

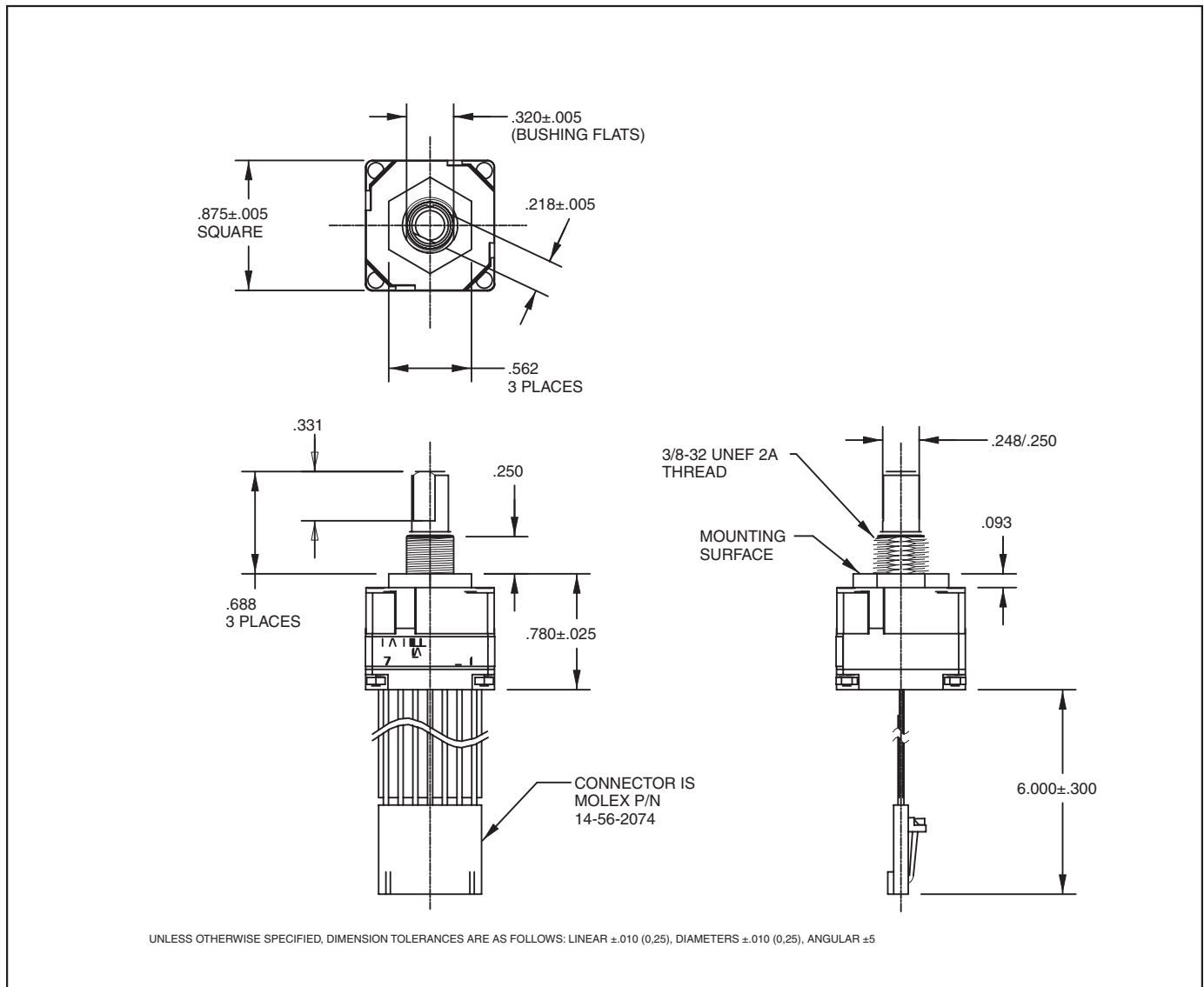
SERIES 61A
Custom, Absolute

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)

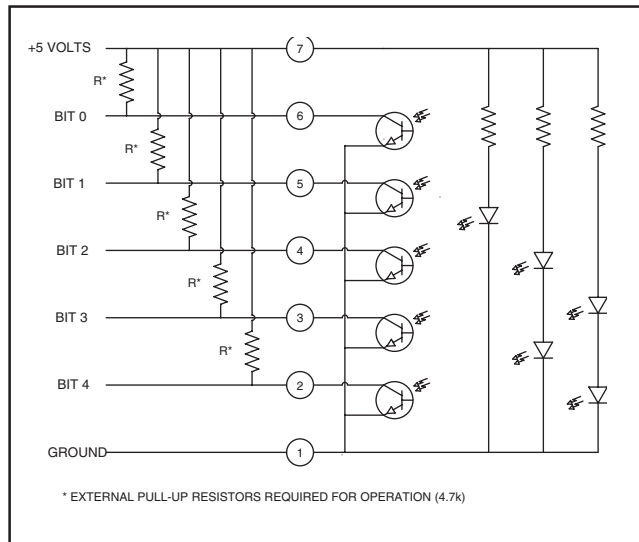


DIMENSIONS In inches (and millimeters)



Optical and Mechanical Encoders

CIRCUITRY



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

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

61A32-060

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 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

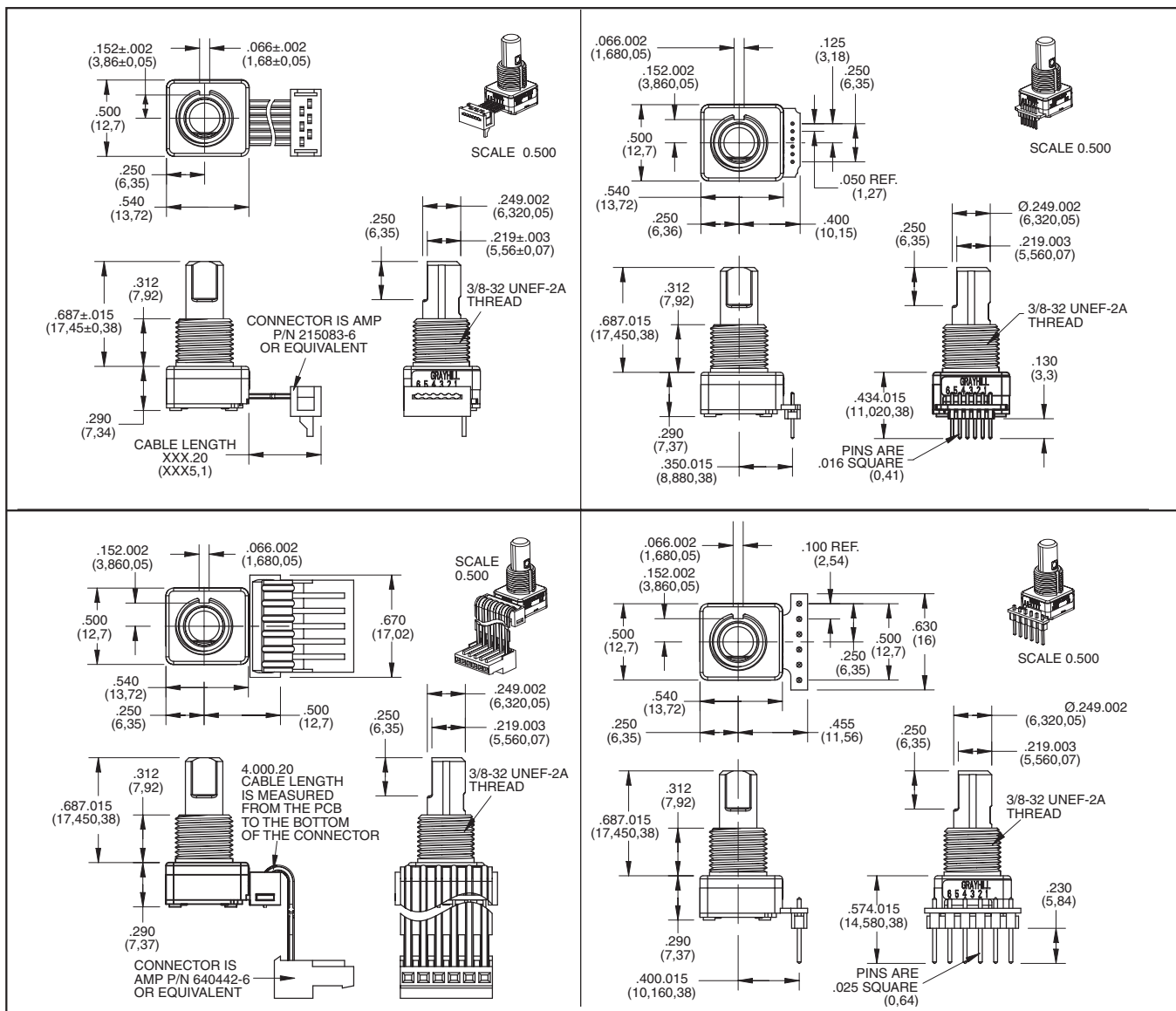
APPLICATIONS

- Global Positioning/Driver Information Systems
- Medical Equipment



DIMENSIONS In inches (and millimeters)

Unless otherwise specified, standard tolerance is ± 0.010 (0,25)



Optical and Mechanical Encoders

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

OUTPUT A

OUTPUT B

POSITION NUMBER

| 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 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 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

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, phosphor 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

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 |

62SXX-XX-040X

SERIES 62AG

Price Competitive Solution

FEATURES

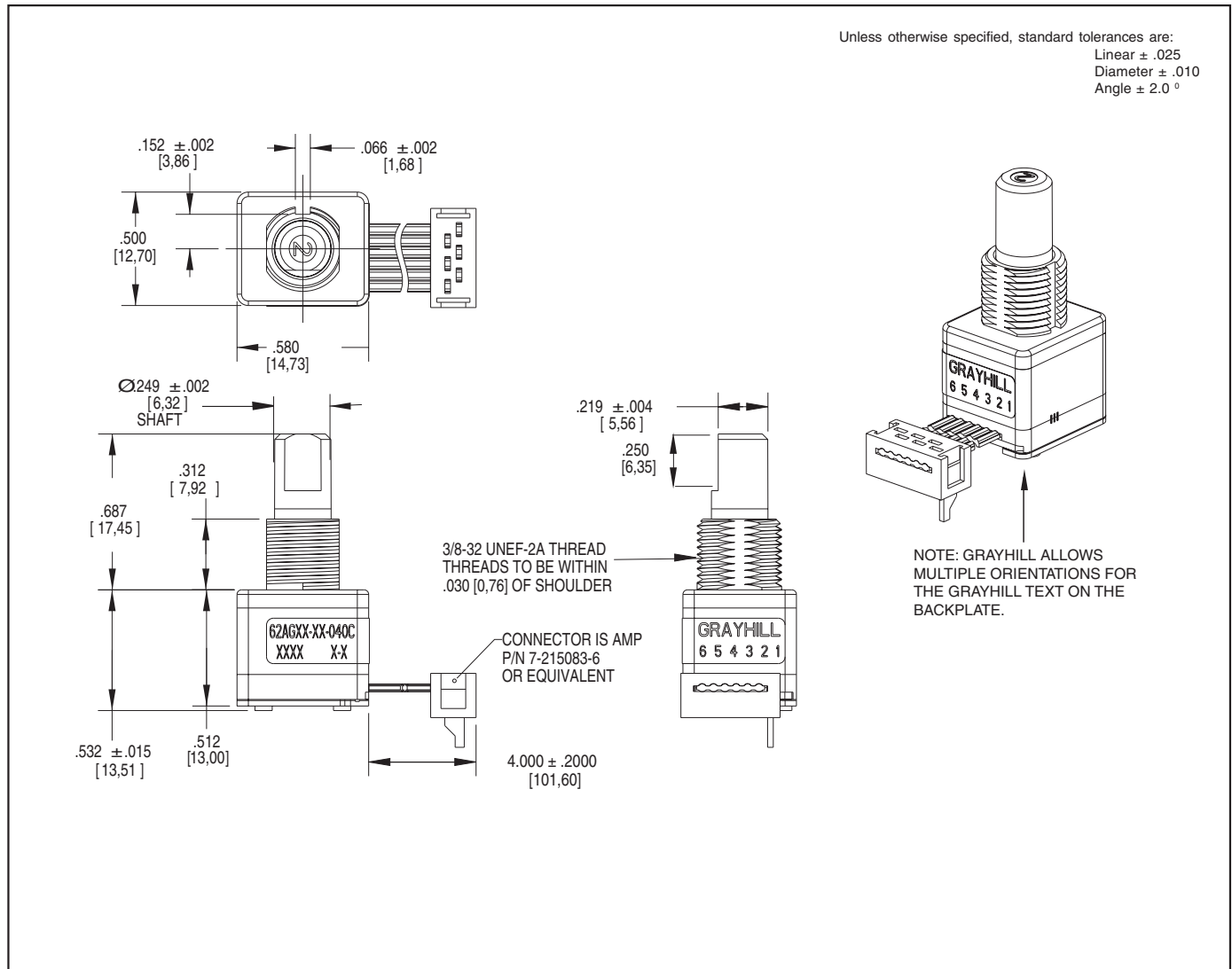
- Long Lasting (1 million cycles)
- Optional pushbutton
- Available in 16 and 32 Detent Positions
- 4 inch cable / connector assembly

APPLICATIONS

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

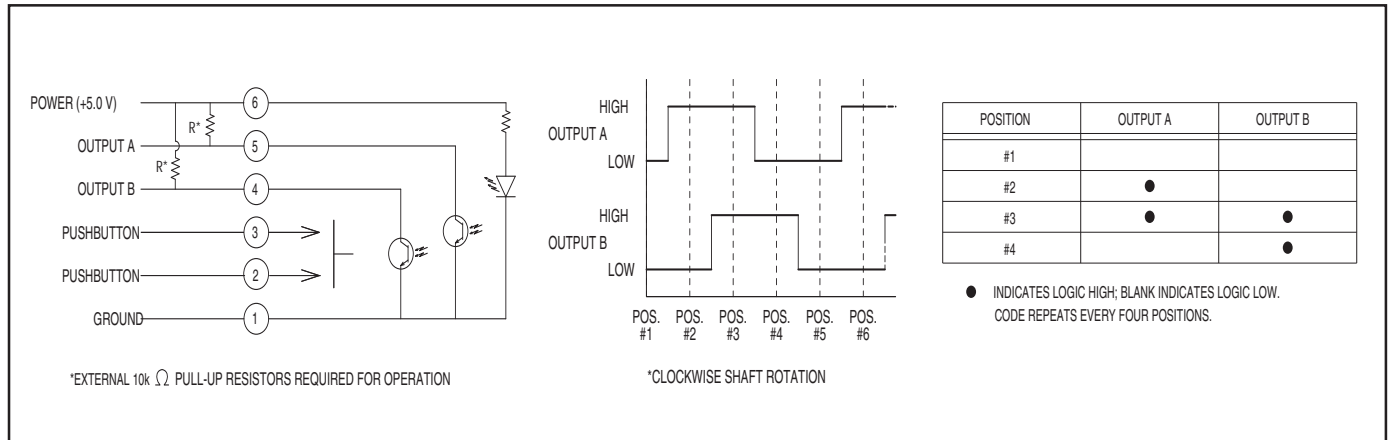


DIMENSIONS In inches (and millimeters)



Optical and Mechanical Encoders

WAVEFORM AND TRUTH TABLE



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 Vdc

Logic low shall be no greater than 1.0 Vdc

Minimum sink current: 0.5 mA for 5 Vdc.

