

MECHANICAL ENCODERS

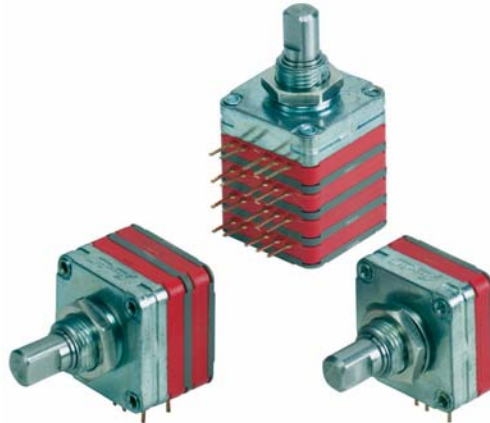
- Standard BCD and Multiple Code Outputs
- As Small as 1/2" Diameter
- Economical Means to Provide Code Output

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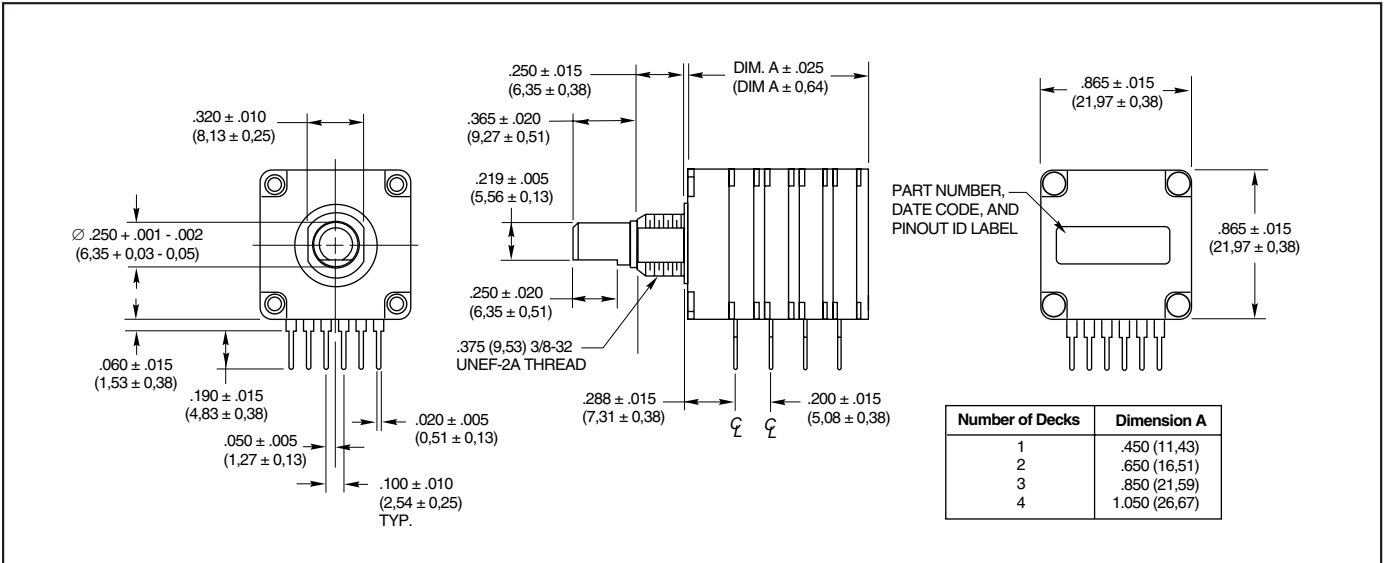
SERIES 25
Multi-Deck

FEATURES

- Multiple Code and Indexing Choices
- Reliability Tested to Listed Specifications
- Less than 1.0" Square
- Termination Choices
- Panel and Shaft Seal Option
- Manufactured to ISO 9001 and Military Standards
- Custom Configurations Available



DIMENSIONS In inches (and millimeters)



Optical and Mechanical Encoders

SPECIFICATIONS

Electrical Ratings

Switching Loads: 150 mA at 120 Vac, resistive; 150 mA at 28 Vdc, resistive

Current Carrying Capacity: 250 mA at 28 Vdc, resistive

Contact Resistance: 75 mΩ maximum after life

Insulation Resistance: 1000 mΩ minimum between terminals and shaft

Voltage Breakdown: 1000 Vac minimum between terminals and shaft

Life Expectancy: 50,000 cycles at rated loads

Contacts: Shorting

Mechanical Ratings

Stop Strength: 10 in-lbs minimum

Rotational Torque: 4-20 in-oz, dependent on the number of decks

Operating Temperature Range: -65°C to +85°C

Non-Turn Device: Flatted mounting bushing, .375" dia. x .320"

Package Size: .865" square

Termination: PC terminals, .100" on center. Decks are .200" apart.

Materials and Finishes

Bushing: Die cast zinc alloy, tin-zinc plated

Mounting Hardware: plated brass

Decks, Deck Separators, End Plate: Thermoplastic

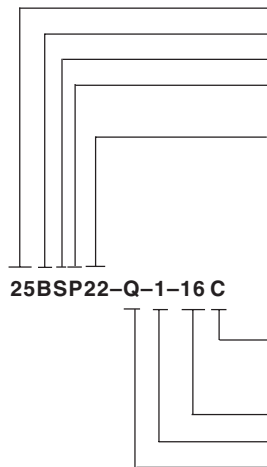
Contacts and Terminals: Gold, silver, nickel-plated beryllium copper

Shaft, Stop Blades: Stainless Steel

Detent Balls: Steel, nickel-plated

Rivets: Brass, zinc-plated

ORDERING INFORMATION



Series 25: Multi-deck

Shaft size: B = 1/4" diameter shaft

Sealed or non-sealed: S = Shaft and panel seal; No letter = no seal

Terminal structure: P = PC, perpendicular to shaft; R = PC, rear facing (one deck only); F = PC, front facing (one deck only).

