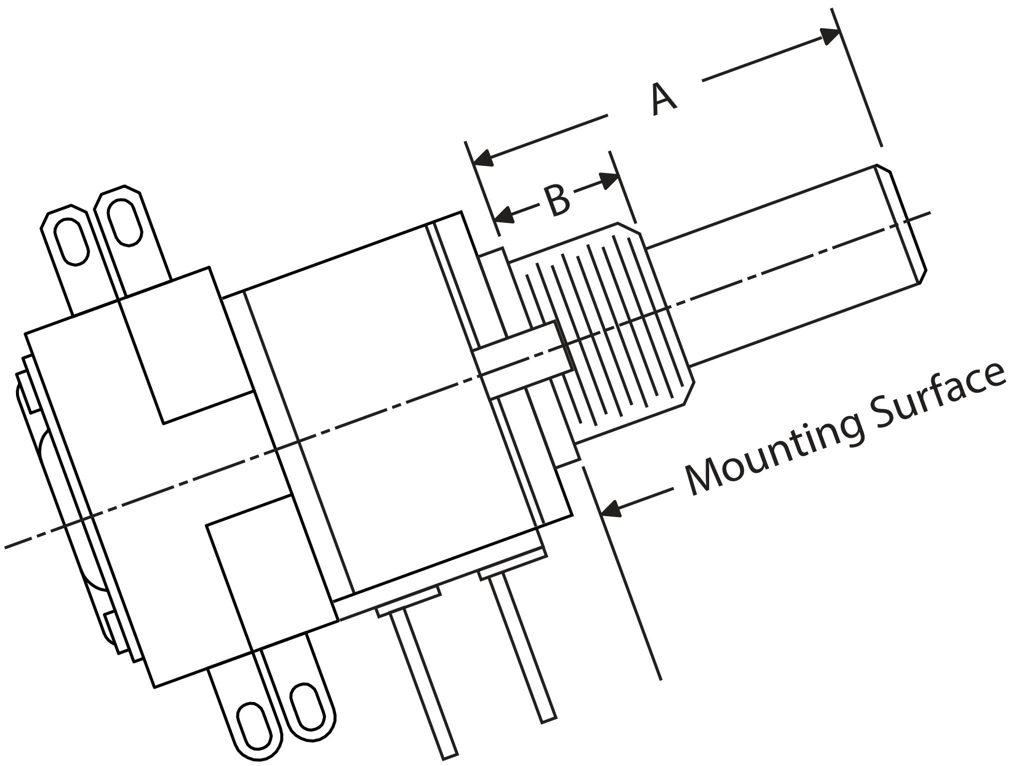
Series S159 MOD-POT^2™ Potentiometers
Custom Potentiometer Designer Guide



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Phone 973-887-2550 • Toll Free 1-800-631-8083 • Fax 973-887-1940

Internet http://www.potentiometers.com

WHY WAIT?

Mod Pot^2 ™ potentiometers are the only "form fit and functional" replacement for the original Mod Pot® and can be configured to match virtually all previous Mod Pot® designs.

Now almost any special combination potentiometer you specify can be prototyped, manufactured and shipped soon after your design is finalized.

Since Mod Pot^2 ™ potentiometers are modular in construction, we can produce prototype quantities of 1/2 inch square (S8X series) or 5/8 inch square (S159 series), conductive plastic or cermet potentiometers, for you in just a few hours . . . . and even production quantities in a matter of days with our VIP (Very Important Potentiometer) service!

Over one billion combinations of single, dual, triple, quad arrangements and rotary switches and hundreds of shaft terminal variations can be produced. The Mod Pot^2 ™ potentiometer family also offers the only true 10-turn Module potentiometer up to 2-sections, including concentric shafts!

If you need a potentiometer and you need it fast, call or email our product manager or fax us your requirements using the Custom Potentiometer Order Forms included in this catalog.

STATE ELECTRONICS

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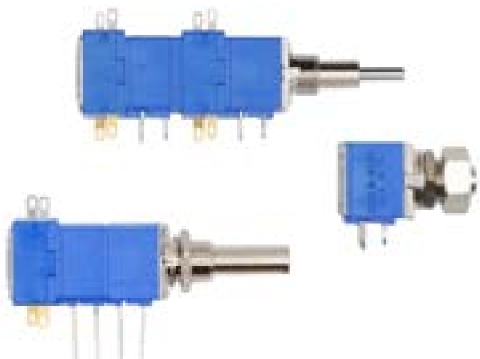
Series S159 Potentiometer

5/8" [15,88mm] Square



Description:

The Series S159 modules are 5/8" square [15,88mm], with metal shaft and bushing.

Combine up to 4 modules, including a rotary switch option.

For more information about this product, visit our website at: **www.potentiometers.com**

Features:

- ***Stackable*** - up to 6 modules
- ***Conductive Plastic or Cermet Resistance Element***
- ***Linear, CW or CCW audio Taper, S-Taper***
- ***Metal Shaft and Bushing***
- ***PCB or Solder Lug Terminals***
- ***Rotary Switch modules***
- ***IP40 Rating***
- ***RoHS Compliant***

Electrical Specifications

Resistance Range - Conductive Plastic
Audio & Linear Taper: 1K ohms to 1 megohm

Resistance Range - Cermet
Linear Taper: 100 ohms to 1 megohm
Audio Taper: 1K ohms to 1 megohm

Total Resistance Tolerance
±10% Standard (±5% Optional)

Independent Linearity: ±5%

Absolute Minimum Resistance: 2 ohms maximum

Effective Electrical Angle - Conductive Plastic
Linear Taper: 240° ±5°; Audio Taper: 225° ±5°

Effective Electrical Angle - Cermet
Linear Taper: 240° ±6°; Audio Taper: 225° ±6°

Contact Resistance Variation
Conductive Plastic: ±1%
Cermet: ±1% or 3 ohms (whichever is greater)

Dielectric Withstanding Voltage (MIL-STD-202 - Method 301)
Sea Level: 1,500 VAC minimum
70,000 feet: 500 VAC minimum

Insulation Resistance: 1,000 megohms minimum

Power Rating at 70°C (Derate to 0 at 125°C)
(Voltage limited by power dissipation or 350 VAC, whichever is less)

Single Section:
Conductive Plastic - Linear Taper: 1 watt
Conductive Plastic - Non-linear Taper: 0.5 watt
Cermet - Linear Taper: 2 watts
Cermet - Non-linear Taper: 1 watt

Multiple Section:
Conductive Plastic - Linear Taper: 0.5 watt/section
Conductive Plastic - Audio Taper: 0.25 watt/section
Cermet - Linear Taper: 1.0 watt/section
Cermet - Non-linear Taper: 0.5 watt/section

Theoretical Resolution: Essentially Infinite

Mechanical Specifications

Mechanical Angle: 300° ±5°

Stop Strength:
1/4" and 1/8" diameter shafts: 4 lb.-in. [45,19 N-cm]

Starting and Running Torque (Non-Locking Bushing):
Single Section: 0.5 to 1.5 oz.-in. [0,35 to 1,06 N-cm]
Dual Section: 0.5 to 1.5 oz.-in. [0,35 to 1,06 N-cm]
Triple Section: 0.5 to 2.0 oz.-in. [0,35 to 1,41 N-cm]
Quad Section: 0.5 to 2.0 oz.-in. [0.35 to 1.41 N-cm]
(Increased Torque Range Available All Designs)

Starting and Running Torque (Locking Bushings):
0.2 to 4.0 oz.-in. [0,14 to 2,82 N-cm]

Shaft Locking Torque with Locknut @ 10 in-lb.
(B & E Bushings): 20 oz-in. [14 N-cm]

Mounting: 15-18 lb.-in. [1,7-2,0 N-m] maximum

Running Torque, Maximum:
Single Section: 0.5 to 2.0 oz.-in. [0,35 to 1,4 N-cm]
Dual Section: 0.5 to 2.0 oz.-in. [0,35 to 1,4 N-cm]

Weight:
Single Section: 21 grams maximum
Additional Sections: 6 grams maximum

Multiple Sections:
6 gangs maximum

Soldering Condition:
Recommended hand soldering using Sn95/Ag5 no clean solder, 0.025" wire diameter. Maximum temperature 750°F [399°C] for 3 seconds.
No wash process to be used with no clean flux.

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Series S159 Potentiometer

5/8" (15,88mm) Square

Environmental Specifications

Operating Temperature Range: -40°C to +125°C

Storage Temperature Range: -55°C to +125°C

Temperature Coefficient over Storage Range:
Conductive Plastic: ±1,000 ppm/°C;
Cermet: ±150 ppm/°C

Vibration (Single Section): 15 G
Total Resistance Shift: ±2% maximum
Voltage Ratio Shift: ±5% maximum

Shock (Single Section): 30 G
Total Resistance Shift: ±2% maximum
Voltage Ratio Shift: ±5% maximum

Load Life: 1,000 hours
Conductive Plastic Total Resistance Shift: ±10% max.
Cermet Total Resistance Shift: ±5% max.

Rotational Life (No Load): 100,000 cycles
Conductive Plastic Total Resistance Shift:
Linear taper: 10 ohms or ±10% TRS max.
(whichever is greater)
Audio taper: ±20% TRS maximum
Cermet Total Resistance Shift:
All tapers: ±20% TRS maximum
Contact Resistance Variation @ 50,000 Cycles:
Audio taper: ±3%
Linear taper: ±2%

Moisture Resistance (MIL-STD-202, Method 103, Condition B)
Conductive Plastic Total Resistance Shift:
(B & E tapers): ±10% TRS max.
(D, G, S & T tapers): ±20% TRS max.
Cermet Total Resistance Shift:
(all tapers): ±5% TRS max.

Insulation Resistance (500 VDC): 100 megohms minimum

IP Rating: IP40

Rotary Switch Electrical Specifications

Contacts
DPST: NO/NO, NC/NC, or NO/NC

Power Rating (Resistive Load)
DPST: 2 A @ 125 volts RMS-60 Hz or 2 A @ 28 VDC,
1 A @ 250 volts RMS-60 Hz

Contact Resistance (0.1 VDC-10 mA)
10 milliohms nominal

Contact Bounce: 5 milliseconds maximum

Dielectric Withstanding Voltage (MIL-STD-202, Method 301)
Sea Level: 1500 VAC minimum

Insulation Resistance: 1000 megohms minimum

Rotary Switch Environmental Specifications

Operating Temperature Range: -35°C to +70°C

Storage Temperature Range: -65°C to +125°C

Vibration (Dual Section): 8 G
(Triple Section): 5 G
(Quadruple Section): 3 G

Shock: (Dual Section): 20 G
(Triple Section): 15 G
(Quadruple Section): 10 G

Contact Resistance: 10 milliohms maximum

Contact Bounce: 0.1 millisecond maximum

Rotational Life: 25,000 cycles
Switch Actuating Torque
(50% Duty cycle @ Rated Power Load):
2 to 7 oz.-in. [1,41 to 4,94 N-cm]
Contact Resistance: 100 milliohms maximum

Moisture Resistance (MIL-STD-202, Method 106, Condition B)
Contact Resistance (0.1 VDC-10 mA):
10 milliohms maximum
Insulation Resistance
(After 24 hours @ room temperature) (500 VDC)
100 megohms minimum

Switch Housing Material:
High temperature, flame retardant, thermosetting plastic

Rotary Switch Mechanical Specifications

Actuating Torque (Each Section, Switch Module Only):
5 to 15 oz.-in. [3,53 to 10,6 N-cm]

Running Torque (Out of Detent, 2-4 Module Assembly):
0.3 to 2 oz.-in. [0,21 to 1,41 N-cm]

Detent: CW or CCW standard

Actuation Angle: 25°

Contact Materials: Fine silver with gold overlay

Terminal Styles: Solder lug only

Standard Orientation: In-line with control terminals

Optional: Rotated 90° CCW from standard

Terminal Strength (Before and After Soldering Heat Exposure): 2 lbs. [0,9 kg] minimum

Disclaimer

Due to the unlimited design combinations, certain designs may not be feasible and/or perform in accordance with all of the specifications.

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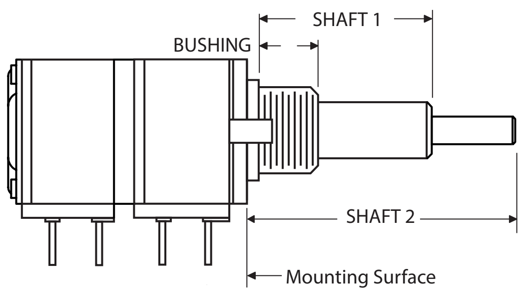
General Design Considerations

Most exterior dimensional references are measured from the potentiometer mounting surface. The mounting surface is the face of the bushing that rests against the inside surface of a panel. "From the Mounting Surface" is abbreviated as F.M.S.

Shaft and bushing lengths, PC Board layout and overall body length are always measured F.M.S. as well as the grid layout for PC board mounted versions.



The first section of the potentiometer is referred to as the "Panel Module". All designs begin with a panel module and may be followed by other modular components such as resistor modules, rotary switches, spacers and finally a rear plate.

The components are held together with 4 non-removable aluminum rivets. In certain application, where riveting may not be practical, small diameter screws may be used. After the panel module, there can be other resistive modules, each measuring .400" [10,16] deep, or switches, measuring .375" [9,52] deep. A spacer measuring 0.100" [2,54] is required between modules in all concentric shaft configurations, the position of which is determined by the controlling shafts.

The pin spacing is a simple .200" x .200" [5,08 x 5,08] pattern for single shaft potentiometers using resistive modules only. Concentric shafts and/or switches alter that pattern and we have included drawings for the most popular configurations.

While it is theoretically possible to have many modules coupled together, we do not recommend more than a total of 3 per shaft.

A rotary switch module must always have a resistive module in front of it; i.e. it can never be the only module, or first module, on a shaft. You can have a maximum of 2 switches per shaft as long as they are preceded by a resistive module.

Resistive modules are available in either straight p.c. leads or solder hooks. Switches are only available with solder terminals that can also use female quick-connects. If you require a switch to be p.c. board mounted, you can incorporate rectangular slots on the board to match the switch terminals. However, it is only possible to do this with one side of the switch; the other side would have to be hand-wired. Switches are also available in a 90° rotated version to reduce the height above the board.

Shafts are available in many lengths, with different end profiles. The most popular shaft ending for single shaft units would be a standard screwdriver slot. The standard orientation of the slot is in line with the internal contact at the full CCW position. When a flatted shaft is specified, it is typically opposite the contact in the full CCW position. However the flat can be orientated at any angle to meet your requirements. Plain round shafts are also popular and can, in many cases, be interchangeable with slotted shafts if delivery time is an issue.

Rotational torque is the amount of force required to turn the shaft on the potentiometer. Each module on a shaft will introduce additional torque. The torque specifications for the most popular configurations are shown elsewhere in this catalog. In every case, the rotational torque has a fairly wide minimum to maximum range and it is not possible to narrow that range. It is possible to increase the minimum rotational torque using internal components; for example high-vibration environments or cockpit applications where you don't want to change a setting by accidentally hitting a knob.

The part numbering scheme shown in the catalog will allow you to specify the most common variations. Once a design is finalized we will assign a unique 6-character part number that will take into consideration all of the options. That part number is also associated with the originating customer for future reference.

Due to the unlimited number of combination available, certain performance specifications may not apply.

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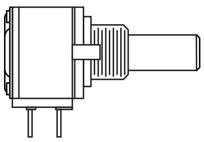
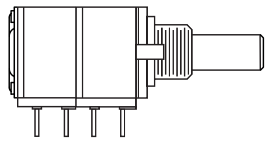
Common Combinations

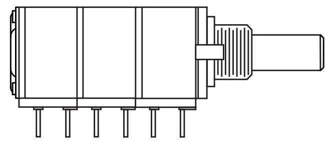
The MOD POT© Potentiometer is available in single, dual, triple, and quadruple construction. This includes potentiometers with or without switches. The table below lists some of the options available for single and multi-section controls. Because of the versatility of the MOD POT© Potentiometer, many other options are available.



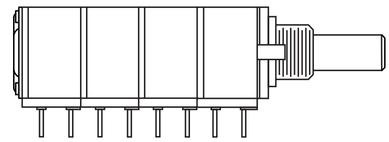
Single Unit



Dual Unit



Triple Unit



Quad Unit

									Switch Module Rotated 90			
					Potentiometer Solder Hooks		Potentiometer PC Leads		Potentiometer Solder Hooks		Potentiometer PC Leads	
	Section #1	Section #2	Section #3	Section #4	Dwg#	Page	Dwg#	Page	Dwg#	Page	Dwg#	Page
Single Section	Potentiometer				1A	8	1A-PC	8				
Dual Section Single Shaft	Potentiometer	Potentiometer			4A	9	4A-PC	9				
	Potentiometer	Rotary Switch			5A	10	5A-PC	11	5A-90°	10	5A-PC-90°	11
Dual Section Concentric Shafts	Potentiometer Outer Shaft	Potentiometer Inner Shaft			7A	12	7A-PC	12				
Triple Section Single Shaft	Potentiometer	Potentiometer	Potentiometer		12A	13	12A-PC	13				
	Potentiometer	Potentiometer	Rotary Switch		13A	14	13A-PC	15	13A-90°	14	13A-PC-90°	15
	Potentiometer	Rotary Switch	Rotary Switch		13B	16	13B-PC	17	13B-90°	16	13B-PC-90°	17
Triple Section Concentric Shafts	Potentiometer Outer Shaft	Potentiometer Inner Shaft	Potentiometer Inner Shaft		15A	18	15A-PC	18				
	Potentiometer Outer Shaft	Potentiometer Outer Shaft	Potentiometer Inner Shaft		15C	19	15C-PC	19				
	Potentiometer Outer Shaft	Potentiometer Inner Shaft	Rotary Switch Inner Shaft		16A	20	16A-PC	21	16A-90°	20	16A-PC-90°	21
Quad Section Single Shaft	Potentiometer	Potentiometer	Potentiometer	Potentiometer	23A	22	23A-PC	22				
	Potentiometer	Potentiometer	Potentiometer	Rotary Switch	23D	23	23D-PC	24	23D-90°	23	23D-PC-90°	24
Quad Section Concentric Shaft	Potentiometer Outer Shaft	Potentiometer Outer Shaft	Potentiometer Inner Shaft	Potentiometer Inner Shaft	26A	25	26A-PC	25				
	Potentiometer Outer Shaft	Potentiometer Outer Shaft	Potentiometer Inner Shaft	Rotary Switch Inner Shaft	27A	26	27A-PC	27	27A-90°	26	27A-PC-90°	27
	Potentiometer Outer Shaft	Rotary Switch Outer Shaft	Potentiometer Inner Shaft	Rotary Switch Inner Shaft	28B	28			28B-90°	28		

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Ordering Information

1. Basic type
2. Type of element (cermet or conductive plastic).
3. Type of terminals (resistor element only).
4. Number of sections.
5. Taper (each element on multi-section controls).
6. Total resistance value in ohms (each element on multi-section controls).
7. Bushing type (plain or locking).
8. Bushing length in inches or millimeters.
9. Bushing diameter .375" [9,52mm] or .250" [6,35mm]
10. Shaft ending (plain, slotted or flatted).
11. Shaft length FMS in inches or millimeters.
12. Switch type (maximum 2 rotary switches per shaft).
13. Locating lug option.
14. Mounting hardware.
15. Your part number, if any.
16. Marking requirement on the part.
17. Special features (forward complete detailed specs).

S159 Resistance Module Options

Element Type			Conductive Plastic = CP Cermet = CM			
Taper			Linear	Log/Audio	Reverse Log / Reverse Audio	S
Resis-tance (ohms)	Code	Ref				
100	101	100	CM	CM	CM	CM
1,000	102	1K	CP & CM	CP & CM	CP & CM	CP & CM
10,000	103	10K	CP & CM	CP & CM	CP & CM	CP & CM
100,000	104	100K	CP & CM	CP & CM	CP & CM	CP & CM
1,000,000	105	1Meg	CP & CM	CP & CM	CP & CM	CP & CM
150	151	150	CM	CM	CM	CM
1,500	152	1.5K	CP & CM	CP & CM	CP & CM	CP & CM
15,000	153	15K	CP & CM	CP & CM	CP & CM	CP & CM
150,000	153	150K	CP & CM	CP & CM	CP & CM	CP & CM
200	201	200	CM			
2,000	202	2K	CP & CM	CP & CM	CP & CM	CP & CM
20,000	203	20K	CP & CM	CP & CM	CP & CM	CP & CM
200,000	204	200K	CP & CM	CP & CM	CP & CM	CP & CM
250	251	250	CM			
2,500	252	2.5K	CP & CM	CP & CM	CP & CM	CP & CM
25,000	253	25K	CP & CM	CP & CM	CP & CM	CP & CM
250,000	254	250K	CP & CM	CP & CM	CP & CM	CP & CM
500	501	500	CP & CM			
5,000	502	5K	CP & CM	CP & CM	CP & CM	CP & CM
50,000	503	50K	CP & CM	CP & CM	CP & CM	CP & CM
500,000	504	500K	CP & CM	CP & CM	CP & CM	CP & CM
750	751	750	CM			
7,500	752	7.5K	CP & CM	CP & CM	CP & CM	CP & CM
75,000	753	75K	CP & CM	CP & CM	CP & CM	CP & CM
750,000	754	750K	CP & CM	CP & CM	CP & CM	CP & CM

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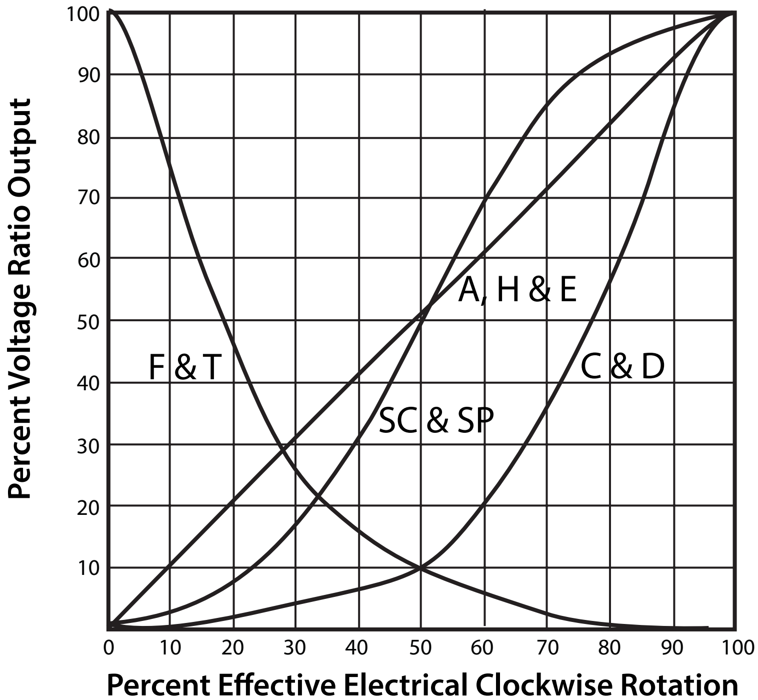
S159 Resistance Tapers



On chart:

Linear Taper (A, H, or E options)
Clockwise Audio Taper (C or D options)
Counterclockwise Audio Taper (F or T options)
Modified Linear Taper (SP or SC) (Special Order)

Element & Taper:

A = Linear Cermet 10%
H = Linear Cermet 5%
E = Linear Conductive Plastic 10%
C = CW Audio Cermet 10%
D = CW Audio Conductive Plastic 10%
F = CCW Audio Cermet 10%
T = CCW Audio Conductive Plastic 10%
SP = Modified Linear "S" Conductive Plastic 10%
SC = Modified Linear "S" Cermet 10%

Tapers A, C, D, E, H, SC & SP are measured between the wiper and the counterclockwise terminal (pins 1 and 2).
Tapers F & T are measured between the wiper and the clockwise terminals (pins 2 and 3).

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Rotary Switch – The rotary switch consists of two sets of contacts. See Part Number Explanation for available options.

Push-pull Switch – A four pole switch that is operated by a .125 inch (3,18mm) diameter solid shaft. An inner concentric shaft that operated the push-pull switch only
may have a diameter of .125 inch (3,18mm) or .078 inch (1,98mm). Shaft lengths are measured from the bushing mounting surface to the free end of the shaft with the shaft in the extended position. **(This option is not currently available)**

Momentary Push Switch – A push-pull switch equipped with a return spring such that the switch will return to the extended postion when the actuating force is removed. **(This option is not currently available)**

Life – The switches will be electrically and mechanically operative after operational life test at rated current and voltage with a resistive load, per switch characteristics below. **(This option is not currently available)**

Electrial Ratings -
2 A @ 125 volts RMS 60HZ or 2 A@ 28 VDC, 1 A @ 250 volts RMS

Terminals – Switches are available with lug terminals only.
It is possible to incorporate slots on your PC board to accept the flat terminals on one side of the switch. Switches are also avialable in 90° rotated versions to reduce the above board height or other clearnce issues.

