
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

Page

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.

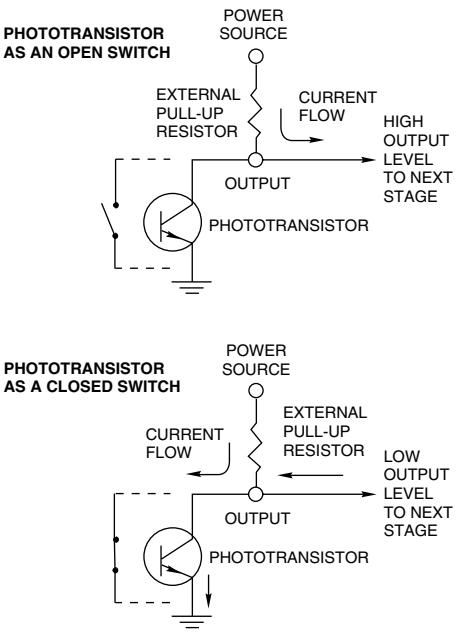
SCHMITT TRIGGERS

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.

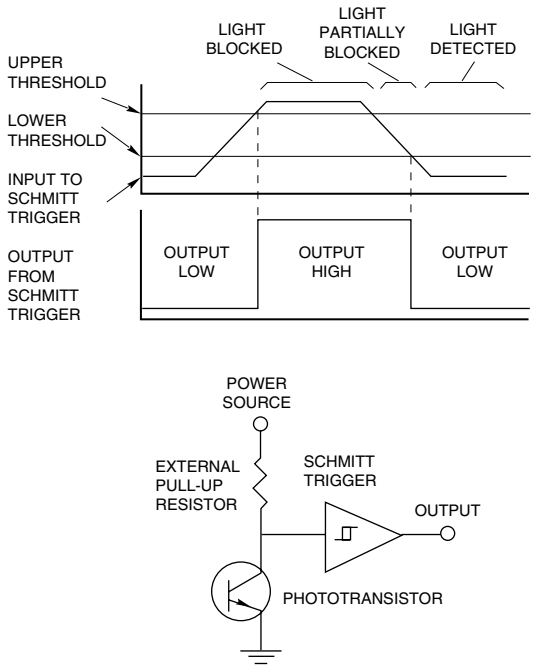
SHAFT AND PANEL SEAL

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



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SERIES 62S

Compact 1/2" Package

FEATURES

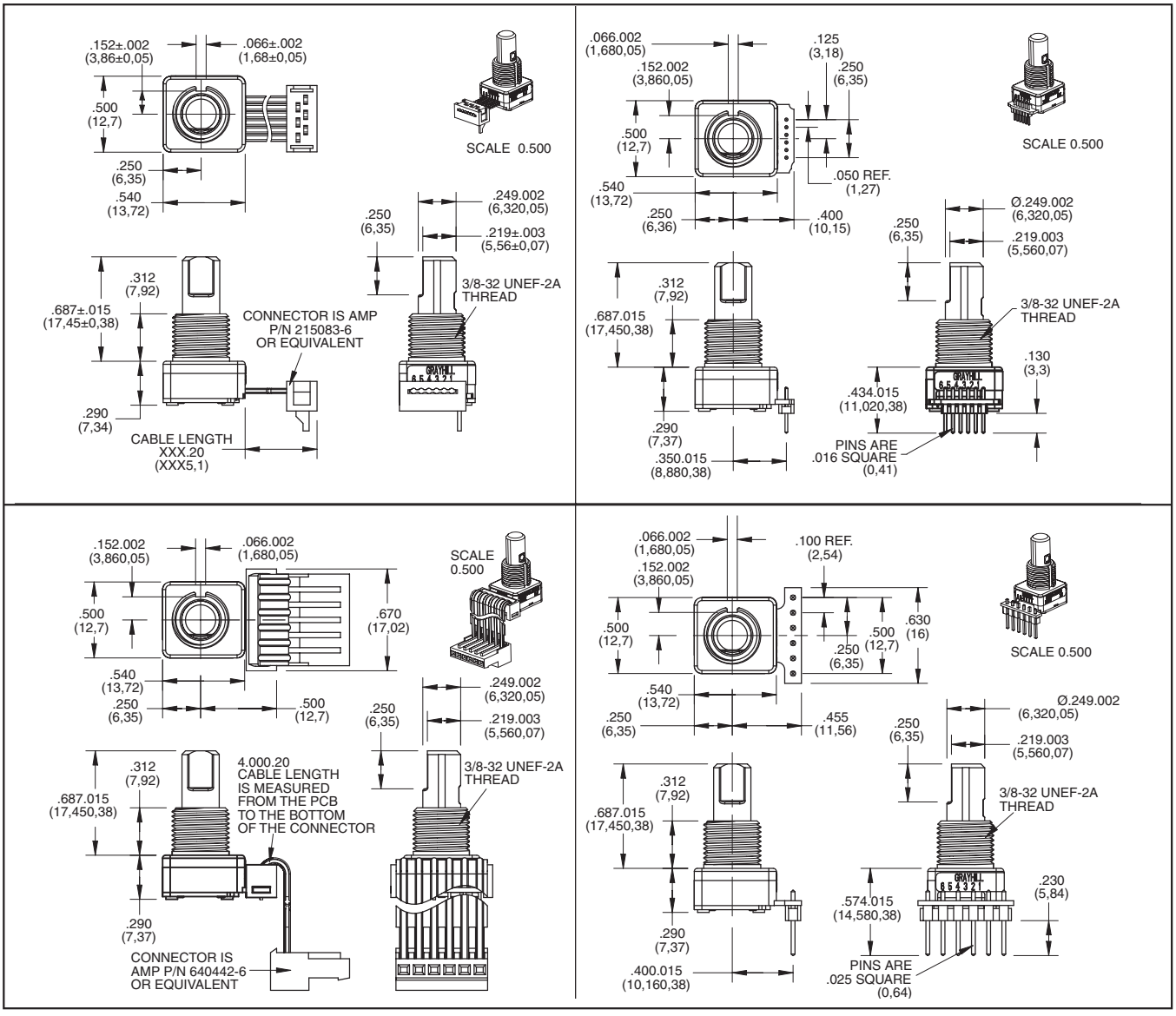
- Compact Size, Requires Minimal Behind Panel Space
- 1/2 Million Rotations for High Torque
- 1 Million Rotational Cycles, 3 Million for Non-Detent Styles
- Optional Integral Pushbutton
- Choices of Cable Length and Terminations

APPLICATIONS

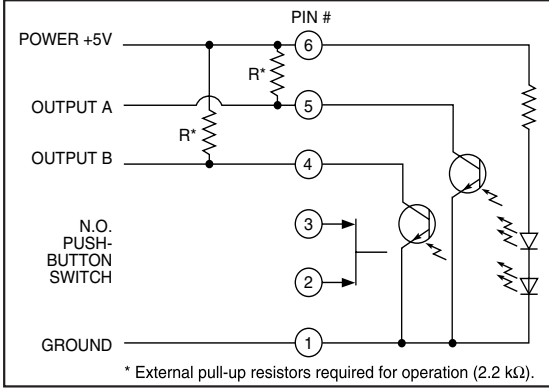
- Global Positioning/Driver Information Systems
- Medical Equipment

DIMENSIONS In inches (and millimeters)

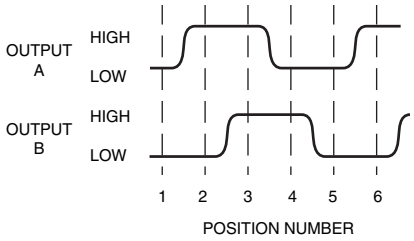
Unless otherwise specified, standard tolerance is ±.010 (0,25)



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



* 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.

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

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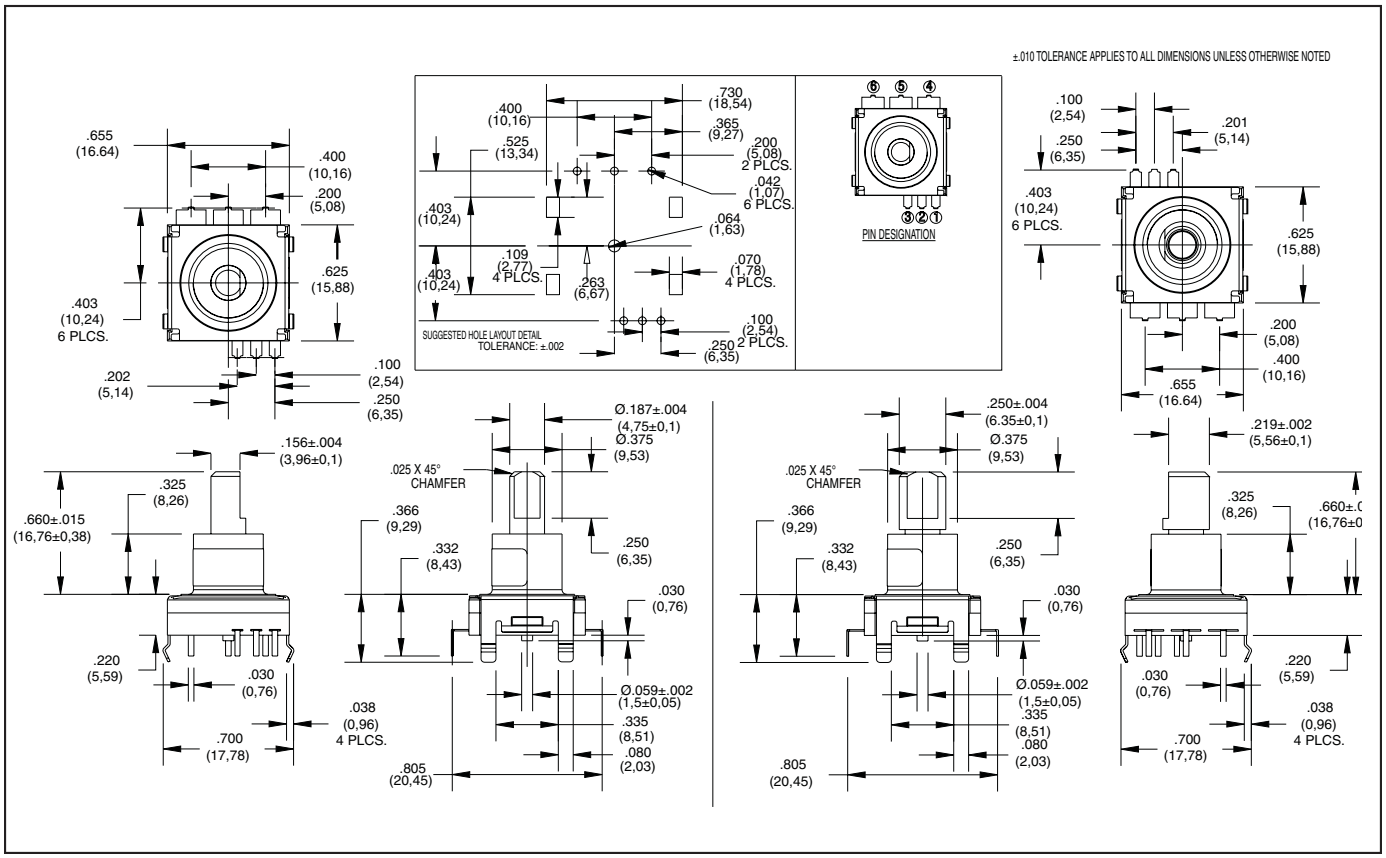
SERIES 62P
Low Cost, PC Mount

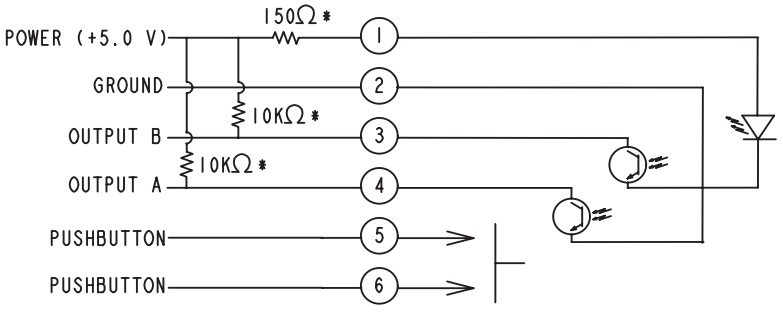
FEATURES
- Low Cost
- Compact Size
- PC Mount
- No De-Bouncing Required
- Reliable, Up to 2 Million Cycles
- Choice of Detent and Pushbutton Force
- Available in 16 Positions
- Quadrature Output

APPLICATIONS
- Automotive Controls
- White Goods
- Audio

DIMENSIONS In inches (and millimeters)

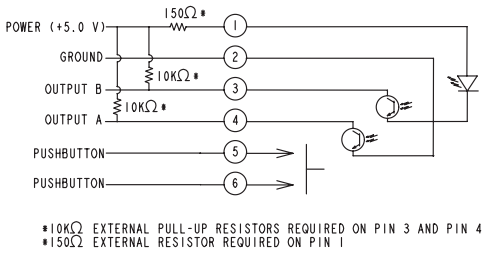


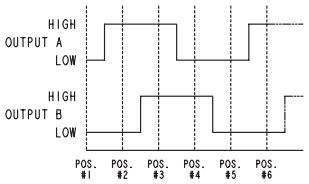
CIRCUITRY



*10KΩ EXTERNAL PULL-UP RESISTORS REQUIRED ON PIN 3 AND PIN 4
*150Ω 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 LOW
○ 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

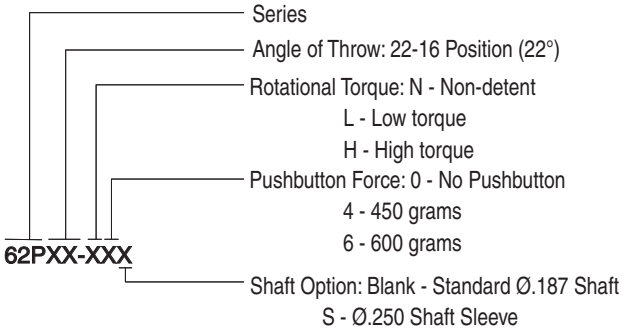
Environmental Ratings

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

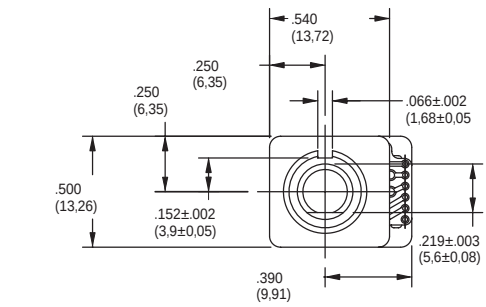
- Low Cost
- Long Life
- Available in 3.3 or 5.0 Vdc Operating Voltages
- High Torque Version to Emphasize Rotational Feel
- Economical Size
- Optically Coupled for More than a Million Cycles
- Optional Integral Pushbutton
- Compatible with CMOS, TTL and HCMOS Logic
- Available in 12,16, 20, 24 and 32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

