DI2020

USE AND MAINTENANCE MANUAL

DECENTRALISED DIGITAL SERVO DRIVE WITH INTEGRATED MOTOR (OBE)

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1. OVERVIEW

1.1. Content of the manual

This manual provides information to the user to ensure proper installation and optimal functioning of the digital servo drives, DI2020 series.
All information contained herein, including methods, techniques and concepts are the exclusive property of Moog Casella and may be neither copied nor used without specific authorization. Moog reserves the right to modify products, and related documentation, at any time, without notice.
The following materials are also available

- QUICK GUIDE - INSTRUCTIONS AND GUIDELINES FOR FIRST START
- MAINTENANCE AND USER MANUAL (this document)
- FIELDBUS MANUAL
- SOFTWARE Dx2020 GUI

ATTENTION
When the drive is in operation, there is a risk of death, serious injury, or serious material damage. Therefore, the installer is required to ensure that the safety instructions detailed in this manual are read, understood and observed by all personnel responsible for the operation of the drive.

1.2. Utilized symbols

	*Danger that can result in death or serious injury*
	*Danger that can result in minor injury and / or property damage*
	Notification of an important information

1.3. Package contents

The complete supply of DI2020 drives includes:

- One DI2020 module

Note: a possible connector kit must be ordered individually and is supplied separately.

1.4. Required qualifications of the users

This manual is intended for qualified personnel, that is having the following skills, depending on the tasks performed:

Transport: The staff must have notions of handling components sensitive to electrostatic charges

Unpacking: The staff must have knowledge of handling of components sensitive to shock and electrostatic discharge

Installation: The staff must have notions of installation of electrical equipment

Startup: The staff must have extensive technical knowledge of electrical drives and their technology.

INFORMATION
The qualified personnel must know and observe the following standards: IEC 60364, IEC 60664, and all relevant national accident prevention regulations.

WARNING
When the drive is in operation there is a risk of death, serious injury or serious damage to property. Therefore, the installer is required to ensure that the safety instructions detailed in this manual are read, understood and observed by all personnel responsible for the operation of the drive.

1.5. Applicable laws

The DI2020 drives meet the Low Voltage Directive (2006/95 / EC) and EMC Directive (2004/108 / EC). The safety function "Safe Torque Off" (STO) integrated in the drive complies with the Machinery Directive (2006/42 / EC).
To comply with the European Directives, the drive meets the requirements of the relevant harmonized installation standards EN 50178 (LVD), EN61800-3 (EMC) and EN 61800-5-2 (Safety of machinery).

The DI2020 drives are CE certified.

2. SYSTEM OVERVIEW

2.1. Product structure

2.1.1. Product description

The DI2020 is part of the new generation of decentralized Moog digital servo drives for the control of synchronous brushless or asynchronous motors; Moog's OBE (On Board Electronics) solution consists of a drive integrated with the DC-powered DM2020 power supply module.

Drive coupled to Size 100 motor				
Number of modules	L (no brake)	L (with brake)	LT (no brake)	LT (with brake)
2	220mm/8.66in	263mm/10.35in	274mm/10.79in	317mm/12.48in
4	263mm/10.35in	306mm/12.05in	317mm/12.48in	360mm/14.17in

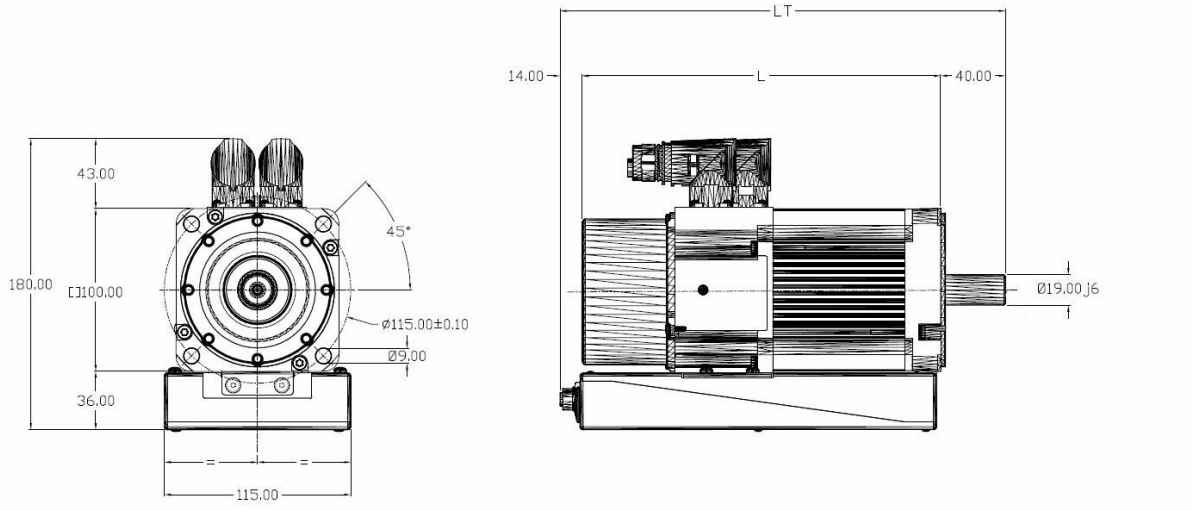


Fig 2.1a View of DI2020 with H100 size motor

Drive coupled to Size 100 motor				
Number of modules	L (no brake)	L (with brake)	LT (no brake)	LT (with brake)
2	218mm/8.58in	261mm/10.28in	271mm/10.67in	314mm/12.36in
4	261mm/10.28in	304mm/11.97in	314mm/12.36in	357mm/14.06in

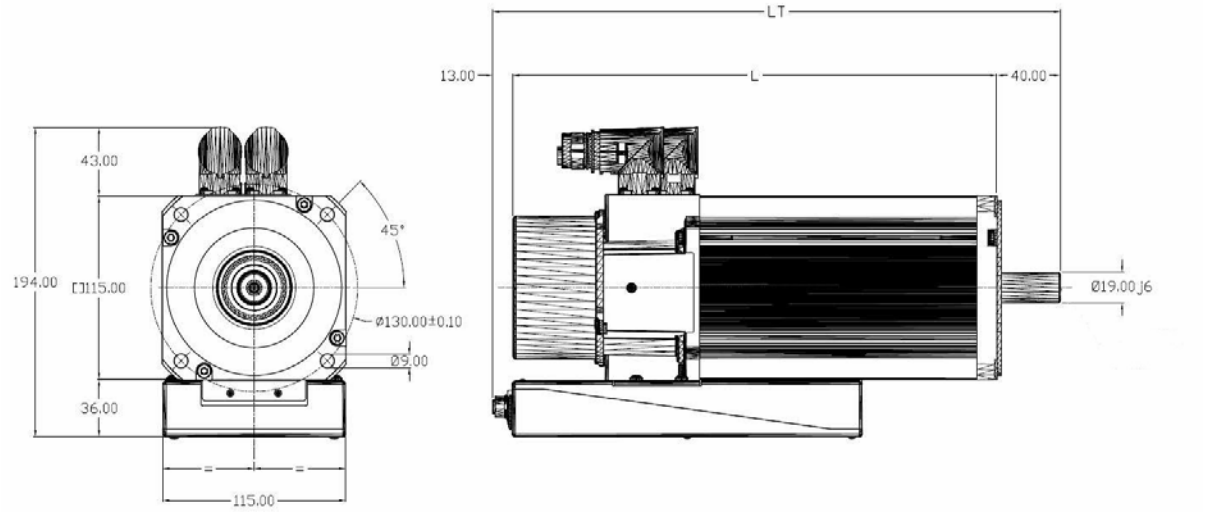


Fig 2.1b View of DI2020 with H115 size motor

Cables and connector coding

Connector code s

X1 complete input connector with contacts (power supply)	BR8904-R
X2 complete output connector with contacts (DI2020 connection)	BR8905-R
X4 and X5 Ethercat connectors	BR8906-R
Full connector Kit (includes all 4 connectors X1, X2, X4 and X5)	BR8903-R

Cable codes Power

supply	CVA*MM*
DI2020 connection power	CVD*MM*

Note: *"MM" indicates cable length in meters*

Wiring terminals Code

X2 connector STO status	BR8901-R
Cap for X5 EtherCat	BR8902-R
Cap for X2 not crimped	BR8900-R

- The DM2020 power supply supplies "DC" power (+ AT and -AT) to the various DI2020 drives through the connection cable applied to the terminal board
- Each DI2020 axis module is only available in the single axis version
- The current flows of the various axes range from 2 Arms to 4 Arms Continuous and from 4 Arms to 8 Arms of Peak
- The sizes of the DI2020 drives currently available are 4

Size	Torque rms at 0 speed (Nm)	Torque rms at rated speed (Nm)	Rated speed (rpm)
122	2,0	1,7	3000
142	3,5	2,1	3000
222	2,7	1,9	3000
242	5,1	2,0	3000

- Compatible feedback systems (to be specified when ordering):
  - RESOLVER 2 poles
  - ENCODER Sincos Hiperface Single turn Capacitive
  - ENCODER Sincos Hiperface Multi turn Capacitive
  - ENCODER Endat 22 Single turn Optical
  - ENCODER Endat 01 Multi turn Optical
  - ENCODER Endat 22 Multi turn Optical
  - ENCODER Endat 01 Single turn Optical
  - ENCODER Endat 22 Single turn Inductive
  - ENCODER Endat 22 Multi turn Inductive

- The control modes are 3:

Mode	Note
Analogic reference	Optional (*)
Fieldbus Can Bus	Optional (*)
Fieldbus EtherCat	Standard

(*) in development

• The motor can be equipped with a parking brake and its functional control circuit. An optional mode is available with a safety brake control circuit (integrated / separate) available with different performance levels

Description	Note
Standard (Brakeless motor)	-
Motor with brake	With functional control of the internal parking brake
Motor without brake and with function SBC Low Level	Funzione Safety Brake Command (Low Level)
Motor with brake and with function SBC Low Level	Funzione Safety Brake Command (Low Level)
Motor without brake and with function SBC High Level	Funzione Safety Brake Command (High Level)
Motor with brake and with function SBC High Level	Funzione Safety Brake Command (High Level)

Key:
Funzione SBC Low Level: Safe Break Control Function Medium Performance Level
Funzione SBC High Level: Safe Break Control Function High Performance Level

- Cooling of the modules by natural convection
- Ethernet Interface with EtherCAT Real Time Protocol according to DS402 (Standard)
- CANOpen interface (option under development) with CANOpen protocol according to profile DS402
- "Safe Torque Off" (STO) integrated in each DI2020
- Configuration / Commissioning via GUI: Dx2020GUI, via USB interface (X6 connector), located at the side of the Fieldbus connectors allows you to configure, calibrate and control the drive
- Diagnostics Alarms: Through GUI or Fieldbus:
  -EMC filters (with power supply kit)
  -Cabling (Hybrid Signal-Power and Communication)
  -Braking resistor (supplied with the power supply)

2.1.2. Working conditions and storage

Operating environment temperature	from 0 °C to 40 °C
Storage temperature	from -25 °C to 55 °C
Transport temperature	from -25 °C to 70 °C
Relative humidity	5…95 % without condensation
Allowed storage humidity	5…95 %
Allowed transport humidity	95 % at 40 °C
Working altitude	Up to 1000 m above AMSL rated performance, over 1000 m over AMSL with reduced current
Certifications	CE, UL (pending)
Protection	IP65
Mechanical strength complies with EN 60721-3-3	CLASS 3M7 Stationary / Sinewave Vibration: • 10mm for frequencies between 2…9 • 30 m/s² for non-stationary vibrations Non-stationary vibration and Type II shocks: • 250 m/s² (25 g) for 6ms
Machine safety	STO (Safe Torque Off) SILCL 3 PL "e" (waiting for certificate)

Model/Code	CC201xxxxx	CC202xxxxx
Mechanical dimensions	50 mm/1.97 inches	150 mm/5.9 inches
Type	L50	L150
Electrical line power supply	3-phase, from 200 to 528 V AC, 50/60 Hz	
Auxiliary busbar power supply	24 V DC +/- 10% (supplied externally)	
Arms rated current	54	128
Arms peak current	130	256
Protection	NTC and bi-metallic thermal protection to 85 °C Detection of loss during input phase Detection of insuf cient input voltage or overvoltage	
Communication	CANopen for sharing data with the drives	
Cooling	Incorporated ventilation	
Weight (kg)	5.1	13.5
Connector code	BC0004R	BC0006R

The power supply model code is shown on two plates: One located on the front above the protector for the module's terminal block and the other on the right-hand side of each axis module.

To request any kind of information about a specific power supply, the details on the side plate identifying each individual power supply must be communicated to Moog-Casella.

Note: A 32Arms power supply is currently under development

Fig 2.2 Example of power supply side plate (A) and front plate (B)

2.1.4. Power supply coding

Version	
2	Standard model
E	Special model
X	Test model

Mechanical hardware con uration			
Value	Power supply model	Width	Rated current (CC)
00	DM2020-PS "S"	50 mm/ 1.97 inches	32 Arms/90 Apk
01	DM2020-PS "M"	50 mm/ 1.97 inches	54 Arms/130 Apk
02	DM2020-PS "L"	150 mm/ 5.90 inches	128 Arms/256 Apk

Hardware revision	
Value - Internal coding (4)	
Value	Power supply model
A	DM2020-PS "L"
B	DM2020-PS "S" DM2020-PS "M"

OPT1 - Special configurations	
Value - Internal coding (4)	
Value	Version
00	Standard

Special variations	
Value - Internal coding (4)	
Value	Description
01	Special Reg. Res. (16 ohm/500 W Armoured)
02	With power connectors & without R.R. on kit
03	With power connectors & Special Reg. Res. (18 ohm/350 W armoured)

OPT2 - Special configurations	
Value - Internal coding (4)	
Value	Version
00	Standard
C0	Conformal coating for standard "00" con guration
50	UL LISTED for standard "00" con guration
L0	- Conformal coating for version "50"

(4) Values assigned by Moog

The first two characters are "CC" and indicate the family (DM2020).

Example: The code CC201A0000 identifies the standard power supply available in 54 A DC in the final production version without special versions.

2.1.5. Standard DI2020 module

Model/Code	CR6 122 X X X XX XX		CR6 142 X X X XX XX		CR6 222 X X X XX XX		CR6 242 X X X XX XX	
Mechanical dimensions	50 mm (1.97 in)							
Configuration	Single		Single		Single		Single	
Type	122		142		222		242	
Current @ 8 kHz	2		4		3		5	
Rated torque Nm	2	-	3.5	-	2.7	-	5.1	-
Peak torque Nm	4	-	7	-	5.4	-	10	-
Cooling	Natural							
Mass (kg) with brake+0.5 kg	6		7		8		10	

The module code is located on the nameplate behind the Fieldbus connectors.
To request any type of information on a specific module it is essential to communicate to Moog-Casella the data on the side plate, which uniquely identify each module.

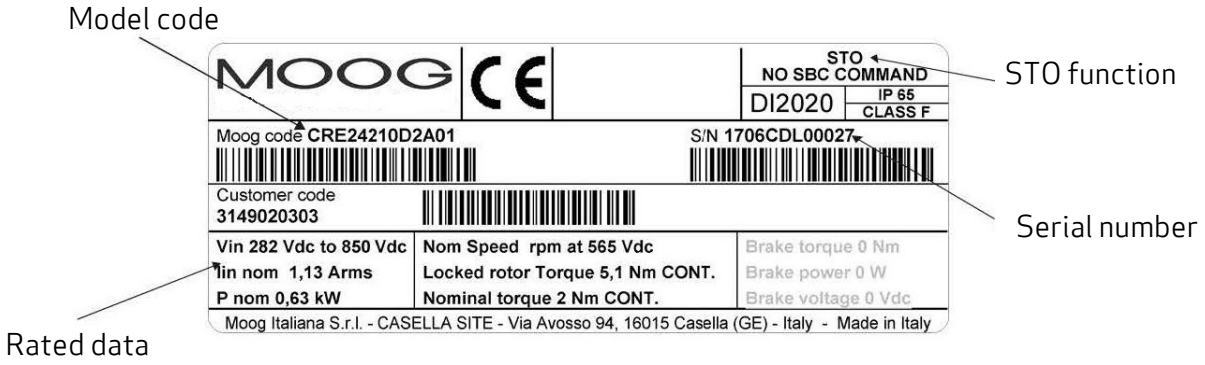


Fig 2.4 Example of DI2020 module plate

2.1.6. DI2020 modules coding

Code structure

Version	
6	Standard
E	Special

System Data			
Valore	Locked rotor Torque	Rated Torque	Rated Speed
122	2.0 Nm (1.47 ft/lb)	1.7 Nm (1.25 ft/lb)	3000 rpm
142	3.5 Nm (2.58 ft/lb)	2.1 Nm (1.55 ft/lb)	3000 rpm
222	2.7 Nm (1.99 ft/lb)	1.9 Nm (1.40 ft/lb)	3000 rpm
242	5.1 Nm (3.76 ft/lb)	2.0 Nm (1.47 ft/lb)	3000 rpm

Motor Configuration	
Value	Description
00	Flange100 mm (3.94 in), standard shaft
02	Flange 100 mm (3.94 in), shaft with key
10	Flange 115 mm (4.53 in), standard shaft
12	Flange 115 mm (4.53 in), shaft with key

Transducer type	
Value	Type
2	RESOLVER 2poles
C	ENCODER Sincos Hyperface Single turn Capacitive (3)
D	ENCODER Sincos Hyperface Multiturn Capacitive
E	ENCODER Endat 22 Single turn Optical (3)
F	ENCODER Endat 01 Multiturn Optical (3)
G	ENCODER Endat 22 Multiturn Optical (3)
L	ENCODER Endat 01 Single turn Optical (3)
I	ENCODER Endat 22 Single turn Inductive (3)
N	ENCODER Endat 22 Multiturn Inductive (3)

Special versions
Value - Internal coding (2)

Special configurations	
Value - Internal coding (2)	
01	Standard (no brake)
02	With brake
31	No brake with SBC low level (3)
32	Brake with SBC low level (3)
61	No brake with SBC high level (3)
62	Brake with SBC high level (3)

Hardware Revision
Value - Internal coding (2)

Fieldbus configuration	
Value	Type
0	Analogue references (option)
1	CanBus configuration (option)
2	EtherCAT configuration (1)

(1) Standard Version

(2) Values assigned by Moog

(3) In development

2.1.7. Capacitive modules models (ABC Auxiliary Bus Capacitor)

Model	Code	Capacity (µF)	Dimensions
DM2020 ABC5	CC55000	5400	50 mm (1.97 in)
DM2020 ABC4	CC55012	4500	
DM2020 ABC3	CC55013	3600	
DM2020 ABC2	CC55014	2700	
DM2020 ABC1	CC55015	1800	

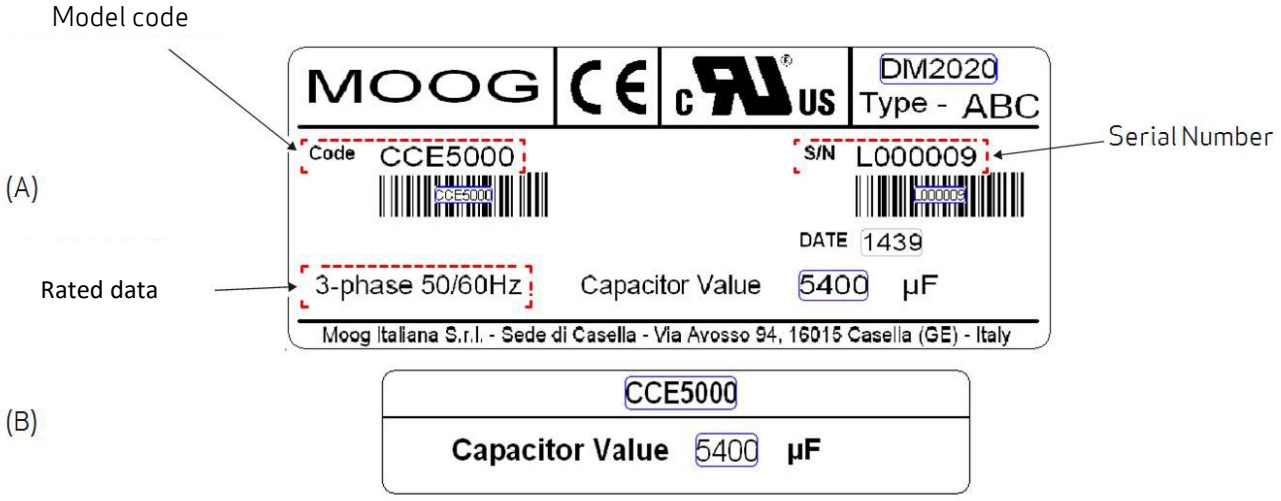


Fig 2.5 Example of capacitive module side (A) and front (B) plate

A capacitive module can be coupled to the power supply unit and DI2020 for energy recovery in the presence of repeated cycles of acceleration and braking of the payload, avoiding dissipating energy on the braking resistor.

2.2. Detailed features and components

2.2.1. Power supply electrical data

The power module has the main function of directly converting (without transformer) the mains voltage into a continuous voltage, which is distributed via the bus bars, providing power to the modules controlling the different axes of the system.

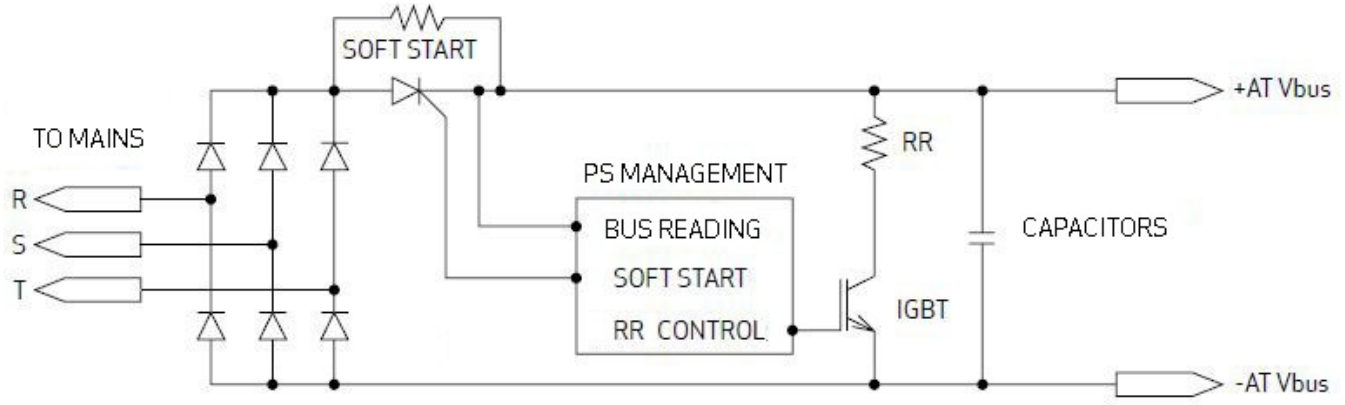


Fig 2.6 Block diagram of the power supply (power components)

Model	Type L50 (M)	Type L150 (L)
ELECTRICAL DATA		
Mains voltage	Three-phase from 200 to 528 V AC 50/60 Hz	
Auxiliary voltage	24 V DC +/-10%, 1 A (supplied externally)	
Rated output current, DC BUS side	54 A	128 Arms
Peak output current, DC BUS side	130 A	256 Arms
DC-link voltage (Vout)	From 282 to 744 V DC	-
Protection	NTC and bi-metallic thermal protection on heat sink to 85 °C Identi fication of absence of input phase Identi fication of insuffi cient voltage (undervoltage) or excessive voltage (overvoltage)	
Communication	CANopen for sharing data with the drives	
Cooling	Incorporated ventilation	
MECHANICAL DATA		
Weight	5.1 kg	13.5 kg
Height	455 mm (17.91 inches)	455 mm (17.91 inches)
Width	50 mm/1.97 inches	150 mm/5.91 inches
Depth	249 mm (9.80 inches)	249 mm (9.80 inches)

Tab 2.4 Power supply characteristics

FUNCTIONS
Soft-start circuit
Braking circuit
BUS cc voltage monitoring
Mains voltage presence and value monitoring
Power supply internal temperature monitoring

