
GRAYHILL
61R128
GRAYHILL
6 5 4 3 2 1

OPTICAL ENCODERS

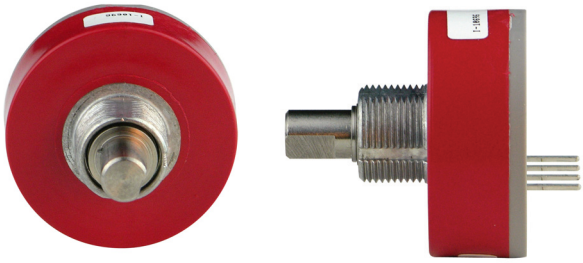
- Eliminates Rotary Mechanical Contacts
- Accurate Resolution up to 1024 Positions
- Logic Compatible
- Selects Menu or Display Items
- Includes Data Input Switch
- Up to 1 Billion Trouble-Free Cycles

SERIES 63K

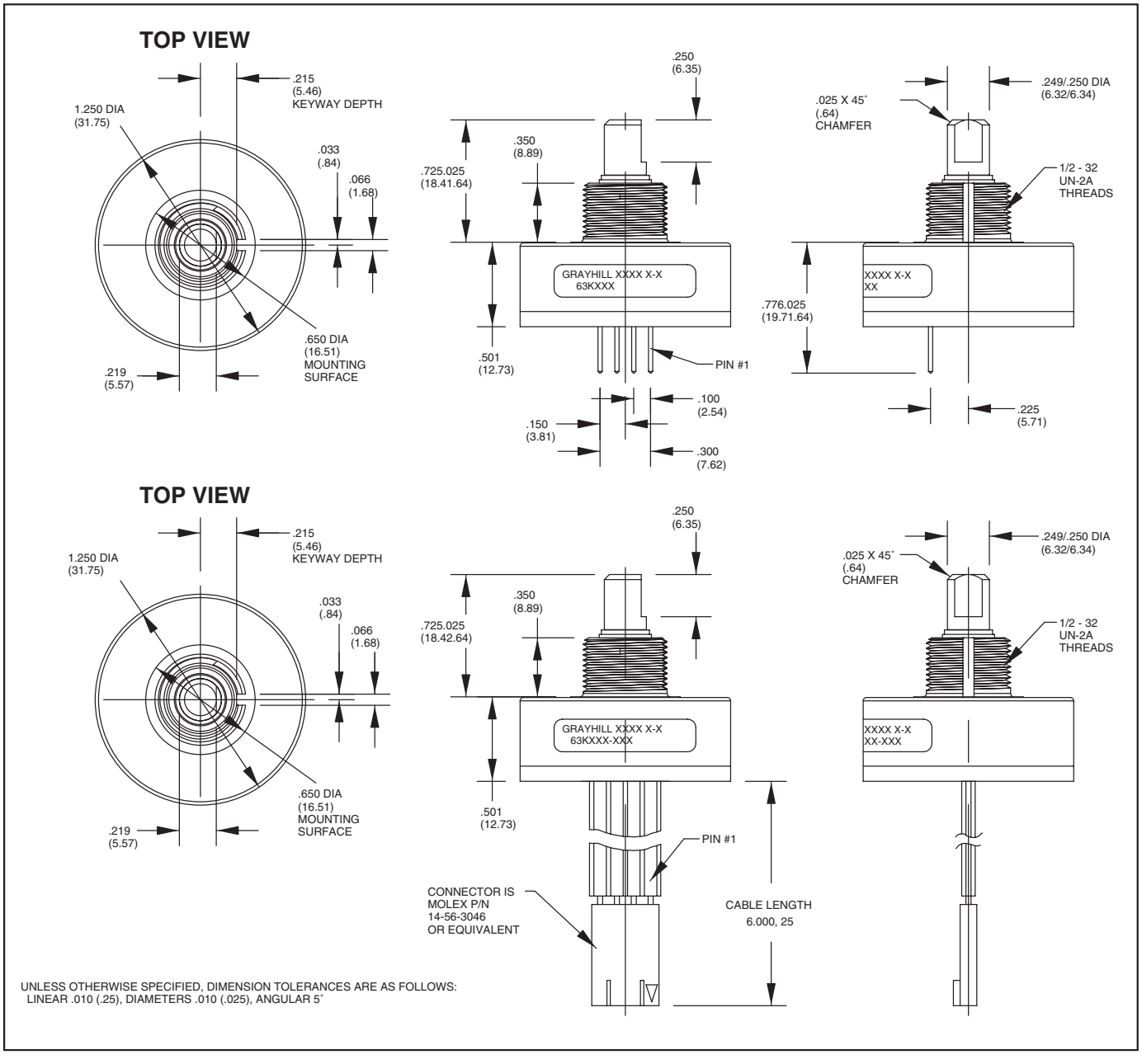
High Resolution, Ball Bearing, 4-Pin

FEATURES

- 25, 32, 50, 64, 100, 128 and 256 Cycles per Revolution Available
- Sealed Version Available
- Rugged Construction
- Cable or Pin Version
- 300 Million Rotational Cycles
- 5,000 RPM Shaft Rotation



DIMENSIONS In inches (and millimeters)



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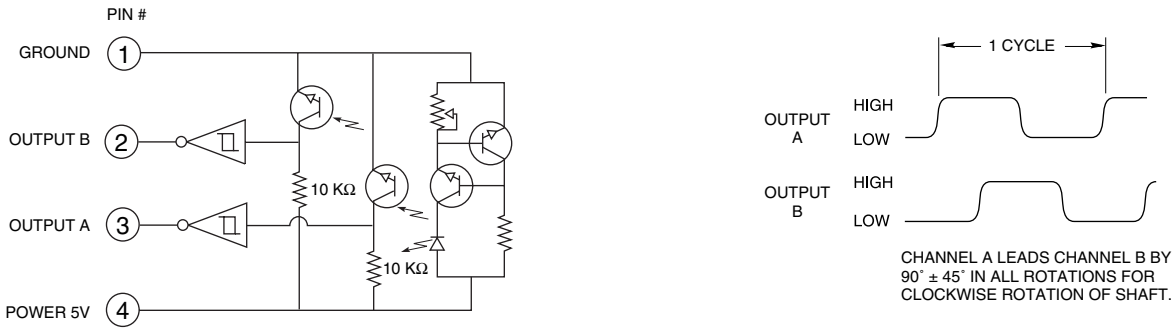
CIRCUITRY AND WAVEFORM: Standard Quadrature 2-Bit Code



SPECIFICATIONS

Electrical Ratings

Operating Voltage: 5.0 ±.25 Vdc
Supply Current: 30 mA maximum at 5 Vdc
Logic Output Characteristics:
Output Type: Open collector with integrated Schmitt Trigger and 10 KΩ pull-up resistor
Maximum Sink Current: 16 mA at .40 volts
Power Consumption: 150 mW maximum
Optical Rise Time: 500 nS typical
Optical Fall Time: 14 nS typical

Mechanical Ratings

Mechanical Life: 300 million revolutions
Time Life: Guaranteed for 10 years of continuous operation (calculated from emitter degradation data)
Mounting Torque: 20 in-lbs maximum
Terminal Strength: 5 lbs terminal pull-out force minimum
Solderability: 95% free of pin holes and voids
Operating Torque: 0.5 in-oz maximum (no detents) for unsealed versions
Externally Applied Shaft Force: Axial: 15 lbs maximum; Radial: 15 lbs maximum

Environmental Ratings

Operating Temperature Range: -40°C to 85°C
Storage Temperature Range: -55°C to 100°C
Relative Humidity: 90-95% at 40°C for 96 hours
Vibration Resistance: Harmonic motion with amplitude of 15g, within a varied 10 to 2000 Hz frequency for 12 hours per MIL-STD-202, Method 204
Shock Resistance: Test 1: 100g for 6 mS, half-sine wave with velocity change of 12.3 ft/s. Test 2: 100g for 6 mS, sawtooth wave with velocity change of 9.7 ft/s.

Materials and Finishes

Bushing: Zinc diecast
Housing: Hiloy 610B
Shaft: Stainless Steel
Code Rotor and Aperture: Chemically etched stainless steel/electroformed nickel
Printed Circuit Board: NEMA Grade FR-4. Five microinches minimum gold over 100 microinches minimum nickel over copper
Optical Barrier: Polyphenylene sulfide, 94 V-0
Backplate: Polyester
Header: Phosphor bronze, 200 microinches tin over 50 microinches nickel (pin version only)
Infrared Emitter: Gallium aluminum arsenide
Photo IC: Planar silicon
Retaining Ring: Stainless steel
Cable: 26 AWG, stranded/tinned wire, PVC coated on .100 (2,54) centers (cable version only)
Connector: Glass-filled PCT, UL94V-0

Bearing Subassembly

Bearing: NSK ABEC 5 (stainless steel)
Preload Collar: 303 (stainless steel)

ORDERING INFORMATION

63KS256–060

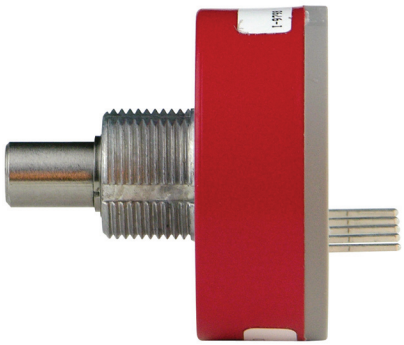
Series
Style: K = Standard, 4-pin, high resolution
KS = Sealed, 4-pin, high resolution
Cycles: per channel per revolution = 25, 32, 50, 64, 100, 128, 256

Termination:
Blank (no dash or numbers): pins as described in drawing.
Cable Termination: 060 = 6.0in. Cable is terminated with Molex Connnector P/N 14-56-3046.

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

SERIES 63R

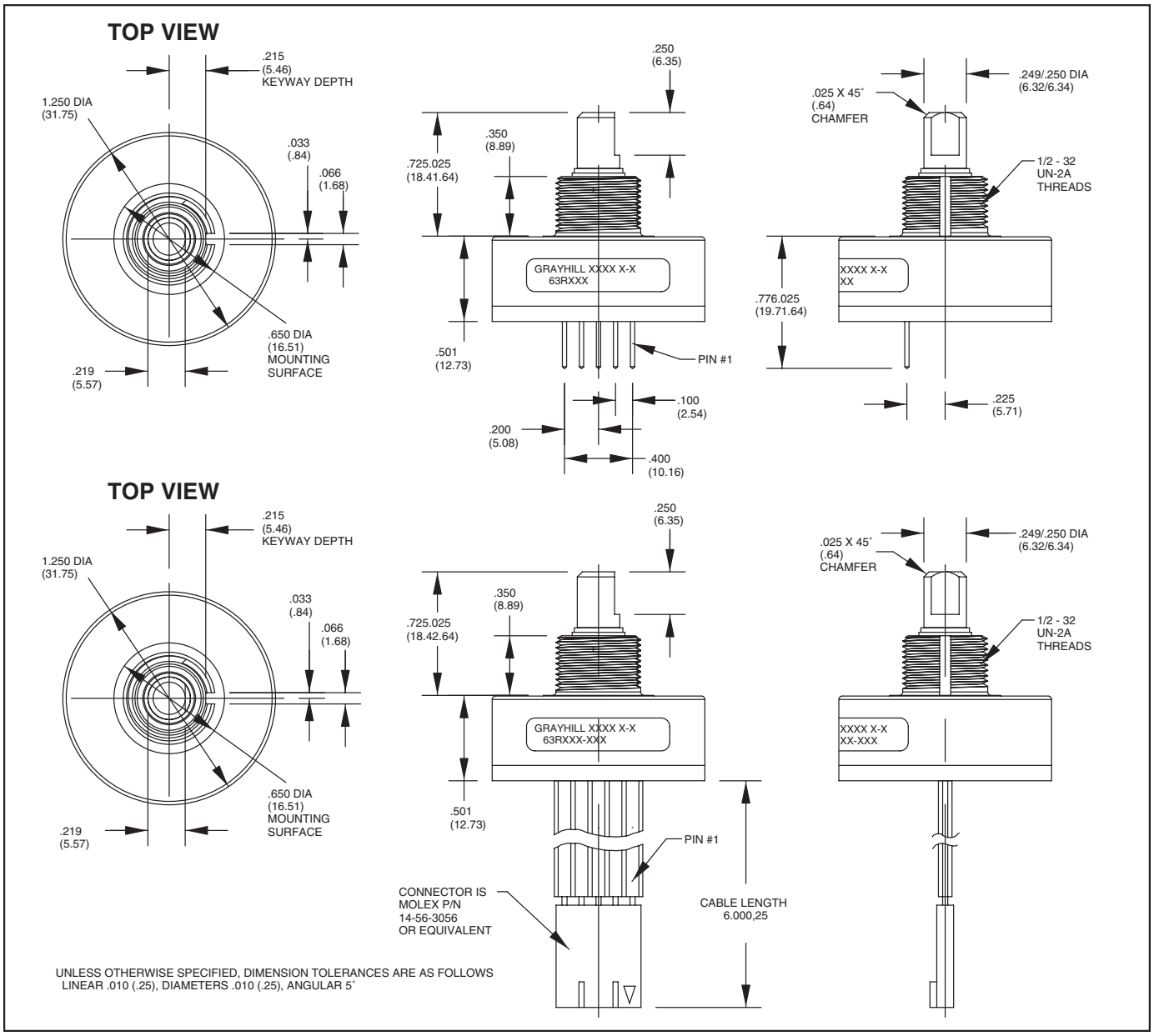
High Resolution, Ball Bearing, 5-pin (Polarized Connection)



FEATURES

- 25, 32, 50, 64, 100, 128 and 256 Cycles per Revolution Available
- Sealed Version Available
- Rugged Construction
- Cable or Pin Versions
- 300 Million Rotational Cycles
- 5000 RPM Shaft Rotation
- Index Pulse Available

DIMENSIONS In Inches (and millimeters)



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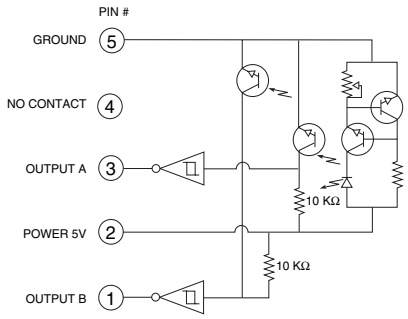
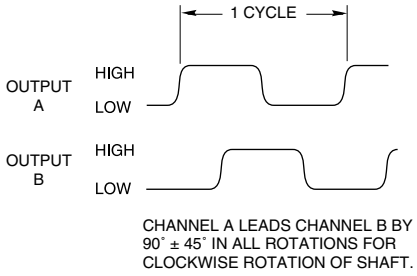
CIRCUITRY AND WAVEFORM: Standard Quadrature 2-Bit Code





CHANNEL A LEADS CHANNEL B BY 90˚ ± 45˚ IN ALL ROTATIONS FOR CLOCKWISE ROTATION OF SHAFT.

SPECIFICATIONS

Electrical Ratings

Operating Voltage: 5 ±.25 Vdc
Supply Current: 30 mA maximum at 5 Vdc
Logic Output Characteristics: Output Type: Open collector with integrated Schmitt Trigger and 10 KW pull-up resistor Maximum Sink Current: 16 mA at .40 volts
Power Consumption: 150 mW maximum
Optical Rise Time: 500 nS typical
Optical Fall Time: 14 nS typical

Mechanical Ratings

Mechanical Life: 300 million revolutions
Time Life: Guaranteed for 10 years of continuous operation (calculated from emitter degradation data)
Mounting Torque: 20 in-lbs maximum
Terminal Strength: 5 lbs terminal pull-out force minimum
Solderability: 95% free of pin holes and voids
Externally Applied Shaft Force: Axial:15 lbs maximum; Radial:15 lbs maximum
Operating Torque: 0.5 in-oz maximum (no detents) for unsealed versions

Environmental Ratings

Operating Temperature Range: -40°C to 85°C
Storage Temperature Range: -55°C to 100°C
Relative Humidity: 90-95% at 40°C for 96 hours
Vibration Resistance: Harmonic motion with amplitude of 15g, within a varied 10 to 2000 Hz frequency for 12 hours per MIL-STD-202, Method 204
Shock Resistance: Test 1: 100g for 6 mS, half-sine wave with velocity change of 12.3 ft/s. Test 2: 100g for 6 mS, sawtooth wave with velocity change of 9.7 ft/s.

Materials and Finishes

Bushing: Zinc diecast
Housing: Hiloy 610B
Shaft: Stainless steel
Code Rotor and Aperture: Chemically etched stainless steel/electroformed nickel
Printed Circuit Board: NEMA Grade FR-4. Five microinches minimum gold over 100 microinches minimum nickel over copper
Optical Barrier: Polyphenylene sulfide, 94 V-0
Backplate: Polyester
Header: Phosphor bronze, 200 microinches tin over 50 microinches nickel (pin version only)
Infrared Emitter: Gallium aluminum arsenide
Photo IC: Planar silicon
Retaining Ring: Stainless steel
Cable: 26 AWG, stranded/tinned wire, PVC coated on .100 (2,54) centers (cable version only)
Connector: Glass-filled PCT, UL94V-0

Bearing Subassembly

Bearing: NSK ABEC 5 (stainless steel)
Preload Collar: 303 stainless steel

ORDERING INFORMATION

63RS256–060

Series
Style: R = Standard, 5-pin, high resolution
RS = Sealed, 5-pin, high resolution
Cycles: per channel per revolution = 25, 32, 50, 64, 100, 128, 256

Termination:
Blank (no dash or numbers): pins as described in drawing.
Cable Termination: 060 = 6.0in. Cable is terminated with Molex Connnector P/N 14-56-3056.

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

SERIES 63T

High Resolution, Hollow Shaft

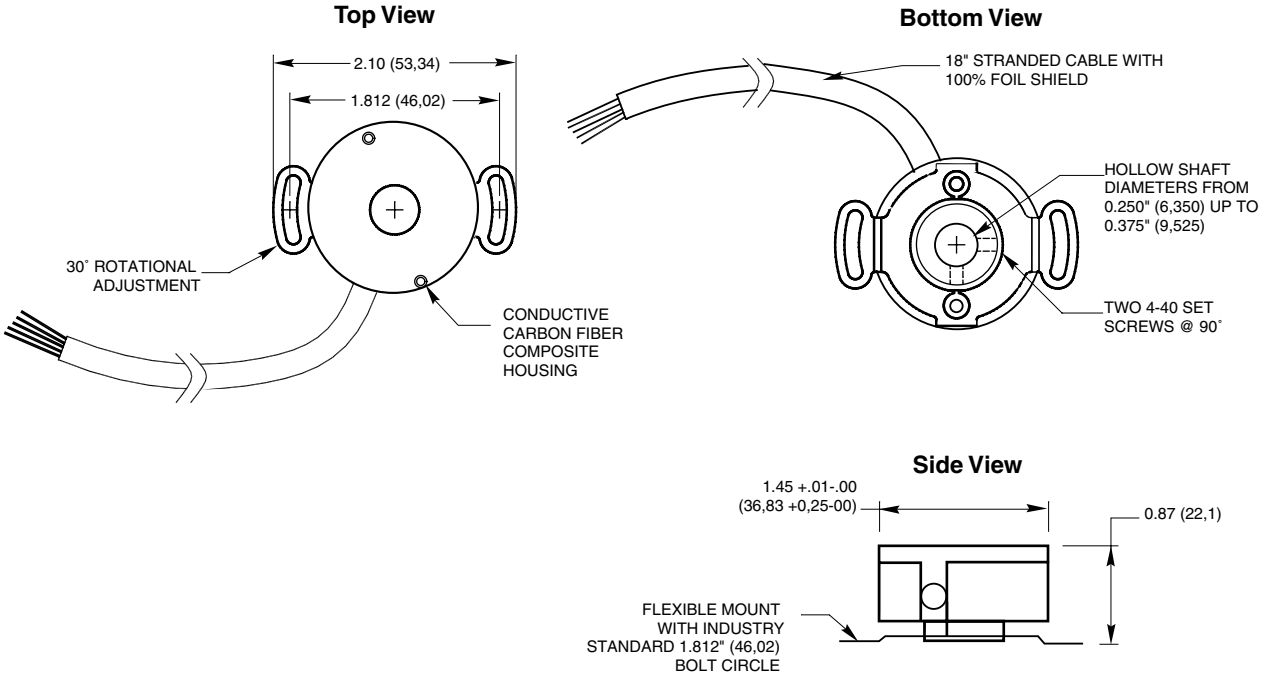
FEATURES

- Low Profile
- Simplified Encoder Attachment
- Resolutions up to 1024 Lines per Revolutions
- Three-Phase Commutation in 4,6 or 8 Pole Versions
- Conductive Carbon Fiber Housing
- Standard 1.812" (46mm) Bolt Circle Mounting
- Hollow Shaft Sizes Up to .375" or 10mm in Diameter
- High Noise Immunity
- Cost Competitive with Modular Encoders
- Industry Standard Line Drivers

APPLICATIONS

- Steer by Wire
- Fractional Horse Power Motors
- Machine Tool Controls
- Material Handling
- Flow Meters

DIMENSIONS In inches (and millimeters)



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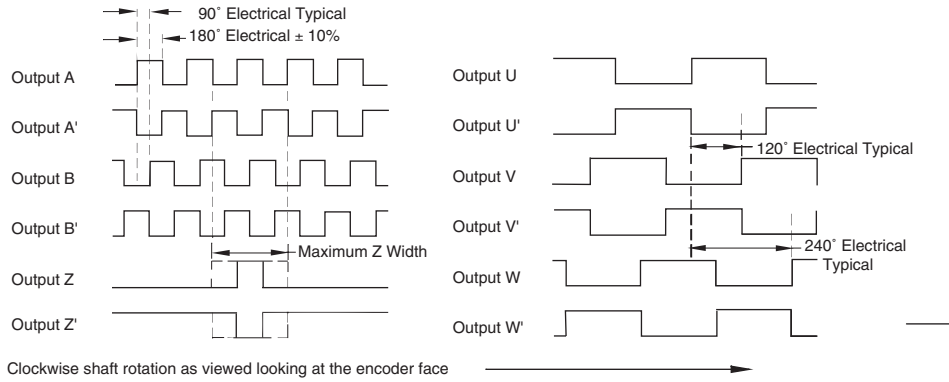
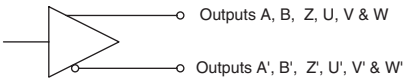
WAVEFORM, CIRCUITRY, AND WIRING DIAGRAM Standard Quadrature 2-Bit Code



Wiring

Red = +Vdc	Violet - Output U
Black - Common	Gray - Output U'
Brown - Output A	Brown/White - Output V
White - Output A'	Red/White - Output V'
Blue - Output B	Orange/White - Output W
Green - Output B'	Yellow/White - Output W'
Orange - Output Z	Black/White - Case Ground
Yellow - Output Z'	Drain Wire - Cable Shield

Output Circuit



SPECIFICATIONS

Electrical Ratings

Input Voltage: 5 ± 5% Vdc or 5-26 Vdc
Ripple Current: 2% peak-to-peak @ 5 Vdc
Output Circuits: AM26LS31 RS422A line driver, OL7272 line driver, TTL
Logic Output Characteristics:
Output Type: Quadrature with channel A leading channel B for CW rotation with index centered over A
Frequency Response: 200 kHz
Symmetry: 180° ±10% typical
Minimum Edge Separation: 54 electrical degrees
Commutation Format: Three phase: 4, 6 or 8 poles
Communtation Accuracy: ±1° mechanical
Input Current Requirements: 125 mA typical, 5 Vdc plus interface loads

Mechanical Ratings

Maximum Shaft Speed: 8,000 RPM
Hollow Shaft Diameter: 0.250", 0.312", 0.375", 6mm, 8mm, 10mm
Radial Shaft Movement: 0.007" (0,178mm) T.I.R.
Axial Shaft Movement: ±0.030"(7,62mm)
Housing: Carbon fiber composite (case ground via cable)
Housing Volume Resistivity: 10^{-2} ohm-cm
Termination:
Standard: 15-conductor stranded cable, 28 AWG, 18" (457mm) in length
Non-commutation and TTL output: 9-conductor stranded cable, 28 AWG, 18" in length
Mounting: 1.812" (46mm) bolt circle
Acceleration: $1x10^5$ radians per second^2
Moment of Inertia: 1.5×10^{-4} oz-in-s^2
Accuracy: ±.8 arc minutes

Environmental Ratings

Operating Temperature Range: -20°C to 100°C typical; -20°C to 120°C optional (contact Grayhill for more information)
Storage Temperature Range: -40°C to 125°C
Relative Humidity: 98% non-condensing
Vibration: 20G's @ 50-500 CPS
Mechanical Shock: 50g @ 11mS duration

OPTIONS

Contact Grayhill for custom terminations, resolutions, mounting configurations, and shaft couplings and configurations.

ORDERING INFORMATION

63TAL-1-1-4-2-1

Series
Resolution: (quadrature cycles per revolution) A = 500, B = 512, C = 1000, D = 1024, E = 256
Voltage: L = 5.0 ± 5% Vdc, H = 5-26 Vdc
Output Option: 1 = AM26LS31 RS422A Line Driver, 2 = OL7272, 5-26 Vdc Line Driver, 3 = TTL, 4 = RS422A, for A, B, Z; Open Collector for U, R, W
Mounting: 1 = Std. 1.812" flex
2 = Size 15 Resolver Mount

Index Gating: 0 = Ungated index; 1 = Gated to A, 180°; 2 = Gated to A and B, 90°
Motor Poles: 4 = 4 pole, 6 = 6 pole, 8 = 8 pole, 0 = no commutation
Hollow Shaft Size: 1 = 0.250", 2 = 0.312", 3 = 0.375", 4 = 6mm, 5 = 8mm, 6 = 10mm

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

SERIES 63Q

High Resolution, 20mm

FEATURES

- Miniature Size, 20mm (0.787") Diameter
- Resolutions up to 1024 Lines per Revolution
- Single Ended and Differential Outputs
- 1 Billion Rotational Life Cycles
- Conductive Carbon Fiber Housing
- IP 50 Sealing
- High Noise Immunity
- Low Supply Current Requirements

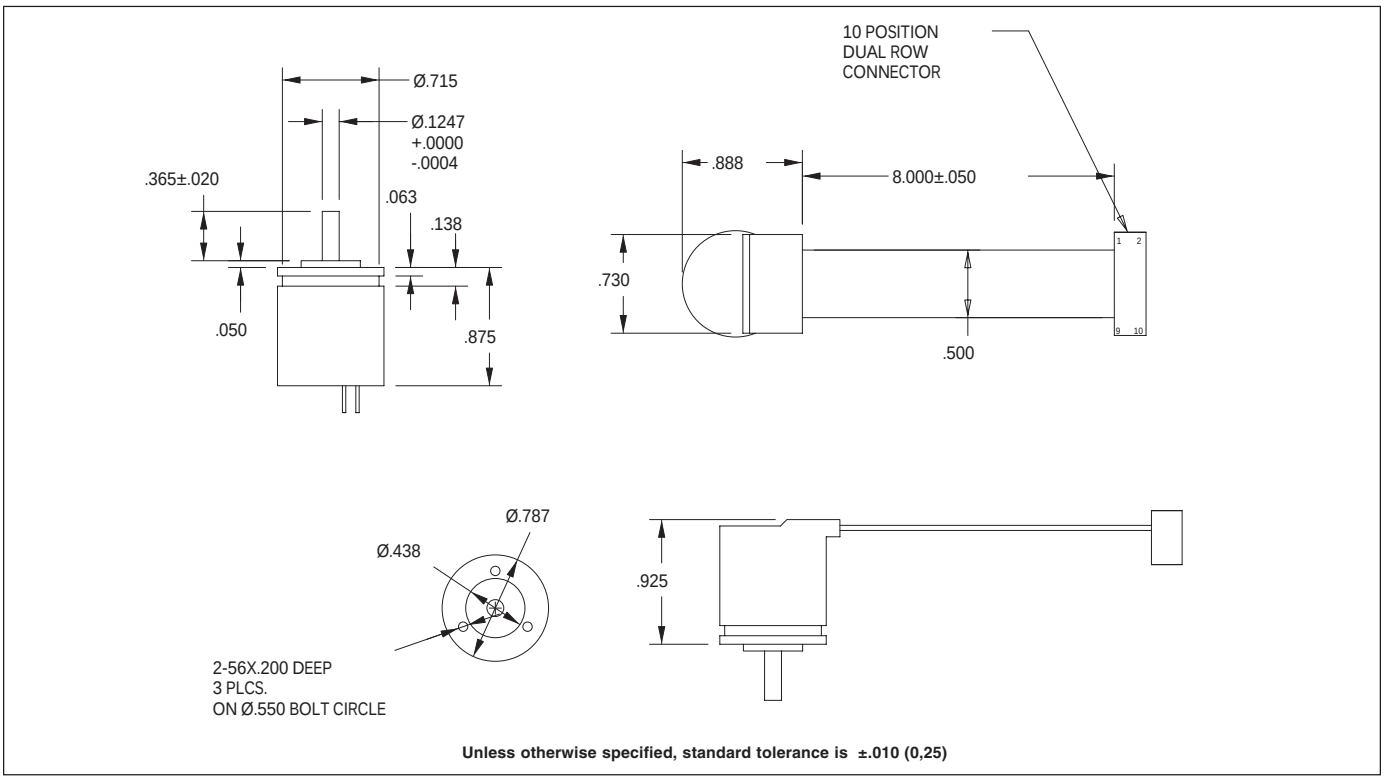
APPLICATIONS

- Steer by Wire
- Fractional Horse Power Motors
- Machine Tool Controls
- Material Handling
- Flow Meters

DESCRIPTION

The Series 63Q is intended for applications requiring high performance, high-resolution digital feedback in a very small package. It provides the resolution of larger encoder packages but in a package only 20mm (0.787") in diameter. Outputs can be configured in either single ended, open collector or internal pull-up resistor, or with an industrial standard RS422A differential line driver. The sensing scheme also embodies a much simplified encoder design, which ultimately results in longer service life, and less down time due to feedback device failure. The encoder housing is constructed of a conductive carbon fiber composite that provides the EMI shielding of an all metal housing and the performance of a lightweight robust assembly.

DIMENSIONS In inches (and millimeters)



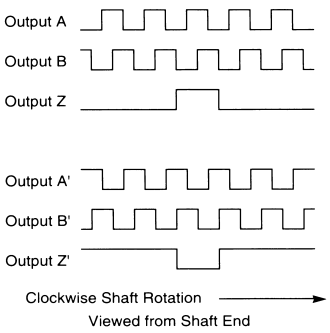
Unless otherwise specified, standard tolerance is ±.010 (0,25)

PIN WIRING, CIRCUITRY, AND WAVEFORM STANDARD

Pin Wiring

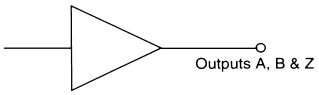
Pin #1	Common
Pin #2	+Vdc
Pin #3	Z
Pin #4	Z'
Pin #5	B
Pin #6	B'
Pin #7	A
Pin #8	A'
Pin #9	N/C
Pin #10	Case

Waveforms

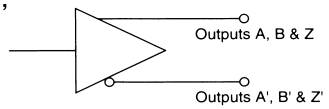


Output Circuits

TTL Output



RS422A Line Driver, OL7272 5-26VDC Line Driver



SPECIFICATIONS

Electrical Ratings

Input Voltage: 5.0 ± 5% Vdc or 5-26 Vdc
Input Current Requirements: 100 mA maximum output option 1 and 2, 50 mA maximum output option 3; plus interface loads
Ripple Current: 2% peak-to-peak @ 5 Vdc
Output Circuits: AM26LS31 RS422A line driver, OL7272 line driver, TTL
Logic Output Characteristics: Output Type: Quadrature with channel A leading channel B for CW rotation with ungated index pulse true over A and B high
Frequency Response: 200 kHz
Symmetry: 180° ±10% typical
Minimum Edge Separation: 54 electrical degrees

Mechanical Ratings

Maximum Shaft Speed: 8,000 RPM
Shaft Diameter: 0.125" (3,175)
Shaft Material: Stainless steel
Bearings: Radial ball bearing, R2 type
Radial Shaft Load: 2 lbs maximum
Axial Shaft Load: 1 lbs maximum
Housing: Carbon fiber composite (case ground via connector)
Housing Volume Resistivity: 10^{-2} ohm-cm
Termination: Two rows of 5 pins on 0.100" centers. 8" ten conductor ribbon cable with 2x5 connector
Mounting: Servo
Moment of Inertia: $9.5x10^{-6}$ oz-in-sec^2
Acceleration: $1x10^5$ radians per second^2

Environmental Ratings

Operating Temperature Range: 0 to 70°C typical; -20°C to 100°C optional (contact Grayhill for more information)
Storage Temperature Range: -40°C to 125°C
Relative Humidity: 98% non-condensing
Vibration: 20G's @ 50-500 CPS
Mechanical Shock: 50G @ 11mS duration

OPTIONS

Contact Grayhill for custom terminations, resolutions, mounting configurations, shaft couplings and configurations, and absolute positioning up to 256 positions.

ORDERING INFORMATION

63QAL-1-P

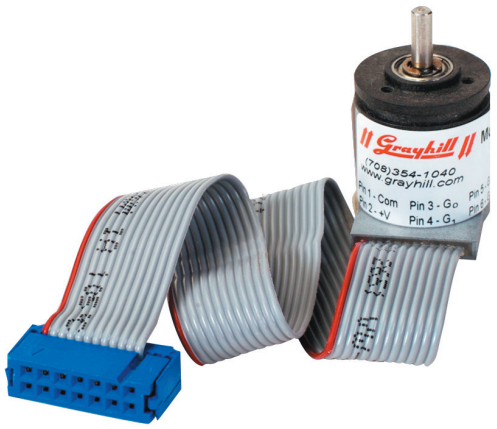
Series
Resolution: (quadrature cycles per revolution) A = 500, B = 512, C = 1000, D = 1024
Voltage: L = 5 ±5% Vdc, H = 5-26 Vdc

Termination: C = 8" cable with connector, P = pin (no cable)
Output Option: 1 = RS422A line driver; 2 = OL7272 (5-26 Vdc) line driver; 3 = TTL output

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

SERIES 63A

High Resolution, 20mm, Absolute Encoding



FEATURES

- Miniature Size, 20mm (0 .787") Diameter
- Single Ended Outputs
- Long Service Life
- Conductive Carbon Fiber Housing
- IP 50 Sealing
- High Noise Immunity
- Low Supply Current Requirements
- 8-Bit Gray Code or Binary Output
- Single Turn 8-Bit Word

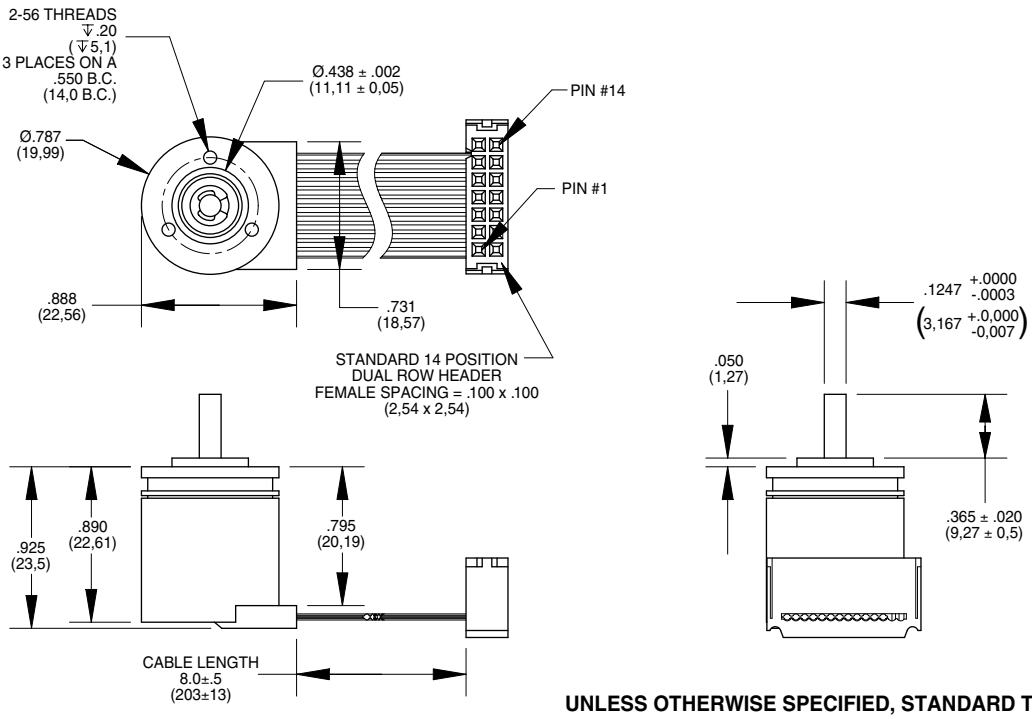
APPLICATIONS

- Steer by Wire
- Machine Tool Controls
- Material Handling
- Flow Meters
- Any Application Requiring Discrete Digital Positioning and Angular Detection at Start Up.