Angle of throw (determines the maximum number of positions):

10 = 10°, 36 positions; 11 = 11.25°, 32 positions; 12 = 12°, 30 positions;

15 = 15°, 24 positions; 18 = 18°, 20 positions; 22 = 22.5°, 16 positions;

30 = 30°, 12 positions; 45 = 45°, 8 positions; 60 = 60°, 6 positions;

90 = 90°, 4 positions.

Stop arrangement: For switches with maximum positions, add C for continuous rotation; add F for stop between first and last. No notation required for less than maximum positions.

Number of positions: Maximum is dependent on the angle of throw. Minimum is two.

Number of decks: One through four possible.

Code output:

B = Binary available in 22.5°

Q = Quadrature

G = Gray available in 22.5°

Specials include 1/8" diameter shaft, custom angles of throw for binary, binary complement and gray code outputs. Contact Grayhill Sales for availability.

Control knobs available, see page I-57.

Available from your local Grayhill Distributor. For prices and discounts, contact a local Sales Office, an authorized local Distributor or Grayhill.

SERIES 25L

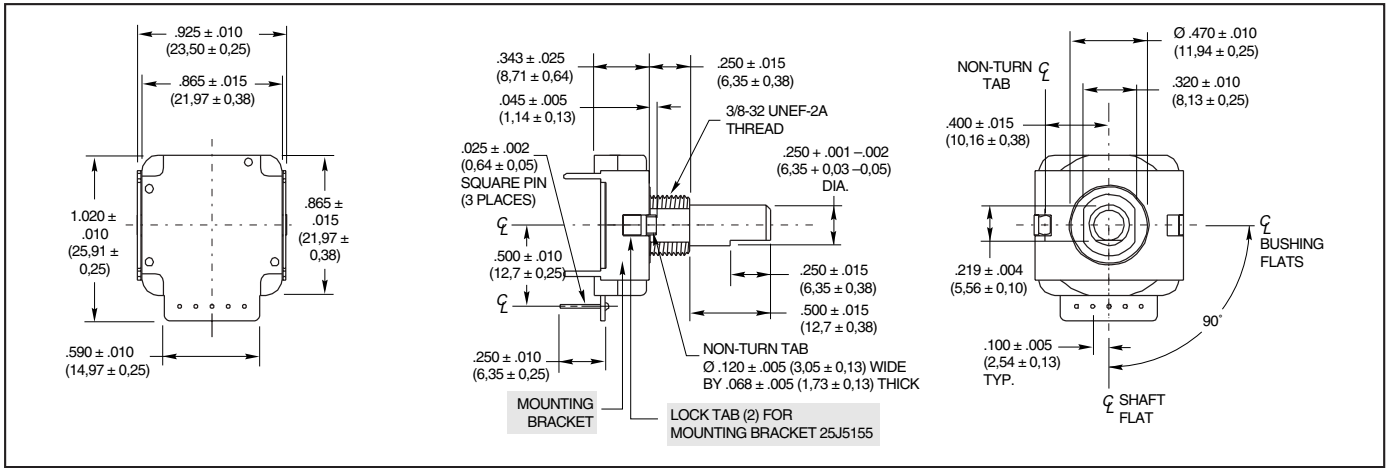
Hex, Gray and Quadrature Code

FEATURES

- Price Competitive to Similar Designs
- Quality Construction and Contact Materials
- Multiple Code and Indexing Choices
- 100,000 Life Cycles
- Less than 1.0" Square
- Manufactured to ISO 9001 Standards



DIMENSIONS In inches (and millimeters)



TRUTH TABLES

Clockwise Rotation					
4-Bit Gray Code-16 Position					
Switch Position	Code Position	Output			
		1	2	4	8
1	0				
2	1	•			
3	2	•	•		
4	3		•		
5	4		•	•	
6	5	•	•	•	
7	6	•		•	
8	7			•	
9	8			•	•
10	9	•		•	•
11	10	•	•	•	•
12	11		•	•	•
13	12		•		•
14	13	•	•		•
15	14	•			•
16	15				•

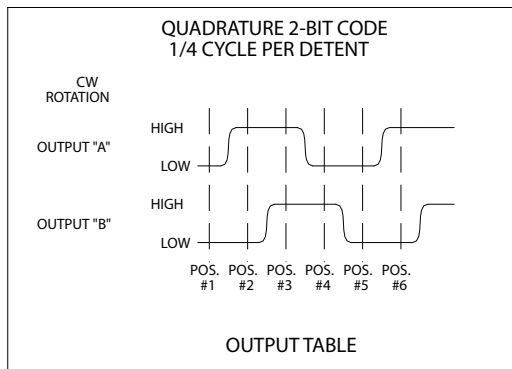
• Indicates closed circuit; blank indicates open circuit.

