# DRIVE CT

Installation manual

Ref.1509

FAGOR

FAGOR AUTOMATION

| | |
|---|---|
| **Title** | **DRIVE CT .** |
| **Type of documentation** | Description, installation and startup of CT series digital drives with FM9 series asynchronous spindle motors. |
| **Electronic document** | man_drive_ct.pdf |
| **Language** | English |
| **Manual reference** | Ref.1509 |
| **Headquarters** | Fagor Automation, S. Coop.<br>B.º San Andrés 19, apdo. 144<br>CP. 20500 - Arrasate - Mondragón<br>Gipuzkoa (Spain)<br>www.fagorautomation.com<br>info@fagorautomation.es |
| **Customer support** |  +34 943 719200 |
| **Service Department** |  +34 943 771118 |

## VERSION HISTORY

| Document reference | Events |
|---|---|
| 1109 | First reference. |
| 1507 | Update connection diagrams. |
| 1509 | Error correction on connection diagrams. |

## Original instructions



FAGOR

### Responsibility exemption

The information described in this manual may be subject to changes due to technical modifications. Fagor Automation S. Coop. reserves the right to change the contents of this manual without prior notice.

The content of this manual and its validity for the product described here has been verified. Nevertheless, the information, technical or otherwise, in these manuals or in any other type of documentation is not guaranteed to be integral, sufficient or up to date.

Involuntary errors are possible, hence the absolute match is guaranteed. However, the contents of manuals and documents are regularly checked and updated implementing the pertinent corrections in later editions.

Fagor Automation S. Coop. will not be held responsible for any losses or damage, direct, indirect or by chance that could result from that information and it will be the user's responsibility to use it.

Responsibility and warranty claims are excluded in case of wrong usage of the unit in wrong environments or when not used for the purpose for which it has been designed, ignoring the warnings and safety indications given in this document and/or legal ones that may be applied to the work place, software modifications and/or repairs made by unauthorized personnel, damage caused by the influence of other nearby equipment.

### Warranty

The warranty terms may be requested from your Fagor Automation representative or through the usual commercial channels.

### Registered trademarks

All registered trade marks, even those not indicated are also acknowledged. When some are not indicated, it does not mean that they are free.

**September 2015 / Ref.1509**

# GENERAL INDEX



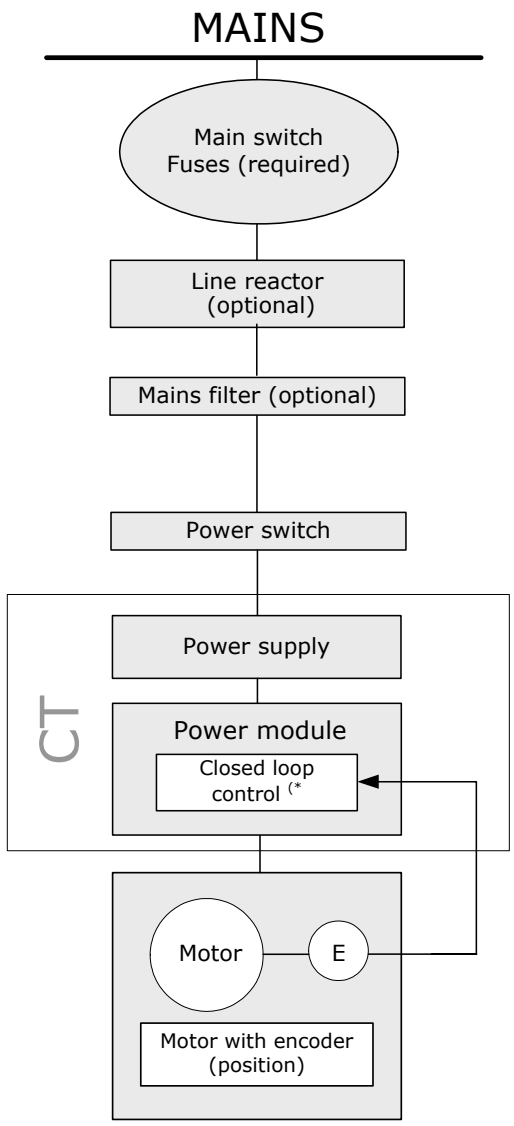
FAGOR

CT

Ref.1509

# 1 DESCRIPTION

The CT drive system is ready to be used in industrial environments and together with the CNC can be used to regulate the control of movements and drives system of the machine. The configuration of the main CT servo drive system follows this general diagram:




* **Note.** The position value may be transferred either to the drive or to the CNC to close the loop.

The CT digital servo drive system has a modular stackable design.

They may be connected directly to three-phase mains of any kind, like TN-S, TN-C-S, TT or IT, with ground connection at any voltage like delta to neutral ground or, centered or in a corner and with a frequency of 50/60 Hz and a nominal voltage range of 380 - 480 ±10 % V AC. This system supplies the electric motors with a three-phase voltage of 380 V AC and a variable frequency with which it will govern its speed.

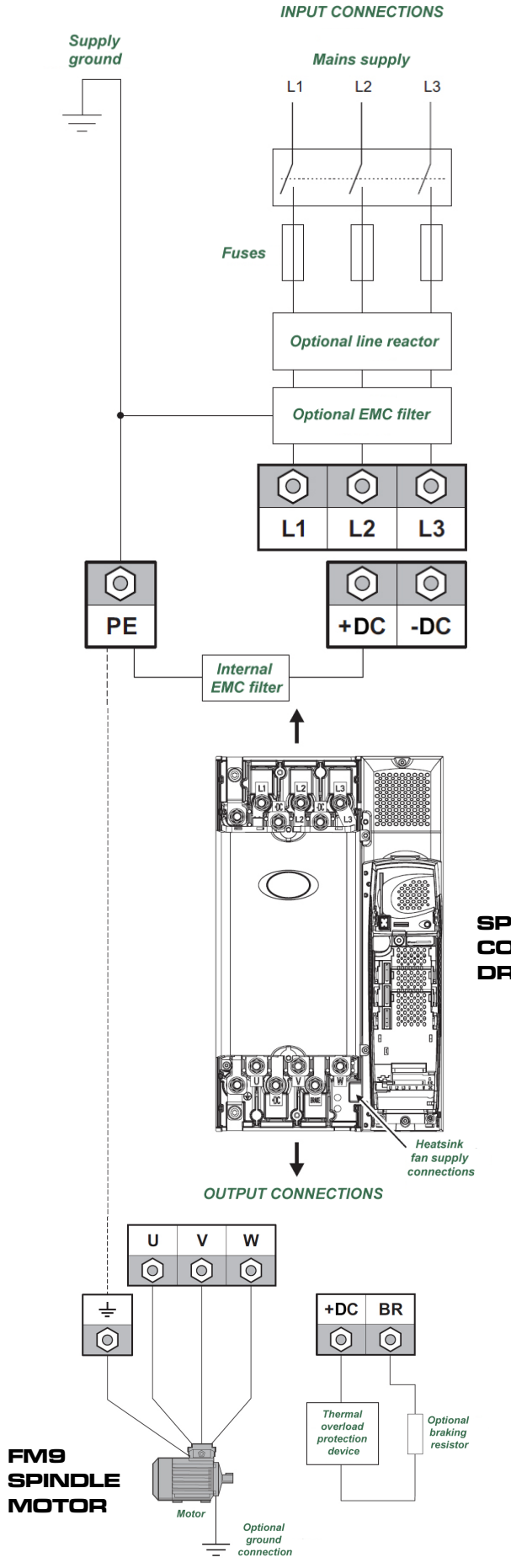
Certain mandatory protection devices must be added between the mains lines and the CT servo drive system. Others may be optional. Which are:

| | |
|---|---|
| Main switch | Mandatory |
| Fuses | Mandatory |
| Line reactor | Optional |
| Mains filters | Optional |
| Power switch | Mandatory |

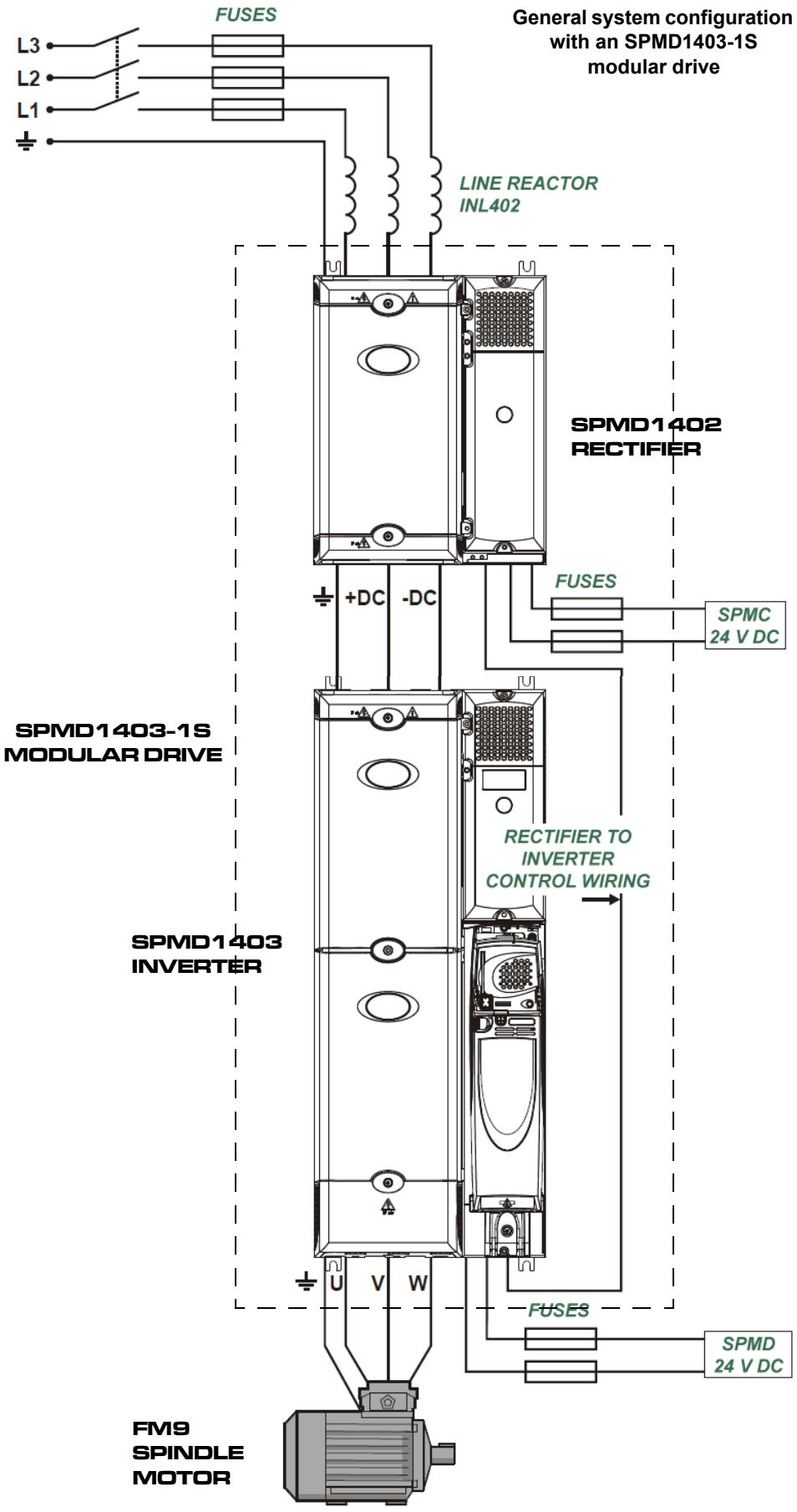
**INFORMATION.** The CT system has been manufactured in accordance with EN 60204-1 in compliance with European Directive 2006/95/EC on Low Voltage.

## System configuration. General diagrams

See the schematic description of all the elements that make up the CT servo drive system:



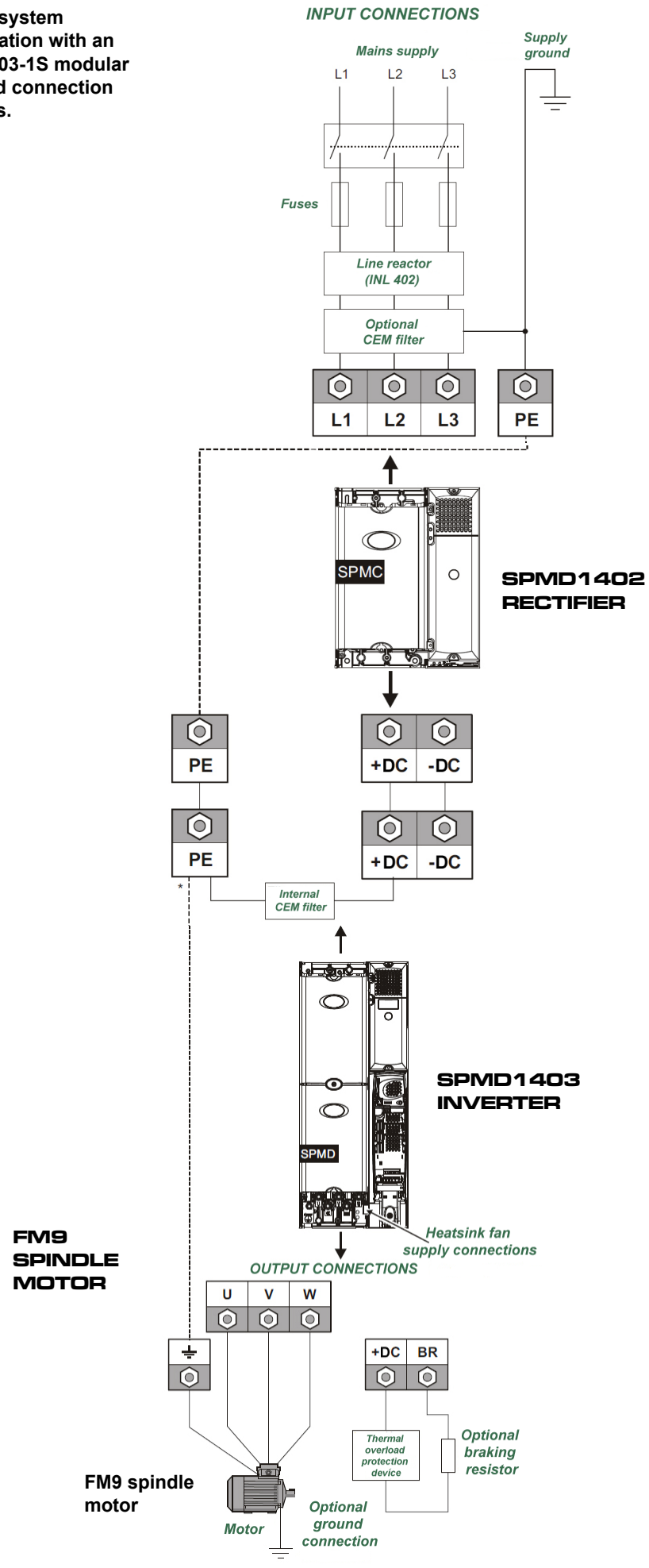

**General system configuration with an SP6402 compact drive and connection terminals.**




**Note.** The fuses related to the 24 V DC power supply are only mandatory with nominal currents over 10 A.

1.

**General system configuration with an SPMD1403-1S modular drive and connection terminals.**




FAGOR

CT

Ref.1509

## Stages of the system configuration

The following steps are a reference to configure and install the CT system.

***Note.*** *This CT system configuration process assumes that the motors of the system are FM9 series motors of the Fagor catalog. These motors come with their manual "man_fm7_fm9_motors.pdf".*

Example procedure

**Stage 1. Analysis of the system location**

- Ambient conditions
- Climate conditions
- Cooling conditions
- Mechanical conditions

**Stage 2. Component selection**

- Motor
- Drive module
- Other auxiliary modules (fuses, filters, inductances, braking resistors, etc.)

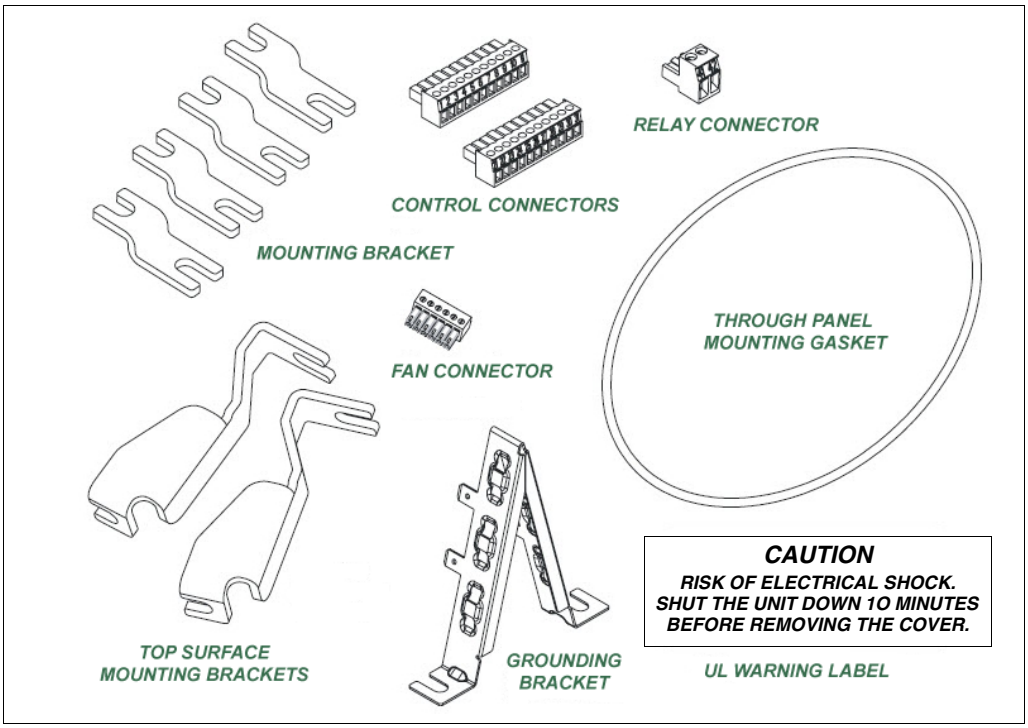
**Stage 3. Installation and connections**

- See the dimension drawings of the units
- Calculate the size and ventilation of the electrical cabinet or enclosure.
- See connection diagrams
- Select power and signal cables
- Connect the motor/encoder
- Run the cables as recommended
- Connect the system to the power lines and to the auxiliary modules

1.

# Supplied accessories

## SP6402 compact drive




## SPMD1403-1S modular drive (SPMD1403+SPMC1402)

Set (SPMC1402 rectifier + SPMD1403 inverter)

| DESCRIPTION | SPMD | SPMC |
|---|---|---|
| UL warning label | CAUTION Risk of electrical shock. Shut the unit down 10 minutes before removing the cover | |
| Nylon washers | M8 M6 | |
| Sealing clips | | |
| Through panel mounting gasket | | |
| Mounting bracket | | |
| Fan / control connector(s) | | |
| Paralleling cable | Slave only | |
| Mounting screws | M8x20 | |
| Control connectors | Master only | |
| Relay connector | Master only | |
| Grounding bracket | Master only | |
| Top surface mounting brackets | | |
| Surface mounting brackets | | |
| Grounding busbar | | |
| EMC output bracket | | |

FAGOR

CT

Ref.1509

# 2 DRIVE MODULES

## Presentation

CT drive models may be:

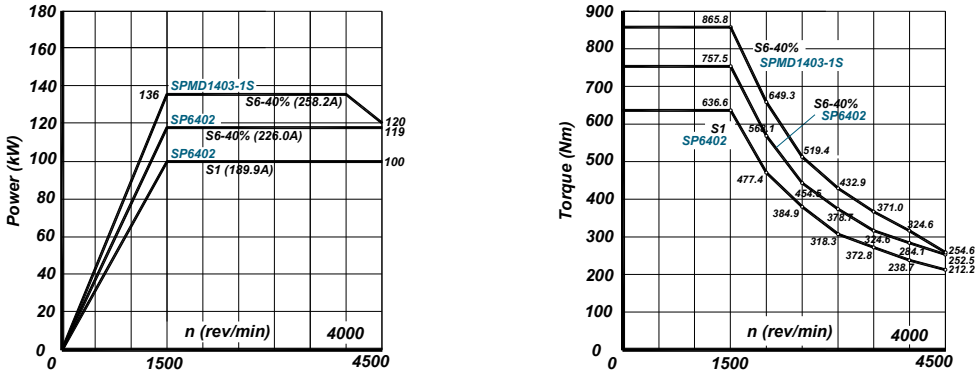
| Drive model | Type |
|---|---|
| SP6402 | Compact drive |
| SPMD1403-1S | Modular drive consisting of:<br>SPMD1403 (inverter)+SPMC1402 (rectifier)+NL402 (input reactor) |

and the associated motors they will be governing are listed in the following table:

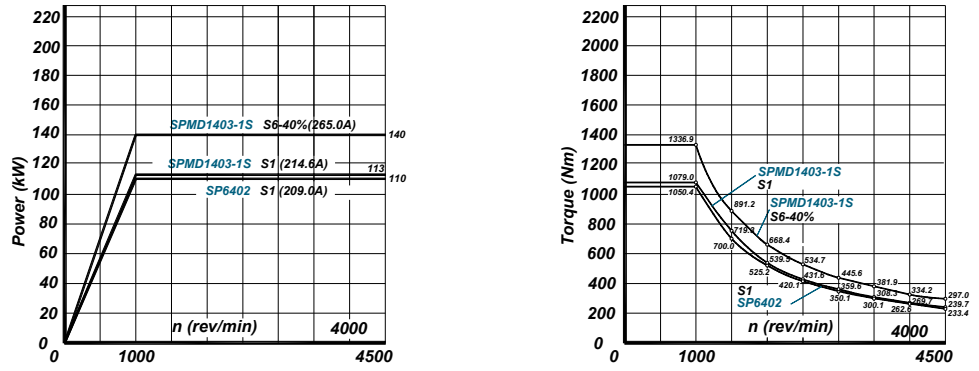
| Motor model | Operating cycle | CT drive model |
|---|---|---|
| FM9-A100-C5Cx-E01 | S1 | SP6402 |
| FM9-A100-C5Cx-E01 | S6-40% | SPMD1403-1S * |
| FM9-B113-C5Cx-E01 | S1 | SPMD1403-1S ** |
| FM9-B113-C5Cx-E01 | S6-40% | SPMD1403-1S *** |
| FM9-A130-C5Cx-E01 | S1 | SPMD1403-1S |
| FM9-A130-C5Cx-E01 | S6-40% | None |

** If an SP6402 drive is installed with this motor to work in a S6-40% duty cycle, it is limited to an overload of 19% over the rated value of the motor for 4 minutes. ** Install this motor with an SP6402 drive only if the power demanded in a continuous cycle S1 does not exceed 110 kW. *** Limited to an overload of 24% over the rated value of the motor for 4 minutes in the S6-40% cycle. See the graphs later on.*

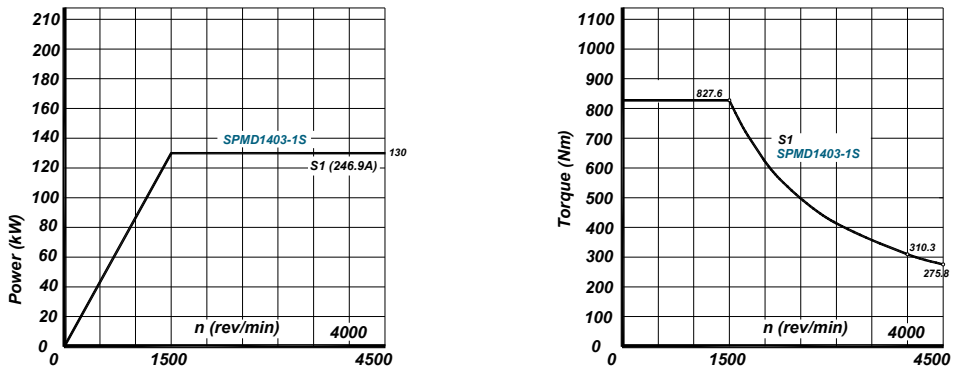
*Power/speed and torque/speed graphs for S1 and S6-40% cycles. FM9-A100-C5Cx-E01 with CT drives.*



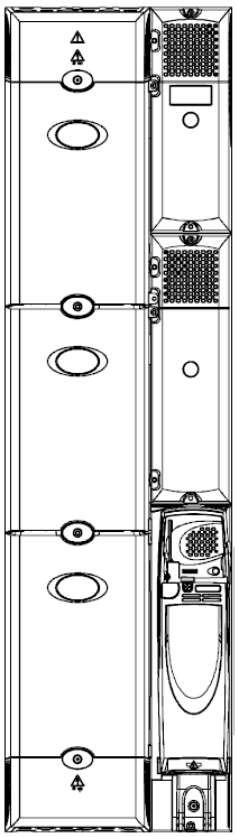

*Power/speed and torque/speed graphs for S1 and S6-40% cycles. FM9-B113-C5Cx-E01 with CT drives.*



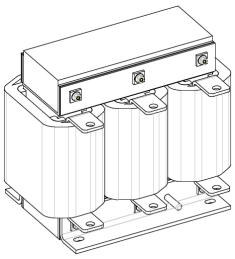

*Power/speed and torque/speed graphs for S1 and S6-40% cycles. FM9-A130-C5Cx-E01 with CT drives.*



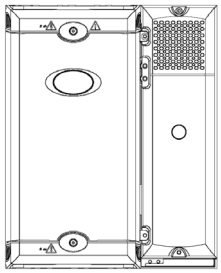
## Outside appearance



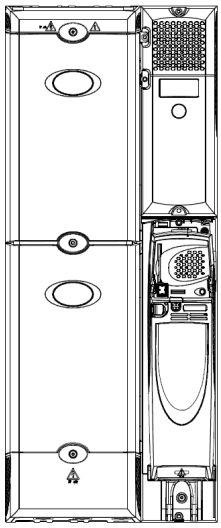
SP6402



INL402



SPMC1402



SPMD1403

SPMD1403-1S

# Technical data

## SP6402 compact drive

***Rated power and current (power reduction for switching frequencies and temperature).***

| *Max. continuous output current at ambient temperature 40°C (104°F)* | | | | |
|---|---|---|---|---|
| *Rated power* | | *Max. continuous output current (in A) allowed at switching frequencies* | | |
| *kW* | *CV* | *3 kW* | *4 kW* | *6 kW* |
| *110* | *150* | *210* | *174.8* | *129.7* |

| *Max. continuous output current at ambient temperature 50°C (122°F)* | | | | |
|---|---|---|---|---|
| *Rated power* | | *Max. continuous output current (in A) allowed at switching frequencies* | | |
| *kW* | *CV* | *3 kW* | *4 kW* | *6 kW* |
| *110* | *150* | *190* | *157.9* | *116.2* |

***Power dissipation***

| *Power loss at ambient temp. 40°C (104°F) considering the current reduction under given conditions.* | | | | |
|---|---|---|---|---|
| *Rated value* | | *Communication baud rates* | | |
| *kW* | *CV* | *3 kW* | *4 kW* | *6 kW* |
| *110* | *150* | *2192* | *2042* | *1888* |

| *Power loss at ambient temp. 50°C (122°F) considering the current reduction under given conditions.* | | | | |
|---|---|---|---|---|
| *Rated value* | | *Communication baud rates* | | |
| *kW* | *CV* | *3 kW* | *4 kW* | *6 kW* |
| *110* | *150* | *1979* | *1851* | *1715* |

*Power supply* ***Requirements of the unit***

| | |
|---|---|
| ***Voltage*** | *380-480 V AC ±10%* |
| ***Nr. phases*** | *3* |
| ***Frequency*** | *48-65 Hz* |

***Power supply requirements of the unit's heatsink fan***

| | |
|---|---|
| ***Rated voltage*** | *24 V* |
| ***Minimum voltage*** | *23.5 V* |
| ***Maximum voltage*** | *27 V* |
| ***Current demand*** | *3.3 A* |
| ***Recommended power supply*** | *24 V, 100 W, 4.5 A* |
| ***Recommended fuse*** | *4 A (fast), ($I^2t$ < 20 $A^2t$)* |

***Motor requirements***

| | |
|---|---|
| ***Nr. phases*** | *3* |
| ***Maximum voltage*** | *480 V AC* |

***Temperature, humidity and cooling method***

| | |
|---|---|
| ***Operating ambient temperature*** | *Between 0 °C and 50 °C (32 °F and 122 °F ).*<br>*Note. An output current reduction must be applied at ambient temperatures over 40 °C (104 °F)* |
| ***Minimum start-up temperature*** | *- 15°C (5°F)*<br>*Note. The power supply must be in cycle when the drive reaches 0°C (32°F)* |
| ***Cooling method*** | *Forced convection* |
| ***Maximum humidity*** | *95% non condensing at 40°C (104°F)* |

### Storage

| | |
|---|---|
| **Long-term storage temperature** | Between - 40°C and +50°C (- 40°F and 122 °F) |
| **Short-term storage temperature** | Between - 40°C and +70°C (- 40°F and 158°F ) |

### Altitude

| | |
|---|---|
| **Range** | Between 0 and 3000 m (9900 feet)* |

** Between 1000 and 3000 m (3300 and 9900 ft) over sea level, the given maximum output current value must be lowered 1% per every 100 m (330 ft) over 1000 m (3300 ft).*



### Protection index

| | |
|---|---|
| **IP** | 20 |

** The SP6402 compact drive comes with a heatsink fan that meets IP 54. Contact Fagor Automation for more detailed information.*

### Corrosive gasses

Corrosive gas concentration must not exceed the levels shown in:

| | |
|---|---|
| **EN 50178** | Table A2 |
| **IEC 60721-3-3** | Class 3C1 |

This corresponds to the levels typical of urban areas with industrial activities and/or heavy traffic, but not in the immediate neighborhood of industrial sources with chemical emissions.

### Vibration

**Bump test.**
Testing in each of three mutually perpendicular axes in turn.

| | |
|---|---|
| **Referenced standard** | IEC 60068-2-29: Eb test: |
| **Severity** | 10g, 6ms, half sine |
| **Number of bumps** | 600 (100 in each direction of each axis) |

**Random vibration test.**
Testing in each of three mutually perpendicular axes in turn.

| | |
|---|---|
| **Referenced standard** | IEC 60068-2-64: Fh test: |
| **Severity** | 1.0 $m^2/s^3$ (0.01 $g^2/Hz$) ASD from 5-20 Hz<br>-3 dB/octave from 20 to 200 Hz |
| **Duration** | 30 minutes in each of three mutually perpendicular axes. |

**Sinusoidal vibration test.**
Testing in each of three mutually perpendicular axes in turn.

| | |
|---|---|
| **Referenced standard** | IEC 60068-2-6: Fc test: |
| **Frequency range** | 2 - 500 Hz |
| **Severity** | 3.5 mm peak displacement from 2 to 9 Hz<br>10 $m/s^2$ peak acceleration from 9 to 200 Hz<br>15 $m/s^2$ peak acceleration from 200 to 500 Hz |
| **Sweep rate** | 1 octave/minute |
| **Duration** | 15 minutes in each of three mutually perpendicular axes. |

***Starts per hour***

By electronic control: unlimited.

By interrupting the AC supply: ≤ 20

***Start up time***

This is the time taken from the moment of applying power to the drive, to the drive being ready to run the motor: Its value is 4 s.

***Output frequency / speed range ratio***

Open-loop frequency range: 0 to 3.000Hz

Closed-loop speed range: 0 to 600 Hz

Closed-loop frequency range: 0 to 1250 Hz

***Overall dimensions***

**H** Height including surface mounting brackets

**W** Width

**D** Forward panel projection when surface mounted

**F** Forward panel projection when through-panel mounted

**R** Rear panel projection when through-panel mounted

| *H* | *W* | *D* | *F* | *R* |
|---|---|---|---|---|
| *1169 mm (46.01 in)* | *310 mm (12.205 in)* | *298 mm (11.732 in)* | *200 mm (7.874 in)* | *≤98 mm (3.858 in)* |

***Approx. mass***

| *kg* | *lb* |
|---|---|
| *75* | *165.3* |

***Input current, fuse and cable size ratings***

The input current is affected by the supply voltage and impedance.

**Typical input current.** The values of typical input current are given to aid calculations for power flow and power loss. These values are stated for a balanced supply.

**Maximum continuous input current** The values of maximum continuous input current are given to aid the selection of cables and fuses. These values are stated for the worst case condition with the unusual combination of stiff supply with bad balance. The value stated for the maximum continuous input current would only be seen in one of the input phases whereas the current in the other two phases would be significantly lower. The values of maximum input current are stated for a supply with a 2% negative phase-sequence imbalance and rated at the maximum supply fault current given in the table.

| *Supply fault current used to calculate maximum input currents* | |
|---|---|
| *Symmetrical fault level* | *100 kA* |

| *Input rated current values, fuse and cable size* | | | | | | | |
|---|---|---|---|---|---|---|---|
| *Typical input current* | *Maximum input current* | *Fuse* | | *Cable size* | | | |
| | | *IEC class gR* | *Ferraz HSJ* | *Input* | | *Output* | |
| *A* | *A* | *A* | *A* | *mm²* | *AWG* | *mm²* | *AWG* |
| *247* | *258* | *315* | *300* | *2x70* | *2x2/0* | *2x70* | *2x2/0* |

***Maximum motor cable length***

| *Nominal 400 V AC voltage* | | |
|---|---|---|
| *Maximum motor cable length allowed depending on frequency* | | |
| *3 kHz* | *4 kHz* | *6 kHz* |
| *250 m (820 ft)* | *185 m (607 ft)* | *125 m (410 ft)* |

### Braking resistor values

| Minimum resistance values and peak power rating for the braking resistor at 40 °C (104 °F) | |
|---|---|
| **External resistor** | **Instantaneous power rating** |
| 5 Ω (tolerance ±10%) | 121.7 kW |

### Tightening torque adjustments

| Drive relay and control terminal data | |
|---|---|
| **Type of connection** | **Torque settings** |
| Plug-in terminal block | 0.5 N·m (0.4 lb·ft) |

| Drive power terminal data | | |
|---|---|---|
| **AC terminals** | **High current DC and braking** | **Ground terminal** |
| M10 stud<br>15 N (11.1 lb·ft) | M10 stud<br>15 N (11.1 lb·ft) | M10 stud<br>15 N (11.1 lb·ft) |

## SPMD1403-1S (SPMD1403+SPMC1402) modular drive

Drive consisting of a rectifier (SPMC1402), an inverter (SPMD1403) and an input reactor (INL402).

