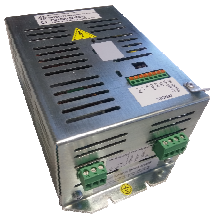
SLP Series

ED500L



ED500/ED1000

ED2000

ID2000

Sensorless & Programmable Inverter For Brushless Motors

ELETTROTEST

ELETTRONICA PROFESSIONALE
PROFESSIONAL ELECTRONICS

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1 SAFETY RECOMMENDATIONS

Follow installation instructions and always connect PE points ⏚ *to earth (ground).*

Shock hazard if the earth connection is missing due to filter capacitances required by CE requirements.

Use a circuit breaker and a T type fuse on live parts as indicated in the installation instructions. The fuse can be placed on conductor L or on conductor N. These means for disconnection must be incorporated in the fixed wiring in accordance with the wiring rules.

Control parameters have been tuned for compatible motors and ventilation appliances. Using other hardware configurations can lead to control/hardware malfunctions.

Inbuilt protections are only intended to prevent a functional damage of the inverter and the motor. Protections are software based and not to be considered as proper security measures to avoid harm or injuries to persons.

The appliance is not to be used by children or persons with reduced physical, sensory or mental capabilities, or lack of experience and knowledge, unless they have been given supervision or instruction.

This appliance can be used by children aged from 8 years and above and persons with reduced physical, sensory or mental capabilities or lack of experience and knowledge if they have been given supervision or instruction concerning use of the appliance in a safe way and understand the hazards involved.

Children shall not play with the appliance.

Cleaning and user maintenance shall not be made by children without supervision.

There are no user serviceable parts inside the appliance. The appliance should not be opened. In case of malfunction contact the manufacturer, its service agent or similarly qualified persons in order to avoid hazards.

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2 GENERAL INFORMATIONS

ED/ID inverters drive BLAC/PMSM motors with a sinusoidal PWM and in sensorless mode. They operate in speed/power/current/flow/pressure control and the control reference is set by an analog/digital input. The inverter functions can be programmed via a Modbus Protocol over a RS485 line. All models have inbuilt protections and a visual/electrical information on the alarm condition. All models are designed to work UNDER VENTILATION.

Model	W_{IN}	I_{IN}	V_{IN}	HW TYPE	Dimensions	IP	Inrush current @ $230V_{AC}$	Expected Life	Leakage current @ 230 V_{AC}	FUSE	ET CODE	Motor Type	Default Programming
	W	*A*	*V*		*W x L x H (mm)*		*A (pk)*	*h*	*mA (rms)*	*Amp*	*Code*	*RPM code*	*Configuration*
ED500L	500	2,5	230	ED500L	82 x 175,5 x 63	IP20	3	30.000	2,5	4AT	99261081	110B01	01002
ED500				ED500	112 x 176 x 83						99261161	110B01	01001
ED500 /M											99261166	110B01	01001
ED1000	1000	5		ED1000						8AT	99261171	110B06	03001
ED1000 /M											99261176	110M01	06001
ED1500 LS	1500	8		ED2000	226,4 x 137,4 x 93				2	16AT	99261184	110B09	04501
ED2000	2000	10									99261181	110B09*	04503
ID2000				ID2000	226,4 x 150 x 112	IP55					99261191	110B09*	04503

** inverter performance exceed motor capabilities, maximum output current have been reduced*

Tab. 2.1- ED Models

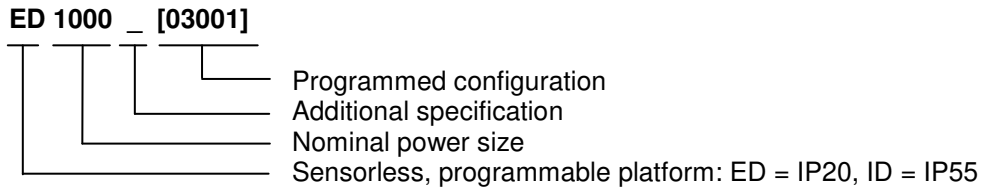
All models have an active PFC (PF > 0.95 at nominal power) and a precharge circuit to reduce inrush current.

The main features are:

- **Programmable motor model for sensorless control;**
- Programmable control operation: speed, power, current, flow, pressure;
- Programmable reference source and range;
- Programmable limitations up to predefined SOA;
- Programmable control response and motor startup;
- Frequency skip band and post ventilation;
- Parameter access limited by authorization levels;
- Standard Modbus protocol over RS485.

See the Programming Manual for further details.

Model coding



ELETTROTEST S.p.A CAN PROVIDE SPECIAL CODES ADAPTED TO CUSTOMER'S MOTOR AND APPLICATION

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3 SPECIFICATIONS

The default configuration provides a speed control in the 100-1550 rpm speed range and 0-10V control signal. In **Errore. L'origine riferimento non è stata trovata.** are listed the typical performances of the base hardware platform.

The icon ✎ indicates that the value/function is programmable.

