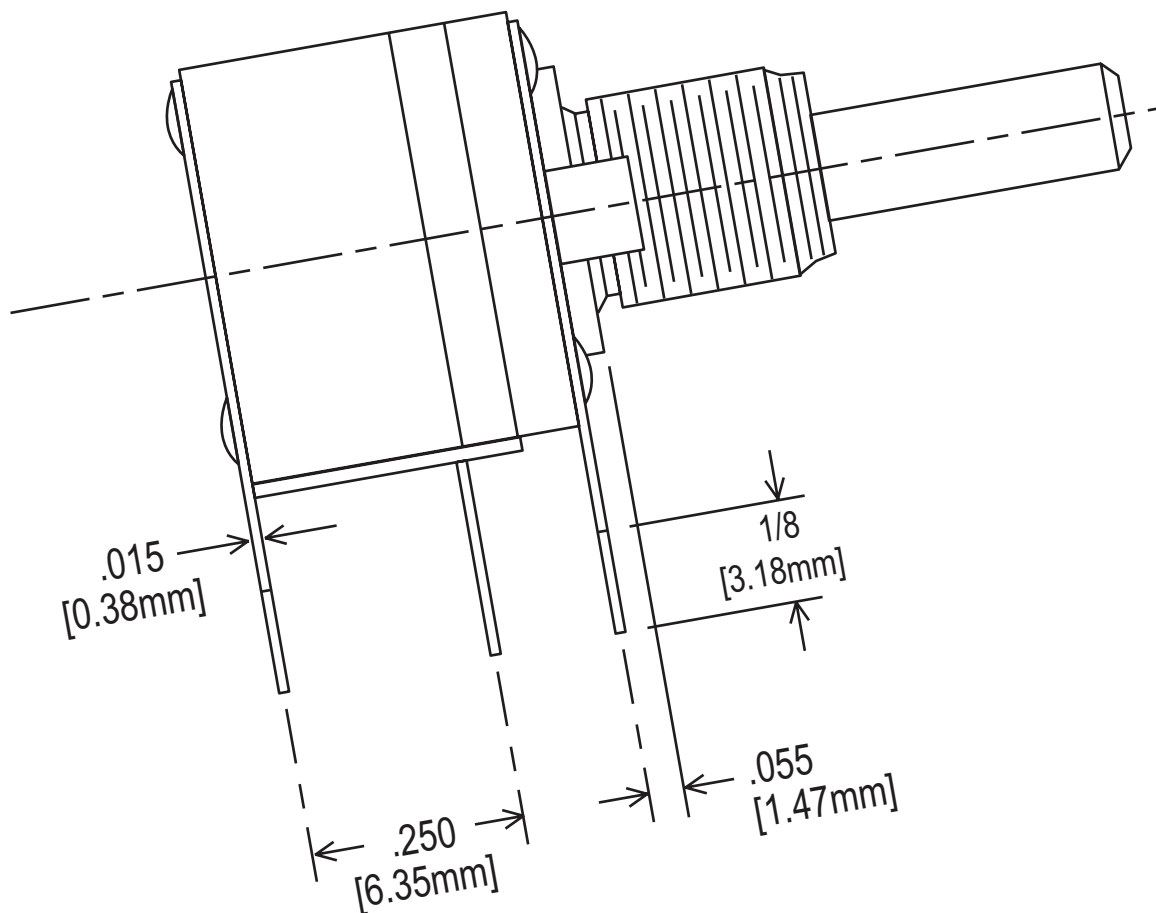


# STATE ELECTRONICS

## Series S88/S89 Custom Potentiometer Designer Guide



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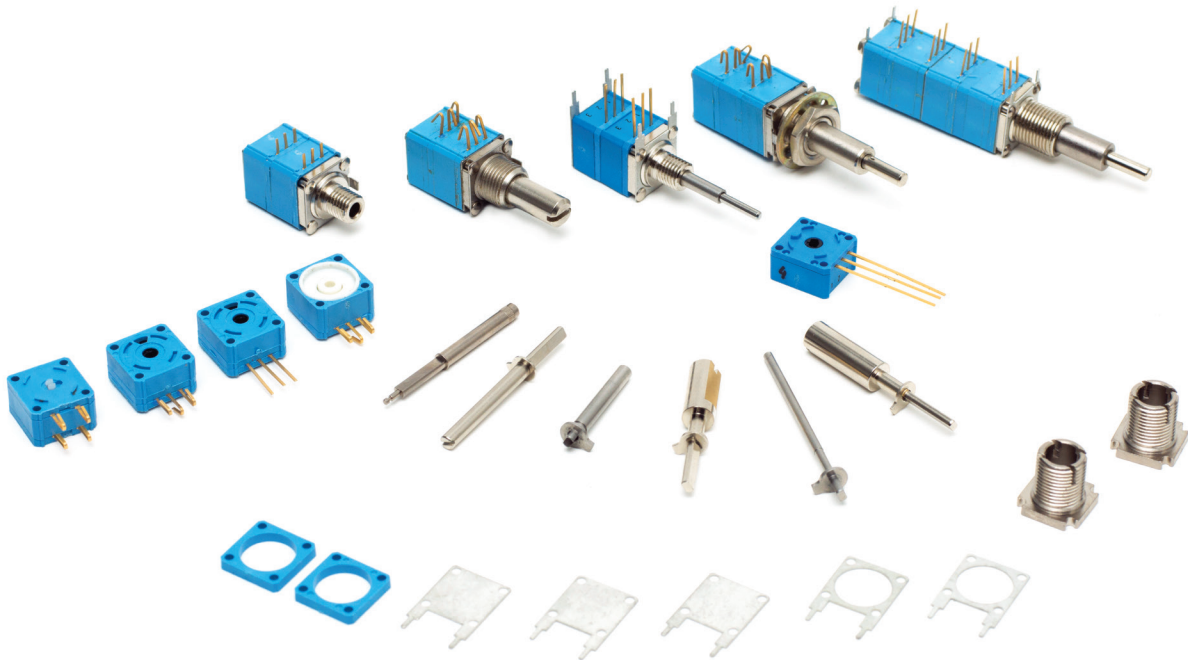
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ISO 9001:2015 and AS9100

THE POTENTIOMETER SPECIALISTS™  
Updated Mar. 15, 2024

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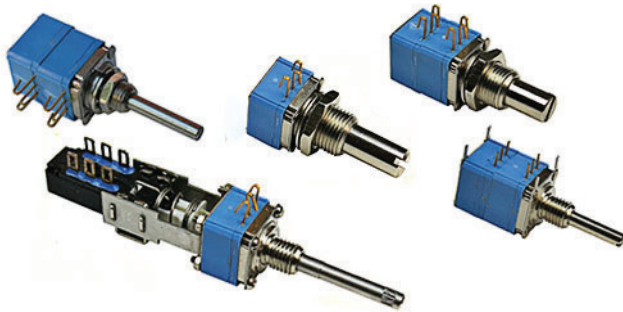
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**Series S88 Potentiometer**

Conductive Plastic - 1/2 inch square; .5 Watt

**Series S89 Potentiometer**

Cermet - 1/2 inch square; 1 Watt



**Description**

The S88 and S89 series are 1/2 in. square, modular, stackable potentiometers. The basic construction suits the series for countless design options.

The S88 and S89 series can be found in a wide range of sophisticated systems in a broad scope of industries.

**Features**

- **Small size** - 1/2 in. square
- **Stackable** - up to 8 modules
- **Switches** - rotary, push-pull, momentary push, and shadow.
- **Versatility** - various shaft, bushings, terminal styles, resistance values, tapers and tolerances. Available in Conductive Plastic or Thick Film Cermet
- **RoHS Compliant**

**Special Features**

- **Detents** - Center detent and 11 position detents available
- **Seals** - mounting and shaft seals
- **Medium torque** - 1 to 6 oz.-in.

	Operational Specifications Resistive Modules Series S88	Operational Specifications Resistive Modules Series S89
<b>Resistance Range</b>	Linear: 100 ohm to 5 megohm Tapered: 500 ohm to 1 megohm <i>See chart, page 7</i>	Linear: 50 ohm to 5 megohm Tapered: 100 ohm to 1 megohm <i>See chart, page 7</i>
<b>Resistance Tolerance</b>	Linear: thru 500K ohm , ±10%; above 500K ohm , ±20%. Tapered: thru 100K ohm , ±10%; above 100K ohm ±20%	Linear: ±10%; ±20% special Tapered: ±10% Under 20 ohm ±20%
<b>Taper</b>	See <i>Taper Curve</i> charts on page 6 for standard and special tapers available	See <i>Taper Curve</i> charts on page 6 for standard and special tapers available
<b>Taper Tolerance</b>	±20% of nominal resistance at 50% ±3% mechanical rotation	±20% of nominal resistance at 50% mechanical rotation
<b>Independent Linearity</b>	±5% standard with specials available	±5% standard with specials available
<b>End Resistance</b>	4 ohms max. each end linear and low side of taper. 1% of total R high side of taper.	2 ohms max. each end (5 ohms - 2.5K ohms) 4 ohms max. each end (above 2.5K)
<b>Dynamic Noise (C.R.V.)</b>	1.5% of total R, standard linear; 1.0% of total R, special linear; 2.2% of total R, tapered.	3.0% of total R, standard linear; 1.5% of total R, special linear (500 ohms and above); 6.0% of total R, tapered.
<b>Static Noise</b>	Up to 30K ohms - 20db; 100K ohms - 12 db; 1 Megohms +3db	Up to 100 ohms - 25db; 10K ohms - 15 db; 100K ohms -10db.

Electrical Specifications continued, next page

	Operational Specifications Resistive Modules Series S88	Operational Specifications Resistive Modules Series S89
<b>Power Rating</b>	0.5 Watt @ 70°C bushing (panel) mounting 0.25 Watt @ 70°C PC mounting (no panel). Derate to 0 watts at 120°C. Derate 50% for non-linear tapers and Derate multiple sections 1/2 wattage of panel unit.	1.0 Watt @ 85°C bushing (panel) mounting 0.5 Watt @ 85°C PC mounting (no panel) Derate to 0 watts at 150°C. Derate 50% for non-linear tapers and Derate multiple sections 1/2 wattage of panel unit.
<b>Working Voltage</b>	350 Vdc across end terminals, but power not to exceed rating.	350 Vdc across end terminals, but power not to exceed rating.
<b>Dielectric Withstanding Voltage</b> <a href="#">(Glossary Definition Link)</a>	750 VAC @ ATM pressure - 760mm Mercury, equivalent to sea level.	900 VAC single standard module and 750 VAC all non-standard constructions @ ATM pressure - 760mm Mercury, equivalent to sea level.
<b>Dielectric Low Pressure</b>	MIL-STD-202G Method 105C – Condition B, 350 VAC @ 3.4 in. [86,36mm] Mercury, equivalent to 50,000 feet.	MIL-STD-202G Method 105C – Condition B, 350 VAC @ 3.4 in. [86,36mm] Mercury, equivalent to 50,000 feet.
<b>Insulation Resistance</b>	1000 megohms minimum for dry, clean conditions @ 25°C	1000 megohms minimum for dry, clean conditions @ 25°C
<b>Temperature Coefficient</b>	See <i>Temperature Resistance Change</i> table on page 8	15 ohms to 100 ohms 250 MP/°C. 100 ohms to 5 Megohms 150 MP/°C Temperature range -55°C to 150°C.
<b>Tracking</b>	10% voltage ratio tracking between sections standard. Specials available.	10% voltage ratio tracking between sections standard. Specials available.
<b>Electrical Rotation</b>	295° ±5°	295° ±5°
<b>Effective Rotation</b>	265° ±7° without switch; 240° ±7° with switch.	265° ±7° -5° without switch; 240° ±7° with switch.
<b>Load Life</b>	10% maximum change in resistance and within end resistance limits with rated power across element, at 70°C ambient temperature. Power applied 1.5 hours "on" 0.5 hours "off" for 1000 hours.	5% maximum change in resistance and within end resistance limits with rated power across element, at 85°C ambient temperature. Power applied 1.5 hours "on" 0.5 hours "off" for 1000 hours.
<b>Rotational Life</b>	Potentiometer: 10% maximum resistance change up to 50,000 cycles under load. Trimmer: 5,000 cycles	Potentiometer: 10% maximum resistance change up to 25,000 cycles under load. Trimmer: 5,000 cycles
<b>Low Temperature Operation</b>	Less than 3% change in total R. Operating torque at -40°C is 30 oz.-in.	Less than 2% change in total R. Operating torque at -40°C is 30 oz.-in.

	Operational Specifications RS	Operational Specifications Push-Pull Switch
<b>Circuit</b>	SPDT	DPST SPDT with customer installed wire jumper
<b>Rating</b>	125MA 28VDC	250MA 30VDC
<b>Rotational Life</b>	15,000 cycles of operation	15,000 cycles of operation

	Operational Specifications Resistive Modules Series S88	Operational Specifications Resistive Modules Series S89
<b>MIL-R-94 Standard</b>	Series S88 is designed to meet MIL-R-94 performance characteristics where applicable	Series S89 is designed to meet MIL-R-94 performance characteristics where applicable
<b>Low Temperature Storage</b>	Less than 2% change in total resistance	Less than 2% change in total resistance
<b>Thermal Cycling</b>	Less than 4% total R change as a result of 5 cycles @ -55°C to +120°C	Less than 3% total R change as a result of 5 cycles @ -55°C to +150°C
<b>Moisture Resistance</b>	10% maximum total R change when tested per method 103 of MIL-STD-202	5% maximum total R change when tested per method 103 of MIL-STD-202
<b>Solderability</b>	Meet the requirements of MIL-STD-202, Method 210, Condition A except immersed within .125 in. of element for 5 seconds.	Meet the requirements of MIL-STD-202, Method 210, Condition A except immersed within .125 in. of element for 5 seconds.
<b>Shock</b>	The total resistance setting change is 2% maximum between left and right terminals and 5% maximum between CCW terminal and center terminal when tested per method 213B condition I of MIL-STD-202. Applicable to single shaft potentiometers only.	The total resistance setting change is 2% maximum between left and right terminals and 5% maximum between CCW terminal and center terminal when tested per method 213 condition I of MIL-STD-202. Applicable to single shaft potentiometers only.
<b>Vibration, High Frequency</b>	No intermittent contacts or open circuits when tested per method 204D Condition C of MIL-STD-202. Resistance setting change is 5% maximum between left (CCW) terminal and center terminal. The total resistance change is 2% maximum between left and right terminals. Applicable to single shaft potentiometers only.	No intermittent contacts or open circuits when tested per method 204D Condition C of MIL-STD-202. Resistance setting change is 5% maximum between left (CCW) terminal and center terminal. The total resistance change is 2% maximum between left and right terminals. Applicable to single shaft potentiometers only.
<b>Washability</b>	Units may be adversely affected if subjected to conventional after-solder board-wash	Units may be adversely affected if subjected to conventional after-solder board-wash
<b>Salt Atmosphere</b>	Visual inspection revealed no damage, defects, or other abnormalities after testing per MIL-STD-202 Method 101E- Condition A	Visual inspection revealed no damage, defects, or other abnormalities after testing per MIL-STD-202 Method 101E- Condition A
<b>Humidity Steady State</b>	10% maximum total R change when tested per MIL-STD-202, Method 103B, Condition B, 96 Hours	5% maximum total R change when tested per MIL-STD-202, Method 103B, Condition B, 96 Hours

## Mechanical Specifications - Series S88 & Series S89

### Body Size

Single module: .5 in. square  $\pm$ .047 in. (except at standoffs)

### Terminals

Printed circuit style on 0.100 in. grid in line, 0.250 in. long.  
Maximum PC terminal length: .875 in.

Terminal spacing in multiple section controls: 0.300 in.  
Solder lugs formed from PC pins to accept 3 - #22 AWG wires.

### Housing

Molded thermoplastic

### Anti-turn Device

Location 1 supplied unless otherwise specified.  
See Chart D.

Anti-turn Device radius: 6,35mm.

### Shafts

Single shaft: 1/8 in. or 1/4 in. dia. Nickel-plated brass.  
Outer Concentric Shaft: 1/8 in. dia. Stainless Steel.  
Inner Concentric Shaft: 0.078 in. dia. Nickel-plated brass.

### Seals

Mounting seal and shaft seal for single shafts only.  
*Caution: These seals are not designed to meet board washing requirements.*

### Bushing Diameter

1/4 in. x 32NEF-2A standard  
3/8 in. x 32NEF-2A optional

When using 3/8 in. diameter bushing, distance from mounting surface to PC terminals is .170 in. *See page 8.*

### Bushing Length

Plain: 1/4 in. , 3/8 in. , or 1/2 in.  
Split-locking type: 3/8 in.

### Rotational Torque

Single and dual concentric controls: 0.2 to 3.0 oz.-in.  
Two Modules: 0.3 to 3.5 oz.-in.  
Three Modules: 0.5 to 4.5 oz.-in.  
Four Modules: 0.5 to 5.5 oz.-in.  
Medium Torque Option for single shaft only: 1 to 6 oz.-in.  
Torque Variation within a rotation: 1 oz.-in. max.

### Stop Torque

Single Solid shaft: 3 lb.-in. (standard)

High Stop Torque (Metal Stop)  
(Recommended for military or high vibration applications)  
3 lb.-in. 1/8" shaft with O-ring  
8 lb.-in. 1/4" or 1/8" shaft without O-Ring

### Actuating Forces

Pot/PP Switch: 10-22 oz.; Dual Pot/PP Switch: 10-25 oz.;  
Pot/MP Switch: 25-40 oz.; Pot/Pot/MP Switch: 25-43 oz.

### Mechanical Rotation

With or without switch:  $295^{\circ} \pm 5^{\circ}$ .

### Maximum Shaft Pull Force

.125 in. diameter shaft: 18 lbs. (20 lbs. Option)  
.250 in. diameter shaft: 10 lbs. (20 lbs. Option)  
Concentric Front & Rear Shaft: 7.5 lbs.  
RS rotary and PP Push-Pull Switches: 10 lbs. (20 lbs. Option)

PP Push-Pull or Momentary Push Switches: 20 lbs.

### Mounting Torque

Torque applied to the mounting nuts should not exceed 15 to 18 in.-lbs. [1,7 to 2,0 N-m]. Tap Terminal Strength 18 lbs. maximum pull

### Hardware

Mounting Hardware available as the following:  
A. Hex mounting nut, Brass, Nickel Plated  
1/4 in. x 32 thread, 5/16 in. across flats, 1/16 in. thick.  
B. Internal tooth lockwasher, Phosphorus Bronze, Nickel Plated, 13/32 in. OD x .025 in. thick.  
C. Jam hex nut, Brass, Nickel Plated 5/16 in. across flats, 5/32 in. thick - supplied with locking type bushings.

### Marking

Terminals are numbered for reference  
State Electronics part number.  
Customer part number optional.

### Shaft Radial Play (single shaft potentiometer)

.028 in. maximum 1 in. from mounting surface with .250 in. diameter bushing

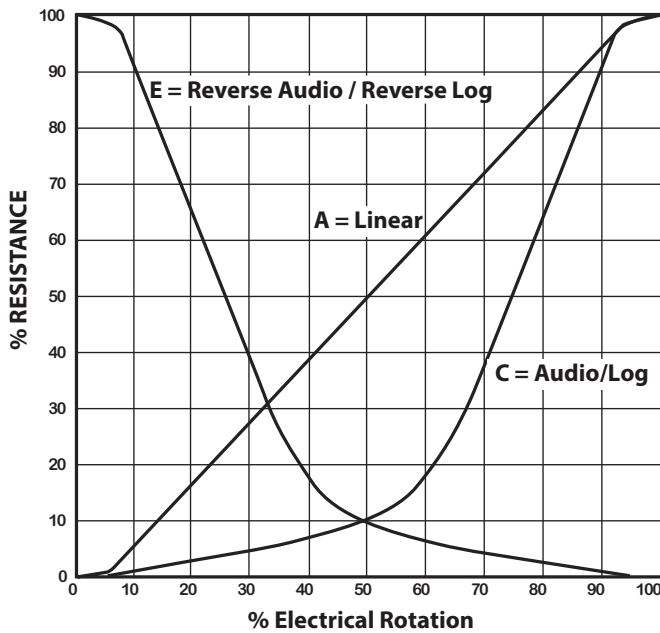
### Shaft End Play

.020 in. maximum

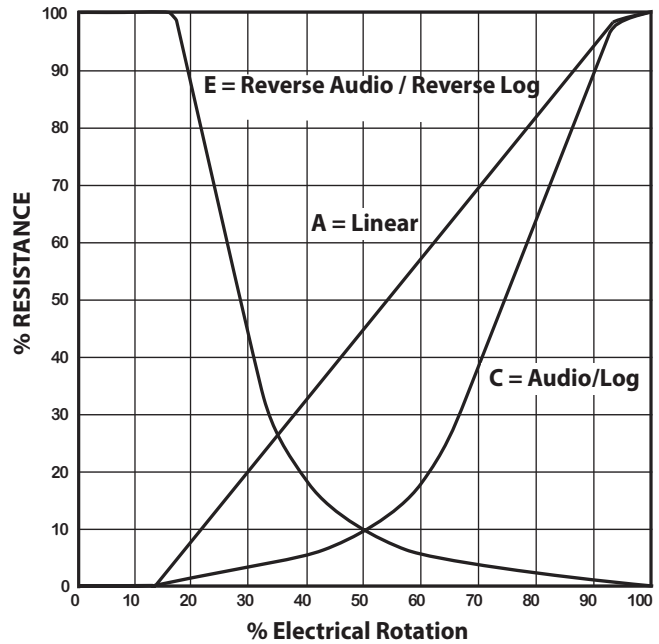
### Construction

Riveted construction is standard.  
Screw construction is available as an option.  
Screws may be required depending on design.

**Standard Tapers for Designs without RS**



**Modified Taper for Designs with RS Honeywell / Clarostat Standard**



**“S” Taper** is linear, the change in resistance value being directly proportional to the degree of rotation. It can be used either as right-hand or left-hand taper. This taper corresponds to **Mil-R94 type “A”**

**“Z” Taper** is measured between the wiper and the counter-clockwise terminals (**pins 1 & 2**) attains 10% resistance value at 50% of clockwise rotation (left-hand). This taper corresponds to **Mil-R94 type “C”**

**“Reverse Z” Taper** is measured between the wiper and the clockwise terminals (**pins 2 & 3**) attains 10% resistance value at 50% of counterclockwise rotation (right-hand). This taper corresponds to **Mil-R94 type “E”**

**Important** - The modified tapers were used by Honeywell and Clarostat for all 388/389 series designs that incorporated a RS. The modified taper is used for all legacy Honeywell or Clarostat designs that incorporated a RS.

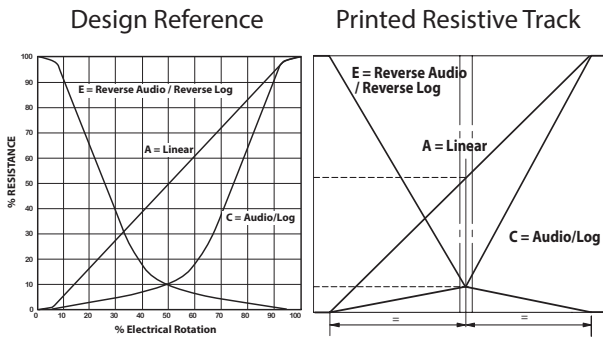
For new designs, State can provide either the standard taper or the modified taper. Unless otherwise specified, the modified tapers will be supplied for all new designs that incorporate a RS.



**General Information about Tapers**

Resistance tapers, curves or laws are terms used to describe the relationship between the mechanical rotation of the potentiometer shaft (wiper positions) and the resulting resistance change or output. To avoid confusion, the measurements must reference the terminals used and the direction of the shaft rotation.

While all manufacturers display the tapers as smooth curves, those curves actually consist of straight line segments which correspond to the number of conductive ink passes during the screening process. The more passes, the smoother the curve.



**Mil-Spec Tapers**

The S8x series potentiometers utilize resistance tapers as defined in Mil-R94; i.e. Linear, Log and Reverse Log. The Mil-spec defines these tapers to correspond to resistance value at the mid-point of the mechanical rotation as follows:

Linear Taper (A) - 50% of the nominal resistance at 50% of the mechanical rotation. Formerly "S" Taper.

Log Taper (C) - 10% of the nominal resistance at 50% of the mechanical rotation. Shown as measured using terminals 1 & 2. Formerly "Z" taper.

Reverse Log Taper (E) - 90% of the nominal resistance at 50% of the mechanical rotation. Shown as measured using terminals 2 & 3. Formerly our "RZ" taper.

Log tapers are often referred to as Audio tapers with Reverse log as Reverse Audio.

Mechanical Rotational Angle (M.R.A.) is the total number of degrees between each rotational stop (~295°). Electrical Rotational Angle (E.R.A.) is the total number of degrees over which the resistance changes (~265°).

The electrical track consists of a narrow pad (~15°) of high-conductive material at each end of the rotation and a center track of resistive material. While there is electrical continuity throughout the entire M.R.A., the resistance change occurs only within the resistive track. The angle representing the resistance track is referred to as the E.R.A.

When a switch is used in combination with a resistive element, the resistive track begins after the switch actuation angle. The logic is that if you are simultaneously using a RS and potentiometer, you would want to have the beginning of the resistance change after the switch is actuated. Also, and by design, the switch snaps into or out of detent and that can result in a spike in the resistance output.

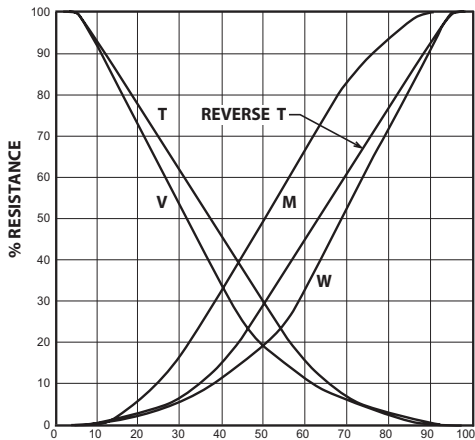
The actuation angle for a typical RS is ~15° so when the resistive track begins after the switch actuation, the E.R.A. is reduced by ~30° to ~240° in total.

Unless otherwise specified, a potentiometer with a RS will utilize resistive modules that have the E.R.A. beginning after the switch is activated.

However, if you prefer to have a wider E.R.A., we can accommodate that choice as well.



**Special Tapers - Special Order Only**



**“W” Taper (A-20)** attains 20% resistance value at 50% of clockwise rotation (left-hand).

**“V” Taper (C-20)** attains 20% resistance value at 50% of counterclockwise rotation (right-hand).

**“T” Taper (A-30)** attains 30% resistance value at 50% of clockwise rotation (left-hand).

**“Reverse T” Taper (C-30)** attains 30% resistance value at 50% of counterclockwise rotation (right-hand).

**“M” Taper** is such that a “W” taper is attained from either the 1 or 3 terminal to the center of the element.

There are hundreds of special curves available and there are no industry standards defining each variation.

The closest actual standard is defined in the Mil-R94 specification (see page 6).

Many companies use an "A B C" method for tapers where A=Log, B=Linear and C=Reverse Log or; A=Linear, B=Log and C=Reverse Log.

To make matters worse, the tapers may not have the same slope (Law) which results in a different resistance value at the mid-point of the rotation. When this is the case, there is typically a number after the taper designation indicating the percentage of the nominal resistance at the mid-point of the shaft rotation.

For example: Assuming that an "A" represents a log taper, and an A-10 designation would result in 10% of the nominal resistance at the mid-point of the shaft rotation—i.e. the same as what is designated in Mil-R94 as a "C" taper—if the mid-point of the shaft rotation results in 20% of the nominal resistance, then in the above example it could be designated an A-20.

State Electronics has custom-designed equipment that allows us to plot the curve of any potentiometer. Once the curve has been identified, we can usually match it with a custom curve, or come close to it with one of our standard curves.

**Standard Resistance Values & Tapers**

	S88 Linear	S88 Log	S88 Reverse Log	S89 Linear	S89 Audio	S89 Reverse Log
50				•		
100	•			•	•	•
250	•			•	•	•
500	•	•	•	•	•	•
1K	•	•	•	•	•	•
2.5K	•	•	•	•	•	•
5K	•	•	•	•	•	•
10K	•	•	•	•	•	•
22K	•	•	•	•	•	•
25K	•	•	•	•	•	•
50K	•	•	•	•	•	•
100K	•	•	•	•	•	•
250K	•	•	•	•	•	•
500K	•	•	•	•	•	•
1M	•	•		•	•	•
2.5M	•			•		
5M	•			•		

• Not Normally Stocked

**Disclaimer**

Due to the unlimited design combinations, certain designs may not perform in accordance with all of the specifications.

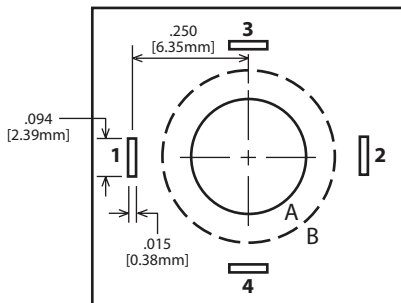
**Temperature Resistance Change**

Nominal Resistance	Maximum Percent Temporary Resistance Change From 25°						
	-55°C	-40°C	0°C	+25°C	+85°C	+105°C	+120°C
100 Ohms	±5.0	±4.0	±1.5	0	±1.5	±2.0	±3.5
10K Ohms	+7.0	+5.5	+2.0	0	±1.5	±2.5	±5.5
100K Ohms	+8.0	+6.0	+2.5	0	±2.0	±3.5	±6.0
1 Megohm	+10.0	+8.0	+3.0	0	±2.5	±4.0	±7.5

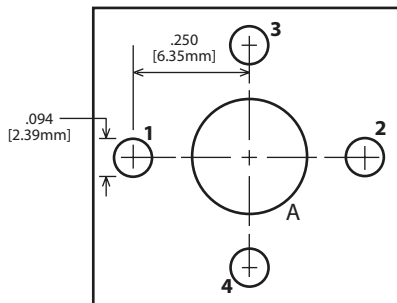
Note: For non-linear tapers, multiply chart values by 1.25

**Locating Tab Options**

PC. Board & Panel Mounting Dimensions Using Slots for Locating Tab(s)



PC. Board & Panel Mounting Dimensions Using Holes for Locating Tab(s)



Ref	Bushing	Mounting Panel Hole
A	1/4 - 32-NEF Max Dia. (0.249 [6,32mm])	0.265" [6,76mm]
B	3/8 - 32-NEF Max Dia. (0.375" [9,53mm])	0.390" [9,91mm]

**Series S88 Locating Lug Style:**

Tab width: .091"  
Tab Height: .041±.005" FMS  
Spacing: .250"

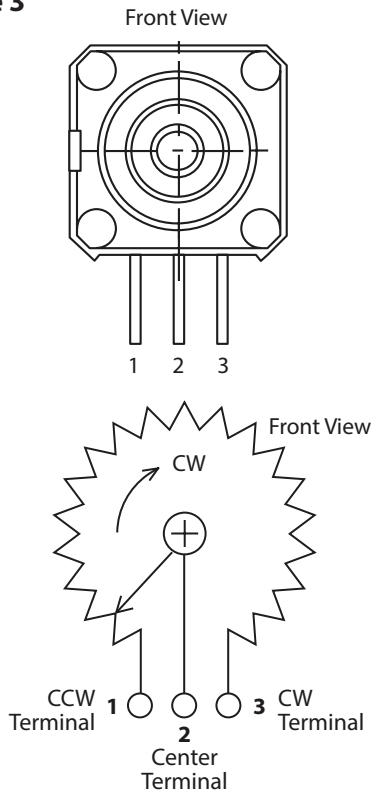
**Option Number**

- 1 = one tab - at 9 o'clock (standard)
- 2 = one tab - at 3 o'clock
- 3 = one tab - at 12 o'clock
- 4 = one tab - at 6 o'clock
- 5 = two tabs - at 3 and 9 o'clock
- 6 = two tabs - at 6 and 12 o'clock
- 7 = No Locating Lug

**NOTE:** Slots are recommended for the locating tab(s) when using 3/8" diameter bushings because of clearance issues.

Potentiometer Schematic

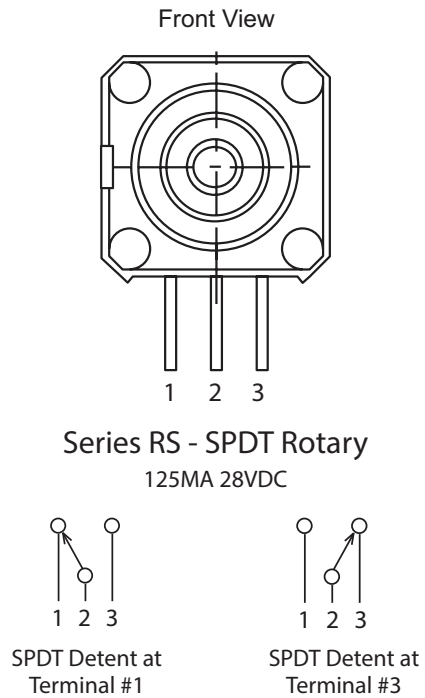
Figure 3



RS Modules

Figure 4

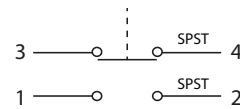
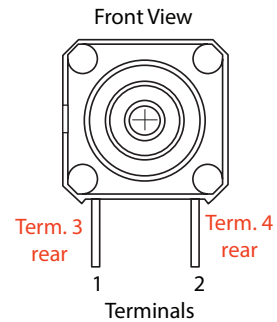
Series RS Switch: Rotary Style



Push-Pull Switch Module

Figure 5

Series PP/MP Switch: Push-Pull



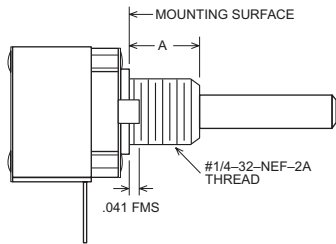
Series BJ Push-Pull  
Series BJM Momentary  
**Push-Pull/Momentary Schematic**

Shaft shown in the extended position  
Note: Connecting terminals 2 and 4 together will create a SPDT switch

Series PP / MP- DPST  
Push-Pull or  
Push-Pull Momentary  
125MA 28VDC

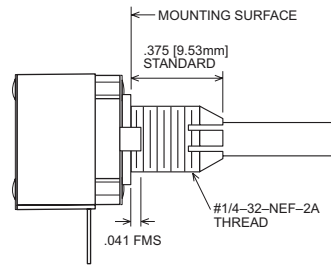
**Series S88/S89 Bushings**

**Figure 6**  
 .250 [6,35mm] Diameter Bushing, Plain Shaft

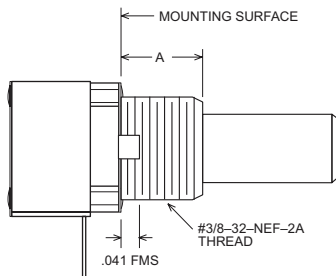


"A" Bushing Lengths for  
 .250" Dia. Bushing:  
 .250 [6.35mm] STD  
 .375 [9.53mm]  
 .500 [12.70mm]

**Figure 8**  
 .250 [6,35mm] Diameter, Locking Bushing

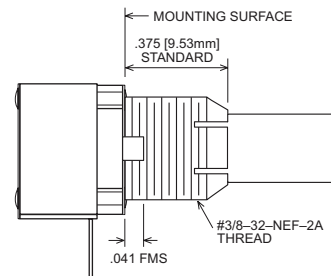


**Figure 7**  
 .375 [9,53mm] Diameter Bushing, Plain Shaft



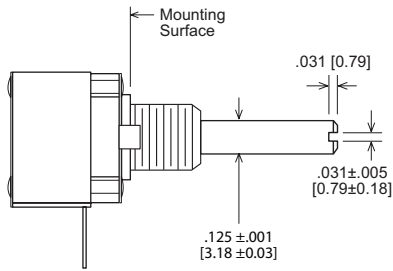
"A" Bushing Lengths for  
 .375" Dia. Bushing:  
 .250 [6.35mm] STD  
 .375 [9.53mm]  
 .500 [12.70mm]

**Figure 9**  
 .375 [9,53mm] Diameter, Locking Bushing

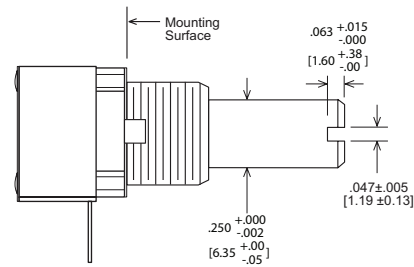


Series S88/S89 Shafts

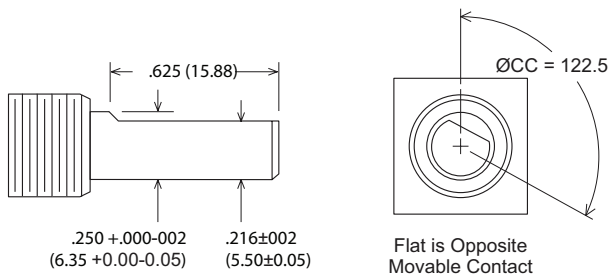
**Figure 10**  
.125 [3,18mm] Diameter - Slotted Shaft



**Figure 11**  
.250 [6,35mm] Diameter - Slotted Shaft

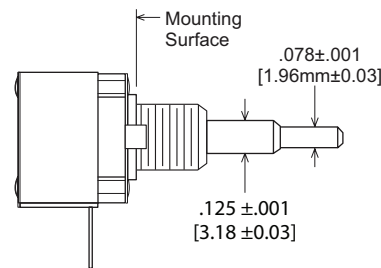


**Figure 12**  
.250 [6,35mm] Diameter - Flatted Shaft



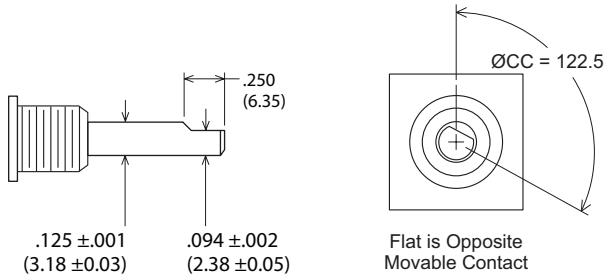
Flat can extend to within .031 [0,79] of mounting bushing where shaft length will not permit standard flat.

**Figure 13**  
.125 [3,18mm] Diameter - Concentric Shafts



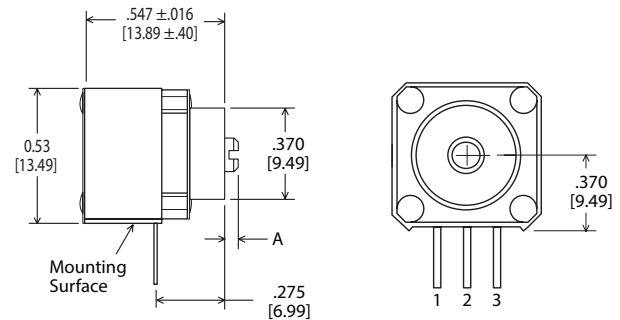
Note: Only plain ends are available for concentric shafts

**Figure 14**  
.125 [3,18mm] Diameter - Flatted Shaft



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

**Figure 15**  
Trimmer



Dimension A: .025 [0.64] Standard  
Other lengths available to .50 [12,70] Maximum

Series S88 and S89 controls are assembled from 1/2" square, stackable potentiometer and switch modules. Combine up to 8 modules, with single or concentric metal shafts. Series S88 potentiometer modules have conductive plastic resistive elements, and Series S89 potentiometer modules have cermet resistive elements.

The most common configurations are listed below. Contact your State Electronics sales representative for your custom requirements.

# Series S88/S89 - Single Shaft Horizontal Mounting Styles

(without PC Support Plates)

**PC Pin Terminals (B22) .875" long, or Solder Hooks**

*Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST*

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PC Pins: 1, 2, 3, or 4 Potentiometer(s) or RS Modules, 3/8" Dia. Bushing.....	19
Solder Hooks: 1, 2, 3, or 4 Potentiometer(s) or RS Modules, 1/4" Dia. Bushing.....	20
Solder Hooks: 1, 2, 3, or 4 Potentiometer(s) or RS Modules, 3/8" Dia. Bushing.....	21
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PC Pins: 3 Potentiometer(s) or RS Modules plus PP/MP, 1/4" or 3/8" Dia. Bushing.....	25
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Solder Hooks: Single Potentiometer or RS plus PP or MP, 1/4" or 3/8" Dia. Bushing .....	26
Solder Hooks: 2 Potentiometer(s) or RS Modules plus PP or MP, 1/4" or 3/8" Dia. Bushing.....	27
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PC Pins or Solder Hooks: Single, Dual Potentiometer with Detent, Valley Style, 3/8" Dia. Bushing .....	29
 <b>Single Shaft with Push-On / Push-Off Switch (Schadow™)</b>	
Single, Dual Potentiometer with DPDT Schadow Switch.....	30

*Note 1: Push-Pull & Momentary Push switches must be the last section*

# Series S88/S89 - Concentric Shafts Horizontal Mount Styles

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

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**Concentric Shafts, Potentiometer(s) and Rotary Switch(es)**

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 Solder Hooks: 2, 3, 4 Potentiometer or RS Modules, Concentric Shafts, 1/4" Bushing..... 34  
 Solder Hooks: 2, 3, 4 Potentiometer or RS Modules, Concentric Shafts, 3/8" Bushing..... 35

**Concentric Shafts, Potentiometer(s) and Rotary Switch(es) +  
Push-Pull (PP) or Momentary Push Switch (MP)** (Note 1)

Solder Hooks: 1 Potentiometer or RS Modules, + PP or MP Switch, 1/4" Bushing..... 37  
 Solder Hooks: 1 Potentiometer or RS Modules, + PP or MP Switch, 3/8" Bushing..... 38  
 Solder Hooks: 2 Potentiometer or RS Modules, + PP or MP Switch, 1/4" Bushing, Outer Shaft/ Module 1..... 39  
 Solder Hooks: 2 Potentiometer or RS Modules, + PP or MP Switch, 1/4" Bushing, Outer Shaft/ Module 1 & 2.... 40  
 Solder Hooks: 2 Potentiometer or RS Modules, + PP or MP Switch, 1/4" Bushing, Outer Shaft/ Module 1..... 39  
 Solder Hooks: 2 Potentiometer or S Modules, + PP or MP Switch, 1/4" Bushing, Outer Shaft/ Module 1 & 2.... 40  
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**Concentric Shafts, Potentiometer(s) with Detents on Inner and/or Outer Shaft**

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**Concentric Shafts, Potentiometer(s) and Rotary Switch(es) with Mounting Feet**

PC Pins: 2 or 3 Potentiometer or RS Modules, Concentric Shaft, 1/4" Dia. Bushing..... 58  
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 PC Pins: 2 or 3 Potentiometer or RS Modules, Concentric Shaft, 3/8" Dia. Bushing..... 60  
 PC Pins: 4 Potentiometer or RS Modules, Concentric Shaft, 3/8" Dia. Bushing..... 64

**Concentric Shafts - Vertical Mount**

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# Series S88/S89 - Single Shaft Horizontal Mounting Styles

## With Mounting Plates - Styles B24-X

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

### Single Shaft - PC Pin Terminals, Rotary Switch(es) + Push-Pull (PP) or Momentary Push (MP) Switch <sup>(Note 1)</sup>

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1 PP or MP (no Potentiometer), 1/4" or 3/8" Bushing .....	52
1 or 2 Potentiometer or RS Modules, 1/4" Dia. Bushing .....	53
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### Single Shaft Detents (Center, 11 or 21), PC Pin Terminals

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### Single Shaft with Push-On / Push-Off Switch (Schadow™)

Single, Dual Potentiometer with DPDT Schadow Switch .....	30
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Note 1: Push-Pull & Momentary Push switches must be the last section

# Series S88/S89 - Vertical Mounting Styles

**PC Pins Formed per Drawing**  
 (Limited to two sections due to lead lengths)

*Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST*

## Single Shaft

A-18, C-8, : 1 Potentiometer or RS, 1/4" Dia. Bushing .....	74
C-15: 1 PP or MP Switch, 1/4" Dia. Bushing .....	74
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C-15: 1 PP or MP Switch, 3/8" Dia. Bushing .....	75
A-19, A-20, C9, C10: 2 Potentiometers or RS Modules, 1/4" Dia. Bushing .....	76
A-19, A-20, C9, C10: 2 Potentiometer or RS Modules, 3/8" Dia. Bushing .....	77
C-11: 1 Potentiometer and PP or MP Switch, 1/4" Dia. Bushing (Note 1) .....	78
C-11: 1 Potentiometer and PP or MP Switch, 3/8" Dia. Bushing (Note 1) .....	79

## Detents (Center, 11 or 21)

C-8, A-18, C10, A20: 1, 2 Potentiometer(s), Detent, Valley Style, 1/4" Dia. Bushing .....	80
C-8, A-18, C10, A20: 1, 2 Potentiometer(s), Detent, Valley Style, 3/8" Dia. Bushing .....	81

*Note 1: Push-Pull & Momentary Push switches must be the last section*

## Screwed Together Construction - May be Required on Certain Designs

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# Motorized Potentiometers

## Motorized Potentiometer (Wire Leads on Motor)

PC Pins: Single Shaft, 1 or 2 Potentiometer(s) or RS Modules, 1/4" or 3/8" Dia. Bushing. . . . . 86  
Solder Hooks: Single Shaft 1 or 2 Potentiometer(s) or RS Modules, 1/4" or 3/8" Dia. Bushing . . . . . 86

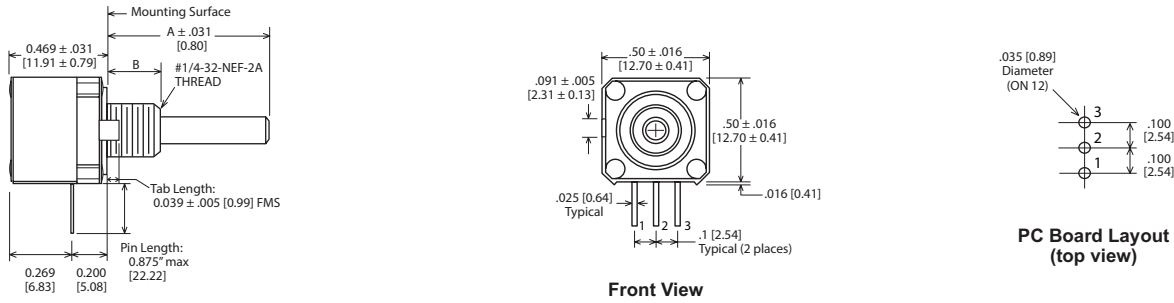
# Drawing Comments

- All Mod-Pot resistive and switched modules are a nominal 0.500 [12,7mm] square.
- Resistive and rotary switch modules are 0.300" [7,62mm] deep.
- Push-pull switches are 0.310" [7,88mm] deep.
- Push-pull or momentary push switches must be the last section in any design.
- Certain designs will require spacers of varying thicknesses between the modules.
- The mounting surface of the potentiometer is the flat portion of the base of the threads on the bushing that would rest against the inside surface of a panel.
- Shaft, bushing, overall depth, and other length dimensions are always referenced from the mounting surface (FMS).
- Options for leads are:  
 Full-length PC leads - 0.875" long  
 B22 0.250" [6,35mm] long  
 B24 cut to match mounting feet specification  
 Solder Hooks
- Lead spacing does not change with the type of termination.
- The lead spacing between resistive and rotary switch modules (designs without spacers) is 0.300" [7.62mm], with 0.100" [2,54mm] on individual pins.
- Lead spacing on an individual push-pull switch is .200" x .200" [5,08mm] x [5,08mm].
- All designs require a front plate, with or without an anti-rotation tab. The single tab can be located at 90° increments and a dual tab at 180° increments.
- Front and rear plates that incorporate feet are also available on most designs. Those feet serve 2 purposes; to support the potentiometer and remove the stress for the leads in PC board applications and to consistently place the center line of the shaft above the surface of the PC board.
- All designs require a rear plate, with or without tabs. A rear plate with tabs is used on vertical mount designs to secure the potentiometer to the PC board and to remove any stress on the PC leads. Vertical mount designs are limited to two sections due to lead lengths.
- State Electronics can build virtually any configuration so, if you can't find a design, please contact our product manager for assistance.
- Most drawing number references will correspond to the chart below.

