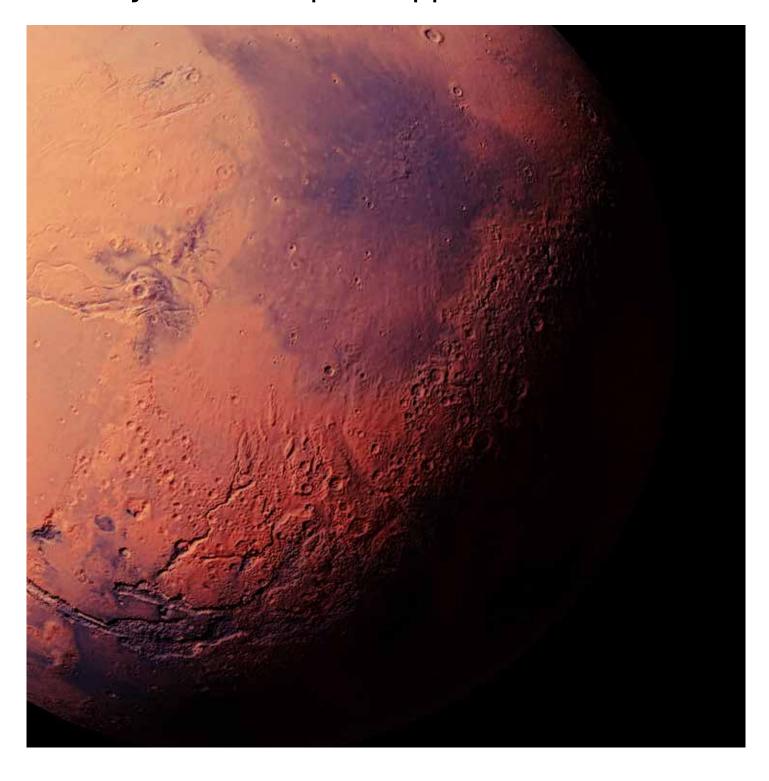


Drive Systems for Space Applications



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Encoders, Resolvers and Brakes	51

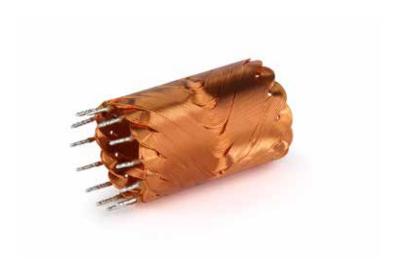
Founded in Switzerland. Available worldwide.

maxon - a strong global brand

maxon, with headquarters in Sachseln/Central Switzerland, has production sites in Switzerland, Germany, Hungary, South Korea, USA, France, Netherlands, Great Britain and China as well as sales companies in more than 30 countries. Our machines and product lines are developed in-house to guarantee cost-effective manufacturing of our products and enables us to create custom solutions to fit your specific application needs.

Precision Drive Systems

maxon develops and builds precision drive systems. Our brushless and brushed DC motors with ironless windings are among the best in the world. Flat motors with iron cores complete our modular product portfolio. maxon's modular system includes planetary and spur gearheads, spindle drives, as well as encoders and control electronics.



Optimized service for space applications

To support customers in the space industry, maxon created a dedicated space group in 2020. The maxon SpaceLab offers optimized service for space applications. This catalog introduces a selection of high-reliability solutions for demanding applications in space environments, with an emphasis on products with space heritage.

With the SpaceLab, maxon has dedicated resources to support our space customers

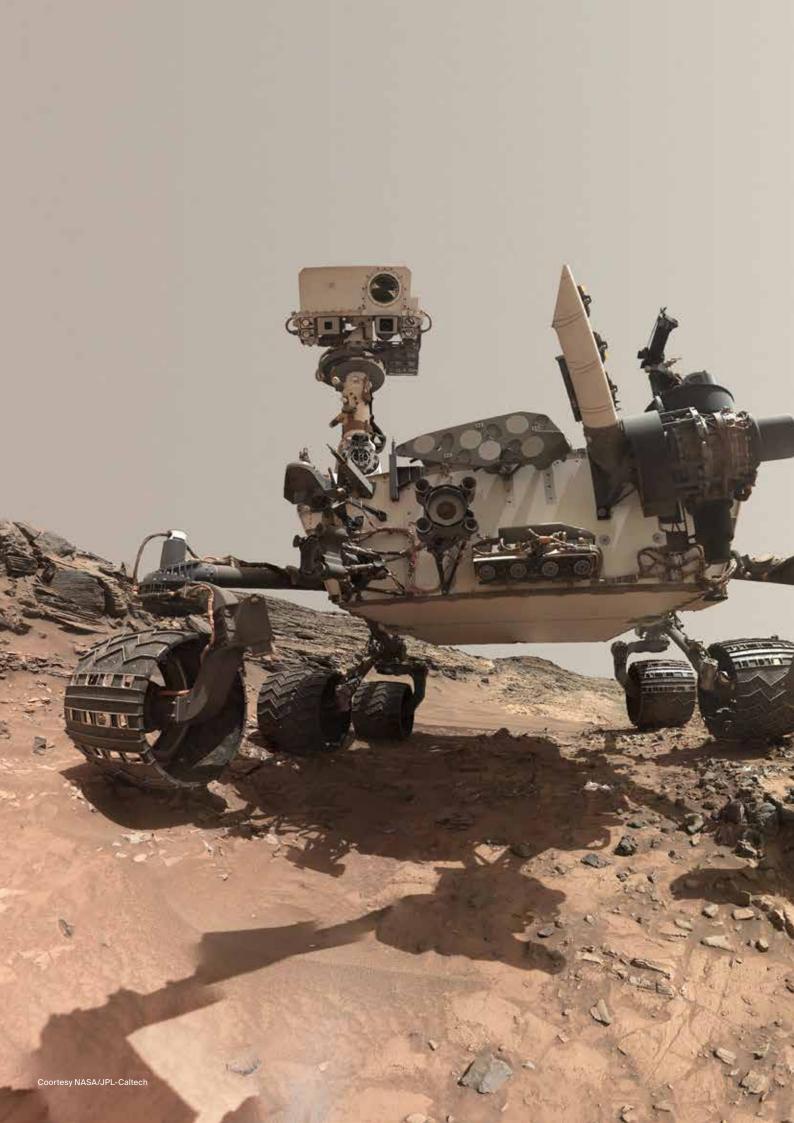
The Spacelab is part of the R&D group and specializes in projects that have the following features and backgrounds:

- → Commercial "new space" applications
- → Space science missions
- → Extreme environments (Cryogenic and ultra-high temperature, vacuum, radiation, high mechanical shock and vibration)
- → These applications can contain high-quality requirements, high technical complexity, small volumes (one shot, micro and small series), and complex test campaigns, but are not limited to these.

The products and services presented here benefit significantly from maxon's economies of scale gained in higher volume aerospace, industrial, automotive and medical applications. These products have also been optimized to achieve higher robustness and reliability levels.

The space catalog products have been developed following the requirements of maxon's AS/EN 9100 Quality Assurance System.

aerospace.maxongroup.com



Space applications

maxon's actuators have been used in numerous space agency funded missions worldwide and can be found on commercial satellites, rovers, science spacecraft, and the ISS. Actuators from maxon's space catalog can be modified as needed to meet the requirements of each customer mission, which include NASA, ESA, JAXA and many private companies in the commercial and new space market. maxon can handle one shot high-end scientific space missions, small volume and high quality commercial space applications and up to high quantity new space satellite constellations.

List of applications where you can find maxon's actuators:

- → Deployment and Rotary Mechanisms
- → Reaction Wheels
- → Gimbal Drives
- → Pump and Valve Actuation
- → Release and Safety Mechanisms
- → Space Robotics
- → Rover Wheel Drive and Steering
- → Launcher Mechanisms
- → And much more

List of successful well-recognized space mission applications:

- → Sojourner
- → Mars Exploration Rover (MER)
- → Phoenix Lander
- → NASA SORCE
- → JAXA Hayabusa2 (Minerva-II)
- → ESA Rosetta
- → ESA Sentinel3
- → NASA InSight
- → ESA Solar Orbiter
- → NASA/JPL Mars2020 "Perseverance"
- → NASA Mars Helicopter "Ingenuity"
- ightarrow NASA LUCY (Deep space mission to the Jupiter Trojans)
- → ESA ExoMars Rover
- → ESA IBDM/ I-HAB
- → SpaceX Dragon





Robot arm actuator with

- → ECX 32 flat + GPX 22 UP + ABX 22 + Harmonic drive + Res
- → ECX 32 flat + GPX 32 UP + ABX 32 + Harmonic drive + Res

Special features: maxon has 3 different sizes rated between 50 Nm and 300 Nm in prototype state. Titanium state, with titanium housings to optimize weight.

Application: Mars Sample Return (MSR), Sample Transfer Arm (STA)

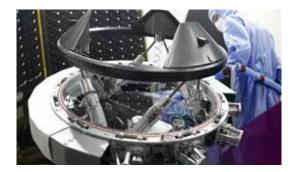


Mars 2020 Perseverance Rover

- → EC 20 flat + GPX 22 UP
- → EC 32 flat + DBX 32

Special features: Modified for ultimate reliability, lowest mass and size.

Application: EC 32 flat motors + detent brake for the sampling & caching, helicopter deployment mechanisms, and EC 20 flat motor + GP 22 UP gearbox for sample handling arm end effector.



IBDM

- → EC 32 flat DW + GPX 22 UP
- → 2x EC4-pole 30 + GPX 42 UP + Spur gear

Special features: Electrical redundant system modified for space environment.

Application: IBDM/IHab docking mechanism. IBDM is an androgynous coupling system. It consists of a hard inner ring (Hard Capture System) and a soft outer ring (Soft Capture System) that has six degrees of freedom and force sensors.



Cube Rover

→ EC 20 flat + GPX 22 UP

Special features: All stainless steel, laser welded connections. Modified for shock, vibration, radiation resistance and operation at extreme temperatures.

Application: Lunar cube rover exploration mission. The drives are also used in various actuator tasks in the ongoing CLPS lunar rover families.



Mars Helicopter Ingenuity

→ DCX 10 S

Special features: Modified industrial COTS product hardened against vibration and shock with a special pinion.

Application: DCX 10 motors for the helicopter swash-plates. This is a mechanism found on all helicopters and is used to adjust the pitch (angle) of the rotor blades, which controls the movement of the vehicle.



ExoMars

→ Main ExoMars drill drive EC 40 + GP 42

Special features: Capsuled main rotor magnet and steering magnet, qualified to -135°C.

Application: ExoMars rover, drill box main drive motor.

maxon space conference publications



The paper "Development of Brushed and Brushless DC Motors for use in the ExoMars Drilling and Sampling Mechanism" was published at the 41st NASA Aerospace Mechanisms Symposium in collaboration with RUAG and ESA and presents a summary of the results of the brushed drive development for the ExoMars Rover.

https://www.esmats.eu/amspapers/pastpapers/pdfs/2012/phillips.pdf



The paper "Mars 2020 maxon Commercial Motor Development from Commercial-Off-the-Shelf to Flight-Qualified Motors, Gearboxes, and Detent Brakes: Overcoming Issues and Lessons Learned" was published at the 45th NASA Aerospace Mechanisms Symposium in collaboration with JPL and precents a summary of the results of the brushless drive development for the Mars Rover Perseverance.

https://esmats.eu/amspapers/pastpapers/pdfs/2020/loschiavo.pdf

Product qualification

Verified by maxon

The space catalog products presented in this brochure have been successfully tested against the maxon industrial standard specifications and qualified against the maxon standard space environmental specifications. Details of the space product specifications and qualification testing are summarized below. Full technical details can be provided upon request.

Note that operation outside of these specifications will not necessarily lead to failure but has not been tested by maxon. Unless specified otherwise in the data sheet(*), the listed drives in this catalog withstand following test conditions:



Temperature and humidity

-70°C to +125°C ambient Operation range Storage range -150°C to +125°C

Humidity storage range Long term storage at ≤60% humidity, ≤30°C

> Short term (up to a few days) storage exposure above the long term storage limits but ≤90% humidity & ≤40°C



Vibration

Sinusoidal vibration

Random vibration In each of the 3 orthogonal axes (frequency range 10-2000 Hz,

RMS acceleration 20 grms, duration: 10 mins in each axis) In each of the 3 orthogonal axes (frequency range 10-200 Hz,

up to 30 g)



Shock

In each of the 3 orthogonal axes, 3 shocks in each axis and direction (up to 3000 g)



Vacuum

Operation and indefinite storage at any pressure between 10⁻⁵ mbar and 1 bar in an earth standard mixture atmosphere. Operation and indefinite storage in a vacuum. Rate of pressure change (raising or lowering): ≤1 bar/min.



Gravity

Operation in any orientation is possible, in any gravity field between 0 and 9.8 ms⁻²



Radiation

Total Ionization Dose (TID)

Any radiation sensitive components will be batch-qualified according to ESCC Basic Specification 22900 using the following parameters:

Dose Level & Rate

- → TID: 100 krad
- → Dose Rate: 1krad/h = 16.7 rad/min = 277 mrad/s
- → Duration: 100 h

Enhanced Low Dose Rate Sensitivity (ELDRS)

Additionally, for integrated circuits based on bipolar technology:

- → ELDRS-TID: 30 krad
- → Max. ELDRS Dose Rate: 0.036 krad/h = 0.6 rad/min = 10 mrad/s
- → Duration: 833.3 h ~= 35 days

Quality assurance

Only performances counts



Drives manufactured by maxon remain reliable even under the most difficult conditions, and have been operating on Mars for years. Apart from highly motivated employees, this requires a sophisticated Quality Management System.

The Quality Management System at maxon is an integral part of the overall management system. The operational and organizational structures, the powers and responsibilities, as well as the process and procedures assessments are documented for all employees. The Quality Management System is enacted, maintained, and periodically verified.

SN EN ISO 9001

SN EN ISO 9001 specifies the requirements to a quality management system (process approach) that an organization has to meet in order to provide products and services that meet the customer expectations as well as to comply with applicable regulatory requirements. Simultaneously, the management system has to be subject to continuous improvement.

EN 9100

This is the aerospace industry's internationally accepted quality standard. It requires companies and employees to reduce potential risks in aerospace applications to a minimum by structuring the design and manufacturing processes accordingly. At maxon, this standard is applied for customer-specific space products on request.

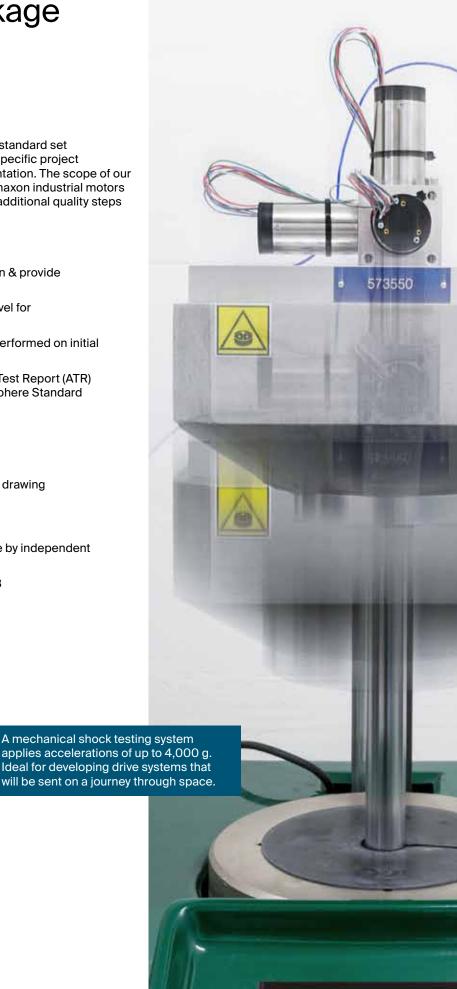
Documentation package

Our services for space projects

Our optional End Item Data Packages (EIDP) provide a standard set of documents for customers who do not already have specific project specifications for additional quality control or documentation. The scope of our documentation goes beyond the usual framework for maxon industrial motors and meets the standard for space hardware including additional quality steps during manufacturing.