DESCRIPTION

The Series 63A is intended for applications requiring high performance, high-resolution digital feedback in a very small package. The Series 63A encoder provides 8-bit absolute resolution in a package only 20mm (0.787") in diameter. Outputs can be configured in either gray code or binary code. The encoder housing is constructed of a conductive carbon fiber composite that provides the EMI shielding of an all metal housing and the performance of a lightweight robust assembly.

DIMENSIONS In inches (and millimeters)



UNLESS OTHERWISE SPECIFIED, STANDARD TOLERANCE IS ±.010 [±,26]

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SPECIFICATIONS

Electrical Ratings

Input Voltage: 5.0 ± 5% Vdc or 5-26 Vdc
Input Current Requirements: 40 mA maximum plus interface loads
Ripple Current: 2% peak-to-peak @ 5 Vdc
Output Circuits: TTL Compatible
VOH >3.80v@-8mA, VOL<0.44v@8mA
VOH >2.50v@-20mA, VOL<0.50v@20mA
Output Format:
Gray code or Binary Code: 8-bit, single turn, single ended. Gray code option utilizes low true Chip Enable (CE') that is pulled down with internal 10K resistor. Positive TTL signal to CE' will force the 8-bit outputs to tri-state condition allowing for shared data paths between encoders, easing basic microprocessor bus interfacing.

Frequency Response: 50 kHz
Output Count Increase: Clockwise rotation (Option A); counter clockwise rotation (Option B) See ordering information.
Positional Accuracy: ±0.5 LSB maximum error

Mechanical Ratings

Maximum Shaft Speed: 8,000 RPM
Shaft Diameter: 0.125" (3,175mm)
Shaft Material: Stainless steel
Bearings: Radial ball bearing, R2 type
Radial Shaft Load: 2 lbs maximum
Axial Shaft Load: 1 lb maximum
Housing: Carbon fiber composite (case ground via connector)
Housing Volume Resistivity: 10^{-2} ohm-cm

Termination: 8" 12-conductor ribbon cable with 2x7 connector
Mounting: Servo
Moment of Inertia: $9.5x10^{-6}$ oz-in-sec^2
Acceleration: $1x10^5$ radians per second^2

Environmental Ratings

Operating Temperature Range: 0 to 70°C typical; -20°C to 100°C optional (contact Grayhill for more information)
Thermal Shutdown: Tambiant max. vs. input voltage max. 40C°= 25.0v, 60°C = 20.0v, 80°C = 15.0v, 100°C = 10.0v (Total load currents=30 mA)
Storage Temperature Range: -40°C to 125°C
Humidity: 98% non-condensing
Vibration: 20g @ 50-500 CPS
Mechanical Shock: 50g @ 11mS duration

OPTIONS

Contact Grayhill for custom terminations and temperature ratings.

ELECTRICAL CONNECTIONS

Pin#	Gray Code	Binary Code	Pin#	Gray Code	Binary Code
1	COM	COM	8	G_5	2^5
2	+V	+V	9	G_6	2^6
3	G_0	2^0	10	G_7	2^7
4	G_1	2^1	11	Case	Case
5	G_2	2^2	12	CE'	N.C.
6	G_3	2^3	13	N.C.	N.C.
7	G_4	2^4	14	N.C.	N.C.

ORDERING INFORMATION

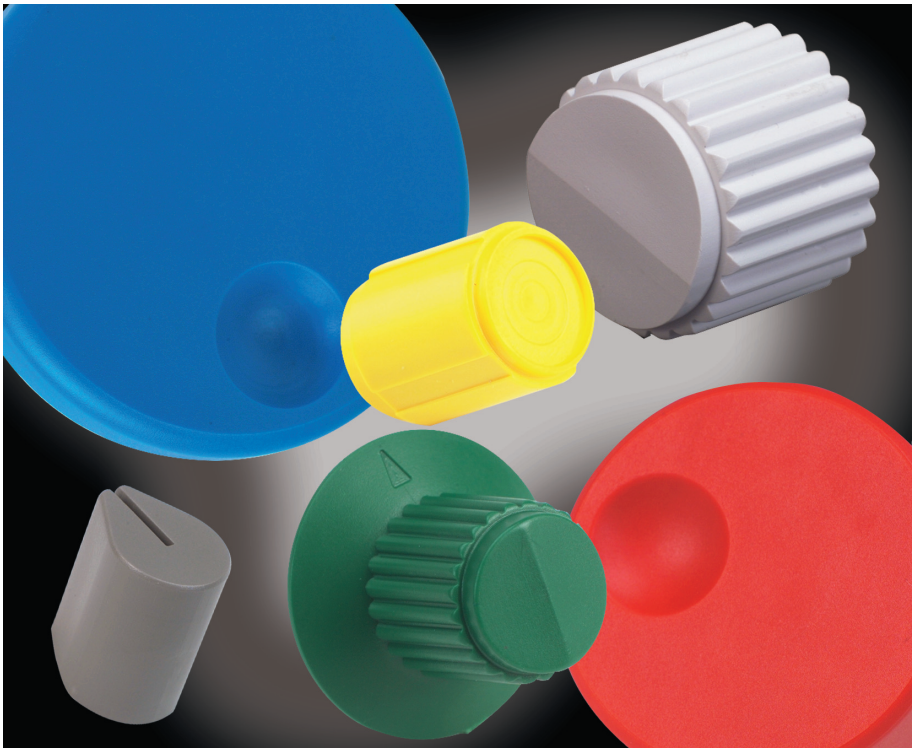
63A256-L-G-A

Series:
Resolution: 256 Absolute Positions
Voltage: L = 5.0 ±5% Vdc, H = 5-26 Vdc
Output Count Increase: A = shaft turned clockwise*, B = shaft turned counterclockwise* (*flange side view)
Output Option: B = Binary, G = Gray Code

Available from your local Grayhill Component 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



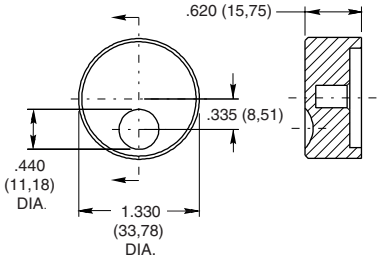
FEATURES

- 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

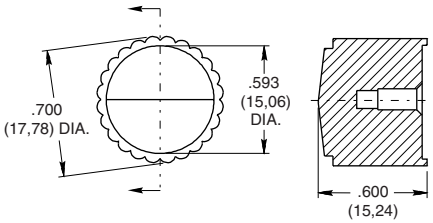
DIMENSIONS In inches (and millimeters)

Style 5013 **Top View**

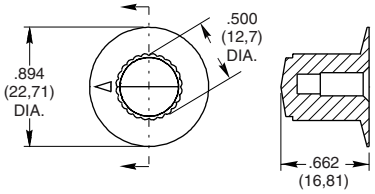


Available in .250 Dia. Shaft only.*

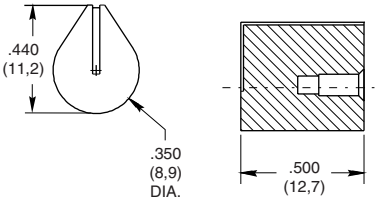
Style 5014 **Top View**



Style 5015 **Top View**



Style 5017 **Top View**

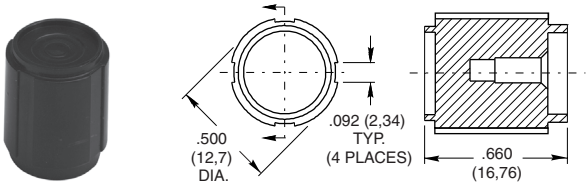


Available in .125 and .157 (4mm) dia. shaft in spring clip (press-on) version only.*

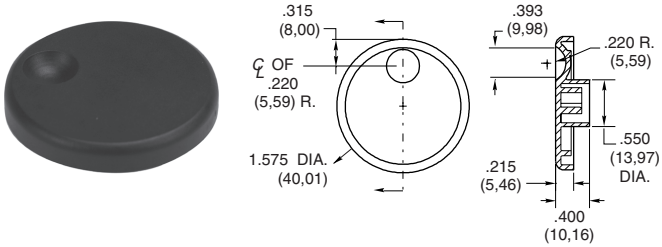
*See Ordering Information.

DIMENSIONS In inches (and millimeters)

Style 5019 **Top View**

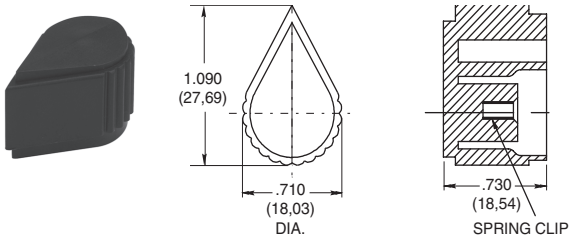


Style 5020 **Top View**

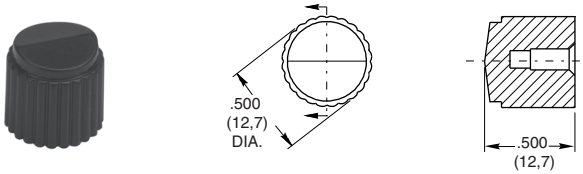


Available in ABS, .250 dia. shaft in spring clip (press-on). The locking clip is also available, requires a custom shaft.**

Style 5028 **Top View**



Style 5029 **Top View**



*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.


GRAYHILL
61R128
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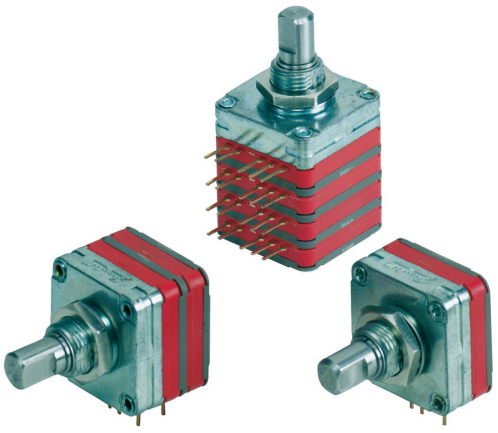
6 5 4 3 2 1

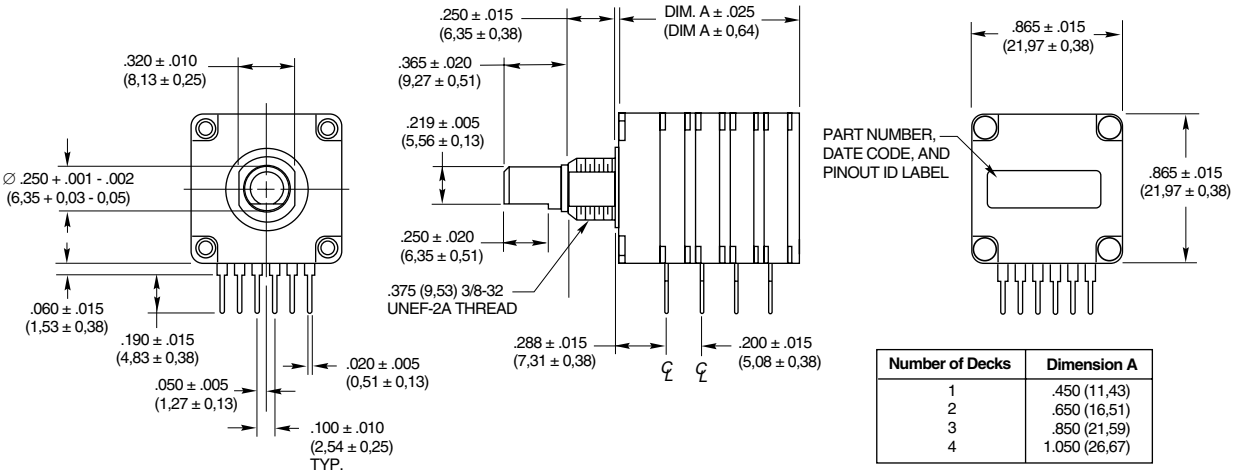
MECHANICAL ENCODERS
- Standard BCD and Multiple Code Outputs
- As Small as 1/2" Diameter
- Economical Means to Provide Code Output

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)



Number of Decks	Dimension A
1	.450 (11,43)
2	.650 (16,51)
3	.850 (21,59)
4	1.050 (26,67)

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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

25BSP22–Q–1–16 C

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°

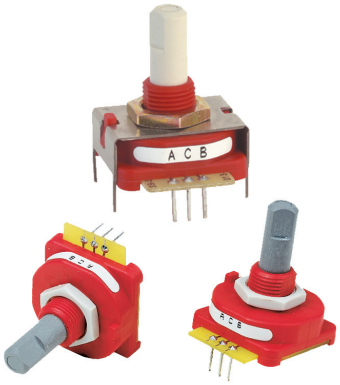
Specials include 1/8" diameter shaft, custom angles of throw for binary, binary complement and gray code outputs. Contact Grayhill Sales for availability.

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

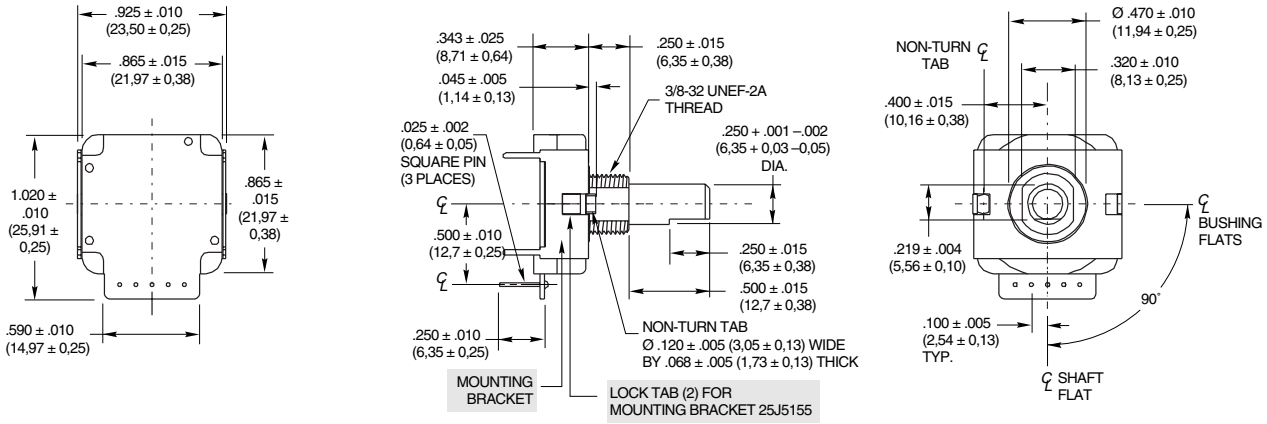
Hex, Gray and Quadrature Code



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	Output "A"	"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.

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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.

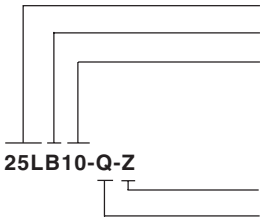
Mechanical Ratings

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, flatted 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)

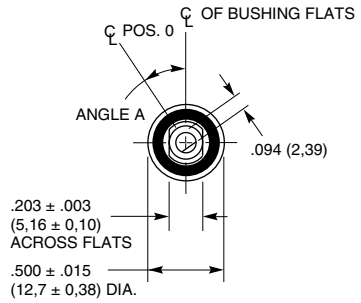
Custom materials, styles, color and markings are available. Custom knobs available, see page I-57.

Available from your local Grayhill Distributor. For prices and discounts, contact a local Sales Office, an authorized local Distributor or Grayhill.
For Custom codes. Termination, Tirque, Angles of Throw, Call Grayhill for more information.

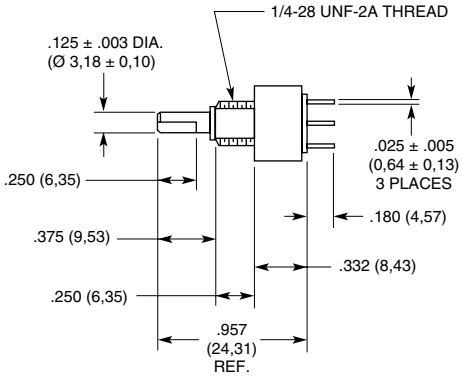
SERIES 26
Binary and Gray Code

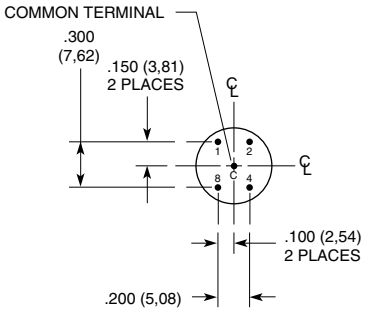
AVAILABLE CODES
- Hexadecimal
- Octal
- BCD (Adjusted)
- Quadrative
- Custom (4-Bit, 16 position maximum)
- RoHS Compliant

DIMENSIONS In inches (and millimeters)



Maximum Switch Positions	Angle A
8	67.5°
16	33.75°





Grayhill part number and date code marked on label. Customer part number marked on request.

Unless specified otherwise, all tolerances are ± .015 (0,38)

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* 1	2	4	8	Gray 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	●	●	●	●				●

*Dot indicates terminal tied to common.

Gray Code Output–Continuous Rotation

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 avalable by contacting the Grayhill sales office.

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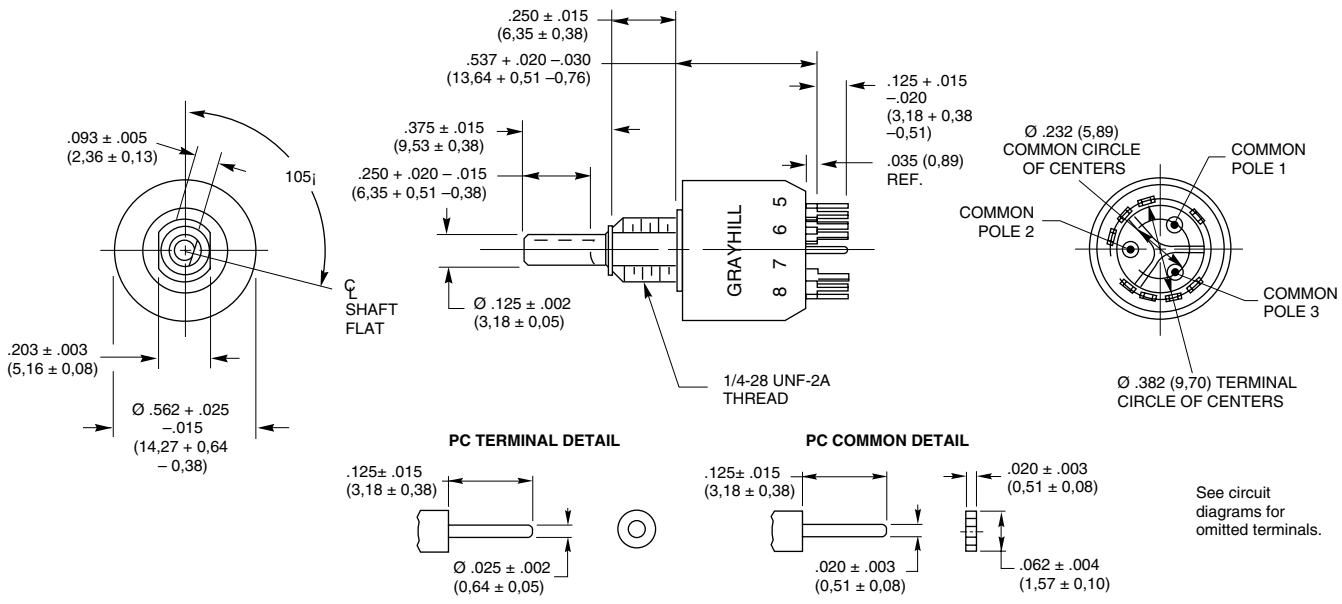
SERIES 51

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)



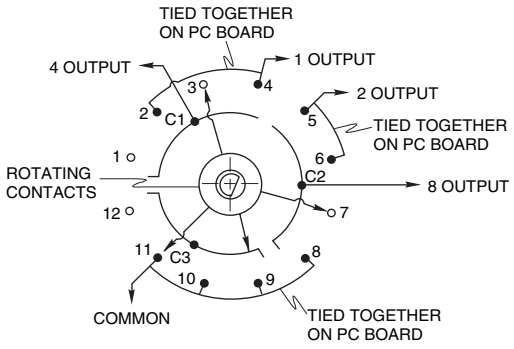
All switches are provided with PC mount terminals.
Grayhill part number and date code marked on label. Customer part number marked on request.

CIRCUIT DIAGRAMS

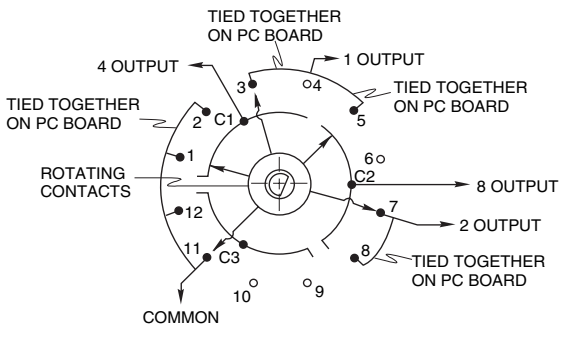
Switch is viewed from the shaft end and shown in switch position number 1, which is decimal number zero and BCD number zero.

● 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.

BCD



BCD Complement



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 to16 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 Unsealed	BCD Output Sealed	BCD Complement Unsealed	BCD Complement 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.

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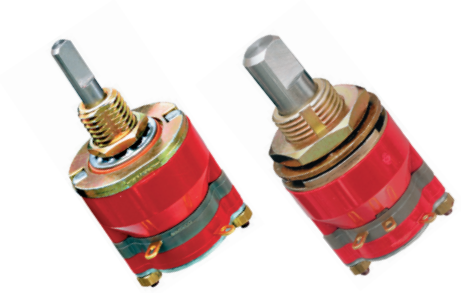
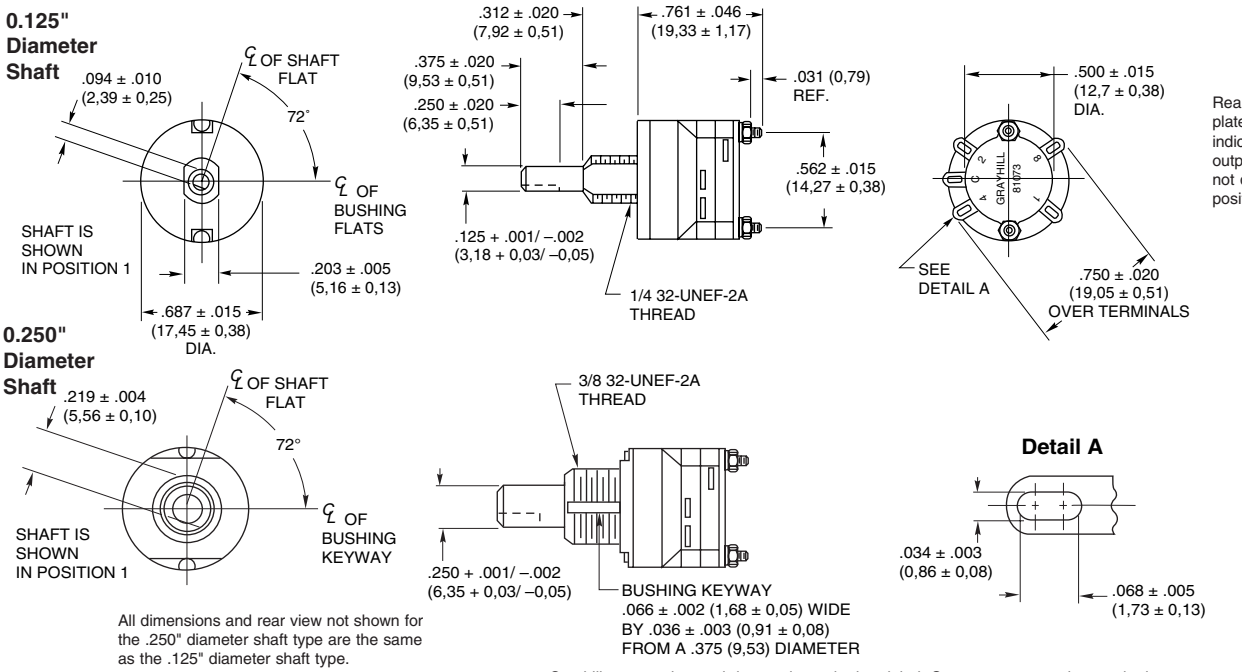
SERIES 71
Binary Code

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)



All dimensions and rear view not shown for the .250" diameter shaft type are the same as the .125" diameter shaft type.

Grayhill part number and date code marked on label. Customer part number marked on request.

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.

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.

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.

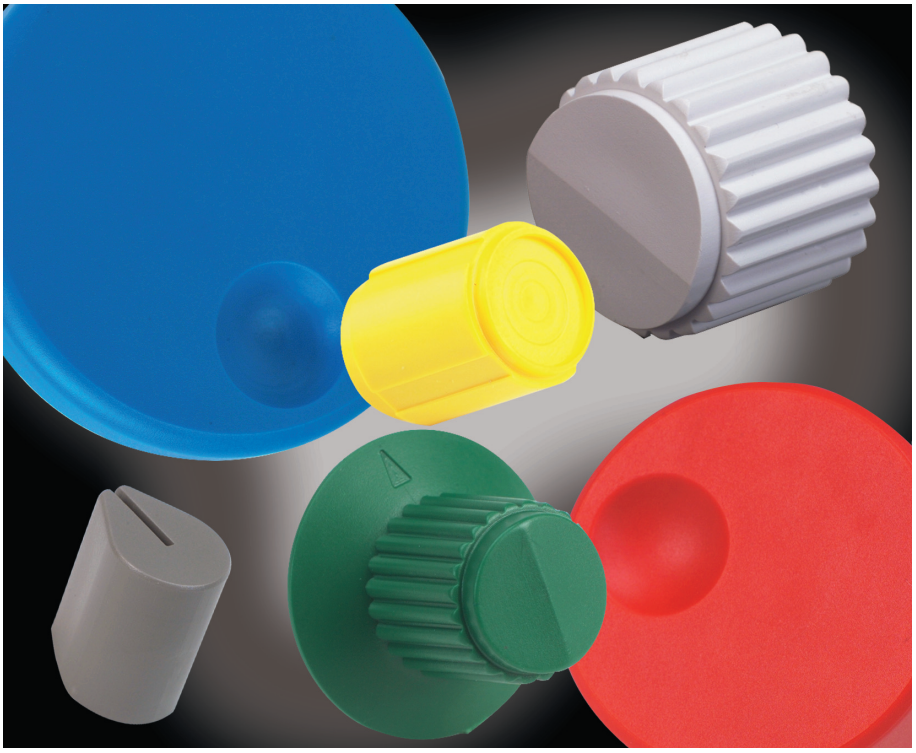
ORDERING INFORMATION

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



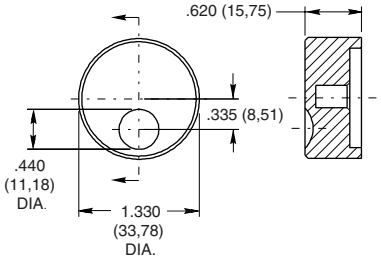
FEATURES

- 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

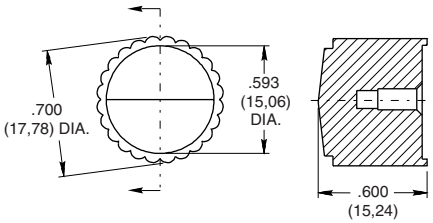
DIMENSIONS In inches (and millimeters)

Style 5013 **Top View**

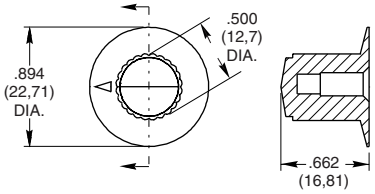


Available in .250 Dia. Shaft only.*

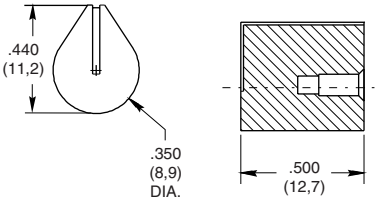
Style 5014 **Top View**



Style 5015 **Top View**



Style 5017 **Top View**

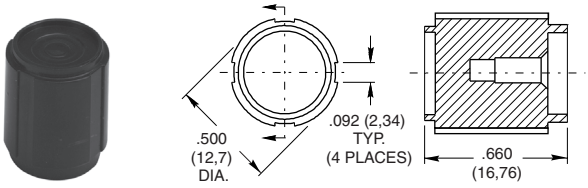


Available in .125 and .157 (4mm) dia. shaft in spring clip (press-on) version only.*

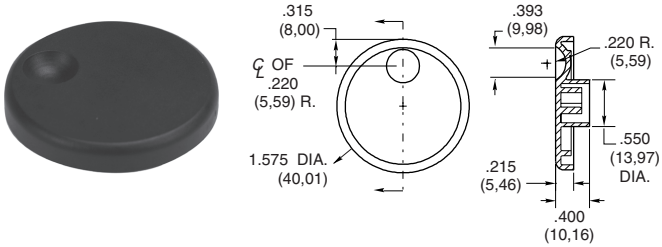
*See Ordering Information.

DIMENSIONS In inches (and millimeters)

Style 5019 **Top View**

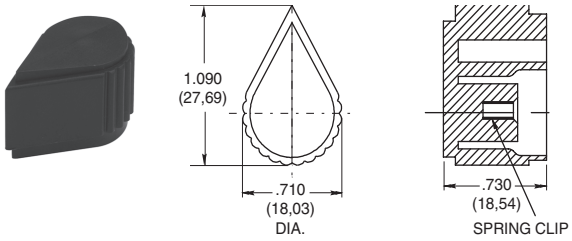


Style 5020 **Top View**

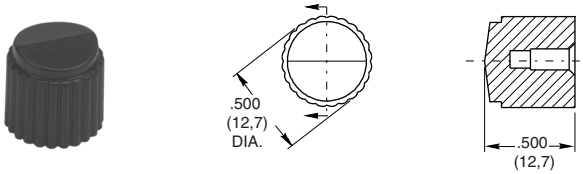


Available in ABS, .250 dia. shaft in spring clip (press-on). The locking clip is also available, requires a custom shaft.**

Style 5028 **Top View**



Style 5029 **Top View**



*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.


GRAYHILL
61R128
GRAYHILL
6 5 4 3 2 1

OPTICAL ENCODERS
- Eliminates Rotary Mechanical Contacts
- Accurate Resolution up to 1024 Positions
- Logic Compatible
- Selects Menu or Display Items
- Includes Data Input Switch
- Up to 1 Billion Trouble-Free Cycles

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

QUADRATURE

All Grayhill encoders use quadrature output code, which is the same as a 2-bit, repeating gray code. Quadrature is the most popular and cost effective output format because only two detectors are required. However, quadrature can only be used in applications where incremental data is required. Absolute positioning is not possible because the code repeats every four positions. In other words, changes in the encoder in magnitude and direction can be determined, but the actual position of the encoder cannot. In most applications this is not a problem.

In a quadrature rotary optical encoder two detectors are used to provide outputs, "A" and "B". The code rotor either blocks the infrared light or allows it to pass to the detectors. As the shaft turns the rotor, the outputs change state to indicate position. The resulting output is two square waves which are 90° out of phase.

OPEN COLLECTOR OUTPUT

The open collector output is typical of the Series 61B, 61C and 62, and is the simplest form of output available. The first step in interfacing with open collector outputs is to provide an external pull-up resistor from each output to the power source. These pull-up resistors provide the output with the high-state voltage when the phototransistor is "off".

In a phototransistor, base current is supplied when light strikes the detector, which effectively grounds the output. Typically, the detector is operated in saturation. This means sufficient light is provided to completely sink, or ground, all the current provided by the pull up resistor plus that of the interfacing electronics. In the logic high state, the light is sufficiently blocked by the rotor and the detector functions like an open circuit. The pull up resistor then provides sourcing current to the interfacing electronics. This "on" or "off" digital arrangement allows the open collector to interface with popular integrated circuit technologies such as TTL, TTL LS, CMOS, and HCMOS.

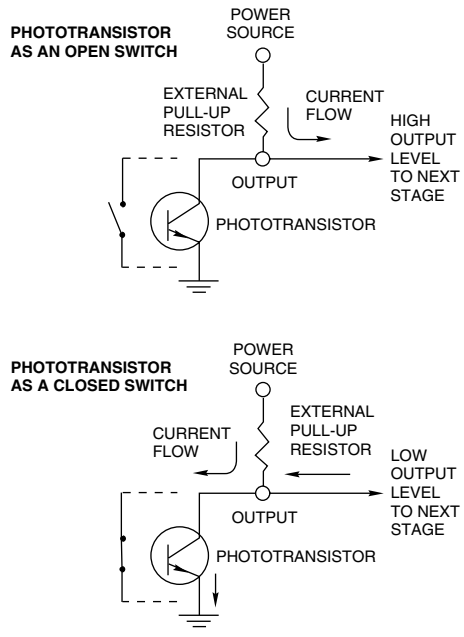
SCHMITT TRIGGERS

To provide signal enhancement it is recommended that a Schmitt Trigger be connected to each output. This device is already included in the Series 61K, 61R, 63K and 63R encoders. The Schmitt Trigger "cleans up" the output into a pure digital signal. It does this by removing the small linear region between the "on" and "off" states of the detector. During this transition the light is only partially blocked and the output is somewhere between what the interfacing circuit might consider to be "on" or "off". In other words, the output is not completely digital. The Schmitt Trigger contains a very important feature which makes it attractive for this application. The device has a higher threshold, or trigger level, when it is in the "on" state than it does in the "off" state. This hysterisis filters any electrical noise, which can cause the output to change state rapidly during the transition. And since the output from the Schmitt Trigger is a pure digital signal and is isolated from the phototransistor, the signal is basically immune to loading problems that can effect encoders without the Schmitt Trigger. Schmitt Triggers are available in most popular IC technologies.

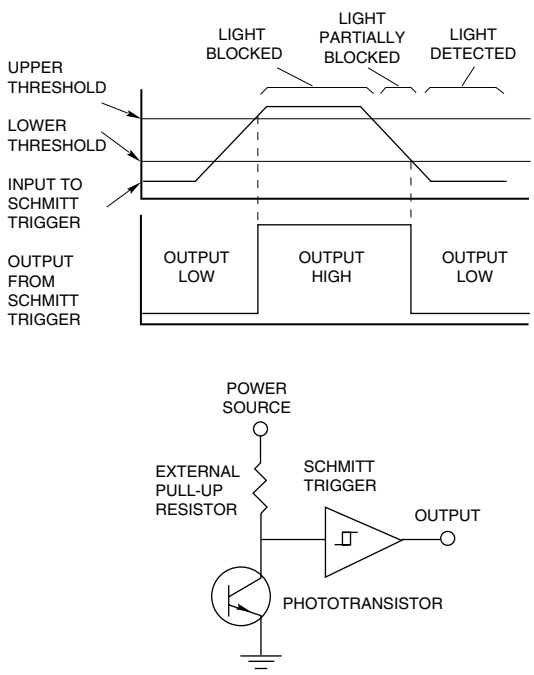
SHAFT AND PANEL SEAL

A shaft and panel seal are available to provide water-tight mounting for the Series 61B, 61D, 61K, 61R and 62 encoders. Sealing is accomplished by an o-ring shaft seal and a panel seal washer. The panel seal washer in the 61B and 61D encoders does not affect the overall dimensions of the switches. In the 61K and 61R encoders, the .045" thick washer is placed over the threads and sits flat on the base of the bushing. The 61KS and 61RS are also epoxy-sealed on the bottom of the switch to provide a completely sealed switch.