2.2.2. DM2020 power supply mechanical data

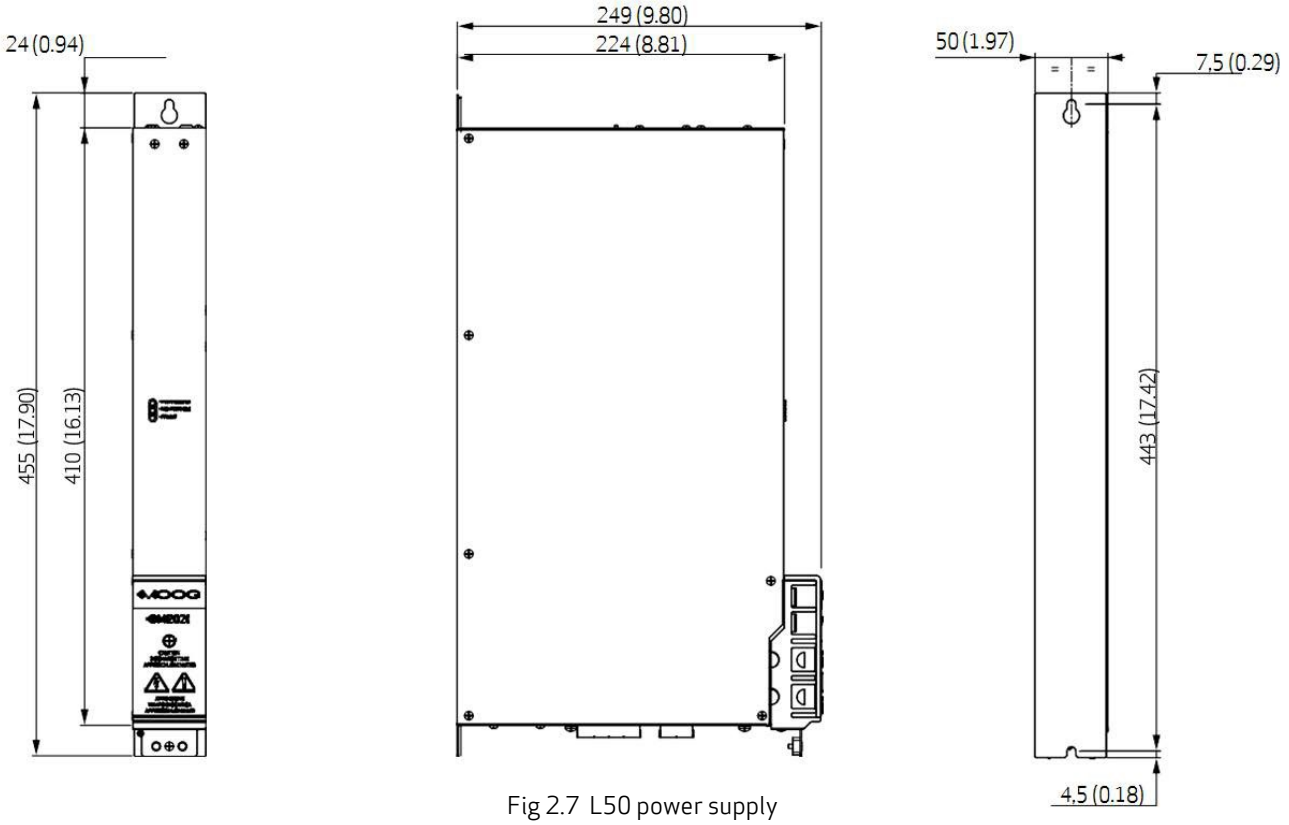


Fig 2.7 L50 power supply

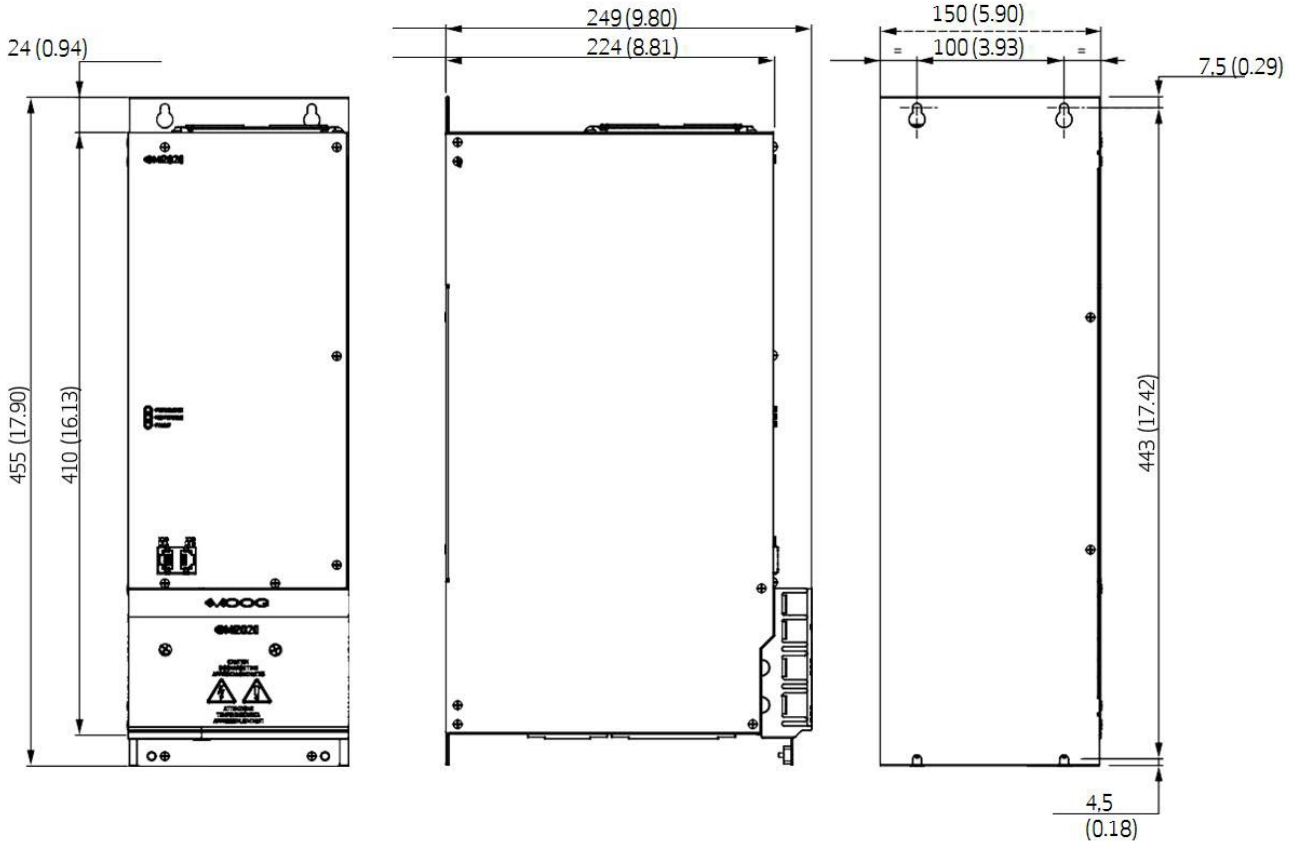


Fig 2.8 L150 power supply

2.2.3. Connectors

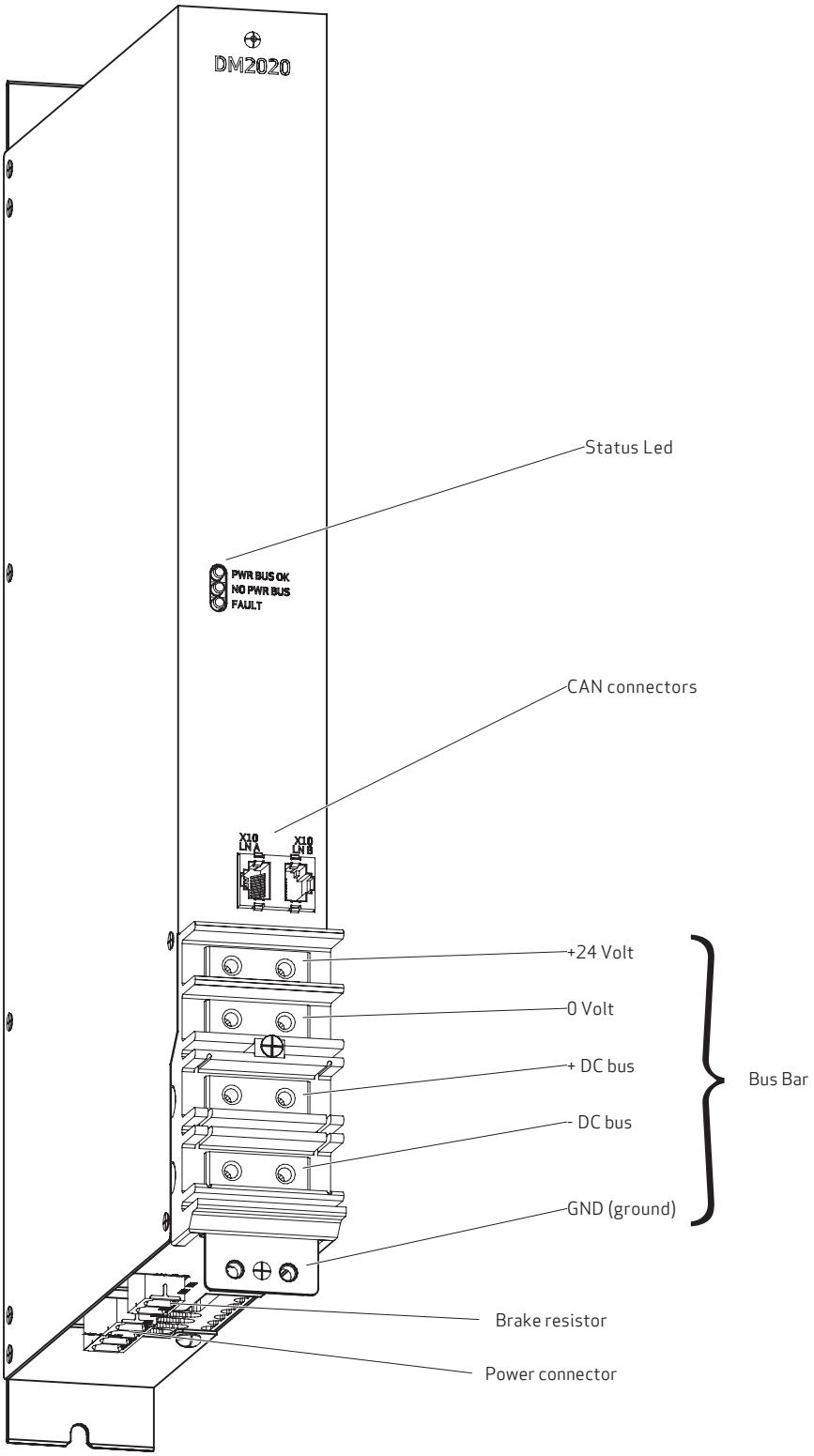
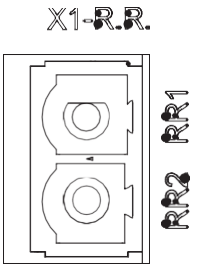


Fig 2.9 Connection layout

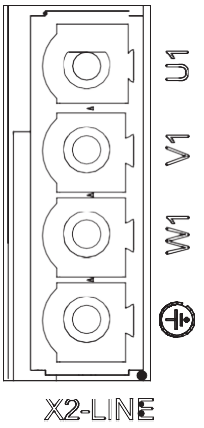
2.2.3.1. Connectors layout

The tables below give details of connectors and the meaning of signalling LEDs

X1: brake resistor	
1	+RR1
2	-RR2



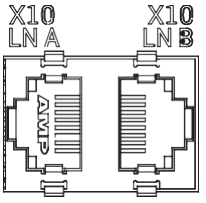
X2: mains	
1	U1
2	V1
3	W1
4	Earth



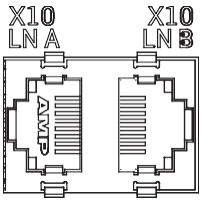
BUSBAR connection	
1	+24 V
2	0 V DC
3	+DC BUS
4	-DC BUS

YELLOW LED	GREEN LED	RED LED	Status
Off	Off	Off	Power supply off or failed
Off	On fixed light	Off	24 Volt applied
Flashing	Flashing	Off	Three-phase power supply present, BUS charging
On fixed light	Flashing	Off	BUS stable, axes ready to be enabled
Off	Off	On fixed light	Power supply fault

X10 LN A CAN connector (according to CIA 402 CAN on RJ45 connector)		
Pin	**Designation**	**Function**
1	Can_H	CAN line positive terminal
2	Can L	CAN line negative terminal
3	0V_Can	CAN line 0 logic
4	Aux_Ps_Fault_neg	Signal (denied) of power supply status
5	Addr_sx_dx	Address for internal communications
6	Ps_out	Power supply command output
7	nc	
8	+5V_Can	CAN line power supply (supplied by power supply)



X10 LN B CAN connector (according to CIA 402 CAN on RJ45 connector)		
Pin	**Designation**	**Function**
1	Can_H	CAN line positive terminal
2	Can L	CAN line negative terminal
3	0V_Can	CAN line 0 logic
4	Aux_Ps_Fault_neg	Signal (denied) of power supply status
5	Addr_sx_dx	Address for internal communications
6	Ps_out	Power supply command output
7	nc	
8	+5V_Can	CAN line power supply (supplied by power supply)



2.2.4. Filters

If the motor power cables are shorter than 50 m, an EMC filter (code AT6013/AT6014 or equivalent can be positioned between the network and the drive.

If cables are longer than 50 m, we recommend contacting Moog-Casella's Applications department.

Filter code	AT6013 (power supply M) / AT6014 (power supply L)
Rated voltage	3 x (400/480 V), 50/60 Hz, at 50 °C
Overload	1.5x per 60 s, repeatable every 60 min.
Ambient temperature	From -25 °C to +100 °C, with current reduction starting from 60 °C (1.3%/°C)
Assembly height	1000 m, with current reduction of up to 4000 m (6%/1000 m)
Relative air humidity	15 - 85% (condensate not permitted)
Storage temperature	From -25 °C to +70 °C
IP protection rating	IP20
Acceptance test	Complies with EC
Non-industrial environment - EN61800-3 complies with radio shielding	Cable length permitted between the drive and motor up to 50 m
Industrial environment - EN61800-3 complies with radio shielding	Cable length permitted between the drive and motor up to 100 m

Code	Suitable for power supply	Type	Rated current [A]	Total current loss [W]	Current on contact [mA]	Weight [kg]	Connection [mm^2]
AT6013	L50	A 1	55	26	33.4	1.8	13 mm^2 ex. PE M6 bolt
AT6014	L150	B 1	130	50	39	2.6	Up to 50 mm^2 PE M10 bolt

Tab 2.5 Main electrical characteristics o lters

If the application requires a direct current less than the maximum that can be managed by the power supply, filters with lower rated current values may be used.

Contact the Applications Service for ratings and a selection of alternative models to those described above.

2.2.5 Brake resistor

When the motor decelerates, braking resistance converts energy into heat.

There are two different brake resistors for the L50 power supply:

Code	Power (W)	Ohm	Notes
Standard	370	15	Supplied
AR5974	500	16	Available as an option to be ordered separately

The braking resistor is not provided for the L150 power supply. The recommended resistor is 4.7 ohms/1000 watts (to be ordered separately using code AR5988).

INFORMATION
If the dissipated power exceeds 1000 W, contact the Applications Service at Moog-Casella for component sizing

CAUTION
For the L50 model, the braking resistor must always be connected as it also features a soft-start function. In the absence of this, the system will not start up; moreover, it will not be possible to stop the rotating motors in a controlled manner.

ATTENTION
Pour le modèle L50, la résistance de freinage doit toujours être raccordée car il dispose également d'une fonction de démarrage progressif. A défaut de cela, le système ne démarrera pas; en outre, il ne sera pas possible d'arrêter les moteurs rotatifs d'une manière contrôlée.

2.2.6. Line inductors

For normal operation, inductors do not have to be used at the power supply input.

However, if using a low-inductance network (below 100 uH, it is advisable to t a line inductor to the network in order to protect the power supply.

Systems with a very low line inductance produce dV/dt values above 1000 V/uS of the three-phase input voltage applied to the drive. This is a limit value for thyristors, which IN THESE PARTICULAR CONDITIONS may become conductive, even without controlled triggering by the internal circuit.

Speci cally, if switched on early, they may cause the fuses in the soft-start circuit to break (the soft-start circuit is designed to limit starting current caused by the DC BUS capacitors preventing uncontrolled currents).

To de ne an approximate value for line inductance, the cable length between the three-phase input of the drive and MV/LV transformer cabin must be considered, using 0.6 uH/m as a typical inductance value per metre of wiring, and summing the inductance of the transformer cabin.

To limit possible dV/dt, the effect of limiting the value induced by the input EMC fillter should also be considered, checking the lter inductance value.

INFORMATION
The inductor must be fitted between the transformer of the cab and the drive

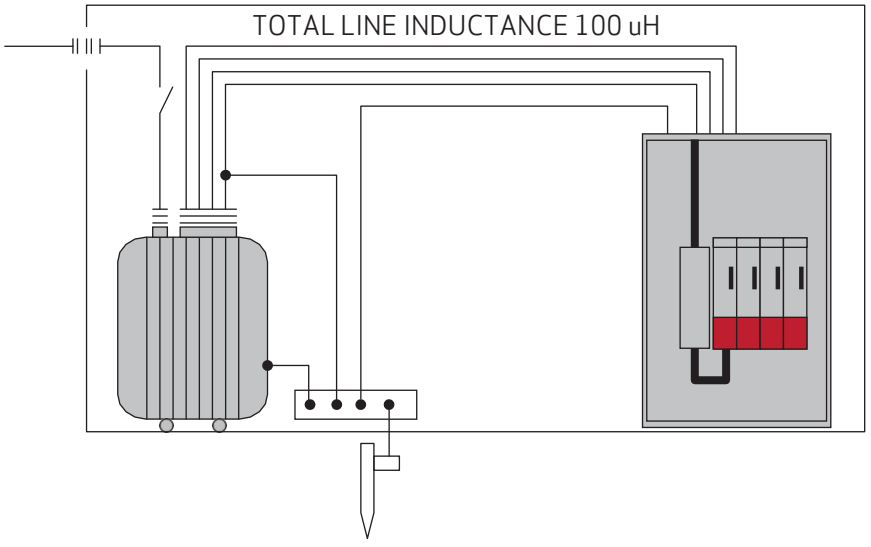
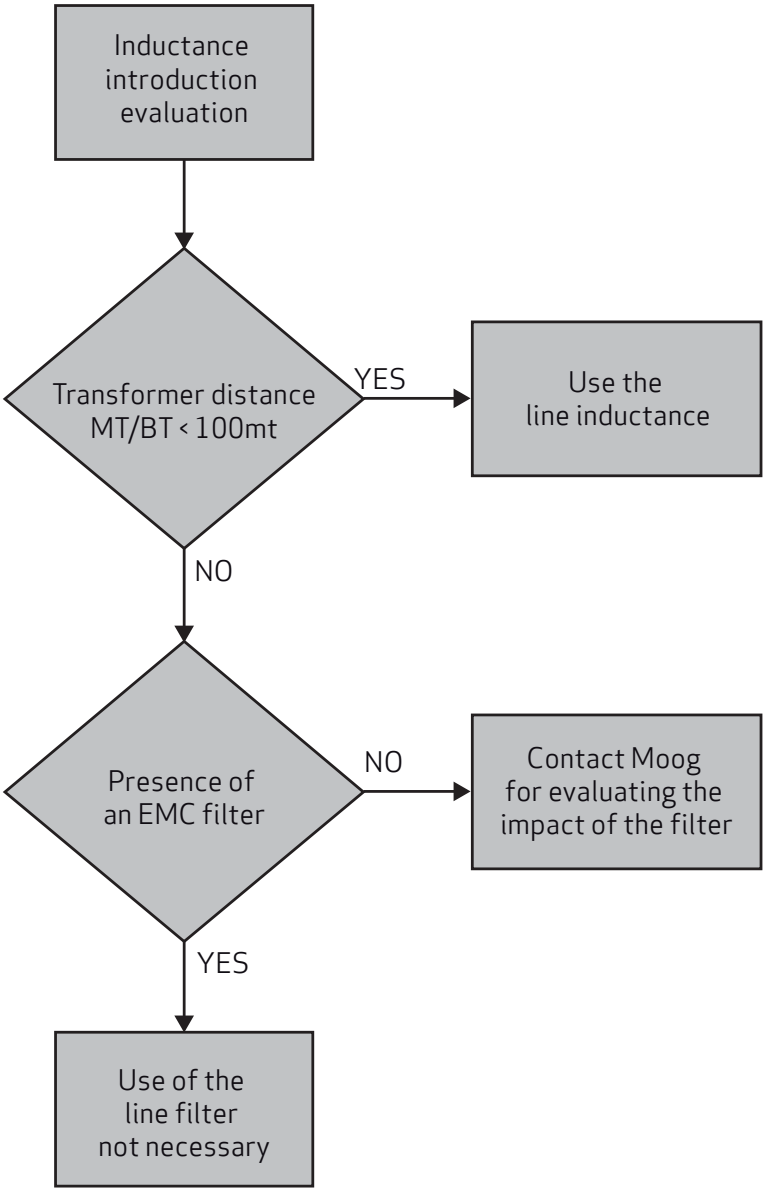


Fig 2.10 Diagram of a three-phase input inductor connection

Power supply size	Inductance value	Current	Frequency
Type L50	0.1 mH	Inom. 60 A	50/60 Hz
Type L150	0.1 mH	Inom. 130 A	50/60 Hz

Tab 2.6 Example of external three-phase inductor dimensioning

How to assess whether an inductor is needed:



Contact the Applications Service at Moog-Casella for more information.

2.2.7. Cables

INFORMATION

The power and control cables (apart from the cables which run from the network to the filter) must be shielded and kept separate from each other if possible, at a distance of more than 200 mm

The cables for the connection between the power supply and the DI2020 can be ordered separately from the DI2020, using the reference table.

INFORMATION

The shielded power cables may be interrupted and connected to earth by a copper bar using a terminal with a cross-section that ensures an effective electrical contact with a greater cross-section than the earthing cable

Power supply cable cross-section

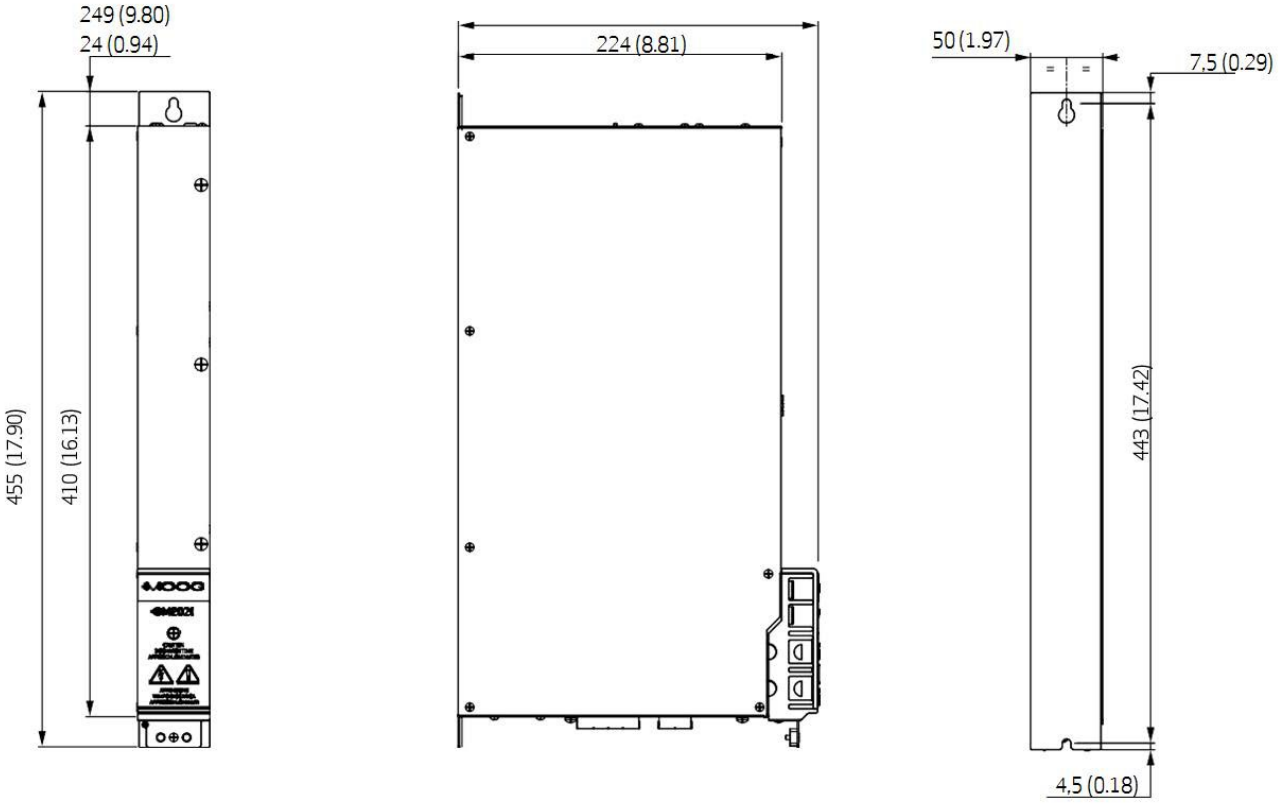
Power supply model	Type L50 (54 A)	Type L150 (128 A)
Network	13 mm² (AWG6)	33 mm² (AWG2)
Brake resistor	13 mm² (AWG6)	33 mm² (AWG2)
24 V DC	0.8 mm² AWG 18	
Earth	13 mm² (AWG6)	33 mm² (AWG2)

See "Metric/AWG conversion table" for the metric/AWG conversion table.

For a + 24Vdc overall power supply, generally consider 1mm² for each DM2020 module to the power supply unit and then at least 4mm² for the DI2020 series (to be checked according to the layout of the installation).

