



# HIGH PERFORMANCE MOTION CONTROL FOR MEDICAL APPLICATIONS

The Medical Industry

WHEN PERFORMANCE REALLY MATTERS®

**MOOG**

# MOTION CONTROL SOLUTIONS WHEN PERFORMANCE 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

Market	Motors	Fully Integrated Servos	Air Moving Blowers	Slip Rings	Fiber Optic Rotary Joints	Rotary Unions
Blood collection, processing and therapy	•	•	•	•		•
Blood / fluid analysis (human / vet)	•	•	•	•		
Critical care technologies	•		•			•
CT technology		•		•	•	•
Dialysis equipment	•					
Hospital ventilators	•	•	•			
Medical centrifuge	•	•		•		•
Optical Coherence Tomography (OCT)					•	
PAPR devices	•					
Patient beds, wheelchairs and other aids	•		•			
Respiratory care (oxygen concentrators, ventilators, cough assist)	•		•			
Surgical care systems	•		•	•		
Surgical lamps and monitoring (4K)	•		•	•		
Surgical robotics		•		•		•
Surgical suite cooling / ventilation / UV sterilization	•		•	•		

# WORLD-CLASS PERFORMANCE IN EVERY PRODUCT

## 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

## 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

## 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 (1,778 mm)

## FIBER OPTIC ROTARY JOINT ADVANTAGES





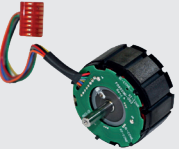
Key attributes:


- 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

# PRODUCT SPECIFICATIONS



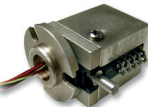
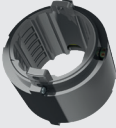



Motors	Diameter inches (mm)	Length inches (mm)	Volts VDC	Rated Torque oz-in (Nm)	Speed rpm	Power watts	Features / Benefits
*BN12, 17, 23, 28, 34, 42 	1.2 to 4.2 (30.48 to 105.66)	1.3 and 5.5 (33.02 and 137.7)	12 to 100	Up to 419 (2.96)	Up to 35,000	Up to 874	<ul style="list-style-type: none"> <li>• Our flagship brushless DC motor series</li> <li>• Low noise</li> <li>• High efficiency</li> <li>• Available in multiple speed and torque variations</li> </ul>
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	<ul style="list-style-type: none"> <li>• High speed, low noise in a larger frame size motor</li> <li>• Ideal for larger centrifuge applications</li> </ul>
BS17HP 	1.7 (38.2)	1.5 - 2 (38.2 - 50.9)	12, 24 and 48	14 - 20 (0.0989 - 0.1412)	2,760 - 6,180	37 - 91	<ul style="list-style-type: none"> <li>• High energy sintered neodymium magnets</li> <li>• High efficiency</li> <li>• 8 pole inside rotor construction</li> <li>• Compact size</li> </ul>
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	<ul style="list-style-type: none"> <li>• Very high torque and efficiency</li> <li>• Low noise</li> <li>• Ideal for oxygen therapy equipment</li> </ul>
Frameless Part Sets 	<p><b>*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.</b></p>						

Integrated Servo Motors	Diameter inches (mm)	Length inches (mm)	Volts VDC	Rated Torque oz-in (Nm)	Speed rpm	Power watts	Features / Benefits
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	<ul style="list-style-type: none"> <li>• Highly compact, fully integrated design</li> <li>• Programmable, can be a machine controller</li> <li>• Low electrical noise emissions</li> </ul>


Air Moving Blowers	Size inches (mm)	Pressure inches (cm)	Flow cfm (lpm)	Voltage	Speed Control / Tach	Features / Benefits
P28 	5 dia. x 2.3 (127 x 58.42)	Up to 28 (71) H2O	Up to 50 (1,416)	DC 12 - 24 Volts	0 - 5 or 0 - 10 Volts speed control Open collector Tach out 2 ppr	<ul style="list-style-type: none"> <li>• Internal or external drive electronics</li> <li>• High efficiency 3-phase brushless DC motor</li> <li>• Low noise</li> <li>• High efficiency</li> </ul>
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	<ul style="list-style-type: none"> <li>• Integrated electronics with customizable system interface</li> <li>• High power density</li> <li>• High pressure</li> </ul>