Open Collector Output



Schmitt Trigger



Grayhill, Inc. • 561 Hillgrove Avenue • LaGrange, Illinois 60525-5997 • USA • Phone: 708-354-1040 • Fax: 708-354-2820 • www.grayhill.com

SERIES 62S

Compact 1/2" Package

FEATURES

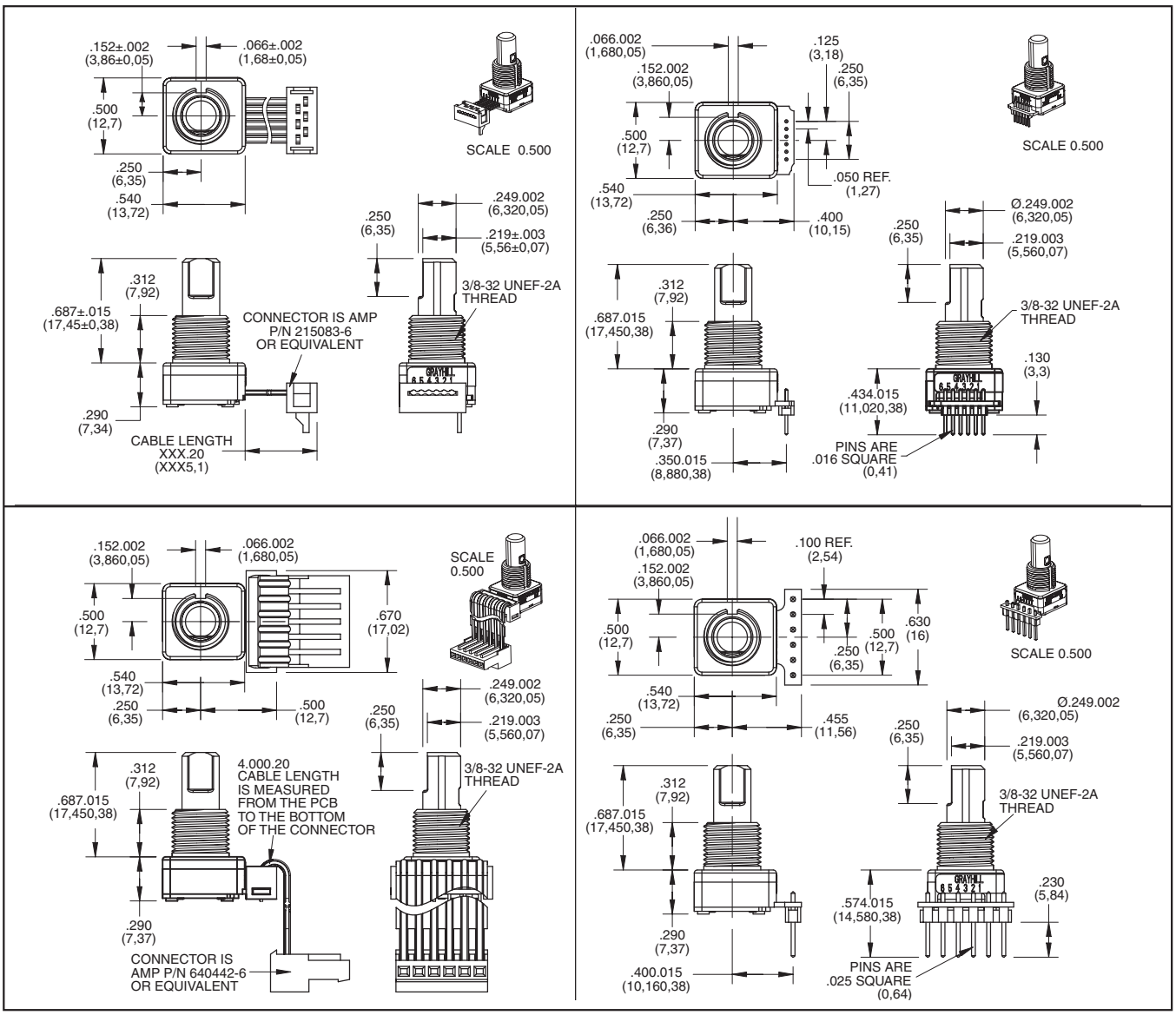
- Compact Size, Requires Minimal Behind Panel Space
- 1/2 Million Rotations for High Torque
- 1 Million Rotational Cycles, 3 Million for Non-Detent Styles
- Optional Integral Pushbutton
- Choices of Cable Length and Terminations

APPLICATIONS

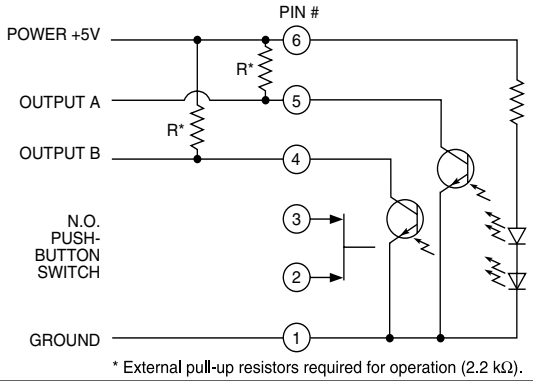
- Global Positioning/Driver Information Systems
- Medical Equipment

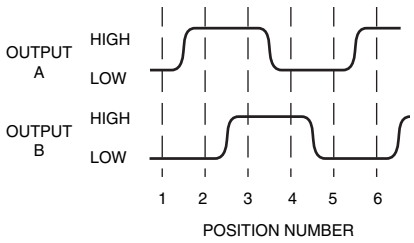
DIMENSIONS In inches (and millimeters)

Unless otherwise specified, standard tolerance is ±.010 (0,25)



CIRCUITRY, TRUTH TABLE, AND WAVEFORM Standard Quadrature 2-Bit Code





Clockwise Rotation		
Position	Output A	Output B
1		
2	●	
3	●	●
4		●

● Indicates logic high; blank indicates logic low.
Code repeats every 4 positions.

SPECIFICATIONS

Environmental Specifications

Operating Temperture Range: -40°C to 85°C
Storage Temperature Range: -55°C to 100°C
Humidity: 96 Hours at 90–95% humidity at 40°C
Mechanical Vibration: Harmonic motion with amplitude of 15G's, within a varied frequency of 10 to 2000 Hz
Mechanical Shock: Test 1: 100G for 6 mS, half sine wave with a velocity change of 12.3 ft/s; Test 2: 100G for 6 mS, sawtooth wave with a velocity change of 9.7 ft/s

Rotary Electrical and Mechanical Specifications

Operating Voltage: 5.00 ±0.25 Vdc
Supply Current: 30mA maximum at 5Vdc
Output: Open collector phototransistor, external pull up resistors are required
Output Code: 2-Bit quadrature, channel A leads channel B by 90° electrically during clockwise rotation of the shaft
Logic Output Characteristics:
Logic High shall be no less than 3.0 Vdc
Logic Low shall be no greater than 1.0 Vdc
Minimum Sink Current: 2.0 mA
Power Consumption: 150 mW maximum
Mechanical Life:

Non-Detent	3 Million Cycles
Low & Medium	1 Million Cycles
High	1/2 Million Cycles

1 cycle is a rotation through all positions and a full return

AVERAGE ROTATIONAL TORQUE SPECIFICATIONS			
	LOW ±0.50 IN-OZ	MEDIUM ±1.40 IN-OZ	HIGH ±1.60 IN-OZ
8 POSITION	1.10	1.85	2.75
12 POSITION	1.00	1.70	2.95
16 POSITION	1.40	2.35	3.40
20 POSITION	1.35	2.05	2.80
24 POSITION	1.25	1.95	2.95
32 POSITION	0.95	1.40	2.15

Torque shall be within 50% of initial value throughout life
Mounting Torque: 15 in-lbs maximum
Shaft Push-Out Force: 45 lbs minimum
Shaft Pull-Out Force: 45 lbs minimum
Terminal Strength: 15 lbs minimum terminal pull-out force for cable or header termination
Solderability: 95% free of pin holes and voids

Pushbutton Electrical and Mechanical Specifications

Rating: 10 mA at 5 Vdc
Contact Resistance: <10Ω
Life: 3 million actuations minimum
Contact Bounce: <4 ms Make, <10 ms Break
Actuation Force: 9-950±250 grams, 5-510±110 grams, 4-400±100 grams, 3-300±90 grams, 2-200±75 grams
Shaft Travel: .020±.010 inch

Materials and Finishes

Bushing: Zamak 2
Shaft: Aluminum or Zamak 2
Retaining Ring: Stainless steel
Pushbutton Actuator: Zytel 70G33L
Detent Spring: Music wire
Detent Ball: Stainless steel
Code Housing: Polyamide polymer, nylon 6/10 alloy UL94HB
Code Rotor: Delrin 100
Printed Circuit Boards: NEMA grade FR-4, double clad with copper, plated with gold over nickel
Infrared Emiting Diode Chips: Gallium aluminum arsenide
Silicon Phototransistor Chips: Gold and Aluminum Alloys
Resistor: Metal oxide on ceramic substrate
Solder Pins: Brass, plated with tin
Pushbutton Dome: Stainless steel
Backplate: Stainless steel
Cable: Copper stranded with topcoat in PVC insulation (Cable version only)
Connector (.050 Center): PA4.6 with tin over nickel plated phosphor bronze
Connector (.100 Center): Nylon UL94V-2, tin plated copper alloy
Label: TT406 Thermal transfer cast film
Solder: Sn/Ag/Cu, Lead-Free, No Clean
Lubricating Grease: NYE nyogel 774L
Hex Nut: Nickel, plated with brass
Lockwasher: Stainless steel
Header: Hi-Temp glass filled thermoplastic UL94V-0, phoshor bronze (pinned versions only)
Strain Relief: Glass filled thermoplastic (.100 center cable versions only)

OPTIONS

Contact Grayhill for custom terminations, shaft and bushing configurations, rotational torque pushbutton force, and code output. Control knobs are also available.

ORDERING INFORMATION

62SXX-XX-040X

Angle of Throw
45=45° for Code Change and 8 Detent Positions
30=30° for Code Change and 12 Detent Positions
22=22.5° for Code Change and 16 Detent Positions
18=18° for Code Change and 20 Detent Positions
15=15° for Code Change and 24 Detent Positions
11=11.25° for Code Change and 32 Detent Positions

Rotational Torque Option
N = Non-detent
L = Low Torque (available with 0, 4, 5, 9 pushbutton only)
M = Medium Torque (available with 0, 5, 9 pushbutton only)
H = High Torque (available with 0, 9 pushbutton only)

Termination
C = .050 Center Ribbon Cable with Connector
S = .050 Center Ribbon Cable with .100 Stripped End
P = .050 Center Pins with .185 Length
CH = .100 Center Ribbon Cable with Connector
SH = .100 Center Ribbon Cable with .100 Stripped End
PH = .100 Center Pins with .230 Length

Cable Length
Cable Termination: 040=4.0in or 040in. Cable is terminated with Amp Connector P/N 640442-6
See Amp Mateability Guide for mating connector details.

Pushbutton Option

0 = NO PUSHBUTTON	4 = 400 Grams
9 = 950 Grams	3 = 300 Grams
5 = 510 Grams	2 = 200 Grams

SERIES 62P

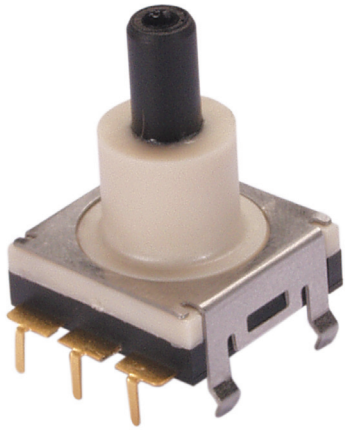
Low Cost, PC Mount

FEATURES

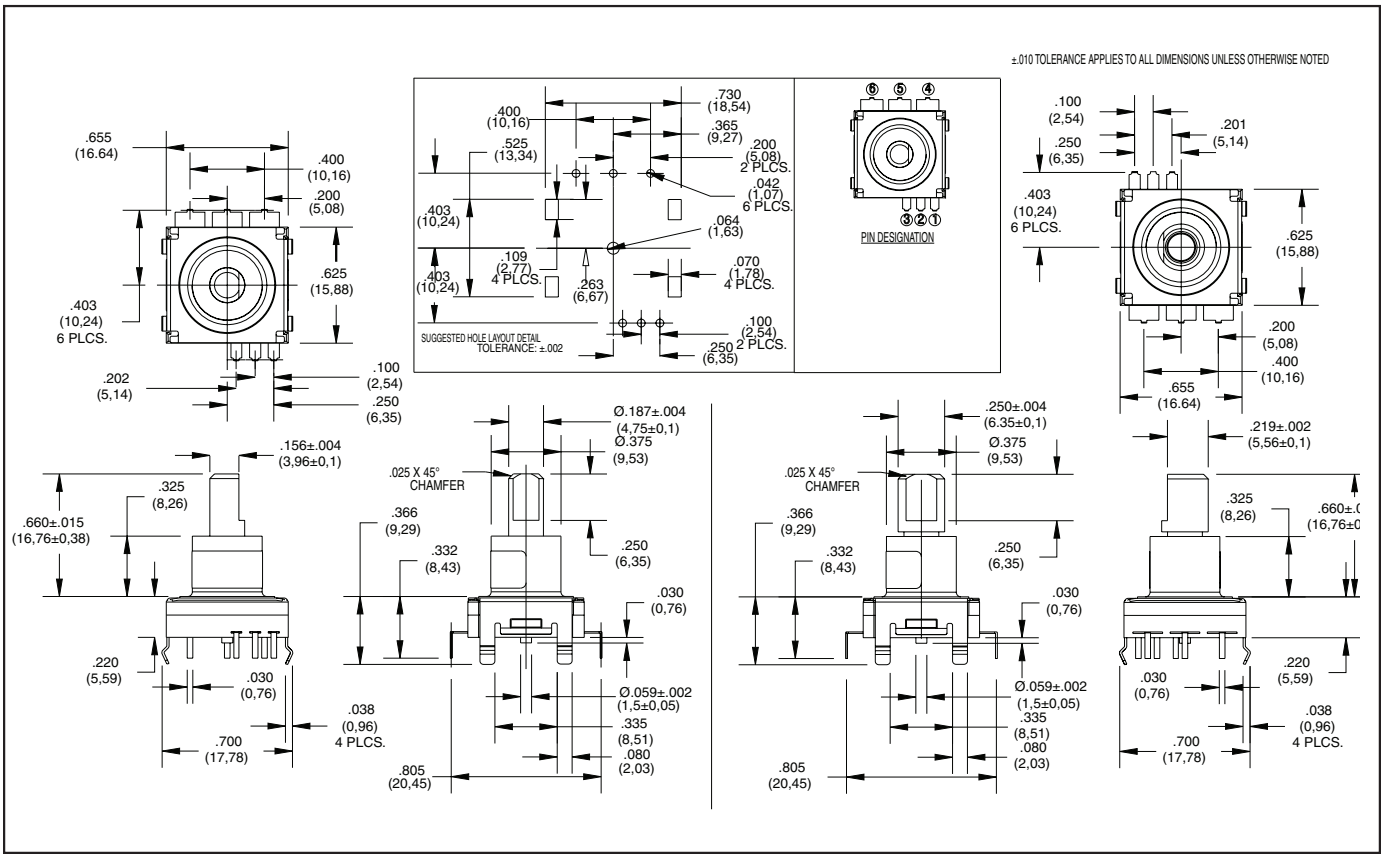
- Low Cost
- Compact Size
- PC Mount
- No De-Bouncing Required
- Reliable, Up to 2 Million Cycles
- Choice of Detent and Pushbutton Force
- Available in 16 Positions
- Quadrature Output

APPLICATION

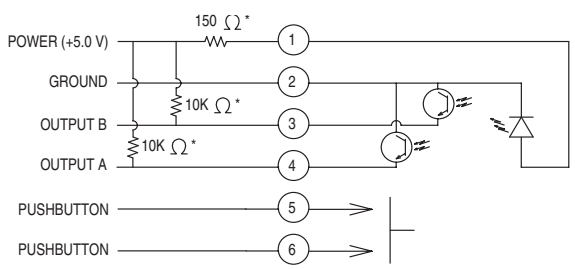
- Automotive Controls
- White Goods
- Audio



DIMENSIONS In inches (and millimeters)

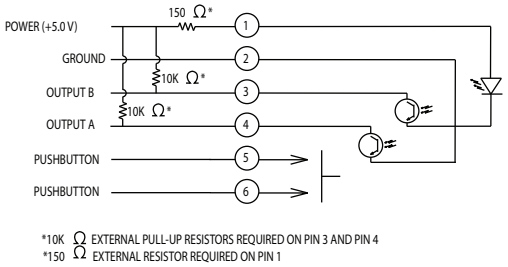


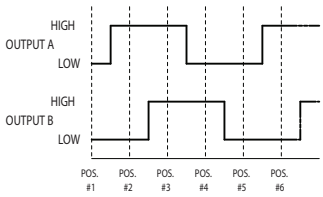
CIRCUITRY



*10K Ω EXTERNAL PULL-UP RESISTORS REQUIRED ON PIN 3 AND PIN 4
Ω *150 EXTERNAL RESISTOR REQUIRED ON PIN 1

WAVEFORM AND TRUTH TABLE Standard Quadrature 2-bit Code





POSITION	OUTPUT A	OUTPUT B
#1		
#2	●	
#3	●	●
#4		●

● INDICATES LOGIC HIGH CODE REPEATS EVERY FOUR POSITIONS.

SPECIFICATIONS

Electrical Ratings

Operating Voltage: 5 Vdc +/-.25 Vdc
Supply Current: 30mA maximum at 5 Vdc
Logic High: 3.0V minimum
Logic Low: 1.0V maximum
Logic Rise and Fall: less than 30 ms

Pushbutton Switch Ratings

Rating: 5.0 Vdc at 10mA resistive
Contact Resistance: less than 10 ohms (TTL or CMOS compatible)
Voltage Breakdown: 250 Vac between mutually insulated parts
Contact Bounce: less than 4 ms at make and less than 10 ms at break
Actuation Life: 3,000,000 operations
Actuation Force: 6: 600 +/- 200 grams
4: 450 +/- 150 grams
Shaft Travel: .015 ± .010 inch

Mechanical Ratings

Operating Torque:
H: 1.4 in-oz +/- 0.6 in-oz initial
L: 0.6 in-oz +/- 0.3 in-oz initial
N: ∠0.5 in-oz initial
Rotational Life:
H&L: 500,000 cycles
N: 2 million cycles
(1 cycle = 360 degree rotation and return)
Shaft Push Out Force:
20 lbs minimum
Operating Speed: 100 RPM maximum
Axial Shaft Play: .010 maximum

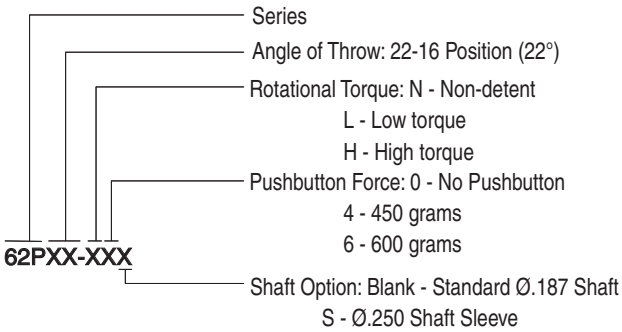
Environmental Ratings

Operating Temperature Range:
-40°C to 85°C
Storage Temperature Range:
-55°C to 100°C
Relative Humidity: 90-95% at 40°C for 96 hours
Vibration Resistance: Harmonic motion with Amplitude of 15g, within a varied 10 to 2000 Hz frequency for 12 hours per MIL-STD-202, Method 204
Mechanical Shock Resistance:
Test 1: Tested at 100g for 6mS, half sine, 12.3 ft/s.
Test 2: 100g for 6mS, Sawtooth, 9.7 ft/s

Materials and Finishes

Code/Pushbutton Housing: Thermoplastic
Shaft: Thermoplastic
Code/Detent Rotor: Reinforced Thermoplastic
Bushing: Thermoplastic
Terminal Pins: Brass, Tin plated
Detent Spring: Stainless Steel
Dome: Stainless Steel
Pushbutton Contact: Nickel plated brass
Phototransistor: Planar Silicon
Detent Balls:
.0625 dia. Stainless Steel
Infrared Emitter:
Gallium Aluminum Arsenide
Label:
White Thermal Transfer Cast Film. Adhesive Coated
Bracket: Stainless Steel, Tin plated

ORDERING INFORMATION



SERIES 62A,V,D

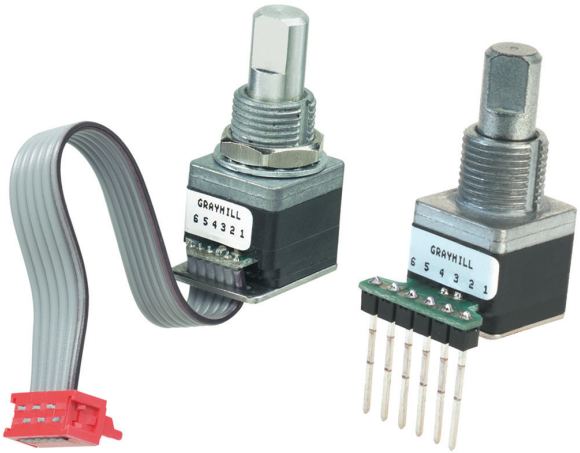
1/2" Package

FEATURES

- Low Cost
- Long Life
- Available in 3.3 or 5.0 Vdc Operating Voltages
- High Torque Version to Emphasize Rotational Feel
- Economical Size
- Optically Coupled for More than a Million Cycles
- Optional Integral Pushbutton
- Compatible with CMOS, TTL and HCMOS Logic
- Available in 12,16, 20, 24 and 32 Detent Positions (Non-detent Also Available)
- Choices of Cable Length and Terminations

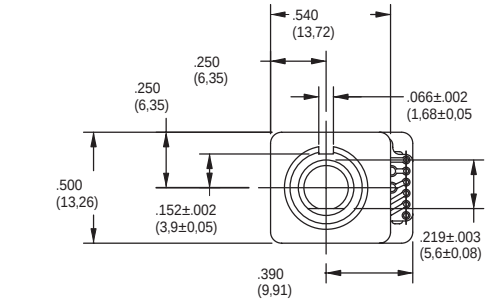
APPLICATIONS

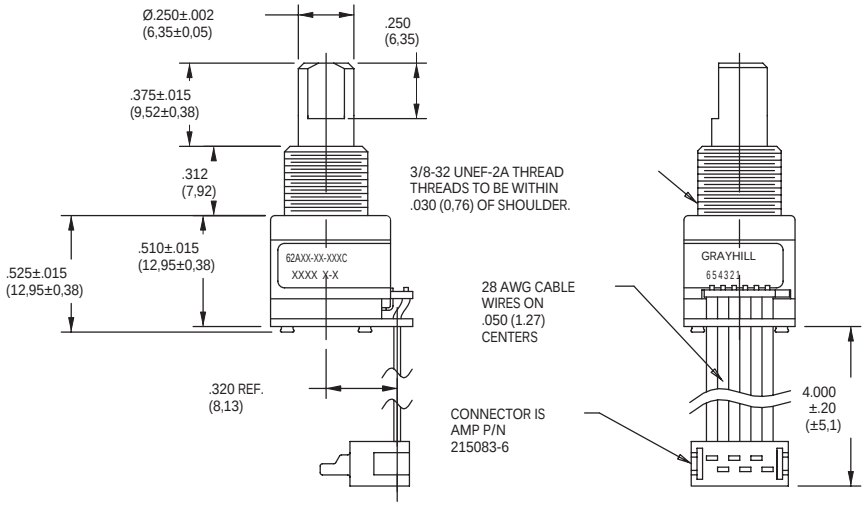
- Global Positioning/Driver Information Systems
- Medical Equipment



DIMENSIONS In inches (and millimeters)

Cable Version

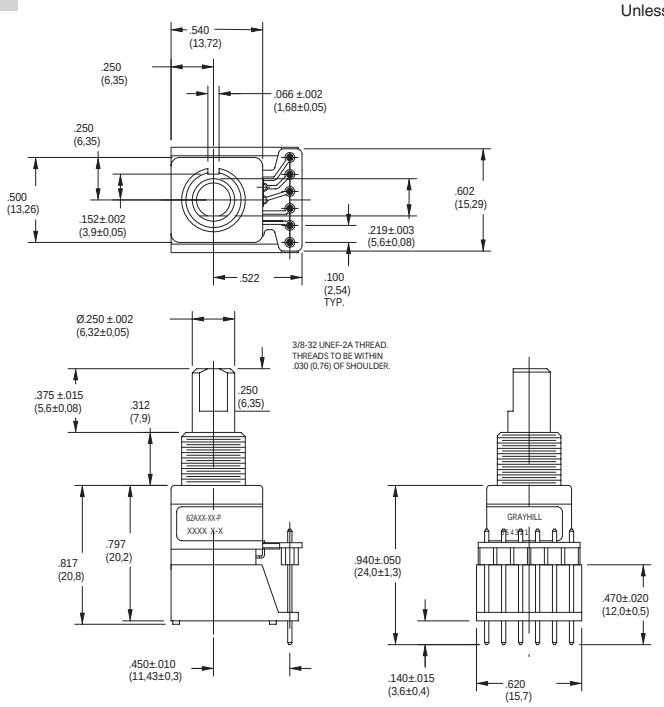




DIMENSIONS In inches (and millimeters)

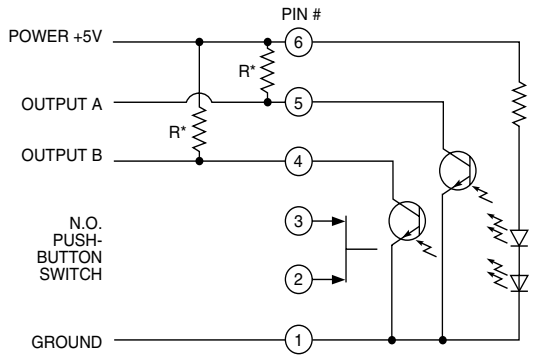
Pin Version

Unless otherwise specified, standard tolerance is ±.010 (0.25)



CIRCUITRY, TRUTH TABLE, AND WAVEFORM Standard Quadrature 2-Bit Code

Standard 5.0 Volt (Styles A and D)

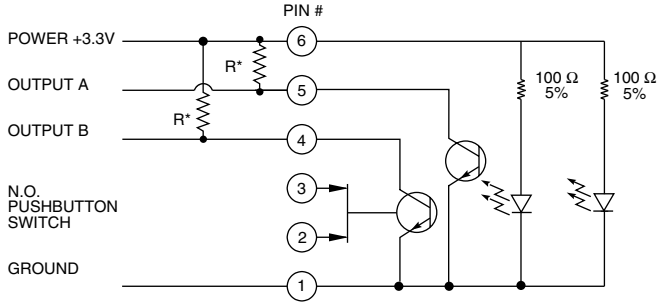


* External pull-up resistors required for operation (2.2 kΩ).

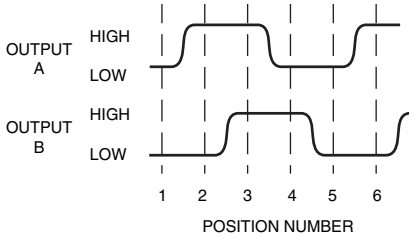
Clockwise Rotation		
Position	Output A	Output B
1		
2	●	
3	●	●
4		●

● Indicates logic high; blank indicates logic low. Code repeats every 4 positions.

3.3 Volt (Style V only)



* External pull-up resisitors required for operation (2.2k Ω)



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SPECIFICATIONS

Electrical and Mechanical Ratings

Rating: 5 Vdc, 10 mA, resistive
Contact Resistance: less than 10 ohms (TTL or CMOS compatible)
Pushbutton Life: 3 million actuations minimum
Contact Bounce: less than 4 mS at make and less than 10 mS at break
Actuation Force: 1000 ±300 grams
Pushbutton Travel: .010/.025 inch
Coding: 2-bit quadrature coded output
Operating Voltage: 5.0 ±.25 Vdc, 3.30±.125 Vdc (style V only)
Voltage Breakdown: 250 Vac between mutually insulated parts
Supply Current: 30 mA maximum
Logic Output Characterisitics:
Logic High: 3.8 Vdc (5.0 Vdc); 2.3 (3.3 Vdc) minimum
Logic Low: 0.8 Vdc maximum
Rotational Life: 1,000,000 cycles minimum (One cycle is a rotation through all positions and a full return)
Minimum Sink Current: 2.0 mA for 5 Vdc; 1.0 mA for 3.3 Vdc
Power Consumption: 150 mW maximum for 5 Vdc; 80 mW for 3.3 Vdc
Optical Rise and Fall Times: less than 30 mS maximum

Operating Torque:
Style A and V: 2.0 ±1.4 in-oz. initially
Style D: 3.5 ±1.4 in-oz initially
Non-detent: less than 1.5 in-oz initially
Shaft Push Out Force: 45 lbs minimum
Mounting Torque: 15 in-lbs maximum
Terminal Strength: 15 lbs cable pull-out force minimum
Operating Speed: 100 RPM maximum
Axial Shaft Play: .010 maximum

Environmental Ratings

Operating Temperature Range: -40°C to 85°C
Storage Temperature Range: -55°C to 100°C
Relative Humidity: 90–95% at 40°C for 96 hours
Vibration Resistance: Harmonic motion with amplitude of 15G, within a varied 10 to 2000 Hz frequency for 12 hours per MIL-STD-202, Method 204
Mechanical Shock: Test 1: 100G for 6 mS, half sine, 12.3 ft/s; Test 2: 100G for 6 mS, sawtooth, 9.7 ft/s

Materials and Finishes

Code Housing: Reinforced thermoplastic
Shaft: Zinc or aluminum
Bushing: Zinc casting
Shaft Retaining Ring: Stainless steel
Detent Spring: Stainless steel
Printed Circuit Boards: NEMA grade FR-4 gold over nickel or palladium
Terminals: Brass, tin-plated
Mounting Hardware: One brass, nickel-plated nut and stainless steel lockwasher supplied with each switch. Nut is 0.094 inches thick by 0.562 inches across flats.
Rotor: Thermoplastic
Code Housing: Thermoplastic
Pushbutton Dome: Stainless steel
Dome Retaining Disk: Thermoplastic
Pushbutton Housing: Thermoplastic
Phototransistor: Planar Silicon NPN
Infrared Emitter: Gallium aluminum arsenide
Pushbutton Contact: Brass, nickel-plated
Flex Cable: 28 AWG, stranded/top coated wire, PVC coated on .050 or .100" centers (cabled version)
Header Pins: Phosphor bronze, tin-plated
Spacer: ABS
Backplate/Strain Relief: Stainless steel

ORDERING INFORMATION

62A22-01-040S

Series
Style: A = 1/2" package, 5.0 Vdc Input, D = high torque w/5.0 Vdc input, V = 3.3 Vdc input
Angle of Throw:

Detent	Non-detent (Styles A&V only)
11 = 11.25° or 32 positions	01 = 11.25° or 32 positions
15 = 15° or 24 positions	05 = 15° or 24 positions
18= 18° or 20 positions	08= 18° or 20 positions
22 = 22.5° or 16 positions	02 = 22.5° or 16 positions
30 = 30° or 12 positions	03 = 30° or 12 positions

Pushbutton Option: 01 = w/o pushbutton, 02 = with pushbutton

Termination: S = Stripped cable; .050" centers
SH = Stripped cable; .100" centers
C = Connector; .050" centers
CH = Connector; .100" centers
P = Pin; .100" centers

Cable Length: Cable Terminination: 040 = 4.0in. Cable is terminated with Amp P/N 215083-6. See Amp Mateability Guide for Mating Connector details.
**Eliminate cable length if ordering pins.* (Ex: 62A22-02-P).

These switches have Quadrature 2-bit code output and an optional shaft actuated pushbutton switch.

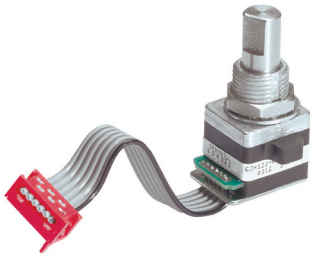
Custom materials, styles, colors, and markings are available. Control knobs available.

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

SERIES 62HS
High Torque

FEATURES
- High Rotational Torque Provides Positive Tactile Feedback
- Optically Coupled for More than a Million Cycles
- Optional Integral Pushbutton
- Compatible with CMOS, TTL and HCMOS Logic
- Available in 8,12 and 16 Detent Positions
- Choice of Cable Length and Terminations

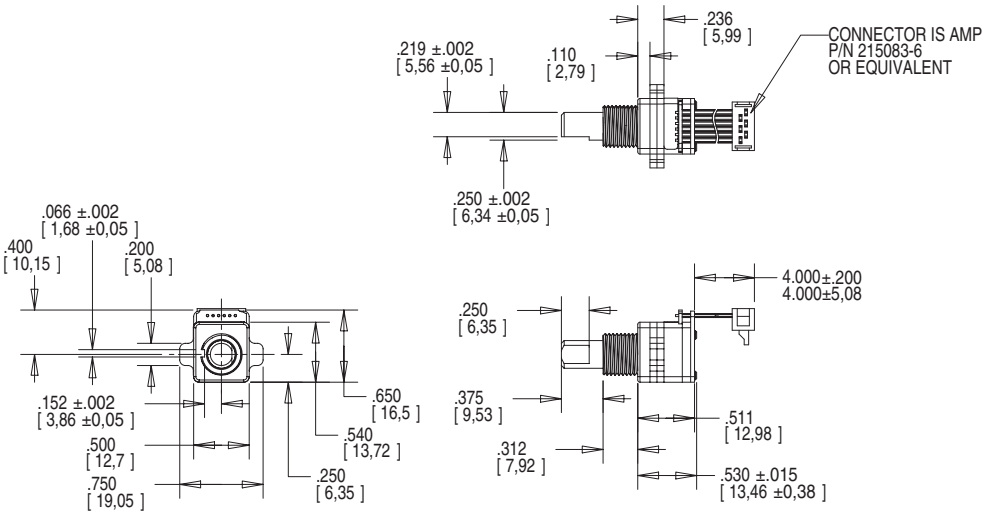
APPLICATIONS
- Avionics



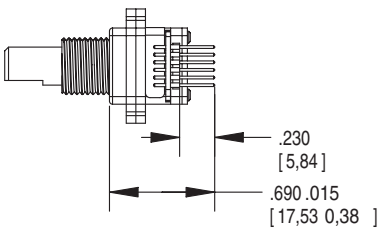
DIMENSIONS In inches (and millimeters)

Unless otherwise specified, standard tolerance is ±.010 (0,25).

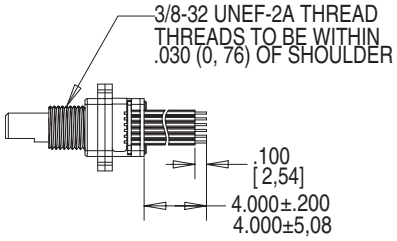
Cable Version



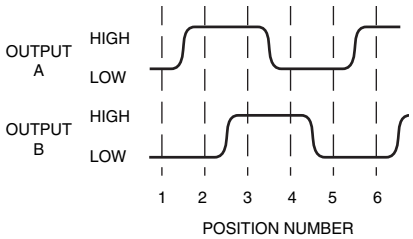
Pin Version



Stripped Version



WAVEFORM AND TRUTH TABLE



Clockwise Rotation		
Position	Output A	Output B
1		
2	●	
3	●	●
4		●

● Indicates logic high; blank indicates logic low. Code repeats every 4 positions.

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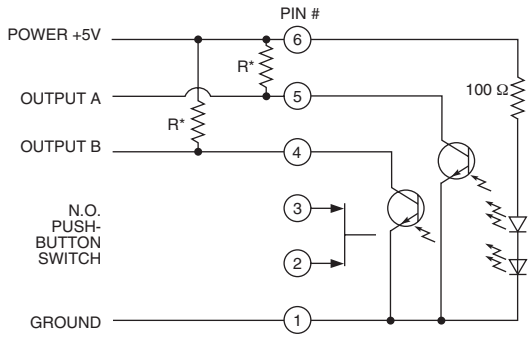
CIRCUITRY



* External pull-up resistors required for operation (2.2 kΩ).