2.2.8 Capacitive Module (ABC)

For high-speed and high-mobility machines, it is possible to reduce most of the energy dissipated by the braking resistor.
A capacitive module is available to increase the energy stored in the braking phase:



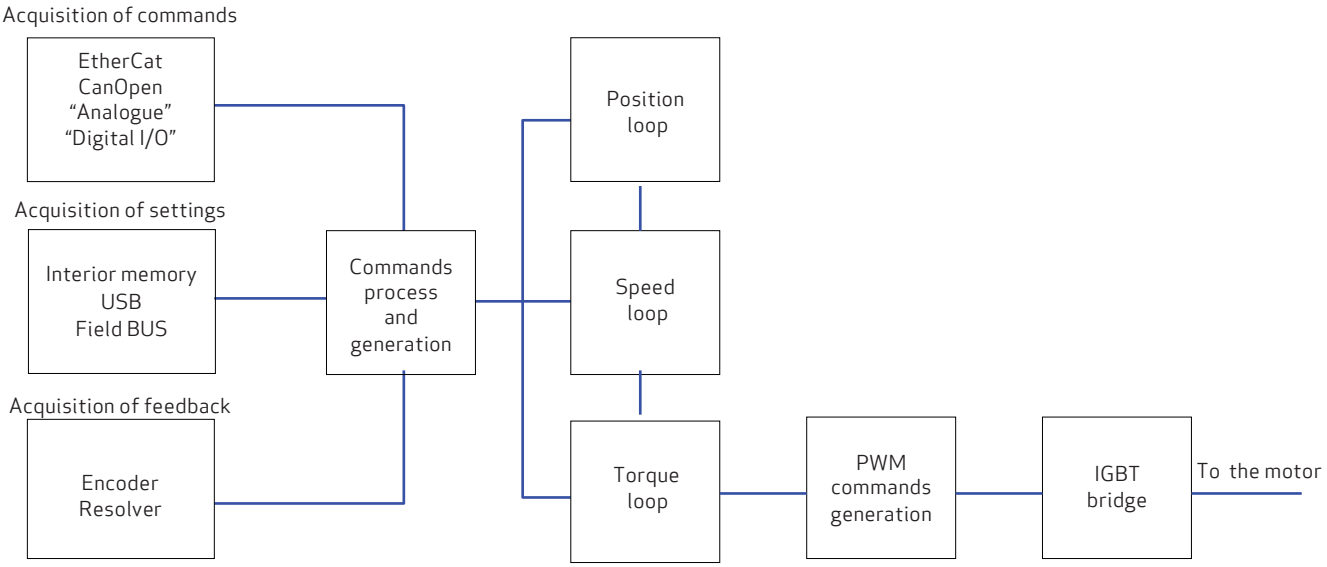
Model/Code	ABC5/CCE5000	ABC4/CCE5012	ABC3/CCE5013	ABC2/CCE5014	ABC1/CCE5015
Capacity (µF)	5400	4500	3600	2700	1800
Width (mm)	50				
Depth (mm)	249				
Height (mm)	455				

The following table summarises the total capacity of the other modules:

Module ID	Total cap. uF
L50 power supply	1800
L150 power supply	4500
DI2020	110

2.3. Axis module

2.3.1. General description of functions



FUNCTIONS

Position controller

Velocity controller

Torque controller

USB interface

EtherCAT interface

CANOpen interface (optional) Analog reference (optional)

Parking brake control (on relevant models) Analog I/O management (optional)

Digital I/O management (optional)

Sensorless mode

Data recording

ELECTRICAL DATA	
Auxiliary voltage	24 Vdc +/- 10 %
DC-link voltage	from 282 to 744 Vcc
Rated torque Nm (0 rpm)	from 2 to 5.1 Nm
Peak torque Nm	from 8 to 22 Nm
Protection	Thermal protection of the heat sink, thermal sensor on the control board undervoltage or overvoltage detection
Cooling	Natural
MECHANICAL DATA	
Weight	between 7 kg and 10 kg

2.3.2. Mechanical Dimensions

The dimensions of the DI2020 are derived from the size of the motor to which the drive is associated. The motors' measurements in turn vary according to their characteristics, as evidenced by the following reference tables:

Motor size 100				
Number of Modules	L (no brake)	L (brake)	LT (no brake)	LT (brake)
2	220mm/8.66in	263mm/10.35in	274mm/10.79in	317mm/12.48in
4	263mm/10.35in	306mm/12.05in	317mm/12.48in	360mm/14.17in

Motor size 115				
Number of Modules	L (no brake)	L (brake)	LT (no brake)	LT (brake)
2	218mm/8.58in	261mm/10.28in	271mm/10.67in	314mm/12.36in
4	261mm/10.28in	304mm/11.97in	314mm/12.36in	357mm/14.06in

2.3.3. Positioning transducers

The DI2020 can be equipped with the following position transducers mounted on the motor :

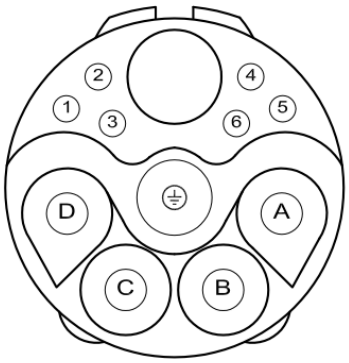
- RESOLVER 2 poles
- ENCODER Sincos Hiperface Single turn Capacitive
- ENCODER Sincos Hiperface Multi turn Capacitive
- ENCODER Endat 22 Single turn Optical
- ENCODER Endat 01 Multi turnOptical
- ENCODER Endat 22 Multi turnOptical
- ENCODER Endat 01 Single turn Optical
- ENCODER Endat 22 Single turn Inductive
- ENCODER Endat 22 Multi turnInductive

Note: The choice of the transducer implies different hardware: it is not possible to change a motor transducer outside of our production plant

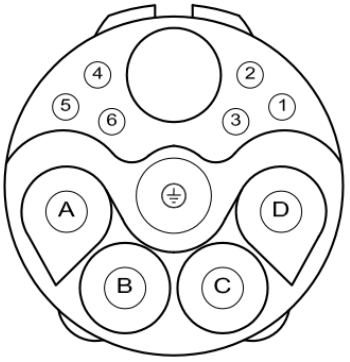
2.3.4. DI2020 connectors

The figure shows hybrid power-signal connectors:
Power connector, input X1 and output X2.

X1



X2

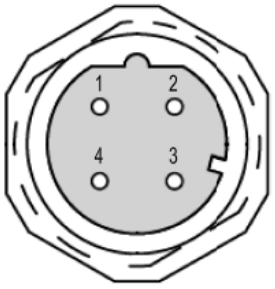


The pin assignment of the two mirroring connectors is shown in the following table.

PIN	Description	Recommended minimum section
1	24 V S1 STO	0.35 mm^2
2	24 V S2 STO	0.35 mm^2
3	FB_BK_STO	0.35 mm^2
4	Spare	
5	Spare	
6	Spare	
A	0 VDC	2.5 mm^2
B	+24 VDC	2.5 mm^2
C	+AT	2.5 mm^2
D	-AT	2.5 mm^2
GND	GROUND	2.5 mm^2

Note: The table refers to both connectors. The pin assignment on the two connectors is specular. X1 contacts are male and correspond to the female contacts on X2.

Ethercat Fieldbus Connector (X4 input, X5 output)

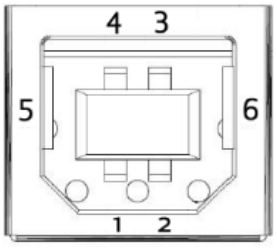


Connector pin-out

Pin	Description
1	Tx +
2	Rx +
3	Rx -
4	Tx -

Note: The table refers to both connectors.

X6 USB Communication connector



Pin	Description
1	USB +5Volt
2	USB Data M
3	USB Data P
4	USB 0Volt
5	Shield
6	Shield

Note: You must use a shielded USB cable

Additional notes on DI2020 power supply

The overall number of modules simultaneously mounted, and the resulting number of separate lines that can be fed, is limited by the performance limits of the power supply module detailed above. These limits are ensured by an integrated thermal protection that intervenes when the maximum rated current is exceeded.

The following elements also contribute to limiting the number of DI2020 that can be put in series through a single line:

- The maximum section of the power cord that the power terminal can hold is 4 mm^2 (AWG12 - terminals A-B-C-D) and the maximum current rating supported by the power wiring (cable + connector) is 30 Arms (according to the CE Certification of the Connector).

- The maximum cross section of the power cable on the signal terminals is 1 mm2 (AWG18 - terminals 1 to 6) and the the maximum nominal current rating supported by the wiring (cable + connector) of the supply is 1.2 Arms (according to the CE certification of the connector).

INFO

Depending on the type of fieldbus you must install a different hardware and firmware . If the connection is via Ethercat, the file will have suffix "_ecat" if through CanBus the file will have suffix "_can".

2.4. Safety and usage guidelines

2.4.1. General description of safety features

Power and control connections can also be powered while the motor is stationary. During operation, the drives can reach high temperatures with the risk of injury.

In addition, voltage strikes can occur with a risk to people's safety and damage to electrical contacts.

Caution: Wait at least six minutes after interrupting the power supply before loosening the connections. As an additional safety measure, however, it is advisable to verify instrumentally that DC BUS voltage values have fallen below 40 V before any interaction with contacts and connections.

2.4.2. STO Safety feature

2.4.2.1. Description

The DI2020 drives include as standard the STO function (Safe Torque Off) that shall ensure personnel protection against accidental restart of the drive.
The DI2020 standard version contains the STO function to be used as interlock against accidental motor starts.
The STO function can be used to turn off the power to prevent accidental starting.
The function disables the power control voltage of the semiconductors of the converter output stage, preventing the drive from generating the voltage required to rotate the motor.
Using this feature, you can perform short-term operations and / or maintenance work on non- electrical parts of the machine without switching off the power supply. This function must be enabled from a safe external control (mechanical or semiconductor) or by a specific external security board.

2.4.2.2. Directives on safety

Attention
Suspended loads must in any case be mechanically locked securely. The STO function, if activated does not ensure suspended loads against damages.

Attention
Removing the 24Vdc from the two inputs of the STO connector the motor is out of control.

Attention
The STO function does not guarantee an electrical separation from the power output so if you need an intervention on the motor cable, you have to disconnect the drive from the power supply always waiting
the discharging time of the intermediate circuit.

Notice
When using the STO function it is necessary to follow the sequence of operations below:

1. Stop the movement in a regulated manner, placing the nominal speed value to zero
2. Upon reaching the zero speed, and in the case of suspended loads, mechanically lock the load
3. Disable the drive and at this point turn on the STO function

Input voltage	24 V +/- 10 %
Max input current	30 mA ⊣⊢ /- 10 %

Tab 2.7 Electrical Features STO Function

2.4.3. Directives on the use of the drives

It is extremely important that the module's technical data and information about connections (plate and documentation) are always available and complied with.
Only qualified technical personnel familiar with transport, installation, assembly and commissioning may carry out these activities.
Qualified personnel shall be familiar with and observe the following standards

- IEC 60364 e IEC 60664
- Accident prevention national regulations
- Safety instructions of the present manual

The drives contain electro-statically sensitive components, which may be damaged by handling if touching a conductive object that is earthed.

Electrostatic charge should be discharged before handling the drive and positioning it on a conductive surface

2.4.3.1. Use as directed

Drives are safety devices that are built into electrical plants or machines, and can only be operated as integral components of such plants or machines.
The manufacturer must produce a risk analysis for the machine, and take appropriate measures to prevent unforeseen movements that can cause injury or damage to persons or property.
If the drives are used in residential areas, in business areas, or in small industrial operations, then additional filters must be implemented by the user after full system measures.

2.4.3.2. Power supply

The DI2020 series drives have to be powered via DM2020 power supply modules connected to three-phase earthed industrial electric networks (TN system, TT system with earthed neutral point, no more than 10 KA symmetrical rated current at 208 V -10%, 230 V, 240 V, 400 V or 480 V +10%).
Overvoltages between phases and the drive housing must not be higher than the peak of 1000 V.
According to the EN61800-3 standard, voltage transient peaks (< 50 ms) between phases must not exceed 1000 V.
Voltage transient peaks (< 50 µs) between a phase and housing must not exceed 2000 V.

2.4.3.3. Prohibited use

Usage which differs from that described in section “Use as directed” are not recommended, and could cause damage to persons, equipment or other items.

Use of the drive is normally prohibited in the following environments:

- potentially explosive areas
- areas with corrosive and/or electrically conductive acids, alkaline solutions, oils, vapours,
- directly on unearthed electrical networks or on asymmetrically earthed power supplies with a voltage above 240 V
- on ships or offshore installations

Installing and starting up the drive is prohibited if the machine in which it is to be installed:

- does not conform to the requirements of the EC Machinery Directive
- does not conform to the EMC Directive or Low Voltage Directives
- does not conform to national regulations

The control of brake holding by the DI2020 drive alone may not be used in applications where personnel security is to be ensured with the motor brake

2.4.3.4 In house storage duration

Storing DI2020 drives under prescribed conditions and for a consecutive period of up to one year does not require specific limitations and requirements; in the case where the storage period is longer than 1 year prior to proceeding to the phases of installation and commissioning of the module perform the following steps:
• Apply gradually a voltage of 300VDCp limited current connecting the positive pole to the connector "X11-RRext" and the negative pole to the connector "X11-V1"
• Keep the voltage value for about 20 minutes
• Disconnect the power source and wait for the discharge time before handling the module

2.4.3.5 Maintenance / cleaning

The DI2020 drives and DM2020 power supply modules are maintenance-free; the opening of the modules will void your warranty.
Cleaning
Do not immerse or spray the module
If the surface is dirty: clean with a dry cloth
In case of dirty ventilation grids: clean with a dry brush

2.4.3.6 Decommissioning

To remove and put out of order a servo drive DI2020 (replacement, dismantling) follow the procedure below:
• Disconnect the supply voltage of the electrical panel and wait
• Check that the heat sink and the mechanical parts temperatures aren't still too high
• Loosen all connections and disconnect them
• Remove the module from the electrical panel

2.4.3.7 Repairs

The servo drive can be repaired only by the manufacturer; the opening of the modules will void your warranty.
Perform decommissioning procedure and send it back to the address of the manufacturer indicated on the product nameplate; if available use the original packaging material.

2.4.3.8 Disposal

In accordance to the 2012/19 / EC Directive all electronic devices are "special waste" and should receive proper professional disposal treatment; after notification, the old modules and their accessories may be returned, at the sender's expense, to be treated and sent to the right disposal facility.

3. TYPE APPROVALS

3.1. EC

According to EU directives, drives shall conform to:

- the EMC Directive 2004/108/EC
- the Low Voltage Directive 2006/95/EC

The DM2020 has been tested in an authorised laboratory to check the parameters on the basis of which conformity to the above Directives is declared.

As regards electromagnetic compatibility, the DM2020 refers to C3 category industrial environments.

CAUTION
In a domestic environment, the DI2020 may emit radio frequency disturbance
ATTENTION
Dans un environnement domestique, le DI2020 peut émettre des perturbations des fréquences radio

INFORMATION
The manufacturer of the end machine or equipment MUST NOT use drives without documentation guaranteeing conformity to the requirements of the Machinery Directive 2006/42/EC

MOOG

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www.moog.it

CENELEC Memorandum N°3

DICHIARAZIONE CE DI CONFORMITA'/ *EU DECLARATION OF CONFORMITY*

Il sottoscritto, rappresentante il seguente costruttore / *The undersigned, representing the following manufacturer*

MOOG ITALIANA S.r.l., Sede di Casella / *Casella Site*
Via Avosso 94, Casella (Genova), Italy

dichiara qui di seguito che i prodotti / *herewith declares that the products*

Marchio / Brand : MOOG
Azionamenti Integrati Serie / Integrated Drives Series: DI2020

risultano in conformità' a quanto previsto dalle seguenti direttive comunitarie / *are in conformity with the provisions of the following EC directives*
(comprese tutte le modifiche applicabili / *including all applicable amendments)*

rif./ *ref* nr	titolo / *title*
2014/30/EC	Direttiva Compatibilità Elettromagnetica/ EMC Directive
2014/35/EC	Direttiva Bassa Tensione/ *Low Voltage Directive*

e che sono state applicate le norme armonizzate, o parti di esse, indicate di seguito / *and that the following harmonized standards, or parts thereof, have been applied*

nr	*issue*	titolo / *title*
EN 61800-5-1	2009	*Adjustable speed electrical power drive systems.* Part 5-1 *Safety requirements. Electrical thermal and energy* Azionamenti elettrici a velocità variabile Parte 5-1:Prescrizioni - Sicurezza elettrica, termica ed energetica
EN 61800-3: 2004 EN 61800-3/A1	2012	*Adjustable speed electrical power drive systems. Part 3: EMC product standard including specific test methods Amendment 1* *Azionamenti elettrici a velocità variabile Parte 3: Requisiti di compatibilità elettromagnetica metodi di prova specifici Amendment 1*
EN 60034-1	2010	*Rotating electrical machines. Part 1: Rating and performance* *Macchine elettriche rotanti. Parte 1: Caratteristiche nominali e di funzionamento*
EN 60034-5:2001 EN 60034-5/A1	2007	*Rotating electrical machines. Part 5: IP Code Amendment 1* *Macchine elettriche rotanti. Parte 5: Codice IP Amendment 1*

Altri riferimenti o informazioni richiesti dalle direttive comunitarie applicabili / *Other references or information required by the applicable EC directives:* La conformità dei prodotti è subordinata al rispetto delle procedure contenute nel "Manuale di installazione". L'utilizzatore ha la responsabilità primaria nel seguire le raccomandazioni del costruttore riguardo alle problematiche EMC./ *The conformity of products is subjected to observation of the procedures included in the proper "Installation Manual". The user has the primary EMC responsibility in following the recommendations of the manufacturer.*
Ultime due cifre dell'anno in cui e' stata affissa la marcatura CE / *Last two digits of the year in which the CE marking was affixed*: 17

Casella, 17 Marzo, 2017

Gianfranco Costa

OPERATION MANAGER

3.2. Safety and Safe Torque Off (Blocking on restart)

The DI2020 includes the Safe Torque Off (STO) function, according to standards EN 61800-5-2; EN/ISO 13849-1:2006. (SILCL 3 PL "e" (as certified below). The function also corresponds to an uncontrolled stop, according to the 0 stop category of IEC/EN 60204-1.

Function validation is based on:

- a guarantee that a single failure does not result in loss of the safety function
- some, but not all, possible failures may be identified
- the sum of several unidentified failures may result in loss of the safety function

The residual risk if two failures occur concurrently in the same power section is that the motor rotates at an angle dependent on the number of polar pairs of the motor; for example, a 6-pole motor will generate a maximum rotation of 60°.

WARNING

Themanufactureroftheendmachineand/orequipmentmustcarryoutandprovideresultsofariskanalysisof the machine according to ISO12100 and ISO14121 and take all measures necessary to prevent unforeseen movementsthatmay harmpersonsordamageproperty.Inparticularthemanufactureroftheendmachineand/ orequipmentmustensure conformitytorelativeproductstandards.

AVERTISSEMENT

Le fabricant de la machine et / ou de l'équipement final doit exécuter et fournir les résultats d'une analyse de risque de la machine selon ISO12100 et ISO14121 et prendre toutes les mesures nécessaires pour empêcher des mouvements imprévus qui peuvent nuire aux personnes ou endommager des biens. En particulier, le fabricant de la machine et / ou de l'équipement final doit assurer la conformité à toute norme spécifiques relatives aux produits mêmes.

Where safety functions are based on electrical/electronic devices (SCRF), the safety integrity levels (SIL) and functional requisites must be indicated for these functions.

Based on CEI EN 62061, this speci cation must include all data that may affect design of the electrical/electronic device, including, where applicable:

- Operating conditions of the machine
- The priority of functions that may be enabled concurrently and cause conflictual actions
- The operating frequency of each SCRF
- The required response time of each SCRF
- A description of each SCRF
- The interface of each SCRF with other machine functions
- A description of the reactions to failure and constraints relative to machine restart, when the reaction to failure causes the machine to stop
- A description of the operating environment
- Tests and associated equipment (e.g. access hatches)
- The frequency of operating cycles and factor of use in operating cycles

4. ELECTRICAL AND MECHANICAL INSTALLATION

4.1. Tools and instruments

We recommend that you have the following tools for installing the various modules:

- Screwdriver Tork T25 (fixing BUS BAR feeder link)
- M4 Cross screwdriver (wall mount for DM2020 power supply)
- M3 Phillips screwdriver (BUS BAR Feeder Protection)
- M8 screws for mounting the DI2020 to the machine

Instruments:
No specific instruments are necessary. However a digital multimeter is advisable, to check voltage, continuity, make comparisons and take readings..

4.2. Mechanical installation

4.2.1. Assembly of components

4.2.1.1. Assembling the power supply

Standard vertical assembly.
Assembly material: 2 M6 cheese-headed screws.
In the case of horizontal assembly, please contact the Applications Department to verify the application.

4.2.1.2. Positioning of brake resistors

Position at the top of the distribution board to facilitate the loss of heat produced.
Installation with brackets supplied for a standard resistor.
Installation on the heat sink (not supplied) for the optional resistor (armoured).

4.2.1.3. Assembling the axes

Mounting Material:

4 screws M8 for fastening to the machine through the appropriate slots of the motor flange.

4.2.1.4. EMC Filters installation

To install filters, follow the instructions to install the power supply.

4.3. Electrical installation and thermal sizing

4.3.1. Safety and general instructions for the board

WARNING
When the drive is operating, there is a risk of death, serious injury or serious material damage
AVERTISSEMENT
Lorsque l'entrainement est en marche, il existe un risque de mort, blessures graves ou dommages matériels importants.

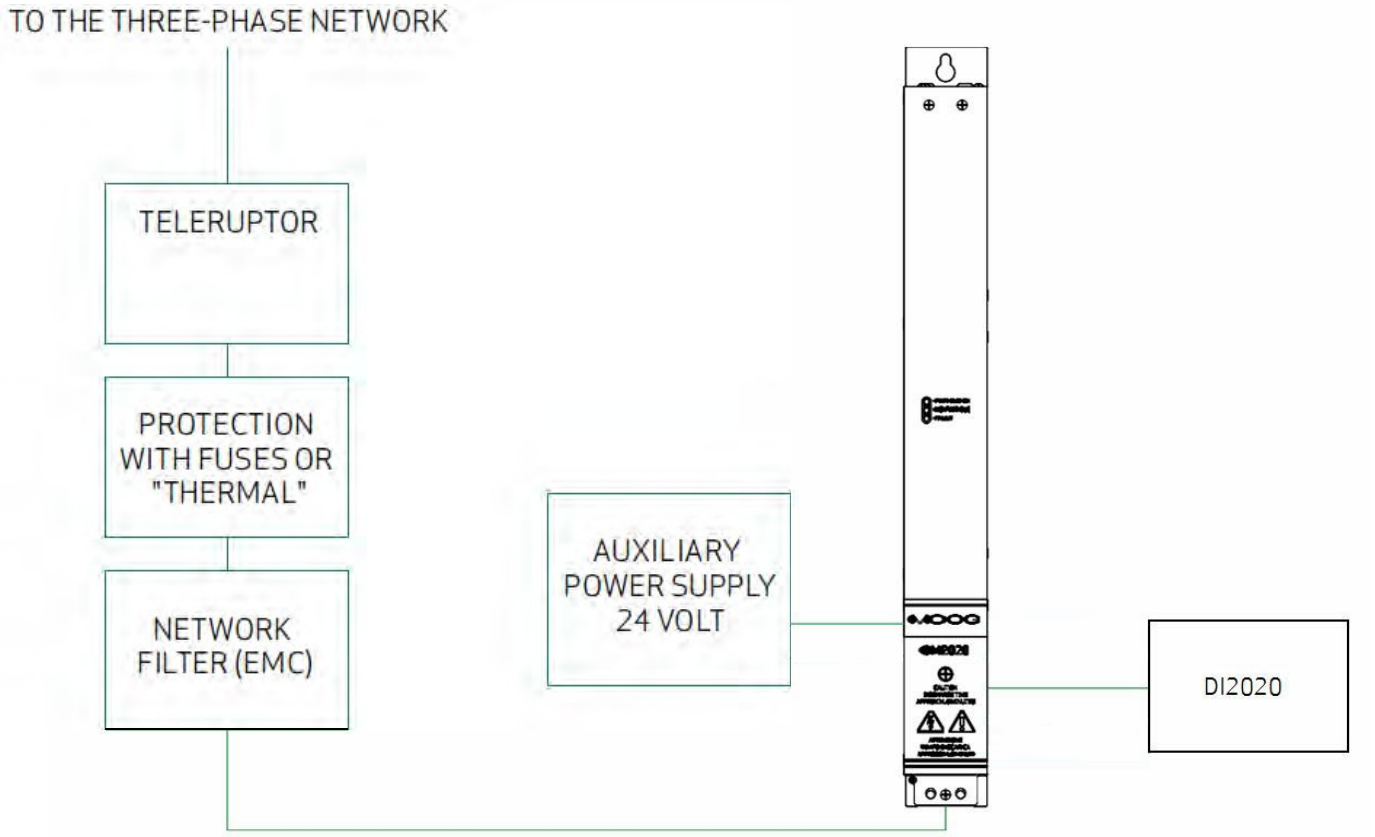


Fig 4.1 Diagram of the distribution board with components for a servo system

Special attention must be paid to the earthing, shielding, use of the filter to reduce or stop particularly steep voltage edges (resulting from PWM modulation) that can generate significant unwanted current through electrostatic couplings and earthing systems. These voltage edges can also generate high frequency irradiated disturbance, above all through the motor cable.

Filters installed on the network will reduce conducted disturbance: See section "Filters" for recommended models.

There are usually two types of problem regarding earthing in boards:

- The (high frequency) EMC earth comprising a portion of an unpainted metal wall, where the drives are positioned and the filters, creating an electrical contact that is adequate for attenuating high frequency disturbance.
- Protective earth (PE) according to EN60204-1, using conductors with a minimum cross-section equal to 10 mm^2.

As regards shielding, all power and control cables must be shielded except for cables running from the mains to the power filter; the shielding of these is linked to the layout of the board, and may not be necessary.

Usually the shield must be connected at each end. In some cases, control cable shielding may be connected at one end only, to eliminate network noise that could interfere with the control signal.

Indications for laying connection cables:

- Do not overlap power cables with signal cables
- The shielding cover must be greater than 70 %
- Do not lay power and signal cables side by side, in particular not close to the power filter, and make sure they are physically separate
- Make sure no loops form in the cables. Keep cables as short as possible and close the potential correctly.
- Keep power supply cables separate from the motor cables
- If the motor is equipped with a stop brake, keep the 24 V brake cables separate from the signal cables; (feedback) unless these are already incorporated in the motor power cable.

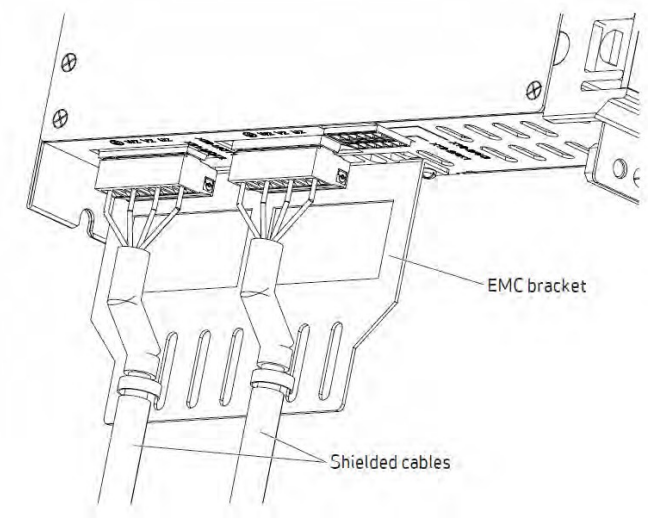


Fig 4.2 Detail of connection between cables and EMC bracket

4.3.1.1. Thermal sizing of the board

4.3.1.2. Dissipation of the power supply unit

% Rated current	Type L50	Type L150
0	25	35
25	75	150
50	125	250
75	175	350
100	225	450

The rst column shows the percentage of current delivered compared to the rated current. The second column shows dissipation data in watts in operating conditions.

4.3.2.3. Dissipation of the axes

% Rated Current	CR6 122 X X X XX XX	CR6 142 X X X XX XX	CR6 222 X X X XX XX	CR6 242 X X X XX XX
0	25	25	25	25
25	50	75	100	125
50	75	125	150	150
75	100	175	200	200
100	125	225	250	275

Warning: the DI2020 normally are installed externally to the board and should not be considered in the thermal calculation of the board itself.