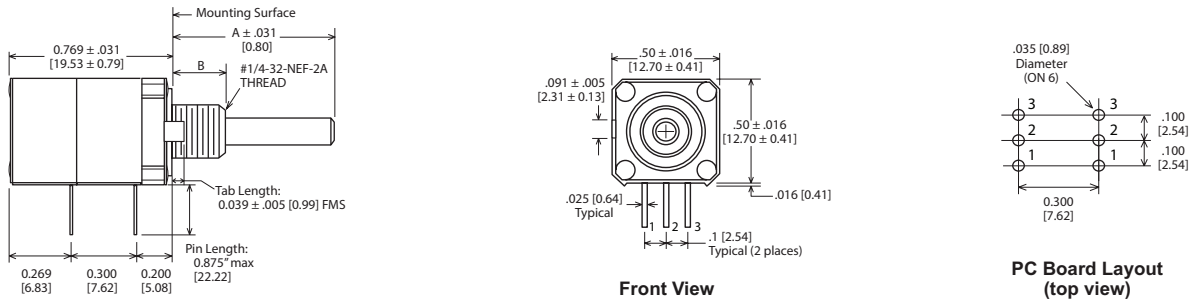
SECTIONS	ShaftS	BUSHING	Module TYPE	TERMINALS	Detents	Concentric ShaftS ONLY Outer Shaft Module #	MOUNTING	Concentric ShaftS ONLY DetentS
1	1 - Single	1 - 1/4"	1 - Pot OR RS	SHA - Solder Hook	<BLANK>	Outer Shaft / Module 1 Inner Shaft Module 2	<BLANK> = Horizontal B22	D0 - Detent Outer Shaft
2	2 - Concentric	2 - 3/8"	2 - Push-Pull	B22 - PC Pins	D - DetentS	Outer Shaft / Module 1 Inner Shaft Module 2 & 3	A18	D1 - Detent Inner Shaft
3			3 - Momentary Push	B24 Support Feet		Outer Shaft / Module 1 & 2 Inner Shaft Module 3	A18-D	D10 - Detent BOTH Shafts
4			4 - Shadow (Single Shaft) 5 - Motorized Single Shaft Only			Outer Shaft / Module 1 Inner Shaft Module 2, 3 & 4 Outer Shaft / Module 1 & 2 Inner Shaft Module 3 & 4 Outer Shaft / Module 1, 2 & 3 Inner Shaft Module 4	A19 A20 A20-D (DetentS)	
							C10 C10-D (DetentS) C11 C15 C15 C8 C8-D (DetentS) C9	

Series S88/S89 - Horizontal Mounting Styles

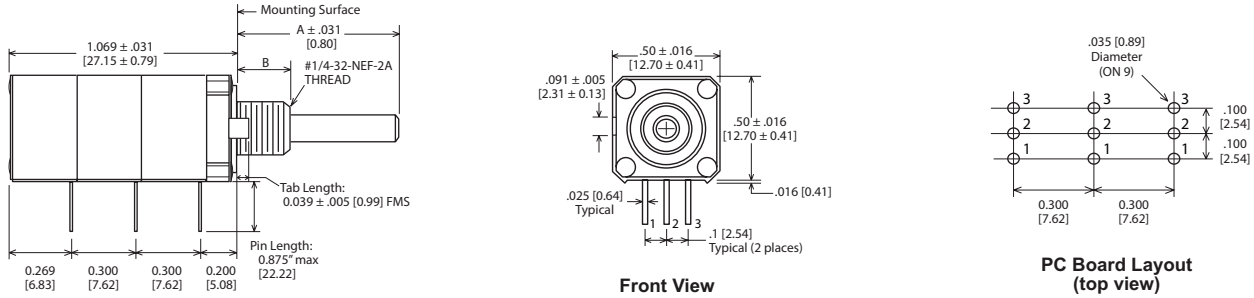
**Drawing 111-1-B22:** B-22 Single Potentiometer or RS, PC Pin Terminals, 1/4" Dia. Bushing



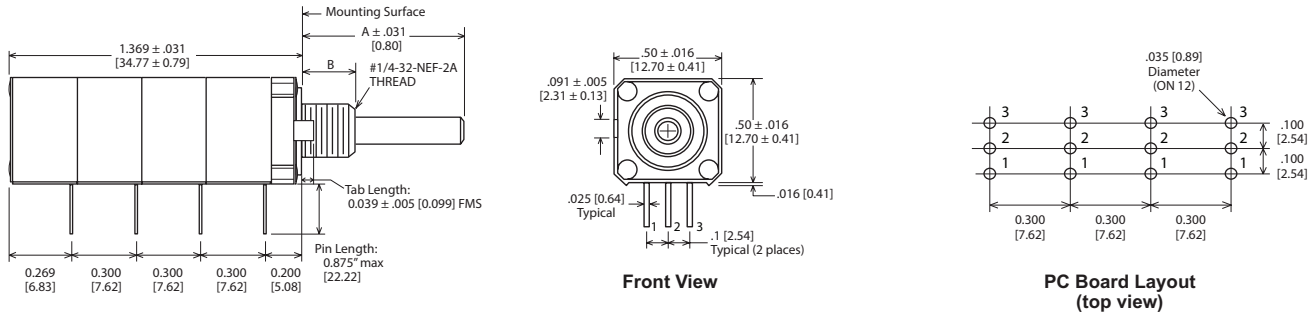
**Drawing 211-1-B22:** B-22 Dual Potentiometer or RS, PC Pin Terminals, 1/4" Dia. Bushing



**Drawing 311-1-B22:** B-22 Triple Potentiometer or RS, PC Pin Terminals, 1/4" Dia. Bushing



**Drawing 411-1-B22:** B-22 Quad Potentiometer or RS, PC Pin Terminals, 1/4" Dia. Bushing

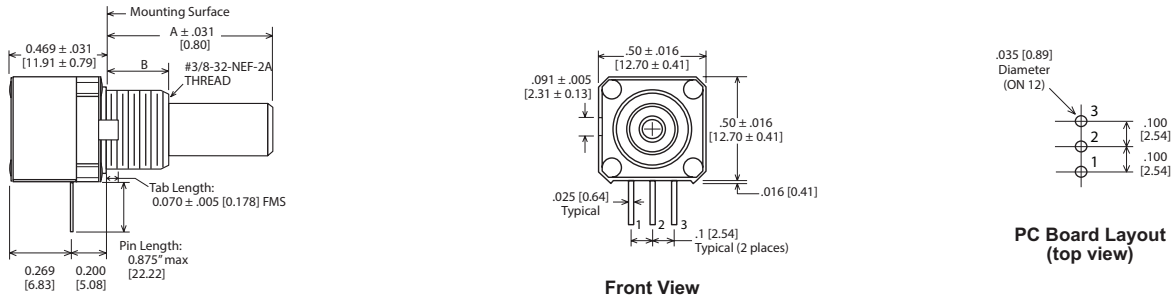


**Notes:**

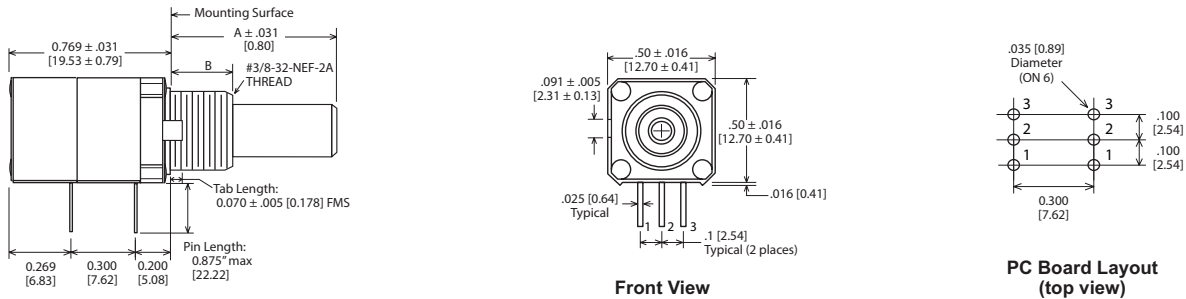
1. Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance  $\pm .016$  [0.40], except as specified.
2. B-22 PC pin length standard is 0.250". Maximum of .875" [22.22]
3. Drawings are not to scale.

Series S88/S89 - Horizontal Mounting Styles

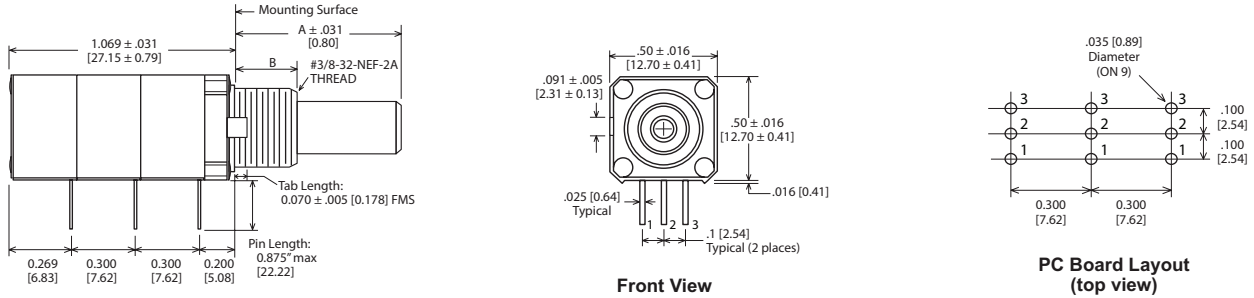
**Drawing 121-1-B22:** B-22 Single Potentiometer or RS, PC Pin Terminals, 3/8" Dia. Bushing



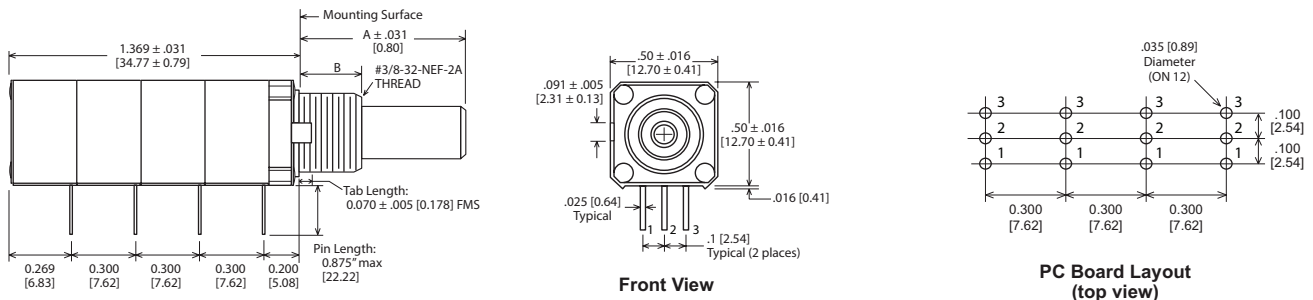
**Drawing 221-1-B22:** B-22 Dual Potentiometer or RS, PC Pin Terminals, 3/8" Dia. Bushing



**Drawing 321-1-B22:** B-22 Triple Potentiometer or RS, PC Pin Terminals, 3/8" Dia. Bushing



**Drawing 421-1-B22:** B-22 Quad Potentiometer or RS, PC Pin Terminals, 3/8" Dia. Bushing



**Notes:**

1. Basic dimensions are in inches.  
Dimensions in brackets are in millimeters.  
Dimensional Tolerance  $\pm .016$  [0.40], except as specified.
2. B-22 PC pin length standard is  $0.250$ ". Maximum of  $.875$ " [22.22]
3. Drawings are not to scale.

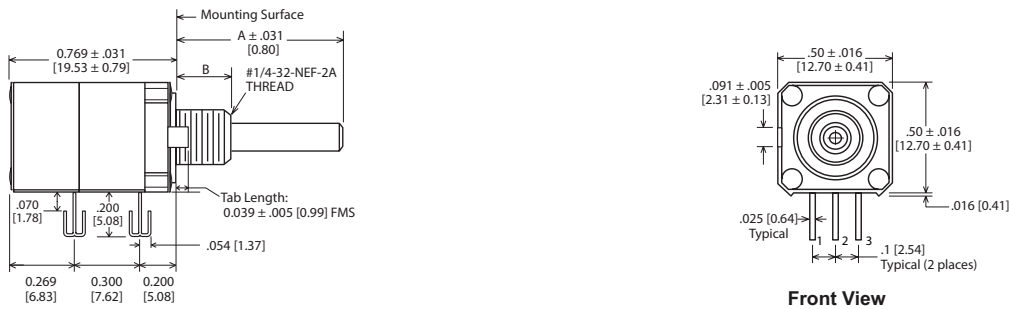
Series S88/S89 - Horizontal Mounting Styles (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

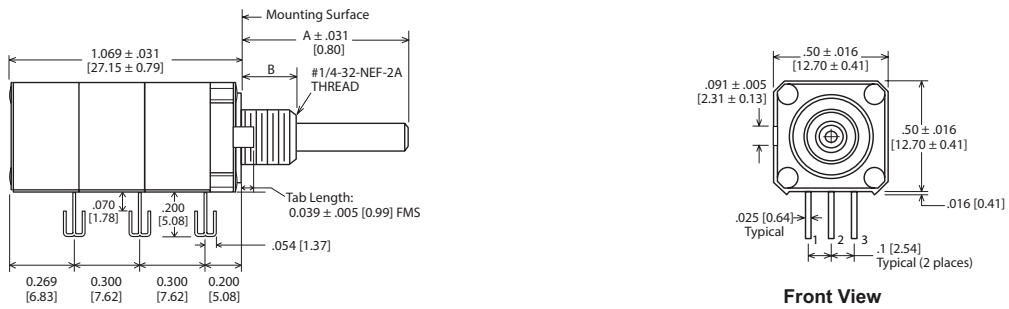
Drawing 111-1-SHA-1A: Single Potentiometer or RS, Solder Hooks, 1/4" Dia. Bushing



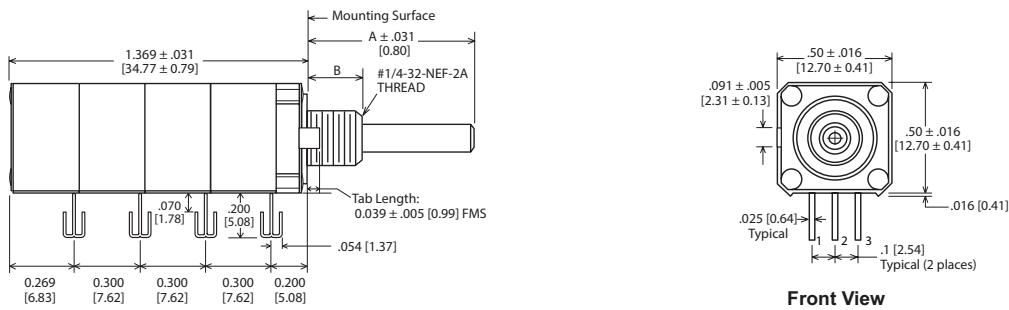
Drawing 211-1-SHA: Dual Potentiometer or RS, Solder Hooks, 1/4" Dia. Bushing



Drawing 311-1-SHA: Triple Potentiometer or RS, Solder Hooks, 1/4" Dia. Bushing



Drawing 411-1-SHA: Quad Potentiometer or RS, Solder Hooks, 1/4" Dia. Bushing



NOTE: Solder Hook Terminal receives (3) NO. 22 AWG .025 [0,64mm] solid wires



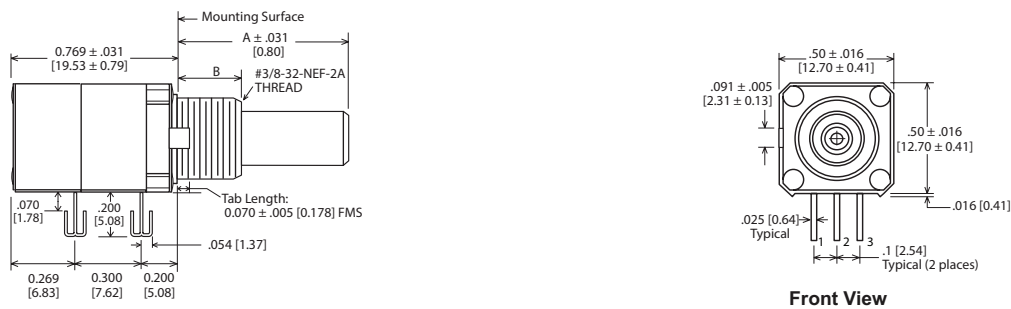
Series S88/S89 - Horizontal Mounting Styles (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

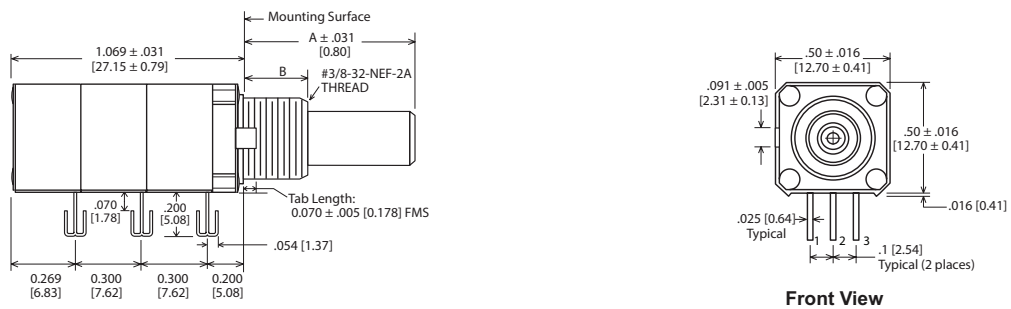
**Drawing 121-1-SHA:** Single Potentiometer or RS, Solder Hooks, 3/8" Dia. Bushing



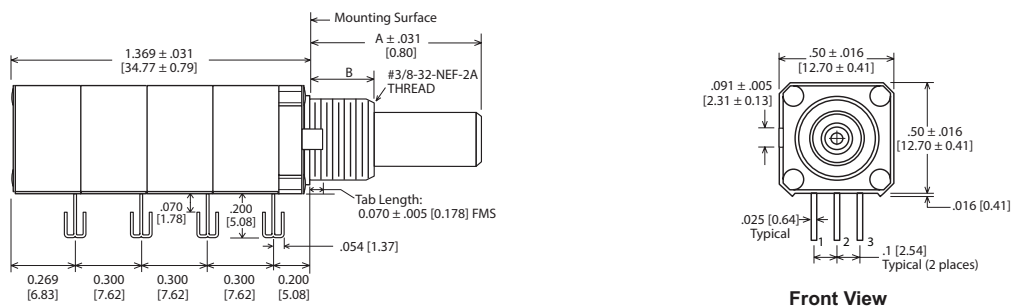
**Drawing 221-1-SHA:** Dual Potentiometer or RS, Solder Hooks, 3/8" Dia. Bushing



**Drawing 321-1-SHA:** Triple Potentiometer or RS, Solder Hooks, 3/8" Dia. Bushing



**Drawing 421-1-SHA:** Quad Potentiometer or RS, Solder Hooks, 3/8" Dia. Bushing



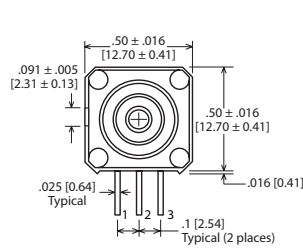
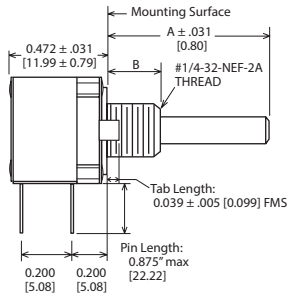
**NOTE:** Solder Hook Terminal receives (3) NO. 22 AWG .025 [0,64mm] solid wires

Series S88/S89 - Horizontal Mounting Styles (continued)

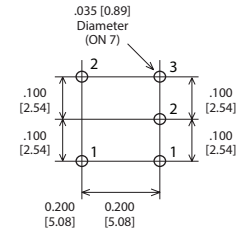
Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

**Drawing 111-2-B22:**

B-22 Single PP or MP, PC Terminals, 1/4" Dia. Bushing



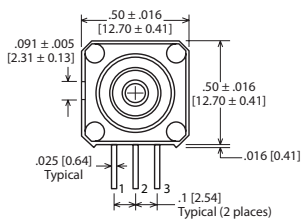
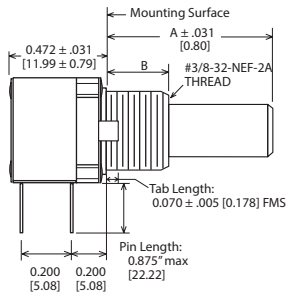
Front View



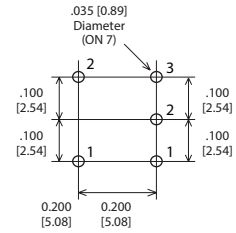
PC Board Layout (Top View)

**Drawing 121-2-B22:**

B-22 Single PP or MP, PC Terminals, 3/8" Dia. Bushing



Front View



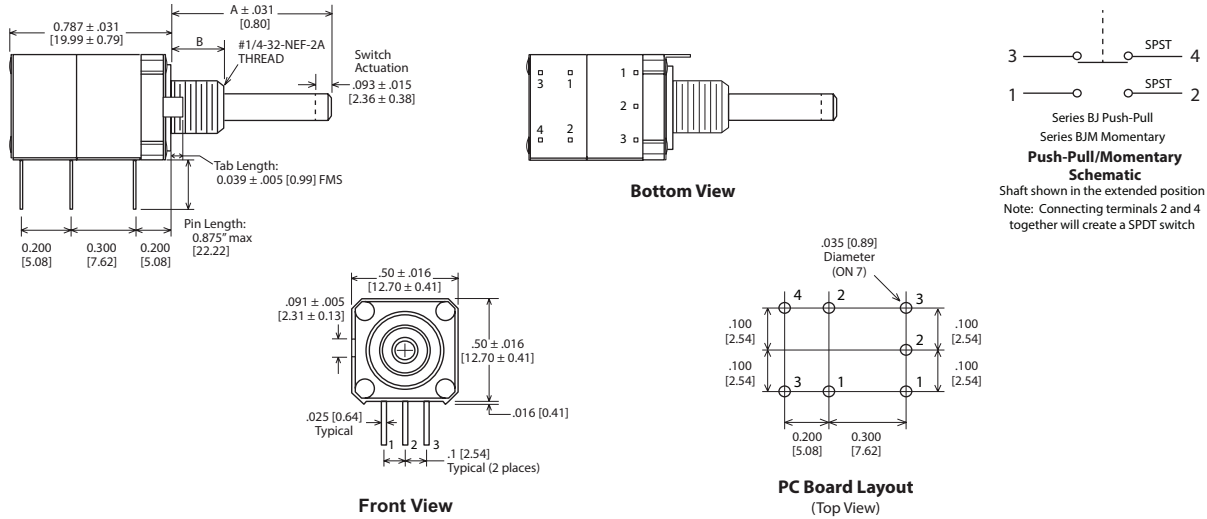
PC Board Layout (Top View)

Series S88/S89 - Horizontal Mounting Styles (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

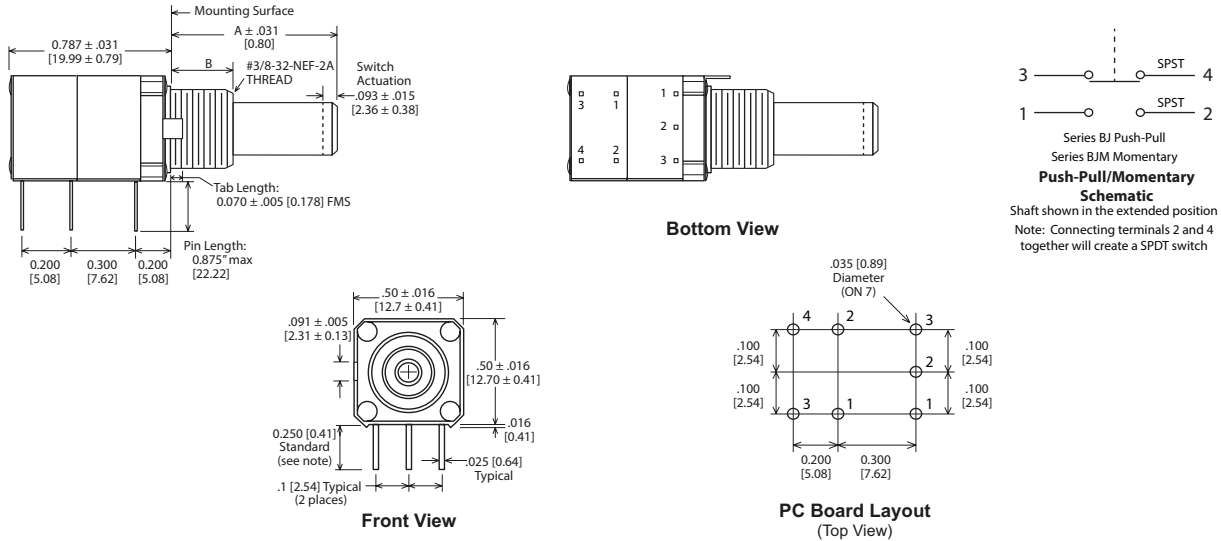
**Drawing 211-2-B22:**

B-22 Single Module, plus Push-Pull/Momentary Switch, PC Pin Terminals, 1/4" Dia. Bushing



**Drawing 221-2-B22:**

B-22 Single Module, plus Push-Pull/Momentary Switch, PC Pin Terminals, 3/8" Dia. Bushing



**Notes:**

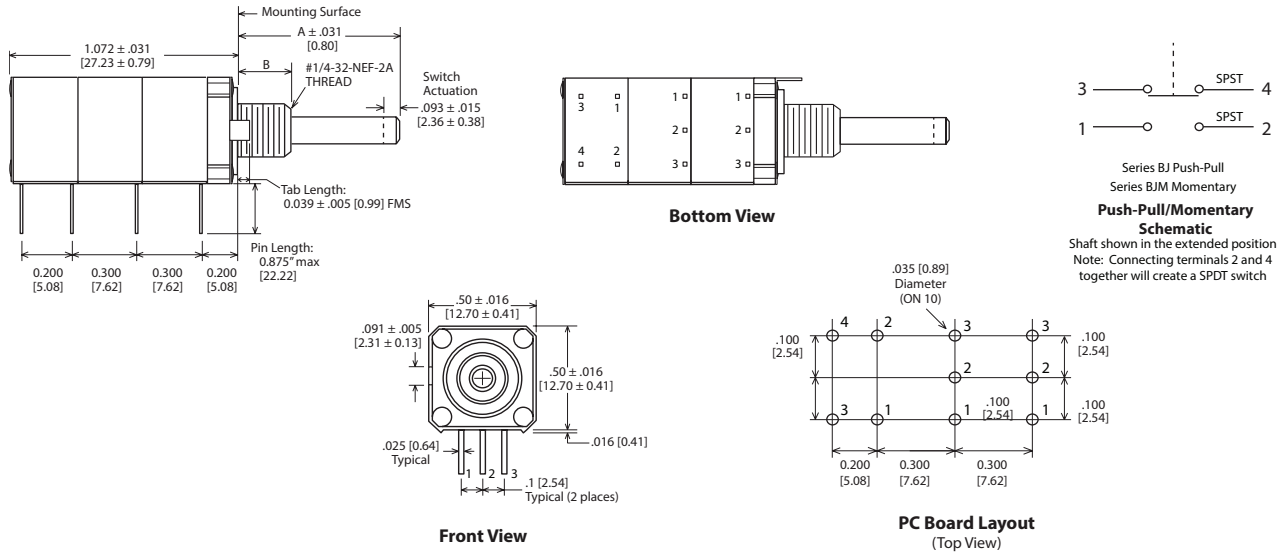
1. Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance  $\pm .016$  [0,40], except as specified.
2. B-22 PC pins length standard is 0.250". Maximum of 0.875" [22.22]
3. Drawings are not to scale.

Series S88/S89 - Horizontal Mounting Styles (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

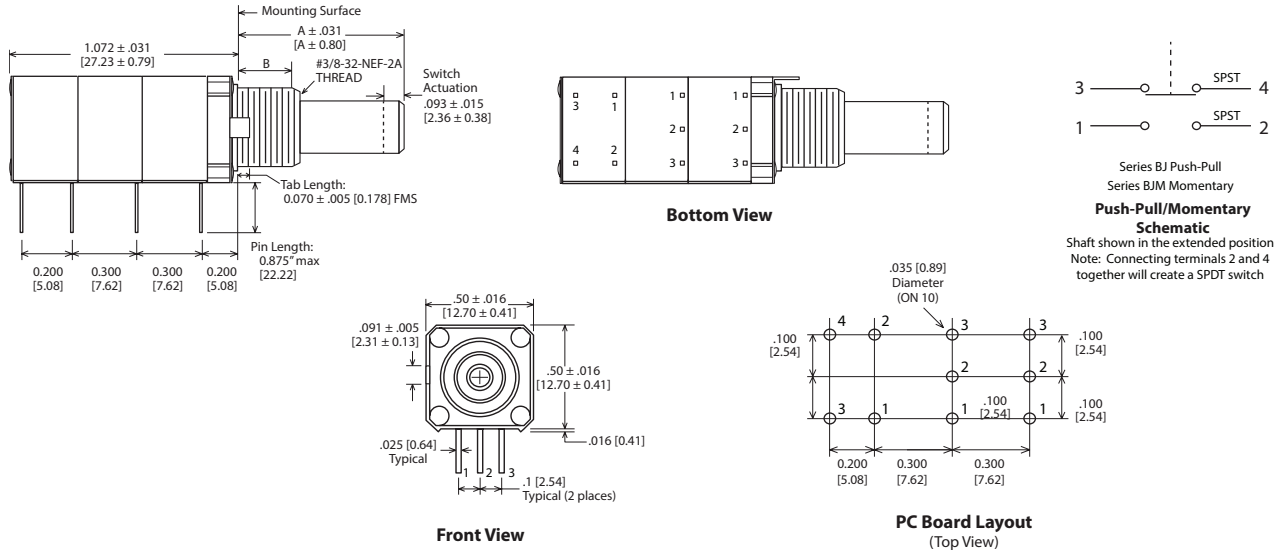
Drawing 311-2-B22:

B-22 Dual Potentiometer or RS, plus Push-Pull/Momentary Switch, PC Pin Terminals, 1/4" Dia. Bushing



Drawing 321-2-B22:

B-22 Dual Potentiometer or RS, plus Push-Pull/Momentary Switch, PC Pin Terminals, 3/8" Dia. Bushing



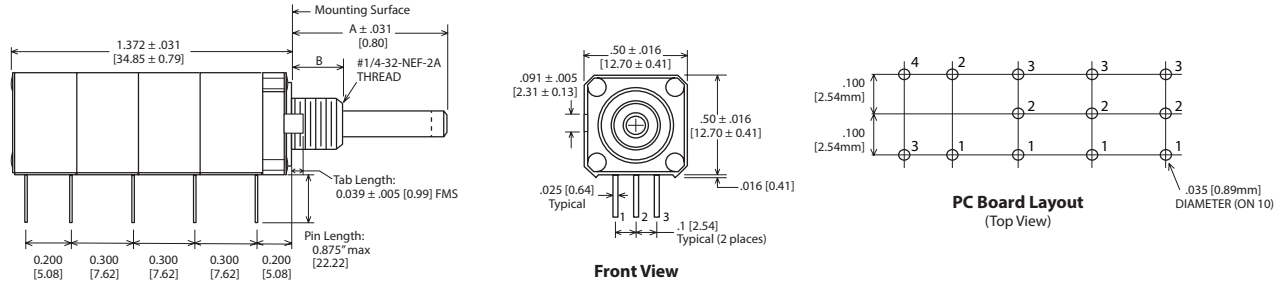
Series S88/S89 - Horizontal Mounting Styles (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

**Drawing 411-2-B22:**

B-22, Triple Potentiometer/RS with (PP) Push-Pull/(MP) Momentary Switch, PC Pin Terminals, 1/4" Dia. Bushing

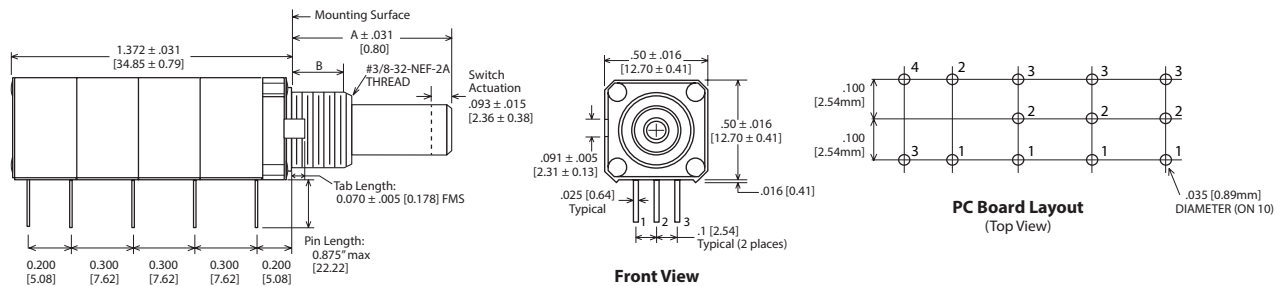
Locating Lug and no Support Brackets



**Drawing 421-2-B22:**

B-22 Triple Potentiometer/RS with (PP) Push-Pull/(MP) Momentary Switch, PC Pin Terminals, 3/8" Dia. Bushing

Locating Lug and no Support Brackets



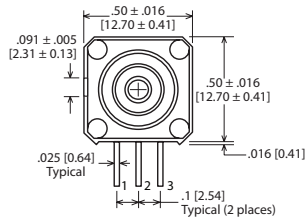
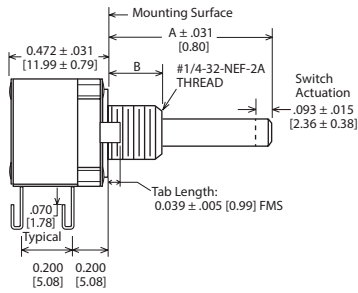
**Notes:**

1. Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance  $\pm .016$  [0,40], except as specified.
2. B-22 PC pins length standard is 0.250". Maximum of 0.875" [22.22]
3. Drawings are not to scale.

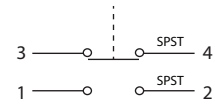
Series S88/S89 - Horizontal Mounting Styles (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

Drawing 111-2-SHA: Single PP OR MP, Solder Hooks, 1/4" Dia. Bushing



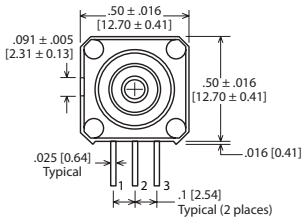
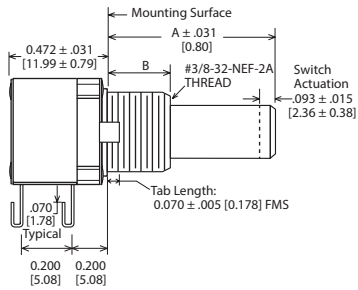
Front View



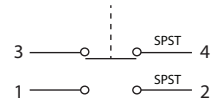
Series BJ Push-Pull  
Series BJM Momentary  
**Push-Pull/Momentary Schematic**

Shaft shown in the extended position  
Note: Connecting terminals 2 and 4 together will create a SPDT switch

Drawing 121-2-SHA: Single PP OR MP, Solder Hooks, 3/8" Dia. Bushing



Front View

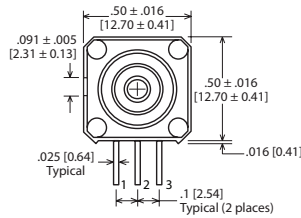
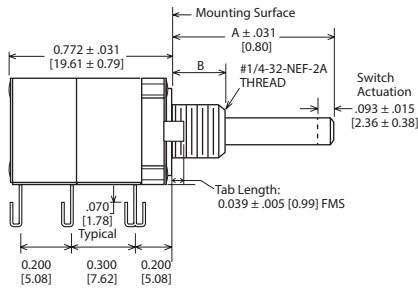


Series BJ Push-Pull  
Series BJM Momentary  
**Push-Pull/Momentary Schematic**

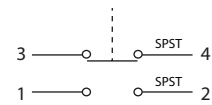
Shaft shown in the extended position  
Note: Connecting terminals 2 and 4 together will create a SPDT switch

Drawing 211-2-SHA:

Single Pot or RS, plus Push-Pull/Momentary Switch, Solder Hooks, 1/4" Dia. Bushing



Front View

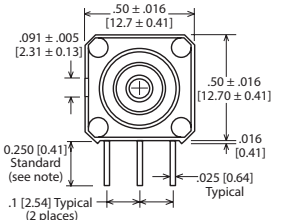
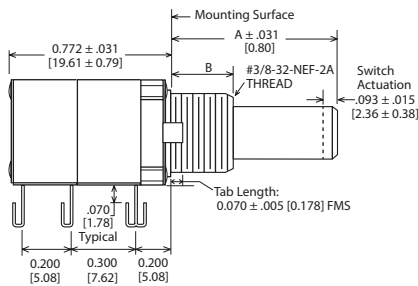


Series BJ Push-Pull  
Series BJM Momentary  
**Push-Pull/Momentary Schematic**

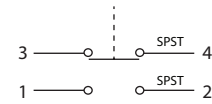
Shaft shown in the extended position  
Note: Connecting terminals 2 and 4 together will create a SPDT switch

Drawing 221-2-SHA:

B-22 Single Pot or RS, plus Push-Pull/Momentary Switch, Solder Hooks, 3/8" Dia. Bushing



Front View



Series BJ Push-Pull  
Series BJM Momentary  
**Push-Pull/Momentary Schematic**

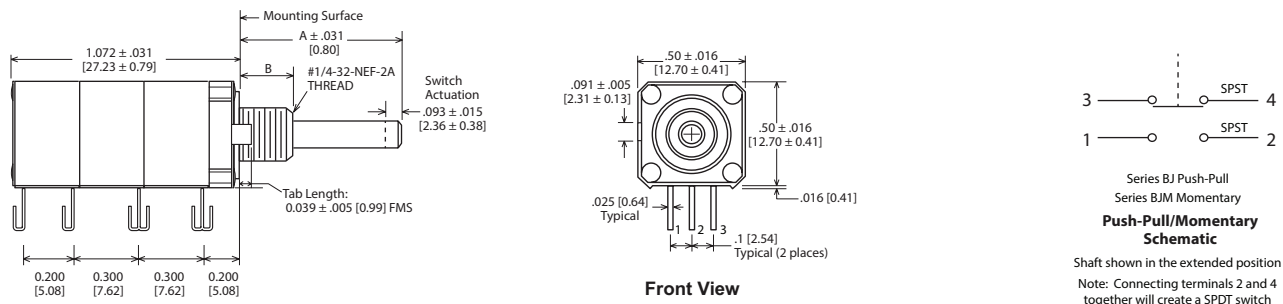
Shaft shown in the extended position  
Note: Connecting terminals 2 and 4 together will create a SPDT switch

Series S88/S89 - Horizontal Mounting Styles (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

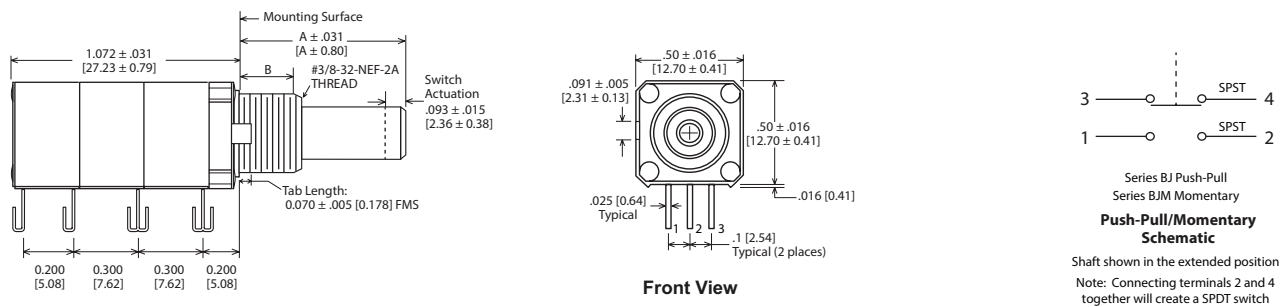
**Drawing 311-2-SHA:**

B-22 Dual Pot or RS, plus Push-Pull/Momentary Switch, Solder Hook Terminals, 1/4" Dia. Bushing



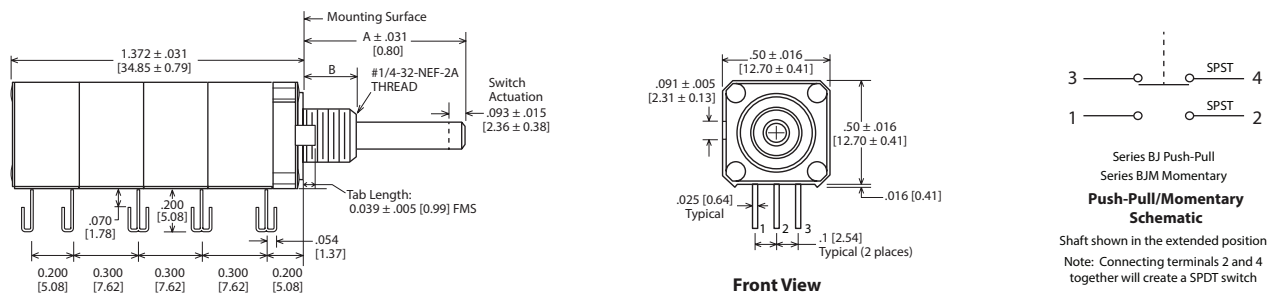
**Drawing 321-2-SHA:**

B-22 Dual Pot or RS, plus Push-Pull/Momentary Switch, Solder Hook Terminals, 3/8" Dia. Bushing



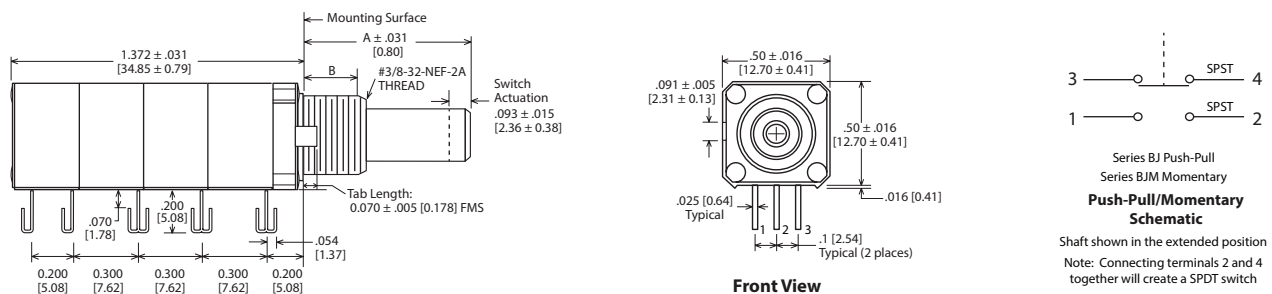
**Drawing 411-2-SHA:**

Triple Potentiometer/RS with (PP) Push-Pull/(MP) Momentary Switch, Solder Hooks, 1/4" Dia. Bushing