SPECIFICATIONS

Pushbutton Switch Ratings

Rating: at 5 Vdc, 10 mA, resistive
Contact Resistance: less than 10 ohms (TTL or CMOS compatible)
Pushbutton Life: 3 million actuations minimum
Voltage Breakdown: 250 Vac between mutually insulated parts
Contact Bounce: less than 4 mS at make and less than 10 mS at break
Actuation Force: 1100 ±300g

Encoder Ratings

Coding: 2-bit quadrature coded output
Operating Voltage: 5.0 ±.25 Vdc
Supply Current: 30 mA maximum@5.0 Vdc
Logic Output Characterisitics:
Logic High: 3.0 Vdc minimum
Logic Low: 1.0 Vdc maximum
Mechanical Life: 1,000,000 cycles minimum (One cycle is a rotation through all positions and a full return)
Minimum Sink Current: 2.0 mA for 5 Vdc
Power Consumption: 150mW maximum
Output: open collector phototransistor
Logic Rise and Fall: less than 30 mS max

Operating Torque: 5.0 in-oz +/- 1.5 in-oz initial
Shaft Push Out Force: 45 lbs minimum
Mounting Torque: 15 in-lbs maximum
Terminal Strength: 15 lbs cable pull-out force minimum
Operating Speed: 100 RPM maximum

Environmental Ratings

Operating Temperature Range: -40°C to 85°C
Storage Temperature Range: -55°C to 100°C
Vibration Resistance: Harmonic motion with amplitude of 15G, within a varied 10 to 2000 Hz frequency for 12 hours
Mechanical Shock: Test 1: 100G, 6 mS, half sine, 12.3 ft/s; Test 2: 100G, 6 mS, sawtooth, 9.7 ft/s
Relative Humidity: 90–95% at 40°C for 96 hours

Materials and Finishes

Code Housing: Reinforced thermoplastic
Shaft: Stainless Steel
Bushing: Zinc casting
Shaft Retaining Ring: Stainless steel
Detent Spring: Stainless steel
Detent Ball: Stainless steel
Detent Section: Hiloy 610
Printed Circuit Boards: NEMA grade FR-4 gold over nickel or palladium
Terminals: Brass, tin-plated
Mounting Hardware: One brass, nickel-plated nut and stainless steel lockwasher supplied with each switch. Nut is 0.094 inches thick by 0.562 inches across flats
Rotor: Thermoplastic
Pushbutton Dome: Stainless steel
Phototransistor: Planar Silicon NPN
Infrared Emitter: Gallium aluminum arsenide
Flex Cable: 28 AWG, stranded/top coated wire, PVC coated on .050" centers (cabled version)
Header Pins: Brass, tin-plated
Spacer: Hiloy 610
Shim: Stainless Steel
Backplate/Strain Relief: Stainless steel

ORDERING INFORMATION

62HSXX-XX-XXXX

Series
Style: HS = High Torque
Angle of Throw: 45 = 45° or 8 positions,30 = 30° or 12 positions, 22 = 22.5° or 16 positions

Termination: S = stripped cable, C = connector, P = pins
Cable Termination: 040 = 4.0in. Cable is terminated with Amp P/N 215083-6. See Amp Mateability Guide for mating connector details.
**Eliminate cable length if ordering pins.* (Ex: 62HS22-H9-P)

Pushbutton Option: 0 = w/o pushbutton, 9 = 1100g

Rotational Torque: H = High Torque

SERIES 62N

1/2" Package, non-turn, Dedicated Shaft

FEATURES

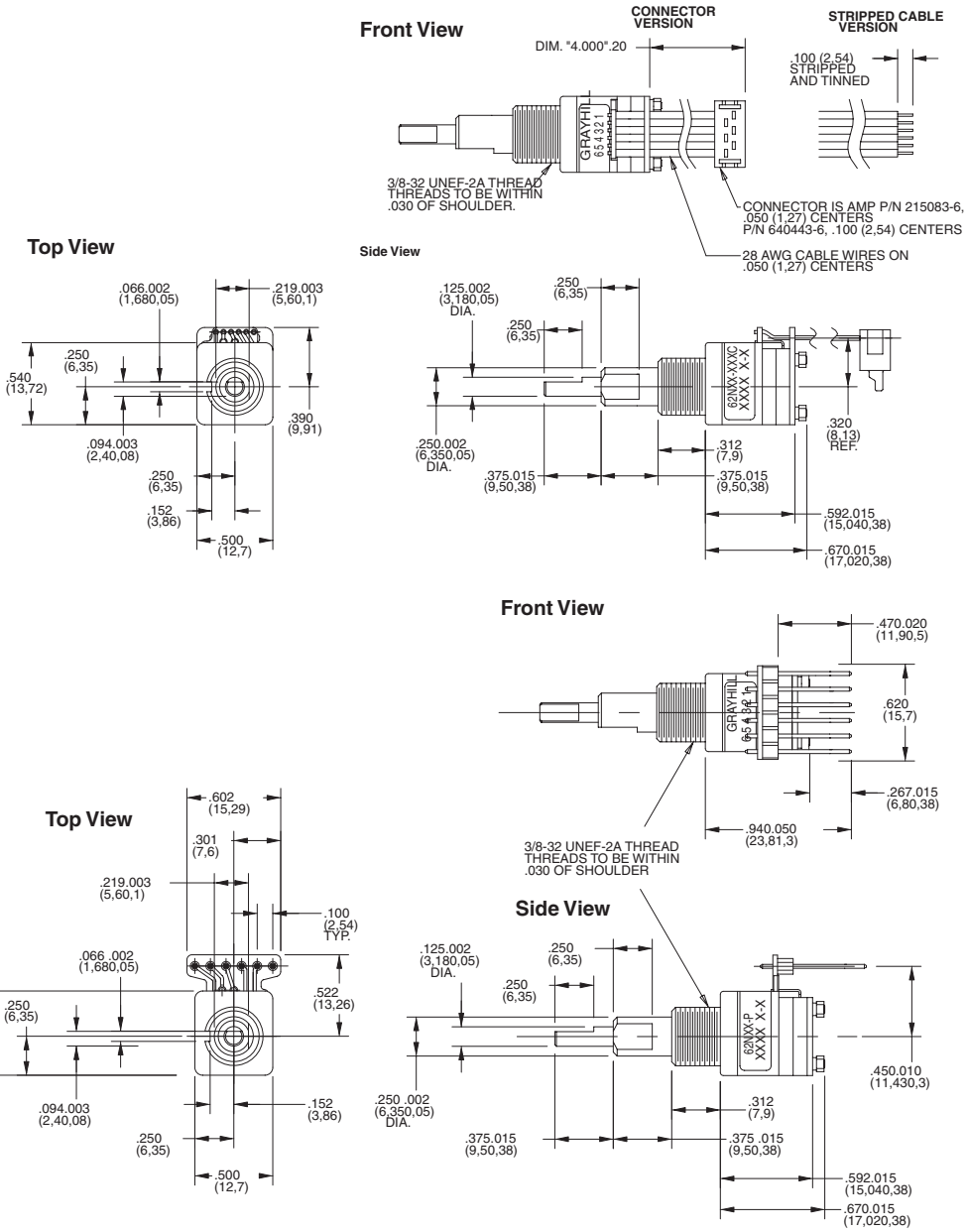
- Non-turn Pushbutton to Ensure Pushbutton Text and Orientation
- Seperate Pushbutton Function
- Low Cost
- Economical Size
- Optically Coupled for More than a Million Cycles
- Compatible with CMOS, TTL and HCMOS Logic
- Available in 12, 16, 24, and 32 Detent Positions (Non-detent Also Available)
- Choices of Cable Length and Terminations

APPLICATIONS

- Global Positioning/Driver Information Systems
- Medical Equipment
- Cockpit Controls
- Mixing Boards

DIMENSIONS In inches (and millimeters)

Cable Version



Unless otherwise specified, standard tolerances are ±0.10 (0,25)

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SPECIFICATIONS

Pushbutton Switch Ratings

Rating: at 5 Vdc, 10 mA, resistive
Contact Resistance: less than 10 ohms (TTL or CMOS compatible)
Pushbutton Life: 3 million actuations minimum
Voltage Breakdown: 250 Vac between mutually insulated parts
Contact Bounce: less than 4 mS at make and less than 10 mS at break
Actuation Force: 1000 ±300g
Pushbutton Travel: .010/.025 inch

Encoder Ratings

Coding: 2-bit quadrature coded output
Operating Voltage: 5.0 ±.25 Vdc
Supply Current: 30 mA maximum@5.0 Vdc
Logic Output Characterisitics:
Logic High: 3.8 Vdc minimum
Logic Low: 0.8 Vdc maximum
Mechanical Life: 1,000,000 cycles minimum (One cycle is a rotation through all positions and a full return)
Minimum Sink Current: 2.0 mA for 5 Vdc
Power Consumption: 150mW maximum
Output: open collector phototransistor
Logic Rise and Fall Times: less than 30 mS maximum

Operating Torque:
Detent: 2.0 in-oz ±70% initially
Non-Detent: less than 1.5 in-oz initially
Shaft Push Out Force: 45 lbs minimum
Mounting Torque: 15 in-lbs maximum
Terminal Strength: 15 lbs cable pull-out force minimum
Operating Speed: 100 RPM maximum

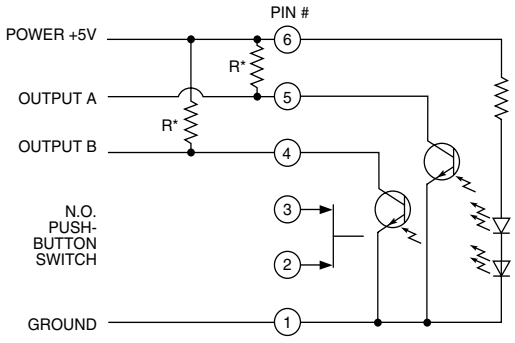
Environmental Ratings

Operating Temperature Range: -40°C to 85°C
Storage Temperature Range: -55°C to 100°C
Vibration Resistance: Harmonic motion with amplitude of 15G, within a varied 10 to 2000 Hz frequency for 12 hours
Mechanical Shock: Test 1: 100G, 6 mS, half sine, 12.3 ft/s; Test 2: 100G, 6 mS, sawtooth, 9.7 ft/s
Relative Humidity: 90–95% at 40°C for 96 hours

Materials and Finishes

Code Housing: Reinforced thermoplastic
Shafts: Aluminum
Bushing: Zinc casting
Shaft Retaining Ring: Stainless steel
Detent Spring: Stainless steel
Printed Circuit Boards: NEMA grade FR-4 gold over nickel or palladium
Terminals: Brass, tin-plated
Mounting Hardware: One brass, nickel-plated nut and stainless steel lockwasher supplied with each switch. Nut is 0.094 inches thick by 0.562 inches across flats
Rotor: Thermoplastic
Code Housing: Thermoplastic
Pushbutton Dome: Stainless steel
Dome Retaining Disk: Thermoplastic
Pushbutton Housing: Thermoplastic
Phototransistor: Planar Silicon NPN
Infrared Emitter: Gallium aluminum arsenide
Pushbutton Contact: Brass, nickel-plated
Flex Cable: 28 AWG, stranded/top coated wire, PVC coated on .050 or .100" centers (cabled version)
Header Pins: Phosphor bronze, tin-plated
Spacer: Thermoplastic
Endcap: Thermoplastic
Non-turn Pin: Stainless steel
Backplate/Strain Relief: Stainless steel
Lockwashers: Stainless steel
Hex Nuts: Stainless steel
Studs: Stainless steel

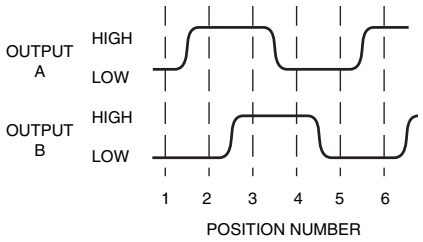
CIRCUITRY, TRUTH TABLE, AND WAVEFORM Standard Quadrature 2-Bit Code



* External pull-up resistors required for operation (2.2 kΩ).

Clockwise Rotation		
Position	Output A	Output B
1		
2	●	
3	●	●
4		●

● Indicates logic high; blank indicates logic low. Code repeats every 4 positions.



ORDERING INFORMATION

62N22-040S

Series and Style = 1/2" package, non-turn, dedicated shaft

Angle of Throw:

Detent	Non-detent
11 = 11.25° or 32 pos.	01 = 11.25° or 32 positions
15 = 15° or 24 positions	05 = 15° or 24 positions
22 = 22.25° or 16 positions	02 = 22.5° or 16 positions
30 = 30° or 12 positions	00 = 30° or 12 positions

Termination: S = Stripped cable; .050" centers
SH = Stripped cable; .100" centers
C = Connector; .050" centers
CH = Connector; .100" centers
P = Pin; .100" centers

Cable Termination: 040 = 4.0in. Cable is terminated with Amp Connector P/N 215088-6. See Amp Mateability Guide for mating connector details.
**Eliminate cable length if ordering pins* (Ex: 62N22-P)

These switches have Quadrature 2-bit code output and an optional shaft actuated pushbutton switch.

Custom materials, styles, colors, and markings are available. Control knobs available.

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

SERIES 62HN

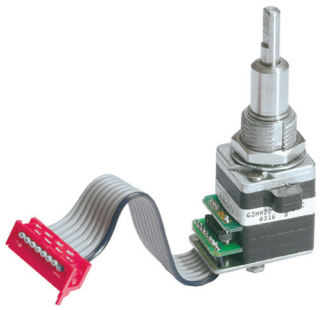
High Torque, Non-Turn Concentric Shaft

FEATURES

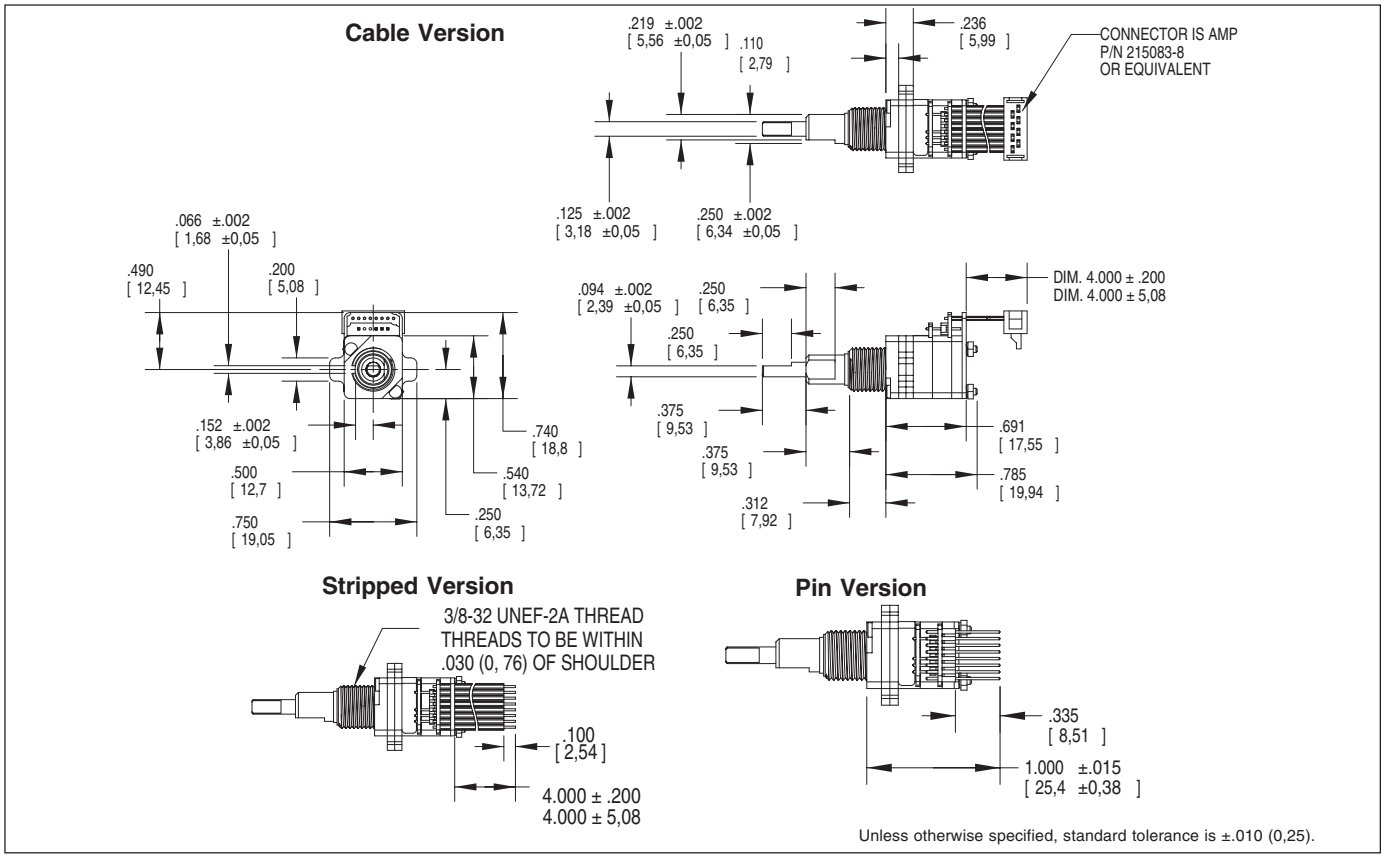
- High Rotational Torque Provides Positive Tactile Feedback
- Non-turn Pushbutton to Ensure Pushbutton Text and Orientation
- Optically Coupled for More than a Million Cycles
- Seperate Pushbutton Function
- Compatible with CMOS, TTL and HCMOS Logic
- Available in 8,12 and 16 Detent Positions
- Choice of Cable Length and Terminations

APPLICATIONS

- Avionics

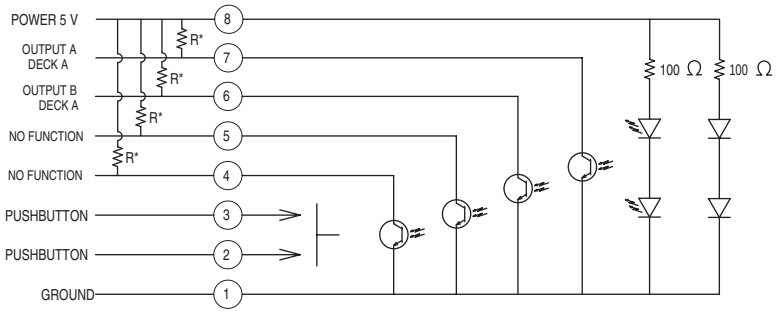


DIMENSIONS In inches (and millimeters)



Unless otherwise specified, standard tolerance is ±.010 (0,25).

CIRCUITRY



*EXTERNAL 2.2k Ω PULL-UP RESISTORS REQUIRED FOR OPERATION

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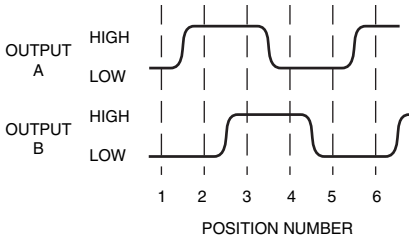
WAVEFORM AND TRUTH TABLE



Clockwise Rotation		
Position	Output A	Output B
1		
2	●	
3	●	●
4		●

● Indicates logic high; blank indicates logic low. Code repeats every 4 positions.

SPECIFICATIONS

Pushbutton Switch Ratings

Rating: at 5 Vdc, 10 mA, resistive
Contact Resistance: less than 10 ohms (TTL or CMOS compatible)
Pushbutton Life: 3 million actuations minimum
Voltage Breakdown: 250 Vac between mutually insulated parts
Contact Bounce: less than 4 mS at make and less than 10 mS at break
Actuation Force: 1100 ±300g

Encoder Ratings

Coding: 2-bit quadrature coded output
Operating Voltage: 5.0 ±.25 Vdc
Supply Current: 30 mA maximum@5.0 Vdc
Logic Output Characterisitics:
Logic High: 3.0 Vdc minimum
Logic Low: 1.0 Vdc maximum
Mechanical Life: 1,000,000 cycles minimum (One cycle is a rotation through all positions and a full return)
Minimum Sink Current: 2.0 mA for 5 Vdc
Power Consumption: 150mW maximum
Output: open collector phototransistor
Logic Rise and Fall Times: less than 30 mS maximum
Operating Torque: 5.0 in-oz +/- 1.5 in-oz initial
Shaft Push Out Force: 45 lbs minimum
Mounting Torque: 15 in-lbs maximum
Terminal Strength: 15 lbs cable pull-out force minimum
Operating Speed: 100 RPM maximum

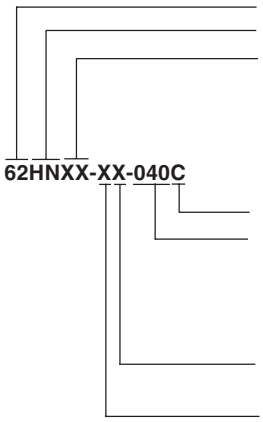
Environmental Ratings

Operating Temperature Range: -40°C to 85°C
Storage Temperature Range: -55°C to 100°C
Vibration Resistance: Harmonic motion with amplitude of 15G, within a varied 10 to 2000 Hz frequency for 12 hours
Mechanical Shock: Test 1: 100G, 6 mS, half sine, 12.3 ft/s; Test 2: 100G, 6 mS, sawtooth, 9.7 ft/s
Relative Humidity: 90–95% at 40°C for 96 hours

Materials and Finishes

Code Housing: Reinforced thermoplastic
Shafts: Stainless Steel
Bushing: Zinc casting
Shaft Retaining Rings: Stainless steel
Detent Spring: Stainless steel
Detent Ball: Stainless steel
Detent Section: Hiloy 610
Printed Circuit Boards: NEMA grade FR-4 gold over nickel or palladium
Terminals: Brass, tin-plated
Mounting Hardware: One brass, nickel-plated nut and stainless steel lockwasher supplied with each switch. Nut is 0.094 inches thick by 0.562 inches across flats
Rotor: Thermoplastic
Pushbutton Dome: Stainless steel
Phototransistor: Planar Silicon NPN
Infrared Emitter: Gallium aluminum arsenide
Flex Cable: 28 AWG, stranded/top coated wire, PVC coated on .050 centers (cabled version)
Header Pins: Brass, tin-plated
Spacer: Hiloy 610
Shim: Stainless Steel
Endcap: Thermoplastic
Non-turn Pin: Stainless steel
Backplate/Strain Relief: Stainless steel
Lockwashers: Stainless steel
Hex Nuts: Stainless steel
Studs: Stainless steel

ORDERING INFORMATION



Series
Style: HN = High Torque, Concentric, Non-Turn
Angle of Throw: 45 = 45° or 8 positions,30 = 30° or 12 positions, 22 = 22.5° or 16 positions

Termination: S = stripped cable, C = connector, P = pins
Cable Termination: 040= 4.0in. Cable is terminated with Amp Connector P/N 215083-6. See Amp Mateability Guide for mating connector details. **Eliminate cable length if ordering pins.* (Ex: 62HN22-H9-P)
Pushbutton Option: 0 = w/o pushbutton, 9 = 1100g pushbutton
Rotational Torque: H = High Torque

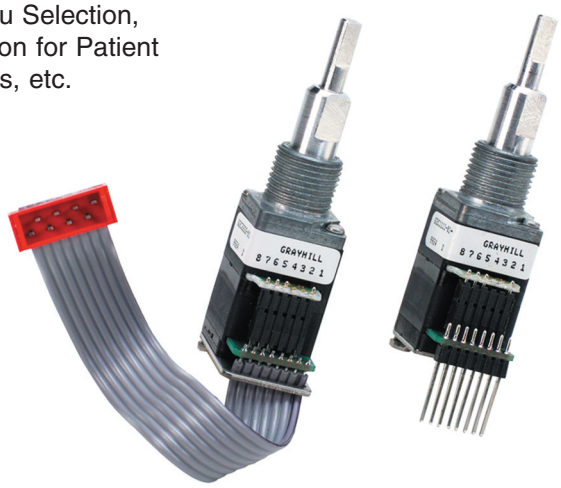
Custom materials, styles, colors, and markings are available. Control knobs available.

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

SERIES 62C
Concentric Shaft

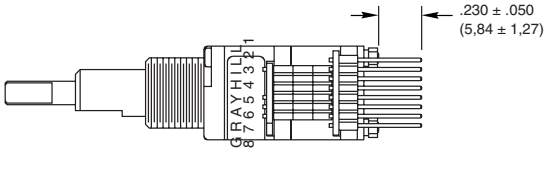
FEATURES
- Economical Size
- Combined Functionality
- Optically Coupled for More than a Million Cycles of Operations
- Optional Integral Pushbutton
- Compatible with CMOS, TTL, and HCMOS Logic
- Available with 12, 16, 24, and 32 Detent Positions for Each Code Section
- Choices of Cable Length and Terminations
- Available in 3.3 Volt Input. (Contact Grayhill for details)

APPLICATIONS
- Used to Set Radio Frequency, Drill Depth, RPM, Menu Selection, Parameter Selection for Patient Monitoring Devices, etc.

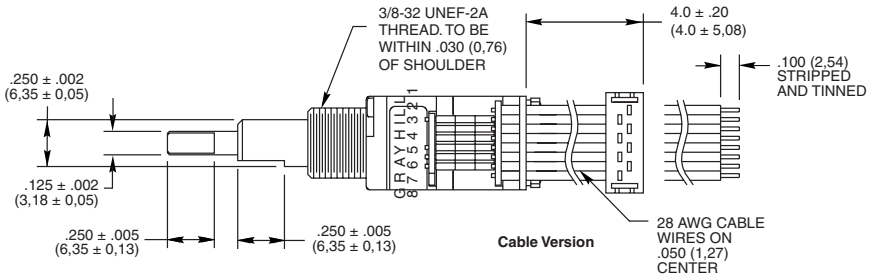


DIMENSIONS In inches (and millimeters)

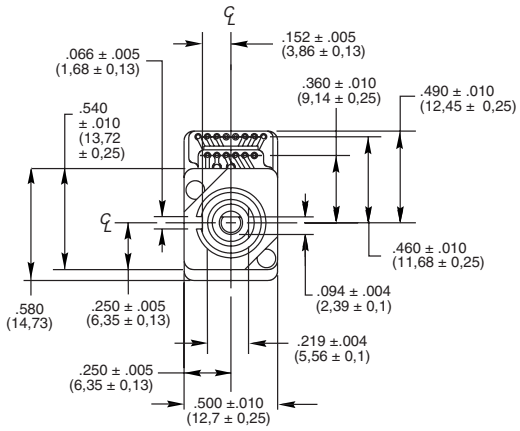
Unless otherwise specified, standard tolerance are:
Linear ± .025
Diameter ± .010
Angle ± 2.0°

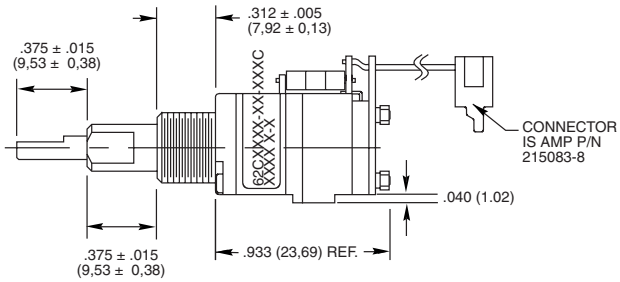


Pin Version

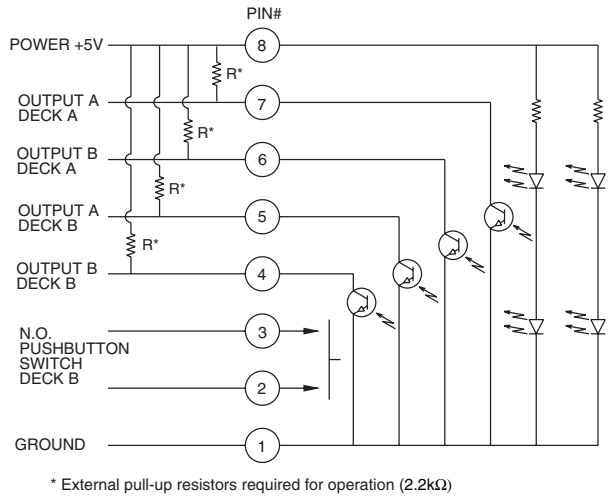


Cable Version





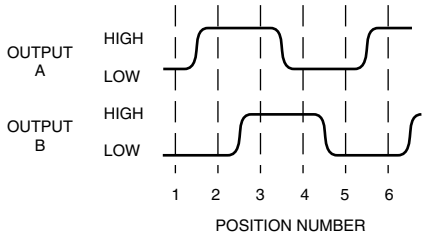
CIRCUITRY, TRUTH TABLE AND WAVEFORM: Standard Quadrature 2-Bit Code



* External pull-up resistors required for operation (2.2kΩ)

Clockwise Rotation		
Position	Output A	Output B
1		
2	●	
3	●	●
4		●

● Indicates logic high; blank indicates logic low. Code repeats every 4 positions.



SPECIFICATIONS

Pushbutton Switch Ratings

Rating: 5 Vdc, 10 mA, resistive
Contact Resistance: less than 10 ohms (TTL or CMOS compatible)
Voltage Breakdown: 250 Vac between mutually insulated parts
Contact Bounce: less than 4 mS at make, less than 10 mS at break
Actuation Life: 3,000,000 operations
Actuation Force: 1000 ± 300 grams
Pushbutton Travel: .010 / .025 inch

Encoder Ratings

Coding: 2-bit quadrature coded output
Operating Voltage: 5 ± .25 Vdc
Supply Current: 50 mA maximum at 5 Vdc
Logic High: 3.8V minimum
Logic Low: 0.8V maximum
Logic Rise and Fall Times: less than 30 mS
Operating Torque: 2.0 in-oz ± 1.4 in-oz initially

Rotational Life: more than 1,000,000 cycles of operation (1 cycle = 360° rotation and return)
Shaft Push Out Force: 45 lbs minimum
Mounting Torque: 15 in-lbs maximum
Operating Speed: 100 RPM maximum
Axial Shaft Play: .010 maximum for each shaft

Environmental Ratings

Operating Temperature Range: -40°C to 85°C
Storage Temperature Range: -55°C to 100°C
Relative Humidity: 90–95% at 40°C for 96 hours
Vibration Resistance: Harmonic motion with amplitude of 15g, within a varied 10 to 2000 Hz frequency for 12 hours per MIL-STD-202, Method 204
Shock Resistance: Test 1: Tested at 100g for 6 mS, half sine, 12.3 ft/s Test 2: 100g for 6 mS, sawtooth, 9.7 ft/s

Materials and Finishes

Bushing: Zinc casting
Shaft: Aluminum
Shaft Retaining Ring: Stainless steel
Detent Spring: Stainless steel
Printed Circuit Board: NEMA grade FR-4
Terminals: Brass, tin-plated
Mounting Hardware: One brass, nickel-plated nut and lockwasher supplied with each switch. (Nut is 0.094 inches thick by 0.562 inches across flats)
Rotor: Thermoplastic
Code Housing: Reinforced thermoplastic
Pushbutton Dome: Stainless steel
Pushbutton Housing: Thermoplastic
Pushbutton Contact: Brass, nickel-plated
Dome Retaining Disk: Thermoplastic
Strain Relief: Stainless steel
Cable: 28 AWG, stranded/top coated wire, PVC coated on .050 centers (cable version only)
Header Pins: Phosphor bronze, tin-plated
Insulator: Glass-filled polyester
Spacer: Zinc casting

ORDERING INFORMATION

62C2211-02-040 C

Series
Style: C = Concentric
Angle of Throw (Deck A): 11 = 11.25° or 32 positions, 15 = 15° or 24 positions, 22 = 22.5° or 16 positions, 30 = 30° or 12 Positions
Angle of Throw (Deck B): 11 = 11.25° or 32 positions, 15 = 15° or 24 positions, 18 = 18° or 20 positions, 22 = 22.5° or 16 positions, 30 = 30° or 12 Positions

Termination: S = stripped cable, C = connector, P = pins
Cable Termination: 040 = 4.0in. Cable is terminated with Amp Connector P/N 215083-6. See Amp Mateability Guide for mating connector details.
**Eliminate cable length if ordering pins.* (Ex: 62C2211-02-P)
Pushbutton Option: 01 = w/o pushbutton, 02 = with pushbutton

Custom custom shaft, pushbutton actuation force and termination options are available.

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

SERIES 62H

High Torque, Concentric Shaft

FEATURES

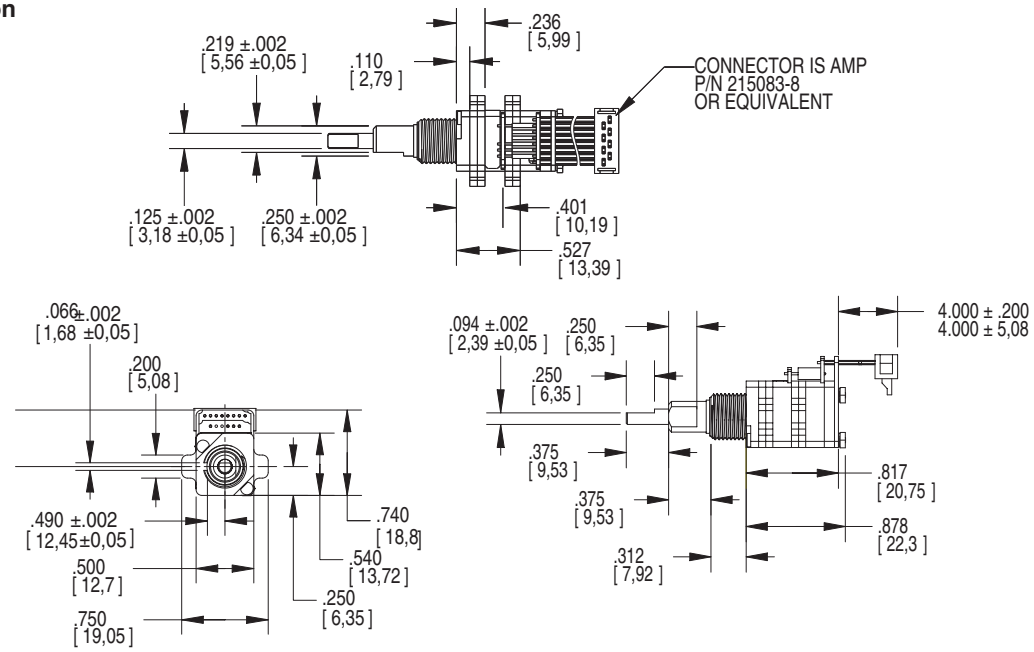
- High Rotational Torque Provides Positive Tactile Feedback
- Optically Coupled for More than a Million Cycles
- Optional Integral Pushbutton
- Compatible with CMOS, TTL and HCMOS Logic
- Available in 8,12 and 16 Detent Positions
- Choice of Cable Length and Terminations

APPLICATIONS

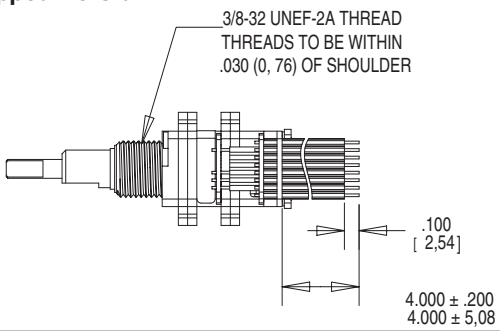
- Avionics

DIMENSIONS In inches (and millimeters)

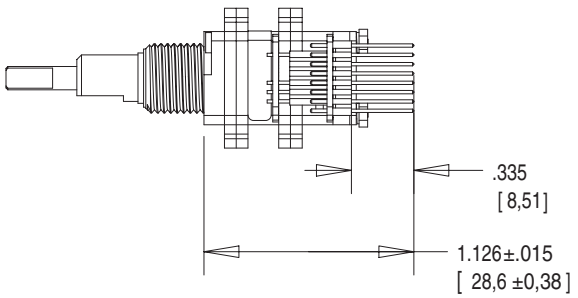
Cable Version



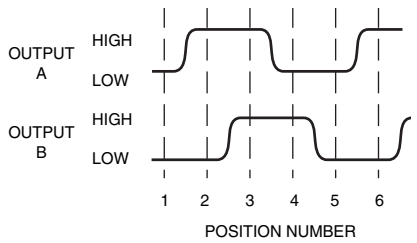
Stripped Version



Pin Version



WAVEFORM AND TRUTH TABLE



Clockwise Rotation		
Position	Output A	Output B
1		
2	●	
3	●	●
4		●

● Indicates logic high; blank indicates logic low. Code repeats every 4 positions.

