

# MOOG

## DS2000

Full digital servodrives for brushless motors  
suitable for universal power supply



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## EXCELLENCE IN MOTION CONTROL

Electronic motion control and actuation of all types of production machinery is becoming more reliant upon the continued advancement of modern technological solutions in terms of cost, performance, reliability and flexibility. As a leading designer of motion control solutions, Moog has provided world-class Electro-Mechanical Actuators, Servomotors, Servodrives and other components meeting each customer's challenge. Moog Servodrives are a proven option for customers that need high dynamic performance and control accuracy. They are user-friendly for easy installation and maintenance, and reliable for heavy-duty applications.

## DS2000 SERVODRIVE CONTROL SOLUTION

The DS2000 servodrive, our fully digital brushless servodrive, introduced onto the world market in 1999, has now been enriched by new important characteristics. Thanks to enhanced control features and rationalised design, OEMs now have the optimal and economic solution for their accurate, rapid and demanding applications, as well as a product that offers an excellent flexibility and performance / cost ratio.

To fully capitalise on the latest digital controller hardware coupled to the latest software control algorithms, we have incorporated many user-friendly features to the DS2000. Within the speed and torque loops, digital filters are incorporated for greater control; we have the capability for both synchronous and asynchronous motor control methods; both resolver and encoder feedback devices can be employed; the facility to control from analogue or digital speed reference signals (CAN protocol) and also the ability to connect to any input supply voltage. The drive can be configured for any of these features without any hardware changes and every aspect is customisable as a consequence of the drive resident parameter and configuration management software program (WinDrive).

DS2000 is a truly universal and cost effective servodrive controller with global appeal.

- Very high signal sampling rates to achieve greater control accuracy and maximise dynamic performance.
- Advanced, innovative product resulting from the use of 'state of the art' hardware and software design tools and fully industrialised construction.
- Standardised and totally interchangeable digital front card with integral fully functional keypad.
- Universally understood parameter names in a user-friendly format.
- Fully rationalised control circuitry design and layout yields greater functionality and flexibility.
- High reliability resulting from optimised use of circuit components.
- Three-phase universal power connection between 65 and 605 Vac

## TYPICAL APPLICATIONS

- General Automation
- Metal forming machines
- Injection and blow-molding machines
- Textile machines
- Handling and assembly systems
- Conveying and storage technology
- Packaging and food processing machines
- Machines tools



This catalog is for users with technical knowledge. To ensure that all necessary characteristics for function and safety of the system are given, the user has to check the suitability of the products described herein. The products described herein are subject to change without notice. In case of doubt, please contact Moog.

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For the most current information, visit [www.moog.com/servomotorsanddrives](http://www.moog.com/servomotorsanddrives)

Dimensions in mm

## GENERAL FEATURES

The entire design of the DS2000 embodies the concept that failures are exponentially related to the number of components which have been, therefore, dramatically reduced. We have only selected leading edge technology components and have employed an extremely high percentage of SMD components, implementing a very highly automated assembly and test process.

## INTEGRAL POWER SUPPLY

In order to make the DS2000 a self-contained stand-alone servodrive, we have integrated the following control and monitoring circuits into its on-board power supply:

- Input power rectification and conditioning section.
- Inrush current limiting 'soft start' circuitry to reduce power supply current on power up.
- High frequency Switch Mode Power Supply (SMPS) circuitry to feed all auxiliary control circuits.
- IGBT motor regenerative power control circuit to ensure the excess motor energy is safely dissipated via a braking resistor. The braking resistors supplied with the DS2000 have been sized on medium-heavy duty cycles. Special ballast resistors can be required in case of particularly heavy duty cycles.
- Auxiliary 24 Vdc control power input available for customer use.

## UNIVERSAL POWER CONNECTION

The drive will accept any voltage between 65 and 506 Vac, three-phase, 50 or 60 Hz without any adjustment. This is achieved thanks to the continuous DC BUS detection circuit controlled from the Digital Signal Processor (DSP); all device protection thresholds are adjusted automatically. Obviously all circuit components are selected and rated for continuous use at the maximum ratings.

## INTEGRAL RESOLVER AND ENCODER INTERFACES

Our standard digital control board provides both interface circuits and connectors to utilise either incremental encoder or resolver as a motor feedback device.

- The resolver pole range covers from 2 to 24; the motor poles have to be an integer multiple of the resolver poles.
- A simulated encoder signal is available that uses the resolver interface and provides user programmable encoder pulses (range: 64, 128, 256, 512 and 1024) and programmable marker pulse duration (range: 1, 1/2 and 1/4).
- The incremental encoder interface is able to manage 1024, 2048, 4096 and 8192 pulses per motor mechanical revolution.

## POWER SECTION COMPONENTS

The DS2000 is able to provide unrivalled performance with respect to the duration and capacity of its current power capabilities. This has been achieved by employing an optimally designed power section created from our substantial experience in the design of servodrives. We have extensive experience in providing customers with electric servo control solutions as working and viable alternatives to the normal and traditional hydraulic methods used in injection moulding, metal forming and blow moulding applications which demand superlative control and management of high peak torque and power amalgamated with peak long duration requirements. All our drive ratings are based on an ambient heatsink temperature of 40°C, with the over temperature threshold set to 71°C and the I<sup>2</sup>T software protection.

## CONFIGURABLE CURRENT LOOP

The current loop is the 'true core' of the servodrive system: it can be configured to suit the motor characteristics and is automatically adjusted according to variations in the DC BUS. B.E.M.F. compensation and phase shift correction routines are also provided. The result is a 'very wide bandwidth' with the advantages of digital technology.

## SPEED CONTROL LOOP

We have achieved a speed loop capable of a very high level of dynamic control with a bandwidth up to 200Hz. The structure is a classic PI configuration but we have incorporated 3 programmable digital filters:

- Low pass filter on the speed error signal (20 to 800Hz).
- Low pass filter on the speed reference signal (1 to 800Hz).
- Notch filter to remove mechanical resonance originating from the motor load (50 to 1500Hz).