(Preliminary)

Power Consumption: 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. Zytel FR-50

Light Pipe: Lexan, GE

Code Rotor: Delrin 100

Housing, Lower: Nylon 6/6 25% glass reinforced. Zytel 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.

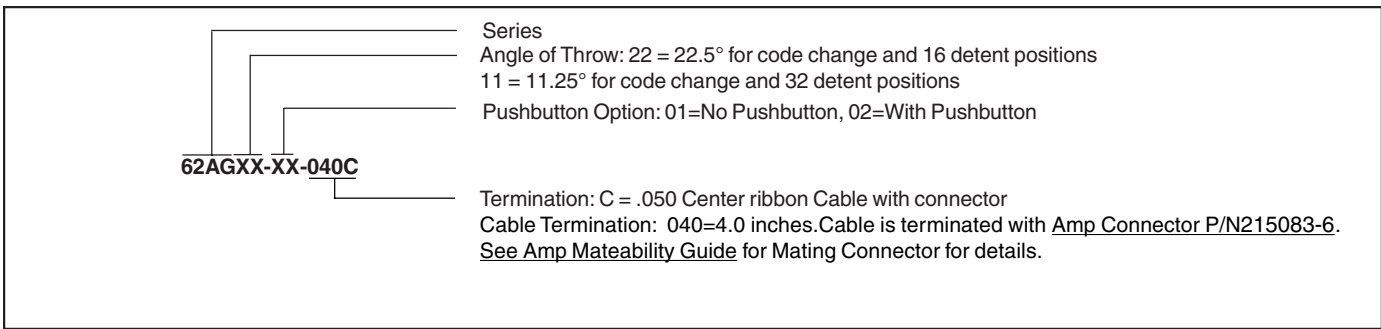
Hex Nut: Brass, Plated with nickel

Lockwasher: Stainless steel

Cable: Copper Stranded with topcoat in PVC insulation

Connector (.050 center): PA4.6 with tin/nickel plated phosphor bronze.

Optical and Mechanical Encoders



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

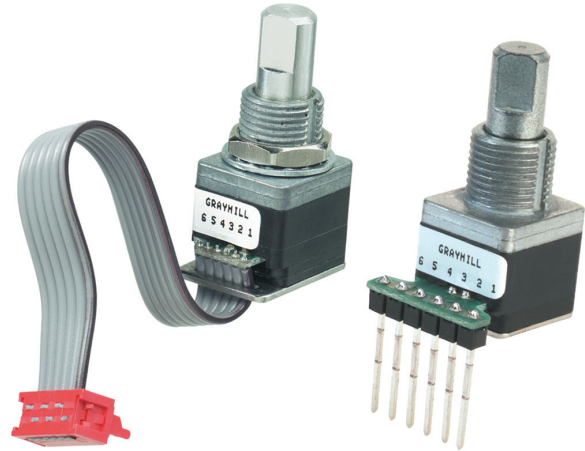
SERIES 62A,V,D 1/2" Package

FEATURES

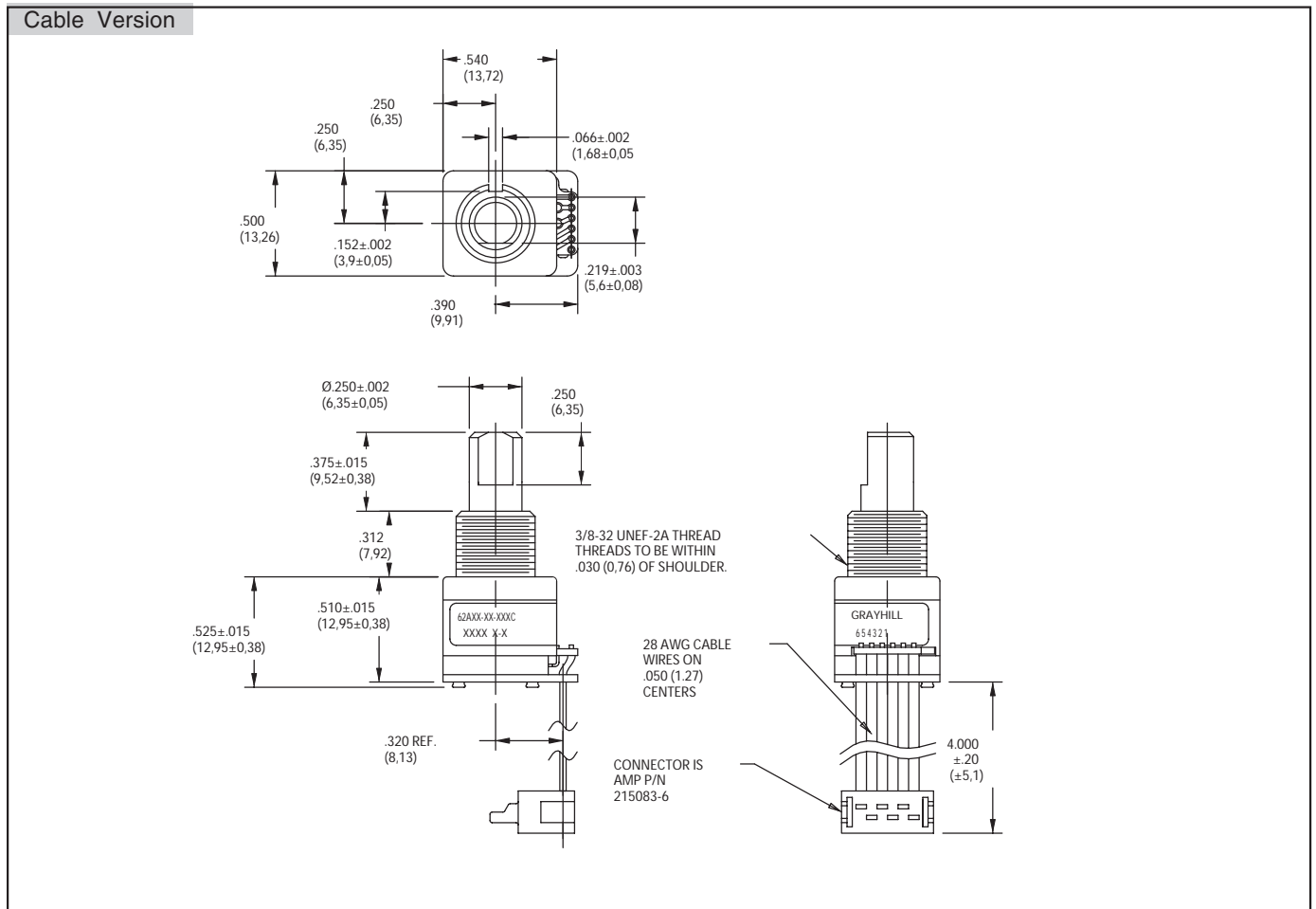
- Low Cost
- Long Life
- Available in 3.3 or 5.0 Vdc Operating Voltages
- High Torque Version to Emphasize Rotational Feel
- Economical Size
- Optically Coupled for More than a Million Cycles
- Optional Integral Pushbutton
- Compatible with CMOS, TTL and HCMOS Logic
- Available in 12,16, 20, 24 and 32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

APPLICATIONS

- Global Positioning/Driver Information Systems
- Medical Equipment

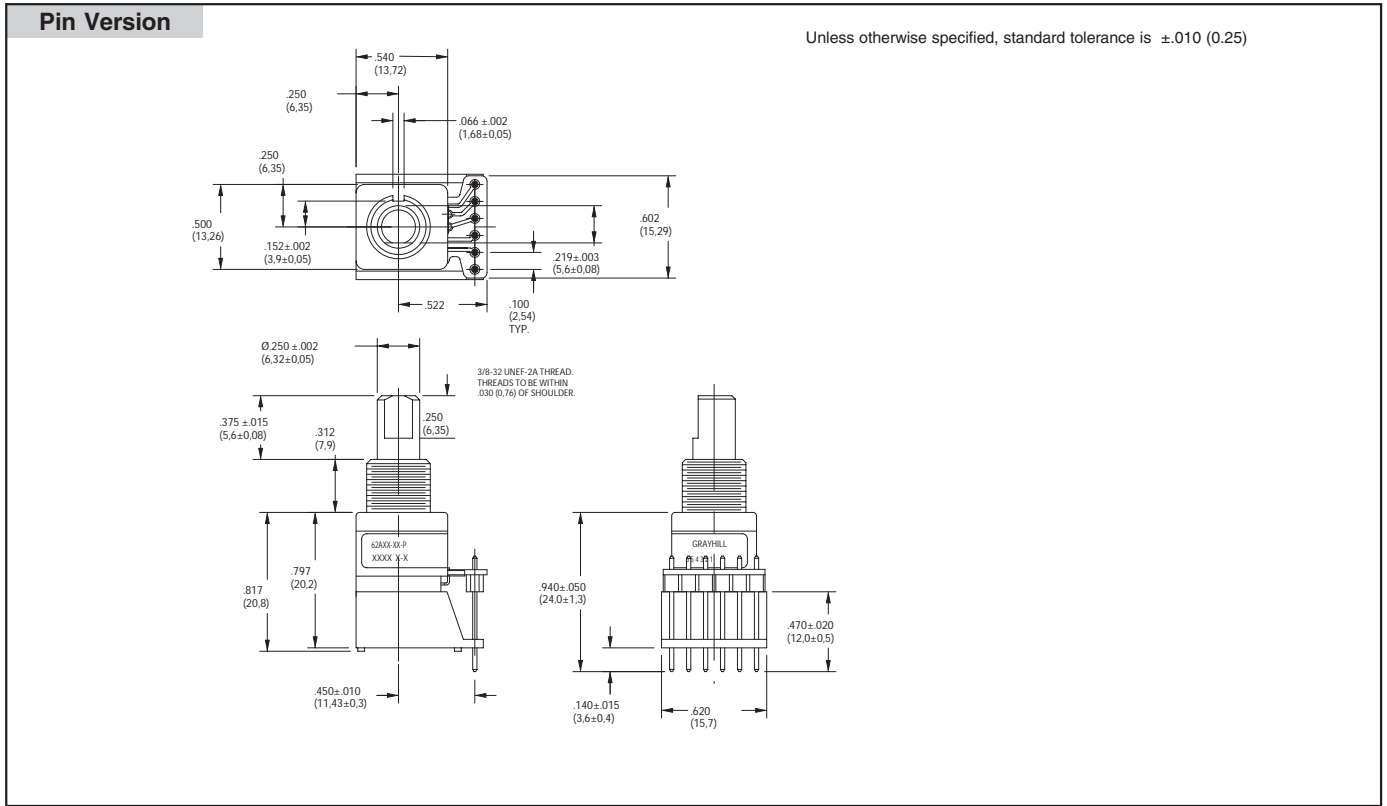


DIMENSIONS In inches (and millimeters)



Optical and Mechanical Encoders

DIMENSIONS In inches (and millimeters)



Optical and Mechanical Encoders

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

Standard 5.0 Volt (Styles A and D)

3.3 Volt (Style V only)

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

Clockwise Rotation

| Position | Output A | Output B |
|----------|----------|----------|
| 1 | | |
| 2 | ● | |
| 3 | ● | ● |
| 4 | | ● |

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

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 Characteristics:

Logic High: 3.8 Vdc (5.0 Vdc); 2.3 (3.3 Vdc) minimum

Logic Low: 0.8 Vdc maximum

Rotational Life: 1,000,000 cycles minimum (One cycle is a rotation through all positions and a full return)

Minimum Sink Current: 2.0 mA for 5 Vdc; 1.0 mA for 3.3 Vdc

Power Consumption: 150 mW maximum for 5 Vdc; 80 mW for 3.3 Vdc

Optical Rise and Fall Times: less than 30 mS maximum

Operating Torque:

Style A and V: 2.0 ±1.4 in-oz. initially

Style D: 3.5 ±1.4 in-oz initially

Non-detent: less than 1.5 in-oz initially

Shaft Push Out Force: 45 lbs minimum

Mounting Torque: 15 in-lbs maximum

Terminal Strength: 15 lbs cable pull-out force minimum

Operating Speed: 100 RPM maximum

Axial Shaft Play: .010 maximum

Environmental Ratings

Operating Temperature Range: -40°C to 85°C

Storage Temperature Range: -55°C to 100°C

Relative Humidity: 90–95% at 40°C for 96 hours

Vibration Resistance: Harmonic motion with amplitude of 15G, within a varied 10 to 2000 Hz frequency for 12 hours per MIL-STD-202, Method 204

Mechanical Shock: Test 1: 100G for 6 mS, half sine, 12.3 ft/s; Test 2: 100G for 6 mS, sawtooth, 9.7 ft/s

Materials and Finishes

Code Housing: Reinforced thermoplastic

Shaft: Zinc or aluminum

Bushing: Zinc casting

Shaft Retaining Ring: Stainless steel

Detent Spring: Stainless steel

Printed Circuit Boards: NEMA grade FR-4 gold over nickel or palladium

Terminals: Brass, tin-plated

Mounting Hardware: One brass, nickel-plated nut and stainless steel lockwasher supplied with each switch. Nut is 0.094 inches thick by 0.562 inches across flats.

