MD MOTION s.r.l.
Via Giuseppe Garibaldi 12/5
San Giorgio di Piano 40016
Bologna Tel. 051.6867021
e-mail: info@mdmotion.it

Using and Instruction Manual

SkyD

Release 0 / 2013-Sep

I. MANUAL INFORMATION

This manual contains all the information required to use the product correctly. It must be considered as an integral part of the device.

The instruction manual is addressed to qualified personnel with an electro technical know-how, technical equipments knowledge and operative installations on site. For a safety and right maintenance, please care all the information here contained.

i.1 REVISIONS

Revision	Description and modify
Rel. 0 / 2013-Sep	1st Edition.

Technical modify should be done whenever the manufacturer requires without previous warning.
The manufacturer has not any responsibilities caused by a wrong use of the electrical device.

All rights reserved. This manual, or single parts of it, can not be used /copied without MD Motion previous authorization and approvals.

i.2 SYMBOLS USED

This part contains all the symbols used and their meaning.



DANGER

Electricity and defects should be a risk for the operator (high voltage, high temperatures).



WARNING

Avoid product injuries the operator must follow scrupulously all the instructions required.



NOTE

Suggests are contained into this information manual. Please care about them.



NOTE

Terms as "inverter", "servo drive", "drive", "equipment", "device" are used by a common issue.

Hereafter it will be named "drive".

II. TABLE OF CONTENTS

I. MANUAL INFORMATION I

i.1 REVISIONS i
i.2 SYMBOLS USED ii

II. TABLE OF CONTENTS III

1. PRODUCT INFORMATION 1

1.1 WARRANTY 1
1.2 LABEL 1

2. SAFETY AND INTERNATIONAL TECHNICAL STANDARD 2

2.1 SAFETY INSTRUCTIONS 2
2.2 DIRECTIVE and TECHNICAL STANDARD EUROPEAN 3

3. GENERAL INSTRUCTIONS 4

3.1 GENERAL DESCTRIPTIONS 4
3.1.1 RUNNING VIEW 5
3.1.2 PROGRAMS and PARAMETERS 5
3.1.3 PC CONNECTIONS and RS-SERIAL LINE 6
3.1.4 WARNINGS and ALARMS 6
3.1.5 AVAILABLE OPTIONS 6
3.2 PRODUCT and OPTIONS ORDER CODE 7
3.3 BLOCK DIAGRAM 8
3.4 CONNECTIONS 10

4. TECHNICAL DATA 11

4.1 SKYD TECHNICAL DATA 11
4.1.1 *PROTECTIONS* 13
4.1.2 ANALOGUE INPUT 13
4.1.3 DIGITAL INPUT 14
4.1.4 DIGITAL OUTPUT 15
4.1.5 ANALOGUE OUTPUT 15
4.2 MOTORS DRIVEN 16
4.2.1 GENERAL DATA 16
4.2.2 ELECTRICAL DATA 16

5. MECHANICAL MOUNTING AND DIMENTIONS 18

5.1 MECHANICAL DIMENTIONS 18
5.2 MOUNTING INSTRUCIONS 19
5.3 FAN-COOLING 21

6. ELECTRICAL INSTALLATION 22

6.1 JUNCTION RULES 23
6.1.1 GROUNDING 23
6.1.2 LINK WIRES 24
6.2 CONNECTORS AND SIGNALS 25
6.3 POWER LINKS: MOTOR and SUPPLY 28
6.3.1 SUPPLY CIRCUIT: External fuse and switches 29
6.3.2 LINE FILTER 30
6.4 CN3 CONNECTOR LINK: RS232 LINE 31
6.5 CN1 CONNECTOR LINK: REPLIED ENCODER 32
6.6 CN4 CONNECTOR LINK: SIGNAL 33

6.7 CN2 CONNECTOR LINK: ENCODER FEEDBACK SIGNALS 34
6.8 BRAKING MODULE 35

7. PROGRAM AND PARAMETERS 36

7.1 PARAMETERS MENU and DESCRIPTION 37
7.2 MOTOR CONTROL SOFTWARE 40
7.2.1 MOTOR CONTROL INSTALLATION 40
7.2.2 MOTOR CONTROL USING 41

8. DIAGNOSTIC 43

8.1 ALARMS 43
8.2 TROUBLES 44

9. APPLICATIONS 47

9.1 DRIVE USING ON MANUAL MODE APPLICATION 47
9.2 NUMERICAL CONTROL and DIFFERENTIAL REFEREMENT APPLICATION 48

1. PRODUCT INFORMATION

1.1 WARRANTY

MD Motion warrants the drive without engineering and manufacturing defects. Transportation, out-packing and mounting injury are not taken under responsibility of the producer.

Warrant period starts from the purchasing till 24 month later.
The warranty is not taken under consideration in case of wrong mounting or tempered of the product.

Out of the rating performances utilization and mounting the manufacturer will not be responsible for all the effects caused to the people, devices or applications linked.

1.2 LABEL

Please find hereafter the label layout and the record linked. It permits to identify the product.

<table>
<tr><td rowspan="2">MD motion</td><td>Code</td><td>Drive code</td></tr>
<tr><td>S. N.</td><td>Serial Number / Part Number</td></tr>
<tr><td>Via Garibaldi 12/5
40016 San Giorgio di Piano
Tel: 051 6867021</td><td colspan="2">CE</td></tr>
</table>

Code Commercial drive code.
S. N. Serial or Part number. It gives a track of the manufacturing period too.

2. SAFETY AND INTERNATIONAL TECHNICAL STANDARD

A wrong use of the product could be dangerous for people or devices linked.
Please follow all the instructions contained into this manual, check the label data carefully before the mounting.

Mounting and Running start-up operations must be done by qualify qualified workers experienced on this matter. They must know the usual safety and linked International Technical Standard.

2.1 SAFETY INSTRUCTIONS

During the normal duty the product can show:

- exposed parts under voltage,
- driving links and power can be under tension, even in case of stopped motor,
- hot surfaces.



WARNING

- The product and/or parts of it could present high current that can be dangerous for the personnel. To avoid injury don't touch the components under tension, wait at least **5 min** after having interrupt the alimentation.
- During the normal duty cycle the drive surface could be very hot. Please be warned the **heat sink surface especially. It should be more than 80°C temp**.



NOTE: ***Sales controlled and linked rule*** *(CEI EN* 61800-3)
"Don't use the drive by a domestic low tension supply. It should be a cause of radio-frequency interferences".

In case of domestic, commercial and industrial drive application the customer must care and/or use right filter units (Not included with the drive).

2.2 DIRECTIVE and TECHNICAL STANDARD EUROPEAN

This product is manufactured according to the Low Voltage European Directive (LVD) 2006/95/CE [and following modify 73/23/CEE] and the EMC European Directive 2004/108/CE [and following modify 89/336/CEE].

According to the Low Voltage Directive in matter of safety and functional, the manufacturer observes the following International Norms:

- **CEI EN 61800-5-1** " Adjustable speed electrical power drive systems: Part 5.1 Safety
- **CEI EN 61800-2** " Adjustable speed electrical power drive systems: Part 2: General requirements - Rating specifications for low voltage adjustable frequency AC power drive systems";
- **CEI EN 60146-1** Semiconductor Converters – General prescriptions and converters switched by the line;
- **CEI EN 60204-1** "Safety of machinery - electrical equipment of industrial machines: Part 1: General requirements".

According to the EMC Directive the manufacturer observes the following International Technical Standard and product issues:

- **CEI EN 61800-3** "Adjustable-speed electric power drive systems - Part 3: EMC Product standard including specific tests".

If all the instructions here contained are respected the Drive follows the Directives mentioned above. For a correct use of the drive this manual shows to the user how to do a correct wiring.
Different way to use the machinery obliges the user to do new measurements and tests da eliminare to satisfy the Rules mentioned above. This makes the manufacter not responsable for them.

The electronic drive (PDS "Power Drive System") must be used on automatic machines with other components as motor, filter, commutation and control circuits, electrical and auxiliary protection circuits. All these parts added are considered as a final complete product pack.

In this case the drive must be considered as a component of a complete product following a different EMC Directive: the EMC rule applied referrers to the final complete system/product-pack.

In case of mounting on machinery, the drive conformity is satisfied whenever the complete system/product satisfies the directive EMC (2004/108/CE) and 2006/42/CE.



WARNING

It is responsibility of the final producer:

- **Avoid personnel injuries caused by wrong movements realazing a machinery analysis of the risks.**
- **To warrant that all the domestic rules are followed.**
- **To garantee that The EMC complete machinery value are under the parameter fixed by the rules.**

3. GENERAL INSTRUCTIONS

In this chapter will be shown the basic information about the use of the SKYD drive to permit the comprehension of the basic functions of it, clarifying what will be said in the next chapters.

3.1 GENERAL DESCTRIPTIONS

The main SKYD drives use needs a a.c. brushless servomotors in closed-loop mode control. (BT1 specify series if referred to the MDMotion group).

Basically the SKYD standard configuration provides the power supplier, the heat sink and the internal clamp. An external braking nit should be supplied on demand.

Signal, power and auxiliary connections are located into the front panel. The logic power supply connector is placed on the top surface.

The SKYD engineering development is particularly focused on the insulation between the "logic" and the "power" circuits.

- The logic part is based on a last generation DSP specially used for servo-control applications. Fast and precise positioning as in real time. The DSP permits to increase and control the direct torque by a flux vector-technology.
- The power circuit is made by a converter with DC-Bus supply, electrolytic capacitors, and IGBT module.

SKYD range is based on three models: 2Arms, 4Arms and 7Arms. The different size means a different IGBT intelligent module. Each model is also available with two different heat sink size. An external fan-cooling should be used for special applications on demand.

The SKYD works with a speed analogue ref.(± 10V) by an acceleration/deceleration programmed ramp; or by an internal ref. stetted before.

3.1.1 RUNNING VIEW

On the front panel there are three LEDs one GREEN and one RED and one YELLOW which identify the operating status of the SKYD.

***GREEN LED**

The green Led indicates the correct supply of the Logic section (24Vdc power supply present).

***RED LED**

The red Led indicates the operating status of the drive:

Fixed On: the drive is not in alarm and the axis is free.

High frequency flash: the drive is not in alarm and the axis is in torque.

Low frequency flash: the drive is in an alarm situation. The number of flashes identifies the alarm code (for the alarm codes, see the chapter "DIAGNOSTICS").

3.1.2 PROGRAMS and PARAMETERS

Thanks to the flexible and complete software the SKYD drive permits to realize custom application.

It’s possible to arrange some parameters as the off-set, the maximum speed, the integral and proportional PiD.

Selecting the motor driven parameters and the main set data linked (Kp, Kt, and so on) the values will be automatically modified.

The Drive programming set up is basically made by a PC (using the RS-232 serial communication link) or by an external key-pad (available on demand).

The key-pad has a LCD display with two lines and 16 characters. A keyboard with 3 main buttons permits to control, manually insert and modify all the parameters needed.

It is possible to show the alarms code too.

The Key-pad module is provided of a 64K memory for the saving of the program of the parameters.

3.1.3 PC CONNECTIONS and RS-SERIAL LINE

Basically the Drive unit has a RS-232 communication door to be linked with a PC.

Using the own "MOTOR CONTROL" software is possible to manage the automatic auto tuning with the motor linked (BT series in case of the MDmotion group), to modify or set the drive, and finally make tests and controls.

The "MOTOR CONTROL" program permits to make a real analysis of the main motor and drive values; which is the application applied and all the dynamic system.

Having a right and balanced system set-up is also possible to save and show graphically all the main values required (es.: voltage, current, speed, and so on).

3.1.4 WARNINGS and ALARMS

For a correct use the SKYD diagnostic shows past and present events occurred. The following protections are improved (as standard):

- Module over temperature,
- Short circuit @ground,
- Short circuit between winding motor,
- Over voltage,
- Over current.

3.1.5 AVAILABLE OPTIONS

The SKYD is a brushless motor drive as standard. The closed loop is made by an Incremental Encoder (5V – Line-Driver).

