



# APEM

## MS series

Mid-size Hall effect joysticks



The MS Series joystick is a contactless, Hall effect controller developed for demanding operator control applications requiring a rugged, yet compact hand-operated positioning device. Available with several ergonomic multi-axes handles while utilizing only five square inches of surface area, the MS Series joystick is ideally suited for off-highway enclosed cabin vehicles. Striking the perfect balance between size and durability, widely used applications include watercraft, agricultural, forestry, and material handling vehicles.

### KEY FEATURES







- Compact size**
- 1, 2 and 3 axes configurations**
- Available with J1939 CANbus**
- Available with USB**
- Redundant outputs available**
- 10 million life cycles**
- Sealed up to IP68**



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### OPTION SELECTION

MS					
<b>SERIES</b>	<b>FRONT BUTTONS</b>	<b>SIDE BUTTONS</b>	<b>SPRING TENSION<sup>3</sup></b>	<b>OUTPUT OPTIONS</b>	<b>ADDITIONAL OPTIONS</b>
	<b>N</b> None <b>O</b> One <b>W</b> Two	<b>0</b> None <b>U</b> One Upper Position <b>L</b> One Lower Position <b>F</b> Two <b>P</b> Proximity Sensor <b>D</b> Deadman	<b>00</b> Standard <b>01</b> Light <b>02</b> Heavy	<b>0</b> 0V to 5V (Rail to Rail) <b>1</b> 0.5V to 4.5V <b>2</b> 0.25V to 4.75V <b>3</b> 1V to 4V <b>4</b> 0V to 5V - Sensor 1 0V to 5V - Sensor 2 <b>5</b> 0.5V to 4.5V - Sensor 1 0.5V to 4.5V - Sensor 2 <b>6</b> 0.25V to 4.75V - Sensor 1 0.25V to 4.75V - Sensor 2 <b>7</b> 1V to 4V - Sensor 1 1V to 4V - Sensor 2 <b>8</b> 0V to 5V - Sensor 1 5V to 0V - Sensor 2 <b>9</b> 0.5V to 4.5V - Sensor 1 4.5V to 0.5V - Sensor 2 <b>10</b> 0.25V to 4.75V - Sensor 1 4.75V to 0.25V - Sensor 2 <b>11</b> 1V to 4V - Sensor 1 4V to 1V - Sensor 2 <b>0-D</b> Discrete <b>0-U</b> USB <b>1-J</b> Cursor Emulation <b>2-C</b> CANbus	<b>V</b> Voltage Regulator <b>D</b> Dual Decode <b>DC</b> Center Detect <b>AD</b> Analog Deadband <b>P</b> Proximity Sensor <b>E</b> Environmental Sealing*
<b>HANDLE</b>		<b>TOP BUTTONS</b>	<b>LIMITER PLATE</b>		
<b>10</b> Ball Tip <b>42</b> Stock Grip <b>31</b> Short Stock Grip <b>23</b> Low Profile <sup>1</sup> (2 Axes) <b>24</b> Low Profile <sup>1</sup> (3 Axes) <b>54</b> Low Profile <sup>1</sup> Square Front (2 Axes) <b>55</b> Low Profile <sup>1</sup> Square Front (3 Axes)		<b>0</b> None <b>1</b> One <b>2</b> Two	<b>S</b> Square  <b>R</b> Round  <b>X</b> Slotted  <b>Y</b> Slotted  <b>P</b> Plus  <b>D</b> Diamond 		

**NOTES:**

1. Low Profile handles are offered in two options:



- 2. Dual Decode cannot be used with CANbus, USB, or Voltage Regulator.
- 3. X/Y axes spring tension. Contact Technical Support for information on the best possible spring for your chosen configuration.



\*Environmental sealing level available up to IP68. Dependent upon handle configuration.

