

9C Servomotors Instructions

1	General	1
2	Technical Specs	1
3	Before Installation	2
4	Mechanical Installation	2
5	Electrical Installation	2
6	Operation.....	4
7	Maintenance	4
8	Troubleshooting	4

1 General

NOTE!

This document states the instructions for installation, operation and maintenance of the 9C Series AC Brushless Servomotors manufactured by ABB S.p.A. – Line S, Italy. This material must be studied before attempting any work on, or with, the servomotor.

1.1 Declaration of Conformity

9C Series Servomotors have been designed in compliance with international standards IEC 60034 and IEC 60072-1.

ABB Sace declares that 9C servomotors comply with the Low Voltage Directive 72/23/EEC integrated by Directive 93/68/EEC and subsequent changes.

1.2 Certificate of Incorporation

ABB Sace, according to what required in the Machinery Directive (MD) 89/392EEC, declares that **9C SERIES Servomotors** must be installed in accordance with our installation instructions and must not be put into service before the machinery into which they are incorporated is declared to comply with the provisions of Machinery Directive.

1.3 Quality

Every ABB motor undergoes a severe test before delivery. The motor mechanical and electrical characteristics are checked in order to ensure excellent quality.

1.4 Validity

These instructions are valid for electric motors manufactured by ABB S.p.A. – Line S “Servomotors Series 9C”

1.5 Information

This short manual is a selection of the overall technical specification described in the 9C Motors Manual, which provides specific information on the motor design, installation guidelines and performance details. The 9C Motors Manual and further specific documentation, such as datasheets, dimension drawings in various 3D formats, technical catalogue and presentation can be downloaded from the web site

www.abb.com/motors&drives

or copied from the documentation CDROM.

NOTE!

9C Servomotors are intended to be coupled with ABB ACSM1 frequency converters. Therefore, the technical documentation of the frequency converter must be studied before attempting any work on, or with, the servomotor.

1.6 Converter Selection

The frequency converter should be selected according to the nominal power and the motor rated power, keeping a margin for energy regeneration in dynamic situations. Data tables of 9C motors for coupling with ACSM1 converters for operation in continuous duty (S1) are available in the 9C Motors Manual. Other couplings are possible and must be estimated for variable loads or different duty types.

2 Technical Specs

2.1 Motor identification

When opening the transport package check the motor type and rated data on the motor plate.



Check:

1. Stall Current “I_o” and Rated Current “I_n”
2. Peak Current “I_p”
3. Stall Torque “T_o” and Rated Torque “T_n”
4. Peak Torque “T_p”
5. Rated Power “P_n”
6. Nominal Frequency “f_n”
7. Rated Speed “N_n”
8. Back-emf voltage at rated speed “B_{emf@N_n}”
9. Position transducer type
10. Brake Type (if present): DC Voltage supply “V”; current “A” in Amperes; Static holding torque “Nm”
11. Serial number “S/N” and “Code 128” bar code
12. Motor “Type” code and type bar code
13. IP protection degree of the motor body
14. Insulation class
15. Markings: CE, UL etc.
16. Manufacturing date
17. Manufacturing Country

2.2 General information

9C Servomotors can be manufactured for usage at line supply voltage up to 400V in three square frames, 9C1, 9C4 and 9C5; square size 80, 118, and 148 mm respectively. The motors are natural air cooled (classified as IC0A0 according to IEC 60034-6).

Allowed coolant is air naturally flowing from the surrounding medium. Other coolants are not allowed.

9C Servomotors are provided by default with sealed, self lubricated, ball bearings, therefore a regular lifetime is guaranteed without maintenance if used according to the manufacturer specifications. Some accessories and special ordering codes are possible. Contact ABB for details.

2.3 Degree of Protection: IP code

9C Servomotors are manufactured according to the Standard IEC 60034-5. The motor body is by default classified as IP65 protection level.

On the DE side the protection level is IP54 by default, but it can be increased depending on the seal type to be mounted.

9C Servomotors are intended for use indoors, in dry and dust free environments. The motors must not be immersed in water or sprayed with water or with any other fluid.

2.4 Motors Weight

The actual weight of each motor depends on size, mounting arrangements and additional equipment integrated into the motor. The following table shows the average weights of the motors in their standard versions.