**Drawing 421-2-SHA:**

Triple Potentiometer/RS with (PP) Push-Pull/(MP) Momentary Switch, Solder Hooks, 3/8" Dia. Bushing





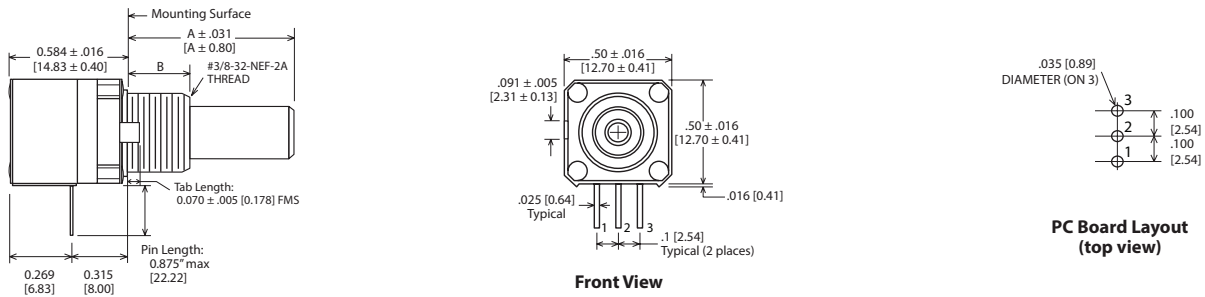


Series S88/S89 - Horizontal Mounting Styles (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

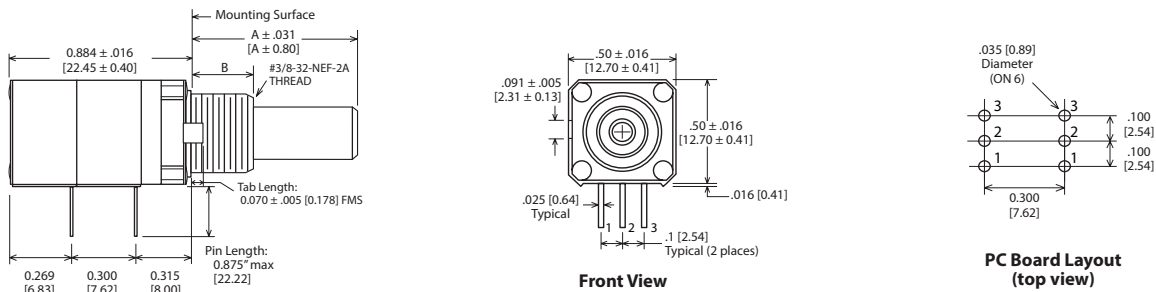
**Drawing 121-1-B22-D:**

B-22 Single Potentiometer with detent, Valley Style, PC Pin Terminals, 3/8" Dia. Bushing



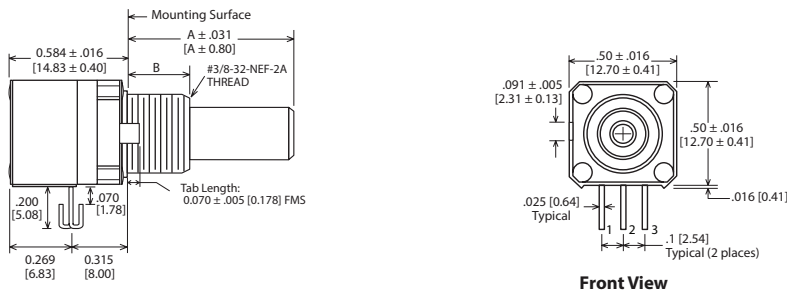
**Drawing 221-1-B22-D:**

B-22 Dual Potentiometer with detent, Valley Style, PC Pin Terminals, 3/8" Dia. Bushing



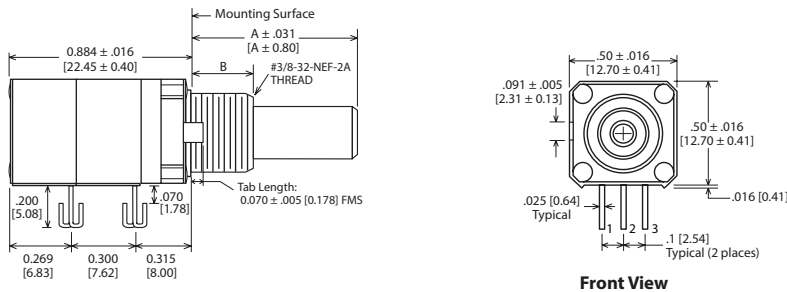
**Drawing 121-1-SHA-D:**

B-22 Single Potentiometer with detent, Valley Style, Solder Hooks, 3/8" Dia. Bushing



**Drawing 221-1-SHA-D:**

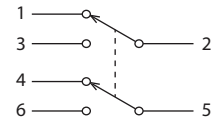
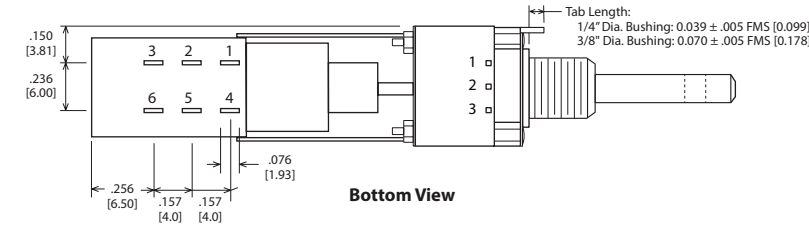
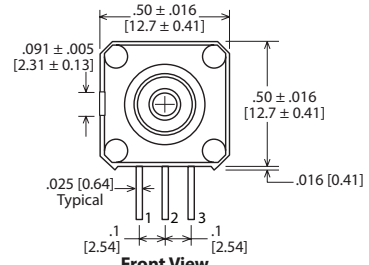
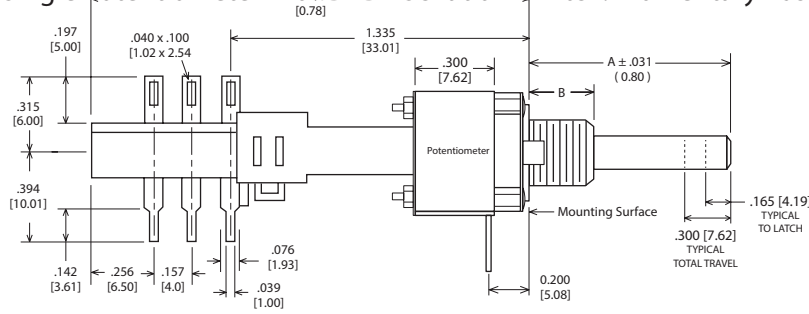
B-22 Dual Potentiometer with detent, Valley Style, Solder Hooks, 3/8" Dia. Bushing



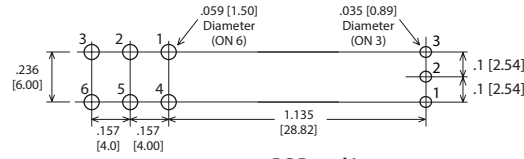
Series S88/S89 - Horizontal Mounting Styles (continued)

**Drawing 211-3-B22:**

Single Potentiometer with DPDT Schadow Switch: Momentary Push or Push On/Push Off



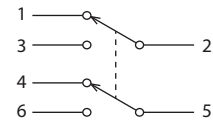
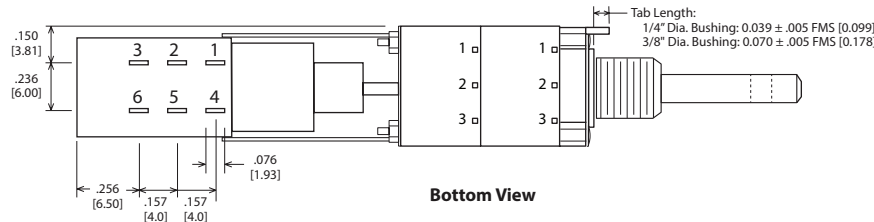
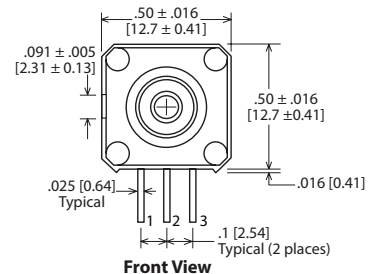
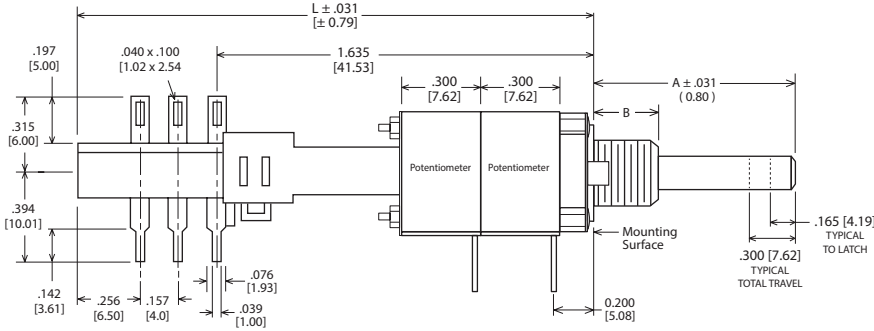
Schadow Switch Schematic DPDT Push-Pull / Momentary (Shown with shaft extended)



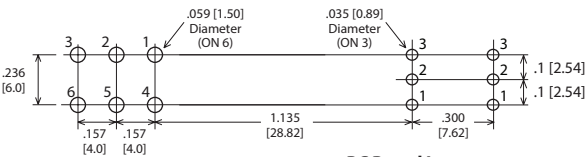
PC Board Layout (Top View)

**Drawing 311-3-B22:**

Dual Potentiometer with DPDT Schadow Switch: Momentary Push or Push On/Push Off



Schadow Switch Schematic DPDT Push-Pull / Momentary (Shown with shaft extended)



PC Board Layout (Top View)

# Design Considerations for Concentric Shafts Potentiometers or Rotary Switches

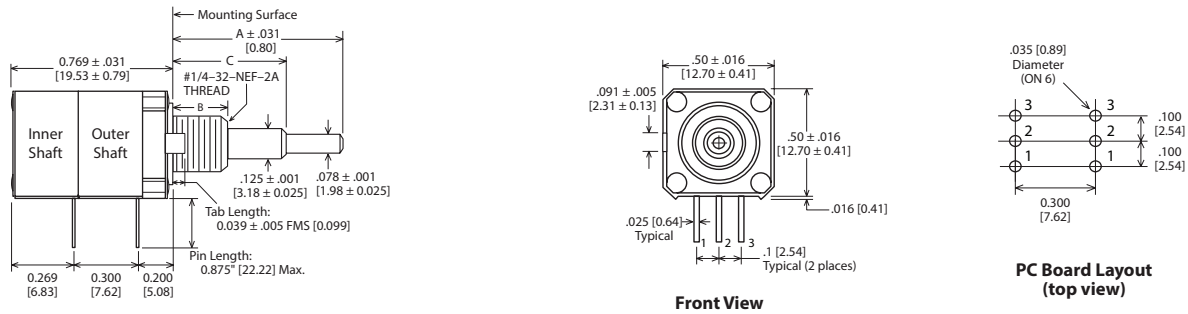
- A concentric shaft potentiometer consists of an inner and outer shaft with a common axis.
- There are two shaft diameter combinations available:  
5/64th" (.078") [1,98mm] Inner shaft with 1/8" (.125") [3,18mm] Outer shaft  
1/8" (.125") [3,18mm] Inner shaft with a 1/4" (.250") [6,35mm] Outer shaft
- All shafts lengths are measured FMS.
- As a general rule, the inner shaft should be at least 1/4" longer than the outer shaft to allow for a knob.
- The outer shaft of a concentric potentiometer always controls the first module. Adjacent module can also be controlled by the outer shaft.
- The inner shaft would control all modules not controlled by the outer shaft.
- If a push-pull or momentary switch is incorporated into the design, it must be the last section and therefore controlled by the inner shaft.
- Designs shown in this catalog are limited to 4 sections. The number of combinations of modules type, their positions, terminations, and shaft combinations make it virtually impossible to show every configuration. State Electronics can build virtually any configuration so, if you can't find a design, please contact our product manager for assistance.

Series S88/S89 - Horizontal Mounting Styles (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

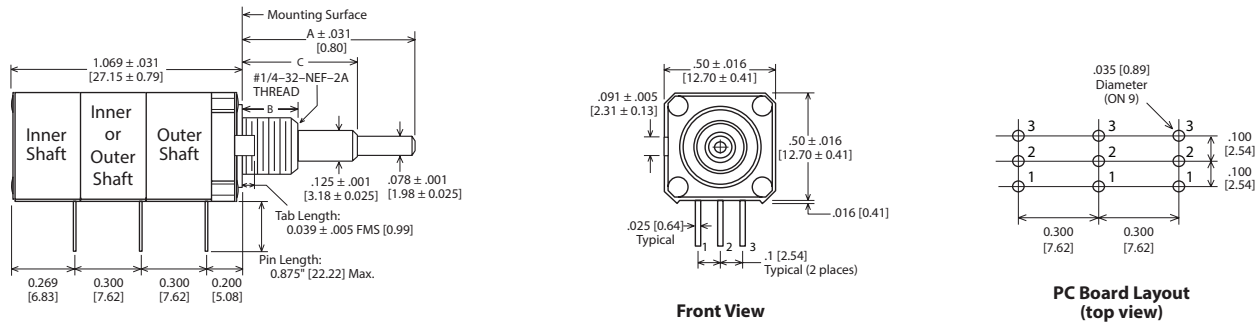
**Drawing 212-1-B22:**

B-22 Dual Potentiometer or RS, Concentric Shaft, PC Pin Terminals, 1/4" Dia. Bushing



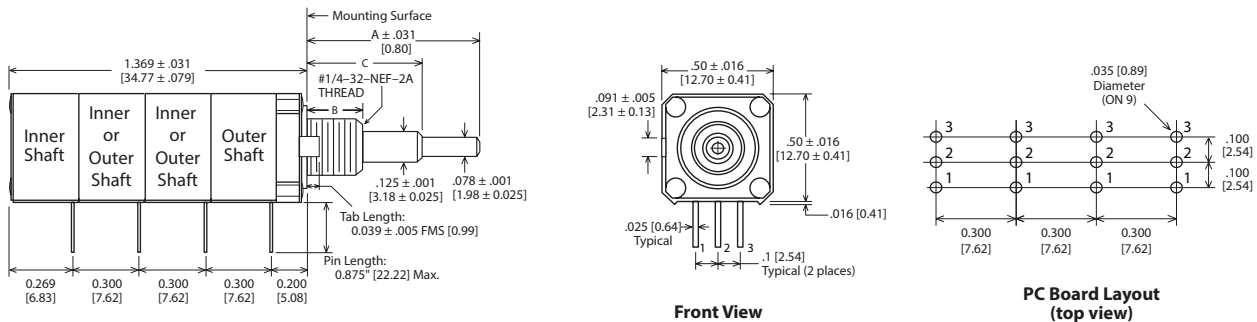
**Drawing 321-1-B22:**

B-22 Triple Potentiometer or RS, Concentric Shaft, PC Pin Terminals, 1/4" Dia. Bushing



**Drawing 421-1-B22:**

B-22 Quad Potentiometer or RS, Concentric Shaft, PC Pin Terminals, 1/4" Dia. Bushing



**Notes:**

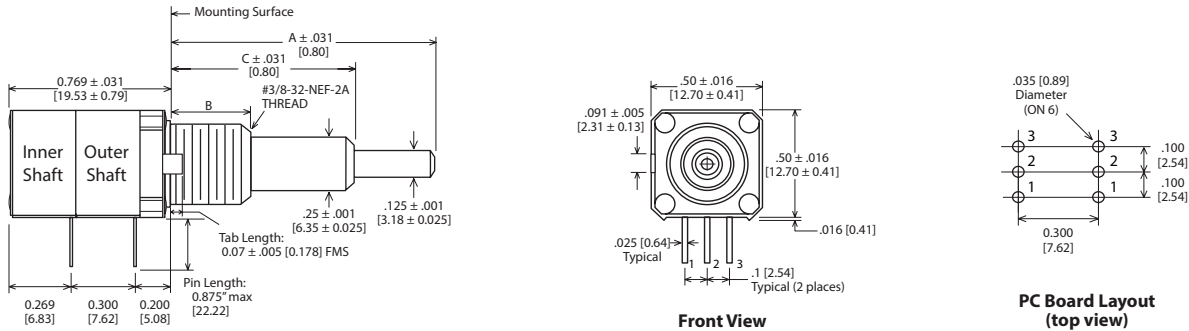
1. Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance ±.016 [0.40], except as specified.
2. B-22 PC pin length standard is 0.250". Maximum of .875" [22.22]
3. Drawings are not to scale.

Series S88/S89 - Horizontal Mounting Styles (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

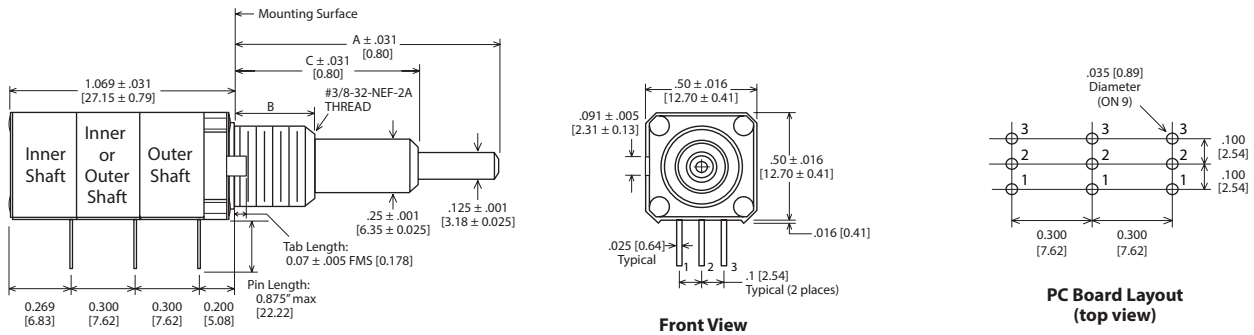
**Drawing 222-1-B22:**

B-22 Dual Potentiometer or RS, Concentric Shaft, PC Pin Terminals, 3/8" Dia. Bushing



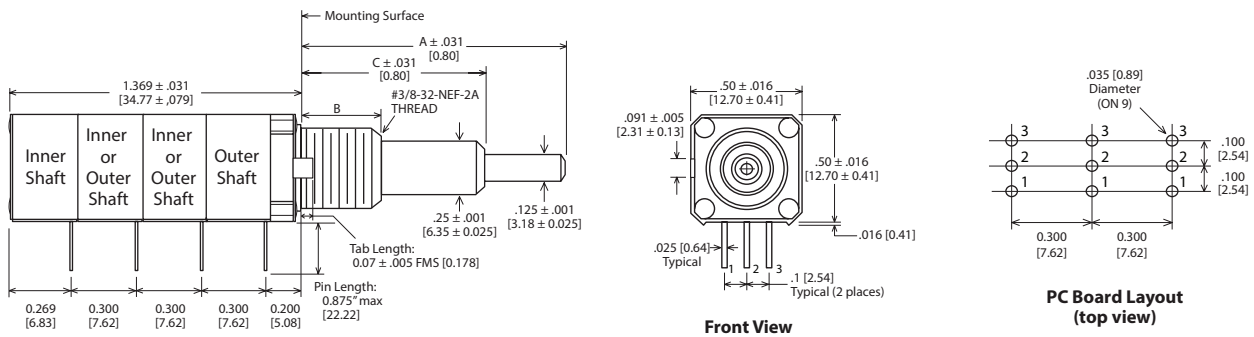
**Drawing 322-1-B22:**

B-22 Triple Potentiometer or RS, Concentric Shaft, PC Pin Terminals, 3/8" Dia. Bushing



**Drawing 422-1-B22:**

B-22 Quad Potentiometer or RS, Concentric Shaft, PC Pin Terminals, 3/8" Dia. Bushing



**Notes:**

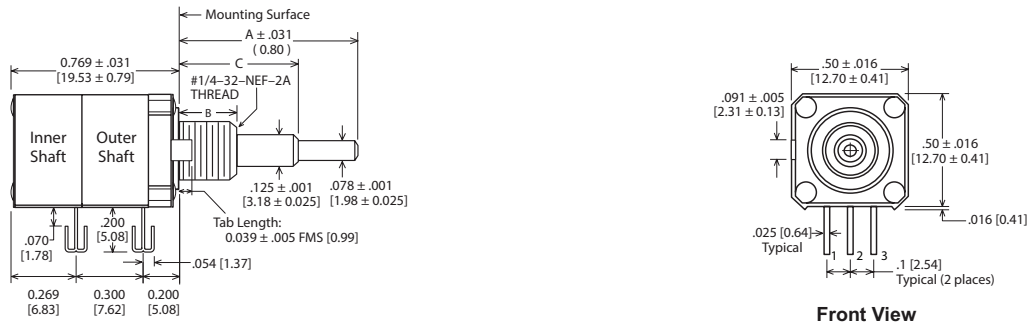
1. Basic dimensions are in inches.  
Dimensions in brackets are in millimeters.  
Dimensional Tolerance  $\pm .016$  [0.40], except as specified.
2. B-22 PC pin length standard is 0.250". Maximum of .875" [22.22]
3. Drawings are not to scale.

Series S88/S89 - Horizontal Mounting Styles (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

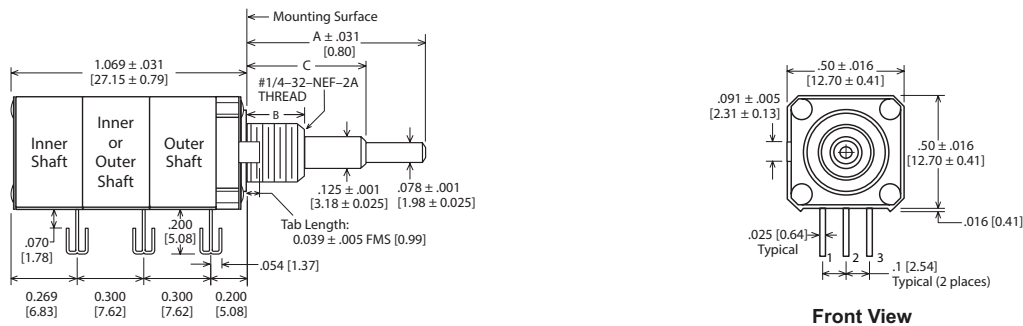
**Drawing 212-1-SHA:**

Dual Potentiometer or RS, Concentric Shaft, Solder Hooks, 1/4" Dia. Bushing



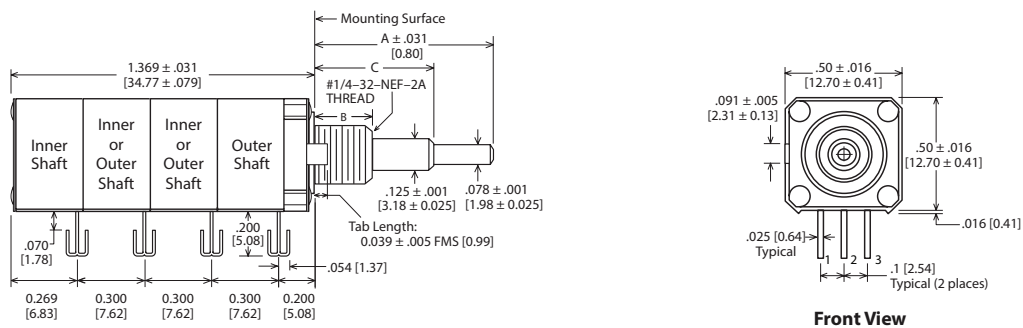
**Drawing 312-1-SHA:**

Triple Potentiometer or RS, Concentric Shaft, Solder Hooks, 1/4" Dia. Bushing



**Drawing 412-1-SHA:**

Quad Potentiometer or RS, Concentric Shaft, Solder Hooks, 1/4" Dia. Bushing



**Notes:**

1. Basic dimensions are in inches.  
Dimensions in brackets are in millimeters.  
Dimensional Tolerance ±.016 [0.40], except as specified.
2. B-22 solder hook length standard is 0.250". Maximum of 0.800"
3. Drawings are not to scale.

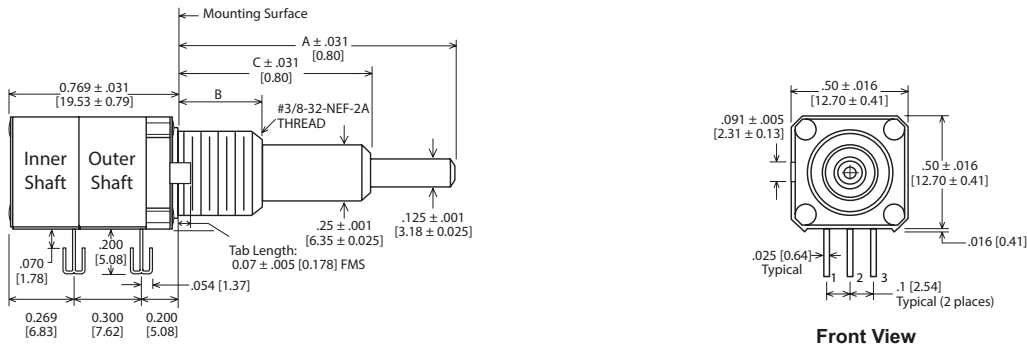


Series S88/S89 - Horizontal Mounting Styles (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

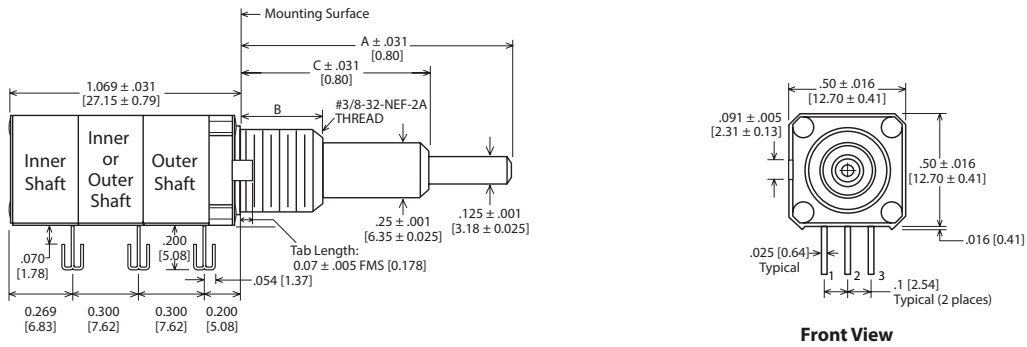
**Drawing 222-1-SHA:**

Dual Potentiometer or RS, Concentric Shaft, Solder Hooks, 3/8" Dia. Bushing



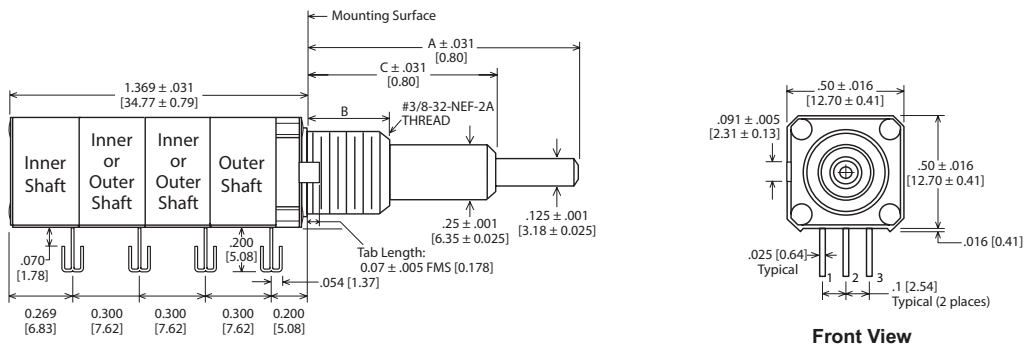
**Drawing 322-1-SHA:**

Triple Potentiometer or RS, Concentric Shaft, Solder Hooks, 3/8" Dia. Bushing



**Drawing 422-1-SHA:**

Quad Potentiometer or RS, Concentric Shaft, Solder Hooks, 3/8" Dia. Bushing



**Notes:**

1. Basic dimensions are in inches.  
Dimensions in brackets are in millimeters.  
Dimensional Tolerance ±.016 [0.40], except as specified.
2. B-22 solder hook length standard is 0.250". Maximum of 0.800"
3. Drawings are not to scale.

# Concentric Shafts

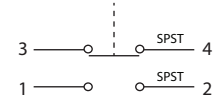
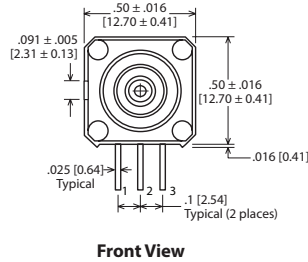
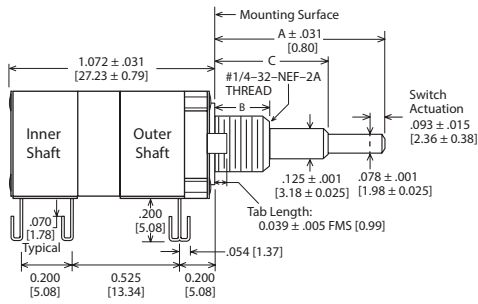
## Potentiometers or Rotary Switches with Push-Pull or Momentary Push Switch

Series S88/S89 - Horizontal Mounting Styles (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

**Drawing 212-2-SHA:**

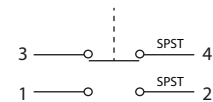
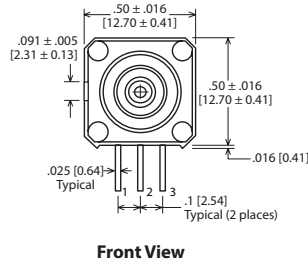
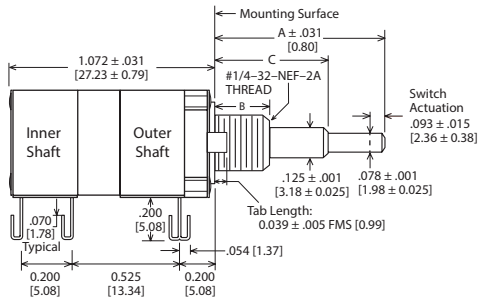
Concentric Shafts, Solder Hooks, 1 Potentiometer(s) or RS + PP, 1/4" Bushing



Series BJ Push-Pull  
Series BJM Momentary  
**Push-Pull/Momentary Schematic**  
Shaft shown in the extended position  
Note: Connecting terminals 2 and 4 together will create a SPDT switch

**Drawing 212-3-SHA:**

Concentric Shafts, Solder Hooks, 1 Potentiometer(s) or RS + MP, 1/4" Bushing



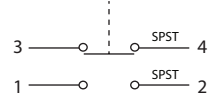
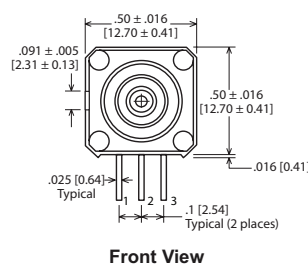
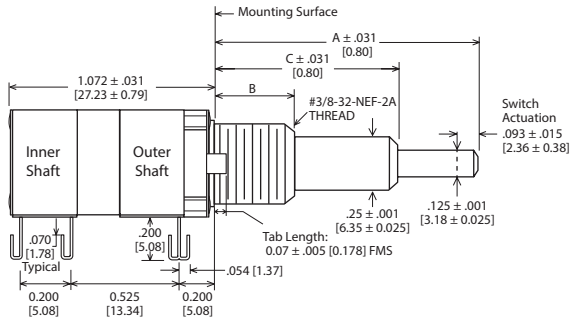
Series BJ Push-Pull  
Series BJM Momentary  
**Push-Pull/Momentary Schematic**  
Shaft shown in the extended position  
Note: Connecting terminals 2 and 4 together will create a SPDT switch

Series S88/S89 - Horizontal Mounting Styles (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

**Drawing 222-2-SHA:**

Concentric Shafts, Solder Hooks, 1 Potentiometer(s) or RS + PP, 3/8" Bushing

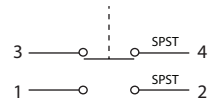
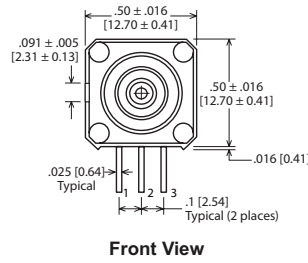
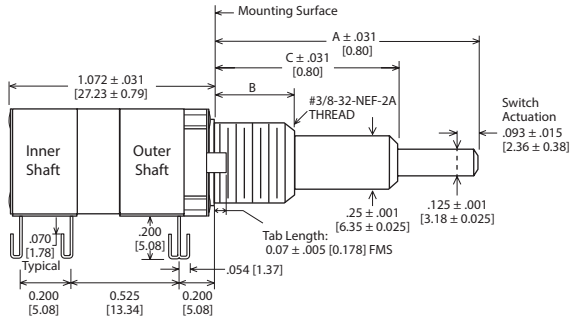


Series BJ Push-Pull  
Series BJM Momentary  
**Push-Pull/Momentary Schematic**

Shaft shown in the extended position  
Note: Connecting terminals 2 and 4 together will create a SPDT switch

**Drawing 222-3-SHA:**

Concentric Shafts, Solder Hooks, 1 Potentiometer(s) or RS + MP, 3/8" Bushing



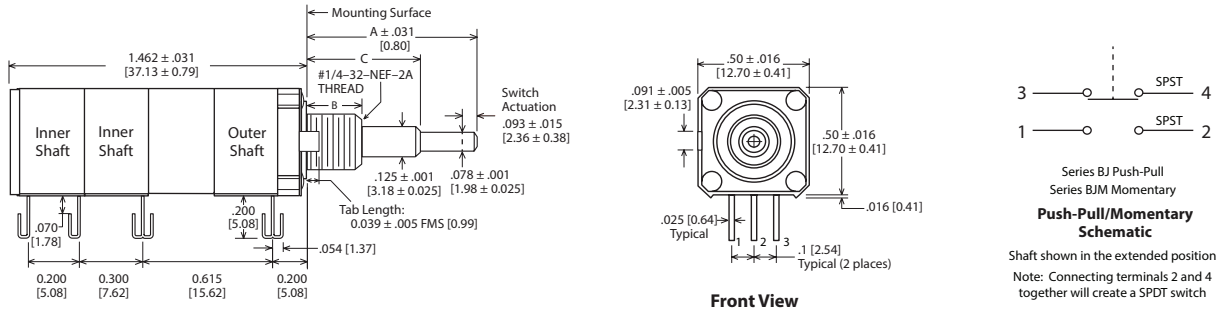
Series BJ Push-Pull  
Series BJM Momentary  
**Push-Pull/Momentary Schematic**

Shaft shown in the extended position  
Note: Connecting terminals 2 and 4 together will create a SPDT switch

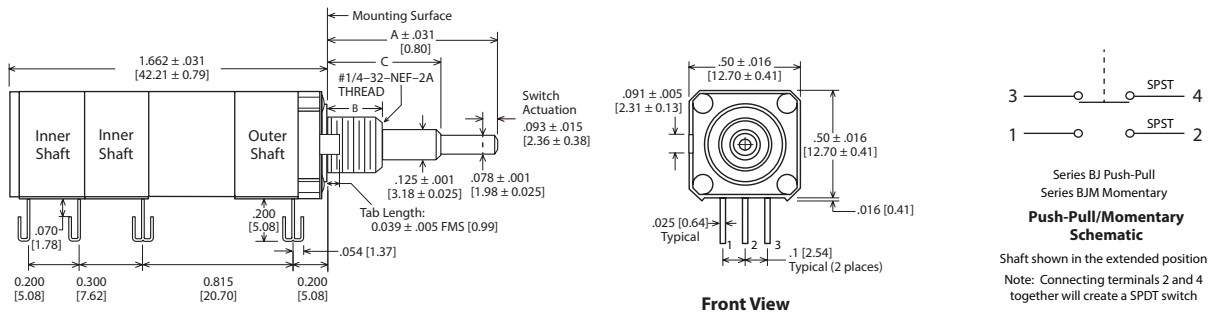
Series S88/S89 - Horizontal Mounting Styles (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPDT; MP = Momentary Push-DPDT

**Drawing 312-2-SHA12:** Concentric Shafts, Solder Hooks, 2 Potentiometer(s) or RS + PP, 1/4" Bushing  
 Section 1 Potentiometer or RS on Outer Shaft  
 Section 2 Potentiometer or RS on Inner Shaft  
 Section 3 Push-Pull Switch on Inner Shaft



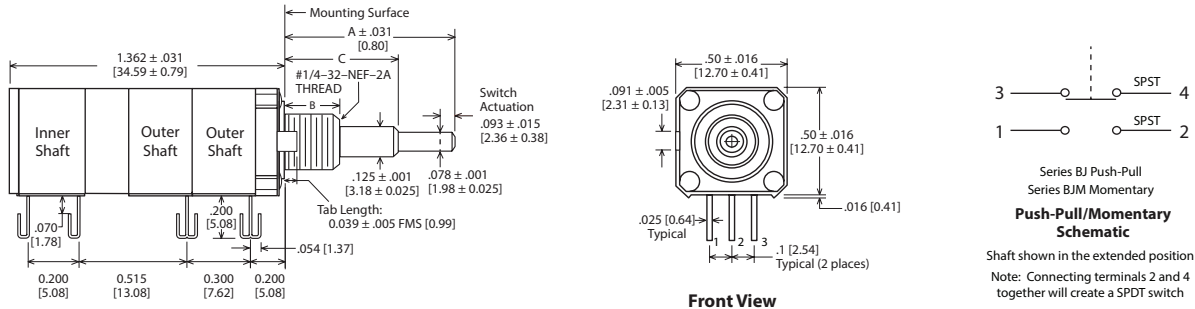
**Drawing 312-3-SHA12:** Concentric Shafts, B22, 2 Potentiometer(s) or RS + MP, 1/4" Bushing  
 Section 1 Potentiometer or RS on Outer Shaft  
 Section 2 Potentiometer or RS on Inner Shaft  
 Section 3 Momentary Push Switch on Inner Shaft



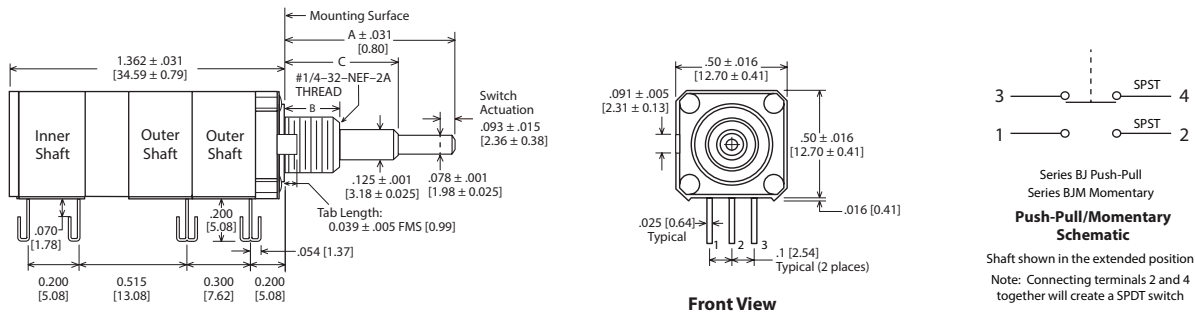
Series S88/S89 - Horizontal Mounting Styles (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

**Drawing 312-2-SHA21:** Concentric Shafts, Solder Hooks, 2 Potentiometer(s) or RS + PP, 1/4" Bushing  
 Section 1 Potentiometer or RS on Outer Shaft  
 Section 2 Potentiometer or RS on Outer Shaft  
 Section 3 Push-Pull Switch on Inner Shaft



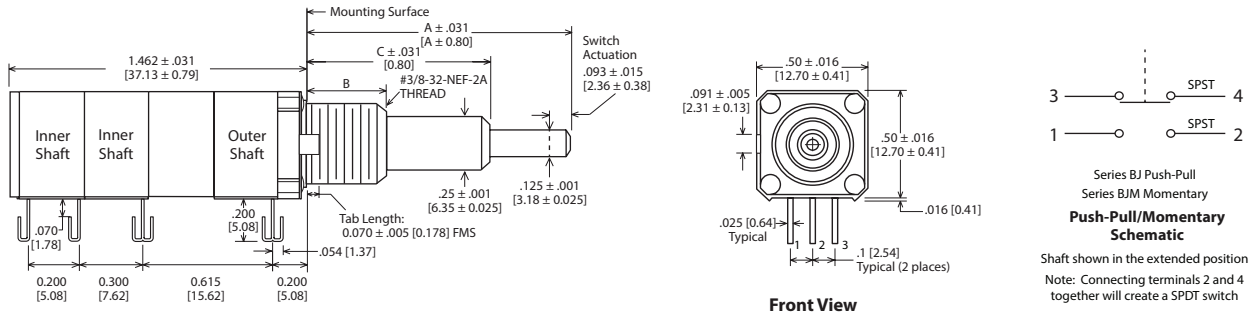
**Drawing 312-3-SHA21:** Concentric Shafts, Solder Hooks, 2 Potentiometer(s) or RS + MP, 1/4" Bushing  
 Section 1 Potentiometer or RS on Outer Shaft  
 Section 2 Potentiometer or RS on Outer Shaft  
 Section 3 Momentary Push Switch on Inner Shaft



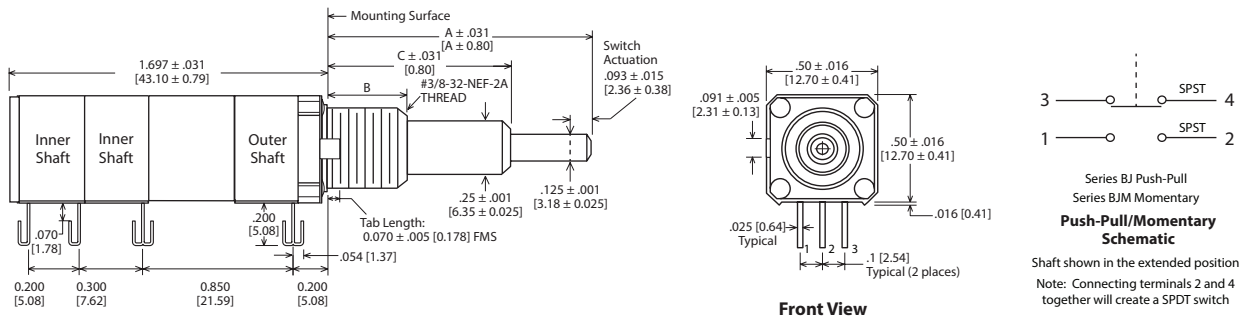
Series S88/S89 - Horizontal Mounting Styles (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

**Drawing 322-2-SHA12:** Concentric Shafts, Solder Hooks, 2 Potentiometer(s) or RS + PP, 3/8" Bushing  
 Section 1 Potentiometer or RS on Outer Shaft  
 Section 2 Potentiometer or RS on Inner Shaft  
 Section 3 Push-Pull Switch on Inner Shaft



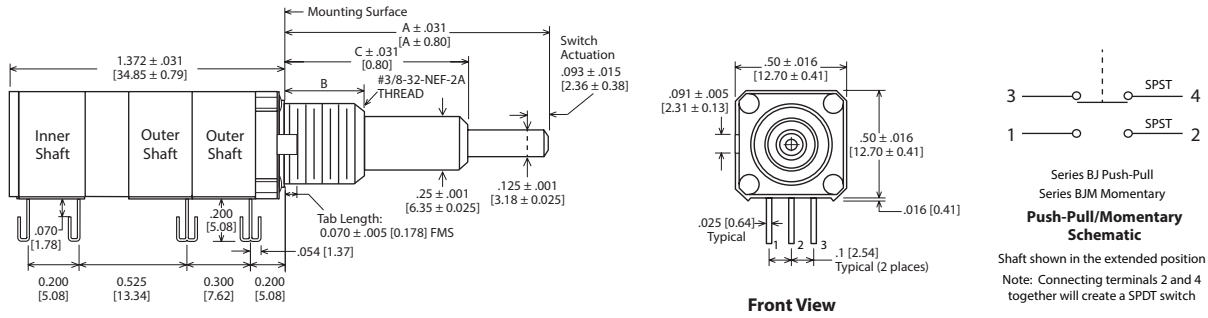
**Drawing 322-3-SHA12:** Concentric Shafts, Solder Hooks, 2 Potentiometer(s) or RS + MP, 3/8" Bushing  
 Section 1 Potentiometer or RS on Outer Shaft  
 Section 2 Potentiometer or RS on Inner Shaft  
 Section 3 Momentary PushSwitch on Inner Shaft



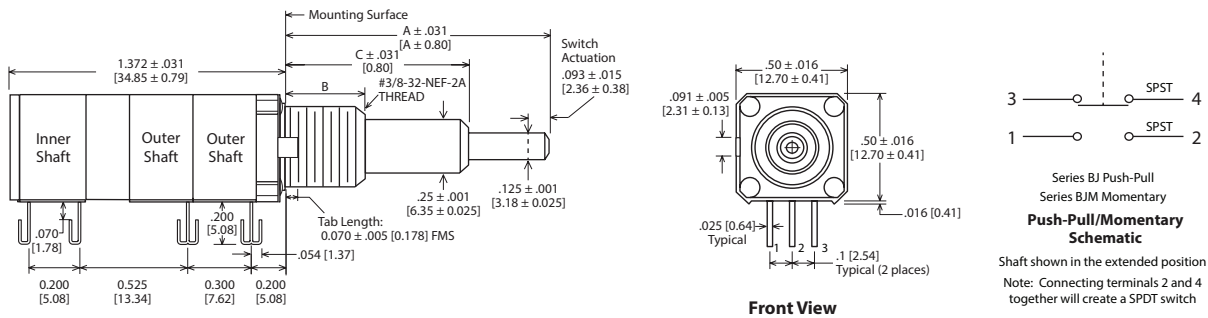
Series S88/S89 - Horizontal Mounting Styles (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