		In Detent				
Switch Number	Detent @	Terminals 1 and 2 are:	Terminals 1 and 2 are:	Actuating Torque	Actuating Angle	Operational Life (Actuations)
SW50	CW END	OPEN	CLOSED	5-15 oz.-in. 3,53 to 10,6 N-cm	25°	25,000
SW51 (STD)	CCW END	OPEN	CLOSED	5-15 oz.-in. 3,53 to 10,6 N-cm	25°	25,000
SW52	CW END	OPEN	OPEN	5-15 oz.-in. 3,53 to 10,6 N-cm	25°	25,000
SW53	CCW END	OPEN	OPEN	5-15 oz.-in. 3,53 to 10,6 N-cm	25°	25,000
SW56 (90°)	CW END	OPEN	CLOSED	5-15 oz.-in. 3,53 to 10,6 N-cm	25°	25,000
SW57 (90°)	CCW END	OPEN	CLOSED	5-15 oz.-in. 3,53 to 10,6 N-cm	25°	25,000
SW58 (90°)	CW END	OPEN	OPEN	5-15 oz.-in. 3,53 to 10,6 N-cm	25°	25,000
SW59 (90°)	CCW END	OPEN	OPEN	5-15 oz.-in. 3,53 to 10,6 N-cm	25°	25,000

PUSH-PULL AND MOMENTARY SWITCHES						
Switch Type	Type	Voltage 60 Hz RMS	Current Amps	Actuating Force	Shaft Travel	Operational Life
SWPP	Push Pull	125	2	7 ounces (1.9N) Min. 19 ounces (5.3N) Max.	1/8 Inch (3.18 mm)	25,000
SWPPM	Push Momentary	125	2	20 ounces (5.6N) Min. 130ounces (8.3N) Max.	1/8 Inch (3.18 mm)	25,000

Rotary Switch

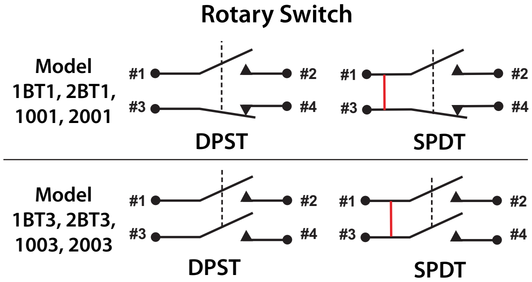

Diagram shows shaft in detent position.
Connect terminals #1 and #3 for SPDT
Red wire shown here can be added by user.
Maximum of 2 rotary switches per shaft.

Push-Pull or Momentary Switch
Model SWPP, SWPPM

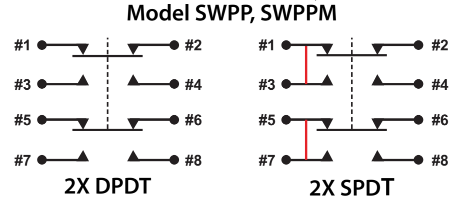

Diagram shows shaft extended
Connect terminals #1 and #3
plus terminals #5 and #7 for 2X SPDT
Red wire shown here can be added by user.

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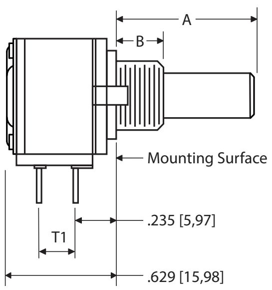
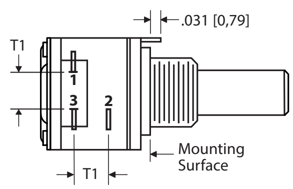
S159 Product Drawings

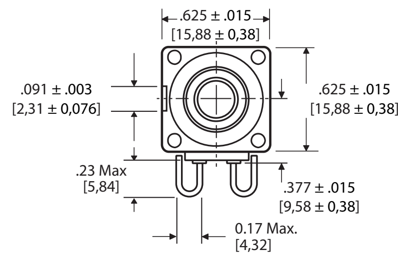
The product drawings on the following pages show over 100 different configurations. Many other options are available - contact your State Electronics sales representative for information.

Section 1: Single module, Single Shaft

1A - Single Potentiometer, Single Shaft, Solder Hooks



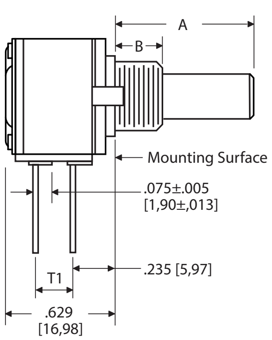


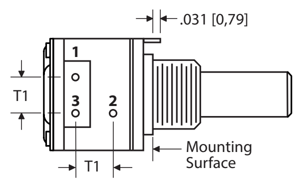


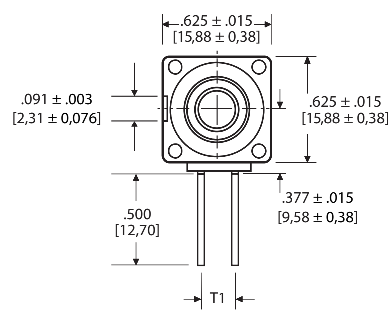
Dimension Notes:
T1 = .200 [5,08]
T2 = .300 ± .010 [7,62 ± 0,25]
T3 = .109 ± .010 [2,78 ± 0,25]
S1 = .350 ± .010 [8,89 ± 0,25]
S2 = .375 ± .010 [8,89 ± 0,25]

Switch terminal hole size: .045 ± .005 x .095 ± .005 [1,14 ± 0,13 x 2,41 ± 0,13]

1A-PC - Single Potentiometer, Single Shaft, Solder Pins







Dimension Notes:
T1 = .200 [5,08]
T2 = .300 ± .010 [7,62 ± 0,25]
T3 = .109 ± .010 [2,78 ± 0,25]
S1 = .350 ± .010 [8,89 ± 0,25]
S2 = .375 ± .010 [8,89 ± 0,25]

Switch terminal hole size: .045 ± .005 x .095 ± .005 [1,14 ± 0,13 x 2,41 ± 0,13]

Notes:

1. Potentiometer Terminals - .031 [,81] Dia., Soft Copper Cda Alloy 110, Tin Plate.
2. Switch Terminals - Soft Copper Cda Alloy 110, Bottom Terminals, Plate 20 Microinches Gold, Top Terminals Tin Plate.
3. Switch Terminal Thickness: 1 & 3, .012 [0,405]; 2 & 4, .018 [0,457]
4. All drawings are shown with 3/8" dia. bushing with 1/4" dia. shaft. 1/4" dia. bushing with 1/8" dia. shaft is available. Locking bushing is also available.
5. Refer to page 29 for Printed Circuit Board Layouts. Refer to page 30 for Bushing, Shaft and Hardware information. Refer to page 33 for Locating Lug options.
6. Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance ±.016 [0,40], except as specified.
7. Drawings not to scale.

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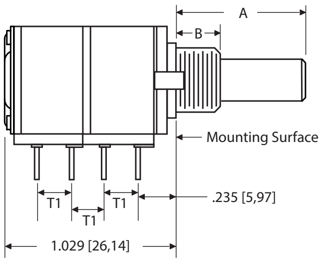
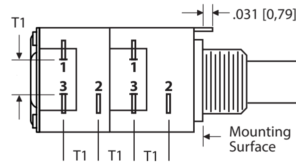
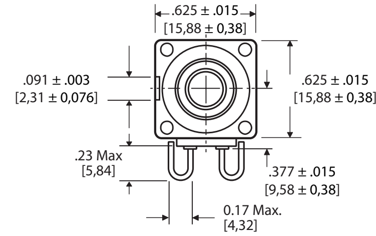
Section 2: Dual module, Single Shaft

4A - Dual Potentiometer, Single Shaft, Solder Hooks





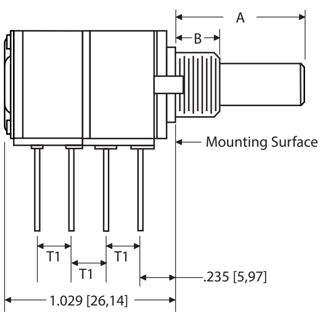


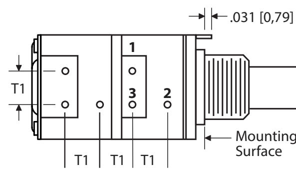
Dimension Notes:

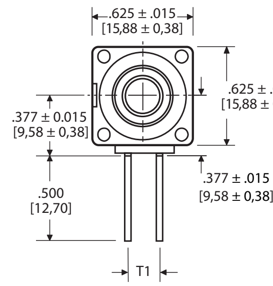
T1 = .200 [5,08]
T2 = .300 ± .010 [7,62 ± 0,25]
T3 = .109 ± .010 [2,78 ± 0,25]
S1 = .350 ± .010 [8,89 ± 0,25]
S2 = .375 ± .010 [8,89 ± 0,25]

Switch terminal hole size: .045 ± .005 x .095 ± .005 [1,14 ± 0,13 x 2,41 ± 0,13]

4A-PC - Dual Potentiometer, Single Shaft, Solder Pins







Dimension Notes:

T1 = .200 [5,08]
T2 = .300 ± .010 [7,62 ± 0,25]
T3 = .109 ± .010 [2,78 ± 0,25]
S1 = .350 ± .010 [8,89 ± 0,25]
S2 = .375 ± .010 [8,89 ± 0,25]

Switch terminal hole size: .045 ± .005 x .095 ± .005 [1,14 ± 0,13 x 2,41 ± 0,13]

Notes:

1. Potentiometer Terminals - .031 [,81] Dia., Soft Copper Cda Alloy 110, Tin Plate.
2. Switch Terminals - Soft Copper Cda Alloy 110, Bottom Terminals, Plate 20 Microinches Gold, Top Terminals Tin Plate.
3. Switch Terminal Thickness: 1 & 3, .012 [0,405]; 2 & 4, .018 [0,457]
4. All drawings are shown with 3/8" dia. bushing with 1/4" dia. shaft. 1/4" dia. bushing with 1/8" dia. shaft is available. Locking bushing is also available.
5. Refer to page 29 for Printed Circuit Board Layouts. Refer to page 30 for Bushing, Shaft and Hardware information. Refer to page 33 for Locating Lug options.
6. Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance ±.016 [0,40], except as specified.
7. Drawings not to scale.

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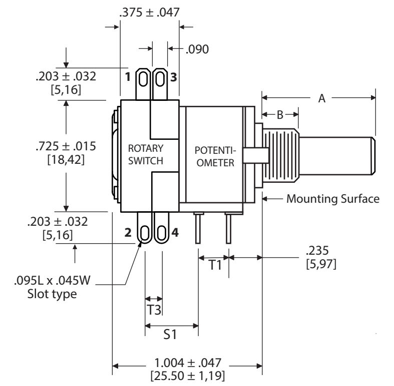
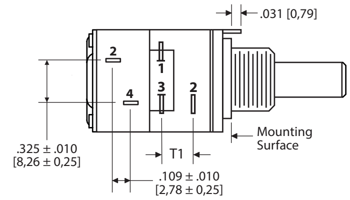
Section 2: Dual module, Single Shaft (continued)

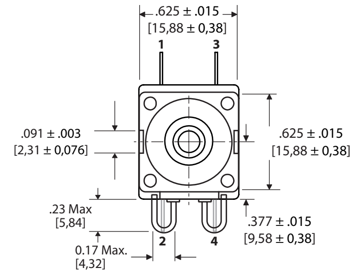
5A - Single Potentiometer, Single DPST Rotary Switch, Solder Hooks

Switch Option specifications

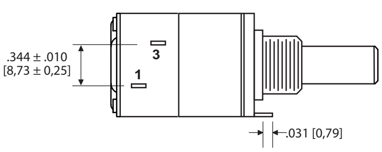




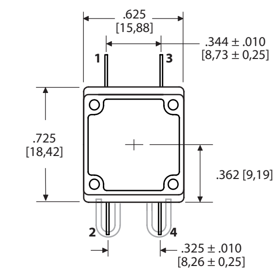
Bottom View



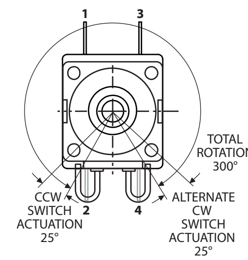
Front View



Top View

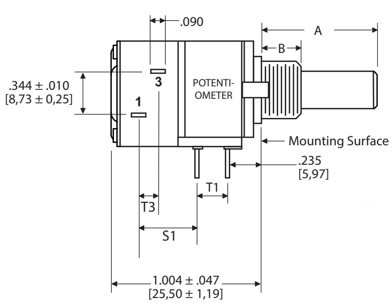


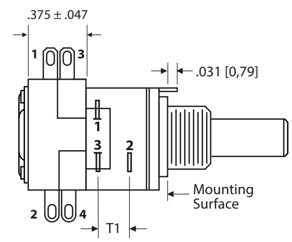
Rear View



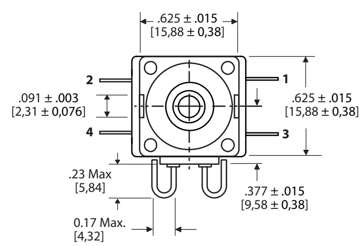
Front View Rotation

5A-90° - Single Potentiometer, Single DPST Rotary Switch, Solder Hooks (Rotated Switch Module)

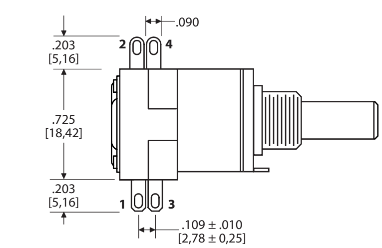




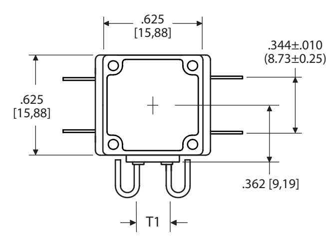
Bottom View



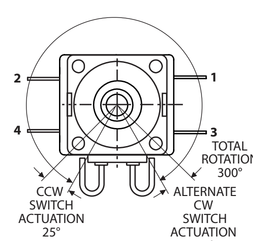
Front View



Top View



Rear View



Front View Rotation

Dimension Notes:

T1 = .200 [5,08]
T2 = .300 ± .010 [7,62 ± 0,25]
T3 = .109 ± .010 [2,78 ± 0,25]
S1 = .350 ± .010 [8,89 ± 0,25]
S2 = .375 ± .010 [8,89 ± 0,25]

Switch terminal hole size: .045 ± .005 x .095 ± .005 [1,14 ± 0,13 x 2,41 ± 0,13]

Notes:

1. Potentiometer Terminals - .031 [,81] Dia., Soft Copper Cda Alloy 110, Tin Plate.
2. Switch Terminals - Soft Copper Cda Alloy 110, Bottom Terminals, Plate 20 Microinches Gold, Top Terminals Tin Plate.
3. Switch Terminal Thickness: 1 & 3, .012 [0,405]; 2 & 4, .018 [0,457]
4. All drawings are shown with 3/8" dia. bushing with 1/4" dia. shaft. 1/4" dia. bushing with 1/8" dia. shaft is available. Locking bushing is also available.
5. Refer to page 29 for Printed Circuit Board Layouts. Refer to page 30 for Bushing, Shaft and Hardware information. Refer to page 33 for Locating Lug options.
6. Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance ±.016 [0,40], except as specified.
7. Drawings not to scale.

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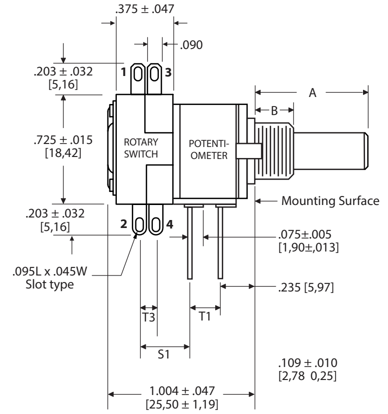
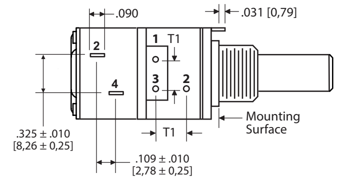
Section 2: Dual module, Single Shaft (continued)

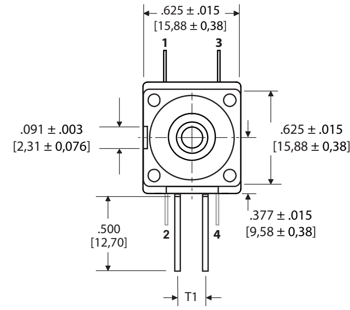
5A-PC - Single Potentiometer, Single DPST Rotary Switch, Solder Pins

[Switch Option specifications]

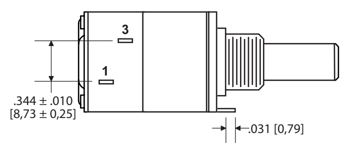




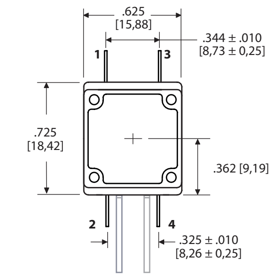
Bottom View



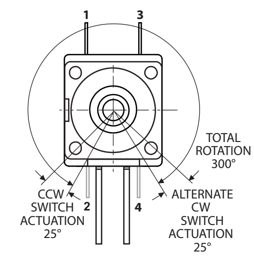
Front View



Top View

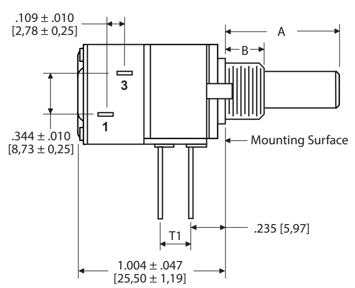


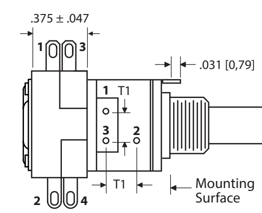
Rear View



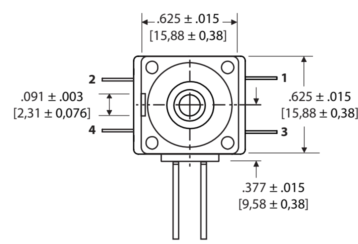
Front View Rotation

5A-PC-90° - Single Potentiometer, Single DPST Rotary Switch, Solder Pins (Rotated Switch Module)

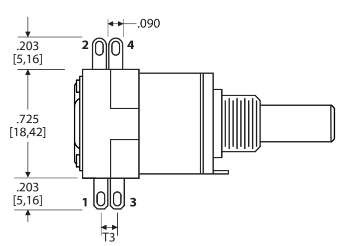




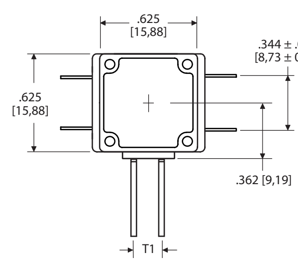
Bottom View



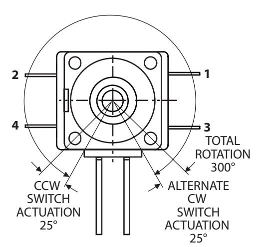
Front View



Top View



Rear View



Front View Rotation

Dimension Notes:

T1 = .200 [5,08]
T2 = .300 ± .010 [7,62 ± 0,25]
T3 = .109 ± .010 [2,78 ± 0,25]
S1 = .350 ± .010 [8,89 ± 0,25]
S2 = .375 ± .010 [8,89 ± 0,25]

Switch terminal hole size: .045 ± .005 x .095 ± .005 [1,14 ± 0,13 x 2,41 ± 0,13]

Notes:

1. Potentiometer Terminals - .031 [,81] Dia., Soft Copper Cda Alloy 110, Tin Plate.
2. Switch Terminals - Soft Copper Cda Alloy 110, Bottom Terminals, Plate 20 Microinches Gold, Top Terminals Tin Plate.
3. Switch Terminal Thickness: 1 & 3, .012 [0,405]; 2 & 4, .018 [0,457]
4. All drawings are shown with 3/8" dia. bushing with 1/4" dia. shaft. 1/4" dia. bushing with 1/8" dia. shaft is available. Locking bushing is also available.
5. Refer to page 29 for Printed Circuit Board Layouts. Refer to page 30 for Bushing, Shaft and Hardware information. Refer to page 33 for Locating Lug options.
6. Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance ±.016 [0,40], except as specified.
7. Drawings not to scale.

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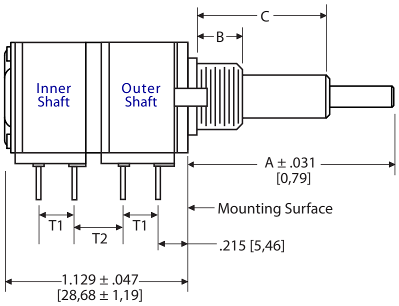
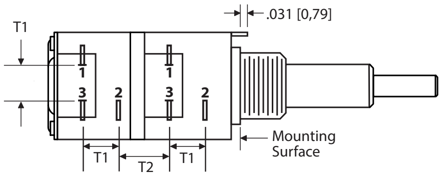
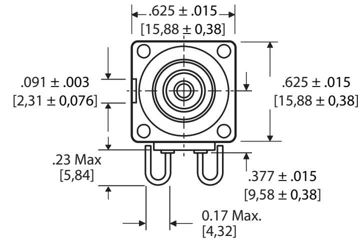
Section 3: Dual module, Concentric Shaft

7A - Dual Potentiometer, Concentric Shaft, Solder Hooks



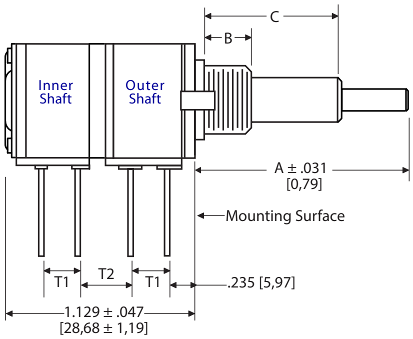


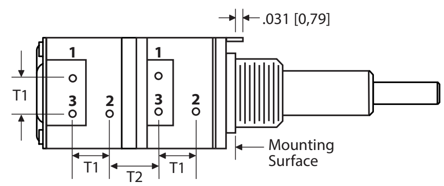


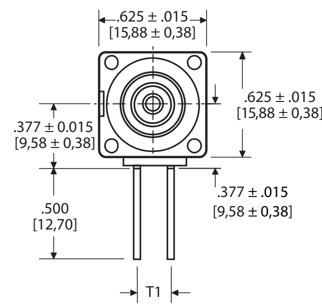
Dimension Notes:
T1 = .200 [5,08]
T2 = .300 ± .010 [7,62 ± 0,25]
T3 = .109 ± .010 [2,78 ± 0,25]
S1 = .350 ± .010 [8,89 ± 0,25]
S2 = .375 ± .010 [8,89 ± 0,25]

Switch terminal hole size: .045 ± .005 x .095 ± .005 [1,14 ± 0,13 x 2,41 ± 0,13]

7A-PC - Dual Potentiometer, Concentric Shaft, Solder Pins







Dimension Notes:
T1 = .200 [5,08]
T2 = .300 ± .010 [7,62 ± 0,25]
T3 = .109 ± .010 [2,78 ± 0,25]
S1 = .350 ± .010 [8,89 ± 0,25]
S2 = .375 ± .010 [8,89 ± 0,25]

Switch terminal hole size: .045 ± .005 x .095 ± .005 [1,14 ± 0,13 x 2,41 ± 0,13]

Notes:

1. Potentiometer Terminals - .031 [,81] Dia., Soft Copper Cda Alloy 110, Tin Plate.
2. Switch Terminals - Soft Copper Cda Alloy 110, Bottom Terminals, Plate 20 Microinches Gold, Top Terminals Tin Plate.
3. Switch Terminal Thickness: 1 & 3, .012 [0,405]; 2 & 4, .018 [0,457]
4. All drawings are shown with 3/8" dia. bushing with 1/4" dia. shaft. 1/4" dia. bushing with 1/8" dia. shaft is available. Locking bushing is also available.
5. Refer to page 29 for Printed Circuit Board Layouts. Refer to page 30 for Bushing, Shaft and Hardware information. Refer to page 33 for Locating Lug options.
6. Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance ±.016 [0,40], except as specified.
7. Drawings not to scale.