These filters permit the use of high gain values that result in minimised overshoot, improved stiffness, high dynamic responses and excellent servo-control performance.

## AUTOMATIC POWER OPTIMIZATION

This algorithm automatically increases the torque of a motor up to its maximum speed rating, resulting in a true constant torque servomotor. Consequently motors wound with higher torque factors can be used.

## INDIRECT FIELD ORIENTED CONTROL (IFOC)

With this vector control software algorithm the DS2000 will control induction motors fitted with a resolver feedback device (as defined at "Resolver interface"). Servomotor type performance is achieved while a much wider constant power range is available than with a synchronous servomotor. Motor selection (brushless or induction) is software programmable.

All the normal parameters are retained, e.g. programmable filters, speed or torque control, etc.

## CHARACTERISTICS OF THE SOFTWARE (RELEASE 3.200)

This software, evolved from the previous version 3.100, has the following new functions:

- **Anti-Free-Wheeling Function:** When the servodrive is in the speed-control mode, this function enables emergency braking controlled by the motor during power outages and in case of motor over-temperature or drive over-temperature.
- **I<sup>2</sup>T IGBT Protection:** This protects the power modules from overheating by cutting off or limiting the delivery of the drive current peak.
- **Protection of the Ballast Resistor:** This enables protection of the ballast resistor when subjected to particularly critical cycles, in which there is an unfavourable imbalance between the applied power and the dissipated power.
- **Programmable Servomotor Torque Increase:** to optimise performance of the motors at high speeds, introducing progressive user-configurable shifting of the phase angle of the simple harmonic current.
- **Selection of Motor PTC/NTC:** the user can select the type of motor temperature sensor and its threshold
- **Automatic Current Offset Compensation:** any offsets introduced by the current-measuring system are automatically compensated by means of a cyclic mean numerical algorithm.
- **Calibration of ENC/OUT Zero Marker:** the zero output signal from the ENC/OUT connector (simulated encoder) can be changed at will to the electrical turn by setting a specific parameter.
- **Motor Code:** WinDrive can be used to store in the drive a code identifying the motor being used.
- **Saving of Digital Speed Reference:** if the drive is reset, operations can be resumed with minimum set-up times.

## WINDRIVE USER INTERFACE

Moog WinDrive is a graphical user interface application running on the Microsoft Windows family of operating systems. It allows the configuration of the Moog motor controller family. It provides the following main features:

- configuration of various aspects of the drive via tabbed panels and dialogs
- access to the Moog standard motor parameter database, and downloading of motor parameter sets
- ability to create non standard motor parameter databases
- ability to monitor faults and status
- drive configuration upload and download
- firmware upgrade
- for some controller types, a graphical oscilloscope
- access to the controller parameter database

## DRIVE CONFIGURATION

The drive can be configured via the built-in keypad and display or via a PC. Management via PC is extremely

flexible thanks to WinDrive, the graphic interface based on the Windows operating system (95-98-2000-NT)

## POSSIBILITY OF ADDING SPECIAL PROGRAMS VIA SERIAL LINE

Special variants to the firmware can be loaded using the WinDrive graphic interface, without intervening on the hardware and without opening the drive.

## ANALOG CONFIGURABLE OUTPUT

A proper control signal connector pin allows the monitoring of the main characteristics:

- speed and reference errors
- current reference
- current limit
- phases electric position
- detected current
- B.E.M.F. and phase voltage
- DC BUS voltage and tacho output

## CAN OPEN INTERFACE (optional)

This digital board mounted option is used where the requirement for the master generated drive speed reference signal is to be transferred via CANbus.

If several drives are to be linked by CAN, it is possible to set the parameters for the entire group (by use of a PC and the relevant program) without the utilization of the master circuit.

Transmission procedure is according to ISO 11898 at a maximum speed of 1Mbit/sec. and according to CANopen standards DS301 (communication) and DSP402 (device configuration).

## ROTARY TABLE CONTROL (optional)

This specially developed software routine controls a high torque servomotor fitted with a high-resolution encoder, suitable for applications that require directly coupled motor and load.

## V/f CONTROL

Special motor V/f control software.

## LIMIT SWITCH MANAGEMENT

An optional card and a dedicated software can provide 3 optional digital inputs on the encoder connector: right limit switch, left limit switch and on-the-fly switching of the control type, from torque to speed and vice versa. Available only in the Resolver version.

## PROTECTIONS

- motor and drive over-temperature
- out of tolerance power supply detection
- encoder or resolver missing signal detection
- output short circuit detection
- ballast resistor missing
- self protected power modules
- I<sup>2</sup>B IGBT protection
- brake resistor protection

## OPTIONS

- separately provided:  
RS232/422/485 (CZ5202 code) converter, including WinDrive communication program
- built-in provided:  
CANbus interface on speed reference  
sinusoidal encoder interface  
"direct drive mode" version  
V/f control  
Limit Switch Management

Note: the product code, including these options, is assigned by the plant.

## INTERFACES

### Analog

- speed reference differential input from 0 to  $\pm 10V$  (adjustable scale)
- auxiliary input voltage 24Vdc
- auxiliary output voltage 15Vdc
- analog configurable output (adjustable scale)
- tachometer signal (adjustable scale)
- peak current limit (adjustable scale)
- resolver

### Digital

- RS485 full-duplex serial or CANbus (optional)
- encoder input
- encoder output (resolver simulated)
- reset
- drive enable input
- drive OK output
- reference enable input
- inputs for right limit switch, left limit switch and on-the-fly switch (optional)

## DIAGNOSTICS

The local display provides data on drive status and possible fault occurrence

## TUNING

- automatic phasing
- programmability through built in keyboard (7 double function pushbuttons); feasible by feeding the drive with the auxiliary 24Vdc only. Main parameters settings are speed, gains, acceleration, torque and all motor and application characteristics.

