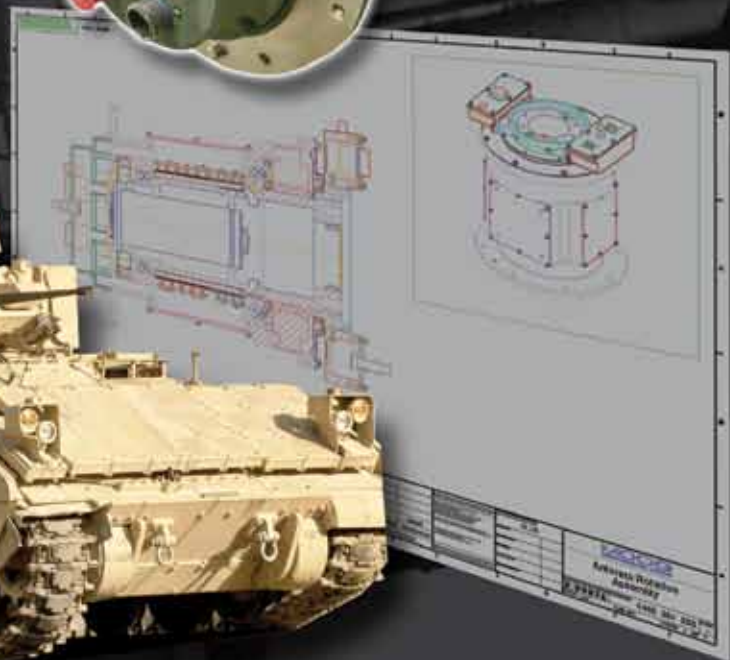


Simplifying Integration of Motion Components into Assemblies



MOOG
COMPONENTS GROUP

Motion integration at work for you



CONNECTING YOUR BUSINESS TO THE RESOURCES YOU NEED

Are you challenged by the demands for connecting a myriad of complex components in your system?

- Transferring power and data across rotating interfaces
- Requiring custom motion and control
- Optimizing system performance and data integrity
- Developing a system solution with limited in-house resources

Moog Components Group is pleased to introduce its Integrated Motion Assemblies. For over 50 years, we have provided customers with motion and power / data products in support of major military, aerospace, medical and high-end commercial and industrial applications. Our products include slip rings, twist capsules, fiber optic rotary joints, fluid rotary unions, high performance DC motors, resolvers, electromechanical actuators and multiplexers.

Moog leverages its expertise in the design and manufacture of components to a new level by offering assemblies that integrate motion and power / data conversion across a rotary interface. Partnering with us allows you the flexibility and time needed to focus on your core business: the overall system solution.

And we have taken our strategy one step further – in addition to Moog’s core products, we can also incorporate other major components including RF rotary joints, brakes, encoders and connectors into the assembly.

Think about it. Moog can provide one assembly that is readily installed into your system and is guaranteed to meet your requirements. Isn’t this better than you working out the design details, sourcing the components and assuring that everything operates correctly and repeatedly?

Moog offers you a solution.



Advantages

IT SIMPLIFIES YOUR WORKLOAD

Now, you only have to manage one assembly from one source. This assembly can be easily installed into your system. No headaches in specifying and integrating engineered components.

THE EXPERTS ARE PART OF YOUR TEAM

Moog has significant experience in producing all of the supporting components that are integrated into our motion assemblies. We perform trade studies between motion products (direct drive motors vs motors with gearing), feedback devices (resolvers vs encoders) and high data rate transfer products (slip rings vs fiber optic rotary joints).

OPTIMIZED PACKAGING

Moog has significant experience in mechanical packaging of rotary components. We ensure robustness and optimized packaging, thus ensuring minimal volume and weight requirements. We understand how our rotary components react to each other and can position these products within the assembly to optimize performance.

