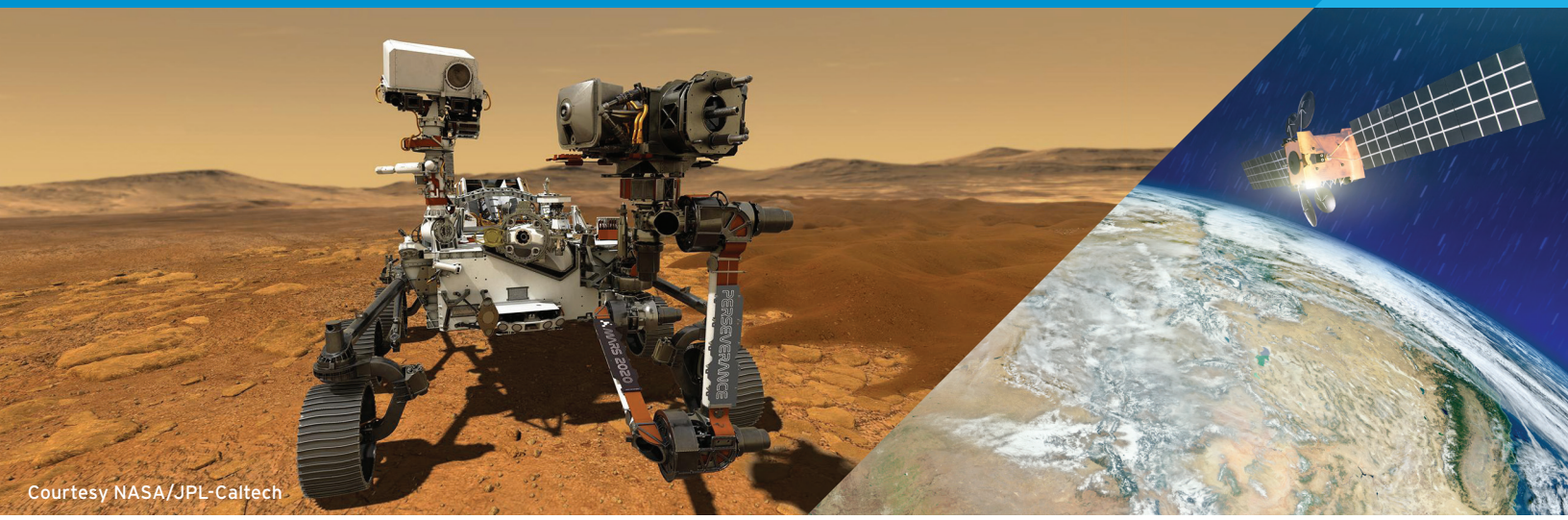
Ducommun

ENGINEERED PRODUCTS

MOTION CONTROL DEVICES (MCD) FOR SPACE, MILITARY & INDUSTRIAL MARKETS



Courtesy NASA/JPL-Caltech

Reliability. Precision. Customization.

Ducommun is a leading global manufacturer of resolvers, motors and actuators for valued customers in the Aerospace, Defense, Space and Upstream Oil Exploration markets. From deep below the earth's surface to the far reaches of space, our Motion Control Devices perform in extreme operating conditions and environments, where precision and reliability are essential.

Expertise & Innovation When It Matters Most

Our technological heritage in Motion Control Devices began in 1948 with the design, manufacturing and introduction of our first MCD products. Today, we build MCD solutions used in a range of modern Military, Space and Industrial applications and programs, including downhole oil exploration tools, shipboard systems, submarines, data tracking and relay satellites, and space exploration launch vehicles.

