Motion Technology Catalog

Slip Rings • Fiber Optic Rotary Joints • Multiplexers • Fluid Rotary Unions

MOOG
COMPONENTS GROUP

Your work demands the right moves.

Moog Components Group is an innovative motion technology company with unique design and manufacturing capabilities for electromechanical and fiber optic products. Founded over 50 years ago, the company's original vision was to become a research and development business offering new technologies for the emerging inertial navigation marketplace for aircrafts. Quickly, it evolved into a manufacturing operation where the designs were crafted into products that were in high demand.

Moog Components Group has a legacy for providing high-quality products used in critical defense and space applications. Over the years, this foundation has expanded to a broad spectrum of industrial markets, including medical, automation, marine and communications. The company is ISO certified and utilizes world-class manufacturing concepts, including Six-Sigma and Lean Manufacturing, to allow the company to produce the highest quality products at competitive prices.

Today, Moog Components Group's core business is motion. Product lines include slip rings, fiber optic rotary joints, motors, resolvers, actuators, fluid rotary unions, fiber optic components and air moving systems. There are seven manufacturing operations with locations in Virginia (Blacksburg and Galax), North Carolina (Murphy), Pennsylvania (Springfield), Canada (Halifax), England (Reading) and Florida, (Naples) with over 1,800 employees worldwide.

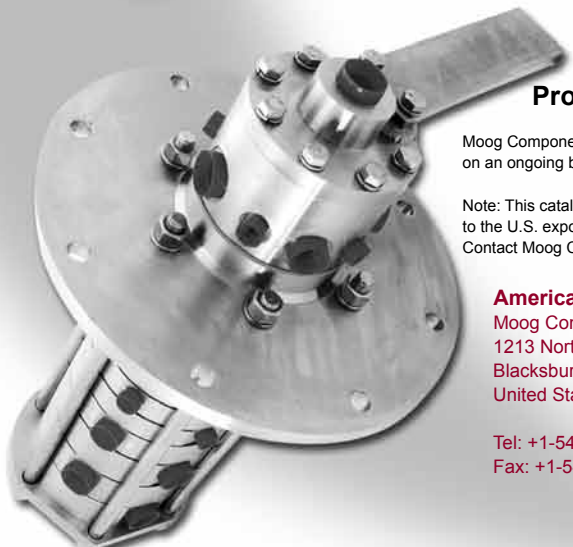
Moog Components Group offers standard and customer-specific solutions for industrial, medical, marine, aerospace and defense applications. More information about Moog Components Group is available at www.moog.com/components.

"Our success is attributed to the ideas, skills and dedication of our employees. These individuals have conquered new markets and built a company that today has a diverse portfolio of applications. With recent acquisitions, our slip ring and fiber optic product lines have expanded and we have evolved into new markets. Now our customers have one company for all their motion solutions - Moog Components Group."

- Larry Ball, President

We have the motion solutions.

Motion Technology Catalog Index



Moog Components Group parts comply with EU Directive 2002/95/EC (Restriction of Hazardous Substances). A product listing will be updated on an ongoing basis. If you are interested in a product list, please visit our website at: www.moog.com/components.

Note: This catalog contains basic marketing information and general part descriptions of Moog Components Group product lines. With respect to the U.S. export regulations, the products described herein are controlled by the U.S. Commerce Department or the U.S. State Department. Contact Moog Components Group for additional detail on the export controls that are applicable to your part.

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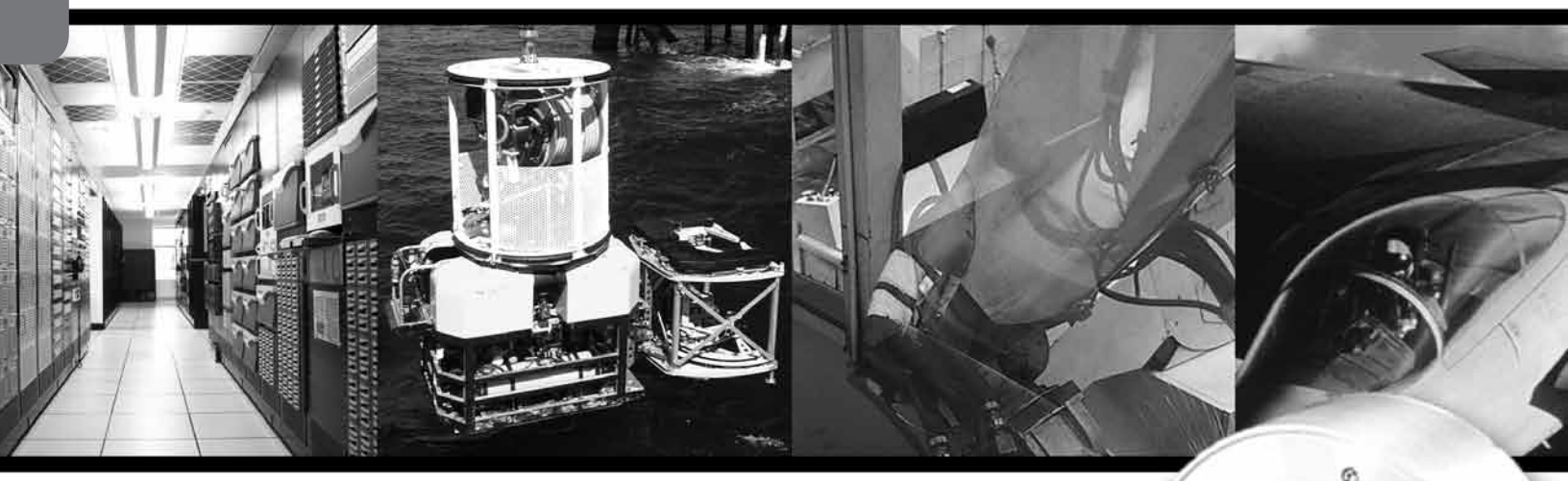
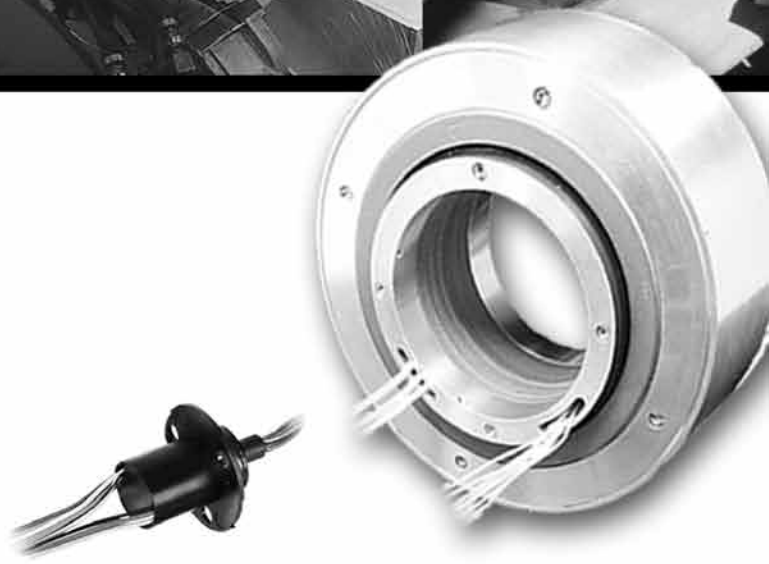
We have your motion application solutions.





Typical Applications

Aerospace / Defense
- Armored vehicle turrets, IR and EO systems
- Missile seeker gimbals and inertial systems
- Helicopter de-ice systems, EO / IR trackers and target systems
- Fixed-wing aircraft - EO / IR trackers, fire control systems, surveillance systems and targeting systems
- Missile counter measures
- Space - solar array mechanisms
- Shipboard / submersible - navigation systems and fire control radar
- Surveillance systems

Industrial
- Medical equipment and devices
- Robotics
- Index tables
- Semiconductor handling
- Pan tilt cameras
- Packaging and processing equipment
- Cable reels
- Wind energy
- CT scanners

Marine
- Remote operated vehicles (ROV)
- Seismic surveying
- Oceanographic winches
- Subsea communications and control
- Floating production, storage and offshore loading (FPSO)
- Diving
- Marine instrumentation
- Downhole / wirelogging and drilling

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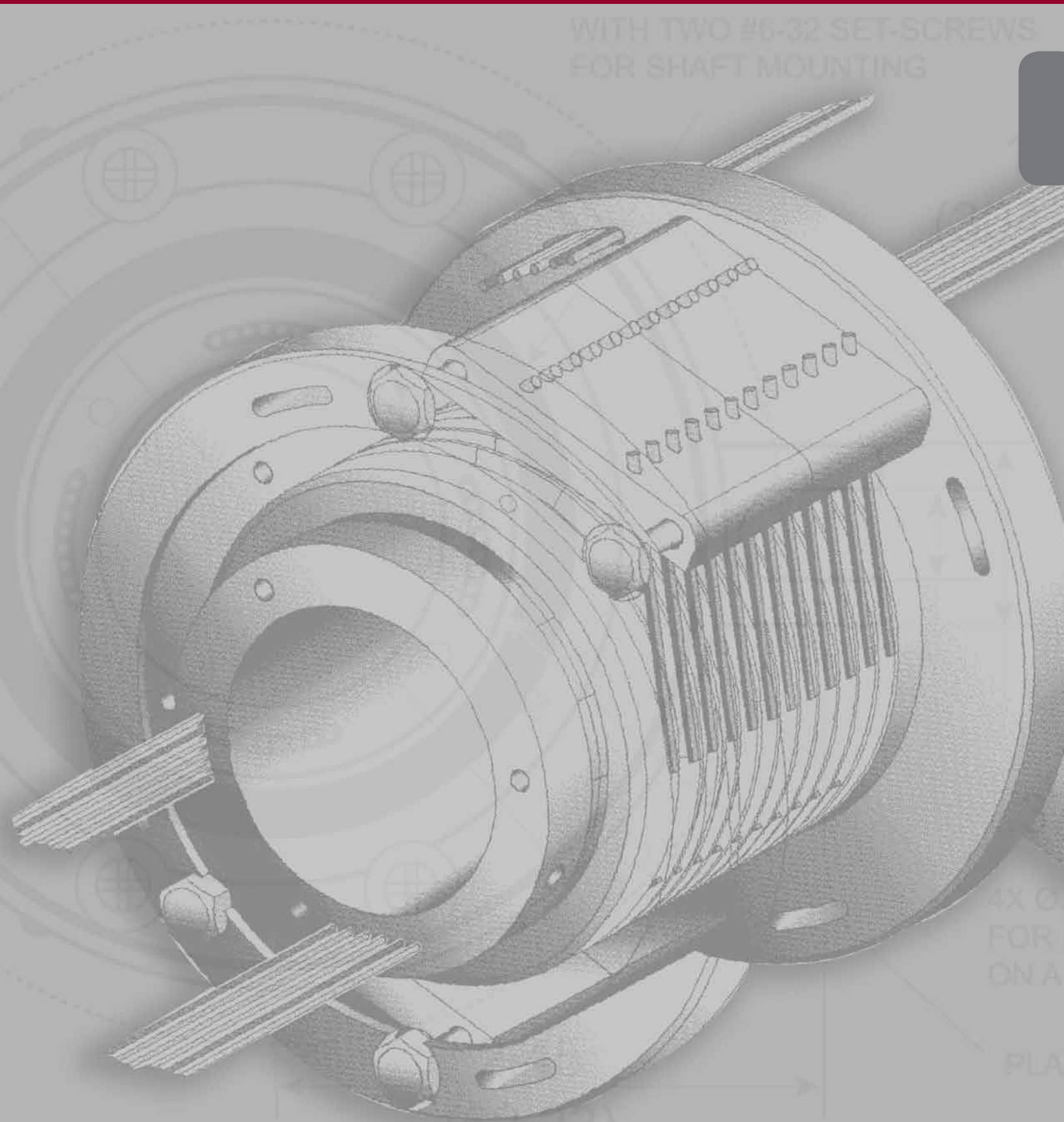


How To Specify A Slip Ring

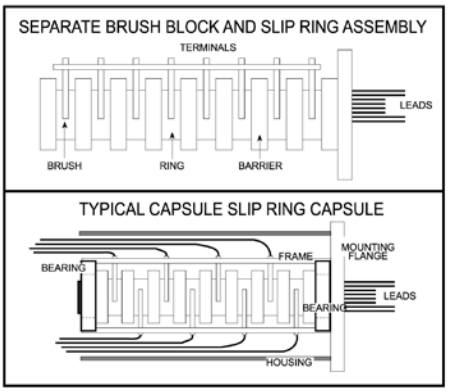
Many of the more than 10,000 slip ring designs are available for use in their existing configuration or they may be modified to meet your specific requirements. New designs can also be created to meet the most demanding specifications.

Our engineers are experienced in a wide range of slip ring applications. A very active in-house quality program solicits the best inputs from all of our many concurrent engineering groups, from start to finish.

This section is designed to guide you through the process of specifying a slip ring. We've outlined below the major considerations that a slip ring engineer will need to know about your application.

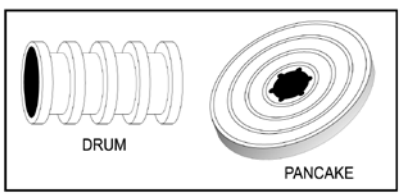
Basic Slip Ring Design

Throughout these pages, you will see three basic terms used for slip rings:
1. Slip Ring Capsule - A fully integrated unit with a housing and bearings.
2. Slip Ring Separates - Separate slip ring rotor and brush blocks for mounting in your system.
3. Twist Capsule - A limited rotation device used typically in scanning applications where continuous rotation is not required.



There are two basic slip ring configurations to consider based on space allocation in your system:

1. The more common drum approach where each ring is adjacent to the next along the centerline, somewhat like the threads on a bolt and
2. The platter approach where the rings are concentric with one another like the grooves on a flat surface. The pancake approach is used when length is at a premium but diameter is less restrictive.

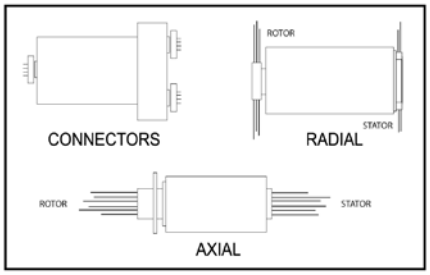


Defining the Mechanical Envelope

The envelope is, of course, largely dictated by the space available in the system. The slip ring engineer should be given the maximum space available in the system so all existing candidate designs can be considered. It is imperative that the space required for the slip ring be specified in the early stages of the system design and that it be consistent with the structural and electrical demands.

Defining System Interface Requirements

The slip ring engineer will need to know these system interface considerations:
1. Can the slip ring mount directly on the center line or is a through-bore required in the slip ring? A through-bore can be used to mount the slip ring on a shaft or used for routing hydraulic lines, pneumatic lines, fiber optic rotary joint, wave guide. etc.
2. How will the slip ring attach to the system? A slip ring must be mounted with a flexible coupling on one side of the unit. Hard mounting on both the rotor and stator will cause the slip ring to fail prematurely by translating system load into the slip ring bearing structure.
3. How should the electrical connections to the slip ring be made? Is it desirable to have connectors integral with the slip ring on both the rotor and stator, or would flying leads on one or the other ends be desirable? And if flying leads are preferred, should they exit the rotor / stator in a radial or axial direction, and what length should the leads be?



Defining Electrical Requirements

The specified current enables the slip ring engineer to propose a unit with the appropriate cross-sectional area of the rings, brushes and lead wires. The specified voltage dictates the spacing between adjacent rings and brushes. It is helpful in achieving the most cost effective and smallest practical envelope not to rate all circuits at the maximum level. For example, if you need 20 circuits total, three of which must carry ten amps, designate three for high current. Don't insist on 100% functional interchangeability by specifying that all 20 circuits carry ten amps. And, if ten amps is a surge current with a continuous current of only two amps, tell us that, too. There is no reason for you to pay for ten amps continuous capacity when you only need two amps.

Be aware that voltage surges and spikes are the major cause of system slip ring failures. Moog Components Group uses a conservative approach to circuit design, however, it is not uncommon in some power supply systems to see voltage spikes ten or more times the normal operating voltage. We strongly recommend surge protection on all power supplies.

Most smaller slip rings will satisfactorily conduct signals to 50 megabits / sec. Special slip rings can be used to pass broadband signals from DC to 1 gigahertz and data rates of 500 megabits or even higher. Cross-talk, insertion loss and bit error rate information can be projected, if tested for actual values, when data rates, formats and impedances are defined. The appropriate shielding techniques will be incorporated to meet the system requirements.

Defining Mechanical Requirements

1. Operating speed (rpm) is an important design parameter. Almost any slip ring can operate successfully at speeds to 100 rpm although many applications only require operation at a few rpm. Slip rings are routinely used to instrument test jet turbine engines operating at speeds in excess of 20,000 rpm. The operating speed, in conjunction with the diameter, dictates the surface speed of the ring relative to the brush and hence the internal design approach and material selection.
2. What rotational life is necessary for your application? Will the unit oscillate or rotate at a continuous speed?

Defining the Environment

The environment in which the slip ring must survive is a key factor. Operating temperature range is important in specifying the proper lubricant. And if the slip ring will operate exposed to the elements or to a hostile environment, integral seals must be included in the design. Any unusual shock or vibration should also be specified.

Your Slip Ring Requirements

For assistance on your slip ring requirements, please complete the *Slip Ring Application Specification Sheet* located on page 7, you can either fax or call and speak with one of our engineers about your optimum slip ring solution.

Many of the slip ring designs and manufacturing processes described are proprietary and are covered under one or more U.S., European or Japanese patents. The information provided is intended to assist the system engineer in initial discussions and is not intended as a specification.

Slip Ring Application Specification Sheet

Please provide as much information as possible, enter NA for those questions that are not critical or important to you. Do not be concerned if you do not have all of the specifications that are requested, we are happy to work with as little or as much information as you can provide. However, the more complete your response, the more thorough our analysis.

Company Information

Company Name _____ Contact _____

Division _____ ❑ Buyer

Address _____ ❑ Engineer

_____ ❑ Other _____

City _____ State/Country _____ Zip/Post Code _____

Phone _____ FAX _____ E-mail _____

1) Description of Application: _____

_____

_____

❑ Commercial
❑ Industrial
❑ Military
❑ Other

2) Type of Slip Ring ❑ Capsule ❑ Separate Brush Block ❑ Other _____
❑ Separate Slip Ring ❑ Poly-Twist (for ± °) _____

3) This Application is: ❑ New ❑ Retrofit / Replacement Type of Application: _____

Current Supplier: _____ Part Number: _____

4) Estimated Annual Quantity: _____ Price Target: _____ Production Start Date: _____

Estimated Life of Program: _____ Tooling $ Available: _____

5) Size Constraints - Mechanical and additional requirements (i.e. resolver, motor, hydraulics, pneumatics, optical channel, etc):

_____

_____

6) Specifications:

Number of Rings: _____

Size: Length _____

Diameter _____

Bore _____

Wear (Life): Hours (or Yrs) _____

at Duty Cycle _____

Operating Temp Range (°C):

Min _____ Max _____ Norm _____

Pressure: Norm _____ Min _____

Vibration: ____ g's @ ____ Hz Shock ____ g's

Sealing: ❑ None ❑ Dust & Splash

❑ Water Spray ❑ Submersion

Rotational Speed: Norm _____

Oscillatory Motion: Yes _____ No _____

Torque: Max Starting _____ gm-cm

Weight (Max): _____

Lead Length: Rotor _____ Stator _____

Connectors: Rotor _____ Stator _____

Lead Exits: Rotor Axial ____ Radial _____

Stator Axial ____ Radial _____

Circuit Function	No. Ring	Current (amps) Normal	Current (amps) Max	Working Volts	Digital Risetime* or Freq. (Hz)	Crosstalk Isolation (dB)

If unknown please specify protocol or data rate.

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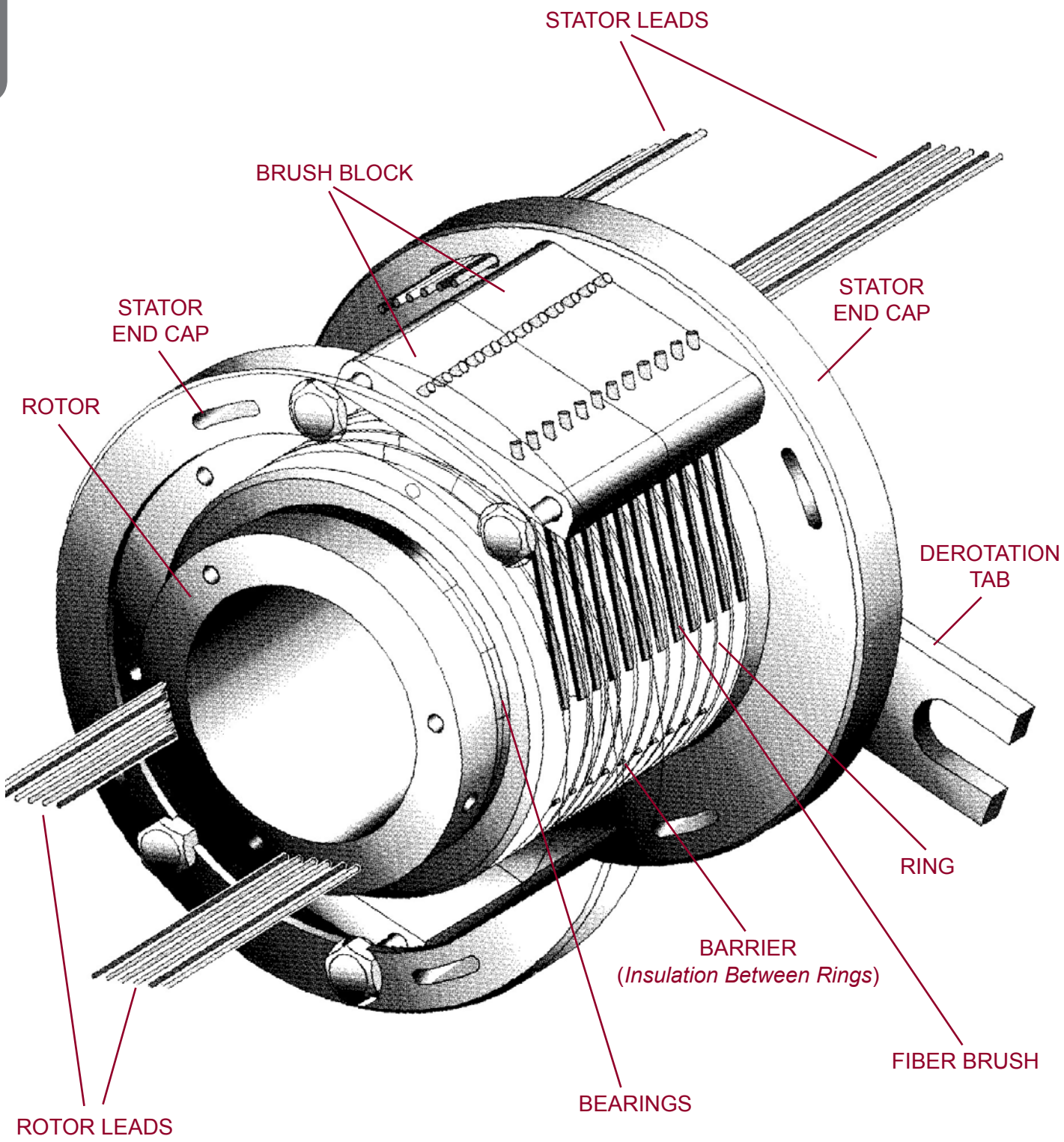
Components Of A Slip Ring



Note: Outer housing is removed for clarity.

Commercial Slip Ring Specification Matrix

Part #	# Rings	Continuous Current (amps)								Coaxial		Standard Operating Voltage (AC)				Size	Bore	Rated Speed	Page #
		2	5	7	10	14	15	30	50	RG178	RG179	120	240	440	600	DIA" x LG"	DIA"	RPM	
SRA-73540-6	6	6										X				.44 x .64		250	41
SRA-73540	12	12										X				.44 x .64		250	41
SRA-73625	18	18										X				.44 x 1.16		100	43
AC6373-6	6	6										X				.5 x .8		100	45
AC6373-12	12	12										X				.5 x 1.07		100	45
SRA-73526	6, 18	X											X			.87 x .57 - 1.11		250	47
SRA-73528	12	X											X			.87 x .76		250	47
SRA-73599	24	X											X			.87 x 1.24		250	47
AC6023-6	6	6											X			.87 x 1.14		250	49
AC6023-12	12	12											X			.87 x 1.41		250	49
AC6023-18	18	18											X			.87 x 1.68		250	49
AC6023-24	24	24											X			.87 x 1.95		250	49
SRA-73574	36	36											X			.87 x 2.4		250	51
SRA-73587	28	24			4								X			.87 x 2.4		250	51
AC6355-36	36	36											X			1 x 2.6		250	53
AC6355-36V	32	28	4										X			1 x 2.6		250	53
AC6355-36X	24	20			4								X			1 x 2.6		250	53
AC6355-36C	26	20	4							2			X			1 x 2.6		250	53
AC6355-36K	26	20	4								2		X			1 x 2.6		250	53
AC6355-56	56	56											X			1 x 3.5		250	53
AC6355-56V	52	48	4										X			1 x 3.5		250	53
AC6355-56X	44	40			4								X			1 x 3.5		250	53
AC6355-56C	46	40	4							2			X			1 x 3.5		250	53
AC6355-56K	46	40	4								2		X			1 x 3.5		250	53
AC7038	IP 65 sealed version of AC6355															1 x 2.6 - 3.6		250	55
AC6305-6	9	6	3									X				.87 x 1.95		250	56
AC6305-9	12	9	3									X				.87 x 1.95		250	56
AC6305-12	15	12	3									X				.87 x 1.95		250	56
AC6310-3	6	3			3							X				.87 x 1.95		250	56
AC6310-6	9	6			3							X				.87 x 1.95		250	56
AC7036	Up to 80	X	X		X		X			X	X		X	X		3.1 x 3.1 - 6.7		250	58
EC4294	2 @ 1 amp											X				1.2 x .68		10,000	68
EC3848-6	6 @ 1 amp											X				1.2 x .98		10,000	68
EC4199	8 @ 1 amp											X				1.2 x .92		10,000	68
EC3848-10	10 @ 1 amp											X				1.2 x 1.2		10,000	68
80050-957 / 1028300-2	2			2									X			1.248 x 2.54		400	60
80050-958 / 1028300-4	4	2		2									X			1.248 x 2.54		400	60
80050-956	2					2							X			1.248 x 2.54		400	60
80050-955	4	2				2							X			1.248 x 2.54		400	60
80059-950	8					8							X			1.58 x 3.07		600	60
SRA-73683-6	6	6											X			1.38 x .82	.5	120	13
SRA-73683-12	12	12											X			1.38 x 1.12	.5	120	13
SRA-73683-18	18	18											X			1.38 x 1.42	.5	120	13
SRA-73683-24	24	24											X			1.38 x 1.72	.5	120	13
AC6438-6	6		6										X			2.1 x 1.6	.5	250	15
AC6438-12	12		12										X			2.1 x 2.1	.5	250	15
AC6438-18	18		18										X			2.1 x 2.7	.5	250	15
AC6438-24	24		24										X			2.1 x 3.2	.5	250	15

List continued on page 10.

Commercial Slip Ring Specification Matrix

Part #	# Rings	Continuous Current (amps)								Coaxial		Standard Operating Voltage (AC)				Size	Bore	Rated Speed	Page #
		2	5	7	10	14	15	30	50	RG178	RG179	120	240	440	600	DIA" x LG"	DIA"	RPM	
AC7094-130	30		30										X			2.17 x 5.02	.5	250	17
AC7094-136	36		36										X			2.17 x 5.57	.5	250	17
AC7094-142	42		42										X			2.17 x 6.13	.5	250	17
AC7094-148	48		48										X			2.17 x 6.69	.5	250	17
AC6349-6	6						6							X		3.07 x 2.9	1	250	19
AC6349-12	12						12							X		3.07 x 4.1	1	250	19
AC6349-18	18						18							X		3.07 x 5.3	1	250	19
AC6349-24	24						24							X		3.07 x 6.5	1	250	19
AC6875	IP 65 sealed version of AC6349															3.07 x 2.9 - 6.5	1.0	250	21
AC4598-6	6				6										X	3.9 x 2.13	1.5	250	22
AC4598-12	12				12										X	3.9 x 3.07	1.5	250	22
AC4598-18	18				18										X	3.9 x 4.01	1.5	250	22
AC4598-24	24				24										X	3.9 x 4.94	1.5	250	22
AC6200-12	12	12											X			3.9 x 2.13	1.5	250	24
AC6200-24	24	24											X			3.9 x 3.07	1.5	250	24
AC6200-36	36	36											X			3.9 x 4.01	1.5	250	24
AC6200-48	48	48											X			3.9 x 4.94	1.5	250	24
AC6200-6P/12S	18	12			6								X (2A)	X (10A)		3.9 x 3.07	1.5	250	24
*AC6200-6P/24S	30	24			6								X (2A)	X (10A)		3.9 x 4.01	1.5	250	24
AC6200-6P/36S	42	36			6								X (2A)	X (10A)		3.9 x 4.94	1.5	250	24
AC6200-12P/12S	24	12			12								X (2A)	X (10A)		3.9 x 4.01	1.5	250	24
AC6200-12P/24S	36	24			12								X (2A)	X (10A)		3.9 x 4.94	1.5	250	24
AC6200-18P/12S	30	12			18								X (2A)	X (10A)		3.9 x 4.94	1.5	250	24
AC6419	IP 65 sealed version of AC4598 and AC6200 series															3.9 x 2.3 - 5.1	1.5	250	26
AC6815	Up to 128	X	3.5		X							2A/60	3.5A/110	10A/220		4.32 x 3.01 - 5.94	1.5	250	27
AC6428-060	60	60											X			3.9 x 6.6	1.375	250	29
AC6428-072	72	72											X			3.9 x 7.5	1.375	250	29
AC6428-084	84	84											X			3.9 x 8.45	1.375	250	29
AC6428-096	96	96											X			3.9 x 9.34	1.375	250	29
AC6429-006	54	48			6								X (2A)	X (10A)		3.9 x 7.5	1.375	250	29
AC6429-012	60	48			12								X (2A)	X (10A)		3.9 x 7.5	1.375	250	29
AC6231	8						8						X			4.25 x 2.75	1.5	2500	66
AC6275	Up to 144		X		X			X	X				X (5A)		X	6.63 x 6.6 - 20.5	2.75	1000	31
AC6793	IP 65 sealed version of AC6275															6.63 x 6.6 - 20.5	2.75	1000	33
AC6098	Up to 72				X			X	X						X	8.0 x 4.6 - 14.4	4	250	34
Std W Series	Up to 36		X					X		X	X		5A/250		30A	5.0 x 1.89 - 5.89	1.5	60	36
Std W Series	Up to 36		X					X		X	X		5A/250		30A	6.5 x 1.89 - 5.89	3.0	60	36
Plus W Series	Up to 124		X					X		X	X		5A/250		30A	5.0 x 2.43 - 10.38	1.5	1000	70
Plus W Series	Up to 124		X					X		X	X		5A/250		30A	6.5 x 2.32 - 10.38	3.0	1000	70
Plus W Series	Up to 124		X					X		X	X		5A/250		30A	7.5 x 2.18 - 10.38	4.0	600	70
Plus W Series	Up to 124		X					X		X	X		5A/250		30A	9.5 x 2.19 - 10.38	6.0	600	70
Plus W Series	Up to 124		X					X		X	X		5A/250		30A	12.5 x 2.43 - 10.38	9.0	600	70
80042-950	8	X											50V			1.52 x 2.29		20,000	62
80043-950	12	X											50V			1.52 x 2.79		20,000	62
80038-950	8	2.5											50V			3.56 x 5.28		12,000	72
80039-950	12	2.5											50V			3.56 x 5.88		12,000	72
80027-950	24	2.5											50V			3.56 x 8.64		12,000	72
56814-950	8	8											X			4.134 x 1.969	2.953	250	39
56871-951	4	4											X			7.165 x 0.787	5.984	250	39
57165-950	5	5											X			2.102 x 1.220	1.652	250	39
57622-950	8	8											X			9.291 x 1.575	7.01	150	39

*Indicates power / signal combined **Note:** Higher speed options available for AC4598, AC6200 and AC6349.

Aerospace / Military Slip Ring Program Matrix

SIG CKTS = Signal Circuits (Rings)
PWR CKTS = Power Circuits (Rings)

Program	Description	Key Features
Bradley Fighting Vehicle	Commander's Independent Viewer AZ Slip Ring	Resolver, 259 SIG CKTS
	A3 Turret Slip Ring	Air Channel, 86 SIG CKTS & 4 PWR CKTS
	AZ Turret Slip Ring	Air Channel, Encoder, 42 SIG CKTS & 2 PWR CKTS
Advanced Targeting Pod	Pitch Axis Slip Ring	45 CKT With In-board Connectors
	Roll Axis Slip Ring	20 PWR CKTS, 3 Twinax High Speed Data Circuits (250 Mbps), 46 SIG CKTS
AH-64A / D Apache Longbow Attack Helicopter	Slip Ring RF Rotary Joint Assembly	6 PWR CKTS: 115 VAC, 4 A; 73 SIG CKTS: 100 V 1 A; Resolver, 4 Channel RF Rotary Coupler
AH64 Apache	Tail Rotor De-ice	2 PWR CKTS 20 A
Avenger Air Defense System	Turret Slip Ring Capsule	Air Channel, Encoder Mount, 2 PWR CKTS 150 A, 28 VDC 61 SIG CKTS 3 A, 28 VDC
Blackhawk and Seahawk	Blackhawk Main Rotor	3 Low PWR CKTS, 5 A, 28 VDC 3 Ø PWR CKTS, 60 A, 200 VAC
	UH60 Tail Rotor	3 Ø PWR CKTS, 20 A, 200 VAC
	Seahawk Main Rotor	3 Ø PWR CKTS, 60 A, 200 VAC; 28 VDC, 5 A
	Blackhawk Tail Rotor	3 Ø PWR CKTS, 20 A, 200 VAC, Separate Cables
F-14 / 15 / 16 LANTIRN	Main De-roll Slip Ring	Dual Axis Rotating (Spin-Despin) Hydraulic Channel 50 PWR CKTS, 130 SIG CKTS, 2 High Voltage (150 V)
Sentinel Radar	Pedestal Slip Ring Capsule	6 PWR CKTS - 3 Ø, 208 VAC, 10 A 73 SIG CKTS
V-22 Osprey	Main Prop Rotor Slip Ring De-ice and Flight Controls	14 PWR CKTS 115 VAC, 1-75 A; 49 SIG CKTS; Resolver; Redundant Bearings; Bearing Failure Sensor
Stryker IAV Mobile Gun System	Turret Slip Ring Assembly	Hydraulics, Breathing Air, Resolver, R/D COH Version, Two High PWR CKTS, 450 A 2 Low PWR CKTS - 75 A, , 135 SIG CKTS Including 100 Mbps - Ethernet RS170 Video
Expeditionary Fighting Vehicle	Turret Slip Ring Assembly	2, 250 A; 8, 120 A; 6, 15 A; 111, Signal; Clean Air Channel FDDI, CAN BUS and RS170 Channels
F35 Joint Strike Fighter	EOTS Roll Slip Ring	4 PWR CKTS - 220 VAC, 2 A; 32 - SIG CKTS and GRNS
S92 Helicopter	Main Rotor De-ice Slip Ring	3 Ø PWR CKTS 60 A, 200 VAC 10 SIG CKTS, Redundant BRGS
	Tail Rotor De-ice Slip Ring	3 Ø PWR CKTS with Ground 20 A, 200 VAC
AWACS	Main Power and Signal Transfer Slip Ring / RF Rotary Joint	16 PWR CKTS - 60 A, 208 VAC; SIG 110 CKTS - 5 A, 200 VAC
	Main Power and Signal Transfer Slip Ring / RF Rotary Joint	16 PWR CKTS - 60 A, 208 VAC; SIG 110 CKTS - 5 A, 200 VAC
AIM-9X Missile	Seeker De-roll Slip Ring / BB Separates	PWR: 2 PWR CKTS - 28 V, 2 A; SIG: 8 SIG CKTS - 28 V, 1 A

Commercial Slip Ring Products

SRA-73683

1/2 inch through-bore miniature slip ring capsule

Description

A slip ring capsule can be used in any electromechanical system that requires unrestrained, intermittent or continuous rotation while transferring power and / or data. A slip ring is also called a rotary electrical joint, collector, commutator or swivel. A slip ring can improve system performance by simplifying operations and eliminating damage prone wires.

The SRA-73683 provides an economical, readily available solution when a compact through-bore configuration is required. This unit provides a 1/2 inch through-bore for shaft mounting, a compact 1.375 inch outside diameter and a very short overall length for minimal space applications. The SRA-73683 provides 2 amp circuits in 6, 12, 18 and 24 ring configurations.

Features

- 1/2 inch through-bore
- Compact 1.375 inch outside diameter
- Speeds up to 120 rpm continuous
- Continuous rotation of power and / or data signals

Benefits

- Transfers power, as well as analog and digital signals
- Compatible with data bus protocols
- Compact packaging

Typical Applications

- Precision rotary equipment
- Semiconductor handling systems
- Robotics
- Camera systems

Slip Rings With Through-Bores

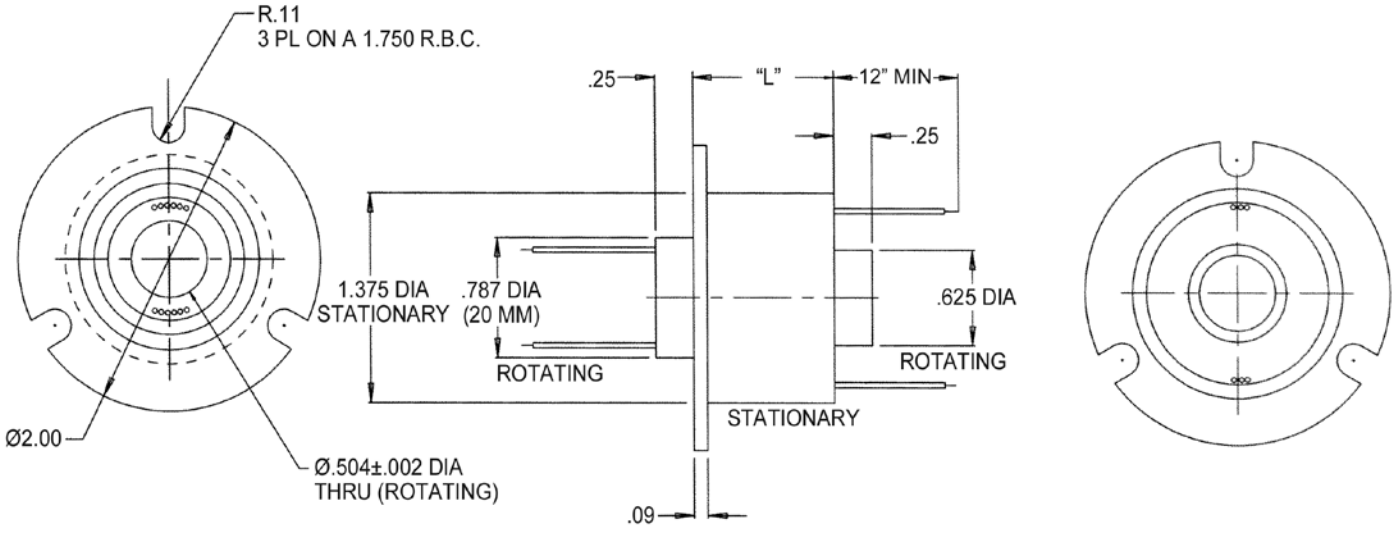
SRA-73683 Specifications	
Operating Speed	120 rpm* continuous
Number of Circuits	6, 12, 18, 24
Lead Length	12, 24, 36 and 48 inches
Lead Size / Type	#26 AWG, Teflon® insulated, stranded
Voltage	210 VAC
Operating Temp.	-40°C to +80°C
Contact Material	Gold
Current Rating	2 A, per ring, max.
Dielectric Strength	500 VRMS, all combinations
Insulation Resistance	1000 megohms min. @ 250 VDC
Electrical Noise	40 milliohm max. @ max. speed

**Please note that the operational life of the unit is dependent upon rotational speed, environment and temperature.*

Wire Color Code			
Ring #	Color	Ring #	Color
1	BLK	13	WHT-RED
2	BRN	14	WHT-ORN
3	RED	15	WHT-YEL
4	ORN	16	WHT-GRN
5	YEL	17	WHT-BLU
6	GRN	18	WHT-VIO
7	BLU	19	WHT-GRY
8	VIO	20	WHT-BLK-BRN
9	GRY	21	WHT-BLK-RED
10	WHT	22	WHT-BLK-ORN
11	WHT-BLK	23	WHT-BLK-YEL
12	WHT-BRN	24	WHT-BLK-GRN

Part Number	Length "L"	Ring Qty.
SRA-73683-6	.82 inch (20,83 mm)	6
SRA-73683-12	1.12 inch (28,45 mm)	12
SRA-73683-18	1.42 inch (36,07 mm)	18
SRA-73683-24	1.72 inch (43,69 mm)	24

SRA-73683 Dimensions



Dimensions in inches

AC6438

1/2 inch through-bore miniature slip ring capsule

Description

A slip ring capsule can be used in any electromechanical system that requires unrestrained, intermittent or continuous rotation while transferring power and / or data. A slip ring is also called a rotary electrical joint, collector, commutator or swivel. A slip ring can improve system performance by simplifying operations and eliminating damage prone wires.

The AC6438 provides an economical, readily available solution when a compact through-bore configuration is required. This unit provides a 1/2 inch through-bore for routing of hydraulic or pneumatic lines, and a compact 2.1 inch outside diameter and a very short overall length for minimal space applications. The AC6438 provides 5 amp circuits in 6, 12, 18 and 24 ring configurations. Similar in design to our very popular AC4598 and AC6200 series, this design features long life, fiber brush contact technology for ultimate performance in many challenging applications.

Features

- 1/2 inch through-bore
- Compact 2.1 inch outside diameter
- Speeds up to 250 rpm continuous
- Multiple circuit configurations
- Continuous rotation of power and / or data signals
- High-impact thermoplastic construction
- Gold plated rings

Benefits

- Transfers power, as well as analog and digital signals
- Compatible with data bus protocols
- Fiber brush technology provides long life and maintenance free operation
- Compact packaging

Typical Applications

- Precision rotary equipment
- Semiconductor handling systems
- Industrial machinery
- Robotics

Slip Rings With Through-Bores

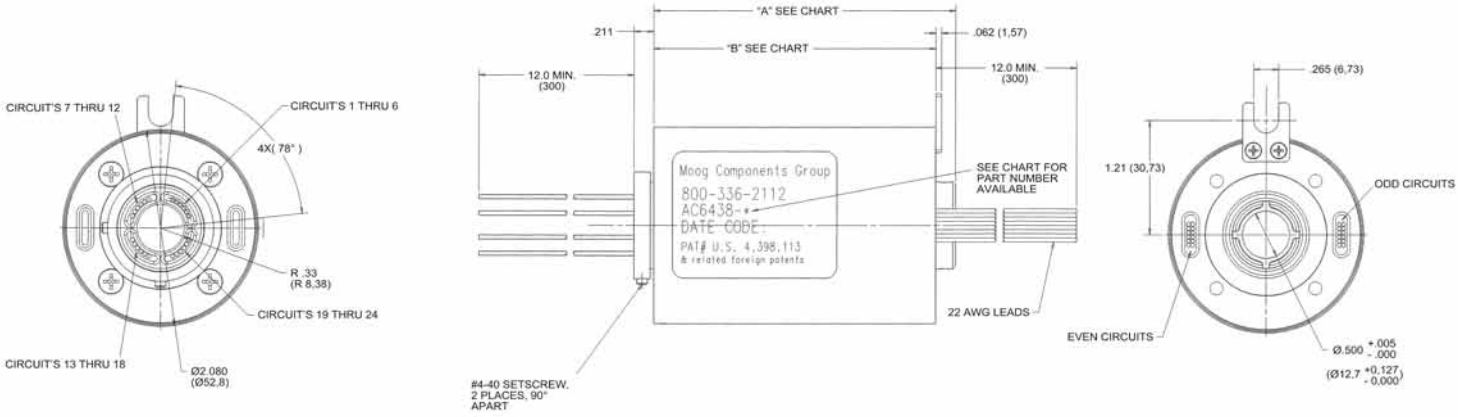
AC6438 Specifications		Options
Operating Speed	250 rpm* continuous	• 24, 36 and 48 inch leads • Alternate lead exits
Number of Circuits	6, 12, 18 or 24	
Lead Length	12 inch standard	
Lead Size / Type	22 AWG, 7 strand	
Voltage	250 AC / DC	
Operating Temp.	-40°C to +80°C	
Current Rating	5 amps / circuit	
Electrical Noise	100 milliohms max. @ 6 VDC, 50 milliamps when running @ 5 rpm	

**Please note that the operational life of the unit is dependent upon rotational speed, environment and temperature.*

Wire Color Code					
Ring #	Color	Ring #	Color	Ring #	Color
1	BLK	9	GRY	17	WHT / BLU
2	BRN	10	WHT	18	WHT / VIO
3	RED	11	WHT / BLK	19	WHT / GRY
4	ORN	12	WHT / BRN	20	WHT / BLK / BRN
5	YEL	13	WHT / RED	21	WHT / BLK / RED
6	GRN	14	WHT / ORN	22	WHT / BLK / ORN
7	BLU	15	WHT / YEL	23	WHT / BLK / YEL
8	VIO	16	WHT / GRN	24	WHT / BLK / GRN

Part Number	AC6438-106	AC6438-112	AC6438-118	AC6438-124
Dimension "A"	1.55 inch (39,37 mm)	2.11 inch (53,60 mm)	2.67 inch (67,81 mm)	3.23 inch (82,04 mm)
Dimension "B"	1.33 inch (33,78 mm)	1.89 inch (48,01 mm)	2.44 inch (61,98 mm)	3.00 inch (76,20 mm)

AC6438 Dimensions



Dimensions in inches (millimeters)

AC7094

1/2 inch through-bore miniature slip ring capsule

Description

A slip ring capsule can be used in any electromechanical system that requires unrestrained, intermittent or continuous rotation while transferring power and / or data. A slip ring is also called a rotary electrical joint, collector, commutator or swivel. A slip ring can improve system performance by simplifying operations and eliminating damage prone wires.

The AC7094 provides an economical, readily available solution when a compact through-bore configuration is required. This unit provides a 1/2 inch through-bore for routing of hydraulic or pneumatic lines, and a compact 2.1 inch outside diameter. The AC7094 provides 5 amp circuits in 30, 36, 42 and 48 ring configurations. Similar in design to our very popular AC4598 and AC6200 series, this design features long life, fiber brush contact technology for ultimate performance in many challenging applications.

Features

- 1/2 inch through-bore
- Compact 2.1 inch outside diameter
- Speeds up to 250 rpm continuous
- Multiple circuit configurations
- Continuous rotation of power and / or data signals
- High-impact thermoplastic construction
- Gold plated rings

Benefits

- Transfers power, as well as analog and digital signals
- Compatible with data bus protocols
- Fiber brush technology provides long life and maintenance free operation
- Compact packaging

Typical Applications

- Precision rotary equipment
- Semiconductor handling systems
- Industrial machinery
- Robotics

Slip Rings With Through-Bores

AC7094 Specifications	
Operating Speed	250 rpm* continuous
Number of Circuits	30, 36, 42 or 48
Lead Length	12 inch standard
Lead Size / Type	22 AWG, 7 strand
Voltage	250 AC / DC
Operating Temp.	-40°C to +80°C
Current Rating	5 amps / circuit
Electrical Noise	100 milliohms max. @ 6 VDC, 50 milliamps when running @ 5 rpm

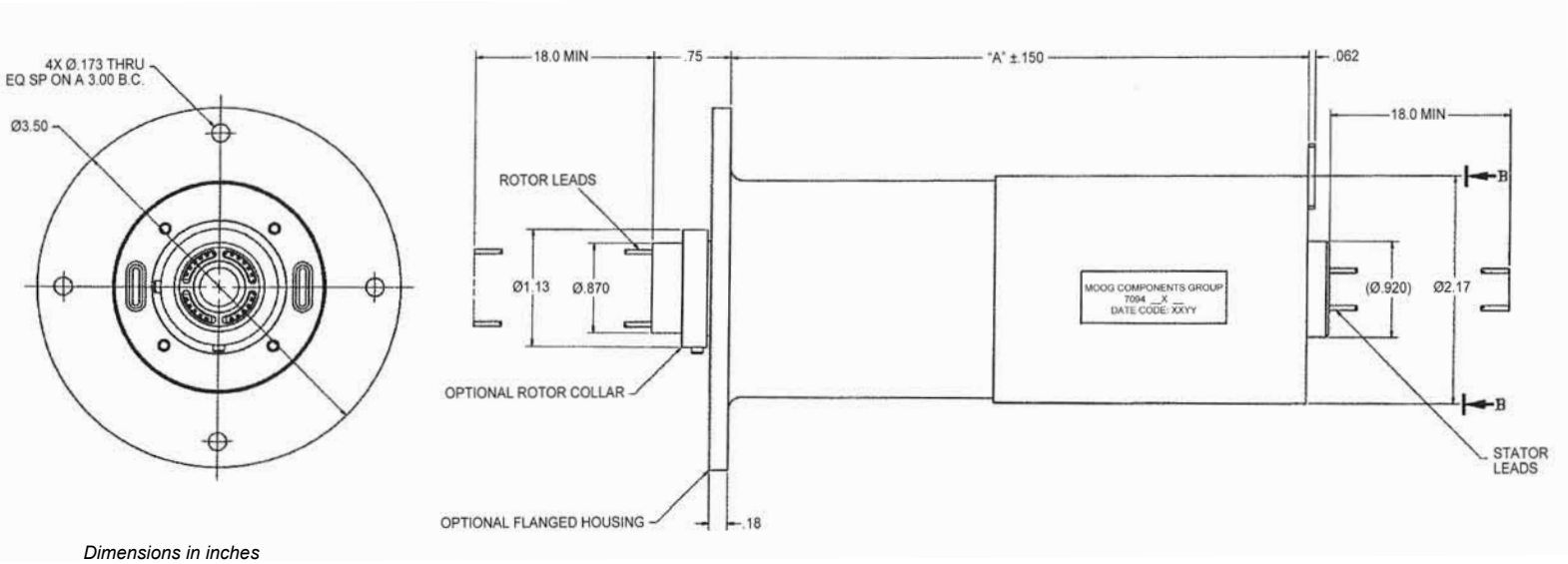
Options
• 24, 36 and 48 inch leads • Alternate lead exits

**Please note that the operational life of the unit is dependent upon rotational speed, environment and temperature.*

Wire Color Code									
Ring #	Color	Ring #	Color	Ring #	Color	Ring #	Color	Ring #	Color
1	BLK	11	WHT / BLK	21	WHT / BLK / RED	31	BLU	41	WHT / BLU
2	BRN	12	WHT / BRN	22	WHT / BLK / ORN	32	VIO	42	WHT / VIO
3	RED	13	WHT / RED	23	WHT / BLK / YEL	33	GRY	43	WHT / GRY
4	ORN	14	WHT / ORN	24	WHT / BLK / GRN	34	WHT	44	WHT / BLK / BRN
5	YEL	15	WHT / YEL	25	BLK	35	WHT / BLK	45	WHT / BLK / RED
6	GRN	16	WHT / GRN	26	BRN	36	WHT / BRN	46	WHT / BLK / ORN
7	BLU	17	WHT / BLU	27	RED	37	WHT / RED	47	WHT / BLK / YEL
8	VIO	18	WHT / VIO	28	ORN	38	WHT / ORN	48	WHT / BLK / GRN
9	GRY	19	WHT / GRY	29	YEL	39	WHT / YEL		
10	WHT	20	WHT / BLK / BRN	30	GRN	40	WHT / GRN		

Part Number	Dimension "A"
AC7094-130	5.016 inch (127,4 mm)
AC7094-136	5.574 (141,6)
AC7094-142	6.132 (155,8)
AC7094-148	6.690 (169,9)

AC7094 Dimensions



Dimensions in inches

AC6349

1 inch through-bore various circuit configurations

Description

A slip ring capsule can be used in any electromechanical system that requires unrestrained, intermittent, or continuous rotation while transferring power and / or data.

The AC6349 provides an economical, readily available solution when a compact through-bore configuration is required. This unit provides a 1 inch through-bore for routing hydraulic or pneumatic lines and a compact 3.1 inch outside diameter for minimal space applications. The 15 amp circuits are available in 6, 12, 18 and 24 ring configurations in 4 housing lengths. Similar in design to our very popular AC4598, this design features long life, fiber brush contact technology for ultimate performance in many challenging applications. Fiber brushes do not require lubrication and produce virtually no wear debris, for maintenance free, life time operation.

Features

- 1 inch bore
- 6, 12, 18 and 24 circuit models
- Precious metal contacts
- 15 amp rings
- Precision ball bearings for long life
- Speeds up to 250 rpm continuous
- Compact size
- Sealed units available
- Flying leads
- Fully compatible with both analog and TTL control level signals
- Rugged black anodized aluminum construction

Benefits

- Unique signal handling performance with minimal electrical circuit noise
- Tight packaging to fit in the most demanding space constraints
- Low torque to minimize system torque budget
- Rapid delivery

Typical Applications

- Packaging / wrapping machinery
- Semiconductor handling systems
- Industrial machinery
- Robotics

Slip Rings With Through-Bores

AC6349 Specifications	
Operating Speed	250 rpm* continuous
Number of Circuits	6, 12, 18, or 24
Lead Length	20 inch standard
Lead Size / Type	14 gauge, white with tags
Voltage	440 VAC
Operating Temp.	-40°C to +80°C
Contact Material	Silver-on-silver
Current Rating	15 amps / circuits
Dielectric Strength	500 VAC @ 60 Hz, between each circuit all other circuits
Insulation Resistance	1000 megohms max. tested 500 VAC
Circuit Resistance	200 milliohms with 12 inch leads
Electrical Noise	60 millionhms max. @ 6 VDC 50 milliamps when running @ 5 rpm
Environmental	Splash and dust seal optional

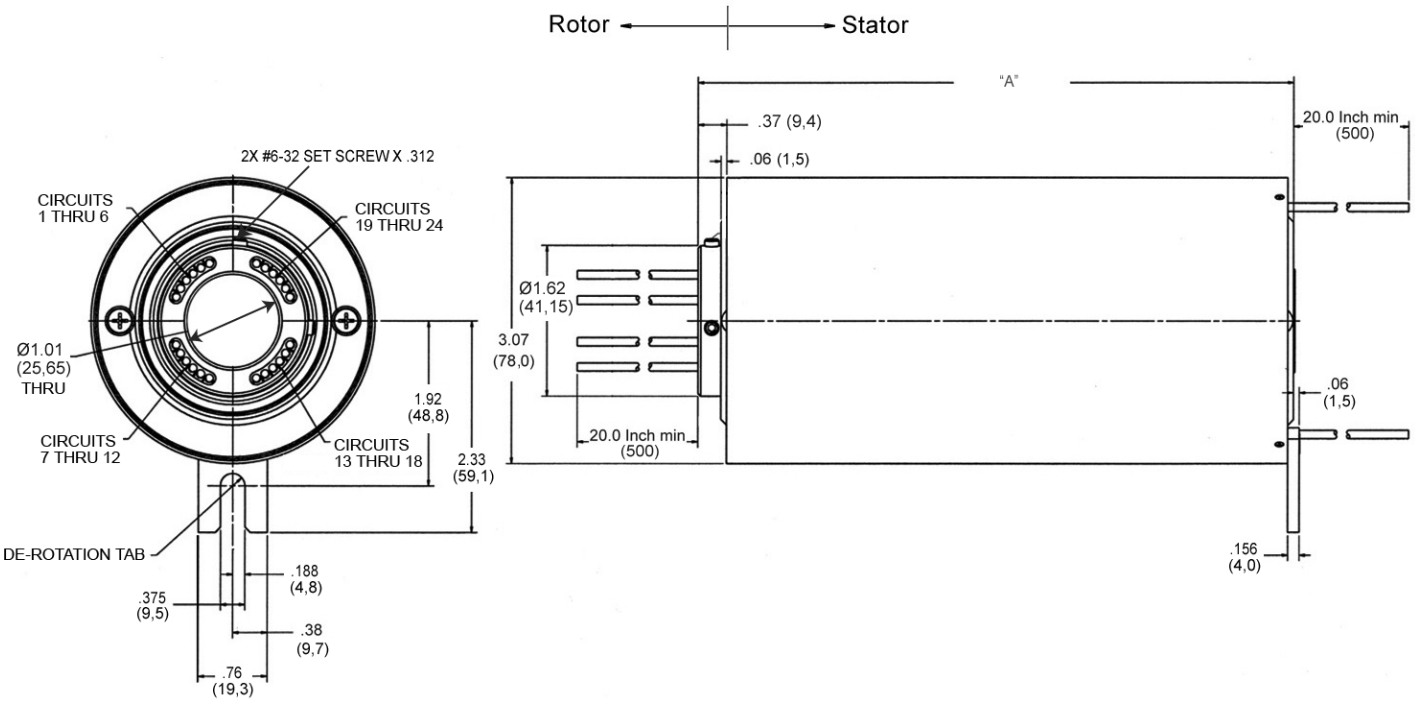
Options
• Steel bearings • Gold - plated rings • Seals • Long leads • IP 65 rated slip ring available (P/N AC6875), see page 21

**Please note that the operational life of the unit is dependent upon rotational speed, environment and temperature.*

Part Number	Length "A"
AC6349 - 6	2.9 inch (73,7 mm)
AC6349 - 12	4.1 inch (104,1 mm)
AC6349 - 18	5.3 inch (149,7 mm)
AC6349 - 24	6.5 inch (165,1 mm)

Standard units are not sealed.

