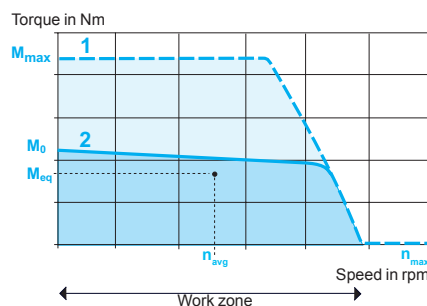


BSH servo motor with straight connectors



BSH servo motor with rotatable angled connectors



Presentation

BSH servo motors are the ideal choice to meet the requirements of dynamics and precision. With five flange sizes and a variety of lengths, there is a suitable solution for most applications, covering a continuous stall torque range from 0.5 to 33.4 Nm for a maximum speed of 9000 rpm.

Thanks to their new winding technology based on salient poles, BSH servo motors are far more compact and offer a higher power density than conventional servo motors.

BSH servo motors are available in four flange sizes: 55, 70, 100 and 140 mm. They are certified as "Recognized" by the Underwriters Laboratories and conform to UL 1004 standards as well as to European directives (CE marking).

BSH servo motors are available with the following variants:

- IP 50 or IP 65 degree of protection
- With or without holding brake
- Straight or angled connectors
- Single turn or multiturn SinCos encoder
- Untapped or keyed shaft end

Torque/speed characteristics

BSH servo motors provide torque/speed curve profiles similar to the example shown on the left with:

- 1 Peak torque, depending on the servo drive model
- 2 Continuous torque, depending on the servo drive model

where:

- n_{max} (in rpm) corresponds to the maximum speed of the servo motor
- M_{max} (in Nm) represents the peak stall torque value
- M_0 (in Nm) represents the continuous stall torque value

Principle for determining servo motor size according to the application

The torque/speed curves can be used to determine the correct servo motor size.

- 1 Locate the work zone of the application in terms of speed.
- 2 Verify, using the servo motor cycle timing diagram, that the torques required by the application during the various phases of the cycle are located within the area bounded by curve 1 in the work zone.
- 3 Calculate the average speed n_{avg} and the equivalent thermal torque M_{eq} (see page 116).
- 4 The point defined by n_{avg} and M_{eq} must be located below curve 2 in the work zone.

Note: For sizing of servo motors, see page 116.

Functions

General functions

BSH servo motors have been developed to meet the following requirements:

- Functional characteristics, ruggedness, safety, etc. in accordance with IEC/EN 60034-1
- Ambient operating temperature:
 - - 20...40°C according to DIN 50019R14.
 - Maximum 55°C with derating from 40°C by 1% of the nominal output power per additional °C
- Relative humidity: IEC 60721-3-3 category 3K4
- Maximum operating altitude: 1000 m without derating, 2000 m with $k = 0.86$, 3000 m with $k = 0.8$ (1)
- Storage and transport temperature: - 25...70°C
- Winding insulation class: F (threshold temperature for windings 155°C) in accordance with DIN VDE 0530
- Power and encoder connection via straight or angled connectors
- Built-in PTC thermistor probe
- Out-of-round, concentricity and perpendicularity between flange and shaft in accordance with DIN 42955, class N
- Permitted mounting positions: no mounting restrictions for IMB5 - IMV1 and IMV3 in accordance with DIN 42950
- Polyester resin-based paint: opaque black RAL 9005

(1) k : derating factor



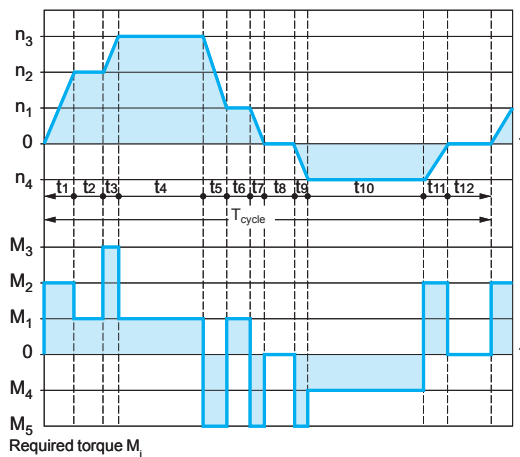
Sizing the servo motor

The "Lexium Sizer" sizing tool is available at www.schneider-electric.com to help you size your servo motor.

These 2 pages are provided to help you understand the calculation method used.