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## EMC

DS 2000 drives meet the EMC product standard EN 61800-3/A11:2000 for industrial environment according to the Directive 89/336/EC.

Product conformity is subjected to filters installation and to recommended procedures as from the Installation Manual and the "Electromagnetic Compatibility" booklet (available on request)

## CONNECTORS

- J1 RS485 serial link or CANbus
- J2A references for speed and current limit
- J2B insulated input and output signals
- J2C encoder output (resolver simulated)
- J4 encoder input
- J5 resolver input

Power connectors are located below the servodrive:

### - size $\mu$ DS, A and B:

- J6 12 pin connector for input and output signals, ballast resistor, 24Vdc, DC BUS

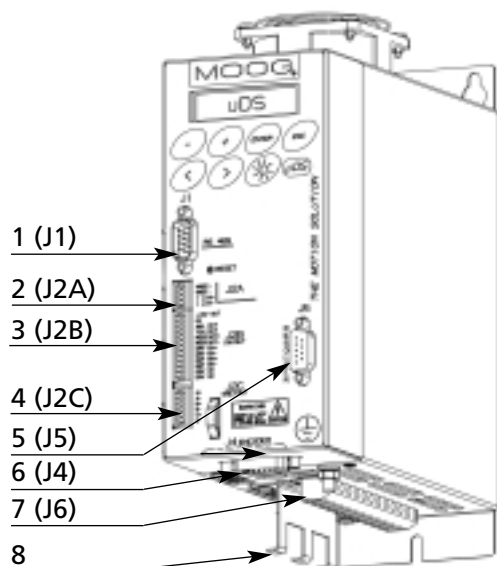
### - size C:

- J6 5 pin connector for input and ballast resistor signals
- J7 4 pin connector for output signal
- J8 2 pin connector for 24Vdc auxiliary supply
- J9 2 pin connector for DC BUS

### - size D:

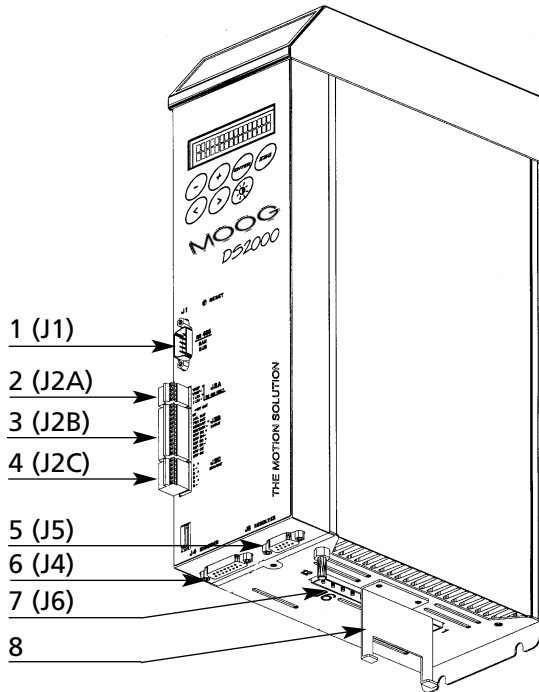
- J8 2 pin connector for 24Vdc auxiliary supply
- J9 terminal box for ballast resistor, input, output and DC BUS signals

## $\mu$ DS



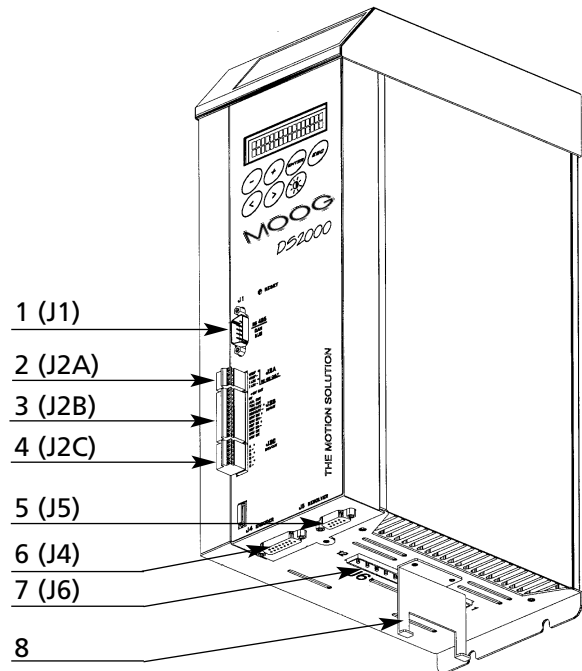
- 1 RS485 and CANopen interface in one connector for the parameterization of several drives without connections changing
- 2 speed reference and current limit or limit switches if communication is effective via CAN
- 3 15Vdc output, signal ground, opto insulated control signal
- 4 simulated encoder output
- 5 input for 2 to 24-pole resolver
- 6 input for incremental encoder
- 7 power connector for AC input voltage, motor output, external ballast resistor, DC BUS, 24Vdc auxiliary supply, ground
- 8 EMC bracket / cable fastener

