# HARDWARE MANUAL

## COMMISSIONING, USE AND MAINTENANCE MANUAL

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|---|---|
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| Voltage category | Low Voltage (400V to 690V) |

## Table of Contents

## About this Manual

The whole chapter explain all about the low voltage SECOM Drive divided by frame, layout and application (such as motor or grid).
The first section summarize the safety rules to run and store this machine; the central part of the manual explain the main guidelines for mechanical and wiring installation. Moreover the last chapter report at last all the information needed for troubleshooting and maintenance.
This manual is structured to be printed chapter by chapter.
Each chapter is been wrote thinking to a specific target audience.

## About SECOM

Power Electronic Equipment & Components

Established in 1975, SECOM is a leading company in the market of power electronic equipment and distribution of components.
Over the years, the company has become an important active player in the design and production of conversion equipment for static energy.

### Mission

To design and create efficient, reliable and innovative solutions for power transmission providing highly competitive prices, dynamic and customer-oriented service.

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# SAFETY INSTRUCTIONS

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## Chapter Table of Contents



### Contents

This chapter contains important safety instructions that users must obey when installing, using or maintaining any of the SECOM DRIVE products covered by this manual. Ignoring these rules could lead to physical injury and/or death of those in the near vicinity of the drive; additionally, the drive and/or driven equipment such as an attached motor may be damaged.
This chapter also contains definitions and symbols used throughout this manual.

### Chapter Target Audience

This chapter is intended for all personnel who use or work with the SECOM DRIVE products covered by this manual.

# 1.1 WARNINGS AND SYMBOLS

Due caution to the usage warnings provided in this manual must be followed by all users of applicable SECOM DRIVE equipment; failure to do so could result in serious or injury or death, and/or damage to the equipment.
For the convenience of the reader the hazard symbols in Tab. 1-1 have been used throughout this manual to highlight risks and recommended practices when maneuvering, installing, maintaining or operating the equipment covered by this manual.

| Symbol | Description |
|---|---|
|  | **Electrical Warning**: lethal voltage electrical discharge hazard, which may result in serious or deadly injuries and/or damage to the equipment. |
|  | **Generic Warning**: generic hazard, not limited to electrical phenomena, which may cause serious or deadly injuries and/or damage the equipment. |
|  | **Electrostatic Discharge** or **Sensitive Devices**: risk of electrostatic discharge, which can injure the operator or damage the equipment. It is mandatory any personnel handling electronic devices use PPE (such as grounding wrist bands) |
|  | **Hot Surface**: It is recommended that personnel work a safe distance away from any equipment covered by the *Hot Surface hazard*; if any personnel are required to operate near the equipment it is mandatory they wear appropriate PPE (such as protective gloves, shoes, etc). |
|  | **Info, Note** or **Notice**: additional useful information the user should pay attention to. |

**Tab. 1-1: Symbols**

# 1.2 TERMS AND ACRONYMS

Tab. 1-2 summarizes all the terms used in the manual.

| Term | Meaning | Description |
|---|---|---|
| **AC** | **Alternating Current**: | Components or parts working with alternating current |
| **ALI_LEM** | **Voltage Sensor** manufactured by SECOM | normally used to sense the DC Voltage |
| **AFE** | **Active Front End**: | a type of line interface converter able to regulate DC bus voltage and AC current |
| **DC** | **Direct Current**. | Components or parts working with direct current |
| **DC bus** | - | Used as a collective term to indicate all power components used in the common DC section of the drive. |
| **DPM** | **Drive Power Module**: | Indicates the power module (converter) including all printed circuit boards (PCBs) |
| **PCB** | **Printed Circuit Board** | |
| **F3E** | **Fundamental Frequency Front End**: | A type of line interface converter like the AFE, but does not regulate neither the DC bus voltage nor the AC current |
| **FSM** | **Finite State Machine** | All control state of the drive, based on *PROFIDrive* standards |
| **FW** | **Firmware** | Binary code for FPGA |
| **HW** | **Hardware** | Supply, control and interface boards. |
| **MCB** | **Main Circuit Breaker** | Main circuit Braked |
| **PE** | **Protective Earth** | Protective Earth contactor |
| **PPE** | **Personal Protective Equipment** | Personal Protective Equipment |
| **Precharge** | | The sequence used to charge the DC bus capacitors before the main breaker is closed. |

| Term | Meaning | Description |
|---|---|---|
| **Prc**<br>**Prc Cmd**<br>**Prc Fdb** | Precharge<br>Precharge Command<br>Precharge Contactor Feedback | Precharge abbreviation<br>Command for starting precharge or activating precharge circuit (SD-MCU digital output)<br>A feedback signal from the precharge device (SD-MCU digital input if configured) |
| **SD-** | **SECOM Drive Component**: | this prefix is used to indicate when a component (or components) is strictly related to SECOM DRIVE, such as electronic board SD-RMU, SD-MCU, etc. |
| **SDM** | **SECOM Drive Manager**: | Coftware configuration tool for drive configuration and monitoring. |
| **SDI** | **SECOM Drive Inverter** | Inverter for motor control or generic load control: DC/AC Drive kind |
| **SDA** | **SECOM Drive AFE** | Regenerative Active Front End drive with low harmonics: AC/DC Drive kind |
| **SDF** | **SECOM Drive F3E** | Regenerative Fundamental Frequency Front End: AC/DC Drive kind |
| **SDS** | **SECOM Drive: Single Drive** | Motor (or load) control with internal rectifier: AC/AC Drive kind |
| **SD-MCU** | **SD Master Control Unit** | It is the main control board and is housed externally to the DPM. For more information about the control system, refer to SOFTWARE MANUAL too. |
| **SDRIVE**<br>**SECOM DRIVE** | **SECOM Drive** | indicates everything concerning the drive, in the context of this manual it is particularly used in reference to the drive power components and electronics. |
| **SD-RMU** | **SD Remote Modulator Unit**: | is the interface board for the control unit SD-MCU |
| **SD-SU** | **SD Supply Unit**: | this board provides the supply for all the electronic devices in the DPM. It is also the first stage analog interface |
| **SD-SYNC** | **SD Synchronization Board** | used to sense the line-to-line voltage and allow the SD-MCU synchronize the converter with the line. |
| **STO** | **Safe Torque Off** | used to describe STO as a function, circuitry or cabling |
| **SW** | **Software** | Binary code and program for control system based on DSP or CPU. |
| **IGBT** | **Electronic switch** | *Insulated Gate Bipolar Transistor*: power semiconductor for switching control. |
| **I/O** | **Input/Output** | Input/Output |
| **Frame** | | Mechanical structure that make up the DPM |
| **EMI** | **Electromagnetic Interference** | Electromagnetic interference |
| **EMC** | **Electromagnetic Compatibility** | Electromagnetic Compatibility |
| **VDC+, VDC–** | **Terminals of the DC bus** | The positive and negative terminals of the DC bus |
| **U, V, W** | **Inverter Output Phases** for DC/AC drives | Inverter Output Phases for DC/AC drives |
| **R, S, T** | **Inverter Input Phases** for AC/AC drives | Inverter Input Phases for AC/AC drives |
| **Safe Working Voltage** | **Less than 50V** unless otherwise stated | The safe working voltage is defined as the maximum voltage for live working as defined in by local safety regulations, however is it is recommended that a safe working voltage close to 0 volts is used. |
| **Single Drive** | **AC/AC Drive** | It's a stand alone drive with AC input and output. A rectifier bridge is internal to the module. For SECOM Drive, the bridge is a semi-controlled bridge; this drive can't be parallelized, so it consists of a single DPM. |
| **Multi Drive** | **DC/AC Drive,**<br>**AC/DC Drive** | It's an inverter with a DC input and AC output and the DC side could be common with many other drives and front ends. For SECOM Drive, the modules which compose a *Multi Drive* are DPM which can be connected in parallel to the AC side. |
| **Single DPM** | **One DPM** | Single power module (could be SDS, SDI, SDA or SDF) |
| **Parallel DPM** | **Many DPMs** | Multiple DPM connected in parallel (could be SDI, SDA or SDF) |
| **Motor Side** | **Drive Motor Front End** | It refers to the AC side of the inverter where motor is connected. For motor application, this is the output side |
| **Line Side,**<br>**Grid Side** | **Drive Power Grid Front End** | It refers to the AC side of the inverter connected to the power grid. For grid application, this is the output side |
| **DC/AC Drive**,<br>**AC/DC Drive,**<br>**AC/AC Drive** | **Input and output of the drive** | *X/Y* refer to the *input/output* of the drive. DC/AC means DC is the input and AC is the output and AC/DC is vice versa. AC/AC indicates the AC input (R, S, T) connected to the grid and the AC output (U, V, W) connected to the load. DC/AC |

**Tab. 1-2: Terms and Acronyms**

# 1.3 STANDARDS

The design, manufacturing and testing of each low voltage converter is performed according to following IEC/EN standards where applicable:

| | |
|---|---|
| IEC 50178 | IEC 50178 Electronic equipment for use in power installations |
| IEC 60146 | Semiconductor converters - General requirements and line commutated converters |
| IEC 60204–1 | Safety of machinery – Electrical equipment of machines. |
| IEC 60364 | Low voltage electrical installations |
| IEC 60664–1 | Insulation coordination for equipment within low-voltage system |
| EN 61439–1 | Low voltage switchgear and control-gear assemblies – Part 1: General rules |
| EN 61439–2 | Low voltage switchgear and control-gear assemblies – Part 2: Power switchgear and control-gear assemblies |
| IEC 61800–2 | Adjustable speed electrical power drive systems – Part 2: General requirements – Rating specifications for low voltage adjustable frequency AC power drive systems |
| IEC 61800–3 | Adjustable speed electrical power drive systems – Part 3: EMC requirements and specific test methods |
| IEC 61800–5 | Adjustable speed electrical power drive systems – Part 5: Safety requirements |

# 1.4 SAFETY OPERATIONS

The following paragraphs describe an overview of safe working practices when maneuvering, installing operating or maintaining the products covered by this manual. Where required further information is provided in the associated chapters.

## 1.4.1 Mechanical and Handling Safety

The following instructions are intended for all personnel who are required to install or move the drive.

**WARNING!** Ignoring the following instructions could lead to physical injury or death and additionally damage the drive and/or equipment.

- If the drive has been electrically disconnected, before performing any mechanical handling, qualified personnel must check the DC voltage is within the limits of the safe working voltage. Refer to chapter *4 – Electrical Installation* for more details on this procedure.
- Use safety shoes with a metal toe cap to avoid foot injury. Wear protective gloves and long sleeves. Be aware that some parts have sharp edges.
- Handle the unit with care.
- Moving a SECOM DRIVE with frame type SDx.3: lift the drive using eyebolts or lifting eyelets as shown in Fig. 1-1. Do not manually tilt the drive, doing so may result in severe injury from the drive toppling over.

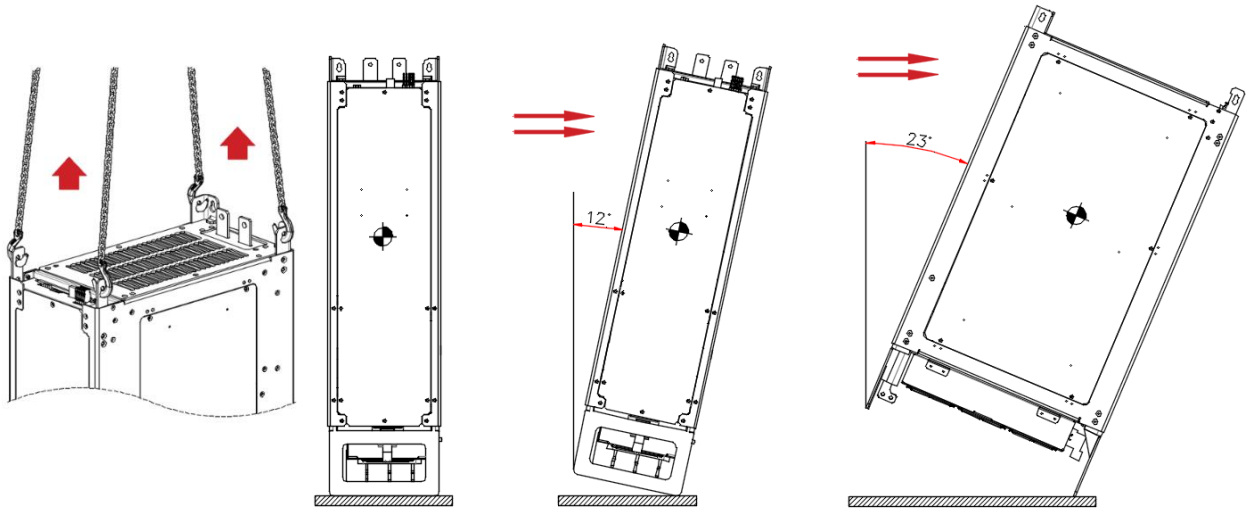



**Fig. 1-1: How to lift and move SDx3 frame**

- Moving SECOM DRIVE frame type SDx.2: lift the drive using eyelets or eyebolts as shown in Fig. 1-2-a.
- To prevent the drive from toppling over when in its fixed location, always use the adjustable and retractable feet located on the lower side of the frame (Fig. 1-2-b).
- Do not leave the module unattended on a sloping floor (Fig. 1-3-a)
- Do not manually tilt the drive, only do so using appropriate lifting equipment. Manually tilting the drive may result in severe injury. The maximum tilt angle is about 7° in the axis depicted in Fig. 1-3-b and 14° in the axis depicted in Fig. 1-3-c.

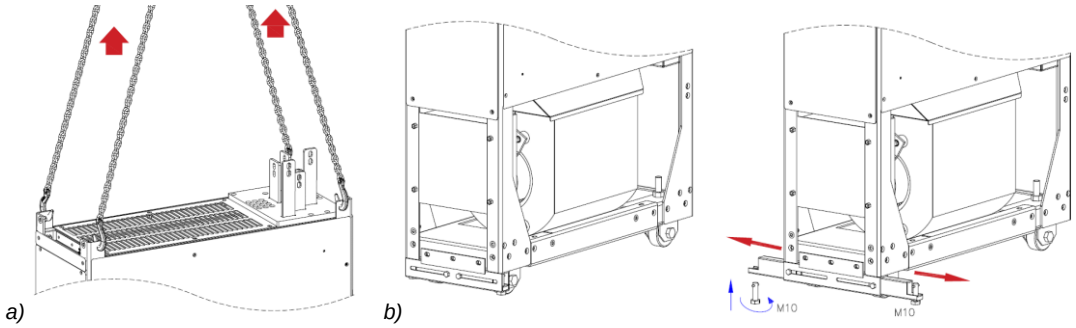



**Fig. 1-2: SDx.2 – Eyelet for lifting (a) and retractable and adjustable feet (b) for overturning avoidance**

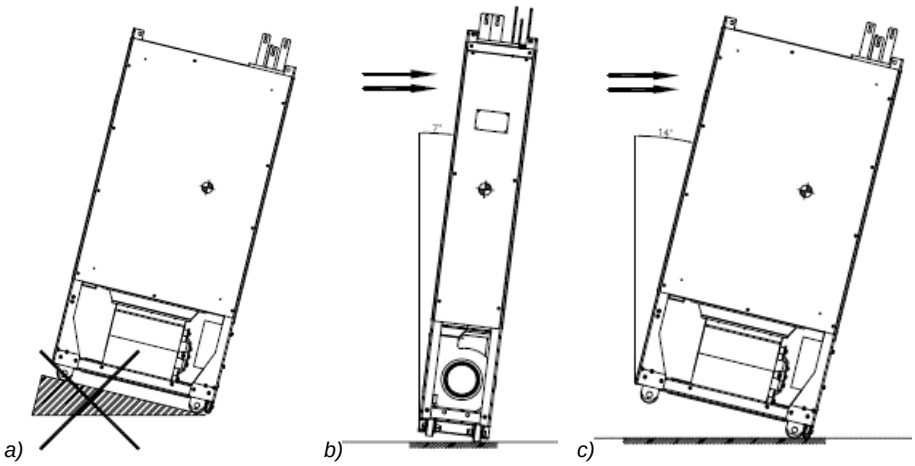



**Fig. 1-3: SDx.2 – Do not left the module on a sloping flor (a) and not overpass the maximum tilting (b, c)**

- The module can only be pushed in the direction of rotation of the wheels, i.e. forwards and backwards. Turning of the converter must be done using appropriate lifting equipment.
- After operation of the drive, some components such as heat sinks may be hot. The drive should be allowed to cool down before any handling is performed or appropriate PPE is must be worn.

## 1.4.2 Installation and Maintenance Safety

These instructions are intended for all personnel who perform installation of the drive into the drive cabinet or are required to perform drive maintenance.

**WARNING!** Ignoring the following instruction could lead to serious physical injury or death, damage to the drive and/or equipment.

- Only qualified technicians can be allowed to install and maintain the drive.
- Ensure that debris from any drilling/boring or grinding do not enter the drive when installing. Electrically conductive debris inside the unit may cause damage or the drive to malfunction.
- The installation cubicle has to provide sufficient cooling. The derating curves in this manual refer to ambient temperature of the converter i.e. the temperature inside the cubicle. Failure to provide adequate cooling will result in mandatory derating of the converter or premature failure.
- Do not attach the drive using rivets or by welding.
- Pay attention to any components with hot surfaces, particularly after operation. Normally the hottest parts of the drive are the component heatsinks and the power stage.
- Perform all operation with the main circuit breaker and switch open, and follow the electrical safety rules listed in section 1.4.3

## 1.4.3 Electrical Safety

These instructions are intended for any personnel who work with the electrical and/or electronic parts of the product, such as the drive, motor cables or electronic circuit boards. In addition to the instructions provided, the relevant local safety standards must also be adhered to.

**WARNING!** Ignoring the following instruction could lead to serious physical injury or even death. Failure to follow the instructions could also damage the drive and/or equipment and increase electromagnetic interference.

- Only qualified technicians should be permitted to install and maintain the drive.

- Never work on the drive, cables or motor while the main supply is applied; always disconnect the input supply and after waiting five minutes verify that the voltage on the following terminals is less than the safe working voltage:
  - Between the AC phases (U-V, V-W, W-U)
  - Between the positive and negative terminal of DC bus

  Perform this measurements with a multimeter with an impedance of at least 1 MΩ.
- Do not make any insulation or voltage withstand tests on the drive. Only SECOM personnel or personnel trained and authorized by SECOM are permitted to do this and in very rare cases.
- Do not connect the drive to a voltage higher than the over voltage trip threshold: this typically results in damage to the drive or where applicable the dynamic brake resistor.
- Do not connect the drive to a voltage higher than *VdcRollback* threshold: this can disable some control functionality during braking the motor. For more information see SOFTWARE MANUAL.
- For the safety of personnel ground the drive, motor and adjoining equipment in all circumstances; additionally this reduces the electromagnetic emission and interference.
- Make sure that grounding conductors are adequately sized according to local safety regulations.

### General safety information

- It is vital, after switching off the drive and disconnecting the main power, verify the motor is at stand still; if the motor is not at stand still it is possible that a dangerous residual voltage remains on the cable or at the drive termination. This is a good procedure for all motor types, but particular attention should payed when working with synchronous motors or permanent magnet motors.
- When the drive is connected to the main supply the drive motor cable terminals are at a dangerously high voltage regardless of whether the motor is rotating or not.
- The *Safe Torque Off* function (STO) does not remove the voltage from the main and auxiliary circuits; in addition, the motor could have voltage applied without generating electromagnetic torque. Furthermore, the function is ineffective against deliberate sabotage or misuse.

### Electronical board safety

**WARNING!** Ignoring the following instruction could result in damage to the printed circuit boards housed in the product.

- The printed circuit boards contain components sensitive to electrostatic discharge. Wear a grounding wrist band when handling the boards. Do not touch the boards unnecessarily.

## 1.4.4 Starting Up Safety

These instructions are intended for personnel who have to operate, commission or use the drive.

**WARNING!** Ignoring the following instruction could lead to physical injury or death, damage the drive and/or equipment.

- Before powering up the drive, all drive covers must be on and in the closed position if applicable. All covers must be kept on during operation.
- Some functionality, such as Grid Waiting, can restart the drive automatically. Users must ensure that functions that perform automatic startup can only be performed in safe situations. See SOFTWARE MANUAL for more information about this type of functionality.
- The maximum power-ups that can be performed in a given period depends on the precharge circuitry. Usually for frame types which have an external precharge circuit, one power up may be performed per minute, but for AC/AC drives with semi-controlled diode bridges, this number of power ups per minute is not restricted.
- Any safety circuits (such as STO) must be connected properly. This is the responsibility of the customer.
- Users must pay attention to the starting sequence while configuring the drive. The Drive is compliant to PROFIDRIVE State Machine; however, the user can modify the start sequence by changing the source command or SW configuration. In the following some particular cases are summarized, but for further information about this logic please refer to the SOFTWARE MANUAL:
  - The drive can be configured to start immediately after the SWITCH ON command, or more precisely when the main breaker is closed and the precharge phase is finished.
  - If the SD-OP unit is the main command source (*Local commands*), the drive is automatically configured as above.
  - The drive can start after the ENABLE OPERATION command when the drive is precharged. In this configuration The SWITCH ON command only precharges the drive.

## 1.4.5 Transport, Storage and Operational Safety Conditions

Particular care must be paid during transport and storage, especially if the drive has to be stored for a long time. In this paragraph users can find some information about procedure and environmental limits to ensure safe conditions during transport, storage and operation.

**WARNING!** Neglecting the following instruction could lead to damage the drive and/or equipment.

### 1.4.5.1 Environment conditions summary for operating, storing and transport

Generally, the drive must be used indoors in a controlled environment. The following table summarizes the environmental conditions, which have to be ensured to guaranty the product life time and safe operation. This information is part of the technical specification; for more information see *2.4 Inverter Specifications*.

| Ambient condition | Operating | Storing | Transport |
|---|---|---|---|
| **Pollution degree** | 2 | | |
| **Contamination level** | IEC/EN 60721-3-3:2002: Classification of environmental conditions- Part 3-3: Classification of groups of environmental parameters and their severities - Stationary use of weather protected locations | IEC 60721-3-1:1997 | IEC 60721-3-2:1997 |
| **Chemical Gasses** | Class 3C2 | Class 1C2 | Class 2C2 |
| **Solid particles** | Class 3S2.<br>No conductive dust is allowed | Class 1S3 | Class 2S2 |
| **Pressure** | 70 to 106 kPa | | |
| **Air temperature** | -20°C to 60°C. Frost is not allowed | | |
| **Relative humidity** | Max 95% in normal conditions<br>Max 60% with aggressive environment<br>Condensation is not allowed. | | |
| **Vibration and shock** | EN 60721-3-2 compliant<br>EN 60068-2-6 compliant | | |
| **Free fall** | Not allowed | | |

**Tab. 1-3: Required Environmental Conditions Summary**

### 1.4.5.2 Reform of DC capacitors

If the drive has been stocked for a year or more without use, the electrolytic capacitors can exhibit reduced performance, in such circumstance the following **"reforming" procedure is mandatory**. Note that "stock" the drive means the drive is never being powered up for at least one year, even if it is already installed.
The reforming procedure consists of connecting a DC power supply to the DC bus of the drive and gradually charging it, the DC bus is then kept at this voltage while the capacitance is reformed. The exact procedure is provided in detail in section 5.2.1 – Reforming of DC Capacitors. Please refer to this chapter for further information.

# PRODUCT DESCRIPTION, SPECIFICATIONS AND RATINGS

# 2

## Chapter Table of Contents



### Contents

This chapter describes the drive and the various components which are needed to operate it. Moreover, it provides:

- Specifications for each drive based on frame size.
- Drive derating factors due to switching frequency, ambient temperature, duty, etc.
- Optional components and any corresponding data (such as for sin filters)
- Overall dimension of each frame type
- Order code system

### Chapter Target Audience

This chapter is intended for personnel working in product procurement or those who need to know the inverter and option specifications.

# 2.1 PRODUCT OVERVIEW

The SECOM DRIVE range is a range of AC/DC and DC/AC drives with power ratings up to 9MW and 8MVA respectively. The SD range can be supplied as a turn key solution preinstalled in standard drive cabinets or as flexible modular frames to be housed by the customer. AC/AC drive product codes are preceded by the prefix SDS while DC/AC drives products are preceded by SDI, see section 0 for more details. Both the SDS and SDI range are available with a single AC output for single drive applications or multiple AC outputs for multidrive applications.

## 2.1.1 Product Features

The SDI range of drives can reach a maximum power of about 8MVA, while the SDS range can reach more than 9MW provided the line interface is an F3E configuration. To reach this power, DC/AC drives must be parallelized and controlled by only one SD-MCU control unit; a parallel converter is a combination of up to eight identical DPM modules.
So in brief, the main features of an SECOM DRIVE are:

- Up to 8 DPM may be configured in parallel with only one SD-MCU
- There is no derating due to parallel configuration
- Simple installation, signal/low power connections are limited to a couple of optical fibers, 24V (and 24V safe if STO is needed) and the auxiliary FAN supply.
- Each DPM can be deactivated via software[1] with appropriate derating of the total drive
- Futureproofed power rating, a SECOM Drive can be retrofitted in parallel just by changing the size via software configuration

### Main Control Application

SECOM Drive is design to cover various market such as oil and gas, energy, metals, etc, which means application for pumps, fans, rolling mills, shear, and much more.
Control applications are divided by Motor control and Grid control. For Grid control, the main control strategy and feature are:

- AFE: control the Vdc with at desired cosϕ at PPC
- F3E: regenerative control cosϕ=1 during regeneration
- Vac Generator: stand alone generator with short-circuit management

For Motor Control, only induction motor is managed. The control strategy proposed are:

- V/Hz: can be open or closed loop and with performances very close to vector sensorless control
- FOC: Field Oriented Control. It needs an encoder but is the best choice in performance

All the motor control strategy have many MACRO function selectable and configurable per-application, such as braking function (Vdc Rollback, Current Rollback), energy saving, Master/Helper, and so on. For all the information regarding Control and Macro application and configuration please refer to SOFTWARE MANUAL.

[1] Pay attention: if the drive is in parallel, disable it means not fire the IGBT, but diode are connected! So the DPM has to be disconnected from other by a switch.

# 2.2 PRODUCT AND OPTION CODE

Any given SECOM DRIVE configuration can be identified by a unique code that defines the drive type, frame, cooling, power and voltage. Following this principal code, which defines the drive size or rating, is an additional string of codes identifying any internal and external options. Tab. 2-1 shows how a SECOM DRIVE code is formed; the table shows there are five codes defining the drive size, up to three codes defining internal options followed by any codes defining external options. The codes listing the external options can be found in Tab. 2-2.

| SECOM DRIVE CODE | | | | | | | | External Option |
|---|---|---|---|---|---|---|---|---|
| Drive Size | | | | | Internal Option | | | |
| SDI | .2 | .A | .610K | .400 | +OLP | +FU | +PS | /... |

**SD Type (frame)**
***SDI***: Inverter/AFE
***SDF***: F3E
***SDS***: Single Drive

**Frame Type**
***.2***: 245x650x1398mm
***.3***: 245x500x830mm
***.4***: 245x500x630mm

**Cooling Type**
***.A***: air cooling
***.W***: water cooling

**Apparent Power**
*Tree numbers and one letter indicate the power*

**Rated Voltage**
***.400***: 380÷480 $V_{ac}$
***.690***: 500÷690 $V_{ac}$

+***OLP***: Internal output reactor‡ (by inverter module)

+***FU***: integrated DC Fuses

+***PS***: Redundant power supply option (Alidan2)

‡: Option is only allowed for SDI/SDA/SDF.2

**Tab. 2-1: SECOM DRIVE code format**

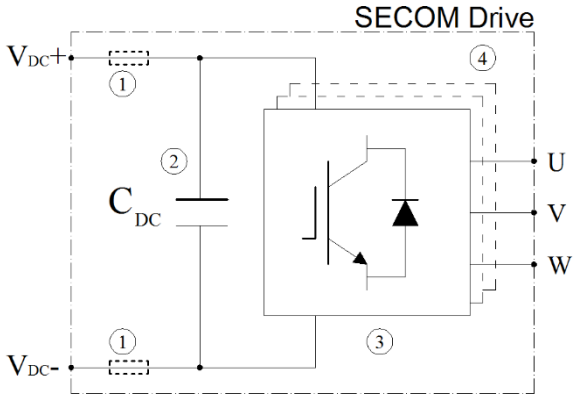
| Option Code | Description |
|---|---|
| /KB1 | AC bus bar option for each DPM for ΔT ≤ 50°C (default) |
| /KB2 | AC bus bar option for each DPM for ΔT ≤ 30°C |
| /KFO | Optical Fiber Kit |
| /FUD | External DC Bus Fuses |
| /OLDV | Output dV/dt reactor |
| /ILF | Input filter for F3E |
| /LCL | Input filter for AFE |
| /SIN | Output sinusoidal filter for inverter |
| /EMI | EMI Filter |
| /KPR | Precharge with resistor |
| /FUA | External AC Fuses |

**Tab. 2-2: SECOM DRIVE external option codes**

# 2.2.1 Principle Schemes

### SDI/SDF.2/3/4

The following Fig. 2-1 show the principle scheme of a DC/AC SECOM Drive for low voltage application. This configuration is valid for all inverter, F3E and AFE applications.



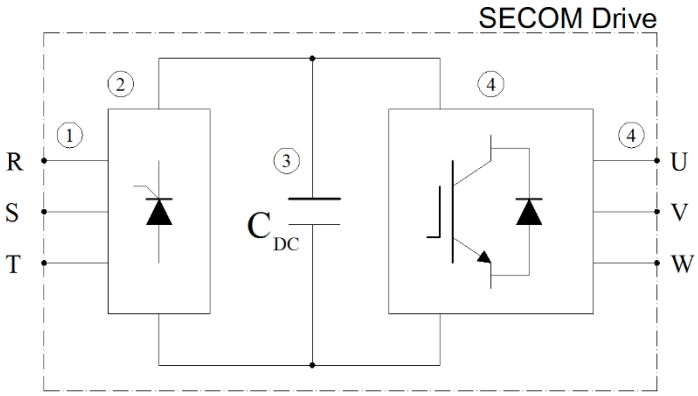

*SECOM DRIVE DC/AC converter*

1. Internal DC Fuses: optional when only one DPM is present. With two or more DPMs in parallel, fuses are mandatory, even if they are fitted externally.
2. DC Bus: the link between rectifier (supply) and inverter.
3. SECOM Drive IGBT Power module (DPM)
4. Parallel DPM configuration (depending on the inverter size)

**Fig. 2-1: SECOM DRIVE DC/AC configuration – principle scheme**

### SDS.2/3/4

Fig. 2-1 shows the principle scheme of a DC/AC SECOM Drive for low voltage application. This configuration is valid for inverter motor control or some special application such as Vac generators for frequency conversion.




*SECOM DRIVE AC/AC converter*

1. AC input 45Hz÷65Hz
2. Semi-controlled diode rectifier: it is used as precharge circuit too. It is not a regenerative configuration.
3. DC Bus: the link between rectifier (supply) and inverter.
4. SECOM Drive IGBT Power module (inverter)
5. AC output

**Fig. 2-2: SECOM DRIVE AC/AC configuration – principle scheme**

## 2.2.1.1 Complete Drive Configuration for SECOM DRIVE

### Diode Rectifier Input with Motor DC/AC Drive

Fig. 2-3 is an example of unipolar scheme to connect a drive for motor control for single or multi-drive with common DC bus. The rectifier is external to the drive and feed the common DC bus where all DC/AC drive are connected.
For parallel configuration, no additional output inductance is normally request and no deratings too is needed. On the other hand, fuses on DC side are needed with parallel configuration.
In order to supply the power parts, AC/DC diode bridge can be formed by one or more units in parallel. SECOM can provide even this kind of component, such as GR6, GR8, GR9 depending on the power requirement or precharge request.
Precharge unit showed in Fig. 2-3 is a simple resistor. Other system are possible, for example semi-controlled bridge, which SECOM can provide, or external precharge unit.

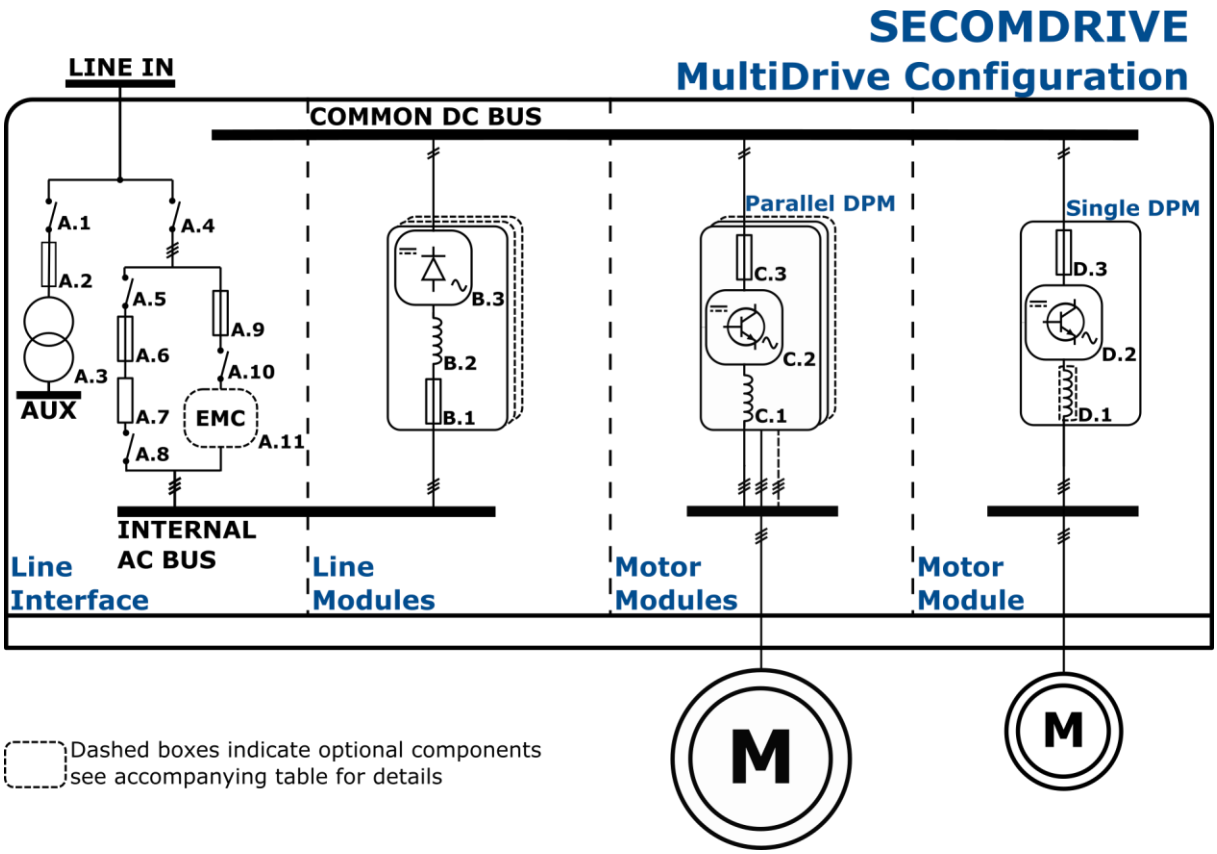



**Fig. 2-3: SECOM DRIVE for motor control and diode power rectifier as frontend**

| ITEM | Description |
|---|---|
| A.1 | Auxiliary contactor |
| A.2 | Auxiliary Fuses |
| A.3 | Auxiliary transformer |
| A.4 | Main contactor (MCB) |
| A.5 | Precharge contactor |
| A.6 | Fuses for precharge circuit |
| A.7 | Precharge resistors |
| A.8 | Precharge contactor |
| A.9 | AC fuses |
| A.10 | AC contactor |
| A.11 | EMC filter |

| ITEM | Description |
|---|---|
| B.1 | AC Fuses for bridge rectifier |
| B.2 | Filter inductance 2% |
| B.3 | Diode Rectifier Bridge |
| C.1 | Inverter decupling inductance (internal) |
| C.2 | Power parts of DPMs |
| C.3 | DC fuses, mandatory in parallel solutions |
| D.1 | Inverter decupling inductance (usually needn't in single DPM) |
| D.2 | Power parts of DPM |
| D.3 | DC fuses, mandatory only with common DC bus |

## AC/DC Fundamental Frequency Front End (F3E) Input with Motor DC/AC Drive

Fig. 2-4 is an example of unipolar scheme to connect a drive for motor control for single or multi-drive with common DC bus. The frontend is a regenerative F3E SECOM DRIVE and feed the common DC bus where all DC/AC drive are connected. In input, F3E needs an inductance. SECOM suggest 4%.
From motor side parallel configuration, no additional output inductance is normally request and no deratings too is needed. On the other hand, fuses on DC side are needed with parallel configuration.

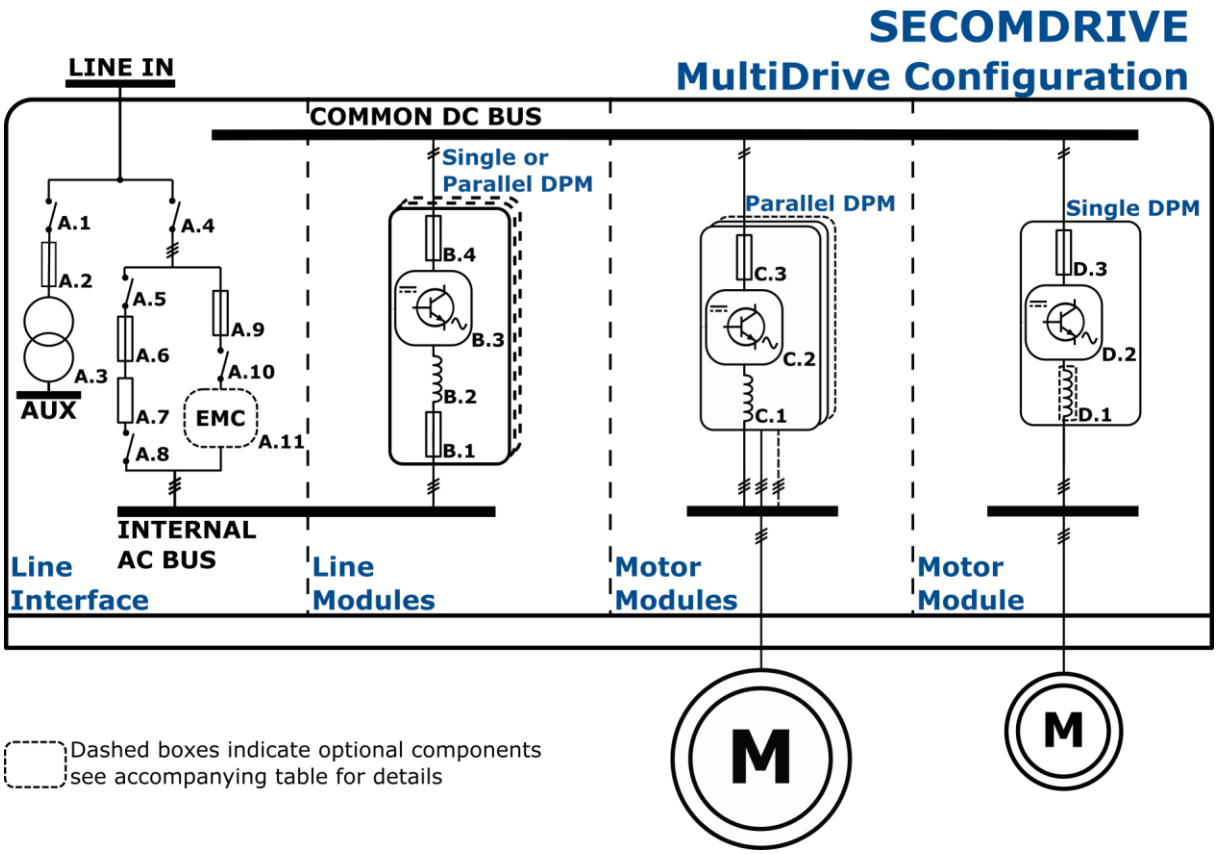



**Fig. 2-4: SECOM DRIVE for motor control and regenerative F3E frontend**

| ITEM | Description |
|---|---|
| A.1 | Auxiliary contactor |
| A.2 | Auxiliary Fuses |
| A.3 | Auxiliary transformer |
| A.4 | Main contactor (MCB) |
| A.5 | Precharge contactor |
| A.6 | Fuses for precharge circuit |
| A.7 | Precharge resistors |
| A.8 | Precharge contactor |
| A.9 | AC fuses |
| A.10 | AC contactor |
| A.11 | EMC filter |

| ITEM | Description |
|---|---|
| B.1 | AC Fuses for F3E |
| B.2 | Filter inductance 4% suggested |
| B.3 | SECOM Drive DPMs |
| B.4 | DC Fuses |
| C.1 | Inverter decupling inductance (internal) |
| C.2 | Power parts of DPMs |
| C.3 | DC fuses, mandatory in parallel solutions |
| D.1 | Inverter decupling inductance (usually needn't in single DPM) |
| D.2 | Power parts of DPM |
| D.3 | DC fuses, mandatory only with common DC bus |

## Active Front End (AFE) Input with Motor DC/AC Drive

Fig. 2-5 is an example of unipolar scheme to connect a drive for motor control for single or multi-drive with common DC bus. The frontend is a SECOM DRIVE regenerative active frontend (AFE) controlling the DC bus voltage of common DC bus. In input, AFE needs an LCL filter to achieve the IEC 519 standard directive. This kind of filters are provided by SECOM.
From motor side parallel configuration, no additional output inductance is normally request and no deratings too is needed. On the other hand, fuses on DC side are needed with parallel configuration.
In this configuration, precharge circuit must be an external circuit controlled by the main control SD-MCU.