This SKYD should be more than a simple brushless motor drive unit. The following configurations are also available on demand:

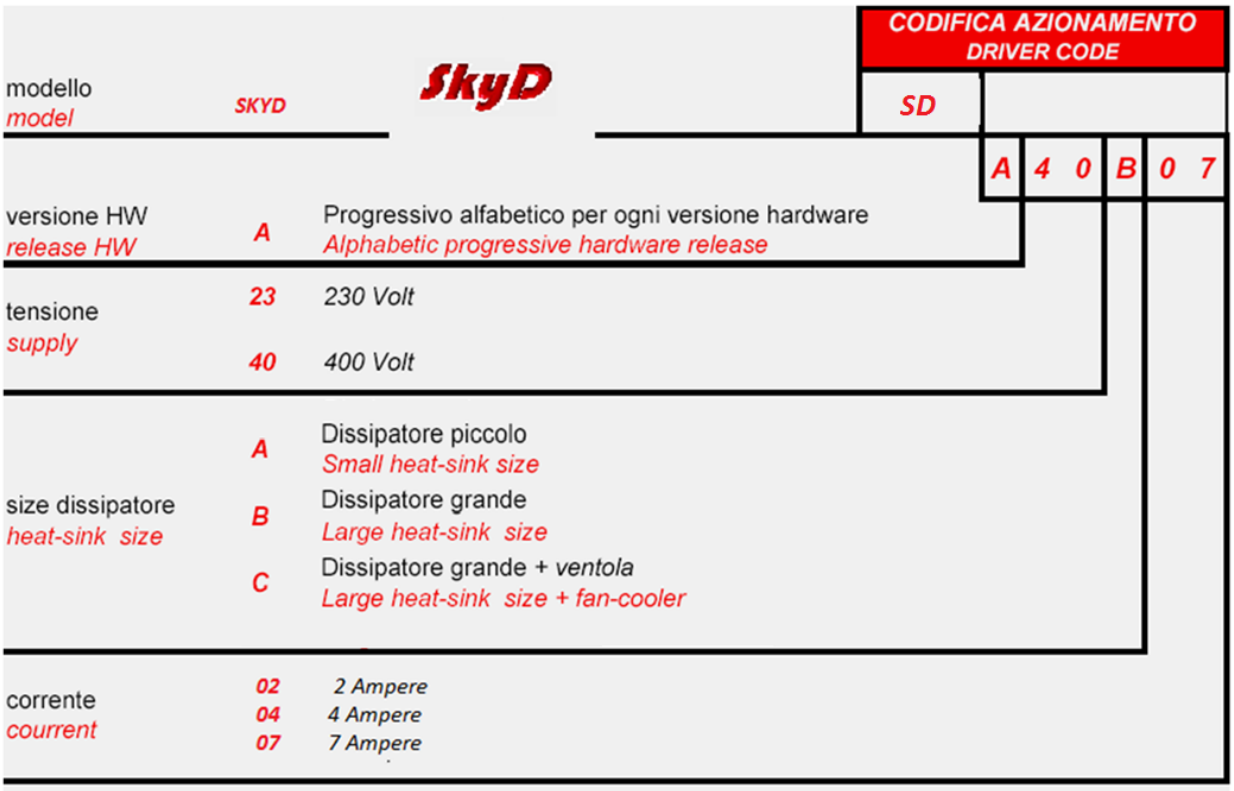
- Stepper motor simulation.
- Full vectorial a.c. motor.
- Sin/Cos.
- CAN Open.

Other options are available on demand:

- Fan-cooler.

3.2 PRODUCT and OPTIONS ORDER CODE

Please find hereafter the table code example.



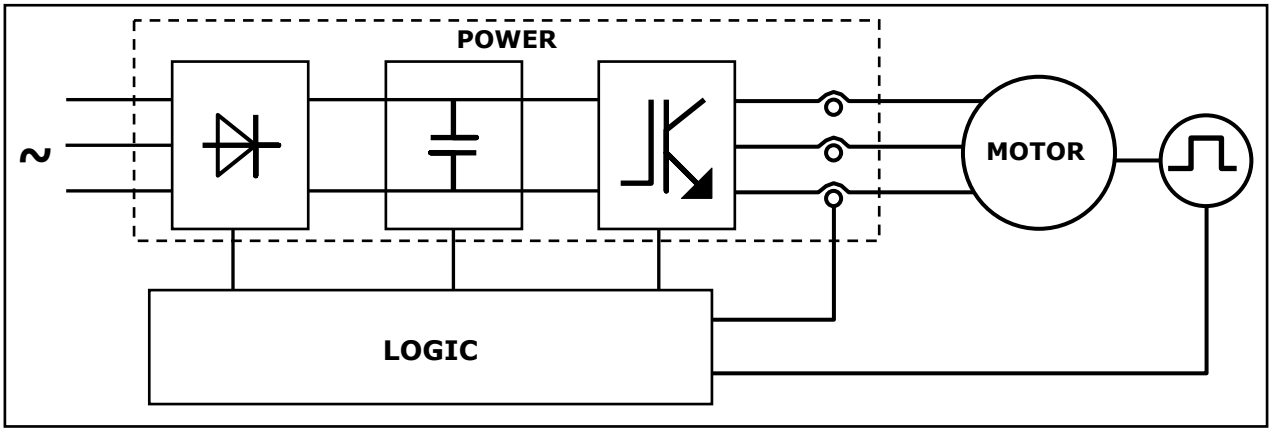
NOTE

The product is equipped of:

- Connectors .
- Instructions Manual .

3.3 BLOCK DIAGRAM

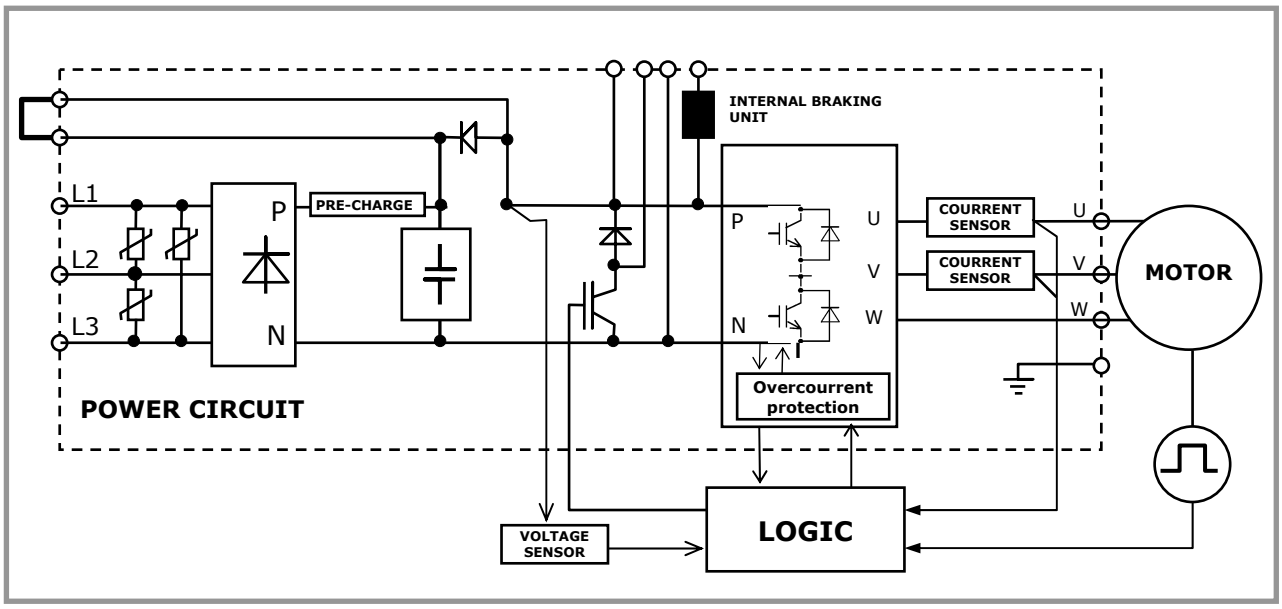
Picture 3.1 SKYD Drive block diagram .



The power and logic circuit diagrams block are following identified.

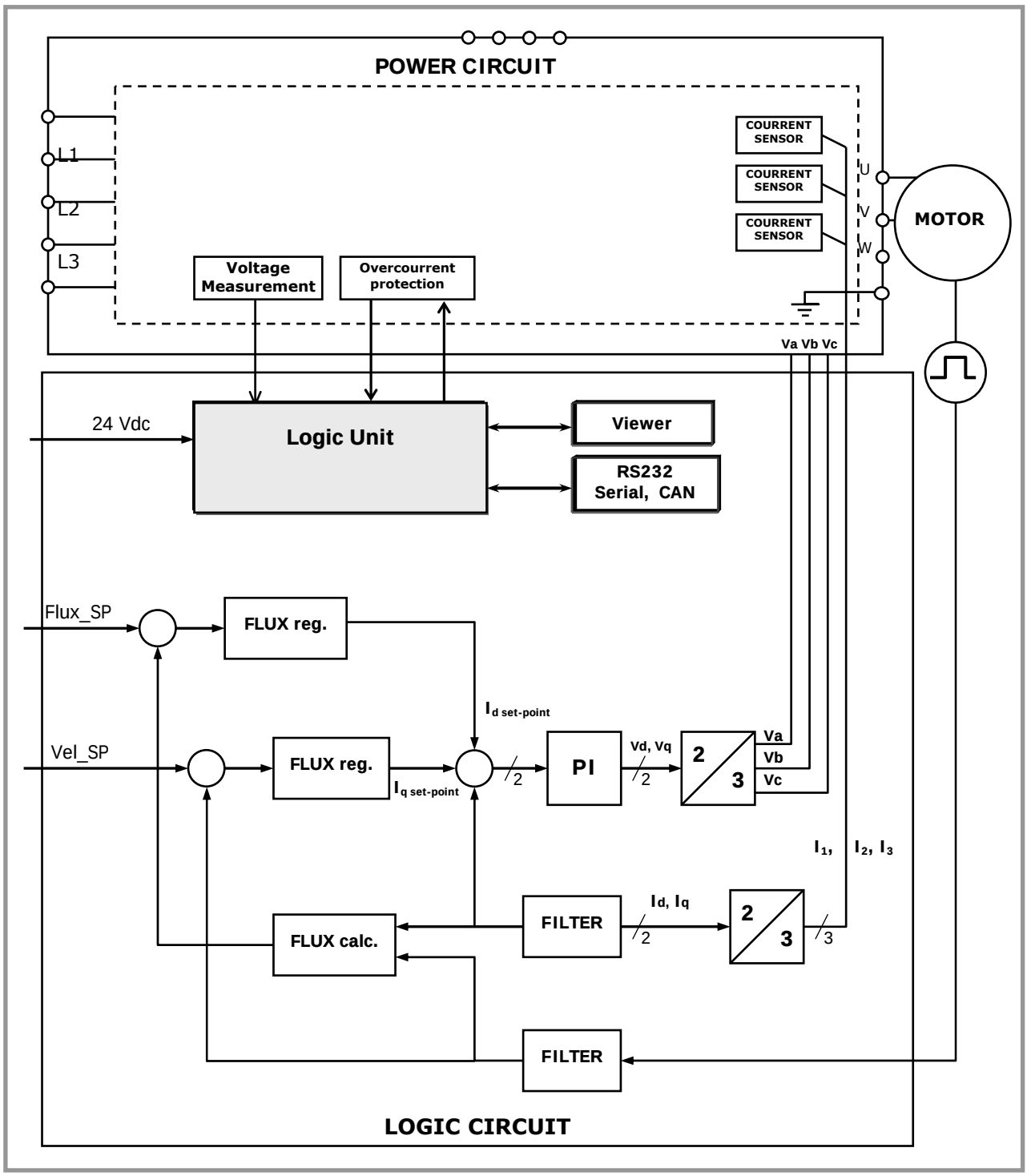
Power circuit switches constant three-phase voltage and frequency on a d.c. voltage. By the way it obtains a new variable three-phase and frequency voltage. This values permit to adjust the speed motor modulation.

Picture 3.2 Power circuit diagram block.



The drive **logic circuit diagram block** referres to the following picture.