4.3.1.4. Thermal dissipation of the accessories

Device	Dissipated power (W)
Network filter for power supply L50	30
Network filter for power supply L150	50
Standard brake resistor	370 or 1000
Optional brake resistor	500

INFORMATION

If possible, the brake resistors should be assembled outside the distribution board, adequately protected from accidental contact, to avoid having to eliminate the heat they generate in the distribution board

4.3.2. Auxiliary power supply features

Auxiliary power must be 24 V with tolerance +/- 10% and "Ripple" less than 200 mV.
The absorbed current will depend on which and how many modules make up the system. The maximum required current will be the sum of the currents required by each component. Place the DI2020 with the brake as close as possible to the DM2020

Modulo	Corrente assorbita (A)
Alimentatore L50	1,00
Alimentatore L150	2,00
DI2020 - 122/222	0,70
DI2020 142/242	0,70
Circuito Freno Motore	0,75

Tab 4.1 Auxiliary circuits input

CAUTION

Where a dedicated power supply for the motor brake is absent, it is important to ensure that the general auxiliary power supply system is correctly dimensioned and that the tolerances comply with those required by the brake which is being controlled

ATTENTION

Lorsqu'une alimentation dédiée pour le frein moteur est absent, il est important de veiller à ce que le système général auxiliaire d'alimentation est correctement dimensionné et les tolérances conformes à celles requises par le frein qui est contrôlé

4.3.4. Connection to the mains

WARNING

The drive must be correctly earthed to prevent injury or death. An insulation transformer must be fitted in mains networks which are not earthed or earthed asymmetrically

AVERTISSEMENT

L'entraînement doit être correctement mis à la terre pour éviter tout risque de blessure ou mort. Un transformateur d'isolation doit être installé dans les conduites maîtresses des réseaux qui ne sont pas mis à la terre ou avec mise à la terre asymétrique

4.3.4.1. Types of mains networks

TN-C network

The type of network shown in the figure is common in many industrial sites and has the following characteristics:

a) Direct mains connection (earthing point)

b) The control unit neutral and earthing of the entire plant are connected to a single connector, the PEN

c) All parts exposed to contact and shielding must be connected to earth

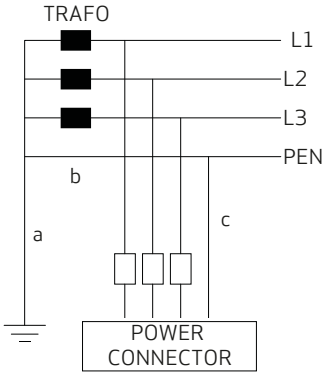


Fig 4.3 TN-C network

TN-S network

The type of network shown in the figure is the most widespread in Europe and has the following characteristics:

a) Direct mains connection (earthing point)
b) NA
c) All parts exposed to contact and shielding must be connected to earth

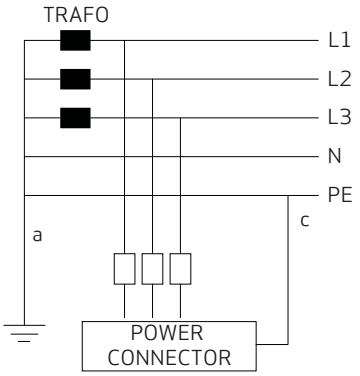


Fig 4.4 TN-S network

TT network

The mains in the figure is not very common and has problems with EMC requirements, which can only be fully met with in-situ measures. The main characteristics are shown below:

a) Direct mains connection (earthing point)
b) NA
b) All parts exposed to contact and shielding must be connected to earth

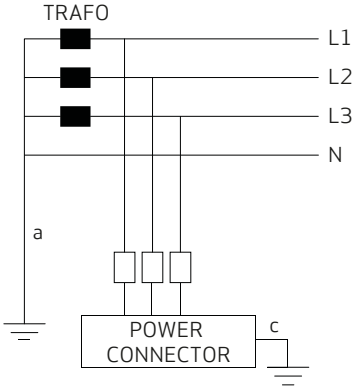


Fig 4.5 TT network diagram

4.3.4.2. Protection components

Fuses

Sizing network fuses: The size of fuses must be immediately greater than the sum of the currents of each module connected to the power supply (with a limit of 54 A, as per the power supply size L50 and 128 for a size L150).

Example: In a system comprising three modules (one size 50 mm 4+6 A module, one size 75 mm 24 A module) a fuse with a size immediately greater than 4+6+24 A=34 or a 36 A fuse will be used, in the instance that both axes are being used at once.

Safety switches for fault currents.

According to EN60204-1 on the electrical equipment of machinery, a safety switch can be used for fault currents, provided it complies with applicable regulations.

To protect from direct accidental contact, a safety switch for fault currents (dispersion) with a sensitivity of 30 mA must be installed on each axis-module/power supply system

The DI2020 does not require fuses on the auxiliary power supply and DC BUS.

4.3.4.3. Earth connection

Two types of earth are usually present in distribution boards:

- (High-frequency) EMC earth comprising an unpainted metal wall, to which the drives and filters are connected, creating an adequate electrical contact
- Protective earth (PE) according to EN60204-1 using conductors with a minimum cross-section of 10 mm^2

The length of the individual cables which connect to the earth must be minimal; for this reason, it is advisable to position an earth bar as close as possible to the drives.

4.3.5. Power supply unit wiring

4.3.5.1. Earthing

Connect the filter and power supply housing to the structure of the board, making sure the contact surface is adequate and the connection has low resistance and low inductance.

Avoid fitting the filter and power supply housing on painted surfaces.

4.3.5.2. Power supply cable connection

See section "Cables" for cable selection.

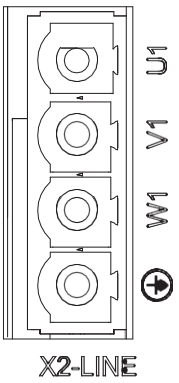


Fig 4.6 Connector X2

4.3.5.3. Brake resistor connection

See section "Brake resistor" for resistor selection.

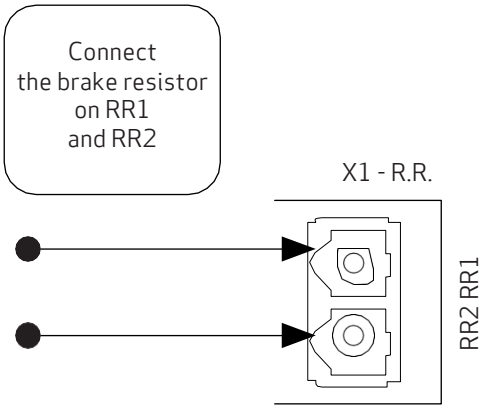


Fig 4.7 Fixed brake resistor connector

Use a shielded cable for the connection, with shielding closed on the drive side.

4.3.5.4. BUSBAR connection

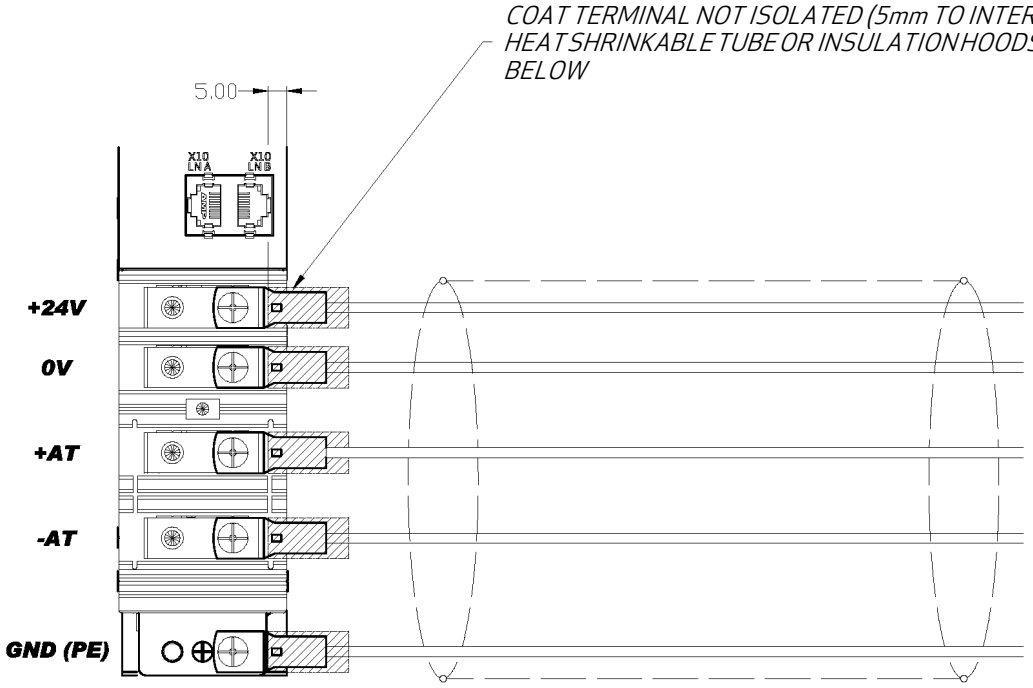
The +DC bus and -DC bus terminals of the power supply and axis modules must be connected in parallel. In this way, the power from the power supply and power from regeneration are divided between all axis modules. Only the BUSBARs provided with the drive must be used for connections.

WARNING

The user is responsible for the physical protection of the BUSBARs and other safety devices intended to prevent harm to persons: For this purpose, the front cover or two side covers provided with the drive must be used (on the two modules at each side of the system).

AVERTISSEMENT

L'utilisateur est responsable de la protection physique des BUSBAR et autres dispositifs de sécurité destinés à prévenir les dommages aux personnes: A cet effet, le capot avant ou le deux couvercles latéraux fournis doivent être utilisés (sur les deux modules de chaque côté)



Connection to DI2020

Cable section	16mm²	35mm²
Closure type	BM 01531	BM 017313
Heat shrinkable tube	TE VERSAFIT 318-0	TE VERSAFIT 112-0
Insulating hood	BM 81016	BM 81035

Note: For heat-shrinkable terminals and tubes, alternative brands may be used provided they are equivalent. The insulating hood is an alternative to the heat shrinkable tubing.

4.3.4.5. Auxiliary voltage and signal connection

The 24 V DC auxiliary voltage must be provided from an external source to the +24 V and 0 V terminals on the front panel.

4.3.4.6. Connecting Signals to the Power Supply

The power supply is equipped with a CAN (X10) connector which provides direct power to the drives' CAN line; the pin is the same as that one the axis modules. See section "Connectors and LEDs".

4.3.5. Axis module wiring

Connect the DI2020 to the DM2020 power supply using shielded cables with a sufficient section such as to ensure a negligible voltage drop towards the chain of connected modules (2.5 mm² minimum section recommended).

4.3.5.1. Earthing

Connect the module housing to the structure of the board, making sure the contact surface is adequate and the connection has low resistance and low inductance. Avoid fitting the module housing on painted or insulated surfaces..

4.3.5.2. Using the brake integrated in the motor

INFORMATION
During the definition of the brake connections, take into account the possible voltage drop across the cables that carry the power supply also to the logic sections of DI2020.

WARNING
Brake power is NOT derived from the drive, but is powered by a 24Volt auxiliary power supply; Keep in mind that it must provide braking power. In case of DI2020 in "cascade", if possible, place the modules with the brake at the beginning of the series.

The figure shows the functional and timing ratios between enable, activate and speed control signals. Engine brake times vary depending on the engine models to which the data is to be referenced.
The external brake activation command must reach the drive when the motor speed is close to or equal to 0. The delay introduced by the drive between the command reception and its transmission to the brake is less than 125 us. The brake activation delay depends on the type of brake and is specified by the Manifacturer

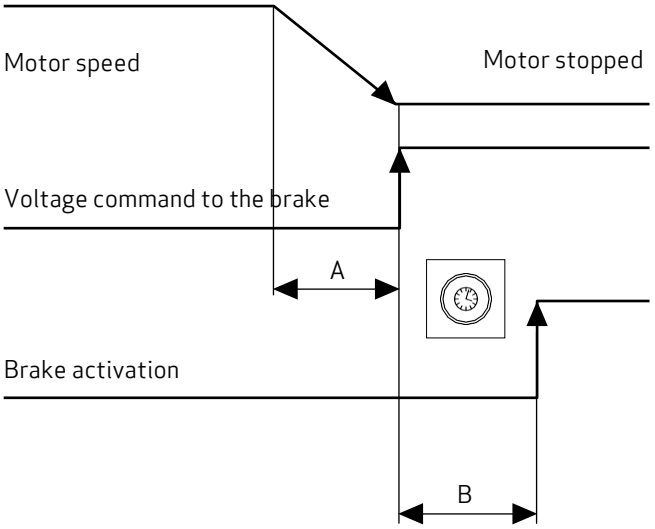


Fig 4.11 Diagram of brake activation times

A. Machine deceleration time (variable)
B. Brake activation (300 ms)

ATTENTION
The same information given for the motor cable applies, so particular care should be paid with shielding, even if the conductors are not already incorporated in the motor cable
ATTENTION
The use of the motor brake does not guarantee any personal safety. Vertical loads in particular require an additional mechanical brake to operate safely; using safety boards, for example

AVERTISSEMENT
La même information donnée pour le câble du moteur s'applique ici, donc un soin particulier doit être payé à la protection, même si les conducteurs ne sont pas encore intégrés dans le câble moteur
AVERTISSEMENT
L'utilisation du frein moteur ne garantit pas la sécurité personnelle. Les charges verticales en particulier exigent un frein mécanique supplémentaire pour fonctionner en toute sécurité; en utilisant des planches de sécurité, par exemple

4.3.5.3. Connecting the Fieldbus

Fieldbus dedicated connectors are X4 (In) and X5 (Out)

The input and output connectors have the same pin-out.

- CAN connection(*)

The same connector is used for the CAN interface.

For connection, use a cable end terminated with two 120 ohm resistors (first and last drive of the "chain"). The length of the cable that can be used to ensure secure communication diminishes as transmission speed increases. The following table can be referenced; FOR LENGTHS OVER 100 METERS please contact our Service for specific length / speed tests.

(*) in development

Transmission speed (kBaud)	Max cable length (m)
1000	10
500	60
250	100

5. COMMISSIONING USING THE GUI

The system is commissioned via the Dx2020 GUI operator interface.
For a detailed description of menus and procedures, please refer to the "Help" guide on the GUI itself.

5.1. Safety

WARNING
The drive may generate voltages up to 900 V, which are potentially lethal
Make sure all live parts are protected from contact with the human body

AVERTISSEMENT

L'entraînement peut générer des tensions jusqu'à 900 V, qui sont potentiellement létale Assurez que toutes les parties électrifiées soient protégés de tout contact avec le corps humain

CAUTION
Changes to parameters without previous checks may cause unexpected and incorrect machine movement

CAUTION
Only qualified personnel are authorised to configure the parameters of a drive in operation

CAUTION
Before making the drive operative, it is advisable to make sure all parameters are configured correctly

ATTENTION

Les changements de paramètres sans contrôles précédents peuvent provoquer un mouvement inattendu et incorrecte de la machine

ATTENTION

Seul le personnel qualifié est autorisé à configurer les paramètres d'un entraînement en fonctionnement

ATTENTION

Avant de procéder à l'opérateur d'entraînement, il est conseillé de vous assurer que tous les paramètres sont configurés correctement

ATTENTION
*When the drives are live, do not loosen the electrical connections. After removing the power supply voltage, capacitors may still have dangerous voltages up to **6**minutes after switching off the mains. To ensure that conditions are safe, measure the voltage on the intermediate direct-current circuit and wait until it has dropped below 40 V*

ATTENTION
During operation, the heat sink and rear panel may reach very high temperatures of up to 80 °C and are therefore a hazard for the operator's safety. Before operating, make sure the heat sink temperature is below 40 °C

ATTENTION
Before installation, the machine manufacturer must carry out an accurate risk assessment and take all measures necessary so that unforeseen movement of the machine does not harm persons or damage property

AVERTISSEMENT
Lorsque les entraînements sont électrifiés, ne pas desserrer les connexions électriques. Après avoir enlevé la tension d'alimentation, les condensateurs peuvent encore avoir des tensions dangereuses jusqu'à 6 minutes après la mise hors circuit. Pour assurer que les conditions soient sécuritaires, mesurer la tension sur le circuit de courant continu intermédiaire et attendre jusqu'à ce qu'il ait chuté en dessous de 40 V

AVERTISSEMENT
Pendant le fonctionnement, le dissipateur de chaleur et le panneau arrière peuvent atteindre des températures très élevées, allant jusqu'à 80 ° C et sont donc un danger pour la sécurité de l'opérateur. Avant de commencer, assurez-vous que la température du dissipateur de chaleur soit inférieure à 40 ° C

AVERTISSEMENT
Avant l'installation, le fabricant de la machine doit effectuer une évaluation précise des risques et prendre toutes les mesures nécessaires pour que le mouvement imprévu de la machine ne nuise pas à personnes ou puisse endommager des biens

5.2. Dx2020 GUI

5.2.1. General description

In addition to the drive, the device comes equipped with a graphical interface software called Dx2020 GUI, which allows the user to set and change the parameters and the configurationof the drives.

The main functions are:

- System configuration with access to the basic system parameters (transducers, digital and analogue I/Os, motor parameters, etc.)
- Calibration of the speed and position loops to personalise and optimise the drive response
- Direct control of the drive (jog mode, speed profile with internal generator)
- Commissioning
- Diagnostics
- Monitoring of the drive's internal variables and of the I/O signals
- Registration of the centre distance sizes via external memory support (memory card)
- Signal visualisation on 4-track digital oscilloscope
- Firmware updating, drive parameter management (saving, backup, etc.)

5.2.2. Minimum PC requirements

- Pentium® II 1 GHz processor or higher
- 512 MB of RAM
- 150 MB of free disk space
- Architectures supported x86 and x64
- Network connection for software download
- Onboard serial port, PCI adapter or USB-serial adapter, Ethernet port, CAN interface (IXXAT)

In order to function, the GUI uses the libraries .NET Framework 4.0, which have the following minimum space requirements:

- x86: 600 MB of free disk space
- x64: 1.5 MB of free disk space

Operating systems

- Windows XP Home Edition (Service Pack 3)
- Windows XP Home Edition (Service Pack 3)
- Windows XP Home Edition (Service Pack x64 3)
- Windows Vista
- Windows 7
- Windows 8
- Windows 8.1
- Windows 10

INFORMATION
There are other versions of Windows XP which are NOT supported by the .NET Framework 4.0.

Windows 8 and Windows 8.1 already have the .NET Framework 4.5 libraries installed, which are simply an update of the 4.0 version. Therefore users with these versions of Windows can download the installer without the .NET Framework 4.0.

INFORMATION
Users must have administration rights, both for installing and running the program

INFORMATION
If the SW system configuration does not satisfy the requirements indicated, it can be updated via the Microsoft Update site or via the update utility installed on the operating system

The following notes refer to a single-axis configuration; For a dual-axis configuration, the same considerations apply.

5.2.3. Dx2020 GUI Installation

Once the installer has been downloaded, launch by double clicking on it. Windows Vista and Windows 7 have a more advanced control system for starting applications than that on Windows XP, called UAC (User Account Control). Every time that any program is launched necessitating further administration rights, this system asks the user if they want to proceed.

The installation software must be requested from the Technical Assistance Service at Moog-Casella.

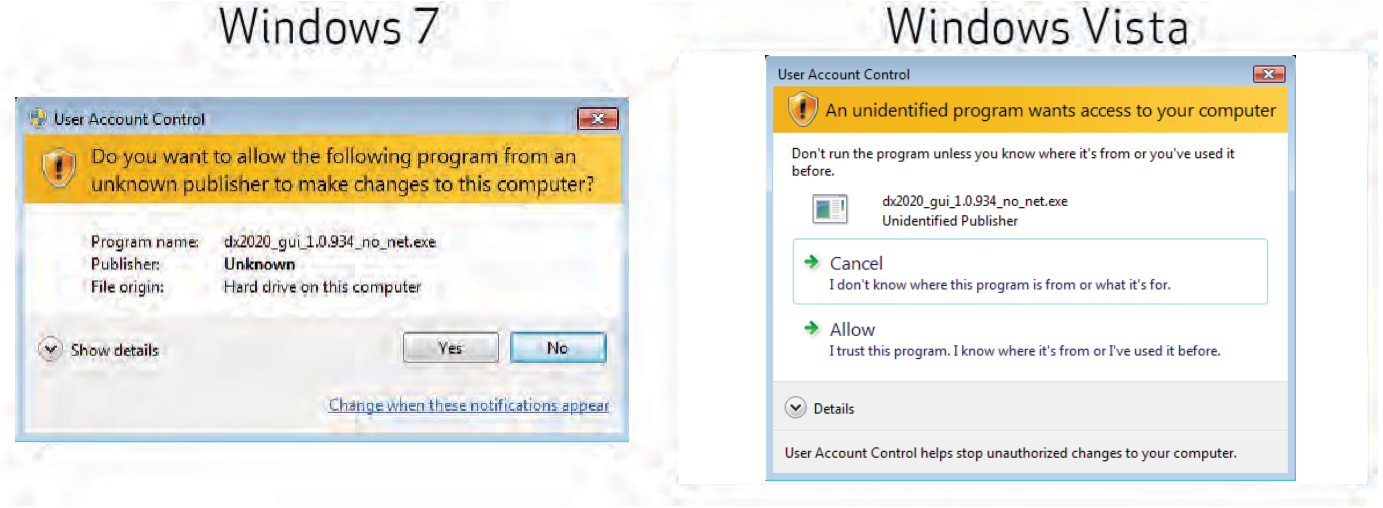


Fig 5.1 Differences in UAC notices

Click on yes or agree to proceed with the installation.

If the software is being installed for the first time on the PC, the user will be asked for language preferences on start-up.

As a default, if available, the program will automatically select the same language as that of the operating system as the first choice.

This setting is applied to both the installer language and the Dx2020 GUI application language.

The languages available are English and Italian.

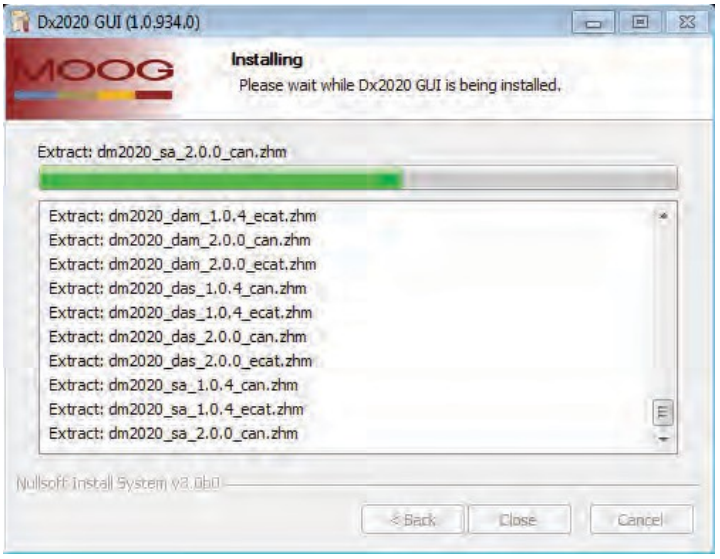
In any case, the language can also be changed from the GUI (Graphics User Interface) at a later time.

After the update, the program will proceed with the installation of the .Net, FrameWork 4, where this is not already present.

Installation of this last package will take between 5 and 10 minutes depending on the PC.

The installer will request the installation of additional components; some are installed automatically whereas others require user permission.

During installation, the steps performed by the installer and any installation errors can be viewed in a LOG window.



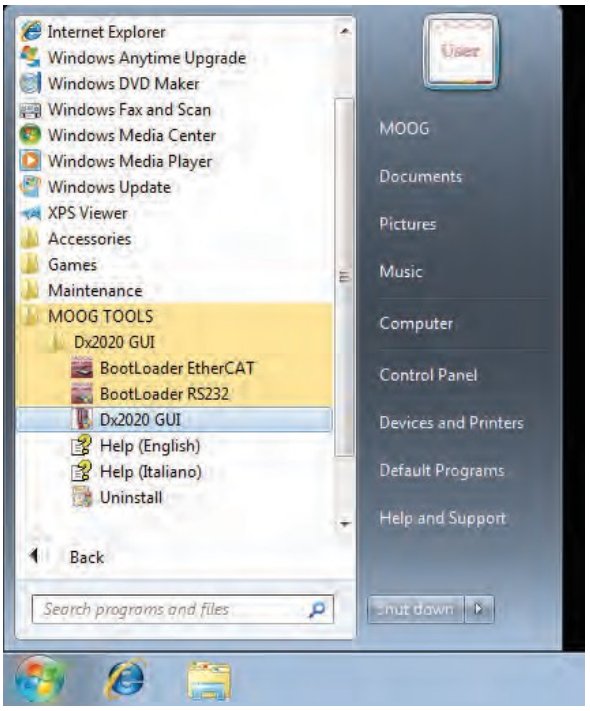
Once the installation has finished, click on **finish**.

Where errors occur during installation, pass the error message on to the Technical Assistance Service.

Once the program is installed, the Dx2020 GUI program icon will be visible.

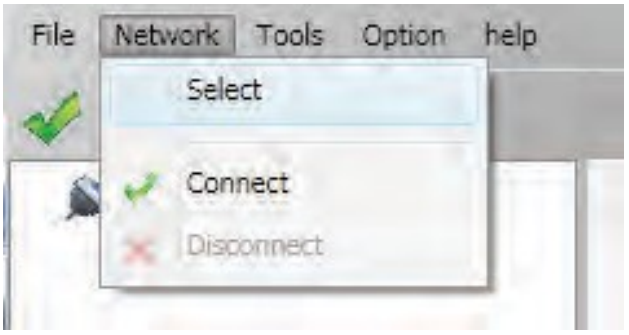
5.2.4. Connection GUI-drive

Launch the executable Dx2020 GUI.



The GUI can connect to the drive via the RS232 serial (X5 connector) or via EtherCAT (connectors X8-X9) or via CAN BUS (connector X10) (see section "Interfaces with "field" and other modules" for details on connectors).

From the Network menu, click on Select to select the type of communication protocol.



Refer to the pages on this in the Online Help guide for more information (see section "How to access the Online Help" for details on how to access this)

To make the connection, supply the driver with 24 V of power and wait for three seconds until the display on the front panel lights up and shows an alphanumeric digit (I, F, S, E).

Select the Connect command on the toolbar or via the Network drop-down menu.

