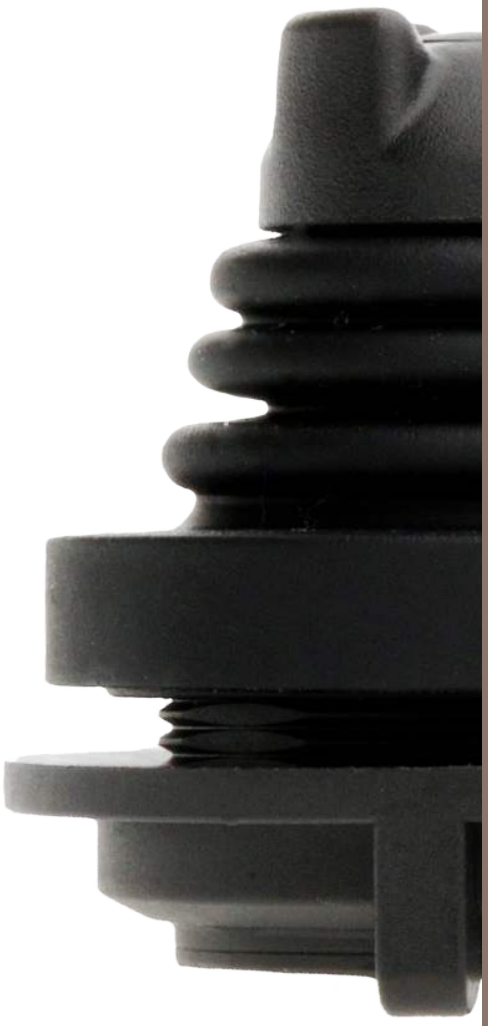
# TS series

Proportional miniature thumb controls • non-contacting Hall effect technology

## DISTINCTIVE FEATURES

**One or two axis**
**Analog, PWM or USB outputs**
**IP67 Above panel sealing mounting**
**Rear or drop-in mounting**
**Pushbutton option**



## ENVIRONMENTAL SPECIFICATIONS

- Operating Temperature: -40 °C to +85 °C (-40 °F to +185 °F)
- Storage Temperature: -40 °C to +85 °C (-40 °F to +185 °F)
- Above Panel Sealing: IP67, IP69K[1] (subject to mounting style & final specifications)
- EMC Immunity Level: EN61000-4-3
- EMC Emissions Level: EN61000-6-3:2001
- ESD:  EN61000-4-3 Level 2 (± 4 kv contact, ± 6 kv air)

## SENSOR SPECIFICATIONS

- Technology: Hall effect sensors, single or dual
- Supply Voltage Range: 5.00 V ± 0.01 VDC
- Supply Current: 11 mA max
- Ratiometric Output Options: See options
- Reverse Polarity max: -10 V
- Transient overvoltage max: 16 V
- Start-up time: 15 ms max
- Output Impedance: 2Ω
- Return to Center Voltage Tolerance: ± 200 mV initial

U.S. Patent #D816,169 S
U.S. Patent #D732,047 S
U.S. Patent #D816,169 S
U.S. Patent #D734,138 S

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## MECHANICAL SPECIFICATIONS

- Operating Force: 3.1 N ± 0.5 N (0.70 lbf ± 0.11 lbf)[2]
- Maximum Vertical Load: 200 N (45 lbf)[2]
- Maximum Horizontal Load: 150 N (33.7 lbf)[2]
- Mechanical Angle of Movement: 50° X & Y axis (subject to limiter plate)
- Expected Life: 1 million cycles
- Mass/Weight: 18.25 g ± 5.0 g (0.64 oz ± 0.18 oz)
- Lever Action (centering): Spring

[1] All options are IP68 and IP69K rated, however drop-in mounting does not prevent panel ingress.
[2] Force applied to the top of the castle cap.

## MATERIALS

- Body: Glass filled nylon
- Threaded Housing: Black oxide plated brass
- Boot: Silicone
- Handles:
  **1, 2, 3, E, F, G** - Glass filled nylon
  **4, 5, 6, 7, 8** - Silicone
  **B, C, D** - Thermoplastic elastomer
  **H** - Polycarbonate

APEM products may be recycled at end-of-life for the re-claiming of valuable metal components.

