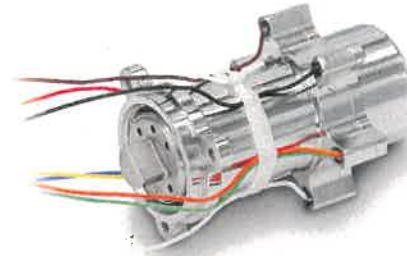


Thanks for participating



JPL Mars 2020 M24 actuator



JPL Mars 2020 M32 actuator



DCX 10 S customized

Thank you for your help in supplying maxon with high quality components. We have the pleasure of being able to inform you that some of your company's components are included in maxon's motors and gearboxes supplied to JPL for the Mars 2020 Perseverance rover and Ingenuity helicopter missions.

With the recent confirmation that the first sample has been successfully collected, we now know that all the actuators we delivered are functioning correctly! If the rest of the mission proceeds as planned, then these samples will eventually be returned to Earth as part of the first sample collection mission on another planet.

A handwritten signature in blue ink, appearing to read 'E. Elmiger'.

Eugen Elmiger
CEO maxon Group

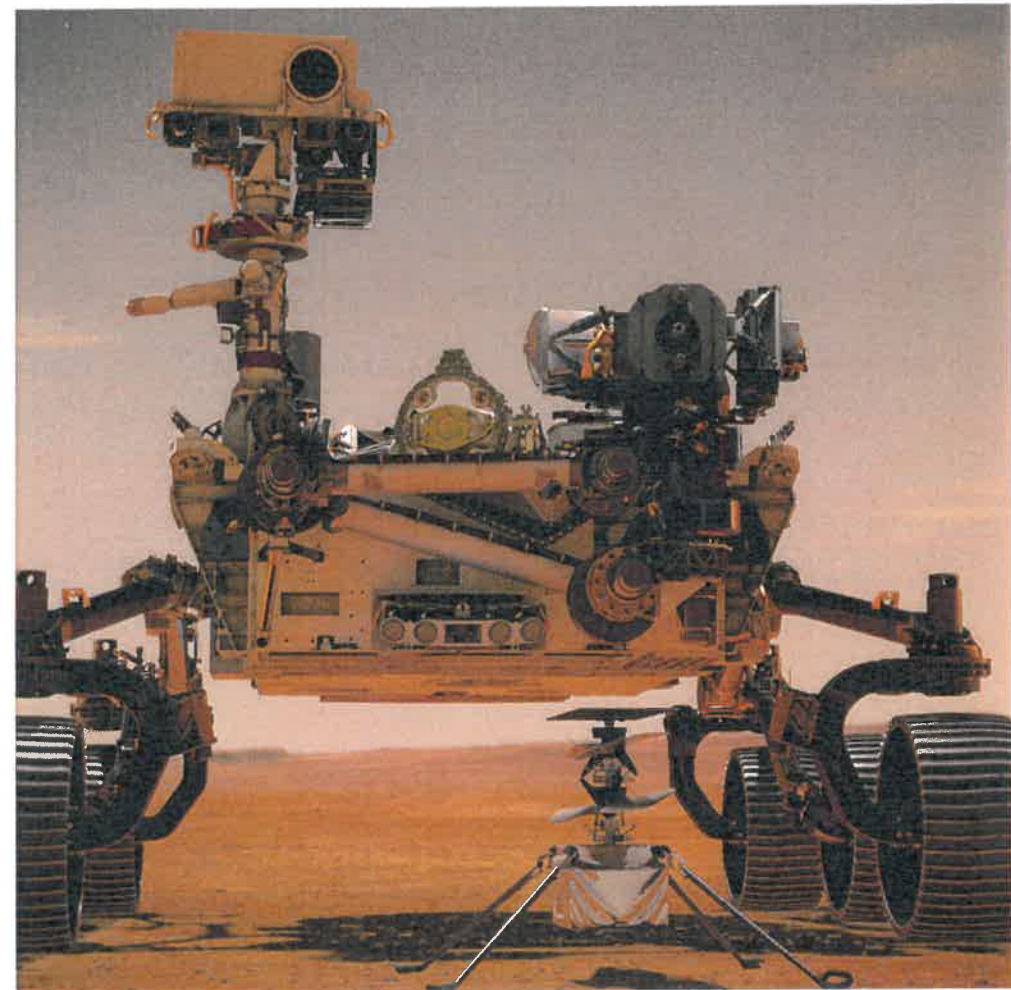
A handwritten signature in blue ink, appearing to read 'Robin R. Phillips'.