Rotor: Thermoplastic

Code Housing: Thermoplastic

Pushbutton Dome: Stainless steel

Dome Retaining Disk: Thermoplastic

Pushbutton Housing: Thermoplastic

Phototransistor: Planar Silicon NPN

Infrared Emitter: Gallium aluminum arsenide

Pushbutton Contact: Brass, nickel-plated

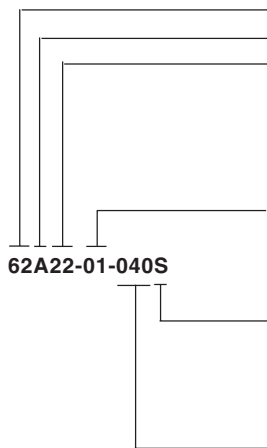
Flex Cable: 28 AWG, stranded/top coated wire, PVC coated on .050 or .100" centers (cabled version)

Header Pins: Phosphor bronze, tin-plated

Spacer: ABS

Backplate/Strain Relief: Stainless steel

ORDERING INFORMATION



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

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

Non-detent (Styles A&V only)

01 = 11.25° or 32 positions

05 = 15° or 24 positions

08 = 18° or 20 positions

02 = 22.5° or 16 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 62B Push-Pull, High Torque

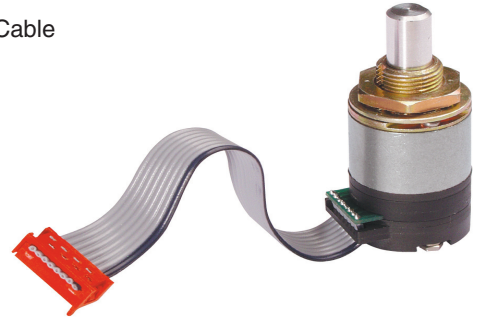
FEATURES

- 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

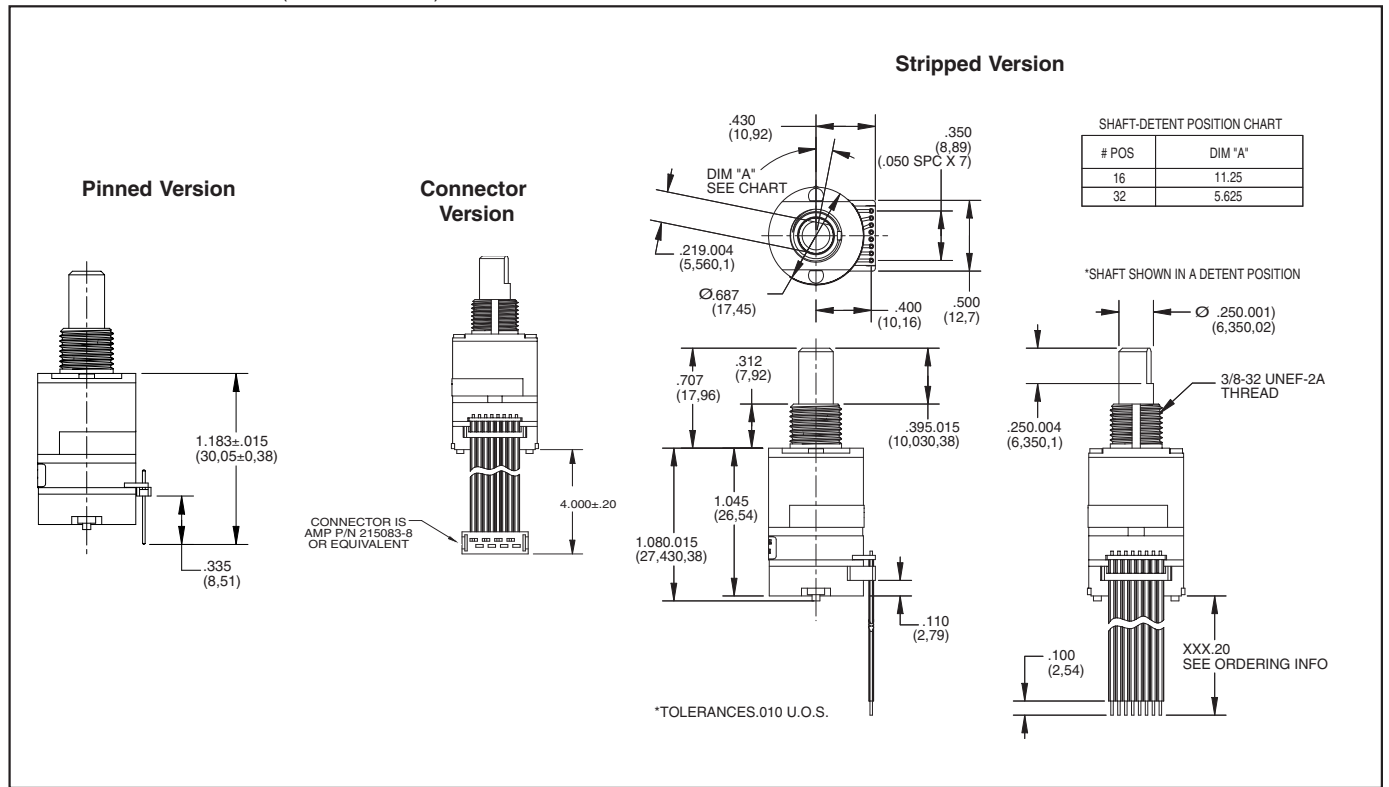
- Pin, Cable and Connector with Cable Termination Options
- Custom Modifications Available

APPLICATIONS

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

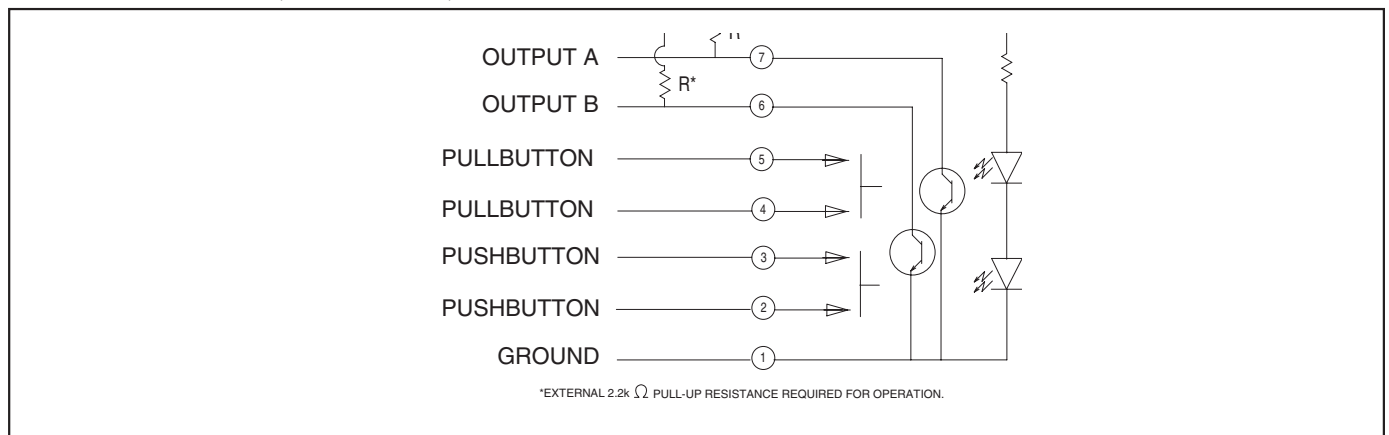


DIMENSIONS In inches (and millimeters)

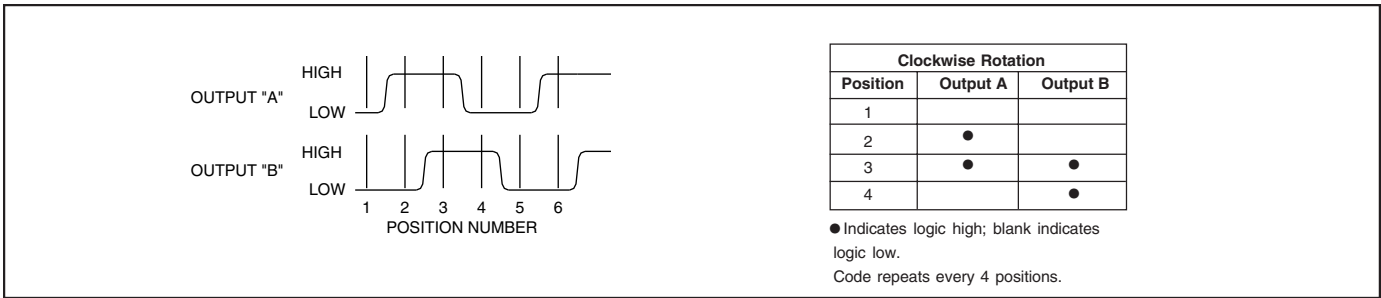


Optical and Mechanical Encoders

SWITCH SCHEMATIC, WAVEFORM, AND TRUTH TABLE



WAVEFORM AND TRUTH TABLE Standard Quadrature 2-Bit Code



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

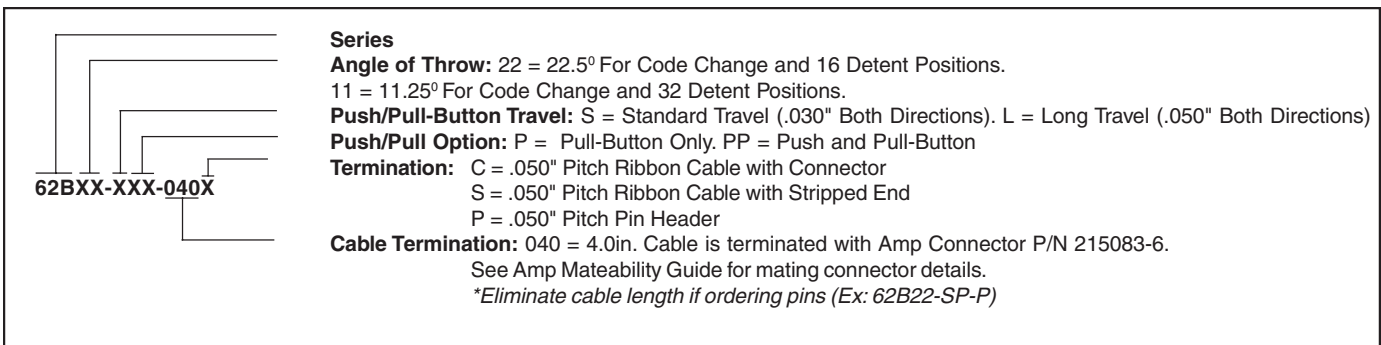
Lubricating Grease: Nye Nyogel 774L

Mounting Hex Nut: Tin/Zinc Over 1/2 Hard Brass

Lockwasher: 8-18 Stainless Steel, Passivate Finish

Pin Header: Hi-Temp Glass Filled Thermoplastic UL94V-0, Phosphor Bronze (Pinned Versions Only)

ORDERING INFORMATION



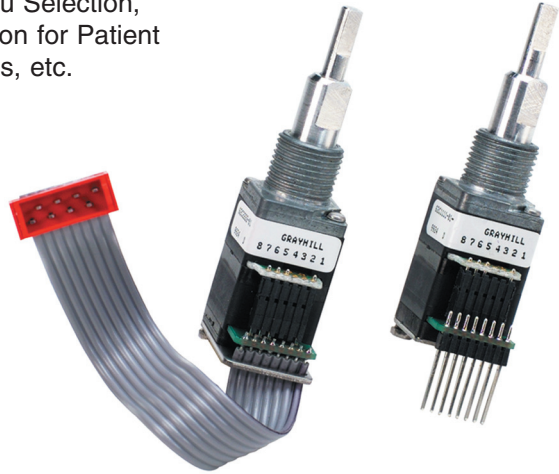
SERIES 62C Concentric Shaft

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

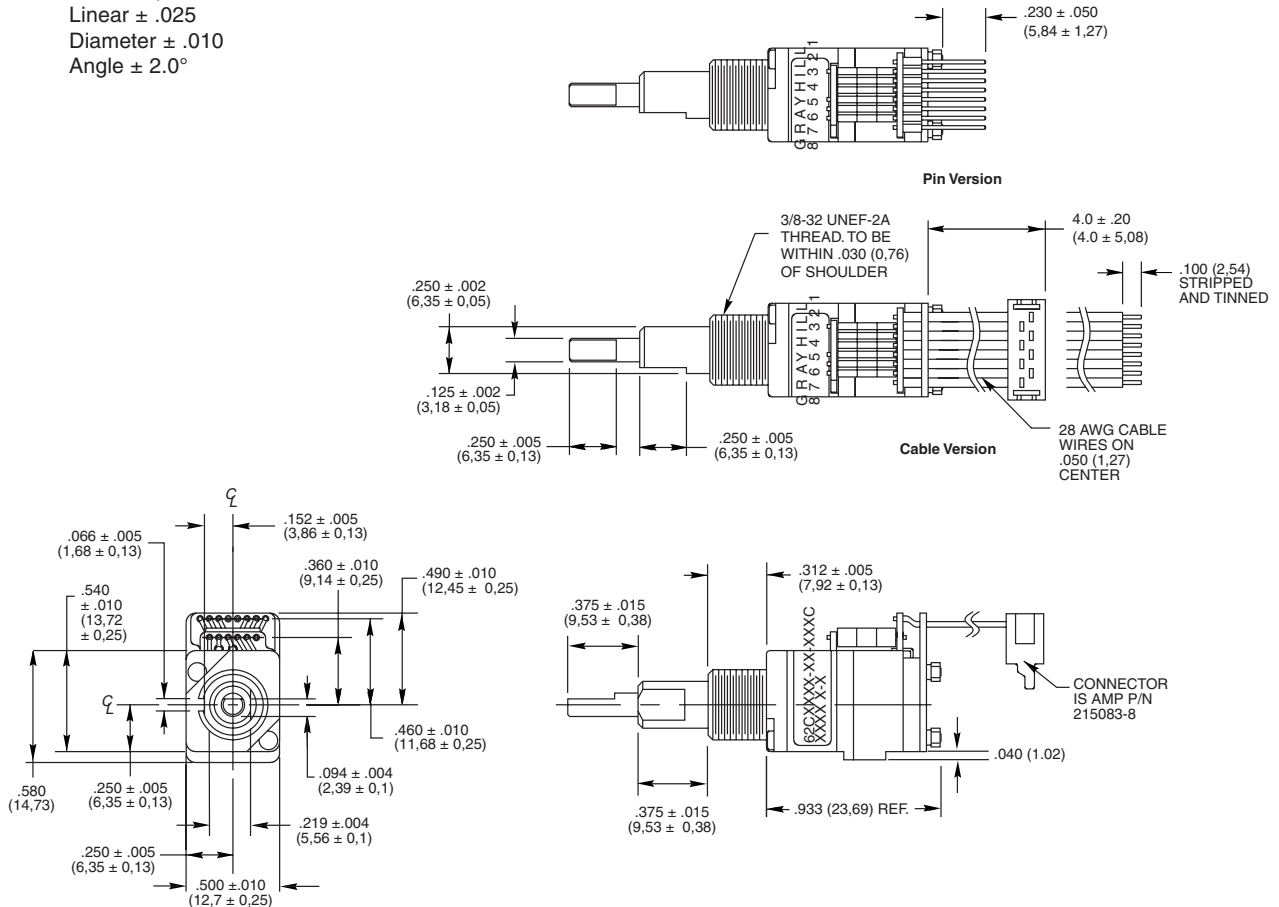
- Used to Set Radio Frequency, Drill Depth, RPM, Menu Selection, Parameter Selection for Patient Monitoring Devices, etc.



