ACCORDING TO THE ANALOG CHANNEL DESIRED CONFIGURATION

Setting up of slow analog channel XAIN8			
0-10V f.s. mode	0-100mV f.s. mode	0-20mA f.s. mode	Temperature reading mode with PT100 thermistor
			

Setting up of slow analog channel XAIN9			
0-10V f.s. mode	0-100mV f.s. mode	0-20mA f.s. mode	Temperature reading mode with PT100 thermistor
			

Setting up of slow analog channel XAIN10			
0-10V f.s. mode	0-100mV f.s. mode	0-20mA f.s. mode	Temperature reading mode with PT100 thermistor
			

Setting up of slow analog channel XAIN11			
0-10V f.s. mode	0-100mV f.s. mode	0-20mA f.s. mode	Temperature reading mode with PT100 thermistor
			

Five acquisition modes are available (see the Programming Manual) for four hardware settings as shown in the table.

Type of preset data acquisition	Set up mode on SW1 and SW2	Full-scale values and notes
Voltage from 0 to 10 V	0-10V f.s. mode	0 ÷ 10 V
Tension from 0 to 100 mV	0-100mV f.s. mode	0 ÷ 100 mV
Current from 0 to 20 mA	0-20mA f.s. mode	0 mA ÷ 20 mA
Current from 4 to 20 mA	0-20mA f.s. mode	4 mA ÷ 20 mA; wire disconnection alarm with current values under 2 mA
Temperature	Temperature reading mode with PT100 thermistor	-50°C ÷ 125 °C. Disconnection alarm or captor short circuit whenever an incorrect resistance measure is detected.

NOTE:

Software parameter setting must be consistent with dip-switch setting. Otherwise, no predictable result is given for acquired values.

NOTE:

Any voltage or current value exceeding full-scale values or dropping below min. values will generate an acquired value limited to the max. measure or the min. measure respectively.

CAUTION:

Voltage inputs have high input impedance and must always be closed when active. Isolating a conductor connected to an analog input set as a voltage input will not ensure that its channel reading will be equal to zero. Zero is detected only if the input is short-circuited or wired to a low-impedance signal source. Relay contact should not series-connected to the inputs to reset the detected value.

6.7.7. WIRING DIAGRAMS

6.7.7.1. CONNECTION OF DIFFERENTIAL ANALOG "FAST" INPUTS

Auxiliary inputs allow auxiliary voltage for signals exceeding ground signals up to a preset maximum voltage value in common mode.
A differential input weakens disturbance due to "ground potentials" occurring when the signal is sent from a source that is located far from the inverter. Disturbance is weakened only if wiring is correct.
Each input is provided with two terminals: a positive terminal and a negative terminal of the differential amplifier; both terminals must be connected to the signal source and the signal grounding respectively. Make sure that the common mode voltage between the signal source grounding and the grounding of auxiliary inputs CMA does not exceed the max. allowable voltage value in common mode.
Do the following to obtain noise rejection benefits:

- provide a common path of the differential torque
- make sure that the signal source grounding does not exceed input voltage in common mode
- use a screened cable and connect the braiding to the relevant clamp situated near the inverter terminals.

The ES847 board is also equipped with an external supply output which should be used for external sensors supply. The maximum available supply voltage should also be observed.
The wiring diagram illustrated in figure 4 shows the correct connection procedure.

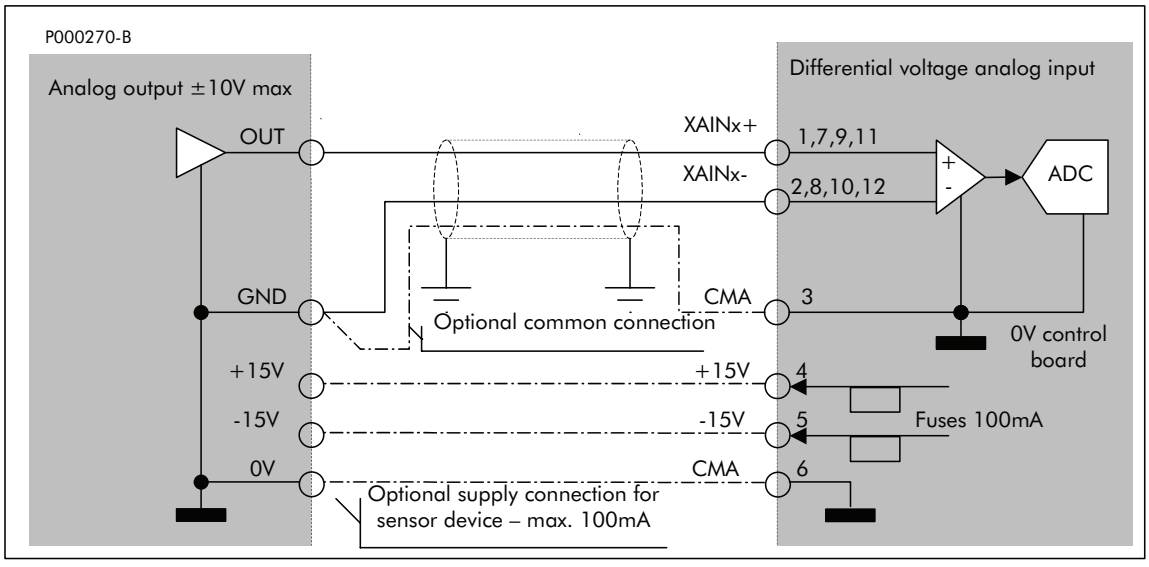


Fig.82: Source of double-pole voltage connection to differential input

NOTE Wiring between terminal CMA and the signal source grounding is required for a proper data acquisition. It can be fitted outside the screened cable or may include the common terminal of the auxiliary analog supply.

NOTE: Supply auxiliary outputs are electronically protected against temporary short-circuits. After wiring the inverter, make sure that the output voltage is correct, as a persistent short-circuit may damage the equipment.

0 1 2 3 4 5 6 7 8

6.7.7.2. CONNECTION OF "FAST" CURRENT INPUTS

Three "fast" analog inputs with low input impedance have been provided; they can acquire current signals for the connection of amperometric transformers (AT) or of sensors with current output.
The full-scale value of said inputs is about 160 mA and for that reason they are specially suitable for XXXX/01-type AT acquisition, where XXXX represents the rms maximum value of primary current to be acquired while 01 represents the maximum value, equal to 100 mArms, of the output current. Some manufacturers have classified said AT as "electronic use devices", to be intended as a low output voltage.
For example, by using a 500/01-type AT it is possible to acquire a primary current up to 500 Arms, which means that an up-to 800 Apk peak value may be read. To obtain a correct reading the input should be programmed as an AT reading by setting up the programming parameter related to the type of AT. See the Programming Manual.
The same inputs may also be used to acquire current output sensors. In such a case the current full-scale value is 20 mA only with respect to the analog channel acquisition range of ±160 mA, then the resulting conversion resolution is decreased to 8 bits instead of 12 bits.
The following wiring diagrams show both correct connection procedures.

