

OPERATING INSTRUCTIONS FOR

# EXPLOSION PROOF DYNAMIC BRUSHLESS SERVOMOTORS

ExD SERIES



Rev. G, July 2012

FULLY CERTIFIED SERVO MOTORS FOR USE IN  
POTENTIALLY EXPLOSIVE ATMOSPHERE IN ACCORDANCE  
WITH ATEX AND IECEX

Whenever the highest levels of motion control performance and design flexibility are required, you'll find Moog's expertise at work. Through collaboration, creativity and world-class technological solutions, we help you overcome your toughest engineering obstacles. Enhance your machine's performance. And help take your thinking further than you ever thought possible.

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**ANNEX**

Electrical data

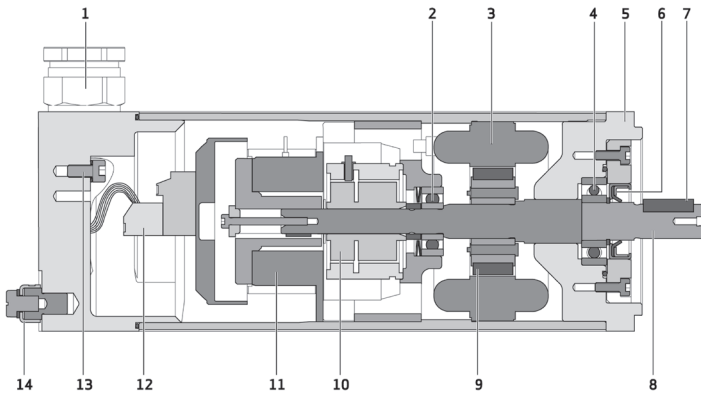
Current installation drawing of the respective motor model

Declaration of conformity

## 1. GENERAL DESCRIPTION

### 1.1 PRINCIPAL OF OPERATION / DESCRIPTION

The principal of operation of the motor is based on an electronically commuted, brushless AC electric motor with stator winding and permanent magnetic excitation in the rotor. The motor is operated via control electronics using an integrated feedback system – resolver or encoder. The components are constructed in accordance with IEC standards. The mechanical interface is represented by standardised flange dimensions with corresponding shaft end. Technical data and the applied standards can be found in the included installation drawing as well as in MOOG motor catalogs.



- |   |                                    |    |  |
|---|------------------------------------|----|--|
| 1 | Cable outlet                       | 9  | Permanent magnets rotor                      |
| 2 | Shaft bearing B (Floating bearing) | 10 | Feedback device                              |
| 3 | Stator winding                     | 11 | Permanent magnet holding<br>brake (optional) |
| 4 | Shaft bearing A (fixed bearing)    | 12 | Connection strip                             |
| 5 | Flange                             | 13 | Internal ground terminal                     |
| 6 | Radial shaft seal                  | 14 | External ground terminal                     |
| 7 | Keyway optional                    |    |  |
| 8 | Shaft                              |    |  |

## 1.2 MODEL STRATEGY

The motors are available in various sizes. Each frame size is modularly designed. Using modular design, changes to the active length of the motor components allow a large power range to be covered. The following standard versions are available:

- Motor with resolver
- Motor with resolver and permanent magnet holding brake
- Motor with encoder
- Motor with encoder and permanent magnet holding brake

## 2. FIELD OF APPLICATION

Typical fields of application for servomotors include robotics and other handling axes, units for actuators as well as special industrial applications. The fields of application for explosion-proof servomotors of series G493, G495, G496 correspond to those listed above, but for which explosion proof restrictions apply.

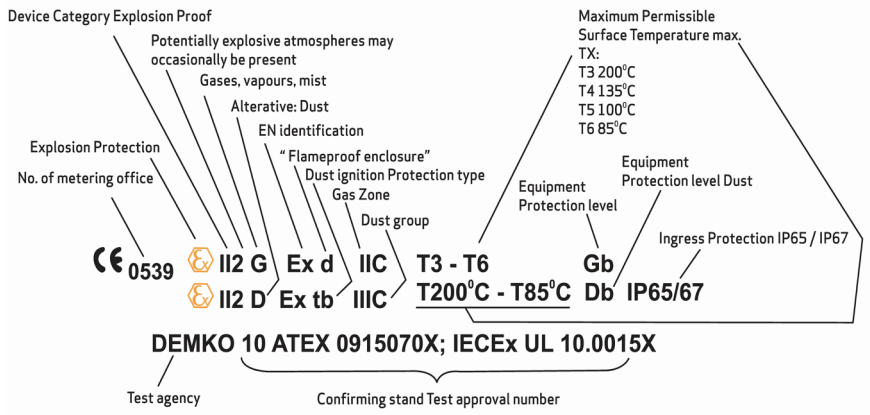
### 2.1 INFORMATION ON THE PROTECTION TYPE