## CONNECTIONS

| WIRING SPECIFICATION (Termination options 1 & 2) | |
|---|---|
| Black | Ground & button common, or LED common |
| Red | Power (5 V)[1] |
| Blue | X axis output (alpha) |
| Yellow | Y axis output (alpha) |
| Orange | Pushbutton switch (option 6 handle) or LED supply (option H handle) [2] [2] |
| Blue/White Stripe | X axis output (beta) |
| Yellow/Black Stripe | Y axis output (beta) |
| Red/White Stripe | Power (5 V) (beta) |
| Black/White Stripe | Ground (beta) |

[1] Hall sensor and LED supply (LED control option 1)
[2] User controllable (LED control option 2)

## PUSHBUTTON SWITCH SPECIFICATIONS (OPTION 6 HANDLE)

- Electrical Life: 100,000 cycles
- Rating: 50 mA, 12 VDC.
- Terminal: Brass with silver plating
- Contact Resistance: 100 mΩ max
- Insulation Resistance: 100 MΩ min. 500 VDC
- Dielectric Strength: 250 VAC /1 minute
- Contact Arrangement: 1 pole 1 throw
- Stop Strength: Max 3 kgf vertical static load for 15 seconds
- Operating Temperature: -25 °C to +70 °C (-4 °F to +158 °F)
- Storage Temperature: -30 °C to +85 °C (-22 °F to +158 °F)
- Vibration Resistance: MIL-STD-202F METHOD 201A
- Shock Resistance: MIL-STD-202F METHOD 213B

## LED SPECIFICATIONS (OPTION H HANDLE)

| LED CONTROL | OPERATING VOLTAGE | OPERATING CURRENT |
|---|---|---|
| 1 – ON, driven by joystick supply voltage | - | 25-30 mA |
| 2 – User controlled | 5 V | 25-30 mA |

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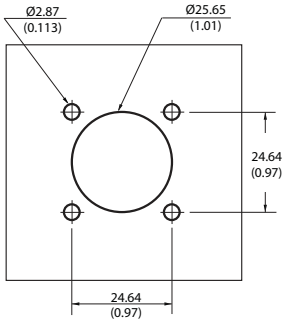
## NEW OPTIONS AVAILABLE

PLASTIC THREADED HOUSING

LED ILLUMINATION OPTION H HANDLE

## MOUNTING

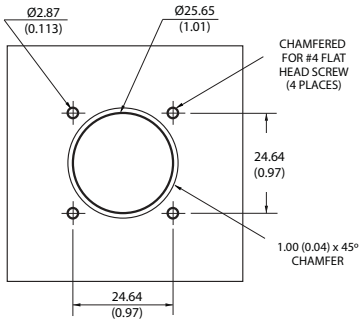
PLASTIC HOUSING - DROP-IN CUTOUT





- The under panel depth for the Drop-in configuration is 16.02 mm (0.631 in).

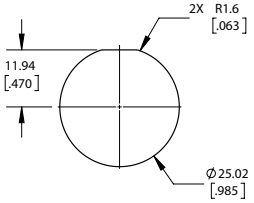
PLASTIC HOUSING - REAR MOUNT OPTION CUTOUT





- The maximum panel thickness for the Rear Mount configuration is 2.032 mm (0.08 in).
- Mounting screws can be driven to a recommended torque of 4 lbf.

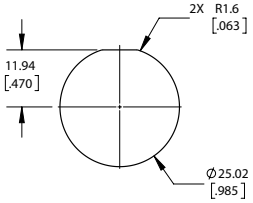
METAL THREADED HOUSING - DROP-IN CUTOUT

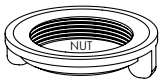




- The under panel depth for the Metal Threaded Housing configuration is 14.55 mm (0.573 in).
- Mounting nut can be tightened to a recommended torque of 10 lbf.

PLASTIC THREADED HOUSING - DROP-IN CUTOUT




- The under panel depth for the Plastic Threaded Housing configuration is 14.55 mm (0.573 in).
- Mounting nut can be tightened to a recommended torque of 10 lbf.

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## BUILD YOUR PART NUMBER

TS

### SERIES

### HANDLE[1]

| | |
|---|---|
| 0 | None |
| 1 | Castle |
| 2 | Winged Hat |
| 3 | Conical |
| 4 | Finger Tip |
| 5 | Round Jog |
| 6 | Pushbutton |
| 7 | Mushroom[1] |
| 8 | Low Profile[1] |
| A | Handles 1, 2, 3 |
| B | Castle, elastomer |
| C | Winged Hat, elastomer |
| D | Conical, elastomer |
| E | Quadcave |
| F | Puck |
| G | Roller |
| H | Castle, LED illumination[1-2] |

### MOUNTING OPTIONS

| | |
|---|---|
| N | None |
| D | Drop-in |
| R | Rear mount |
| A | Drop-in and Rear Mount |
| T | Threaded housing, Metal |
| P | Threaded housing, Plastic |