DIMENSIONS In inches (and millimeters)

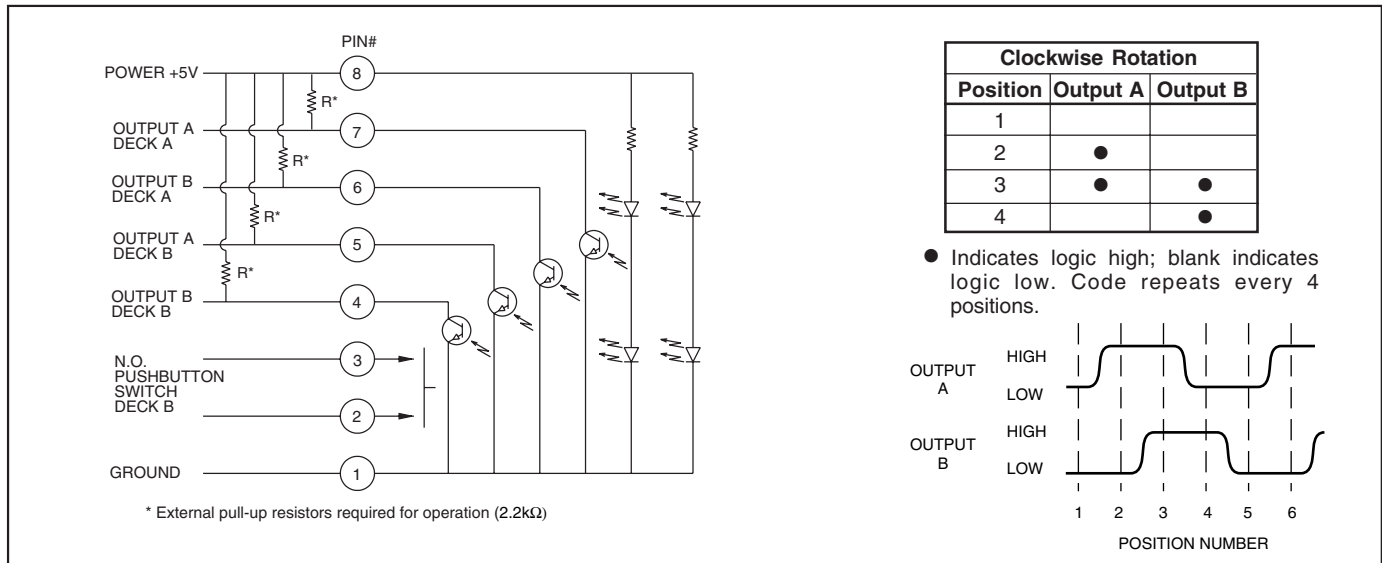
Unless otherwise specified, standard tolerance are:

- Linear $\pm .025$
- Diameter $\pm .010$
- Angle $\pm 2.0^\circ$



Optical and Mechanical Encoders

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



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

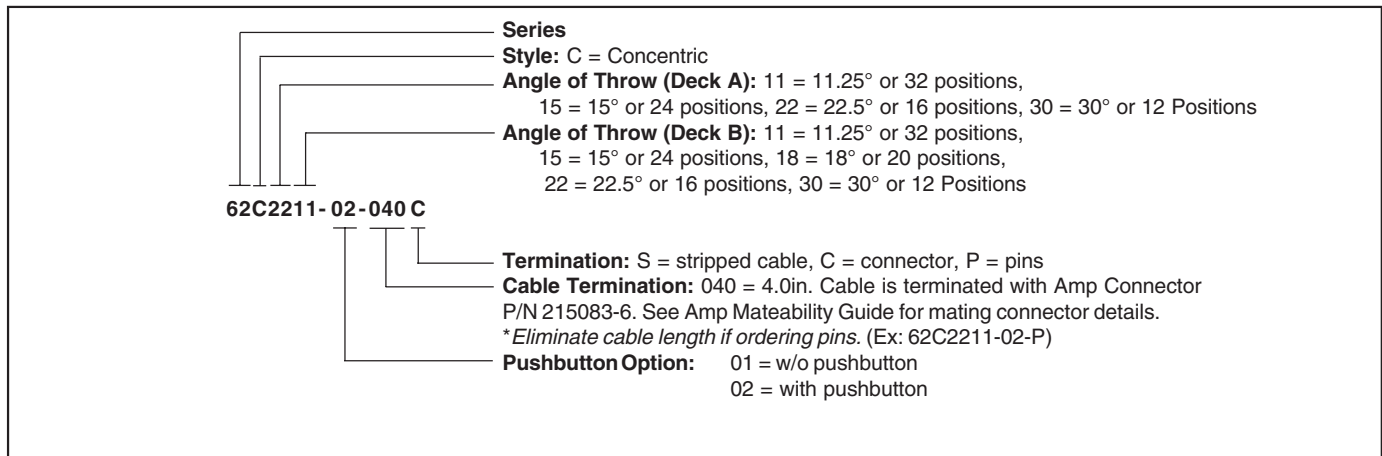
Environmental Ratings

- 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



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 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

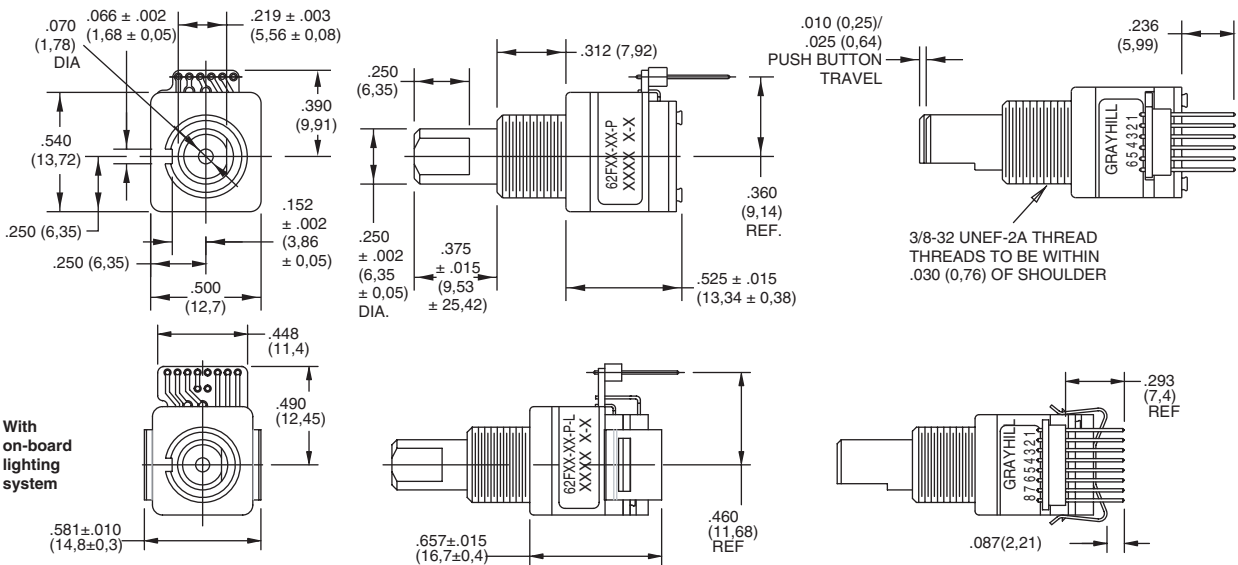
APPLICATIONS

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

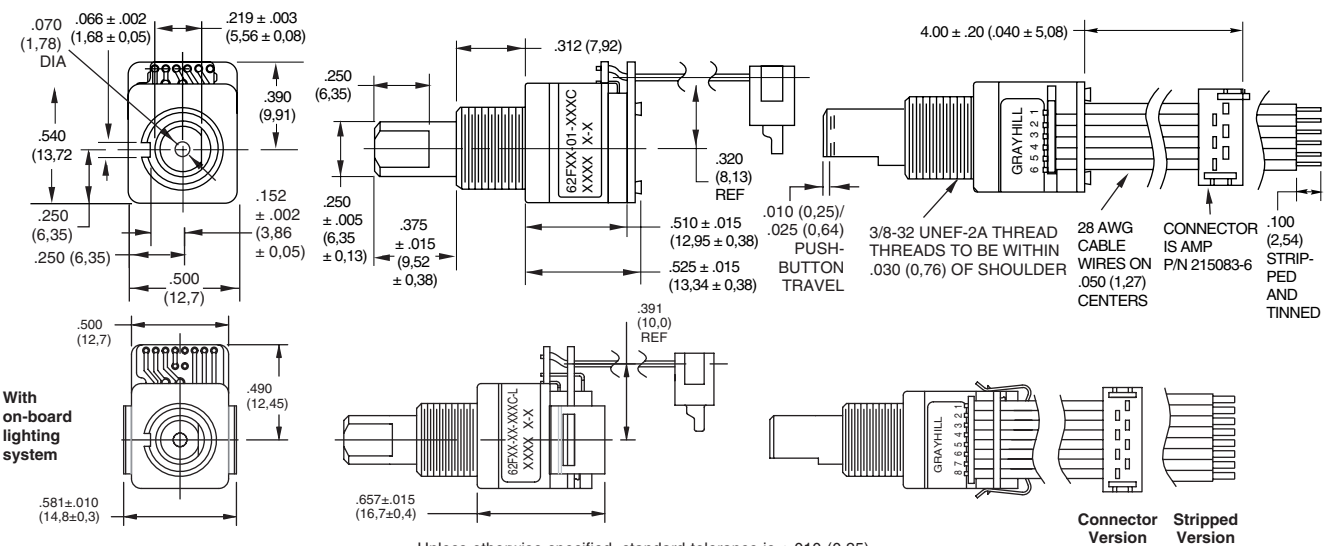


DIMENSIONS In inches (and millimeters)

Pin Version



Cable Version



Unless otherwise specified, standard tolerance is ± 0.10 (0,25).



Optical and Mechanical Encoders

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

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

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

SPECIFICATIONS

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 Characteristics:**
 - 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

62F22-01-040S-L

| | | |
|---------------|-------------------------------|-----------------------------|
| 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.

Optical and Mechanical Encoders

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

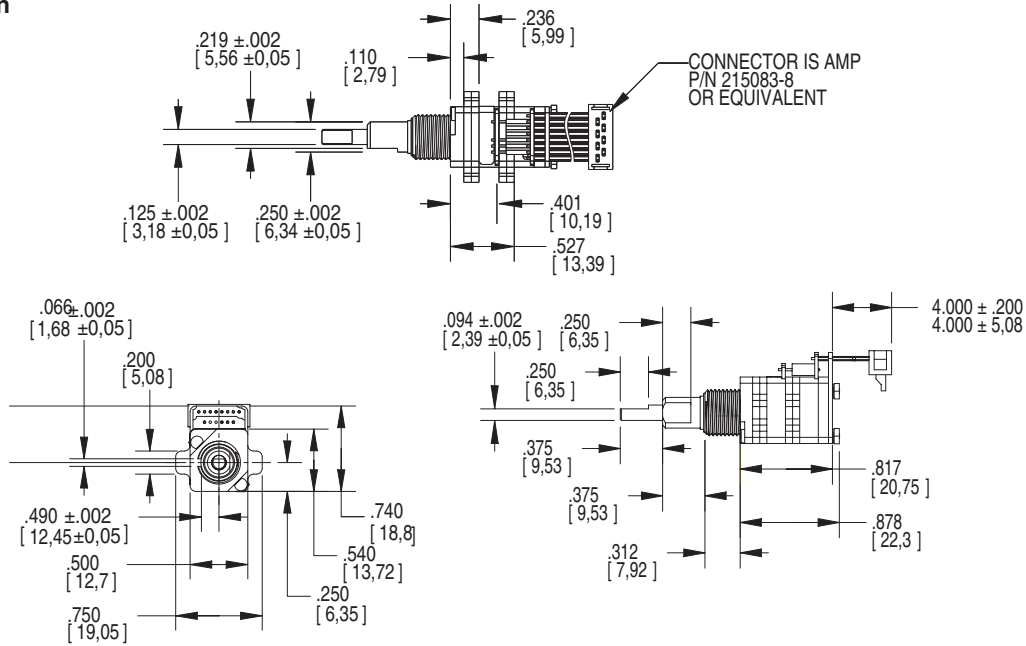
APPLICATIONS

- Avionics

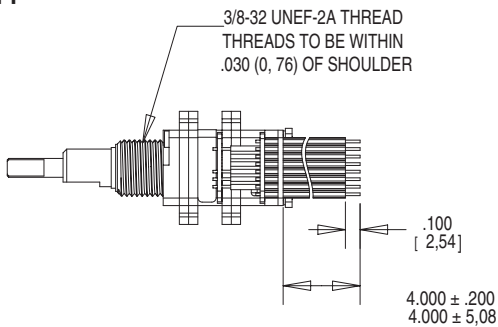


DIMENSIONS In inches (and millimeters)