**Drawing 322-2-SHA21:** Concentric Shafts, Solder Hooks, 2 Potentiometer(s) or RS + PP, 3/8" Bushing  
 Section 1 Potentiometer or RS on Outer Shaft  
 Section 2 Potentiometer or RS on Outer Shaft  
 Section 3 Push-Pull Switch on Inner Shaft



**Drawing 322-3-SHA21:** Concentric Shafts, Solder Hooks, 2 Potentiometer(s) or RS + MP, 3/8" Bushing  
 Section 1 Potentiometer or RS on Outer Shaft  
 Section 2 Potentiometer or RS on Outer Shaft  
 Section 3 Momentary Push Switch on Inner Shaft

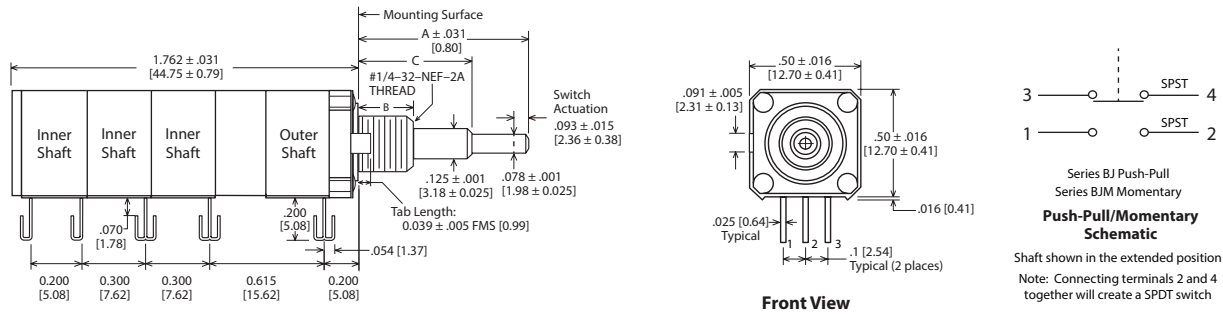




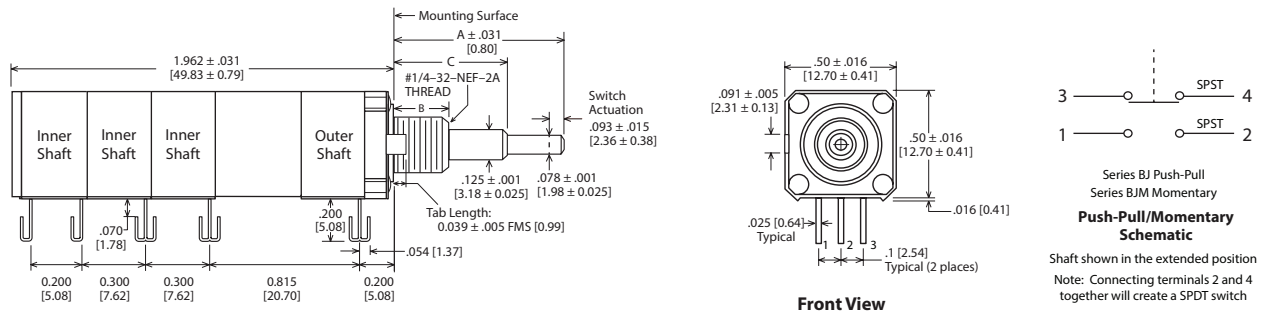
Series S88/S89 - Horizontal Mounting Styles (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

**Drawing 412-2-SHA13:** Concentric Shafts, Solder Hook, 3 Potentiometer(s) or RS + PP, 1/4" Bushing  
 Section 1 Potentiometer or RS on Outer Shaft  
 Section 2 Potentiometer or RS on Inner Shaft  
 Section 3 Potentiometer or RS on Inner Shaft  
 Section 4 Push-Pull Switch on Inner Shaft



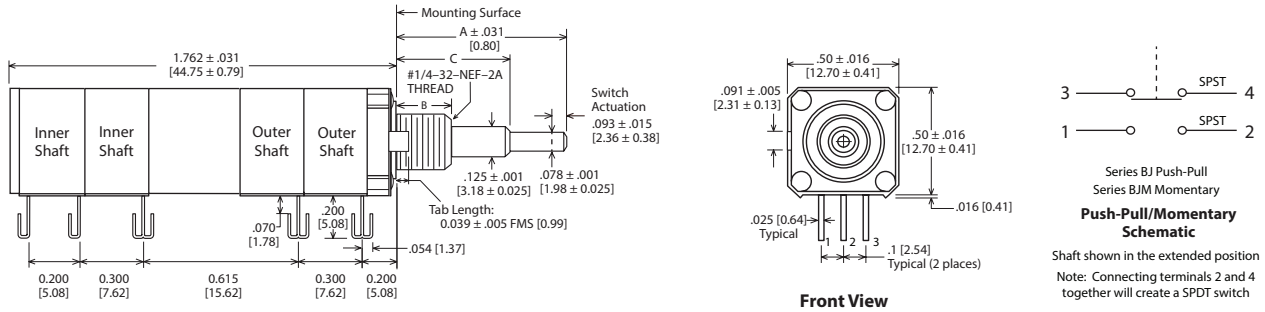
**Drawing 412-3-SHA13:** Concentric Shafts, Solder Hook, 3 Potentiometer(s) or RS + MP, 1/4" Bushing  
 Section 1 Potentiometer or RS on Outer Shaft  
 Section 2 Potentiometer or RS on Inner Shaft  
 Section 3 Potentiometer or RS on Inner Shaft  
 Section 4 Momentary Push Switch on Inner Shaft



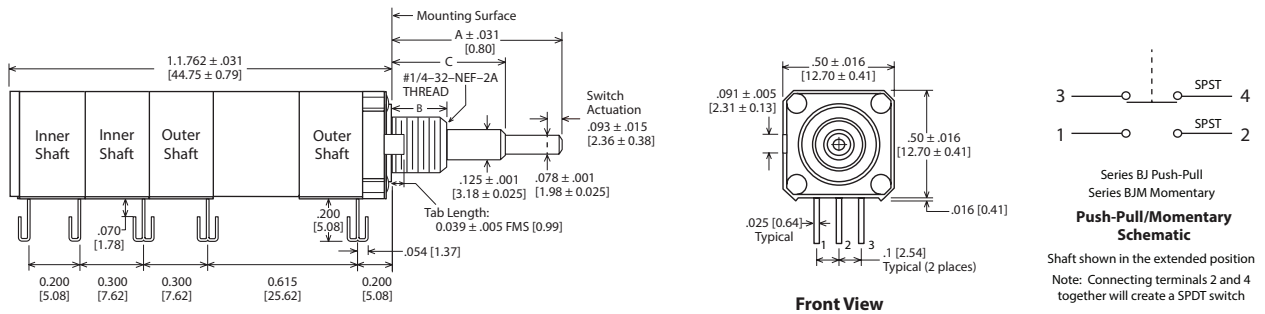
Series S88/S89 - Horizontal Mounting Styles (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

**Drawing 412-2-SHA22:** Concentric Shafts, B22, 3 Potentiometer(s) or RS + PP, 1/4" Bushing  
 Section 1 & 2 Potentiometer or RS on Outer Shaft  
 Section 3 Potentiometer or RS on Inner Shaft  
 Section 4 Momentary Push Switch on Inner Shaft



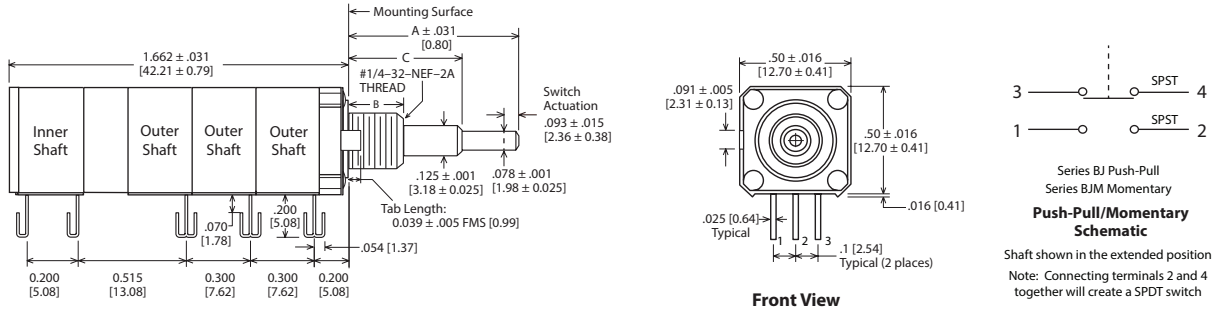
**Drawing 412-3-SHA-22:** Concentric Shafts, B22, 3 Potentiometer(s) or RS + MP, 1/4" Bushing  
 Section 1 & 2 Potentiometer or RS on Outer Shaft  
 Section 3 Potentiometer or RS on Inner Shaft  
 Section 4 Momentary Push Switch on Inner Shaft



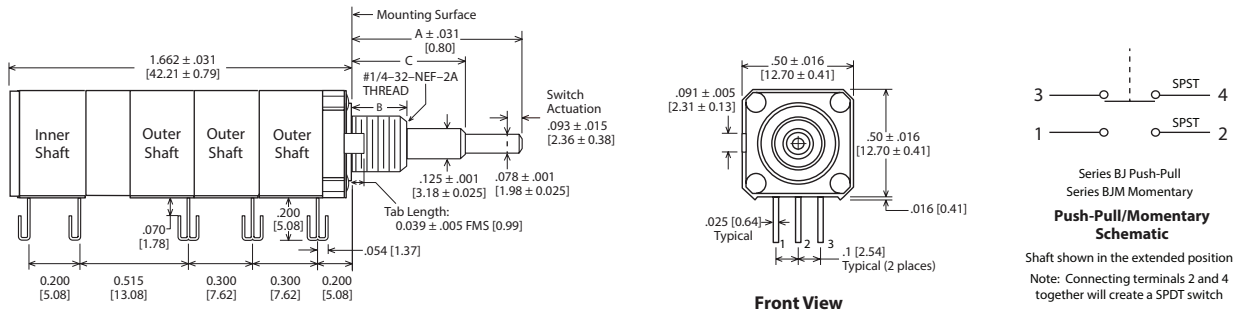
Series S88/S89 - Horizontal Mounting Styles (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

**Drawing 412-2-SHA31:** Concentric Shafts, B22, 3 Potentiometer(s) or RS + PP, 1/4" Bushing  
 Section 1, 2 & 3 Potentiometers or RS on Outer Shaft  
 Section 4 Push-Pull Switch on Inner Shaft



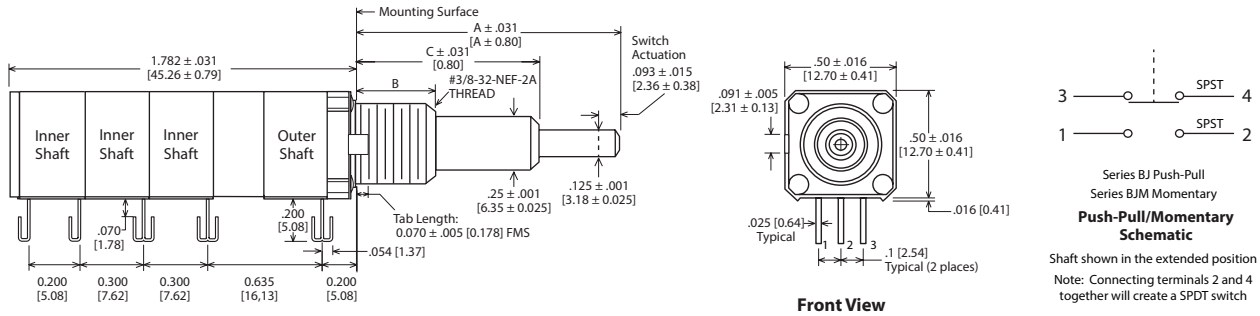
**Drawing 412-3-SHA-31:** Concentric Shafts, B22, 3 Potentiometer(s) or RS + MP, 1/4" Bushing  
 Section 1, 2 & 3 Potentiometers or RS on Outer Shaft  
 Section 4 Momentary Push Switch on Inner Shaft



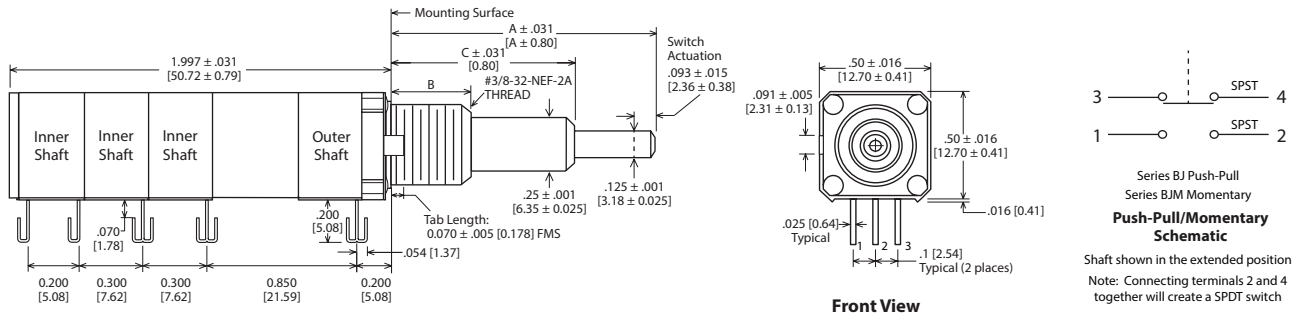
Series S88/S89 - Horizontal Mounting Styles (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

**Drawing 422-2-SHA13:** Concentric Shafts, Solder Hook, 3 Potentiometer(s) or RS + PP, 3/8" Bushing  
 Section 1 Potentiometer or RS on Outer Shaft  
 Section 2 Potentiometer or RS on Inner Shaft  
 Section 3 Potentiometer or RS on Inner Shaft  
 Section 4 Push-Pull Switch on Inner Shaft



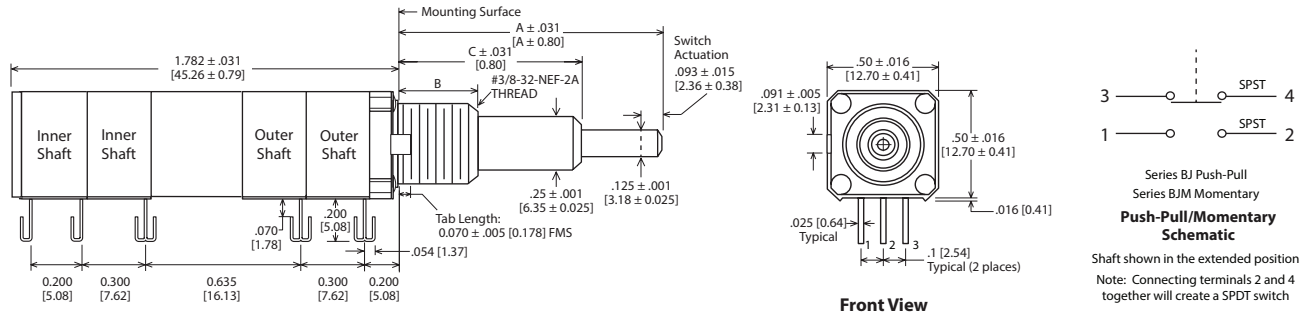
**Drawing 422-3-SHA13:** Concentric Shafts, Solder Hook, 3 Potentiometer(s) or RS + MP, 3/8" Bushing  
 Section 1 Potentiometer or RS on Outer Shaft  
 Section 2 Potentiometer or RS on Inner Shaft  
 Section 3 Potentiometer or RS on Inner Shaft  
 Section 4 Momentary Push Switch on Inner Shaft



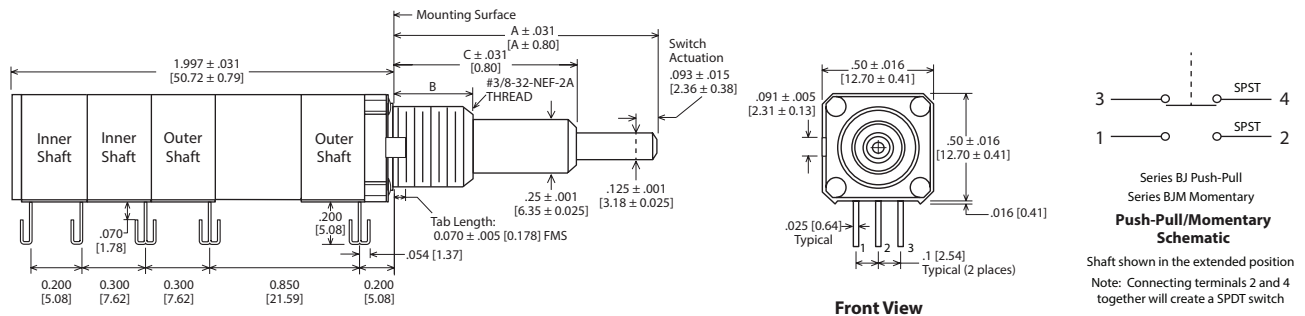
Series S88/S89 - Horizontal Mounting Styles (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

**Drawing 422-2-SHA22:** Concentric Shafts, B22, 3 Potentiometer(s) or RS + PP, 3/8" Bushing  
 Section 1 & 2 Potentiometer or RS on Outer Shaft  
 Section 3 Potentiometer or RS on Inner Shaft  
 Section 4 Momentary Push Switch on Inner Shaft



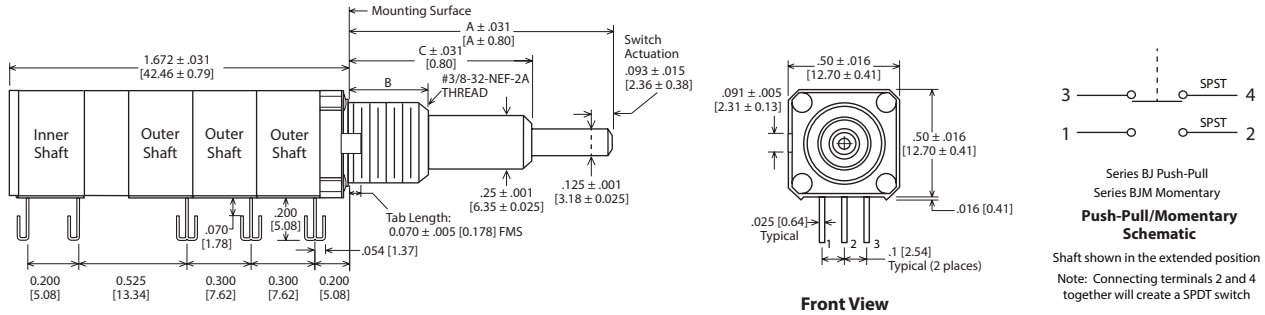
**Drawing 422-3-SHA-22:** Concentric Shafts, B22, 3 Potentiometer(s) or RS + MP, 3/8" Bushing  
 Section 1 & 2 Potentiometer or RS on Outer Shaft  
 Section 3 Potentiometer or RS on Inner Shaft  
 Section 4 Momentary Push Switch on Inner Shaft



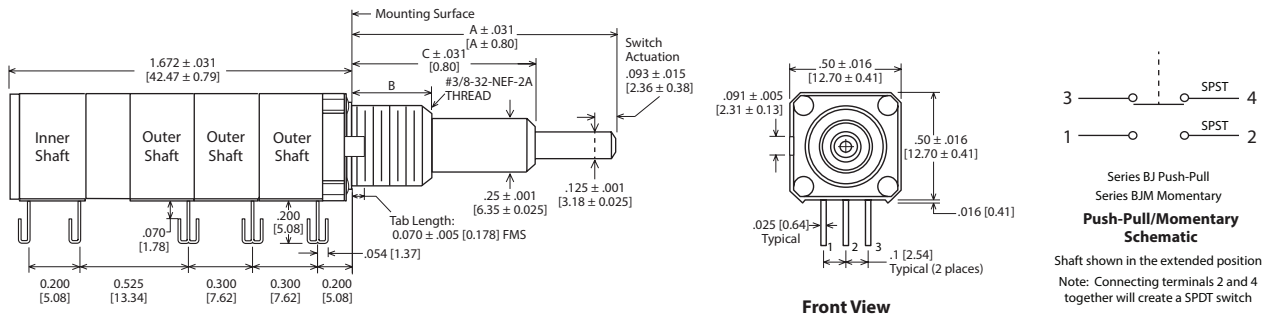
Series S88/S89 - Horizontal Mounting Styles (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

**Drawing 422-2-SHA31:** Concentric Shafts, B22, 3 Potentiometer(s) or RS + PP, 3/8" Bushing  
 Section 1, 2 & 3 Potentiometers or RS on Outer Shaft  
 Section 4 Momentary Push Switch on Inner Shaft



**Drawing 422-3-SHA-31:** Concentric Shafts, B22, 3 Potentiometer(s) or RS + MP, 3/8" Bushing  
 Section 1, 2 & 3 Potentiometers or RS on Outer Shaft  
 Section 4 Momentary Push Switch on Inner Shaft

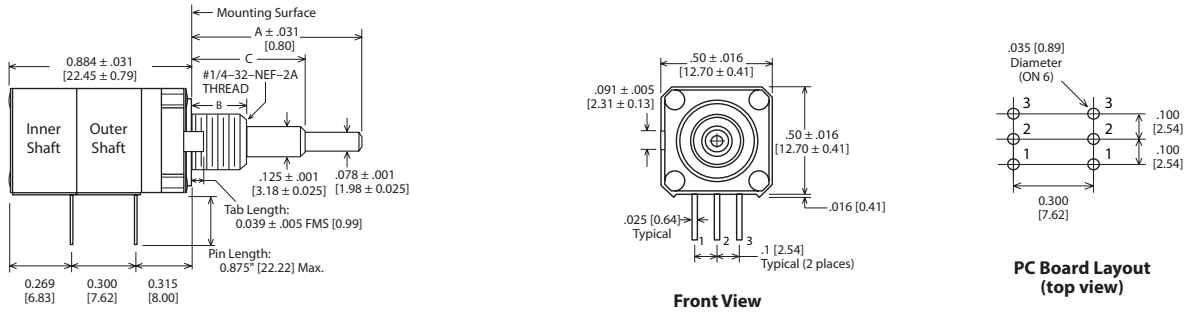


Series S88/S89 - Horizontal Mounting Styles (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

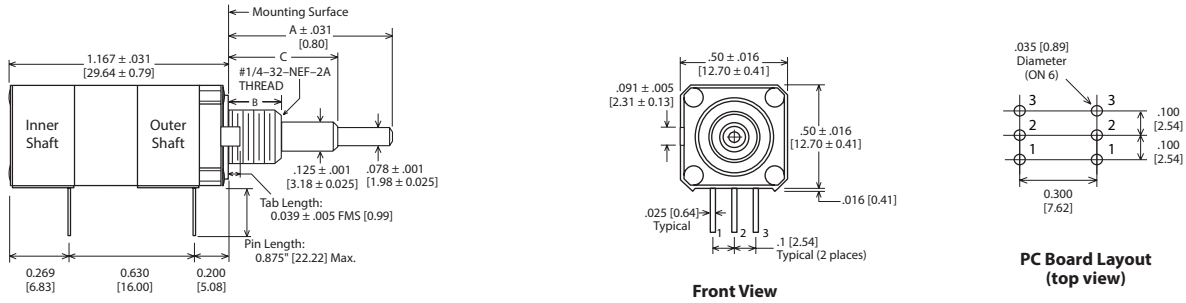
**Drawing 212-1-B22DO:**

B22, Concentric Shafts, 2 Potentiometer(s) or RS's with Detents on Outer Shaft, 1/4" Dia. Bushing



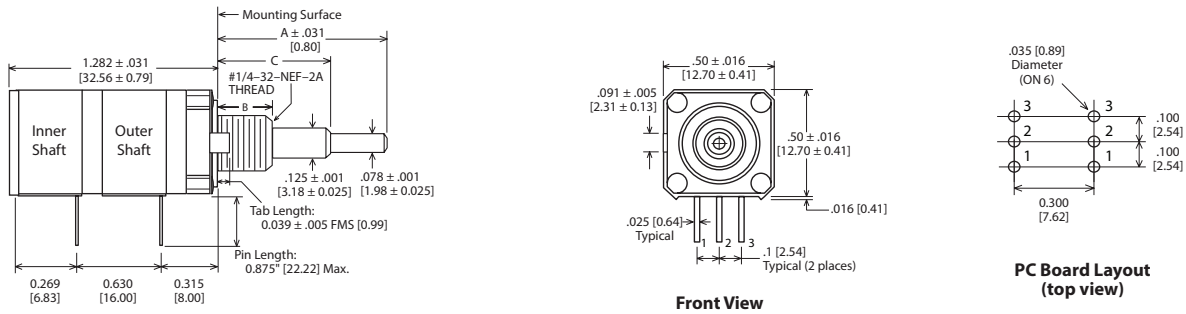
**Drawing 212-1-B22DI:**

B22, Concentric Shafts, 2 Potentiometer(s) or RS's with Detents on Inner Shaft, 1/4" Dia. Bushing



**Drawing 212-1-B22DOI:**

B22, Concentric Shafts, 2 Potentiometer(s) or RS's with Detents on Both Shafts, 1/4" Dia. Bushing

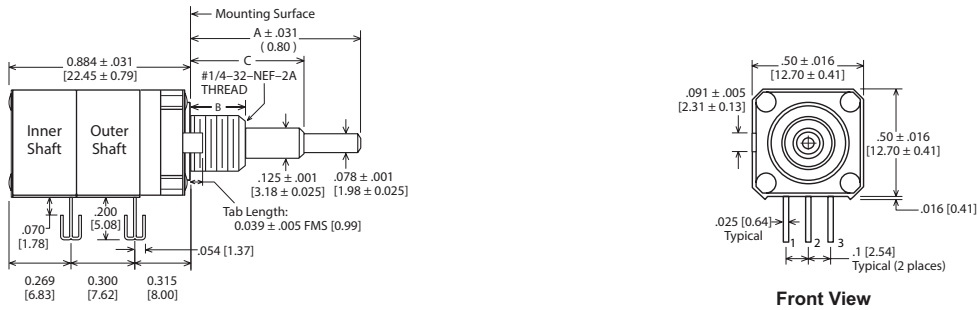


Series S88/S89 - Horizontal Mounting Styles (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

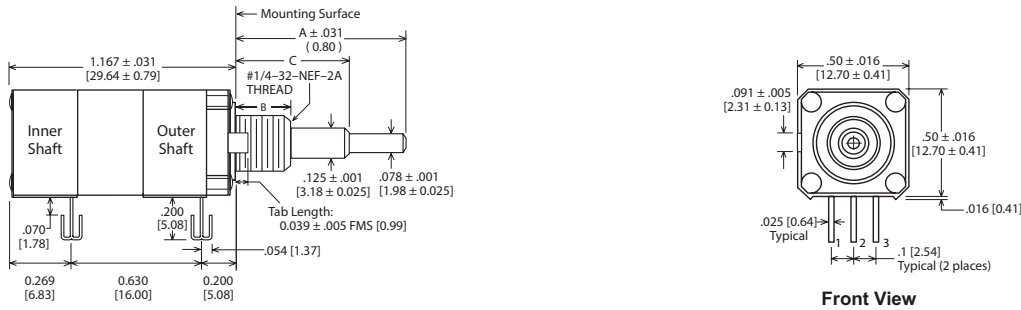
**Drawing 212-1-ADO:**

Solder Hooks, Concentric Shafts, 2 Potentiometer(s) or RS's with Detents on Outer Shaft, 1/4" Dia. Bushing



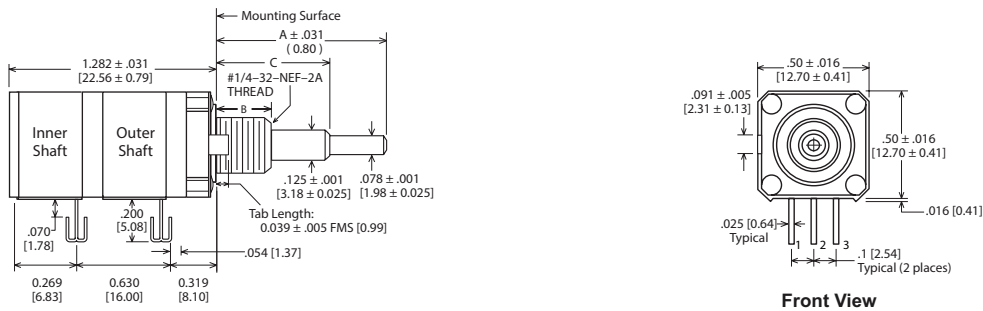
**Drawing 212-1-ADI:**

Solder Hooks, Concentric Shafts, 2 Potentiometer(s) or RS's with Detents on Inner Shaft, 1/4" Dia. Bushing



**Drawing 212-1-ADOI:**

Solder Hooks, Concentric Shafts, 2 Potentiometer(s) or RS's with Detents on Both Shafts, 1/4" Dia. Bushing

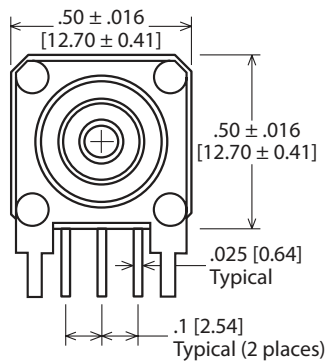




# HORIZONTAL MOUNTING WITH SUPPORT PLATES

Mounting feet are available on most designs and provide:

- Support for the front and rear of the potentiometer thereby removing the stress from the PC leads
- Consistent distance from the surface of the PC board and the center line of the shaft
- A grounding path from the board to the bushing of the potentiometer.



**Front View**

**Support Plate Dimensions:**

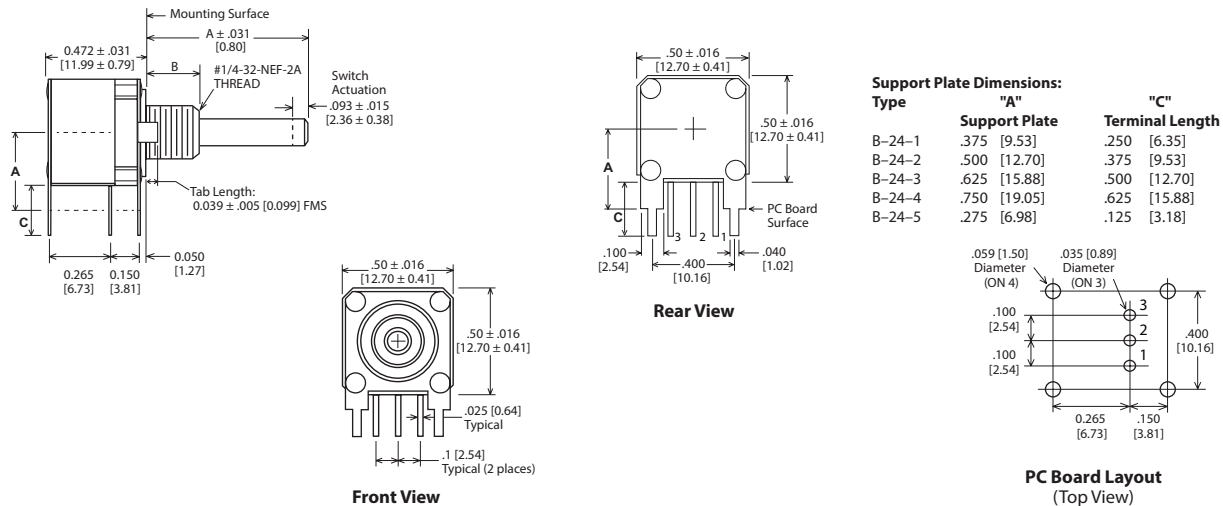
Type	"A" Support Plate	"C" Terminal Length
B-24-1	.375 [9.53]	.250 [6.35] STANDARD
B-24-2	.500 [12.70]	.375 [9.53]
B-24-3	.625 [15.88]	.500 [12.70]
B-24-4	.750 [19.05]	.625 [15.88]
B-24-5	.275 [6.98]	.125 [3.18]

Series S88/S89 - Horizontal Mounting Styles with Support Plates (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

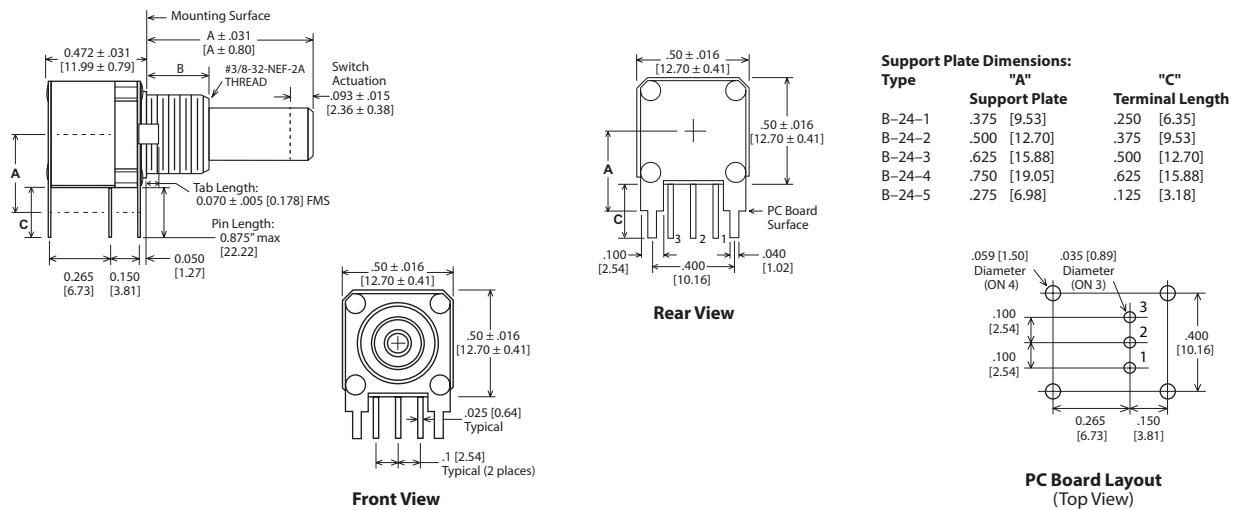
**Drawing 111-2-B24:**

B-24 Single Push-Pull or Momentary Switch, Support Plates, 1/4" Dia. Bushing



**Drawing 121-2-B24:**

B-24, Single Push-Pull or Momentary Switch, Support Plates, 3/8" Dia. Bushing



**Notes:**

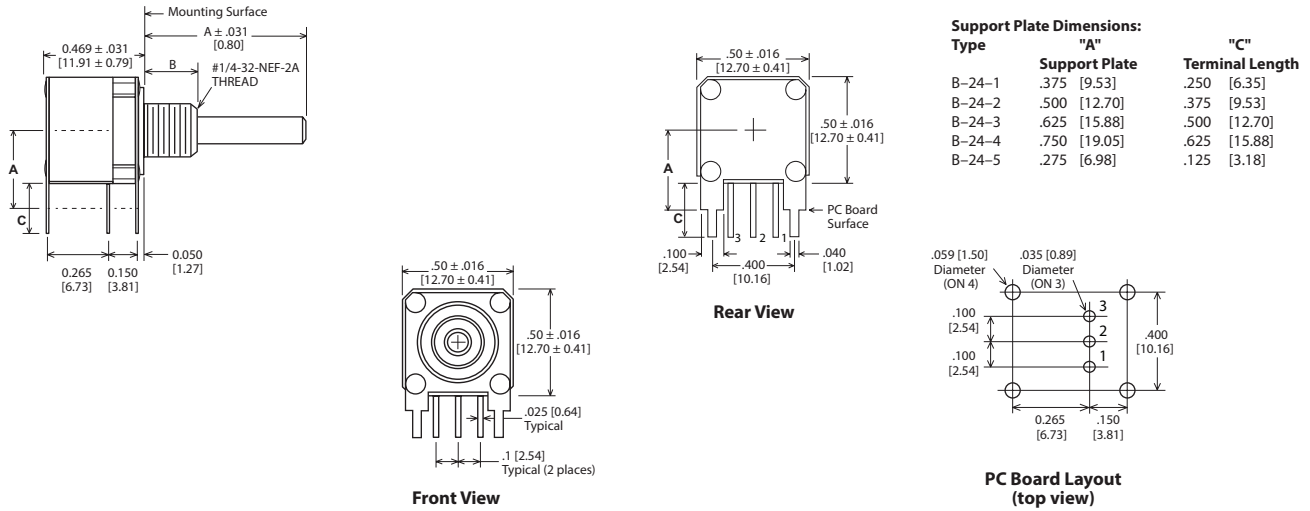
1. Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance  $\pm 0.016$  [0,40], except as specified.
2. B24 PC pin length per chart. .875" [22.22] Max.
3. Drawings are not to scale.

Series S88/S89 - Horizontal Mounting Styles with Support Plates (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

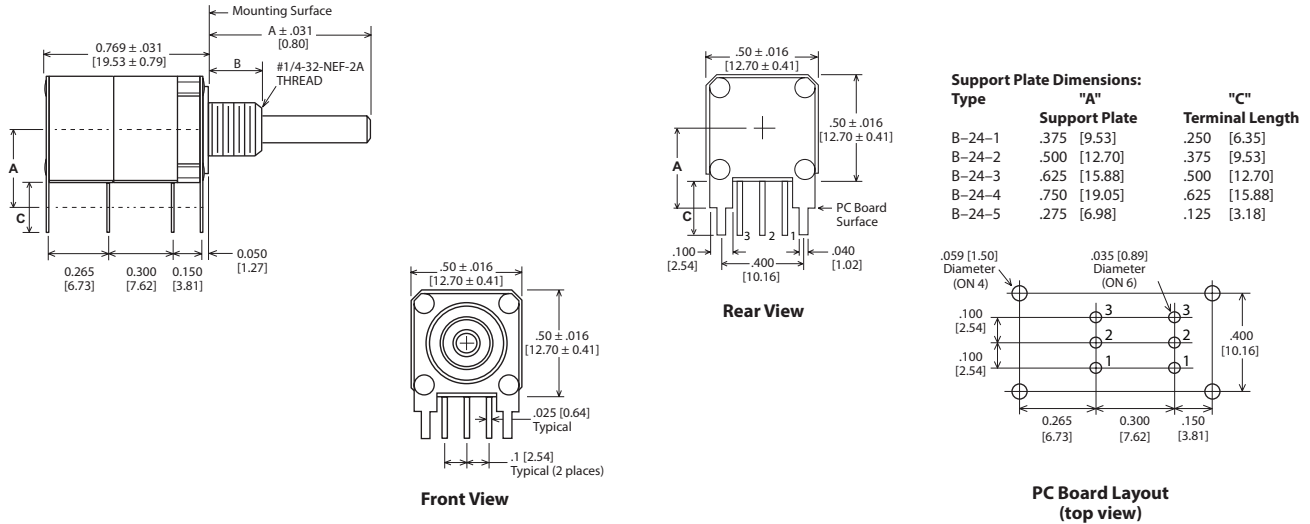
**Drawing 111-1-B24:**

B-24 Single Potentiometer or RS, Support Plates, 1/4" Dia. Bushing



**Drawing 211-1-B24:**

B-24 Dual Potentiometer or RS, Support Plates, 1/4" Dia. Bushing



**Notes:**

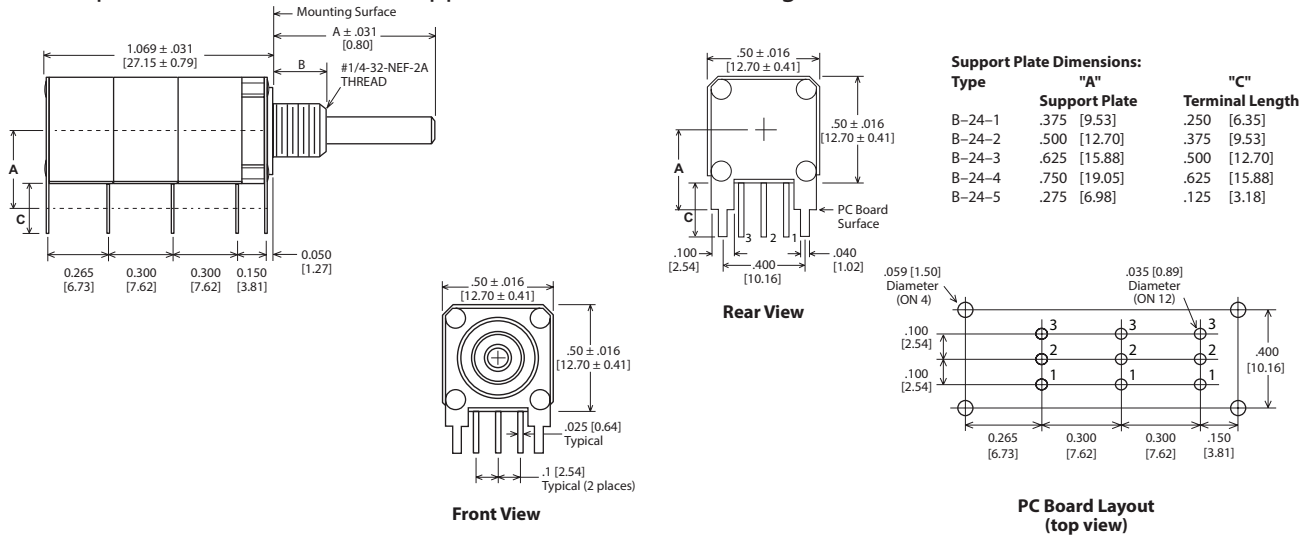
1. Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance  $\pm 0.016$  [0.40], except as specified.
2. B24 PC pin length per chart. .875" [22.22] Max.
3. Drawings are not to scale.

Series S88/S89 - Horizontal Mounting Styles with Support Plates (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

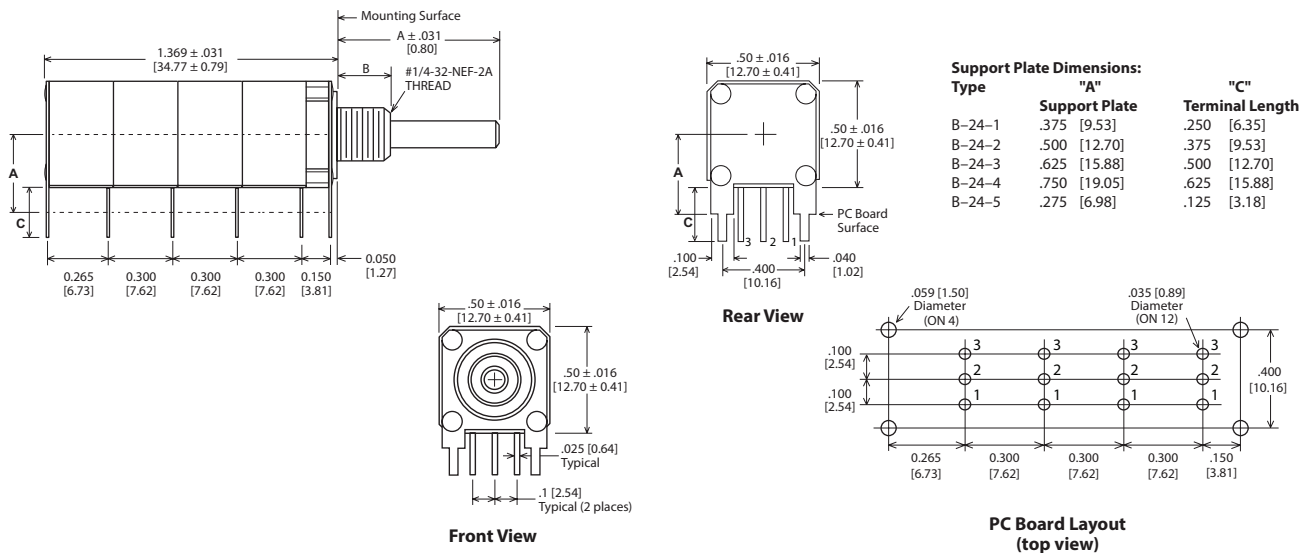
**Drawing 311-1-B24:**

B-24 Triple Potentiometer or RS, Support Plates, 1/4" Dia. Bushing



**Drawing 411-1-B24:**

B-24 Quad Potentiometer or RS, Support Plates, 1/4" Dia. Bushing



**Notes:**

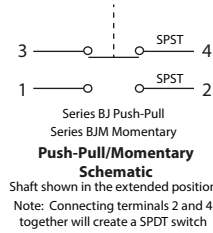
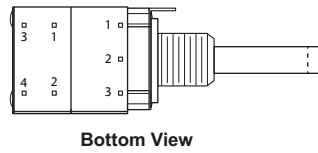
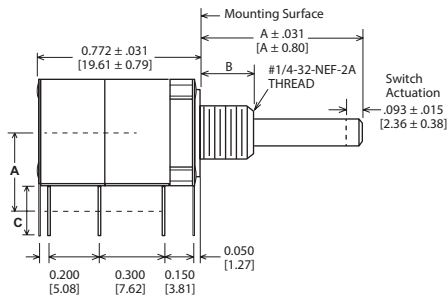
- Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance  $\pm 0.016$  [0.40], except as specified.
- B24 PC pin length per chart. .875" [22.22] Max.
- Drawings are not to scale.