The servomotor is only suitable for the protection type indicated on the name plate. To ensure danger free operation, all installation and safety instructions must be observed. Furthermore, when using as system components, it must be ensured that the respective explosion-proof guidelines for the entire system are adhered to. A skilled operator may be required for handling these series of motor.



### 2.2 EXPLOSION-PROOF TYPE CODE

The following explosion-proof characteristics apply for the motor series described here. These characteristics are also indicated on the motor name plate.



## 2.3 MOTOR NAME PLATE

The data described below can be found on the motor name plate. Motor-specific details and performance data on the name plate are provided in this description only as labeling examples. The correct data can be found on the name plate of the motors and motor data sheet supplied along with the Motor as per Electrical data. Using the Motor data the user has to select a suitable drive.

**Further details on your motor can be found on the name plate of the respective motor. This information is necessary for configuring the controller and for inquiries to Moog.**

**For this reason, please note down the information on the name plates if the name plates are not accessible when the motor is installed.**



### General details

Model	Motor model number
S/N	Serial number
Date	Production date: Year / Week
Typ	Encoded information of the Motor
Brake:	(optional) Details on the brake torque while at a standstill

### Norms:

IP65	As per IEC60034-5
IP67	As per IEC60034-5
I.L.C.F	Motor approved for insulation class F(155 °C) All coil materials are class H(180 °C)
IEC34	Motor fulfils all requirements of IEC34
CE	We will supply the declaration of conformity upon request

### Performance data (add data are specified for 25°C)

$n_N$	Normal speed at nominal power $P_N$
$P_N$	Normal power (maximum continuous power)
$U_d$	Normal operating voltage (Drive DC bus voltage)
$M_0$	Continuous stall torque
$I_0$	Continuous stall current (current at $M_0$ )
$J$	Rotor inertia

### For PWM converter:

$n_{max}$	Maximum speed of motor
$M_{max}$	Maximum torque of motor
$f_{sw}$	Minimum switching frequency
$n_{min}$	Minimum speed of the motor will be 0 min <sup>-1</sup>

### For Gas and Dust:

**CE 0539 II2 G Ex d IIC T3 - T6 Gb**  
**II2 D Ex tb IIIC T200°C-T85°C Db IP65/67**  
**DEMKO 10 ATEX 0915070X; IECEx UL 10.0015X**

### For Gas only:

**CE 0539 II2 G Ex d IIC T3 - T6 Gb**

Identification for explosion proof classification, see section 2.2

## 3. TRANSPORT

Immediately upon delivery of the motor, please examine the package contents for intactness and check that the agreed delivery contents are complete. In particular, check the shaft end and the motor connectors for transport damage.

Please use the data on the name plate to check whether the delivered motor model matches is as per ordered.

The cover cable glands are secured only provisionally to the housing as the connection cable must still be connected to the motor(see section 5.1).

## 4. INSTALLATION INSTRUCTION

### 4.1 SAFETY AND COMMISSIONING INSTRUCTIONS

The motor used is an explosion-proof model with special safety-relevant requirements. To prevent hazards caused by improper installation, the described instructions regarding motor and cable installation must be adhered to. The type of explosion protection can be found on the explosion-proof type code in the operating instructions (Section 2.2). The suitability for use in a given area must be approved by an authorised test centre.



### 4.2 INSTALLATION DIMENSIONS

The installation dimensions for the respective motor model can be found in the provided installation drawing.

### 4.3 MOTOR INSTALLATION / DEINSTALLATION

For motor mounting, Moog recommends the use of hex socket-head screws as defined by DIN 912 8.8. The use of an Allen key considerably simplifies installation, particularly with the G493 models. With this model size, the screws which are used must not exceed 40 mm in length.