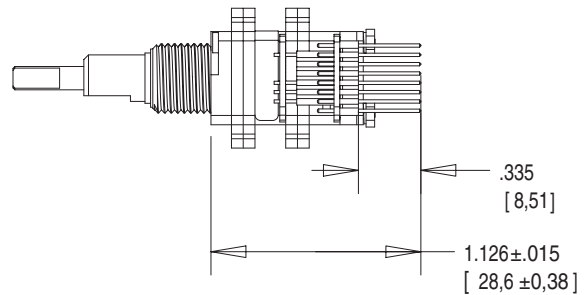
Cable Version



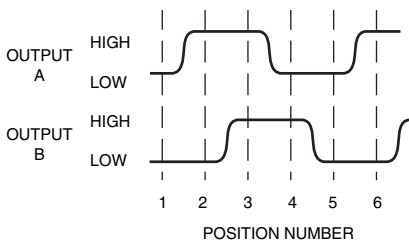
Stripped Version



Pin Version



WAVEFORM AND TRUTH TABLE

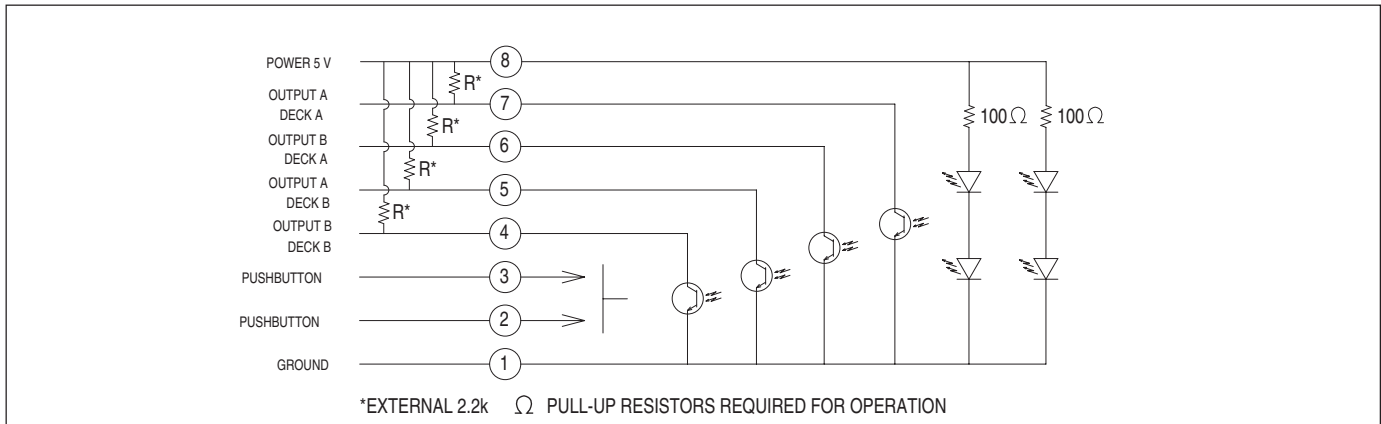


| Clockwise Rotation | | |
|--------------------|----------|----------|
| Position | Output A | Output B |
| 1 | | |
| 2 | ● | |
| 3 | ● | ● |
| 4 | | ● |

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



CIRCUITRY



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 Characteristics:**
- 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

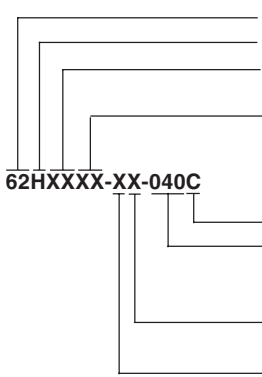
- Operating Temperature Range:** -40°C to 85°C
- Storage Temperature Range:** -55°C to 100°C
- Vibration Resistance:** Harmonic motion with amplitude of 15G, within a varied 10 to 2000 Hz frequency for 12 hours
- Mechanical Shock:** Test 1: 100G, 6 mS, half sine, 12.3 ft/s; Test 2: 100G, 6 mS, sawtooth,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



Series

Style: H = High Torque, Concentric

Angle of Throw (Deck A): 45 = 45° or 8 positions, 30 = 30° or 12 positions, 22 = 22.5° or 16 positions

Angle of Throw (Deck B): 45 = 45° or 8 positions, 30 = 30° or 12 positions, 22 = 22.5° or 16 positions

Termination: S = stripped cable, C = connector, P = pins

Cable Termination: 040 = 4.0in. Cable is terminated with Amp Connector P/N 215083-8. See Amp Mateability Guide for mating connector details.
*Eliminate cable length if ordering pins. (Ex: 62H2222-H9-P)

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

Rotational Torque: H = High Torque

Optical and Mechanical Encoders

SERIES 62HN

High Torque, Non-Turn Concentric Shaft

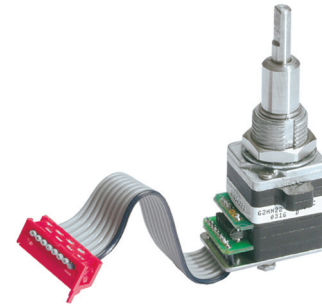
FEATURES

- High Rotational Torque Provides Positive Tactile Feedback
- Non-turn Pushbutton to Ensure Pushbutton Text and Orientation
- Optically Coupled for More than a Million Cycles
- Separate Pushbutton Function

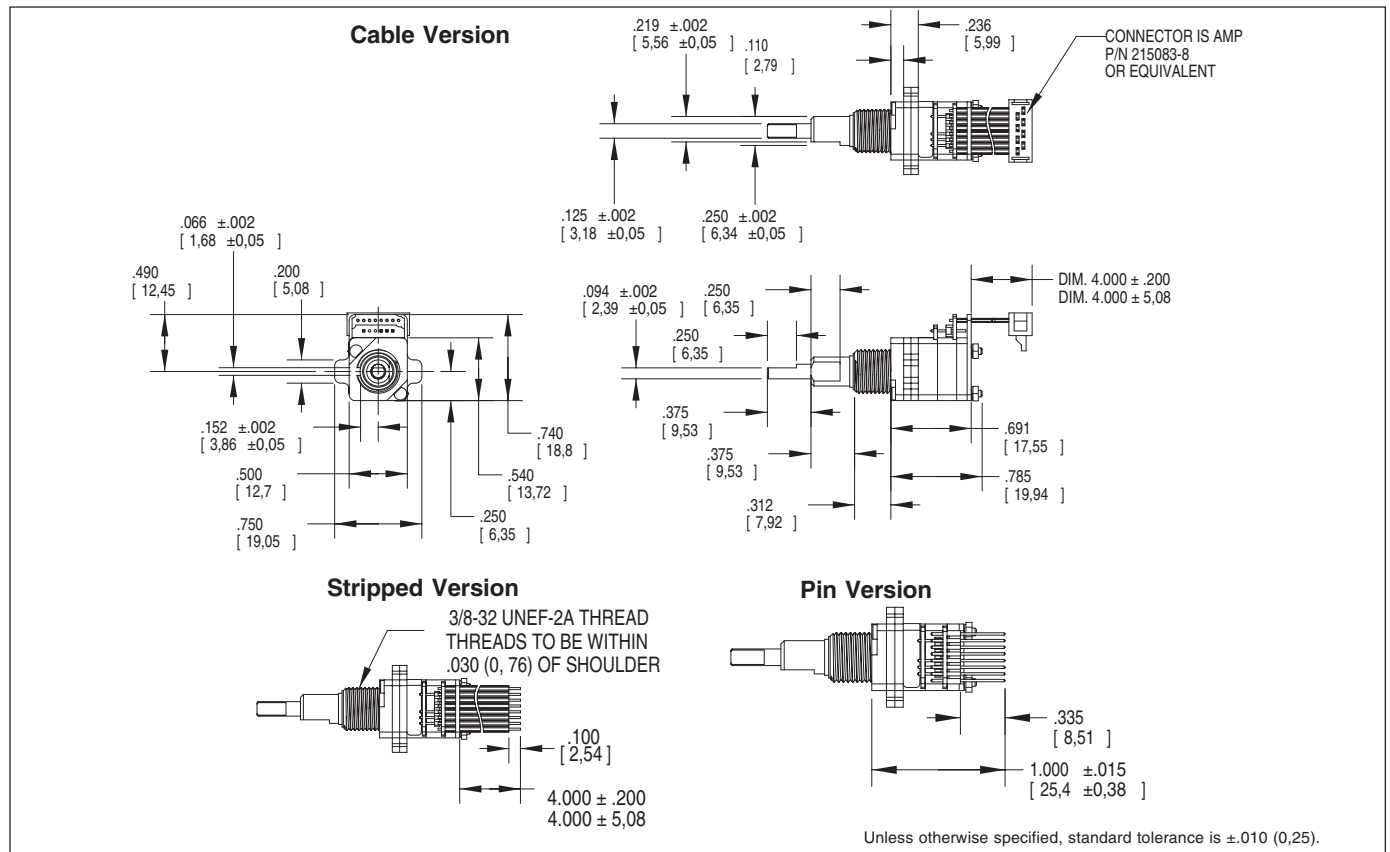
- Compatible with CMOS, TTL and HCMOS Logic
- Available in 8,12 and 16 Detent Positions
- Choice of Cable Length and Terminations

APPLICATIONS

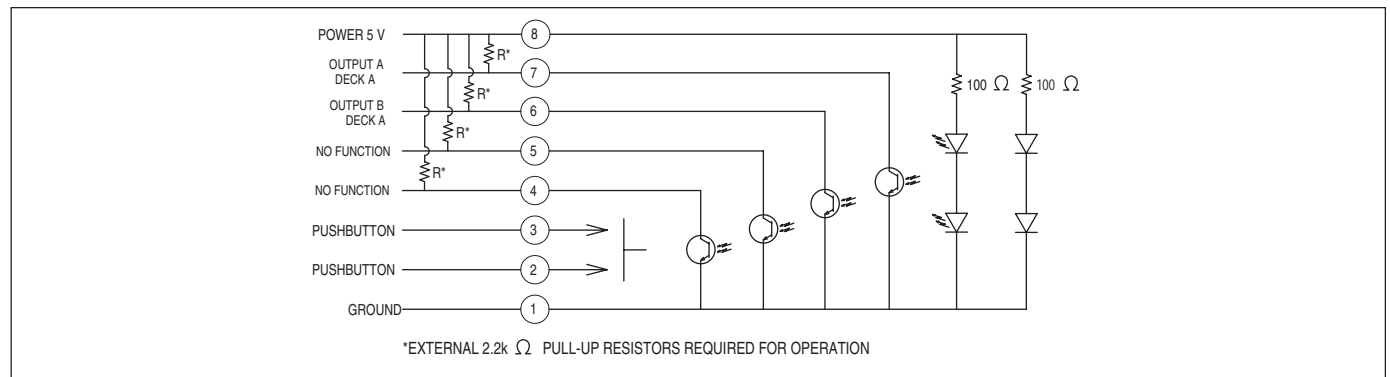
- Avionics



DIMENSIONS In inches (and millimeters)

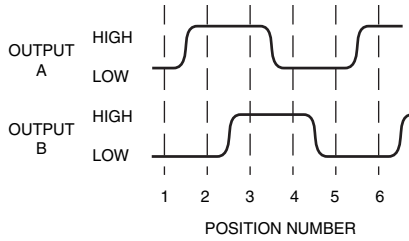


CIRCUITRY



Optical and Mechanical Encoders

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 Characteristics:**
- 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

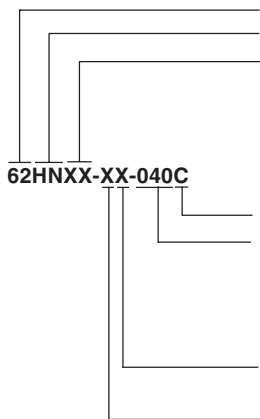
- Operating Temperature Range:** -40°C to 85°C
- Storage Temperature Range:** -55°C to 100°C
- Vibration Resistance:** Harmonic motion with amplitude of 15G, within a varied 10 to 2000 Hz frequency for 12 hours
- Mechanical Shock:** Test 1: 100G, 6 mS, half sine, 12.3 ft/s; Test 2: 100G, 6 mS, sawtooth,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

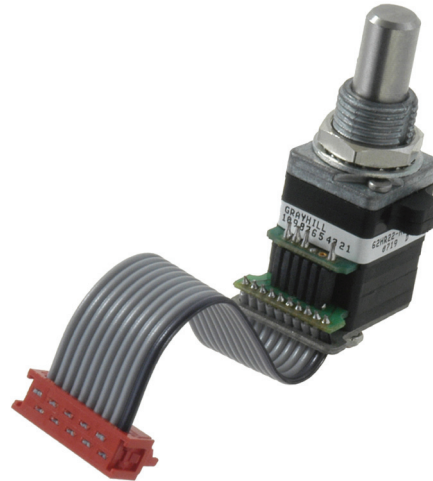
SERIES 62HR
1/2" Package, Redundant Circuitry
High Torque