The scope includes:

- → Assignment of a project manager to track production & provide customer support
- → Creation of production flow chart to subassembly level for production tracking
- → First article inspection (FAI) to VDA 2.5 or EN9102, performed on initial series production units
- Acceptance Test Procedure (ATP) and Acceptance Test Report (ATR) which includes all testing performed in Earth atmosphere Standard Temperature and Pressure (STP):
 - No-load performance verification
 - Load test performance at nominal load (or customer specific working point)
 - Measure key mechanical dimensions on interface drawing
 - Measure mass
 - Dielectric strength test (500V DC for 10 seconds)
- → Inspection of production documentation & hardware by independent (Q group) inspectors
- → Final assembly of actuator in clean room ISO class 8



Scope of "Standard Space Documentation Package" option compared with ordering hardware only:

	Hardware only	Standard Space Documentation Package
Production Flow Chart	No	Yes
Production according to detailed work instructions (SPD) including each production step countersigned by independent inspector. (Note the work instructions are not deliverable but can be reviewed at maxon.)	No	Yes
Order Tracking	No special tracking (maxon standard processes)	SpaceLab (Dedicated Project Manager)
Interface Control Drawing (ICD) with dimensions etc.	Yes	Yes
3D STEP model of overal envelop	Yes	Yes
Datasheet	Yes	Yes
Functional Tests	Yes (no mapping of test results to S/N), no ATR provided (available at maxon)	Yes (results mapped to S/N) as described above
Customized Acceptance Test Procedure (ATP)	No, maxon standard only	Yes
Acceptance Test Report (ATR)	No	Yes
Declared Material List (DML)	No	Yes
Declared Process List (DPL)	No	Yes
Certificate of Conformity (CoC)	Yes	Yes
First Article Inspection (FAI)	No	Yes

Philosophy of termology

From BB to FM level



BB Breadboard

A unit built to test electrical performance only. May include some customization for interfacing; however, includes no design modifications to meet environmental requirements.



EM

Engineering model

Design is as close as possible to the final configuration; however, modifications based on testing may still be necessary.



QM Qualification model

Design is planned as identical to FM configuration. Material certification for non-standard components in the load path and production documentation for any steps that deviate from the industrial standard.

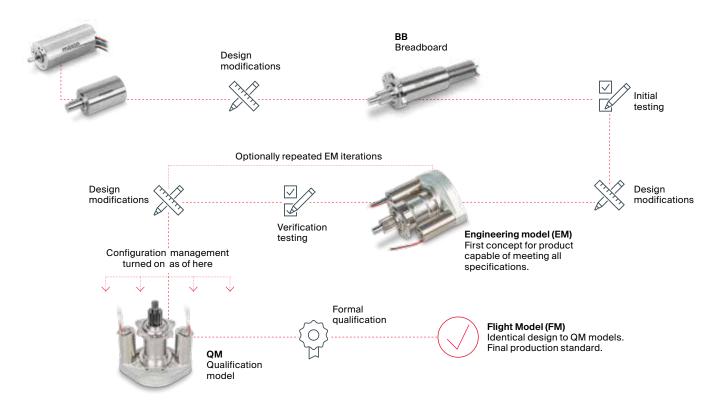


FM

Flight model

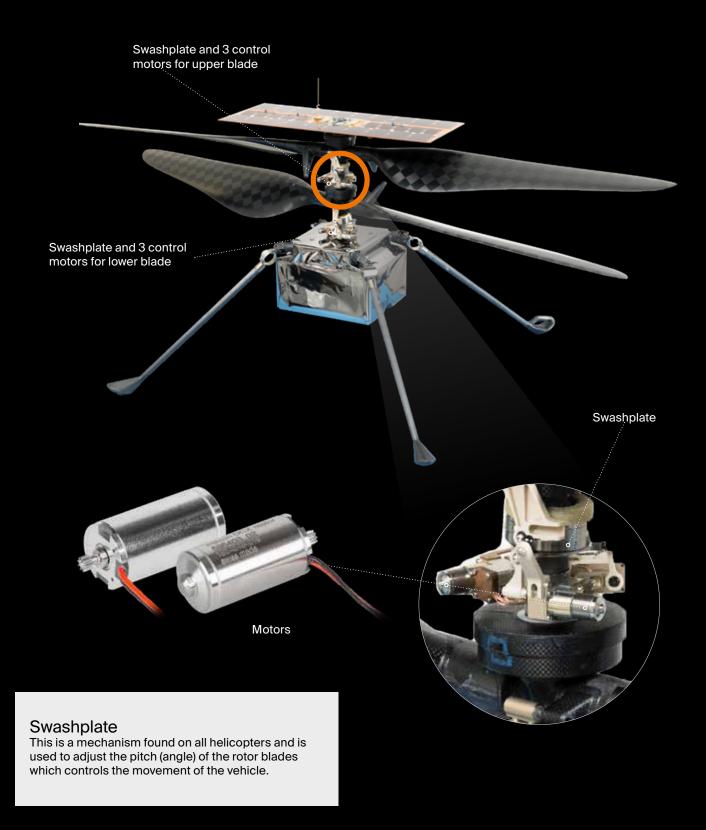
Final configuration.
Production documentation
according to maxon's
EN9100 certified "space"
standard processes.

Development Process (idealized)



For products being used in space and with minor modifications, this process can be shortened, depending on the customer needs and which model types are needed.

First helicopter on Mars "Ingenuity"



Drive Systems for Space

Reliable, robust and delivered quickly

The space catalog products are based on industrial designs that have been modified and qualified in space agency science missions or have flight heritage with commercial space customers. The key modifications that enabled a successful qualification or flight have been maintained in the space catalog products and may be used in other space applications with a high degree of confidence that they will perform as required.

maxon modular system

The motors, gearheads, encoders, and brakes from maxon are perfectly matched to each other and can be combined to meet specific requirements.



Special features for space

- Reduced quantity of adhesives selected for compatibility with the space environment, all stainless steel, laser welded connections.
- Modified for shock, vibration, radiation resistance, and low outgassing operation in vacuum at extreme temperatures.

Available drive components for space



1 Cylindrical brushless DC motors (BLDC)

- ECX 6*
- ECX 8*
- EC 13
- EC4-pole 22
- EC4-pole 30
- EC 40 L



2 Flat brushless DC motors (Outer-runner BLDC)

- EC 20 flat framed / frameless
- EC 32 flat framed / frameless
- EC 45 flat framed / frameless
- EC 60 flat framed* / frameless
- EC 90 flat framed* / frameless*



3 Stepper motor

- Stepper 10*

*In development - prototypes available



4 Brushed DC motors

- DCX 6*
- DCX 8*
- DCX 10 S/L
- DCX 14 L
- DCX 22 S/L
- DCX 32 L
- DCX 35 L

5 Planetary and Screw Drive Gearboxes

- GPX 6
- GPX 8
- GP 10
- GPX 14 UP
- GPX 22 UP
- GPX 32 UP
- GPX 42 UP
- GPX 58 UP
- Screw drives

Special features: Adhesive free, all stainless steel, laser welded and cold formed connections. Modified for shock, vibration and low outgassing operation in vacuum at extreme temperatures.



6 Feedback Sensors

- Ø13 mm 8 quad-cpt hall sensor based encoder (optionally with electrical redundancy)
- Ø19 mm 128 quad-cpt MR encoder (optionally with electrical redundancy)
- Harowe resolvers
- Micronor resolvers

7 Brakes

- ABX 22* + ABX 32* active electro-mechanical spring brake, 20-100 mNm
- DBX 22 + DBX 32 fully passive detent brake

^{*}In development - prototypes available

^{*}Not yet available

^{*}In development - prototypes available

^{*}In development - prototypes available

Redundant motors

When no mistakes are allowed to happen

Whether it's a Mars science mission, a commercial satellite or a manned transport to the ISS, the reliability of individual components is of immense importance in all space applications. Since maxon systems drive many mission-critical components failure is not a option, so we offer electrically redundant motors to protect the entire mission. Depending on the redundancy requirement, maxon SpaceLab provides various solutions.



The typically chosen redundancy for a flat motor is a serial arrangement. There are two physically separated stator systems with windings and commutation sensors, which share the rotor and the shaft.

Possible motor types (for space applications):

→ EC flat motors



One possible redundancy for long cylindrical motors can be achieved with two separate motors (both with own bearings), which are coupled with an Oldham coupling.

Possible motor types:

→ Cylindrical brushless and brushed motors



Another way of redundancy for long cylindrical motors is the coupling of two separate motors (both with own bearings) via a spur gear stage. The spur gear can be designed with 1:1 or higher ratio.

Possible motor types (for space applications):

→ Cylindrical brushless and brushed motors



Other redundant parts:

For some piece parts, redundancy options are available (eg. modified circuit boards with redundant hall sensors).

Special designs

Developed for the most demanding space missions

In addition to reliable standard components, the SpaceLab portfolio also includes solutions according to highly specific customer specifications. These development-intensive applications are designed, tested and produced in-house by maxon in defined process sequences. Our space experts assist in defining the project scope considering technology, cost and time, accompanied from the specification phase to ramp-up and ensure the most reliable product support in the space industry.

Examples of special designs:

- → Fully customized actuators
- → Joint actuators
- → Special interfaces (e.g. flanges with inserts)
- → Size scale up/down from available designs
- → Extended rotor inertia for reaction wheels
- → Optimized weight (e.g. stepped gearboxes)



Mars2020 "Perseverance"

EC 32 flat + detent brake with special customized interface



ExoMars "Rosalind Franklin"

Customized Interface flange



U-turn spur gearbox with a EC4-pole 22 + GPX 22 UP to reduce length of unit



Mars Sample Return

Joint actuators with harmonic drive

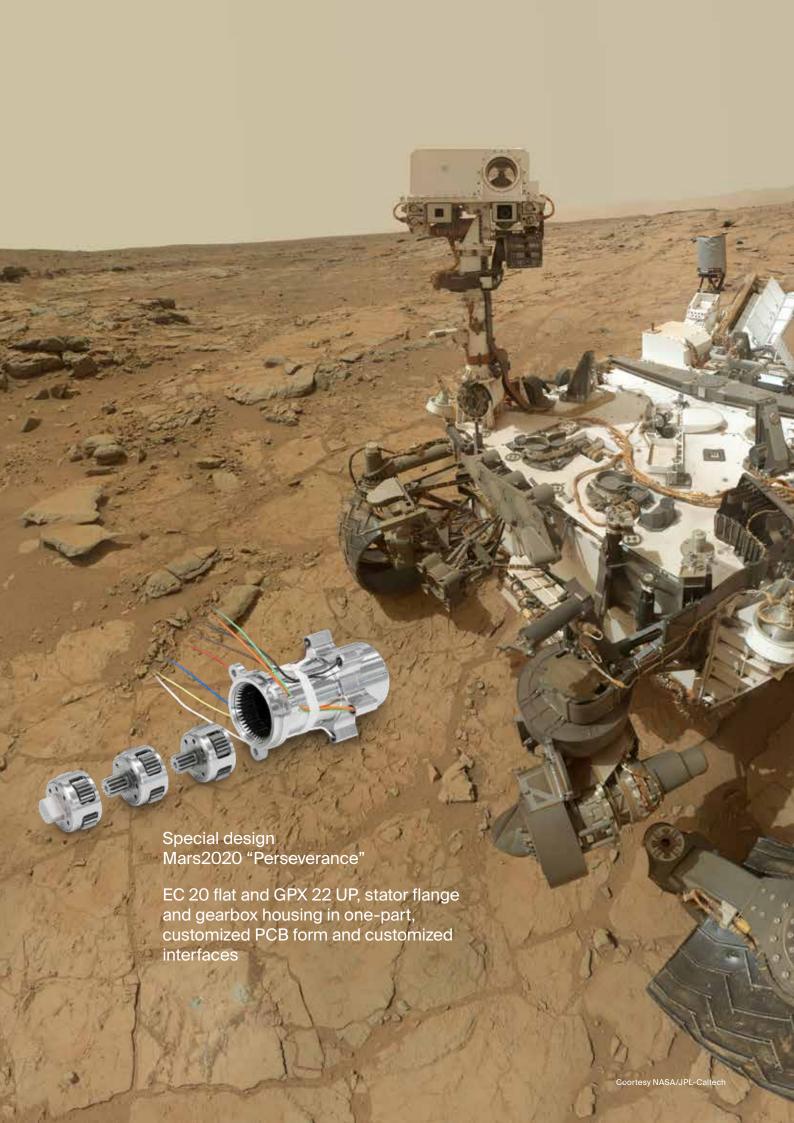


Mars Sample Return

Special gearbox combination with stepped planetary gearbox and active brake



Harsh environmental joint actuator, motor with sinter filter



Motor range

Dedicated to space

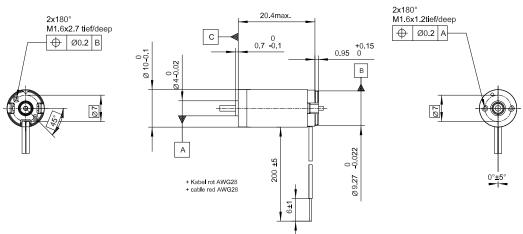
DCX 10 S SPACE, 1 W	22
DCX 10 L SPACE, 1.5 W	23
DCX 14 L SPACE, 6 W	24
DCX 22 S SPACE, 14 W	25
DCX 22 L SPACE, 20 W	26
DCX 32 L SPACE, 70 W	27
DCX 35 L SPACE, 80 W	28
EC 13 SPACE, 30 W	29
EC4-pole 22 SPACE, 90 W	30
EC4-pole 30 SPACE, 150 W	31
EC 40 L SPACE, 400 W	32
EC 20 flat SPACE, 5 W	33
EC 32 flat SPACE, 15 W	34
EC 45 flat SPACE, 50 W	35
EC frameless 20 flat SPACE, 5 W	36
EC frameless 32 flat SPACE, 15 W	37
EC frameless 45 flat SPACE, 50 W	38
EC frameless 60 flat SPACE, 100 W	39



DCX 10 S SPACE Ø10 mm, precious metal brushes, DC motor

Key Data: 1/1.4 W, 0.9 mNm, 14 300 rpm



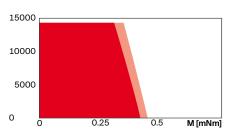


M 1:1

Data at nominal voltage		
Nominal voltage	V	12
No-load speed	rpm	11900
No-load current	mA	18.1
Nominal speed	rpm	8380
Nominal torque	mNm	0.383
Nominal current	Α	0.0602
Stall torque	mNm	1.37
Starting current	Α	0.16
Peak efficiency	%	46.9
Characteristics		
Terminal resistance phase-phase	Ω	74.9
Terminal inductance	mH	0.868
Torque constant	mNm/A	8.53
Speed constant	rpm/V	1120
Speed/torque gradient	rpm/mNm	9830
Mechanical time constant	ms	7.43
Rotor inertia	gcm ²	0.0722
Thermal data		
Therm. resistance housing-ambient (N)	K/W	45.1
Therm. resistance winding-housing (N)	K/W	157
Therm. time constant winding	S	33.8
Therm. time constant motor	s	187
Ambient temperature, min.	°C	-55
Ambient temperature, max.	°C	85
Winding temperature, max.	°C	100
Mechanical data		
Speed limit	rpm	14300
Axial play, min.	mm	0
Axial play, max.	mm	0.1
Preload force, min.	N	0
Radial play, maximum, max.	mm	0.015
Axial force (dynamic), max.	N	0.5
Axial force (static), max.	N	8.8
Axial force, shaft supported, max.	N	120
Radial force, max.	N	1.5
Distance from flange	mm	5
Other specifications		
Pole pair number	-	1
Number of collector segments	-	7
Weight of motor	g	6.3

Data under vacuum conditions.

Operating range n [rpm]



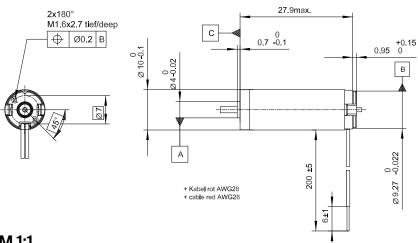
■ Continuous operation
 ■ Continuous operation with reduced thermal resistance R_{th2} 50%
 □ Short term operation

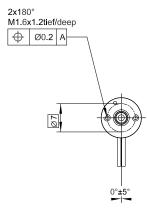
The shown data are applicable to one specific winding. More windings available.