To be able to size the servo motor you need to know the equivalent thermal torque and the average speed required by the mechanism to be used with the servo motor. Both values are calculated using the motor cycle timing diagram and should be compared with the speed/torque curves given for each servo motor (see the characteristics of the servo motor/servo drive combinations).

Servo motor speed n_i



Motor cycle timing diagram

The motor cycle is made up of several sub-cycles, the duration of which is known. Each sub-cycle is divided into phases which correspond to the periods of time during which the motor torque is constant (1 to 3 phases maximum per sub-cycle).

This division into phases can be used to calculate the following for each phase:

- Duration (t_i)
- Speed (n_i)
- Required torque value (M_i)

The curves on the left show the four phase types:

- Constant acceleration during times t_1 , t_3 and t_9
- At work during times t_2 , t_4 , t_6 and t_{10}
- Constant deceleration during times t_5 , t_7 and t_{11}
- Motor stopped during times t_8 and t_{12}

The total duration of the cycle is:

$$T_{\text{cycle}} = t_1 + t_2 + t_3 + t_4 + t_5 + t_6 + t_7 + t_8 + t_9 + t_{10} + t_{11} + t_{12}$$

Calculating the average speed n_{avg}

The average speed is calculated using the formula: $n_{\text{moy}} = \frac{\sum |n_i| \cdot t_i}{\sum t_i}$

- n_i corresponds to the different work speeds
- $\frac{n_i}{2}$ corresponds to the average speeds during the constant acceleration and deceleration phases.

In the timing diagram above:

Duration t_i	t_1	t_2	t_3	t_4	t_5	t_6	t_7	t_8	t_9	t_{10}	t_{11}	t_{12}
Speed $ n_i $	$\frac{ n_2 }{2}$	$ n_2 $	$\frac{ n_3 + n_2 }{2}$	$ n_3 $	$\frac{ n_3 + n_1 }{2}$	$ n_1 $	$\frac{ n_1 }{2}$	0	$\frac{ n_4 }{2}$	$ n_4 $	$\frac{ n_4 }{2}$	0

The average speed is calculated as follows:

$$n_{\text{moy}} = \frac{\frac{n_2}{2} \cdot t_1 + n_2 \cdot t_2 + \frac{n_3 + n_2}{2} \cdot t_3 + n_3 \cdot t_4 + \frac{n_3 + n_1}{2} \cdot t_5 + n_1 \cdot t_6 + \frac{n_1}{2} \cdot t_7 + \frac{n_4}{2} \cdot t_9 + n_4 \cdot t_{10} + \frac{n_4}{2} \cdot t_{11}}{T_{\text{cycle}}}$$

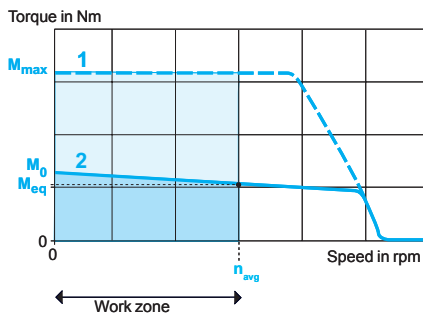
Calculating the equivalent thermal torque M_{eq}

The equivalent thermal torque is calculated using the formula:

$$M_{\text{eq}} = \sqrt{\frac{\sum M_i^2 \cdot t_i}{T_{\text{cycle}}}}$$

In the timing diagram above, this formula gives the following calculation:

$$M_{\text{eq}} = \sqrt{\frac{M_2^2 \cdot t_1 + M_1^2 \cdot t_2 + M_3^2 \cdot t_3 + M_1^2 \cdot t_4 + M_5^2 \cdot t_5 + M_1^2 \cdot t_6 + M_5^2 \cdot t_7 + M_5^2 \cdot t_9 + M_4^2 \cdot t_{10} + M_2^2 \cdot t_{11}}{T_{\text{cycle}}}}$$



Sizing the servo motor (continued)

Determining the size of the servo motor

The point defined by the two preceding calculations (average speed and equivalent thermal torque) where the:

- horizontal axis represents the average speed n_{avg}
 - vertical axis represents the thermal torque M_{eq}
- must be within the area bounded by curve 2 and the work zone.

The motor cycle timing diagram should also be used to ensure that all torques M_i required for the different speeds n_i during the various cycle phases are within the area bounded by curve 1 and the work zone.