Clockwise Rotation					
4-Bit Binary Code Hexadecimal-16 Position					
Switch Position	Code Position	Output			
		1	2	4	8
1	0				
2	1	•			
3	2		•		
4	3	•	•		
5	4			•	
6	5	•		•	
7	6		•	•	
8	7	•	•	•	
9	8				•
10	9	•			•
11	10		•	•	•
12	11	•	•		•
13	12			•	•
14	13	•	•	•	•
15	14		•	•	•
16	15	•	•	•	•

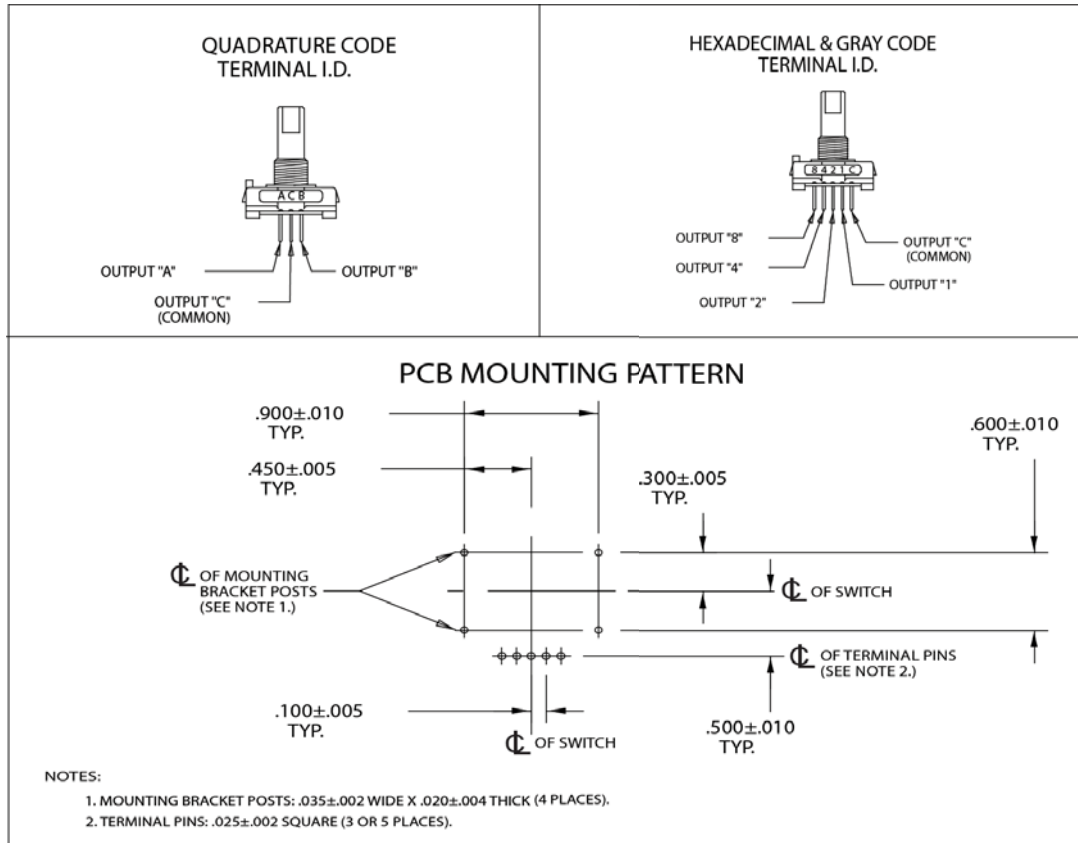
• Indicates closed circuit; blank indicates open circuit.

Clockwise Rotation		
Quadrature 2-Bit Code 1/4 Cycle per Detent		
Switch Position	"A"	Output "B"
1		
2	•	
3	•	•
4		•
5		
6	•	
7	•	•
8		•
9		
10	•	
11	•	•
12		•
13		
14	•	
15	•	•
16		•
17		
18	•	
19	•	•
20		•
21		
22	•	
23	•	•
24		•
25		
26	•	
27	•	•
28		•
29		
30	•	
31	•	•
32		•
33		
34	•	
35	•	•
36		•

• Indicates closed circuit; blank indicates open circuit. Code repeats every 4 positions.



Optical and Mechanical Encoders



Optical and Mechanical Encoders

SPECIFICATIONS

Electrical Ratings

Switching Loads: 1.5 mA at 115 Vac, resistive; 150 mA at 14 Vdc, resistive
 Current Carrying Capacity: 250 mA maximum at 28 Vdc, resistive load
 Contact Resistance: 75 mΩ, typical
 Insulation Resistance: 1000 mΩ minimum between terminals
 Voltage Breakdown: 1000 Vac minimum between terminals
 Life Expectancy: 100,000 cycles of operation at rated loads. One cycle of operation is a rotation through all of the active positions and a return to the starting position.

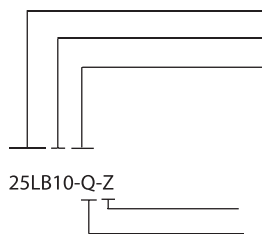
Mechanical Ratings

Rotational Torque: 2 to 6 in-oz
 Operating Temperature Range: -40 C° to +85 C°
 Storage Temperature Range: -65 C° to +85 C°
 Continuous Rotation: All standard switches are continuous rotation. Desired stop locations supplied upon request.
 Anti-Rotation Device: Integral non-turn tab, flattened bushing, .375" diameter, .320 double "D" across flats.
 Termination: Standard is PC style, parallel to shaft, facing rear. Options include PC, parallel to shaft, facing front.
 Panel Mounting Torque: 10 in-lbs maximum

Materials and Finishes

Bushing/Housing and Shaft/Rotor: Reinforced thermoplastic
 Detent Ball: Stainless steel, nickel-plated
 Detent Spring: Tinned music wire
 Contacts: Beryllium copper, gold plate over nickel
 Terminals: Copper alloy, #725, 100% tin plate over nickel plate
 Output Board: FR-4, copper/nickel-plated
 Mounting Nut: Brass, tin/zinc-plated hex nut
 Mounting Bracket: Stainless Steel, tin-plated

ORDERING INFORMATION



Series: 25L = Economical, single deck encoder
 Housing Color: B = Black housing; R = Red housing
 Angle of Throw: 10 = 10°, 36 positions; 11 = 11.25°, 32 positions;
 15 = 15°, 24 positions; 18 = 18°, 20 positions;
 22 = 22.5°, 16 positions; 30 = 30°, 12 positions;
 45 = 45°, 8 positions

Mounting Bracket: Z = with bracket, Blank = no bracket
 Code Output: H = Hexadecimal available only in 22.5°
 G = Gray available only in 22.5°
 Q = Quadrature (2-bit)

Custom materials, styles, color and markings are available. Custom knobs available.