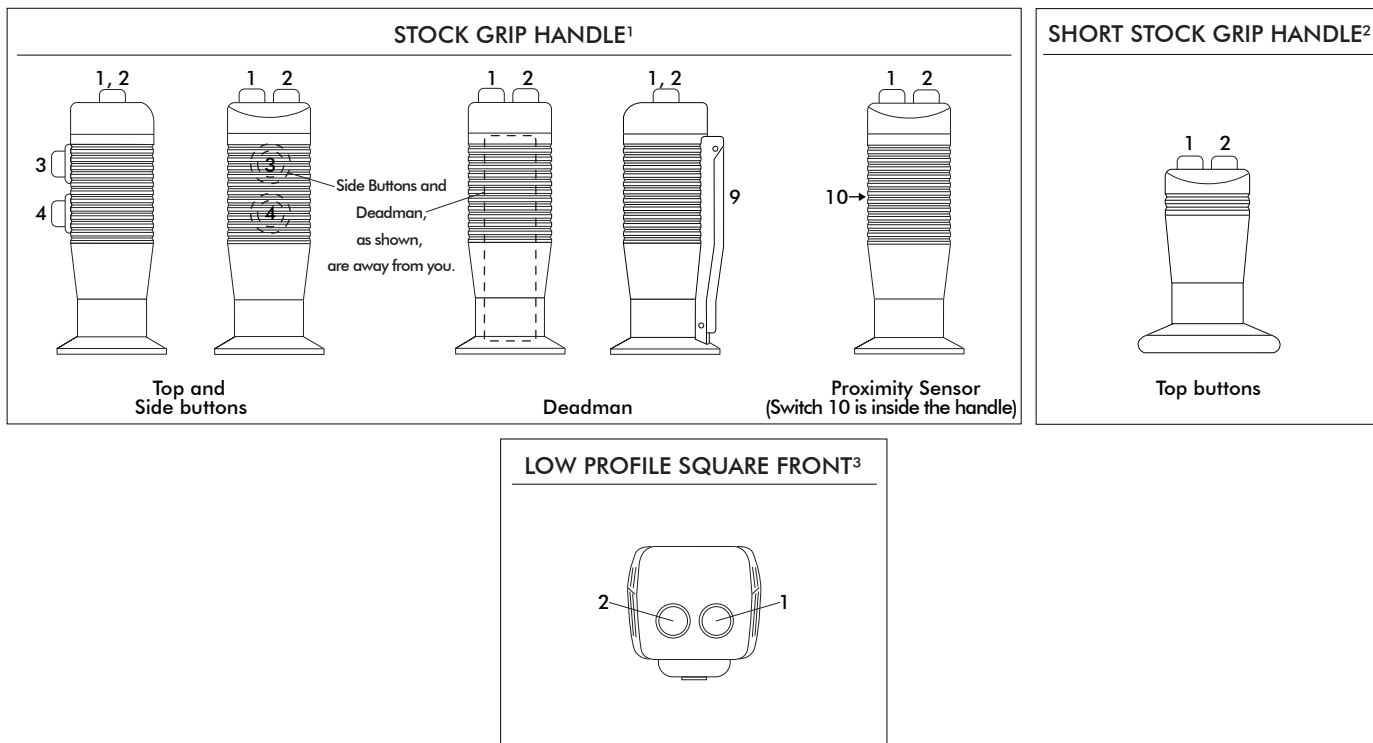


Mounting accessories. Standard hardware includes: 4 screws (6-32x7/8)