### TERMINATION[2]

| | |
|---|---|
| 1 | 22 AWG PTFE, 25 cm ± 1.27 cm [2-1] |
| 2 | 28 AWG PTFE, 25 cm ± 1.27 cm [2-2] |
| 3 | 72" Overmold Cable with USB Male Type Connector |
| 4 | 2.54 mm (0.100") Pitch TE Connector |
| 5 | 2.54 mm (0.100") Pitch TE Connector with 10" Mating Harness |

### LIMITER

| | |
|---|---|
| U | Single axis |
| S | Square |
| G | Guided feel |
| P | Plus |

### OUTPUT OPTIONS [4]

| | |
|---|---|
| 00 | 0 V to 5 V |
| 01 | 0.25 V to 4.75 V |
| 02 | 0.5 V to 4.5 V |
| 03 | 1 V to 4 V |
| 04 | 0 V to 5 V - Sensor 1<br>0 V to 5 V - Sensor 2 |
| 05 | 0.25 V to 4.75 V - Sensor 1<br>0.25 V to 4.75 V - Sensor 2 |
| 06 | 0.5 V to 4.5 V - Sensor 1<br>0.5 V to 4.5 V - Sensor 2 |
| 07 | 1 V to 4 V - Sensor 1<br>1 V to 4 V - Sensor 2 |
| 08 | 0 V to 5 V - Sensor 1<br>5 V to 0 V - Sensor 2 |
| 09 | 0.5 V to 4.5 V - Sensor 1<br>4.5 V to 0.5 V - Sensor 2 |
| 10 | 0.25 V to 4.75 V - Sensor 1<br>4.75 V to 0.25 V - Sensor 2 |
| 11 | 1 V to 4 V - Sensor 1<br>4 V to 1 V - Sensor 2 |
| 12 | Customer specified |
| 13 | PWM |
| 14 | USB (Game Controller) |
| 15 | Joyball (Cursor emulation) |

### POWER SUPPLY OPTIONS

| | |
|---|---|
| A | Single |
| B | Independent [5] |

### LED CONTROL

| | |
|---|---|
| BLANK | No illumination |
| 1 | ON, driven by joystick supply voltage [6] |
| 2 | User controlled [7] |

### LED COLOR

| | |
|---|---|
| BLANK | No illumination |
| BB | Blue |
| RR | Red |

[1] Mushroom and Low Profile handles not available with P (threaded housing, plastic) or T (threaded housing, metal) housing options.
[1-2] Contact factory if USB output is needed with illuminated castle actuator.
[2-1] Wires are thick, robust, and best suited for stand alone applications.
[2-2] Wires are thin and best suited for tightly constrained wire routing.
[3] Contact factory for PWM configuration.
[4] Output voltage is ratiometric to supply voltage.
[5] Only available on dual output. Not available with Handle 6 (Pushbutton). Not available with termination options 4 or 5.
[6] LED control is driven by joystick supply voltage. Illumination is constantly on
[7] LED requires independent 5V supply. Illumination is user controlled.

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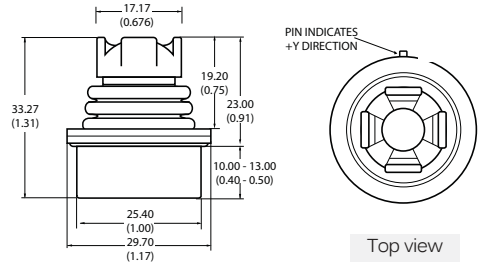
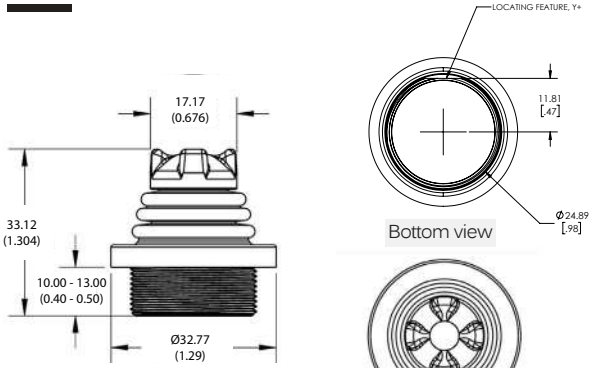
## PLASTIC HOUSING