AC6349 Dimensions



Dimensions in inches (millimeters)

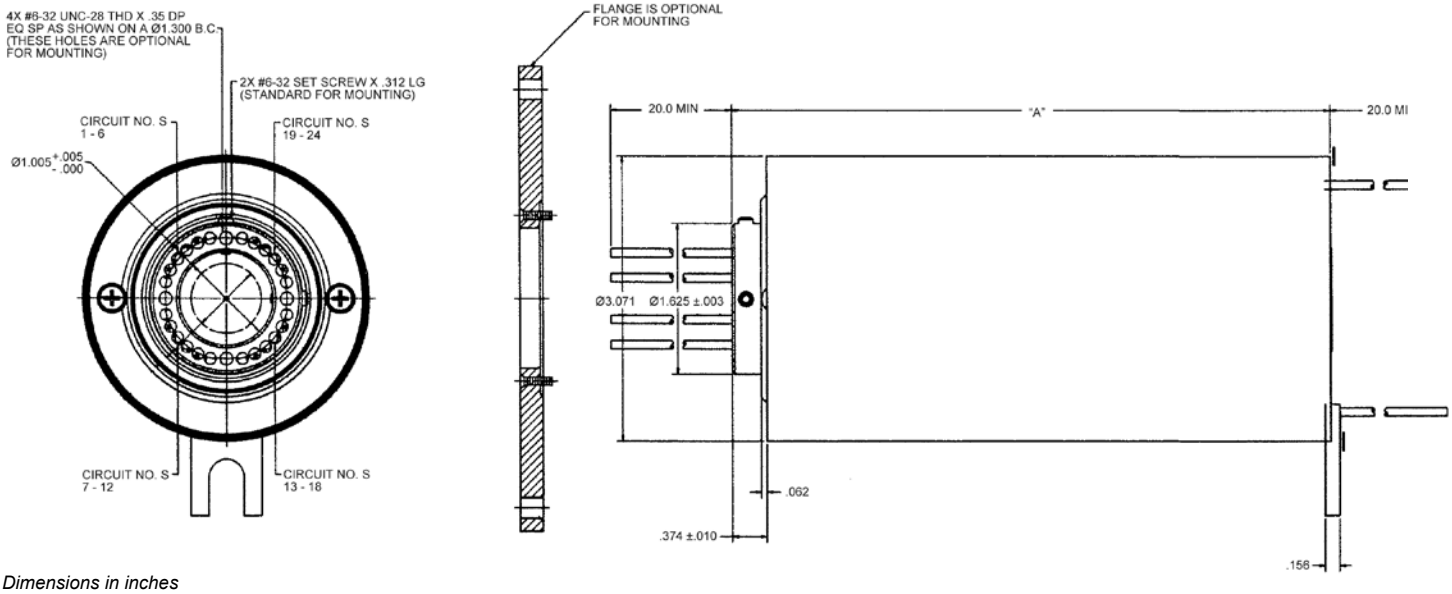
AC6875 Specifications (IP 65 Sealed Version of AC6349)		Options
Operating Speed	250 rpm* continuous	• Steel bearings • Gold - plated rings • Seals • Long leads
Number of Circuits	6, 12, 18, or 24	
Lead Length	20 inch standard	
Lead Size / Type	14 gauge, white with tags	
Voltage	440 VAC	
Operating Temp.	-40°C to +80°C	
Contact Material	Silver-on-silver	
Current Rating	15 amps / circuits	
Dielectric Strength	500 VAC @ 60 Hz, between each circuit all other circuits	
Insulation Resistance	1000 megohms max. tested 500 VAC	
Circuit Resistance	200 milliohms with 12 inch leads	
Electrical Noise	60 millionhms max. @ 6 VDC 50 milliamps when running @ 5 rpm	
Environmental	IP 65 sealed	

**Please note that the operational life of the unit is dependent upon rotational speed, environment and temperature.*

Part Number	Length "A"
AC6875-6	2.9 inch (73,7 mm)
AC6875-12	4.1 inch (104,1 mm)
AC6875-18	5.3 inch (149,7 mm)
AC6875-24	6.5 inch (165,1 mm)

Standard units are not sealed.

AC6875 Dimensions



Dimensions in inches

AC4598

10 amp per circuit 1-1/2 inch through-bore

Description

A slip ring can be used in any electromechanical system that requires unrestrained, continuous rotation while transferring power and / or data from a stationary to a rotating structure. A slip ring is also called a rotary electrical interface, collector, swivel, or a rotary joint. A slip ring can improve system performance by simplifying operations and eliminating damage-prone wires dangling from movable joints.

The 1-1/2 inch through-bore provides routing space for hydraulics, pneumatics or for a concentric shaft mount.

The AC4598 uses our unique fiber brush technology which offers several advantages over conventional slip ring contacts, including multiple points of contact per brush bundle, low noise, electrical and low contact wear rates. In addition, fiber brushes do not require lubrication and produce virtually no wear debris.

Features

- 1-1/2 inch through-bore
- Speeds up to 250 rpm continuous
- 6, 12, 18 or 24 ten amp circuits
- 16 gauge, 12 inch lead wire - longer lead lengths are available
- Higher rotational speeds with alternate bearings (optional)
- Various axial and radial lead exits are available
- Splash seals for dust and moisture resistance
- Standard collar mounting - flange mounting optional
- Also available with 12, 24, 36 and 48, 2 amp rings or power and signal combinations. Please refer to AC6200 data sheet.

Benefits

- Transfers analog and digital signals
- Compatible with data bus protocols
- Fiber brush technology provides long life and maintenance-free operation (no lubrication required)
- Continuous 360° rotation of power or data signals

Typical Applications

- Industrial machinery - machining centers, rotary index tables, heavy equipment turrets or cable reels, test equipment, packaging machines, palletizing machines, magnetic clutches, process control equipment, rotary sensors, emergency lighting, robotics
- Exhibit / display equipment
- Medical equipment

AC4598 Specifications	
Operating Speed	250 rpm* continuous
Number of Circuits	6, 12, 18 or 24
Lead Wire	16 gauge, 12 inches (300 mm)
Voltage	600 VAC
Operating Temp.	-40°C to 80°C
Current Rating	10 amp circuits
Torque	Approx. .5 in-oz (36.00 cm-g) per circuit unsealed
	Add approx. 10 in-oz (720.08 cm-g) for dust seals
Noise	Less than 100 milliohms peak @ 6 VDC, 50 mA, 5 rpm
Sealed Units	Optional intermittent splash and gross particle exclusion only

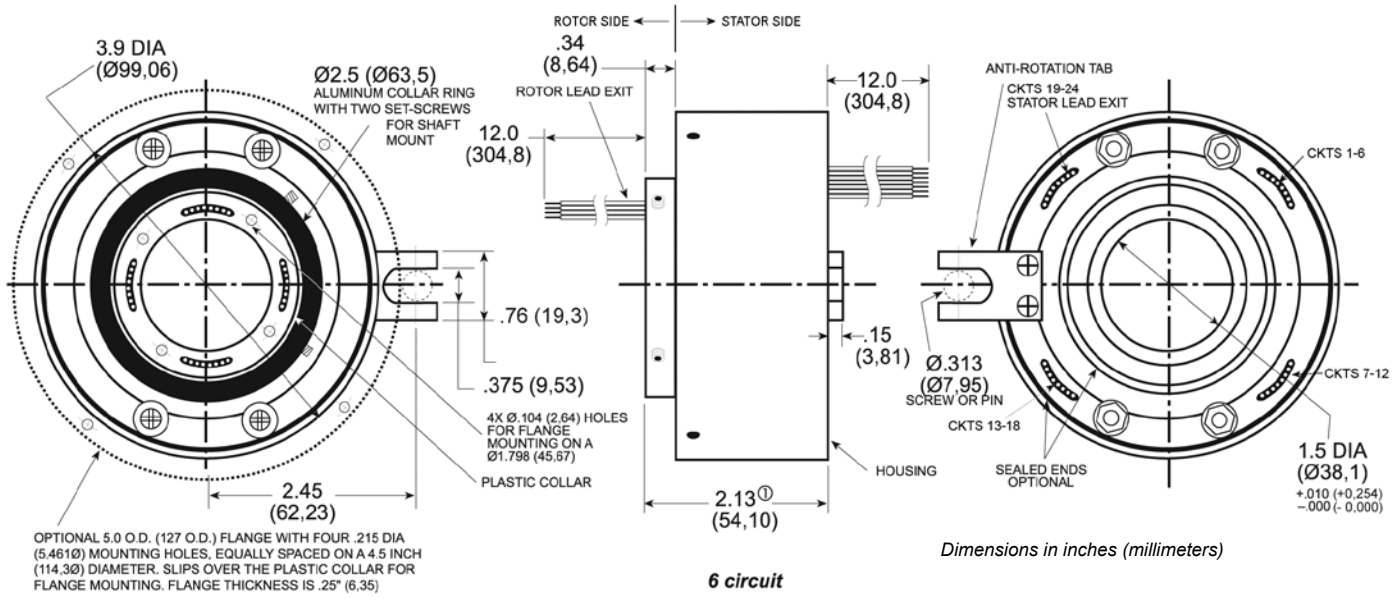
Options

- 5 inch (127 mm) O.D. flange with 4 mounting holes
- Splash seals for dust and moisture resistance
- Various axial and radial lead exits are available
- Longer lead lengths are available
- Higher rotational speeds with alternate bearings
- Higher current and voltage capacity per circuit
- Signal and power circuit combination
- IP 65 rated slip ring available (P/N AC6419), see page 26

**Please note that the operational life of the unit is dependent upon rotational speed, environment and temperature.*

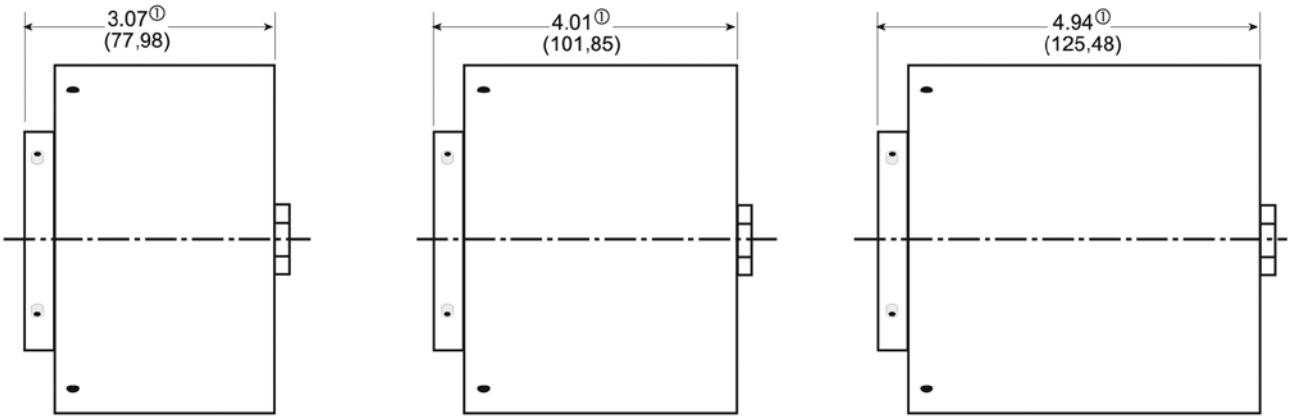
Lead Wire Color Code

Ring #	Color	Ring #	Color	Ring #	Color	Ring #	Color	Ring #	Color	Ring #	Color
1	Blk	5	Yel	9	Gry	13	Wht-Red	17	Wht-Blu	21	Wht-Blk-Red
2	Brn	6	Grn	10	Wht	14	Wht-Orn	18	Wht-Vio	22	Wht-Blk-Orn
3	Red	7	Blu	11	Wht-Blk	15	Wht-Yel	19	Wht-Gry	23	Wht-Blk-Yel
4.	Orn	8	Vio	12	Wht-Brn	16	Wht-Grn	20	Wht-Blk-Brn	24	Wht-Blk-Grn



Dimensions in inches (millimeters)

6 circuit



12 circuit ***18 circuit*** ***24 circuit***

Notes:

1. Drawings not actual size, measurements are in inches (millimeters)
2. Rotor and stator leads exit 4 places, 90° apart, 6 leads per exit relative to circuit count
3. ① = *Flange mounted, add .188 (4,78) for flange, no collar ring*

AC6200

1-1/2 inch through-bore 12, 24, 36 and 48 circuit versions

Description

A slip ring can be used in any electromechanical system that requires unrestrained, continuous rotation while transferring power and/or data from a stationary to a rotating structure. A slip ring is also called a rotary electrical interface, collector, swivel or a rotary joint. A slip ring can improve system performance by simplifying operations and eliminating damage-prone wires dangling from movable joints.

The 1-1/2 inch unobstructed through-bore provides routing space for hydraulics, pneumatics or for a concentric shaft mount.

The AC6200 uses fiber brush technology which offers several advantages over conventional slip ring contacts including multiple points of contact per brush bundle and low contact wear rates. In addition, fiber brushes do not require lubrication and produce virtually no wear debris, for maintenance free, life time operation.

Features

- 1-1/2 inch through-bore
- Speeds up to 250 rpm continuous
- 12, 24, 36 and 48 circuit versions with 2 amp contacts
- Power and signal (10 and 2 amp) circuits may be combined
- Shaft, brush block and cover are molded of high-impact thermoplastic
- Optional steel bearing and splash seals for harsh environments (special order)
- Collar mounting is standard; flange mounting optional
- 26 gauge color coded, 12” lead wires
- Continuous 360° rotation of power or data signals
- Also available with 6, 12 and 18, 10 amp rings. Please refer to AC4598 data sheet.
- Silver plated rings, silver alloy brushes

Benefits

- Transfers control and data signals
- Fiber brush technology provides maintenance-free operation (no lubrication required)
- Modular design meets special requirements through off-the-shelf manufacturing techniques
- Compact packaging

Typical Applications

- Industrial machinery – machining centers, rotary index tables, heavy equipment turrets or cable reels, test equipment, packaging and palletizing machines, magnetic clutches, process equipment, rotary sensor, emergency lighting, robotics
- Exhibit / display equipment
- Medical equipment

AC6200 Specifications	
Operating Speed	250 rpm* continuous
Number of Circuits	12, 24, 36, 48
Lead Wire	26 gauge, 12 inches, 12 colors with number tags
Voltage	220 VAC
Operating Temp.	-40°C to 80°C
Current Rating	2 amps / circuits
Torque	Approx. .5 in-oz per circuit unsealed
	Add approx. 10 in-oz for dust seals
Noise	Less than 60 milliohms peak @ 6 VDC, 50 mA, 5 - 15 rpm
Sealed Units	Optional intermittent splash and large particle exclusion only

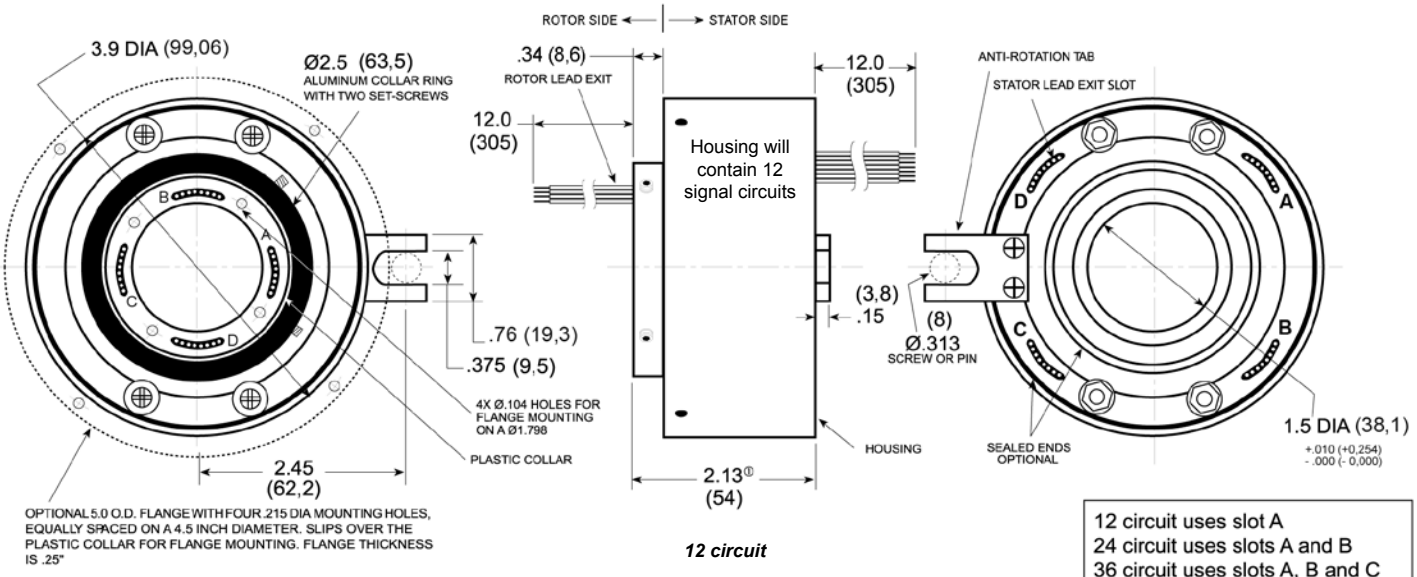
Options

- 5 inch O.D. flange with 4 mounting holes
- Splash seals for dust and moisture resistance
- Various axial and radial lead exits are available
- Signal and power circuit combination for
- 2 and 10 amp applications
- Gold plated rings
- IP 65 rated enclosure available (P/N AC6419), see page 26

**Please note that the operational life of the unit is dependent upon rotational speed, environment and temperature.*

Lead Wire Color Code

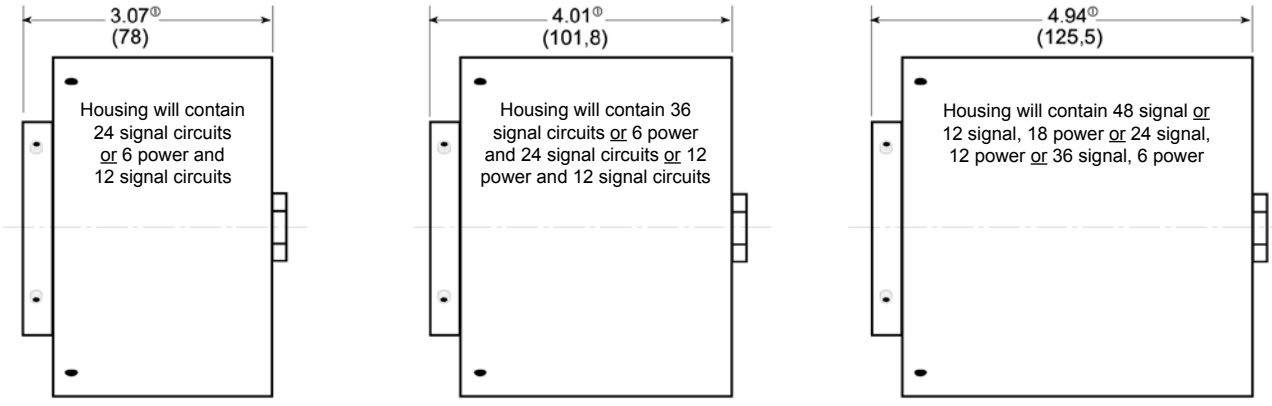
A			B			C			D		
1. Blk	5. Yel	9. Gry	13. Blk	17. Yel	21. Gry	25. Blk	29. Yel	33. Gry	37. Blk	41. Yel	45. Gry
2. Brn	6. Grn	10. Wht	14. Brn	18. Grn	22. Wht	26. Brn	30. Grn	34. Wht	38. Brn	42. Grn	46. Wht
3. Red	7. Blu	11. Wht-Blk	15. Red	19. Blu	23. Wht-Blk	27. Red	31. Blu	35. Wht-Blk	39. Red	43. Blu	47. Wht-Blk
4. Orn	8. Vio	12. Wht-Brn	16. Orn	20. Vio	24. Wht-Brn	28. Orn	32. Vio	36. Wht-Brn	40. Orn	44. Vio	48. Wht-Brn



12 circuit

Dimensions in inches (millimeters)

12 circuit uses slot A
24 circuit uses slots A and B
36 circuit uses slots A, B and C
48 circuit uses slots A, B, C and D



24 circuit *36 circuit* *48 circuit*

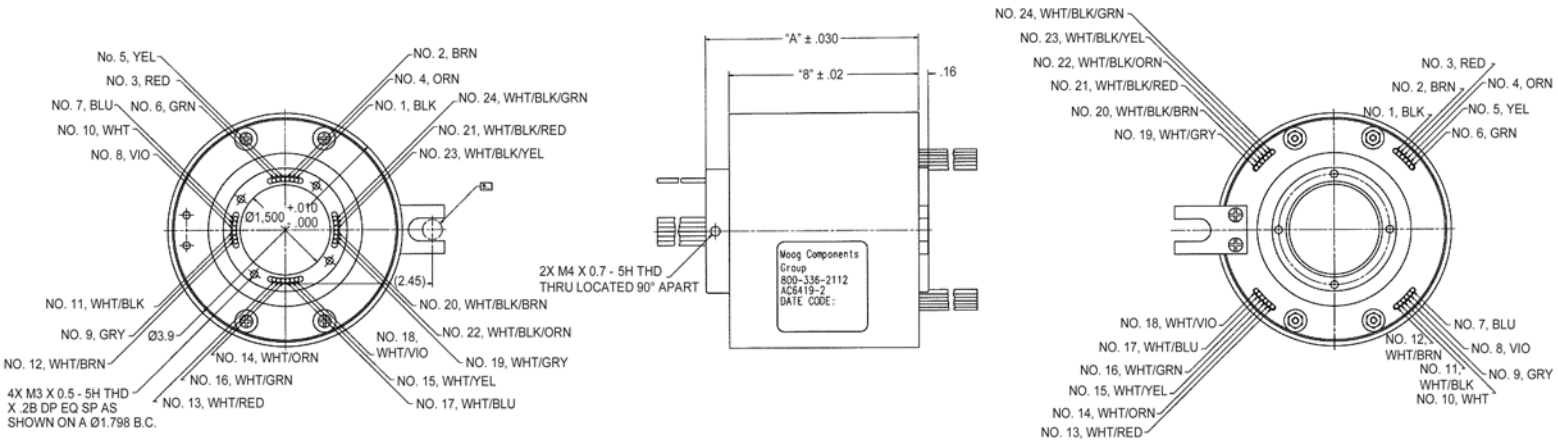
Notes:

1. Drawings not actual size, dimensions are in inches (millimeters)
2. Rotor and stator leads exit 4 places, 90° apart, 12 leads per exit relative to circuit count
3. ① = *Flange mounted, add .188 (4,8) for flange*

AC6419 Specifications (IP 65 Sealed Version of AC4598 and AC6200)		Options
Operating Speed	250 rpm* continuous	• 5 inch (127 mm) O.D. flange with 4 mounting holes • Splash seals for dust and moisture resistance • Various axial and radial lead exits are available • Longer lead lengths are available • Higher rotational speeds with alternate bearings • Higher current and voltage capacity per circuit • Signal and power circuit combination
Number of Circuits	6, 12, 18 or 24	
Lead Wire	16 gauge, 12 inches (300 mm)	
Voltage	600 VAC	
Operating Temp.	-40°C to 80°C	
Current Rating	10 amp circuits	
Torque	Approx. .5 in-oz (36.00 cm-g) per circuit unsealed	
	Add approx. 10 in-oz (720.08 cm-g) for dust seals	
Noise	Less than 100 milliohms peak @ 6 VDC, 50 mA, 5 rpm	
Environmental	IP 65 sealed	

Please note that the operational life of the unit is dependent upon rotational speed, environment and temperature.

AC6419 Dimensions



Dimensions in inches

AC6815

1-1/2 inch through-bore 2 A, 3.5 A, 10 A and high speed data

Description

A slip ring can be used in any electromechanical system that requires unrestrained, continuous rotation while transferring power and/or data from a stationary to a rotating structure. A slip ring is also called a rotary electrical interface, collector, swivel or a rotary joint. A slip ring can improve system performance by simplifying operations and eliminating damage-prone wires dangling from movable joints.

The 1-1/2 inch unobstructed through-bore provides routing space for hydraulics, pneumatics or for a concentric shaft mount.

The AC6815 is designed for error free data communication transmission. Using patented “broadband” slip ring technology, this slip ring is pre-engineered to carry a wide variety of data formats. For example, the AC6815 can handle Ethernet channels of 10, 100 and 1000 BaseT. The precious metal contacts are maintenance free and provide long life and are part of the error-free data communication link.

Features

- 1-1/2 inch through-bore
- Speeds up to 250 rpm continuous
- Power and signal (2, 3.5 and 10 amp) circuits may be combined
- Collar mounting is standard; flange mounting with connectorized unit
- 16, 24 and 26 gauge, 24” lead wires
- Continuous 360° rotation of power or data signals
- Gold alloy bifurcated brushes, gold plated rings
- Prewired for high speed data transmission

Benefits

- Transfers control and data signals
- Bifurcated gold alloy brush technology provides maintenance-free operation (no lubrication required)
- Modular design meets special requirements through off-the-shelf manufacturing techniques
- Compact packaging
- Increased circuit density
- Transmit high speed data
  - Ethernet (10 / 100 / 1000 BaseT)
  - Profibus
  - Control Net
  - USB 1.0
  - Video
  - CanBus
  - Device Net

Typical Applications

- Industrial machinery – machining centers, rotary index tables, heavy equipment turrets or cable reels, test equipment, packaging and palletizing machines, magnetic clutches, process equipment, rotary sensor, emergency lighting, robotics
- Exhibit / display equipment
- Medical equipment

Slip Rings With Through-Bores

AC6815 Specifications	
Operating Speed	250 rpm* continuous
Number of Circuits	See chart below
Lead Wire	16, 24 and 26 gauge, 24 inches
Voltage	2 A / 60 VAC, 3.5 A / 110 VAC and 10 A / 220 VAC
Operating Temp.	-40°C to +80°C max.
Current Rating	2 amps / circuits, 3.5 amps / circuits and 10 amps / circuits
Torque	Approx. .5 in-oz per circuit
Noise	Less than 50 milliohms peak @ 6 VDC, 50 mA, 5 - 15 rpm
Sea Levels	Intermittent splash and large particle exclusion - IP50

Options
• Various axial and radial lead exits are available • Up to 48 inch flying leads from rotor and / or stator • Signal and power circuit combination for 2, 3.5 and 10 amp applications • Connectorized specialized data circuits / platters • Connectorized housing to eliminate flying leads

Please note that the operational life of the unit is dependent upon rotational speed, environment and temperature.

AC6815 Part Numbering System

AC6815 - □□□□□□□□□□ - □□□□ - □□□ - □□

#1 #2 #3 #4 #5 #6 #7 #8 #9 #10

PLATTER CIRCUIT SIGNAL TYPE
(From chart below)

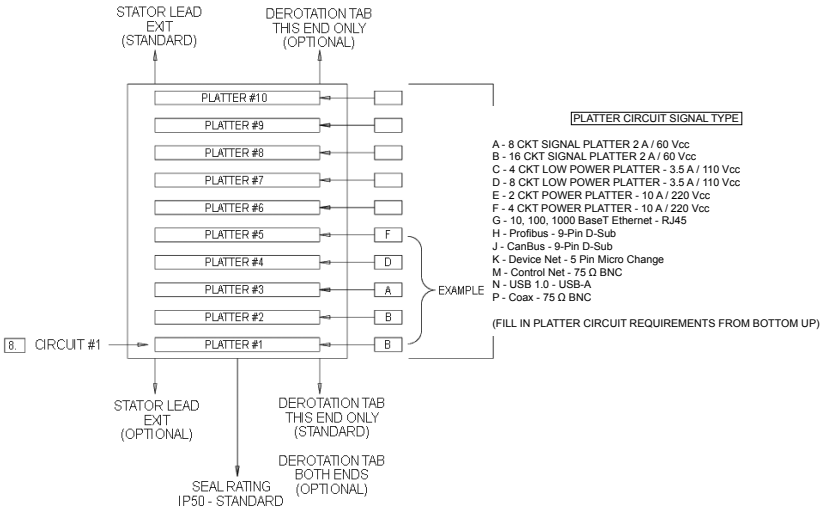
STATOR LEAD EXITING
S - Standard
O - Optional

DE-ROTATION TAB
S - Standard
O - Optional
B- Both

SEAL LEVEL
50 - IP50

LEAD LENGTH (Inches)
024 = 24.0 (Standard)
CON = Connectorized

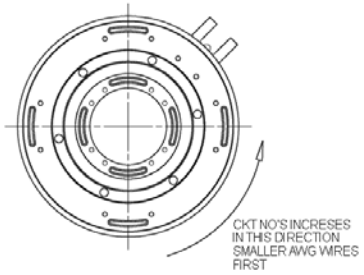
CUSTOM MODIFICATION
(00-Standard)

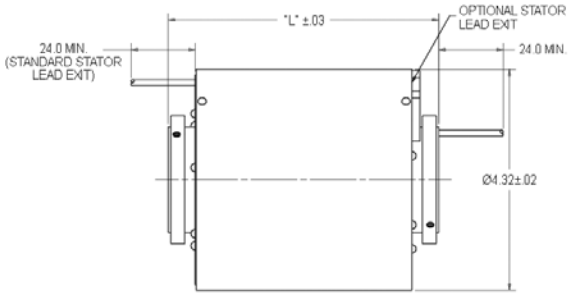


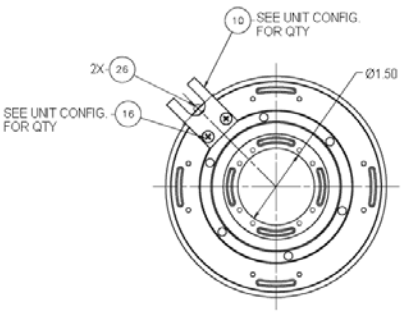
# of Platters	Flying Leads	Connectorized Housing
	"L"	"L"
1	3.01	6.68
2	3.34	7.00
3	3.66	7.33
4	3.99	7.66
5	4.32	7.98
6	4.64	8.31
7	4.97	8.63
8	5.29	8.96
9	5.62	9.29
10	5.95	9.61

Note: Platters 1 thru 8 are standard, 9 and 10 are options.

AC6815 Dimensions







Dimensions in inches

AC6428

1-3/8 inch through-bore in 60, 72, 84 and 96, 2 amp circuit versions

AC6429

1-3/8 inch through-bore in 48, 2 amp circuits and 6 or 12, 10 amp circuits

Description

A slip ring capsule can be used in any electromechanical system that requires unrestrained, intermittent, or continuous rotation while transferring power and / or data. A slip ring is also called a rotary electrical joint, collector, commutator, or swivel. A slip ring can improve system performance by simplifying operations and eliminating damage prone wires.

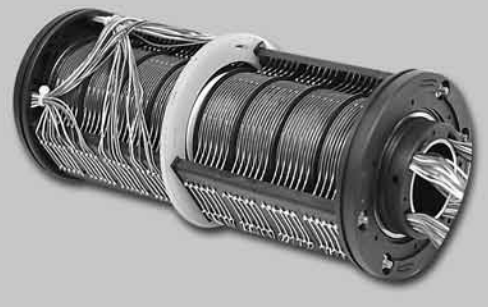
The AC6428 and AC6429 provide an economical, readily available solution when a compact, through bore configuration is required. This unit provides a 1-3/8 inch through bore for routing of hydraulic or pneumatic lines, and a compact 3.9 inch outside diameter for minimal space applications. The AC6428 provides 2 amp circuits in 60, 72, 84 and 96 ring configurations. The AC6429 provides 48, 2 amp rings coupled with either 6 or 12, 10 amp circuits. Similar in design to our very popular AC4598 and AC6200 series, this design features long life, fiber brush contact technology for ultimate performance in many challenging applications.

Features

- 1-3/8 inch through-bore
- Speeds up to 250 rpm continuous
- Multiple circuit configurations
- Continuous rotation of power and / or data signals
- High-impact thermoplastic construction
- Sealed to exclude dust and light fluid splash

Benefits

- Transfers power, as well as analog and digital signals
- Compatible with data bus protocols
- Fiber brush technology provides long life and maintenance free operation
- Compact packaging



Typical Applications

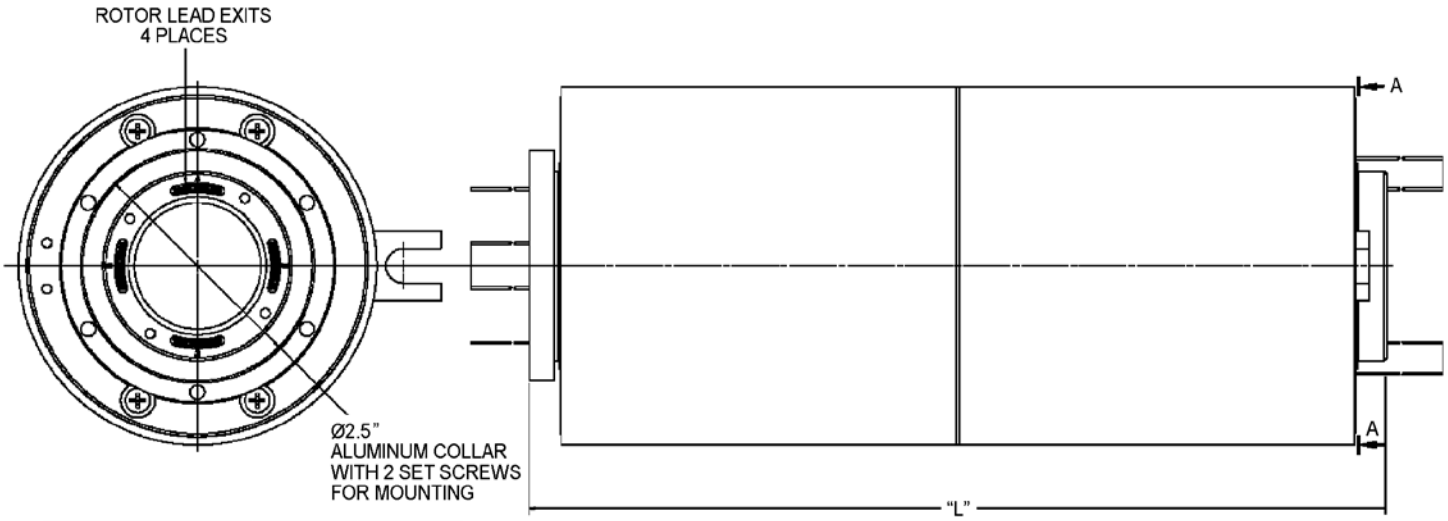
- Precision rotary equipment
- Semiconductor handling systems
- Industrial machinery
- Robotics

Slip Rings With Through-Bores

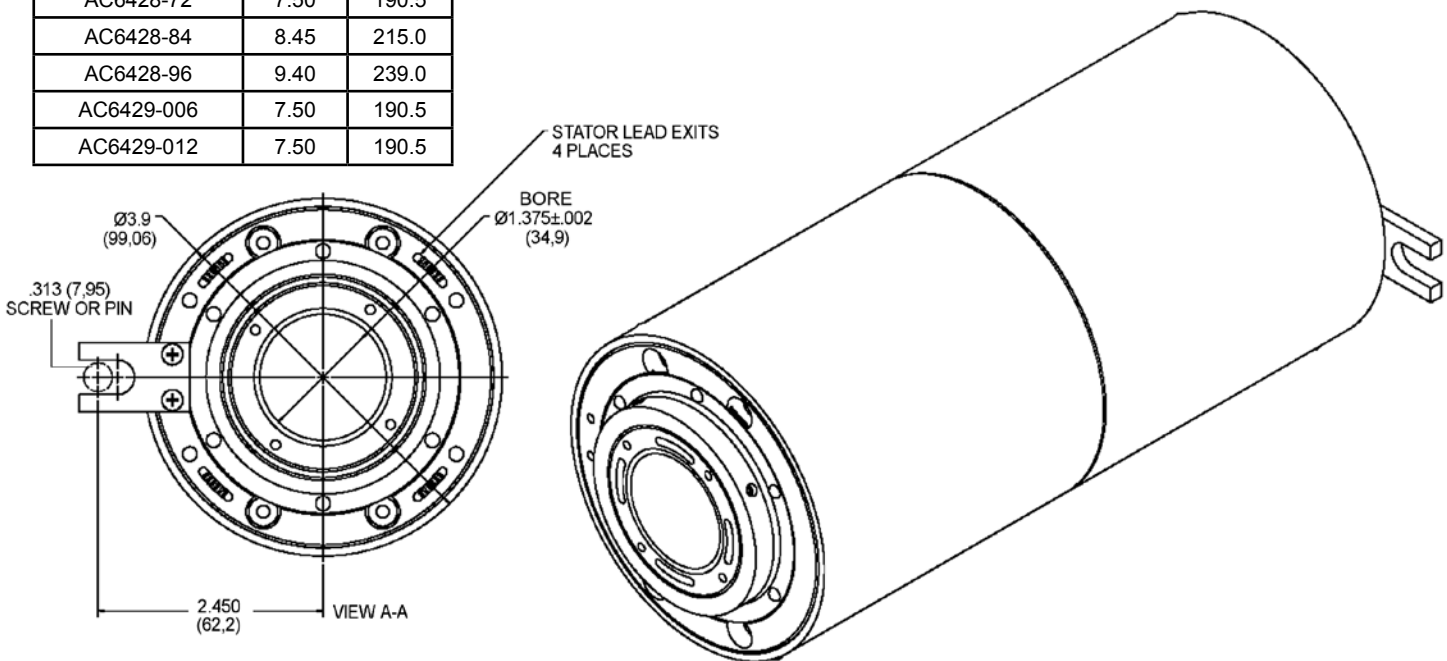
Specifications	AC6428	AC6429
Operating Speed	250 rpm* continuous	250 rpm* continuous
Number of Circuits	60, 72, 84, 96	48 @ 2 amp PLUS 6 or 12 @ 10 amp
Lead Lengths	40 inches (1000 mm)	40 inches (1000 mm)
Voltage	220 VAC	220 VAC, 2 amp; 460 VAC 10 amp
Current Ratings	2 amps / circuits	10 amp and 2 amp / circuits
Lead Size / Type	26 AWG	26 AWG, 2 amp circuits 16 AWG, 10 amp circuits
Operating Temp.	-40°C to +80°C max.	-40°C to +80°C max.
Noise	Less than 60 milliohms @6 VDC, 50 milliamps when running @ 5 rpm	

**Please note that the operational life of the unit is dependent upon rotational speed, environment and temperature.*

Optional Gold Plated Rings Available



Part Number	"L"	
	in.	mm.
AC6428-60	6.60	167.7
AC6428-72	7.50	190.5
AC6428-84	8.45	215.0
AC6428-96	9.40	239.0
AC6429-006	7.50	190.5
AC6429-012	7.50	190.5



Dimensions in inches (millimeters)

AC6275

2-3/4 inch through-bore

Description

A slip ring can be used in any electromechanical system that requires unrestrained, continuous rotation while transferring power and / or data from a stationary to a rotating structure. A slip ring is also called a rotary electrical interface, collector, swivel or a commutator. A slip ring can improve system performance by simplifying operations and eliminating damage-prone wires dangling from movable joints.

The 2-3/4 inch unobstructed through-bore provides routing space for hydraulics, pneumatics or for a concentric shaft mount.

The AC6275 uses our fiber brush technology which offers several advantages over conventional slip ring contacts including multiple points of contact per brush bundle, low contact force per fiber and low contact wear rates. In addition, fiber brushes do not require lubrication and produce virtually no wear debris. The AC6275 features field serviceable brush blocks.

Features

- 2-3/4 inch through-bore
- Compact 6.63 inch outside diameter
- Modular design - a single module can have: one 50 amp ring; two 30 amp rings; one, two or three 10 amp rings or six 5 amp signal rings
- Up to 24-50 amp circuits, 48-30 amp circuits, 72-10 amp rings or 144-5 amp rings in a 24 module length, or combinations of all four in a single housing
- Speeds up to 1,000 rpm continuous
- Steel bearings and machined shaft and housing for harsh environments
- Collar mounting is standard; flange mounting is optional
- Various lead exits are available
- Silver plated rings are standard. Gold plated, optional.
- 20, 16, 10 and 8 gauge lead wire
- Continuous 360° rotation of power or data signals
- Sealed unit
- Available as slip ring / brush block separates
- Brush assemblies are field serviceable

Benefits

- Transfers control and data signals
- Fiber brush technology provides maintenance-free operation (no lubrication required)
- Modular design meets special requirements through off-the-shelf manufacturing techniques
- Customized configurations for your application

Typical Applications

- Industrial machinery – machining centers, rotary index tables, heavy equipment turrets or cable reels, test equipment, packaging and palletizing machines, magnetic clutches, process equipment, rotary sensors, emergency lighting, robotics
- Exhibit / display equipment
- Medical equipment

Slip Rings With Through-Bores

AC6275 Specifications	
Operating Speed	1,000 rpm* continuous
Number of Circuits	Various configurations
Lead Lengths	12 inch (304 mm) min. from point of exit
Lead Size	Signal circuits: #20 AWG, 5 amps #16 AWG, 10 amps Power circuits: #10 AWG, 30 amps #8 AWG, 50 amps
Lead (Colors)	All white with tags
Voltage	250 VAC for 5 A 600 VAC for 10 A, 30 A and 50 A
Max. Ambient Temp.	-40°C to +80°C
Contact Material	Precious metal
Current Rating	5, 10, 30 and 50 amps
Noise	100 milliohms, max. @ 5 VDC, 50 milliamps, 5 rpm
Dust / Splash Seals	Standard lip seal

Options

- Longer lead lengths available
- Power and signal combinations
- Rotor and stator lead exits
- Gold plated rings
- IP65 sealing (P/N AC6793), see page 33

**Please note that the operational life of the unit is dependent upon rotational speed, environment and temperature.*

Part Number	# of Circuits	Capsule Length (L)	# of Modules
AC6275–6	6 power ckts max. or 36 signal ckts max.	6.6 inch	6
AC6275–12	12 power ckts max. or 72 signal ckts max.	11.2 inch	12
AC6275–18	18 power ckts max. or 108 signal ckts max.	15.7 inch	18
AC6275–24	24 power ckts max. or 144 signal ckts max.	20.5 inch	24

The AC6275 commercial slip ring provides configuration flexibility to meet your application needs. This product can be configured as required, with 5 amp signal, 10 amp rings, 30 amp rings and 50 amp rings.

Four set lengths are available, based on the number of modules that are required. These lengths are provided in the capsule length chart above. Each module has either 1-50 amp ring or 2-30 amp rings. For 10 amp rings, there are 1 to 3 rings per module. For 5 amp rings, there are 6 per module. Blank spacer modules are available for greater separation of power and signal circuits.

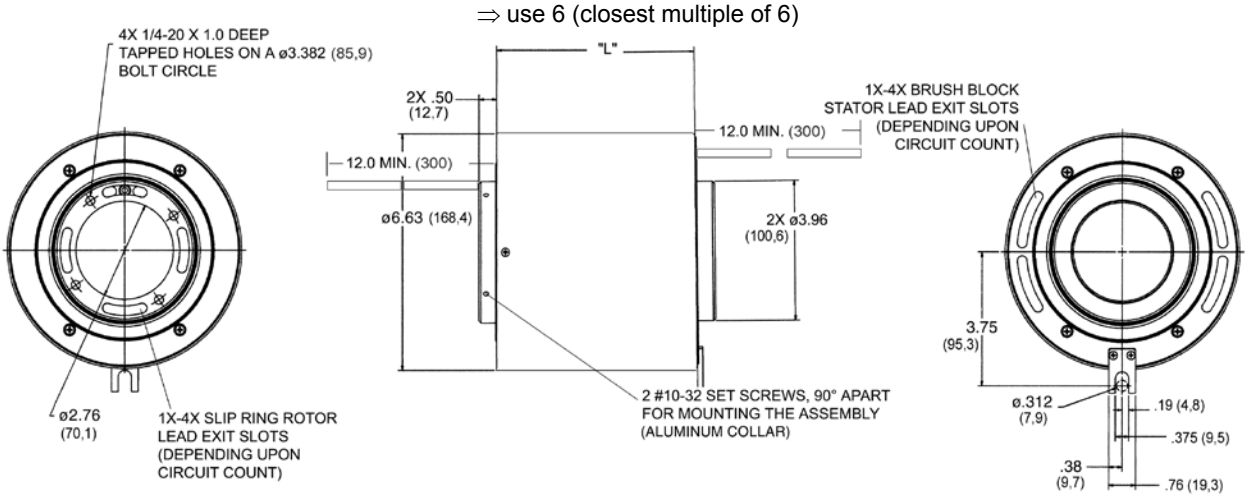
1) Define the number of signal / 5 amp rings and round up to the closest multiple of 6. Divide by 6 for number of 6 ring modules.
2) Define the number of 10 amp rings and round up to the closest multiple of 3 (e.g. 9 divided by 3 equals 3, 3 ring modules).
3) Define the number of 30 amp rings and round up to the closest multiple of 2. Divide by 2 for the number of 30 amp modules.
4) Total the number of signal / 5, 10 amp, 30 amp and 50 amp modules to define the total number of modules required.
5) If your total does not equal the 6, 12, 18 or 24 contained in the 4 lengths above, we will use spacers to fill out the unit to the nearest multiple of 6.

Example: 5, 10 amp rings (2 X 3 = 6), 6 / 3 = 2 modules

(3 each) 30 amp rings = 2 modules

+4 modules

⇒ use 6 (closest multiple of 6)



Dimensions in inches (millimeters)

AC6793 Specifications (IP 65 Sealed Version of AC6275)		Options
Operating Speed	1,000 rpm* continuous	• Longer lead lengths available • Power and signal combinations • Rotor and stator lead exits • Gold plated rings
Number of Circuits	Various configurations	
Lead Lengths	12 inch (304 mm) min. from point of exit	
Lead Size	Signal circuits: #20 AWG, 5 amps #16 AWG, 10 amps Power circuits: #10 AWG, 30 amps #8 AWG, 50 amps	
Lead (Colors)	All white with tags	
Voltage	250 VAC for 5A 600 VAC for 10A, 30A and 50A	
Max. Ambient Temp.	-40°C to +80°C	
Contact Material	Precious metal	
Current Rating	5, 10, 30 and 50 amps	
Noise	100 milliohms, max. @ 5 VDC, 50 milliamps, 5 rpm	
Environmental	IP 65 sealed	

Please note that the operational life of the unit is dependent upon rotational speed, environment and temperature.

Part Number	# of Circuits	Capsule Length (L)	# of Modules
AC6793–6	6 power ckts max. or 36 signal ckts max.	6.6 inch	6
AC6793–12	12 power ckts max. or 72 signal ckts max.	11.2 inch	12
AC6793–18	18 power ckts max. or 108 signal ckts max.	15.7 inch	18
AC6793–24	24 power ckts max. or 144 signal ckts max.	20.5 inch	24

The AC6275 commercial slip ring provides configuration flexibility to meet your application needs. This product can be configured as required, with 5 amp signal, 10 amp rings, 30 amp rings and 50 amp rings.

Four set lengths are available, based on the number of modules that are required. These lengths are provided in the capsule length chart above. Each module has either 1-50 amp ring or 2-30 amp rings. For 10 amp rings, there are 1 to 3 rings per module. For 5 amp rings, there are 6 per module. Blank spacer modules are available for greater separation of power and signal circuits.

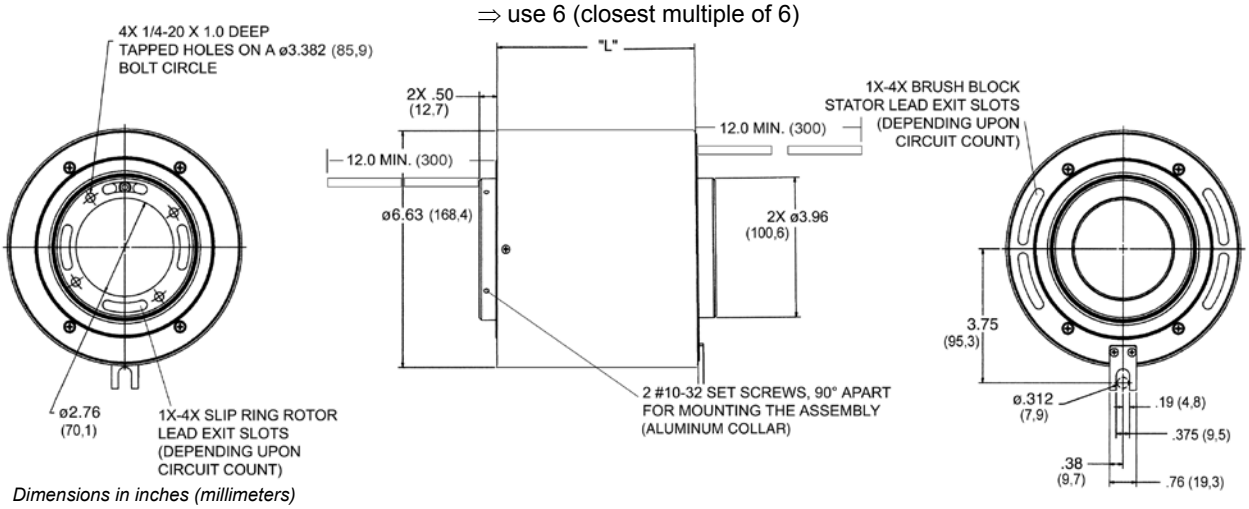
1) Define the number of signal / 5 amp rings and round up to the closest multiple of 6. Divide by 6 for number of 6 ring modules.
2) Define the number of 10 amp rings and round up to the closest multiple of 3 (e.g. 9 divided by 3 equals 3, 3 ring modules).
3) Define the number of 30 amp rings and round up to the closest multiple of 2. Divide by 2 for the number of 30 amp modules.
4) Total the number of signal / 5, 10 amp, 30 amp and 50 amp modules to define the total number of modules required.
5) If your total does not equal the 6, 12, 18 or 24 contained in the 4 lengths above, we will use spacers to fill out the unit to the nearest multiple of 6.

Example: 5, 10 amp rings (2 X 3 = 6), 6 / 3 = 2 modules

(3 each) 30 amp rings = 2 modules

+4 modules

⇒ use 6 (closest multiple of 6)



Dimensions in inches (millimeters)

AC6098
4 inch through-bore

Description
A slip ring can be used in any electromechanical system that requires unrestrained, continuous rotation while transferring power and / or data from a stationary to a rotating structure. A slip ring is also called a rotary electrical interface, commutator, collector, swivel or a rotary joint.

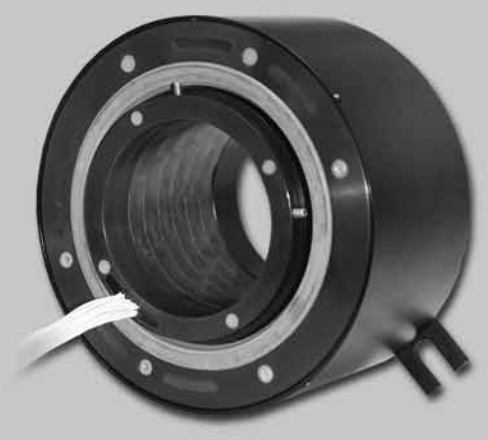
The AC6098 is a commercial slip ring capsule that features a 4 inch through-bore and a compact 8.13 inch outside diameter. The through-bore provides routing space for hydraulics, pneumatics, or for a concentric shaft mount.

This slip ring is available in four lengths, from 4.6 to 14.5 inches (depending on the number of circuits required). It can be manufactured with 1 to 72 signal rings or 1 to 24 power rings. This "stacked module" approach allows us to quickly assemble the exact number and type of circuits that our customers require. Unlike most competitive units, the AC6098 transfers low level control and data signals. In addition, signal / data circuits can be combined with power circuits all in the same assembly. The slip ring can run up to 250 rpm continuous.

The AC6098 uses our fiber brush technology which offers several advantages over conventional slip ring contacts including multiple points of contact per brush bundle, low contact force per fiber and low contact wear rates. In addition, fiber brushes do not require lubrication and produce virtually no wear debris.

Features
- 4 inch through-bore
- 1 to 72 signal rings (signal up to 10 amps)
- 1 to 24 power rings (30 amp or 50 amp or some combination)
- Can combine signal and power in same slip ring
- Handles controller signals
- Speeds up to 250 rpm
- Silver plated rings; silver alloy fiber brushes
- Sealed against dust and splash
- Brush assemblies are field serviceable (if required)

Benefits
- Compact design
- Design flexibility to meet your requirements
- Transfers low level control and data signals
- Provides the exact number of circuits required
- Fiber brush technology provides maintenance-free operation (no cleaning or lubrication required)



Typical Applications
- Industrial machinery - machining centers, rotary index tables, heavy equipment turrets or cable reels, test equipment, packaging and palletizing machines, robotics, process equipment and rotary sensors
- Amusement rides
- Exhibit / display equipment
- Medical equipment

AC6098 Specifications		Options
Operating Speed	250 rpm*	• Longer lead lengths available • Power and signal combinations • Gold plated rings
Number of Circuits	Various configurations	
Lead Lengths	12 inch (304 mm) min. from point of exit	
Lead Size	Signal circuits: #16 AWG, 10 amps Power circuits: #10 AWG, 30 amps #8 AWG, 50 amps	
Leads	All white with tags	
Voltage	600 VAC	
Max. Ambient Temp.	80°C	
Contact Material	Precious metal	
Current Rating	10, 30 and 50 amps	
Noise	100 MΩ at 6 volts DC, 50 mA at 5 rpm	
Dust / Splash Seals	Standard lip seal	

**Please note that the operational life of the unit is dependent upon rotational speed, environment and temperature.*

Part Number	# of Circuits	Capsule Length	# of Modules
AC6098–6	6 power ckts max. or 18 signal ckts max.	4.43 inch (112,5 millimeters)	1 to 6
AC6098–12	12 power ckts max. or 36 signal ckts max.	7.78 inch (197,5)	7 to 12
AC6098–18	18 power ckts max. or 54 signal ckts max.	11.12 inch (282,6)	13 to 18
AC6098–24	24 power ckts max. or 72 signal ckts max.	14.47 inch (368,3)	19 to 24

The AC6098 commercial slip ring provides configuration flexibility to meet your application needs. This product can be configured as required, with signal / 10 amp rings, 30 amp rings and 50 amp rings.

Four set lengths are available, based on the number of modules that are required. These lengths are provided in the capsule length chart above. Blank spacer modules are available for greater separation of power and signal circuits. Each 30 amp and 50 amp ring is one module. For signal / 10 amp rings, there are 1 to 3 rings per module. To determine the length of your capsule:

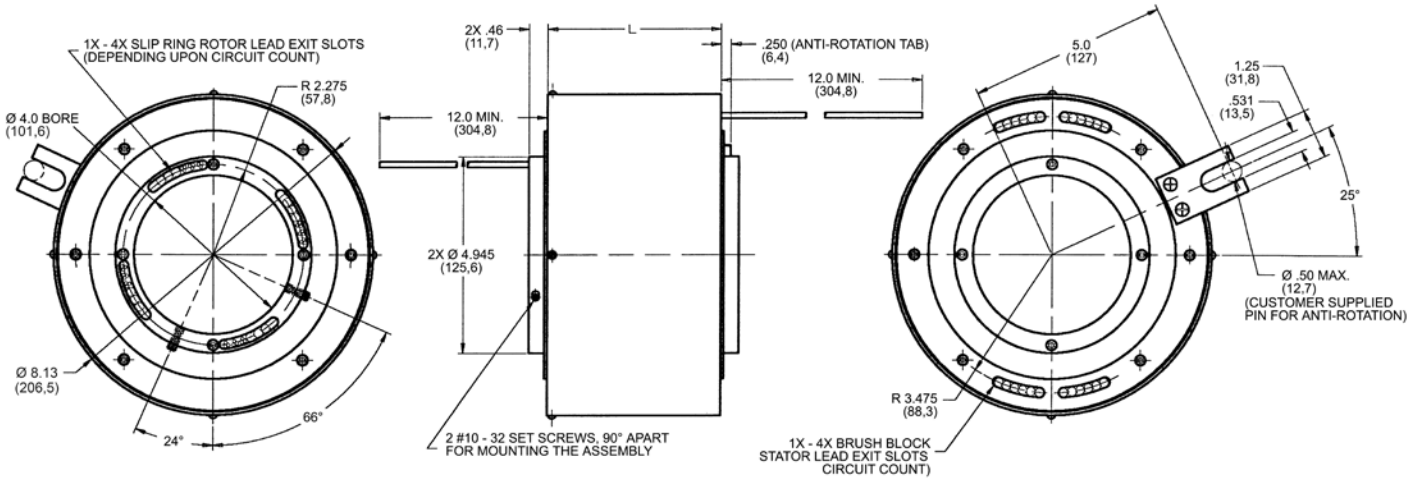
1) Define the number of signal / 10 amp rings, and round up to the closest multiple of 3 (i.e. 7 signal rings rounds up to 9 rings).
2) Divide this number by 3 to determine the number of signal / 10 amp modules.
3) Total the number of signal / 10 amp, 30 amp and 50 amp modules to define the total number of modules required.
4) If your total does not equal the 6, 12 18 or 24 contained in the 4 lengths above, we will use spacers to fill out the unit to the nearest multiple of 6.

Example: 5 signal rings (2 X 3 = 6), 6 / 3 = 2 signal modules

(3 each) 30 amp rings = 3 modules

+5 modules

⇒ use 6 (closest multiple of 6)



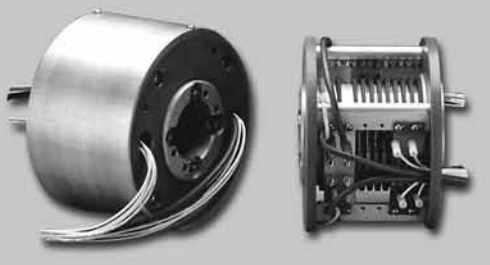
Dimensions in inches (millimeters)

Endura-Trac™
Standard W series

Description
The Endura-Trac™ series of slip ring assemblies were developed for a wide variety of applications and environments. The flexible design and through-bore capability of up to 3 inches, along with many other options make it ideal for a designer to incorporate into new and retrofit applications. Modular construction allows a range of signal and power combinations with power circuits up to 30 amps and signal circuits up to 5 amps. These slip ring assemblies are a quick turn solution for your application. Off-the-shelf components allow for a delivery which meets your needs.

Features
- Unobstructed bore sizes from 1-1/2 inches to 3 inches
- Up to 24 signal circuits, up to 12 power circuits
- Continuous bidirectional rotation up to 60 rpm
- All metal dust cover
- Flying lead wire bundle, 24 inch lead length
- #20 AWG signal lead wire, #12 AWG power lead wire
- Shaft, rotor, or both can rotate
- Leadwires can exit from same or opposite ends of the rotor and stator

Benefits
- Ease of installation
- Compatible with data bus protocols
- Transfers power, as well as analog and digital signals
- Replaceable brush blocks
- 27 different combinations of signals and power circuits



Typical Applications
- Packaging machines
- Index tables
- Paper and film converting
- Rotary machines
- Machine tools
- Automation equipment
- Medical equipment
- Surveillence equipment
- Inspection equipment

Standard W Series Specifications		Options
Operating Speed	60 RPM	• Open frame • Drive adaptor for stator de-rotation • Longer lead lengths • Special wiring or harnes requirements (coaxial, twinaxial and triaxial cable, thermocouple) • High voltage option to 3000 V • Various power and signal configurations available
Power Circuits	Up to 12 power circuits: 30 A / 600 volts	
Signal Circuits	Up to 24 signal circuits: 5 A / 250 volts	
Terminals	Power circuits - 12 AWG flying leads Signal circuits - 20 AWG flying leads	
Mounting	Shaft mounting	
Temperature Range	-20˚C to +90˚C	
Dielectric Strength	1000 volts 50Hz for 10 seconds	
Insulation Resistance	>200 MΩ at 1000 volts DC	

**Please note that the operational life of the unit is dependent upon rotational speed, environment and temperature.*

Bore Size	ID Actual	OD	S	R
1.5 inch (38,1 mm)	1.52 inch (38,61)	5 inch (127,00)	4.033 inch (102,44)	1.896 inch (48,16)
3.0 inch (76,2)	3.02 inch (76,71)	6.50 inch (165,10)	5.488 inch (139,40)	3.396 inch (86,26)

To determine length of overall unit, use the following formulas or contact us for assistance.