Moog motors can become very hot during operation. Therefore, during installation ensure that heat can be adequately dissipated, i.e. the motor should be flanged to as a minimum 300X300X12 mm bracket. Furthermore, adequate convection must be ensured. In some cases, it may be necessary to safeguard the motors against physical contact, as there is a risk of injury through burning. Before mounting a coupling on the motor shaft, the shaft should be thoroughly degreased. When using a degreaser (grease dissolving agent), ensure that it does not penetrate the bearings, as this would compromise their lifetime lubrication. For secure torque transfer, we recommend the use of a clamp coupling or a shrink fitting.

**Impermissibly high axial or radial forces on the shaft can damage the motor during installation.** The bearing damages which may occur as a result will contribute in a reduction in the operating life of the motor. Forcefully pushing axially the rotor shaft can affect the function of the optional brake to the point that it has no or only reduced braking action. For this reason, excessive force and impacts on the front end of the shaft and the rear housing cover are always to be avoided. **The shocks associated with blows of a hammer will always exceed the permissible axial and radial forces.**

**The maximum permissible axial and radial forces for Moog motors during installation:**

G493XXXX 150 N axial force, 500 N radial force.

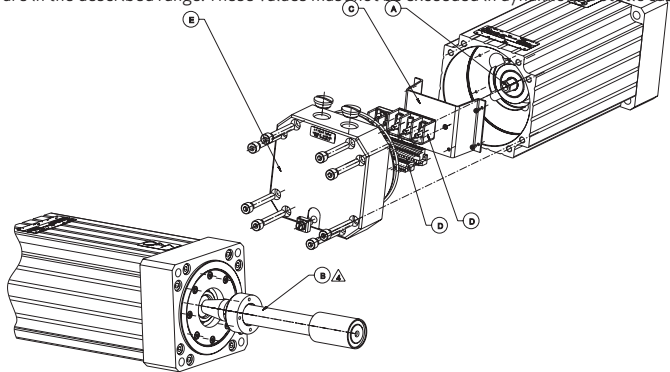
G495XXXX 400 N axial force, 1600 N radial force.

G496XXXX 500 N axial force, 2000 N radial force

**This information is applicable during installation. Lower forces apply when the motor is rotating. See technical data.**

4.4 ASSEMBLY OF BALL SCREW (SPECIAL MOTOR)  
Values for torque see Installation drawing.

During the ballscrew assembling you must avoid, any damage on flange parts.  
It must be sure, that after assembly of the ball screw, the flame path gaps per IEC / EN 60079-1 are in the described range. These values must not be exceeded in dynamic and static case.



Console and cable cleat are just fixed for transport. After disassembling for using the hexagon ( A ) to hold against the torque by mounting the ball screw ( B ), are console ( C ) and cable cleats ( D ) must be assembled as shown in the picture above. All screws must be mounted with LOCTITE 243 or compatible glue. The assembly of the cover ( E ) are describe into the operating instruction and will follow after connecting the cable.

5. ELECTRICAL CONNECTION

The cables described in the following table are suitable for connecting MOOG motors of series G493, G495 and G496



The following details regarding the cable characteristics are to be adhered to in all cases.



**Attention: A rotating motor can discharge dangerously high voltage. Therefore, always ensure that current-carrying parts are safeguarded and insulated.**

G493...	Power cable 4x1.5mm <sup>2</sup> (power) + 2x1.0mm <sup>2</sup> Signal cable Yx2x0.25mm <sup>2</sup> Leads twisted pairs + outer shielding Ambient temp -20°C to +40°C Cable durability -20°C to min. +90°C Ambient temp. -40°C to +80°C Cable durability -40°C to min. +130°C
G495 ... L10,L20 G495 ... L30,L50 G496 ... L15,L90	Power cable 4x2.5mm <sup>2</sup> (power) + 2x1.0mm <sup>2</sup> (brake) + outer shielding Power cable 4x4.0mm <sup>2</sup> (power) + 2x1.0mm <sup>2</sup> (brake) + outer shielding Signal cable Y x2x0.25mm <sup>2</sup> Loads, twisted pairs + outer shielding  Y=Number of pairs of loads to be selected appropriately for the Used feedback systems (resolver, encoder ) in addition, each G493... G495 and G496.... Is equipped with an NTC and PTC whereby The PTC must always be connected, to the certified temperature Monitoring Device.  Ambient temp -20°C to +40°C Cable durability -20°C to min. +110°C Ambient temp. -40°C to +80°C Cable durability -40°C to min. +130°C Ambient temp. -40°C to +100°C Cable durability -40°C to min. +140°C