Robin Phillips
Head of maxon SpaceLab

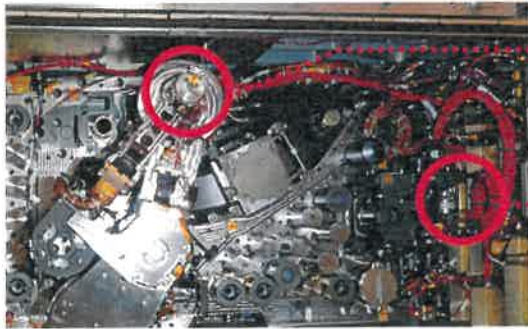
Actuators for the Mars 2020 Mission Rover Perseverance Helicopter Ingenuity

The maxon solution

Robin Phillips, Lynn Braunschweig, Florbela Costa
maxon international ag, April 2021

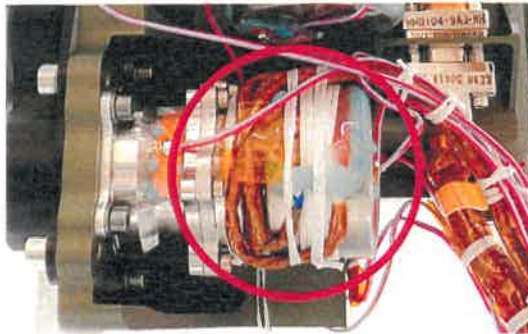


Actuators as installed in rover

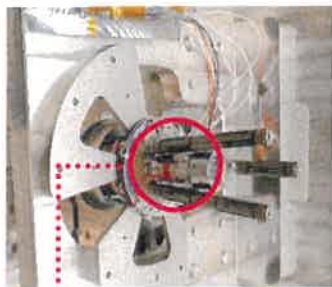


..... **EC 32 flat on sample handling assembly arm / 3x**
 - Elbow joint, Shoulder joint
 - Linear movement

..... **EC 32 flat / 2x**
 - Sealing station piston
 - Release mechanism for sample drop-off



..... **EC 32 flat / 2x**
 - Sealing station piston
 - Release mechanism for sample drop-off

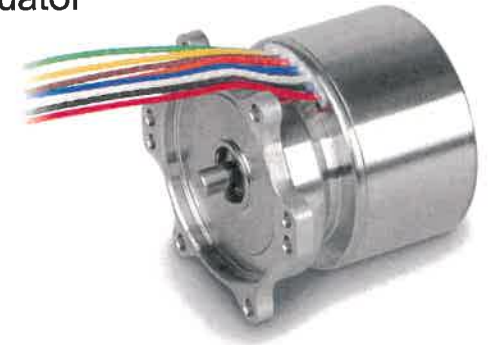


..... **EC 20 flat + GPX 22 UP / 1x**
 - Sample handling arm end effector



..... **EC 32 flat / 1x**
 - Helicopter deployment

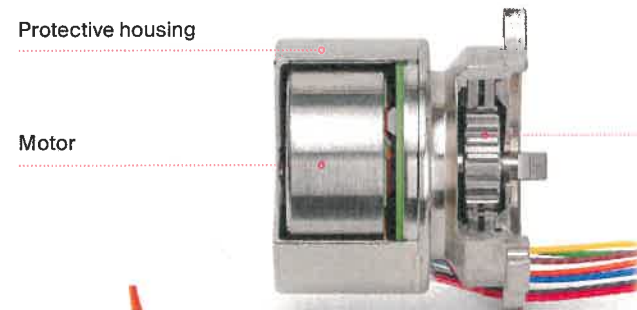
JPL Mars 2020 M32 actuator



Protective housing

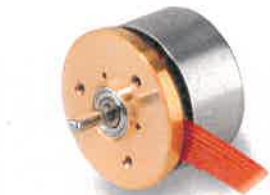
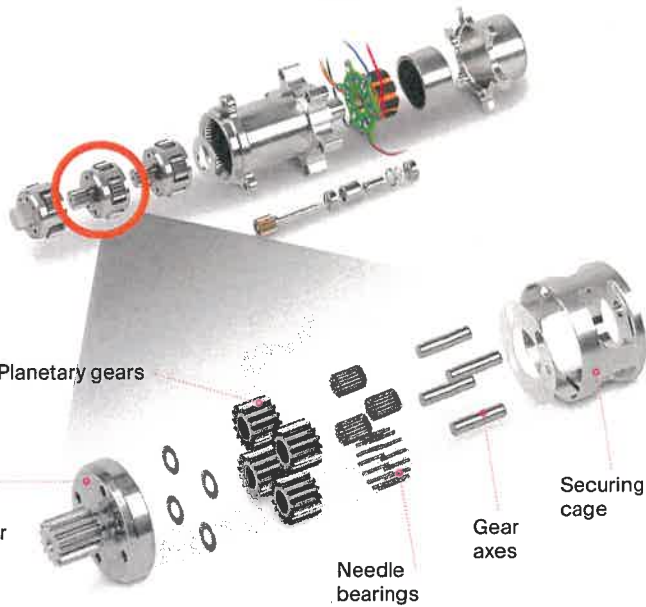
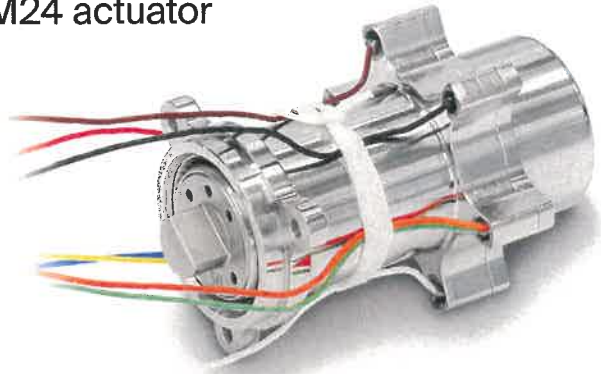
Motor