Series S88/S89 - Horizontal Mounting Styles (continued)

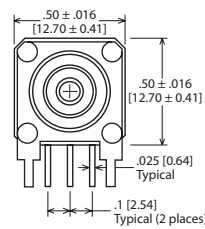
Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

**Drawing 211-2-B24:**

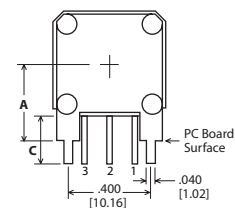
B-22 Single Module, plus Push-Pull/Momentary Switch, PC Pin Terminals, Support Plate, 1/4" Dia. Bushing



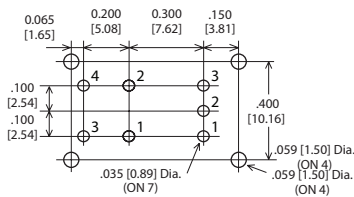
**Front View**



**Rear View**



**PC Board Layout (Top View)**

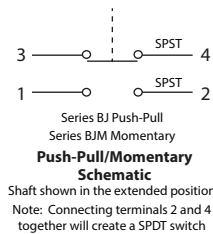
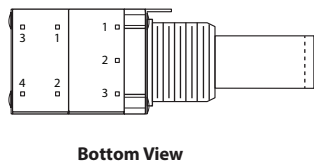
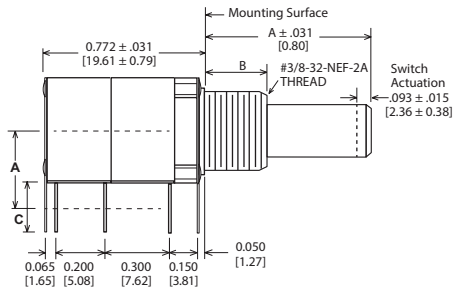


**Support Plate Dimensions:**

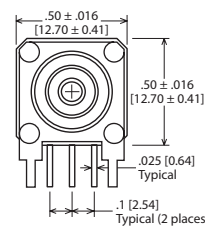
Type	"A" Support Plate	"C" Terminal Length
B-24-1	.375 [9.53]	.250 [6.35]
B-24-2	.500 [12.70]	.375 [9.53]
B-24-3	.625 [15.88]	.500 [12.70]
B-24-4	.750 [19.05]	.625 [15.88]
B-24-5	.275 [6.98]	.125 [3.18]

**Drawing 221-2-B24:**

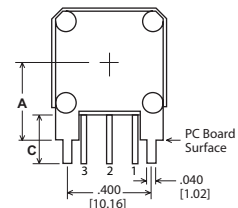
B-24 Single Module, plus Push-Pull/Momentary Switch, PC Pin Terminals, Support Plate, 3/8" Dia. Bushing



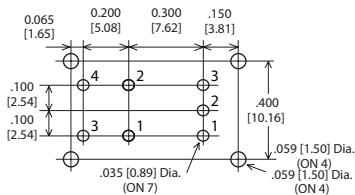
**Front View**



**Rear View**



**PC Board Layout (Top View)**



**Support Plate Dimensions:**

Type	"A" Support Plate	"C" Terminal Length
B-24-1	.375 [9.53]	.250 [6.35]
B-24-2	.500 [12.70]	.375 [9.53]
B-24-3	.625 [15.88]	.500 [12.70]
B-24-4	.750 [19.05]	.625 [15.88]
B-24-5	.275 [6.98]	.125 [3.18]

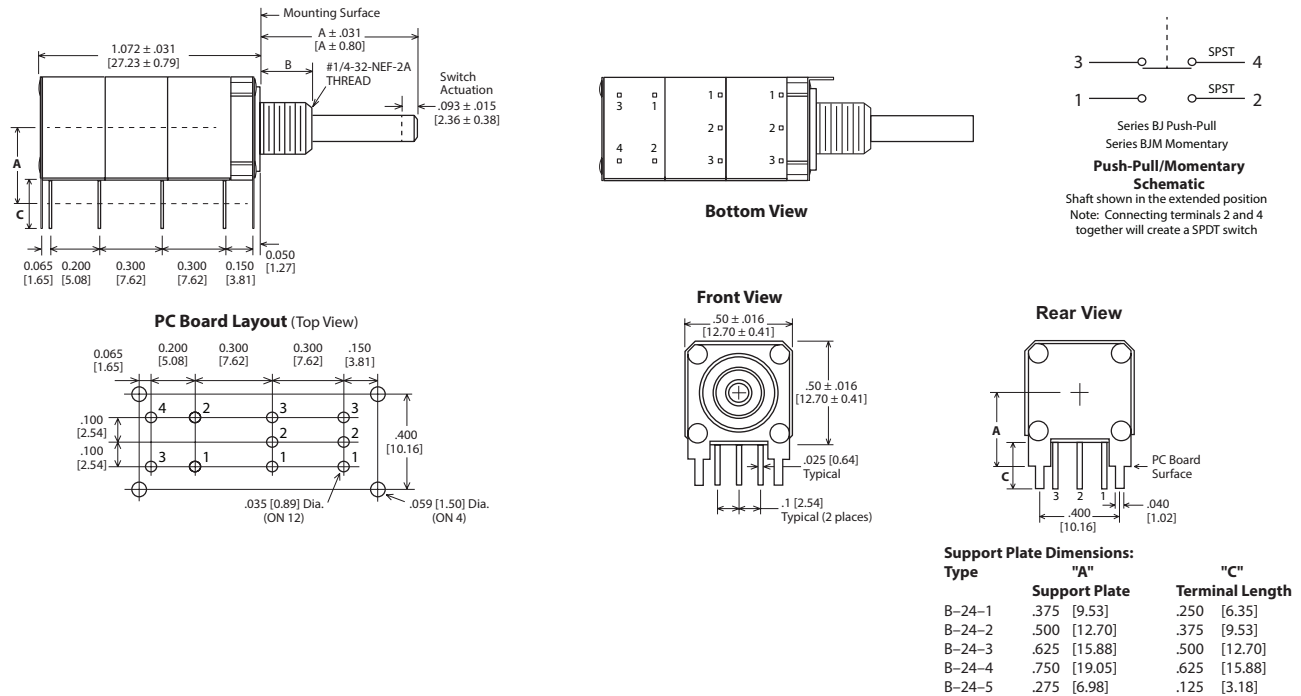
**Notes:**

- Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance ±.016 [0.40], except as specified.
- B24 PC pin length per chart. .875" [22.22] Max.
- Drawings are not to scale.

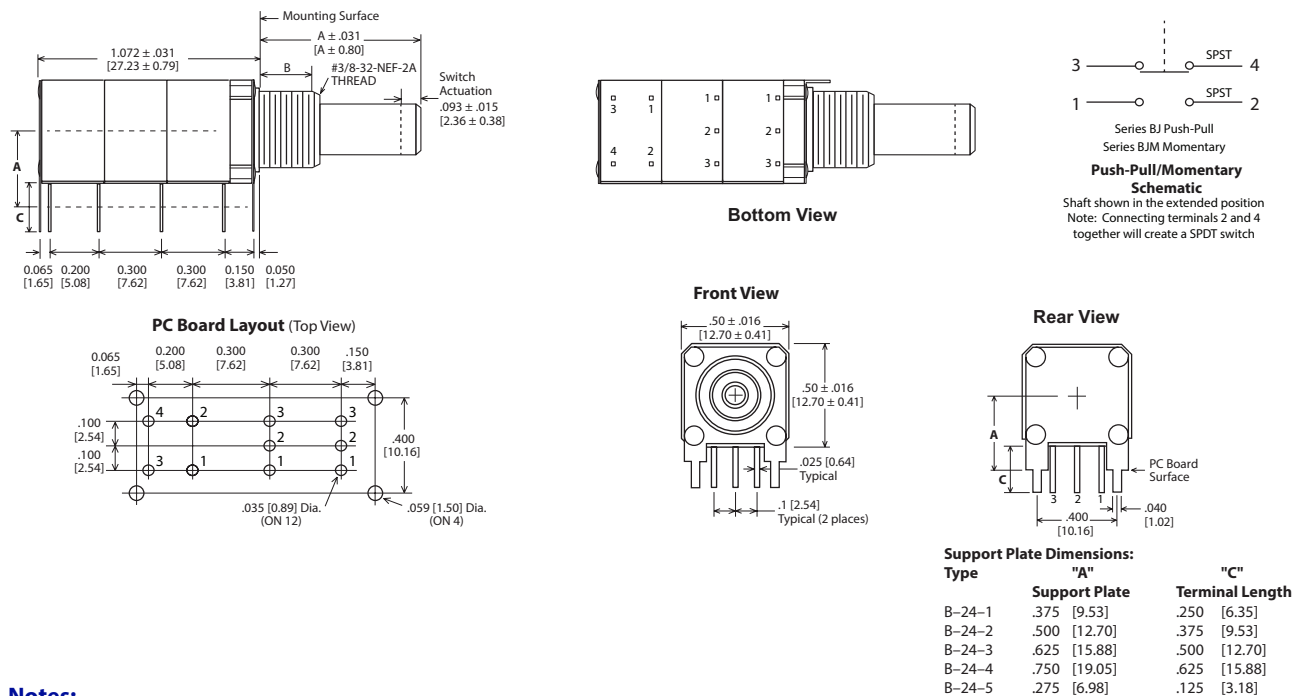
Series S88/S89 - Horizontal Mounting Styles (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

**Drawing 311-2-B24:** B-24 Dual Potentiometer or RS, plus Push-Pull/Momentary Switch, PC Pin Terminals with Support Plates, 1/4" Dia. Bushing



**Drawing 321-2-B24:** B-24 Dual Potentiometer or RS, plus Push-Pull/Momentary Switch, PC Pin Terminals with Support Plates, 3/8" Dia. Bushing



**Notes:**

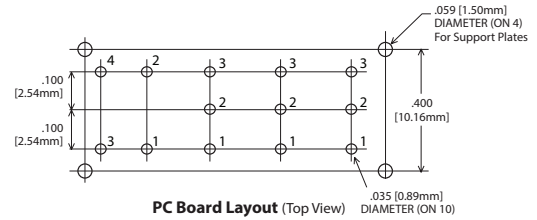
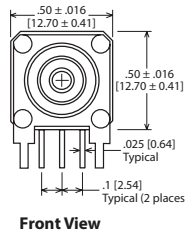
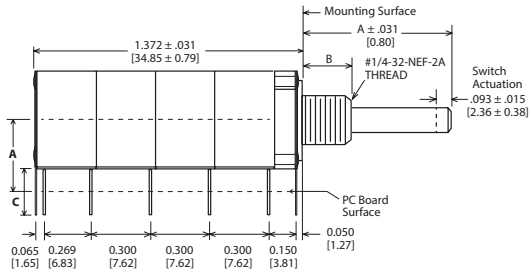
- Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance  $\pm 0.016$  [0.40], except as specified.
- B24 PC pin length per chart. .875" [22.22] Max.
- Drawings are not to scale.

Series S88/S89 - Horizontal Mounting Styles (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

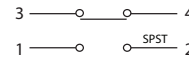
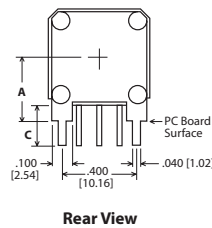
**Drawing 411-2-B24:** B-24, Triple Potentiometer/RS with (PP) Push-Pull/(MP) Momentary Switch, PC Pin Terminals with Support Plates, 1/4" Dia. Bushing

Support Brackets and no Locating Lug



Support Plate Dimensions:

Type	"A" Support Plate	"C" Terminal Length
B-24-1	.375 [9.53]	.250 [6.35]
B-24-2	.500 [12.70]	.375 [9.53]
B-24-3	.625 [15.88]	.500 [12.70]
B-24-4	.750 [19.05]	.625 [15.88]
B-24-5	.275 [6.98]	.125 [3.18]

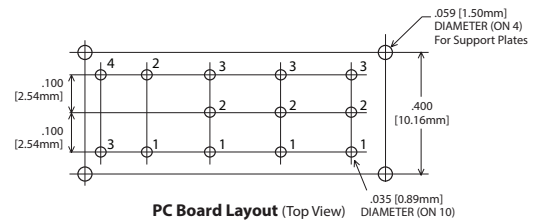
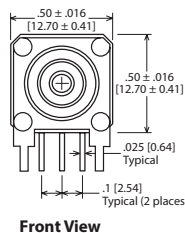
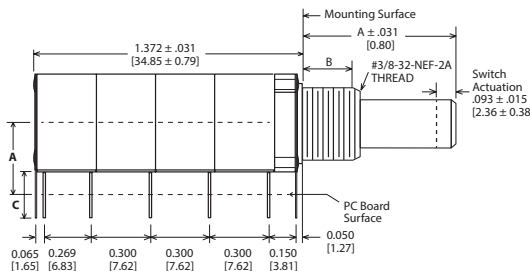


Series BJ Push-Pull  
Series BJM Momentary  
**Push-Pull/Momentary Schematic**

Shaft shown in the extended position  
Note: Connecting terminals 2 and 4 together will create a SPDT switch

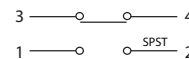
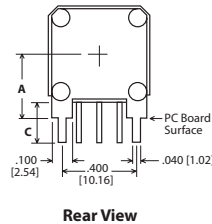
**Drawing 421-2-B24:** B-24, Triple Potentiometer/RS with (PP) Push-Pull/(MP) Momentary Switch, PC Pin Terminals with Support Plates, 3/8" Dia. Bushing

Support Brackets and no Locating Lug



Support Plate Dimensions:

Type	"A" Support Plate	"C" Terminal Length
B-24-1	.375 [9.53]	.250 [6.35]
B-24-2	.500 [12.70]	.375 [9.53]
B-24-3	.625 [15.88]	.500 [12.70]
B-24-4	.750 [19.05]	.625 [15.88]
B-24-5	.275 [6.98]	.125 [3.18]



Series BJ Push-Pull  
Series BJM Momentary  
**Push-Pull/Momentary Schematic**

Shaft shown in the extended position  
Note: Connecting terminals 2 and 4 together will create a SPDT switch

Notes:

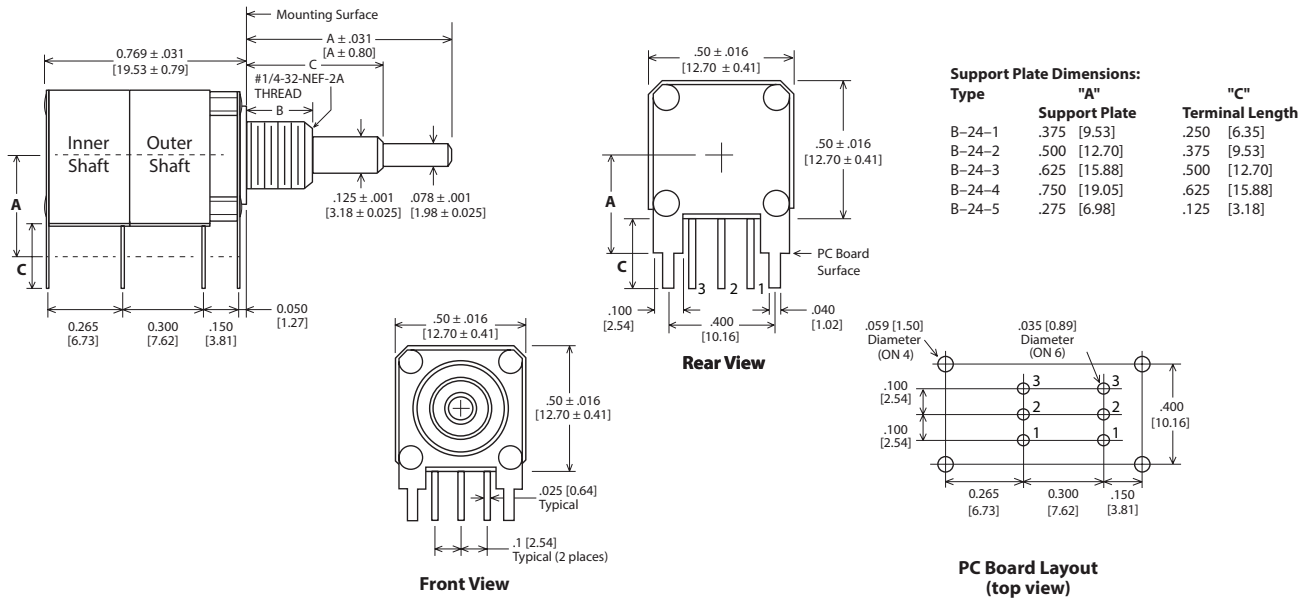
- Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance ±.016 [0.40], except as specified.
- B24 PC pin length per chart. .875" [22.22] Max.
- Drawings are not to scale.

Series S88/S89 - Horizontal Mounting Styles with Support Plates (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

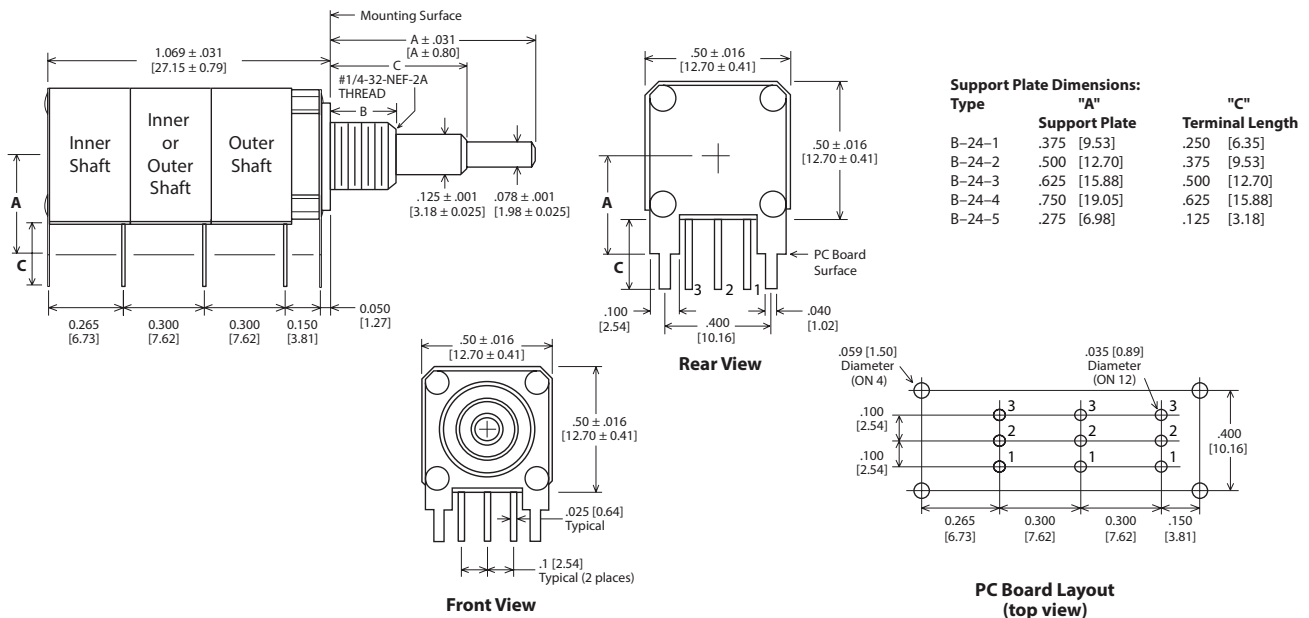
**Drawing 212-1-B24:**

B-24 Dual Potentiometer or RS, Concentric Shaft, PC Pin Terminals, Support Plates, 1/4" Dia. Bushing



**Drawing 312-1-B24:**

B-24 Triple Potentiometer or RS, Concentric Shaft, PC Pin Terminals, Support Plates, 1/4" Dia. Bushing



**Notes:**

1. Basic dimensions are in inches.  
Dimensions in brackets are in millimeters.  
Dimensional Tolerance  $\pm 0.016$  [0.40], except as specified.
2. B24 PC pin length per chart. .875" [22.22] Max.
3. Drawings are not to scale.

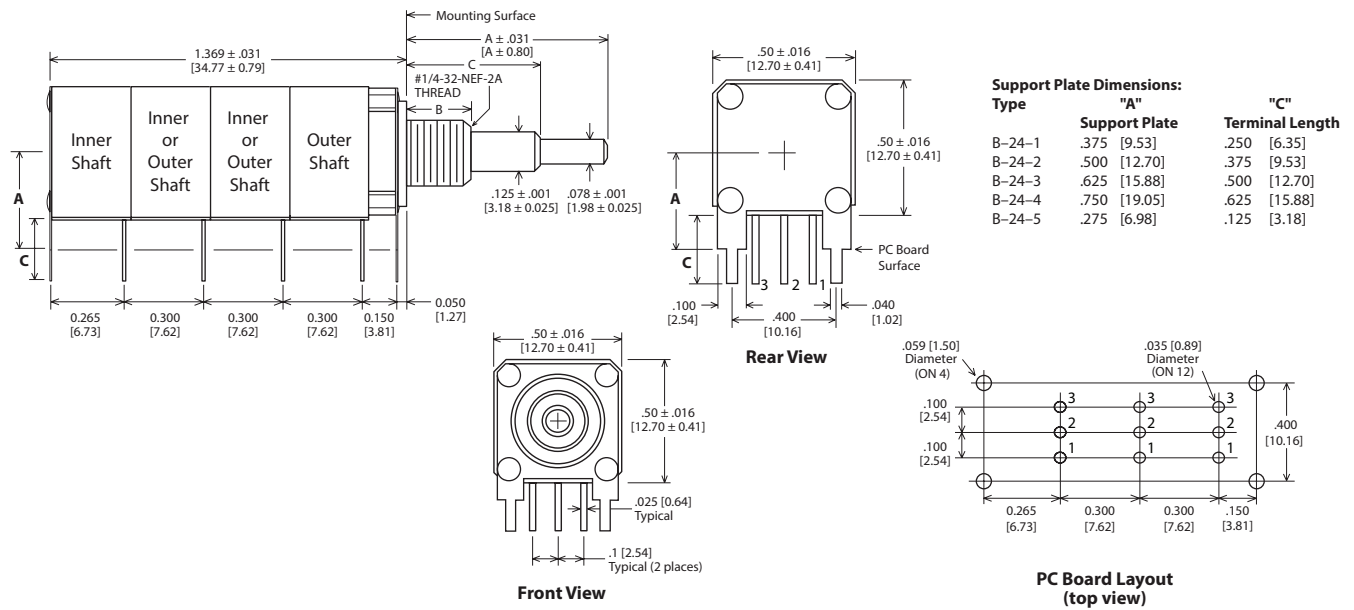


Series S88/S89 - Horizontal Mounting Styles with Support Plates (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

**Drawing 412-1-B24:**

B-24 Quad Potentiometer or RS, Concentric Shaft, PC Pin Terminals, Support Plates, 1/4" Dia. Bushing



**Notes:**

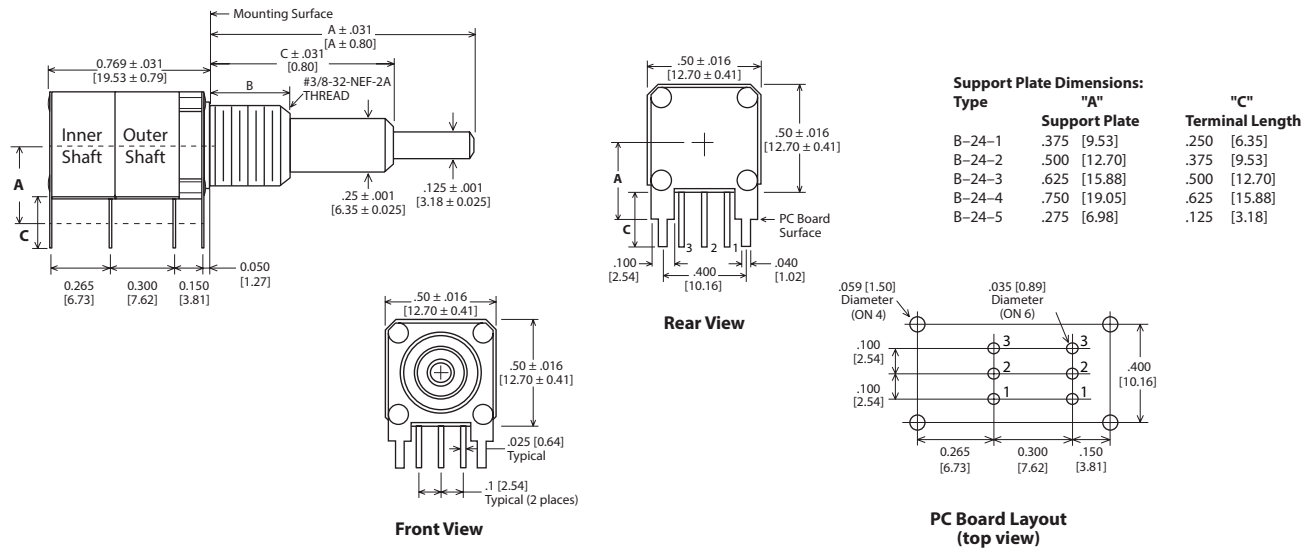
1. Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance  $\pm .016$  [0.40], except as specified.
2. B24 PC pin length per chart. .875" [22.22] Max.
3. Drawings are not to scale.

Series S88/S89 - Horizontal Mounting Styles with Support Plates (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

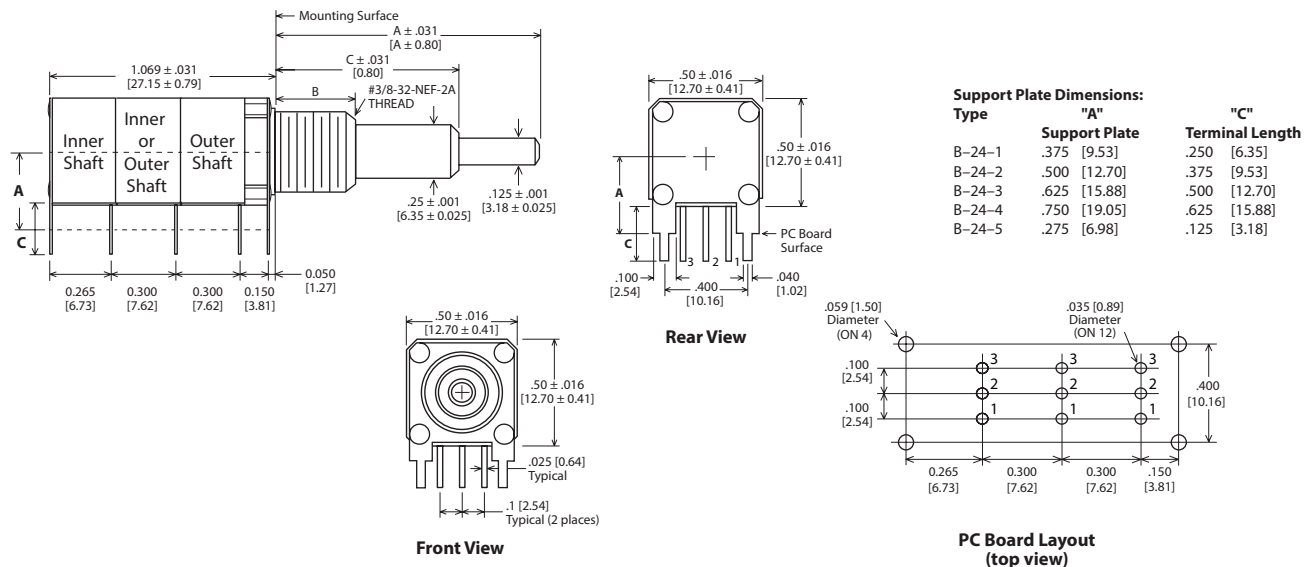
**Drawing 222-1-B24:**

B-24 Dual Potentiometer or RS, Concentric Shaft, PC Pin Terminals, Support Plates, 3/8" Dia. Bushing



**Drawing 322-1-B24:**

B-24 Triple Potentiometer or RS, Concentric Shaft, PC Pin Terminals, Support Plates, 3/8" Dia. Bushing



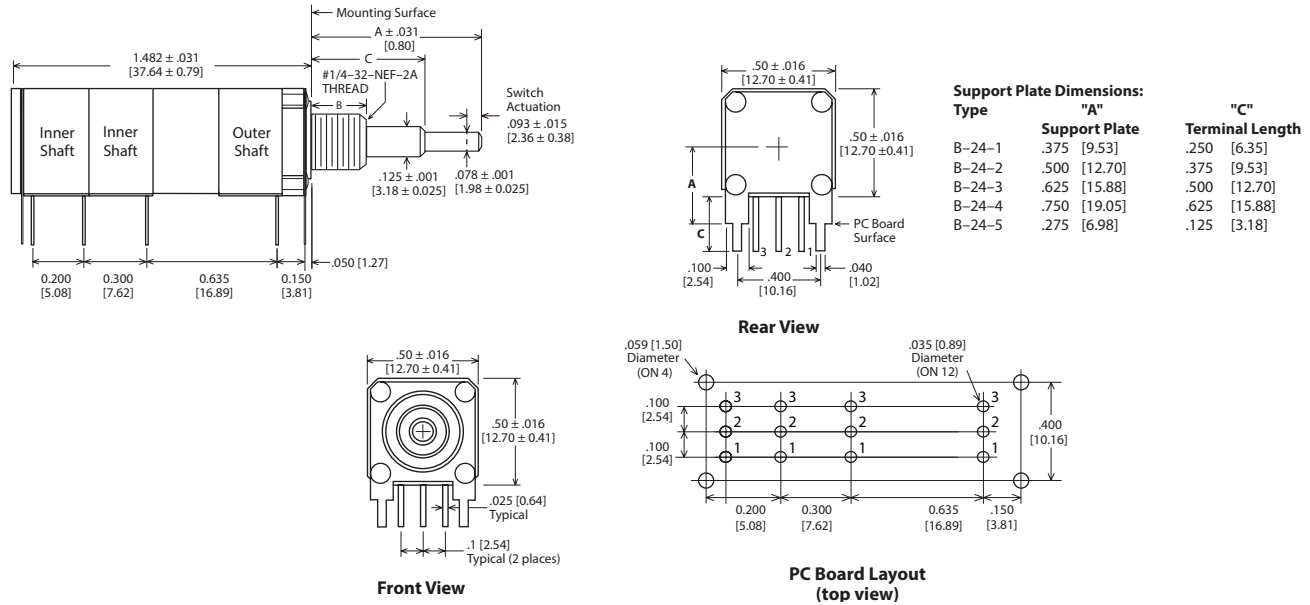
**Notes:**

- Basic dimensions are in inches.  
Dimensions in brackets are in millimeters.  
Dimensional Tolerance  $\pm 0.016$  [0,40], except as specified.
- B24 PC pin length per chart. .875" [22.22] Max.
- Drawings are not to scale.

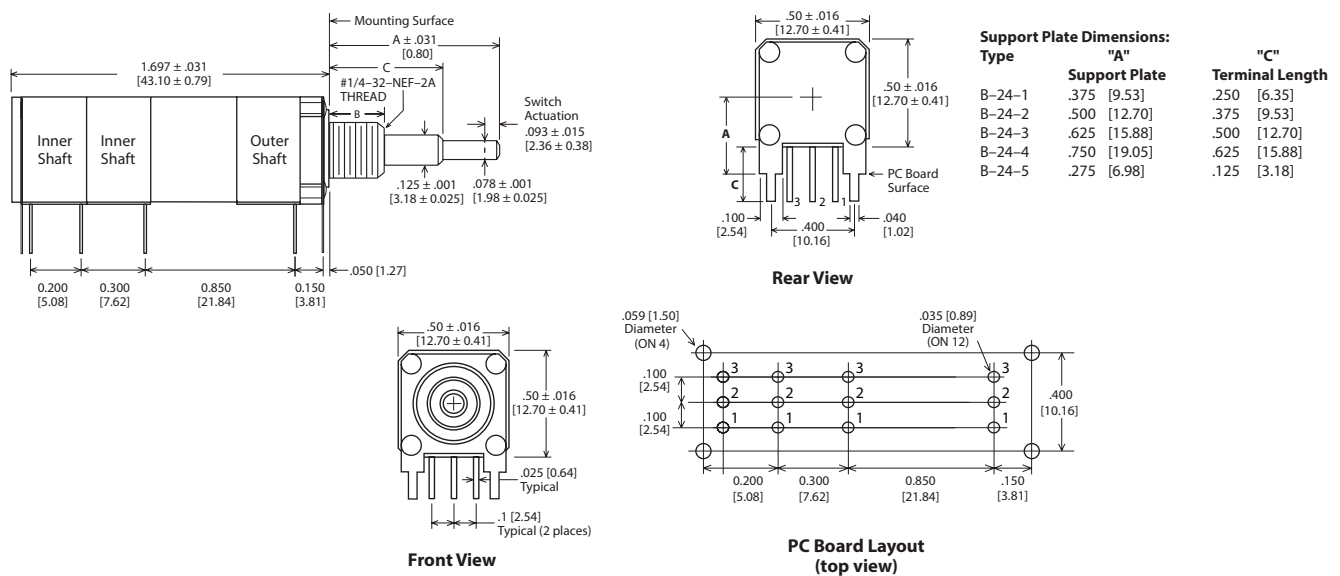
Series S88/S89 - Horizontal Mounting Styles with Support Plates (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

**Drawing 312-2-B24-12:** Concentric Shafts, B24, 2 Potentiometer(s) or RS + PP, 1/4" Bushing  
 Section 1 Potentiometer or RS on Outer Shaft  
 Section 2 Potentiometer or RS on Inner Shaft  
 Section 3 Push-Pull Switch on Inner Shaft



**Drawing 312-3-B24-12:** Concentric Shafts, B24, 2 Potentiometer(s) or RS + MP, 1/4" Bushing  
 Section 1 Potentiometer or RS on Outer Shaft  
 Section 2 Potentiometer or RS on Inner Shaft  
 Section 3 Push-Pull Switch on Inner Shaft



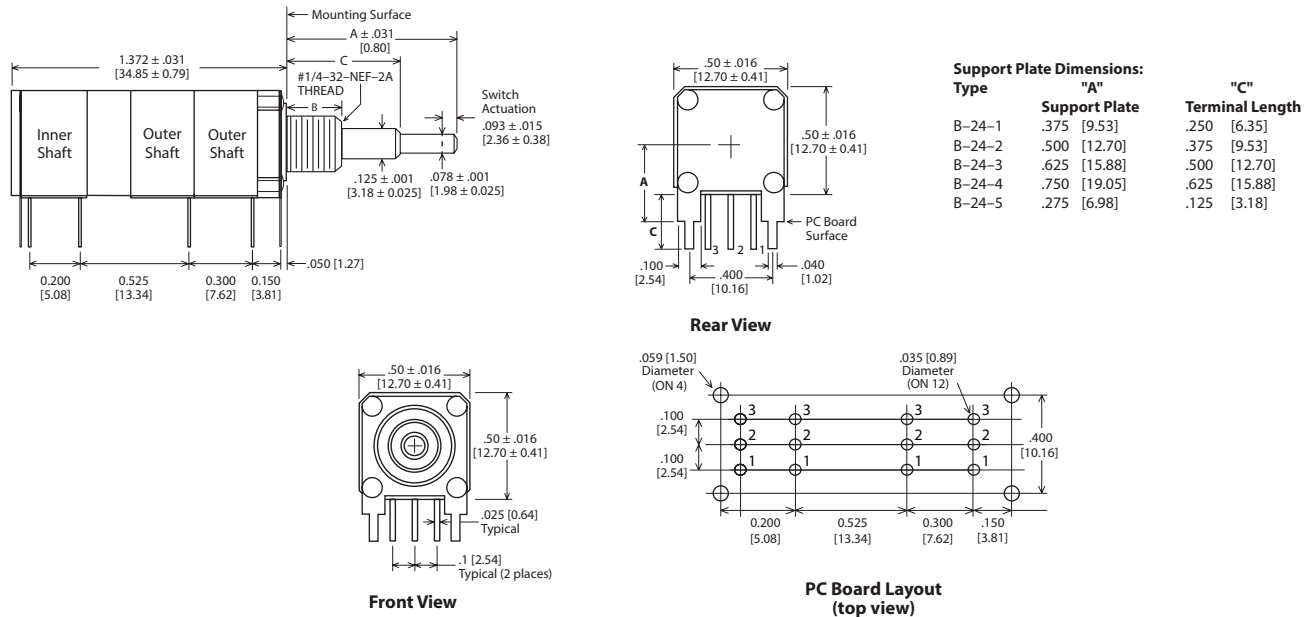
**Notes:**

1. Basic dimensions are in inches.  
 Dimensions in brackets are in millimeters.  
 Dimensional Tolerance  $\pm 0.016$  [0.40], except as specified.
2. B24 PC pin length per chart. .875" [22.22] Max.
3. Drawings are not to scale.

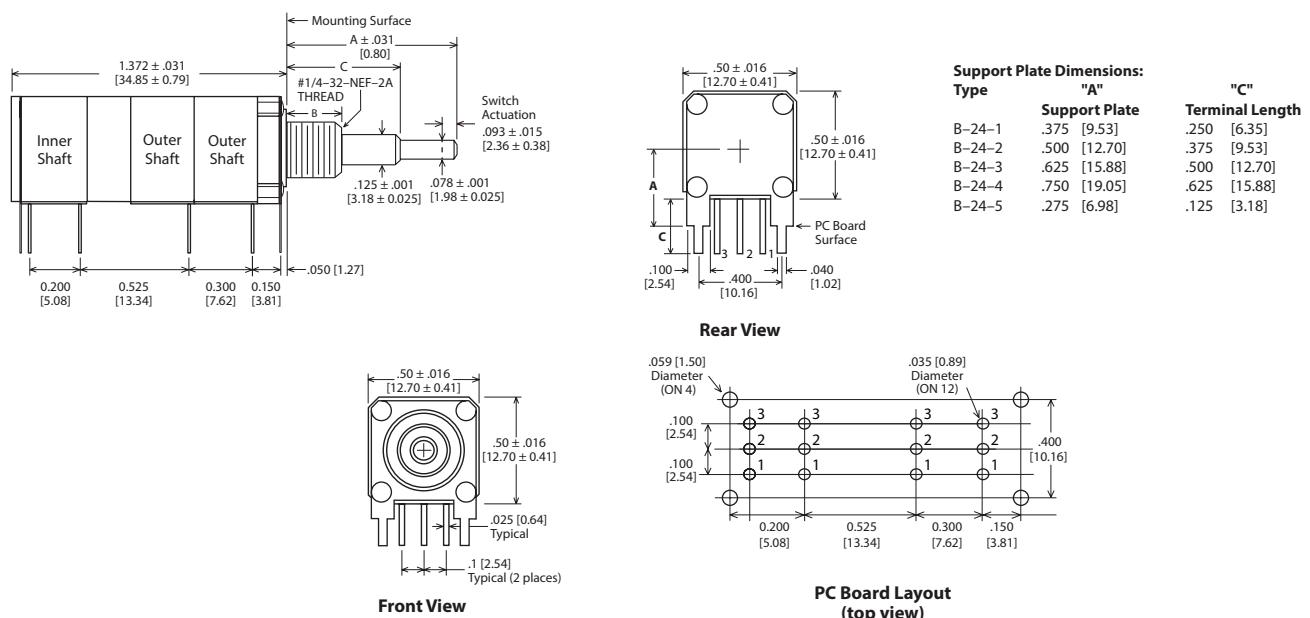
Series S88/S89 - Horizontal Mounting Styles with Support Plates (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

**Drawing 312-2-B24-21:** Concentric Shafts, B24, 2 Potentiometer(s) or RS + PP, 1/4" Bushing  
 Section 1 Potentiometer or RS on Outer Shaft  
 Section 2 Potentiometer or RS on Outer Shaft  
 Section 3 Push-Pull Switch on Inner Shaft



**Drawing 312-3-B24-21:** Concentric Shafts, B22, 2 Potentiometer(s) or RS + MP, 1/4" Bushing  
 Section 1 Potentiometer or RS on Outer Shaft  
 Section 2 Potentiometer or RS on Outer Shaft  
 Section 3 Momentary Push Switch on Inner Shaft



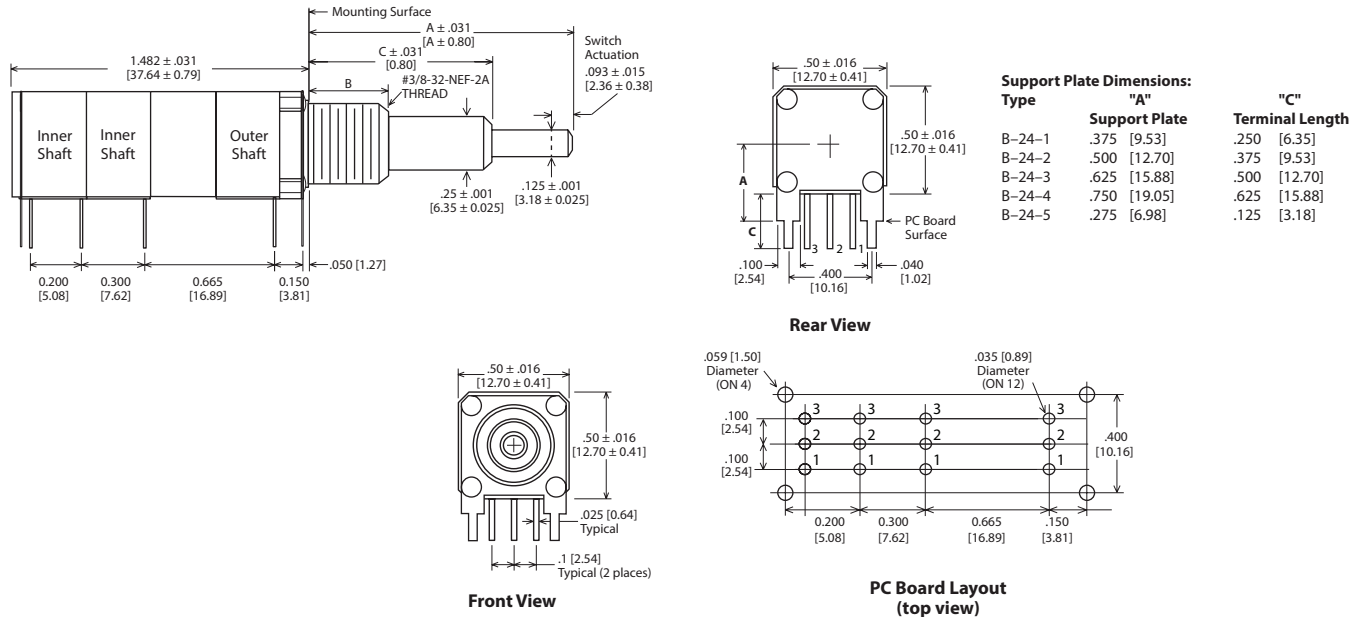
**Notes:**

1. Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance  $\pm 0.016$  [0.40], except as specified.
2. B24 PC pin length per chart. .875" [22.22] Max.
3. Drawings are not to scale.

