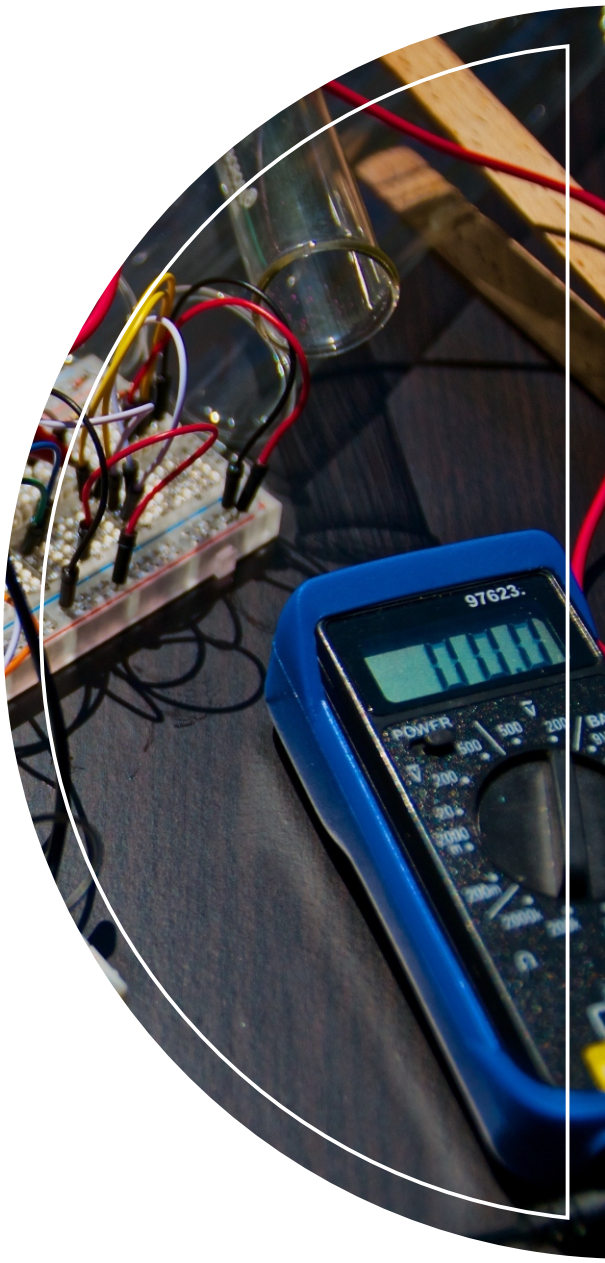
Brushless DC Motor & Actuator Design Guidelines

BUCCO TECHNOLOGY

Contents



1. About Us

BUCCO aims to provide high technology and robust solutions to the electric motor & actuator demands of the industry.

Design& Development → Manufacturing → Test & Monitoring → Mass Production → A/S & Maintenance → Solution