Available from your local Grayhill Distributor. For prices and discounts, contact a local Sales Office, an authorized local Distributor or Grayhill. For custom codes, termination, rotational torque, angles of throw, call Grayhill for more information.

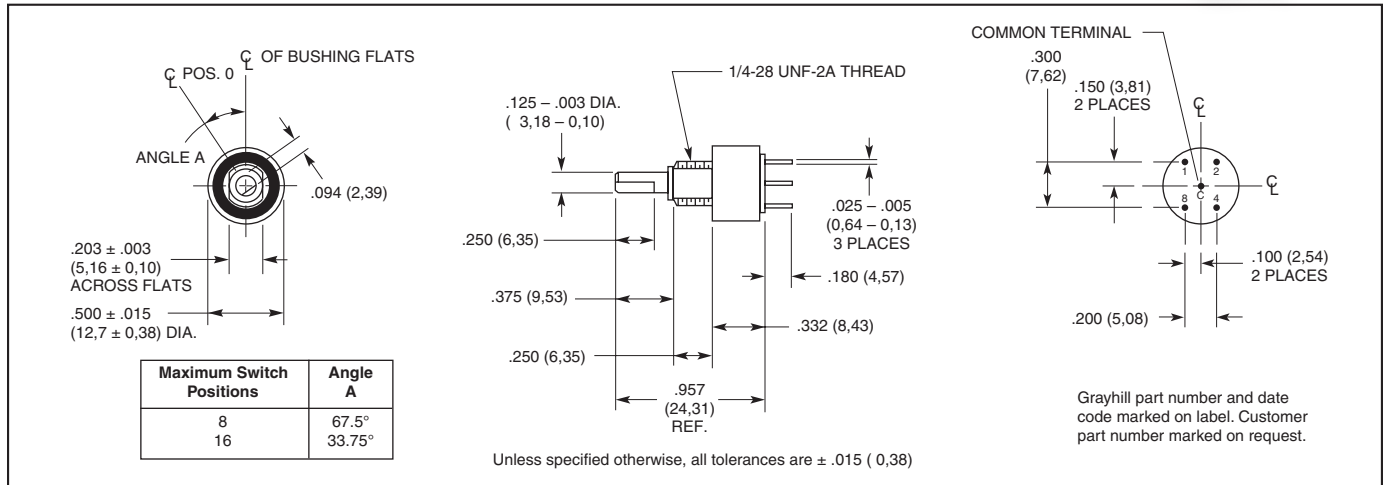
SERIES 26 Binary and Gray Code

AVAILABLE CODES

- Hexadecimal
- Octal
- BCD (Adjusted)
- Quadrative
- Custom (4-Bit, 16 position maximum)
- RoHS Compliant



DIMENSIONS In inches (and millimeters)



Maximum Switch Positions	Angle A
8	67.5°
16	33.75°

SPECIFICATIONS

Electrical Ratings

Rated: 25,000 cycles with logic compatible loads. Make and break 200 mA.

Contact Resistance: 500 milliohms maximum (less than 100 milliohms initially)

Insulation Resistance: 1000 megohms minimum (10,000 megohms initially)

Dielectric Strength: 250 Vac minimum

Materials and Finishes

Panel Seal: Silicone Rubber

Shaft Seal: Fluorosilicone

Mounting Nut (mounting hardware—one per switch): Brass, tin/zinc-plated

Internal Tooth Lockwasher (mounting hardware—one per switch): Steel, tin/zinc-plated

Detent Balls: Carbon steel, nickel-plated

Detent Spring: Pretinned music wire

Detent Rotor: Thermoplastic

Shaft, Stop Arm and Stop Pins: Stainless steel

Bushing: Zamak II tin/zinc alloy, zinc-plated

Switch Base: Diallyl phthalate

Printed Circuit Board: NEMA Grade FR-4.

Terminals: Brass, gold-plated over nickel plate

Contacts: Copper alloy, gold-plated over nickel plate

Additional Characteristics

Rotational Torque: 4 to 8 oz-in on a new switch.

Vibration Resistance: 10 to 55 Hz at 0.060" double amplitude; no damage and no contact openings per MIL-STD-202,

Method 201A

Shock Resistance: Passes medium requirement MIL-S-3785 (MIL-STD-202, Method 213)

Stop Strength: 5 in-lbs minimum

Terminals: All switches are provided with all 5 terminals, regardless of the number of active positions.

Relative Humidity: 90-95% at 40°C for 240 hours (MIL-STD-202 Method 103, Test Condition A)

OPTIONS

Adjustable Stop Switches

The switch may have continuous rotation, or be adjusted to limit the rotation. The panel seal ring can be removed to expose the stop pin holes on the front of the switch. Two stop pins and panel seal o-ring are supplied with the switch. One or both may be used to limit the rotation as desired.

Shaft and Panel Seal

All switches are provided with a shaft and panel seal.

ORDERING INFORMATION

BCD Output—Adjustable Stop

Number of Positions	Part Number
8 Positions	26ASD45-01-1-AJS
16 Positions	26ASD22-01-1-AJS

Available from your local Grayhill Distributor. For prices and discounts, contact a local Sales Office, an authorized local Distributor or Grayhill.