***Rated power and current (power reduction for switching frequencies and temperature).***

| *SPMD1403. Max. continuous output current at ambient temperature 40 °C (104 °F) in slaved or unslaved SPMD drive* | | | | |
|---|---|---|---|---|
| *Rated value* | | *Max. continuous output current (in A) allowed at these switching frequencies* | | |
| *kW* | *CV* | *3 kW* | *4 kW* | *6 kW* |
| *132* | *175* | *248* | *206* | *151* |

| *SPMD1403. Max. continuous output current at ambient temperature 50°C (122°F) in slaved or unslaved SPMD drive* | | |
|---|---|---|
| *Max. continuous output current (in A) allowed for these switching frequencies* | | |
| *3 kW* | *4 kW* | *6 kW* |
| *224* | *186* | *137* |

| *SPMC1402. Max. nominal values allowed* | | | | | |
|---|---|---|---|---|---|
| *Ambient temp. 35 °C/95 °F* | | *Ambient temp. 40°C/104°F* | | *Ambient temp. 50°C/122°F* | |
| *Maximum input AC urrent* | *Maximum output DC current* | *Maximum input AC urrent* | *Maximum output DC current* | *Maximum input AC urrent* | *Maximum output DC current* |
| *A* | *A* | *A* | *A* | *A* | *A* |
| *358* | *394* | *344* | *379* | *302* | *333* |

***Power dissipation***

| *Power loss in W of the docked SPMD drive at ambient temp. 40 °C (104 °F) considering the current reduction under given conditions.* | | | | |
|---|---|---|---|---|
| *Rated value* | | *Switching frequencies* | | |
| *kW* | *CV* | *3 kW* | *4 kW* | *6 kW* |
| *132* | *175* | *2930* | *3290* | *3120* |

***Note.*** *Power loss figures for the SPMD docked drives represent losses for the IGBT, rectifier and control master pod at the maximum current given.*

| *Power loss in W of the undocked SPMD drive at ambient temp. 40 °C (104 °F) considering the current reduction under given conditions.* | | | | |
|---|---|---|---|---|
| *Rated value* | | *Switching frequencies* | | |
| *kW* | *CV* | *3 kW* | *4 kW* | *6 kW* |
| *132* | *175* | *2210* | *2570* | *2760* |

***Note.*** *Power loss figures for the SPMD undocked drive represent losses for the IGBT and control master pod at the maximum current given.*

| Power loss in W of the docked SPMD drive at ambient temp. 50°C (122°F) considering the current reduction under given conditions. | | |
|---|---|---|
| Communication baud rates | | |
| 3 kW | 4 kW | 6 kW |
| 2930 | 2980 | 2810 |

**Note.** *Power loss figures for the SPMD docked drives represent losses for the IGBT, rectifier and control master pod at the maximum current given.*



| Power loss in W of the undocked SPMD drive at ambient temp. 50°C (122°F) considering the current reduction under given conditions. | | |
|---|---|---|
| Communication baud rates | | |
| 3 kW | 4 kW | 6 kW |
| 2210 | 2520 | 2520 |

**Note.** *Power loss figures for the SPMD docked drive represent losses for the IGBT and control master pod at the maximum current given.*

| Power loss of the SPMC1402 drive at ambient temp. 40/50 °C (104/122 °F) | |
|---|---|
| Max. losses | 871 W |

| Power losses from the front of the drive when through-panel mounted | |
|---|---|
| SPMD1403 | ≤ 300 W |
| SPMC1402 | ≤ 50 W |

| Input line reactor power losses at ambient temp. 40/50 °C (104/122 °F) | |
|---|---|
| INL402 | 205 W |

Power supply **Requirements**

| | |
|---|---|
| Voltage | 380-480 V AC ±10% |
| Nr. phases | 3 |
| Frequency | 48-65 Hz |

**Power supply requirements of the heatsink fan of the SPMD**

| | |
|---|---|
| Rated voltage | 24 V |
| Minimum voltage | 23.5 V |
| Maximum voltage | 27 V |
| Current demand | 4.5 A |
| Recommended power supply | 24 V, 5 A |
| Recommended fuse | 6.3 A (fast), ($I^2t$ < 100 $A^2t$) |

**Requirements of the external 24 V power supply of the SPMC**

| | |
|---|---|
| Rated voltage | 24 V |
| Minimum voltage | 23 V |
| Maximum voltage | 28 V |
| Current demand | 3 A |
| Minimum start up voltage | 18 V |
| Recommended power supply | 24 V, 100 W, 4.5 A |
| Recommended fuse | 4 A (fast), ($I^2t$ < 20 $A^2t$) |

**Note.** *If the SPM 24V power supply is used to supply the Unidrive SPMD or SPMC, no fuses are required.*

**Motor requirements**

| | |
|---|---|
| Nr. phases | 3 |
| Maximum voltage | 480 V AC |

### *Temperature, humidity and cooling method*

| | |
|---|---|
| ***Operating ambient temperature*** | *Between 0 °C and 50 °C (32 °F and 122 °F ).*<br>*Note. An output current reduction must be applied at ambient temperatures over 40 °C (104 °F)* |
| ***Minimum start-up temperature*** | *- 15°C (5°F)*<br>*Note. The power supply must be in cycle when the drive reaches 0°C (32°F)* |
| ***Cooling method*** | *Forced convection* |
| ***Maximum humidity*** | *95% non condensing at 40 °C (104 °F)* |

### *Storage*

| | |
|---|---|
| ***Long-term storage temperature*** | *Between - 40°C and +50°C (- 40°F and 122 °F)* |
| ***Short-term storage temperature*** | *Between - 40°C and +70°C (- 40°F and 158°F)* |

### *Altitude*

| | |
|---|---|
| ***Range*** | *Between 0 and 3000 m (9900 feet)** |

** Between 1000 and 3000 m (3300 and 9900 ft) over sea level, the given maximum output current value must be lowered 1% per every 100 m (330 ft) over 1000 m (3300 ft). For example at 3.000m (9.900ft) the output current of the drive would have to be de-rated by 20%.*

### *Protection index*

| | |
|---|---|
| ***IP*** | *20* |

** The SPMD modular drive comes with a heatsink fan that meets IP 54 rating. Contact Fagor Automation for more detailed information.*

### *Corrosive gasses*

Corrosive gas concentration must not exceed the levels shown in:

| | |
|---|---|
| ***EN 50178*** | *Table A2* |
| ***IEC 60721-3-3*** | *Class 3C2* |

This corresponds to the levels typical of urban areas with industrial activities and/or heavy traffic, but not in the immediate neighborhood of industrial sources with chemical emissions.

### *Vibration*

**Bump test.**
Testing in each of three mutually perpendicular axes in turn.

| | |
|---|---|
| ***Referenced standard*** | *IEC 60068-2-29: Eb test:* |
| ***Severity*** | *10g, 6ms, half sine* |
| ***Number of bumps*** | *600 (100 in each direction of each axis)* |

**Random vibration test.**
Testing in each of three mutually perpendicular axes in turn.

| | |
|---|---|
| ***Referenced standard*** | *IEC 60068-2-64: Fh test:* |
| ***Severity*** | *1.0 $m^2/s^3$ (0.01 $g^2/Hz$) ASD from 5 - 20 Hz*<br>*-3 dB/octave from 20 to 200 Hz* |
| ***Duration*** | *30 minutes in each of three mutually perpendicular axes.* |

**Sinusoidal vibration test.**
Testing in each of three mutually perpendicular axes in turn.

| | |
|---|---|
| ***Referenced standard*** | *IEC 60068-2-6: Fc test:* |
| ***Frequency range*** | *2 - 500 Hz* |
| ***Severity*** | *3.5 mm peak displacement from 2 to 9 Hz*<br>*10 $m/s^2$ peak acceleration from 9 to 200 Hz*<br>*15 $m/s^2$ peak acceleration from 200 to 500 Hz* |
| ***Sweep rate*** | *1 octave/minute* |
| ***Duration*** | *15 minutes in each of three mutually perpendicular axes.* |

2.

***Starts per hour***

By electronic control: unlimited.

By interrupting the AC supply: ≤ 20

***Start up time***

This is the time taken from the moment of applying power to the drive, to the drive being ready to run the motor: Its value is 4 s.

***Output frequency / speed range ratio***

Open-loop frequency range: 0 to 3.000Hz

Closed-loop speed range: From 0 to 40.000 rpm.

Closed-loop frequency range: 0 to 1250 Hz Limited to 600 Hz for best performance.

***Acoustic noise***

| ***Maximum pressure level at 1m (dBA)*** | | |
|---|---|---|
| | ***Max. speed*** | ***Max. speed*** |
| ***SPMD1403*** | *75* | *43* |
| ***SPMC1402*** | *53* | *43* |

***Overall dimensions***

**H** Height including surface mounting brackets

**W** Width

**D** Forward panel projection when surface mounted

**F** Forward panel projection when through-panel mounted

**R** Rear panel projection when through-panel mounted

| | ***H*** | ***W*** | ***D*** | ***F*** | ***R*** |
|---|---|---|---|---|---|
| ***SPMD1403*** | *795.5 mm (31.319 in)* | *310 mm (12.205 in)* | *298 mm (11.732 in)* | *202 mm (7.953 in)* | *≤95 mm (3.740 in)* |
| ***SPMC1402*** | *399.1 mm (15.731 in)* | *310 mm (12.205 in)* | *298 mm (11.732 in)* | *202 mm (7.953 in)* | *≤95 mm (3.740 in)* |

***Approx. mass***

| | ***kg*** | ***lb*** |
|---|---|---|
| ***SPMD1403*** | *42* | *92.6* |
| ***SPMC1402*** | *20* | *44* |

***Input current, fuse and cable size ratings***

The input current is affected by the supply voltage and impedance.

**Typical input current.** The values of typical input current are given to aid calculations for power flow and power loss. These values are stated for a balanced supply.

**Maximum continuous input current** The values of maximum continuous input current are given to aid the selection of cables and fuses. These values are stated for the worst case condition with the unusual combination of stiff supply with bad balance. The value stated for the maximum continuous input current would only be seen in one of the input phases whereas the current in the other two phases would be significantly lower. The values of maximum input current are stated for a supply with a 2% negative phase-sequence imbalance and rated at the maximum supply fault current given in the table.

| ***Supply fault current used to calculate maximum input currents*** | |
|---|---|
| ***Symmetrical fault level*** | |
| ***SPMD1403*** | *100 kA* |
| ***SPMC1402*** | *100 kA* |

**WARNING.** Fuse protection must be provided at the power input.

| SPMD1403. Input rated current values, fuse and cable size | | | | | | | |
|---|---|---|---|---|---|---|---|
| Typical input DC current | Maximum input DC current | Maximum input DC current for rated cable | DC IEC fuse class aR | Typical cable section | | | |
| | | | | DC input | | Motor output | |
| A | A | V | A | mm² | AWG | mm² | AWG |
| 314 | 457 | 800 | 560 | 2x120 | 2x4/0 | 2x120 | 2x4/0 |

**Note.** *B2 type has been considered as cable installation method.*

**INFORMATION.**
Fuse ratings are for a DC supply or paralleled DC bus arrangements. When supplied by a single SPMC or SPMU of the correct rating, the AC input fuses provide protection for the drive and no DC fuse is required.

| SPMC1402. Input rated current values, fuse and cable size | | | | | | | |
|---|---|---|---|---|---|---|---|
| Maximum input current | Typical output DC current | Semiconductor fuse in series with HRC fuse | | Typical cable section | | | |
| | | HRC IEC class gG UL class J | Semiconductor IEC class aR | AC input | | DC output | |
| A | A | A | A | mm² | AWG | mm² | AWG |
| 344 | 379 | 450 | 400 | 2x120 | 2x4/0 | 2x120 | 2x4/0 |

**Note.** *B1 or C type has been considered as cable installation method.*

**INFORMATION.**
The cable sizes noted in the previous table are typical cable sizes based on UL 508C and IEC 60364-5-52:2001. Maximum cable sizes are 2 x 240mm² or 2 x 400 kcmil per pole. The user will have to decide what size of cable to use in any given application based on the local wiring regulations. Use of high temperature cables that are thinner than those stated maybe possible.

### Nominal ratings of the line reactor INL402

| Nominal ratings of the 400 V input line reactor INL402 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Current | Inductance | Overall width W | Overall depth D | Overall height H | Approx. mass | Max. ambient temp. | Min. air flow |
| A | µH | mm | mm | mm | kg | ° C | m/s |
| 339 | 44 | 276 | 200 | 225 | 36 | 50 | 1 |

### Maximum motor cable length

| Maximum motor cable length allowed depending on frequency | | |
|---|---|---|
| 3 kHz | 4 kHz | 6 kHz |
| 250 m (820 ft) | 185 m (607 ft) | 125 m (410 ft) |

### Braking resistor values

| SPMD1403. Minimum resistance values and peak power rating for the braking resistor at 40 °C (104 °F) | | |
|---|---|---|
| External resistor | Instantaneous power rating * | Average power for 60 s |
| 3.8 Ω (tolerance ±10%) | 160 kW | 160 kW |

* *Continuous rating if drive is part of a common DC bus system.*

*Tightening torque adjustments*

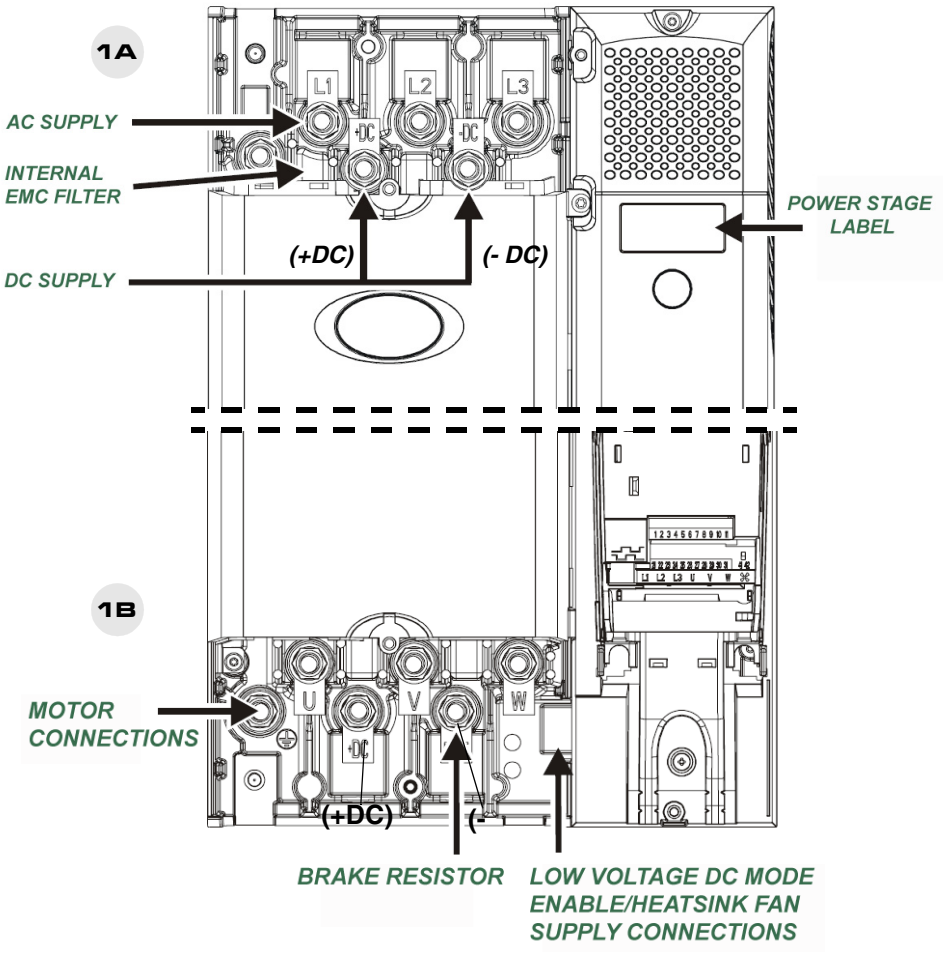
| *Drive relay and control terminal data* | |
|---|---|
| ***Type of connection*** | ***Torque settings*** |
| *Plug-in terminal block* | *0.5 N·m (0.4 lb·ft)* |

| *Drive power terminal data* | | |
|---|---|---|
| ***AC terminals*** | ***High current DC and braking*** | ***Ground terminal*** |
| *M10 stud 15 N (11.1 lb·ft)* | *M10 stud 15 N (11.1 lb·ft)* | *M10 stud 15 N (11.1 lb·ft)* |

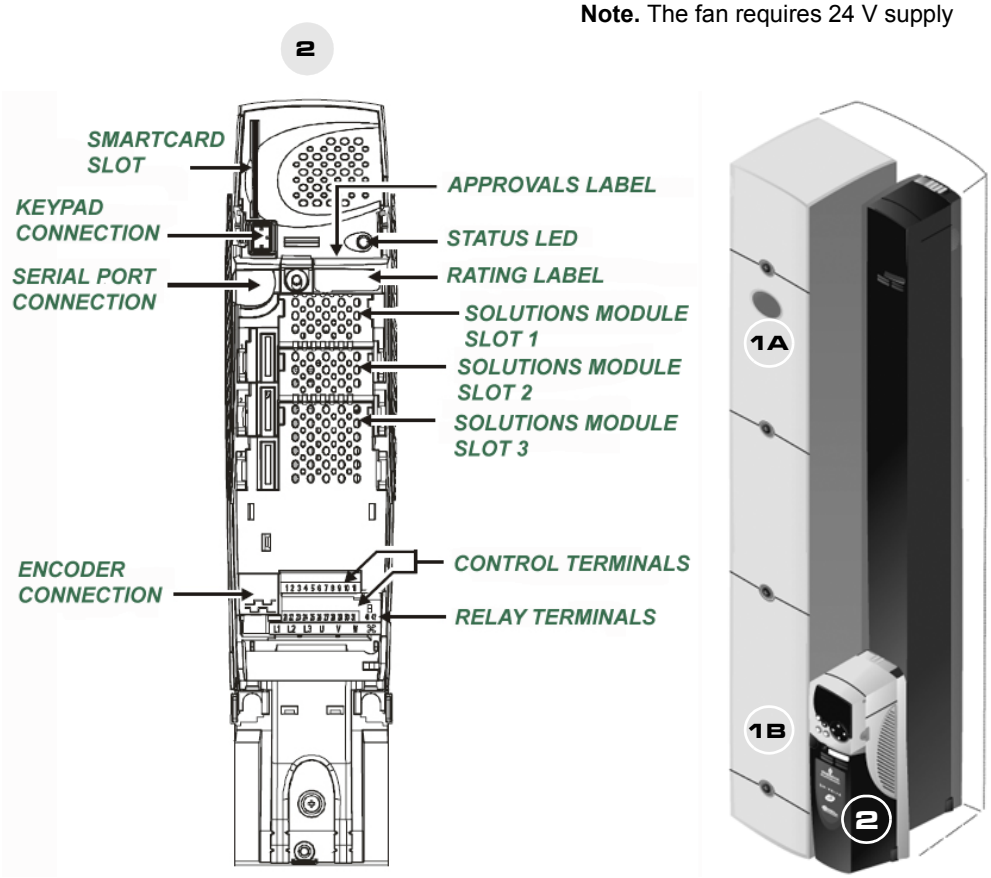
** Torque tolerance: ±10%.*

# Connector layout

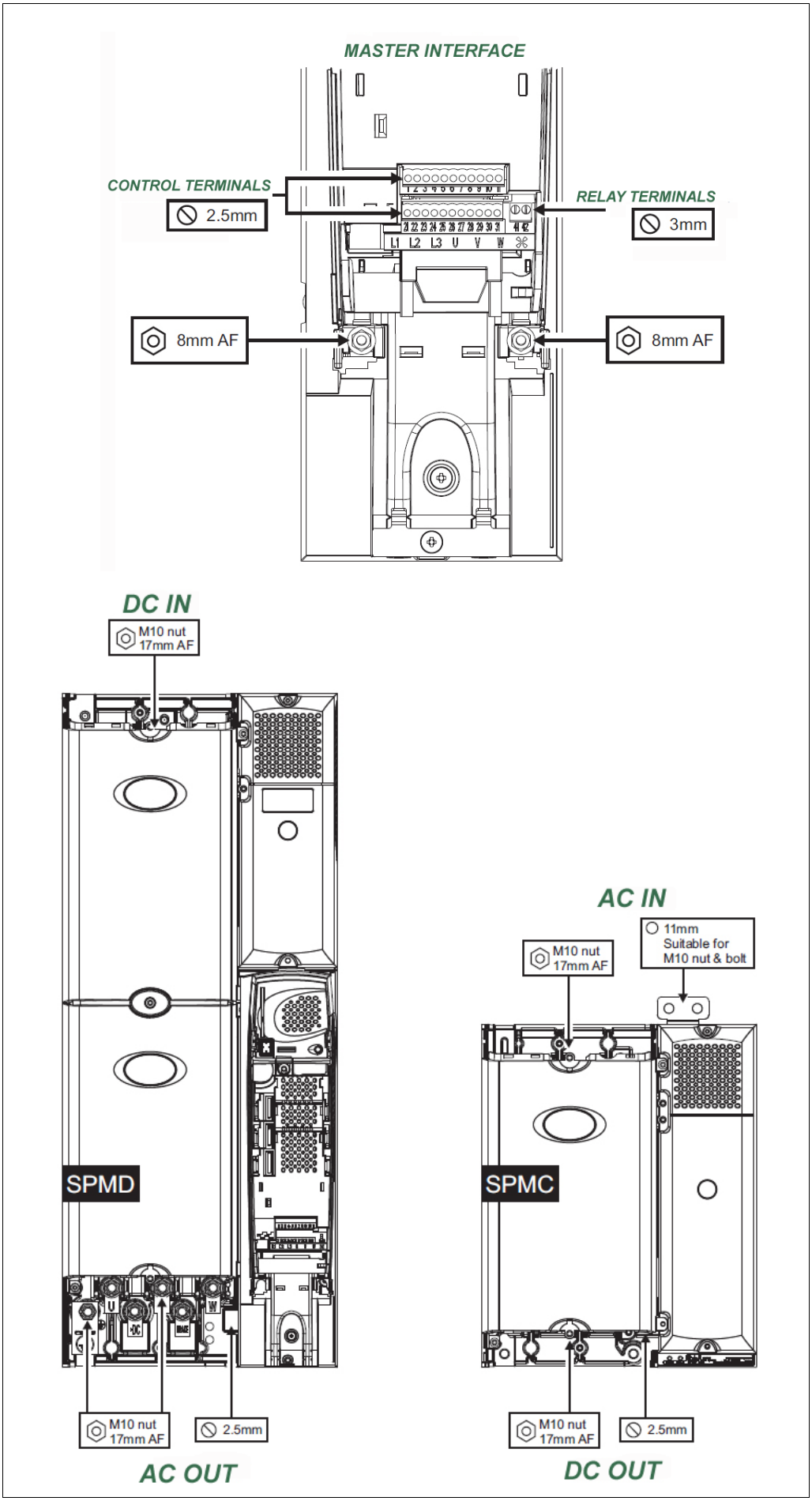
## SP6402 compact drive




**Note.** The fan requires 24 V supply



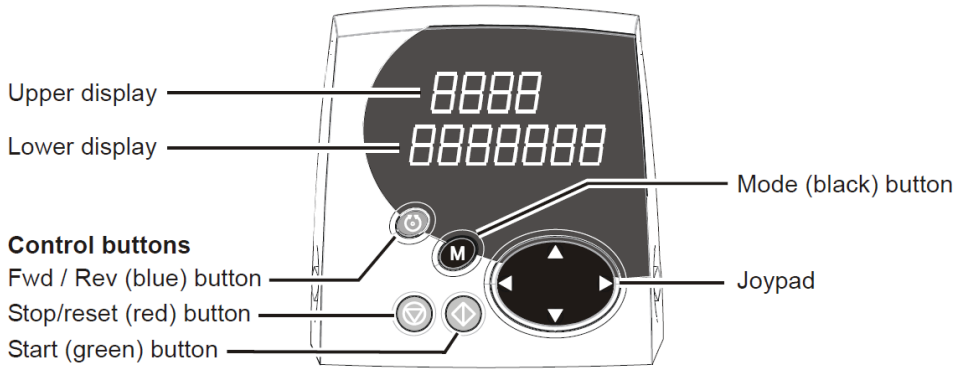
## SPMD1403-1S (SPMD1403+SPMC1402) modular drive



# 3 OTHER MODULES

## SM-Keypad

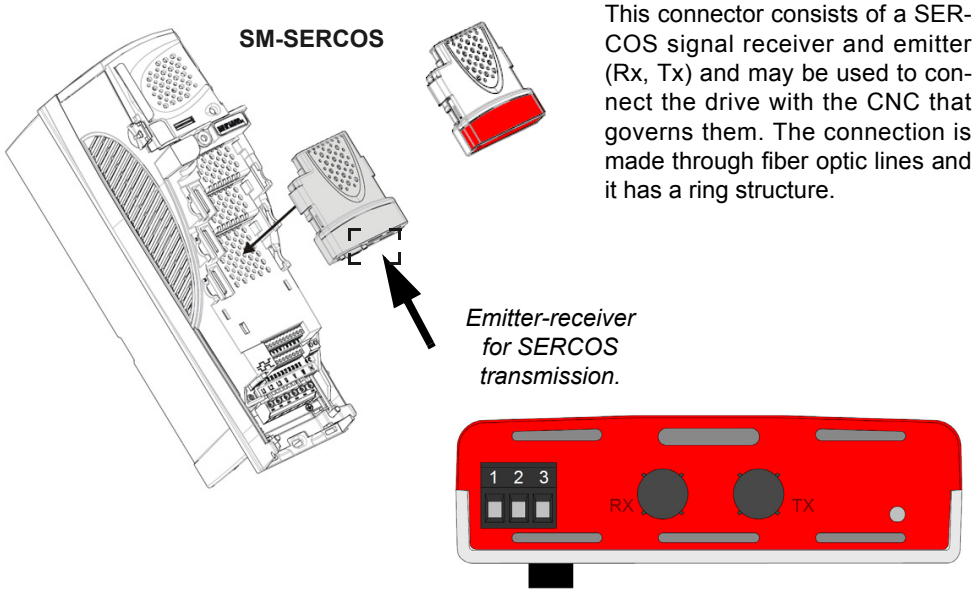
Screen with LED indicators, inexpensive and with hot connection. It has two rows of 7-segment LED's. The top row shows the drive status or the menu and the number of parameters displayed. The bottom row shows the parameter value or a particular disconnection type.




## SM-SERCOS

Solutions module to set SERCOS communication in the servo system. It is identified by its red color.

SERCOS option. Meets Class B. Speed, torque and position control modes supported at data speeds (bits/s): 2MB, 4 MB, 8 MB and 16 MB. Minimum network cycle time of 250 µs. Two high-speed test digital inputs at 1µs for position capturing.




This connector consists of a SERCOS signal receiver and emitter (Rx, Tx) and may be used to connect the drive with the CNC that governs them. The connection is made through fiber optic lines and it has a ring structure.

*Emitter-receiver for SERCOS transmission.*

# EMC external mains filters

| Mains filters | Drive |
|---|---|
| 4200-6603 | SP6402 |
| 4200-6315 | SPMD1403-1S |

## Filter 4200-6603

### Rated values

| Data of external mains filter 4200-6603 (optional) | | | | | | |
|---|---|---|---|---|---|---|
| Maximum DC current. | | Rated voltage | Protection degree | Power dissipation at rated current | Ground link | |
| at 40 °C (104 °F) | at 50°C (122°F) | | IP | | Symmetrical Power supply (phase-phase and | Worst conditions |
| A | A | V | | W | mA | mA |
| 260 | 237 | 480 | 00 | 14.2 | 41.0 | 219 |

**Note.** *The discharge resistance will be 1 MΩ in a star (Y) connection between phases with the tip of the star connected to ground through a 680 kΩ resistor (i.e. line to line 2 Ω, line to ground 1.68 MΩ).*

**Overall dimensions**

| H (height) | W (width) | D (depth) |
|---|---|---|
| 135 mm (5.315 in) | 295 mm (11.614 in) | 230 mm (9.055 in) |

**Approx. mass**

| kg | lb |
|---|---|
| 5.25 | 11.6 |

For further detail, see dimensions section.

### Tightening torque adjustments

| Data of external mains filter terminal 4200-6603 (optional) | | | |
|---|---|---|---|
| Power supply connections | | Ground connections | |
| Max. cable section | Max. torque | Size of ground connection terminal | Max. torque |
| 70 mm² | 12 N·m (8.8 lb·ft) | M10 | 25 N·m (18.4 lb.ft) |

## Filter 4200-6315

### Rated values

| Data of external mains filter 4200-6315 (optional) | | | | | | |
|---|---|---|---|---|---|---|
| Maximum DC current. | | Rated voltage | Protection degree | Power dissipation at rated current | Ground link | |
| at 40 °C (104 °F) | at 50°C (122°F) | | IP | | Symmetrical Power supply (phase-phase and | Open circuit 1 phase |
| A | A | V | | W | mA | mA |
| 340 | | 480 | 00 | | 52.0 | 293 |

**Note.** *The discharge resistance will be 1 MΩ in a star (Y) connection between phases with the tip of the star connected to ground through a 680 kΩ resistor (i.e. line to line 2 Ω, line to ground 1.68 MΩ).*

**Overall dimensions**

| H (height) | W (width) | D (depth) | kg | lb |
|---|---|---|---|---|
| 136 mm (5.354 in) | 339 mm (13.346 in) | 230 mm (9.055 in) | 5.5 | 12.11 |

**Approx. mass**

For further detail, see dimensions section.

### Tightening torque adjustments

| Data of external mains filter terminal 4200-6315 (optional) | | |
|---|---|---|
| Power supply connections | Ground connections | |
| Max. torque | Size of ground connection terminal | Max. torque |
| 12 N·m (8.8 lb·ft) | M10 | 25 N·m (18.4 lb.ft) |

## Braking resistors

Braking takes place when the drive decelerates the motor or prevents it from running at higher speed for mechanical reasons. While braking, the energy of the motor returns to the drive. When the drive brakes the motor, the drive can absorb a maximum amount of regenerated power equivalent to its energy dissipating (loss) capability. When the power generated is likely to be greater than the losses, the DC bus voltage of the drive increases. In case of malfunction, the drive brakes the motor using the PI control that extends the deceleration time to prevent the DC voltage to rise above the reference value set by the user. If the drive is supposed to lower the speed of a load or retain an overhauling load, a braking resistor will have to be installed. The DC voltage at which the drive activates the braking transistor for the drive whose rated voltage is 400 V is 780 V.



### Combination of braking resistors for the devices

| *Braking resistor model* | *Required Ohmage* | *Power that may be* | *Drive* |
|---|---|---|---|
| ***RE/PR5R-11000*** | *5 Ω* | *11.0 kW* | *SP6402* |
| ***RE/PR3.8R-13200*** | *3.3 Ω* | *13.2 kW* | *SPMD1403-1S* |
| ***RE/PR5R-33000*** | *5 Ω* | *33.0 kW* | *SP6402* |
| ***RE/PR3.8R-40000*** | *3.3 Ω* | *40.0 kW* | *SPMD1403-1S* |

### Braking resistor sizing

The calculation data required to size the braking resistor needed for an application are:

| *Physical magnitudes* | *For example* |
|---|---|
| *Inertia ** | *1.479 kg·m²* |
| *Braking cycle* | *5 s every 30 s* |
| *Required braking time* | *5 s* |
| *Motor Power* | *100 kW* |
| *Drive power* | *110 kW* |
| *Rated motor torque (Mn)* | *636.6 N·m* |
| *Rated motor speed (nN)* | *1500 rpm* |
| *Operating voltage of the braking transistor for a rated voltage of the drive of 400 V* | *780 V*<br>*DC bus voltage* |

** The inertia value to be considered is the one corresponding to the moving mass. If only the rotor of the motor is to be braked, only the motor inertia is taken into account. This example uses that of the FM9-A100-C5C□-E01 motor*

***1. Calculation of the maximum braking torque available.***

***M = 175 % x Mn motor*** *(drive configured with closed loop control)*

*M = 1.75 x 636.6 = 1114.05 N·m*

***Note.*** *The drive is assumed as the braking torque limiting device. Check the maximum motor torque to guarantee proper performance. A more powerful drive can control greater loads and, therefore, the maximum deceleration torque is higher.*

***2. Calculation of the minimum braking time possible to ensure that the braking time required by the application to stop de motor is longer.***

$M = J \cdot \alpha$ *where:*

| *Symb.* | *Description* | *Units* |
|---|---|---|
| $J$ | *Motor inertia* | *kg·m²* |
| $\alpha$ | *Angular acceleration* | *rad/s²* |

$\alpha = \omega / t_b$ *with:*

| *Symb.* | *Description* | *Units* |
|---|---|---|
| $\omega$ | *Angular speed* | *rad/s* |
| $t_b$ | *Minimum deceleration time* | *s* |

*plus,* $\omega = 2\pi \cdot n_N / 60$ *with:*

| *Symb.* | *Description* | *Units* |
|---|---|---|
| $n_N$ | *Rated motor speed* | *rev/min* |

*therefore:*

$M = J \cdot \omega / t_b = J \cdot \pi \cdot nN / 30 \cdot t_b =$ *1.479x$\pi$ x1500 / 30·$t_b$ = 1114.05 N·m*

*and therefore:*

$t_b =$ *0.21 s is the minimum time the motor can be stopped and the time required by the application for braking, 5 s, is therefore within the specs of the 100 kW drive.*

### *3. Torque and power needed for a required motor braking time of 5 s*

$M =$ *1.479x$\pi$ x1500 / 30x5 = 46.46 N·m*

*and the power, therefore:*

$P =$ *$\pi$ x n x M / 30x10³ = $\pi$ x n x M / 30x10³ with:*

| Symb. | Description | Units |
|---|---|---|
| P | Power | kW |
| n | Motor Speed | rpm |
| M | Max. braking torque | Nm |

$P =$ *$\pi$ x 1500 x 46.46 / 30x10³ = $\pi$ x n x M / 30x10³ = 7.29 kW*

### *4. Braking resistance*

$P = V^2/R$

*7.29 x10³ = 780²/R*

$R =$ *83.45 $\Omega$ is the minimum braking resistance with a 110 kW drive.*

*The calculation is the result of assuming constant speed, but the speed gets lower as the movement of the load slows down. Therefore, the avarage power needed to obtain the resistance value is:*

$P_{average} = 0.5 \times J \cdot \overline{\omega}^2 / t$

$P_{average} =$ *0.5 x 1.479 x (2x$\pi$x1500/60)²/5 = 3.64 kW. This braking power is needed for 4 seconds every 30 seconds.*

*Assuming that the resistors admits (dissipates) this overload; then, for a continuous duty cycle:*

$P_N =$ *3.64x5/30 = 0.6 kW that is the power that would be required for instantaneous braking.*

# 4 MECHANICS

This chapter describes how to use all the mechanical characteristics to install the drive. It must be installed inside an enclosure. Here are the most important characteristics:

- Through-the-wall mounting
- IP 20 as standard
- Enclosure size and mounting diagram
- Installation of the solutions module
- Pin layout and torque adjustments
- Coupling of the SPMD1403 and SPMC1402
- Remote mounting of the main control unit



## Safety data

**WARNING.** Using the instructions.
Follow the installation instructions for mechanical and electrical systems carefully. When in doubt, contact the supplier of the unit. It is up to the owner or user of the drive to ensure that the installation as well as maintenance and performance of the optional external units comply with the laws and practice codes of the country where they will be used.