DCX 10 L SPACE Ø10 mm, precious metal brushes, DC motor

Key Data: 1.5/3 W, 2.2 mNm, 14300 rpm



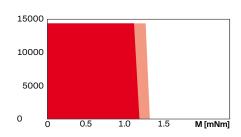




M 1:1

Data at nominal voltage		
Nominal voltage	V	12
No-load speed	rpm	11300
No-load current	mA	10.1
Nominal speed	rpm	8080
Nominal torque	mNm	1.21
Nominal current	Α	0.131
Stall torque	mNm	4.36
Starting current	Α	0.439
Peak efficiency	%	72.5
Characteristics		
Terminal resistance phase-phase	Ω	27.3
Terminal inductance	mH	0.362
Torque constant	mNm/A	9.95
Speed constant	rpm/V	960
Speed/torque gradient	rpm/mNm	2640
Mechanical time constant	ms	3.68
Rotor inertia	gcm ²	0.133
Thermal data		
Therm. resistance housing-ambient (N)	K/W	43.8
Therm. resistance winding-housing (N)	K/W	75.8
Therm. time constant winding	S	31
Therm. time constant motor	S	241
Ambient temperature, min.	°C	-30
Ambient temperature, max.	°C	85
Winding temperature, max.	°C	100
Mechanical data		
Speed limit	rpm	14300
Axial play, min.	mm	0
Axial play, max.	mm	0.15
Preload force, min.	N	0
Radial play, maximum, max.	mm	0.015
Axial force (dynamic), max.	N	0.1
Axial force (static), max.	N	30
Axial force, shaft supported, max.	N	120
Radial force, max.	N	0.8
Distance from flange	mm	5
Other specifications		
Pole pair number	-	1
Number of collector segments	-	7
Weight of motor	g	11





Continuous operation
Continuous operation with reduced thermal resistance R_{th2} 50% ☐ Short term operation

Data under vacuum conditions.

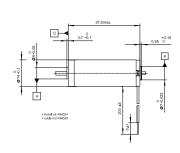
The shown data are applicable to one specific winding. More windings available.

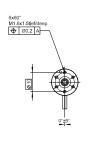
DCX 14 L SPACE Ø14 mm, graphite brushes, DC motor

Key Data: 6/10 W, 6.9 mNm, 17000 rpm



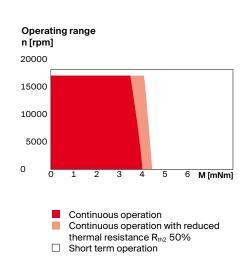






M 1:2

Data at nominal voltage		
Nominal voltage	V	24
No-load speed	rpm	15500
No-load current	mA	32.6
Nominal speed	rpm	13800
Nominal torque	mNm	4.01
Nominal current	Α	0.307
Stall torque	mNm	38.2
Starting current	Α	2.61
Peak efficiency	%	78.9
Characteristics		
Terminal resistance phase-phase	Ω	9.18
Terminal inductance	mH	0.403
Torque constant	mNm/A	14.6
Speed constant	rpm/V	654
Speed/torque gradient	rpm/mNm	411
Mechanical time constant	ms	4.27
Rotor inertia	gcm ²	0.991
Thermal data		
Therm. resistance housing-ambient (N)	K/W	26.6
Therm. resistance winding-housing (N)	K/W	61.7
Therm. time constant winding	s	87.9
Therm. time constant motor	S	271
Ambient temperature, min.	°C	-70
Ambient temperature, max.	°C	125
Winding temperature, max.	°C	155
Mechanical data		
Speed limit	rpm	17000
Axial play, min.	mm	
Axial play, max.	mm	0.1
Preload force, min.	N	8.0
Radial play, maximum, max.	mm	0.015
Axial force (dynamic), max.	N	0.8
Axial force (static), max.	N	18
Axial force, shaft supported, max.	N	300
Radial force, max.	N	10
Distance from flange	mm	5
Other specifications		
Pole pair number	-	1
Number of collector segments	-	7
Weight of motor	g	26



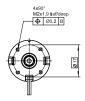
Data under vacuum conditions.

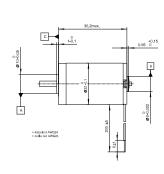
The shown data are applicable to one specific winding. More windings available.

DCX 22 S SPACE Ø22 mm, graphite brushes, DC motor

Key Data: 14/24 W, 15.3 mNm, 18 000 rpm



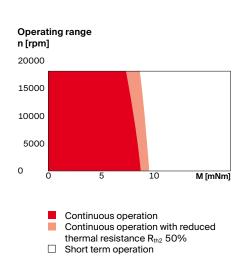






M 1:2

Data at nominal voltage		
Nominal voltage	V	12
No-load speed	rpm	12400
No-load current	mA	81.5
Nominal speed	rpm	11400
Nominal torque	mNm	8.77
Nominal current	Α	1.04
Stall torque	mNm	108
Starting current	Α	
Peak efficiency	%	84.1
Characteristics		
Terminal resistance phase-phase	Ω	1.02
Terminal inductance	mH	0.0576
Torque constant	mNm/A	9.18
Speed constant	rpm/V	1040
Speed/torque gradient	rpm/mNm	116
Mechanical time constant	ms	6.22
Rotor inertia	gcm ²	5.14
Thermal data		
Therm. resistance housing-ambient (N)	K/W	19.2
Therm. resistance winding-housing (N)	K/W	50.1
Therm. time constant winding	S	142
Therm. time constant motor	s	634
Ambient temperature, min.	°C	-55
Ambient temperature, max.	°C	100
Winding temperature, max.	°C	155
Mechanical data		
Speed limit	rpm	18000
Axial play, min.	mm	0
Axial play, max.	mm	0.1
Preload force, min.	N	2.5
Radial play, maximum, max.	mm	0.02
Axial force (dynamic), max.	N	2.5
Axial force (static), max.	N	30
Axial force, shaft supported, max.	N	440
Radial force, max.	N	16
Distance from flange	mm	5
Other specifications		
Pole pair number	-	1
Number of collector segments	-	9
Weight of motor	g	66



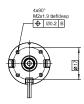
Data under vacuum conditions.

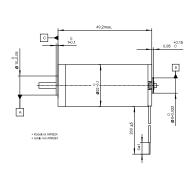
The shown data are applicable to one specific winding. More windings available.

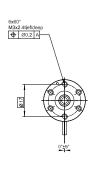
DCX 22 L SPACE Ø22 mm, graphite brushes, DC motor

Key Data: 20/49 W, 32.2 mNm, 18 000 rpm



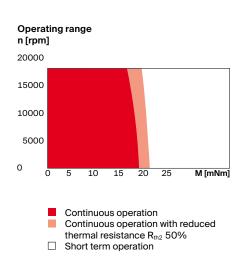






M 1:2

Data at nominal voltage		
Nominal voltage	V	48
No-load speed	rpm	10100
No-load current	mA	11.1
Nominal speed	rpm	9350
Nominal torque	mNm	20.8
Nominal current	Α	0.471
Stall torque	mNm	294
Starting current	Α	
Peak efficiency	%	91.6
Characteristics		
Terminal resistance phase-phase	Ω	7.39
Terminal inductance	mH	0.746
Torque constant	mNm/A	45.2
Speed constant	rpm/V	211
Speed/torque gradient	rpm/mNm	34.5
Mechanical time constant	ms	3.26
Rotor inertia	gcm ²	9.02
Thermal data		
Therm. resistance housing-ambient (N)	K/W	16.3
Therm. resistance winding-housing (N)	K/W	32.7
Therm. time constant winding	S	167
Therm. time constant motor	s	775
Ambient temperature, min.	°C	-55
Ambient temperature, max.	°C	125
Winding temperature, max.	°C	155
Mechanical data		
Speed limit	rpm	18000
Axial play, min.	mm	0
Axial play, max.	mm	0.15
Preload force, min.	N	2.5
Radial play, maximum, max.	mm	0.02
Axial force (dynamic), max.	N	2.5
Axial force (static), max.	N	30
Axial force, shaft supported, max.	N	440
Radial force, max.	N	16
Distance from flange	mm	5
Other specifications		
Pole pair number	-	1
Number of collector segments	-	9
Weight of motor	g	95

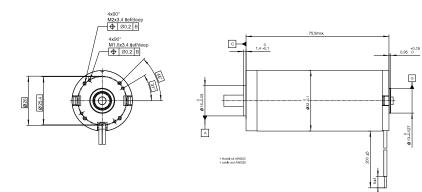


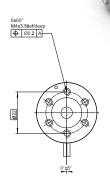
Data under vacuum conditions.

The shown data are applicable to one specific winding. More windings available.

DCX 32 L SPACE Ø32 mm, graphite brushes, DC motor

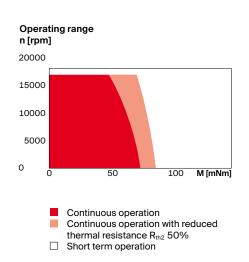
Key Data: 70/110 W, 128 mNm, 11300 rpm





M 1:2

Data at nominal voltage		10
Nominal voltage	V	18
No-load speed	rpm	8620
No-load current	mA	272
Nominal speed	rpm	8250
Nominal torque	mNm	62.2
Nominal current	Α	3.45
Stall torque	mNm	2120
Starting current	Α	
Peak efficiency	%	87.1
Characteristics		
Terminal resistance phase-phase	Ω	0.165
Terminal inductance	mH	0.0525
Torque constant	mNm/A	19.5
Speed constant	rpm/V	490
Speed/torque gradient	rpm/mNm	4.15
Mechanical time constant	ms	3.32
Rotor inertia	gcm ²	76.4
Thermal data		
Therm. resistance housing-ambient (N)	K/W	8.7
Therm. resistance winding-housing (N)	K/W	16.4
Therm. time constant winding	S	337
Therm. time constant motor	s	1000
Ambient temperature, min.	°C	-40
Ambient temperature, max.	°C	100
Winding temperature, max.	°C	155
Mechanical data		
Speed limit	rpm	11300
Axial play, min.	mm	0
Axial play, max.	mm	0.1
Preload force, min.	N	7
Radial play, maximum, max.	mm	0.02
Axial force (dynamic), max.	N	7
Axial force (static), max.	N	22.6
Axial force, shaft supported, max.	N	2510
Radial force, max.	N	65.3
Distance from flange	mm	5
Other specifications		
Pole pair number	-	1
Number of collector segments	_	9
Number of collector segments		v

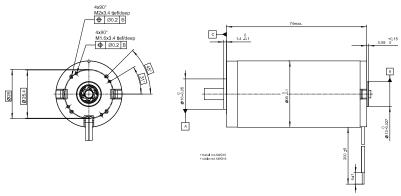


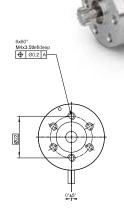
Data under vacuum conditions.

The shown data are applicable to one specific winding. More windings available.