2. Applications & Advantages


Defense Industry

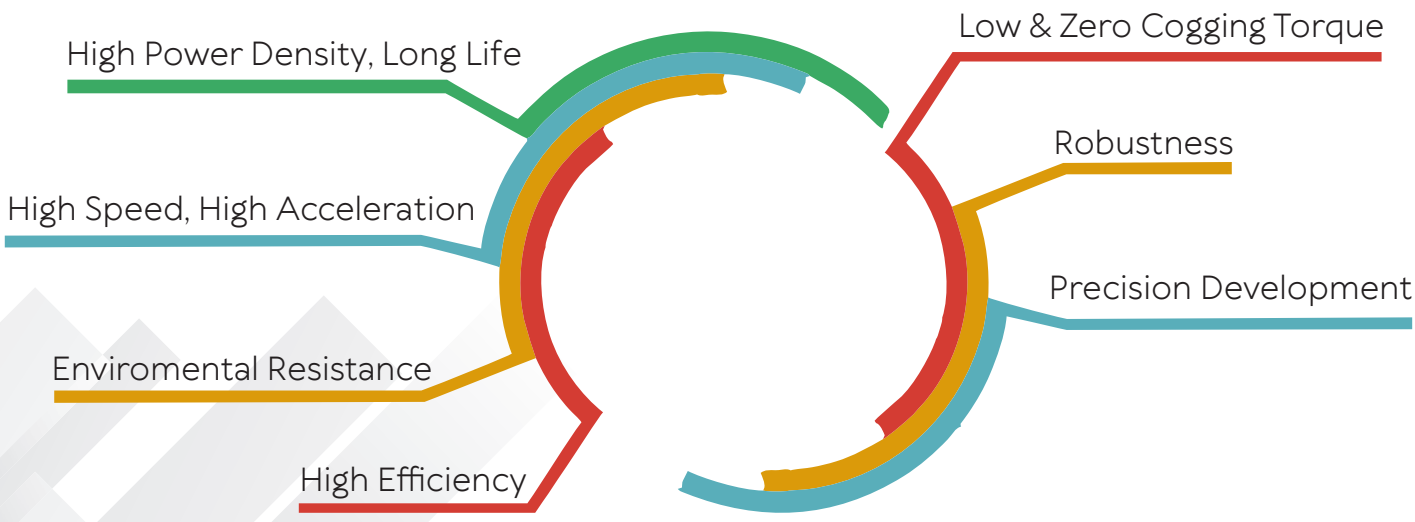

Machining

Medical


Aeronautics


Robotics


Fields of Hight Technology

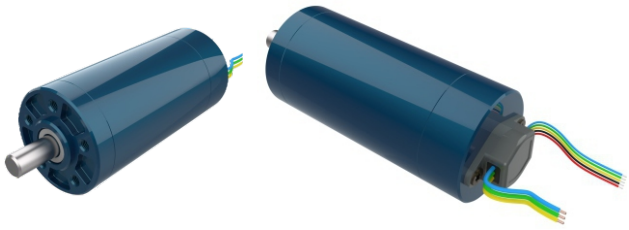


3. Product Overview

BLDC Servo Motor and Actuator Systems

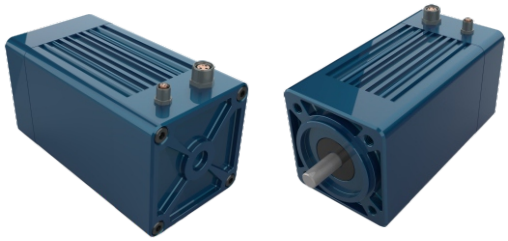
1- (RB) Round Body

(20-2000 W 1500 - 15000 rpm)



2. (SB) Square Body

(200-3000W 1500 - 5000 rpm)



3- (EH) E-Hub

(025-5 kW, 300- 2000 rpm)

4. (ET) E-Traction

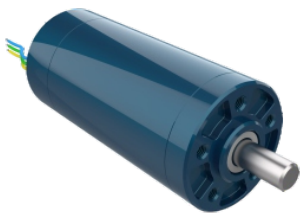
(0.5-10 kW, 1000 - 3500 rpm)

5. (HS) High Speed

(20-500 W 20000 - 10000 rpm)