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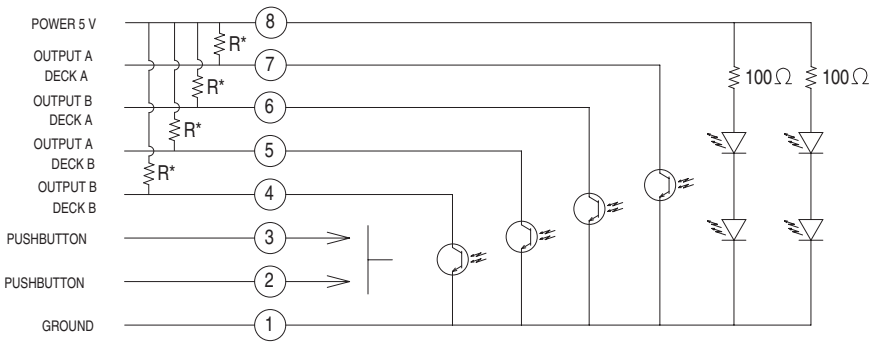
CIRCUITRY



*EXTERNAL 2.2k Ω PULL-UP RESISTORS REQUIRED FOR OPERATION

SPECIFICATIONS

Pushbutton Switch Ratings

Rating: at 5 Vdc, 10 mA, resistive
Contact Resistance: less than 10 ohms (TTL or CMOS compatible)
Pushbutton Life: 3 million actuations minimum
Voltage Breakdown: 250 Vac between mutually insulated parts
Contact Bounce: less than 4 mS at make and less than 10 mS at break
Actuation Force: 1100 ±300g
Shaft Travel: .020±.010 inch

Encoder Ratings

Coding: 2-bit quadrature coded output
Operating Voltage: 5.0 ±.25 Vdc
Supply Current: 50 mA maximum@5.0 Vdc
Logic Output Characterisitics:
Logic High: 3.0 Vdc minimum
Logic Low: 1.0 Vdc maximum
Mechanical Life: 1,000,000 cycles minimum (One cycle is a rotation through all positions and a full return)
Minimum Sink Current: 2.0 mA for 5 Vdc
Power Consumption: 150mW maximum
Output: open collector phototransistor
Logic Rise and Fall Times: less than 30 mS maximum
Operating Torque: 5.0 in-oz +/- 1.5 in-oz initial
Shaft Push Out Force: 45 lbs minimum
Mounting Torque: 15 in-lbs maximum
Terminal Strength: 15 lbs cable pull-out force minimum
Operating Speed: 100 RPM maximum

Environmental Ratings

Operating Temperature Range: -40°C to 85°C
Storage Temperature Range: -55°C to 100°C
Vibration Resistance: Harmonic motion with amplitude of 15G, within a varied 10 to 2000 Hz frequency for 12 hours
Mechanical Shock: Test 1: 100G, 6 mS, half sine, 12.3 ft/s; Test 2: 100G, 6 mS, sawtooth, 9.7 ft/s
Relative Humidity: 90–95% at 40°C for 96 hours

Materials and Finishes

Code Housing: Reinforced thermoplastic
Shafts: Stainless Steel
Bushing: Zinc casting
Pushbutton Actuator: Zytel 70G33L
Shaft Retaining Rings: Stainless steel
Detent Spring: Stainless steel
Detent Ball: Stainless steel
Detent Section: Hiloy 610
Printed Circuit Boards: NEMA grade FR-4 gold over nickel or palladium
Terminals: Brass, tin-plated
Mounting Hardware: One brass, nickel-plated nut and stainless steel lockwasher supplied with each switch. Nut is 0.094 inches thick by 0.562 inches across flats
Rotor: Thermoplastic
Pushbutton Dome: Stainless steel
Phototransistor: Planar Silicon NPN
Infrared Emitter: Gallium aluminum arsenide
Flex Cable: 28 AWG, stranded/top coated wire, PVC coated on .050 or .100" centers (cabled version)
Header Pins: Brass, tin-plated
Spacer: Hiloy 610
Shim: Stainless Steel
Backplate/Strain Relief: Stainless steel
Lockwashers: Stainless steel
Hex Nuts: Stainless steel
Studs: Stainless steel

ORDERING INFORMATION

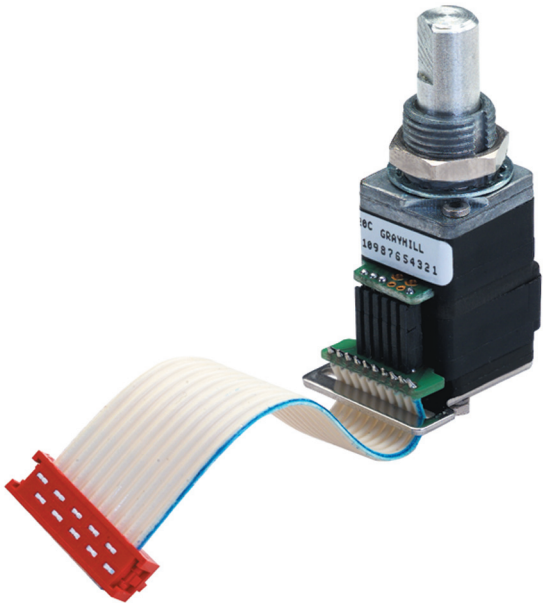
62HXXXX-XX-040C

Series
Style: H = High Torque, Concentric
Angle of Throw (Deck A): 45 = 45° or 8 positions,30 = 30° or 12 positions, 22 = 22.5° or 16 positions
Angle of Throw (Deck B): 45 = 45° or 8 positions, 30 = 30° or 12 positions, 22 = 22.5° or 16 positions

Termination: S = stripped cable, C = connector, P = pins
Cable Termination: 040 = 4.0in. Cable is terminated with Amp Connector P/N 215083-8. See Amp Mateability Guide for mating connector details. **Eliminate cable length if ordering pins.* (Ex: 62H2222-H9-P)
Pushbutton Option: 0 = w/o pushbutton, 9 = 1100g pushbutton
Rotational Torque: H = High Torque

SERIES 62R

1/2" Package, Redundant Circuitry



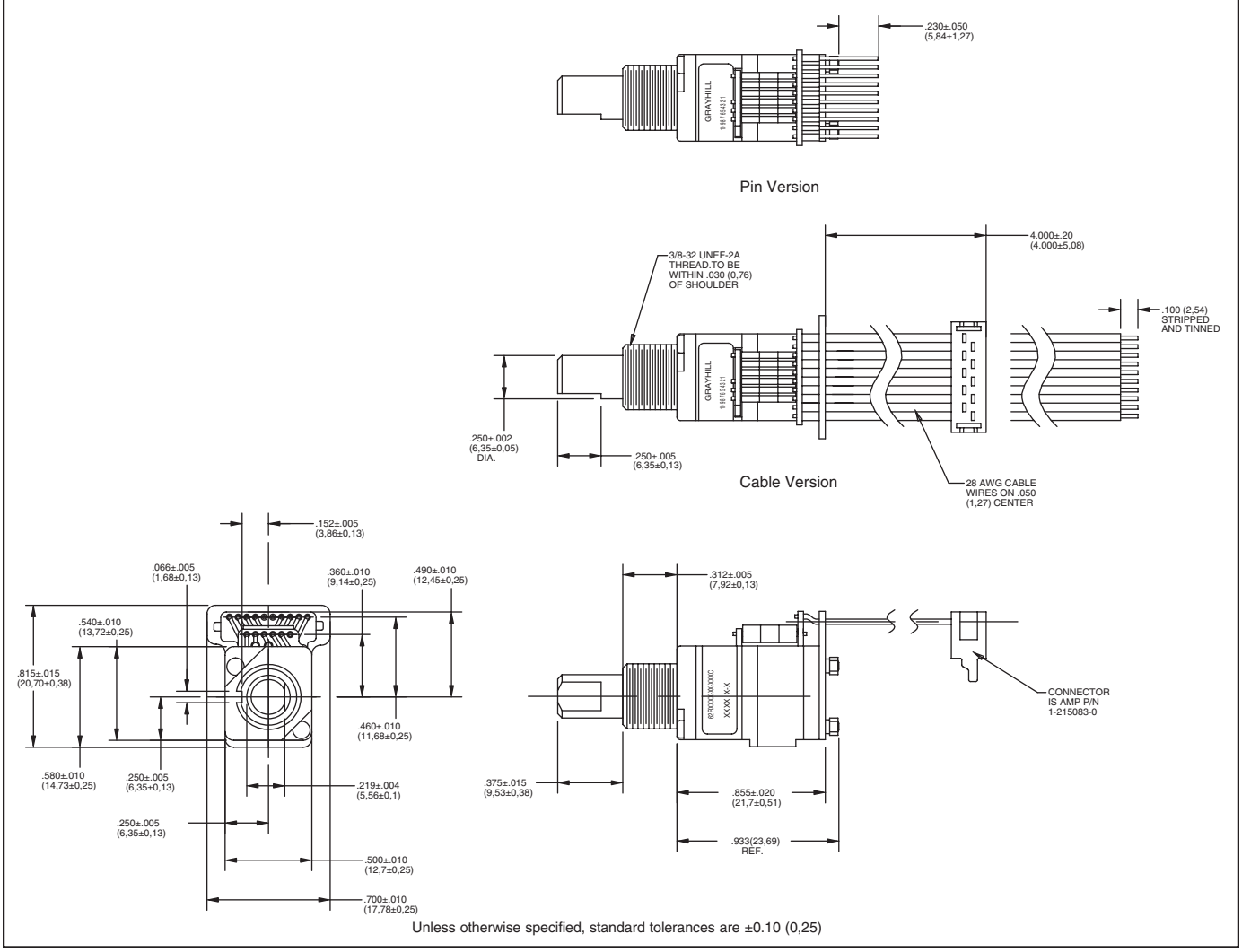
FEATURES

- Redundant Circuitry
- 1 Million Rotational Cycles
- Compatible with CMOS, TTL and HCMOS Logic
- Optional Integral Pushbutton
- Available in 12, 16, 24, and 32 Detent Positions
- Choices of Cable Length and Terminations
- Ideal for Critical Applications

APPLICATIONS

- Cockpit Controls
- Medical Equipment

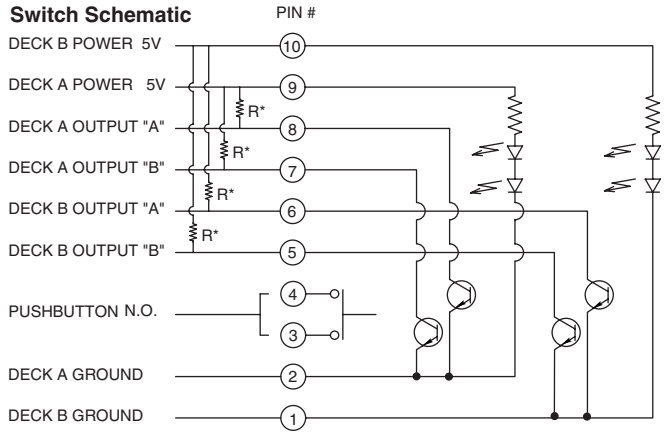
DIMENSIONS In inches (and millimeters)



Unless otherwise specified, standard tolerances are ±0.10 (0,25)

CIRCUITRY, TRUTH TABLE, AND WAVEFORM Standard Quadrature 2-Bit Code

Switch Schematic



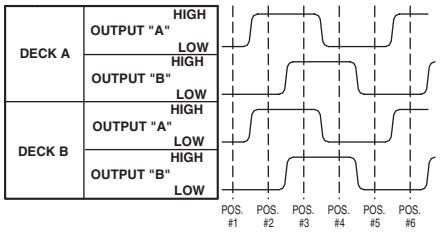
* 2.2k EXTERNAL PULL-UP RESISTORS REQUIRED FOR OPERATION

Truth Table (CW Rotation)

POSITION	DECK A		DECK B	
	OUTPUT "A"	OUTPUT "B"	OUTPUT "A"	OUTPUT "B"
1				
2	●		●	
3	●	●	●	●
4		●		●

● INDICATES LOGIC HIGH. BLANK INDICATES LOGIC LOW. CODE REPEATS EVERY 4 POSITIONS

Wave Form (CW Rotation)



SPECIFICATIONS

Pushbutton Switch Ratings

Pushbutton Rating: 10 mA, 5 Vdc, resistive
Contact Resistance: less than 10 ohms (TTL or CMOS compatible)
Pushbutton Life: 3 million actuations min.
Contact Bounce: less than 4 mS at make and less than 10 mS at break
Actuation Force: 1000 ±300 grams
Pushbutton Travel: .010/.025"

Switch Ratings

Coding: 2-bit quadrature coded output
Operating Voltage: 5.0 ±.25 Vdc
Voltage Breakdown: 250 Vac between mutually insulated parts
Supply Current: 30 mA maximum @ 5.0 Vdc (per deck)
Logic Output Characterisitics:
Logic High: 3.5 Vdc minimum
Logic Low: 1.5 Vdc maximum
Mechanical Life: 1,000,000 cycles minimum (One cycle is a rotation through all positions and a full return)
Minimum Sink Current: 2.0 mA
Power Consumption: 150mW max. (per deck)
Output: open collector phototransistor
Optical Rise and Fall Times: less than 30 mS maximum
Operating Torque: 3.5 ±1.4 in-oz initially
Shaft Push Out Force: 45 lbs minimum
Mounting Torque: 15 in-lbs max.
Terminal Strength: 15 lbs cable pull-out force min.
Operating Speed: 100 RPM max.

Environmental Ratings

Operating Temperature Range: -40°C to 85°C
Storage Temperature Range: -55°C to 100°C
Vibration Resistance: Harmonic motion with amplitude of 15G's, within a varied 10 to 2000 Hz frequency for 12 hours
Mechanical Shock: Test 1: 100g, 6 mS, half sine, 12.3 ft/s; Test 2: 100g, 6 mS, sawtooth, 9.7 ft/s
Humidity: 90–95% at 40°C for 96 hours

Materials and Finishes

Shaft: Aluminum
Bushing: Zinc casting
Shaft Retaining Ring: Stainless steel
Detent Spring: Stainless steel
Printed Circuit Boards: NEMA grade FR-4 gold over nickel or palladium
Terminals: Brass, tin-plated
Mounting Hardware: One brass, nickel-plated nut and stainless steel lockwasher supplied with each switch. Nut is 0.094 inches thick by 0.562 inches across flats
Rotor: Thermoplastic
Code Housing: Thermoplastic
Pushbutton Dome: Stainless steel
Dome Retaining Disk: Thermoplastic
Pushbutton Housing: Thermoplastic
Phototransistor: Planar Silicon NPN
Infrared Emitter: Gallium aluminum arsenide
Pushbutton Contact: Brass, nickel-plated
Flex Cable: 28 AWG stranded, halogen-free polyolefin insulation on .050" centers (cabled version)
Header Pins: Phosphor bronze, tin-plated
Spacer: Zinc casting
Backplate/Strain Relief: Stainless steel
Lockwasher(s): Stainless steel
Hex Nuts: Stainless steel
Studs: Stainless steel

OPTIONS

Contact Grayhill for custom terminations, shaft and bushing configurations, and resolutions. Control knobs are also available.

ORDERING INFORMATION

62R22-01-040S

Series
Angle of Throw: 11 = 11.25° or 32 pos., 15 = 15° or 24 pos, 22 = 22.5° or 16 positions, 30 = 30° or 12 Positions
Pushbutton Option: 01 = w/o pushbutton, 02 = with pushbutton

Termination: .050" centers; S = Stripped cable, C = Connector, P = Pin
Cable Length: 040 = 4.0 inches. Cable is terminated with Amp Connector P/N 215083-8. See Amp Mateability Guide for mating connector details.
* *Eliminate cable length if ordering pins.* (Ex: 62R22-02-P)

Custom materials, styles, colors, and markings are available. Control knobs available.

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

SERIES 62HR

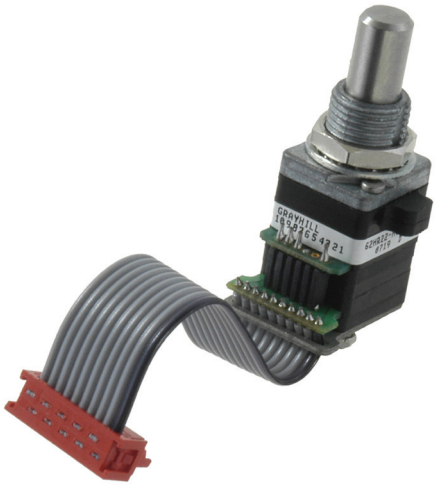
1/2" Package, Redundant Circuitry
High Torque

FEATURES

- Redundant Circuitry
- 1 Million Rotational Cycles
- Compatible with CMOS, TTL and HCMOS Logic
- Optional Integral Pushbutton
- Available in 12, 16, 24, and 32 Detent Positions
- Choices of Cable Length and Terminations
- Ideal for Critical Applications

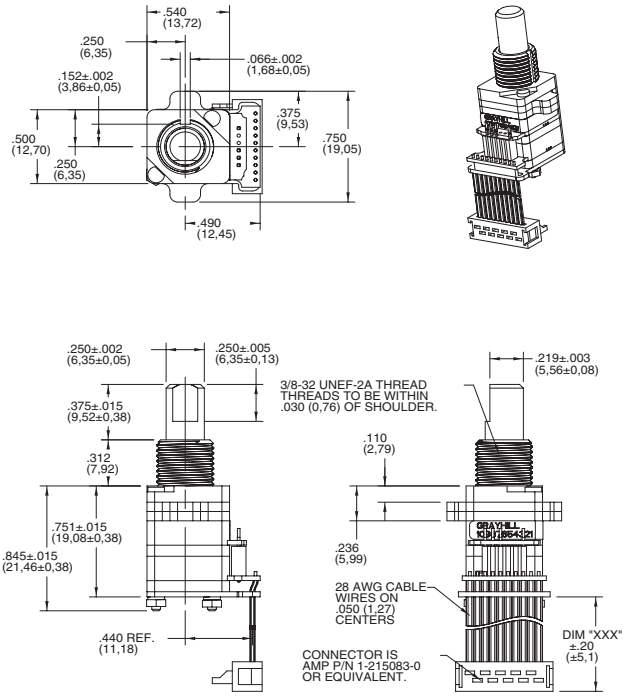
APPLICATIONS

- Cockpit Controls
- Medical Equipment



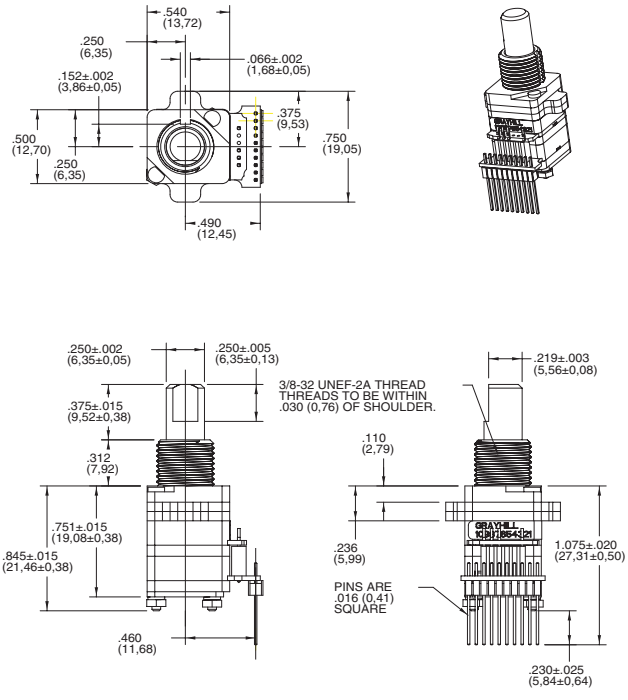
DIMENSIONS In inches (and millimeters)

SERIES 62HR WITH .050 CENTER RIBBON CABLE



UNLESS OTHERWISE SPECIFIED, STANDARD TOLERANCE IS ±.010 (0,25).

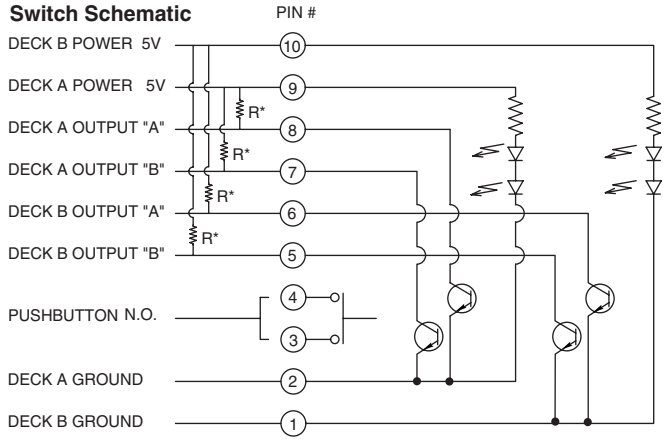
SERIES 62HR WITH .050 CENTER TERMINAL PINS



UNLESS OTHERWISE SPECIFIED, STANDARD TOLERANCE IS ±.010 (0,25).

CIRCUITRY, TRUTH TABLE, AND WAVEFORM Standard Quadrature 2-Bit Code

Switch Schematic



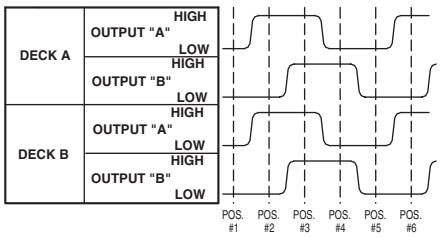
* 2.2k EXTERNAL PULL-UP RESISTORS REQUIRED FOR OPERATION

Truth Table (CW Rotation)

POSITION	DECK A		DECK B	
	OUTPUT "A"	OUTPUT "B"	OUTPUT "A"	OUTPUT "B"
1				
2	●		●	
3	●	●	●	●
4		●		●

● INDICATES LOGIC HIGH. BLANK INDICATES LOGIC LOW. CODE REPEATS EVERY 4 POSITIONS

Wave Form (CW Rotation)



SPECIFICATIONS

Pushbutton Switch Ratings

Rating: at 5 Vdc, 10 mA, resistive
Contact Resistance: less than 10 ohms (TTL or CMOS compatible)
Pushbutton Life: 3 million actuations minimum
Voltage Breakdown: 250 Vac between mutually insulated parts
Contact Bounce: less than 4 mS at make and less than 10 mS at break
Actuation Force: 1100 ±300g

Encoder Ratings

Coding: 2-bit quadrature coded output
Operating Voltage: 5.0 ±.25 Vdc
Supply Current: 30 mA maximum@5.0 Vdc
Logic Output Characterisitics:
Logic High: 3.0 Vdc minimum
Logic Low: 1.0 Vdc maximum
Mechanical Life: 1,000,000 cycles minimum (One cycle is a rotation through all positions and a full return)
Minimum Sink Current: 2.0 mA for 5 Vdc
Power Consumption: 150mW maximum
Output: open collector phototransistor
Logic Rise and Fall: less than 30 mS maximum
Operating Torque: 5.0 in-oz +/- 1.5 in-oz initial
Shaft Push Out Force: 45 lbs minimum
Mounting Torque: 15 in-lbs maximum
Terminal Strength: 15 lbs cable pull-out force minimum
Operating Speed: 100 RPM maximum

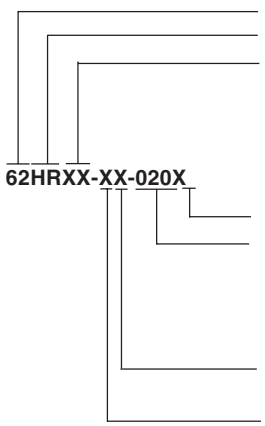
Environmental Ratings

Operating Temperature Range: -40°C to 85°C
Storage Temperature Range: -55°C to 100°C
Vibration Resistance: Harmonic motion with amplitude of 15G, within a varied 10 to 2000 Hz frequency for 12 hours
Mechanical Shock: Test 1: 100G, 6 mS, half sine, 12.3 ft/s; Test 2: 100G, 6 mS, sawtooth, 9.7 ft/s
Relative Humidity: 90–95% at 40°C for 96 hours

Materials and Finishes

Code Housing: Reinforced thermoplastic
Shaft: Stainless Steel
Bushing: Zinc casting
Shaft Retaining Ring: Stainless steel
Detent Spring: Stainless steel
Detent Ball: Stainless steel
Detent Section: Hiloy 610
Printed Circuit Boards: NEMA grade FR-4 gold over nickel or palladium
Terminals: Brass, tin-plated
Mounting Hardware: One brass, nickel-plated nut and stainless steel lockwasher supplied with each switch. Nut is 0.094 inches thick by 0.562 inches across flats
Rotor: Thermoplastic
Pushbutton Dome: Stainless steel
Phototransistor: Planar Silicon NPN
Infrared Emitter: Gallium aluminum arsenide
Flex Cable: 28 AWG, stranded/top coated wire, PVC coated on .050" centers (cabled version)
Header Pins: Brass, tin-plated
Spacer: Hiloy 610
Shim: Stainless Steel
Backplate/Strain Relief: Stainless steel

ORDERING INFORMATION



Series
Style: HR = High Torque, Redundant
Angle of Throw: 45 = 45° or 8 positions,30 = 30° or 12 positions,
22 = 22.5° or 16 positions

Termination: S = stripped cable, C = connector, P = pins
Cable Length: 020 = 2.0 inches. Cable is terminated with Amp Connector P/N 1-215083-0. See Amp Mateability Guide for mating connector details. **Eliminate cable length if ordering pins.* (Ex: 62HR22-H9-P)
Pushbutton Option: 0 = w/o pushbutton, 9 = 1100g pushbutton
Rotational Torque: H = High Torque

SERIES 62F

1/2" Package, Lighted Shaft

FEATURES

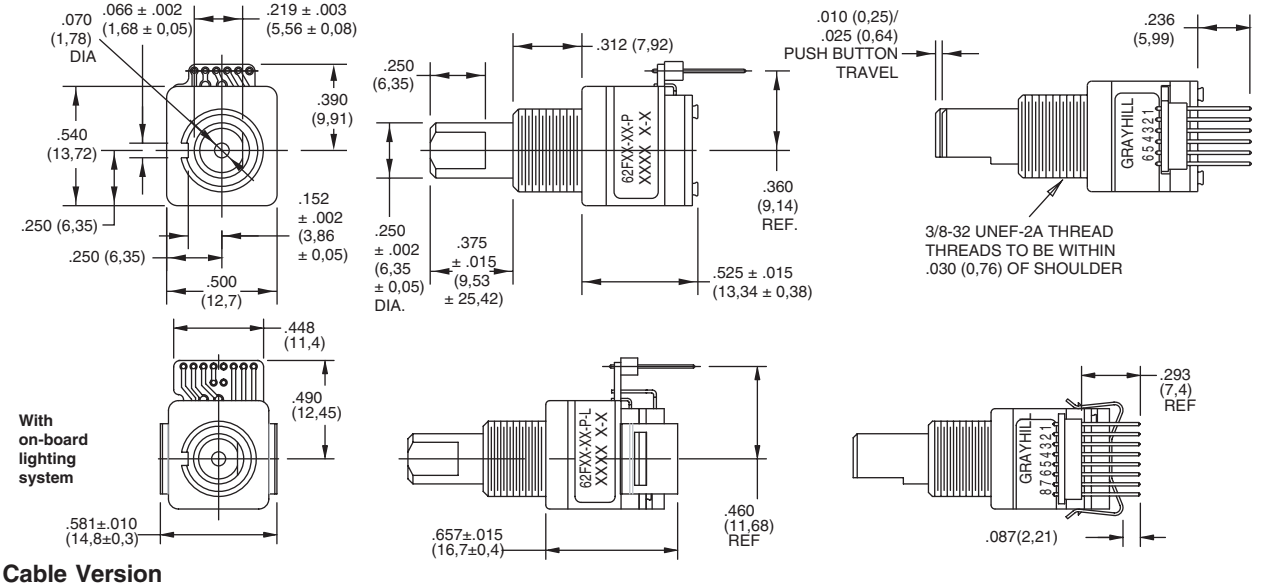
- Integrated Self-Lighting System for Knob Illumination
- 1 Million Rotational Cycles
- 1/2" Package
- Compatible with CMOS, TTL and HCMOS Logic
- Optional Integral Pushbutton
- Choices of Cable Length and Terminations
- Other Customized Solutions Available

APPLICATIONS

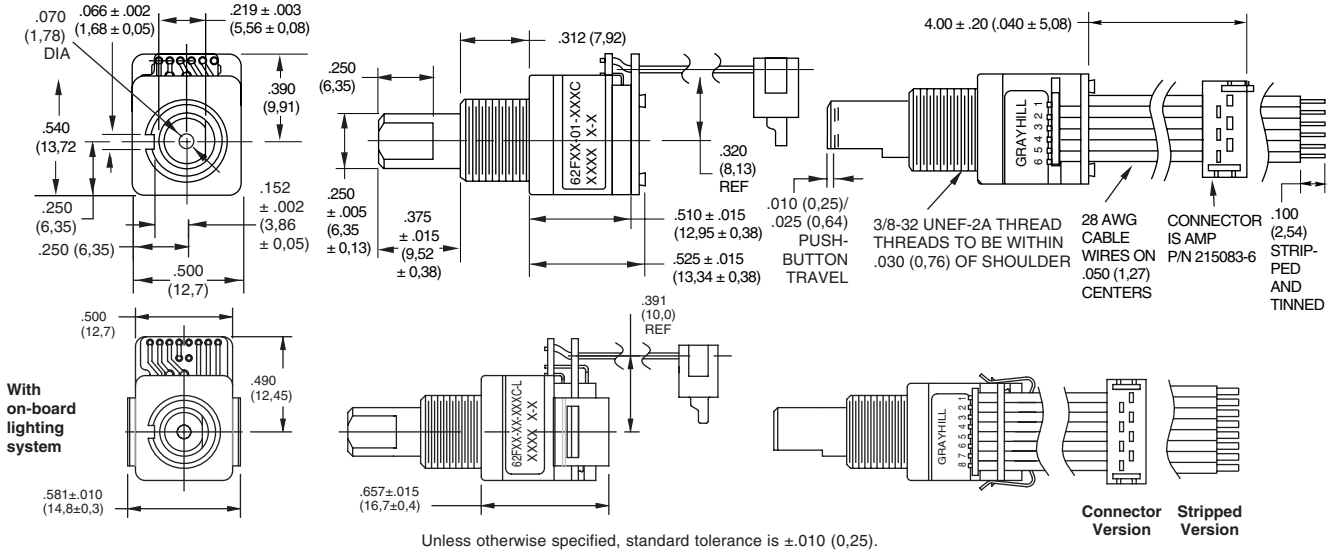
- Global Positioning/Driver Information Systems
- Medical Equipment
- Cockpit Controls
- Mixing Boards

DIMENSIONS In inches (and millimeters)

Pin Version



Cable Version



Unless otherwise specified, standard tolerance is ±.010 (0,25).

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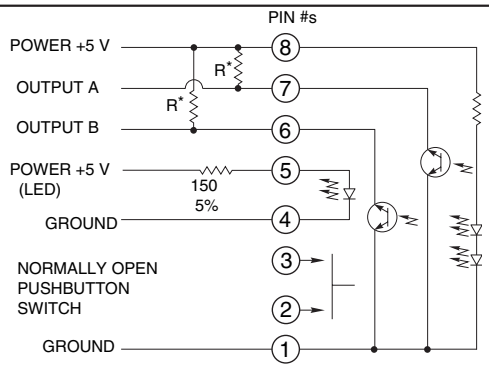
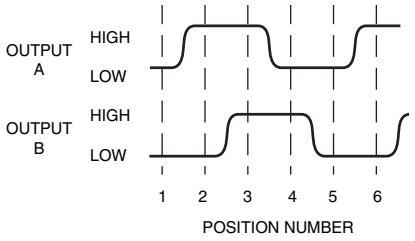
CIRCUITRY, TRUTH TABLE, AND WAVEFORM Standard Quadrature 2-Bit Code





Clockwise Rotation		
Position	Output A	Output B
1		
2	●	
3	●	●
4		●

● Indicates logic high; blank indicates logic low. Code repeats every 4 positions.

* EXTERNAL PULL-UP RESISTORS REQUIRED FOR OPERATION (2.2k).
** Circuit shown with on-board lighting system. Versions without on-board lighting system do not have LED power connections. Refer to standard 62A series for circuitry.

SPECIFICATIONS

Pushbutton Switch Ratings

Rating: 5 Vdc, 10 mA, resistive
Contact Resistance: less than 10 ohms (TTL or CMOS compatible)
Pushbutton Life: 3 million actuations minimum
Contact Bounce: less than 4 mS at make and less than 10 mS at break
Actuation Force: 500 ±300 grams
Pushbutton Travel: .010/.025 inch

Switch Ratings

Coding: 2-bit quadrature coded output
Operating Voltage: 5.0 ±.25 Vdc
Voltage Breakdown: 250 Vac between mutually insulated parts
Supply Current: 30 mA maximum
Logic Output Characterisitics:
Logic High: 3.8 Vdc minimum
Logic Low: 0.8 Vdc maximum
Rotational Life: 1,000,000 cycles minimum (One cycle is a rotation through all positions and a full return)
Minimum Sink Current: 2.0 mA
Power Consumption: 150mW maximum
Optical Rise and Fall Times: less than 30 mS maximum

Operating Torque:
Detent: 2.0 ±1.4 in-oz initially
Non-detent: less than 1.5 in-oz initially
Shaft Push Out Force: 45 lbs minimum
Mounting Torque: 15 in-lbs maximum
Terminal Strength: 15 lbs cable pull-out force minimum
Operating Speed: 100 RPM maximum
Axial Shaft Play: .010 maximum

Environmental Ratings

Operating Temperature Range: -40°C to 85°C
Storage Temperature Range: -55°C to 100°C
Relative Humidity: 90–95% at 40°C for 96 hours
Vibration Resistance: Harmonic motion with amplitude of 15G's, within a varied 10 to 2000 Hz frequency for 12 hours per MIL-STD-202, Method 204
Mechanical Shock: Test 1: 100G for 6 mS, half sine, 12.3 ft/s; Test 2: 100G for 6 mS, sawtooth, 9.7 ft/s

Materials and Finishes

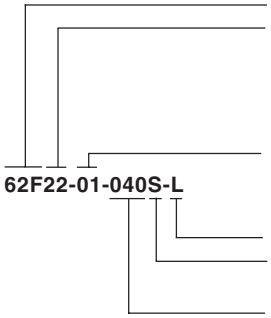
Code Housing: Reinforced thermoplastic
Shaft: Aluminum
Bushing: Zinc casting
Shaft Retaining Ring: Stainless steel
Detent Spring: Stainless steel

Printed Circuit Boards: NEMA grade FR-4 gold over nickel or palladium
Terminals: Brass, tin-plated
Mounting Hardware: One brass, nickel-plated nut and stainless steel lockwasher supplied with each switch. Nut is 0.094 inches thick by 0.562 inches across flats
Rotor: Thermoplastic
Code Housing: Thermoplastic
Pushbutton Dome: Stainless steel
Dome Retaining Disk: Thermoplastic
Pushbutton Housing: Thermoplastic
Phototransistor: Planar Silicon NPN
Pushbutton Contact: Brass, nickel-plated
Flex Cable: 28 AWG, stranded/top coated wire, PVC coated on .050 or .100" centers (cabled version)
Header Pins: Phospher bronze, tin-plated
Spacer: ABS
Backplate/Strain Relief: Stainless steel
Lockwasher: Stainless steel
Light Pipe: Thermoplastic
LED Housing: Thermoplastic

OPTIONS

Contact Grayhill for custom terminations, shaft and bushing configurations, and resolutions. Control knobs are also available.

ORDERING INFORMATION



Series
Angle of Throw: Detent
11 = 11.25° or 32 pos.
15 = 15° or 24 positions
18 = 18° or 20 pos.
22 = 22.5° or 16 positions
Non-detent
01 = 11.25° or 32 positions
05 = 15° or 24 positions
08 = 18° or 20 positions
02 = 22.5° or 16 positions
Pushbutton Option: 01 = w/o pushbutton, 02 = with pushbutton

LED: blank = no LED, L = supplied with LED
Termination: S = Stripped cable; S-L = Stripped cable, LED; C = Connector; C-L = Connector, LED; P = Pin; P-L = Pin, LED
Cable Termination: 040 = 4.0in. Cable is terminated with Amp P/N 215083-6. See Amp Mateability guide for mating connector details.
**Eliminate cable length if ordering pins.* (Ex: 62A22-02-P)

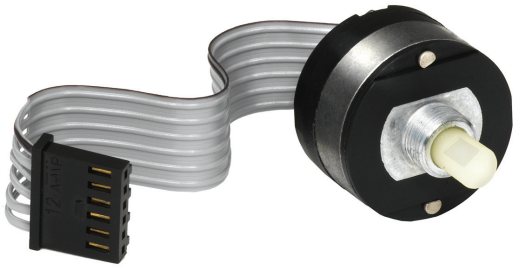
Custom materials, styles, colors, and markings are available. Control knobs available.