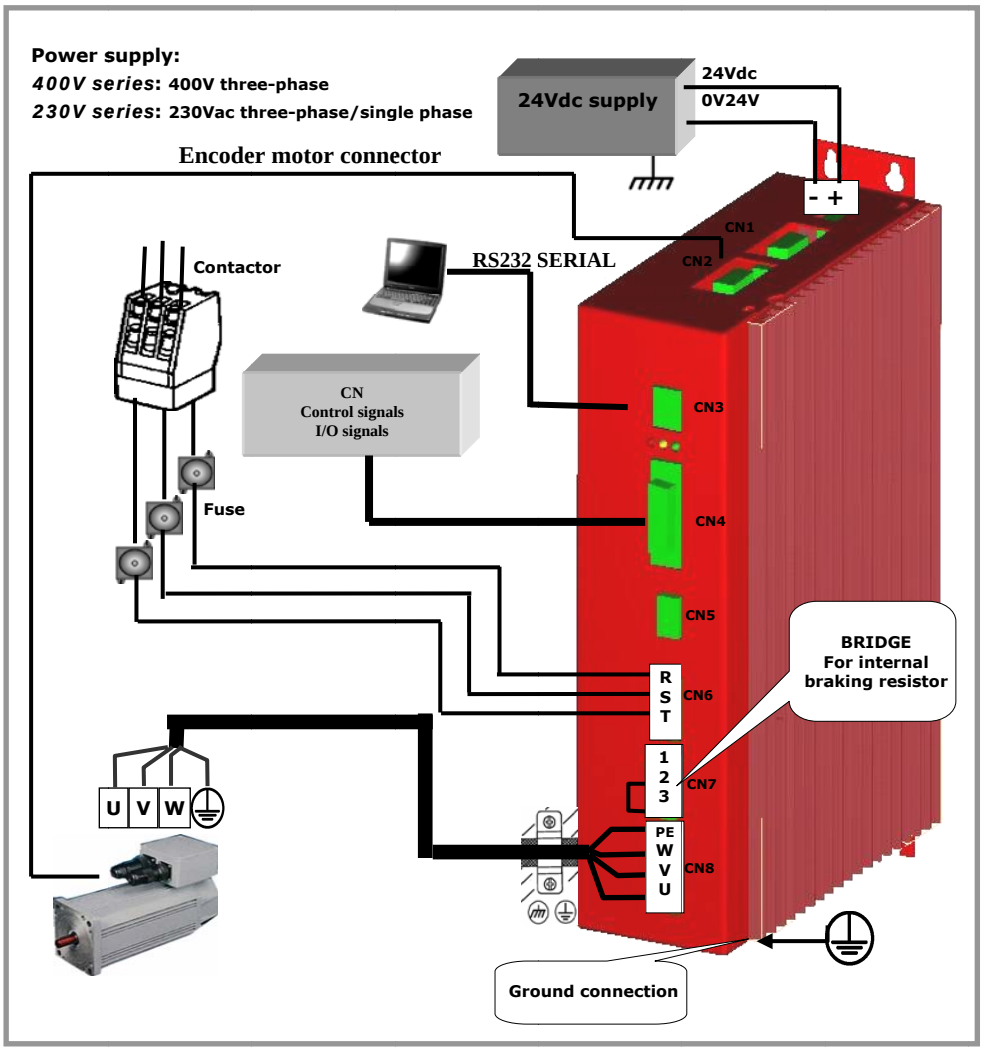
Picture 3.3 Logic circuit diagram block.



3.4 CONNECTIONS

This charter shows all the possible connections between the drive and the other components.

Picture 3.4 SKYD connections diagram.



4. TECHNICAL DATA

This charter shows the SKYD technical data and the synoptic combination table between drive-motor.

4.1 SKYD TECHNICAL DATA

This table resumes the electrical data, environment and physic values of the three SKYD models.
Analogue and Digital I/O are following remarked.

Table 4.1 SKYD Electrical Data.

Electrical Data	SKYD 23- ..-02	SKYD 23- ..-04	SKYD 23- ..-07	Unit
Supply	230 ±10% 1 – 3 phase	230 ±10% 1 – 3 phase	230 ±10% 1 – 3 phase	Vac a 50/60 Hz
Logic supply	+24 ±10%	+24 ±10%	+24 ±10%	Vdc **Insulated**
Motor supply	180	180	180	Vac RMS Phase to Phase.
PWM Frequency (switching)	20	20	20	kHz PWM .
Rating Power	0,6	1,2	2,1	KW
Rating Current	2	4	7	A rms
Peak Current	4	8	14	A rms

Electrical Data	SKYD 40- ..-02	SKYD 40- ..-04	SKYD 40- ..-07	Unit
Supply	400 ±10% 3 phase	400 ±10% 3 phase	400 ±10% 3 phase	Vac a 50/60 Hz
Logic supply	+24 ±10%	+24 ±10%	+24 ±10%	Vdc **Insulated**
Motor supply	330	330	330	Vac RMS Phase to Phase.
PWM Frequency (switching)	20	20	20	kHz PWM .
Rating Power	1,1	2,2	4	KW
Rating Current	2	4	7	A rms
Peak Current	4	8	14	A rms

Table 4.2 SKYD Environment.

Environment	SKYD 40- .. -02 23- ..-02	SKYD 40- ..-04 23- ..-04	SKYD 40- ..-07 23- ..-07	Unit
Transport temperature	-25 … +55			°C
Transport Humidity	95%			W.C.
Storage temperature	-20 … +70			°C
Storage Humidity	95%			W.C.
Rated working Temperature From +45 to +55 by power adsorbing 2,5%/K.	-20 ... +45 @ nominal value			°C
Rated working Humidity	From 5% to 85%			W.C.
Altitude	Up to 1000 mt. Without derating. From 1000 to 2500 m the power must be 2% / 100mt derated.			

Table 4.3 SKYD Physic Data.

Physic Data	SKYD			Unit
	A 02	A 04	B 07	
Weight	2	2	2,5	Kg
Braking Unit	100	100	100	W
Degree Protection	IP20		IP20	--
Crash resistance	0.5g		0.5g	-
Fan-Cooling	On Demand (24V d.c. supply).			
Vibration resistance	0.5 g for all the directions: 0-10Hz.			
Braking unit circuit	Internal.			

4.1.1 *PROTECTIONS*

Avoid wrong uses the drive has many protections improved as following:

- Supply over voltage: 770 Vdc on the DCBUS.
- Under voltage, DCBUS not sufficient supply: 420 Vdc.
- Motor over temperature: 125°C ± 5°C.
- Power module over temperature: 75°C.
- Short circuit between phases.
- Short circuit @earth.
- Motor over current.

4.1.2 ANALOGUE INPUT

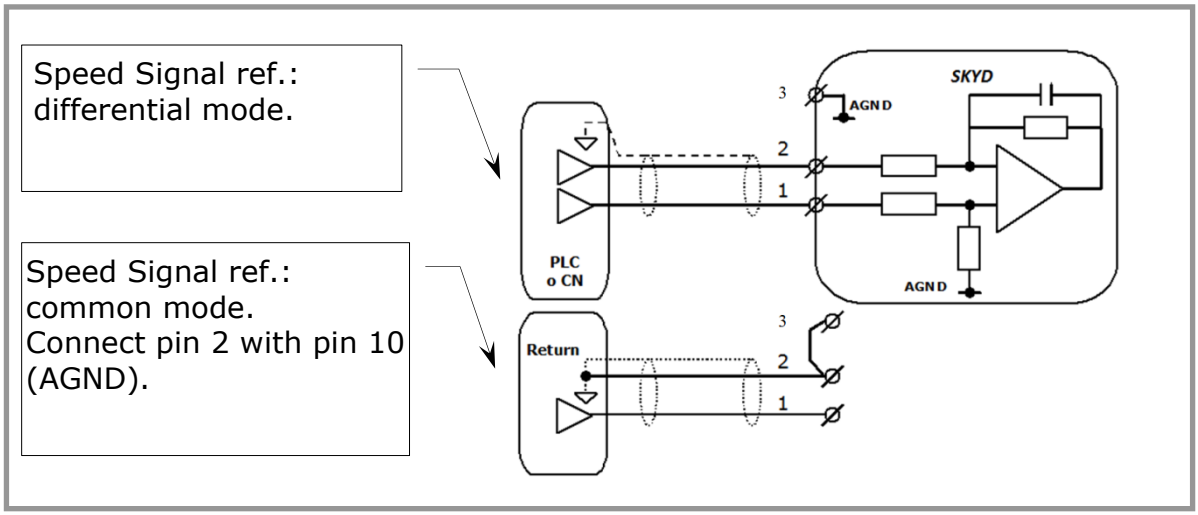
Nr. 2: Differential (+VREF, -VREF) and (ATEXREF, ATEXREF\).

- **+VREF, -VREF differential ±10V**

  The SKYD has a analogue inputs to be used for a PC or CNC link.

  The CNC or PLC "Ax" board used has an analogue output as "differential mode" or "common mode". The connections must be done following the figured instructions.

Picture 4.1 Differential analogue input (+VERF, -VREF).



- **ATEXREF, ATEXREF** (**A**nalogue **T**orque **Ex**ternal **Ref**erence)

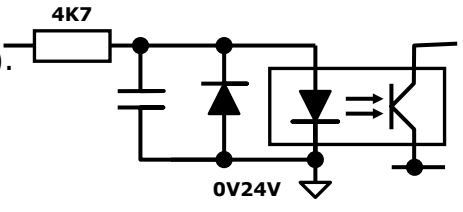
  ±10V Differential, 10KΩ Impedance.
  Differential analogue input for speed control with rated torque limited from the motor .

4.1.3 DIGITAL INPUT

SKYD drive has 7 digital input: two of them are optional (on demand).
All the digital input are insulated by opt insulators @ 0 potential; hereafter the diagram circuit.

Picture 4.2 Digital input diagram circuit.

- Nr. 7 isolated digital input.
  (DIEN, DTEN, DIN1, DIN2, DIN3, DIN4,DIN5).

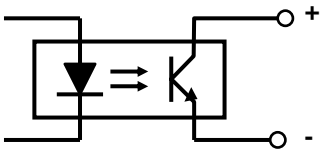


4.1.4 DIGITAL OUTPUT

The digital output are insulated. The following picture swohs the circuit diagram.

Picture 4.3 Digital output circuit diagram.

- Nr. 3, Insulated.
  DOUT1+, DOUT1-
  DOUT2+ , DOUT2-
  OK+ , OK-

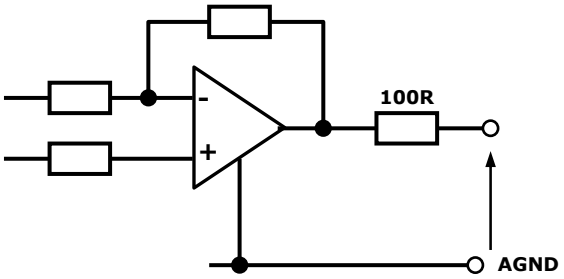


4.1.5 ANALOGUE OUTPUT

The analogue output circuit diagram referres to the followed picture.

Picture 4.4 Analogue circuit diagram.

Nr. 1: ANOUT1



4.2 MOTORS DRIVEN

SKYD drive is made to control brushless a.c. servomotors.

Especially set and programmed for own BT brushless a.c. servomotors.

4.2.1 GENERAL DATA

BT series are an high efficiency IP54 6Poles servomotors.
Thanks to the last FeNdB permanent magnet series the motor can work up to 150°C without deterioration.

The main stones of these motors are high performance, fast and flexible adjustment during the duty cycle, tough and reliability. All in small and compact dimensions.

The bearings used are an high charge capability series with double standard protection and self-lubricating for their complete life.

The standard feedback is made by an incremental encoder. Also available other feedback as SinCos, Absolute Single-Multi tour Encoder, Resolver, and so on.
24Vd.c. permanent magnet braking are available on demand.

4.2.2 ELECTRICAL DATA

Find hereafter the BT-servomotors and SKYD-drive combination table.

Table 4.4 Servo motor Performance.

SKYD 23 model drive			**A 07**
Servo motor Performance			**K2S3E2F**
Supply		Vac	**180**
Continuous Torque	**T_{sc}**	Nm	**2,4**
Torque constant	**Kt**	Nm/A	**0,51**
Continuous Current	**I_{sc}**	Arms	**4,7**
Rated Speed	**Nn**	Rpm	**3000**
Maximum Speed	**Vmax**	Rpm	**5000**
Peak Torque	**Tp**	Nm	**6**
Peak Current	**Ip**	Arms	**11,75**
Rotor Inertia	**J**	$mKgm^2$	**0,114**
"MOTOR" parameter value			**8**

The standard sale brushless servo motors includes:

- PT100.
- Incremental Encoder
- 90° reversible terminal box.
- MIL-C-26482 series 1 Signal Connector.



WARNING
The motor/drive combination is made by "MOTOR" parameter following the table mentioned above.

5. MECHANICAL MOUNTING AND DIMENTIONS

SKYD is designed for a wall mounting and vertical fixing into an electronic equipment.

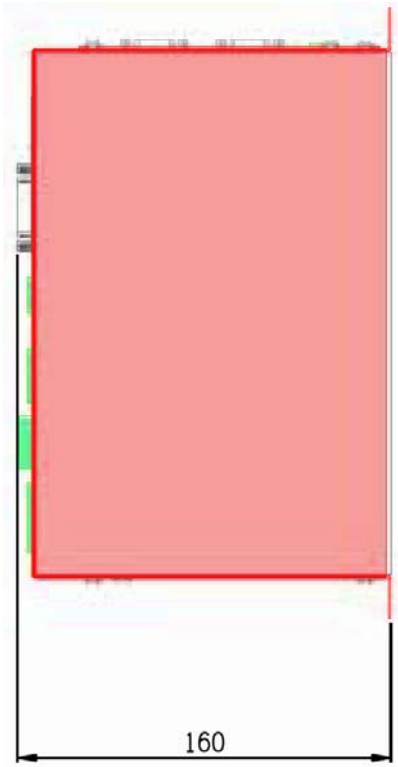
It can not be used in dangerous and pollution environments.