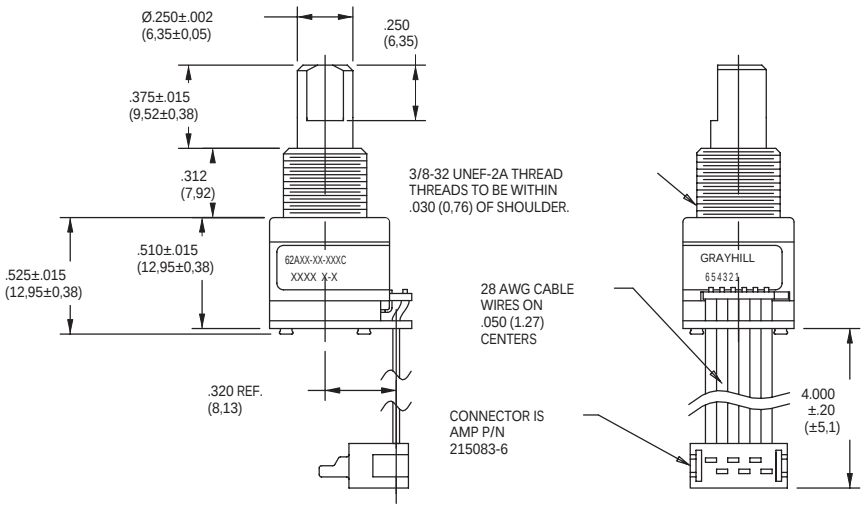
APPLICATIONS

- Global Positioning/Driver Information Systems
- Medical Equipment

DIMENSIONS In inches (and millimeters)

Cable Version

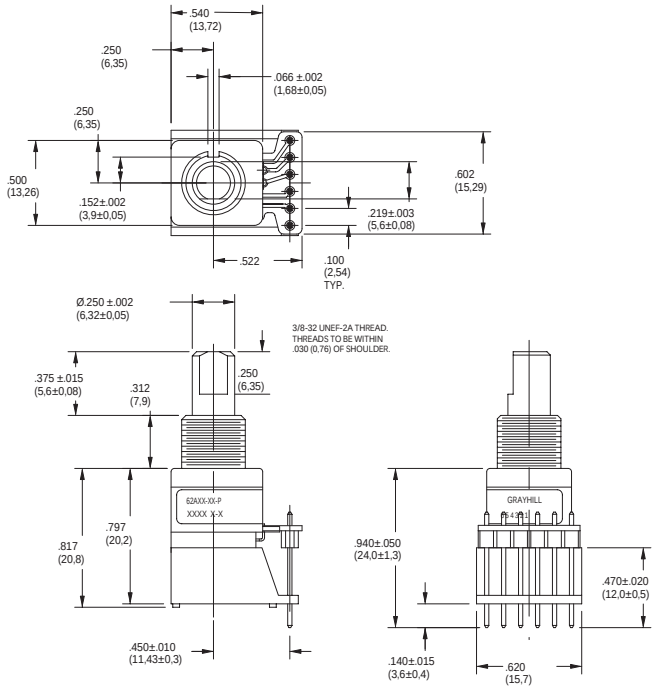




DIMENSIONS In inches (and millimeters)

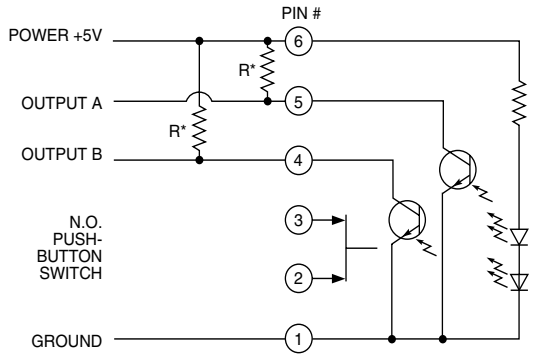
Pin Version

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)

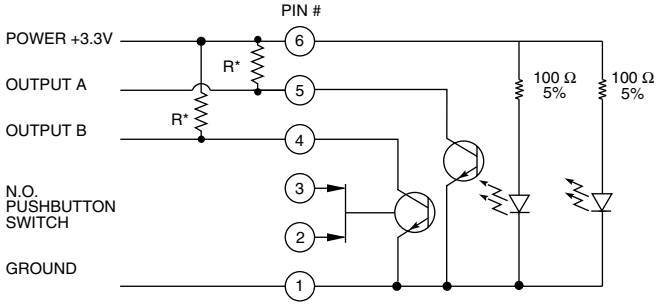


* External pull-up resistors required for operation (2.2 kΩ).

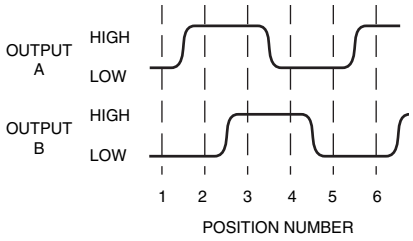
Clockwise Rotation		
Position	Output A	Output B
1		
2	●	
3	●	●
4		●

● 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: Phospher 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 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).

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

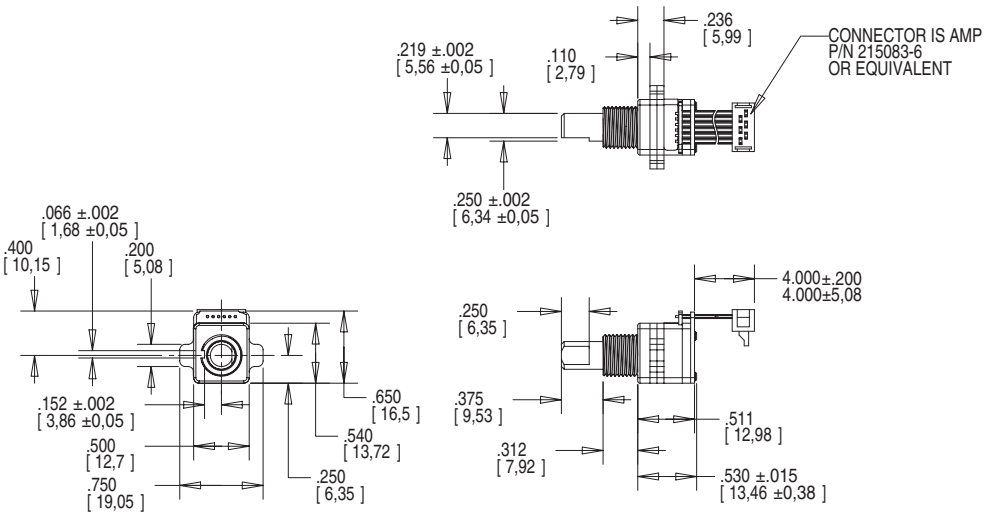
FEATURES
- High Rotational Torque Provides Positive Tactile Feedback
- Optically Coupled for More than a Million Cycles
- Optional Integral Pushbutton
- Compatible with CMOS, TTL and HCMOS Logic
- Available in 8,12 and 16 Detent Positions
- Choice of Cable Length and Terminations

APPLICATIONS
- Avionics

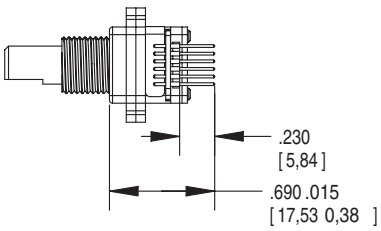
DIMENSIONS In inches (and millimeters)

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

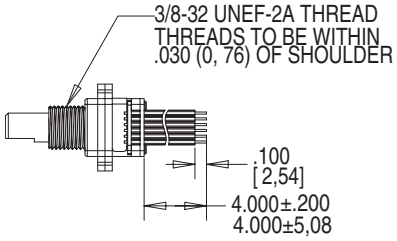
Cable Version



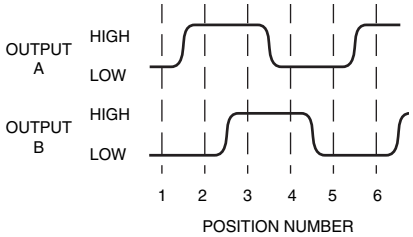
Pin Version



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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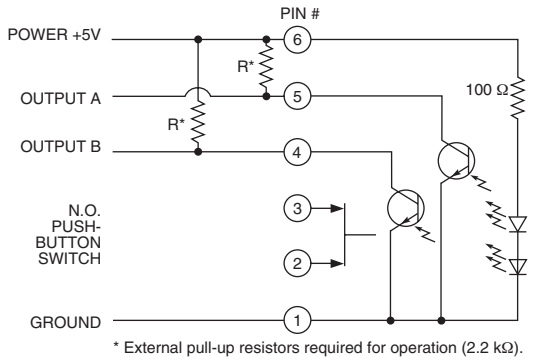
CIRCUITRY



* 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

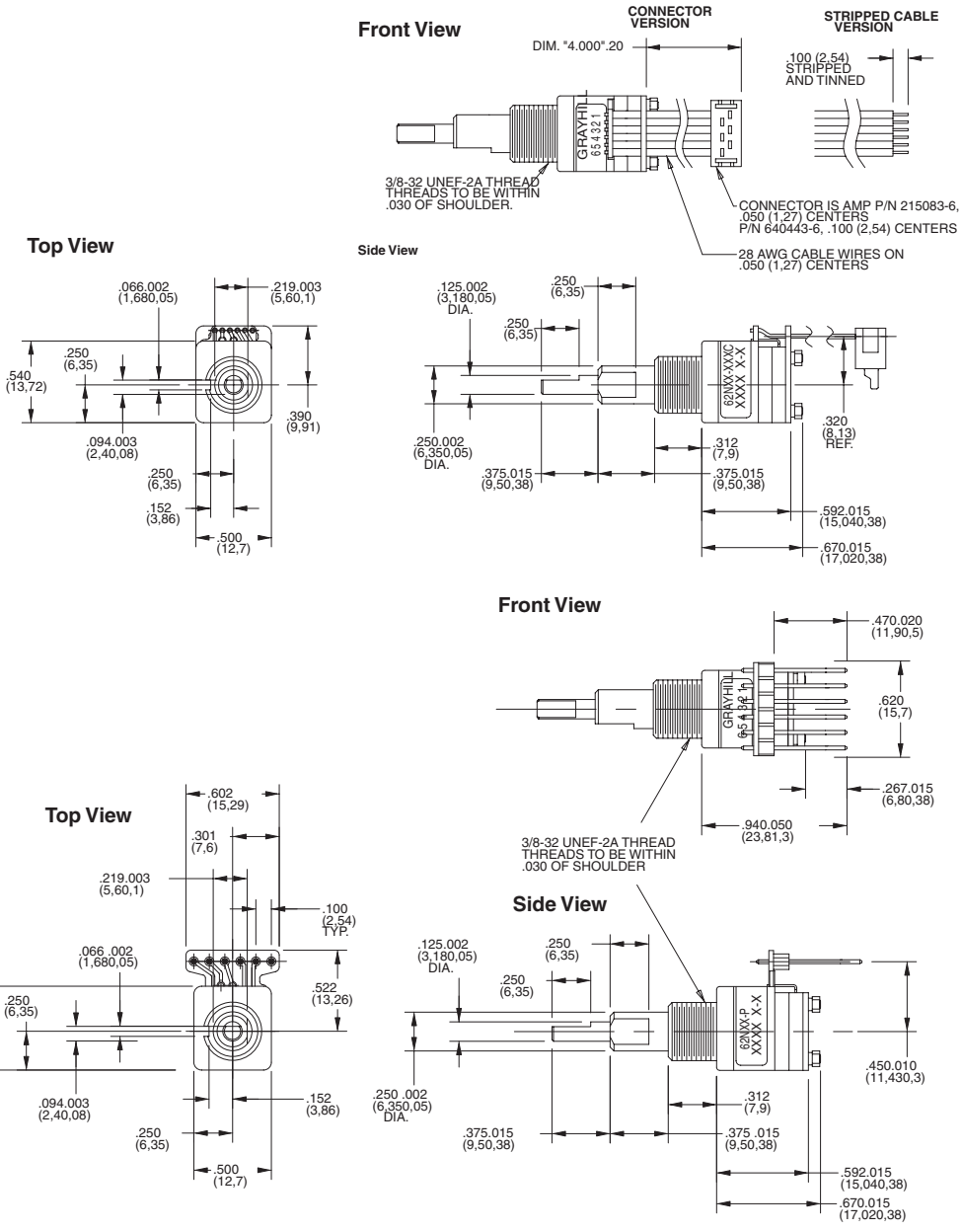
- Non-turn Pushbutton to Ensure Pushbutton Text and Orientation
- Seperate Pushbutton Function
- Low Cost
- Economical Size
- Optically Coupled for More than a Million Cycles
- Compatible with CMOS, TTL and HCMOS Logic
- Available in 12, 16, 24, and 32 Detent Positions (Non-detent Also Available)
- Choices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

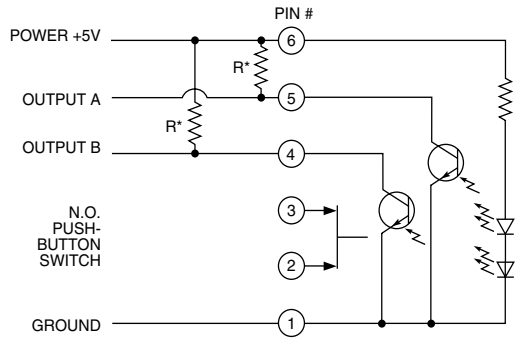
Environmental Ratings

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

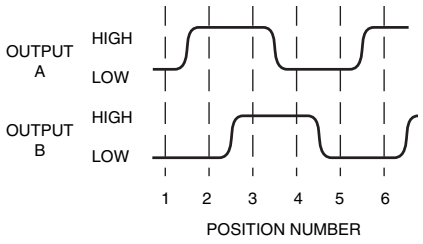
CIRCUITRY, TRUTH TABLE, AND WAVEFORM Standard Quadrature 2-Bit Code