CODE AND TRUTH TABLE

Switch Position	Code Position	BCD Output*				Gray Output*			
		1	2	4	8	1	2	4	8
1	0								
2	1	●				●			
3	2		●			●	●		
4	3	●	●				●		
5	4			●			●	●	
6	5	●		●		●	●	●	
7	6		●	●		●		●	
8	7	●	●	●				●	
9	8				●			●	●
10	9	●			●	●		●	●
11	10		●		●	●	●	●	●
12	11	●	●		●		●	●	●
13	12			●	●		●		●
14	13	●		●	●	●	●		●
15	14		●	●	●	●			●
16	15	●	●	●	●				●

*Dot indicates terminal tied to common.

Gray Code Output—Adjustable Stop

Number of Positions	Part Number
16 Positions	26GSD22-01-1-AJS
8 Positions	26GSD45-01-1-AJS

Custom switches with options such as 1/4" shaft diameter, longer shaft or terminals available by contacting Grayhill sales. Custom encoders with options such as: custom code output, 1/4" shaft diameter, and longer shaft and terminal lengths are available by contacting the Grayhill sales office.

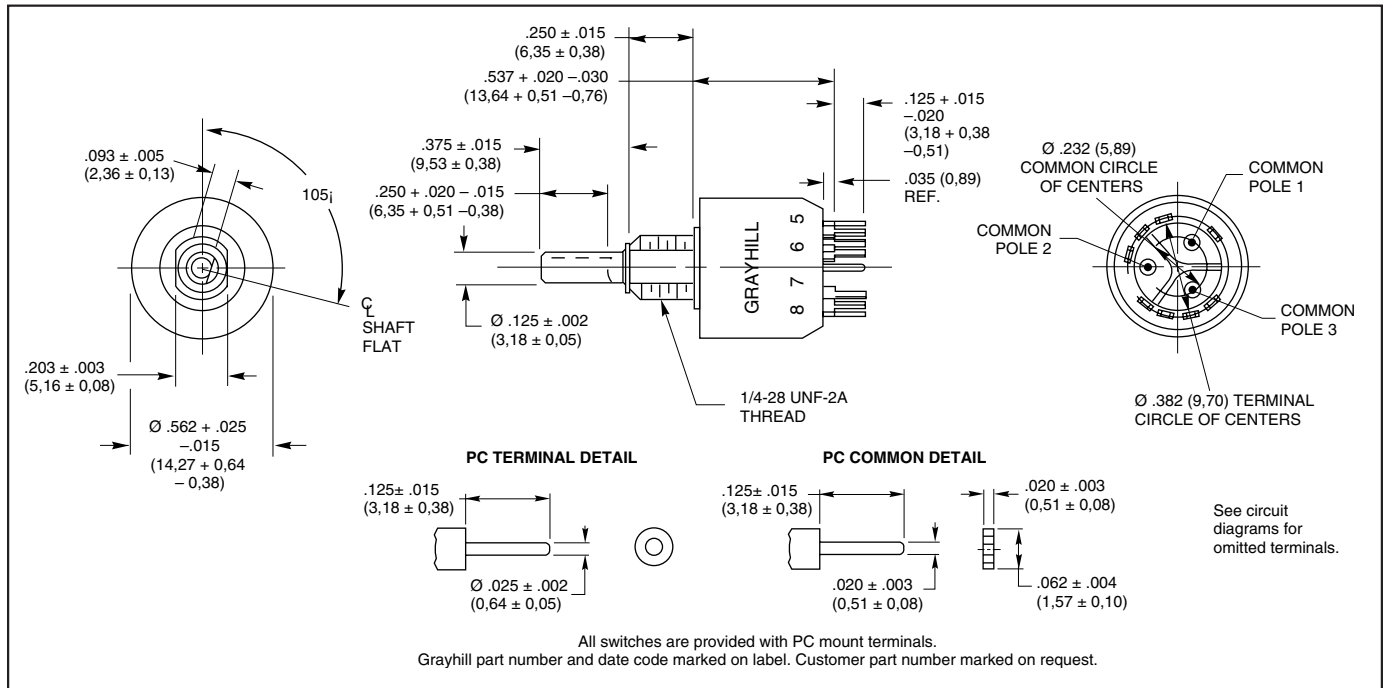
SERIES 51
Binary or Binary
Complement Code

FEATURES

- PC Mount, 30° Angle of Throw
- 2 to 12 Positions
- .562" Diameter, 200 mA
- Shaft and Panel Seal
- Adjustable Stop Versions



DIMENSIONS In Inches (and millimeters)



