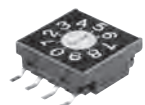


FRO1 SeriesG4

10mm Ultra-Thin DIP; 100mA @ 5V DC; 100mA @ 50V DC
Straight PC & Right Angle PC
Through-hole Mount
Decimal & Hexadecimal



FRO2 SeriesG12

10mm Ultra-Thin DIP; 100mA @ 5V DC; 100mA @ 50V DC
Gull Wing Terminals
Upright Mount
Decimal & Hexadecimal



MR SeriesG16

0.4VA & 250mA Logic Level
Process Sealed
Straight PC
PC & Bushing Mount



MR SeriesG22

Power Rated 2A, 3A, 5A & 10A @ 125V AC
PC Turret, Turret & Solder Lug
Bushing Mount



MRB SeriesG28

0.4VA Logic Level
Process Sealed
Straight & Right Angle Bracketed PC



ND SeriesG34

8mm Process Sealed DIP; 100mA @ 5V DC
Straight & Right Angle PC
Decimal & Hexadecimal



ND3 SeriesG38

8mm Process Sealed DIP; 100mA @ 5V DC
Gull Wing Terminals
Upright & Right Angle Mount
Decimal & Hexadecimal



HS13 & HS16 Series..... G46

6A & 12A @ 125V AC

HS13: 2-4 Positions; Nonshorting

HS16: 1-6 Poles; 2-11 Positions; Nonshorting or Shorting

Solder Lug

Bushing Mount



TS Series G46

6A @ 125V AC

1-5 Poles

2-11 Positions

Nonshorting

Screw Lug

Bushing Mount



PS Series G46

30A @ 125V AC

1-5 Poles

2-11 Positions

Nonshorting

Screw Lug

Bushing Mount

Toggles

Rockers

Pushbuttons

Illuminated PB

Programmable

Keylocks

G Rotaries

Slides

Tactiles

Tilt

Touch

Indicators

Accessories

Supplement

General Specifications

Electrical Capacity (Resistive Load)

Switching Rating: 100mA @ 5V DC
Nonswitching Rating: 100mA @ 50V DC

Other Ratings

Contact Resistance: 100 milliohms maximum; 30 milliohms maximum for contact point
Insulation Resistance: 1,000 megohms minimum @ 250V DC
Dielectric Strength: 250V AC minimum for 1 minute minimum
Mechanical Life: 10,000 detent operations minimum
Electrical Life: 10,000 detent operations minimum

Notes: A detent operation is one actuator position operation or stepping.

A cycle is one 360° rotation. 10,000 detent operations equal 625

cycles for hexadecimal devices or 1,000 cycles for decimal devices.

Nominal Operating Torque: Metal Shaft: 0.009Nm for decimal devices; 0.011Nm for hexadecimal devices
 All other Actuator types: 0.008Nm for decimal devices; 0.01Nm for hexadecimal devices
Contact Timing: Nonshorting

Materials & Finishes

Actuators: Screwdriver and Plastic Shaft - Glass fiber reinforced polyamide (UL94V-0);
 Dial - Polyoxymethylene; Metal Shaft - Brass with nickel plating
Bushing : Brass with nickel plating (for Metal Shaft model)
Outer Case: Glass fiber reinforced PBT (for Metal Shaft model)
Housing & Base: Glass fiber reinforced polyamide (UL94V-0)
Movable Contacts: Copper alloy with gold plating
Stationary Contacts: Phosphor bronze with gold plating
Terminals: Phosphor bronze with gold plating
Terminal Cover: Polyamide (Right angle model only)
Bracket: Phosphor bronze with tin plating (for Metal Shaft model)

Environmental Data

Operating Temperature Range: -25°C through +85°C (-13°F through +185°F)
Humidity: 90 ~ 95% humidity for 240 hours @ 40°C (104°F)
Vibration: 10 ~ 55Hz with peak-to-peak amplitude of 1.5mm traversing the frequency range & returning in 5 minutes; 3 right angled directions for 2 hours
Shock: 50G (490m/s²) acceleration (tested in 6 right angled directions, with 5 shocks in each direction)

Processing

Soldering: Wave Soldering Recommended. See Profile A in Supplement section.
 Manual Soldering: See Profile A in Supplement section.
 Note: During soldering process, set the switch to the following position:
 FR01FR10P, FR01FR16P, FR01KR10P, FR01KR16P, FR01SR10P, FR01SR16P,
 FR01AR10PB, FR01AR16PB, FR01AR10HB, FR01AR16HB: 0 position;
 FR01FC10P, FR01KC10P, FR01FC10H, FR01KC10H,
 FR01SC10P, FR01AC10PB, FR01AC10HB: 7 position;
 FR01FC16P, FR01KC16P, FR01FC16H, FR01KC16H,
 FR01SC16P, FR01AC16PB, FR01AC16HB: F position
Cleaning: These devices are not process sealed. Hand clean locally using alcohol based solution.
 Custom process sealed version available; contact factory.

Standards & Certifications

Flammability Standards: UL94V-0 rated actuator, housing and base
 The FR01 Series rotaries have not been tested for UL recognition or CSA certification.
 These switches are designed for use in a low-voltage, low-current circuit.
 When used as intended, the results do not produce hazardous energy.

Distinctive Characteristics

Compact dimensions and low profile allow high density mounting and close stacking of PC boards.

Highly visible legends and choice of screwdriver, shaft or dial actuators with arrow position indication provide trouble-free code setting. Knob actuator also available.

Real or complement code setting identified by color-keyed actuator.

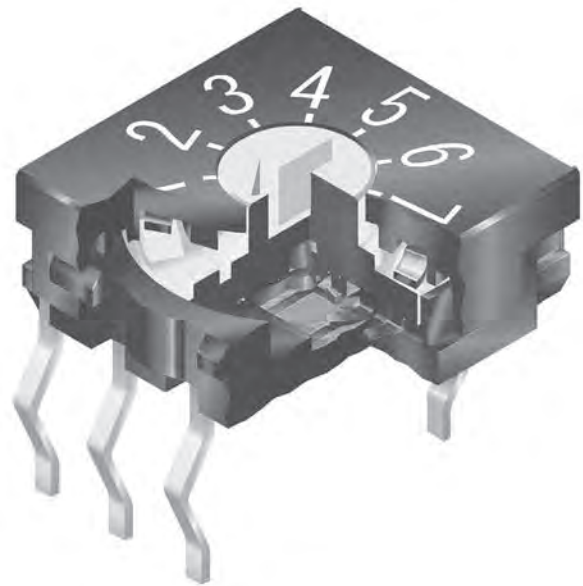
Detent mechanism gives crisp, positive action for accurate switch setting.

Crimped terminals ensure secure PC mounting and prevent dislodging during soldering.

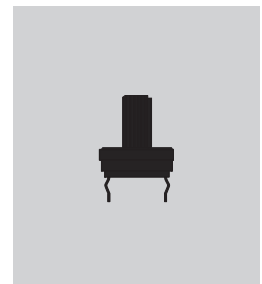
Cam activated movable contact and gold contacts assure contact reliability and continuity.

Surface mount model with screwdriver actuation available and shown in the surface mount section.

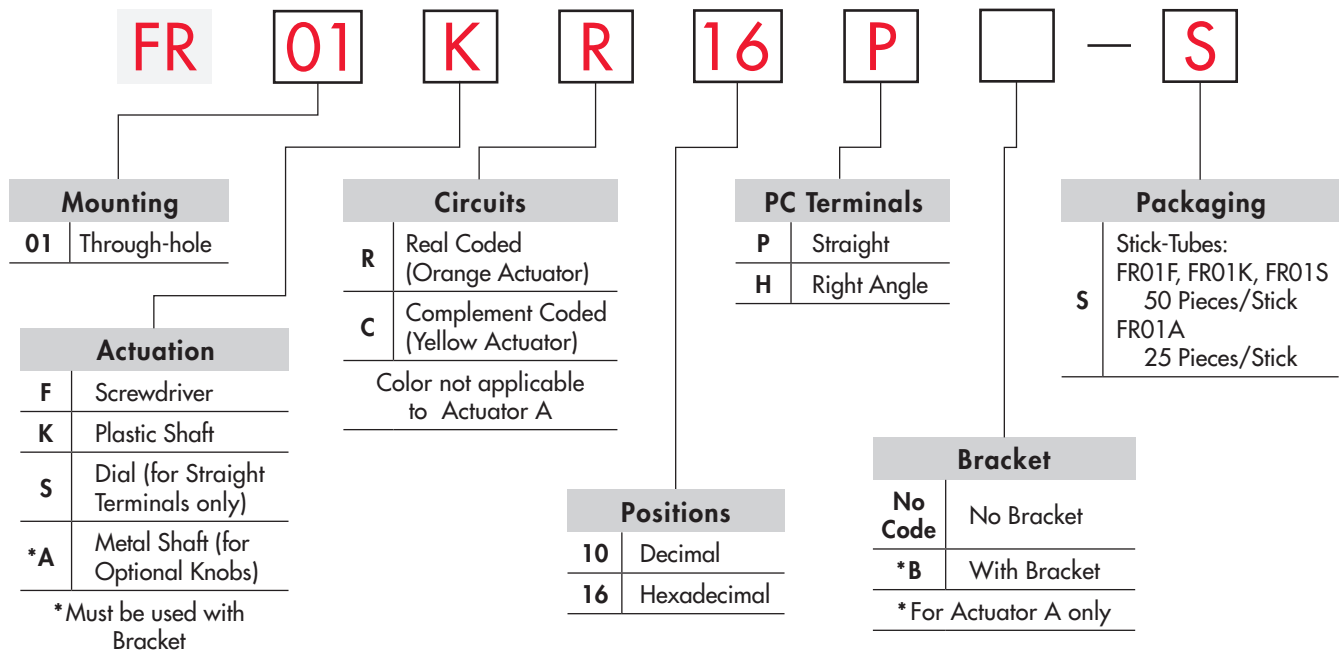
Contact factory for custom models with .200" (5.08mm) terminal spacing.



Actual Size

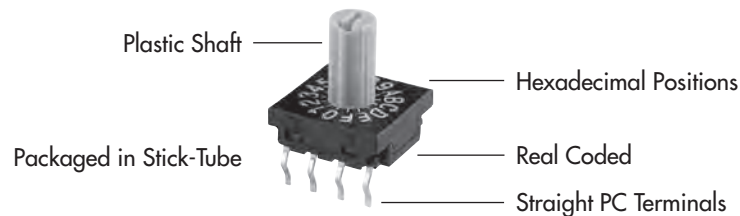


TYPICAL SWITCH ORDERING EXAMPLE



DESCRIPTION FOR TYPICAL ORDERING EXAMPLE

FR01KR16P-S



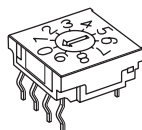
MOUNTING

01 Through-hole

ACTUATION

F Screwdriver

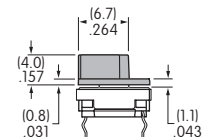
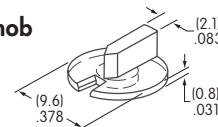
Adjusted with a flat tipped screwdriver



Actuators are fully rotational either clockwise or counterclockwise.
Actuator Colors: Orange for real coded devices; Yellow for complement coded devices.

AT4180
Optional Snap-on Knob

Polyamide
Black knob with transparent flange

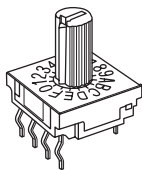


Install knob before mounting on PCB for right angle type; it should not be removed once mounted. When mounting, align slit in knob with arrowhead on actuator.

ACTUATION

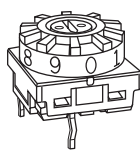
K Plastic Shaft

Adjusted by hand
or with flat tipped
screwdriver



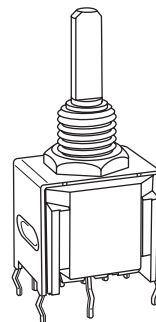
S Dial

Adjusted by hand
or with flat tipped
screwdriver



A Metal Shaft

Knob options
illustrated below
with color choices



Actuators are fully rotational and operate either clockwise or counterclockwise.
Colors for Actuators K and S: Orange for real coded devices; Yellow for complement coded devices

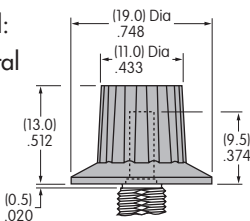
Mounting hardware is available if needed for models with Actuator A:
Hexagon Nut AT513M, Locking Ring AT515M, and Lockwasher AT509; all are shown in the Accessories and Hardware section.

OPTIONAL KNOBS FOR METAL SHAFT

AT433
Plain Black

Material:
Polyacetal

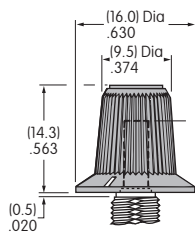
Color:
Black



AT4103 Small
Color Tipped

Polyester Base:
Black

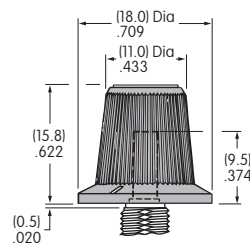
Polyamide Tip
Colors:
A, B, C, E, F, G, H



AT4104 Large
Color Tipped

Polyester Base:
Black

Polyamide Tip
Colors:
A, B, C, E, F, G, H



Knob Orientation: When installed with shaft flat rotated 180° from bushing flat as shown in "Typical Switch Dimensions," white line on cap points to Actuator Position 0 noted in truth tables below.

Color Codes: **A** Black **B** White **C** Red **E** Yellow **F** Green **G** Blue **H** Gray

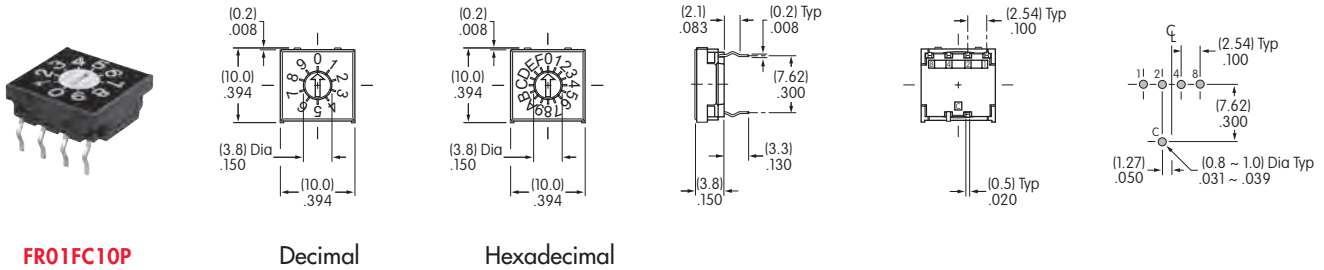
TRUTH TABLES (CIRCUITS & POSITIONS)

Actuator Position ● = ON		<div>10</div> Decimal										<div>16</div> Hexadecimal																	
		0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F		
Terminal No. (Output)																													
<div>R</div> Real Coded Model Numbers: FR01FR, FR01KR, FR01SR, FR01AR	1		●		●		●		●		●		●		●		●		●		●		●		●		●		
	2			●	●			●	●					●	●			●	●				●	●			●	●	
	4					●	●	●	●							●	●	●	●					●	●	●	●		
	8									●	●									●	●	●	●	●	●	●	●	●	
<div>C</div> Complement Coded Model Numbers: FR01FC, FR01KC FR01SC, FR01AC	1	●		●		●		●		●		●		●		●		●		●		●		●		●			
	2	●	●			●	●		●	●	●	●			●	●			●	●			●	●					
	4	●	●	●	●					●	●	●	●	●						●	●	●	●						
	8	●	●	●	●	●	●	●	●			●	●	●	●	●	●	●	●										

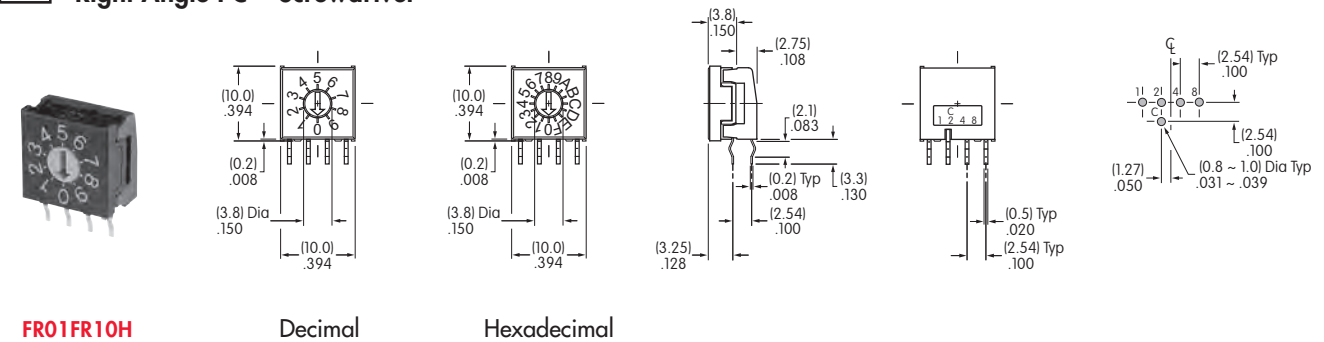
Terminal numbers are actually on the switch.
Above sequence shown for clockwise rotation.