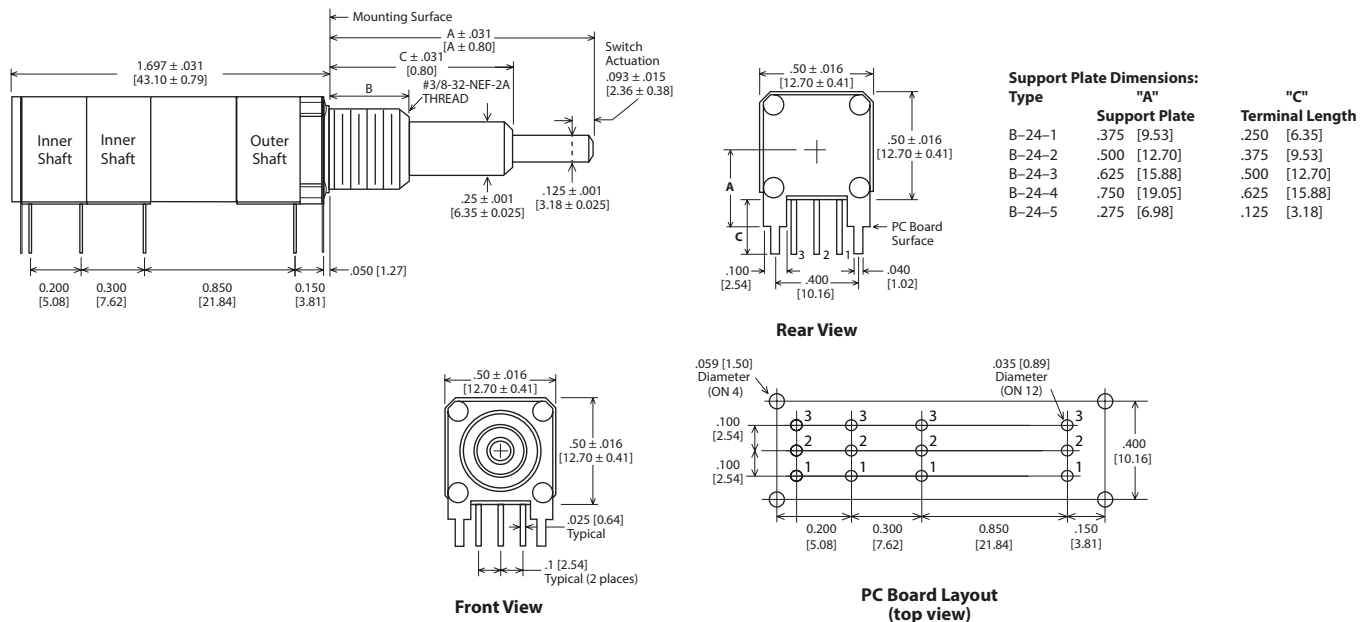
Series S88/S89 - Horizontal Mounting Styles with Support Plates (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

**Drawing 322-2-B24-12:** Concentric Shafts, B24, 2 Potentiometer(s) or RS + PP, 3/8" Bushing  
 Section 1 Potentiometer or RS on Outer Shaft  
 Section 2 Potentiometer or RS on Inner Shaft  
 Section 3 Push-Pull Switch on Inner Shaft



**Drawing 322-3-B24-12:** Concentric Shafts, B24, 2 Potentiometer(s) or RS + MP, 3/8" Bushing  
 Section 1 Potentiometer or RS on Outer Shaft  
 Section 2 Potentiometer or RS on Inner Shaft  
 Section 3 Momentary Push Switch on Inner Shaft



**Notes:**

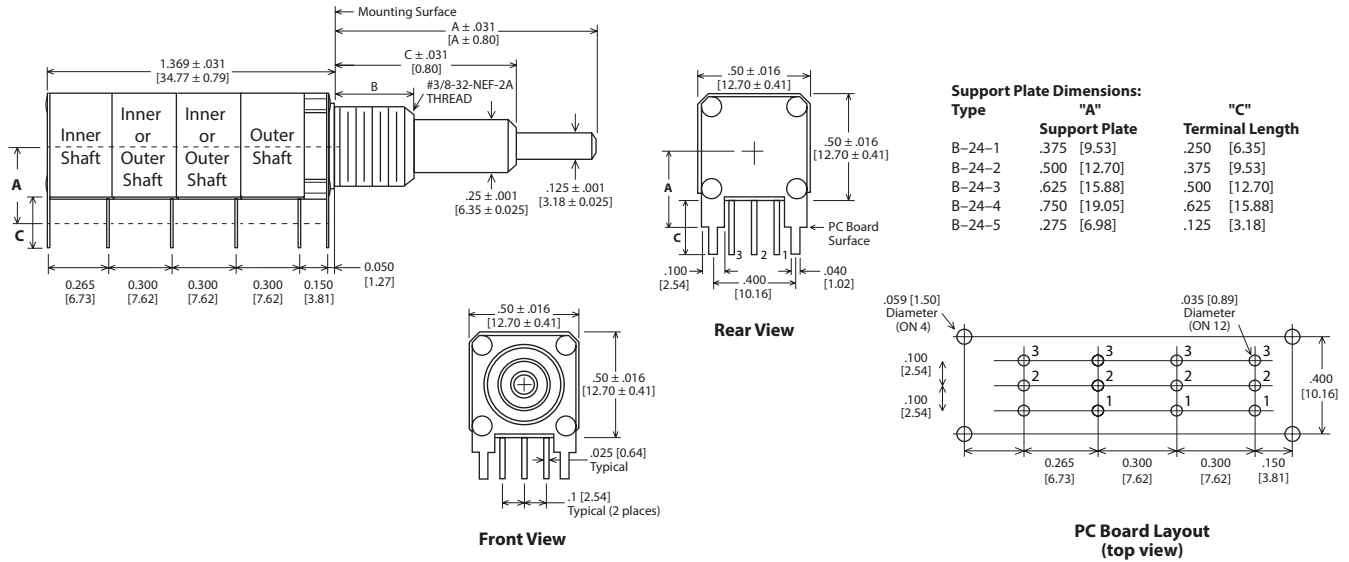
1. Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance  $\pm 0.016$  [0.40], except as specified.
2. B24 PC pin length per chart. .875" [22.22] Max.
3. Drawings are not to scale.

Series S88/S89 - Horizontal Mounting Styles with Support Plates (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

**Drawing 422-1-B24-13:**

B-24 Quad Potentiometer or RS, Concentric Shaft, PC Pin Terminals, Support Plates, 3/8" Dia. Bushing



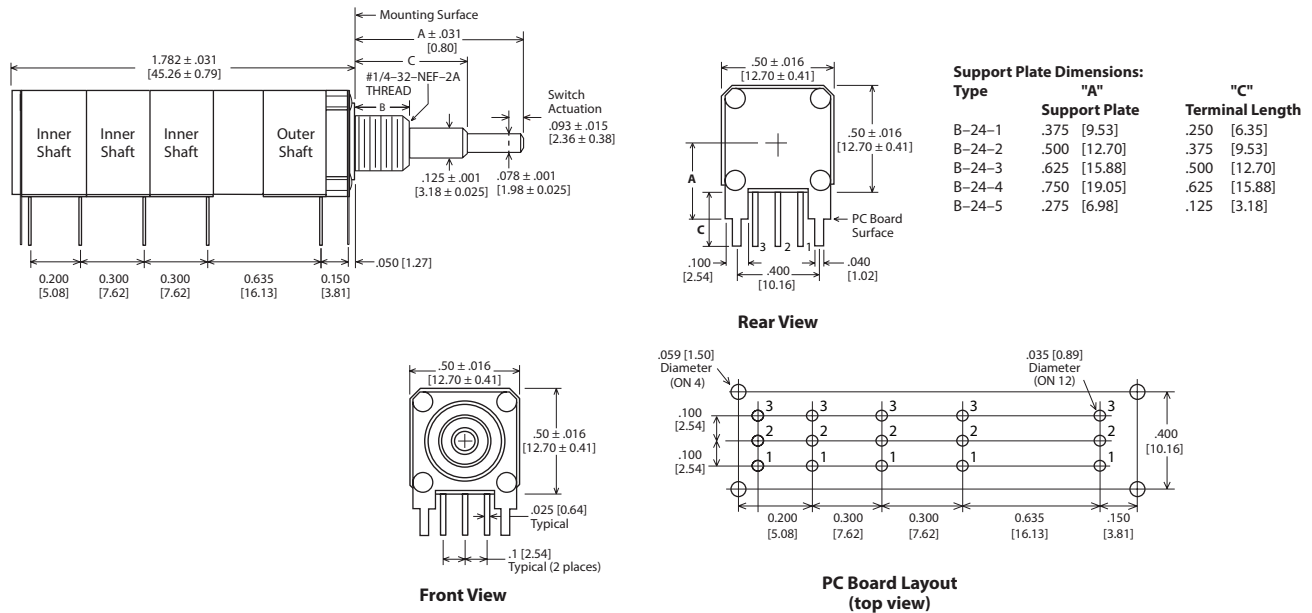
**Notes:**

1. Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance  $\pm 0.016$  [0,40], except as specified.
2. B24 PC pin length per chart. .875" [22.22] Max.
3. Drawings are not to scale.

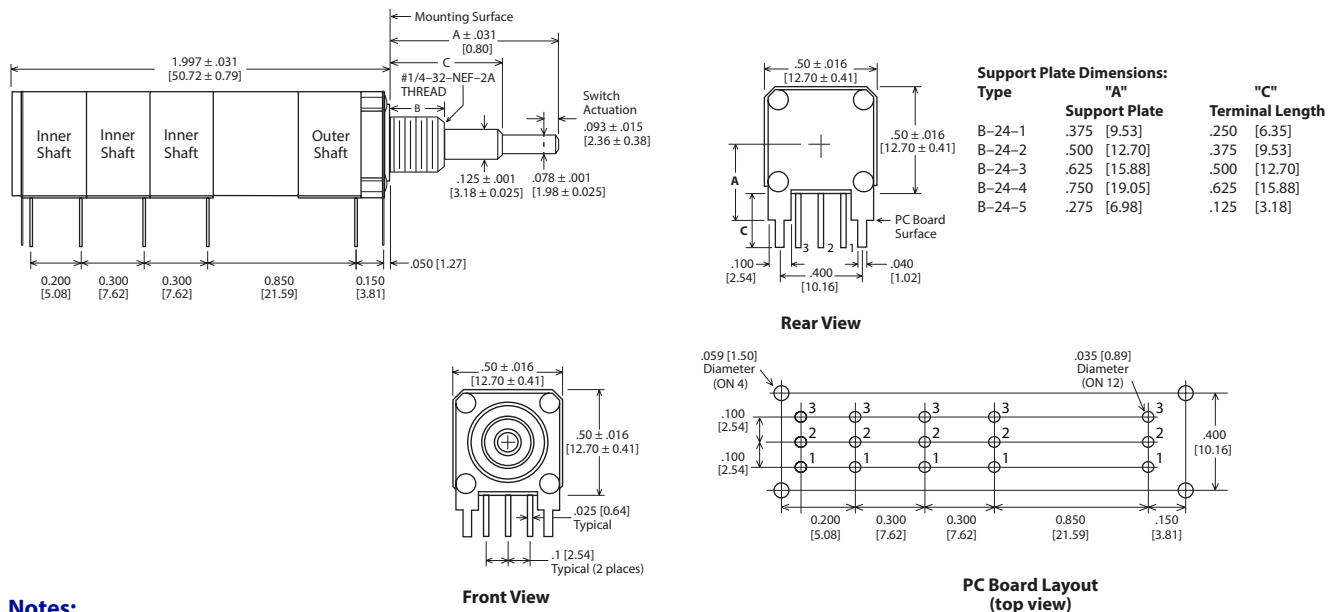
Series S88/S89 - Horizontal Mounting Styles with Support Plates (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

**Drawing 412-2-B24-13:** Concentric Shafts, B24, 3 Potentiometer(s) or RS + PP, 1/4" Bushing  
 Section 1 Potentiometer or RS on Outer Shaft  
 Section 2 Potentiometer or RS on Inner Shaft  
 Section 3 Potentiometer or RS on Inner Shaft  
 Section 4 Push-Pull Switch on Inner Shaft



**Drawing 412-3-B24-13:** Concentric Shafts, B24, 3 Potentiometer(s) or RS + MP, 1/4" Bushing  
 Section 1 Potentiometer or RS on Outer Shaft  
 Section 2 Potentiometer or RS on Inner Shaft  
 Section 3 Potentiometer or RS on Inner Shaft  
 Section 4 Momentary Push Switch on Inner Shaft



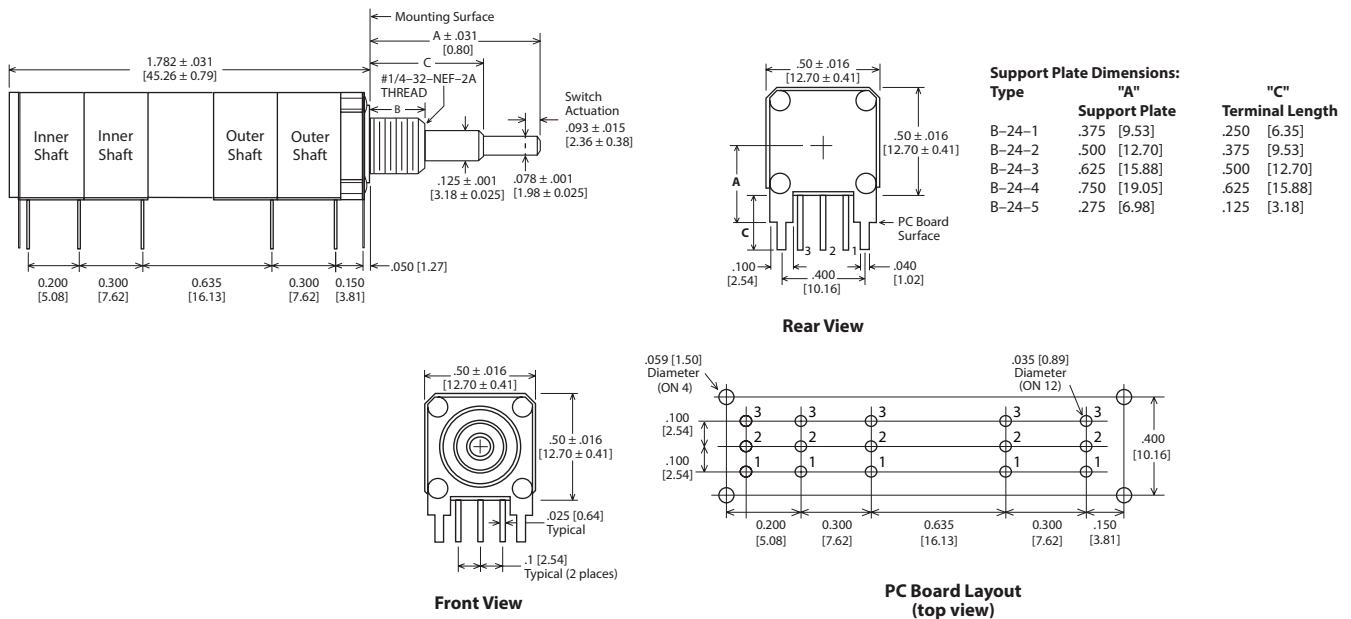
**Notes:**

1. Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance  $\pm 0.016$  [0.40], except as specified.
2. B24 PC pin length per chart. .875" [22.22] Max.
3. Drawings are not to scale.

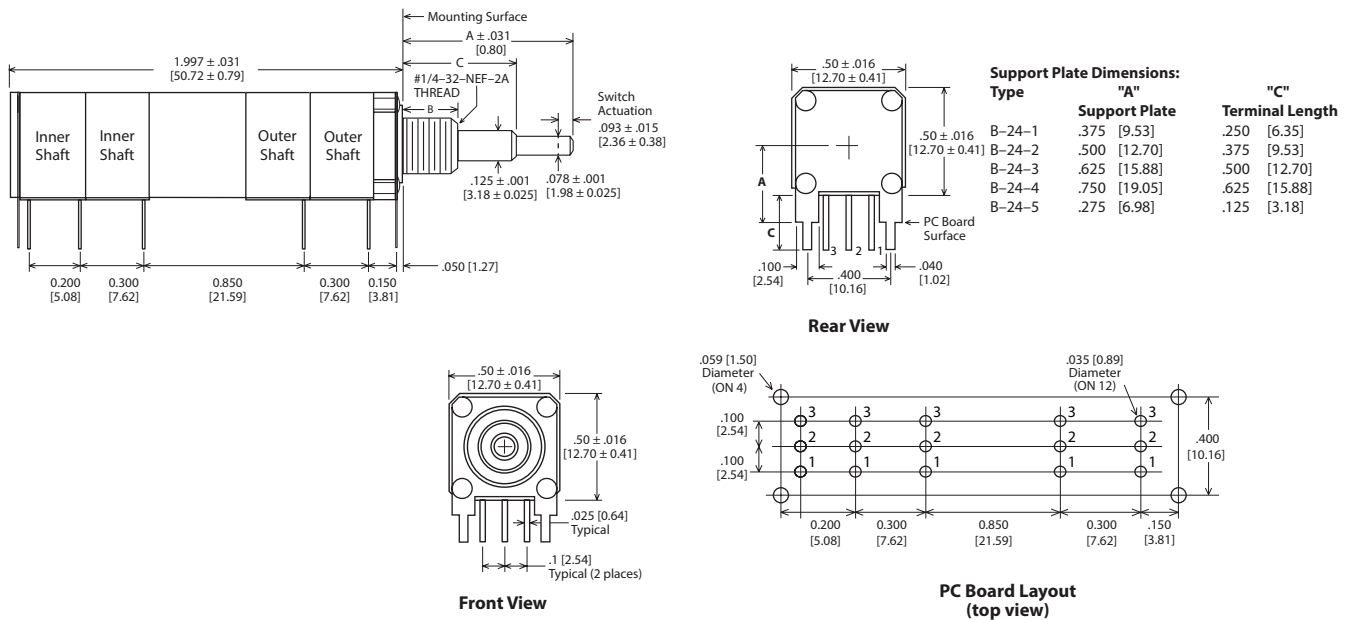
Series S88/S89 - Horizontal Mounting Styles with Support Plates (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

**Drawing 412-2-B24-22:** Concentric Shafts, B24, 3 Potentiometer(s) or RS + PP, 1/4" Bushing  
 Section 1 & 2 Potentiometer or RS on Outer Shaft  
 Section 3 Potentiometer or RS on Inner Shaft  
 Section 4 Momentary Push Switch on Inner Shaft



**Drawing 412-3-B24-22:** Concentric Shafts, B24, 3 Potentiometer(s) or RS + MP, 1/4" Bushing  
 Section 1 & 2 Potentiometer or RS on Outer Shaft  
 Section 3 Potentiometer or RS on Inner Shaft  
 Section 4 Momentary Push Switch on Inner Shaft



**Notes:**

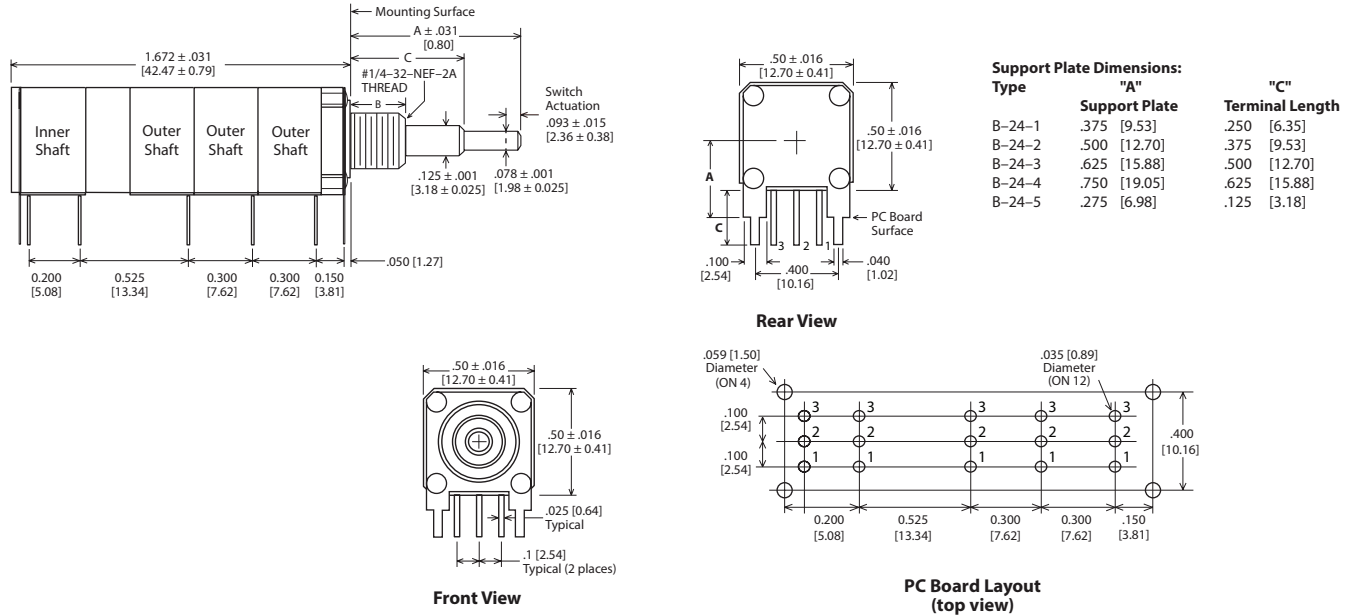
- Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance ±.016 [0.40], except as specified.
- B24 PC pin length per chart. .875" [22.22] Max.
- Drawings are not to scale.



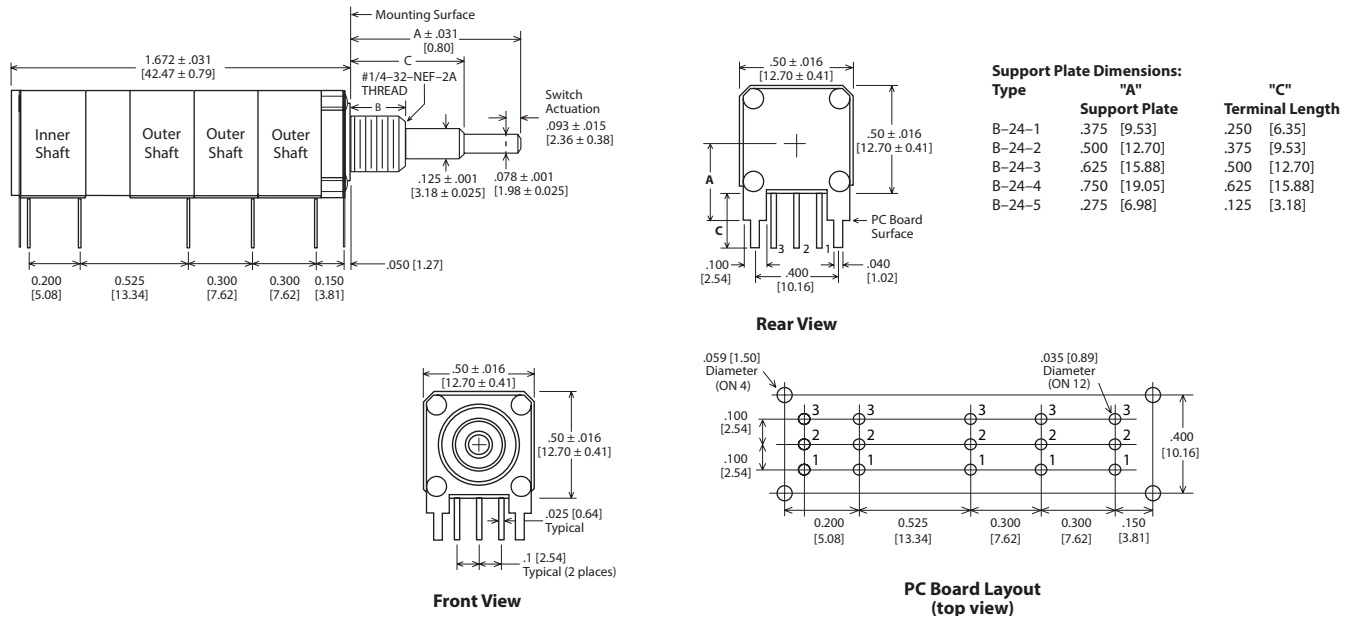
Series S88/S89 - Horizontal Mounting Styles with Support Plates (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

**Drawing 412-2-B24-31:** Concentric Shafts, B24, 3 Potentiometer(s) or RS + PP, 1/4" Bushing  
 Section 1, 2 & 3 Potentiometers or RS on Outer Shaft  
 Section 4 Push-Pull Switch on Inner Shaft



**Drawing 412-3-B24-31:** Concentric Shafts, B24, 3 Potentiometer(s) or RS + MP, 1/4" Bushing  
 Section 1, 2 & 3 Potentiometers or RS on Outer Shaft  
 Section 4 Momentary Push Switch on Inner Shaft



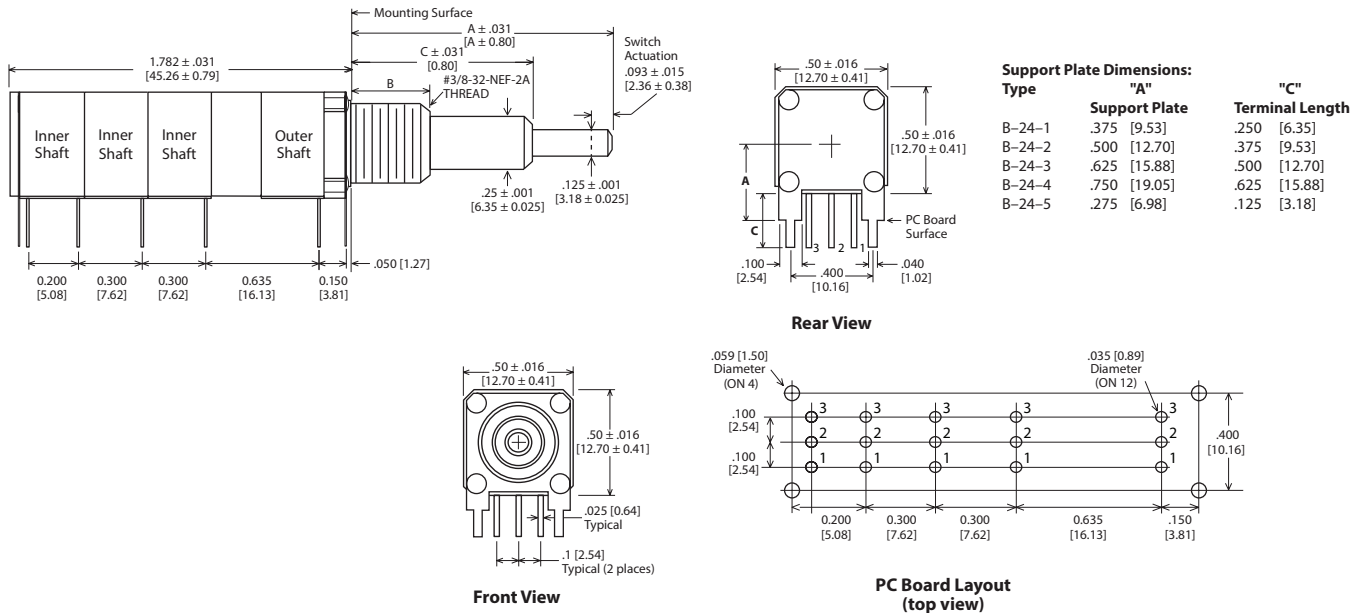
**Notes:**

- Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance  $\pm 0.016$  [0,40], except as specified.
- B24 PC pin length per chart. .875" [22.22] Max.
- Drawings are not to scale.

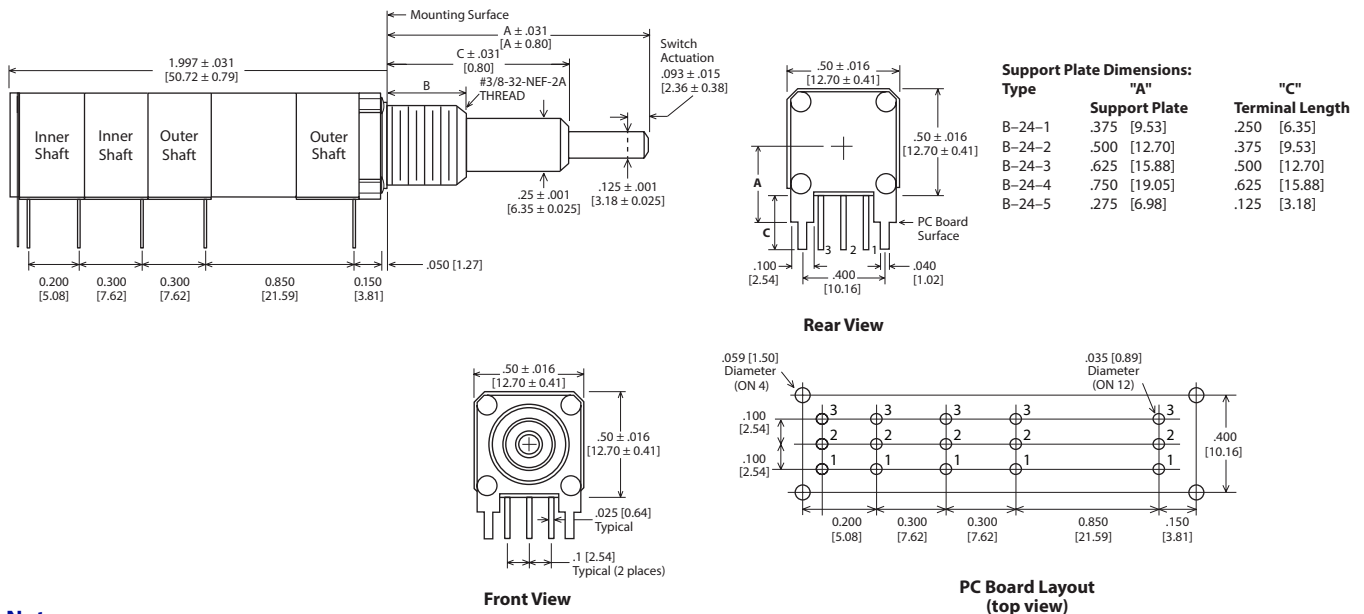
Series S88/S89 - Horizontal Mounting Styles with Support Plates (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

**Drawing 422-2-B24-13:** Concentric Shafts, B24, 3 Potentiometer(s) or RS + PP, 3/8" Bushing  
 Section 1 Potentiometer or RS on Outer Shaft  
 Section 2 Potentiometer or RS on Inner Shaft  
 Section 3 Potentiometer or RS on Inner Shaft  
 Section 4 Push-Pull Switch on Inner Shaft



**Drawing 422-3-B24-13:** Concentric Shafts, B24, 3 Potentiometer(s) or RS + MP, 3/8" Bushing  
 Section 1 Potentiometer or RS on Outer Shaft  
 Section 2 Potentiometer or RS on Inner Shaft  
 Section 3 Potentiometer or RS on Inner Shaft  
 Section 4 Momentary Push Switch on Inner Shaft



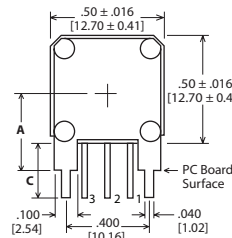
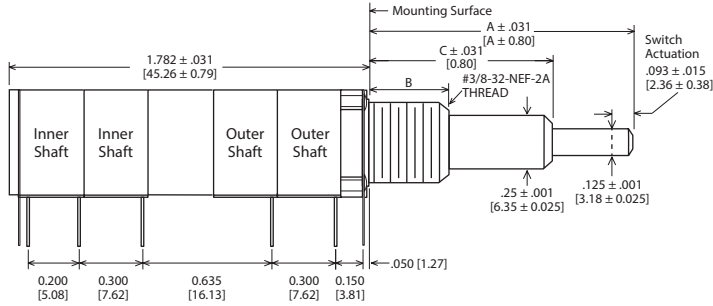
**Notes:**

1. Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance  $\pm 0.016$  [0.40], except as specified.
2. B24 PC pin length per chart. .875" [22.22] Max.
3. Drawings are not to scale.

Series S88/S89 - Horizontal Mounting Styles with Support Plates (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

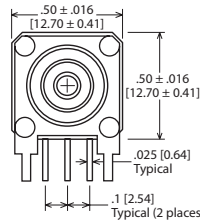
**Drawing 422-2-B24-22:** Concentric Shafts, B22, 3 Potentiometer(s) or RS + PP, 3/8" Bushing  
 Section 1 & 2 Potentiometer or RS on Outer Shaft  
 Section 3 Potentiometer or RS on Inner Shaft  
 Section 4 Momentary Push Switch on Inner Shaft



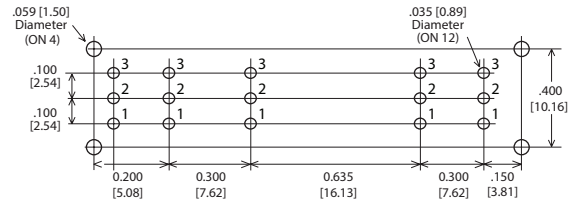
Support Plate Dimensions:

Type	"A" Support Plate	"C" Terminal Length
B-24-1	.375 [9.53]	.250 [6.35]
B-24-2	.500 [12.70]	.375 [9.53]
B-24-3	.625 [15.88]	.500 [12.70]
B-24-4	.750 [19.05]	.625 [15.88]
B-24-5	.275 [6.98]	.125 [3.18]

Rear View

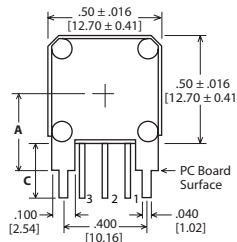
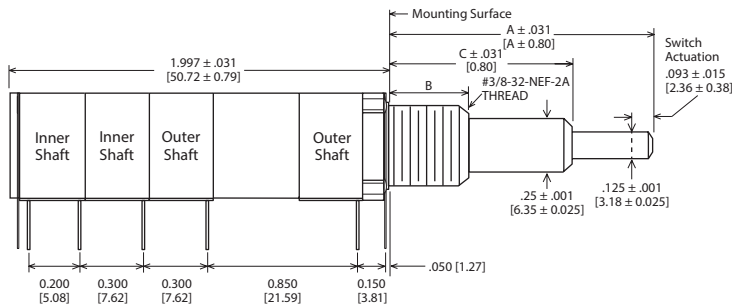


Front View



PC Board Layout (top view)

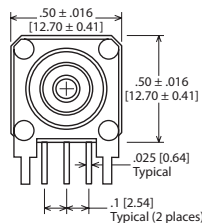
**Drawing 422-3-B24-22:** Concentric Shafts, B22, 3 Potentiometer(s) or RS + MP, 3/8" Bushing  
 Section 1 & 2 Potentiometer or RS on Outer Shaft  
 Section 3 Potentiometer or RS on Inner Shaft  
 Section 4 Momentary Push Switch on Inner Shaft



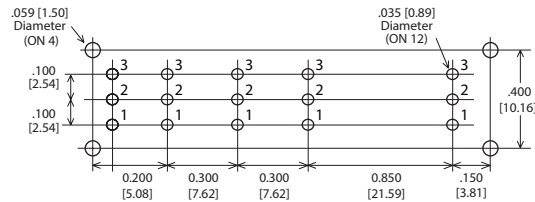
Support Plate Dimensions:

Type	"A" Support Plate	"C" Terminal Length
B-24-1	.375 [9.53]	.250 [6.35]
B-24-2	.500 [12.70]	.375 [9.53]
B-24-3	.625 [15.88]	.500 [12.70]
B-24-4	.750 [19.05]	.625 [15.88]
B-24-5	.275 [6.98]	.125 [3.18]

Rear View



Front View



PC Board Layout (top view)

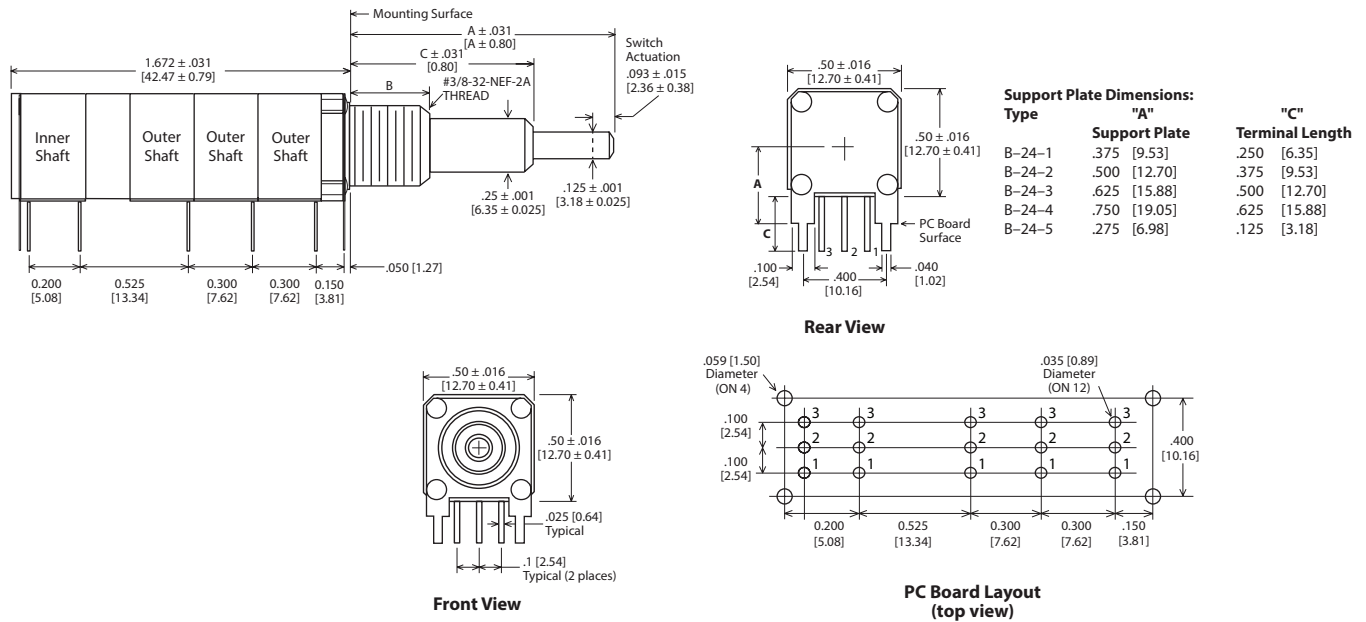
**Notes:**

- Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance  $\pm 0.016$  [0,40], except as specified.
- B24 PC pin length per chart. .875" [22.22] Max.
- Drawings are not to scale.

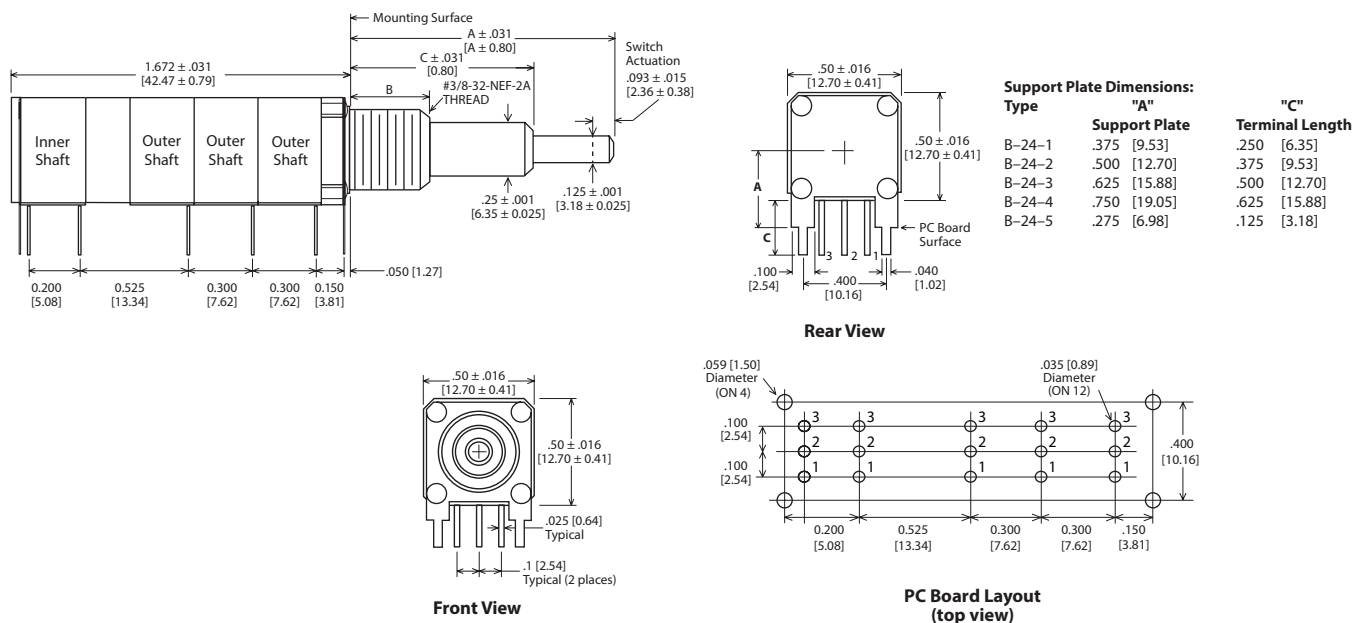
Series S88/S89 - Horizontal Mounting Styles with Support Plates (continued)

Switch Abbreviations: RS = Rotary-SPDT; PP = Push-Pull-DPST; MP = Momentary Push-DPST

**Drawing 422-2-B24-31:** Concentric Shafts, B24, 3 Potentiometer(s) or RS + PP, 3/8" Bushing  
 Section 1, 2 & 3: 2 Potentiometers or RS on Outer Shaft  
 Section 4: Momentary Push Switch on Inner Shaft



**Drawing 422-3-B24-31:** Concentric Shafts, B24, 3 Potentiometer(s) or RS + MP, 3/8" Bushing  
 Sections 1, 2 & 3: 2 Potentiometers or RS on Outer Shaft  
 Section 4: Momentary Push Switch on Inner Shaft



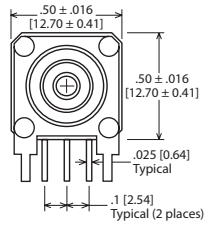
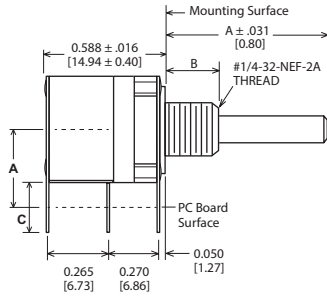
**Notes:**

- Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance  $\pm 0.016$  [0.40], except as specified.
- B24 PC pin length per chart. .875" [22.22] Max.
- Drawings are not to scale.

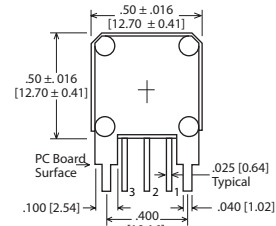
Series S88/S89 - Horizontal Mounting Styles with Support Plates (continued)

**Drawing 111-1-B24-D:**

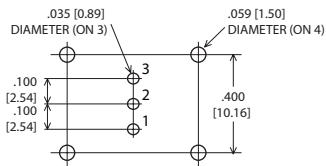
B-24 Single Potentiometer with detent, Valley Style, PC Pin Terminals, Support Plates, 1/4" Dia. Bushing



Front View



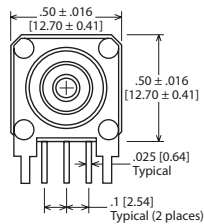
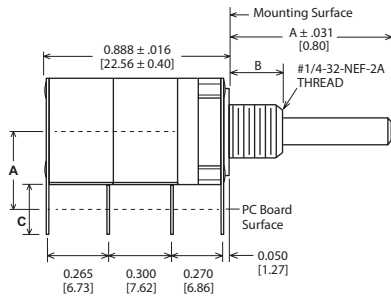
Rear View



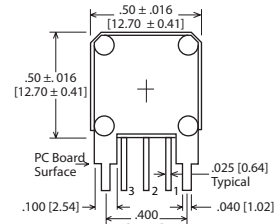
PC Board Layout  
(Top View)

**Drawing 211-1-B24-D:**

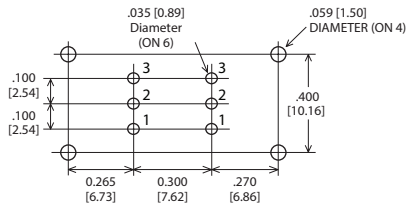
B-24 Dual Potentiometer with detent, Valley Style, PC Pin Terminals, Support Plates, 1/4" Dia. Bushing



Front View



Rear View

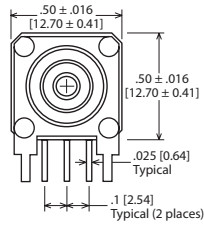
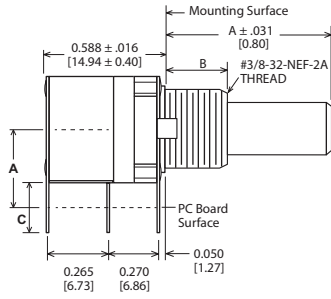


PC Board Layout  
(Top View)

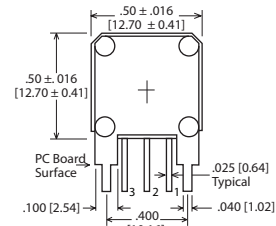
Series S88/S89 - Horizontal Mounting Styles with Support Plates (continued)

**Drawing 121-1-B24-D:**

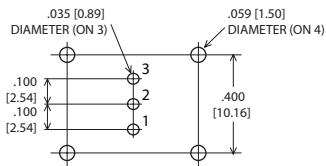
B-24 Single Potentiometer with detent, Valley Style, PC Pin Terminals, Support Plates, 3/8" Dia. Bushing



Front View



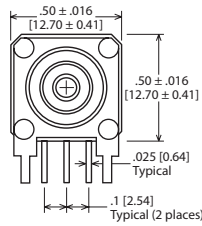
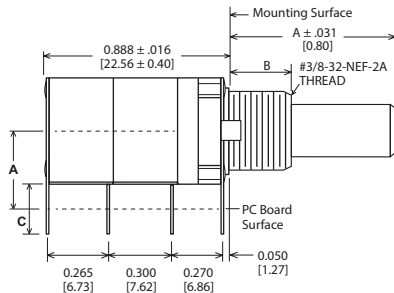
Rear View



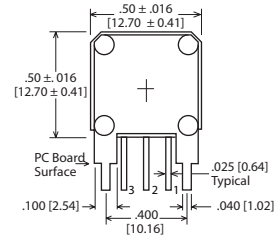
PC Board Layout  
(Top View)

**Drawing 221-1-B24-D:**

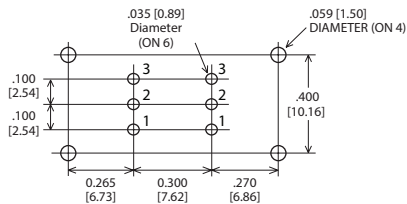
B-24 Dual Potentiometer with detent, Valley Style, PC Pin Terminals, Support Plates, 3/8" Dia. Bushing



Front View



Rear View

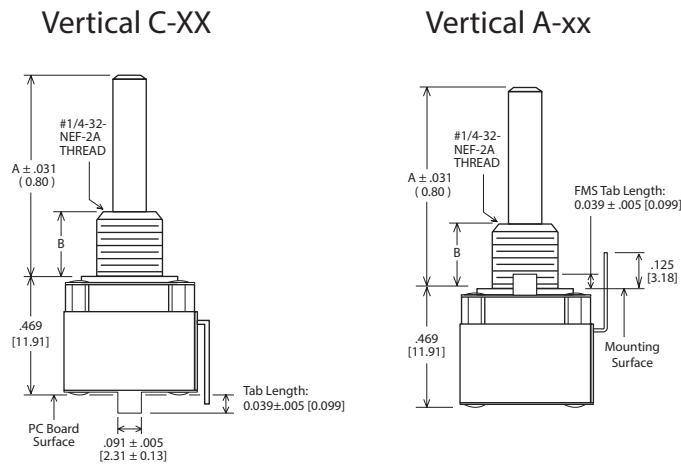


PC Board Layout  
(Top View)

# VERTICAL MOUNTING

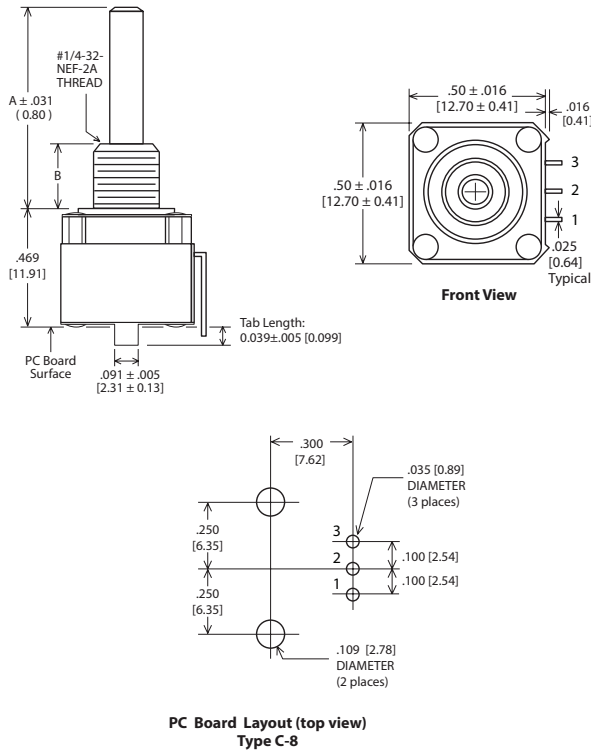
Vertical mounted pots are typically attached to a PC board at a 90° angle. The leads can be formed towards the rear of the potentiometer for C-XX mounting style or towards the front of the potentiometer for A-XX mounting.