Optical and Mechanical Encoders

CIRCUIT DIAGRAMS

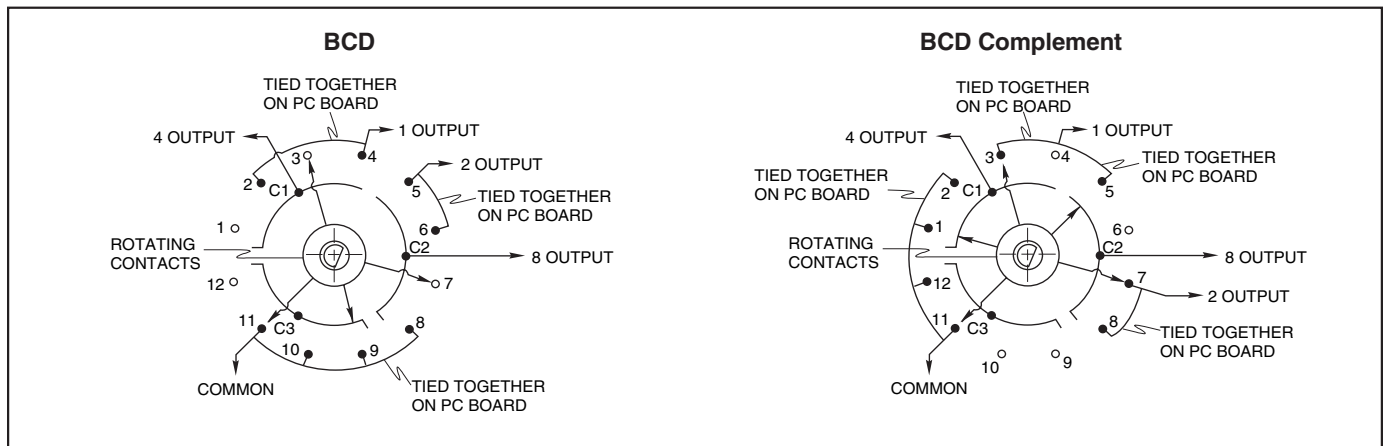
Switch is viewed from the shaft end and shown in switch position number 1, which is decimal number zero and BCD number zero.

- Indicates Terminal is present.
- Indicates Terminal is omitted.

Note: Connections must be made on PC board to

generate code output.

Switch position numbers do not correspond to the decimal input or binary output. See Truth Tables.



TRUTH TABLES

Binary Code Decimal

Dec. No.	Switch Pos'n.*	2nd Pin**	Output Terminal			
			1	2	4	8
0	1	4-5				
1	2	5-6	●			
2	3	6-7		●		
3	4	7-8	●	●		
4	5	8-9			●	
5	6	9-10	●		●	
6	7	10-11		●	●	
7	8	11-12	●	●	●	
8	9	12-1				●
9	10	1-2	●			●
10	11	2-3		●		●
11	12	3-4	●	●		●

Binary Code Decimal Complement

Dec. No.	Switch Pos'n.*	2nd Pin**	Output Terminal			
			1	2	4	8
0	1	12-1	●	●	●	●
1	2	1-2		●	●	●
2	3	2-3	●		●	●
3	4	3-4			●	●
4	5	4-5	●	●		●
5	6	5-6		●		●
6	7	6-7	●			●
7	8	7-8				●
8	9	8-9	●	●	●	●
9	10	9-10		●	●	
10	11	10-11	●		●	●
11	12	11-12			●	

● Indicates contact made to common

* The switch position number is the terminal location opposite the shaft flat; it is not the same as the decimal number.

** To limit an adjustable stop switch to the decimal number shown, insert the second pin in the hole lying between the 2 switch positions indicated.

OPTIONS

Adjustable Stops

Set and reset stops to limit rotation. All dimensions are the same as for fixed stop switches. Switches are shipped with the stop blades located to limit rotation to 11 switch positions. For continuous rotation, remove both blades. For limited rotation, remove the 2nd (clockwise) blade and move it to the hole located between the positions shown in the Truth Tables. Removal of a plastic washer provides access to the blades and slots. Adjustable stop versions are available in unsealed styles only.

Shaft and Panel Seal

Switches are available in sealed or unsealed styles. For sealed style, the panel is sealed by an o-ring at the base of the bushing. The shaft is sealed by an o-ring inside of bushing. After the switch is mounted, seals do not alter the dimensions of the unsealed style.

SPECIFICATIONS

Electrical Rating

Rated: To make and break 125 mA 30 Vdc resistive load for 25,000 cycles of operation.

Cycle: (1 cycle = 360° rotation and return) Test conditions are standard atmospheric pressure, 25°C and 68% relative humidity.

Contact Resistance: 20 milliohms initially, 300 milliohms maximum after life

Insulation Resistance: 50,000 megohms initially, 10,000 megohms after life

Voltage Breakdown: 500 Vac between mutually insulated parts

Materials and Finishes

Bases: Thermoset plastic

Detent Rotor: Nylon

Shaft, Stop Blades, Stop Arm, Thrust Washer And Retaining Ring: Stainless steel

Detent Balls: Steel, nickel-plated

Bushing: Zinc, Tin-zinc-plated

Detent Spring: Stainless steel

Common Terminals and Rings: Brass, gold plate .00003" minimum over silver plate .0003" minimum

Terminals: Brass with silver contact surface, gold-plated .00003"

Rotor Contact: Berillium copper with silver contact surface

Shaft And Panel Seal: Silicone rubber

Mounting Hardware: One mounting nut, .089" thick by .375" across flats, and one internal tooth lockwasher are supplied with the switch.

Additional Characteristics

Contact Type: Wiping contacts

Shaft Flat Orientation: Switch position is defined as that position that is opposite the shaft flat. The location of the contacts in relation to the shaft flat is shown on the circuit diagram.

Terminals: Only the active position terminals, as shown in the circuit diagram are supplied with the switch. All common terminals are supplied.

Stop Strength: 7.5 in-lbs minimum

Rotational Torque: 8 to 16 in-oz

Bushing Mounting: Required for these switches

Maximum Mounting Torque: 15 in-lbs.