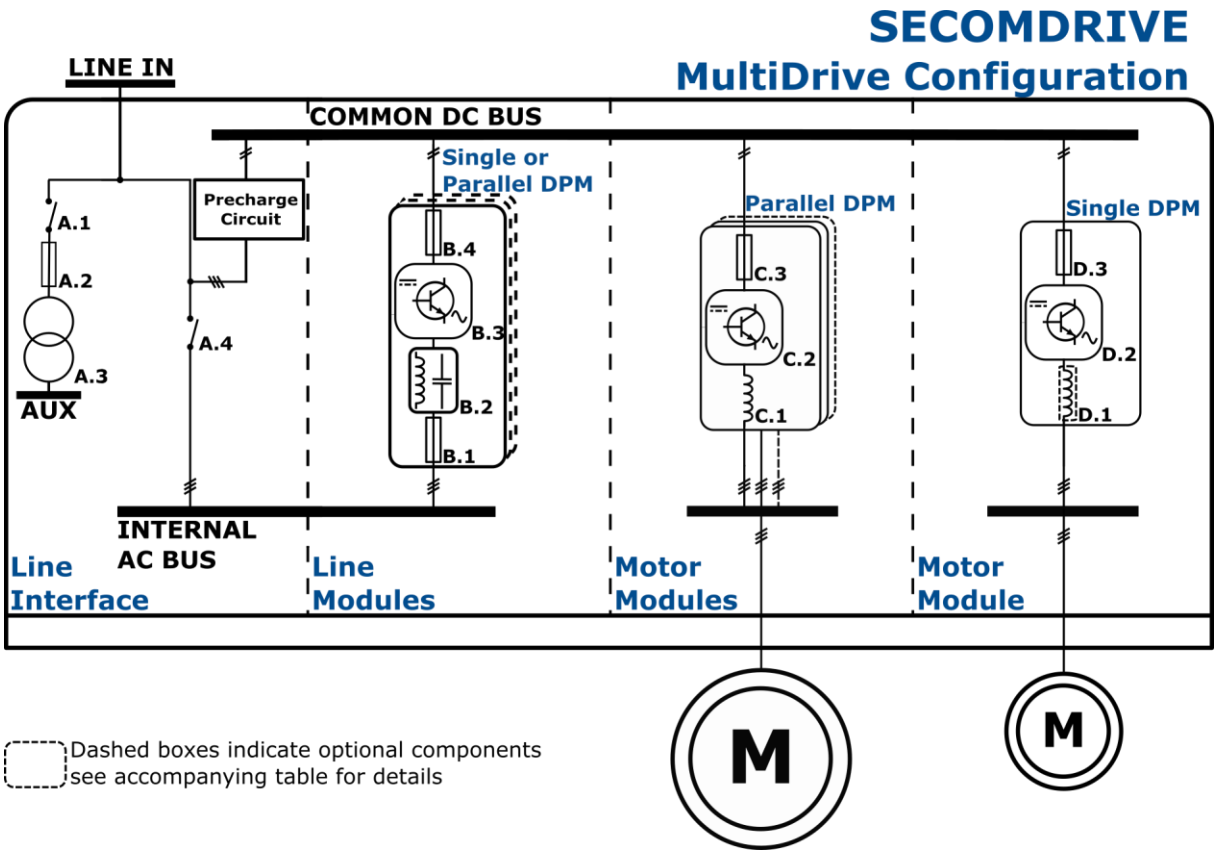



**Fig. 2-5: SECOM DRIVE for motor control and regenerative active frontend**

| ITEM | Description |
|---|---|
| A.1 | Auxiliary contactor |
| A.2 | Auxiliary Fuses |
| A.3 | Auxiliary transformer |
| A.4 | Main contactor (MCB) |
| A.5 | Precharge contactor |
| B.1 | AC Fuses for F3E |
| B.2 | Filter inductance 4% suggested |
| B.3 | SECOM Drive DPMs |
| B.4 | DC Fuses |

| ITEM | Description |
|---|---|
| C.1 | Inverter decupling inductance (internal) |
| C.2 | Power parts of DPMs |
| C.3 | DC fuses, mandatory in parallel solutions |
| D.1 | Inverter decupling inductance (usually needn't in single DPM) |
| D.2 | Power parts of DPM |
| D.3 | DC fuses, mandatory only with common DC bus |

## 2.2.2 External Control Parts

The main control unit is composed mainly by one board (SD-MCU) and optionally a panel operator (SD-OP).

### 2.2.2.1 Master Control Unit: SD-MCU

#### SD-MCU Overview

The SD-MCU (Fig. 2-6) has the following characteristics:

- Power supply: 24V
- Power consumption: 9 W
- 16 digital inputs
- 6 relays outputs
- 4 open collector outputs
- 8 analog input (±5.5 V)
  - 2 input @ ±15V fed from internal power supply, but with low power consumption (such as LEM with voltage output)
  - 6 input @ ±15V fed from external power supply to let high power consumption (such as LEM with current output)
- Can Open master and slave
- Modbus TCP master and slave
- Profibus DP slave (optional with SD-COMX10)
- ProfiNet slave (optional with SD-COMX51)
- Incremental encoder interface (optional with SD-ENC)
- Fiber optic interface to DPM

To know the details regarding all the pin-out, dimension, etc. of the board, refer to chapter 4.7


**Fig. 2-6: SD-MCU and optional items**

### 2.2.2.2 Operator Panel: SD-OP

Fig. 2-7 shows the Operator Panel. It is designed to be mounted on a front door of the cabinet, close to the SD-MCU. Fig. 2-7-b shows the hole the technician can use to fix the SD-OP to the door with self-tapping screws. Self-tapping screw are included with the operator panel.
Connect the SD-OP to the SD-MCU using an USB 2 cable Male-A – Male-B up to 6m long with ferrites on both edge. SD-OP can't remain on if USB cable is disconnected.

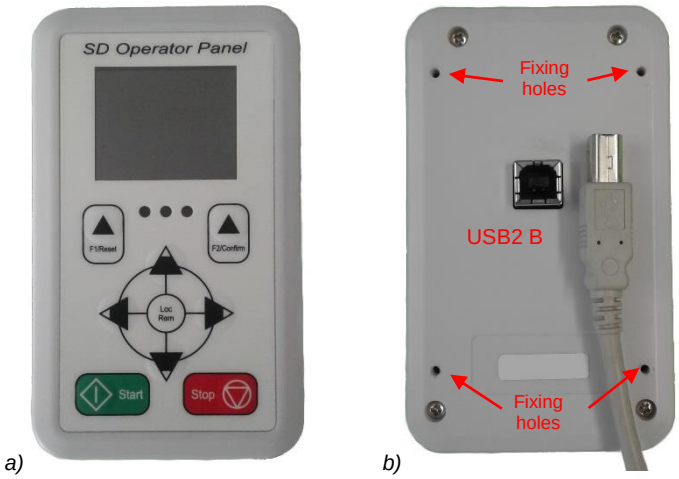



**Fig. 2-7: SD-OP – Operator Panel front (a) and back (b)**

### 2.2.2.3 Synchronization Board: SD-SYNC

SD-SYNC is an option for motor control, while is mandatory for grid application such as AFE and F3E because it is required for synchronization. The input side can stand up to 1200 $V_{peak}$. That means this board is always the same for 400V or 690V application.
To use correctly this board, phase $V_{12}$ (or $V_{RS}$) and $V_{31}$ (or $V_{TR}$) must be connected on the high voltage side. For more information about installation and wiring, refer to paragraph 4.7.5.2.

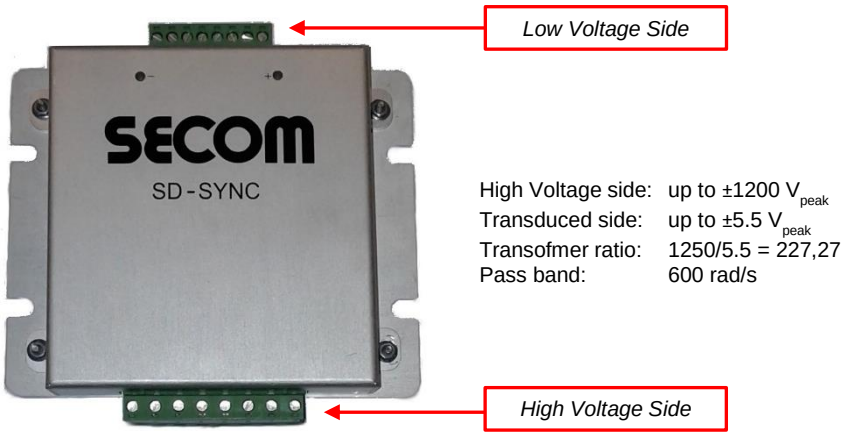



**Fig. 2-8: Synchronization Board**

# 2.3 PLATE DATA LABEL

Plate data label is structured as follow:

- AC Output is always the 3-phase output indicated with U/V/W. On the label, output is always indicated with "2", such as V2, I2, etc.
- Input is always DC for SDI/SDA/SDF products, while it is AC for SDS. In particular:
  - AC is indicated with "1", such as V1, I1, etc to indicate rated voltage, rated current and so on. Input phases are R/S/T
  - DC is indicated with "dc", such as Vdc and Idc. Input phases ar VDC+ VDC–.

Fig. 2-9 report the example with the same DPM, but different function:

1. SECOM DRIVE product logo
2. *Control code* is the name of the DPM the user has to set into the drive configuration:
   a. For Motor DC/AC control is the same of point 3 (or the power is very similar)
   b. For AFE control (SDA) is the same of Motor control, but the power is different because of the default switching frequency
3. *Drive Code* is the DPM code which represent the power, the function and the internal option of the drive
4. *ID Code* is the code the user has to communicate to SECOM to obtain a spare parts
5. *Serial Number* is an internal SECOM codification
6. *AC Output* indicates the ratings of U/V/W phases depending on the application
7. *Output* is always AC
8. *Input* could be AC or DC depending on the kind of the module (AC/AC od DC/AC)

### Input/Output for Motor Control (SDI – Fig. 2-9.A)

The output voltage *V2* can vary from 0 to the actual *Vdc*/√2. Output current I2 have three values: $I_n$ / $I_{LD}$ / $I_{HD}$; these values are referred respectively to no duty, low duty and heavy duty at 1250Hz of switching frequency. Output frequency *f2* spread from 0 to 500Hz but the maximum frequency depends on the switching frequency.
On DC side, the rated *Vdc* for motor control is the AC nominal voltage by √2. *Udc* indicate the range of voltage the drive can work.

### Input/Output for Single Drive Motor Control (SDS – Fig. 2-9.B)

The output voltage *V2* can vary from 0 to the input voltage *V1*. Input and output current I2 and I1 have three values: $I_n$ / $I_{LD}$ / $I_{HD}$; these values are referred to 1250Hz of switching frequency. Output frequency *f2* spread from 0 to 500Hz but the maximum frequency depends on the switching frequency. The input frequency can vary from 45 to 65 Hz.

### Input/Output for F3E Control (SDF – Fig. 2-9.C)

The AC output side can be connected to network of 50/60Hz. The AC current is 0.866 times less than DC input current. The DC input current has only two values: the nominal current (no duty) and the heavy duty: by design no low duty for is provided for F3E.

### Input/Output for AFE Control (SDF – Fig. 2-9.D)

The control code for AFE is the one corresponding to the AFE DPM used as motor control. In other word is the Drive Code for the DPM used at 1250Hz of switching frequency, while AFE is used at 2500Hz or more; so, the *Drive Code* report the DPM power with a deratings. For software configuration, user has to select the *Control Code* and control AFE to obtain the correct drive ratings; see SOFTWARE MANUAL for more information.
The AC output side can be connected to network of 50/60Hz. The AC current is 0.866 times less than DC input current. The DC input current has three values: the nominal current (no duty), the low duty current and the heavy duty current.

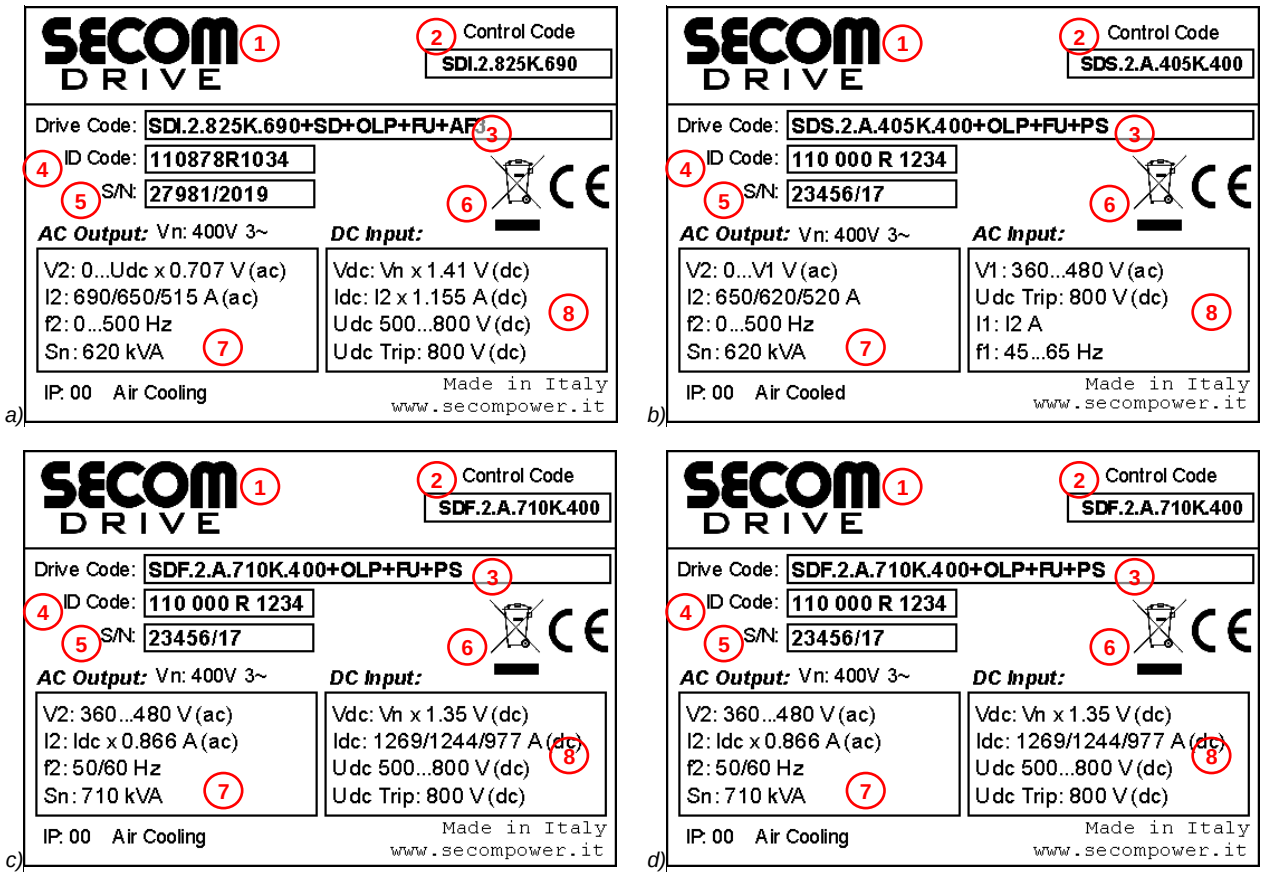



**Fig. 2-9: Plate Data example for the same DPM used as Motor DC/AC (*a*), SDS (*b*), F3E (*c*) and AFE (*d*).**

# 2.4 INVERTER SPECIFICATIONS

As already mentioned in chapter 1.4.5, the drive has to be used in indoor and controlled environment.
Table Tab. 2-3 lists all drive specifications divided for DC/AC drives and AC/AC drives.

| Electrical Data | SDI / SDA / SDF | SDS |
|---|---|---|
| AC Line input voltage (Vin) | Depending on DC power supply | 380V ÷ 480V ± 10%<br>500V ÷ 690V ± 10% |
| AC Line ouput voltage (Vout)<br>- first harmonic - | 0 ÷ Vdc/√2 standard modulation<br>0 ÷ Vdc·0.86 overmodulation[2] | 0 ÷ Vin standard modulation<br>0 ÷ Vin·1.2 overmodulation[2] |
| DC voltage Trip threshold ($Vdc_{Trip}$) | 820V for SD*x.x.x.x*.400<br>1200V for SD*x.x.x.x*.690 | |
| DC voltage allowed range (Vdc) | Vin·√2 ÷ 90%$Vdc_{Trip}$ (not continually) | |
| Continually DC voltage | Vin·1.5 | |
| Input frequency range | / | 45 ÷ 65 Hz |
| Output frequency range | For motor application: 0 ÷ 500 Hz (@5kHz of switching frequency)<br>For grid application: 50/60Hz | |
| Interface DPM Power Supply | 24Vdc (21V ÷ 27V) @ 2.5 A | |
| SD-MCU power supply | 24Vdc @ 1A without analog supply | |
| STO SIL3 | STO: 24Vdc – 20mA for each channel | |
| Fan Power Supply | 400V ÷ 440V ~3AC 1450W 50Hz, 3.6A<br>480V ~3AC 1450W 60Hz, 3.5A<br>230V ~1AC 400W 50Hz, 2.5A | |

[2] This is the value of the first harmonic. Even if it seems better than standard modulation, the drawbacks are an increase in harmonic distortion and a loss in control performance. Moreover, an LCL filter may be resonant.

| | | |
|---|---|---|
| Bars material | Copper (Cu) or aluminum (Al), depending on the drive size | |
| **Mechanical Data** | **SDI / SDA / SDF** | **SDS** |
| Vibration stress | EN 60721-3-3 Class 3M1 compliant<br>EN 60068-2-6 | |
| Shock | EN 60068-2-27 compliant<br>Not allowed during operation or without packaging | |
| Free fall | Not allowed | |
| Ingress protection rating EN60529 | IP20 for the removable frame type<br>IP00 for the open frame type | |
| Cooling system | Forced air with internal Fan | |
| Heat | See paragraph 2.5.1, 2.5.3, 2.5.4 | |
| Weight | SDI/SDF/SDA/SDS.2 up to 178kg<br>SDI/SDF/SDA/SDS.3 up to 100kg | |
| **Environment Conditions** | **SDI / SDA / SDF** | **SDS** |
| Pollution degree | 2 or lower (free from corrosive fumes, inflammable gasses, fog, vapor oil or dipped water)<br>- Avoid marine environment<br>- No conductive dust allowed | |
| Relative humidity | For storage: EN 60721-3-1 class 1K3 for relative humidity<br>During operation: EN 60721-3-3 class 3M1 for relative humidity<br>No condensation allowed.<br>Max 95% in normal conditions<br>Max 60% with aggressive environment | |
| Ambient temperature | 0°C ÷ 40°C without derating<br>40°C ÷ 60°C with derating (see Fig. 2-10) | |
| Altitude installation | Up to 2000m above sea level with no derating<br>>2000m with derating (see Fig. 2-11) | |
| **Safety Function** | **SDI / SDA / SDF** | **SDS** |
| STO SIL3 | On SD-RMU, 2 independent input channels (24Vdc or pulsed 80% on 10ms of period) | |

**Tab. 2-3: Inverter Hardware Specifications**

Tab. 2-4 report the main characteristics of the control system divided by motor control (induction motor) and grid control. Depending on the application, other function (called MACRO Function) can be enabled. For all the information about MACRO function, please refer to SOFTWARE MANUAL.

**INDUCTION MOTOR CONTROL HIGHLIGHTS**

| Device Options: | | Encoder | Output Voltage sensor | Output LC filter | DC Voltage accuracy | Vdc Response | Transient current Response | 1° Harmonic Current Accuracy | Transient Speed response | Speed Accuracy |
|---|---|---|---|---|---|---|---|---|---|---|
| V/Hz | Scalar | Option* | Option | Option | - | - | Slow | < 1% | Slow | 1% |
| | Open loop | Option* | Option | Option | High | slow | Fast | < 1% | Fast | < 1% |
| | Closed loop | Option* | Option | Option | High | slow | Fast | < 1% | Fast | < 1% |
| Field Oriented (FOC) | | Yes | Option | Option | High | fast | Very fast | < 1% | Very fast | < 0.01% |
| Sensorless (FOC) | | Option† | Option | Option | High | fast | Very fast | < 1% | Very fast | < 0.3%Π |

**GRID CONTROL HIGHLIGHTS**

| Device Options: | Output Voltage sensor | Output LC filter | DC Voltage accuracy | Transient DC Voltage Response | Transient current Response | 1° Harmonic Current Accuracy | Active current control | Reactive current control | Grid parallel |
|---|---|---|---|---|---|---|---|---|---|
| AFE | Yes | Yes/Option‡ | < 1% | Very Fast | Very Fast | < 1% | Yes | Yes | Yes |
| F3E | Yes | Option | - | Very Fast | - | - | - | No | Yes |
| $V_{AC}$ Gen. | Option | Option‡ | - | - | Very Fast | < 1% | - | - | No |

* Only for speed measuring. No control functions are associated
† For speed measuring or option function such as losing encoder: the control system switch to the speed estimator on the fly and vice versa
Π With speed > 3%
‡ Mandatory to be compliant with IEEE 519 directive

**Tab. 2-4: Control Application Highlights**

# 2.5 TECHNICAL DATA AND SIZE

SECOM DRIVEs have different rated data depending on duty (overload class), switching frequency and voltage ratings.
Tables in this chapter list all the variation of rated data of each size. As mentioned in 2.1, a Drive Size is a combination of DPM in parallel. In each size is indicated how much DPM are connected, but other DPM combinations are possible up to 8 module in parallel.

### Default Duty

Thermal behavior of the drive is supposed to reach the steady state in about 5 minutes (300s). If the load duty of the machinery driven by inverter lasts more than 5 minutes, inverter is supposed to work in continuative duty.
Each DPM, and consequently the whole inverter, has tree configurable duty:

- Continuative duty (Class 0) Called $I_N$ the nominal current, only $I_N$ is allowed continually with (theoretically) no overload.
- Low Duty (Class 1) Called $I_{LD}$ the nominal current, the duty consist of 110% of $I_{LD}$ for 60s, 100% of $I_{LD}$ for 240s.
- High Duty (Class 2) Called $I_{HD}$ the nominal current, the duty consist of 150% of $I_{HD}$ for 60s, 100% of $I_{HD}$ for 240s.

**NOTE**: maximum allowed current by the inverter is higher than during overload. If the load configuration exceed the maximum inverter current, the control system (AFE and Inverter) will clamp the reference current to this limit. F3E can't regulate the current, so an *Overcurrent* trip may occur.

**NOTE**: even if user configure a duty, the drive will regulate the current to the limit set by the load. In other words, the current limit depends on the load configuration, which means that the current could be more than the value of current during overload phase. This situation leads to reduce the overload time. When the overload time expired, SECOM CONTROL unit suppose the drive is in overloaded condition and only now the current will be limited to the nominal value of the class until the drive will be no longer overloaded.

### How to read tables below

- Same colors row indicate the same DPMs.
- The number of DPM in parallel for standard size, are indicated into DIMENSION column.
- Columns meaning are:
  - **$S_N$**: apparent power
  - **$I_N$**: class 0 nominal AC current (continuative duty)
  - **$I_{DCN}$**: class 0 nominal DC current (continuative duty)
  - **$P_N$**: class 0 estimated rated power of induction motor (continuative duty)
  - **$I_{LD}$**: class 1 nominal AC current (low duty)
  - **$I_{DC\ LD}$**: class 1 nominal DC current (low duty)
  - **$P_{LD}$**: class 1 estimated rated power of induction motor (low duty)
  - **$I_{HD}$**: class 2 nominal AC current (heavy duty)
  - **$I_{DC\ HD}$**: class 2 nominal DC current (heavy duty)
  - **$P_{HD}$**: class 2 estimated rated power of induction motor (heavy duty)
  - **Heat Loss**: power dissipation due to efficiency
  - **Air flow**: air flow due to cooling system
  - **CP**: Converter Parallel, which mean DPM in parallel

Low Duty (LD): 1 minute at 110% every 5 minute
Heavy Duty (HD): 1 minute at 150% every 5 minute

Dimension:

- 1 x SDF.4.A.xxxx = 245 x 630 x 500 (W x H x D)
- 1 x SDF.3.A.xxxx = 245 x 830 x 500 (W x H x D)
- 1 x SDF.2.A.xxxx = 245 x 1398 x 650 (W x H x D)

Note: Water cooled and air cooling version have the same ratings.

## 2.5.1 Inverter – Rated Data – SDI

The following table lists the inverter with rated voltage 400V, but it is usable between 360V and 480V. A derating coefficient must be applied to obtain the real current with higher switching frequency (see Tab. 2-7 and section 2.5.5.3).

| CODE Vn: 360÷480 V | SN [kVA] | IN [A] | ILD [A] | IHD [A] | PN [kW] | PLD [kW] | PHD [kW] | HEAT LOSS [kW] | AIR FLOW [m³/h] | CP |
|---|---|---|---|---|---|---|---|---|---|---|
| SDI.4.A.030K.400 | 29 | 42 | 37 | 32 | 23 | 21 | 18 | 0,4 | 200 | 1 |
| SDI.4.A.040K.400 | 40 | 58 | 51 | 44 | 31 | 30 | 25 | 0,6 | 300 | 1 |
| SDI.4.A.055K.400 | 52 | 75 | 67 | 56 | 42 | 38 | 32 | 0,8 | 400 | 1 |
| SDI.4.A.070K.400 | 73 | 105 | 96 | 82 | 54 | 54 | 47 | 1,1 | 500 | 1 |
| SDI.4.A.085K.400 | 87 | 125 | 115 | 98 | 66 | 65 | 56 | 1,3 | 500 | 1 |
| SDI.3.A.110K.400 | 110 | 159 | 145 | 115 | 80 | 80 | 70 | 1,6 | 700 | 1 |
| SDI.3.A.166K.400 | 166 | 240 | 220 | 170 | 132 | 132 | 110 | 2,4 | 800 | 1 |
| SDI.3.A.230K.400 | 229 | 330 | 310 | 230 | 160 | 132 | 132 | 3,3 | 1100 | 1 |
| SDI.2.A.290K.400 | 291 | 420 | 410 | 330 | 250 | 250 | 200 | 4,2 | 1750 | 1 |
| SDI.2.A.350K.400 | 353 | 510 | 500 | 410 | 300 | 300 | 250 | 5,1 | 1750 | 1 |
| SDI.2.A.450K.400 | 450 | 650 | 620 | 520 | 400 | 350 | 300 | 6,5 | 1750 | 1 |
| SDI.2.A.520K.400 | 520 | 750 | 710 | 570 | 500 | 450 | 350 | 7,5 | 1750 | 1 |
| SDI.2.A.575K.400 | 579 | 835 | 780 | 600 | 560 | 500 | 450 | 8,4 | 1750 | 1 |
| SDI.2.A.874K.400 | 874 | 1261 | 1203 | 1009 | 800 | 700 | 600 | 12,6 | 3500 | 2 |
| SDI.2.A.1M00.400 | 1008 | 1455 | 1377 | 1106 | 1000 | 900 | 700 | 14,6 | 3500 | 2 |
| SDI.2.A.1M12.400 | 1122 | 1620 | 1513 | 1164 | 1120 | 1000 | 900 | 16,2 | 3500 | 2 |
| SDI.2.A.1M50.400 | 1512 | 2182 | 2066 | 1659 | 2400 | 2100 | 1800 | 21,8 | 5250 | 3 |
| SDI.2.A.1M68.400 | 1683 | 2429 | 2270 | 1746 | 3000 | 2700 | 2100 | 24,3 | 5250 | 3 |
| SDI.2.A.2M24.400 | 2245 | 3240 | 3026 | 2328 | 4480 | 4000 | 3600 | 32,4 | 7000 | 4 |
| SDI.2.A.2M80.400 | 2806 | 4050 | 3783 | 2910 | 12000 | 10500 | 9000 | 40,5 | 8750 | 5 |
| SDI.2.A.3M35.400 | 3367 | 4860 | 4540 | 3492 | 18000 | 16200 | 12600 | 48,6 | 10500 | 6 |
| SDI.2.A.3M90.400 | 3928 | 5670 | 5296 | 4074 | 31360 | 28000 | 25200 | 56,7 | 12250 | 7 |
| SDI.2.A.4M45.400 | 4489 | 6480 | 6053 | 4656 | 96000 | 84000 | 72000 | 64,8 | 14000 | 8 |

**Tab. 2-5: Inverter Rated Data (360V÷480V)**

The following table lists the inverter with rated voltage 690V, but it is usable between 500V and 690V. A derating coefficient must be applied to obtain the real current with higher switching frequency (see Tab. 2-7 and section 2.5.5.3).

| CODE Vn: 500÷690 V | SN [kVA] | IN [A] | ILD [A] | IHD [A] | PN [kW] | PLD [kW] | PHD [kW] | HEAT LOSS [kW] | AIR FLOW [m³/h] | CP |
|---|---|---|---|---|---|---|---|---|---|---|
| SDI.4.A.050K.690 | 50 | 42 | 37 | 32 | 40 | 36 | 31 | 0,5 | 200 | 1 |
| SDI.4.A.070K.690 | 70 | 58 | 51 | 44 | 54 | 52 | 43 | 0,8 | 300 | 1 |
| SDI.4.A.090K.690 | 90 | 75 | 67 | 56 | 73 | 66 | 55 | 1,0 | 400 | 1 |
| SDI.4.A.125K.690 | 125 | 105 | 96 | 82 | 93 | 93 | 81 | 1,4 | 500 | 1 |
| SDI.4.A.150K.690 | 150 | 125 | 115 | 98 | 114 | 112 | 97 | 1,6 | 500 | 1 |
| SDI.3.A.190K.690 | 185 | 159 | 145 | 115 | 132 | 132 | 120 | 2,1 | 700 | 1 |
| SDI.3.A.280K.690 | 280 | 240 | 220 | 170 | 228 | 228 | 190 | 3,1 | 800 | 1 |
| SDI.3.A.310K.690 | 310 | 260 | 245 | 202 | 277 | 228 | 228 | 3,4 | 1100 | 1 |
| SDI.2.A.460K.690 | 460 | 390 | 365 | 290 | 400 | 355 | 315 | 5,1 | 1750 | 1 |
| SDI.2.A.560K.690 | 560 | 470 | 440 | 370 | 500 | 450 | 355 | 6,1 | 1750 | 1 |
| SDI.2.A.710K.690 | 710 | 590 | 550 | 440 | 560 | 560 | 450 | 7,7 | 1750 | 1 |
| SDI.2.A.825K.690 | 825 | 690 | 650 | 515 | 710 | 630 | 560 | 9,0 | 1750 | 1 |
| SDI.2.A.1M00.690 | 1000 | 835 | 780 | 590 | 800 | 710 | 630 | 10,9 | 1750 | 1 |
| SDI.2.A.1M36.690 | 1368 | 1145 | 1067 | 854 | 1120 | 1120 | 900 | 14,9 | 3500 | 2 |
| SDI.2.A.1M60.690 | 1600 | 1339 | 1261 | 999 | 1420 | 1260 | 1120 | 17,4 | 3500 | 2 |
| SDI.2.A.1M93.690 | 1936 | 1620 | 1513 | 1145 | 1600 | 1420 | 1260 | 21,1 | 3500 | 2 |
| SDI.2.A.2M40.690 | 2400 | 2008 | 1892 | 1499 | 2130 | 1890 | 1680 | 26,1 | 5250 | 3 |
| SDI.2.A.2M90.690 | 2904 | 2430 | 2270 | 1717 | 2400 | 2130 | 1890 | 31,6 | 5250 | 3 |
| SDI.2.A.3M85.690 | 3872 | 3240 | 3026 | 2289 | 3200 | 2840 | 2520 | 42,1 | 7000 | 4 |
| SDI.2.A.4M85.690 | 4840 | 4050 | 3783 | 2862 | 4000 | 3550 | 3150 | 52,6 | 8750 | 5 |
| SDI.2.A.5M80.690 | 5808 | 4860 | 4540 | 3434 | 4800 | 4260 | 3780 | 63,2 | 10500 | 6 |
| SDI.2.A.6M75.690 | 6776 | 5670 | 5296 | 4006 | 5600 | 4970 | 4410 | 73,7 | 12250 | 7 |
| SDI.2.A.7M70.690 | 7744 | 6480 | 6053 | 4578 | 6400 | 5680 | 5040 | 84,2 | 14000 | 8 |

**Tab. 2-6: Inverter Rated Data (500V÷690V)**

The following table lists the derating coefficients due to switching frequency to multiply each current value of inverter ratings above. Low voltage SECOM Drive have 4 standard switching frequency, but the user can vary it from a minimum of 1250 Hz to 5000 Hz with a resolution of 1 Hz via software using SDM. These coefficients will be automatically adapted.

| CODE Vn: 360÷480 V | K 1.25 kHz | K 2 kHz | K 2.5 kHz | K 3.5 kHz | K 5 kHz |
|---|---|---|---|---|---|
| SDI.4.A.030K.400 | 1,00 | 0,77 | 0,64 | 0,44 | 0,24 |
| SDI.4.A.040K.400 | 1,00 | 0,77 | 0,64 | 0,44 | 0,24 |
| SDI.4.A.055K.400 | 1,00 | 0,77 | 0,64 | 0,44 | 0,24 |
| SDI.4.A.070K.400 | 1,00 | 0,77 | 0,64 | 0,44 | 0,24 |
| SDI.4.A.085K.400 | 1,00 | 0,77 | 0,64 | 0,44 | 0,24 |
| SDI.3.A.100K.400 | 1,23 | 1,00 | 0,89 | 0,70 | 0,45 |
| SDI.3.A.160K.400 | 1,23 | 1,00 | 0,89 | 0,70 | 0,45 |
| SDI.3.A.200K.400 | 1,27 | 1,00 | 0,87 | 0,62 | 0,35 |
| SDI.2.A.290K.400 | | 1,00 | 0,90 | 0,71 | 0,59 |
| SDI.2.A.350K.400 | | 1,00 | 0,90 | 0,71 | 0,59 |
| SDI.2.A.450K.400 | | 1,00 | 0,90 | 0,71 | 0,59 |
| SDI.2.A.540K.400 | | 1,00 | 0,90 | 0,71 | 0,59 |
| SDI.2.A.620K.400 | | 1,00 | 0,90 | 0,71 | 0,59 |
| SDI.2.A.900K.400 | | 1,00 | 0,90 | 0,71 | 0,59 |
| SDI.2.A.1M08.400 | | 1,00 | 0,90 | 0,71 | 0,59 |
| SDI.2.A.1M24.400 | | 1,00 | 0,90 | 0,71 | 0,59 |
| SDI.2.A.1M62.400 | | 1,00 | 0,90 | 0,71 | 0,59 |
| SDI.2.A.1M86.400 | | 1,00 | 0,90 | 0,71 | 0,59 |
| SDI.2.A.2M48.400 | | 1,00 | 0,90 | 0,71 | 0,59 |
| SDI.2.A.3M10.400 | | 1,00 | 0,90 | 0,71 | 0,59 |
| SDI.2.A.3M72.400 | | 1,00 | 0,90 | 0,71 | 0,59 |
| SDI.2.A.4M34.400 | | 1,00 | 0,90 | 0,71 | 0,59 |
| SDI.2.A.4M96.400 | | 1,00 | 0,90 | 0,71 | 0,59 |

| CODE Vn: 500÷690 V | K 1.25 kHz | K 2 kHz | K 2.5 kHz | K 3.5 kHz | K 5 kHz |
|---|---|---|---|---|---|
| SDI.4.A.050K.690 | 1,00 | 0,77 | 0,64 | 0,44 | 0,24 |
| SDI.4.A.070K.690 | 1,00 | 0,77 | 0,64 | 0,44 | 0,24 |
| SDI.4.A.090K.690 | 1,00 | 0,77 | 0,64 | 0,44 | 0,24 |
| SDI.4.A.125K.690 | 1,00 | 0,77 | 0,64 | 0,44 | 0,24 |
| SDI.4.A.150K.690 | 1,00 | 0,77 | 0,64 | 0,44 | 0,24 |
| SDI.3.A.190K.690 | 1,23 | 1,00 | 0,89 | 0,70 | 0,45 |
| SDI.3.A.280K.690 | 1,23 | 1,00 | 0,89 | 0,70 | 0,45 |
| SDI.3.A.310K.690 | 1,27 | 1,00 | 0,87 | 0,62 | 0,35 |
| SDI.2.A.460K.690 | 1,00 | 0,84 | 0,75 | 0,59 | 0,36 |
| SDI.2.A.560K.690 | 1,00 | 0,84 | 0,75 | 0,59 | 0,36 |
| SDI.2.A.710K.690 | 1,00 | 0,84 | 0,75 | 0,59 | 0,36 |
| SDI.2.A.825K.690 | 1,00 | 0,84 | 0,75 | 0,59 | 0,36 |
| SDI.2.A.1M00.690 | 1,00 | 0,87 | 0,78 | 0,59 | 0,36 |
| SDI.2.A.1M36.690 | 1,00 | 0,84 | 0,75 | 0,59 | 0,36 |
| SDI.2.A.1M60.690 | 1,00 | 0,84 | 0,75 | 0,59 | 0,36 |
| SDI.2.A.1M93.690 | 1,00 | 0,87 | 0,78 | 0,59 | 0,36 |
| SDI.2.A.2M40.690 | 1,00 | 0,84 | 0,75 | 0,59 | 0,36 |
| SDI.2.A.2M90.690 | 1,00 | 0,87 | 0,78 | 0,59 | 0,36 |
| SDI.2.A.3M85.690 | 1,00 | 0,87 | 0,78 | 0,59 | 0,36 |
| SDI.2.A.4M85.690 | 1,00 | 0,87 | 0,78 | 0,59 | 0,36 |
| SDI.2.A.5M80.690 | 1,00 | 0,87 | 0,78 | 0,59 | 0,36 |
| SDI.2.A.6M75.690 | 1,00 | 0,87 | 0,78 | 0,59 | 0,36 |
| SDI.2.A.7M70.690 | 1,00 | 0,87 | 0,78 | 0,59 | 0,36 |

**Tab. 2-7: Inverter derating coefficient due to switching frequency for 400V and 690V sizes**

## 2.5.2 Single Drive – Rated Data – SDS

Single Drive (SDS) has an integrated semi-controlled diode bridge. Tab. 2-8 and Tab. 2-9 list the SDS ratings.

| CODE Vn: 360÷480 V | SN [kVA] | IN [A] | ILD [A] | IHD [A] | PN [kW] | PLD [kW] | PHD [kW] | HEAT LOSS [kW] | AIR FLOW [m³/h] | CP |
|---|---|---|---|---|---|---|---|---|---|---|
| SDS.3.A.110K.400 | 111 | 159 | 145 | 115 | 108 | 107 | 100 | 1,6 | 700 | 1 |
| SDS.3.A.166K.400 | 167 | 240 | 220 | 170 | 162 | 158 | 151 | 2,4 | 800 | 1 |
| SDS.3.A.230K.400 | 229 | 330 | 310 | 230 | 222 | 214 | 207 | 3,3 | 1100 | 1 |
| SDS.2.A.260K.400 | 291 | 420 | 410 | 330 | 282 | 307 | 263 | 4,2 | 1750 | 1 |
| SDS.2.A.315K.400 | 353 | 510 | 500 | 410 | 342 | 382 | 319 | 5,1 | 1750 | 1 |
| SDS.2.A.405K.400 | 450 | 650 | 620 | 520 | 437 | 484 | 407 | 6,5 | 1750 | 1 |
| SDS.2.A.495K.400 | 499 | 720 | 680 | 540 | 484 | 503 | 451 | 7,2 | 1750 | 1 |
| SDS.2.A.545K.400 | 547 | 790 | 740 | 560 | 531 | 522 | 494 | 7,9 | 1750 | 1 |

**Tab. 2-8: Single Drive Inverter Rated Data (360V÷480V)**

| CODE Vn: 500÷690 V | SN [kVA] | IN [A] | ILD [A] | IHD [A] | PN [kW] | PLD [kW] | PHD [kW] | HEAT LOSS [kW] | AIR FLOW [m³/h] | CP |
|---|---|---|---|---|---|---|---|---|---|---|
| SDS.3.A.190K.690 | 190 | 159 | 145 | 115 | 184 | 135 | 107 | 1,6 | 700 | 1 |
| SDS.3.A.285K.690 | 287 | 240 | 220 | 170 | 278 | 205 | 158 | 2,4 | 800 | 1 |
| SDS.3.A.310K.690 | 311 | 260 | 245 | 202 | 302 | 228 | 188 | 2,6 | 1100 | 1 |
| SDS.2.A.375K.690 | 466 | 390 | 365 | 290 | 452 | 340 | 270 | 3,9 | 1750 | 1 |
| SDS.2.A.560K.690 | 562 | 470 | 440 | 370 | 545 | 410 | 345 | 4,7 | 1750 | 1 |
| SDS.2.A.705K.690 | 705 | 590 | 550 | 440 | 684 | 512 | 410 | 5,9 | 1750 | 1 |
| SDS.2.A.825K.690 | 825 | 690 | 650 | 515 | 800 | 605 | 480 | 6,9 | 1750 | 1 |
| SDS.2.A.930K.690 | 932 | 780 | 733 | 555 | 904 | 683 | 517 | 7,8 | 1750 | 1 |

**Tab. 2-9: Single Drive Inverter Rated Data (500V÷690V)**

With various switching frequency, SDS has the derating factor reported in Tab. 2-10. The coefficient is 1 when it refers to the nominal switching frequency. The Drive Rated Power is referred to the nominal switching frequency.