FEATURES

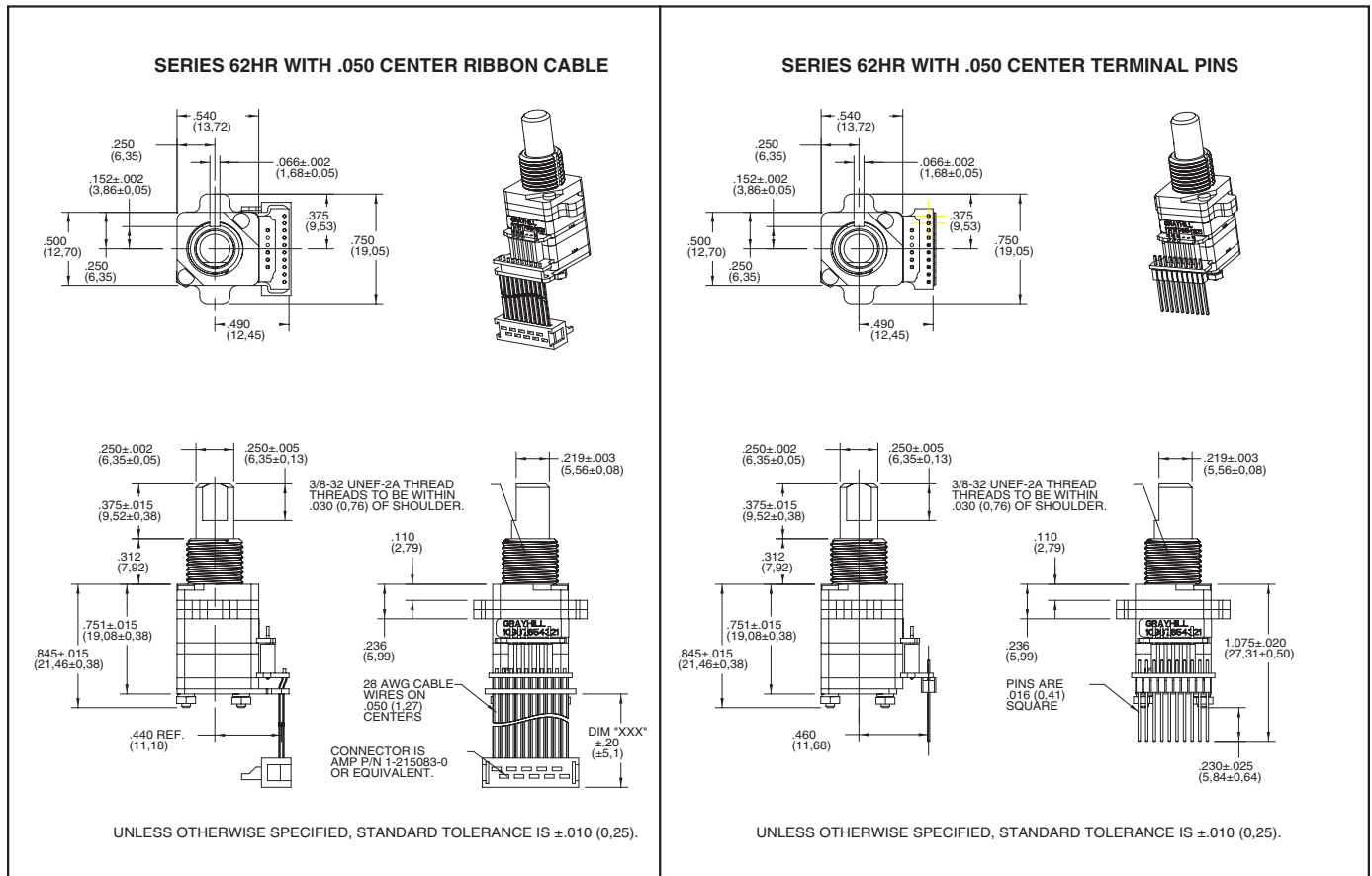
- Redundant Circuitry
- 1 Million Rotational Cycles
- Compatible with CMOS, TTL and HCMOS Logic
- Optional Integral Pushbutton
- Available in 12, 16, 24, and 32 Detent Positions
- Choices of Cable Length and Terminations
- Ideal for Critical Applications

APPLICATIONS

- Cockpit Controls
- Medical Equipment



DIMENSIONS In inches (and millimeters)



Optical and Mechanical Encoders

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 Characteristics:**
- 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

Optical and Mechanical Encoders

SERIES 62HS High Torque

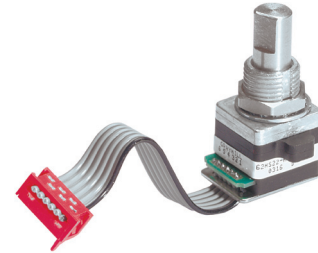
FEATURES

- 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

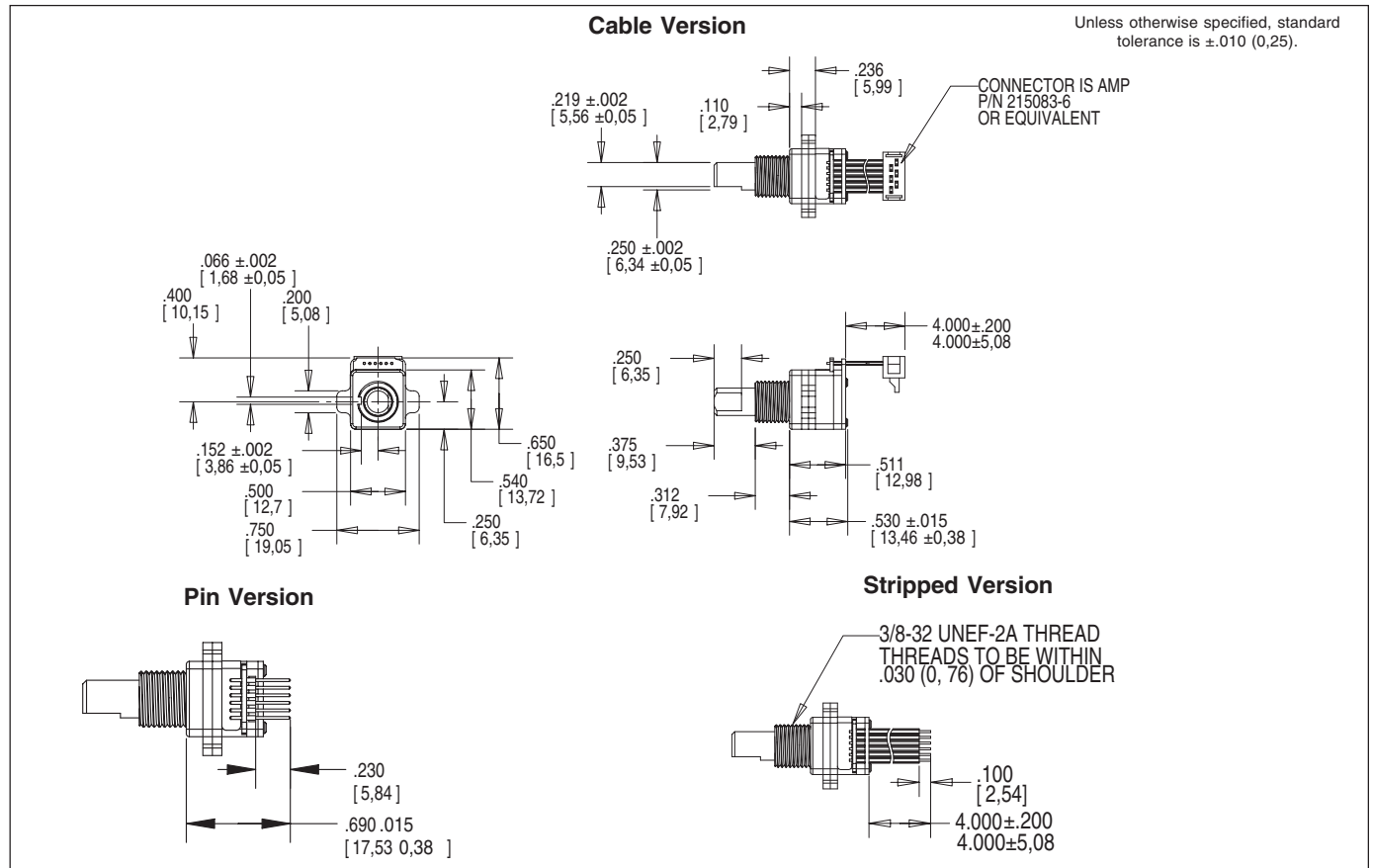
- Available in 8, 12 and 16 Detent Positions
- Choice of Cable Length and Terminations

APPLICATIONS

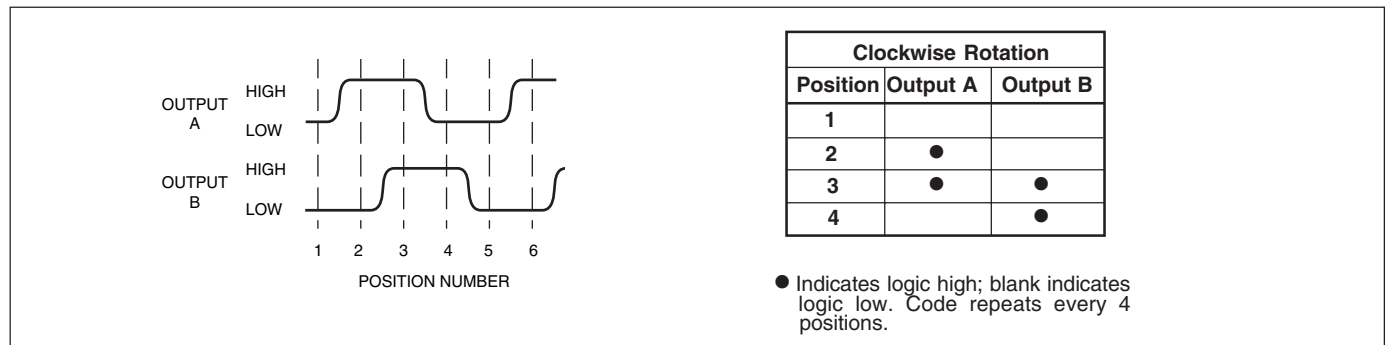
- Avionics



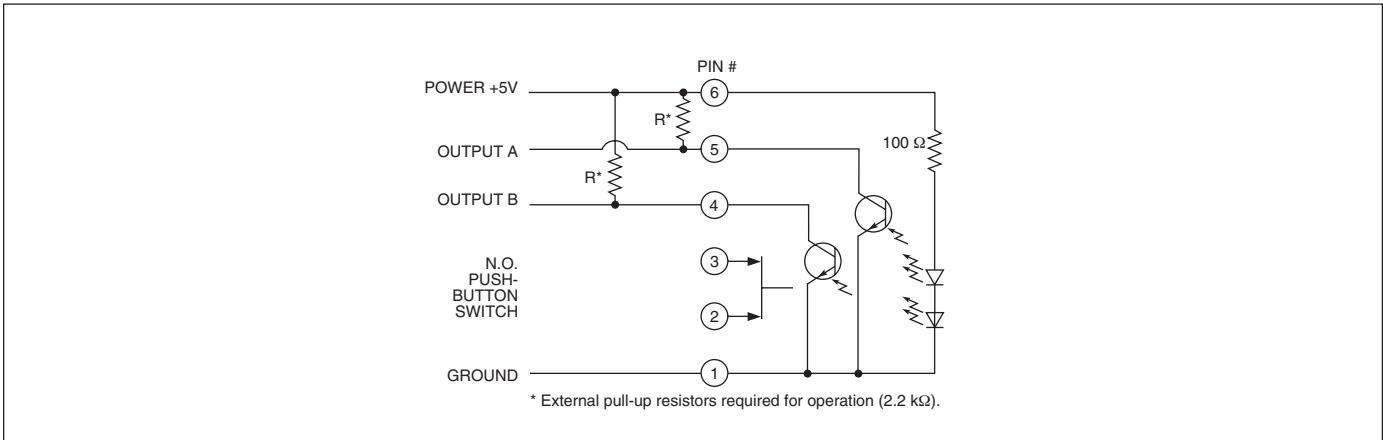
DIMENSIONS In inches (and millimeters)



WAVEFORM AND TRUTH TABLE



CIRCUITRY



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 Characteristics:**
- 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

Optical and Mechanical Encoders

ORDERING INFORMATION

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

62HSXX-XX-XXXX

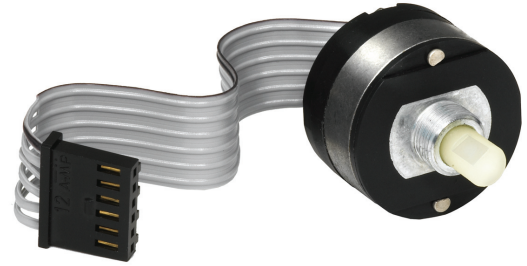
SERIES 62M
Magnetic Detent

FEATURES

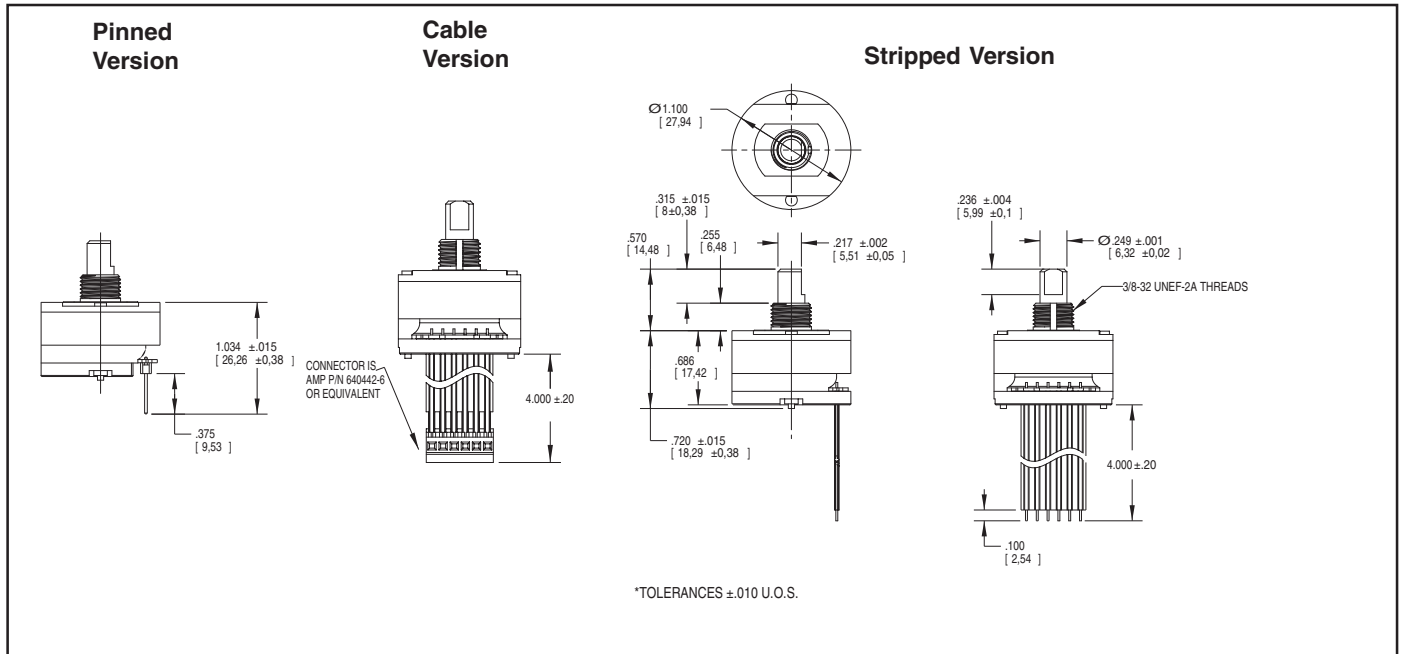
- Ultra Smooth Magnetic Detent
- 10 Million Rotational Cycles, Ten Times the Life of a Mechanical Detent System
- Optional Integrated Pushbutton
- Available in 24 Positions
- Choice of Cable Lengths