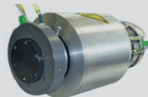
# PRODUCT SPECIFICATIONS

Slip Rings	Circuits	Through-bore inches (mm)	Current amp	Voltage VAC	Operational Speed rpm	Features / Benefits
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	<ul style="list-style-type: none"> <li>• Compatible with data bus protocols</li> <li>• Maintenance-free operation</li> <li>• Continuous 360° rotation of power or data signals</li> </ul>
AC7203 	Ethernet plus, 2 amp, 5 amp and 10 amp	No	2 to 10	240 (On power circuits)	Up to 250	<ul style="list-style-type: none"> <li>• Fully compliant with IEEE 802.3 formats</li> <li>• Sealing to dust and light fluids splash available</li> <li>• Compact</li> </ul>
SRA-73540 / SRA-73799 	6, 12, 18, with Ethernet options	No	2	120 VAC	Up to 250	<ul style="list-style-type: none"> <li>• Gold-on-gold contacts</li> <li>• Mounting flange on housing</li> <li>• Flexible, color-coded, silver-plated, stranded copper lead wire</li> <li>• Superior handling of low level control signals</li> </ul>
EC3848 	Up to 10 (2, 6, 8 and 10)	No	1	Low millivolt range to 100 VDC	0 - 10,000	<ul style="list-style-type: none"> <li>• Speeds up to 10,000 rpm without cooling</li> <li>• 2, 6, 8 and 10 circuit models</li> <li>• Precision ball bearings</li> <li>• 1 amp / 100 VDC circuits</li> <li>• Precious metal contacts</li> </ul>
F 7154 B 	Up to 5	1.968 (50)	12	50 V	20	<ul style="list-style-type: none"> <li>• Free cable or customized connectors</li> <li>• Housing in Pa66 UL</li> <li>• Maintenance free</li> </ul>
F 5220 	10 (4x power, 6x signal)	3.157 (80.2)	12	25 V	30	<ul style="list-style-type: none"> <li>• Maintenance free</li> <li>• Complies with medical standards</li> <li>• Housing in Pa66 UL</li> </ul>
F 5426 A 	9 (4x power, 2x signal, 3x video)	No	6	20 V	15	<ul style="list-style-type: none"> <li>• Maintenance free</li> <li>• Complies with medical standards</li> <li>• Incl. connectors</li> <li>• RoHS compliant</li> </ul>
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	<p>Optical single channels available with data rates up to 5 Gbps.</p> <p>Non-contacting data link to support up to 40 Gbps data rate on single axial plane .</p>

# PRODUCT SPECIFICATIONS

Fiber Optic Rotary Joints	Insertion Loss	Maximum Rotational Speed rpm	Operating Temperature	Size inches (mm)	Features / Benefits
206 	1.5 dB	1,000	-40 to +60°C	Minimum length: 2.36 (59.94) Flange diameter: 1.50 (38.10) Drum diameter: 0.77 (19.55)	<ul style="list-style-type: none"> <li>Provides rotary coupling for a singlemode fiber link</li> <li>Passive bidirectional device</li> <li>Stainless steel housing</li> </ul>

Rotary Unions	Media	Speed rpm	Temperature	Size inches (mm)	Features / Benefits
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)	<ul style="list-style-type: none"> <li>Cip / Sip capable</li> <li>Designed without deadspace</li> <li>Integrated cleaning and sterilization channels</li> <li>Certified according to FDA and UPS Cl.6</li> </ul>

Combination Rotary Union, Slip Ring and FORJ	Rotary Union	Slip Ring	Fiber Optic Rotary Joint	Speed rpm	Features / Benefits
ROTOKOMBI 	2x water / glycol at 15 bar	6x power max 60 amp 8x signal 24 V 1x CAN Bus	1x optical channel max 30 Gbit/s	Max 40	<ul style="list-style-type: none"> <li>Integrated cooling channels</li> <li>Long service life</li> <li>High-speed data transmission up to 30 Gbit/s</li> </ul>

# MORE PRODUCTS. MORE SUPPORT.

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.

## North America

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Moog Medical Various Products Market Brochure  
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For product information, visit

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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.