5.1 MECHANICAL DIMENTIONS

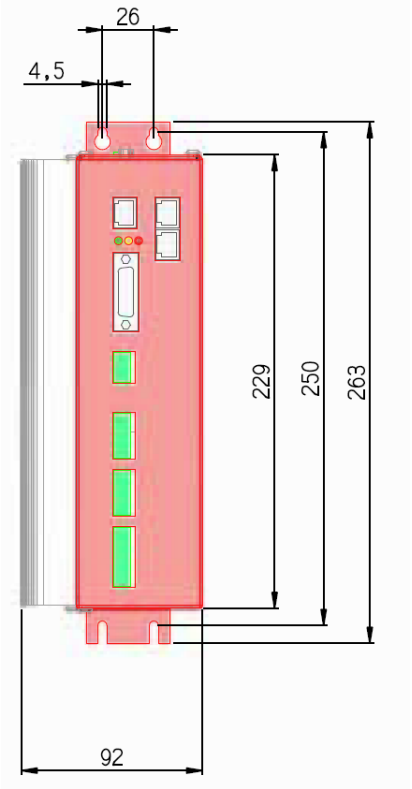
All the fixing dimensions and holes positions are following remarked. All the models configuration have a small and large heat sink. By the way the drive can be supplied either in A (small heat sink), B (large heat sink), C (large heat sink + fan cooler) configuration.

Picture 5.1 SKYD Mechanical dimensions.

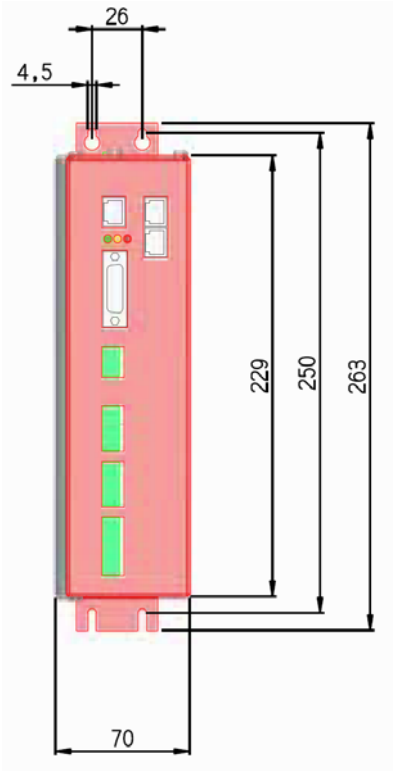
Lateral View
SHYD
Depth (connectors included)



Front View
SKYD
With Large heat sink (B/C)



Front View
SKYD
With Small heat sink (A)



Mechanical dimensions used are on mm.

5.2 MOUNTING INSTRUCIONS

The SKYD is provide for vertical fixing with an external fan cooler fixed below (on demand or required by the application). The cooling flux must be free to come trough the mechanical ways easily. Other outside component cant heat the cooling air.

The SKYD positioning and mechanical fixing must respect the following instructions.

Mounting environments: Clean industrial ambient only. Not pollution and conductor material are admitted. Corrosive, liquid and dangerous environments too.
Don't fix it near/on heat surfaces (as transformers).

Mounting distances: Having an optimal cooling action the vertical mounting is recommended. Minimum distances between the drive and the equipment walls, or other devices, must be respected too.
100mm on the top, 40mm from the heat sink and 20mm from the lateral side are distances recommended.

Airing: Please care a sufficient air exchanging into the closed equipment.
The maximum ambient temperature admitted must be warranted.

Mounting: Fix the drive vertically using the proper mounting components. Not painted metallic surface only.
Fix the SKYD using all the screws provided. Put it on the equipment earth.



WARNING

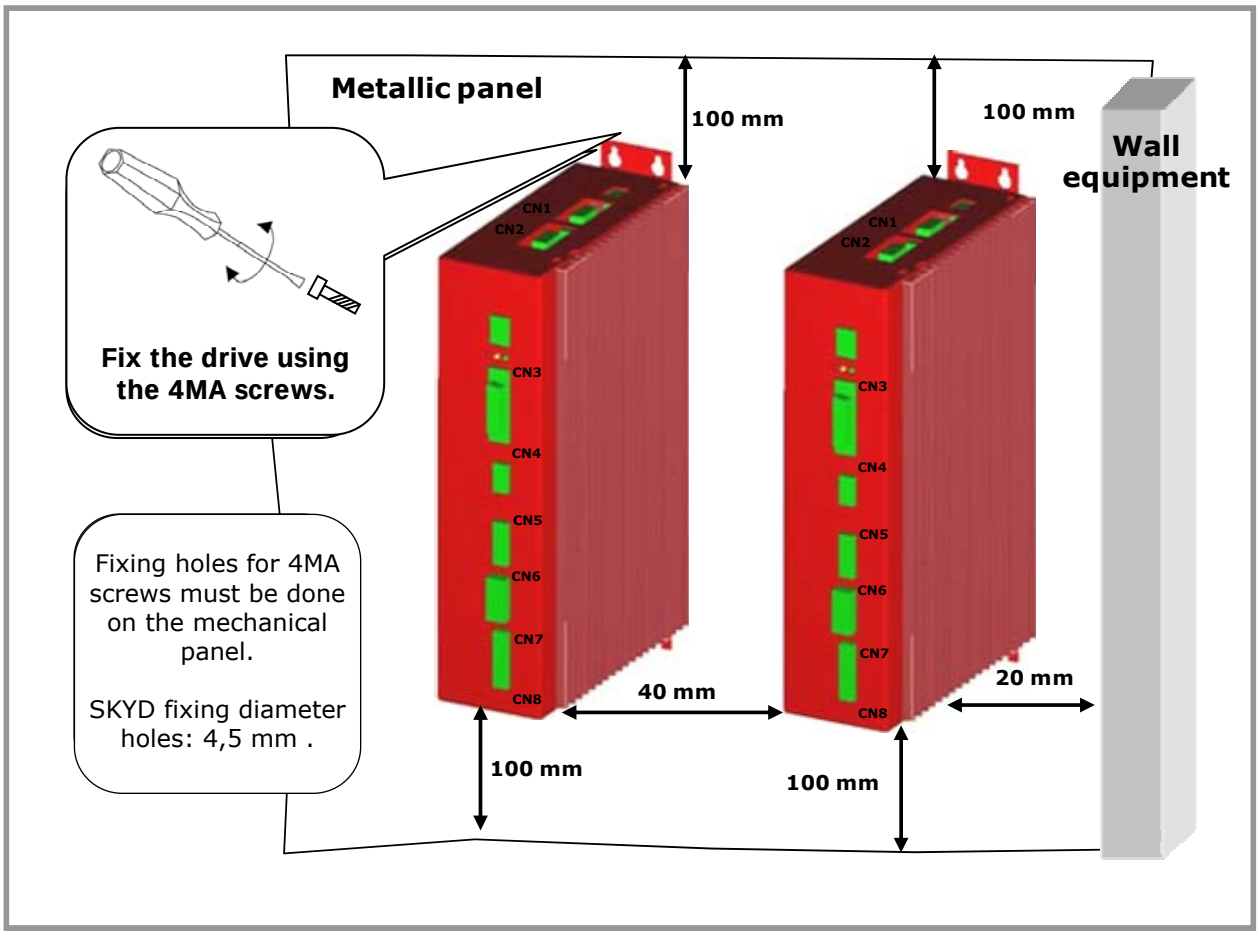
Avoid injuries and not correct use please care about the instructions mentioned above.

Avoid wrong mounting be careful to the following picture and the information.

1. Drill 4 holes 4MA screws fixing on the metallic equipment surface, due to the SKYD position provided. Respect the minimum mounting distances required.
2. Place the drive vertically on the metallic equipment surface centring the fixing holes on the top.
3. Fix the SKYD superior side by the 4MA screws without lock.
4. Verifying the right contact between the drive and the panel surface, lock the screws.
5. Turn the upper screws before and following the others.

The picture shows the mounting the minimum distances required for the drive fixing. In case of many drive too.

Picture 5.2 SKYD Mechanical Fixing and minimum distances.



5.3 FAN-COOLING

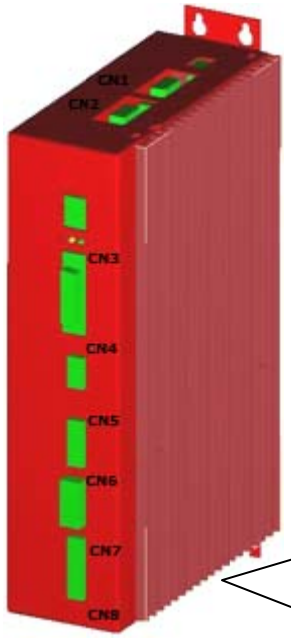
The SKY mounting into an electric cabinet must care about the sufficient cooling required and it must not influence the right air circulation.

The drive dissipation should change due different charge applied or duty cycle. To have the best performance a fan-cooler should be applied if necessary.

The fan is mounted below.

WARNING: FAN
The external fan is automatically powered by the DSP if necessary.

Picture 5.3 SKYD Fan.



Product code	SKYD Description
SD A 23 C 07 ..	Large heat sink with 1 fan (7 A)

Fan position

Mechanical dimensions 60x60x26 mm.
(Mechanical dim. ref. to the picture 5.3).

6. ELECTRICAL INSTALLATION

The SKYD mounting, maintenance and running operation must be done by qualified personnel only who has a specify electro technical knowledge and have had already worked with such applications.
The personnel must care about the existing grounded kink and the right cables protection following the national and/or international rules required.
Read carefully this manual before the start up operations.



WARNING

- Avoid injuries don't apply voltage supply over the operative drive.
- The start up must be done by qualify personnel only.
- The motor must be overload protected.

The SKYD conformity is assured if all the instructions here contained are followed only.



WARNING

- ***All the links must be done without voltage applied****, the power and 24V auxiliary and other devices to.*
- ***Be sure the equipment is swiched off*** *(by blocks, warnings and so on).* ***The single voltages must be inserted if the drive is grounded only.***
- ***Do not unscrew the electrical links when the drive is under tension. Otherwise it could bring faults to the equipment.***
- ***The driving and power links can be under tension when the motor is stopped too,*** *300sec. After the switch off the capacitors could be dangerous****. Wait 5 min*** *till the supply is lesser than 40V.*

6.1 JUNCTION RULES

According to the electric international rules Drivers and motors must be grounded.
Hereafter are shown the main instructions.

6.1.1 GROUNDING

Be sure the grounding between motor and drive is made correctly.
Do not use mounting painted surfaces (these can conduct).
A correct grounding solves many systems faults before.
For a right grounding find the following suggests:

- Clean deeply the case contact SKYD surfaces before the grounding, because EMC rules and safety.
- Link the earth drive connection to the equipment earth by a yellow-green cable shorter than possible.
- A good grounded radiofrequency contact panel fixing must be done. Use larger surfaces.
- Avoid disturbs ground the motor case by a separate connection to other grounding devices. A low motor case impedance is required; the normal motor link or a simple mechanical fixing is not sufficient. An added good grounding link is required.

Bad grounding are dangerous for the motor (caused by common impedance link only). It means:

- High hot motor temp. and/or noisily running,
- Bad driving @low speeds,
- Off-set speed point difficult to be zero,
- Not regular and continuously positioning mistakes.



NOTE



The grounding picture is placed on all the connection circuits and it shows a larger conductive link between the drive and the equipment surface is required.



High frequency dissipations must be permitted by this link. Don't mistake the symbol with the PE grounding (ref. EN 60204).

EQUIPMENT GROUNDING BAR.
It's the point every SKYD grounding wires are putted on. It must be placed nearly to the PE input. From this point all the grounding SKYD 0V (GND), CNC and other auxiliary (+24VDC) links start.

6.1.2 LINK WIRES

Place power and driving cables separately. 20 cm minimum distance is required. In this way the immunity interferences recommendations are respected.
Following all the standing cables suggests.

A) Separate cable techniques must be used: stand the power and driving cables separately. During the standing procedure the physic power and signal cables separation must be cared. 20 cm as min. distance is recommended. If the power cable has other signal cables inside (as brake) these must be protected and separated.

B) Don't cross the wires. 90° crosses are permitted if necessary only.

C) Metallic wire boxes grounded are recommended; the motor grounding cable must be separated and not a multi polar cable component.

Cable section

All the cables that drive high currents must be as large as the EN60204 remarks.