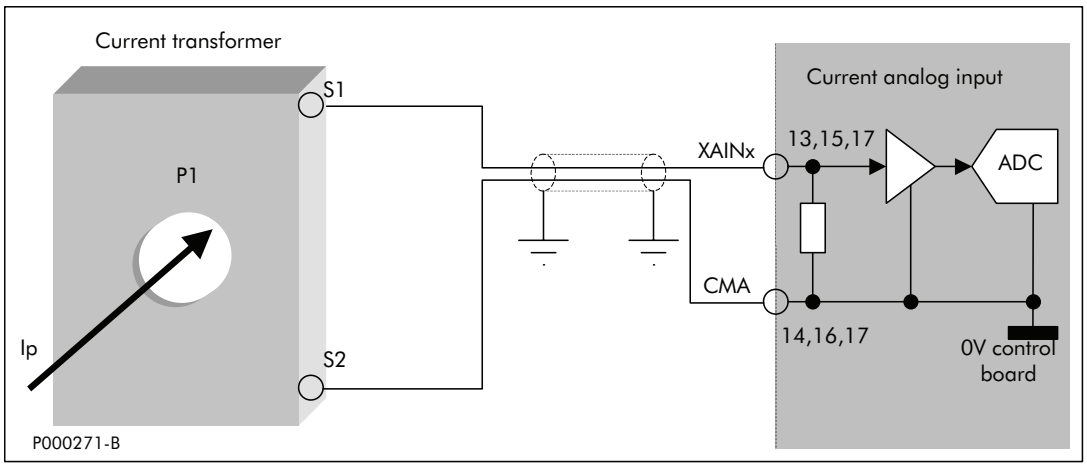


Fig.83: AT connection to "fast" current inputs XAIN5, XAIN6, XAIN7.

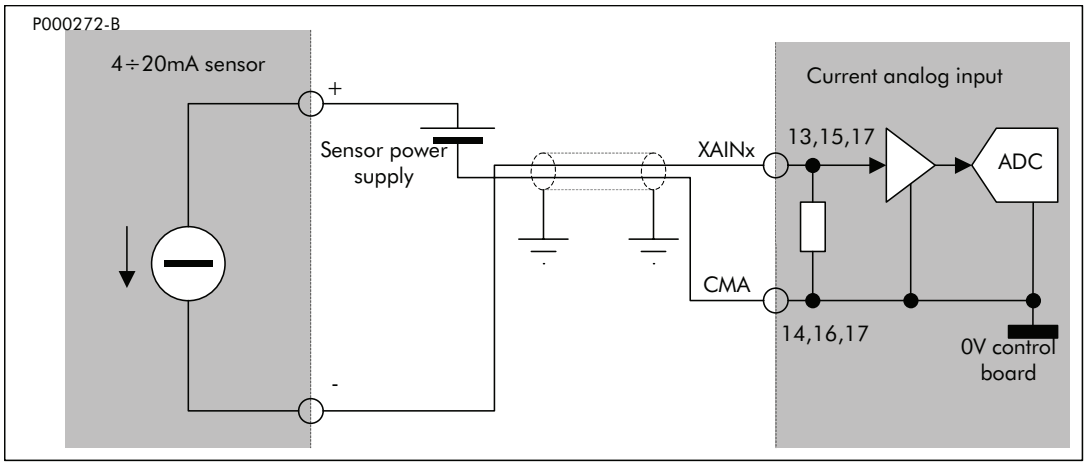


Fig.84: Connection of sensors 0÷20mA (4÷20mA) to "fast" current inputs XAIN5, 7.

NOTE: Do not use + 24 v from terminals 44 and 49 of ES847 board to supply analog 4 - 20 mA sensors; this supply is referred to the common terminal of digital inputs (CMD – terminals 43 and 50) and not to the common terminal of analog inputs CMA. A galvanic isolation exists and should be kept between both terminals.

6.7.7.3. CONNECTION OF "SLOW" ANALOG INPUTS TO VOLTAGE SOURCES

It is advisable to connect the voltage source with twisted pair by connecting the braiding from the ES847 board side. Connect the braiding to the inverter enclosure by using the cable clamps situated close to the terminal boards.
Even if the "slow" acquisition analog channels are characterized by a cut frequency slightly higher than 10Hz, and so the main disturbance source represented by the mains frequency is already softened, it is advisable to carefully perform the connections, especially in case of setting up with 100mV full-scale value or whenever connections are longer than ten meters. Figure 7 shows a connection to acquire a voltage source.
It is necessary to properly set up the configuration dip-switches relevant to the used analog channel by setting up full-scale value at 10V or 100mV according to your needs and to set up the relevant programming parameter.

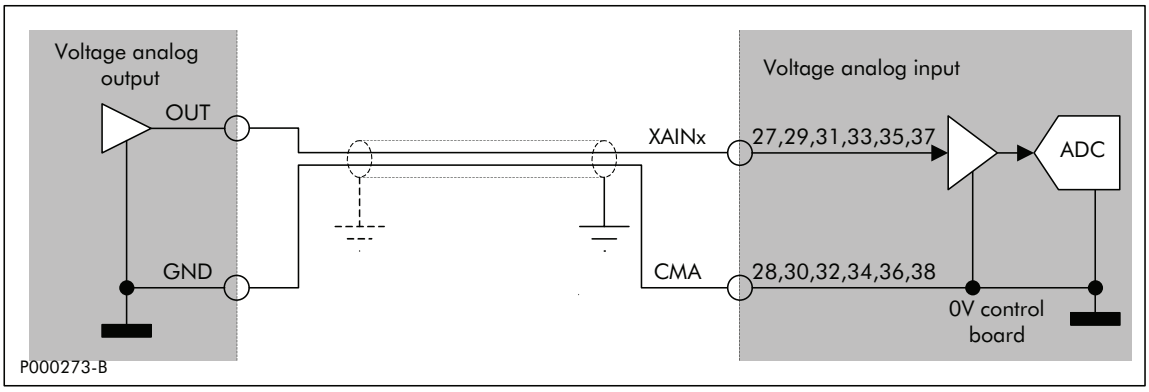


Fig.85: Voltage source connection to analog input

6.7.7.4. CONNECTION OF "SLOW" ANALOG INPUTS TO CURRENT SOURCES

Connection of slow analog inputs to current sources is identical to the procedure detailed in figure 6. The channels accepting current signals with 20mA f.s. are XAIN8, XAIN9, XAIN10, XAIN11, corresponding to terminals 27, 29, 31, 33. Also in this case it is necessary to correctly set up the configuration dip-switches relevant to the used analog channel by setting up the full-scale value at 20mA f.s. and by correctly setting up the relevant programming parameter at 0÷20mA or 4÷20mA.

6.7.7.5. CONNECTION OF "SLOW" ANALOG INPUTS TO PT100 THERMISTOR

The ES847 board permits to directly perform temperature measures through the connection of standard PT100 thermoresistances. A two-wire connection is used to simplify the wiring procedure. For this reason it is more convenient to limit the cable length and not to expose it to high temperature variations during the operation cycle. Figure 8 shows the correct connection procedure: it is advisable to use a screened cable with braiding directly connected to the inverter grounding through the cable clamps supplied.
Calibrate the measure on the installation whenever the connection includes the upper cable at a distance of about ten meters. For example, by performing the connection with 1mm^2 twisted pair (AWG 17), a reading error of about +1°C each 10-meter length shall be detected.
Measure calibration is obtained by connecting to the line terminals a PT100 sensor emulator instead of sensor, whose setting up should be 0°C (or a resistance with a value precision of 100Ω 0,1%); then the measure setting function should be actuated. See the Programming manual for a detailed procedure.
The PT100 emulator allows checking the measure correct operation on different areas before the connection to the sensor.