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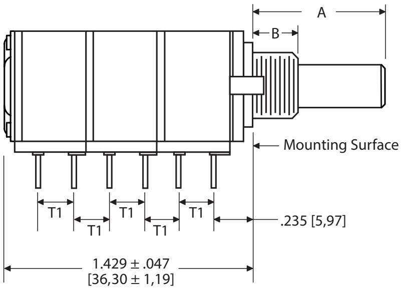
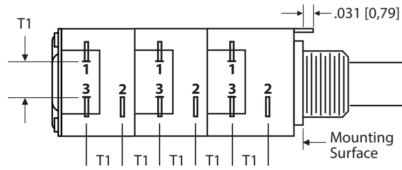
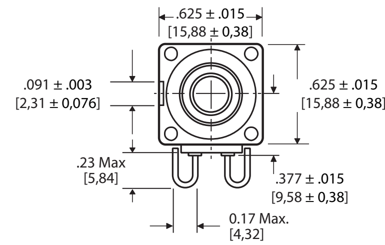
Section 4: Triple module, Single Shaft

12A - Triple Potentiometer, Single Shaft, Solder Hooks





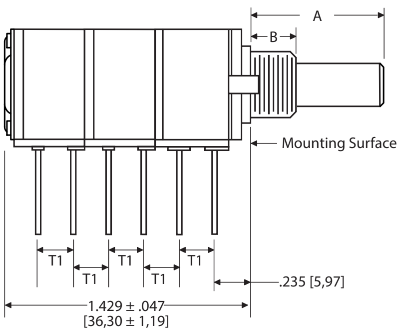


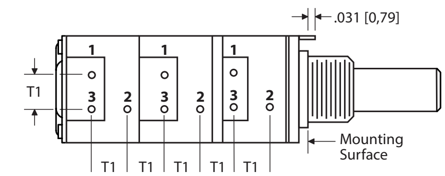
Dimension Notes:

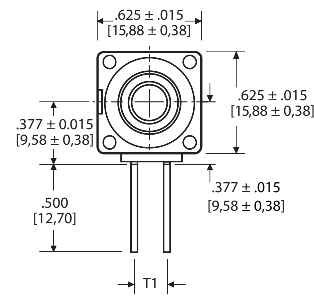
T1 = .200 [5,08]
T2 = .300 ± .010 [7,62 ± 0,25]
T3 = .109 ± .010 [2,78 ± 0,25]
S1 = .350 ± .010 [8,89 ± 0,25]
S2 = .375 ± .010 [8,89 ± 0,25]

Switch terminal hole size: .045 ± .005 x .095 ± .005 [1,14 ± 0,13 x 2,41 ± 0,13]

12A-PC - Triple Potentiometer, Single Shaft, Solder Pins







Dimension Notes:

T1 = .200 [5,08]
T2 = .300 ± .010 [7,62 ± 0,25]
T3 = .109 ± .010 [2,78 ± 0,25]
S1 = .350 ± .010 [8,89 ± 0,25]
S2 = .375 ± .010 [8,89 ± 0,25]

Switch terminal hole size: .045 ± .005 x .095 ± .005 [1,14 ± 0,13 x 2,41 ± 0,13]

Notes:

1. Potentiometer Terminals - .031 [,81] Dia., Soft Copper Cda Alloy 110, Tin Plate.
2. Switch Terminals - Soft Copper Cda Alloy 110, Bottom Terminals, Plate 20 Microinches Gold, Top Terminals Tin Plate.
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6. Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance ±.016 [0,40], except as specified.
7. Drawings not to scale.

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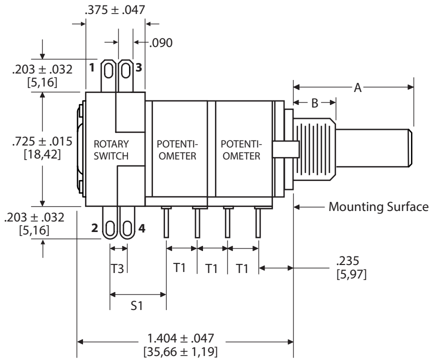
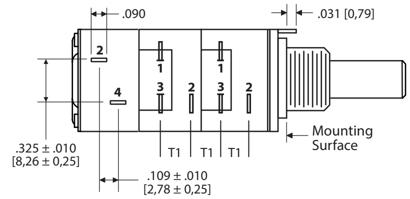
Section 4: Triple module, Single Shaft (continued)

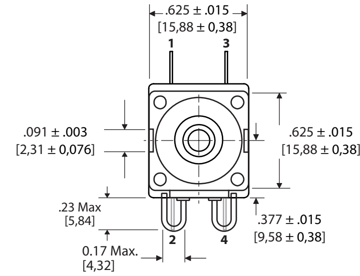
13A - Dual Potentiometer, Single Rotary Switch, Solder Hooks

[Switch Option specifications]

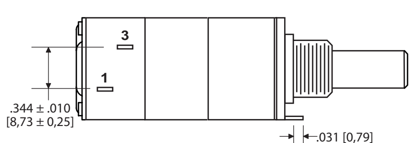




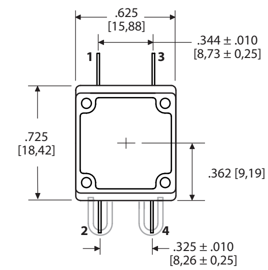
Bottom View



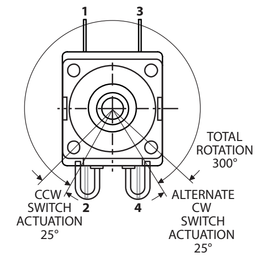
Front View



Top View



Rear View

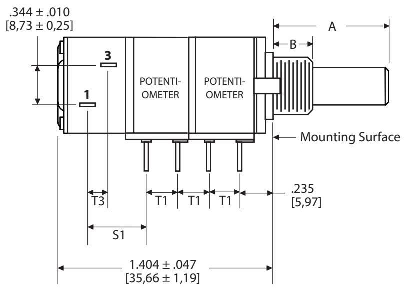


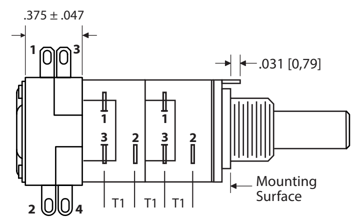
Front View Rotation

Dimension Notes:
T1 = .200 [5,08]
T2 = .300 ± .010 [7,62 ± 0,25]
T3 = .109 ± .010 [2,78 ± 0,25]
S1 = .350 ± .010 [8,89 ± 0,25]
S2 = .375 ± .010 [8,89 ± 0,25]

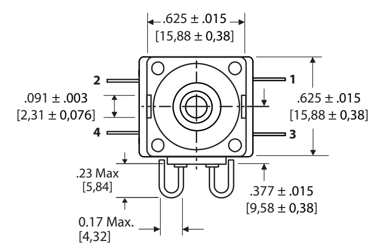
Switch terminal hole size: .045 ± .005 x .095 ± .005 [1,14 ± 0,13 x 2,41 ± 0,13]

13A-90° - Dual Potentiometer, Single Rotary Switch, Solder Hooks (Rotated Switch Module)

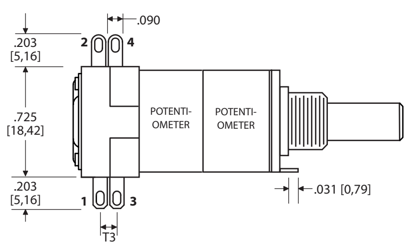




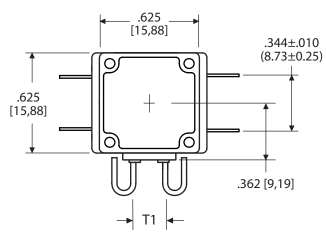
Bottom View



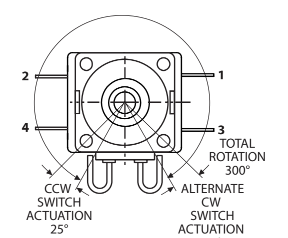
Front View



Top View



Rear View



Front View Rotation

Dimension Notes:
T1 = .200 [5,08]
T2 = .300 ± .010 [7,62 ± 0,25]
T3 = .109 ± .010 [2,78 ± 0,25]
S1 = .350 ± .010 [8,89 ± 0,25]
S2 = .375 ± .010 [8,89 ± 0,25]

Switch terminal hole size: .045 ± .005 x .095 ± .005 [1,14 ± 0,13 x 2,41 ± 0,13]

Notes:

1. Potentiometer Terminals - .031 [,81] Dia., Soft Copper Cda Alloy 110, Tin Plate.
2. Switch Terminals - Soft Copper Cda Alloy 110, Bottom Terminals, Plate 20 Microinches Gold, Top Terminals Tin Plate.
3. Switch Terminal Thickness: 1 & 3, .012 [0,405]; 2 & 4, .018 [0,457]
4. All drawings are shown with 3/8" dia. bushing with 1/4" dia. shaft. 1/4" dia. bushing with 1/8" dia. shaft is available. Locking bushing is also available.
5. Refer to page 29 for Printed Circuit Board Layouts. Refer to page 30 for Bushing, Shaft and Hardware information. Refer to page 33 for Locating Lug options.
6. Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance ±.016 [0,40], except as specified.
7. Drawings not to scale.

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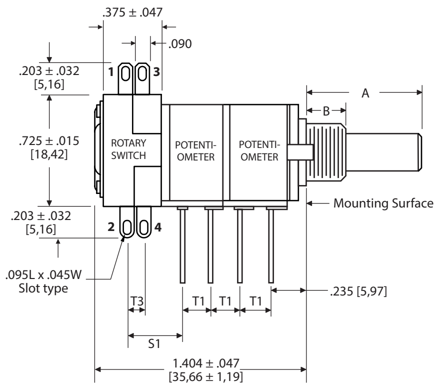
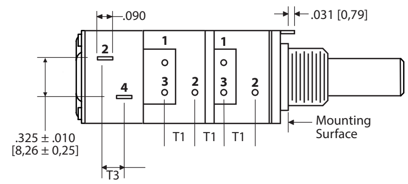
Section 4: Triple module, Single Shaft (continued)

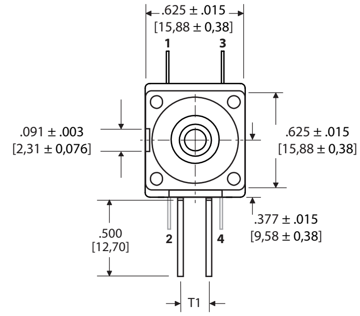
13A-PC - Dual Potentiometer, Single Rotary Switch, Solder Pins

[Switch Option specifications](#)

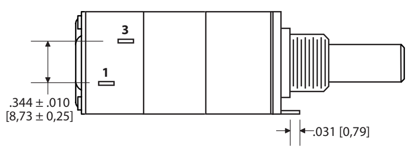




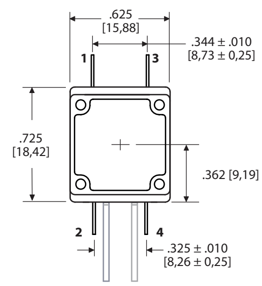
Bottom View



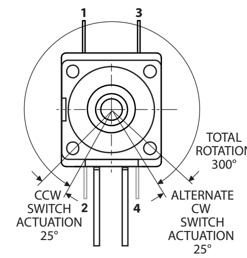
Front View



Top View



Rear View

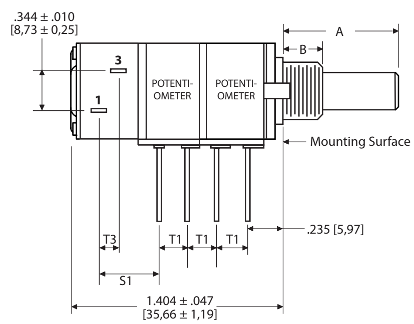


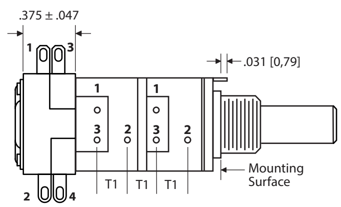
Front View Rotation

Dimension Notes:
T1 = .200 [5,08]
T2 = .300 ± .010 [7,62 ± 0,25]
T3 = .109 ± .010 [2,78 ± 0,25]
S1 = .350 ± .010 [8,89 ± 0,25]
S2 = .375 ± .010 [8,89 ± 0,25]

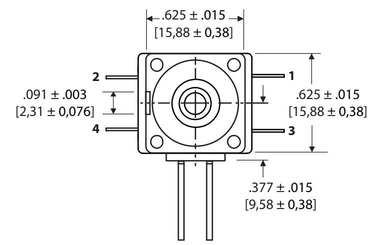
Switch terminal hole size: .045 ± .005 x .095 ± .005 [1,14 ± 0,13 x 2,41 ± 0,13]

13A-PC-90° - Dual Potentiometer, Single Rotary Switch, Solder Pins(Rotated Switch Module)

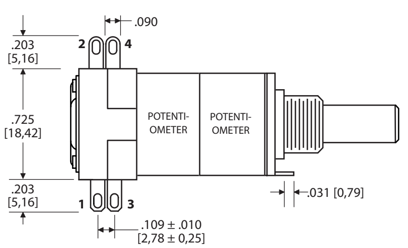




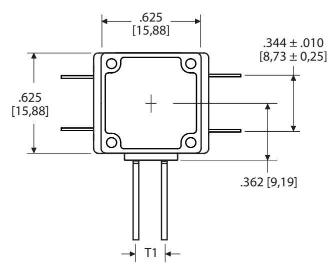
Bottom View



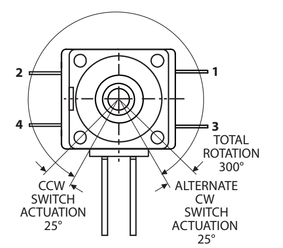
Front View



Top View



Rear View



Front View Rotation

Dimension Notes:
T1 = .200 [5,08]
T2 = .300 ± .010 [7,62 ± 0,25]
T3 = .109 ± .010 [2,78 ± 0,25]
S1 = .350 ± .010 [8,89 ± 0,25]
S2 = .375 ± .010 [8,89 ± 0,25]

Switch terminal hole size: .045 ± .005 x .095 ± .005 [1,14 ± 0,13 x 2,41 ± 0,13]

Notes:

1. Potentiometer Terminals - .031 [,81] Dia., Soft Copper Cda Alloy 110, Tin Plate.
2. Switch Terminals - Soft Copper Cda Alloy 110, Bottom Terminals, Plate 20 Microinches Gold, Top Terminals Tin Plate.
3. Switch Terminal Thickness: 1 & 3, .012 [0,405]; 2 & 4, .018 [0,457]
4. All drawings are shown with 3/8" dia. bushing with 1/4" dia. shaft. 1/4" dia. bushing with 1/8" dia. shaft is available. Locking bushing is also available.
5. Refer to page 29 for Printed Circuit Board Layouts. Refer to page 30 for Bushing, Shaft and Hardware information. Refer to page 33 for Locating Lug options.
6. Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance ±.016 [0,40], except as specified.
7. Drawings not to scale.

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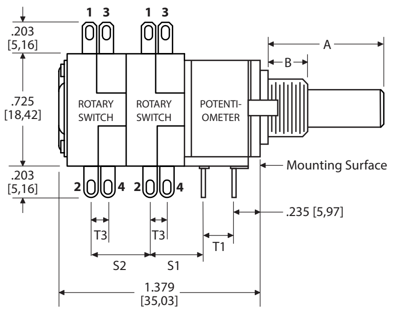
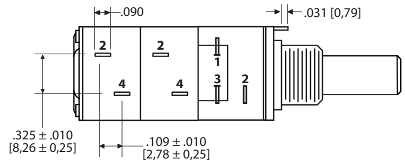
Section 4: Triple module, Single Shaft (continued)

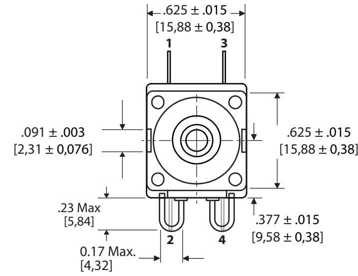
13B - Single Potentiometer, Dual Rotary Switch, Solder Hooks

Switch Option specifications

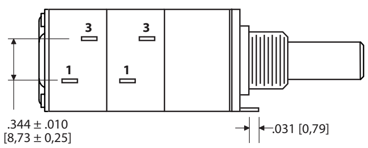




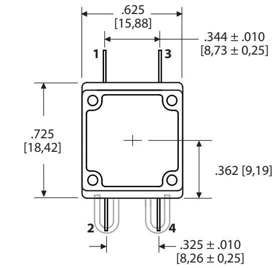
Bottom View



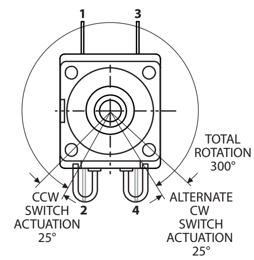
Front View



Top View

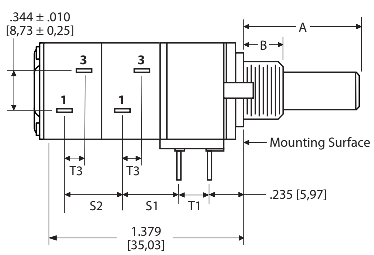


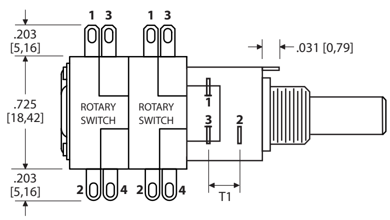
Rear View



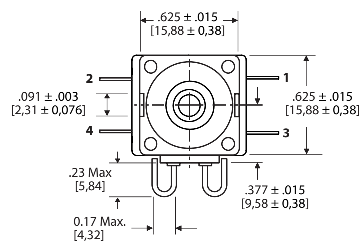
Front View Rotation

13B-90° - Single Potentiometer, Dual Rotary Rotary Switch, Solder Hooks (Rotated Switch Module)

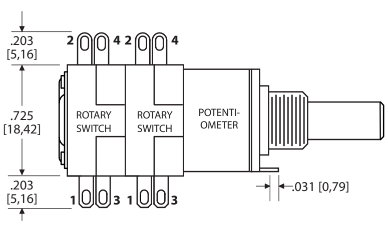




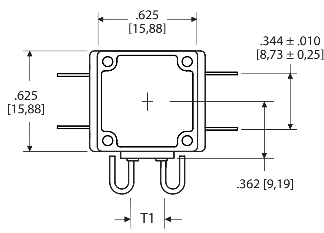
Bottom View



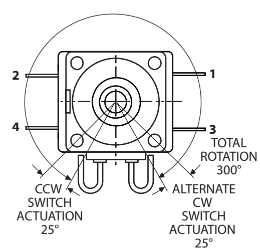
Front View



Top View



Rear View



Front View Rotation

Dimension Notes:
T1 = .200 [5,08]
T3 = .109 ± .010 [2,78 ± 0,25]
S1 = .350 ± .010 [8,89 ± 0,25]
S2 = .375 ± .010 [8,89 ± 9,52]

Switch terminal hole size: .045 ± .005 x .095 ± .005 [1,14 ± 0,13 x 2,41 ± 0,13]

Notes:

1. Potentiometer Terminals - .031 [,81] Dia., Soft Copper Cda Alloy 110, Tin Plate.
2. Switch Terminals - Soft Copper Cda Alloy 110, Bottom Terminals, Plate 20 Microinches Gold, Top Terminals Tin Plate.
3. Switch Terminal Thickness: 1 & 3, .012 [0,405]; 2 & 4, .018 [0,457]
4. All drawings are shown with 3/8" dia. bushing with 1/4" dia. shaft. 1/4" dia. bushing with 1/8" dia. shaft is available. Locking bushing is also available.
5. Refer to page 29 for Printed Circuit Board Layouts. Refer to page 30 for Bushing, Shaft and Hardware information. Refer to page 33 for Locating Lug options.
6. Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance ±.016 [0,40], except as specified.
7. Drawings not to scale.

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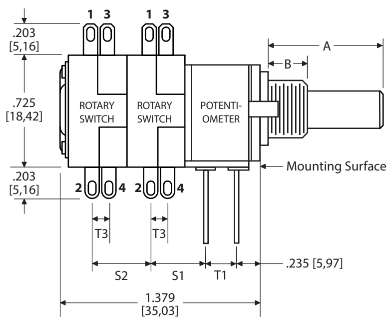
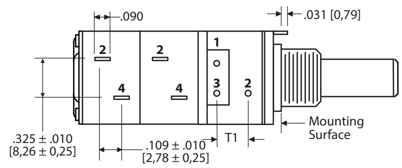
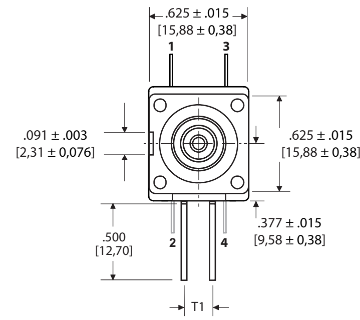
13B-PC - Single Potentiometer, Dual Rotary Switch, Solder Pins

[Switch Option specifications](#)

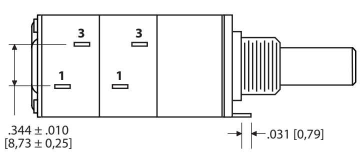




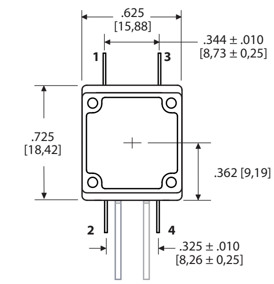
Bottom View



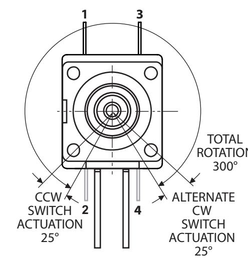
Front View



Top View



Rear View



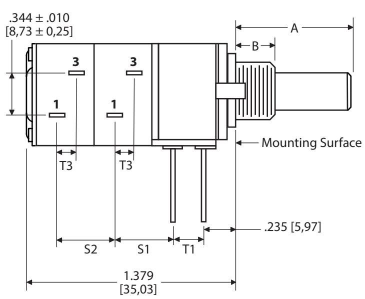
Front View Rotation

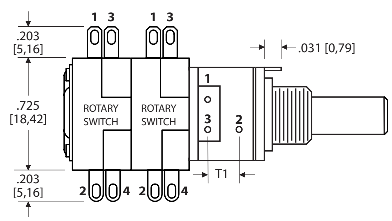
Dimension Notes:

T1 = .200 [5,08]
T2 = .300 ± .010 [7,62 ± 0,25]
T3 = .109 ± .010 [2,78 ± 0,25]
S1 = .350 ± .010 [8,89 ± 0,25]
S2 = .375 ± .010 [8,89 ± 0,25]

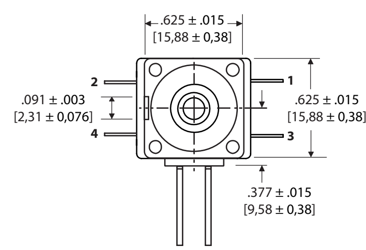
Switch terminal hole size: .045 ± .005 x .095 ± .005 [1,14 ± 0,13 x 2,41 ± 0,13]

13B-PC-90° - Single Potentiometer, Dual Rotary Rotary Switch, Solder Pins (Rotated Switch Module)

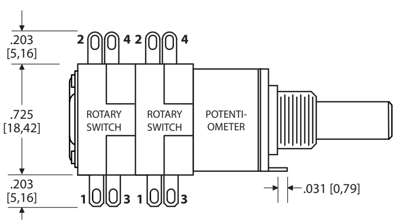




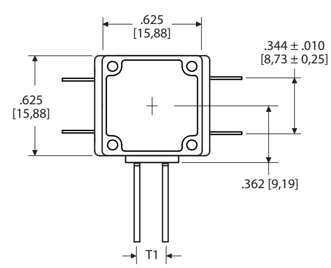
Bottom View



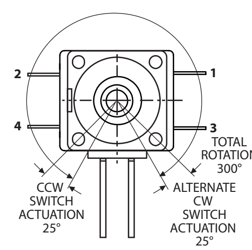
Front View



Top View



Rear View



Front View Rotation

Dimension Notes:

T1 = .200 [5,08]
T2 = .300 ± .010 [7,62 ± 0,25]
T3 = .109 ± .010 [2,78 ± 0,25]
S1 = .350 ± .010 [8,89 ± 0,25]
S2 = .375 ± .010 [8,89 ± 0,25]

Switch terminal hole size: .045 ± .005 x .095 ± .005 [1,14 ± 0,13 x 2,41 ± 0,13]

Notes:

1. Potentiometer Terminals - .031 [,81] Dia., Soft Copper Cda Alloy 110, Tin Plate.
2. Switch Terminals - Soft Copper Cda Alloy 110, Bottom Terminals, Plate 20 Microinches Gold, Top Terminals Tin Plate.
3. Switch Terminal Thickness: 1 & 3, .012 [0,405]; 2 & 4, .018 [0,457]
4. All drawings are shown with 3/8" dia. bushing with 1/4" dia. shaft. 1/4" dia. bushing with 1/8" dia. shaft is available. Locking bushing is also available.
5. Refer to page 29 for Printed Circuit Board Layouts. Refer to page 30 for Bushing, Shaft and Hardware information. Refer to page 33 for Locating Lug options.
6. Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance ±.016 [0,40], except as specified.
7. Drawings not to scale.

