

# DC-Micromotors

Precious Metal Commutation

6,8 mNm

8,5 W

## Series 2224 ... SR

| Values at 22°C and nominal voltage    |                                                         | 2224 U                  | 003 SR                                      | 006 SR | 012 SR | 018 SR                   | 024 SR | 036 SR |                                     |
|---------------------------------------|---------------------------------------------------------|-------------------------|---------------------------------------------|--------|--------|--------------------------|--------|--------|-------------------------------------|
| 1                                     | Nominal voltage                                         | $U_N$                   | 3                                           | 6      | 12     | 18                       | 24     | 36     | V                                   |
| 2                                     | Terminal resistance                                     | $R$                     | 0,56                                        | 1,94   | 8,71   | 17,5                     | 36,3   | 91,4   | $\Omega$                            |
| 3                                     | Efficiency, max.                                        | $\eta_{max}$            | 80                                          | 82     | 82     | 82                       | 81     | 80     | %                                   |
| 4                                     | No-load speed                                           | $n_0$                   | 8 100                                       | 8 200  | 7 800  | 8 100                    | 7 800  | 7 800  | min <sup>-1</sup>                   |
| 5                                     | No-load current, typ. (with shaft ø 2 mm)               | $I_0$                   | 0,066                                       | 0,029  | 0,014  | 0,01                     | 0,007  | 0,005  | A                                   |
| 6                                     | Stall torque                                            | $M_H$                   | 18,5                                        | 21,2   | 19,8   | 21,4                     | 19     | 16,9   | mNm                                 |
| 7                                     | Friction torque                                         | $M_R$                   | 0,23                                        | 0,2    | 0,2    | 0,21                     | 0,2    | 0,22   | mNm                                 |
| 8                                     | Speed constant                                          | $k_n$                   | 2 730                                       | 1 380  | 657    | 454                      | 328    | 219    | min <sup>-1</sup> /V                |
| 9                                     | Back-EMF constant                                       | $k_E$                   | 0,366                                       | 0,725  | 1,52   | 2,2                      | 3,04   | 4,56   | mV/min <sup>-1</sup>                |
| 10                                    | Torque constant                                         | $k_M$                   | 3,49                                        | 6,92   | 14,5   | 21                       | 29,1   | 43,5   | mNm/A                               |
| 11                                    | Current constant                                        | $k_I$                   | 0,286                                       | 0,144  | 0,069  | 0,048                    | 0,034  | 0,023  | A/mNm                               |
| 12                                    | Slope of n-M curve                                      | $\Delta n / \Delta M$   | 438                                         | 387    | 394    | 379                      | 411    | 462    | min <sup>-1</sup> /mNm              |
| 13                                    | Rotor inductance                                        | $L$                     | 11                                          | 45     | 200    | 450                      | 800    | 1 800  | $\mu$ H                             |
| 14                                    | Mechanical time constant                                | $\tau_m$                | 11                                          | 11     | 11     | 11                       | 11     | 11     | ms                                  |
| 15                                    | Rotor inertia                                           | $J$                     | 2,4                                         | 2,7    | 2,7    | 2,8                      | 2,6    | 2,3    | gcm <sup>2</sup>                    |
| 16                                    | Angular acceleration                                    | $\alpha_{max}$          | 77                                          | 78     | 74     | 77                       | 74     | 74     | ·10 <sup>3</sup> rad/s <sup>2</sup> |
| 17                                    | Thermal resistance                                      | $R_{th1} / R_{th2}$     | 5 / 20                                      |        |        |                          |        |        | K/W                                 |
| 18                                    | Thermal time constant                                   | $\tau_{w1} / \tau_{w2}$ | 6,8 / 440                                   |        |        |                          |        |        | s                                   |
| 19                                    | Operating temperature range:                            |                         |                                             |        |        |                          |        |        |                                     |
|                                       | – motor                                                 |                         | -30 ... +85 (optional version -55 ... +125) |        |        |                          |        |        | °C                                  |
|                                       | – winding, max. permissible                             |                         | +125                                        |        |        |                          |        |        | °C                                  |
| 20                                    | Shaft bearings                                          |                         | sintered bearings                           |        |        | ball bearings, preloaded |        |        |                                     |
| 21                                    | Shaft load max.:                                        |                         | (standard)                                  |        |        | (optional version)       |        |        |                                     |
|                                       | – with shaft diameter                                   |                         | 2                                           |        |        | 2                        |        |        | mm                                  |
|                                       | – radial at 3 000 min <sup>-1</sup> (3 mm from bearing) |                         | 1,5                                         |        |        | 8                        |        |        | N                                   |
|                                       | – axial at 3 000 min <sup>-1</sup>                      |                         | 0,2                                         |        |        | 0,8                      |        |        | N                                   |
|                                       | – axial at standstill                                   |                         | 20                                          |        |        | 10                       |        |        | N                                   |
| 22                                    | Shaft play:                                             |                         |                                             |        |        |                          |        |        |                                     |
|                                       | – radial                                                | ≤                       | 0,03                                        |        |        | 0,015                    |        |        | mm                                  |
|                                       | – axial                                                 | ≤                       | 0,2                                         |        |        | 0                        |        |        | mm                                  |
| 23                                    | Housing material                                        |                         | steel, black coated                         |        |        |                          |        |        |                                     |
| 24                                    | Mass                                                    |                         | 46                                          |        |        |                          |        |        | g                                   |
| 25                                    | Direction of rotation                                   |                         | clockwise, viewed from the front face       |        |        |                          |        |        |                                     |
| 26                                    | Speed up to                                             | $n_{max}$               | 9 000                                       |        |        |                          |        |        | min <sup>-1</sup>                   |
| 27                                    | Number of pole pairs                                    |                         | 1                                           |        |        |                          |        |        |                                     |
| 28                                    | Magnet material                                         |                         | NdFeB                                       |        |        |                          |        |        |                                     |
|                                       |                                                         |                         |                                             |        |        |                          |        |        |                                     |
|                                       |                                                         |                         |                                             |        |        |                          |        |        |                                     |
|                                       |                                                         |                         |                                             |        |        |                          |        |        |                                     |
|                                       |                                                         |                         |                                             |        |        |                          |        |        |                                     |
| Rated values for continuous operation |                                                         |                         |                                             |        |        |                          |        |        |                                     |
| 29                                    | Rated torque                                            | $M_N$                   | 2,2                                         | 4,5    | 6,7    | 6,8                      | 6,6    | 6,1    | mNm                                 |
| 30                                    | Rated current (thermal limit)                           | $I_N$                   | 0,7                                         | 0,7    | 0,52   | 0,37                     | 0,25   | 0,16   | A                                   |
| 31                                    | Rated speed                                             | $n_N$                   | 7 170                                       | 6 390  | 4 390  | 4 800                    | 4 300  | 4 060  | min <sup>-1</sup>                   |

**Note:** Rated values are calculated with nominal voltage and at a 22°C ambient temperature. The  $R_{th2}$  value has been reduced by 0%.

### Note:

The diagram indicates the recommended speed in relation to the available torque at the output shaft for a given ambient temperature of 22°C.

The diagram shows the motor in a completely insulated as well as thermally coupled condition ( $R_{th2}$  50% reduced).

The nominal voltage ( $U_N$ ) curve shows the operating point at nominal voltage in the insulated and thermally coupled condition. Any points of operation above the curve at nominal voltage will require a higher operating voltage. Any points below the nominal voltage curve will require less voltage.