* 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

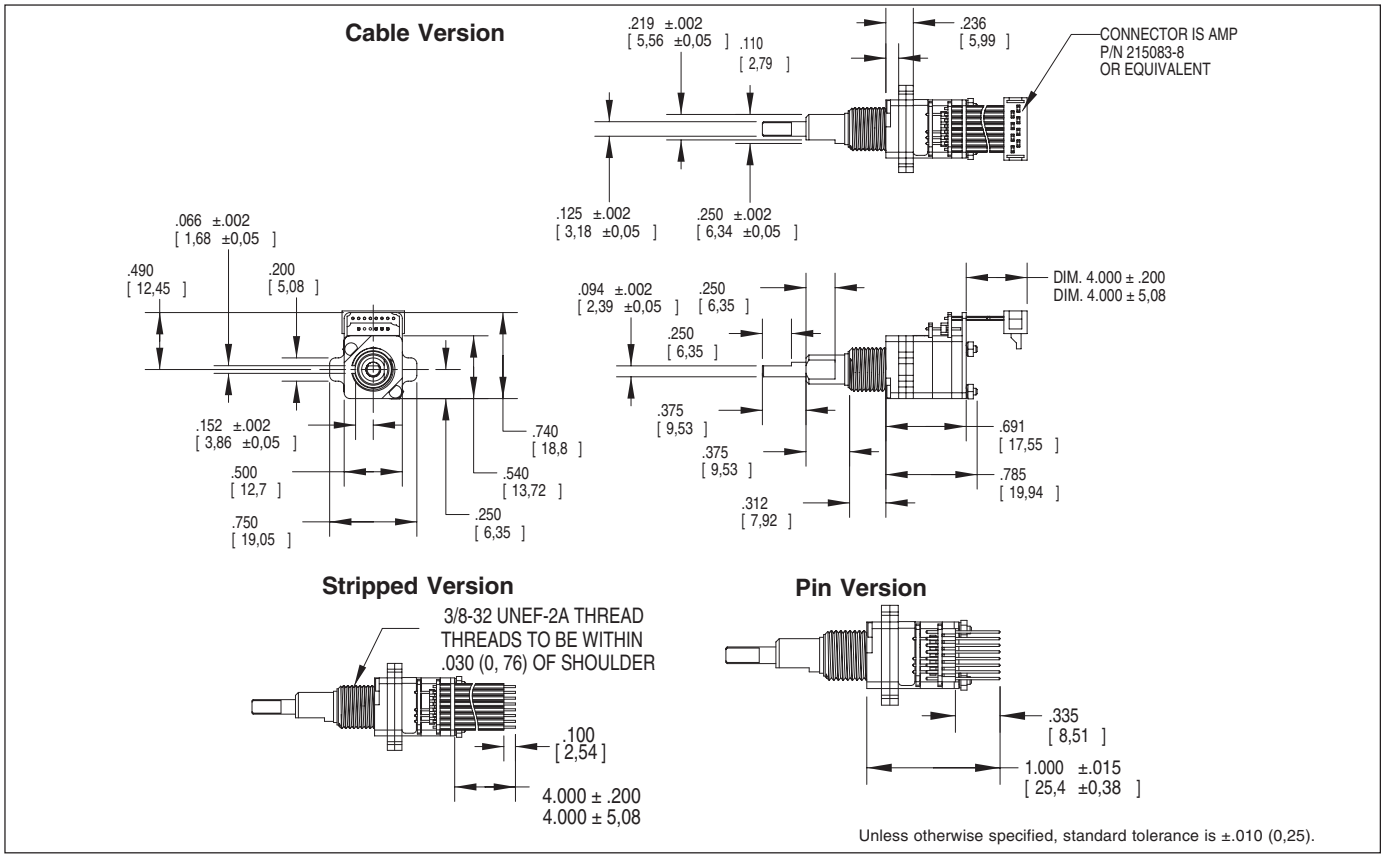
FEATURES

- 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

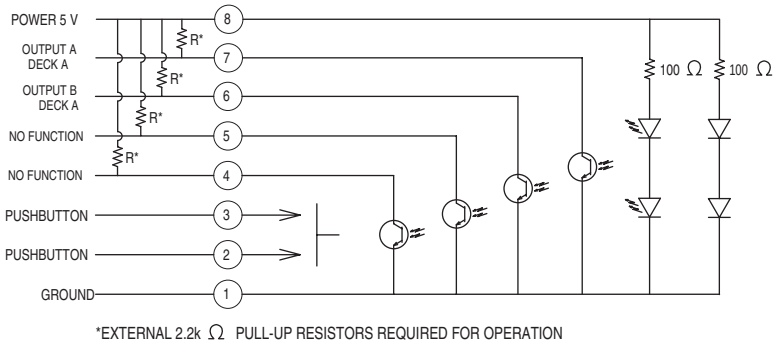
- Avionics

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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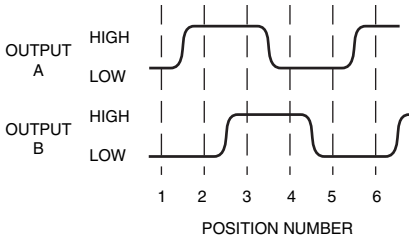
WAVEFORM AND TRUTH TABLE



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

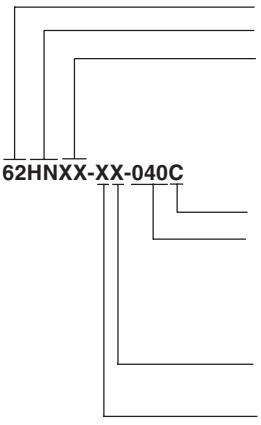
Environmental Ratings

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.

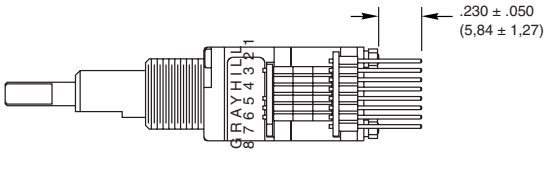
SERIES 62C
Concentric Shaft

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)

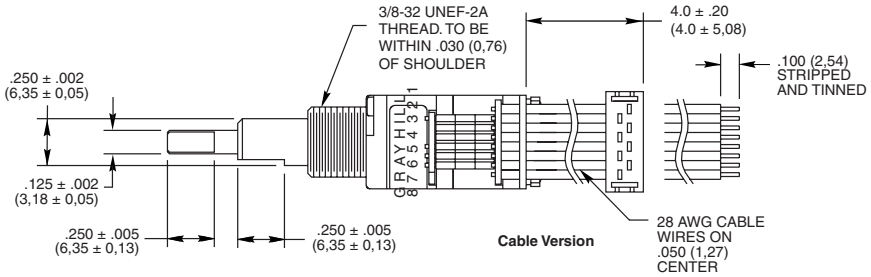
APPLICATIONS
- Used to Set Radio Frequency, Drill Depth, RPM, Menu Selection, Parameter Selection for Patient Monitoring Devices, etc.

DIMENSIONS In inches (and millimeters)

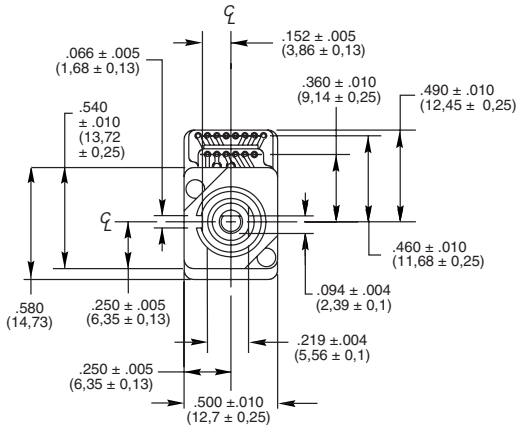
Unless otherwise specified, standard tolerance are:
Linear ± .025
Diameter ± .010
Angle ± 2.0°

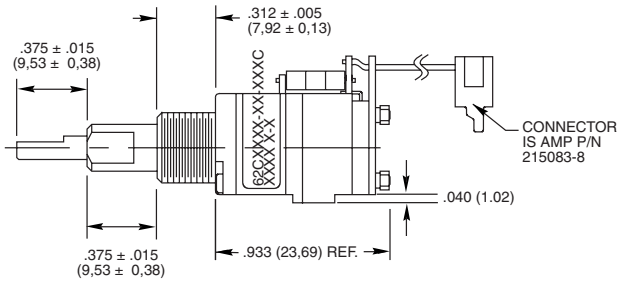


Pin Version

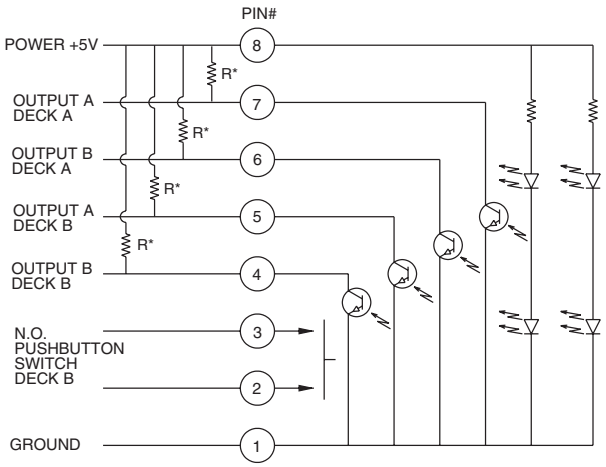


Cable Version





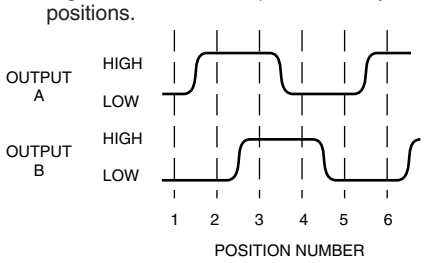
CIRCUITRY, TRUTH TABLE AND WAVEFORM: Standard Quadrature 2-Bit Code



* 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

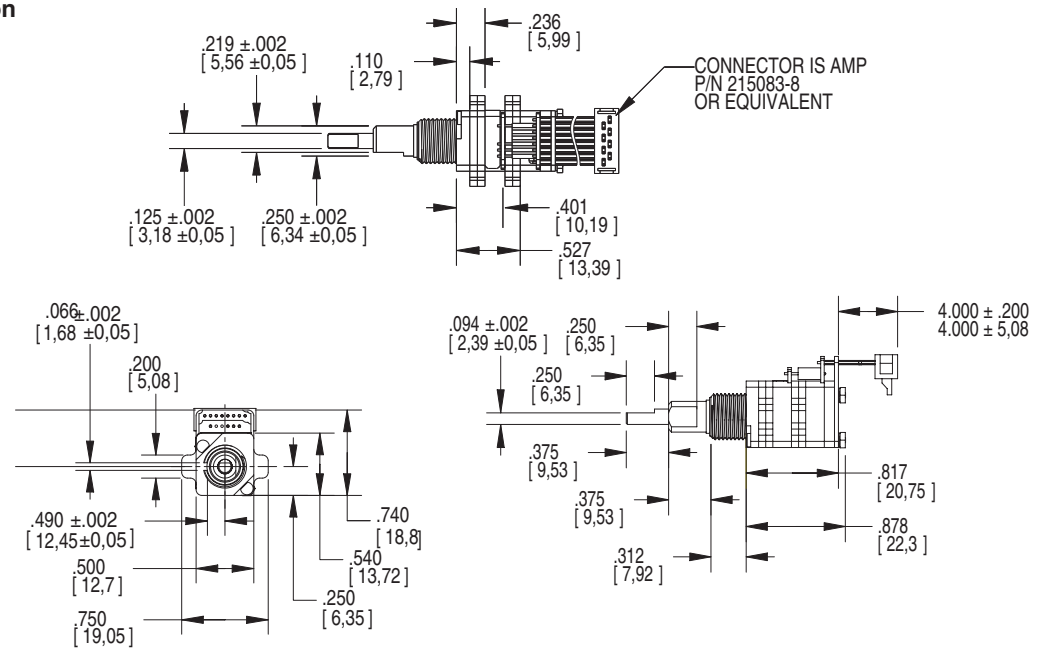
- High Rotational Torque Provides Positive Tactile Feedback
- Optically Coupled for More than a Million Cycles
- Optional Integral Pushbutton
- Compatible with CMOS, TTL and HCMOS Logic
- Available in 8,12 and 16 Detent Positions
- Choice of Cable Length and Terminations

APPLICATIONS

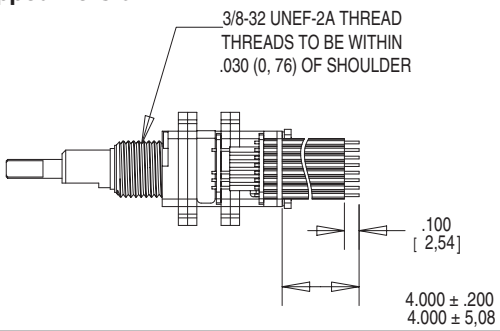
- Avionics

DIMENSIONS In inches (and millimeters)

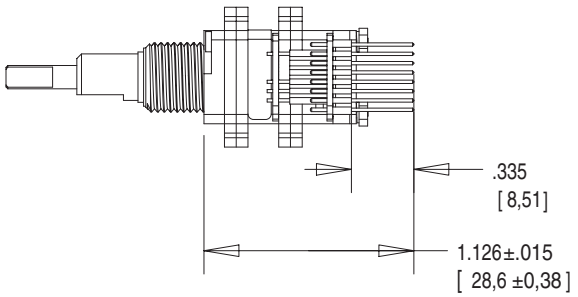
Cable Version



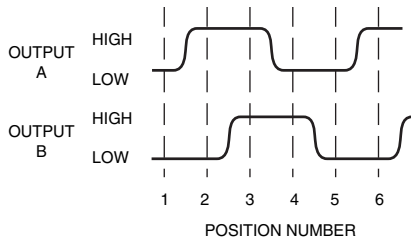
Stripped Version



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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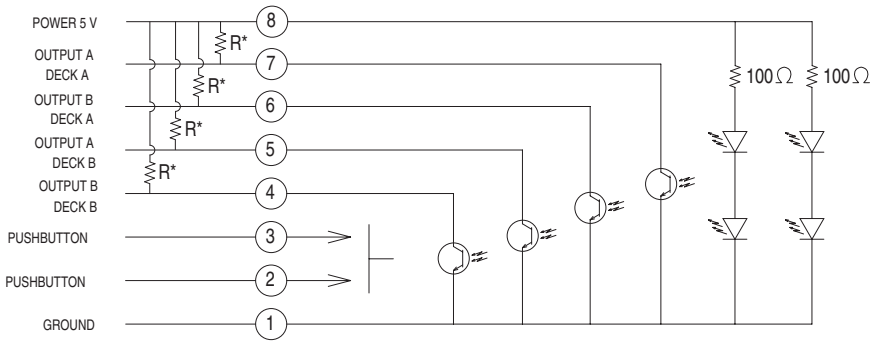
CIRCUITRY



*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

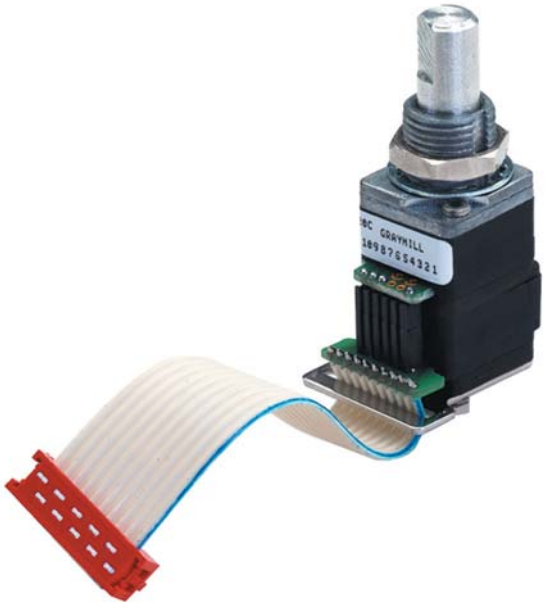
62HXXXX-XX-040C

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.
**Pushbutton Option:* Eliminate cable length if ordering pins.* (Ex: 62H2222-H9-P)
0 = w/o pushbutton, 9 = 1100g pushbutton
Rotational Torque: H = High Torque

SERIES 62R

1/2" Package, Redundant Circuitry



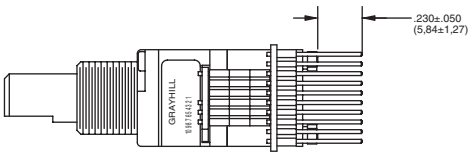
FEATURES

- 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

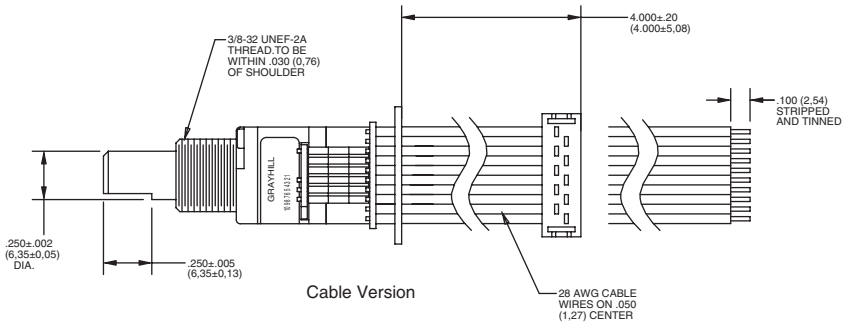
APPLICATIONS

- Cockpit Controls
- Medical Equipment

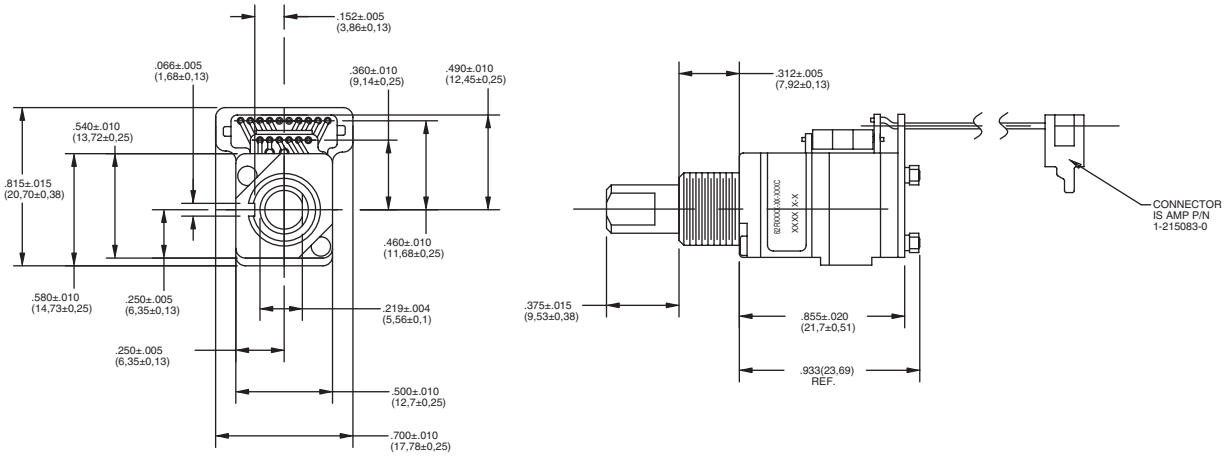
DIMENSIONS In inches (and millimeters)



