

Digital DRIVE for Brushless motor IMD 40 Series

INSTALLATION GUIDE

Read manual before installing and respect
all indications with this icon:



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1- Introduction

1-1- Warning



Read this manual before first installing, nonobservance may result in property damages and in personal injuries.

Only suitable qualified personnel should undertake the mounting, installation, operation and maintenance of the equipment must be complied with the general setup and safety regulations for work on power installations (e.g. DIN, VDE, EN, IEC or other national and international regulations).

It is important that all safety instructions are strictly followed. Personal injury can result from a poor understanding of the safety requirements.

The following safety regulations should be followed:

• VDE 0100	Specification for the installation of power systems up to 1000 V
• VDE 0113	Electrical equipment of machines
• VDE 0160	Equipment for power systems containing electronic components.

- *Never open the equipment.*
- *Dangerous high voltages exist within the equipment and on the connectors. Because of this, before removing any of the connectors, it is necessary to remove the power and wait at least 5 minutes to allow the capacitors to discharge.*
- *Never connect or disconnect the drive with power applied.*
- *Some of the drive's surfaces can be very hot.*

Some of the drive's components are susceptible to damage from electrostatic discharges. Always handle the equipment using appropriate anti-static precautions.

We have gone to great lengths to ensure this documentation is correct and complete. However, since it is not possible to produce an absolutely error-free text. No responsibility will be assumed by SERAD for all damages caused by using this documentation and software.

We reserve the right to make changes to all or part of the specification without prior notice.

1-2- IMD series drive description

Supply :	230V to 480V AC $\pm 10\%$ three phase
Auxiliary supply :	24 V DC $\pm 10\%$, 0.5A typical (0,8A max if all options)
Supply filter :	Integral
Switching frequency :	6.67 kHz sine-wave PWM
DC bus voltage :	310V to 680V
Braking resistance :	External resistor : Min value Max. cont. power Imp power 18 Ω 15K Ω 31K Ω
Protection :	Short circuit between phases, phase to earth, over current, I _{2t} Over voltage, under voltage Motor feedback fault
Motor feedback :	Resolver SinCos encoder Hiperface ^(option)
Master encoder :	Incremental encogger Absolute encoder SSI SinCos encoder Hiperface ^(option) Virtual
Encoder emulation :	Incremental : A, /A, B, /B, Z, /Z 1 to 100 000 points per rev
Diagnostic :	STATUS display
Communication :	RS 232 MODBUS RTU RS 422 ^(option) , RS 485 MODBUS RTU ^(option) EtherCAT ^(option) CANopen ^(option)
Digital inputs :	4 inputs (with 2 fast inputs I3 and I4) 12 additional inputs with expansion module (with 2 fast inputs I15 and I16) Type: PNP, 24V DC, 8mA per input and 15 per fast input Logic 0: Between 0 and 5 V Logic 1: Between 8 and 30 V
Digital outputs :	2 outputs as standard S1 : Relay, 48V dc / 48V ac, 3A max S2 : NPN (open collector) 24V dc, 100mA 8 additional outputs with expansion module Type : PNP 24V dc, 500mA max per output Protected against short circuit and over temperature.
Analogue inputs :	2 inputs : Input voltage : ± 10 V Maximum voltage : ± 12 V Input impedance : 20 Kohms Resolution : 16 bits for input 1 and 12 bits for input 2
Analogue output :	1 output : Output voltage : ± 10 V Maximum current : 5 mA Resolution : 8 bits, bandwidth 20Hz
Architecture :	Processor :150 MHz DSP and 100 000 gates FPGA FLASH memory for programs and parameters

	RAM memory for data FRAM memory for variables Real-time, multi-tasking kernel
Control loops :	Current loop : 75 μ s Speed loop : 150 μ s Position loop : 150 μ s
Operating modes :	Torque mode Speed mode Position mode Stepper Mode (pulse input, direction) Motion functions (absolute, relative and infinite movements, S profile) Advanced motion functions (gearbox, CAM profiles, CAMBOX functions, triggered movement)
Operating temperature :	0 to 40°C
Storage temperature :	-10 to 70°C
Degree of protection :	IP 20
Weight	14,5 Kg

Drive	Rated current	Peak current (2s)	Rated power	Dimensions w x h x d
IMD / 40	40 Aeff	80 Aeff	22 kVA	188 x 410 x 284