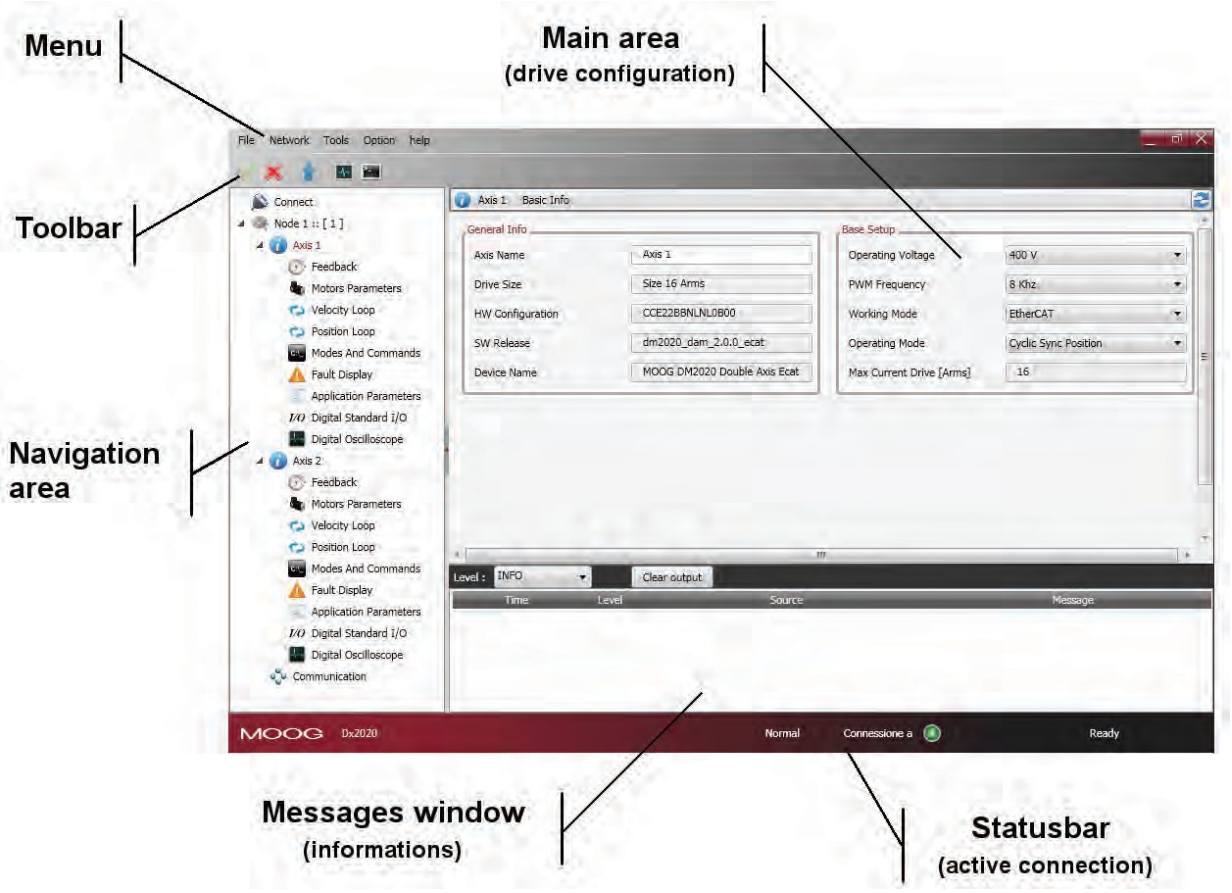
The status bar LED will turn green.

Wait for the GUI to connect to the drive and automatically upload the parameters.

INFORMATION
In the event of anomalies during connection, refer to the "Trouble Shooting" chapter and follow the steps recommended

5.2.5. Layout

When making the connection, the screen will display the following.



- Menu: The following menus are present: File, Network, Tools, Options and ?
  Refer to the Online Help on the application for more information.
- Toolbar:


Connect: Open the communication port selected


Disconnect: Close the communication port


Load all: Update all of the parameters of the connected axes


Monitor: Open the monitoring window


Terminal: Open the terminal form manual access


Load view: Update the parameters in the current view only

- Navigation area:
  The intuitive, organised structure of this area allows users to access all of the information they need, divided into views.
  Connections can be made to single-axis modules or dual-axis modules. For dual-axis modules, the rst axis shown is axis 1 (master), followed by axis 2 (slave).
  Each axis has a sub-menu which groups the parameters by function (transducer, motor, velocity loop, etc.).
  Clicking on the sub-menu in the main area will display the associated graphics window.
  The last element of the menu relates to the EtherCAT or CAN communication parameters (one per module).

- Main area:
  This area displays the information and parameters relating to the view selected in the navigation area.
  This window allows users to view and set DI2020 drive parameters.
  Refer to the Online Help on the application for more information.

This area is dedicated to displaying messages that may have different meanings. You can set a filter to display messages by type (ERROR, WARNING, INFO, DEBUG).

- Status bar:
  The status bar displays information on the status of the application.
  It indicates which protocol is currently in use, whether a connection is present, and the progress of operations across all views.

Refer to the Online Help present on the application for more information on the DM2020 program.

5.2.6. Updating firmware (Bootloader)

The firmware can be updated either via the RS232 serial or via the EtherCAT. The file to be downloaded has the extension *.zhm. The firmware is updated via dedicated applications (Bootloader EtherCAT and Bootloader RS232) that are installed at the same time as the Dx2020 GUI.

- The firmware can only be downloaded if the GUI is disconnected from the driver
- The procedure is accessed from the Menu/Tools tab on the menu bar
- Follow the relevant instructions on the Online Help present on the operator interface

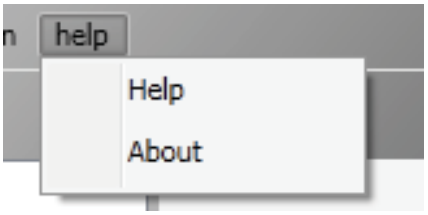
To access the dedicated tools: Go to PC Start/Programs/MoogTools/Dx2020 GUI/Bootloader/...

See the Online Help for details.

5.2.7. How to access the Online Help

This can be accessed in two ways:

1) Via the Dx2020 GUI operator interface: From the menu bar, select ?



2) From the PC Start menu/Programs/MoogTools/Dx2020 GUI/Help, in this case, it is not necessary to have launched the operator interface.

5.3. System configuration

After defining the communication and connecting to the drive, the following steps must be followed:

1. Identification of the single-axis modules
2. Configuration of I/O (*)
3. Configuration of control loops (torque, speed, position)
4. Configuration of faults
5. Application parameters
6. Definition of modes and commands
7. Power supply
8. Enabling the STO
9. Enabling

** in development*

Note: Configuration of motor parameters and transducers is carried out at the factory

5.3.1. Axis modules identification

Follow the instructions in the Online Help Guide on connections

5.3.2 Defluxing ("Field Weakening Algorithm")

If you require a maximum speed which is considerably higher than the nominal speed stated on the motor, click on "Activate deflux" which will allow the speed to increase beyond the nominal value, to the detriment of the continual torque generated, due to greater losses in the rotor at high speed. This function can be exploited automatically by enabling "Deflux"; contact the Applications Service for guidance on the maximum speed that can be set.

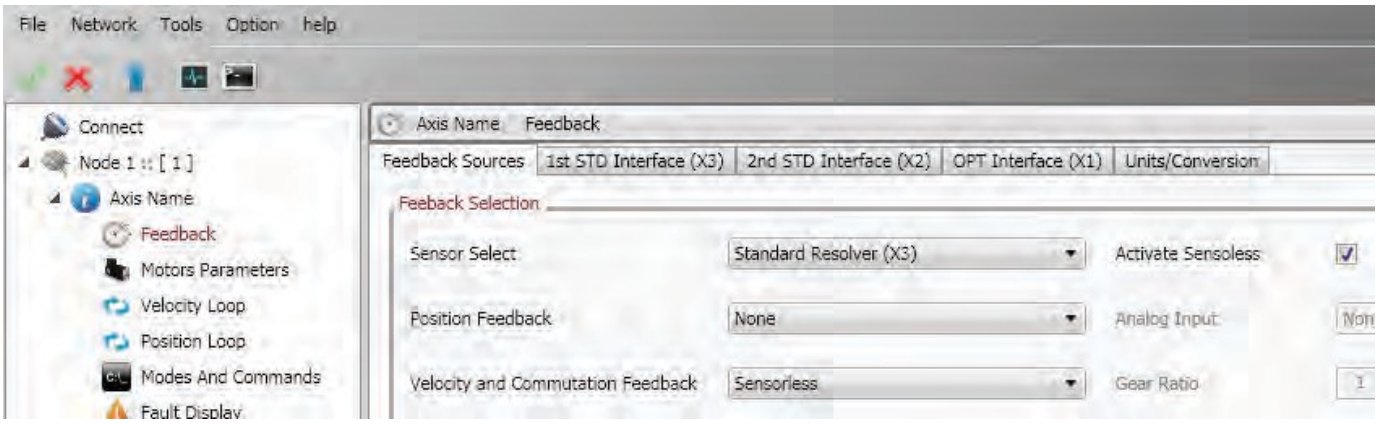
Where asynchronous IFOC motors are being used, the correct current Id and flow Sg can be requested from the Applications Service, providing the motor's electrical parameters to be checked.

The motor brake (if present) can be configured from the Motor Parameters tab. Link View Motor Brake.

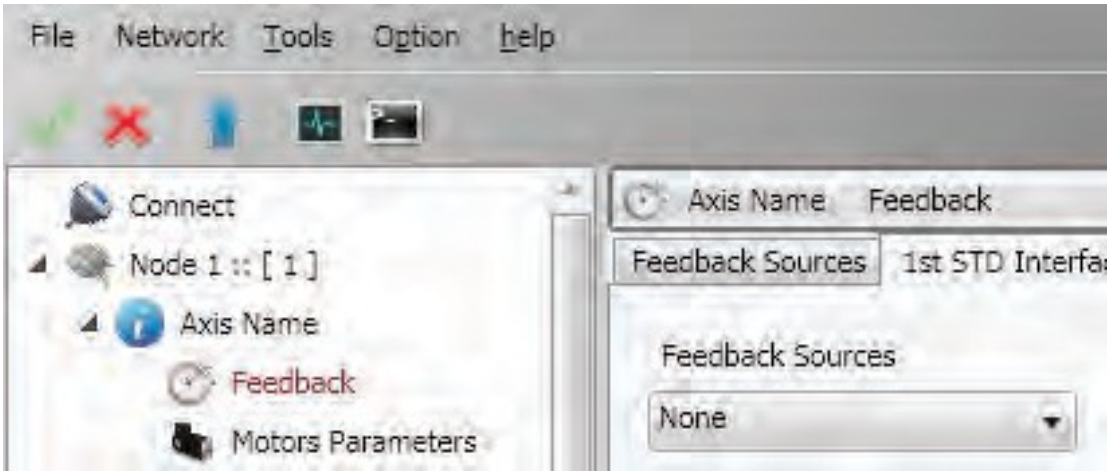
Refer to the Online Help for more information on configuration, selecting **Configuration Views/Motor Parameters.**

5.3.3.1. Sensorless

The DM2020 features the Sensorless operating mode, with no speed transducer.
In order to enable it, select Feedback from the navigation area.
Under the tab Feedback sources, set the fields as indicated in the figure.



Under the tab **1 STD interface (X3)**, set the fields as indicated in the figure.

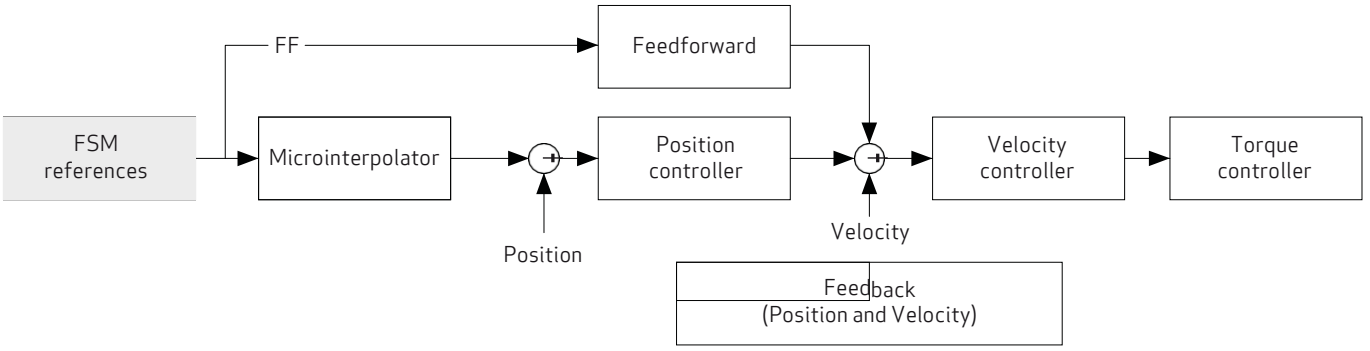


5.3.4. Control loops configuration

5.3.4.1. Control mode configuration

The DM2020 manages up to three control loops depending on the operating mode of the drive: The torque, velocity and position loop, each inside the other, with the torque loop innermost, the velocity loop intermediate and position loop outermost, so that the output of each loop is the reference for the next internal loop.

The following figure illustrates the general block diagram of the control structure



Depending on the structure chosen, the user will have to provide the reference torque, speed or position.

INFORMATION
The control loops must be calibrated by qualified personnel.

5.3.4.2. Torque loops parameters configuration

The torque loop (or current, given the direct proportionality) is the innermost. The parameters are set automatically from the motor data, which in turn is set via the Motor Parameters menu.

The user can configure the bandwidth passing through the closed torque loop via the Terminal window, setting the "bandPass" variable; the possible values are 3000 (default), 2000.1000, 600.400 in Hz.

INFORMATION
Changing the bandwidth with regard to the default value may result in reduced motor performance.

5.3.4.3. Speed loops parameters configuration

The speed control must ensure that the motor speed follows the speed reference as closely as possible, both in static and dynamic conditions. The quality of response from the system depends on the loop parameter settings.

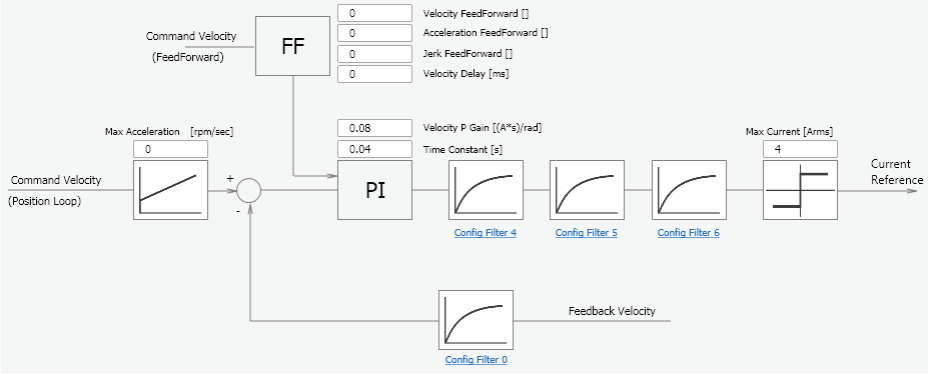
Basic velocity control is PI (proportional-integral) with an additional Feedforward (ff_calc) command, torque compensation and variable saturation (SAT_VARIABLE).

The proportional term produces an action; this is stronger the bigger the error, while the integral term (velocity error) corrects small errors that remain in time, due to constant disturbance and enables required targets to be reached.

The Feedforward block is used to minimise the velocity error in the case of disturbance known beforehand, directly contributing to the velocity reference processed by the PI regulation, with the linear combination of velocity, acceleration, jerk and delayed velocity in n samples references, calculated downstream the microinterpolator and makes it possible to minimise errors during transients.

The variable saturation block prevents the formation of fixed axis position instability (zero velocity reference, acting as a "low pass" filter with an extremely limited band.

To set the parameters, select Velocity loop from the Navigation area: A window will open showing the block diagram of the loop in question.



The standard network corrector (PI) is recognised, characterised by two parameters. Subsequently, there is a sequence of filters and one filter on the feedback chain; this allows for the use of more complex control structures, as well as filtering of known disorders (notch filter).

5.3.5 Filter Configuration

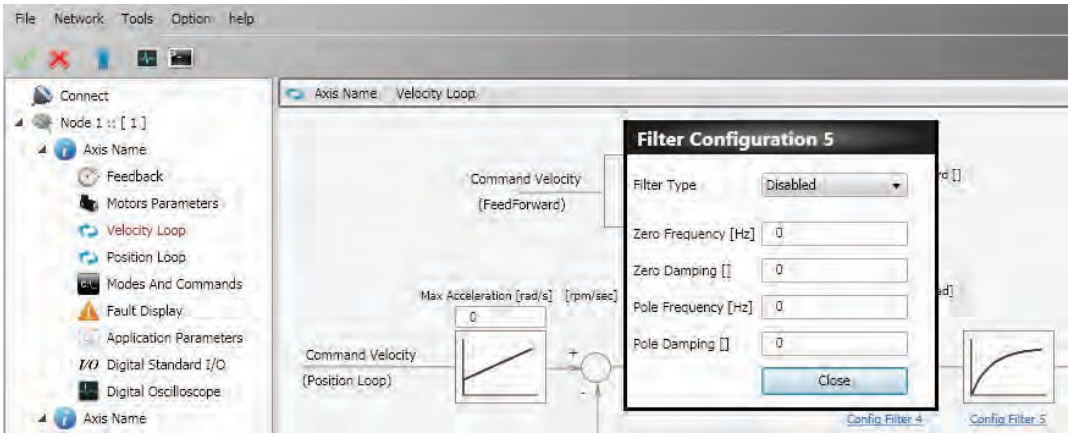
The four filters all have the same basic 2nd order IIR structure. They can be configured according to requirements (to access the configuration menu for each filter, click on the Config Filter link underneath each block)

Users can choose from the following types:

- Lag: The filter consists of a real pole and a real zero. The frequency of the pole and zero are entered, and have to be positive or zero.
- Bq: This is a standard biquad filter, with a pair of complex combined zeros and a pair of complex combined poles. The parameters that must be specified are:
  - Frequency of the zero
  - Damping of the zero
  - Frequency of the pole
  - Dampening of the pole

  The frequencies must be positive or zero. The damping factors must be between -1 and 1.
- Pole: The filter has a single real pole. The parameter to be specified is the pole frequency, which must be positive or zero.
- DbPole: The filter has two complex combined poles. The parameters that must be specified are:
  - Frequency of the pole
  - Dampening of the pole

  The frequency must be positive. The damping factor must be between -1 and 1.
- Dircoef: Enter the coefficients of the filter numerator and denominator (rarely used)



INFORMATION

Keep the filter deactivated until all other filter parameters have been entered

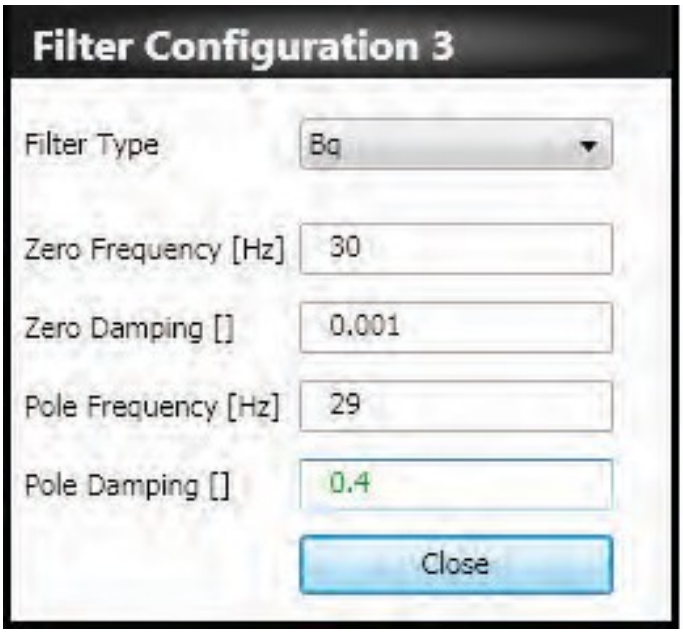
INFORMATION

The parameters must be entered according to an established order:

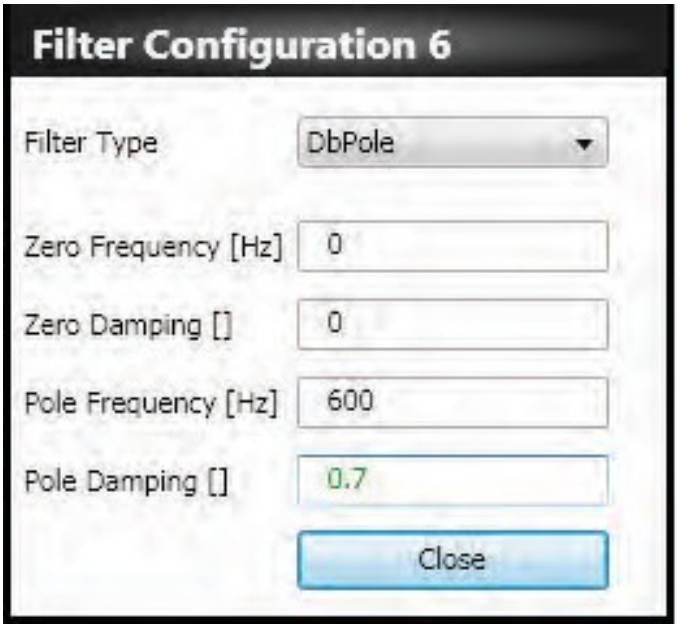
1. Damping
2. Frequency
3. Type of filter

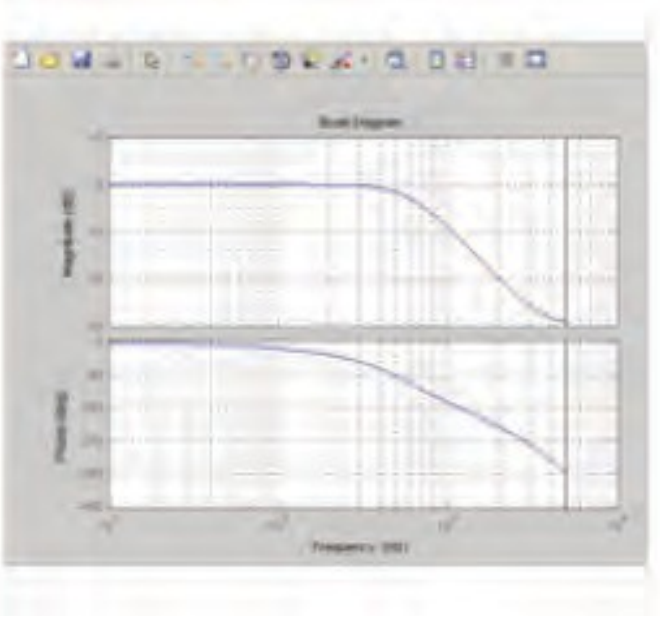
Examples of filters

Example of a notch filter configuration: You want to enter a notch filter centred at 30 Hz



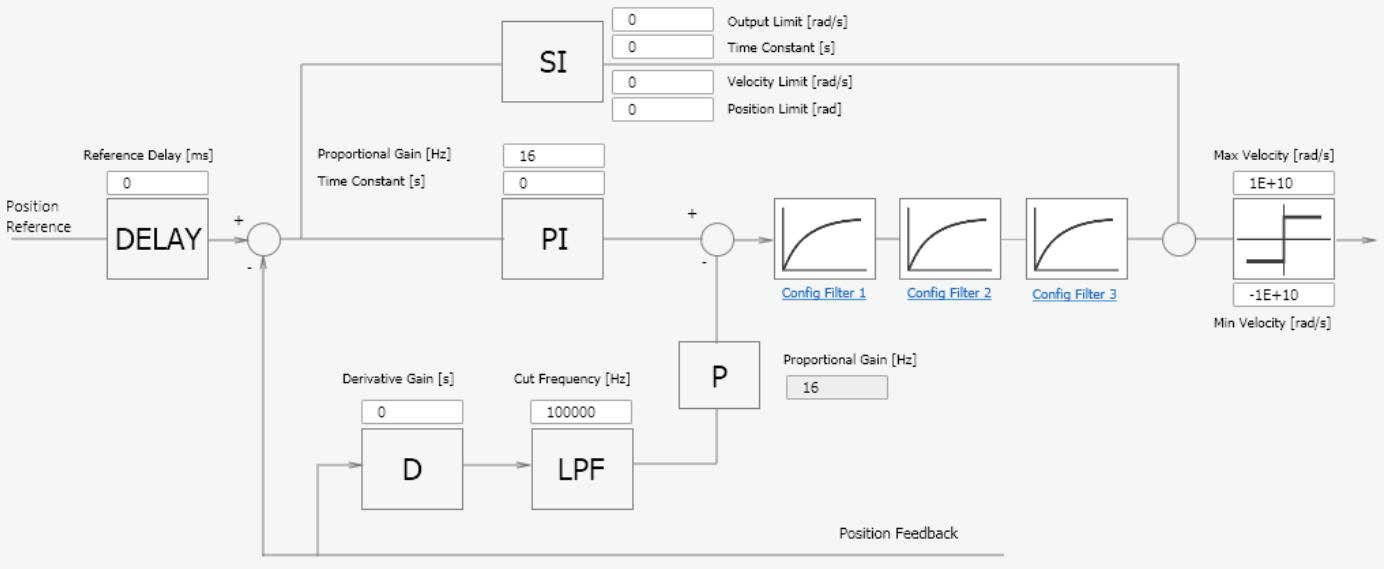
Example of configuration of a 2nd order low-pass filter





5.3.5.4. Position loops parameters configuration

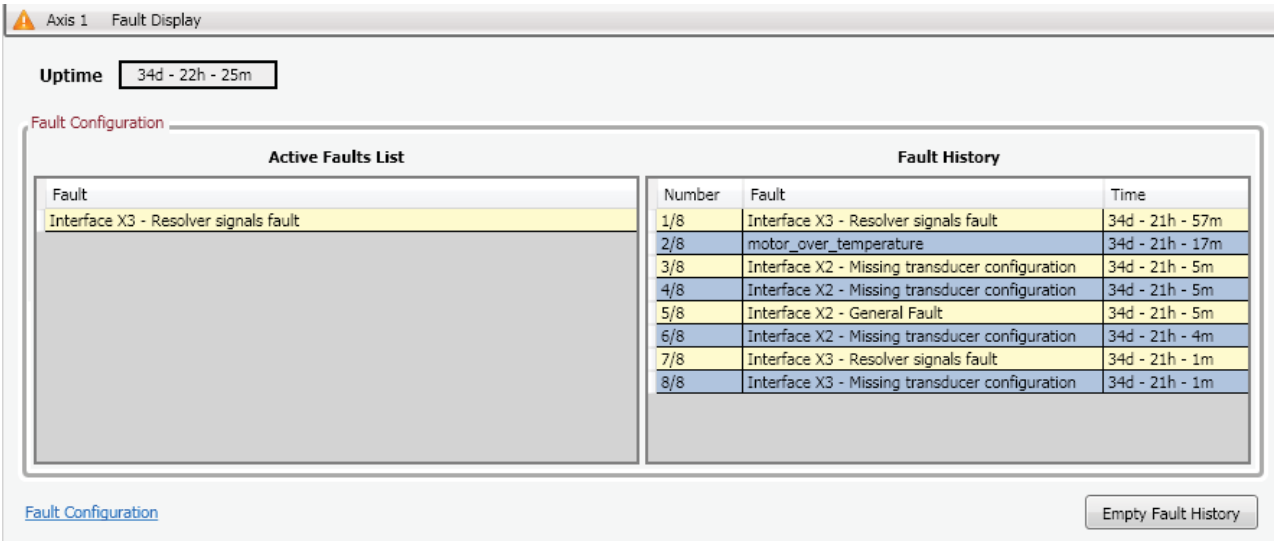
The position control must ensure that the motor speed follows the position reference as closely as possible. The quality of response from the system depends on the loop parameter settings.
The position control is PID-type (proportional-integral-derivative).
The proportional term products an action that is stronger the bigger the error.
The derivative term observes whether the error is increasing or decreasing, damping system behaviour.
The integral term cancels the steady-state error.
To set the parameters, select Position loop from the Navigation area: A window will open showing the block diagram of the loop in question.



