HIGH PERFORMANCE MOTION CONTROL FOR MEDICAL APPLICATIONS

The Medical Industry

WHEN PERFORMANCE REALLY MATTERS®
The medical market is a market in motion – both literally and figuratively. With the Baby Boomers reaching retirement age and technology advancing almost exponentially, this is an exciting market for companies that supply components and assemblies into medical applications. The marketplace is vast with products ranging from simple syringes and disposables to complex diagnostic machinery such as CT scanners and MRI equipment. Embedded in the overall market are many sub-markets that require motion components. Partner with Moog for our medical device design experience and knowledge of FDA process.

Typical applications include:

• Medical centrifuges
• CT scanner, MRI and diagnostic equipment
• Airway clearance therapy
• Patient lifts, patient beds and mobility equipment
• Oxygen concentration and generation equipment
• Medical pumps, blowers and compressors
• Surgical instruments – saws and drills
• Blood / fluid analysis (human / vet)
• Surgical suite cooling / ventilation / UV sterilization
• Powered air-purifying respirator (PAPR) systems
• Surgical lamps and monitoring (4K)
• Surgical robotics
DESIGNING EXCEPTIONAL ACCURACY IN MEDICAL APPLICATIONS

Our product offering for medical applications features advanced proprietary technology and innovative designs that deliver unparalleled accuracy and reliable performance in a variety of medical applications.

Motors
Silencer® series brushless DC motors offer these advantages and more. With a broad array of offerings (seven base frame sizes, high speed, high efficiency and high power versions, inside and outside rotor versions, drive electronics, optional gearheads, brakes, encoders), Moog is well positioned to provide solutions to various medical applications by combining our expertise in air moving solutions with our innovative motor technology. Our BSG23 motor was specifically designed to meet the requirements for portable oxygen therapy devices.

Fully Integrated Servos
Moog Animatics’ SmartMotor™ is a fully integrated servo capable of being a master controller to both other SmartMotor™ servos and other devices, often becoming a replacement to PLCs or other controllers in a system. If the SmartMotor™ is added to an existing system as an extension to a machine design, it may only require minimal hand shaking with the main controller while independently maintaining its own subsystem control. The SmartMotor™ offers flexibility and maximum capabilities while reducing costs and build time, thanks to a minimal need for programming and wiring.

Air Moving Blowers
Combining our expertise in thermal management with our innovative motor technology, Moog has expanded options for solving difficult thermal, airflow, acoustic, weight, cubic space and efficiency problems. As an optimum choice for each application, we are offering tailored airflow products that are designed using off-the-shelf components to provide a cost effective solution without compromising performance. We are dedicated to providing our customers with efficient, high-quality and on-target solutions.

Slip Rings
As a world leader in slip ring design and manufacturing, Moog is well positioned to work closely with medical device manufacturers to integrate slip rings into their designs. Our slip rings are maintenance-free and have the highest possible safety, e.g., for the endless rotating transmission of video data (4K). Both as a standard series, but also customer-specific. In small and large series.

Fiber Optic Rotary Joints
Fiber Optic Rotary Joints (FORJs) are to optical signals what electrical slip rings are to electrical signals, a means to pass signals across rotating interfaces, particularly when transmitting large amounts of data. FORJs maintain the intrinsic advantages of fiber end to end.

Rotary Unions
Moog’s high advanced rotary unions are specially designed to fulfill the requirements of the medical industry as for the use in cleanroom environment. We use sealing technologies that have proven their worth for decades. Our rotary unions meets the highest demands in terms of accuracy and reliable transmission of media such as water, gas, vacuum, emulsion, oil and more.

Market / Product Offering

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<td>Optical Coherence Tomography (OCT)</td>
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<td>Patient beds, wheelchairs and other aids</td>
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<td>Respiratory care (oxygen concentrators, ventilators, cough assist)</td>
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<td>Surgical care systems</td>
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<td>Surgical lamps and monitoring (4K)</td>
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<td>Surgical robotics</td>
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<td>Surgical suite cooling / ventilation / UV sterilization</td>
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**MOTOR ADVANTAGES**

Motors for typical medical applications, particularly portable ones, are required to be:

- Efficient
- Quiet
- Reliable - long life
- Arcless - produces no sparks or arcing in normal operation
- High power density - high torque / cost / size ratio
- Precision rotor balance
- High speed (centrifuge, saw and drill applications)

**INTEGRATED SERVO ADVANTAGES**

Brushless DC servo motor (with optional brake), combined with feedback (encoder), controller, memory, power amplifier, logical I/O, and communications network:

- Fully integrated into a compact unit that’s easy to install and use
- Reduces cable complexity
- Reduces machine replication time and costs
- Reduces programming time
- Simplifies field service
- Adding additional axes to existing machines is easy

**AIR MOVING BLOWER ADVANTAGES**

The Moog AirMax™ series of blowers and tailored air moving products for medical applications offer:

- High power density (more airflow at pressure per unit volume)
- High efficiency brushless DC motors (no arcs / sparks during commutation)
- Integrated drive electronics with speed control and alarm options
- Wide variety of input voltages AC and DC
- Precision dynamic balance for low vibration
- Reliable - long life ball bearings
- Low noise operation