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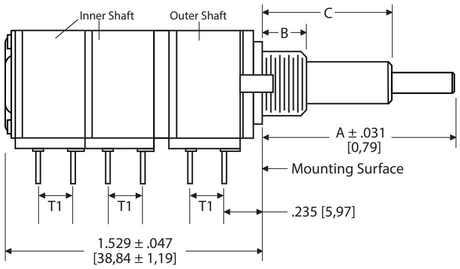
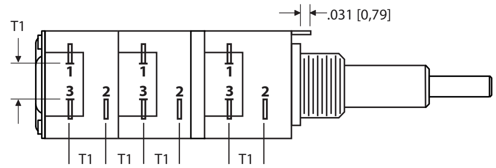
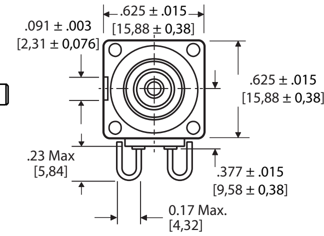
Section 5: Triple module, Concentric Shaft

15A - Triple Potentiometer, Concentric Shaft, Solder Hooks



As shown, Outer Shaft operates First Section



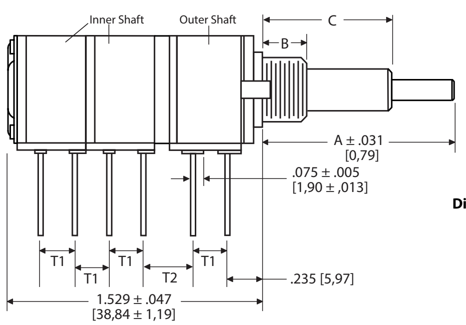


Dimension Notes:

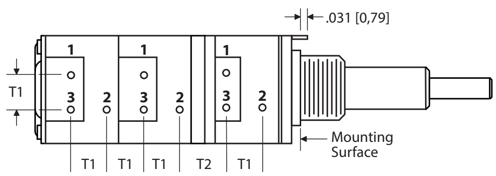
T1 = .200 [5,08]
T2 = .300 ± .010 [7,62 ± 0,25]
T3 = .109 ± .010 [2,78 ± 0,25]
S1 = .350 ± .010 [8,89 ± 0,25]
S2 = .375 ± .010 [8,89 ± 0,25]

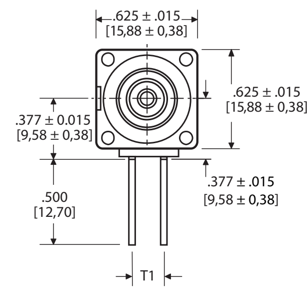
Switch terminal hole size: .045 ± .005 x .095 ± .005 [1,14 ± 0,13 x 2,41 ± 0,13]

15A-PC - Triple Potentiometer, Concentric Shaft, Solder Pins



As shown, Outer Shaft operates First Section





Dimension Notes:

T1 = .200 [5,08]
T2 = .300 ± .010 [7,62 ± 0,25]
T3 = .109 ± .010 [2,78 ± 0,25]
S1 = .350 ± .010 [8,89 ± 0,25]
S2 = .375 ± .010 [8,89 ± 0,25]

Switch terminal hole size: .045 ± .005 x .095 ± .005 [1,14 ± 0,13 x 2,41 ± 0,13]

Notes:

1. Potentiometer Terminals - .031 [,81] Dia., Soft Copper Cda Alloy 110, Tin Plate.
2. Switch Terminals - Soft Copper Cda Alloy 110, Bottom Terminals, Plate 20 Microinches Gold, Top Terminals Tin Plate.
3. Switch Terminal Thickness: 1 & 3, .012 [0,405]; 2 & 4, .018 [0,457]
4. All drawings are shown with 3/8" dia. bushing with 1/4" dia. shaft. 1/4" dia. bushing with 1/8" dia. shaft is available. Locking bushing is also available.
5. Refer to page 29 for Printed Circuit Board Layouts. Refer to page 30 for Bushing, Shaft and Hardware information. Refer to page 33 for Locating Lug options.
6. Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance ±.016 [0,40], except as specified.
7. Drawings not to scale.

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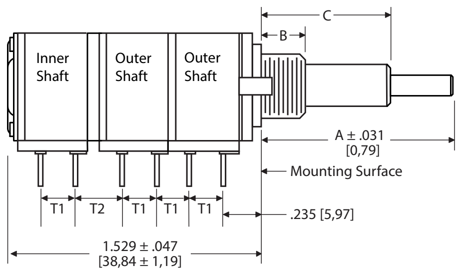
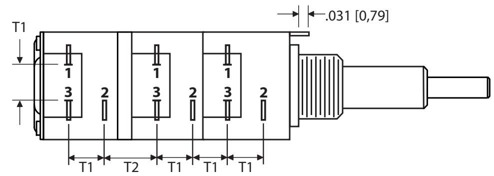
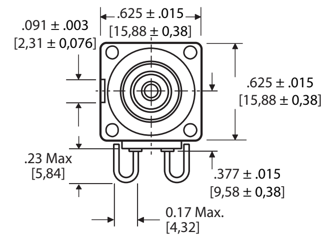
Section 5: Triple module, Concentric Shaft

15C - Triple Potentiometer, Concentric Shaft, Solder Hooks



As shown, Outer Shaft operates sections 1 & 2, Inner Shaft section 3



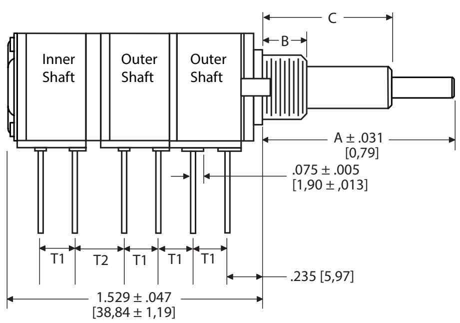


Dimension Notes:

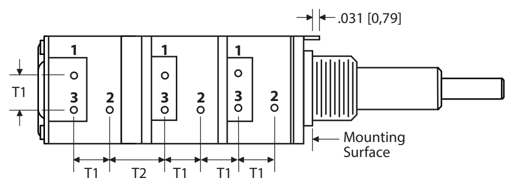
T1 = .200 [5,08]
T2 = .300 ± .010 [7,62 ± 0,25]
T3 = .109 ± .010 [2,78 ± 0,25]
S1 = .350 ± .010 [8,89 ± 0,25]
S2 = .375 ± .010 [8,89 ± 0,25]

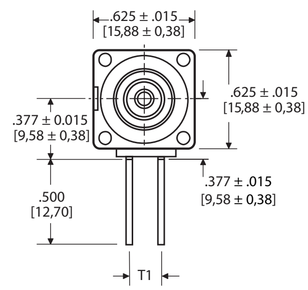
Switch terminal hole size: .045 ± .005 x .095 ± .005 [1,14 ± 0,13 x 2,41 ± 0,13]

15C-PC - Triple Potentiometer, Concentric Shaft, Solder Pins



As shown, Outer Shaft operates sections 1 & 2, Inner Shaft section 3





Dimension Notes:

T1 = .200 [5,08]
T2 = .300 ± .010 [7,62 ± 0,25]
T3 = .109 ± .010 [2,78 ± 0,25]
S1 = .350 ± .010 [8,89 ± 0,25]
S2 = .375 ± .010 [8,89 ± 0,25]

Switch terminal hole size: .045 ± .005 x .095 ± .005 [1,14 ± 0,13 x 2,41 ± 0,13]

Notes:

1. Potentiometer Terminals - .031 [,81] Dia., Soft Copper Cda Alloy 110, Tin Plate.
2. Switch Terminals - Soft Copper Cda Alloy 110, Bottom Terminals, Plate 20 Microinches Gold, Top Terminals Tin Plate.
3. Switch Terminal Thickness: 1 & 3, .012 [0,405]; 2 & 4, .018 [0,457]
4. All drawings are shown with 3/8" dia. bushing with 1/4" dia. shaft. 1/4" dia. bushing with 1/8" dia. shaft is available. Locking bushing is also available.
5. Refer to page 29 for Printed Circuit Board Layouts. Refer to page 30 for Bushing, Shaft and Hardware information. Refer to page 33 for Locating Lug options.
6. Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance ±.016 [0,40], except as specified.
7. Drawings not to scale.

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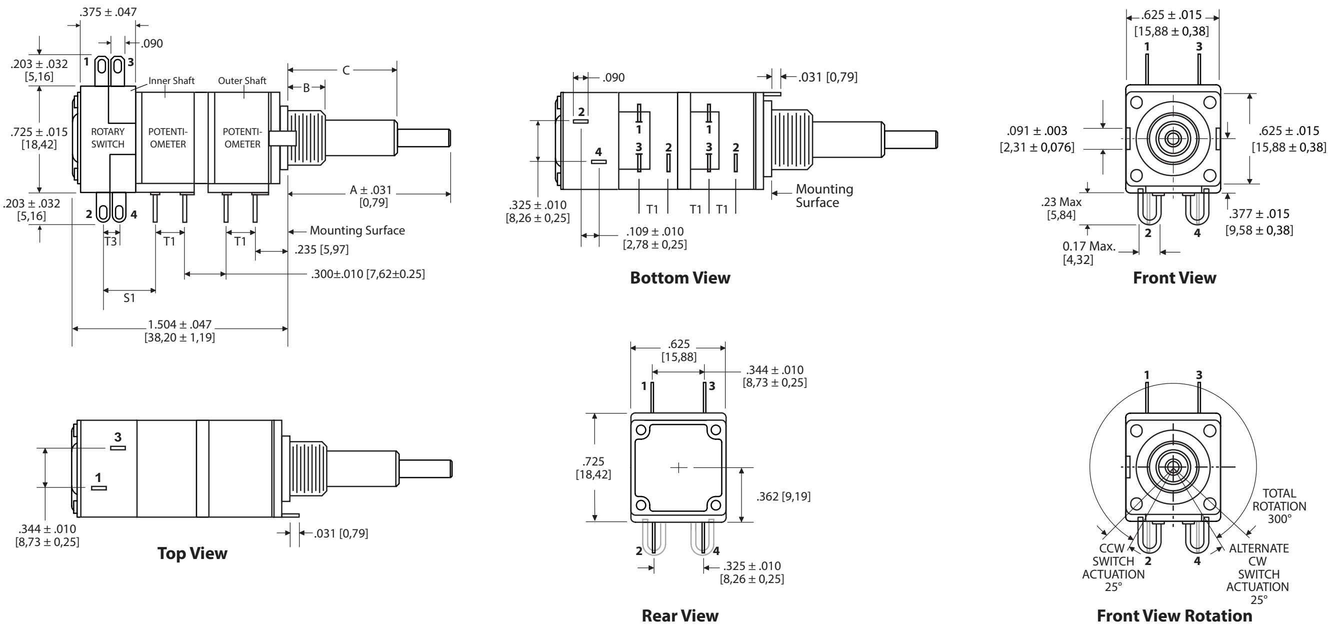
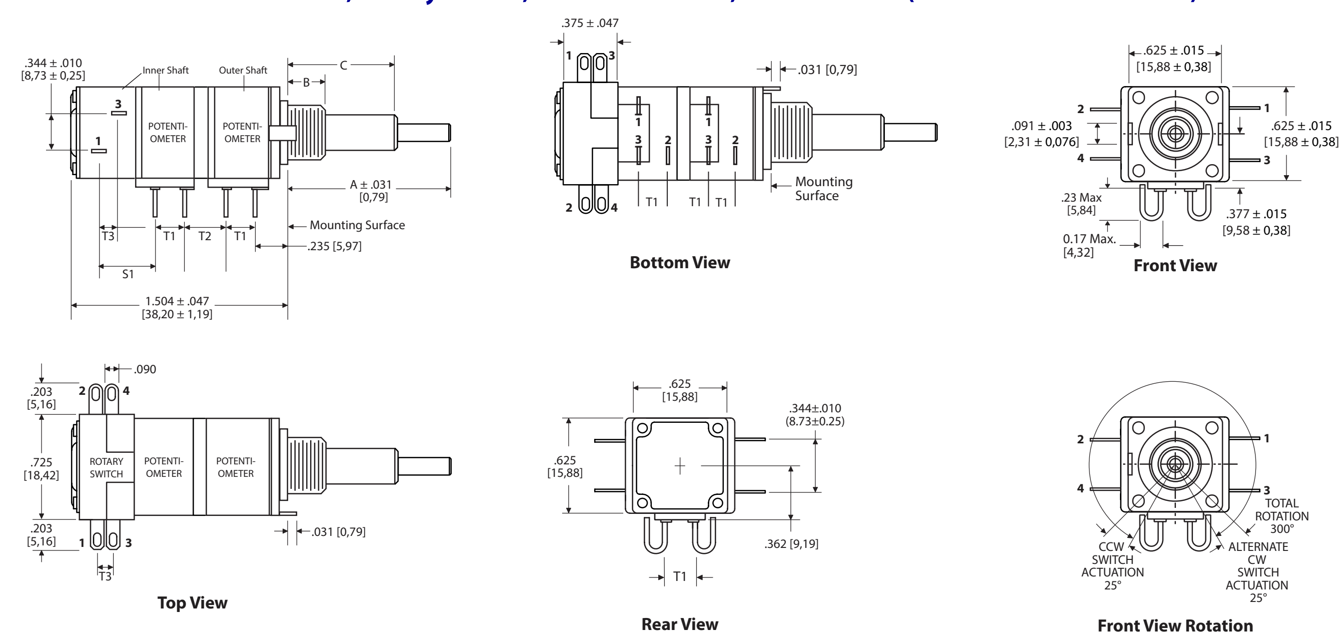
Section 5: Triple module, Concentric Shaft (continued)

16A - Dual Potentiometer, Rotary Switch, Concentric Shaft, Solder Hooks

[Switch Option specifications]



16A-90° - Dual Potentiometer, Rotary Switch, Concentric Shaft, Solder Hooks (Rotated Switch Module)



Dimension Notes:
T1 = .200 [5,08]
T2 = .300 ± .010 [7,62 ± 0,25]
T3 = .109 ± .010 [2,78 ± 0,25]
S1 = .350 ± .010 [8,89 ± 0,25]
S2 = .375 ± .010 [8,89 ± 0,25]

Switch terminal hole size: .045 ± .005 x .095 ± .005 [1,14 ± 0,13 x 2,41 ± 0,13]

Notes:

1. Potentiometer Terminals - .031 [,81] Dia., Soft Copper Cda Alloy 110, Tin Plate.
2. Switch Terminals - Soft Copper Cda Alloy 110, Bottom Terminals, Plate 20 Microinches Gold, Top Terminals Tin Plate.
3. Switch Terminal Thickness: 1 & 3, .012 [0,405]; 2 & 4, .018 [0,457]
4. All drawings are shown with 3/8" dia. bushing with 1/4" dia. shaft. 1/4" dia. bushing with 1/8" dia. shaft is available. Locking bushing is also available.
5. Refer to page 29 for Printed Circuit Board Layouts. Refer to page 30 for Bushing, Shaft and Hardware information. Refer to page 33 for Locating Lug options.
6. Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance ±.016 [0,40], except as specified.
7. Drawings not to scale.

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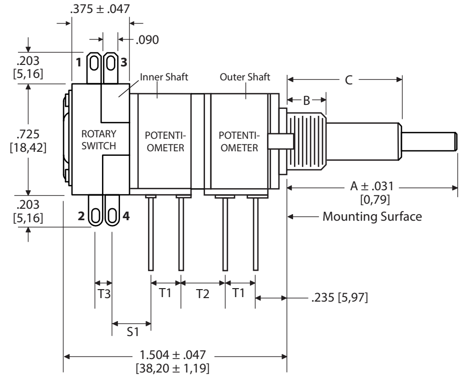
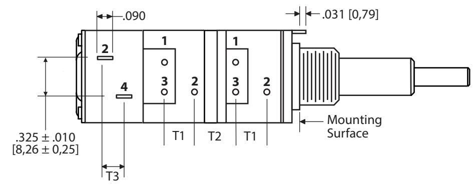
Section 5: Triple module, Concentric Shaft (continued)

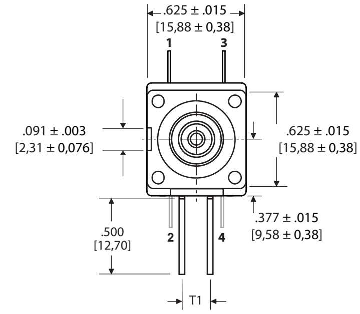
16A-PC - Dual Potentiometer, Rotary Switch, Concentric Shaft, Solder Pins

[Switch Option specifications]

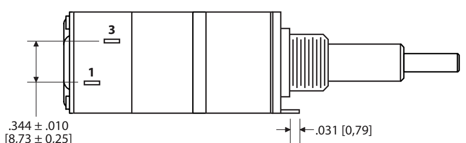




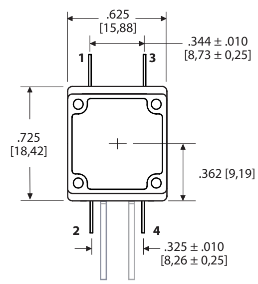
Bottom View



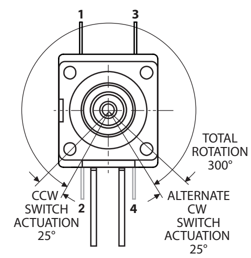
Front View



Top View



Rear View

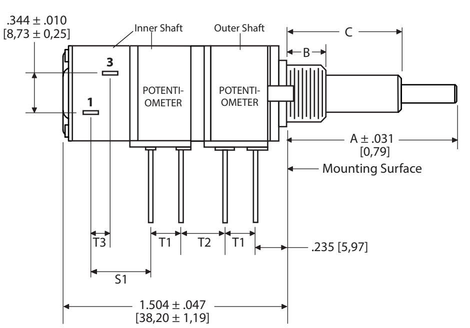


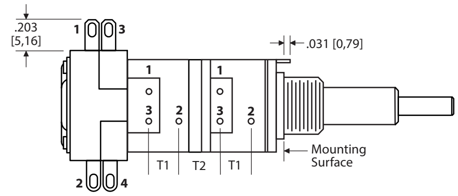
Front View Rotation

Dimension Notes:
- **T1** = .200 [5,08]
- **T2** = .300 ± .010 [7,62 ± 0,25]
- **T3** = .109 ± .010 [2,78 ± 0,25]
- **S1** = .350 ± .010 [8,89 ± 0,25]
- **S2** = .375 ± .010 [8,89 ± 0,25]

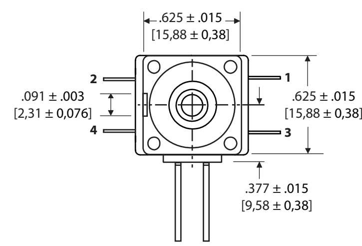
Switch terminal hole size: .045 ± .005 x .095 ± .005 [1,14 ± 0,13 x 2,41 ± 0,13]

16A-PC-90° - Dual Potentiometer, Rotary Switch, Concentric Shaft, Solder Pins (Rotated Switch Module)

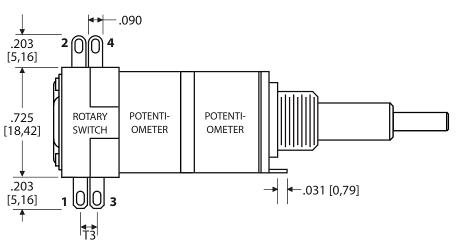




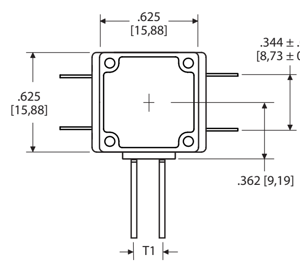
Bottom View



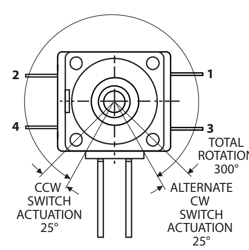
Front View



Top View



Rear View



Front View Rotation

Dimension Notes:
- **T1** = .200 [5,08]
- **T2** = .300 ± .010 [7,62 ± 0,25]
- **T3** = .109 ± .010 [2,78 ± 0,25]
- **S1** = .350 ± .010 [8,89 ± 0,25]
- **S2** = .375 ± .010 [8,89 ± 0,25]

Switch terminal hole size: .045 ± .005 x .095 ± .005 [1,14 ± 0,13 x 2,41 ± 0,13]

Notes:

1. Potentiometer Terminals - .031 [,81] Dia., Soft Copper Cda Alloy 110, Tin Plate.
2. Switch Terminals - Soft Copper Cda Alloy 110, Bottom Terminals, Plate 20 Microinches Gold, Top Terminals Tin Plate.
3. Switch Terminal Thickness: 1 & 3, .012 [0,405]; 2 & 4, .018 [0,457]
4. All drawings are shown with 3/8" dia. bushing with 1/4" dia. shaft. 1/4" dia. bushing with 1/8" dia. shaft is available. Locking bushing is also available.
5. Refer to page 29 for Printed Circuit Board Layouts. Refer to page 30 for Bushing, Shaft and Hardware information. Refer to page 33 for Locating Lug options.
6. Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance ±.016 [0,40], except as specified.
7. Drawings not to scale.

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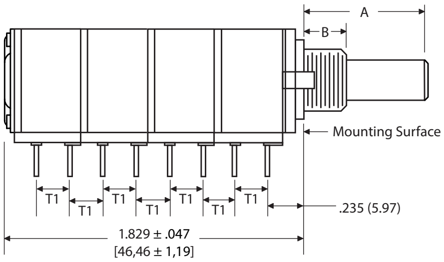
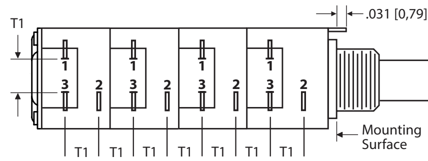
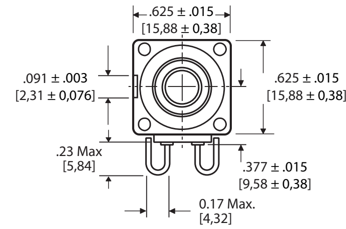
Section 6: Quad module, Single Shaft

23A - Quad Potentiometer, Single Shaft, Solder Hooks





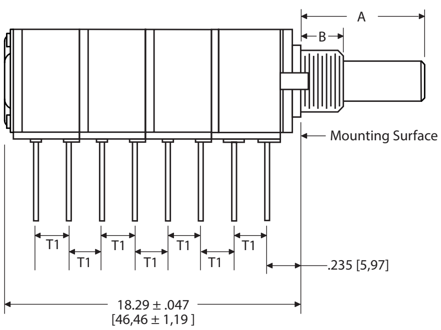


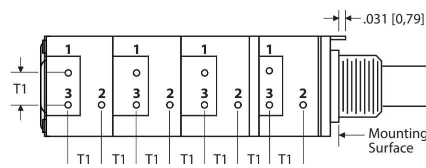
Dimension Notes:

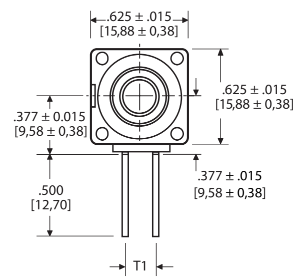
T1 = .200 [5,08]
T2 = .300 ± .010 [7,62 ± 0,25]
T3 = .109 ± .010 [2,78 ± 0,25]
S1 = .350 ± .010 [8,89 ± 0,25]
S2 = .375 ± .010 [8,89 ± 0,25]

Switch terminal hole size: .045 ± .005 x .095 ± .005 [1,14 ± 0,13 x 2,41 ± 0,13]

23A-PC - Quad Potentiometer, Single Shaft, Solder Pins







Dimension Notes:

T1 = .200 [5,08]
T2 = .300 ± .010 [7,62 ± 0,25]
T3 = .109 ± .010 [2,78 ± 0,25]
S1 = .350 ± .010 [8,89 ± 0,25]
S2 = .375 ± .010 [8,89 ± 0,25]

Switch terminal hole size: .045 ± .005 x .095 ± .005 [1,14 ± 0,13 x 2,41 ± 0,13]

Notes:

1. Potentiometer Terminals - .031 [,81] Dia., Soft Copper Cda Alloy 110, Tin Plate.
2. Switch Terminals - Soft Copper Cda Alloy 110, Bottom Terminals, Plate 20 Microinches Gold, Top Terminals Tin Plate.
3. Switch Terminal Thickness: 1 & 3, .012 [0,405]; 2 & 4, .018 [0,457]
4. All drawings are shown with 3/8" dia. bushing with 1/4" dia. shaft. 1/4" dia. bushing with 1/8" dia. shaft is available. Locking bushing is also available.
5. Refer to page 29 for Printed Circuit Board Layouts. Refer to page 30 for Bushing, Shaft and Hardware information. Refer to page 33 for Locating Lug options.
6. Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance ±.016 [0,40], except as specified.
7. Drawings not to scale.