TYPICAL SWITCH DIMENSIONS

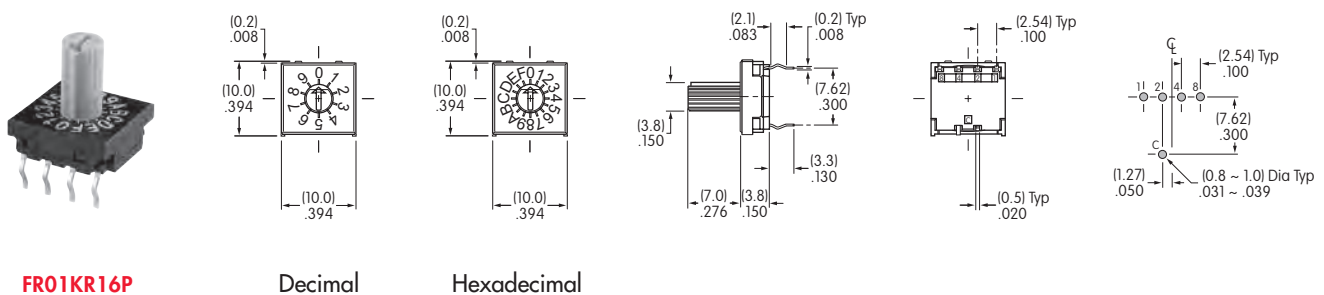
P Straight PC • Screwdriver



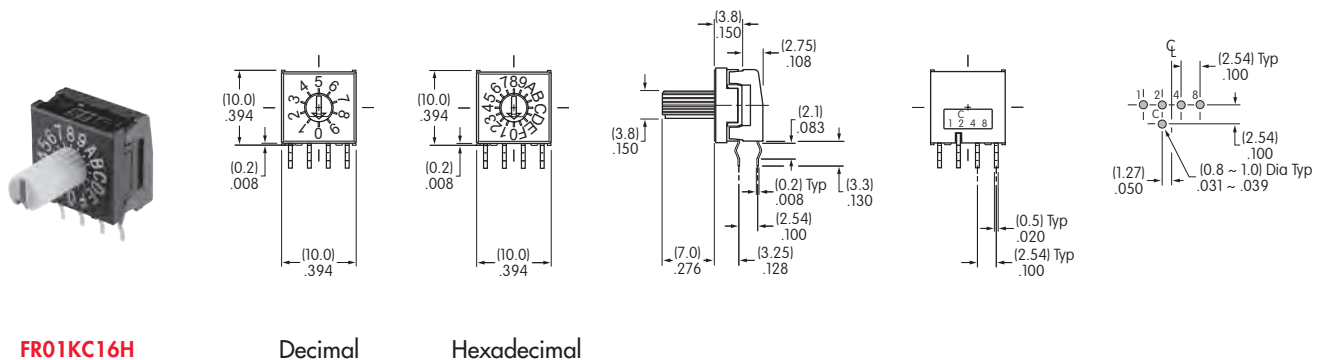
H Right Angle PC • Screwdriver



P Straight PC • Plastic Shaft



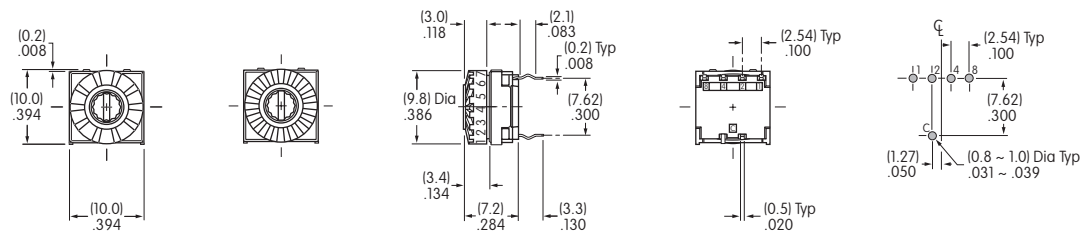
H Right Angle PC • Plastic Shaft



TYPICAL SWITCH DIMENSIONS

Straight PC • Dial

P



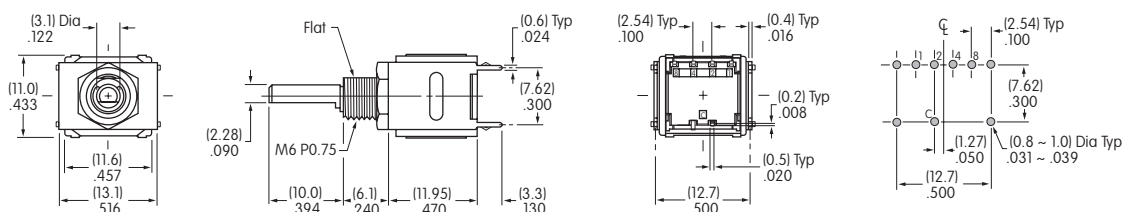
Decimal

Hexadecimal

FR01SR10P

Straight PC • Metal Shaft

P

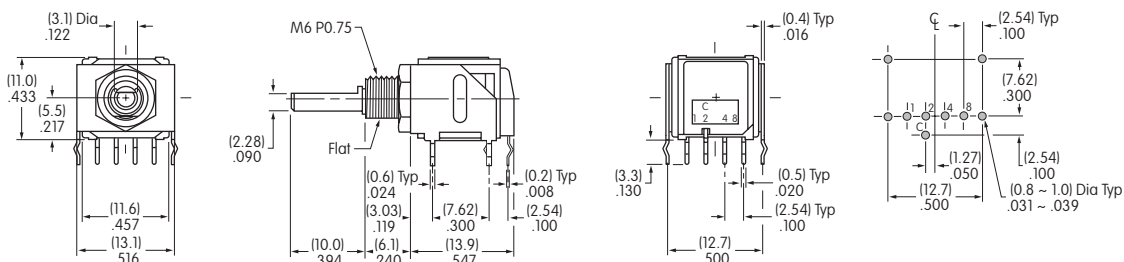


Shown in Position 0 with shaft flat rotated 180° from bushing flat

FR01AR10PB

Right Angle PC • Metal Shaft

H



Shown in Position 0 with shaft flat rotated 180° from bushing flat

FR01AC16HB

PACKAGING



Stick-Tube

FR01F, FR01K & FR01S

Each stick-tube contains 50 switches.
Switches must be ordered in 50-piece increments.

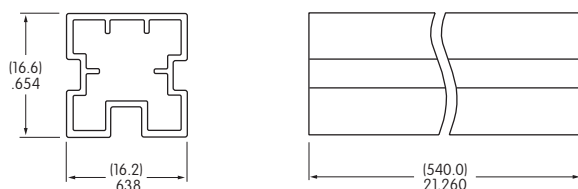
FR01A

Each stick-tube contains 25 switches.
Switches must be ordered in 25-piece increments.

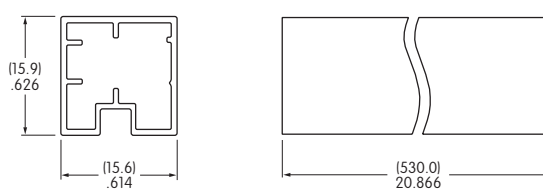
Note: Transport and storage temperatures should not exceed 50°C (122°F). Store stick tubes on flat surface.



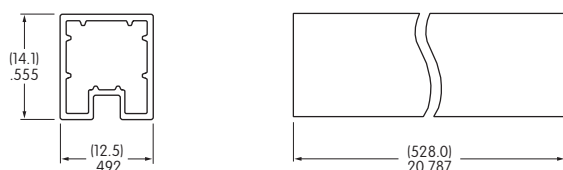
FR01F with Screwdriver Actuation & Straight PC



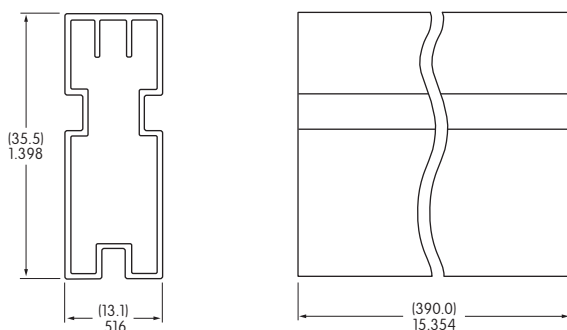
FR01K with Plastic Shaft & Right Angle PC



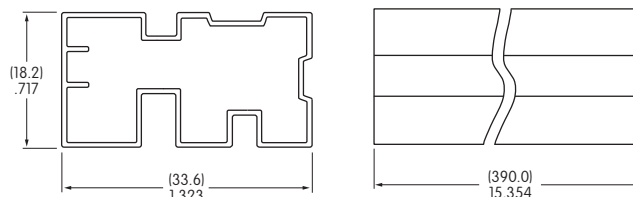
FR01S with Dial Actuation & Straight PC



FR01A with Metal Shaft & Straight PC



FR01A with Metal Shaft & Right Angle PC



General Specifications

Electrical Capacity (Resistive Load)

Switching Rating:	100mA @ 5V DC
Nonswitching Rating:	100mA @ 50V DC

Other Ratings

Contact Resistance:	100 milliohms maximum for circuit; 30 milliohms maximum for contact point
Insulation Resistance:	1,000 megohms minimum @ 250V DC
Dielectric Strength:	250V AC minimum for 1 minute minimum
Mechanical Life:	10,000 detent operations minimum
Electrical Life:	10,000 detent operations minimum
Notes: A detent operation is one actuator position operation or stepping. A cycle is one 360° rotation. 10,000 detent operations equal 625 cycles for hexadecimal devices or 1,000 cycles for decimal devices.	

Nominal Operating Torque:	0.008Nm for decimal devices; 0.01Nm for hexadecimal devices
Contact Timing:	Nonshorting

Materials & Finishes

Actuator:	Screwdriver and Plastic Shaft - Glass fiber reinforced polyamide (UL94V-0)
Housing & Base:	Glass fiber reinforced polyamide (UL94V-0)
Leaf Spring:	Stainless steel
Movable Contacts:	Copper alloy with gold plating
Stationary Contacts:	Phosphor bronze with gold plating
Terminals:	Phosphor bronze with gold plating

Environmental Data

Operating Temperature Range:	-25°C through +85°C (-13°F through +185°F)
Humidity:	90 ~ 95% humidity for 240 hours @ 40°C (104°F)
Vibration:	10 ~ 55Hz with peak-to-peak amplitude of 1.5mm traversing the frequency range & returning in 5 minutes; 3 right angled directions for 2 hours
Shock:	50G (490m/s ²) acceleration (tested in 6 right angled directions, with 5 shocks in each direction)

Processing

Soldering:	Reflow Soldering Recommended. See Profile A in Supplement section. Manual Soldering: See Profile A in Supplement section. Note: During soldering process, set the switch to the following position: FR02FR10P, FR02FR16P, FR02KR10P, FR02KR16P: 0 position; FR02FC10P, FR02KC10P: 7 position; FR02FC16P, FR02KC16P: F position
Cleaning:	These devices are not process sealed. Hand clean locally using alcohol based solution.

Standards & Certifications

Flammability Standards:	UL94V-0 rated actuator, housing, & base The FR02 Series rotaries have not been tested for UL recognition or CSA certification. These switches are designed for use in a low-voltage, low-current circuit. When used as intended, the results do not produce hazardous energy.
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Distinctive Characteristics

Slim .150" (3.8mm) body has the lowest profile in the industry and allows close stacking of PC boards.

Highly visible legends and choice of screwdriver or shaft actuators with arrow position indication provide trouble-free code setting.

Detent mechanism gives crisp, positive action for accurate switch setting.

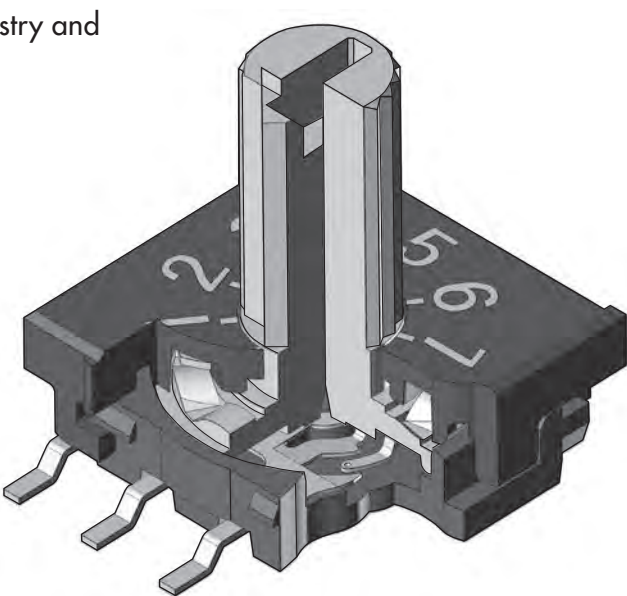
Use of heat resistant resin allows infrared convection reflow soldering.

Gull-winged terminals ensure mechanical stability during soldering and simplify solder joint inspection.

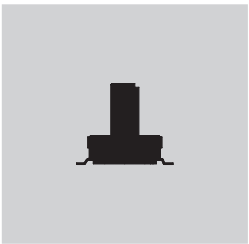
Cam activated movable contact and gold contacts assure contact reliability and continuity.

Tape-reel packaging meets EIA-481-2 Standard.

Coplanarity: all considered surfaces must lie between two parallel planes that are a maximum distance apart of .0059" (0.15mm). (Additional coplanarity details in Terms and Acronyms in the Supplement section.)



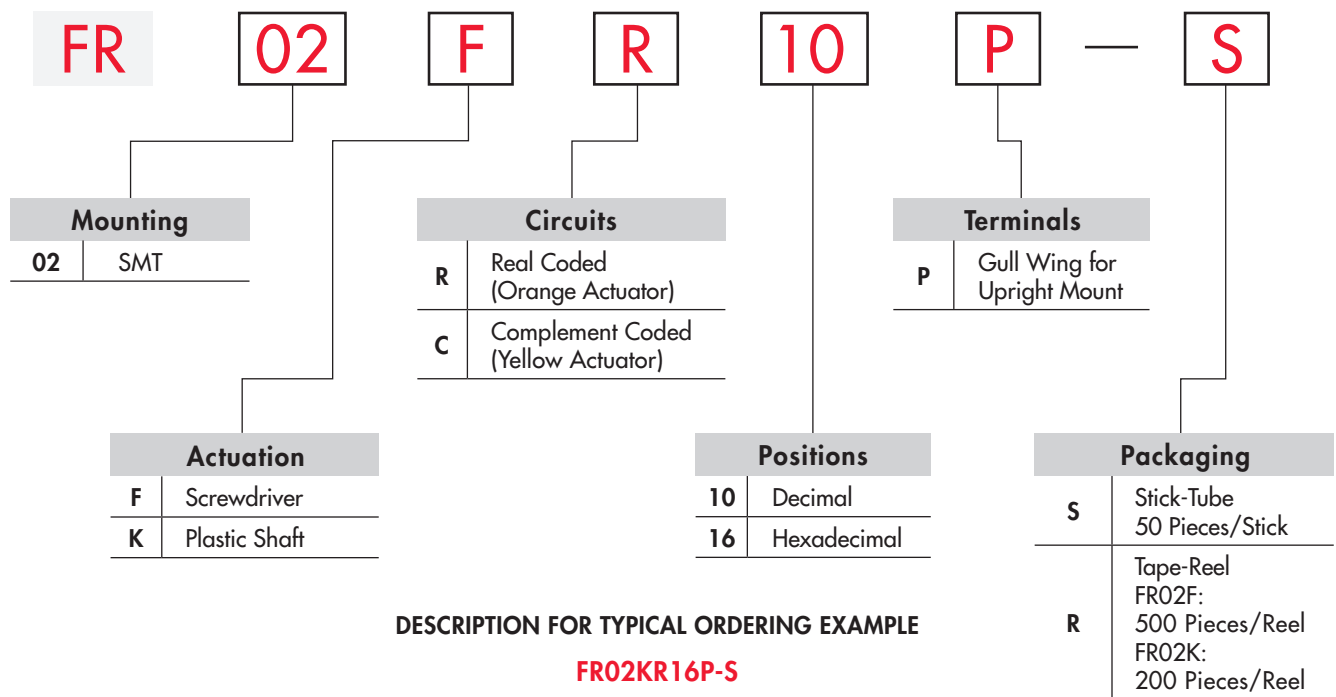
Actual Size



TRUTH TABLES (CIRCUITS & POSITIONS)																											
Actuator Position ● = ON		10 Decimal										16 Hexadecimal															
		0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
<div>R</div> Real Coded Model Numbers: FR02FR, FR02KR	1		●		●		●		●		●		●		●		●		●		●		●		●		●
	2			●	●			●	●				●	●			●	●			●	●			●	●	
	4				●		●		●	●				●		●	●	●				●	●		●	●	
	8					●	●	●	●						●	●	●	●					●	●	●	●	
										●	●									●	●	●	●	●	●	●	●
<div>C</div> Complement Coded Model Numbers: FR02FC, FR02KC	1	●		●		●		●		●		●		●		●		●		●		●		●		●	
	2	●	●			●	●		●	●	●	●			●	●			●	●			●	●		●	
	4	●	●	●	●				●	●	●	●	●	●					●	●	●	●					
	8	●	●	●	●	●	●	●			●	●	●	●	●	●	●	●									

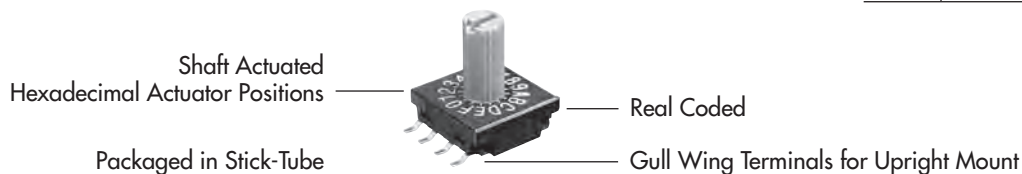
Terminal numbers are actually on the switch.

TYPICAL SWITCH ORDERING EXAMPLE



DESCRIPTION FOR TYPICAL ORDERING EXAMPLE

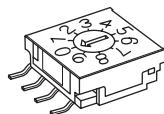
FR02KR16P-S



ACTUATION

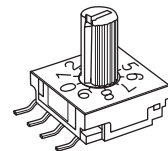
F Screwdriver

Adjusted with a flat tipped screwdriver



K Plastic Shaft

Adjusted by hand or with flat tipped screwdriver



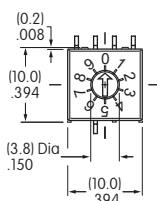
Actuators are fully rotational either clockwise or counterclockwise.
Actuator Colors: Orange for real coded devices; Yellow for complement coded devices.