**WARNING.** Up to the installer.
Only professional installers familiarized with safety and EMF requirements must install this drive. It is up to the installer to ensure that the final system or product complies with all the relevant laws of the country where it will be used.

**WARNING.** Unit lifting. The units weigh in kg (lb):
SP6402 compact drive ➔ 75 kg (165 lb)
SPMD1403-1S modular drive consisting of (SPMD1403 + SPMC1402) ➔ [42 kg (92.6 lb) + 20 kg (44 lb)]

## Planning the installation

Before installing it, bear in mind the following:

### Access

Only authorized personnel must have access to it. It must comply with the safety regulations where it will be used. The protection index specs of the drive depend on the installation.

### Environmental protection

The drives must be protected against:

- Humidity, including condensation, water leaks and water particles. An anti-condensation radiator may be needed; if so, it must be turned off when the drive is running.
- Contamination with electrically conductive material.
- Any dust type contamination that may hinder the performance of the fan or block air flow through several components.
- Higher temperatures than those indicated for operation and storage.
- Corrosive gasses.

### Cooling

The heat generated by the drive must be removed without rising its running temperature too high. Cooling in closed enclosures worse than in ventilated fairings and, consequently, the cooling cycle may be longer and/or need internal air flowing fans.

### Electrical safety

The installation must be safe both under normal conditions and in case of malfunction. Follow the electrical installation instructions of previous chapters.

### Fire protection

The enclosure of the drive is not classified as fireproof Therefore, fireproof enclosure must be installed.

### ElectroMagnetic Compatibility EMC

Variable speed drives are powerful electronic circuits that can cause electromagnetic interference if proper wiring is not carefully done during installation. Just take some precautions to prevent interference with industrial control units around. It is a must to respect the strict emission limits or take all the protections possible when knowing that there are other units sensitive to electromagnetic waves nearby. The drive has an internal EMF filter that reduces emissions under specific conditions. Extreme conditions may require an external EMC filter at the drive inputs that must be installed as close to it as possible. Besides room for the filters, certain distance is also required for independent wiring.

### Dangerous areas

The drive must never be mounted in an area considered dangerous unless proper enclosure is installed and the installation is certified.

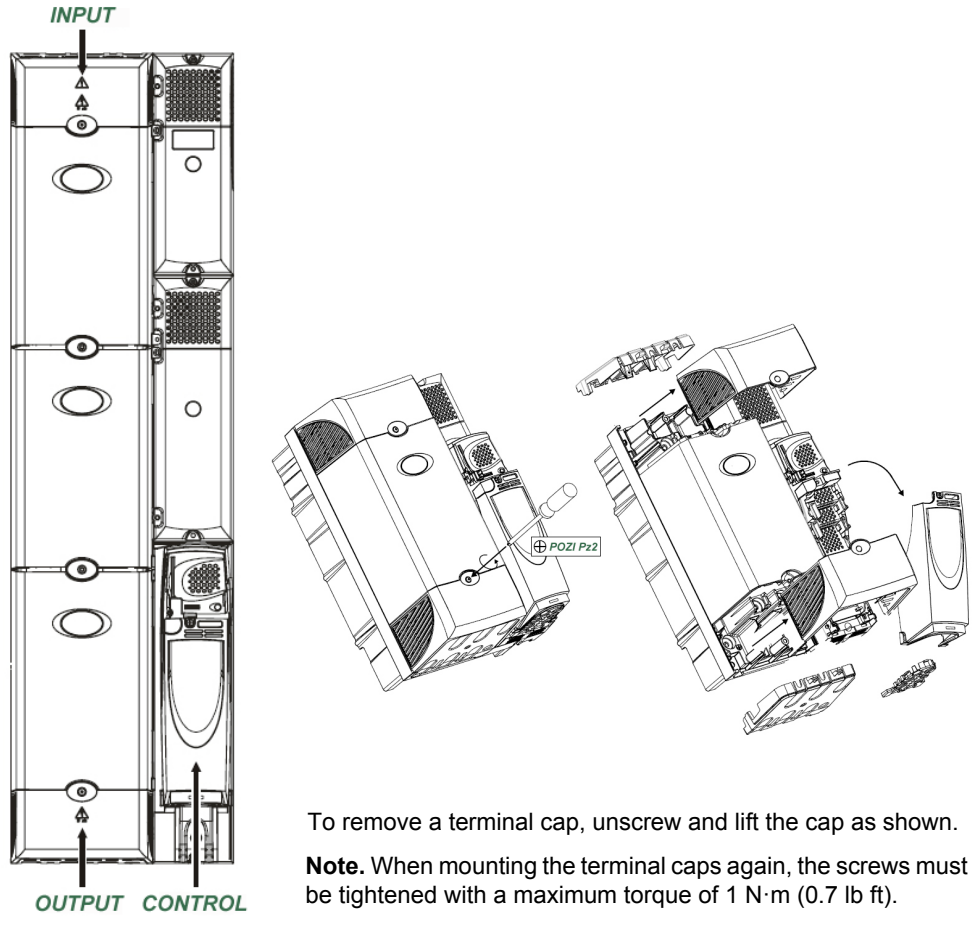
## Removing the terminal caps

**WARNING.**
**Insulation device.** Before removing any lid of the drive or perform repairs, AC power must be removed from the drive using a proper insulation device.

**WARNING.**
**Stored charge.** The drive contains capacitors that stay charged with a potential deadly charge after removing AC power from the unit. If the drive has been connected to power, the AC power must be removed at least ten minutes before going on with the job. Usually, an internal resistor discharges the capacitors. However, on particular and rare failures, the capacitors may not discharge or it may not be possible to discharge them by applying voltage to the output terminals. If the malfunction causes the drive screen to turn off immediately; more than likely, the capacitors have not been discharged. In this case, contact your FAGOR representative.

### SP6402 compact drive

This drive has three terminal caps: control, input and output. The following figure shows the location and identification of the terminal caps:



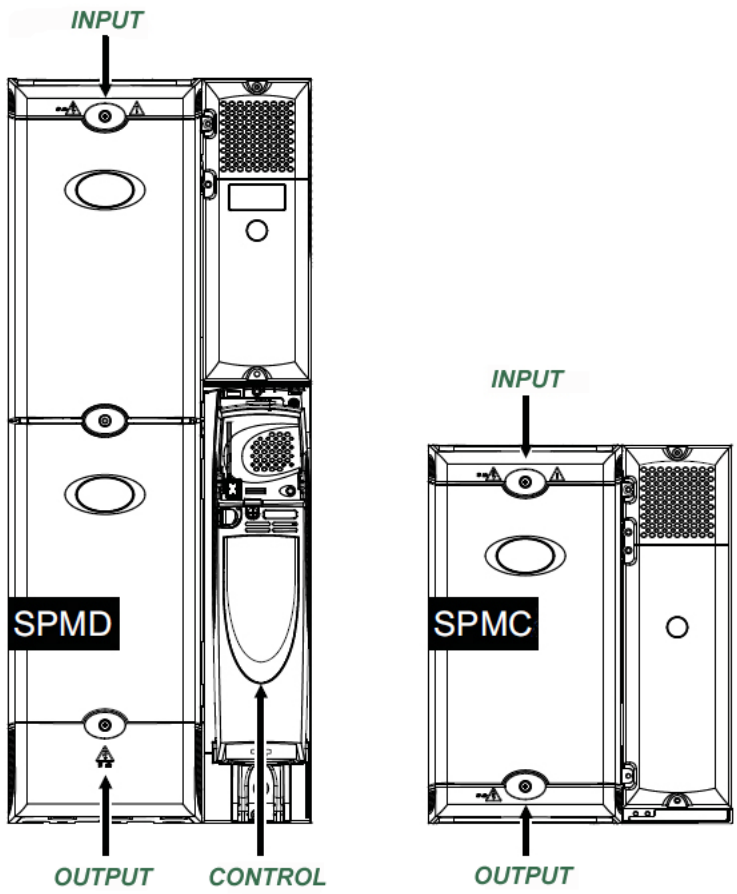

To remove a terminal cap, unscrew and lift the cap as shown.

**Note.** When mounting the terminal caps again, the screws must be tightened with a maximum torque of 1 N·m (0.7 lb ft).

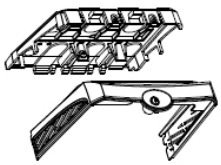
4.

## SPMD1403-1S modular drive (SPMD1403 + SPMC1402)

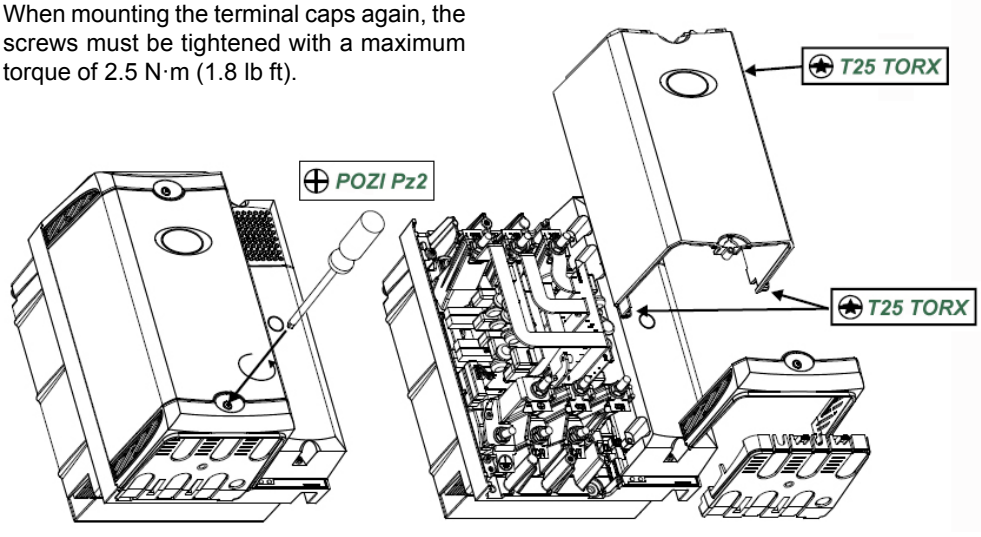
This drive has three terminal caps: control, input and output. The figure shows the location and identification of the terminal caps: Accessing all the terminals of the rectifier requires removing the terminal caps and that of the enclosure.




To remove a terminal cap, unscrew and lift the cap as shown. When mounting the terminal caps again, the screws must be tightened with a maximum torque of 1 N·m (0.7 lb ft).



**Note.** When removing the middle enclosure of the SPMC rectifier, remove the three screws Torx T25 as shown in the figure. When mounting the terminal caps again, the screws must be tightened with a maximum torque of 2.5 N·m (1.8 lb ft).



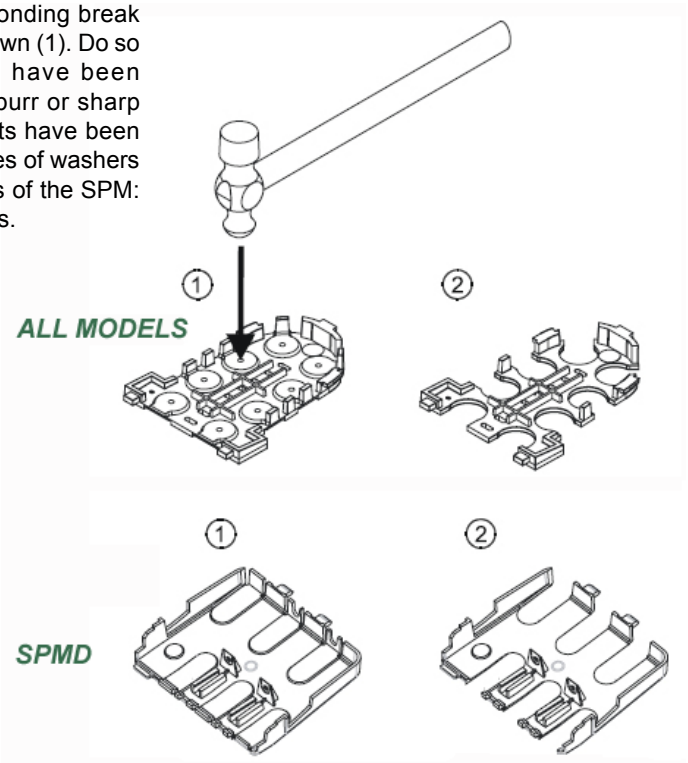

FAGOR

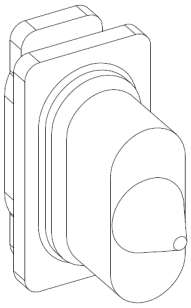
CT

Ref.1509

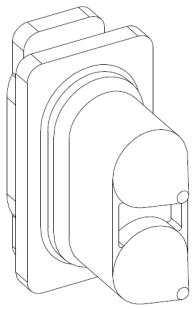
## Removing the break points of the handguard and the DC terminal cap

Place the handguard on a flat and firm surface and hit the corresponding break points with a hammer as shown (1). Do so until all the break points have been removed (2). Remove the burr or sharp edges when the break points have been removed. There are two types of washers available for the handguards of the SPM: simple or double cable inputs.



SINGLE CABLE ENTRY GROMMET



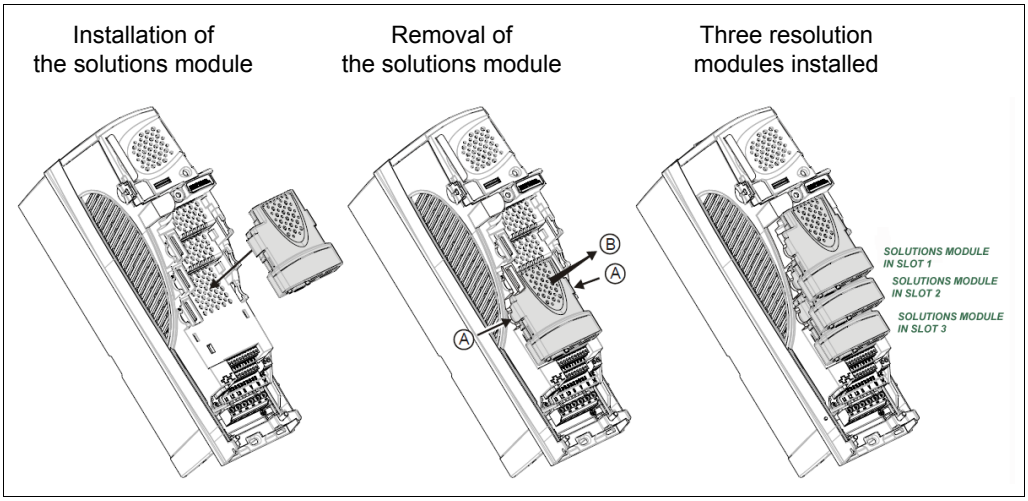
DOUBLE CABLE ENTRY GROMMET

**Note.** The washers for handguards guarantee IP20 protection in open environments.

**Note.** The drive must not work without handguards and washers, because a serious breakdown can cause sparks. The handguards and the washers must be properly installed to guarantee UL compliance.

## Installation and removal of a resolution module

**WARNING.**
Power the drive down before installing/uninstalling the solutions module. Otherwise the product might break down.



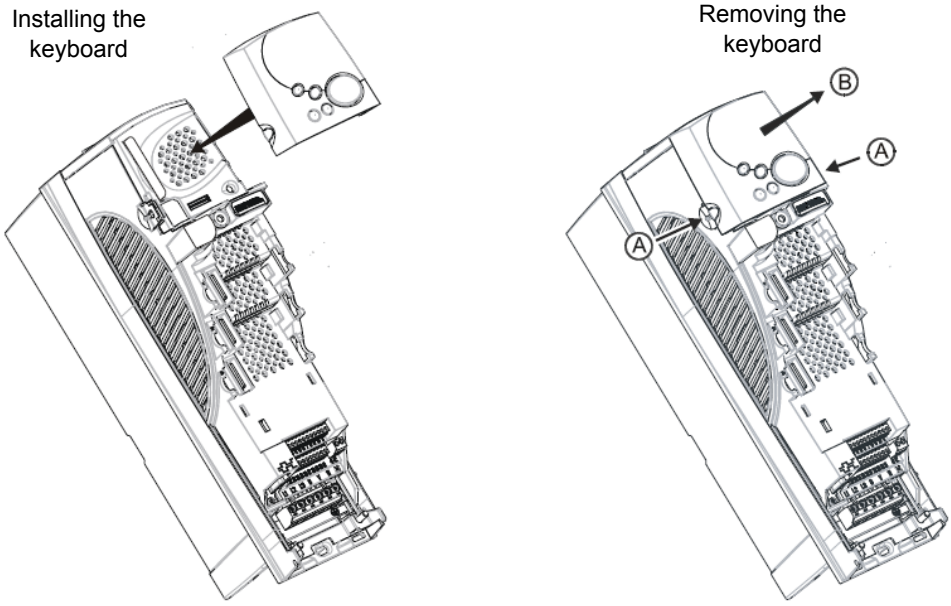

To install the solutions module, press down in the direction shown in the figure until it fits in place.

To remove the solutions module, press up at the positions shown (A) and pull in the direction shown (B).

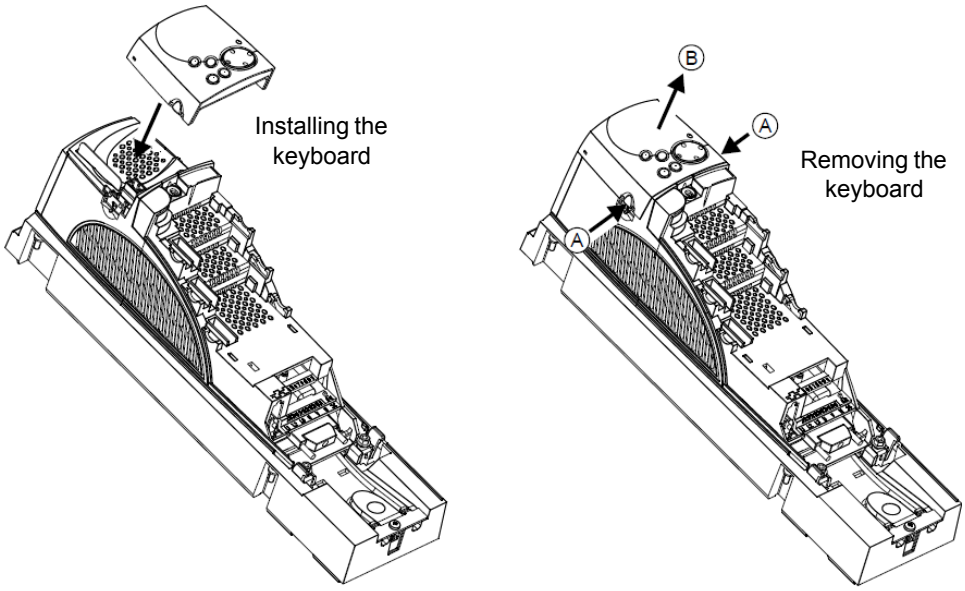
The drive lets you use the three slots for resolution modules at the same time as shown in the figure.

***Note.*** *The slots of the solutions module should be used in the following order: slot 3, slot 2 and slot 1.*

## Installation and removal of a keyboard




To install it, lign up the keyboard and press softly in the indicated direction until it fits in place. To remove it, press the tabs up (A) and lift the keyboard at the same time in the direction shown (B).




To install it, lign up the keyboard and press softly in the indicated direction until it fits in place. To take it apart, press the tabs (A) in while lifting the keyboard in the direction shown (B).

***Note.*** *The keyboard may be installed and uninstalled while the drive is connected to power and driving the motor as long as it is not working in keyboard mode.*

# Mounting methods

The drives may be mounted on a surface or using a panel with proper mounting plates. The chapter on dimensions shows the dimensions of the units and the mounting holes for these methods for preparing the rear support plate.

Surface mounting consists in mounting the drive onto a wall or onto the rear plate of the enclosure. Through-panel mounting consists in securing the drive with the heatsink sticking out to the outside through the enclosure panel. This reduces the temperature inside the enclosure.

4.

**WARNING.**
The heatsink can reach temperatures over 70 °C (158 °F) when the drive works with heavy loads for a certain amount of time. Do not touch the heatsink.

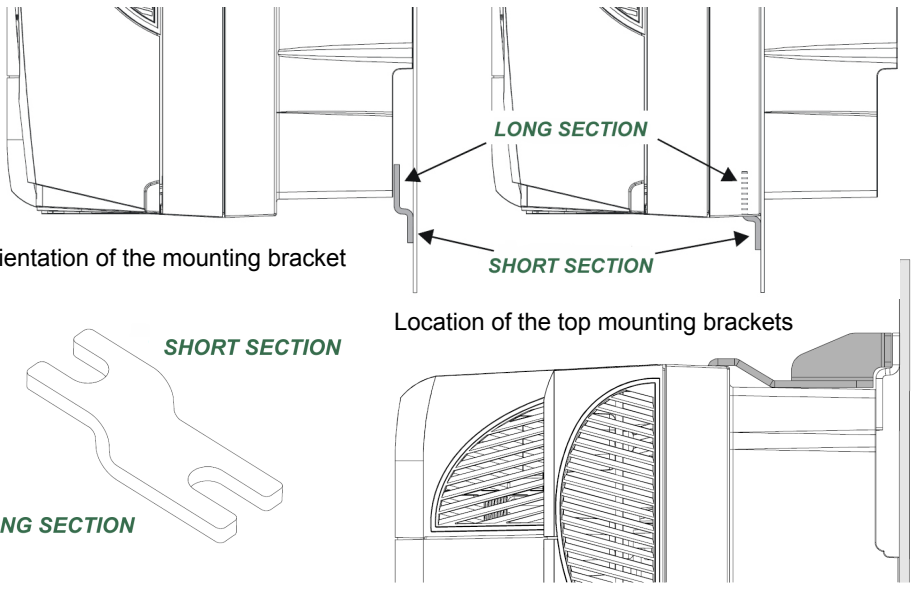
**Drive lifting.**
The approximate mass of the modules is:
SP6402: 75 kg (165 lb)
SPMD1403: 42 kg (92.6 lb), SPMC1402: 20 kg (44 lb)
Use proper protections to lift these units.

## SP6402 mounting bracket

| Model size | Surface | Through-panel | Hole size |
|---|---|---|---|
| SP6402 |  x4 | | 8.5mm (0.335in) |
| |  x2 | | |

## Installation of the mounting bracket

The SP6402 drive uses the same brackets for surface mounting as for through-panel mounting. The mounting bracket has a long section and a short section.




The mounting bracket must be installed properly oriented with the long section inserted or fixed on the drive and the short section fixed to the rear plate. The figure shows the orientation of the bracket for surface mounting and for through-panel mounting.

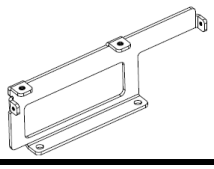
FAGOR

CT

Ref.1509

Mounting SP6402 drives on a surface requires another two top mounting brackets. Both brackets must be installed on top of the drive, as shown in the figure. The bolts of the drive chassis must be tightened with a maximum torque of 10 N·m (7.4 lb ft).

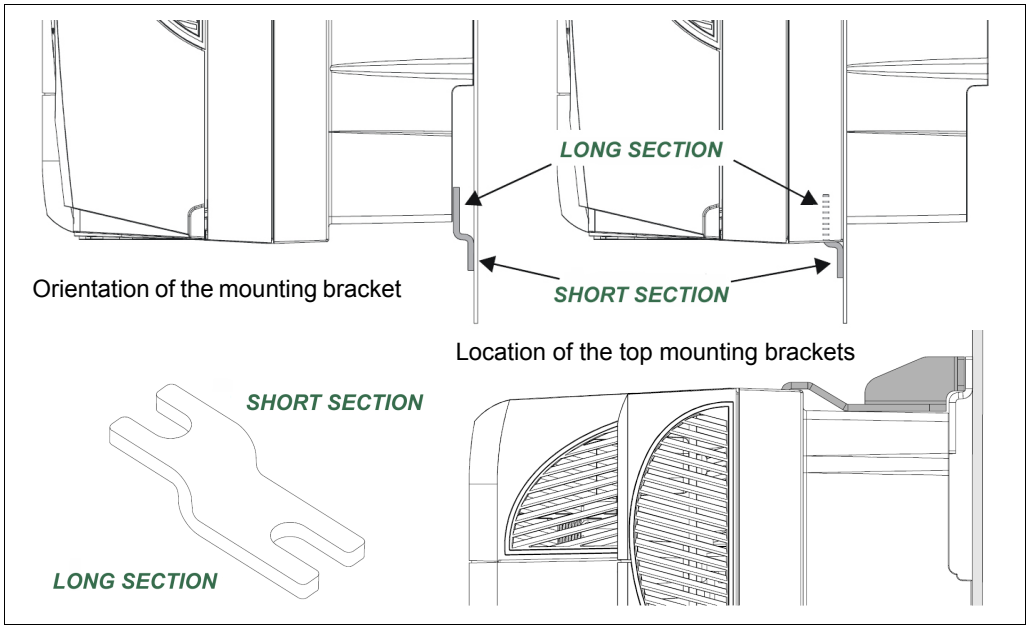
### SPMD1403 and SPMC1402 mounting brackets

| Model size | Surface | Through-panel | Hole size |
|---|---|---|---|
| SPMD |  x4 | | 8.5mm (0.335in) |
| SPMC |  x2 | | 8.5mm (0.335in) |
| |  x1 | | |

### Installation of the mounting brackets

#### Common brackets

The SPMD1403 and SPMC1402 drives use the same brackets for surface mounting as for through-panel mounting. The mounting bracket has a long section and a short section.



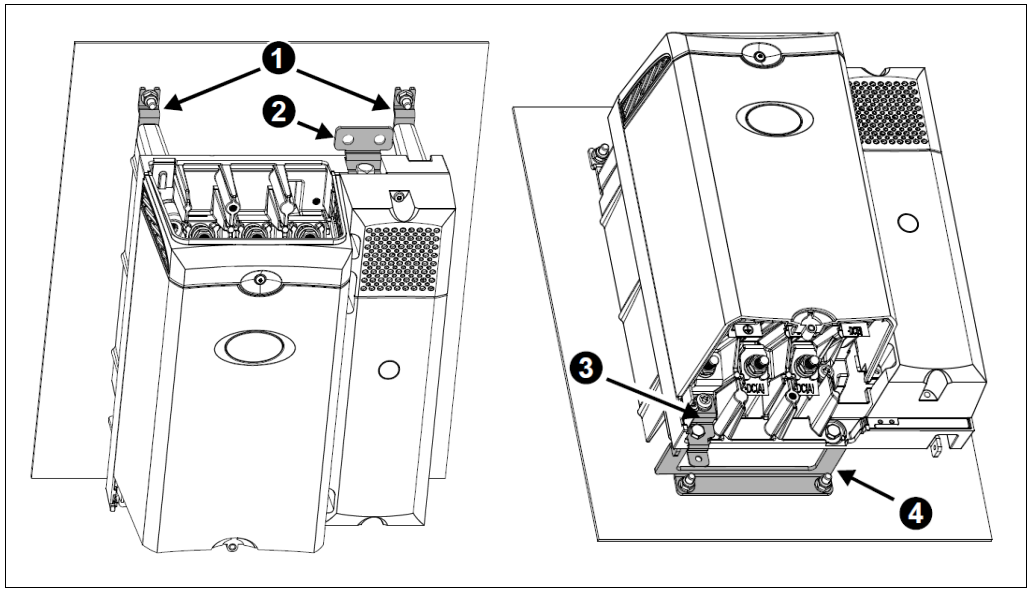

The mounting bracket must be installed properly oriented with the long section inserted or fixed on the drive and the short section fixed to the rear plate. The figure shows the orientation of the bracket for surface mounting and for through-panel mounting.

In through-panel mounting, the mounting brackets for the left side of the SPMD1403 module may be secured with the screws it comes with. This only applies to the bottom of the SPMC1402 rectifier. On the right side, the mounting brackets are only inserted into the slots of the drive chassis; they do not carry mounting screws.

4.

**Specific brackets**

The following figure shows the surface mounting brackets for the SPMC1402 rectifier.



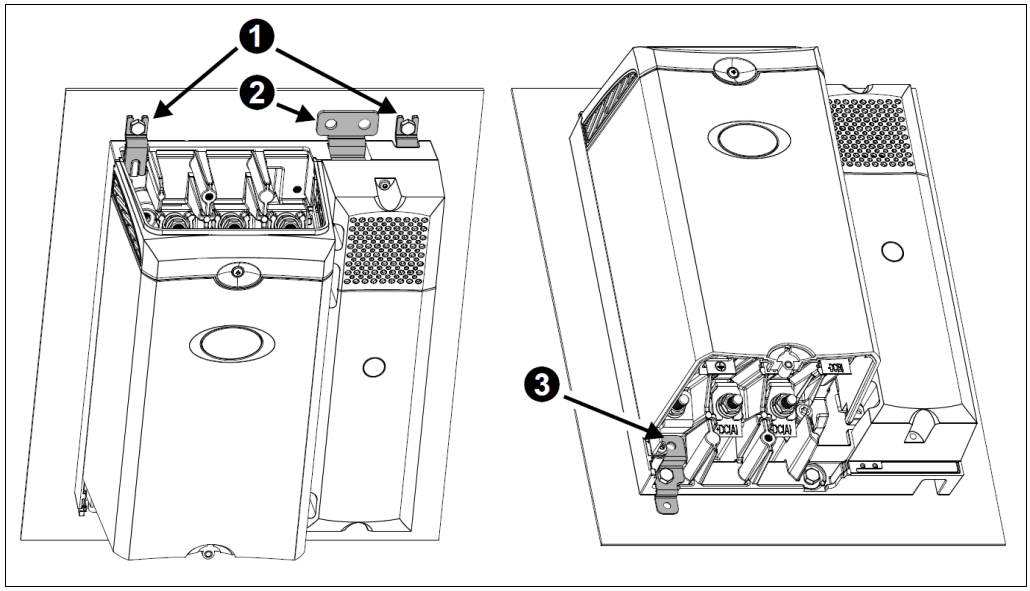

1. Common mounting bracket of the SPM unit: make sure that the short section is fixed to the rear plate.

2. Power grounding clamp for the SPMC1402 rectifier: mounting the clamp requires 20 M10 screws 40 mm long (1.575 in) with vibration proof washers. Tightening torque 15 N·m (11.1 lb ft).

3. Power grounding clamp for the SPMC1402 rectifier motor.

4. SPMC1402 rectifier surface mounting bracket: mounting the bracket requires M8 screws 20 mm long (0.787 in) with vibration proof washers. Tightening torque 9 N·m (6.6 lb ft).

The following figure shows the through-panel mounting brackets for the SPMC1402 rectifier.




1. Common mounting bracket of the SPM unit: make sure that the short section is fixed to the rear plate.

2. Power grounding clamp for the SPMC1402 rectifier: mounting the clamp requires 20 M10 screws 40 mm long (1.575 in) with vibration proof washers. Tightening torque 15 N·m (11.1 lb ft).

3. Power grounding clamp for the SPMC1402 rectifier motor.

## Coupling of the SPMD1403 and SPMC1402

An AC input/output drive may be obtained by coupling the SPMC1402 module to an SPMD1403. This coupling offers several benefits:

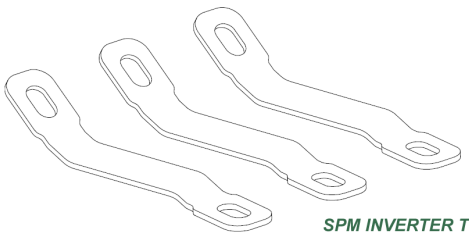
- Better enclosure mounting diagram
- Fewer cables

The coupling implies less air flow at the heatsink and affects the rated power of the drive. Check the rated power and current values (less power for switching frequency and temperature) in the technical data section of chapter 2.



