

## SERIES 60AD

### Optical Encoder with integrated Joystick and Pushbutton

#### FEATURES

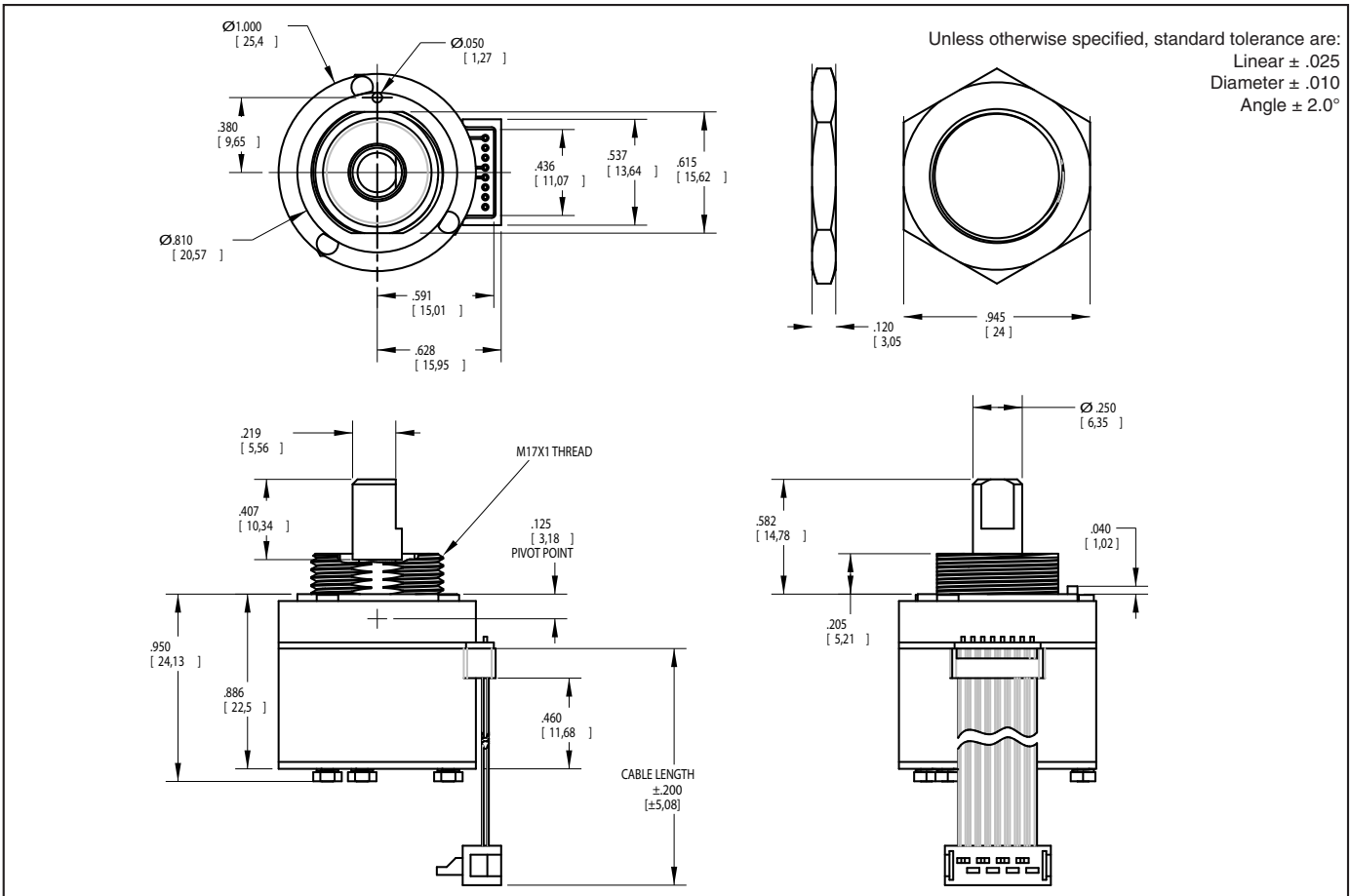
- Dome contacts provide excellent tactile feedback in all directions
- Choices of actuation force, cable length and termination
- Customized solutions available

#### APPLICATIONS

- Aerospace
- Automotive
- Medical devices



#### DIMENSIONS in inches (and millimeters)



Optical and Mechanical Encoders

#### ORDERING INFORMATION

**60AD18-4-M-060S**

**Angle of Throw:** 18= 18° or 20 positions  
**Joystick:** 4= Four contacts & directions;  
 8= Four contacts & eight directions

**Termination:** 0.050" center P= pin header; C= connector; S= stripped cable  
**Cable Length:** 020 thru 250 in 1/2 inch increments, 060= 6.0 inch cable  
**Force Option:** (see table) L=low, M=medium, H=high

|                                     | OPTION    |           |           |
|-------------------------------------|-----------|-----------|-----------|
|                                     | L         | M         | H         |
| 1 ACTUATION FORCE (JOYSTICK) [g]    | 550±200   | 725±200   | 1050±250  |
| 2 ACTUATION FORCE (PUSHBUTTON) [g]  | 625±200   | 800±200   | 1100±250  |
| 3 AVERAGE ROTATIONAL TORQUE [in-oz] | 1.50±0.75 | 3.50±1.75 | 5.00±2.00 |

For prices and custom configurations, contact a local sales office, an authorized distributor, or Grayhill's sales department.