TYPICAL SWITCH DIMENSIONS

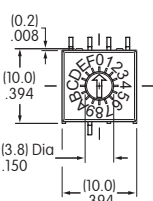
P Upright • Screwdriver



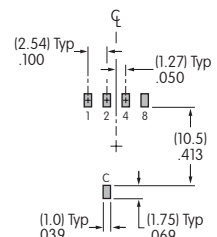
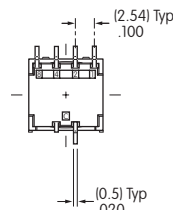
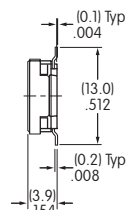
FR02FC10P



Decimal



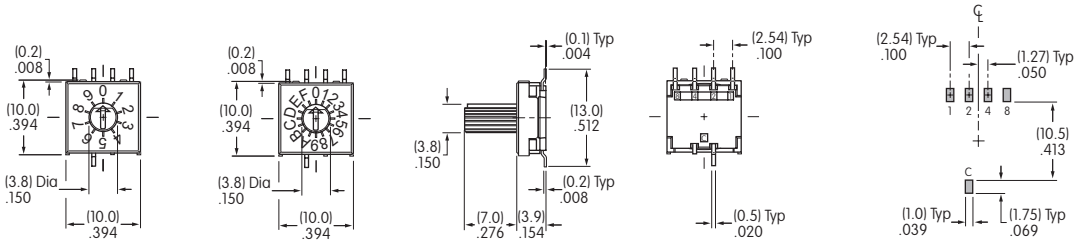
Hexadecimal



TYPICAL SWITCH DIMENSIONS

Upright • Plastic Shaft

P



Decimal

Hexadecimal

FR02KC16P

PACKAGING

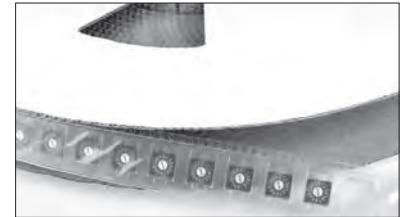
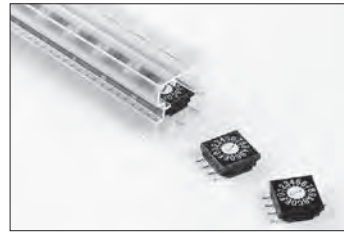
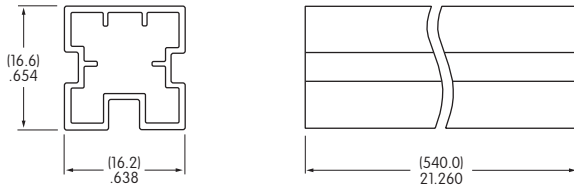
S

Stick-Tube

FR02F & FR02K

Each stick-tube contains 50 switches.

Switches must be ordered in 50-piece increments.



R

Tape-Reel

FR02F

Switches must be ordered in 500-piece increments. This packaging meets EIA-481-2 Standard.

Each tape-reel of 550 pockets contains 500 switches.

Minimum Leader Length: 15.748" (400mm)

Minimum Trailer Length: 6.299" (160mm)

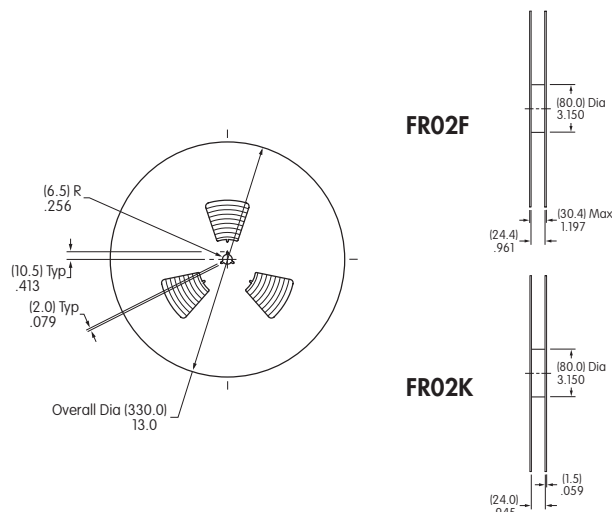
FR02K

Switches must be ordered in 200-piece increments. This packaging meets EIA-481-2 Standard.

Each tape-reel of 250 pockets contains 200 switches.

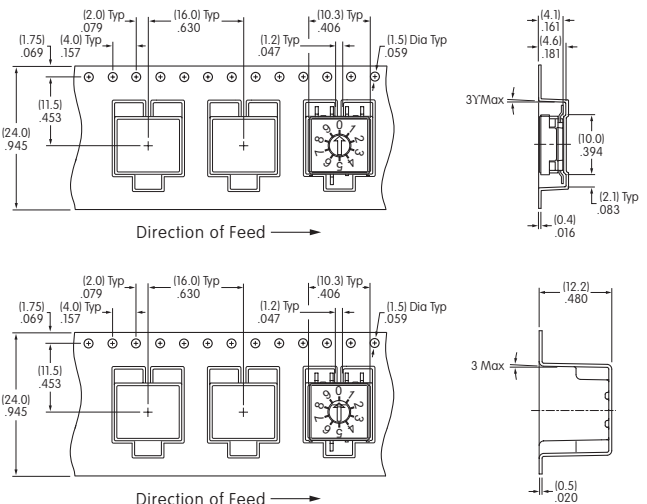
Minimum Leader Length: 15.748" (400mm)

Minimum Trailer Length: 6.299" (160mm)



FR02F

FR02K



General Specifications

Electrical Capacity (Resistive Load)

For MRA: 250mA @ 125V AC
 For MRF or MRK: 0.4VA maximum @ 28V AC/DC maximum
 (Applicable Range 0.1mA ~ 0.1A @ 20mV ~ 28V)
 Note: Find additional explanation of operating range in Supplement section.

Other Ratings

Contact Resistance: 10 milliohms maximum for MRA; 50 milliohms maximum for MRF & MRK
Insulation Resistance: 100 megohms minimum @ 500V DC
Dielectric Strength: 1,000V AC minimum for 1 minute minimum for MRA
 500V AC minimum for 1 minute minimum for MRF & MRK
Mechanical Life: 30,000 operations minimum
Electrical Life: 10,000 operations minimum
Range of Operating Torque: 0.02 ~ 0.07Nm for MRA; 0.005 ~ 0.02Nm for MRF & MRK
Contact Timing: Nonshorting (break-before-make)
 MRA – self-cleaning, sliding contact; MRF & MRK – self-cleaning, rotary contactor disk
Indexing: 30°

Materials & Finishes

Shaft: Brass with nickel plating
Stopper Plate: Steel with zinc plating for MRA & MRK; polyamide cover with stopper for MRF
Bushing/Housing: Zinc alloy with zinc plating
Movable Contacts: Copper with silver plating for MRA; phosphor bronze with gold plating for MRF & MRK
End Contacts & Terminals: Brass with silver plating for MRA; phosphor bronze with gold plating for MRF & MRK
Common Contacts & Terminals: Brass with silver plating for MRA; phosphor bronze with gold plating for MRF & MRK
Base: Diallyl phthalate for MRA; fiberglass reinforced polyamide for MRF & MRK

Environmental Data

Operating Temperature Range: -10°C through +70°C (+14°F through +158°F)
Humidity: 90 ~ 95% humidity for 96 hours @ 40°C (104°F)
Vibration: 10 ~ 55Hz with peak-to-peak amplitude of 1.5mm traversing the frequency range & returning in 1 minute; 3 right angled directions for 2 hours
Shock: 50G (490m/s²) acceleration (tested in 3 right angled directions, with 3 shocks in each direction)
Sealing: MRK model meets IP67 of IEC60529 standards

Installation

Mounting Torque: .686Nm (6.08 lb•in)
Cap Installation Force: 19.6 ~ 29.4N (4.41 ~ 6.61 lbf) for MRA & MRK

Processing

Soldering Time & Temperature: Wave Soldering for MRA: See Profile A in Supplement section.
 Wave Soldering for MRF & MRK: See Profile B in Supplement section.
 Manual Soldering for MRA: See Profile A in Supplement section.
 Manual Soldering for MRF & MRK: See Profile B in Supplement section.
Cleaning: Automated cleaning recommended. Stopper plate, as well as washers for MRA & MRK, must be in place to maintain automated cleaning. See Cleaning specifications in Supplement section.

Standards & Certifications

MRA, MRF, & MRK models have not been tested for UL recognition or CSA certification. These switches are designed for use in a low-voltage, low-current, logic-level circuit. When used as intended in a logic-level circuit, the results do not produce hazardous energy.

Distinctive Characteristics

Low profile body of MRF model accommodates space limitations required for PCB mounting. For the MRA and MRK bushing mount models, the range of behind panel body depths is .323" to .669" (8.2mm to 17.0mm).

Positive detent mechanism for distinct feel and audible feedback.

Metal bushing and housing construction increases durability.

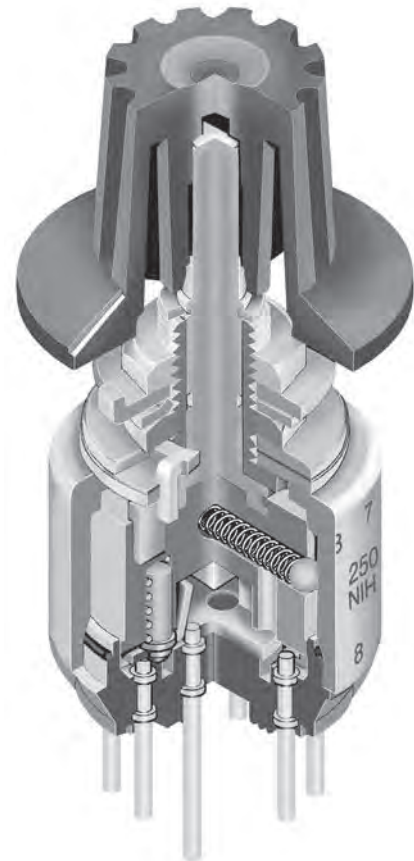
Adjustable stopper plate allows 2–12 position settings.

High contact reliability achieved by the self-cleaning contact mechanism.

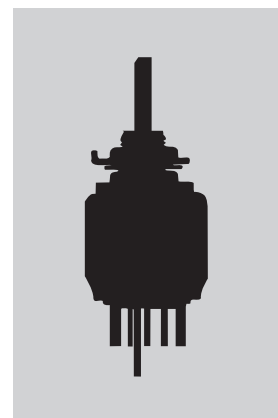
Break-before-make contact timing with sliding contacts in MRA and rotary contactor disk in MRF and MRK models.

Interior housing seal and molded-in PC terminals, plus shaft rubber o-ring on MRA and MRK and polyamide cover on MRF model, allow cleaning after automated soldering.

MRK model meets IP67 of IEC60529 specifications (similar to NEMA 4 & 13).



Actual Size



TYPICAL SWITCH ORDERING EXAMPLE

MR

A

206

A



Actuators & Terminals

A	Shaft Actuated with PC Terminals
F	Low Profile Screwdriver Actuated with PC Terminals
K	Low Profile Shaft Actuated with PC Terminals

Poles & Circuits

112	SP with 2-12 Positions
206	DP with 2-6 Positions
403	4P with 2-3 Positions

Knobs

A	Plain Black
B	Small Color Tipped
C	Large Color Tipped

Colors

For Plain Knob	
No Code	Black
For Color Tipped	
A	Black
B	White
C	Red
E	Yellow
F	Green
G	Blue
H	Gray

DESCRIPTION FOR TYPICAL ORDERING EXAMPLE

MRA206-A



Shaft Actuated with Plain Black Knob

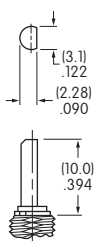
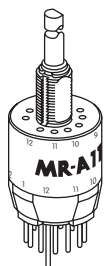
DP with 2-6 Adjustable Positions

PC Terminals

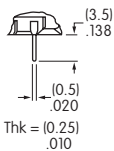
ACTUATORS & TERMINALS

A

Shaft Actuated with PC Terminals



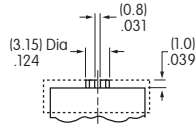
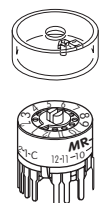
Shaft



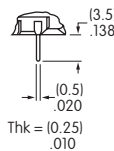
Terminal

F

Low Profile Screwdriver Actuated with PC Terminals



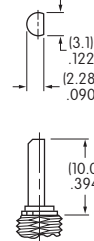
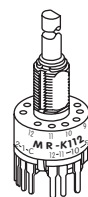
Slotted for Screwdriver



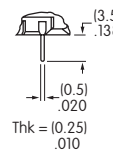
Terminal

K

Low Profile Shaft Actuated with PC Terminals



Shaft



Terminal

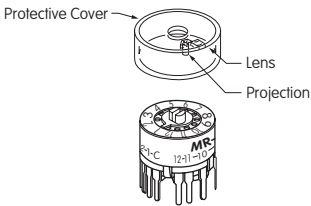
POLES & CIRCUITS					
Pole	Model	Number of Positions	Stopper Settings	Number of Terminals	Schematics
SP	MRA112	2-12	2, 3, 4, . . . 12	1 COM, 12 LOAD	
	MRF112	2-12	2, 3, 4, . . . 12	1 COM, 12 LOAD	
	MRK112	2-12	2, 3, 4, . . . 12	1 COM, 12 LOAD	
DP	MRA206	2-6	2, 3, 4, 5, 6	2 COM, 12 LOAD	
	MRF206	2-6	2, 3, 4, 5, 6	2 COM, 12 LOAD	
	MRK206	2-6	2, 3, 4, 5, 6	2 COM, 12 LOAD	
4P	MRA403	2-3	2, 3	4 COM, 12 LOAD	
	MRF403	2-3	2, 3	4 COM, 12 LOAD	
	MRK403	2-3	2, 3	4 COM, 12 LOAD	

POSITION SETTING FOR MRA, MRF, & MRK MODELS

Each switch is supplied with the stopper set for the maximum number of positions allowed for that model. Prior to installation, the desired position setting should be made. Contact factory for continuous rotation.

MRF Models

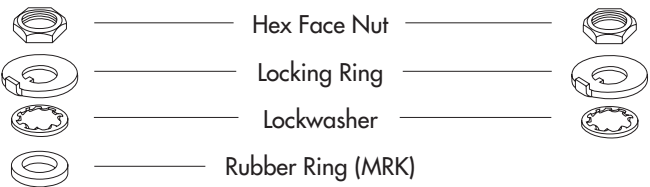
- 1. Remove the protective cover from the switch body.
- 2. Turn the shaft counterclockwise to the extreme left by using a screwdriver.
- 3. Inside the cover is a magnifying lens which would be positioned over the number which is to be the maximum position used; when the cover is then snapped into the switch, the projection beside the lens fits into the correct hole for setting the stop.



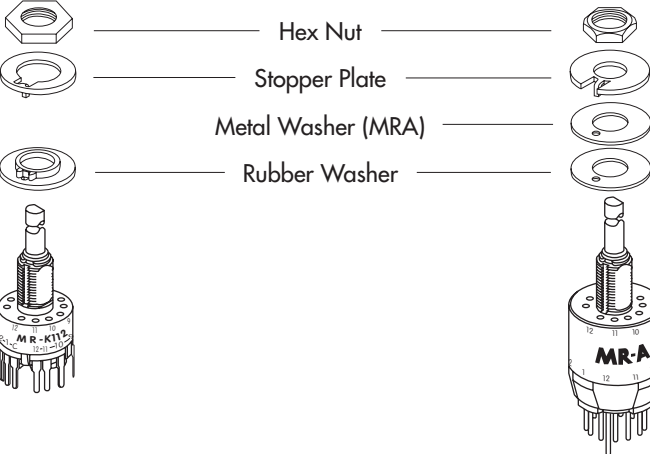
MRK & MRA Models

- 1. Using the actuator knob, turn the shaft counterclockwise to the extreme left. If the shaft is not turned counterclockwise to the extreme left, proper setting cannot be achieved. At this extreme position, the white line on the knob points to the number 1 position shown on the side of the switch.
- 2. Remove the knob from the shaft and loosen the nut far enough to allow raising the stopper plate, plus washer(s), for resetting to the desired position.
- 3. Note the position numbers on the side of the switch; these correspond to the terminal numbers and stopper holes. Insert the stopper in the hole numbered for the maximum desired number of stop settings. Satisfactory switch functioning cannot be assured if the stopper plate is not properly positioned.
- 4. Tighten the nut (beveled side up) firmly against the stopper plate.

Standard Mounting Hardware
Packaged Loose with Each Switch:



Factory Assembled:

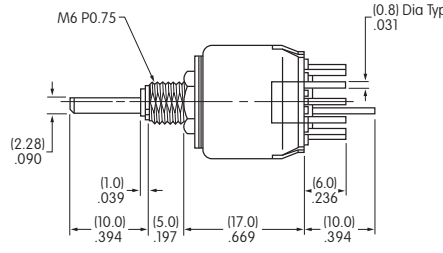
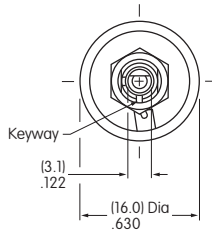


TYPICAL SWITCH DIMENSIONS

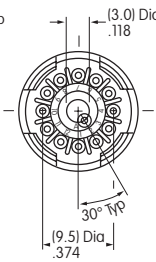
MRA • PC Terminals



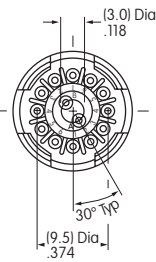
MRA112



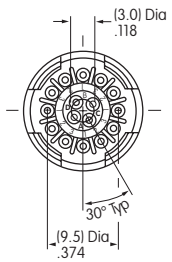
1 Pole



2 Pole



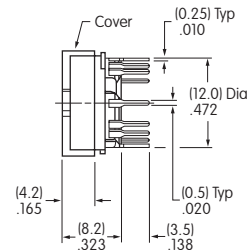
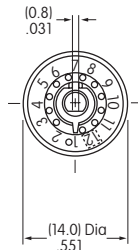
4 Pole



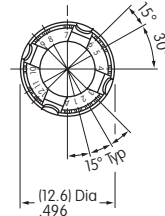
MRF • PC Terminals



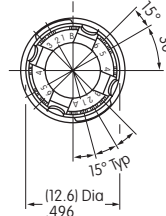
MRF403



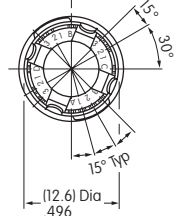
1 Pole



2 Pole



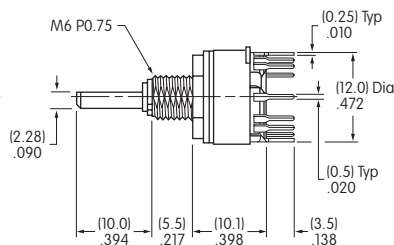
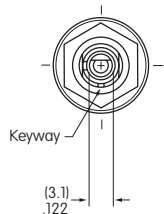
4 Pole



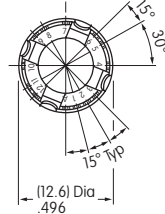
MRK • PC Terminals



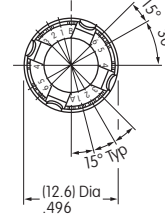
MRK112



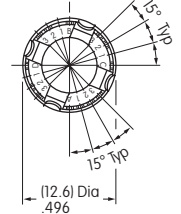
1 Pole



2 Pole



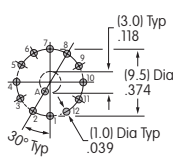
4 Pole



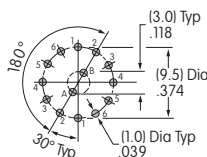
MRK devices are designed to be panel mounted. Installation without panel mounting will affect reliability.