Frame	Size	Motor code	Weight [kg]	Weight with brake [kg]
9C1	1	9C1.1	3.0	3.5
	2	9C1.2	3.9	4.4
	3	9C1.3	4.8	5.3
	4	9C1.4	5.7	6.1
9C4	1	9C4.1	4.1	5.2
	2	9C4.2	7.0	8.1
	3	9C4.3	9.9	11.0
	4	9C4.4	12.8	14.9
9C5	2	9C5.2	16.0	19.2
	3	9C5.3	20.0	23.2
	4	9C5.4	24.0	27.2
	5	9C5.5	28.0	31.2
	6	9C5.6	32.0	35.2

2.5 Lifting

Due to the small size of the motors, lifting lugs are not provided. If needed lift the motor using belts. Do not hang the motor on the shaft.

When lifting the motor avoid collision with any other equipment, and damage of any part of the motor.

WARNING!

Do not lift the motor when connected to the load.

2.6 Storage

The motors should always be stored indoors, in dry, vibration free and dust free environments.

Ambient temperature for storing is -30° to +85°C.

If long storing is foreseen, rotate the shaft periodically by hand until free smooth rotation is achieved (supply the brake if present).

When starting the motor the first time, run the motor slow for a short run-in.

3 Before Installation

3.1 Intended use

9C Servomotors are intended for use in industrial application.

WARNING!

The motor is intended for installation and use by qualified personnel, familiar with electrical machines and safety requirements.

WARNING!

The safety equipment necessary to prevent accidents and electric shock must be provided by the installer.

ABB motors are intended to be driven by frequency converters. The documentation of the converter must be studied before the mechanical and electrical installation of the motor.

3.2 Operating Conditions

Ambient temperature allowed is 0°C to 40°C.

A derating of the motor electrical performance is mandatory in the range 40°C to 50°C.

Maximum altitude for the installation is 1000 m.a.s.l.

3.3 Foundation

The installer has full responsibility for the preparation of the machine flange and its foundation.

The foundation and the mounting flange must be compliant with international standards.

The foundation must be prepared and properly dimensioned in order to avoid vibrations during operation, in dynamic situations, and to withstand eventual short circuit stresses.

4 Mechanical Installation

Lift the motor by using belts, if required, and place it carefully on the machine with due professional care. Follow the instruction below to fix the motor to the mounting flange and to couple it to the load.

4.1 Mounting

9C Servomotors are designed according to IEC 60034-7 for flange installation, with horizontal shaft.

Therefore, by default, they can be mounted in the following configuration:

IMB5 the motor is flange-mounted on the DE side with passing holes on the flange, the motor shaft is horizontal.

If other mounting is required, e.g. IMV1 or IMV3, please refer to the motor complete installation manual. Check for detailed instructions and limitation of use.

4.2 Alignment and Balancing

Proper mechanical installation includes correct alignment between motor and load to avoid vibrations and, consequently, shaft, bearing failures.

The form tolerance of the mechanics for mounting the motor must meet the specifications given on the motor overall dimension drawings.

The rotor is already balanced, when a keyway is present it is normally balanced with half keyway. Pulleys, couplings and loads in general applied to the motor must be balanced too before being connected to the motor.

4.3 Couplings

Since the most delicate parts of a servomotor are bearings and shaft, a particular care must be taken when mounting and coupling of the motor to its load.

WARNING!

Mechanical couplings, pulleys and pinions must be connected to the motor shaft using adequate tools, **absolutely avoiding the use of a hammer**, which could cause serious damage to the motor.

5 Electrical Installation

WARNING!

Electrical installation must be carried out only by skilled persons.

Carefully observe the international safety standards.

WARNING!

Electrical installation includes preparation and layout of the power and signal cables, observing the safety requirements, insulation distances, grounding of the machine, and compliance to EMC standards.

WARNING!

Before any operation of electrical installation or maintenance switch off both power and auxiliary supply of the drive.

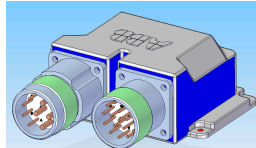
It is recommended to perform the installation of the motor observing the grounding and cabling instructions required by the frequency converter.

When preparing the installation, select the size of the power cables according to the current load and the length of the cable.

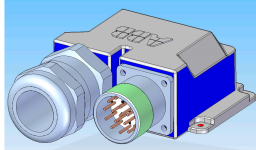
5.1 Connection Box

In 9C motors a connection box is always provided. It can be configured in one of the following ways:

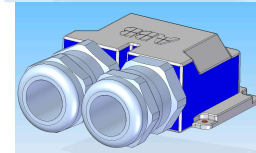
- Signal and Power connectors



- Signal connector and power cable skintop

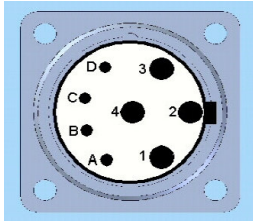


- Double skintop, for signal and power cables.