**The installation and deinstallation of the cables must always be performed while the control electronics are switched off. Removal of hardware enable for the control electronics is not sufficient. During installation, take particular care to ensure that the cross section of the earthing conductor fulfills the applicable standards.**



Attention: Small conductor cross sections result in an impermissible, excessive warming of the cable. This can result in a loss of motor power, particularly in long supply lines. When installing the supply lines, we recommend that the power and signal cables be shielded. The shielding is to be connected to the earthing potential at both ends.

Selection of the cable should meet the ATEX and IECEx requirement and the application local regional regulatory and statutory requirement.

Selection of the cable should also ensure that the temperature rating based on the selected T code and respective ambient temperature are met. The information on the T code and ambient can be found on the motor name plate. Higher temperature cables can be used.

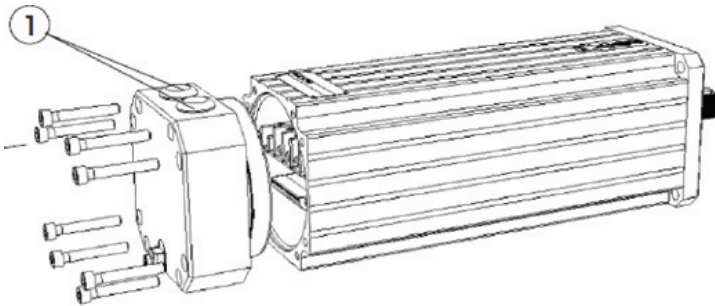
## 5.1 INSTALLING THE CONNECTION CABLE

**For motor models with moulded cables, the cable is already installed and guided out of the motor through a special cover. Therefore, no cable needs to be connected within motors of these models. The locally applicable installation regulations, e.g. IEC / EN 60079-14, are to be observed during installation and setup. Cable entry must be confirmed as flame proof and dust ignition protected "tb" product and confirming to IEC/EN 60079-1 and IEC/EN 60079-31. Contact local application engineers for more details.**



For motor models without moulded cables the following preparation to be followed,  
**Preparing the motor**

After unpacking the motor, the cover is taken off and the sealing plugs (1) removed.

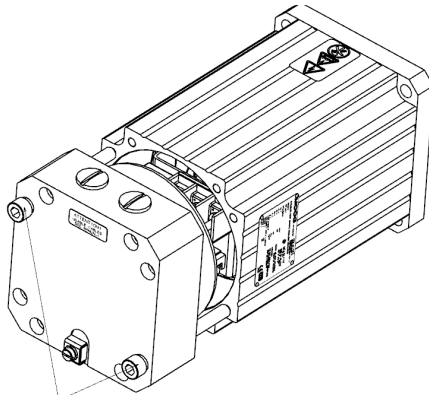




### Preparing the motor

For G495 and G496 use M10 grub screw to disassemble the motor.

Details about the position of the grub screw can be found on the installation drawing.



M10x1.5x100 MM JACKING SCREW

### Preparing the connection cable

The connection cable must be prepared on the electronics end for the connection to the motor.

Before attaching the cable lugs or parallel connectors, the cables are pulled through the mounted cable glands on the motor cover.

- **The cable glands, certified and approved in accordance with IEC 60079-1 and IEC/EN 60079-31, must be mounted. The cable glands used, must be ATEX and IECEx certified as Ex d IIC and Ex tb IIIC with IP65/67 accordingly. The cable gland used must be equivalent too or with higher temperature rating based on the selected T code and respective ambient temperature. The information on the T code and ambient can be found on the motor name plate.**
- **Refer accompanying installation drawing for the cable mounting location, number of cable glands and the thread size.**
- **Ensure that at least 5 threads of the cable gland are engaged with the mounting thread in the motor cover.**



The cable jacket which protrudes into the motor cover is to be removed. The cable leads of the power and signal cables are to be long enough that the cables can be mounted without difficulty, yet not unnecessarily long. With the cables mounted, it should be possible to hinge open the cover 90° from the motor housing (2). When stripping the insulation, the shield meshing of the power and signal cables must be retained in the stripped section of the cable (unwind, then twist separately). The shielding is to be fitted with heat-shrink tubing, additionally the entire area between the jacket and the stripped cable needs to be fitted with a larger piece of heat-shrink tubing (6).