### Installation of the coupling kit

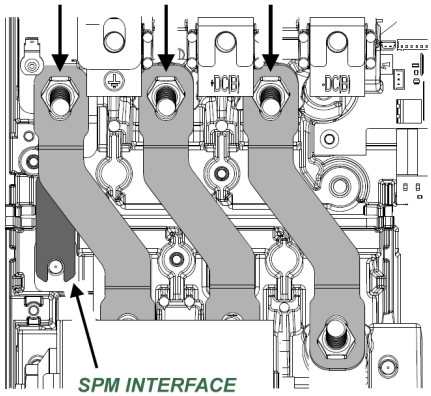
When installing an SPMD1403 and an SPMC1402 vertically, a coupling kit may be used to connect both modules electrically.



SPM INVERTER TO RECTIFIER BUSBARS

SPM INTERFACE BRACKET

First connect the SPM contact bracket and then the SPM inverter to the busbar of the rectifier using proper terminals.




***Note.*** *When it is coupled with the SPMC1402 module, do not apply a current reduction to the SPMD1403 inverter. The rated power and current values (less power for switching frequency and temperature) are the same when coupled and when not coupled.*

# Terminal sizes and torque adjustments

**WARNING.**
In order to avoid fire risks and the no compliance with UL regulation, make sure to apply the specific tightening torque to power and ground terminals. See the following tables.



| *Relay and control terminal data (in all models)* | |
|---|---|
| ***Type of connection*** | ***Torque adjustment*** |
| *Plug-in terminal block* | *0.5 N·m (0.4 lb·ft)* |

| *Power supply terminal data (in all models)* | | |
|---|---|---|
| ***AC terminals*** | ***High current and braking DC*** | ***Ground terminal*** |
| *M10 stud*<br>*15 N·m (11.1 lb·ft)* | *M10 stud*<br>*15 N·m (11.1 lb·ft)* | *M10 stud*<br>*15 N·m (11.1 lb·ft)* |

| *External EMC filter terminal data* | | | |
|---|---|---|---|
| ***External filter*** | ***Power supply connections*** | ***Ground connections*** | |
| | ***Max. torque*** | ***Terminal size*** | ***Max. torque*** |
| ***4200-6603*** | *12 N·m* | *M10* | *12 N·m* |
| ***4200-6315*** | *12 N·m* | *M10* | *25 N·m* |

## Periodic maintenance

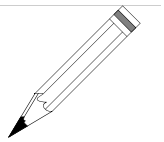
The drive must be installed in a cool, clean and well ventilated place not exposed to humidity or dust. The ensure unit and installation reliability, run the following periodic checks:

| ***Environment*** | |
|---|---|
| ***Ambient temperature*** | *Make sure that the enclosure temperature remains at or below the specified maximum temperature.* |
| ***Dust*** | *Make sure that the drive is dust free and dust does not accumulate on the heatsink nor on the fan of the drive. The lifespan of the fan gets shorter in dusty environments.* |
| ***Humidity*** | *Make sure that there is no condensation in the drive enclosure.* |

| ***Enclosure*** | |
|---|---|
| ***Enclosure door filters*** | *Make sure that the filters are not blocked and air flows freely.* |

| ***Electrical*** | |
|---|---|
| ***Screw connections*** | *Make sure that all screw connections are tight.* |
| ***Crimp terminals*** | *Make sure that all crimp terminals stay tight and check for any discoloration which could indicate overheating.* |
| ***Cables*** | *Check that the cables are not damaged.* |

4.



# 5 CABLES



Cable sizes are from IEC 60364-5-52:2001 table A.52.C with correction factor for 40 °C ambient of 0.87 (from table A52.14) for cable installation method B2 (multicore cable in conduit). Cable size may be reduced if a different installation method is used, or if the ambient temperature is lower. The recommended cable sizes above are only a guide. The mounting and grouping of cables affects their current-carrying capacity, in some cases smaller cables may be acceptable but in other cases a larger cable is required to avoid excessive temperature or voltage drop. Refer to local wiring regulations for the correct size of cables.

The recommended output cable sizes assume that the motor maximum current matches that of the drive. Where a motor of reduced rating is used the cable rating may be chosen to match that of the motor. To ensure that the motor and cable are protected against over-load, the drive must be programmed with the correct motor rated current.

Since capacitance in the motor cable causes loading on the output of the drive, ensure the cable length does not exceed the values given in the technical data tables. Use 105 °C (221 °F) (UL 60/75 °C temp rise) PVC-insulated cable with copper conductors having a suitable voltage rating, for the following power connections:

- AC supply to external EMC filter (when used)
- AC supply (or external EMC filter) to drive
- Drive to motor
- Drive to braking resistor

## AC supply cable to external EMC filter

| *Drive model* | *Input cable* | *Meaning* |
|---|---|---|
| ***SP6402*** | *2x 4x70 mm²* | *2 shielded 4-wire cables with a 70 or 120 mm² section depending on model.* |
| ***SPMD1403-1S*** | *2x 4x120 mm²* | |

## AC supply cable - or external EMC filter - to drive

| *Drive model* | *Input cable* | *Meaning* |
|---|---|---|
| ***SP6402*** | *2x 4x70 mm²* | *2 shielded 4-wire cables with a 70 or 120 mm² section depending on model.* |
| ***SPMD1403-1S*** | *2x 4x120 mm²* | |

## Motor-drive power cable

| *Motor model governed for S1 duty cycle* | *Drive model* | *Power cable* |
|---|---|---|
| *FM9-A100-C5Cx-E01* | *SP6402* | *2x MPC-4x50* |
| *FM9-B113-C5Cx-E01* | *SPMD1403-1S* | ***2x MPC-4x50 ** |
| *FM9-A130-C5Cx-E01* | *SPMD1403-1S* | *2x MPC-4x70* |

** For air room temperature 40 ºC (104 ºF) or less and installation method other than type B2 (under channels) according to EN 60204-1. Otherwise, install power cable 2x MPC-4x70.*

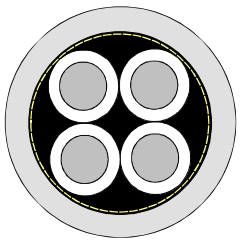
5.

### Maximum length

**INFORMATION.**
The maximum length for the motor power cable MPC-4x for best performance must not exceed the values shown in the attached table.

| *Maximum motor cable length allowed depending on frequency.* | | | | | | |
|---|---|---|---|---|---|---|
| *Drive model* | *3 kHz* | | *4 kHz* | | *6 kHz* | |
| *SP6402* | *250 m* | *820 ft* | *185 m* | *607 ft* | *125 m* | *410 ft* |
| *SPMD1403-1S* | *250 m* | *820 ft* | *185 m* | *607 ft* | *125 m* | *410 ft* |

### Mechanical characteristics

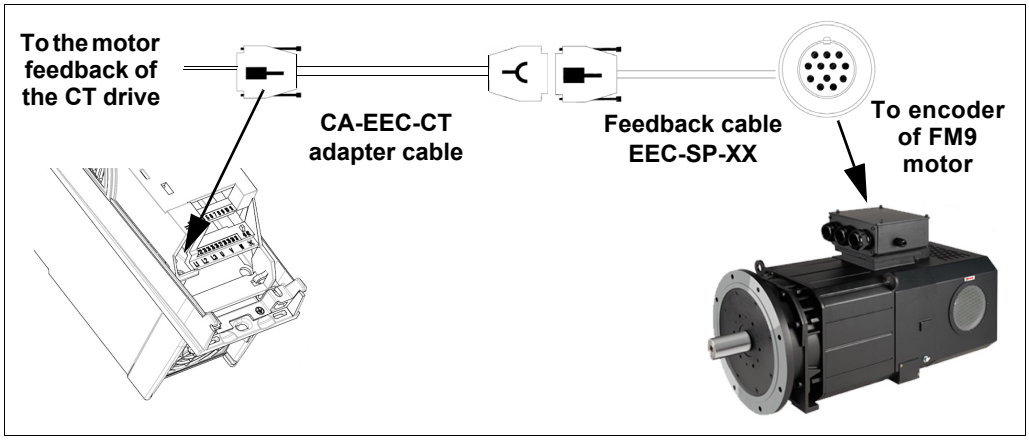


**MPC- 4x ...**

| | |
|---|---|
| **Type** | Shield. It ensures EMC compatibility. |
| **Approx. Dmax** | Cable MPC-4x50 ➔ Dmax = 40.1 mm<br>Cable MPC-4x70 ➔ Dmax = 42.1 mm |
| **Flexibility** | High. Special to be used in cable carrying chains with a bending radius of 12 times the Dmax under dynamic conditions (when flexed) and 4 times the Dmax under static conditions. |
| **Covering** | PUR. Polyurethane resistant to chemical agents used in machine tools. |
| **Temperature** | Work: -10°C/80°C (14°F/176°F)<br>Storage: - 40°C/80°C (-40°F/176°F) |
| **Rated voltages according to IEC** | Uo / U: 600/1000 V |

# Motor feedback cables

An FM9 motor encoder is connected to a CT drive through motor cable **EEC-SP-XX** plus an adapter cable **CA-EEC-CT**. FAGOR supplies both cables upon request with a connector at each end.

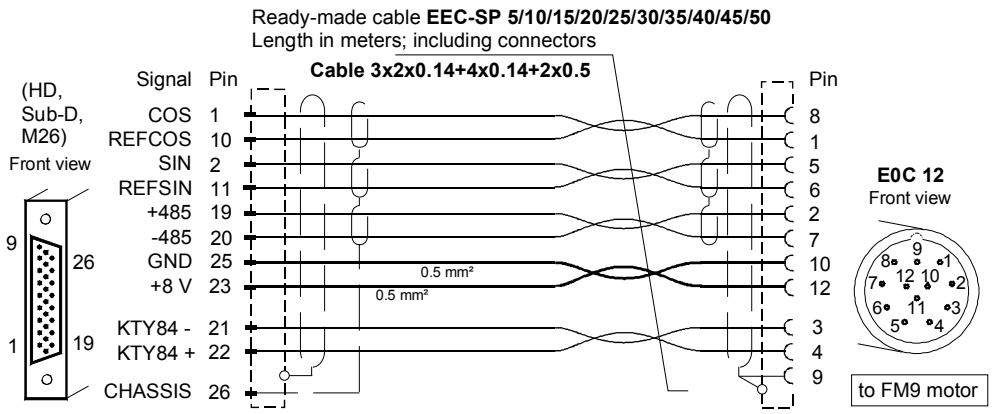



## EEC-SP-XX cable

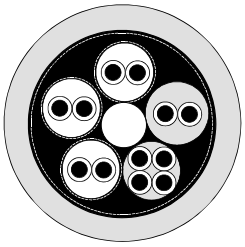
### Sales reference

| *Range of EEC-SP-XX cables. The number indicates their length in meters including the connectors.* | | | | |
|---|---|---|---|---|
| *EEC-SP-5* | *EEC-SP-15* | *EEC-SP-25* | *EEC-SP-35* | *EEC-SP-45* |
| *EEC-SP-10* | *EEC-SP-20* | *EEC-SP-30* | *EEC-SP-40* | *EEC-SP-50* |

### Diagram



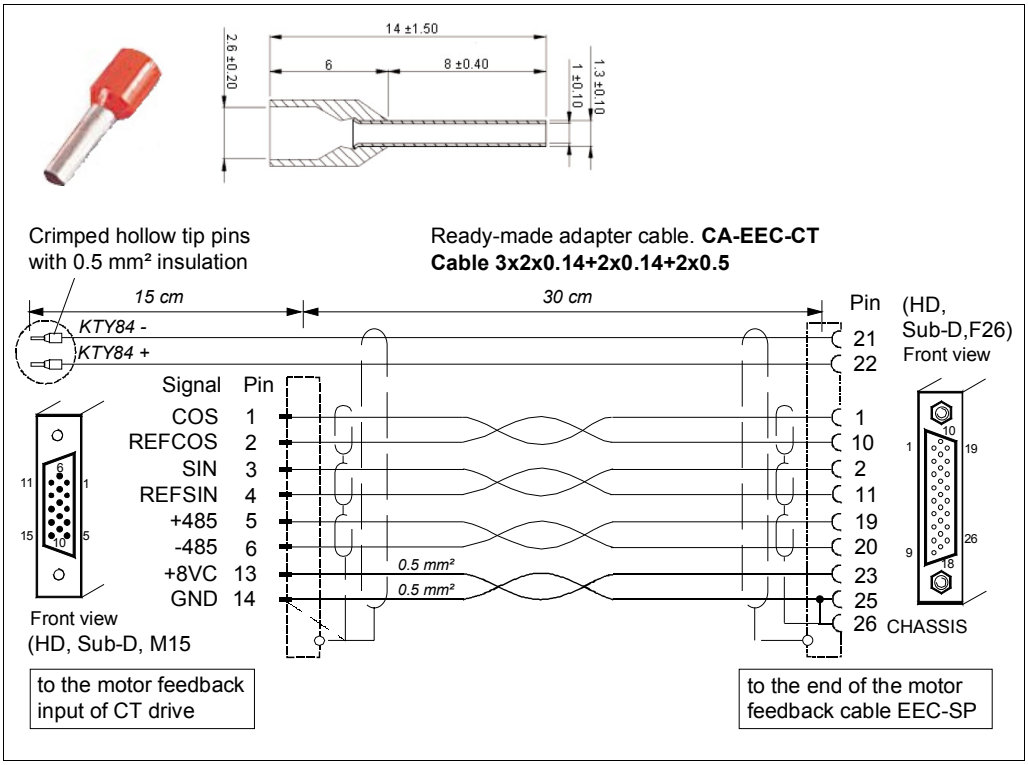

### Mechanical characteristics



| | |
|---|---|
| **Type** | Overall shield. Shielded twisted pairs. |
| **Approx. Dmax** | 8.5 mm |
| **Flexibility** | High. Special for controlling servo drives, with a minimum bending radius under dynamic conditions (when flexed) of 12 times the Dmax. (=100 mm). |
| **Covering** | PUR. Polyurethane resistant to chemical agents used in machine tools. |
| **Temperature** | Work: 0°C/80°C (32°F/176°F)<br>Storage: - 40°C/80°C (-40°F/176°F) |
| **Work voltage** | U: 250 V |

## CA-EEC-CT adapter cable

### Diagram



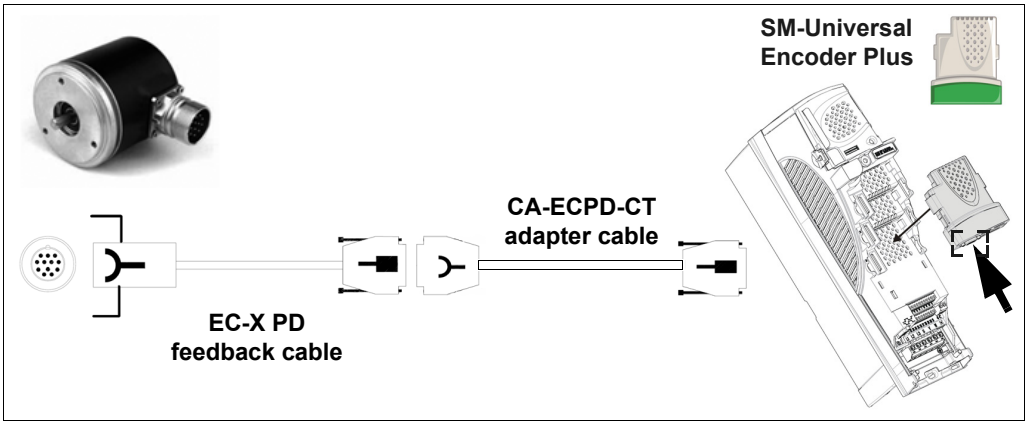

### Mechanical characteristics

The mechanical characteristics of this adapter cable are identical to those of the EEC-SP-XX and have already given in this same section.

# Direct feedback cables

## With external incremental feedback

**An external incremental feedback device (linear or rotary)** with sinusoidal signals (1Vpp) or square (differential TTL) signals must be connected to a CT drive through a direct feedback cable **EC-X PD** plus the adapter cable **CA-ECPD-CT**. Fagor supplies both cables upon request with a connector at each end.

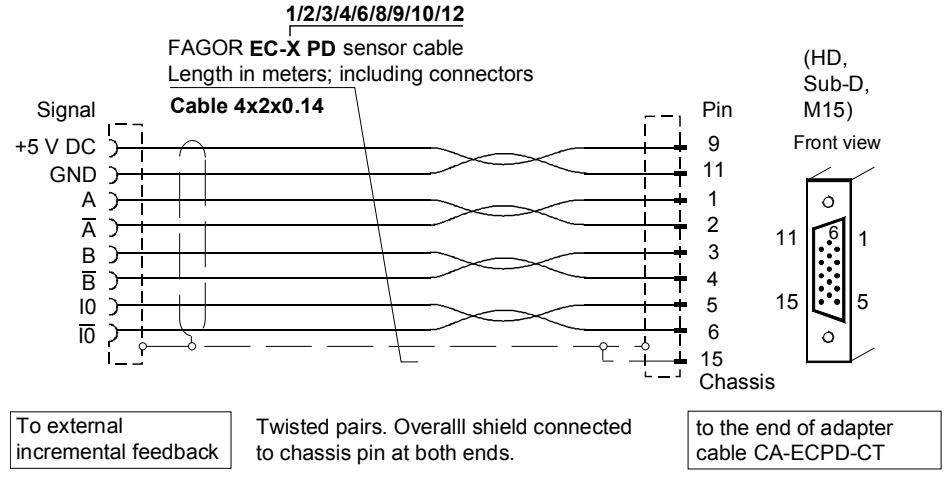



### EC-X PD cable

#### Sales reference

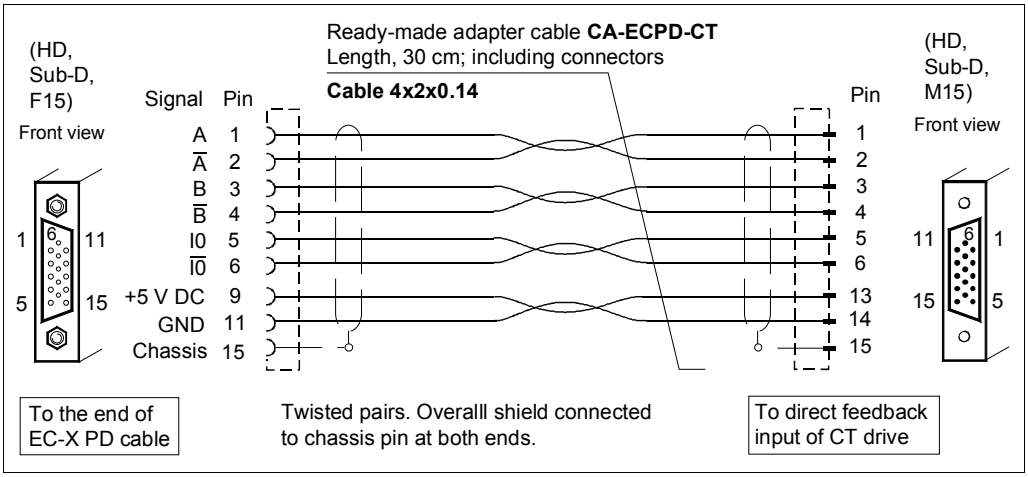
| *Range of EC-X PD cables.*<br>*The number indicates their length in meters including the connectors.* | | | | |
|---|---|---|---|---|
| *EC-1 PD* | *EC-2 PD* | *EC-3 PD* | *EC-4 PD* | *EC-6 PD* |
| *EC-8 PD* | *EC-9 PD* | *EC-10 PD* | *EC-12 PD* | |

#### Diagram




### CA-ECPD-CT adapter cable

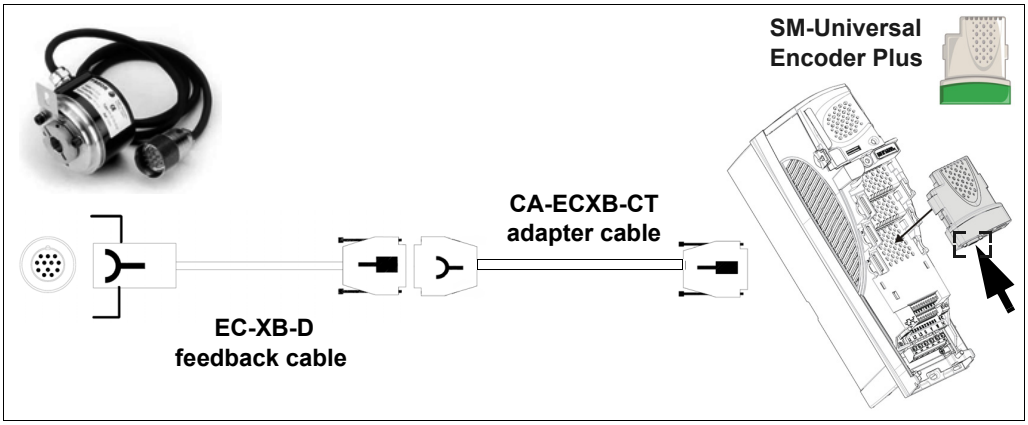
#### Diagram



5.

## With external absolute feedback

**An external absolute feedback device (SSI FAGOR)** with sinusoidal signals (1Vpp) must be connected to a CT drive through a direct feedback cable **EC-XB-D** plus the adapter cable **CA-ECXB-CT**. Fagor supplies both cables upon request with a connector at each end.

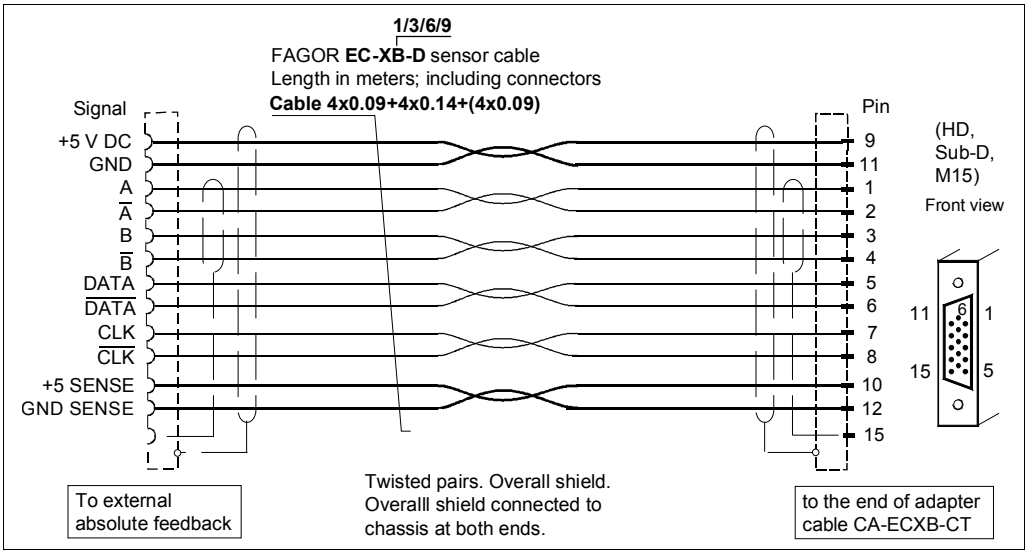



### EC-XB-D cable

#### Sales reference

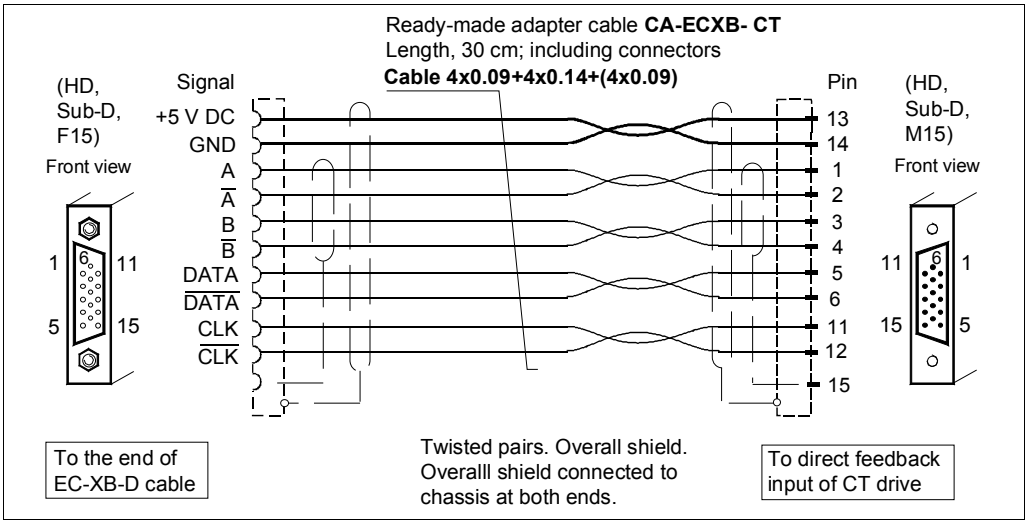
| *Range of EC-XB-D cables. The number indicates their length in meters including the connectors.* | | | | | |
|---|---|---|---|---|---|
| *EC-1B-D* | *EC-3B-D* | *EC-6B-D* | *EC-9B-D* | | |

#### Diagram




### CA-ECXB-CT adapter cable

#### Diagram




FAGOR

CT

Ref.1509

## Communication cable. SERCOS optical fiber

FAGOR supplies the fiber optic cables for SERCOS communications between the drive and the CNC in a ring connection and in lengths ranging from 1 to 100 meters. For SERCOS connection under 40 m, use the fiber optic cable with polymer core.

### Sales references

| *Range of SFO-XX cables. The number indicates their length in meters.* | | |
|---|---|---|
| *SFO-1* | *SFO-5* | *SFO-10* |
| *SFO-3* | *SFO-7* | *SFO-12* |

| *Range of SFO-FLEX-XX cables. The number indicates their length in meters.* | | |
|---|---|---|
| *SFO-FLEX-10* | *SFO-FLEX-25* | *SFO-FLEX-40* |
| *SFO-FLEX-15* | *SFO-FLEX-30* | |
| *SFO-FLEX-20* | *SFO-FLEX-35* | |

### Maximum length

**INFORMATION.**
The maximum length for fiber optic cables of the references mentioned earlier for best performance is 40 meters.

### Mechanical characteristics of the SFO-XX cable

| | |
|---|---|
| **Flexibility** | Normal. It must only be used in systems under static conditions where the minimum bending radius is 30 mm.<br>Use only in static conditions ! |
| **Covering** | PUR. Polyurethane resistant to chemical agents used in machine tools. |
| **Temperature** | Work: -20°C/80°C (-4°F/176°F)<br>Storage: -35°C/85°C (-31°F/185°F) |

### Mechanical characteristics of the SFO-FLEX-XX cable

| | |
|---|---|
| **Flexibility** | High. Special for cable-carrying chains with a minimum bending radius, in dynamic conditions, is 70 mm.<br>Use only in dynamic conditions ! |
| **Covering** | PUR. Polyurethane resistant to chemical agents used in machine tools. |
| **Temperature** | Work: -20°C/70°C (-4°F/158°F)<br>Storage: -40°C/80°C (-40°F/176°F) |

**INFORMATION.**
The SFO-FLEX-XX fiber optic cables are compatible with the SFO-XX cables. The SFO-FLEX-XX are more flexible.

***Note.*** *If the fiber optic cable for SERCOS communication between modules is going to be moving (dynamic conditions), always use the SFO-FLEX-XX cable. The SFO-XX cable will be enough for static conditions (resting). The useful life time of the SFO-XX cannot be guaranteed if it is installed in applications where it works under dynamic conditions (moving).*

For SERCOS connection over 40 m, use the fiber optic cable with glass core.

### Sales reference

| *Range of SFO-V-FLEX-XX cables. The number indicates their length in meters.* | | |
|---|---|---|
| *SFO-V-FLEX-40* | *SFO-V-FLEX-60* | *SFO-V-FLEX-100* |
| *SFO-V-FLEX-50* | *SFO-V-FLEX-75* | |

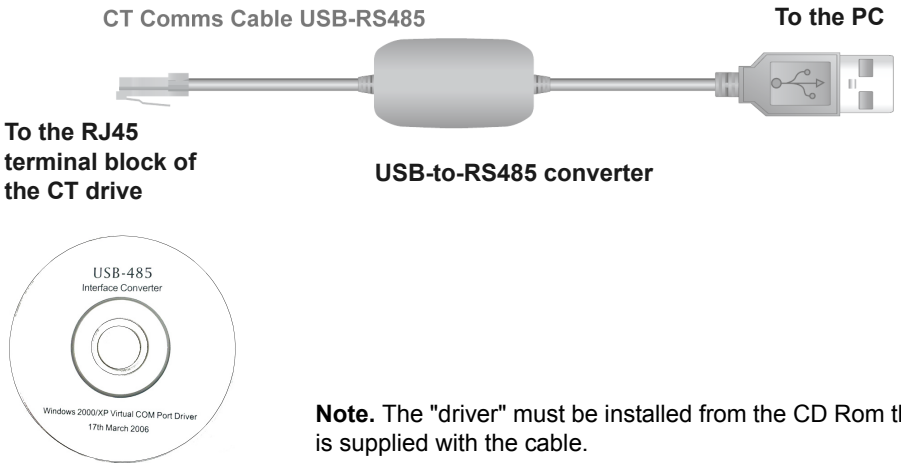
### Mechanical characteristics of the SFO-V-FLEX-XX cable

| | |
|---|---|
| **Flexibility** | The minimum bending radius will be 60 mm in dynamic conditions and 45 in static conditions. |
| **Covering** | PUR. Polyurethane resistant to chemical agents used in machine tools. |
| **Temperature** | Work: -40°C/80°C (-40°F/176°F)<br>Storage: -40°C/80°C (-40°F/176°F) |



## PC-DRIVE serial communication cable

FAGOR supplies, upon request, the USB communication cable for CT Comms (CT Comms Cable USB-RS485) under the reference 4500-0096 to connect the drive to a PC. A CD Rom with the driver for it is also supplied together with the cable.

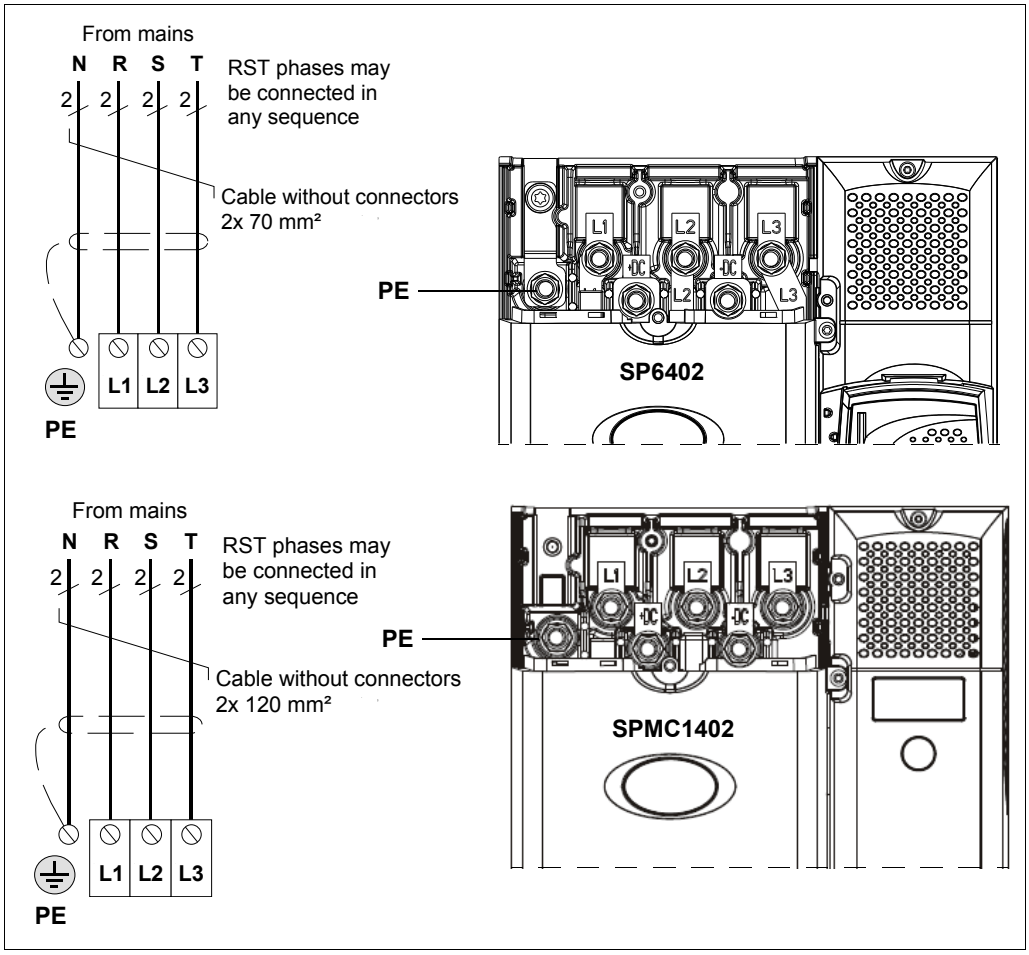



**Note.** The "driver" must be installed from the CD Rom that is supplied with the cable.

# 6 CONNECTIONS

## Mains connection

The module is connected to mains through input terminals L1, L2 and L3 using two 4-wire shielded cables. They phases may be connected in any sequence.




**MANDATORY.**
The equipment must be protected with fuses on the three-phase supply lines L1, L2 and L3. Follow the instructions given in the section on "protection fuses".