DS2000 - Size A



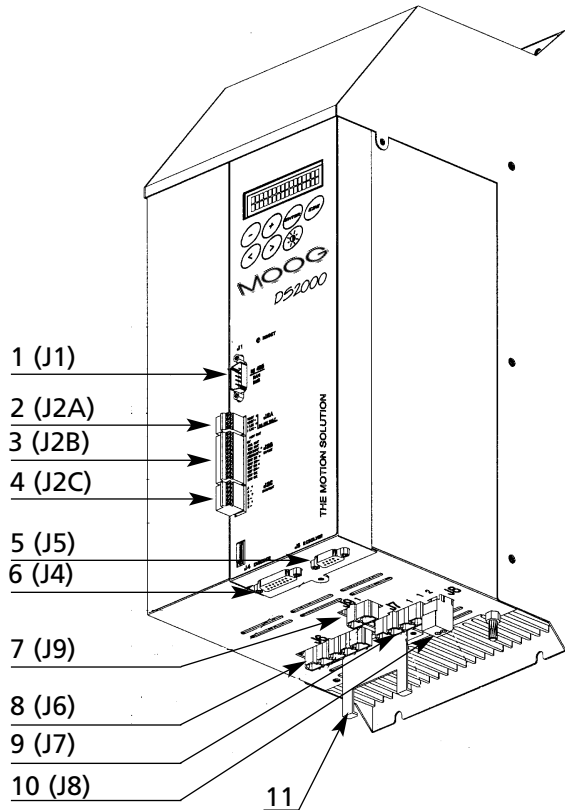
- 1 RS485 and CANopen interface in one connector for the parameterization of several drives without connections changing
- 2 speed reference and current limit or limit switches if communication is effective via CAN
- 3 15Vdc output, signal ground, opto insulated control signal
- 4 simulated encoder output
- 5 input for 2 to 24-pole resolver
- 6 input for incremental encoder
- 7 power connector for AC input voltage, motor output, external ballast resistor, DC BUS, 24Vdc auxiliary supply, ground
- 8 EMC bracket / cable fastener

DS2000 - Size B



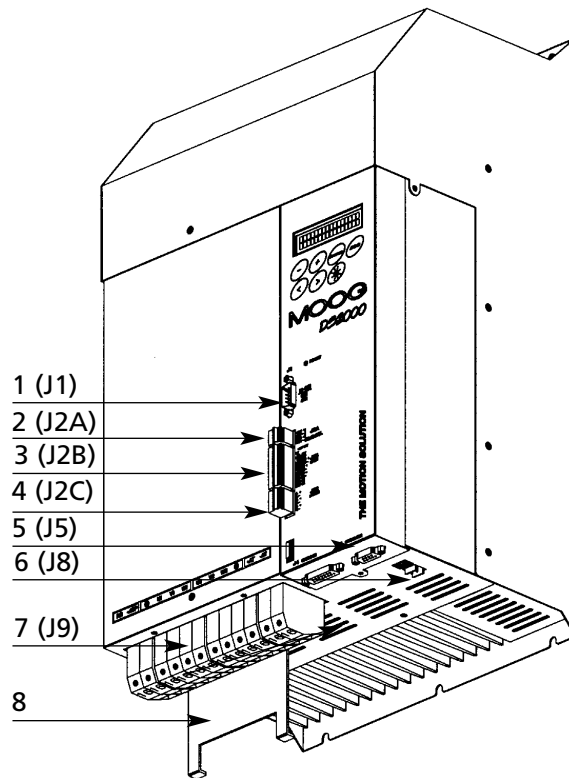
- 1 RS485 and CANopen interface in one connector for the parameterization of several drives without connections changing
- 2 speed reference and current limit or limit switches if communication is effective via CAN
- 3 15Vdc output, signal ground, opto insulated control signal
- 4 simulated encoder output
- 5 input for 2 to 24-pole resolver
- 6 input for incremental encoder
- 7 power connector for AC input voltage, motor output, external ballast resistor, DC BUS, 24Vdc auxiliary supply, ground
- 8 EMC bracket / cable fastener

DS2000 - Size C



- 1 RS485 and CANopen interface in one connector for the parameterization of several drives without connections changing
- 2 speed reference and current limit or limit switches if communication is effective via CAN
- 3 15Vdc output, signal ground, opto insulated control signal
- 4 simulated encoder output
- 5 input for 2 to 24-pole resolver
- 6 input for incremental encoder
- 7 DC BUS
- 8 power connector for AC input voltage and external ballast resistor
- 9 power connector for motor output and ground
- 10 24Vdc auxiliary supply
- 11 EMC bracket / cable fastener

DS2000 - Size D

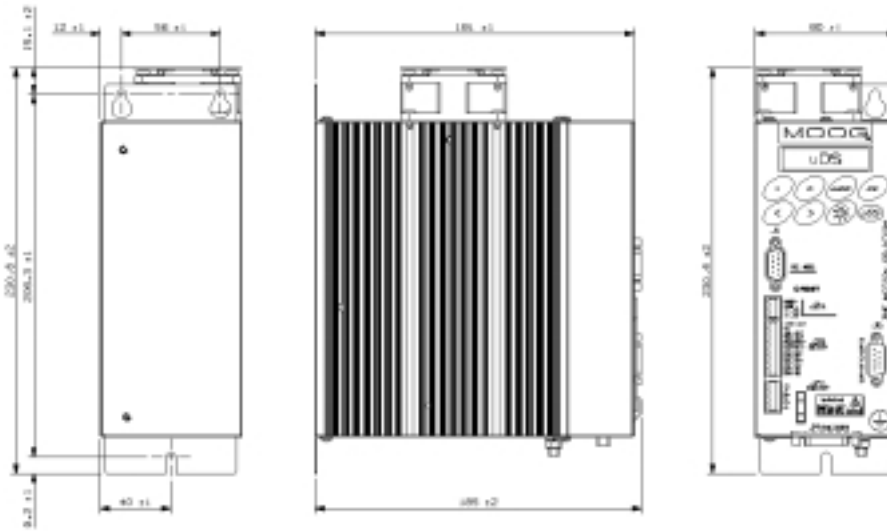


- 1 RS485 and CANopen interface in one connector for the parameterization of several drives without connections changing
- 2 speed reference and current limit or limit switches if communication is effective via CAN
- 3 15Vdc output, signal ground, , opto insulated control signal
- 4 simulated encoder output
- 5 input for 2 to 24-pole resolver
- 6 power connector for 24Vdc auxiliary supply
- 7 power connector for ballast resistor, input, output and DC BUS signals
- 8 EMC bracket / cable fastener