Motor and Supply cable sections

SD A 23 – A– 02 : 1 mm² section (AWG17).
SD A 23 – A – 04 : 1,5 mm² section (AWG15).
SD A 23 – B/C– 07 : 2,5 mm² section (AWG14).

Signal cable section

0,5 mm² section (AWG20).

6.2 CONNECTORS AND SIGNALS

The following two pictures show all the connectors and signals available.

Picture 6.1a SKYD Connections and Signals.

24VDC AUX: 24Vdc supply
2 poles connector

Pin	Name	Description
-	0V24V	24Vdc refereeing
+	24V	24Vdc supply

SUPPLY: Drive supply
3 poles connector

Pin	Name	Description
R	Phase R	R Phase Supply
S	Phase S	S Phase Supply
T	Phase T	T Phase Supply

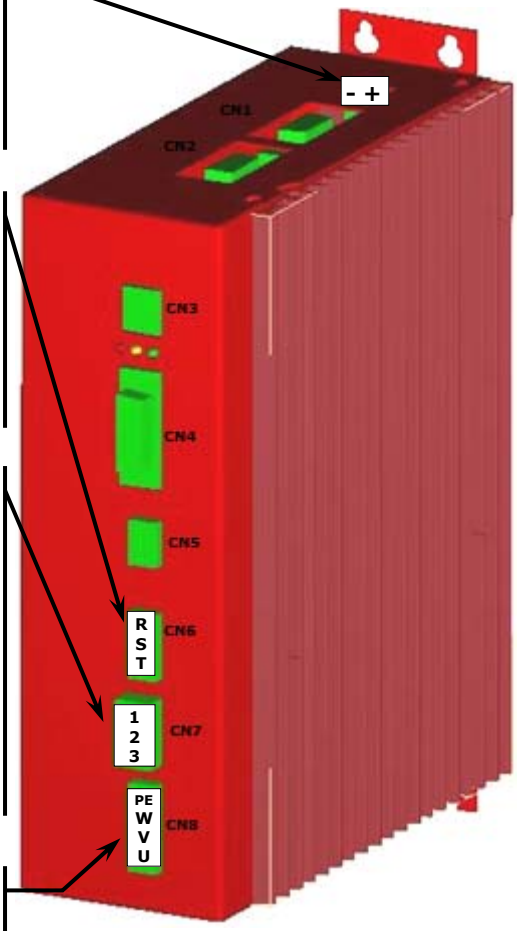
BRAKE: Brake Resistor
3 poles connector

Pin	Name	Description
1	RES EXT	External resistor
2	COMUNE	Common
3	RES INT	100W Internal Resistor

NOTE: Brake resistance connections must be referred to the own chapter.

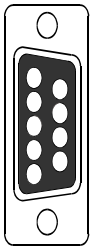
MOTOR: Motor Supply
4 poles connector

Pin	Name	Description
U	Phase U	Motor U Out Phase
V	Phase V	Motor V Out Phase
W	Phase W	Motor W Out Phase
PE	Ground	Earth



Picture 6.1b SKYD Connections and Signals.

CN1: REPLIED ENCODER



Pin	Encoder output options	
	Name	Description
1	A\	Phase A\ Encoder
2	A	Phase A Encoder
3	B	Phase B Encoder
4	B\	Phase B\ Encoder
5	GND	Ground Reference
6	Z	Phase Z (Zero) Encoder
7	Z\	Phase Z\ (Zero\) Encoder
8	--	Reserved signal
9	- -	Reserved signal

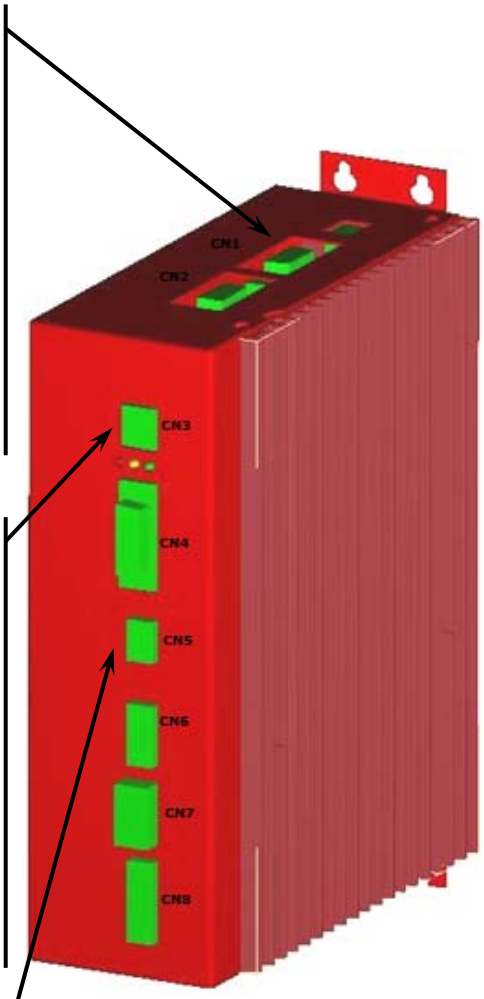
CN3: RS232 LINE (SERIAL)
RJ45 Connector

Pin	Name	Description
1	--	Reserved Pin
2	**RX**	**Receiving signal**
3	**TX**	**Transmitting signal**
4	--	Reserved Pin
5	**GND**	**Reference signal**
6	--	Reserved Pin
7	--	Reserved Pin
8	--	Reserved Pin
9	--	Reserved Pin

CN5:Brake Motor

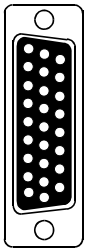


Pin	Name	Description
+	24V	+24V Brake motor Power
-	0V24V	0V Brake motor Power

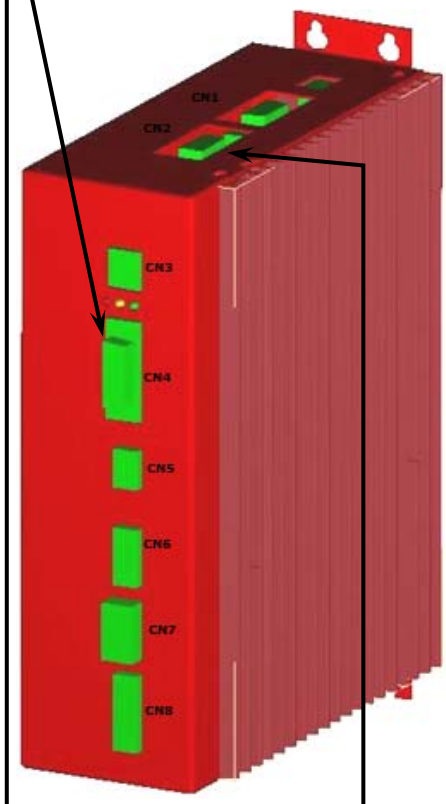


Picture 6.1c SKYD Signal and Connections.

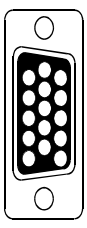
CN4: SIGNAL
26Poles female Connector SubD HD



Pin	Name	Description
1	+VREF	Analogical differential reference signal of speed/torque, positive
2	-VREF	Analogical differential reference signal of speed/torque, negative
3	ANOUT1 R	ANOUT1 reference ground
4	DOUT1+	Digital output1 + (programmable)
5	DOUT1-	Digital output1 - (programmable)
6	DOUT2+	Digital output2 + (programmable)
7	-	-
8	DTEN	Enable motor's control, digital input.
9	DIEN	Enable speed +/-VREF reference signal, digital input.
10	-	-
11	ATEXREF\	input signal differential analogical programmable ATEXREF, negative.
12	ANOUT1	Programmable analogical output1
13	-	-
14	OK+	Digital Output Drive OK +
15	OK-	Digital Output Drive OK -
16	DOUT2-	Digital output2- (programmable)
17	DIN2	Digital input2 (programmable)
18	DIN1	Digital input1 (programmable)
19	ATEXREF	input signal differential analogical programmable ATEXREF, positive.
20	-	-
21	+VPOT	+10V supply for external potentiometer
22	-VPOT	-10V supply for external potentiometer
23	0V24V	24Vdc reference, digital input ground
24	DIN5	Digital input2 (programmable)
25	DIN3	Digital input2 (programmable)
26	DIN4	Digital input2 (programmable)



CN2: FEEDBACK

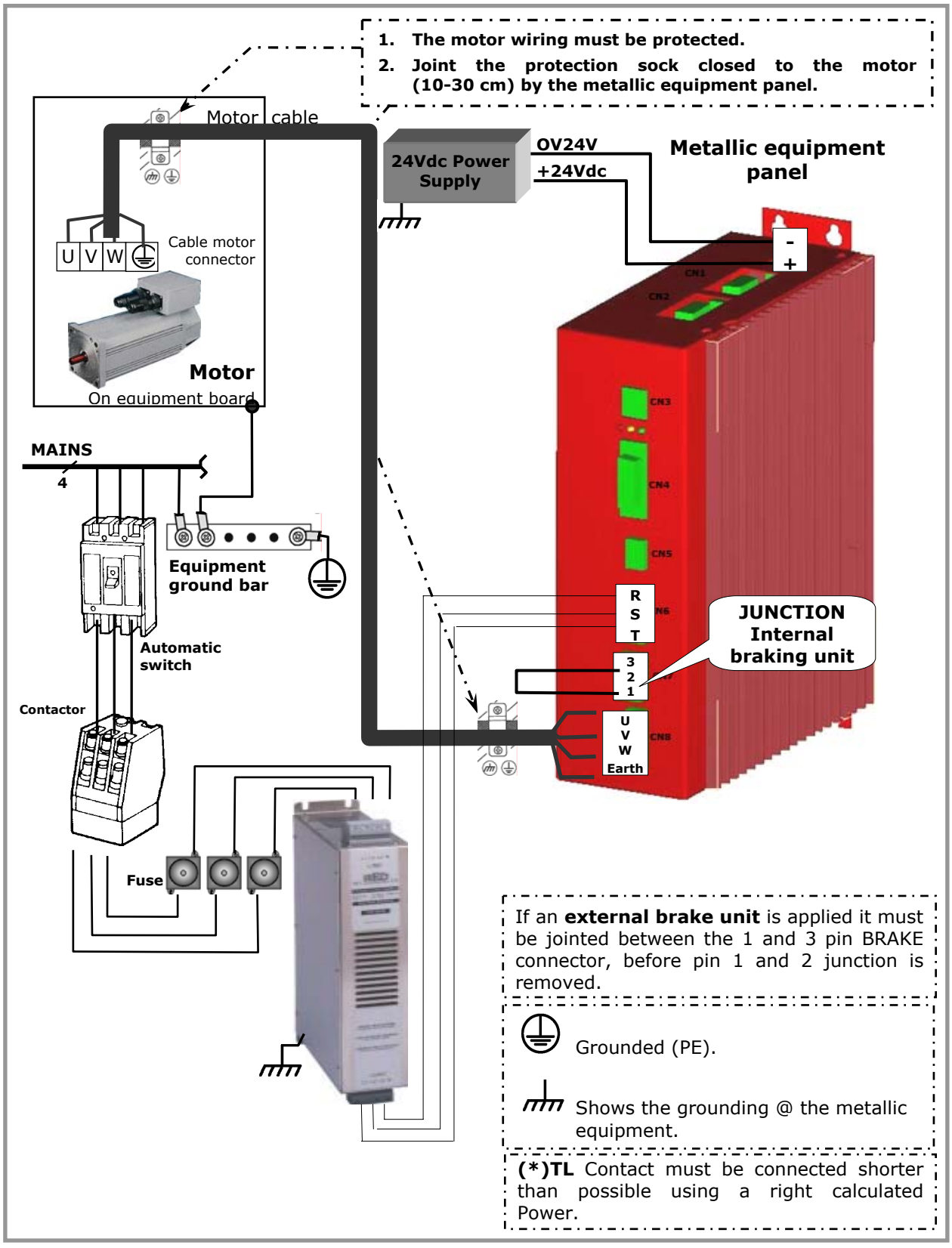


Pin	ENCODER		RESOLVER	
	Name	Signal Description	Name	Signal Description
1	+VENC	Encoder Supply	- -	Reserved signal
2	A	Phase A Encoder	SEN	Sine signal
3	A\	Phase A\ Encoder	REFSEN	Sine signal Reference
4	B	Phase B Encoder	COS	Cosine signal
5	B\	Phase B\ Encoder	REFCOS	Cosine signal Reference
6	Z	Encoder Zero	- -	Reserved signal
7	Z\	Encoder Zero\	- -	Reserved signal
8	PTC	Motor thermistor	PTC	Motor thermistor
9	0V	Thermistor referring	0V	Thermistor Reference
10	U	Phase U Encoder	- -	Reserved signal
11	V	Phase V Encoder	- -	Reserved signal
12	W	Phase W Encoder	- -	Reserved signal
13	0VENC	+VENC Referring	- -	Reserved signal
14	- -	Reserved Signal	ECC	ECC Resolver signal
15	--	Reserved Signal	REFECC	ECC Resolver Reference

6.3 POWER LINKS: MOTOR and SUPPLY

This picture shows all the motor & drive links available.