DCX 35 L SPACE ∅35 mm, graphite brushes, DC motor

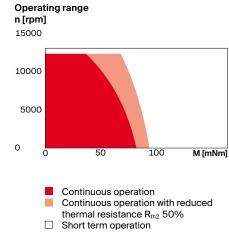
Key Data: 80/120 W, 138 mNm, 12300 rpm





M 1:2

Nominal voltage V 36 No-load speed rpm 7920 No-load current mA 167 Nominal speed rpm 7630 Nominal torque mNm 66.8 Nominal torque mNm 2160 Starting current A 50.3 Peak efficiency % 87.7 Characteristics	Noninal voltage V 36 No-load speed rpm 7920 No-load current mA 167 Nominal speed rpm 7630 Nominal torque mNm 66.8 Nominal current A 1.72 Stall torque mNm 2160 Starting current A 50.3 Peak efficiency % 87.7 Characteristics Terminal resistance phase-phase Ω 0.716 Terminal inductance mH 0.26 Torque constant mNm/A 42.9 Speed constant rpm/V 223 Speed constant rpm/NNm 3.72 Speed /torque gradient rpm/mNm 3.72 Rechanical time constant ms 3.92 Rotor inertia gcm² 101 Therm. resistance housing-ambient (N) K/W 15 Therm. time constant winding s 345 Therm. time constant winding s 345 Therm. time constant winding s 345 Therm. time constant motor s 1230 Ambient temperature, min. °C 40 Ambient temperature, max. °C 100 Winding temperature, max. °C 155 Mechanical data Speed limit rpm 12300 Axial play, min. mm 0.1 Preload force, min. N 7 Radial play, max. mm 0.1 Preload force, shaft supported, max. N 2.6 Axial force, (dynamic), max. N 2.6 Axial force, shaft supported, max. N 2.5 Other specifications Pole pair number N 65.3 Distance from flange mm 5 Other specifications	Data at nominal voltage		
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Nominal current	Nominal current			
Stall torque mNm 2160 Starting current A 50.3 Peak efficiency % 87.7 Characteristics Terminal resistance phase-phase Ω 0.716 Terminal inductance mH 0.26 Torque constant mNM/A 42.9 Speed constant rpm//mNm 3.72 Mechanical time constant ms 3.92 Rotor inertia gcm² 101 Therm. resistance housing-ambient (N) K/W 8.4 Therm. resistance winding-housing (N) K/W 15 Therm. time constant winding s 3.45 Therm. time constant motor s 1230 Ambient temperature, min. °C -40 Ambient temperature, max. °C 100 Winding temperature, max. °C 155 Mechanical data rpm 12300 Axial play, min. mm 0.1 Axial play, max. mm 0.1 Preload force, min.	Stall torque mNm 2160 Starting current A 50.3 Peak efficiency % 87.7 Characteristics Terminal resistance phase-phase Ω 0.716 Terminal inductance mH 0.26 Torque constant mNm/A 42.9 Speed/torque gradient rpm/wNm 3.72 Mechanical time constant ms 3.92 Rotor inertia gcm² 101 Thermal data Therm. resistance housing-ambient (N) K/W 8.4 Therm. resistance winding-housing (N) K/W 15 Therm. time constant winding s 345 Therm. time constant motor s 1230 Ambient temperature, min. °C -40 Ambient temperature, max. °C 100 Winding temperature, max. °C 100 Mechanical data rpm 0 Speed limit rpm 0 Axial play, min. mm 0 Axial forc			
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Peak efficiency % 87.7 Characteristics Ω 0.716 Terminal resistance phase-phase Ω 0.716 Terminal inductance mH 0.26 Torque constant mNm/A 42.9 Speed constant rpm/V 223 Speed/forque gradient ms 3.92 Mechanical time constant ms 3.92 Rotor inertia gcm² 101 Thermal data Therm. time constant incompanient (N) K/W 8.4 Therm. resistance winding-housing (N) K/W 15 Therm. time constant winding s 345 Therm. time constant motor s 1230 Ambient temperature, min. °C -40 Ambient temperature, max. °C 100 Winding temperature, max. °C 155 Mechanical data rpm 12300 Axial play, min. mm 0 Axial play, max. mm 0 Speed limit rpm <td< td=""><td>Peak efficiency % 87.7 Characteristics π 0.716 Terminal resistance phase-phase Ω 0.716 Terminal inductance mH 0.26 Torque constant mNm/A 42.9 Speed constant rpm/V 223 Speed/torque gradient ms 3.92 Rotor inertia gcm² 101 Thermal data gcm² 101 Thermal data K/W 8.4 Therm. resistance housing-ambient (N) K/W 15 Therm. resistance winding-housing (N) K/W 15 Therm. time constant winding s 345 Therm. time constant motor s 1230 Ambient temperature, min. °C -40 Ambient temperature, max. °C 100 Winding temperature, max. °C 155 Mechanical data s 155 Speed limit rpm 12300 Axial play, min. mm 0 Axial play, maximum, max.</td><td></td><td>А</td><td>50.3</td></td<>	Peak efficiency % 87.7 Characteristics π 0.716 Terminal resistance phase-phase Ω 0.716 Terminal inductance mH 0.26 Torque constant mNm/A 42.9 Speed constant rpm/V 223 Speed/torque gradient ms 3.92 Rotor inertia gcm² 101 Thermal data gcm² 101 Thermal data K/W 8.4 Therm. resistance housing-ambient (N) K/W 15 Therm. resistance winding-housing (N) K/W 15 Therm. time constant winding s 345 Therm. time constant motor s 1230 Ambient temperature, min. °C -40 Ambient temperature, max. °C 100 Winding temperature, max. °C 155 Mechanical data s 155 Speed limit rpm 12300 Axial play, min. mm 0 Axial play, maximum, max.		А	50.3
Characteristics Ω 0.716 Terminal inductance mH 0.26 Torque constant mNm/A 42.9 Speed constant rpm/V 223 Speed/forque gradient rpm/mNm 3.72 Mechanical time constant ms 3.92 Rotor inertia gcm² 101 Therm. resistance housing-ambient (N) K/W 8.4 Therm. resistance winding-housing (N) K/W 15 Therm. time constant winding s 345 Therm. time constant motor s 1230 Ambient temperature, min. °C -40 Ambient temperature, max. °C 100 Winding temperature, max. °C 155 Mechanical data s 1230 Speed limit rpm 12300 Axial play, min. mm 0 Axial play, max. mm 0 Preload force, min. N 7 Radial play, maximum, max. N 7 Axial force	Characteristics Ω 0.716 Terminal resistance phase-phase Ω 0.716 Terminal inductance mH 0.26 Torque constant mNm/A 42.9 Speed constant rpm/V 223 Speed/torque gradient rpm/mNm 3.72 Mechanical time constant ms 3.92 Rotor inertia ms 3.92 Therm. time constant winding s 4.45 Therm. time constant winding s 3.45 Therm. time constant motor s 1.230 Ambient temperature, min. °C -40 Ambient temperature, max. °C 100 Winding temperature, max. °C 155 Mechanical data rpm		%	
Terminal resistance phase-phase Ω 0.716 Terminal inductance mH 0.26 Torque constant mNm/A 42.9 Speed constant rpm/V 223 Speed/torque gradient rpm/mNm 3.72 Mechanical time constant ms 3.922 Rotor inertia gcm² 101 Thermal data Therm. resistance housing-ambient (N) K/W 8.4 Therm. resistance winding-housing (N) K/W 15 Therm. time constant winding s 345 Therm. time constant motor s 1230 Ambient temperature, min. °C -40 Ambient temperature, max. °C 100 Winding temperature, max. °C 155 Mechanical data s 1230 Speed limit rpm 0 Axial play, min. mm 0 Axial play, max. mm 0.1 Preload force, min. N 7 Radial play, maximum, max. N <td>Terminal resistance phase-phase Ω 0.716 Terminal inductance mH 0.26 Torque constant mNm/A 42.9 Speed constant rpm/W 223 Speed/forque gradient rpm/mNm 3.72 Mechanical time constant ms 3.92 Rotor inertia gcm² 101 Therm. resistance housing-ambient (N) K/W 8.4 Therm. resistance bousing-ambient (N) K/W 8.4 Therm. resistance winding-housing (N) K/W 15 Therm. time constant motor s 1230 Ambient temperature, min. °C -40 Ambient temperature, max. °C 100 Winding temperature, max. °C 155 Mechanical data rpm 12300 Speed limit rpm 12300 Axial play, max. mm 0 Preload force, min. N 7 Radial play, maximum, max. N 7 Axial force (static), max. N 2.5</td> <td></td> <td></td> <td>-</td>	Terminal resistance phase-phase Ω 0.716 Terminal inductance mH 0.26 Torque constant mNm/A 42.9 Speed constant rpm/W 223 Speed/forque gradient rpm/mNm 3.72 Mechanical time constant ms 3.92 Rotor inertia gcm² 101 Therm. resistance housing-ambient (N) K/W 8.4 Therm. resistance bousing-ambient (N) K/W 8.4 Therm. resistance winding-housing (N) K/W 15 Therm. time constant motor s 1230 Ambient temperature, min. °C -40 Ambient temperature, max. °C 100 Winding temperature, max. °C 155 Mechanical data rpm 12300 Speed limit rpm 12300 Axial play, max. mm 0 Preload force, min. N 7 Radial play, maximum, max. N 7 Axial force (static), max. N 2.5			-
Terminal inductance mH 0.26 Torque constant mNm/A 42.9 Speed constant rpm/V 223 Speed/torque gradient rpm/mNm 3.72 Mechanical time constant ms 3.92 Rotor inertia gcm² 101 Thermal data Therm. resistance housing-ambient (N) K/W 8.4 Therm. resistance winding-housing (N) K/W 15 Therm. time constant winding s 345 Therm. time constant motor s 1230 Ambient temperature, min. °C -40 Ambient temperature, max. °C 100 Winding temperature, max. °C 155 Mechanical data s 12300 Axial play, min. mm 0 Axial play, max. mm 0.1 Preload force, min. N 7 Radial play, maximum, max. N 7 Axial force (dynamic), max. N 25 Axial force, shaft supported, max.	Terminal inductance mH 0.26 Torque constant mNm/A 42.9 Speed constant rpm/V 223 Speed/torque gradient rpm/mNm 3.72 Mechanical time constant ms 3.92 Rotor inertia gcm² 101 Thermal data Therm. resistance housing-ambient (N) K/W 8.4 Therm. resistance winding-housing (N) K/W 15 Therm. time constant winding s 345 Therm. time constant motor s 1230 Ambient temperature, min. °C -40 Ambient temperature, max. °C 100 Winding temperature, max. °C 155 Mechanical data s 1230 Axial play, min. mm 0.1 Axial play, max. mm 0.1 Preload force, min. N 7 Radial play, maximum, max. N 7 Axial force (dynamic), max. N 7 Axial force (static), max.		Ω	0.716
Speed constant rpm/V 223 Speed/torque gradient rpm/mNm 3.72 Mechanical time constant ms 3.92 Rotor inertia gcm² 101 Therm. resistance housing-ambient (N) K/W 8.4 Therm. resistance winding-housing (N) K/W 15 Therm. time constant winding s 345 Therm. time constant motor s 1230 Ambient temperature, min. °C -40 Ambient temperature, max. °C 100 Winding temperature, max. °C 155 Mechanical data Speed limit rpm 12300 Axial play, min. mm 0.1 Axial play, max. mm 0.1 Preload force, min. N 7 Radial play, maximum, max. N 7 Axial force (dynamic), max. N 7 Axial force, shaft supported, max. N 25.0 Axial force, shaft sup	Speed constant rpm/V 223 Speed/torque gradient rpm/mNm 3.72 Mechanical time constant ms 3.92 Rotor inertia gcm² 101 Therm. resistance housing-ambient (N) K/W 8.4 Therm. resistance housing-ambient (N) K/W 8.4 Therm. resistance winding-housing (N) K/W 15 Therm. time constant winding s 345 Therm. time constant motor s 1230 Ambient temperature, min. °C -40 Ambient temperature, max. °C 100 Winding temperature, max. °C 155 Mechanical data Speed limit rpm 12300 Axial play, min. mm 0 Axial play, max. mm 0.1 Preload force, min. N 7 Radial play, maximum, max. n 7 Axial force (dynamic), max. N 25 Axial force, shaft supported, max. N </td <td></td> <td>mH</td> <td>0.26</td>		mH	0.26
Speed/torque gradient rpm/mNm 3.72 Mechanical time constant ms 3.92 Rotor inertia gcm² 101 Therm. resistance housing-ambient (N) Therm. resistance winding-housing (N) K/W 8.4 Therm. time constant winding s 345 Therm. time constant motor s 1230 Ambient temperature, min. °C -40 Ambient temperature, max. °C 100 Winding temperature, max. °C 155 Mechanical data Speed limit rpm 12300 Axial play, min. mm 0.1 Axial play, max. mm 0.1 Preload force, min. N 7 Radial play, maximum, max. N 7 Axial force (dynamic), max. N 7 Axial force, shaft supported, max. N 25.10 Distance from flange mm 5 Other specifications	Speed/torque gradient rpm/mNm 3.72 Mechanical time constant ms 3.92 Rotor inertia gcm² 101 Thermal data Therm. resistance housing-ambient (N) K/W 8.4 Therm. resistance winding-housing (N) K/W 15 Therm. time constant winding s 345 Therm. time constant motor s 1230 Ambient temperature, min. °C -40 Ambient temperature, max. °C 100 Winding temperature, max. °C 155 Mechanical data Speed limit rpm 12300 Axial play, min. mm 0 Axial play, min. mm 0 Axial play, max. mm 0.1 Preload force, min. N 7 Radial play, maximum, max. n 7 Axial force (dynamic), max. N 7 Axial force (static), max. N 2510 Radial force, max.	Torque constant	mNm/A	42.9
Mechanical time constant ms 3.92 Rotor inertia gcm² 101 Thermal data Therm. resistance housing-ambient (N) K/W 8.4 Therm. resistance winding-housing (N) K/W 15 Therm. time constant winding s 345 Therm. time constant motor s 1230 Ambient temperature, min. °C -40 Ambient temperature, max. °C 100 Winding temperature, max. °C 155 Mechanical data s 1230 Speed limit rpm 12300 Axial play, min. mm 0.1 Axial play, max. mm 0.1 Preload force, min. N 7 Radial play, maximum, max. n 7 Axial force (dynamic), max. N 25 Axial force (static), max. N 25 Axial force, shaft supported, max. N 25 Distance from flange mm 5 Other specifications </td <td>Mechanical time constant ms 3.92 Rotor inertia gcm² 101 Thermal data Therm. resistance housing-ambient (N) K/W 8.4 Therm. resistance winding-housing (N) K/W 15 Therm. time constant winding s 345 Therm. time constant motor s 1230 Ambient temperature, min. °C -40 Ambient temperature, max. °C 100 Winding temperature, max. °C 155 Mechanical data Speed limit rpm 12300 Axial play, min. mm 0 Axial play, min. mm 0 Axial play, max. mm 0.1 Preload force, min. N 7 Radial play, maximum, max. nm 0.02 Axial force (dynamic), max. N 7 Axial force (static), max. N 2.5 Axial force, shaft supported, max. N 65.3 Distance from flange mm 5</td> <td>Speed constant</td> <td>rpm/V</td> <td>223</td>	Mechanical time constant ms 3.92 Rotor inertia gcm² 101 Thermal data Therm. resistance housing-ambient (N) K/W 8.4 Therm. resistance winding-housing (N) K/W 15 Therm. time constant winding s 345 Therm. time constant motor s 1230 Ambient temperature, min. °C -40 Ambient temperature, max. °C 100 Winding temperature, max. °C 155 Mechanical data Speed limit rpm 12300 Axial play, min. mm 0 Axial play, min. mm 0 Axial play, max. mm 0.1 Preload force, min. N 7 Radial play, maximum, max. nm 0.02 Axial force (dynamic), max. N 7 Axial force (static), max. N 2.5 Axial force, shaft supported, max. N 65.3 Distance from flange mm 5	Speed constant	rpm/V	223
Mechanical time constant ms 3.92 Rotor inertia gcm² 101 Thermal data Therm. resistance housing-ambient (N) K/W 8.4 Therm. resistance winding-housing (N) K/W 15 Therm. time constant winding s 345 Therm. time constant motor s 1230 Ambient temperature, min. °C -40 Ambient temperature, max. °C 100 Winding temperature, max. °C 155 Mechanical data Speed limit rpm 12300 Axial play, min. mm 0.1 Axial play, max. mm 0.1 Preload force, min. N 7 Radial play, maximum, max. N 7 Axial force (dynamic), max. N 7 Axial force, shaft supported, max. N 2510 Radial force, max. N 65.3 Distance from flange mm 5 Other specifications	Mechanical time constant ms 3.92 Rotor inertia gcm² 101 Thermal data Therm. resistance housing-ambient (N) K/W 8.4 Therm. resistance winding-housing (N) K/W 15 Therm. time constant winding s 345 Therm. time constant motor s 1230 Ambient temperature, min. °C -40 Ambient temperature, max. °C 100 Winding temperature, max. °C 155 Mechanical data Speed limit rpm 12300 Axial play, min. mm 0.1 Axial play, min. mm 0.1 Preload force, min. N 7 Radial play, maximum, max. mm 0.02 Axial force (dynamic), max. N 7 Axial force (static), max. N 2.5 Axial force, shaft supported, max. N 65.3 Distance from flange mm 5 Other specifications n 1 <t< td=""><td>Speed/torque gradient</td><td>rpm/mNm</td><td>3.72</td></t<>	Speed/torque gradient	rpm/mNm	3.72
Thermal data K/W 8.4 Therm. resistance winding-housing (N) K/W 15 Therm. time constant winding s 345 Therm. time constant motor s 1230 Ambient temperature, min. °C -40 Ambient temperature, max. °C 100 Winding temperature, max. °C 155 Mechanical data rpm 12300 Speed limit rpm 12300 Axial play, min. mm 0 Axial play, max. mm 0.1 Preload force, min. N 7 Radial play, maximum, max. nm 0.02 Axial force (dynamic), max. N 2 Axial force (static), max. N 25.10 Axial force, shaft supported, max. N 65.3 Distance from flange mm 5 Other specifications	Thermal data K/W 8.4 Therm. resistance housing-ambient (N) K/W 15 Therm. resistance winding-housing (N) K/W 15 Therm. time constant winding s 345 Therm. time constant motor s 1230 Ambient temperature, min. °C -40 Ambient temperature, max. °C 100 Winding temperature, max. °C 155 Mechanical data *** *** Speed limit rpm 12300 Axial play, min. mm 0.1 Axial play, max. mm 0.1 Preload force, min. N 7 Radial play, maximum, max. mm 0.02 Axial force (dynamic), max. N 7 Axial force (static), max. N 22.6 Axial force, shaft supported, max. N 2510 Radial force, max. N 65.3 Distance from flange mm 5 Other specifications ** 1 Pole	Mechanical time constant	•	3.92
Therm. resistance housing-ambient (N) K/W 8.4 Therm. resistance winding-housing (N) K/W 15 Therm. time constant winding s 345 Therm. time constant motor s 1230 Ambient temperature, min. °C -40 Ambient temperature, max. °C 100 Winding temperature, max. °C 155 Mechanical data rpm 12300 Speed limit rpm 0 Axial play, min. mm 0 Axial play, max. mm 0.1 Preload force, min. N 7 Radial play, maximum, max. nm 0.02 Axial force (dynamic), max. N 7 Axial force, shaft supported, max. N 25.10 Radial force, max. N 65.3 Distance from flange mm 5 Other specifications	Therm. resistance housing-ambient (N) K/W 8.4 Therm. resistance winding-housing (N) K/W 15 Therm. time constant winding s 345 Therm. time constant motor s 1230 Ambient temperature, min. °C -40 Ambient temperature, max. °C 100 Winding temperature, max. °C 155 Mechanical data Speed limit rpm 12300 Axial play, min. mm 0.1 Axial play, max. mm 0.1 Preload force, min. N 7 Radial play, maximum, max. mm 0.02 Axial force (dynamic), max. N 7 Axial force (static), max. N 25.6 Axial force, shaft supported, max. N 25.10 Radial force, max. N 65.3 Distance from flange mm 5 Other specifications Pole pair number - 1 Number of collector segments - 11 </td <td>Rotor inertia</td> <td>gcm²</td> <td>101</td>	Rotor inertia	gcm ²	101
Therm. resistance winding-housing (N) K/W 15 Therm. time constant winding s 345 Therm. time constant motor s 1230 Ambient temperature, min. °C -40 Ambient temperature, max. °C 100 Winding temperature, max. °C 155 Mechanical data Speed limit rpm 12300 Axial play, min. mm 0.1 Axial play, max. mm 0.1 Preload force, min. N 7 Radial play, maximum, max. mm 0.02 Axial force (dynamic), max. N 7 Axial force, shaft supported, max. N 25.0 Radial force, max. N 65.3 Distance from flange mm 5 Other specifications	Therm. resistance winding-housing (N) K/W 15 Therm. time constant winding s 345 Therm. time constant motor s 1230 Ambient temperature, min. °C -40 Ambient temperature, max. °C 100 Winding temperature, max. °C 155 Mechanical data *** *** Speed limit rpm 12300 Axial play, min. mm 0.1 Axial play, max. mm 0.1 Preload force, min. N 7 Radial play, maximum, max. mm 0.02 Axial force (dynamic), max. N 7 Axial force (static), max. N 2510 Axial force, shaft supported, max. N 2510 Radial force, max. N 65.3 Distance from flange mm 5 Other specifications Pole pair number - 1 Number of collector segments - 11	Thermal data	ű	
Therm. time constant winding s 345 Therm. time constant motor s 1230 Ambient temperature, min. °C -40 Ambient temperature, max. °C 100 Winding temperature, max. °C 155 Mechanical data Speed limit rpm 12300 Axial play, min. mm 0.1 Axial play, max. mm 0.1 Preload force, min. N 7 Radial play, maximum, max. mm 0.02 Axial force (dynamic), max. N 2 Axial force (static), max. N 22.6 Axial force, shaft supported, max. N 2510 Radial force, max. N 65.3 Distance from flange mm 5 Other specifications	Therm. time constant winding s 345 Therm. time constant motor s 1230 Ambient temperature, min. °C -40 Ambient temperature, max. °C 100 Winding temperature, max. °C 155 Mechanical data Speed limit rpm 12300 Axial play, min. mm 0.1 Axial play, max. mm 0.1 Preload force, min. N 7 Radial play, maximum, max. mm 0.02 Axial force (dynamic), max. N 7 Axial force (static), max. N 22.6 Axial force, shaft supported, max. N 2510 Radial force, max. N 65.3 Distance from flange mm 5 Other specifications Pole pair number - 1 Number of collector segments - 11	Therm. resistance housing-ambient (N)	K/W	8.4
Therm. time constant motor s 1230 Ambient temperature, min. °C -40 Ambient temperature, max. °C 100 Winding temperature, max. °C 155 Mechanical data speed limit rpm 12300 Axial play, min. mm 0.1 Axial play, max. mm 0.1 Preload force, min. N 7 Radial play, maximum, max. mm 0.02 Axial force (dynamic), max. N 2 Axial force (static), max. N 2510 Radial force, max. N 65.3 Distance from flange mm 5 Other specifications	Therm. time constant motor s 1230 Ambient temperature, min. °C -40 Ambient temperature, max. °C 100 Winding temperature, max. °C 155 Mechanical data *** Speed limit *** rpm 12300 Axial play, min. mm 0.1 Axial play, max. mm 0.1 Preload force, min. N 7 Radial play, maximum, max. mm 0.02 Axial force (dynamic), max. N 7 Axial force (static), max. N 2.5 Axial force, shaft supported, max. N 2510 Radial force, max. N 65.3 Distance from flange mm 5 Other specifications Pole pair number - 1 Number of collector segments - 11	Therm. resistance winding-housing (N)	K/W	15
Ambient temperature, min. °C -40 Ambient temperature, max. °C 100 Winding temperature, max. °C 155 Mechanical data Speed limit rpm 12300 Axial play, min. mm 0.1 Axial play, max. mm 0.1 Preload force, min. N 7 Radial play, maximum, max. mm 0.02 Axial force (dynamic), max. N 2.0 Axial force (static), max. N 2.5 Axial force, shaft supported, max. N 2.5 Radial force, max. N 65.3 Distance from flange mm 5 Other specifications	Ambient temperature, min. °C -40 Ambient temperature, max. °C 100 Winding temperature, max. °C 155 Mechanical data	Therm. time constant winding	s	345
Ambient temperature, max. °C 100 Winding temperature, max. °C 155 Mechanical data Speed limit rpm 12300 Axial play, min. mm 0 Axial play, max. mm 0.1 Preload force, min. N 7 Radial play, maximum, max. mm 0.02 Axial force (dynamic), max. N 2 Axial force (static), max. N 25.10 Axial force, shaft supported, max. N 65.3 Distance from flange mm 5 Other specifications	Ambient temperature, max. \$\frac{\text{°C}}{\text{100}}\$ Winding temperature, max. \$\frac{\text{°C}}{\text{155}}\$ \text{Mechanical data} Speed limit Speed limit Speed limit Axial play, min. Axial play, max. Preload force, min. Radial play, maximum, max. Axial force (dynamic), max. Axial force (static), max. Axial force (static), max. Axial force, shaft supported, max. Radial force, max. N Speed limit N T Radial force (dynamic) Speed limit N T Radial force (dynamic) Speed limit N T Radial force (static) Speed limit Speed limit N T Radial force (static) Speed limit Speed limi	Therm. time constant motor		1230
Winding temperature, max. °C 155 Mechanical data speed limit rpm 12300 Axial play, min. mm 0 Axial play, max. mm 0.1 Preload force, min. N 7 Radial play, maximum, max. mm 0.02 Axial force (dynamic), max. N 7 Axial force (static), max. N 22.6 Axial force, shaft supported, max. N 2510 Radial force, max. N 65.3 Distance from flange mm 5 Other specifications	Winding temperature, max. °C 155 Mechanical data Speed limit rpm 12300 Axial play, min. mm 0 Axial play, max. mm 0.1 Preload force, min. N 7 Radial play, maximum, max. mm 0.02 Axial force (dynamic), max. N 7 Axial force, shaft supported, max. N 2510 Radial force, max. N 65.3 Distance from flange mm 5 Other specifications Pole pair number - 1 Number of collector segments - 11	Ambient temperature, min.	°C	-40
Mechanical data rpm 12300 Axial play, min. mm 0 Axial play, max. mm 0.1 Preload force, min. N 7 Radial play, maximum, max. mm 0.02 Axial force (dynamic), max. N 7 Axial force (static), max. N 22.6 Axial force, shaft supported, max. N 2510 Radial force, max. N 65.3 Distance from flange mm 5 Other specifications	Mechanical data rpm 12300 Axial play, min. mm 0 Axial play, max. mm 0.1 Preload force, min. N 7 Radial play, maximum, max. mm 0.02 Axial force (dynamic), max. N 7 Axial force (static), max. N 22.6 Axial force, shaft supported, max. N 2510 Radial force, max. N 65.3 Distance from flange mm 5 Other specifications Pole pair number - 1 Number of collector segments - 11	Ambient temperature, max.	°C	100
Speed limit rpm 12300 Axial play, min. mm 0 Axial play, max. mm 0.1 Preload force, min. N 7 Radial play, maximum, max. mm 0.02 Axial force (dynamic), max. N 7 Axial force (static), max. N 22.6 Axial force, shaft supported, max. N 2510 Radial force, max. N 65.3 Distance from flange mm 5 Other specifications	Speed limit rpm 12300 Axial play, min. mm 0 Axial play, max. mm 0.1 Preload force, min. N 7 Radial play, maximum, max. mm 0.02 Axial force (dynamic), max. N 7 Axial force (static), max. N 22.6 Axial force, shaft supported, max. N 2510 Radial force, max. N 65.3 Distance from flange mm 5 Other specifications Pole pair number - 1 Number of collector segments - 11		°C	155
Axial play, min. mm 0 Axial play, max. mm 0.1 Preload force, min. N 7 Radial play, maximum, max. mm 0.02 Axial force (dynamic), max. N 7 Axial force, static), max. N 22.6 Axial force, shaft supported, max. N 2510 Radial force, max. N 65.3 Distance from flange mm 5 Other specifications	Axial play, min. mm 0 Axial play, max. mm 0.1 Preload force, min. N 7 Radial play, maximum, max. mm 0.02 Axial force (dynamic), max. N 7 Axial force, shaft supported, max. N 25.0 Axial force, shaft supported, max. N 65.3 Distance from flange mm 5 Other specifications Pole pair number - 1 Number of collector segments - 11	Mechanical data		
Axial play, max. mm 0.1 Preload force, min. N 7 Radial play, maximum, max. mm 0.02 Axial force (dynamic), max. N 7 Axial force (static), max. N 22.6 Axial force, shaft supported, max. N 2510 Radial force, max. N 65.3 Distance from flange mm 5 Other specifications	Axial play, max. mm 0.1 Preload force, min. N 7 Radial play, maximum, max. mm 0.02 Axial force (dynamic), max. N 7 Axial force (static), max. N 22.6 Axial force, shaft supported, max. N 2510 Radial force, max. N 65.3 Distance from flange mm 5 Other specifications Pole pair number - 1 Number of collector segments - 11	Speed limit	rpm	12300
Preload force, min. N 7 Radial play, maximum, max. mm 0.02 Axial force (dynamic), max. N 7 Axial force (static), max. N 22.6 Axial force, shaft supported, max. N 2510 Radial force, max. N 65.3 Distance from flange mm 5 Other specifications	Preload force, min. N 7 Radial play, maximum, max. mm 0.02 Axial force (dynamic), max. N 7 Axial force, (static), max. N 22.6 Axial force, shaft supported, max. N 2510 Radial force, max. N 65.3 Distance from flange mm 5 Other specifications Pole pair number - 1 Number of collector segments - 11		mm	
Radial play, maximum, max. mm 0.02 Axial force (dynamic), max. N 7 Axial force (static), max. N 22.6 Axial force, shaft supported, max. N 2510 Radial force, max. N 65.3 Distance from flange mm 5 Other specifications	Radial play, maximum, max. mm 0.02 Axial force (dynamic), max. N 7 Axial force (static), max. N 22.6 Axial force, shaft supported, max. N 2510 Radial force, max. N 65.3 Distance from flange mm 5 Other specifications Pole pair number - 1 Number of collector segments - 11			0.1
Axial force (dynamic), max. N 7 Axial force (static), max. N 22.6 Axial force, shaft supported, max. N 2510 Radial force, max. N 65.3 Distance from flange mm 5 Other specifications	Axial force (dynamic), max. N 7 Axial force (static), max. N 22.6 Axial force, shaft supported, max. N 2510 Radial force, max. N 65.3 Distance from flange mm 5 Other specifications Pole pair number - 1 Number of collector segments - 11	Preload force, min.	N	7
Axial force (static), max. N 22.6 Axial force, shaft supported, max. N 2510 Radial force, max. N 65.3 Distance from flange mm 5 Other specifications	Axial force (static), max. N 22.6 Axial force, shaft supported, max. N 2510 Radial force, max. N 65.3 Distance from flange mm 5 Other specifications Pole pair number - 1 Number of collector segments - 11	, ,,		
Axial force, shaft supported, max. Radial force, max. Distance from flange Other specifications N 2510 Rodial force, max. N 65.3 mm 5	Axial force, shaft supported, max. N 2510 Radial force, max. N 65.3 Distance from flange mm 5 Other specifications Pole pair number - 1 Number of collector segments - 11			
Radial force, max. Distance from flange Other specifications N 65.3 mm 5 Other specifications	Radial force, max. N 65.3 Distance from flange mm 5 Other specifications - 1 Pole pair number - 1 Number of collector segments - 11	Axial force (static), max.	N	
Distance from flange mm 5 Other specifications	Distance from flange mm 5 Other specifications 5 Pole pair number - 1 Number of collector segments - 11			
Other specifications	Other specificationsPole pair number-1Number of collector segments-11		N	
	Pole pair number - 1 Number of collector segments - 11		mm	5
Dala madu mumahan	Number of collector segments - 11			
			-	
		g .	-	
	Weight of motor g 385	Weight of motor	g	385