### Cable installation with terminal block

- **The cable glands, certified and approved in accordance with IEC/EN 60079-1 and IEC/EN 60079-31, must be mounted.**
- **In particular, the permissible cable diameter must be observed.**
- **The motor cables are to be connected to the power and signal cables in accordance with the accompanying installation drawing.**
- **The wiring diagram can be found in the installation drawing provided for the respective motor model.**

The power leads and the brake leads (optional) are to be prepared with solder-free, galvanized cable lugs for G495 and G496 models or with wire-end sleeves for G493 models. The clamping area of the cable lugs / wire-end sleeves is to be selected appropriately for the conductor cross section and must be suitable for the connection clamps.

The earthing leads and the shielding are to be prepared with solder-free, galvanized cable lugs.

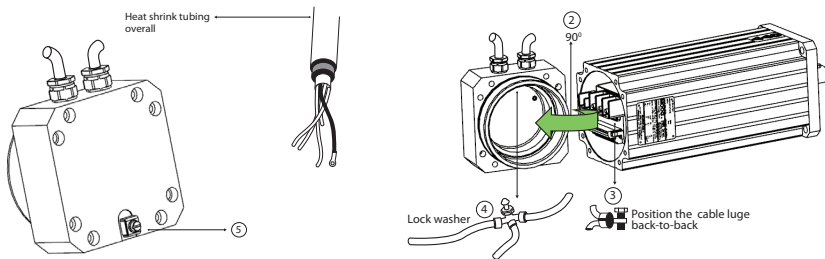
An M4 blind thread is provided on the inside of the motor cover for securing the earthing leads and shielding.

The signal leads are provided with wire-end sleeves and are to be connected to the corresponding connections on the motor.

The terminal area is to be selected appropriately for the conductor cross section.

The cable lugs / wire-end sleeves for the power cable are to be connected to the corresponding connections on the motor (see installation drawing). For G495, G496 models, after removing the clamping nut, position the cable lugs back-to-back and hand tighten! (3)

The cable lugs (4) of the earthing lead and the shielding are to be secured to the inside of the cover with a DIN 912 M4X6 8.8 hex socket-head screw and hand tightened. A DIN 7980-4-Fst Ø 4.3 mm lock washer must be placed between the upper cable lug and the screw head. (4)



**Cable installation with serial conductors**

- The connection diagram can be founded in the installation drawing provided for the respective motor model.
- The cable glands, certified and approved in accordance with IEC / EN 60079-1 and IEC / EN 60079-31 , must be mounted as per the installation instruction provided by the manufacturer.
- In particular, the permissible cable diameter must be observed.

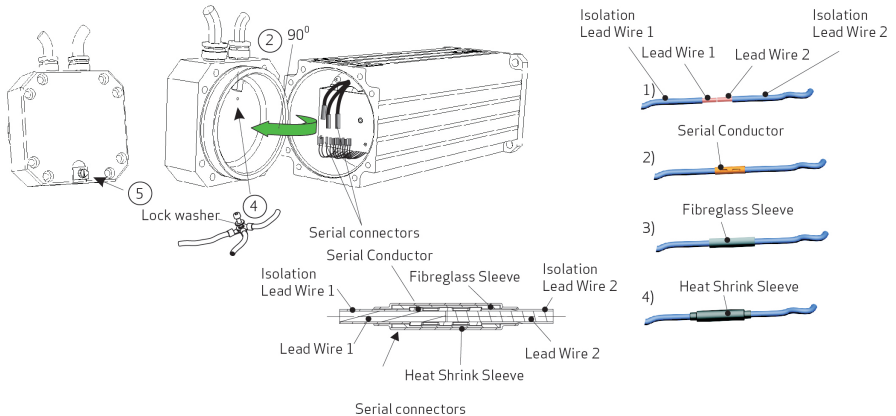


The serial connectors are to be selected appropriately for the cable cross sections and are to be crimped to the connections on the motor with the tool designed for this purpose.