## AC supply requirements

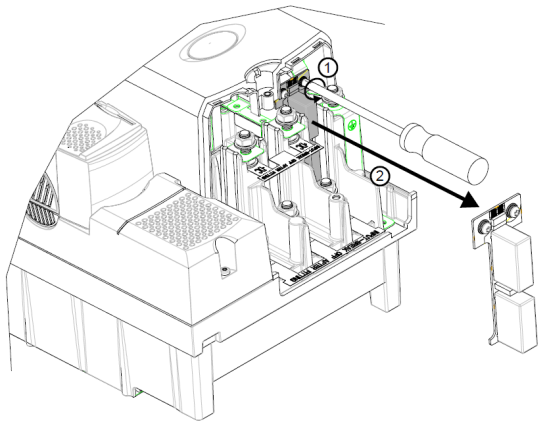
- Voltage: 380-480 ±10 %
- Nr. of phases: 3
- Maximum current unbalance: 2 % negative phase sequence (equivalent to 3 % of voltage unbalance between phases).
- Frequency range: 48-65 Hz
- For UL compliance only, maximum three-phase loss current must be limited to 100 kA.

6.

### Supply types

These devices may be used with any type of supply, like TN-S, TN-C-S, TT or IT, with ground connection at any voltage like delta to neutral ground or, centered or in a corner. According to IEC 60664-1, these devices may be used with supply to Class III (or lower) facilities. This means that they may be permanently connected to the supply source indoors, but when installed outdoors, an additional over-voltage suppressor must be used (transient over-voltage suppression) to lower it from class IV to class III.

**WARNING.**
**Operation with IT supply (not connected to ground)**. Special care must be taken when using internal or external EMC filters with a supply that is not connected to ground because if there were a ground leak in the motor circuit, the drive might not be disconnected and the filter could get overloaded. In this case, the filter cannot be used (uninstall it) or a separate protection must be used against motor ground leak. See the uninstalling instructions in the figure to remove the internal filter. For further information on ground leak protection, contact your FAGOR representative.




**1.** Remove the screws. **2.** Remove the filter in the shown direction.

A ground leak in the supply will have no effect in this case. If the motor must continue running with a ground leak in its own circuit, an input isolating transformer will be needed and if an EMC filter is required, it must be located in the main circuit. Unusual risks are possible with supplies not connected to ground with more than one source; e.g. on ships. For further information, contact your FAGOR representative.

### Line inductance

In principle, the SP6402 compact drive does not need a line reactor. Only when necessary, it will have to have one or more of its own reactors. Either three separate reactors or one three-phase reactor may be used.

#### Rated current of the reactor

The rated current of the line reactors must be:

***DC rated current.*** No less than the input DC rated current of the drive.

***Repetitive rated peak current.*** No less than twice the input DC rated current of the drive.

## Rated values

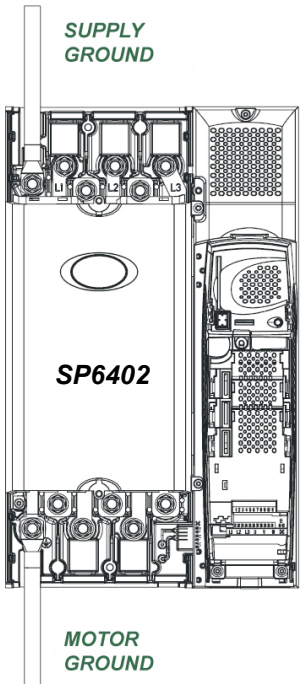
See the technical data tables at the beginning of this manual.

## Ground connections

The drive must be connected to the ground of the AC power supply system. Ground cables must meet local regulations and practice codes.

### SP6402 compact drive

Motor supply and ground connections must be done through an M10 bolt located on top (supply) and bottom (motor) of the drive. See figure.



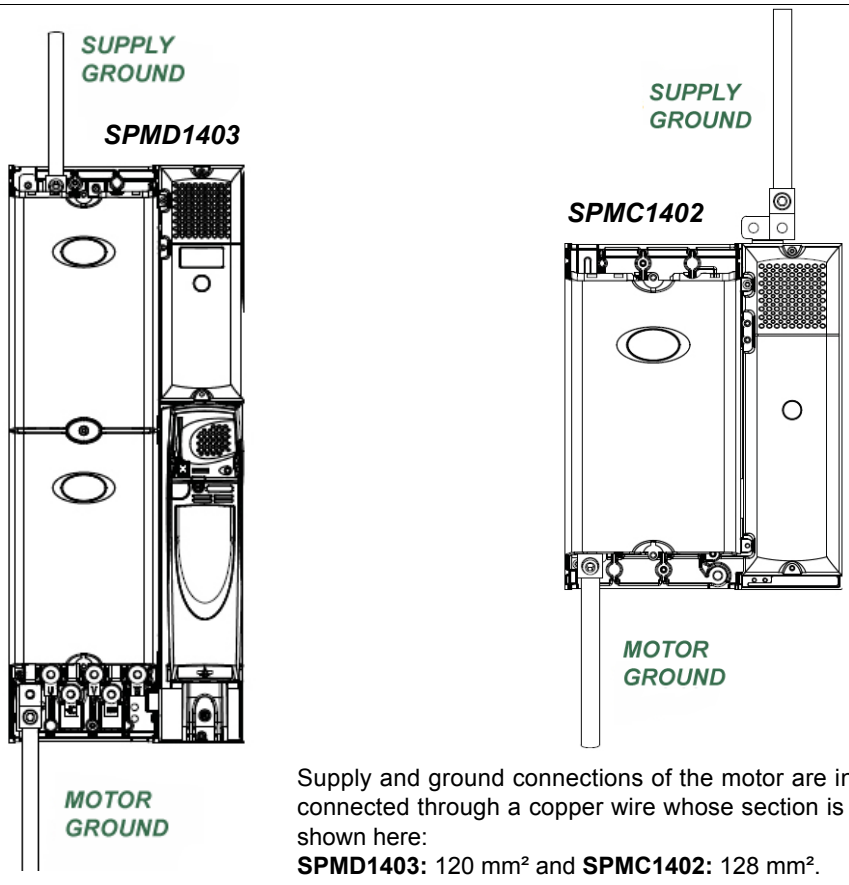

Supply and ground connections of the motor are internally connected through a copper wire whose section is 75 mm² (0.12 in² or slightly larger than 2/0 AWG). This connection is enough for ground connection (equipotential) of the motor circuit under the following conditions:

| ***According to regulations*** | ***Terms*** |
|---|---|
| ***IEC 60204-1 and EN 60204-1*** | *Phase supply wires with a cross section not larger than 150 mm².* |
| ***NFPA 79*** | *Supply device with rated protection not greater than 1000 A.* |

When not meeting all the conditions, an additional ground connection is required to join the ground connection of the motor circuit with the ground connection of the supply.

### SPMD1403-1S modular drive (SPMD1403 + SPMC1402)

On SPMD and SPMC drives, motor supply and ground connections must be done through an M10 bolt located on top (supply) and bottom (motor) of the drive. See figure.




Supply and ground connections of the motor are internally connected through a copper wire whose section is the one shown here:
**SPMD1403:** 120 mm² and **SPMC1402:** 128 mm².

## Connection of protection fuses

Fuses or some other protection are required both at the AC supply input of the unit and at the rest of AC connections. The rated voltage of the fuse must match the supply voltage of the drive. See the recommended values of the protection fuses for each drive.

### SP6402 compact drive

| *Input rated current values, fuse and cable size* | | | | | | | |
|---|---|---|---|---|---|---|---|
| *Typical input current* | *Maximum input current* | *Fuse* | | *Cable size* | | | |
| | | *IEC class gR* | *Ferraz HSJ* | *Input* | | *Output* | |
| *A* | *A* | *A* | *A* | *mm²* | *AWG* | *mm²* | *AWG* |
| *247* | *258* | *315* | *300* | *2x120* | *2x4/0* | *2x120* | *2x4/0* |

### SPMD1403-1S modular drive (SPMD1403 + SPMC1402)

| *SPMD1403. Input rated current values, fuse and cable size.* | | | | | | | |
|---|---|---|---|---|---|---|---|
| *Typical input DC current* | *Maximum input DC current* | *Maximum input DC current for rated cable* | *DC IEC fuse class aR* | *Typical cable section* | | | |
| | | | | *DC input* | | *Motor output* | |
| *A* | *A* | *V* | *A* | *mm²* | *AWG* | *mm²* | *AWG* |
| *314* | *457* | *800* | *560* | *2x120* | *2x4/0* | *2x120* | *2x4/0* |

***Note.*** *B2 type has been considered as cable installation method.*

| *SPMC1402. Input rated current values, fuse and cable size.* | | | | | | | |
|---|---|---|---|---|---|---|---|
| *Maximum input current* | *Typical output DC current* | *Semiconductor fuse in series with HRC fuse* | | *Typical cable section* | | | |
| | | *HRC IEC class gG UL class J* | *Semiconductor IEC class aR* | *AC input* | | *DC output* | |
| *A* | *A* | *A* | *A* | *mm²* | *AWG* | *mm²* | *AWG* |
| *344* | *379* | *450* | *400* | *2x120* | *2x4/0* | *2x120* | *2x4/0* |

***Note.*** *B1 or C type has been considered as cable installation method.*

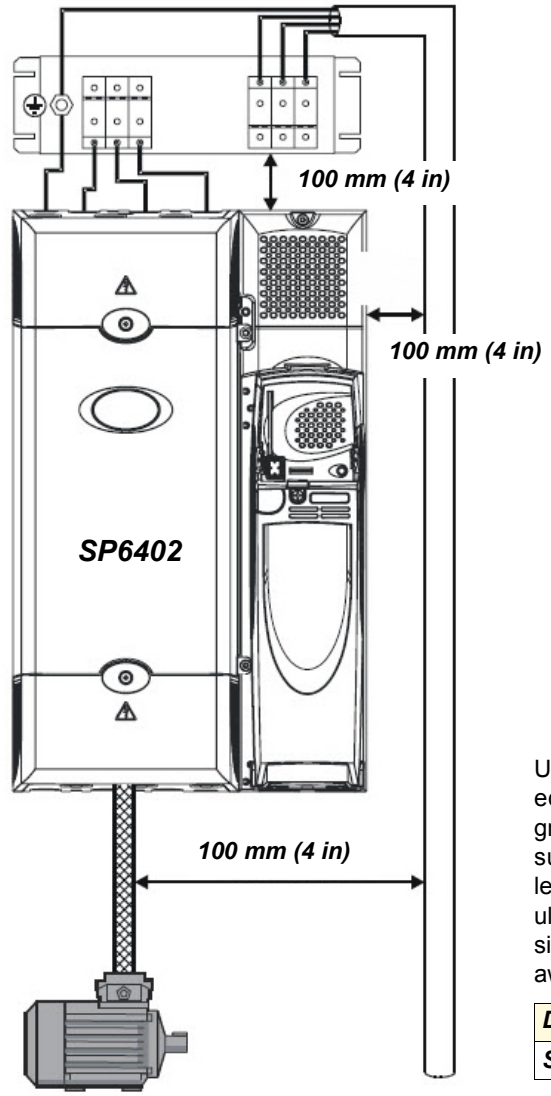
**WARNING.**
AC supply of the drive must have fuses with the values shown in the technical data tables at the beginning of this appendix or the right protection against overload and short-circuits. Fire may be caused when not following these recommendations meticulously.

## Connection of external EMC filters

Variable speed drives are powerful electronic circuits that can cause electromagnetic interference if proper wiring is not carefully done during installation. Just take some precautions to prevent interference with industrial control units around. It is a must to respect the strict emission limits or take all the protections possible when knowing that there are other units sensitive to electromagnetic waves nearby. The drive has an internal EMF filter that reduces emissions under specific conditions. Extreme conditions may require an external EMC filter at the drive inputs that must be installed as close to the drives as possible. Besides room for the filters, certain distance is also required for independent wiring.



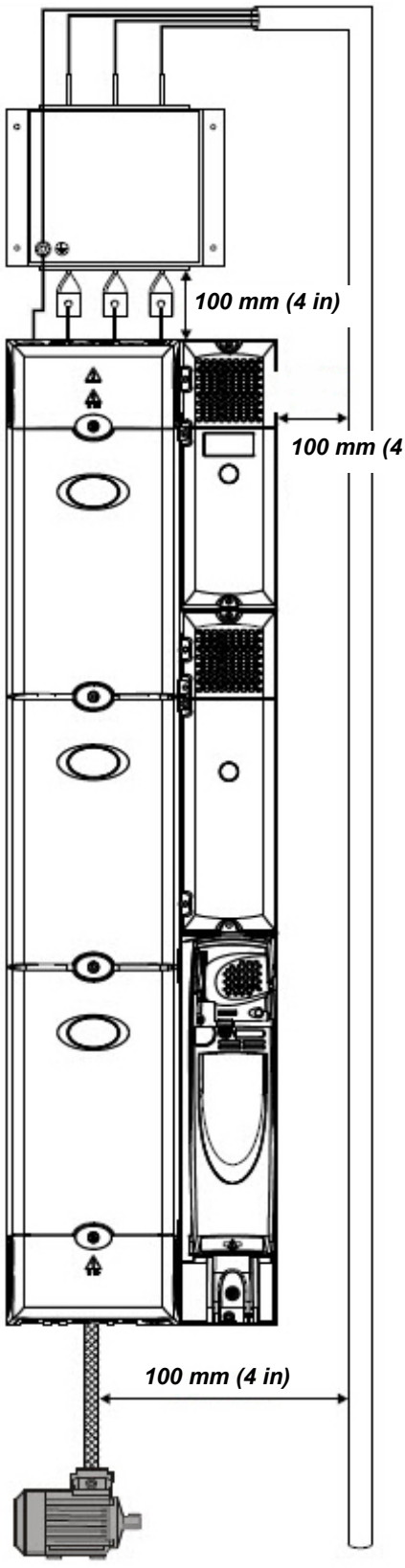
### SP6402 compact drive




Use the recommended filter and shielded motor cable. See the mounting diagram in the figure. Make sure that the AC supply cables and ground cable are at least 100 mm away from the power module and the motor cable. Place sensitive signal circuits more than 300 mm (12 in) away from the power module.

| *Drive* | *External mains filter* |
|---|---|
| ***SP6402*** | *4200-6603* |

## SPMD1403-1S modular drive (SPMD1403 + SPMC1402)




***SPMD1403-1S***

Use the recommended filter and shielded motor cable. See the mounting diagram in the figure. Make sure that the AC supply cables and ground cable are at least 100 mm away from the power module and the motor cable. Place sensitive signal circuits more than 300 mm (12 in) away from the power module.

| *Drive* | *External mains filter* |
|---|---|
| ***SPMD1403-1S*** | *4200-6315* |

## Connection of the line induction

Line inductance means including chokes on each of the three power lines. Its function is to reduce the harmonics generated in mains. The recommended value is given by the formula in (Y%):

$$L = \frac{Y}{100} \times \frac{V}{\sqrt{3}} \times \frac{1}{2\pi f I}$$

where:

| *Symb.* | *Description* | *Units* |
|---|---|---|
| ***I*** | *Input rated current of the drive* | *A* |
| ***L*** | *Inductance* | *H* |
| ***f*** | *Supply frequency* | *Hz* |
| ***V*** | *Voltage between lines* | *V* |

For an easier choice:

| *Drive* | *Line inductance* |
|---|---|
| ***SP6402*** | *IND SP6402* |

## Connection of the external braking resistors

Braking takes place when the drive decelerates the motor or prevents it from running at higher speed for mechanical reasons. While braking, the energy of the motor returns to the drive. When the drive brakes the motor, the drive can absorb a maximum amount of regenerated power equivalent to its energy dissipating (loss) capability. When the power generated is likely to be greater than the losses, the DC bus voltage of the drive increases. In case of malfunction, the drive brakes the motor using the PI control that extends the deceleration time to prevent the DC voltage to rise above the reference value set by the user. If the drive is supposed to lower the speed of a load or retain an overhauling load, a braking resistor will have to be installed. The table shows the DC voltage at which the drive activates the braking transistor.

| *Rated voltage of the drive* | *DC bus voltage* |
|---|---|
| *400 V* | *780 V* |

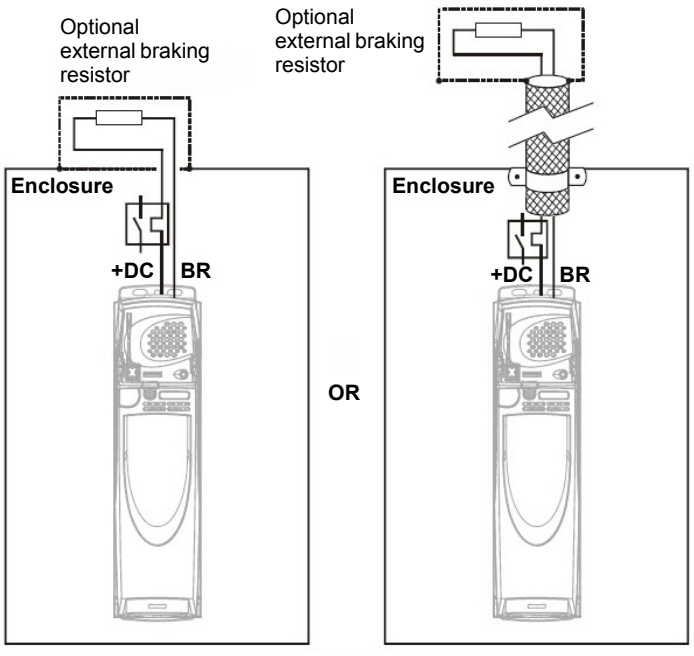
**WARNING.**
**Protection against overload**
When using an external braking resistor, an overload protection device must be installed in the circuit of the resistor.

If the braking resistor is to be mounted outside the enclosure, make sure to use a ventilated metal frame for these purposes:

- Avoid accidental contact with the resistor.
- Allow proper ventilation for the resistor.

When having to comply with EMC regulations, the cable used in external connections must be shielded because it sticks out of the metal enclosure. Internal connections do not require shielded cables.

### SP6402 compact drive

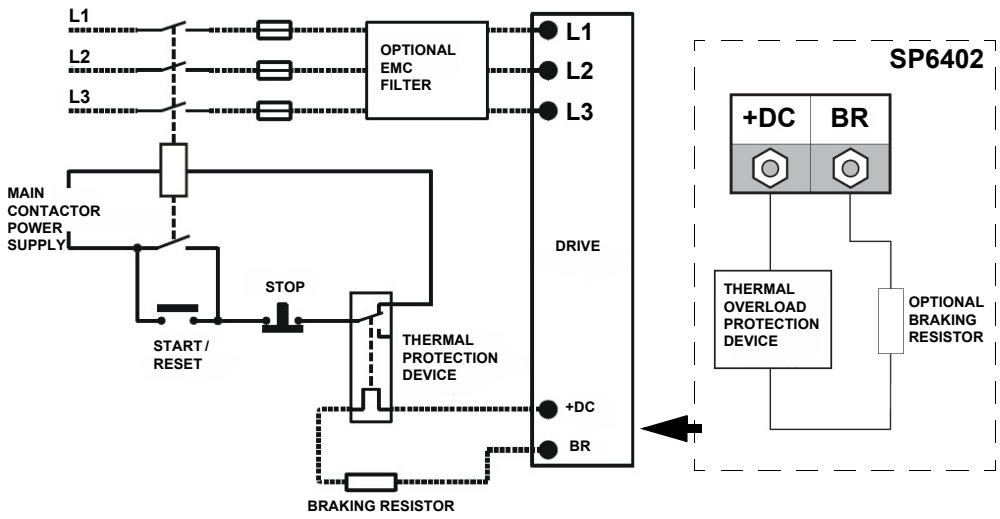



Connecting unshielded cables to optional braking resistors is allowed as long as the cables are not run outside the enclosure. Make sure to leave a minimum gap of 300 mm (12 in) from the signal cables and the AC supply cables to the external EMC filter. If no gap is possible, the cables will have to be shielded.

**Minimum resistance and rated power. Models associated with the drives**

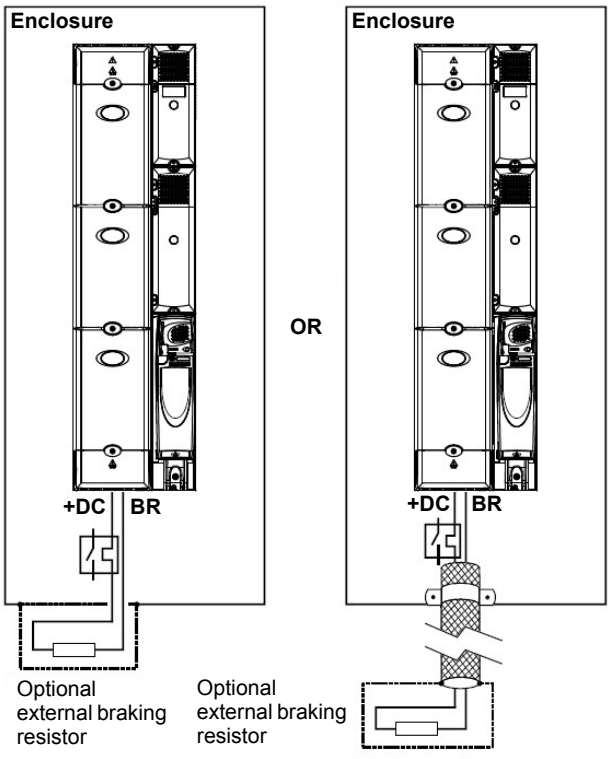
| *Drive* | *External Ballast resistor* | | | |
|---|---|---|---|---|
| | *Min. braking resistance* | *RMS power* | *Sealing degree* | *Model* |
| ***SP6402*** | *5.0 Ω* | *11 kW* | *IP 29* | ***RE/PR5R-11000*** |
| ***SP6402*** | *5.0 Ω* | *33 kW* | *IP 29* | ***RE/PR5R-33000*** |

### Typical protection circuit of the braking resistor




The thermal protection circuit must disconnect the AC supply of the drive when the resistor overloads due to a malfunction.

## SPMD1403-1S modular drive (SPMD1403 + SPMC1402)



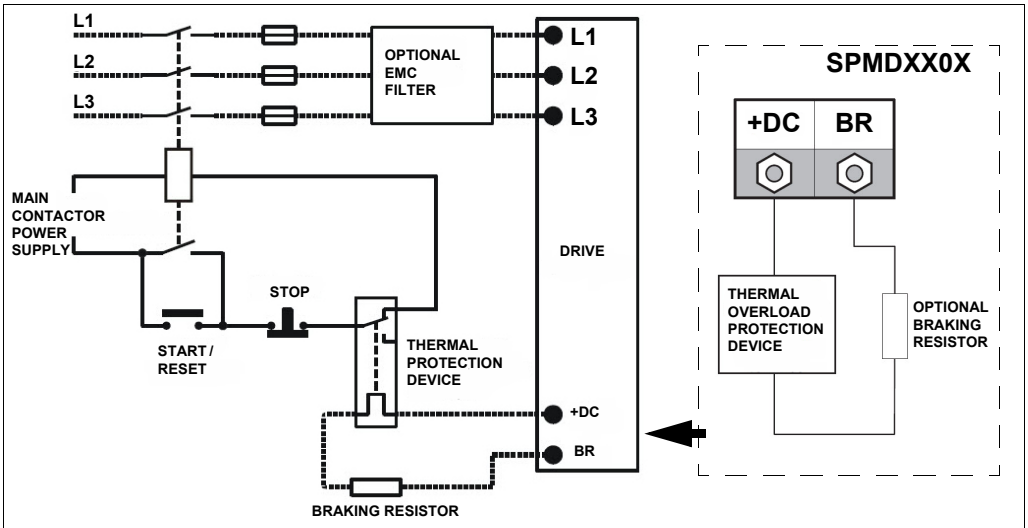

Connecting unshielded cables to optional braking resistors is allowed as long as the cables are not run outside the enclosure. Make sure to leave a minimum gap of 300 mm (12 in) from the signal cables and the AC supply cables to the external EMC filter. If no gap is possible, the cables will have to be shielded.

### Minimum resistance and rated power. Models associated with the drives

| *Drive* | *External Ballast resistor* | | | |
|---|---|---|---|---|
| | *Min. braking resistance* | *RMS power* | *Sealing degree* | *Model* |
| *SPMD1403-1S* | *3.8 Ω* | *13.2 kW* | *IP 29* | *RE/PR3.8R-13200* |
| *SPMD1403-1S* | *3.8 Ω* | *40.0 kW* | *IP 29* | *RE/PR3.8R-40000* |

6.

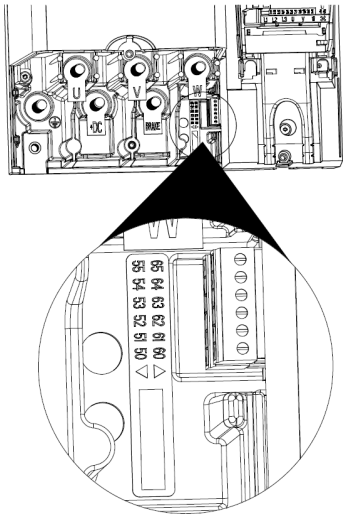
**Typical protection circuit of the braking resistor**

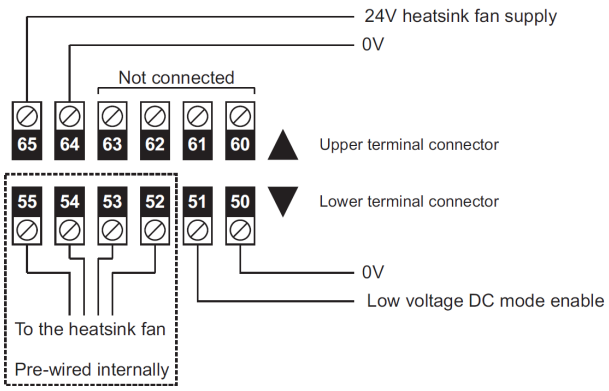



The thermal protection circuit must disconnect the AC supply of the drive when the resistor overloads due to a malfunction.

## Connection of the heatsink fan supply

The heatsink fan of the **SP6402** compact drive and that of the **SPMD1403** modular drive require an external 24 V DC power supply. The heatsink fan supply is connected at the top terminal block near the W phase output of the drive. The following figure shows the location of the heatsink fan supply connections.






The supply requirements for the heatsink fan are:

Rated voltage: 24.0 V DC
Minimum voltage: 23.5 V DC
Maximum voltage: 27.0 V DC
Current demand:
**SP6402:** 3.3 A
**SPMD1403:** 4.5 A
Recommended supply:
**SP6402:** 24 V, 100 W, 4.5 A
**SPMD1403:** 24 V, 120 W, 5 A
Recommended fuse:
**SP6402:** 4 A fast ($I^2t$ less than 20 $A^2s$)
**SPMD1403:** 6.3 A fast ($I^2t$ less than 100 $A^2s$)

**Note.** A 1 mm² (16 AWG) cable should be used to supply the heatsink fan.

## Connection of 24 V DC control supply

The 24 V DC input of the **SP6402** compact drive and that of the **SPMD1403** modular drive has three functions:

- It can be used to supplement the drive's own internal 24 V DC when several modules are being used and the current drawn by these modules is greater than the drive can supply. If too much current is drawn from the drive, the drive will initiate a 'PS.24 V' trip
- It can be used as a back-up power supply to keep the control circuits of the drive powered up when the line power supply is removed. This allows any fieldbus modules, application modules, encoders or serial communications to continue to run.
- It can be used to commission the drive when line power voltage is not available, as the display operates correctly. However, the drive will be in the UV trip state unless either line power or low voltage DC operation is enabled, therefore diagnostics may not be possible. Power down save parameters are not saved when using the 24 V back-up power supply input.

The working voltage range of the 24 V power supply is as follows:

- Max./min. continuous operating voltage: 30.0/19.2 V
- Nominal operating voltage: 24.0 V
- Minimum start up voltage: 21.6 V
- Maximum power supply requirement at 24 V DC: 60 W
- Maximum continuous operating voltage: 30.0 V
- Recommended fuse: 3 A, 50 V DC.

Minimum and maximum voltage values include ripple and noise. Ripple and noise values must not exceed 5 %.

**MANDATORY.**
A 1 mm² cable should be used to for the 24 V DC control supply.

## Connection of low voltage DC power supply

The **SP6402** compact drive and the **SPMD1403** modular drive can be operated from low voltage DC supplies, nominally 24 V DC (control) and 48 V DC (power). The low voltage DC power operating mode is designed either, to allow for motor operation in an emergency back-up situation following failure of the AC supply, for example in elevators; or to limit the speed of a servo motor during commissioning, for example a robot cell.

The working voltage range of the low voltage DC power supply is as follows:

- Min. continuous operating voltage: 36.0 V
- Nominal operating voltage: 48.0 V
- Max. braking IGBT turn on voltage: 127.2 V
- Max. over voltage trip threshold: 139.2 V

Minimum and maximum voltage values include ripple and noise. Ripple and noise values must not exceed 5 %.

**MANDATORY.**
A 1 mm² (16 AWG) cable should be used to activate the low voltage mode.

# Connection of control and communication signals

## Control connections

### SP6402 compact drive

#### General

| Function | Qty | Available control parameters | Terminal Nr. |
|---|---|---|---|
| **Differential analog input** | 1 | Destination, offset, offset trim, invert, scaling | 5, 6 |
| **Single ended analog input** | 2 | Mode, offset, scaling, invert, destination | 7, 8 |
| **Analog output** | 2 | Source, mode, scaling | 9, 10 |
| **Digital input** | 3 | Destination, invert, select logic | 27, 28, 29 |
| **Digital input/output** | 3 | Input / output mode select, destination / source, invert, logic select | 24, 25, 26 |
| **Relays** | 1 | Source, invert | 41, 42 |
| **Turn drive on (safe turn-off)** | 1 | | 31 |
| **+10 V user output** | 1 | | 4 |
| **+24 V user output** | 1 | Source, invert | 22 |
| **Common at 0 V** | 6 | | 1, 3, 11, 21, 23, 30 |
| **+24 V external input** | 1 | | 2 |

**Destination parameter.** Indicates the parameter that is being controlled by the terminal or function

**Source parameter.** Indicates the parameter being output by the terminal.

**Mode parameter.** **Analog.** Indicates the mode of operation of the terminal, e.g. voltage 0-10 V, current 4-20 mA etc.
**Digital.** Indicates the mode of operation of the terminal, e. g. positive / negative logic (the Drive Enable terminal is fixed in positive logic), open collector.

Note that all analog terminal functions can be programmed in menu 7 and all digital terminal functions (including the relay) can be programmed in menu 8 from the application for PC: CTSoft.

**WARNING.**
The control circuits are isolated from the power circuits in the drive by basic insulation (single insulation) only. The installer must ensure that the external control circuits are insulated from human contact by at least one layer of insulation (supplementary insulation) rated for use at the AC supply voltage.

**WARNING.**
If the control circuits are to be connected to other circuits classified as Safety Extra Low Voltage (SELV) (e.g. to a personal computer), an additional isolating barrier must be included in order to maintain the SELV (Separated or **S**afety **E**xtra-**L**ow **V**oltage). classification.

**WARNING.**
If any of the digital inputs or outputs (including the drive enable input) are connected in parallel with an inductive load (i.e. contactor or motor brake) then suitable suppression (i.e. diode or varistor) should be used on the coil of the load. If no suppression is used then over voltage spikes can cause damage to the digital inputs and outputs on the drive.

**WARNING.**
Ensure the logic sense is correct for the control circuit to be used. Incorrect logic sense could cause the motor to be started unexpectedly. Positive logic is the default state for the SP6402.

## Notes

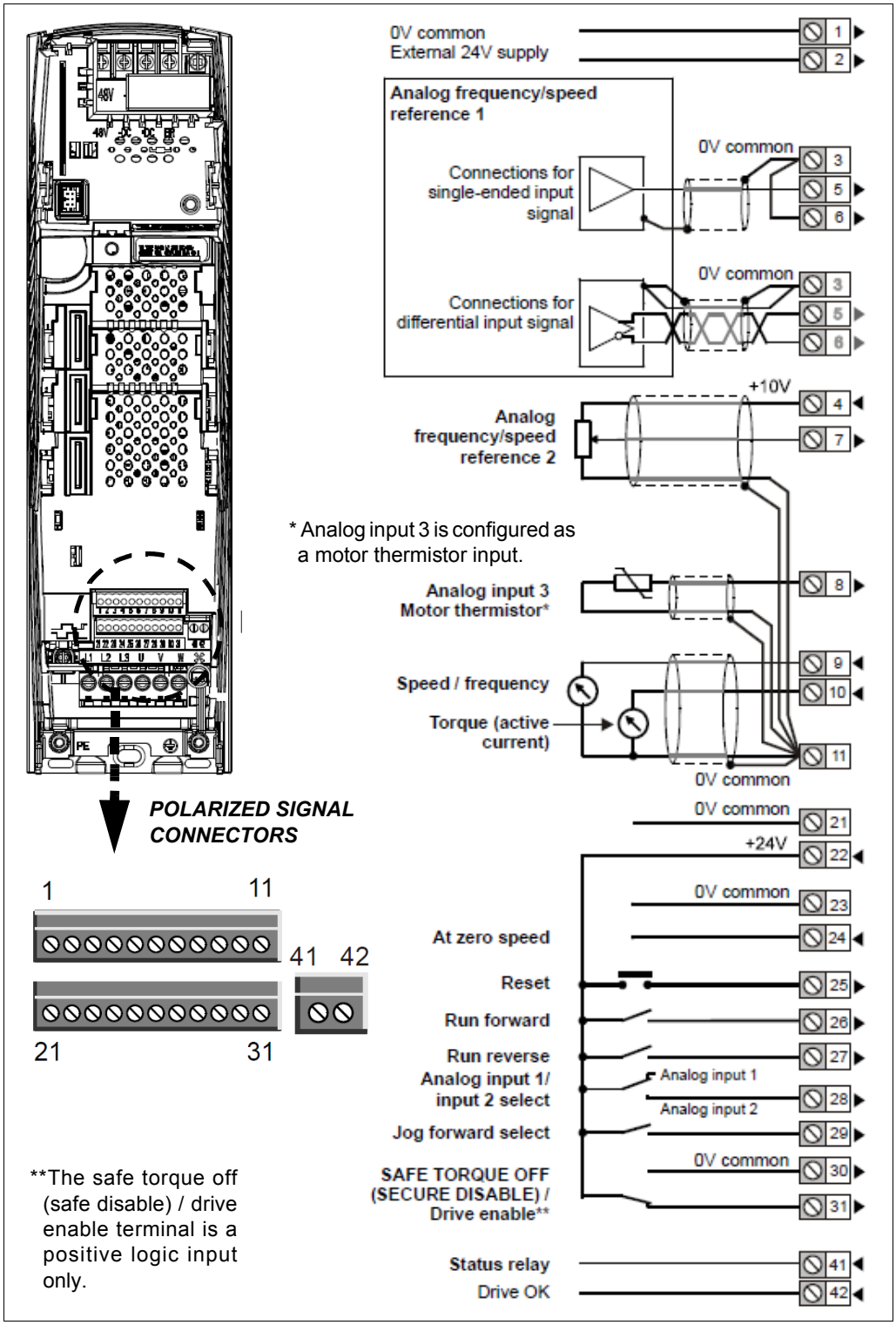
Any signal cables which are carried inside the motor cable will pick up large pulse currents via the cable capacitance. The shield of these signal cables must be connected to ground close to the point of exit of the motor cable, to avoid this noise current spreading through the control system.