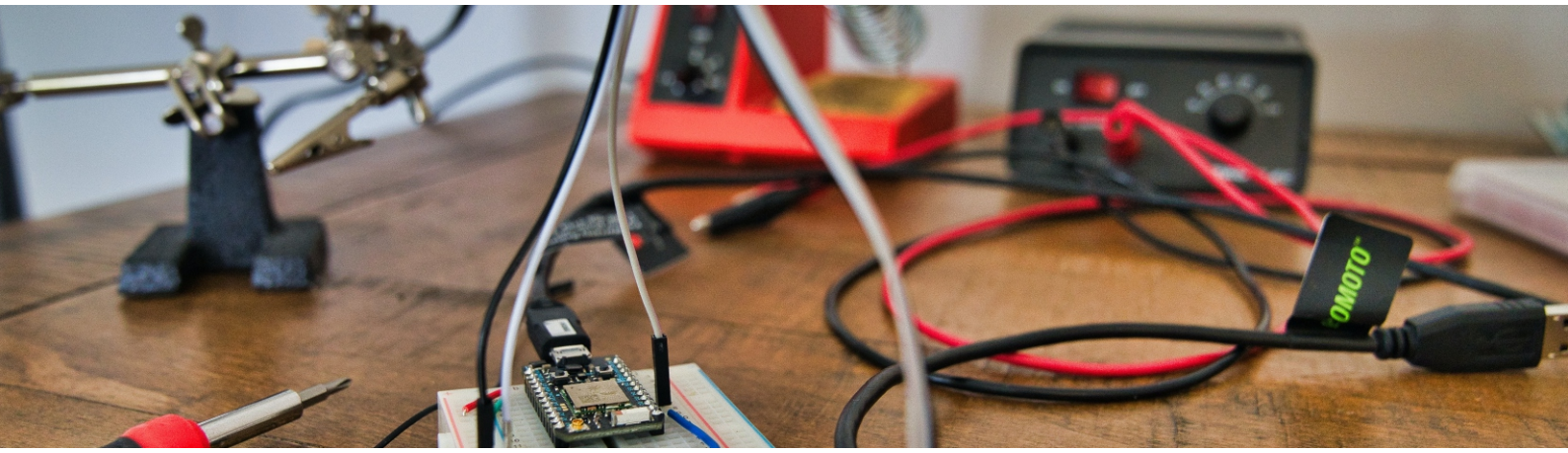
6. (SL) Slotless

(5-120 W, 8000- 30000 rpm)



4. Design Guidelines

- General Parameters
- Electrical Parameters
- Mechanical Parameters



5. General Parameters

G1. Product Code

RB	2000	/	48	/	8000	/	GD
1	2		3		4		5

Example Code Description: Round Body 2000W, 48V, 8000 rpm motor integrated gearbox and driver.

1: Product Code (Page:4)

2: Power (W)

3: Voltage (V)

4: Speed (rpm)

5: Accessory (A: Actuator, G: Gearbox, D:Driver, B:Brake)

G2. Housing Material

The motor housing material can be produced from different materials, especially aluminum and stainless steel. When issues such as durability, corrosion resistance and lightness are discussed, the most suitable material is selected according to the customer's request.

G3. Housing Surface

The housing can be painted or coated with electrostatic paint, anodized coating, electroless nickel plating and similar coating types as desired.

G4. Sensor Type

Products can be produced with or without sensors. The sensor type is chosen completely in line with the product usage area and customer demand.
The main types are as follows;
*Sensorless
*Hall Effect Sensor
*Incremental Encoder
*Absolute Encoder
*Resolver

G5. Driver

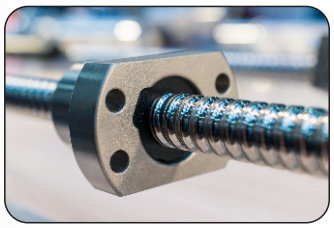
The motor and actuator products, integrated or external driver option is also carried out if desired. In its integrated state, the driver is placed inside the motor body.

G6. Gearbox

Geared products can be offered in low speed and high torque applications. Generally, planetary gearboxes are preferred. Transmission ratios and backlash values of the gearboxes are selected according to the application in line with the customer demand.

G7. Ball & Roller Screw

Ball & Roller screws are preferred in linear actuator applications. The following formulas are used in the screw selection;



Speed Formula

$$N = \frac{60 \,.\, S}{P_L \,.\, t}$$

N: Operating Speed (rpm)
S: Stroke (mm)
t: Time per stroke (sec)
P_L: Product Lead (mm)

Torque Formula

$$T = \frac{F\,max \,.\, P_L}{2{,}000 \,.\, \pi \,.\, \eta_p}$$

T: Torque (Nm)
F max: Maximum Force (N)
P_L: Product Lead (mm)
η_p: Product Efficiency (%)

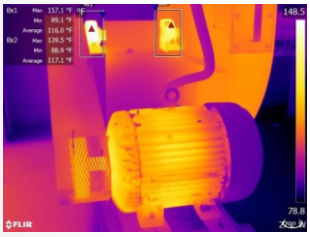
Power Formula

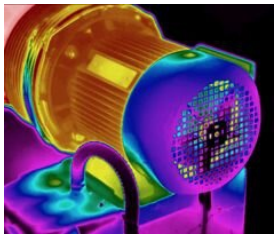
$$P = \frac{F\,max \,.\, N.\, P_L}{60{,}000.\eta_p}$$

P: Power (W)
F max: Maximum Force (N)
N: Speed (rpm)

G8. Temperature Sensor

When desired, a temperature sensor is placed inside the motor to control the bearing and winding temperatures.



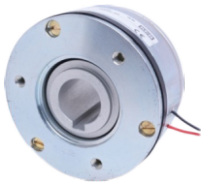


G9. Connector Type

The most suitable connector is determined in line with the customer's request. Military type connectors are preferred in defense industry applications. IP level is also important in connector selection.