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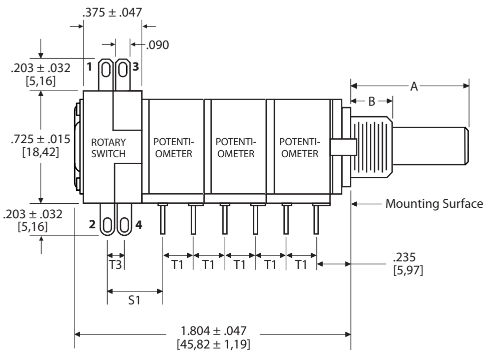
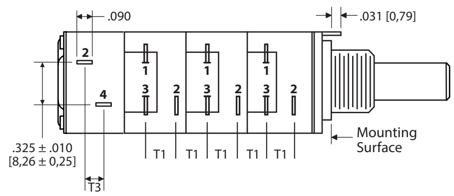
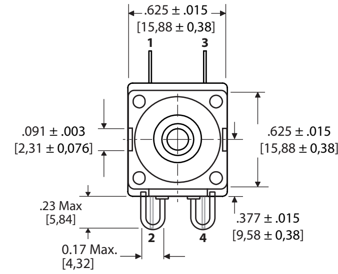
23D - Triple Potentiometer, Rotary Switch, Solder Hooks

[Switch Option specifications]

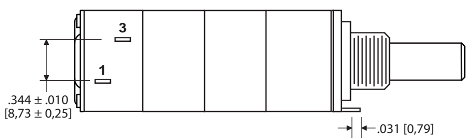




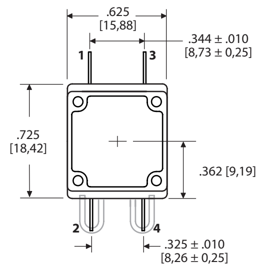
Bottom View



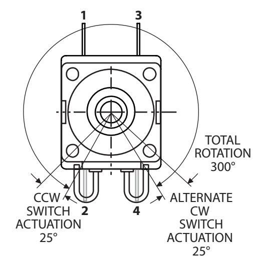
Front View



Top View



Rear View

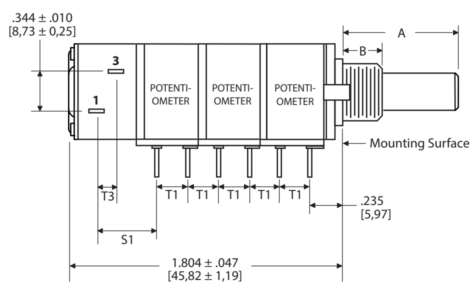


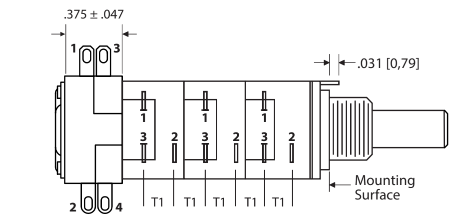
Front View Rotation

Dimension Notes:
T1 = .200 [5,08]
T3 = .109 ± .010 [2,78 ± 0,25]
S1 = .350 ± .010 [8,89 ± 0,25]
S2 = .375 ± .010 [8,89 ± 9,52]

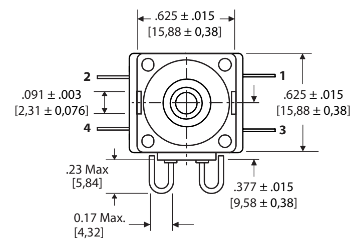
Switch terminal hole size: .045 ± .005 x .095 ± .005 [1,14 ± 0,13 x 2,41 ± 0,13]

23D-90° - Triple Potentiometer, Rotary Switch, Solder Hooks (Rotated Switch Module)

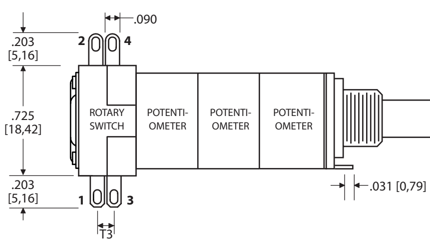




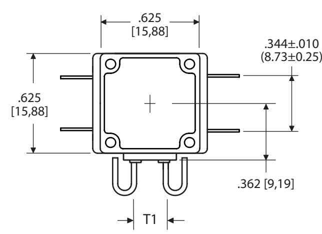
Bottom View



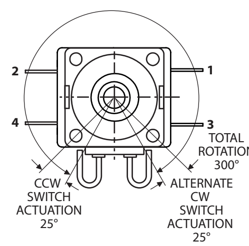
Front View



Top View



Rear View



Front View Rotation

Dimension Notes:
T1 = .200 [5,08]
T3 = .109 ± .010 [2,78 ± 0,25]
T4 = .300 ± .010 [7,62 ± 0,25]
S1 = .350 ± .010 [8,89 ± 0,25]
S2 = .375 ± .010 [8,89 ± 9,52]

Switch terminal hole size: .045 ± .005 x .095 ± .005 [1,14 ± 0,13 x 2,41 ± 0,13]

Notes:

1. Potentiometer Terminals - .031 [,81] Dia., Soft Copper Cda Alloy 110, Tin Plate.
2. Switch Terminals - Soft Copper Cda Alloy 110, Bottom Terminals, Plate 20 Microinches Gold, Top Terminals Tin Plate.
3. Switch Terminal Thickness: 1 & 3, .012 [0,405]; 2 & 4, .018 [0,457]
4. All drawings are shown with 3/8" dia. bushing with 1/4" dia. shaft. 1/4" dia. bushing with 1/8" dia. shaft is available. Locking bushing is also available.
5. Refer to page 29 for Printed Circuit Board Layouts. Refer to page 30 for Bushing, Shaft and Hardware information. Refer to page 33 for Locating Lug options.
6. Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance ±.016 [0,40], except as specified.
7. Drawings not to scale.

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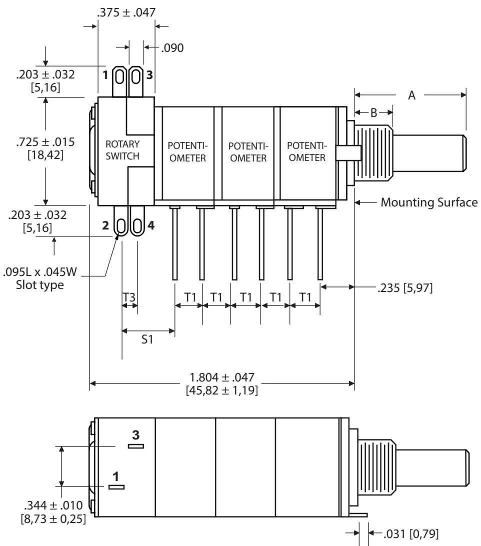
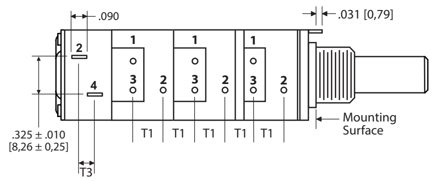
23D-PC - Triple Potentiometer, Rotary Switch, Solder Pins

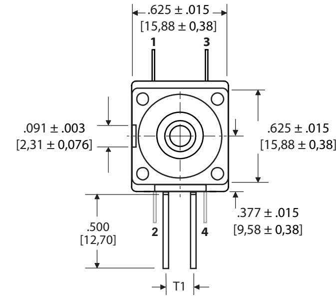
[Switch Option specifications]



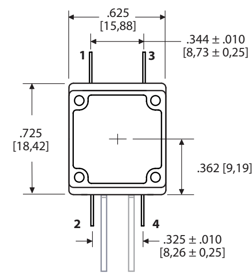
Top View



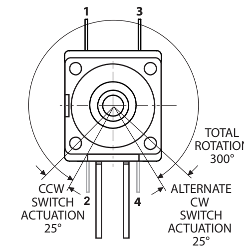
Bottom View



Front View



Rear View

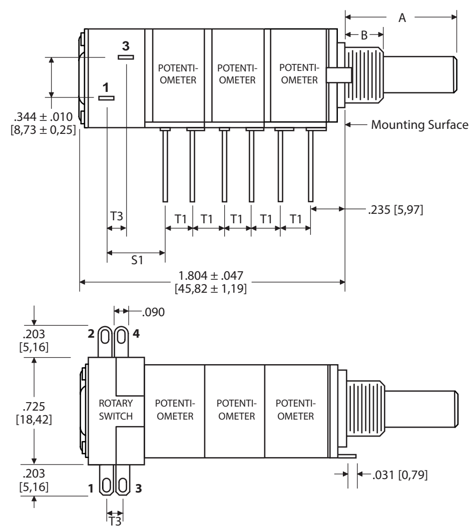


Front View Rotation

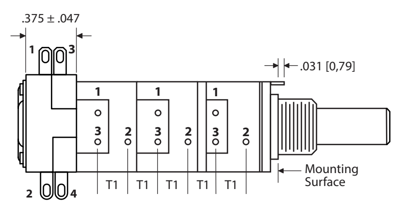
Dimension Notes:
T1 = .200 [5,08]
T2 = .300 ± .010 [7,62 ± 0,25]
T3 = .109 ± .010 [2,78 ± 0,25]
S1 = .350 ± .010 [8,89 ± 0,25]
S2 = .375 ± .010 [8,89 ± 0,25]

Switch terminal hole size: .045 ± .005 x .095 ± .005 [1,14 ± 0,13 x 2,41 ± 0,13]

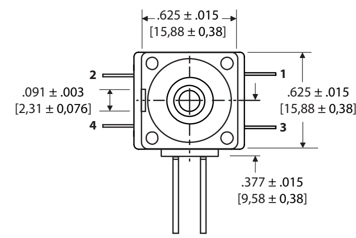
23D-PC-90° - Triple Potentiometer, Rotary Switch, Solder Pins (Rotated Switch Module)



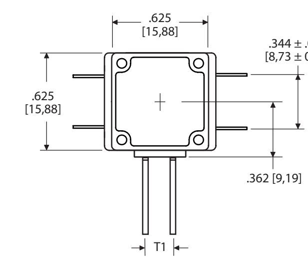
Top View



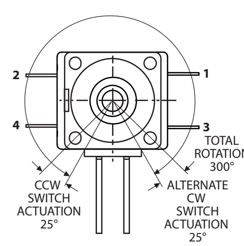
Bottom View



Front View



Rear View



Front View Rotation

Dimension Notes:
T1 = .200 [5,08]
T2 = .300 ± .010 [7,62 ± 0,25]
T3 = .109 ± .010 [2,78 ± 0,25]
S1 = .350 ± .010 [8,89 ± 0,25]
S2 = .375 ± .010 [8,89 ± 0,25]

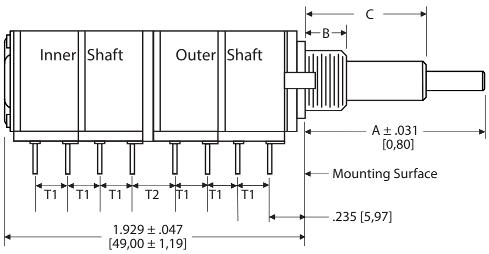
Switch terminal hole size: .045 ± .005 x .095 ± .005 [1,14 ± 0,13 x 2,41 ± 0,13]

Notes:

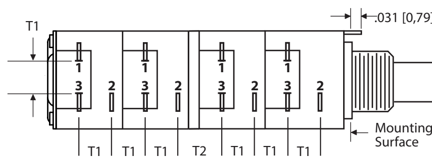
1. Potentiometer Terminals - .031 [,81] Dia., Soft Copper Cda Alloy 110, Tin Plate.
2. Switch Terminals - Soft Copper Cda Alloy 110, Bottom Terminals, Plate 20 Microinches Gold, Top Terminals Tin Plate.
3. Switch Terminal Thickness: 1 & 3, .012 [0,405]; 2 & 4, .018 [0,457]
4. All drawings are shown with 3/8" dia. bushing with 1/4" dia. shaft. 1/4" dia. bushing with 1/8" dia. shaft is available. Locking bushing is also available.
5. Refer to page 29 for Printed Circuit Board Layouts. Refer to page 30 for Bushing, Shaft and Hardware information. Refer to page 33 for Locating Lug options.
6. Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance ±.016 [0,40], except as specified.
7. Drawings not to scale.

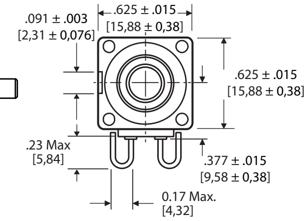
Section 7: Quad module, Concentric Shaft

26A - Quad Potentiometer, Solder Hooks



As shown, Outer Shaft operates first two sections



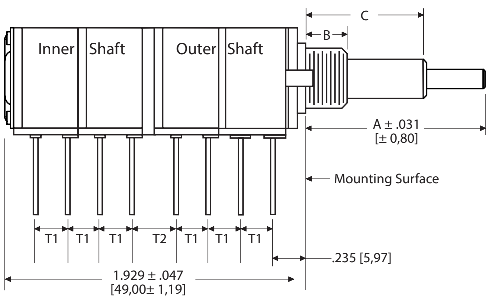


Dimension Notes:

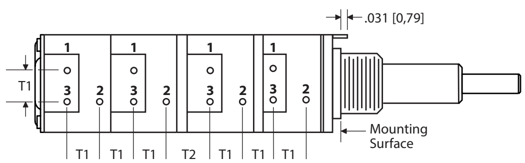
T1 = .200 [5,08]
T2 = .300 ± .010 [7,62 ± 0,25]
T3 = .109 ± .010 [2,78 ± 0,25]
S1 = .350 ± .010 [8,89 ± 0,25]
S2 = .375 ± .010 [8,89 ± 0,25]

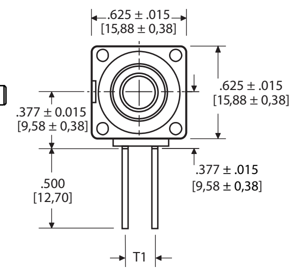
Switch terminal hole size: .045 ± .005 x .095 ± .005 [1,14 ± 0,13 x 2,41 ± 0,13]

26A-PC - Quad Potentiometer, Solder Pins



As shown, Outer Shaft operates first two sections





Dimension Notes:

T1 = .200 [5,08]
T2 = .300 ± .010 [7,62 ± 0,25]
T3 = .109 ± .010 [2,78 ± 0,25]
S1 = .350 ± .010 [8,89 ± 0,25]
S2 = .375 ± .010 [8,89 ± 0,25]

Switch terminal hole size: .045 ± .005 x .095 ± .005 [1,14 ± 0,13 x 2,41 ± 0,13]

Notes:

1. Potentiometer Terminals - .031 [,81] Dia., Soft Copper Cda Alloy 110, Tin Plate.
2. Switch Terminals - Soft Copper Cda Alloy 110, Bottom Terminals, Plate 20 Microinches Gold, Top Terminals Tin Plate.
3. Switch Terminal Thickness: 1 & 3, .012 [0,405]; 2 & 4, .018 [0,457]
4. All drawings are shown with 3/8" dia. bushing with 1/4" dia. shaft. 1/4" dia. bushing with 1/8" dia. shaft is available. Locking bushing is also available.
5. Refer to page 29 for Printed Circuit Board Layouts. Refer to page 30 for Bushing, Shaft and Hardware information. Refer to page 33 for Locating Lug options.
6. Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance ±.016 [0,40], except as specified.
7. Drawings not to scale.

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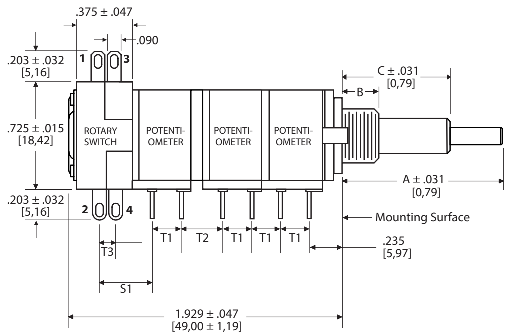
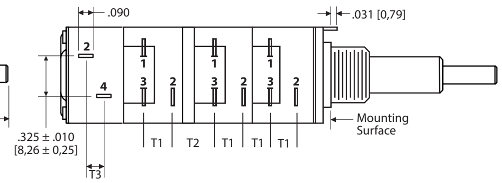
Section 7: Quad module, Concentric Shaft (continued)

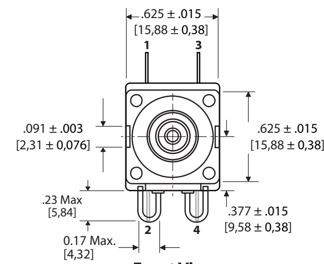
27A - Triple Potentiometer, Rotary Switch, Solder Hooks

[Switch Option specifications]

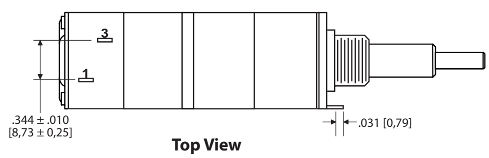




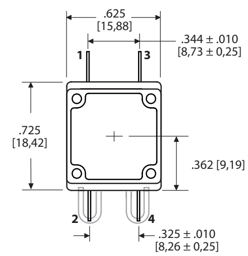
Bottom View



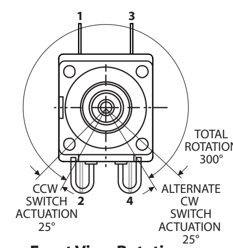
Front View



Top View



Rear View



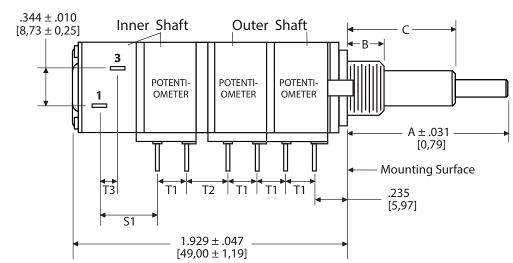
Front View Rotation

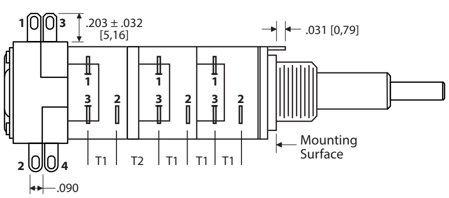
Dimension Notes:

T1 = .200 [5,08]
T2 = .300 ± .010 [7,62 ± 0,25]
T3 = .109 ± .010 [2,78 ± 0,25]
S1 = .350 ± .010 [8,89 ± 0,25]
S2 = .375 ± .010 [8,89 ± 0,25]

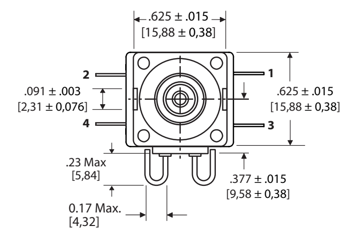
Switch terminal hole size: .045 ± .005 x .095 ± .005 [1,14 ± 0,13 x 2,41 ± 0,13]

27A-90° - Triple Potentiometer, Rotary Switch, Solder Hooks (Rotated Switch Module)

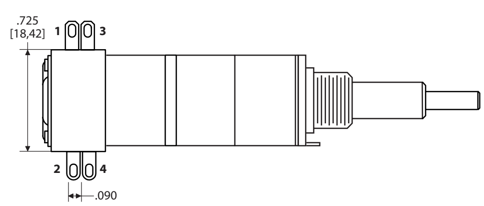




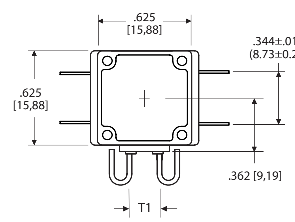
Bottom View



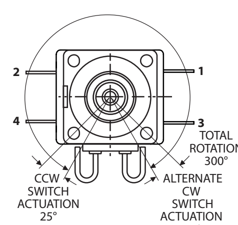
Front View



Top View



Rear View



Front View Rotation

Dimension Notes:

T1 = .200 [5,08]
T2 = .300 ± .010 [7,62 ± 0,25]
T3 = .109 ± .010 [2,78 ± 0,25]
S1 = .350 ± .010 [8,89 ± 0,25]
S2 = .375 ± .010 [8,89 ± 0,25]

Switch terminal hole size: .045 ± .005 x .095 ± .005 [1,14 ± 0,13 x 2,41 ± 0,13]

Notes:

1. Potentiometer Terminals - .031 [,81] Dia., Soft Copper Cda Alloy 110, Tin Plate.
2. Switch Terminals - Soft Copper Cda Alloy 110, Bottom Terminals, Plate 20 Microinches Gold, Top Terminals Tin Plate.
3. Switch Terminal Thickness: 1 & 3, .012 [0,405]; 2 & 4, .018 [0,457]
4. All drawings are shown with 3/8" dia. bushing with 1/4" dia. shaft. 1/4" dia. bushing with 1/8" dia. shaft is available. Locking bushing is also available.
5. Refer to page 29 for Printed Circuit Board Layouts. Refer to page 30 for Bushing, Shaft and Hardware information. Refer to page 33 for Locating Lug options.
6. Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance ±.016 [0,40], except as specified.
7. Drawings not to scale.

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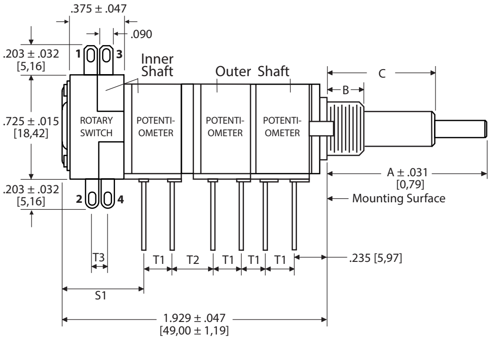
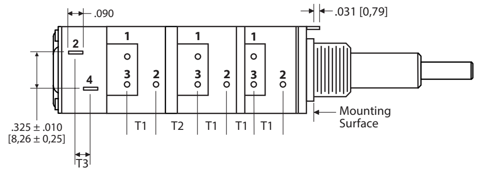
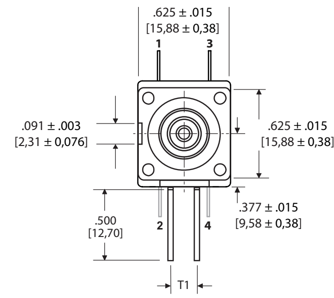
27A-PC - Triple Potentiometer, Rotary Switch, Solder Pins

[Switch Option specifications]

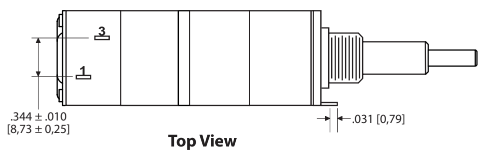




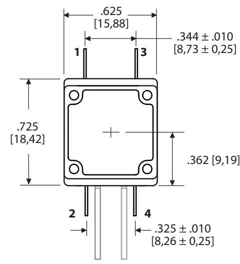
Bottom View



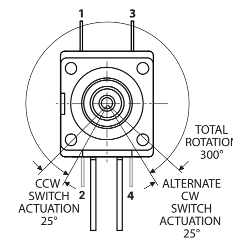
Front View



Top View



Rear View



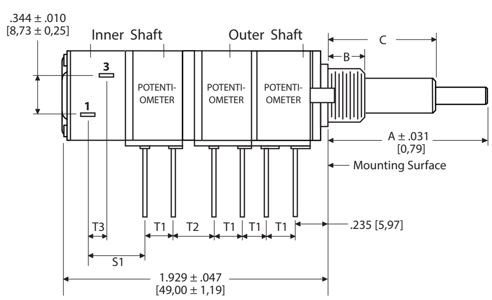
Front View Rotation

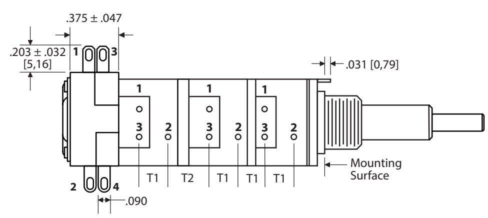
Dimension Notes:

T1 = .200 [5,08]
T2 = .300 ± .010 [7,62 ± 0,25]
T3 = .109 ± .010 [2,78 ± 0,25]
S1 = .350 ± .010 [8,89 ± 0,25]
S2 = .375 ± .010 [8,89 ± 0,25]

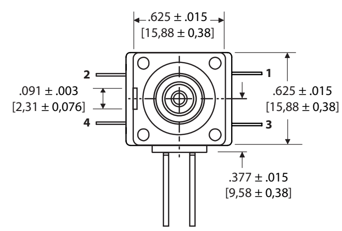
Switch terminal hole size: .045 ± .005 x .095 ± .005 [1,14 ± 0,13 x 2,41 ± 0,13]

27A-PC-90° - Triple Potentiometer, Rotary Switch, Solder Pins (Rotated Switch Module)

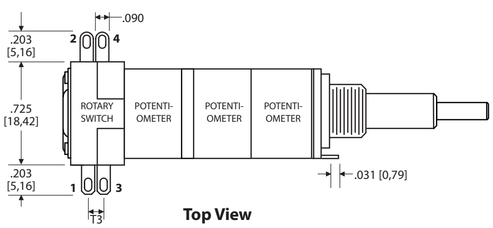




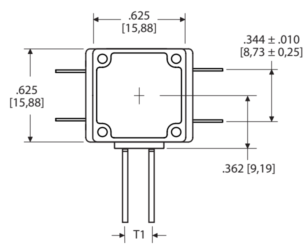
Bottom View



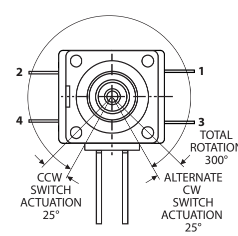
Front View



Top View



Rear View



Front View Rotation

Dimension Notes:

T1 = .200 [5,08]
T2 = .300 ± .010 [7,62 ± 0,25]
T3 = .109 ± .010 [2,78 ± 0,25]
S1 = .350 ± .010 [8,89 ± 0,25]
S2 = .375 ± .010 [8,89 ± 0,25]

Switch terminal hole size: .045 ± .005 x .095 ± .005 [1,14 ± 0,13 x 2,41 ± 0,13]

Notes:

1. Potentiometer Terminals - .031 [,81] Dia., Soft Copper Cda Alloy 110, Tin Plate.
2. Switch Terminals - Soft Copper Cda Alloy 110, Bottom Terminals, Plate 20 Microinches Gold, Top Terminals Tin Plate.
3. Switch Terminal Thickness: 1 & 3, .012 [0,405]; 2 & 4, .018 [0,457]
4. All drawings are shown with 3/8" dia. bushing with 1/4" dia. shaft. 1/4" dia. bushing with 1/8" dia. shaft is available. Locking bushing is also available.
5. Refer to page 29 for Printed Circuit Board Layouts. Refer to page 30 for Bushing, Shaft and Hardware information. Refer to page 33 for Locating Lug options.
6. Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance ±.016 [0,40], except as specified.
7. Drawings not to scale.