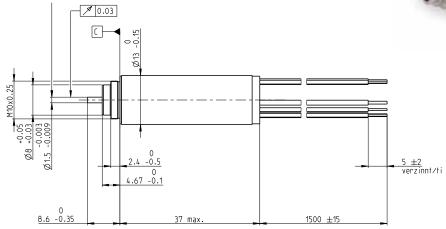
Data under vacuum conditions.

The shown data are applicable to one specific winding. More windings available.

EC 13 SPACE Ø13 mm, brushless, 30 watt



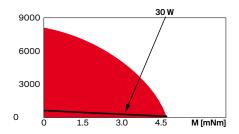




M 1:1

Data at nominal voltage		
Nominal voltage	V	4.5
No-load speed	rpm	6690
No-load current	mA	69.9
Nominal speed	rpm	2410
Nominal torque	mNm	3.85
Nominal current	Α	0.698
Stall torque	mNm	6.37
Starting current	Α	
Peak efficiency	%	56.2
Characteristics		
Terminal resistance phase-phase	Ω	4.23
Terminal inductance	mH	0.213
Torque constant	mNm/A	5.99
Speed constant	rpm/V	1590
Speed/torque gradient	rpm/mNm	1120
Mechanical time constant	ms	1.68
Rotor inertia	gcm ²	0.143
Thermal data		
Therm. resistance housing-ambient (N)	K/W	33.8
Therm. resistance winding-housing (N)	K/W	8
Therm. time constant winding	S	5.92
Therm. time constant motor	s	638
Ambient temperature, min.	°C	-60
Ambient temperature, max.	°C	100
Winding temperature, max.	°C	155
Mechanical data		
Speed limit	rpm	90000
Axial play, min.	mm	0
Axial play, max.	mm	0.85
Preload force, min.	N	1.8
Radial play, maximum, max.	mm	0
Axial force (dynamic), max.	N	1.5
Axial force (static), max.	N	10
Axial force, shaft supported, max.	N	250
Radial force, max.	N	4
Distance from flange	mm	5
Other specifications		
Pole pair number	-	1
Number of collector segments	-	3
Weight of motor	g	37.8



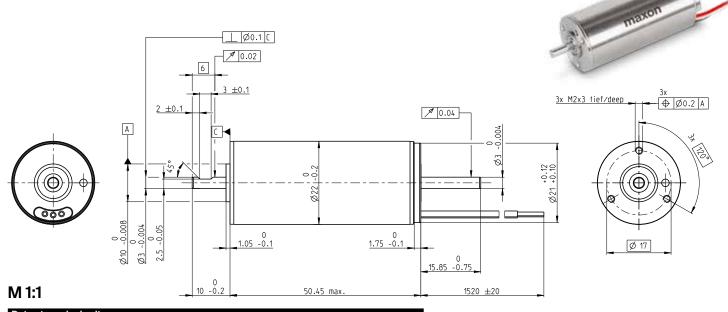


Continuous operation
 Continuous operation with reduced thermal resistance R_{th2} 50%
 Short term operation

Data under vacuum conditions.

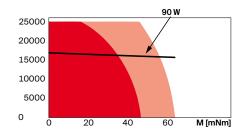
The shown data are applicable to one specific winding. More windings available.

EC4-pole 22 SPACE Ø22 mm, brushless, 90 watt



Data at nominal voltage		
Nominal voltage	V	48
No-load speed	rpm	16800
No-load current	mA	128
Nominal speed	rpm	16200
Nominal torque	mNm	35.6
Nominal current	Α	1.43
Stall torque	mNm	1020
Starting current	Α	37.7
Peak efficiency	%	89
Characteristics		
Terminal resistance phase-phase	Ω	1.27
Terminal inductance	mH	0.123
Torque constant	mNm/A	27.1
Speed constant	rpm/V	352
Speed/torque gradient	rpm/mNm	16.6
Mechanical time constant	ms	1.54
Rotor inertia	gcm ²	8.91
Thermal data		
Therm. resistance housing-ambient (N)	K/W	16
Therm. resistance winding-housing (N)	K/W	1.61
Therm. time constant winding	S	11.8
Therm. time constant motor	S	1400
Ambient temperature, min.	°C	-20
Ambient temperature, max.	°C	100
Winding temperature, max.	℃	155
Mechanical data		
Speed limit	rpm	25000
Axial play, min.	mm	0
Axial play, max.	mm	0.14
Preload force, min.	N	3
Radial play, maximum, max.	mm	0
Axial force (dynamic), max.	N	4
Axial force (static), max.	N	53
Axial force, shaft supported, max.	N	600
Radial force, max.	N	16
Distance from flange	mm	5
Other specifications		
Pole pair number	-	2
Number of collector segments	-	3
Weight of motor	g	175

Operating range n [rpm]



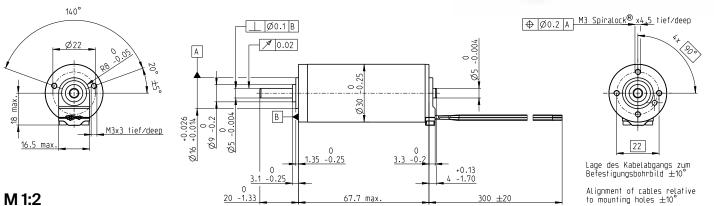
■ Continuous operation
■ Continuous operation with reduced thermal resistance R_{th2} 50%
□ Short term operation

Data under vacuum conditions.