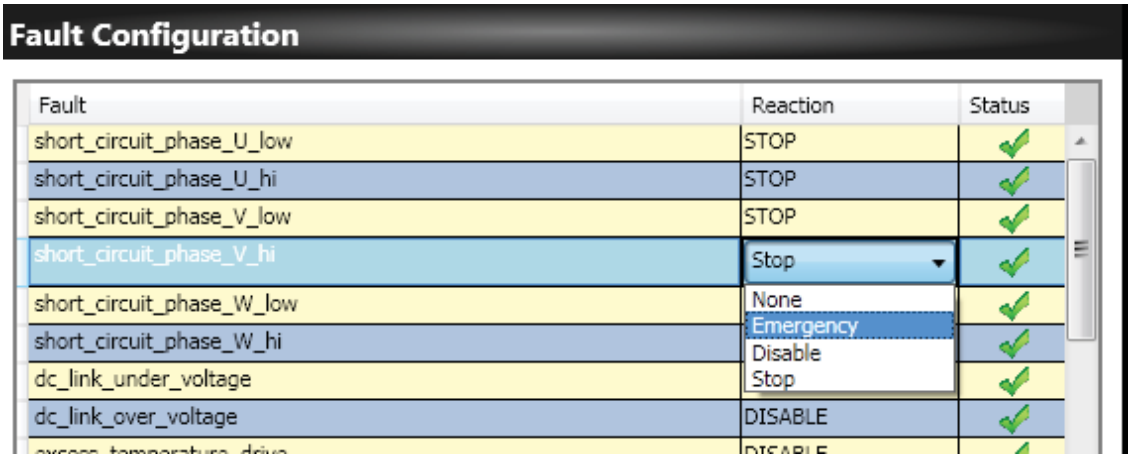
The standard network corrector (PID) is recognised, characterised by four parameters. There is subsequently a sequence of filters which allows more complex control structures to be implemented. See section “Configuration of filters” for setting filter parameters.

5.3.6. Fault configuration

From the 'Navigation area, select View Fault
The screen relating to the fault in question will appear. Any alarms active at that time will be listed on the left-hand side of the window (active fault list) and a list of the 8 most recent alarms will appear on the right-hand side (fault history).



The reaction of the drive to each alarm can be Configured individually by selecting the Fault Configurationlink
A window will open with a list of the faults which can be managed: A reaction can be chosen for each fault from a drop-down menu.

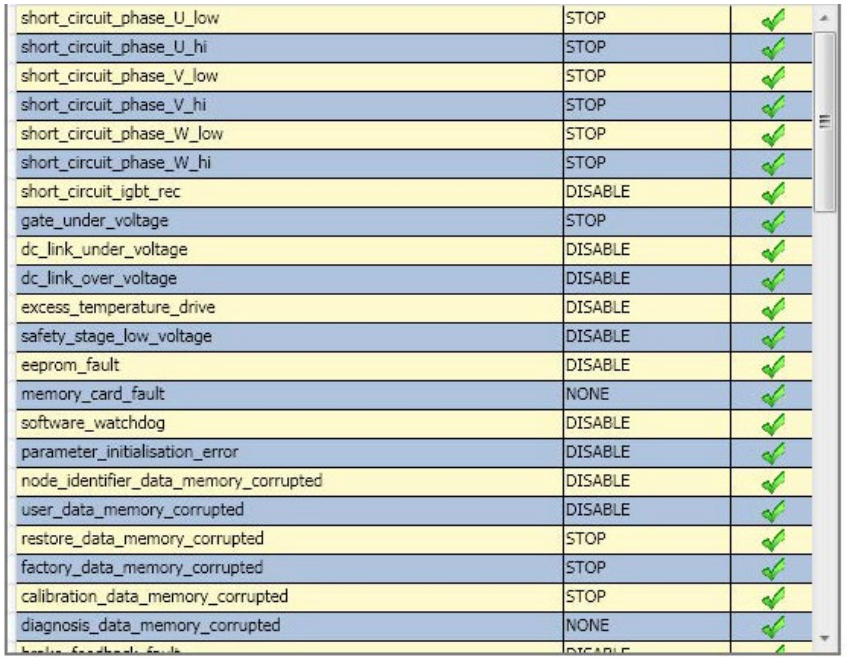


There are four options:

Reaction	Effect
None	The alarm is ignored *ATTENTION* *Onlyduringcommissioningortroubleshooting.Settingstobeavoided withthemachineinnormaloperatingconditions* *AVERTISSEMENT* *Seulement au cours de mise en service ou de dépannage. Paramètres à éviter avec la machine dans des conditions normales de fonctionnement*
Emergency	The drive sends an emergency message but is not stopped or disabled
Disabling	Disables the drive and carries out the con gured stop procedure (from Application Parameters/Fault Reactions
Stop	Immediate disabling; The drive stops motor control, if the moving axis continues to move due to inertia.

The most appropriate reaction must be programmed for each alarm, based on the machine's characteristics.
For some alarms, the Dx2020GUI prevents some reactions from being selected in order to guarantee the integrity of the drive (for example, it is not possible to activate emergency braking after “overvoltage”).

Here below some alarms on the DI2020:



short_circuit_phase_U_low	STOP
short_circuit_phase_U_hi	STOP
short_circuit_phase_V_low	STOP
short_circuit_phase_V_hi	STOP
short_circuit_phase_W_low	STOP
short_circuit_phase_W_hi	STOP
short_circuit_igbt_rec	DISABLE
gate_under_voltage	STOP
dc_link_under_voltage	DISABLE
dc_link_over_voltage	DISABLE
excess_temperature_drive	DISABLE
safety_stage_low_voltage	DISABLE
eeprom_fault	DISABLE
memory_card_fault	NONE
software_watchdog	DISABLE
parameter_initialisation_error	DISABLE
node_identifier_data_memory_corrupted	DISABLE
user_data_memory_corrupted	DISABLE
restore_data_memory_corrupted	STOP
factory_data_memory_corrupted	STOP
calibration_data_memory_corrupted	STOP
diagnosis_data_memory_corrupted	NONE

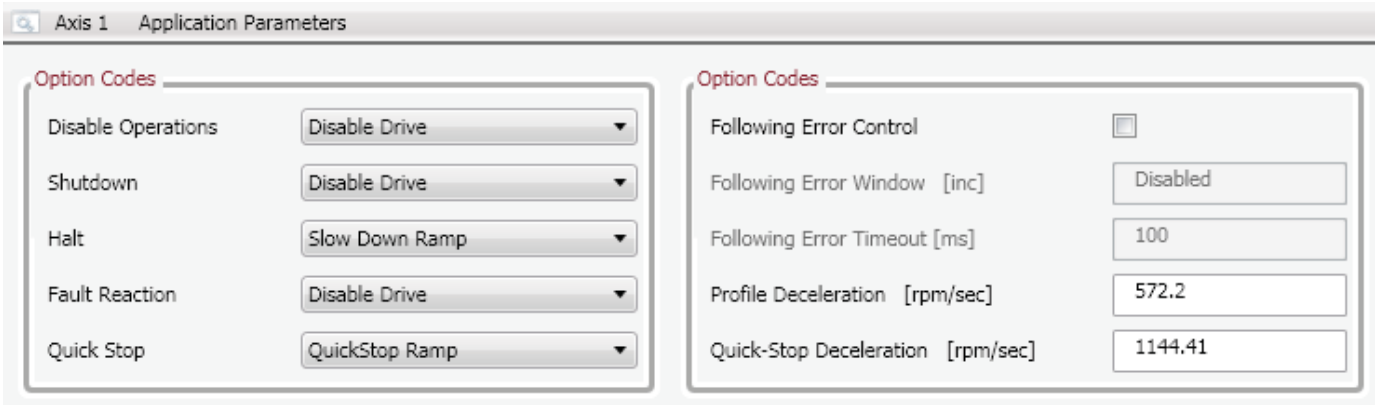
The faults listed below cannot be configured and the reaction is always “STOP”:

- short_circuit_phase_U_low
- short_circuit_phase_U_hi
- short_circuit_phase_V_low
- short_circuit_phase_V_hi
- short_circuit_phase_W_low
- short_circuit_phase_W_hi
- restore_data_memory_corrupted
- factory_data_memory_corrupted
- calibration_data_memory_corrupted

Contact Moog-Casella's Service for suggestions or specific checks.

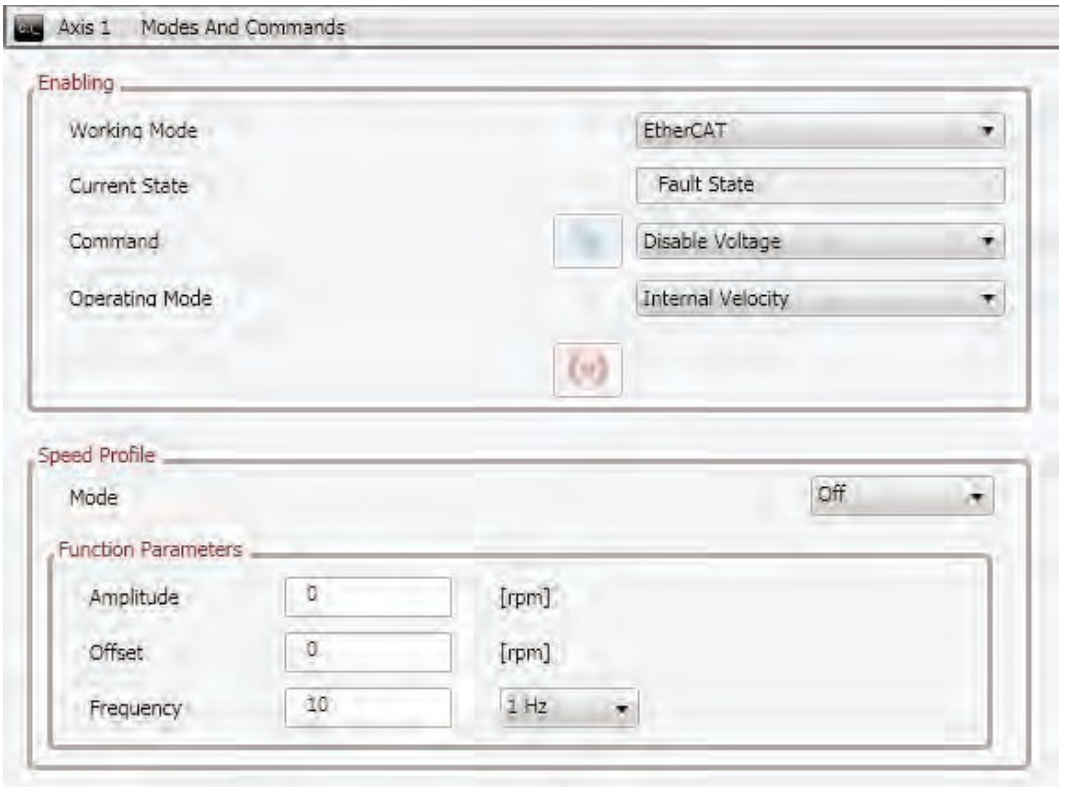
5.3.7. Application parameters

From this menu, it is possible to configure the drive reaction when specific events occur.



5.3.8. Configuration of modes and commands

This menu allows users to determine the origin of the controls and the function performed by the drive.



Operating mode

INFORMATION
Check that the firmware installed supports the selected fieldbus (with EtherCA fieldbuses, the firmware will have the filename extension _ecat, and with CA fieldbuses, the firmware will have the file extension _can).

The drive command source will be set. The following values can be chosen:

- EtherCAT
  The drive receives commands/set-points remotely via the EtherCA fieldbus (if supported by the drive)
- CANopen
  The drive receives commands/set-points remotely via the CAN bus (if supported by the drive)
- Local
  The drive receives commands/set-points from Dx2020 GUI
- Analogue
  The drive receives commands/set-points through con gured digital and analogue inputs (see Online Help, Con guration Views / I/O standard digital, for more information)

Current status

View the current status of the state machine (FSA - Finite State Automaton), defined in line with the standard DS402 which governs the drive (see below - state machine).

Command

Select the command which will be processed by the state machine of the drive. The command will essentially will be sent when the Send key is pressed; this key will only be enabled if the operating mode is set to “Local”

Operating mode

The operating mode – or the function performed by the drive – will be set. The following values can be chosen:

- Analogue speed

  The drive runs a speed control following a reference from an analogue input. A variable torque limit can also be set, again from the analogue input. Typical operating mode: Analogue)
- Analogue torque

  The drive runs a torque control following a reference from an analogue input. Typical operating mode: Analogue)
- Analogue torque

  The drive runs a torque control following a reference from an analogue input. Typical operating mode: Analogue)
- Internal speed

  The drive runs operates a speed control following a reference generated inside the drive itself (see function generator) (typical operating mode: Local)
- Internal torque

  The drive runs a torque control following a reference generated inside the drive itself (see function generator) (typical operating mode: Local)
- Cyclic Synch Position

  The drive runs a position control following a reference generated cyclically by a device/remote control. This is the Cyclic Synchronous Position Mode, as defined in the DS402 standard. Typical operating mode: EtherCAT/CANOpen)
- Cyclic Synch Velocity

  The drive runs a speed control following a reference generated cyclically by a device/remote control. This is the Cyclic Synchronous Velocity Mode, as defined in the DS402 standard. Typical operating mode: EtherCAT/CANOpen)
- Cyclic Synch Torque

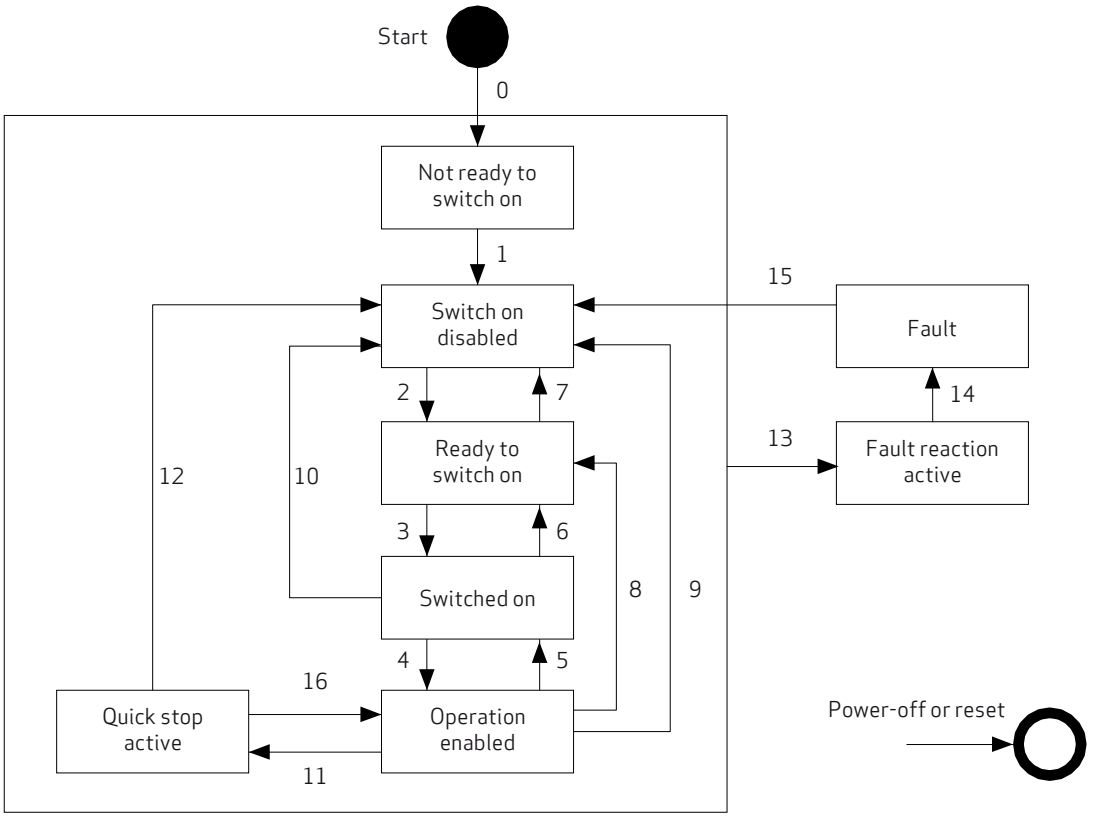
  The drive runs a torque control following a reference generated cyclically by a device/remote control. This is the Cyclic Synchronous Torque Mode, as defined in the DS402 standard. Typical operating mode: EtherCAT/CANOpen)

INFORMATION
There are other modes relating to specific applications; these are not described in this document

When the commands to the drive are of internal origin (e.g: Operating mode = Local, Operative mode = Internal speed) the different reference profiles can be categorised (Square, Triangle, Sawtooth, Keystone, Breast, Profile, Jog).

DI2020 state machine

Please refer to the Online Help, Configuration views/Modes and Commands, for details on the FSA



Function	FSA states							
	Not ready to switch on	Switch on disabled	Ready to switch on disabled	Switched on	Operation enabled	Quick stop active	Fault reaction active	Fault
Brake applied, if present	Yes	Yes	Yes	Yes	Yes/No	Yes/No	Yes/No	Yes
Low-level power applied	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
High-level power applied	Yes/No	Yes/No	Yes/No	Yes	Yes	Yes	Yes	Yes/No
Drive function enabled	No	No	No	No	Yes	Yes	Yes	No
Configuration allowed	Yes	Yes	Yes	Yes	Yes/No	Yes/No	Yes/No	Yes

Transition	Event(s)	Action(s)
0	Automatic transition after power-on or reset application	Drive device self-test and/or self initialisation shall be performed.
1	Automatic transition	Communication shall be activated.
2	Shutdown command from control device or local signal	None
3	Switch on command received from control device or local signal	The high-level power shall be switched on, if possible.
4	Enable operation command received from control device or local signal	The drive function shall be enabled and all internal set-points cleared.
5	Disable operation command received from control device or local signal	The drive function shall be disabled.
6	Shutdown command received from control device or local signal	The high-level power shall be switched off, if possible.
7	Quick stop or disable voltage command from control device or local signal	None
8	Shutdown command from control device or local signal	The drive function shall be disabled, and the high-level power shall be switched off, if possible.
9	Disable voltage command from control device or local signal	The drive function shall be disabled, and the high-level power shall be switched off, if possible.
10	Disable voltage or quick stop command from control device or local signal	The high-level power shall be switched off, if possible.
11	Quick stop command from control device or local signal	The quick stop function shall be started.
12	Automatic transition when the quick stop function is completed and quick stop option code is 1, 2, 3 or 4, or disable voltage command received from control device (depends on the quick stop option code)	The drive function shall be disabled, and the high-level power shall be switched off, if possible.
13	Fault signal (see also IEC 61800-7-301)	The configured fault reaction function shall be executed.
14	Automatic transition	The drive function shall be disabled; the highlevel power shall be switched off, if possible.
15	Fault reset command from control device or local signal	A reset of the fault condition is carried out, if no fault exists currently on the drive device; after leaving the Fault state, the Fault reset bit in the controlword shall be cleared by the control device.
16	Enable operation command from control device, if the quick stop option code is 5, 6, 7, or 8	The drive function shall be enabled.
NOTE: It is not recommended to support transition 16.		

5.4. Power supply

Provide three-phase power to the system and verify the correct sequence of LEDs on the power supply module (see section "Connectors and LEDs") and use the “Monitor” function on the GUI to verify the correct value of the DC BUS voltage (about 560 V) (see section “Layout”).

INFORMATION

The charging time of the DC bus depends on the number of modules and the value of the soft-start resistance used; with standard resistance, the time is around three seconds with two 50 mm modules connected.

5.5. Enabling the STO

The STO circuit must be activated to enable the axis

The 24 V power supply to the STO circuit must be integrated with the chain of emergencies.

See chapter 7.

WARNING

After working on connections, replacing parts and on initial plant start-up, the STO function should always be checked

WARNING

Do not access the protected area and do not touch any live part or high-voltage part of the drive

Openingofaprotectivedoormustcausethechainofemergenciestointervene(interruptionofmotorpower),alongwith theSTO

If the STO signal is not removed with the correct sequence, “F” (fault) is displayed

AVERTISSEMENT

Après avoir travaillé sur les connexions, le remplacement des pièces et le démarrage initial, la fonction STO doit toujours être vérifiée

AVERTISSEMENT

Ne pas accéder à la zone protégée et ne toucher aucune partie électrifiée ou la partie en haute tension de l'entraînement

L'ouverture d'une porte de protection doit provoquer la chaîne des urgences à intervenir (interruption de l'alimentation du moteur), avec le STO.

Si le signal de STO n'est pas annullé avec la séquence correcte, "F" (défaut) va apparaître.

5.5.1. “Autophasing”

INFORMATION
The motor must be free to rotate.

INFORMATION
The release of the brake, when present, is part of the autophasing procedure, both when configuring the automatic brake control and the manual control.

Autophasing is run by Dx2020 GUI software.

Once the motor parameters have been set, select “Modes and Commands” in the navigation area.

Check that the power supply and the STO are then press the following in sequence in the “Command field:

- “Power off”
- “Power on”, leaving the drive in this status

The drive will indicate enabling with an “S” on the display.

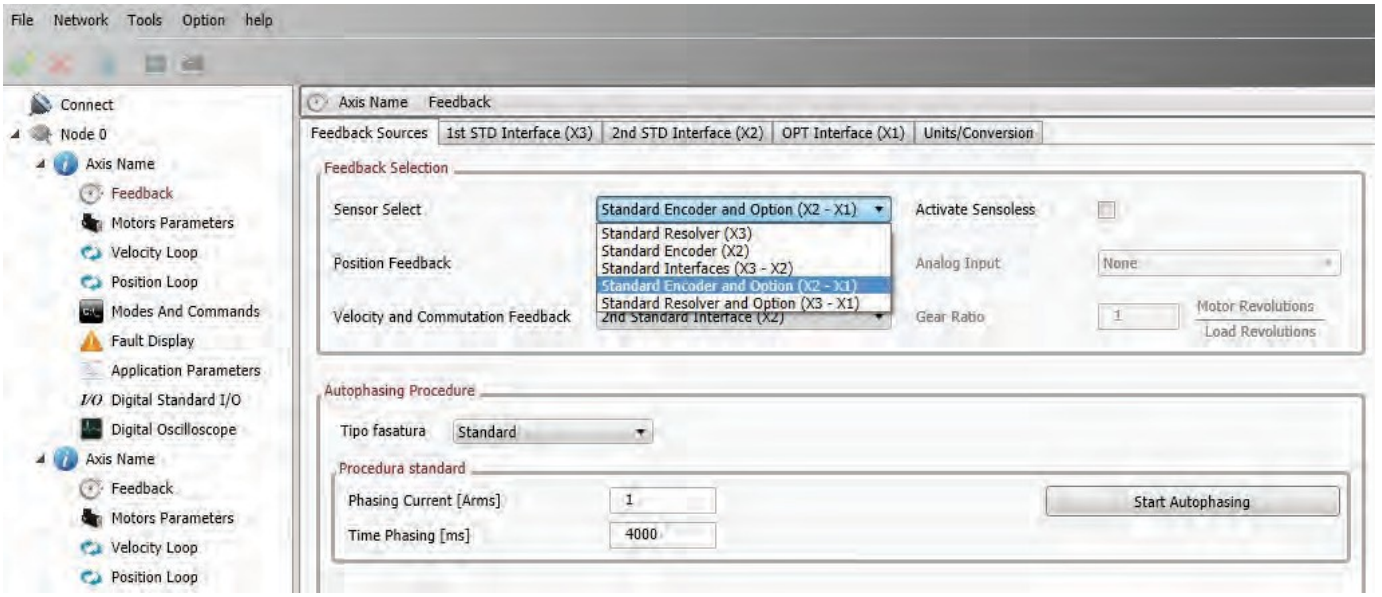
From the navigation area, select “Feedback”: Select the tab “Feedback sources”.

Con gure the timing current with a value equal to the rated motor current (Timing Current field).

Configure the timing time as required (set to a maximum value of 4 seconds).

Press the “Begin timing” button: The progress indicator will be displayed (green if OK, red if there are alarms).

By selecting the tab “1° STD interface ” or “2° STD interface ” or “Optional Interface”, the timing values for before and after the operation can be viewed in order to ensure that this process is taking place correctly.



5.6. Enabling the axis

The drive implements the DS402 pro le (standard Cia). The enabling of the drive depends on the application of a command which can be received remotely (fi eldbus (EtherCAT or CAN)), via HW (analogue function) or from the GUI (Local operation).

- Fieldbus (EtherCAT or CAN): Enabling is carried out by the Master (PLC) via Control-Word
- Analogue: Enabling is carried out by hardware, configuring the I/Os at the same time
- Local: Enabling is carried out by a command from the GUI (Mode and Commands/Command)

The sequence of commands for enabling is as follows:

1) Fault reset (if fault present)
2) Power off
3) Power on
4) Enable operation

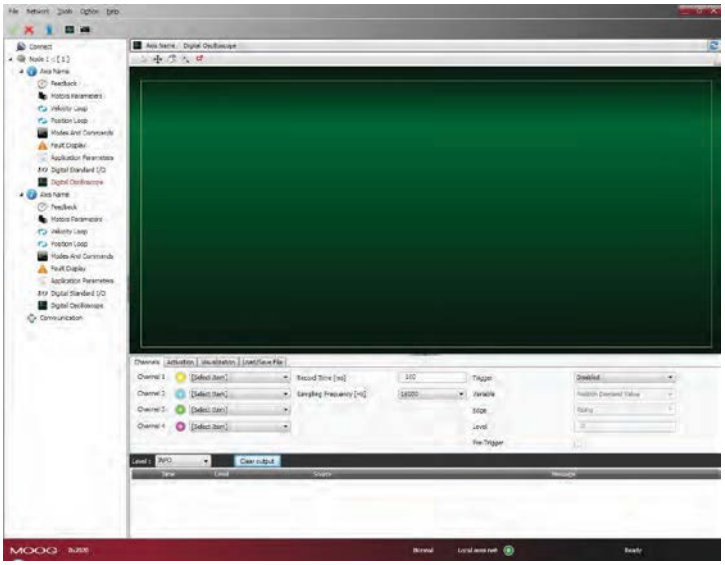
See the Online Help for more details.