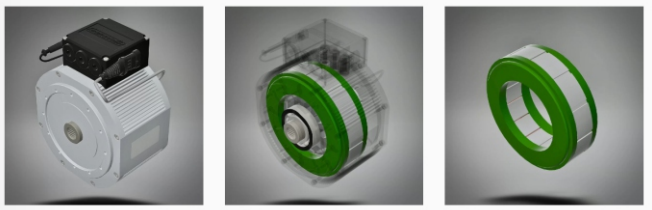
G10. Brake

If requested, servo brakes can be integrated into the products. The brakes are available in normally open and normally closed versions. Brake torque can be determined according to the application.



G11. Potting Encapsulation

In cases where it is necessary to increase the heat transfer or in underwater applications, the windings of the products can be enclosed in epoxy. Although the disadvantages of this application are cost and weight, it can be preferred in applications that require robustness.



G12. IP Level

The following table will be used when determining the IP level;

INGRESS PROTECTION MARKING

SOLID PROTECTION

0	Non protected
1	Protected against a solid object greater than 50 mm, such as a hand.
2	Protected against a solid object greater than 12 mm, such as a finger.
3	Protected against a solid object greater than 2.5 mm, such as a screwdriver.
4	Protected against a solid object greater than 1 mm, such as a most screws and wires.
5	Dust protected. Prevents ingress of dust sufficient to cause harm.
6	Dust tight. no ingress of dust.

WATER PROTECTION

0	Non protected
1	Protected against vertical dripping water. Limited liquid entry.
2	Protected against vertical dripping water when tilted up 15°. Limited liquid entry.
3	Protected against spraying water at an angle 60° Limited liquid entry.
4	Protected against splashes of water at any angle. Limited liquid entry.
5	Protected against low pressure water jets from any directions. Limited liquid entry.
6	Protected against high pressure water jets from any directions. Limited liquid entry.
7	Protected against the effects immersion of water between 15 cm and 1 m for 30 minutes.
8	Protected against the effects immersion of water under pressure for long periods.
9	Protected from close-range, powerful, high-temperature water jets.

IEC®

The IP rating system is defined in international standard IEC 605029. IP ratings are used to classify and define of ingress protection on electrical devices against solids and water. By defining a rating, the IP system ensures specific levels of overate when products are faced with varying elements.

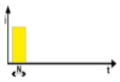
G13. Duty Cycle

The following table will be used when determining the Duty Cycle ;

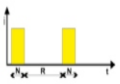
DUTY CYCLES ACCORDING TO IEC 34 STANDARD

S1 CONTINUOUS DUTY
Operation with constant load over a sufficient duration for reaching a thermal equilibrium.

S2 SHORT TIME DUTY
Short time operation, total cooling between each start.

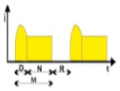


S3 INTERMITTENT PERIODIC DUTY
The starting current has no significant effect on temperature rise. To be followed by the maximum operating time.



S4 INTERMITTENT DUTY WITH STARTING
Repetition of cycles including:
- starting period D
- period of constant speed N
- rest period R

To be followed by the duty factor in %, as well as the number of starts per hour.



Our cholce:S4-The only representative duty cycle for actuator operation is S4.

Level	Name	Explanation
S1	Continuous duty	The motor works at a constant load for enough time to reach temperature equilibrium.
S2	Short-time duty	The motor works at a constant load, but not long enough to reach temperature equilibrium. The rest periods are long enough for the motor to reach ambient temperature.
S3	Intermittent periodic duty	Sequential, identical run and rest cycles with constant load. Temperature equilibrium is never reached. Starting current has little effect on temperature rise.
S4	Intermittent periodic duty with starting	Sequential, identical start, run and rest cycles with constant load. Temperature equilibrium is not reached, but starting current affects temperature rise.
S5	Intermittent periodic duty with electric braking	Sequential, identical cycles of starting, running at constant load and running with no load. No rest periods.
S6	Continuous operation with intermittent load	Sequential, identical cycles of running with constant load and running with no load. No rest periods.
S7	Continuous operation with electric braking	Sequential identical cycles of starting, running at constant load and electric braking. No rest periods.
S8	Continuous operation with periodic changes in load and speed	Sequential, identical duty cycles run at constant load and given speed, then run at other constant loads and speeds. No rest periods.