Picture 6.2 SKYD power wire connections.



The protection made by press-cable is better if made on the conductors closed to the drive filter.



WARNING: MOTOR WIRE

The motor wire must be protected.

Link the cable by press-cable nearly to the metallic equipment surface (10-30 cm are sufficient).



WARNING: LINE FILTER

The Filter unit must be linked nearly to the drive. Don't stand input and out cables on parallel.

The SKYD and Filter unit cable length must be shorter than 30 cm. If not protected cables must be used. In this case the protection must be done grounding @360° to all the cable points.

6.3.1 SUPPLY CIRCUIT: External fuse and switches

A protection gate between the net and the drive is always recommended; for this goal late fuses and switches can be used.

Fuses

Avoid switch on current peaks the fuses used must be on "late type".

To get superior warranties Extra-Fast fuses.

If many drives are linked to a common secondary wind three fuses per drive are necessary.
Avoid switch on current peaks the fuses used must be on "late type".

Switches

Avoid not regular d.c. adsorbing values use differential switches on d.c. dispersion or universal.

For a correct switch size calculation is necessary to care about the internal RFI filter capacitors.

Drive	Fuse	Note
SD -A- 02	4 A	-
SD -A- 04	8 A	-
SD - B/C - 07	14 A	-

6.3.2 LINE FILTER

PWM 20KHz power signal switching is the drive standard value.
Referring to the international rules it is a disturbs generator. PWM 20KHz are switched by the SKYD. Referring to the EMC norms the drive is considerate a disturbs generator. To respect the EMC values fixed a filter unit must be applied. The filter must be placed on the main supply line, before the drive (see picture 6.2).

Filter unit mission is to ground the bad frequency. These units can drive leakage currents (mA values). To put on safety link the connector before the drive is switch on. A wrong link invalids the filter action.
Leakage current values must be considered while the drive adjustment are made.



WARNING: LINE FILTER

The filter must be calculated according to the rated current drive.

For multi-ax systems a single filter unit is suggested. Put it before the drive supply.

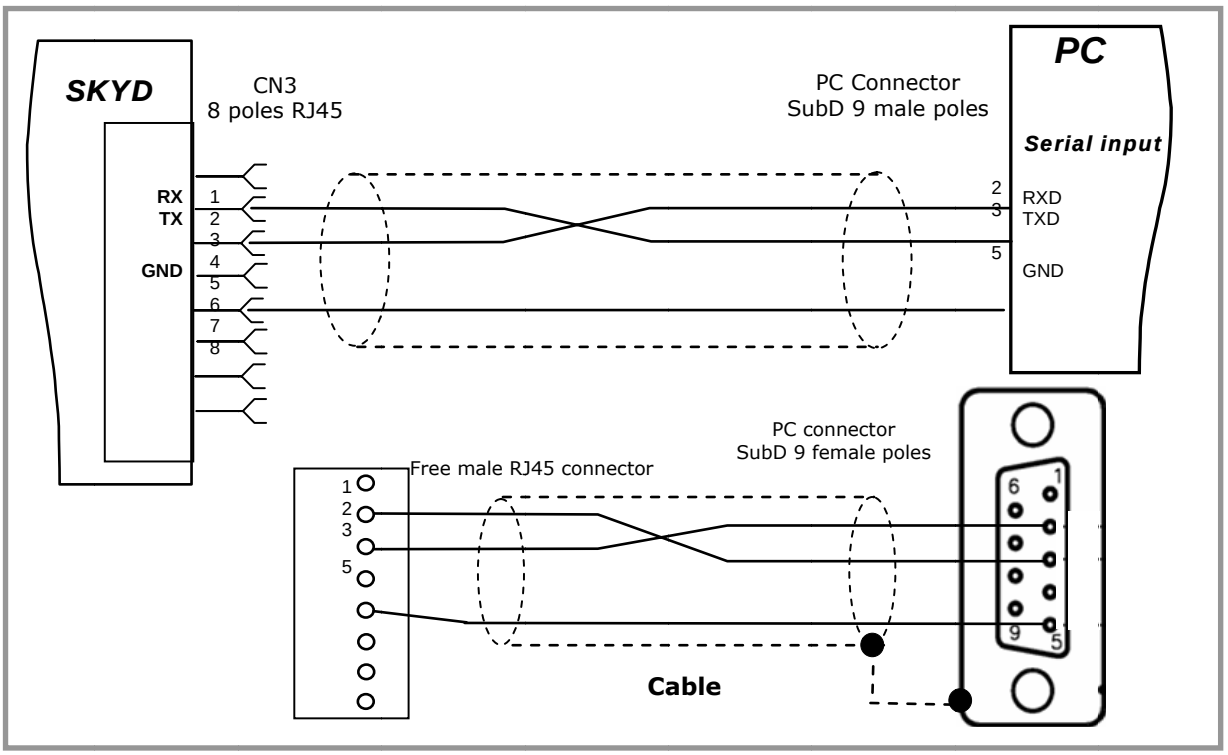
In this case the filter calculation must care about all the current added.

6.4 CN3 CONNECTOR LINK: RS232 LINE

The automatic drive set up is made through the RS232 interface communication.
All the parameters can be modified by the "Motion Control" software (set up, positioning, running and others main parameters).
This software must be installed on a PC supporting systems as. Windows 98 - Windows 2000 - Windows XP - Windows NT, see capther 7.

Link the serial interface (CN3) drive interface to the PC interface with an own transmission cable (see the following connections).

Picture 6.3 Connector Links CN3, RS232 LINE.



WARNING: SERIAL CABLE

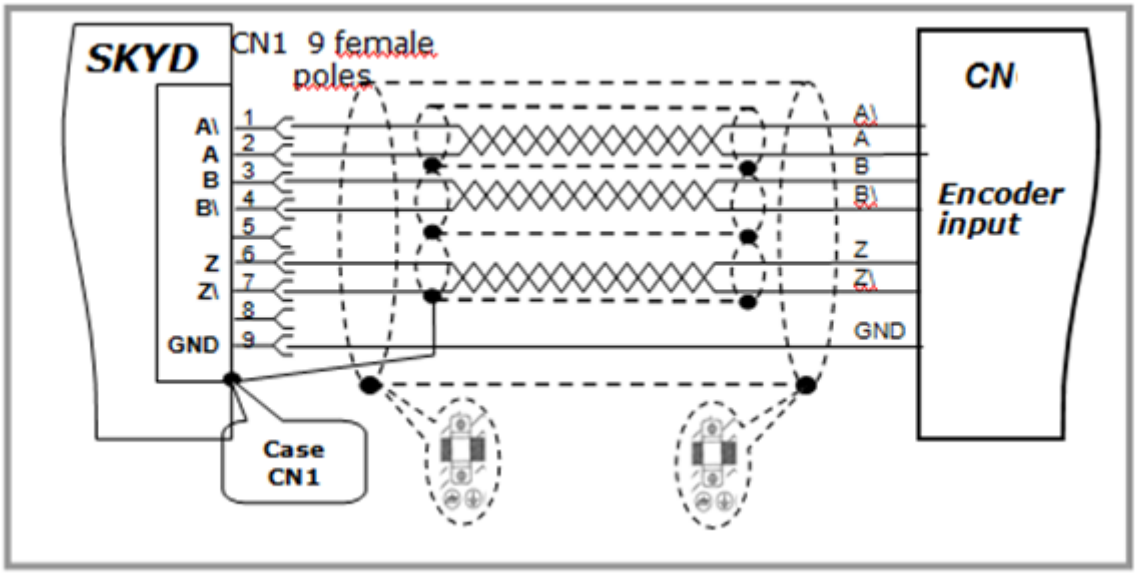
- **The Serial cable must be protected and its length must be 5mt maximum.**
- **Serial cable connected without supply voltage only.**
- **Transmission cable can be supplied on demand (optional).**

6.5 CN1 CONNECTOR LINK: REPLIED ENCODER

REPLIED ENCODER CONNECTIONS

If CN1 is linked to a PLC or CNC device by replied encoder feedback the connections to be used are the following picture.

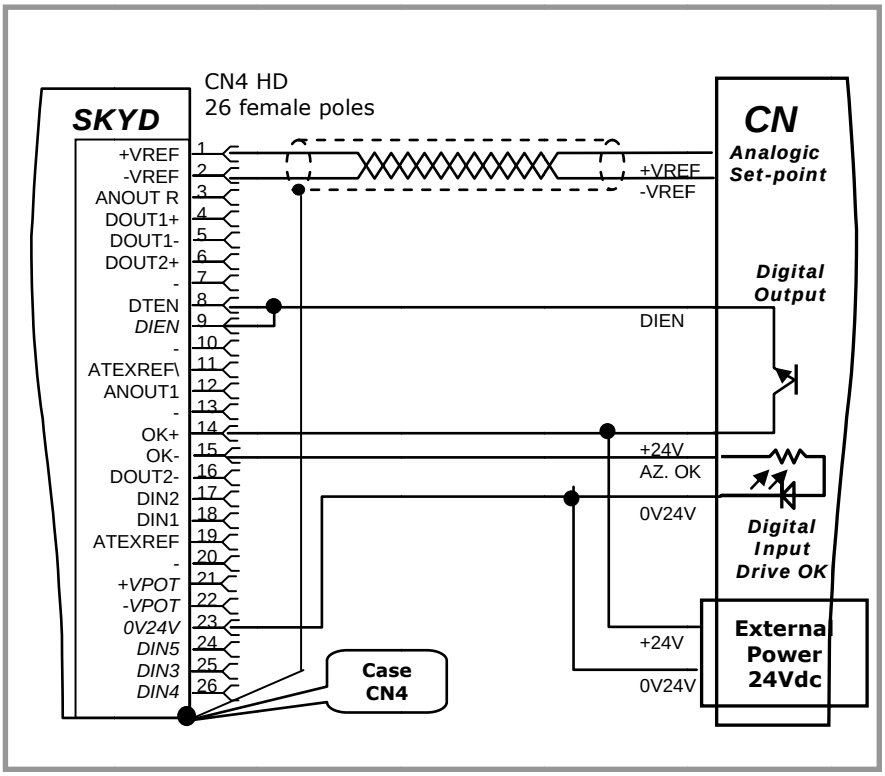
Picture 6.4 CN1 connector connections: REPLIED ENCODER.



6.6 CN4 CONNECTOR LINK: SIGNAL

CN4 possible connections are shown in the following picture.

Picture 6.5 CN4 connector connections.



WARNING
Option connections as

- **Analogue Output (ANOUT1);**

must be referred to the own chapter (Applications).