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### STANDARD CONFIGURATIONS



DEFAULT WIRE COLOR CODE*		
COLOR	FUNCTION	AWG
RED	Vcc or Vdd	28
BLACK	Ground	
BLUE	X Axis	
YELLOW	Y Axis	
GREEN	Z Axis	
WHITE	Switch Common (optional)	22
ORANGE	Switch 1 (optional)	
VIOLET	Switch 2 (optional)	
GRAY	Switch 3 (optional)	
BROWN	Switch 4 (optional)	
PINK	Switch 5 (optional)	
BLUE/WHITE	Switch 6 (optional)	
YELLOW/BLACK	Switch 7 (optional)	
GREEN/BLACK	Switch 8 (optional)	
VIOLET/WHITE	Deadman - Switch 9 (optional)	
YELLOW/WHITE	Proximity Sensor - Switch 10 (optional)	
RED/WHITE	Index Trigger - Switch 11 (optional)	
LIGHT GREEN	LED 12 (optional)	
LIGHT ORANGE	LED 13 (optional)	
GRAY/WHITE	LED 14 (optional)	
BLACK/WHITE	LED 15 (optional)	

AVAILABLE BUTTON COLORS	
	White
	Gray
	Black
	Red <sup>4</sup>
	Orange
	Yellow
	Green
	Blue
	Purple

\* - Starting from the strain relief, the cable is 406mm (16in) long, 6.40mm (0.25in) stripped with plug, covered with an expandable cable sleeve.

#### NOTES:

1. The maximum possible configuration for the Stock Grip handle is up to 2 Top Buttons and 2 Side Buttons. A handle with a Deadman or a Proximity Sensor can have 2 Top Buttons, but no Side Buttons.
2. The maximum possible configuration for the Short Stock Grip handle is up to 2 Top Buttons. It is not possible with Deadman, Index Trigger, Proximity Switch, or Side Buttons.
3. The maximum possible configuration for the Low Profile Square Front handle is up to 2 Front Buttons. It is not possible with Deadman, Index Trigger, Proximity Switch, or Top Buttons.
4. If unspecified, the pushbuttons will have snap action momentary switches with red button caps.

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### SPECIFICATIONS

#### MECHANICAL (FOR X AND Y AXES)

Break Out Force	-	5.6N (1.25lbf)
Operating Force	-	7.5N (1.70lbf)
Maximum Applied Force	-	650N (145lbf)
Mechanical Angle of Movement	-	40°
Expected Life	-	10 million cycles
Material	-	Glass reinforced nylon
Lever Action (Centering)	-	Spring centering

#### MECHANICAL (FOR Z AXIS)

Break Out Force	-	0.15N·m (1.33lbf-in)
Operating Force	-	0.25N·m (2.21lbf-in)
Maximum Allowable Force	-	4.50N·m (39.83lbf-in)
Hand Mechanical Angle	-	68°
Handle Action	-	Spring return
Expected Life	-	1 million cycles

#### ENVIRONMENTAL

Operating Temperature	-	-25°C to 70°C (-13°F to 158°F)
Storage Temperature	-	-40°C to 70°C (-40°F to 158°F)
Sealing (IP)	-	Up to IP68
EMC Immunity Level (V/M)	-	IEC 61000-4-3:2006
EMC Emissions Level	-	IEC 61000-4-8:2009
ESD	-	IEC 61000-4-2:2008

#### ELECTRICAL

Sensor	-	Hall effect
Resolution	-	Infinite
Supply Voltage Operating	-	5.00VDC
Reverse Polarity Max	-	-14.5VDC
Oversvoltage Max	-	18VDC
Output Voltage	-	0V to 5V
Output Impedance	-	6Ω
Current Consumption Max	-	10mA max per axis
Return to Center Voltage (No Load)	-	±200mV

#### STANDARD SWITCH CHARACTERISTICS/RATINGS

Electrical Resistive Load:	-	5A
Electrical Inductive Load:	-	3A
DWV:	-	1050Vrms
Low Level:	-	10mA @ 30mV
Electrical Life:	-	25,000 cycles 5A @ 28VDC resistive snap-action
Mechanical Life:	-	1 million cycles
Environmental Seal:	-	IP67
Action:	-	Momentary, snap-action
Operating Force:	-	7.5N±2.0N (1.69lbf±0.45lbf)
Total Travel:	-	0.080 inches max
Over Travel:	-	0.010 inches min

