**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)

<table>
<thead>
<tr>
<th>Option</th>
<th>L</th>
<th>M</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ACTUATION FORCE (JOYSTICK) [g]</td>
<td>550±200</td>
<td>725±200</td>
<td>1050±250</td>
</tr>
<tr>
<td>2. ACTUATION FORCE (PUSHBUTTON) [g]</td>
<td>625±200</td>
<td>800±200</td>
<td>1100±250</td>
</tr>
<tr>
<td>3. AVERAGE ROTATIONAL TORQUE [in-oz]</td>
<td>1.50±0.75</td>
<td>3.50±1.75</td>
<td>5.00±2.00</td>
</tr>
</tbody>
</table>

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

JOYSTICK POSITION DIAGRAM

ENCODER WAVEFORM

ENCODER TRUTH TABLE

SPECIFICATIONS

Rotary Specifications
Operating Voltage: 5.00 ± 0.25 Vdc
Supply Current: 20mA max at 5 Vdc
MinimumSink Current: 2.0mA at 5 Vdc
Power Consumption: 100 mW max at 5 Vdc
Output: Open collector phototransistor, 2.2k Ω 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. max.
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 ± .010 in.

Joystick Specifications
Supply Current: 5mA max
Output Code: 2-Bit
Logic Output Characteristics:
Neutral Position: 2.5 ± 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: Polymethylmethacrylate; 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.