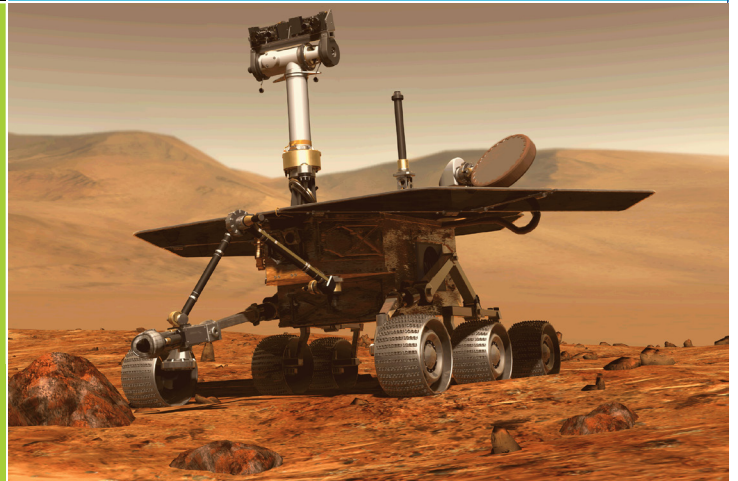


Engineered Products Space Heritage



Ducommun LaBarge Technologies Carson Space Heritage Overview

For over 40 years Ducommun LaBarge Technologies (DLT), Carson Engineered Products has legacy working with both government/defense and commercial space applications. With an extensive heritage of custom solutions, we can offer a broad range of switching solutions and motion control device solutions to both communications link applications and redundancy applications.

Ducommun space qualified products have been used in a variety of space applications where electrical performance, weight, size and reliability have been mission critical.

Space Qualified Products and Services

Capabilities

- Engineering
- Mechanical
- Testing
- Assemblies
- Certifications

Product Lines

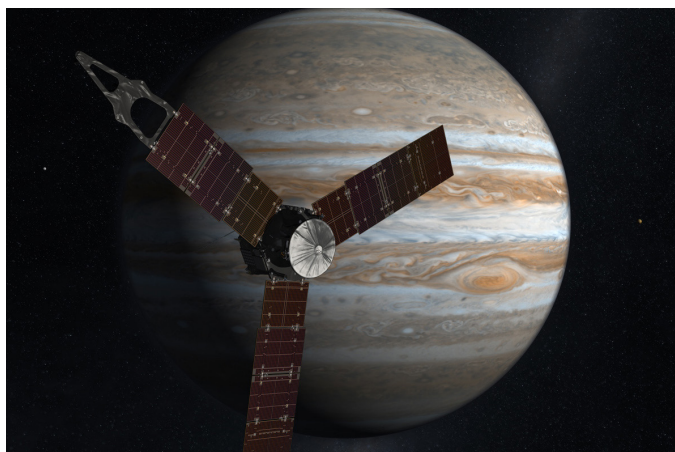
- Motion Control Devices (MCD)
- RF Products

Ducommun Space Heritage

MCD Space Heritage Programs

Since 1948, the MCD group has had the legacy of working with defense & commercial space application motors, resolvers and actuators. Over the past decade MCD has energized its engineering group and has grown as an innovative leader in custom design and manufacture of precision motion control devices for space applications. MCD takes pride in developing creative solutions based on unique requirements from its customers in the space industry.

- NASA SMAP
- NASA JUNO
- Intelsat
- Inmarsat
- Mexsat
- NASA Nu Star
- NASA TDRS
- ESA Rosetta
- ESA Venus Express
- MDA Dextre Robot
- US Air Force WGS
- JPL
 - > Mars Pathfinder (6 BLDC Motors)
 - > Mars Rovers
 - > Cassini
- Hubble Rescue
- Space Shuttle
- MILSTAR Satellites (40 resolvers)
- Hughes Space System Microwave Group
- International Space Station (55 resolvers)



RF Space Heritage

Since 1987, Ducommun RF Products has had the legacy working with both government/defense and commercial space applications. Because of our heritage, we can offer a broad range of switching solutions to both communications link applications and redundancy applications.

Ducommun RF Coaxial space qualified switches have been used in a variety of space applications where electrical performance, weight, size and reliability have been mission critical. Our heritage includes both S and K Level qualification testing and screening.