| CODE Vn: 360÷480 V | K 1.25 kHz | K 2 kHz | K 2.5 kHz | K 3.5 kHz | K 5 kHz |
|---|---|---|---|---|---|
| SDS.3.A.110K.400 | 1,061 | 1,00 | 0,91 | 0,77 | 0,64 |
| SDS.3.A.166K.400 | 1,061 | 1,00 | 0,91 | 0,77 | 0,64 |
| SDS.3.A.230K.400 | 1,061 | 1,00 | 0,91 | 0,77 | 0,64 |
| SDS.2.A.260K.400 | | 1,00 | 0,90 | 0,71 | 0,59 |
| SDS.2.A.315K.400 | | 1,00 | 0,90 | 0,71 | 0,59 |
| SDS.2.A.405K.400 | | 1,00 | 0,90 | 0,71 | 0,59 |
| SDS.2.A.495K.400 | | 1,00 | 0,90 | 0,71 | 0,59 |
| SDS.2.A.545K.400 | | 1,00 | 0,90 | 0,71 | 0,59 |

| CODE Vn: 500÷690 V | K 1.25 kHz | K 2 kHz | K 2.5 kHz | K 3.5 kHz | K 5 kHz |
|---|---|---|---|---|---|
| SDS.3.A.190K.690 | 1,061 | 1,00 | 0,91 | 0,77 | 0,64 |
| SDS.3.A.285K.690 | 1,061 | 1,00 | 0,91 | 0,77 | 0,64 |
| SDS.3.A.310K.690 | 1,061 | 1,00 | 0,91 | 0,77 | 0,64 |
| SDS.2.A.375K.690 | | 1,00 | 0,90 | 0,71 | 0,59 |
| SDS.2.A.560K.690 | | 1,00 | 0,90 | 0,71 | 0,59 |
| SDS.2.A.705K.690 | | 1,00 | 0,90 | 0,71 | 0,59 |
| SDS.2.A.825K.690 | | 1,00 | 0,90 | 0,71 | 0,59 |
| SDS.2.A.930K.690 | | 1,00 | 0,90 | 0,71 | 0,59 |

**Tab. 2-10: Single Drive Inverter derating coefficient due to switching frequency for 400V and 690V sizes**

## 2.5.3 AFE – Rated Data – SDA

Minimum switching frequency of AFE with LCL filter is 2500 Hz and default DC Voltage reference is 1.5·Vac. Nominal voltage is 400V. The following tables are used for the selection of power module SDA. On the name plate of power module will be indicated the SDA (AFE) code with his ratings and the Inverter code too for selecting the drive size via Secom Drive Manager (SDM) or Operator Panel (SD-OP).

| CODE Vn: 360÷480 V | SN [kVA] | IN [A] | ILD [A] | IHD [A] | IDCN [A] | IDC LD [A] | IDC HD [A] | PDCN [kW] | PDC LD [kW] | PDC HD [kW] | HEAT LOSS [kW] | AIR FLOW [m³/h] | CP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SDA.4.A.019K.400 | 19 | 27 | 23,7 | 20,5 | 30 | 27 | 23 | 19 | 16 | 14 | 0,3 | 200 | 1 |
| SDA.4.A.026K.400 | 26 | 37 | 32,6 | 28,2 | 42 | 37 | 32 | 25 | 22 | 19 | 0,4 | 300 | 1 |
| SDA.4.A.034K.400 | 34 | 48 | 42,9 | 35,8 | 54 | 49 | 41 | 33 | 29 | 24 | 0,5 | 400 | 1 |
| SDA.4.A.047K.400 | 47 | 67 | 61,4 | 52,5 | 76 | 70 | 59 | 46 | 42 | 36 | 0,7 | 500 | 1 |
| SDA.4.A.056K.400 | 56 | 80 | 73,6 | 62,7 | 91 | 83 | 71 | 55 | 50 | 43 | 0,8 | 500 | 1 |
| SDA.3.A.098K.400 | 98 | 141 | 129 | 102 | 159 | 145 | 115 | 96 | 87 | 69 | 1,4 | 700 | 1 |
| SDA.3.A.148K.400 | 148 | 213 | 195 | 151 | 241 | 221 | 171 | 145 | 132 | 102 | 2,1 | 800 | 1 |
| SDA.3.A.200K.400 | 200 | 286 | 268 | 199 | 323 | 304 | 225 | 196 | 182 | 135 | 2,9 | 1100 | 1 |
| SDA.2.A.264K.400 | 264 | 380 | 370 | 298 | 429 | 419 | 337 | 259 | 252 | 202 | 4,2 | 1750 | 1 |
| SDA.2.A.320K.400 | 320 | 461 | 452 | 370 | 522 | 511 | 419 | 314 | 307 | 252 | 5,1 | 1750 | 1 |
| SDA.2.A.408K.400 | 408 | 587 | 560 | 470 | 665 | 634 | 532 | 400 | 380 | 319 | 6,5 | 1750 | 1 |
| SDA.2.A.470K.400 | 470 | 678 | 642 | 515 | 767 | 726 | 583 | 461 | 436 | 350 | 7,5 | 1750 | 1 |
| SDA.2.A.524K.400 | 524 | 755 | 705 | 542 | 854 | 798 | 614 | 514 | 479 | 368 | 8,4 | 1750 | 1 |
| SDA.2.A.790K.400 | 790 | 1139 | 1087 | 912 | 1329 | 1268 | 1063 | 774 | 761 | 638 | 11,4 | 3500 | 2 |
| SDA.2.A.911K.400 | 911 | 1315 | 1245 | 999 | 1534 | 1452 | 1166 | 893 | 871 | 699 | 13,1 | 3500 | 2 |
| SDA.2.A.1M01.400 | 1014 | 1464 | 1367 | 1052 | 1708 | 1595 | 1227 | 994 | 957 | 736 | 14,6 | 3500 | 2 |
| SDA.2.A.1M37.400 | 1367 | 1972 | 1867 | 1499 | 2301 | 2178 | 1749 | 1340 | 1307 | 1049 | 19,7 | 5250 | 3 |
| SDA.2.A.1M52.400 | 1521 | 2196 | 2051 | 1578 | 2562 | 2393 | 1841 | 1491 | 1436 | 1104 | 22,0 | 5250 | 3 |
| SDA.2.A.2M03.400 | 2029 | 2928 | 2735 | 2104 | 3415 | 3190 | 2454 | 1988 | 1914 | 1472 | 29,3 | 7000 | 4 |
| SDA.2.A.2M54.400 | 2536 | 3659 | 3418 | 2630 | 4269 | 3988 | 3068 | 2485 | 2393 | 1841 | 36,6 | 8750 | 5 |
| SDA.2.A.3M04.400 | 3043 | 4391 | 4102 | 3155 | 5123 | 4786 | 3681 | 2982 | 2871 | 2209 | 43,9 | 10500 | 6 |
| SDA.2.A.3M55.400 | 3550 | 5123 | 4786 | 3681 | 5977 | 5583 | 4295 | 3479 | 3350 | 2577 | 51,2 | 12250 | 7 |
| SDA.2.A.4M06.400 | 4057 | 5855 | 5469 | 4207 | 6831 | 6381 | 4908 | 3976 | 3828 | 2945 | 58,6 | 14000 | 8 |

**Tab. 2-11: AFE Rated Data (360V÷480V) @ 2500 Hz of switching frequency**

Nominal voltage of the following AFE is 690V.

| CODE Vn: 500÷690 V | SN [kVA] | IN [A] | ILD [A] | IHD [A] | IDCN [A] | IDC LD [A] | IDC HD [A] | PDCN [kW] | PDC LD [kW] | PDC HD [kW] | HEAT LOSS [kW] | AIR FLOW [m³/h] | CP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SDA.4.A.033K.690 | 33 | 27 | 24 | 20 | 30 | 27 | 23 | 32 | 28 | 24 | 0,5 | 200 | 1 |
| SDA.4.A.045K.690 | 45 | 37 | 33 | 28 | 42 | 37 | 32 | 44 | 38 | 33 | 0,8 | 300 | 1 |
| SDA.4.A.058K.690 | 58 | 48 | 43 | 36 | 54 | 49 | 41 | 57 | 50 | 42 | 1,0 | 400 | 1 |
| SDA.4.A.081K.690 | 81 | 67 | 61 | 52 | 76 | 70 | 59 | 79 | 72 | 61 | 1,4 | 500 | 1 |
| SDA.4.A.097K.690 | 97 | 80 | 74 | 63 | 91 | 83 | 71 | 95 | 86 | 73 | 1,6 | 500 | 1 |
| SDA.3.A.164K.690 | 164 | 141 | 129 | 102 | 159 | 145 | 115 | 161 | 151 | 119 | 2,1 | 700 | 1 |
| SDA.3.A.250K.690 | 250 | 213 | 195 | 151 | 241 | 221 | 171 | 245 | 228 | 176 | 3,1 | 800 | 1 |
| SDA.3.A.270K.690 | 270 | 225 | 212 | 175 | 255 | 240 | 198 | 265 | 248 | 205 | 3,4 | 1100 | 1 |
| SDA.2.A.328K.690 | 328 | 278 | 260 | 206 | 314 | 294 | 234 | 321 | 304 | 242 | 5,1 | 1750 | 1 |
| SDA.2.A.400K.690 | 400 | 335 | 313 | 263 | 379 | 354 | 298 | 392 | 367 | 308 | 6,1 | 1750 | 1 |
| SDA.2.A.506K.690 | 506 | 420 | 391 | 313 | 475 | 443 | 354 | 496 | 459 | 367 | 7,7 | 1750 | 1 |
| SDA.2.A.548K.690 | 548 | 457 | 431 | 341 | 517 | 487 | 386 | 537 | 504 | 400 | 9,0 | 1750 | 1 |
| SDA.2.A.664K.690 | 664 | 553 | 517 | 391 | 626 | 585 | 442 | 651 | 605 | 458 | 10,9 | 1750 | 1 |
| SDA.2.A.0M97.690 | 974 | 815 | 759 | 608 | 950 | 886 | 709 | 955 | 917 | 734 | 14,9 | 3500 | 2 |
| SDA.2.A.1M06.690 | 1061 | 887 | 836 | 662 | 1035 | 975 | 772 | 1040 | 1009 | 799 | 17,4 | 3500 | 2 |
| SDA.2.A.1M28.690 | 1283 | 1073 | 1003 | 758 | 1252 | 1170 | 885 | 1257 | 1211 | 916 | 21,1 | 3500 | 2 |
| SDA.2.A.1M59.690 | 1591 | 1331 | 1253 | 993 | 1552 | 1462 | 1159 | 1559 | 1513 | 1199 | 26,1 | 5250 | 3 |
| SDA.2.A.1M93.690 | 1925 | 1610 | 1504 | 1138 | 1878 | 1755 | 1327 | 1887 | 1816 | 1374 | 31,6 | 5250 | 3 |
| SDA.2.A.2M57.690 | 2566 | 2147 | 2005 | 1517 | 2505 | 2340 | 1770 | 2515 | 2422 | 1832 | 42,1 | 7000 | 4 |
| SDA.2.A.3M21.690 | 3208 | 2684 | 2507 | 1896 | 3131 | 2925 | 2212 | 3144 | 3027 | 2290 | 52,6 | 8750 | 5 |
| SDA.2.A.3M85.690 | 3849 | 3220 | 3008 | 2275 | 3757 | 3509 | 2655 | 3772 | 3632 | 2747 | 63,2 | 10500 | 6 |
| SDA.2.A.4M49.690 | 4491 | 3757 | 3510 | 2655 | 4383 | 4094 | 3097 | 4401 | 4238 | 3205 | 73,7 | 12250 | 7 |
| SDA.2.A.5M13.690 | 5132 | 4294 | 4011 | 3034 | 5009 | 4679 | 3539 | 5029 | 4843 | 3663 | 84,2 | 14000 | 8 |

**Tab. 2-12: AFE Rated Data (500V÷690V) @ 2500 Hz of switching frequency**

## 2.5.4 F3E – Rated Data – SDF

Nominal voltage of the following F3E is 400V.

| CODE Vn: 360÷480 V | SN [kVA] | IN [A] | ILD [A] | IHD [A] | IDCN [A] | IDC LD [A] | IDC HD [A] | PDCN [kW] | PDC LD [kW] | PDC HD [kW] | HEAT LOSS [kW] | AIR FLOW [m³/h] | CP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SDF.4.A.035K.400 | 35 | 50 | 49 | 38 | 62 | 61 | 47 | 34 | 33 | 26 | 0,5 | 200 | 1 |
| SDF.4.A.050K.400 | 50 | 70 | 69 | 54 | 87 | 85 | 67 | 49 | 46 | 36 | 0,6 | 300 | 1 |
| SDF.4.A.060K.400 | 60 | 90 | 88 | 69 | 112 | 110 | 86 | 58 | 59 | 46 | 0,8 | 400 | 1 |
| SDF.4.A.090K.400 | 90 | 130 | 127 | 100 | 162 | 158 | 124 | 87 | 86 | 67 | 1,2 | 500 | 1 |
| SDF.4.A.110K.400 | 110 | 155 | 152 | 119 | 193 | 189 | 148 | 107 | 102 | 80 | 1,4 | 500 | 1 |
| SDF.3.A.140K.400 | 140 | 200 | 196 | 154 | 249 | 244 | 192 | 136 | 132 | 103 | 1,8 | 700 | 1 |
| SDF.3.A.210K.400 | 210 | 305 | 299 | 235 | 380 | 372 | 292 | 204 | 201 | 158 | 2,7 | 800 | 1 |
| SDF.3.A.270K.400 | 270 | 390 | 382 | 300 | 485 | 475 | 373 | 262 | 257 | 202 | 3,5 | 1100 | 1 |
| SDF.2.A.312K.400 | 312 | 450 | 441 | 346 | 560 | 549 | 431 | 303 | 296 | 233 | 4,1 | 1750 | 1 |
| SDF.2.A.400K.400 | 402 | 580 | 568 | 446 | 722 | 707 | 555 | 390 | 382 | 300 | 5,2 | 1750 | 1 |
| SDF.2.A.485K.400 | 485 | 700 | 686 | 538 | 871 | 853 | 670 | 470 | 461 | 362 | 6,3 | 1750 | 1 |
| SDF.2.A.590K.400 | 590 | 850 | 833 | 654 | 1058 | 1036 | 814 | 572 | 560 | 440 | 7,7 | 1750 | 1 |
| SDF.2.A.710K.400 | 710 | 1020 | 999 | 785 | 1269 | 1244 | 977 | 689 | 672 | 528 | 9,2 | 1750 | 1 |
| SDF.2.A.970K.400 | 970 | 1400 | 1371 | 1076 | 1742 | 1707 | 1339 | 941 | 922 | 723 | 12,6 | 3500 | 2 |
| SDF.2.A.1M18.400 | 1180 | 1700 | 1665 | 1308 | 2116 | 2073 | 1628 | 1145 | 1119 | 879 | 15,3 | 3500 | 2 |
| SDF.2.A.1M42.400 | 1420 | 2040 | 1998 | 1570 | 2539 | 2487 | 1954 | 1377 | 1343 | 1055 | 18,4 | 3500 | 2 |
| SDF.2.A.1M77.400 | 1770 | 2550 | 2498 | 1962 | 3174 | 3109 | 2442 | 1717 | 1679 | 1319 | 23,0 | 5250 | 3 |
| SDF.2.A.2M13.400 | 2130 | 3060 | 2998 | 2355 | 3808 | 3731 | 2931 | 2066 | 2015 | 1583 | 27,5 | 5250 | 3 |
| SDF.2.A.2M84.400 | 2840 | 4080 | 3997 | 3140 | 5078 | 4974 | 3908 | 2755 | 2686 | 2110 | 36,7 | 7000 | 4 |
| SDF.2.A.3M55.400 | 3550 | 5100 | 4996 | 3925 | 6347 | 6218 | 4885 | 3444 | 3358 | 2638 | 45,9 | 8750 | 5 |
| SDF.2.A.4M26.400 | 4260 | 6120 | 5995 | 4710 | 7616 | 7461 | 5862 | 4132 | 4029 | 3165 | 55,1 | 10500 | 6 |
| SDF.2.A.4M97.400 | 4970 | 7140 | 6995 | 5495 | 8886 | 8705 | 6839 | 4821 | 4701 | 3693 | 64,3 | 12250 | 7 |
| SDF.2.A.5M68.400 | 5680 | 8160 | 7994 | 6280 | 10155 | 9948 | 7816 | 5510 | 5372 | 4220 | 73,4 | 14000 | 8 |

**Tab. 2-13: F3E Rated Data (360V÷480V)**

Nominal voltage of the following F3E is 690V.

| CODE Vn: 500÷690 V | SN [kVA] | IN [A] | ILD [A] | IHD [A] | IDCN [A] | IDC LD [A] | IDC HD [A] | PDCN [kW] | PDC LD [kW] | PDC HD [kW] | HEAT LOSS [kW] | AIR FLOW [m³/h] | CP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SDF.4.A.060K.690 | 60 | 50 | 49 | 38 | 62 | 61 | 47 | 58 | 57 | 44 | 0,5 | 200 | 1 |
| SDF.4.A.084K.690 | 85 | 70 | 69 | 54 | 87 | 85 | 67 | 82 | 79 | 63 | 0,7 | 300 | 1 |
| SDF.4.A.108K.690 | 110 | 90 | 88 | 69 | 112 | 110 | 86 | 107 | 102 | 80 | 0,9 | 400 | 1 |
| SDF.4.A.155K.690 | 150 | 130 | 127 | 100 | 162 | 158 | 124 | 146 | 148 | 116 | 1,3 | 500 | 1 |
| SDF.4.A.185K.690 | 190 | 155 | 152 | 119 | 193 | 189 | 148 | 184 | 176 | 138 | 1,6 | 500 | 1 |
| SDF.3.A.240K.690 | 235 | 200 | 196 | 154 | 249 | 244 | 192 | 228 | 227 | 179 | 2,0 | 700 | 1 |
| SDF.3.A.350K.690 | 379 | 330 | 323 | 235 | 411 | 402 | 292 | 368 | 375 | 272 | 3,3 | 800 | 1 |
| SDF.3.A.460K.690 | 472 | 400 | 392 | 300 | 498 | 488 | 373 | 458 | 454 | 348 | 4,0 | 1100 | 1 |
| SDF.2.A.540K.690 | 540 | 450 | 441 | 346 | 560 | 549 | 431 | 524 | 511 | 401 | 4,5 | 1750 | 1 |
| SDF.2.A.695K.690 | 695 | 580 | 568 | 446 | 722 | 707 | 555 | 674 | 659 | 517 | 5,8 | 1750 | 1 |
| SDF.2.A.840K.690 | 840 | 700 | 686 | 538 | 871 | 853 | 670 | 815 | 795 | 624 | 7,0 | 1750 | 1 |
| SDF.2.A.1M02.690 | 1020 | 850 | 833 | 654 | 1058 | 1036 | 814 | 989 | 965 | 758 | 8,5 | 1750 | 1 |
| SDF.2.A.1M22.690 | 1220 | 1020 | 999 | 785 | 1269 | 1244 | 977 | 1183 | 1158 | 910 | 10,2 | 1750 | 1 |
| SDF.2.A.1M68.690 | 1680 | 1400 | 1371 | 1076 | 1742 | 1707 | 1339 | 1630 | 1590 | 1247 | 14,0 | 3500 | 2 |
| SDF.2.A.2M04.690 | 2040 | 1700 | 1665 | 1308 | 2116 | 2073 | 1628 | 1979 | 1931 | 1516 | 17,0 | 3500 | 2 |
| SDF.2.A.2M44.690 | 2440 | 2040 | 1998 | 1570 | 2539 | 2487 | 1954 | 2367 | 2317 | 1820 | 20,4 | 3500 | 2 |
| SDF.2.A.3M06.690 | 3060 | 2550 | 2498 | 1962 | 3174 | 3109 | 2442 | 2968 | 2896 | 2274 | 25,5 | 5250 | 3 |
| SDF.2.A.3M66.690 | 3660 | 3060 | 2998 | 2355 | 3808 | 3731 | 2931 | 3550 | 3475 | 2730 | 30,6 | 5250 | 3 |
| SDF.2.A.4M88.690 | 4880 | 4080 | 3997 | 3140 | 5078 | 4974 | 3908 | 4734 | 4633 | 3640 | 40,8 | 7000 | 4 |
| SDF.2.A.6M10.690 | 6100 | 5100 | 4996 | 3925 | 6347 | 6218 | 4885 | 5917 | 5792 | 4550 | 51,0 | 8750 | 5 |
| SDF.2.A.7M32.690 | 7320 | 6120 | 5995 | 4710 | 7616 | 7461 | 5862 | 7100 | 6950 | 5460 | 61,2 | 10500 | 6 |
| SDF.2.A.8M54.690 | 8540 | 7140 | 6995 | 5495 | 8886 | 8705 | 6839 | 8284 | 8109 | 6370 | 71,4 | 12250 | 7 |
| SDF.2.A.9M76.690 | 9760 | 8160 | 7994 | 6280 | 10155 | 9948 | 7816 | 9467 | 9267 | 7280 | 81,6 | 14000 | 8 |

**Tab. 2-14: F3E Rated Data (500V÷690V)**

## 2.5.5 Deratings

Main deratings are due to

- Ambient temperature (K1) Fig. 2-10
- Altitude (K2) Fig. 2-11
- Switching Frequency (K3) Fig. 2-12
- Output Frequency (K4) Fig. 2-13

The SECOM DRIVE Control (SD-MCU) manage these deratings automatically modifying the rated current, but the user has to configure properly the drive. For more information refer to SOFTWARE MANUAL.

### Example

To know the real current a drive can supply, user has to multiply the rated current by all derating coefficient. Suppose to choose a drive in low duty with nominal current. The real nominal current will be:

$$I_n = I_{LowDuty} \cdot K1 \cdot K2 \cdot K3 \cdot K4$$

### 2.5.5.1 Deratings due to Ambient Temperature

The drive is designed to provide the rated power at 40°C. The figure Fig. 2-10 represent the derating tendency; this value has to be multiplier by the rated current. Users have to set the working ambient temperature into the drive configuration (see SOFTWARE MANUAL).

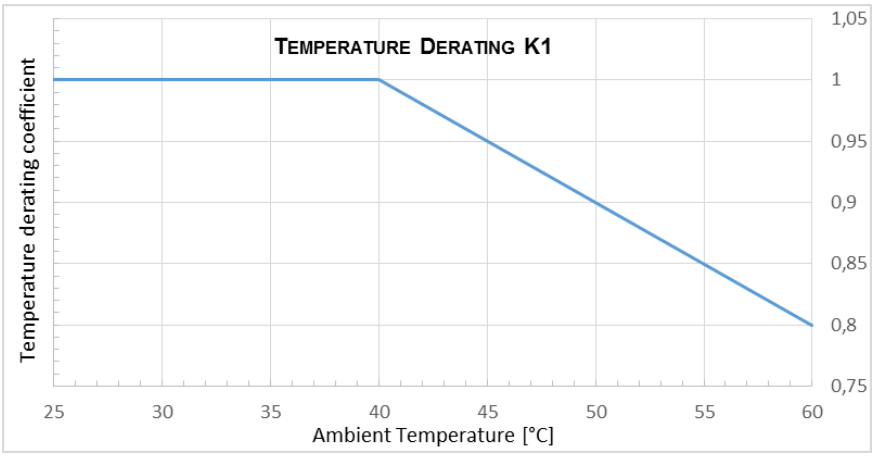



**Fig. 2-10: Temperature derating coefficient for all size**

### 2.5.5.2 Deratings due to Altitude

Even in this case, the value of the coefficient must be multiplied by inverter rated current. Users have to set the altitude into the drive configuration (see SOFTWARE MANUAL).

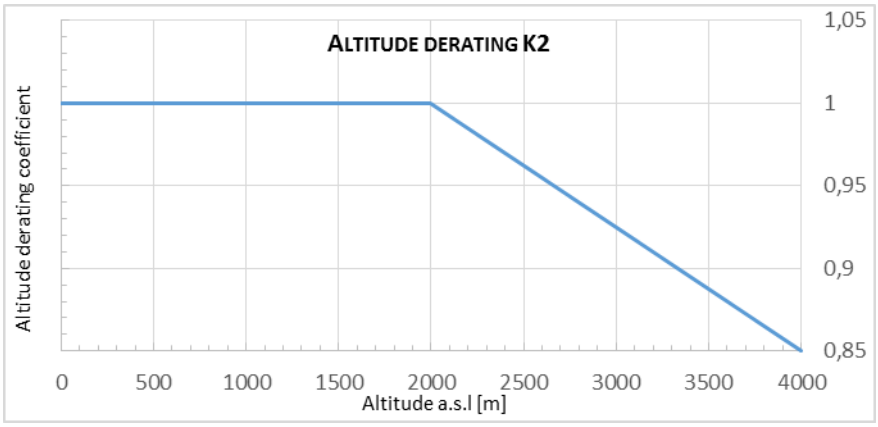



**Fig. 2-11: Altitude derating coefficient for all size**

### 2.5.5.3 Derating due to Switching Frequency and Output Frequency

While users configure the drive, they have to select the switching frequency: it depends on the size and frame. Automatically the control system will apply all frequency derating. However, Fig. 2-12 and Fig. 2-13 represent these derating to let the users know the tendency of this coefficient. To know exactly the derating applied, users can use the rating tables or, better, change the switching frequency into the drive configuration end the real rated current; this way is the best mainly for switching frequency up to 2500Hz.
To know all the derating at the default switching frequency, refer to Tab. 2-7.

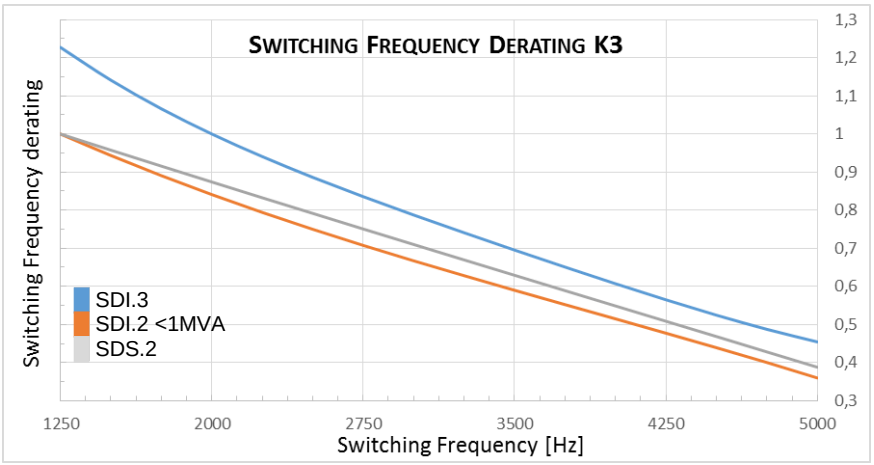



**Fig. 2-12: Switching Frequency derating example for SDI.2 and SDI.3**

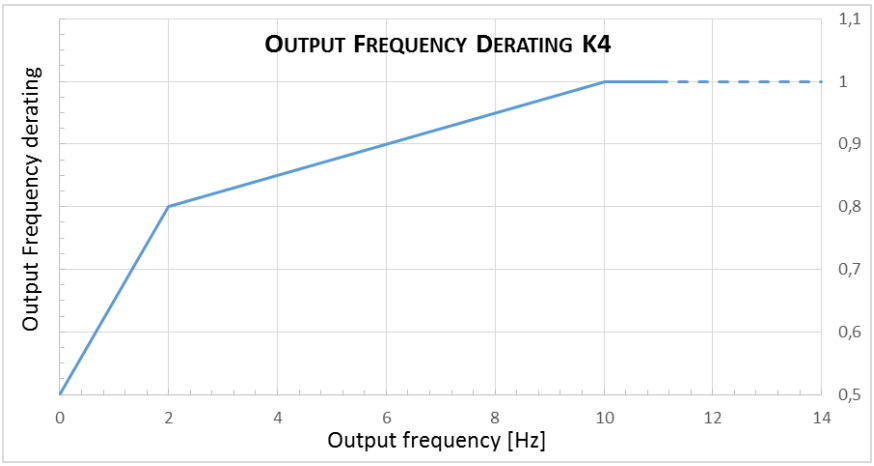



**Fig. 2-13: Output Frequency derating coefficient for all sizes**

**NOTE:** even if users can modify the switching frequency with a resolution of 1Hz between min and max, SECOM DRIVE is tested and delivered only for the four main frequency. Changing the value of the frequency to values different from default ones, is suggested only for very fine tunings (for example to avoid frequency resonance).

**NOTE:** for AFE configuration, the switching frequency can't be set lower than 2500Hz because of the LCL filter.

## 2.5.6 Filters

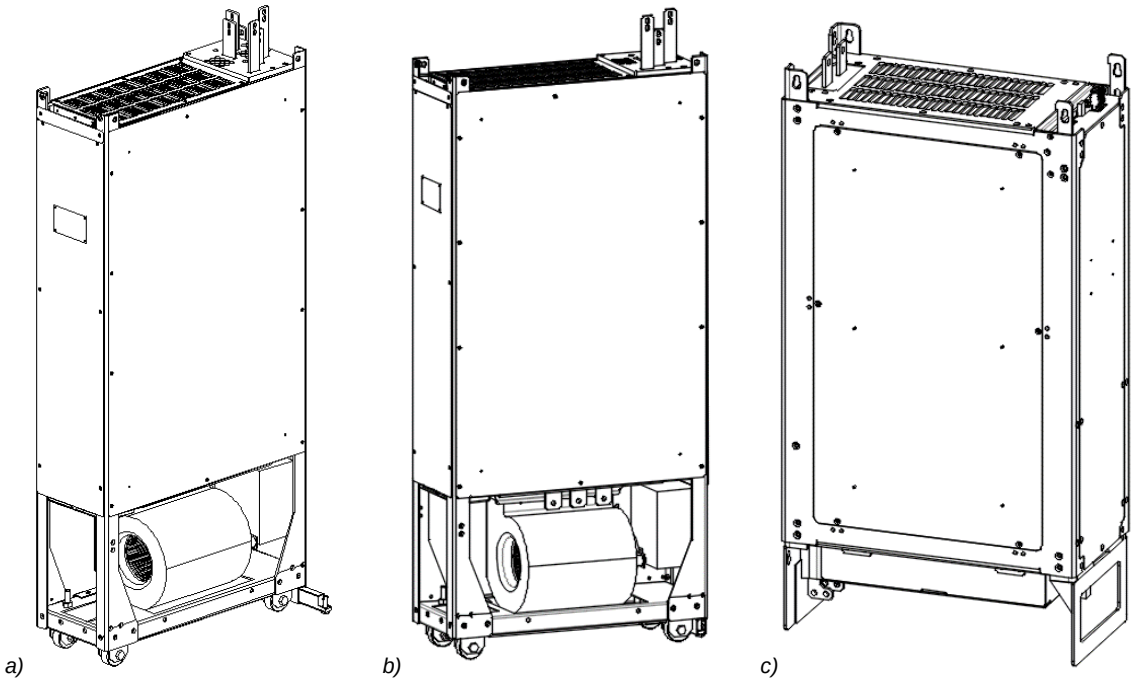
SECOM suggest this kind of filter depending on the drive type:

- L@2% for diode bridge or semi-controlled bridge
- L@4% for F3E
- LCL for AFE (mandatory to achieve the IEEE 519 directive) – contact SECOM for more information

The inner inductance is suggested to guarantee the life time of some component of the drive. Variation or elimination of this component is possible only if another inductance is present, such as a transformer. Only SECOM R&D can approve such modification.

## 2.5.7 DPM Overall Dimension

The following paragraph indicate the dimension of the power module (DPM) with some option connected. Fig. 2-14 show the 3D vision of frames 2 and 3.



*a)* *b)* *c)*

**Fig. 2-14: SDx.2 frame (a), SDS.2 frame and SDx.3 frame (b)**

### 2.5.7.1 Frame 2 – Air cooled

This kind of frame is identified by a code starting with **SDI/SDA/SDF.2.A.**[…]. Fig. 2-15-a shows the standard configuration size, while Fig. 2-15-b shows the size with a rear bar option.

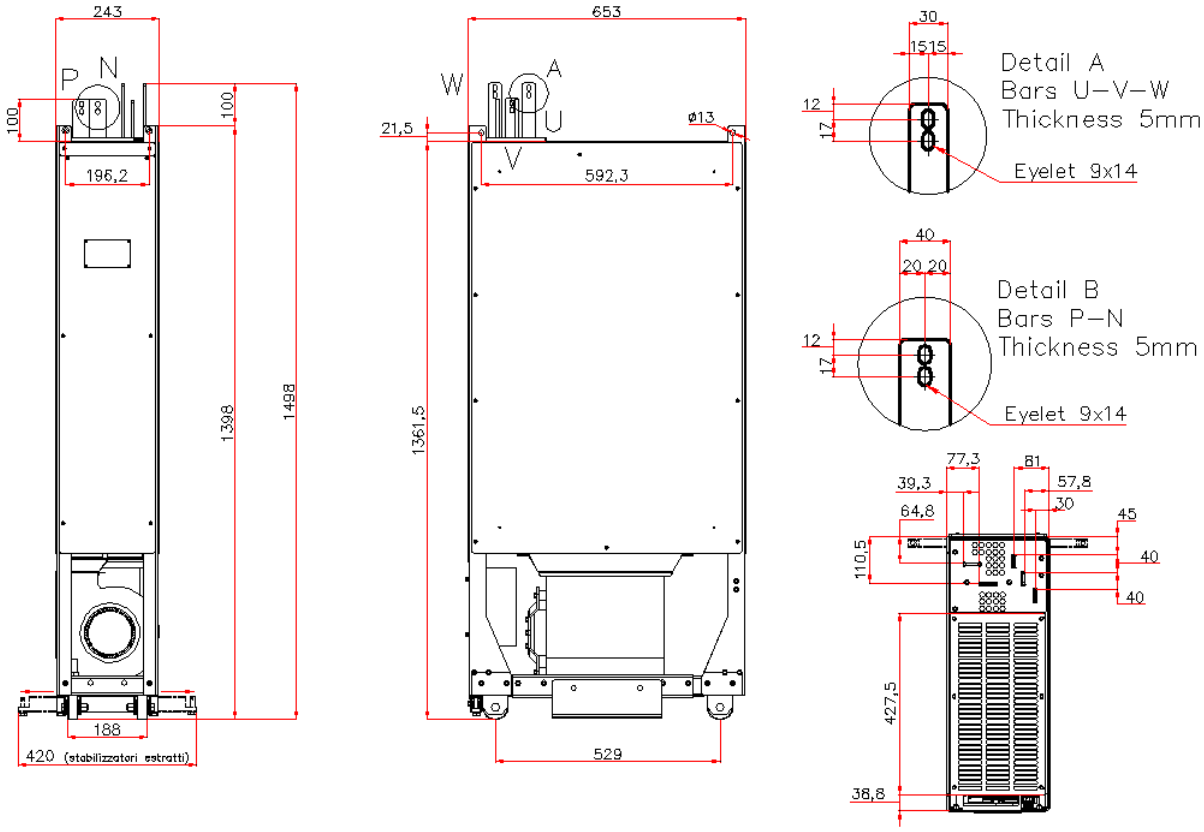



**Fig. 2-15: Frame SDI/SDA/SDF.2 overall dimension with air cooling system**

### 2.5.7.2 Frame 2 – Water cooled

This kind of frame is identified by a code starting with **SD*x*.2.W.**[…]. For this product variation, please ask SECOM customer service or technical support.

### 2.5.7.3 Frame 2 – Air cooled Single Drive

This kind of frame is identified by a code starting with **SD*S*.2.A.**[…].

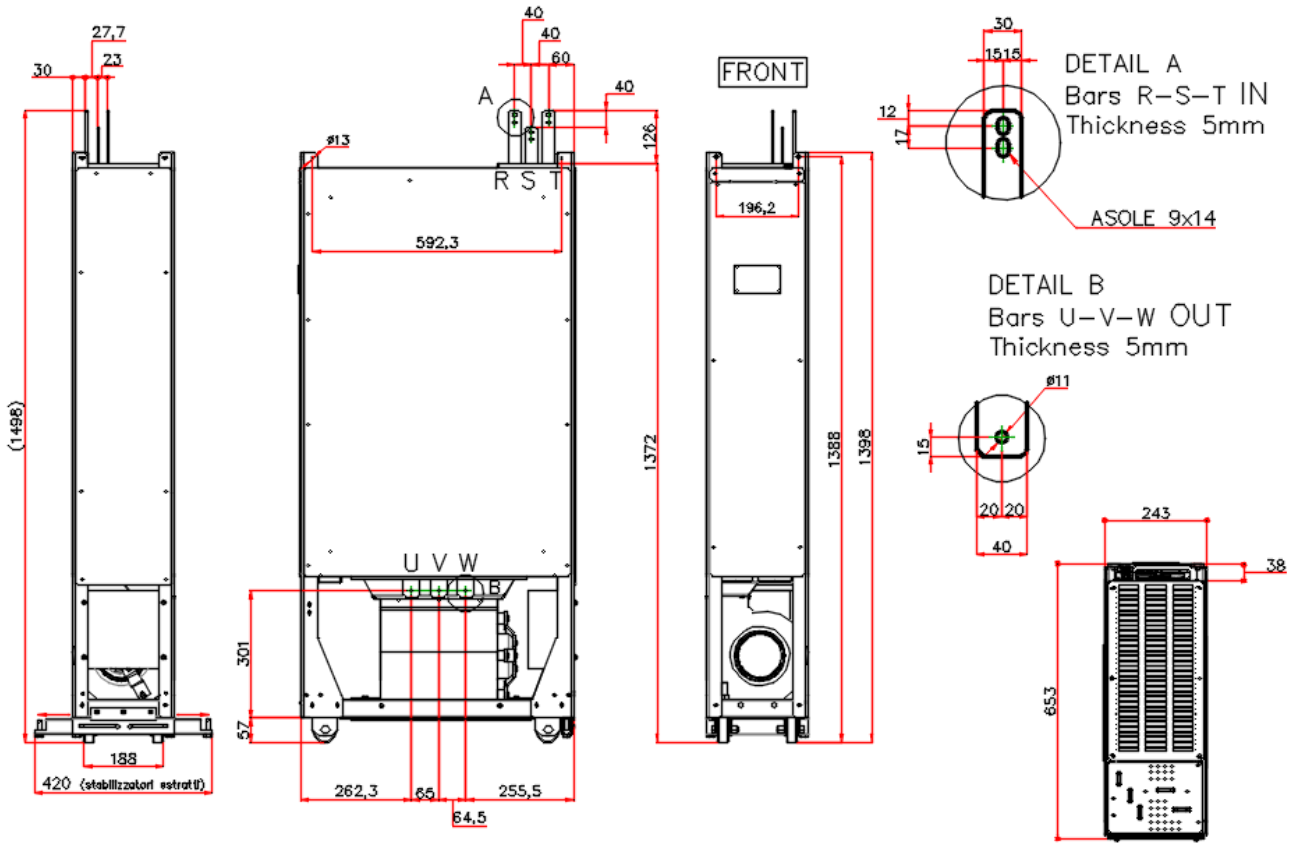



**Fig. 2-16: Frame SDS.2 overall dimension with air cooling system**

### 2.5.7.4 Frame 3 – Air cooled

This kind of frame is identified by a code starting with **SDx.3.A.**[…]. Fig. 2-17-a shows the standard configuration size for frame 3 for SDS.3A frame. SDI/SDA/SDF.3.A frame has no RST input phase on the lateral side.

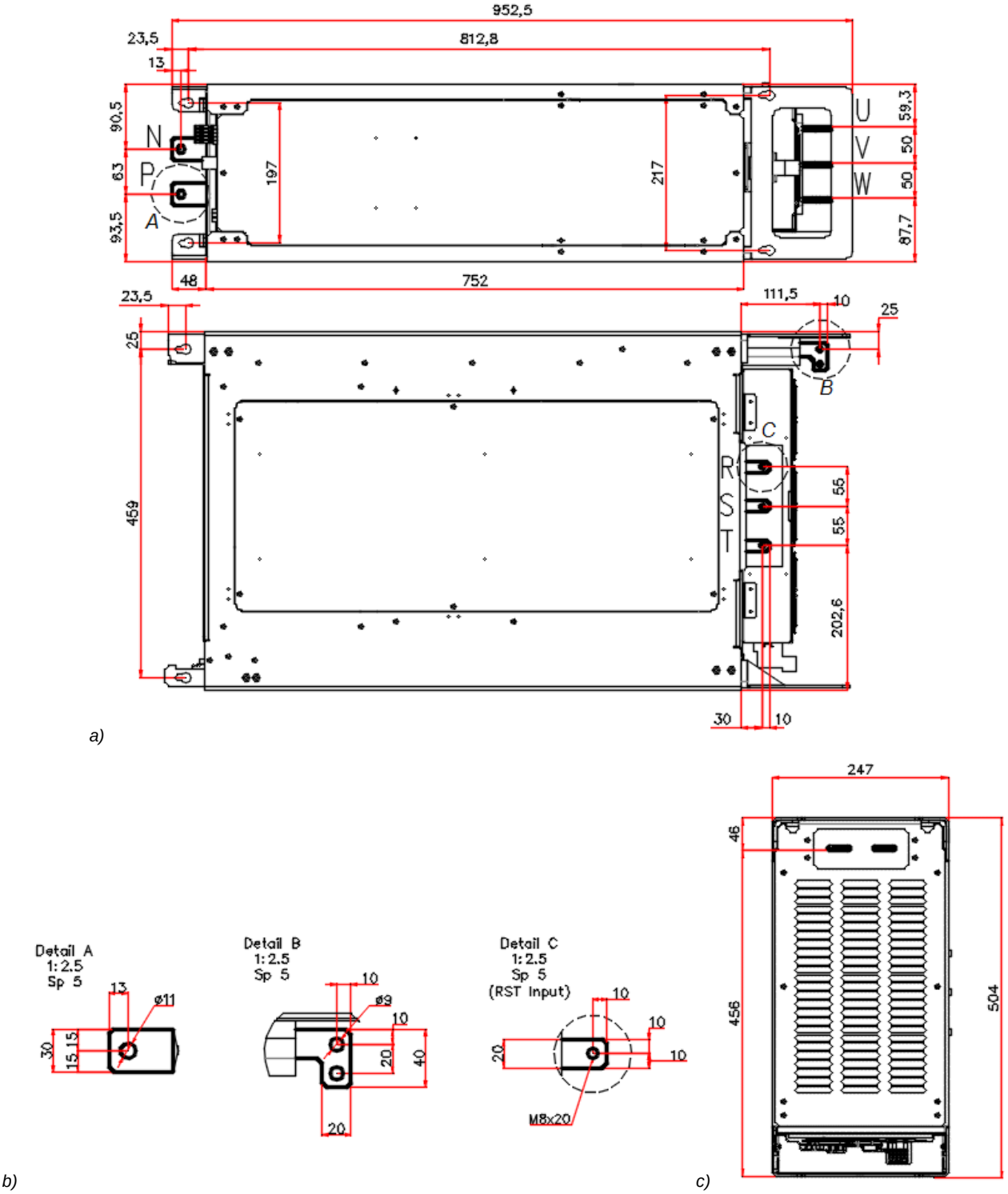



**Fig. 2-17: Frame 3 overall dimension. Air cooling system**

### 2.5.7.5 Frame 4 – Air cooled

This kind of frame is identified by a code starting with **SDx.4.A.**[…]. As it considered a special product, please contact SECOM for further information.