ORDERING INFORMATION

Type Of Switch	Maximum No. Of Positions	BCD Output		BCD Complement	
		Unsealed	Sealed	Unsealed	Sealed
Fixed Stop	7	513360-7	513374-7	513361-7	513375-7
	8	513360-8	513374-8	513361-8	513375-8
	9	513360-9	513374-9	513361-9	513375-9
	10	513360-10	513374-10	513361-10	513375-10
	11	513360-11	513374-11	513361-11	513375-11
	12	513360-12-F	513374-12-F	513361-12-F	513375-12-F
Continuous Rotation	12	513360-12-C	513374-12-C	513361-12-C	513375-12-C
Adjustable Stop	12	513385	—	513384	—

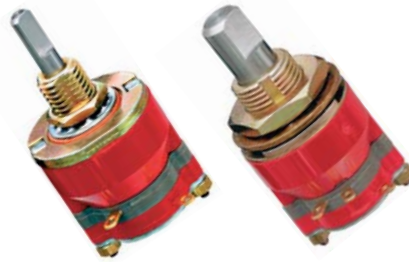
The -C suffix indicates continuous rotation. The -F suffix indicates a fixed stop between positions 1 and 12.

Available from your local Grayhill Distributor. For prices and discounts, contact a local Sales Office, an authorized local Distributor or Grayhill.

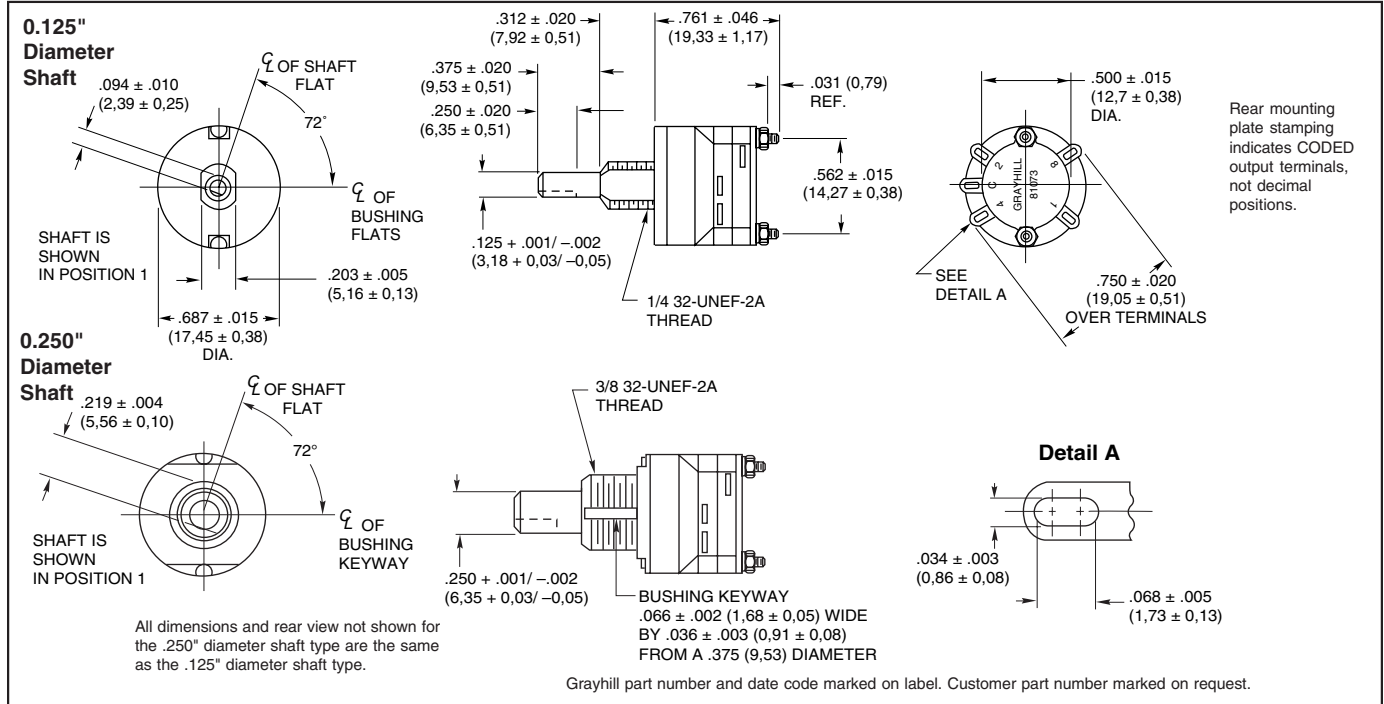
SERIES 71
Binary Code

FEATURES

- 1/4" or 1/8" Shaft Diameters
- 25,000 Cycles at 125 mA
- Optional Seal Versions
- Adjustable Stop Versions



DIMENSIONS In inches (and millimeters)



CODE AND TRUTH TABLE

Output Terminal	Decimal Position									
	0	1	2	3	4	5	6	7	8	9
1		*		*		*		*		*
2			*	*		*		*		*
4					*	*	*	*		
8									*	*

I Indicates contact is made to the common.

SPECIFICATIONS

Electrical Rating

Rated: To make and break 125 mA at 30 Vdc resistive at standard conditions

Life Expectancy: 25,000 cycles at rated load; 50,000 cycles mechanical. For ratings at different loads and conditions, contact Grayhill.

Contact Resistance: 100 milliohms maximum (50 milliohms initially)

Insulation Resistance: As measured between mutually insulated parts

Initially: 50,000 megohms minimum

After Life: 10,000 megohms minimum

Voltage Breakdown: 500 Vac between mutually insulated parts

Carry Current: These switches will carry 3 amperes with a maximum contact temperature rise of 20°C.

OPTIONS

Shaft and Panel Seal

Shaft is sealed by o-ring inside the bushing; panel is sealed by o-ring at the base of the bushing. Seals do not alter dimensions as shown in the drawing when switch is mounted. Panel seal is silicone rubber. Shaft seal is an o-ring per MIL-P-5516B. Shaft and panel seal is not available on adjustable stop switch.

Additional Characteristics

Rotational Torque: 8 to 16 oz-in.