Applications

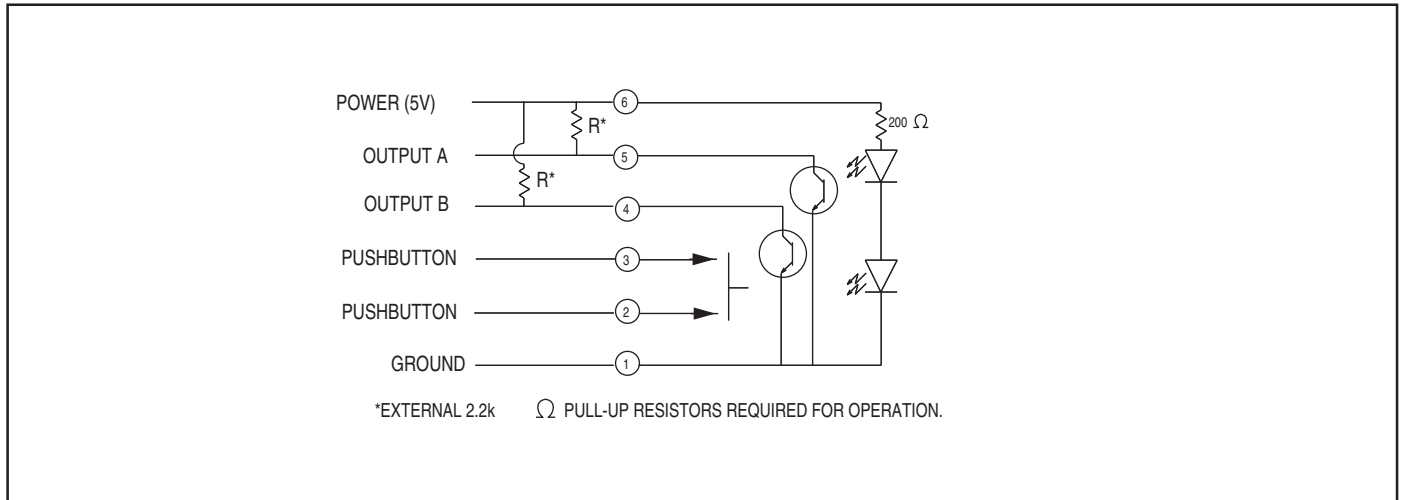
- Medical
- Audio
- Instrumentation



DIMENSIONS In inches (and millimeters)

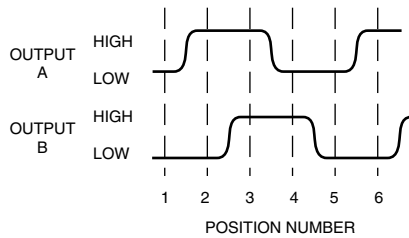


SWITCH SCHEMATIC



Optical and Mechanical Encoders

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)

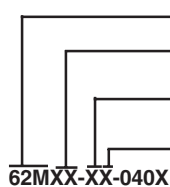
Label: TT406 Thermal Transfer Cast Film

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 Thermoplastic 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 62N
1/2" Package, non-turn, Dedicated Shaft



FEATURES

- Non-turn Pushbutton to Ensure Pushbutton Text and Orientation
- Separate Pushbutton Function
- Low Cost
- Economical Size
- Optically Coupled for More than a Million Cycles
- Compatible with CMOS, TTL and HCMOS Logic

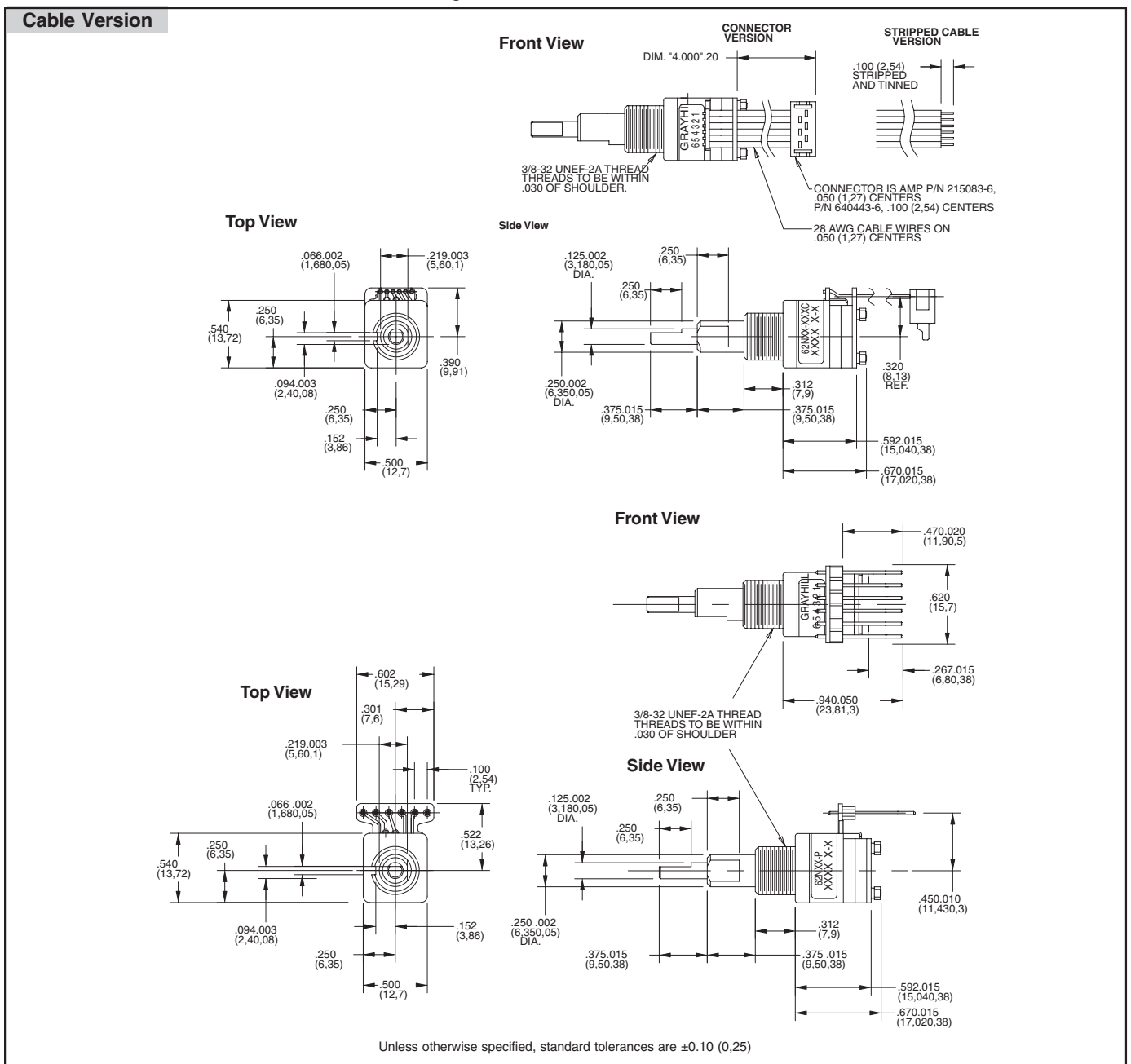
- Available in 12, 16, 24, and 32 Detent Positions (Non-detent Also Available)
- Choices of Cable Length and Terminations

APPLICATIONS

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



DIMENSIONS In inches (and millimeters)



Optical and Mechanical Encoders

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 Characteristics:
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

| 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 (2.2 kΩ).

ORDERING INFORMATION

62N22-040S

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

Angle of Throw: Detent
 11 = 11.25° or 32 pos.
 15 = 15° or 24 positions
 22 = 22.25° or 16 positions
 30 = 30° or 12 positions

Non-detent
 01 = 11.25° or 32 positions
 05 = 15° or 24 positions
 02 = 22.5° or 16 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.

Optical and Mechanical Encoders

SERIES 62P
Low Cost, PC Mount

FEATURES

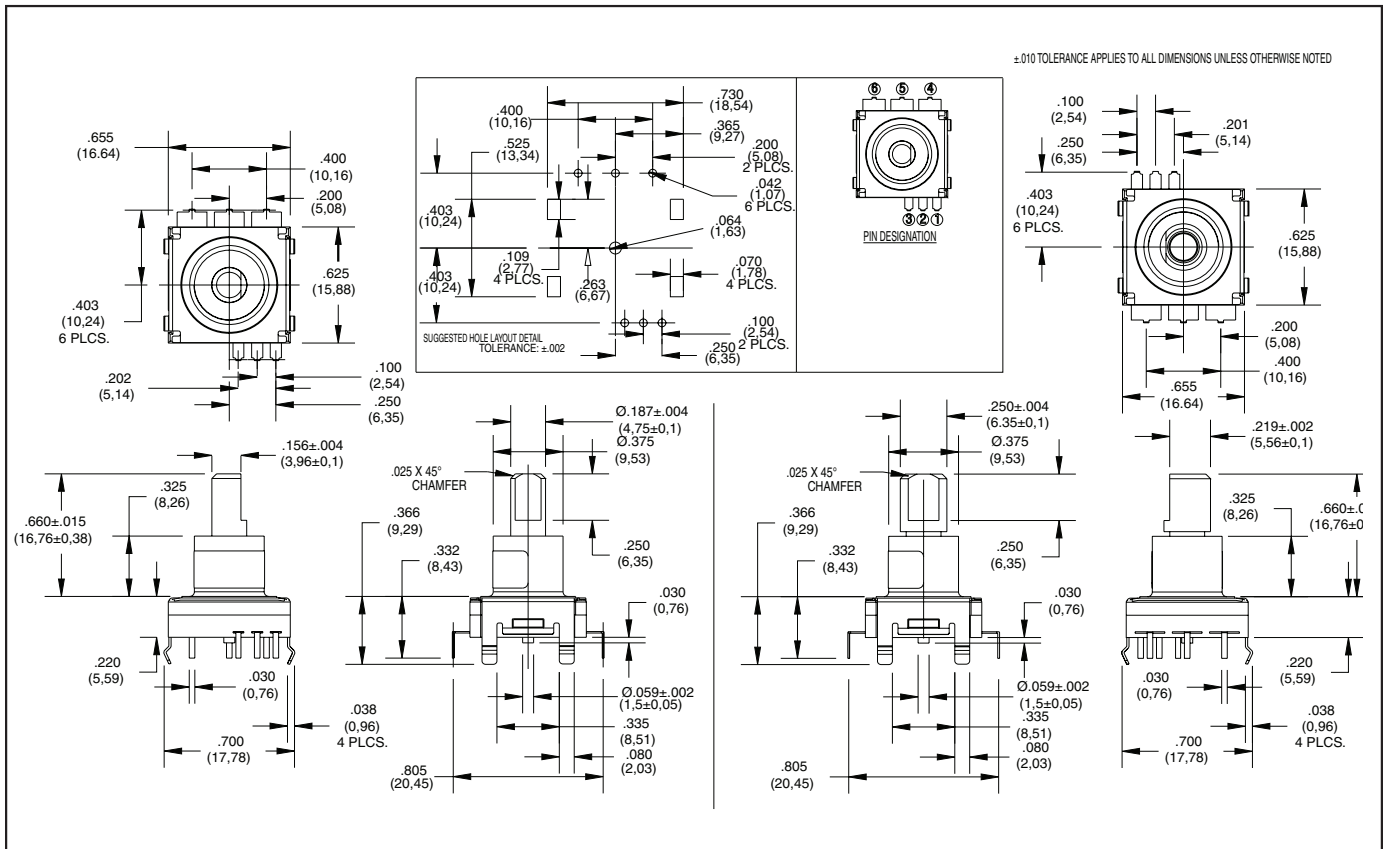
- Low Cost
- Compact Size
- PC Mount
- No De-Bouncing Required
- Reliable, Up to 2 Million Cycles
- Choice of Detent and Pushbutton Force
- Available in 16 Positions
- Quadrature Output

APPLICATION

- Automotive Controls
- White Goods
- Audio

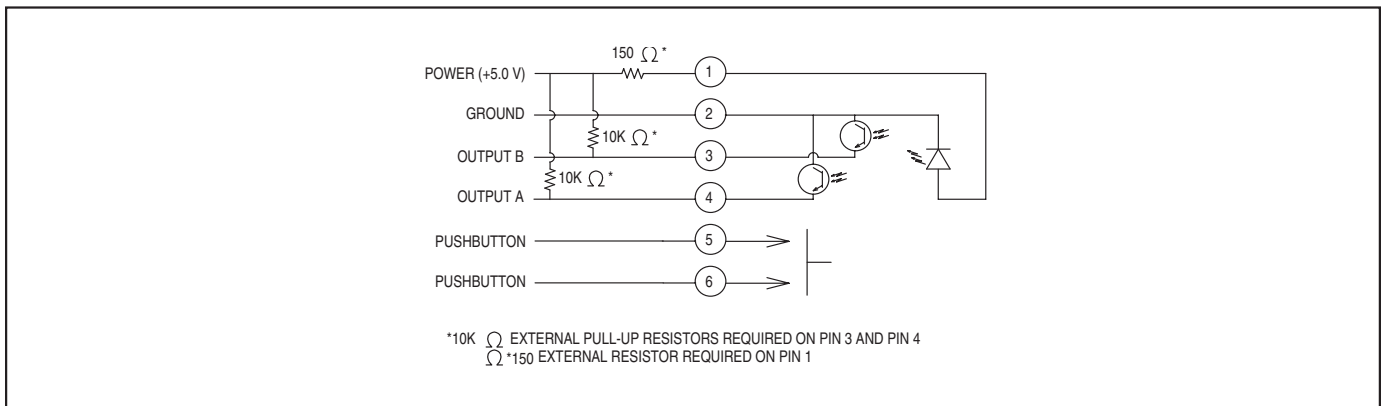


DIMENSIONS In inches (and millimeters)

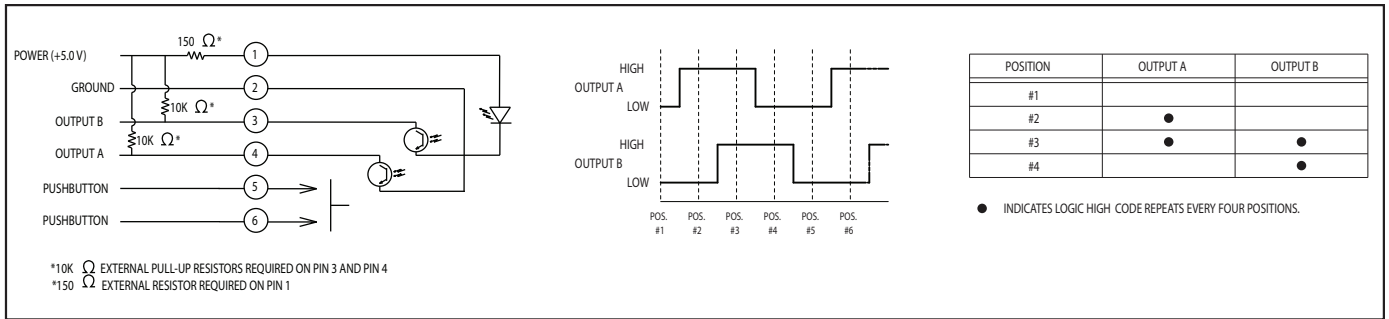


Optical and Mechanical Encoders

CIRCUITRY



WAVEFORM AND TRUTH TABLE Standard Quadrature 2-bit Code



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.