#### CAN OUTPUT VERSION

Supply Voltage Range (Vdc)	-	6V to 40V
Can Version	-	J1939

#### NOTES:

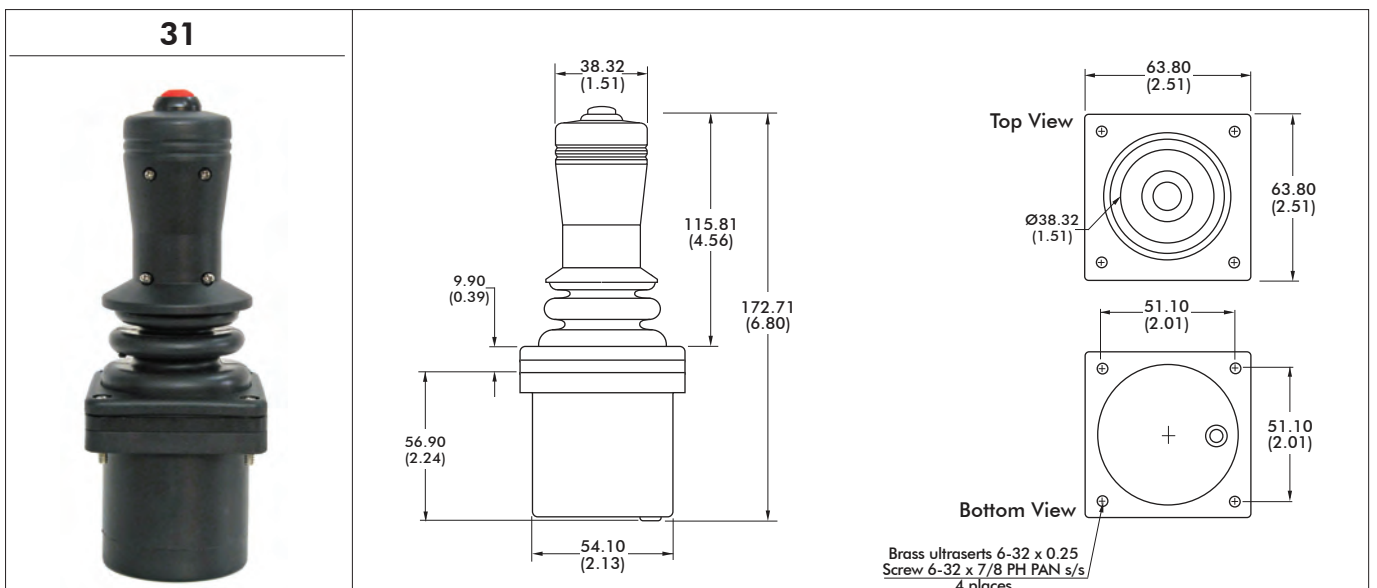