Detent brake



Core features are shared with the catalog standard equivalent product:
EC 32 flat

JPL Mars 2020 M24 actuator



Core features are shared with the catalog standard equivalent products:
EC 20 flat

GPX 22 UP



Perseverance is just stage one of Mars Sample Return

CURRENT MISSION

Mars 2020 (Perseverance) collects samples, packages them in tubes and deposits them in «caches» on the surface of Mars.



late 2020's



Sample Fetch Mission Lander:
Launch late in 2020's decade, landing ~2030 (long travel time due to high mass of lander). Lander built by JPL.

Rover returns to lander and transfers collected samples into lander.



Lander deploys the SFR (Sample Fetch Rover), built by ESA. Rover drives to collect Mars 2020 samples.



early 2030's

Rocket launches from lander in early 2030's, taking samples into Mars orbit. Launcher built by JPL.

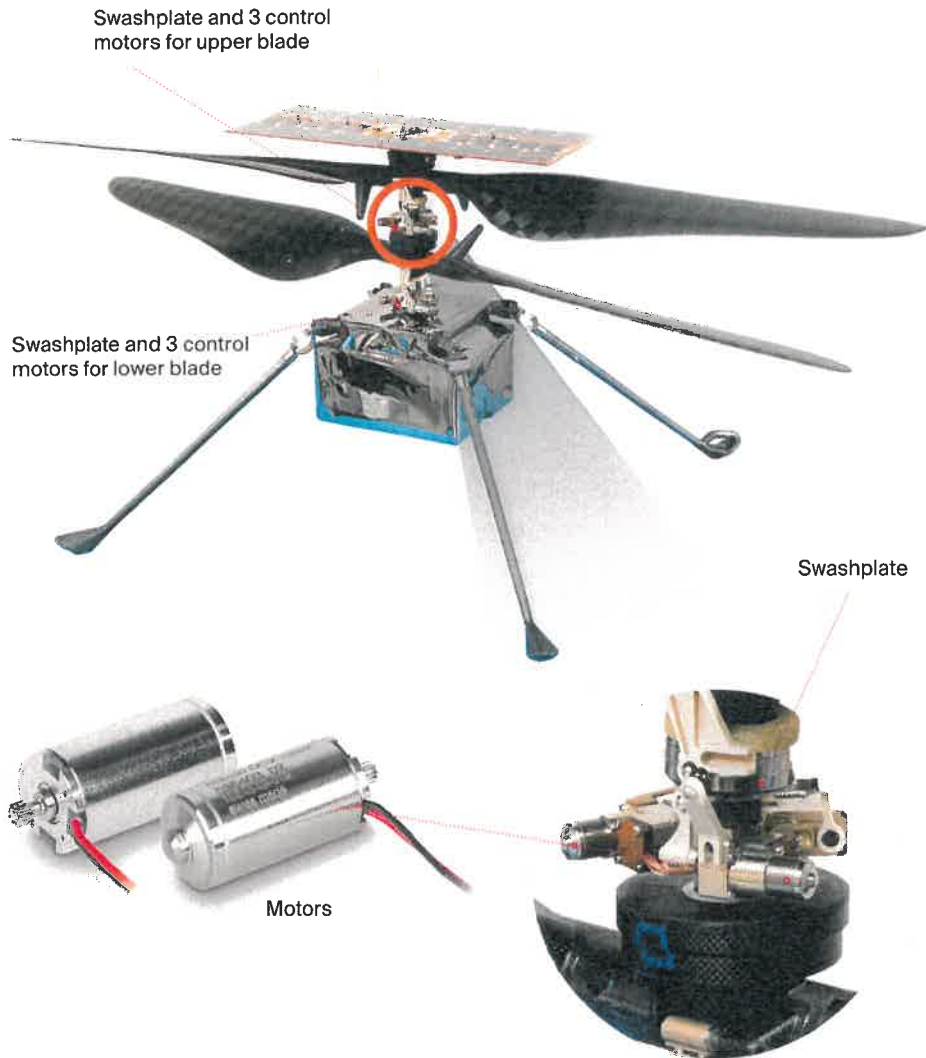


early - mid 2030's



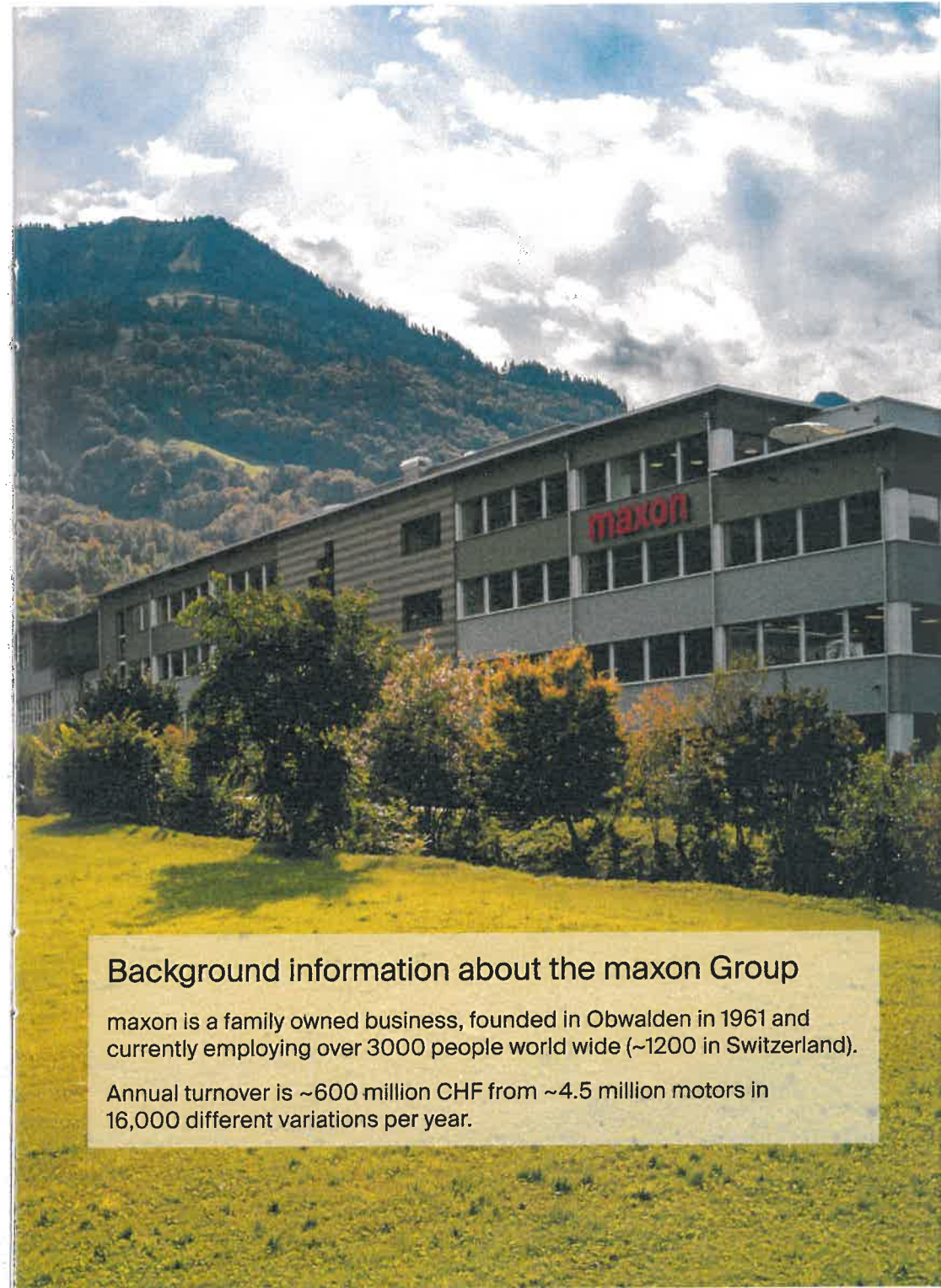
Samples collected in Mars orbit by Earth Return Orbiter (built by ESA). Samples fly back to Earth and land about 1 year after launch from Mars surface.

First helicopter on Mars «Ingenuity»



Swashplate

This is a mechanism found on all helicopters and is used to adjust the pitch (angle) of the rotor blades and thereby controls the movement of the vehicle.



Background information about the maxon Group

maxon is a family owned business, founded in Obwalden in 1961 and currently employing over 3000 people world wide (~1200 in Switzerland).

Annual turnover is ~600 million CHF from ~4.5 million motors in 16,000 different variations per year.