2- Installation

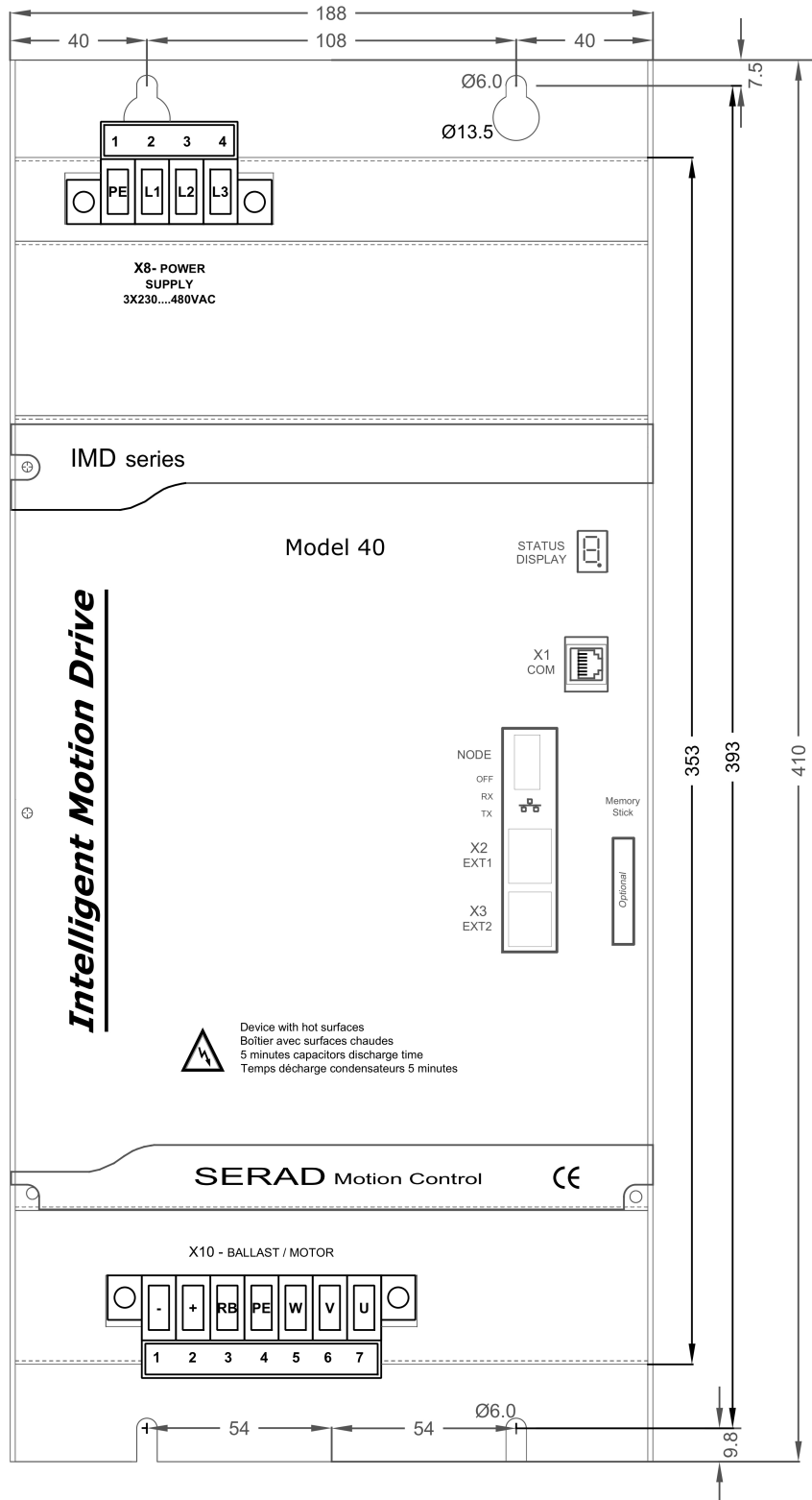
2-1- General



It is very important to adhere to the following:

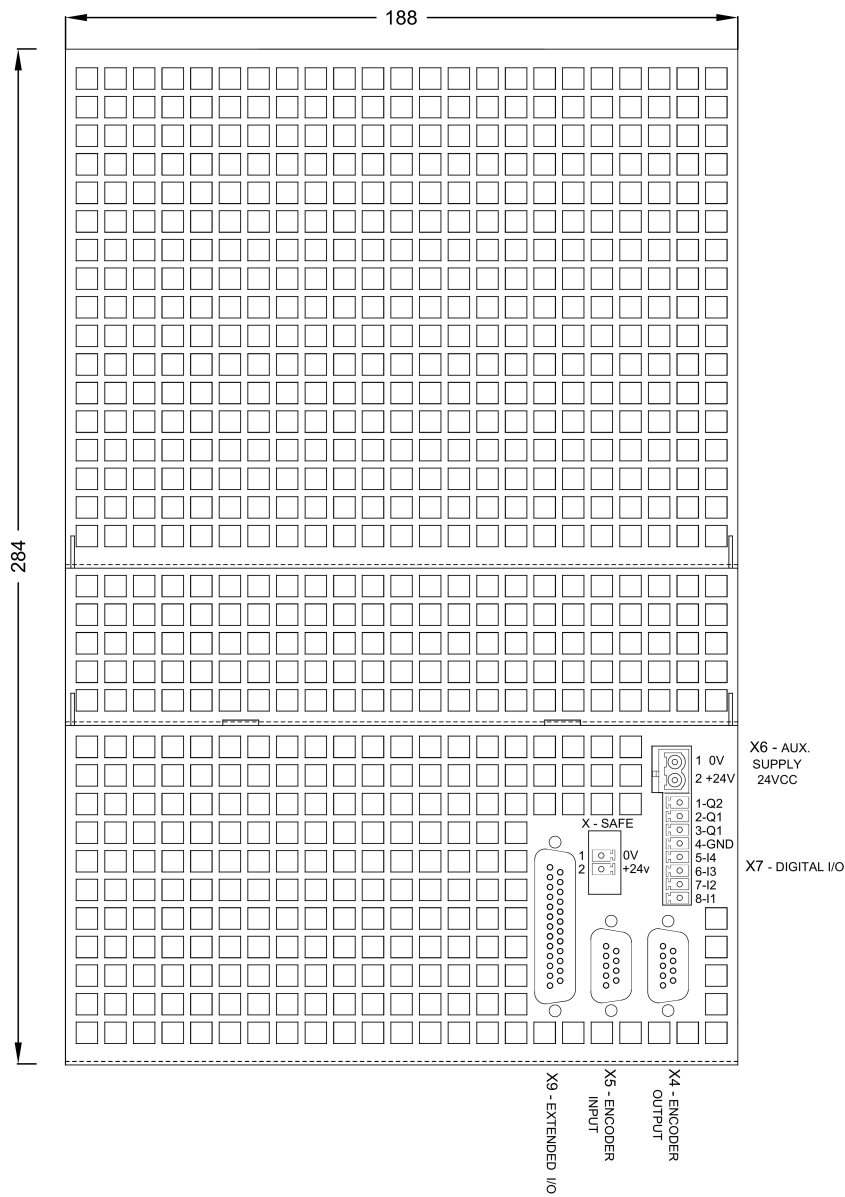
- ↳ A badly earthed connection can damage electronic drive components.
- ↳ The drive must be installed vertically in free air to ensure cooling by natural convection.
- ↳ It must be protected from excess humidity, liquids, and dirt.
- ↳ The motor, resolver and encoder cables must be screened, the screen being earthed at both ends of the cable.
- ↳ The analogue I/O must use screened cable, the screen being earthed at one end only.
- ↳ The cable for the RS 232 serial link between the drive and the PC must be screened, the screen being earthed at both ends of the cable. It should be disconnected from the drive when no longer in use. All of these cables, as well as the I/O cables, should be run separately from the power cables.
- ↳ Diodes must be fitted across the loads on all static digital outputs (Q2 to Q10). These diodes must be positioned as close to the load as possible. The supply and signal cables must be free from over-voltage transients.
- ↳ Safety standards specify a manual reset after a stop caused either by a supply interruption, or by an emergency stop or by a drive fault.
- ↳ For all serious faults, it is obligatory to remove the high voltage supply to the drive.
- ↳ The Drive Ready output should be connected in series in the emergency stop loop.
- ↳ In the case of axis over-travel, the over-travel limit switches must be connected to the limit inputs or in series with the emergency stop loop. It is also recommended to use the software limits.
- ↳ If the drive is configured in speed loop, the drive enable input should be controlled by the supervisory controller (CNC, PLC etc).
- ↳ If the drive is configured in position loop, the parameter "Maximum following error" should be set appropriately.
- ↳ If the drive contains an application program developed using iDPL, connect a signal 'Cabinet supplies OK' to one of the digital inputs and monitor it in a non-blocking safety task. On detection of an excess following error the drive will be put in open loop mode and the drive ready relay will be opened. If another action is required you should use the SECURITY instruction.