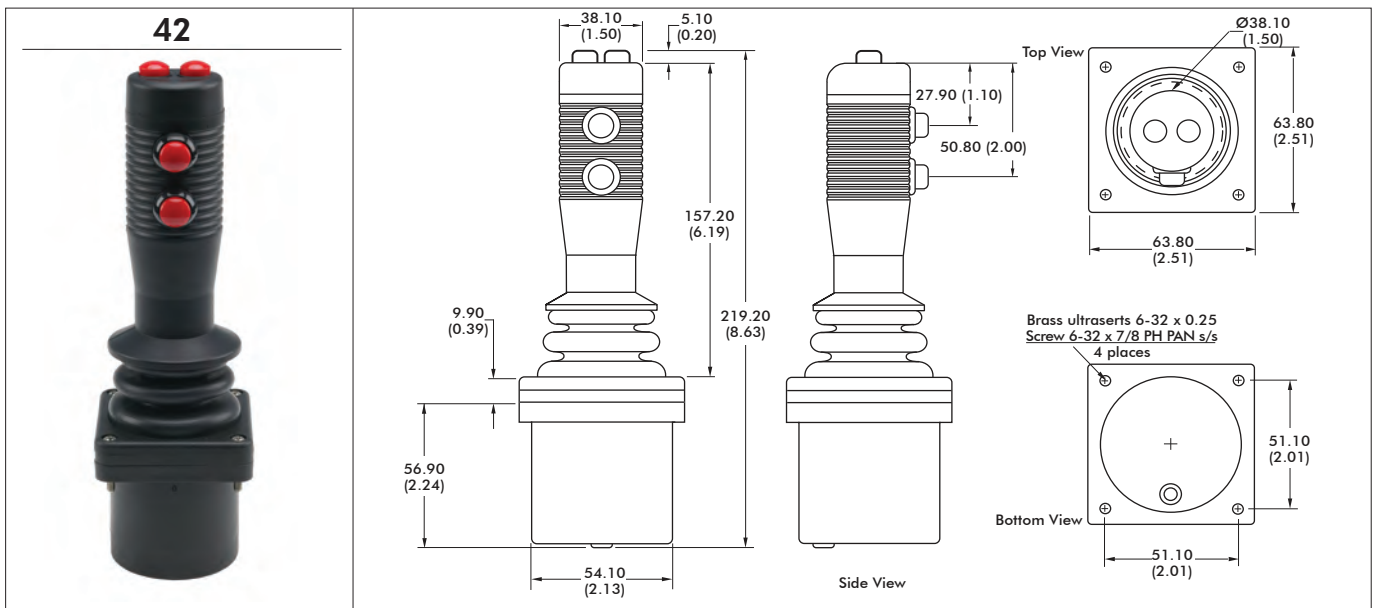
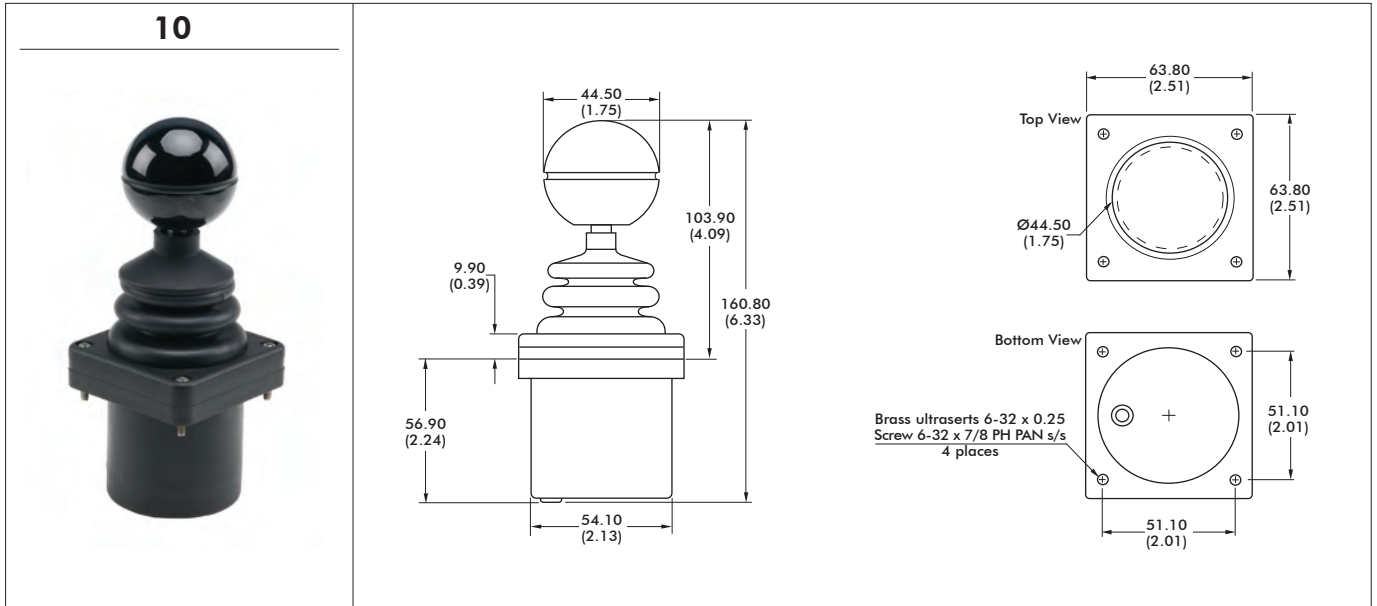
- All values are nominal
- Exact specifications may be subject to configuration.