Flexible solutions for combining your rotary components

INTEGRATING THE COMPONENTS

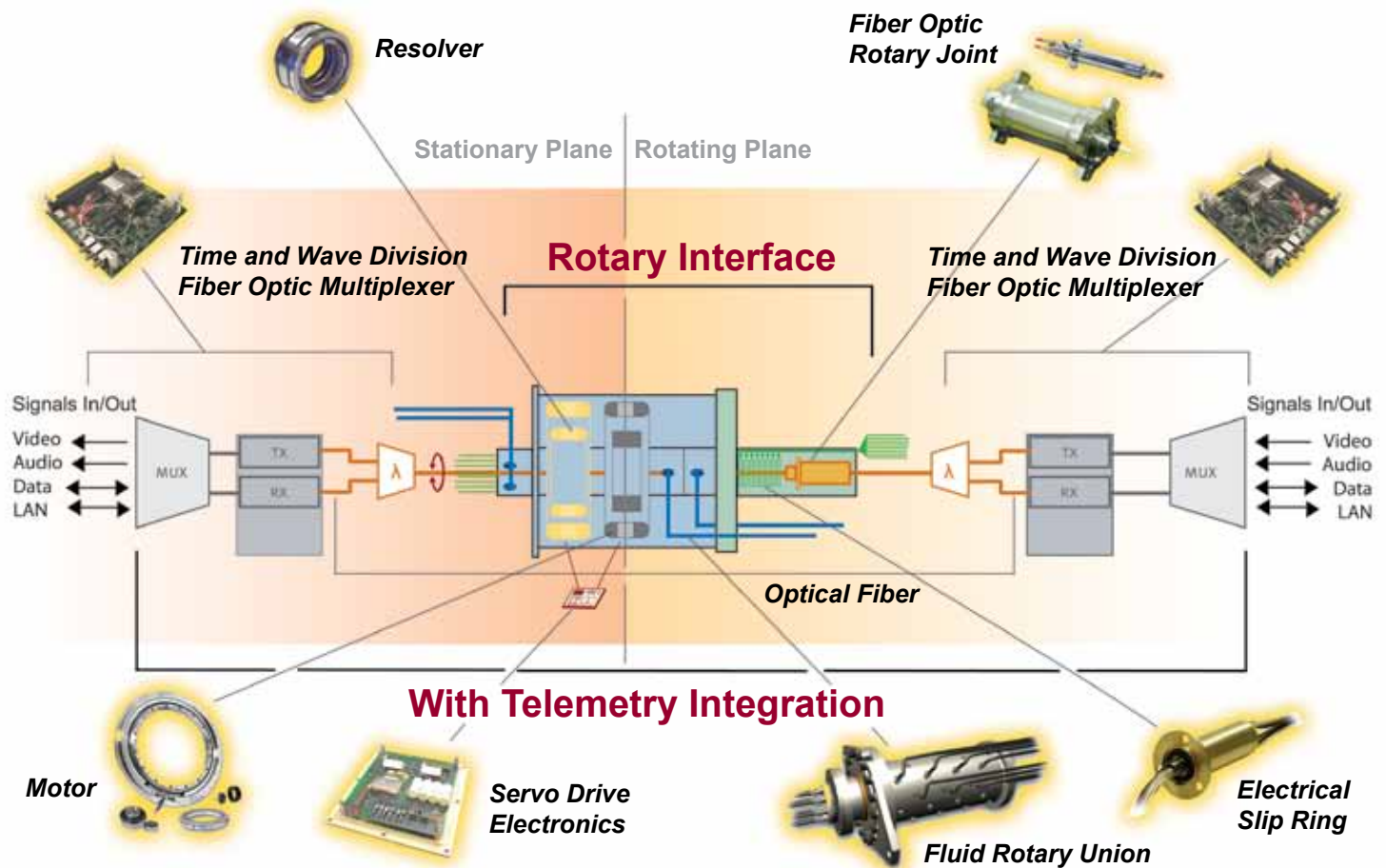
Rotary Interface

Moog can offer an integrated assembly that includes slip ring or twist capsule, fiber optic rotary joint, RF rotary joint, fluid rotary union with housing and bearings. This assures the transfer of electrical power, data, and fluid power across two rotating planes in your system. Then, if motion control is needed, we offer the motor, resolver, encoder, actuator or brake in the one unit. It can slew, track and stop where you need it.