5.7. Oscilloscope function and log files (".UCX")

From the Navigation area, select "Digital oscilloscope".

5.7.1. Configure recording

Select the "Channels" tab. For each channel, choose the variable you want to view from the drop-down menu.
The number of variables that can be accessed depends on the user access mode ("Advanced" or "Normal").
To change the access mode, select "Options/modes" from the toolbar and continue with your choice.
A maximum of four tracks can be viewed..
Set the duration of the recording in msec ("Recording time") and the "Sampling frequency" in Hz.
It is possible to trigger viewing (and recording) on a specific event by choosing "Enabled" from the "Trigger" field (choosing "Continuous" will automatically provide repeated views of the same event).
To con gure the trigger: Choose the trigger variable from those which appear in the drop-down menu in the "Variable" eld. Next, choose the front ("Ascent"/"Descent" in the "Front"f i eld) and the level of activation of the trigger (numeric value, in the "Level eld).
The setting of the "Pre Trigger" allows users to view up to 512 bytes before the signal is triggered.



5.7.2. Launch recording

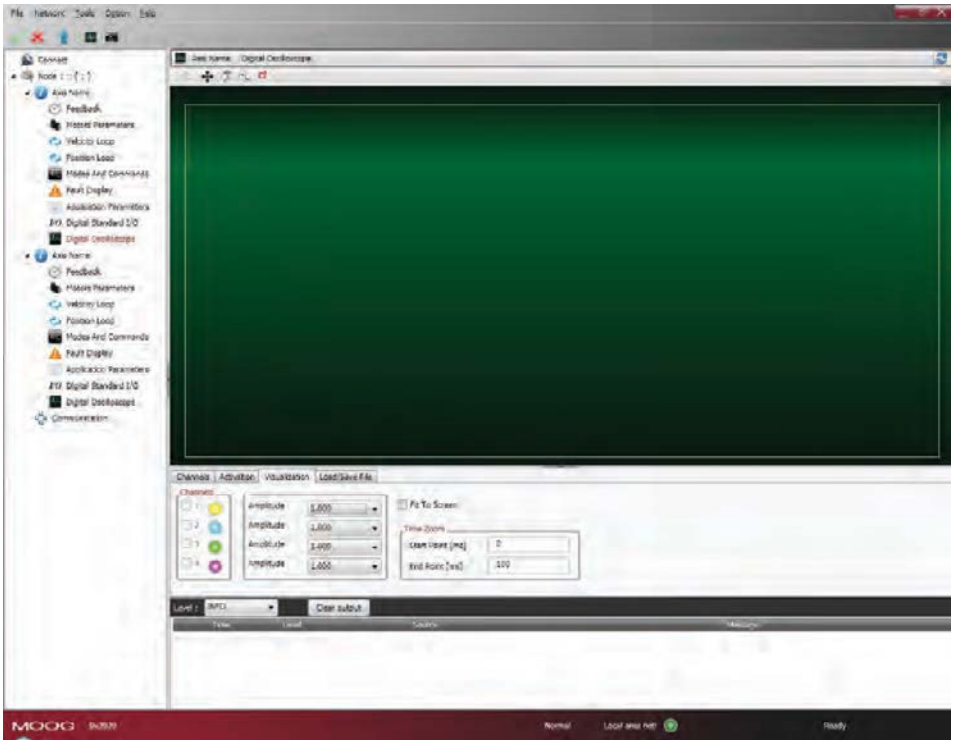
Select the "Activation" tab.
From the "Select output field, choose one of the three options from the drop-down menu:

- See in GUI: The sizes are only viewed and not recorded
- Local save: The sizes are viewed and saved on the PC in the directory indicated in the "Output folder field
- Save on memory card: The sizes are viewed and saved on the SD card inserted into the front slot

Launch recording by pressing the "Start" button and stop by pressing the "Stop" button.

5.7.3. View the record

Select the "View" tab
Once they have been retrieved, the data will be shown on the display.

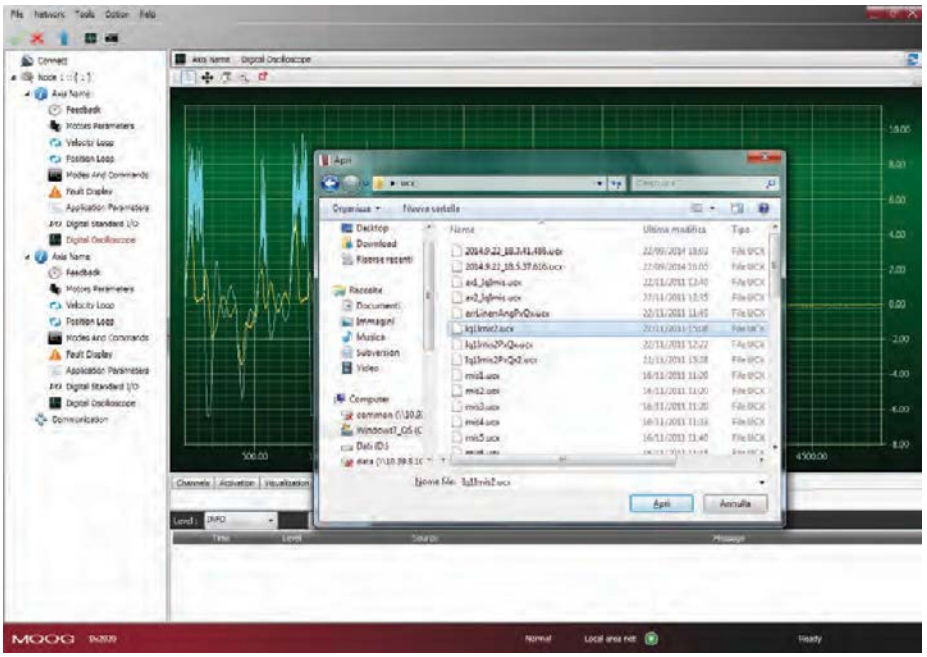


In the top-left corner are the functions Cursor Activation (Cursor ), Moving the Graphic (Pan ), Magni cation of Details (Zoom ) and automatic printing of the image (Screenshot ); The mouse cursor reveals the legend of each of the four buttons when it hovers over each of them.

By selecting Auto Range, each signal is shown in the window; otherwise the data is displayed in the scale in which it is obtained, unless it is changed by varying the scale via the Scale command.

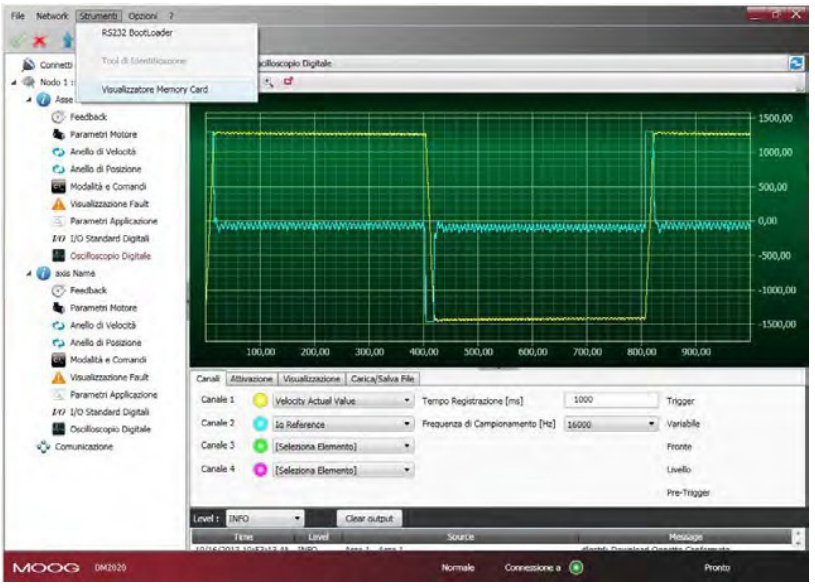
5.7.4. UCX file management

When data is saved in Local, a file is created with the name, date and time that this occurs. The extension of these files is ".UCX". To view archived recordings, go to the "**Load/Save file**" tab and then access the file system via the "**Open UCX**" button.



The GUI also allows users to read data on the memory card directly.

From the toolbar, select "View memory card".

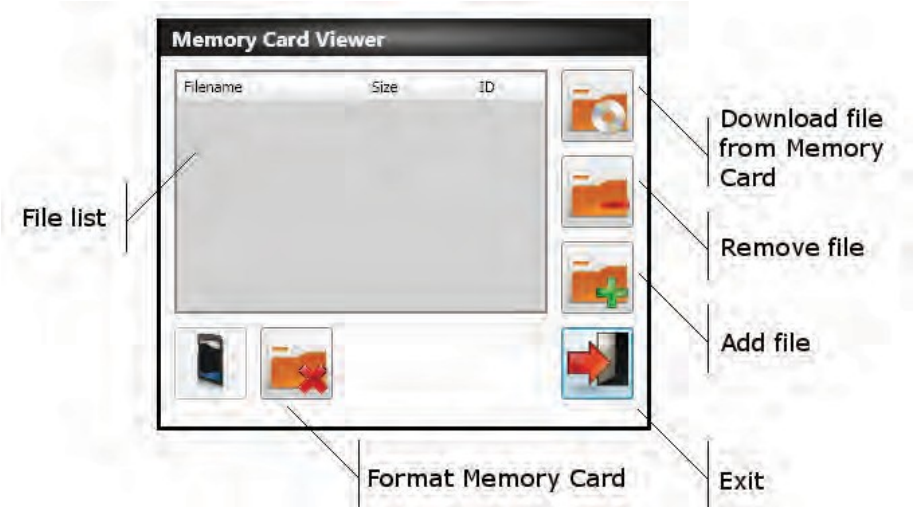


A dialogue box will open with buttons which allow users to open and proces les; by selecting the icon with the memory car, the content can be viewed. The name of file is fixed: rec.ucx

Warning: The name of the file cannot be changed.

Each time a recording is made, the file on the SD card will be overwritten.

The copy on the PC automatically changes the file name.



INFORMATION

In all cases, in order to record/view, the memory car must be in the drive

INFORMATION

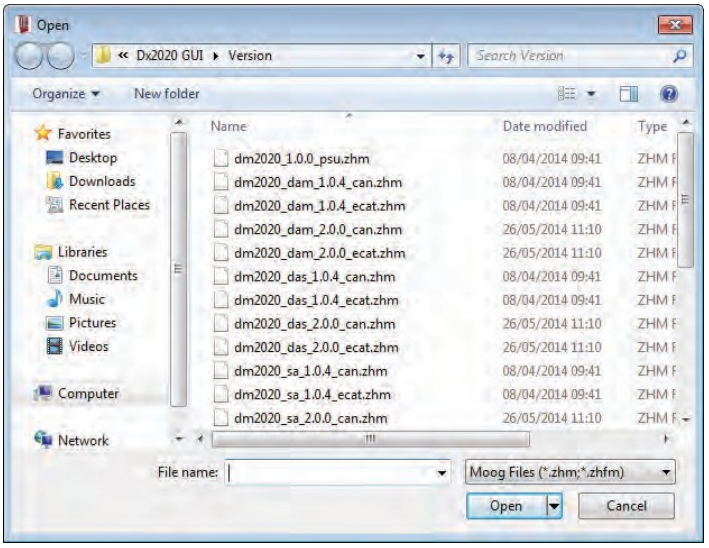
In cases where the user does not have administration rights, the GUI is not able to record/view signals. Contact the IT department for the creation of a dedicated folder with rights of access in terms of both reading and writing.
After doing this, select the folder by clicking on the Browse button

5.8. Use of the GUI in OFF-LINE mode

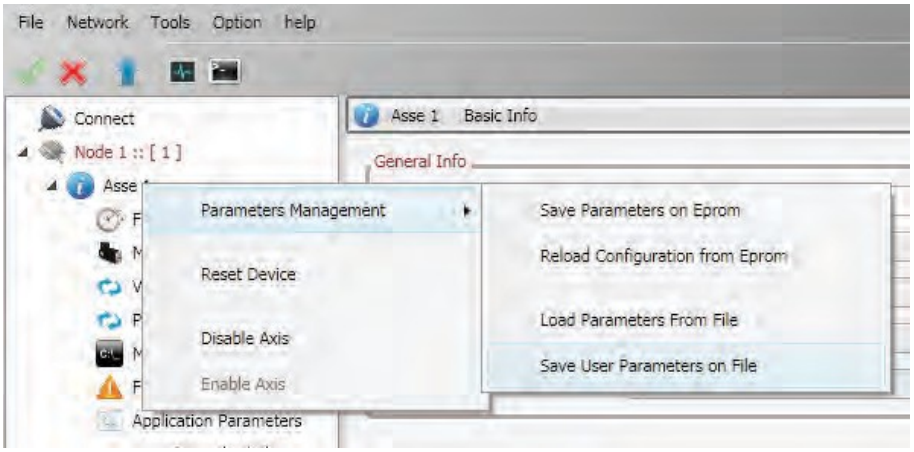
The GUI can also be used in offline mode, without the drive to prepare the drive configuration files, or to edit them or check their contents.

To go into offline mode, select File/OFF LINE from the menu toolbar.

Select File/Open for the SW release with which to work.



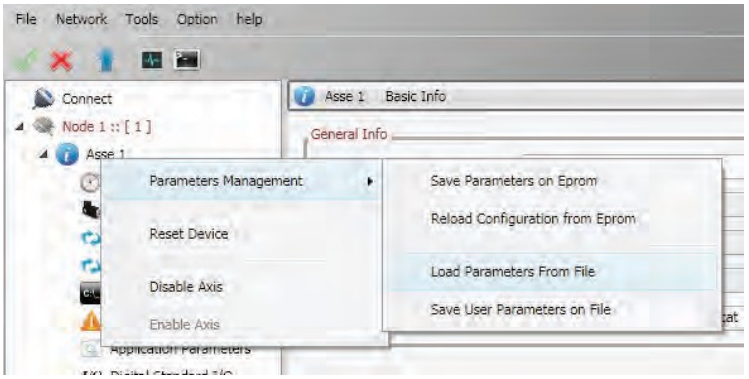
To check a file's parameters, from the main menu select the axis with the right button of the mouse, load the parameters as if there was a real drive connected, change them if needed and save the new configuration file to the new parameters.



5.9. Parameters management menu

Clicking once on the right mouse button on the axis name will open the menu. The following operations can be carried out:

- Manage parameters:
  - Save the current configuration on the internal memory of the drive
  - Restore a saved configurationfrom the internal memory
  - Upload a configuration saved onto the file (download file parameters)
  - Save the current configuration onto the file (upload file parameters)
- Reset item: Reset the selected device
- Disable axis: Disable the axis selected
- Enable axis: Enable the axis selected



6. TROUBLESHOOTING

6.1. Introduction

The main malfunctions are listed and described below, along with a set of instructions on how to resolve them.
If any problem persists, contact the Moog-Casella Service Centre.

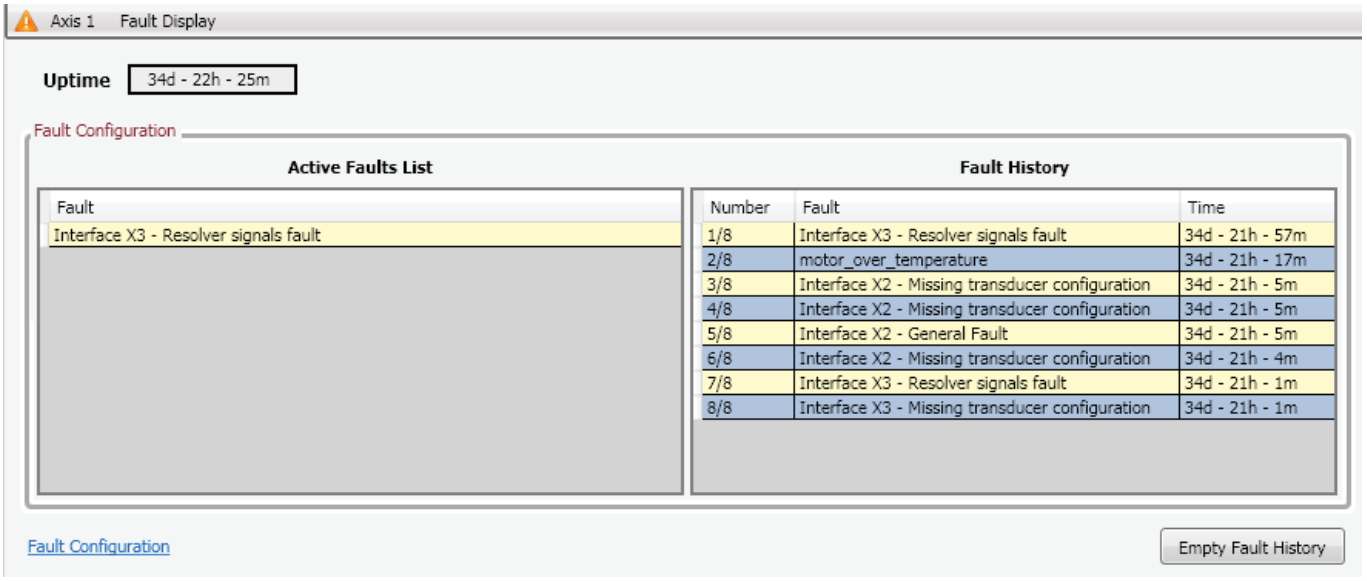
6.2. Power supply unit anomalies

YELLOW LED	GREEN LED	RED LED	Status
Off	Off	On fixed light	Power supply fault

Cause	Check
The drive temperature is high	• Check the direct current being delivered to the axes • Check the effectiveness of the fans
Correcting the fault	Check the brake resistor
Overvoltage	

6.3. Axis module anomalies

The axis module alarms are indicated on the axis display with the letter F. For a detailed analysis, connect to the Dx2020 GUI software, select "Fault display" from the main menu, then proceed with anomaly analysis:
Any alarms active at that time will be listed on the left-hand side of the window (active fault list) and a list of the 8 most recent alarms will appear on the right-hand side (fault history).



6.3.1. Power section alarms

- Short_Circuit_Phase_x_Low
- Short_Circuit_Phase_x_Hi

Identifying the IGBT affected by the x phase: (U, V or W)

This type of alarm occurs when the drive identifies excess current or a short circuit on one of the six output stage IGBTs.

Probable causes of this type of alarm are listed in the table:

Cause	Check
Motor short circuit	Use a multimeter or other suitable instrument to check motor insulation. Alternatively: • Remove the motor power cable • Enable the axis again • If the problem is remedied, replace the motor
Short circuit between the motor cables.	Disconnect the cable from the motor and drive and use a multimeter or other suitable instrument to check cable insulation. Alternatively: • Remove the motor power cable on the drive side • Enable the axis again
Wrong current loop regulation	Check the motor parameters entered in the drive configuration.
Damaged internal drive components	If the problem persists after carrying out all checks, replace the drive.

6.3.2. Alarm due to VBUS voltage not within tolerance limits

Fault		Cause	Check
DC_Link_Under Voltage	Voltage beneath minimum threshold set	Circuit reading fault	Measure the voltage on the DC BUS and compare with that measured by the drive.
DC_Link_Over Voltage	Voltage higher than the maximum value permitted.	Brake resistor is not connected to the power supply module or is faulty	Measure the ohmic value of the resistor and replace it if necessary.

Tab 6.2 Analysis of problems due to VBUS voltage not within tolerance limits

WARNING

In the case of controlled braking, the kinetic energy available is regenerated on the BUS DC and partly stored in the capacitors; the excess, if not dissipated by the braking resistor (RR on the power supply), can result in DC_Link_Over Voltage and damagedrives

AVERTISSEMENT

Dans le cas de freinage contrôlé, l'énergie cinétique disponible est régénérée sur le bus DC et en partie stockée dans les condensateurs; l'excès, sinon dissipé par la résistance de freinage (RR sur l'alimentation), peut entraîner "DC_Link_Over _Voltage "et endommager les unités

6.3.3. Drive or motor over-temperature

- excess_temperature_drive
- motor_temperature_warning
- motor_over_temperature

If a drive or motor over-temperature is reported, the cause of the problem must be analysed based on the table:

Cause	Check
The drive temperature is high (above 50 °C)	• Check the efficiency of the cooling fans; replace if they do not work; • Check the direct current of the module axes; if above the required value, check the operating status of the machine
The motor temperature is high (above 85 °C on the motor structure)	• Check there are no variations in the machine operating cycle; check whether control parameters are no longer suitable for the application • Check that motor timing has not changed
The drive temperature is low (below 50 °C)	Possible fault in the temperature reading inside the circuit
The motor temperature is low (below 60 °C on the motor structure)	Possible fault on the internal thermal sensor or a thermal protection configuration error (using software)

6.3.4. STO signal removal

Safety_stage_low_voltage: STO protection intervention
If the power to the STO circuit is disconnected, the drive releases the axis, disabling the output power.
If there is a conflict between the command and signal feedback, the STO circuit inside the drive could be damaged; check that 24 V DC absorption on the two inputs is approximately 50 mA per input. If absorption is different from this value, replace the module.

6.3.5. Memory device errors

eeprom_fault
The drive's internal memory is damaged or inaccessible. The drive module must be replaced.

6.3.6. Data Corrupted Fault

- parameter_initialisation_error
- node_identi er_data_memory_corrupted
- user_data_memory_corrupted
- restore_data_memory_corrupted
- factory_data_memory_corrupted
- calibration_data_memory_corrupted
- diagnosis_data_memory_corrupted

If saved data is corrupted, the drive reports an alarm. To solve the problem, try checking the drive configuration using the GUI and saving the parameters in advanced mode, then reset the drive and restart the GUI. If the problem persists, replace the drive.

6.3.7 Brake Chopper Fault

brake_feedback_fault

This alarm indicates a fault in the motor brake circuit.
The drive checks that the output voltage is consistent with the command. The alarm may be caused by a mismatch between the command and output voltage.
The internal circuit is protected from short circuits and the protection is enabled if current to the motor brake exceeds 2 A. If this occurs, the causes may be:

- Short circuit on the brake connection cable
- Short-circuit in the brake
- Fault in the detection circuit

Since the brake is integrated into the drive, it is necessary to send the DI2020 to the Assistance service for correction of braking circuit problems.

6.3.8. Feedback deviceerrors

For correct operation, all feedback signals must reach the drive in an appropriate way; if this does not happen, the causes are indicated by the alarm which identifies in detail which transducer function is wrong or missing.
Since the connection is integrated into the drive, send the DI2020 to our Service for the appropriate checks
In the Fault Configuration screen, feedback errors are identified by:

- Interface STD

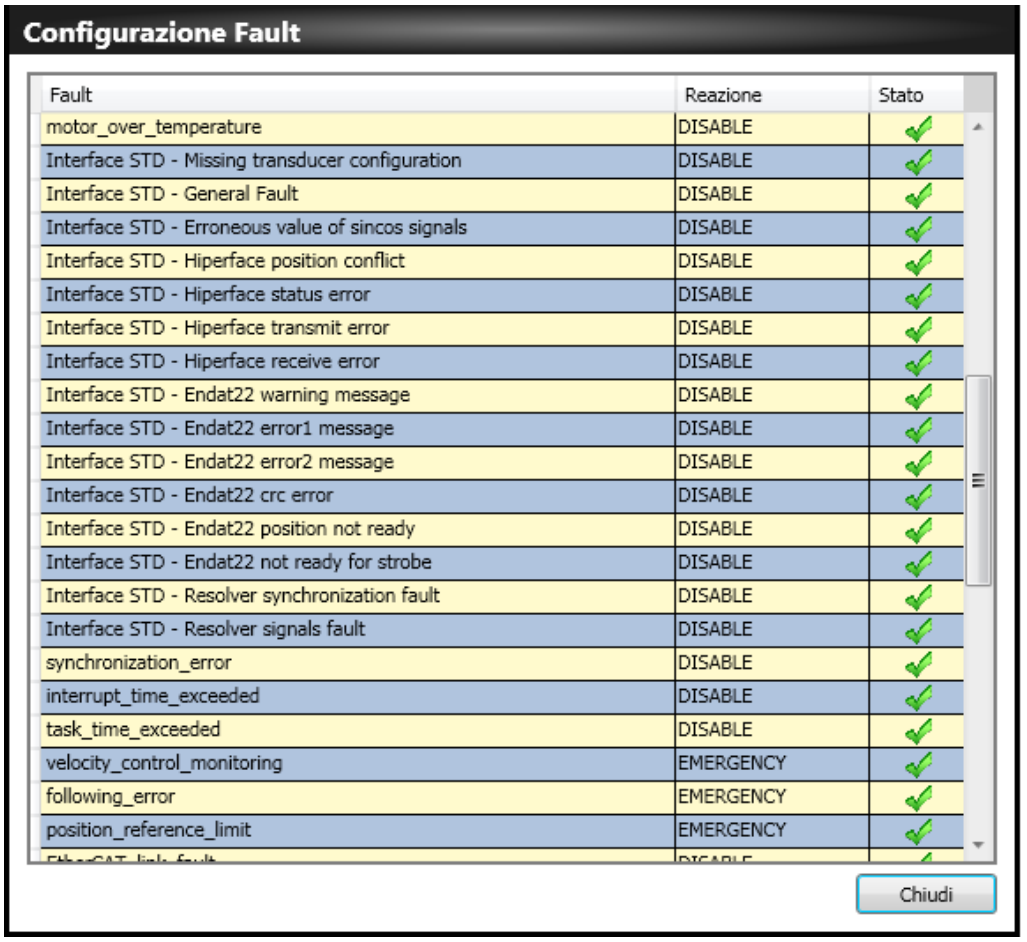


Fig 6.1 Screen showing errors on feedback devices

Fault	Cause	Check
Missing Transducer Configuration	Interface X3 is enabled, but transducer configuration is missing.	Configure .
Resolver Signals Fault	Signal resolver level error (amplitude)	Carrying out cable compensation
Erroneous value of sincos signals	Each alarm describes the problem in detail. Except in cases of incorrect or missing configurationof the device, replace the motor	
Hiperface position con ict		
Hiperface status error		
Hiperface transmit error		
Hiperface receive error		
EnDat22 warning message		
EnDat22 error1 message		
EnDat22 error2 message		
EnDat22 crc error		
EnDat22 position not ready		
EnDat22 not ready for strobe		

6.3.9. Synchronization, Interrupt Time and Task Time Error

Fault	Cause	Check
synchronization_error	Irregular internal frequency interrupt	Reprogramming of drive (firmware and parameters); if the alarm persists, replace the drive
Interrupt_time_exceeded	Internal interrupt signal not detected	
Task_time_exceeded	The execution of the task has exceeded the maximum time limit	

6.3.10. EtherCAT fault

Fault	Cause	Check
EtherCAT_communication_fault	Communication error	Check the wiring configuration of the communication of the drive and/or the EtherCAT master
EtherCAT_link_fault	Eth link not present	
EtherCAT_rpdo_data	PDO data received not correct	
EtherCAT_rpdo_time_out	PDO data not received or received after time-out	
EtherCAT_tpdo_data	PDO data received not transmitted	
EtherCAT_tpdo_time_out	PDO data not transmitted or transmitted after time-out	
Internal_transmit_pdo_time_out	Error in internal PDO communication error (dual-axis)	
Internal_receive_pdo_time_out	PDO internal communication time-out (dual-axis)	

6.3.11. Internal communication fault

Fault	Cause	Check
Internal_communication_fault	Generic internal communication fault (dual-axis module)	Reprogramme the drive (firmware and parameters) of the two cards. If the fault persists, send away for repairs
Internal_communication_ heartbeat_error	Internal communication fault – the axis 1(2) does not detect the presence of the axis 2(1) (dual-axis module)	

6.3.1.2. CAN bus alarms

Fault	Cause	Check
CAN_communication_fault	PDO data not received or received after time-out	Check the wiring and the configuration of the communication of the drive and/or the CAN master
CAN_rpdo0_time_out	PDO data not received or received after time-out	
CAN_rpdo1_time_out		
CAN_rpdo2_time_out		
CAN_rpdo3_time_out		
CAN_rpdo0_data	PDO data received not correct	
CAN_rpdo1_data		
CAN_rpdo2_data		
CAN_rpdo3_data		
CAN_tpdo0_time_out	PDO data not transmitted or transmitted after time-out	
CAN_tpdo1_time_out		
CAN_tpdo2_time_out		
CAN_tpdo3_time_out		
CAN_tpdo0_data	PDO data not transmitted	
CAN_tpdo1_data		
CAN_tpdo2_data		
CAN_tpdo3_data		
CAN_sync_consumer_time_out	Sync not received or received after time-out	
CAN_life_guard_error	Error on life guarding protocol	Check the configuration

6.4. Viewing alarms in the "Analogue" operating mode

If the drive is in "Analogue" operating mode (Mode and Commands/Operating Mode: Analogue), the display on the front will signify an error index along with an alarm, formed from two numbers. In this way, the user can identify the cause of the error(s) present without using the PC. For example, in the case of an eeprom_fault (index 11), the sequence F-1-1 will be displayed.