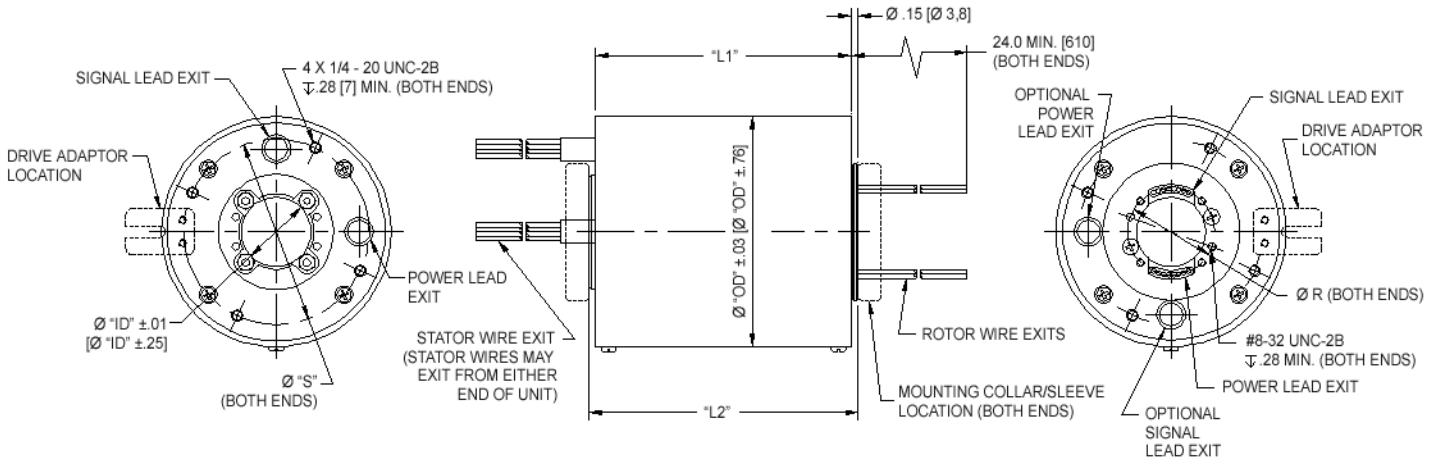
xx = Total number of signal rings
yy = Total number of power rings

L1 = .2(xx) + .4(yy) + .80
L2 = .2(xx) = .4(yy) + 1.09

Number of signal rings (multiples of 4)

Number of power rings (multiples of 2)	0	4	8	12	16	20	24
0		-	-	-	-	-	-
2	-	-	-	-	-	-	
4	-	-	-	-	-		
6	-	-	-	-			
8	-	-	-				
10	-	-					
12	-						

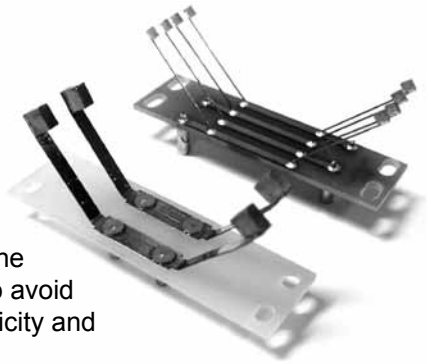
Standard W Series Dimensions



Dimensions in inches [millimeters]

Endura-Trac™ Accessories

Our pre-engineered slip rings that feature a flexible design, minimized lead times and maximum reliability



Mounting Guidelines

There are several mounting options available on Endura-Trac™ products. One of the most important rules to remember when designing the installation of a slip ring is to avoid hard mounting both the rotating and stationary sections. This can transfer concentricity and axial run-out into the slip ring assembly and can adversely affect slip ring life.

Hard Mounting (Fixed Mounting): Any concentricity or axial run-out in the rotating-mechanical system is transferred to the slip ring assembly.

Soft Mounting (Floating Mount): Any concentricity or axial run-out in the rotating-mechanical system is not transferred to the slip ring assembly.

Ideally, the inner portion of the slip ring (ID) should be mounted by attaching a flange directly to it with screws or by using a Mounting Collar Kit that attaches to the slip ring rotor section and connects to the shaft with set-screws. The outer portion of the slip ring (OD) is soft mounted using a Drive Adapter Kit. If the OD is hard mounted in a housing or with a flange, the ID may be soft mounted using a flexible coupling. Hard mounting both the rotor and stator is not recommended.

Mounting Accessories

The Mounting Collar Kit attaches to either end of the slip ring rotor and facilitates mounting to a shaft by means of 2 set-screws located approximately 100° apart. All mounting collars add 0.50 inch to the overall unit length.

Drive Adapter Kits are the perfect solution for soft mounting the stator section of the slip ring. This simple pin-in-slot arrangement prevents system concentricity or axial run-out problems from being transferred into the slip ring.

Mounting Accessories For Standard and Plus W Series

Bore Size (Inch)	W-Series	Mounting Collar Kit Part Number	Drive Adapter Kit Part Number
1.5	Standard	W1500086	W1500087
1.5	Plus	W1500090	W1500087
3.0	Standard	W3000046	W1500087
3.0	Plus	W3000069	W1500087
4.0	Plus	W4000035	W1500087
6.0	Plus	W6000021	W1500087
9.0	Plus	W9000019	W1500087

Replacement Brush Blocks Standard and Plus W-Series

Bore Size (Inch)	Circuit Type	Part Number
1.5	Signal	W1500053
	Power	W1500088
3.0	Signal	W3000057
	Power	W3000058
4.0	Signal	W4000029
	Power	W4000030
6.0	Signal	W6000019
	Power	W6000017
9.0	Signal	W9000011
	Power	W9000012

Replacement brush block assemblies are easy to install with a standard screw driver and socket wrench. They are made of the same reliable silver composite brushes that are provided on the original unit. Contact the factory for assistance. Custom formulations of silver composite brushes with additives can extend brush life or be used in adverse environments.

Split Slip Rings

Description

For some applications, particularly machinery and equipment upgrades, it is impossible to access either end of the rotating shaft to allow the addition of a conventional slip ring. For these applications, we have a special slip ring solution which includes a split slip ring and a conventional brush block. The slip ring is essentially supplied as two semi-circular parts, which are then clamped around the shaft with a tightening system to rigidly fix the two halves together. Since the two semi-circulars sections are finish machined and gold plated at the factory in the assembled condition, the effects of the gap on the overall operation of the slip ring are minimized. Electrical connections can either be standard or custom.

Features

- Separate split ring and brush block
- Minimal disturbance electrically at the split of the slip ring

Benefits

- Enables existing rotating shaft to be retrofitted with a slip ring

Typical Applications

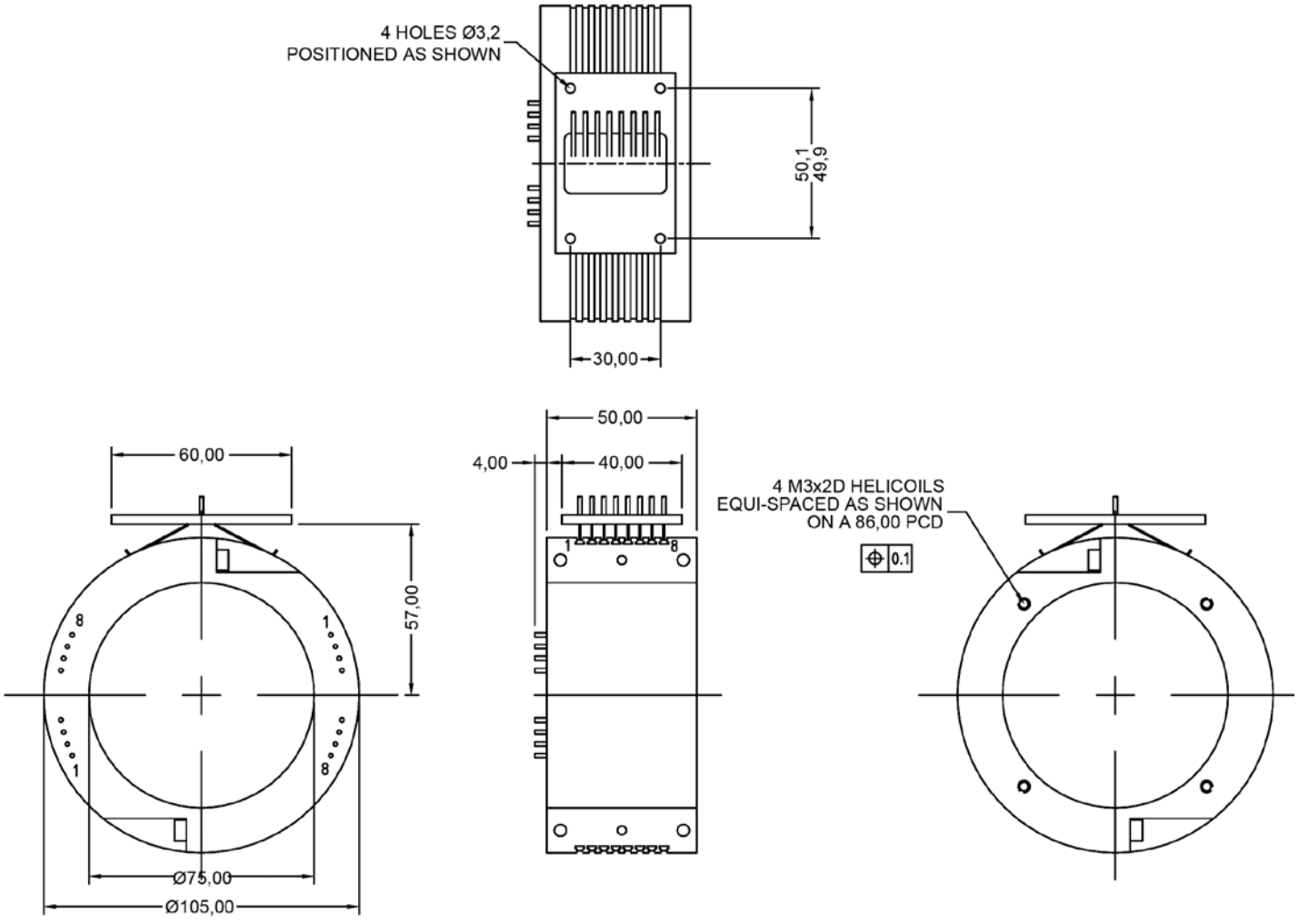
- Updates of large complex machinery

Split Slip Rings

As these are special applications, we show a selection of units delivered in the past. Please contact us with your exact requirements.

Part No.	Internal Diameter	External Diameter	Length	No. of Rings	Current Capability
56814-950	75 mm	105 mm	50 mm	8	2 A
56871-951	152 mm	182 mm	20 mm	4	2 A
57165-950	42 mm	61 mm	31 mm	5	2 A
57622-950	178 mm	221 mm	40 mm	8	2 A

Split Slip Ring Dimensions



Dimensions in millimeters

SRA-73540

Compact slip ring capsule

Description

A slip ring can be used in any electromechanical system that requires unrestrained, continuous rotation while transferring power and / or data from a stationary to a rotating structure. A slip ring is also called a rotary electrical interface, commutator, collector, swivel or an electrical rotary joint.

This slip ring which we call our “mini”, is our newest design and smallest physical package. It can incorporate up to 12 circuits, each rated at 2 amps. This unit is ideal for use where mounting space is limited and critical, without sacrificing current handling capability.

Features

- 6 and 12 circuit models
- 2 amp, 120 VDC / VAC circuits
- Precision assembly to provide exceptional rotational life
- Speeds up to 250 rpm continuous
- Compact size .44 inch diameter, .64 inch long
- Gold-on-gold contacts
- Mounting flange on housing
- Flexible, color-coded, silver-plated, stranded copper lead wire
- Superior handling of low level control signals

Benefits

- Extremely compact
- Low torque
- Quick shipment
- High bandwidth transfer capability

Typical Applications

- CCTV pan / tilt camera mounts
- Medical equipment
- Robot end effectors
- Miniature cable reels
- Laboratory equipment

Slip Ring Capsules (Compact)

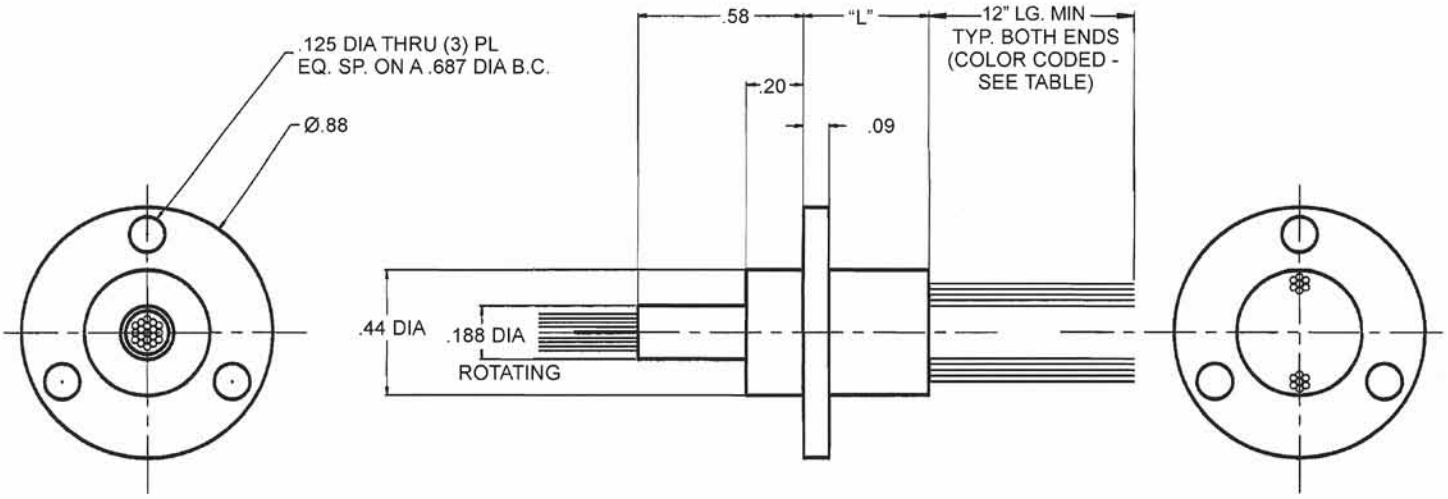
SRA-73540 Specifications	
Operating Speed	250
Number of Circuits	6, 12
Lead Lengths	12, 24, 36 and 48 inches
Lead Size / Type	#28 AWG, Teflon® insulated, stranded cond.
Voltage	120 VDC
Max. Ambient Temp.	-40°C to +80°C
Contact Material	Gold
Current Rating	2 A per ring, maximum
Dielectric Strength	500 VRMS, all combinations
Insulation Resistance	1000 megohms min. @ 250 VDC
Noise	60 milliohms max. tested @ 6 VDC, 40 milliamps when running @ 5 - 15 rpm

Lead Wire Color Code	
Ring #	**Color Code**
1	BLK
2	BRN
3	RED
4	ORN
5	YEL
6	GRN
7	BLU
8	VIO
9	GRY
10	WHT
11	WHT-BLK
12	WHT-BRN

**Please note that the operational life of the unit is dependent upon rotational speed, environment and temperature.*

Part Number	"L" Dimension	Ring Qty.
SRA-73540-6	.44 inch (11,78 mm)	6
SRA-73540	.44 inch (11,78 mm)	12

SRA-73540 Dimensions



Dimensions in inches

SRA-73625

Compact slip ring capsule

Description

A slip ring can be used in any electromechanical system that requires unrestrained, continuous rotation while transferring power and/or data from a stationary to a rotating structure. A slip ring is also called a rotary electrical interface, commutator, collector, swivel or an electrical rotary joint.

The SRA-73625 miniature capsule provides up to 18, 2 amp rated contacts in a small, .44 inch diameter design. Color-coded lead wires are provided on both the rotor and stator to allow simplified electrical connections. Similar in design to our SRA-73540, the SRA-73625 allows tremendous flexibility in dealing with system size restrictions.

Features

- 18 circuit
- 2 amp, 120 VDC / VAC circuits
- Precision assembly to provide exceptional rotational life
- Speeds up to 100 rpm continuous
- Compact size .44 inch diameter
- Gold-on-gold contacts
- Mounting flange on housing
- Flexible, color-coded, silver-plated, stranded copper lead wire
- Superior handling of low level control signals

Benefits

- Extremely compact
- Low torque
- Quick shipment
- High bandwidth transfer capability

Typical Applications

- CCTV pan / tilt camera mounts
- Medical equipment
- Robot end effectors
- Miniature cable reels
- Laboratory equipmentp

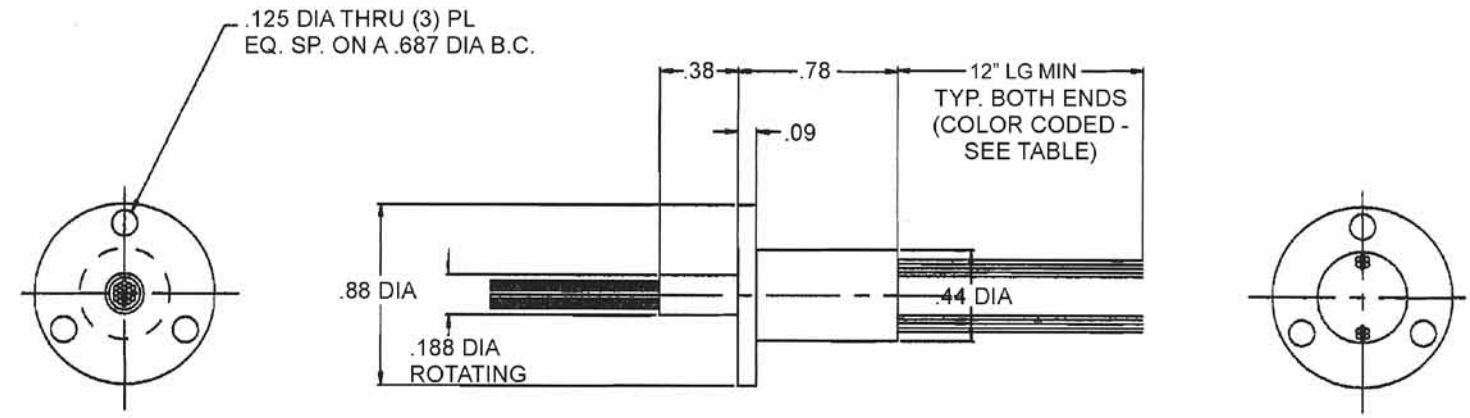
Slip Ring Capsules (Compact)

SRA-73625 Specifications	
Operating Speed	100 rpm*
Number of Circuits	18
Lead Lengths	12, 24, 36 and 48 inches
Lead Size / Type	#28 AWG, Teflon® insulated, stranded cond.
Voltage	120 VDC / VAC
Max. Ambient Temp.	-40°C to +80°C
Contact Material	Gold
Current Rating	2 amps
Dielectric Strength	500 VRMS
Insulation Resistance	1000 megohms @ 250 VDC
Noise	60 milliohms max. tested @ 6 VDC, 40 milliamps when running @ 5 - 15 rpm

Lead Wire Color Code			
Ring #	**Color Code**	**Ring #**	**Color Code**
1	BLK	10	WHT
2	BRN	11	WHT-BLK
3	RED	12	WHT-BRN
4	ORN	13	WHT-RED
5	YEL	14	WHT-ORN
6	GRN	15	WHT-YEL
7	BLU	16	WHT-GRN
8	VIO	17	WHT-BLU
9	GRY	18	WHT-VIO

**Please note that the operational life of the unit is dependent upon rotational speed, environment and temperature.*

SRA-73625 Dimensions



Dimensions in inches

AC6373

Compact slip ring capsule

Description

A slip ring can be used in any electromechanical system that requires unrestrained, continuous rotation while transferring power and/or data from a stationary to a rotating structure. A slip ring is also called a rotary electrical interface, commutator, collector, swivel or an electrical rotary joint.

The AC6373 miniature capsule provides up to 12, 2 amp rated contacts in a small, 1/2 inch diameter design. Color-coded lead wires are provided on both the rotor and stator to allow simplified electrical connections. Similar in design to our very popular AC6023 family, the AC6373 allows tremendous flexibility in dealing with system size restrictions. It is available in 6 and 12 circuit configurations.

Features

- 6 and 12 circuit models
- 2 amp, 120 VDC / VAC circuits
- Precision assembly to provide exceptional rotational life
- Speeds up to 100 rpm continuous
- Compact size 1/2 inch diameter, .58 inch or .83 inch long
- Gold-on-gold contacts
- Mounting flange on housing
- Flexible, color-coded, silver-plated, stranded copper lead wire
- Superior handling of low level control signals

Benefits

- Extremely compact
- Low torque
- Quick shipment
- High bandwidth transfer capability

Typical Applications

- CCTV pan / tilt camera mounts
- Medical equipment
- Robot end effectors
- Miniature cable reels
- Laboratory equipment

Slip Ring Capsules (Compact)

AC6373 Specifications	
Operating Speed	100 rpm* continuous
Number of Circuits	6 or 12
Lead Lengths	12, 24, 36 and 48 inches
Lead Size / Type	26 (7 / 34) silver plated copper Type ET Teflon® insulated
Voltage	120 VDC ; 120 VAC
Max. Ambient Temp.	-40°C to +80°C
Contact Material	Gold
Current Rating	2 amps / circuit
Dielectric Strength	250 VAC @ 60 Hz, between each circuit and all other circuits
Insulation Resistance	1000 megohms @ 250 VDC
Noise	60 milliohms max. tested @ 6 VDC, 50 milliamps when running @ 5 - 15 rpm

AC6373 Lead Wire Color Codes			
Ring #	**Color Code**	**Ring #**	**Color Code**
#1	BLK	#7	BLU
#2	BRN	#8	VIO
#3	RED	#9	GRY
#4	ORN	#10	WHT
#5	YEL	#11	WHT-BLK
#6	GRN	#12	WHT-BRN

Part Number	Length "L"
AC6373 - 6	.58 inch (14,7 mm)
AC6373 - 12	.83 inch (21,1 mm)

**Please note that the operational life of the unit is dependent upon rotational speed, environment and temperature.*

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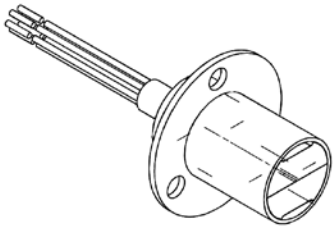
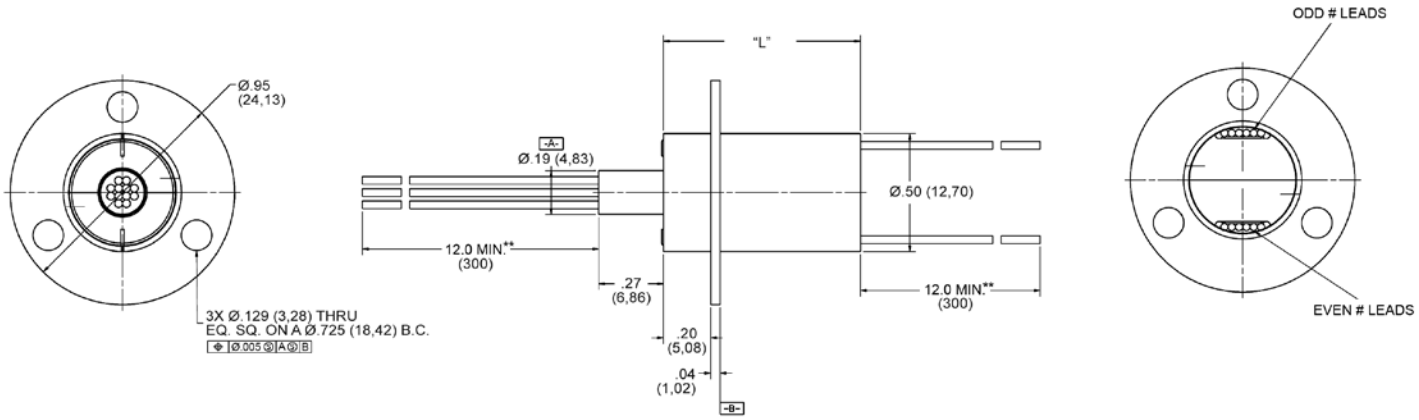
AC6373 Dimensions





Dimensions in inches (millimeters)

SRA-73526 / SRA-73528 / SRA-73599

Compact in various circuit configurations

Description

A slip ring can be used in any electromechanical system that requires unrestrained, continuous rotation while transferring power and / or data from a stationary to a rotating structure. A slip ring is also called a rotary electrical interface, commutator, collector, swivel or an electrical rotary joint.

Features

- 6, 12, 18 and 24 circuit models
- 2 amp / 210 VDC / 240 VAC circuits
- Precision ball bearings meet or exceed life requirements for most commercial applications
- Speeds up to 250 rpm continuous
- Compact size: .87 inch to 1.44 inch lengths (depending upon number of circuits)
- Gold-on-gold contacts
- Compatible with data bus protocols
- Flexible, color-coded, silver-plated, Teflon® insulated lead wires
- Transfers analog and digital signals

Benefits

- Smooth running
- Low torque
- Compact
- Quick shipment

Typical Applications

- CCTV pan / tilt camera mounts
- Electrical test equipment
- Manufacturing and process control equipment
  - Indexing tables
  - Robotics (end-effectors, arms, vision systems, sensors)
- Exhibit / display equipment
- Medical equipment

Slip Ring Capsules (Compact)

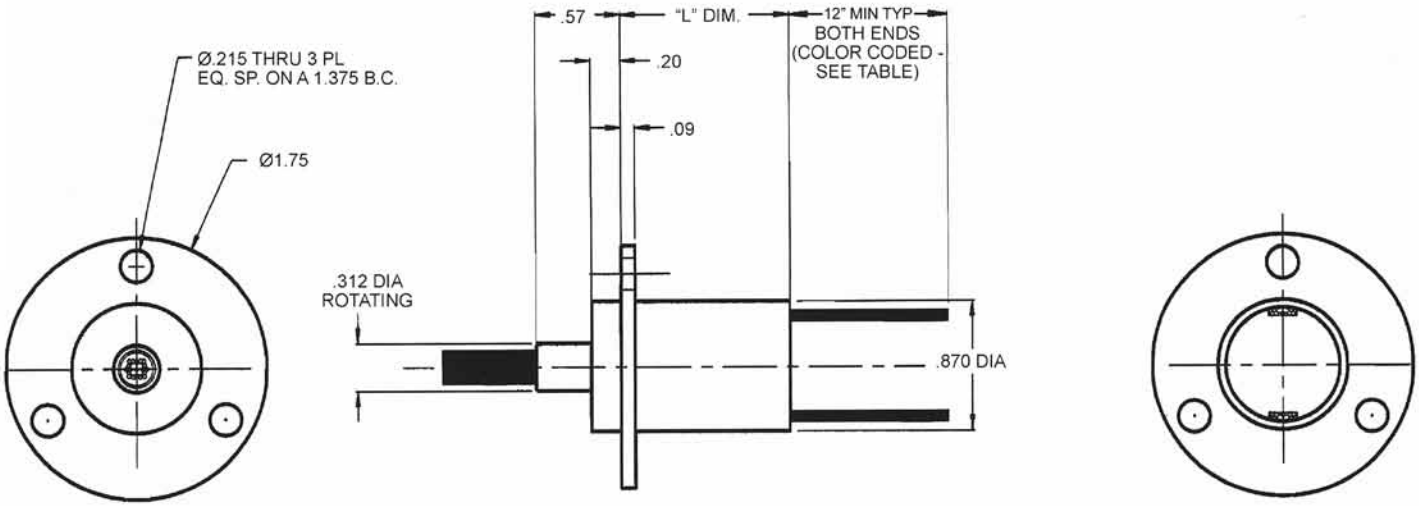
SRA-73526 / SRA-73528 / SRA-73599 Specifications	
Operating Speed	250 rpm* continuous
Number of Circuits	6, 12, 18, or 24
Lead Lengths	12, 24, 36 and 48 inches
Lead Size / Type	#26 AWG Teflon® insulated, stranded cond.
Voltage	210 VDC / 240 VAC
Temperature Range	-40°C to +80°C
Contact Material	Gold
Current Rating	2 A, per ring, max.
Dielectric Strength	500 VRMS, all combinations
Insulation Resistance	1000 megohms min. @ 250 VDC
Electrical Noise	60 milliohms max. tested @ 6 VDC, 40 milliamps when running @ 5 - 15 rpm

**Please note that the operational life of the unit is dependent upon rotational speed, environment and temperature.*

Lead Wire Color Code					
Ring#	**Color Code**	**Ring#**	**Color Code**	**Ring#**	**Color Code**
1	BLK	9	GRY	17	WHT-BLU
2	BRN	10	WHT	18	WHT-VIO
3	RED	11	WHT-BLK	19	WHT-GRY
4	ORN	12	WHT-BRN	20	WHT-BLK-BRN
5	YEL	13	WHT-RED	21	WHT-BLK-RED
6	GRN	14	WHT-ORN	22	WHT-BLK-ORN
7	BLU	15	WHT-YEL	23	WHT-BLK-YEL
8	VIO	16	WHT-GRN	24	WHT-BLK-GRN

Part Number	Length "L"	# of Circuits
SRA-73526-6	.57	6
SRA-73528	.76	12
SRA-73526-18	1.11	18
SRA-73599	1.24	24

SRA-73526 / SRA-73528 / SRA-73599 Dimensions



Dimensions in inches

AC6023

Compact in various circuit configurations

Description

A slip ring can be used in any electromechanical system that requires unrestrained, continuous rotation while transferring power and / or data from a stationary to a rotating structure. A slip ring is also called a rotary electrical interface, commutator, collector, swivel or an electrical rotary joint.

The AC6023 slip ring capsule is a standard, off-the-shelf unit that uses gold contacts at the rotary interface. Color-coded lead wires are used on both the stator and rotor for simplified electrical connections.

The AC6023 utilizes 90° V-groove rings to provide smoother running, lower torque and lower (electrical) noise than competitive slip rings. It is available in 6, 12, 18 and 24 circuit models.

Features

- 6, 12, 18 and 24 circuit models
- 2 amp / 210 VDC / 240 VAC circuits
- Precision ball bearings meet or exceed life requirements for most commercial applications
- Speeds up to 250 rpm continuous
- Compact size: 0.57 inch to 1.38 inch lengths (depending upon number of circuits)
- Gold-on-gold contacts
- 12 inch, 24 inch, 36 inch, 48 inch standard lead lengths
- Compatible with data bus protocols
- Sealed units are also available (dust and light splash only)
- Flexible, color-coded, silver-plated, Teflon® insulated lead wires
- Transfers analog and digital signals
- Also available with 5 and 10 amp power rings combined with 2 amp rings. Please refer to AC6305 / AC6310 data sheet.

Benefits

- Smooth running
- Low torque
- Compact
- Quick shipment

Typical Applications

- CCTV pan / tilt camera mounts
- Electrical test equipment
- Manufacturing and process control equipment
  - Indexing tables
  - Robotics (end-effectors, arms, vision systems, sensors)
- Exhibit / display equipment
- Medical equipment

Slip Ring Capsules (Compact)

AC6023 Specifications	
Operating Speed	250 rpm* continuous
Number of Circuits	6, 12, 18, or 24
Lead Lengths	12, 24, 36, and 48 inches
Lead Size / Type	28 (7 / 34) silver plated copper, type ET Teflon®
Voltage	210 VDC / 240 VAC
Temperature Range	-40°C to +80°C
Contact Material	Gold
Current Rating	2 amps / ckt
Dielectric Strength	250 VAC @ 60 Hz, between each circuit and all other circuits
Insulation Resistance	1000 megohms @ 500 VDC
Electrical Noise	60 milliohms max. tested @ 6 VDC, 50 milliamps when running @ 5 rpm

Custom Assemblies

Aside from the standard configurations shown here, we have a wide variety of special designs, which have been customized to meet the particular needs of an individual application.

- Termination of lead wires into your chosen crimps and / or connectors
- Inclusion of coax and miniature data bus cables
- Addition of specialist components (chokes, in-line resistors etc.)
- Placement of custom circuitry directly onto the unit
- Custom harnessing
- Custom mechanical integration features
- Rear access (through) shafts
- Low rotational torque units for self-levelling applications
- Combination slip ring / fiber optic joints (see also pages 81 - 106)

Please contact us to discuss your precise needs.

Options

- Splash seals for dust and moisture resistance

*Please note that the operational life of the unit is dependent upon rotational speed, environment and temperature.

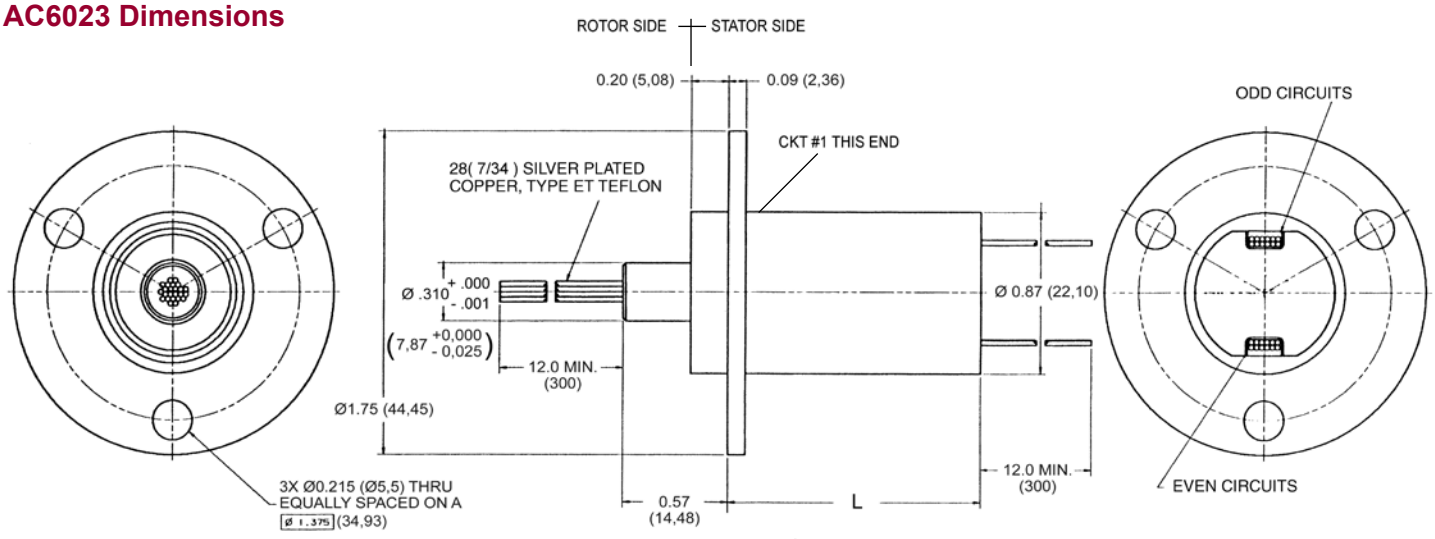
Lead Wire Color Codes

Ring#	Color Code	Ring#	Color Code	Ring#	Color Code
1	BLK	9	GRY	17	WHT-BLU
2	BRN	10	WHT	18	WHT-VIO
3	RED	11	WHT-BLK	19	WHT-GRY
4	ORN	12	WHT-BRN	20	WHT-BLK-BRN
5	YEL	13	WHT-RED	21	WHT-BLK-RED
6	GRN	14	WHT-ORN	22	WHT-BLK-ORN
7	BLU	15	WHT-YEL	23	WHT-BLK-YEL
8	VIO	16	WHT-GRN	24	WHT-BLK-GRN

Capsule Length = L

Part Number	Capsule Length (L)	# Of Circuits
AC6023–6	0.57 inch (14,5 mm)	6
AC6023–12	0.84 inch (21,3 mm)	12
AC6023–18	1.11 inch (28,2 mm)	18
AC6023–24	1.38 inch (35,1mm)	24

AC6023 Dimensions



Dimensions in inches (millimeters)

SRA-73574 / SRA-73587

Compact in various circuit configurations

Description

A slip ring capsule can be used in any electromechanical system that requires unrestrained, intermittent, or continuous rotation while transferring power and / or data.

The SRA-73574 / SRA-73587 provides an economical, readily available solution when a compact, high circuit count configuration is required. Our standard units, offer 36, 2 amp, 4, 10 amp and 24, 2 amp signal rings, respectively. These units can be modified to provide various combinations of power, signal and coax circuits. Similar in design to our very popular AC6023, this design features gold-on-gold contact technology for ultimate performance in many challenging applications.

Features

- 2 amp and 10 amp circuit combinations standard
- Precision ball bearing for long life
- Speeds up to 250 rpm continuous
- Compact size
- Transfers analog and digital signals
- Compatible with data bus protocols

Benefits

- Unique signal handling performance with minimal electrical circuit noise
- Tight packaging to fit in the most demanding space constraints
- Low torque to minimize system torque budget
- Rapid delivery

Typical Applications

- Pan / tilt camera mounts
- Rotary index tables
- Rate tables
- Lighting
- Robotics

Slip Ring Capsules (Compact)

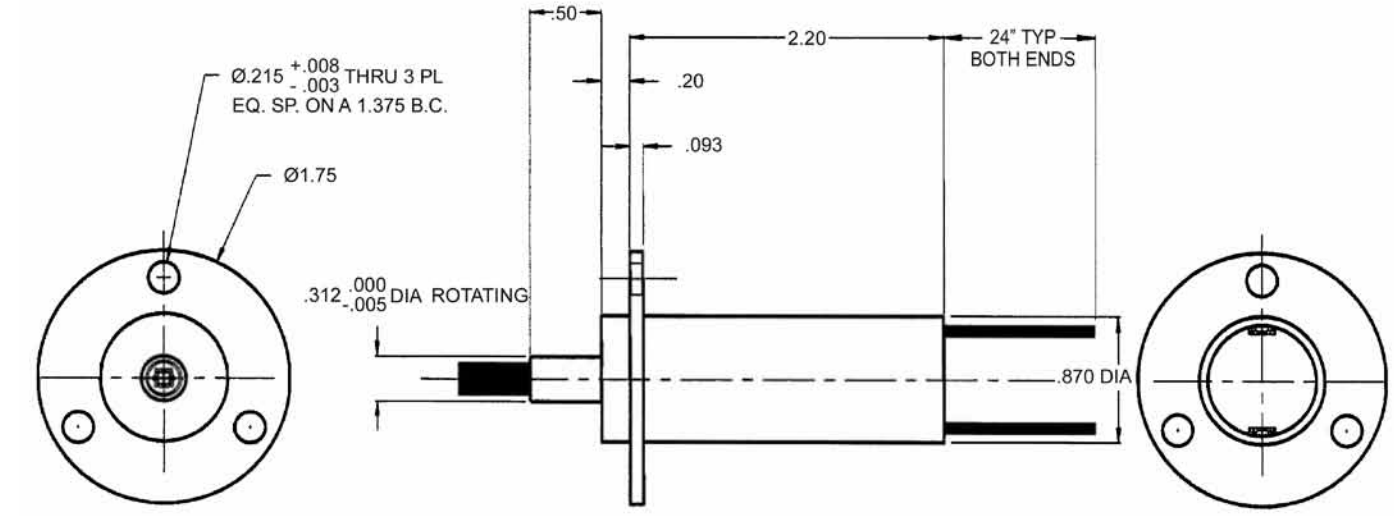
Specifications	SRA-73574	SRA-73587
Operating Speed	250 rpm*	250 rpm*
Circuit Configurations	36 circuits @ 2 A., #26 AWG Teflon® insulated, stranded cond.	4 power 10 A continuous, #18 AWG Teflon® insulated, stranded cond. 24 signal, 2 A, #26 AWG Teflon insulated, stranded cond.
Rotation	Bidirectional	Bidirectional
Voltage	210 VDC / 240 VAC	210 VDC / 240 VAC
Contact Material	Precious metal	Precious metal
Dielectric Strength	500 VRMS, all combinations	500 VRMS, all combinations
Insulation Resistance	1000 megohms min. @ 250 VDC	1000 megohms min. @ 250 VDC

**Please note that the operational life of the unit is dependent upon rotational speed, environment and temperature.*

SRA-73574 Lead Wire Color Codes							
Ring #	Color Code	Ring #	Color Code	Ring #	Color Code	Ring #	Color Code
1	BLK	10	WHT	19	WHT-GRY	28	WHT-BRN-RED
2	BRN	11	WHT-BLK	20	WHT-BLK-BRN	29	WHT-BRN-ORN
3	RED	12	WHT-BRN	21	WHT-BLK-RED	30	WHT-BRN-YEL
4	ORN	13	WHT-RED	22	WHT-BLK-ORN	31	WHT-BRN-GRN
5	YEL	14	WHT-ORN	23	WHT-BLK-YEL	32	WHT-BRN-BLU
6	GRN	15	WHT-YEL	24	WHT-BLK-GRN	33	WHT-BRN-VIO
7	BLU	16	WHT-GRN	25	WHT-BLK-BLU	34	WHT-BRN-GRY
8	VIO	17	WHT-BLU	26	WHT-BLK-VIO	35	WHT-RED-ORN
9	GRY	18	WHT-VIO	27	WHT-BLK-GRY	36	WHT-RED-YEL

SRA-73587 Lead Wire Color Codes	
Ring #	Color Code
1 - 24	SAME AS SHOWN ON SRA-73574
25	WHT (18 AWG)
26	BRN (18 AWG)
27	RED (18 AWG)
28	ORN (18 AWG)

SRA-73574 / SRA-73587 Dimensions



Dimensions in inches

AC6355

Compact in various circuit configurations

Description

A slip ring capsule can be used in any electromechanical system that requires unrestrained, intermittent, or continuous rotation while transferring power and / or data.

The AC6355 provides an economical, readily available solution when a compact, high circuit count configuration is required. Our standard units, AC6355-36 and AC6355-56 offer 36, 2 amp and 56, 2 amp signal rings, respectively. These units can be modified to provide various combinations of power, signal and coax circuits. Similar in design to our very popular AC6023, this design features gold-on-gold contact technology for ultimate performance in many challenging applications.

Features

- Standard 36 and 56 circuit models with 2 amp circuits
- 2 amp, 5 amp, 10 amp circuit combinations standard; 50 or 75 ohm coax circuit combinations are optional
- Precision ball bearing for long life
- Speeds up to 250 rpm continuous
- Compact size
- Sealed units available (dust and light splash only)
- Metal housing available
- Transfers analog and digital signals
- Compatible with data bus protocols

Benefits

- Unique signal handling performance with minimal electrical circuit noise
- Tight packaging to fit in the most demanding space constraints
- Low torque to minimize system torque budget
- Rapid delivery

Typical Applications

- Pan / tilt camera mounts
- Rotary index tables
- Rate tables
- Lighting
- Robotics

Slip Ring Capsules (Compact)

AC6355 Specifications		
Operating Speed	250 rpm* continuous	
Circuit Configurations	36 ring	56 ring
	36 @ 2 amp	56 @ 2 amp
	4 @ 5 amp; 28 @ 2 amp	4 @ 5 amp; 48 @ 2 amp
	4 @ 10 amp; 20 @ 2 amp	4 @ 10 amp; 40 @ 2 amp
Lead Length	24 inch (600 mm)	
Lead Size / Type	2 amp, 26 AWG 5 amp, 20 AWG 10 amp, 16 AWG	
Housing	Plastic	
Voltage	240 VAC	
Operating Temp.	-40°C to +80°C	
Contact Material	Gold-on-gold, signal; silver-on-gold, power	
Dielectric Strength	250 VAC @ 60 Hz, between each circuit and all other circuits	
Insulation Resistance	1000 megohms max tested @ 500 VDC	
Electrical Noise	60 milliohms max. when tested @ 6VDC 50 milliamps when running @ 10 rpm	

Options

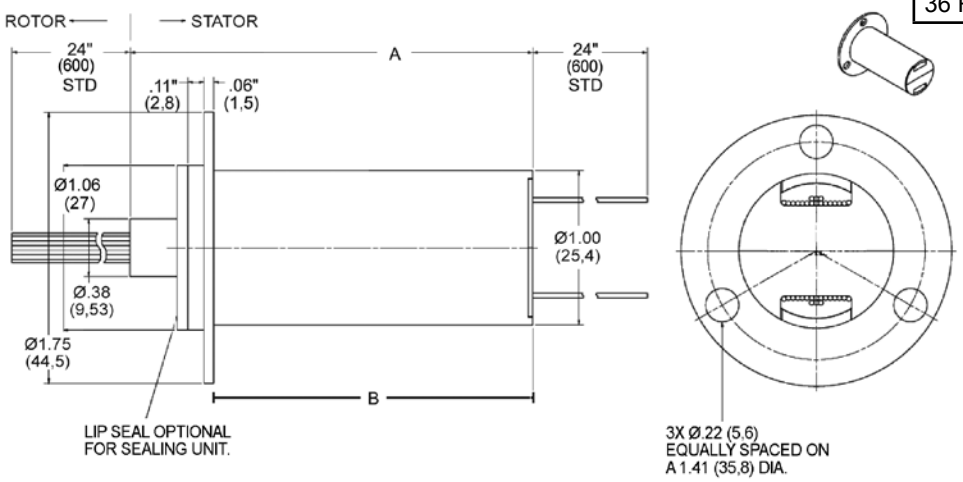
- 50 or 75 ohm coax combined with 2 and 5 amp rings
- 48 inch (1200 mm)
- Aluminum housing, black anodized
- 50 ohm coax, RG178
- 75 ohm coax, RG179
- Splash seals for dust and moisture resistance
- Non-flanged housing available
- IP 65 rated slip ring available (P/N AC7038), see page 55

**Please note that the operational life of the unit is dependent upon rotational speed, environment and temperature.*

AC6355 Lead Wire Color Codes											
Ring #	Color Code	Ring #	Color Code	Ring #	Color Code	Ring #	Color Code	Ring #	Color Code	Ring #	Color Code
1	BLK	11	WHT-BLK	21	RED	31	WHT-RED	41	YEL	51	WHT-YEL
2	BRN	12	WHT-BRN	22	ORN	32	WHT-ORN	42	GRN	52	WHT-GRN
3	RED	13	WHT-RED	23	YEL	33	WHT-YEL	43	BLU	53	WHT-BLU
4	ORN	14	WHT-ORN	24	GRN	34	WHT-GRN	44	VIO	54	WHT-VIO
5	YEL	15	WHT-YEL	25	BLU	35	WHT-BLU	45	GRY	55	BLK
6	GRN	16	WHT-GRN	26	VIO	36	WHT-VIO	46	WHT	56	BRN
7	BLU	17	WHT-BLU	27	GRY	37	BLK	47	WHT-BLK		
8	VIO	18	WHT-VIO	28	WHT	38	BRN	48	WHT-BRN		
9	GRY	19	BLK	29	WHT-BLK	39	RED	49	WHT-RED		
10	WHT	20	BRN	30	WHT-BRN	40	ORN	50	WHT-ORN		

2 amp leads will be color coded and number tagged
5 amp rings will have 20 AWG black lead wire, tagged
10 amp rings will have 16 AWG black lead wire, tagged

AC6355	A	B
56 Ring	3.50 in (88,9 mm)	2.96 (75,3)
36 Ring	2.60 (66,04)	2.06 (52,4)

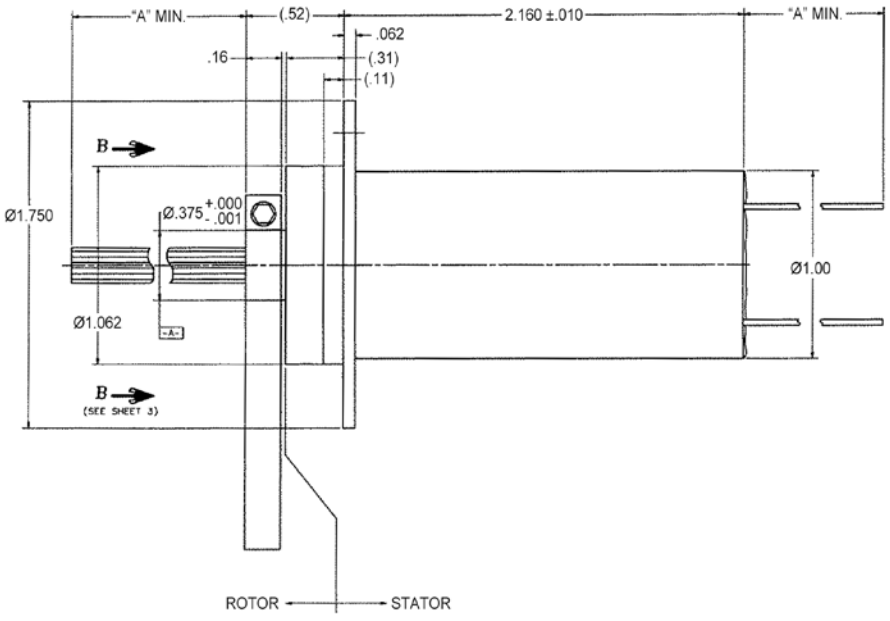


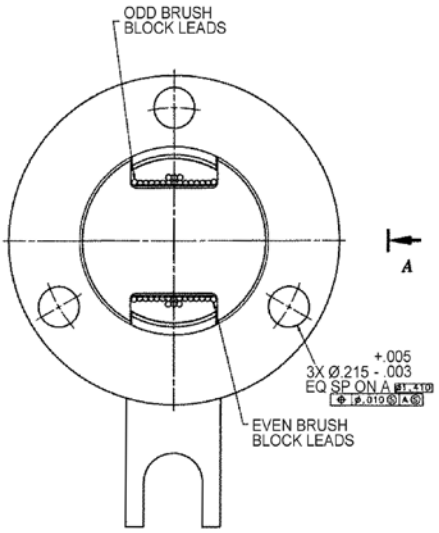
Dimensions in inches (millimeters)

AC7038 Specifications (IP 65 Sealed Version of AC6355)			Options
Operating Speed	250 rpm* continuous		• 50 or 75 ohm coax combined with 2 and 5 amp rings • 48 inch (1200 mm) • Aluminum housing, black anodized • 50 ohm coax, RG178 • 75 ohm coax, RG179 • Splash seals for dust and moisture resistance
Circuit Configurations	36 ring	56 ring	
	36 @ 2 amp	56 @ 2 amp	
	4 @ 5 amp; 28 @ 2 amp	4 @ 5 amp; 48 @ 2 amp	
	4 @ 10 amp; 20 @ 2 amp	4 @ 10 amp; 40 @ 2 amp	
Lead Length	24 inch (600 mm)		
Lead Size / Type	2 amp, 26 AWG 5 amp, 20 AWG 10 amp, 16 AWG		
Housing	Plastic		
Voltage	240 VAC		
Operating Temp.	-40°C to +80°C		
Contact Material	Gold-on-gold, signal; silver-on-gold, power		
Dielectric Strength	250 VAC @ 60 Hz, between each circuit and all other circuits		
Insulation Resistance	1000 megohms max tested @ 500 VDC		
Electrical Noise	60 milliohms max. when tested @ 6VDC 50 milliamps when running @ 10 rpm		
Environmental	IP 65 sealed		

Please note that the operational life of the unit is dependent upon rotational speed, environment and temperature.

AC7038 Dimensions





Dimensions in inches

AC6305
AC6310

Compact in various circuit configurations

Description

A slip ring can be used in any electromechanical system that requires unrestrained, continuous rotation while transferring power and / or data from a stationary to a rotating structure. A slip ring is also called a rotary electrical interface, commutator, collector, swivel or an electrical rotary joint.

The AC6305 provides three, 5 amp circuits combined with 6, 9, or 12 signal (2 amp max) circuits. The AC6310 provides three, 10 amp circuits and 3 or 6 signal circuits. This compact power and signal handling design provides unique capability for many challenging applications.

Features

- 6, 9, 12 and 15 circuit models
- 5 amp / 2 amp and 10 amp / 2 amp circuit combinations
- Precision ball bearings meet or exceed life requirements for most commercial applications
- Speeds up to 250 rpm continuous
- Compact size: 1.38 inch long
- Gold-on-gold contacts
- 12, 24, 36, 48 inch standard lead lengths (longer lead lengths are available)
- Sealed units are also available (dust and light splash only)
- Flexible silver-plated copper, color-coded, Teflon® insulated lead wires
- Fully compatible with both analog and TTL control level signals
- Also available with 6, 12, 18, and 24, 2 amp rings. Please refer to AC6023 data sheet.

Benefits

- Smooth running
- Low torque
- Compact
- Very low noise (electrical)
- Quick shipment

Typical Applications

- CCTV pan / tilt camera mounts
- Electrical test equipment
- Manufacturing and process control equipment
  - Indexing tables
  - Robotics (end-effectors, arms, vision systems, sensors)
- Exhibit / display equipment
- Medical equipment

Specifications	AC6305	AC6310	Options
Operating Speed	250 rpm* continuous	250 rpm* continuous	• Splash seals for dust and moisture resistance • Metal housings with and without flanges
Number of Circuits	3 @ 5 amps and 6, 9, or 12 @ 2 amps	3 @ 10 amps and 3 or 6 @ 2 amps	
Lead Lengths	12, 24, 36 and 48 inches	12, 24, 36 and 48 inches	
Lead Size / Type	2 amp, 26 gauge silver plated copper, Teflon® 5 amp, 20 gauge silver plated copper, Teflon®	2 amp, 26 gauge silver plated copper, Teflon® 10 amp,16 gauge tin plated copper, Teflon®	
Voltage	120 VAC	120 VAC	
Max Ambient Temp.	-40°C to +80°C	-40°C to +80°C	
Contact Material	Gold	Gold	
Current Rating	5 amps and 2 amps / ckt	10 amps and 2 amps / ckt	
Dielectric Strength	250 VAC @ 60 Hz, between each circuit and all other circuits	250 VAC @ 60 Hz, between each circuit and all other circuits	
Insulation Resistance	1000 megohms @ 500 VDC	1000 megohms @ 500 VDC	
Noise	60 milliohms max. tested @ 6 VDC, 50 milliamps when running @ 5 rpm	60 milliohms max. tested @ 6 VDC, 50 milliamps when running @ 5 rpm	

Please note that the operational life of the unit is dependent upon rotational speed, environment and temperature.

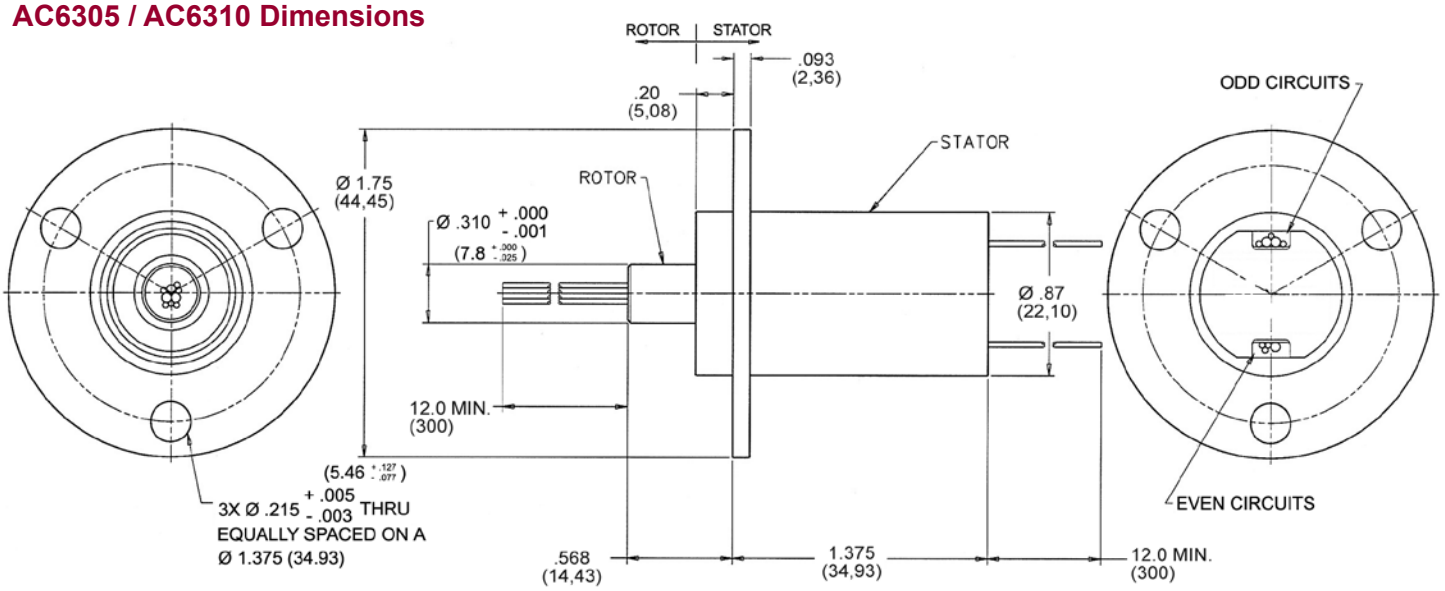
AC6305 Lead Wire Color Codes

	Ring #	Color Code	Ring #	Color Code
20 AWG TAGGED LEADS	1	BLK	9	GRN
	2	BLK	10	BLU
	3	BLK	11	VIO
	4	BLK	12	GRY
	5	BRN	13	WHT
	6	RED	14	WHT-BLK
	7	ORN	15	WHT-BRN
	8	YEL		

AC6310 Lead Wire Color Codes

	Ring #	Color Code	Ring #	Color Code
16 AWG TAGGED LEADS	1	BLK	9	GRN
	2	BLK		
	3	BLK		
	4	BLK		
	5	BRN		
	6	RED		
	7	ORN		
	8	YEL		

AC6305 / AC6310 Dimensions



Dimensions in inches (millimeters)

AC7036

Integrated AC6349 and AC6355 slip ring capsules for high circuit density

Description

A slip ring capsule can be used in any electromechanical system that requires unrestrained, intermittent, or continuous rotation while transferring power and / or data.

The AC7036 integrates two of our popular slip ring capsules, the AC6349 and AC6355, creating one compact assembly. Connecting hardware is used to combine these units by inserting the AC6355 in the bore of the AC6349. This combination provides a wide range of circuit capabilities up to 24 circuits rated at 15 amps and 36 or 56 circuits rated at 2 amps, in a compact 6.5 inch length and 3.1 inch diameter. The outer capsule features 6, 12, 18, or 24 circuits rated at 15 amps, while the inner capsule can be configured with 2 amp, 5 amp, 10 amp, or coax circuits.

