

## Poly-Twist™ Twist Capsules

*Limited Rotation Interconnecting Device –  
A Highly Reliable Slip Ring Substitute for Limited  
Rotation Applications*

*Number of circuits limited only to space  
availability*

### Description

Moog Components Group is a leading designer and manufacturer of slip rings, devices that can be used in any electromechanical system that requires unrestrained rotation while transferring power and / or data. However, some applications require only limited rotation.

To fill the need for limited rotation applications, we introduced Poly-Twist™ Twist Capsules, a reliable slip ring substitute that provides up to 1-1/2 turns of rotational freedom. For over 50 years, we've designed and manufactured thousands of units - from miniature to very large assemblies - for a variety of applications.

### Features

- Eliminates sliding contacts and associated electrical noise
- Bearingless units available
- No shearing, pulling, sliding or abrading occurs during operation - flexible tapes provide connections between oscillating and stationary circuits
- Provides rotational freedom - up to 1-1/2 turns in each direction from center line
- Low and consistent torque
- Long performance - life often measured in the millions of cycles
- Low outgassing
- High reliability for space/vacuum applications
- Can save weight and increase reliability by replacing flexible cables and harnesses that wear and break
- High frequency and power circuits available
- Multiple methods available for termination of electrical interfaces
- Mechanical stops for over-travel protection
- Existing designs can be modified to meet custom requirements

### Integration Capabilities

- Coax cable
- Resolvers
- Fiber optic channels
- RF joints
- Motors
- Hydraulic / pneumatic (fluid) joints
- Servo actuators

- Export of the items in this brochure is regulated by the U.S. Department of State. Buyer shall comply with these regulations.

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### Typical Applications

- Forward-Looking-Infra-Red Systems (FLIRs) elevation and azimuth gimbals
- Inertial navigation systems for air, land, and sea
- Spacecraft instrumentation and solar arrays
- Missile counter measures
- Missile guidance systems
- Shipboard communication systems
- Terrain-following radar
- Satellite experiments

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## GENERAL CONSIDERATIONS FOR POLY-TWIST™ CAPSULES

### How They Work

Poly-Twists resemble slip ring assemblies in size and appearance and provide multiple turns of rotational freedom. They utilize a flexible circuit tape for those applications where continuous rotation is not required.

Poly-Twists 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 suspended on ball bearings. One end of each tape 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.

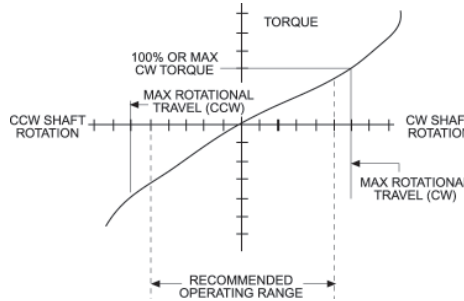
Electrical noise is eliminated because there are no sliding contacts - flexible tapes provide the connection between the rotating and stationary circuits. The tapes provide constant circuit resistance which is not degraded by wear, shock or vibration during the life of the Poly-Twist - often measured in millions of cycles. Many existing designs are available or we can custom design a Poly-Twist to meet your specific requirement.

### Torque

The key to low torque and long life in Poly-Twist capsules is the flexing element. No shearing, pulling, sliding or abrading occurs during oscillation of the unit. Consequently, the endurance limit is well beyond what can be achieved with flexible cabling and wire bundles.

Torque is reduced. Size is minimal. Handling and mounting are simplified. Flexible cables or harnesses presently being used can be replaced, eliminating fatigue wear.

The characteristically low shaft torque varies with the number, size and configuration of the flexible circuit tapes. The typical torque vs. travel curve is approximately linear over the operating range of the Poly-Twist as indicated in the diagram below. The maximum torque occurs at maximum angular excursion. Poly-Twist designs using symmetrical circuit tapes will have similar torque values in each direction.



### Mounting

A brief view of the drawings that follow will illustrate some of the typical Poly-Twist mounting provisions available in standard units. Poly-Twist units should be installed with one member floating and one member hard mounted, similar to the mounting of miniature slip ring capsules. The floating member may be driven by a drive key, pin, or by the leads. This method of mounting prevents overloading of the capsule bearings due to improper shaft alignment.

Poly-Twist devices may be supplied without bearings if the customer desires to mount the Poly-Twist directly to an existing shaft or rotating assembly. The Poly-Twist may also be designed with a center line through-bore to meet special application requirements.

Our engineers will be pleased to discuss Poly-Twist designs to meet your specifications.