If the drive is used in eldbus mode (EtherCAT/CAN, the display will show a xed F, and the error code will be transmitted via an EMERGENCY message (according to the CANopen standard) composed of an error code and error register

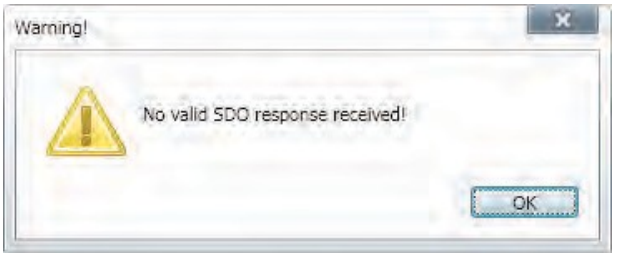
Fault index	Error code	Error register	Fault	Fault
1	0x2344	0x04	short_circuit_phase_U_low	IGBT fault phase U lower arm
2	0x2345	0x04	short_circuit_phase_U_hi	IGBT fault phase U upper arm
3	0x2346	0x04	short_circuit_phase_V_low	IGBT fault phase U lower arm
4	0x2347	0x04	short_circuit_phase_V_hi	IGBT fault phase U upper arm
5	0x2348	0x04	short_circuit_phase_W_low	IGBT fault phase W lower arm
6	0x2349	0x04	short_circuit_phase_W_hi	IGBT fault phase W upper arm
7	0x3220	0x04	dc_link_under_voltage	Bus undervoltage
8	0x3210	0x04	dc_link_over_voltage	Bus overvoltage
9	0x4310	0x08	excess_temperature_drive	Excessive drive temperature (IGBT module protection)
10	0x5114	0x04	safety_stage_low_voltage	STO power circuit not detected (this fault is detected only in "operation Enable")
11	0x5530	0x01	eeprom_fault	Error reading EEPROM memory from the power block or invalid content.
12	0x5540	0x01	sd_memory_fault	External memory card not detected.
13	0x6010	0x01	software_watchdog	Software alarm
14	0x6320	0x01	parameter_initialisation_error	Initialisation error
15	0x6311	0x01	node_identi er_data_memory_ corrupted	Not used
16	0x6312	0x01	user_data_memory_corrupted	Parametric user memory corrupt/not Configured
17	0x6313	0x01	restore_data_memory_corrupted	Not used
18	0x6314	0x01	factory_data_memory_corrupted	Constructor parameter memory corrupt/not Configured
19	0x6315	0x01	calibration_data_memory_ corrupted	Not used
20	0x6316	0x01	diagnosis_data_memory_ corrupted	Not used
21	0x7110	0x01	brake_feedback_fault	Brake status signal inconsistent
22	0x7124	0x08	motor_temperature_warning	Motor temperature warning
23	0x7125	0x08	motor_over_temperature	Motor temperature fault
24	0x7380	0x01	Interface X3 - Missing transducer configuration	Interface X3 transducer enabled but not Configured
25	0x7381	0x01	Interface X3 - General fault	Not used
26	0x738D	0x01	Interface X3 - Resolver synchronisation fault	Resolver signal synchronisation error (phase)
27	0x738E	0x01	Interface X3 - Resolver signals fault	Signal resolver level error (amplitude)
28	0x7390	0x01	Interface X2 - Missing transducer configuration	Interface X2 transducer enabled but not Configured
29	0x7391	0x01	Interface X2 - General fault	Initialisation error or transducer not detected
30	0x7392	0x01	Interface X2 - Erroneous value of sincos signals	Sinusoidal signal amplitude inconsistent

Fault index	Error code	Error register	Fault	Fault
31	0x7393	0x01	Interface X2 - Hiperface position con ict	Digital position (Hiperface protocol) inconsistent with calculated position
32	0x7394	0x01	Interface X2 - Hiperface status error	Encoder status error (Hiperface protocol)
33	0x7395	0x01	Interface X2 - Hiperface transmit error	Encoder transmission error (Hiperface protocol)
34	0x7396	0x01	Interface X2 - Hiperface receive error	Encoder reception error (Hiperface protocol)
35	0x7397	0x01	Interface X2 - EnDat22 warning message	Warning message from EnDat 22 encoder
36	0x7398	0x01	Interface X2 - EnDat22 error1 message	Type 1 error message from EnDat 22 encoder
37	0x7399	0x01	Interface X2 - EnDat22 error2 message	Type 2 error message from EnDat 22 encoder
38	0x739A	0x01	Interface X2 - EnDat22 crc error	CRC error from EnDat 22 encoder
39	0x739B	0x01	Interface X2 - EnDat22 position not ready	Position error - not ready from EnDat 22 encoder
40	0x739C	0x01	Interface X2 - EnDat22 not ready for strobe	Strobe error - not ready from EnDat 22 encoder
41	0x73A0	0x01	Interface X1 - Missing transducer configuration	Optional interface X1 transducer enabled but not Configured
42	0x73A1	0x01	Interface X1 - General fault	Initialisation error or transducer not detected (optional interface X1)
43	0x73A2	0x01	Interface X1 - Erroneous value of sincos signals	Amplitude of sinusoidal signals inconsistent (optional interface X1)
44	0x73A3	0x01	Interface X1 - Hiperface position con ict	Digital position (Hiperface protocol) inconsistent with calculated position (optional interface X1)
45	0x73A4	0x01	Interface X1 - Hiperface status error	Encoder status error (Hiperface protocol - optional interface X1)
46	0x73A5	0x01	Interface X1 - Hiperface transmit error	Encoder transmission error (Hiperface protocol - optional interface X1)
47	0x73A6	0x01	Interface X1 - Hiperface receive error	Encoder reception error (Hiperface protocol - optional interface X1)
48	0x73A7	0x01	Interface X1 - EnDat22 warning message	Warning message from EnDat 22 encoder (optional interface X1)
49	0x73A8	0x01	Interface X1 - EnDat22 error1 message	Type 1 error message from EnDat 22 encoder (optional interface X1)
50	0x73A9	0x01	Interface X1 - EnDat22 error2 message	Type 2 error message from EnDat 22 encoder (optional interface X1)
51	0x73AA	0x01	Interface X1 - EnDat22 crc error	CRC error from EnDat 22 encoder (optional interface X1)
52	0x73AB	0x01	Interface X1 - EnDat22 position not ready	Position error - not ready from EnDat 22 encoder (optional interface X1)
53	0x73AC	0x01	Interface X1 - EnDat22 not ready for strobe	Strobe error - not ready from EnDat 22 encoder (optional interface X1)
54	0x73AD	0x01	Interface X1 - Resolver synchronization fault	Not used
55	0x73AE	0x01	Interface X1 - Resolver signals fault	Not used
56	0x8700	0x01	synchronization_error	Irregular internal frequency interrupt
57	0x6102	0x01	interrupt_missing (era Interrupt_ time_exceeded)	Internal interrupt signal not detected
58	0x6103	0x01	Task_time_exceeded	The execution of the task has exceeded the maximum time limit

Fault index	Error code	Error register	Fault	Fault
59	0x8400	0x01	velocity_control_monitoring	Error - maximum speed exceeded
60	0x8611	0x01	following_error	Error following position
61	0x8612	0x01	position_reference_limit	Not used
62	0x8101	0x10	EtherCAT_link_fault	EtherCAT link not found
63	0x8100	0x10	EtherCAT_communication_fault	Generic EtherCAT communication fault
64	0x8231	0x10	EtherCAT_rpdo_time_out	PDO reception time-out
65	0x8241	0x10	EtherCAT_rpdo_data	Error PDO reception data
66	0x8235	0x10	EtherCAT_tpdo_time_out	PDO transmission time-out
67	0x8245	0x10	EtherCAT_tpdo_data	Error PDO transmission data
68	0x8181	0x10	Internal_communication_fault	Generic internal communication fault (dual-axis module)
69	0x8182	0x10	Internal_communication_ heartbeat_error	Internal communication fault – the axis 1(2) does not detect the presence of the axis 2(1) (dual-axis module)
70	0x8183	0x10	internal_receive_pdo_time_out	Internal communication fault - PDO reception time-out (dual-axis module)
71	0x8184	0x10	internal_transmit_pdo_time_out	Internal communication fault - PDO transmission time-out (dual-axis module)
72	0x3100	0x10	Phases_not_ok	Not used
73	0x3200	0x04	Overcurrent	Overcurrent fault
74	0x8100	0x04	CAN_communication_fault	Generic CAN communication fault
75	0x8231	0x10	CAN_rpdo0_time_out	PDO0 reception time-out
76	0x8232	0x10	CAN_rpdo1_time_out	PDO1 reception time-out
77	0x8233	0x10	CAN_rpdo2_time_out	PDO2 reception time-out
78	0x8234	0x10	CAN_rpdo3_time_out	PDO3 reception time-out
79	0x8241	0x10	CAN_rpdo0_data	Error PDO0 reception data
80	0x8242	0x10	CAN_rpdo1_data	Error PDO1 reception data
81	0x8243	0x10	CAN_rpdo2_data	Error PDO2 reception data
82	0x8244	0x10	CAN_rpdo3_data	Error PDO3 reception data
83	0x8235	0x10	CAN_tpdo0_time_out	PDO0 transmission time-out
84	0x8236	0x10	CAN_tpdo1_time_out	PDO1 transmission time-out
85	0x8237	0x10	CAN_tpdo2_time_out	PDO2 transmission time-out
86	0x8238	0x10	CAN_tpdo3_time_out	PDO3 transmission time-out
87	0x8245	0x10	CAN_tpdo0_data	Error PDO0 transmission data
88	0x8246	0x10	CAN_tpdo1_data	Error PDO1 transmission data
89	0x8247	0x10	CAN_tpdo2_data	Error PDO2 transmission data
90	0x8248	0x10	CAN_tpdo3_data	Error PDO3 transmission data
91	0x8130	0x10	CAN_life_guard_error	Error on life guardian error
92	0x823A	0x10	CAN_sync_consumer_time_out	Time out sync

6.5. Anomalies during GUI - drive connection

In cases where communication between the PC and the drive fails, an error message will appear.



If the connection is made via serial:

- Check that the correct COM port is selected and the baud rate is set to 115200.

If the connection is made via CAN:

- Make sure that the CAN line is terminated correctly;
- Make sure that the IXXATe converters is used and that the drivers are properly installed on the PC;
- Make sure that the baud rate and the node are Configured as per the settings on the drive.

INFORMATION

For the firmware _ecat version, the default baud rate is 1 Mbps, while for the firmware _can version, the predefined value is 500 Kbps. The default node is 127 for both firmware versions.

To check the values set on the drive, proceed as follows:

- Connect to the drive using another network (serial or EtherCAT if supported);
- Read the baud rate value from the terminal (locbdr parameter for the firmware _ecat version or canbdr parameter for the firmware _can version);
- Read the node ID from the terminal (locmodide parameter for the _ecat version or the modide parameter for the firmware _can version).

If the connection is made via EtherCAT:

- Check that the correct network card is selected;
- Check that the cable being used is appropriate.

7. SAFE TORQUE OFF SAFETY FUNCTiON *(TRANSLATION OF ORIGINAL INSTRUCTIONS)*

7.1. Application

The Safe Torque Off (STO) safety function of the DM2020 has been manufactured with a redundant circuit incorporated into the control board.

The STO function must only be used according to the instructions in this Manual.

WARNING

Even in cases where the STO function is not to be used in any way, it is nonetheless important that the supply voltage to the STO circuit remains switched on. In such cases, the STO circuit should not be included in the emergency chain.

AVERTISSEMENT

Même dans les cas où la fonction STO n'est pas utilisée en aucune manière, il est néanmoins important que la tension d'alimentation au circuit de STO reste activée. Dans de tels cas, le circuit de STO ne doit pas être inclus dans la chaîne des emergences.

7.2. Risk assessment of the installation

The functional safety requirements of a drive depend on the application, and must be considered during the overall risk assessment of the installation. Where the supplier of the drive is not responsible for powered devices, the subject designing the installation is responsible for a risk assessment, and for specifying requirements relative to the functional integrity levels and safety integrity levels (SIL) of the drive according to CEI EN 62061:2005 and/or performance levels (PL) according to EN ISO 13849-1:2008.

The table below, identical to Table 4 of UNI EN ISO 13849-1:2008, shows the relationship between PL and SIL.

PL	SIL (IEC 61508-1, by way of example) high/continual operating mode
a	No correspondence
b	1
c	1
d	2
e	3

Tab 7.1 Relationship between performance levels (PL) and safety integrity levels (SIL)

INFORMATION

As SIL 4 refers to catastrophic events, it does not concern risks relative to machines.

The risk assessment of the machine must be carried out according to the Machinery Directive 2006/42/EC, referring to UNI EN ISO 12100:2010 and must contain the configuration of the safety circuit relative to the complete machine, considering all components incorporated in the safety system, including the drive.

7.3. Assembly and production testing

The Safe Torque Off (STO) circuit is assembled and tested at Moog-Casella.

7.4. Identification of the STO function on the drive's side plate

The new Safe Torque Off (STO) circuit is identified by the legend “Safe Torque Off” on the plate.

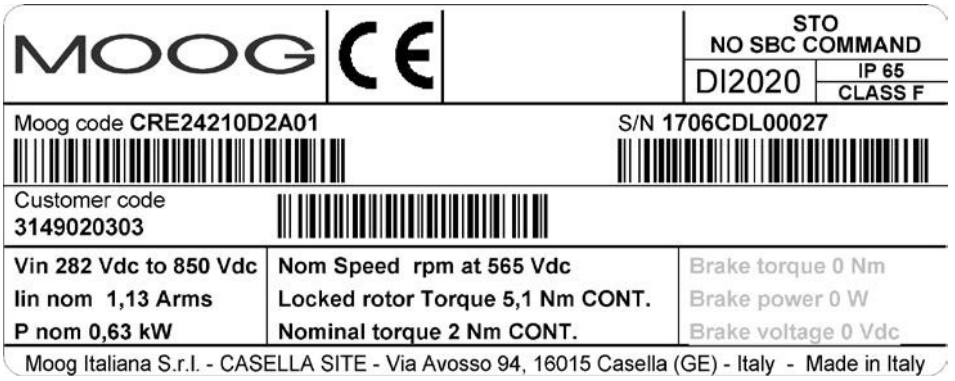


Fig 7.3 Example of identification of the STO function
(in this case without "safe brake control")

NOTE: Due to the certification process, at this time, this chapter will be subject to changes and modifications. For any information, please contact Moog Casella.

8 Annexes

8.1 Glossary

A	
Acceleration	The rate of increase of velocity with respect to time
Alarms	Irregular operating situations highlighted by LED or DISPLAY, with subsequent analysis via GUI.
Asynchronous Motor	Motor in which the rotor and the magnetic field turn at different speeds.
B	
Base control board	Section of the main control circuit with interface to other internal or external functions and slots for optional modules.
Brushless Motor	Motor in which the rotor and the magnetic field rotate at the same speed. The rotor is normally constituted by magnets according to one or more polar couples. The stator is constituted by a three-phase winding housed in the slots of a magnetic lamination pack.
C	
CANopen	CANopen is a communication protocol used in automation systems. The communication profiles and the basic specifications of the CANopen devices are provided by the CAN in Automation (CiA) draft standard 301. The motion control is instead specified in CiA402.
Capacity towards ground	The drives and the power supply have a capacitance to ground (the metal case), composed mainly by the capacitors on the DC bus circuit in order to have a low impedance connection for high frequency currents of dispersion.
DC bus	Circuit constituted from the rectified and flattened network voltage.
Braking Circuit	Circuit that turns into heat the excess energy regenerated by the motor during the deceleration phase.
Short Circuit	Connection into electrical conduction between two phases or conductors with different polarity of an alternating or continuous voltage.
Clock	Timing signal.
Control loops	Set of hardware and firmware circuits that determine the control of the quantities relating to torque, speed, position on the basis of the values measured by the relative sensors. They can be closed or open. The closed control loops are based on sensors for the feedback signals: resolvers and encoders for position and speed loop, Hall effect current sensors for the current loop. A typical open control loop is related to the control voltage / frequency (V /F) of an asynchronous motor without speed transducer.
Convection	Free movement of air (not forced) for cooling.
D	
DC bus - Intermediate circuit	It is the power supply for the individual axis modules formed from the rectified grid voltage and filtered by powerful capacitors..
Disable	Removes the ENABLE signal.
Deceleration	The rate of decrease of velocity with respect to time
Display	Part of the front panel used for the visual signaling of information.
Directive (Machine)	The Machinery Directive is a set of rules defined by the European Union, which serve to provide the necessary requirements for health and safety relating to the design and construction of machinery present on the European market. It applies to fixed, mobile, transportable and hoisting / moving machinery.

Directive (Low Voltage)	The Low Voltage Directive concerns machinery in which electric low voltage circuits are present. The manufacturer must compile a technical dossier, make a declaration of conformity and affix the CE marking.
Dispersion towards ground	Current (usually of reduced intensity) flowing from a wire to the ground.
Dynamic braking	The energy accumulated by the motor during the acceleration is converted into heat through the braking resistor.
Directive (EMC)	The EMC Directive requires that all electrical and electronic devices placed on the market from 1 January 1996 must satisfy the essential requirements of electromagnetic compatibility. The essential electromagnetic compatibility requirements are met by applying the harmonized technical standards published in the EU Official Journal. The harmonized standards can be essentially divided into: • Product standards • Generic standards • Basic standards
E	
Electric Drive	Electric power converter for controlling torque speed and position of a motor. It consists of four main parts: • Rectifier of AC mains voltage • DC link voltage rectified and leveled • Inverter of the rectified voltage in voltage with frequency and voltage variables • Control circuit that transmits signals for the switching of the power semiconductors of the inverter
Electric noise	Set of unwanted signals or current that overlap the useful signal typically transmitted on a communication channel between electronic devices.
EMC	Radio frequency emitted during the electronic power equipment operation, likely to generate or induce disturbances in other electronic equipment.
Emissions	Electromagnetic interference caused by electronic equipment operating at frequencies likely to generate or induce disturbances.
Enable	Signal that enables the drive.
Encoder	Motor component that detects the value of the position of the shaft and transmits it to the drive to operate the control.
Encoder incremental	Motor component that detects the incremental changes in the position of the shaft and transmits them to drive to operate the control with information the current position.
Encoder simulated	TTL encoder signals (A, B and C) differential line drivers generated by the drive, starting from internal information, to emulate an encoder.
Encoder sinusoidal	Motor component that detects the incremental changes in the position of the shaft and transmits the drive to operate the control with information the current position. The information is acquired through the reading of two sinusoidal signals sampled from the drive.
EnDat 22	Serial protocol for communication with Heidenhain encoder. Allows the reading of the position of absolute encoders, as well as updating and saving data stored in the encoder. It is compatible with the previous version 21 offering advantages such as the transfer of other data together with that of position without a separate request.
EtherCAT	communication protocol implemented on the Ethernet the network for the synchronous transmission of information
Ethernet	High speed data communication network.

F	
Filter (Network)	Device that reduces noise generated by the power supply cables.
FMEA	Failure Mode and Effects Analysis.
FieldBus	Structure that allows communication between different devices; are connection lines on which the digital information is transferred from one or more sources to one or more destinations. Their aim is therefore to reduce the number of interconnections required. The bus techniques are of great importance in microprocessor systems but it is necessary to regulate this flow of data in order to allow for a single communication at a time by disabling other possible data sources at that moment.
Fuses	Overcurrent protection devices
G	
Grade of protection (Protection grade)	Security level of the system components.
Ground	Connectionof the conductoror the frameto the ground connector.
GUI	Graphical User Interface.
H	
Hyperface	Fully digital, synchronous two-way, multi-channel protocol to transfer position information and speed that requires minimal wiring between drive and feedback from the motor (2-wire).
I	
IGBT	semiconductor devices for the control of PWM switching..
Interface Fieldbus	EtherCAT or CANopen
IFOC (control)	Indirect Field Oriented Control
M	
Machine	Set of mechanical devices, connected to each other of which at least one is in motion.
Multiaxis system	Machine with several axes with independent transmission.
R	
Rectifier	Circuit that converts an AC voltage into a DC voltage.
Regolator P	Regulating circuit functioning in a purely proportional manner.
Regolator PI	Control circuit running in a proportional and integral way.
Regolator PID	Proportional adjustment circuit functioning, integral and derivative way
Reset	Restart the microprocessor.
Braking resistor	When the motor decelerates, a braking resistor converts the kinetic energy of the motor into heat. The braking resistor is automatically connected to the DC bus voltage when the bus voltage exceeds its threshold and intervenes in the braking circuita.
RS232	Very common standard hardware for the transmission of signals with the same voltage level. Suitable for low transmission rates and limited distances.
S	
Serial Communication	Transmission based on sending each signal at different times.
Shield	Devices designed to reduce electromagnetic emissions.
Servodrive	Drive that operates the regulation of torque, speed and position of a servomotor.
Safety	All necessary measures to avoid damage to property or to persons.
Soft-start	Circuit for limiting the power from the network to the system during the power up
Stiffness	Capacity of a mechanical system to withstand the stresses or disorders that are applied from outside.
STO	Safe Torque Off: protection against unexpected restart. The STO function safely interrupts the power supply to the motor.

8.2 Conversion table Metric/AWG

AWG	Diameter		Cross-section		Ohmic resistance at 20 ° C	Weight
	mils	mm	Circ. mils	mm^2	/km	g/m
44	2.0	0.50	4.00	0.0020	8498	0.0180
43	2.2	0.055	4.84	0.0025	7021	0.0218
42	2.5	0.063	6.25	0.0032	5446	0.0281
41	2.8	0.071	7.84	0.0039	4330	0.0352
40	3.1	0.079	9.61	0.0049	3540	0.0433
39	3.5	0.089	12.3	0.0062	2780	0.0552
38	4.0	0.102	16.0	0.0081	2130	0.0720
37	4.5	0.114	20.3	0.0103	1680	0.0912
36	5.0	0.127	25.0	0.0127	1360	0.1126
35	5.6	0.142	31.4	0.0159	1080	0.1412
34	6.3	0.160	39.7	0.0201	857	0.1785
33	7.1	0.180	50.4	0.0255	675	0.2276
32	8.0	0.203	64.0	0.0324	532	0.2886
31	8.9	0.226	79.2	0.0401	430	0.3571
30	10.0	0.254	100	0.0507	340	0.4508
29	11.3	0.287	128	0.0649	266	0.5758
28	12.6	0.320	159	0.0806	214	0.7157
27	14.2	0.361	202	0.102	169	0.9076
26	15.9	0.404	253	0.128	135	1.1383
25	17.9	0.455	320	0.162	106	1.4433
24	20.1	0.511	404	0.205	84.2	1.8153
23	22.6	0.574	511	0.259	66.6	2.3064
22	25.3	0.643	640	0.324	53.2	2.8867
21	28.5	0.724	812	0.411	41.9	3.6604
20	32.0	0.813	1020	0.519	33.2	4.6128
19	35.9	0.912	1290	0.653	26.4	5.8032
18	40.3	1.02	1620	0.823	21.0	7.3209
17	45.3	1.15	2050	1.04	16.6	9.2404
16	50.8	1.29	2580	1.31	13.2	11.6212
15	57.1	1.45	3260	1.65	10.4	14.6885
14	64.1	1.63	4110	2.08	8.28	18.4512
13	72.0	1.83	5180	2.63	6.56	23.3616
12	80.8	2.05	6530	3.31	5.21	29.4624
11	90.7	2.30	8230	4.17	4.14	37.0512
10	101.9	2.588	10380	5.26	3.277	46.7232
9	114.4	2.906	13090	6.63	2.600	58.9248
8	125.5	3.264	16510	8.37	2.061	74.4000
7	114.3	3.655	20820	10.55	1.634	93.744
6	162.0	4.115	26240	13.30	1.296	118.1472
5	181.9	4.620	33090	16.77	1.028	148.8
4	204.3	5.189	41740	21.15	0.8152	187.488
3	229.4	5.287	52260	26.67	0.6466	235.592
2	257.6	6.543	66360	33.62	0.5128	299.088
1	289.3	7.348	83690	42.41	0.4065	376.464
1/0	324.9	8.252	105600	53.49	0.3223	474.672
2/0	364.8	9.266	133100	67.43	0.2557	599.664
3/0	409.6	10.40	167800	85.01	0.2028	755.904
4/0	460.0	11.68	211600	107.22	0.1608	953.808