Features

- Multiple circuit combinations
- High circuit density
- Precious metal contacts
- Speeds to 150 RPM continuous
- Flying leads
- Rugged black anodized aluminum construction

Benefits

- Isolations between power (outer) and signal (inner)
- Tight packaging to fit the most demanding applications
- Low torque
- Built from readily available components for rapid delivery
- Rotor flange for ease of mounting

Typical Applications

- Gimble systems
- Packaging equipment
- Rotary tables
- Motion control systems
- Robotics

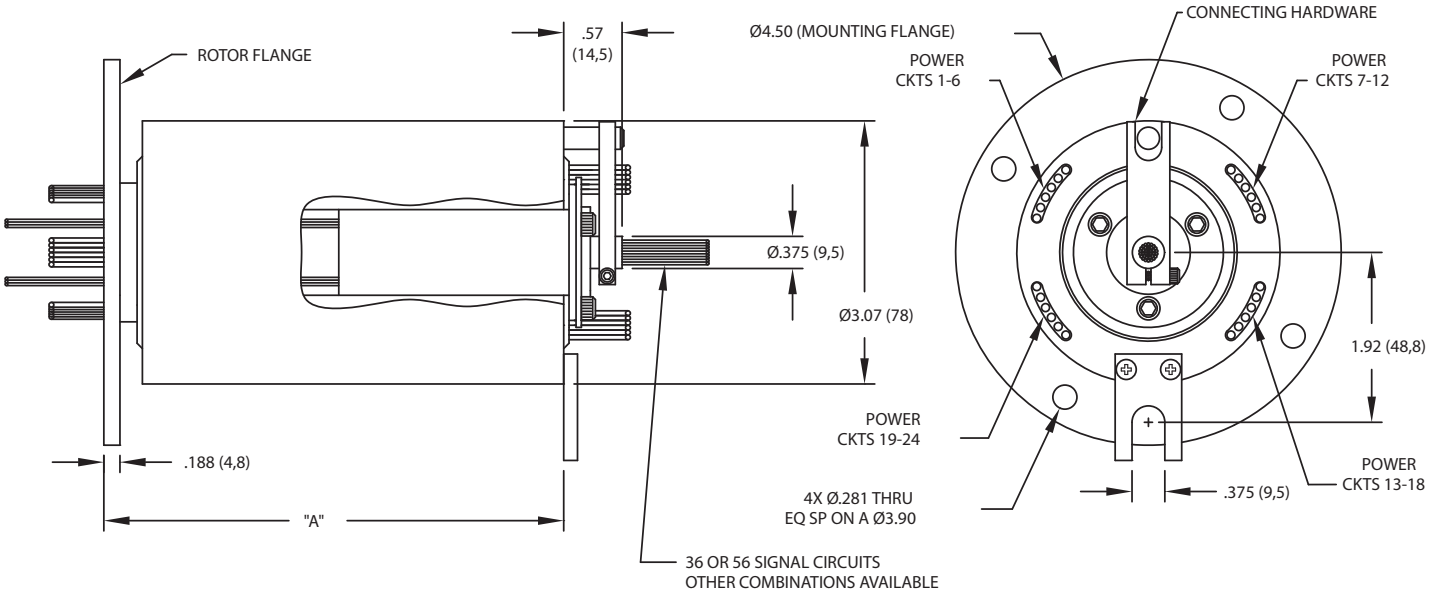
AC7036 Specifications	
Operating Speed	150 rpm*
Number of Circuits	Variable, refer to AC6349 and AC6355 data sheets
Lead Length	20 inch minimum
Lead Size	14 AWG outer capsule, refer to AC6355 data sheet for inner
Voltage	440 V on 15 Amp; varies on inner see AC6355 data sheet
Operating Temp.	-40°C to +80°C
Contact Material	Silver-on-silver outer / gold-on-gold inner
Current Rating	15 amps outer capsule (AC6349) 2, 5, 10 amp inner capsule (AC6355)
Dielectric Strength	500 VAC @ 60 Hz between circuits outer capsule 250 VAC @ 60 Hz between circuits inner capsule
Insulation Resistance	1000 megohms max tested at 500 VAC
Electrical Noise	60 milliohms max when tested @ 6 VDC 50 milliamps when running @ 5 rpm
Environmental	Enclosed capsule

Options
• Seals • Long leads • Harnessing

**Please note that the operational life of the unit is dependent upon rotational speed, environment and temperature.*

Part Number	Length "A"
AC7036-6	3.06 in (77,7 mm)
AC7036 - 12	4.24 in (107,7 mm)
AC7036 - 18	5.43 in (137,9 mm)
AC7036 - 24	6.62 in (168,1 mm)

AC7036 Dimensions



Dimensions in inches (millimeters)

P Series

Compact slip rings

Description

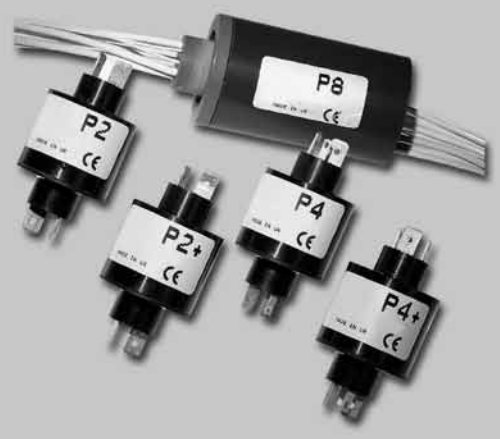
The P series slip rings are compact, cost effective mercury free slip rings designed for industrial manufacturing. The P2 has two rings, each able to carry 7 amps. The P4 has two rings rated at 7 amps and two at 2 amps. All are fully ball raced and suitable for mounting in any orientation. The P2+ and P4+ are capable of conducting 14 amps through the power circuits and in the case of the P4+, 2 amps through the 2 signal circuits. These units are ideal for applications where currents are increased due to lower distribution voltage. They are well suited for use in the food and packaging industries. The P8 Lite is capable of carrying 14 amps on each of the 8 rings. All P Series units feature gold slip rings and gold alloy brushes. Standard spade terminals or flying leads allow rapid installation.

Features

- Mercury free
- Reliable rotational connections for power, signal and data transmission
- Speeds from 400 to 600 rpm
- Fast on spade terminals or flying leads
- CE marked

Benefits

- Compact and robust design
- Designed for low cost
- Gold slip rings and gold alloy brushes for high reliability
- Mount in any orientation



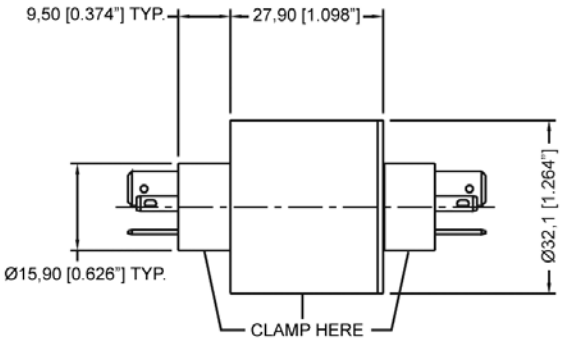
Typical Applications

- Machine tools
- Heated rollers
- Food manufacturing
- Chemical processing
- Packaging

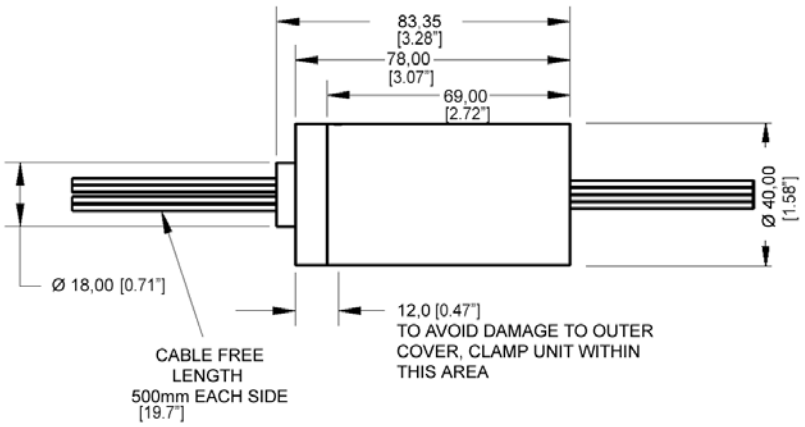
P Series Specifications					
	P2	**P4**	**P2+**	**P4+**	**P8 Lite**
Part Number	80050-957 / 1028300-2	80050-958 / 1028300-4	80050-956	80050-955	80059-950
Maximum Speed	400 rpm	400 rpm	400 rpm	400 rpm	600 rpm
Power Circuits	2 @ 7 amps	2 @ 7 amps	2 @ 14 amps	2 @ 14 amps	8 @ 14 amps
Signal Circuits	-	2 @ 2 amps	-	2 @ 2 amps	-
Terminals Power	0.8 x 6.35	0.8 x 6.35 0.8 x 2.80	0.8 x 6.35	0.8 x 6.35 0.8 x 2.80	ETFE Flying Leads Power 16 AWG [PARA]
Mounting	As Shown On Drawing				
Maximum Voltage	240	240	240	240	240
Temperature Range	-20°C to +90°C	-20°C to +90°C	-20°C to +90°C	-20°C to +90°C	-20°C to +80°C
Dielectric Strength	500 volts 50 Hz for 10 seconds	500 volts 50 Hz for 10 seconds	500 volts 50 Hz for 10 seconds	500 volts 50 Hz for 10 seconds	500 volts 50 Hz for 10 seconds
Insulation Resistance	>200 MOhms at 500 volts DC	>200 MOhms at 500 volts DC	>200 MOhms at 500 volts DC	>200 MOhms at 500 volts DC	>200 MOhms at 500 volts DC
Sealing	-	-	-	-	IP22

**Please note that the operational life of the unit is dependent upon rotational speed, environment and temperature.*

P Series Dimensions



P2, P2+, P4, P4+ Series



P8 Lite Series

Dimensions in millimeters [inches]

REVISED 10/10

PH Series

Description

Suitable for industrial applications such as general purpose instrumentation and testing, the PH series rugged design makes it an optimum choice for adverse operating conditions. Continuous silver connection ensuring minimal thermal error making this design compatible with thermocouple and strain gauge instrumentation.

Quick and easy to install, these units are available with either 8 or 12 circuits. Both options operate at speeds up to 20,000 rotations per minute.

Features

- Optimum for adverse operating conditions
- Continuous silver connection ensuring minimal thermal error
- Compatible with the thermocouple and strain gauge instrumentation
- Quick and easy to install
- Available with either 8 or 12 circuits
- Speeds up to 20,000 rotations per minute

Benefits

- Compact size
- Low drive torque requirement

Typical Applications

- Test apparatus for thermocouples and strain gages
- General purpose instrumentation and testing

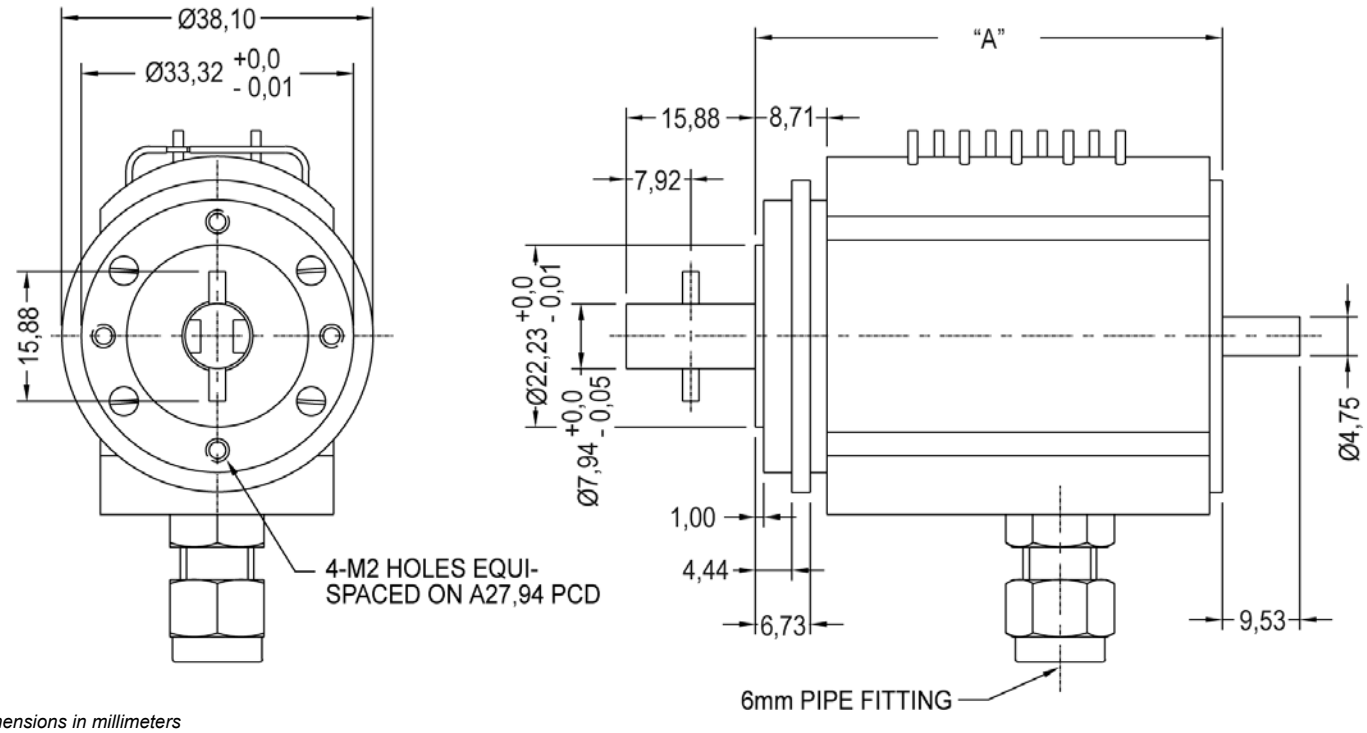
PH Series Specifications	
Terminals	Silver
Mounting	Flange mounting - 4 holes M2
Maximum Voltage	50 volts
Temperature Range	-20ºC to +90ºC
Maximum Current	2 amps
Dielectric Strength	500 volts 50Hz for 10 seconds
Insulation Resistance	>200MΩ at 500 volts
Cooling Air Pressure	1.4kg / cm2

**Please note that the operational life of the unit is dependent upon rotational speed, environment and temperature.*

Note: *Operation at maximum rotational speed requires cooling air to be supplied through the inlet and outlet ports provided.*

Series	Part Number	Number of Circuits	Length (A)	Max. Speed RPM
PH 08	80042-950	8	57,15 mm	20.000
PH 12	80043-950	12	69,85 mm	20.000

PH Series Dimensions



Dimensions in millimeters

AC3757

Miniature slip ring assembly

Description

A slip ring can be used in any electromechanical system that requires unrestrained, continuous rotation while transferring power and / or data from a stationary to a rotating structure. A slip ring is also called a rotary electrical interface, commutator, collector, swivel or a rotary joint.

The AC3757 high speed slip ring provides 36 circuits and operational speeds up to 6,000 rpm. Our fiber brush technology minimizes contact wear and resultant debris while it extends operational life.

Features

- 36 circuits
- High speed performance with customer's cooling systems:
  - 4,000 rpm without cooling
  - 6,000 rpm with gas cooling (nitrogen)
- Thermocoupled leads are available
- Low noise. The low contact force of the fiber brush design reduces resistance (noise) while providing superior power and data transfer capability.
- Cooling tubes

Benefits

- Fiber brush technology. The sliding electrical contacts used in the AC3757 slip ring features our fiber brush technology to provide these benefits:
  - Low contact force per fiber
  - Low contact wear rates
  - Contact surfaces that do not require lubrication
  - Ability to perform in vacuum and varied ambient conditions
- Improved system performance. Slip rings can improve mechanical performance, simplify system operation and eliminate damage-prone wires dangling from movable joints.

Typical Applications

This slip ring provides high speed performance and is successfully serving in applications such as:

- Centrifuges
- Tire testing
- Gasoline or diesel engine testing

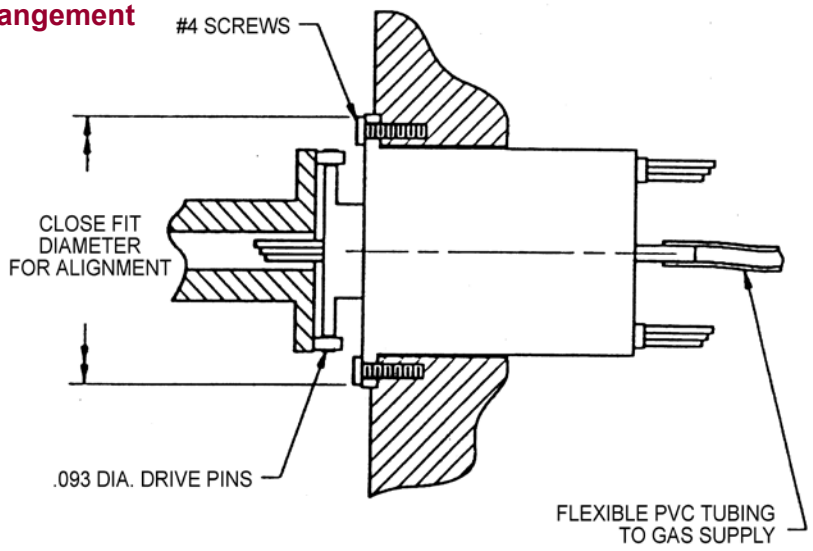
AC3757 Specifications	
Ring O.D.	0.270 inch
Ring Pitch	0.032 inch
Flange Diameter	1.600 inch
Bore	None
Volts (Peak to Peak)	70
Circuits **Leads** 1–26 30 (19 / 42) AWG silver plated standard copper conductor 27–36 Solid chromel & alumel leads	
All leads are color coded extruded teflon insulation.	
Chromel / alumel thermocouple pairs are attached to each bearing and to brushes #1 and #12 to monitor temperature.	

Lead Wire Color Codes

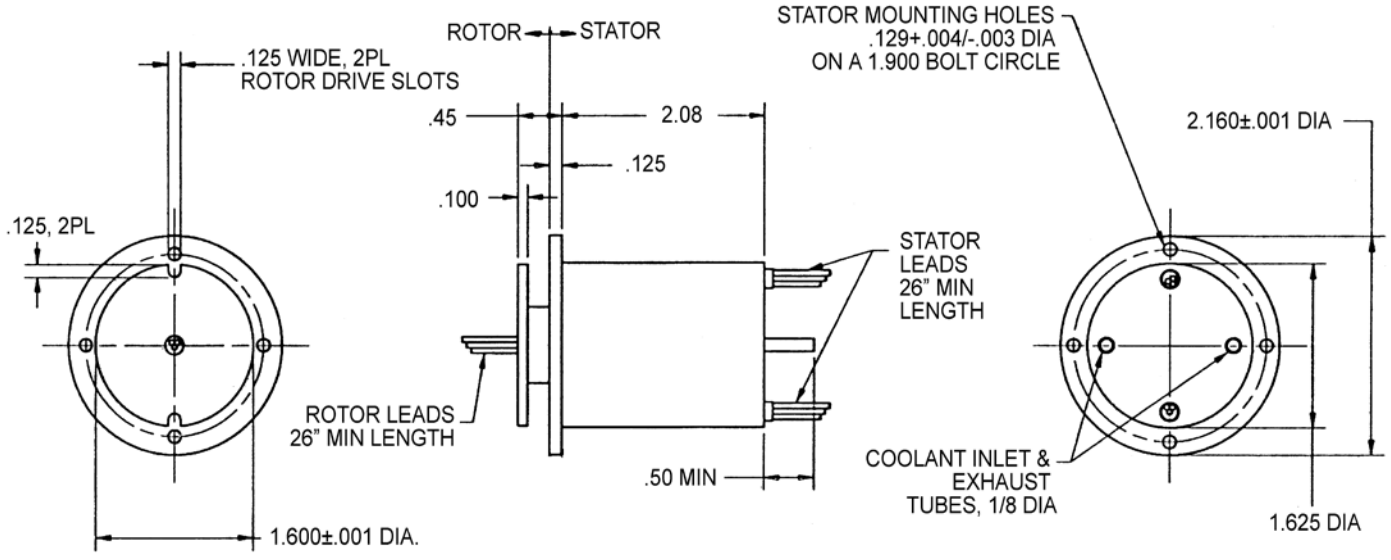
Ring #	Color Code	Ring #	Color Code	Ring #	Color Code	Ring #	Color Code
1	BLK	10	WHT	19	WHT-GRY	28	ORN (ALUMEL)
2	BRN	11	WHT-BLK	20	WHT-BLK-BRN	29	BLK (CHROMEL)
3	RED	12	WHT-BRN	21	WHT-BLK-RED	30	BRN (ALUMEL)
4	ORN	13	WHT-RED	22	WHT-BLK-ORN	31	RED (CHROMEL)
5	YEL	14	WHT-ORN	23	WHT-BLK-YEL	32	ORN (ALUMEL)
6	GRN	15	WHT-YEL	24	WHT-BLK-GRN	33	BLK (CHROMEL)
7	BLU	16	WHT-GRN	25	WHT-BLK-BLU	34	BRN (ALUMEL)
8	VIO	17	WHT-BLU	26	WHT-BLK-VIO	35	RED (CHROMEL)
9	GRY	18	WHT-VIO	27	RED (CHROMEL)	36	ORN (ALUMEL)

Note: Other combinations of standard conductors and thermocouple leads are available.

Recommended Mounting Arrangement



AC3757 Dimensions



Dimensions in inches

AC6231

High speed through-bore capsule

Description

A slip ring capsule can be used in any electromechanical system that requires unrestrained, intermittent, or continuous rotation while transferring power and / or data. A slip ring is also called a rotary electrical joint, collector, commutator, or swivel. A slip ring can improve system performance by simplifying operations and eliminating damage prone wires.

The AC6231 provides a high performance solution when a through-bore configuration with high-speed operation is required. This unit provides a 1-1/2 inch through-bore for shaft mounting and a compact 4.25 inch outside diameter and very short overall length for minimal space applications. The AC6231 provides eight 15 amp circuits. Similar in design to our very popular AC4598 and AC6200 series, this design features long life, fiber brush contact technology for ultimate performance in many challenging applications. Brush blocks are easily replaceable for extended life.

Features

- 1-1/2 inch through-bore
- Compact 4.25 inch outside diameter
- Speeds up to 2500 rpm continuous
- Transfers power, as well as analog and digital signals
- Rugged black anodized aluminum construction

Benefits

- Compatible with data bus protocols
- Fiber brush technology provides long life and operation
- Compact packaging
- Ease of installation

(outer cover removed for view)

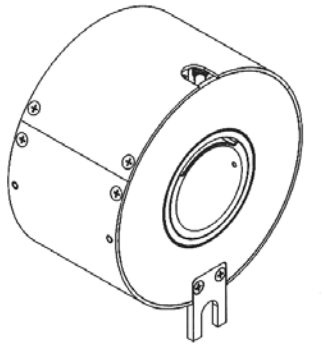
Typical Applications

- Precision rotary equipment
- High speed testing
- Semiconductor handling systems
- Industrial machinery
- Robotics

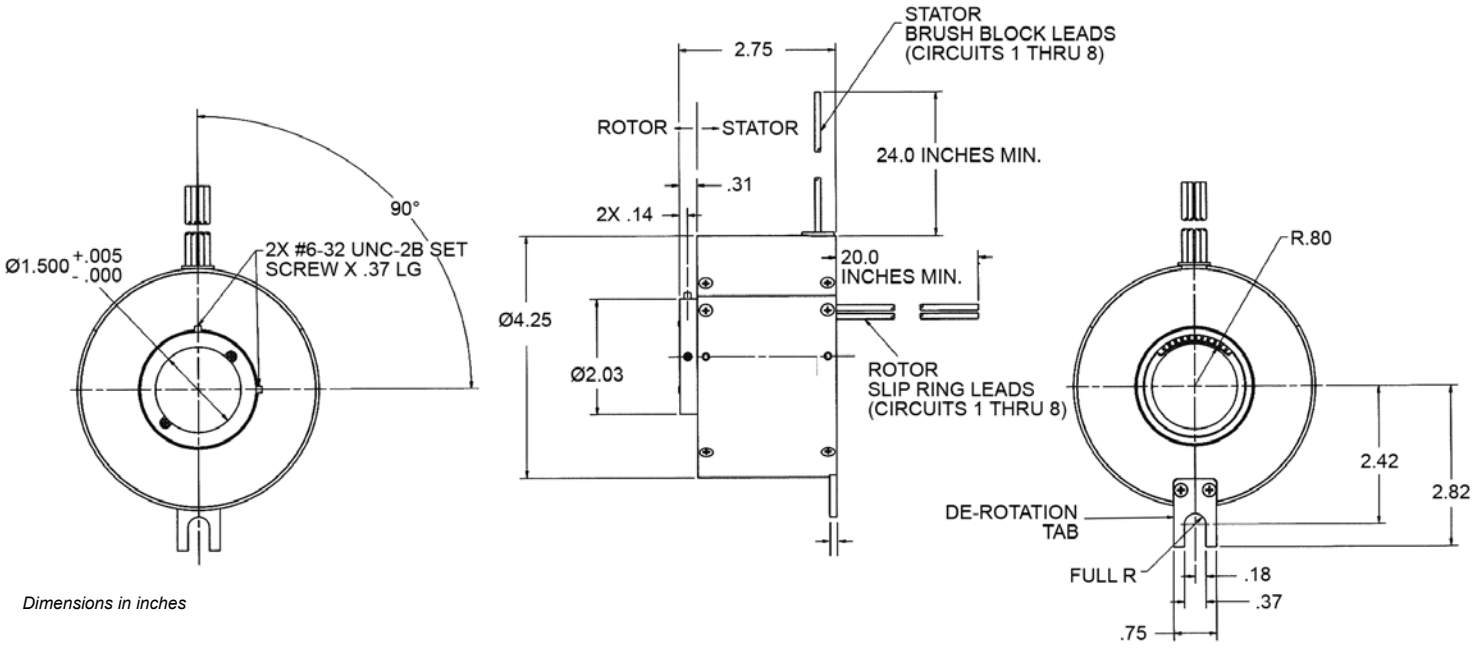
Specifications	
Operating Speed	2500 rpm* continuous
Number of Circuits	8
Lead Lengths	20 inch rotor, 24 inch stator
Lead Size / Type	14 AWG, (19 / 27) strand, UL 1213 white
Voltage	220 VAC
Operating Temp.	-40°C to +80°C
Current Rating	15 amps / circuit
Noise	Less than 60 milliohms peak-to-peak

**Please note that the operational life of the unit is dependent upon rotational speed, environment and temperature.*

AC6231 Dimensions



VIEW SHOWN WITHOUT LEADS AND GROMMET



Dimensions in inches

EC3848

High speed

Description

A slip ring can be used in any electromechanical system that requires unrestrained, continuous rotation while transmitting power and / or data from a stationary to a rotating structure. A slip ring is also called a rotary electrical interface, collector, swivel or rotary joint. A slip ring can improve system performance by simplifying operations and eliminating damage-prone wires dangling from moving joints.

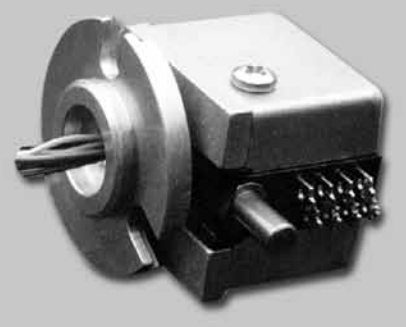
The EC3848 features precious metal brushes and rings. Flying lead wires on the rotating side and solder terminals on the stator side complete the electrical connections. Precision ball bearings and the patented fiber brush design allow operation up to 10,000 rpm without the need for cooling equipment. Fiber brush technology offers several advantages over conventional slip ring contacts including multiple points of contact per brush bundle, low contact force per fiber and low contact wear rates. In addition, fiber brushes do not require lubrication and produce virtually no wear debris.

Features

- 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

Benefits

- Transfers control and data signals
- Fiber brush technology provides maintenance-free operation (no lubrication required)
- Standard design meets high speed requirements at a fraction of the cost of a custom assembly

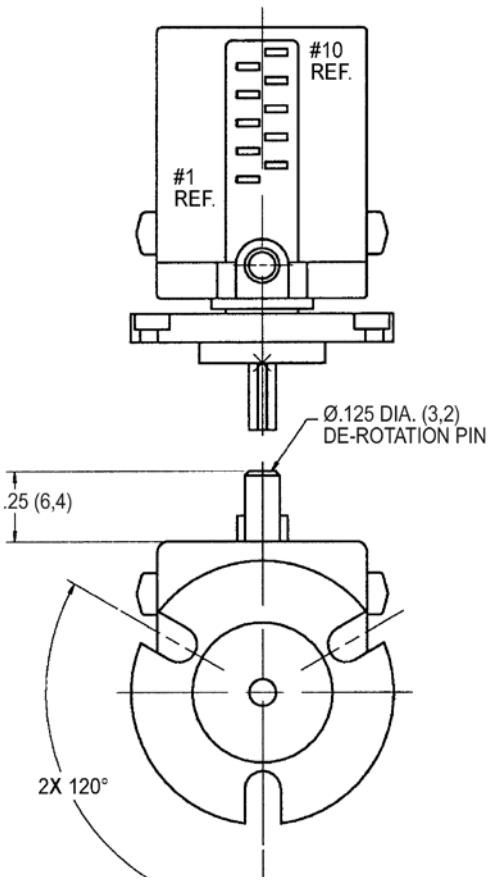


Typical Applications

- Centrifuges
- Various high speed instrumentation applications such as tire testing

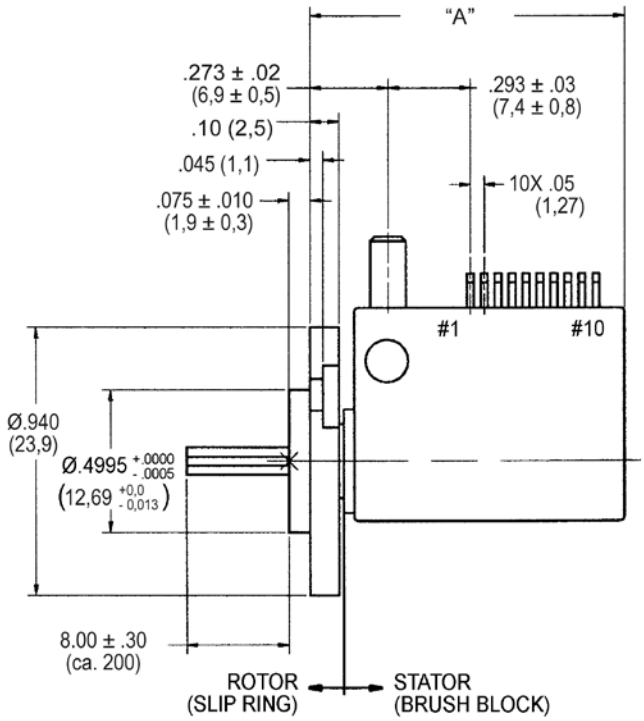
Specifications	
Operating Speed	0 - 10,000 rpm*
Number of Rings	Up to 10 (2, 6, 8 and 10)
Electrical Connections	30 (19 / 42) AWG leads on rotor Solder terminals on stator
Voltage	Low millivolt range to 100 VDC
Maximum Ambient Temperature	50°C (120°F) over 1,000 rpm 80°C (175°F) up to 1,000 rpm
Contact Material	Precious metal
Current Rating	1.0 amps maximum per ring
Insulation Resistance	1000 MΩ at 500 VDC
Electrical Noise	20 mΩ at 5 rpm 6 VDC, 50 mA current
Cooling	Not required

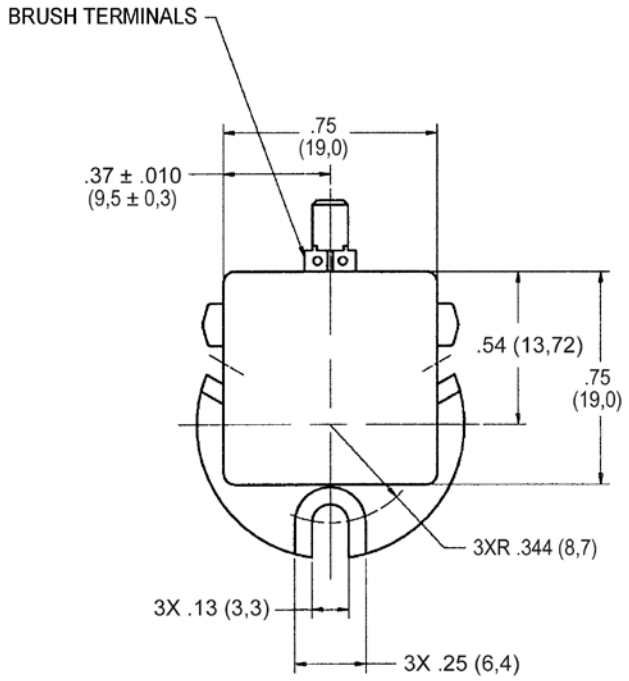
** Please note that the operational life of the unit is dependent upon rotational speed, environment and temperature.*



Lead Wire Color Code			
Ring #	Color	Ring #	Color
1	BLK	6	GRN
2	BRN	7	BLU
3	RED	8	VIO
4	ORN	9	GRY
5	YEL	10	WHT

Part #	Length "A"
EC4294-2	0.71 inch (18,1 mm)
EC3848-6	0.91 inch (23,2 mm)
EC4199-8	1.02 inch (25,8 mm)
EC3848-10	1.11 inch (28,3 mm)





Dimensions in inches (millimeters)

Endura-Trac™
Plus W series

Description
The Endura-Trac™ series of slip ring assemblies were developed for a wide variety of applications and environments. The flexible design and through-bore capability of up to 9 inches, along with many other options make it ideal for a designer to incorporate into new and retrofit applications. Modular construction allows a range of signal and power combinations with power circuits up to 30 amps and signal circuits up to 5 amps. These slip ring assemblies are a quick turn solution for your application. Off-the-shelf components allow for a delivery which meets your needs. The Plus W series is DeviceNet and ControlNet capable.

Features
- Unobstructed bore sizes from 1.5 inch to 9.0 inch
- Up to 100 signal circuits (rated at 250 V / 5 A each)
  Up to 24 power circuits (rated at 600 V / 30 A each)
  For combinations of these, see chart on next page
- Continuous bidirectional rotation up to 1,000 rpm
- Flying lead wire bundle, 24 inch lead length
- #20 AWG signal lead wire, #12 AWG power lead wire
- All metal exterior cover
- Shaft and flange mounting
- Stator, rotor, or both can rotate

Benefits
- Ease of installation
- Compatible with data bus protocols
- Transfers power, as well as analog and digital signals
- Replaceable brush blocks
- 169 different combinations of signals and power circuits

Typical Applications
- Packaging machines
- Index tables
- Paper and film converting
- Rotary machines
- Machine tools
- Automation equipment
- Medical equipment
- Surveillance equipment
- Inspection equipment

Plus W Series Specifications	
Maximum Speed	1.5 and 3.0 inch bore: 1000 rpm 4.0, 6.0 and 9.0 inch bore: 600 rpm
Power Circuits	Up to 24 power circuits: 30 A / 600 volts
Signal Circuits	Up to 100 signal circuits: 5 A / 250 volts
Terminals	Power circuits - 12 AWG flying leads Signal circuits - 20 AWG flying leads
Mounting	Shaft mounting
Temperature Range	-20˚C to +90˚C
Dielectric Strength	1000 volts 50 Hz for 10 seconds
Insulation Resistance	>200 MΩ at 1000 volts DC

Options

- Open frame
- Drive adaptor for stator de-rotation
- Longer lead lengths
- Special wiring or harnes requirements (coaxial, twinaxial and triaxial cable, thermocouple)
- Sealed version (NEMA 12)
- High voltage option to 3000 V
- Various power and signal configurations available

**Please note that the operational life of the unit is dependent upon rotational speed, environment and temperature.*

Bore Size	ID Actual	OD	Max RPM	"L1"	S	R
1.5 inch (38,1 mm)	1.52 (38,61)	5.00 (127,00)	1000	.2 (XX) + .4 (YY) + 1.63	4.033 (102,44)	1.896 (48,16)
3.0 (76,2)	3.02 (76,71)	6.50 (165,10)	1000	.2 (XX) + .4 (YY) + 1.52	5.488 (139,40)	3.396 (86,26)
4.0 (101,6)	4.02 (102,11)	7.50 (190,50)	600	.2 (XX) + .4 (YY) + 1.38	6.500 (165,10)	4.396 (111,66)
6.0 (152,40)	6.02 (152,91)	9.50 (241,30)	600	.2 (XX) + .4 (YY) + 1.39	8.332 (211,63)	6.646 (168,81)
9.0 (228,60)	9.02 (229,11)	12.50 (317,50)	600	.2 (XX) + .4 (YY) + 1.63	11.500 (292,10)	9.858 (250,39)

Note: For "Sealed Unit" add .75 (19,05) for length.

To determine length of overall unit, use the following formulas or contact us for assistance.

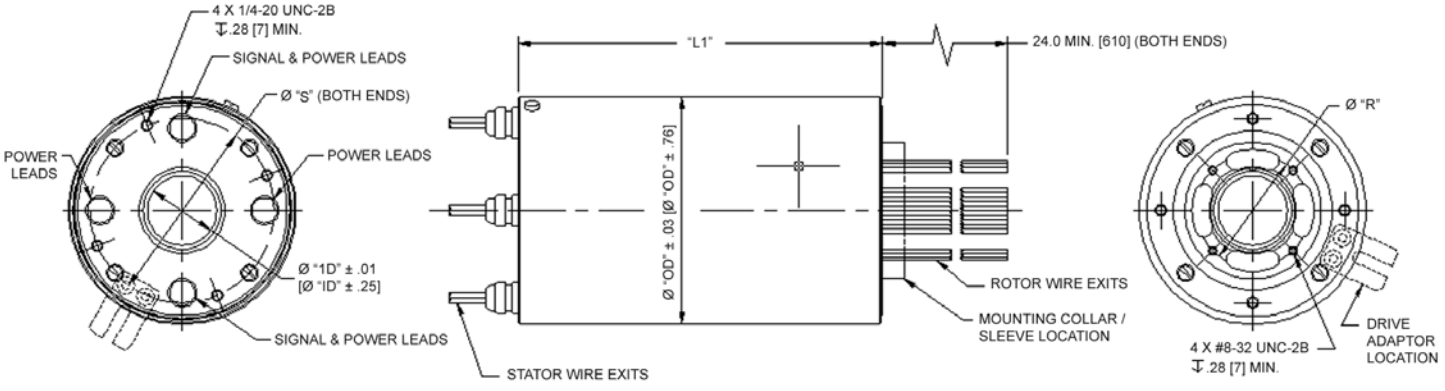
xx = Total number of signal rings
yy = Total number of power rings

L1 = .2 (xx) + .4 (yy) + .1.63

Number of signal rings (multiples of 4)

Number of power rings (multiples of 2)	0	4	8	12	16	20	24	28	32	36	40
0		-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	
4	-	-	-	-	-	-	-	-	-		
6	-	-	-	-	-	-	-	-			
8	-	-	-	-	-	-	-				
10	-	-	-	-	-	-					
12	-	-	-	-	-						
14	-	-	-	-							
16	-	-	-								
18	-	-									
20	-										

Plus W Series Dimensions



Dimensions in inches [millimeters]

The end views shown above are for the 1.5 inch ID slip ring. Please consult factory for 3, 4, 6 and 9 inches.

PM Series

Description

Suitable for a wide variety of industrial applications, the PM series is designed to transmit power and data signals at high speeds. Compatible with thermocouple and strain gauge instrumentation, the PM series is designed to maintain reliable performance under adverse operating conditions. Continuous silver connections ensure minimal thermal error. Quick and easy to install and available with 8, 12 and 24 circuits.

Features

- Suitable for a wide variety of industrial applications
- Transmits power and data signals at high speeds
- Compatible with thermocouple and strain gauge instrumentation
- Reliable performance under adverse operating conditions
- Continuous silver connections ensure minimal thermal error
- Quick and easy to install
- Available with 8, 12 and 24 circuits

Benefits

- High rotational speed
- Low torque required to drive this unit

Typical Applications

- Instrumentation and testing

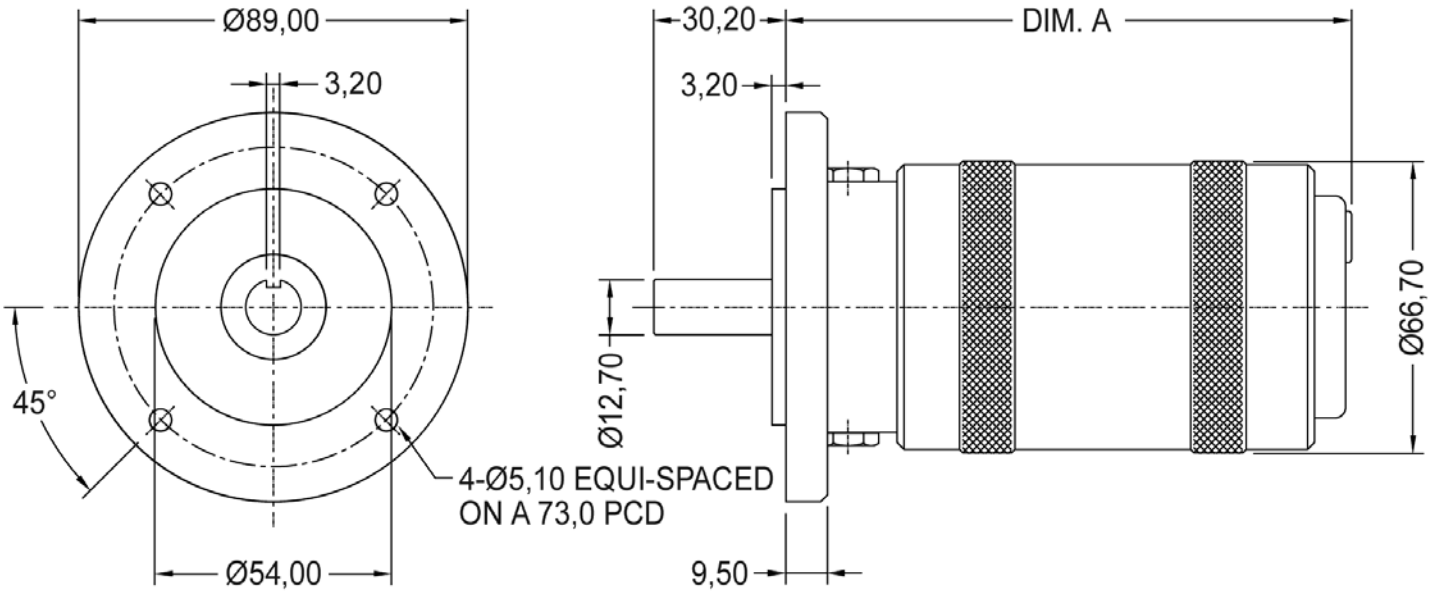
PM Series Specifications	
Terminals	Silver
Mounting	Flange mounted 4 holes ø5,1 mm equi-spaced on a 73,0 mm P.C.D.
Cooling Air Pressure	1.4kg / cm2
Brush Lifting Air Pressure	4.2 kg / cm2
Maximum Voltage	50 volts
Temperature Range	-20ºC to +90ºC
Maximum Current	2.5 amps
Dielectric Strength	500 volts 50 Hz for 10 seconds
Insulation Resistance	>200 MΩ at 500 volts DC

**Please note that the operational life of the unit is dependent upon rotational speed, environment and temperature.*

Note: Operation at maximum rotational speed requires cooling air to be supplied through the inlet and outlet ports provided.

Series	Part Number	Number of Ways	Length Diameter	Weight gm	Starting Torque g-cm	Maximum Speed RPM
PM-08	80038-950	8	132 mm	1000	290	12,000
PM-12	80039-950	12	147 mm	1140	406	12,000
PM-24	80027-950	24	216 mm	1820	812	12,000

PM Series Dimensions



Dimensions in millimeters

Large Slip Ring Assemblies

Description

Large bore slip rings represent the union of manufacturing processes and technologies that enable us to offer large, high volume slip rings with advanced features that are cost effective. The manufacturing processes allow the slip ring to be built in an assembly-line fashion, significantly reducing delivery time and price.

Features

- Drum or platter style
- Inside diameters up to 55 inches
- Optical single channels available with data rates up to 5 Gp / s
- Lengths to 18 inches
- Rotational speeds to 300 rpm
- Power rings rated to 1000 V with current to 300 amp
- Data rings from DC to 80 Mb / s
- Quieter mechanical system operation
- Low life time maintenance
- Multiple brush tip options with minimal debris

Large Bore Slip Rings With Optics

These large bore slip rings feature optical channels for high speed optical communications, up to 5 Gb / s. This patented technology also has the capability to transfer multiple optical signals per optical channel, resulting in data transfer rates in excess of 5 Gb / s per optical channel.

- ID to 55 inches, length to 18 inches
- Drum or platter style
- 80 Mb / s to 5 Gb / s per channel, aggregate data rate greater than 80 Gb / s
- Rotational speed dependent on diameter
- To 1000 V; 300 amps

Typical Applications

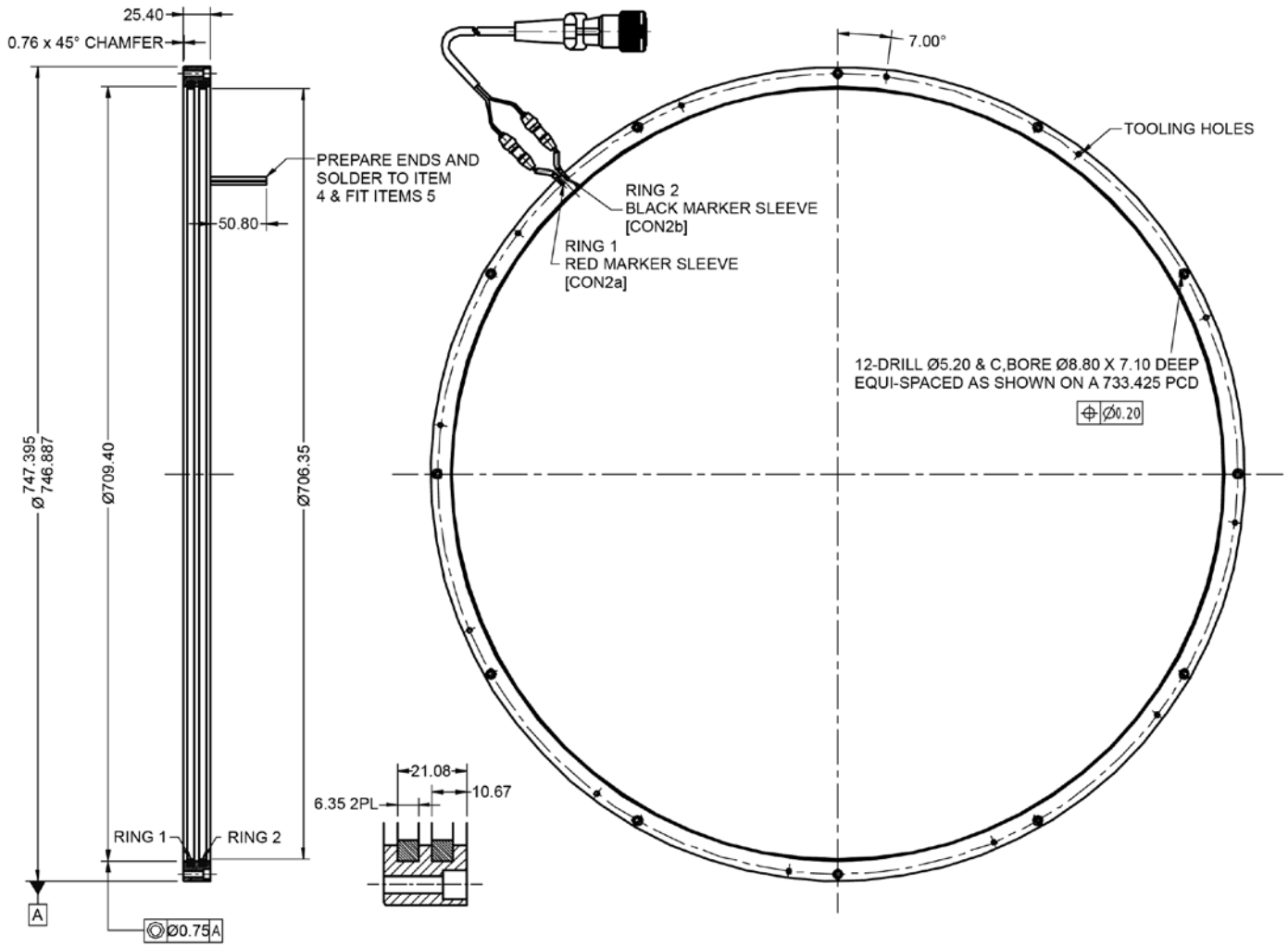
- Medical CT scanners
- Luggage scanners
- Amusement rides
- Cranes
- Offshore mooring

Specifications*		Options
Size Range	ID to 55 inches; length to18 inches	Apart from CT scanning solutions we also provide large diameter slip rings for industrial and military applications. These are custom designed against your specific requirements. An example is shown below. Contact us to have your specific needs quoted.
Rotational Speed	Dependent upon the diameter	
Signal Data Rate Electrical Optical	 DC to 80 Mb / s 80 Mb / s to 5 Gb / s per optical channel	
Number of Circuits	Application and space dependent	
Power	1000 V, 300 amps	

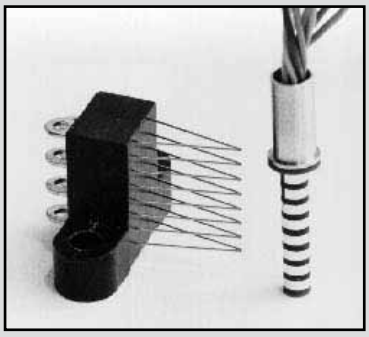
**Designed to customer specifications.*

Note: Slip ring designs within these general specifications may be for either military or commercial applications. Military slip ring designs require specific licensing for export.

Large Slip Ring Dimensions



AC2690 – Slip Ring
AC259 – Brush Block
Miniature slip ring separate assemblies

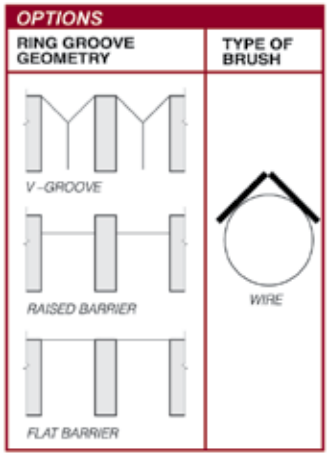


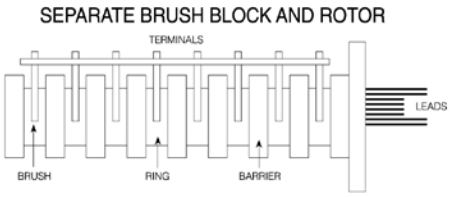
Description
Sometimes a self-contained “capsule” slip ring is not practical due to system size constraints or cost limitations. We can provide the slip ring (rotor) and brush block (stator) as separate components to be mated by the customer in their system. The rotor is supplied in a drum configuration which features consecutive individual rings along the axis of rotation. Miniature separates may have slip ring rotor diameters less than 0.100 inch.

A slip ring can be used in any electromechanical system that requires unrestrained, intermittent or continuous rotation while transmitting power and / or data. It can improve mechanical performance, simplify system operation and eliminate damage-prone wires dangling from movable joints.

Options Available
Slip Ring
- Raised barrier (.110 diameter)
- V-groove (90°) in each ring

Brush Block
- Flying leads
- Gold or tin plated terminals





Typical Applications
- Instrumentation
- Displays and avionics
- Testing and measuring
- Custom machinery
- OEM machinery

Slip Ring Separate: AC2690 Specifications

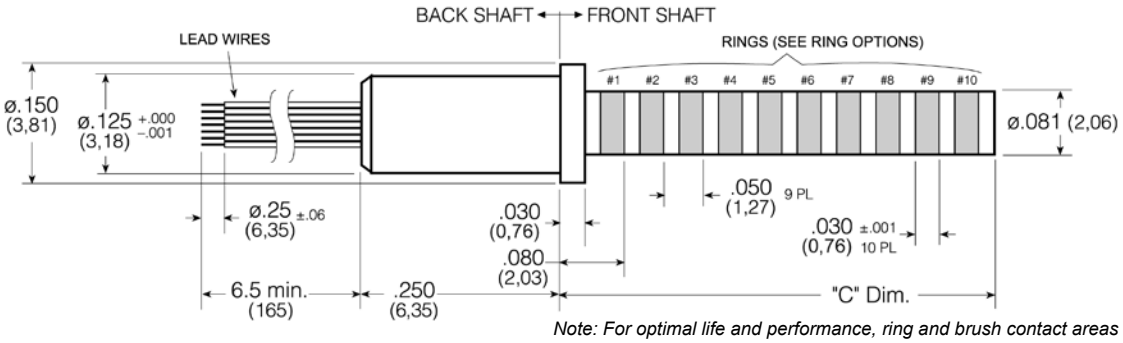
Materials:

- Contact surface - 24K nickel hardened gold
- Backshaft - 303 stainless steel
- Leads - #30 AWG silver plated copper, Teflon® insulated
- Dielectric - plastic (mineral filled epoxy)
- A voltage of 1000 V RMS 60Hz shall be applied between all circuits for a period of 10 seconds without breakdown

Teflon® is a registered trademark of E.I. du Pont de Nemours and Co.

Part #	# of Circuits	Dimension "C"
AC2690–1	1	0.100 inches (2,54 mm)
AC2690–2	2	0.150 (3,81)
AC2690–3	3	0.200 (5,08)
AC2690–4	4	0.250 (6,35)
AC2690–5	5	0.300 (7,62)
AC2690–6	6	0.350 (8,89)
AC2690–7	7	0.400 (10,16)
AC2690–8	8	0.450 (11,43)
AC2690–9	9	0.500 (12,7)
AC2690–10	10	0.550 (13,97)

Lead Wire	Color Codes
#1	Brown
#2	Red
#3	Orange
#4	Yellow
#5	Green
#6	Blue
#7	Violet
#8	Gray
#9	White
#10	Black



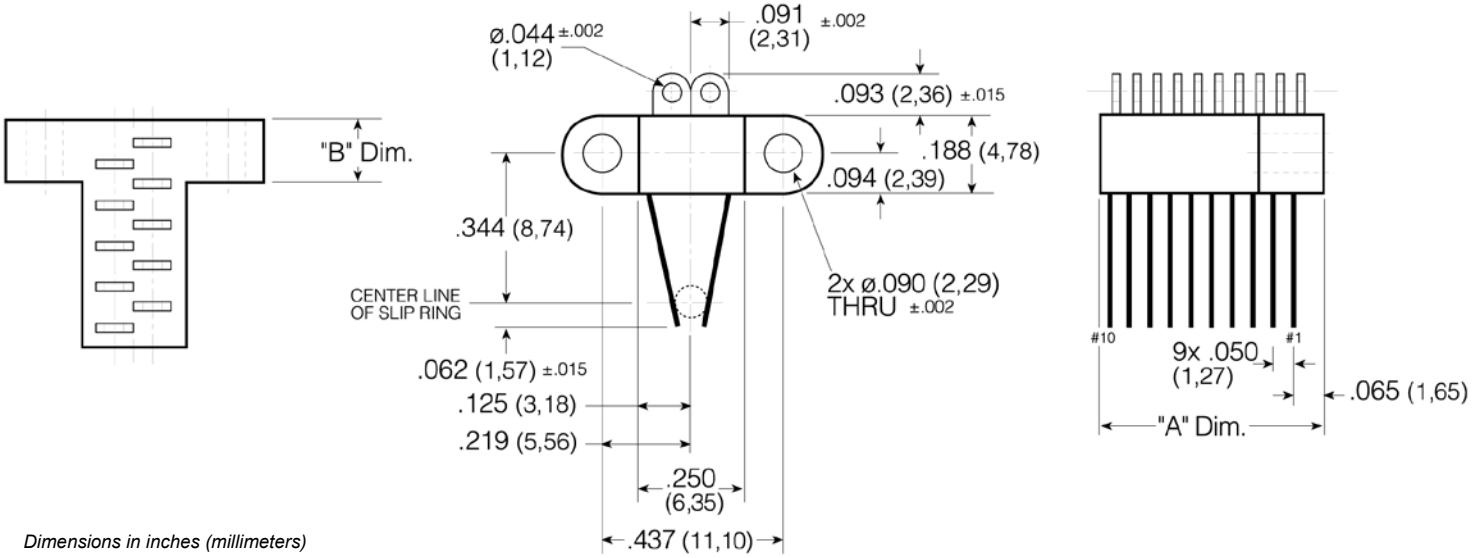
Note: For optimal life and performance, ring and brush contact areas should be lubed.

Brush Block Separate: AC259 Specifications

Materials:

- Brushes - palladium alloy (ASTM B540) (.007 dia.)
- Plastic - polyester
- Terminals - .015 thick brass, silver (gold or tin optional) plated
- Flying leads optional
- A voltage of 1000V RMS 60Hz shall be applied between all circuits for a period of 10 seconds without breakdown
- Brush contact pressure approx. 5 grams when positioned on .081 dia. ring (AC2690-)

Part #	# of Circuits	Dimension "A"	Dimension "B"
AC259–1	1	0.100 inches (2,54 mm)	0.100 inches (2,54 mm)
AC259–2	2	0.140 (3,56)	0.140 (3,56)
AC259–3	3	0.190 (4,83)	0.156 (3,96)
AC259–4	4	0.240 (6,10)	0.156 (3,96)
AC259–5	5	0.290 (7,37)	0.156 (3,96)
AC259–6	6	0.340 (8,64)	0.156 (3,96)
AC259–7	7	0.390 (9,91)	0.156 (3,96)
AC259–8	8	0.440 (11,18)	0.156 (3,96)
AC259–9	9	0.490 (12,45)	0.156 (3,96)
AC259–10	10	0.540 (13,72)	0.156 (3,96)



Dimensions in inches (millimeters)

MD6038 – *Slip Ring*
MD6043 – *Brush Block*
Miniature slip ring separates with through-bore

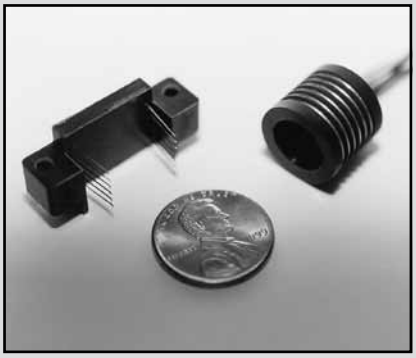
Description
A slip ring can be used in any electromechanical system that requires unrestrained, continuous rotation while transferring power and / or data from a stationary to a rotating structure. A slip ring is also called a rotary electrical interface, commutator, collector, swivel or a rotary joint.

Sometimes a self contained “capsule” is not practical due to size constraints or cost limitations, and a “separate” is the solution. The term separate indicates an individual rotor / brush block combination. If a separate rotor / stator approach is best for your application, consider our MD series.

The MD series slip ring separate has 6 circuits and features a 3/8” unobstructed bore through the center that provides routing space for hydraulics, pneumatics, or for a concentric shaft mount.

Features
- 6 circuits
- 3/8 inch unobstructed bore. Other bore sizes also available.
- Gold-on-gold contacts. Provide enhanced conductivity and low noise.
- Excellent signal handling performance. Noise as low as 15 milliohms per circuit pair can be achieved at 60-100 rpm.

Benefits
- Improved system performance. Slip rings can improve mechanical performance, simplify system operation and eliminate damage-prone wires dangling from movable joints.
- Long Life. We use gold on gold contacts to extend unit life to exceed or meet the requirements for most commercial / industrial requirements.