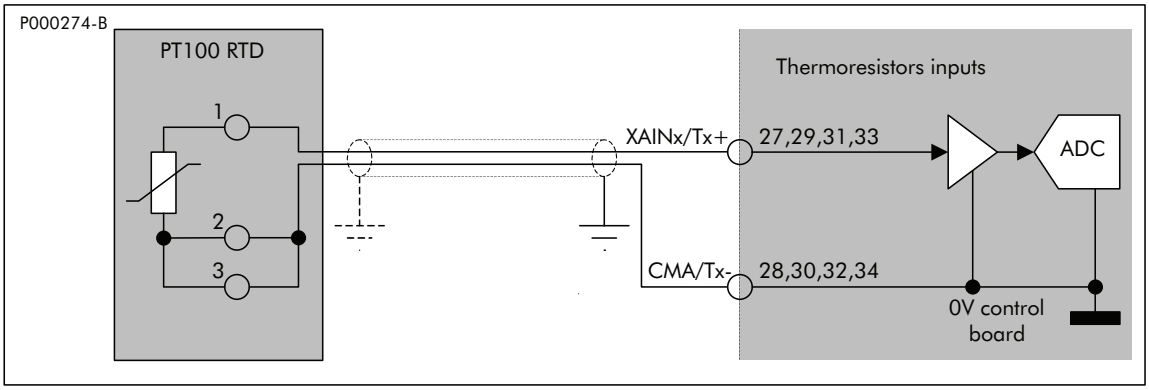


Fig.86: PT100 thermoresistances connection to XAIN8 – 11 /T1 - 4 analog channels

NOTE: Software parameter setting must be consistent with dip-switch setting. Otherwise, no predictable result is given for acquired values.

NOTE: Any voltage or current value exceeding full-scale values or dropping below min. values will generate an acquired value limited to the max. measure or the min. measure respectively.

CAUTION: Voltage inputs have high input impedance and must always be closed when active. Isolating a conductor connected to an analog input set as a voltage input will not ensure that its channel reading will be equal to zero. Zero is detected only if the input is short-circuited or wired to a low-impedance signal source. Relay contact should not series-connected to the inputs to reset the detected value.

6.7.7.6. CONNECTION OF ISOLATED DIGITAL INPUTS

All digital inputs are galvanically isolated with respect to zero volt of the inverter control board; consider isolated power supply on terminals 44 and 49 or 24 V auxiliary supply before activating the inverter digital inputs.
The figure below shows the different control modes based on the inverter supply or the output of a control system (e.g. PLC). Internal supply, + 24 VDC, (terminals 44 and 49) is protected by a 200 mA self-resetting fuse.

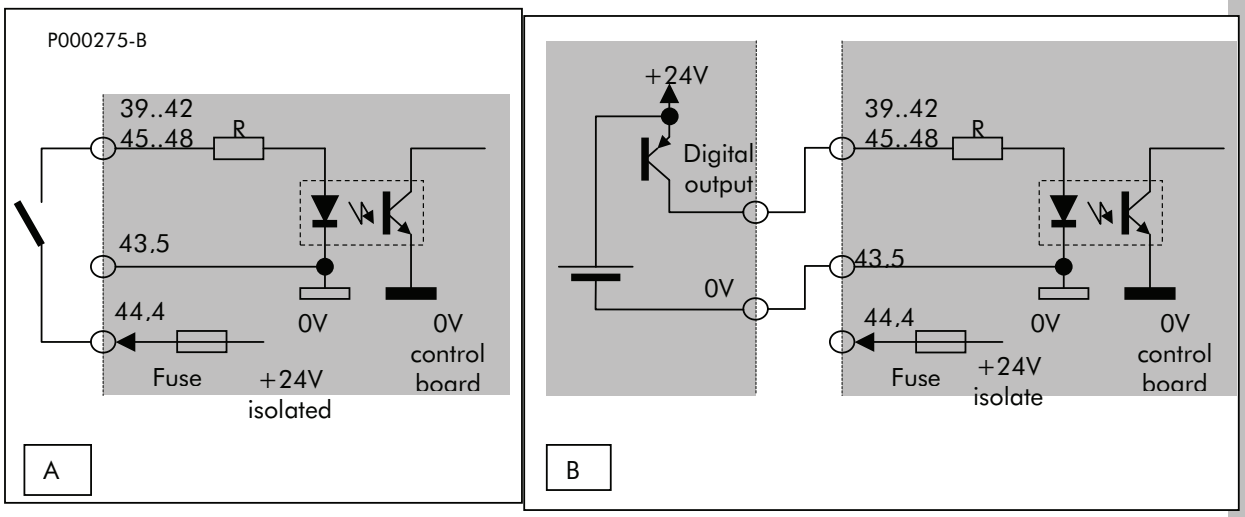


Fig.87: A PNP command (active to + 24 V) through a voltage-free contact

B PNP command (active to + 24 V), outcoming from a different device (PLC, digital output board, etc.)

0 1 2 3 4 5 6 7 8

6.7.7.7. CONNECTION OF ENCODER OR FREQUENCY INPUT

Digital auxiliary inputs XMDI7 and XMDI8 may acquire fast digital signals and be used for the connection of an incremental encoder (push-pull encoder, single-ended encoder) or for the acquisition of a frequency input. Consider that by inserting board ES847 encoder B functions move from the base control terminals of ES821 board to control terminals of board ES847. An incremental encoder must be connected to "fast" inputs XMDI7 and XMDI8 as shown in figure 10.

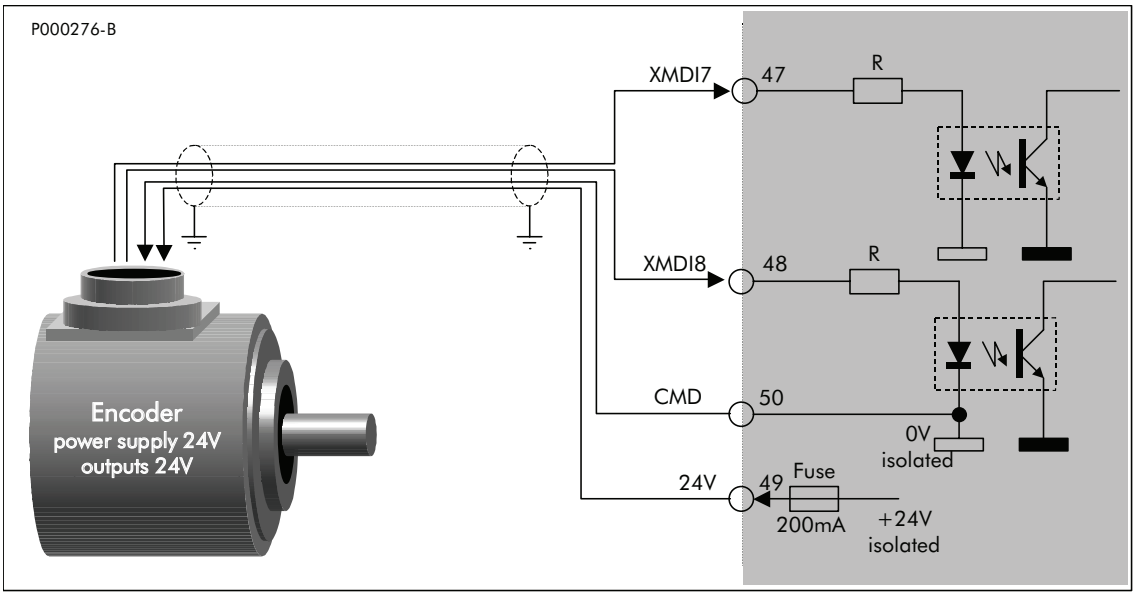


Fig.88: Connection of incremental encoder to fast inputs XMDI7 and XMDI8

An incremental encoder must have PUSH-PULL outputs and must be powered at 24 V directly to the inverter isolated power supply delivered to terminals + 24 V (49) and CMD (50). Max. allowable feeding current is 200 mA and is protected by a self-resetting fuse.
Only encoders of that type may be connected to SINUS PENTA's terminal board. Max. signal frequency is 155 kHz for 1024 pls/rev at 9000 rpm.
Input XMDI8 allows also to acquire a square-wave frequency signal from 10 kHz up to 100 kHz which is converted into an analog value to be used as a reference. Then, the frequency signal will be converted into an analog value to be used as a frequency reference. Frequency values corresponding to the minimum reference and the maximum reference may be set as operating parameters.
Signals must be sent from a Push-pull, 24 V output with a common reference to terminal CMD (50) (see figure 11).