See code-specific technical drawing for detailed informations

Supply	**ED500L**	**ED500**	**ED1000**	**ID/ED2000**
Type	Single phase - L/N	Single phase - L/N	Single phase - L/N	Single phase - L/Nì
V_{NOM}	230 Vac ±10% 50/60 Hz	230 Vac ±10% 50/60 Hz	230 Vac ±10% 50/60 Hz	230 Vac ±10% 50/60 Hz
W_{IN}	500 W (limit 550 W ±6%)	500 W (limit 550 W ±6%)	1000 W (limit 1100 W ±6%)	2000 W (limit 2100 W ±6%)
VA_{IN}	525 VA (limit 580 VA ±6%)	525 VA (limit 580 VA ±6%)	1050 VA (limit 1160 VA ±6%)	2100 VA (limit 2200 VA ±6%)
I_{IN}	2,5 Arms	2,5 Arms	5 Arms	10 Arms
Undervoltage	180 Vac	180 Vac	180 Vac	210 Vac
Leakage current	2,5 mA ±20% @ 230Vac, 50 Hz	2,5 mA ±20% @ 230Vac, 50 Hz	2,5 mA ±20% @ 230Vac, 50 Hz	2 mA ±20% @ 230Vac, 50 Hz
Inrush Current	3 Apk @ 230 Vac, T_{AMB} = 25°C, precharge function	3 Apk @ 230 Vac, T_{AMB} = 25°C, precharge function	3 Apk @ 230 Vac, T_{AMB} = 25°C, precharge function	3 Apk @ 230 Vac, T_{AMB} = 25°C, precharge function
Environment	**ED500L**	**ED500**	**ED1000**	**ID/ED2000**
T_{AMB}	-20° to +50°C under ventilation	-20° to +50°C under ventilation	-20° to +50°C under ventilation	-20° to +50°C under ventilation
Air speed on both heatsinks	6 m/s Derating on insufficient ventilation	3 m/s Derating on insufficient ventilation	6 m/s Derating on insufficient ventilation	6 m/s Derating on insufficient ventilation
Altitude	<2000m	<2000m	<2000m	<2000m
Protection	**ED500L**	**ED500**	**ED1000**	**ID/ED2000**
IEC Protection Class	Class I Signal part is a low voltage double insulation with respect to live parts Signal GND is connected to PE with 4,7nF 250V Y2 capacitor	Class I Signal part is a low voltage double insulation with respect to live parts Signal GND is connected to PE with 4,7nF 250V Y2 capacitor	Class I Signal part is a low voltage double insulation with respect to live parts Signal GND is connected to PE with 4,7nF 250V Y2 capacitor	Class I Signal part is a low voltage double insulation with respect to live parts Signal GND is connected to PE with 4,7nF 250V Y2 capacitor
IP Grade	IP20	IP20	IP20	IP20 / IP55
Dimensions	**ED500L**	**ED500**	**ED1000**	**ID/ED2000**
W x L x H	82 x 175,5 x 63 mm	112 x 176 x 83 mm + 7.5 mm H faston	112 x 176 x 83 mm + 7.5 mm H faston	ED: 226,4 x 137,4 x 93 mm + 7.5 mm H faston ID: 226,4 x 150 x 112 mm
Motor Output	**ED500L**	**ED500**	**ED1000**	**ID/ED2000**
Type	Sinusoidal 3 Phase U/V/W (PWM)	Sinusoidal 3 Phase U/V/W (PWM)	Sinusoidal 3 Phase U/V/W (PWM)	Sinusoidal 3 Phase U/V/W (PWM)
W_{OUT} ✎	460 W (limit 500 W ±6%)	460 W (limit 500 W ±6%)	910 W (limit 1000 W ±6%)	1800 W (limit 1900 W ±6%)
$V_{OUT,MAX}$ ✎	234 Vrms	234 Vrms	234 Vrms	234 Vrms
$I_{OUT,MAX}$ ✎	1,9 Arms	1,9 Arms	3,2 Arms	7 Arms
F_{OUT} ✎	7 - 103 Hz (100 - 1550 rpm on 8 poles)	7 - 103 Hz (100 - 1550 rpm on 8 poles)	7 - 103 Hz (100 - 1550 rpm on 8 poles)	7 - 103 Hz (100 - 1550 rpm on 8 poles)
$S_{SPEED-RAMP}$ ✎	7 Hz/s (100 rpm/s on 8 poles)	7 Hz/s (100 rpm/s on 8 poles)	7 Hz/s (100 rpm/s on 8 poles)	7 Hz/s (100 rpm/s on 8 poles)

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Signal I/O	ED500L	ED500	ED1000	ID/ED2000
AL1, AL2	Alarm, Tacho, Multifuncion ✎ AL1: NPN open collector (24 V max, 20 mA sink) AL2: 0,+5V source @ 10 µA typical (24 V max, 20 mA sink)	Alarm, Tacho, Multifuncion ✎ AL1: NPN open collector (24 V max, 20 mA sink) AL2: 0,+5V source @ 10 µA typical (24 V max, 20 mA sink)	Alarm, Tacho, Multifuncion ✎ AL1: NPN open collector (24 V max, 20 mA sink) AL2: 0,+5V source @ 10 µA typical (24 V max, 20 mA sink)	Alarm, Tacho, Multifuncion ✎ AL1: NPN open collector (24 V max, 20 mA sink) AL2: 0,+5V source @ 10 µA typical (24 V max, 20 mA sink)
V+	10 Volt regulated ±5% (max load 16 mA)	10 Volt regulated ±5% (max load 16 mA)	10 Volt regulated ±5% (max load 16 mA)	10 Volt regulated ±5% (max load 16 mA)
IN	0-10 Vdc or 10V PWM, RIN = 160kΩ, τ = 41ms $V_{IN,START}$ = 0.5 V, $V_{IN,STOP}$ = 0.25V, V_{IN,MAX_SPEED} = 9 V (±100 mV) ✎	0-10 Vdc or 10V PWM, RIN = 160kΩ, τ = 41ms $V_{IN,START}$ = 0.5 V, $V_{IN,STOP}$ = 0.25V, V_{IN,MAX_SPEED} = 9 V (±100 mV) ✎	0-10 Vdc or 10V PWM, RIN = 160kΩ, τ = 41ms $V_{IN,START}$ = 0.5 V, $V_{IN,STOP}$ = 0.25V, V_{IN,MAX_SPEED} = 9 V (±100 mV) ✎	0-10 Vdc or 10V PWM, RIN = 160kΩ, τ = 41ms $V_{IN,START}$ = 0.5 V, $V_{IN,STOP}$ = 0.25V, V_{IN,MAX_SPEED} = 9 V (±100 mV) ✎
VOL	Offline programming input voltage (5,5-15 Vdc)	Offline programming input voltage (5,5-15 Vdc)	Offline programming input voltage (5,5-15 Vdc)	Offline programming input voltage (5,5-15 Vdc)
RS485 -/A, +/B	RS485 signals	RS485 signals	RS485 signals	RS485 signals
Control	**ED500L**	**ED500**	**ED1000**	**ID/ED2000**
Default ✎	Speed control in normal operation, speed reduction in limitation condition ✎	Speed control in normal operation, speed reduction in limitation condition ✎	Speed control in normal operation, speed reduction in limitation condition ✎	Speed control in normal operation, speed reduction in limitation condition ✎
T_{ON}	4 s *	4 s *	4 s *	4 s *
T_{START}	6 s	6 s	6 s	6 s
$T_{STARTUP}$	2 s	2 s	2 s	2 s
Compliance	**ED500L**	**ED500**	**ED1000**	**ID/ED2000**
Safety	EN 60335-1 Pollution Degree 3 compliant	EN 60335-1 Pollution Degree 3 compliant	EN 60335-1 Pollution Degree 3 compliant	EN 60335-1 Pollution Degree 3 compliant
EMC **	EN 61000-6-2 EN 61000-6-3 EN 61000-3-2	EN 61000-6-2 EN 61000-6-3 EN 61000-3-2	EN 61000-6-2 EN 61000-6-3 EN 61000-3-2	EN 61000-6-2 EN 61000-6-3 EN 61000-3-2