## 2.5.8 Option – Kit Bars: dimension and rated data

Default configuration of DPM DC/AC has both DC and AC on the upper side. To let the user able to connect the motor cable from the lower side, a rear kit bar is provided by SECOM as option. There are two kind of kit bars: the former has single bars while the second has double bars, as shown in Fig. 2-18.

**Note**: this kit bar is designed only for one DPM. SECOM design other kind of bus bar kits for special use on request. If customer needs different type for parallel configuration, please contact SECOM customer service.

Bars are made of aluminum or copper depending on the current; these bus bars are designed to be connected to only one DPM, so if parallel connection is needed, it will be made at the bus bar output. The current ratings are compliant with DIN 43670 for a ΔT by 30°C and 50°C considering an ambient temperature of 35° and an AC frequency by 60Hz. Ratings of each kits are indicated in Tab. 2-15 and these values are RMS.

| Code | Bus Bar | Material | Section | In (ΔT 30°)‡ | In (ΔT 50°)‡ |
|---|---|---|---|---|---|
| **/KB1** | Single bar | Al | 1x (60x6) | 512A | 717A |
| **/KB1** | Single bar | Cu | 1x (60x6) | 806A | 1128A |
| **/KB2** | Double bar | Al | 2x (60x6) | 950A | 1331A |
| **/KB2** | Double bar | Cu | 2x (60x6) | 1132A | 1585A |

‡: Ambient temperature 35° and 60Hz frequency. For other coefficients please refer to the DIN 43 670 specification

**Tab. 2-15: Kit bars rated current (DIN 43 670 compliant)**

To order the option, please refer to Tab. 5-25 in chapter 5

### General choosing suggestion

SECOM suggest to connect kit bars of same material of the drive, especially in harsh environment. For what concern the ratings, tables Tab. 2-16 and Tab. 2-17 report the suggested kit bar for inverter and F3E; tables are organized as follow:

- *In*: indicates the continuative current (S1 duty) of the DPM.
- *Up to 50°C*: indicates what kind of kit is suggested to stay below this temperature.
- *30°C*: indicate what kind of kit is needed to stay below this temperature.

To choose a bus bar, a technician has previously to choose the drive with the relative duty, but kits are chosen using the continuative current of the drive.
SECOM suggest to use always bus bars that keeps the temperature step lower than 50°C according with IEC 61800-5-1 prescription[3].
AC output bar is useful only for SDI.2/SDF.2/SDS.2 frame. SDA frame usually requires an external filter which has to be installed without bus bar.

| INVERTER CODE VN: 400 OR 690V | AN [kVA] | IN‡ [A] | KIT CODE *ΔT up to 50°C* | KIT CODE *ΔT = 30°C* |
|---|---|---|---|---|
| SDI.2.x.290K.400 | 290 | 420 | /KB1 | /KB2 |
| SDI.2.x.350K.400 | 350 | 510 | /KB1 | /KB2 |
| SDI.2.x.450K.400 | 450 | 650 | /KB1 | /KB2 |
| SDI.2.x.540K.400 | 540 | 780 | /KB1 | /KB2 |
| SDI.2.x.620K.400 | 620 | 890 | /KB1 | /KB2 |
| SDI.2.x.460K.690 | 460 | 390 | /KB1 | /KB2 |
| SDI.2.x.560K.690 | 560 | 470 | /KB1 | /KB2 |
| SDI.2.x.710K.690 | 710 | 590 | /KB1 | /KB2 |
| SDI.2.x.825K.690 | 825 | 690 | /KB1 | /KB2 |
| SDI.2.x.1M00.690 | 1.000 | 830 | /KB1 | /KB2 |

‡: Nominal current in continuative duty and switching frequency 1250Hz

**Tab. 2-16: Suggested bus bar kits ratings for inverter (switching frequency = 1250Hz, continuative duty)**

| F3E CODE VN: 400 OR 690V | AN [kVA] | IN‡ [A] | KIT CODE *ΔT up to 50°C* | KIT CODE *ΔT = 30°C* |
|---|---|---|---|---|
| SDF.2.x.320K.400 | 290 | 420 | /KB1 | /KB2 |
| SDF.2.x.400K.400 | 350 | 510 | /KB1 | /KB2 |
| SDF.2.x.485K.400 | 450 | 650 | /KB1 | /KB2 |
| SDF.2.x.590K.400 | 540 | 780 | /KB1 | /KB2 |
| SDF.2.x.710K.400 | 620 | 890 | /KB1 | /KB2 |
| SDF.2.x.540K.690 | 540 | 450 | /KB1 | /KB2 |
| SDF.2.x.695K.690 | 695 | 580 | /KB1 | /KB2 |

[3] See IEC 61800-5-1 (2003), External parts: table 12 – *Maximum measured temperature of external parts*

| F3E CODE VN: 400 OR 690V | AN [kVA] | IN‡ [A] | KIT CODE *ΔT up to 50°C* | KIT CODE *ΔT = 30°C* |
|---|---|---|---|---|
| SDF.2.x.840K.690 | 840 | 700 | /KB1 | /KB2 |
| SDF.2.x.1M02.690 | 1.020 | 850 | /KB1 | /KB2 |
| SDF.2.x.1M22.690 | 1.220 | 1.020 | /KB1 | /KB2 |

‡: Nominal current in continuative duty

**Tab. 2-17: Suggested bus bar kits ratings for F3E**

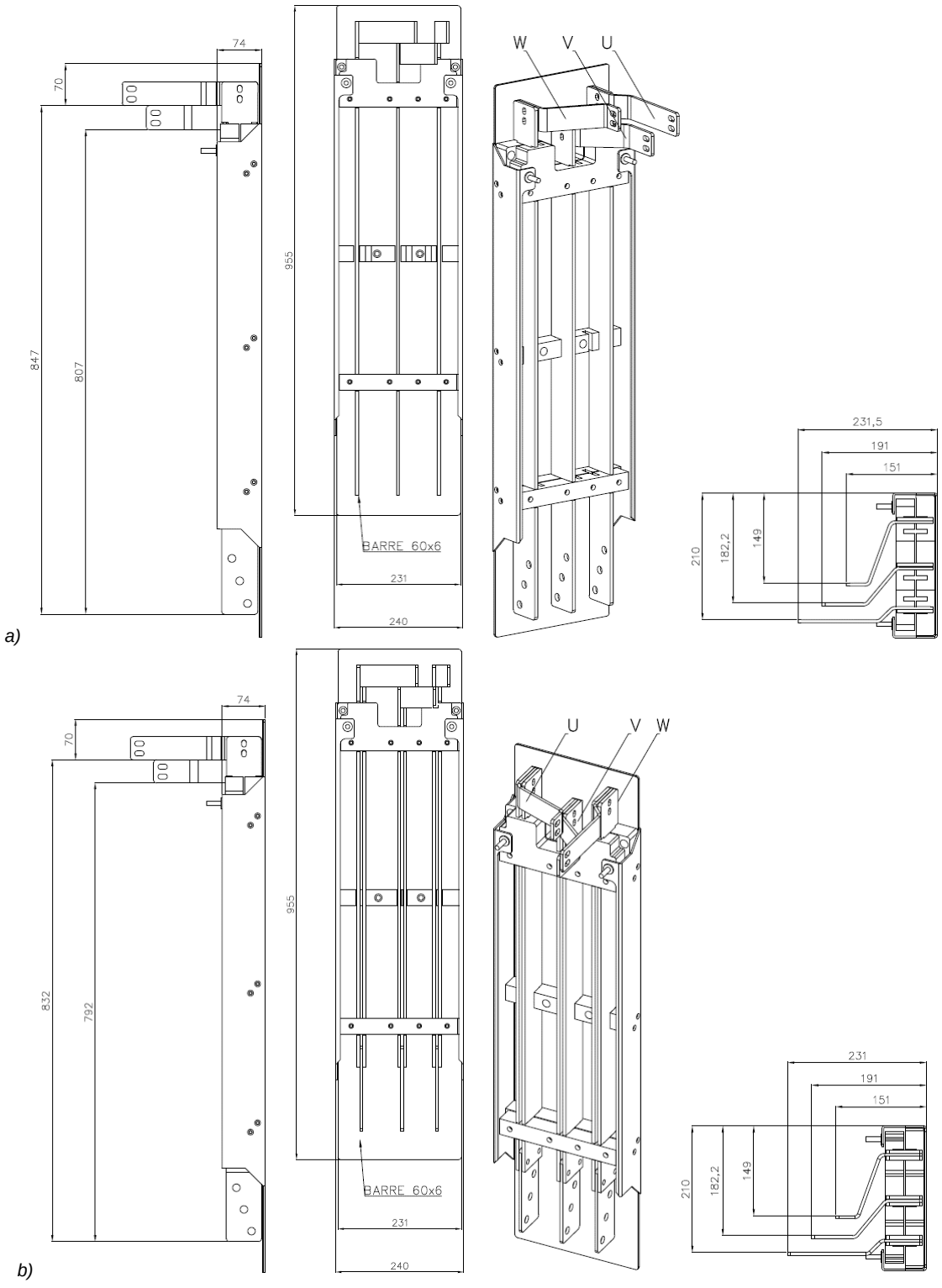



**Fig. 2-18: Rear Kit with single bar (a) and with double bar (b)**

# MECHANICAL INSTALLATION

3

## Chapter Table of Contents



### Contents

A description of mechanical installation of the drive into a cabinet. Each frame have a dedicated section.
This chapter does not mention mechanical installation of control boards; these information are briefly reported in chapter 4 – *Electrical Installation*.

### Chapter Target Audience

People who has to plan how place a SECOM Drive into a cabinet.

# 3.1 SAFETY

In general, always refer to the rules described in chapter *1 – Safety Instructions*, in particular the paragraph 1.4.1. However some reminds are reported in the follow.

**WARNING!** Frames have different shape. SDx.2 has wheels and can be moved back and forth on the direction of the wheels, but even a lifting eyes are provided to ensure the stability; SDx.3 has no wheals and has got only the lifting eyes to lift and move it. So in any case do not tilt the drive.

### SDx.3 Frame: lift and move

Lifting and moving the drive is allowed with proper eyelet (Fig. 3-1). Do not tilt the drive to avoid module overturning (Fig. 3-2): the center of gravity is high and the DPM is heavy.

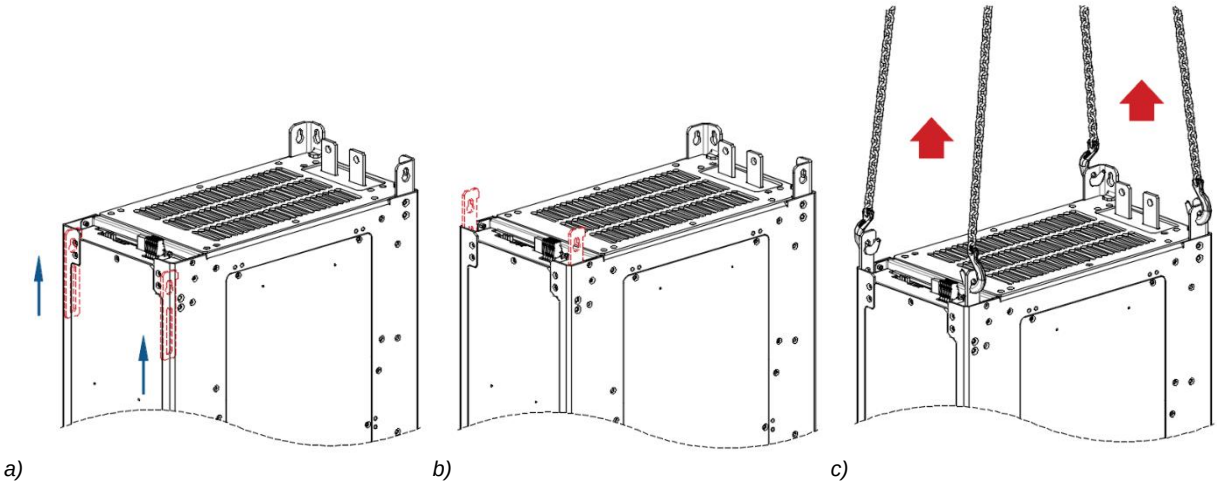



**Fig. 3-1: SDx.3 – Eyelet for lifting: hide (a), pull out (b) and lift (c)**

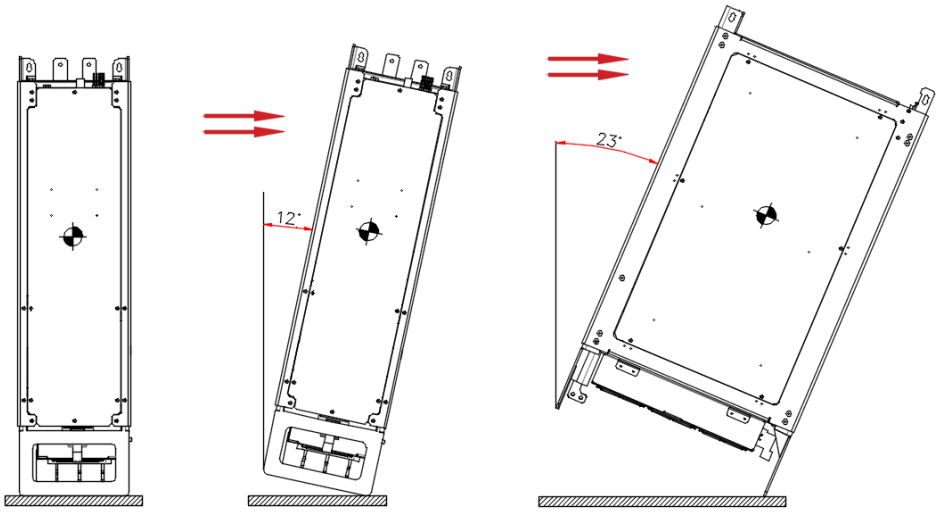



**Fig. 3-2: SDx.3 – Do not overpass the maximum tilting**

### SDx.2 Frame: lift and move

Lifting and moving the drive is allowed with proper eyelets as shown in Fig. 3-3. Do not tilt the drive because of the high center of gravity and do not left it unattended on a sloping floor (Fig. 3-4). Move the drive in the direction of the wheals.

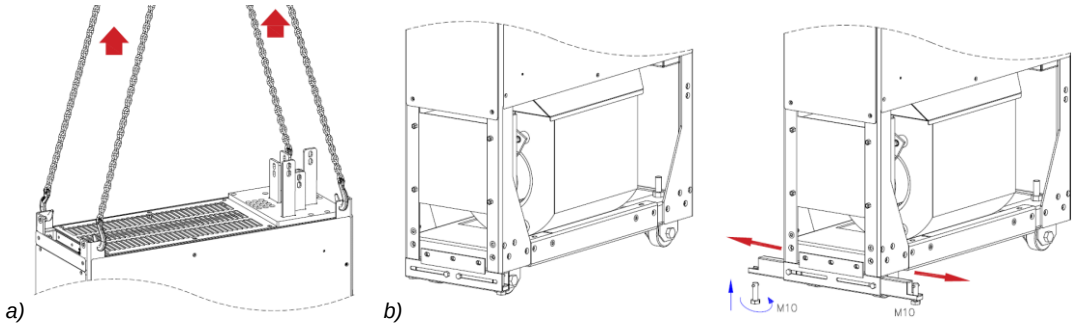



**Fig. 3-3: SDx.2 – Eyelet for lifting (a) and retractable and adjustable feet (b) for overturning avoidance**

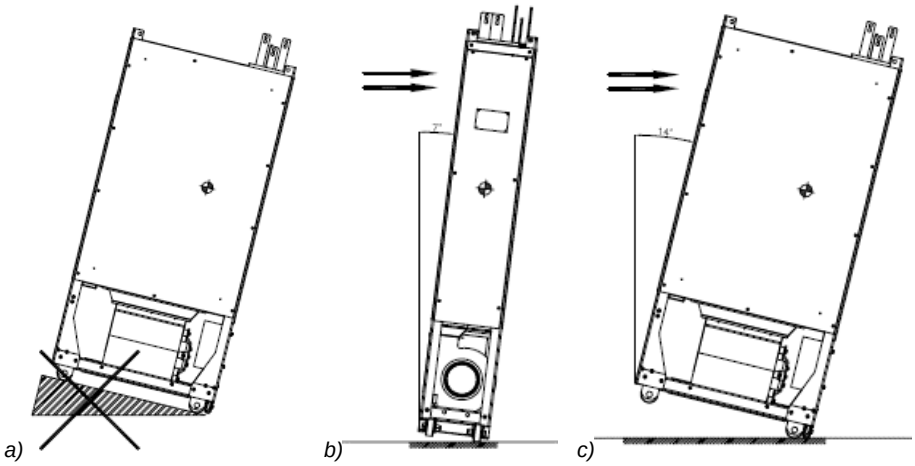



**Fig. 3-4: SDx.2 – Do not left the module on a sloping flor (a) and not overpass the maximum tilting (b, c)**

# 3.2 INSTALLING FRAME 2 (SDX.2)

Frames SDI/SDF/SDA.2 are designed to install various DPMs in parallel. SDS.2 is a single drive: no parallel connection can made, but dimension are the same of other SDx.2 frame; what is different is the presence of AC side input.

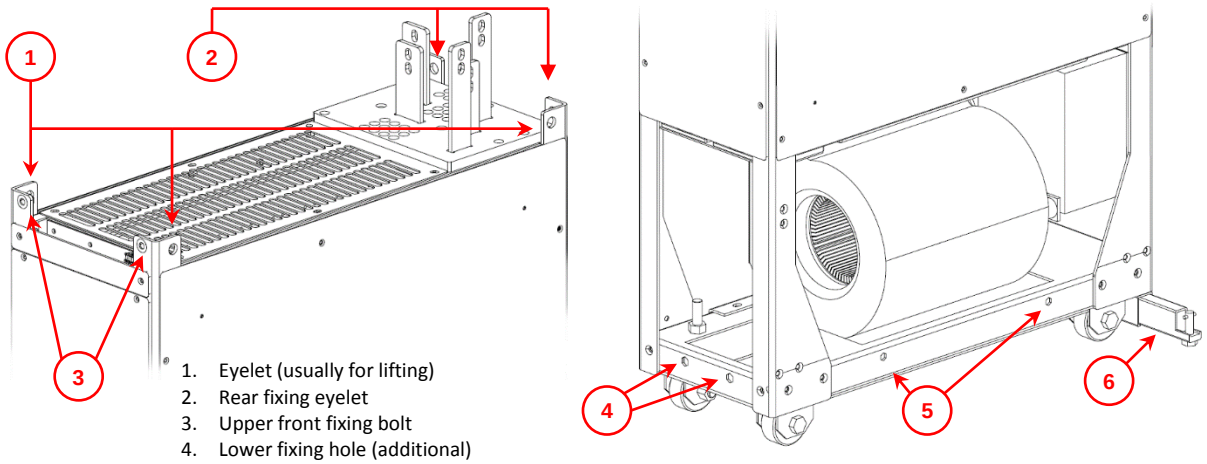
### Cabinet requirements

- The cabinet has to carry the weight of each DPMs. The weight is reported in table Tab. 2-3, but for this size is up to 178kg
- Consider this frame has both DC input and AC output on high side
- SDS.2 has the AC input on upper side and output on right lower side
- A plane or some reinforcement must be placed on the back to block de drive to the cabinet.
- Protect the drive from dust, humidity and with proper cooling system to avoid overheating (Tab. 2-3)
- Plan how to place and connect all electromechanical equipment (such as contactors, switches, power cable, etc)
- Plan a compartment of the cubicle where are placed all the electronic control devices (such as SD-MCU)
- To parallelize the DC bus, consider the use of bars and plan how to connect them to each DPM

## 3.2.1 Frame 2 – Install the DC/AC Drive

DC/AC Drive is designed to be installed in a cabinet. The cabinet must be compliant at least with all environmental prescription reported in Tab. 2-3 and summarized above (3.2).

- Put the retractable rear feet inside end fix them before moving the drive (Fig. 3-5.5).
- Move the drive near the installation site. Drive can be pushed or pulled on the wheels direction. If it would be necessary to turn left or right, user has to fasten the upper eyelet of the drive (Fig. 3-5.1) to a hoist with proper chains or cords to avoid toppling of the module.
- Pull the drive inside the cubicle, helping yourself with a rail. Pull the drive against the rear wall of the cubicle.
- Fix the drive to the upper rear side with a bolt and washer. Fasten enough to avoid losing grip due to vibration (Fig. 3-5.2).
- If the cabinet has to be shipped to another customer, SECOM suggests to fix the dive in at least one of this two point too:
    - Upper front, with a further reinforce bar (Fig. 3-5.3)
    - Lower front, with a further reinforce plate (Fig. 3-5.4)
- Modules are designed to put them one next to each other.




1. Eyelet (usually for lifting)
2. Rear fixing eyelet
3. Upper front fixing bolt
4. Lower fixing hole (additional)
5. Lower aside fixing hole (usually for packaging and transport)
6. Retractable and adjustable rear feet (for stabilization)

**Fig. 3-5: SDI/SDA/SDF.2 eyelet and fixing holes**

### 3.2.1.1 Installing the DPM with the rear kit bar option

As mentioned in 2.5.8, a rear kit bar is provided by SECOM as option and only for frame 2. The DPM is designed to be placed in touch with the wall of the cabinet. If kit bas is present, it is placed between wall and DPM and the DPM has to be fastened using the fixing ping of the kit bars (Fig. 3-6). The pins require a M8 bolt.

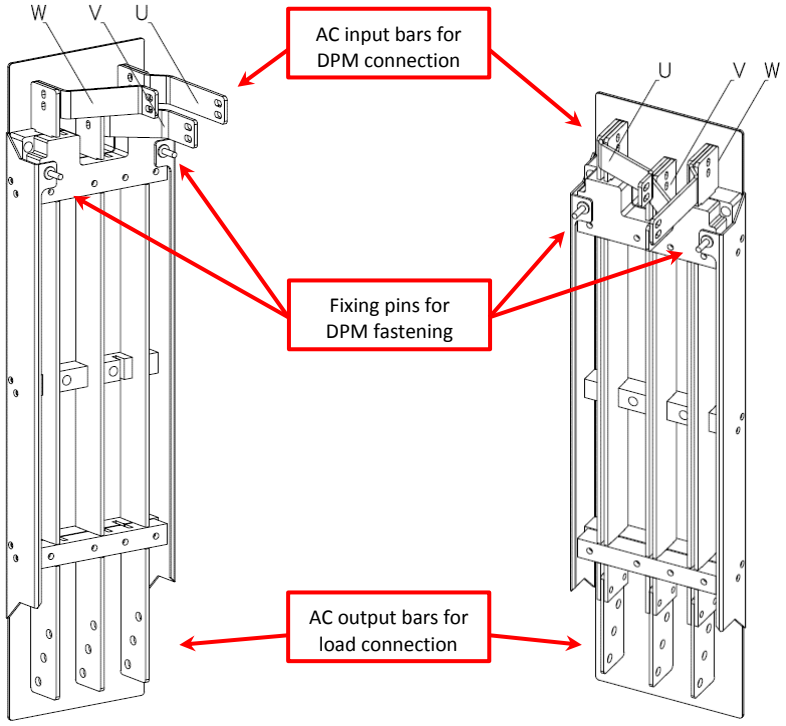



**Fig. 3-6: Bus bar kits fixing pins for the DPM fastening**

The DPM module will be fastened subsequently to the kit bar. To do so:

- Mount the kit against the wall of the cubicle or cabinet
- Push the DPM into the cubicle till the screw of the kit (Fig. 3-7.b) enter into the rear eyelet (Fig. 3-5.2) of the DPM itself
- Fix with bolts M8 the DPM to the kit (Fig. 3-6, Fig. 3-7)
- Connect the AC output to the kit bar with M8 screw

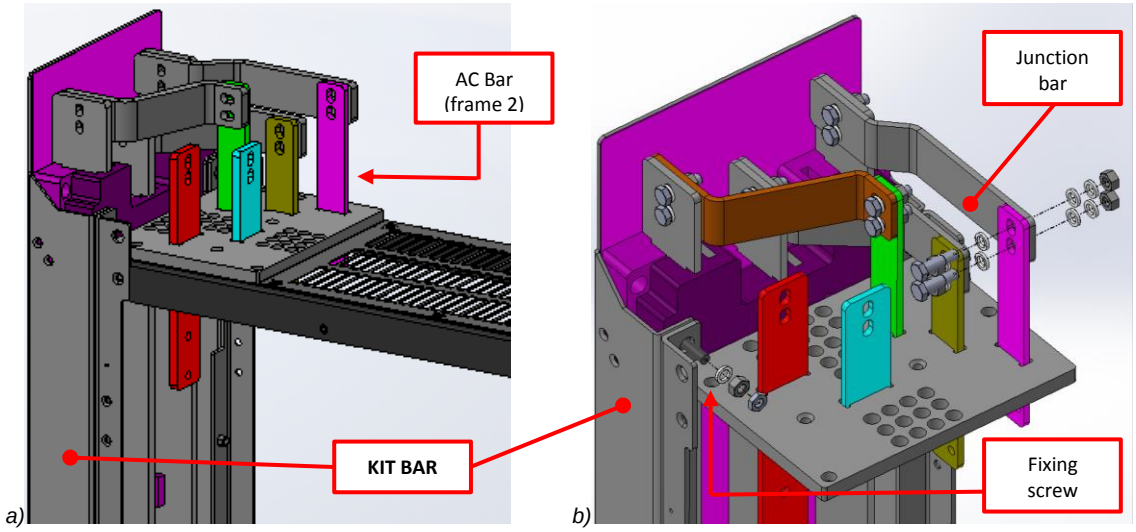
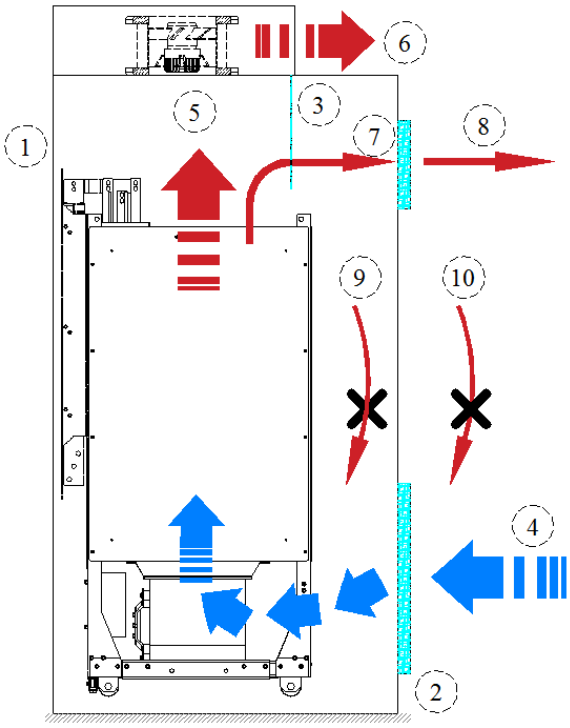



**Fig. 3-7: Connection between rear kit bar and SDx.2 frame (M8 screw)**

## 3.2.2 Frame 2 – Cooling Prescription

The SDx.2 frame is designed to be placed into a cabinet. Fig. 3-8 show how the air must flow in and out the cabinet. In general, designer technicians have to consider:

- Air flow: up to 1800 $m^3/h$ for each DPM (see rating table for further information)
- Avoid both internal and external air recirculation
- Add a proper air extraction fan to help the air recirculation
- The cabinet must be installed in a proper environment in term of humidity and temperature




1. Cabinet
2. Filter on door (it could have a fan)
3. Optional air flow barrier to avoid hot air flow recirculation
4. External cool hair
5. DPM hot air (internal to the cabinet)
6. Hot air extracted from the cabinet
7. Internal hot air
8. Hot air extracted from auxiliary fan filter
9. Internal hot air recirculation must be avoided
10. External hot air recirculation must be avoided

Air flow: up to 1800$m^3/h$

**Fig. 3-8: SDx.2 Ventilation Prescription**

# 3.3 INSTALLING FRAME 3 (SDX.3)

Frames SDx.3 are designed to work without output parallel connection. Each drive can cave a common DC bus, but SDS.3 which has an AC input.

### Cabinet requirements

- This frame has to be mounted on a plane or structure and has a clearance to the ground: the structure has to carry the weight of each DPMs. The weight is reported in table Tab. 2-3, but for this size is 100kg
- Consider this frame has DC input from high side and AC output on lower side
- Protect the drive from dust, humidity and with proper cooling system to avoid overheating (Tab. 2-3)
- Plan how to place and connect all electromechanical equipment (such as contactors, switches, power cable, etc)
- Plan a compartment of the cubicle where are placed all the electronic control devices (such as SD-MCU)
- To parallelize the DC bus, consider the use of bars and plan how to connect them to each DPM

## 3.3.1 Frame 3 – Install the Drive

DC/AC Drive is designed to be installed in a cabinet, against the wall in an upright position. The cabinet must be compliant at least with all environmental prescription reported in Tab. 2-3 and summarized above (0).

- Before moving the frame 3 kind module, pull out the eyelet on the upper-front side; to do so, user needs to unscrew the lateral screws which keep hidden these eyelets (Fig. 3-9)
- Move the drive near the installation site. User has to move the module using a hoist with proper chains or cords to avoid toppling of the module. Eyelet on top must be used (Fig. 3-1.a).
- Pull the drive inside the cubicle, helping yourself with hoist. Pull the drive against the rear wall of the cubicle.
- Fix the drive to the upper and lower rear side (Fig. 3-9) with a bolt and washer. Fasten enough to avoid losing grip due to vibration.

Modules are designed to put them one next to each other.

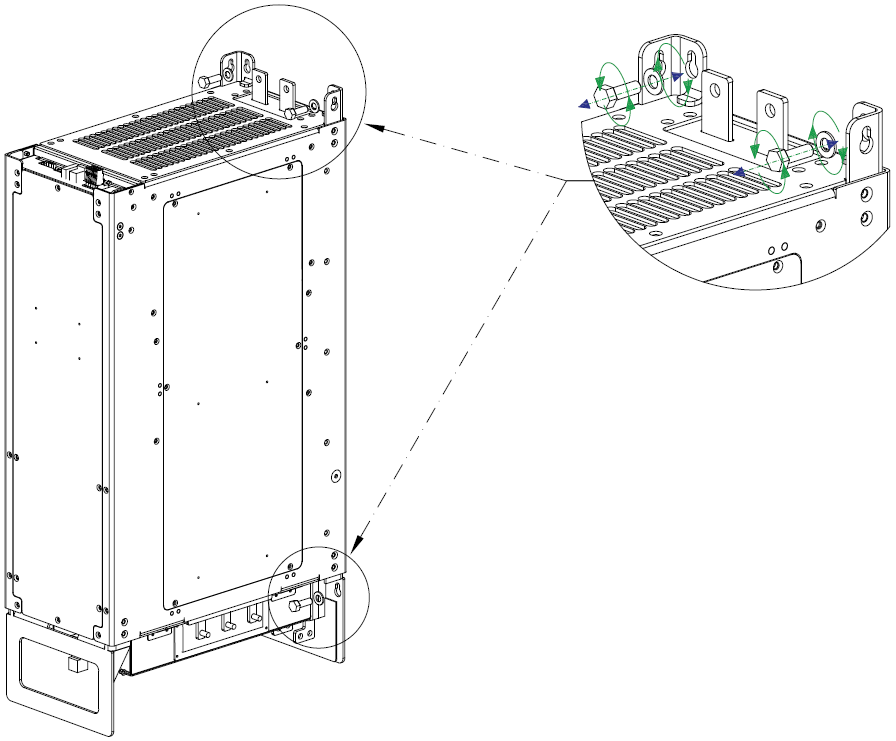
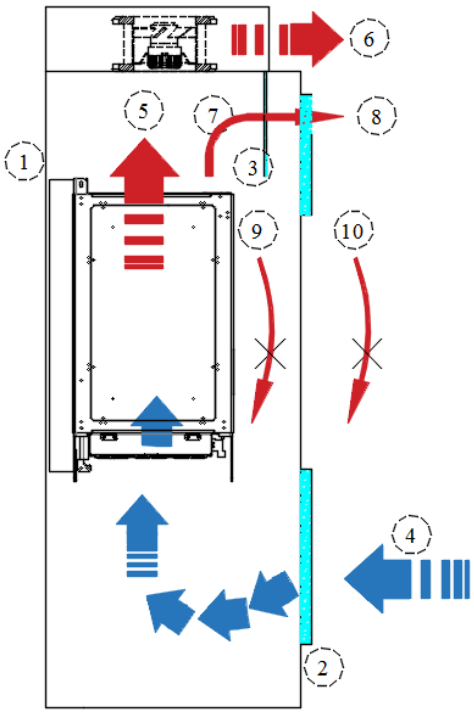


**Fig. 3-9: SDI/SDA/SDS/SDF.3 eyelet and fixing holes**

## 3.3.2 Frame 3 – Cooling Prescription

The SDx.3 frame is designed to be placed into a cabinet. Fig. 3-10 show how the air must flow in and out the cabinet. In general, designer technicians have to consider:

- Air flow: up to 1100 $m^3$/h for each DPM (see rating table for further information)
- Avoid both internal and external air recirculation
- Add a proper air extraction fan to help the air recirculation
- The cabinet must be installed in a proper environment in term of humidity and temperature




11. Cabinet
12. Filter on door (could have a fan)
13. Optional air flow barrier to avoid hot air flow recirculation
14. External cool hair
15. DPM hot air (internal to the cabinet)
16. Hot air extracted from the cabinet
17. Internal hot air
18. Hot air extracted from auxiliary fan filter
19. Internal hot air recirculation must be avoided
20. External hot air recirculation must be avoided

Air flow: up to 1100$m^3$/h

**Fig. 3-10: SDx.3 Ventilation Prescription**

# ELECTRICAL INSTALLATION

# 4

## Chapter Table of Contents



### Contents

This chapter describes electrical installation and wiring of a Secom Drive. To aid in the description of this process some technical terms have been described in Section 4.2. Before reading the other section of this chapter, it is highly recommended that the reader familiarizes themselves with this terminology.
The installation of high power connections in a Secom Drive system is explained in sections 4.3 - 4.5 for DC/AC, AC/DC and AC/AC connections respectively. Information regarding installation of auxiliary connections such as the drive fans can be found in section 4.6. Installation of all drive control connections and system, including the master control unit, precharge system, and encoder are explained in section 4.7.

### Chapter Target Audience

This chapter is aimed at electricians and electrical design engineers, or any personnel that need to know how to connect the drive electrical and electronic components, the drive power consumption, cable ratings, etc.

# 4.1 SAFETY

The general safety rules described in chapter *1 – Safety Instructions* are applicable here, as they are in all situations. It is recommended that the reader pays particular attention to paragraphs 1.4.2 and 1.4.3. In addition some further rules specific to electrical installation are provided here.

**WARNING!** SECOM DRIVE products are designed for industrial applications. When the drive is ON, even when not running, the drive is energized; working on the drive in this state poses a lethal electrical risk. Installation and operation of the drive must be carried out by skilled personnel.
Improper connection and configuration of the drive may lead to serious injury, damage to the drive and/or to the motor.

**WARNING!** SECOM DRIVE is a Variable Frequency Drive (VFD) and has to be properly configured to avoid damaging the motor or generating hazards to people in the vicinity of the drive or motor.

**WARNING!** Running the drive without a ground connection is not allowed, not only for safety reasons, but also to prevent electrical disturbances. Connect the motor cable shield to the ground of the motor and the cabinet (PE). If the shield connection is not IEC 61439-1 compliant, use a separate cable to connect the ground of the motor with the cabinet's ground.

# 4.2 DRIVE TERMINOLOGY

The technical nature of the electrical installation chapter requires some specific terms to be defined. These terms are provided in this section. It is highly recommended that the reader takes the time to read and understand Tab. 4-1.

| Term | Meaning | Description | Product Code |
|---|---|---|---|
| **Single Drive** | **AC/AC Inverter** | A single drive is a stand alone drive, with an AC input and output. A rectifier bridge provides the internal DC-Link inside the module. In SECOM Drives, the rectifier stage is a semi-controlled bridge; this drive can't be connected in parallel, it consists of a single AC/AC DPM. | SDS |
| **Multi Drive** | **Drive with common DC bus** | Multi Drive is a term used to describe a drive configuration using a common DC bus to connect separate inverter stages and/or frontend stages. | SDI, SDA, SDF |
| **DPM** | **Drive Power Module** | A drive power module indicates a power electronics building block used to construct the power stage of a drive, it could be a frontend, inverter or AC/AC converter. | SDI, SDA, SDF, SDS |
| **Single DPM** | **One DPM** | Single DPM is used to highlight one single drive power module. Could be indicated as *Single SDx* too. | SDI, SDA, SDF, SDS |
| **Parallel DPM** | **Multiple DPMs** | Parallel DPM is used to describe DPMs that are connected in parallel on both the AC side and DC side, such that the power transfer is shared between parallel modules. Multiple DPM connected in parallel. Could be indicated as *Parallel SDx* too. | SDI, SDA, SDF |
| **Motor Side** | **Drive Motor Front End** | Motor side is used to refer to the AC side of inverter DPMs, where the motor is connected. In motor application, this is referred to as the output side. | SDI, SDS |
| **Line Side, Grid Side** | **Drive Power Grid Front End** | Line Side or Grid Side refers to the AC side of front end DPMs connected to the power grid. In grid application, this is referred to as the output side. | SDA, SDF, SDS |
| **DC/AC** | **Input / output** | When DC/AC is used to refer to a DPM, for example, it means the DC side is considered the input and the AC side the output | SDI |
| **AC/DC** | **Input / output** | When AC/DC is used to refer to a DPM for example, it means the AC side is considered the input and the DC side the output | SDA, SDF |
| **AC/AC Drive** | **Input / output** | The term AC/AC drive is used to mean a complete AC to AC drive with internal DC-Link. The AC grid side is considered the input side (R, S, T) and the motor AC side is the output (U, V, W) | SDS |

**Tab. 4-1: Important definitions and terminology used throughout this chapter**

# 4.3 SECOM DRIVE DC/AC MOTOR SIDE WIRING

This section covers the connection and wiring of DPMs, from a DC bus to one or more motors. The following cases are considered; motors fed by a single DPM, motors driven by parallel DPMs and multiple Motors driven by a single inverter. Throughout this section (4.3), *output side* refers to the AC side towards the motor, while the DC side is considered as an input. In all installations covered here, the earth connection is located in the front-lower part of the frame, as shown in the Fig. 4-1.

**WARNING!** All DPMs connected to the common DC bus must be compliant with the voltage rating of the DC bus and the DPM AC connection point. I.e. the DPM/s which feed the DC bus or DPM/s driving machinery from the DC bus, mustn't increase the common DC bus voltage upper above the rating of any of the SECOM Drive DPMs. Failure to adhere to this rule will cause serious damage to the DPMs.

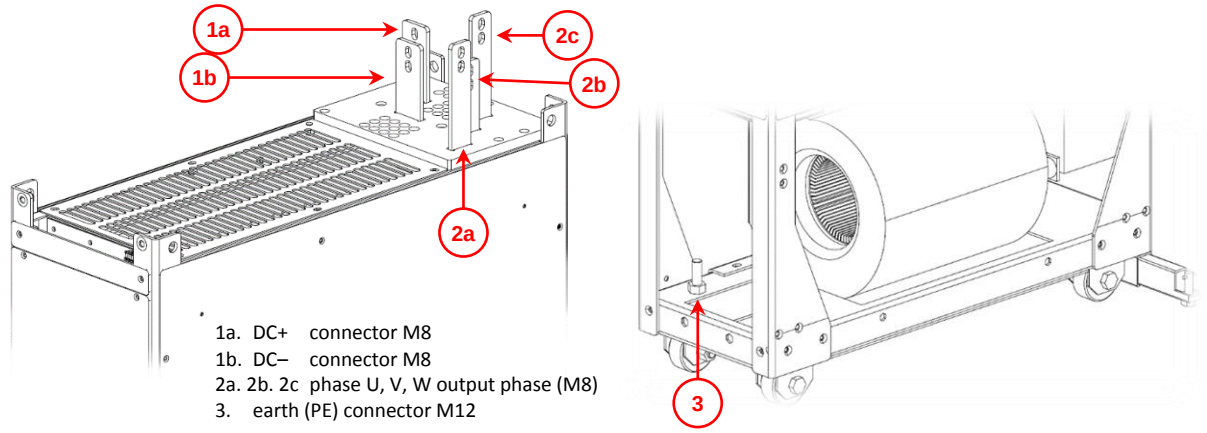
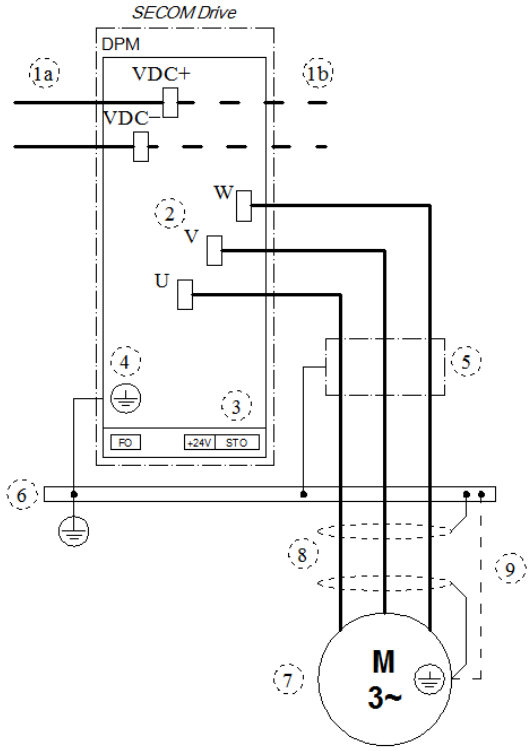



**Fig. 4-1: SDI/SDA/SDF.2 electrical terminals**

The motor side can be configured as a single DPM (Fig. 4-2) or parallel DPMs (Fig. 4-3) as described in the follow.