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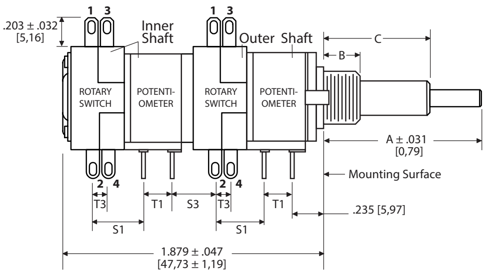
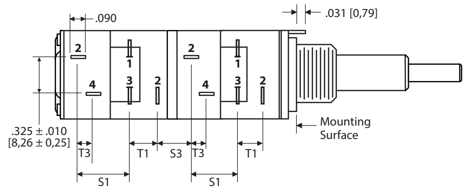
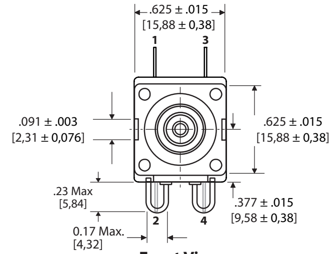
28B - Potentiometer, Rotary Switch, Potentiometer, Rotary Switch, Solder Hooks

Switch Option specifications

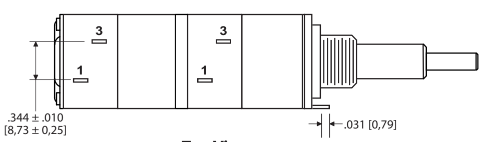




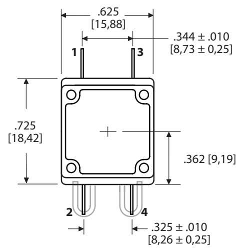
Bottom View



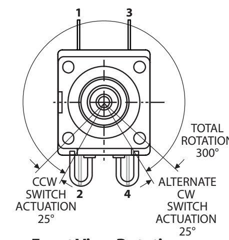
Front View



Top View



Rear View

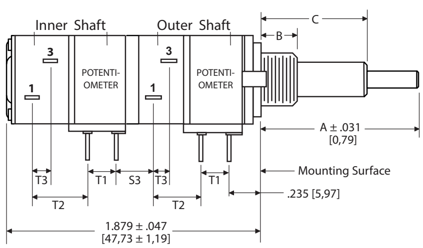


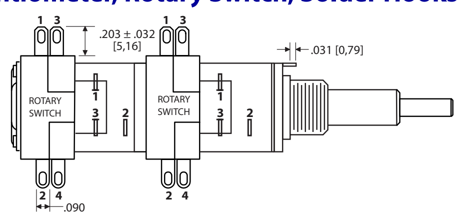
Front View Rotation

Dimension Notes:
T1 = .200 [5,08]
T2 = .300 ± .010 [7,62 ± 0,25]
T3 = .109 ± .010 [2,78 ± 0,25]
S1 = .350 ± .010 [8,89 ± 0,25]
S2 = .375 ± .010 [8,89 ± 0,25]
S3 = .450 ± .010 [11,43 ± 0,25]

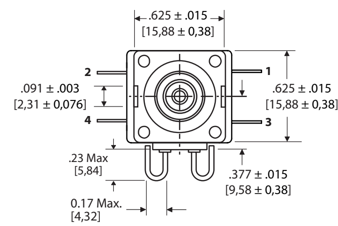
Switch terminal hole size: .045 ± .005 x .095 ± .005 [1,14 ± 0,13 x 2,41 ± 0,13]

28B-90° - Potentiometer, Rotary Switch, Potentiometer, Rotary Switch, Solder Hooks (Rotated Switch Modules)

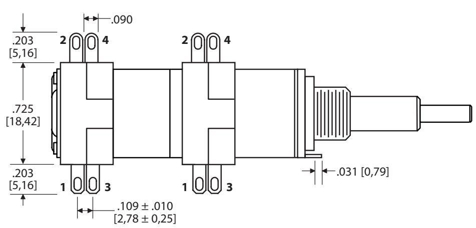




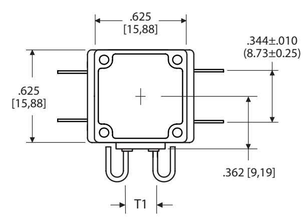
Bottom View



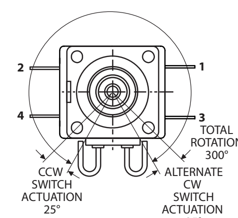
Front View



Top View



Rear View



Front View Rotation

Dimension Notes:
T1 = .200 [5,08]
T2 = .300 ± .010 [7,62 ± 0,25]
T3 = .109 ± .010 [2,78 ± 0,25]
S1 = .350 ± .010 [8,89 ± 0,25]
S2 = .375 ± .010 [8,89 ± 0,25]
S3 = .450 ± .010 [11,43 ± 0,25]

Switch terminal hole size: .045 ± .005 x .095 ± .005 [1,14 ± 0,13 x 2,41 ± 0,13]

Notes:

1. Potentiometer Terminals - .031 [,81] Dia., Soft Copper Cda Alloy 110, Tin Plate.
2. Switch Terminals - Soft Copper Cda Alloy 110, Bottom Terminals, Plate 20 Microinches Gold, Top Terminals Tin Plate.
3. Switch Terminal Thickness: 1 & 3, .012 [0,405]; 2 & 4, .018 [0,457]
4. All drawings are shown with 3/8" dia. bushing with 1/4" dia. shaft. 1/4" dia. bushing with 1/8" dia. shaft is available. Locking bushing is also available.
5. Refer to page 29 for Printed Circuit Board Layouts. Refer to page 30 for Bushing, Shaft and Hardware information. Refer to page 33 for Locating Lug options.
6. Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance ±.016 [0,40], except as specified.
7. Drawings not to scale.

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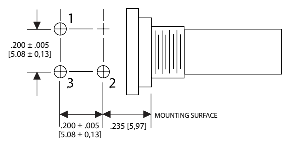
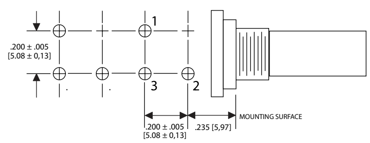
RECOMMENDED PC BOARD LAYOUTS

SINGLE SHAFT

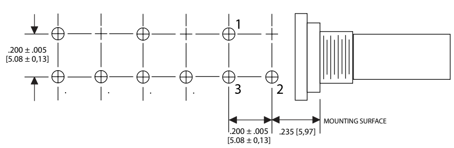
Recommended PC Board Hole Size = .045 [1,14]



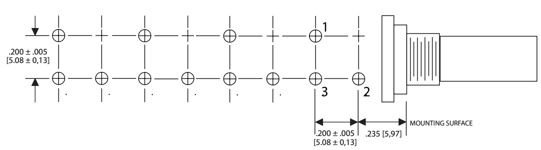
SINGLE SECTION



DUAL SECTION

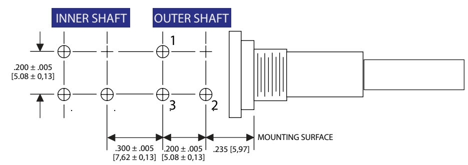


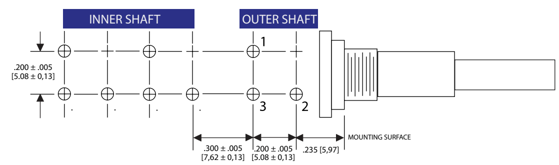
TRIPLE SECTION

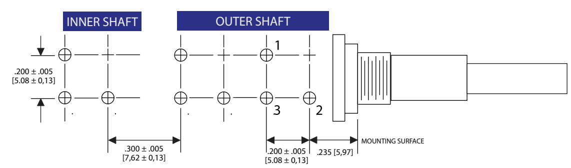


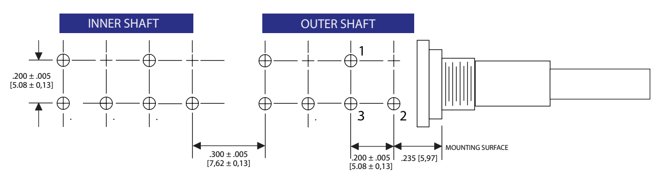
QUAD SECTION

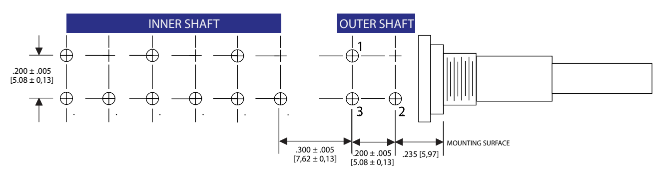
CONCENTRIC SHAFTS

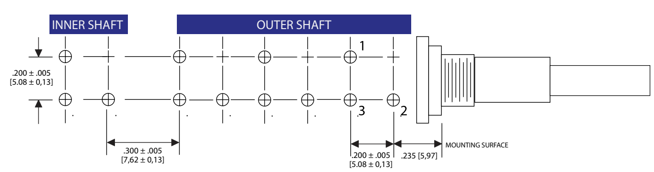












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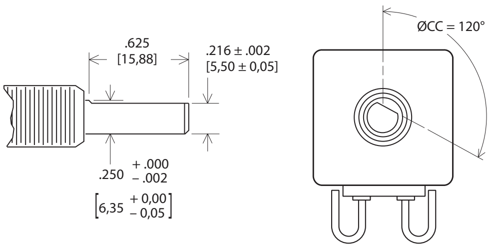
DIMENSIONS

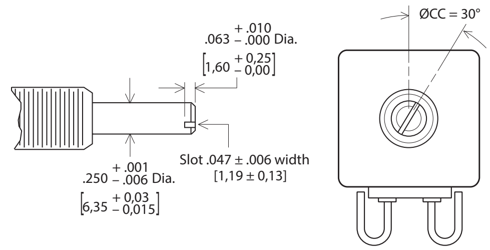
Bushing & Shaft Dimensions

1/4" Standard Flatted Shaft



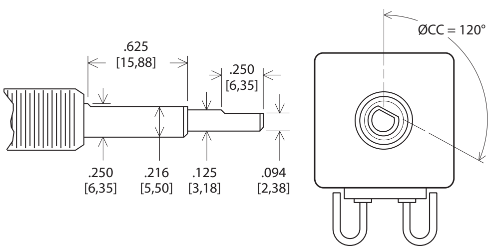
Flat is opposite movable contact

1/4" Standard Slotted Shaft



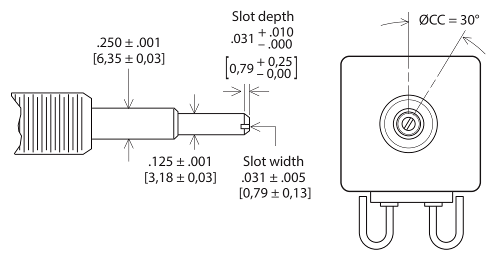
Screwdriver slot is in line with movable contact

1/4" Standard Concentric Flatted Shaft



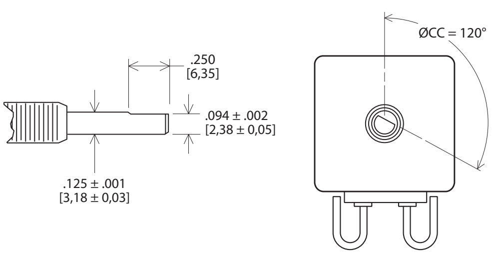
Flat is opposite movable contact

1/4" Standard Concentric Slotted Shaft



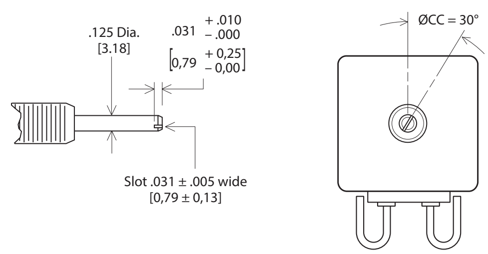
Screwdriver slot is in line with movable contact

1/8" Standard Flatted Shaft (F1 Shown)



Flat is opposite movable contact

1/8" Standard Slotted Shaft

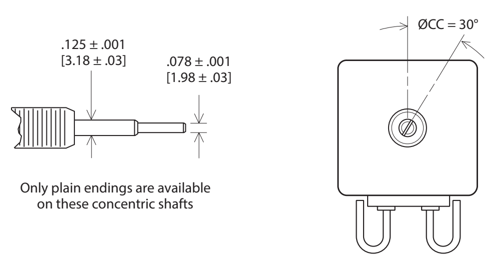


Screwdriver slot is in line with movable contact

Flat will extend to within .031 [0,79] of mounting bushing where shaft length will not permit standard flat.

All shafts are shown in extreme counterclockwise position. Angle applies to potentiometers only.

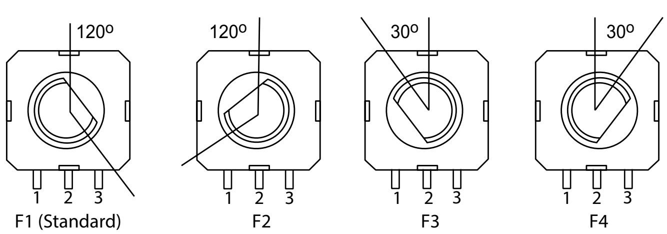
1/8" Concentric Shafts



Only plain endings are available on these concentric shafts

Shaft Flat Orientations

(Other Angles Available)



Standard Bushing and Shaft Dimensions are shown on Page 11

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Bushing & Shaft Combinations

Type	Shaft Dia. Inch [mm]	Used With Bushing Inch [mm]	Shaft Ending		
			Slotted	Flatted	Plain
Single Shaft	.250 [6,35] Dia. Solid	.375 [9,52] Dia. Bushing	X	X	X
Single Shaft	.125 [3,18] Dia. Solid	.250 [6,35] Dia.Bushing	X	X	X
Concentric Shaft	.250 [6,35] Dia. Outer Hollow	.375 [9,52] Dia. Bushing	X	X	X
	.125 [3,17] Dia. Inner Solid		X	X	X
Concentric Shaft	.125 [3,17] Dia. Outer Hollow	.250 [6,35] Dia. Bushing	X	X	X
	.078" [1,98] Solid Inner		N/A	N/A	X

Popular Shaft Lengths

Fraction	Inch	Metric
1/4	.250	6,35
3/8	.375	9,52
7/16	.4375	11,11
1/2	.500	12,70
5/8	.625	15,88
3/4	.750	19,05
7/8	.875	22,23
1	1.00	25,40
1-1/8	1.125	28,58
1-1/4	1.25	31,75
1-1/2	1.50	38,10
2	2.00	50,80
2-1/2	2.50	63,50
3	3.00	76,20

Popular BushingLengths

Diameter Inch [mm]	Type	Length Inch [mm]	
.250 [6,35]	Plain	.250 [6,35]	
		.375 [9,52]	
		.500 [12,7]	
	Locking	.375 [9,52]	
		.500 [12,7]	
.375 [9,52]	Plain	.250 [6,35]	
		.375 [9,52]	
		.500 [12,7]	
	Locking	.375 [9,52]	
		.500 [12,7]	

- Shaft and Bushing lengths are both measured from the mounting surface (FMS).
- The inner shaft on a concentric shaft design must be sufficiently longer than the outer shaft to accommodate a knob.
- A shaft flat must end be at least 0.312 [0,79] above the top of the bushing.
- We can manufacturer any other bushing or shaft profile to meet your requirements.
- Metric sized shafts and bushing are available.

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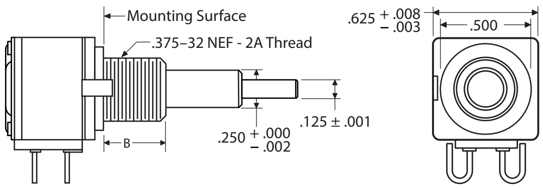
DIMENSIONS

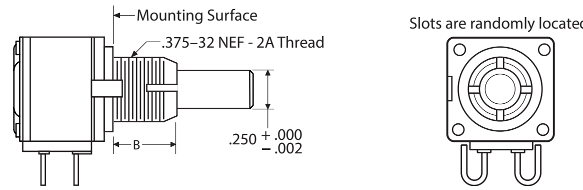
Bushing and Hardware Dimensions

3/8" Plain Bushing



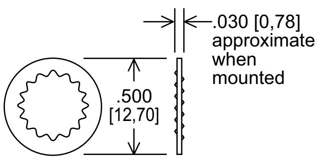
"B" STANDARD BUSHING LENGTHS
.250 [6,35] – **.375** [9,53] - **.500** [12.7]

3/8" Locking Bushing

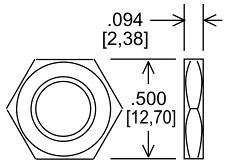


"B" STANDARD BUSHING LENGTHS
.375 [9,53] - **.500** [12.7]

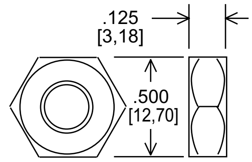
Mounting Hardware for 3/8" Bushing



LOCK WASHER



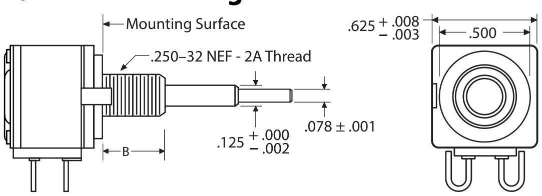
MOUNTING NUT



LOCK NUT

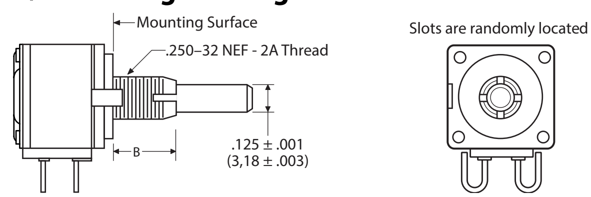
MAXIMUM MOUNTING PANEL THICKNESS:
.062–.188 [1,59–4,76]
when used with
one standard M-2898 Lock Washer
and one standard M-2786 Mounting Nut

1/4" Plain Bushing



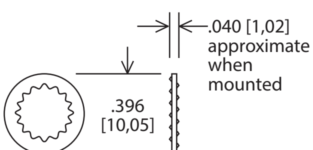
"B" STANDARD BUSHING LENGTHS
.250 [6,35] – **.375** [9,53] - **.500** [12.7]

1/4" Locking Bushing

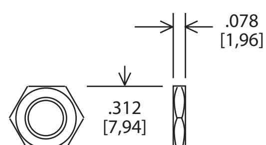


"B" STANDARD BUSHING LENGTHS
.375 [9,53] - **.500** [12.7]

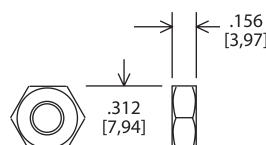
Mounting Hardware for 1/4" Bushing



LOCK WASHER



MOUNTING NUT



LOCK NUT

MAXIMUM MOUNTING PANEL THICKNESS:
.062–.188 [1,59–4,76]
when used with
one standard M-2898 Lock Washer
and one standard M-2786 Mounting Nut

[Standard Bushing and Shaft Dimensions are shown on Page 11]

Dimensions
Basic dimensions are in inches.
Dimensions shown in brackets are in millimeters.

Tolerance
Dimensional tolerance ±.016 [0,40]
Angular tolerance ± 5°, except as specified

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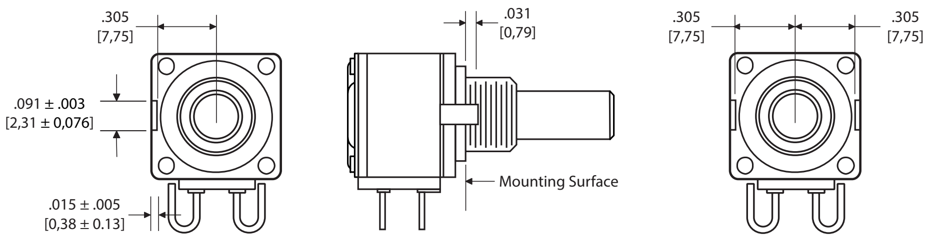
DIMENSIONS

Locating Lug Options – Series S159

Options A, B & C (.305 Center) Option C is standard and is used unless otherwise specified

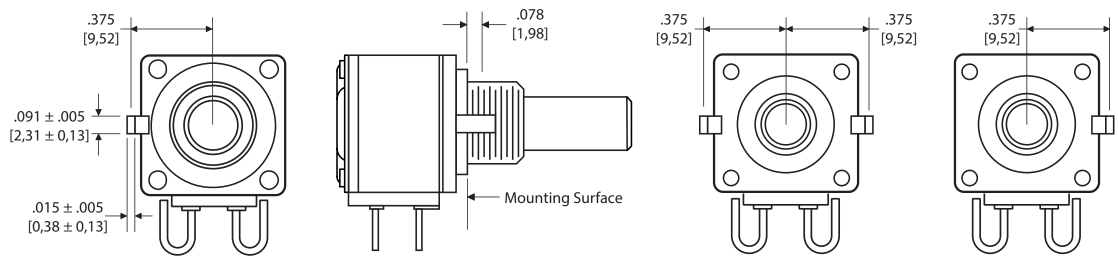


OPTION C single left lug
9 o'clock / 270°

OPTION B left & right lugs
3 & 9 o'clock / 90 & 270°

OPTION A single right lug
90° / 3 o'clock

Options J, K & J9 (.347 Center) Compatible with Mil-Spec RV5

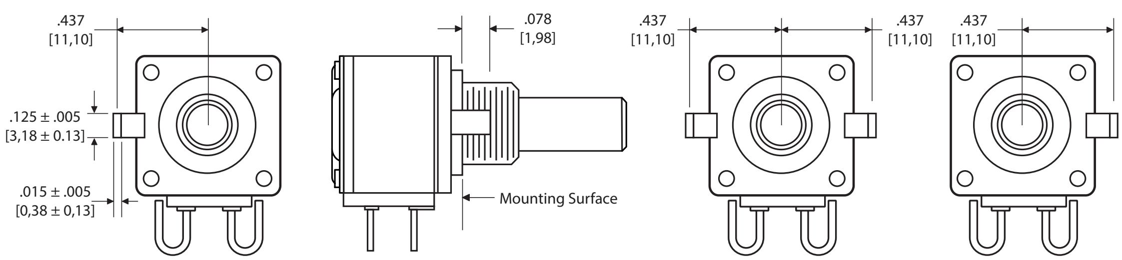


OPTION J Extended left lug
9 o'clock / 270°

OPTION K Extended left & right lug
3 & 9 o'clock / 90 & 270°

OPTION J9 Extended right lug 90°
/ 3 o'clock

Options 6, 7 and C (.437 Center) Special Order Only

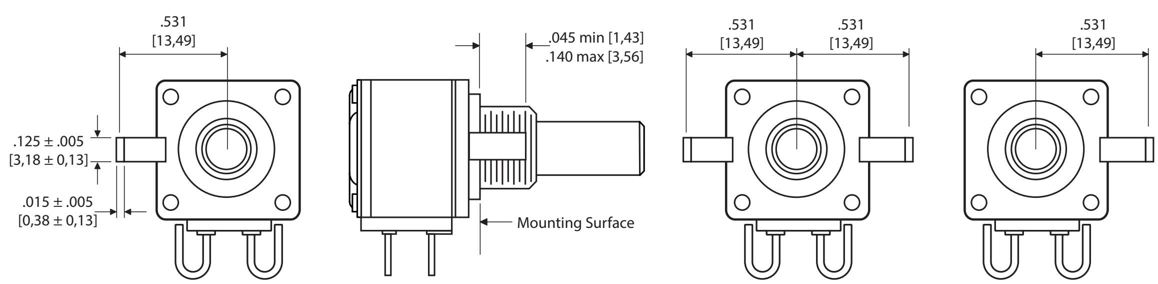


OPTION ?? Extended left lug
9 o'clock / 270°

OPTION ?? Extended left & right lug
3 & 9 o'clock / 90 & 270°

OPTION ?? Extended right lug
90° / 3 o'clock

Options 8, 9 and D (.531 Center) Compatible with Mil-Spec RV4



OPTION E Extended left lug
9 o'clock / 270°

OPTION ?? Extended left & right lug
3 & 9 o'clock / 90 & 270°

OPTION E Extended right lug
90° / 3 o'clock

Basic dimensions in inches.
Dimensions in brackets are in millimeters.