Top view

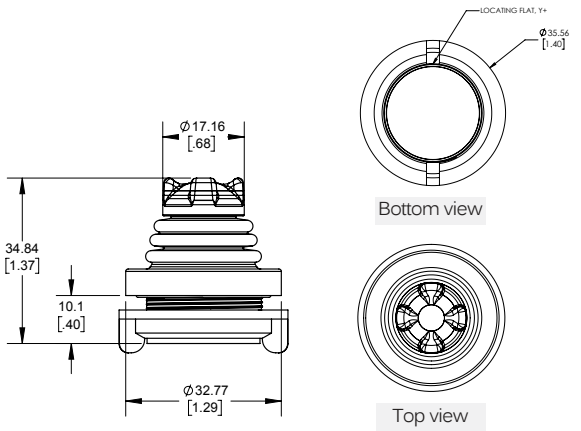
## METAL THREADED HOUSING




Bottom view

Top view

## PLASTIC THREADED HOUSING




Bottom view

Top view

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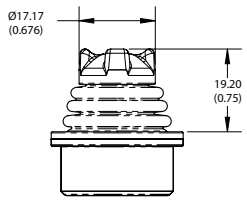
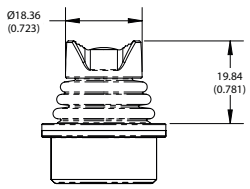
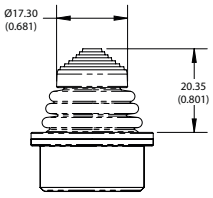
## HANDLE OPTIONS



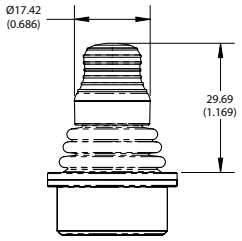

**1** Castle
**B** Castle (elastomer)



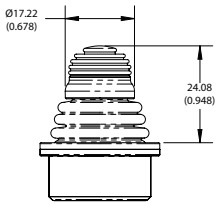

**2** Winged hat
**C** Winged hat (elastomer)



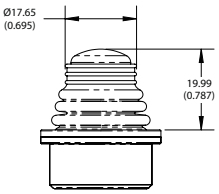

**3** Conical
**D** Conical (elastomer)



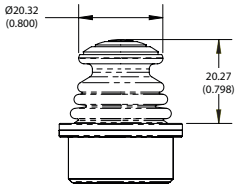

**4** Fingertip



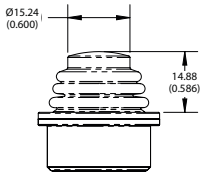

**5** Round jog



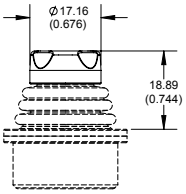

**6** Pushbutton



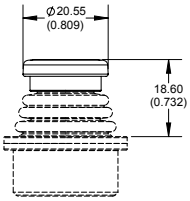

**7** Mushroom



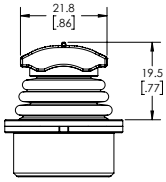

**8** Low profile



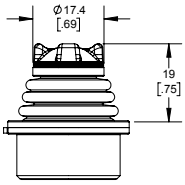

**E** Quadcave




**F** Puck




**G** Roller




**H** Castle, LED illumination

## USB OPTIONS

USB : GAME CONTROLLER

Featuring USB 2.0 HID compliant interface. APEM's USB joysticks are recognized as standard HID "game controller" devices. Adhering to the HID specification, APEM's USB joysticks are plug-and-play with most versions of Windows. Joystick button and axis assignments are dependent upon the controlled application.

- Features:
  - USB 2.0 HID compliant "game controller" device
  - Easy to install and operate
  - Functions determined by controlled application
- Supplied wiring: USB Male Type A Connector with 72" overmolded cable

USB: JOYBALL (CURSOR EMULATION)

The cursor emulation option converts a multi-axis joystick into a mouse or cursor control device

- Applications: The cursor emulation option is ideal for vehicle applications subjected to dirt and high vibration which makes operating a traditional cursor control device difficult. The Cursor Emulation option is widely used in shipboard and military applications.
- Features:
  - HID compliant "pointing device"
  - Plug-and-play with USB option
- Supplied wiring: USB Male Type A Connector with overmolded cable