FOOTPRINTS

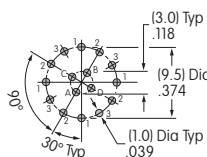
Single Pole MRA112



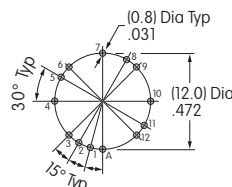
Double Pole MRA206



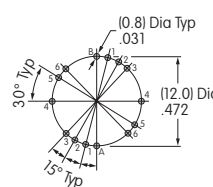
Four Pole MRA403



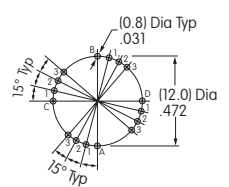
Single Pole MRF112 MRK112



Double Pole MRF206 MRK206



Four Pole MRF403 MRK403

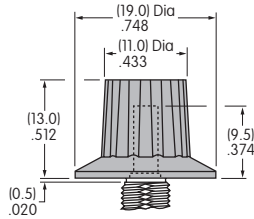


KNOBS

A AT433 Plain Black

Material:
Polyacetal

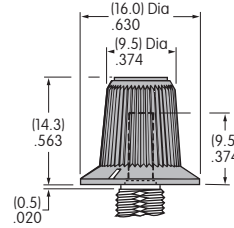
Color:
Black
only



B AT4103 Small Color Tipped

Base Material:
Polyester
Base Color:
Black

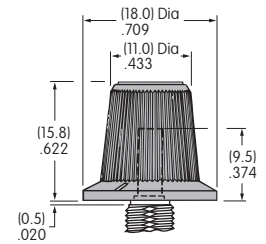
Polyamide Tip
Colors:
A, B, C, E, F, G, H



C AT4104 Large Color Tipped

Base Material:
Polyester
Base Color:
Black

Polyamide Tip
Colors:
A, B, C, E, F, G, H

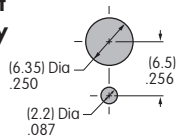


Color Codes: **A** Black **B** White **C** Red **E** Yellow **F** Green **G** Blue **H** Gray

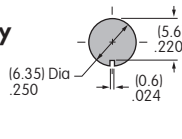
PANEL CUTOUTS & MAXIMUM EFFECTIVE PANEL THICKNESS

MRA & MRK Nonsealed Panel

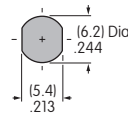
Without
Keyway



With
Keyway



MRK Sealed Panel



With Standard Hardware on Nonsealed Panel:
MRA .067" (1.7mm) MRK .087" (2.2mm)

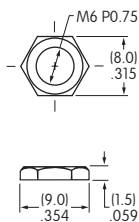
Without Locking Ring on Nonsealed Panel:
MRA .098" (2.5mm) MRK .118" (3.0mm)

With AT513M & AT535 only on Sealed Panel:
MRK .106" (2.7mm)

STANDARD MOUNTING HARDWARE

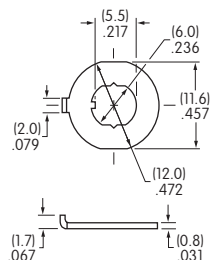
AT513M Metric Hexagon Nut

Material:
Brass, nickel plating
1 for MRA; 1 for MRK



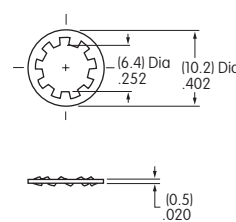
AT545 Locking Ring

Material:
Steel, chromate over zinc plating
1 for MRA; 1 for MRK



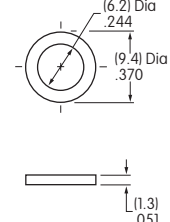
AT509 Lockwasher

Material:
Steel, chromate over zinc plating
1 for MRA; 1 for MRK



AT535 Rubber Ring

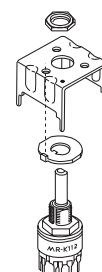
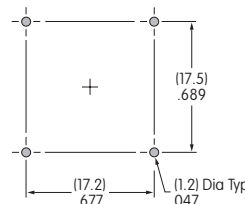
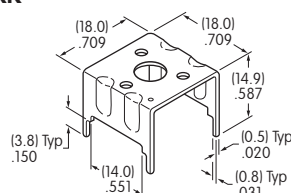
Material:
Nitrile butadiene rubber
1 for MRK



OPTIONAL SUPPORT BRACKET

AT543 Support Bracket for MRK

Material:
Steel with tin plating



A support bracket is needed when the MRK is mounted only to a PC board and does not have the bushing through a panel.

General Specifications

Electrical Capacity (Resistive Load)

For MRX:	2A @ 125V AC or 1A @ 30V DC
For MRY:	For MRY106G: 0.4VA maximum @ 28V AC/DC maximum (Applicable Range 0.1mA ~ 0.1A @ 20mV ~ 28V) Note: See Supplement Index to find explanation of operating range. For all other MRY models: 3A @ 125V AC or 2A @ 30V DC
For MRT:	For MRT22: 10A @ 125V AC or 4A @ 30V DC For MRT23: 5A @ 125V AC or 3A @ 30V DC

Other Ratings

Contact Resistance:	10 milliohms maximum for MRX, MRY, & MRT; 20 milliohms maximum for MRY106G
Insulation Resistance:	100 megohms minimum @ 500V DC for MRX & MRY 200 megohms minimum @ 500V DC for MRT
Dielectric Strength:	1,000V AC minimum for 1 minute minimum
Mechanical Life:	15,000 operations minimum
Electrical Life:	7,500 operations minimum
Range of Operating Torque:	0.03 ~ 0.15Nm for MRX; 0.02 ~ 0.10Nm for MRY; 0.02 ~ 0.05Nm for MRT
Contact Timing:	Nonshorting (break-before-make) MRX: Self-cleaning, sliding contact; MRY: Rotary contactor dish; MRT: Butt contacts
Indexing:	45° for MRX; 60° for MRY; 120° for MRT22; 60° for MRT23

Materials & Finishes

Shaft:	Brass with nickel plating
Stopper Plate:	Steel with zinc plating for MRX & MRY
Bushing/Housing:	Brass with nickel plating
Movable Contacts:	Silver alloy for MRX & MRT; copper with silver plating for MRY106; copper with gold plating for MRY106G
End Contacts & Terminals:	Silver alloy & copper with silver plating for MRX & MRT; silver alloy plus brass with silver plating for MRY106; silver alloy with gold plating for MRY106G
Common Contacts & Terminals:	Copper with silver plating for MRX, MRY106 & MRT22; brass with gold plating for MRY106G; brass with silver plating for MRT23
Base:	Phenolic resin

Environmental Data

Operating Temperature Range:	-10°C through +70°C (+14°F through +158°F)
Humidity:	90 ~ 95% humidity for 96 hours @ 40°C (104°F)
Vibration:	10 ~ 55Hz with peak-to-peak amplitude of 1.5mm traversing the frequency range & returning in 1 minute; 3 right angled directions for 2 hours
Shock:	50G (490m/s ²) acceleration (tested in 3 right angled directions, with 3 shocks in each direction)

Installation

Mounting Torque:	.686Nm (6.08 lb•in)
Cap Installation Force:	19.6 ~ 29.4N (4.41 ~ 6.61 lbf)
Soldering Time & Temperature:	Manual Soldering: See Profile A in Supplement section.

Standards & Certifications

UL:	File No. E44145 - Recognized only when ordered with marking on switch. Add "/U" or "/CUL" before dash in part number to order UL recognized switch. MRT22 models recognized at 10A @ 125V AC; MRT23 models recognized at 5A @ 125V AC
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Distinctive Characteristics

Positive detent mechanism for distinct feel and audible feedback.

Metal bushing and housing construction increases durability.

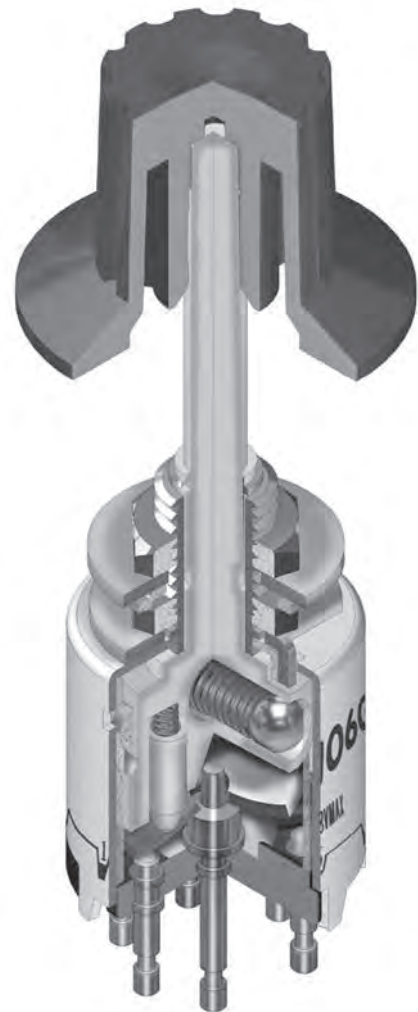
Adjustable stopper plate allows 2-8 position settings.

High contact reliability achieved by the self-cleaning contact mechanism.

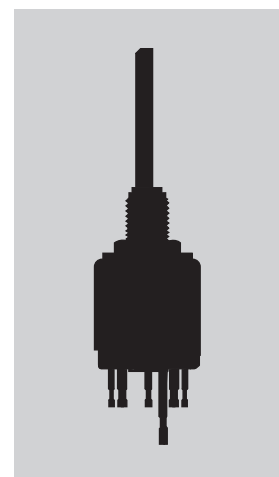
Break-before-make contact timing with various mechanism types: sliding contacts in MRX, contactor dish in MRY, and butt contacts in MRT models.

Terminal types include PC-turret for MRX, turret for MRY, and solder lug for MRT models.

Molded-in PC-turret and turret terminals prevent entry of flux and other contaminants.



Actual Size



Toggles

Rockers

Pushbuttons

Illuminated PB

Programmable

Key locks

Rotaries

Slides

Tactiles

Tilt

Touch

Indicators

Accessories

Supplement

TYPICAL SWITCH ORDERING EXAMPLE

MR

X

108

A

Actuators & Terminals

Poles & Circuits

Knobs

Colors

X Shaft Actuated with PC-Turret Terminals

108 SP with 2-8 Positions
204 DP with 2-4 Positions
402 4P with 2 Positions

A Plain Black
B Small Color Tipped
C Large Color Tipped

For Plain Knob

No Code Black

For Color Tipped

A Black
B White
C Red
E Yellow
F Green
G Blue
H Gray

Y Shaft Actuated with Turret Terminals

106 SP with 2-6 Positions
106G SP with 2-6 Positions Gold Contacts 0.4VA

T Shaft Actuated with Solder Lug Terminals

22 DPDT ON-NONE-ON
23 DPDT ON-OFF-ON

DESCRIPTION FOR TYPICAL ORDERING EXAMPLE

MRX108-A

Shaft Actuated with Plain Black Knob

SP with 2-8 Adjustable Positions

PC-Turret Terminals



IMPORTANT:

MRT Switches are supplied without UL & cULus marking unless specified.

UL & cULus recognized only when ordered with marking on the switch.

Specific models, ratings, & ordering instructions are noted on the General Specifications page.

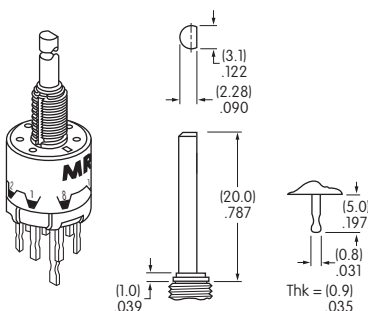


ACTUATORS & TERMINALS

X Shaft Actuated with PC-Turret Terminals

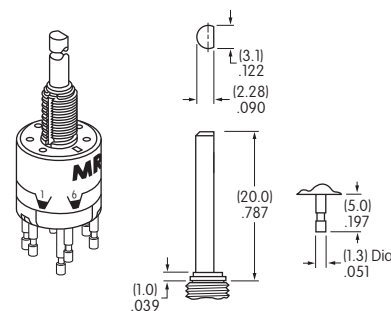
Y Shaft Actuated with Turret Terminals

T Shaft Actuated with Solder Lug Terminals



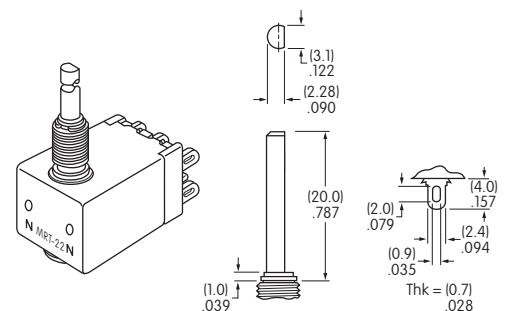
Shaft

Terminal



Shaft

Terminal



Shaft

Terminal

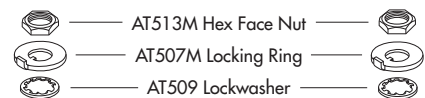
POLES & CIRCUITS					
Pole	Model	Number of Positions	Stopper Settings	Number of Terminals	Schematics
SP	MRX108	2-8	2, 3, 4, 5, 6, 7, 8	1 COM, 8 LOAD	
	MRY106 MRY106G	2-6	2, 3, 4, 5, 6	1 COM, 6 LOAD	
DP	MRX204	2-4	2, 3, 4	2 COM, 8 LOAD	
DPDT	MRT22	2	ON-NONE-ON	2-3 2-1 5-6 5-4	
	MRT23	3	ON-OFF-ON	2-3 OPEN 2-1 5-6 OPEN 5-4	
4P	MRX402	2	1 & 2	4 COM, 8 LOAD	

POSITION SETTING FOR MRX & MRY MODELS

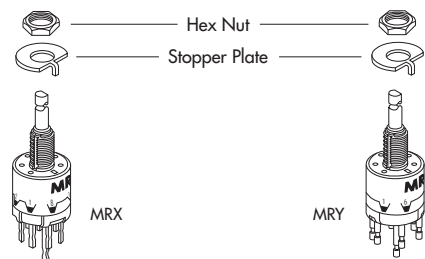
Each switch is supplied with the stopper set for the maximum number of positions allowed for that model. Prior to installation, the desired position setting should be made. Contact factory for continuous rotation.

1. Using the actuator knob, turn the shaft counterclockwise to the extreme left. If the shaft is not turned to this extreme position where the white line on the knob points to the number 1 position shown on the side of the switch, proper setting cannot be achieved.
2. Remove the knob from the shaft and loosen the nut far enough to allow raising the stopper plate for resetting to the desired position.
3. Note the position numbers on the side of the switch; these correspond to the terminal numbers and stopper holes. Insert the stopper in the hole numbered for the maximum desired number of stop settings. Satisfactory switch functioning cannot be assured if the stopper plate is not properly positioned.
4. Tighten the nub (beveled side up) firmly against the stopper plate.

Mounting Hardware Packaged Loose with Each Switch

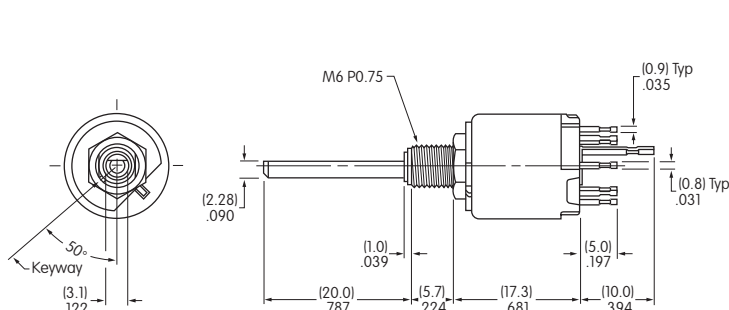


Factory Assembled:

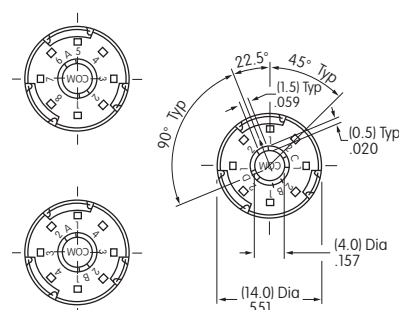


TYPICAL SWITCH DIMENSIONS

Single, Double & Four Pole



MRX • PC-Turret Terminals

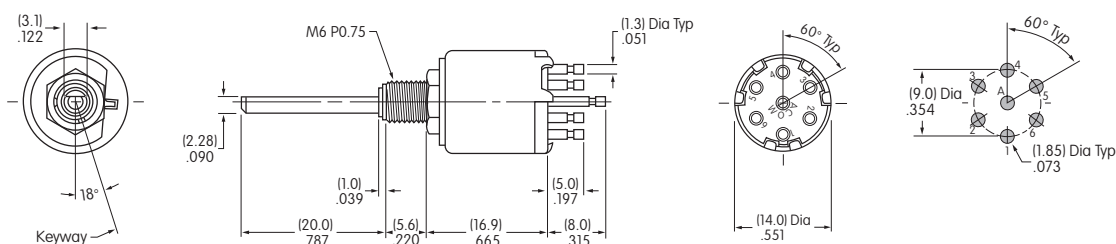


MRX108

TYPICAL SWITCH DIMENSIONS

MRY • Turret Terminals

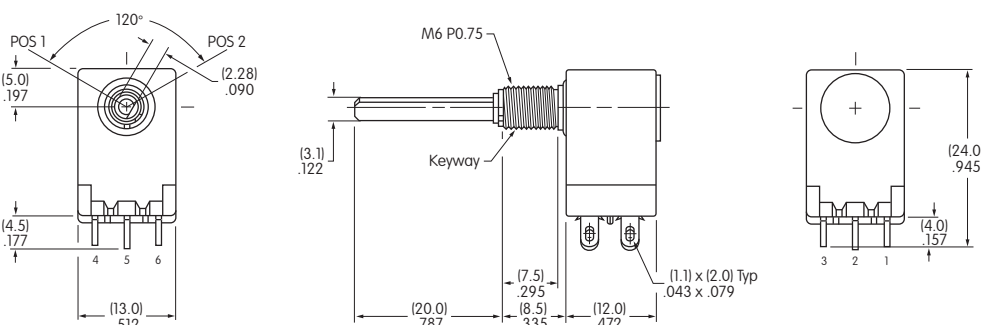
Single Pole



MRY106

MRT • Solder Lug Terminals

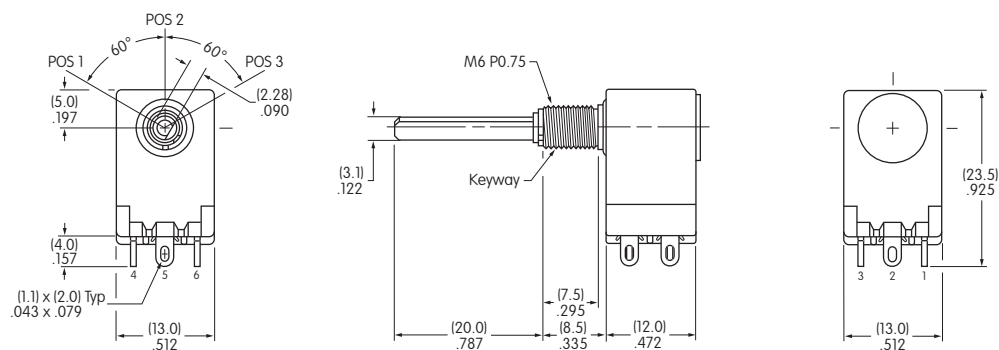
Double Pole



MRT22

MRT • Solder Lug Terminals

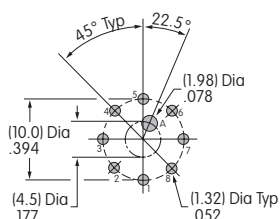
Double Pole



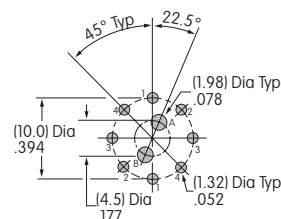
MRT23

PC FOOTPRINTS FOR MRX SINGLE, DOUBLE, & FOUR POLE

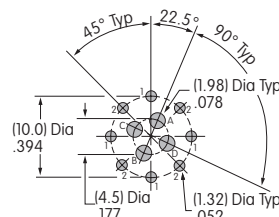
Single Pole



Double Pole

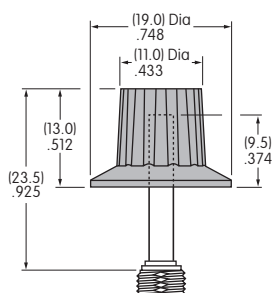


Four Pole



KNOBS

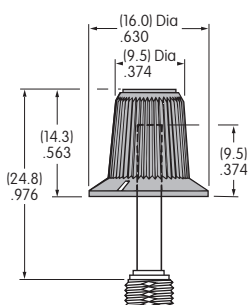
A AT433 Plain Black



Material: Polyacetal

Color: Black only

B AT4103 Small Color Tipped



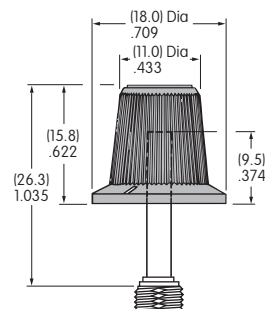
Base Material: Polyester

Base Color: Black

Polyamide Tip

Colors: A, B, C, E, F, G, H

C AT4104 Large Color Tipped



Base Material: Polyester

Base Color: Black

Polyamide Tip

Colors: A, B, C, E, F, G, H

Color Codes:

A

Black

B

White

C

Red

E

Yellow

F

Green

G

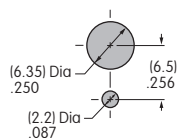
Blue

H

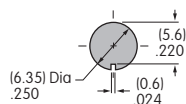
Gray

PANEL CUTOUTS & MAXIMUM EFFECTIVE PANEL THICKNESS

Without Keyway



With Keyway



Maximum Effective Panel Thickness

With Standard Hardware: MRX & MRY .095" (2.4mm); MRT .106" (2.7mm)

Without Locking Ring: MRX & MRY .126" (3.2mm); MRT .138" (3.5mm)

General Specifications

Electrical Capacity (Resistive Load)

Logic Level: 0.4VA maximum @ 28V AC/DC maximum
(Applicable Range 0.1mA ~ 0.1A @ 20mV ~ 28V)
Note: See Supplement Index to find explanation of operating range.

Other Ratings

Contact Resistance: 80 milliohms maximum
Insulation Resistance: 100 megohms minimum @ 500V DC
Dielectric Strength: 500V AC minimum for 1 minute minimum
Mechanical Life: 30,000 operations minimum
Electrical Life: 10,000 operations minimum
Operating Torque: 0.04Nm average
Contact Timing: Nonshorting (break-before-make)
Indexing: 45° for On-On-On & 90° for On-None-On

Materials & Finishes

Shaft: Brass with nickel plating
Bushing: Zinc alloy with nickel plating
Frame/Bracket: Steel with tin plating
Movable Contacts: Beryllium copper spring with gold plating
Stationary Contacts: Copper with gold plating
Terminals: Brass with tin plating
Base: Polyamide

Environmental Data

Operating Temperature Range: -10°C through +70°C (+14°F through +158°F)
Humidity: 90 ~ 95% humidity for 96 hours @ 40°C (104°F)
Vibration: 10 ~ 55Hz with peak-to-peak amplitude of 1.5mm traversing the frequency range & returning in 1 minute; 3 right angled directions for 2 hours
Shock: 50G (490m/s²) acceleration (tested in 3 right angled directions, with 5 shocks in each direction)
Sealing: Use of optional o-ring AT535 with MRB meets IP67 of IEC60529 specifications

Installation

Mounting Torque: .686Nm (6.08 lb•in)
Cap Installation Force: 19.6 ~ 29.4N (4.41 ~ 6.61 lbf)

PCB Processing

Soldering: Wave Soldering Recommended: See Profile B in Supplement section
Manual Soldering: See Profile B in Supplement section
Cleaning: Automated cleaning. See Cleaning specifications in Supplement section.

Standards & Certifications

The MRB Series rotaries have not been tested for UL recognition or CSA certification. These switches are designed for use in a low-voltage, low-current, logic-level circuit. When used as intended in a logic-level circuit, the results do not produce hazardous energy.

Distinctive Characteristics

Double flatted bushing prevents rotation in panel and increases stability.

Totally sealed construction, achieved with combination of an interior o-ring, a seal between the frame and base, plus insert molded terminals, prevents contact contamination and allows automated soldering and cleaning.

Positive detent mechanism for distinct feel and audible feedback.

Break-before-make contact timing with sliding contact mechanism.

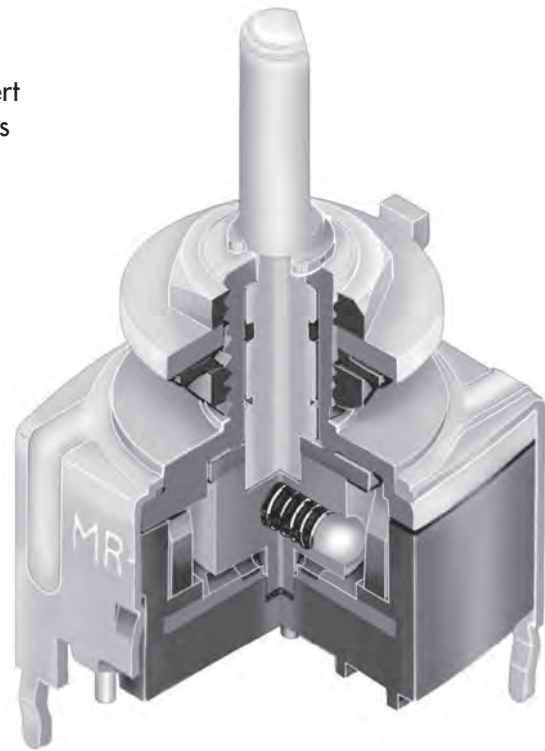
Metal bushing and frame/bracket provide durability.

Panel seal, achieved with use of optional exterior o-ring, conforms to IP67 of IEC60529 Standards.

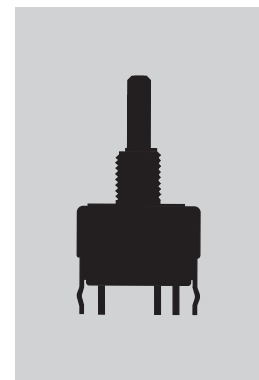
High contact reliability achieved by the self-cleaning contact mechanism.

.100" x .100" (2.54mm x 2.54mm) terminal spacing conforms to standard PC board grid spacing for straight and right angle mounting.

Insert molded terminals lock out flux and other contaminants.



Actual Size



TYPICAL SWITCH ORDERING EXAMPLE

MRB

1

2

B

A

Poles	
1	SPDT SP3T
2	DPDT DP3T

Terminals	
B	Straight with Bracket
H	Right Angle with Bracket

Knobs	
A	Plain Black
B	Small Color Tipped
C	Large Color Tipped

Colors	
For Plain Knob	
No Code	Black
For Color Tipped	
A	Black
B	White
C	Red
E	Yellow
F	Green
G	Blue
H	Gray

Circuits & Indexing				
2	ON	NONE	ON	90°
4	ON	ON	ON	45°

DESCRIPTION FOR TYPICAL ORDERING EXAMPLE

MRB12B-A

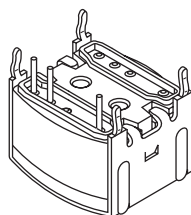


POLES & CIRCUITS

Pole	Model	Actuator Positions			Connected Terminals			Throw & Schematics	
		Position 1	Position 2	Position 3	Position 1	Position 2	Position 3	Note: Terminal numbers are not actually on switch	
SP	MRB12	ON	NONE	ON	C1-1	OPEN	C1-2	SPDT	
	MRB14	ON	ON	ON	C1-1	C1-2	C1-3	SP3T	
DP	MRB22	ON	NONE	ON	C1-1 C2-4	OPEN	C1-2 C2-5	DPDT	
	MRB24	ON	ON	ON	C1-1 C2-4	C1-2 C2-5	C1-3 C2-6	DP3T	

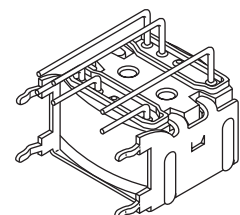
TERMINALS

B Straight PC Terminals with Bracket



SPDT

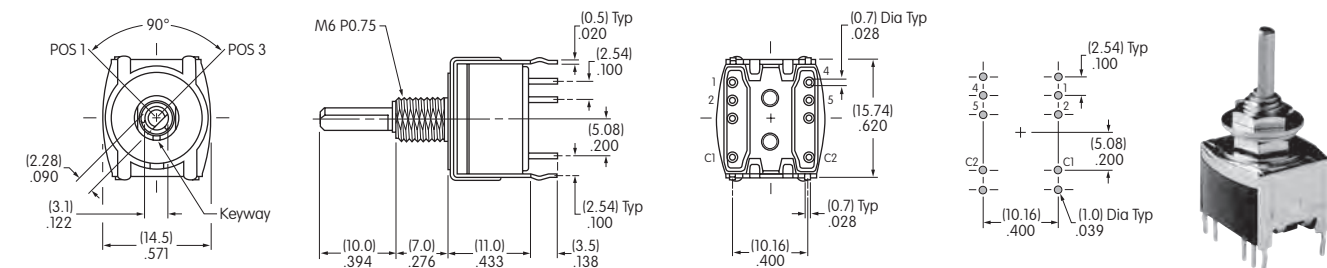
H Right Angle PC Terminals with Bracket



DPDT

TYPICAL SWITCH DIMENSIONS

90° Indexing • SPDT & DPDT • Straight PC

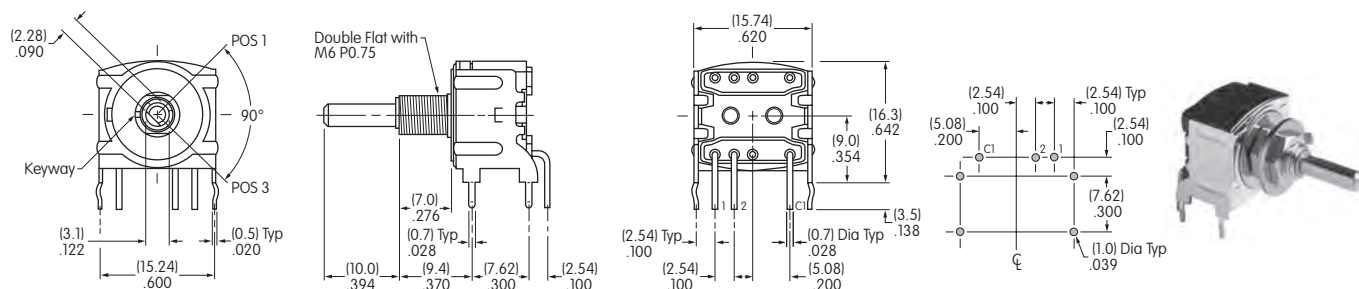


Actuator shown in Position 1

Single pole model does not have terminals 4, 5 & C2

MRB12B

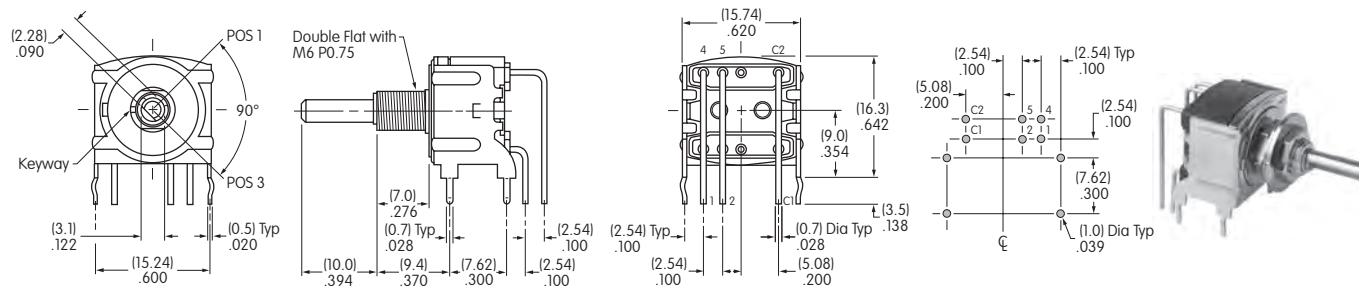
90° Indexing • SPDT • Right Angle PC



Actuator shown in Position 1

MRB12H

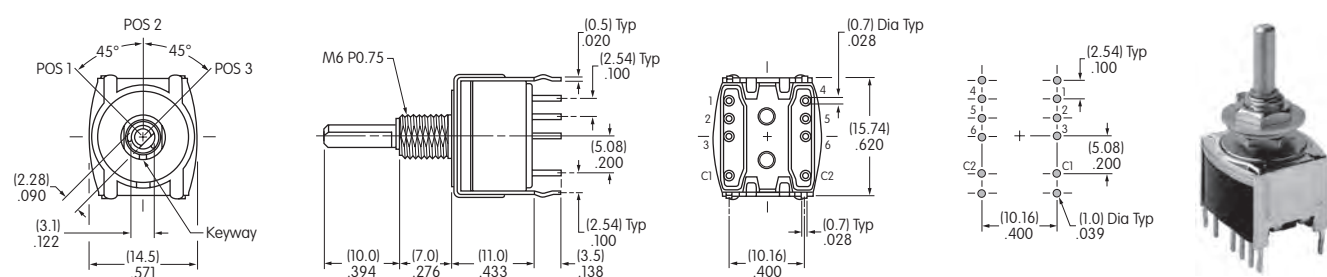
90° Indexing • DPDT • Right Angle PC



Actuator shown in Position 1

MRB22H

45° Indexing • SP3T & DP3T • Straight PC



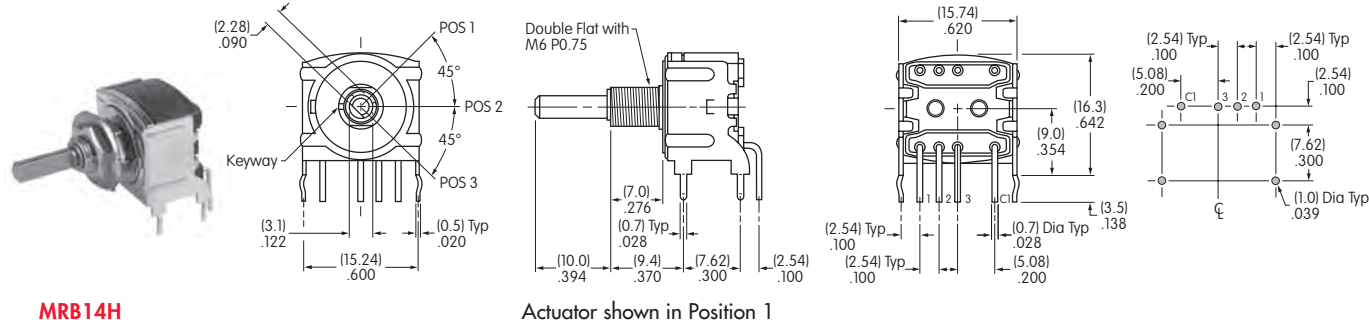
Actuator shown in Position 1

Single pole model does not have terminals 4, 5, 6 & C2

MRB14B

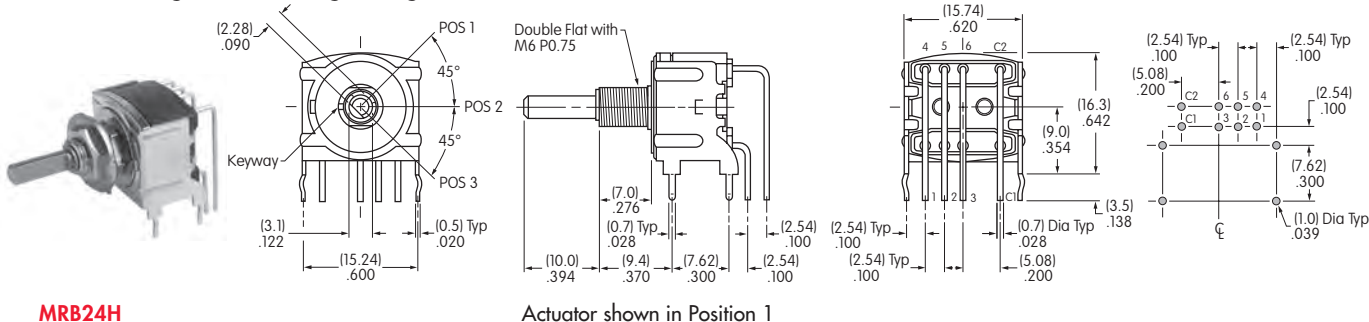
TYPICAL SWITCH DIMENSIONS

45° Indexing • SP3T • Right Angle PC



MRB14H

45° Indexing • DP3T • Right Angle PC

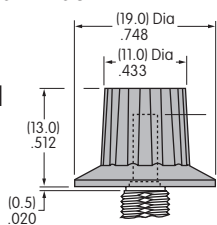


MRB24H

KNOBS

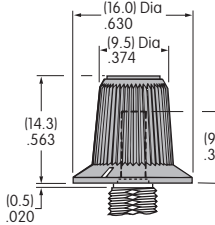
A AT433 Plain Black

Material:
Polyacetal
Color:
Black



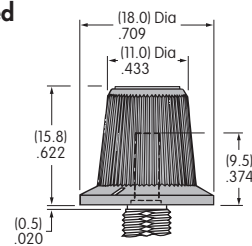
B AT4103 Small Color Tipped

Polyester Base:
Black
Polyamide Tip
Colors:
A, B, C, E, F, G, H



C AT4104 Large Color Tipped

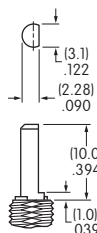
Polyester Base:
Black
Polyamide Tip
Colors:
A, B, C, E, F, G, H



Color Codes:

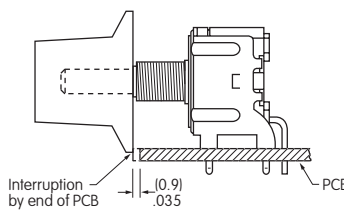
A Black **B** White **C** Red **E** Yellow **F** Green **G** Blue **H** Gray

Shaft Detail



Mounting Precaution for Cap Clearance on Right Angle Models

When mounting a right angle switch, a cap clearance of .035" (0.9mm) is recommended.