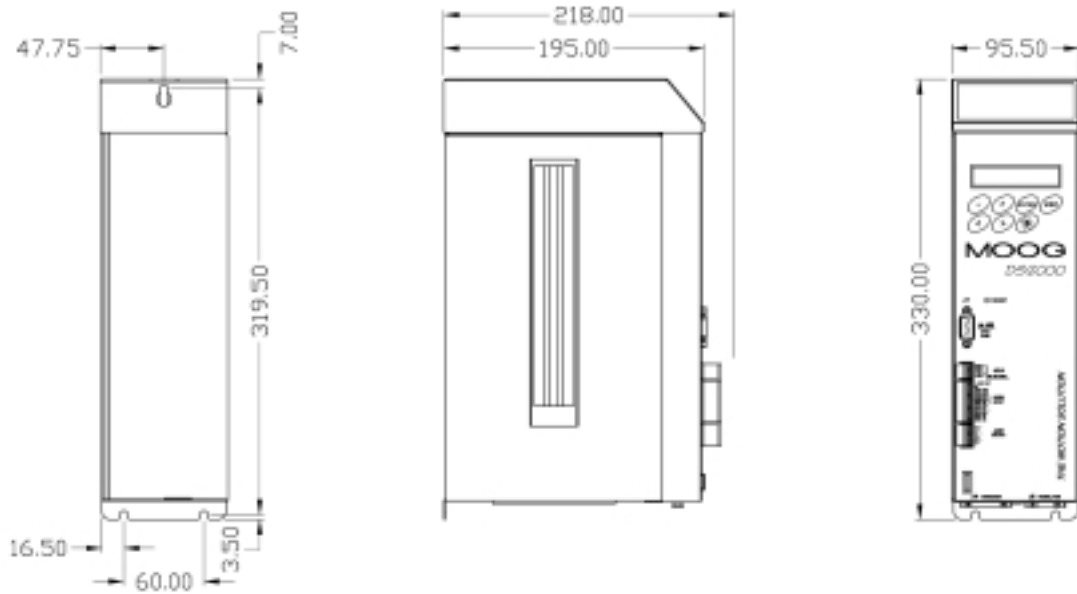


**DIMENSIONS**

DS2000 - Size  $\mu$ DS

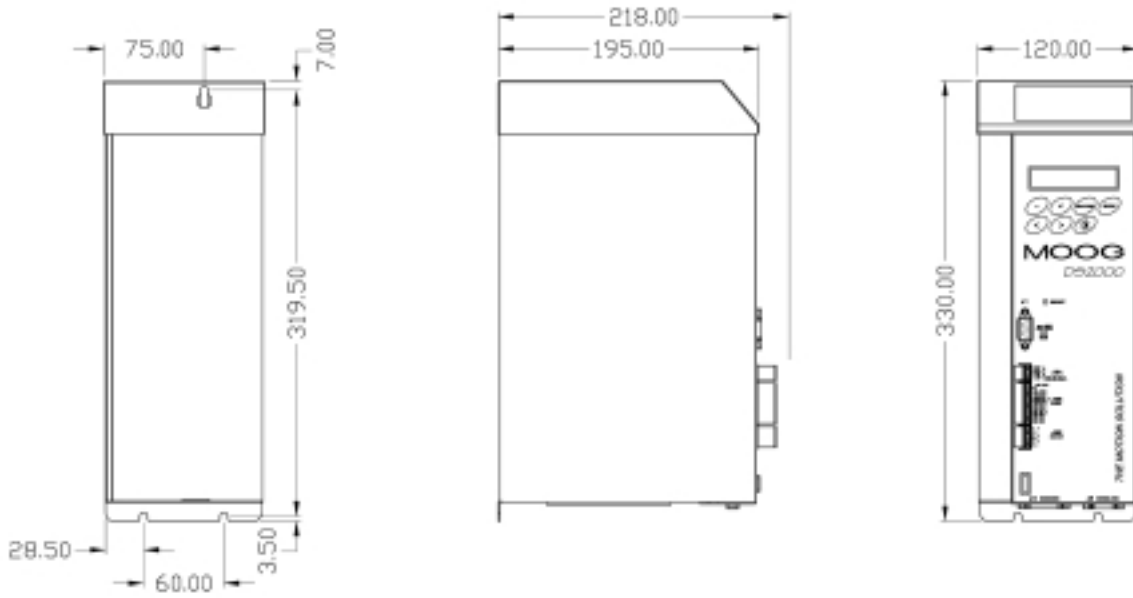


DS2000 - Size A

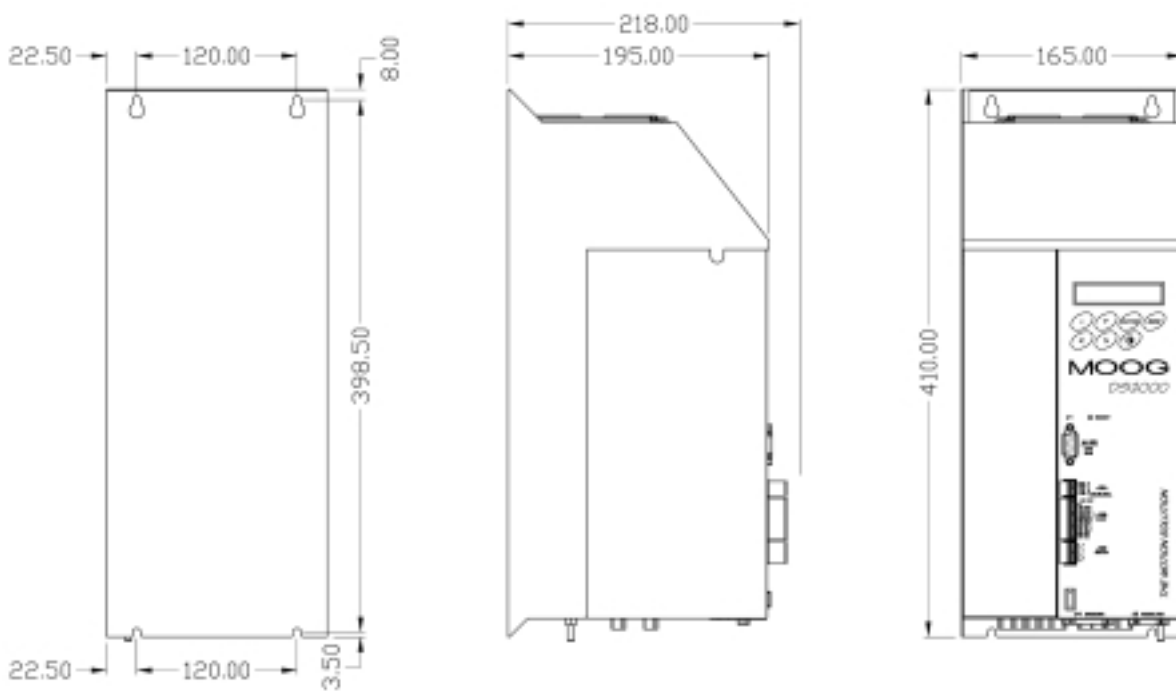


**DIMENSIONS**

**DS2000 - Size B**

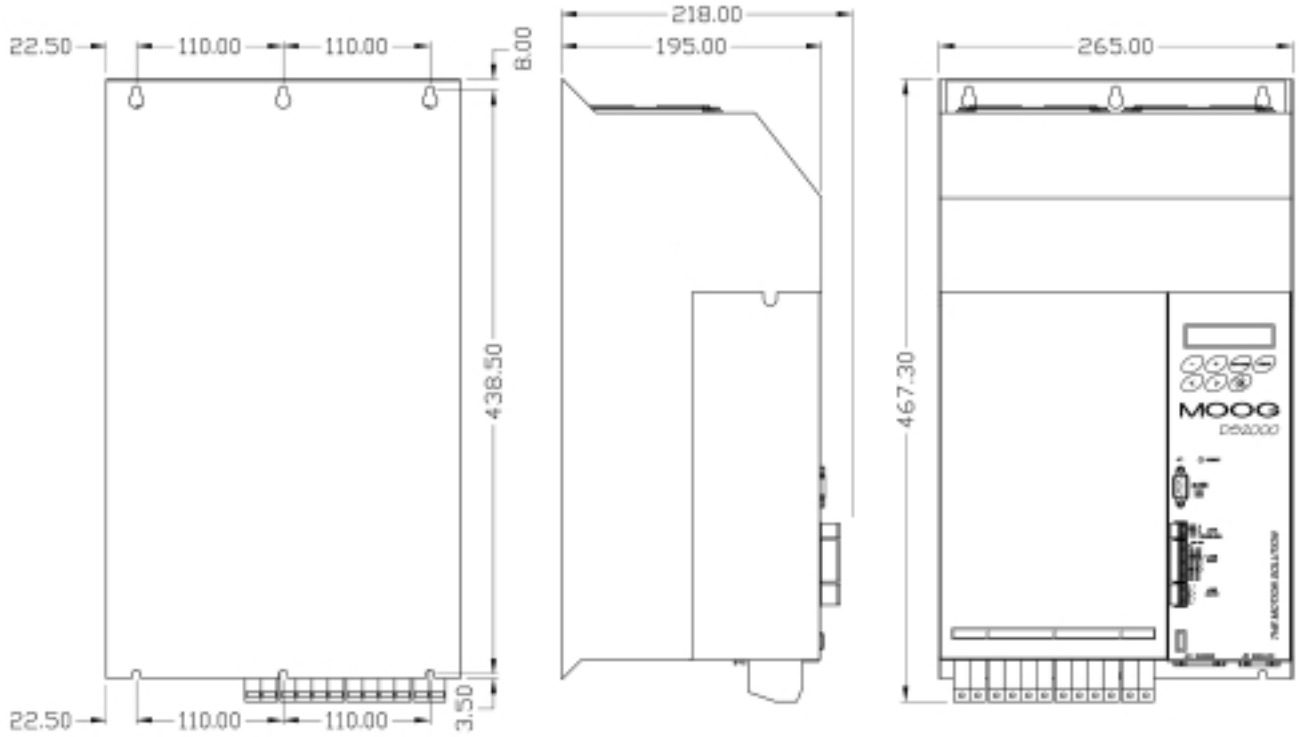








**DS2000 - Size C**



**DIMENSIONS**

**DS2000 - Size D**









Model/Code <sup>(1)</sup>	CZ1300 XXX	CZ1301 XXX	CZ1000 XXX	CZ1001 XXX	CZ1002 XXX	CZ1003 XXX
Type	3/11	6/22	3/9	4/12	6/15	8/22
Size	μA	μA	A	A	A	A
Input voltage	3-phase 65÷506 Vac 50/60 Hz at rated performance	3-phase 65÷506 Vac 50/60 Hz at rated performance	3-phase <sup>(2)</sup> 65÷506 Vac 50/60 Hz at rated performance	3-phase 65÷506 Vac 50/60 Hz at rated performance	3-phase 65÷506 Vac 50/60 Hz at rated performance	3-phase 65÷506 Vac 50/60 Hz at rated performance
Auxiliary current	24 Vdc	24 Vdc	24 Vdc	24 Vdc	24 Vdc	24 Vdc
Nominal current	3 Arms	6 Arms	3 Arms	4 Arms	6 Arms	8 Arms
Max current	8 Arms	16 Arms	6.4 Arms	8.5 Arms	10.6 Arms	15.6 Arms
PWM frequency	10 kHz	10 kHz	10 kHz	10 kHz	10 kHz	10 kHz