TOLERANCE

Dimensional tolerance ±.016 [0,40] except as specified.

NOT TO SCALE

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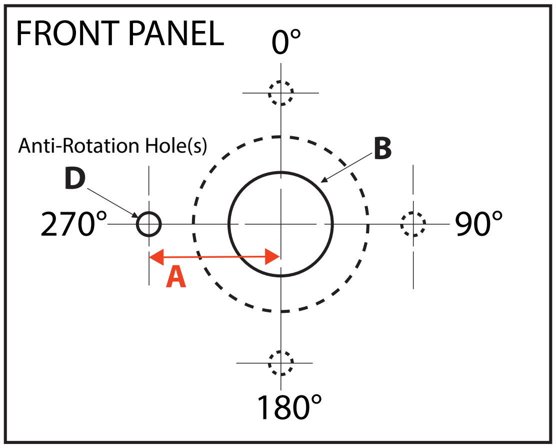
DIMENSIONS

Mounting Holes



1/4" Diameter Bushing - DIMENSION B

Minimum hole dia. for 1/4" dia. bushing = .261 [6,63]

3/8" Diameter Bushing - DIMENSION B

Minimum hole dia. for 1/4" dia. bushing = .406 [10,31]

ANTI-ROTATION LUG OPTIONS

"A" LUG LOCATION	**LUG OPTION**	Number of Lugs	**ORIENTATION** Clockwise (CW) from top of potentiometer	**DIMENSION "D"** Anti-Rotation Lug Hole dia.
0.305" [7,75] MOD-POT™	D	0	0º (12 o'clock)	Not required
		1	90º (3 o'clock)	.096 [2,44]
		1	180º (6 o'clock)	
	C (std)	1	270º (9 o'clock)	
		1	0º & 180º	
		2	90º & 270º	
		2	0º & 180º	
.375" [9,52] MIL-R-94 RV5		0	0º (12 o'clock)	Not required
	J	1	90º (3 o'clock)	.096 [2,44]
		1	180º (6 o'clock)	
	K	1	270º (9 o'clock)	
	SPECIAL	1	0º & 180º	
	E	2	90º & 270º	
	N	2	0º & 180º	
.437 [11,10] MIL-R-94 RV2	N	0	0º (12 o'clock)	Not required
		1	90º (3 o'clock)	.128 [3,24]
	SPECIAL	1	180º (6 o'clock)	
	E	1	270º (9 o'clock)	
		1	0º & 180º	
		2	90º & 270º	
		2	0º & 180º	
.531 [13,49 MIL-R-94 RV4		0	0º (12 o'clock)	Not required
		1	90º (3 o'clock)	.128 [3,24]
		1	180º (6 o'clock)	
		1	270º (9 o'clock)	
		1	0º & 180º	
		2	90º & 270º	
		2	0º & 180º	

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Ordering Information - Single Turn Potentiometers

Example Part Number: **S159PC-A3A-B24-A103-A103-SW50CW** (Two 10K Potentiometer Modules, plus Rotary Switch Module)

S159PCR A3AB24 A103 A103 SW50CWOPTIONS

G100-116
See shaft comments

Model
S159

Anti-Rotation Lug:
- **A** = Single .305" R, 90° CW
- **B** = Double .305" R, 90° & 270° CW
- **C** = Single .305" R, 270° CW
- **G** = Single .305" R, 0° CW
- **D** = No Lug
- **E** = Single .531" R, 90° CW
- **F** = Single .305" R, 180° CW
- **J** = Single .375" R, 90° CW
- **K** = Double .375" R, 90° & 270° CW
- **L** = Single .375" R, 270° CW
- **M** = Single .531" R, 270° CW
- **N** = Double .531" R, 90° & 270° CW

Configuration #:
See *page page 36*

Bushing:
- **A** = Plain 3/8" Dia. x 3/8" Length
- **B** = Locking 3/8" Dia. x 3/8" Length
- **C** = Plain 1/4" Dia. x 1/4" Length
- **D** = Plain 1/4" Dia. x 1/2" Length
- **E** = Locking 1/4" Dia. x 1/2" Length
- **F** = Plain 3/8" Dia. x 1/2" Length
- **J** = Plain 3/8" Dia. x 1/4" Length
- **N** = Plain 1/4" Dia. x 3/8" Length

Metric Bushings - Special Order

Style:
- **PC** = Potentiometer Module(s) PC Board Pin
- **SH** = Potentiometer Module(s) Solder Hooks
- **PCR** = Potentiometer Module(s) PC Board Pins + Switch(es)
- **SHR** = Potentiometer Module(s) Solder Hooks + Switch(es)

Rotary Switch Module(s) have solder lugs.

Element & Taper:
- **A** = Linear Cermet 10%
- **H** = Linear Cermet 5%
- **E** = Linear Conductive Plastic 10%
- **C** = CW Audio Cermet 10%
- **F** = CCW Audio Cermet 10%
- **D** = CW Audio Conductive Plastic 10%
- **T** = CCW Audio Conductive Plastic 10%
- **SP** = Modified Linear Conductive Plastic
- **SC** = Modified Linear Cermet

Resistance:

101 = 100 ohms	**752** = 7.5K ohms
151 = 150 ohms	**103** = 10K ohms
201 = 200 ohms	**153** = 15K ohms
251 = 250 ohms	**203** = 20K ohms
501 = 500 ohms	**253** = 25K ohms
751 = 750 ohms	**503** = 50K ohms
102 = 1.0K ohms	**753** = 75K ohms
152 = 1.5K ohms	**104** = 100K ohms
202 = 2.0K ohms	**254** = 250K ohms
252 = 2.5 K ohms	**504** = 500K ohms
202 = 2.0K ohms	**105** = 1M ohms
502 = 5.0K ohms	

Switch Vertical Terminals:
- **SW50CW** = DPST N.O./N.C. CW
- **SW51CCW** = DPST N.O./N.C. CCW (standard)
- **SW52CW** = DPST N.O./N.O. CW
- **SW53CCW** = DPST N.O./N.O. CCW

Switch Horzontal Terminals:
- **SW56HCW** = DPST N.O./N.C. CW
- **SW57HCCW** = DPST N.O./N.C. CCW
- **SW58HCW** = DPST N.O./N.O. CW
- **SW59HCCW** = DPST N.O./N.O. CCW
- **SWPP** = PUSH-PULL SPDT X 2
- **SWPPM** = PUSH-PULL SPDT X 2

- **SS** = Internal shaft seal
- **SPS** = Shaft & panel seal
- **MT** = Medium torque

List multiple options sequentially and separated by a dash (-)

Part number for multiple section potentiometers must have a taper and resistance value and/or switch codelisted for each section, sequenced front to rear.

Maximum of 2 rotary switches per shaft. First module on each shaft must be a potentiometer.

Shaft:

Code	**Description**
A =	Single Plain 1/4" Dia.
B =	Single Slotted 1/4" Dia.
C =	Single Flatted 1/4 " Dia. (Std F1 Orientation)
E =	Single Slotted 1/8 " Dia.
F =	Single Flatted 1/8 " Dia. (Std F1 Orientation)
G =	Dual Concentric Plain Outer 1/4" Dia. - Inner 1/8" Dia.
K =	Dual Concentric Plain Outer 1/8" Dia. - Inner 5/64" Dia.

Metric Shafts - Special Order

Concentric shafts will require two shaft lengths to be designated as follows:

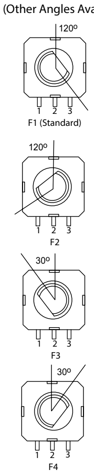
Configuration = G or K followed by Outer shaft length code "X" Inner shaft length

Example: G100X124

Dual Concentric Plain:
Outer 1/4" Dia., 1" long
Inner 1/8" Dia., 1-3/4" long

Code	**Shaft Length (FMS)**
12 =	3/8"
16 =	1/2"
20 =	5/8"
24 =	3/4"
28 =	7/8"
100 =	1"
104 =	1-1/8"
108 =	1-1/4"
112 =	1-3/8"
116 =	1-1/2"
120 =	1-5/8"
124 =	1-3/4"
128 =	1-7/8"
200 =	2"
208 =	2-1/4"
216 =	2-1/2"
224 =	2-3/4
300 =	3"

Shaft Flat Orientations
(Other Angles Available)



Design considerations:

1. The shaft diameter will determine the bushing diameter.
2. Shaft and bushing lengths are always measured from the mounting surface (FMS), and therefore the shaft length is always greater than the bushing length.
3. Imperial shaft & bushing lengths shown above are designated in 32nds: 24 = 24/32" or 3/4 of an inch.
4. Special shaft and bushings lengths or profiles are available. Full list of shaft length codes - See page **page 37**

The part numbering format shown above is for pre-production specifications only and will not be the same as the production version. Once a design has been finalized a unique identifier is assigned which reflects all of the options approved by the customer. Due to the unlimited number of feature combinations, it may not be possible to use the above to specify your requirement. All of the specifications listed in this catalog may not apply to certain combinations of options.

For pricing and delivery information, Create an RFQ on our website or contact a State Electronics Sales Specialist at 800-631-8083.

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MOD-POT² ™ Potentiometer - Single Turn Potentiometer Configuration Options

SINGLE SHAFT

		Section #							
Total Sections	MP2 Config #	Panel 1	2	3	4	5	6	7	8
1	1	S							
2	2	S	S						
3	3	S	S	S					
4	4	S	S	S	S				
5	5	S	S	S	S	S			
6	6	S	S	S	S	S	S		
7	7	S	S	S	S	S	S	S	
8	8	S	S	S	S	S	S	S	S

CONCENTRIC SHAFTS

		Section #							
		O = Section Controlled by Outer Shaft				I = Section Controlled by Inner Shaft			
Total Sections	MP2 Config #	Panel 1	2	3	4	5	6	7	8
2	11	O	I						
3	21	O	O	I					
3	12	O	I	I					
4	22	O	O	I	I				
4	31	O	O	O	I				
4	13	O	I	I	I				
5	41	O	O	O	O	I			
5	32	O	O	O	I	I			
5	23	O	O	I	I	I			
5	14	O	I	I	I	I			
6	51	O	O	O	O	O	I		
6	42	O	O	O	O	I	I		
6	33	O	O	O	I	I	I		
6	24	O	O	I	I	I	I		
6	15	O	I	I	I	I	I		
7	61	O	O	O	O	O	O	I	
7	52	O	O	O	O	O	I	I	
7	43	O	O	O	O	I	I	I	
7	34	O	O	O	I	I	I	I	
7	25	O	O	I	I	I	I	I	
7	16	O	I	I	I	I	I	I	
8	71	O	O	O	O	O	O	O	I
8	62	O	O	O	O	O	O	I	I
8	53	O	O	O	O	O	I	I	I
8	44	O	O	O	O	I	I	I	I
8	35	O	O	O	I	I	I	I	I
8	26	O	O	I	I	I	I	I	I
8	17	O	I	I	I	I	I	I	I

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MOD-POT² Potentiometer - Shaft Length Codes

Fraction	Shaft Code 32nds	FMS in.	FMS mm
1/32	01	0.03125	0,7938
1/16	02	0.06250	1,5875
3/32	03	0.09375	2,3813
1/8	04	0.12500	3,1750
5/32	05	0.15625	3,9688
3/16	06	0.18750	4,7625
7/32	07	0.21875	5,5563
1/4	08	0.25000	6,3500
9/32	09	0.28125	7,1438
5/16	10	0.31250	7,9375
11/32	11	0.34375	8,7313
3/8	12	0.37500	9,5250
13/32	13	0.40625	10,3188
7/16	14	0.43750	11,1125
15/32	15	0.46875	11,9063
1/2	16	0.50000	12,7000
17/32	17	0.53125	13,4938
9/16	18	0.56250	14,2875
19/32	19	0.59375	15,0813
5/8	20	0.62500	15,8750
21/32	21	0.65625	16,6688
11/16	22	0.68750	17,4625
23/32	23	0.71875	18,2563
3/4	24	0.75000	19,0500
25/32	25	0.78125	19,8438
13/16	26	0.81250	20,6375
27/32	27	0.84375	21,4313
7/8	28	0.87500	22,2250
29/32	29	0.90625	23,0188
15/16	30	0.93750	23,8125
31/32	31	0.96875	24,6063
1	100	1.00000	25,4000

Fraction	Shaft Code 32nds	FMS in.	FMS mm
1-1/32	101	1.0313	26,1938
1-1/16	102	1.0625	26,9875
1-3/32	103	1.0938	27,7813
1-1/8	104	1.1250	28,5750
1-5/32	105	1.1563	29,3688
1-3/16	106	1.1875	30,1625
1-7/32	107	1.2188	30,9563
1-1/4	108	1.2500	31,7500
1-9/32	109	1.2813	32,5438
1-5/16	110	1.3125	33,3375
1-11/32	111	1.3438	34,1313
1-3/8	112	1.3750	34,9250
1-13/32	113	1.4063	35,7188
1-7/16	114	1.4375	36,5125
1-15/32	115	1.4688	37,3063
1-1/2	116	1.5000	38,1000
1-17/32	117	1.5313	38,8938
1-9/16	118	1.5625	39,6875
1-19/32	119	1.5938	40,4813
1-5/8	120	1.6250	41,2750
1-21/32	121	1.6563	42,0688
1-11/16	122	1.6875	42,8625
1-23/32	123	1.7188	43,6563
1-3/4	124	1.7500	44,4500
1-25/32	125	1.7813	45,2438
1-13/16	126	1.8125	46,0375
1-27/32	127	1.8438	46,8313
1-7/8	128	1.8750	47,6250
1-29/32	129	1.9063	48,4188
1-15/16	130	1.9375	49,2125
1-31/32	131	1.9688	50,0063
2	200	2.0000	50,8000

Fraction	Shaft Code 32nds	FMS in.	FMS mm
2-1/32	201	2.0313	51,5938
2-1/16	202	2.0625	52,3875
2-3/32	203	2.0938	53,1813
2-1/8	204	2.1250	53,9750
2-5/32	205	2.1563	54,7688
2-3/16	206	2.1875	55,5625
2-7/32	207	2.2188	56,3563
2-1/4	208	2.2500	57,1500
2-9/32	209	2.2813	57,9438
2-5/16	210	2.3125	58,7375
2-11/32	211	2.3438	59,5313
2-3/8	212	2.3750	60,3250
2-13/32	213	2.4063	61,1188
2-7/16	214	2.4375	61,9125
2-15/32	215	2.4688	62,7063
2-1/2	216	2.5000	63,5000
2-17/32	217	2.5313	64,2938
2-9/16	218	2.5625	65,0875
2-19/32	219	2.5938	65,8813
2-5/8	220	2.6250	66,6750
2-21/32	221	2.6563	67,4688
2-11/16	222	2.6875	68,2625
2-23/32	223	2.7188	69,0563
2-3/4	224	2.7500	69,8500
2-25/32	225	2.7813	70,6438
2-13/16	226	2.8125	71,4375
2-27/32	227	2.8438	72,2313
2-7/8	228	2.8750	73,0250
2-29/32	229	2.9063	73,8188
2-15/16	230	2.9375	74,6125
2-31/32	231	2.9688	75,4063
3	300	3.0000	76,2000

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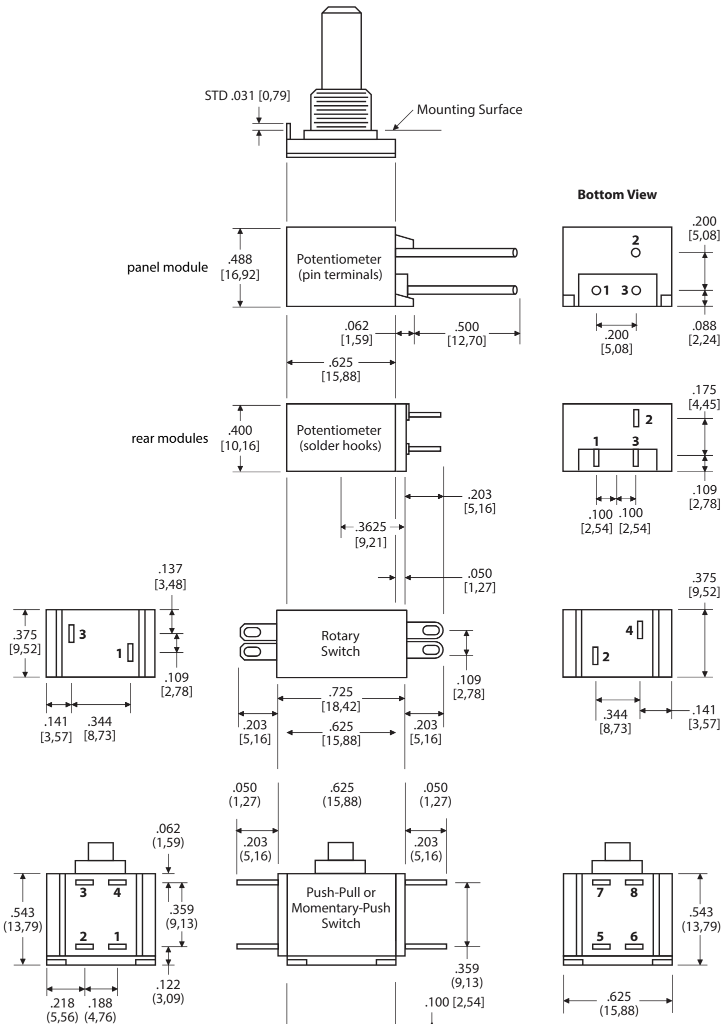
DIMENSIONS

Master Assembly Drawing



All drawings are shown with 3/8" dia. bushing with 1/4" dia. shaft. 1/4" diameter bushing with 1/8" diameter shaft is available. Locking bushing is also available.

Refer to page 34 for **Locating Lug options**.

Potentiometer (pin terminal) module. Up to four modules of this type can be included in an assembly.

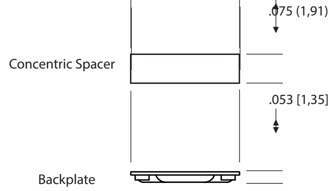
Potentiometer (solder hook) module. Up to four modules of this type can be included in an assembly.

Rotary Switch module. Multiple modules of this type can be included in an assembly. This module can be assembled sideways if needed for easier access to solder lugs.

Refer to page 38 for **Switch options**.

Push-Pull or Push-Momentary module. single module of this type can be included in an assembly, but must be the last module. This module can be assembled sideways if needed for easier access to solder lugs.

Refer to page 38 for **Switch options**.



Concentric Spacer is installed between resistive modules or when a rotary switch follows a rotary switch with concentric shaft construction.

Backplate

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Mod-Pot™ SERIES OPTIONS

	5/8" Square / Modular Design				1/2" Square / Modular Design		
	The 70, 72 & 73 Obsolete Replaced by S159 Series		S159		S88 / 388	S89 / 389	S127
Technology	**Conductive Plastic**	**Cermet**	**Conductive Plastic**	**Cermet**	**Conductive Plastic**	**Cermet**	**Conductive Plastic**
Max Wattage Rating	1-Watt	2-Watt	1-Watt	2-Watt	1/2-Watt	1	1/2-Watt
Operating Temperature (°C)	-55 ° to 120 °	-55 ° to 150 °	-40 ° to 125 °	-40 ° to 125 °	-55° to 120°	-55° to 150°	-55° to 125°
Temperature Coefficient (TC)	+/-5% (Typical)	150 PPM °C	+/-10%	150 PPM °C	+/-5% (Typical)	150 PPM °C	+/-5% (Typical)
Rotational Life	100,000		100,000		50,000	25,000	1,000,000
Mechanical Rotation	300°	300°	300°	300°	295°	295°	295°
Effective Electrical Rotation (ERA)	260° LinearTapers	260° LinearTapers	265° Linear Taper	265° Linear Taper	265° Linear Taper	265° Linear Taper	265°
	260° Non- Linear Tapers	260° Non- Linear Tapers	225° Non-Linear Taper	225° Non-Linear Taper	265° Non-Linear Taper	265° Non-Linear Taper	250° Non-Linear Taper
PC Board Support Feet	No	No	No	No	Yes	Yes	Yes
Verticle Mount	No	No	No	No	Yes	Yes	Special Order
Sections	6		4		8		4
Detents	Not Available		Not Available		Center, CW+CCW, 11 Other - Special Order		Center & 11
Rotary Switch CCW or CW Detent Maximum of 2-Switches per Shaft	2A @125VAC, 1 x SPST, N.O. + 1 x SPST N.C. Or SPDT with Wire Jumper 25,000 cycles		2A @125VAC, 2A @28VDC, 1A @ 250VAC 1 x SPST, N.O. + 1 x SPST N.C. Or SPDT with Wire Jumper 25,000 cycles		125 MA @ 28VDC SPDT		0.5A @ 30VDC SPDT CCW Detent Only
Push-Pull Switch	2A @125VAC 1 x DPST, N.O. + 1 x DPST N.C. or DPDT with Wire Jumper. 25,000 cycles		Not Available		250 MA @ 30 VDC SPST N.O. + SPST N.C. or SPDT with Wire Jumper		Not Available
Push-Momentary							
Push-On / Push-Off	Not Available		Not Available		Optional 500 MA @ 30VDC DPDT		
Max Shaft Single Length	3"		3"		3"		2"
Concentric Shafts .078 / .125	6-Sections		6-Sections		6-Sections		Not Available
Concentric Shafts .125 / .250	6-Sections						
Vernier Drive	Optional		10-Turn Option		No		No
Internal Shaft Seal	Optional		Optional		Optional		Standard
IP Rated	No		IP40		No		IP67
Motorized Option	No		No		Yes		No
Stop Torque	4 lb.-in.		4 lb.-in.		3 lb.-in.		2.5 lb.-in.
High Stop Torque	Not Available		Not Available		8 in / pd 5 in / pd for 1/8" Dia with o-ring		Not Available
Rotational Torque Standard (Min / Max) Single section	0.3 / 3.0 oz.-in.		0.2 to 1.5 oz.-in.		0.2 / 3.0 oz.-in.		1.5 Max oz.-in.
Rotational Torque, Meduim Torque Option (Min / Max)	Available - Varies with each configuration		Available		1 - 6 oz.-in.		Not Available
Rotary Switch Actuating Torque	20 oz.-in.		2 to 7 oz.-in.		3.3 - 10.5 oz.-in.		2 oz.-in.

Note: Most parameters (wattage rating, rotational torque, etc.) are affected by the total number of sections. Download full specifications for further details.

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Series S159-10 5/8" Modular
Precision 10-Turn Potentiometer

Description:

The Series S159-10 Precision 10-Turn Potentiometer modules are 5/8" square [15.88mm], with metal shaft and bushing.

Wirewound or Hybrid elements are available. Hybrid utilizes a wirewound element covered with a conductive plastic coating, which offers temperature stability, low-noise, and virtually infinite resolution. Combine up to 2 modules.