RF Space Heritage Programs

- LEO
- METOP
- GALEX
- C/NOFS TDRS
- SWIFT
- MATSAP
- GPS II
- Hot Bird 6
- GLAST
- GeoEYE-1/OrbView V

Capabilities

Engineering

- 25 Designers and Engineers
- Electrical & Mechanical Design Capabilities
- Various CAD/CAM Capabilities
- Spectral Radiometry
- Dedicated Teams for each product line

Mechanical

- Sheet Metal Stamping and Forming
- Injection Molding
- Tool making center
- Laser etching
- NASA Certified Soldering
- Material & Component Traceability
- CNC Center

Testing

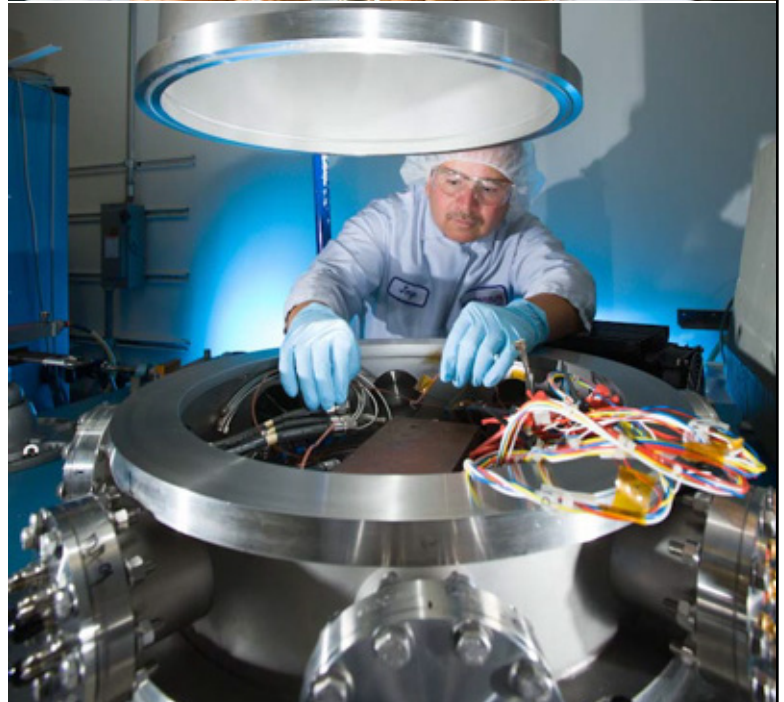
- Environmental
 - > Thermal
 - > Vacuum
 - > Humidity
- Corona
- High Power
- RF to 50 GHz

Assembly

- Lean environment
- Dedicated assembly cells
- Class 10,000 clean rooms with Class 100 flow benches

Certifications

- ISO 9001 Certified
- AS9100 Rev C
- MIL-PRF-22885 QPL
- FAA (ACSEP)
- FAA Repair Station (MMF)
- NASA-STD-8739.3
- MIL-L-85762A



RF Products

SPDT Switch



DPDT Transfer Switch



SP8T Switch



SPDT Space Product Heritage

DLT manufactures quality, reliable and high frequency SPDT switches that can operate from DC to 46 GHz with 55 dB minimum isolation. The DK series operates DC to 40 GHz and uses a K Connector. The DL series operates DC to 46 GHz and uses a 2.4 mm connector.

Program	RF Conn	Range (GHz)	RF Power (wcw)
Classified	SMA	DC - 18	1
C/NOFS	SMA	DC - 3	50
MTSAT	SMA	22.5 - 29	52
SWIFT	SMA	2.1064 - 2.2875	10
METOP	SMA	0.4 - 0.4130	
Classified	SMA	9.4 - 9.8	5W avg 15W pk
GALEX	SMA	0.1 - 10	10
International Space Station	SMA	DC-3 11 - 13	50 W 10 W
GPS	TNC	0.1 - 2.0	160
GPSII	TNC	DC - 2.0	210
MTSAT	TNC	1.68 - 1.7	104
GPSII Stop Gap	TNC	1.15 - 1.605	275
Classified	SMA	DC - 16	N/A
Classified	SMA	DC - 18.0	40 - 10

Transfer Switch Space Heritage

DLT manufactures quality, reliable and high frequency Transfer Switches that can operate from DC to 46 GHz with 55 dB minimum isolation. The TK series operates DC to 40 GHz and uses a K Connector. The TL series operates DC to 46 GHz and uses a 2.4 mm connector.

Program	RF Conn	Range (GHz)	RF Power (wcw)
MTSAT	SMA	0.10 - 2.9	26
LEO	SMA	6.9 - 9.0	10
Hot Bird-6	SMA	10.5 - 12.7	10
METOP	SMA	10.95 - 12.75	10
SWIFT	SMA	2.1064 - 2.2875	20
GLAST	SMA	2.1 - 2.3 14.8 - 15.2	20.8 55.2
SAMARITAN Mission	SMA	6.0 - 8.0	2Wavg.

All specifications are subject to change without notice. Please contact a sales representative for additional information.