The cable lugs (4) of the earthing lead and the shielding are to be secured to the inside of the cover with a DIN 912 M4X6-8.8 hex socket-head screw and hand tightened. A DIN 7980-4-Fst Ø 4.3mm lock washer must be placed between the upper cable lug and the screw head.

**Attention : Do not operate the motor with removed cover, due to missing protective earth connection.**



**The fiberglass sleeve needs to overlap the serial conductor, as well as the heat shrink sleeve overlaps the fibre sleeve by a minimum of 5mm.**

**Cover assembly**

**The orientation of the cover is shown in the included installation drawing.**

During cover assembly, the external cables must be repositioned so that the outer cable jacket aligns evenly with the inside of the cover to prevent cable jamming during the assembly process. Cables without jacket must not protrude into the threaded connection. The upper part of the threaded connection is to be tightened in accordance with the manufacturer's specifications. The lower part is to be held in place to keep it from turning as the upper part is tightened. The cover is to be placed on the motor housing and tightened with the DIN 912 M4x20 - 8.8 socket-head screws to 3 Nm for models G493, M8 x 55 - 8.8 socket-head screws to 16 Nm for models G495 and M8 x 65 - 8.8 socket-head screws to 16 Nm for models G496.

**Connection of the external protective earth conductor**

The connection terminal (5) is provided with a protective earth symbol. The connection is carried out in accordance with DIN 0720. The maximum cable cross section which can be accepted in the terminal for the different models is:

- G493 4 mm<sup>2</sup> for single-wire conductors
- G495, G496 10 mm<sup>2</sup> for fine-wired conductors and 16 mm<sup>2</sup> for single-wire conductors

**Note: Earth conductor to be equal or greater than the phase conductor.**

**Connection of the internal protective earth conductor**

The connection terminal (4) is provided for the internal protective earth conductor. The terminal is suitable for terminating 4mm<sup>2</sup> conductors.

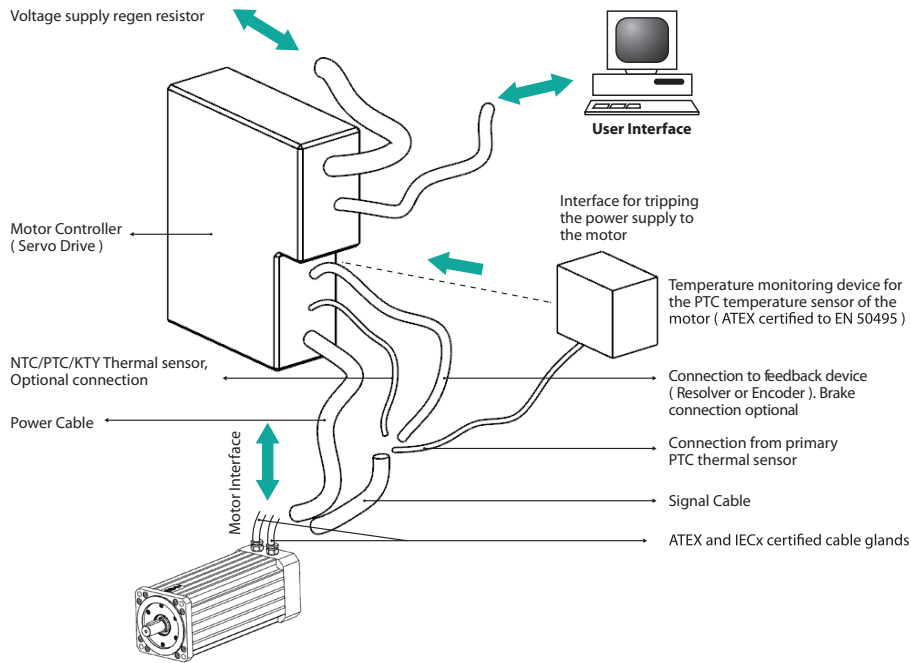


## 6. OPERATING THE MOTOR

After connecting the motor to the control electronics, the motor is to be operated in accordance with the operating instructions for the electronics. We cannot guarantee the replacement of motors which are damaged due to incorrectly connected or unsuitable third-party electronics. Moreover, incorrect installation, improper operation or other improper work at the motor could result in dangers such as overheating, over voltage etc., which could compromise the desired protection for use in explosive atmospheres. In cases where Moog electronics are used, the corresponding operating instructions for the electronics are included. The Motor data required for the selection of the right drive can be found in the Motor data sheet as per annex "Electrical data" supplied along with the Motor.