Markets & End Use

- Space Exploration Vehicles
- Satellites GEO & LEO
- Launch Vehicles
- Oil Exploration
- Downhole Drilling
- Submarines
- Commercial & Military Aerospace
- Ground Vehicles
- Missile Systems
- Custom Solutions

Space Programs

- Mars Rovers
- CASSINI
- COWVR
- Dream Chaser
- Rosetta
- Venus Express
- Hubble Rescue
- INMARSAT
- ISS Dextre Robot
- Mexsat
- MILSTAR
- SMAP
- Sentinel 6
- Space Shuttle
- SWOT
- Osiris-Rex
- Europa Clipper

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Space

For decades, we've served as a leading supplier of high reliability, integrated products and solutions for Space programs. Space-qualified stepper motors, BLDC motors and resolvers for Satellites and Space exploration vehicles are core competencies. Ducommun supplied actuators for the Rover Stand-up Operation on the NASA Mars Exploration Rover and Brushless DC motors for the Mars Pathfinder program. We built 42 resolvers for the International Space Station (ISS). Our latest programs include the design and manufacturing of resolvers for NASA's Frontiers Mission to Jupiter and resolvers and variable reluctance resolvers for the historic Mars 2020 Mission Perseverance Rover.

Military & Defense

Ducommun's highly specialized stepper and DC electric motors, position sensors (resolvers) and electromechanical actuators are found in antennas, waveguide systems, gimbals for azimuth and elevation positioning, missile wing deploy and CAS (control actuation system) motors. We continue to lead the industry as a manufacturer of high-quality, reliable products with proven success in demanding applications for military aircraft, submarines, ground defense and weapon systems.

Upstream Oil & Gas Market

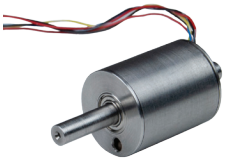
Ducommun offers decades of experience in designing and manufacturing highly reliable motors and alternators for downhole oil exploration tools. The motors are used miles beneath the earth's surface at extreme temperatures of up to 260˚C and high pressures of up to 30,000 psi. Our latest development of high-efficiency motors provides additional reliability for the increasingly demanding downhole drilling environment.

Since the early 1990s, Ducommun has provided stepper motors for Tracking and Data Relay Satellites (TDRS), including weather satellite systems.

Ducommun's legacy in Motion Control Devices has been used in the military market for decades. Our engineers recently leveraged this expertise when designing and building an advanced missile system.

Ducommun's Motion Control Devices offer reliability and performance in the most extreme conditions and environments.

Our Products



Stepper Motors

- Permanent Magnet
- Hybrid
- Variable Reluctance (VR)
- 2, 3 & 4-Phase
- Optional with Gear Head

DC-Motors

- Brushless Motors (BLDC)
- Coreless Motors
- Pancake or Housed
- Optional Gear Head, Feedback &/or Brake

AC-Motors/ Alternators

- Oil Exploration for High Temp (260˚C)
- High Efficiency
- Optional with Gear Head
- Single & 3-Phase

Resolvers

- High Accuracy up to +/- 5 Arc-Sec
- Pancake or Housed
- Single, Dual & Multi-Speed
- Brushless (Rotary Transformer)

Variable Reluctance Resolvers (Brushless)

- Accuracy up to +/- 2 Arc-Min
- Compact Design, Lightweight
- No Rotary Transformer Required

Actuator Assemblies

- Rotary/Linear
- With Gear Head, Lead Screw, etc.
- Permanent Magnet, Multi-Position

Our Capabilities

Engineering

- Decades of Experience in Design & Manufacturing
- New Product Development
- Mechanical & Electromagnetic Analysis

Environmental Test

- Thermal Cycle/Shock
- Thermal Vacuum
- Pyroshock
- ESS

Assembly

- Highly Skilled Personnel for Component & System Assemblies
- J-STD-001 Space
- Addendum Soldering

Program Management

- Customer Interface
- Lifecycle Management
- Performance Driven

Quality

- ISO 9001 / AS9100 Cert
- Clean Rooms Class ISO 7+8
- Flow Benches ISO 5
- Continuous Improvement Six/Sigma

Testing

- High Accuracy Testing
- Dynamometer
- Customer-Approved Acceptance Tests

Manufacturing

- Complete In-House Machining Capabilities
- Industry-Standard Capabilities
- Rapid Prototyping
- Material & Component Traceability

Aftermarket Offering

- In addition to our original equipment, we offer aftermarket spares and a full range of MRO services for the Upstream Oil Exploration and Military markets.