The safe torque off (safe disable) / drive enable terminal is a positive logic input only. It is not affected by the setting of the positive logic select parameter.

The common 0 V from analog signals should, wherever possible, not be connected to the same 0 V terminal as the common 0 V from digital signals. Terminals 3 and 11 should be used for connecting the 0 V common of analog signals and terminals 21, 23 and 30 for digital signals. This is to prevent small voltage drops in the terminal connections causing inaccuracies in the analog signals.



## Default terminal functions



## Specifications of the control terminals

| | |
|---|---|
| ***1*** | ***Common at 0 V*** |
| ***Function*** | *Common connection for all external devices* |
| ***2*** | ***+24 V external input*** |
| ***Function*** | *Control circuit supply without supplying current to the power phase* |
| *Rated voltage* | *+ 24.0 V DC* |
| *Min. continuous operating voltage* | *+ 19.2 V DC* |
| *Max. continuous operating voltage* | *+ 30.0 V DC* |
| *Min. start up voltage* | *21.6 V DC* |
| *Recommended power supply* | *60 W, 24 V DC nominal* |
| *Recommended fuse* | *3 A, 50 V DC* |
| ***3*** | ***Common at 0 V*** |
| ***Function*** | *Common connection for all external devices* |
| ***4*** | ***+10 V user output*** |
| ***Function*** | *Supply for external analog devices* |
| *Voltage tolerance* | *± 1%* |
| *Nominal output current* | *10 mA* |
| *Protection* | *Current limit and trip at 30 mA* |
| | ***Precision reference Analog input 1*** |
| ***5*** | ***Non-inverting input*** |
| ***6*** | ***Inverting input*** |
| ***Default function*** | *Frequency/speed reference* |
| *Type of input* | *Bipolar differential analog*<br>*(For single-ended use, connect terminal 6 to terminal 3)* |
| *Full scale voltage range* | *± 9.8 V ± 1 %* |
| *Absolute maximum voltage range* | *± 36 V relative to 0 V* |
| *Working common mode voltage range* | *± 13 V relative to 0 V* |
| *Input resistance* | *100 kΩ ± 1%* |
| *Resolution* | *16-bit plus sign (as speed reference)* |
| *Monotonic* | *Yes (including 0 V)* |
| *Dead band* | *None (including 0 V)* |
| *Jumps* | *None (including 0 V)* |
| *Maximum offset* | *700 µV* |
| *Maximum non linearity* | *0.3 % of input* |
| *Maximum gain asymmetry* | *0.5 %* |
| *Input filter bandwidth single pole* | *~1 kHz* |
| ***7*** | ***Analog input 2*** |
| ***Default function*** | *Frequency/speed reference* |
| ***Operating in Voltage mode*** | |
| *Full scale voltage range* | *± 9.8 V ± 3 %* |
| *Maximum offset* | *± 30 mV* |
| *Absolute maximum voltage range* | *± 36 V relative to 0 V* |
| *Input resistance* | *> 100 kΩ* |
| ***Operating in current mode*** | |
| *Current ranges* | *0 to 20 mA ± 5 %, 20 to 0 mA ± 5 %*<br>*4 to 20 mA ± 5 %, 20 to 4 mA ± 5 %* |
| *Maximum offset* | *250 µA* |
| *Absolute max. voltage (reverse bias)* | *- 36 V max.* |
| *Absolute max. current* | *+ 70 mA* |
| *Equivalent input resistance* | *Not greater than 200 Ω at 20 mA* |

| | |
|---|---|
| ***Common to all models*** | |
| *Resolution* | *10 bits + signal* |
| ***8*** | ***Analog input 3*** |
| ***Default function*** | *Motor temperature sensor input* |
| *Type of input* | *Bipolar single-ended analog voltage, unipolar current or motor thermistor input* |
| ***Operating in voltage mode (by default)*** | |
| *Voltage range* | *± 9.8 V ± 3 %* |
| *Maximum offset* | *± 30 mV* |
| *Absolute maximum voltage range* | *± 36 V relative to 0 V* |
| *Input resistance* | *> 100 kΩ* |
| ***Operating in current mode*** | |
| *Current ranges* | *0 to 20 mA ± 5 %, 20 to 0 mA ± 5 %*<br>*4 to 20 mA ± 5 %, 20 to 4 mA ± 5 %* |
| *Maximum offset* | *250 µA* |
| *Absolute max. voltage (reverse bias)* | *- 36 V max.* |
| *Absolute max. current* | *+ 70 mA* |
| *Equivalent input resistance* | *Not greater than 200 Ω at 20 mA* |
| ***Operating in motor thermistor input mode*** | |
| *Internal pull-up voltage* | *< 5 V* |
| *Trip threshold resistance* | *3.3 kΩ ± 10 %* |
| *Reset resistance* | *1.8 kΩ ± 10 %* |
| *Short-circuit detection resistance* | *50 Ω ± 30 %* |
| ***Common to all models*** | |
| *Resolution* | *10 bits + signal* |

Analog input T8 3 has a parallel connection with pin 15 of the drive encoder connector.

| | |
|---|---|
| ***9*** | ***Analog output 1*** |
| ***10*** | ***Analog output 2*** |
| ***Default function of pin 9*** | *OL > Motor frequency output signal*<br>*CL > Speed output signal* |
| ***Default function of pin 10*** | *Active motor current* |
| *Output type* | *Bipolar single-ended analog voltage or unipolar current* |
| ***Operating in voltage mode (by default)*** | |
| *Voltage range* | *± 9.6 V ± 5 %* |
| *Maximum offset* | *100 mV* |
| *Maximum output current* | *± 10 mA* |
| *Load impedance* | *1 kΩ min.* |
| *Protection* | *35 mA max. Protection against short-circuit* |
| ***Operating in current mode*** | |
| *Current ranges* | *0 to 20 mA ± 10 %*<br>*4 to 20 mA ± 10 %* |
| *Maximum offset* | *600 µA* |
| *Max. voltage without load* | *+ 15 V* |
| *Max. load impedance* | *15 Ω* |
| ***Common to all models*** | |
| *Resolution* | *10 bits + signal in voltage mode* |
| ***11*** | ***Common at 0 V*** |
| ***Function*** | *Common connection for all external devices* |
| ***21*** | ***Common at 0 V*** |
| ***Function*** | *Common connection for all external devices* |

| | |
|---|---|
| ***22*** | ***User output + 24 V (selectable)*** |
| ***Function (by default)*** | *+ 24 V user output* |
| *Programmability* | *Can be switched on or off to act as a fourth digital output (positive logic only) by setting the source parameter and source invert.* |
| *Nominal output current* | *200 mA (including all digital I/O)* |
| *Maximum output current* | *240 mA (including all digital I/O)* |
| *Protection* | *Current limit and trip* |
| ***23*** | ***Common at 0 V*** |
| ***Function*** | *Common connection for all external devices* |
| ***24*** | ***Digital I/O 1*** |
| ***25*** | ***Digital I/O 2*** |
| ***26*** | ***Digital I/O 3*** |
| ***Terminal 24 default function*** | *AT ZERO SPEED output* |
| ***Terminal 25 default function*** | *DRIVE RESET input* |
| ***Terminal 26 default function*** | *RUN FORWARD input* |
| *Type* | *Positive or negative logic digital inputs, positive or negative logic push-pull outputs or open collector outputs* |
| ***Operating as an input*** | |
| *Absolute maximum applied voltage range* | *± 30 V* |
| *Load* | *< 2 mA at 15 V DC* |
| *Input thresholds* | *10.0 V (320 ºF) ± 0.8 V* |
| ***Operating as an output*** | |
| *Nominal maximum output current* | *200 mA (total including terminal 22)* |
| *Maximum output current* | *240 mA (total including terminal 22)* |
| ***Common to all models*** | |
| *Voltage range* | *0 to + 24 V* |
| ***27*** | ***Digital input 4*** |
| ***28*** | ***Digital input 5*** |
| ***29*** | ***Digital input 6*** |
| ***Terminal 27 default function*** | *RUN REVERSE input* |
| ***Terminal 28 default function*** | *Analog INPUT 1 / INPUT 2 select* |
| ***Terminal 29 default function*** | *JOG SELECT input* |
| *Type* | *Negative or positive logic digital inputs* |
| *Voltage range* | *0 to + 24 V* |
| *Absolute maximum applied voltage range* | *± 30 V* |
| *Load* | *< 2 mA at 15 V DC* |
| *Input thresholds* | *10.0 V (320 ºF) ± 0.8 V* |
| ***30*** | ***Common at 0 V*** |
| ***Function*** | *Common connection for all external devices* |
| ***31*** | ***Drive enable (SAFE TORQUE OFF - SAFE DISABLE -*** |
| *Type* | *Positive logic only digital input* |
| *Voltage range* | *0 to + 24 V* |
| *Absolute maximum applied voltage range* | *± 30 V* |
| *Thresholds* | *18.5 V (320 ºF) ± 0.5 V* |

The drive enable terminal (T31) provides a SAFE TORQUE OFF (SAFE DISABLE) function. It meets the requirements of EN954-1 category 3 for the prevention of unexpected starting of the drive. It may be used in a safety-related application in preventing the drive from generating torque in the motor to a high level of integrity.

| | |
|---|---|
| ***41*** | ***Relay contacts*** |
| ***42*** | |

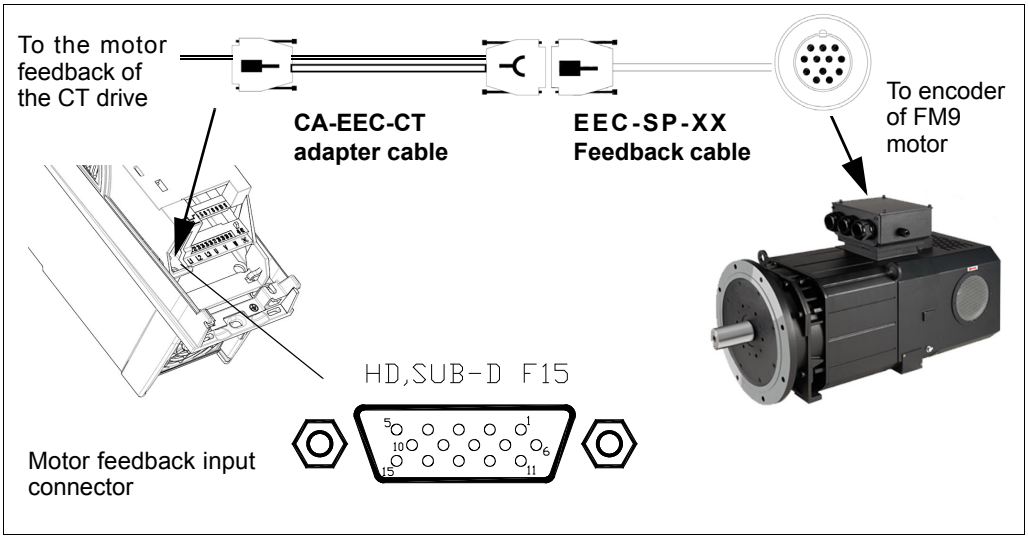
| | |
|---|---|
| ***Default function*** | *Drive OK indicator* |
| *Contact voltage rating* | *240 V AC, Installation over-voltage category II* |
| *Contact maximum current rating* | *2 A, 240 V AC*<br>*4 A, 30 V DC resistive load*<br>*0.5 A, 30 V DC inductive load (L/R = 40 ms)* |
| *Contact minimum recommended rating* | *12 V, 100 mA* |
| *Contact type* | ***N**ormally **O**pen (N. O.)* |
| *Default contact condition* | *Closed when power applied and drive OK is ok.* |
| *Update period* | *4 ms* |

**MANDATORY.**
A fuse or other over-current protection should be installed in the relay circuit.

6.

### Motor feedback connection

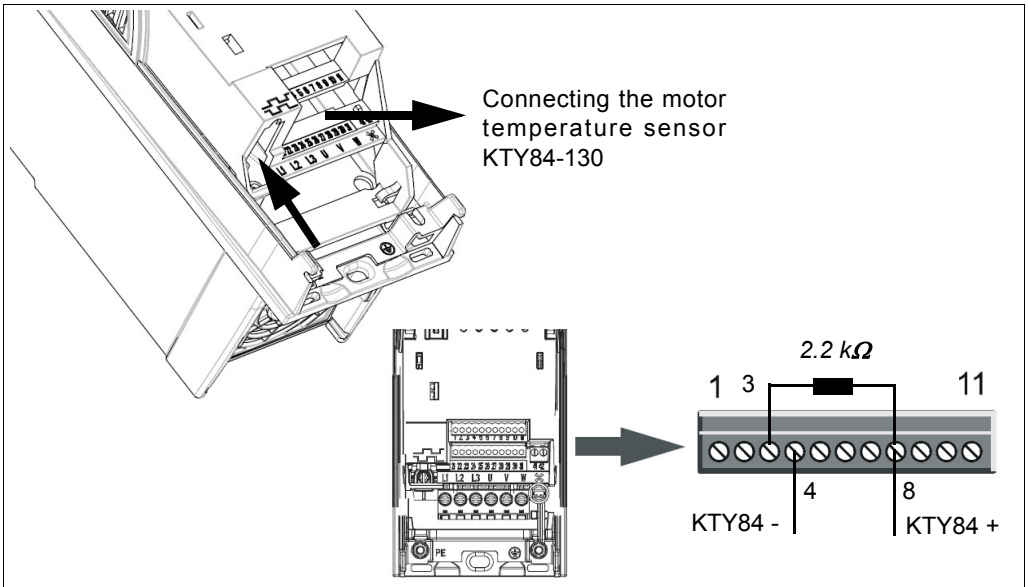
The motor feedback of FM9 spindles to be governed by CT servo drives is a sinusoidal encoder. The connection must be made between the connector of the motor feedback and the 15-pin HD Sub-D, F15 female connector of the drive through the EEC-SP feedback cable together with a CA-EEC-CT adapter cable. See figure.




For further detail on the cables supplied by FAGOR for connecting the motor feedback, see chapter on "cables". The technical data for the FM9 motor feedback connector is shown in the corresponding motor manual.

### Connection of the terminals of the temperature sensor KTY84-130

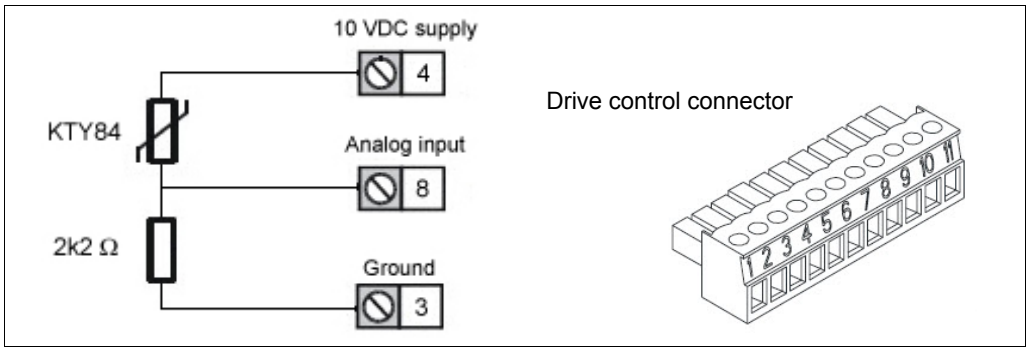
The two wires of the KTY84-130 coming from the **CA-EEC-CT** adapter cable must be connected as shown in the following figure:




**Note.** Both wires (KTY84- and KTY84+) come from the feedback adapter cable. Watch the polarity as shown in the figure when making the connection. Refer to the diagram of the adapter cable shown earlier.

Take the 2 wires for the temperature sensor (KTY84 - and KTY84+) coming from the feedback adapter cable to pins 4 and 8 respectively of the 11-pin control connector. Also install a standard 2.2 kΩ resistor between pins 3 and 8 of this connector.

The temperature sensor KTY84 -130 (located next to the FAGOR motor winding) must be connected to the drive through a voltage divider. Remember to install an external 2.2 kΩ resistor.






### Motor over-temperature alarm parameter setting

Set parameter 00.21 (analog input mode T8 3) to "Volt" and set "th" (thermistor) as default value. This way, the analog input becomes a general purpose input and is no longer the thermistor input.

### Generating the motor over-temperature alarm

With the connection shown, when the motor temperature reaches 130 ºC (266 ºF), the voltage at pin 8 goes down to 6.7 V. When a lower voltage is reached, it generates a motor over-temperature alarm and the display of the drive shows it as "external trip".

To set the motor over-temperature alarm, set the parameters of the drive as shown next.

### Parameter settings for the analog I/O

07.18 (Destination of analog input T8 3) = 0 (Source of threshold detector 1).

### Threshold detector parameter setting

12.03 (Source of threshold detector 1) = 07.03 (Destination of analog input T8 3)

12.04 (Threshold detector 1, threshold level) = 67 %

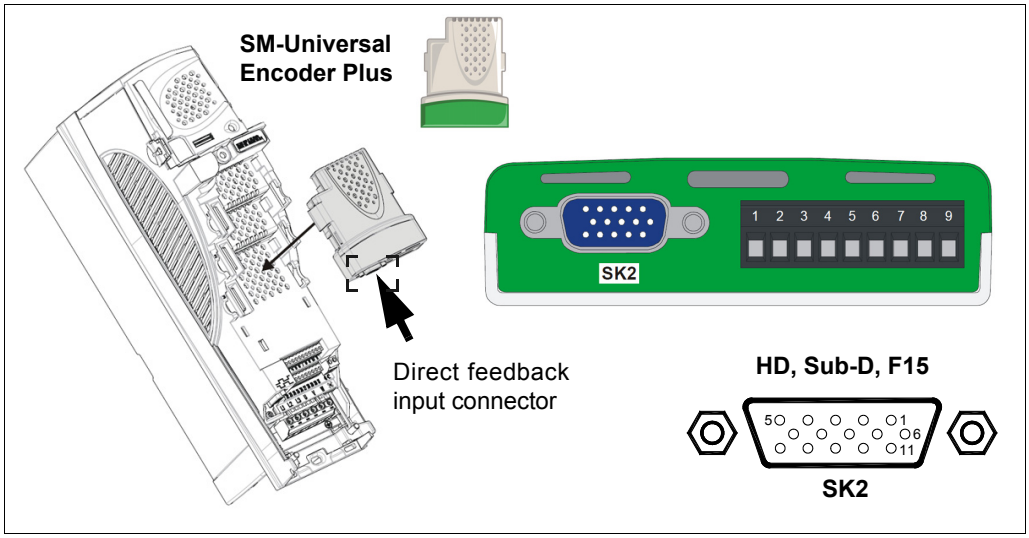
12.05 (Threshold detector 1 hysteresis) = 3 to 5 %

12.06 (Threshold detector 1, output invert) = 1 (On) (to detect lower levels than the threshold voltage)

12.07 (Threshold detector 1 destination) = 10.32 (External trip)

### Direct feedback connection

There are two types of direct feedback: Either with external incremental feedback device or with external absolute feedback device. The drive must have the solutions module **SM-Universal Encoder Plus** installed. The connection between the external linear or rotary encoder and the female, 15-pin HD, Sub-D, **SK2** connector of this solution module must be made through the direct feedback cable and its corresponding adapter. See figure to locate the connector on the unit.

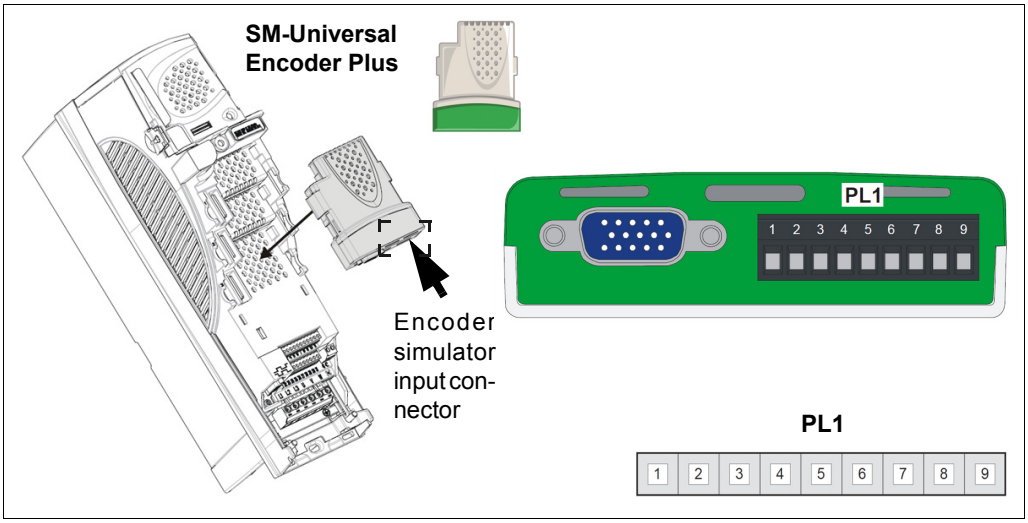



For further detail on the cable and adapter used to connect the direct feedback, see the chapter on "cables".

6.

## Encoder simulator connection

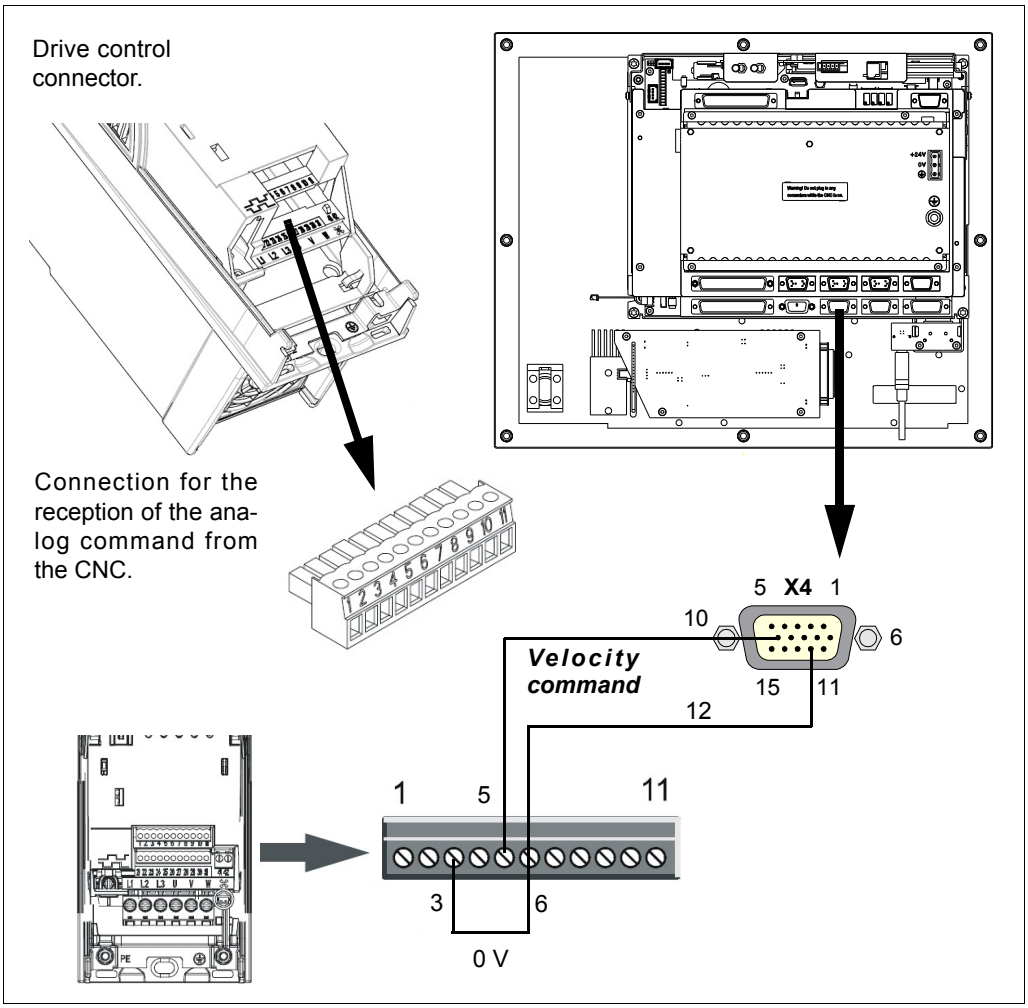
When the motor feedback is a sinusoidal encoder, the drive can generate a set of signals that simulate those of a differential TTL encoder attached to the rotor of the motor. The drive must have the solutions module **SM-Universal Encoder Plus** installed. The connection between the 8055 CNC (X1, X2, X3 or X4) / 8055i (X10, X11, X12 or X13) / 8065 / 8070 (Local Counter 1/2) and the 9-pin PL1 connector of the resolution module is done with the SEC-HD-CT cable of the encoder simulator. See figure  to locate the connector on the unit.




For further detail on the cable used to connect the encoder simulator, see the chapter on "cables".

## Connection for the reception of the analog command

The drive has an analog input in its 11-pin control connector to receive the analog velocity command from the CNC. (e.g. from connector X4 of the 8055i CNC).




FAGOR

CT

Ref.1509

## SERCOS ring connection

The SERCOS IEC 1491 interface is an international standard for digital communications between CNC's and servo drives of CNC machines.

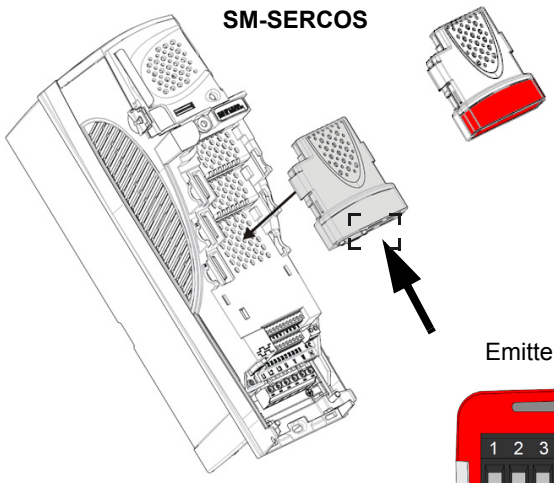
The SERCOS communication ring integrates several functions:

- It carries the velocity command from the CNC to the drive in digital format with greater accuracy and immunity against outside disturbances.
- It carries the feedback signal from the drive to the CNC.
- It communicates the errors and manages the basic control signals of the drive (enables).
- It allows setting, monitoring and diagnosis of the parameters from the CNC with simple and standard procedures.

All this drastically reduces the hardware required at the drive, hence, making it more reliable.

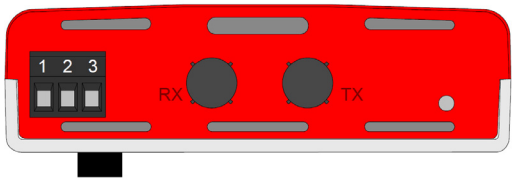
Its open standard structure provides compatibility between CNC's and servo systems from different manufacturers on the same machine.

The different drive modules and the CNC are connected through SERCOS connector of the solutions module **SM-SERCOS** through optic fiber. See the chapter on cables in this manual.




This connector consists of a SERCOS signal receiver and emitter (Rx, Tx) and may be used to connect the drive with the CNC that governs them. The connection is made through fiber optic lines and it has a ring structure.

Emitter-receiver for SERCOS transmission




| *Pin* | *Function* | *Description* |
|---|---|---|
| ***1*** | *OV* | *0 V connection for digital I/O* |
| ***2*** | *DI/PO* | *Digital input 0* |
| ***3*** | *DI/P1* | *Digital input 1* |
| ***RX*** | *Rx data* | *Optic "receive" input* |
| ***TX*** | *Tx data* | *Optic "send" input* |

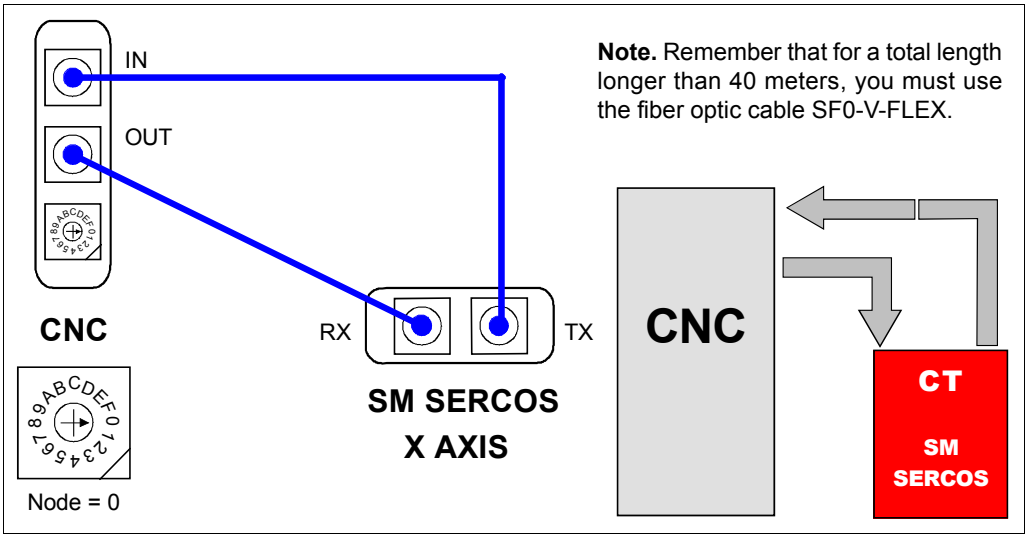
### Interconnection

Connect the drive to be governed by the CNC in the SERCOS ring.

- Connect on the fiber optic line, the Tx terminal of the drive with the IN terminal of the CNC.
- Connect the Rx terminal of the drive with the OUT terminal of the CNC.

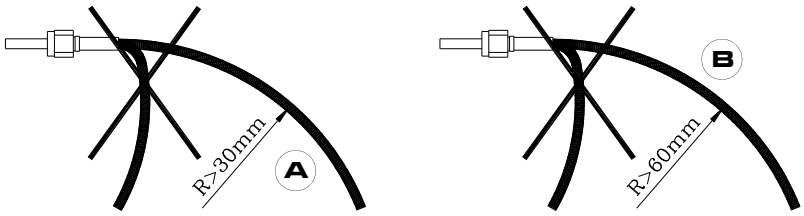
When all these connections have been made, the ring will be closed.

With each drive, FAGOR supplies a fiber optic line to connect it to the CNC and, upon request, the rest of the required optical fiber. See the chapter on cables.




**Note.** Remember that for a total length longer than 40 meters, you must use the fiber optic cable SF0-V-FLEX.

**WARNING.**
The bending radius of fiber optic cables SF0 and SF0-FLEX must always be more than 30 mm. For SF0-V-FLEX cables, this radius must be more than 60 mm.



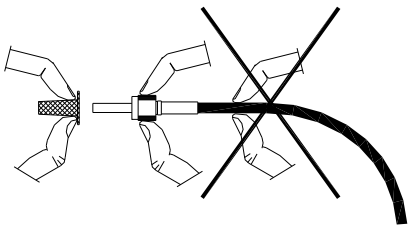

Minimum bending radius.
**A.** Fiber optic cables SF0 and SF0-FLEX. **B.** Fiber optic cable SF0-V-FLEX.

### Transmission speed (rate)

Meets class B. Speed, torque and position control modes supported at data speeds (bits/s): 2 MB, 4 MB, 8 MB and 16 MB. Minimum network cycle time of 250 µs. Two high-speed test digital inputs at 1µs for position capturing.

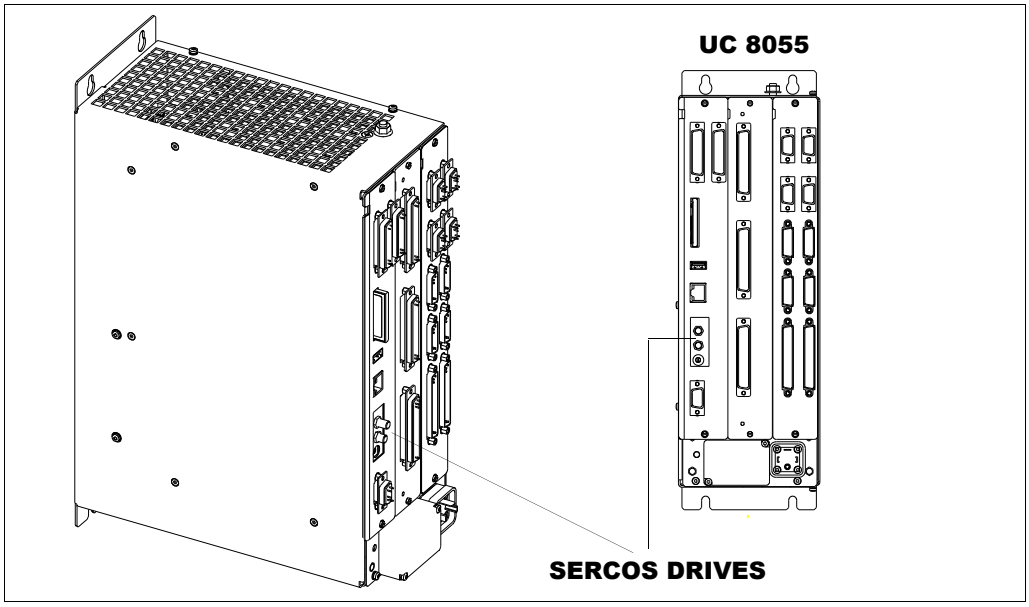
### Handling the optic fiber

FAGOR supplies the fiber optic cables with its terminals protected with a hood. Remove the terminal protecting hood before connecting any of these cables. Either to remove the terminal protecting hood or to connect and disconnect the cable, the cable must always be held by the terminal, never pull at the cable because it could get damaged. See figure.