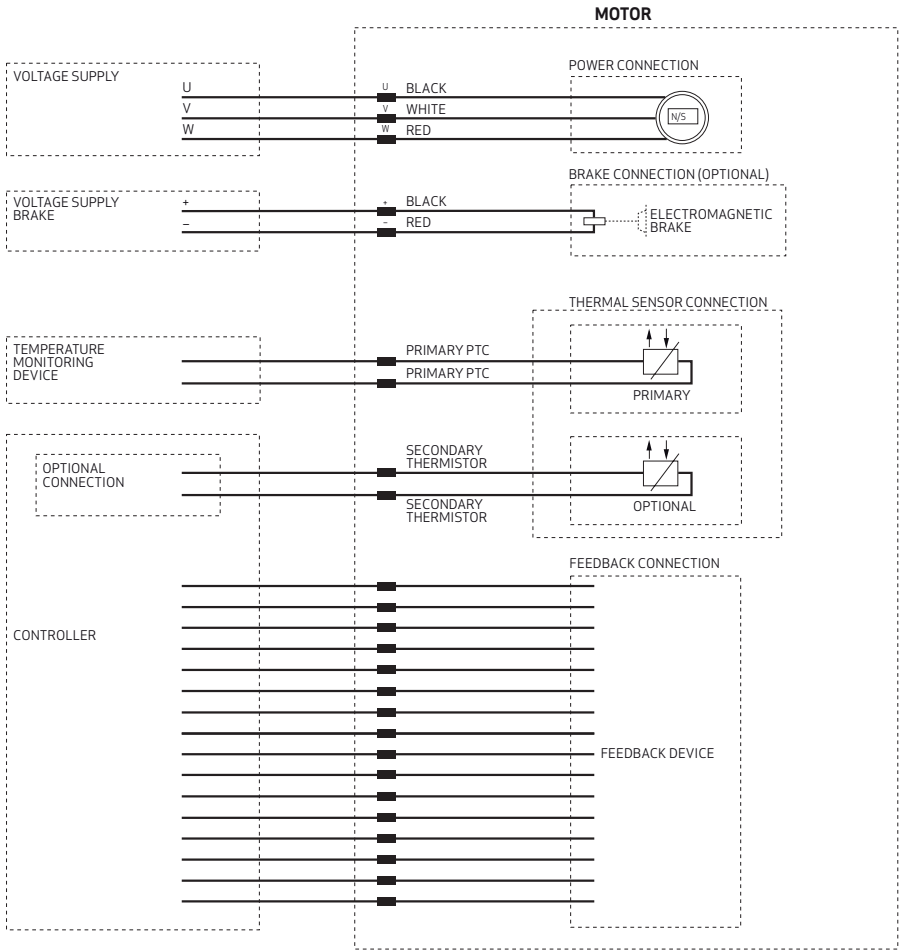


connection example



Explosion proof dynamic brushless servo motor ExD series

Typical wiring diagram



## 7. MAINTENANCE

Due to their construction, the MOOG brushless servomotors of series G493 G495 and G496 are maintenance free. The bearings are the only components subject to wear and are provided with life-time lubrication (at least 20,000 operating hours at the specified maximum axial and radial forces). If damage is found on the motor, it can generally be repaired by Moog.