**JOYSTICK OPERATION + ENCODER WAVEFORM AND TRUTH TABLE** Standard Quadrature 2-Bit Code

### SWITCH SCHEMATIC

**\*EXTERNAL PULL-UP RESISTORS REQUIRED FOR OPERATION (2.2k $\Omega$ ).**

### JOYSTICK POSITION DIAGRAM

\* INDICATES DIRECTION OF D-FLAT ON BUSHING

### ENCODER WAVEFORM (C.W. ROTATION)

### ENCODER TRUTH TABLE (C.W. ROTATION)

| POSITION | OUTPUT A | OUTPUT B |
|----------|----------|----------|
| #1       | ○        | ○        |
| #2       | ○        | ○        |
| #3       | ○        | ○        |
| #4       | ○        | ○        |

○ INDICATES LOGIC-HIGH  
○ INDICATES LOGIC-LOW  
CODE REPEATS EVERY FOUR POSITIONS

### JOYSTICK TRUTH TABLE

| POSITION | X OUTPUT | Y OUTPUT |
|----------|----------|----------|
| 1        | NEUTRAL  | HIGH     |
| 2        | HIGH     | HIGH     |
| 3        | HIGH     | NEUTRAL  |
| 4        | HIGH     | LOW      |
| 5        | NEUTRAL  | LOW      |
| 6        | LOW      | LOW      |
| 7        | LOW      | NEUTRAL  |
| 8        | LOW      | HIGH     |
| 9        | NEUTRAL  | NEUTRAL  |

**SPECIFICATIONS**

**Rotary Specifications**

**Operating Voltage:** 5.00  $\pm$  0.25 Vdc  
**Supply Current:** 20mA max at 5 Vdc  
**Minimum Sink Current:** 2.0mA at 5 Vdc  
**Power Consumption:** 0.1mW max at 5 Vdc  
**Output:** Open collector phototransistor, 2.2k  $\Omega$  external pull-up resistors are required  
**Output Code:** 2-Bit quadrature, channel A leads channel B by 90° in clockwise rotation  
**Logic Output Characteristics:**  
 High: No less than 3.5 Vdc  
 Low: No greater than 1.0 Vdc  
**Mechanical Life:** 1 million rotational cycles (through all positions and a full return)  
**Rotational Torque:** see table  
**Maximum Rotational Speed:** 100 RPM  
**Mounting Torque:** 15 in-lbs. maximum  
**Shaft Push/Pull Out Force:** 45 lbs min.  
**Shaft Side-Load Force:** 20 lbs. min.  
**Terminal Strength:** 15 lbs pull-out force min.

**Pushbutton Specifications**

**Rating:** 10 mA at 5 Vdc resistive  
**Contact Resistance:** less than 10 ohms  
**Contact Bounce:** < 4ms make, <10 ms break  
**Mechanical Life:** 1 million actuations min.  
**Actuation Force:** see table  
**Pushbutton Travel:** .027  $\pm$  .010 in.

**Joystick Specifications**

**Supply Current:** 5mA max  
**Output Code:** 2-Bit  
**Logic Output Characteristics:**  
 Neutral Position: 2.5  $\pm$  0.5 Vdc  
 High-State Position: >4.5 Vdc  
 Low-State Position: <0.5 Vdc  
**Mechanical Life:** 500k cycles min.  
**Actuation Force:** see table  
**Angle of Throw:** 3.5° +2°/-1°

**Environmental Ratings**

**Operating Temp. Range:** -40°C to 85°C  
**Storage Temp. 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 10 to 2000 Hz 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**

**Detent Housing:** Nylon 6/10  
**Shaft:** Nylon 6/10  
**Shaft Insert:** 303 stainless steel  
**Joystick Housing:** Nylon 6,10  
**Centering Plate:** Nylon 6,10  
**Detent Balls:** Carbon steel  
**Detent Springs:** Music wire  
**Dome Contacts:** Stainless steel  
**Dome Housings:** Polycarbonate over brass-lead frame  
**Dome Retainers:** Nylon 6,0; 30% glass-filled  
**Joystick Actuators:** Polyphthalamide; 50% glass filled  
**Pushbutton Dome Retainer:** Polycarbonate  
**Printed Circuit Board:** NEMA grade FR-4. Glass-cloth epoxy, double clad with copper  
**Infrared Emitter:** Gallium arsenide  
**Phototransistor:** Planar silicon  
**Resistors:** Metal oxide on ceramic substrate  
**Solder:** 95.5% SN, 3% AG, 0.5% CU

**OPTIONS**

Contact Grayhill for custom terminations, rotational torque, number of positions, shaft configurations, and resolutions.