Pin Version



Cable Version



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

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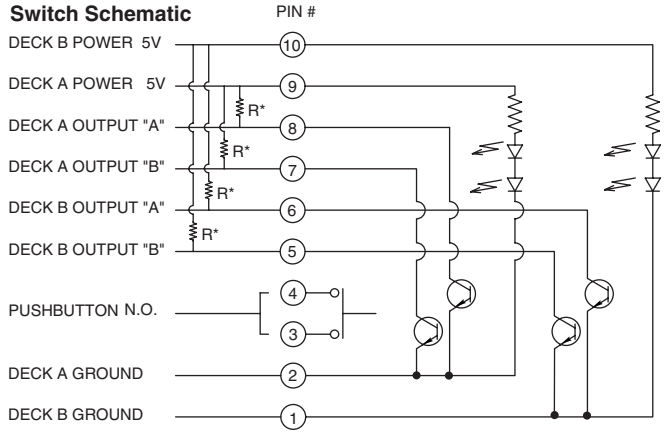
CIRCUITRY, TRUTH TABLE, AND WAVEFORM Standard Quadrature 2-Bit Code

Switch Schematic



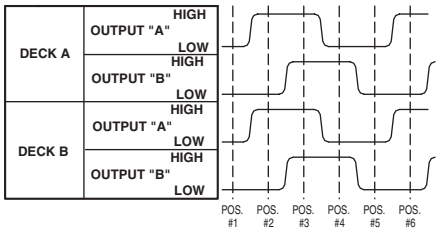
* 2.2k EXTERNAL PULL-UP RESISTORS REQUIRED FOR OPERATION

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

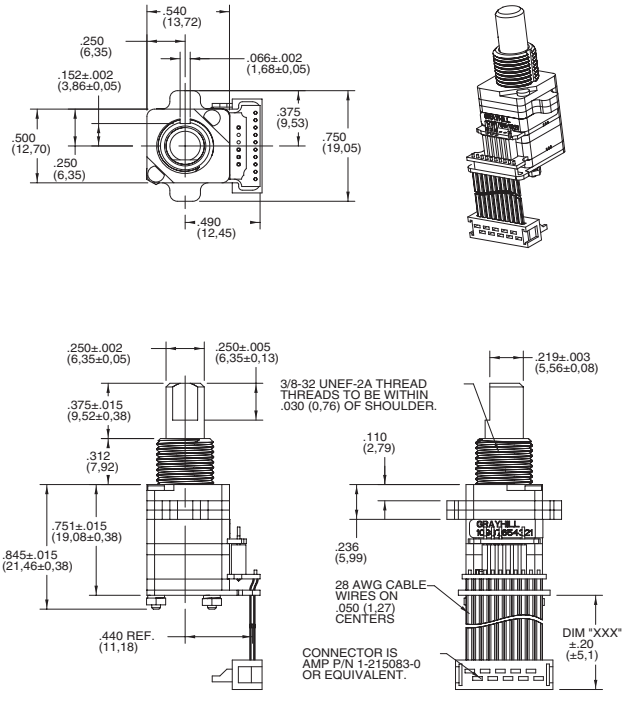
- Redundant Circuitry
- 1 Million Rotational Cycles
- Compatible with CMOS, TTL and HCMOS Logic
- Optional Integral Pushbutton
- Available in 8, 12, and 16 Detent Positions
- Choices of Cable Length and Terminations
- Ideal for Critical Applications

APPLICATIONS

- Cockpit Controls
- Medical Equipment

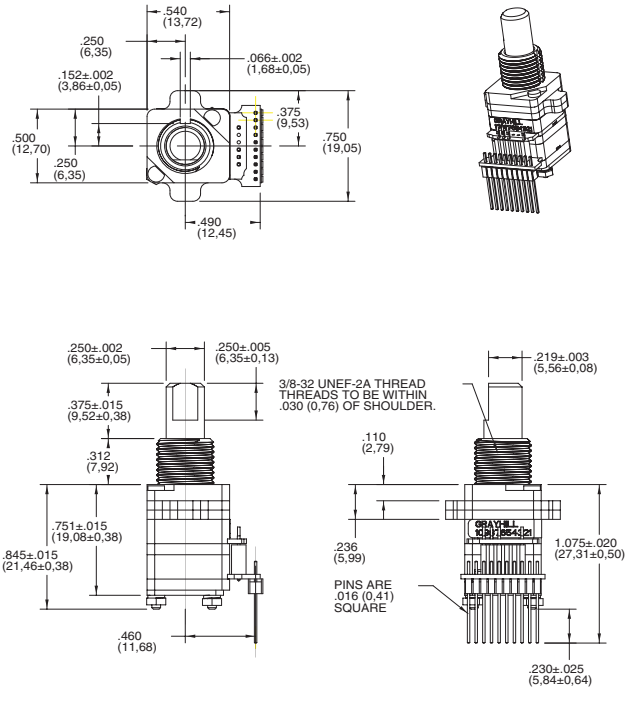
DIMENSIONS In inches (and millimeters)

SERIES 62HR WITH .050 CENTER RIBBON CABLE



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

SERIES 62HR WITH .050 CENTER TERMINAL PINS

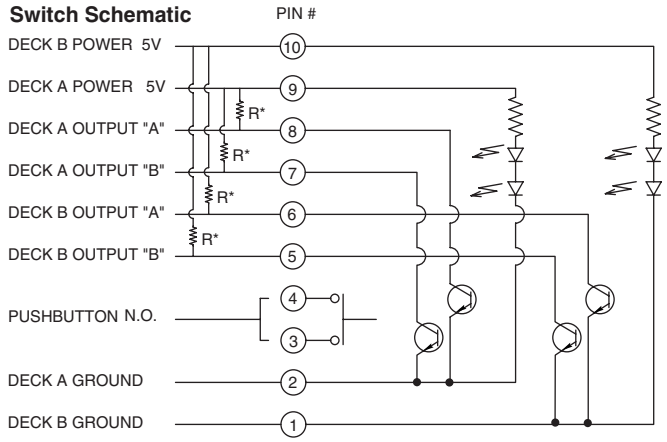


UNLESS OTHERWISE SPECIFIED, STANDARD TOLERANCE IS ±.010 (0,25).

CIRCUITRY, TRUTH TABLE, AND WAVEFORM

Standard Quadrature 2-Bit Code

Switch Schematic



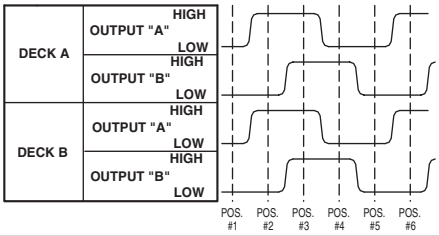
* 2.2k EXTERNAL PULL-UP RESISTORS REQUIRED FOR OPERATION

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

62HRXX-XX-020X

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

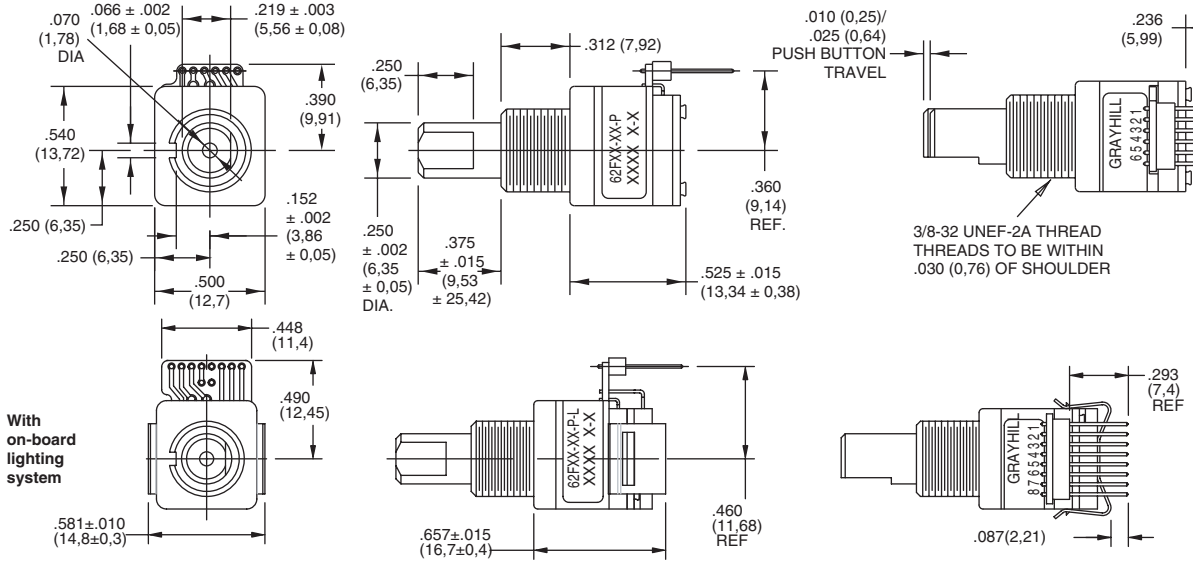
- Integrated Self-Lighting System for Knob Illumination
- 1 Million Rotational Cycles
- 1/2" Package
- Compatible with CMOS, TTL and HCMOS Logic
- Optional Integral Pushbutton
- Choices of Cable Length and Terminations
- Other Customized Solutions Available

APPLICATIONS

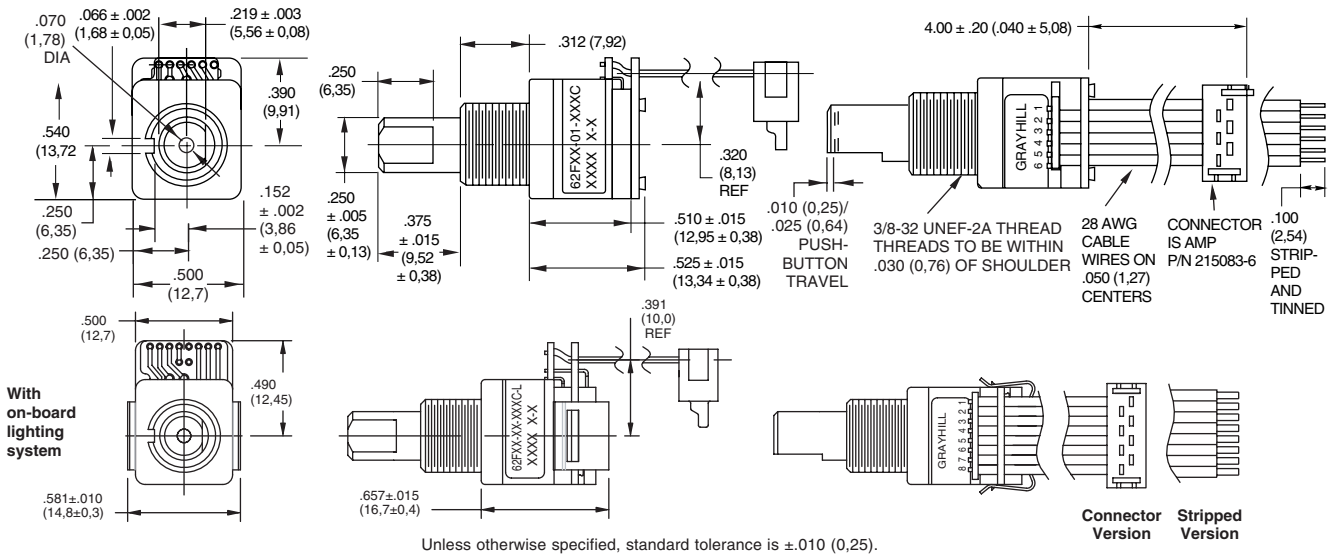
- Global Positioning/Driver Information Systems
- Medical Equipment
- Cockpit Controls
- Mixing Boards

DIMENSIONS In inches (and millimeters)

Pin Version



Cable Version



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

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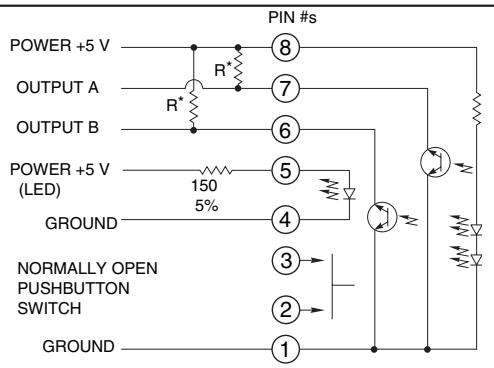
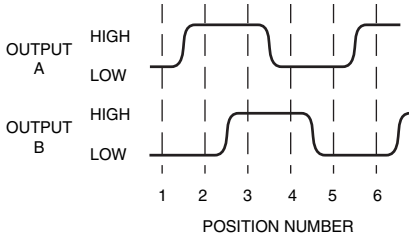
CIRCUITRY, TRUTH TABLE, AND WAVEFORM Standard Quadrature 2-Bit Code





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

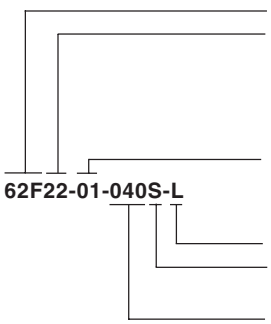
Code Housing: Reinforced thermoplastic
Shaft: Aluminum
Bushing: Zinc casting
Shaft Retaining Ring: Stainless steel
Detent Spring: Stainless steel

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: Phosphor 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 / **Non-detent**
11 = 11.25° or 32 pos. / 01 = 11.25° or 32 positions
15 = 15° or 24 positions / 05 = 15° or 24 positions
18 = 18° or 20 pos. / 08 = 18° or 20 positions
22 = 22.5° or 16 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.