Contact Technical Support for the performance of your specific configuration.

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## Mid-size Hall effect joysticks

### DIMENSIONAL DRAWINGS

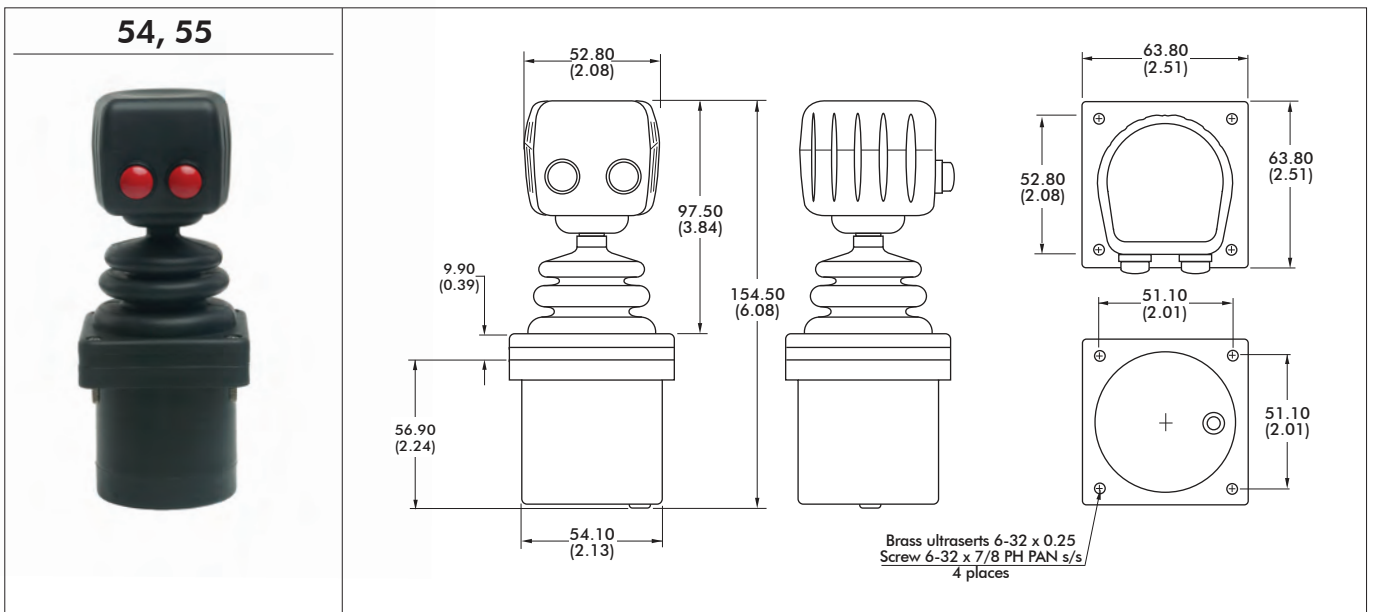
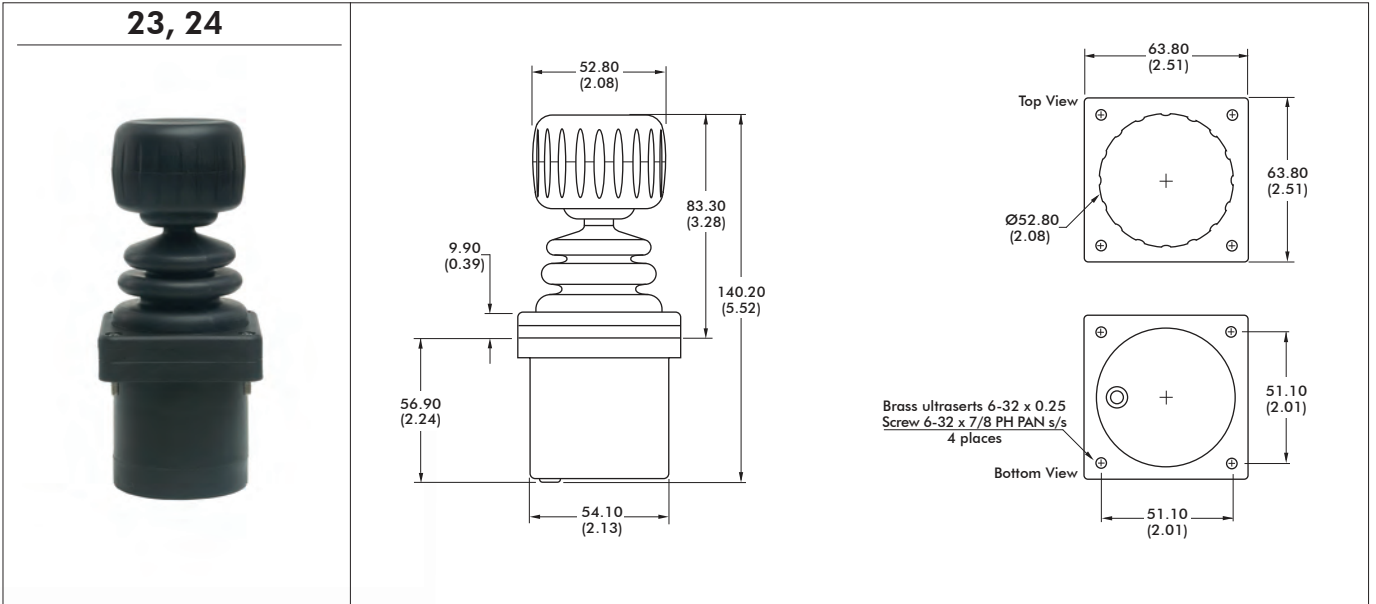