**The motor must be directly thermally monitored using Temperature monitoring device for the PTC temperature sensor of the motor - ATEX certified to EN 50495. The PTC temperature sensor is located in the stator coil. This is the primary protection for the safe operation of the motor. In addition to primary PTC sensors additional set of PTC/NTC/KTY is provided in the winging as secondary protection sensors which can be connected to the drive.**



**For operation without the use of actuation of the additional PTC/NTC/KTY temperature sensor by the servocontroller, the motor unit must be sized in such a way that the trigger temperature of the direct temperature monitor is not reached during fault-free operation. If the device switches off, this is due to an emergency shutdown and is indicative of a malfunction of motor operation. The cause of overheating should always be corrected before continuing operation.**

### 7.1 REPAIR PROCESSING

Should it be necessary to repair a MOOG motor, all non-MOOG attachment parts such as gearing, gear wheels, pinions are to be dismantled, as MOOG cannot guarantee that they will be dismantled correctly. Grease and dirt present at the connection flange of the motor should also be removed. If possible, a detailed description of the malfunction or failure report is to be included with the shipping papers. The shipping paper is to be clearly labeled with **"For Repair"**. The motor is to be packed in a shockproof manner to prevent damage during transport and sent to the address listed below or to the regional branch office.



No repairs may be performed by third parties due to reasons of product liability, as the applicable safety regulations (e.g. IEC guidelines) and Moog quality standards cannot generally be maintained by the customer.

## 8. SPECIAL CONDITIONS FOR SAFE USE

- For ambient temperatures below -10 °C and above +60 °C use field wiring suitable for both minimum and maximum ambient temperature.
- Contact Moog for information on the dimensions of the flameproof joints.
- Yield strength of the front and rear cover assembling fasteners shall not be less than 640 MPa.
- The class of fit between the fasteners and stator frame shall be of medium fit 6H/6g.
- All cable entry devices and blanking elements shall be IECEx/ ATEX certified in type of explosion protection flameproof enclosure "d", dust protection "tb", suitable for the conditions of use and correctly installed.
- The drive used along to the servomotor shall be of specification as specified by manufacturer and suitable for the motor electrical specifications and operating characteristics.
- The o-rings and seal material on which the IP protection is relied on shall not be replaced.
- The motor can withstand peak torque for maximum 10% of the time.
- Each motor shall use a suitable thermal protector based on its rated ambient and surface temperature class (T-code).
- Every motor covered under this certificate shall be connected to a temperature monitoring device in field. The temperature monitoring device connected to the PTC temperature sensor in the motor shall be ATEX certified to latest edition of the EN 50495 standard.



# TAKE A CLOSER LOOK

Moog designs a range of motion control products that complement the performance of those featured in this catalog. Visit our website for more information and contact the Moog facility nearest you.

Argentina  
+54 11 4326 5916  
info.argentina@moog.com

Australia  
+61 3 9561 6044  
info.australia@moog.com

Brazil  
+55 11 3572 0400  
info.brazil@moog.com

Canada  
+1 716 652 2000  
info.canada@moog.com

China  
+86 21 2893 1600  
info.china@moog.com

Finland  
+358 10 422 1840  
info.finland@moog.com

France  
+33 1 4560 7000  
info.france@moog.com

Germany  
+49 7031 622 0  
info.germany@moog.com

Hong Kong  
+852 2 635 3200  
info.hongkong@moog.com

India  
+91 80 4057 6666  
info.india@moog.com

Ireland  
+353 21 451 9000  
info.ireland@moog.com

Italy  
+39 0332 421 111  
info.italy@moog.com

Japan  
+81 46 355 3767  
info.japan@moog.com

Korea  
+82 31 764 6711  
info.korea@moog.com

Luxembourg  
+352 40 46 401  
info.luxembourg@moog.com

The Netherlands  
+31 252 462 000  
info.thenetherlands@moog.com

Norway  
+47 6494 1948  
info.norway@moog.com

Russia  
+7 8 31 713 1811  
info.russia@moog.com

Singapore  
+65 677 36238  
info.singapore@moog.com

South Africa  
+27 12 653 6768  
info.southafrica@moog.com

Spain  
+34 902 133 240  
info.spain@moog.com

Sweden  
+46 31 680 060  
info.sweden@moog.com

Switzerland  
+41 71 394 5010  
info.switzerland@moog.com

United Kingdom  
+44 168 429 6600  
info.uk@moog.com

USA  
+1 716 652 2000  
info.usa@moog.com  
[www.moog.com/industrial](http://www.moog.com/industrial)

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Moog Controls India Pvt. Ltd.,  
KIADB Industrial Area  
No. 99P, 100P & 41P  
Electronic city phase II, Hosur  
road, Bangalore - 560100,  
Karnataka, India