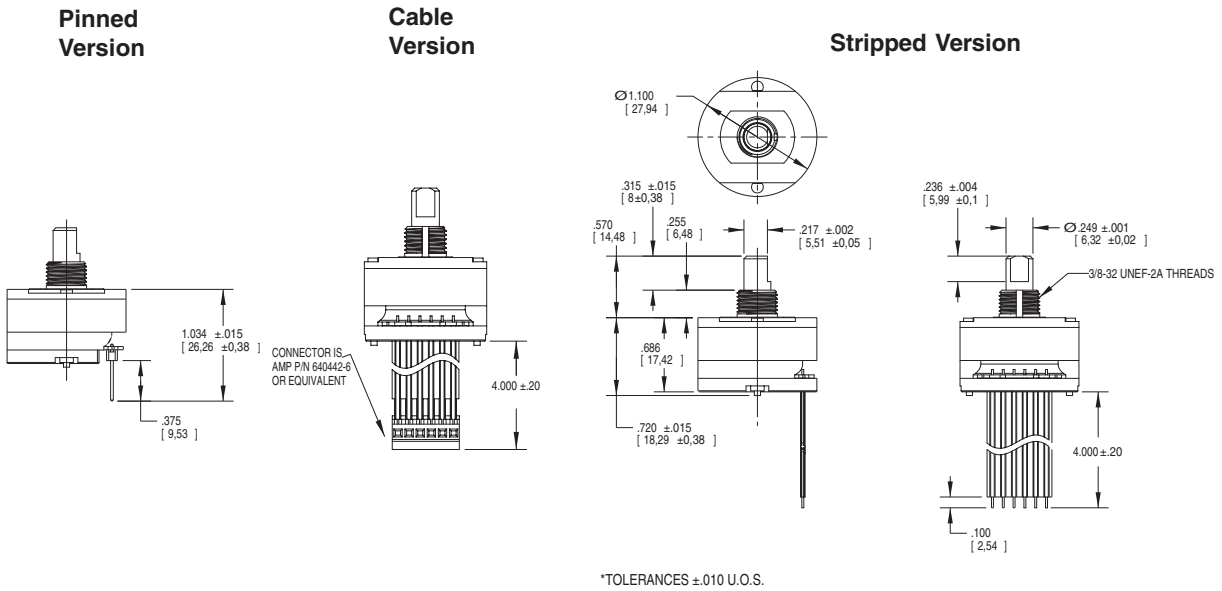
Available from your local Grayhill Component Distributor. For prices and discounts, contact a local Sales Office, an authorized local Distributor, or Grayhill.

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

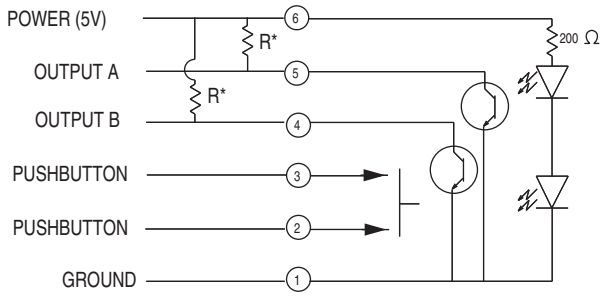
Applications
- Medical
- Audio
- Instrumentation

DIMENSIONS In inches (and millimeters)



*TOLERANCES ±.010 U.O.S.

SWITCH SCHEMATIC



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

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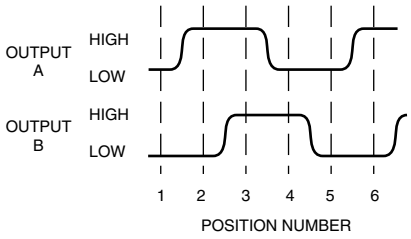
WAVEFORM AND TRUTH TABLE



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

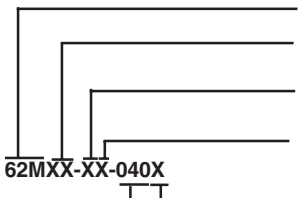
Operating Voltage: 5.00±.25 Vdc
Supply Current: 30 mA maximum at 5 Vdc
Output: Open collector phototransistor, external pull-up resistors are required
Output Code: Two-bit quadrature, channel A leads channel B by 90° electrically during clockwise rotation of the shaft
Logic Output Characteristics:
Logic 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)

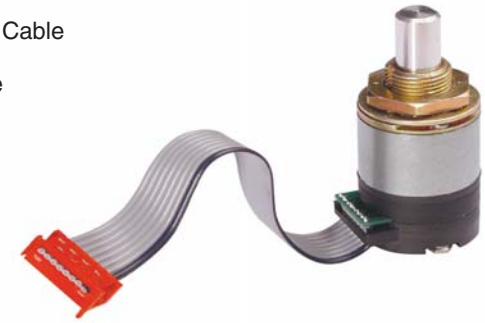


Series
Angle of Throw: 15 = 15° for code change and 24 detent positions
Rotational Torque: H=High Torque (1.70 in-oz), M=Medium Torque (1.25 in-oz), L=Low Torque (0.75 in-oz)
Pushbutton Option: 0=Non-Pushbutton, 2 = 200 grams, 3 = 300 grams, 4 = 510 grams
Termination: CH =.100 Cable with connector, SH = 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)*

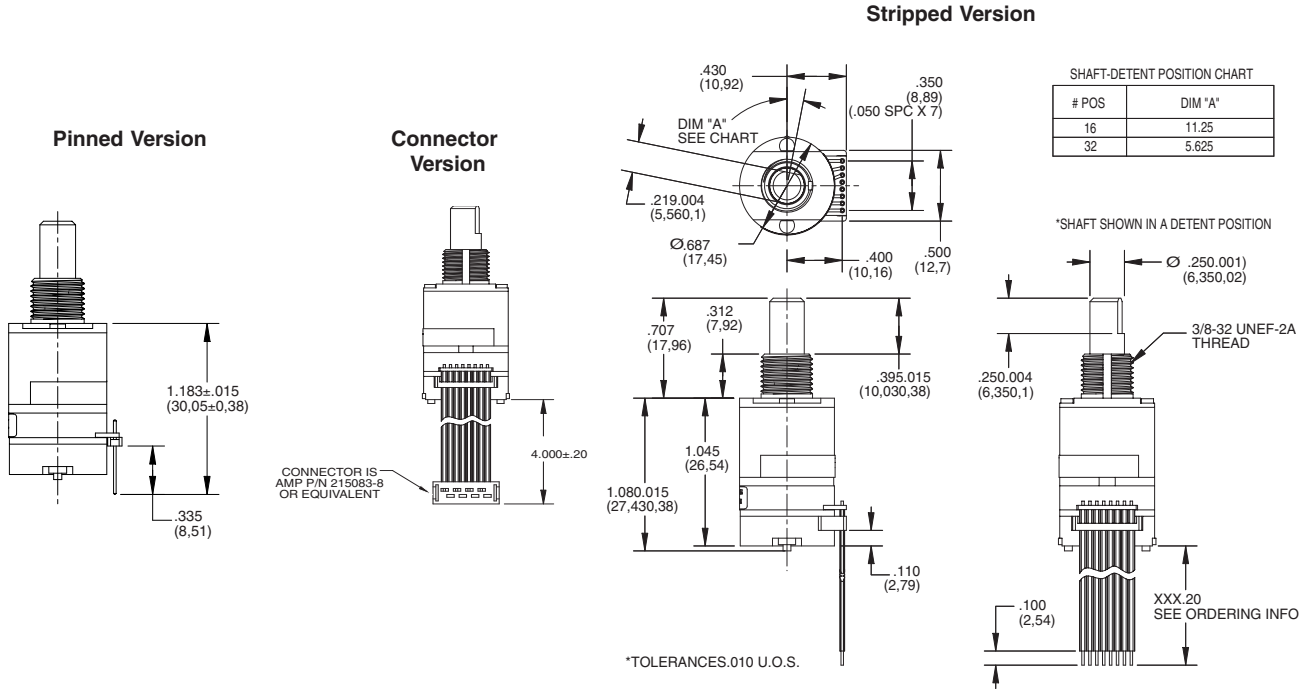
SERIES 62B
Push-Pull, High Torque

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

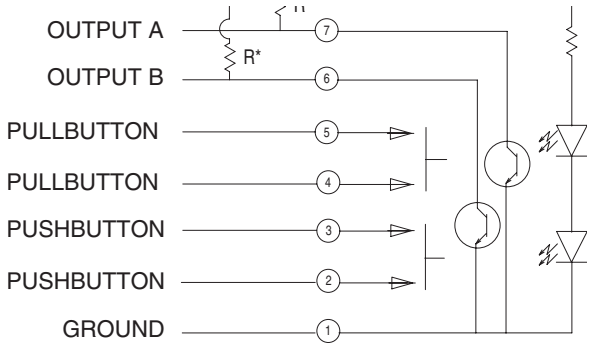
APPLICATIONS
- Use for Menu Scrolling or Function Selection
- Avionics
- Industrial
- Medical



DIMENSIONS In inches (and millimeters)

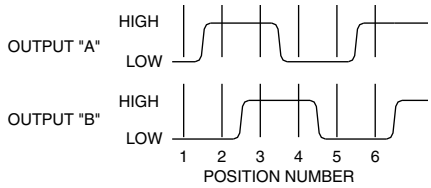


SWITCH SCHEMATIC, WAVEFORM, AND TRUTH TABLE



*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

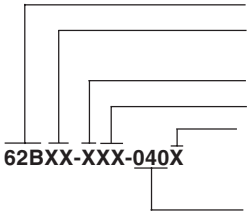
Pull-Button/Push-Button Electrical and Mechanical Specifications

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



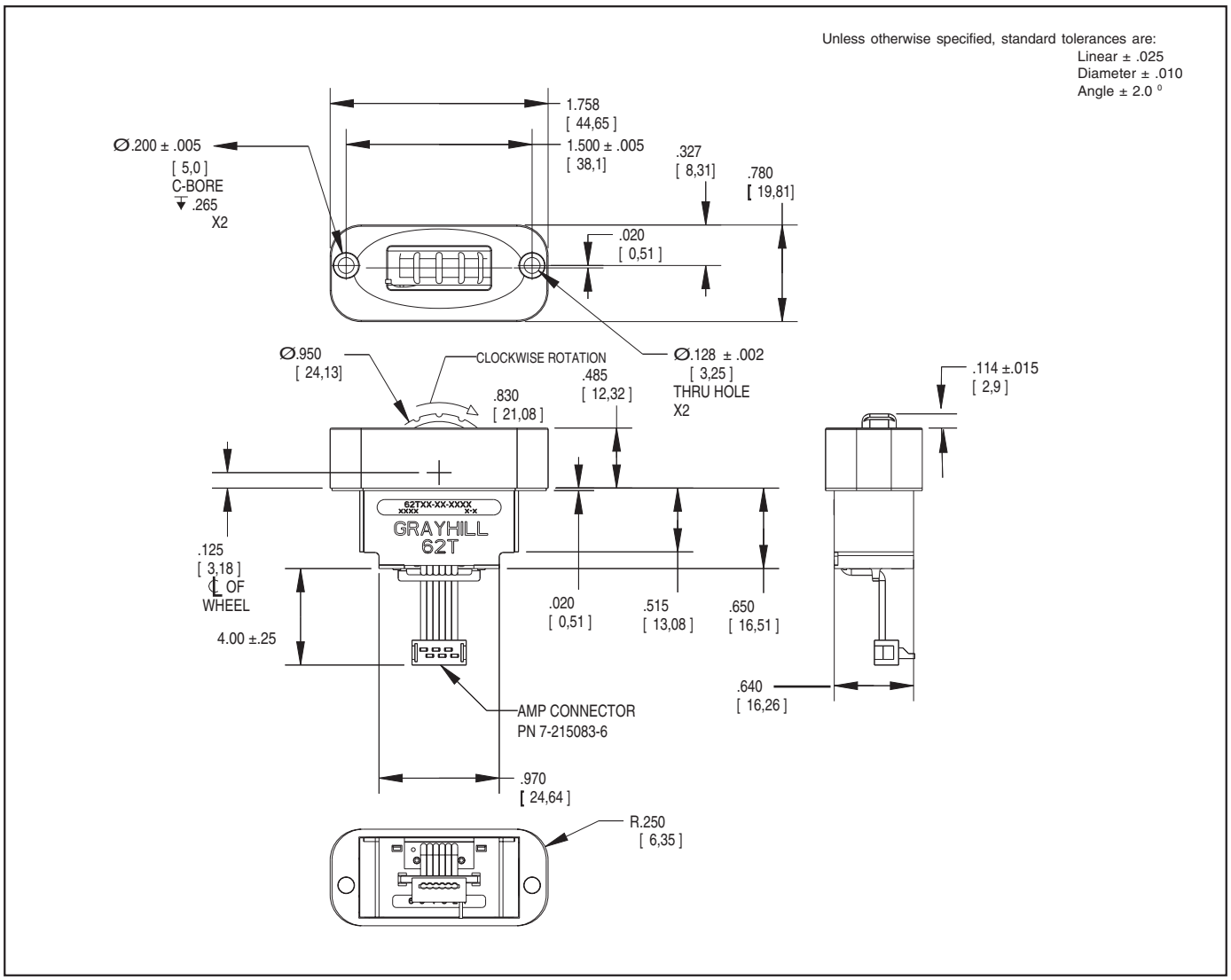
Series
Angle of Throw: 22 = 22.5° For Code Change and 16 Detent Positions.
11 = 11.25° For Code Change and 32 Detent Positions.
Push/Pull-Button Travel: S = Standard Travel (.030" Both Directions). L = Long Travel (.050" Both Directions)
Push/Pull Option: P = Pull-Button Only. PP = Push and Pull-Button
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)



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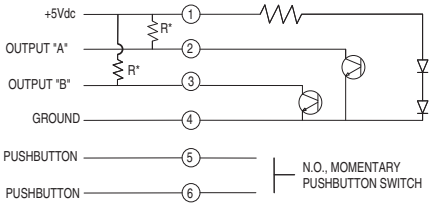
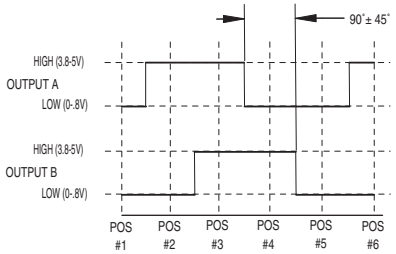
WAVEFORM AND TRUTH TABLE



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

62T22-XX-040C

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.

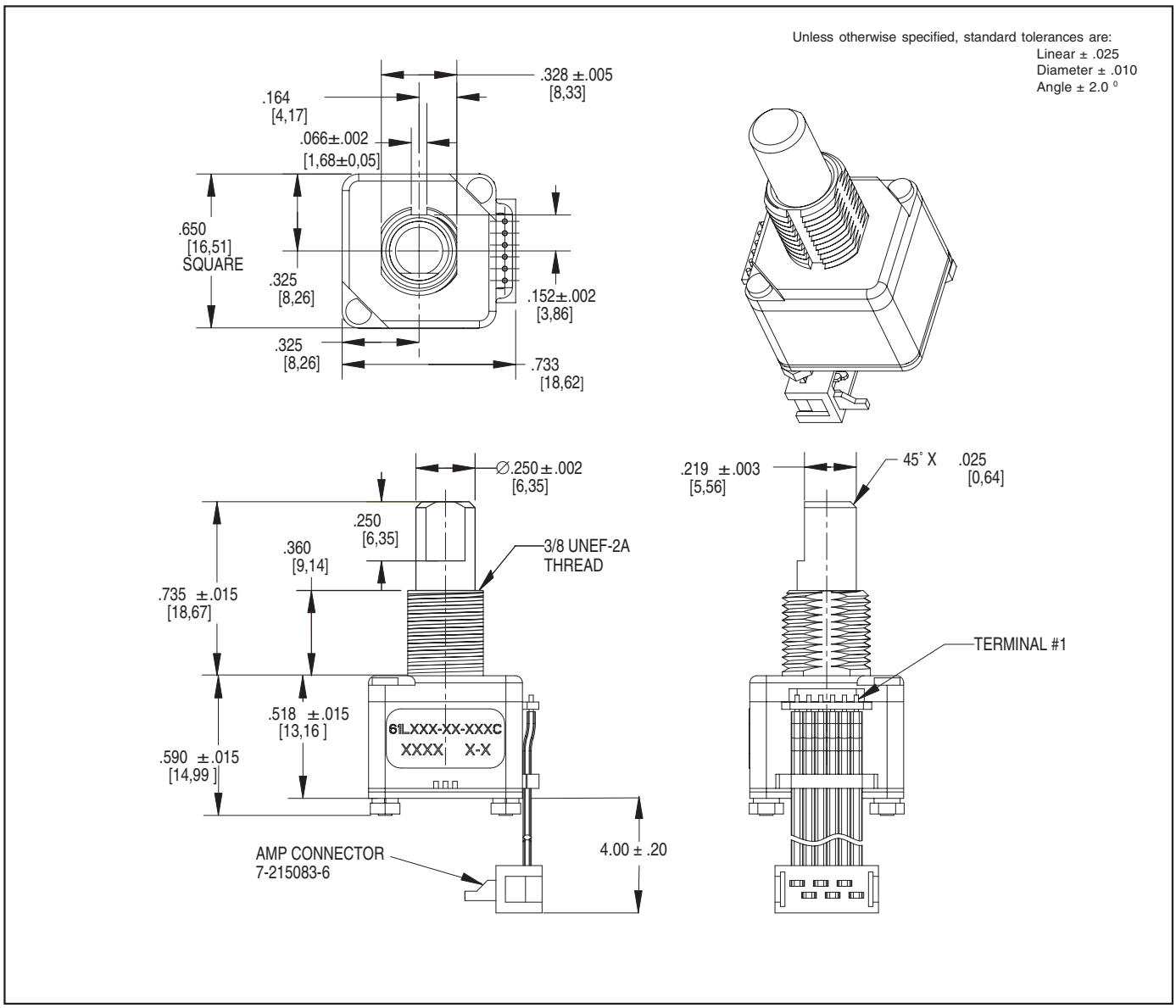
Available from your local Grayhill Component Distributor. For pricing an discounts, contact a local Sales Office, an authorized local Distributor, or Grayhill.