The shown data are applicable to one specific winding. More windings available.

EC4-pole 30 SPACE Ø30 mm, brushless, 150 watt





Data at nominal voltage		
Nominal voltage	V	48
No-load speed	rpm	17100
No-load current	mA	489
Nominal speed	rpm	17000
Nominal torque	mNm	27.5
Nominal current	Α	1.51
Stall torque	mNm	3310
Starting current	Α	
Peak efficiency	%	88.1
Characteristics		
Terminal resistance phase-phase	Ω	0.386
Terminal inductance	mH	0.0636
Torque constant	mNm/A	26.6
Speed constant	rpm/V	359
Speed/torque gradient	rpm/mNm	5.21
Mechanical time constant	ms	1.92
Rotor inertia	gcm ²	35.2
Thermal data		
Therm. resistance housing-ambient (N)	K/W	11.1
Therm. resistance winding-housing (N)	K/W	0.48
Therm. time constant winding	S	4.9
Therm. time constant motor	S	1780
Ambient temperature, min.	°C	-40
Ambient temperature, max.	°C	150
Winding temperature, max.	°C	155
Mechanical data		
Speed limit	rpm	25000
Axial play, min.	mm	0
Axial play, max.	mm	0.14
Preload force, min.	N	8
Radial play, maximum, max.	mm	5.5
Axial force (dynamic), max.	N	73
Axial force (static), max.	N	1300
Axial force, shaft supported, max.	N	25
Radial force, max.	N	5
Distance from flange	mm	5
Other specifications		
Pole pair number	-	2
Number of collector segments	-	3
Weight of motor	g	300

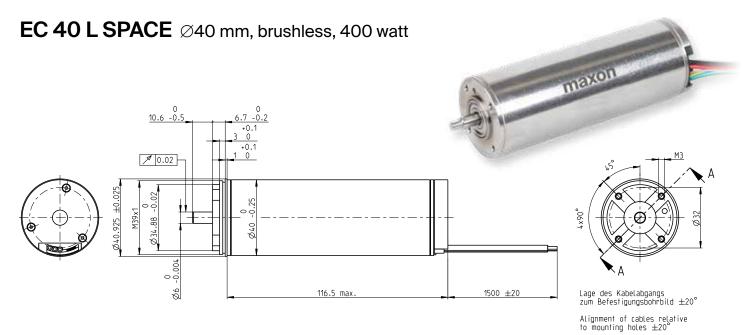
Operating range n [rpm]

25000
20000
15000
10000
5000
0 50 100 150 M [mNm]

Continuous operation
Continuous operation with reduced thermal resistance R_{th2} 50%
Short term operation

Data under vacuum conditions.

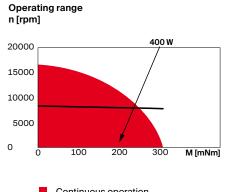
The shown data are applicable to one specific winding. More windings available.



M 1:2

Data at nominal voltage Nominal voltage	V	28
No-load speed		8450
No-load current	rpm mA	673
Noninal speed		8200
· ·	rpm mNm	114
Nominal torque Nominal current	Δ	4.27
	mNm	4.27
Stall torque	minm A	4210
Starting current		000
Peak efficiency	%	86.6
Characteristics Terminal resistance phase-phase	Ω	0.209
·		0.209
Terminal inductance	mH	31.5
Torque constant	mNm/A	
Speed constant	rpm/V	303
Speed/torque gradient	rpm/mNm	2.02
Mechanical time constant	ms	1.95
Rotor inertia	gcm ²	92.5
Thermal data		
Therm. resistance housing-ambient (N)	K/W	6.3
Therm. resistance winding-housing (N)	K/W	0.88
Therm. time constant winding	S	23.6
Therm. time constant motor	S	2310
Ambient temperature, min.	°C	-40
Ambient temperature, max.	°C	100
Winding temperature, max.	°C	155
Mechanical data		
Speed limit	rpm	20000
Axial play, min.	mm	0.14
Axial play, max.	mm	19.7
Preload force, min.	N	19.7
Radial play, maximum, max.	mm	36.6
Axial force (dynamic), max.	N	2590
Axial force (static), max.	N	78.8
Axial force, shaft supported, max.	N	5
Radial force, max.	N	4
Distance from flange	mm	5
Other specifications		
Pole pair number	-	1
Number of collector segments	-	3
Weight of motor	g	895



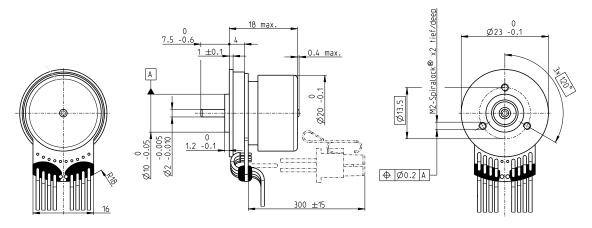


Continuous operation
 Continuous operation with reduced thermal resistance R_{th2} 50%
 Short term operation

The shown data are applicable to one specific winding. More windings available.

EC 20 flat SPACE Ø20 mm, brushless, 5 watt

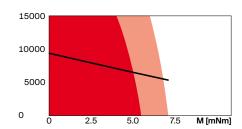




M 1:1

Data at nominal voltage		
Nominal voltage	V	12
No-load speed	rpm	9370
No-load current	mA	53.2
Nominal speed	rpm	6400
Nominal torque	mNm	5.23
Nominal current	Α	0.471
Stall torque	mNm	18.9
Starting current	Α	
Peak efficiency	%	67.9
Characteristics		
Terminal resistance phase-phase	Ω	7.48
Terminal inductance	mH	0.754
Torque constant	mNm/A	11.8
Speed constant	rpm/V	812
Speed/torque gradient	rpm/mNm	517
Mechanical time constant	ms	27.6
Rotor inertia	gcm ²	5.1
Thermal data		
Therm. resistance housing-ambient (N)	K/W	31.1
Therm. resistance winding-housing (N)	K/W	7.98
Therm. time constant winding	S	4.33
Therm. time constant motor	S	51.7
Ambient temperature, min.	°C	-40
Ambient temperature, max.	°C	100
Winding temperature, max.	°C	125
Mechanical data		
Speed limit	rpm	15000
Axial play, min.	mm	0
Axial play, max.	mm	0.14
Preload force, min.	N	2
Radial play, maximum, max.	mm	1.8
Axial force (dynamic), max.	N	26
Axial force (static), max.	N	200
Axial force, shaft supported, max.	N	5.3
Radial force, max.	N	5
Distance from flange	mm	5
Other specifications		
Pole pair number	-	4
Number of collector segments	-	3
Weight of motor	g	22

Operating range n [rpm]



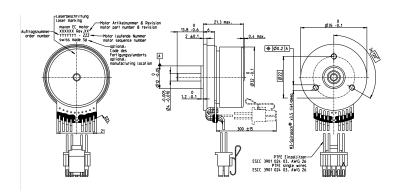
■ Continuous operation
■ Continuous operation with reduced thermal resistance R_{th2} 50%
□ Short term operation

Data under vacuum conditions.

The shown data are applicable to one specific winding. More windings available.

EC 32 flat SPACE Ø32 mm, brushless, 15 watt



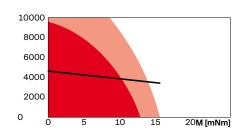


M 1:2

Data at nominal voltage		
Nominal voltage	V	12
No-load speed	rpm	4540
No-load speed	mA	118
Noninal speed	rpm	3810
Nominal torque	mNm	10.2
Nominal current	Δ	0.51
Stall torque	mNm	82.3
Starting current	A	3.42
Peak efficiency	%	66.8
Characteristics	90	00.0
Terminal resistance phase-phase	Ω	3.51
Terminal inductance	mH	1.39
Torque constant	mNm/A	24.1
Speed constant	rpm/V	397
·	•	57.8
Speed/torque gradient	rpm/mNm	
Mechanical time constant	ms	21.2 35
Rotor inertia	gcm ²	
Thermal data	K/W	33.3
Therm, resistance housing-ambient (N)	K/W	22.5
Therm. resistance winding-housing (N)		37.8
Therm. time constant winding Therm, time constant motor	S	37.8
	s °C	
Ambient temperature, min.	℃	-40
Ambient temperature, max.	°C	100
Winding temperature, max.	- °C	125
Mechanical data	WID 100	10000
Speed limit	rpm	
Axial play, min.	mm	0.6
Axial play, max.	mm	
Preload force, min.	N	5 4.8
Radial play, maximum, max.	mm	
Axial force (dynamic), max.	N N	45
Axial force (static), max.		1000
Axial force, shaft supported, max.	N	14
Radial force, max.	N	5
Distance from flange	mm	5
Other specifications		
Pole pair number	-	4
Number of collector segments Weight of motor	-	3
	g	57

Data under vacuum conditions.

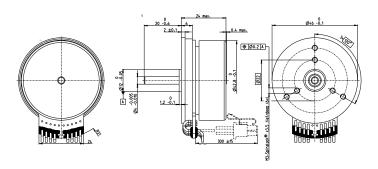
Operating range n [rpm]



■ Continuous operation
■ Continuous operation with reduced thermal resistance R_{th2} 50%
□ Short term operation

The shown data are applicable to one specific winding. More windings available.

EC 45 flat SPACE Ø45 mm, brushless, 50 watt



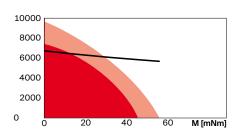


M 1:2

Data at nominal voltage		
Nominal voltage	V	24
No-load speed	rpm	6710
No-load current	mA	185
Nominal speed	rpm	6540
Nominal torque	mNm	8.36
Nominal current	Α	0.421
Stall torque	mNm	571
Starting current	Α	23.3
Peak efficiency	%	83
Characteristics		
Terminal resistance phase-phase	Ω	1.03
Terminal inductance	mH	0.572
Torque constant	mNm/A	33.5
Speed constant	rpm/V	285
Speed/torque gradient	rpm/mNm	8.77
Mechanical time constant	ms	12.4
Rotor inertia	gcm ²	135
Thermal data		
Therm. resistance housing-ambient (N)	K/W	22.4
Therm. resistance winding-housing (N)	K/W	33.9
Therm. time constant winding	s	126
Therm. time constant motor	s	1120
Ambient temperature, min.	°C	-40
Ambient temperature, max.	°C	100
Winding temperature, max.	°C	125
Mechanical data		
Speed limit	rpm	10000
Axial play, min.	mm	0
Axial play, max.	mm	0.14
Preload force, min.	N	4
Radial play, maximum, max.	mm	
Axial force (dynamic), max.	N	3.8
Axial force (static), max.	N	53
Axial force, shaft supported, max.	N	1000
Radial force, max.	N	20
Distance from flange	mm	5
Other specifications		
Pole pair number	-	8
Number of collector segments	-	3
Weight of motor	g	110

Data under vacuum conditions.

Operating range n [rpm]



Continuous operation
 Continuous operation with reduced thermal resistance R_{th2} 50%
 Short term operation

The shown data are applicable to one specific winding. More windings available.

This product is not yet fully qualified by maxon, however design is closely based on equivalent product qualified and/or flown on a space science mission.

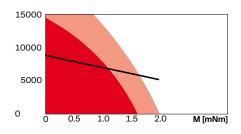
EC frameless 20 flat SPACE Ø20 mm, brushless, 5 watt



M 1:1

Data at nominal voltage	V	10
Nominal voltage	-	12
No-load speed	rpm	9140
No-load current	mA	43
Nominal speed	rpm	6670
Nominal torque	mNm	1.28
Nominal current	Α.	0.147
Stall torque	mNm	5.67
Starting current	A	0.503
Peak efficiency	%	50.9
Characteristics		-
Terminal resistance phase-phase	Ω	23.9
Terminal inductance	mH	2.35
Torque constant	mNm/A	11.3
Speed constant	rpm/V	847
Speed/torque gradient	rpm/mNm	1790
Mechanical time constant	ms	72.1
Rotor inertia	gcm ²	3.84
Thermal data		
Therm. resistance housing-ambient (N)	K/W	66.8
Therm. resistance winding-housing (N)	K/W	39.2
Therm. time constant winding	S	12.1
Therm. time constant motor	s	111
Ambient temperature, min.	°C	-40
Ambient temperature, max.	°C	100
Winding temperature, max.	°C	125
Mechanical data		
Speed limit	rpm	15000
Axial play, min.	mm	0
Axial play, max.	mm	0.14
Preload force, min.	N	2
Radial play, maximum, max.	mm	1.8
Axial force (dynamic), max.	N	18
Axial force (static), max.	N	200
Axial force, shaft supported, max.	N	1.9
Radial force, max.	N	5
Distance from flange	mm	5
Other specifications		
Pole pair number	-	4
Number of collector segments	-	3
Weight of motor	g	15

Operating range n [rpm]



■ Continuous operation
■ Continuous operation with reduced thermal resistance R_{th2} 50%
■ Short term operation

Data under vacuum conditions.

The shown data are applicable to one specific winding. More windings available.

This product is not yet fully qualified by maxon and/or flown on a space science mission.

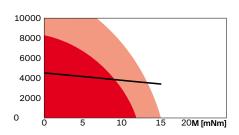
EC frameless 32 flat SPACE Ø32 mm, brushless, 15 watt



M 1:2

Data at nominal voltage		
Nominal voltage	V	24
No-load speed	rpm	4530
No-load current	mA	36.9
Nominal speed	rpm	3810
Nominal torque	mNm	9.6
Nominal current	Α	0.218
Stall torque	mNm	85.3
Starting current	Α	1.74
Peak efficiency	%	73.2
Characteristics		
Terminal resistance phase-phase	Ω	13.8
Terminal inductance	mH	7.72
Torque constant	mNm/A	49
Speed constant	rpm/V	195
Speed/torque gradient	rpm/mNm	54.8
Mechanical time constant	ms	20.1
Rotor inertia	gcm²	35
Thermal data		
Therm. resistance housing-ambient (N)	K/W	48.9
Therm. resistance winding-housing (N)	K/W	20.5
Therm. time constant winding	S	36.1
Therm. time constant motor	S	543
Ambient temperature, min.	°C	-40
Ambient temperature, max.	°C	100
Winding temperature, max.	°C	125
Mechanical data		
Speed limit	rpm	10000
Axial play, min.	mm	0
Axial play, max.	mm	0.6
Preload force, min.	N	5
Radial play, maximum, max.	mm	4.8
Axial force (dynamic), max.	N	45
Axial force (static), max.	N	1000
Axial force, shaft supported, max.	N	14
Radial force, max.	N	5
Distance from flange	mm	5
Other specifications		
Pole pair number	-	4
Number of collector segments	-	3
Weight of motor	g	57

Operating range n [rpm]



Continuous operation
 Continuous operation with reduced thermal resistance R_{th2} 50%
 Short term operation

Data under vacuum conditions.

The shown data are applicable to one specific winding. More windings available.

This product is not yet fully qualified by maxon and/or

flown on a space science mission.

