Technical Terms
of
Micro-Drives DC Motors
as
Published on the Datasheet

All values at 22°C. All values at nominal voltage, motor only, without load.

All ratings and data are for nominal values, except where specifically noted.

1 **Nominal Voltage** [Volt]

The nominal voltage at which all other characteristics indicated are measured.

2 **Winding Resistance** [Ω]

The winding resistance measured directly on the commutator. This value is with no commutator segments commutated.

For precious metal brushes this same measurement can be done at the motor terminals as long as no commutator segments are commutated or shorted during the measurement.

The value is directly affected by the coil temperature (temperature coefficient: 0.004 / °C).

3 **Output power** P_2 max. [W]

The maximum obtainable mechanical power achieved at the nominal voltage.

$$P_{2\max} = \frac{R}{4} \cdot \left(\frac{U_N}{R} - I_O \right)^2$$

4 Efficiency ηmax. [%]

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The max. ratio between the absorbed electrical power and the obtained mechanical power of the motor. It does not always correspond to the optimum working point of the motor.

$$\eta_{\max.} = \left(1 - \sqrt{\frac{I_o \cdot R}{U_N}}\right)^2 \cdot 100$$

5 **No-load speed** [rpm] ± x %

The maximum speed the motor attains under no-load conditions at nominal voltage.

$n_o = (U_N - I_o \bullet R) \bullet k_n \qquad \pm x\%$

Tolerance depends on actual motor series.

This is a measured value.

6 **No-load current** Io [A] ± 50%

The current consumption of the motor at nominal voltage and under no-load conditions. This current produces a torque that is equal and opposite the motor's Coulomb and Viscous friction torque at the no load speed.

The value is influenced by temperature and can increase several times for a given motor with larger shaft, reinforced brushes or different lubricant.

This is a measured value.

7 **Stall torque** M_H [mNm]

The Theoretical torque developed by the motor at zero speed and nominal voltage.

$T_s = V / R\, k_M$

This is a calculated value.

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8 **Friction torque** M_R [mNm]

Torque losses caused by the friction of brushes, bearings and commutator.

$$M_R = k_M \bullet I_o$$

This is a calculated value.

9 **Speed constant** k_n [rpm/V]

The speed variation per Volt applied to the motor terminals at constant load. This is the reciprocal of the back emf constant.

$$K_n = 1/k_E$$

This is a calculated value.

10 **Back-EMF constant** k_E [mV/rpm]

The constant corresponding to the relationship between the induced voltage in the rotor at the speed of rotation.

$$k_E = 2\pi \bullet k_M / 60$$

This is a calculated value from no load conditions.

$$k_E = (U_N - I_o \bullet R) / n_o$$

11 **Torque constant** k_M [mNm/A]

The constant corresponding to the relationship between the torque developed by the motor and the current drawn.

This is a calculated value from no load conditions.

12 **Current constant** k_I [A/mNm]

The constant between the current in the motor and the torque developed.

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$k_I = 1 / k_M$

This is the reciprocal of the Torque Constant.

This is a calculated value.

13 **Slope of n-M curve** $\Delta n/\Delta M$ [rpm/mNm]

The ratio of the speed variation to the torque variation. The smaller the value, the more powerful the motor.

It is the ratio of no load speed to stall torque.

$\Delta n/\Delta M = n_o / Ts$

This is a calculated value

14 **Rotor inductance** [µH]

The inductance measured directly on the motor commutator segments with the rotor in the motor housing. Measured with a Sencore LC53 Meter. Different measuring methods will result in different values.

This is as reference value and has no tolerance.

15 **Mechanical time constant** t_m [ms]

The time required for the motor to reach a speed of 63% of its final no-load speed, from standstill. This is a calculated value.

$t_m = R \bullet J / K_M^2 / 10$

This is a calculated value

16 **Rotor inertia** J [gcm^2]

Rotor's mass dynamic inertia moment.

This is a measured value. It is derived from the motor's measured mechanical time constant.

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17 **Angular acceleration** max. [10^3 rad/s^2]

The acceleration obtained from standstill under no-load conditions and at nominal voltage. This is a calculated value.

$$\alpha_{max} = 10{,}000 \bullet Ts / J$$

This is a calculated value

18 **Thermal resistance** R_{th1}/R_{th2} [°C / W]

R_{th1} corresponds to the value between the rotor and housing.

R_{th2} corresponds to the value between the housing and the ambient air.

R_{th2} can be reduced by enabling exchange of heat between the motor and the ambient air (for example using a heat sink or forced air cooling).

This is a measured and will vary by motor winding.

19 **Thermal time constant** τ_{w1} / τ_{w2} [s]

The thermal time constant specifies the time needed for the rotor and housing to reach a temperature equal to 63% of final value.

This is a measured value by determining the thermal time constant of a rotor at maximum rotor temperature cooling down to ambient temperature.

This is a measured and will vary by motor winding.

20 **Operating temperature range** [°C]

Indicates the min and max motor operating temperature, as well as the maximum permitted rotor temperature.

21 **Shaft bearings**

The bearings used for the DC-Micromotors.

22 **Shaft load** max. [N]

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The shaft load at a specified shaft diameter.
The ratings indicate a lifetime in excess of 500 hours.

23 **Shaft play** [mm]

The shaft play on the bearings, measured at the bearing exit.

24 **Housing material**

The housing material and the surface protection.

25 **Weight** [g]

The average weight of the basic motor type.

26 **Direction of rotation**

The direction of rotation is viewed from the front face. Positive voltage to the + terminal gives clockwise rotation of the motor shaft.

Generally motors are designed for clockwise (CW) and counterclockwise (CCW) operation; the direction of rotation is reversible. When this is not the case and the motors are optimized for unidirectional operation it will be noted.

27 **Speed $n_{e\ max}$**. [rpm]

The maximum recommended operating speed.

28 **Torque $M_{e\ max}$** [mNm]

The maximum recommended torque rating.

The maximum recommended torque rating is the product of the maximum allowable current, based on thermal limits of the motor, and the nominal torque constant (k_M [mNm/A]) at 22º C. The temperature coefficient of the magnet is disregarded.

$Me\ max. = I_{e\ max} \bullet k_M$

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29 **Current Ie max** [A]

The maximum allowable current is based on the thermal limits of the maximum permissible standard rotor temperature at 22°C ambient.

The maximum allowable current is the amount of current required to raise the coil temperature to the maximum allowable temperature as determined by the thermal resistance of the motor. The temperature coefficient of the coil is included.

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