* T_{ON} = Precharge time after power on
T_{START} = Motor activation time after power on
$T_{STARTUP}$ = Startup phase after motor activation (brake + align)
** *These products are intended to be used inside other applications. Compliance is referred to conditions expressed in §6. Additional filters may be required in case of other installation layouts*

Tab. 3.1 - Technical specifications

Protection	Type	ED500L	ED500	ED1000	ED2000	Notes
OverTemperature	Alarm *	105°C ✎	105°C ✎	105°C ✎	105°C ✎	Abs Max, lower values allowed (reset below Temp. Lim)
OverVoltage	Alarm	➨	➨	➨	➨	440 Vdc Bus
UnderVoltage	Alarm	➨	➨	➨	➨	330 Vdc Bus 180 Vac Supply 160 Vac Supply with motor active
OverCurrent	Alarm	3 A	3 A	4 A ✎	7 A ✎	Abs Max, lower values allowed
BlockedRotor	Alarm	80 rpm ✎	80 rpm ✎	80 rpm ✎	80 rpm ✎	Abs min, higher values are programmable
Temp. Limitation	Limitation **	90 °C ✎	90 °C ✎	90 °C ✎	90 °C ✎	
Curr. Limitation	Limitation	2 A ✎	2 A ✎	3,5 A ✎	6 A ✎	
LowInputVoltage	Limitation	➨	➨	➨	➨	Power derating from MaxPower to 300W below 200 Vac down to160 Vac supply (linear)

** Alarm: motor haled and restarted after a pause of 10 seconds*
*** Limitation: speed reduction in order to keep inverter or motor in programmed safe operating area*

Tab. 3.2 - Alarms and limitations

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4 OPERATION

Values in graphs refer to a typical 1000 W , 1550 rpm, 0-10V signal application.

The icon ✎ indicates that the value/function is programmable.

4.1 Normal operation

During normal operation (no alarms, no limitations) the selected control type is active and the motor is driven up to the selected working point. A change in the load condition or a variation of the supply voltage is compensated to keep the working point at the desired reference value. A programmable input signal (analog or digital) sets the reference value and a DIP switch selector is provided for additional functions.

Tab. 4.1 associates the DIP switches positions with the minimum and maximum reference values ✎. The DIP switches should be operated only when the inverter is powered OFF. Refer to "Speed reference input signal (Connector C)" in §5 for connections.

N°	Speed max	DIP 1	DIP 2	DIP 3	W limit (± 6%)
1	1550 rpm	OFF	OFF	OFF	1100 W
2	1450 rpm	ON	OFF	OFF	1100 W
3	1350 rpm	OFF	ON	OFF	1100 W
4	1250 rpm	ON	ON	OFF	1100 W
5	1150 rpm	OFF	OFF	ON	1100 W
6	1050 rpm	ON	OFF	ON	1100 W
7	950 rpm	OFF	ON	ON	1050 W
8	850 rpm	ON	ON	ON	950 W

Tab. 4.1 - Speed Range Select Table (ex. for ED1000 on 110B06) ✎

The relation between the voltage of the INPUT (IN) signal and the speed reference is shown in Fig. 4.1.

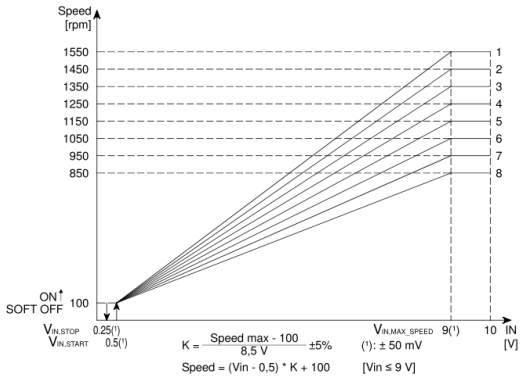

Fig. 4.1 - IN voltage Vs Speed reference ✎

Power ON — at power on the inverter waits $T_{STARTUP}$ seconds before reacting to a user reference setpoint. This pause is for internal voltages stabilization.

Start/Stop — when the voltage of the INPUT (IN) signal is set above $V_{IN,START}$ the inverter begins to drive the motor. A startup phase that lasts $T_{STARTUP}$ seconds is needed to synchronize the inverter with the motor for maximum efficiency. After the startup phase the inverter increases the speed to reach the user setpoint with a linear reference ramp. When the voltage of the INPUT (IN) signal is set below $V_{IN,STOP}$ = ½ $V_{IN,START}$ the inverter reduces the speed with a linear reference ramp until the motor stops. Note: if the selected control is, for example, the power-control the reference is in Watts and the linear ramp slope is in W/s; thus reference reduction is linear but speed reduction is not.

Breaking — during the startup phase a soft breaking action is performed.

Setpoint variation — a change in the reference setpoint is performed with a linear ramp of reference from the old reference point to the new one. The slope of the ramp is programmable with distinct values for positive slope and negative slope. The ramp is active both during acceleration and during deceleration.

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4.2 Alarms

The inverter has inbuilt protections to prevent it from working in unsafe conditions. The activation of a protection is indicated by the Alarm LED (red) inside the inverter (for alarms and limitations) and with an NPN opto-isolated transistor connected to the Alarm (AL1) signal.