5.2 Power connector

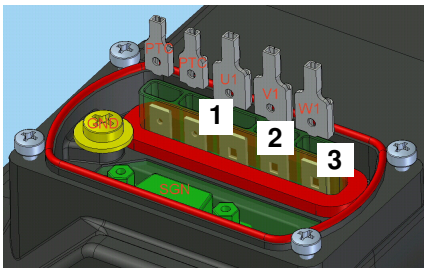
Both power and signal cable connectors must be securely tightened to their respective connectors on the motor, to ensure proper electrical connection and avoid risk of loosening due to vibrations. The power connector layout is the following:



Pin	Phase
3	U
1	V
4	W
2	⊥
A	Brake +
B	Brake -
C	-
D	-

5.3 Power skintop

The power cable shall pass through the passing hole using M25 cable gland (skintops); every cable must be connected to the appropriate terminal, observing the labels inside the connection box and the cabling instructions of the frequency converter. The supply cable female fastons, must be suitable for 6.3X0.8 mm male fastons, and must be firmly inserted in the male contacts on the motor internal connection plate, observing the phase correspondence "U", "V", "W" of the picture and table below.



Servomotor	Faston		
	1	2	3
9C1	U	V	W
9C4	U	V	W
9C5	U	V	W

The yellow-green earth cable must be connected to the ground screw inside the motor terminal box, which is marked with the earth symbol according to international standards.

The ground terminal must be equipped with an M4 eyebolt.

If the double skintop option is used, the signal cable must be prepared with two female faston connectors, marked with "PTC" in the picture above, suitable for 4.8X0.8 mm male fastons.

5.4 Brake

If the servomotor is equipped with a parking brake, terminals of the brake may be on the power connector or inside the connection box, depending on the connection box configuration.

The brake is unlocked when powered with 24VDC and locked when discharged.

If the connection box is configured for power cable and skintop, than the brake terminals must be naked, tinned wires to be screwed in the proper terminals inside the motor.

5.5 Thermal Protection

WARNING!

The windings of 9C Servomotors are manufactured according to **Class F insulation system**, that means max ambient temperature 40°C and max windings temperature 155°C.

Therefore, the thermal sensors integrated into the servomotors must be connected to the converter control circuit and adequate alarm levels must be set in order to prevent high temperature and damage to windings insulation.

9C Servomotors embody a PTC thermal sensor. The operating point of the thermal sensor is 140°C with $\pm 5^\circ\text{K}$ tolerance range.

In any case, the tripping levels must be estimated according to the temperature diagram of the PTC sensor used.

The thermal sensor terminals may be on signal cable or inside the connection box, depending on the configuration of the connection box. When inside the connection box the signal cable must be equipped with two female faston connectors, suitable for 4.8X0.8 mm male fastons.

5.6 Position Transducer

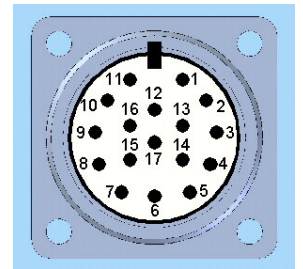
The pin layout can be different depending on the position transducer, therefore, in general, refer to the pin layout annexed with the motor. Standard 9C Servomotors are equipped with a resolver. Various types of encoders are also possible, therefore not all of them can be here listed.

5.6.1 Signal Connector

The signal connector of the position transducer is a standard 17-pins male connector for industrial application embodied into the connection box.

The PIN-out of the connector is here shown for resolver and Heidenhain EQN type Endat encoder.

PIN	Resolver	EQN Endat
1	S1 (Cos +)	Sensor
2	S2 (Sin +)	-
3	S3 (Cos -)	-
4	S4 (Sin -)	Sensor
5	Temperature sensor +	
6	Temperature sensor -	
7	R1 (Supply +)	Up
8	R2-R3 (Supply -)	CLOCK
9		CLOCK -
10		0 V
11	Internal shield	
12		B +
13		B -
14		DATA
15		A +
16		A -
17		DATA -



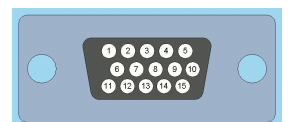
5.6.2 D-SUB Internal connector

When the connection box is provided with skintop for signal cable, than the signal cable must be equipped with a female, D-SUB 15-pin HD compact connector, and with two additional fastons for the thermal sensor.

The following picture shows the 15-pin HD male connector mounted inside the motor box.

The PIN-out of the 15-pin HD compact connector is here shown for resolver and Heidenhain EQN type Endat encoder.