For more information about this product, visit our website at: **www.potentiometers.com**

Features:

- ***5/8" Square Modular 10-Turn Panel Control***
- ***Stackable** - up to 2 modules*
- ***Linear Taper***
- ***±0.25% Independent Linearity***
- ***Wirewound or Hybrid Element***
- ***Metal Shaft and Bushing***
- ***PCB or Solder Lug Terminals***
- ***IP40 Rating***
- ***RoHS Compliant***

Electrical Specifications

Resistance Range - Wirewound Element
J Linear Taper: 200 ohms to 100K ohms

*Resistance Range - **Hybrid Element***
K Linear Taper: 1K ohms to 100K ohms

Total Resistance Tolerance
Wirewound: ±5%
Hybrid: ±10%

Independent Linearity: ±0.25%

Absolute Minimum Resistance:
Wirewound: 1.0 ohm or 0.1% (whichever is greater)

Effective Electrical Angle: 3600° +10, -0°

Dielectric Withstanding Voltage (MIL-STD-202 - Method 301)
Sea Level: 1,000 VAC minimum

Insulation Resistance: 1,000 megohms minimum

Power Rating: +70°C: 1 watt; +125°C: 0 watt
(Voltage limited by power dissipation or 350 VAC, whichever is less

Theoretical Resolution:
Wirewound: See table
Hybrid: Essentially Infinite

End Voltage
Hybrid (K Taper): 0.2% of applied voltage

Noise:
Wirewound: (J Taper): 100 ohms

Output Smoothness
Hybrid (K Taper): 0.15% maximum

Mechanical Specifications

Mechanical Angle: 3600° +15°, -0°

Stop Strength:
33.90 N-cm (48.0 oz.-in.) minimum

Starting Torque:
Running torque plus 0.7 N-cm (1.0 oz.-in.) max

Running Torque (1 or 2 sections):
0.18 to 1.41 N-cm (0.25 to 2.0 oz.-in.)

Mounting Torque (Torque on Bushing):
1.7-2.0 N-m (15-18 lb.-in.) maximum

Shaft Runout: 0.15 mm (0.006 in.) T.I.R.

Shaft End Play: 0.36 mm (0.014 in.) T.I.R.

Shaft Radial Play: 0.13 mm (0.005 in.) T.I.R.

Weight: Single Section - 21 gm (0.75 oz.)
Each additional Section: 18 gm (0.65 oz.)

Terminals: Printed circuit terminals or solder lugs

Soldering Condition:
Recommended hand soldering using Sn95/Ag5 no clean solder, 0.025" wire diameter.
Maximum temperature 399°C (750°F) for 3 seconds.
No wash process to be used with no clean flux.

Ganging (Multiple Section Potentiometers): 2 modules max.

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Series S159-10 5/8" Modular
Precision 10-Turn Potentiometer

Environmental Specifications

Operating Temperature Range: +1° C to +125° C

Storage Temperature Range: -55°C to +125°C

Temperature Coefficient over Storage Range:
Wirewound: ±50 ppm/°C;
Hybrid: ±100 ppm/°C

Vibration (Single Section): 15 G
Total Resistance Shift: ±2% maximum
Voltage Ratio Shift: ±0.2% maximum
Wiper Bounce: 0.1 millisecond maximum

Shock (Single Section): 50 G
Total Resistance Shift: ±2% maximum
Voltage Ratio Shift: ±0.2% maximum
Wiper Bounce: 0.1 millisecond maximum

Load Life: 1,000 hours
Wirewound: Total Resistance Shift: ±2% max.
Hybrid: Total Resistance Shift: ±5% max.

Rotational Life - Wirewound (No Load):
1,000,000 shaft revolutions, ±5% TRS maximum

Rotational Life - Hybrid (No Load):
4,000,000 shaft revolutions, ±5% TRS maximum

Moisture Resistance (MIL-STD-202, Method 103, Condition B)
Wirewound: ±2% Total Resistance Shift max.
Hybrid: ±5% Total Resistance Shift max.

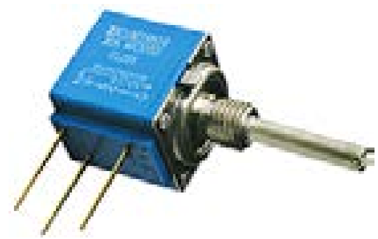
Insulation Resistance (500 VDC): 100 megohms minimum

IP Rating: IP40

Wirewound Resolution Table

Resistance (Ohms)	Resolution (Nom.) (%)
200	.048
500	.037
1 K	.032
2 K	.031
5 K	.023
10 K	.020
20 K	.015
50 K	.012
100 K	.010

Dimensional Drawings



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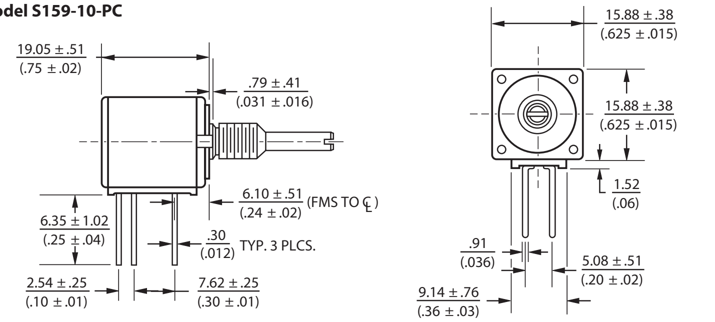
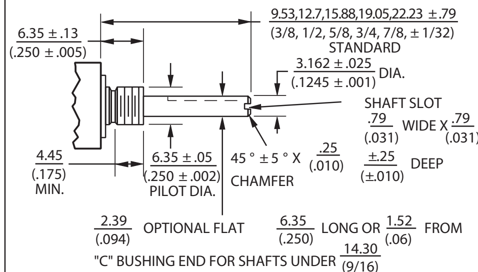
Series S159-10 5/8" Modular
Precision 10-Turn Potentiometer

Dimensional Drawings

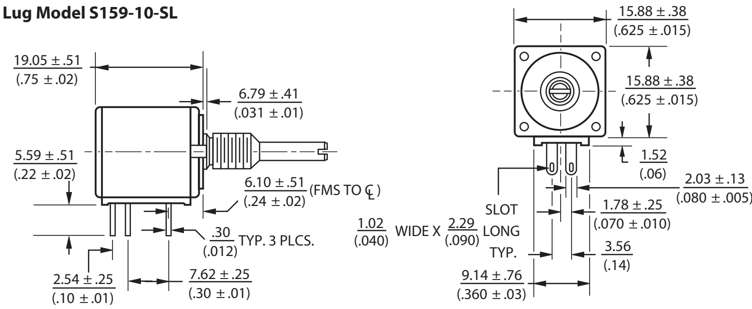
PC Pin Model S159-10-PC



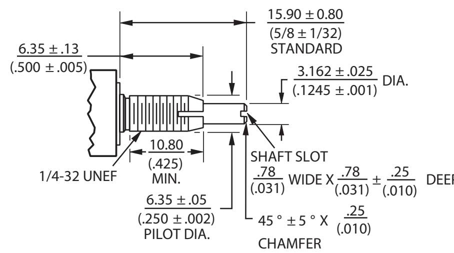
"C" Bushing
1/4 " (6.35 mm) Dia. Plain - Single Shaft

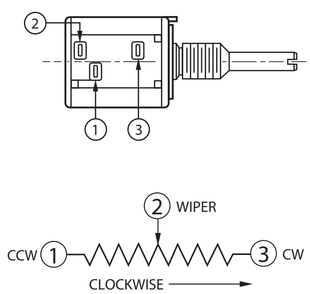


Solder Lug Model S159-10-SL

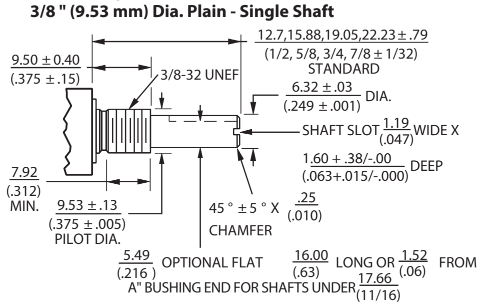


"E" Bushing
1/4 " (6.35 mm) Dia. Locking - Single Shaft

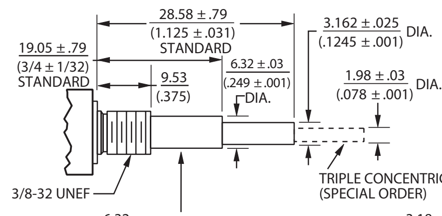




"A" Bushing
3/8 " (9.53 mm) Dia. Plain - Single Shaft

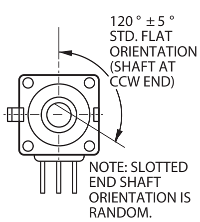


"A" Bushing
3/8 " (9.53 mm) Dia. Plain - Concentric Shaft

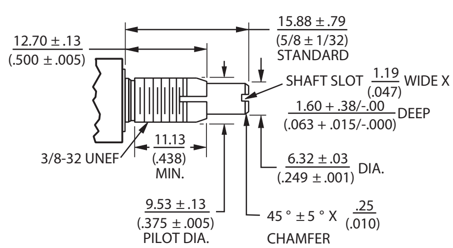


OUTER SHAFT 6.32 (.249) DIA. OPERATES SECTION #1 INNER SHAFT 3.18 (.125) DIA. OPERATES SECTION #2, #3, & #4 ("G" STYLE)

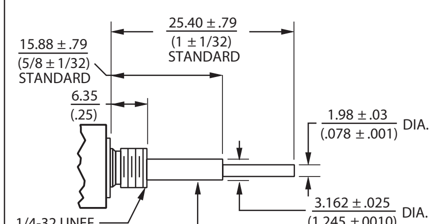
Shaft Flat Orientation



"B" Bushing
3/8 " (9.53 mm) Dia. Plain - Single Shaft

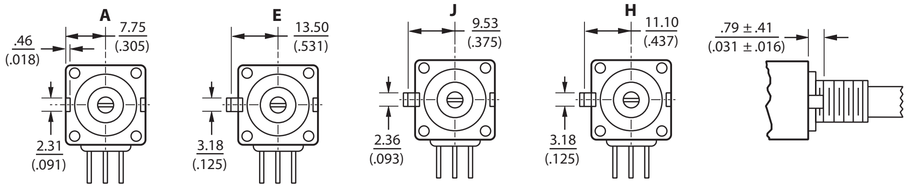


"C" Bushing
1/4 " (6.35 mm) Dia. Plain - Concentric Shaft



OUTER SHAFT 3.18 (.125) DIA.OPERATES SECTION #1 INNER SHAFT 1.98 (.08) DIA. OPERATES SECTION #2, #3, & #4 ("K" STYLE)

Locating Lug Options



TOLERANCES EXCEPT AS SHOWN: DECIMALS .XXX ± .127 (.005)
.XX± .38 (.015)
ANGLE ± 5°
FRACTIONS ± 1/64

DIMENSIONS: MM / (INCHES)

NOTE: "D" OPTION - NO A/R LUG. OTHER LOCATING LUG OPTIONS AVAILABLE. FOR DETAILS CONSULT FACTORY.

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Ordering Information - S159-10 Precision Ten Turn Modular Potentiometer

Example Part Number: **S159-10-PC-A2A-B28-J103**

S159-10 PC A 2 A B 28 J 103

Model
S159-10

Element & Taper:
J = Linear Wirewound 10-Turn ±5%
K = Linear Hybrid 10-Turn ±10%

Anti-Roation Lug:
A = Single .305" R, 90° CW
B = Double .305" R, 90° & 270° CW
C = Single .305" R, 270° CW
D = No Lug
E = Single .531" R, 90° CW
F = Single .305" R, 180° CW
J = Single .375" R, 90° CW
K = Double .375" R, 90° & 270° CW

Code	SHAFT LENGTH (FMS) Description	AVAILABLE ONLY IN BUSHING Code
12	3/8"	C, J, N
16	1/2"	A, C, J, N
20	5/8"	A, B, C, E, J, N
24	3/4"	A, B, C, E, J, N
28	7/8"	A, B, C, E, J, N
32	1"	A, B, C, E, J, N
36	1-1/8"	A, B, C, E, J, N
40	1-1/4"	A, B, C, E, J, N
	Metric	
10	10mm	U
13	13mm	U
16	16mm	R,
19	19mm	R
22	22mm	R, U
30	30mm	R
42	42mm	R
50	50mm	R

Resistance	Element
201 = 200 ohms	J
501 = 500 ohms	J
102 = 1.0 K ohms	J, K
202 = 2.0 K ohms	J, K
502 = 5.0 K ohms	J, K
103 = 10 K ohms	J, K
203 = 20 K ohms	J, K
503 = 50 K ohms	J, K
104 = 100 K ohms	J, K

Modules:
1 = Single
2 = Double

Bushing:
A = Plain 3/8" Dia. x 3/8" Length
B = Locking 3/8" Dia. x 1/2" Length
C = Plain 1/4" Dia. x 1/4" Length
E = Locking 1/4" Dia. x 1/2" Length
J = Plain 3/8" Dia. x 1/4" Length
N = Plain 1/4" Dia. x 3/8" Length
R = Plain 10mm Dia. x 9mm Length
U = Plain 7mm Dia. x 6mm Length

Style
PC = PC Pins
SH = Solder Hooks

Shaft Type Code Description	Available only for Lengths	Bushings Code
A = Single Plain 1/4" Dia	16, 20, 24,28	A, B, J
B = Single Slotted 1/4" Dia	16, 20, 24,28	A, B, J
C = Single Flatted 1/4" Dia	20,24,28	A, B, J
E = Single Slotted 1/8" Dia	12,16,20,24,28	C, E, N
G = Dual Concentric Plain (Outer 1/4" Dia - Inner 1/8" Dia) Outer Operates Section 1	36,40	A, J
K = Dual Concentric Plain (Outer 1/8" Dia - Inner 5/64" Dia) Outer Operates Section 1	32,36	C, N
L = Dual Concentric Plain (Outer 1/4" Dia - Inner 1/8" Dia) Outer Operates Section 1/2	36,40	A, J
M = Dual Concentric Plain (Outer 1/8" Dia - Inner 5/64" Dia) Outer Operates Section 1	32,36	C, N
N = Dual Concentric Plain (Outer 1/4" Dia - Inner 1/8" Dia) Outer Operates Section 1/2	36,40	A, J
P = Dual Concentric Plain (Outer 1/8" Dia - Inner 5/64" Dia) Outer Operates Section 1/2	32,36	C, N
R = Single Slotted 6 mm Dia	16,19,22,50	R
T = Single Slotted 4 mm Dia	10,13,22	U
V = Dual Concentric Plain (Outer 6mm Dia - Inner 3mm Dia) Outer Operates Section 1	30,42	R

For pricing and delivery information, **Create an RFQ on our website** or
Contact your State Electronics Sales Representative at 973-887-2550

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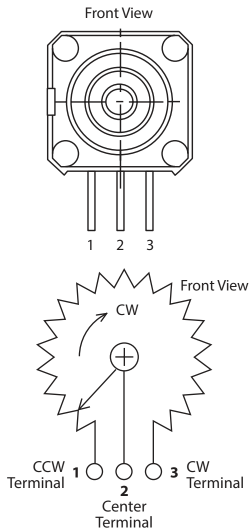
GLOSSARY OF TERMS

Input and Output Terms

Output Voltage
(e) The voltage between the wiper terminal and the designated reference point. Unless otherwise specified, the designated reference point is the CCW terminal (See 3.1).

Figure 1
Circuit and Travel Diagram



Output Ratio
(e/E) The ratio of the output voltage to the designated input reference voltage. Unless otherwise specified, the reference voltage is the total applied voltage.

Rotation and Translation

Total Mechanical Travel
The total travel of the shaft between integral stops, under the specified stop load. In potentiometers without stops, the mechanical travel is continuous.

Mechanical Overtravel - Wirewound
The shaft travel between each End Point (or Theoretical End Point for Absolute Conformity or Linearity units) and its adjacent corresponding limit of Total Mechanical Travel.

Mechanical Overtravel
The shaft travel between each Theoretical End Point and its adjacent corresponding limit of Total Mechanical Travel.

Backlash
The maximum difference in shaft position that occurs when the shaft is moved to the same actual Output Ratio point from opposite directions.

Theoretical Electrical Travel
The specified shaft travel over which the theoretical function characteristic extends between defined Output Ratio limits, as determined from the Index Point.

Electrical Overtravel - Nonwirewound
The shaft travel over which there is continuity between the wiper terminal and the resistance element beyond each end of the Theoretical Electrical Travel.

Electrical Continuity Travel
The total travel of the shaft over which electrical continuity is maintained between the wiper and the resistance element.

Tap Location
The position of a tap relative to some reference. This is commonly expressed in terms of an Output Ration and/or a shaft position. When a shaft position is specified, the Tap Location is the center of the Effective Tap Width.

Resistance

End Resistance
The resistance measured between the wiper terminal and an end terminal with the shaft positioned at the corresponding End Point.

Temperature Coefficient Of Resistance
The unit change in resistance per degree celsius change from a reference temperature, expressed in parts per million per degree celsius as follows:

$$\text{T.C.} = \frac{R_2 - R_1}{R_1(T_2 - T_1)} \quad \text{x } 106$$

Where:
R1 = Resistance at reference temperature in ohms.
R2 = Resistance at test temperature in ohms
T1 = Reference temperature in degrees celsius.
T2 = Test temperature in degrees celsius.

Conformity and Linearity

Linearity
A specific type of conformity where the theoretical function characteristic is a straight line.

Mathematically:

$$\frac{e}{E} = f(W) \pm C = A(W) + B \pm C$$

Where:
A is the given slope; B is given intercept at W=0.
W = Angle or slope

Absolute Linearity
The maximum deviation of the actual function characteristic from a fully defined straight reference line. It is expressed as a percentage of the Total Applied Voltage and measured over the Theoretical Electrical Travel. An Index Point on the actual output is required.

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General Electrical Characteristics

Noise
Any spurious variation in the electrical output not present in the input, defined quantitatively in terms of an equivalent parasitic, transient resistance in ohms, appearing between the contact and the resistance element when the shaft is rotated or translated. The Equivalent Noise Resistance is defined independently of the resolution, the functional characteristics, and the total travel. The magnitude of the Equivalent Noise Resistance is the maximum departure from a specified reference line. The wiper of the potentiometer is required to be excited by a specified current and moved at a specified speed.

Output Smoothness
(Non-wirewound Potentiometers Only)
Output Smoothness is a measurement of any spurious variation in the electrical output not present in the input. It is expressed as a percentage of the Total Applied Voltage and measured for specified travel increments over the Theoretical Electrical Travel. Output Smoothness includes effects of contact resistance variations, resolution, and other micrononlinearities in the output.

Resolution
A measure of the sensitivity to which the Output Ratio of the potentiometer may be set.

Dielectric Strength
Ability to withstand under prescribed conditions, a specified potential of a given characteristic between the terminals of each cup and the exposed conducting surfaces of the potentiometer, or between the terminals of each cup and the terminals of every other cup in the gang without exceeding a specified leakage current value.

Insulation Resistance
The resistance to a specified impressed DC voltage between the terminals of each cup and the exposed conducting surfaces of the potentiometer, or between the terminals of each cup and the terminals of every other cup in the gang, under prescribed conditions.

Power Rating
The maximum power that a potentiometer can dissipate under specified conditions while meeting specified performance requirements.

Power Derating
The modification of the nominal power rating for various considerations such as Load Resistance, Output Slopes, Ganging, nonstandard environmental conditions and other factors.

Life
The number of shaft revolutions or translations obtainable under specific operating conditions and within specified allowable degradations of specific characteristics.

Mechanical Characteristics

Shaft Runout
The eccentricity of the shaft diameter with respect to the rotational axis of the shaft, measured at a specified distance from the end of the shaft. The body of the potentiometer is held fixed and the shaft is rotated with a specified load applied radially to the shaft. The eccentricity is expressed in inches, TIR.

Lateral Runout
The perpendicularity of the mounting surface with respect to the rotational axis of the shaft, measured on the mounting surface at a specified distance from the outside edge of the mounting surface. The shaft is held fixed and the body of the potentiometer is rotated with specified loads applied radially and axially to the body of the pot. The Lateral Runout is expressed in inches.

Shaft Radial Play
The total radial excursion of the shaft, measured at a specified distance from the front surface of the unit. A specified radial load is applied alternately in opposite directions at a specified point. Shaft Radial Play is expressed in inches.

Shaft End Play
The total axial excursion of the shaft, measured at the end of the shaft with a specified axial load supplied alternately in opposite directions. Shaft End Play is expressed in inches.

Starting Torque
The maximum moment in the clockwise and counterclockwise directions required to initiate shaft rotation anywhere in the Total Mechanical Travel.

Running Torque
The maximum moment in the clockwise and counterclockwise directions required to sustain uniform shaft rotation at a specified speed throughout the Total Mechanical Travel.

Moment of Inertia
The mass moment of inertia of the rotating elements of the potentiometer about their rotational axis.

Static Stop Strength
The maximum static load that can be applied to the shaft at each mechanical stop for a specified period of time without permanent change of the stop positions greater than specified.

Dynamic Stop Strength
The inertia load, at a specified shaft velocity and a specified number of impacts, that can be applied to the shaft at each stop without a permanent change of the stop position greater than specified.

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All agreements are more contingent upon strikes, accidents or causes of delay beyond our control

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On approved orders, terms are net thirty (30) days from the date of invoice. The Company may at any time, when in its opinion the financial condition of the customer warrants it, either hold or suspend credit. In cases where credit is not established or satisfactory financial information is not available, the terms are credit card or bank transfer. Each shipment will be considered a separate and independent transaction and payment should be made accordingly.

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Claims and Rejected Material

Claims for defective material must be made within 30 days of the customer's receipt of shipment.
No products may be returned without a return authorization (RMA).

Country of Origin

The S8x, 38X, 70 series and S159 MOD-POT® & MOD-POT² ™ potentiometer products are assembled in the United States at our facility located in East Hanover, New Jersey, USA, using globally sourced components.

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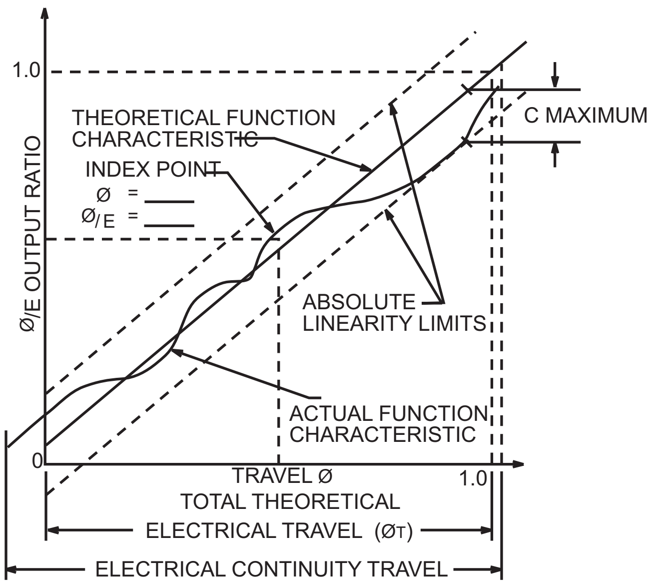
The straight reference line may be fully defined by specifying the low and high theoretical end Output Rations separated by the Theoretical Electrical Travel. Unless otherwise specified, these end Output Rations are 0.0 and 1.0 respectively.

Mathematically:

$$\frac{e}{E} = A(W/W_T) + B \pm C$$

Where:
A is the given slope; B is given intercept at W=0.
Unless otherwise specified: A-1; B=0

Figure 2
Absolute Linearity



Independent Linearity

The maximum deviation, expressed as a percent of the Total Applied Voltage, of the actual function characteristic from a straight reference line with its slope and position chosen to minimize deviations over the Actual Electrical Travel, or any specified portion thereof.

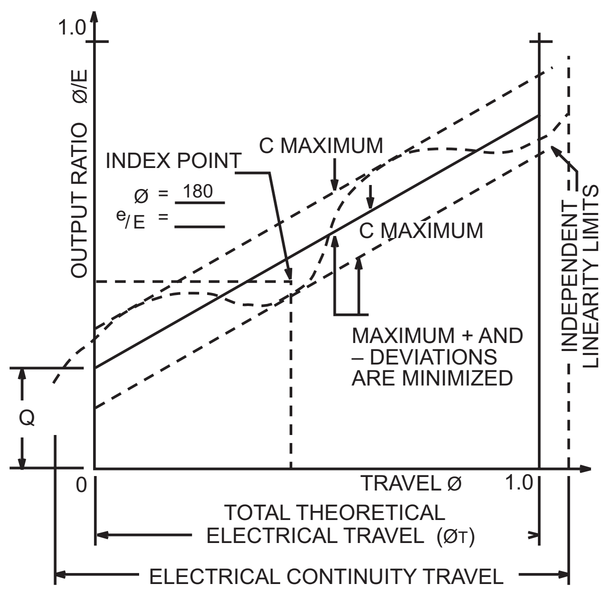
Note: End Voltage requirements, when specified, will limit the slope and position of the reference line.

Mathematically:

Where: $\frac{e}{E} = P(W/W_A) + Q \pm C$

P is unspecified slope; Q is unspecified intercept at W=0. And both are chosen to minimize C but are limited by the End Voltage requirements.

Figure 3
Independent Linearity



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