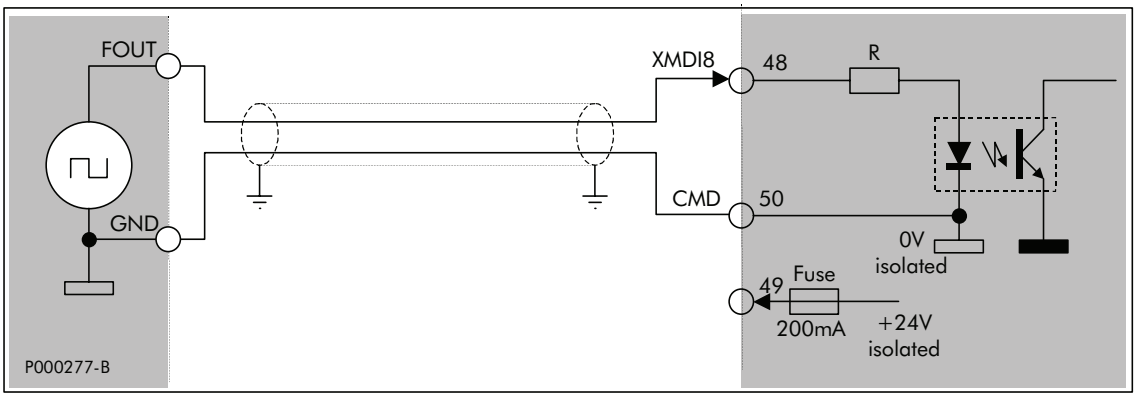


Fig.89: Signal sent from a Push-pull, 24 V output

6.7.7.8. CONNECTION OF ISOLATED DIGITAL OUTPUTS

Multifunction outputs XMDO1..8 (terminals 51..62) are equipped with a common terminal CMDO 1..8 being isolated with respect to the other outputs. In this way they can be used both to control PNP and NPN loads, according to the following wiring diagrams detailed in figures 1.12 and 1.13.
Please consider that the output produces electric conductibility (similar to a closed contact) between terminal MDO2 and CMDO2 when it is active, i.e. when symbol ■ is displayed near the output. In such a condition loads connected as PNP and loads connected as NPN may be connected.
Supply may be taken both by the inverter insulated supply and by an external 24 or 48V source (dotted lines in figures).

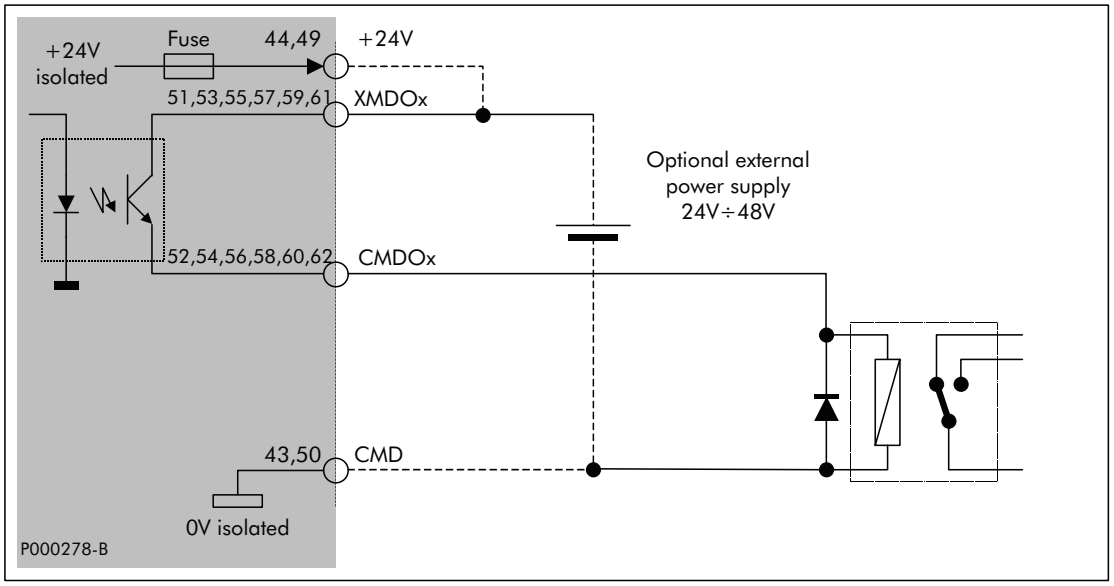


Fig.90: PNP output connection for relay control

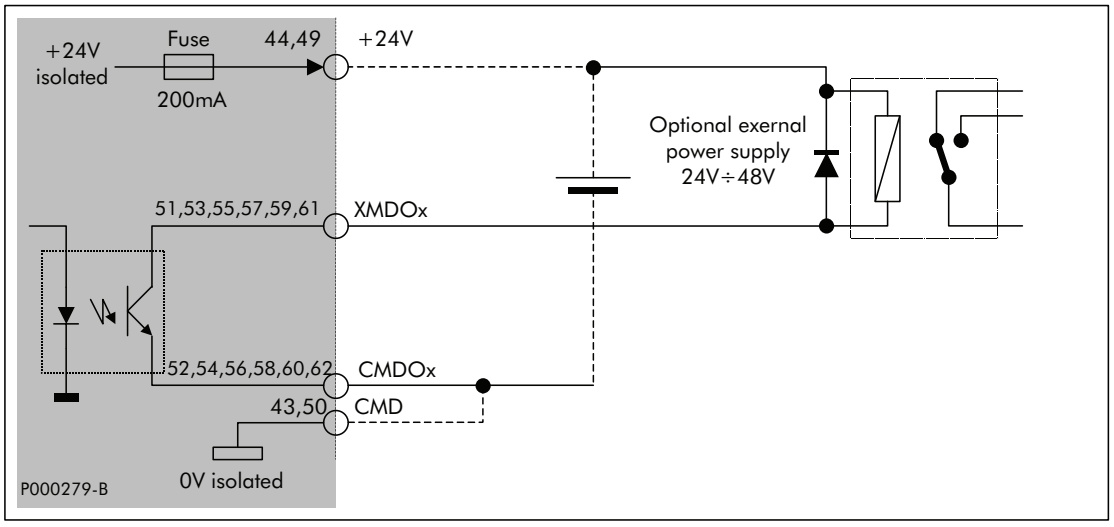


Fig.91: NPN output connection for relay control

CAUTION:

By using an inductive load (e.g. relay coils) the recirculation diode should always be connected as shown in the figure.

NOTE:

Do not connect the inner insulated supply and the outer supply simultaneously to supply the output. The dotted connections indicated on the figures are to be considered alternative each other.

NOTE:

XMDO1..8 digital outputs are protected against temporary short circuits through self-resetting fuse. After wiring the inverter, make sure that the output voltage is correct, as a persistent short-circuit may damage the equipment.

6.7.8. ENVIRONMENTAL FEATURES

Operating temperature:	0 to +50 °C ambient temperature (contact Elettronica Santerno for higher ambient temperatures)
Relative humidity:	5 to 95% (Non condensing)
Max. operating altitude	4000 m (a.s.l.)