PIN	Resolver	EQN Endat
1	S1 (Cos +)	Sensor
2	S2 (Sin +)	-
3	S3 (Cos -)	-
4	S4 (Sin -)	Sensor
5	R1 (Supply +)	Up
6	R2-R3 (Supply -)	CLOCK
7		CLOCK -
8		0 V
9	Internal shield	
10		B +
11		B -
12		DATA
13		A +
14		A -
15		DATA -

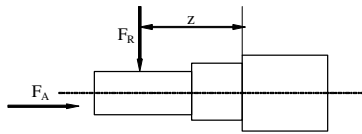


6 Operation

6.1 Bearings

Standard 9C Servomotors integrate double metallic shield, type ZZ-C3, permanently greased, ball bearings.

The figure below shows schematically the loads that can be acting on the DE shaft.



where “FA” is the axial load [N], “FR” is the radial load [N], “z” is distance between centres of DE bearing and radial load (e.g. a pulley).

Radial load usually occurs when a pulley is applied to the shaft. Ball bearings can bear radial load. Low axial load is permissible but should be avoided in order to extend the bearing lifetime.

For the best use of 9C Servomotors, loads acting on the shaft must be calculated in order to guarantee a regular lifetime of 20,000 hours in continuous duty of the ball bearings with permanent lubrication. Details on the bearings lifetime calculation can be found in the 9C Motors Manual.

Abnormal noisiness, high temperature and vibrations during operation reveal bearing failure.

Faulty bearings can be safely replaced as ordinary maintenance in the factory. Please contact ABB for repairing service.

6.2 Performances

The motor plate states the motor rated voltage, rated power, rated speed and maximum speed for operation in continuous duty S1. Load curves and further electrical characteristics are available in the 9C Motors Manual.

In continuous duty the motor should be driven at rated speed to produce rated torque.

NOTE!

Note that the maximum speed is a critical speed for the motor and its components, which must never be exceeded.

6.3 Overload

If different periodic duty types, such as S6, S2 and S3, are foreseen, the motor overload and a consequent time of operation at no-load must be calculated case by case.

6.4 Noise

Noise of motors is mainly due to the rotational speed and friction effects.

If noise is above normal level, inspect the motor and the machine for causes. In case of loud mechanical noise:

- Check that the motor is well fixed to the mounting flange and to the foundation.
- Check the balancing, the mechanical strength and alignment of motor, load, pulley, coupling halves and of any other rotating part involved.
- Check integrity of the bearings, or vibrations of the shaft end.

When running the motor with a frequency converter, the noise level of the motor may increase due to electromagnetic noise. Magnetic noise is generated by harmonic components in the converter output voltage that can be reduced by:

- Increasing the converter switching frequency.
- Filtering the converter output voltage by a suitable output filter or an additional motor reactance.
- Adjusting the parameters of the frequency converter.
- Adding an antinoise metallic guard.

7 Maintenance

Ordinary maintenance of 9C Servomotors.

- Check the general condition of the motors regularly.
- Check the motor for normal operation.
- Keep clean the motor, in order to ensure free ventilation and cooling.
- Check that the motor is not noisy during operation and that vibrations do not exceed standard levels.

Extraordinary repairs must be executed only by ABB.

When ordering spare parts, take note of the motor code “Type” and the serial number “S/N” printed on the motor plate.

For any communication and support, please contact ABB.

8 Troubleshooting

PROBLEM	CAUSE	ACTION
Motor does not start	Wrong connections	Check the connections of the motor power and signal cables.
	Mechanical brake	Check that the brake is supplied with 24VDC in tolerance range and that is not locked.
	Mechanical failure	Check that the mechanics coupled to the servomotor allow free rotation.
	Parameters	Check the parameters' settings of the drive system.
	Overload	Reduce the load or resize the motor.
Motor does not reach the rated speed	Parameters	Check the parameters' settings of the drive.
	Overload	Reduce the load or resize the motor.
Motor runs in wrong direction	Connections	Check both power and signal connections on the motor- and converter side.
Motor overheated	Overload	Reduce the load or resize the motor.
	Wrong connections	Check that no phase is incidentally open or grounded.
	Harmonic distortion	High harmonic distortion in the frequency converter output is not allowed.
Vibrations or loud noise	Foundation	Check that the machine flange is adequate. Renew and reinforce foundation if necessary.
	Bearings failure	Contact ABB for repairs.
	Misalignment	Check for correct alignment of motor and load. Ignoring misalignment can cause serious damage of bearings, shaft and mechanics.