With no alarms, the (AL1) output signal is connected to GND(-) (NPN contact closed). In this condition the contact can sink up to 20 mA at 25°C. An alarm opens the NPN contact, disconnecting (AL1) from GND (-) and setting it in an high impedance state. Refer to §5 for schematics and connections.

On each alarm the inverter stops the motor and waits 10s before trying to restart the motor. During the 10s pause the Alarm LED blinks and the NPN contact opens.

CONTROL ALARM TYPES	LED (red) INDICATIONS	ALARM INDICATIONS AL1	ACTIONS	NOTES
Overtemperature	Slow Blink 3 s ON, 1 s OFF	Slow Blink 3 s ON, 1 s OFF	Motor OFF	Continuos autorestart
Overvoltage				
Undervoltage				
Overcurrent				
Over Load	Fast Blink 1 s ON, 1 s OFF	Fast Blink 1 s ON, 1 s OFF	Speed reduction	Power limitation
Torque Limit				Current limitation
Safety Control				Temperature limitation
Deflux				Output voltage limitation
No Serial Com	Pulsed 1 s ON, 3 s OFF	See TAB.3	Motor OFF	Bad or absent serial communication
No Alarms	OFF	OFF	/	/

Tab. 4.2 - Control Alarms

INTERFACE ALARM TYPES	LED A (red) INDICATIONS	ALARM INDICATIONS AL1, AL2
Memory Error	ON	ON, ON
Empty Memory		
No Serial Comm		
No Alarms	OFF	See TAB.2

Tab. 4.3 - Interface Alarms

4.3 Limitations

A speed reduction is performed to reach a safe working point in case of an excessive load, an excessive temperature condition or a very low input voltage. The reduction of the speed causes a reduction of the input power that allows the inverter not to exceed the programmed power limit curve or the programmed maximum internal temperature.
This is a condition of limited but controlled performance in which the speed control is not active. The final speed depends on load conditions and ambient temperature. the Alarm LED blinks and the NPN contact opens (DIP4=OFF), both with a rate of 0.5s-ON, 0.5s-OFF.

Over Load — the Power Limit Vs Speed curve in Fig. 4.2 is programmed to drive the load to the nearest acceptable working point. A minimum speed is always kept to ensure ventilation on motor and inverter.

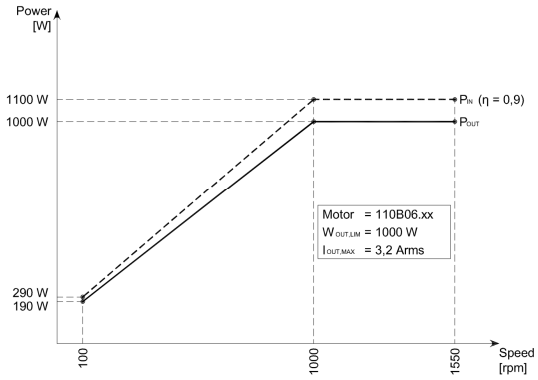

Fig. 4.2 - Power Limit Vs Speed (ex. for ED1000)

Temperature Limitation — If the inverter reads and internal temperature above 90°C it reduces the speed of the motor to come back to a reading of 90°C. The final speed depends on the ability of the air temperature to cool

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down the inverter. The speed will not go below about 300 rpm to keep the air moving around the case with a minimum amount of power input. If the internal temperature continues to rise and exceeds 105°C the inverter stops the motor and the limitation transforms into an alarm. The inverter waits for the internal temperature to go below 90°C to start again the motor.

Current Limit — during a speed transient or in abnormal load conditions the inverter will limit the phase current value to prevent excessive accelerations or motor stops.

Low Input Voltage — the inverter performance is reduced when the supply voltage goes below 200 Vac. This reduction is intended to limit the input current of the inverter and is proportional to the reduction of the input voltage. Fig. 4.3 shows the linear relation between maximum input power and supply voltage. If the input voltage reaches 160 Vac the inverter stops the motor and goes into an UnderVoltage alarm condition. The inverter waits for the voltage to go above 180 Vac to start the motor again.

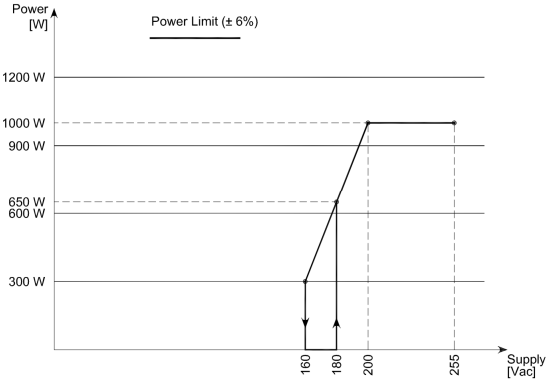

Fig. 4.3 - Max Power Vs Supply Voltage (ex. for ED1000)

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5 MECHANICAL AND CONNECTIONS