Figure 1.2 — IEC 60034-1 Duty Cycle Chart

G14. Ambient Temperature

The operating ambient temperature of the product is an important design criterion. Minimum, nominal and maximum ambient temperature must be specified during the design process.

6. Electrical Parameters

E1. Power

While determining the required motor power, the speed and torque requirement should be determined first. After these values are determined, the power calculation can be found by the formula below;

$$P(kW) = \frac{T(Nm).N(rpm)}{9550}$$

P: Power
T: Torque
N: Speed

E2. Speed

When determining the speed requirement, the desired speed value in the nominal operating state of the motor should be taken into account.

E3. Torque

When determining the torque requirement, the desired torque value in the nominal operating state of the motor should be taken into account.

E4. Supply Voltage

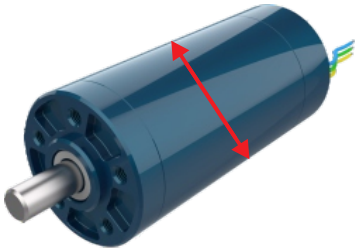
The supply voltage must be given by the customer according to the application.
The connection between motor power, current and voltage is as follows;

$$P = I.V$$

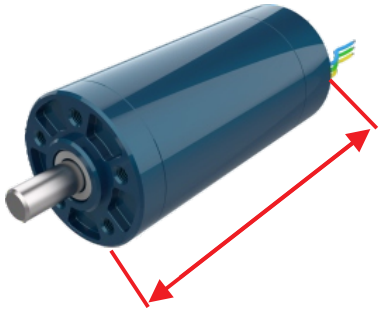
P: Power (W)
I: Ampere (A)
V: Voltage (V)

7. Mechanical Parameters

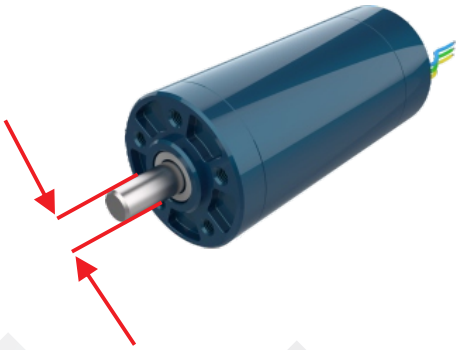
M1. Outer Diameter



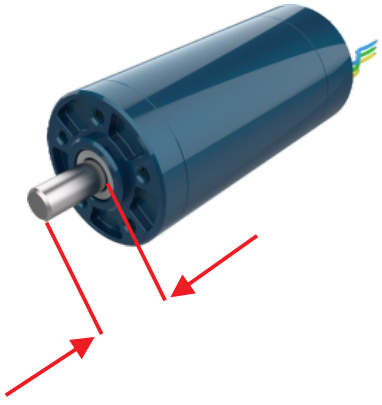
M2. Body Lenght



M3. Shaft Diameter



M4. Shaft Lenght



8. Product Selection Guide

Company Name:	Contact:

General Parameters

G1	Product Type	RB	SB	EH	ET	HS	SL
G2	Housing Material	Steel	Stainless S.	Aluminium	Cast	Other	
G3	Housing Surface	Painted	Coated	None			
G4	Sensor Type	Sensorless	Hall Sensors	Absolute Encoder	Incremental Encoder	Resolver	
G5	Driver	Integrated	Included	None			
G6	Gearbox	Yes	No				
G7	Ball & Roller Screw	Yes	No				
G8	Temperature Sensor	Yes	No				
G9	Connector Type	Standart	IP	MIL Type	Other		
G10	Brake	Yes	No				
G11	Epoxy Coated Winding	Yes	No				
G12	IP Level 1st Digit-Solid	0-6					
	IP Level 2nd Digit-Liquid	0-9					
G13	Duty Cycle	S1-S8					
G14	Ambient Temperature	C°					

Electrical Parameters				
E1	Rated Power	kW	min	max
E2	Rated Speed	rpm	min	max
E3	Rated Torque	Nm	min	max
E4	DC Supply Voltage	VCD		
Mechanical Parameters				
M1	Outer Diameter	mm	min	max
M2	Body Lenght	mm	min	max
M3	Shaft Diameter	mm		
M4	Shaft Lenght	mm		

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