6.7.9. ELECTRIC FEATURES

6.7.9.1. ANALOG INPUTS

Analog inputs with fast sampling ±10V f.s.	*Value*			
	Min	*Typ.*	*Max*	*Unit of m.*
Input impedance		10		kΩ
Offset cumulative error and gain with respect to full-scale value		0.5		%
Temperature coefficient of gain error and offset			200	ppm/°C
Digital resolution			12	bit
Value of voltage LSB		5.22		mV/LSB
Max. voltage of differential input common mode	-15		+15	V
Persistent overload on inputs with no damaging	-30		+30	V
Input filter cut frequency (Butterworth second order)		5.1		kHz
Sampling periods (depending on the application SW used)	0.2		1.2	ms

Analog inputs with fast sampling for current measure	*Value*			
	Min	*Typ.*	*Max*	*Unit of m.*
Input impedance		33.3		Ω
Offset cumulative error and gain with respect to full-scale value		0.5		%
Temperature coefficient of gain error and offset			200	ppm/°C
Digital resolution			12	bit
Value of current LSB		78.1		µA/LSB
Equivalent resolution in 0-20mA acquisition mode			8	bit
Persistent overload on inputs with no damaging	-3.7		+3.7	V
Input filter cut frequency (Butterworth second order)		5.1		kHz
Sampling periods (depending on the application SW used)	0.2		1.2	ms

Analog inputs with slow sampling set up in 0-10V mode	*Value*			
	Min	*Typ.*	*Max*	*Unit of m.*
Input impedance		40		kΩ
Offset cumulative error and gain with respect to full-scale value		0.5		%
Temperature coefficient of gain error and offset			200	ppm/°C
Digital resolution			12	bit
Value of voltage LSB		2.44		mV/LSB
Persistent overload on inputs with no damaging	-30		+30	V
Input filter cut frequency (low pass first order)		13		Hz
Sampling periods (depending on the application SW used)	10		1000	ms

Analog inputs with slow sampling set up in 0-20mA mode	*Value*			
	Min	*Typ.*	*Max*	*Unit of m.*
Input impedance		124.5		Ω
Offset cumulative error and gain with respect to full-scale value		0.5		%
Temperature coefficient of gain error and offset			200	ppm/°C
Digital resolution			12	bit
Value of current LSB		4.90		µA/LSB
Persistent overload on inputs with no damaging	-3.7		+3.7	V
Input filter cut frequency (low pass first order)		13		Hz
Sampling periods (depending on the application SW used)	10		1000	ms

Analog inputs with slow sampling set up in 0-100mV mode	*Value*			
	Min	*Typ.*	*Max*	*Unit of m.*
Input impedance	1			MΩ
Offset cumulative error and gain with respect to full-scale value		0.2		%
Temperature coefficient of gain error and offset			50	ppm/°C
Digital resolution			12	bit
Value of voltage LSB		24.7		µV/LSB
Persistent overload on inputs with no damaging	-30		+30	V
Input filter cut frequency (low pass first order)		13		Hz
Sampling periods (depending on the application SW used)	10		1000	ms

Analog inputs with slow sampling set up in temperature measure with PT100	*Value*			
	Min	*Typ.*	*Max*	*Unit of m.*
Type of probe	PT100 thermistor connected to 2 wires			
Measure range	-50		125	°C
Polarization current of element PT100		0.67		mA
Measure temperature coefficient			50	ppm/°C
Digital resolution			12	bit
Maximum cumulative measure error on temperature range -40÷+50°		0.5	1.5	°C
Temperature LSB average value (SW linearization function)		0.098		°C/LSB
Persistent overload on inputs with no damaging	-10		+10	V
Input filter cut frequency (low pass first order)		13		Hz
Sampling periods (depending on the application SW used)	10		1000	ms

6.7.9.2. DIGITAL INPUTS

Digital inputs features	*Value*			
	Min	*Typ.*	*Max*	*Unit of m.*
XMDIx input voltage related to CMD	-30		30	V
Voltage for logic level 1 between XMDIx and CMD	15	24	30	V
Voltage for logic level 0 between XMDIx and CMD	-30	0	5	V
Current absorbed by XMDIx at logic level 1	5	9	12	mA
Input frequency for "fast" inputs XMDI7, XMDI8			155	kHz
Duty-cycle allowed for frequency input	30	50	70	%
Min. time period at high level for "fast" inputs XMDI7, XMDI8	4.5			µs
Isolation test voltage between CMD terminals (43 and 50) with respect to CMA terminals (3-6-14-16-18-28-30-32-34-36-38)	500Vac, 50Hz, 1min.			

6.7.9.3. DIGITAL OUTPUTS

Digital inputs features	*Value*			
	Min	*Typ.*	*Max*	*Unit of m.*
Voltage range for outputs XMDO1..8	20	24	50	V
Maximum current to be switched from outputs XMDO1..8			50	mA
Voltage drop of XMDO1..8 outputs in active mode			2	V
Leakage current of XMDO1..8 outputs in inactive mode			4	µA
Isolation test voltage between terminals CMDO1..8 and CMA	500Vac, 50Hz, 1min.			

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6.7.9.4. SUPPLY OUTPUTS

Features of the analog supply outputs	*Value*			
	Min	*Typ.*	*Max*	*Unit of m.*
Voltage available on terminal +15V (4) relating to CMA (6)	14.25	15	15.75	V
Voltage available on terminal -15V (5) relating to CMA (6)	-15.75	-15	-14.25	V
Maximum current produced by output +15V and to be absorbed by output –15V			100	mA

Features of the digital supply outputs	*Value*			
	Min	*Typ.*	*Max*	*Unit of m.*
Voltage available on terminals +24V (44 and 49) relating to CMD (43 and 50)	21	24	27	V
Maximum current produced by output +24V			200	mA

CAUTION: Avoid exceeding min. and max. input or output voltage values not to cause irreparable damages to the equipment

NOTE: Isolated supply output and auxiliary output are protected by a self-resetting fuse capable of preventing the inverter internal supply from damaging due to a short-circuit; nevertheless, if a short-circuit occurs, the inverter could lock and stop the motor.

6.8. FIELDBUS PROFIBUS-DP COMMUNICATION BOARD

The communication board Profibus allows to interface an Inverter of the Sinus PENTA serial to an outer control unit, to for instance, a PLC with communication interface PROFIBUS-DP. The Sinus PENTA inverter, operates as a Slave device driver by a Master (PLC) by means of control messages and reference values completely corresponding to those received through the terminal board. Moreover the Master is also able to read the operation state of the inverter. In order to get the detail of the communication possibilities available with Profibus, see Sinus PENTA Programmation Instruction

The features of the Profibus communication board are detailed hereunder

- types of fieldbus: PROFIBUS-DP EN 50170 (DIN 19245 Part 1) with protocol version 1.10.
- automatic detection of the baudrate in the range 9600 bit/s ÷ 12 Mbit/s
- transmission device: bus line PROFIBUS type A or B as specified in EN50170
- Fieldbus type: communiction Master-Slave. Max. 126 stations connected in multidrop
- fieldbus connector: 9-pins female DSUB
- cable: twisted pair data cable EIA RS485
- max. length of the bus: 200m @ 1.5Mbit/s extensible with repeaters
- isolation: the bus is galvanically separated from the remaining electronic by means of a DC/DC converter
- The bus signals (line A and B) are isolated by means of optocouplers
- ASIC of communication PROFIBUS -DP: chip Siemens SPC3
- hardware configuration: switch for bus termination and rotary-switch for branch point address allocation
- indication of condition: Multicoloured led indicating the board status and led indicating the fieldbus status