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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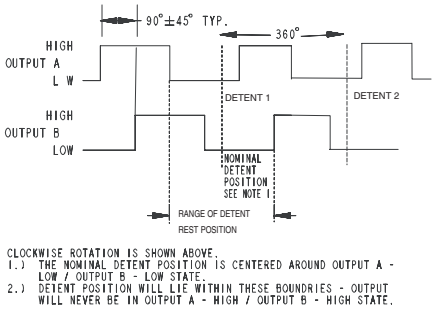
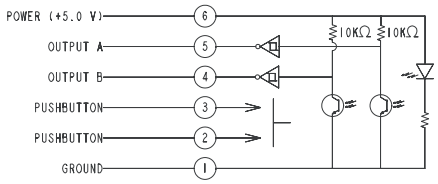
CIRCUITRY, WAVEFORM AND TRUTH TABLE





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

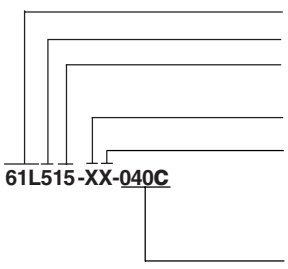
Output Code: Two-bit quadrature, channel A leads channel B by 90° electrically during clockwise rotation of the shaft.
Logic Output Characteristics:
Logic high signal shall be no less than 3.8 Vdc
Logic low signal shall be no greater than 0.8 Vdc
Minimum Sink Current: 2.0 mA
Power Consumption: 150 mW 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



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

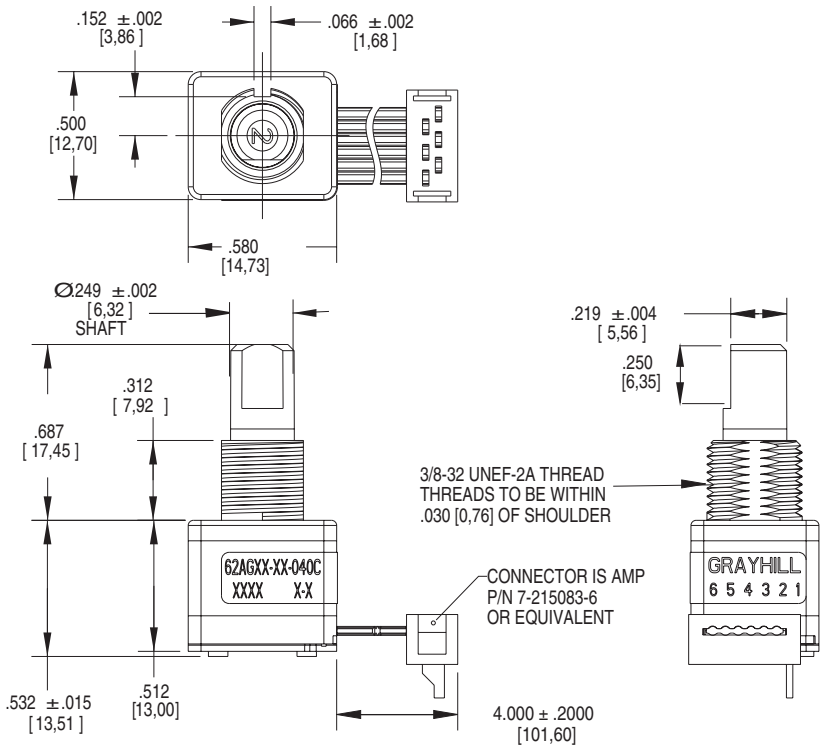
- Long Lasting (1 million cycles)
- Optional pushbutton
- Available in 16 and 32 Detent Positions
- 4 inch cable / connector assembly

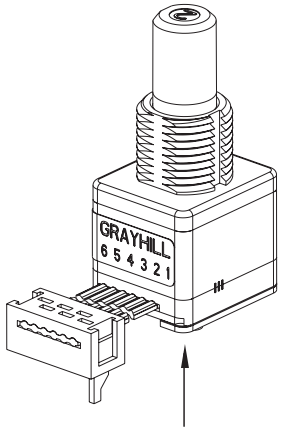
APPLICATIONS

- 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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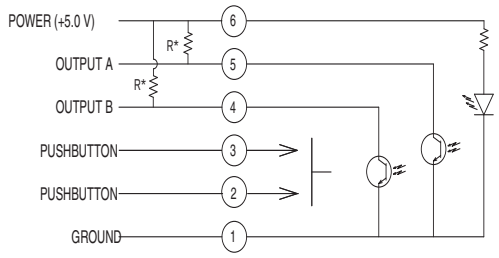
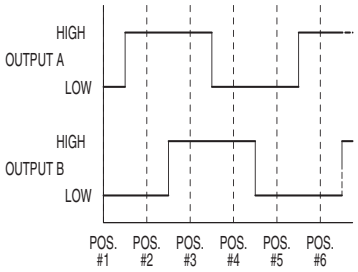
WAVEFORM AND TRUTH TABLE



*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

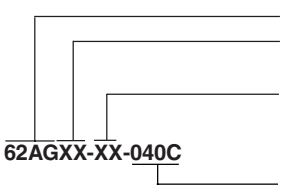
Operating Voltage: 5.00±0.25 Vdc
Supply Current: 30 mA maximum at 5 Vdc.
Logic Output Characteristics:
Logic high shall be no less than 3.0 VdcLogic low shall be no greater than 1.0 Vdc
Minimum sink current: 0.5 mA for 5 Vdc. (Preliminary)
Power Consumtpion: 150 mW maximum for 5 Vdc
Output: Open Collector 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

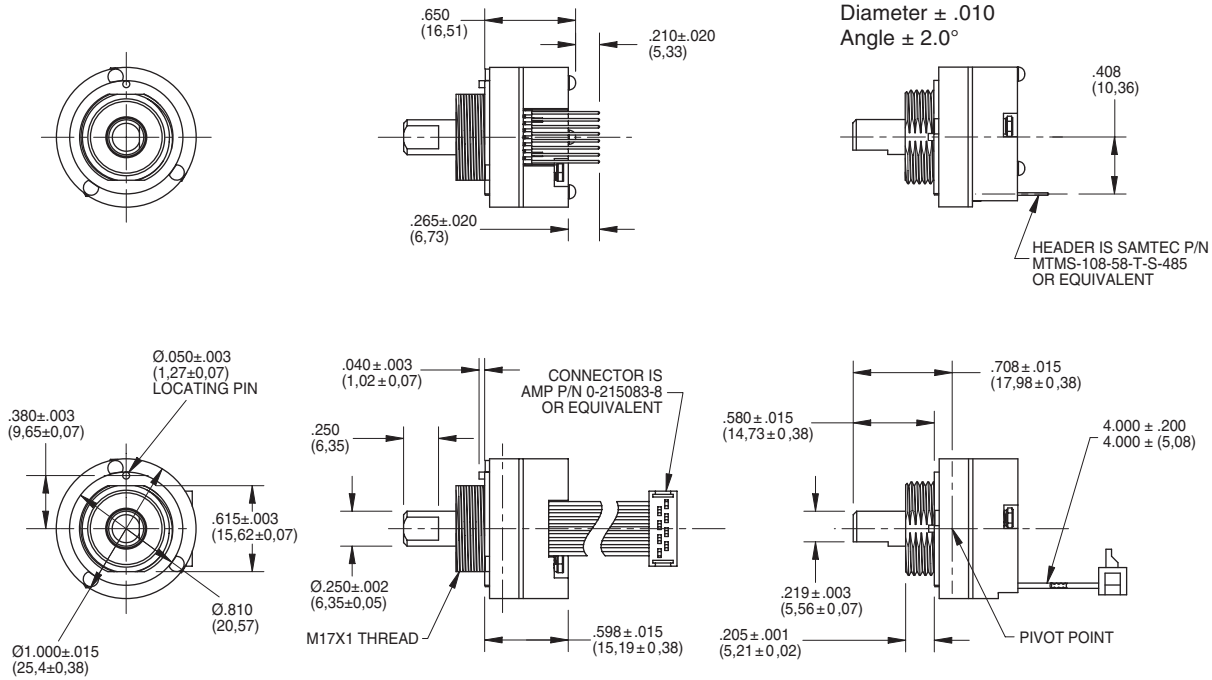
FEATURES
- Optical Encoder, Pushbutton, and Joystick in One Shaft
- Long Life, High Reliability
- Compatible with CMOS, HCMOS, and TTL Logic
- Choices of Cable Length and Termination
- Customized Solutions Available

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

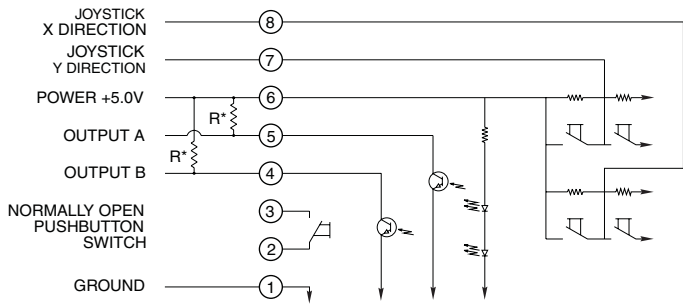
DIMENSIONS In inches (and millimeters)

Pin Version

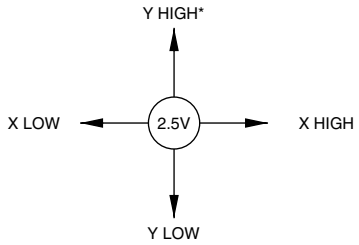
Unless otherwise specified, standard tolerance are:
Linear ± .025
Diameter ± .010
Angle ± 2.0°



CIRCUITRY AND JOYSTICK OPERATION Standard Quadrature 2-Bit Code

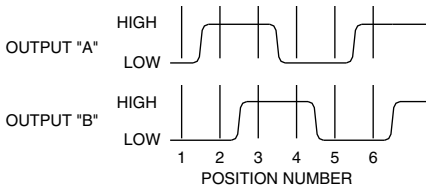


*EXTERNAL PULL-UP RESISTORS REQUIRED FOR OPERATION (2.2kΩ).



* 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

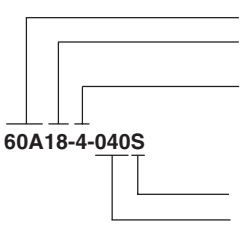
Materials and Finishes

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



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.

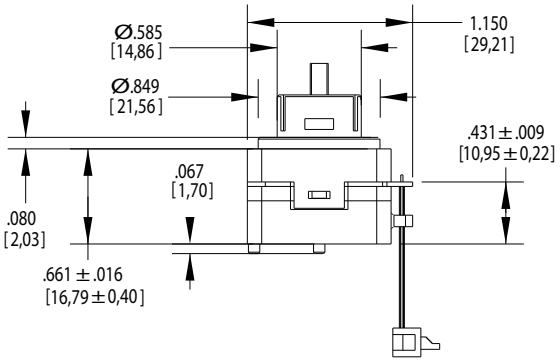
SERIES 60C
Multi-Function Joystick

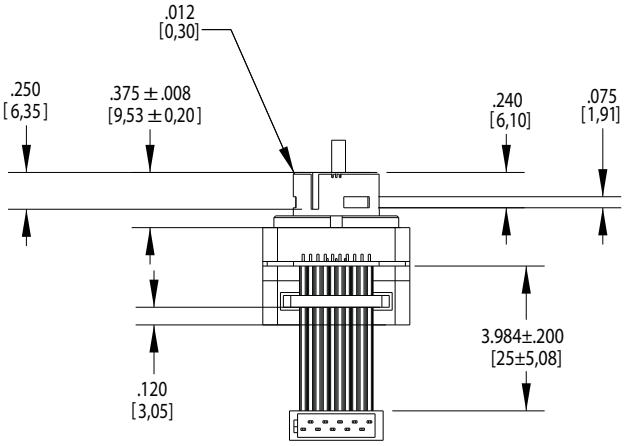
FEATURES
- Three-in-One Optical Encoder, Pushbutton, and Joystick
- Compact Packaging
- Choices of Cable Length and Termination
- Customized Solutions Available

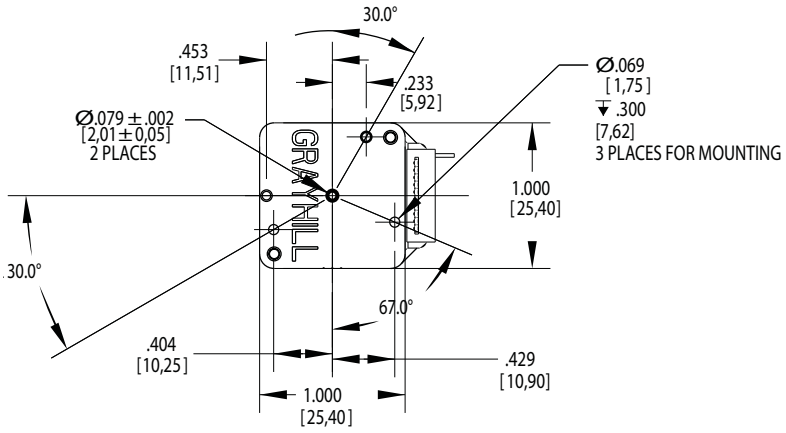
APPLICATIONS
- Automotive Navigation & Infotainment Equipment
- Avionics
- Medical Equipment

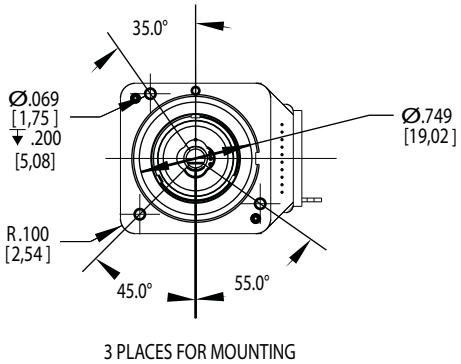
DIMENSIONS In inches (and millimeters)