Typical Applications

This separate assembly provides high speed performance and an unobstructed bore-through the center of the unit. It is successfully performing in instrumentation applications where miniaturization is critical, such as:

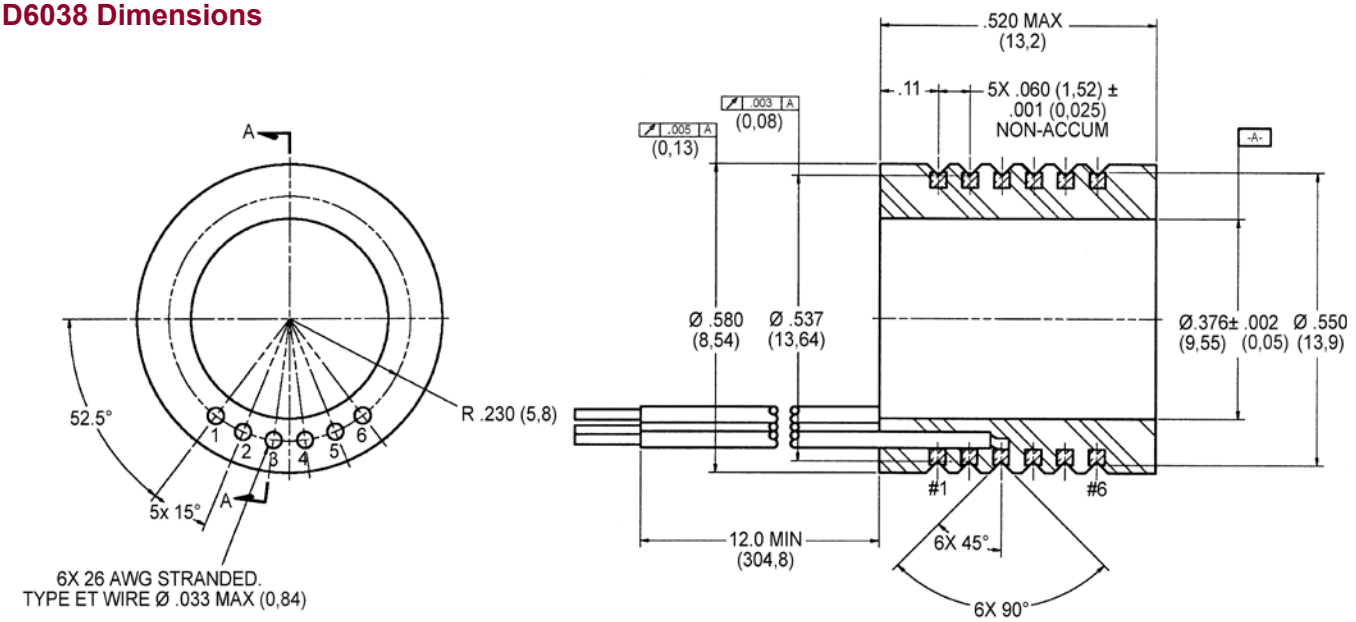
- Aircraft cockpit instruments
- Sputtering machines for the manufacture of integrated circuits
- Custom machinery
- OEM machinery
- Power tools

Specifications	
Ring O.D.	.550 inch (13,9 mm)
Ring-to-Ring Pitch	.060 inch (1,52 mm)
Bore	.376 inch (9,55 mm)
Volts (Test)	500 VRMS
Ring Groove Geometry: V-Groove with Raised Barriers	

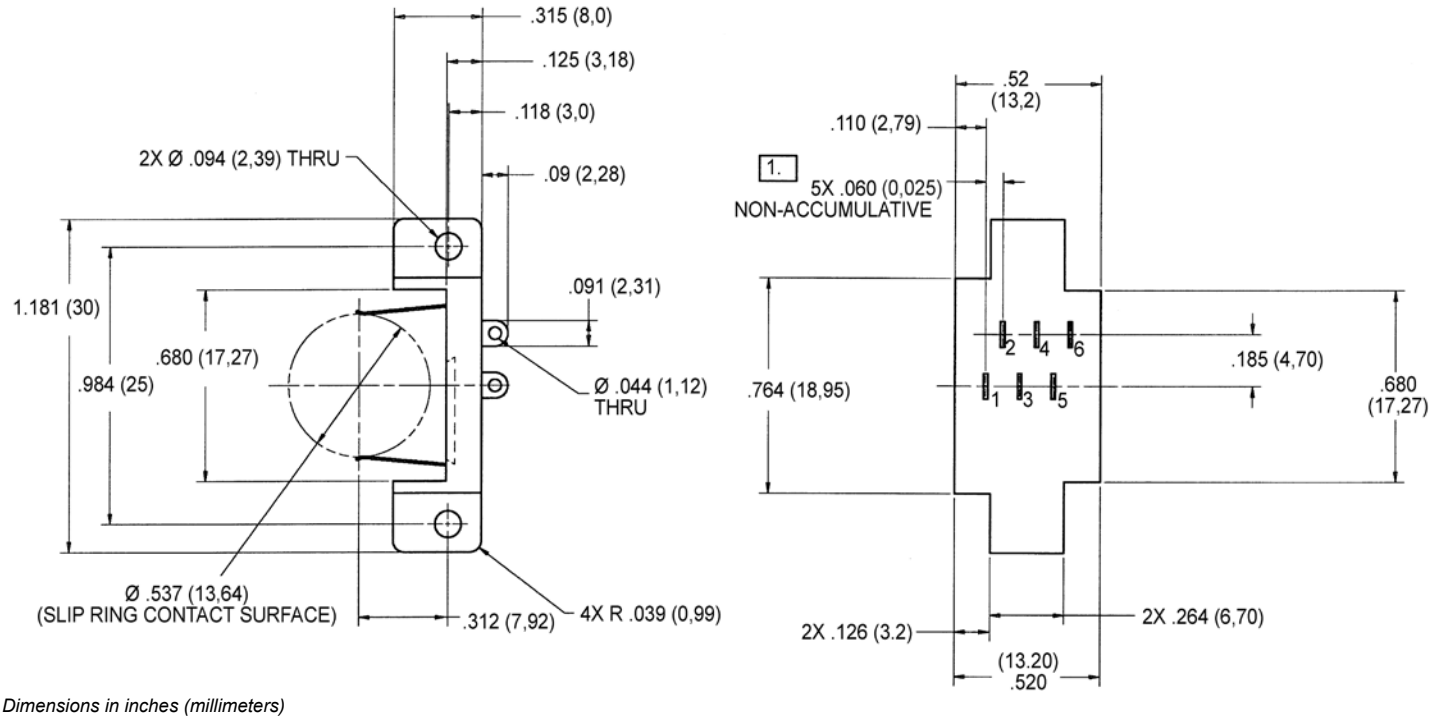
Lead Wire Color Codes	
Ring #	**Color Code**
1	BLK
2	BRN
3	RED
4	ORN
5	YEL
6	GRN

Note: For optimal life and performance, ring and brush contact areas should be lubed.

MD6038 Dimensions



MD6043 Dimensions



Dimensions in inches (millimeters)

Slip Ring Platter Separates

Description

For space and cost conscious requirements, platter separates can be an ideal solution. The units supplied generally consist of a slip ring based on a PCB style and a matching brush block or board depending on the requirements. Various configurations are manufactured – from simple components, through units with fixed spacing arrangements to products with integrated bearing components.

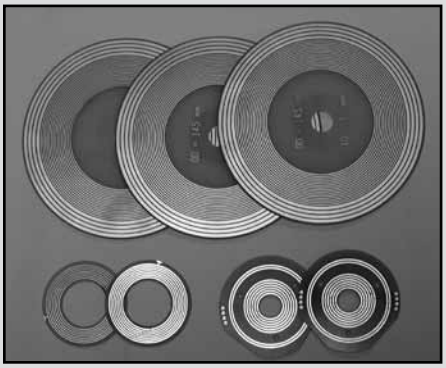
Full mounting details are supplied with the unit and the customer is required to lubricate the slip ring during installation.

Features

- Separate components or integrated assemblies
- Simple installation
- Pre-set brush springs

Benefits

- Suits applications with minimal available space
- Can utilize existing bearing system
- Custom configuration to suit application



Typical Applications

- Process machinery
- Medical equipment
- Test and measurement equipment

Fiber Optic Rotary Joints

Description

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. Moog Components Group has been producing fiber optic rotary joints for over 20 years.

Single or Multi-channel

FORJs are available in single and multi-channel options. The most cost and size efficient options are the single and dual channel designs. If more than two fibers are present in a system, multiplexing solutions are available to combine multiple channels onto one or two fibers to allow the use of a one or two channel FORJ.

In cases where more than two fibers are required, Moog has three designs; FO190, FO242 and FO291 where single channels are stacked to achieve the desired number of channels. The FO300 uses a common de-rotating optical element for all fiber channels.

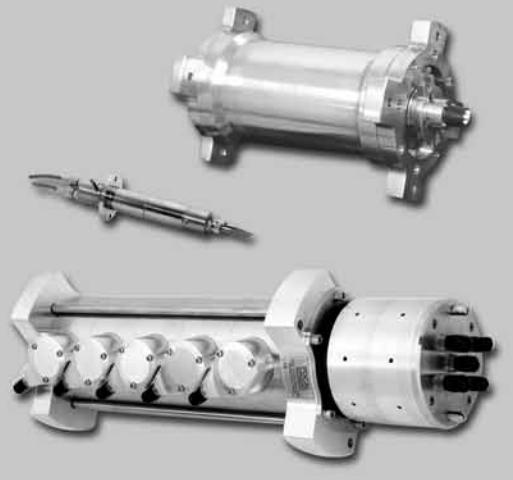
Singlemode or Multimode

Singlemode fibers allow the propagation of a singlemode of optical energy due to their small core size and small numerical aperture and for this reason they exhibit very high bandwidths. Most singlemode fiber systems operate at 1300 nm and 1550 nm wavelengths because of lower fiber attenuation at these wavelengths. Because of these smaller core sizes and numerical aperture, singlemode FORJs must be designed with very precise mechanical alignments.

Multimode fibers have large cores and large numerical apertures allowing the propagation of multiple modes of optical energy. These features allow larger amounts of light to be transmitted from sources such as LEDs and VCSELs, but result in higher attenuation and dispersion. Because of these attenuation and dispersion features, multimode fiber systems are typically used for shorter datacom links. Most multimode systems operate at 850 nm and 1300 nm.

Features

- Ruggedized for harsh environments
- Compact sizes
- Variety of configuration options
- Custom designs available



Typical Applications

- Robotics
- Vehicle turrets
- Radar antennas
- Medical systems
- Security systems
- Sensor platforms
- Material handling systems
- Remotely operated vehicles
- Fiber optic cable reels
- Video surveillance systems
- Marine propulsion systems
- Wind energy turbines

Fiber Optic Rotary Joints (FORJ)

FORJ Performance Data

Product	Performance							Physical					
	Fiber Type		Channels	Insertion Loss - Maximum dB MM = 5.5 dB		Maximum Rotational Speed	Operating Temperature	Size Inches (mm)			Standard Interface		
-	SM	MM	-	SM	MM	RPM	-	Minimum Length	Flange Diameter	Drum Diameter	Pigtail / Adaptor	Connector Type	Pigtail Length
FO228	N	Y	1	NA	4.0	100	-40 to +75 C	1.75 (44.45)	1.50 (38.10)	0.73 (18.54)	Adaptor	FC or ST	NA
FO282	Y	N	1	4.0	NA	100	-40 to +75 C	1.75 (44.45)	1.50 (38.10)	0.73 (18.54)	Adaptor	FC or ST	NA
FO197	N	Y	1	NA	3	1000	-40 to +60 C	2.38 (60.45)	1.50 (38.10)	0.62 (15.74)	Pigtail or Adaptor	FC, ST for Adaptors; As Required on Pigtails	As Required
FO206	Y	Y	1	3.5	NA	1000	-40 to +60 C	2.36 (59.94)	1.50 (38.10)	0.77 (19.55)	Pigtail or Adaptor	FC / PC Standard Alternates Available	As Required
FO285 *	Y	Y	1	3.5	NA	500 +	-55 to +75 C	1.02 (25.90)	0.75 (19.05)	0.037 (.93)	Pigtail	As Required	As Required
FO286 *	N	Y	1	NA	2.5	500 +	-55 to +75 C	0.75 (19.05)	0.75 (19.05)	0.037 (.93)	Pigtail	As Required	As Required
FO300 **	Y	Y	12 SM 19 MM	5	5	100	-40 to +60 C	4.22 (107.18)	1.8 (45.72)	2.35 (59.69)	Pigtail	As Required	As Required
FO215 *	N	Y	2	NA	5.5	500 +	-40 to +60 C	P: 3.30 (83.82)	P: 1.50 (38.10)	P: 0.75 (19.05)	Pigtail or Adaptor	ST, FC, SC, LC	As Required
FO257	Plastic		2	8 ***		500 +	-40 to +60 C	3.47 (88.13)	1.85 (46.99)	1.24 (31.49)	Pigtail	ST or SMA	As Required
FO292 *	N	Y	2	NA	5.5	500 +	-40 to +60 C	2.25 (57.15)	1.25 (31.75)	0.50 (12.7)	Pigtail	ST, FC, SC, LC	As Required
FO242 *	Y	N	2 to 5	5.5	NA	100 +	-40 to +60 C	See Data Sheet	5.02 (127.50)	5.00 (127.00)	Adaptor	FC / PC Standard; ST Optional	NA
FO291 ***	Y	Y	2 to 9	6	5.5	100 +	-40 to +60 C	See Data Sheet	See Data Sheet	See Data Sheet	Adaptor	FC / PC Standard; ST Optional	NA
FO190 *	N	Y	2 to 21**	NA	5.5	100	-40 to +60 C	See Data Sheet	5.02 (127.50)	5.00 (127.0)	Adaptor	FC / PC, ST	NA
Hybrid Units													
H18	Y	Y	1 Optic 18 Elec.	3.5	2.5	500	-20 to +60 C	3.4 (86.36) MM, 3.64 (92.45) SM	1.75 (44.45)	0.87 (22.0)	Pigtail	As Required	As Required
H24	Y	Y	1 Optic 24 Elec.	3.5	2.5	500	-20 to +60 C	3.7 (93.98) MM, 3.94 (100.07) SM	1.75 (44.45)	0.87 (22.0)	Pigtail	As Required	As Required

* The FO242 and FO190 can be combined to offer a hybrid multimode and singlemode solution
SM = Singlemode MM = Multimode
** More passes are available with a custom design
*** 1 MM pass can be accommodated on the FO291

* Right angle options available
** Consult factory for number of passes available for SM and MM combination applications
*** Pigtail length effect with plastic fiber

Note: Optical values for all listed multimode FORJs are based on use with LED sources.

Shock and Vibration

Moog Component Group FORJs support high shock and vibration environments, long life requirements of more than 200,000 hours and long data links over 100 km of fiber. Units are available that are tested to MIL-STD-167-1, MIL-STD-202, MIL-STD-204 for vibration and MIL-STD-810D / E and MIL-STD-901D for shock.

Options

- Supply and installation of customer specific connectors and fibers
- Customization of mounting configurations, housing materials and drive couplers
- Fluid filling and pressure compensation for underwater use

FO228 / FO282

Fiber optic rotary joint

Description

The FO228 (single-pass multimode) and the FO282 (single-pass singlemode) are passive and bidirectional, and maintain the benefits of fiber optics (such as high bandwidth and EMI immunity) in systems with a rotational interface.

These cost efficient FORJ models are designed for applications having moderate demands for optical performance and life. Due to their lens-less design, they can operate at any wavelength supported by the fiber used in the assembly.

Both models can be combined with our electrical and fluid slip rings, giving a single, compact package for optical signals, electrical power and fluid transfer.

Features

- Provides rotary coupling for a multimode or singlemode fiber link
- Passive bidirectional device
- Low cost
- Can be combined with our electrical slips and fluid unions
- Alternative drive coupling and mounting arrangements are available (consult factory for specification details)
- Connectorized interfaces, for easy fiber cable replacement
- Can be integrated into existing slip ring designs
- Aluminum or anodized aluminum housing
- Rugged design
  - MIL-STD-167-1 ship vibration
  - MIL-STD-810D functional shock (40 g)

Typical Applications

- Cable reelers used in EOD robots
- Material handling systems
- Security cameras

Fiber Optic Rotary Joints (FORJ)

Specifications				
	FO228 (Multimode)		**FO282 (Singlemode)**	
Fiber Size (Microns)	50/125 or 62.5/125 (consult factory for other sizes)		9/125 SMF-28 (consult factory for other sizes)	
Insertion Loss	Typical < 2.5 dB	Maximum < 4.0 dB	Typical < 2.5 dB	Maximum < 4.0 dB
Rotation Variation	Typical < 0.5 dB	Maximum < 1.0 dB	Typical < 0.5 dB	Maximum < 1.5 dB
Wavelength	Broadband (fiber dependant)			
Rotational Speeds	To 100 rpm. Higher rotational speeds should be discussed with the factory			
Temperature	-40 to +75 deg C. Consult factory for extended range			
Life	500,000 revolutions			
Exterior Surfaces	Aluminum or anodized aluminum			
Vibration	Tested to MIL-STD-167-1 (ships)			
Shock	Tested to MIL-STD-810D			
Terminations	Standard with ST or FC connector receptacles. Can be pigtailed with cable and connectors to meet customer's requirements.			
Pigtail Length	As required			

Hybrid Units

Can be combined with electrical and fluid slip rings

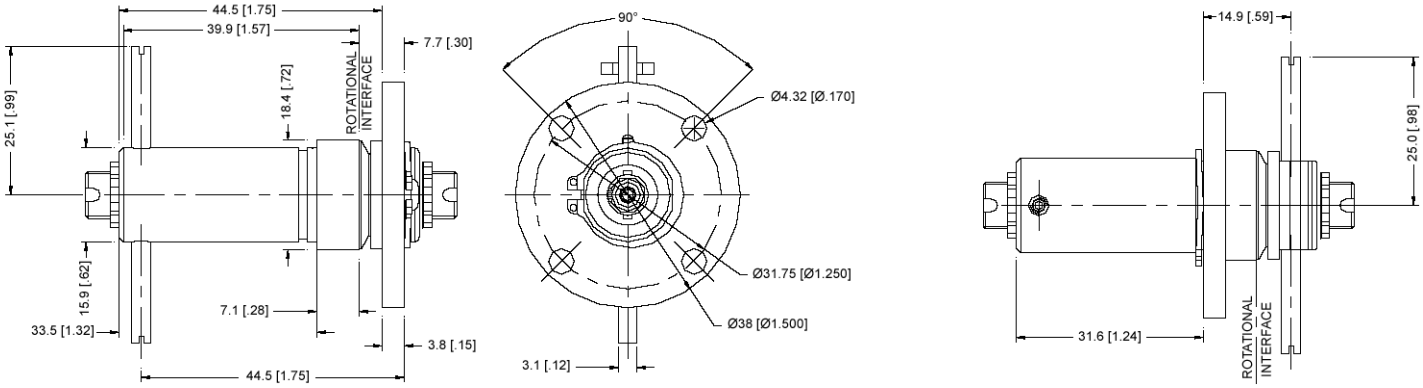
Mounting Options

Available with or without mounting flange (consult factory for details)

Terminations

Built-in FC or ST connector receptacles

FO228 and FO282 Dimensions



Shaft Mounting Arrangement

Body Mounting Arrangement

Dimensions in inches [millimeters]

FO197

Fiber optic rotary joint

Description

The FO197 is a single-pass, multimode fiber optic rotary joint (FORJ). It is passive and bidirectional, and allows the transfer of any type of optical signal across rotational interfaces.

The FO197 fiber optic rotary joint can be combined with our electrical and / or fluid slip rings, providing a single, compact package for optical signals, electrical power and fluid transfer.

The FORJ can be assembled with pigtail lengths tailored to the customer's application or installed with connector bushings (ST or FC). Housing, mounting flange and drive features can also be customized to meet the customer's requirements.

Features

- Provides rotary coupling for a multimode fiber link
- Passive bidirectional device
- Can be combined with our electrical slips and fluid unions
- Alternative drive coupling and mounting arrangements are available (consult factory for specification details)
- Connectorized interfaces, for easy fiber cable replacement
- Can be integrated into existing slip ring designs
- Stainless steel, aluminum or anodized aluminum housing
- Rugged design
  - MIL-STD-167-1 ship vibration
  - MIL-STD-810D functional shock (40 g)

Typical Applications

- Remote I/O in industrial machinery
- Video surveillance systems
- Material handling systems
- Sensor platforms
- Indexing tables
- Cable reels
- Robotics
- Turrets

FO197 Specifications		
Fiber Size (Microns)	50 / 125, 62.5 / 125, 100 / 140 or 200 / 230	
Insertion Loss	Typical < 1.5 dB	Maximum < 3.0 dB
Rotation Variation	Typical < 0.5 dB	Maximum < 1.0 dB
Back Reflection	Typical 22 dB	18 dB Minimum
Wavelengths	850, 1300 or 1550 nm. Consult factory for multi-wavelength applications.	
Rotational Speeds	To 1000 rpm. Higher rotational speeds should be discussed with the factory.	
Temperature	-40 to +60 deg C (dry version). Consult factory for extended range.	
Dispersion	< 10 picoseconds (calculated)	
Exterior Surfaces	Stainless steel, aluminum or anodized aluminum	
Vibration	Tested to MIL-STD-167-1 (ships)	
Shock	Tested to MIL-STD-810D	
Terminations	ST or FC connector receptacles or pigtailed with cable and connectors to meet customer's requirements	
Pressure	Up to 10000 psi (69,000 kPa) for fluid filled version*	
Pigtail Length	As required	

**Fluid filled version is slightly larger than shown below.*

Hybrid Units

Can be combined with electrical and fluid slip rings.

Mounting

See diagrams for details. Customized mounting flanges also available.

Pressure

Optional fuid-filled version for pressure compensation (in a slightly lager housing than shown).

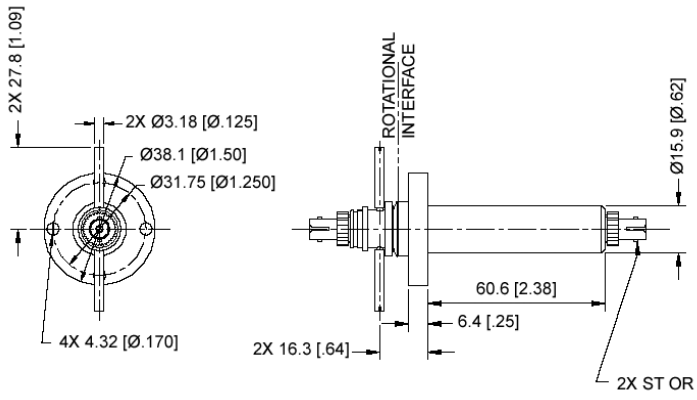
Exterior Surfaces

Stainless steel, aluminum or anodized.

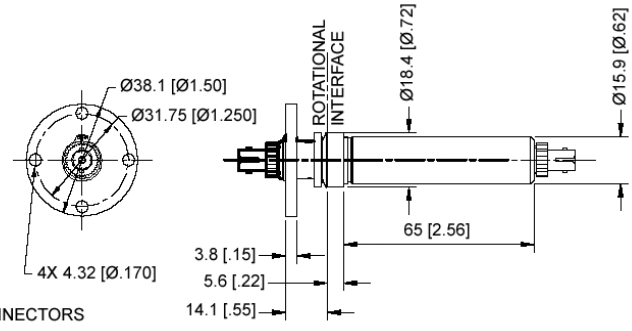
Terminations

ST or FC connector receptacles or pigtailed with cable and connectors to meet customer's requirements.

FO197 Dimensions



Body Mounting Arrangement (B)



Shaft Mounting Arrangement (S)

FO206

Fiber optic rotary joint

Description

The FO206 is a single-pass, singlemode fiber optic rotary joint (FORJ). It is passive and bidirectional, and allows the transfer of optical signals across rotational interfaces.

The FORJ maintains the full benefit of fiber optics end-to-end in digital and analog transmission to and from rotating equipment. These benefits include high bandwidth and immunity to most forms of EMI.

The FO206 can be combined with our electrical and fluid slip rings, providing a single, compact package for optical signals, electrical power and fluid transfer. Most of the external features on the FO206 can be modified to meet the customer's custom requirements.

Features

- Provides rotary coupling for a singlemode fiber link
- Passive bidirectional device
- Can be combined with our electrical slips and fluid unions
- Connectorized interfaces, for easy fiber cable replacement
- Customized mounting flanges available
- Optional fluid-filled version for deep submergence to 10,000 psi (69,000 kPa)
- Can be integrated into existing slip ring designs
- Stainless steel housing
- Rugged design
  - MIL-STD-167-1 ship vibration
  - MIL-STD-810D functional shock (40 g)

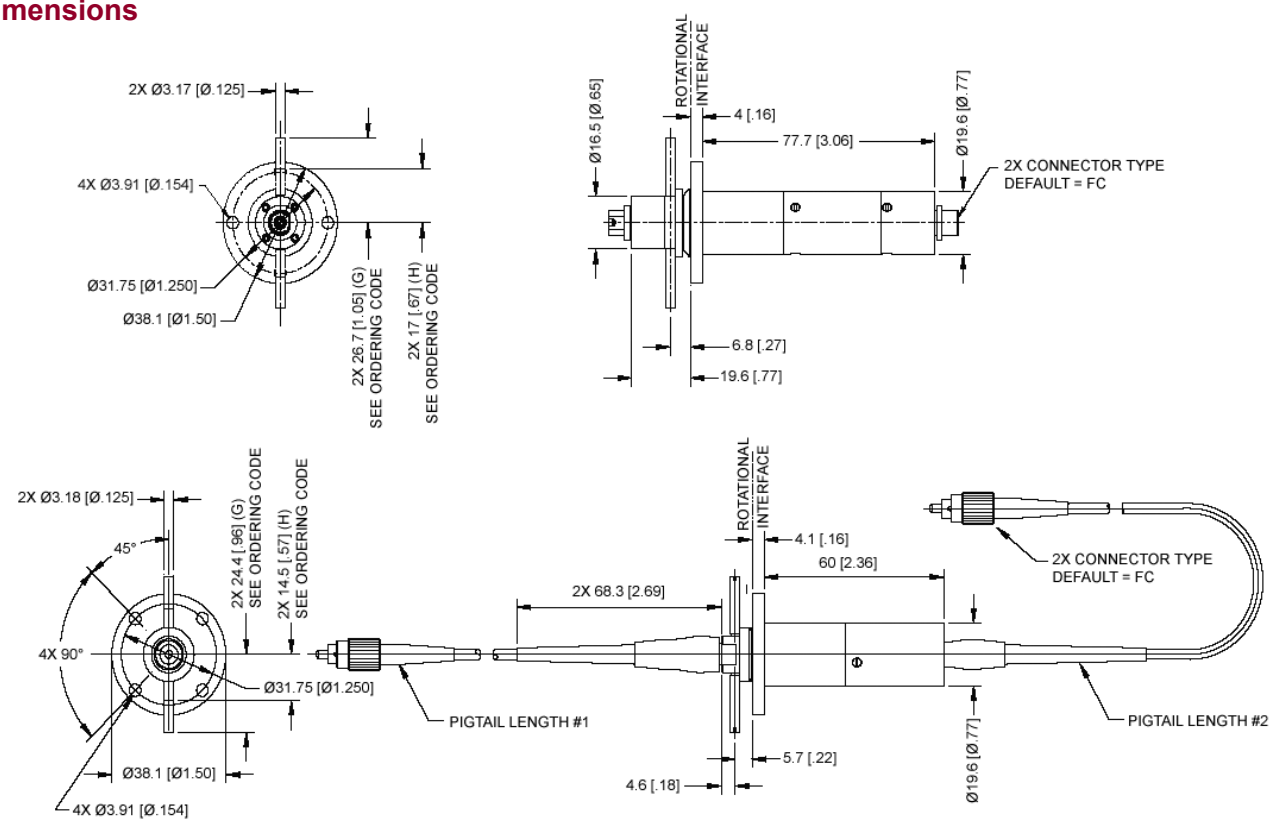
Typical Applications

- Vehicle turrets
- Industrial machine tools
- Undersea telemetry
- Radar antennas
- Cable reels
- Robotics

FO206 Specifications			
Fiber Size (Microns)		9 / 125 SMF-28. Consult factory for other SM fiber types	
Insertion Loss		Typical < 1.5 dB	Maximum < 3.5 dB
Rotation Variation		Typical < 0.5 dB	Maximum < 1.0 dB
Back Reflection	Standard	Typical 22 dB	18 dB Minimum
	Optional	Typical 40 dB	35 dB Minimum
Wavelengths		1310 and / or 1550 nm. Consult factory for other wavelength applications	
Rotational Speeds		To 1000 rpm. Higher rotational speeds should be discussed with the factory.	
Temperature		-40 to +60 deg C (dry version) -20 to +60 deg C (wet version). Consult factory for extended range.	
Dispersion		< 50 fs / nm (calculated)	
Exterior Surfaces		Stainless steel	
Vibration		Tested to MIL-STD-167-1 (ships)	
Shock		Tested to MIL-STD-810D	
Terminations		Standard is with FC / PC connector receptacles at each end. Alternative connectors types available dependant on configuration (ST, FC/APC). Pigtails can be supplied with cable and connectors to meet customer's requirements.	
Pressure		Up to 10000 psi (69,000 kPa) for fluid filled version*	
Pigtail Length		As required	

**Fluid filled version is slightly larger than shown below.*

FO206 Dimensions



Dimensions in inches [millimeters]

FO285 / FO286

Fiber optic rotary joint

Description

The FO285 (single-pass singlemode) and the FO286 (single-pass multimode) are passive and bidirectional, and allow the transfer of optical signals across rotational interfaces.

With a body diameter of only 9.5 mm and lengths of 26 mm and 19 mm for the FO285 and FO286 respectively, both units are ideally suited to applications where size and weight are critical issues. An extremely cost effective solution for high data rate signals, both models also offer other benefits of fiber optics, including low spark hazard and immunity to electromagnetic interference.

Both models can be combined with our electrical and fluid slip rings, and with our entire line of video and data multiplexers to provide a complete solution.

Features

- Provides rotary coupling for a multimode or singlemode fiber link
- Passive bidirectional device
- Low cost, small size
- Can be combined with our electrical slips and fluid unions
- Alternative drive coupling and mounting arrangements are available (consult factory for specification details)
- Can be integrated into existing slip ring designs
- Stainless steel or aluminum construction
- Rugged design
  - MIL-STD-167-1 ship vibration
  - MIL-STD-810F functional shock (40 g)
- 90° fiber exits available for limited space requirements

Typical Applications

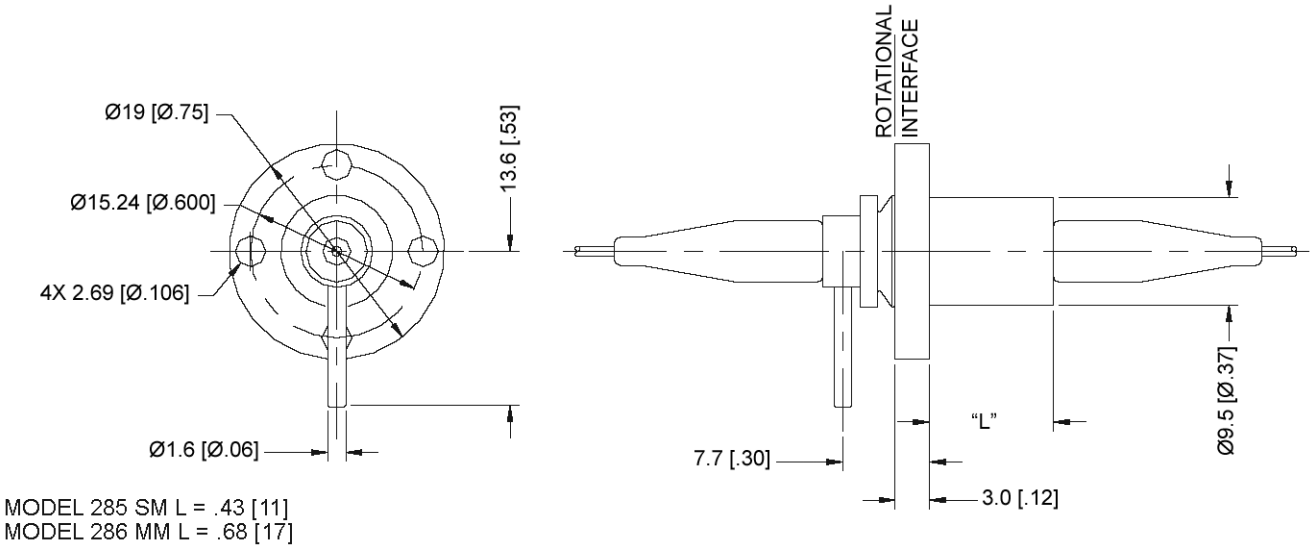
- Unmanned ground vehicles
- Robots
- Surveillance systems
- Industrial automation
- Unmanned aerial vehicles and sub-systems

Fiber Optic Rotary Joints (FORJ)

Specifications				
	FO285 (Singlemode)		**FO286 (Multimode)**	
Fiber Size (Microns)	9 / 125 SMF-28 (consult factory for other sizes)		50 / 125 or 62.5 / 125 (consult factory for other sizes)	
Insertion Loss	Typical < 1.5 dB	Maximum < 3.5 dB	Typical < 1.5 dB	Maximum < 2.5 dB
Rotation Variation	Typical < 0.5 dB	Maximum < 1.5 dB	Typical < 0.5 dB	Maximum < 1.0 dB
Back Reflection*	Typical 22 dB	18 dB Minimum	Typical 22 dB	18 dB Minimum
Wavelength	1310 / 1550 nm (consult factory for other wavelengths)		850, 1300 or 1550 nm (consult factory for multi-wavelengths applications)	
Dimensions	9.5 mm diameter x 26 mm length		9.5 mm diameter x 19 mm length	
Weight/Material	Stainless steel: 16 g (pigtailed with connectors)		Aluminum: 7g, Stainless steel: 14 g (pigtailed with connectors)	
Rotational Speeds	To 1000 rpm. Higher rotational speeds should be discussed with the factory.			
Temperature	-55 to +75 deg C. Consult factory for extended range.			
Vibration	Tested to MIL-STD-167-1 (ships)			
Shock	Tested to MIL-STD-810F			
Terminations	Pigtailed with cable and connectors to meet customer's requirements 900 micron buffered cable standard			
Pigtail Length	As required			

**35 dB minimum back reflection option available for FO285.*

FO285 and FO286 Dimensions



MODEL 285 SM L = .43 [11]
MODEL 286 MM L = .68 [17]

Dimensions in inches [millimeters]

FO300

Fiber optic rotary joint

Description

The FO300 is a multi-pass fiber optic rotary joint (FORJ). It allows the transfer of optical signals across a rotational interface and is passive and bidirectional. The smaller version “A” accommodates up to 19 separate singlemode or multimode optical fibers. The larger version “B” supports up to 31 separate channels. A third fluid-filled and pressure compensated version for up to 13 singlemode fibers is also available for use in subsea.

The FO300 can be combined with electrical and / or fluid slip rings, providing a single package for optical signals, electrical power and fluid transfer.

Features

- Up to 31 Fiber Optic Channels in a very small form factor
- The smaller version “A” accommodates up to 19 separate singlemode or multimode optical fibers. The larger version “B” supports up to 31 separate channels.
- Can be combined with electrical slip rings and fluid rotary unions
- Stainless steel construction
- Rugged design

Typical Applications

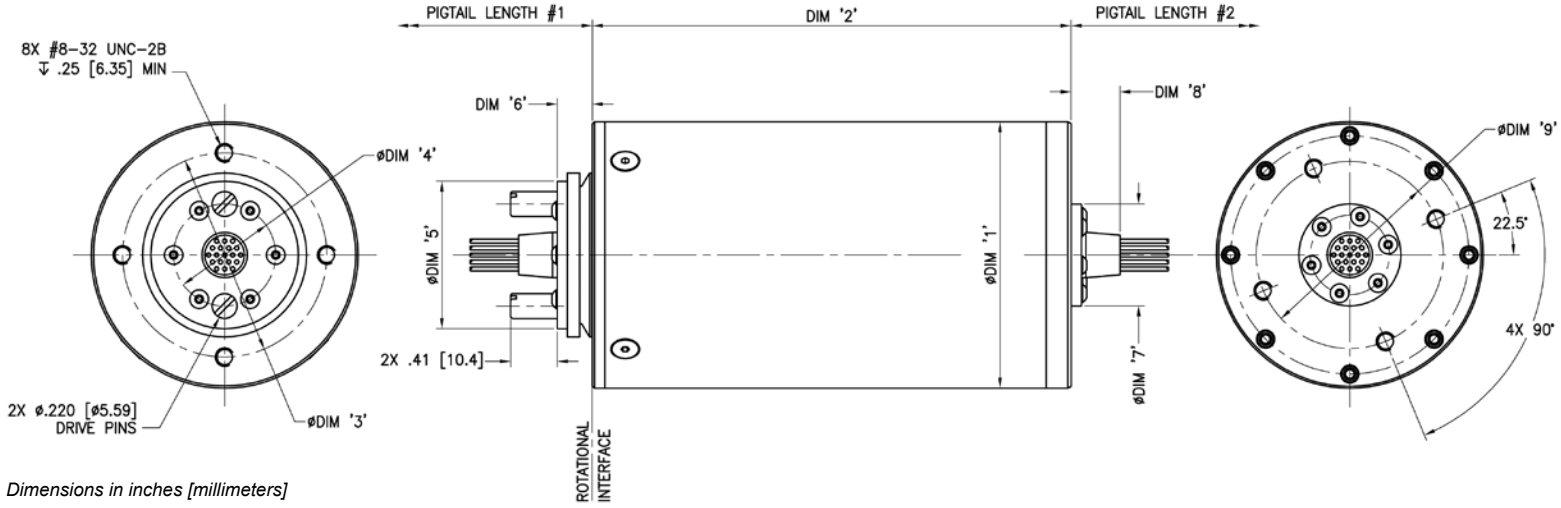
- Vehicle Turrets
- Radar Antennas
- Material Handling
- Remotely Operated Vehicles
- Fiber Optic Cable Reels

FO300 Specifications					
	Version	Channels	Fiber Type		
			9 / 125 Singlemode	50 / 125 Multimode	62.5 / 125 Multimode
Maximum Insertion Loss Over Rotation (dB)	A	≤ 19	4 dB	4 dB	4 dB
	B	≤ 31	4.5 dB	6 dB	6 dB
Insertion Loss Variation Over Rotation (dB)	A	≤ 19	1.5 dB	1.5 dB	1.5 dB
	B	≤ 31	1.5 dB	1.5 dB	1.5 dB
Minimum Return Loss Over Rotation (dB)	A,B	A,B	18 dB	18 dB	18 dB
Wavelength	A,B	A,B	1310 / 1550 nm	850 / 1300 nm 1300 / 1550 nm	850 / 1300 nm 1300 / 1500 nm
				Consult factory for other wavelengths	
Rotational Speed	A,B	A,B	To 100 rpm Consult factory for extended range		
Temperature	A,B	A,B	-20° C to +60° C Standard Consult factory for extended range		
Dispersion	A,B	A,B	< 50 fs / nm (Calculated)		
Exterior Surfaces	A,B	A,B	Stainless Steel		
Vibration	A,B	A,B	Tested to MIL-STD-167-1 (Ships)		
Shock	A,B	A,B	Tested to MIL-STD-810F		
Connectors	A,B	A,B	As Requested		
Pigtail Length	A,B	A,B	As Requested		

- Consult factory for higher channel count
- Consult factory for different fiber types
- Pigtailed FORJ; measured from outside ends of FORJ flanges, does not include shaft torque pins, strain relief, or pigtails

Dimensions Inches [mm]	Version "A"	Version "B"
DIM "1"	Ø2.35 $^{+.00}_{-.01}$ [Ø59.7 $^{+.00}_{-.03}$]	Ø2.72 $^{+.00}_{-.01}$ [Ø69.1 $^{+.00}_{-.03}$]
DIM "2"	4.22 [107.2]	5.76 [146.2]
DIM "3"	Ø1.800 [Ø45.72]	Ø2.100 [Ø53.34]
DIM "4"	Ø.90 [Ø22.9]	Ø1.060 [Ø26.92]
DIM "5"	Ø1.30 [Ø33]	Ø1.55 [Ø39.4]
DIM "6"	.31 [7.9]	Ø.32 [8.1]
DIM "7"	Ø.90 [Ø22.9]	Ø1.24 [Ø31.5]
DIM "8"	Ø.43 [10.9]	.38 [9.6]
DIM "9"	Ø1.650 [Ø41.91]	Ø1.800 [Ø45.72]

FO300 Dimensions



Dimensions in inches [millimeters]

FO215

Fiber optic rotary joint

Description

The FO215 is an ultra-compact, two pass, multimode fiber optic rotary joint (FORJ). It is passive and bidirectional, and allows the transfer of optical signals on two separate optical fibers across rotational interfaces.

The FO215 can be combined with our electrical and fluid slip rings, giving a single, compact package for optical signals, electrical power and fluid transfer.

The FORJ can be assembled with pigtail lengths tailored to the customer's application. Housing, mounting flange and drive features can also be customized to meet the customer's requirements.

Features

- Provides rotary coupling for two multimode fibers
- Passive bidirectional device
- Can be combined with our electrical slips and fluid unions
- Connectorized version allows for easy fiber cable replacement
- Customized mounting flanges available
- Optional fluid-filled version for deep submergence to 10,000 psi (69,000 kPa)
- Can be integrated into existing slip ring designs
- Stainless steel housing (aluminum for connectorized version)
- Rugged design
  - MIL-STD-167-1 ship vibration
  - MIL-STD-810E functional shock (40 g)

Typical Applications

- Winches and cable reels for remotely operated vehicles
- Remote I / O in industrial machinery
- Video surveillance systems
- Material handling systems
- Sensor platforms
- Robots
- Turrets

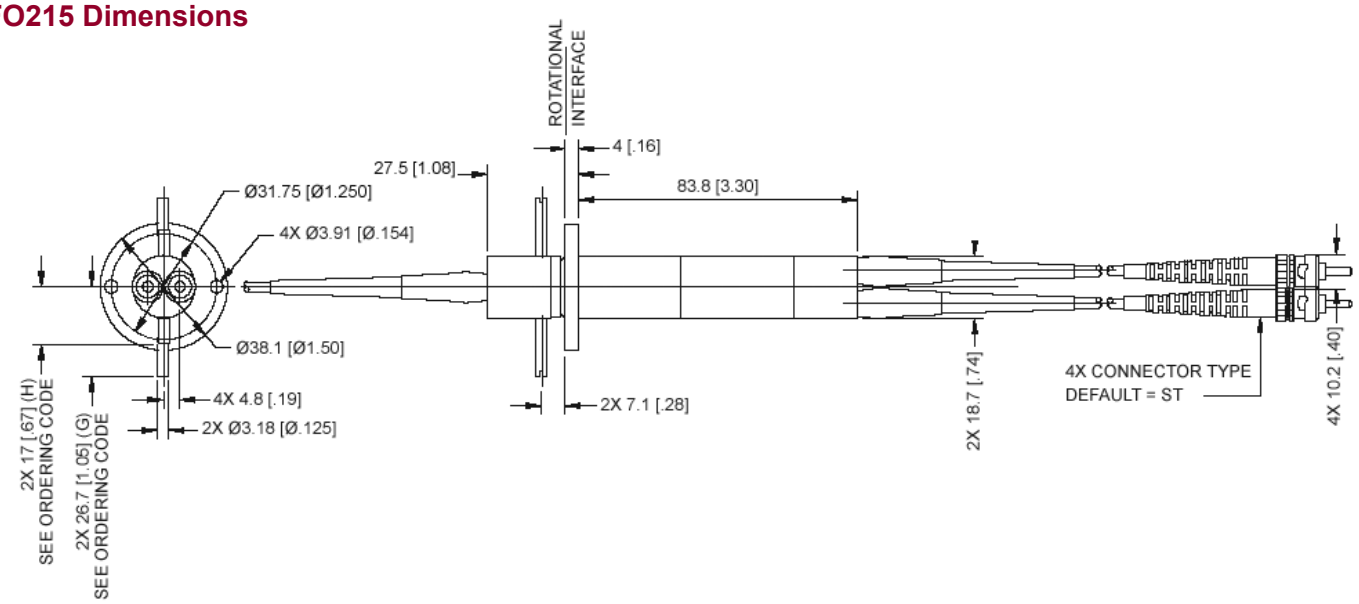
FO215 Specifications			
Fiber Size (Microns):	50 / 125 or 62.5 / 125. Consult factory for other fiber types.		
Insertion Loss*		Typical	Maximum
	Channel 1	< 1.5 dB	< 3.0 dB
	Channel 2	< 4.5 dB	< 5.5 dB
Rotation Variation	Typical < 0.5 dB	Maximum < 1.0 dB	
Back Reflection	Consult factory		
Wavelengths	850, 1300 or 1550 nm. Consult factory for other multi-wavelength applications.		
Rotational Speeds	To 500 rpm. Higher rotational speeds should be discussed with the factory.		
Temperature	-40 to +60 deg C (dry version) -20 to +60 deg C (wet version) Consult factory for extended range.		
Dispersion	< 10 ps (calculated)		
Exterior Surfaces	Stainless steel (aluminum for connectorized version)		
Vibration	Tested to MIL-STD-167-1 (ships)		
Shock	Tested to MIL-STD-810E		
Terminations	Standard is with pigtail cables terminated with ST connectors at each end. Alternative connectors types available (FC, SC, LC).		
Pressure	Up to 10000 psi (69,000 kPa) for fluid filled version**		
Pigtail Length	As required		

**Add 0.5 - 1.0 dB to the insertion loss for connectorized version*

***Fluid filled version is slightly larger than shown below.*

Note: Optical values given are based on use with LED sources.

FO215 Dimensions



Dimensions in inches [millimeters]

FO257

Fiber optic rotary joint

Description

The FO257 is a compact, two pass, fiber optic rotary joint (FORJ) for plastic optical fiber.

Ideally suited to SERCOS applications, the FO257 can be combined with our electrical and fluid slip rings, giving a single, compact package for optical signals, electrical power and fluid transfer.

The FORJ can be assembled with pigtail lengths tailored to the customer's application. Housing, mounting flange and drive features can also be customized to meet application requirements.

Features

- Provides rotary coupling for two multimode plastic large core fibers
- Passive and bidirectional
- Can be combined with various electrical slip rings and fluid unions
- Customized mounting flanges available
- Can be integrated into existing slip ring designs
- Aluminum housing
- Can be supplied with large core glass pigtails to reduce overall system loss
- Rugged design
  - MIL-STD-167-1 ship vibration
  - MIL-STD-810E functional shock (40 g)

Typical Applications

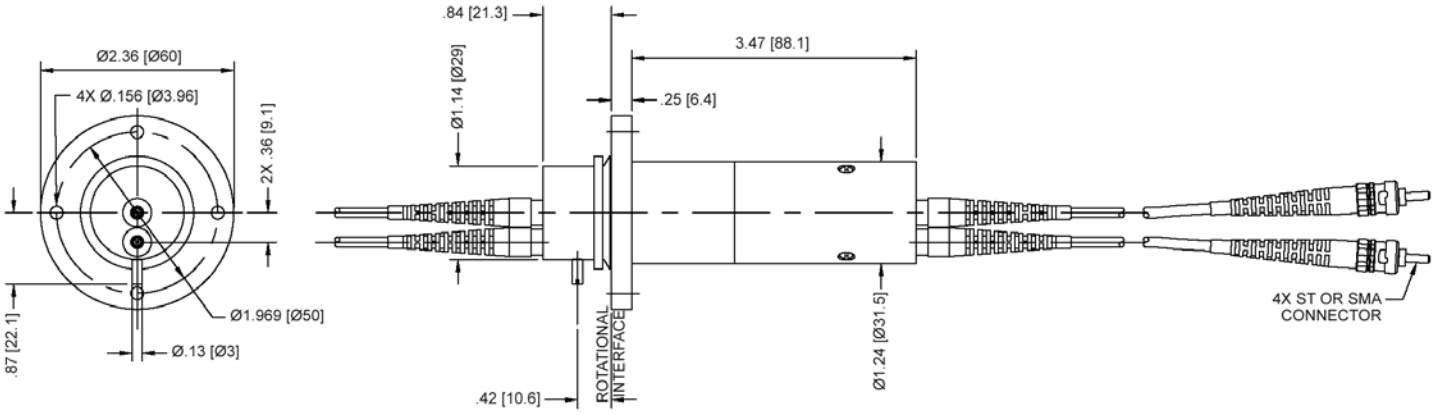
- Automation systems
- Packaging and special machinery
- Medical equipment
- Indexing tables
- Cable reels

FO257 Specifications			
Fiber Size (Microns)	1000 plastic. Consult factory for other fiber types.		
Insertion Loss*		Typical	Maximum
	Channel 1	< 4.0 dB	< 10.0 dB
	Channel 2	< 6.0 dB	< 10.0 dB
Rotation Variation	Typical < 0.5 dB	Maximum < 1.0 dB	
Back Reflection	Consult factory		
Wavelengths	630 or 650 nm. Consult factory for other multi-wavelength applications.		
Rotational Speeds	To 200 rpm. Higher rotational speeds should be discussed with the factory.		
Temperature	-40 to +60 deg C (dry version)		
Exterior Surfaces	Aluminum		
Vibration	Tested to MIL-STD-167-1 (ships)		
Shock	Tested to MIL-STD-810F		
Terminations	Standard is with pigtail cables terminated with ST or SMA connectors at each end. Consult factory for other connector types.		
Pigtail Length*	As required		

**Insertion loss values are based on a FORJ with 1-meter plastic pigtails at each end. Add 0.01dB for each meter of 1000-micron core glass added to pigtails or 0.15 dB for each meter of plastic 1000-micron core fiber.*

Note: Optical values given are based on use with LED sources.

FO257 Dimensions



FO292

Fiber optic rotary joint

Description

The FO292 is an ultra-compact, two pass, multimode fiber optic rotary joint (FORJ). It is passive and bidirectional, and allows the transfer of optical signals on two separate optical fibers across rotational interfaces.

The FO292 can be combined with our electrical and fluid slip rings, giving a single, compact package for optical signals, electrical power and fluid transfer.

The FORJ can be assembled with pigtail lengths tailored to the customer's application. Housing, mounting flange and drive features can also be customized to meet the customer's requirements. The FO292 can also be installed with one or both ends having a 90° cable exit, providing even more flexibility when installing the unit into existing slip ring assemblies or installations with little clearance space.

Features

- Provides rotary coupling for two multimode fibers
- Passive and bidirectional
- Can be combined with various electrical slip rings and fluid unions
- Smaller and more compact than the standard FO215 with improved back reflection performance
- Customized mounting flanges available
- Optional 90 degree cable exits at either end of the FORJ
- Optional fluid-filled version for deep submergence to 10,000 psi (69,000 kPa)
- Can be integrated into existing slip ring designs
- Stainless steel housing
- Rugged design
  - MIL-STD-167-1 ship vibration
  - MIL-STD-810E functional shock (40 g)

Typical Applications

- Winches and cable reels for remotely operated vehicles
- Remote I / O in industrial machinery
- Video surveillance systems
- Material handling systems
- Sensor platforms
- Robots
- Turrets

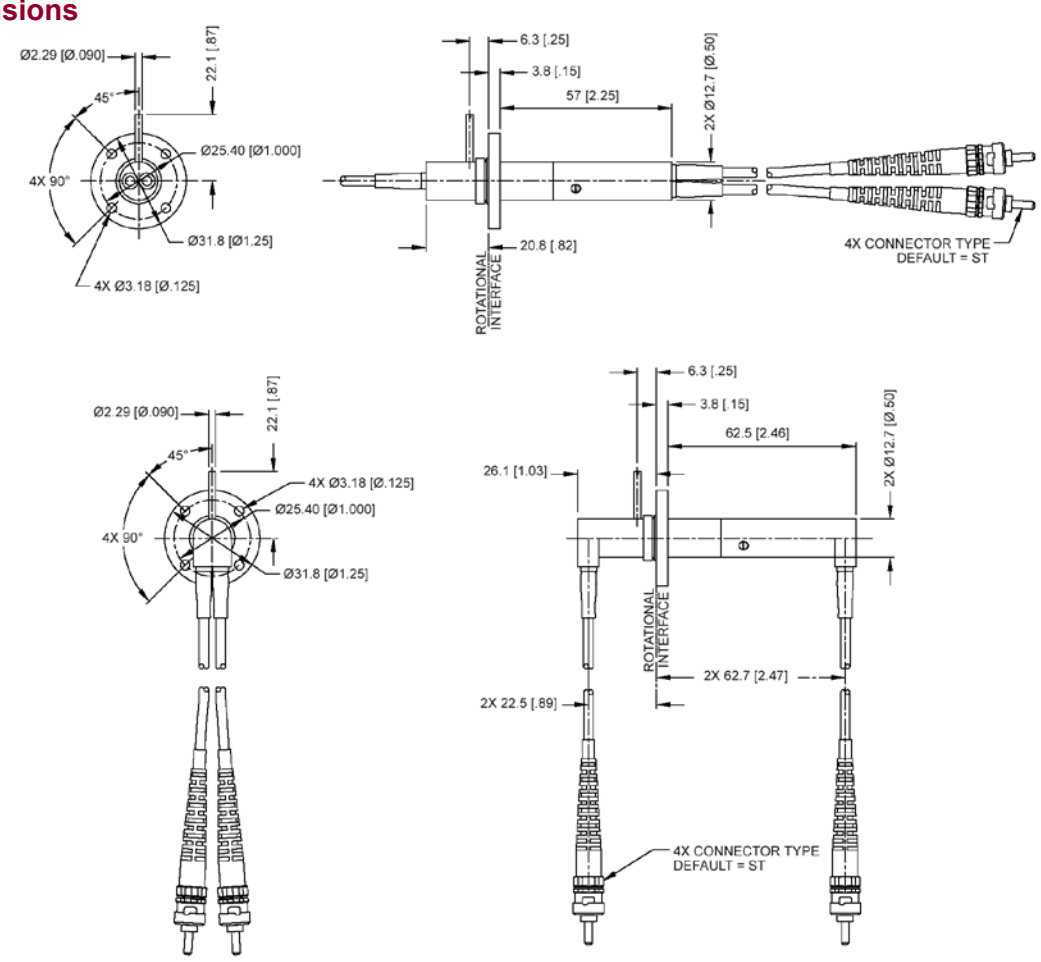
FO292 Specifications			
Fiber Size (Microns)	50 / 125 or 62.5 / 125. Consult factory for other fiber types.		
Insertion Loss*		Typical	Maximum
	Channel 1	< 1.5 dB	< 3.0 dB
	Channel 2	< 4.5 dB	< 6.0 dB
Rotation Variation	Typical < 0.5 dB	Maximum < 1.0 dB	
Back Reflection	Typical 20 dB	18 dB Minimum	
Wavelengths	850, 1300 or 1550 nm. Consult factory for other multi-wavelength applications.		
Rotational Speeds	To 500 rpm. Higher rotational speeds should be discussed with the factory.		
Temperature	-40 to +60 deg C (dry version) -20 to +60 deg C (wet version) Consult factory for extended range.		
Dispersion	< 10 ps (calculated)		
Exterior Surfaces	Stainless steel		
Vibration	Tested to MIL-STD-167-1 (ships)		
Shock	Tested to MIL-STD-810F		
Terminations	Standard is with pigtail cables terminated with ST connectors at each end. Alternative connectors types available (FC, SC, LC).		
Pressure	Up to 10000 psi (69,000 kPa) for fluid filled version*		
Pigtail Length*	As required		

** Add 0.5 dB to the insertion loss to version with 90 degree cable exits.*

** Fluid filled version is slightly larger than shown below.*

Note: Optical values given are based on use with LED sources.

FO292 Dimensions



FO242

Fiber optic rotary joint

Description

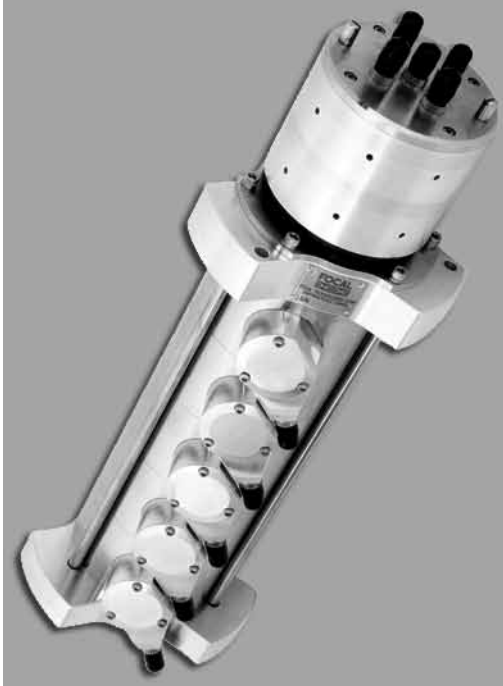
The FO242 is a multi-pass, singlemode fiber optic rotary joint (FORJ). It is passive and bidirectional, and allows the transfer of optical signals across a rotational interface on 2 to 6 separate singlemode optical fibers.

The FO242 can be combined with our electrical and / or fluid slip rings giving a single, compact package for optical signals, electrical power and fluid transfer.

Other options include fluid-filling for pressure compensation permitting operation at any ocean depth, and the combination of the FO190 to include up to 19 multimode passes.

Features

- 2 to 6 singlemode channels
- Can be combined with our electrical slips, fluid unions and the FO190 multimode fiber optic rotary joint
- Alternative drive coupling arrangements are available (consult factory for specification details)
- Tested to 10,000 psi (69,000 kPa) when fluid-filled
- Stainless steel and aluminum construction
- Connectorized interfaces, for easy fiber cable replacement
- Rugged design
  - MIL-STD-167-1 ship vibration
  - MIL-STD-810D functional shock (40 g)



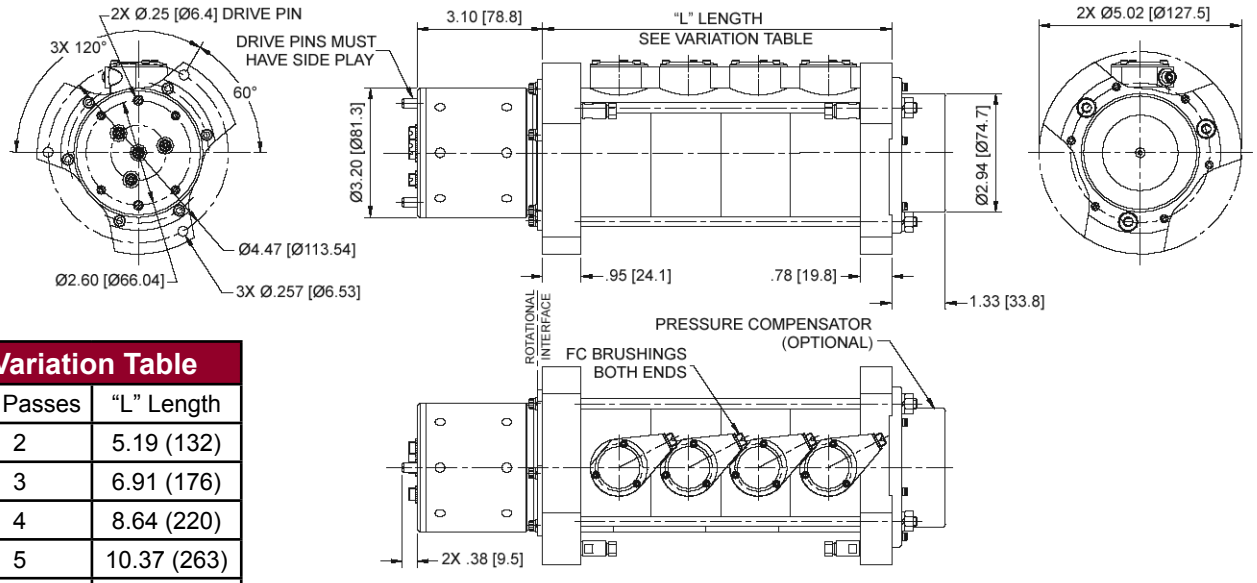
Typical Applications

- Remotely operated vehicles
- Floating production systems
- Undersea telemetry
- Seismic streamers
- Radar antennas
- Cable reels

FO242 Specifications											
Fiber Size (Microns)	9 / 125 SMF-28										
Insertion Loss (dB)	Channel	2-pass		3-pass		4-pass		5-pass		6-pass	
		Typ.	Max.	Typ.	Max.	Typ.	Max.	Typ.	Max.	Typ.	Max.
	1	2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0
	2	2.5	4.0	2.5	4.0	2.5	4.0	2.5	4.0	2.5	4.0
	3			2.5	4.5	3.5	5.0	3.5	5.0	3.5	5.0
	4					4.0	5.5	5.0	6.5	5.0	6.5
	5							5.5	6.5	6.0	6.5
	6									6.5	7.5
Rotation Variation	Typical < 0.5 dB					Maximum < 1.5 dB					
Back Reflection*	Typical 22 dB					18 dB Minimum					
Wavelengths	1310 / 1550 nm. Consult factory for other wavelengths.										
Rotational Speeds	To 100 rpm dry and 60 rpm fluid filled. Higher rotational speeds should be discussed with the factory.										
Temperature	-40 to +60 deg C standard. Consult factory for extended range.										
Dispersion	< 50 fs / nm (calculated)										
Exterior Surfaces	Stainless steel and aluminum										
Vibration	Tested to MIL-STD-167-1 (ships)										
Shock	Tested to MIL-STD-810E										
Connectors	FC / PC connector bushings standard (ST connector bushings optional)										
Pressure	Up to 10000 psi (69,000 kPa) for fluid filled version										
Pigtail Length	As required										

**Lower back reflection available, consult factory.*

FO242 Dimensions



Variation Table	
No. Passes	"L" Length
2	5.19 (132)
3	6.91 (176)
4	8.64 (220)
5	10.37 (263)
6	12.10 (307)

Dimensions in inches [millimeters]

FO291

Fiber optic rotary joint

Description

The FO291 is a multi-pass, singlemode fiber optic rotary joint (FORJ). It is passive and bidirectional, and allows the transfer of optical signals across a rotational interface on 2 to 9 separate singlemode optical fibers.