## Motors fed by a single DPM

In the majority of SECOM DRIVE applications an individual inverter DPM is able to provide sufficient output power to feed each motor. The typical motor connection required for this scenario is shown in Fig. 4-2; this connection is applicable for both SDI.2 and SDI.3 inverter frame sizes.




1. Common DC bus: feed can be provided by a diode bridge, AFE or F3E frontend (1*a*); the DC bus can be extended to other inverters (1*b*)
2. Inverter AC Output
3. Interface with main control board: Tx/Rx fiber optic connections, power supply (24V) and STO
4. Frame ground
5. External optional choke used with long motor cables. In very rare cases, such as revamping motors not designed for VFDs, an LC filter is required.
6. Earth bar (PE), shields and ground are connected here
7. 3-phase motor
8. Cable shield: connected at both ends to ground.
9. Additional ground connection if cable shield is not IEC 61439-1 compliant.

*NOTE*: fan power supply or water cooling connection are not indicated

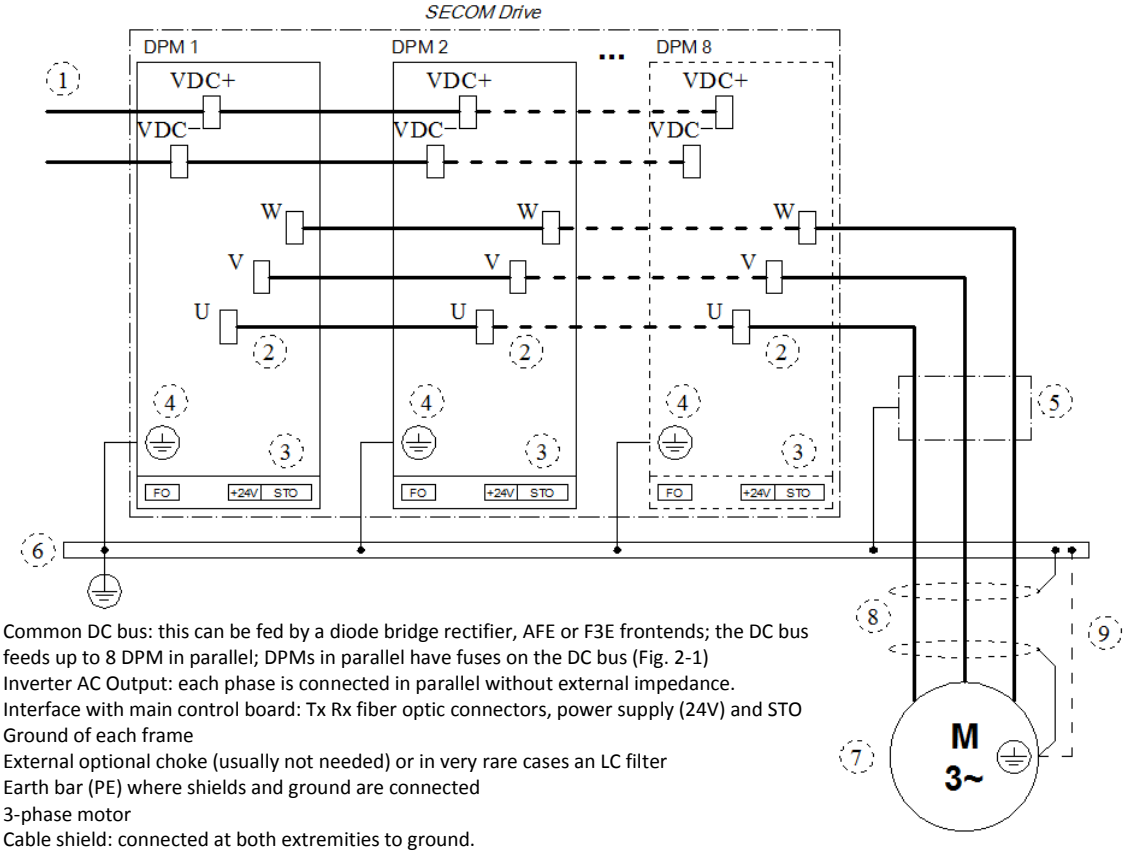
**Fig. 4-2: Motor Connection for single DC/AC power module**

### Motors driven by parallel DPMs (applicable only to SDI.2 frame)

In applications where a high-power (1MW or greater) motor is present, a parallel inverter configuration is typically required to meet the output power demands of each high-power motor. Motors driven by parallel inverters are connected as in figure Fig. 4-3; designers should pay attention to the following recommendations:

- Each DPM's DC bus bars are connected to the common DC bus
- Each DPM's AC bus bars of each DPM module are connected to the motor, usually using one of the following methods:
  1. If the motor connection length is <100m, the DPM AC output phases are connected together using a common bus bar; the motor phases are then connected to these bars with cables (parallel cables may be used to achieve the correct rating).
  2. If the motor connection length is >100m, method 1 is used typically with the addition of a choke between the bar and motor cable.
  3. In some rare cases, an LC filter is needed (usually if the motor is not designed to be driven by an inverter and/or is a very old design)

Fig. 4-3 represents a principle[4] scheme of the connection.




1. Common DC bus: this can be fed by a diode bridge rectifier, AFE or F3E frontends; the DC bus feeds up to 8 DPM in parallel; DPMs in parallel have fuses on the DC bus (Fig. 2-1)
2. Inverter AC Output: each phase is connected in parallel without external impedance.
3. Interface with main control board: Tx Rx fiber optic connectors, power supply (24V) and STO
4. Ground of each frame
5. External optional choke (usually not needed) or in very rare cases an LC filter
6. Earth bar (PE) where shields and ground are connected
7. 3-phase motor
8. Cable shield: connected at both extremities to ground.
9. Additional ground connection if cable shield is not IEC 61439-1 compliant.

*NOTE*: fan power supply or water cooling connection are not indicated

**Fig. 4-3: Motor Connection for DC/AC power module parallel configuration**

### Multiple Motors driven by a single inverter

In special applications, multiple motors can be connected to the same AC output of the same SDI/SDS drive. In other words, motors are connected in parallel among each other and only one inverter controls them. In any case, for each motor, installation engineers must follow the grounding an shielding prescription described above.
For further technical details for special application, please contact SECOM technical department.

## 4.3.1 Motor Cable Connection Procedure

This procedure provides a step by step guide for installation engineers to connect the DPM/s to the drive motor/s.
The drive must be installed and rigidly fixed following the mechanical installation instructions provided in chapter *3 – Mechanical Installation*.

**WARNING!** The specific safety requirements listed in section 4.1 and the general safety requirements listed in chapter *1 – Safety Instructions* must be observed.

- Ground each drive frame by connecting the ground terminal from each frame (DPM) to the internal cabinet PE.
- Connect the DC bus (VDC+ and VDC-) of each frame.
- If DPMs are connected in parallel, connect the AC output bus bars to a common 3-phase bar.

[4] In the case of multiple parallel DPMs, the AC outputs should be connected to a common 3-phase output bar to which the motor is connected.

- If needed, connect the du/dt filter to the output bus bars (if there are many DPM) or directly to the drive (if there is a single DPM).
- Connect the filter to ground.
- Connect the motor cables to the inverter side:
  - When using a du/dt filter: connect the motor cables to the filter
  - Where a filter is not used and a single DPM is used, connect the motor cable directly to the SECOM DRIVE DPM
  - Where a filter is not used and DPMs are connected in parallel to drive the motor, connect the motor cable directly to the common output bar.
- Terminate any shielded cables with shielded cable glands if possible, otherwise connect the shields to the nearest ground point inside the cabinet.
- On the motor side, do the same:
  - Connect the power cable to the motor
  - Connect together the shield to the ground (motor should be connected to the same ground as the drive)

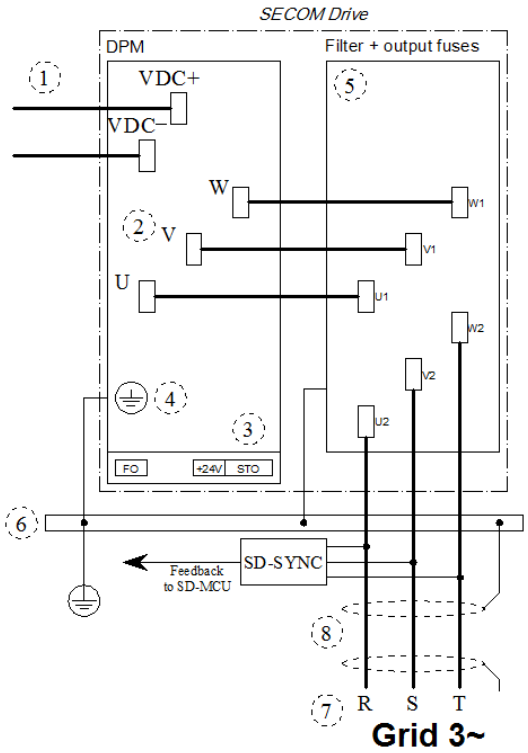
# 4.4 SECOM DRIVE AC/DC GRID FRONT END SIDE WIRING

Drives for motor control require a main power supply feeding the DC link; this could be a SECOM Drive front end DPM, a SECOM rectifier (such as GR9) or another brands device. Front end converters are available from the SECOM Drive range in various power ratings, see chapter 2 for more details. The following provides a description of the electrical installation procedure for the drive front end. It should be noted that it is only applicable to the SECOM DRIVE range, if a third party product is used their instructions must be followed; in addition the product ratings must be compliant with the ratings of any SECOM Drive products used: SECOM cannot be held liable for any damage caused to third party products, occurring as a result of incorrect ratings. As with the inverter stage, the front end side can be configured as a single (Fig. 4-4) or parallel DPMs (Fig. 4-5), both arrangements are described in subsections below. The front end type is indicated by the product code of the DPM, products starting with the prefix SDA are AFEs, while those starting with SDF are F3Es. As with the inverters stage, only frame 2 type allows parallel configuration (so SDA.2 and SDF.2).
In this section, the input side refers to the AC side toward the grid while the DC side is considered as the output.

**WARNING!** All DPMs connected to the common DC bus must be compliant with the voltage rating of the DC bus and the DPM connection point. I.e. the DPM/s which feed the DC bus or DPM/s driving machinery from the DC bus, mustn't increase the common DC bus voltage upper above the rating of any of the SECOM Drive DPMs. Failure to adhere to this rule will cause serious damage to the DPMs.

## Grid application with a single DPM

This section describes the parts required and wiring method for installation of a single DPM. For this arrangement, one DPM and a single filter is required; Fig. 4-4. Shows the DPM, the filter and the power connections required for this type of installation. The filter is rated according to the power of the drive. An SD-SYNC card is used to supply feedback of the network voltage and allow synchronization.




1. Common DC bus: this is the output of the active front end
2. Inverter AC Input: connected to the filter
3. Interface with main control board: Tx and Rx fiber optic connectors, power supply (24V); STO must be connected to 24V even not safe
4. Frame ground
5. External filter module: L for SDF.2/3, LCL for SDA.2/3
6. Earth bar (PE) where shields and ground are connected
7. 3-phase grid connection
8. Cable shield: connected at both extremities to ground

*NOTE*: fan power supply or water cooling connection is not shown for the DPM nor the filter.

*NOTE*: fuses are needed on output filter.

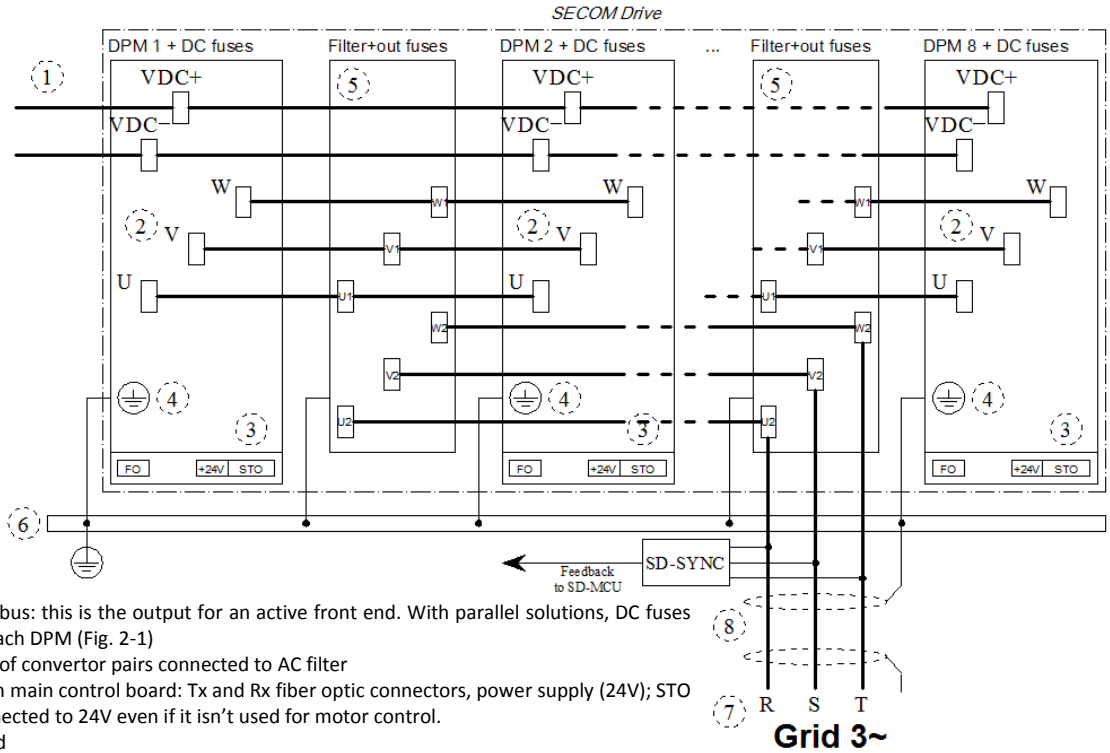
**Fig. 4-4: Grid Connection for single AC/DC power module**

## Grid application with parallel DPM (applicable only to SDA/SDF.2 frame)

As was the case with single DPMs, grid applications requiring parallel DPMs also require the use of an input filter. Each filter module can accept up to 2 DPMs in parallel, the following bullet points should be taken into consideration:

- Even number of DPMs: in this configuration, each filter is identical and is used to connect pairs of DPMs to the grid and as such it must be appropriately rated for two DPMs.
- Odd number of DPMs: this uses the configuration as above, but the remaining DPM has a filter rated for a single DPM.

For ease of installation and maintenance, it is best to use an even number of DPMs where possible. Fig. 4-5 shows the required connections for an active front-end parallel configuration. As can be seen, the DC bus is connected in parallel to every DPM, while, on the AC side, DPMs are connected in pairs with an AC input filter. The filters are then connected in parallel to the AC grid terminals.




1. Common DC bus: this is the output for an active front end. With parallel solutions, DC fuses needed for each DPM (Fig. 2-1)
2. AC terminals of convertor pairs connected to AC filter
3. Interface with main control board: Tx and Rx fiber optic connectors, power supply (24V); STO must be connected to 24V even if it isn't used for motor control.
4. Frame ground
5. External filter module: L for SDF.2/3, LCL for SDA.2/3. LCL fuses require between filter and grid connection.
6. Earth bar (PE), where shields and ground are connected
7. 3-phase grid connection
8. Cable shield: connected at both extremities to ground

*NOTE*: fan power supply or water cooling connection are not shown for both DPM and filter.

**Fig. 4-5: Grid Connection for DC/AC power module parallel configuration**

## 4.4.1 Grid Cable Connection Procedure

This procedure indicates step by step operations to connect the line interface DPMs and associated AC filters to the AC grid.
The drive and all equipment must already be installed and fixed in place following the procedure provided in chapter *3 – Mechanical Installation*.

**WARNING!** The specific safety requirements listed in section 4.1 and the general safety requirements listed in chapter *1 – Safety Instructions* must be observed.

### Single DPM

- Ground the drive and filter modules, connect the frame to the internal cabinet ground bar (PE).
- Connect the DC bus (VDC+ and VDC-) of each drive power module (DPM).
- Connect the DPM AC side (UVW) to the filter (U1V1W1).
- Connect the filter ground to the internal cabinet ground bar.
- Connect the grid cable to the filter side (U2V2W2)
- Terminate any shielded cables with shielded cable glands if possible, otherwise connect the shields to the nearest ground point inside the cabinet.
- On the grid side, do the same:
  - Connect the power cable to the grid (normally a terminal pane or a transformer)
  - Connect the shield to the ground conductor

### Multiple DPM (parallel connection)

- Ground the drive and filter modules by connecting the frame with the internal cabinet ground bar (PE).
- Connect the DC bus (VDC+ and VDC-) of each drive power module (DPM).

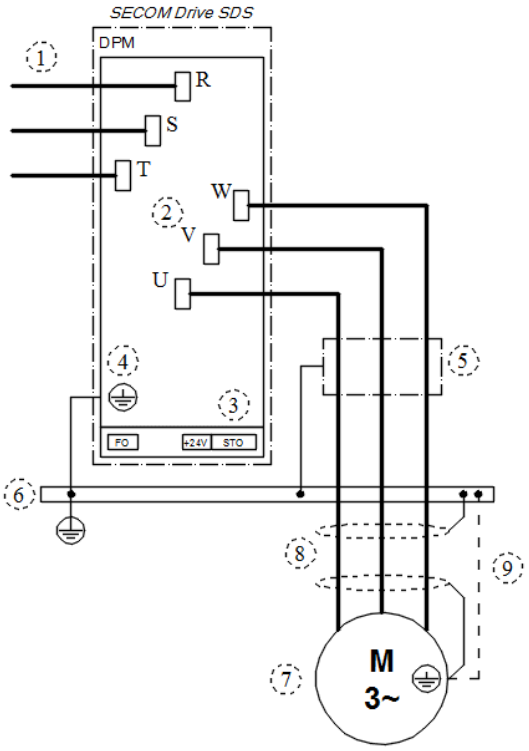
- For each pair of DPMs, connect the AC side (UVW) to the corresponding filter (U1V1W1).
- If there is an unpaired DPM, connect the AC side (UVW) to its corresponding filter (U1V1W1).
- Connect the ground of each filter to the internal cabinet ground bar.
- Connect the AC filter grid side terminals (U2V2W2) creating a point of common coupling (PCC), typically this is done using a 3-phase bus bar.
- Connect the grid cable to the PCC described above.
- Terminate any shielded cables with shielded cable glands if possible, otherwise connect the shields to the nearest ground point inside the cabinet.
- On the grid side, do the same:
  - Connect the power cable to the grid (normally a terminal box or a transformer)
  - Connect the shield to the ground conductor

# 4.5 SECOM AC/AC DRIVE WIRING

AC/AC drives (SDS.x) for motor control require a 3-phase main power supply on the input; the rectifier and precharge circuit is inner of the frame. The input rated voltage of the frame SDS.x could be 400V or 690V.

**WARNING!** Commissioner technicians must pay attention to not connect a SDS with input rated voltage of 400V with 690V grid voltage to avoid serious damage of the DPM.

In this section, *output side* refer to the AC side toward the motor (or load) and phases are indicated with U-V-W, while *input side* is AC too, but indicated with R-S-T. The input side is in the lower part of the frame, is located the earth connection. These terminals are shown in the following Fig. 4-1.




1. Inverter AC Input for AC/AC drive (power grid side)
2. Inverter AC Output (motor or load side)
3. Interface with main control board: Tx/Rx fiber optic connections, power supply (24V) and STO
4. Frame ground
5. External optional choke used with long motor cables. In very rare cases, such as revamping motors not designed for VFDs, an LC filter is required.
6. Earth bar (PE), shields and ground are connected here
7. 3-phase motor
8. Cable shield: connected at both ends to ground.
9. Additional ground connection if cable shield is not IEC 61439-1 compliant.

*NOTE*: fan power supply or water cooling connection are not indicated

**Fig. 4-6: Motor connection for AC/AC single drive**

## 4.5.1 SDS – Motor Cable Connection Procedure

This procedure provides a step by step guide for installation engineers to connect the DPM/s to the drive motor/s.
The drive must be installed and rigidly fixed following the mechanical installation instructions provided in chapter *3 – Mechanical Installation*.

**WARNING!** The specific safety requirements listed in section 4.1 and the general safety requirements listed in chapter *1 – Safety Instructions* must be observed.

- Ground each drive frame by connecting the ground terminal from the frame (DPM) to the internal cabinet PE.
- On upper side, connect the AC input bars (R-S-T) to the main power supply line (usually from the MCB output).
- If needed, connect the du/dt filter to the output bars (U-V-W) of the drive.

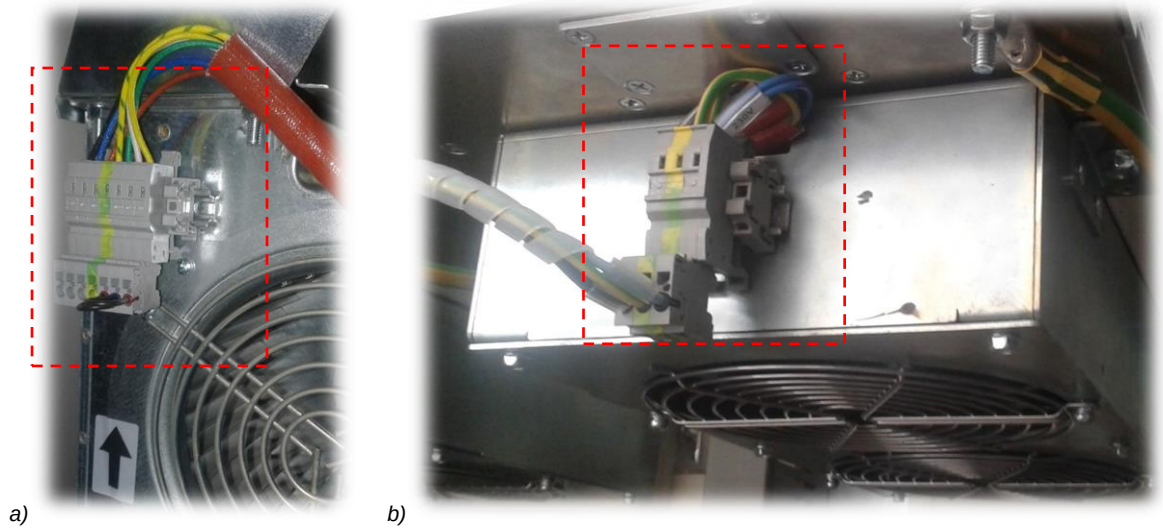
- Connect the filter to ground.
- Connect the motor cables to the inverter side:
  - When using a du/dt filter: connect the motor cables to the filter
  - Where a filter is not used and a single DPM is used, connect the motor cable directly to the SECOM DRIVE SDS DPM
- Terminate any shielded cables with shielded cable glands if possible, otherwise connect the shields to the nearest ground point inside the cabinet.
- On the motor side, do the same:
  - Connect the power cable to the motor
  - Connect together the shield to the ground (motor should be connected to the same ground as the drive)

# 4.6 DPM'S FAN AND CONTROL CONNECTIONS

This section describes the required auxiliary and control connections for all DPMs.

## Cooling Fans

For air cooled inverters, the fans/blowers form part of the auxiliary circuits. The terminal box for each cooling fan can be found adjacent to the fan in each DPM, as shown in Fig. 4-7. The auxiliary circuit is required to supply each fan with 400V 3~.

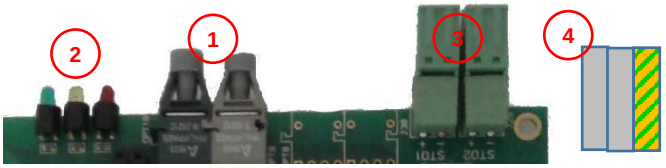


*a)* *b)*

**Fig. 4-7: Cooling Fan terminal block position for frame SDx.2 (a) and SDx.3 (b)**

## DPM Interface description

This interface is the same for all the frames (SDx.2/.3) and is the part of SD-RMU board exposed to the user. Fig. 4-8 shows the interface for the frame.




1. Optical Coupler TX-RX for SD-MCU interface (on SD-RMU)
2. DPM Status LED (on SD-RMU)
3. Two channel STO (on SD-RMU): 2 channel at 24V
4. Electronic power supply (24V)

**Fig. 4-8: DPM interface**

## DPM Interface wiring

- Connect the optical fibers from the SD-MCU control unit to each DPM interface
- Connect the 24V power supply to the DPM interface
- Connect 24V to all STO channels of each DPM. To be SIL3 compliant, the customer is required to connect two independent 24V supplies for each channel; if the customer chooses not to do this, a lower safety level should be calculated. This calculation is the responsibly of the customer.
- In the case of an AFE/F3E, the STO circuit is present; however its function can be ignored for this application. To avoid unwanted error messages, it is sufficient to connect it to a non-SIL certified 24V supply.
- Connect the fan supply or water cooling connections depending on the cooling system required.

# 4.7 WIRING A COMPLETE CONTROL SYSTEM

A complete control system consists of:

- One SD-MCU: Main Control Unit + internal options such as encoder, profibus, profinet, etc.
- From 1 to 8 DPM: interface SD-RMU board inside each DPM
- SD-SYNC: synchronization board, optional for motor control, mandatory for grid control
- I/O Expansion: for custom logic (see SOFTWARE MANUAL)

The SD-MCU is the *Main Control Unit*, it is connected to each of the DPMs and any interface boards (such as SD-SYNC or I/O expansions), to control and monitor the drive. One SD-MCU can control up to 8 DPM in parallel.
The following shows the layout of the board, the available options, how to mechanically and electrically install this board and the operator panel. For further information regarding parametrization, control and real-time PLC features please refer to SOFTWARE MANUAL.

### Electrical and Data Connectors

For the benefit of installation engineers the following provides a brief list of the required header types to install a complete control system. This information allows the engineer to select the correct wire (or cable) and terminal for wiring.

| Icon example | Header | Information | Used on |
|---|---|---|---|
|  | Screwless | Wire range 0.14÷0.5 mm$^2$,<br>pitch 2.5 mm | SD-RMU, SD-MCU |
|  | Screw | Wire range 0.2÷1.5 mm$^2$<br>pitch 3.5 mm | SD-MCU |
|  | Screw | Wire range 0.2÷2.5 mm$^2$<br>pitch 3.5 mm | SD-SYNC, ALI_LEM |
|  | Screwless | Wire range 0.2÷2.5 mm$^2$, gray for power conductor,<br>yellow-green for earth conductor | DPM electronic supply<br>Fan supply |
|  | Ethernet | Cat 5, Cat 5e or Cat 6 are suggested; depending on disturbance of the fieldbus, ethernet speed and plant design in general | SD-MCU<br>SD-COMX51 |
|  | USB 2<br>A-B | USB 2 cable, up to 6m (pear-to-pear)<br>Male A – Male B<br>With ferrite on both edge | SD-MCU+SD-OP |
|  | USB 2<br>A-µB | USB 2 cable, up to 2.5m suggested<br>Male A – Male micro-B | PC+SD-MCU |
|  | Profibus<br>D-Sub | D-Sub cable, 9-pin connector, 12Mbit/s<br>See *Profibus Installation Guideline* for more information | SD-COMX10 |
|  | POF cable | A kind of Plastic Optical Fiber for AVAGO/Broadcom Versatile Link | SD-MCU<br>SD-RMU |
|  | AVAGO<br>Versatile<br>Link | AVAGO/Broadcom Versatile Link transceiver. | SD-MCU<br>SD-RMU |

**Tab. 4-2: Headers and Cables**

## 4.7.1 SD-MCU Mechanical Drawings, Layout and Terminals

Fig. 4-9 show the dimensions of the SD-MCU. To mount this board use the four eyelets on left and right side of the case. It is recommended that a spacer is used to separate the bottom of the case from the mounting surface.

The SD-MCU case is made of anodized aluminum, this means it is insulated (unless the cover is damaged or scratched); to ground the case (and the electronics inside) there is a specific GND connector (see Fig. 4-11).

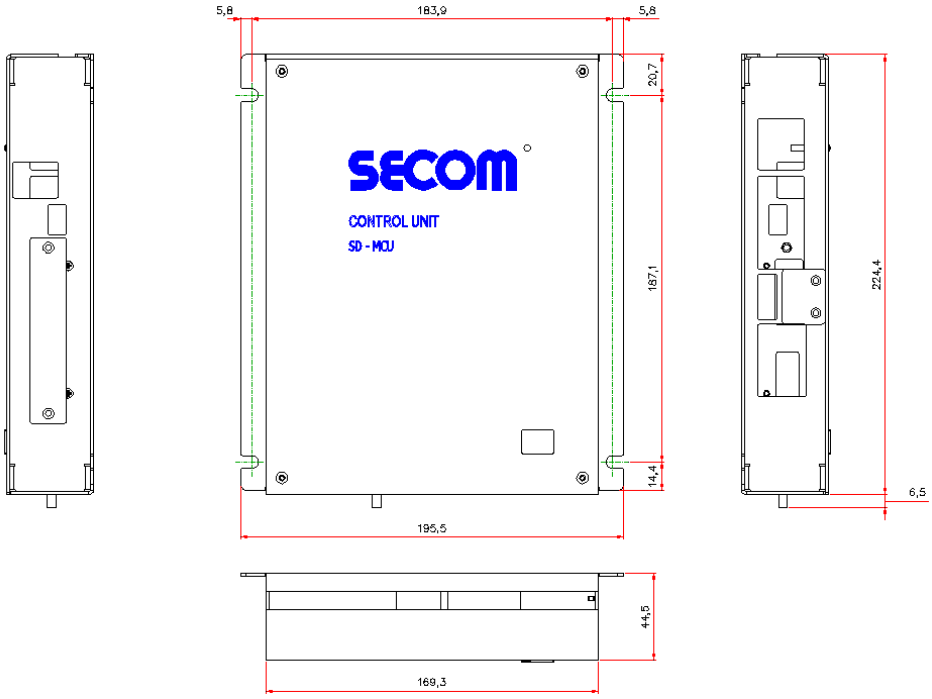



**Fig. 4-9: SD-MCU mechanical drawings**

A 3D drawing of the SD-MCU is shown in Fig. 4-10; each side is labeled with a letter, these letters are used in conjugation with Fig. 4-11, Fig. 4-12, Fig. 4-13, and Fig. 4-14 to illustrate the connections of the SD-MCU. A detailed description of the pin outs of each SD-MCU connector is listed in Tab. 4-3

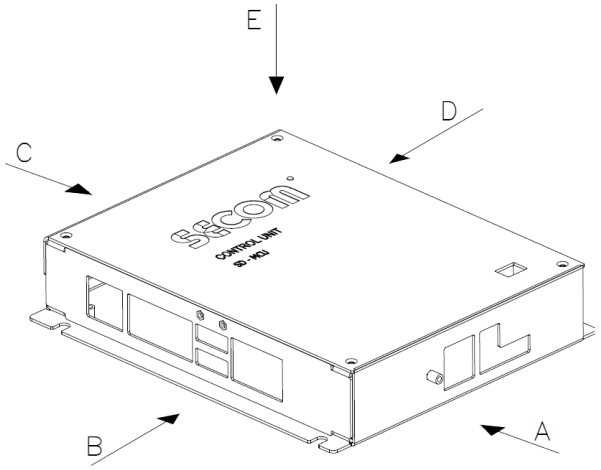



**Fig. 4-10: SD-MCU overall drawing, each side is labeled with a reference letter**

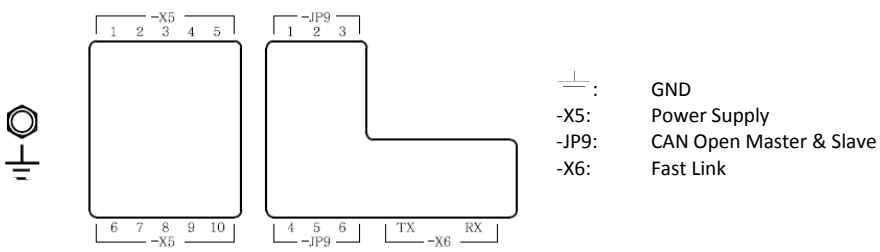
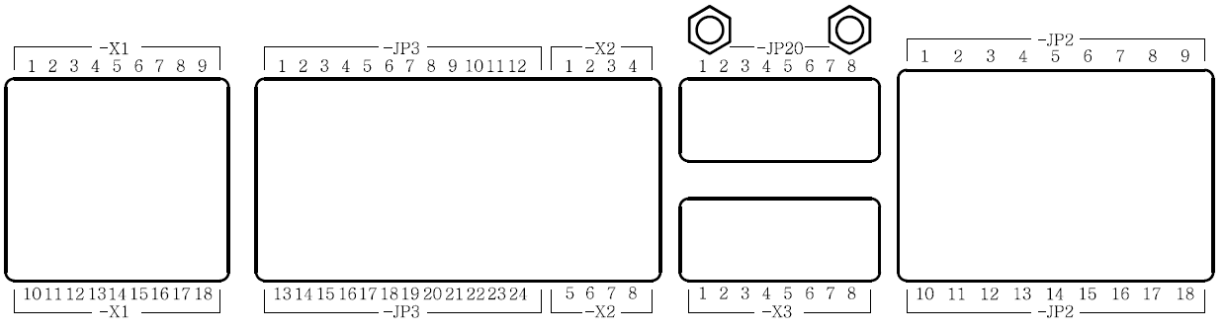



**Fig. 4-11: Side A of Fig. 4-10 – grounding, power supply, CAN Open and Fast Link**




-X1: Digital Input
-JP3: Analog Input (±15V fed form external supply)
-X2: Analog Input (±15V fed form SD-MCU supply with low power)
-JP20: Incremental Encoder
-X3: Digital Output (open collector)
-JP2: Digital Output (relays)

**Fig. 4-12: Side B of Fig. 4-10 – digital input, analog input, incremental encoder, digital output, relays output**

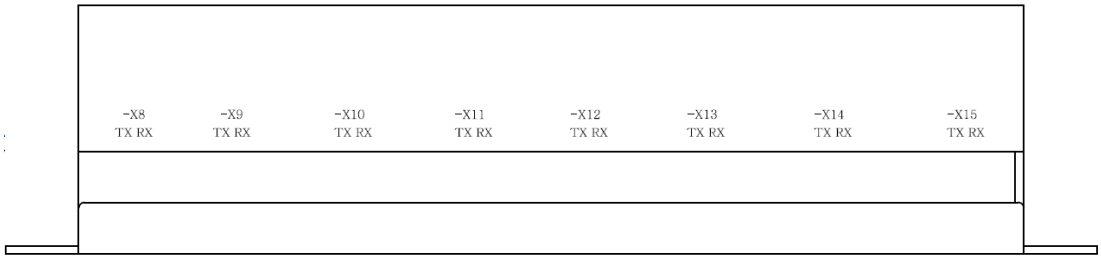
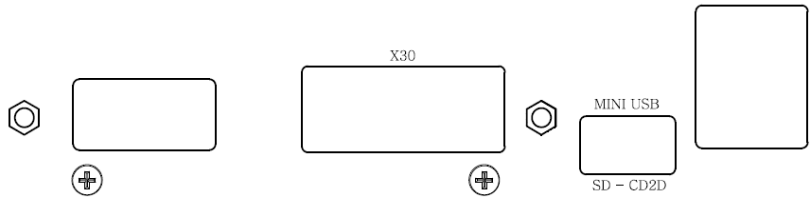



**Fig. 4-13: Side C of Fig. 4-10 – fiber optics interface to DPMs**




-X30: Profibus or ProfiNet option
Mini USB
SD-Card slot
ETH0: Ethernet (ModbusTCP, HMI, SDM, SDScope, etc)
USB0: for SD-OP, saving logs, updating system, etc

**Fig. 4-14: Side D of Fig. 4-10 – SD-COMX (10 or 51), mini USB, SD card, Ethernet and USB**

| Side | Type | Connector | Description | Cable |
|---|---|---|---|---|
| A | Supply | X5-1 | Not connect / *External supply +15V* | Ø 1,5 mm² Pitch 3.5 mm |
| | | X5-2 | Not connect / *External supply 0V (same as X5-4)* | |
| | | X5-3 | Not connect / *External supply -15V* | |
| | | X5-4 | Not connect / *External supply 0V (same as X5-2)* | |
| | | X5-5 | Not connect | |
| | | X5-6 | Not connect | |
| | | X5-7 | **0V** supply | |
| | | X5-8 | **24V** supply ± 10 % | |
| | | X5-9 | Not connect | |
| | | X5-10 | Not connect | |
| | CAN Open fieldbus | JP9-1 | CAN Open Slave – GND | |
| | | JP9-2 | CAN Open Slave – CAN - | Ø 1,5 mm² Pitch 3.5 mm |
| | | JP9-3 | CAN Open Slave – CAN + | |
| | | JP9-4 | CAN Open Master – GND | |
| | | JP9-5 | CAN Open Master – CAN - | |
| | | JP9-6 | CAN Open Master – CAN + | |
| | | X6-TX | TX cable for fiber optic connection (fast link) | Fiber optics |
| | | X6-RX | RX cable for fiber optic connection (fast link) | |
| | | ⏚ | Ground connection (for shielding) | |
| B | Digital Inputs | X1-1 | Digital input 1 (24 V) see note e | Ø 0,5 mm² Pitch 2.5 mm |
| | | X1-2 | Digital input 2 (24 V) see note e | |
| | | X1-3 | Digital input 3 (24 V) see note e | |
| | | X1-4 | Digital input 4 (24 V) see note e | |
| | | X1-5 | Digital input 5 (24 V) see note e | |
| | | X1-6 | Digital input 6 (24 V) see note e | |
| | | X1-7 | Digital input 7 (24 V) see note e | |
| | | X1-8 | Digital input 8 (24 V) see note e | |
| | | X1-9 | Ground (0V) – Common ground only for digital inputs from 1 to 8 | |
| | | X1-10 | Digital input 9 (24 V) see note e | |
| | | X1-11 | Digital input 10 (24 V) see note e | |
| | | X1-12 | Digital input 11 (24 V) see note e | |
| | | X1-13 | Digital input 12 (24 V) see note e | |
| | | X1-14 | Digital input 13 (24 V) – Fault Acknowledge see note c | |
| | | X1-15 | Digital input 14 (24 V) – Enable Operation see note c | |

| Side | Type | Connector | Description | Cable |
|---|---|---|---|---|
| | | X1-16 | Digital input 15 (24 V) – Switch ON[see note c] | |
| | | X1-17 | Digital input 16 (24 V) – Pulse Enable[see note d] | |
| | | X1-18 | Ground (0V) – Common ground only for digital inputs from 9 to 16 | |
| | Analog Inputs | JP3-1 | Not connect / *External +15V (same as X5-1 if external supply is present, otherwise is internal)* | Ø 0,5 mm² Pitch 2.5 mm |
| | | JP3-2 | Auxiliary 0V analog inputs (common with all the analog inputs 0V) | |
| | | JP3-3 | Auxiliary Analog input 1[f] (voltage range ±5.5 V; configurable for customer: ±5 or 4-20mA) | |
| | | JP3-4 | Not connect / *External -15V (same as X5-3 if external supply is present, otherwise is internal)* | |
| | | JP3-5 | Not connect / *External +15V (same as X5-1 if external supply is present, otherwise is internal)* | |
| | | JP3-6 | Auxiliary 0V analog inputs (common with all the analog inputs 0V) | |
| | | JP3-7 | Auxiliary Analog input 2[f] (voltage range ±5.5 V; configurable for customer: ±5 or 4-20mA) | |
| | | JP3-8 | Not connect / *External -15V (same as X5-3 if external supply is present, otherwise is internal)* | |
| | | JP3-9 | Not connect / *External +15V (same as X5-1 if external supply is present, otherwise is internal)* | |
| | | JP3-10 | Auxiliary 0V analog inputs (common with all the analog inputs 0V) | |
| | | JP3-11 | Auxiliary Analog input 3[f] (voltage range ±5.5 V; configurable for customer: ±5 or 4-20mA) | |
| | | JP3-12 | Not connect / *External -15V (same as X5-3 if external supply is present, otherwise is internal)* | |
| | | JP3-13 | Not connect / *External +15V (same as X5-1 if external supply is present, otherwise is internal)* | |
| | | JP3-14 | 0V analog inputs (common with all the analog inputs 0V) | |
| | | JP3-15 | Analog input 4 (voltage range ±10 V) | |
| | | JP3-16 | Not connect / *External -15V (same as X5-3 if external supply is present, otherwise is internal)* | |
| | | JP3-17 | Not connect / *External +15V (same as X5-1 if external supply is present, otherwise is internal)* | |
| | | JP3-18 | 0V analog inputs (common with all the analog inputs 0V) | |
| | | JP3-19 | Analog input 5 (voltage range ±10 V) | |
| | | JP3-20 | Not connect / *External -15V (same as X5-3 if external supply is present, otherwise is internal)* | |
| | | JP3-21 | Not connect / *External +15V (same as X5-1 if external supply is present, otherwise is internal)* | |
| | | JP3-22 | 0V analog inputs (common with all the analog inputs 0V) | |
| | | JP3-23 | Analog input 6 (voltage range ±10 V) | |
| | | JP3-24 | Not connect / *External +15V (same as X5-3 if external supply is present, otherwise is internal)* | |
| | | X2-1 | Auxiliary +15V for SD-SYNC supply | Ø 0,5 mm² Pitch 2.5 mm |
| | | X2-2 | Auxiliary 0V for SD-SYNC supply or for analog inputs (common with all the analog inputs 0V) | |
| | | X2-3 | Auxiliary Analog input 7[f]: SD-SYNC TV12 (configurable for customer ±5V with pull-up) | |
| | | X2-4 | Auxiliary -15V for SD-SYNC supply | |
| | | X2-5 | Auxiliary +15V – Not connect (same as X2-1) | |
| | | X2-6 | Auxiliary 0V analog inputs (common with all the analog inputs 0V) | |
| | | X2-7 | Auxiliary Analog input 8[f]: SD-SYNC TV31 (configurable for customer ±5V with pull-up) | |
| | | X2-8 | Auxiliary -15V – Not connect (same as X2-4) | |
| | SD-ENC Encoder board (optional) | JP20-1 | Encoder supply 24V/5V (it is an output for SD-MCU). The supply value depends on the encoder board type. | Ø 0,5 mm² Pitch 2.5 mm |
| | | JP20-2 | Encoder channel A+ | |
| | | JP20-3 | Encoder channel A- | |
| | | JP20-4 | Encoder channel B+ | |
| | | JP20-5 | Encoder channel B- | |
| | | JP20-6 | Encoder channel Z+ | |
| | | JP20-7 | Encoder channel Z- | |
| | | JP20-8 | Encoder 0V | |
| | Digital outputs | X3-1 | open collector output 1[see note a, e] | Ø 0,5 mm² Pitch 2.5 mm |
| | | X3-2 | 0V output 1 | |
| | | X3-3 | open collector output 2[see note a, e] | |
| | | X3-4 | 0V output 2 | |
| | | X3-5 | open collector output 3[see note a, e] | |
| | | X3-6 | 0V output 3 | |
| | | X3-7 | open collector output 4[see note a, e] | |
| | | X3-8 | 0V output 4 | |
| | | JP2-1 | Digital output 1 – NO contact relay[see note b, e] default: MCB Close Command | Ø 1,5 mm² Pitch 3.5 mm |
| | | JP2-2 | Digital output 1 – C contact relay | |
| | | JP2-3 | Digital output 1 – NC contact relay[see note b, e] | |
| | | JP2-4 | Digital output 2 – NO contact relay[see note b, e] default: Precharge Close Command | |
| | | JP2-5 | Digital output 2 – C contact relay | |
| | | JP2-6 | Digital output 2 – NC contact relay[see note b, e] | |
| | | JP2-7 | Digital output 3 – NO contact relay[see note b, e] | |
| | | JP2-8 | Digital output 3 – C contact relay | |
| | | JP2-9 | Digital output 3 – NC contact relay[see note b, e] | |
| | | JP2-10 | Digital output 4 – NO contact relay[see note b, e] | |
| | | JP2-11 | Digital output 4 – C contact relay | |
| | | JP2-12 | Digital output 4 – NC contact relay[see note b, e] | |
| | | JP2-13 | Digital output 5 – NO contact relay[see note b, e] default: Fan ON command | |
| | | JP2-14 | Digital output 5 – C contact relay | |
| | | JP2-15 | Digital output 5 – NC contact relay[see note b, e] | |
| | | JP2-16 | Digital output 6 – NO contact relay[see note b] Fault relay (fixed function) | |
| | | JP2-17 | Digital output 6 – C contact relay Fault relay (fixed function) | |
| | | JP2-18 | Digital output 6 – NC contact relay[see note b] Fault relay (fixed function) | |
| **C** | DPM interface | X8-TX | TX fiber optic communication cable for DPM1 | Fiber optic |
| | | X8-RX | RX fiber optic communication cable for DPM1 | |
| | | X9-TX | TX fiber optic communication cable for DPM2 | |
| | | X9-RX | RX fiber optic communication cable for DPM2 | |
| | | X10-TX | TX fiber optic communication cable for DPM3 | |
| | | X10-RX | RX fiber optic communication cable for DPM3 | |
| | | X11-TX | TX fiber optic communication cable for DPM4 | |
| | | X11-RX | RX fiber optic communication cable for DPM4 | |
| | | X12-TX | TX fiber optic communication cable for DPM5 | |
| | | X12-RX | RX fiber optic communication cable for DPM5 | |
| | | X13-TX | TX fiber optic communication cable for DPM6 | |

| Side | Type | Connector | Description | Cable |
|---|---|---|---|---|
| | | X13-RX | RX fiber optic communication cable for DPM6 | |
| | | X14-TX | TX fiber optic communication cable for DPM7 | |
| | | X14-RX | RX fiber optic communication cable for DPM7 | |
| | | X15-TX | TX fiber optic communication cable for DPM8 | |
| | | X15-RX | RX fiber optic communication cable for DPM8 | |
| D | SD-COMX10 SD-COMX51 (optional) | X30 | SD-COMX10: Profibus DP slave Optional fieldbus board (if mounted) | 9 pin Profibus D-Sub |
| | | | SD-COMX51: ProfiNet slave Optional fieldbus board (if mounted) | Cat5 / 5e / 6 |
| | | Eth0 | Ethernet connection (i.e. for SDM, Modbus ) 10/100/1000 Mbit/s | Cat5 / 5e / 6 |
| | | USB0 | Usb device for memory stick or SD-OP | Up to 6m |
| | | SD-CD2D | Micro SD card slot | |
| E | | Display | It provides some information about the MCU FSM (number). See SOFTWARE MANUAL | |
| | | Status led | It provides further information about the drive status (blinking code). See SOFTWARE MANUAL | |

*Note a: open collector contact type Voltage: Up to 24 VDC, On-state resistance: 200 mΩ, Nominal load current: 1.3 A, Clamping energy: 150 mJ*
*Note b: relay contact type: bifurcated crossbar, Rated load: 0.3 A at 125 VAC, 1 A at 30 VDC, Rated carry current: 2 A, Max switching voltage: 125 VAC, 60 VDC, Max switching current: 1 A*
*Note c: these functions are mandatory only if the main command word comes from Terminal Board (see SOFTWARE MANUAL)*
*Note d: Pulse Enable must be always at 24V whatever it is the command source. If this signal is low, the drive can't switch on and all IGBTs aren't pulsed*
*Note e: Configurable I/O*
*Note f: Auxiliary Analog Input could be used for control features such as sensing auxiliary current or synchronization voltage. In these cases, customer can't use them. Moreover, Auxiliary Analog Input 1/2/3 have a burden resistor which can be adapted*

**Tab. 4-3: SD-MCU Connectors detailed description**

## 4.7.2 Precharge Information

For correct operation of SECOM Drive inverters, it is mandatory that a precharge phase is used; i.e. the DC voltage must be increased gradually to the nominal value, in order to avoid damage to the internal capacitors. The ways this is implemented is application dependent; however, in general precharge schemes can be divided into internal precharge or external precharge circuits. The SD-MCU can be configured for both cases.