CONVERSION TABLE		
FROM	TO	MULTIPLY BY
<b>Length</b>		
inches	cm	2.540
feet	cm	30.48
cm	inches	.3937
cm	feet	3.281x10 <sup>-2</sup>
<b>Mass</b>		
oz	g	28.35
lb	g	453.6
g	oz	3.527x10 <sup>-2</sup>
lb	oz	16.0
g	lb	2.205x10 <sup>-3</sup>
oz/lb		6.250x10 <sup>-2</sup>
<b>Torque</b>		
oz-in	g-cm	72.01
lb-ft	g-cm	1.383x10 <sup>4</sup>
g-cm	oz-in	1.389x10 <sup>-2</sup>
lb-ft	oz-in	192.0
g-cm	lb-ft	7.233x10 <sup>-5</sup>
oz-in	lb-ft	5.208x10 <sup>-3</sup>
<b>Rotation</b>		
rpm	degrees/sec	6.0
rad/sec	degrees/sec	57.30
degrees/sec	rpm	.1667
rad/sec	rpm	9.549
degrees/sec	rad/sec	1.745x10 <sup>-2</sup>
rpm	rad/sec	.1047
<b>Moment Of Inertia</b>		
oz-in <sup>2</sup>	g-cm <sup>2</sup>	182.9
lb-ft <sup>2</sup>	g-cm <sup>2</sup>	4.214x10 <sup>5</sup>
g-cm <sup>2</sup>	oz-in <sup>2</sup>	5.467x10 <sup>-3</sup>
lb-ft <sup>2</sup>	oz-in <sup>2</sup>	2.304x10 <sup>3</sup>
g-cm <sup>2</sup>	lb-ft <sup>2</sup>	2.373x10 <sup>-6</sup>
oz-in <sup>2</sup>	lb-ft <sup>2</sup>	4.340x10 <sup>-4</sup>
oz-in-sec <sup>2</sup>	g-cm <sup>2</sup>	7.062x10 <sup>4</sup>

### A Life Test Summary of Typical Poly-Twist™ Capsules

Part Number	Serial Number	Number of Circuits	Degrees of Travel	Cycle Rate	Cycles without Failure
BB4271	58	34	±180° (360° Total)	60 per min	16,761,600*
DT4096	1-T	20	±40° (80° Total)	4 per min	10,500,000*
DT4097	1-T	20	±40° (80° Total)	4 per min	19,500,000*

\*Exceeded life requirements test terminated.

**Note:** The actual results may vary, depending upon the specific application.

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## TECHNOLOGY COMPARISONS AND TYPICAL SPECIFICATIONS

### A Comparison: Cable Wrap vs. Poly-Twist™ Twist Capsule vs. Slip Ring

**Note:** A rating of 1 is most desirable.

Property	Cable Wrap	Poly-Twist™ Twist Capsule	Slip Ring	Comments
Life Expectancy	3	1	2	
Signal Quality Over Life	2 or 1	2 or 1	3	
Torque	3	1	2	
Linearity of Torque	3	1	2	
Stability	3	1	2	Unpredictable, cables flop around
Cost:				
Large Diameter (D / L > 1); 125 ckts	1	2	3	
Small Diameter (D / L < 1); 125 ckts	1	3	2	
Circuit Density:				
(D / L > 1)	3	1	2	
(D / L < 1)	3	1	1	Slip ring and twist capsule about equal
Voltage Drop	2 or 1	3	1 or 2	Depends on cable wrap service loop length required to accommodate travel
Crosstalk	1	3	2	*If space sufficient, coax can be used internal to twist capsule
Controlled Impedance	1	3	2	*If space sufficient, coax can be used internal to twist capsule
Insulation Resistance:				
Dry	1	3	2	
Humid	1	2	3	Slip ring most affected by humidity
Total Rotational Travel	3	2	1	Cable wraps have very poor bend radius

### Specifications for typical Poly-Twist designs

This information lists some of our typical designs with various ranges in the number of circuits. These parts are only a few of our designs.

So that we can better serve you, please call us and talk to one of our design engineers about your application. Perhaps one of our other standard designs, not shown in this application guide, would fit your application better, or we can design one to meet your specific requirements\*.

\*Tooling and engineering charges may apply.

Technical drawing showing front, side, and top views of a Poly-Twist Twist Capsule. Dimensions are provided in inches (with millimeters in parentheses). Key dimensions include: 2X .656 (16.7), R .530 MAX (13.5), .187 MAX (4.75), .115±.010 (2.92), .0315±.002 (8.00), .0415 (10.6), 2X ø.112±.003 (2.85), .590±.010 (15.0), ø1.560±.010 (39.7), .750 MAX (19.1), .030 MAX (.762), .520 (13.2) MAX, .400 (10.2) MAX, .110±.010, .085±.005, .060 MIN, .885 MAX, .308 MIN (7.82), ø.365±.010 (9.27), .965±.005 (24.5), 250 (6.35), 1.69±.05 (42.3), 2X ø.096 (2.44).

**Part Number *KK4284 (20)***

- NUMBER OF CIRCUITS: 20
- ROTATION: ±45°
- CAPSULE CURRENT RATING: 6 AMPS MAX ALL CIRCUITS COMBINED

# CKTS	AMPS PER CKT
20	0.3

- LEAD SIZE: #30 AWG
- SPECIAL FEATURES: Rotor connector wired with PC tape.

Dimensions are in inches (millimeters)