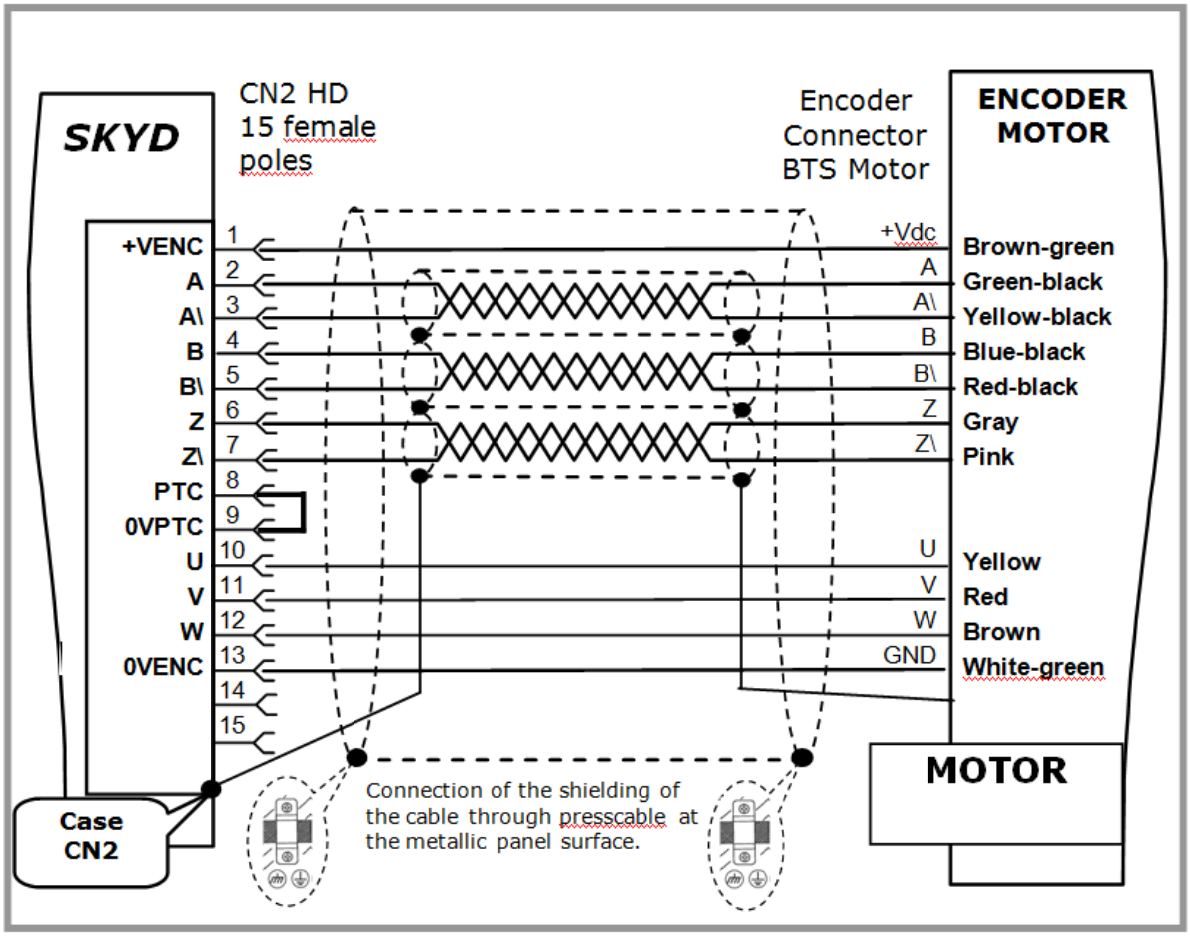
6.7 CN2 CONNECTOR LINK: ENCODER FEEDBACK SIGNALS

CN2 connector (15 poles) contains the motor feedback signals.
The cable used must be protected with a minimum section:

- 0,25 mm² for distance of 20 mt.
- 0,35 mm² for superior distance of 20 mt.

Sock and other wires must be connected as in the following picture.

a) Picture 6.6 Links connector CN2: Motor AKIM with encoder with commutation phases FNCC 40H 865P2500 5V-R1



WARNING: ENCODER CABLE

- **Encoder cable protected only. It must be linked at the metallic equipment panel surface; the doubles differential signals A and A\, B and B\, Z and Z\ must be linked with the 13 connector pin protection.**

6.8 BRAKING MODULE

In case of fast decelerations, high inertial charges the brushless motors are generators. The drives save the energy get back from the motors as d.c. current.
Avoid dangerous voltage by DC BUS increases is necessary to use a braking module.
The energy saved is dissipated on the braking unit as hot.

Basically SKYD is equipped with an internal brake unit (**100Ω, 100W**). The module is operative linking the BRAKE connector 2 and 3 Pin.
If the internal resistor is not sufficient is possible to add an external braking module.

In case of external unit used (on demand) disconnect the mentioned above link.
On the contrary link the BRAKE connector 1 and 2 Pin.

The rated clamp value must correspond to the medium dissipated energy during the deceleration.
The calculation formula to be used is the following:

$$\mathbf{P = 0.2 * J t * \cdot \omega^2 * f}$$

Where:

P = Dissipated Power [Watt] .

J t = Total Inertia [Kg m^2] .

ω = Max angular speed [rad / sec] .

f = Work cycle repetition frequency (Hertz, Nr. of cycles per sec.) .

7. PROGRAM AND PARAMETERS

SKYD drive are set by standard program and parameters.
Many applications can be satisfied with the standard configuration.

An accurate and good quality modulation of these parameters can obtain better performance in all the applications.

Read carefully the following parameters description.

The correct SKYD use is obtained after a complete parameters set up. The following table shows how all the parameters and values have to be setted, configuration default is included.

Table 7.1 SKYD Parameters.

Main Parameters		*Min Value*	*Max Value*	*Default Value*
GPS	Speed-loop proportional gain	0	255	0
GIS	Speed-loop integral gain	0	255	128
Offset	Offset on the speed set-point	0	255	128
adj Speed	Adjust Speed	0	255	128
Speed Nom	Motor rated speed	0	255	153
Ft speed	Input set point filter	0	255	128
Acc. Ramp.	Acceleration maximum Ramp	0	5000	0
Dec. Ramp.	Deceleration maximum Ramp	0	5000	0
Em. Ramp.	Emergency Maximum Ramp	0	5000	0
Tsc	Torque control in continuous service	0	255	255
Tp	Peak torque control	0	255	255
I2t	Derating factor function	50	12750	5000
Set Point	Reference type	0	4	0
Direction	Motor rotation direction	0	1	0
MOTOR	Motor selection	0	20	-
Control	Loop motor control	0	1	0
Feedback	Type of transducer of position used	0	1	1
Encoder Resolution	Number of Encoder channels	0	5	0

Encoder emulated	Encoder Emulated partition	0	4	0
RegisterX	Register	0	6000	0

The parameters value are between 0 and 255. All the sets can be saved on RAM, EEPROM or others file. The files can be used for other applications in a second time.

7.1 PARAMETERS MENU and DESCRIPTION

This charter describes a description of the SkyD parameters, their means and the range of value they can have. Those parameters are divided in different pages: User Parameters, Advanced Parameters, Manager Register.

User Parameters

a) GPS
Sets the speed loop proportional gain. It's a direct inertia function. Having a perfect speed motor control this value must be set.

b) GIS
Sets the speed loop integral gain.

c) Offset
Sets the offset on the speed set-point. With a value of 128 there is no offset adjust.

d) adj Speed
Sets the maximum speed ±12,5%

e) Speed Nom
Sets the rated speed motor.
Speed Nom = 153 → 3000 rpm
Speed Nom = 255 → 5000 rpm

f) Ft speed
Sets the input set point filter. The value represents the filter frequency ,ex.: if Speed Filter =255 , frequency of the cut is 400Hz.

g) Acc. Ramp.
Sets the acceleration ramp based on a speed ref. step.

h) Dec. Ramp.
Sets the deceleration ramp based on a speed ref. step.

i) Em. Ramp.
Sets an Emergency Maximum Ramp on a speed ref. step.

j) Tsc
Sets the motor torque on continuous duty.
By Tsc=255 rated motor torque is available on Δθavv=65°.

By Tsc<255 motor torque is decreased. In case of hot/dangerous environments this derating mode is suggested.

k) Tp

Sets the motor peak torque.
By Tp=225 standard peak is available.

l) I2t

This parameter sets up the derate factor.
I2T function increase the rated current value in a defined cycle. It depends to the motor driven.
The value represents the time (in ms) for which is possible to give the peak torque before it gets declassed to nominal to prevent the motor.

m) Set point

Individualizes the reference used.
Set point = 0: Reference of analogical speed range [10V,10V]
Set point = 1: Internal setpoint to motor test
Set point = 2: Reserved
Set point = 3: Reference of speed by registers
Set point = 4: Reference of analogical speed range [0V,10V]

n) Direction

Shows the rotation verse.
CW is on direction=0 for default, hourly rotation of the motor with positive signal.

Advanced parameter

o) MOTOR

This parameter selects the motor drive (View 4.1.2 Motor Table)
This parameter is on default depending on the joining drive-motor.

p) Control

Sets the loop mode.
Control = 0 on default, speed control
Control = 1 current loop

q) Feedback

Sets the transducer of position.
Feedback = 0 : Encoder Less Wiring
Feedback = 1 : Encoder Standard

r) Encoder Resolution

Sets the encoder resolution. This parameter is used to select the number of encoder pulse of the Motor:

Encoder Resolution =0	1024 channels
Encoder Resolution =1	2048 channels
Encoder Resolution =2	4096 channels
Encoder Resolution =3	1000 channels
Encoder Resolution =4	2000 channels

Encoder Resolution =5 2500 channels

s) Encoder emulated

This parameter is used to reduce the number of emulated encoder pulse of the CN1 output, which is used as input in the PLC, CNC, ...Since the number of pulses of the encoder installed on the motor may be excessive, its value can be divided by modifying the parameter "Encoder emulated" according to the table below:

Encoder Emulato = 0 no division
Encoder Emulato = 1 division by 2
Encoder Emulato = 2 division by 4
Encoder Emulato = 3 division by 8
Encoder Emulato = 4 division by 16

Manager register

t) RegisterX

List of the usable registers to plan references of speed selected through digital entries.
Represents the value of speed of reference in rpm.

7.2 MOTOR CONTROL SOFTWARE

The "Motor Control" is the set up program standard supplied with the drive. The minimum PC features required are Windows 98/2000/NT/XP.

The software operates through the RS232 drive port (CN3 connector).

7.2.1 MOTOR CONTROL INSTALLATION

Hardware Requires
The Drive serial interface (CN3, RS232) must be linked by the serial cable (**standard supplied**).

Minimum PC features required

Processor:	Pentium II o or more.
Operative system:	WINDOWS 98 /2000 / ME/XP , WINDOWS NT4.0.
Graphic board :	Colours and Windows compatible
Drive :	CD-ROM (for software and the operative system).
Hard Disk:	5 Mb free as minimum.
Memory flash :	8Mb free as minimum.
Interface:	COM1, COM2, COM3 o COM4 serial free.

Link to the PC serial interface
Link to the PC serial interface connect the cable of transmission from one serial inteface to the serial interface RS 232 (CN3) of the SKYD.
Extract and plug-in the alimentation cable only if the power supply are not connected (driver and PC)

Installation instruction on WINDOWS 98/ 2000/ ME/ XP/ NT/7

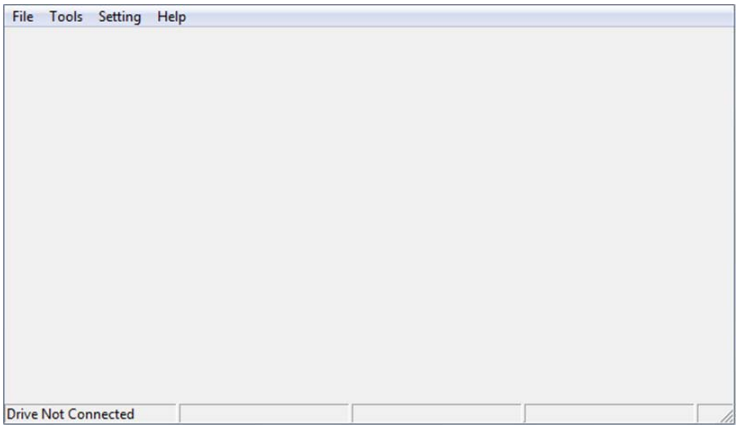
1. Run the installation program: MotorControl.msi
2. Follow on-screen instructions to complete the set-up
3. At the end of setup in "Programs" there is a program "Motor Control"
4. Create a link on desktop to run the program "Motor Control"
5. Execute the dedicated software with a double click the desktop icon "MOTOR CONTROL" (see picture below).



7.2.2 MOTOR CONTROL USING

The Motor Control software permits a typical file management by the "File" and "Setting" menu for set-up and viewing.
See the following pictures.

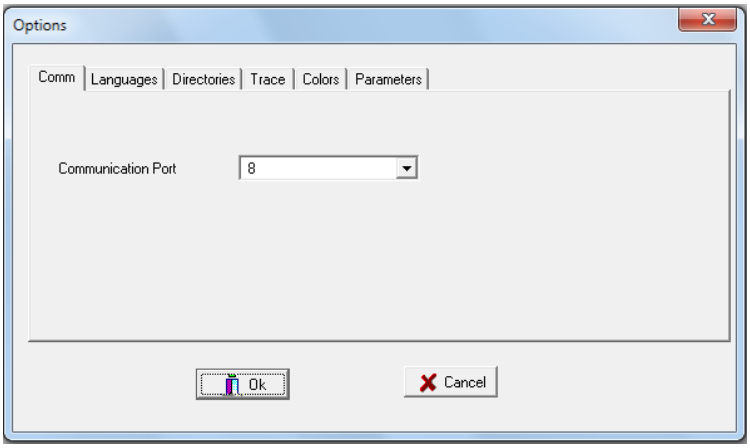
Picture 7.1 Motor Control Main Menu.



By the Setting menu is possible to set the program, the communication PC port, the language and the grid colours.

Picture 7.2 Setting Option sub folder menu.

.