5.1 Model ED500L

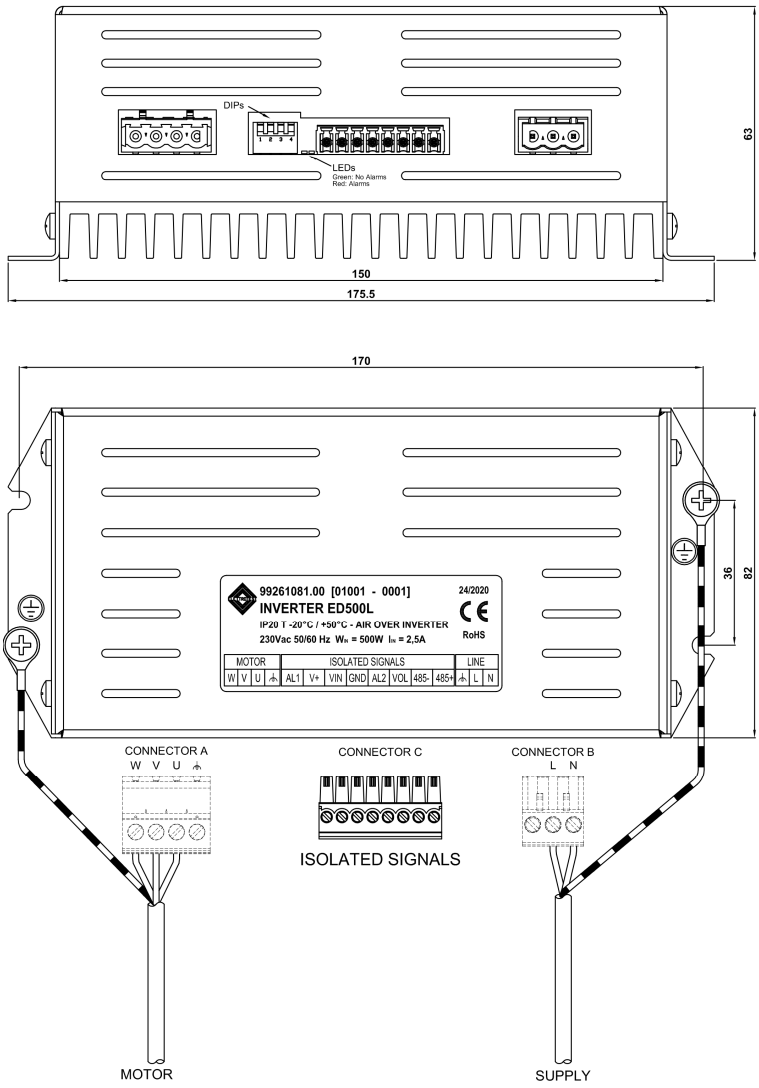

Fig. 5.1 - ED500L side and top views (labels are indicative)

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5.2 Models ED500/ED1000

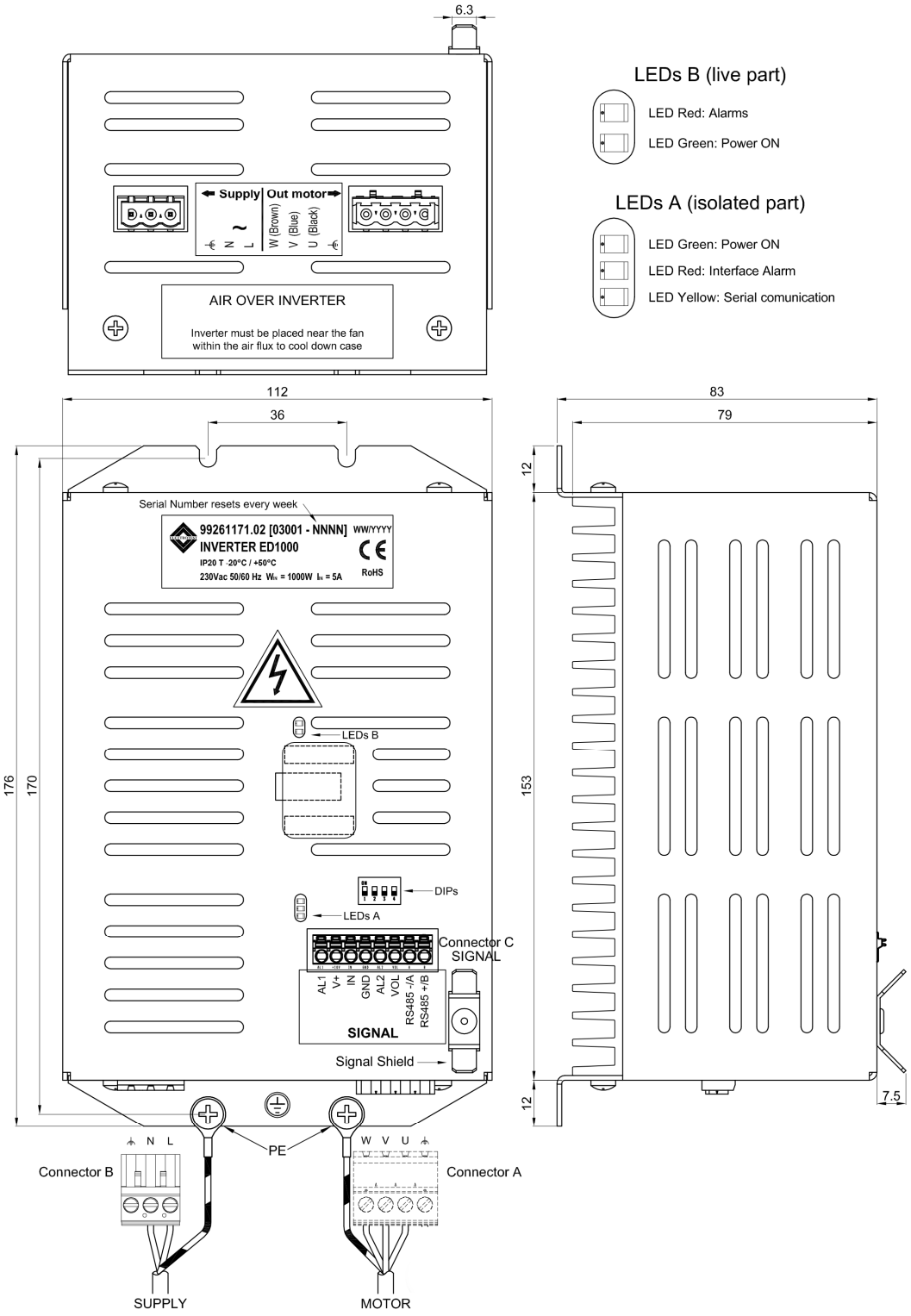

Fig. 5.2 - ED500/ED1000 side and top views (labels are indicative)