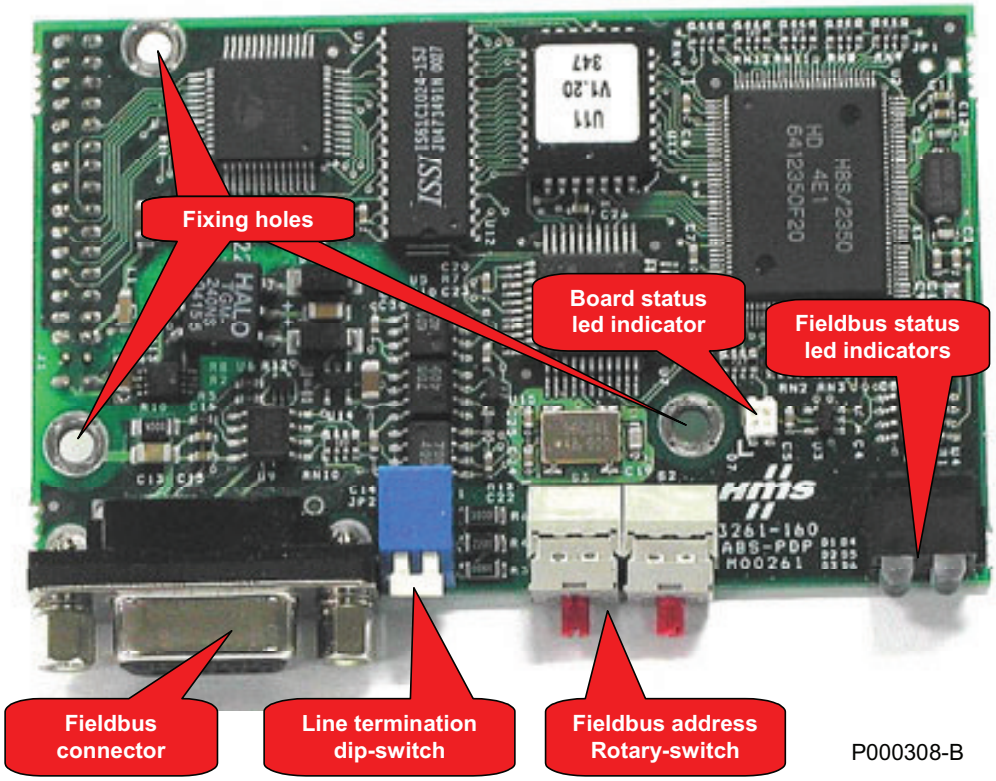

Fig.92: Fieldbus PROFIBUS-DP communication board

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6.8.1. IDENTIFICATION DATA

Description	*Ordering code*	*Compatibility*
KIT ANYBUS-S PROFIBUS-DP	ZZ4600040	All inverters serial Sinus PENTA, all converters serial DCREG2 and DCREG4

6.8.2. INSTALLING THE FIELDBUS BOARD ON THE INVERTER (SLOT B)

1) Turn off the inverter and wait at least 5 minutes
2) The inverter and the board contain electronic components which may be affected by electrostatic discharges. We recommend to take all necessary precautions, before getting access inside of the inverter and handling on its board. The board installation should be performed in a work station equipped with grounding system for the operator and with a antistatic surface. If this equipment is not available, we recommend to wear at least the suitable grounding arm band, correctly connected to the PE conductor.

Remove the protection cover of the inverter terminal board handling on the two frontal screws of the cover bottom. In this way, slot B of the PENTA control board will be accessible, slot that will have the Profibus communication board installed.

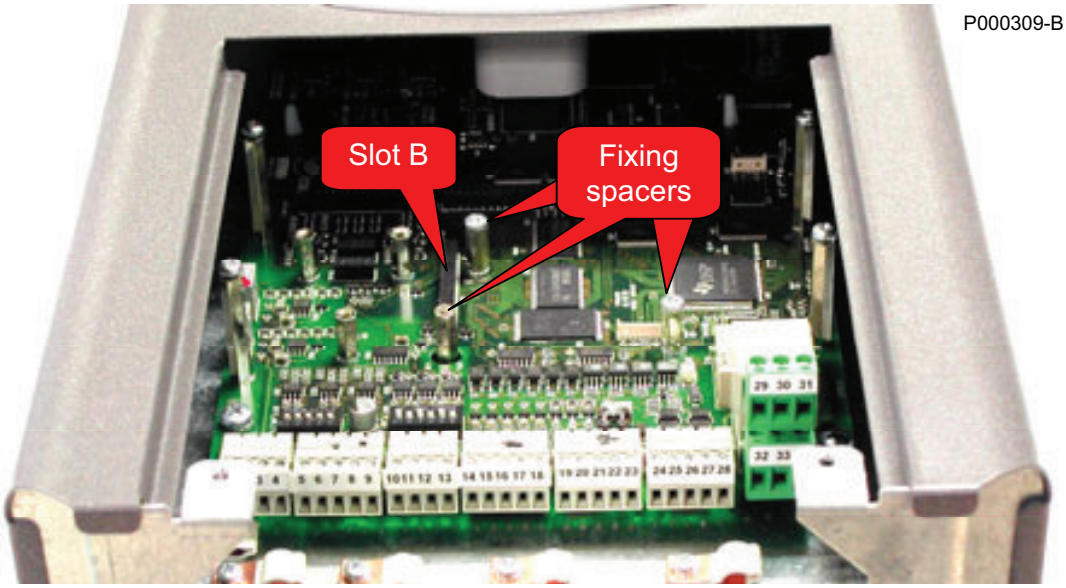

Fig.93 Position of slot B inside of cover for PENTA inverter terminal boards

Insert the board into slot B, paying attention that the board comb connector covers only the front part of the slot leaving the last 6 pins free. If the board is correctly installed, the three fastening holes and the corresponding seats of the little metallic columns of support are aligned. After checking the correct alignment, tighten the three fastening screws as shown in figures 92 and 93.