EC frameless 45 flat SPACE Ø42.8 mm, brushless, 50 watt



M 1:2

Data at nominal voltage		
Nominal voltage	V	24
No-load speed	rpm	6710
No-load current	mA	185
Nominal speed	rpm	6500
Nominal torque	mNm	10.3
Nominal current	Α	0.474
Stall torque	mNm	560
Starting current	Α	22.4
Peak efficiency	%	82.7
Characteristics		
Terminal resistance phase-phase	Ω	1.07
Terminal inductance	mH	0.572
Torque constant	mNm/A	33.5
Speed constant	rpm/V	285
Speed/torque gradient	rpm/mNm	9.13
Mechanical time constant	ms	12.1
Rotor inertia	gcm²	127
Thermal data		
Therm. resistance housing-ambient (N)	K/W	23.3
Therm. resistance winding-housing (N)	K/W	16.1
Therm. time constant winding	S	59.9
Therm. time constant motor	s	1160
Ambient temperature, min.	°C	-40
Ambient temperature, max.	°C	100
Winding temperature, max.	°C	125
Mechanical data		
Speed limit	rpm	10000
Axial play, min.	mm	0
Axial play, max.	mm	0
Preload force, min.	N	0
Radial play, maximum, max.	mm	0
Axial force (dynamic), max.	N	0
Axial force (static), max.	N	0
Axial force, shaft supported, max.	N	0
Radial force, max.	N	5
Distance from flange	mm	5
Other specifications		-
Pole pair number	-	8
Number of collector segments	-	3
Weight of motor	g	110

Data under vacuum conditions.

Operating range n [rpm]

10000
8000
4000
2000
0 20 40 60 M [mNm]

Continuous operation
Continuous operation with reduced thermal resistance R_{th2} 50%
Short term operation

The shown data are applicable to one specific winding. More windings available.

This product is not yet fully qualified by maxon and/or flown on a space science mission.

EC frameless 60 flat SPACE Ø60 mm, brushless, 100 watt



M 1:2

Data at nominal voltage		
Nominal voltage	V	24
No-load speed	rpm	4230
No-load current	mA	568
Nominal speed	rpm	4290
Nominal torque	mNm	-30.6
Nominal current	Α	0
Stall torque	mNm	4260
Starting current	Α	79.7
Peak efficiency	%	84
Characteristics		
Terminal resistance phase-phase	Ω	0.301
Terminal inductance	mH	0.188
Torque constant	mNm/A	53.4
Speed constant	rpm/V	179
Speed/torque gradient	rpm/mNm	1.01
Mechanical time constant	ms	13.2
Rotor inertia	gcm ²	1250
Thermal data		
Therm. resistance housing-ambient (N)	K/W	13
Therm. resistance winding-housing (N)	K/W	15.6
Therm. time constant winding	S	164
Therm. time constant motor	s	468
Ambient temperature, min.	°C	-40
Ambient temperature, max.	°C	100
Winding temperature, max.	°C	125
Mechanical data		
Speed limit	rpm	6000
Axial play, min.	mm	0
Axial play, max.	mm	0
Preload force, min.	N	0
Radial play, maximum, max.	mm	0
Axial force (dynamic), max.	N	0
Axial force (static), max.	N	0
Axial force, shaft supported, max.	N	0
Radial force, max.	N	5
Distance from flange	mm	5
Other specifications		
Pole pair number	-	7
Number of collector segments	-	3
Weight of motor	g	333

Data under vacuum conditions.

Operating range n [rpm]

6000
4000
2000

Continuous operation
Continuous operation with reduced thermal resistance R_{th2} 50%
Short term operation

The shown data are applicable to one specific winding. More windings available.

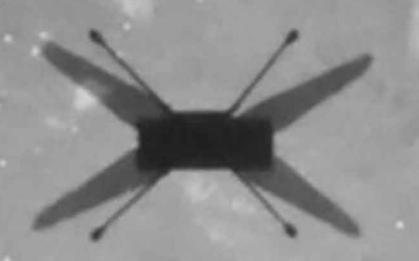
This product is not yet fully qualified by maxon and/or flown on a space science mission.

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April 25, 2021

Ingenuity's black-and-white camera took this photo of the helicopter's own shadow during its third flight.

Coortesy NASA/JPL-Caltech



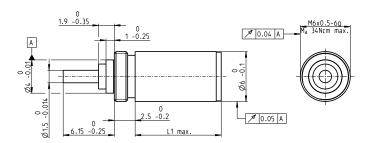
Gearboxes

Dedicated to space

GPX 6 SPACE	42
GPX 8 SPACE	43
GP 10 SPACE	44
GP 13 SPACE	45
GPX 14 UP SPACE	46
GPX 22 UP SPACE	47
GPX 32 UP SPACE	48
GPX 42 UP SPACE	49



GPX 6 SPACE Ø6 mm, planetary gearhead



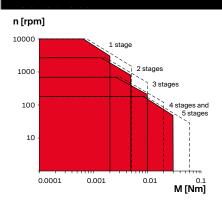


M 1:2

Key Data		
Max. transmittable power	W	0.6
Max. continuous torque	Nm	0.03
Max. continuous input speed	rpm	40 000
Ambient temperature	°C	-40 +100
Bearing at output		Ball bearing

Operating Range (output shaft)

Continuous operation
Intermittent operation



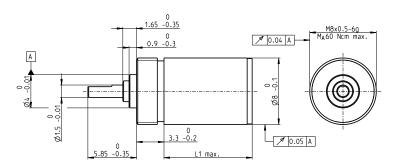
Specifications								
Number of stages		1	2	3	4	5		
Max. transmittable power (continuous)	W	0.63	0.39	0.20	0.15	0.04		
Max. transmittable power (intermittent)	W	0.79	0.49	0.25	0.18	0.05		
Max. continuous torque	Nm	0.002	0.005	0.01	0.03	0.03		
Max. intermittent torque	Nm	0.005	0.01	0.02	0.06	0.06		
Max. continuous input speed	rpm	40000	40000	40000	40000	40 000		
Max. intermittent input speed	rpm	40000	40000	40000	40000	40000		
Max. efficiency	%	88	77	68	60	52		
Average backlash no load	۰	1.8	2.0	2.2	2.5	2.8		
Max. axial load (dynamic)	N	5	5	5	5	5		
Max. radial load, 5 mm from flange	N	5	6	7	8	8		
Gearhead length L11	mm	5.3	7.8	10.4	13.0	15.6		
Weight	g	1.7	2.1	2.5	2.9	3.3		

Configuration								
Number of stages		1	2	3	4	5		
Reduction Absolute reduction: (see online)	X:1	3.9	15	57	221	854		

Flange	Standard flange/flange with centering diameter							
Shaft	Length/flat face	-						

¹ This length may vary depending on the configuration and choice of motor. The effective length is calculated at the end of the configuration process.

GPX 8 SPACE Ø8 mm, planetary gearhead





M 1:2

Key Data			
Max. transmittable power	W	0.84	
Max. continuous torque	Nm	0.1	
Max. continuous input speed	rpm	12 000	
Ambient temperature	°C	-15 +80	
Bearing at output		Ball bearing	

Operating Range (output shaft) n [rpm] n [rpm] Continuous operation 10000 10000 Intermittent operation 1000 1000 100 100 10 10 0.001 0.01 0.001 0.01 0.1 M [Nm] M [Nm]

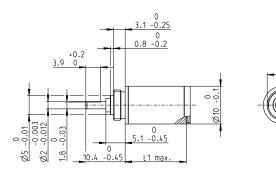
Specifications									
Number of stages		1	2	2	3	3	4	4	5
Max. transmittable power (continuous)	W	0.840	0.520	0.140	0.390	0.060	0.130	0.040	0.040
Max. transmittable power (intermittent)	W	1.05	0.650	0.180	0.490	0.080	0.160	0.060	0.050
Max. continuous torque	Nm	0.010	0.020	0.008	0.060	0.020	0.080	0.040	0.100
Max. intermittent torque	Nm	0.015	0.030	0.012	0.090	0.030	0.120	0.060	0.150
Max. continuous input speed	rpm	12000	12000	12000	12000	12000	12000	12000	12000
Max. intermittent input speed	rpm	20000	20000	20000	20000	20000	20000	20000	20000
Max. efficiency	%	90	81	76	73	66	65	57	59
Average backlash no load	۰	1.8	2.0	2.4	2.2	2.6	2.5	2.8	2.8
Max. axial load (dynamic)	N	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Max. radial load, 5 mm from flange	N	5	6	6	7	7	8	8	8
Gearhead length L1 ¹	mm	5.5	8.1	8.3	10.7	11.1	13.3	13.9	15.9
Weight	g	2.6	3.2	3.2	3.8	3.8	4.4	4.4	5.0

Configuration									
Number of stages		1	2	2	3	3	4	4	5
Reduction	X:1	4	16	36	64	216	256	1296	1024

Flange	Standard flange/flange with centering diameter
Shaft	Length/flat face

¹ This length may vary depending on the configuration and choice of motor. The effective length is calculated at the end of the configuration process.

GP 10 SPACE Ø10 mm, planetary gearhead



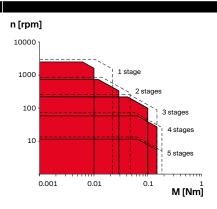


M 1:1

key Data		
Max. transmittable power	W	1.6
Max. continuous torque	Nm	0.15
Max. continuous input speed	rpm	12000
Ambient temperature	°C	-40 +80
Bearing at output		Ball bearing

Operating Range (output shaft)

Continuous operation
Intermittent operation



M8x0.75 M_A max. 80Ncm

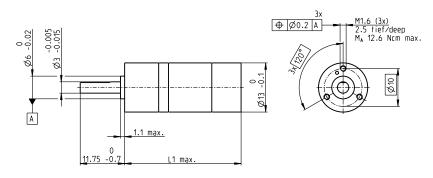
Specifications Number of stages		1	2	3	1			-
		10	4.0	_	0.40	010		
Max. transmittable power (continuous)	W	1.6	1.2	1.0	0.40	0.10		
Max. transmittable power (intermittent)	W	2.0	1.5	1.3	0.50	0.13		
Max. continuous torque	Nm	0.01	0.03	0.10	0.15	0.15		
Max. intermittent torque	Nm	0.02	0.05	0.15	0.20	0.20		
Max. continuous input speed	rpm	12000	12000	12000	12000	12000		
Max. intermittent input speed	rpm	15000	15 000	15 000	15 000	15000		
Max. efficiency	%	90	81	73	65	59		
Average backlash no load	۰	1.5	1.8	2.0	2.2	2.5		
Max. axial load (dynamic)	N	5	5	5	5	5		
Max. radial load, 5 mm from flange	N	5	10	15	20	25		
Gearhead length L1 ¹	mm	9.9	13.4	16.6	19.8	23.0		
Weight	g	6.7	7.2	7.7	8.2	8.7		

Configuration								
Number of stages		1	2	3	4	5		
Reduction	X:1	4	16	64	256	1024		

Flange Standard flange
Shaft Length/flat face

¹ This length may vary depending on the configuration and choice of motor. The effective length is calculated at the end of the configuration process.

GP 13 SPACE Ø13 mm, planetary gearhead



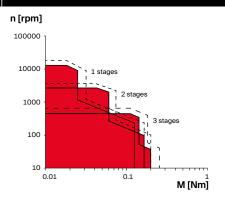


M 1:1

Key Data		
Max. transmittable power	W	22 (3.2)
Max. continuous torque	Nm	0.15
Max. continuous input speed	rpm	60 000
Ambient temperature	°C	: -10 +135
Bearing at output		Ball bearing

Operating Range (output shaft)

Continuous operation
.....Intermittent operation



Specifications		,				
Number of stages		1	2	3	5	
Max. transmittable continuous power	W	22 (3.2)	11 (1.6)	6 (0.8)	0.10	
Max. transmittable intermittent power	W	27 (4)	13 (2)	7 (1)	0.13	
Max. continuous torque	Nm	0.025 (0.13)	0.06 (0.16)	0.15 (0.2)	0.15	
Max. intermittent torque	Nm	0.030 (0.16)	0.075 (0.2)	0.19 (0.25)	0.20	
Max. continuous input speed	rpm	60000	60000	60 000	12 000	
Max. intermittent input speed	rpm	75 000	75 000	75 000	15 000	
Max. efficiency	%	85	80	70	59	
Average backlash no load	0	1.2	1.4	1.6	2.5	
Max. axial load (dynamic)	N	20	20	20	5	
Max. radial load, 5 mm from flange	N	10	15	25	25	
Gearhead length L1 ¹	mm	30.8	36.6	42.4	23.0	
Weight	g	21	26	30	8.7	

Configuration						
Number of stages		1	2	3	5	
Reduction	X:1	5	25	125	1024	

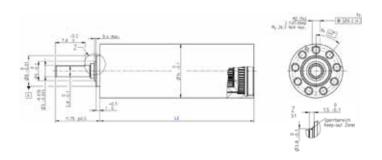
Flange	Standard flange/configurable flange
Shaft	Length/flat face

¹ This length may vary depending on the configuration and choice of motor. The effective length is calculated at the end of the configuration process.

^{*}Values in parentheses apply in case of reduced speed (according to diagram).

GPX 14 UP SPACE Ø14 mm, planetary gearhead



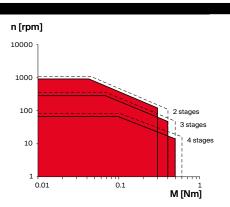


M 1:1

Key Data		
Max. transmittable power	W	4.0
Max. continuous torque	Nm	0.50
Max. continuous input speed	rpm	16 000
Ambient temperature	°C	-55 +100, optional -70 +200
Bearing at output		Ball bearing
		•

Operating Range (output shaft)

Continuous operation
Intermittent operation



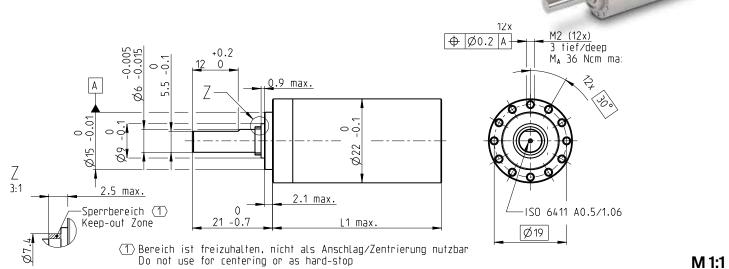
Considirations				
Specifications				
Number of stages		2	3	4
Max. transmittable power (continuous)	W	4.0	2.0	0.7
Max. transmittable power (intermittent)	W	5.0	2.5	1.0
Max. continuous torque	Nm	0.30	0.40	0.50
Max. intermittent torque	Nm	0.40	0.50	0.60
Max. continuous input speed	rpm	14000	16000	16000
Max. intermittent input speed	rpm	17500	20000	20000
Max. efficiency	%	95	90	85
Average backlash no load	۰	1.3	1.45	1.7
Max. axial load (dynamic)	N	20	20	20
Max. radial load, 5 mm from flange	N	45	70	70
Gearhead length L1 ¹	mm	38.1	45.0	51.9
Weight	g	23	29	35

Configuration Number of stages		2	3	4					
Reduction Absolute reduction: (see online)	X:1	28, 35, 44	150,186 231, 287	794, 987 1227, 1526 1897					
Version	Ultra F	Performance							
Flange	Standa	Standard flange							
Shaft	Standa	ard length/flat face							

GPX 22 UP SPACE^{*} Ø22 mm, planetary gearhead

Ultra Performance, for space applications

Key Data: 1.0-5.2 mNm



RЛ	1	•	1
IVI		•	ı

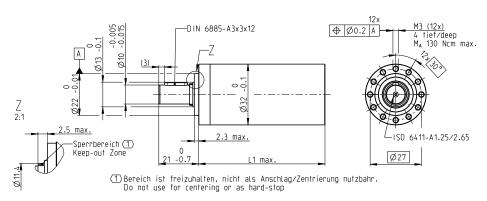
Technical Data								
Planetary gearhead		1			straigh	nt teeth		
Output shaft	stainless steel							
Bearing at output			ball b	earing				
Radial play, 10 mm from flange					max. (D.1 mm		
Axial play					max. 0	.15 mm		
Max. permissible axial load					75	i N		
Max. permissible force for press fits					120	O N		
Sense of rotation, drive to output						=		
Recommended input speed					< 800	0 rpm		
max. short time allowed input speed					< 10 0	00 rpm		
Recommended temperature range					-55°	+100°C		
Recommended temperature range -55° +100°C						+200°C		
Number of stages			1	2	3	4	5	
Max. radial load, 10 mm from flange			90 N	140 N	150 N	150 N	150 N	
, , , , , , , , , , , , , , , , , , ,								
Number of stages			1	2	3	4	5	
Max. continuous torque		Nm	1	2.9	4.3	5.2	5.2	
Intermittently permissible torque at gear output		Nm	1.5	4.35	6.45	7.8	7.8	
Max. overload torque 1		Nm	2	5.8	8.6	10.4	10.4	
Max. efficiency		%	85	90	85	80	75	
Weight		g	75	85	100	115	130	
Average backlash no load		ò	1	1.2	1.6	2	2	
Stiffness		°/Nm						
Gearhead length L1		mm	25	34.7	44.3	54		
Max. transferable continuous power		W	60	40	20	10	6	
Max. transferable short-time power		W	90	60	30	15	10	
Configuration								
Numer of stages			1	2	3	4		
Reduction	X:1		3.9, 5.3	16, 21, 26,	62, 83, 103,	243, 326, 406,	on request	
Absolute reduction: (see online)				28, 35	111, 138, 150, 172, 186, 231	439, 546, 590, 679, 734, 794, 913, 987, 1135, 1227, 1526	only	