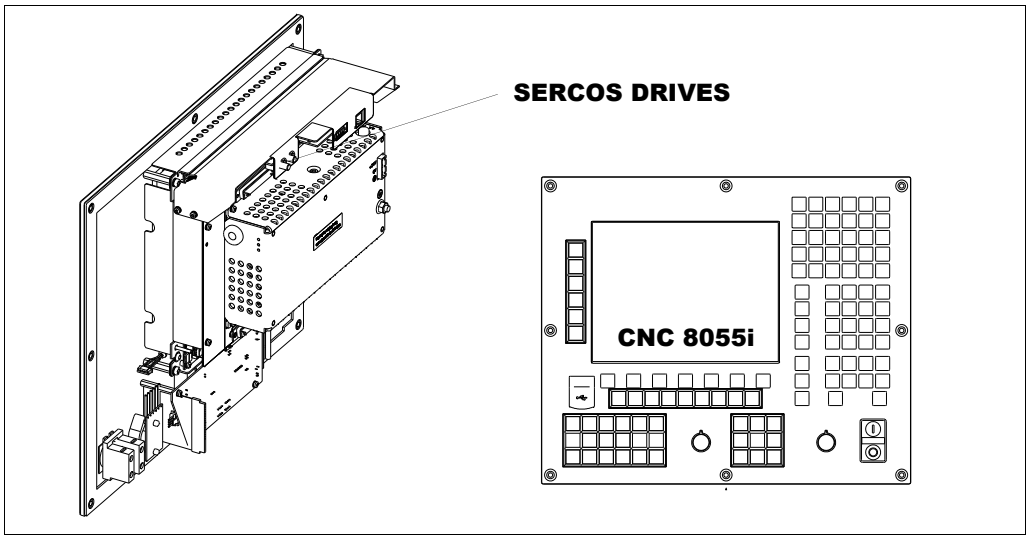
### SERCOS connection with a FAGOR UC 8055

A drive is connected to a FAGOR 8055 CNC via SERCOS through the SERCOS DRIVES connector located on the front panel of the Central Unit. See figure.



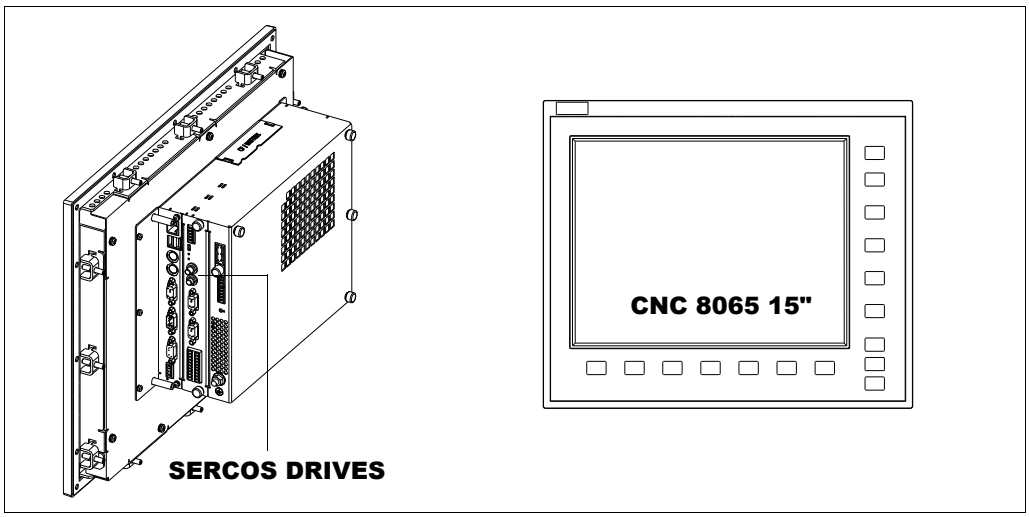

### SERCOS connection with a FAGOR 8055i CNC

The SERCOS connection of the FAGOR 8055i CNC will be made through the SERCOS DRIVES connector on the top rear of the module. See figure.




### SERCOS connection with a FAGOR 8065 CNC

A drive is connected to a FAGOR 8065 CNC via SERCOS through the SERCOS DRIVES connector located on the right side of the module. See figure.




FAGOR

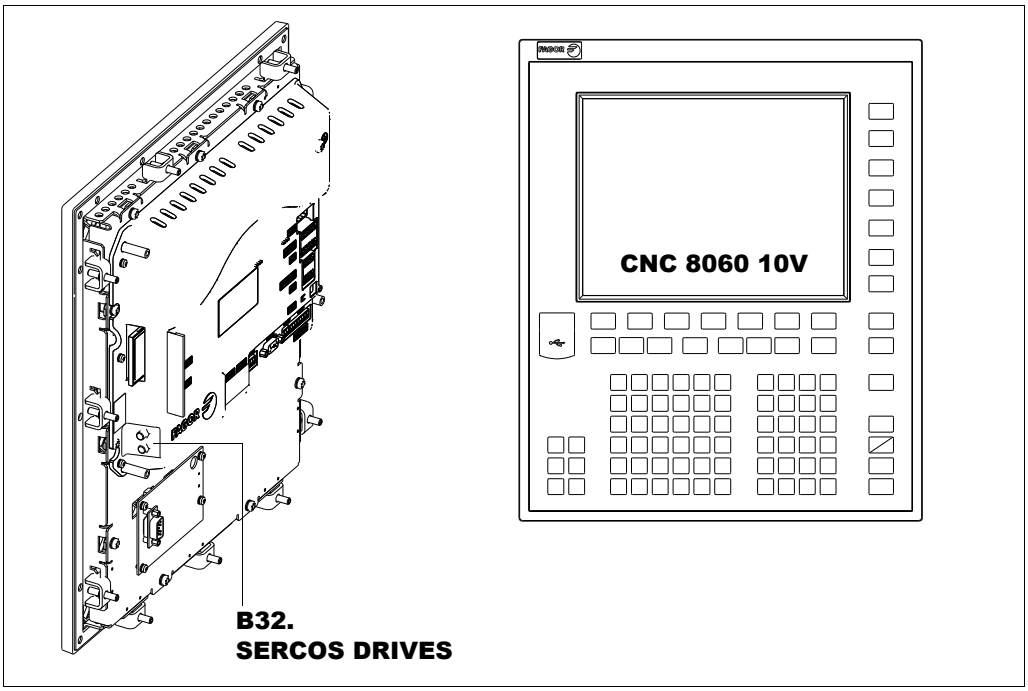
CT

Ref.1509

6.

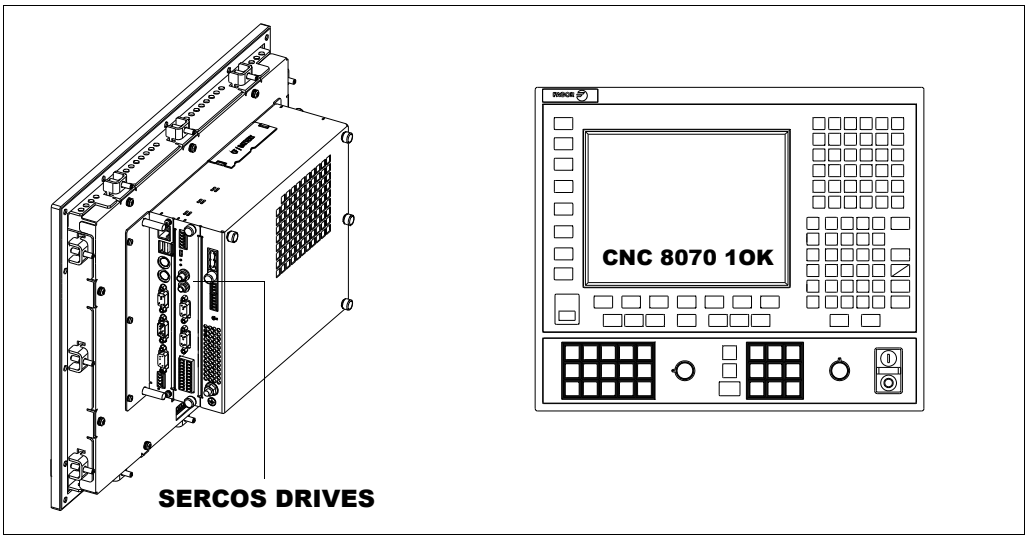
### SERCOS connection with a FAGOR 8060 CNC

A drive is connected to a FAGOR 8060 CNC via SERCOS through the SERCOS DRIVES (B32) connector located on the right side of the module. See figure.




### SERCOS connection with a FAGOR 8070 CNC

The FAGOR 8070 CNC is connected to the drives via SERCOS through the SERCOS DRIVES connector located on the right side of the module. See figure.




FAGOR

CT

Ref.1509

## RS-232 serial line connection between a PC and the drive

This connection is necessary in order to establish communication between the applications for PC: CTSoft (parameter setting) and CTScope (real time oscilloscope) and the drive. The purposes of these applications are:

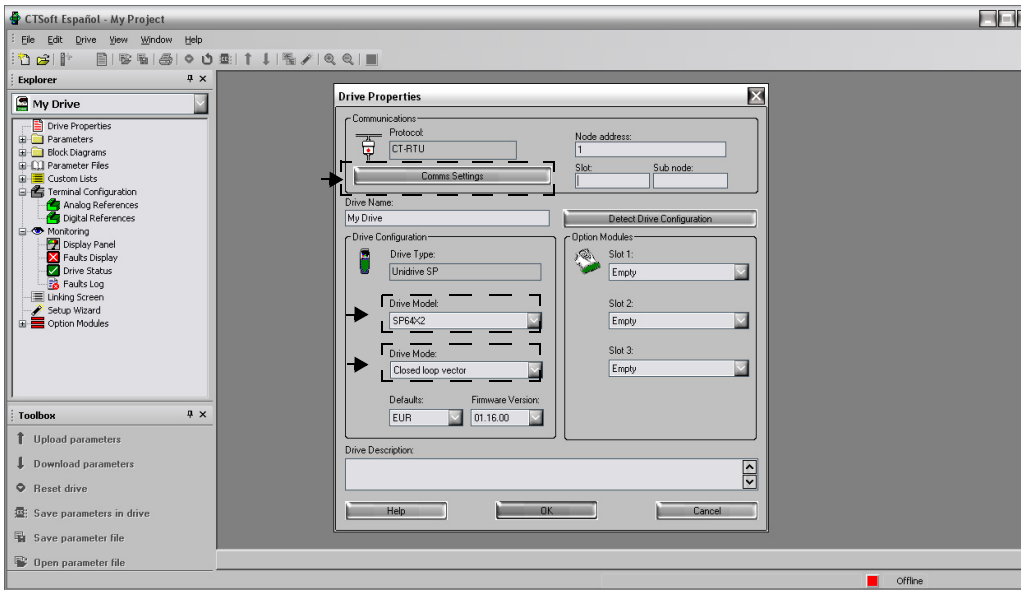
### CTSoft application

The **CTSoft** application for PC is a configuration tool for drive setup and commissioning as well drive optimizing and monitoring. It makes it possible to:

- Easily configure the drive through its help system.
- Read, save and load the configuration parameters of the drive.
- Manage drive data.
- Display and edit the configuration with animated diagrams.

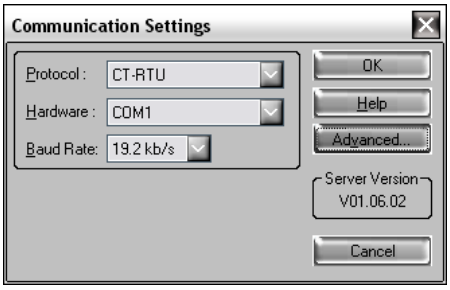
| |
|---|
| ***Note.*** *This can also be done via keyboard and the display on the unit.* |

**MANDATORY.**
After installing and running the CTSoft program on your PC, don't forget to select, in the drive's properties window, the type of drive (e.g. SP64x2) and the "vector closed loop" mode.




### Set up communication. Parameter setting

Communication setup must be done using the "communication options" button of the previous window.




Make sure that the selected COMx serial port is the right one.

Keep the default configuration for the rest of parameters.

Check that the "basic configuration" on the 0 menu matches the following parameters:

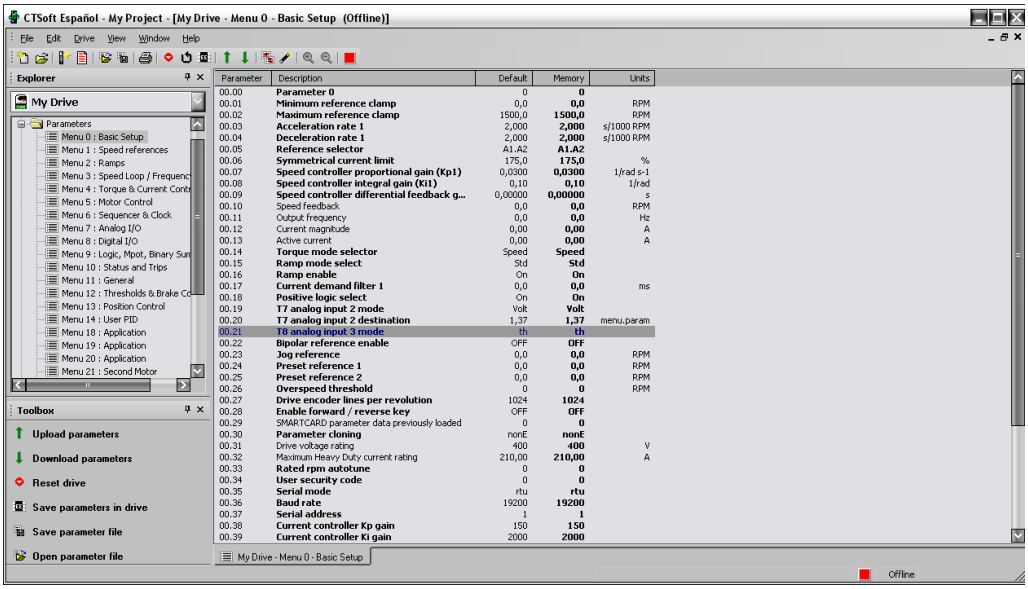
| *Parameter* | *Description* | *Values* |
|---|---|---|
| ***00,35*** | *Serial mode* | *rtu* |
| ***00,36*** | *Baudrate* | *19200* |
| ***00,37*** | *Serial address* | *1* |

Now see how to access the parameter menus.

6.

## Parameter setting

The parameters must be set before executing the autotuning and each parameter is accessed from the parameter menus in the side window.




## Motor parameter setting

| Parameter | Description |
|---|---|
| **00,44** | *(05.09) Nominal voltage* |
| **00,46** | *(05,07) Nominal motor current* |
| **00,47** | *(05,06) Nominal frequency* |
| **00,45** | *(05,08) Nominal speed* |
| **00,42** | *(05,11) Number of motor poles = 4* |

## Encoder parameter setting

| Parameter | Description |
|---|---|
| **03,38** | *Drive encoder type = 7 SC.Hiper (SinCos [sine-cosine] with Hyperface)* |
| **03,34** | *Lines per turn of the drive encoder = 1024* |
| **03,39** | *Drive encoder termination selection = 1* |
| **03,36** | *Drive encoder power supply voltage = 8 V* |

## Other parameter setting

| Parameter | Description |
|---|---|
| **00,02** | *(01,06) Maximum reference clamp. Maximum motor speed. At first, set it to a low value. Set it to the actual maximum speed of the motor after running the autotuning and make sure that the motor runs fine.* |
| **01,10** | *Bipolar reference enable = ON.* |
| **00,21** | *Analog input mode T8 3 = Volt.*<br>*To avoid alarms due to lack of a thermistor.* |
| **11,31** | *User drive mode = CL VECt (vector closed loop).*<br>*Make sure that this parameter is set this way, not in any other way.* |
| **02,04** | *Ramp mode selection = FASt (with braking resistor).* |

After the changes, save parameters into the flash memory of the drive (press the button shown on the side menu of CTSoft) and then run the auto-tuning.

## Auto-tuning

The auto-tuning is done through parameter 00,40.

There are two types of autotuning available:

| | |
|---|---|
| ***While stopped*** | ***00,40=1*** |
| ***While turning*** | ***00,40=2*** |

Use the auto-tuning "while turning" whenever possible. It can only be performed when the motor is free, i.e. it is not mounted on the machine. If it is mounted on the machine, run the autotuning "while stopped".

To run the autotuning, follow these steps:

- Make sure that both the "run" signal (pin 26) and the "drive enable" signal (pin 31) are disabled. The display of the unit shows "inh".
- Set parameter 00,40=2.
- Activate the "run" signal (pin 26). The display of the unit shows "rdY".
- Activate the "run" signal (pin 31).

The motor then starts turning and the display shows "auto" and "tune" sequentially during the process.

At the end of the process, the motor stops, parameter 00,40 changes automatically to "0" and the display shows "rdY".

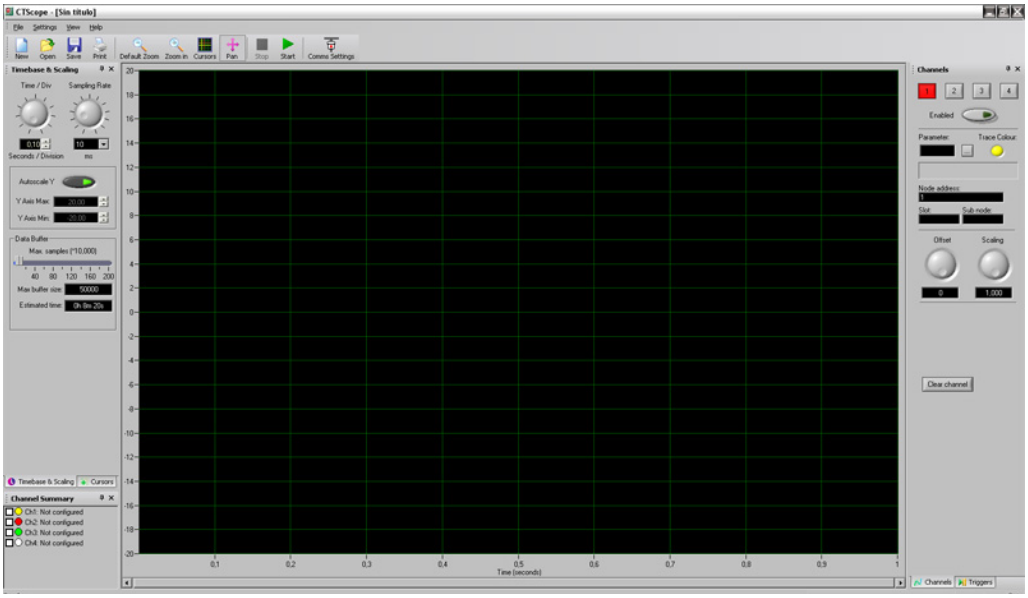
- Turn the drive off and back on. The display now shows "run".

The drive is now on and the motor is ready to run.

6.

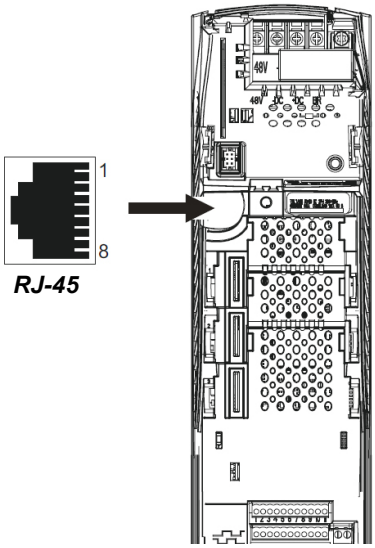
### CTScope application

The **CTScope** application is a full software-based oscilloscope to monitor and analyze the changing values of the drive. The time base may be set for a high-speed capture during setup or an intermittent (time lapse) capture to check long-term trends. The interface is based on a traditional oscilloscope that looks pretty familiar.



**MANDATORY.**
Close the CTSoft program while running the CTScope program.

The drive comes with a standard serial communication port that supports two-wire EIA-485 communication.




***Details of the RJ-45 connector connection***

| Pin | Function |
|---|---|
| **1** | *120 Ω terminating resistor* |
| **2** | *RX TX* |
| **3** | *0 V isolated* |
| **4** | *+ 24 V (100 mA)* |
| **5** | *0 V isolated* |
| **6** | *TX enable* |
| **7** | *RX\ TX* |
| **8** | *RX\ TX\ (if terminating resistors are needed, connect to 1)* |
| **Outside** | *0 V isolated* |

The cable connection diagram is shown in the chapter on "cables" in this manual.

### Isolation of the serial communication port

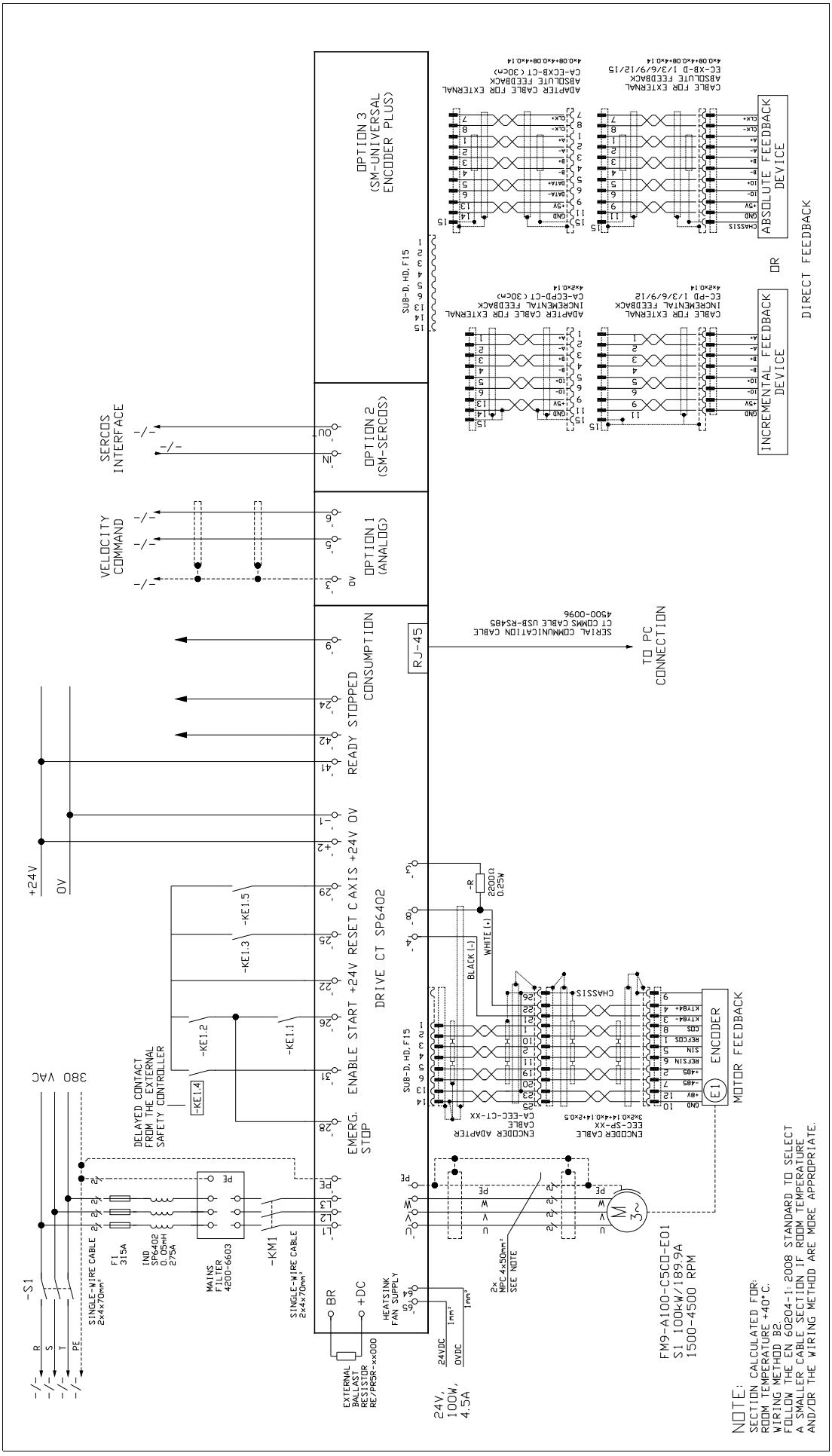
The serial communication port has double isolation and meets the requirements of EN 50187 for safety extra low voltage (SELV) circuits.

**WARNING.**
The control PC must be connected to ground in order to meet IEC 60950 requirements on safety extra low voltage (IT units). As an alternative, on laptops or similar systems that do not have a ground connection, an isolation device must be added to the communications cable.

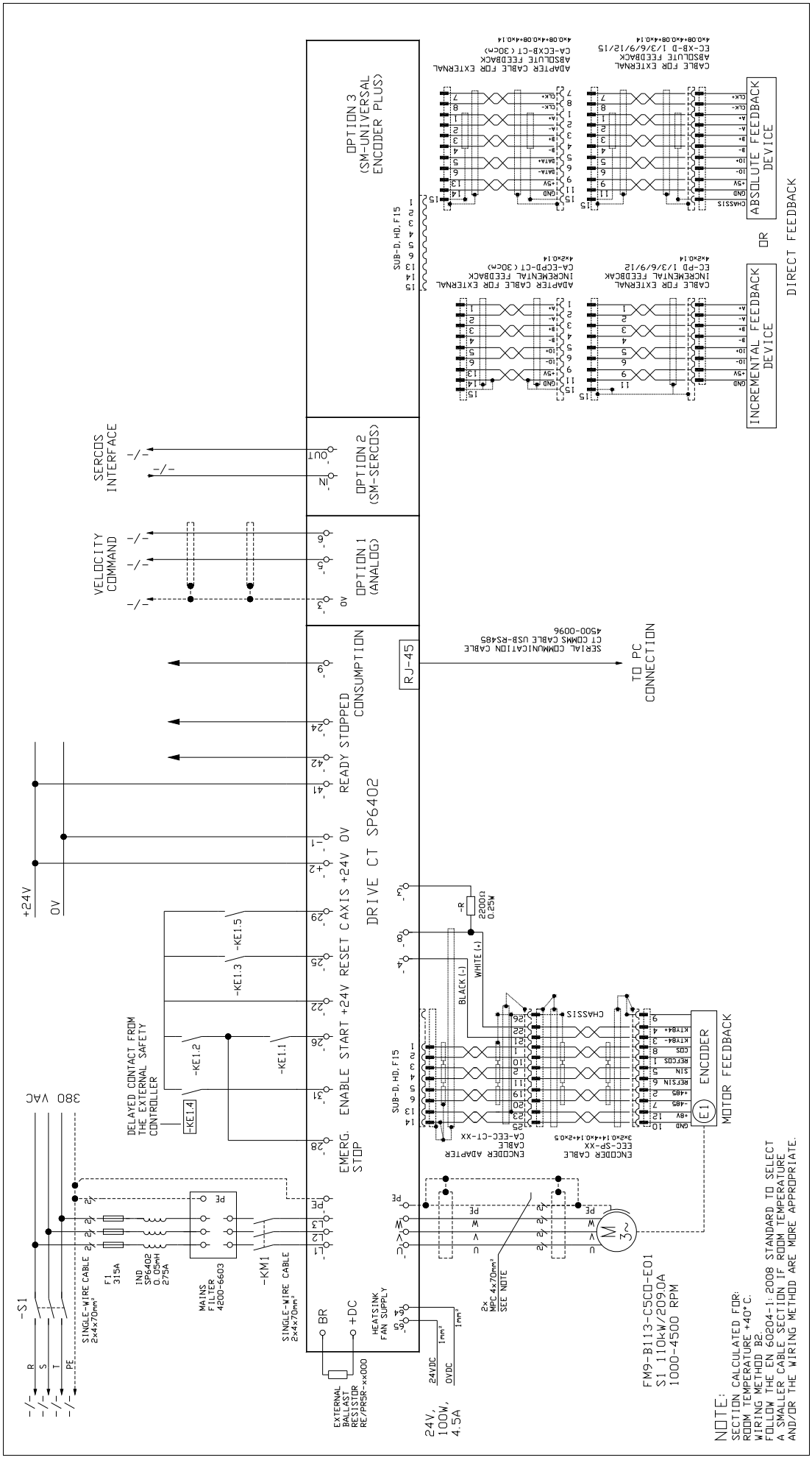
For further detail on the isolated serial communication cable, see the chapter on "cables" in this manual.