2-2- Front view



	STATUS	7-segment diagnostic display
X1	COM	RS-232 serial port for communication with a PC
X2	EXT1	Extension: Optional communications ports
X3	EXT2	Extension: Optional communications ports
X8	POWER SUPPLY	Single / Three-phase power supply
X10	RB / MOTOR	External braking resistor and motor supply

2-3- Top view

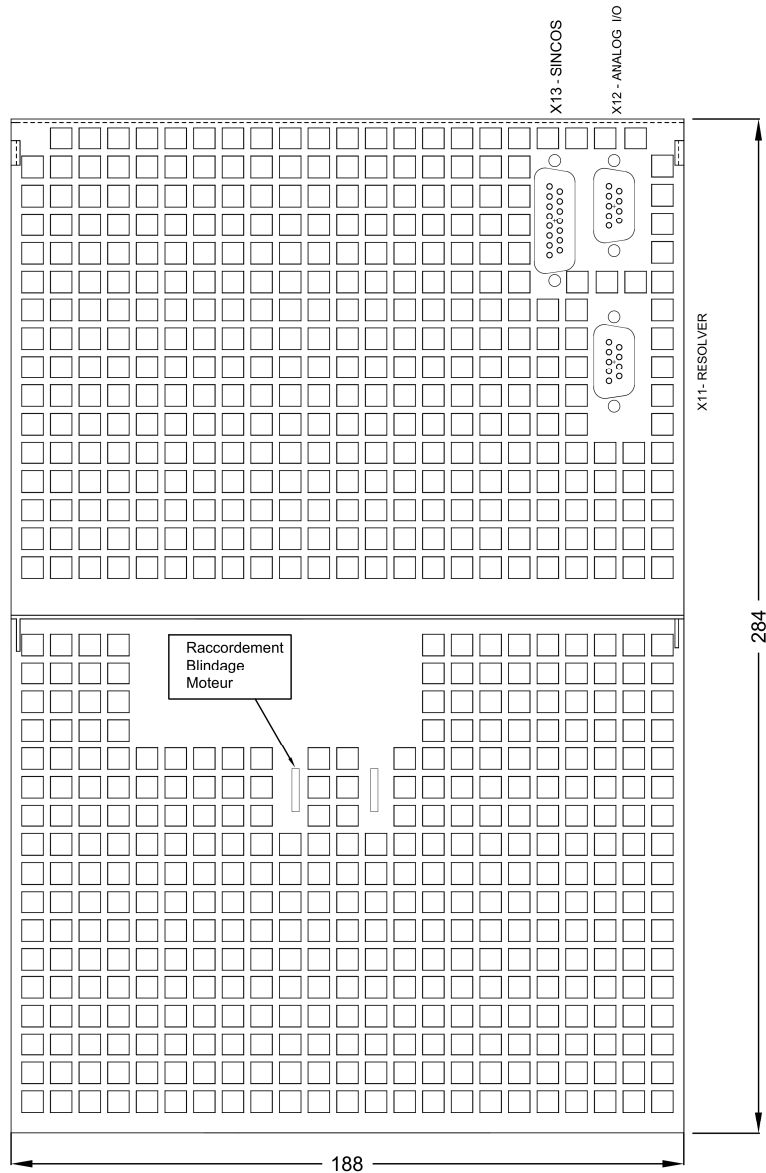


X4	ENCODER	OUTPUT	Multifunction encoder output
X5	ENCODER	INPUT	Multifunction encoder input
X6	24Vdc		Auxiliary 24V DC supply
X7	I/O		Digital I/O
X9	EXT I/O		Option: I/O expansion board
X	SAFE		Option : Safety input



The voltage on connector X8 can reach 480V!

2-4- Bottom view



X11	FEEDBACK	Motor position feedback (resolver / encoder)
X12	ANALOG	Analogues I/O
X 13	SINCOS	Motor position feedbacks (if SINCOS encoder is used)