Thermal protection	+71 °C on the heatsink	+71 °C on the heatsink	+71 °C on the heatsink	+71 °C on the heatsink	+71 °C on the heatsink	+71 °C on the heatsink
Built-in ballast resistor	120 ohm/100W	120 ohm/100W	82 ohm/100W code CZ1100XXX (not UL) [option]	82 ohm/100W code CZ1101XXX (not UL) [option]	56 ohm/150W code CZ1102XXX (not UL) [option]	NA
External ballast resistor	120 ohm/50W [option]	120 ohm/100W [option]	75 ohm/100W	75 ohm/100W	51 ohm/200W	51 ohm/200W
Communication	RS422-458, RS232 [with adapter]	RS422-458 RS232 [with adapter]	RS422-458 RS232 [w/adapt.] CAN [option]	RS422-458 RS232 [w/adapt.] CAN [option]	RS422-458 RS232 [w/adapt.] CAN [option]	RS422-458 RS232 [w/adapt.] CAN [option]
Mass	2.7 kg	2.7 kg	4.5 kg	4.5 kg	4.5 kg	4.5 kg
Working ambient temperature	0÷+40 °C	0÷+40 °C	0÷+40 °C	0÷+40 °C	0÷+40 °C	0÷+40 °C
Storage temperature	-25÷+55 °C	-25÷+55 °C	-25÷+55 °C	-25÷+55 °C	-25÷+55 °C	-25÷+55 °C
Transportation temperature	-25÷+70 °C	-25÷+70 °C	-25÷+70 °C	-25÷+70 °C	-25÷+70 °C	-25÷+70 °C
Certification						