# 7 CONNECTION DIAGRAMS

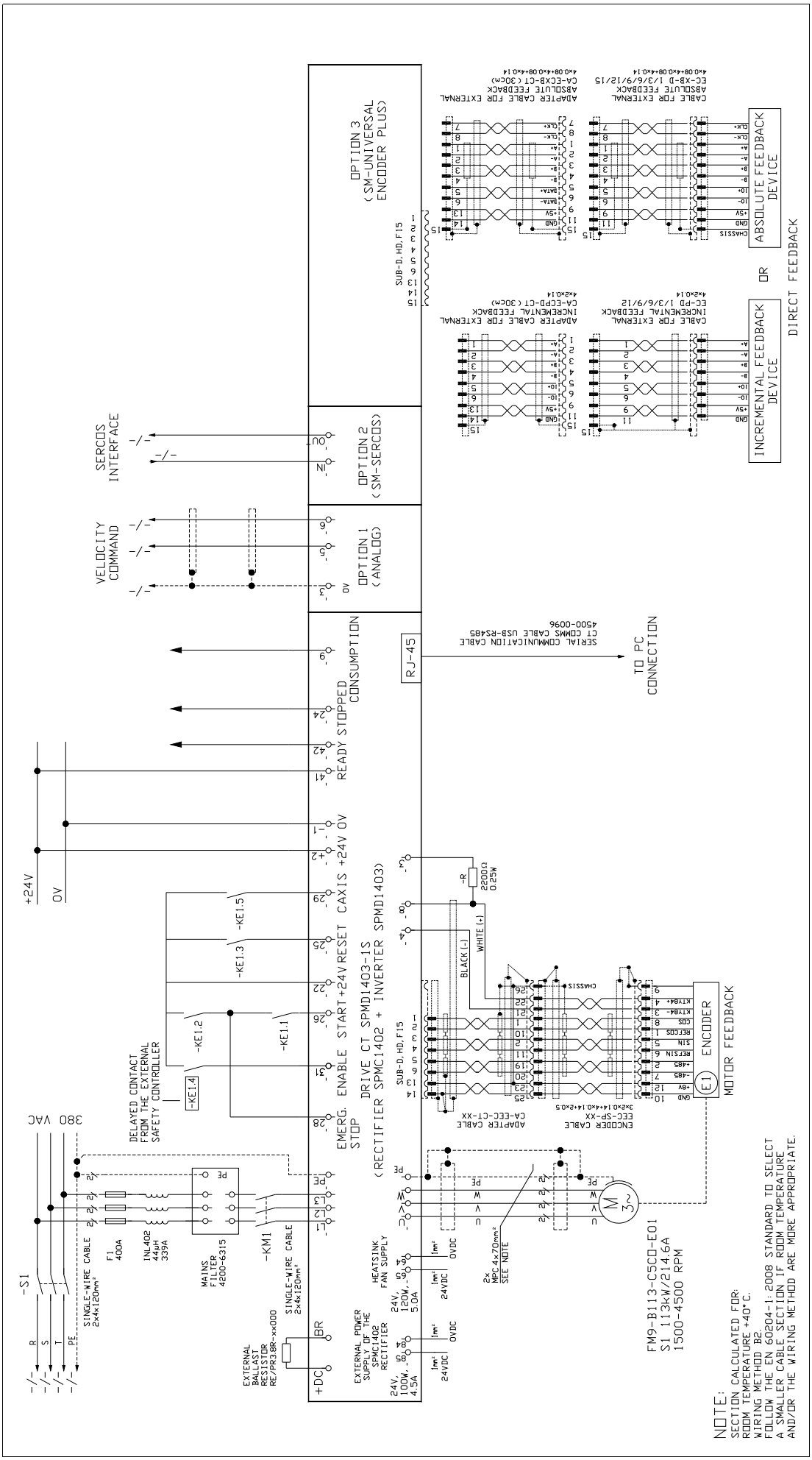
## SP6402 drive with FM9-A100-C5Cx-E01 asynchronous motor



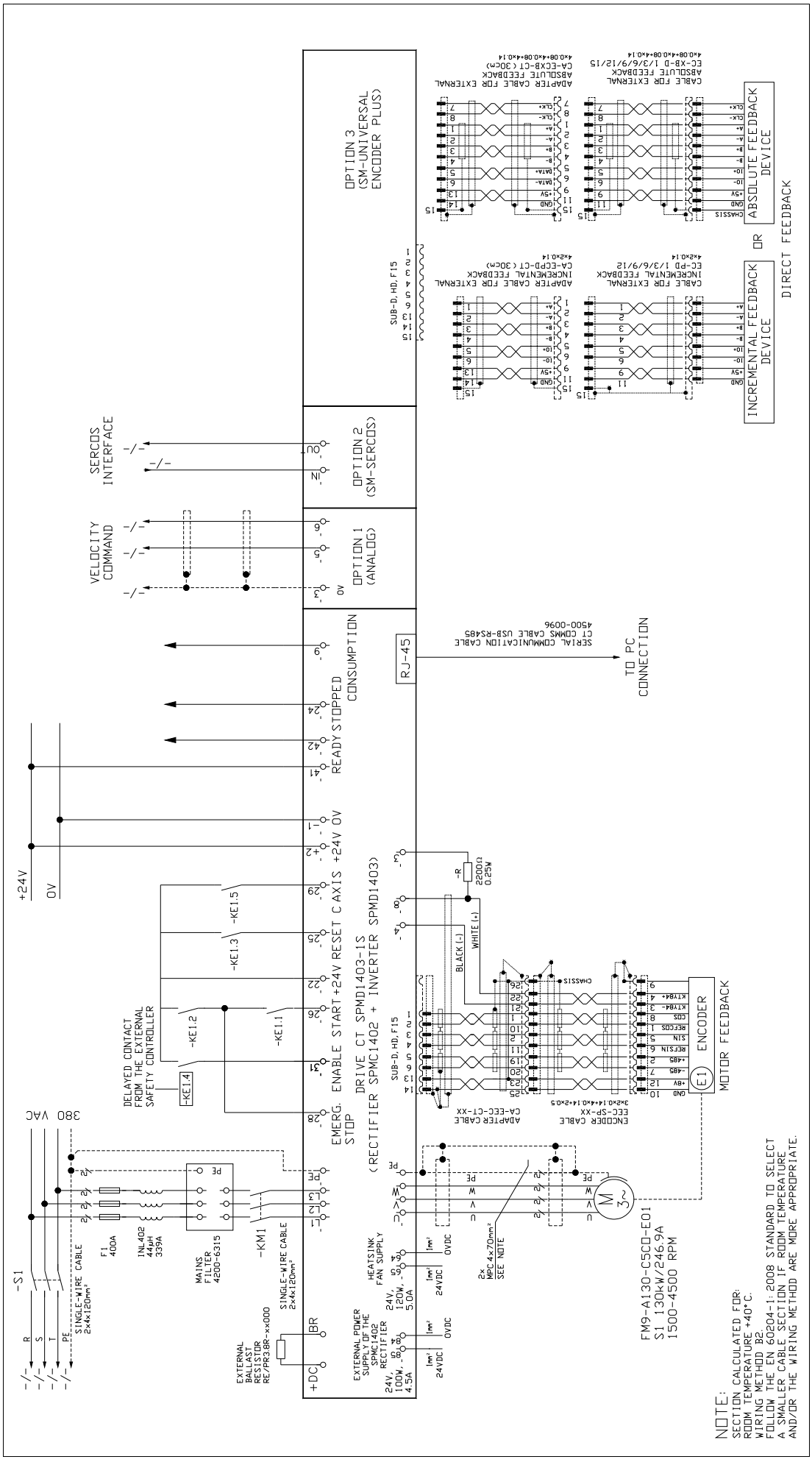
## SP6402 drive with FM9-B113-C5Cx-E01 asynchronous motor



## SPMD1403-1S drive with FM9-B113-C5Cx-E01 asynchronous motor



## SPMD1403-1S drive with FM9-A130-C5Cx-E01 asynchronous motor

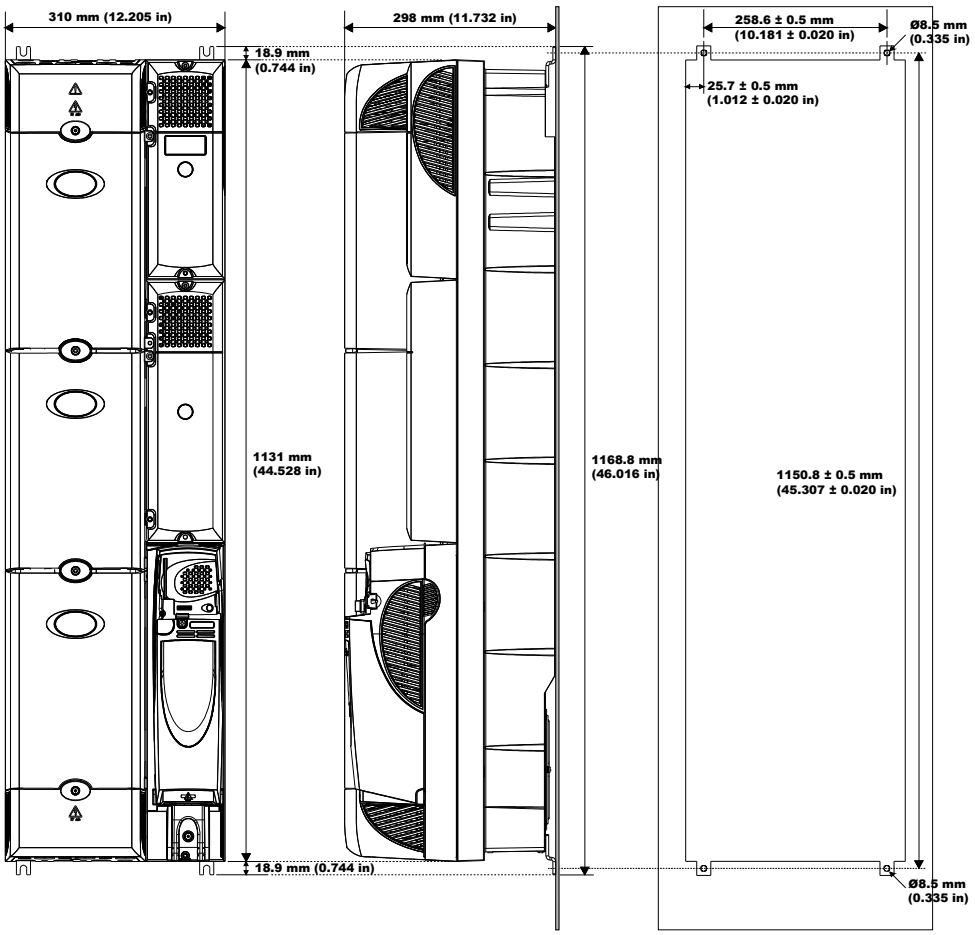


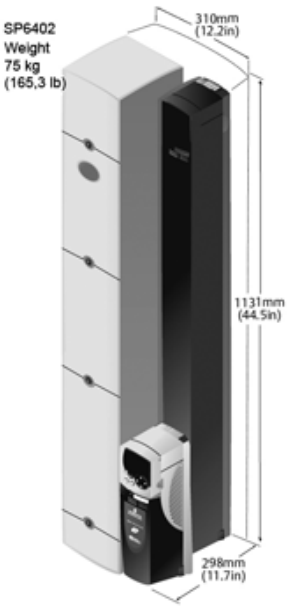
# 8 DIMENSIONS

When designing and building the electrical cabinet, it is crucial to consider the necessary space to include the modules that will make up the servo system, auxiliary modules and other elements such as cables and connectors.

## Drives

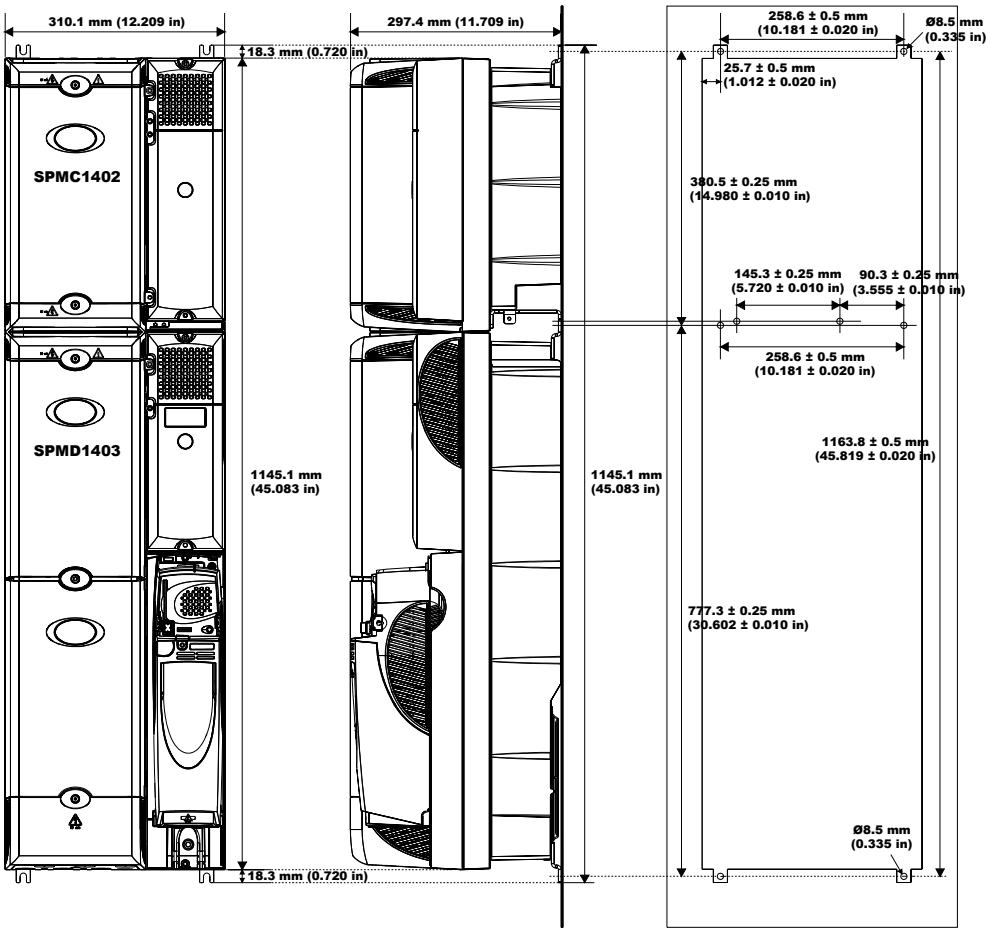
### SP6402 compact drive

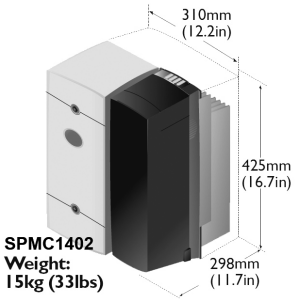


8.

## SPMD1403-1S modular drive (SPMD1403 + SPMC1402)



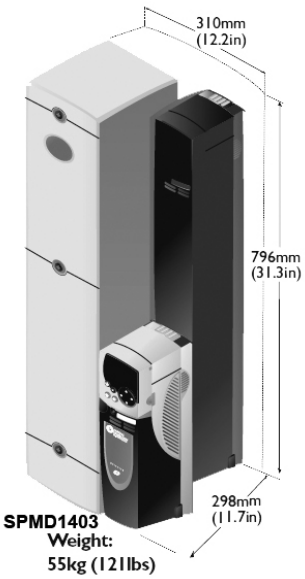



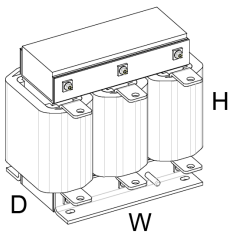

### SPMC1402 (rectifier)

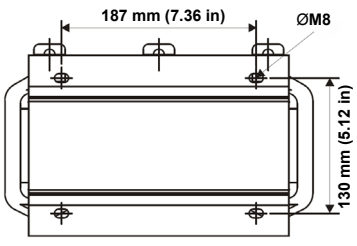
| Dimensions | H | W | D | F | R | Units | Mass |
|---|---|---|---|---|---|---|---|
| mm | 399.1 | 310 | 298 | 202 | ≤95 | kg | 20 |
| inches | 15.71 | 12.20 | 11.73 | 7.95 | ≤3.74 | lb | 44 |

### SPMD1403 (inverter)

| Dimensions | H | W | D | F | R | Units | Mass |
|---|---|---|---|---|---|---|---|
| mm | 795.5 | 310 | 298 | 202 | ≤95 | kg | 42 |
| inches | 31.31 | 12.20 | 11.73 | 7.95 | ≤3.95 | lb | 92.6 |




### INL402 (input line reactor)

| Width W mm (in) | Depth D mm (in) | Height H mm (in) | Mass kg (lb) |
|---|---|---|---|
| 276 (10.86) | 200 (7.87) | 225 (8.85) | 36 (79.36) |

| Max. losses W | Current A | Inductance µH | Tamb. max. °C/°F | Min. air flow m/s |
|---|---|---|---|---|
| 205 | 339 | 44 | 50/122 | 1 |

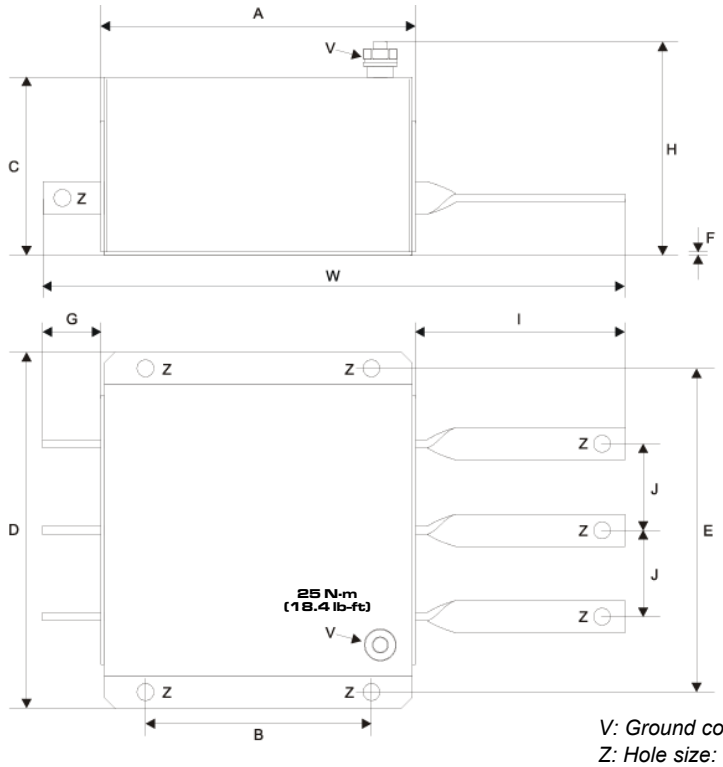
FAGOR

CT

Ref.1509

# Mains filters

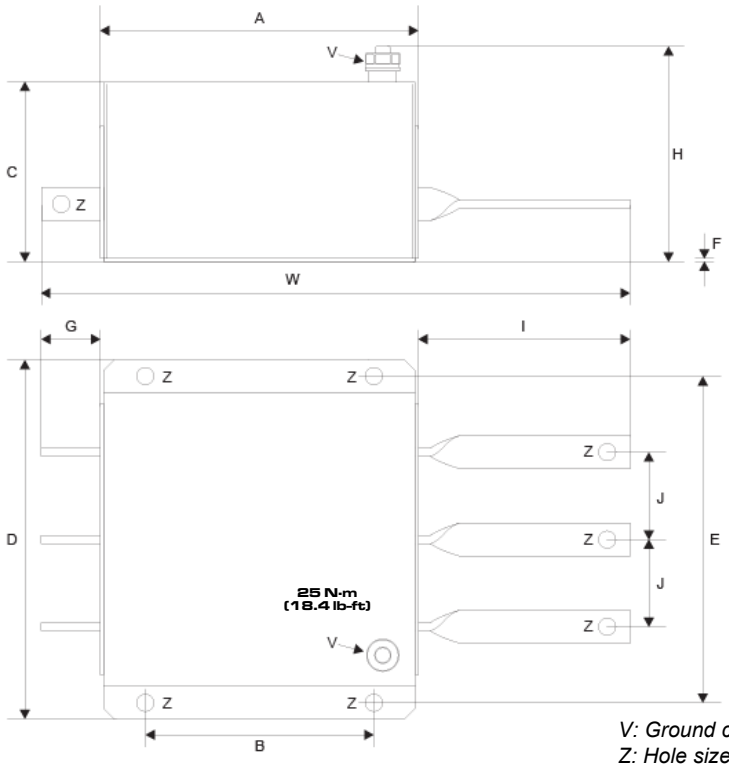
## Filter 4200-6603




*V: Ground connection terminal: M10*
*Z: Hole size: ∅10.5 mm*

| Dimensions | A | B | C | D | E | F | G | H | I | J | W |
|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 196 | 139.9 | 108 | 230 | 210 | 2 | 38 | 136 | 128 | 53.5 | 364 |
| inches | 7.71 | 5.50 | 4.25 | 9.05 | 8.26 | 0.07 | 1.49 | 5.35 | 5.03 | 2.10 | 14.33 |

## Filter 4200-6315



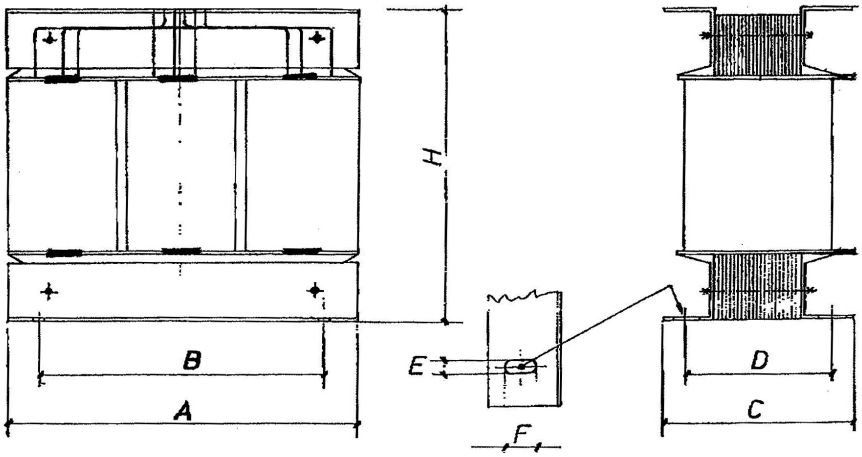

*V: Ground connection terminal: M10*
*Z: Hole size: ∅10.5 mm*

| Dimensions | A | B | C | D | E | F | G | H | I | J | W |
|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 220 | 170 | 110 | 230 | 210 | 2 | 43 | 136 | 76 | 60 | 339 |
| inches | 8.66 | 6.69 | 4.33 | 9.05 | 8.26 | 0.07 | 1.69 | 5.35 | 2.99 | 2.36 | 13.34 |

8.

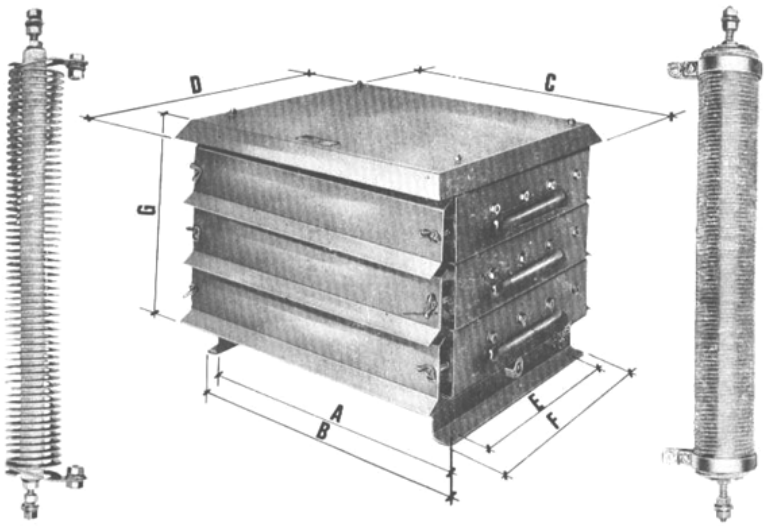
## Chokes

### Inductance IND SP6402




| Dimensions in mm/in | A | B | C | D | E | F | H |
|---|---|---|---|---|---|---|---|
| IND SP6402 | 240/9.4 | 180/7.0 | 170/6.7 | 140/5.5 | 9/0.3 | 13/0.5 | 205/8.0 |

## External braking resistors




| Dimensions in mm/in | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| RE/PR5R-11000 | 430/16.9 | 455/17.9 | 500/19.6 | 415/16.3 | 303/11.9 | 385/15.1 | 290/11.4 |
| RE/PR3.8R-13200 | 430/16.9 | 455/17.9 | 500/19.6 | 415/16.3 | 303/11.9 | 385/15.1 | 290/11.4 |
| RE/PR5R-33000 | 430/16.9 | 455/17.9 | 500/19.6 | 570/22.4 | 452/17.8 | 535/21.0 | 605/23.8 |
| RE/PR3.8R-40000 | 430/16.9 | 455/17.9 | 500/19.6 | 570/22.4 | 452/17.8 | 535/21.0 | 605/23.8 |

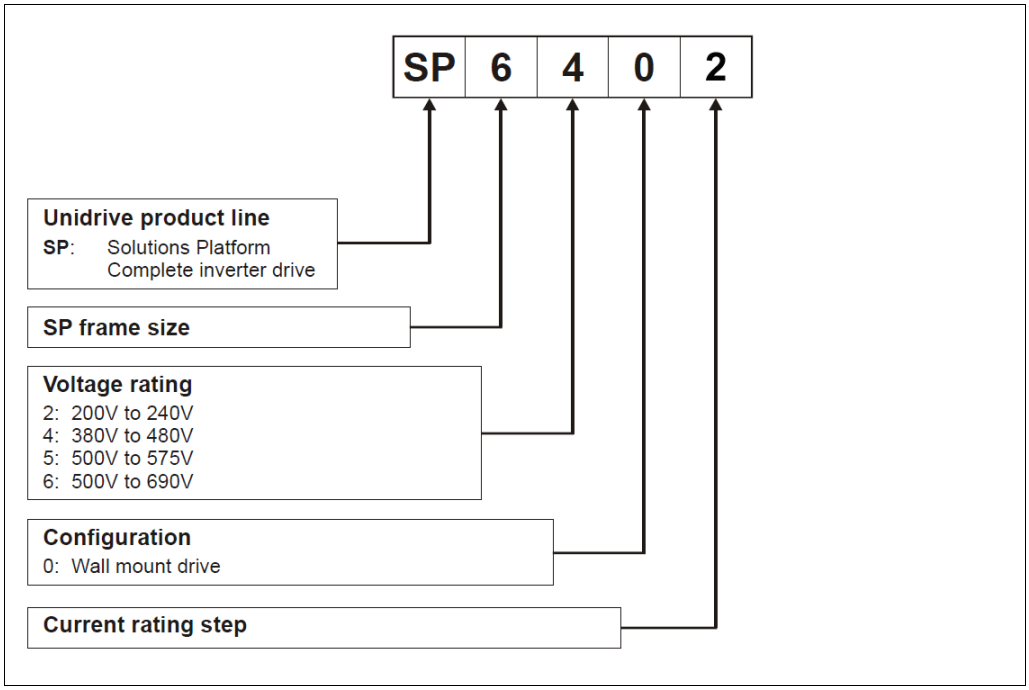
FAGOR

CT

Ref.1509

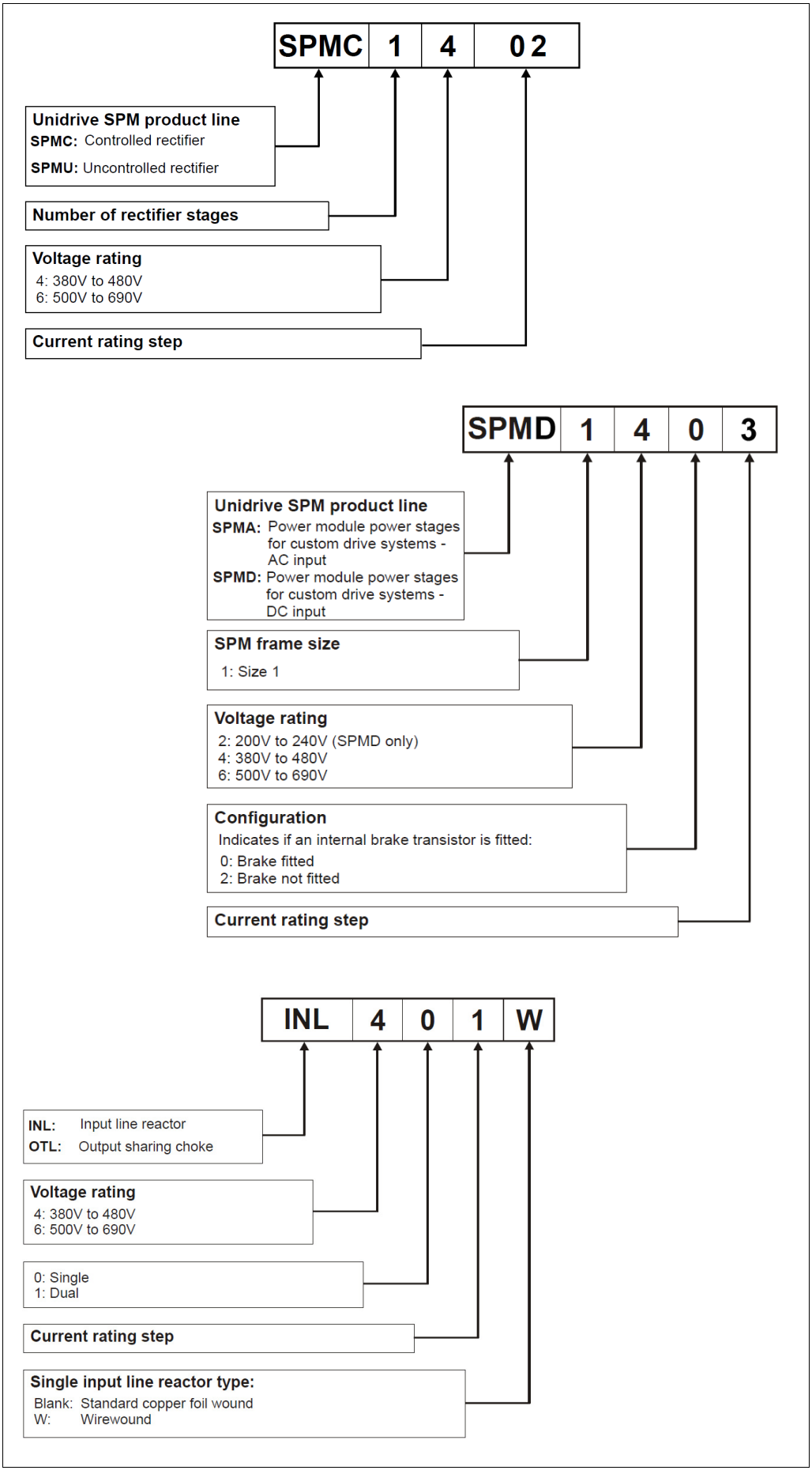
# 9 SALES REFERENCE

## SP6402 compact drive



## SPMD1403-1S modular drive

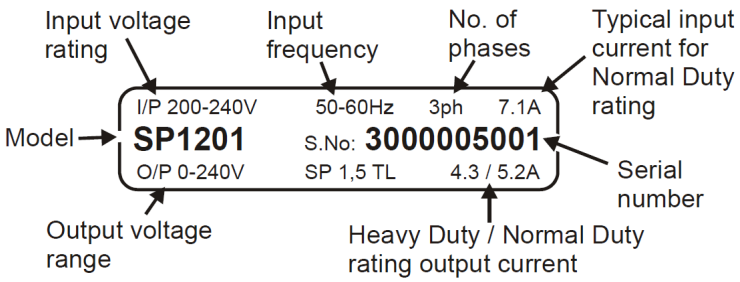
SPMC1402 rectifier + SPMD1403 inverter + INL402 input line reactor



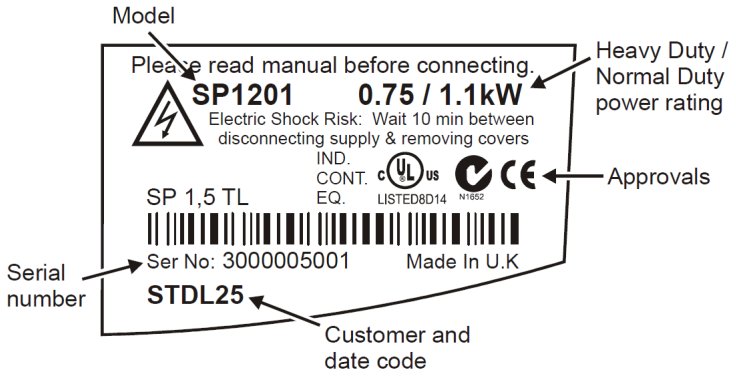
# 10 CHARACTERISTICS PLATE

## SP6402 compact drive

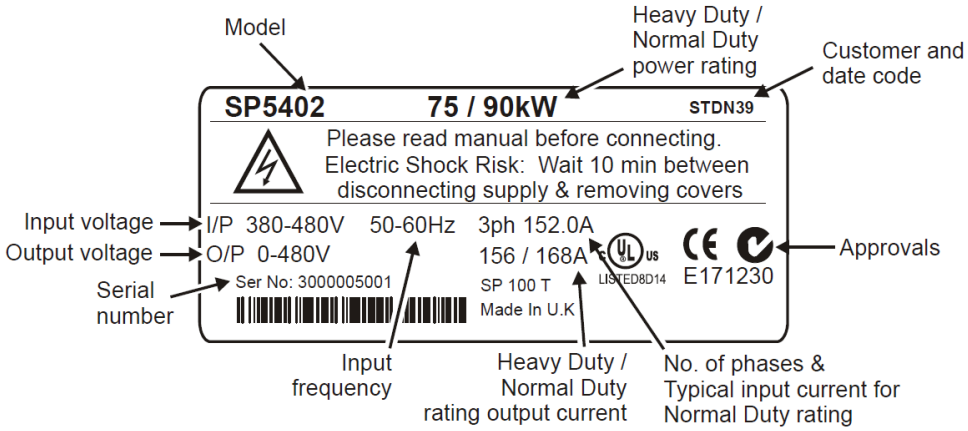
### Rating label




### Approvals label




### Power stage label




**Key to approvals**

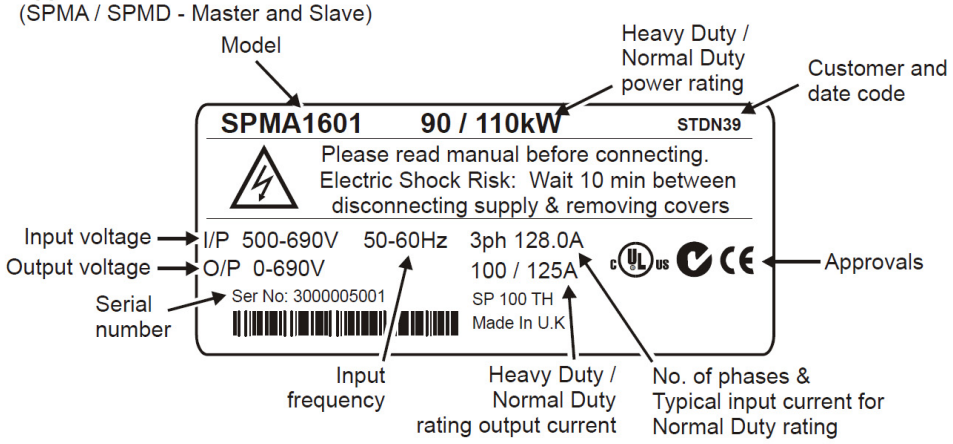
| | | |
|---|---|---|
| CE | CE approval | Europe |
| C Tick | C Tick approval | Australia |
| cULus | UL / cUL approval | USA & Canada |

10.

## SPMD1403-1S modular drive

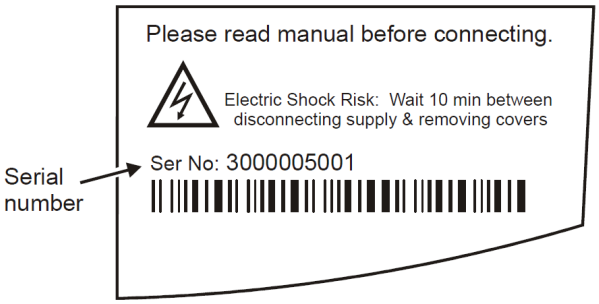
SPMC1402 rectifier + SPMD1403 inverter + INL402 input line reactor

**Approvals label A**
(SPMA / SPMD - Master and Slave)

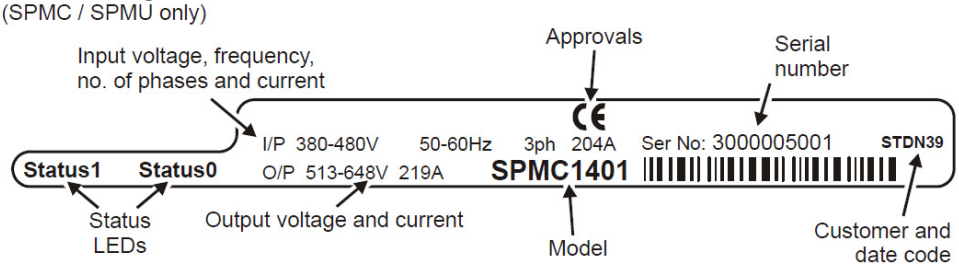



**Rating label**
(SPMA / SPMD - Master and Slave)


**Approvals label B**
(SPMA / SPMD - Master only)




**Rectifier rating label**
(SPMC / SPMU only)




**Key to approvals**

| | | |
|---|---|---|
| CE | CE approval | Europe |
| N1652 | C Tick approval | Australia |
| cULus | UL / cUL approval | USA & Canada |

FAGOR

CT

Ref.1509

FAGOR

FAGOR AUTOMATION

**Fagor Automation S. Coop.**

Bº San Andrés, 19 - Apdo. 144
E-20500 Arrasate-Mondragón, Spain
Tel: +34 943 719 200
+34 943 039 800
Fax: +34 943 791 712
E-mail: info@fagorautomation.es
www.fagorautomation.com

AENOR
ER
Empresa Registrada
ER-073/1994

CERTIFIED
IQNet
MANAGEMENT SYSTEM