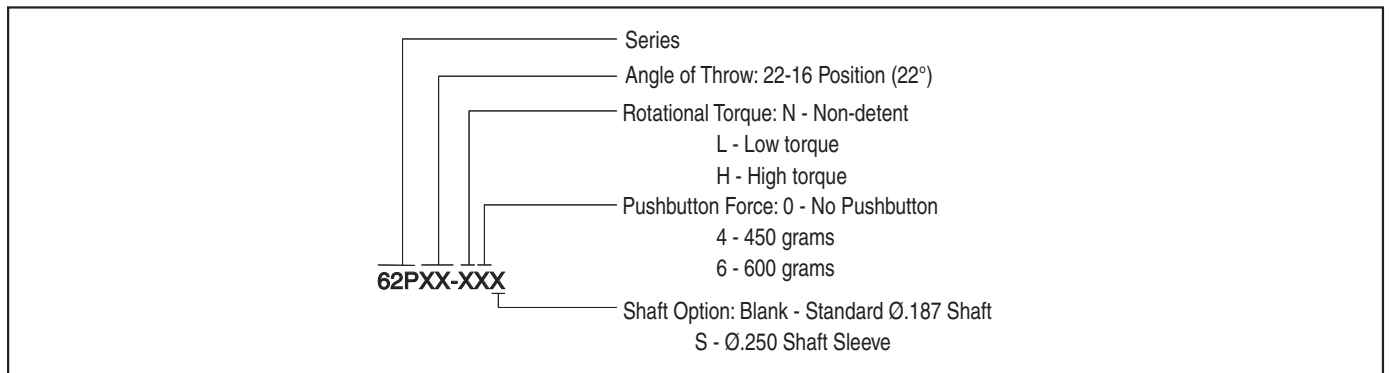
Test 2: 100g for 6mS, Sawtooth, 9.7 ft/s

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

Optical and Mechanical Encoders

ORDERING INFORMATION



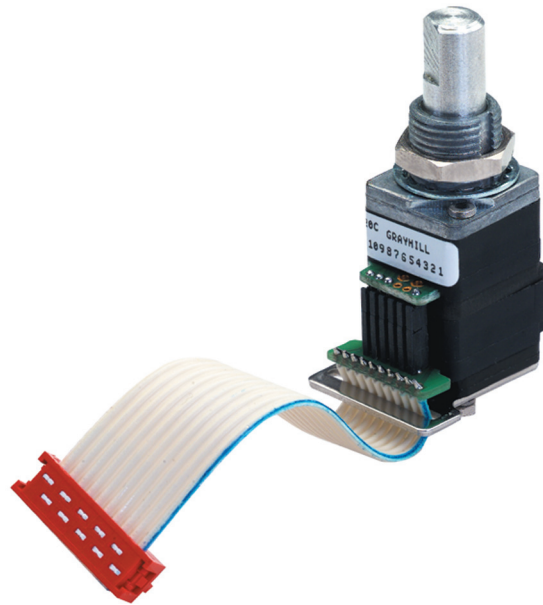
SERIES 62R
1/2" Package, Redundant Circuitry

FEATURES

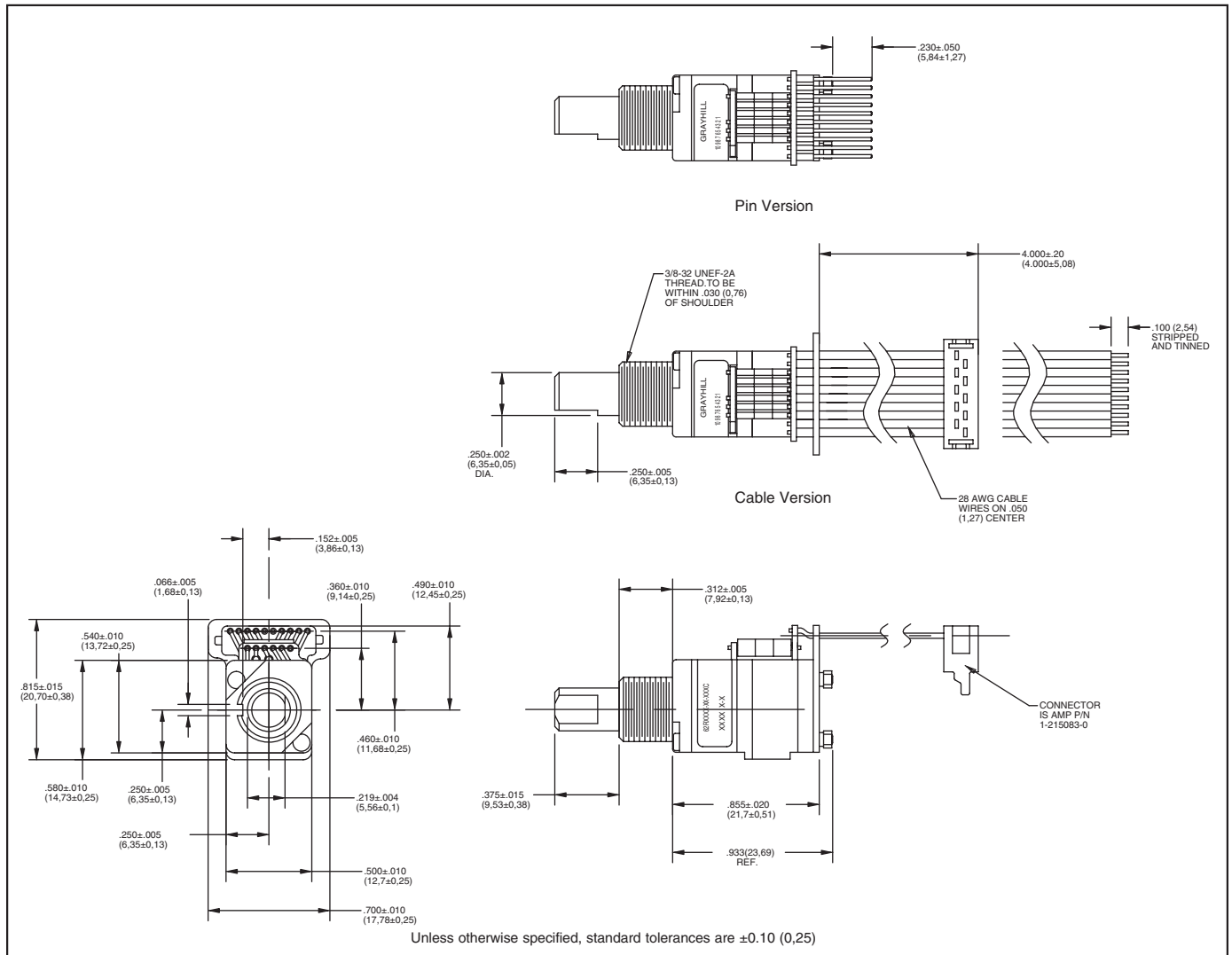
- Redundant Circuitry
- 1 Million Rotational Cycles
- Compatible with CMOS, TTL and HCMOS Logic
- Optional Integral Pushbutton
- Available in 12, 16, 24, and 32 Detent Positions
- Choices of Cable Length and Terminations
- Ideal for Critical Applications

APPLICATIONS

- Cockpit Controls
- Medical Equipment



DIMENSIONS In inches (and millimeters)



Optical and Mechanical Encoders

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

Switch Schematic

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 Characteristics:**
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

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.

Optical and Mechanical Encoders

SERIES 61M
Optically Coupled for Simulated
Mechanical Rotary Switch Output

FEATURES

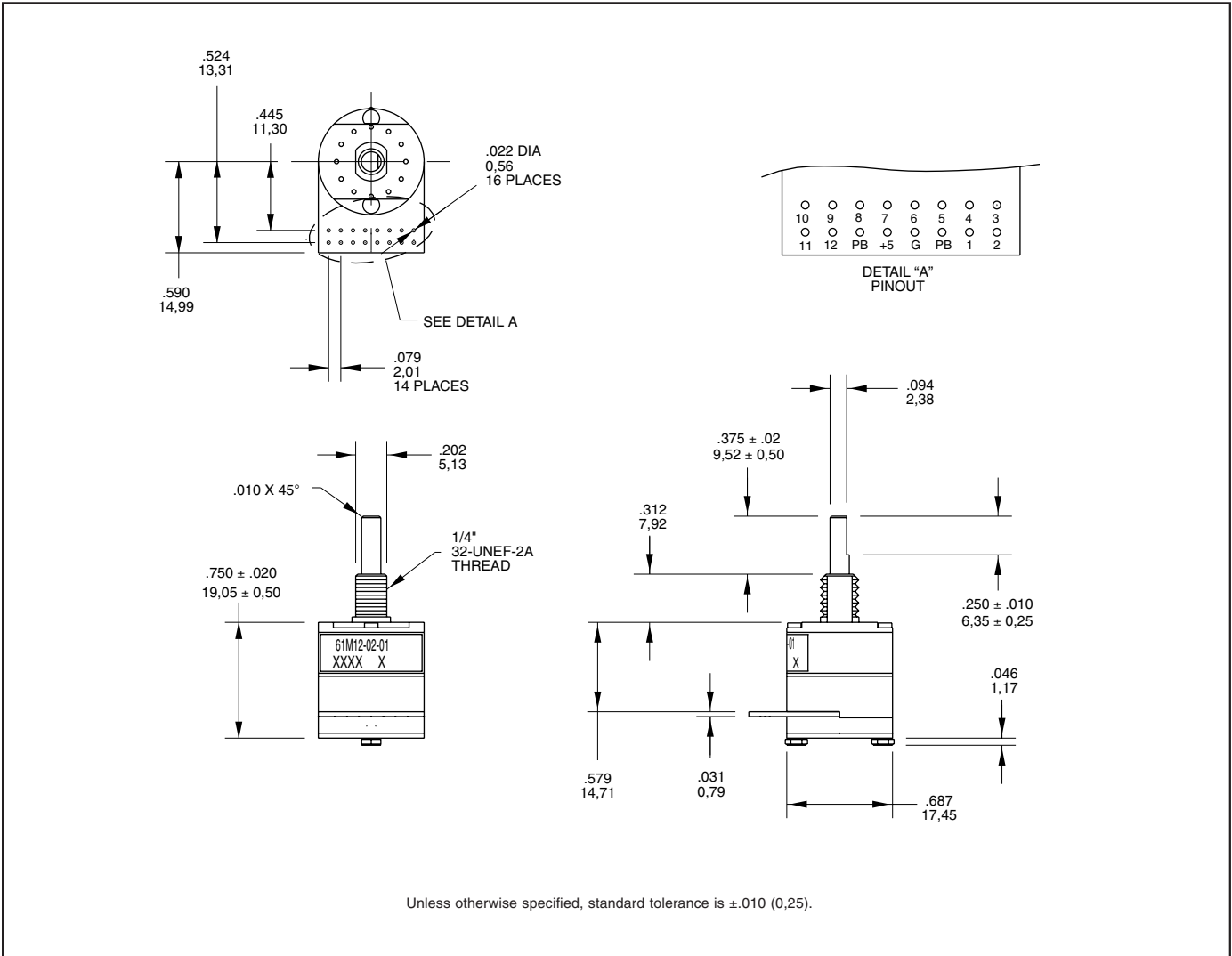
- Optical Alternative to Rotary Contacts
- One Pulse Per Detent Position Per Rotation
- Long Life of a Million Cycles
- With or Without Pushbutton
- Continuous Rotation and Fixed Stops Available
- Rugged Construction
- 8, 10 and 12 Positions Available

Applications

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



DIMENSIONS In inches (and millimeters)



Optical and Mechanical Encoders

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

SWITCH SCHEMATIC

N.O. PUSHBUTTON

Note: External pull-up resistors required for operation. 20k Ω 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

Optical and Mechanical Encoders

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. \pm 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 \pm .25 Vdc
- Supply Current:** 60mA maximum at 5 Vdc
- Logic High:** 3.8V minimum
- Logic Low:** .8V minimum
- Logic Rise and Fall Time:** 30mS Typ.

Environmental

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

Materials and Finishes

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

OPTIONS

Contact Grayhill for customer application needs.

ORDERING INFORMATION

Series
"M" Style

Angle of Throw: Detent

- 08 = 45° or 8 positions
- 10 = 36° or 10 positions
- 12 = 30° or 12 positions

Termination: 01 = without terminal pins, 02 = with terminal pins

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

61MXX-XX-XX

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.