Motion Control Devices

Resolvers & Variable Reluctance Resolvers (VRR)

Along with the conventional resolvers, DLT offers the variable reluctance resolvers which are highly reliable brushless resolvers without rotary transformers. Unlike conventional resolvers, the VRR has both primary and secondary windings in the stator assembly and no windings in the rotor. This offers significant advantages in price, weight and envelope dimensions thus making VRR's highly reliable for harsh environments.

Standard Resolver

- Sizes: OD 0.8 up to 13.4 inches
- Housed or Pancake and Brush or Brushless
- Single and Multi-Speed
- High accuracies (up to 5 arc seconds)
- Frequency: 400-100,000 Hz

Variable Reluctance Resolver

- Frame Sizes: OD 0.8 up to 9 inches
- Up to 30% mass reduction compared to standard resolvers
- Accuracy up to ± 6 arc minutes

Brushless DC Motor

DLT offers low cogging Brushless DC motor with cogging torque of less than 1 oz-in zero peak, low detent torque and sinusoidal back-EMF with harmonic content of less than 4%.

- Brush or Brushless
- Housed or Rotor/Stator assemblies
- With Resolver or Tachometers
- Gear heads: Harmonic Drives, Spur Gears, Planetary Gears
- Brakes and Clutches
- Standard and Custom Design

Stepper Motors

DLT offers wide variety of Stepper motors that can offer high holding torque, low cogging, small stepping angles and high pull-in torque.

- Permanent & Consistant Magnet Stepper Motors: 2, 3, and 4 phase
- Variable Reluctance (VR) Stepper Motors 2, 3, and 4 phase
- Hybrid Stepper Motors
- Unipolar or Bipolar
- Bifilar or tandem designs
- With Planetary Gear Heads or Harmonic Drive Gears, Low backlash gear heads
- Micro Steppings

Variable Reluctance Resolver



Brushless DC Motor



Stepper Motor



Space-Qualified Wire Harness Capabilities

Standard Wire Harness Capabilities

- Automated wire cutting & stripping
- Automated hot stamp marking
- Laser and ink jet marking & printing
- Automatic planetary cable winding
- Braiding (EMI shielding, protective covering)
- Cable looming and weaving
- Conformal coating using urethanes, silicones, epoxies
- Cupric and ferric etch systems
- Extensive testing capabilities
- Extrusion of tubing and cable jacketing
- High-reliability soldering & assembly
- Rubber & thermoplastic molding
- Thermoplastic injection molding
- Potting
- Welding & brazing
- Ultrasonic welding
- Vacuum bake oven
- Vacuum lamination of flex circuitry

Specialized Capabilities

- Class 100,000 Clean Room with capabilities to Class 10,000
- Micro-D connectors
- Solder station utilizing 50 x zoom vision system
- X-ray/CT Scan

Workmanship & Quality

- AS9100:2004
- ISO 9001:2000
- MIL-STDs
- ANSI
- IPC
- NADACAP certified AC7121- Cable and Harness Assemblies (Joplin, MO)
- NASA-STDs
 - > 3 NASA 8739.4 certified instructors in-house for crimp, cable & harness and hand solder
 - > 50+ certified NASA 8739.3 operators and 20+ operators certified to ANSI/J-001



ATLAS Programs

- Atlas V Harnesses
- Atlas III Harnesses
- Atlas Centaur Harnesses
- Atlas Fuel Depletion Probe CCAs
- Atlas II Fuel Probe Assembly

Space Shuttle Program

- AFT Load Controller Cables
- FWD Load Controller Cables
- MEC Master Events Ctrl
- SRB Range Safety Antennas
- SRB Hybrid Couplers

Satellite Program Examples

- APS Glory
- ASIASAT Harnesses
- BONUM 1 Satellite
- BRAZILSAT Harnesses
- Golden Gate Harnesses
- LANDSAT Flex Circuits
- SIRUS Satellite Harnesses
- TDRS Satellite Harnesses

Ducommun Miltec Space Systems/EV Testing

Ducommun Miltec Overview

Founded in April 1997, Ducommun Miltec is a leading technology provider with design, development, integration and test capabilities in the areas of Missile and Weapon Systems, Space Systems, Aviation and Security and Surveillance Technologies. In January 2006, Miltec was acquired by Ducommun, Inc, a premier provider of engineering and manufacturing services to the aerospace and defense industry.

Ducommun Miltec headquarters are located in Huntsville and the collective divisions provide extensive in-house engineering and technical assistance capabilities in all applicable areas related to defense and aerospace systems. These areas include space and homeland security systems, aerodynamics, propulsion, guidance-navigation-and control, lethality/warheads, simulation, avionics, structures, software, test and launch operations, seekers and sensors, nano-satellites, mission execution training and signal processing.