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

SERIES 62M
Magnetic Detent

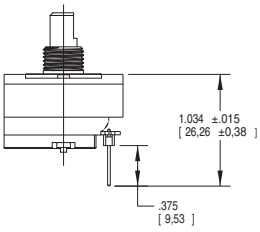
FEATURES
- Ultra Smooth Magnetic Detent
- 10 Million Rotational Cycles, Ten Times the Life of a Mechanical Detent System
- Optional Integrated Pushbutton
- Available in 24 Positions
- Choice of Cable Lengths

Applications
- Medical
- Audio
- Instrumentation

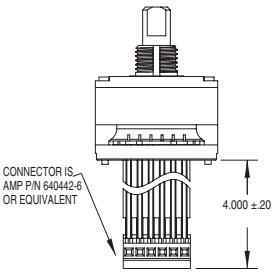


DIMENSIONS In inches (and millimeters)

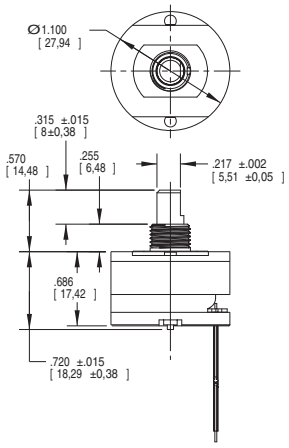
Pinned Version

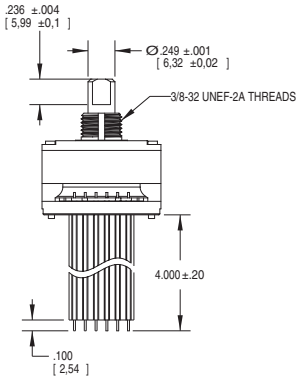


Cable Version



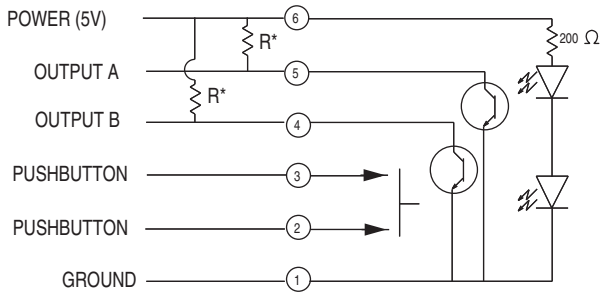
Stripped Version





*TOLERANCES ±.010 U.O.S.

SWITCH SCHEMATIC



*EXTERNAL 2.2k Ω PULL-UP RESISTORS REQUIRED FOR OPERATION.

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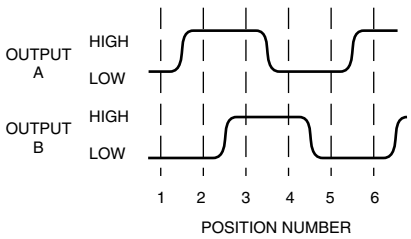
WAVEFORM AND TRUTH TABLE



Clockwise Rotation		
Position	**Output A**	**Output B**
1		
2	●	
3	●	●
4		●

• Indicates logic high; blank indicates logic low. Code repeats every 4 positions.

SPECIFICATIONS

Environmental Specifications

Operating Temperature Range: -40° C to 85° C
Storage Temperature Range: -55° C to 100° C
Humidity: 96 hours at 90-95% humidity at 40° C
Mechanical Vibration: Harmonic motion with amplitude of 15 g, within a varied frequency of 10 to 2000 Hz
Mechanical Shock:
Test 1: 100 g for 6 ms half-sine wave with a velocity change of 12.3 ft/sec
Test 2: 100 g for 6 ms sawtooth wave with a velocity change of 9.7 ft/sec

Rotary Electrical and Mechanical Specifications

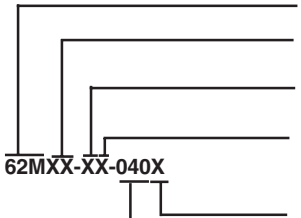
Operating Voltage: 5.00±.25 Vdc
Supply Current: 30 mA maximum at 5 Vdc
Output: Open collector phototransistor, external pull-up resistors are required
Output Code: Two-bit quadrature, channel A leads channel B by 90° electrically during clockwise rotation of the shaft
Logic Output Characteristics:
Logic high signal shall be no less than 3.0 Vdc
Logic low signal shall be no greater than 1.0 Vdc
Minimum Sink Current: 2.0 mA
Power Consumption: 150 mW maximum
Mechanical Life: 10 million rotational cycles of operation. One cycle is a rotation through all positions and a full return
Tolerances: H=1.70 ± 1.00 in-oz, M=1.25 ± 0.75 in-oz, L=0.75 ± 0.5 in-oz
Mounting Torque: 15 in-oz maximum
Shaft Pull-Out Force: 45 lbs minimum
Terminal Strength: 15 lbs minimum terminal pull-out force for cable or header termination
Solderability: 95% free of pin holes and voids

Pushbutton Electrical and Mechanical Specifications

Rating: 10 mA at 5 Vdc
Contact Resistance: <10 ohms
Life: 3 million actuations minimum
Contact Bounce: <4 ms make,<10 ms break
Actuation Force: 2=200±75 grams, 3=300±90 grams, 4=510±150 grams
Shaft Travel: .25 ± .010 inches

Materials and Finishes

Bushing: Zinc Diecast, Cadmium Plated per QQP-416, Class II, Type II
Insert Molded into 25% Glass Reinforced Nylon Zytel FR-50
Shaft: NdFeB XE-3594 over Grilamid LV23H
Stator: Powdered Metal per F-0000-20
Through Bolts: 305 Stainless Steel
Through Bolts Nuts: Stainless Steel
Spacer Washer: Brass
Snap Dome: Stainless Steel
Printed Circuit Boards: Nema Grade FR4, Double Clad with Copper, Plated with Gold over Nickel
Infrared Light Emitting Diode Chips: Gallium Aluminum Arsenide
Silicon Phototransistor Chips: Gold and Aluminum Alloys
Resistor: Metal Oxide on Ceramic Substrate
Solder Pins: Brass, Plated with Tin
Code Rotor: Acetal (Delrin 100)
Code Housing: Polyamide Polymer (Nylon 6/10 Alloy)
Backplate Strain Relief: Hiloy-610
Cable: Copper Standard with Topcoat in PVC Insulation (Cabled Versions Only)
Connector: PA4.6 with Tin Plated Copper Alloy (Cable/Connector Versions)
Label: TT406 Thermal Transfer Cast Film
Solder: Sn/Ag/Cu, Lead Free, No Clean
Mounting Hex Nut: Tin/Zinc Over 1/2 Hard Brass
Lockwasher: 8-18 Stainless Steel, Passivate Finish
Pin Header: Hi-Temp Glass Filled Thermo-plastic UL94V-0, Phosphor Bronze (Pinned Versions Only)

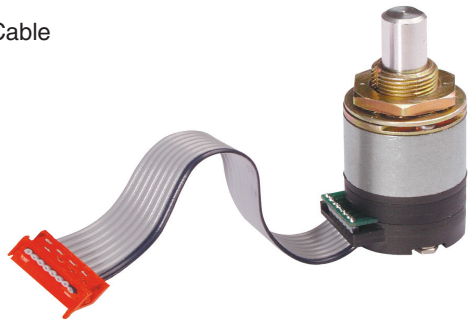


Series
Angle of Throw: 15 = 15° for code change and 24 detent positions
Rotational Torque: H=High Torque (1.70 in-oz), M=Medium Torque (1.25 in-oz), L=Low Torque (0.75 in-oz)
Pushbutton Option: 0=Non-Pushbutton, 2 = 200 grams, 3 = 300 grams, 4 = 510 grams
Termination: CH =.100 Cable with connector, SH = Cable with Stripped-End, PH = Pin Header
Cable Termination: 040 = 4.0in. Cable is terminated with Amp Connector P/N 215083-6. See Amp Mateability Guide for mating connector details.
**Eliminate cable length if ordering pins (Ex: 62M22-42-PH)*

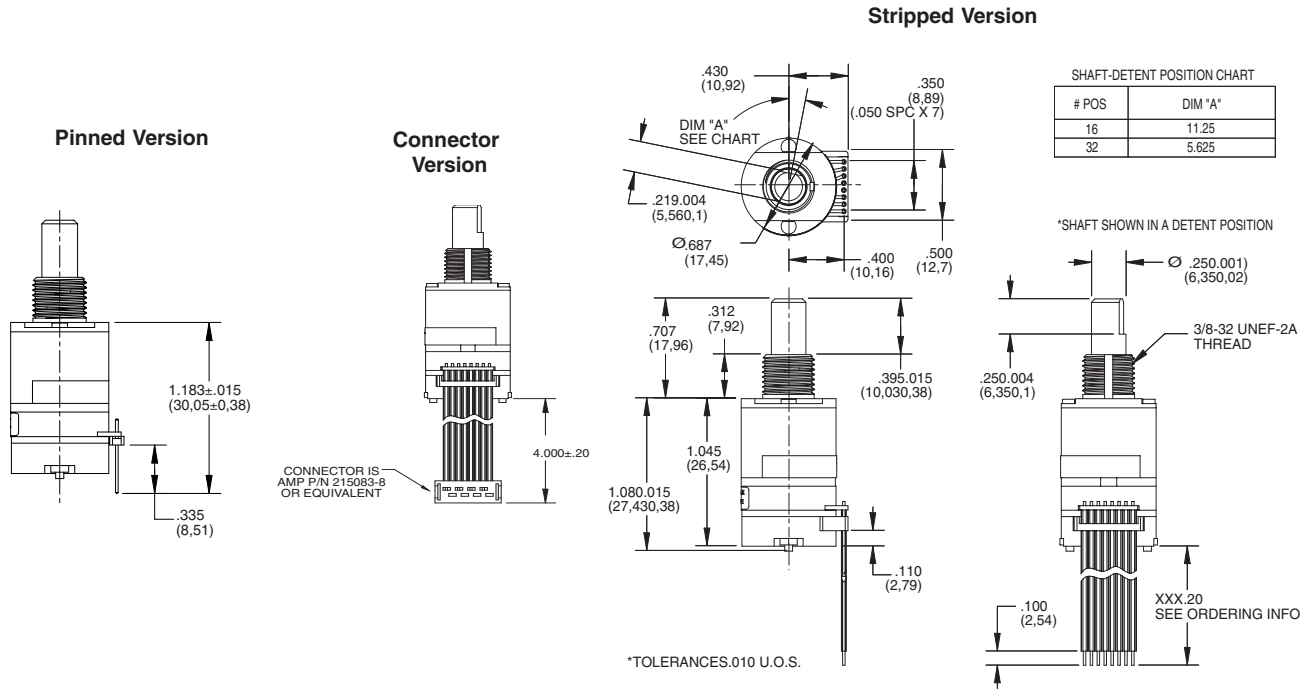
SERIES 62B
Push-Pull, High Torque

FEATURES
- Multiple Switching Functions Available in One Compact Device
- Push and Pull Travel Options
- Pull Shaft Resists Accidental Actuation
- High Rotational Torque for Positive Detent Feel and Superior Tactile Feedback
- Long Life, High Reliability
- CMOS, HCMOS, and TTL Compatible
- Pin, Cable and Connector with Cable Termination Options
- Custom Modifications Available

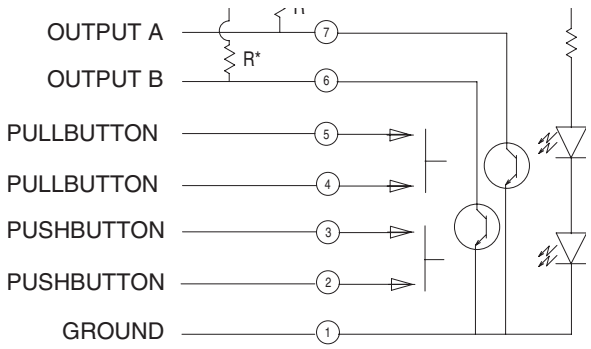
APPLICATIONS
- Use for Menu Scrolling or Function Selection
- Avionics
- Industrial
- Medical



DIMENSIONS In inches (and millimeters)

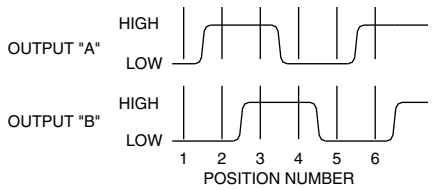


SWITCH SCHEMATIC, WAVEFORM, AND TRUTH TABLE



*EXTERNAL 2.2k Ω PULL-UP RESISTANCE REQUIRED FOR OPERATION.

WAVEFORM AND TRUTH TABLE Standard Quadrature 2-Bit Code



Clockwise Rotation		
Position	Output A	Output B
1		
2	●	
3	●	●
4		●

● Indicates logic high; blank indicates logic low.
Code repeats every 4 positions.

SPECIFICATIONS

Environmental Specifications

Operating Temperature Range: -40° C to 85° C
Storage Temperature Range: -55° C to 100° C
Humidity: 96 hours at 90-95% humidity at 40° C
Mechanical Vibration: Harmonic motion with amplitude of 15 g, within a varied frequency of 10 to 2000 Hz
Mechanical Shock:
Test 1: 100 g for 6 ms half-sine wave with a velocity change of 12.3 ft/sec
Test 2: 100 g for 6 ms sawtooth wave with a velocity change of 9.7 ft/sec

Rotary Electrical and Mechanical Specifications

Operating Voltage: 5.00±.25 Vdc
Supply Current: 30 mA maximum at 5 Vdc
Output: Open collector phototransistor, external pull-up resistors are required
Output Code: Two-bit quadrature, channel A leads channel B by 90° electrically during clockwise rotation of the shaft
Logic Output Characteristics:
Logic high signal shall be no less than 3.0 Vdc
Logic low signal shall be no greater than 1.0 Vdc
Minimum Sink Current: 2.0 mA
Power Consumption: 150 mW maximum
Mechanical Life: 1 million rotational cycles of operation. One cycle is a rotation through all positions and a full return
Average Rotational Torque: 6.0±1.5 in-oz initially. Torque shall be within 50% of initial value throughout life
Mounting Torque: 15 in-oz maximum
Shaft Push-Out Force: 45 lbs minimum
Shaft Pull-Out Force: 20 lbs minimum
Terminal Strength: 15 lbs minimum terminal pull-out force for cable or header termination
Solderability: 95% free of pin holes and voids

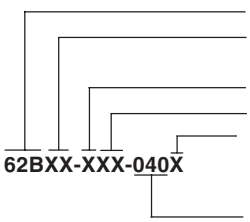
Pull-Button/Push-Button Electrical and Mechanical Specifications

Rating: 10 mA at 5 Vdc
Contact Resistance: <10 ohms
Life: 3 million actuations minimum
Contact Bounce: <4 ms make,<10 ms break
Actuation Force: 1700±450 g for both push and pull-button
Shaft Travel: .030±.010 standard travel. .050±.010 long travel

Materials and Finishes

Bushing: Zinc Diecast, Cadmium Plated per QQP-416, Class II, Type II
Shaft: Aluminum
Detent Cover: Powered Metal per SS-316N1-25
Through Bolts: 305 Stainless Steel
Through Bolts Nuts: 305 Stainless Steel
Shaft Travel Springs: Carbon Steel, Oil Dip Finish
Detent Ball: Stainless Steel
Detent Spring: Tinned Music Wire
Spacer/Push Dome Retainer: Ryton R-4
Push Actuator: Zytel 70G33L
Snap Dome: Stainless Steel
Printed Circuit Boards: Nema Grade FR4, Double Clad with Copper, Plated with Gold over Nickel
Infrared Light Emitting Diode Chips: Gallium Aluminum Arsenide
Silicon Phototransistor Chips: Gold and Aluminum Alloys
Resistor: Metal Oxide on Ceramic Substrate
Solder Pins: Brass, Plated with Tin
Code Rotor: Delrin 100
Code Housing: Hiloy-610
Pull Dome Retainer: Ryton R-4
Pull Actuator: Polyurethane, Isoplast 101 LGF40 Blk
Cover: Ryton R-4
Cable: Copper Standard with Topcoat in PVC Insulation (Cabled Versions Only)
Connector: PA4.6 with Tin over Nickel Plated Phosphor Bronze (Cable/Connector Versions)
Label: TT406 Thermal Transfer Cast Film
Solder: Sn/Ag/Cu, lead-free, no clean
Lubricating Grease: Nye Nyogel 774L
Mounting Hex Nut: Tin/Zinc Over 1/2 Hard Brass
Lockwasher: 8-18 Stainless Steel, Passivate Finish
Pin Header: Hi-Temp Glass Filled Thermo-plastic UL94V-0, Phosphor Bronze (Pinned Versions Only)

ORDERING INFORMATION



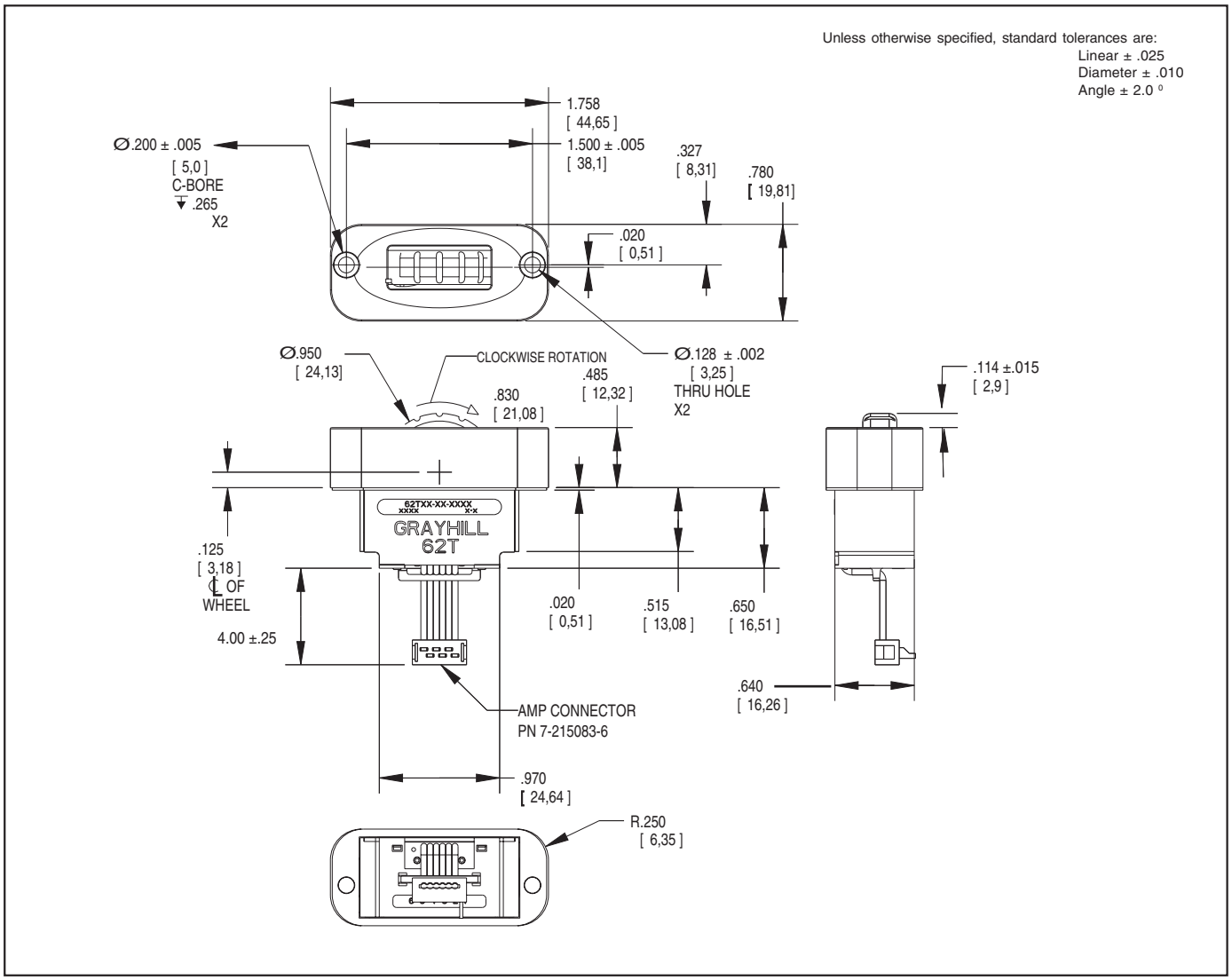
Series
Angle of Throw: 22 = 22.5° For Code Change and 16 Detent Positions.
11 = 11.25° For Code Change and 32 Detent Positions.
Push/Pull-Button Travel: S = Standard Travel (.030" Both Directions). L = Long Travel (.050" Both Directions)
Push/Pull Option: P = Pull-Button Only. PP = Push and Pull-Button
Termination: C = .050" Pitch Ribbon Cable with Connector
S = .050" Pitch Ribbon Cable with Stripped End
P = .050" Pitch Pin Header
Cable Termination: 040 = 4.0in. Cable is terminated with Amp Connector P/N 215083-6.
See Amp Mateability Guide for mating connector details.
**Eliminate cable length if ordering pins (Ex: 62B22-SP-P)*

SERIES 62T
Thumbwheel

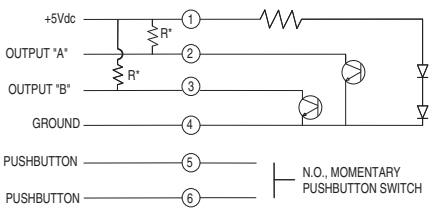
FEATURES
- Sealed against dust and particles
- Custom bezels that will blend with HMI grips and control panels
- Optional integrated pushbutton with over 3 million actuations
- MIL-STD-202 and MIL-STD-810F Compliant
- Standard panel seal

APPLICATIONS
- Scroll & select equipment in industrial and non-automotive transportation applications

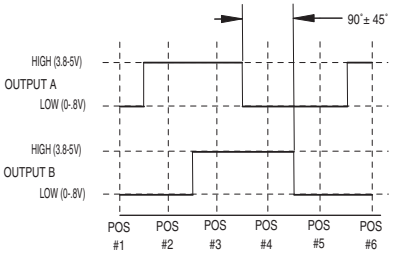
DIMENSIONS In inches (and millimeters)



WAVEFORM AND TRUTH TABLE



R* - TWO 2.2K Ω RESISTORS REQUIRED FOR OPERATION.



POSITION	OUTPUT A	OUTPUT B
#1		
#2	●	
#3	●	●
#4		●

● Indicates logic high; blank indicates logic low.
Code repeats every 4 positions.

SPECIFICATIONS

Environmental Specifications

MIL-STD-810F Qualified

Operating Temperature Range: -40° C to 85° C
Storage Temperature Range: -55° C to 100° C
Humidity: 96 hours at 90-95% humidity at 40° C
Mechanical Vibration: Harmonic motion with amplitude of 15g, within a varied frequency of 10 to 2000 Hz
Mechanical Shock:
Test 1: 100g for 6 ms half-sine wave with a velocity change of 12.3 ft/sec
Test 2: 100g for 6 ms sawtooth wave with a velocity change of 9.7 ft/sec

Rotary and Mechanical Specifications

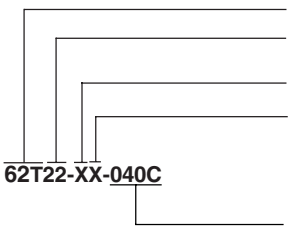
Operating Voltage: 5.00±0.25 Vdc
Supply Current: 25mA Max.
Output: Open collector phototransistor, external pull up resistors are required
Output Code: Two-bit quadrature, channel a leads channel B by 90° electrically during clockwise rotation of the thumbwheel
Logic high shall be no less than 3.8 Vdc
Logic low shall be no greater than 0.8 Vdc
Power Consumption: 125 mW Max.
Mechanical Life: 1,000,000 cycles of operation for Low and Non-Rotational Torque. 500,000 cycles of operation for Medium Rotational Torque. 1 cycle is a rotation through all positions and a full return.
Average Rotational Torque:
M: 2.2±.75 in-oz, L: 1.2±0.5 in-oz, N: <0.50 in-oz. Initially torque shall be within 75% of initial value throughout life.

Pushbutton Electrical and Mechanical Specifications

Rating: 10mA @ 5 Vdc
Contact Resistance: <10W
Life: 3 million actuations minimum
Contact Bounce: <4 ms make, <10ms break
Actuation Force: N – None, 7–700g, 10 – 1000g.
Thumbwheel Travel: .060 ± .015 in

Materials and Finishes

Face Plate: Plastic
Housing: Nylon 6/6
Side Plate: Reinforced thermoplastic
Wiper: Silicone rubber with adhesive
Gasket: Silicone rubber with adhesive
Wheel: Plastic
Shaft: Aluminum
Slide Springs: Music wire
Detent Spring: Music wire
Detent Balls: Nickel plated stainless steel
PC Boards: NEMA grade FR4. Double clad with copper plated
Plated with gold over nickel
Pushbutton board is tin plating over copper
LED: Gallium Aluminum Arsenide
Phototransistor: Gold and Aluminum Alloys
Code Section Housing: Reinforced plastic
Detent Housing: Thermoplastic
Code Rotor: Delrin 100 plastic
Dome: Stainless steel
Dome retainer: Delrin 100 plastic
Slide Rods: Stainless steel
Splining Key: Stainless steel
Actuator: Reinforced thermoplastic
Screws: Aluminum or Stainless
Wiper Plate: Copper
Solder: 63/67 tin-lead, no clean - low residue flux



Series
Angle of Throw: 22 = 22.5° for code change and 16 detent positions
Rotational Torque: N = Non-Detent, L=Low Torque, M=Medium Torque
Pushbutton Option: 0=No Pushbutton, 7=700 grams, 10=1000 grams

Termination: C = .050 Center ribbon Cable with connector
Cable Termination: 040=4.0 inches. Cable is terminated with Amp Connector P/N 7-215083-6.
See Amp Mateability Guide for Mating Connector details.

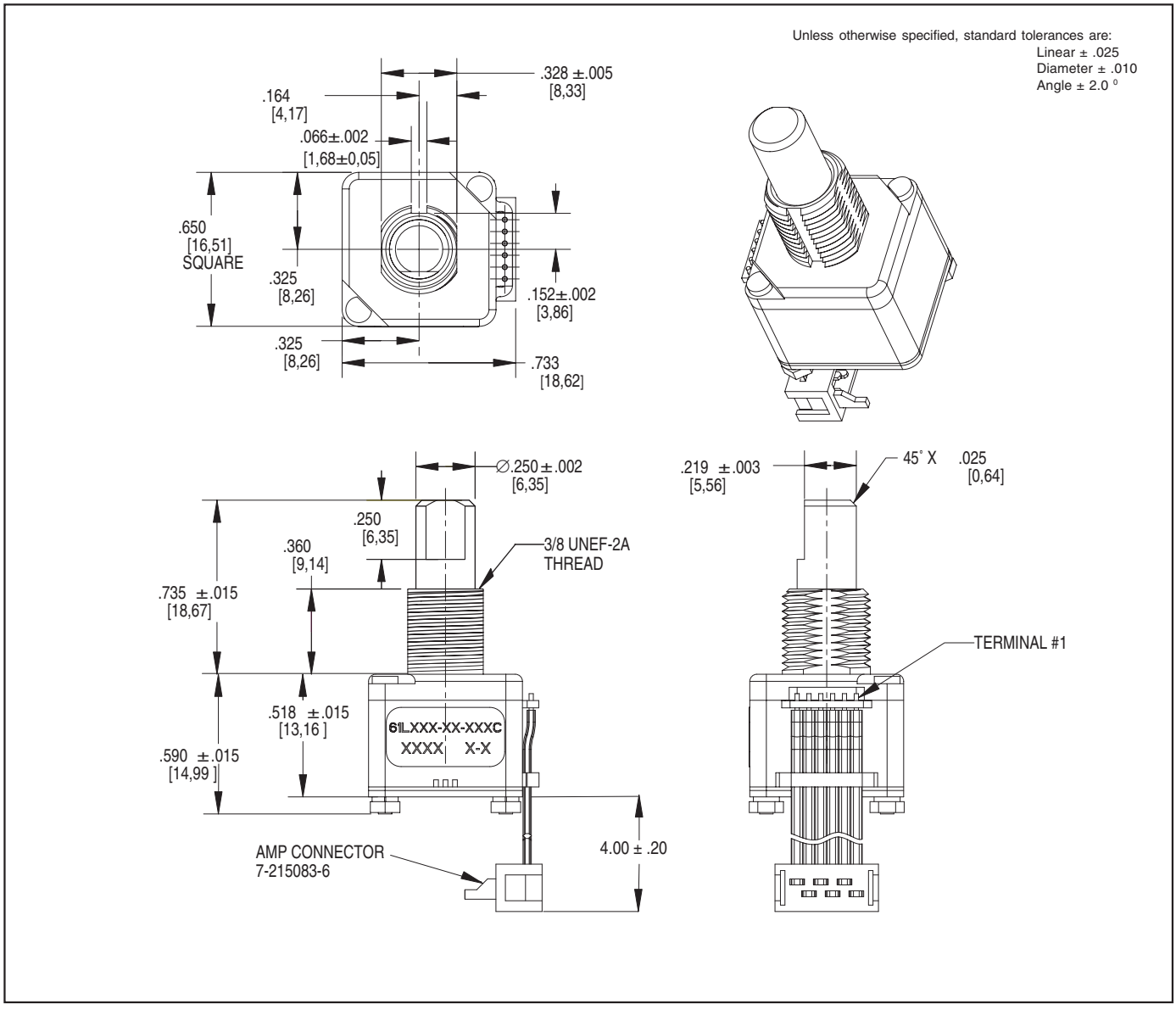
Available from your local Grayhill Component Distributor. For pricing an discounts, contact a local Sales Office, an authorized local Distributor, or Grayhill.

SERIES 61L
Full Quadrature Cycle Per Detent

FEATURES
- .650 sq. inch package size
- Optically coupled for 1 million rotational cycles
- Optional integrated pushbutton
- Detented and non-detented versions available
- Available in 24 positions

APPLICATIONS
- Medical Devices
- Test and Measurement Equipment
- Other Scroll and Select Applications

DIMENSIONS In inches (and millimeters)



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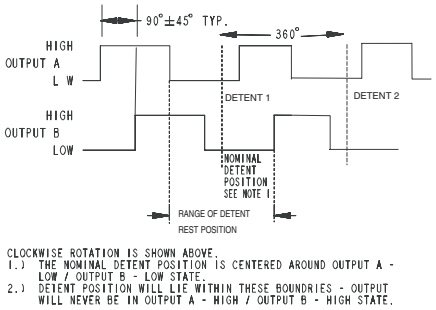
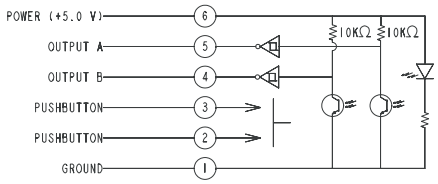
CIRCUITRY, WAVEFORM AND TRUTH TABLE





NOMINAL CODE THROUGH ONE DETENT POSITION.

OUTPUT A	OUTPUT B
●	
●	●
	●

● Indicates logic high; blank indicates logic low. Code repeats every four cycles.

SPECIFICATIONS

Environmental Specifications

Operating Temperature Range: -40° C to 85° C
Storage Temperature Range: -55° C to 100° C
Humidity: 96 hours at 90-95% humidity at 40° C
Mechanical Vibration: Harmonic motion with amplitude of 15g, within a varied frequency of 10 to 2000 Hz
Mechanical Shock:
Test 1: 100g for 6 ms half-sine wave with a velocity change of 12.3 ft/sec
Test 2: 100g for 6 ms sawtooth wave with a velocity change of 9.7 ft/sec

Rotary Electrical and Mechanical Specifications

Operating Voltage: 5.00±.25Vdc
Supply Current: 30 mA maximum at 5Vdc

Output Code: Two-bit quadrature, channel A leads channel B by 90° electrically during clockwise rotation of the shaft.
Logic Output Characteristics:
Logic high signal shall be no less than 3.8 Vdc
Logic low signal shall be no greater than 0.8 Vdc
Minimum Sink Current: 2.0 mA
Power Consumption: 150 mW maximum
Mechanical Life: 1 million cycles of operation for Medium, Low and Non-Detent. 1/2 million cycles of operation for High. One cycle is a rotation through all positions and a full return.

Average Rotational Torque: H= 6.0 ± 2.6 in-oz, M= 2.7 ± 1.8 in-oz, L= 1.4 ± 0.8 in-oz, N= <0.50 in-oz. Torque shall be within 50% of inital value throughout life.
Mounting Torque: 15 in-oz maximum
Shaft Push-Out Force: 45 lbs minimum
Shaft Pull-Out Force: 45 lbs minimum
Terminal Strength: 15 lbs minimum terminal pull-out force for cable or header termination
Solderability: 95% free of pinholes and voids

Pushbutton Electrical and Mechanical Specifications

Rating: 50 mA at 12 Vdc
Contact Resistance: <10Ω
Life: 1/2 million actuations minimum
Contact Bounce: <4 ms make, <10 ms break
Actuation Force:510 ±150 grams
Shaft Travel: .025 ± .015 inch

Materials and Finishes

Bushing: Zinc
Shaft: Aluminum
Retaining Ring: Stainless Steel
Detent Spring: Music Wire
Detent Ball: High Carbon Chrome, Nickel finish
Code Housing: Polyamide Polymer, Hiloy 610
Aperture: Stainless Steel

Detent: Polyamide Polymer, Hiloy 610
Rotor Hub: Polyamide Polymer, Hiloy 610
Code Rotor: Stainless Steel
Printed Circuit Boards: Nema Grade FR4, Double Clad with Copper, Plated with Gold over Nickel
Infrared Light Emitting Diode Chips: Gallium Aluminum Arsenide
Silicon Phototransistor Chips: Gold and Aluminum Alloys
Resistor: Metal Oxide on Ceramic Substrate
Solder Pins: Brass, Plated with Tin
Tact Switch: Cover - Stainless Steel, contact Disc - Phosphor Bronze with silver cladding, terminal - brass with silver cladding, base - UL94V-0 Nylon 19: High Temp
Back Plate: Stainless Steel
Spacer: Nomex Type 410
Cable: Copper Standard with Topcoat in PVC Insulation
Connector: Glass filled Polyester, Tin/Nickel Phosphor Bronze
Label: TT406 Thermal Transfer Cast Film
Solder: 96.5% tin / 3% silver / 0.5% copper, no clean
Lubricating Grease: NYE Nyogel 774L
Studs: Stainless Steel
Lockwasher: Stainless Steel
Hex Nuts: Stainless Steel

61L515-XX-040C

Series
Operating Voltage: 5 = 5 Volts
Angle of Throw: 15 = 15° for complete quadrature cycle change and 24 detent positions
Rotational Torque: N = Non-Detent, H=High Torque, M=Medium Torque, L=Low Torque
Pushbutton Option: 0=Non-Pushbutton, 5=510 grams
Termination: C = .050 Center ribbon Cable with connector
Cable Termination: 040=4.0 inches. Cable is terminated with Amp Connector P/N7-215083-6.
See Amp Mateability Guide for Mating Connector details.