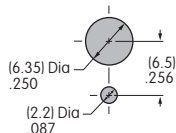


Standard Hardware Supplied

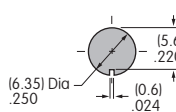
AT513M Hex Nut
AT545 Locking Ring
AT509 Lockwasher
Optional Hardware
AT535 O-ring for Panel Seal
See Supplement for details

PANEL CUTOUTS & MAXIMUM EFFECTIVE PANEL THICKNESS

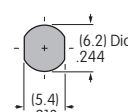
With Standard Hardware
.087" (2.2mm)



Without Locking Ring
.118" (3.0mm)



Sealed Panel with 1 Hex Nut & 1 Rubber O-ring
.165" (4.2mm)



General Specifications

Electrical Capacity (Resistive Load)

Switching Rating:	100mA @ 5V DC
Nonswitching Rating:	100mA @ 50V DC

Other Ratings

Contact Resistance:	80 milliohms maximum for circuit; 30 milliohms maximum for contact point
Insulation Resistance:	1,000 megohms minimum @ 250V DC
Dielectric Strength:	250V AC minimum for 1 minute minimum
Mechanical Life:	20,000 detent operations minimum
Electrical Life:	20,000 detent operations minimum
Notes: A detent operation is one actuator position operation or stepping. 20,000 detent operations = 1,250 cycles for hexadecimal devices or 2,000 cycles for decimal devices. A cycle is one 360° rotation.	
Nominal Operating Torque:	0.006Nm
Contact Timing:	Nonshorting (break-before-make)

Materials & Finishes

Actuator:	Glass fiber reinforced polyamide
Housing:	Glass fiber reinforced polyamide (UL94V-0)
O-ring:	Nitrile butadiene rubber
Base:	Glass fiber reinforced polyamide (UL94V-0)
Movable Contact:	Beryllium copper with gold plating
Stationary Contacts:	Brass with gold plating
Terminals:	Brass with gold plating

Environmental Data

Operating Temperature Range:	-25°C through +75°C (-13°F through +167°F)
Humidity:	90 ~ 95% humidity for 96 hours @ 40°C (104°F)
Vibration:	10 ~ 55Hz with peak-to-peak amplitude of 1.5mm traversing the frequency range & returning in 1 minute; 3 right angled directions for 2 hours
Shock:	50G (490m/s ²) acceleration (tested in 6 right angled directions, with 5 shocks in each direction)

Processing

Soldering:	Wave Soldering Recommended: See Profile B in Supplement section. Note: During Wave Soldering process, set the switch to the following position: NDFR10, NDFR16, NDKR10, NDKR16: 0 position; NDFC10, NDKC10: 7 position; NDFC16, NDKC16: F position. Manual Soldering: See Profile B in Supplement section.
Cleaning:	Automated Cleaning. See Cleaning Specifications in Supplement section.

Standards & Certifications

Flammability Standards:	UL94V-0 rated housing & base The ND Series rotaries have not been tested for UL recognition or CSA certification. These switches are designed for use in a low-voltage, low-current, logic-level circuit. When used as intended in a logic-level circuit, the results do not produce hazardous energy.
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Distinctive Characteristics

Sealed construction prevents contact contamination and allows automated soldering and cleaning. Sealed design accomplished with seals between the actuator and housing and between housing and base.

Highly visible legends and choice of screwdriver or shaft actuation to provide trouble-free code setting.

Detent mechanism designed for crisp, positive action for accurate switch setting.

Bifurcated, spring loaded contacts give unmatched logic-level reliability.

Heat tolerant resin used for body meets UL flammability rating of 94V-0 and maintains switch reliability through automated soldering process.

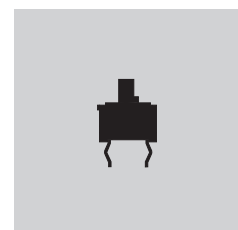
Crimped terminals ensure secure PC mounting and prevent dislodging during soldering.

.100" (2.54mm) terminal grid spacing between pin centers, plus 3-by-3 terminal arrangement for footprint pattern equivalent to industry standard.

Epoxy sealed terminals lock out flux, solvents, and other contaminants.



Actual Size



TYPICAL SWITCH ORDERING EXAMPLE

ND

K

C

10

P

Actuators	
F	Screwdriver Actuated
K	Shaft Actuated

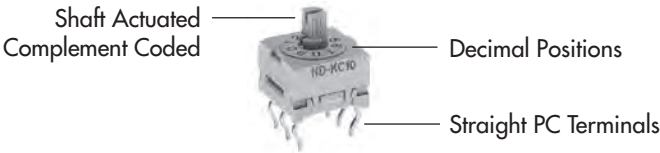
Circuits	
R	Real Coded (White Actuator)
C	Complement Coded (Red Actuator)

Positions	
10	Decimal
16	Hexadecimal

Terminals	
P	Straight
H	Right Angle

DESCRIPTION FOR TYPICAL ORDERING EXAMPLE

NDKC10P

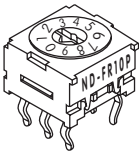


ACTUATORS

F

Screwdriver Actuated

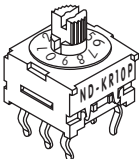
Actuator colors:
White for real coded
Red for complement coded



K

Shaft Actuated

Actuator colors:
White for real coded
Red for complement coded



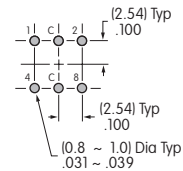
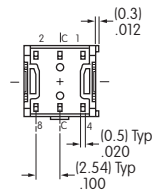
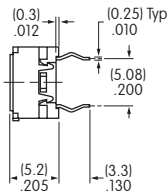
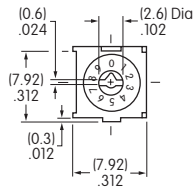
Actuators are fully rotational in either direction.

TRUTH TABLES (CIRCUITS & POSITIONS)

Actuator Position ● = ON		10 Decimal										16 Hexadecimal															
		0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
<div>R</div> Real Coded Model Numbers: NDFR, NDKR	1		●		●		●		●		●		●		●		●		●		●		●		●		●
	2			●	●			●	●				●	●			●	●			●	●			●	●	
	4					●	●	●	●						●	●	●	●					●	●	●	●	
	8									●	●									●	●	●	●	●	●	●	
<div>C</div> Complement Coded Model Numbers: NDFC, NDKC	1	●		●		●		●		●		●		●		●		●		●		●		●		●	
	2	●	●			●	●		●	●	●	●			●	●			●	●			●	●			
	4	●	●	●	●				●	●	●	●	●	●					●	●	●	●					
	8	●	●	●	●	●	●	●	●			●	●	●	●	●	●	●									

TYPICAL SWITCH DIMENSIONS

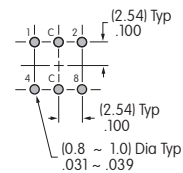
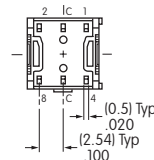
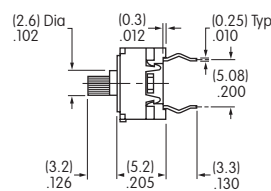
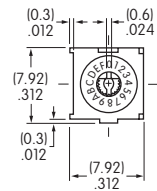
Screwdriver Actuated • Straight PC



Terminal numbers are not on switch

NDFR10P

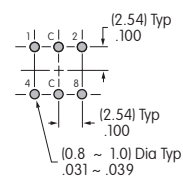
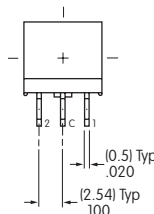
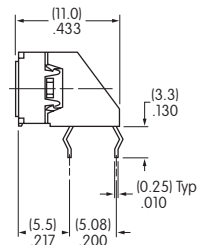
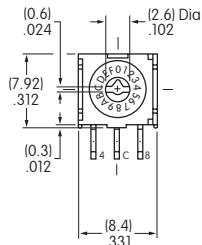
Shaft Actuated • Straight PC



Terminal numbers are not on switch

NDKC16P

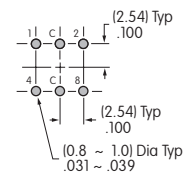
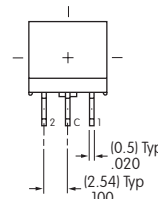
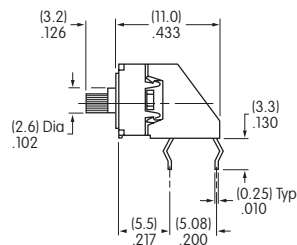
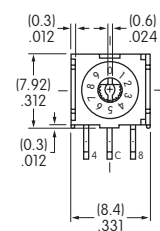
Screwdriver Actuated • Right Angle PC



Terminal numbers are on terminal cover

NDFC16H

Shaft Actuated • Right Angle PC



Terminal numbers are on terminal cover

NDKR10H

General Specifications

Electrical Capacity (Resistive Load)

Switching Rating:	100mA @ 5V DC
Nonswitching Rating:	100mA @ 50V DC

Other Ratings

Contact Resistance:	80 milliohms maximum for circuit; 30 milliohms maximum for contact point
Insulation Resistance:	1,000 megohms minimum @ 250V DC
Dielectric Strength:	250V AC minimum for 1 minute minimum
Mechanical Life:	20,000 detent operations minimum
Electrical Life:	20,000 detent operations minimum
Note: A detent operation is one actuator position operation or stepping. 20,000 detent operations = 1,250 cycles for hexadecimal devices or 2,000 cycles for decimal devices. A cycle is one 360° rotation.	
Nominal Operating Torque:	.061 kgf/cm (.846 oz/in)
Contact Timing:	Nonshorting (break-before-make)

Materials & Finishes

Actuator:	Glass fiber reinforced polyamide
Housing:	Glass fiber reinforced polyamide (UL94V-0)
O-ring:	Nitrile butadiene rubber
Base:	Glass fiber reinforced polyamide (UL94V-0)
Movable Contact:	Beryllium copper with gold plating
Stationary Contacts:	Brass with gold plating
Terminals:	Brass with gold plating

Environmental Data

Operating Temperature Range:	-25°C through +85°C (-13°F through +185°F)
Humidity:	90 ~ 95% humidity for 100 hours @ 40°C (104°F)
Vibration:	10 ~ 55Hz with peak-to-peak amplitude of 1.5mm traversing the frequency range & returning in 1 minute; 3 right angled directions for 2 hours
Shock:	50G (490m/s ²) acceleration (tested in 6 right angled directions, with 5 shocks in each direction)

Processing

Soldering:	Reflow Soldering: See Profile B in Supplement section. Note: During Reflow Soldering process, set the switch to the following position: ND3FR10, ND3FR16, ND3KR10, ND3KR16: 0 position; ND3FC10, ND3KC10: 7 position; ND3FC16, ND3KC16: F position. Manual Soldering: See Profile B in Supplement section.
Cleaning:	Automated cleaning. See Cleaning Specifications in Supplement section.

Standards & Certifications

Flammability Standards:	UL94V-0 rated housing & base The ND3 Series rotaries have not been tested for UL recognition or CSA certification. These switches are designed for use in a low-voltage, low-current, logic-level circuit. When used as intended in a logic-level circuit, the results do not produce hazardous energy.
--------------------------------	--

Distinctive Characteristics

Sealed construction prevents contact contamination and allows vapor phase and IR reflow soldering. Sealed design accomplished with seals between the actuator and housing and between housing and base.

Highly visible legends and choice of screwdriver or shaft actuation to provide trouble-free code setting.

Detent mechanism designed for crisp, positive action for accurate switch setting.

Bifurcated, spring loaded contacts give unmatched logic-level reliability.

Heat tolerant resin used for body meets UL flammability rating of 94V-0 and maintains switch reliability through vapor phase and infrared convection reflow soldering.

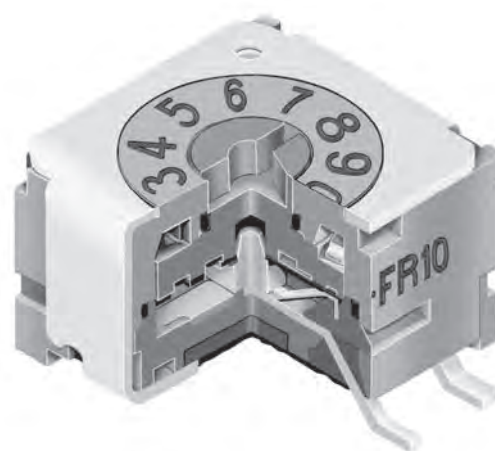
Gull-winged terminals ensure mechanical stability during soldering and simplified solder joint inspection.

.100" (2.54mm) terminal grid spacing between pin centers, plus 3-by-3 terminal arrangement for pad layout pattern equivalent to industry standard.

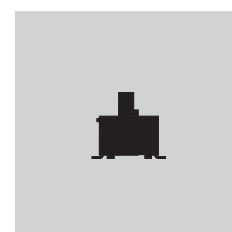
Epoxy sealed terminals lock out flux, solvents, and other contaminants.

Packaging in tape-reel or partitioned tray. Tape-reel packaging meets EIA-481-D Standard.

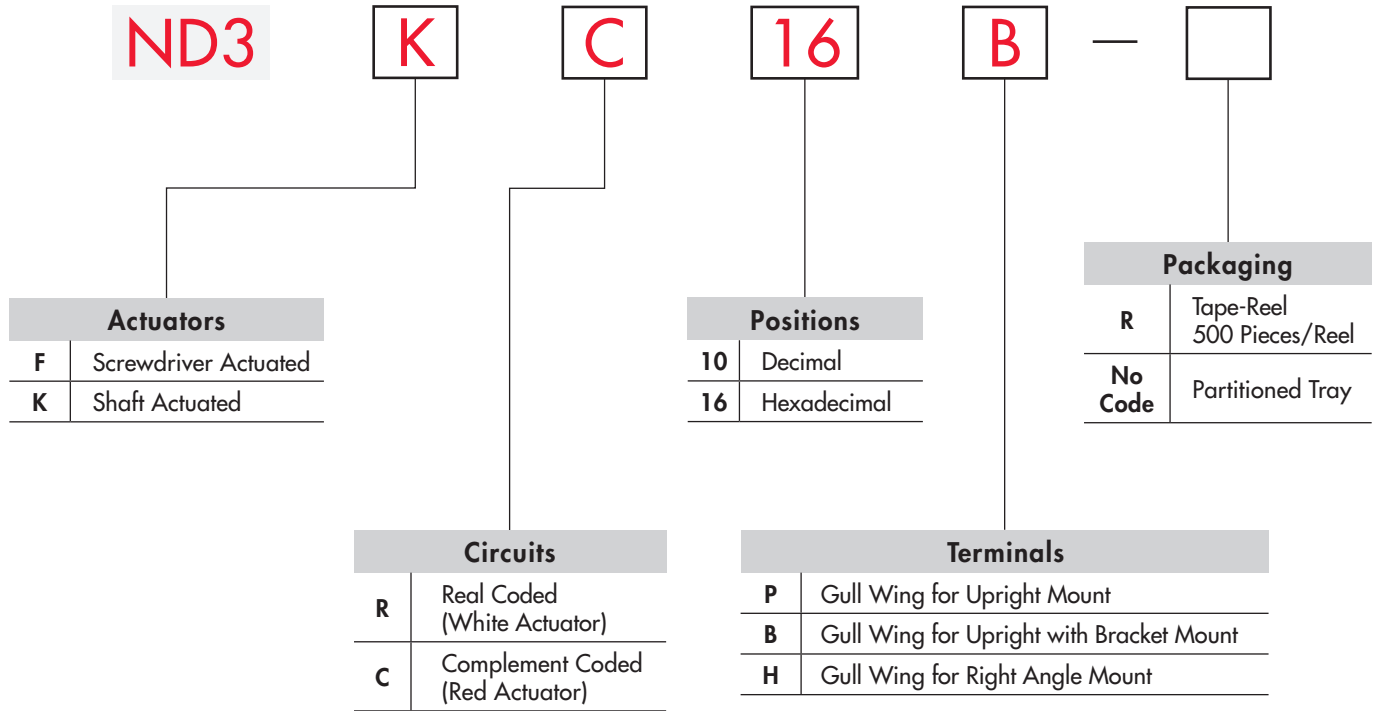
Coplanarity: all considered surfaces must lie between two parallel planes that are a maximum distance apart of .0059" (0.15mm). (Additional coplanarity details in Terms and Acronyms in the Supplement section.)