Space Systems Capabilities

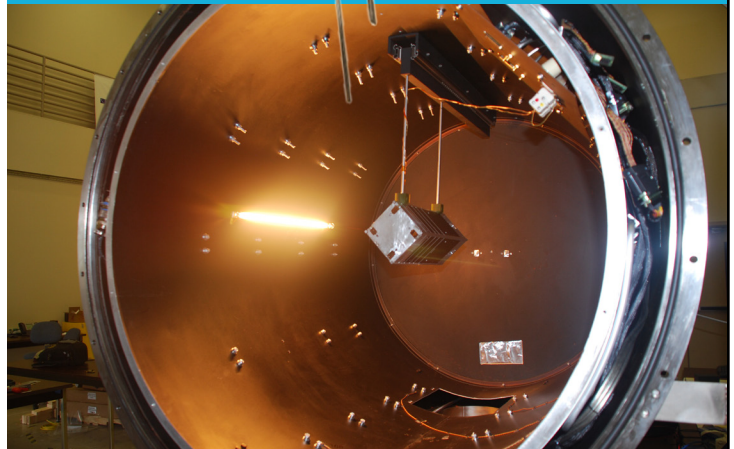
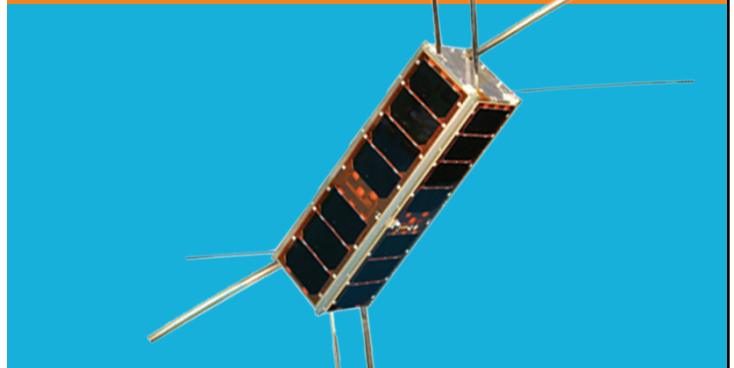
Ducommun Miltec delivers innovated solutions for our many customers via engineering services, prototype development, structures, avionics, satellites, launch vehicles, health monitoring and KV's

- Aerodynamics/CFD
- Avionics Design (Hardware/Software)
- Launch Vehicle Design
- Satellite Design
- Orbital Mechanics
- Propulsion Integration
- Structural/Thermal Analysis
- System Engineering
- System IA&T

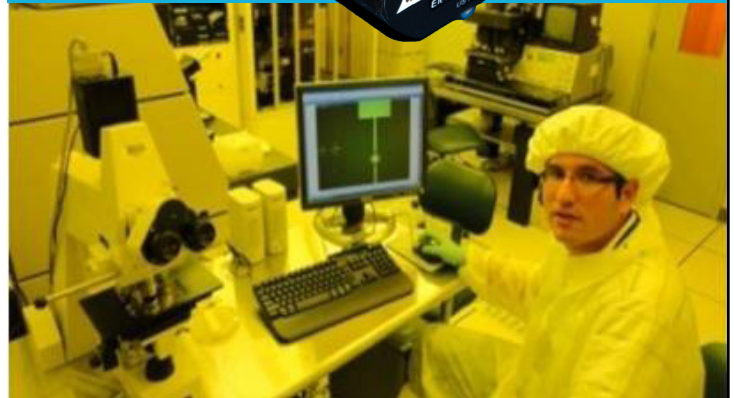
Environmental Testing Capabilities

- Comprehensive testing capabilities
- Aerodynamics/CFD
- Environmental Stress Screening (ESS)
- Vibration Testing
- Shock Testing
- Deployment Test

Nanosatellites Solution



MINI HD



For additional information about Ducommun Miltec's Capabilities please contact us at marketing@one.ducommun.com

Ducommun Incorporated

- Growing profitably to \$1 Billion
- Powered by the development and full commitment of our people
- Driving innovative solutions and services to the aerospace, defense & diverse technology-driven markets

Core Values

- Honesty
- Professionalism
- Respect
- Customer Orientation
- Continuous Improvement
- Teamwork

Ducommun Incorporated Key Drivers

- Designs, engineers and manufactures aerospace and electromechanical components and subassemblies
- Expertise in high-mix, low-volume manufacture of custom, complex, high-reliability, mission-critical products
- Broad range of capabilities in electronics and interconnects to electromechanical and high-end final assemblies
- Extensive value-added services, such as engineering and design, program management and aftermarket support
- Growth-oriented

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