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5.3 Model ED2000

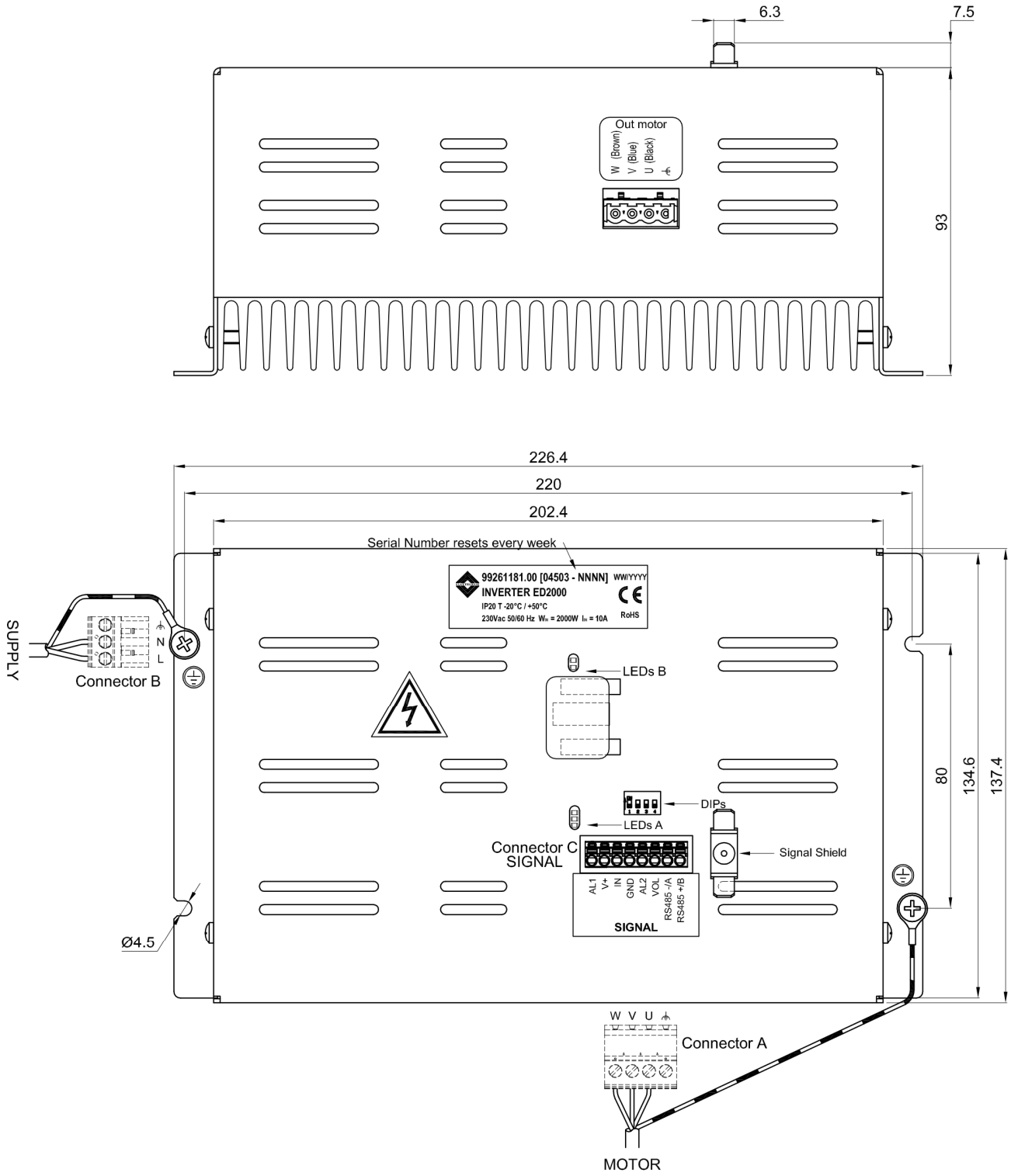

Fig. 5.3- ED2000 side and top views (labels are indicative)