Actual Size



TYPICAL SWITCH ORDERING EXAMPLE



DESCRIPTION FOR TYPICAL ORDERING EXAMPLE

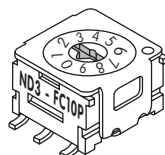
ND3KC16B



ACTUATION

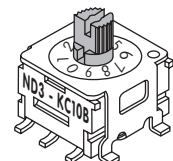
F Screwdriver Actuated

Actuator colors:
White for real coded
Red for complement coded



K Shaft Actuated

Actuator colors:
White for real coded
Red for complement coded

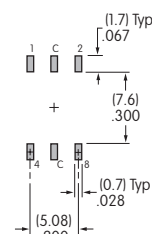
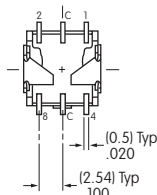
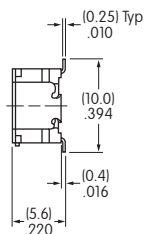
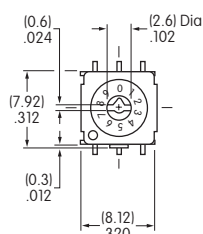


Actuators are fully rotational in either direction.

TRUTH TABLES (CIRCUITS & POSITIONS)

Actuator Position ● = ON		10 Decimal										16 Hexadecimal															
		0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
R Real Coded Model Numbers: ND3FR, ND3KR	1		●		●		●		●		●		●		●		●		●		●		●		●		●
	2			●	●			●	●					●	●			●	●			●	●			●	●
	4					●	●	●	●							●	●	●	●				●	●	●	●	
	8									●	●								●	●	●	●	●	●	●	●	●
C Complement Coded Model Numbers: ND3FC, ND3KC	1	●		●		●		●		●		●		●		●		●		●		●		●		●	
	2	●	●			●	●			●	●	●	●			●	●			●	●			●	●		
	4	●	●	●	●					●	●	●	●	●	●					●	●	●	●				
	8	●	●	●	●	●	●	●	●			●	●	●	●	●	●	●									

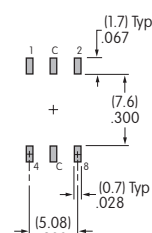
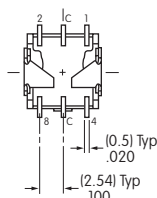
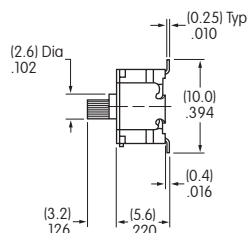
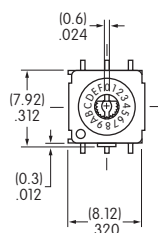
TYPICAL SWITCH DIMENSIONS



Screwdriver Actuated • Upright

Terminal numbers are not on switch.

ND3FR10P

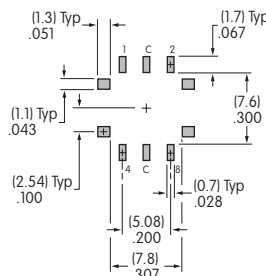
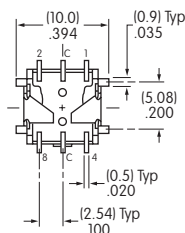
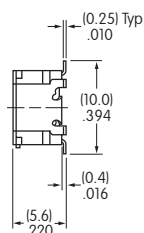
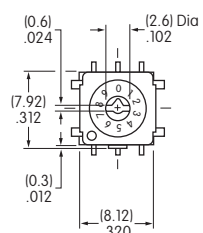


Shaft Actuated • Upright

Terminal numbers are not on switch.

ND3KC16P

Screwdriver Actuated • Upright with Bracket

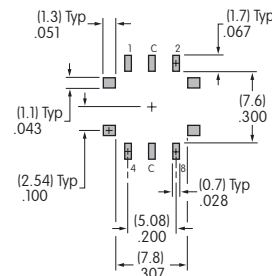
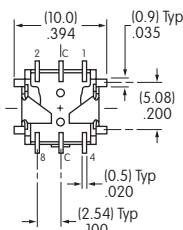
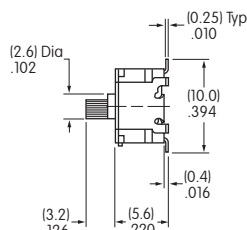
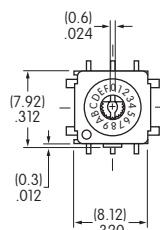


Terminal numbers are not on switch.

ND3FR10B

TYPICAL SWITCH DIMENSIONS

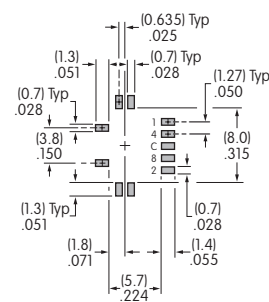
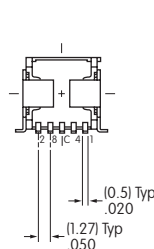
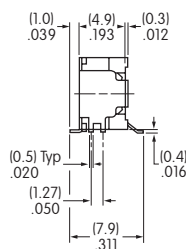
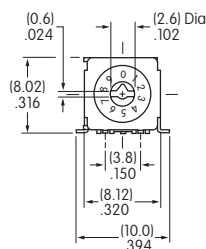
Shaft Actuated • Upright with Bracket



ND3KC16B

Terminal numbers are not on switch.

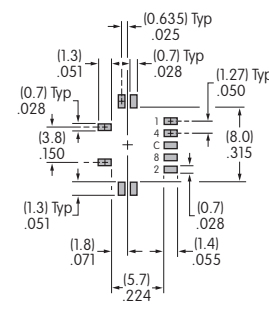
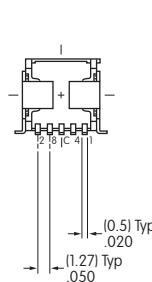
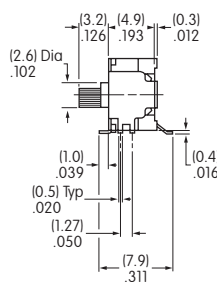
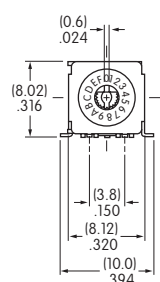
Screwdriver Actuated • Right Angle



ND3FC10H

Terminal numbers are not on switch.

Shaft Actuated • Right Angle



ND3KR16H

Terminal numbers are not on switch.

PACKAGING

Toggles

Rockers

Pushbuttons

Illuminated PB

Programmable

Key locks

G Rotaries

Slides

Tactiles

Tilt

Touch

Indicators

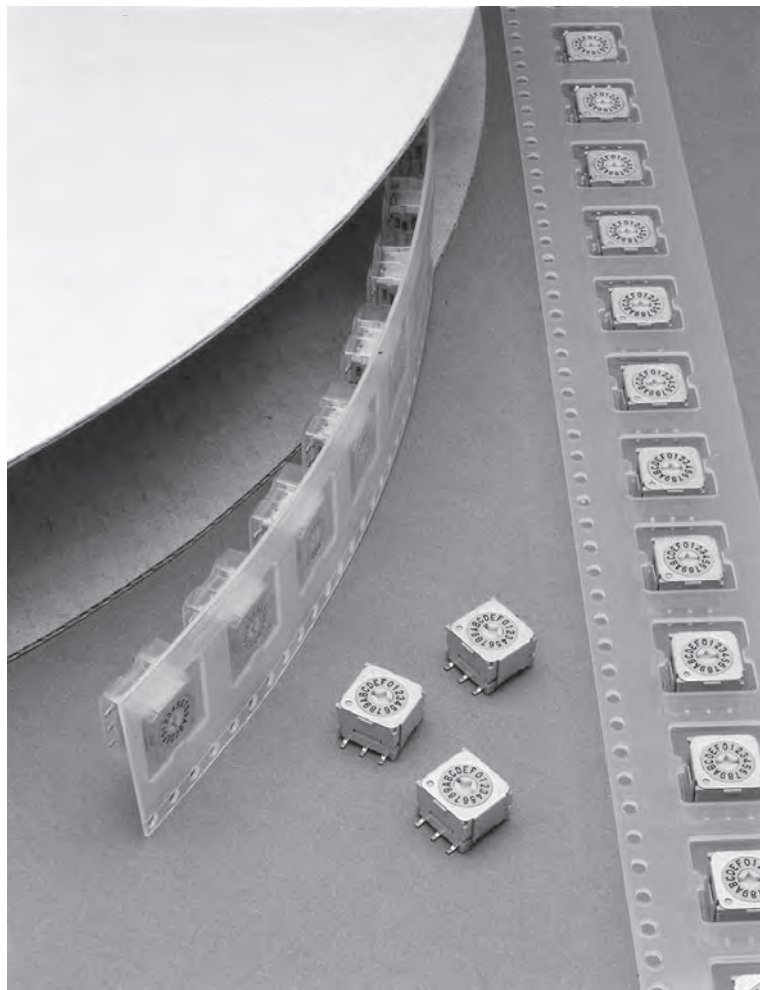
Accessories

Supplement

R Tape-Reel Packaging for Upright & Right Angle

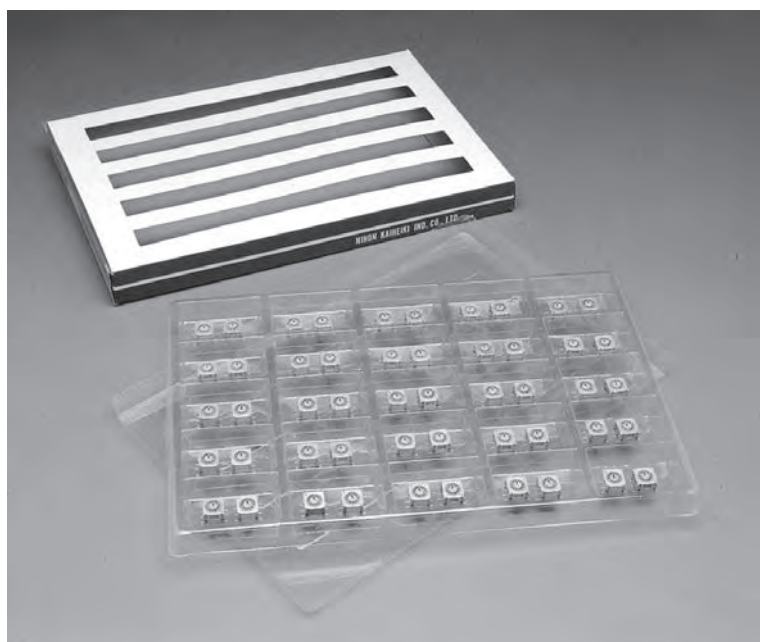
Switches must be ordered in 500-piece increments when tape-reel packaging is selected.

This packaging meets EIA-481-D Standard for "16mm and 24mm Embossed Carrier Taping of Surface Mount Components for Automatic Handling."



No Code Partitioned Tray for Upright & Right Angle Any Quantity

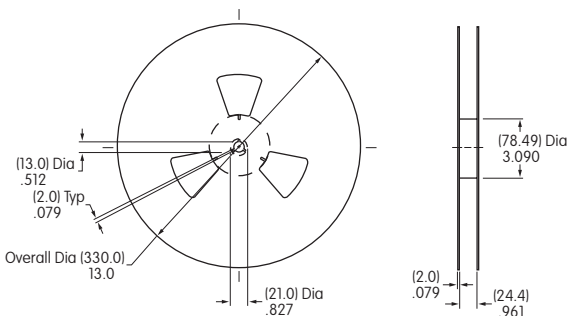
If the ND3 is ordered in less than 500-piece increments, the switches are packaged in a partitioned tray. No code is required.



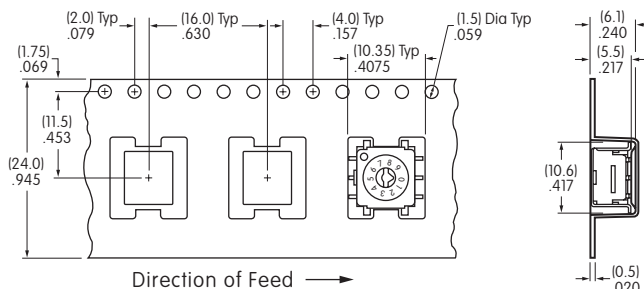
PACKAGING (CONTINUED)

For Upright & Upright with Bracket (Codes P & B with F Actuator)

Each tape-reel of 550 pockets contains 500 switches
 Minimum Leader Length: 9.05" (230mm) Minimum Trailer Length: 6.30" (160mm)



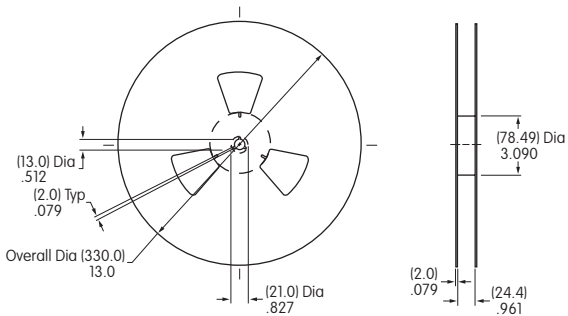
Reel Dimensions



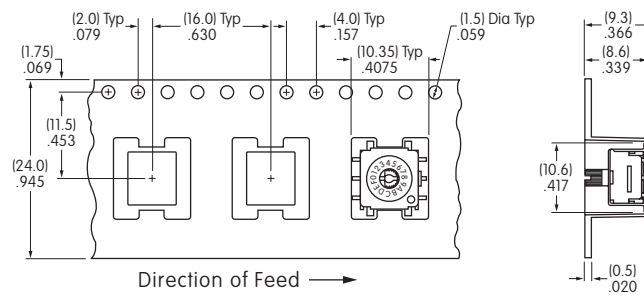
Tape Dimensions

For Upright & Upright with Bracket (Codes P & B with K Actuator)

Each tape-reel of 530 pockets contains 500 switches
 Minimum Leader Length: 9.05" (230mm) Minimum Trailer Length: 6.30" (160mm)



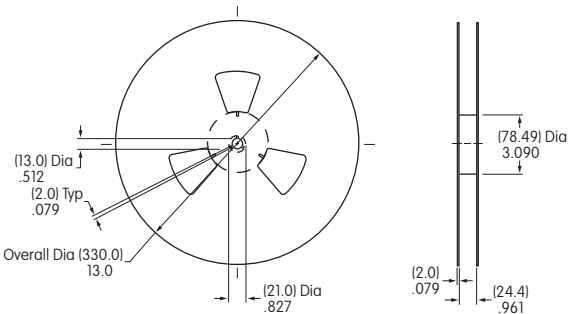
Reel Dimensions



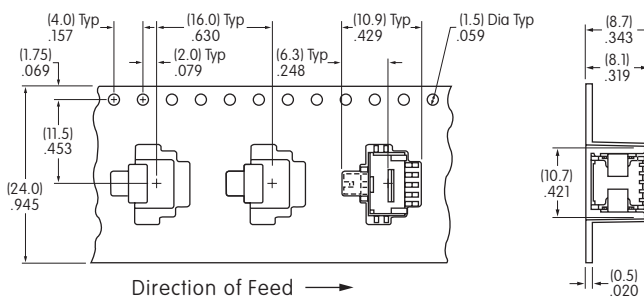
Tape Dimensions

For Right Angle (Code H with F or K Actuator)

Each tape-reel of 550 pockets contains 500 switches
 Minimum Leader Length: 9.05" (230mm) Minimum Trailer Length: 6.30" (160mm)



Reel Dimensions



Tape Dimensions

GENERAL SPECIFICATIONS

Electrical Capacity

Resistive Load: HS13: 6A @ 125V AC, 3A @ 250V AC, or 5A @ 30V DC
 HS16: 12A @ 125V AC or 6A @ 250V AC
 TS: 6A @ 125/250V AC
 PS: 30A @ 125/250V AC

Other Ratings

Contact Resistance: 10 milliohms maximum
Insulation Resistance: 200 megohms minimum @ 500V DC
Dielectric Strength: 1,500V AC minimum for 1 minute minimum
Mechanical Life: HS: 15,000 operations minimum
 TS: 30,000 operations minimum
 PS: 10,000 operations minimum
Electrical Life: HS: 7,500 operations minimum
 TS: 10,000 operations minimum
 PS: 5,000 operations minimum
Indexing: 30° for HS16, TS & PS; 45° for HS13
Contact Timing: Nonshorting HS13; Shorting & Nonshorting HS16; Nonshorting TS; Nonshorting PS
Range of Operating Torque: HS16: 0.54 ~ 0.64Nm for first pole & 0.05Nm for each additional pole
 HS13: 0.15 ~ 0.24Nm
 TS: 0.09Nm for first pole & (0.07Nm x total number of poles) + 0.13Nm for additional poles
 PS: 0.14Nm for each pole

Materials & Finishes

Knob: Phenolic resin
Shaft: HS13: brass; HS16, TS, & PS: brass with nickel plating
Bushing: HS13: brass; HS16, TS, & PS: brass with nickel plating
Case: Phenolic resin
Movable Contacts: HS13, HS16, & TS phosphor bronze; PS silver alloy
Stationary Contacts: HS13, HS16, & PS: brass with silver plating; TS: phosphor bronze
Terminals: HS: phosphor bronze; TS & PS: copper with silver plating

Environmental Data

Operating Temp Range: -10°C through +70°C (+14°F through +158°F)
Humidity: 90 ~ 98% humidity for 96 hours @ 40°C (104°F)
Vibration: 10 ~ 55 Hz with peak-to-peak amplitude of 1.5mm traversing the frequency range & returning in 1 minute; 3 right angled directions for 2 hours
Shock: 50G (490m/s²) acceleration (tested in 3 right angled directions, with 3 shocks in each direction)

Installation

Mounting Torque: 2.94Nm (26 lb•in)
Maximum Panel Thickness: Shown with panel cutouts in following drawings
Soldering Time & Temperature: Manual Soldering (HS series only): See Profile A in Supplement section.