The rear plate used on a vertical mounted potentiometer has two tabs that are used to provide support, thereby removing the stress from the PC leads.

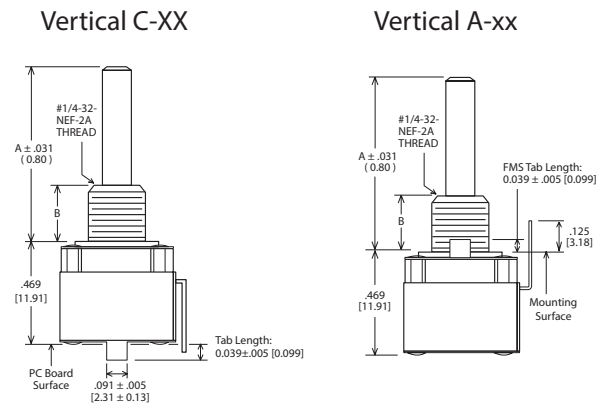


Series S88/S89 - Vertical Mounting Styles (continued)

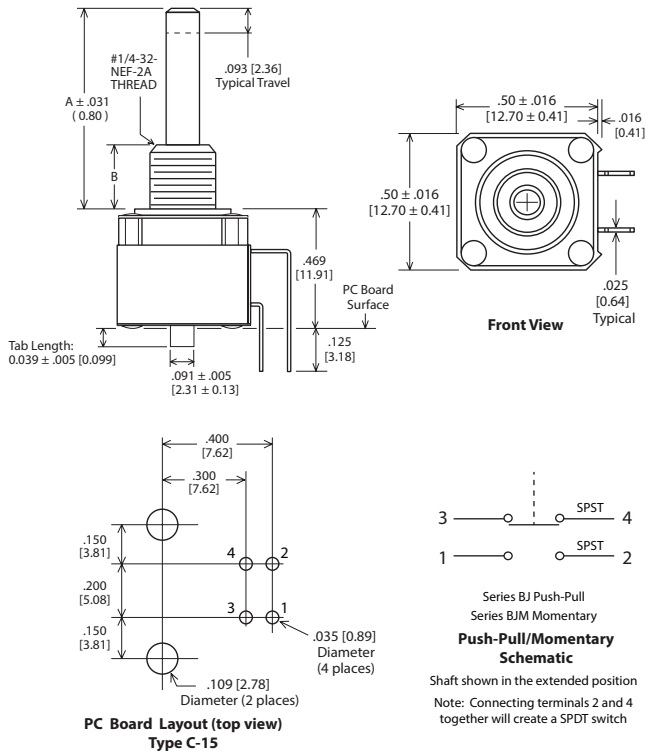
**Drawing 111-1-C8:** C-8 Single Potentiometer or RS, PC Pin Terminals, 1/4" Dia. Bushing



**Drawing 111-1-A18:** A-18 Single Potentiometer or RS, PC Pin Terminals, 1/4" Dia. Bushing



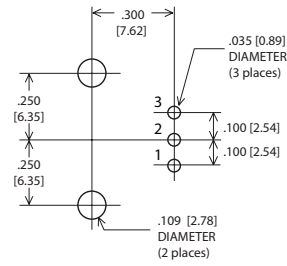
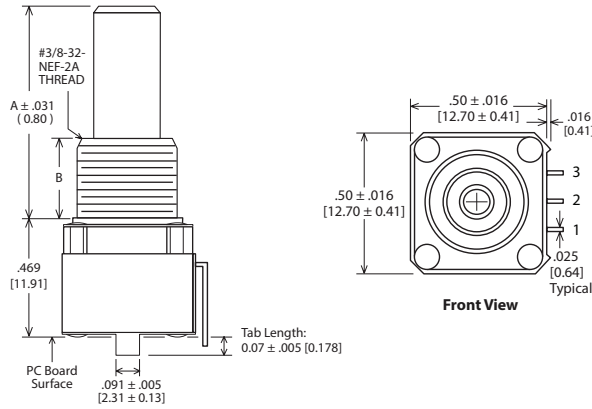
**Drawing 111-2-C15:** C-15 Single PP Push-Pull / MP Momentary Switch, PC Pin Terminals, 1/4" Dia. Bushing





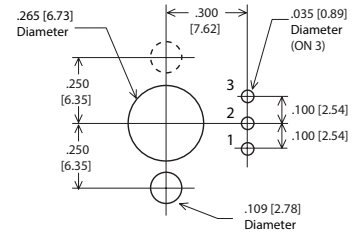
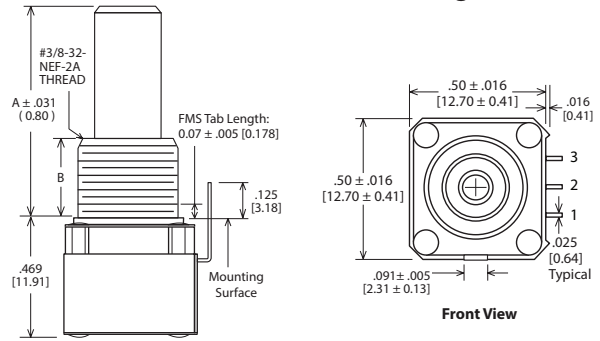
Series S88/S89 - Vertical Mounting Styles (continued)

**Drawing 121-1-B8:** C-8 Single Potentiometer or RS, PC Pin Terminals, 3/8" Dia. Bushing



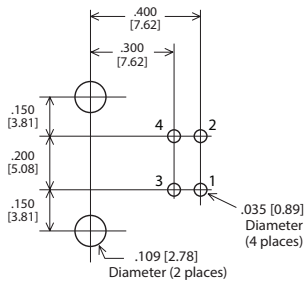
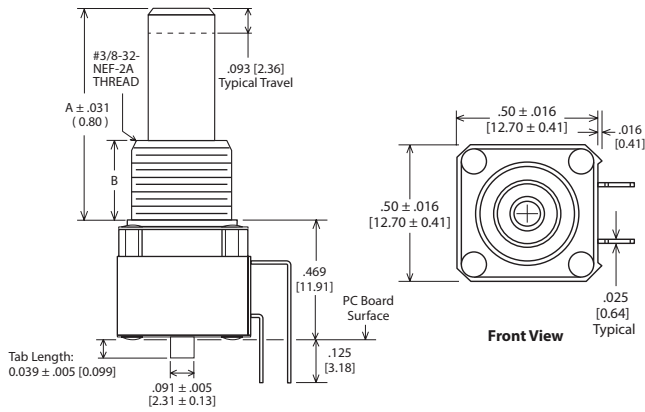
PC Board Layout (top view)  
Type C-8

**Drawing 121-1-A18:** A-18 Single Potentiometer or RS, PC Pin Terminals, 3/8" Dia. Bushing

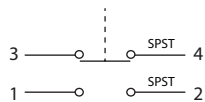


PC Board Layout (top view)  
Type A-18

**Drawing 121-2-C15:** C-15 Single PPS Push-Pull / PPSM Momentary Switch, PC Pin Terminals, 3/8" Dia. Bushing



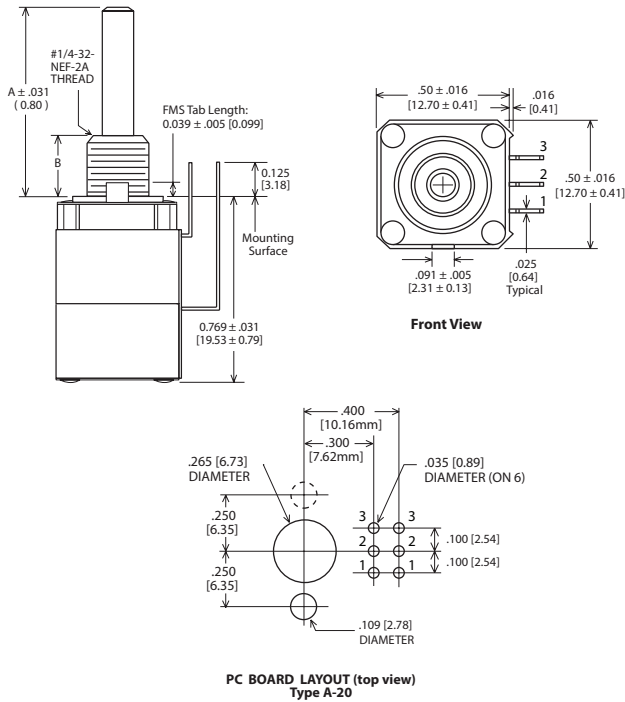
PC Board Layout (top view)  
Type C-15



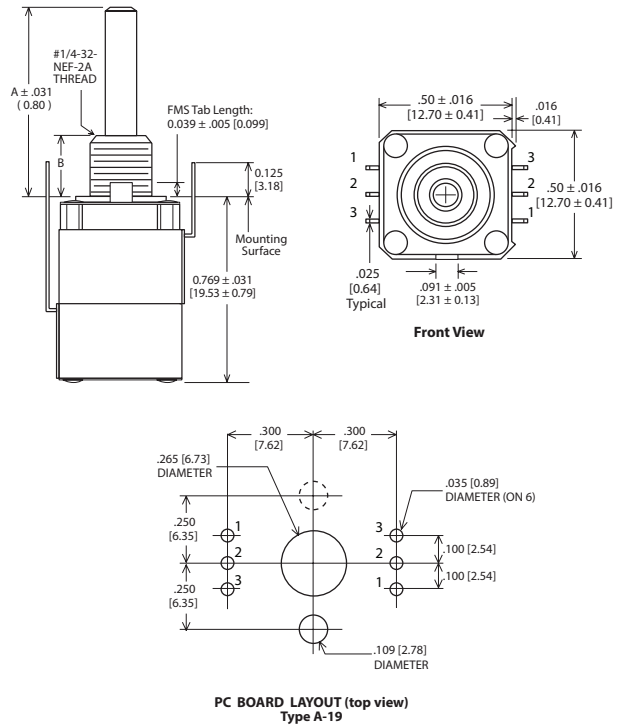
Series BJ Push-Pull  
Series BJM Momentary  
**Push-Pull/Momentary Schematic**  
Shaft shown in the extended position  
Note: Connecting terminals 2 and 4 together will create a SPDT switch

Series S88/S89 - Vertical Mounting Styles (continued)

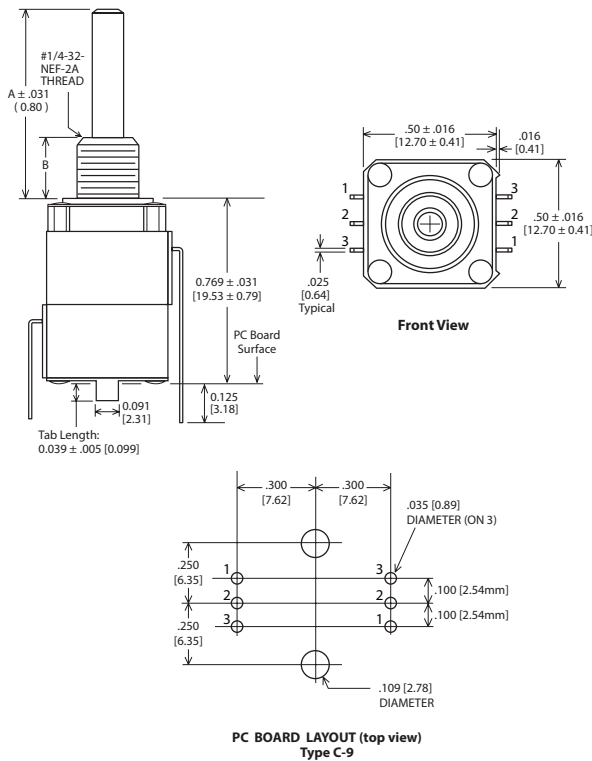
**Drawing 211-1-A20:** A-20 Dual Potentiometer or RS, PC Pin Terminals, 1/4" Dia. Bushing



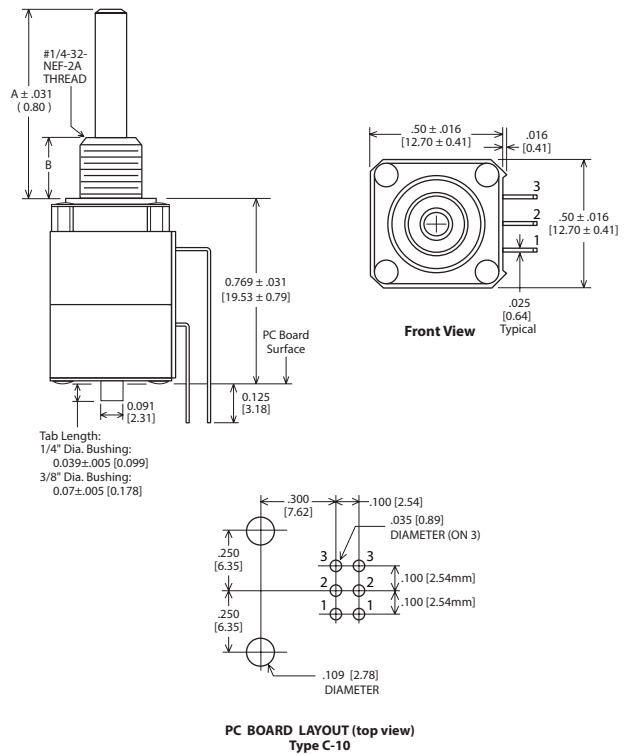
**Drawing 211-1-A19:** A-19 Dual Potentiometer or RS, PC Pin Terminals, 1/4" Dia. Bushing



**Drawing 211-1-C9:** C-9 Dual Potentiometer or RS, PC Pin Terminals, 1/4" Dia. Bushing



**Drawing 211-1-C10:** C-10 Dual Potentiometer or RS, PC Pin Terminals, 1/4" Dia. Bushing

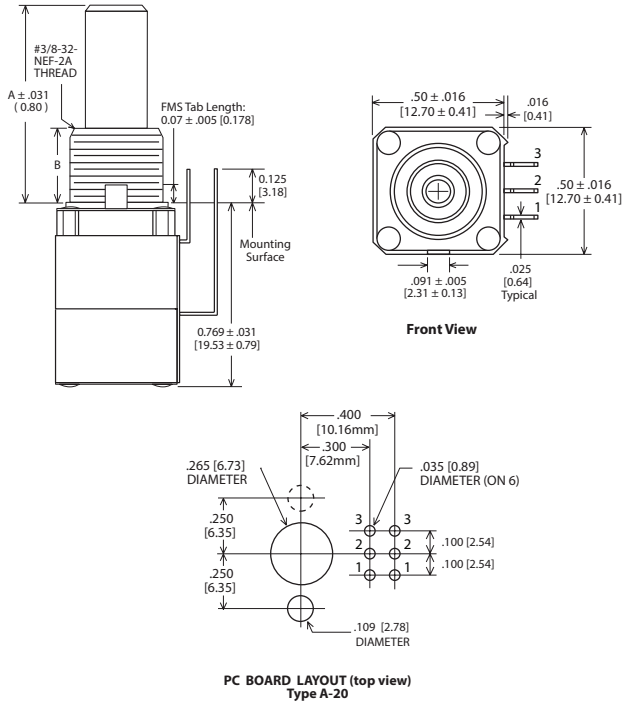


**Notes:**

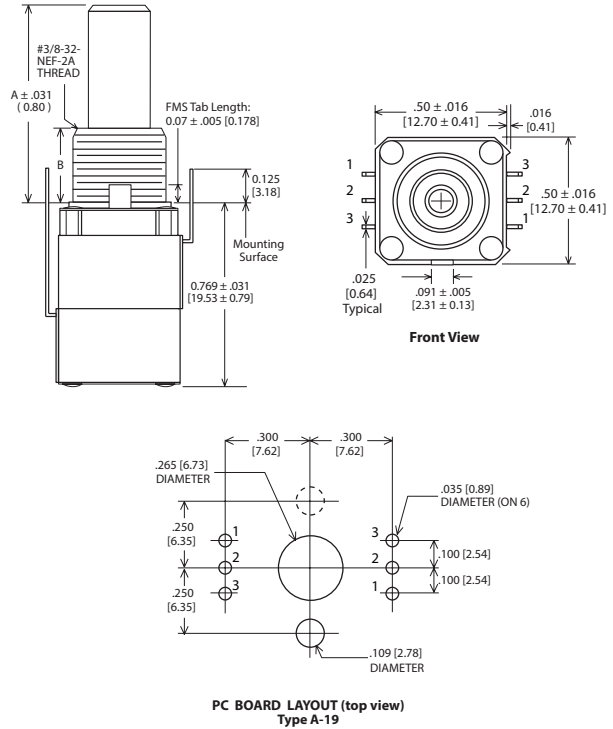
- Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance ± .016 (0.40), except as specified.
- Drawings are not to scale.

Series S88/S89 - Vertical Mounting Styles (continued)

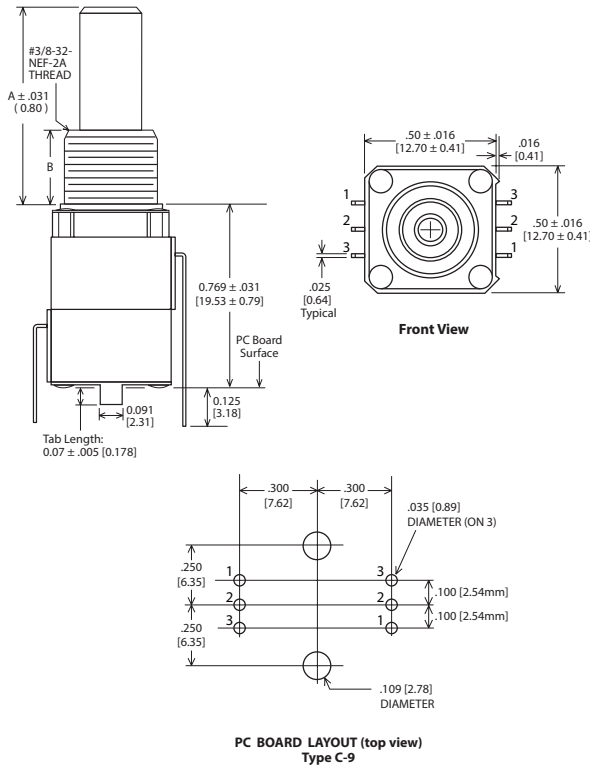
**Drawing 221-1-A20:** A-20 Dual Potentiometer or RS, PC Pin Terminals, 3/8" Dia. Bushing



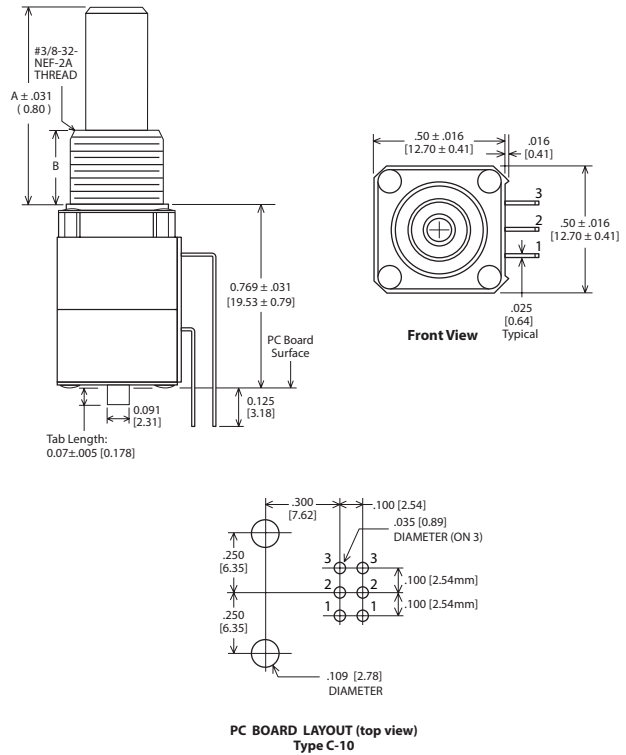
**Drawing 221-1-A19:** A-19 Dual Potentiometer or RS, PC Pin Terminals, 3/8" Dia. Bushing



**Drawing 221-1-C9 2:** C-9 Dual Potentiometer or RS, PC Pin Terminals, 3/8" Dia. Bushing



**Drawing 221-1-C10:** C-10 Dual Potentiometer or RS, PC Pin Terminals, 3/8" Dia. Bushing

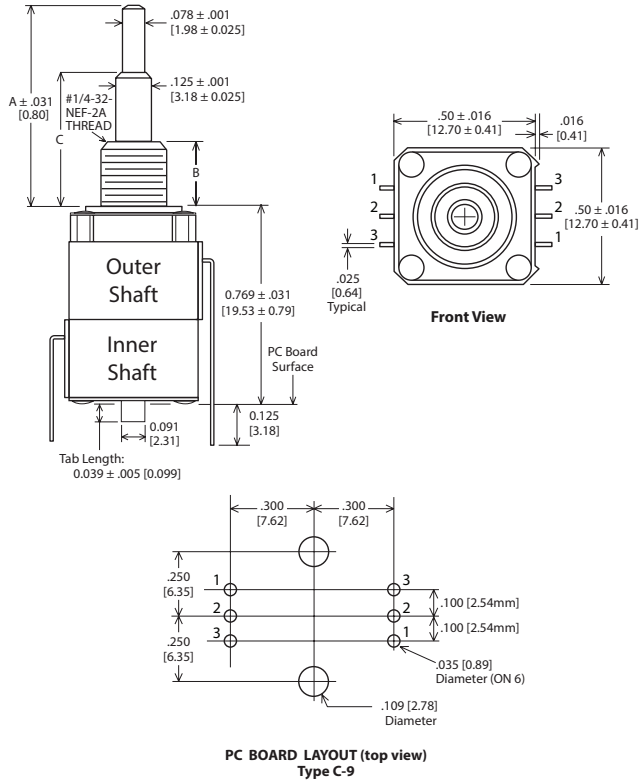


**Notes:**

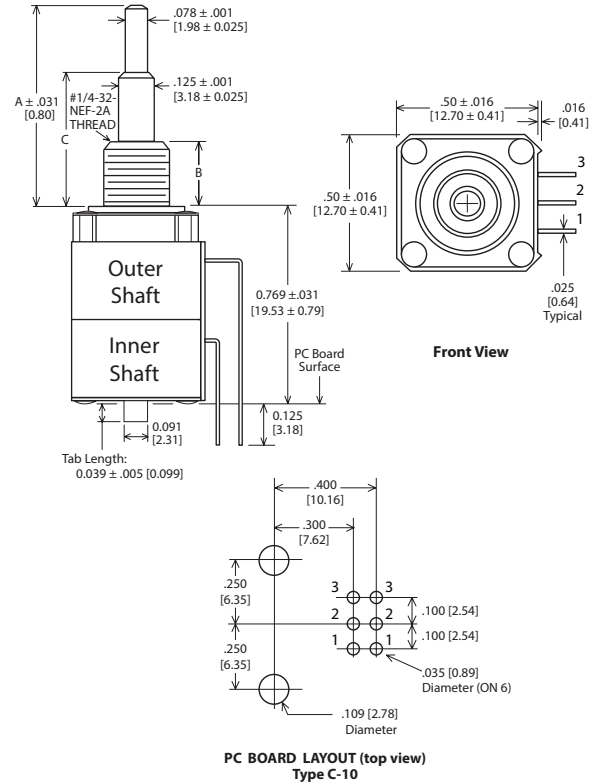
1. Basic dimensions are in inches. Dimensions in brackets are in millimeters. Dimensional Tolerance ± .016 (0.40), except as specified.
2. Drawings are not to scale.

Series S88/S89 - Vertical Mounting Styles (continued)

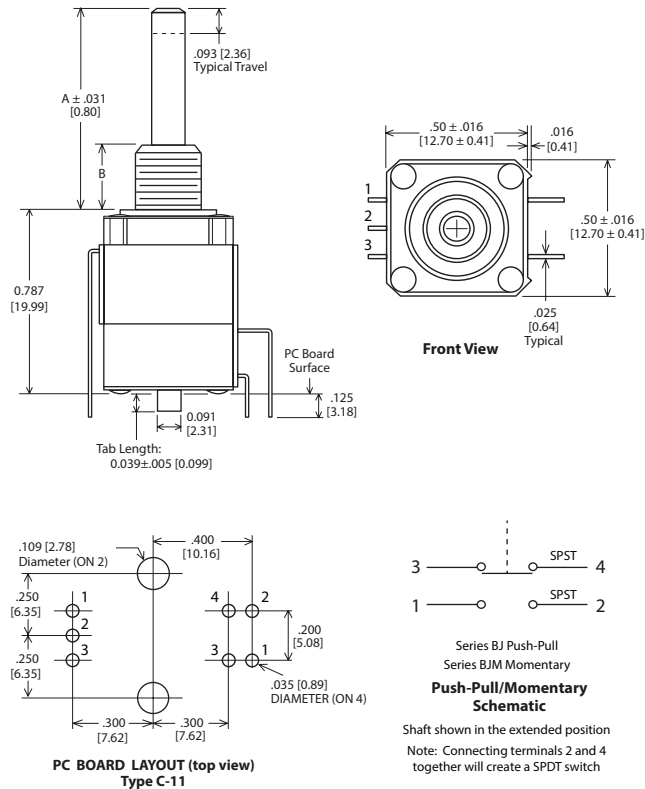
**Drawing 212-1-C9:** C-9 Dual Potentiometer, Concentric Shaft, PC Pin Terminals, 1/4" Dia. Bushing



**Drawing 212-1C10:** C-10 Dual Potentiometer Concentric Shaft, PC Pin Terminals, 1/4" Dia. Bushing



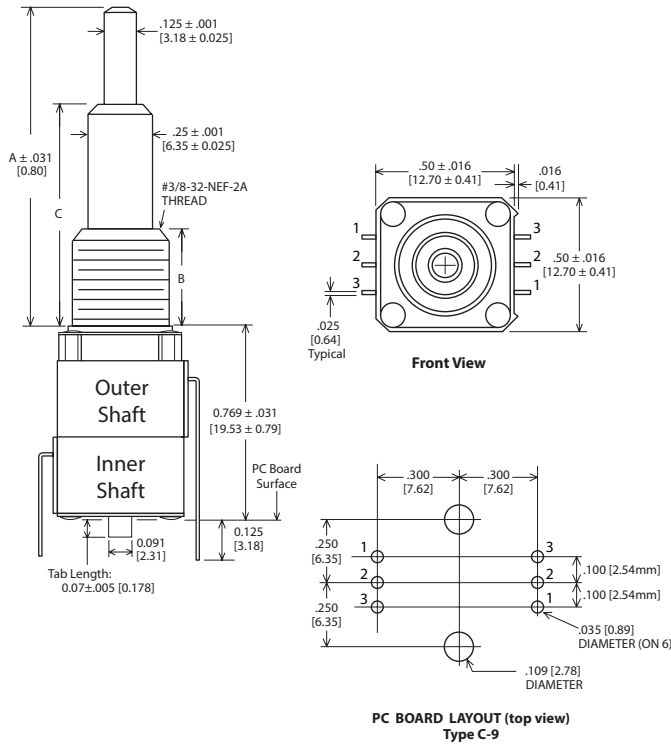
**Drawing 212-2-C11:** C-11 Single Potentiometer and PP/MP Switch, PC Pin Terminals, 1/4" Dia. Bushing



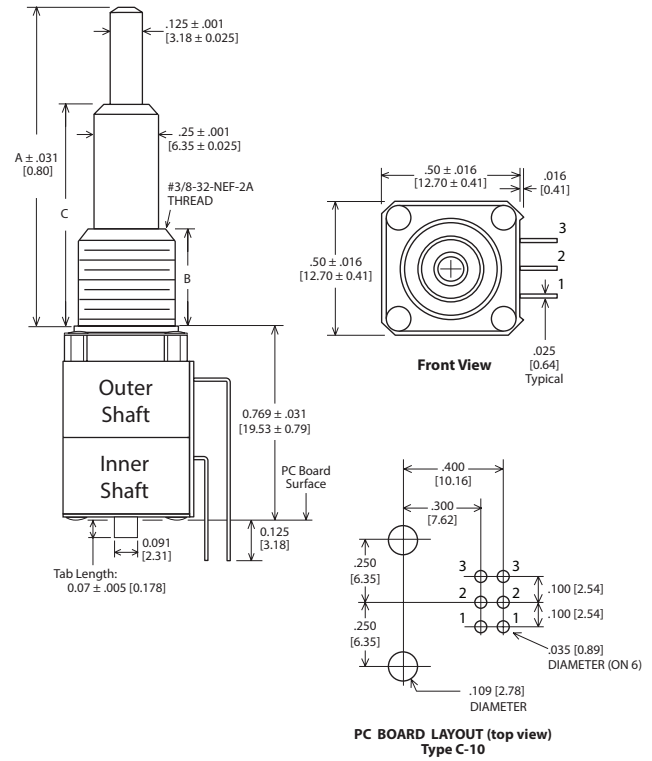
**DIMENSION NOTES**  
 A= Shaft Length (Out Position)  
 B = Bushing Length  
 .250 [6.35mm] STD  
 .375 [9.53mm]  
 .500 [12.70mm]

Series S88/S89 - Vertical Mounting Styles (continued)

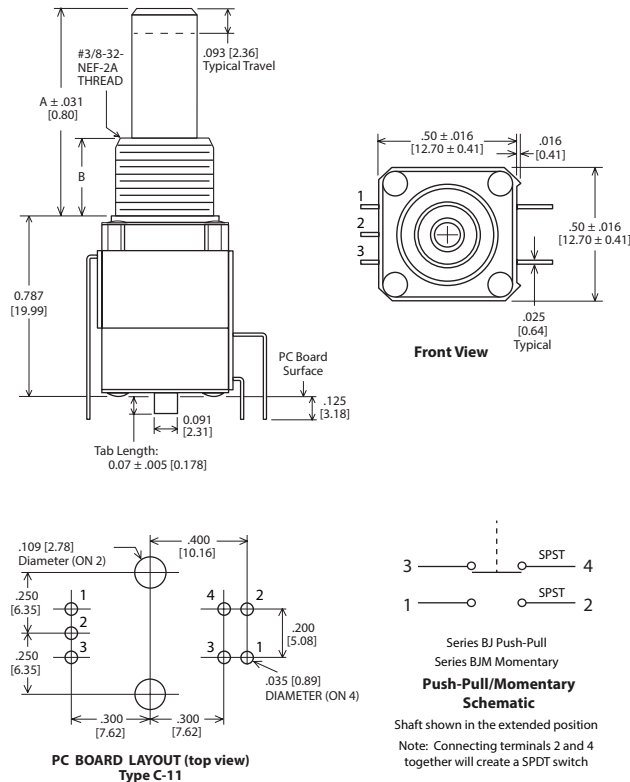
**Drawing 222-1-C9:** C-9 Dual Potentiometer, Concentric Shaft, PC Pin Terminals, 3/8" Dia. Bushing



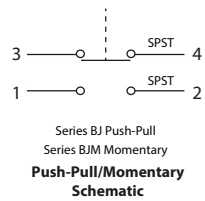
**Drawing 222-1-C10:** C-10 Dual Potentiometer, Concentric Shaft, PC Pin Terminals, 3/8" Dia. Bushing



**Drawing 222-2-C11:** C-11 Single Potentiometer and PP/MP Momentary Switch, PC Pin Terminals, 3/8" Dia. Bushing



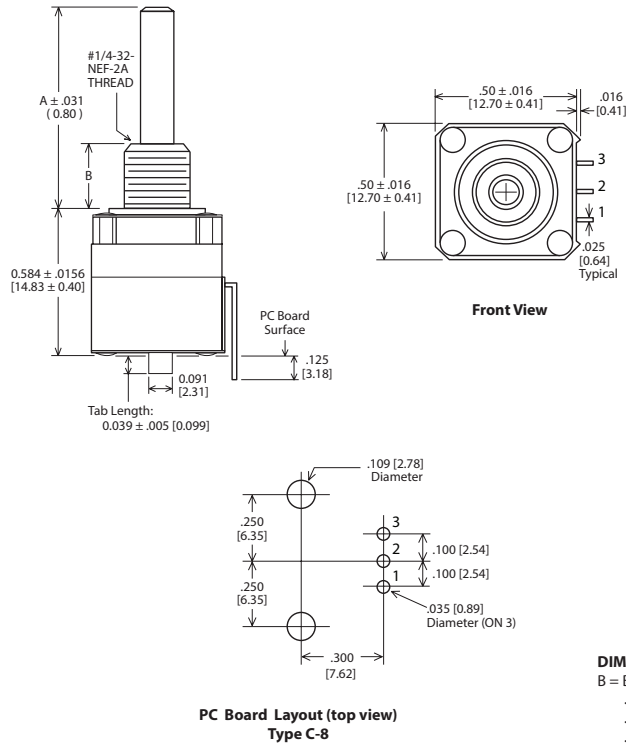
**DIMENSION NOTES**  
 A= Shaft Length (Out Position)  
 B= Bushing Length  
 .250 [6.35mm] STD  
 .375 [9.53mm]  
 .500 [12.70mm]



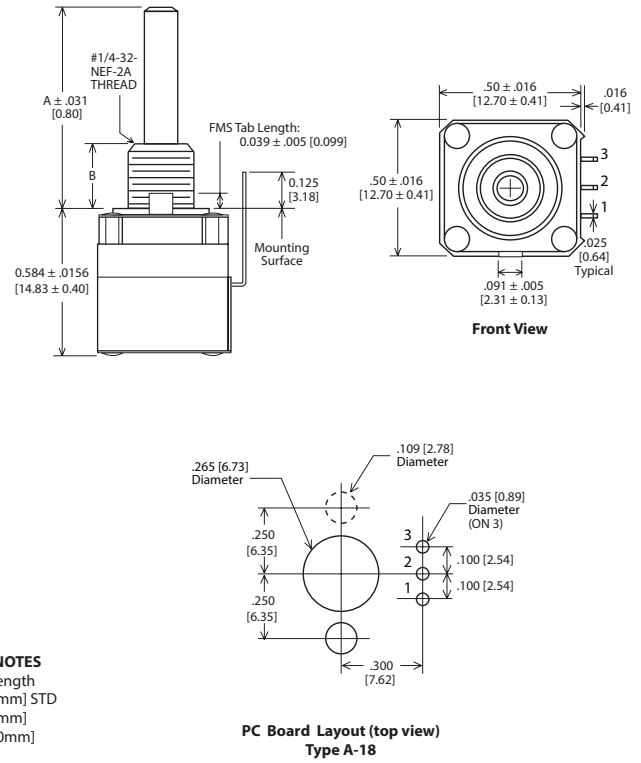
Shaft shown in the extended position  
 Note: Connecting terminals 2 and 4 together will create a SPDT switch

Series S88/S89 - Vertical Mounting Styles (continued)

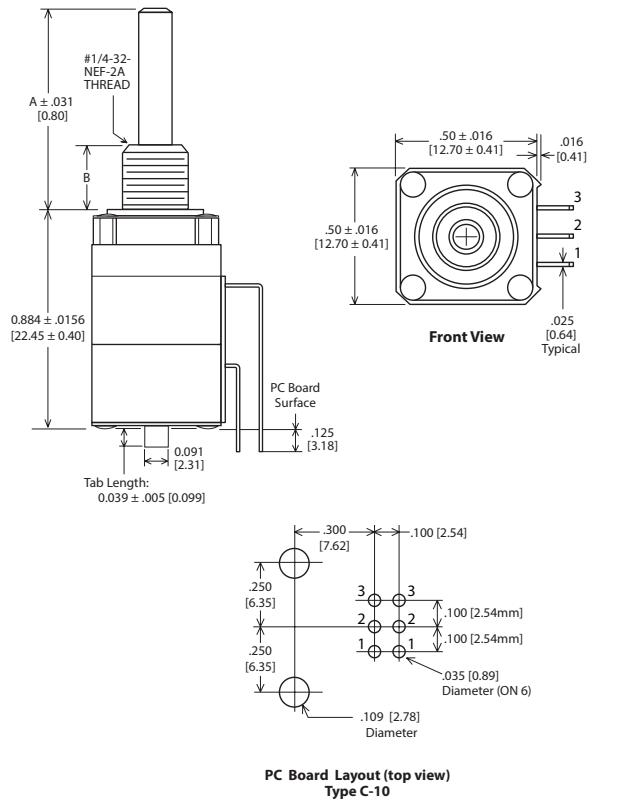
**Drawing 111-1-C8-D:** C-8 Single Potentiometer with Detent, PC Pin Terminals, 1/4" Dia. Bushing



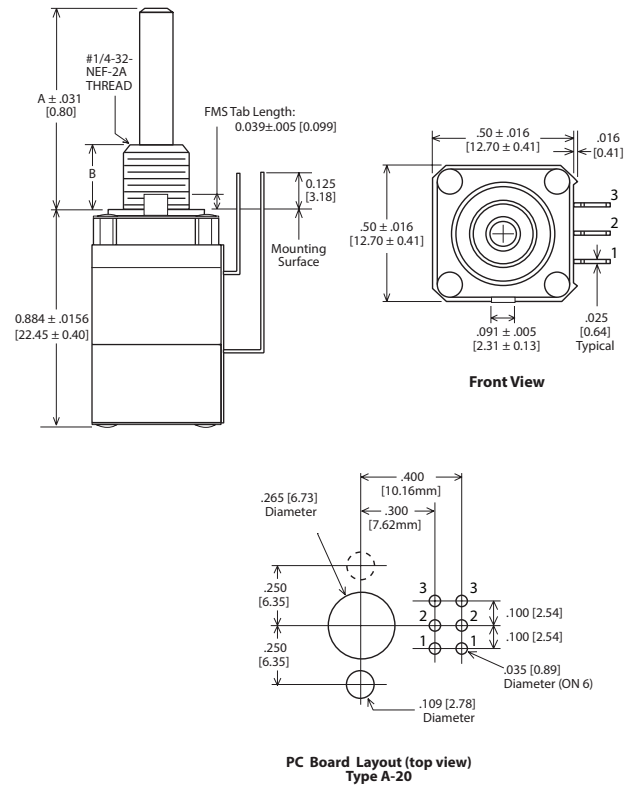
**Drawing 111-1-A18-D:** A-18 Single Potentiometer with Detent, PC Pin Terminals, 1/4" Dia. Bushing



**Drawing 211-1-C10-D:** C-10 Dual Potentiometer with Detent, PC Pin Terminals, 1/4" Dia. Bushing

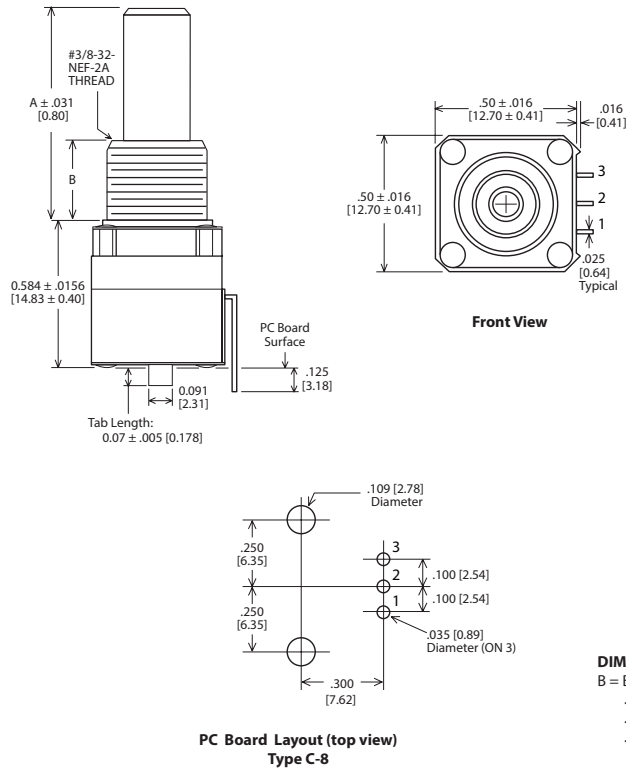


**Drawing 211-1-A20-D:** A-20 Dual Potentiometer with Detent, PC Pin Terminals, 1/4" Dia. Bushing

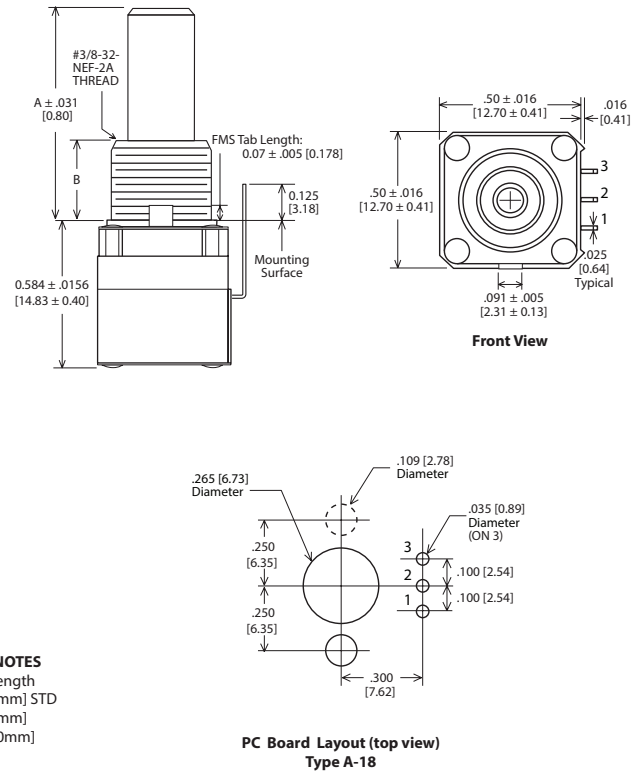


Series S88/S89 - Vertical Mounting Styles (continued)

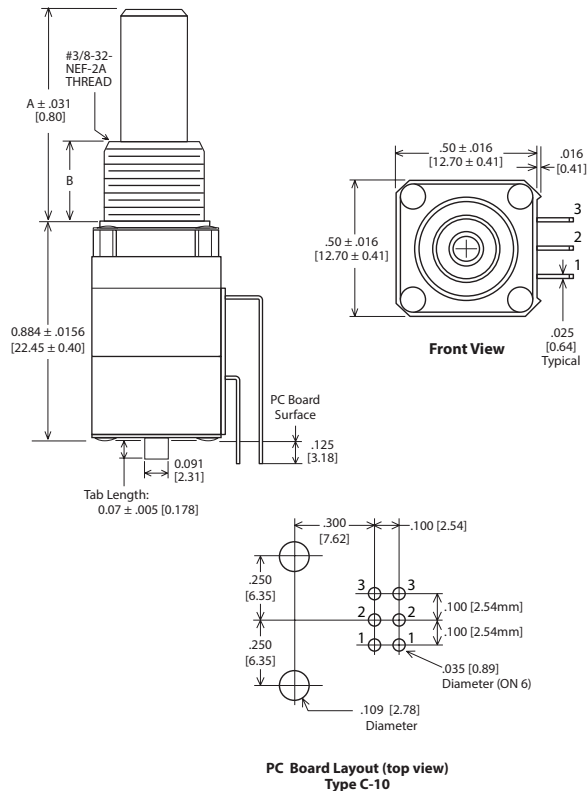
**Drawing 121-1-C8-D:** C-8 Single Potentiometer with Detent, PC Pin Terminals, 3/8" Dia. Bushing



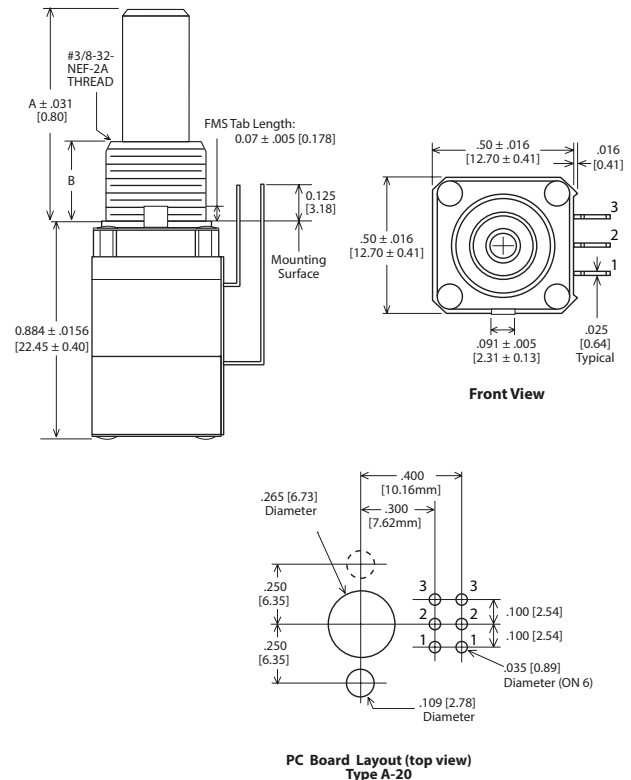
**Drawing 121-1-A18-D:** A-18 Single Potentiometer with Detent, PC Pin Terminals, 3/8" Dia. Bushing