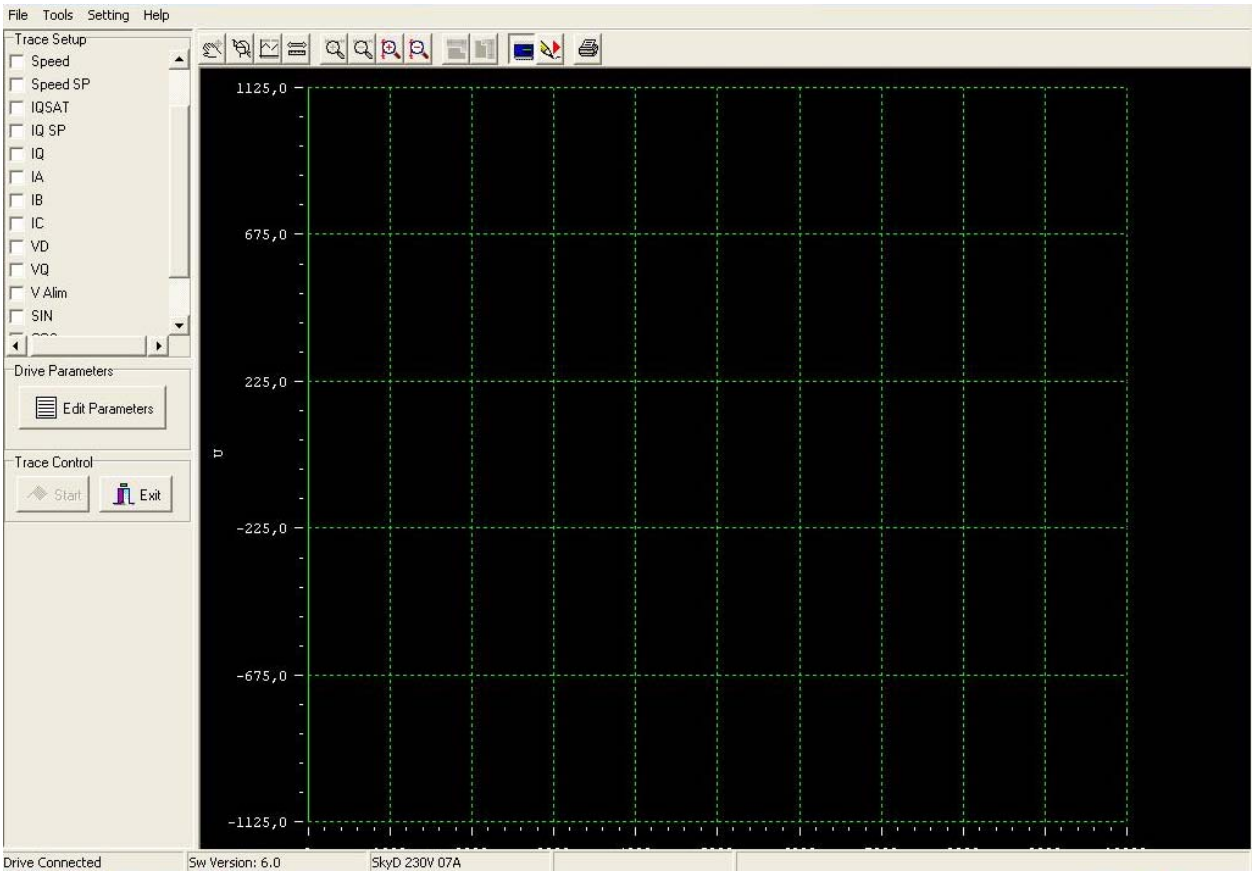


By the "Tools" menu is possible to set up the drive (Parameter Programming).

Is also available the Trace value viewer.

By the following Trace menu is possibile to analyze all the main values motor/drive system. A graphic grid is also viewed by the same system. For a real time modify view the graphic mode has the oscilloscope simulation function.

Picture 7.2 Tool subfolder: Trace.



8. DIAGNOSTIC

On the driver frontal are expected two leds to view the working progress and discovers and identifies the SKYD alarm.

The **READY** indicator (green led)

- turns on when the logical section is alimented.

The **FAULT** indicator (red led)

- **Fixed On:** the drive is not in alarm and the axis is free.
- **High frequency flash**: the drive is not in alarm and the axis is in torque.
- **Low frequency flash**: the drive is in an alarm situation. The number of flashes identifies the alarm code. For the code of the errors refer to table 8.1.

8.1 ALARMS

The intermittence shows the alarm code.

The following table contents the alarms and the nr. of intermittences.

Table 8.1 SKYD alarms code.

Red led flash	**ALARM**	DESCRIPTION
Nr. 01	OVERVOLTAGE	Tension on the Bus in C.C. above the allowed limit.
Nr. 02	UNDERVOLTAGE	Tension on the Bus in C.C. too low.
Nr. 03	OVERCURRENT	Required current to the drive, too high.
Nr 04	ENCODER FAULT	Alarm of the position sensor.
Nr. 05	HEATSINK OVERTEMP	High heat sink temperature.
Nr. 06	MOTOR OVERTEMP	High motor temperature.
Nr. 07	IGBT FAULT	Excessive current or short circuit on the three phases and ground, over temperature or under voltage in the power stage.
Nr. 15	MOTOR OUT OF CONTROL	Motor out of control

For a complete and correct alarm explanation please refer to the “trouble” chapter.

8.2 TROUBLES

The following chapter cares about the SKYD generated alarms and the solutions available.

Table 8.2 SKYD alarms code and possible solutions.

Alarm code	Description	Possible solutions to stop the alarm
Nr 01: OVERVOLTAGE	Too high DC-Bus voltage admitted.	• Too high voltage supply. • High inertia load and braking resistor wrong calculated. • Braking resistor on fault or not linked. Werify the internal link.
Nr 02: UNDERVOLTAGE	DC-Bus too low supply.	• Too low supply voltage. • No supply.
Nr 03: OVERCURRENT	Too high drive current required.	• Fast acceleration with high load inertia. • Fast braking with high load inertia. • Verify the motor selected is the motor really used.
Nr 04 : ENCODER FAULT	Feedback Alarm.	• Verify the right mounting and links.
Nr 05: HEATSINK OVERTEMP	High heat sink temperature.	• Environment temps. Higher than the admitted rated value. • Insufficient cooling. • Hard duty cycle.
Nr 06: MOTOR OVERTEMP	High motor temperature.	• Verify the motor link is right. • Too high motor load. • Hard duty cycle.
Nr 07: IGBT FAULT	High current or U-V-W phases; short circuit; power component under-voltage.	• Verify the motor link is right. • Verify if short circuits are occurred.
Nr 15 : MOTOR OUT OF CONTROL	Motor movement not congruent with command	• Verify the position sensor connections.

Table 8.3 SKYD faults and possible solutions.

Fault	Possible causes	Possible solutions to eliminate the fault
A) **Bad communication**	**A.1)** Wrong cable. **A.2)** Error link. **A.3)** Wrong PC interface.	**A.1)** Use a NON null modem cable. **A.2)** Connect on the right port. **A.3)** Select the right interface.
B) **GREEN LED OFF**	**B.1)** The logic isn't powered.	**B.1)** 24VDC AUX connector must be supplied.

Hereafter few possible fault caused by the drive. Possible solutions are included too.

Table 8.4 Motor fault and possible solutions.

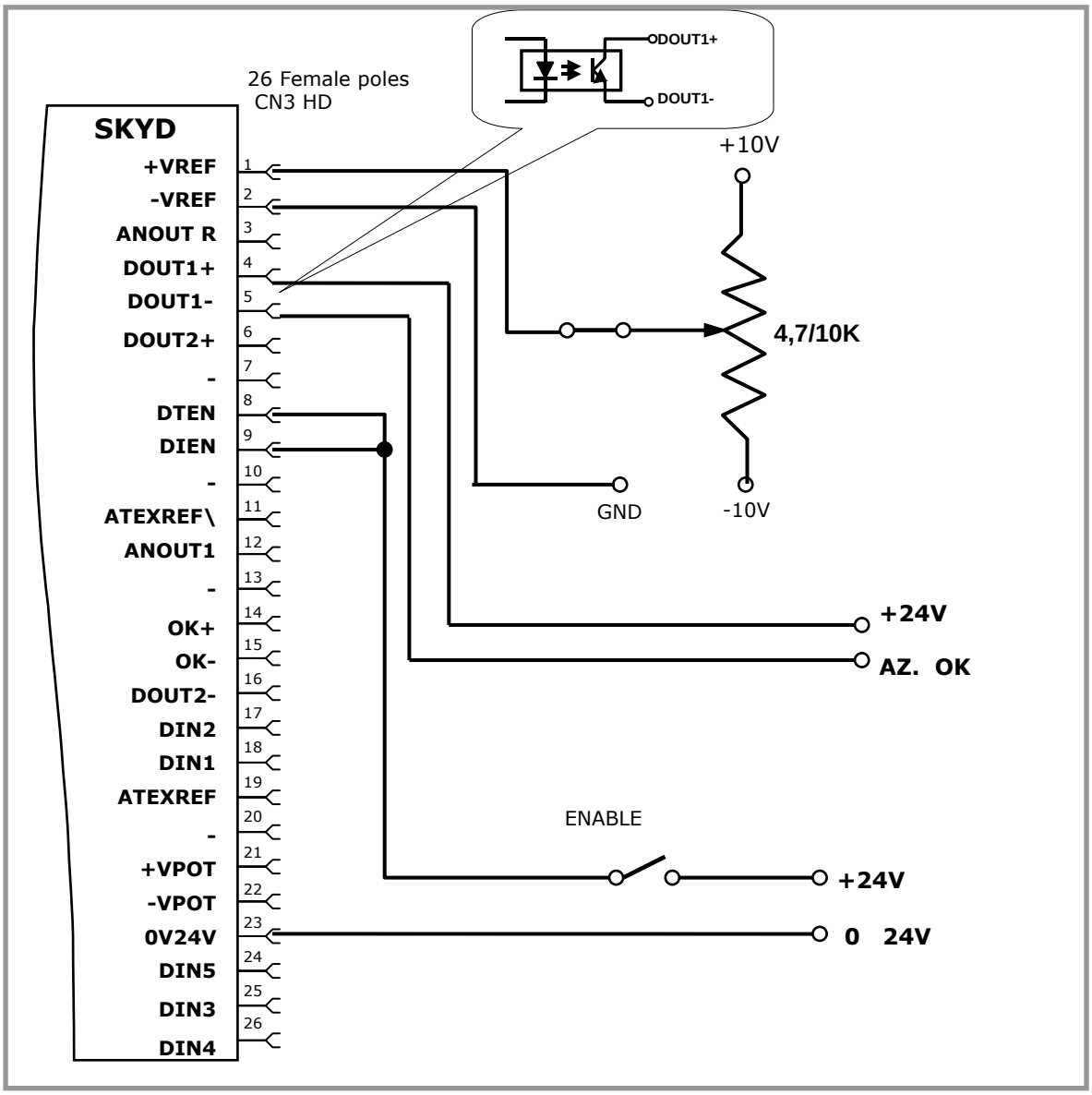
Fault motor	Trouble	Solutions
A) The motor runs on step mode or vibrates	**A.1)** Bad link. **A.2)** Set-Point wrong value.	**A.1)** Be sure the resolver/motor links are accorded to the instructions showed on chapt. 6. Protection cables included. **A.2)** Verify and/or modify the set-up value.
B) The motor remains "on torque mode" and doesn't follow the speed analogical ref.	**B.1)** No enable. **B.2)** Set-Point.	**B.1)** DIEN enabled signal must be verified. **B.2)** Verify +/-VREF of **CN4** set point is in.
C) Analogical speed ref. not well followed	**C.1)** CN4 connection port.	**C.1)** Verify 0V signal and the set point speed ref. (**CN4** pin 1 and 2).
D) Not fix rotor position on motor looked mode.	**D.1)** Feedback. **D.2)** Wrong links.	**D.1)** Encoder fault. **D.2)** Be sure the Encoder/Motor links are accorded to the instructions showed on chapt. 5.2. Protection cables included.
E) The motor doesn't perform	**E.1)** Electromagnetic disturbs. **E.2)** Setup. **E.3)** Wrong link.	**E.1** External disturbs can be present closet to the cables (ex: relè, switching, powers and so on). **E.2** Verify and/or modify the I^2T parameter. **E.3** Verify the power and signal cables are rightly speared.

9. APPLICATIONS

9.1 DRIVE USING ON MANUAL MODE APPLICATION

ENABLE SIGNAL LINK

Picture 9.1 CN4 Links on manual mode using.



9.2 NUMERICAL CONTROL and DIFFERENTIAL REFEREMENT APPLICATION

Picture 9.2 CN4 links on numerical control and differentila referement application.