**SLIP RING ADVANTAGES**

Slip rings in medical applications feature the following:

- Hybrid slip ring design to offer high quality slip rings as cost effective solution
- Fiber brush technology with long maintenance-free life and minimal wear debris, 30 million rev or three year maintenance free brush technology
- Low audible noise for overall quieter mechanical system operation
- Optical channels for high-speed data communications (fiber optic rotary joints), off axis, EMI immune optical channel to support high speed data communication up to 10 Gbps including bidirectional
- High circuit density and compact design
- Non contacting data link to support up to 40 Gbps data rate on single axial plane
- Technology build for future upgrade with no mechanical change to gantry size
- Large bore designs with an inside diameter up to 70 inches (1778 mm)

**FIBER OPTIC ROTARY JOINT ADVANTAGES**

Key attributes:

- Low insertion loss and rotational variation
- Optimized for wavelengths used for medical optical imaging
- Ultra-low back reflection
- High rotational speeds
- Can be combined into integrated and customized fiber optic rotary joint / BN series motor / resolver packages
- Immunity against Electro-Mechanical Interference (EMI), Radio Frequency (RF) and electrical noise

Key specifications:

- 1.5 dB max insertion loss, includes 0.5 dB maximum rotational variation
- Better than 40 dB return loss
- 1,000 rpm, contact factory for higher speeds

**ROTARY UNION ADVANTAGES**

Rotary unions are required for the transfer of media between stationary and rotating machine parts in many medical applications.

- High plant availability
- Increased production rates through innovative, advanced technology
- No component exchange when using different media
- Combined systems possible: rotary union + slip ring + FORJ
## PRODUCT SPECIFICATIONS

### Motors

<table>
<thead>
<tr>
<th>Motors</th>
<th>Diameter inches (mm)</th>
<th>Length inches (mm)</th>
<th>Volts VDC</th>
<th>Rated Torque oz-in (Nm)</th>
<th>Speed rpm</th>
<th>Power watts</th>
<th>Features / Benefits</th>
</tr>
</thead>
</table>
| *BN12, 17, 23, 28, 34, 42* | 1.2 to 4.2 (30.48 to 105.66) | 1.3 and 5.5 (33.02 and 137.7) | 12 to 100 | Up to 419 (2.96) | Up to 35,000 | Up to 874 | • Our flagship brushless DC motor series  
• Low noise  
• High efficiency  
• Available in multiple speed and torque variations |
| BN34HS | 3.4 (86.36) | 2.5 and 3.5 (63.5 and 88.9) | 24, 50 and 100 | Up to 78 (0.5508) | Up to 14,000 | Up to 591 | • High speed, low noise in a larger frame size motor  
• Ideal for larger centrifuge applications |
| BS17HP | 1.7 (38.2) | 1.5 - 2 (38.2 - 50.9) | 12, 24 and 48 | 14 - 20 | 2760 - 6180 | 37 - 91 | • High energy sintered neodymium magnets  
• High efficiency  
• B pole inside rotor construction  
• Compact size |
| BSG23 | 2.25 (57.15) | 1.9 and 2.8 (48.26 and 71.12) | 12, 24 and 48 | Up to 114 (0.8050) | Up to 15,000 | Up to 170 | • Very high torque and efficiency  
• Low noise  
• Ideal for oxygen therapy equipment |

### Frameless Part Sets

*Most BN series motors are available as frameless part sets. Frameless part sets are economical and allow the end user to seamlessly integrate into their assemblies.*

### Integrated Servo Motors

<table>
<thead>
<tr>
<th>Integrated Servo Motors</th>
<th>Diameter inches (mm)</th>
<th>Length inches (mm)</th>
<th>Volts VDC</th>
<th>Rated Torque oz-in (Nm)</th>
<th>Speed rpm</th>
<th>Power watts</th>
<th>Features / Benefits</th>
</tr>
</thead>
</table>
| SmartMotor™ | Up to 3.4 (86.36) | 2.3 - 6.89 (58.42 - 175.01) | 24 to 48 | Up to 261 (1.84) | Up to 10,400 | Up to 925 Peak | • Highly compact, fully integrated design  
• Programmable, can be a machine controller  
• Low electrical noise emissions |