**Drawing 221-1-C10-D:** C-10 Dual Potentiometer with Detent, PC Pin Terminals, 3/8" Dia. Bushing

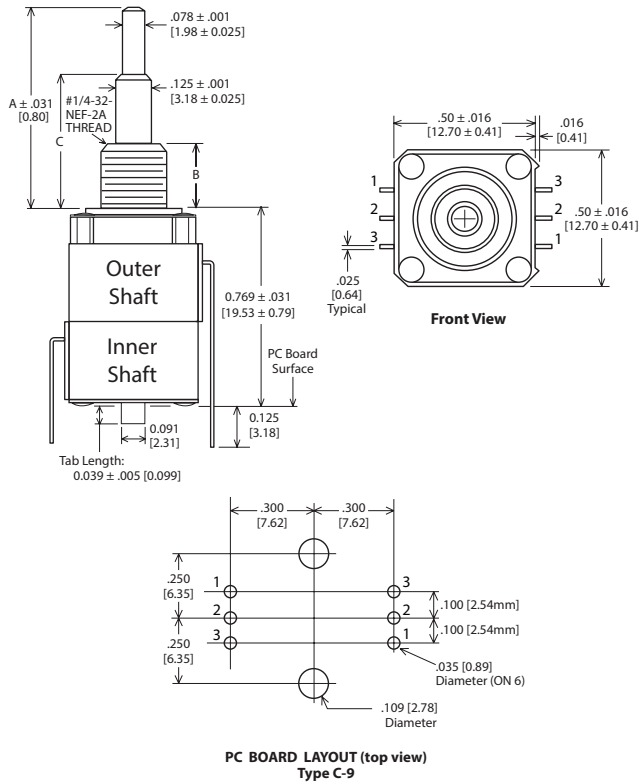


**Drawing 221-1-A20-D:** A-20 Dual Potentiometer with Detent, PC Pin Terminals, 3/8" Dia. Bushing

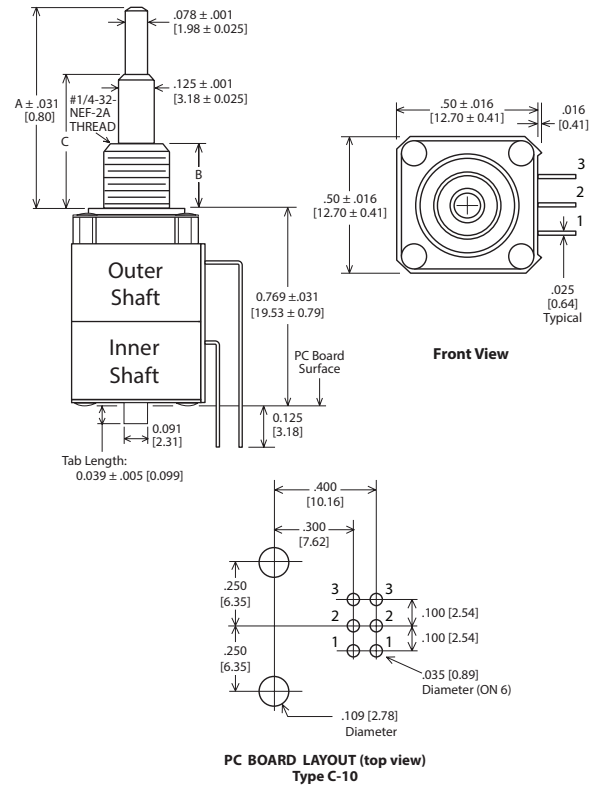


Series S88/S89 - Vertical Mounting Styles (continued)

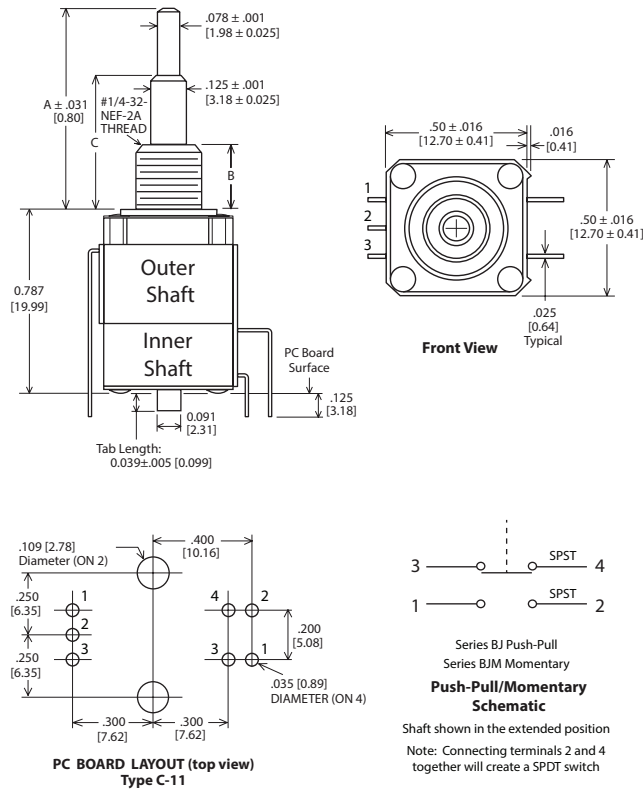
**Drawing 212-2-C9:** Concentric Shafts, C9  
1 Potentiometer + PP Switch, 1/4" Dia. Bushing



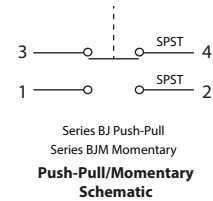
**Drawing 212-2-C10:** Concentric Shafts, C10  
1 Potentiometer + PP Switch, 1/4" Dia. Bushing



**Drawing 212-2-C11:** Concentric Shafts, C11  
1 Potentiometer + PP Switch, 1/4" Dia. Bushing



**DIMENSION NOTES**  
 A = Shaft Length (Out Position)  
 B = Bushing Length  
 .250 [6.35mm] STD  
 .375 [9.53mm]  
 .500 [12.70mm]



Shaft shown in the extended position  
 Note: Connecting terminals 2 and 4 together will create a SPDT switch



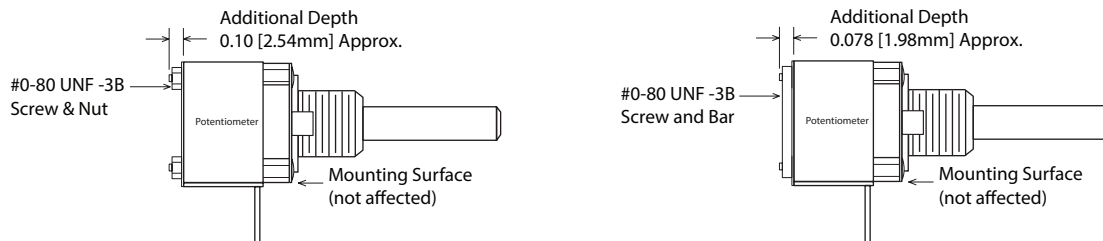
**Series S88/S89 - Designs Incorporating Screws**

Most designs utilize a riveted construction. However, certain combinations of component parts cannot use rivets and when that is the case, screws are used. There are also applications where screws are used when a customer wants to fine tune the phasing (angle) between multiple resistor sections.

Screws are inserted through the front mounting plate and do not affect the mounting surface or alter any clearances at that surface. The nuts or retaining bars used on the back plate will alter the overall length of the assembly, which is typically not an issue unless it is a vertical mount design.

Loc-Tite is used in all designs that incorporate screws. The only exception would be based on a customer's request in order to allow them to alter the phase of each section.

**Drawing 50-1: Rear Detail for Screwed-together Construction**

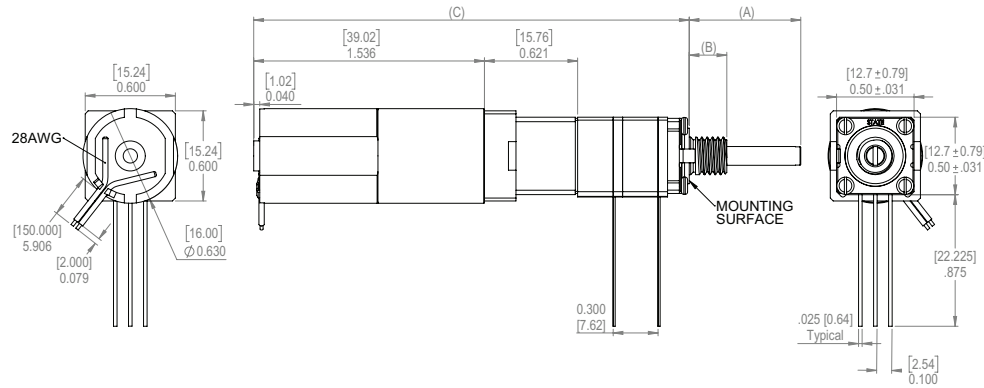


# MOTORIZED POTENTIOMETER

A motorized potentiometer provides the ability to control a potentiometer from a remote location, or a quick way to bring a potentiometer or a series of potentiometers back to a predetermined position. They are typically found in professional sound mixing equipment to return multiple faders back to a "home" position.

Any single shaft potentiometer can be motorized. The rotational speed of the motor is determined by the voltage applied and/or the gear ratio selected.

# MOTORIZED POTENTIOMETERS



The series S8XMP Motorized Potentiometer is an assembly utilizing any single shaft S8x potentiometer (as many as four ganged units) and a geared motor, coupled by a slip clutch for limited mechanical rotation and manual adjustment of the potentiometer.

## Features

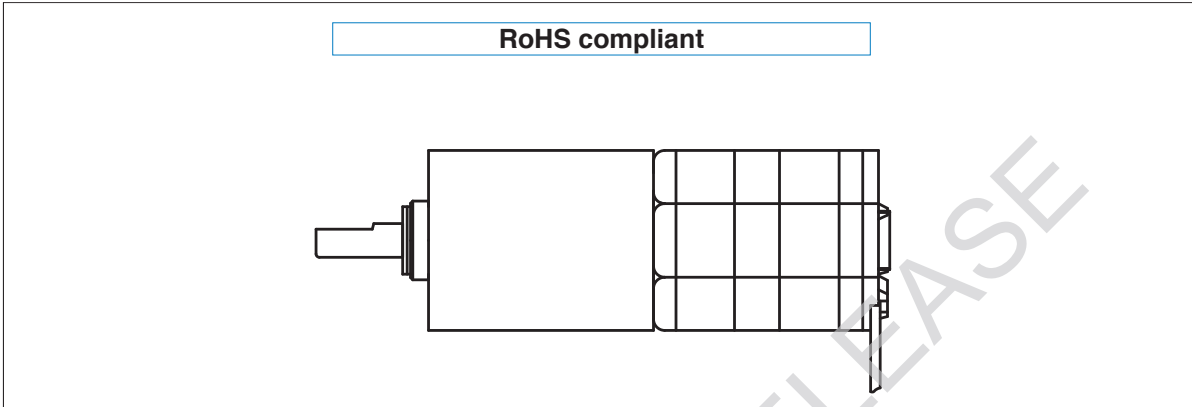
- Small size
- Remote operation
- Slip clutch for manual operation
- Memory reset applications
- 1/2" square potentiometer
- Gear Motor: 0.63" Diameter

## To Request a Quotation:

- Step 1:** Using our online Request a Quote option, create a detailed specification for the S8X potentiometer.
- Step 2:** Choose the appropriate gear ratio for the motor.
- Step 3:** Choose the operating voltage (6 or 12 VDC).



# S8X MOTORS



## ■ TYPICAL PART NUMBER DESIGNATION

Part number of S8x series potentiometer coupled to this motor

S8XM - L##### - 060 - 00

Series name

Rated voltage

6 = 6V OR 12 = 12V

Gear ratio

030= 1/30    60=1/60    120=1/120    240= 1/240=300

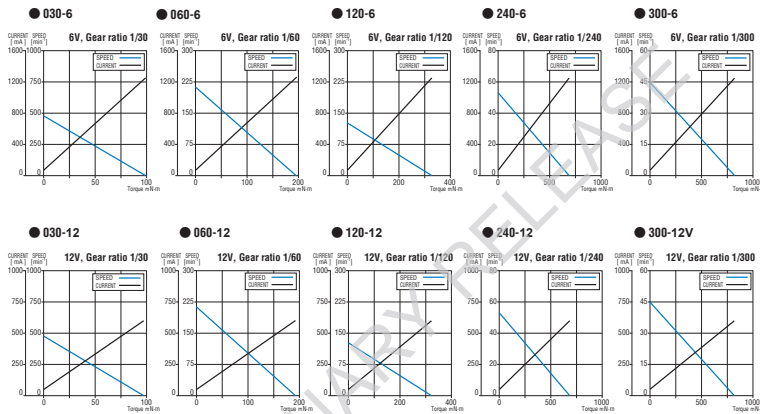
## ■ LIST OF PART NUMBER & SPECIFICATIONS

Gear Ratio	Rated Voltage	Part Number	Torque (mNm)			Speed (min <sup>-1</sup> ) (Reference) RPM		Current (mA)			Length (mm)		Weight (g) (Reference)
			Rated	Max.	Starting	No-Load	Rated	No-Load	Rated	Starting	Motor	Gear	
1/30	DC6 V	M030-6V	20	30	> 50	477	380	< 160	< 400	< 1600	35	14	25
	DC12 V	M030-12V						< 80	< 250	< 800			
1/60	DC6 V	M060-6V	40	60	> 100	213	160	< 160	< 400	< 1600	38	17	30
	DC12 V	M060-12V						< 80	< 250	< 800			
1/120	DC6 V	M120-6V	60	90	> 170	127	100	< 160	< 400	< 1600	41	20	35
	DC12 V	M120-12V						< 80	< 250	< 800			
1/240	DC6 V	M240-6V	120	180	> 350	53	40	< 160	< 400	< 1600	41	20	35
	DC12 V	M240-12V						< 80	< 250	< 800			
1/300	DC6 V	M300-5V	160	240	> 400	45	34	< 160	< 400	< 1600	41	20	35
	DC12 V	M300-12V						< 80	< 250	< 800			

# STATE ELECTRONICS S8X MOTORS

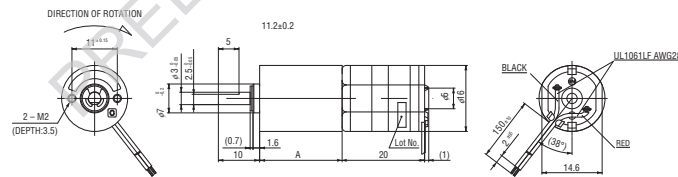
## PERFORMANCE CURVES

(Figures in the table are typical values under rated operating condition.)



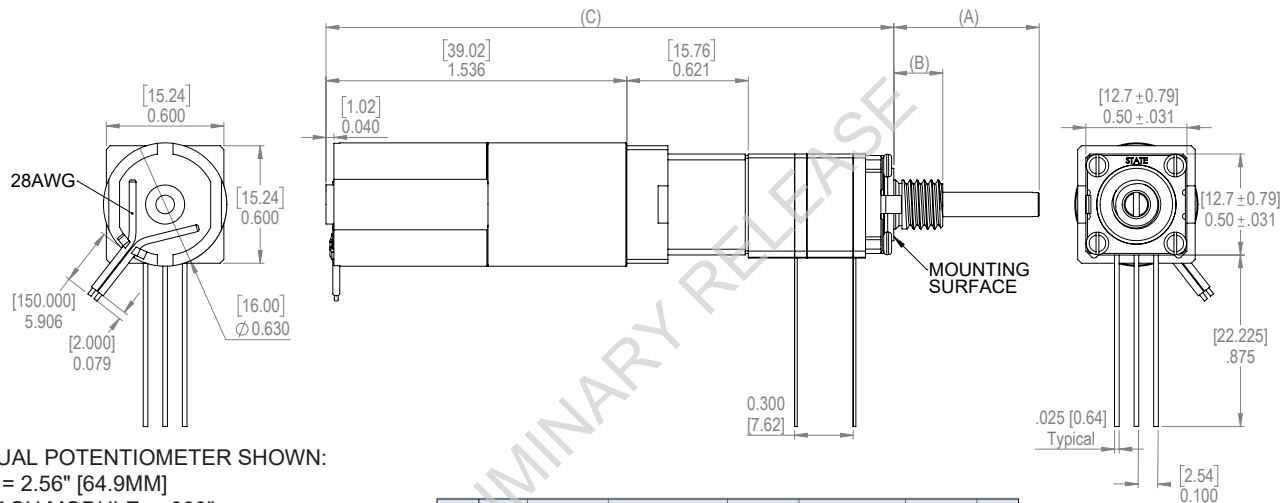
## OUTLINE DIMENSIONS

(Unit: mm)



**Mark A**

Gear ratio	1/30	1/60	1/120	1/240	1/300
A	14	17	20		



DUAL POTENTIOMETER SHOWN:  
 C = 2.56" [64.9MM]  
 EACH MODULE = .300"  
 (ADD OR SUBTRACT FROM ABOVE FOR FINAL DEPTH  
 STANDARD MOTOR = 1:120

Gear Ratio	Rated Voltage	Part Number	Torque (mNm)			Speed (in <sup>3</sup> ) (Reference)			Current (mA)			Length (mm)		Weight (g) (Reference)
			Rated	Max.	Starting	No-Load	Rated	No-Load	Rated	Starting	Motor	Gear		
1/30	DC6 V	MG168-030-AA-00	20	30	> 50	477	380	< 160	< 400	< 1600	35	14	25	
	DC12 V	MG168-030-AB-00						< 80	< 250	< 800				
1/60	DC6 V	MG168-060-AA-00	40	60	> 100	213	160	< 160	< 400	< 1600	38	17	30	
	DC12 V	MG168-060-AB-00						< 80	< 250	< 800				
1/120	DC6 V	MG168-120-AA-00	80	90	> 170	127	100	< 160	< 400	< 1600				
	DC12 V	MG168-120-AB-00						< 80	< 250	< 800				
1/240	DC6 V	MG168-240-AA-00	120	180	> 350	53	40	< 160	< 400	< 1600	41	20	35	
	DC12 V	MG168-240-AB-00						< 80	< 250	< 800				
1/300	DC6 V	MG168-300-AA-00	160	240	> 400	45	34	< 160	< 400	< 1600				
	DC12 V	MG168-300-AB-00						< 80	< 250	< 800				

**MOD-POT®**  
**Series S88/S89**  
 Request For Quotation  
 Single Page Form

**1/2" Square Modular Potentiometer**  
 Conductive Plastic - 1/2 Watt  
 Cermet - 1 Watt

**STATE ELECTRONICS**  
 36 ROUTE 10 EAST HANOVER, N.J. 07936  
 TEL. 973-887-2550 Toll Free 800-631-8083

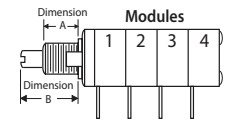
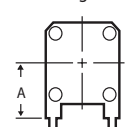
[Request Quotation Online at Potentiometers.com](http://www.potentiometers.com)

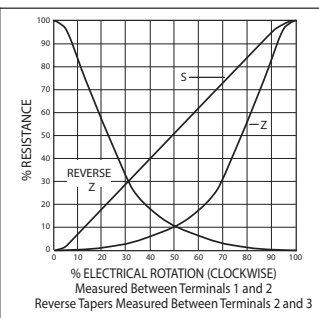
Customer Name \_\_\_\_\_ Address \_\_\_\_\_

City, State, Zip, Country \_\_\_\_\_ Customer Part Number/When Specified \_\_\_\_\_

SEE DATA SHEETS FOR ASSEMBLED DIMENSIONS & DETAILED DESCRIPTION OF THE FOLLOWING OPTIONS:

**FOLLOW STEPS TO DESCRIBE CONTROL**

<b>STEP 1</b>	<b>RESISTANCE ELEMENT</b> (Select One)	<input type="checkbox"/> Conductive Plastic Series S88	<input type="checkbox"/> Cermet Series S89	<b>LOCATING LUG OPTIONS</b> (circle one or X for none)		<b>Printed Circuit Terminal Styles (Check One)</b> <input type="checkbox"/> C8 <input type="checkbox"/> A18 <input type="checkbox"/> C10 <input type="checkbox"/> A20 <b>Optional B-24 Mounting Plate</b> <input type="checkbox"/> B-24-1 .375 <input type="checkbox"/> B-24-2 .500 <input type="checkbox"/> B-24-3 .625 <input type="checkbox"/> B-24-4 .750 <input type="checkbox"/> B-24-5 .275 		
<b>STEP 2</b>	<b>TERMINALS</b> (Select One)	B22 P.C. Pin Style Terminals (See Other Options At Right)		<input type="checkbox"/> .350" length	<input type="checkbox"/> .875" length			
<b>STEP 3</b>	<b>TAPER</b>	S = Linear, C = Log, E = Reverse Log (Insert Taper Designation Letter for Each Resistance Module)		<b>Module 1</b>	<b>Module 2</b>		<b>Module 3</b>	<b>Module 4</b>
<b>STEP 4</b>	<b>CONCENTRIC SHAFT OPTION</b>	For Concentric shafts only - Specify controlling shaft 0 = Outer - 1 = Inner						
<b>STEP 5</b>	<b>RESISTANCE VALUE</b> (Insert for Each Resistance Module)	Nominal Resistance Values in Ohms 100 1K 10K 100K 1.0 Meg 250 2.5K 25K 250K 2.5 Meg 500 5K 50K 500K 5 Meg Other Values Available on Special Order Standard Tolerance: 10%						
<b>STEP 6</b>	<b>SWITCH MODULES</b> (Insert for Each Switch Module)	AJ Rotary SPDT CW or CCW detent BJ Push-Pull SPDT (last section only) BJM Momentary SPDT (last section only) Schadow DPDT Momentary (last section only) Schadow DPDT Push-Push (last section only)						
<b>STEP 7</b>	<b>BUSHING</b> (Select Length and Diameter)	Length (Dim "A") <input type="checkbox"/> 1/4" <input type="checkbox"/> 3/8" <input type="checkbox"/> Locking 3/8"		Bushing Diameter <input type="checkbox"/> 1/4" <input type="checkbox"/> 3/8" <input type="checkbox"/> 1/2" <input type="checkbox"/> Trimmer (Flat - no threads)				
<b>STEP 8</b>	<b>SHAFT</b> (Select Diameter and Length)	Length (Dim "B" Inches): From Mounting Surface (FMS)		1/8" Diameter <input type="checkbox"/> 5/16 <input type="checkbox"/> 3/8 <input type="checkbox"/> 7/16 <input type="checkbox"/> 1/2 <input type="checkbox"/> 5/8 <input type="checkbox"/> 3/4 <input type="checkbox"/> 7/8 <input type="checkbox"/> 1" <input type="checkbox"/> 2" <input type="checkbox"/> Other _____				
		Concentric Combinations (Up to 3 modules. Panel module controlled by outer shaft.)	Shaft Diameter Combination: <input type="checkbox"/> .125" Outer / .078" Inner Dia. <input type="checkbox"/> .250" Outer / .125" Inner Dia.	Outer Shaft Length - Specify <input type="checkbox"/> 7/8" <input type="checkbox"/> 1 1/2" Other _____			Inner Shaft Length - Specify <input type="checkbox"/> 1 1/8" <input type="checkbox"/> 1 3/4" Other _____	
<b>STEP 9</b>	<b>LOCATING LUG OPTIONS</b> (Select One)	<input type="checkbox"/> 1 = tab at 9 o'clock (std) <input type="checkbox"/> 2 = tab at 3 o'clock <input type="checkbox"/> 3 = tab at 12 o'clock <input type="checkbox"/> 4 = tab at 6 o'clock <input type="checkbox"/> 5 = tabs at 3 and 9 o'clock <input type="checkbox"/> 6 = tabs at 6 and 12 o'clock <input type="checkbox"/> 7 = No Locating Lug						
<b>STEP 10</b>	<b>MOUNTING HARDWARE</b> (Select One)	<input type="checkbox"/> STANDARD Mounting Nut + Lock-Washer		<input type="checkbox"/> External Shaft Seal APM Hex Seal ©			<input type="checkbox"/> Panels Seal Stato-Seal © Parker Hannifin	
<b>STEP 11</b>	<b>MARKING</b> (Select One)	<input type="checkbox"/> STANDARD State Electronics P/N & Date and Lot #		<input type="checkbox"/> OTHER _____				
<b>STEP 12</b>	<b>QUANTITY</b>							
<b>STEP 13</b>	<b>SPECIAL FEATURES</b>							



NOTE: SELECT THE DIMENSIONS WHICH ARE REQUIRED AND FILL IN ALL APPROPRIATE BOXES

Date: \_\_\_\_\_ Requested By: \_\_\_\_\_ Title: \_\_\_\_\_ Phone: \_\_\_\_\_

**DISCLAIMER:** Due to the unlimited design combinations, certain designs may not perform in accordance with all of the published specifications. There may also be combinations available that cannot be specified using this form. Contact Sales if there are any questions.

Fax or scan and email completed form to: **STATE ELECTRONICS**, 36 Route 10, East Hanover, NJ 07936 • FAX 973-887-1940 • email: aturner@state-elec.com  
 For assistance, contact Clarosystem Product Manager **Toll-free: 800-631-8083**

**MOD-POT®**  
**Series S88/S89**  
 Request For Quotation  
 Page 1 of 3

**1/2" Square Modular Potentiometer**  
 Conductive Plastic - 1/2 Watt  
 Cermet - 1 Watt

**STATE ELECTRONICS**  
 36 ROUTE 10 EAST HANOVER, N.J. 07936  
 TEL. 973-887-2550 Toll Free 800-631-8083

[Request Quotation Online at Potentiometers.com](http://Potentiometers.com)

**Series S88/S89 Custom Ordering Information – Follow Steps to Describe Control**

**1** Resistance Element (choose one)  Series S88 Conductive Plastic  Series S89 Cermet

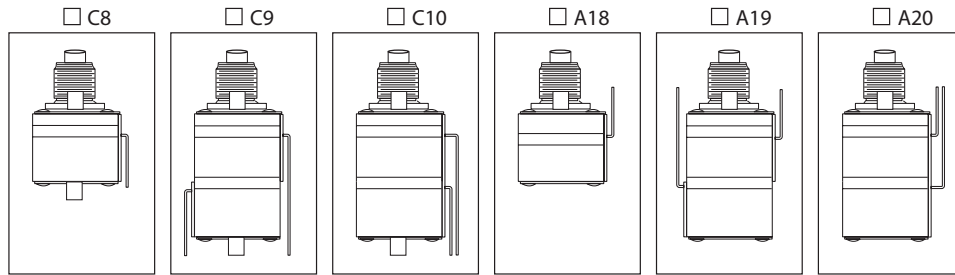
**2** Terminals OR Support Plates (choose one)

Terminals (choose style)

Solder Hook

- PC Pin Style B22 (specify length)
- .250 in. (6.35mm)
  - .350 in. (8.89mm)
  - .750 in. (19.05mm)
  - .500 in. (12.7mm)
  - .625 in. (15.875mm)
  - .875 in. (22.225mm) Standard

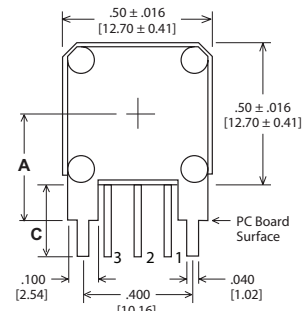
PC Pin Style special configuration (specify)



Optional Support Plates (choose one type)

Type	"A" Support Plate		"C" Terminal	
	in.	(mm)	in.	(mm)
<input type="checkbox"/> B-24-1	.375	(9.53)	.250	(6.35)
<input type="checkbox"/> B-24-2	.500	(12.53)	.375	(9.35)
<input type="checkbox"/> B-24-3	.625	(15.88)	.500	(12.70)
<input type="checkbox"/> B-24-4	.750	(19.05)	.625	(15.88)
<input type="checkbox"/> B-24-5	.275	(6.98)	.125	(3.18)
* B-24-6	.2969	(7.54)	.175	(4.45)
* B-24-7	.4375	(11.11)	.315	(8.00)
* B-24-8	.5625	(14.28)	.425	(10.8)

\* (Discontinued - For Reference Only)



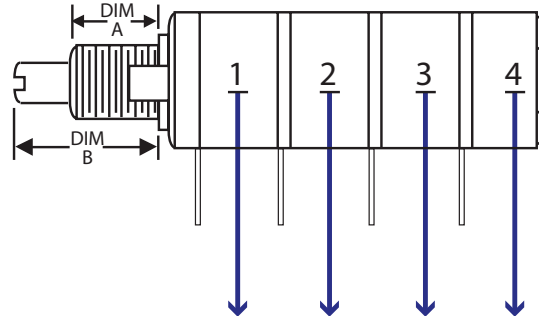
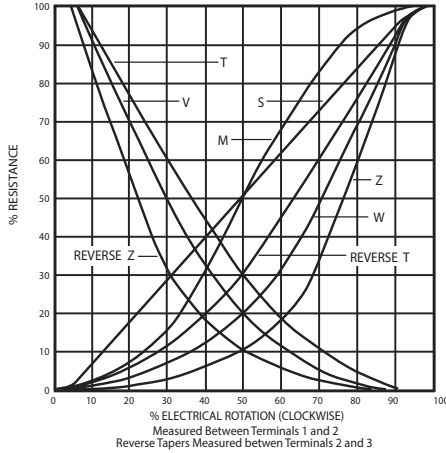
Rear View

**MOD-POT®**  
**Series S88/S89**  
 Request For Quotation  
 Page 2 of 3

**1/2" Square Modular Potentiometer**  
 Conductive Plastic - 1/2 Watt  
 Cermet - 1 Watt



36 ROUTE 10 EAST HANOVER, N.J. 07936  
 TEL. 973-887-2550 Toll Free 800-631-8083



**3** Taper (Insert taper designation letter below module or modules)

Cermet or Conductive Plastic	Taper Design
Linear	S
Clockwise Modified Log	Z
Counter Clockwise Modified Log	RZ
Modified Linear	M*
Counter Clockwise Modified Log	V*
Modified Log	W*
Counter Clockwise Modified Log	T*
Modified Log	RT* *(special order)

**4** Tolerance (Insert tolerance for each resistance module)

Cermet: 10% standard; 5% special  
 Conductive Plastic: 10% standard

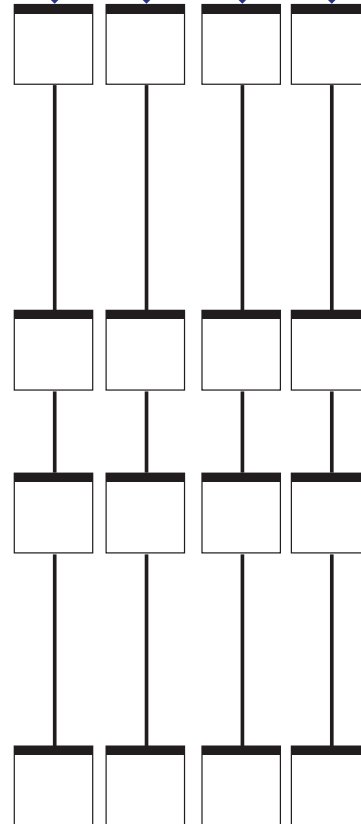
**5** Resistance Value (Insert for each resistance module)

Nominal Resistance Values in Ohms				
100	1K	10K	100K	1.0 Meg
250	2.5K	25K	250K	2.5 Meg
500	5K	50K	500K	5.0 Meg

Other Values Available  
 on Special Order

**6** Switch Modules (Insert designation in proper module box)

- RS-CCW SPDT Rotary – CCW detent (Standard)
- RS-CW SPDT Rotary – CW detent
- PP SPDT Push-Pull (last section only)
- PPM SPDT Push Momentary (last section only)
- Schadow DPDT Push-Push (single shaft, last section only)
- Schadow DPDT Momentary (single shaft, last section only)





**MOD-POT®**  
**Series S88/S89**  
 Request For Quotation  
 Page 3 of 3

**1/2" Square Modular Potentiometer**  
 Conductive Plastic - 1/2 Watt  
 Cermet - 1 Watt

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 36 ROUTE 10 EAST HANOVER, N.J. 07936  
 TEL. 973-887-2550 Toll Free 800-631-8083

**7** Special Options (Specify if required)

8 lb. Stop Torque (If an internal shaft seal is selected, reduce to 5 lb. Stop Torque)

**8** Bushing (Choose length and diameter)

Length (Dim "B")  Plain .250 in. (6.35mm)  Plain .375 in. (9.53mm)  
 Plain .500 in (12.70mm)  
 Locking .375 in (9.53mm)  
 Locking .500 in (9.53mm)

Diameter  Plain .250 in. (6.35mm)  
 Plain .375 in. (9.53mm)

**9** Single Shafts

Diameter (Choose one)  .125 in. (3.18mm) (with .250 in. (6.35mm) Dia. bushing)  
 .250 in. (6.35mm) (with .375 in. (9.53mm) Dia. bushing)

Length (Dim "A") from mounting surface (FMS) (specify) \_\_\_\_\_

**Concentric Shafts** (available for Up to 4 modules. Module closest to Panel is controlled by outer shaft.)

.125 in. (3.18mm) Outer Diameter; .078 in. (1.98mm) Inner Diameter  
 .250 in. (6.35mm) Outer Diameter; .125 in. (3.18mm) Inner Diameter

Length FMS (specify) Outer \_\_\_\_\_ Inner \_\_\_\_\_

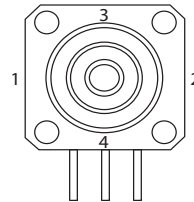
Circle as required Controls Module(s) 1 2 3 Controls Module(s) 2 3 4

**10** Shaft Ending (Select one)

Plain  Flatted (specify length & thickness) \_\_\_\_\_  
 Slotted  Special (specify) \_\_\_\_\_

**11** Locating Lug Options (Select one)

- 1 = one tab - at 9 o'clock (standard)
- 2 = one tab - at 3 o'clock
- 3 = one tab - at 12 o'clock
- 4 = one tab - at 6 o'clock
- 5 = two tabs - at 3 and 9 o'clock
- 6 = two tabs - at 6 and 12 o'clock
- 7 = No Locating Lug



**12** Mounting Hardware (Specify)

Standard  IP66 Hardware  None

**13** Marking (Specify)

Standard  Other \_\_\_\_\_

**DISCLAIMER:** Due to the unlimited design combinations, certain designs may not perform in accordance with all of the specifications

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
Max Wattage Rating	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 125°
Temperature Coefficient (TC)	+/-5% (Typical)	150 PPM °C	+/-10%	150 PPM °C	+/-5% (Typical)
Rotational Life	100,000	300°	100,000	300°	1,000,000
Mechanical Rotation	300°	300°	300°	300°	295°
Effective Electrical Rotation (ERA)	260° Linear Tapers	260° Linear Tapers	265° Linear Taper	265° Linear Taper	265°
PC Board Support Feet	260° Non-Linear Tapers	260° Non-Linear Tapers	225° Non-Linear Taper	265° Non-Linear Taper	265° Non-Linear Taper
Vehicle Mount	No	No	No	No	Yes
Sections	No	No	No	No	Yes
	6	4	8	8	4
Detents	Not Available	Not Available	Center, CW+CCW, '11 Other - Special Order	Center & '11	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	250 MA @ 30 VDC SPST N.O. + SPST N.C. or SPDT with Wire Jumper	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	Optional 500 MA @ 30VDC DPDT		Not Available
Push-Momentary	Not Available	Not Available			
Push-On / Push-Off	Not Available	Not Available			
Max Shaft Single Length	3"	3"	3"	3"	2"
Concentric Shafts .078 / .125	6-Sections	6-Sections	6-Sections	6-Sections	Not Available
Concentric Shafts .125 / .250	6-Sections	6-Sections	6-Sections	6-Sections	Not Available
Vernier Drive	Optional	10-Turn Option	No	No	No
Internal Shaft Seal	Optional	Optional	Optional	Optional	Standard
IP Rated	No	IP40	No	No	IP67
Motorized Option	No	No	Yes	Yes	No
Stop Torque	4 lb.-in.	4 lb.-in.	3 lb.-in.	3 lb.-in.	2.5 lb.-in.
High Stop Torque	Not Available	Not Available	5 in / pd for 1/8" Dia with o-ring	8 in / pd	Not Available
Rotational Torque Standard (Min / Max)	0.3 / 3.0 oz.-in.	0.2 to 1.5 oz.-in.	0.2 / 3.0 oz.-in.	0.2 / 3.0 oz.-in.	1.5 Max oz.-in.
Single section	Available - Varies with each configuration	Available	Available	1 - 6 oz.-in.	Not Available
Rotational Torque, Medium Torque Option (Min / Max)	20 oz.-in.	2 to 7 oz.-in.	3.3 - 10.5 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.

# LEGACY DRAWING CROSS REFERENCE

## Current Drawing References to Legacy Drawing References (Prior to 2023)

Before 2023	Current
11-1	111-1-B22
11-2	311-1-B22
11-3	411-1-B22
11-4	211-1-B22
12-1	111-1-B24
12-2	211-1-B24
12-3	311-1-B24
12-4	411-1-B24
11-1B	121-1-B22
11-2B	221-1-B22
11-3B	321-1-B22
11-4B	421-1-B22
13-1	111-1-SHA
13-1B	121-1-SHA
13-2B	221-1-SHA
13-3	311-1-SHA
13-3	211-1-SHA
13-3B	321-1-SHA
13-4	411-1-SHA
13-4B	421-1-SHA
14-1	111-1-B24-D
14-2	211-1-B24-D
14-3	111-1-B22-D
14-3A	121-1-B22-D
14-4	211-1-B22-D
14-4A	221-1-B22-D
14-5	111-1-SHA-D
14-6	211-1-SHA-D
15-1	211-2-B22
15-1A	221-2-B22
15-2	211-2-B24

Before 2023	Current
15-3	211-2-SHA
15-3	411-2-B22
15-3A	221-2-B24
15-3A	221-2-SHA
15-3B	411-2-B24
15-3D	421-2-B24
15-4	311-2-B22
15-5	311-2-B24
15-6	311-2-SHA
15-7	321-2-B22
15-8	321-2-B24
15-9	321-2-SHA
16-1A	212-1-B22
16-2A	312-1-B22
16-3A	212-1-B24
16-3A	121-1-SHA-D
16-3B	222-1-B24
16-4	411-2-SHA
16-4A	312-1-B24
16-4A	221-1-SHA-D
16-4B	322-1-B24
16-4C	421-2-SHA
16C-1A	222-1-B22
16C-2A	322-1-B22
17-1	121-1-B24-D
17-1A	212-1-SHA
17-1A	312-1-SHA
17-1B	222-1-SHA
17-2	221-1-B24-D
17-2C	322-1-SHA
18-1	211-3-B22

Before 2023	Current
18-2	311-3-B22
19-1	111-1-C8
19-1A	121-1-C8-D
19-2	121-1-A18
20-1	111-2-C15
20-1A	121-2-C15
20-2	211-1-A19
20-2A	221-1-A19
20-3	211-1-A20
20-3A	221-1-A20
21-3	211-1-C9
21-3A	221-1-C9
21-4	211-1-C10
21-4	212-1-C10
21-4A	221-1-C10
22-1	212-2-C9
22-1A	222-1-C9
22-2	212-2-C10
22-2A	222-1-C10
22-3	212-2-C11
22-3A	222-2-C11
23-1	111-1-C8-D
23-1A	121-1-C8
23-2	111-1-A18-D
23-2A	121-1-A18-D
23-3	211-1-C10-D
23-3A	221-1-C10-D
23-4	211-1-A20-D
23-4A	221-1-A20-D

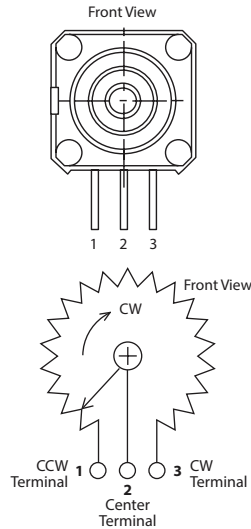
# GLOSSARY OF TERMS

## 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 Ratio 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:

$$T.C. = \frac{R_2 - R_1}{R_1(T_2 - T_1)} \times 10^6$$

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.

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

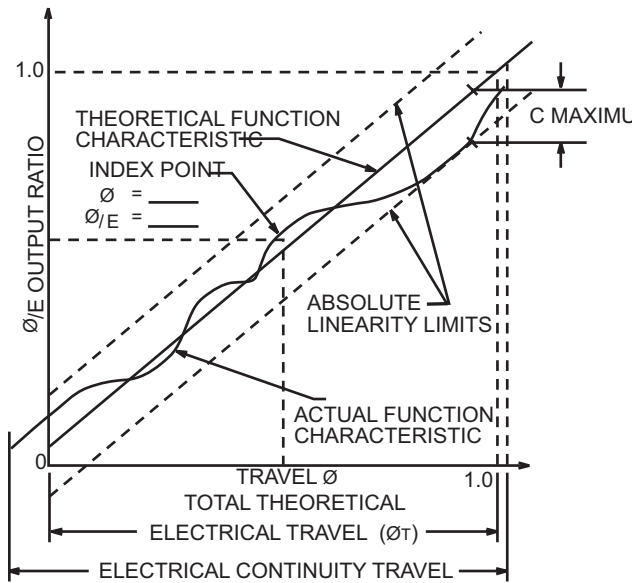
Mathematically:

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

Where:

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

Figure 2



**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.

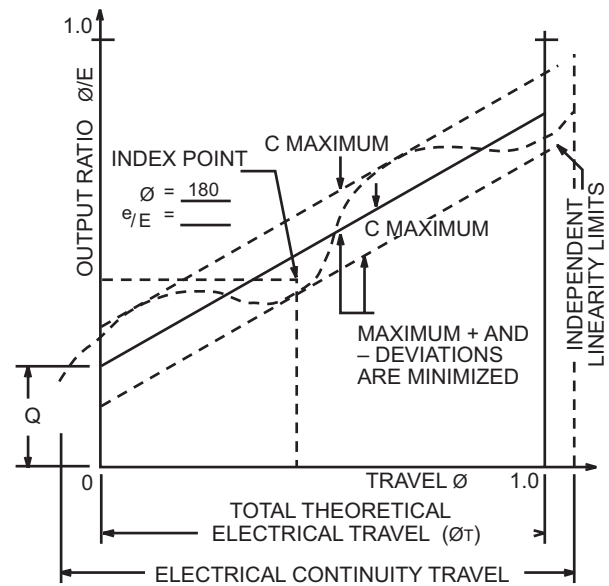
Mathematically:

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

Where:

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**



---

## 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 micron-nonlinearities 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 (single shaft potentiometer)

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.

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## Stop Strength

### 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.

## General Terms and Conditions of Sale

### Orders

All orders are suPPect to acceptance by State Electronics, E. Hanover, NJ. No order or contract shall be deemed accepted unless and until such acceptance is made in writing by State Electronics.

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

### Prices and Specifications

Prices, quotations, specifications and other terms and all statements appearing in the Company's catalogs and advertisements, and otherwise made by the Company, are suPPect to change without notice. State Electronics reserves the right to make changes in design at any time without incurring any obligation to provide same units previously purchased or to continue to supply discontinued items. The specifications shown in the sales literature are not always the latest version. Certified current specification prints are available upon request.

Unless specifically provided in writing, prices quoted are based upon manufacture of quantities and types originally specified and are suPPect to revision when interpretation or engineering changes are initiated by the customer. Quoted prices are based upon present cost of materials and labor and are suPPect to change without notice.

We are not responsible for typographical errors made in any of our publications or for stenographic or clerical errors made in preparations of quotations, all such errors are suPPect to correction.

### Delivery

Delivery promise is based on our best estimate of the date material will be shipped from our factory and we assume no responsibility for losses, damage or consequential damages due to delays.

### Authorization

State Electronics does not have any authorized distributors, independent representatives or agents.

State Electronics is an Authorized Distributor for the Sensing and Control Division of Honeywell International.

### Terms of Payment

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 cash with order or C.O.D. at the option of the Company. Each shipment will be considered a separate and independent transaction and payment should be made accordingly.

### Shipments

All shipments are made F.O.B. shipping point (unless otherwise specified) and packaging for domestic shipment is included in the quoted price. When special domestic or export packaging is specified involving greater expense than is customary, a charge will be made to cover such extra expense. Unless otherwise specified, we will normally use the best, least expensive surface transportation. Reasonable care is exercised in packaging our products for shipment and no responsibility is assumed by the Company for delay, breakage or damage after having made delivery in good order to the carrier. All claims for breakage or damage should be made to the carrier, but will be glad to render all possible assistance in securing satisfactory adjustment of such claims.

### 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 388 / 389, S88 / S89, 70 and S159 series Mod-Pot products are assembled in the United States at our facility located in East Hanover, New Jersey, USA.

### Export Information

HARMONIZED TARIFF SCHEDULE (HTS #) - 8533.31.0000

EXPORT CONTROL CLASSIFICATION # (ECCN #) - EAR99



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ISO 9001:2015 and AS9100  
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 Updated Mar. 15, 2024

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