The FO291 can be combined with our electrical and / or fluid slip rings, giving a single, compact package for optical signals, electrical power and fluid transfer, with ISO 9000 quality.

Other options include fluid-filling for pressure compensation permitting operation at any ocean depth, and the combination of the FO190 to include up to 19 multimode passes.

Features

- 2 to 9 single mode channels
- Can be combined with our electrical slip rings, fluid rotary unions and the FO190 multimode fiber optic rotary joint
- Alternative drive coupling arrangements are available (consult factory for specification details)
- Tested to 10,000 psi (69,000 kPa) when fluid-filled
- Aluminum and stainless steel construction
- Connectorized interfaces, for easy fiber cable replacement
- Rugged design
  - MIL-STD-167-1 ship vibration
  - MIL-STD-810F functional shock (40g)

Typical Applications

- Remotely operated vehicles
- Floating production systems
- Undersea telemetry
- Seismic streamers
- Radar antennas
- Cable reels

Fiber Optic Rotary Joints (FORJ)

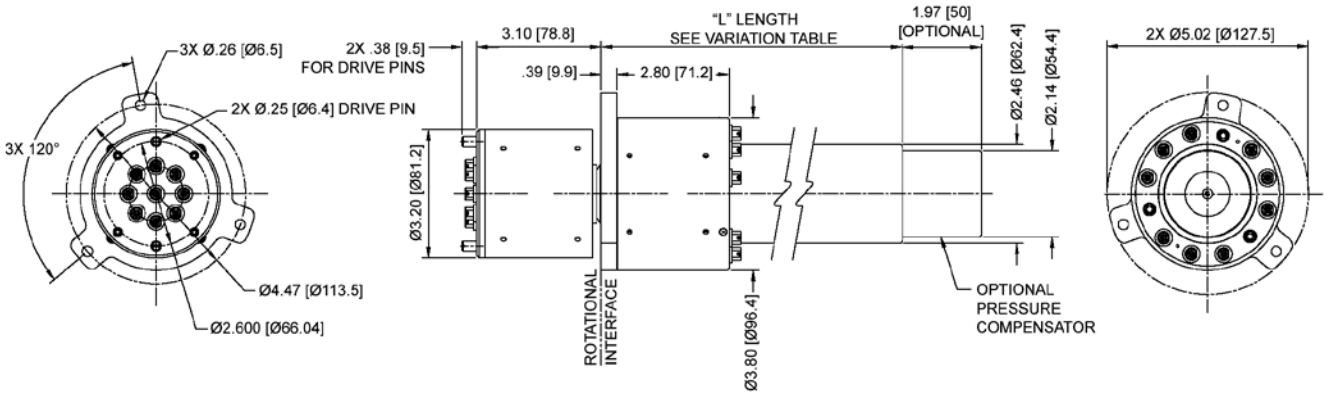
FO291 Specifications									
Fiber Size (Microns)	9 / 125 SMF-28								
Insertion Loss (dB)* (Typical / Maximum) Includes Rotation Variation	Channel	2-Pass	3-Pass	4-Pass	5-Pass	6-Pass	7-Pass	8-Pass	9-Pass
	1	2.0/3.0	2.0/3.0	2.0/3.0	2.0/3.0	2.0/3.0	2.0/3.0	2.0/3.0	2.0/3.0
	2	2.0/3.5	2.5/3.5	2.5/3.5	2.5/3.5	2.5/3.5	2.5/3.5	2.5/3.5	2.5/3.5
	3		2.5/4.0	3.0/4.0	3.0/4.0	3.0/4.0	3.0/4.0	3.0/4.0	3.0/4.0
	4			3.0/5.0	3.5/5.0	3.5/5.0	3.5/5.0	3.5/5.0	3.5/5.0
	5				3.5/5.5	4.0/5.5	4.0/5.5	4.0/5.5	4.0/5.5
	6					4.5/6.5	5.0/6.5	5.0/6.5	5.0/6.5
	7						5.5/6.5	5.5/6.5	5.5/6.5
	8							6.0/6.5	6.0/6.5
	9								6.0/6.5
Rotation Variation	Typical < 1.0 dB, maximum < 2.0 dB								
Back Reflection**	Typical > 22 dB, minimum > 18 dB								
Wavelengths	1310 / 1550 nm. Consult factory for other wavelengths								
Rotational Speeds	To 100 rpm dry and 60 rpm fluid filled. Consult factory for higher rotational speeds								
Temperature	-40 to +60 deg C standard. Consult factory for extended range								
Dispersion	< 50 fs / nm (calculated)								
Exterior Surfaces	Stainless steel and aluminum								
Vibration	Tested to MIL-STD-167-1 (Ships)								
Shock	Tested to MIL-STD-810F								
Connectors	FC / PC connector bushings standard (ST connector bushings optional)								
Pressure	Up to 10,000 psi (69,000 kPa) for fluid filled version								
Pigtail Length	FORJ is connectorized with FC / PC, ST optional. Pigtail length and connector type optional								

*Insertion loss values include fiber cables attached at both ends of a connectorized FORJ.

**Lower back reflection available, consult factory.

Variation Table	
No. Passes	**“ L” Length**
2	3.82 (97)
3	4.70 (119)
4	5.59 (142)
5	6.47 (164)
6	7.36 (187)
7	8.24 (209)
8	9.13 (232)
9	10.01 (254)

FO291 Dimensions



FO190

Fiber optic rotary joint

Description

The FO190 is a multipass fiber optic rotary joint (FORJ) for 2 to 21 multimode fibers. It is passive and bidirectional and allows the transfer of data, video and other signals on separate fibers across rotational interfaces.

The FO190 can be combined with our electrical and / or fluid slip rings, giving a single, compact package for optical signals, electrical power and fluid transfer.

Other options include fluid-filling for pressure compensation permitting operation at any ocean depth, and the combination of the FO242 to include up to 6 singlemode passes.

Features

- 2 to 21 multimode channels
- Lightweight aluminum construction
- Can be combined with our electrical slips, fluid unions and the FO242 singlemode fiber optic rotary joint
- Alternative drive coupling arrangements are available (consult factory for specification details)
- Tested to 10,000 psi (69,000 kPa) when fluid-filled
- Connectorized interfaces, for easy fiber cable replacement
- Rugged design
  - MIL-STD-167-1 ship vibration
  - MIL-STD-810E functional shock (40 g)
  - MIL-STD-901D heavy shock (65 g)

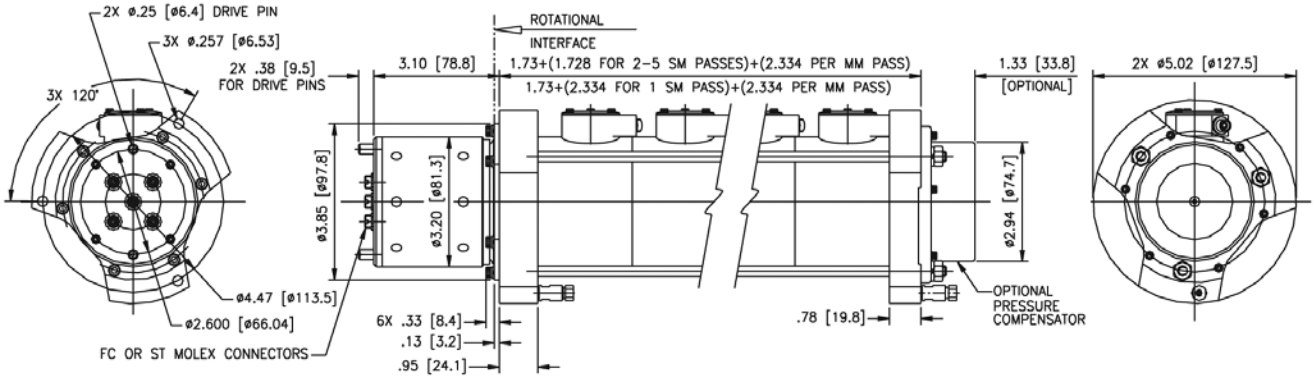
Typical Applications

- Winches and cable reels for ROV's
- Remote I / O in industrial machinery
- Towed arrays and dipping sonar
- Material handling systems
- Surveillance systems
- Cranes

FO190 Specifications	
Fiber Size (Microns)	50 / 125 (SMF-28 compatible)
Insertion Loss (Maximum Values)	<table><tr><th>Fiber Size</th><th>Loss</th></tr><tr><td>50 / 125</td><td>6.5 dB</td></tr><tr><td>62.5 / 125</td><td>5.5 dB</td></tr><tr><td>100 / 140</td><td>5.5 dB</td></tr><tr><td>200 / 230</td><td>13 dB</td></tr></table>
Rotation Variation	<1.5 dB
Wavelengths	850, 1300 or 1550 nm. Consult factory for multi-wavelength applications.
Rotational Speeds	To 100 rpm dry and 60 rpm fluid filled. Higher rotation speeds should be discussed with the factory.
Temperature	-40 to +60 deg C
Dispersion	< 10 picoseconds (calculated)
Return Loss	< -18 dB
Vibration	Tested to MIL-STD-167-1 (ships)
Shock	Tested to MIL-STD-810E and MIL-STD-901D
Connectors	FC / PC connector bushings standard. (ST connector bushings optional.)

Note: Optical values given are based on use with LED sources.

FO190 Dimensions



Dimensions in inches [millimeters]

H18 / H24 FORJ

Fiber optic rotary joints

Description

The H18 / H24 fiber optic rotary joints effectively combine a compact electrical slip ring with a fiber optic rotating joint. Both offer the flexibility of electrical, power and optical signal transfer through a single rotational joint. The H18 and H24 are low cost solutions for high data rate transmission to greater than 2.5 Gb / sec on the optical channel.

Features

- Combined compact electrical slip ring with fiber optic rotating joint
- Flexibility of signal transfer through a single rotational joint
- Low cost solution for high data rate transmission
- Standard 18 or 24 circuit model with 2 amp circuits
- Precision ball bearing for long life
- Speeds up to 250 rpm continuous
- Compact size
- Metal housing available
- Transfer analog and digital signals
- Compatible with data bus protocols

Benefits

- Unique signal handling performance with minimal electrical circuit noise
- Tight packaging to fit in the most demanding space constraints
- Low torque to minimize system torque budget
- Rapid delivery

Typical Applications

- CCTV and dome camera manufacturing
- Robotics
- Upgrading legacy equipment
- Digital communications and video

Fiber Optic Hybrid Units

Specifications		
	Singlemode H1817-950 / H2418-950	Multimode H1810-950 / H2417-950
Wavelengths	1310 and 1550 nm (consult factory for multi-wavelength applications)	850, 1310 and 1550 nm (consult factory for multi-wavelength applications)
Fiber Size	9 / 125 µm (consult factory for other sizes)	50 / 125 or 62.5 / 125 µm (consult factory for other sizes)
Insertion Loss	<2.5 dB (typical: <2.0 dB)	<2.5 dB (typical: <2.0 dB)
Return Loss	<-18 dB (standard). <-35 dB option available (consult factory for details)	<-18 dB
Rotation Variation	<1.5 dB (typical <0.5 dB)	<1.0 dB (typical <0.5 dB)
Maximum Speed	500 rpm (consult factory for higher speeds)	500 rpm (consult factory for higher speeds)
Terminations	Pigtailed cable and connectors	Pigtailed cable and connectors
Jacket Type	900 µm	900 µm

Electrical Circuits

Up to 18 x 2 amps circuits
Up to 4 x 6 amps circuits
Other combinations of the above available on request

Rated Voltage

210 VDC / 240 VAC

Insulation Resistance

200 M at 500 VAC

Electrical Cables

Color coded, silver plated
E or PTFE insulated lead wires

Temperature

-20° to +60° C

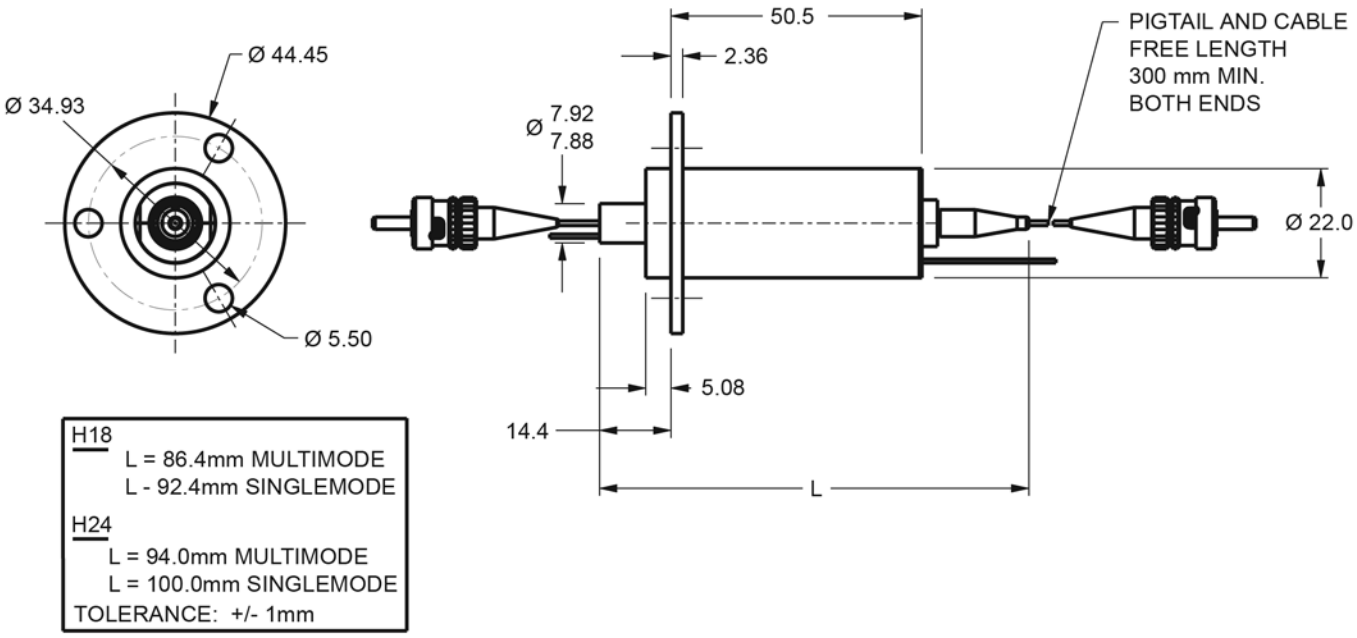
Mounting Options

Flanged as standard
Other configurations available on request

Bearings

Precision ball bearings fitted throughout

H18 / H24 Dimensions



Dimensions in inches (millimeters)

Electro-Optic Systems

Description

The dramatic increase of sophisticated gimbaled electro-optic sensor systems that provide battlefield information has led to major developments in supporting hardware. These EO systems require an enormous amount of data to be transmitted across the rotating axes as well as power and other signals. Moog Components Group has always been one step ahead of these requirements with the development of high bandwidth slip rings, twist capsules, fiber optic rotary joints and multiplexing technologies.

Moog Components Group has participated in the development of many of the major airborne and groundbased EO systems The Abrams Tank Commander's Independent Thermal Viewer (CITV) has used our slip ring assembly to allow continuous rotation on the azimuth axes since the program's inception. The Bradley armored vehicle also uses Moog's slip ring on the azimuth axis of its Commander's Independent Viewer (CIV); in addition the CIV uses a Moog Components Group's twist capsule on the elevation axis.

Moog Components Group's slip rings and twist capsules are used extensively in airborne EO systems. The latest upgrade to the F-18 Hornet's EO sensor suite, Advanced Targeting Forward Looking Infrared (ATFLIR), utilizes a Moog slip ring to allow continuous rotation in the roll axis and a twist capsule for scanning, or limited rotation, in the elevation and yaw axes. The Low Altitude Navigation and Targeting Infrared for Night (LANTIRN), and its successor Sniper, pods used for EO targeting and navigation on the F-16 uses Moog slip rings and twist capsules exclusively. The Predator UAV, LAMPS helicopter, and Apache helicopter all "see in the dark" because Moog Components Group hardware transmit data and power reliably.

Features

- Multiple contact technologies suited for the application
  - Monofilament wire brush
  - Multiple precious metal fiber brush
  - Composite brush
- Environmental sealing
- EMI Shielding
- FEA structure analysis
- High shock and vibration capabilities
- Wide operating temperature envelope
- Vertical integration of position sensors and ancillary products
- High frequency bandwidth
- High reliability and life
- Redundant bearing designs

Typical Applications

- Blade de-ice
- Blade position
- Tip lights
- Flight controls
- FLIR systems
- Target acquisition systems
- Weapon stations

ELECTRO-OPTIC SYSTEMS SLIP RING DESIGNS

Low Profile Azimuth Slip Rings

System height is often the primary concern of the EO gimbal designer. Moog Components Group has the solution with its patented broadband platter slip ring design. This broadband technology allows the slip ring designer to package multiple high speed data lines on slip ring platters, and then "stack" these platters with their accompanying brush blocks into a very low profile design. Power rings as well as discrete signals and video can also be placed on these slip ring platters. This has led to a dramatic decrease in typical slip ring height or length over traditional slip ring "drum-style" designs.

High Speed Data

The dramatic improvement in image quality, the use of multi-sensors, and increased communication requirements have driven the need for EO Systems to significantly increase transmission speeds of data channels with every generation of upgrade. We have EO slip rings that handle as many as two dozen data channels at over 400 Mbps each, for an aggregate bandwidth of 12 Gpbs. Slip ring/fiber optic rotary joint hybrid designs contain both copper lines for power and signals, as well as fiber lines for fiber optic signals.

Design and manufacturing techniques have been developed and patented that increase signal bandwidth while controlling crosstalk and EMI/EMC. A arrange of solutions is available to handle data channels such as GigE, Fibre Channel, and IEEE1394 to name just a few. These high speed data solutions are being used in existing EO system as well as turret, radar, and other advanced technology applications.

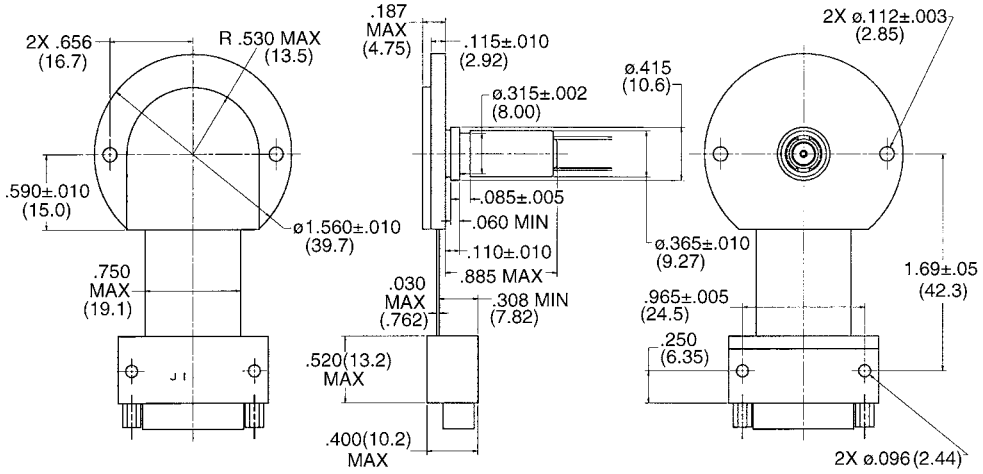
Poly-Twist or Twist Capsules

In most cases gimbaled EO systems require continuous, unlimited rotation on just one axis, typically the azimuth or roll axis. In this case slip rings are the ideal solution for transmitting signals across the rotating interface. Normally the other axes (pitch, elevation, or yaw), require only limited rotation, i.e., less than 360 degrees. This allows the use of a Poly-Twist to transmit electrical power and signals. By the use of wrapping flexible circuits , the Poly-Twist designer is able to increase circuit density, decrease weight, and improve system reliability over traditional cable wraps. The long life, low and consistent torque, and the small size make Poly-Twists the best solution for scanning, or limited rotation axes in EO systems.

Poly-Twists—How They Work

Poly-Twists resemble slip ring assemblies in size and appearance and provide multiple turns of rational freedom. They operate by winding and unwinding flexible circuit tapes wrapped around a central shaft in a configuration resembling a clock spring. The central shaft is generally supported by ball bearings, but bearing-less assemblies are available. One end of the shaft is fastened to the shaft, with lead wires extending from the shaft either axially or radially. The other end of the tape is fastened to the Poly-Twist frame, which is usually considered stationary. Stator lead wire terminations may also be either axial or radial. The flexing element is the key to the low torque and long life of the Poly-Twist. The stress on the flexible circuit is well below its endurance stress limit producing very low torque levels and very long operational life.

Electro-Optic System Slip Ring Design



Dimensions in inches (millimeters)

Vehicular Slip Rings

Reliable signal and power coupling in the most rugged battlefield conditions

Description

The increasing complexity of modern military vehicles demands slip rings that provide reliable electrical interfaces between the stationary and rotating parts of these vehicles. Moog Components Group slip rings have been chosen to operate on numerous vehicular programs to meet these challenges. M1 / A2 and M60 tanks, A2 / A3 Bradley Fighting Vehicles, Stryker, Light Armored Vehicles (LAVs), and V150 Commando Vehicles are just a small sample of these vehicular programs.

Technological developments have yielded stabilized gun systems, laser target acquisition and fire control systems, and high bandwidth data communications that create unique demands for vehicular slip rings. We meet all of these challenges effectively and economically. A sampling of our many active vehicular slip ring designs are shown on the following pages, or our engineering department can tailor a slip ring for your vehicular application, often within the existing envelope. Contact us with your requirements.

Features

- Supports modern data communication technologies
- Full environmental sealing capabilities
- EMI shielding available
- Range of operating voltages compatible with any vehicular system
- Hydraulic rotary joint options
- Gold-on-gold contacts for signal and data integrity
- Meets military shock and vibration requirements
- Speed, torque and frequency characteristics designed for specific vehicular applications
- High power capability to support present and future vehicular system needs
- High frequency coax channels available
- Through-bore designs
- Cam-operated microswitches
- Vertical integration with resolvers, fiber optics, fluidic interfaces, hydraulics, pneumatics and motors
- Filtered air transfer for chemical, biological and radiological (NBC) requirements and / or electronics cooling and pneumatic rotary joint options for crew station breathing and electronic cooling
- High speed data capabilities

Typical Applications

- Tanks
- Light armored vehicles
- Armored personnel carriers
- Retrievers
- Armored field artillery vehicles
- Brigade command vehicles
- Reconnaissance vehicles
- Mobile missile launchers
- Independently rotating commander stations
- Forward-Looking-Infra-Red systems (FLIRs) or viewers

VEHICULAR SLIP RING DESIGN CRITERIA

Electrical slip rings are used in vehicles such as tanks, retrievers, light armored vehicles, mobile missile launchers, and armored personnel carriers. A typical vehicle might contain slip rings in the turret, the commander station and the infrared sight. In each of these systems, slip rings have provided reliable signal and power coupling under the most rugged battlefield conditions.

In addition to producing compact slip rings where minimal space is available, we have provided units that combine conventional electrical slip rings with resolvers, encoders, fiber optics, pneumatics and hydraulics rotary joints.

Design

Moog Components Group can offer the most valuable design assistance by being involved early in the development of the vehicle. The internal design of the slip ring capsule will be driven by the circuit requirements and the space available for mounting the slip ring capsule. From our vast product line, we can pull from the following design criteria:

- use of existing designs
- single drum
- concentric drums
- single pancake
- stacked pancakes
- combination of designs
- clear through-bore to allow another device to occupy the centerline
- connectors – case mounted or attached to cables
- mechanical support – on either side of the rotating interface.

Power Circuits

Theoretically, there is no limit to the amount of power that can be transferred by the slip ring capsule. Most hull-to-turret slip ring capsules are capable of transferring 150 amps continuously. It is important that the power duty cycles (including surge currents) be accurately defined as early as possible in the design stage. (Requiring the slip ring capsule to operate at continuous current levels that will not be encountered in the field takes space that could be more effectively used for signal requirements.) If the space available for the slip ring capsule is limited, it may be advantageous to transfer the power at higher voltages and lower currents. The power ground can be made through the case of the slip ring capsule or insulated from case ground.

Signal Circuits

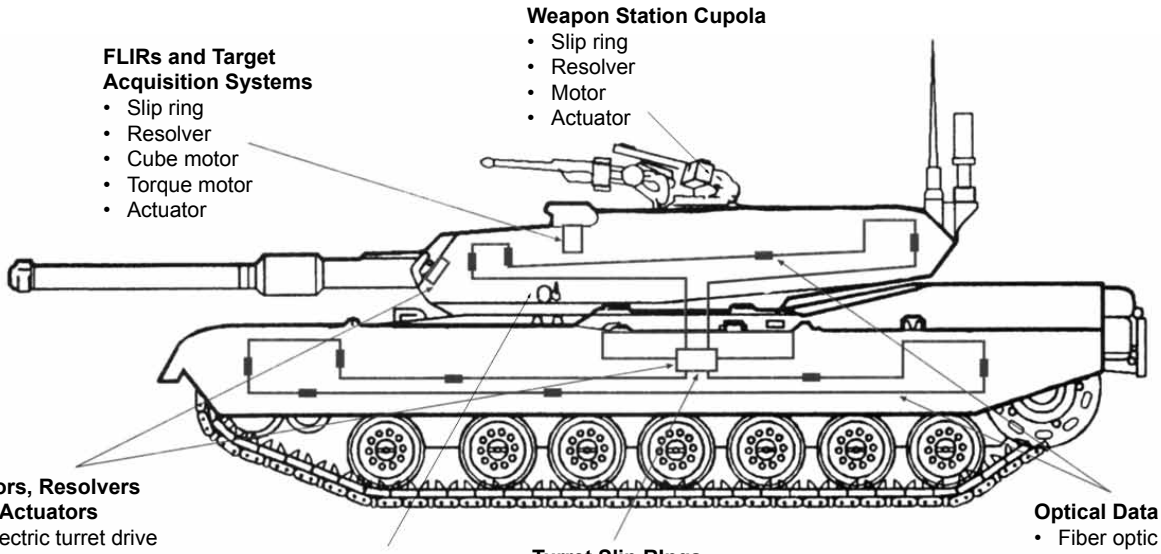
Signal requirements for vehicular slip ring capsules continue to be increasingly demanding. The circuit functions and electrical isolation requirements have a significant impact on the design of the slip ring capsule. A typical vehicular slip ring will include circuits for powering electronic equipment, video circuits, and analog and digital control circuits.

Sometimes it is important that sensitive circuits have additional isolation from other circuits to meet heightened sensitivity requirements. Circuit isolation requirements are more easily addressed early in the design stages.

Slip Ring Expertise

Vehicles such as tanks, retrievers, mobile missile launchers, light armored vehicles and armored personnel carriers pose a variety of challenges. Hydraulically-actuated equipment in the turret may require the combination of conventional electrical slip ring with a hydraulic joint to form an electro-hydraulic slip ring, thereby providing reliable fluidic interfacing. The threat of a NBC environment may require pneumatic channels through the slip ring to provide filtered air to crewmembers' facemasks. The introduction of an independently rotating commander station or cupola may require a slip ring large enough in diameter to encompass the station, yet very thin in cross section to minimize

Components for Vehicular Systems



VEHICULAR SLIP RING DESIGN CRITERIA

space requirements. These advances in military technology, plus many others, have challenged the capabilities of the slip ring industry, demanding equally sophisticated solutions for reliable vehicle operation.

Moog Components Group consistently meets these challenges successfully and economically. For more than 50 years we have been involved in the design, development, and production of quality slip rings for many diverse applications. Recognized as leaders in slip ring research and testing, our team of engineers, scientists, and manufacturing personnel have focused their total resources toward one goal—providing you with the best possible product.

To that end, we have:

- Established a complete Research & Development team, conducting numerous on-going studies in such areas as tribology—the science of friction, wear and high bandwidth communication.
- Studied the effect of environmentally-induced contaminants on slip ring contacts and made substantial progress in making slip rings more tolerant of hostile environments.
- Consolidated all of the functions of product design, tool design, manufacturing, and product testing into a well-integrated in-house operation certified to AS9100 Rev. B ISO 9001-2000.
- Combined field-proven slip ring designs with high-volume tooling techniques resulting in high quality hull-to-turret slip rings at attractive unit prices.
- Presented technical papers dealing with the field of electrical contacts and the applications of our technology to a diverse marketplace.

In view of our many years of applications experience and proven performance, it is easy to understand why our slip rings have been chosen to be used on numerous vehicular programs, including:

- APC
- M60 A1 & A2
- HSTV
- M2 & M3 Bradley
- Leopard
- M48
- LAV
- 8x8
- M728 CEV
- Centurion
- Commando V150
- Stryker
- AAV
- Bionix

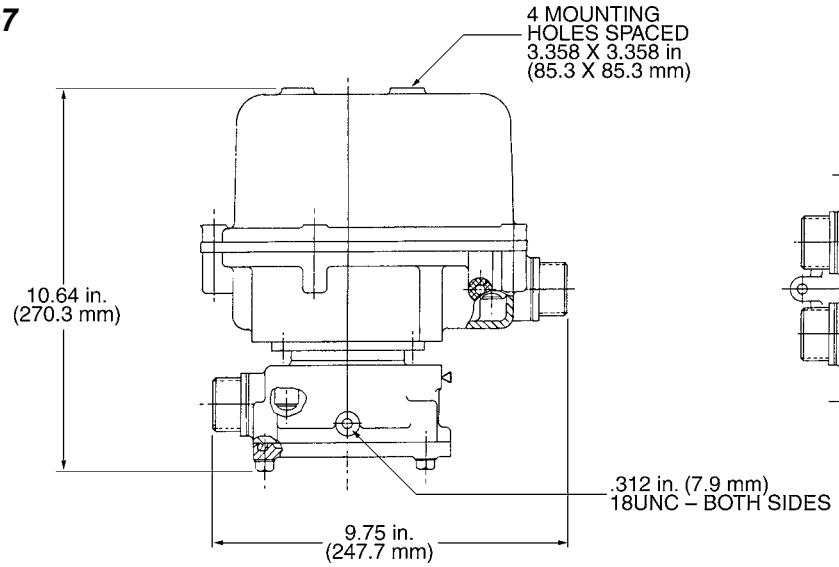
Vehicular and Turret Slip Ring Specifications

The following table presents a cross-section of our vehicular designs. These products are for reference purposes only. Please contact the factory concerning your requirements. Tooling charges may apply.

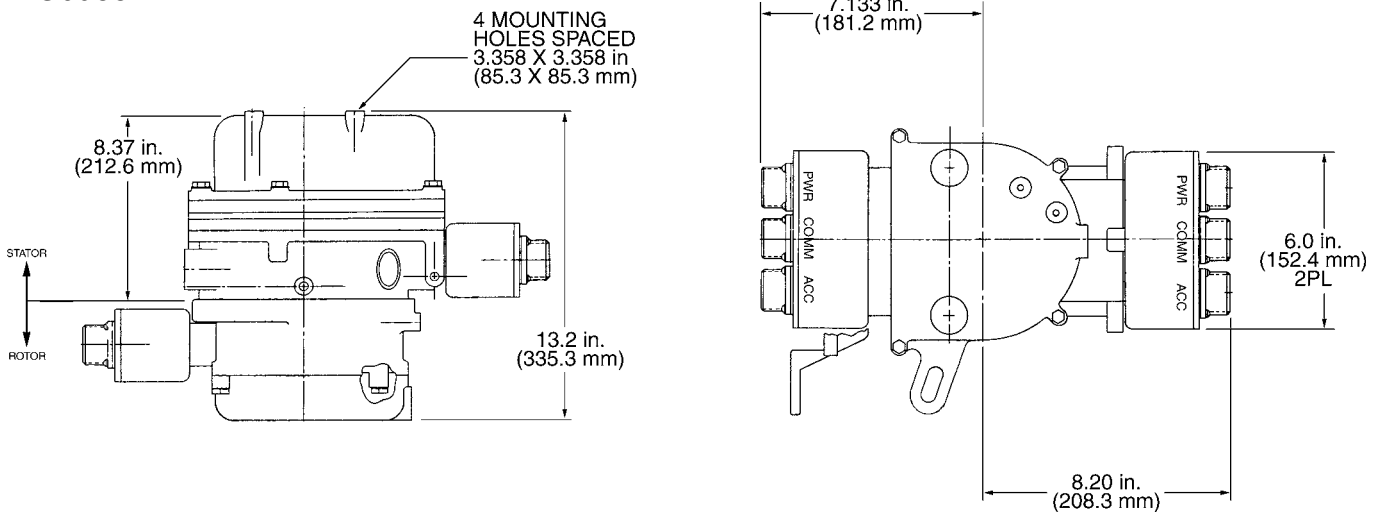
Vehicular Slip Ring	Power			Signal			Comments
	Number of Circuits	Cont. Current Rating	Voltage Rating	Number of Circuits	Gauge or Type	Intended Signal	
AC3497	1 1	150 amps 150 amps	Ground	12	Control	5 amps, 150 V	2 cam design for dual fire control Variations available
AC6033	1 1	150 amps 150 amps	Ground	18	Control	5 28 VDC	Dual cam NBC air channel Variations available
VSR-3733	2	200 amps	24 VDC	42	20 AWG	3 amps, 28 VDC	NBC air channel Size similar to JZ4994
VSR-4906	2	200 amps	24 VDC	61	20 AWG	3 28 VDC, 28 VDC	NBC air channel Size similar to JZ4994
VSR-4994	4	200 amps	24 VDC	86	24 AWG	2 - 4 amps, 28 VDC	NBC air channel (2) 1553 Data-bus (8) RS-170 Video
VSR-6057	2	250 amps	18 - 32 VDC	238	24 AWG	2 - 4 28 VDC, 28 VDC	EMI features concentric rings and high isolation
VSR-6772	2 2	450 amps 75 amps	28 VDC 28 VDC	150	28 AWG	100 Mbit Ethernet	Contains resolver, R to D network, power distribution network and pneumatic and hydraulic rotary joint
VSR-2000	2	50 amps	250 VDC	12 or 24		10 amps, 250 VDC	High current and alternate signal configurations available
VSR-7001	2 4 4 11	150 amps 120 amps 80 amps 13 amps	20 - 33 VDC 20 - 33 VDC 20 - 33 VDC 20 - 33 VDC	32 18 6 3 4	22 AWG 24 AWG 28 AWG Twinax MIL-C-17 / 94 28 AWG Twinax	5 amps, 20 - 33 VDC 3 amps, 20 - 33 VDC Serial Data RG-179 Gigabit Ethernet	Gigabit ethernet channels Immersible to 1 meter (2) RS-170 video Air channel

Typical Vehicular Slip Ring Designs

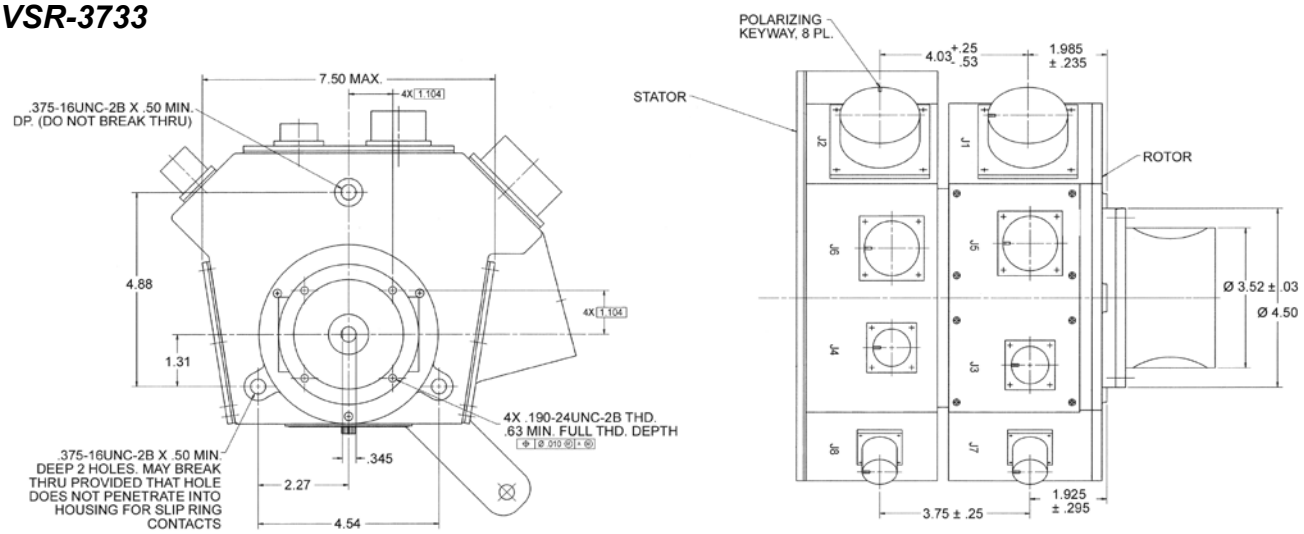
AC3497



AC6033

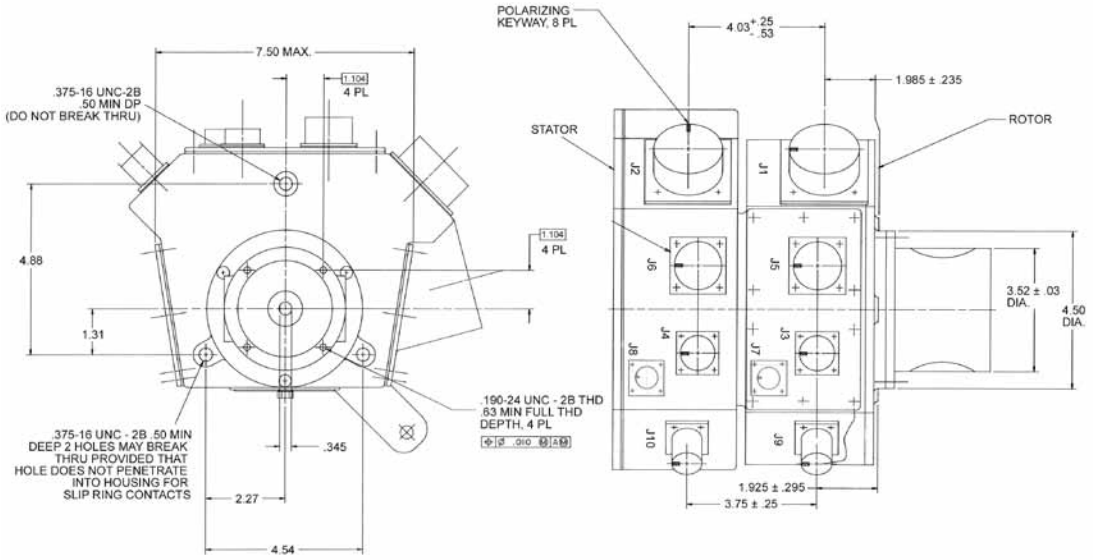


VSR-3733

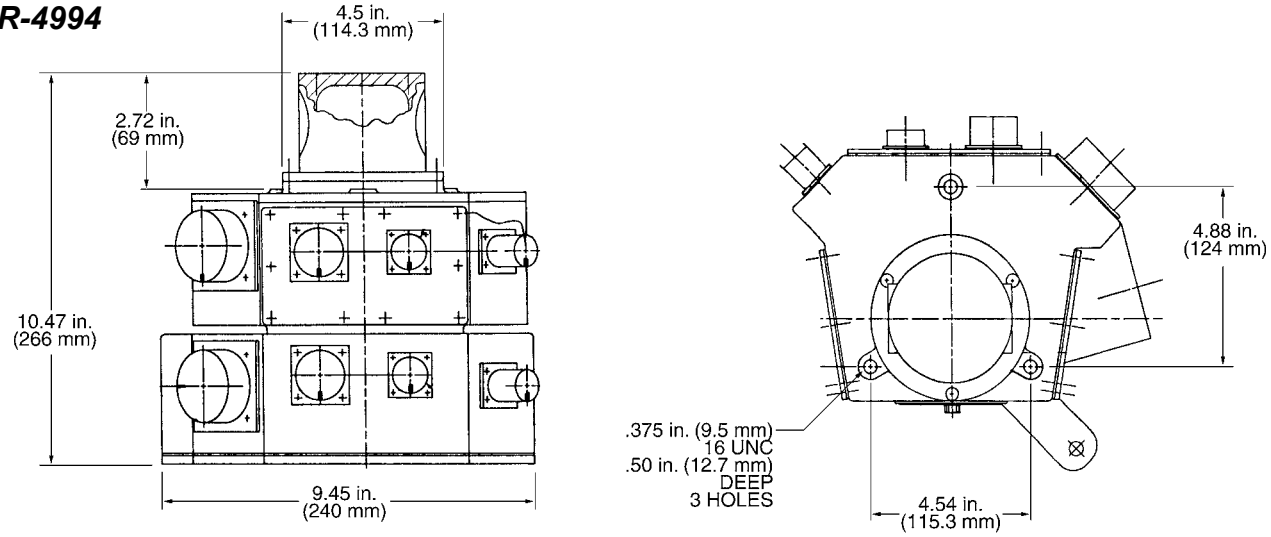


Typical Vehicular Slip Ring Designs

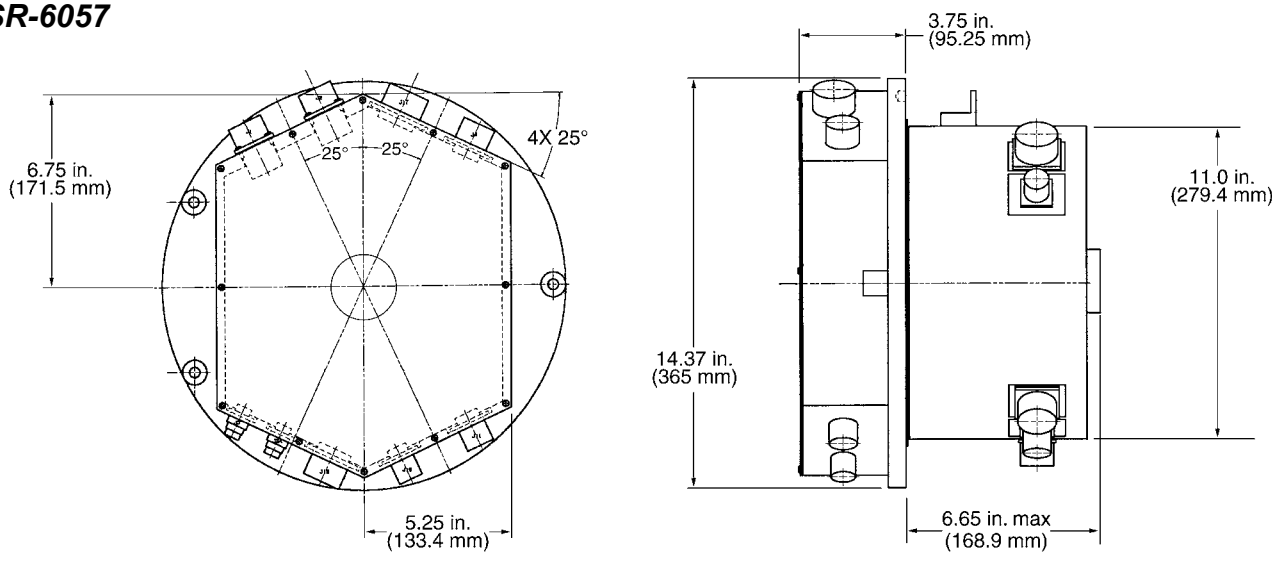
VSR-4906



VSR-4994

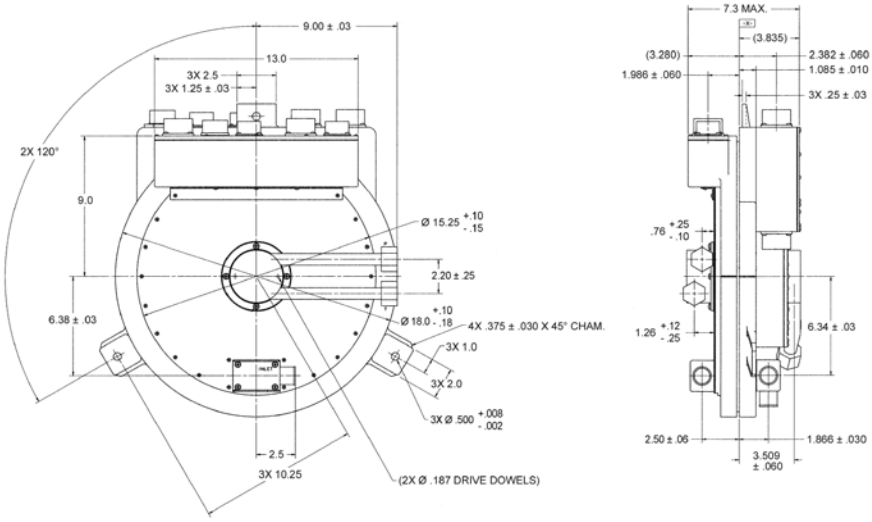


VSR-6057

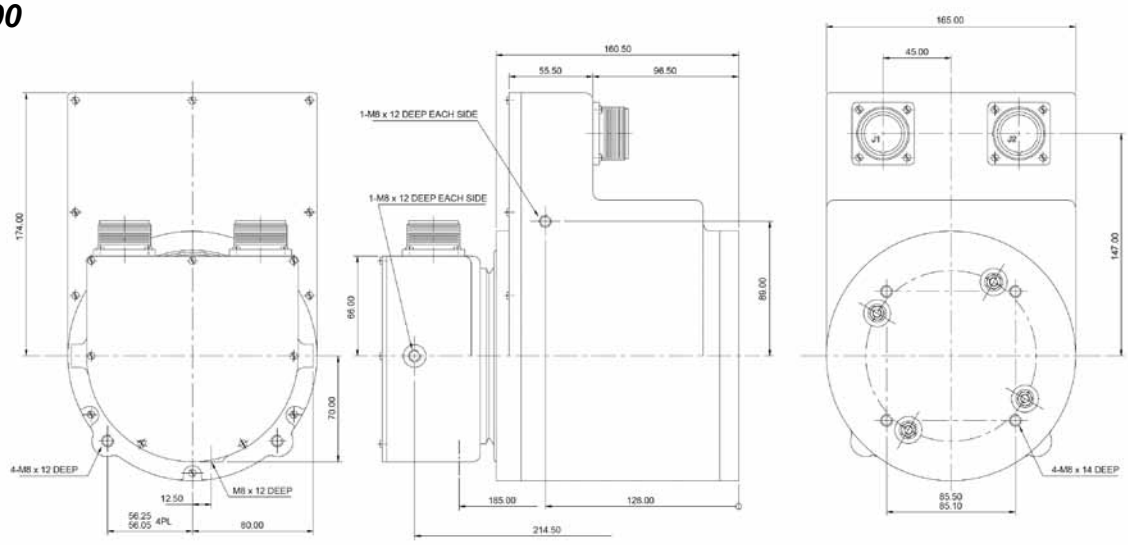


Typical Vehicular Slip Ring Designs

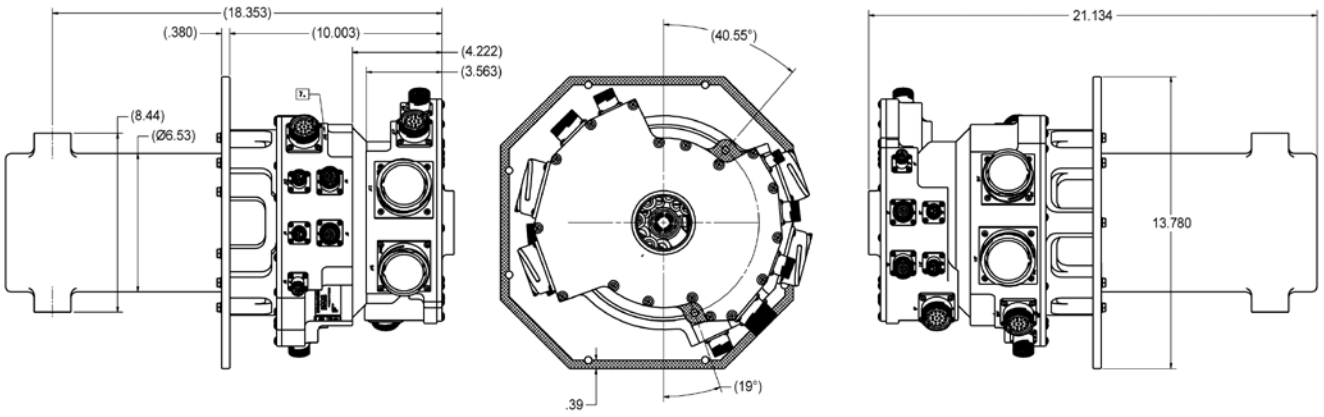
VSR-6772



VSR-2000



VSR-7001



Helicopter Slip Rings

Proven reliability in the most demanding of applications and environments

Description

Today's rotorcraft applications place unique demands on slip ring technology because of equipment requirements and environmental conditions. From de-ice applications (with their need for high rotational speed, exposure to weather conditions and high vibration) to weapon stations and electro-optic sensor systems (with high bandwidth signal transmission), helicopter slip rings must perform in a highly reliable mode with the latest product advancements.

Our many years of experience in this arena has allowed Moog Components Group to be a leader in slip ring technology for rotorcraft applications. Employing a combination of precious metal fiber and composite brush technology for signal and power transfer, we are qualified to meet the most demanding applications effectively and economically. Contact us with your requirements so we can help you find a solution.

Features

- Multiple contact technologies suited for the application
  - Monofilament wire brush
  - Multiple precious metal fiber brush
  - Composite brush
- Environmental sealing
- EMI Shielding
- FEA structure analysis
- High shock and vibration capabilities
- Wide operating temperature envelope
- Vertical integration of position sensors and ancillary products
- High frequency bandwidth
- High reliability and life
- Redundant bearing designs

Typical Applications

- Blade de-ice
- Blade position
- Tip lights
- Flight controls
- FLIR systems
- Target Acquisition systems
- Weapon stations

HELICOPTER SLIP RING DESIGN CRITERIA

Electrical slip rings are used in helicopter, tilt-rotor and rotorcraft applications for a variety of applications. Historically, slip rings were initially intended for use in blade de-ice and tip-light applications where electrical power was required for the main and tail rotor blades. Today, with the advent of tilt-rotor aircraft, slip rings are transmitting flight control and blade position data. Reliability and data integrity has never been more important.

Advanced aircraft now carry infrared and electro-optic sensors, target acquisition systems and weapon stations requiring unrestrained rotation. As a result, slip rings (and our related motion technology components) play a much broader and important role.

In addition to producing compact, light weight and highly reliable slip rings, we have provided units that combine conventional electrical slip rings with resolvers, encoders, fiber optic rotary joints and other commodities.

Design

Moog Components Group can offer the most valuable design assistance by being involved early in the development of the aircraft and related subsystems. The internal design of the slip ring capsule will be driven by the circuit requirements, need for ancillary products and the space available for mounting the slip ring capsule. We can offer the following design criteria:

- Use of existing designs
- Single drum
- Concentric drums
- Single pancake
- Stacked pancakes
- Combination of designs
- Clear through-bore to allow for another device or bearing structure
- Connectors – case mounted or attached to cables
- Mechanical support – on either side of the rotating interface including the stand pipe

Power Circuits

Theoretically, there is no limit to the amount of power that can be transferred by the slip ring assembly. Most rotorcraft de-ice slip rings carry less than 100 amperes of current. It is important that the power duty cycle be defined as early as possible in the design stage. Thermal design requirements can affect other design parameters. If the space available for the slip ring capsule is limited, it may be advantageous to transfer the power at higher voltages. Power can be grounded either through the case of the slip ring or insulated from the case.

Signal Circuits

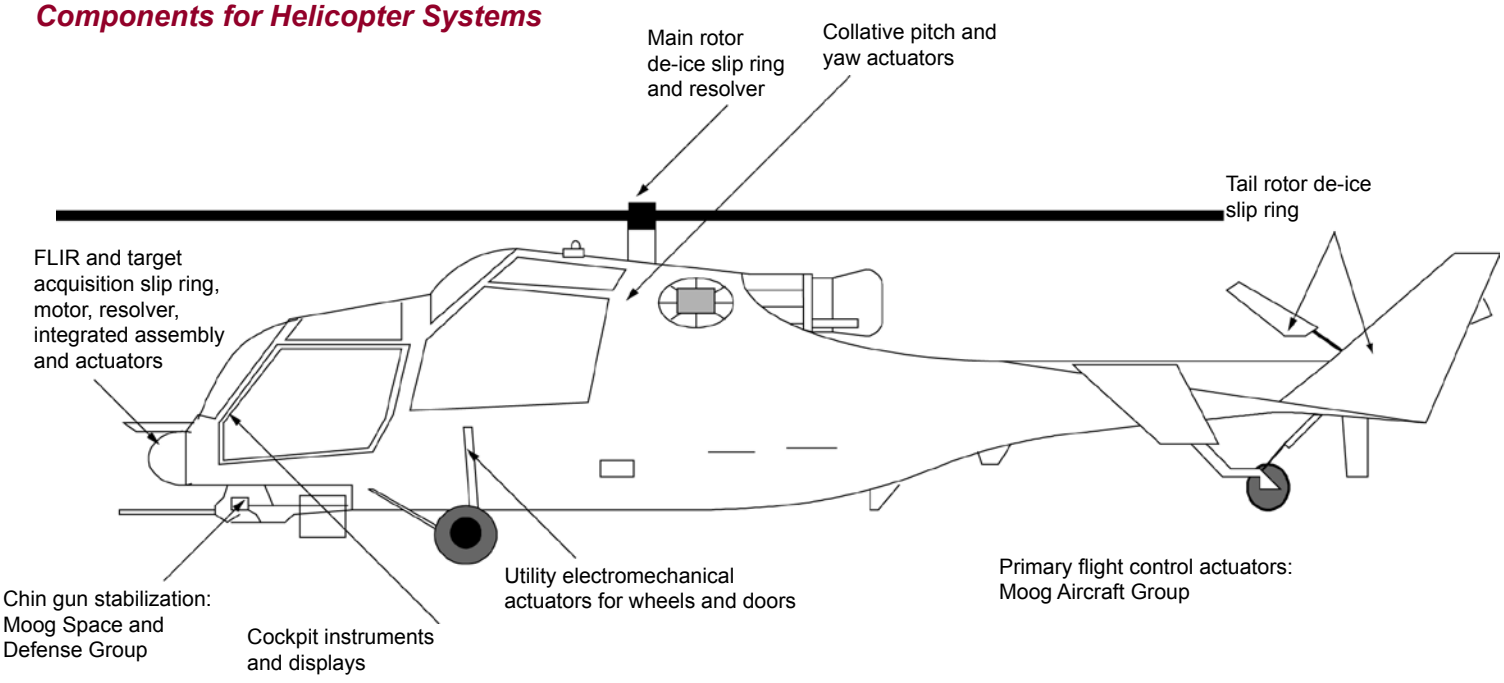
Signal requirements for a rotorcraft slip ring capsule continues to be increasingly demanding, particularly with the advent of tiltrotor aircraft, electro-optics and target acquisition systems. The circuit functions and electrical isolation requirements have a significant impact on the design of the slip ring. While a de-ice system has few signal requirements, tiltrotor aircraft require flight control circuitry and electro-optic sensors often requiring high-bandwidth video, analog and digital control circuitry.

It is often important that sensitive circuits have additional isolation from other circuits and impedance matching for high bandwidth. Such requirements can be much better addressed early in the design stages.

Slip Ring Experience

Rotorcraft applications pose a variety of design challenges. High vibration, harsh environments and high reliability demands products from a proven supplier. Moog Components Group has a long history of supplying slip ring and motion technology (motors, resolvers, fiber optic and subsystem) products to the rotorcraft industry. Current fielded systems include Apache, Blackhawk, Seahawk, EH-101, S-92, V-22, CV-22 and BA-609 to name a few. Let us put our experience to work for your next rotorcraft application.

Components for Helicopter Systems



Propeller Slip Rings

Description

Fixed wing propeller aircraft use specialist de-icing slip rings to pass electrical power from the airframe generators to the rotating propellers. These propellers are heated to avoid the build up of ice either in flight or on the ground in difficult weather conditions.

The correct choice of materials for the rings and brushes, together with a very fine surface finish on the rings themselves, ensure the optimum life of the unit in operation. The life time is generally in excess of 1500 hours at 1200 rpm – equivalent to >100 million revolutions, with only a simple maintenance operation to change the brushes and brush block.

Units are designed for each application in conjunction with the customers' requirements.

Typically these slip rings are supplied to the Propeller system manufacturer.