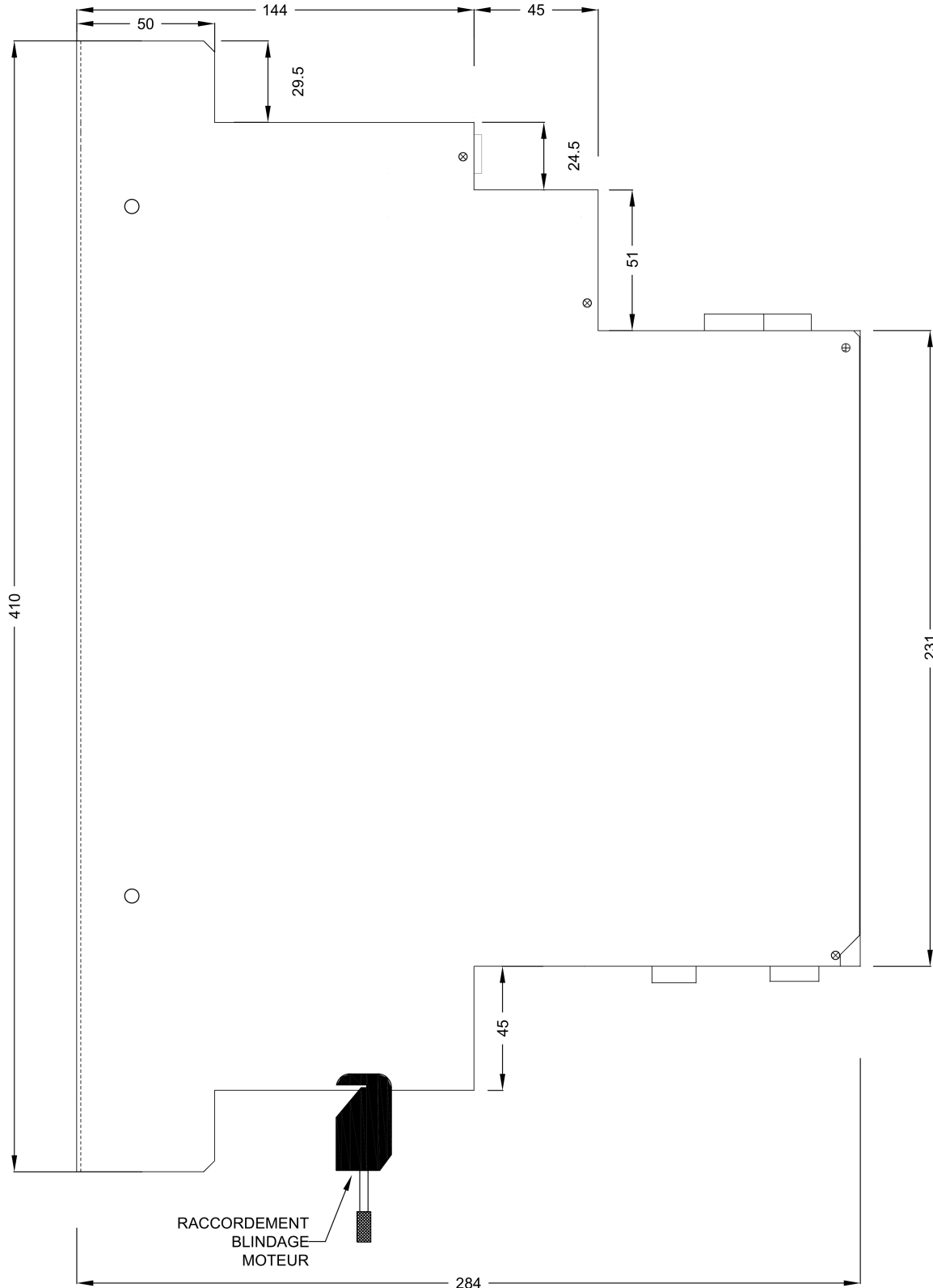


Care must be taken when making connection to connector X10. An incorrect connection can seriously damage the drive. Dangerous voltages are present on X10 (900V).

Wait at least 5 minutes to allow the capacitors to discharge before remove connector.


2-5- Mounting

Several drives can be mounted side-by-side provided that enough space (at least 40 mm) is left to ensure good natural convection. Let a space greater than 90 cm over and under drives to allow for the various connectors and cables to be fitted



2-6- Connector pin assignments

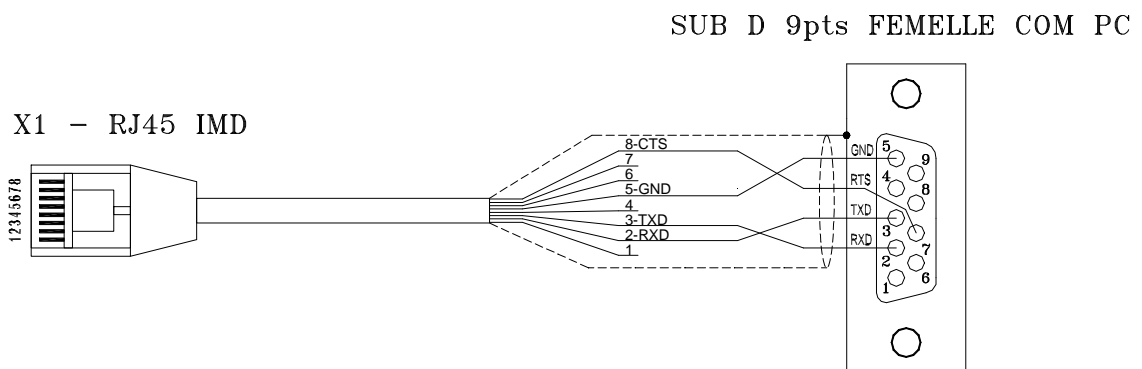
X1: RJ45 serial port for downloading programs and parameters.

N°	Name	Type	Description
1			
2	RXD	Inp	Receive data
3	TXD	Out	Transmit data
4			
5	GND		0V
6			
7			
8	CTS	Inp	Clear to send
	SHIELD		Connect the shield to the shell of the connector


In the iDPL software, the RS232 communication is established when the icon in the bottom left side is in this fixed state :



If the connection is not stable (state icon connected/disconnected), check if the cable and the USB-serial converter are certified by SERAD. Otherwise please contact our technical department.



X2 & X3: Extension: Optional communications port

N°	Module RS 232	Module RS 422	Module RS 485	Module CANopen	Module EtherCAT	Module TCP
1					TD +	TD +
2	RXD	RX+			TD -	TD -
3	TXD	RX-			RD +	RD +
4						
5	GND	GND	GND	GND		
6					RD -	RD -
7		TX-	TRX-	CAN_L		
8		TX+	TRX+	CAN_H		
	Connect the shield to the shell of the connector					

- X2 and X3 are identical and have the same connection. They make easier drive network connection.
- For the TCP module, refer to the documentation [TCP option installation guide](http://www.serad.fr) available on www.serad.fr
- Node Address : For RS422, RS485 and CANopen, the NodeID corresponds to the five firstly dipswitchs + 1

Ex:

Node ID n°	1	2	3	4	5	6	7	8	9	10	...	32
Dip switch												
1	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON		ON
2	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF		ON
3	OFF	OFF	OFF	OFF	ON	ON	ON	ON	OFF	OFF		ON
4	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON		ON
5	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF		ON

For the RS422, RS485 and CANopen module, the terminal resistor is activated by the dip switch n°6 (120 Ω).



In CANopen, do not use the Node ID n° 1 if you have a multi drive project.



RS232 communication allows communication with only 1 device (ex: 1 PLC and 1 IMD drive).