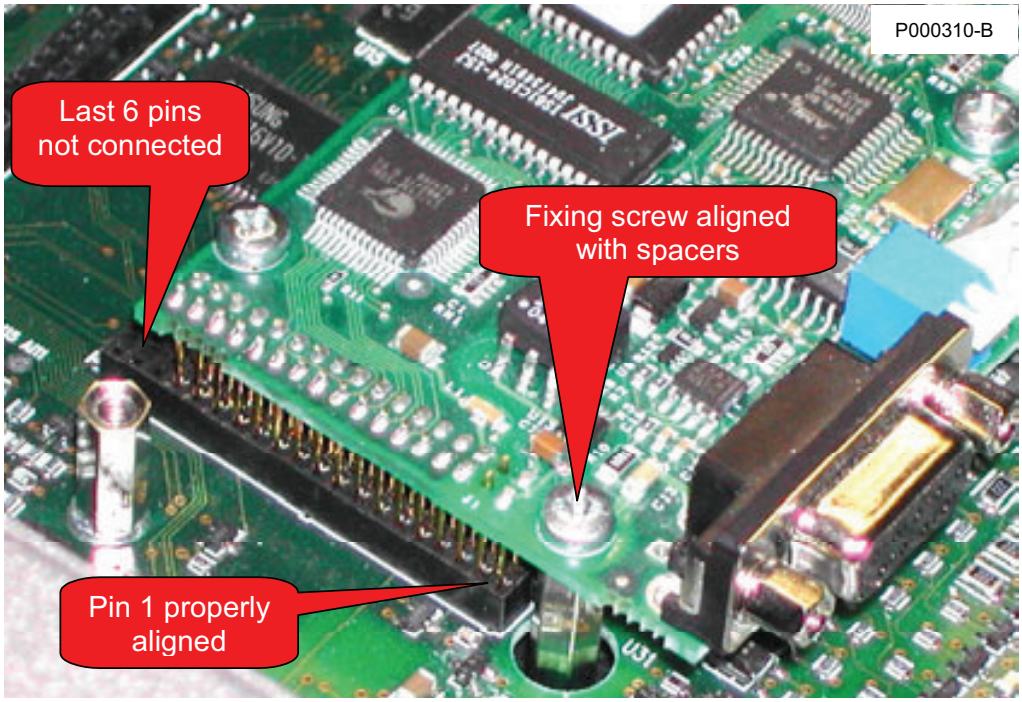

Fig.94: Checking correct alignement of contact comb on connector slot B

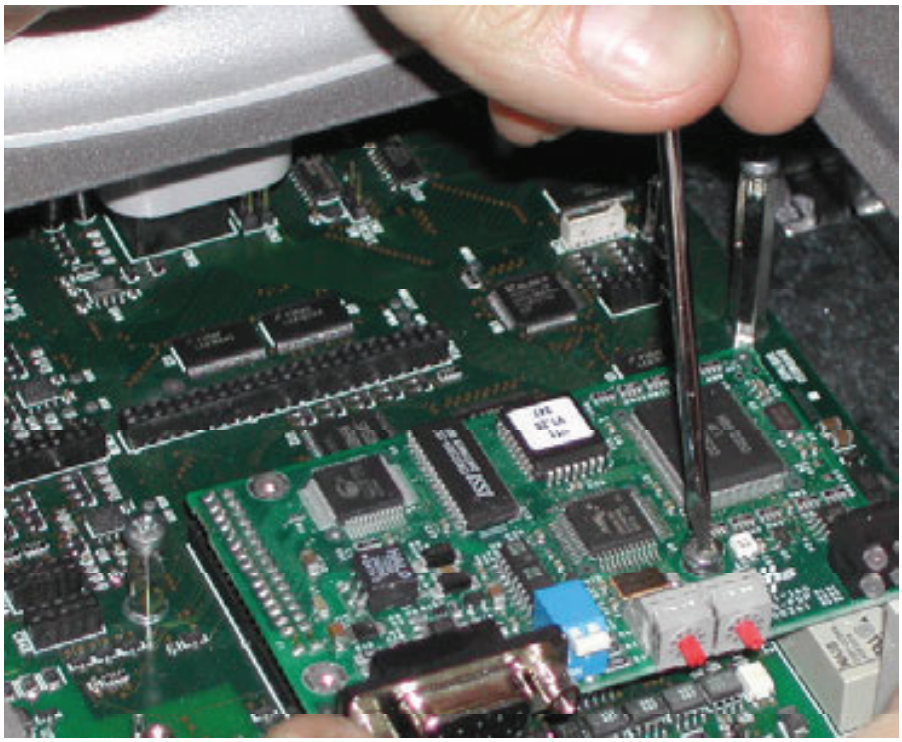

Fig.95: Board fixing on slot B

3) Configurate dip-switches and rotary-switches by following the indication given in the relevant section.
4) Carry out connection of cable Profibus by inserting the proper connector in the plug D-sub and by tightening the coupling screws.
5) Supply the inverter and carry out the programmation of the parameters relevant to the use of the Profibus-DP board, referring to relevant section of Sinus PENTA Programmation Instruction.

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DANGER: Before gaining access to the components inside the inverter, remove voltage from the inverter and wait at least 5 minutes. Wait for a complete discharge of the internal components to avoid any electrical shock hazard.

CAUTION: Do not connect or disconnect signal terminals or power terminals when the inverter is on. Beyond the hazard of electric shock, here is also the risk of damaging the inverter.

NOTE: All fastening screws for removable parts (terminal cover, serial interface connector, cable path plates, etc.) are black, rounded-head, cross-headed screws. Only these screws may be removed when connecting the equipment. If other screws or bolts are removed, the product guarantee will be no longer valid.

6.8.3. FIELDBUS CONNECTOR

D-Sub 9-pins female connector.

Pins located as shown in the table.

N.	*Name*	*Description*
-	Screen	Connector housing linked to a PE
1	N.C.	
2	N.C.	
3	B-Line	Positive RxD/TxD according to specificaions RS 485
4	RTS	Request To Send – active high in trasmission
5	GND	Ground of isolated bus according to 0V control board
6	+5V	Driver bus supply isolated by the circuits of the control board
7	N.C.	
8	A-Line	Negative RxD/TxD according to specifications RS 485
9	N.C.	

6.8.4. BOARD SETTING

The communication board PROFIBUS-DP is equipped with a dip-switch and with two rotary-switches for configuration, they are necessary to set the operation mode.
The dip-switch located aside the fieldbus connector allows to insert the line termination. The termination is inserted by pushing lever downward as per following table

Termination of fieldbus line cut in	Termination of fieldbus line cut out
	

The termination of the fieldbus line should be cut in only with the first and last device of a chain, as explained with figure 94.
The figure shows a common configuration where the first device is the Master (PLC, Bus Bridge or Repeater), but this device can be connected also in central position. Anyway, the rule stating that termination should always be connected to first or last device, is always valid.

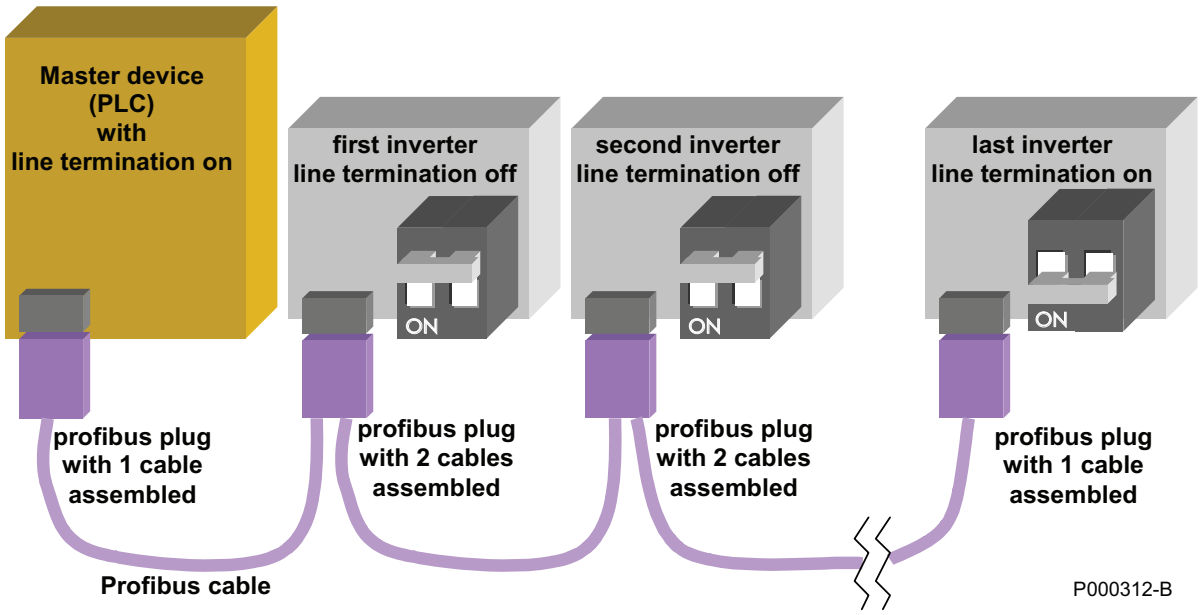

Fig.96: Diagram of Profibus chain with correct setting of line terminations underlined.