GPX 32 UP SPACE* Ø32 mm, planetary gearhead

Ultra Performance, for space applications

Key Data: 2.2-12.6 mNm





M 1:2

				straigh	t teeth		
		stainless steel					
		ball bearing					
		max. 0.1 mm					
				max. 0	.15 mm		
				150) N		
				250	N C		
					=		
				< 600	0 rpm		
				< 750	0 rpm		
				-55°	+100°C		
				-70°	+200°C		
		1	2	3	4	5	
		150 N	200 N	250 N	250 N	250 N	
		1	2	3	4	5	
	Nm	2.2	4.8	10.4	12.6	12.6	
	Nm	3.3	7.2	15.6	18.9	18.9	
	Nm	4.4	9.6	20.8	25.2	25.2	
	%	95	90	85	80	75	
	g	175	245		375	440	
	•	0.8	1	1.2	1.5	1.5	
	°/Nm						
	mm	37.4	51.9	66.5	81.1		
	W	215	135	55	25	15	
	W	320	200	80	40	20	
		1	2				
X:1		3.9, 5.3	16, 21, 26,	62, 83, 103,		on request	
			28, 35	111, 138, 150, 172, 186, 231	679, 734, 794, 913, 987, 1135,	only	
	X:1	Nm Nm % g °/Nm mm W	1 Nm 2.2 Nm 3.3 Nm 4.4 % 95 g 175 ° 0.8 °/Nm mm 37.4 W 215 W 320	150 N 200 N 1 2 Nm 2.2 4.8 Nm 3.3 7.2 Nm 4.4 9.6 % 95 90 g 175 245 ° 0.8 1 °/Nm mm 37.4 51.9 W 215 135 W 320 200 X:1 2 X:1 2,5,5,3 16,21,26,	ball be max. 0 max. 0 150 256 < 600 < 750 -55° 1 2 3 150 N 200 N 250 N 1 2 3 150 N 200 N 250 N 1 2 3 Nm 2.2 4.8 10.4 Nm 3.3 7.2 15.6 Nm 4.4 9.6 20.8 % 95 90 85 g 175 245 315 ° 0.8 1 1.2 °/Nm mm 37.4 51.9 66.5 W 215 135 55 W 320 200 80 X:1 2 3 X:1 2 3 X:1 2 3 X:1 3.9, 5.3 16, 21, 26, 62, 83, 103, 28, 35 111, 138, 150,	ball bearing max. 0.1 mm max. 0.15 mm 150 N 250 N = <pre></pre>	ball bearing max. 0.1 mm max. 0.15 mm 150 N 250 N = < 6000 rpm < 7500 rpm < 250 m < 3 4 5 < 4 5 < 1 2 3 4 5 < 5 mm < 250 N <a< td=""></a<>

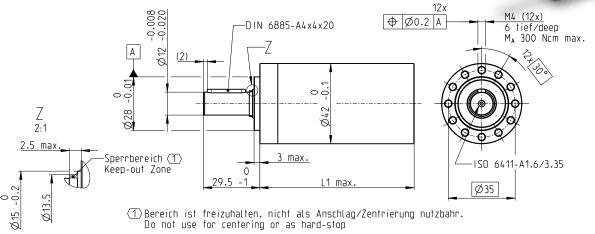
GPX 42 UP SPACE^{*} Ø42 mm, planetary gearhead

Ultra Performance, for space applications

Key Data: 4.5-35.0 mNm



M 1:2



S								
Technical Data								
Planetary gearhead					straigh	t teeth		
Output shaft					stainles	ss steel		
Bearing at output					ball be	earing		
Radial play, 10 mm from flange					max. ().1 mm		
Axial play					max. 0	.15 mm		
Max. permissible axial load					29	N C		
Max. permissible force for press fits					470	O N		
Sense of rotation, drive to output					:	=		
Recommended input speed					< 600	0 rpm		
max. short time allowed input speed					< 750	0 rpm		
Recommended temperature range					-55°	+100°C		
Recommended temperature range -55° +100°C					-70° ·	+200°C		
Number of stages			1	2	3	4	5	
Max. radial load, 10 mm from flange			350 N	525 N	750 N	750 N	750 N	
Number of stages			1	2	3	4	5	
Max. continuous torque		Nm	4.5	18	32	35	35	
Intermittently permissible torque at gear output		Nm	6.75	27	48	52.5	52.5	
Max. overload torque 1		Nm	9	36	64	70	70	
Max. efficiency		%	95	90	85	80	75	
Weight		g	330	470	610	750	890	
Average backlash no load		•	0.8	1	1.2	1.5	1.5	
Stiffness		°/Nm						
Gearhead length L1		mm	43.5	62.2	80.8	99.5		
Max. transferable continuous power		W	380	240	100	45	25	
Max. transferable short-time power		W	570	360	150	65	35	
Configuration								
Numer of stages			1	2	3	4		
Reduction	X:1		3.9, 5.3	16, 21, 26,	62, 83, 103,	243, 326, 406,	on request	
Absolute reduction: (see online)				28, 35	111, 138, 150, 172, 186, 231	439, 546, 590, 679, 734, 794, 913, 987, 1135,	only	
						1227.1526		



Encoders, Resolvers and Brakes

Dedicated to space

ENC 13 SPACE	52
MR-TYPE M-32I-LR-2C-32P SPACE	53
Harowe Resolver 10 BRC	54
Micronor Resolver	55
DBX 22 Detend Brake	56
DBX 32 Detend Brake	56



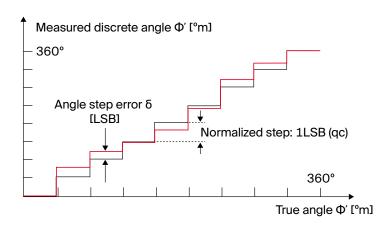


Technical Data					
Parameter	Test Condition	Unit	Min.	Max.	
Supply voltage (V _{cc})		V	-16	16	
Output current (I _Q)	Latch-Up condition	mA	-100	100	
Operating temperature (T _{amb})		°C	-70	80	
Storage temperature (T _{store})		°C	-130	150	
Operating Range					
Parameter	Test Condition	Unit	Min.	Тур	Max.
Supply voltage (Vcc)		V	+4.5	+5	+5.5
Supply current (I _{cc})		mA		7.7	16
Output current HIGH-Level (IOH)	VCC - VOH < 0.5 V	μΑ			50
Output current LOW-Level (IOL)	VOL < 0.5 V	mA	-40		
Output satturation voltage (VOL)	IOH = -40 mA	V		0.25	0.5
Rise / fll time t _r ; t _F , 10%; 90%	Rpull-down = 1.2 kΩ; CL £ 33 pF, Rpull-up = 10 kΩ	μs			1

Inkremental Interface					
Parameter	Test Condition	Unit	Min.	Тур	Max.
Number of redundant encoders				2	
Number of channels	ChA1, ChB1, ChA2, ChB2			2x2	
Counts per turn (N)		cpt		2	
Pulse frequency (f _{pulse})		kHz		200	

DNL (Differential Non-Linearity)

The DNL is the maximum positive or negative average angle step error. It is measured in units of LSB (Least Significant Bit), which is the minimum measurable difference betweet two angle values at a given resolution (= quadcount, = state, = increment).



MR-Type M-32i-LR-2C-32P SPACE Encoder



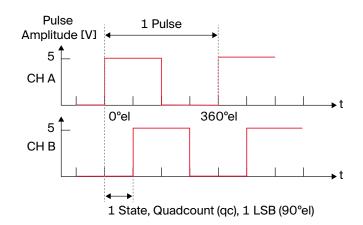
Characteristic		
Pulses per turn		32 (= 128 state transitions)
Number of channels		2
Max. impulse frequency	mA	Max. 8kHz
Supply voltage V _{CC}	V	4.5 5.5
Output signal V _{CC} = 5VDC		TTL compatible
Phase shift	Ω	90°e ± 45°e
Output current per channel	mA	Max. 5
Input supply current	mA	Max. 50
Operating temperature	°C	-60 and +95

Where the maxon catalog refers to "counts per turn" (cpt) it actually means "pulses per turn" and hence there are 4x more quadrature states per turn.

eg. in maxon terminology a 32 cpt encoder has 128 quadrature states per turn.

Output signal

Each redundant encoder output has two channels with a square wave as shown in the following diagram:



This product is not yet fully qualified by maxon, however design is closely based on equivalent product qualified and flown on agency mission project.

1.1 Electrical redundancy

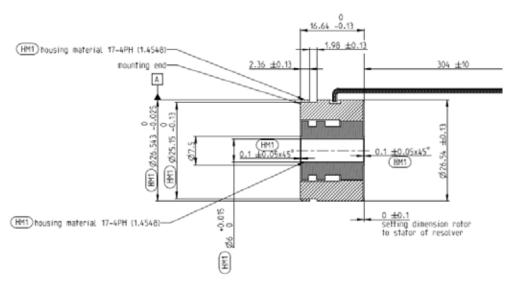
Full electrical redundancy is provided, with the redundant circuit fully isolated from the primary circuit. There is no mechanical redundancy as only one target will be used.

1.1 Output wiring

Redundant encoder half have 4 wires type ESCC 3901 024 02 AWG28 (ie. 8 total) with the following functions:

Primary encoder	Secondary encode
V _{cc}	V _{cc} ^I
GND	GND ¹
Channel A	Channel A ¹
Channel B	Channel B ^I

Harowe Resolver 10 BRC, 7 volt



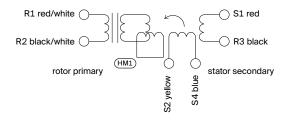
M 1:1

		444785	551795	551793	578405
Туре					
Shaft diamter	mm	6	6	6	6
Max. speed	rpm	20000	20000	20000	20000
Wire length	mm	304	630	780	1520

Technical Data		
Input voltage		7V peak, 10 kHz
Transmission ratio		0.5
Error	arcmin	± 20
Rotor inertia	gcm ₂	2.19
Weight	g	40
Operating temperature range	°C	-55 +204

Pin Allocation

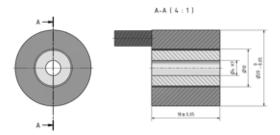
R1 - Prim + red/white R2 - Prim GND black/white S1 - cos + red S2 - sin + yellow S3 - cos black S4 - sin blue



Phasing equation increasing angle for CCW rotation as viewed from mounting end E (S1-S3) = KE (R1-R2) $\cos \theta$ E (S2-S4) = KE (R1-R2) $\sin \theta$

MICRONOR Resolver RE 2010-Special Ø20 mm, 5 V_{rms}





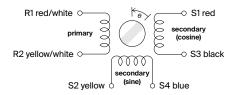
M 1:1

		595016
Туре		
Shaft diamter	mm	4
Max. speed	rpm	180000
Wire length	mm	300

Technical Data		
Input voltage		5V rms, 8 kHz
Transmission ratio		0.5 ±10%
Error	arcmin	± 60
Rotor inertia	gcm ₂	2.0
Operating temperature range	°C	-196 +220

Electrical Connection

Ref+	red/white	R1
Ref-	yellow/white	R2
Cos+	red/white	S1
Cos-	black	S3
Sin+	yellow	S2
Sin-	blue	S4
Wire	AWG 26 Kapton-ins	sulated



 θ increases for CCV rotation when viewed from lead exit end V (S1-S3) = V (R1-R2) x TR x cos θ V (S2-S4) = V (R1-R2) x TR x sin θ

DBX 22 Detent Brake Ø22 mm, 8/20 mNm





DBX 32 Detent Brake Ø32 mm, 16 mNm



Important information

- → Fully passive non-contact holding brake (no electrical power needed)
- → Based on magnetic cogging
- → Not able to handle dynamic braking
- ightarrow Effect of the cogging torque reduces with increasing speed
- → Schematic image: does not necessarily reflect the delivery state

Specifications

In general the maxon standard specifications nos. 100–103 apply – see the current edition of the maxon product catalog. In addition for all the space products the product has also been qualified against the maxon standard space environmental specifications (maxon document 8200274, which can be provided on request). A summary of the space product specifications and qualification testing is provided in the section "Product qualification" on page 10 of this space catalog.

Configuration management

As standard, maxon cannot guarantee no design changes will be made over the lifetime of the product but will provide notice of any changes in the design of the product that affect FFF ("form fit or function") of the product and also of major changes in production processes. "Major" changes for processes can be understood to mean the change of one type of process (eg. welding) to another (eg. gluing) but will not include details of how a process is performed (eg. parameters used or tooling used). "Function" in FFF is to be interpreted in terms of the applicable specifications, as described above under "Specifications".

Since to keep costs as low as possible, maxon's space products are based on, and share many parts with, industrial catalog standard parts. These are subject to a continuous improvement process, which means changes at piece part level will occur from time to time. Where maxon identifies a risk that FFF of the final product may be affected (this will usually be via the effect a piece part change may have on the "function" of the overall product) a description of the planned change will be provided together with a timetable for the change. If after analysis you decide not to accept the change, it may be necessary to increase the cost of the product (after a suitable last buy opportunity) in order to cover the costs of continuing to make the original part (in some special circumstances it may not be possible to continue with the original part).

If this "standard" configuration management process is not acceptable, a customized version can be negotiated (but is likely to involve additional costs).

Non-Conformity Management

Non-Conformance Reports (NCRs) will only be issued for defects in the deliverable product that impact FFF, where "Function" is to be interpreted in terms of the applicable specifications, as described above under "Specifications". NCRs at piece part or sub-assembly level, that do not affect FFF of the delivered product, will be documented and released by maxon internally without the customer being informed.



Questions about your application or need support in selection best actuator? Contact maxon experts in Spacelab: space@maxongroup.com



Stefan DillierBusiness Development Manager
Space Projects

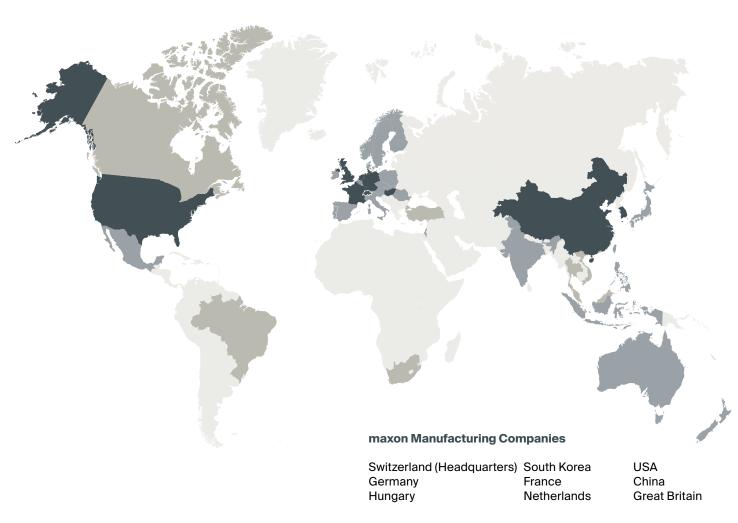


Robin Phillips Head of maxon SpaceLab Space Projects



Nico Steinert Senior System Engineer and Project Manager Space Projects

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