- Node Address : For RS422, RS485 and CANopen, the NodeID corresponds to the six firstly dipswitchs + 1

Ex:


Node ID n°	1	2	3	4	5	6	7	8	9	10	...	64
Dip switch												
1	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON		ON
2	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF		ON
3	OFF	OFF	OFF	OFF	ON	ON	ON	ON	OFF	OFF		ON
4	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON		ON
5	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF		ON
6	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF		ON

X4: Multifunction encoder output:

- Encoder emulation output

The choice of the number of points is made from the iDPL software.

Connector : SUBD 9 way female

N°	Name	Type	Encoder emulation
1	A	Out	Channel A
2	/A	Out	Channel A inverted
3	B	Out	Channel B
4	/B	Out	Channel B inverted
5	Z	Out	Channel Z
6	/Z	Out	Channel Z inverted
7			
8	GND		0V
9			
	SHIELD		Connect the shield to the shell of the connector

NC (Not connected): It is forbidden to connect this pins.


X5: Multifunction encoder input:

- Incremental encoder input
- SSI encoder input
- Stepper input

The choice of the input is made in iDPL software in the Multifunction encoder input windows

5V TTL encoder (0-5V, differential)

Connector : SUBD 9 way male

N°	Name	Type	Incremental encoder	Codeur SSI	Stepper
1	A	Inp	Channel A	Data	Direction
2	/A	Inp	Channel A inverted	/Data	/Direction
3	B	Inp	Channel B	NC	Pulse
4	/B	Inp	Channel B inverted	NC	/Pulse
5	Z	I/O	Zero marker	Clock	NC
6	/Z	I/O	Zero marker inverted	/Clock	NC
7	+5Vdc	Out	Supply for external encoder, 100 mA max.*	NC	NC
8	GND		0V	0V	0V
9		Inp	NC	SSI selection : Connect pins 8 and 9	NC
	SHIELD		Connect the shield to the shell of the connector		

* If the feedback is SINCOS then don't use 5V powersupply (pin 7 of connector X5) but an external powersupply.



NC (Not connected): It is forbidden to connect this pins.

X6: 24V dc supply

Connector: Removable 2 ways, 5.08mm pitch

N°	Name	Type	Description
1	XGND		0V
2	24Vdc	Inp	Control card supply, backup motor position

X7: Digital I/O

Connector: Removable 8 ways, 3.81mm pitch

N°	Name	Type	Description
1	Q2	Out	Output 2, programmable : type NPN, 24 Vdc, 100mA
2	Q1	Out	Output 1, programmable : standard function DRIVE READY
3	Q1		Relay contact, N/O between terminals 2 and 3
4	DGND		0V digital I/O
5	I4	Inp	Input 4, programmable
6	I3	Inp	Input 3, programmable
7	I2	Inp	Input 2, programmable
8	I1	Inp	Input 1, programmable:standard function ENABLE



The output Q2 is NPN open collector: the load must be connected between Q2 and +24V DC.

X8: High voltage supply

Connector: Removable 4 ways, 7.62mm pitch

N°	Name	Type	Description
1	PE		Supply earth
2	L1	Inp	Supply L1 for 400V
3	L2	Inp	Supply L2 for 400V
4	L3	Inp	Supply L3 for 400V



Care must be taken when making connection to connector X8.


Wait at least 5 minutes to allow the capacitors to discharge before remove connector.

The armoured motor cable must arrive directly on the terminals of the drive.

Connect the shield (on drive side) to the srew provided (see Front view of the drive).

X9: Option: Expansion module, 12 inputs / 8 outputs

Connector: SUBD 25 way female

N°	Name	Type	Description
1	I5	Inp	Input 5, programmable
2	I6	Inp	Input 6, programmable
3	I7	Inp	Input 7, programmable
4	I8	Inp	Input 8, programmable
5	I9	Inp	Input 9, programmable
6	I10	Inp	Input 10, programmable
7	IOGND*		0V digital I/O
8	Q3	Out	Output 3, programmable
9	Q4	Out	Output 4, programmable
10	Q5	Out	Output 5, programmable
11	Q6	Out	Output 6, programmable
12	IO 24Vdc**	Inp	External supply, 24 V dc
13	IO 24Vdc**	Inp	External supply, 24 V dc
14	I11	Inp	Input 11, programmable
15	I12	Inp	Input 12, programmable
16	I13	Inp	Input 13, programmable
17	I14	Inp	Input 14, programmable
18	I15	Inp	Input 15, programmable
19	I16	Inp	Input 16, programmable
20	Q7	Out	Output 7, programmable
21	Q8	Out	Output 8, programmable
22	Q9	Out	Output 9, programmable
23	Q10	Out	Output 10, programmable
24	IOGND*		0V digital I/O
25	IOGND*		0V digital I/O
	SHIELD		Connect the shield to the shell of the connector

* Pins 7, 24, 25: internal connection

** Pins 12, 13: internal connection

X10: Motor power

Connector: Removable 7 ways, 7.62mm pitch

N°	Nom	Type	Description
1	DC Bus -	Out	DC Bus -
2	DC Bus +	Out	DC Bus + / External brake resistor *
3	RB		External brake resistor *
4	PE		Motor earth
5	W	Out	Motor phase W
6	V	Out	Motor phase V
7	U	Out	Motor phase U

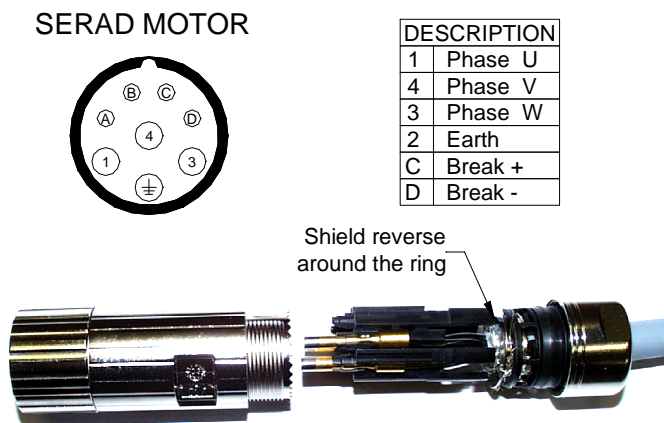
The motor power cable must arrive directly on the terminals of the drive.

Connect the shield (on drive side) to the screw provided (see Bottom view of the drive).