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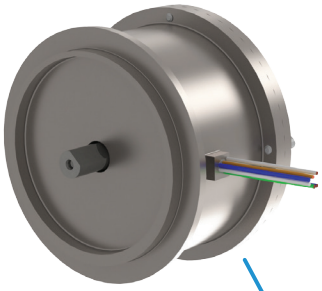
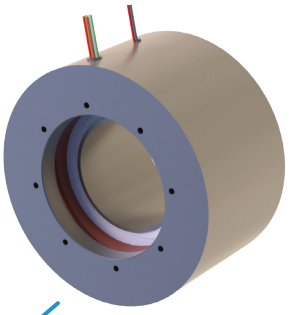
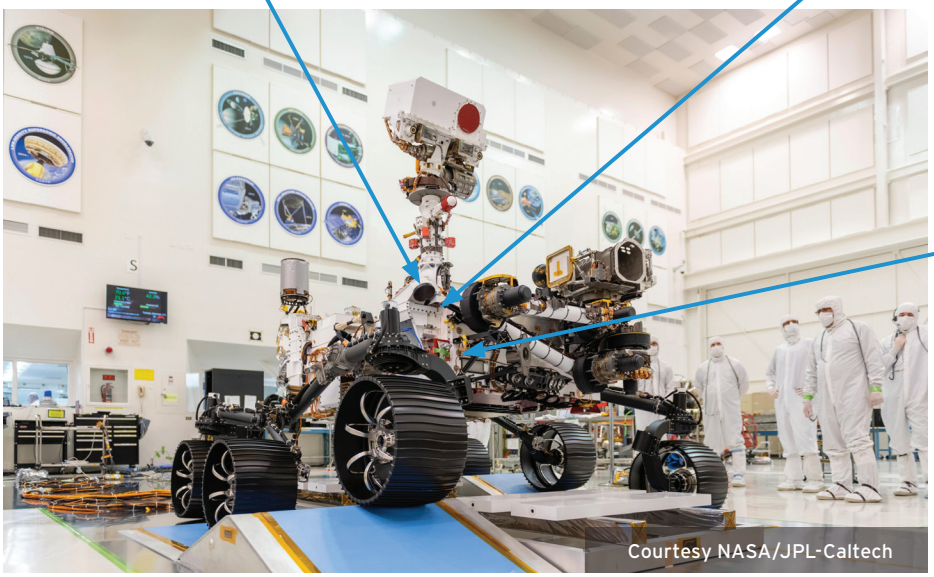
Critical Parts for Critical Missions: Mars 2020 Perseverance Rover



Bit carousel docking assembly resolver
Used to return the drill bits back into the bit carousel. The drilling is done by the robotic arm.



Bit carousel rotor mechanism resolver
Used to measure the angle of rotation of the bit carousel. The carousel holds all the drill bit tools for drilling the core samples.



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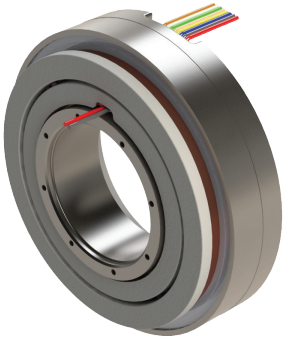

Sample handling assembly resolver
Used to transfer the Mars surface core samples into a clean sample collection tube.

Mars 2020 Mission Perseverance Rover: Ducommun's Motion Control Devices Team in Carson, California, provided our customer JPL with three resolvers to be used on the Perseverance Rover for sample handling, bit carousel docking assembly and rotor mechanism.

CONNECT WITH A DUCOMMUN MOTION CONTROL DEVICES (MCD) PRODUCTS REPRESENTATIVE OR VISIT DUCOMMUN.COM

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ABOUT DUCOMMUN: Ducommun Incorporated delivers innovative, value-added design, engineering and manufacturing solutions to customers in the aerospace, defense and industrial markets. Founded in 1849, the Company specializes in two core areas, Electronic Systems and Structural Systems. It produces complex products and components for commercial aircraft platforms, mission-critical military and space programs, and select industrial applications.