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5.4 Model ID2000

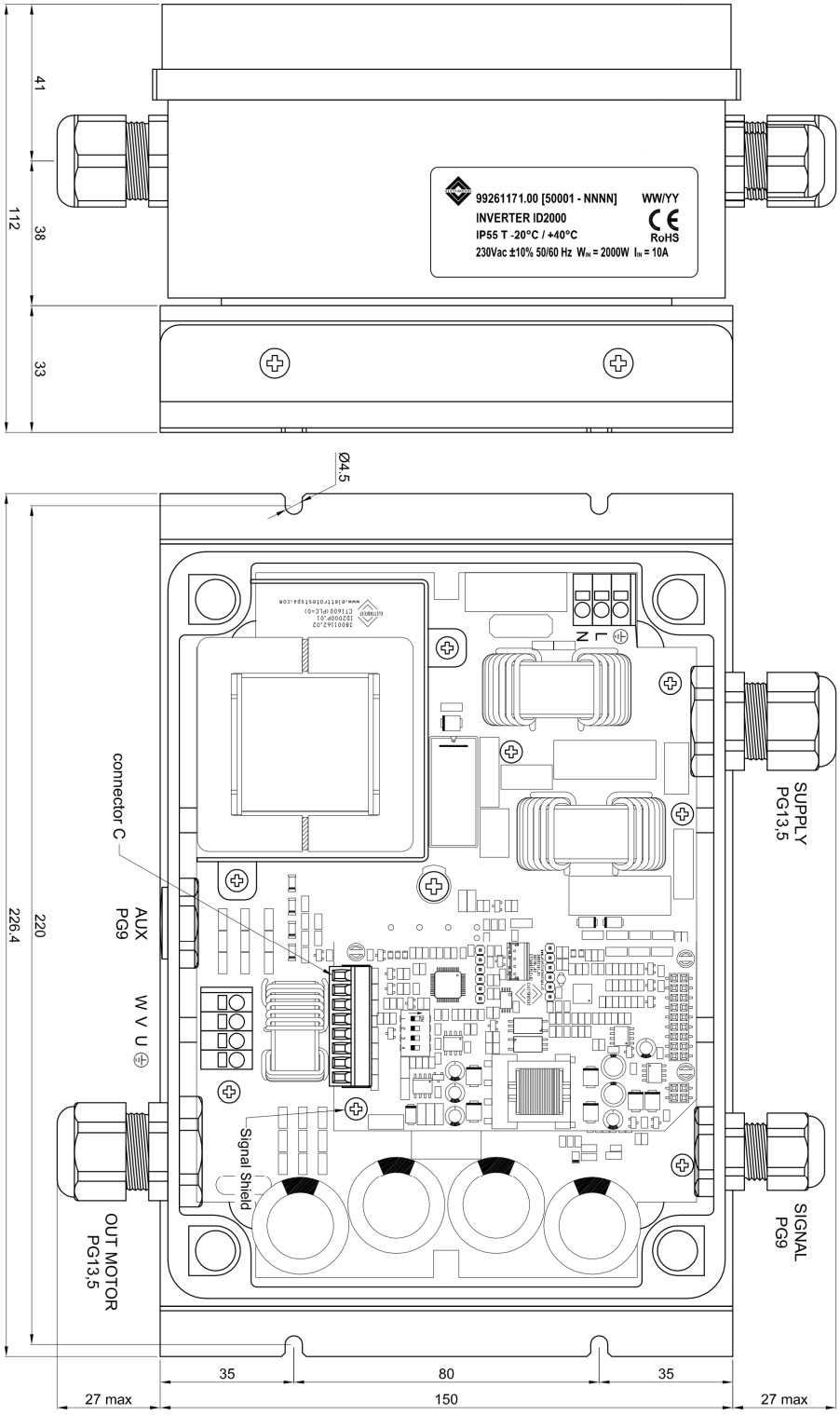

Fig. 5.4- ID2000 side and top views (labels are indicative)

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5.5 SIGNAL CONNECTR – Internal interface (Connector C)

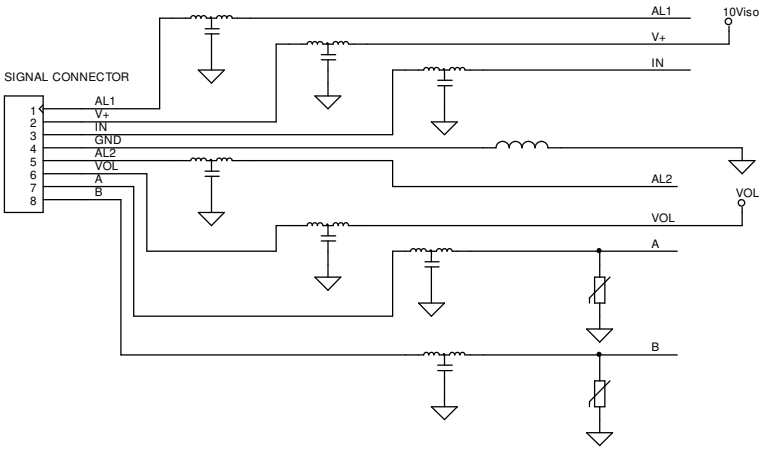

Fig. 5.5 - Internal interface to Signal Connector

IN - Speed reference input signal (Connector C)
Connect the INPUT (IN) signal to a 0-10V DC source with GND (-) as voltage reference. V+ provides a regulated voltage source of 10 V ±5% (16 mA max) to drive a potentiometer as shown in Fig. 5.6.

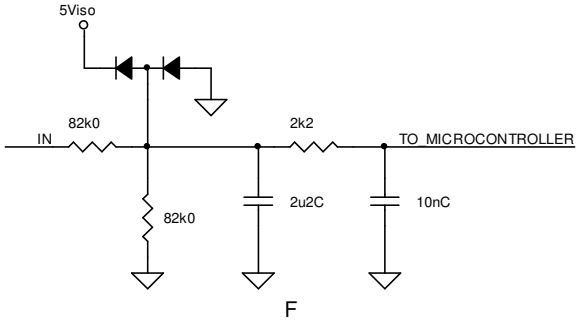

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Fig. 5.6 - Input signal interface

AL1, AL2 output (Connector C)
Alarm/Tacho/Multifunction output

AL1: NPN open collector, 24 Vmax, 20 mA sink

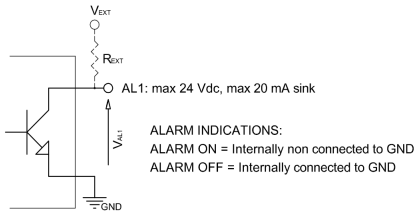

Fig. 5.7 – Interface circuit for AL1

AL2: 0, +5 V source @ 10 µA typical, 24 Vmax, 20 mA sink

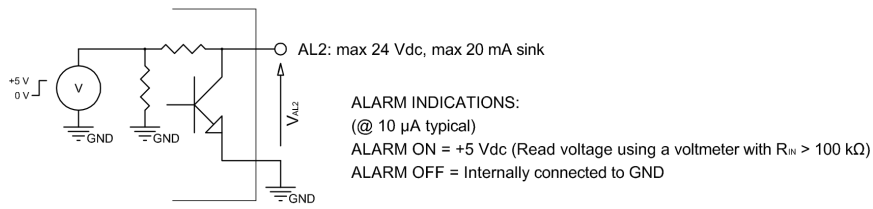

Fig. 5.8 – Interface circuit for AL2

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Alarm function: the output returns information on the alarm condition: Alarm (A) is disconnected from Gnd (-) in case of an alarm (Refer to §4.2 for more informations) and connected to Gnd in case on normal operation. Can be programmed to output a pulse coded information or a steady state.

Tacho function: the output is a square wave of ON and OFF levels and its frequency F is proportional to the mechanical speed of the motor in rpm: Speed [rpm] = F * 60.

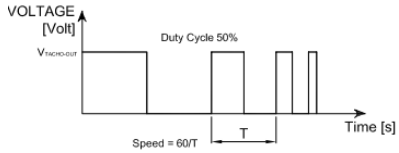

Fig. 5.9 - Multifunction output signal Alarm/Tacho

Multifunction: the output returns information on various inverter conditions, see the Programming Manual for details.