*Connect the external resistor between terminals 2 and 3




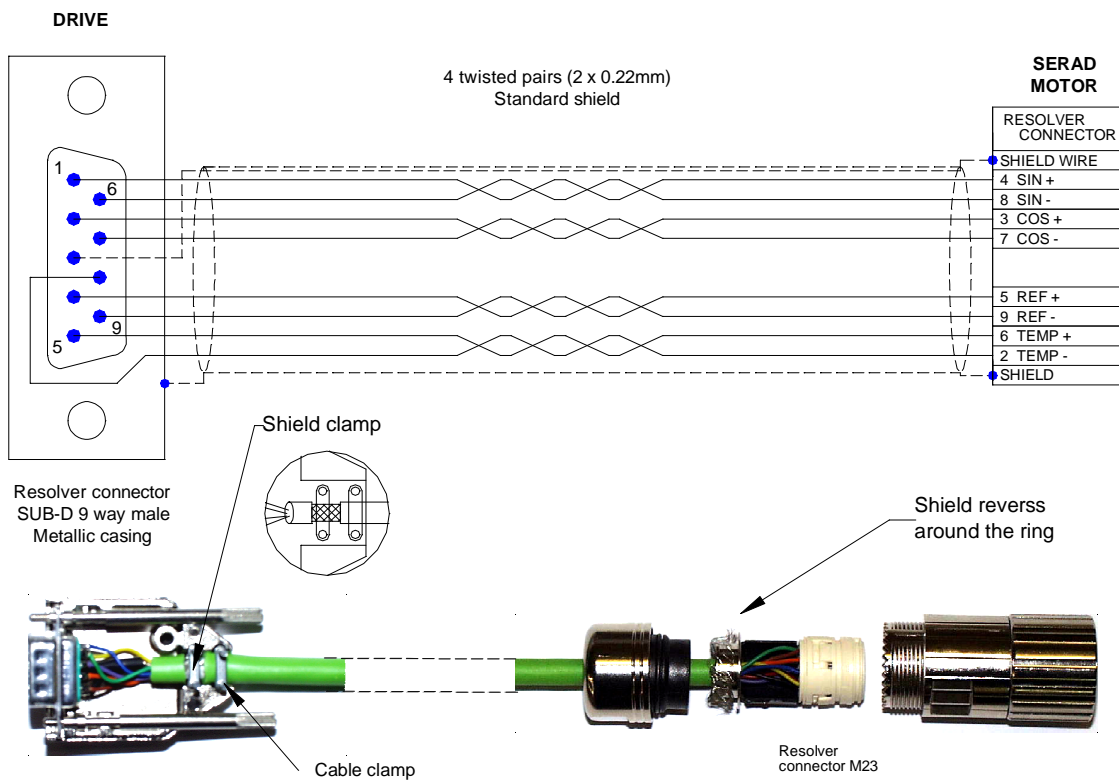
Care must be taken when making connection to connector X10. An incorrect connection can seriously damage the drive. Dangerous voltages are present on X10.



X11: Motor position feedback (resolver)


Connector: SUBD 9 way female

N°	Name	Type	Description
1	S2	Inp	Sine Hi
2	S1	Inp	Cosine Hi
3	AGND		0V analogue
4	R1	Out	Reference Hi
5	°CM+	Inp	Motor temperature sensor Hi
6	S4	Inp	Sine Lo
7	S3	Inp	Cosine Lo
8	°CM-	Inp	Motor temperature sensor Lo
9	R2	Out	Reference Lo
	SHIELD		Connect the shield to the shell of the connector




X12: Analogue I/O

Connector : SUBD 9 way male

N°	Name	Type	Description
1	IN2 -	Inp	Analogue input 2
2	IN2+	Inp	Analogue input 2 : assigned to torque limit
3	IN1-	Inp	Analogue input 1
4	IN1+	Inp	Analogue input 1 : assigned to speed or torque command
5	AGND		0V analogue
6	-12V	Out	-12V, 20 mA output
7	AGND		0V analogue
8	+12V	Out	+12V, 20 mA output
9	OUT	Out	Analog output (function monitor)
	SHIELD		Connect the shield to the shell of the connector

X13: Option: SinCos encoder input

Connector: SUBD 15 way male

N°	Name	Type	Description
1	°CM +	Inp	Motor temperature sensor Hi
2	AGND		0V analogue
3	/DATA	I/O	/DATA (EnDat*) /RS485 (HIPERFACE)
4	/CLK	Out	/CLOCK (EndDat*)
5	+5V	Out	+5V, 200 mA output (EnDat*)
6			
7	REFCOS	Inp	Cosine Hi
8	REFSIN	Inp	Sine Hi
9	°CM-	Inp	Motor temperature sensor Lo
10	+8,3V	Out	+8.3V, 150 mA output(HIPERFACE)
11	DATA	I/O	DATA (EnDat*) RS485 (HIPERFACE)
12	CLK	Out	CLOCK (EndDat*)
13			
14	COS	Inp	Cosine Lo
15	SIN	Inp	Sine Lo
	SHIELD		Connect the shield to the shell of the connector

* EnDat in developeping

X SAFE : Option : Safety input SIL2

Connector removable 2 ways, 3.81mm pitch

N°	Name	Type	Description
1	0V	In	0V
2	24V	In	Input

Refer to the documentation [Safety option installation guide](http://www.serad.fr) available on www.serad.fr

2-7- Cables

We can made you all cables with connectors (standard, robotics ...), contacts us.

- RS 232 serial communication cable, X1:

Screened cable, 4 core

Connect the shield on each extremity, to the shell of the connector (RJ45 and SUBD).

- Encoder cable, X4/X5:

Screened cable with 4 twisted pairs, 0.25 mm²

Connect the shield on each extremity, to the shell of the connector.

- Analogue cable, X12:

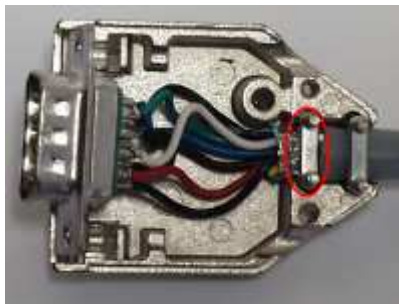
Screened cable, 2 core, 0.25 mm² per analogue input.

Connect the shield: on drive side to the screw provided (see 2-2 Front view) and on the other side to the shell equipment (ex. Motion controller ...)