1. **Internal Precharge**: the precharge phase is controlled by the SD-MCU, including the command and feedback of the precharge circuit and the main circuit breaker (MCB). This is the default and the most common used configuration.
2. **External Precharge**: the precharge is controlled by external logic (such as plant automation) or by an external device (for example another independent SECOM Drive). In this mode the SD-MCU determines the precharge phase has finished if the measured DC-Bus voltage is greater than a configurable threshold and an external feedback[5] *Precharge OK* is high.

For more information about the logic, timing, interlocks and alarms related to the precharge sequence, refer to SOFTWARE MANUAL. In this HARDWARE MANUAL, only wiring information is provided.

### Precharge commands and feedback

The SD-MCU I/O used to manage the precharge is configurable, as indicated in Tab. 4-3; uses can decide to use this I/O as they require. Remember that all the I/O is configurable and so the user can remap the I/O to an internal control variable to exclude some feedback from the control chain.

**WARNING!** The SECOM Drive SD-MCU is very flexible in its configuration; user access to I/O mapping is very liberal. This flexibility can, in the case of incorrect configuration, lead to damage and as such technicians must be very careful when remapping the I/O. For example, if the I/O is remapped in such a way that the close command to the MCB is inadvertently sent high, before the precharge phase is complete and the MCB is closed, the DPM will be severely damaged!

The SECOM Drive SD-MCU is shipped with a default configuration of logic and I/O mapping. The following table lists the default configuration.

| Default I/O mapping for Precharge | | | Needed for internal Prc management | Needed for external Prc management |
|---|---|---|---|---|
| **Signal** | **Description** | **Default I/O** | | |
| *Prc Cmd* | Activate precharge circuit | DO2: JP2-4 (relay) | X | Generated internally |
| *Prc Fdb* | Feedback from precharge circuit | DI: disabled | | |
| *Ext. Prc Ok* | Precharge is completed | DI: disabled | | if enabled |
| *MCB Cmd* | MCB close command | DO1: JP2-1 (relay) | X | |
| *MCB Fdb* | MCB close command | DI: disabled | | |

**Tab. 4-4: Precharge I/O – default configuration**

**Note**: SD-MCU controls by default a single MCB with one command and one feedback. Large plants may require/have a more complex MCB arraignments with Open and Close commands, as well as Close and Fault feedback. The SD-MCU can be used control this type of MCB, but a small PLC logic block must either be provided by SECOM (on request) or alternatively implemented independently by customers. If this function is to be provided independently, please refer to SOFTWARE MANUAL or contact SECOM for field application help.

[5] The external precharge feedback is configurable and can be bypassed too. Please refer to SOFTWARE MANUAL for more information.

### 4.7.2.1 Precharge circuits examples

By default the SECOM Drive range is not shipped with a precharge circuit; however a suitable circuit may be ordered separately, for more information, please contact SECOM customer service. If the client decides to fit a non-SECOM branded circuit, the final choice of circuit is the responsibility of the client; however, some application examples are provided in the following.

#### Motor Control precharge: inverter with semi-controlled diode bridge

A typical arrangement is the case of an inverter connected to a DC-Bus fed from a bridge rectifier, as shown in Fig. 4-15. In this example it is imagined that a GR9 (SECOM semi-controlled diode bridge) and an SDI inverter are installed together. Precharge is controlled by the inverter SD-MCU; first a precharge command is issued to the GR9; after the DC-Link is precharged, a feedback command is sent back to the SD-MCU. The control SD-MCU then sends a signal to close the MCB and feedback is sent back to the SD-MCU typically by an auxiliary contact. In the example provided a SECOM GR9 is used as the bridge rectifier; however, the example is equally applicable to non-SECOM branded front ends; however, it is essential to use the I/O shown in Fig. 4-15.

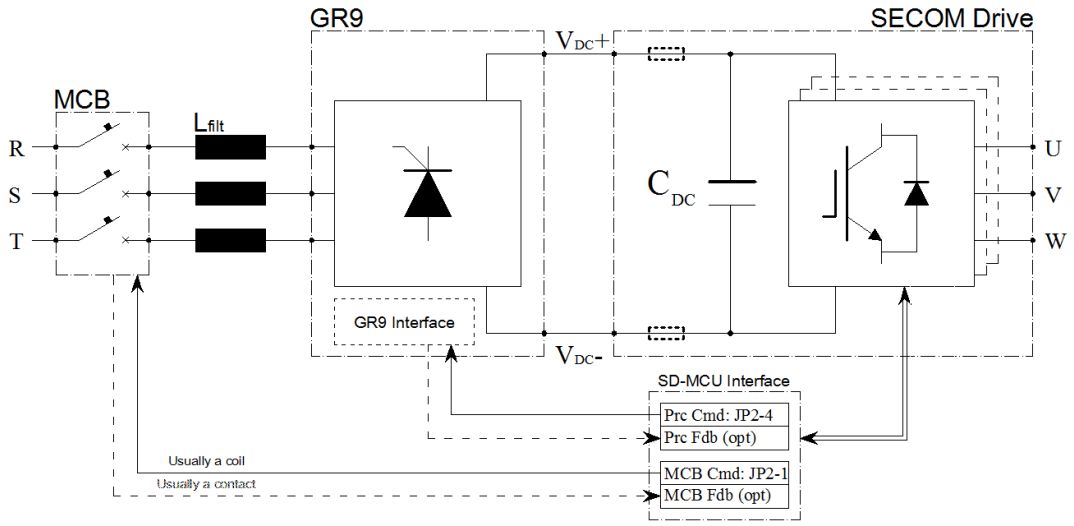



**Fig. 4-15: Motor Control Precharge with semi-controlled bridge – principle scheme example**

#### Motor Control precharge: inverter on common DC bus (multi drive)

In this scenario, a SECOM Drive is connected to a common DC bus as shown in Fig. 4-16; in this example the bus has its own precharge scheme which operates independently of any other inverters on the bus. If it is possible that the drive is connected to the bus, while the bus is energized, then a precharge circuit on DC side is needed. In this scenario the SD-MCU is used to command a precharge contactor that allows the local DC-Link capacitor to be precharged through a resistor; the SD-MCU then commands a primary contactor which connects the drive directly to the DC-Bus. In such circumstances feedback is usually not required; however, feedback may be provided and used as an internal control variable if desired.

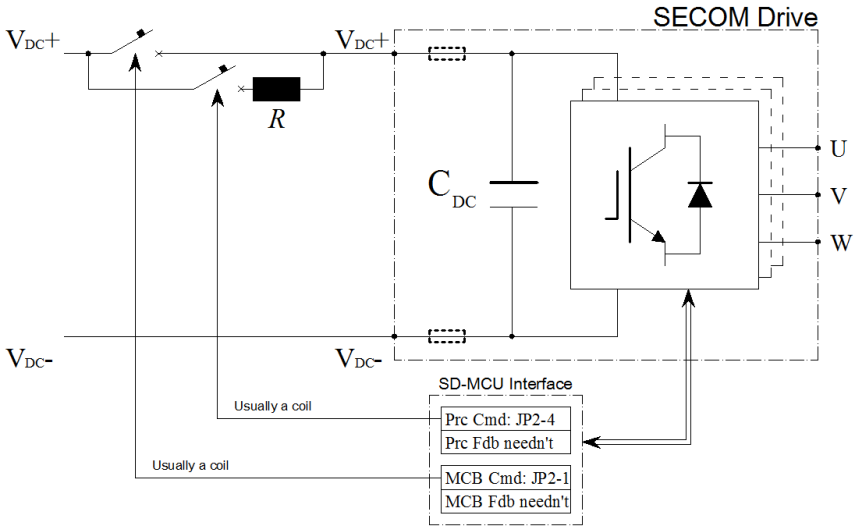



**Fig. 4-16: Motor Control DC Precharge – principle scheme example**

#### Fundamental Frequency Front End precharge

Where an F3E is used as the front end, precharge may be performed either with AC resistors or via an external device. Fig. 4-16 represents a precharge circuit using the AC precharge resistor method. In this particular example precharge resistors are used for 2-phase, however precharge resistors in all 3-phases can be used too. The SD-MCU closes the precharge contactor PRC, such that the AC line voltage is rectified and the capacitor, $C_{DC,}$ is charged to a portion of its nominal value. The Main MCB is then closed and the capacitor finishes charging.

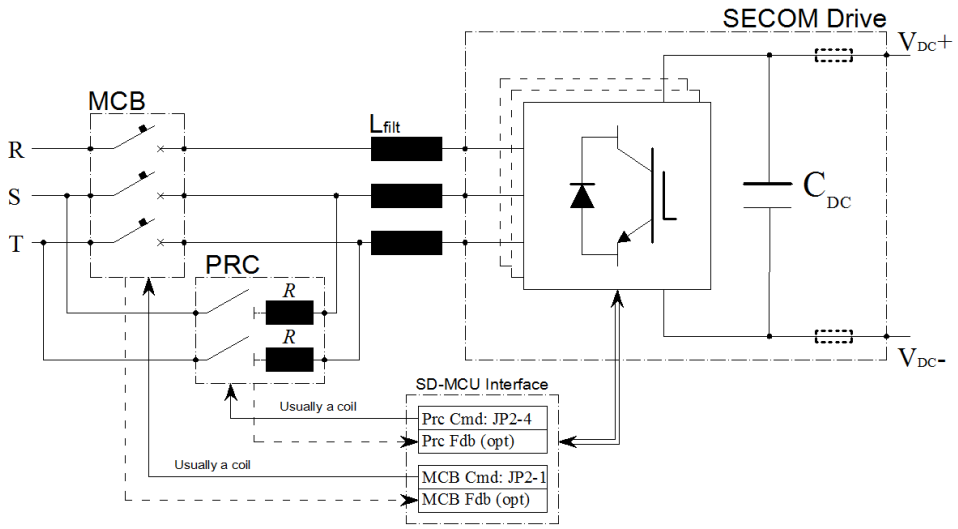



**Fig. 4-17: F3E Precharge – principle scheme example**

### Active Front End precharge with LCL filter present

SECOM suggests that in AFE applications an external precharge circuit as shown in Fig. 4-18. A precharge circuit is selected with a power rating sufficient to precharge the DC capacitors, but a fraction of the main drive. Once the external circuit has precharged the capacitor, $C_{DC,}$ the drive can be synchronized with the grid to minimize inrush current related to the LCL filter. The use of AC precharge resistors are discouraged because the low resistance value, required to prevent a high voltage drop, results in high peak current on the DC capacitors.

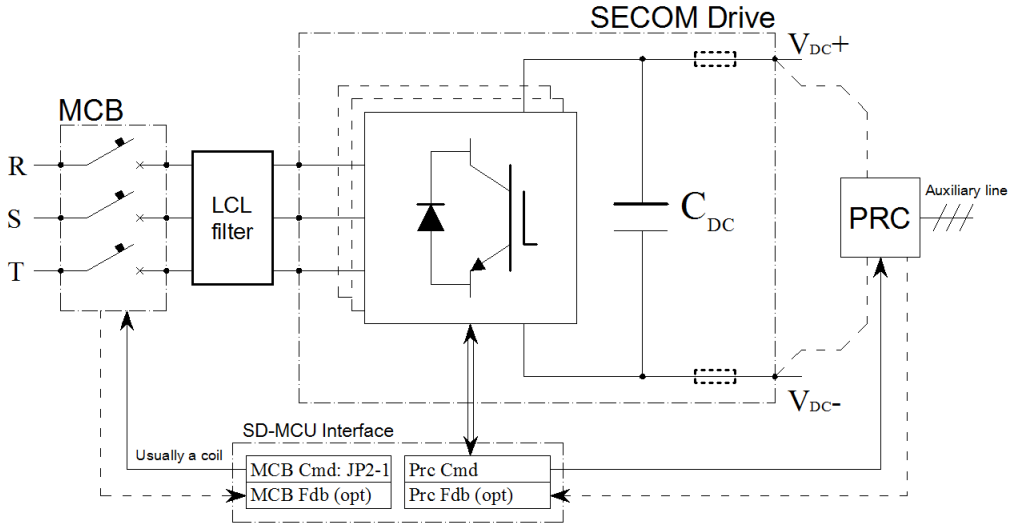



**Fig. 4-18: AFE Precharge – principle scheme example**

## 4.7.3 Connecting a SD-MCU Unit to the DPMs

**WARNING!** Many of the connections are made with fiber optic cables and as such they are very sensitive to dirt and dust; for this reason, each unused fiber optic connection point must be closed with the rubber cap provided. In addition, the optic fiber cable must be handled with care. Do not touch the end of the fiber with bare hands, do not use excessive force when inserting or removing the optic fiber connectors.

**WARNING!** When performing maintenance on the I/O terminal block headers, remove the headers from the electronic boards. Do not turn the terminal block header screws, while the headers are connected to the board. Avoid hazardous operations that can lead to damage of the printed circuit. Additionally, the electrical cable used to connect the terminal blocks must be terminated with the appropriate ferrule.

### SD-MCU cable connection

Procedure:

- Route the cable to the control unit
- Terminate the electrical cables
- Remove the I/O terminal block header, regardless if it is a screw or screw less header.
- Insert properly the terminated cable to the terminal block header (see Tab. 4-3) and fix in place with a screw if present or by releasing the spring if it is a screw-less connector

- Connect the terminal block header to the correct I/O terminal

## DPM control interface and connection to the control unit

An SD-MCU board can control up to 8 DPMs in parallel. Each DPM has an interface pane with the following terminals:

- A pair of optic fiber connectors (TX/RX), for communication with the SD-MCU
- 24V x 2 channel STO SIL3
- 3 status LEDs
- 24V for internal electronic supply

Each DPM is controlled by the SD-MCU using a communication protocol, this requires two signals for each DPM TX and RX. These signals are made using fiber optic cables; when routing these cables remember that the first optic connector of an SD-MCU used for this communication is the -8X terminal, accordingly the eighth terminal used is the -15X. To connect each DPM to the SD-MCU control board, the user has to perform the follow operations:

- Connect the DPM **TX** optic fiber to the corresponding SD-MCU **RX** receiver connector. For example, the first DPM must be connected to the -8X/RX of the SD-MCU, the second DPM on -9X/RX and so on.
- Connect the DPM **RX** optic fiber to the corresponding SD-MCU **TX** transmitter connector. For example, the first DPM must be connected to the -8X/TX of SD-MCU, the second DPM on -9X/TX and so on.
- STO must be always connected to 24V, even if the STO function is not required. The wiring of a safety circuit is the responsibility of the client.
- Connect a 24V power supply

The DPM fans are located on the bottom of the module. Typically, a contactor is required for two/there-phase supply (depending on the DPM frame type). This contactor is actuated by the SD-MCU; if a feedback signal is provided from the contactor, the SD-MCU can be configured to read this signal. The procedure to connect the DPM fans are as follows

- Connect the fan main supply (Fig. 4-7) to the contactor
- Use one of the available digital I/O from the SD-MCU to control the contactor
- If feedback to the SD-MCU is required, attach and wire a NO auxiliary contactor to the main fan contactor

**WARNING!** Before precharge, running and/or loading of the drive, correct fan rotation must be checked or more precisely air flow direction must be checked. Air must be drawn up from the bottom of the DPM and exit from the upper side.

## Motor control connection principle scheme

Fig. 4-19 shows an example arrangement for a motor control application. Here the SD-MCU is used to control the inverter fan/s, and the precharge circuit. The fan supply for all inverter DPMs is controlled by relay K1 driven from JP2-13/15, feedback from K1 is provided to X1-12. The precharge phase is controlled by the SD-MCU using relays K2 and K3 to drive the precharge contactor and MCB respectively. The scheme is presented as an application example; the actual circuit implemented and component selection is the responsibility of the end user.

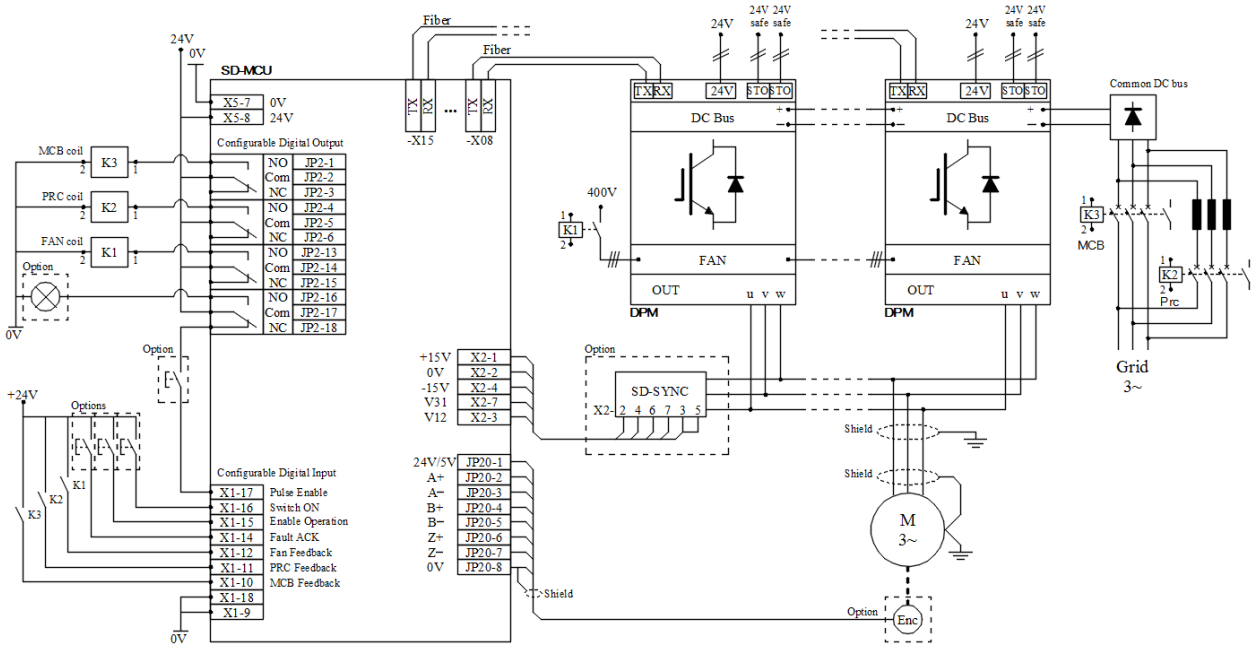



**Fig. 4-19: Principle scheme of control wiring as example**

The following is a checklist of operations required to connect a control scheme

- ✓ Connect a 24V power supply to the DPM (this could be the same used for the SD-MCU)
- ✓ Connect a 24V power supply to the STO (see section 4.7.5.4 for further details)
- ✓ Connect the optical connections of the TX/RX of the DPM with the corresponding RX/TX connections of the SD-MCU
- ✓ Connect the fan power supply
- ✓ Connect a 24V power supply to the SD-MCU (this can be the same as the one used for the DPM); with high electromagnetic disturbance, it could be helpful to apply a little ferrite (for example: WE 742 7143) with one or two twist. In any way, power supply must be stable and regulated and it must be always greater than 20V even transiently.
- ✓ Connect the digital output as follows (some of these are optional):
  - MCB Close Command -X16-1 if used, configure the SD-MCU to control the MCB

- Precharge Command -X16-2 if used, configure the SD-MCU to control the precharge sequence
- Inverter Fan Command -X16-5 if used, configure the SD-MCU to control the fans
- Fault Active -X16-6 optional, but not configurable, typically used to open the pulse enable chain interlock

✓ Connect the main digital input:
- Pulse Enable -X1-16 mandatory
- Enable Operation -X1-15 mandatory when the SD-MCU command is sent from the SD-MCU
- Switch On -X1-14 mandatory when the SD-MCU command is sent from the SD-MCU
- Fault Acknowledge -X1-13 mandatory when the SD-MCU command is sent from the SD-MCU
- Fan Feedback if used, configure the SD-MCU software accordingly
- Precharge Feedback if used, configure the SD-MCU software accordingly
- MCB Feedback if used, configure the SD-MCU software accordingly

✓ Connect the analog inputs:
- Connect the SD-SYNC feedback as explained in 4.7.5.2 (mandatory for AFE and F3E, optional for some motor application)
- Connect auxiliary analog input if required by the application

✓ If needed, connect the Encoder Cable on JP20 terminals

✓ If needed by PLC or automation, connect the logic expansion (such as Beckhoff) and/or all the fieldbus

## 4.7.4 Operator Panel Connection

The SD-OP is an optional user interface panel that allows remote operation and monitoring of a SECOM Drive; when used it is connected to the SD-MCU via USB. Each Operator Panel (SD-OP) can monitor and control only one SD-MCU at a time.
The following bullet points and Fig. 4-20 explain how to connect an SD-OP:

- A USB 2 cable (Male A – Male B) is needed, the cable can be up to 5m long
- Connect the type-B end of the cable to the female B connector on the rear side of the SD-OP (see Fig. 4-20.a)
- Connect the type-A end of the cable to the female USB0 type A connector on the SD-MCU (see Fig. 4-20.b or Fig. 4-14)

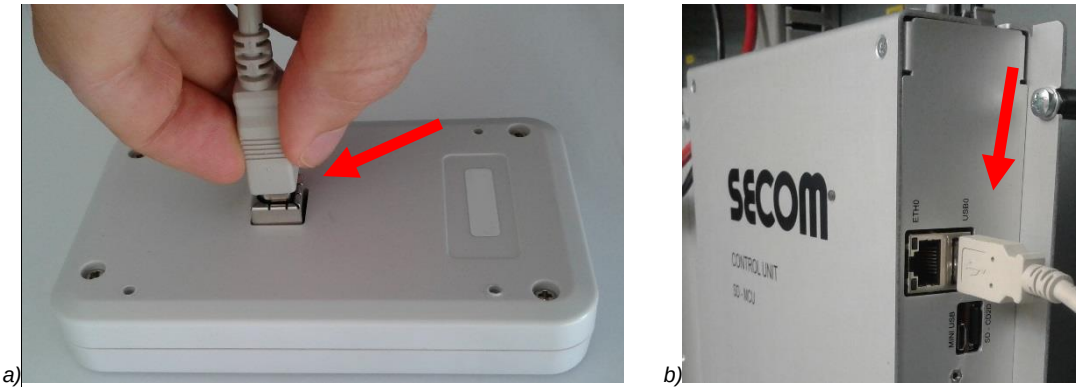



**Fig. 4-20: SD-OP cable connection**

**NOTE**: the USB cable must have ferrites on both edge. If the electromagnetic disturbance are high, the cable is quite long (>2.5m) or the cable hasn't the ferrites, an additional ferrite is required and it must be connected in the vicinity of the Male-A connector.
SECOM suggest a WURTH Elektronik 742 712 21 which allows up to tree tweests (see Fig. 4-21).

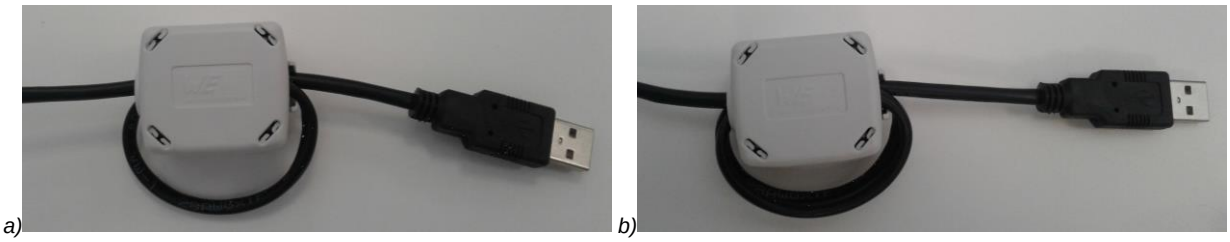



**Fig. 4-21: USB cable with additional ferrite on Male-A edge with two (a) or tree (b) twists**

## 4.7.5 Options

The following features depend on application or on client customization. Indeed, options can be mandatory in some case or always present but not used without a software plugin provided by SECOM or written by customer. To know how to activate and use the option or how to write a PLC software please refer to SOFTWARE MANUAL.

### 4.7.5.1 Fieldbus Connection

The SD-MCU has an internal real-time PLC. This PLC can be programmed directly by customers or alternatively, on request, by SECOM personnel. When the SD-MCU is operating as a fieldbus master, it is possible to add additional fieldbus slaves, such as I/O expansion boards; to do so an additional PLC program is required to describe the slave interface type. For further information please refer to SOFTWARE MANUAL.

The following on-board fieldbus Masters are provided by default with the SD-MCU:

- CAN Open
- Modbus TCP

In addition to the on-board master fieldbus, the following on-board fieldbus Slave are present too; these fieldbus slaves allow the drive to be configured and controlled by plant automation:

- CAN Open (default)
- Modbus TCP (default)
- Profibus DP (option)
- ProfiNet (option)

For further information on how to configure a slave fieldbus, please refer to SOFTWARE MANUAL.

### CAN Open Master and Slave

Fig. 4-22-*a* shows the SD-MCU CAN Open connector (pinout reported in Tab. 4-3-C *CAN Open Fieldbus*). To use CAN Open a termination resistance must be applied. For this purpose the SC-MCU is fitting with an on board terminating resistor, which can be enabled or disabled using a switch located on the SD-MCU board, shown in (Fig. 4-22-*b*). To access this switch, the front cover of SD-MCU case must be removed, as such this task should be only performed by a properly qualified technician.

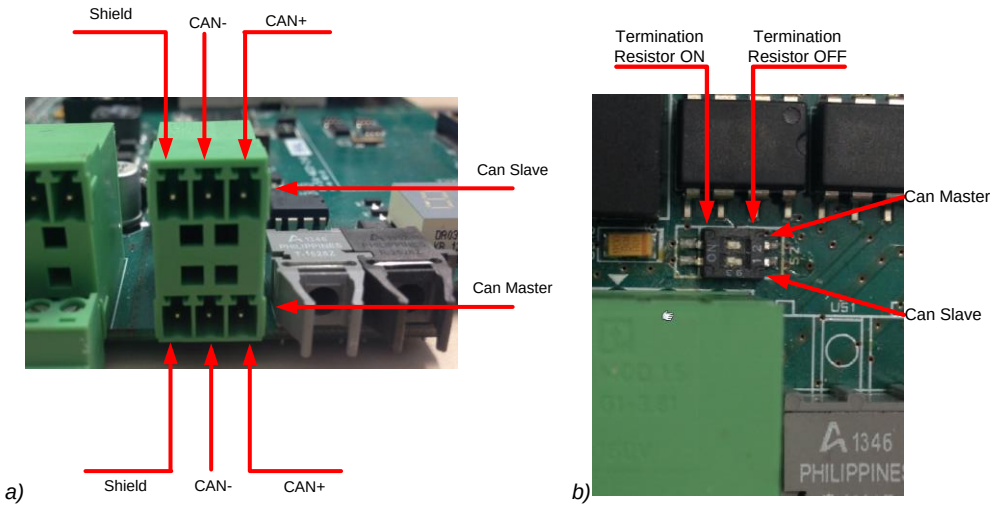



**Fig. 4-22: CAN Open Master and Slave connector**

### Modbus TCP Master and Slave

Modbus TCP is a protocol transmitted over TCP/IP protocol, as such the connector used is a standard RJ45 connector typically used for ethernet applications. The connector used on the SD-MCU for Modbus TCP is labelled ETH0.

### Profibus DP Slave

Profibus slave is an optional extra. It requires a Profibus cable with DB-9 connectors. For more information about Profibus, see Tab. 4-2 and *Profibus Installation Guideline*.

## 4.7.5.2 Synchronization Board Layout – SD-SYNC

The SD-SYNC synchronization board is used to provide feedback of AC voltages to the SC-MCU; in motor control applications it is an optional extra, whereas in grid application its use is mandatory. The SD-SYNC case is insulated and therefore it is not possible to ground the case; however a PE pin is provided on the SD-SYNC connector and should be connected to GND. Fig. 4-23 show the dimensions of the unit, but an additional 2 cm must be added to take into account the presence of terminal blocks.

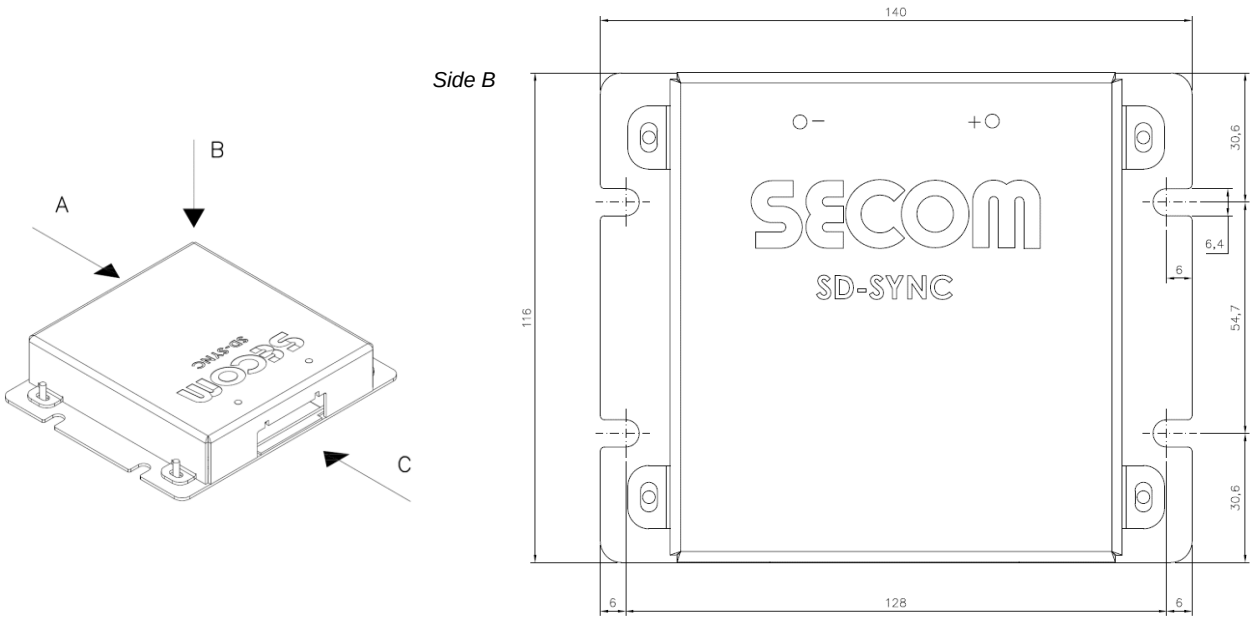
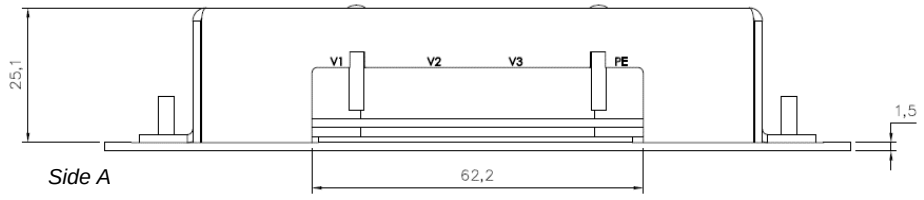


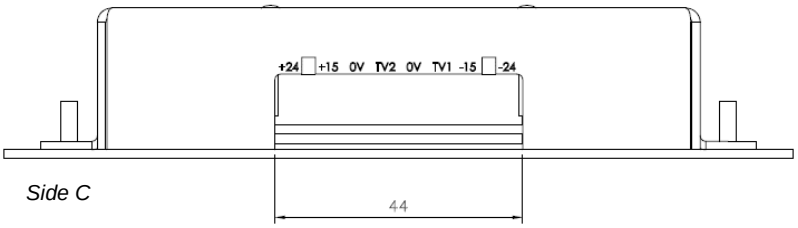

**Fig. 4-23: SD-SYNC mechanical drawings**

The high voltage input terminal block of the SD-SYNC is connected to the AC side (usually a power grid), the maximum permissible line-to-line voltage for measurement is 1250V (peak value). The low voltage output is usually connected to the SD-MCU analog input to allow the synchronization with the grid (or the load). The output signal has a range of ±5.5V≡±1250V input; the sensor can be supplied with ±15V or ±24V. If the supply is present, the two leds on the front ("-" and "+") of the case will be on.




**X1 Input connector (high voltage side):**
X1-1: V1
X1-3: V2
X1-5: V3
X1-8: PE
X1-2,4,6,7: not connected

**Fig. 4-24: Side A of Fig. 4-23 – Input line-to-line voltage from load (usually the grid)**




**X2 Output connector:**
X2-1: +24V X2-8: -24V
X2-2: +15V X2-7: -15V
X2-3, X2-5: 0V
X2-4: TV2: transduced V31
X2-6: TV1: transduced V12

**Fig. 4-25: Side C of Fig. 4-23 – Output sensing toward SD-MCU**

### Connecting SD-SYNC output to SD-MCU analog input

The SD-MCU is able to provide the power supply for SD-SYNC from an internal ±15V supply. Note that this information can be derived from Tab. 4-3 *Analog input*. The mapping of connections from SD-MCU to SD-SYNC is provided in Tab. 4-5; if the connections are not mentioned, do not connect:

| Function | SD-SYNC terminal | SD-MCU terminal |
|---|---|---|
| +15V | X2-2 | X2-1 (or X2-5) |
| 0V | X2-3, X2-5 | X2-2 (common with other 0V) |
| TV2 (V31) | X2-4 | X2-7 |
| TV1 (V12) | X2-6 | X2-3 |
| -15V | X2-7 | X2-4 (or X2-8) |

**Tab. 4-5: Required connections from SD-SYNC to SD-MCU for AC feedback**

## 4.7.5.3 Encoder

SD-ENC is an option mounted on the carrier board of SD-MCU. This board is used to supply an encoder, the default SD-ENC version is 24V. An alternative version with a 5V supply can be installed upon request.

A shield cable for the encoder is required. The shield should be connected to ground at the termination next to SD-MCU. The user can connect the other end of shield to the 0V of the encoder (JP20-8)
For more information about pinout see Tab. 4-3.

### 4.7.5.4 STO

Safe Torque Off circuit is located on SD-RMU board (see Fig. 4-26, detail of Fig. 5-7). This safety circuit is SIL3 compliant, which imply two channels are present. Wiring a safety circuit is up to the client who can wire a safety circuit SIL3, SIL2, SIL1 or even not safe.

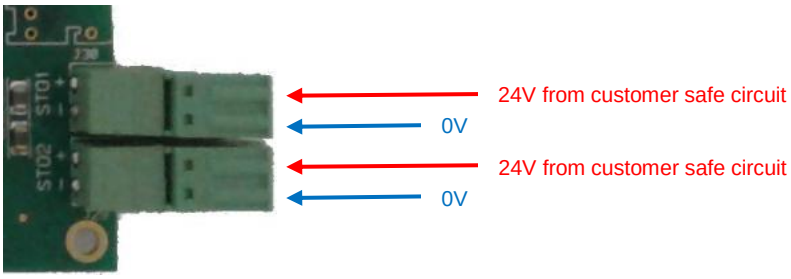



**Fig. 4-26: STO wiring information**

# COMMISSIONING AND MAINTENANCE

5

## Chapter Table of Contents



### Contents

All information regarding how to run the drive and troubleshooting. Here are reported all the item code to order spare parts.

### Chapter Target Audience

Maintenance technician and/or buyers who have to know spare parts codification.

# 5.1 SAFETY

In general, always refer to the rules described in chapter *1 – Safety Instructions*, in particular paragraphs 1.4.2 and 1.4.3. However some reminds are reported in the follow.

**WARNING!** SECOM DRIVE is designed for industrial application. When it is ON (not only RUN), the drive is energized; installing and operating the drive has to be carried out by skilled personnel.
Maintenance of the drive must be performed with no energized power part, which means that technician or skilled personnel has to disconnect the drive from the grid supply and wait at least 5 minutes to allow the voltage be close to zero. After this time, users must measure the residual DC bus voltage, which has to be close to zero before operating on power parts. Moreover, motor must be stand still too, mainly If it is synchronous or permanent magnet motor, to avoid hazardous voltage on both AC and DC side of inverter.

**WARNING!** Maintaining the drive without a ground connection is not allowed, mainly for safety reasons. Be aware the inverter ground is connected to the earth bar of the plant or the cabinet (PE).

**WARNING!** If drive is just switched off, before putting hands on, pay attention to hot surface normally located on lateral plane and above, where hot air flows up.