Moog Components pedigree extends over many years and the following programmes are examples of where our products are used :

- Jetstream
- Fokker 50
- SAAB 340
- Grumman
- SAAB 2000
- De Havilland Dash 8
- Lockheed Martin C130J
- ATR42
- Airbus A400M

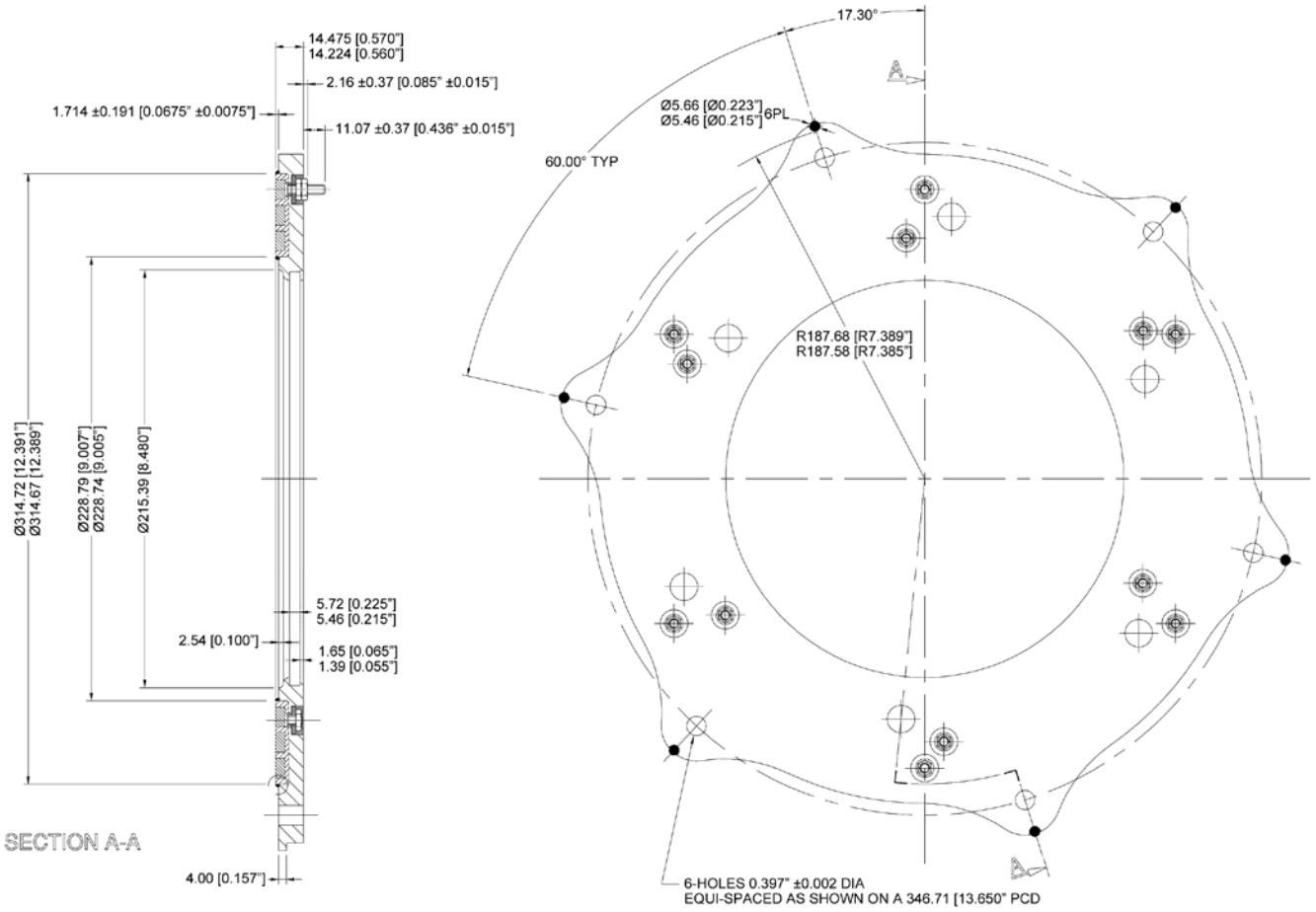
Features

- Low brush wear
- Integrated rings and housings
- Beryllium free design
- Low maintenance solution, replacable brushes
- Diamond turned finish on the slip ring

Typical Applications

- Blade de-ice

Typical Propeller Slip Ring Dimensions



Dimensions in millimeters (inches)

Miniature Slip Ring Capsules

AC264
AC267

Miniature slip ring capsules in various circuit configurations

Description

A slip ring capsule can be used in any electromechanical system that requires unrestrained, intermittent or continuous rotation while transferring power and / or data.

Miniature slip ring capsule assemblies economically address both critical space and weight limitations. Each assembly includes the rotor, brush blocks, frame, ball bearings and dust cover. Existing designs are available or we can custom design slip rings to meet your specific requirement.

Although originally designed for commercial uses, the miniature slip ring capsule is well suited for many military applications.

Features

- Rugged stainless steel housing
- Up to 60 rings can be packaged in a self-contained envelope 1.957 inch long and .50 inch barrel diameter
- Gold-on-gold sliding contact technology
- Up to 100 rpm operation
- Low noise; as low as 25 milliohms
- Long life. Several million total revolutions at speeds up to 60 rpm have been obtained.

Benefits

- Precise, tight packaging capabilities for meeting stringent design criteria
- Proprietary plating techniques provide improved reliability, longer life and increased efficiency
- Unique signal handling performance to minimize noise and increase speed
- Configuration flexibility allows for packaging from 16 to 60 circuits

Typical Applications

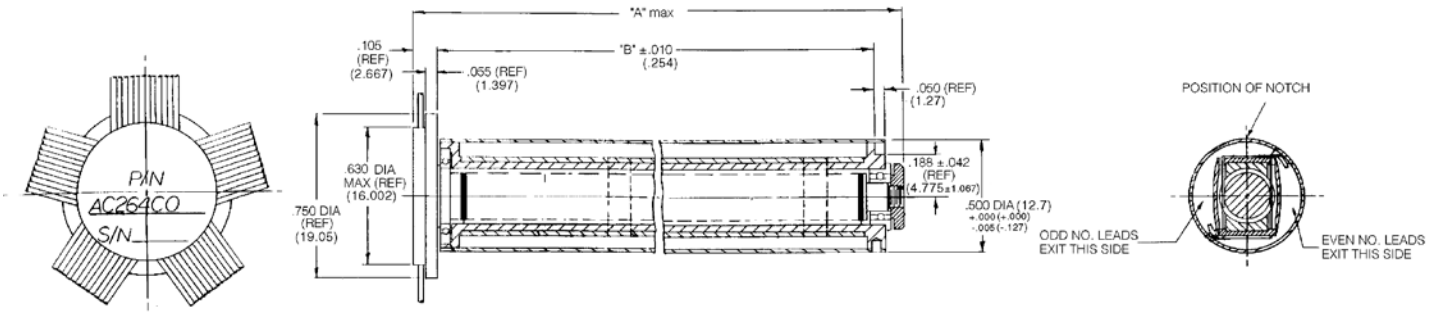
This slip ring provides high speed performance and is successfully serving in various applications such as:

- Gimballed pitch, roll and yaw axes of inertial navigation systems
- Missile weapon systems
- Unmanned aerial vehicles (UAV)

AC264 Specifications	
Current Rating	.8 amp per circuit
Lead Size	30 AWG
Dielectric Strength	500 VAC
Insulation Resistance	1000 mohms @ 500 VDC
Circuit Resistance	265 mohms with 12 in. leads both ends
Starting Torque	2 grams-centimeters max. per circuit
Noise	50 mohms tested @ 5 rpm test current 50 MA

No. of Circuits	"A" Dimension	"B" Dimension
20	1.04 (26.3)	0.757 (19.2)
30	1.34 (33.9)	1.057 (26.8)
40	1.64 (41.5)	1.357 (34.5)
50	1.94 (49.1)	1.657 (42.1)
60	2.24 (56.8)	1.957 (49.7)a

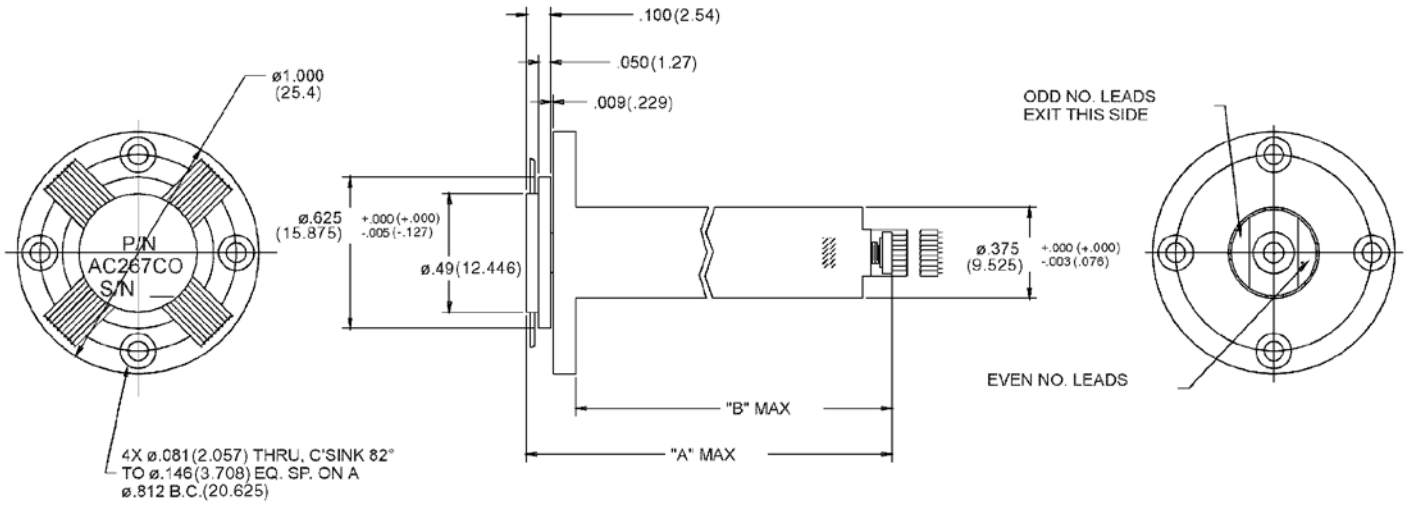
AC264 Dimensions



AC267 Specifications	
Current Rating	.8 amp per circuit
Lead Size	30 AWG
Dielectric Strength	500 VAC
Insulation Resistance	1000 mohms @ 500 VDC
Circuit Resistance	270 mohms with 12 in. leads both ends
Starting Torque	1.5 grams-centimeters max. per circuit
Noise	25 mohms tested @ 5 rpm with test current 100 MA

No. of Circuits	"A" Dimension	"B" Dimension
16	0.91 (23.2)	0.71 (18.0)
20	1.03 (26.2)	0.83 (21.0)
24	1.15 (29.3)	0.95 (24.1)
28	1.27 (32.3)	1.07 (27.1)
32	1.39 (35.4)	1.19 (30.2)
36	1.51 (38.4)	1.31 (33.2)

AC267 Dimensions



Dimensions in inches (millimeters)

AC6292

Miniature slip ring capsule - circuit configuration for commercial and military applications

Description

A slip ring capsule can be used in any electromechanical system that requires unrestrained, occasional or continuous rotation while transferring power and / or data.

Miniature slip ring capsule assemblies economically address both critical space and weight limitations. Each assembly includes the rotor, brush blocks, frame, ball bearings and dust cover.

These slip rings can be configured with spacing between rings of 0.006 inch and brush diameters no larger than a human hair. Existing designs are available or we can custom design slip rings to meet your specific requirement.

Features

- Center-to-center adjacent ring spacings as small as 0.015 inch can be obtained
- 80 rings packaged in a self-contained envelope 3.3 inches long and 1.5 inch barrel diameter
- Gold-on-gold sliding contact technology
- Up to 40 rpm operation
- Low noise; as low as 15 milliohm per circuit pair
- Long life; several million total revolutions have been obtained

Benefits

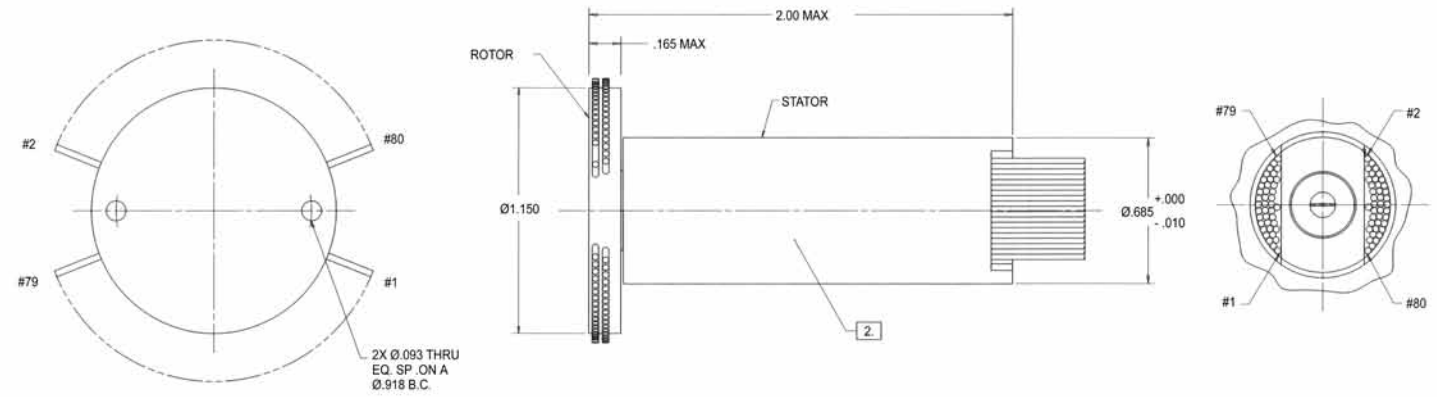
- Precise, tight packaging capabilities for meeting stringent design criteria
- Proprietary plating techniques provide improved reliability, longer life and increased efficiency
- Unique signal handling performance to minimize noise and increase speed
- Other configurations are available from 16 to 95 circuits
- We also manufacture commercial slip rings from 6 to 56 circuits

Typical Applications

- Gimballed pitch, roll and yaw axes of inertial navigation systems
- Missile weapon systems
- Unmanned aerial vehicles (UAV)
- Airborne camera platforms

AC6292 Specifications	
Current Rating	0.8 amp per circuit
Lead Size	30 AWG
Dielectric Strength	1000 V (test)
Insulation Resistance	1000 megohms
Circuit Resistance	0.27 ohms (leads @ 24 in.)
Starting Torque	240 gm cm
Noise	30 milliohms max.
Rotational Speed	40 rpm max.
Lead Length	24 inches each end

AC6292 Dimensions



Dimensions in inches

RK4288

Miniature slip ring capsule circuit configuration for commercial and military applications

Description

A slip ring capsule can be used in any electromechanical system that requires unrestrained, occasional or continuous rotation while transferring power and / or data.

Miniature slip ring capsule assemblies economically address both critical space and weight limitations. Each assembly includes the rotor, brush blocks, frame, ball bearings and dust cover.

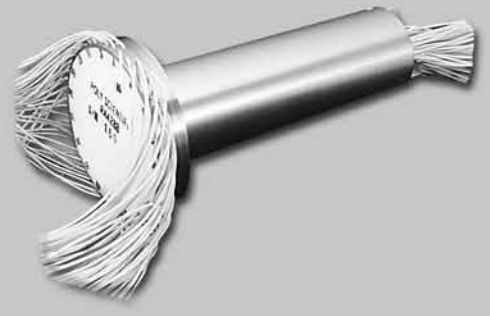
These slip rings can be configured with spacing between rings of 0.015 inch and brush diameters no larger than a human hair. Existing designs are available or we can custom design slip rings to meet your specific requirement.

Features

- Center-to-center adjacent ring spacings as small as 0.015 inch can be obtained
- 95 rings packaged in a self-contained envelope 3.3 inches long and 1.5 inch barrel diameter
- Gold-on-gold sliding contact technology
- Up to 40 rpm operation
- Low noise; as low as 15 milliohm per circuit pair
- Long life; several million total revolutions have been obtained

Benefits

- Precise, tight packaging capabilities for meeting stringent design criteria
- Proprietary plating techniques provide improved reliability, longer life and increased efficiency
- Unique signal handling performance to minimize noise and increase speed
- Other configurations are available from 16 to 80 circuits
- We also manufacture commercial slip rings from 6 to 24 circuits



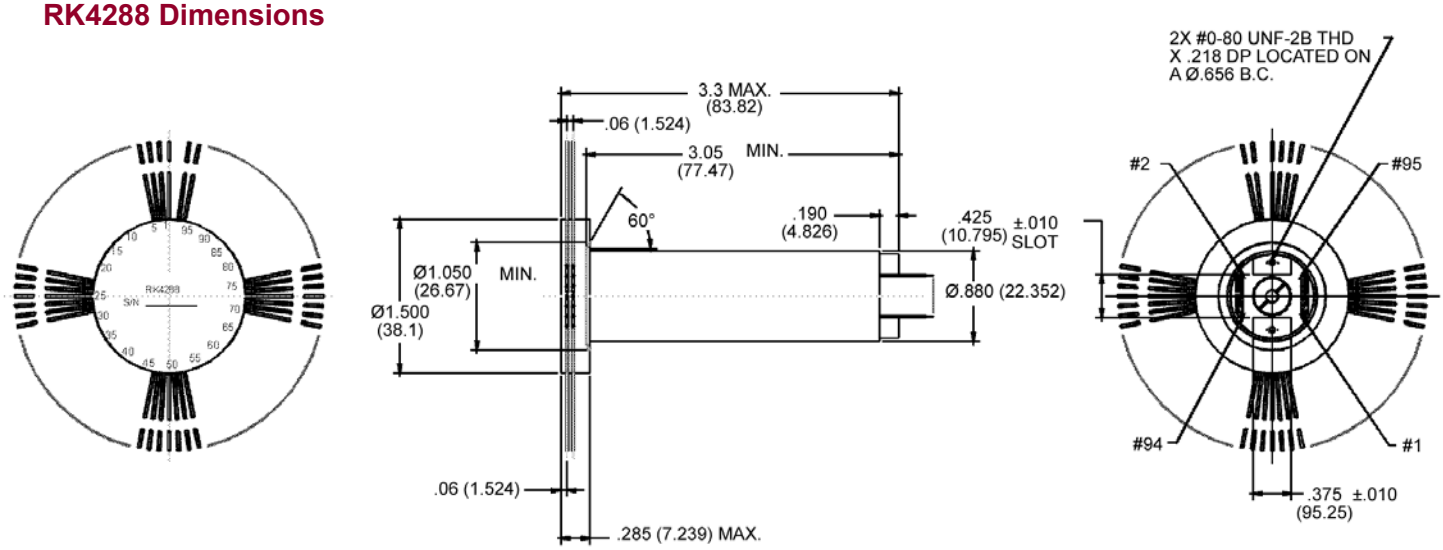
Typical Applications

This slip ring provides high speed performance and is successfully serving in applications such as:

- Gimballed pitch, roll and yaw axes of inertial navigation systems
- Satellite de-spin assemblies
- Deep earth drilling projects
- Missile weapon systems
- Unmanned aerial vehicles (UAV)
- Airborne camera platforms

RK4288 Specifications	
Current Rating	0.8 amp per circuit
Lead Size	30 AWG
Dielectric Strength	1000 V (test)
Insulation Resistance	1000 megohms
Circuit Resistance	0.27 ohms (leads @ 24 in.)
Starting Torque	240 gm cm
Noise	30 milliohms max.
Rotational Speed	40 rpm max.
Lead Length	24 inches each end

RK4288 Dimensions



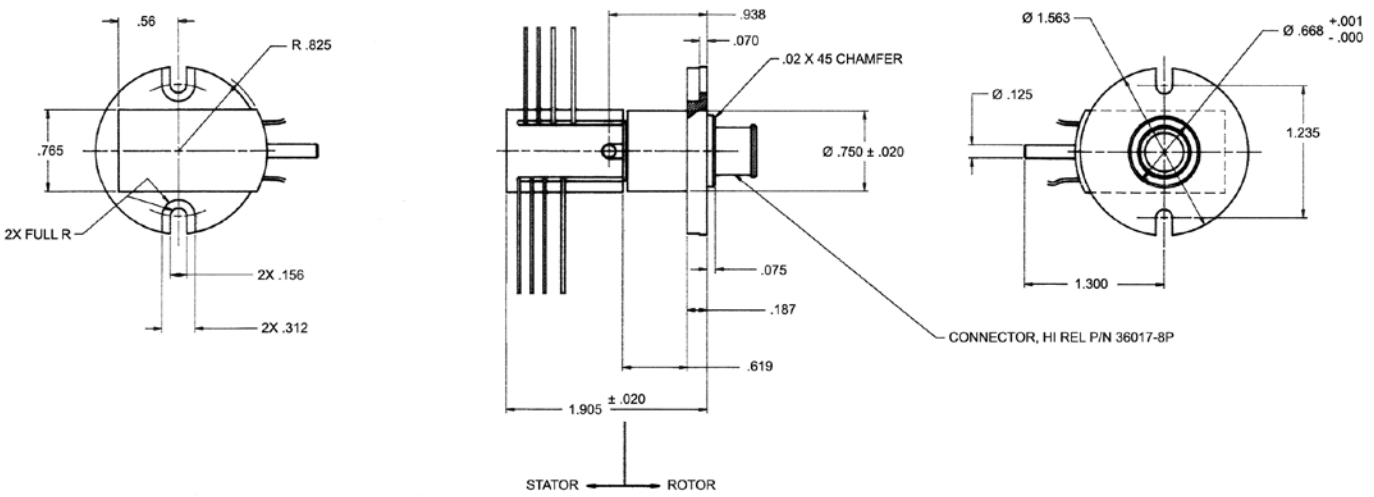
Dimensions in inches (millimeters)

Miniature Slip Ring Capsules

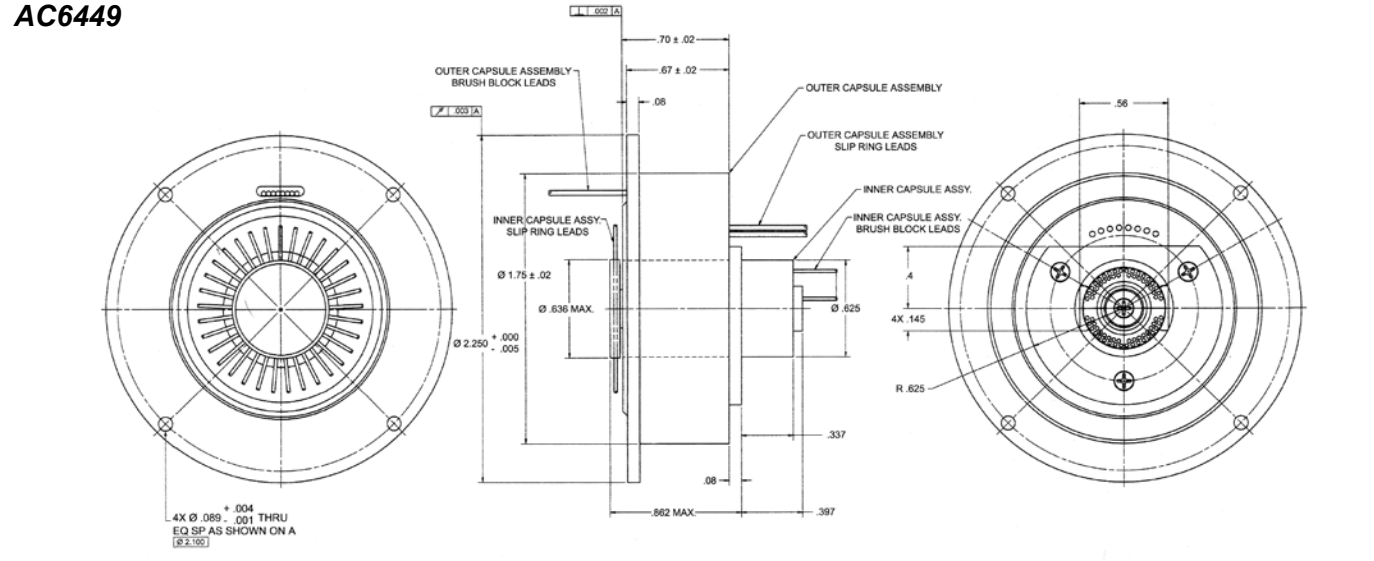
Part #	No. of Ckts.	Signal	Power	Length (inch)	O.D. Housing (inch)	O.D. Flange	Other
RT4922	5	5 @ 1A	0	1.10	0.47”	0.87”	1 segmented circuit
SJ4834	8	5 @ 1A	3 @ 4A	1.90	0.75”	1.56”	Integral rotor connector
RE4590	12	12 @ 1A	0	0.60	0.38”	0.48”	10 in. lead length
JJ6095	15	15 @ 1A		1.1	1.0”	1.4”	O’ring, sealed bearing, fiber brush
GS2725	29	23 @ 0.5A	6 @ 2A	0.83	0.39”	1.24”	Lead length is 11 in. min.
RE4815	32	32 @ 1A	0	1.32	0.50”	0.60”	Lead length is 24 in. rotor & 12 in. stator
GS2388	38	38 @ 1A	0	1.0	0.41”	1.26”	Rotor leads: 12 in.; brush block leads 8 in.
BB3199	39	39 @ 1A	0	1.03	0.59”	0.65”	24/12 in. lead length
BB2759	45	45 @ 1A	0	1.03	0.59”	0.65”	Rotor leads: 24 in.; brush block leads 12 in.
NH3302	60	60 @ 1A	0	2.24	0.50”	0.75”	Lead length is 12 in.
BB2871	65	65 @ 1A	0	1.28	0.65”	0.64”	Higher voltage on 5 ckts
AC6449	74	66 @ 1A	8 @ 3A	1.26	1.75”	2.25”	Concentric unit
AC6292	80	57@ 1 A	23 @ 3 A	2.00	0.68”	1.15”	COTS - export w/out license
RK4288	95	95 @ 1A	0	3.3	0.88”	1.50”	Lead length is 24 in.

Typical Miniature Slip Ring Capsule Designs

SJ4834



AC6449



M Series

Slip ring capsules

Description

The M series of slip ring assemblies were developed for a wide variety of applications and environments. The M series is an ideal choice for limited space applications. As many as 120 separate circuits are accommodated in a 2.7 inch diameter OD envelope and in less than 5.50 inches long. These slip ring assemblies are a quick turn solution for your application. Off the shelf components allow for a delivery which meets your needs.

Features

- Ideal for limited space applications
- Modular construction for up to 120 circuits
- All circuits 60 V / 2 A each
- Continuous bidirectional rotation up to 1,000 rpm
- Dust-proof cover standard
- Flange mounting
- Superior signal quality
- 24 inch flying leads, optional wiring and harnessing available
- #26 AWG lead wire

Typical Applications

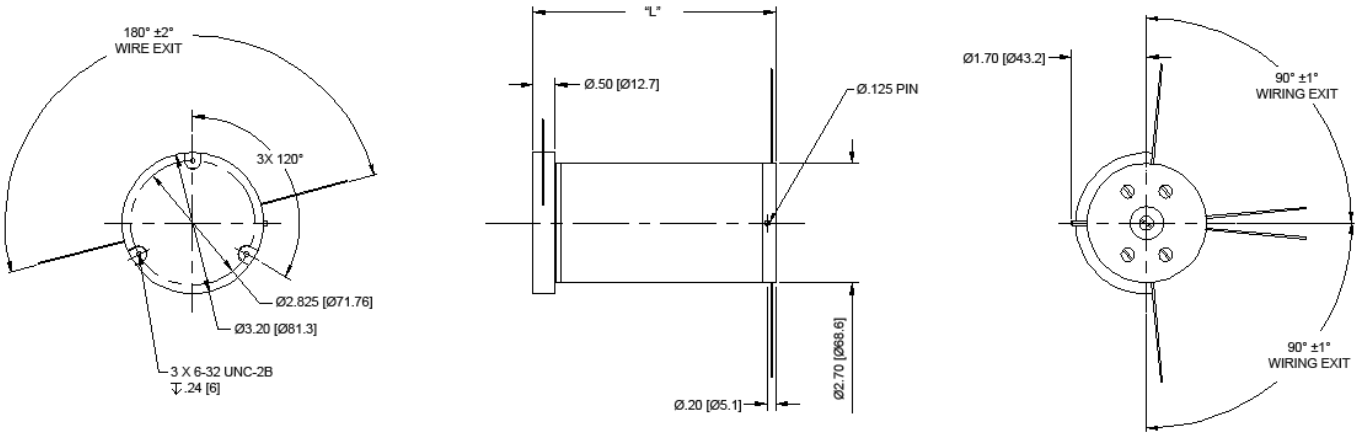
- Surveillance equipment

Miniature Slip Ring Capsules

M Series Specifications		Options
Circuits	Up to 120 circuits: 2 A /60 volts	• Longer leads
Maximum Speed	1000 RPM	• Special wiring
Terminals	#26 AWG flying leads	• Fiber optic rotary joint
Mounting	Flange mounting	• High voltage option to 120 V

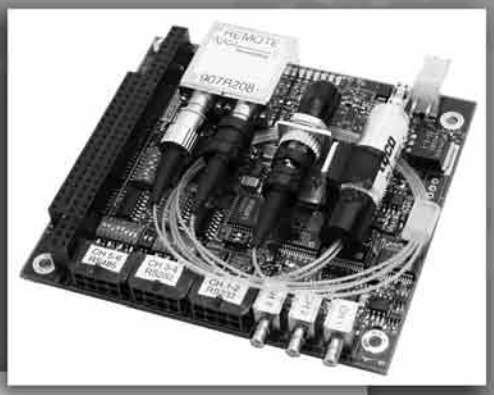
Number of Circuits	"L"
40	2.80
80	4.15
120	5.50

M Series Dimensions



Dimensions in inches (millimeters)


MODEL 903
Video/Data
Multiplexer
RS-485
RS-232
MODEL 903
Power
Supply
POWER
FOCAL



Marine / Energy Slip Rings

Designed to function in extreme marine environments

Description

Moog Components Group has delivered trusted technology products and services to the offshore petroleum, oceanographic, seismic and maritime industries for more than 20 years. Working from our well-equipped facility in Halifax, Nova Scotia, Canada, we have earned a reputation for unsurpassed service and custom solutions.

Today, we have the capacity to do more. Together with our manufacturing operations in United Kingdom and United States, we are an alliance dedicated to providing integrated custom solutions.

From design to deployment, our experienced team of professionals specializes in providing custom electrical slip rings, fiber optic rotary joints, hydraulic utility swivels and fiber optic multiplexer solutions for the worldwide marine industry. Product features include hybrid packages that combine fiber, electrical, and fluid rotary joints, packaging for harsh environments, explosion-proof / flameproof for hazardous locations, and adaptation to customer's size and mounting constraints.

Innovation and performance in all that we do. From our ability and willingness to customize products, to our unmatched global capacity, Moog Components Group is defining and delivering custom integrated and proven solutions for the harshest marine environments in the world.

Features

- Products designed for the harsh marine environment
- High voltage and high current slip rings (35 kV, 800 A)
- Experience and expertise in all aspects of fiber optics
- Flameproof / explosion proof design
- Ability to customize designs
- Fluid filled and temperature / pressure compensated designs for submerged applications
- Experience with all communications protocols used for the transmission of video and data

Typical Applications

- Remotely operated vehicles (ROV)
- Seismic surveying
- Oceanographic winches
- Subsea communications and control
- Floating production, storage and offshore loading (FPSO)
- Downhole / wirelogging and drilling
- Diving
- Marine instrumentation

FOCAL™

Model 129

Slip ring

Description

The Model 129 is a power slip ring used in marine and industrial applications worldwide. When rugged environments demand reliable, continuous operating performance, the 129 is the slip ring of choice. Capable of transmitting up to 5000 volts and 175 amps per slip ring pass, the 129 can reliably transfer power across a rotating interface.

Features

- Stainless steel housing provided for rugged environments
- Hazardous area certification available
- Power and signal transfer integrated into a single unit

Benefits

- Each unit designed, manufactured, and tested in accordance with the highest quality standards
- Maintenance free operation
- Proven reliable, long life performance
- Integration with fiber optic rotary joints and fluid rotary unions to provide a complete rotating interface solution

Typical Applications

- Industrial machinery
- FPSO swivel stacks

FOCAL™

Electrical	
Voltage	Maximum 5000 VAC
Current	Maximum 175 A per pass [1] Maximum current not specified [2]
[1] Higher current ratings possible by wiring passes in parallel	
[2] All current ratings based on a 20 °C ambient temperature	

Electrical Power Performance	
Flashover Voltage	24 000 VAC
Insulation Resistance [1]	Minimum 500 MΩ @ 1 kVDC
Short Circuit Rating	11 kA / 1s, 17 kA peak
Other Devices [1]	RF Rotary Joint, Shaft Encoder, Sensors
[2] Value dependent on wire type	

Electrical Signal Performance	
Contact Resistance	20 mΩ nominal
Insulation Resistance [1]	Minimum 500 MΩ @ 1 kVDC
Insertion Loss (Nominal) RG59 coax	1.5 dB maximum up to 30 MHz
Crosstalk (Nominal) RG59 coax	-15 dB maximum up to 30 MHz
[1] Minimum 100 MΩ for shield passes	

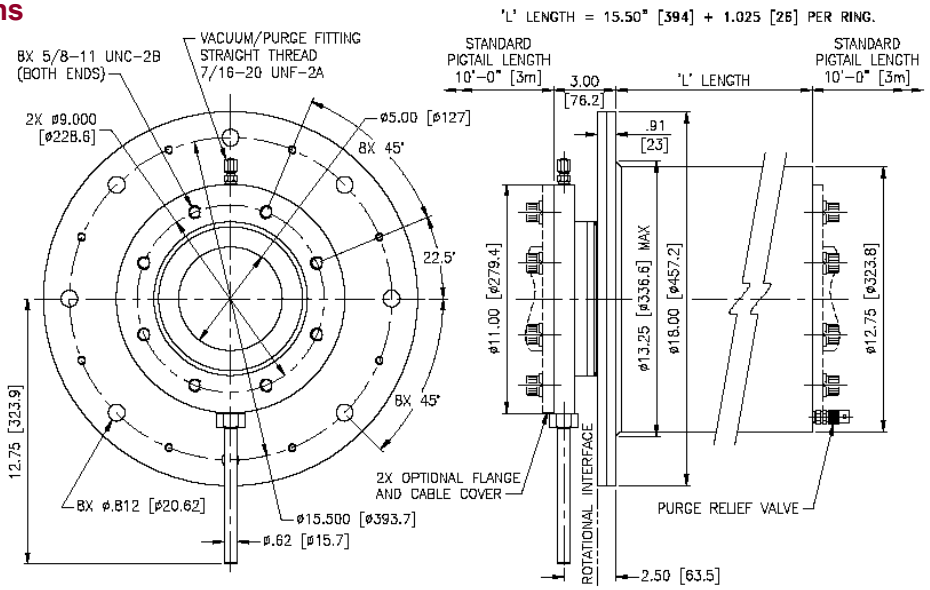
Mechanical	
Rotation Speed	Maximum 50 rpm continuous [1]
Protection Class	IP 66
Operating Temperature	-20 °C to + 55 °C [2]
Housing	Stainless steel (304)
Length "L"	Varies with number of electrical passes
[1] Higher rotational speeds possible. Please consult factory.	

Hazardous Area Option: Model 129X	
CSA Certification	Class 1, Group C, D
KEMA Certification (Model 295-X)	ATEX CE Ex II 2 G EEx d IIB T5 (in accordance with ATEX directive 94 / 9 / EC)
Can be supplied with purge fittings for use with a certified purge system	

Terminations	
Standard	Loose wire pigtails, 10 ft [3.0 m] in length
Flange & Cable Covers	Various entry threads and orientations available
Cabled Pigtails	Tinned copper braid and heat shrink installed over loose wire pigtails
Special [1]	Supply and installation of connectors, terminals, conduit, cable, glands, junction boxes
[1] Integration of customer supplied product possible	

Additional Options	
Fiber Optics	Fiber Optic Rotary Joint (FORJ) or Optical Converter
Fluid	Fluid Rotary Union (FRU)
Design Certification	ABS, DNV, BV, LRS
Submersed Applications	Fluid filling fittings or fluid filled / pressure compensated at factory Internal pressure compensation
Other Devices [1]	RF Rotary Joint, Shaft Encoder, Sensors, Heater or Heat Trace Cable
Ingress Protection	IP 68
Extended Temperature Range	
[1] Integration of customer supplied product possible	

Model 129 Dimensions



Dimensions in inches [millimeters]

Model 159

Slip ring

Description

The Model 159 is the solution for higher current applications. Designed to accommodate up to 660 amps total current, the 159 can be customized to fit specific requirements. Incorporating both power and signal transfer into a single unit provides the needed versatility for marine, industrial, and defence applications.

Features

- Stainless steel housing for rugged environments
- Slip ring design provides sealing to IP66 requirements
- Can accommodate a variety of wire and cable types
- Hazardous area certification available
- Power and signal transfer integrated into a single unit

Benefits

- Each unit is designed, manufactured, and tested in accordance with the highest quality standards
- Maintenance free operation
- Proven, reliable, long life performance
- Integration with fiber optic rotary joints and fluid rotary unions to provide a complete rotating interface solution

Typical Applications

- Winches
- Remote operated vehicles (ROV)
- FPSO swivel stacks

FOCAL™

Electrical	
Voltage	Maximum 3500 VAC
Current	Maximum 60 A per pass [1] Maximum 660 A total current [2]
[1] Higher current ratings possible by wiring passes in parallel	
[2] All current ratings based on a 20 °C ambient temperature	

Electrical Power Performance	
Flashover Voltage	14 000 VAC
Insulation Resistance [1]	Minimum 500 MΩ @ 1 kVDC
Short Circuit Rating	2.2 kA / 1s, 5.6 kA peak
[1] Value dependent on wire type	

Electrical Signal Performance	
Contact Resistance	20 mΩ nominal
Insulation Resistance [1]	Minimum 500 MΩ @ 1 kVDC
Insertion Loss (Nominal) RG59 coax	1.5 dB maximum up to 30 MHz
Crosstalk (Nominal) RG59 coax	-15 dB maximum up to 30 MHz
[1] Value dependent on wire type	

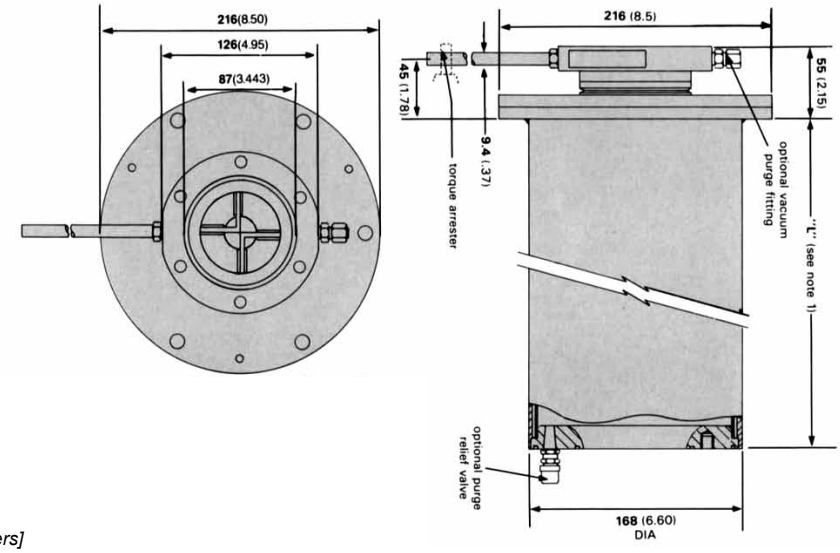
Mechanical	
Rotation Speed	Maximum 50 rpm continuous [1]
Ingress Protection	IP 66
Operating Temperature	-20 °C to + 55 °C
Housing	Stainless steel (304)
Length "L"	Varies with number of electrical passes
[1] Higher rotational speeds possible. Please consult factory.	

Hazardous Area Option	
KEMA Certification (Model 295-X)	ATEX CE II 2 G EEx d IIB T5 (in accordance with ATEX directive 94 / 9 / EC)

Terminations	
Standard	Loose wire pigtails, 10 ft [3.0 m] in length
Flange & Cable Covers	Various entry threads and orientations available
Cabled Pigtails	Tinned copper braid and heat shrink installed over loose wire pigtails
Special [1]	Supply and installation of connectors, terminals, conduit, cable, glands, junction boxes
[1] Integration of customer supplied product possible	

Additional Options	
Fiber Optics	Fiber Optic Rotary Joint (FORJ) or Optical Converter
Fluid	Fluid Rotary Union (FRU)
Design Certification	ABS, DNV, BV, LRS
Submersed Applications	Fluid filling fittings or fluid filled/pressure compensated at factory Internal pressure compensation
Other Devices[1]	RF Rotary Joint, Shaft Encoder, Sensors, Heater or Heat Trace Cable
Ingress Protection	IP 68
Extended Temperature Range	
[1] Integration of customer supplied product possible	

Model 159 Dimensions



Dimensions in inches [millimeters]

Model 176

Slip ring

Description

The Model 176 electrical slip rings are used in marine, industrial and defence applications. Comprised of power and signal electrical passes, the 176 provides superior performance and reliability in demanding operating environments. Highly configurable, the 176 can be customized to meet customer specific needs.

Features

- Stainless steel enclosure for open deck use
- Sealed housing design tested to IP66 standards
- Can accommodate a variety of wire and cable types
- Hazardous area certification available
- Reliable operation under shock and vibration

Benefits

- Each unit designed, manufactured, and tested in accordance with the highest quality standards
- Maintenance free operation
- More than 25 years of proven field performance
- Integration with fiber optic rotary joints and fluid rotary unions to provide a complete rotating interface solution

Typical Applications

- Remote operated vehicles (ROV)
- Winch and TMS applications
- Mine countermeasures
- Towed instrument arrays

FOCAL™

Electrical	
Voltage	Maximum 5000 VAC
Current	Maximum 20 A per pass [1] Maximum 720 A total current [2]
[1] Higher current ratings possible by wiring passes in parallel	
[2] All current ratings based on a 20 °C ambient temperature	

Electrical Power Performance	
Contact Resistance	20 mΩ nominal
Flashover Voltage	16 000 VAC [1]
Insulation Resistance [2]	Minimum 500 MΩ @ 1 kVDC
Short Circuit Rating	1.5 kA / 1s, 3.7 kA peak
[1] Applies to 5 kV rated passes	
[2] Value dependent on wire type	

Electrical Signal Performance	
Contact Resistance	20 mΩ nominal
Insulation Resistance [1]	Minimum 500 MΩ @ 1 kVDC
Insertion Loss (Nominal) RG59 coax	1.5 dB maximum up to 30 MHz
Crosstalk (Nominal) RG59 coax	-15 dB maximum up to 30 MHz
[1] Value dependent on wire type	

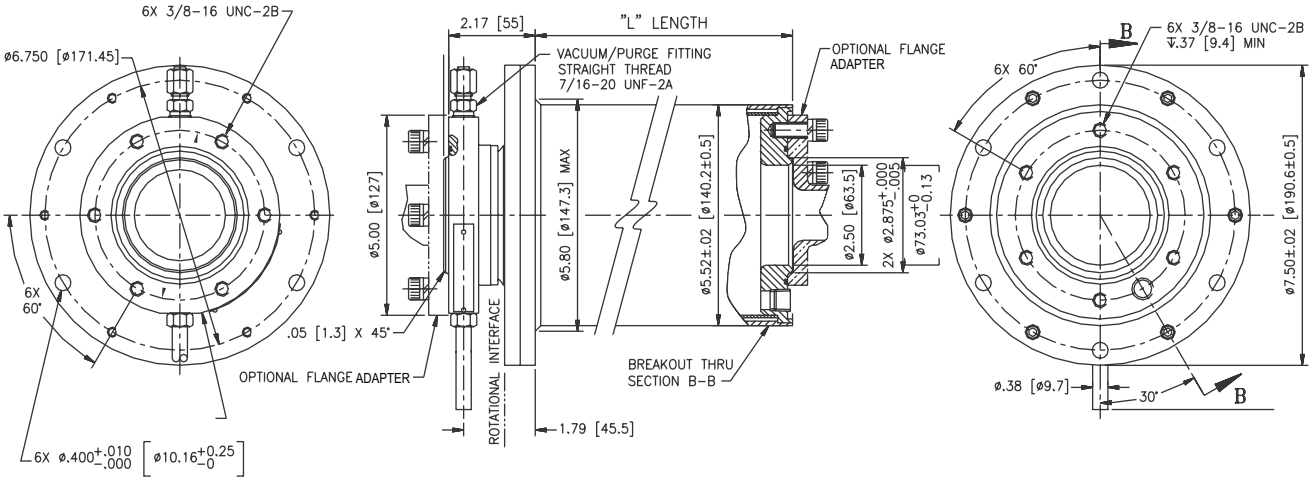
Mechanical	
Rotation Speed	Maximum 50 rpm continuous [1]
Protection Class	IP 66
Operating Temperature	-20 °C to + 55 °C [2]
Housing	Stainless steel (304)
Length "L"	Varies with number of electrical passes
[1] Higher rotational speeds possible. Please consult factory.	
[2] -20 °C to +40 °C for CSA certified Model 176-X	

Hazardous Area Option: Model 176-X	
CSA Certification	Class 1, Group C, D Zone 1 Group IIB
KEMA Certification	ATEX CE Ex II 2 G Ex d IIB T5 (in accordance with ATEX directive 94 / 9 / EC)
Can be supplied with purge fittings for use with a certified purge system	

Terminations	
Standard	Wire pigtails, 10 ft [3.0 m] in length
Flange & Cable Covers	Various entry threads and orientations available
Special [1]	Supply and installation of connectors, terminals, conduit, cable, glands, junction boxes
[1] Integration of customer supplied product possible	

Additional Options	
Fiber Optics	Fiber Optic Rotary Joint (FORJ) or Optical Converter
Covered Pigtails	Tinned copper braid and heat shrink installed over loose wire pigtails
Fluid Classification	Fluid Rotary Union (FRU)
Design Certification	ABS, DNV, BV, LRS
Submersed Applications	Fluid filling fittings or fluid filled / pressure compensated at factory Internal pressure compensation Model 176TMS Option. Contact factory for details.
Other Devices [1]	RF Rotary Joint, Shaft Encoder, Sensors
Ingress Protection [2]	IP 66
Extended Temperature Range	
[1] Integration of customer supplied product possible	
[2] Contact factory for higher ingress protection	

Model 176 Dimensions



Dimensions in inches [millimeters]

Model 180

Slip ring

Description

Ideal for small systems, the Model 180 is a compact, rugged unit designed for harsh operating conditions. For the hazardous area environment, the 180-X is a fully certified flameproof enclosure. When underwater operational capability is required, the 180 can also be adapted for use as a fluid filled pressure compensated unit. Available in both standard “L” lengths or custom designs.

Features

- Stainless steel enclosure for open deck use
- Sealed housing design tested to IP66 standards
- Can accommodate a variety of wire and cable types
- Hazardous area certification available
- Reliable operation under shock and vibration
- Compact size

Benefits

- Each unit designed, manufactured, and tested in accordance with the highest quality standards
- Maintenance free operation
- More than 20 years of proven field performance
- Integration with fiber optic rotary joints and fluid rotary unions to provide a complete rotating interface solution

Typical Applications

- Remote operated vehicles (ROV)
- Winch and TMS applications
- Industrial machinery
- Seismic surveying

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Electrical	
Voltage	Maximum 1000 VAC
Current	Maximum 7 A per pass [1] Maximum 100 A total current [2]
[1] Higher current ratings possible by wiring passes in parallel	
[2] All current ratings based on a 20 °C ambient temperature	

Electrical Performance	
Contact Resistance	20 mΩ nominal
Flashover Voltage	4000 VAC
Insulation Resistance [1]	Minimum 500 MΩ @ 1 kVDC
Insertion Loss (Nominal) RG179 coax	1.5 dB maximum up to 30 MHz
Crosstalk (Nominal) RG179 coax	-40 dB maximum up to 30 MHz
Bit Error Rate	Digital data transmission is greater than 25 Mbps at BER of 10^{-9}
[1] Value dependent on wire type	

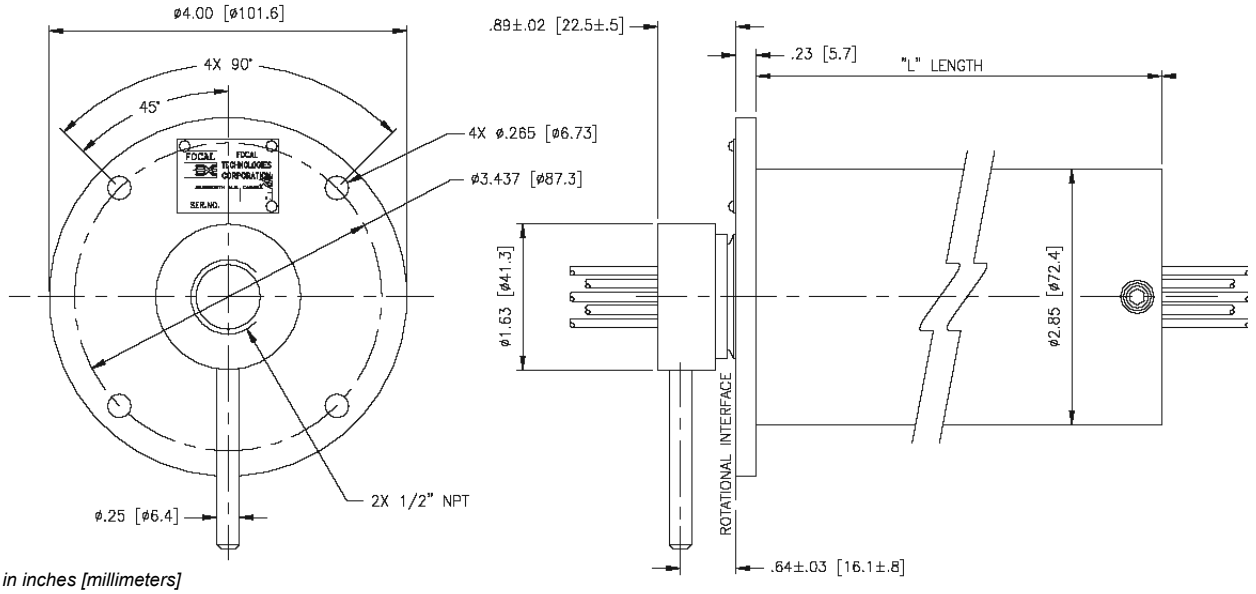
Mechanical	
Rotation Speed	Maximum 100 rpm continuous [1]
Ingress Protection	IP 66
Operating Temperature	-20 °C to + 55 °C [2]
Housing	Stainless steel (304)
Length "L"	Varies with number of electrical passes [3]
[1] Higher rotational speeds possible. Please consult factory.	
[2] -20 °C to +40 °C for CSA certified Model 180-X	
[3] Maximum number of electrical passes is 60	

Hazardous Area Option: Model 180-X	
CSA Certification	Class 1, Group C, D Zone 1 Group IIB
KEMA Certification	ATEX CE Ex II 2 G Ex d IIB T5 (in accordance with ATEX directive 94 / 9 / EC)
Can be certified as associated apparatus (Ex d[ib] IIB T5) on special order	

Terminations	
Standard	Wire pigtails, 4 ft [1.2 m] in length, exiting via ½" or ¾" NPT female port
Special [1]	Supply and installation of connectors, terminals, conduit, cable, glands, junction boxes
[1] Integration of customer supplied product possible	

Additional Options	
Optics [1]	Fiber Optic Rotary Joint (FORJ) or Optical Converter
Fluid	Fluid Rotary Union (FRU)
Design Classification	ABS, DNV, BV, LRS
Submersed Applications	Fluid filling fittings or fluid filled/pressure compensated at factory
Other Devices [2]	RF Rotary Joint, Shaft Encoder, Sensors
Ingress Protection[3]	IP 66
Extended Temperature Range	
[1] Maximum number of electrical passes is reduced to 30	
[2] Integration of customer supplied product possible	
[3] Contact factory for higher ingress protection	

Model 180 Dimensions



Dimensions in inches [millimeters]

250

FPSO swivel

Description

We design, manufacture and deliver unique FPSO swivels to meet the demanding requirements of offshore operators worldwide. Typically comprised of Electrical Slip Rings, Hydraulic Utility Swivels and Fiber Optic Rotary Joints, swivels are used in a variety of Floating Production, Storage and Offloading (FPSO) Systems including buoys, turret moorings and offshore loading towers. Our FPSO swivels permit the continuous delivery of electrical power and signals, hydraulic fluids, and fiber optic signals, with unlimited freedom of the vessel to weathervane about its mooring point. All FPSO swivels are approved by a marine authority and are certified for use in hazardous locations.

Features

- Stainless steel construction standard
- Large hollow bores
- Flameproof or purged / pressurized
- Integral junction boxes available
- Fluids for hydraulic control and chemical injection
- Single and multimode fiber
- Wide variety of cable entry methods

Benefits

- Each unit designed, manufactured, and tested in accordance with the highest quality standards
- Optical, electrical and fluid in one assembly
- Modeled with leading CAD software and files shared with customers
- Fully inspected and tested before shipment
- On-site installation support
- Complete document package provided

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295-X

FPSO swivel

Description

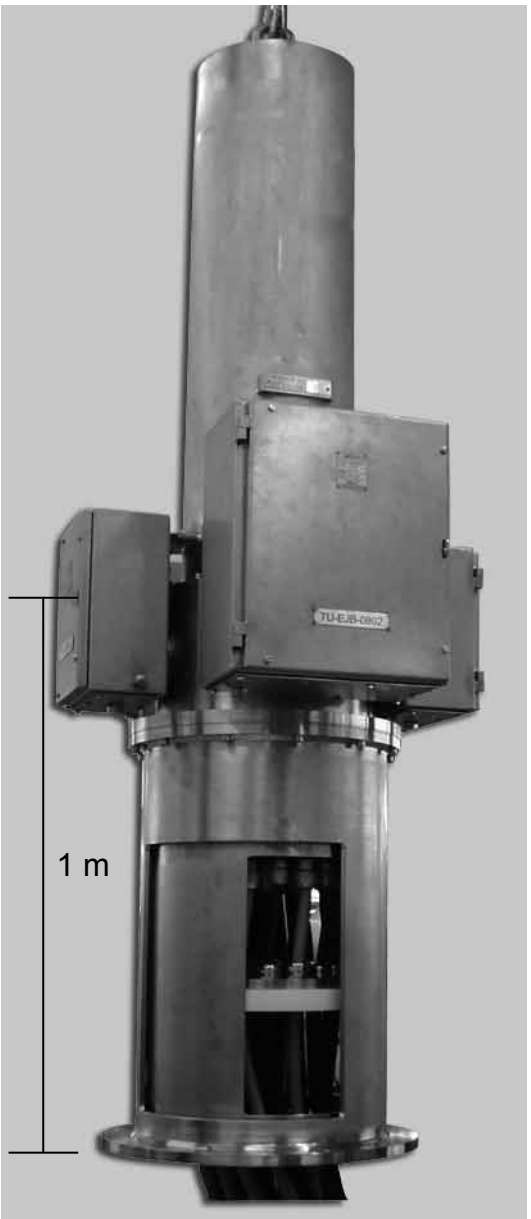
The 295-X is a standardized electrical / optical slip ring designed for the offshore oil industry. This design is type certified for hazardous area environments allowing for shorter design customization and assembly time. Available in sizes ranging to a maximum overall length of approximately 140 inches (3.5 m) and overall diameter of 12 inches (300 mm), this model meets the needs to transfer utility power, electrical and optical signals on a variety of offshore swivel applications.

Features

- 316 stainless steel housing available for corrosion resistance
- Hazardous area certified in accordance with European Community ATEX directive 94 / 9 / EC
- Standardized design can accommodate variety of cable entry methods

Benefits

- Each unit is designed, manufactured, and tested in accordance with the highest quality standards
- Integration with fiber optic rotary joints and fluid rotary unions to provide a complete rotating interface solution
- Design customization to meet both customer and marine authority specifications



Typical Applications

- CALM buoy
- Submerged turret loading vessel
- FPSO swivel stacks

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Electrical	
295-X is rated in accordance with customer requirements	
Voltage	Maximum 5000 VAC
Current	Designed to customer specifications

Electrical Power Performance	
295-X power performance is design in accordance with customer specifications and Certifying Authority requirements	
Flashover Voltage	Typically 4x V_{rated}
Insulation Resistance	This will vary depending on design specifications. Contact factory for further details.
Short Circuit Rating	

Electrical Signal Performance	
Contact Resistance	20 mΩ nominal
Insulation Resistance [1]	Minimum 500 MΩ @ 1 kVDC
Insertion Loss [2] **(Nominal) RG59 coax**	1.5 dB maximum up to 30 MHz
Crosstalk [2] **(Nominal) RG59 coax**	-15 dB maximum up to 30 MHz
[1] Value dependent on wire type. [2] Performance depends on configuration of signal circuits.	

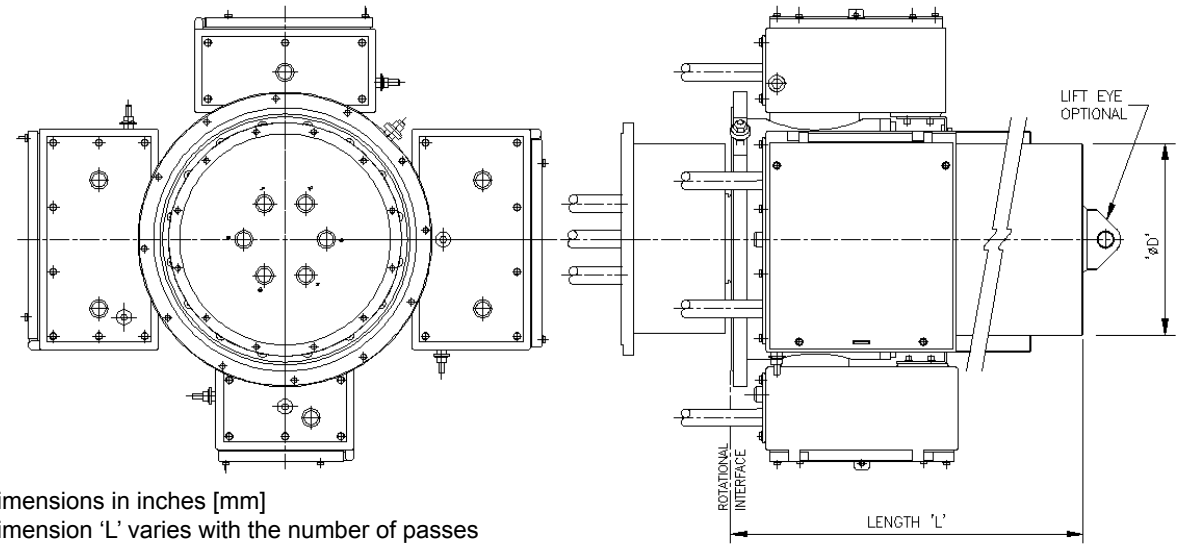
Mechanical	
Rotation Speed	Maximum 50 rpm continuous [1]
Protection Class	IP 66
Operating Temperature	-20 °C to + 55 °C
Housing	Stainless steel (304)
Length "L"	Varies with number of electrical passes
[1] Higher rotational speeds possible. Please consult factory.	

Hazardous Area Option: 295-X	
KEMA Designation for ATEX certified unit.	ATEX CE Ex II 2 G Ex d IIB T5

Terminations	
Standard	Integral armoured cables on the geo stationary side, increased safety junction boxes on the rotating side
Special [1]	Supply and installation of connectors, terminals, conduit, cable, glands, junction boxes
[1] Integration of customer supplied product possible	

Additional Options	
Fiber Optics	Fiber Optic Rotary Joint (FORJ) or Optical Converter
Fluid	Fluid Rotary Union (FRU)
Design Certification	ABS, DNV, BV, LRS
Submersed Applications	Fluid filling fittings or fluid filled / pressure compensated at factory
Other Devices[1]	RF Rotary Joint, Shaft Encoder, Sensors, Heat Trace Cable
Ingress Protection	IP 68
Extended Temperature Range	
[1] Integration of customer supplied product possible	

FO295-X Dimensions



1. Dimensions in inches [mm]
2. Dimension 'L' varies with the number of passes
3. Dimension 'Ø D' maximum 12.75 [323.8]
4. Customer interface and drive arrangement may vary.

Multiplexers and Media Converters

Ruggedized to function in harsh marine environments

Description

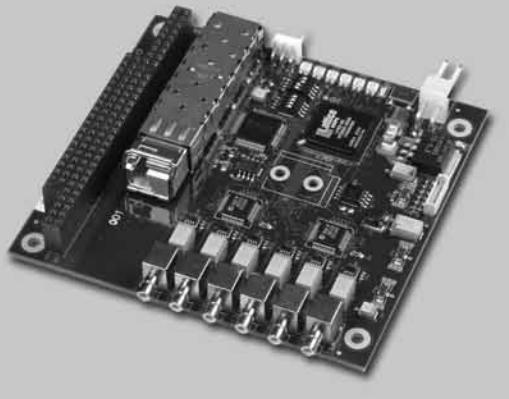
To exploit the full bandwidth of fiber, multiplexing combines many signals of various types — video, serial data, network data, control lines — into one high speed optical signal. Multiplexers that combine a number of electrical signals are typically called time division multiplexers (TDM), as each input signal is assigned a time slot in the outgoing data stream. Moog has a wide range of TDM options that allow multiple electrical channels to be multiplexed onto one or more optical fibers.