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6 INSTALLATION

6.1 Mandatory

Connections

- insert a fuse properly sized to maximum current (Tab. 2.1 for suggested values) and a differential circuit breaker (A-Type at least, B-Type recommended); these means for disconnection must be incorporated in the fixed wiring;
- connect power-ground cable and motor-ground cable with appropriate screw to slotted holes with label ⏚; only screws that generate a full form standard machine screw thread must be used for earhting continuity;
- refer to §5 for proper connection of conductors and cables;
- inverter must be installed inside a box so that the terminals used for the connection of external conductors can only be accessible after the removal of a non-detachable cover;
- the metal plate on which the inverter is mounted must be connected to earth (ground);
- use only specified motors
- the dimensions of the space provided for the inverter, the dimensions of the means for supporting, the distances between the inverter and the surround parts and the ventilation openings should guarantee the specified air speed on both heatsinks

Cables

- the supply cable must:
  - take into account the insulation requirements for a single phase product and the operating conditions;
  - have a minimum cross-sectional area of 1mm²;
  - have a green/yellow core that is connected to the earthing terminal of the appliance and to the earthing contact of the plug.
- if the supply cable is damaged, it must be replaced by the manufacturer, its service agent or similarly qualified persons in order to avoid hazards;
- supply cable is not provided;
- motor cable is provided with the motor;
- signal cable is not provided but must comply with the requirements for the supply cable;
- supply, motor and signal cables must be distinct cables. Do not use a single multipole cable to carry power supply and motor output. Do not use multipole cables to carry signal and power I/O;
- a chord anchorage must be provided for each flexible cable with connector.

Inverter must be in the air flux in order to cool down (refer to air speed values in the specifications table). Control parameters have been tuned for compatible motors and ventilation appliances. Using other hardware configurations can lead to control/hardware malfunctions.

6.2 Recommended

Motor cable

- motor cable should be as short as possible to reduce EMI emissions (< 50cm)
- if the cable can not be shortened to the appropriate length a shielded cable shall be used.
- ferrite near inverter Motor Connector A (e.g. ANRA13 3 turns or ANRA 507 2 turns, U-V-W only, no PE)

Signal cable

- signal, motor and power cables should not run close to each other to avoid bypassing EMI filters and to avoid interferences in control signals;
- use a shielded cable (w/wo a ferrite on internal conductors) and connect shield pigtail to the faston connector near the signal connector C entry

Connectors

- use the following connectors for IP20 models:

Connector A	Motor	Phoenix IC 2,5/4-ST-5,08	(order code 99999007)
Connector B	Power Supply	Phoenix MSTB 2,5/3-ST-5,08	
Connector C	Signal	Phoenix FMC 1,5/8-ST-3,81	

Examples for cables: the H05VVF type (300/500V, 60°C) for visible cable installation or a PVC, 450/750V, 70°C type if inside a tube or raceway.

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6.3 Wiring

Inverter example ED1000

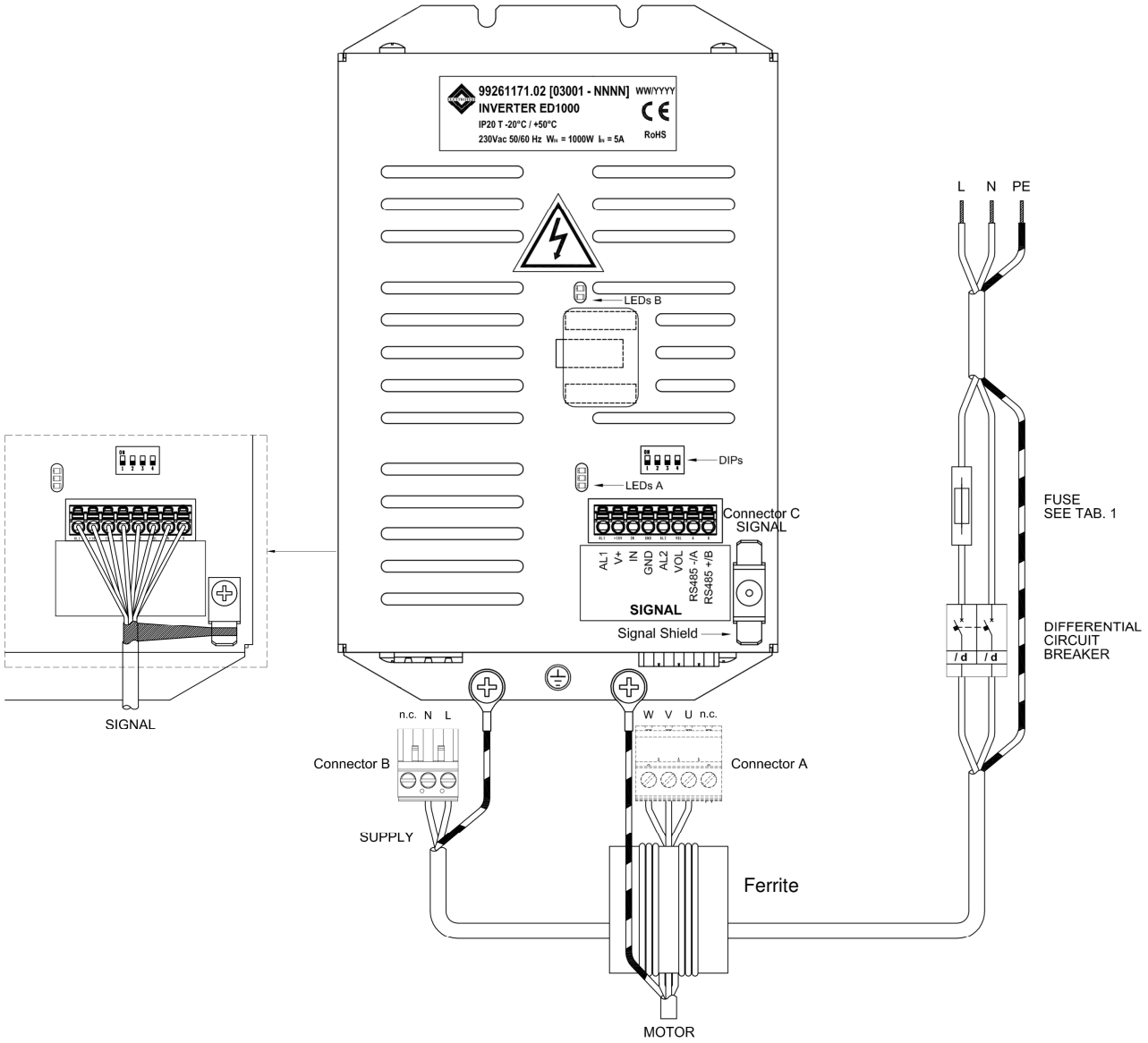

Fig. 6.1 - Typical wiring for cables and filters

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7 CONTACTS

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