### Air Moving Blowers

<table>
<thead>
<tr>
<th>Air Moving Blowers</th>
<th>Size inches (mm)</th>
<th>Pressure inches (cm)</th>
<th>Flow cfm (lpm)</th>
<th>Voltage</th>
<th>Speed Control / Tach</th>
<th>Features / Benefits</th>
</tr>
</thead>
</table>
| P28 | 5 dia. x 2.3 (127 x 58.42) | Up to 28 (71) H2O | Up to 50 (1416) | DC 12 - 24 Volts | 0 - 5 or 0 - 10 Volts speed control  
Open collector Tach out 2 ppr | • Internal or external drive electronics  
• High efficiency 3-phase brushless DC motor  
• Low noise  
• High efficiency  
• Integrated electronics with customizable system interface  
• High power density  
• High pressure |
| P45 | 3.15 dia. x 2.1 (80.01 x 51.4) | Up to 54 (138) H2O | Up to 25 (708) | DC 24 Volts | 0 - 5 Volts speed control  
Open collector Tach out 2 ppr |
<table>
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<tr>
<th>Slip Rings</th>
<th>Circuits</th>
<th>Through-bore inches (mm)</th>
<th>Current amp</th>
<th>Voltage VAC</th>
<th>Operational Speed rpm</th>
<th>Features / Benefits</th>
</tr>
</thead>
</table>
| AC4598 / AC6200 | Ethernet plus, 2 amp signal and 10 amp power | 1.5 (38.1) | Up to 25 | 600 | Up to 250 standard, options up to 1,000 | • Compatible with data bus protocols  
• Maintenance-free operation  
• Continuous 360° rotation of power or data signals |
| AC7203 | Ethernet plus, 2 amp, 5 amp and 10 amp | No | 2 to 10 | 240 (On power circuits) | Up to 250 | • Fully compliant with IEEE 802.3 formats  
• Sealing to dust and light fluids splash available  
• Compact |
| SRA-73540 / SRA-73799 | 6, 12, 18, with Ethernet options | No | 2 | 120 VAC | Up to 250 | • Gold-on-gold contacts  
• Mounting flange on housing  
• Flexible, color-coded, silver-plated, stranded copper lead wire  
• Superior handling of low level control signals |
| EC3848 | Up to 10 (2, 6, 8 and 10) | No | 1 | Low millivolt range to 100 VDC | 0 - 10,000 | • Speeds up to 10,000 rpm without cooling  
• 2, 6, 8 and 10 circuit models  
• Precision ball bearings  
• 1 amp / 100 VDC circuits  
• Precious metal contacts |
| F 7154 B | Up to 5 | 1.968 (50) | 12 | 50 V | 20 | • Free cable or customized connectors  
• Housing in Pa66 UL  
• Maintenance free |
| F 5220 | 10 (4x power, 6x signal) | 3.157 (80.2) | 12 | 25 V | 30 | • Maintenance free  
• Complies with medical standards  
• Housing in Pa66 UL |
| F 5426 A | 9 (4x power, 2x signal, 3x video) | No | 6 | 20 V | 15 | • Maintenance free  
• Complies with medical standards  
• Incl. connectors  
• RoHS compliant |
| Platter Style Slip Ring | Moog patented hybrid slip ring design available with optical and non-contacting data link | Yes | 300 | 480 AC or 1,000 DC | 300 | Optical single channels available with data rates up to 5 Gbps.  
Non-contacting data link to support up to 40 Gbps data rate on single axial plane. |
# PRODUCT SPECIFICATIONS

<table>
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<tr>
<th>Fiber Optic Rotary Joints</th>
<th>Insertion Loss</th>
<th>Maximum Rotational Speed rpm</th>
<th>Operating Temperature</th>
<th>Size inches (mm)</th>
<th>Features / Benefits</th>
</tr>
</thead>
</table>
| 206                       | 1.5 dB         | 1000                          | -40 to +60°C          | Minimum length: 2.36 (59.94) Flange diameter: 1.50 (38.10) Drum diameter: 0.77 (19.55) | • Provides rotary coupling for a singlemode fiber link  
• Passive bidirectional device  
• Stainless steel housing |

<table>
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<tr>
<th>Rotary Unions</th>
<th>Media</th>
<th>Speed rpm</th>
<th>Temperature</th>
<th>Size inches (mm)</th>
<th>Features / Benefits</th>
</tr>
</thead>
</table>
| M35 L2+S3-I   | 1x nitrogen at 3 bar (43.5 psi); 1x vacuum at 0.1 bar (14.5 psi); 1x medical infusion at 3 bar (43.5 psi) | Max 15 | Up to 150°C | Length: 7.87 (200) Outer diameter: 5.62 (143) Shaft diameter: 1.57 (40) | • Cip / Sip capable  
• Designed without deadspace  
• Integrated cleaning and sterilization channels  
• Certified according to FDA and UPS CL6 |

<table>
<thead>
<tr>
<th>Combination Rotary Union, Slip Ring and FORJ</th>
<th>Rotary Union</th>
<th>Slip Ring</th>
<th>Fiber Optic Rotary Joint</th>
<th>Speed rpm</th>
<th>Features / Benefits</th>
</tr>
</thead>
</table>
| ROTOKOMBI                                   | 2 x water / glycol at 15 bar | 6 x power max 60 amp 8 x signal 24 V 1 x CAN Bus | 1 x optical channel max 30 Gbit/s | Max 40 | • Integrated cooling channels  
• Long service life  
• High-speed data transmission up to 30 Gbit/s |
Moog designs a range of motion control products to complement those featured in this document. Moog also provides service and support for all our products. For more information, contact the Moog facility closest to you.

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Moog Medical Various Products Market Brochure
MCM/Rev-. July 2021, Id. CDL63405-en

For product information, visit www.moog.com

This technical data is based on current available information and is subject to change at any time. Specifications for specific systems or applications may vary.