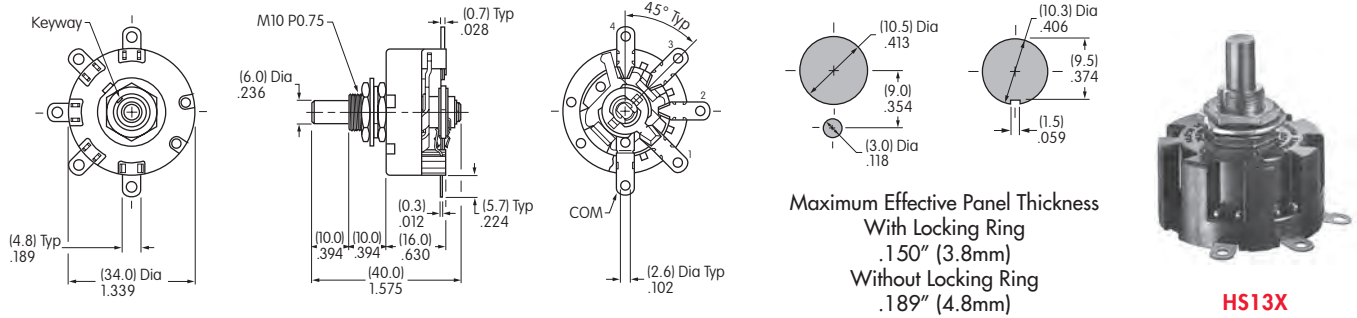
Standards & Certifications

UL: **File No. E44145 - Recognized only when ordered with marking on switch.**
 Add "/U" or "/CUL" to end of part number to order UL recognized switch.
 HS16 models 1– through 6–pole are recognized at 12A @ 125V AC & 6A @ 250V AC
 See Supplement section to find UL or cULus rating details.

6 AMP SINGLE POLE/NONSHORTING/45° INDEXING

Round Shaft	D-flat Shaft	Number of Positions	Stopper Settings	Number of Terminals	Load Terminals	Schematics
HS13X	HS13X-D	2	Fixed	1 COM, 2 LOAD	1 & 2	HS13X
HS13Y	HS13Y-D	3	Fixed	1 COM, 3 LOAD	1, 2, & 3	HS13Y
HS13Z	HS13Z-D	4	Fixed	1 COM, 4 LOAD	1, 2, 3, & 4	HS13Z

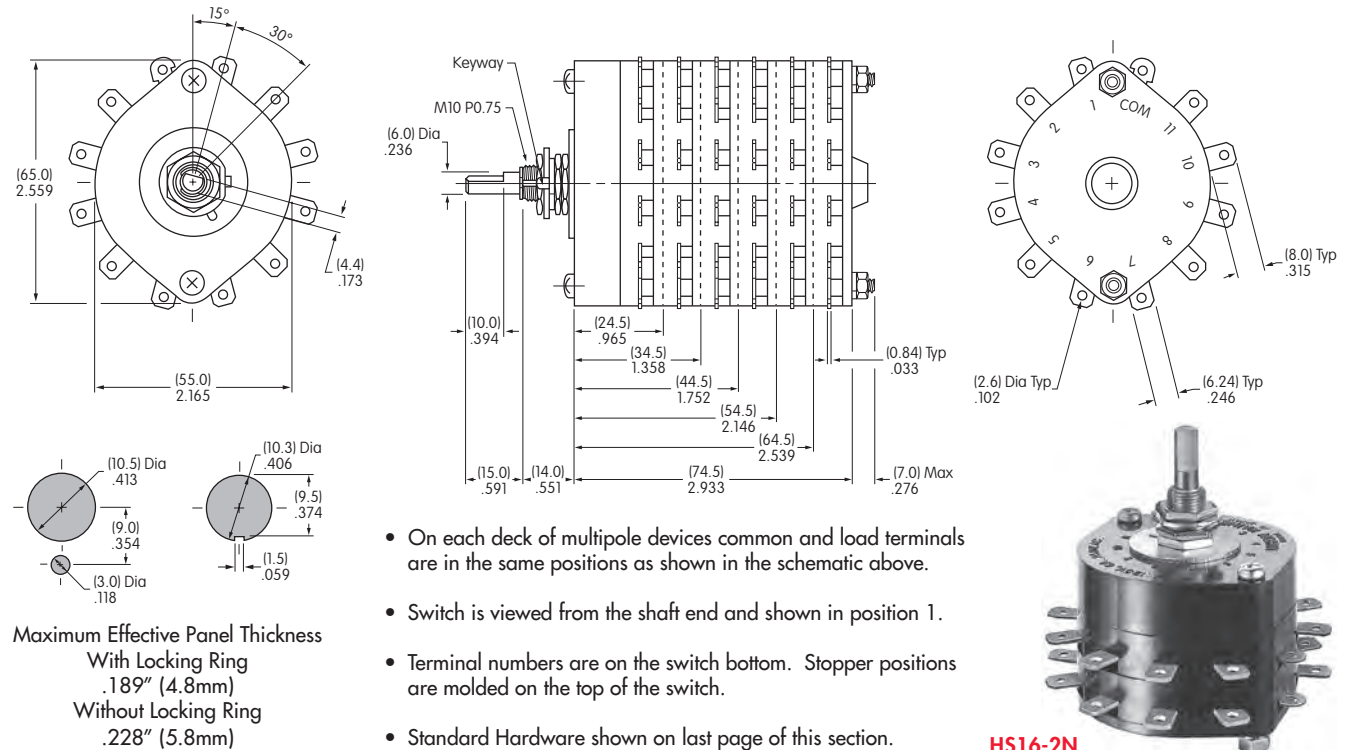
Switch is viewed from shaft end and shown in position 1. Terminal numbers are not on switch. Standard Hardware shown on last page of this section.



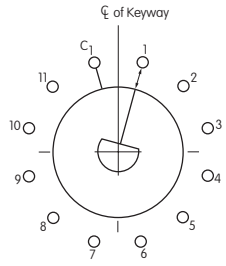
12 AMP/SHORTING & NONSHORTING/30° INDEXING

Knurled Shaft		D-flat Shaft		Pole	Number of Positions	Stopper Settings	Number of Terminals	Schematic
Nonshorting	Shorting	Nonshorting	Shorting					
HS16-1	HS16-1S	HS16-1N	HS16-1SN	1P	2-11	2, 3, 4 . . . 11	1 COM, 11 LOAD	
HS16-2	HS16-2S	HS16-2N	HS16-2SN	2P	2-11	2, 3, 4 . . . 11	2 COM, 22 LOAD	
HS16-3	HS16-3S	HS16-3N	HS16-3SN	3P	2-11	2, 3, 4 . . . 11	3 COM, 33 LOAD	
HS16-4	HS16-4S	HS16-4N	HS16-4SN	4P	2-11	2, 3, 4 . . . 11	4 COM, 44 LOAD	
HS16-5	HS16-5S	HS16-5N	HS16-5SN	5P	2-11	2, 3, 4 . . . 11	5 COM, 55 LOAD	
HS16-6	HS16-6S	HS16-6N	HS16-6SN	6P	2-11	2, 3, 4 . . . 11	6 COM, 66 LOAD	

Switch is viewed from shaft end and shown in position 1. Terminal numbers are not on switch. Standard Hardware shown on last page of this section.

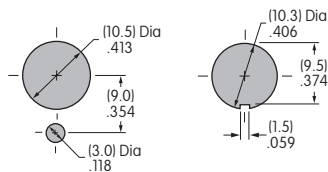


6 AMP/NONSHORTING/ADJUSTABLE STOP/30° INDEXING

Model	Pole	Number of Positions	Stopper Settings	Number of Terminals	Shaft Type	Schematic
TS1N	1P	2-11	2, 3, 4 . . . 11	1 COM, 11 LOAD	D Flat	 <p>On each deck of multipole devices common & load terminals are in the same positions as shown in this schematic.</p> <p>Switch is viewed from the shaft end and shown in position 1.</p> <p>Terminal numbers are on the switch bottom. Stopper positions are molded on the top of the switch.</p>
TS2N	2P	2-11	2, 3, 4 . . . 11	2 COM, 22 LOAD	D Flat	
TS3N	3P	2-11	2, 3, 4 . . . 11	3 COM, 33 LOAD	D Flat	
TS4N	4P	2-11	2, 3, 4 . . . 11	4 COM, 44 LOAD	D Flat	
TS5N	5P	2-11	2, 3, 4 . . . 11	5 COM, 55 LOAD	D Flat	

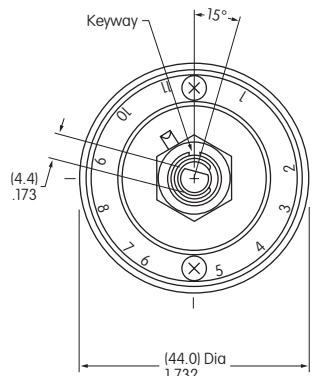
• Standard Hardware shown on last page of this section.

Panel Cutouts

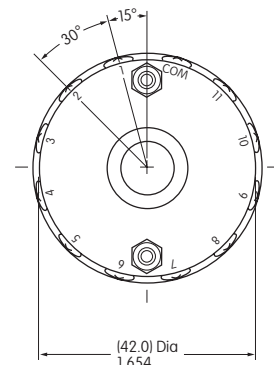


Maximum Effective Panel Thickness
 With Locking Ring
 .189" (4.8mm)
 Without Locking Ring
 .228" (5.8mm)

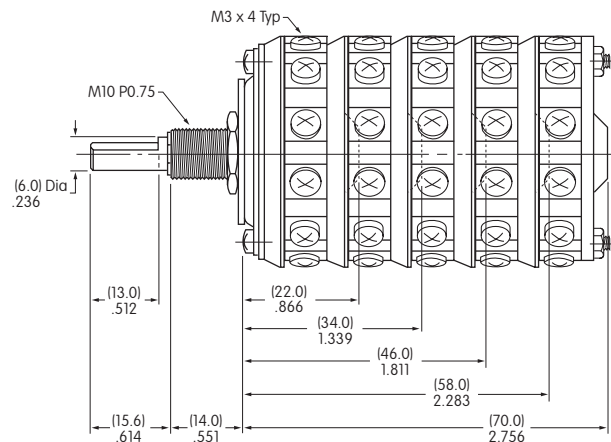
Top



Bottom



TS5N



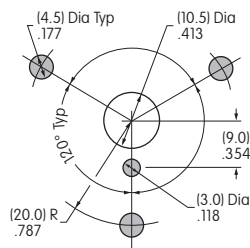
30 AMP/NONSHORTING/ADJUSTABLE STOP/30° INDEXING

Knurled Shaft	D Flat Shaft	Pole	Number of Positions	Stopper Settings	Number of Terminals	Schematic
PS1	PS1N	1P	2-11	2, 3, 4 . . . 11	1 COM, 11 LOAD	
PS2	PS2N	2P	2-11	2, 3, 4 . . . 11	2 COM, 22 LOAD	
PS3	PS3N	3P	2-11	2, 3, 4 . . . 11	3 COM, 33 LOAD	
PS4	PS4N	4P	2-11	2, 3, 4 . . . 11	4 COM, 44 LOAD	
PS5	PS5N	5P	2-11	2, 3, 4 . . . 11	5 COM, 55 LOAD	

On each deck of multipole devices common & load terminals are in the same positions as shown in this schematic. Switch is viewed from the shaft end and shown in position 1. Terminal numbers are on switch bottom. Stopper positions are molded on the top of the switch.

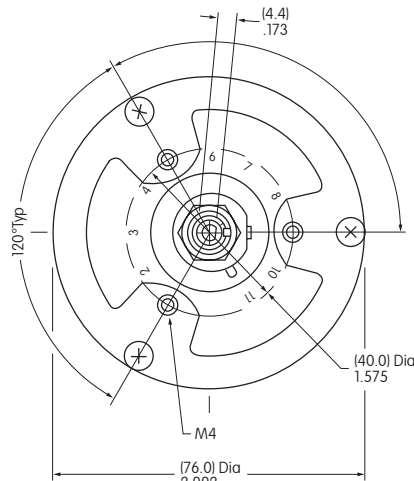
- Standard Hardware shown on last page of this section.

Panel Cutout

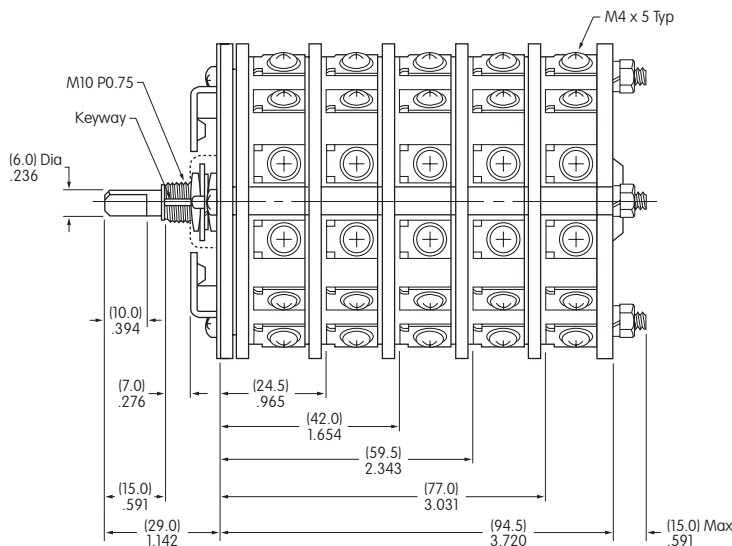
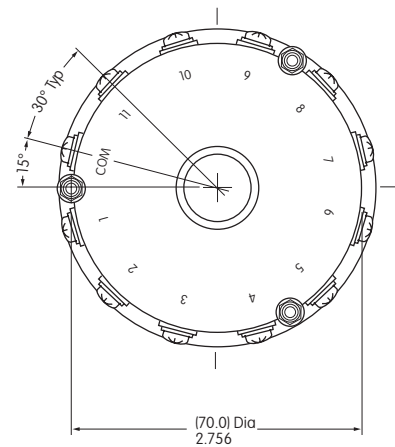


Maximum Effective Panel Thickness
Without Locking Ring
.189" (4.8mm)

Top



Bottom

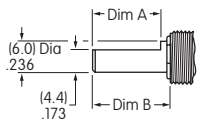


PS4N

SHAFT TYPES

D Flat Shaft

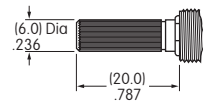
For use with
AT431 and AT432



Dimension A	Dimension B
For TS (13.0) .512	For TS (15.6) .614
For HS (10.0) .394	For HS (15.0) .591

Knurled Shaft

Not for use with
AT431 or AT432

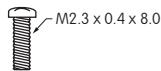
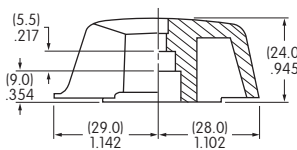
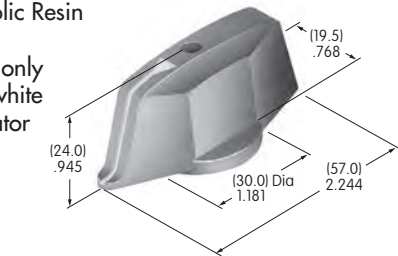


OPTIONAL KNOBS FOR D FLAT SHAFTS

AT431 Large Knob

Phenolic Resin

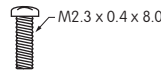
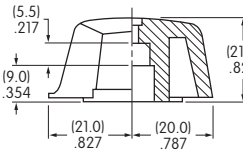
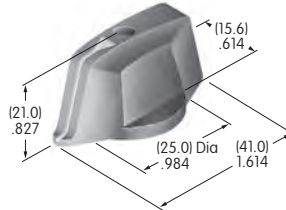
Black only
with white
indicator
line



AT432 Small Knob

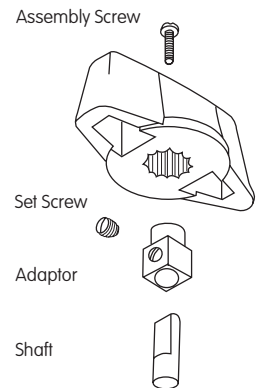
Phenolic Resin

Black only
with white
indicator
line



Knob Orientation

The rotary knobs used on the D-flat shafts can be oriented on the switch to suit the customer's particular front panel needs simply by sliding the knob over the square adaptor at the preferred orientation.



STOPPER SETTING

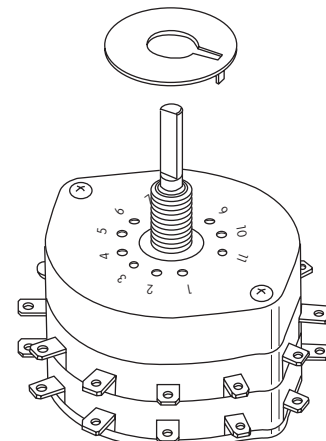
For HS16, TS, & PS Models

The HS16, TS, and PS switches are supplied with the stopper plate set for the maximum number of positions allowed for that model. Prior to installation, the desired stopper setting should be made:

1. Be sure the shaft is turned counterclockwise to the extreme left. If the shaft is not turned counterclockwise to the extreme left, proper setting cannot be achieved.
2. Loosen the nut far enough to allow raising the stopper plate for resetting.
3. Insert the stopper in the numbered hole for the desired stopper setting. Satisfactory switch functioning cannot be assured if the stopper plate is not properly positioned.
4. Tighten the nut firmly against the stopper plate.

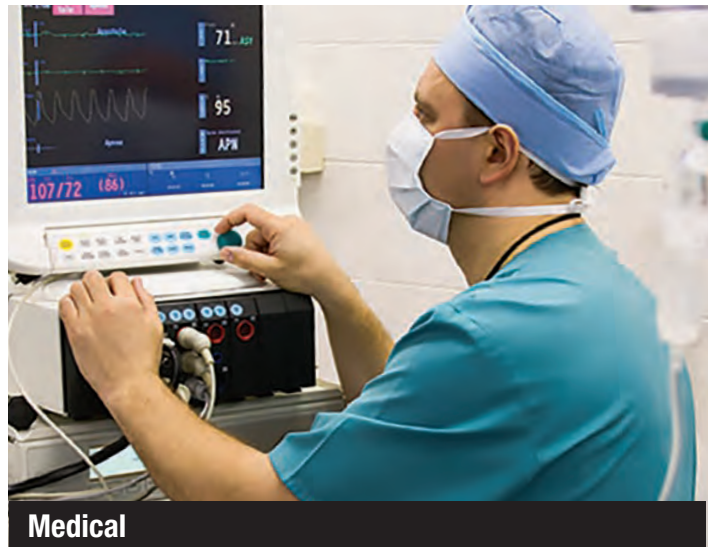
Standard Hardware Supplied with HS, TS, and PS:

AT526 Hex Mounting Nut (quantity 3)
AT518 Locking Ring (quantity 1)
AT520 Split Lockwasher (quantity 1)
Use of mounting supports on PS is optional; screws are not provided.





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Warranty: All NKK products are warranted against defects in workmanship, material and construction for a period of one (1) year from the date of shipment if the products have been properly installed, used, and maintained. There are no express warranties of merchantability or fitness for a particular purpose. Materials, finishes, and component parts are subject to change without notification.



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