Multiplexers that combine a number of optical signals onto one fiber are also available. These multiplexers use wavelength-division multiplexing (WDM) to transmit signals at multiple wavelengths of light on the same optical fiber. Optical splitters and switches may be added to provide redundancy in the fiber links.

Both multiplexing techniques can be used separately or together to simplify optical transmission systems and reduce cost, improve reliability, reduce weight and improve performance. Multiplexed systems also simplify system upgrades since numbers of channels and channel bandwidth is a function of the electronics rather than the transmission line or components. Moog multiplexers accommodate the ever-increasing data rates needed for digital video and industrial data protocols, as well as high speed networks such as Ethernet.

Features

- Support for broadcast quality video in composite (NTSC / PAL), Y / C (S-video), RGB, and YPrPb formats
- Support for digital video formats including SDI and HD-SDI
- Support for many serial data, network, and bus protocols, including TTL, RS-232, RS-485 / 422, Ethernet, CANBus, ARCNET, Profibus, USB, ECL / PECL, and various sonars
- Support for many analog signal formats, including audio, hydrophones, and various sensors
- Modular system for easy reconfiguration with up to 32 video channels and 256 data channels per system
- Low latency data transmission for time-critical control, e.g. force-feedback robotic manipulators
- Embedded diagnostics including LED indicators and PC based diagnostics via serial, Ethernet or Modbus interfaces
- Pressure tolerant electronics and optics available



Typical Applications

Industrial
- Remotely Operated Vehicles (ROVs)
- Pipe Inspection Robots
- Video Security Systems
- Tether Management Systems
- FPSO Communications
  Process Control

Military
- Bomb Disposal Robots
- Tactical Networks
- Defense Systems
- Armored Vehicle Turrets
- Electro-optic Sensors

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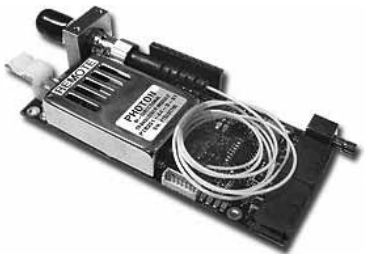
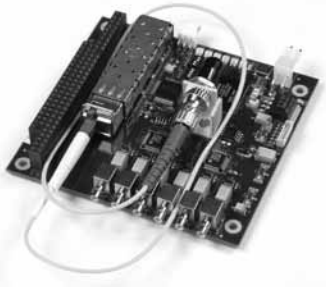



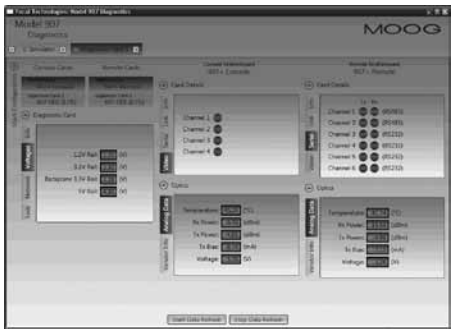
Product Summary

Model Number	Description	Video	Serial Data (RS-232 / 422 / 485)	Ethernet	Diagnostics
Model 903 Family (Rack Mounted 3U Eurocard Form Factor)					
903	Video + Data Multiplexer	8 x NTSC / PAL	64	3 x 10 / 100 M	LED, RS-232, Ethernet*
903-HD	Compact Video + Data Multiplexer	8 x NTSC / PAL	16	-	LED, RS-232, Ethernet*
EIB-10 / 100	3-Port Ethernet Media Converter	-	-	3 x 10 / 100 M	LED
ECL-01	ECL (Sonar) Media Converter	-	1 x ECL, 30-150 Mbps	-	LED
ECL-02	Dual ECL (Sonar) Media Converter	-	2 x ECL, 30-150 Mbps	-	LED
HDSDI-MC	HD-SDI Media Converter	1 x SMPTE 292	-	-	LED
GBES-MC	4-Port Gigabit Ethernet Media Converter	-	-	4 x 10 / 100 / 1000 M	LED
Model 907 Family (PC / 104 Form Factor)					
907-R / C	3-Channel Video + Data Multiplexer	3 x NTSC / PAL	6 - 48**	3 x 10 / 100 M	LED
907+R / C	4-Channel Video + Data Multiplexer	4 x NTSC / PAL	6 - 54**	3 x 10 / 100 M	LED, Ethernet*
907V-R / C	6-Channel Video Multiplexer	6 x NTSC / PAL	0 - 48**	3 x 10 / 100 M	LED, Ethernet*
907-GBE	Gigabit Ethernet Media Converter	-	-	1 x 10 / 100 / 1000 M	LED, Ethernet*
907-GBE2	Dual Gigabit Ethernet Media Converter	-	-	2 x 1000 M	LED, Ethernet*
907-GBES	4-Port Gigabit Media Converter	-	-	4 x 10 / 100 / 1000 M	LED, Ethernet*
907-HDV	HD-SDI Media Converter	1 x SMPTE 292	-	-	LED, Ethernet*
907-ECL	ECL (Sonar) Media Converter	-	1 x ECL, 30-150 Mbps	-	LED, Ethernet*
907-HDM2	HD-SDI + Data Multiplexer	1 x SMPTE 292	4 - 20**	-	LED, Ethernet*
Model 914 Family (Credit Card Sized Form Factor)					
914-R / C	1-Channel Video + Data Multiplexer	1 x NTSC / PAL	4 - 6**	-	LED
914-MCS	2-Port Ethernet Media Converter	-	-	2 x 10 / 100 M	LED
914-GBE	Gigabit Ethernet Media Converter	-	-	1 x 10 / 100 / 1000 M	LED
914-HDV	HD-SDI Media Converter	1 x SMPTE 292	-	-	LED

For full product details please see product data sheets found on the website at: www.moog.com.
*Ethernet diagnostics via FMB-X for 903 and via 907-DIAG-E card for 907.
**Minimum serial channels are included on board; maximum channels require expansion cards.

Multiplexer Diagnostics Software

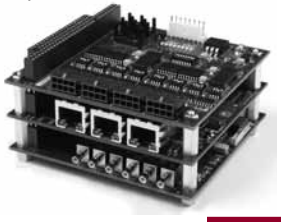
This software is available to monitor multiplexer performance from the console end of a system. Optical power, voltage levels, and system status can be monitored for both uplink and downlink communications over standard Ethernet, Modbus, and Modbus TCP / IP.



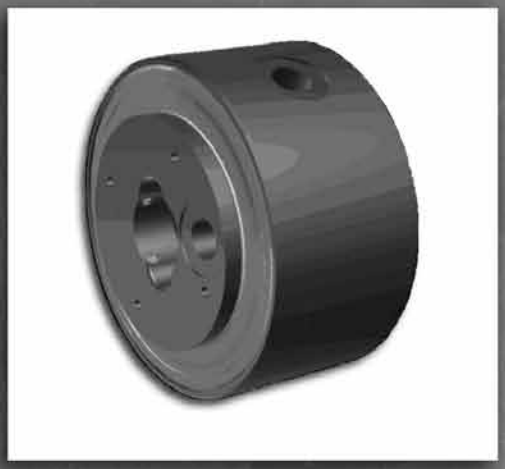
Custom Solutions

Our advanced CAD systems enable rapid development of new interfaces and packages to suit diverse applications. With more than 100 different types of printed circuit boards developed in the last five years, we have established an experienced team of designers with expertise in software, firmware, high-speed digital and analog interfaces, and fiber optics. Existing custom systems support high shock and vibration environments, EMC, and long life requirements of more than 200,000 hours and long data links with up to 200 km of fiber. Moreover, our experience with the detailed design of fiber optic transmitters and receivers provides a level of optimization and performance that is not achievable with commercial devices.

Contact Moog for custom mulitplexer solutions for subsea controls, defense and other specialized rugged applications.



Fluid Rotary Unions (FRU)



Fluid Rotary Unions

Description

Initially to serve in diver life-support unmbilical systems, fluid rotary unions have been diversified to include a broad range of applications.

Our fluid rotary unions are currently used around the world to ensure reliable transmission of life support, process, power and control fluids. Currently, fluid rotary unions rated for pressures up to 15,000 psi (1000 bar) are available. Seals are selected based on chemical compatibility, design pressure, design temperature, required service life and acceptable leakage rate. Leak collection can be supplied when required for environmental or personnel safety. Fluid rotary unions can be combined with our electrical slip rings, motor, resolvers and fiber optic rotary joints.

Features

- Customized mounting and drive configurations
- Customized materials to satisfy weight, chemical compatibility and other requirements
- Customized port configurations
- Hard coating, standard on high pressure fluid rotary unions, can be selected for improved abrasion resistance and extended seal life
- Leakage detection and collection ports (drain to tank)
- Optional hollow bore

Typical Applications

- Marine and life support systems such as saturation diving
- Training centrifuges for pilots and astronauts
- Industrial indexing tablets
- Chemical injection systems
- FPSO hydraulic power and control systems
- Semiconductor clean room robotics

Fluid Rotary Unions (FRU)

Specifications							
Part #	**Hollow Bore**	**Passes Qty Size**	**Pressure**	**Speed (rpm)**	**Sample Applications**	**Mounting Flange**	**Comments**
70	Optional	≤ 11 ≤ 1 inch	≤ 3000 psi ≤ 200 bar	≤ 10	Diving Industrial Scientific	Standard	1, 2, 3, 4, 12, 13
134	N/A	1 ≤ 1 inch	≤ 4000 psi ≤ 275 bar	≤ 5	Seismic	N/A	See Note 1, 2, 3, 5, 12
136	Optional	≤ 5 ≤1/2 inch	≥ 5000 psi ≥ 345 bar	≤ 1000	Scientific Military Cooling Systems	Optional	See Note 1, 2, 3, 6, 12, 13
255	Optional	Multiple 1/4 - 1-1/2 inch	≤ 5000 psi ≤ 345 bar	≤ 50	Industrial Military	Optional	See Note 1, 2, 3, 7, 12, 13
248	Optional	Multiple ≤ 1/4 inch	≤ 1000 psi ≤ 70 bar	≤ 100	Scientific Industrial	Optional	See Note 1, 2, 3, 8, 12, 13
271	Optional	≤ 5 ≤ 3/4 inch	≤ 1000 psi ≤ 70 bar	≤ 25	Industrial Military Scientific	Optional	See Note 1, 2, 3, 9, 12, 13
278	Standard	2 ≤1/2 inch	≤ 150 psi ≤ 10 bar	≤ 150	Military Cooling Systems	Optional	See Note 1, 2, 3, 12, 13
284	Standard	Multiple 1/4 - 2-1/2 inch	≤ 15000 psi ≤ 1000 bar	≤ 5	FPSO and SPM Hydraulic Controls	Standard	See Note 1, 2, 3, 10, 11, 12, 13
290	Standard	≤ 2 ≤ 3 inch	≤ 200 psi ≤ 15 bar	≤ 5	FPSO and SPM Fire Suppression	Standard	See Note 1, 2, 3, 10, 11, 12, 13
301	N/A	1 1/2 inch	≤ 145 psi ≤ 10 bar	≤ 250	Industrial	Standard	1, 2
306	1-1/2 inch	1 1/2 inch	≤ 145 psi ≤ 10 bar	≤ 100	Industrial	Optional	1, 2
307	Standard	2 1/8 inch	≤ 145 psi ≤ 10 bar	≤ 200	Industrial	Optional	1, 2, 3

Dimensional drawings available upon request.

Notes:

1. Values are representative of a typical range only and do not indicate limits.
2. Typical uses listed. Units suitable for other applications.
3. All models are available combined with ESR and FORJ.
4. Available in a number of std configurations. Utilizes a stacked housing design.
5. Generally a COTS pipe swivel combined with an ESR.
6. May require auxiliary cooling.
7. Utilizes a single piece housing design.
8. Basically a smaller version of the FO255.
9. Includes all FRU that are fully integrated with either ESR and FORJ.
10. Leak measurement and collection ports std.
11. FPSO - floating production and off loading. SPM - Single point mooring.
12. Material selection based on application and includes chemical compatibility, design pressure, design temperature, required service life.
13. Hollow bore may be on axis or a parallel axis wire path as required for the application.

Model 70

Description

A fluid rotary union (FRU) functions as a rotary interface for fluid carrying conduit between stationary and rotating equipment. The fluid being conveyed can be liquid, gas, or vacuum. A fluid rotary union is also called a rotary union, fluid swivel, utility swivel, hydraulic swivel, hydraulic utility swivel, or rotary joint. Unlike flexible conduit, a fluid rotary union allows continuous unrestrained rotation of movable joints in machinery.

The Model 70 is a multi pass fluid rotary union with over 30 years service as the diving industry standard fluid joint. It is available as a stand alone FRU or combined with electric slip ring and fiber optic rotary unions. Typically configured with up to 12 passes, inter-port mixing is prevented through the use of double seals and an intermediate vent between passes. It has also proven itself in non diving applications such as centrifuge, indexing tables, and floating oil production swivels where product quality is paramount. The Model 70 is available in several standard port configurations or types as illustrated below.

The Model 70 is available with the standard seal technology or with a new low leakage seal option. In its standard configuration, it is rated for 1000 psi [68 bar] at 10 rpm continuous service and up to 30 rpm intermittent service.

Features

- Configurable with up to 12 ports as standard
- 1/4, 1/2, 5/8 and 1 inch SAE straight thread o-ring ports standard
- Corrosion resistant materials suitable for hot sea water and other harsh chemicals
- Rated to 1000 psi [68 bar] at 10 rpm continuous service
- Maximum speed 30 rpm intermittent
- Polymer bearings eliminate the need for periodic service
- Optional rolling element bearing design available
- Available with hollow bore for ESR / FORJ pigtails

Benefits

- Continuous 360º rotation
- Proven reliability
- Maintenance free service
- Configurable

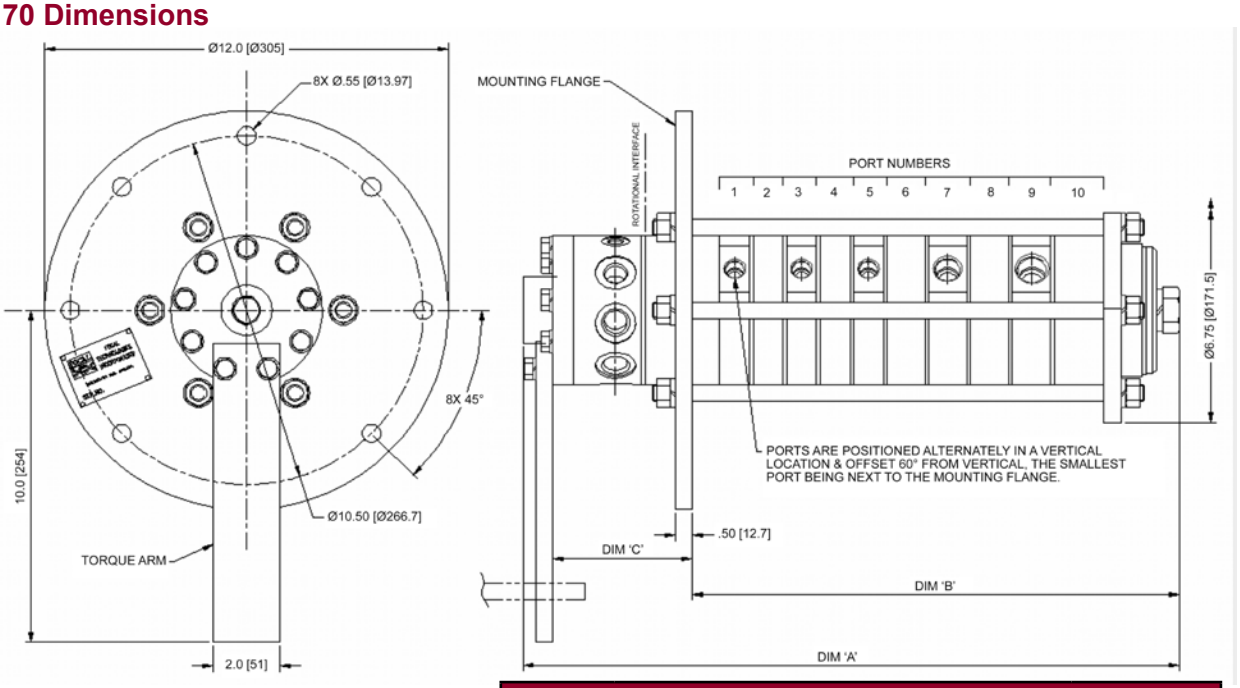
Typical Applications

- Industrial – machining centers, rotary index tables, heavy equipment turrets, cable reels, packaging machines, palletizing machines, labeling machines, remote sensing
- Marine – diving umbilical winches, seismic survey winches, hydraulic control winches
- Scientific – centrifuges
- Military – radar turrets

Model 70 Specifications	
Ambient Temperature Gases Liquids	-40º to 60º C -40º to 100º C 0º to 60º C
Pressure	1000 psi
Rotational Speed	10 rpm continuous 30 rpm intermitent
Torque	Approx. 80 lb-ft [110 N-m]
Shock / Vibration	Mil-Std-167 (ships)
Weight	Dependent on configuration
Environmental	Marine, open deck
Leakage Std. Seal	167 std. mL / min N_2 gas per seal rotating @ 1000 psi max Typically less than 30 std. mL / min N_2 gas per seal rotating @ 1000 psi
Low Leak Seal	2 std. mL / min N_2 gas per seal rotating @ 1000 psi max Typically less than 0.05 std. mL / min N_2 gas per seal rotating @ 1000 psi
Nominal Port Size 1/4 inch 1/2 inch 5/8 inch 1 inch	SAE straight thread O-ring thread size 7/16-20 UNF 3/4-16 UNF 7/8-14 UNF (passage size suitable for 3/4” nominal, 1-1/16-12 UN adapter) 1-5/16-12 UN

Please note that operational life of the unit is dependent upon rotational speed, environment and temperature. Flexible conduit should be used to couple to the rotating component. The torque arm must be loose coupled.

Model 70 Dimensions



Dimensions in inches [millimeters]

Sample Configurations*				
Type	0-1-4-5	0-3-1-6	1-1-4-5	0-5-0-5
Port Size	Number of Ports			
1”	0	0	1	0
5/8”	1	3	1	5
1/2”	4	1	4	0
1/4”	5	6	5	5
DIM ‘A’	19.47 [494]	20.41 [518]	22.03 [559]	21.26 [540]
DIM ‘B’	14.50 [368]	14.88 [378]	16.50 [419]	15.77 [400]
DIM ‘C’	4.14 [105]	4.03 [102]	4.53 [115]	4.15 [105]

**Note: There are other configurations are available, please contact factory for more information.*

Model 301

Description

A fluid rotary union (FRU) functions as a rotary interface for fluid carrying conduit between stationary and rotating equipment. The fluid being conveyed can be liquid, gas, or vacuum. A fluid rotary union is also called a rotary union, fluid swivel, utility swivel, hydraulic swivel, hydraulic utility swivel, or rotary joint. Unlike flexible conduit, a fluid rotary union allows continuous unrestrained rotation of movable joints in machinery.

The Model 301 is a single pass fluid rotary union. It can be operated as a stand alone FRU. Its design has been optimized to allow an AC4598 / AC6200 electric slip ring (ESR) to be mounted directly on the Model 301 body, simplifying the integration and mounting arrangement.

The Model 301 utilizes sealed-for-life rolling element bearings to provide long trouble free service. Filled PTFE based seals run on a hardened surface to provide long service life, minimizing frictional heat generation and operational torque. The BSPP ports and mounting flange allow convenient fixturing against an O-ring sealed shaft or separate threaded conduit.

Features

- 1-1/2 inch body O.D. to mount AC4598 / AC6200
- Optional torque arm (required for L.H. rotation) matches AC4598 / AC6200 torque arm allowing a single anti rotation interface
- 1 pass with 1/2 inch BSPP ports
- Rated to 145 psi [10 bar] at 250 rpm continuous service
- Maximum working pressure 180 psi [12.5 bar]
- Maximum recommended speed 2000 rpm (intermittent or with sufficient medium flow to cool assembly)
- Optional IP65 seal available
- Stainless steel version available as special order

Benefits

- Continuous 360º rotation
- FRU transfers air, oil, other non-corrosive medium
- Provides long maintenance free service
- Convenient mounting of FRU / ESR combination

Typical Applications

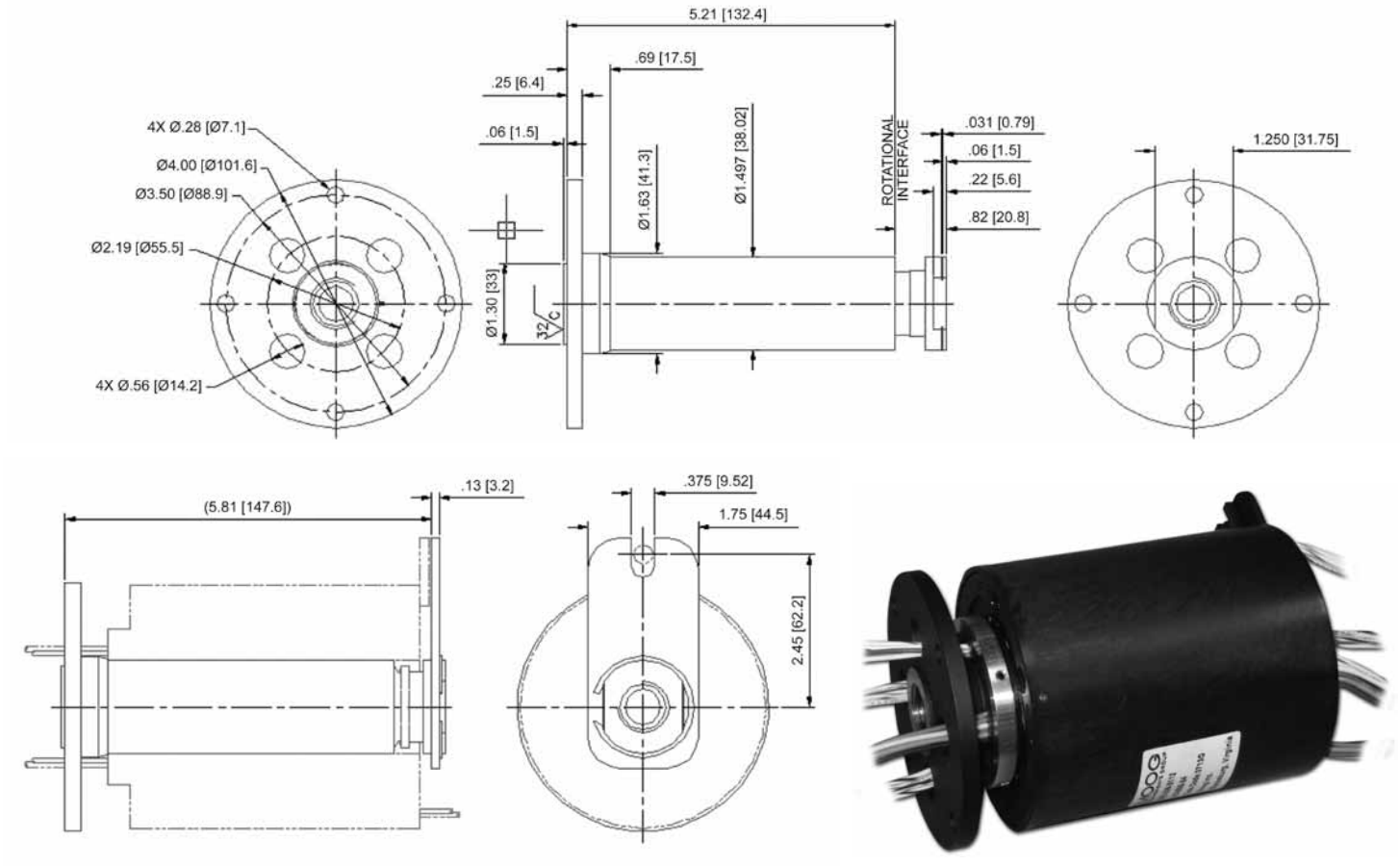
- Industrial – machining centers, rotary index tables, heavy equipment turrets, cable reels, packaging machines, palletizing machines, labeling machines, remote sensing

Fluid Rotary Unions (FRU)

Model 301 Specifications		Options
Operating Temperature	-40º to 60º C with optional ESR -40º to 80º C without ESR installed	• IP65 seal • Stainless steel construction • Torque arm (required for LH rotation)
Passes Quantity Size	1x 1/2” BSPP	
Pressure and Speed	145 psi [10 bar] @ 250 rpm	
Maximum Pressure	180 psi [12.5 bar]	
Maximum Speed	2000 rpm (intermittent or with sufficient cooling from medium)	
Maximum Torque (Estimated)	2.5 lb-in [282 N-mm]	
Environmental	IP65 option (jetted water and dust seal option)	

Please note that operational life of the unit is dependent upon rotational speed, environment and temperature. Flexible conduit should be used on the torque are end to avoid side loading, which can shorten operational life.

Model 301 Dimensions



Dimensions in inches [millimeters]

Shown with optional torque arrest, IP65 seal and AC4598 installed.

Model 306

Description

A fluid rotary union (FRU) functions as a rotary interface for fluid carrying conduit between stationary and rotating equipment. The fluid being conveyed can be liquid, gas, or vacuum. A fluid rotary union is also called a rotary union, fluid swivel, utility swivel, hydraulic swivel, hydraulic utility swivel, or rotary joint. Unlike flexible conduit, a fluid rotary union allows continuous unrestrained rotation of movable joints in machinery.

The Model 306 is a single pass fluid rotary union. It can be operated as a stand alone FRU. Its design has been optimized to allow easy integration with an AC4598 / AC6200 electric slip ring (ESR). The 1-1/2 inch hollow bore and ESR pigtail channels allow concentric shaft mounting or optional flange mounting with an ESR mounted directly to it using the optional adapter.

The Model 306 utilizes sealed-for-life rolling element bearings to provide long trouble free service. Filled PTFE based seals run on a hardened surface to provide long service life, minimizing frictional heat generation and operational torque.

Features

- 1-1/2 inch through bore
- Pigtail channels integral to shaft
- 1 pass with 1/2 inch BSPP ports
- Rated to 145 psi [10 bar] at 100 rpm continuous service.
- Maximum working pressure 4000 psi [275 bar]
- Maximum recommended speed 450 rpm (intermittent or with sufficient medium flow to cool assembly)
- 1/2-13 UNC-2B thread for torque arm
- Optional ESR drive pin matches AC4598 / AC6200 torque arm allowing a single anti rotation interface
- Optional ESR mount for AC4598 / AC6200 leaves reduced bore clear
- Stainless steel version available as special order

Benefits

- Continuous 360º rotation
- FRU transfers air, oil, other non-corrosive medium
- Provides long maintenance free service
- Convenient mounting of FRU / ESR combination

Typical Applications

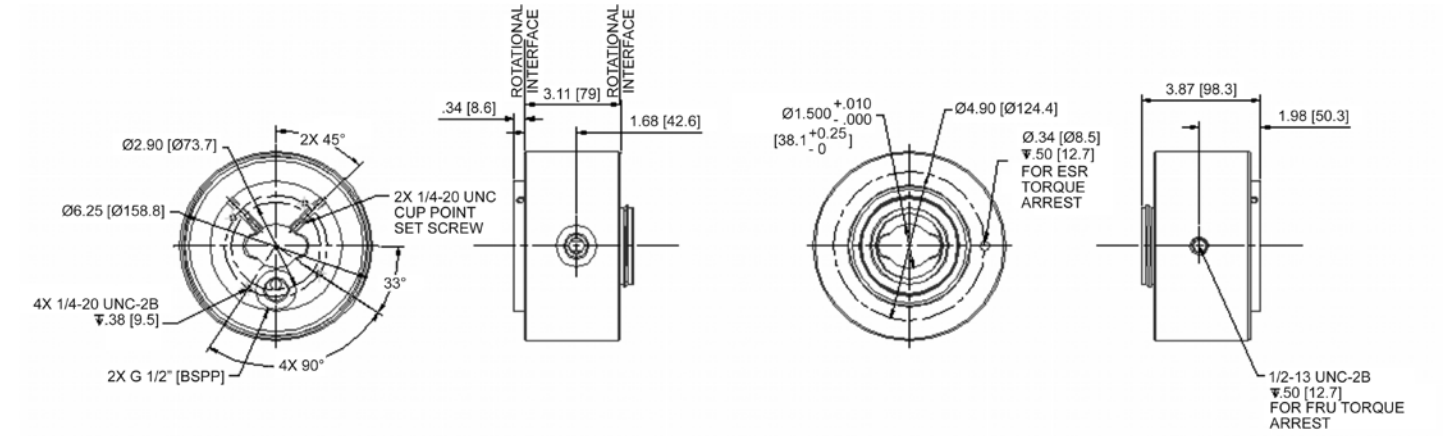
- Industrial machinery – machining centers, rotary index tables, heavy equipment turrets, cable reels, packaging machines, palletizing machines, labeling machines, remote sensing

Fluid Rotary Unions (FRU)

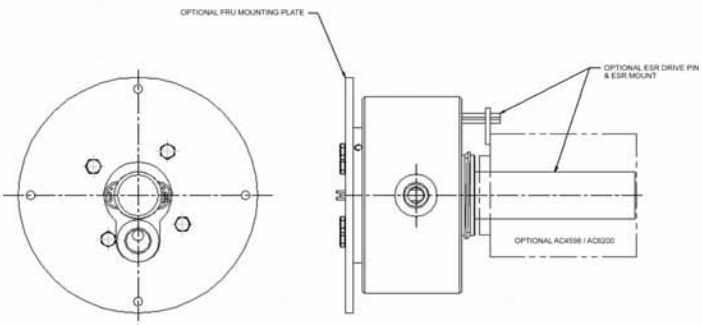
Model 306 Specifications		Options
Operating Temperature	-40º to 100º C	• Stainless steel construction • Torque arm
Passes Quantity Size	1x 1/2” BSPP	
Pressure and Speed	145 psi [10 bar] @ 100 rpm and 60º C	
Maximum Pressure	4000 psi [275 bar]	
Maximum Speed	450 rpm (intermittent or with sufficient cooling from medium)	
Maximum Torque (Estimated)	6 lb-ft [8 N-m]	
Weight	25 lb [11 kg]	
Environmental	IP42	

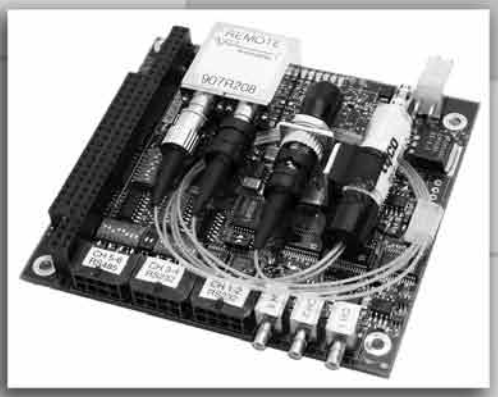
Please note that operational life of the unit is dependent upon rotational speed, environment and temperature. Flexible conduit should be used on the torque are end to avoid side loading, which can shorten operational life.

Model 306 Dimensions



Dimensions in inches [millimeters]





Integrated Mechanisms

Moog Components Group's unique product offering of motion technology (slip rings, motors, resolvers, drives and actuators) and fiber optic products provides the capital assets and engineering capabilities to design, manufacture and integrate these discrete products into an integrated gimbaled mechanism. In today's business environment where many corporate strategies are to focus on core competencies, let Moog Components Group take the design and integration of these discrete components into fully functional and tested subassemblies that are ready for installation into the end-item assembly. Should your strategy be to outsource these assemblies on a build-to-print basis, we are ready to apply our resources so you can achieve those goals too.

Our integrated assemblies range from simple combinations of slip rings and resolvers to sophisticated electro-mechanical assemblies including the motor, drive electronics, fiber optic rotary joints, hydraulic and pneumatic swivels and RF rotary joints. We also offer and provide fully integrated servo and utility actuators complete with precision gearing, clutches, brakes and closed-loop control electronics.

Our business strategy is simple, let Moog Components Group focus on what we do best so our customer can focus on what they do best. This strategy provides our customers with many measurable benefits.

Optimized systems that operate at peak performance

Tolerance stack up can rob magnetic and electromechanical designs of their intended performance capabilities. Maintaining air gap and mechanical tolerances are critical in precision electromechanical mechanisms. Even though the discrete components fall within specified tolerances, tolerance stack up may result in system performance problems. The end result is costly system redesign, component matching or assembly shimming for each item produced.

When a single manufacturer of these magnetic and electromechanical components has this responsibility, these issues can be offset with optimized processing of the discrete components ensuring a final assembly optimized for performance, electrically and mechanically aligned and fully tested.

System design can often be optimized when a single manufacturer can conduct trade-off studies of the various components. Within a given mechanical envelop, space can be optimized, total component count reduced and structures sculpted with an end result of increased MTBF and reduced end-item weight.

Resource Optimization

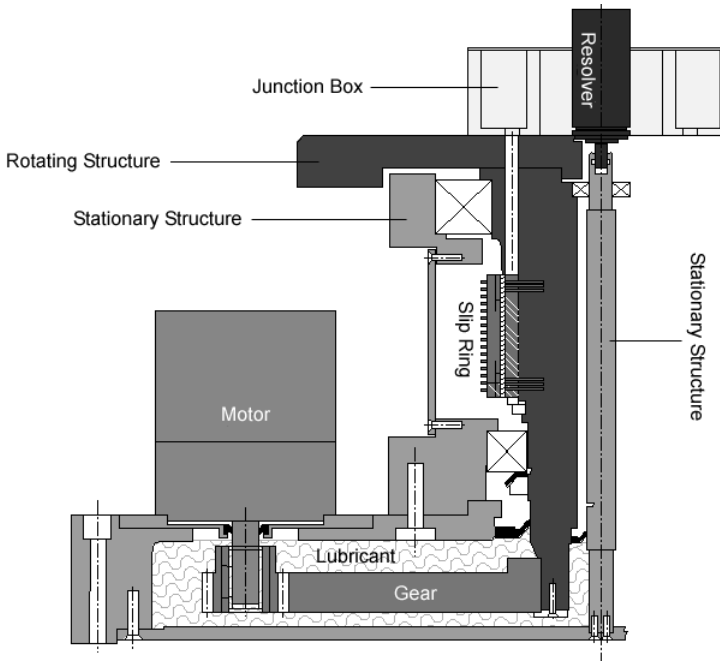
This approach ensures system engineers are focused on the system, not its components. By optimizing and focusing engineering resources, program risks are minimized, schedules maintained and costs reduced. Additionally, overhead costs are reduced by eliminating the manpower of soliciting multiple contractors and resulting contract administration, multiple incoming inspections of discreet components and the resulting expenses of pulling and distributing component kits. Additional program costs are saved by eliminating the need of holding multiple design reviews at different locations, multiple qualification tests and the review and approval of their related documents.

Accountability

You are assured that all system components are integrated properly and a fully tested end-item assembly is delivered. And, in the rare case that a technical problem should occur, you know exactly who to call for immediate help.

Example of Integrated Motion Technology

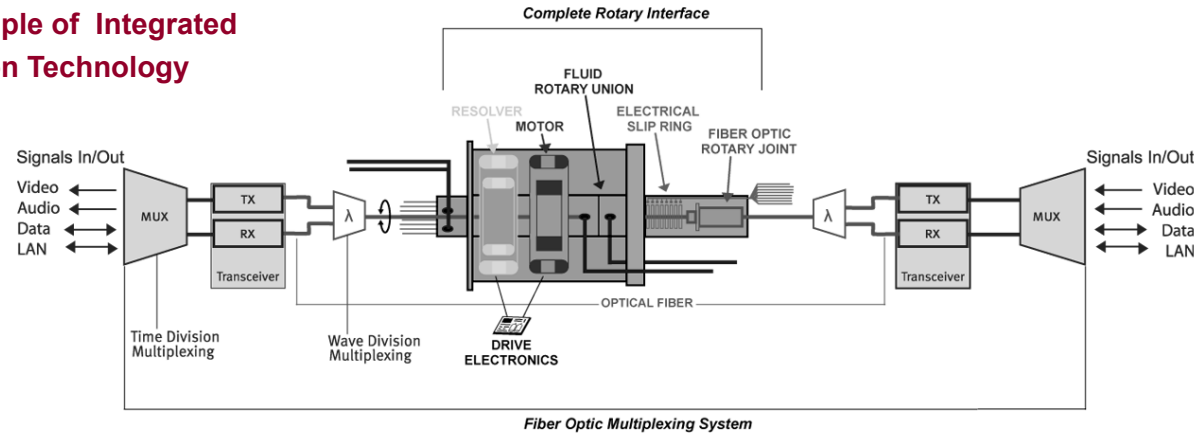
Radar Pedestal



With all marine, military and aerospace programs, a heritage of program success is essential. Moog Components Group has successfully provided integrated mechanisms to many mission critical programs including the following:

Marine Market		
Platform	***Integrated Assembly***	***Status***
Floating Production Storage and Offloading Vessel (FPSO)	Slip ring, FORJ, HUS and OEO converter Cables and junction boxes	Production
Remotely Operated Vehicles	Multiplexer, slip ring and FORJ	Production
Seismic Streamer	Slip ring and FRU Slip ring and FORJ	Production Production
Single Point Mooring System CALM Buoys	Slip ring, FORJ and FRU	Production
Military Market		
Platform	***Integrated Assembly***	***Status***
Helicopter	Slip ring, resolver and RF rotary joint	Production
Helicopter	Twist cap and resolver	EMD
Rotorcraft	Slip ring, resolver and monopole sensor	Production
Armored Vehicle	Slip ring, resolver, R-to-D network, hydraulic and pneumatic swivel, and power distribution	Production
Armored Vehicle	Slip ring, encoder and pneumatic swivel	Production
Radar	Slip ring, motor, resolver, motor control and drive electronics, and 2-channel FORJ	EMD
Radar	Slip ring, digital resolver, motor and bull-gear	EMD
Radar	Servo actuator, motor and drive electronics	Production
Radar	Slip ring, FORJ and FRU	Production
Naval Towed Arrays	Slip ring, FORJ and FRU	Production
Space Market		
Platform	***Integrated Assembly***	***Status***
Solar Array Drive	Slip ring, motor, harmonic drive and potentiometer	Flight
Solar Array Drive	Slip ring, motor and resolver	To-be-flown
Satellite Mechanism	Motor, ball screw and balanced weight	Flight
Industrial Market		
Platform	***Integrated Assembly***	***Status***
Rotary Piston Machining Centre	Mux, slip ring, FORJ and FRU	Prototype
Coal Stacker, Reclaimer	Slip ring, FORJ, FRU and encoder	Production

Example of Integrated Motion Technology



Fiber Optic Multiplexing System

Moog Components Group looks forward to applying our design and manufacturing resources to your program's integrated assembly needs.

Do Slip Rings Fit in the Digital World?

Introduction

As the analog world gives way to the digital in more and more applications, design engineers are faced with replacing traditional analog components with their digital equivalents. Nowhere is this more evident than in the electro-mechanical world. Analog resolvers are being replaced by digital encoders and digital drive circuitry has become commonplace for motor control. When part of the system has to rotate, and a rotary connection for power and digital data is required, what does the designer do? Can the traditional slip ring with its sliding electrical contacts handle the job?

The Problem

Slip rings were originally designed to carry AC and DC power from a rotating platform to a stationary structure, or vice versa. Many applications also required, and still require, the transmission of relatively low bandwidth analog and digital control signals. In this environment, the traditional slip ring performs extremely well. Modern control systems now also require the transmission of high bandwidth analog and digital signals through the slip rings. Typical examples are analog and digital video signals. Until recently, bandwidths measured in the tens of megahertz were generally adequate. Today, and in the future, bandwidths will be required that are orders of magnitudes higher.

Basic Slip Ring Configuration

A basic slip ring, shown schematically in Figure 1, is composed of four elements, or components:

- A ring assembly that provides one or more circuit paths. Each ring is electrically conductive and provides a circuit path over a full 360 degrees of rotation of the ring assembly.
- Brushes provide electrical contact between the rotating (usually the ring) and the stationary parts of the assembly. The brushes ride on the ring, and are mounted in a brush block assembly, usually on the stationary structure.
- Input and output leads that connect the ring and brushes to the outside world.
- Connectors that connect to the slip ring assembly wiring. Connectors are optional, and are often specified by the customer.

Factors Affecting Slip Ring Performance

The following factors will determine the data rate that can be transmitted through a slip ring:

- The frequency response, or insertion loss, of the rings and brushes.
- The impedance, as a function of frequency, of the assembly.
- The differential time delay, as a function of frequency, through the device.
- Crosstalk between circuits.
- Frequency response of the leads and connectors.

The primary factor is frequency response, or bandwidth. Digital data streams will begin to suffer errors from insufficient bandwidth when the digital signal is attenuated, or distorted, to such an extent that the digital receivers cannot properly recognize the received signal. A digital signal is composed of a fundamental frequency at the basic signaling rate, as well as the odd harmonics of the fundamental. The required bandwidth of the slip ring may be several times the data rate.

For example, a 1 MHZ square wave may require a bandwidth of 5 or 7 MHz (5th and 7th harmonics). As the data rate is increased, eventually the harmonics is matched to the external system input and output impedances. Using transmission line theory, the designer will vary ring geometry, spacing, and dielectric material, to obtain the needed impedance. Often a ring and brush impedance of 70 to 150 ohms is obtainable, which should be well suited for many of today's digital systems. As a rule of thumb, a smaller diameter ring will result in a higher data rate. For very high data rates and / or large ring diameters, multiple taps and multiple brushes are often used to minimize signal path lengths.

For optimal performance, high frequency digital signals should be driven differentially, and connected to the slip ring using twisted pair, shielded cable such as CAT5 or CAT5e. This same wiring, including the shield, should be continued through the slip ring. Ideally, the internal slip ring wiring would also be twisted pair shielded cable, however, this may not always be possible due to physical constraints. Connectors, if used, must also be designed, or chosen, to have an impedance and frequency response consistent with system requirements.

Crosstalk between sensitive circuits will also be minimized by proper lead routing and shielding. Sensitive circuits (victims) should be routed within the slip ring as far away from noisy circuits (sources) as possible. Also, all unused circuits should be terminated in the characteristic impedance of the cables used.

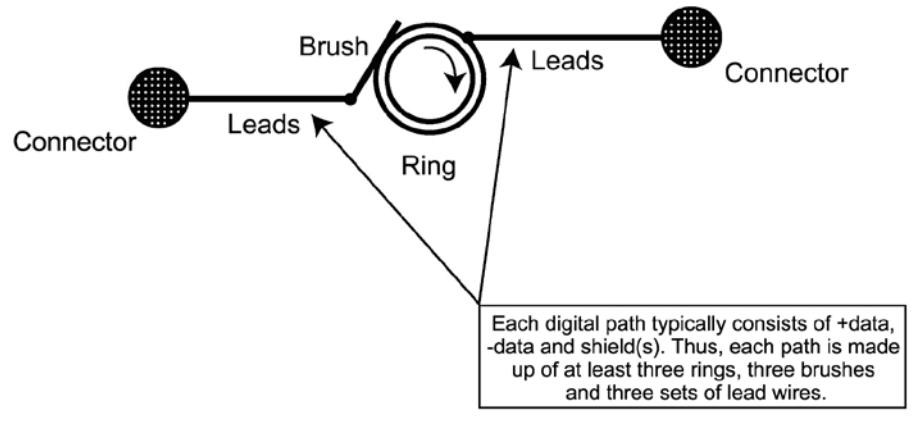
Specifying a High Performance Slip Ring

This article has attempted to make users aware of factors that determine slip ring performance, and of the limitations imposed by the total system in which the slip ring must operate. It is no longer adequate to simply request a device "that will transmit 50 mbs." The best solution is obtained when the entire system is known and understood, and usually requires a compromise between performance, size, weight, number of circuits, external factors, and cost.

The following parameters should be specified to assure satisfactory operation in a specific application:

- Data bus used to transmit data, i.e. Profibus, Ethernet, Firewire
- Cable type used to connect to the slip ring
- Maximum cable length between transmitter and receiver
- Maximum data rate
- Maximum error rate that can be tolerated
- Maximum size, i.e. diameter and length

Figure 1 - Basic Slip Ring



- Number of circuits and their ratings, i.e. voltage, current
- Maximum operating speed of rotation
- Operating environment

Moog Components Group has thousands of slip ring designs, including many standard "off the shelf" designs. Our engineering staff is available to modify an existing design or to provide a completely new design, if required. However, customers are encouraged to evaluate a standard design before requesting modifications that may not be needed.

We have tested many of our standard designs for high data rate performance. Devices with through bores of up to six inches have been tested. Testing has included insertion loss, frequency response, bit error rates, differential time delay, and impedance over frequency. In some cases we have identified, and implemented, design modifications to significantly improve performance. As a general statement, all devices that have been tested will support digital data rates of at least 50 mbs. This verifies that our standard units will operate successfully in a wide variety of standard data systems in use world–wide. These include, but are not limited to: Device Net, CAN Open, Profibus, and Ethernet 10Base T. Additionally, several models tested are suitable for Ethernet 100Base T, and Firewire at 400 mbs.

For the most demanding applications, we have integrated single channel and multiple channel fiber optic rotary joints (FORJs) into our standard slip ring assemblies. The FORJ is used to carry the very high data rate signals, or those circuits requiring very low cross talk or high noise immunity, while conventional slip ring technology is used for transmitting power and other control signals. We can also provide the hardware to perform the electrical- to optical- back to electrical conversion.

Slip Ring Fundamentals

A standard slip ring has four elements, or components:

- A **ring assembly** provides one or more circuit paths. Each ring is electrically conductive and provides a circuit path over a full 360° of rotation of the ring assembly.
- **Brushes** provide electrical contact between the rotating (usually the ring) and the stationary parts of the assembly. The brushes ride on the ring, and are mounted in a brush block assembly, usually on the stationary structure.
- Input and output **leads** connect the ring and brushes to the outside world.
- **Connectors** link to the slip ring assembly wiring. They are optional and often specified by the customer.

Applications

Industrial and Commercial

- Semiconductor equipment
- Industrial machinery
- Robotics
- Medical equipment
- Packaging machines
- Cable reels
- Laboratory equipment
- CCTV camera mounts
- Lighting
- Rotary index tables
- Rate tables
- Medical CT scanners
- Amusement rides
- Flight simulation

Aerospace and Military

- Inertial navigation systems
- Missile weapon systems
- Satellite assemblies
- Unmanned aerial vehicles
- Airborne camera platforms
- Shipboard communication systems
- Radar
- Tanks
- Light armored vehicles
- Helicopters
- Aircraft

Marine

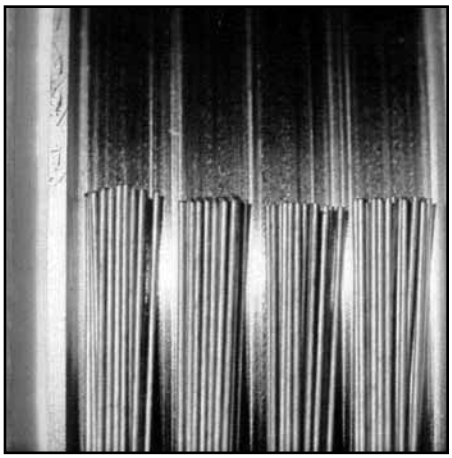
- Remote operated vehicles (ROV)
- Seismic surveying
- Oceanographic winches
- Subsea communications and control
- Floating production, storage and offshore loading (FPSO)
- Diving
- Marine instrumentation
- Downhole / wirelogging and drilling

Moog Components Group fiber brush contact technology was initially developed to solve a critical problem in military / aerospace applications. With many years of successful performance in highly critical slip ring applications, the fiber brush technology is available in commercial products as well.

Fiber Brush Technology For Commercial / Industrial Applications

For many years the traditional design for rotary contact slip rings used either a lubricated monofilament brush or a self-lubricating composite brush. While these traditional approaches have proven to be successful through testing and field experience, improved performance is always desirable. To that end, we developed the fiber brush technology. A chart comparing the advantages of different contact technologies is shown on page 180.

Today's industrial / commercial equipment slip ring requirements are becoming more and more demanding. High operational speeds, long life, no maintenance, and data transfer capability, are the general expectations in slip ring performance. Taking advantage of the developments done in our Advanced Materials Research and Development Department, we have transferred the fiber brush technology to cost effective commercially available products to address today's critical applications.
Military / aerospace applications require slip



rings that provide minimal debris generation, low electrical noise, both high and low current transmission capabilities, low outgassing and a long operational life. They must also operate flawlessly in a wide operating temperature range, and at a variety of brush ring surface speeds, as well as in air or vacuum conditions.

Fiber Brush Contact Technology

Fiber brush is the term for a particular design of sliding electrical contacts. Fiber brushes are simply a group of individual metal fibers (wires) that are collimated by and terminated

into a metal tube as illustrated in the photo on the left. In this cantilevered design, the free, unterminated end of the fiber brush bundle rides in a groove on the ring surface.

Many Advantages

Fiber brushes have many distinct and measurable advantages over conventional slip ring contacts in military / aerospace applications:

- Multiple points of ring contact per brush bundle
- Ability to perform in ambient conditions as well as in vacuum conditions
- Contact surfaces that do not require lubrication
- Long life
- Low contact force per fiber
- Low contact wear rates
- High power circuit density
- Low dynamic contact resistance (noise)
- High and low current carrying abilities
- Low outgassing
- Very little debris generation
- Wide operating temperature range
- Wide range of brush / ring surface speeds

Proven Performance

As an alternative to traditional sliding contact designs, Moog Components Group fiber brush was developed to meet the increasing demands of slip ring performance. The technology has been used in many demanding applications such as:

- CT Scan systems
- High speed testing
- Robotic welding systems
- High-speed, in-line inspection systems
- Radar platforms

A Growing History

Moog Components Group started in 1953 as a supplier of high reliability slip rings to the military and aerospace community. Over the years we have developed a reputation as a quality and precision supplier for space, weapons, aircraft and other mission critical program requirements. It is this stringent quality and technology that has now carried over to our commercial products group. We have adapted technology designed and produced for defense applications for use in our growing line of standard commercial products.

All of our experience and expertise helps our customers in a very real measurable fashion. We make a point to fully understand our customers' applications and by teaming with our customers we are able to efficiently coordinate their needs with our engineering and production departments. We have for years had a Commercial Slip Ring Team that provides focus allowing us to slash lead times and develop special designs fast and accurately.

Technology Comparison

Generally, aerospace slip rings and brushes (sliding electrical contacts) are designed using traditional contact technologies such as lubricated monofilament wire brushes or self-lubricated composite brushes. These approaches have been proven successful many times through testing and actual flight experience. There are, however, some disadvantages to these approaches.

Composite Brushes

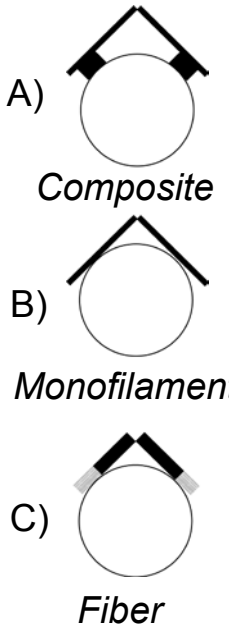
Unlike monofilament brushes, composite brushes provide their own lubrication through the addition of an embedded solid lubricant to the composition of the brush. The nature of this lubrication mechanism requires that the brush must experience wear to transfer the lubricant from the brush to the ring. This wear results in some amount of electrically conductive debris being generated within the slip ring. While small amounts of this debris can generally be tolerated if proper design procedures are followed, the extended life requirements of new aerospace slip rings could result in the generation of intolerable amounts of this conductive debris.

Also, the contact materials used in composite brush slip ring designs can be contaminated by absorption of airborne gasses. The principal form of this contamination is silver sulfide, which appears as tarnish. When exposed to temperatures of less than 178°C, these films have semiconducting properties (increase in electrical conductivity with increased temperature). The presence of silver sulfide films at low temperatures may cause unacceptably high contact resistance on low current circuits. Below is a chart that summarizes the characteristics of the different types of contact technologies.

Monofilament Brushes

Aerospace rated monofilament brushes depend on intentional lubrication of the contact surfaces to perform properly. Many of the liquid lubricants used will not meet NASA outgassing requirements, and the ones that do typically have poor viscosity characteristics at low temperatures. Designs using this contact technology must be analyzed to ensure that sufficient lubrication is maintained throughout the system life requirements.

Types Of Brushes



Materials Choices

One of the most important features of any military or aerospace design is the choice of component materials. Materials must be carefully chosen to reduce outgassing, control dissimilar thermal expansions, reduce galvanic corrosion, and provide nuclear hardening, among other concerns. Materials choices for fiber brush slip rings are much the same as used in traditional slip ring designs with the major exception of the contacts. Fiber brush contacts (fiber and ring surfaces) can be manufactured using alloys of copper, gold, silver and palladium. The actual choice of contact materials depends largely on the electrical requirements of the slip ring. Moog Components Group controls all materials and materials suppliers to verify and ensure consistent quality.

Commercial Fiber Brush Products

Our commercial fiber brush products include a variety of products with power capabilities up to 100 amps and down to low level data transfer, all within the same housed design. Our product family includes:

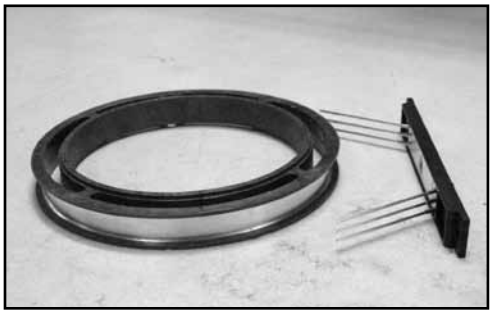
- AC6349, 1 inch bore
- AC4598, 1.5 inch bore
- AC6200, 1.5 inch bore
- AC6275, 2.75 inch bore
- AC6098, 4 inch bore
- EC3848, high speed

These products are highly configurable to meet your requirements with readily available products.

Fiber Brush Slip Ring Technology

Commercial Separate Products

These products are highly configurable to meet your requirements with readily available products.



In addition to these enclosed slip ring capsules we also provide fiber brush separates. When a "self-contained" capsule is not practical due to system size or cost constraints, fiber brush separates are an excellent alternative. These separates are available in the following configurations:

Bore Size	Current
1.8"	2 amps
2.8"	5 amps
	10 amps
	30 amps
	50 amps
4.0"	10 amps
	30 amps
	50 amps

Properly mounted and aligned, fiber brush separates provide the same exceptional performance characteristics of our self-contained capsule designs.

Our Staff

Our staff includes electrical, mechanical, manufacturing and software engineers, metallurgists, chemists, physicists and materials scientists. Our emphasis on research and product development has provided us with the expertise to solve real-life manufacturing problems. Using state-of-the-art tools in our complete analytical facility, our capabilities include a full range of environmental test, calibration and inspection services. We have recognized expertise in tribology (the science of friction and wear), precision gearing, magnetic circuit design, PWM amplifier design and in the supporting materials sciences.

Our engineers can work from your designs, or create a custom design for you.

Consistent Quality

Moog Components Group places a continuing emphasis on quality manufacturing and product development to ensure that our products meet our customer's requirements as well as our stringent quality goals. We have committed to the Total Quality Management Program with a policy of "Do It Right the First Time" and a goal of "Zero Defects". We are ISO 9001 Certified to ensure the consistent quality and reliable performance of our products.

The newest initiative of our division is Demand Flow® Technology (DFT). DFT is a demand driven manufacturing flow system that economically manages in-process inventory. The concept operates with a "line-of-sight" premise which provides visibility for all in-process work. This concept has helped the division be more efficient and flexible to customer schedule changes, reduced inventories and improved organizational operations. Benefits include streamlined processes to accommodate jobs with a quick turn-around, reduced cycle time to cut costs, and greater customer responsiveness.

(1)Roberts E.W., Sliding Electrical Contracts in Space: Observations on Existing Technology and New Trends in Low-Speed Applications, European Space Tribology Laboratory.

Demand Flow® is a registered trademark of the J_c-I-T Institute of Technology, Inc.

Comparison of sliding electrical contacts for space applications.

Composite Brushes Ag / MoS_2 / Graphite	**Monofilament Brushes** Lubricated	**Fiber Brushes** Unlubricated
Most flight history	Considerable flight history	Growing flight history
Meets outgassing requirements	Does not meet outgassing requirements	Meets outgassing requirements
Self lubricating contacts (solid lubricant in brushes)	Requires liquid lubricant on contact surface	No oil or dry film lubricant application required
Requires largest ring-to-ring axial pitch	Requires smallest axial pitch (50% of composite brush pitch)	Requires less axial pitch than composites (70% of composite brush pitch)
Manufacture subject to greatest number of process variables	Manufacture subject to few process variables	Manufacture subject to few process variables
Greatest amount of wear debris generation (approximately 100 times the wear rate of fiber or monofilament brushes)	Much smaller amount of wear debris generation than composite brushes	Smaller amount of wear debris generation than composite and monofilament brushes
High electrical noise if operated in humid environment	Low electrical noise in air and vacuum	Low electrical noise in air and vacuum
Must operate in vacuum or dry inert atmosphere	Operational in air or vacuum with lubricant present	Operational in air or vacuum
Wide operating temperature range	Viscosity limited operating temperature range	Wide operating temperature range
Wide range of surface speeds	Limited range of surface speeds	Wide range of surface speeds

Notes

Product Summary

Motion Technology

Slip Rings

Moog Components Group is the world leader in slip ring design and manufacturing -- offering thousands of models. Slip rings are used in systems that require continuous rotation while transmitting power and data from a stationary unit to a rotating device.

Fiber Optic Rotary Joints

Moog Components Group's fiber optic rotary joints 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.

Motors

Moog Components Group provides a complete line of brush and brushless DC motors. These high performance motors are developed for a wide variety of applications, including medical, automation, industrial, aerospace and defense.

Resolvers

Moog Components Group's line of brushless resolvers are economical and highly accurate motion feedback sensors that are used to provide position and velocity information for closed-loop control, as well as brushless DC motor commutation.

Actuators

Moog Components Group offers high technology and utility electromechanical rotary and linear actuators for aerospace and industrial applications. These actuators utilize brush and brushless DC motors, planetary gears, modulated smart servo amplifiers, PWM amplifiers, multi-speed resolvers and potentiometers.

Fluid Rotary Unions

Moog Components Group's expanded line of fluid rotary unions offer reliable transmission of life support, process, power and control fluids. Fluid rotary unions can be combined with slip rings, fiber optic rotary joints, motors and resolver.

Air Moving

Moog Components Group now offers tailored airflow products that are designed using off-the-shelf components to provide cost effective solutions. With Moog's expertise in thermal management and innovative motor technology, there are new ways to solve difficult thermal, airflow, acoustic and efficiency problems.

Fiber Optics

Moog Components Group expands and enhances its motion capabilities with expertise in fiber optic design. From MEMS-based fiber optic switches to large rotary joints and multiplexers to fiber optic modems, we offer an array of solutions for today's demanding applications.

Custom Solutions

Moog Components Group does not stop with just standard models. Over the years, we have learned that many projects require a product that has unique specifications - either designed from scratch or modified from another design. One of Moog Components Group's strong points is providing exactly the right custom solution.

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