# 5.2 COMMISSIONING

It is supposed the pre-commissioning of the drive is already done. As pre-commissioning it is intended that all mechanical and electrical installation are performed. Please refer to chapters 3 and 4 for more information.
After that, commission can start.

## 5.2.1 Reforming of DC Capacitors Procedure

If the drive has been stocked for a year or more without use, the electrolytic capacitors can exhibit reduced performance, in such circumstance the following **"reforming" procedure is mandatory**. Note that "stock" the drive means the drive is never being powered up for at least one year, even if it is already installed.

**WARNING!** Ignoring the following instruction could lead to serious physical injury or even death, damage the drive and/or equipment. To perform this procedure, user may have to operate on the electrical power part with high voltage, such as the DC bus, in such circumstance local safety procedures for live working must be followed. After performing the "**reform"** procedure, the standard electrical safety instructions in section 1.4.3 must be followed while performing any further maintenance.

### Reform after a storage lasting between one and two years

If the drive is installed:

- Switch on the auxiliary circuit (24V)
- Switch the power on and perform the precharge of the drive: DC bus will be charged at about the nominal voltage
- Leave the drive precharged for at least 2 hours
- Do not operate the drive
- Do not connect any load to the drive
- After reforming is completed, switch the power off and wait 5 minutes for capacitors to discharge.

If the drive is an SDS, the precharge is performed using a DCS1 board. Usually this board is configured to precharge a drive in about 6-7s (alwaid <10s). Since usually the control system is configured to precharge and start immediately, users have to reconfigure it to avoid the load feeding.

If the drive is not installed and DC bars are accessible, the procedure is the same described in the dub paragraph below (*Reform after a storage lasting more than two years*).

### Reform after a storage lasting more than two years (DC bus accessible)

Regardless of whether the drive is installed or not, trained personnel have to reach the DC bus bars and connect a power supply as showed in Fig. 5-1 following these instructions:

- Disconnect all other external equipment not concerning the SECOM Drive from DC bas bars.
- Place the drive in a safe area or cordon off the adjacent area to prevent access to exposed equipment with dangerously high voltages.
- Follow all safety precautions against electrical shock and/or mechanical injuries
- If it's needed, preinstall a suitable measuring device capable of measuring the DC bus voltage
- Switch on the auxiliary circuit (24V)
- Connect a controlled DC power supply[6] to positive DC bars and negative DC bars: pay attention to the polarity (Fig. 5-1).

[6] Possibly the power supply have to supply less than 1A; even better if this power supply have a current limiter.

- Rise the DC voltage until nominal rectified voltage (or peak voltage of rated AC output voltage), for instance:
  - From 564Vdc to 650Vdc for SDx.x.x.x.400.x
  - From 973Vdc to 1000Vdc for SDx.x.x.x.690.x
- Leave the drive precharged for at least 2 hours
- Do not operate the drive
- Do not connect any load to the drive
- After reforming is completed, switch the power supply off and wait at least 5 minutes for capacitors to discharge.
- For safety reasons, measure the residual voltage of DC bus and, if the voltage is less than the safe working voltage, remove the power supply and measuring device (if connected).

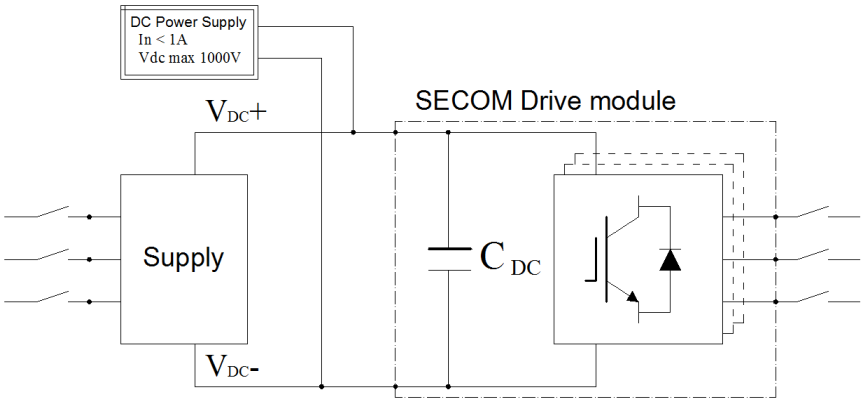



**Fig. 5-1: Circuit example for capacitance reforming**

### Reform after a storage lasting more than two years (DC bus NOT accessible)

Usually SDS have no access to the DC bus. The only way to perform the reforming of the capacitors is connect the DC Power supply between two phases of the AC output. The rest is quite similar as before:

- Disconnect all other external equipment not concerning the SECOM Drive from DC bas bars.
- Place the drive in a safe area or cordon off the adjacent area to prevent access to exposed equipment with dangerously high voltages.
- Follow all safety precautions against electrical shock and/or mechanical injuries
- If it's needed, preinstall a suitable measuring device capable of measuring the DC bus voltage; in an SDS remove the lateral cover.
- Switch on the auxiliary circuit (24V)
- Connect a controlled DC power supply[7] between two AC output phases.
- Rise the DC voltage until nominal rectified voltage (or peak voltage of rated AC output voltage)
- Leave the drive precharged for at least 2 hours
- Do not operate the drive
- Do not connect any load to the drive
- After reforming is completed, switch the power supply off and wait at least 5 minutes for capacitors to discharge.
- For safety reasons, measure the residual voltage of DC bus and, if the voltage is less than the safe working voltage, remove the power supply and measuring device (if connected).

## 5.2.2 Check Air Cooling (Fans) or Water Cooling

- ✓ Visual checks: verify if there are mechanical damage, correct supply connection, no debris (such as screw, washer, etc) into the rotor, etc.
- ✓ Check if supply is properly connected and if the air flows in the correct direction. Usually this can be performed suppling the fan, for example when start auxiliary circuit.

### Water Cooling

- ✓ Check if tube is correctly connected
- ✓ Check if motor and pumps work properly
- ✓ If it is possible start the pumps, check if the pressure and flow rate

## 5.2.3 Check DPM Interface State

To the interface of DPM, only a couple of fiber optics and 24V for supply and STO have to be connected.

### SD-RMU

- ✓ Check the presence of 24V of power supply on the connector.
- ✓ Power On the 24V and check if exposed LED is ON. Usually:
  - Green LED is blinking if DPM is waiting for configuration

[7] Possibly the power supply have to supply less than 1A; even better if this power supply have a current limiter.

- Green LED is ON if the DPM is correctly configured and no hardware fault is present on the DPM
- Yellow LED is ON if Pulses are Enable (which means the drive is in RUN)
- Red LED is ON if at least one fault is present on DPM

✓ Check if couple optical fiber is connected the correct optical socket. Verify it the fiber is fastened try to pull out gently.

### STO

STO is always present even if no motor control is present. If STO is needed, a safety circuit must be wired by the customer.

✓ Check if 24V is present on each STO input
✓ Check if STO works disconnecting one of the two 24 the first time, and both the connectors the second time. When STO is opened, the red LED blinks, while is ON if only one channel is lost.

## 5.2.4 Check Control Integrity

### SD-MCU supply

Power up the control, the 7-segment display will be on and, after few seconds, the led on the front panel of SD-MCU must blink with any frequency. If it is steady ON or OFF, the board is dead.

### SD-MCU notification

Some fault can be useful for hardware fault and integrity detection. As just mentioned, if SD-MCU is in fault state, the alarm list is available connecting to the SD-MCU control board with SDM or via SD-OP. For all the information regarding this list, please refer to SOFTWARE MANUAL; for now it is enough to know that alarms are divided in Hardware and Software alarms. Being this document a HARDWARE MANUAL, only hardware fault (or fault directly related with the power parts) will be analyzed. Please refer to paragraph *5.5 –Troubleshooting* for the list of hardware alarms.

## 5.2.5 Start Auxiliary Circuit

If possible, start manually the auxiliary circuit such as fan power supply and electronic supply (24V). So, check if:

- Cooling system is ready and works properly
- DPM interface is ON
- SD-MCU is ON and the status led is blinking in some way

## 5.2.6 Start the Drive for the First Time

Before proceed, users have to be sure to have checked all the issues, and all parts (DPM, SD-MCU, Auxiliary, etc) are supposed to work properly.

### Testing the Precharge

If it is possible, disconnect the main supply of the drive to verify if precharge circuit and sequence is correct, so:

- Check if SWITCH ON command close the precharge contactor (for example SD-MCU control the precharge contactor like in Fig. 4-16 or Fig. 4-17)
- At the same time, MCB mustn't be closed
- After a while[8], the control system SD-MCU[9] has to show an alarm of *precharge timeout*

If user want to test all the precharge logic, always without no supply connected, the SCOM Drive Control can be configured in simulation mode, which means that the DC voltage is simulated:

- Set the control in *Simulation Mode* (refer to SOFTWARE MANUAL to know how)
- Check if SWITCH ON command close the precharge contactor
- SD-MCU show a nominal value of Vdc and after a while will happen:
  - Open the precharge contactor
  - Close the MCB

If everything is correct, no alarms happen.

**Note:** For safety reason, if the control is in simulation mode and for whatever reason a DC voltage is applied, the drive goes immediately in the fault sate.

### Precharge

- Remove the *Simulation Mode* if enabled (refer to SOFTWARE MANUAL to know how)
- Send SWITCH ON command
- Precharge contactor is closed and Vdc rise up
- If the voltage reach the *Precharge Ok Threshold*, the control open the precharge contactor and close the MCB
- Depending on the configuration, will happen two things:
  1. Inverter start immediately
  2. Inverter switch to READY TO OPERATE state and the control is waiting for ENABLE OPERATION command

[8] The time to show the alarms is configurable; usually the delay is 10s÷20s
[9] SD-MCU is supposed to be properly configured and working

### No Load Pulses

If the load is already connected to the inverter, user can skip this part.
With precharged inverter and with load not connected to the AC side of the inverter, start the inverter.
Depending on the configuration, the drive will start only with SWITCH ON command, or with ENABLE OPERATION command after SWITCH ON command.

### Start the Drive with Load

- Precharge the drive
- Send ENABLE OPERATION command if needed
- No alarms or fault should happen
- Load the drive if it is possible

## 5.3 PROGRAMMED MAINTENANCE

From the study of *Minimum Time To Failure* (MTTF) of all the components of the biggest drive size, the outcome is that the whole drive has a MTTF of 1.5 year, which means that before this time, maintenance has to be performed. Tab. 5-1 reports the maximum time that the maintainers should respect to perform the maintenance. Note that the column *Max time* is calculated by the biggest and the smallest size of each frame. User can find the correct value of each size linearly.
This time must be considered from the end of commissioning.

| Product | Max time for maintenance | Suggested time for maintenance |
|---|---|---|
| Frame SDx.2 | 1.5÷2.1 year | 1 year or each planned plant downtime |
| Frame SDx.3 | 1.8÷2.4 year | 1 year or each planned plant downtime |

**Tab. 5-1: Maximum and suggested maintenance intervals**

The following table (Tab. 5-2) report the MTTF in year of the main components to help the technicians to plan the maintenance of the DPM in terms of revamping or substitutions. Values depend on the number of single components that compose the single item; reported values are the worst cases.

| Item | Max time for substitution | Suggested time for substitution |
|---|---|---|
| DC capacitors bank | 30 years | 15 years (10 years in harsh[10] environment) |
| IGBTs | 64 years | 30 years (15 years in harsh[10] environment) |
| Fan (3-phase) | 16 years | 8 years (5 years in harsh[10] environment) |
| DC Fuses | 5700 years | Never |
| Sensors | 54 years | 15 years |
| Electronic boards | 15 years | 15 years (10 years in harsh[10] environment) |

**Tab. 5-2: Maximum and suggested substitution time for the main components of a DPM**

### Fans Maintenance

Check fans regularly, mainly if the environment dusty. Check the rotation, noise and if it is possible the current consumption.
Pay attention to the cabinet filters too: filters has to be changed according to the cabinet maintenance prescriptions and each time they are dirty and air flow is decreased or compromised.

### DC Capacitors bank

DC Capacitors are electrolytic and a damage of this component during operation of the drive can severely damage other components of the DPM. Only SECOM or trained personnel must perform the substitution of this component.

### IGBTs

Only SECOM or trained personnel must perform the substitution of this component.

### Air Cubicle Filters

To avoid pollution and guarantee a correct air flow into the cabinet, the air filters, normally located on the door of the cabinet, must be substituted if:

- Too much dirt is present and air aspiration is very reduced
- Filter is damaged
- Filter is been installed since too much time, depending on plant pollution (usually one year)

In any case, maintainer has to follow the maintenance prescription of the installed filter or provided by the vendor of the cabinet.

### STO Test

*Safe Torque Off* function should be tested at least one time a year. Depending on the customer cabinet and/or automation, SECOM suggest to test the function during downtime of machinery opening the STO safety circuit and checking the communication from the drive control (SD-MCU).

[10] Harsh environment means for example polluted environment (such as chemical plant, marine, etc), high amount of dust or debris, and in general all environment that doesn't respect the environmental prescription (see 1.4.5.1 and Tab. 1-3)

On SD-RMU board, the yellow led is ON if STO circuit is opened (so STO is activated).
If STO doesn't work anymore, SD-RMU board must be replaced (see 5.4.3.1).

## 5.4 MAINTENANCE

In this paragraph it follow the operation to be performed to replace the DPM components. To order a new component please refer to *0* –

*Spare Parts* Codes.

## 5.4.1 Replace Fan

Fans ad located on the bottom of the drive in both frame SDx.2 and SDx.3. in the following, the procedure to substitute the fan on each frame.

**WARNING!** Before to perform any action, disconnect all main and auxiliary power supply. Moreover verify the voltage is lower than safe working voltage measuring it.

**NOTE:** if the fan is broken, do not try to repair it. Just replace it with the new one.

### Fan for SDx.2 frame

Normally the frame has to be pulled out form the cabinet because of the little space available. Mounted fan is shown in Fig. 5-2.D.
To unmount the fan:

- Disconnect the power part of the module:
  - DC bar
  - AC bars on the rear side
  - All fixing screws if needed
- Disconnect the fan power supply (Fig. 4-7.a)
- Pull out the module form the cabinet
- Disconnect the bar on the lower-left side removing the two M6 screw (Fig. 5-2.C)
- Unscrew the four screw on the top of the fan (lower side of the DPM, Fig. 5-2.B)
- Carry out the fan from the frame (Fig. 5-2.A)

To mount the fan:

- Put the new fan inside the frame into the lower part of the module (Fig. 5-2.A)
- Fix the fan screwing the four screw (Fig. 5-2.B)
- Connect the bar on the lower-left side (Fig. 5-2.C)
- Pull the module inside the cabinet
- Mounting the power parts:
  - DC bars
  - AC bars on the rear side
  - All fixing screw if needed
- Connect the fan power supply
- Remember to verify the correct rotation at the first start

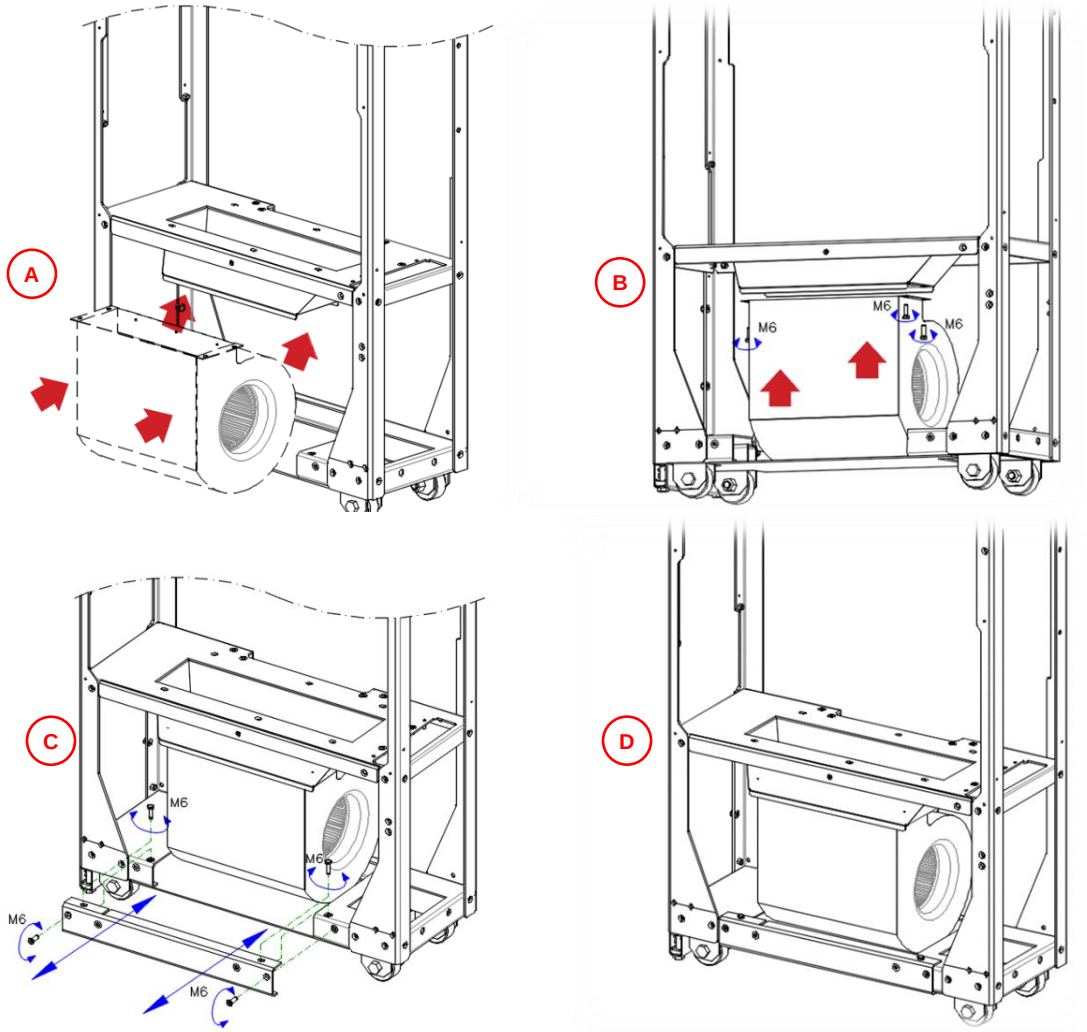



**Fig. 5-2: Cooling fan for SDx.2 frame – Replace/Mounting steps**

### Fan for SDx.3 frame

Usually this drive is mounted on the wall of the cabinet and it has a relatively wide space under it, useful to disconnect the fan without uninstall the module.
To unmount the fan:

- Disconnect the fan power supply
- Unscrew the four screw on lower side of the DPM
- Remove the fan

To mount the fan:

- Replace the fan
- Fix the fan on the bottom with the four screw
- Connect the fan power supply
- At the first start verify the correctness of air flow

## 5.4.2 Replace Internal DC Fuses

Internal DC fuses are optional and the socket can vary among frames and power ratings. If fuses are present, technician have to detect the kind of fuses to follow the correct procedure to mount/unmount the component. DC fuses are located internally to the DPM in the upper side. To handle them, usually the drive must be carried out from the cabinet and the lateral cover must be removed.

**WARNING!** Before to perform any action, disconnect all main and auxiliary power supply. Moreover, verify the voltage is lower than safe working voltage measuring it.

### Replacing slotted blade fuses in SDx.3 frame

Internal fuses in SDx.3 frame are located on the rear part, which means that maintainers have to remove the drive from the cabinet rear wall. The fuses mounted on SDx.3 frame is always the slotted blade kind reported in Fig. 5-3.

- Disconnect the all the power part of the drive (AC and DC), the fan supply and the interface cable (24V, optical fiber and STO)
- Remove the bolts on the eyelet and pull out the module from the cabinet
- Remove the rear cover to access to the fuses
- Remove the fuse strike or only the cable
- Unscrew the two terminals of the fuses: is not needed unscrew completely the screw, but it is enough to losing the grip; that reduce the possibility to loss bolts or washer down into the power parts (Fig. 5-4.B).
- Rotate and pull out the fuses (Fig. 5-4.C, Fig. 5-4.D)
- Replace the fuses with the new ones
- Tight the screws to fasten the fuses (Fig. 5-4.A, Fig. 5-4.B).
- Reconnect the fuse strike (Fig. 5-3) or only the wire
- Mount the rear cover
- Pull the module inside the cubicle and remount it fixing it to the wall of the cabinet
- Mounting the power parts:
    - DC bars
    - AC bars on the rear side
    - All fixing screw if needed
- Connect all the interface cable and fan supply
- Start the auxiliary and verify that the control do not report any alarm regarding the fuses

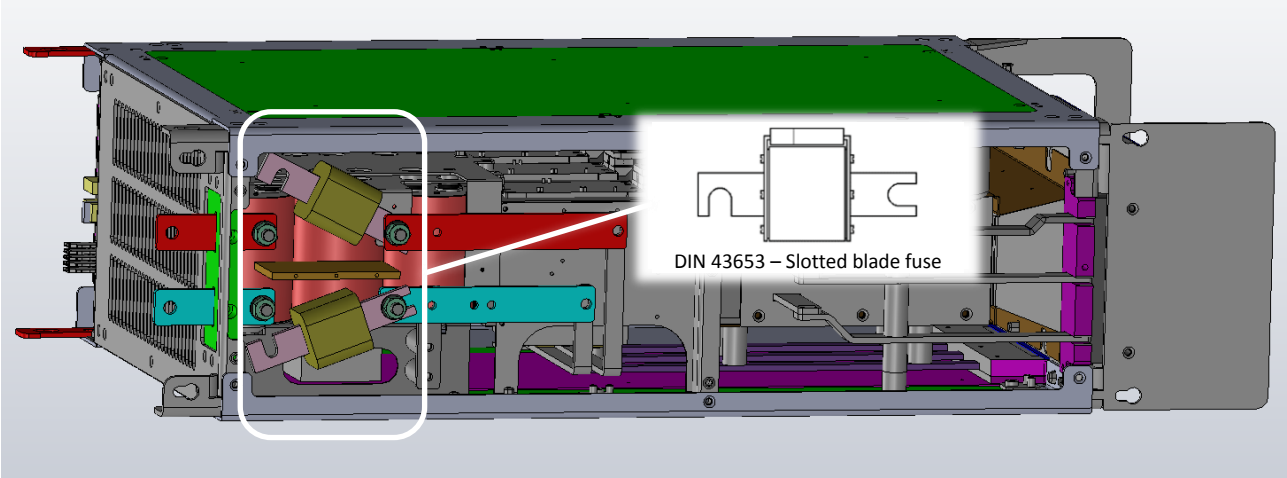



**Fig. 5-3: Slotted blade type fuses for SDx.3 and some SDx.2 size (European standard DIN 43653)**

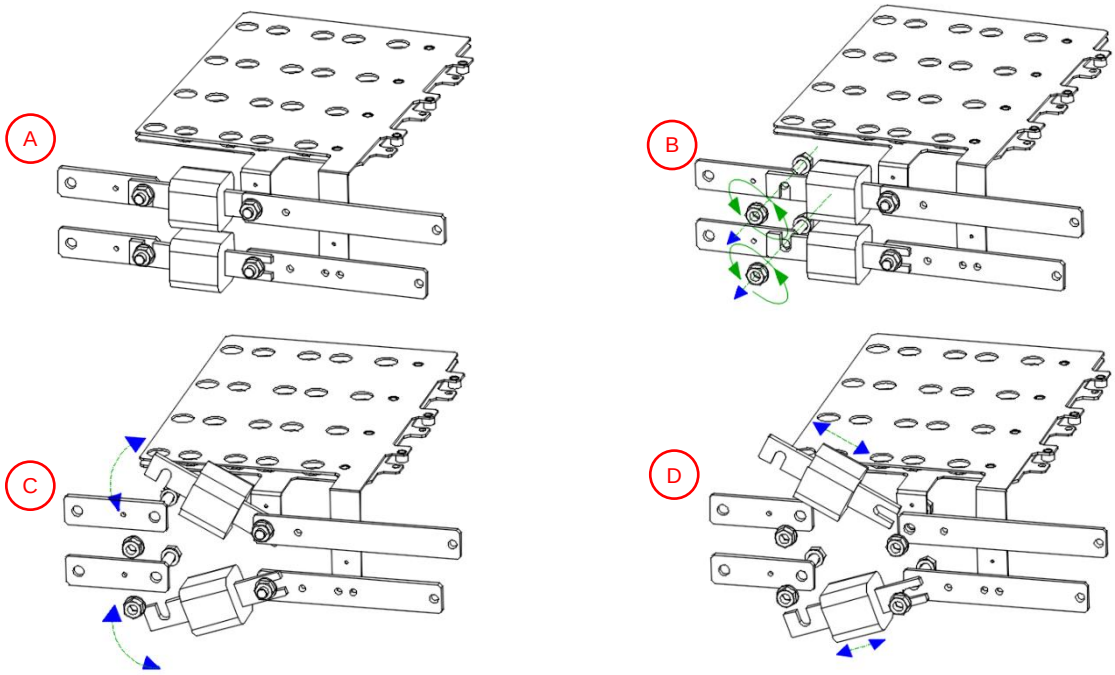



**Fig. 5-4: Internal slotted blade fuse – mounting/unmounting steps**

## Replacing flush-end fuses in SDx.2 frame

Flush-end fuses are used to reach the current of the biggest size.
Note that if there is enough space into the cubicle to operate, it could be not necessary to remove the drive.

- Switch off the drive and remove main and auxiliary power supply.

- Disconnect the power part of the module:
  - DC bar
  - AC bars on the rear side
  - All fixing screws if needed
- Pull out the module form the cabinet
- Remove the cover on the left side of the DPM
- Remove the wire to the fuse striker
- Unscrew the two terminals of the fuses: both pin and bolt. Pay very much attention to not lose the washer or bolt into the bank capacitors.
- Pull out the fuses
- Replace the fuses with the new ones
- Screw the pin, washer and bolt. So, tight the screws to fasten the fuses (50 Nm because ungreased thread)
- Connect the wire to the fuse striker
- Mount the lateral cover
- Pull the module inside the cabinet and fix it to the wall
- Mounting the power parts:
  - DC bars
  - AC bars on the rear side
  - All fixing screw if needed
- Start the auxiliary and verify that the control do not report any alarm regarding the fuses

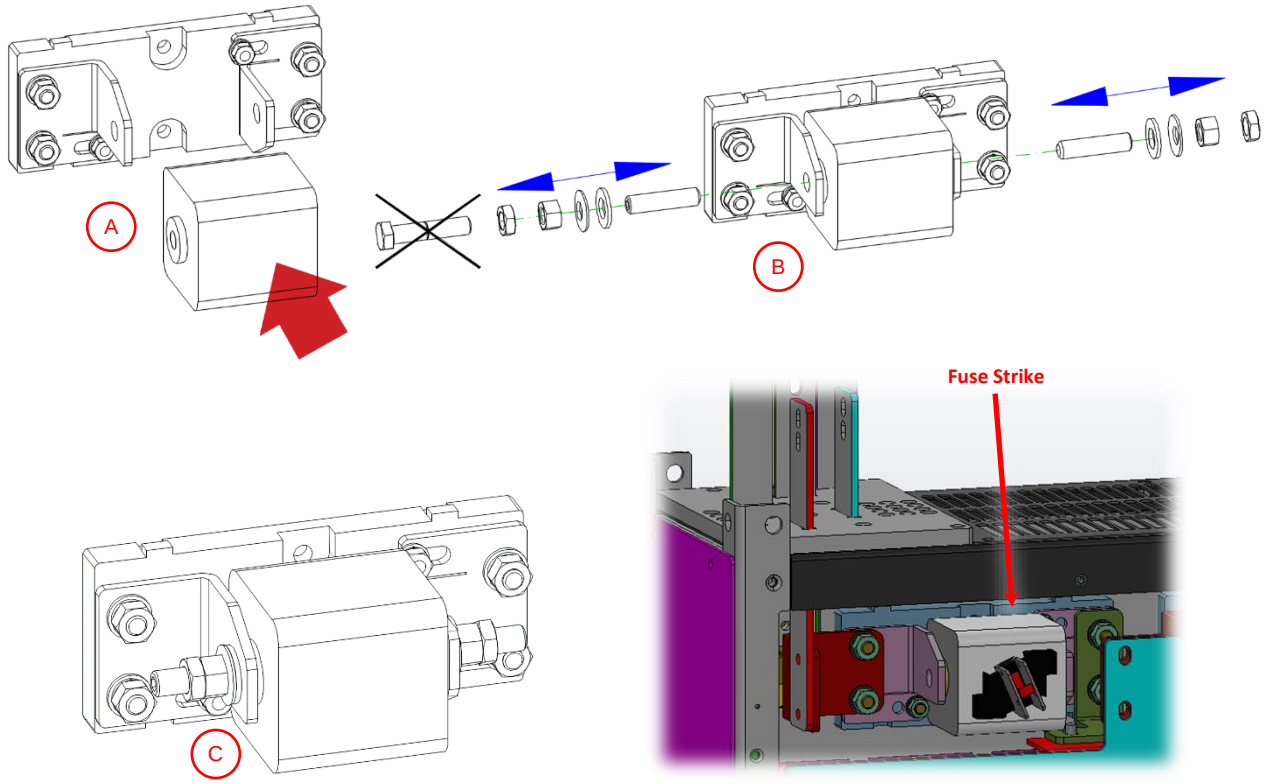



**Fig. 5-5: Internal flush-end fuse – mounting/unmounting steps**

## 5.4.3 Replace Electronic Boards

The main electronic board are located on the front of the DPM. To reach them, the frontal plate must be removed. Figure Fig. 5-6 show where all PCBs are located and where they will be placing if replaced.

**Sensitive Devices**: risk of electrostatic discharge, which can injure the operator or damage the equipment. It is mandatory the personnel who handling electronic devices wears PPE (such as grounding wrist bands) when touch or replace all the PCBs.

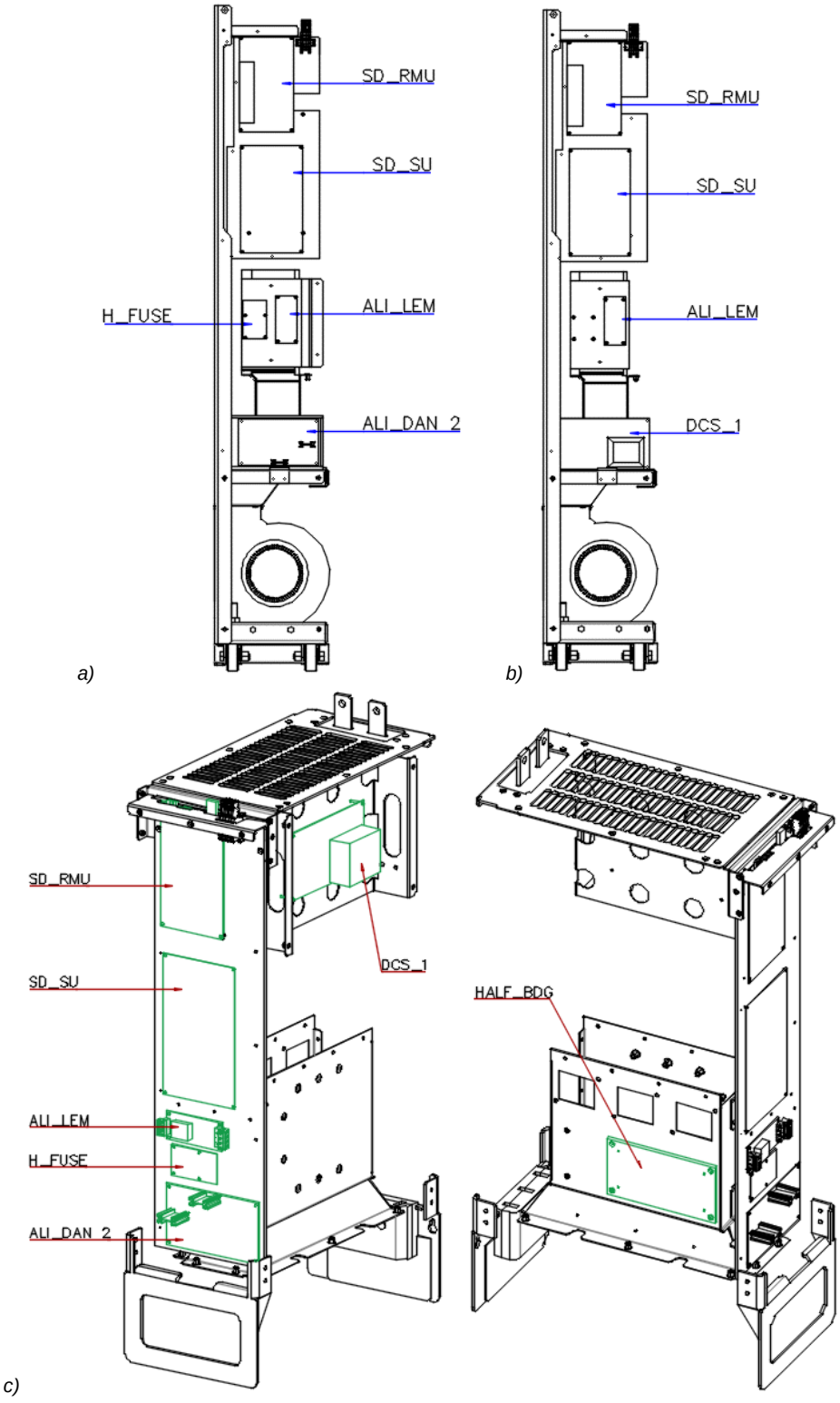



**Fig. 5-6: PCBs location on SDI/SDA/SDF.2 (a), SDS.2 (b) and SDx.3 (c) frame**

### 5.4.3.1 SD-RMU: SECOM Drive – Remote Modulator Unit

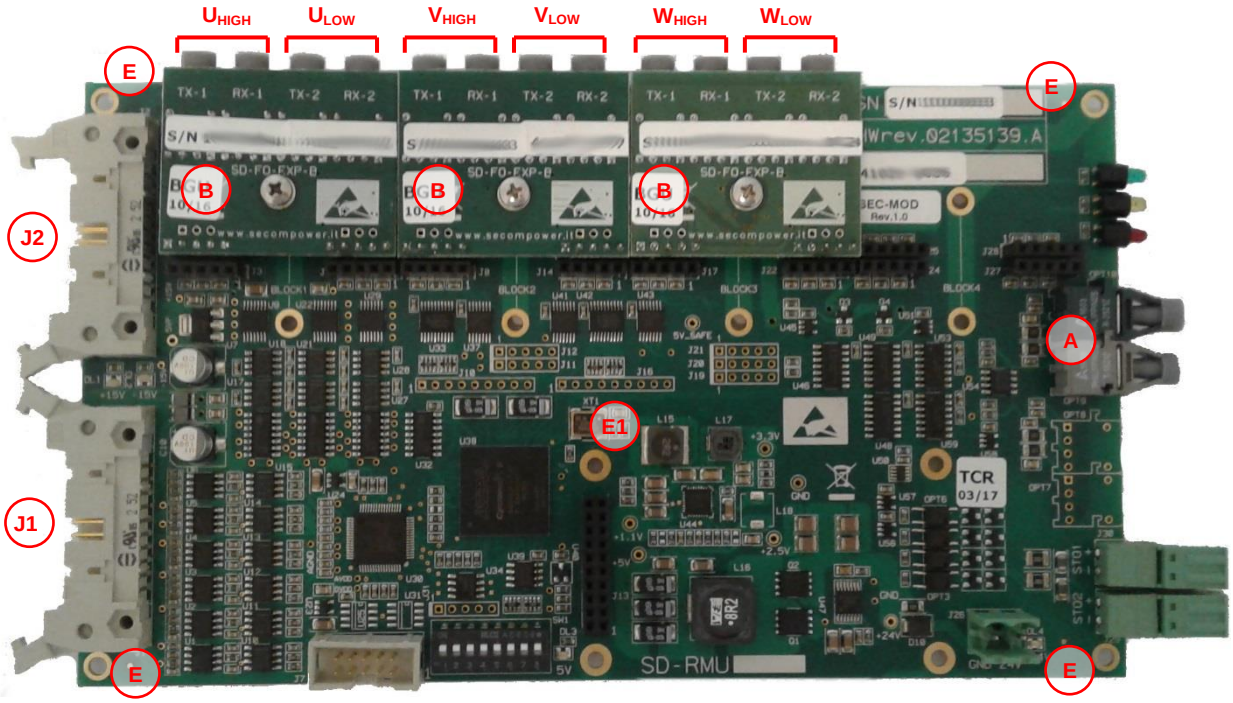



**Fig. 5-7: SD-RMU**

Optical fiber couple (Fig. 5-7.A) is only for communication with SD-MCU. If this connector is wrong, the integrity of the drive is not in danger. Only an alarm of wrong communication will happen. On the contrary, for command fiber optics is mandatory to respect the command to avoid wrong commutations, which can lead to serious damage of the drive.

The SD-RMU has piggyback mounted onboard (Fig. 5-7.B) named SD-FO-EXP-B. These are optical expansion coupe to connect the driver board to fire the IGBTs. The following table (Tab. 5-3) reports the connection.

| Connector | Description |
|---|---|
| Block 1 TX-1 | High IGBT command U |
| Block 1 RX-1 | High IGBT feedback U |
| Block 1 TX-2 | Low IGBT command U |
| Block 1 RX-2† | Low IGBT feedback U |

| Connector | Description |
|---|---|
| Block 2 TX-1 | High IGBT command V |
| Block 2 RX-1 | High IGBT feedback V |
| Block 2 TX-2 | Low IGBT command V |
| Block 2 RX-2† | Low IGBT feedback V |

| Connector | Description |
|---|---|
| Block 3 TX-1 | High IGBT command W |
| Block 3 RX-1 | High IGBT feedback W |
| Block 3 TX-2 | Low IGBT command V |
| Block 3 RX-2† | Low IGBT feedback V |

†: Depending on the frame or diver board, this fiber optic is not present and so, there is only one feedback every two IGBTs.

**Tab. 5-3: Driver command and feedback for IGBTs**

Pay attention to not bend the board when handle it and when mount it to the drive; Fig. 5-7-E show the minimum via hole for fixing, in particular the Fig. 5-7-E1 that avoid bending in the near vicinity to the integrated circuit.

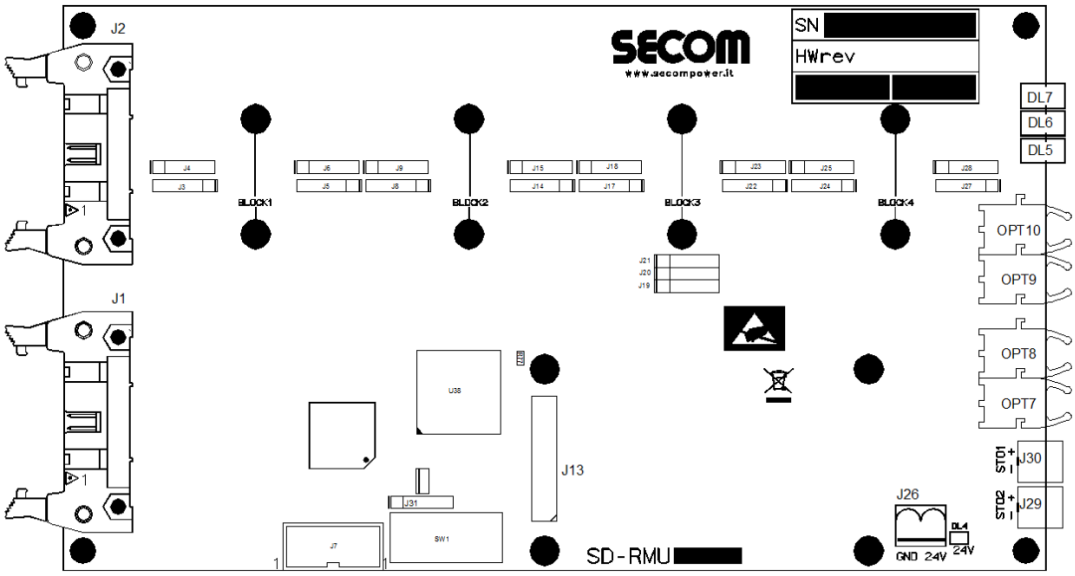



**Fig. 5-8: SD-RMU Layout**

| Connector | Description |
|---|---|
| J1 | Flat cable to SD-SU-J1 |
| J2 | Flat cable to SD-SU-J2 |
| J13‡ | Expansion connector |
| J26‡ | +24V for stand alone working |
| J29 | STO second channel |
| J30 | STO first channel |

| Connector | Description |
|---|---|
| OPT10 | RX Communication channel |
| OPT9 | TX Communication channel |
| OPT8† | Fast Link IN |
| OPT7† | Fast Link OUT |
| DL7 | Green LED |
| DL6 | Yellow LED |
| DL5 | Red LED |

‡: Do not connect anything. Only for test or stand alone supply.
†: Usually is not mounted. Reserved for special feature

**Tab. 5-4:SD-RMU main connectors**

Technician must be very careful when connect each other the SD-RMU and SD-SU boards. The following flat (Fig. 5-9-a) must be used; they have the pin1 of the first terminal mapped on pin 20 of the second one. Improper crimp or connection of the flat cable will damage the boards. Please use only the provided flat cables.

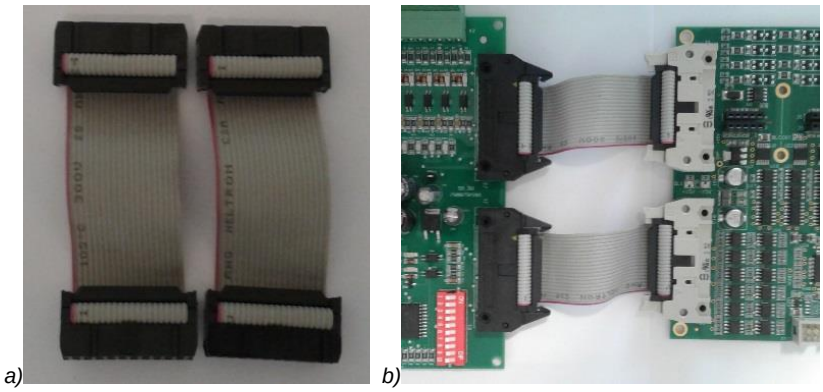



**Fig. 5-9: Flat connector (a) and connection between SD-SU and SD-RMU (b)**

### 5.4.3.2 SD-SU: SECOM Drive – Supply Unit

SD-SU board (Fig. 5-10) is the main supplier for all the electronics: SD-RMU, IGBT Drive, current and voltage sensor, etc. Moreover this board bring the drive size configuration. So, when the board is replaced (or installed), technician has to pay attention to the configuration of the dip switch S1.