- Motor feedback cable (resolver), X11:

Screened cable with 4 twisted pairs, 0.25 mm²

Ground the shield of the feedback SUBD as shown below:



- Motor power cable, X10:

Screened cable, 4 core, (+2 for a brake), use 16 mm²

Connect the shield (on drive side) with the bride (see mounting view of the drive page 11).

2-8- Connection diagrams / Protections



All connections must be realised by qualified personnel. The cables must be tested before being connected as any wiring fault can give rise to serious problems

Remove all voltages before inserting the connectors.

Ensure that the earth connection to the drive is correctly made (pin 1 of the connector X8).

Connect the motor earth to the drive (pin 4 of the connector X10) before applying any voltages.

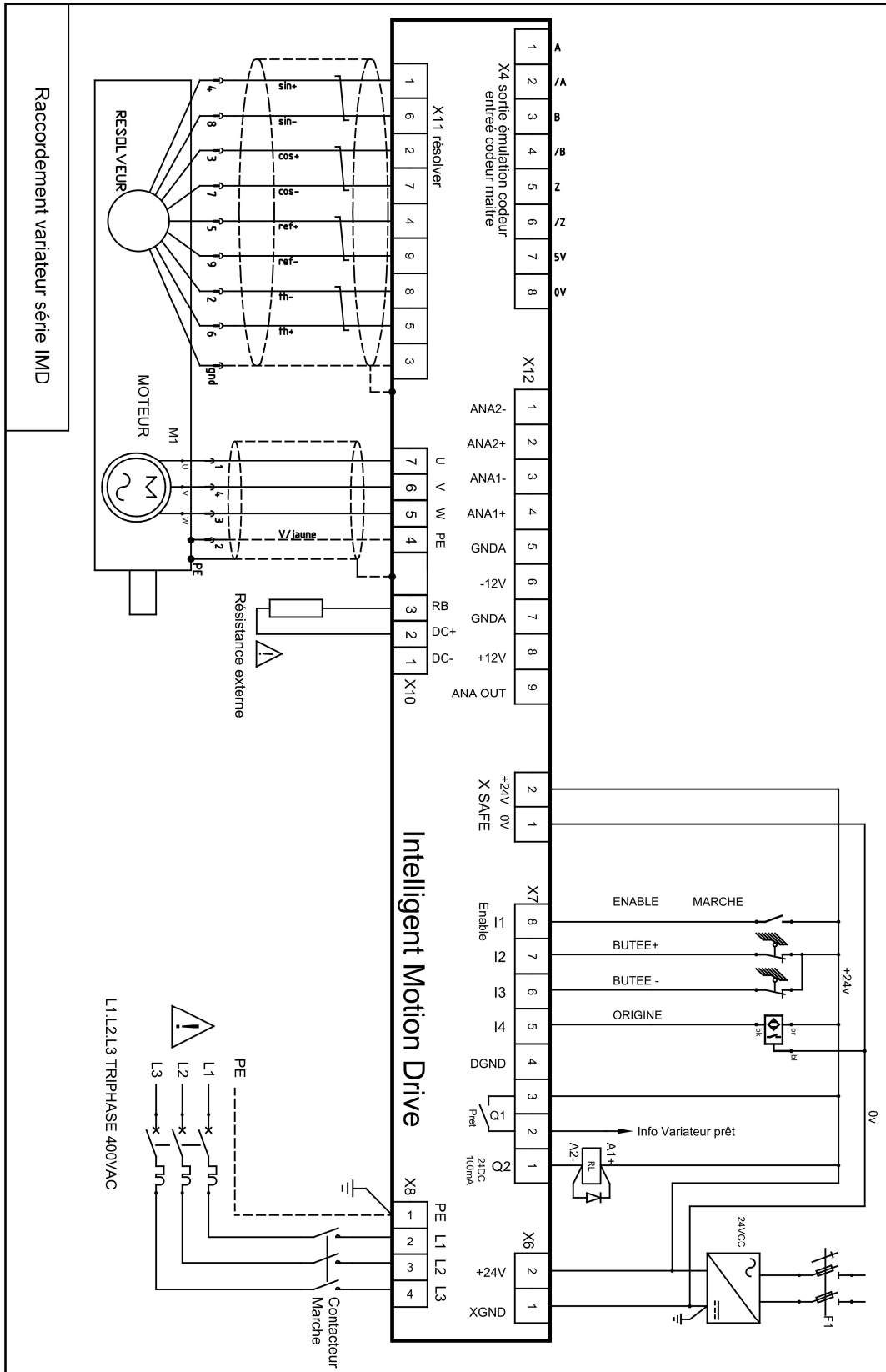
For the shielded cables, to connect the braid to the frame at each extremity via the caps of the connectors (for the SUBD) or the screws provided for this purpose (X7) in order to ensure an optimal equipotentiality.

Preventive reference rejection measures should be taken for control panel, such as connections contactors (obligatory on brake) and relay using RC elements or diodes(ex 1N4007).

Drive	Input voltage	Maximal input current	Safety device: cutout C curve	Wire
IMD / 40	400V triphasé	65A	40A maxi	16 ²