With Telemetry Integration

We can take the rotary interface assembly and add Moog designed / manufactured data multiplexing and conversion equipment. This allows the seamless transfer of demanding video and data protocols across rotating planes thus providing the customer with a point-to-point interface. We support many protocols, including:

- DeviceNet
- ControlNet
- USB (All)
- Ethernet (10 / 100 / 1000 Base-T, CX, SX and 10 Gig-E)
- PROFIBUS
- IEEE 1394 / 1394b (Firewire)
- Fiber Channel
- RS-232
- RS-422 / 485
- CANbus
- Hotlink
- LVDS
- MIL-STD-1553
- NTSC Composite Video (SMPTE 170M)
- SMPTE 259M
- HD-SDI
 - SMPTE 372M
 - SMPTE 424
 - SMPTE 292M



Engaging the resources

ENGINEERING EXPERTISE

Moog's legacy of designing custom products, such as slip rings, fiber optic rotary joints, motors and actuators is vast, allowing us to successfully support our customers on critical programs with Integrated Motion Assemblies. Our resident technical disciplines include mechanical, electrical, electromagnetic, engineering science and mechanics, metallurgical engineering, materials science, physics and chemistry. We also have other resources to pull from including universities and Moog's other business segments.



PROJECT MANAGEMENT

Moog plans, organizes and manages the details of your project keeping within the scope, time and cost constraints that you define. This solution optimizes the allocation of all resources (parts and suppliers) and minimizes risk. Moog has a dedicated program management team that we can assign to your project.

MANUFACTURING

Moog Components Group has seven major sites located in three countries. These sites include all support staff, engineering, production control, purchasing and quality assurance to ensure the seamless transition from design to prototyping to qualification to production. Many sites have model shops to support prototype builds. We also maintain extensive in-house machining capabilities for quick-turn, as well as qualified out-source facilities to manage production quantities. We operate several cellular manufacturing areas for like-process builds. We also have chemical plating at various sites that allows us to maintain control of these critical processes.

Our sites have dedicated facilities and resources that build Integrated Motion Assemblies. These resources include highly-skilled people, special processes and equipment that focus on these assemblies. The support staff is located in the same site to facilitate high productivity.

GLOBAL SOURCING

Moog has extensive resources to allow proper sourcing of material and sub-assembly work. We have decades of experience with offshore assembly and vendor management. We have established partnerships with several companies that parallel some of our in-house processes. Moog supplies training, materials and tooling for each process and then audits that process to ensure integrity. This global sourcing supports business growth while effectively managing cost and overhead.

Partnering for success

BUILD TO PRINT

Moog is able to take the documentation of your proven system and provide you with an Integrated Motion Assembly. We can manage existing suppliers, accomplish the manufacturing and assembly, and test / inspect to your requirements.

BUILD TO SPEC

Another alternative is build-to-spec which allows Moog to leverage its complete engineering, manufacturing and cost-effective purchasing capabilities to support the development and manufacturing of the assembly to your specifications. Now you have a robust solution with optimum performance and packaging.

CUSTOM SOLUTIONS

Moog understands that your unique applications can require a custom solution that is developed from a clean sheet of paper. We are eager to work with you to define requirements, architecture, test and inspection, and manufacturing methodologies. This innovative partnering and open dialogue allows us to support your vision in providing compliant hardware.

QUALITY, TEST AND INSPECTION

The quality of the integrated assembly is a critical consideration in each step of the manufacturing process. Moog consistently delivers high quality hardware to our customers. We are AS9100 certified and have a dedicated team of quality engineers who work together to make sure each product meets specifications and on-time delivery.



Moog has the ability to support environmental screening, including vibration, shock, temperature and humidity testing. We have the ability to perform mechanical and electrical test / inspection and utilize automated test stands to support production jobs. Moog's team is trained to employ Six Sigma tools to evaluate in-process and final test results and can generate and monitor process behavior charts to ensure meeting critical performance parameters.

Moog also has test and analysis equipment to verify major critical parameters including electrical noise, material strength and composition, and tribological properties. Our ability to detect and correct problems is greatly enhanced with this equipment and knowledge.