Contacts: Non-shorting wiping contacts

Shaft Flat Orientation: As shown in the drawing, switch would provide a decimal 1 output.

Materials and Finishes

Base: Diallyl per MIL-M-14

Rotor Mounting Plate: Thermoplastic.

Rotor Contact: Phosphor Bronze, gold-plated 30 microinches minimum

Terminals: Brass, gold plate (20 microinches) minimum over silver plate (300 microinches) minimum

Additional Materials: Other switch materials and finishes are the same as listed for the standard switch. See Standard Switch.

Adjustable Stop Switches

Adjustable stop switch lets you limit the number of positions. Remove and relocate pins in the front plate. A sticker holds the pins in place. With the exception of holes in the front plate, all dimensions, ratings, and characteristics are the same as the other Series 71 coded switches. For diagrams, see Standard Switch.

ORDERING INFORMATION

Shaft Diameter And Description	Part Number
1/8" Continuous Rotation	71AY23401
1/8" Cont. Rot., Sealed	71AY23402
1/4" Continuous Rotation	71BY23403
1/4" Cont. Rot., Sealed	71BY23404
1/8" Adjustable Stops	71AD36-3118
1/4" Adjustable Stops	71BD36-3119

Available from your local Grayhill Distributor. For prices and discounts, contact a local Sales Office, an authorized local Distributor or Grayhill.

CONTROL KNOBS
Ideally Suited for Encoder and Rotary Switches

FEATURES

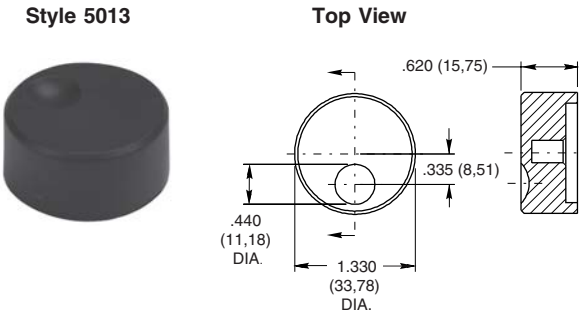
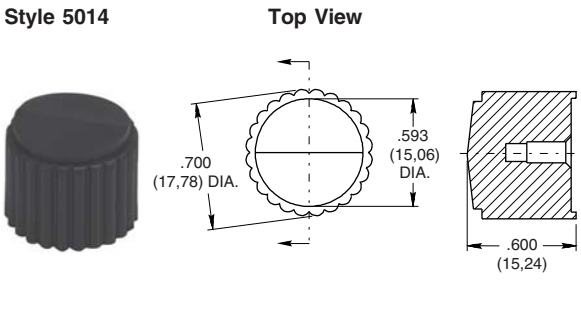
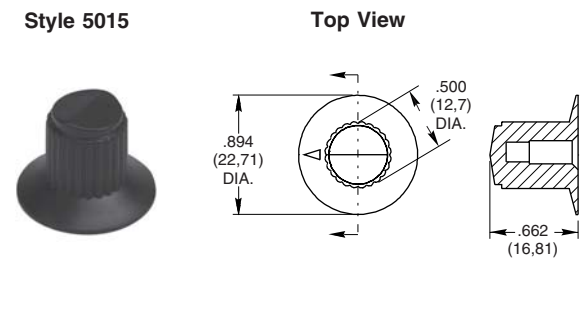
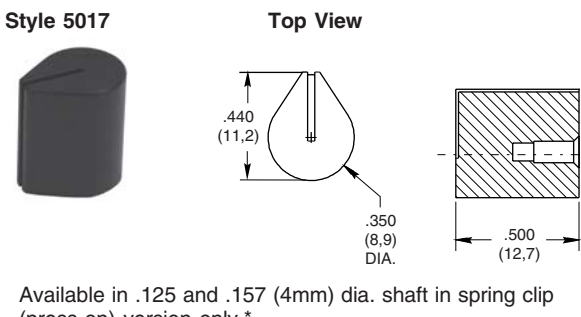
- Standard Fit for Grayhill Encoder and Rotary Switches
- Custom Materials, Styles, Colors and Markings Available
- Standard Black or Gray
- Choice of Spring Clip (Press-On) or Metal Insert with Set Screw Versions

Contact Grayhill for special design considerations



Optical and Mechanical Encoders

DIMENSIONS In inches (and millimeters)

<p>Style 5013</p>  <p>Available in .250 Dia. Shaft only.*</p>	<p>Style 5014</p> 
<p>Style 5015</p> 	<p>Style 5017</p>  <p>Available in .125 and .157 (4mm) dia. shaft in spring clip (press-on) version only.*</p>

*See Ordering Information.

DIMENSIONS In inches (and millimeters)

<p>Style 5019</p>	<p>Style 5020</p> <p>Available in ABS, .250 dia. shaft in spring clip (press-on). The locking clip is also available, requires a custom shaft.**</p>
<p>Style 5028</p>	<p>Style 5029</p>

*See Ordering Information.

**Contact Grayhill representative

ORDERING INFORMATION

11K5028-KCNB

Series
Style*: 5013, 5014, 5015, 5017, 5019, 5020, 5028, 5029
 (see dimension drawings for style options)

Shaft Diameter:
J = .125 dia. shaft
E = .157 (4mm) dia. shaft
K = .250 dia. shaft

Knob Color:
B = Black
G = Gray

Material:
A = ABS (available on the styles 5017 and 5020 only)
N = Nylon

Version:
C = Spring Clip (press-on)
L = Locking Clip (available on the style 5020 only)
M = Metal Insert w/Set Screw(s)

Custom materials, styles and colors are available.

For prices and discounts, contact a local sales office or Grayhill.

Optical and Mechanical Encoders