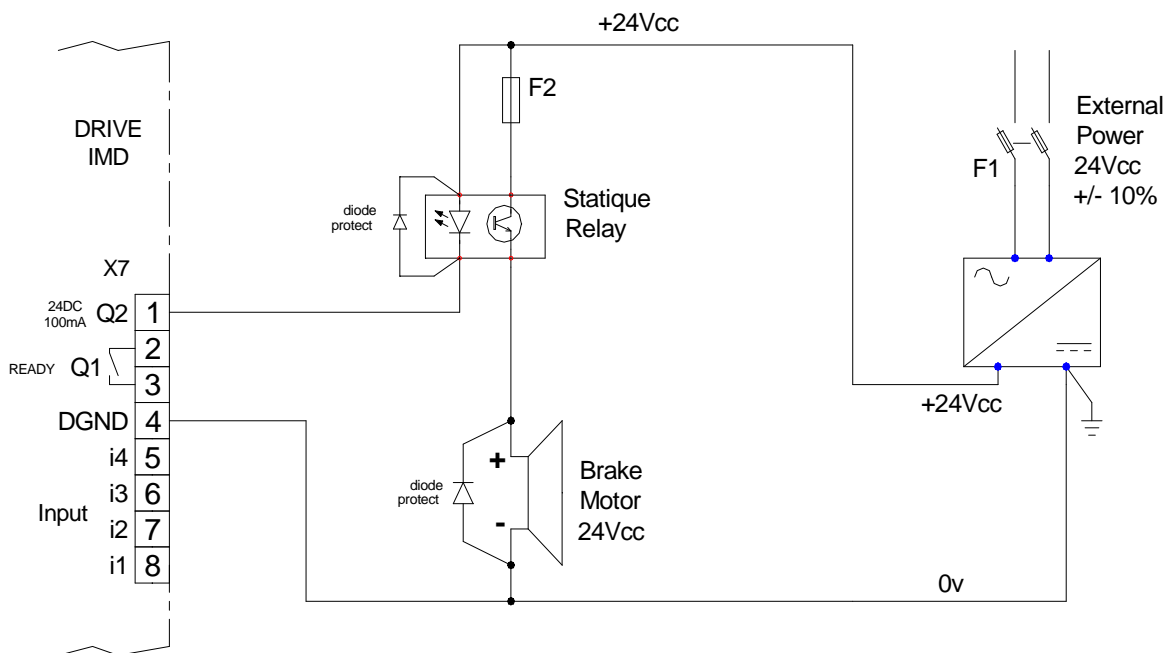
Caution: the ringing current can reach 50A during 3ms.

2-9- Stand-alone drive



The output Q2 is NPN open collector, 100mA max. The load must be connected between Q2 and +24Vdc.

2-10- Connecting a motor brake



The output Q2 is NPN open collector, 100mA max. The load must be connected between Q2 and +24Vdc.

Using the iDPL parameter set-up window, select the function Brake for output 2.



It is obligatory to put the 2 protection diodes else drive components can be damaged.

2-11- System checks before starting

- ↪ With the Enable input off, switch on the auxiliary 24V dc supply.
- ↪ Ensure that on the **STATUS display**, the point blinking.
- ↪ Apply power.
- ↪ If the Status display shows an **error message** check the list of error codes.


2-12- STATUS DISPLAY


▪ When the drive is starting

1) BOOT initialisation

Before the initialisation of the boot, the STATUS DISPLAY display :

In case of initialisation fault, you may have the following faults :

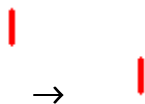
➤  : Checksum fault during the initialisation.

➤  : The OS is not loaded correctly. Refer to the documentation [loading of operating system](#) available on www.serad.fr

➤  : Internal fault

2) OS initialisation

The segments switch on fastly in the following order :



3) **End initialisation**, the number of OS version is displayed

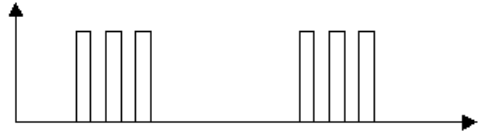


The example above gives you the OS version 3.38

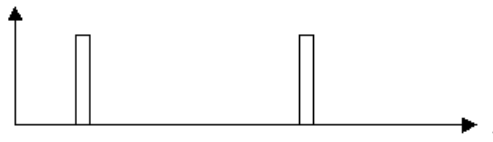
▪ **Drive running**

• **Blinking of the point**

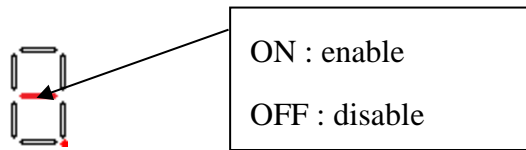
If system is linking (IDPL link) :



If the drive is not linked :



• **Enable state**



If the instructions display is used in a tasks, the display is a priority.

• **Motor position state**

The segments around are moving serving the motor position.

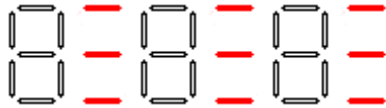


If the instructions display is used in a tasks, the display is a priority.

- **X-SAFE state**

In case of drive with safety :

- 3 segments horizontales blinking indicate they don't have 24v on the X-safe connector.



- When the 24v is back again on the X-safe connector, the status display go back on normal running, if the instruction display have been used before, the status display can be locked on this state :



When a new instruction display is used the satus display will change.

2-13- Error messages:

801

DC Bus over-voltage : an over-voltage has been detected on the internal dc bus. This fault can be due either to an over-voltage on the supply or to the braking resistance being insufficient.

802

DC Bus under-voltage : an under-voltage has been detected on the internal dc bus. This condition is only monitoring when the drive is active (Enable = ON, tension DC Bus voltage lesser then a drive's parameter) and when drive try to pass enable (DC Bus voltage lesser than 250V).

803

I²t motor : I²t motor detected.

804

Over-current : a current greater than the maximum current has been detected. The drive must be powered 24Vdc (Connector X6) for 15 min before it can be unlocked (iDPL v3.38 or higher). Immediate unlocking possible by computer in advanced mode.

805

Short-circuit : a short-circuit between phases or between a motor phase and earth has been detected. The drive must be powered 24Vdc (Connector X6) for 15 min before it can be unlocked (iDPL v3.38 or higher). Immediate unlocking possible by computer in advanced mode.

806

Temperature IGBT : maximum temperature attained in the drive.

807

Temperature motor : maximum motor temperature attained.

808

Resolver fault : Resolver feedback or absolute encoder or SinCOS signals defective.

809

Invalid parameters : checksum error on the drive parameters or parameters not initialised.

810

Drive type error : the parameter file does not correspond to the drive type or parameters not configured.

811

iDPL error : an error has been detected during the execution of the iDPL tasks (division by zero, not correct instruction, CAM or synchro. movement error ...).

812

Following error : the maximum following error has been exceeded. Contact technical support.

813

FLASH memory error: impossible writting. Contact technical support.

E 14

FPGA error : impossible loading or CAN communication error.
Contact technical support.

E 15

Over velocity : motor velocity is higher than nominal speed in torque mode

E 16

Feedback saturation error. Feedback or SinCos signals are too high.

E 17

Power supply error (24v). Please check the power supply (see 1-2).

E 18

Error during a writing operation on the memory stick.

E 19

The loading from the memory stick to the drive have failed, because the datas are corrupted. The memory stick have been remove and update by the drive project.

E 20

External communication failed. The EtherCAT communication lost.