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









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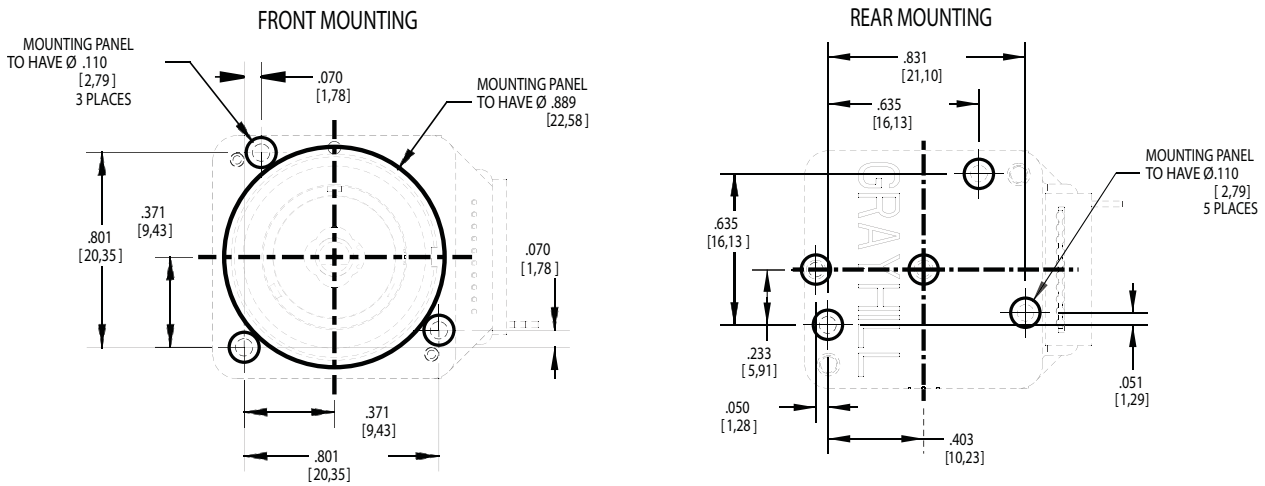
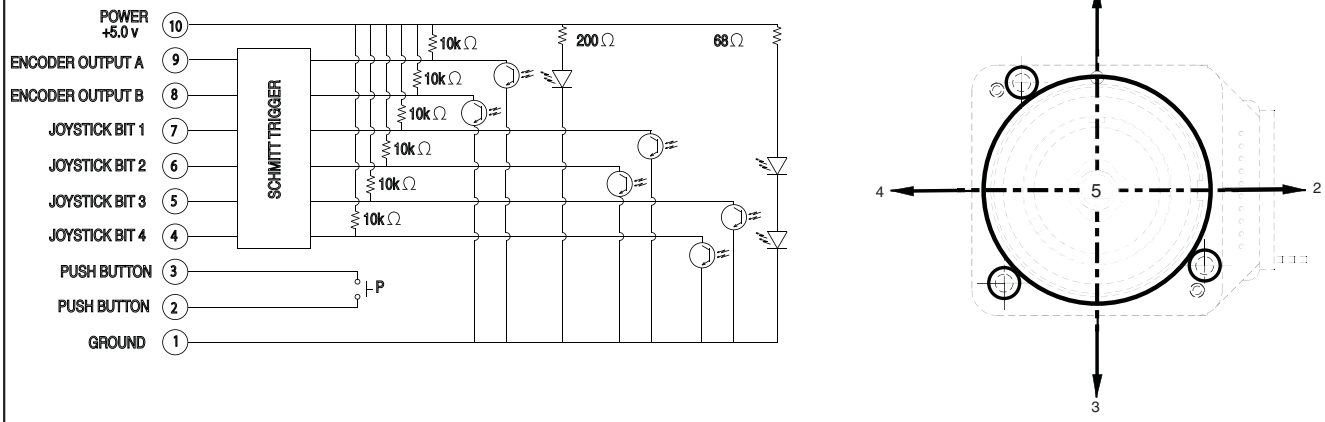
FRONT AND REAR MOUNTING



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

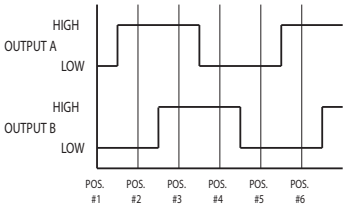
CODE REPEATS EVERY FOUR POSITIONS.

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

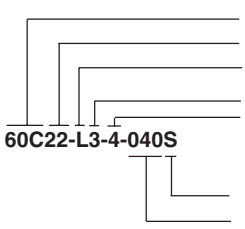
Materials and Finishes

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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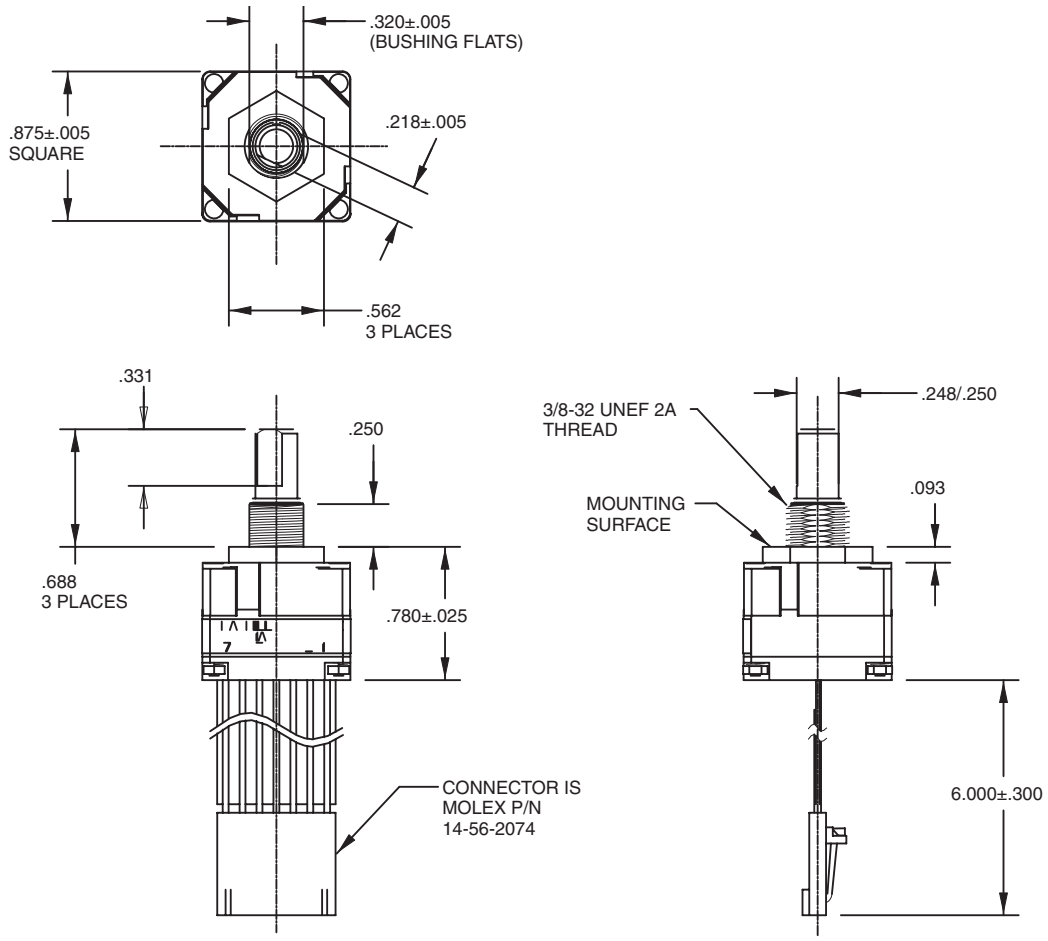
SERIES 61A
Custom, Absolute

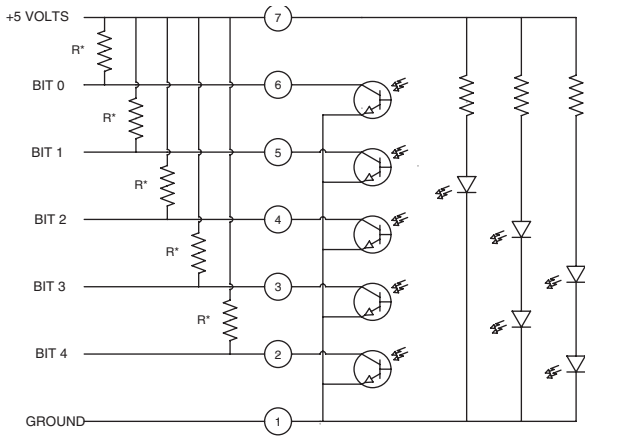
FEATURES
- Absolute Position Sensing
- 3, 4, or 5-Bit Custom Output Coding
- 8 to 32 Positions
- Fixed Stops Only
- Angles of Throw to 45° (Design Specifications Will Dictate the Angle of Throw)

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.

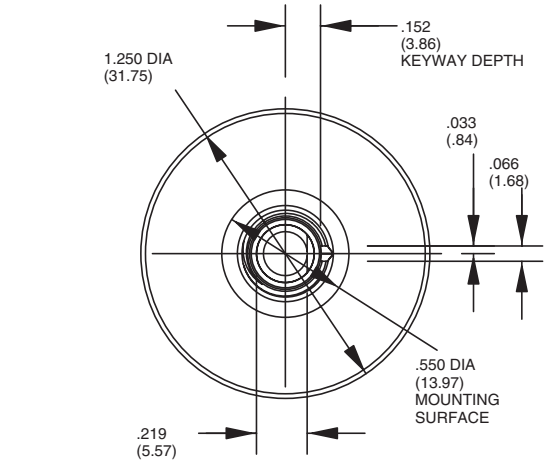
Available from your local Grayhill Component Distributor. For prices and discounts, contact a local Sales Office, an authorized local Distributor, or Grayhill.

SERIES 61K
High Resolution, 4-Pin

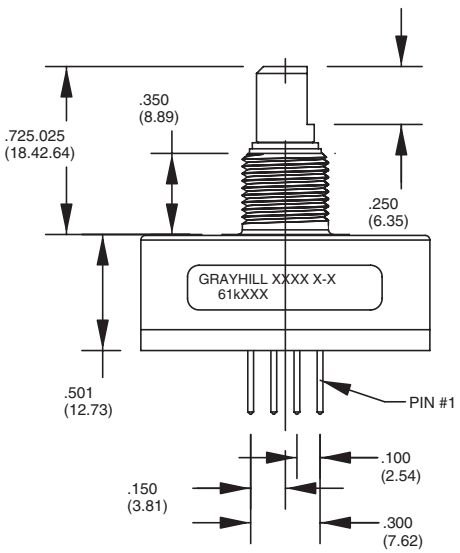
FEATURES
- 25, 32, 50, 64, 100, 128 and 256 Cycles per Revolution Available
- Sealed Version Available
- Rugged Construction
- Cable or Pin Versions
- 10 Million Rotational Life Cycles
- 300 RPM Shaft Rotation

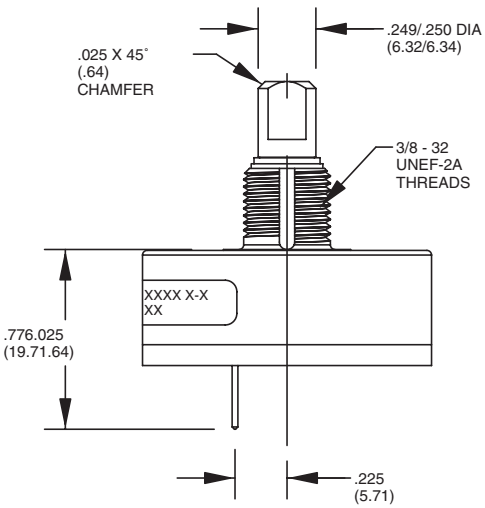
DIMENSIONS In inches (and millimeters)

Pin Version



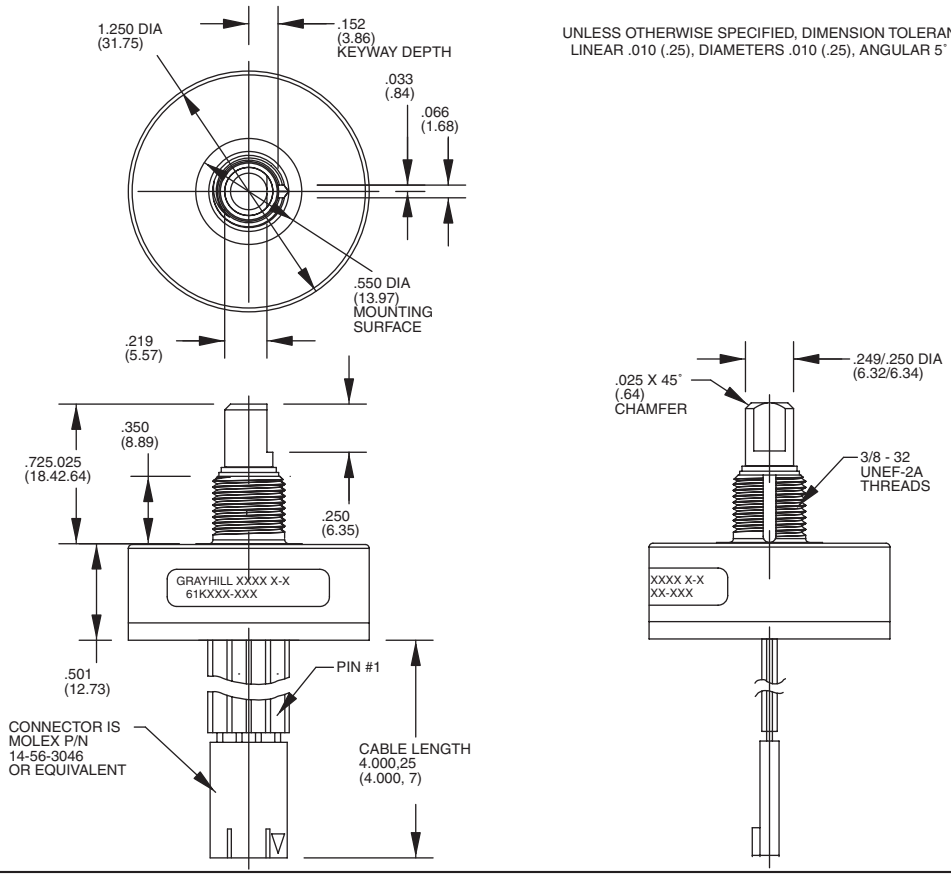
Unless otherwise specified, standard tolerance are:
Linear ± .010
Diameter ± .025
Angle ± 2.0°



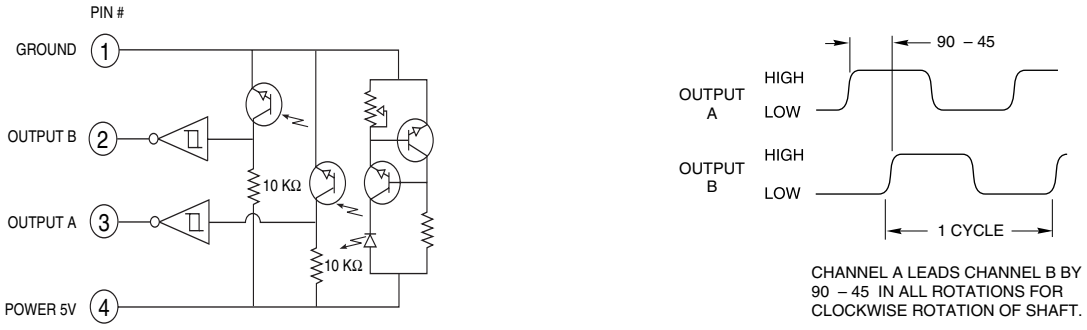


DIMENSIONS In inches (and millimeters)