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

SERIES 62AG

Price Competitive Solution

FEATURES

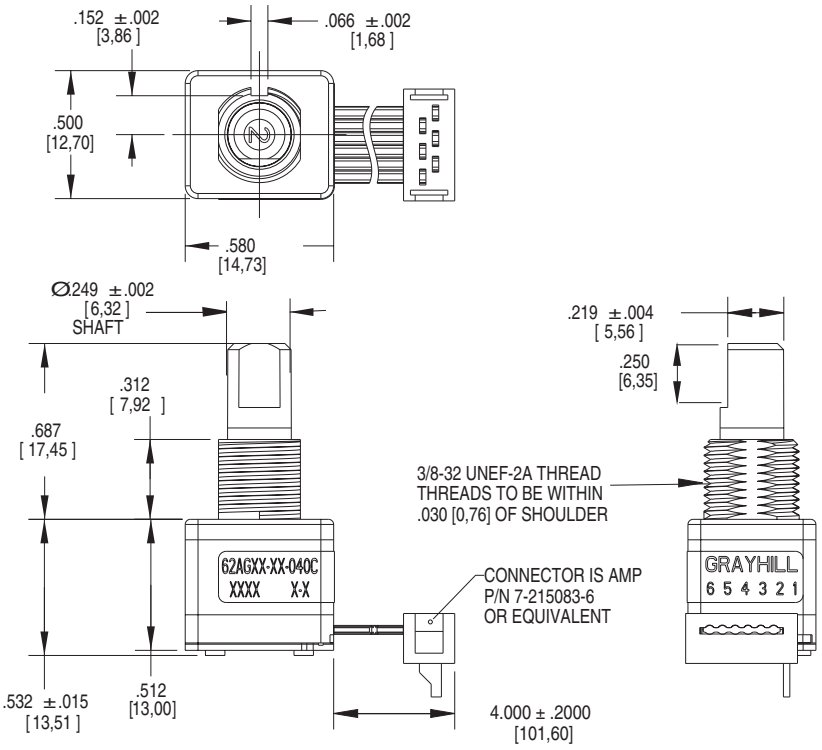
- Long Lasting (1 million cycles)
- Optional pushbutton
- Available in 16 and 32 Detent Positions
- 4 inch cable / connector assembly

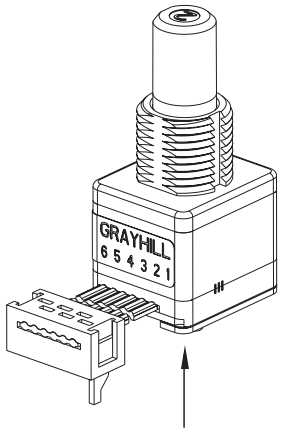
APPLICATIONS

- Automotive audio, navigation & driver information systems
- Medical Equipment
- Test & Measurement Equipment
- Audio & Video Equipment

DIMENSIONS In inches (and millimeters)

Unless otherwise specified, standard tolerances are:
Linear ± .025
Diameter ± .010
Angle ± 2.0 °





NOTE: GRAYHILL ALLOWS MULTIPLE ORIENTATIONS FOR THE GRAYHILL TEXT ON THE BACKPLATE.

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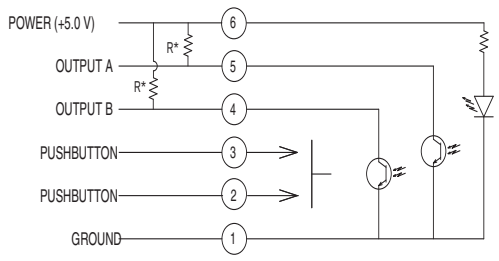
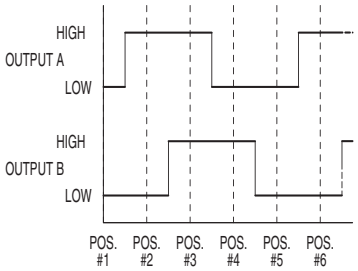
WAVEFORM AND TRUTH TABLE



*EXTERNAL 10k Ω PULL-UP RESISTORS REQUIRED FOR OPERATION



*CLOCKWISE SHAFT ROTATION

POSITION	OUTPUT A	OUTPUT B
#1		
#2	●	
#3	●	●
#4		●

● INDICATES LOGIC HIGH; BLANK INDICATES LOGIC LOW.
CODE REPEATS EVERY FOUR POSITIONS.

SPECIFICATIONS

Environmental Specifications

Operating Temperature Range: -40°C to 85°C
Storage Temperature: -43°C to 38°C
Humidity: 96 Hours at 90-95% humidity at 40°C
Mechanical Vibration: Harmonic motion with amplitude of 15g within a varied frequency of 10 to 2000 Hz for 12 hours
Mechanical Shock
Test 1: 100g for 6 ms half-sine wave with a velocity change of 12.3 ft/s.
Test 2: 100g for 6 ms sawtooth wave with a velocity change of 9.7 ft/s.

Rotary Electrical and Mechanical Specifications

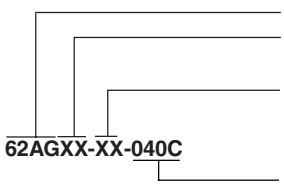
Operating Voltage: 5.00±0.25 Vdc
Supply Current: 30 mA maximum at 5 Vdc.
Logic Output Characteristics:
Logic high shall be no less than 3.0 VdcLogic low shall be no greater than 1.0 Vdc
Minimum sink current: 0.5 mA for 5 Vdc. (Preliminary)
Power Consumtpion: 150 mW maximum for 5 Vdc
Output: Open Collector Phototransistor
Optical Rise Time: 30ms maximum.
Optical Fall Time: 30ms maximum.
Average Rotational Torque:
2.0±1 4 in-oz before life. 50% of initial value after 1 million cycles.
Mechanical Life: 1,000,000 cycles of operation. 1 cycle is a rotation through all positions and a full return.
Mounting Torque: 15in-lbs. maximum
Shaft Pushout Force: 45 lbs. minimum
Terminal Strength: 15 lbs. Cable pull out force minimum
Solderability: 95% free of pin holes and voids
Maximum rotational speed: 100 rpm.

Pushbutton Electrical and Mechanical Specifications

Rating: 10 mA @ 5 Vdc
Contact Resistance: <10 W (Compatible with CMOS or TTL)
Life: 1 million actuations minimum
Contact Bounce: <4 ms make, <10ms break
Actuation Force: 510±150 grams
Shaft Travel: .017 ± .008 INCH

Materials and Finishes

Bushing: Zamak 2
Shaft: Zamak 2
Detent Rotor: Reinforced Nylon Zytel 70G33L UL 94
Detent Spring: 303 Stainless Steel
Housing, Upper: Nylon 6/6 25% glass reinforced. Zytec FR-50
Light Pipe: Lexan, GE
Code Rotor: Delrin 100
Housing, Lower: Nylon 6/6 25% glass reinforced. Zytec FR-50
Pushbutton Actuator: Reinforced nylon. Zytel 70G33L. UL 94
Pushbutton Dome: Stainless Steel
Printed Circuit Board: NEMA Grade FR4, Double clad with copper, Plated with gold over nickel
Infrared Emitting Diode: Gallium Arsenide
Phototransistor Diode: NPN Silicon
Resistor: Metal oxide on ceramic substrate
Spacer: Pet plastic
Backplate: Stainless Steel
Label: TT406 thermal transfer cast film.
Solder: 96.5% tin / 3% silver / 0.5% copper. No clean.
Hex Nut: Brass, Plated with nickel
Lockwasher: Stainless steel
Cable: Copper Stranded with topcoat in PVC insulation
Connector (.050 center): PA4.6 with tin/ nickel plated phosphor bronze.



Series
Angle of Throw: 22 = 22.5° for code change and 16 detent positions
11 = 11.25° for code change and 32 detent positions
Pushbutton Option: 01=No Pushbutton, 02=With Pushbutton

Termination: C = .050 Center ribbon Cable with connector
Cable Termination: 040=4.0 inches.Cable is terminated with Amp Connector P/N215083-6.
See Amp Mateability Guide for Mating Connector for details.

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

SERIES 60A
Joystick

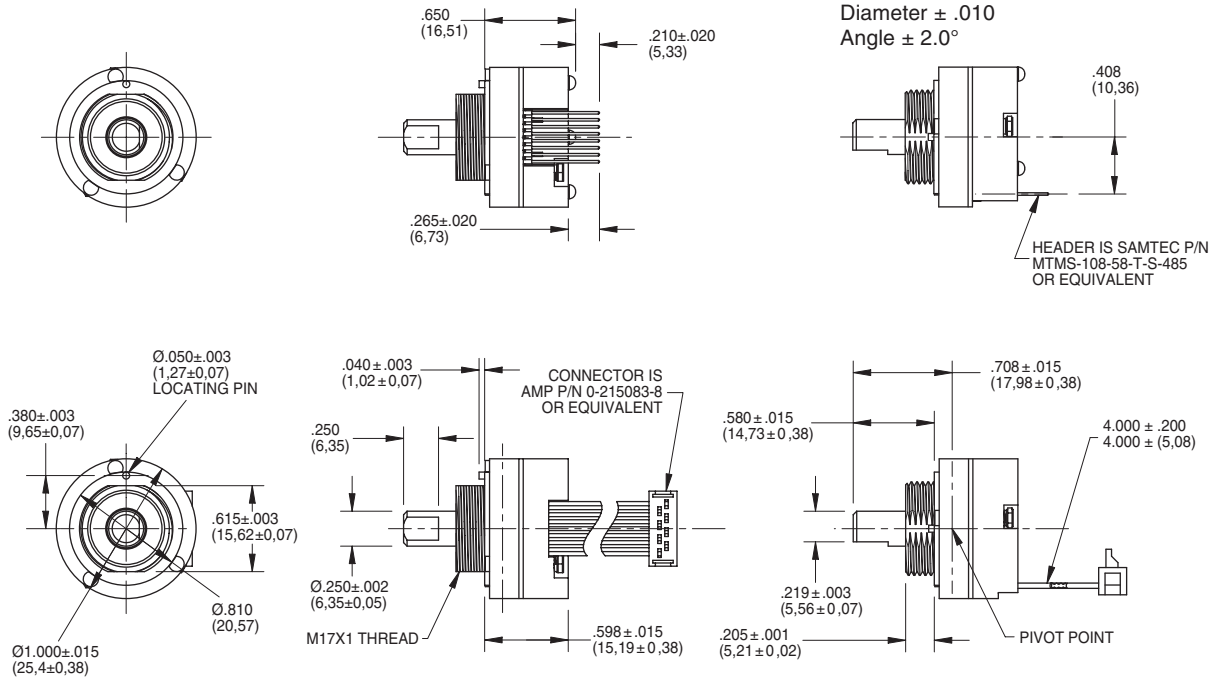
FEATURES
- Optical Encoder, Pushbutton, and Joystick in One Shaft
- Long Life, High Reliability
- Compatible with CMOS, HCMOS, and TTL Logic
- Choices of Cable Length and Termination
- Customized Solutions Available

APPLICATIONS
- Global Positioning/Driver Information Systems
- Medical Equipment Control
- Radio Control
- Robotics
- Commercial Appliances

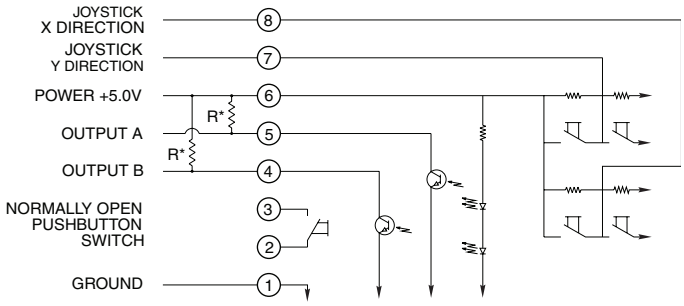
DIMENSIONS In inches (and millimeters)

Pin Version

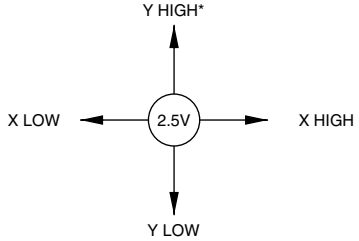
Unless otherwise specified, standard tolerance are:
Linear ± .025
Diameter ± .010
Angle ± 2.0°



CIRCUITRY AND JOYSTICK OPERATION Standard Quadrature 2-Bit Code

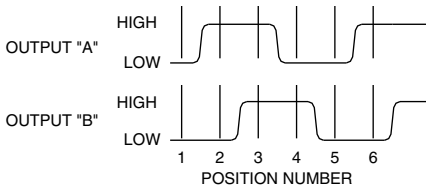


*EXTERNAL PULL-UP RESISTORS REQUIRED FOR OPERATION (2.2kΩ).



* DEFINED BY LOCATING PIN ON TOP OF HOUSING

WAVEFORM AND TRUTH TABLE Standard Quadrature 2-Bit Code



Clockwise Rotation		
Position	Output A	Output B
1		
2	●	
3	●	●
4		●

● Indicates logic high; blank indicates logic low. Code repeats every 4 positions.

SPECIFICATIONS

Rotary Electrical and Mechanical Ratings

Operating Voltage: 5.00 ± 0.25 Vdc
Supply Current: 20 mA maximum at 5 Vdc
Output: Open collector phototransistor. External pull up resistors are required
Output Code: 2-Bit quadrature, channel A leads channel B by 90° electrically during clockwise rotation of the shaft
Logic Output Characteristics:
High: No less than 3.5 Vdc
Low: No greater than 1.0 Vdc
Minimum Sink Current: 2.0 mA
Power Consumption: 100 mW maximum
Mechanical Life: 1 million rotational cycles of operation (1 cycle is a rotation through all positions and a full return)
Average Rotational Torque: 2.0 ± 1.0 in-oz initially, torque shall be within 50% of initial value throughout life
Mounting Torque: 15 in-lbs. maximum
Shaft Push-Out Force: 45 lbs minimum
Shaft Pull-Out Force: 45 lbs minimum
Terminal Strength: 15 lbs terminal pull-out force minimum for cabled and header termination
Solderability: 95% free of pin holes and voids

Pushbutton Electrical and Mechanical Ratings

Rating: 10 mA at 5 Vdc resistive
Contact Resistance: less than 10 ohms
Life: 1 million actuations minimum
Contact Bounce: < 4 mS make, 10 mS break
Actuation Force: 400 ± 150 grams force
Shaft Travel: 0.020 ± 0.010 inches

Joystick Electrical and Mechanical Ratings

Supply Current: 5 mA maximum
Output Code: 2-Bit
Logic Output Characteristics:
Neutral: 2.5 ± 0.5 Vdc
High: > 4.5 Vdc
Low: < 0.5 Vdc
Angle of Throw: 8° ± 2° in all directions
Life: 500,000 actuations in each direction

Environmental Ratings

Operating Temperature Range: -40°C to 85°C
Storage Temperature Range: -55°C to 100°C
Relative Humidity: 96 hours at 90-85% humidity at 40°C
Vibration: Harmonic motion with amplitude of 15g, within a varied 10 to 2000 Hz frequency for 12 hours
Mechanical Shock:
Test 1: 100g for 6ms half-sine wave with a velocity change of 12.3 ft/s
Test 2: 100g for 6ms sawtooth wave with a velocity change of 9.7 ft/s

Materials and Finishes

Assembly Studs: 305 Stainless steel
Detent Housing: Polyamide polymer (nylon 6/10 alloy)
Printed Circuit Boards: Glass cloth epoxy double clad with copper gold over nickel plated
Infrared Emitting Diode Chips: Gallium aluminum arsenide
Silicon Phototransistor Chips: Gold and aluminum alloys
Resistors: Metal oxide on ceramic substrate
Solder Pins: Brass, Plated with tin
Shaft: Polyamide polymer (nylon 6/10 alloy) with stainless steel insert
Detent Balls: Carbon steel plated with nickel
Detent Springs: Music wire plated with tin
Code Rotor: 33% Glass reinforced nylon 66
Pushbutton Dome: Stainless steel
Pushbutton Dome Retainer: Polycarbonate
Joystick Housing: Polyamide polymer (nylon 6/10 alloy)
Joystick Contact: Stainless steel, silicone rubber, brass with silver cladding, high-temp thermoplastic, phosphor bronze with silver cladding
Cable: Copper stranded with plating in PVC insulation
Connector: PA 4.6 with tin over nickel plated phosphor bronze
Lockwashers: Stainless steel with passivate finish
Hex Nuts: 303 Stainless steel
Label: TT406 Thermal transfer cast film
Solder: Sn/Ag/Cu, Lead-Free, No Clean
Mounting Nut: Polyurethane
Lubricating Grease: Nye nyogel 774L

OPTIONS

Contact Grayhill for custom terminations, rotational torque, number of positions, shaft configurations, and resolutions. Control knobs are also available.

ORDERING INFORMATION

60A18-4-040S

Series
Angle of Throw: Detent: 18 = 18° or 20 positions; Non-detent: 08 = 18° or 20 positions; Non-Turn: 00 = Joystick and Pushbutton only
Joystick Contacts: 2 = 2 Discrete Contacts
4 = 4 Discrete Contacts
8 = 4 Contacts in 8 possible directions

Termination: S = Stripped cable; .050" centers; C = Connector; .050" centers; P = Pin; .050" centers
Cable Termination: 040 = 4.0in. Cable is terminated with Amp Connector P/N 215083-6. See Amp Mateability Guide for mating connector details.
**Eliminate cable length if ordering pins (Ex: 60A18-4-P)*

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

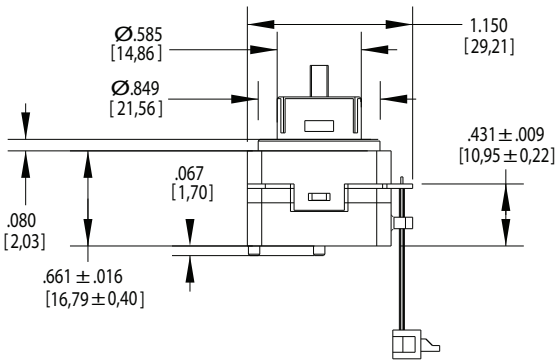
SERIES 60C
Multi-Function Joystick

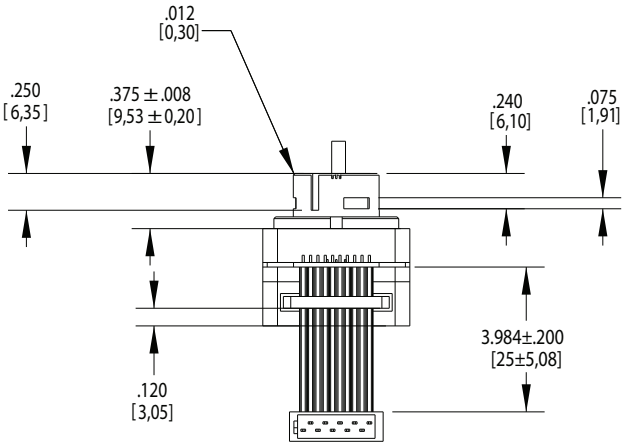
FEATURES
- Three-in-One Optical Encoder, Pushbutton, and Joystick
- Compact Packaging
- Choices of Cable Length and Termination
- Customized Solutions Available

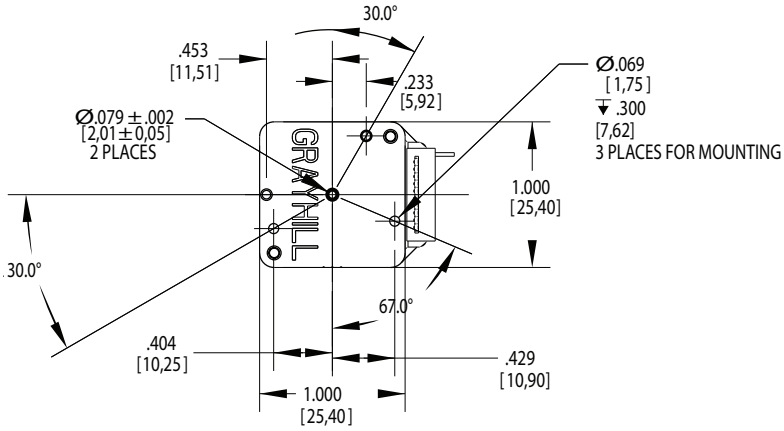
APPLICATIONS
- Automotive Navigation & Infotainment Equipment
- Avionics
- Medical Equipment

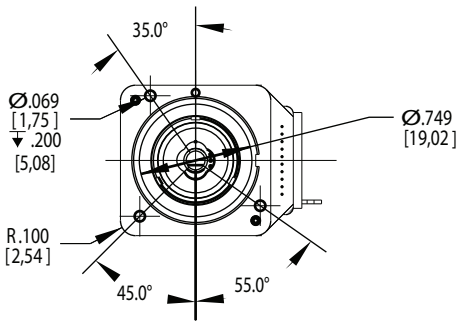
DIMENSIONS In inches (and millimeters)

Unless otherwise specified, standard tolerance are:
Linear ± .025
Diameter ± .010
Angle ± 2.0°









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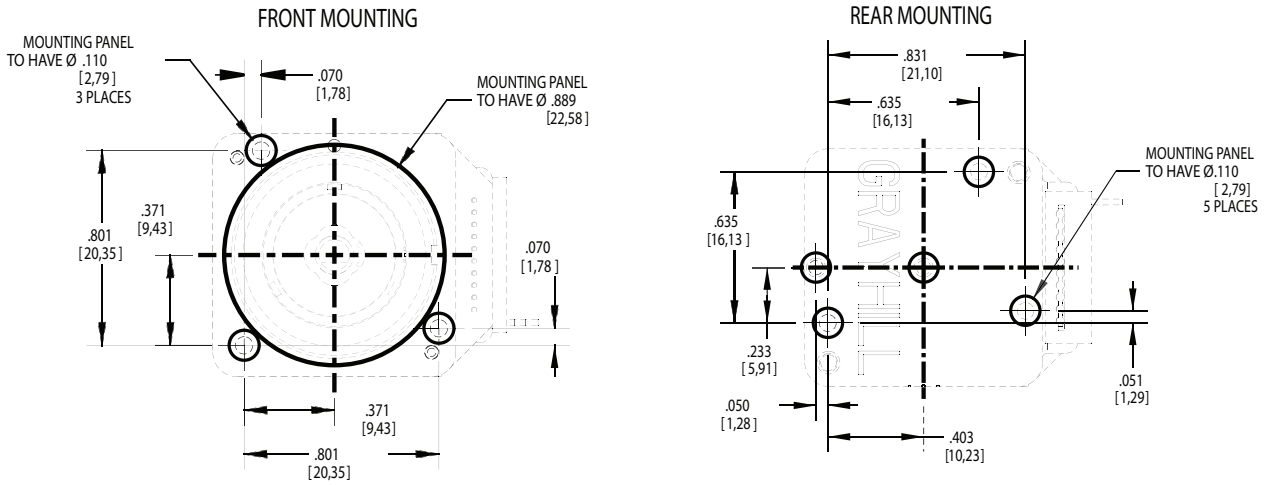
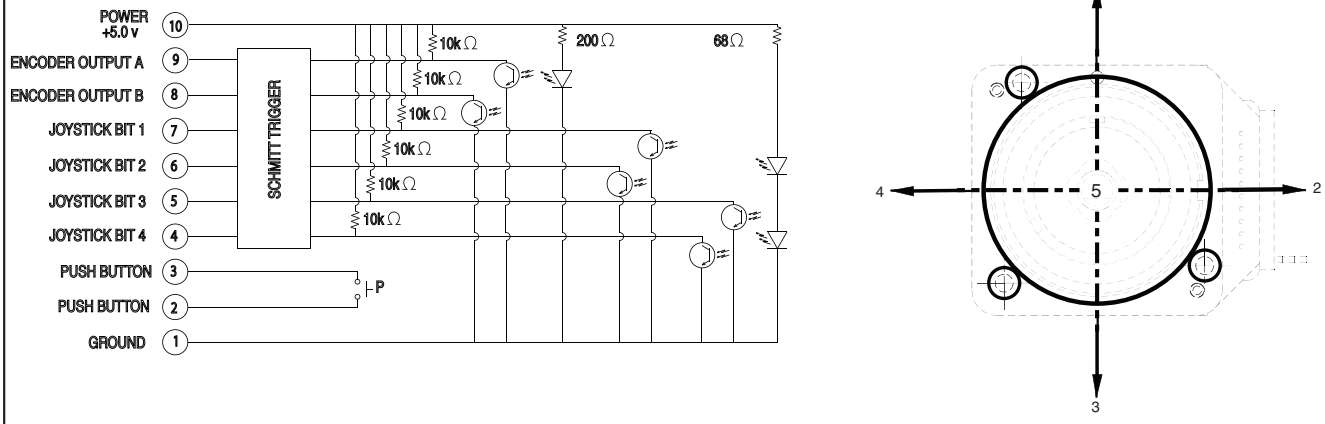
FRONT AND REAR MOUNTING



CIRCUITRY AND JOYSTICK OPERATION Standard Quadrature 2-Bit Code



WAVEFORM AND TRUTH TABLE Standard Quadrature 2-Bit Code

OUTPUT FOR JOYSTICK OPERATION

POSITION	BIT 1	BIT 2	BIT 3	BIT 4
1		●	●	●
2	●	●		●
3	●		●	●
4	●	●	●	
5	●	●	●	●

● INDICATES LOGIC HIGH

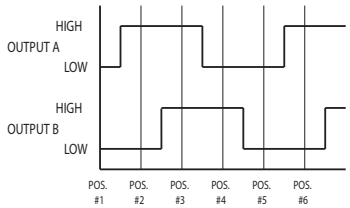
CODE REPEATS EVERY FOUR POSITIONS.

OUTPUT FOR ROTARY ENCODER OPERATION

POSITION	OUTPUT A	OUTPUT B
#1		
#2	●	
#3	●	●
#4		●

● INDICATES LOGIC HIGH

CODE REPEATS EVERY FOUR POSITIONS.



SPECIFICATIONS

Rotary Electrical and Mechanical Ratings

Operating Voltage: 5.00 ± 0.25 Vdc
Supply Current: 35mA at TYP at 5 Vdc
Output: Direct output from converting Schmidt trigger
Output Code: 2-Bit quadrature, channel A leads channel B by 90° electrically during clockwise rotation of the shaft
Logic Output Characteristics:
High: No less than 3.5 Vdc
Low: No greater than 1.0 Vdc
Minimum Sink Current: 2.0 mA
Power Consumption: XXX mW maximum
Mechanical Life: 500 thousand rotational cycles of operation (1 cycle is a rotation through all positions and a full return)
Average Rotational Torque: 2.0 ± 1.0 in-oz initially, torque shall be within 50% of initial value throughout life
Mounting Torque: 15 in-lbs. maximum
Shaft Push-Out Force: 20 lbs minimum
Shaft Pull-Out Force: 20 lbs minimum
Terminal Strength: 15 lbs terminal pull-out force minimum for cabled and header termination
Solderability: 95% free of pin holes and voids

Pushbutton Electrical and Mechanical Ratings

Rating: 10 mA at 5 Vdc resistive
Contact Resistance: less than 10 ohms
Life: 500 thousand actuations minimum
Contact Bounce: < 4 mS make, 10 mS break
Actuation Force: 600 ± 150 grams force
Shaft Travel: 0.020 ± 0.010 inches

Joystick and Mechanical Ratings

Supply Current: 35mA at TYP at 5 Vdc
Output Code: 2-Bit quadrature, channel A leads channel B by 90° electrically during clockwise rotation of the shaft
Logic Output Characteristics:
Neutral: 2.5 ± 0.5 Vdc
High: > 4.5 Vdc
Low: < 0.5 Vdc
Angle of Throw: 7° ± 2° in all directions
Life: 500 thousand actuations in each direction

Environmental Ratings

Operating Temperature Range: -40°C to 85°C
Storage Temperature Range: -55°C to 100°C
Relative Humidity: 96 hours at 90-95% humidity at 40°C
Vibration: Harmonic motion with amplitude of 15g, within a varied 10 to 2000 Hz frequency for 12 hours
Mechanical Shock:
Test 1: 100g for 6ms half-sine wave with a velocity change of 12.3 ft/s
Test 2: 100g for 6ms sawtooth wave with a velocity change of 9.7 ft/s
Thermocycle: 4 hours cycling between -40°C to 80°C

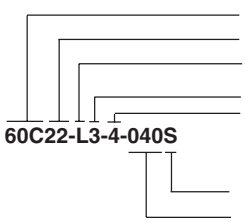
Materials and Finishes

Bushing: Thermoplastic
Upper Housing: Thermoplastic
Infrared Emitting Diode Chips: Gallium aluminum arsenide
Backplate: Thermplastic
Lightpipe, Joystick: Thermoplastic
Lightpipe, 16 pos: Thermoplastic
Centering Profile: Thermoplastic
Shaft Inner: Aluminum
Barbed Rivet: Stainless Steal
Silicon Phototransistor Chips: Planar
Resistors: Carbon film
Solder Pins: Stainless steel
Shaft Outer: Thermoplastic
Slider Plate: Thermoplastic
Detent Balls: Carbon steel 100 with nickel finish
Centering Balls: Carbon steel 100 with nickel finish
Detent Springs: Music wire plated with tin
Centering Springs: Music wire plated with tin
Schmidt Trigger: RoHS Compliant TSSOP, 14 pin
Pushbutton Rocker: Thermoplastic
Pushbutton Actuator: Thermoplastic
Pushbutton Dome: Stainless steel
Label: TT406 Thermal transfer cast film
Solder: 95.5% Sn/ 4% Ag/ 0.5% Cu

OPTIONS

Contact Grayhill for custom terminations, rotational torque, number of positions, shaft configurations, and resolutions. Control knobs are also available.

ORDERING INFORMATION



Series
Angle of Throw: 22 = 22.5° or 16positions
Rotation Torque: L = Low torque, M = Medium torque, H= High torque
Pushbutton: 3= 300 grams
Joystick: 4 = Four directions

Termination: S = Stripped cable; .050" centers; C = Connector; .050" centers;
Cable Termination: 040 = 4.0in. Cable is terminated with Amp Connector P/N 215083-6.

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

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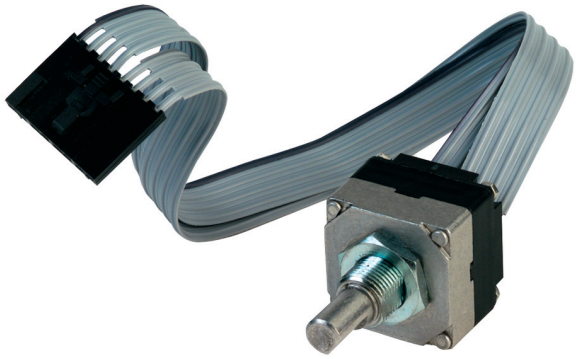
SERIES 61A

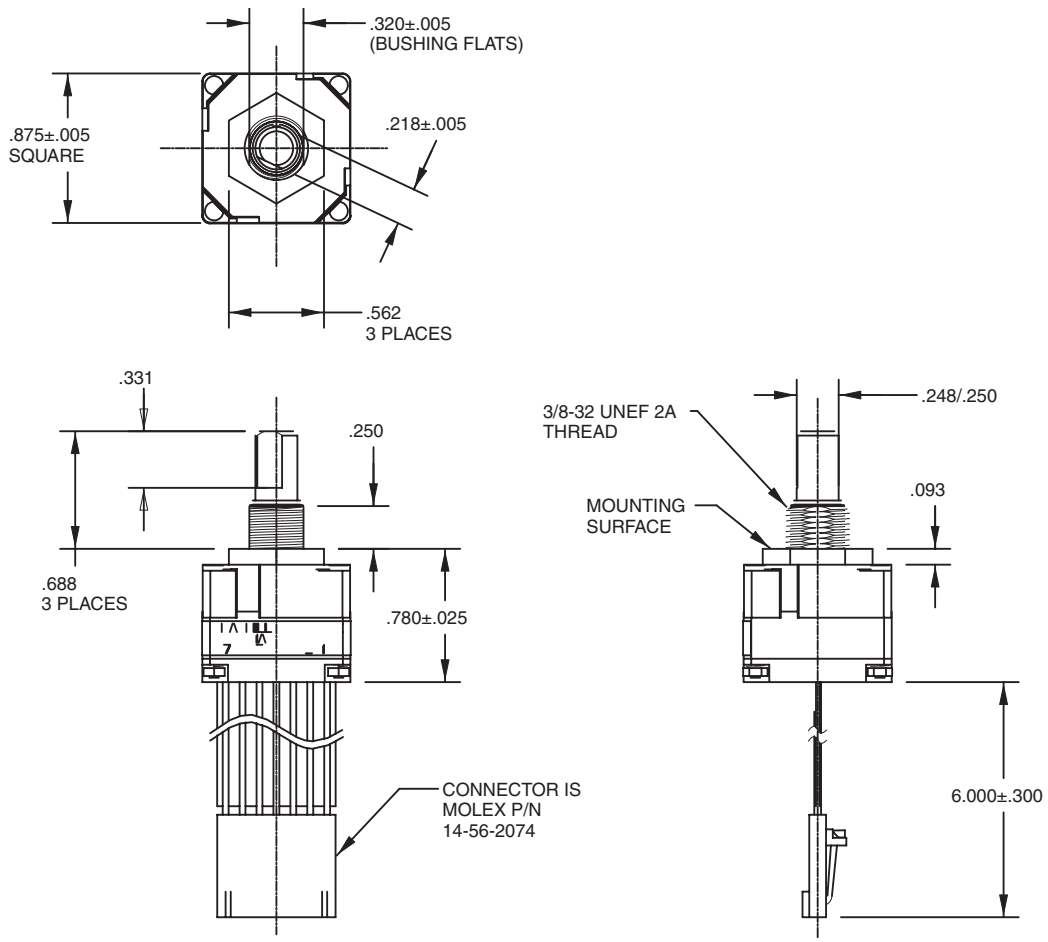
Custom, Absolute

FEATURES

- Absolute Position Sensing
- 3, 4, or 5-Bit Custom Output Coding
- 8 to 32 Positions
- Fixed Stops Only
- Angles of Throw to 45° (Design Specifications Will Dictate the Angle of Throw)

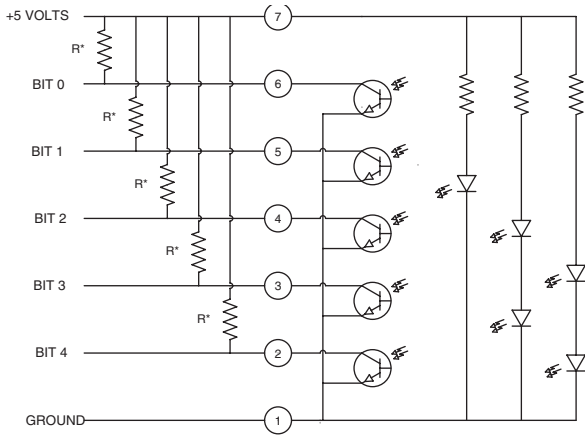


DIMENSIONS In inches (and millimeters)



UNLESS OTHERWISE SPECIFIED, DIMENSION TOLERANCES ARE AS FOLLOWS: LINEAR ±.010 (0,25), DIAMETERS ±.010 (0,25), ANGULAR ±5

CIRCUITRY



* EXTERNAL PULL-UP RESISTORS REQUIRED FOR OPERATION (4.7k)

TRUTH TABLE

3 BIT, 8 POSITION

Position	B2	B3	B4
1			
2			●
3		●	●
4		●	
5	●	●	
6	●	●	●
7	●		●
8	●		

● INDICATES LOGIC HIGH
BLANK INDICATES LOGIC LOW

4 BIT, 16 POSITION

Position	B1	B2	B3	B4
1				
2				●
3			●	●
4			●	
5		●	●	
6		●	●	●
7		●		●
8		●		
9	●	●		
10	●	●		●
11	●	●	●	●
12	●	●	●	
13	●		●	
14	●		●	●
15	●			●
16	●			

● INDICATES LOGIC HIGH
BLANK INDICATES LOGIC LOW

5 BIT, 32 AND 24 POSITION

Position	B0	B1	B2	B3	B4
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	●				

● INDICATES LOGIC HIGH
BLANK INDICATES LOGIC LOW

SPECIFICATIONS

Ratings

Operating Voltage: 5 ±.25V DC
Supply Current: 85 mA maximum at 5V DC
Life: 1 million cycles of operation; 1 cycle is rotation through all positions and a full return
Rotational Torque: 1.5 in-oz (Initial)
Output High: 3.8V minimum for CMOS & HCMOS; 2.7V minimum for TTL
Output Low: 0.8V maximum
Shaft Push Out Force: 25 lbs.
Mounting Torque: 10 in-lb maximum
Load Current: 5 mA maximum per channel
Logic Rise and Fall Times: 30 mSec typical

Environmental

Operating Temperature Range: -40°C to +85°C
Storage Temperature Range: -55°C to +100°C
Vibration: MIL-STD 202, method 204, condition B
Mechanical Shock: 100 g's, 6 ms, half Sine 12.3 ft/s and 100 g's, 6 ms, sawtooth, 9.7 ft/s
Humidity: 90-95% Relative humidity at 40°C for 96 hrs.

Materials and Finishes

Detent Housing: Stainless Steel
Bushing: Brass, tin/zinc plated
Shaft: Stainless steel
Detent Balls: Steel, nickel-plated
Code Housings: Nylon 6/10
Backplate: Nylon 6/10
Aperture: Chemically etched stainless steel with black oxide finish
Rotor: Electroformed nickel and chemically etched stainless steel with black oxide finish
Detent Springs: Tinned music wire
PC Boards: NEMA grade FR-4
Through Bolts: Stainless steel, unplated
Through Bolt Nuts: Stainless steel
Mounting Hardware: One brass, tin/zinc-plated nut and one stainless steel, zinc-plated lockwasher supplied with each switch. Nut is 0.094 inches thick by 0.562 inches across flats.

