

## SERIES 60AD

### Optical Encoder with integrated Joystick and Pushbutton

#### FEATURES

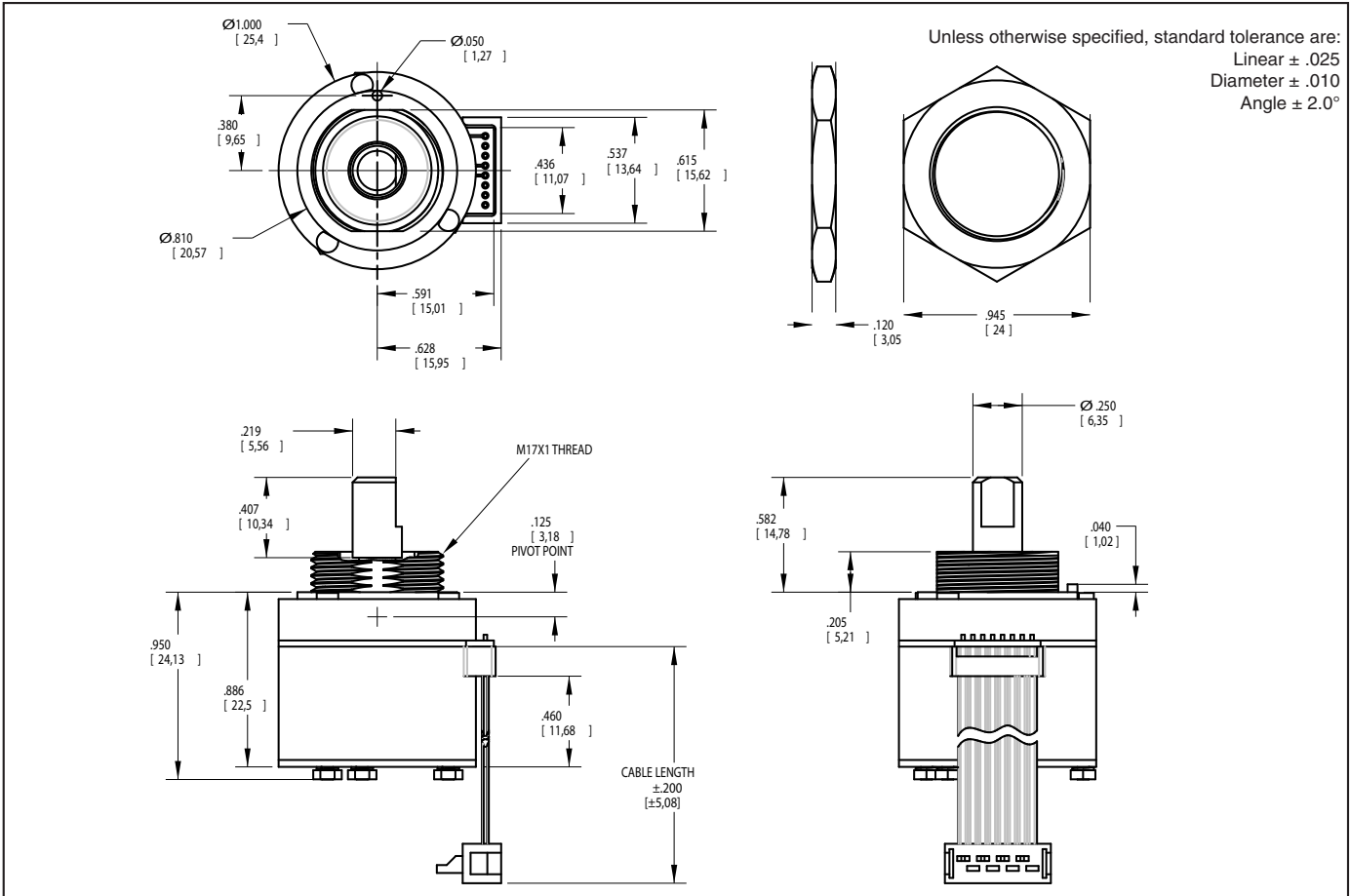
- Dome contacts provide excellent tactile feedback in all directions
- Choices of actuation force, cable length and termination
- Customized solutions available

#### 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.