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

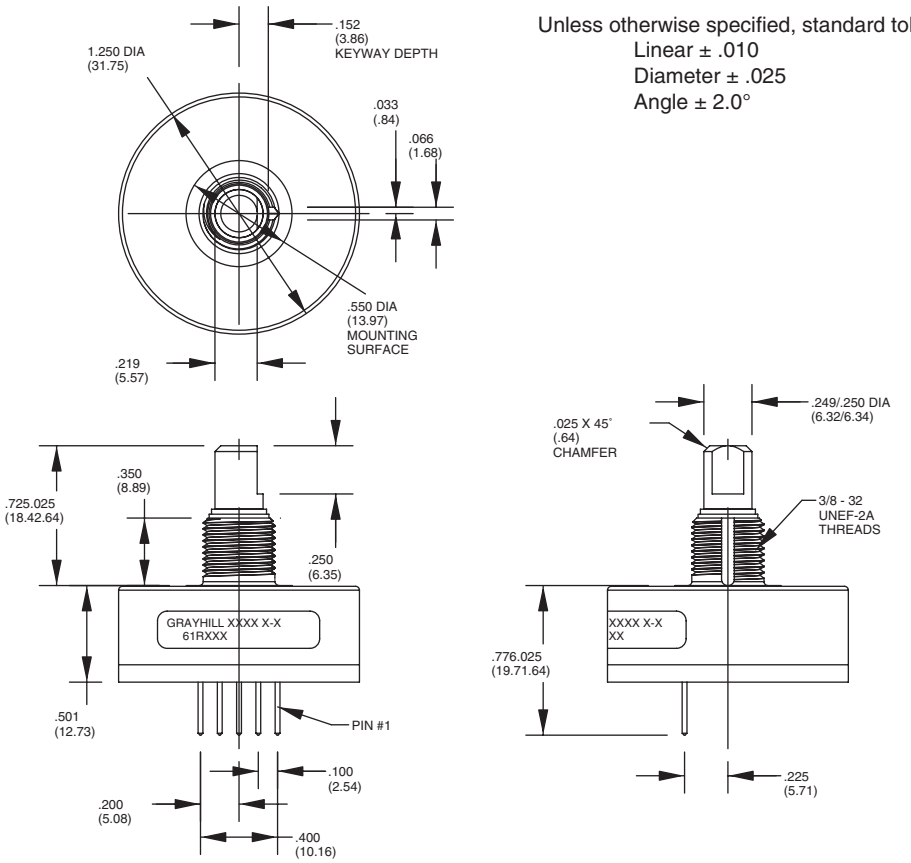
High Resolution, 5-Pin (Polarized Connection)

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)

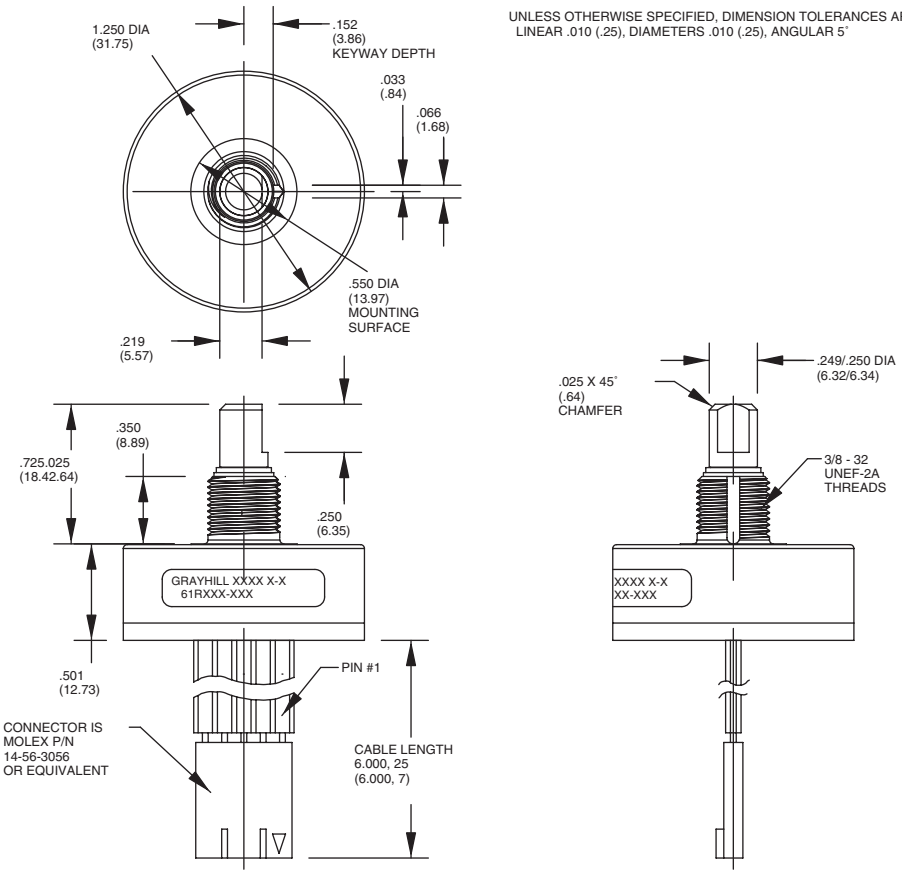
Pin Version



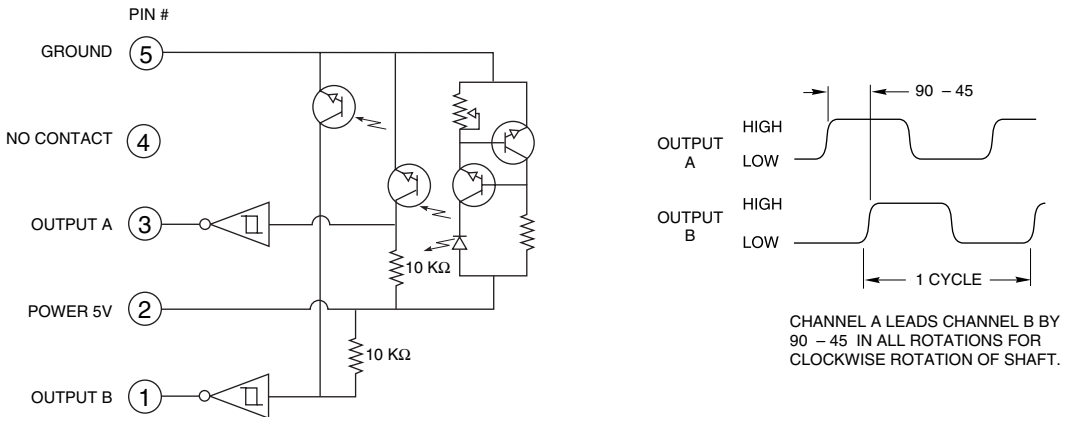
Unless otherwise specified, standard tolerance are:
Linear ± .010
Diameter ± .025
Angle ± 2.0°

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: Zytel FR-50
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

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

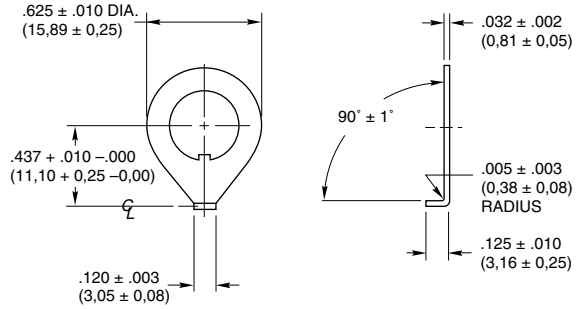
Non-Turn Washer

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

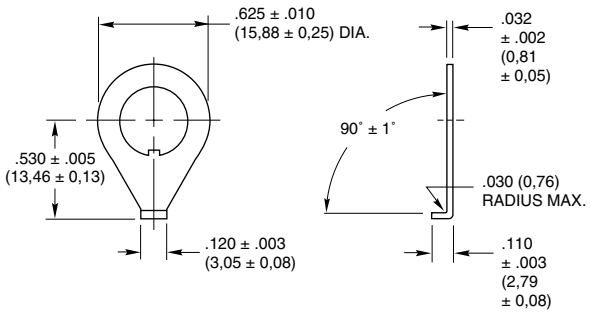
Shaft and Panel Seal

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

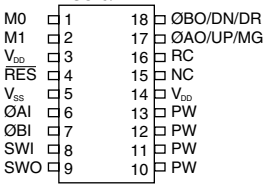
FEATURES
- Interfaces with all Grayhill and Most Standard Quadrature Optical Encoders
- Power Reduction of Up to 75-90% in Optical Encoder Use Through Power Management Feature
- User Selectable Output Modes: Magnitude/Direction, Up/Down, Standard Quadrature
- Simplified Microprocessor Interface Reduces 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.

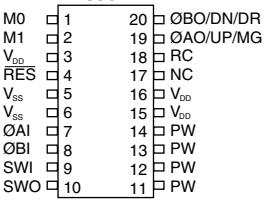
Name	Type*	Description
M0, M1	I	Mode selection input pins
V_{DD}	P	3–6 Vdc power source
$\overline{RES}$	I	Reset pin, normally connected to V_{DD}
V_{SS}	P	GND, 0v nominal power return
ØAI, ØBI	I	Phase A and B quadrature input pins
SWI	I	Switch input pin
SWO	O	Debounced switch output pin
NC	O	No connect, 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.

SERIES 61M

Optically Coupled for Simulated Mechanical Rotary Switch Output

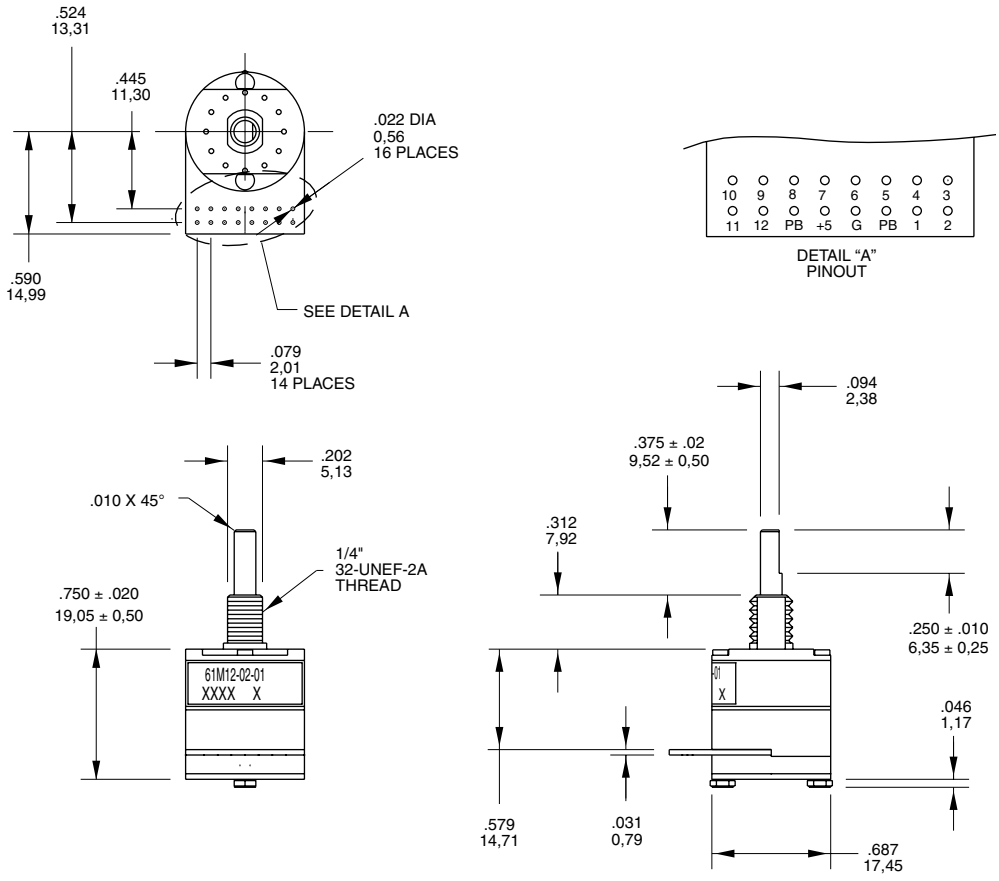
FEATURES

- 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

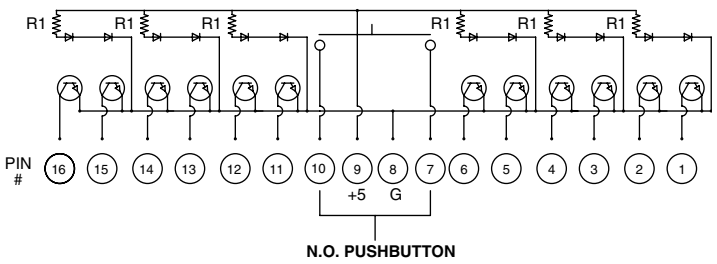
DIMENSIONS In inches (and millimeters)



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

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

SWITCH SCHEMATIC



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

61MXX-XX-XX

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.

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

CONTROL KNOBS

Ideally Suited for Encoder and Rotary Switches

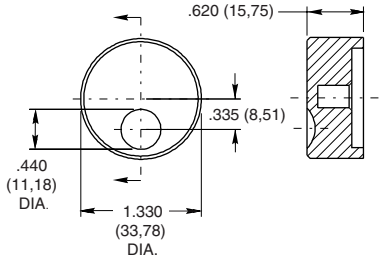
FEATURES

- 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

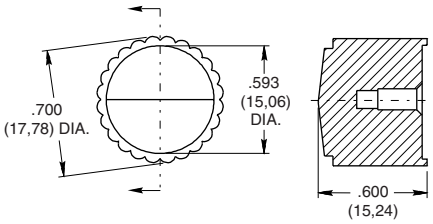
DIMENSIONS In inches (and millimeters)

Style 5013 **Top View**

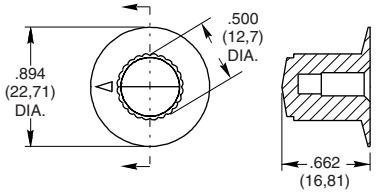


Available in .250 Dia. Shaft only.*

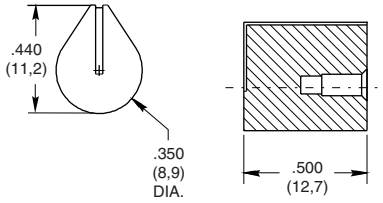
Style 5014 **Top View**



Style 5015 **Top View**



Style 5017 **Top View**

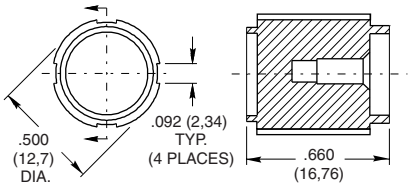


Available in .125 and .157 (4mm) dia. shaft in spring clip (press-on) version only.*

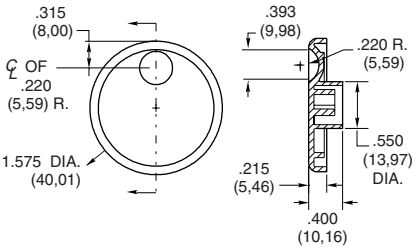
*See Ordering Information.

DIMENSIONS In inches (and millimeters)

Style 5019 **Top View**

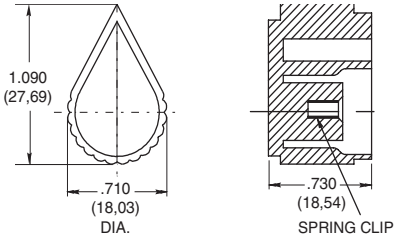


Style 5020 **Top View**

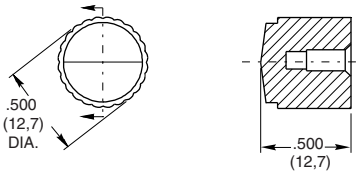


Available in ABS, .250 dia. shaft in spring clip (press-on). The locking clip is also available, requires a custom shaft.**

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.