Each device of the chain should have a different Profibus address. The address of the Sinus PENTA serial inverters is set by handling on the rotary-switches placed on the interface board. Each rotary-switch has a pivot that can be rotated, by means of a screwdriver, to each of the references numbered 0 to 9.
The left rotary-switch allows to set dozens, while the right one allows to set the units of Profibus address. The figure 95 shows an example of correct position to set address 19.

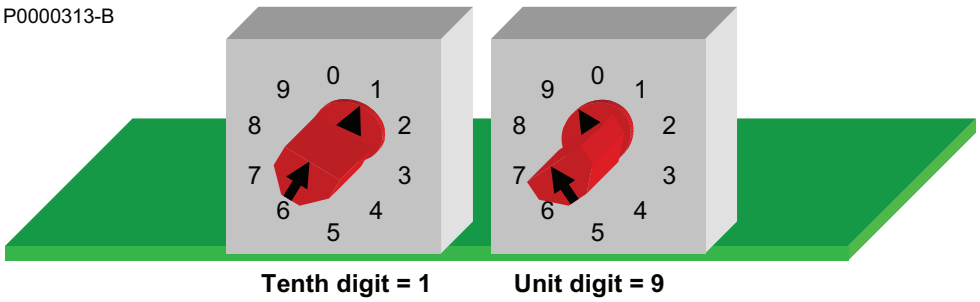

Fig.97: Example of rotary-switch position to set Profibus address 19.

NOTE:

By means of the rotary-switches the profibus addresses from 1 to 99 can be set. If addresses from 100 to 125 are to be set, this is possible only by sending the mailbox telegram FB_SET_NODE_ADDRESS to the device. For further information, please contact Elettronica Santerno S.p.A.

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6.8.5. CONNECTION TO FIELDBUS

To enable the correct operation of the bus, it is absolutely necessary to carry out a wiring obtained correctly especially if the fieldbus has to work at high speeds (higher or equal to 1,5Mb/s).
Figure 5 represents the topoligy recommended for a Profibus path connecting more devices.
It is necessary to use the cable homologated for Profibus. We recommend to use "Profibus Standard Bus Cables" type A, to observe the maximum connection lengths according to the baudrate and to use suitable connectors.
Following table shows standard baudrate values and the corresponding maximal bus length in case you are to use a cable type A.

Allowable Baudrate	*Maximal length for A calbe*
9.6 kbit/s	1.2 km
19.2 kbit/s	1.2 km
45.45 kbit/s	1.2 km
93.75 kbit/s	1.2 km
187.5 kbit/s	1 km
500 kbit/s	400 m
1.5 Mbit/s	200 m
3 Mbit/s	100 m
6 Mbit/s	100 m
12 Mbit/s	100 m

We advise to use Profibus FC (FastConnect) connectors, showing following advantages:

- They have internal cable connections of the type of insulation perforation and therefore no welding operations are necessary
- They can house two cables, one at input and the other at output, so as to realize the connection of the intermediate branching points without taking advantage of the "stubs" (T fittings) avoiding signal reflections
- They are equipped with internal termination resistors connected with a switch placed on the connector body
- They are equipped with an inner impedance adapting grid to compensate the connector capacity.

NOTE: If Profibus FC connectors with inner termination are used, it is possible to insert without distinction, in the single devices at bus ends, either the connector terminator or the board terminators. Never activate at the same time the terminators on the board and the terminators on the connector, moreover do not activate the terminators of the intermediate branching points.

NOTE: For a general information on the Profibus, we recommend to refer to Internet site http://www.profibus.com. It is particularly possible to download document "Installation Guideline for PROFIBUS DP/FMS" giving all advices for a correct wiring

6.8.6. STATUS INDICATORS

The module is equipped with four LEDs installed in the front at one bi-coloured red/green for debugging pursposes, as shown in the figure 96.

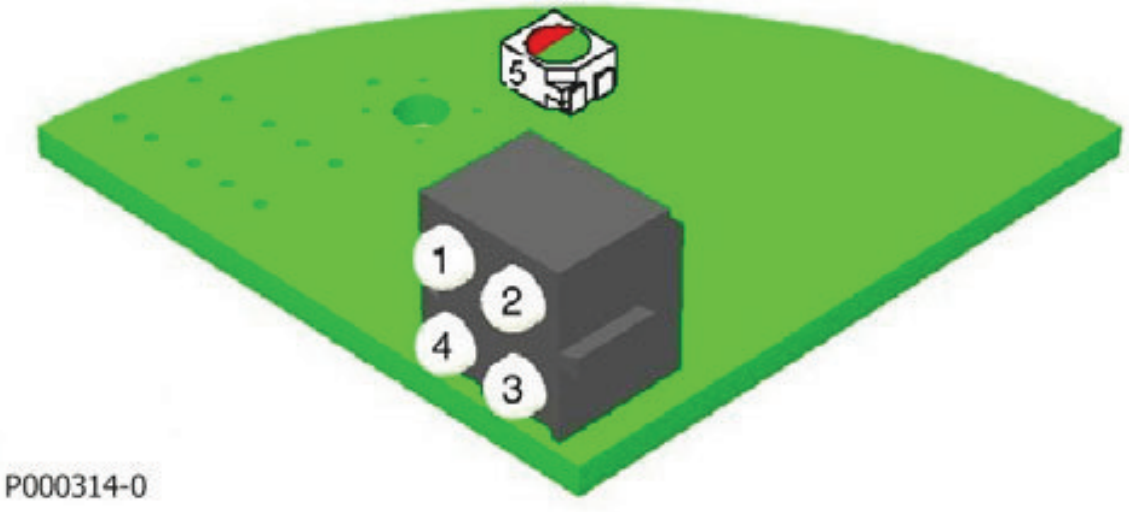

Fig.98: Position of indicator Leds on the board

Led 1 is not used, while the others indicate the status as per following table.

Name	*Function*
2. On-Line	This indicates that the converter is On-Line on the Fieldbus: **Green** – the module is ON-Line and the data exchange can be performed. **Off** – The module is not On-Line
3. Off-Line	This indicates that the converter is Off-Line on the Fieldbus: **Red** – The module is Off-Line and the data exchange cannot be performed. **Off** – The module is not Off-Line
4. Fieldbus Diagnostic	It indicates some errors on the Fieldbus date: **Red blinker at 1 Hz** – Error during configuration the length of IN and OUT messages during module initialisation does not correspond to the length of messages fixed during initialisation of the mains. **2 Hz red blinker** – Data error in the User's Parameters: the length and/or contents of User's Parameters Data set during initialization of module does not correspond to the length and/or contents of the data fixed during the mains initialization. **4 Hz red blinker –** Error in the initialization of the Fieldbus communication ASIC **Off** – No error available
5. Board diagnostic	**Red** – Inner error not specified, or module operatine at bootloader mode **1 Hz Red blinker** – RAM fault **2 Hz red blinker** – ASIC or FLASH fault **4 Hz Red blinker** – DPRAM fault **2 Hz green binker** – Module not initialized **1 Hz green binker** – Module initialized and operating.

6.8.7. ENVIRONMENTAL FEATURES

Operating temperature:	0 to +50 °C ambient temperature (contact Elettronica Santerno for higher ambient temperatures)
Relative humidity:	5 to 95% (Non condensing)
Max. operating altitude	4000 m (a.s.l.)