ORDERING INFORMATION

61A32-060

Series
Style: A = unsealed
Number of positions: 32 = 32 positions with 10" of throw
16 = 16 positions with 18" of throw
8 = 8 positions with 26" of throw

Termination: Cable Termination: 060=6.0 inches. Cable is terminated with Molex connector P/N 14-56-2074.

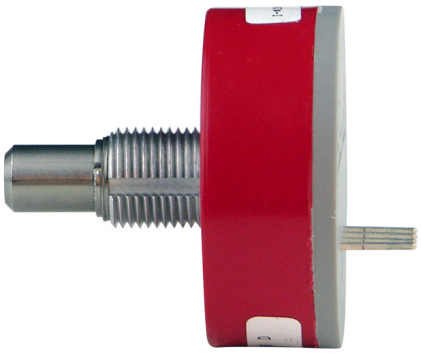
Available from your local Grayhill Component Distributor. For prices and discounts, contact a local Sales Office, an authorized local Distributor, or Grayhill.

SERIES 61K

High Resolution, 4-Pin

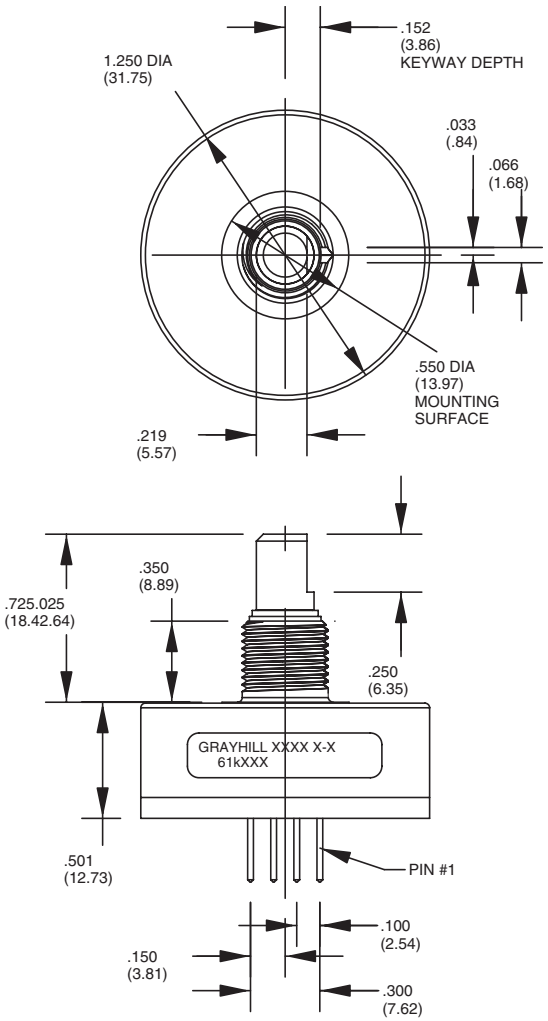
FEATURES

- 25, 32, 50, 64, 100, 128 and 256 Cycles per Revolution Available
- Sealed Version Available
- Rugged Construction
- Cable or Pin Versions
- 10 Million Rotational Life Cycles
- 300 RPM Shaft Rotation

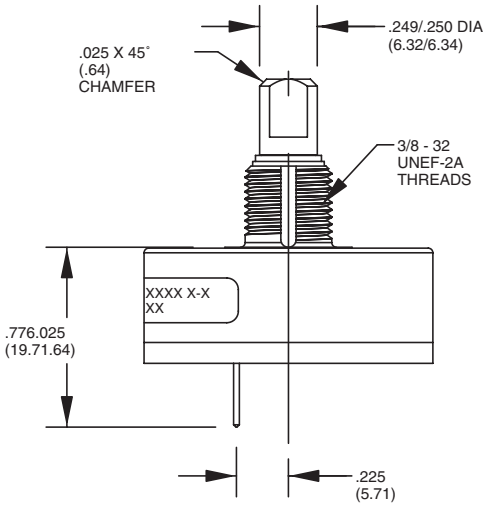


DIMENSIONS In inches (and millimeters)

Pin Version

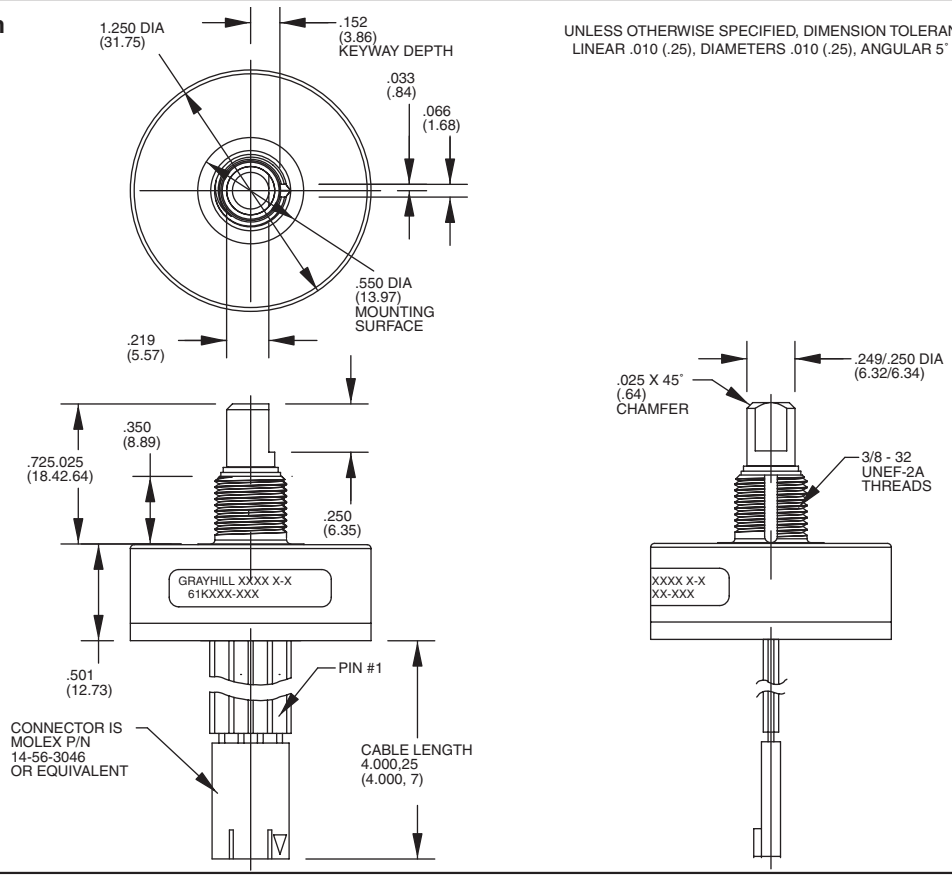


Unless otherwise specified, standard tolerance are:
Linear ± .010
Diameter ± .025
Angle ± 2.0°

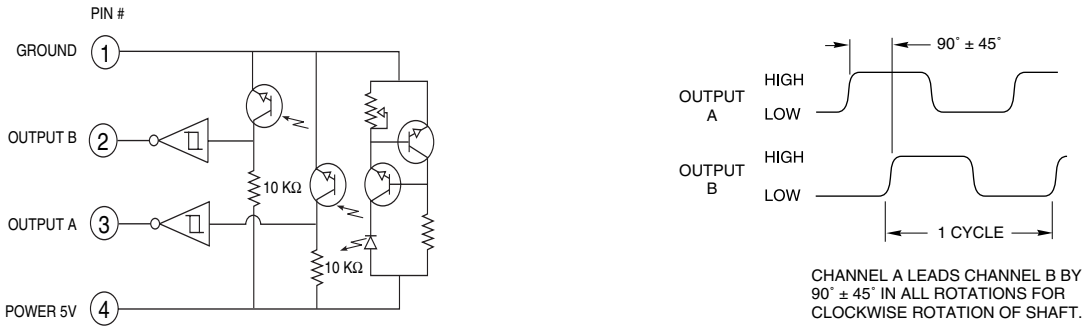


DIMENSIONS In inches (and millimeters)

Cable Version



CIRCUITRY, TRUTH TABLE, AND WAVEFORM: Standard Quadrature 2-Bit Code



SPECIFICATIONS

Electrical Ratings

Operating Voltage: 5.0 ±.25 Vdc
Supply Current: 30 mA maximum at 5 Vdc
Logic Output Characteristics:
Output Type: Open collector with integrated Schmitt Trigger and 10K ohms pull-up resistor
Maximum Sink Current: 16 mA at .40 volts
Power Consumption: 150 mW maximum
Optical Rise Time: 500 nS typical
Optical Fall Time: 16 nS typical

Mechanical Ratings

Mechanical Life: 10 million revolutions
Time Life: Guaranteed for 10 years of continuous operation (calculated from emitter degradation data)
Mounting Torque: 20 in-lbs maximum
Shaft Push Out Force: 100 lbs
Terminal Strength: 5 lbs terminal pull-out force minimum
Solderability: 95% free of pin holes and voids
Operating Torque: 1.5 in-oz maximum (no detents) for unsealed versions

Environmental Ratings

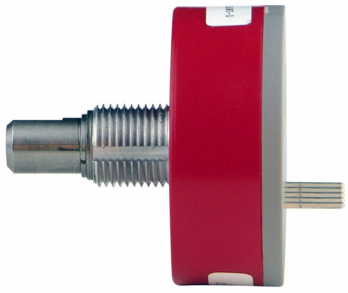
Operating Temperature Range: -40°C to 85°C
Storage Temperature Range: -55°C to 100°C
Relative Humidity: 90-95% at 40°C for 96 hours
Vibration Resistance: Harmonic motion with amplitude of 15g, within a varied 10 to 2000 Hz frequency for 12 hours per MIL-STD-202, Method 204
Mechanical Shock: Test 1: 100g for 6 mS, half-sine wave with velocity change of 12.3 ft/s. Test 2: 100g for 6 mS, sawtooth wave with velocity change of 9.7 ft/s.

SERIES 61R

High Resolution, 5-Pin (Polarized Connection)

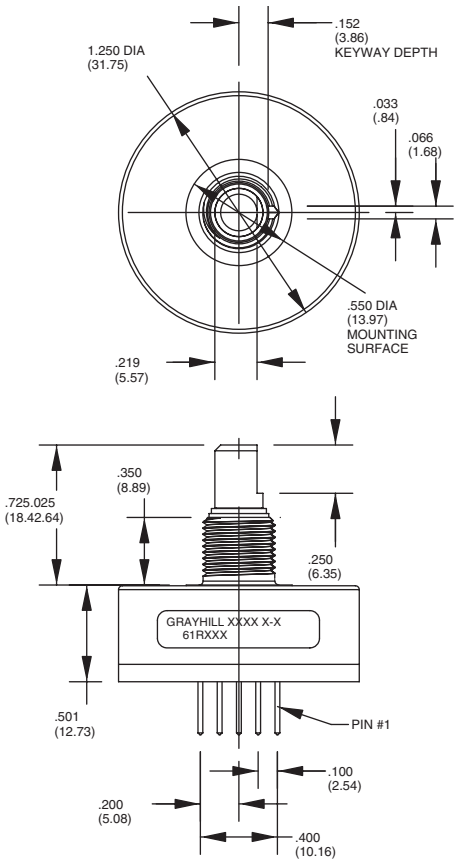
FEATURES

- 25, 32, 50, 64, 100, 128 and 256 Cycles per Revolution Available
- Sealed Version Available
- Rugged Construction
- Cable or Pin Version
- 10 Million Rotational Cycles
- 300 RPM Shaft Rotation
- Index Pulse Available

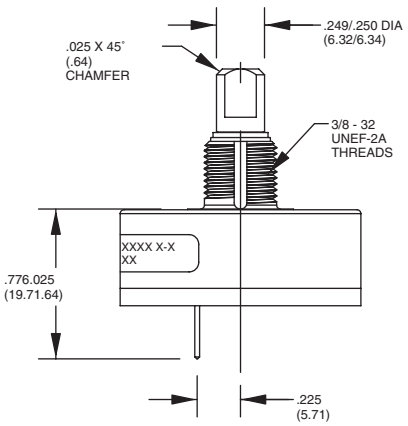


DIMENSIONS In inches (and millimeters)

Pin Version

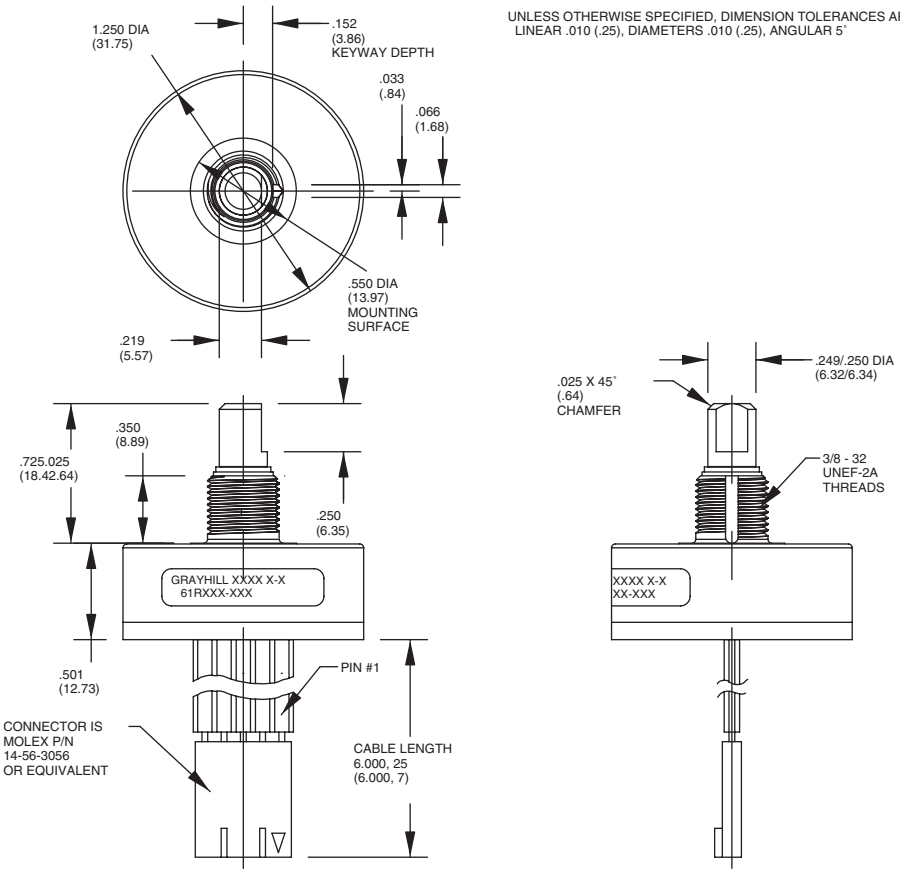


Unless otherwise specified, standard tolerance are:
Linear ± .010
Diameter ± .025
Angle ± 2.0°

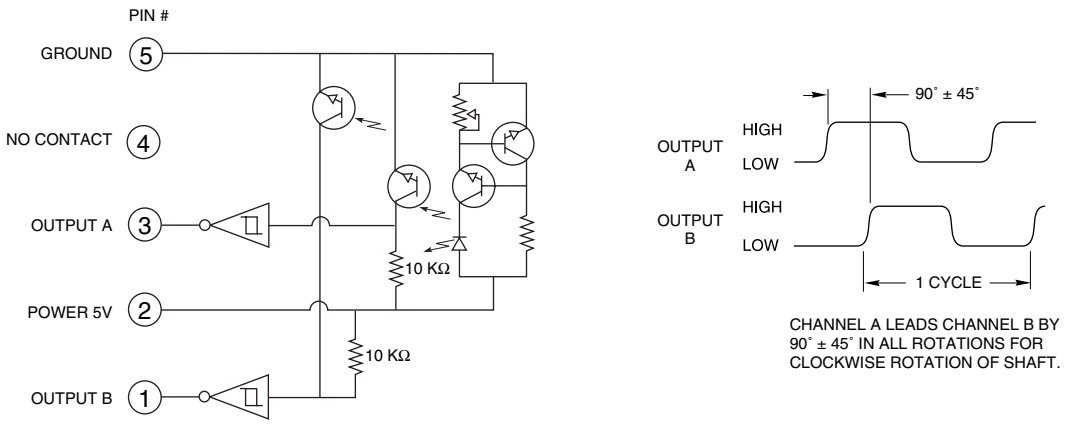


DIMENSIONS In inches (and millimeters)

Cable Version



CIRCUITRY, TRUTH TABLE, AND WAVEFORM: Standard Quadrature 2-Bit Code



SPECIFICATIONS

Electrical Ratings

Operating Voltage: 5.0 ±.25 Vdc
Supply Current: 30 mA maximum at 5 Vdc
Logic Output Characteristics:
Output Type: Open collector with integrated Schmitt Trigger and 10K ohms pull-up resistor
Maximum Sink Current: 16 mA at .40 volts
Power Consumption: 150 mW maximum
Optical Rise Time: 500 nS typical
Optical Fall Time: 16 nS typical

Mechanical Ratings

Mechanical Life: 10 million revolutions
Time Life: Guaranteed for 10 years of continuous operation (calculated from emitter degradation data)
Mounting Torque: 20 in-lbs maximum
Shaft Push Out Force: 100 lbs
Terminal Strength: 5 lbs terminal pull-out force minimum
Solderability: 95% free of pin holes and voids
Operating Torque: 1.5 in-oz maximum (no detents) for unsealed versions

Environmental Ratings

Operating Temperature Range: -40°C to 85°C
Storage Temperature Range: -55°C to 100°C
Relative Humidity: 90-95% at 40°C for 96 hours
Vibration Resistance: Harmonic motion with amplitude of 15g, within a varied 10 to 2000 Hz frequency for 12 hours per MIL-STD-202, Method 204

Shock Resistance: Test 1: 100g for 6 mS, half-sine wave with velocity change of 12.3 ft/s. Test 2: 100g for 6 mS, sawtooth wave with velocity change of 9.7 ft/s.

Materials and Finishes

Bushing: Aluminum
Code Housing: Hiloy 610B
Shaft: Stainless steel
Retaining Ring: Stainless steel
Code Rotor and Aperture: Chemically etched stainless steel/electroformed nickel
Printed Circuit Board: NEMA Grade FR-4. Five microinches minimum gold over 100 microinches minimum nickel over copper
Optical Barrier: Polyphenylene sulfide, 94 V-0
Backplate: Polyester
Header: Phosphor bronze, 200 microinches tin over 50 microinches nickel (pin version only)
Infrared Emitter: Gallium aluminum arsenide
Photo IC: Planar silicon
Cable: 26 AWG, stranded/tinned wire, PVC coated on .100 (2,54) centers (cable version only)

ORDERING INFORMATION

61RS256 – 060

Series
Style: K = Standard, 4-pin, high resolution
KS = Sealed, 4-pin, high resolution
R = Standard, 5-pin, high resolution
RS = Sealed, 5-pin, high resolution
Cycles: per channel per revolution = 25, 32, 50, 64, 100, 128, 256

Cable Termination: 060 = 6.0in. Cable is terminated with Molex Connector P/N 14-56-3056.

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

ACCESSORIES

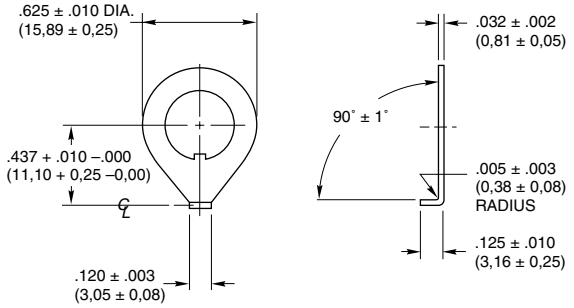
Non-Turn Washer

The Series 61 bushing is 3/8 inches in diameter and has a non-turn keyway to prevent rotation of the switch body when the panel is cut to fit. Another way to keep the switch from turning is to use a non-turn washer. The washer is cadmium-plated brass.
Part number: **12C1087-1**
Part number: **SHH694-11,** 302-2B stainless steel, no plating

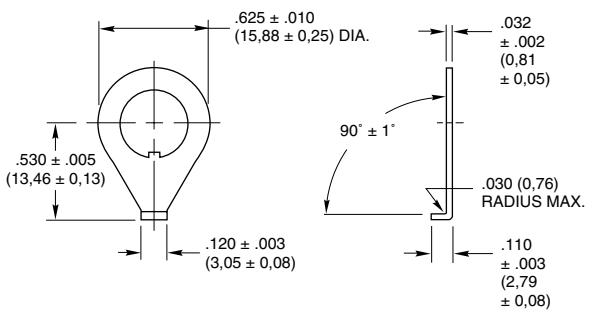
Shaft and Panel Seal

For shaft and panel seal version, the shaft is sealed by an o-ring inside the bushing. The panel is sealed by a flat gasket .045" thick at the base of the bushing. The panel seals will increase the behind panel dimension by .020" to .040", when the switch is mounted. The panel seal is silicon rubber.

DIMENSIONS In inches (and millimeters)



Part Number: **12C1087-1**



Part Number: **SHH694-11**

SERIES 65
Optical Encoder Interface

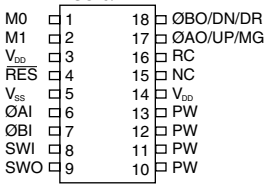
FEATURES
- Interfaces with all Grayhill and Most Standard Quadrature Optical Encoders
- Power Reduction of Up to 75-90% in Optical Encoder Use Through Power Management Feature
- User Selectable Output Modes: Magnitude/Direction, Up/Down, Standard Quadrature
- Simplified Microprocessor Interface Reduces Design Time
- Debounces Encoder Integral Pushbutton Switch
- Ideal for Battery Powered Applications that Include Optical Encoders

DESCRIPTION
The GH65C11-X is designed to receive input from standard quadrature optical encoders. The power management feature allows power to the encoder to be applied only during sampling intervals, thus conserving power (especially advantageous in battery powered systems). Sample rate is a nominal 4K per second allowing high speed quadrature input. The optical encoder interface can operate in 1 of 3 user-selectable output modes. These modes are: magnitude and direction, up and down count, and standard quadrature. Debouncing of an integral pushbutton switch within the optical encoder can also be accomplished.

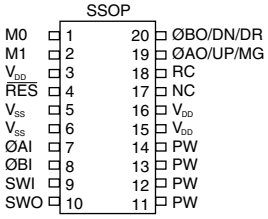
Name	Type*	Description
M0, M1	I	Mode selection input pins
V_{DD}	P	3–6 Vdc power source
$\overline{RES}$	I	Reset pin, normally connected to V_{DD}
V_{SS}	P	GND, 0v nominal power return
ØAI, ØBI	I	Phase A and B quadrature input pins
SWI	I	Switch input pin
SWO	O	Debounced switch output pin
NC	O	No connect, this pin must be left unconnected
PW	O	Power source for encoder power management
RC	I/O	RC oscillator pin
ØBO/DN/DR	O	Phase B, down, direction, mode conditional output pin
ØAO/UP/MG	O	Phase A, up, magnitude, mode conditional output pin

* Pin Types: I = Input, O = Output, P = Power.

SOIC/DIP



SSOP



ORDERING INFORMATION

GH65C11-X-YY

Temperature:
C = Commercial (0° C to 70° C)
N = Industrial (-40° C to 85° C)

Packaging:
PD = 18 lead 300 mil wide Plastic DIP
SO = 18 lead 300 mil wide gull wing SOIC
SS* = 20 lead SSOP

* The SS package style is not available in the -40°C to 85°C temperature range.

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

For additional information about the use of the GH65 interface chips with optical encoders request Grayhill Application Note #719.

Grayhill, Inc. • 561 Hillgrove Avenue • LaGrange, Illinois 60525-5997 • USA • Phone: 708-354-1040 • Fax: 708-354-2820 • www.grayhill.com

SERIES 61M

Optically Coupled for Simulated Mechanical Rotary Switch Output

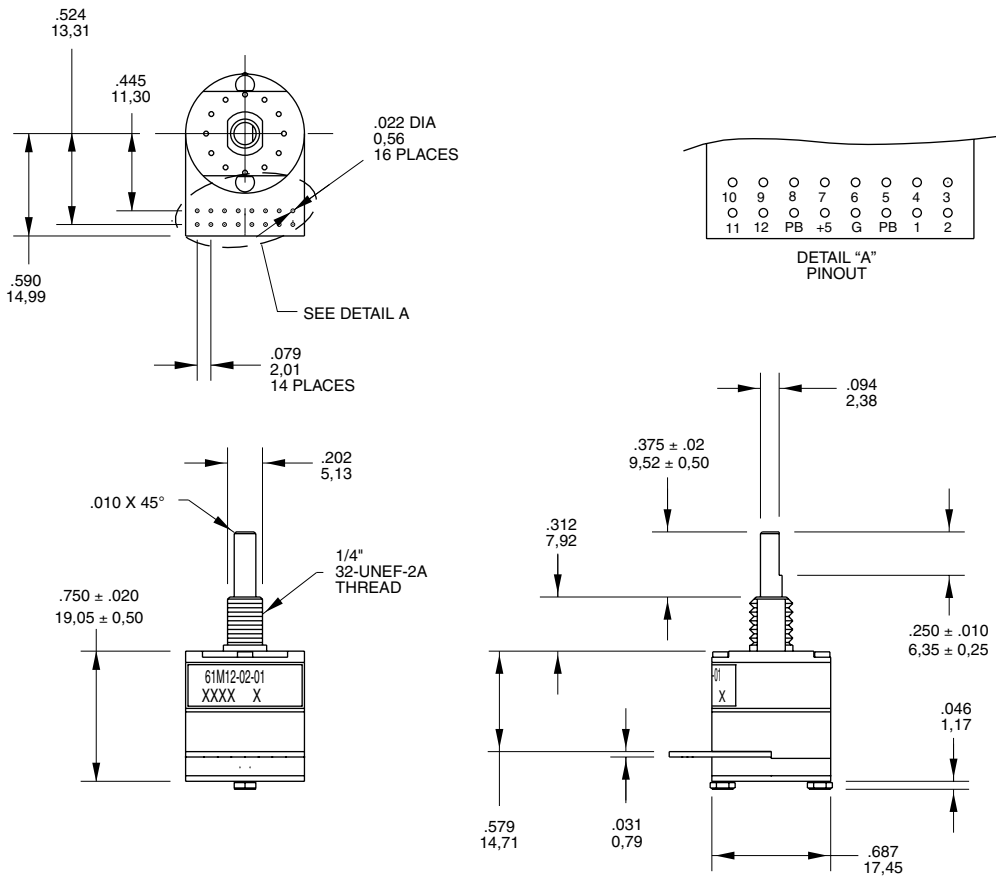
FEATURES

- Optical Alternative to Rotary Contacts
- One Pulse Per Detent Position Per Rotation
- Long Life of a Million Cycles
- With or Without Pushbutton
- Continuous Rotation and Fixed Stops Available
- Rugged Construction
- 8, 10 and 12 Positions Available

Applications

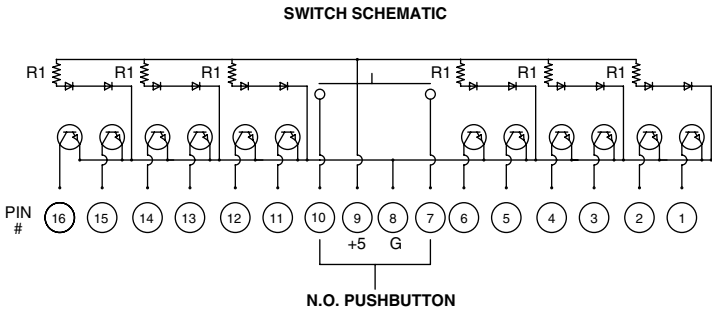
- Avionics
- Any application requiring rotary switch output and the increased reliability of an optical device

DIMENSIONS In inches (and millimeters)



Unless otherwise specified, standard tolerance is ±.010 (0,25).

CIRCUITRY, TRUTH TABLE, AND WAVEFORM Standard Quadrature 2-Bit Code



Note: External pull-up resistors required for operation. 20kÝ is suggested.

POSITION	PIN NUMBER											
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12
1	•											
2		•										
3			•									
4				•								
5					•							
6						•						
7							•					
8								•				
9									•			
10										•		
11											•	
12												•

Note:
Blank Indicates high state
• Indicates low state
Code repeats every 12 positions

SPECIFICATIONS

Pushbutton Ratings

Operating Voltage: 5 Vdc, 60mA maximum, resistive
Contact Resistance: Less than 10 Ohms
Voltage Breakdown: 250 Vac between mutually insulated parts
Contact Bounce: Less than 4 mS at make and less than 10 mS at break
Actuation Life: 3,000,000 operations
Actuation Force: Maximum actuation force of 650 grams and a minimum force of 300 grams
Pushbutton Travel: .010/.025

Mechanical Ratings

Life Expectancy: 1 million cycles of operation; (1 cycle=360° rotation and return)
Rotational Torque: 10 in-oz. ±3 in-oz. customs also available.
Shaft Pushout Force: 50 lbs. minimum
Mounting Torque: 20 in-lbs. maximum

Switch Ratings

Output: One pulse per position per rotation (360 degrees CW/CCW)
Operating Voltage: 5.0 ± .25 Vdc
Supply Current: 60mA maximum at 5 Vdc
Logic High: 3.8V minimum
Logic Low: .8V minimum
Logic Rise and Fall Time: 30mS Typ.

Environmental

Operating Temperature Range: -40°C to +85°C
Storage Temperature Range: -55°C to + 100°C
Vibration: MIL-STD 202, Method 204, Condition B
Mechanical Shock: 100g's, 6 ms, Half Sine, 12.3 ft/s and 100g's, 6 ms, Sawtooth, 9.7 ft/s
Humidity: 90-95% Relative Humidity at 40°C for 96 hours

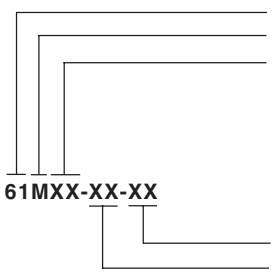
Materials and Finishes

Code Housing: Nylon (Red) Hiloy 610
Detent Housing: Stainless Steel
Rotor: Reinforced Thermoplastic, 30% Glass Filled Polyester
Bushing: Zinc Die Cast, Cadmium Plated
Shaft: Stainless Steel
Detent Balls: 302 Stainless Steel
Through Bolts: 305 Stainless Steel
Through Bolt Nuts: Stainless Steel
Printed Circuit Boards: NEMA Grade FR-4
Terminals: Copper Alloy
Aperture: Chem Etched Stainless Steel and/or Electroformed Nickel
Dome Retainer: Thermoplastic
Mounting Hardware: One Brass, cadmium-plated nut and lockwasher supplied with each switch

OPTIONS

Contact Grayhill for customer application needs.

ORDERING INFORMATION



Series
"M" Style
Angle of Throw: Detent
08 = 45° or 8 positions
10 = 36° or 10 positions
12 = 30° or 12 positions

Termination: 01 = without terminal pins, 02 = with terminal pins
Pushbutton Option: 01 = without P.B., 02 = with P.B.

Custom materials, styles, colors, and markings are available. Control knobs available.

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

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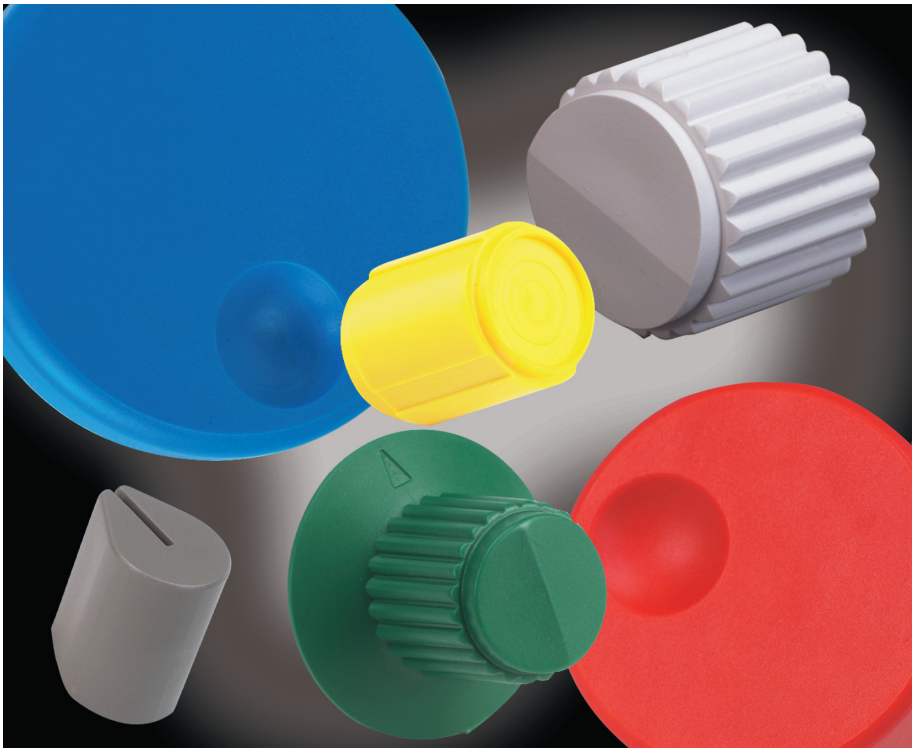
CONTROL KNOBS

Ideally Suited for Encoder and Rotary Switches



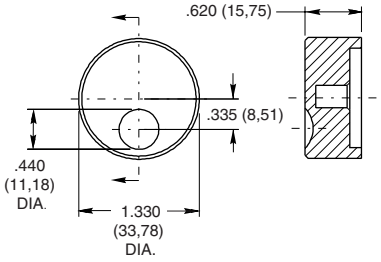
FEATURES

- 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

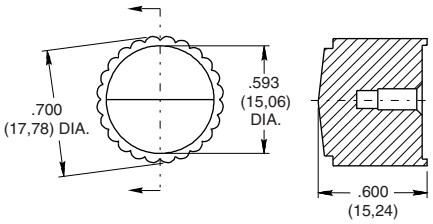
DIMENSIONS In inches (and millimeters)

Style 5013 **Top View**

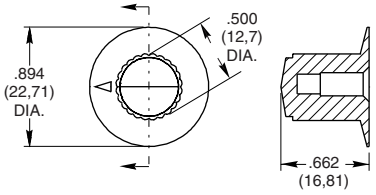


Available in .250 Dia. Shatt only.*

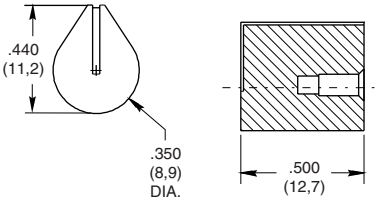
Style 5014 **Top View**



Style 5015 **Top View**



Style 5017 **Top View**

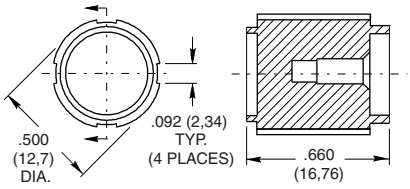


Available in .125 and .157 (4mm) dia. shaft in spring clip (press-on) version only.*

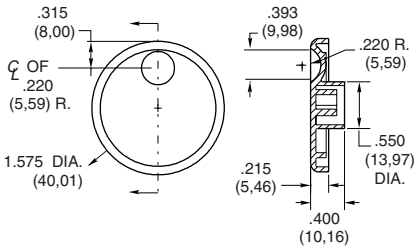
*See Ordering Information.

DIMENSIONS In inches (and millimeters)

Style 5019 **Top View**

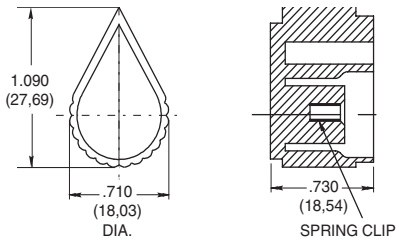


Style 5020 **Top View**

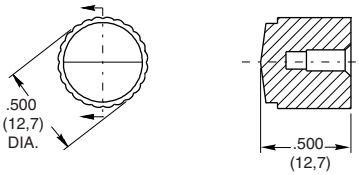


Available in ABS, .250 dia. shaft in spring clip (press-on). The locking clip is also available, requires a custom shaft.**

Style 5028 **Top View**



Style 5029 **Top View**



*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.