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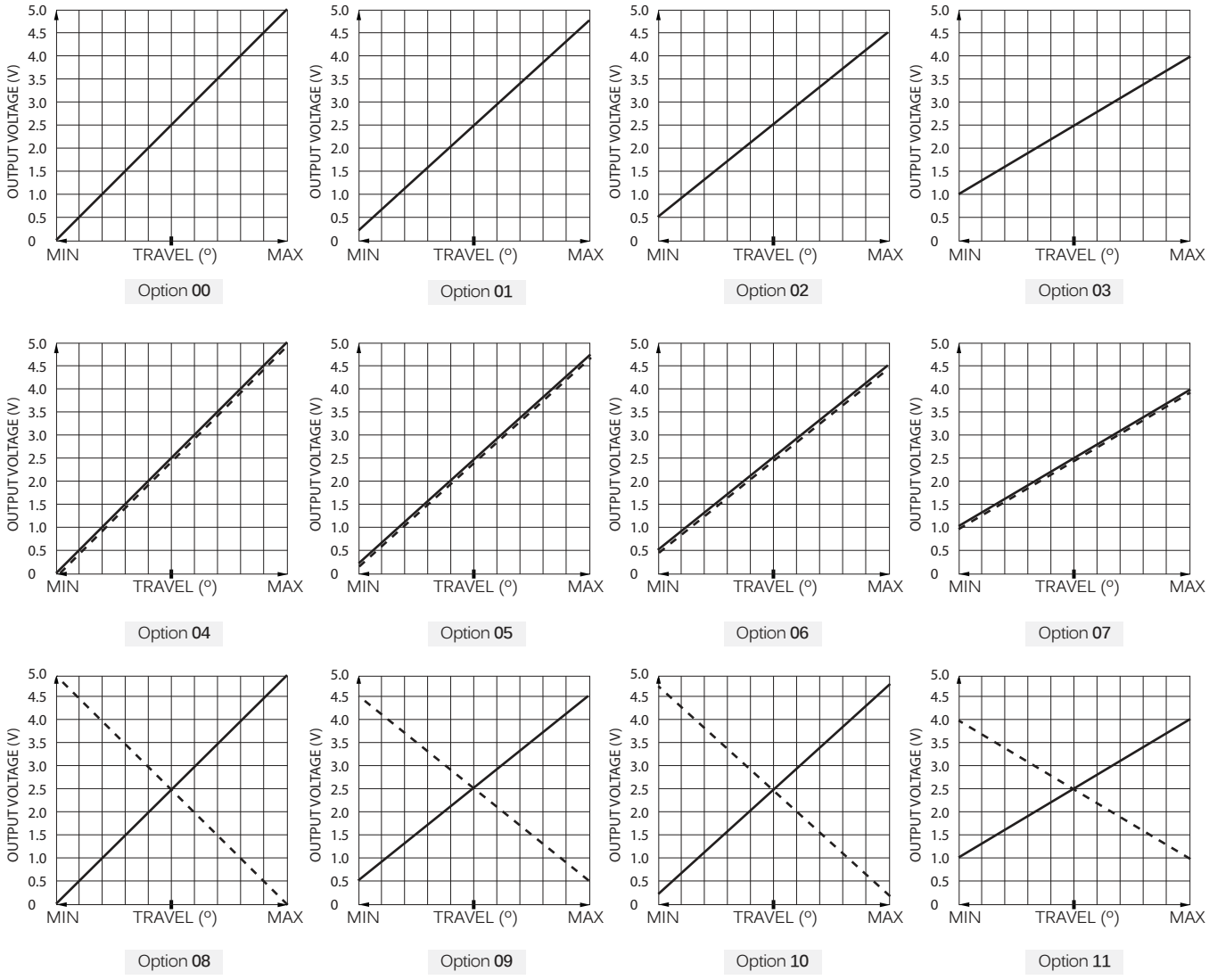
## VOLTAGE OUTPUT OPTIONS [1]




## CONNECTOR TERMINATION OPTION

| PINOUT SPECIFICATION | | |
|---|---|---|
| | TE 3-647166-5 | TE 3-647166-7 |
| PIN 1 | Y (alpha) | Pushbutton / LED |
| PIN 2 | 5 VDC [1] | GND / Pushbutton common / LED common |
| PIN 3 | X (alpha) | X (alpha) |
| PIN 4 | GND/ Pushbutton common / LED common | Y (beta) |
| PIN 5 | Pushbutton / LED | Y (alpha) |
| PIN 6 | - | 5 VDC |
| PIN 7 | - | X (beta) |

[1] Voltage outputs are ratiometric to supply voltage

- Single output configurations feature a five position TE 3-647166-5 connector.
- Dual output configurations feature a seven position TE 3-647166-7 connector.
- A mating harness is not included, but may be specified for single output configurations at the time of order for an additional charge.
- The five function harness is part number 505-499.
- The seven function harness is part number 505-500.