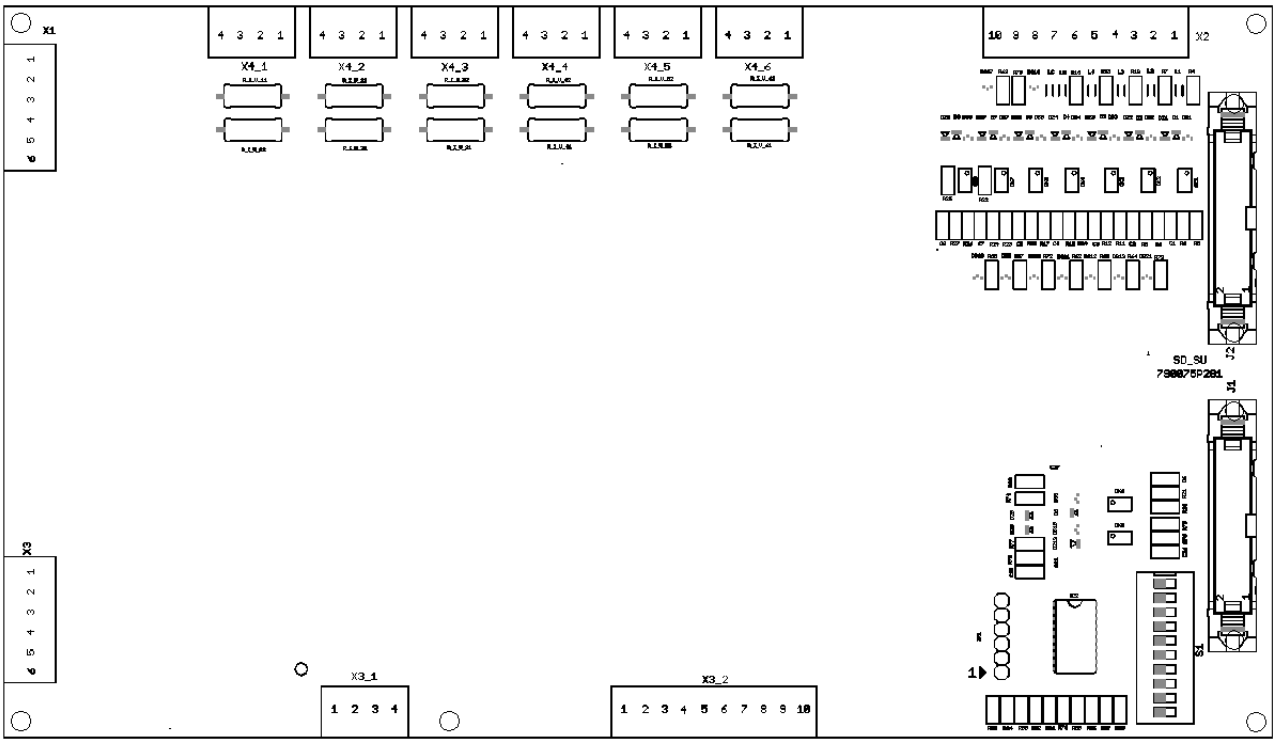



**Fig. 5-10: SD-SU Layout**

| X4_1/2/4/5/6 | Description |
|---|---|
| 1 | Output Measure |
| 2 | 0V |
| 3 | +15/+24V |
| 4 | -15/-24V |

**Tab. 5-5: 6 Analog Input**

| X3_1 | Description |
|---|---|
| 1 | +24V |
| 2 | +24V |
| 3 | 0V |
| 4 | 0V |

**Tab. 5-6: DC Power supply for Driver boards**

| X1 | Description |
|---|---|
| 1 | +24V SECOM input |
| 2 | +24V SECOM input |
| 3 | PE |
| 4 | PE |
| 5 | 0V SECOM input |
| 6 | 0V SECOM input |

**Tab. 5-7: External Supply from ALIDAN2**

| X3 | Description |
|---|---|
| 1 | +24V EXTERNAL |
| 2 | +24V EXTERNAL |
| 3 | PE |
| 4 | PE |
| 5 | 0V EXTERNAL |
| 6 | 0V EXTERNAL |

**Tab. 5-8: SD-SU Power Supply**

| X2 | Description |
|---|---|
| 1 | DI1 – unused |
| 2 | 0V |
| 3 | DI2 – unused |
| 4 | 0V |
| 5 | DI3 – unused |
| 6 | 0V |
| 7 | DI4 – Thermal clip |
| 8 | 0V |
| 9 | DI5 – Fuse Fault |
| 10 | 0V |

**Tab. 5-9: Digital Input**

| X3_2 | Description |
|---|---|
| 1 | +24V HF driver 1 |
| 2 | –24V HF driver 1 |
| 3 | +24V HF driver 2 |
| 4 | –24V HF driver 2 |
| 5 | +24V HF driver 3 |
| 6 | –24V HF driver 3 |
| 7 | +24V HF driver 4 |
| 8 | –24V HF driver 4 |
| 9 | *Reserved* |
| 10 | 0V-A |

**Tab. 5-10: High frequency power supply for Driver boards**

Digital input DI5 is a cumulative signal of all the DC fuse striker contact. Digital Input DI4 is a cumulative signal of all the tree signals coming from thermal clip mounted on the heatsink next to the IGBT. The thermal threshold of these clips is 90°C.
Connector J1 and J2 is the interface between the SD-SU and SD-RMU. Pay attention to the cable as mentioned in 5.4.3.1 (Fig. 5-9).

Regarding the dip switch SW1, the codification can be retrieved by the control (with SDM) and it also reported in the following table **Errore. L'origine riferimento non è stata trovata.**; the number in *Drive Size Code* must be set in dip switch as binary code.

**Note:** remember with Active Front-End (AFE) the *Drive Size* is different from *Converter Name* because the AFE rated switching frequency is 2500Hz, while the converter switching frequency is usually lower. To find out what is the correct converter name see plate data (Fig. 2-9) or matching the row of table Tab. 2-8 with Tab. 2-11 and Tab. 2-9 with Tab. 2-12.

| Converter Name | Drive Root | Parallel Number | Switching [Hz] (fw1) | Vn [V] | Drive Size Code | Drive Size Binary Code |
|---|---|---|---|---|---|---|
| SDI.4.A.030K.400 | SDI.4.A.030K.400-LV2L | 1 | 1250 | 400 | 20 | 10100 |
| SDI.4.A.040K.400 | SDI.4.A.040K.400-LV2L | 1 | 1250 | 400 | 21 | 10101 |
| SDI.4.A.055K.400 | SDI.4.A.055K.400-LV2L | 1 | 1250 | 400 | 22 | 10110 |
| SDI.4.A.070K.400 | SDI.4.A.070K.400-LV2L | 1 | 1250 | 400 | 23 | 10111 |
| SDI.4.A.085K.400 | SDI.4.A.085K.400-LV2L | 1 | 1250 | 400 | 24 | 11000 |
| SDI.3.A.110K.400 | SDI.3.A.110K400-LV2L | 1 | 2000 | 400 | 25 | 11001 |
| SDI.3.A.166K.400 | SDI.3.A.166K400-LV2L | 1 | 2000 | 400 | 26 | 11010 |
| SDI.3.A.230K.400 | SDI.3.A.229K400-LV2L | 1 | 2000 | 400 | 27 | 11011 |
| SDI.2.A.290K.400 | SDI.2.A.291K.400-LV2L | 1 | 2000 | 400 | 28 | 11100 |
| SDI.2.A.350K.400 | SDI.2.A.353K.400-LV2L | 1 | 2000 | 400 | 29 | 11101 |
| SDI.2.A.450K.400 | SDI.2.A.450K.400-LV2L | 1 | 2000 | 400 | 30 | 11110 |
| SDI.2.A.520K.400 | SDI.2.A.520K.400-LV2L | 1 | 2000 | 400 | 31 | 11111 |
| SDI.2.A.575K.400 | SDI.2.A.575K.400-LV2L | 1 | 2000 | 400 | 32 | 100000 |
| SDI.2.A.847K.400 | SDI.2.A.450K.400-LV2L | 2 | 2000 | 400 | 30 | 11110 |
| SDI.2.A.977K.400 | SDI.2.A.520K.400-LV2L | 2 | 2000 | 400 | 31 | 11111 |
| SDI.2.A.1M11.400 | SDI.2.A.575K.400-LV2L | 2 | 2000 | 400 | 32 | 100000 |
| SDI.2.A.1M46.400 | SDI.2.A.520K.400-LV2L | 3 | 2000 | 400 | 31 | 11111 |
| SDI.2.A.1M67.400 | SDI.2.A.575K.400-LV2L | 3 | 2000 | 400 | 32 | 100000 |
| SDI.2.A.2M22.400 | SDI.2.A.575K.400-LV2L | 4 | 2000 | 400 | 32 | 100000 |
| SDI.2.A.2M78.400 | SDI.2.A.575K.400-LV2L | 5 | 2000 | 400 | 32 | 100000 |
| SDI.2.A.3M34.400 | SDI.2.A.575K.400-LV2L | 6 | 2000 | 400 | 32 | 100000 |
| SDI.2.A.3M90.400 | SDI.2.A.575K.400-LV2L | 7 | 2000 | 400 | 32 | 100000 |
| SDI.2.A.4M45.400 | SDI.2.A.575K.400-LV2L | 8 | 2000 | 400 | 32 | 100000 |
| SDS.3.A.110K.400 | SDS.3.A.110K.400-LV2L | 1 | 2000 | 400 | 33 | 100001 |
| SDS.3.A.166K.400 | SDS.3.A.166K.400-LV2L | 1 | 2000 | 400 | 34 | 100010 |
| SDS.3.A.230K.400 | SDS.3.A.229K.400-LV2L | 1 | 2000 | 400 | 35 | 100011 |
| SDS.2.A.260K.400 | SDS.2.A.291K.400-LV2L | 1 | 2000 | 400 | 36 | 100100 |
| SDS.2.A.315K.400 | SDS.2.A.353K.400-LV2L | 1 | 2000 | 400 | 37 | 100101 |
| SDS.2.A.405K.400 | SDS.2.A.450K.400-LV2L | 1 | 2000 | 400 | 38 | 100110 |
| SDS.2.A.495K.400 | SDS.2.A.499K.400-LV2L | 1 | 2000 | 400 | 39 | 100111 |
| SDS.2.A.545K.400 | SDS.2.A.547K.400-LV2L | 1 | 2000 | 400 | 40 | 101000 |
| SDI.4.A.050K.690 | SDI.4.A.050K.690-LV2L | 1 | 1250 | 690 | 41 | 101001 |
| SDI.4.A.070K.690 | SDI.4.A.070K.690-LV2L | 1 | 1250 | 690 | 42 | 101010 |
| SDI.4.A.090K.690 | SDI.4.A.090K.690-LV2L | 1 | 1250 | 690 | 43 | 101011 |
| SDI.4.A.125K.690 | SDI.4.A.125K.690-LV2L | 1 | 1250 | 690 | 44 | 101100 |
| SDI.4.A.150K.690 | SDI.4.A.150K.690-LV2L | 1 | 1250 | 690 | 45 | 101101 |
| SDI.3.A.190K.690 | SDI.3.A.190K.690-LV2L | 1 | 2000 | 690 | 46 | 101110 |
| SDI.3.A.280K.690 | SDI.3.A.287K.690-LV2L | 1 | 2000 | 690 | 47 | 101111 |
| SDI.3.A.310K.690 | SDI.3.A.311K.690-LV2L | 1 | 2000 | 690 | 48 | 110000 |
| SDI.2.A.460K.690 | SDI.2.A.460K.690-LV2L | 1 | 1250 | 690 | 49 | 110001 |
| SDI.2.A.560K.690 | SDI.2.A.560K.690-LV2L | 1 | 1250 | 690 | 50 | 110010 |
| SDI.2.A.710K.690 | SDI.2.A.710K.690-LV2L | 1 | 1250 | 690 | 51 | 110011 |
| SDI.2.A.825K.690 | SDI.2.A.825K.690-LV2L | 1 | 1250 | 690 | 52 | 110100 |
| SDI.2.A.1M00.690 | SDI.2.A.1M00.690-LV2L | 1 | 1250 | 690 | 53 | 110101 |
| SDI.2.A.1M36.690 | SDI.2.A.710K.690-LV2L | 2 | 1250 | 690 | 51 | 110011 |
| SDI.2.A.1M60.690 | SDI.2.A.825K.690-LV2L | 2 | 1250 | 690 | 52 | 110100 |
| SDI.2.A.1M92.690 | SDI.2.A.1M00.690-LV2L | 2 | 1250 | 690 | 53 | 110101 |
| SDI.2.A.2M40.690 | SDI.2.A.825K.690-LV2L | 3 | 1250 | 690 | 52 | 110100 |
| SDI.2.A.2M88.690 | SDI.2.A.1M00.690-LV2L | 3 | 1250 | 690 | 53 | 110101 |
| SDI.2.A.3M84.690 | SDI.2.A.1M00.690-LV2L | 4 | 1250 | 690 | 53 | 110101 |
| SDI.2.A.4M81.690 | SDI.2.A.1M00.690-LV2L | 5 | 1250 | 690 | 53 | 110101 |
| SDI.2.A.5M77.690 | SDI.2.A.1M00.690-LV2L | 6 | 1250 | 690 | 53 | 110101 |
| SDI.2.A.6M73.690 | SDI.2.A.1M00.690-LV2L | 7 | 1250 | 690 | 53 | 110101 |
| SDI.2.A.7M69.690 | SDI.2.A.1M00.690-LV2L | 8 | 1250 | 690 | 53 | 110101 |
| SDS.3.A.190K.690 | SDS.3.A.190K.690-LV2L | 1 | 2000 | 690 | 54 | 110110 |
| SDS.3.A.285K.690 | SDS.3.A.287K.690-LV2L | 1 | 2000 | 690 | 55 | 110111 |

| Converter Name | Drive Root | Parallel Number | Switching [Hz] (fw1) | Vn [V] | Drive Size Code | Drive Size Binary Code |
|---|---|---|---|---|---|---|
| SDS.3.A.310K.690 | SDS.3.A.311K.690-LV2L | 1 | 2000 | 690 | 56 | 111000 |
| SDS.2.A.375K.690 | SDS.2.A.466K.690-LV2L | 1 | 1250 | 690 | 57 | 111001 |
| SDS.2.A.560K.690 | SDS.2.A.562K.690-LV2L | 1 | 1250 | 690 | 58 | 111010 |
| SDS.2.A.705K.690 | SDS.2.A.705K.690-LV2L | 1 | 1250 | 690 | 59 | 111011 |
| SDS.2.A.825K.690 | SDS.2.A.825K.690-LV2L | 1 | 1250 | 690 | 60 | 111100 |
| SDS.2.A.930K.690 | SDS.2.A.932K.690-LV2L | 1 | 1250 | 690 | 61 | 111101 |
| SDF.4.A.035K.400 | SDF.4.A.035K.400-LV2L | 1 | - | 400 | 62 | 111110 |
| SDF.4.A.050K.400 | SDF.4.A.048K.400-LV2L | 1 | - | 400 | 63 | 111111 |
| SDF.4.A.060K.400 | SDF.4.A.062K.400-LV2L | 1 | - | 400 | 64 | 1000000 |
| SDF.4.A.090K.400 | SDF.4.A.090K.400-LV2L | 1 | - | 400 | 65 | 1000001 |
| SDF.4.A.110K.400 | SDF.4.A.107K.400-LV2L | 1 | - | 400 | 66 | 1000010 |
| SDF.3.A.140K.400 | SDF.3.A.139K.400-LV2L | 1 | - | 400 | 67 | 1000011 |
| SDF.3.A.210K.400 | SDF.3.A.211K.400-LV2L | 1 | - | 400 | 68 | 1000100 |
| SDF.3.A.270K.400 | SDF.3.A.270K.400-LV2L | 1 | - | 400 | 69 | 1000101 |
| SDF.2.A.312K.400 | SDF.2.A.312K.400-LV2L | 1 | - | 400 | 70 | 1000110 |
| SDF.2.A.400K.400 | SDF.2.A.402K.400-LV2L | 1 | - | 400 | 71 | 1000111 |
| SDF.2.A.485K.400 | SDF.2.A.485K.400-LV2L | 1 | - | 400 | 72 | 1001000 |
| SDF.2.A.590K.400 | SDF.2.A.589K.400-LV2L | 1 | - | 400 | 73 | 1001001 |
| SDF.2.A.710K.400 | SDF.2.A.707K.400-LV2L | 1 | - | 400 | 74 | 1001010 |
| SDF.2.A.970K.400 | SDF.2.A.485K.400-LV2L | 2 | - | 400 | 72 | 1001000 |
| SDF.2.A.1M18.400 | SDF.2.A.589K.400-LV2L | 2 | - | 400 | 73 | 1001001 |
| SDF.2.A.1M42.400 | SDF.2.A.707K.400-LV2L | 2 | - | 400 | 74 | 1001010 |
| SDF.2.A.1M77.400 | SDF.2.A.589K.400-LV2L | 3 | - | 400 | 73 | 1001001 |
| SDF.2.A.2M13.400 | SDF.2.A.707K.400-LV2L | 3 | - | 400 | 74 | 1001010 |
| SDF.2.A.2M84.400 | SDF.2.A.707K.400-LV2L | 4 | - | 400 | 74 | 1001010 |
| SDF.2.A.3M55.400 | SDF.2.A.707K.400-LV2L | 5 | - | 400 | 74 | 1001010 |
| SDF.2.A.4M26.400 | SDF.2.A.707K.400-LV2L | 6 | - | 400 | 74 | 1001010 |
| SDF.2.A.4M97.400 | SDF.2.A.707K.400-LV2L | 7 | - | 400 | 74 | 1001010 |
| SDF.2.A.5M68.400 | SDF.2.A.707K.400-LV2L | 8 | - | 400 | 74 | 1001010 |
| SDF.4.A.060K.690 | SDF.4.A.060K.690-LV2L | 1 | - | 690 | 75 | 1001011 |
| SDF.4.A.084K.690 | SDF.4.A.084K.690-LV2L | 1 | - | 690 | 76 | 1001100 |
| SDF.4.A.108K.690 | SDF.4.A.108K.690-LV2L | 1 | - | 690 | 77 | 1001101 |
| SDF.4.A.155K.690 | SDF.4.A.155K.690-LV2L | 1 | - | 690 | 78 | 1001110 |
| SDF.4.A.185K.690 | SDF.4.A.185K.690-LV2L | 1 | - | 690 | 79 | 1001111 |
| SDF.3.A.240K.690 | SDF.3.A.239K.690-LV2L | 1 | - | 690 | 80 | 1010000 |
| SDF.3.A.350K.690 | SDF.3.A.394K.690-LV2L | 1 | - | 690 | 81 | 1010001 |
| SDF.3.A.460K.690 | SDF.3.A.478K.690-LV2L | 1 | - | 690 | 82 | 1010010 |
| SDF.2.A.540K.690 | SDF.3.A.538K.690-LV2L | 1 | - | 690 | 83 | 1010011 |
| SDF.2.A.695K.690 | SDF.3.A.693K.690-LV2L | 1 | - | 690 | 84 | 1010100 |
| SDF.2.A.840K.690 | SDF.3.A.837K.690-LV2L | 1 | - | 690 | 85 | 1010101 |
| SDF.2.A.1M02.690 | SDF.2.A.1M02.690-LV2L | 1 | - | 690 | 86 | 1010110 |
| SDF.2.A.1M22.690 | SDF.2.A.1M22.690-LV2L | 1 | - | 690 | 87 | 1010111 |
| SDF.2.A.1M68.690 | SDF.3.A.837K.690-LV2L | 2 | - | 690 | 85 | 1010101 |
| SDF.2.A.2M04.690 | SDF.2.A.1M02.690-LV2L | 2 | - | 690 | 86 | 1010110 |
| SDF.2.A.2M44.690 | SDF.2.A.1M22.690-LV2L | 2 | - | 690 | 87 | 1010111 |
| SDF.2.A.3M06.690 | SDF.2.A.1M02.690-LV2L | 3 | - | 690 | 86 | 1010110 |
| SDF.2.A.3M66.690 | SDF.2.A.1M22.690-LV2L | 3 | - | 690 | 87 | 1010111 |
| SDF.2.A.4M88.690 | SDF.2.A.1M22.690-LV2L | 4 | - | 690 | 87 | 1010111 |
| SDF.2.A.6M10.690 | SDF.2.A.1M22.690-LV2L | 5 | - | 690 | 87 | 1010111 |
| SDF.2.A.7M32.690 | SDF.2.A.1M22.690-LV2L | 6 | - | 690 | 87 | 1010111 |
| SDF.2.A.8M54.690 | SDF.2.A.1M22.690-LV2L | 7 | - | 690 | 87 | 1010111 |
| SDF.2.A.9M76.690 | SDF.2.A.1M22.690-LV2L | 8 | - | 690 | 87 | 1010111 |

**Tab. 5-11: SD-SU dip switch configuration for drive size settings**

### 5.4.3.3 ALI_LEM

ALI_LEM (Fig. 5-11) is the board delegated to the sensing of the DC voltage. The range and the conversion ratio is: 0÷1250V≡0÷5.5V. LEDs D1 and D2 indicates respectively whether +15V and -15V supply are present.

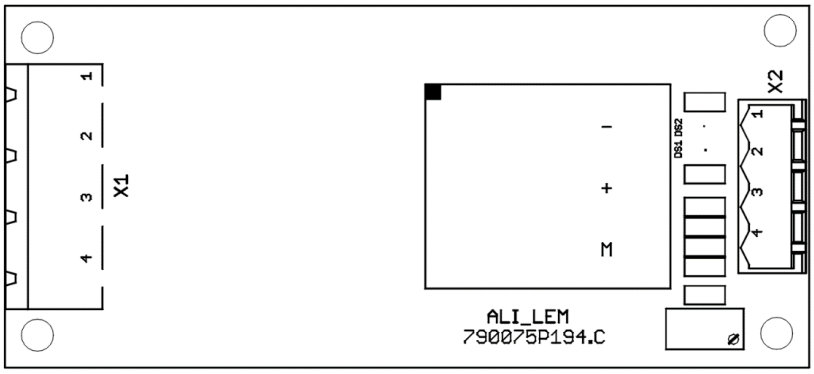



**Fig. 5-11: ALI_LEM Layout**

| X1 | High Voltage Terminals |
|---|---|
| 1 | VDC + |
| 2 | - |
| 3 | - |
| 4 | VDC – |

**Tab. 5-12: 6 Analog Input**

| X2 | Low Voltage Terminals |
|---|---|
| 1 | -15V |
| 2 | +15V |
| 3 | 0V |
| 4 | TV |

**Tab. 5-13: Power supply for Driver boards**

### 5.4.3.4 H_FUSE

H_FUSE (Fig. 5-12) protect the ALIDAN2 board. It mount fuses of 1A, 1000V. Pay attention that all the terminal blocks are high voltage.

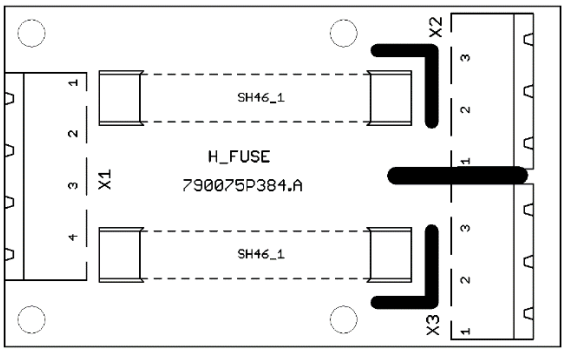



**Fig. 5-12: H_FUSE Layout**

| X1 | Input Terminal |
|---|---|
| 1 | VDC + |
| 2 | - |
| 3 | - |
| 4 | VDC – |

**Tab. 5-14: 6 Analog Input**

| X2/X3 | Output Terminal |
|---|---|
| 1 | VDC + |
| 2 | - |
| 3 | VDC – |

**Tab. 5-15: Power supply for Driver boards**

### 5.4.3.5 ALIDAN2

ALIDAN2 (Fig. 5-13) is the auxiliary supply board which use the DC voltage to generate the internal +24V supply.

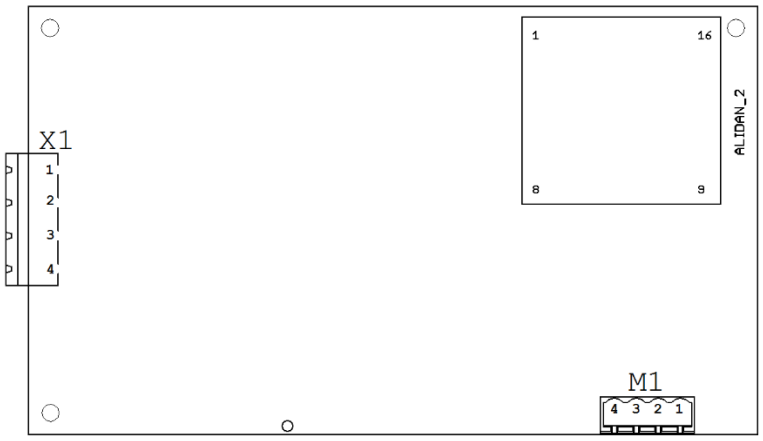



**Fig. 5-13: ALIDAN 2 Layout**

| X1 | High Voltage Input Terminal |
|---|---|
| 1 | VDC + |
| 2 | - |
| 3 | - |
| 4 | VDC – |

**Tab. 5-16: 6 Analog Input**

| M1 | Low Voltage Output Terminal |
|---|---|
| 1 | +24 V |
| 2 | +24 V |
| 3 | 0 V |
| 4 | 0 V |

**Tab. 5-17: Power supply for Driver boards**

### 5.4.3.6 HALF-BDG

This board is mounted only in SDx.3 frame and is used to control the blowers. The AC input (X2) comes from a single phase transformer 230V/22V.

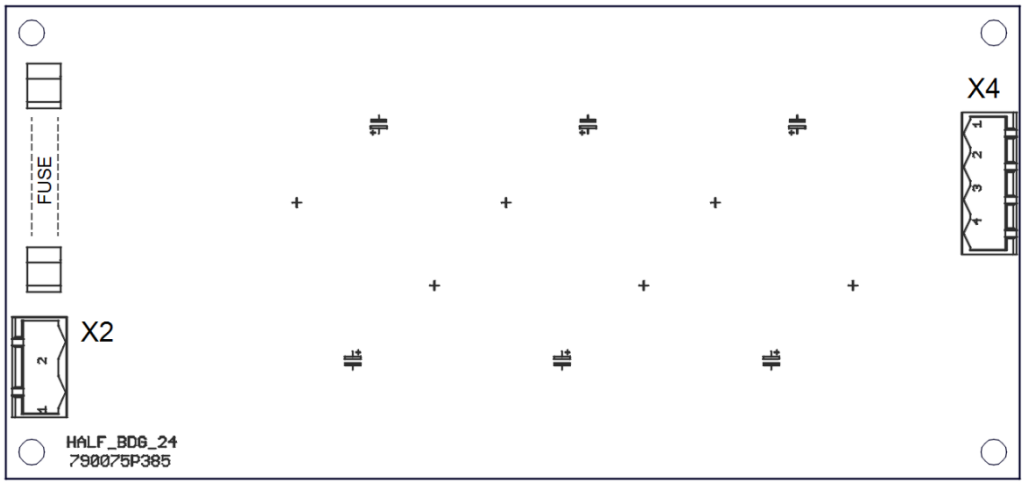



**Fig. 5-14: HALF_BDG_25 Layout**

| X2 | AC input (single phase) |
|---|---|
| 1 | AC Phase |
| 2 | Neutral |

**Tab. 5-18: 6 Single phase input**

| X4 | Output |
|---|---|
| 1 | +24 V (power) |
| 2 | 0 V (power) |
| 3 | K2+ NO relay contact |
| 4 | K2- NO relay contact |

**Tab. 5-19: DC output and digital fault**

### 5.4.3.7 DCS1 – precharge controller

DCS1 is the board used by SDS to pulse the semi-controlled bridge to perform the precharge (locate it with Fig. 5-6.b). This board must be configured to:

- Manage only a signal for start up.

- Perform the faster ramp to load the DC bus.
- Used with 400V and 690V

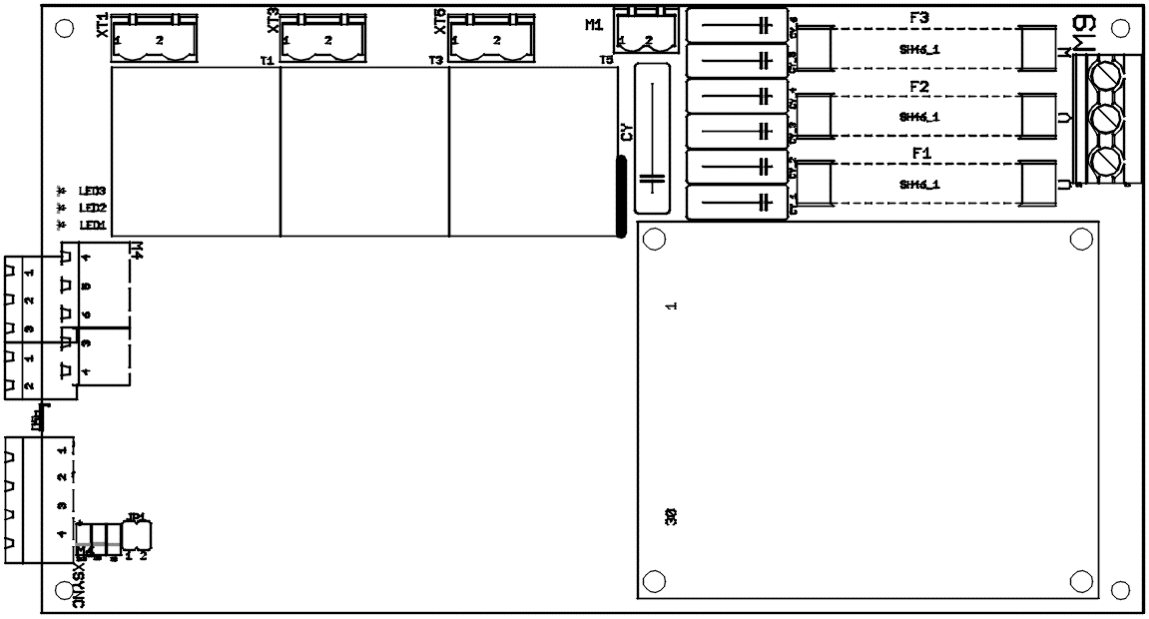



**Fig. 5-15: DCS1 Layput**

| M9 | AC input phase |
|---|---|
| 1 | U |
| 2 | V |
| 3 | W |

**Tab. 5-20: DCS1 Three phase input**

| XT1/3/5 | Thyristor 1/2/3 command |
|---|---|
| 1 | Gate |
| 2 | Katode |

**Tab. 5-21: DCS1 Thyristors command**

| M4 | Output |
|---|---|
| 1 – 2 | RESET IN – GND |
| 3 – 4 | START IN – GND |
| 6 – 7 – 8 | FAULT NC – Com - NO |
| 9 – 10 | FAULT IN – GND |
| 5 | Not used |

**Tab. 5-22: DC output and digital fault**

For SDS use, this board must be configured as follow:

- M4-9/10 short-circuited
- JP1: remove jumper 2 to make the precharge faster (<10s), remove jumper 1 too to make it the fastest. SECOM suggest to remove only the jumper 2 to reduce the DC current.

# 5.5 TROUBLESHOOTING

Following table summarizes all possible hardware alarms, the causes and the way to solve the problem. Usually, alarms can be detected in several way; the majority of the faults regard the DPM. A fault can be detected via:

- SD-RMU: the red LED is on (not blinking)
- SD-MCU: the display indicates **F–**
- SD-OP: show an icon which indicates the fault (see SOFTWARE MANUAL)
- SDM: the drive manager indicate a fault of the module (see SOFTWARE MANUAL)

| Fault and Code Name | Description, Causes and Troubleshooting |
|---|---|
| **Over Current**<br><br>DPM *x* – Overcurrent *y* | ***DESCRIPTION***: instantaneous current has reached the Overcurrent trip threshold. Each phase of each DPM can indicate this alarm; the "*x*" indicate the number of the DPMs (1÷8), and "*y*" indicate the phase (1÷3). |

| Fault and Code Name | Description, Causes and Troubleshooting |
|---|---|
| | ***CAUSES***:<br>• If current is not under control, the load variation has to be not too much faster and/or is such to generate a ripple greater than 15% (while current is next to max allowed current)<br>• If current is under control, the regulator could not be tuned properly or the load is such to generate a ripple greater than 15%(while current is next to max allowed current)<br>• Speed control is not properly tuned or is not coordinated with current control, so the current could be unstable and lead to a fault<br>• A short-circuit with a not so low impedance could be happened to the output AC side of the drive (or DPM)<br>• The analog terminal block of SD-SU is not connected or screws have not enough grip to fasten the cables termination |
| | ***TROUBLESHOOTING***:<br>• If current is under control, tune the current regulator<br>• Avoid too fast load variation |
| **Over Voltage DC**<br><br>DPM *x* – VdcH Max | ***DESCRIPTION***: instantaneous DC voltage has reached the Overvoltage trip threshold. "*x*" indicates the DPM number (1÷8). |
| | ***CAUSES***:<br>• With motor control, *Vdc Rollback* macro function is disabled or not tuned properly<br>• With AFE:<br>▪ Vdc regulator is not tuned properly<br>▪ inverter has reached the current capability while the load is regenerating more than the AFE regenerative power limit<br>• With common DC bus, another device is regenerating energy<br>• An overvoltage on power grid could be happened<br>• The analog terminal block of SD-SU is not connected or screws have not enough grip to fasten the cables termination |
| | ***TROUBLESHOOTING***:<br>• Enable and ore tune Vdc Rollback macro function<br>• Tune AFE regulators<br>• The analog terminal block of SD-RMU and/or SD-SU is not connected or screws have not enough grip to fasten the cables termination |
| **IGBT Desaturation**<br><br>DPM *x* – Desat IGBT *y* | ***DESCRIPTION***: IGBT "*y*"-*th* desaturation of DPM number "*x*". Odd number of IGBT in some frame can be cumulative for the phases. |
| | ***CAUSES***:<br>• A short circuit with zero impedance on the AC output of the drive is happened<br>• Damage, disturbance or low supply voltage on electronic driver board<br>• Serious damage of power parts |
| | ***TROUBLESHOOTING***:<br>• Check if cable of load are damaged<br>• Check the power supply of the driver board (from SD-SU), check the driver cards and clean them from dust or dirt if needed. Check if the board is visibly damaged too.<br>• Substitute the power module |
| **Earth Protection**<br><br>DPM *x* – Earth Protection | ***DESCRIPTION***: SD-RMU detect the current of each DPM flowing toward earth for more than 5 seconds. |
| | ***CAUSES***:<br>• Current sensor terminals (from each side: sensor and SD-SU) ad not fastened<br>• Current sensor can be damaged or burden resistor on SD-SU are not well welded<br>• Some parts (DC and AC) are lost their insulation between earth<br>• Load insulation can be damaged |
| | ***TROUBLESHOOTING***:<br>• Check SD-SU terminal block of current sensors<br>• Check the terminals of current sensors<br>• Insulation must be verified: only authorized and skilled personnel can perform this check |
| **Earth Protection**<br><br>Earth Protection | ***DESCRIPTION***: SD-MCU detect the total current flowing toward earth for more than 5 seconds. |
| | ***CAUSES***:<br>• Some parts (DC and AC) are lost their insulation between earth<br>• Load insulation can be damaged |
| | ***TROUBLESHOOTING***:<br>• If *DPM x – Earth Protection* is present, maintainer has to solve this problem before<br>• Insulation must be verified: only authorized and skilled personnel can perform this check |
| **Fuse Fault**<br><br>DPM *x* – Fuse Fault | ***DESCRIPTION***: one or more internal DC fuses (if they are present) of the DPM number "*x*" are opened. This is a cumulative signal |
| | ***CAUSES***:<br>• With common DC bus, a short-circuit on the DC bus can be happened<br>• Internal power parts (DC capacitors or IGBT) could be short-circuited<br>• Contact on the fuse striker may have lose grip |

| Fault and Code Name | Description, Causes and Troubleshooting |
|---|---|
| | ***TROUBLESHOOTING***:<br>• Check if other equipment connected to the DC bus have caused the fault and replace the fuses<br>• Disconnect the DI5 from SD-SU (see Tab. 5-9) and check the continuity<br>• Check the drive integrity (visually or burning smell) and verify the fuse striker wiring<br>• If DPM is seriously damaged, substitute it, otherwise change only the fuses |
| **Phase Current Unbalance**<br><br>DPM *x* – Phase *y* current unbalance | ***DESCRIPTION***: transduced current of the phase "*y*" of DPM number "*x*" is far from average value of the same phase of all the DPMs in parallel. |
| | ***CAUSES***:<br>• Wiring of the power parts, mainly next to the parallel connection, could unbalance the load<br>• Damage of internal circuits |
| | ***TROUBLESHOOTING***:<br>• Check the wiring of parallel connection<br>• Check drive integrity |
| **Heatsink Fault**<br><br>DPM *x* – heatsink temp fault | ***DESCRIPTION***: heatsink has reached an anomalous temperature |
| | ***CAUSES***:<br>• Ambient temperature is very high and the drive is working with high current so that the heatsink has overcome the 90°C<br>• Heatsink is not properly cooled<br>• If current is not too high, probably the cabinet temperature (ambient temperature) is too high<br>• One of the three thermal clip on the heatsink are opened or not connected<br>• Heatsink could be obstructed (usually due to dust or pollution) |
| | ***TROUBLESHOOTING***:<br>• Check the cooling system of the DPM (for example if fan is running properly which means the correct wise and/or enough pressure)<br>• Check the cooling of the cabinet: no hot air recirculation is allowed<br>• Disconnect the DI4 from SD-SU (see Tab. 5-9) and check the continuity<br>• Clean the heatsink and remove the obstruction if needed. |
| **Size Mismatch**<br><br>Size Mismatch | ***DESCRIPTION***: at least one power module size differs from the selected one or it isn't detected. |
| | ***CAUSES***:<br>• Configured size via software is different with the one selected on SD-SU boars dip switch S1.<br>• Communication between SD-RMU and SD-MCU is wrong, so this alarm may happen<br>• Communication problem between SD-SU and SD-RMU<br>• The cpu on SD-SU is not programmed |
| | ***TROUBLESHOOTING***:<br>• Check if the size is correctly configured according to the drive size indicated on the plate data and so verify the size codification on the dip switch of SD-SU<br>• Check the optical fiber couple between SD-MCU and SD-RMU<br>• Check the flat connection between SD-RMU and SD-SU<br>• If SD-RMU or SD-SU board are damaged, replace them<br>  **WARNING!** Modify the DPM dip switch is a hazardous procedure which can lead to damage the drive or injure or kill people in the vicinity of the machine. This procedure is not protected against sabotage. |
| **STO**<br><br>STO Activated<br>DPMx – STO Fault<br><br>Red LED blink | ***DESCRIPTION***: at least one channel of STO is opened. |
| | ***CAUSES***:<br>• STO circuit is opened.<br>• If STO is wrongly enabled, wire of safety circuit could be damaged or terminal connectors are not proper plugged into SD-RMU<br>• STO circuit on SD-RMU could be damaged |
| | ***TROUBLESHOOTING***:<br>• Check the wiring of safety circuit and the terminals of SD-RMU<br>• Replace DS-RMU |

**Tab. 5-23: Troubleshooting**

# 5.6 SPARE PARTS CODES

Spare part regarding only the electronic board inside the DPM. To order the whole module, please refer to the ordering code reported on the plate data.

| Item | Ordering Code |
|---|---|
| SD-SU | Depending on DPM size. Contact SECOM |
| SD-RMU | 110878R5001 |
| ADLIDAN2 | 790075P192 |
| H_FUSE | 790075P384 |
| ALI_LEM | 790075P297 |
| SD-SYNC | 790075P280 |
| SD-OP | 790075P415 |
| SD-MCU | Contact SECOM |
| SD-COMX-10 | 790075P254 |
| SD-COMX-51 | 790075P416 |
| SD-ENC (24V) | 790075P252 |
| SD-ENC (5V) | 790075P275 |

**Tab. 5-24: Ordering Code for Electronic Board**

| Kit Bar Code | Material | Ordering Code |
|---|---|---|
| /KB1 | Al | 110871R1001 |
| /KB1 | Cu | 110871R1002 |
| /KB2 | Al | 110871R1003 |
| /KB2 | Cu | 110871R1004 |

**Tab. 5-25: Ordering Code for AC bus bar kits**

| Fuses for Drive Size | Ordering Code |
|---|---|
| SDx.2: Up to 700A @ 400V | 170M6465 |
| SDx.2: From 700A @ 400V | 170M6467 |
| SDx.2: Up to 700A @ 690V | 170M6499 |
| SDx.2: From 700A @ 690V | 170M6501 |
| SDx.3: Up to 240A @ 400V | 170M4209 |
| SDx.3: From 240A @ 400V | 170M4210 |
| SDx.3: Up to 240A @ 690V | 170M4190 |
| SDx.3: From 240A @ 690V | 170M4191 |

**Tab. 5-26: Ordering Code for internal fuses**

| Ferrite | Suggested useage | Ordering Code |
|---|---|---|
| WE 742 712 21 | USB cable from SD-OP to SD-MCU | 790066P726 |
| WE 742 7143 | SD-MCU power supply (24V) | 790066P725 |

**Tab. 5-27: Ordering Code for ferrites (suggested items)**

Svn check