(1) For each code both the drive and the installation kit are provided.

The installation kit includes:

- installation manual
- female connectors (4 for sizes μDS, A, B and D, 7 for size C)
- 2 male sub-D connectors (only for sizes A,B,C and D)
- 11 crimping connectors (for size C only)
- cable fastener (only for sizes A,B,C and D)
- brake resistor with proper brackets (only for sizes A,B,C and D)

(2) Type 3/9 is also available for a single-phase power supply, following connection of the auxiliary 24 VDC supply (the product code is factory assigned) from 103 Vac up to 243 VAC, 50/60 Hz.

Model/Code <sup>(1)</sup>	CZ1008 XXX	CZ1005 XXX	CZ1006 XXX	CZ1007 XXX	CZ1009 XXX	CZ1010 XXX
Type	14/42	20/45	25/70	30/90	50/140	60/180
Size	B	C	C	C	D	D
Input voltage	3-phase 65÷506 Vac 50/60 Hz at rated performance	3-phase 65÷506 Vac 50/60 Hz at rated performance	3-phase 65÷506 Vac 50/60 Hz at rated performance	3-phase 65÷506 Vac 50/60 Hz at rated performance	3-phase 65÷506 Vac 50/60 Hz at rated performance	3-phase 65÷506 Vac 50/60 Hz at rated performance
Auxiliary current	24 Vdc	24 Vdc	24 Vdc	24 Vdc	24 Vdc	24 Vdc
Nominal current	14 Arms	20 Arms	25 Arms	30 Arms	50 Arms	60 Arms
Max current	29.7 Arms	31.8 Arms	49.5 Arms	63.6 Arms	99.3 Arms	127.6 Arms
PWM frequency	10 kHz	10 kHz	10 kHz	10 kHz	10 kHz	10 kHz
Thermal protection	+71 °C on the heatsink	+71 °C on the heatsink	+71 °C on the heatsink	+71 °C on the heatsink	+71 °C on the heatsink	+71 °C on the heatsink
Built-in ballast resistor	NA	NA	NA	NA	NA	NA
External ballast resistor	33 ohm/250W	12 ohm/370W	12 ohm/370W	12 ohm/370W	10 ohm/750W	10 ohm/750W
Communication	RS422-458 RS232 [w/adapt.] CAN [option]	RS422-458 RS232 [w/adapt.] CAN [option]	RS422-458 RS232 [w/adapt.] CAN [option]	RS422-458 RS232 [w/adapt.] CAN [option]	RS422-458 RS232 [w/adapt.] CAN [option]	RS422-458 RS232 [w/adapt.] CAN [option]
Mass	6 kg	10 kg	10 kg	10 kg	22 kg	22 kg
Working ambient temperature	0÷+40 °C	0÷+40 °C	0÷+40 °C	0÷+40 °C	0÷+40 °C	0÷+40 °C
Storage temperature	-25÷+55 °C	-25÷+55 °C	-25÷+55 °C	-25÷+55 °C	-25÷+55 °C	-25÷+55 °C
Transportation temperature	-25÷+70 °C	-25÷+70 °C	-25÷+70 °C	-25÷+70 °C	-25÷+70 °C	-25÷+70 °C
Certification						

(1) For each code both the drive and the installation kit are provided. The installation kit includes:  
 - installation manual  
 - female connectors (4 for sizes μDS, A, B and D, 7 for size C)  
 - 2 male sub-D connectors (only for sizes A,B,C and D)  
 - 11 crimping connectors (for size C only)  
 - cable fastener (only for sizes A,B,C and D)  
 - brake resistor with proper brackets (only for sizes A,B,C and D)

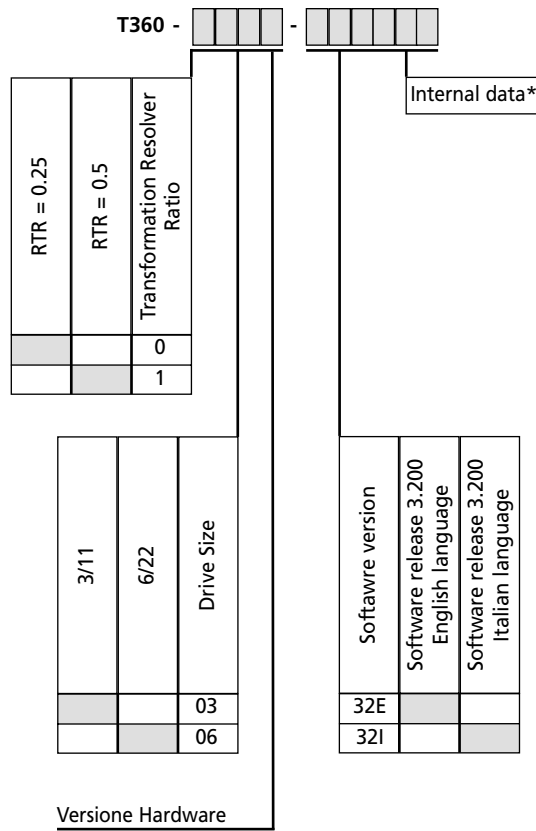
Note:  
 code XXX is assigned by the plant according to the motor matching and requested options (see pages 14 and 15).  
 If motor is not FASTACT series, following data are to be specified:

- motor poles
- resolver poles
- transformation ratio
- encoder pulses (when required)
- V = power supply
- I<sub>n</sub> = nominal current, locked motor
- rpm = nominal speed
- fem = back EMF at 1000 rpm
- I<sub>max</sub> = max current
- R<sub>w</sub> = winding resistance at 20°C (phase to phase)
- L<sub>w</sub> = inductance (phase to phase)

# ORDERING INFORMATION

# DS2000

Drive Type:  $\mu$ DS



**Note :**

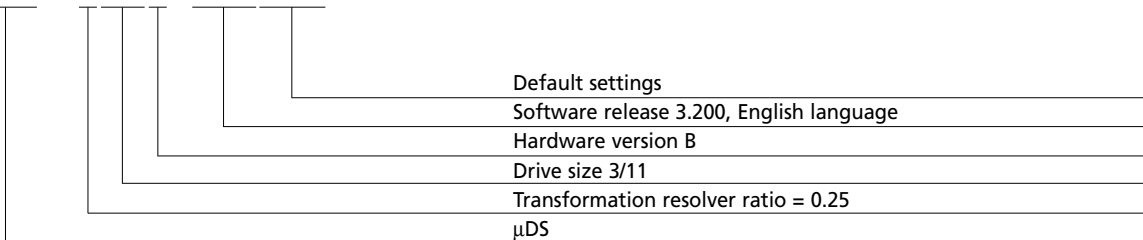
\* Assigned by the plant according to the motor matching

All drives are equipped with a 120 Ohm built-in ballast resistor

External ballast resistors are options to be separately ordered

**EXAMPLE:**

TS360 - 003B - 32E000



# ORDERING INFORMATION

# DS2000

**MOTOR DATA :** motor data must be provided for a drive proper coding

Drive type: DS2000

Width (mm)	Size	Current (A)
95.5	A	3 / 9
		4 / 12
		6 / 15
		8 / 22
120	B	14 / 42
165	C	20 / 45
		25 / 70
		30 / 90
265	D	50 / 140
		60 / 180

Software language: Italian **I**  
Software language: English **E**

Special version

Internal Data\*

Resolver/encoder version	Motor with resolver							Motor with encoder				
	Marker			Simulated encoder pulses				Pulses				
	1/1	1/2	1/4	64	128	256	512	1024	1024	2048	4096	8192
00												
01												
02												
03												
04												
05												
06												
07												
08												
09												
10												
11												
12												
13												
14												
21												
22												
23												
24												

Built-in ballast resistor **	Without ballast resistor	Sinusoidal encoder interface	CANbus interface	Electrical option
				01
				02
				03
				04
				05
				06
				07
				08

**Note :**  
\* Assigned by the plant according to the motor matching  
\*\*Valid only for size A, currents 3/9, 4/12 and 6/15

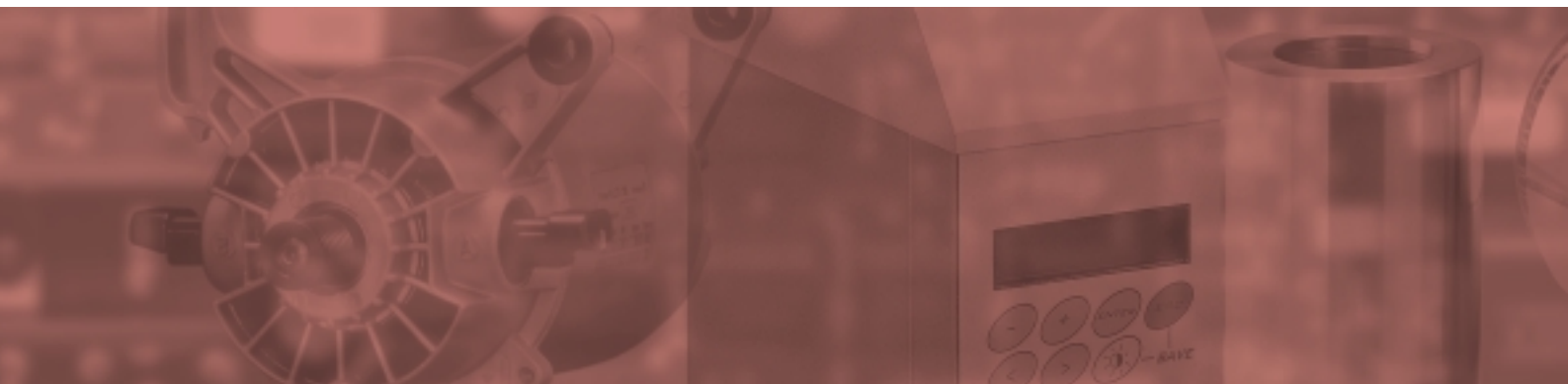
**EXAMPLE:**

DS **A** - **4** / **12** **E** **03** - **01** - **00** - **10**

- Motor matching identification
- No special version
- Resolver marker 1/1, simulated encoder pulses 64
- Without ballast resistor
- SW language: English
- Current 4/12 A
- Size A
- DS2000



**Argentina  
Australia  
Austria  
Brazil  
China  
Finland  
France  
Germany  
India  
Ireland**



**Italy  
Japan  
Korea  
Luxembourg  
Norway  
Russia  
Singapore  
South Africa  
Spain  
Sweden  
United Kingdom  
USA**

# MOOG

**COMPANY WITH INTEGRATED  
MANAGEMENT SYSTEM  
CERTIFIED BY DNV  
=ISO 9001/ISO 14001=**

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