Successful solutions

CHALLENGE:

Customer needed a complete azimuth drive assembly that supports a 900 lb cruise missile defense radar under a tethered balloon. The assembly must support the transfer of power and data and control the radar in the azimuth axis.

SOLUTION:

Moog designed and built the azimuth drive assembly that integrated power and data slip rings, two-channel fiber optic rotary joint, direct drive motor, resolver and a motion controller in a specially designed housing with bearings. This assembly was designed to control a 900 lbm, 300,000 lb-in² suspended load between rest and 30 RPM.



CHALLENGE:

Customer needed a two-axis mechanical gimbal assembly that can be slewed and pointed at an incoming threat. It must meet airborne environment requirements and have minimum space and weight.

SOLUTION:

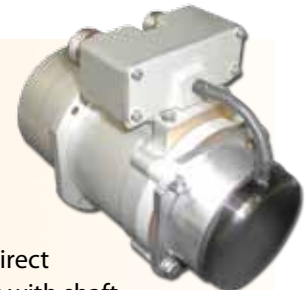
Moog provided integrated assemblies that integrated motors, resolvers and slip rings into custom structures with bearings and seals. The solution met all requirements of minimal slew time with a combined mass of less than 20 lbs while operating in various airborne environments.

CHALLENGE:

Customer required drive assembly for integration into two major flight control surface actuation systems for a commercial aircraft system.

SOLUTION:

Moog designed and supplied complete assemblies that included a high performance direct drive DC brushless motor, resolver, and brake integrated into a robust, yet light housing with shaft. Moog was able to minimize space and weight by designing the motor's magnetic field as part of the output shaft assembly.



Successful solutions



CHALLENGE:

Customer needed to ensure system performance and high reliability of the flight control surfaces for a High Altitude Long Endurance Unmanned Aerial Vehicle (UAV). The UAV can be deployed for days at a time at altitudes up to 65,000 feet so temperature variation was critical for design.

SOLUTION:

Moog provided its standard 150 in-lb rated rotary electromechanical servo actuator and developed a thermal management system that detects the cold temperature environment (as low as -85° C). The actuator employs a fully integrated servo controller and film potentiometer position feedback along with a high reliability stainless steel gear train. The thermal system and integrated heater circuit allows operation at 100% of performance through all operating extremes.

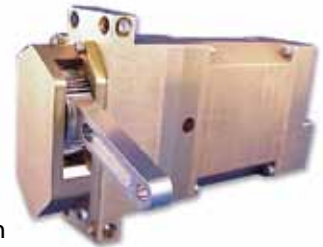


CHALLENGE:

Customer needed to rapidly develop a higher reliability, digital interface source for servoactuators on a tactical class UAV. The actuators are a drop-in replacement on all flight control surfaces and improve environmental and EMI performance.

SOLUTION:

Moog responded with a single design DSP-based control design that moves flaps, aileron and ruddervator positions despite the varying loads. Because the aerodynamic loads are doubled at several positions on the vehicle, Moog developed a second stage bolt-on gearbox that doubles the output torque from 50 to 100 in-lbs. This allows the use of the same basic configuration at multiple positions. Moog also designed a highly reliable solid state solution for position feedback utilizing an magnetic encoder.



CHALLENGE:

Continue to offer our customer a Build to Print (BTP) capability for ongoing support of the CH-47 program. Moog has been working with our prime customer and the US Army user for more than 20 years on this program.

SOLUTION:

While providing several different dash numbers of a baseline design, Moog has assumed responsibility for managing and maintaining a supply source for these trim actuators. The 145C6100-4 is used to trim the longitudinal axis of the flight controls. It is controlled by the AFCS TRIM switches on the pilot and co-pilot cyclic control sticks. A servomotor is incorporated for flight director coupling in the longitudinal axis. There are two CCDAs installed in the CH-47F aircraft: 145C6100-3 for the collective and 145C6100-4 for the longitudinal axis. In addition to ongoing responsibility for multi-year support, Moog has also recently conducted a full-up environmental re-qualification of these units. The results of our efforts allows us to offer our customer recommendations for design enhancement and any changes for continued compliance.



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