# MS series

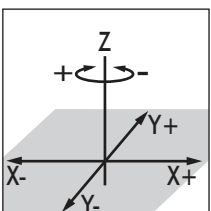
## Mid-size Hall effect joysticks

### DIMENSIONAL DRAWINGS - continued

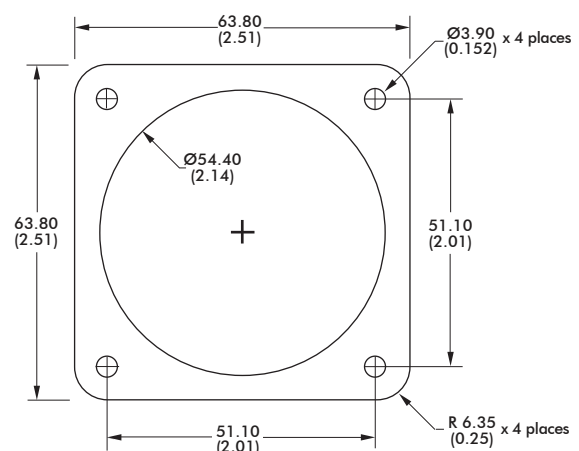


#### NOTES

1. Dimensions are in mm/(inch)
2. Standard configurations feature a rubber grommet as indicated in the above drawings. An optional plastic strain relief is available and will increase under panel mounting depth by 19.05 (0.75).
3. Actual strain relief position may vary
4. Axes orientation:



#### MOUNTING CUTOUT DIMENSIONS

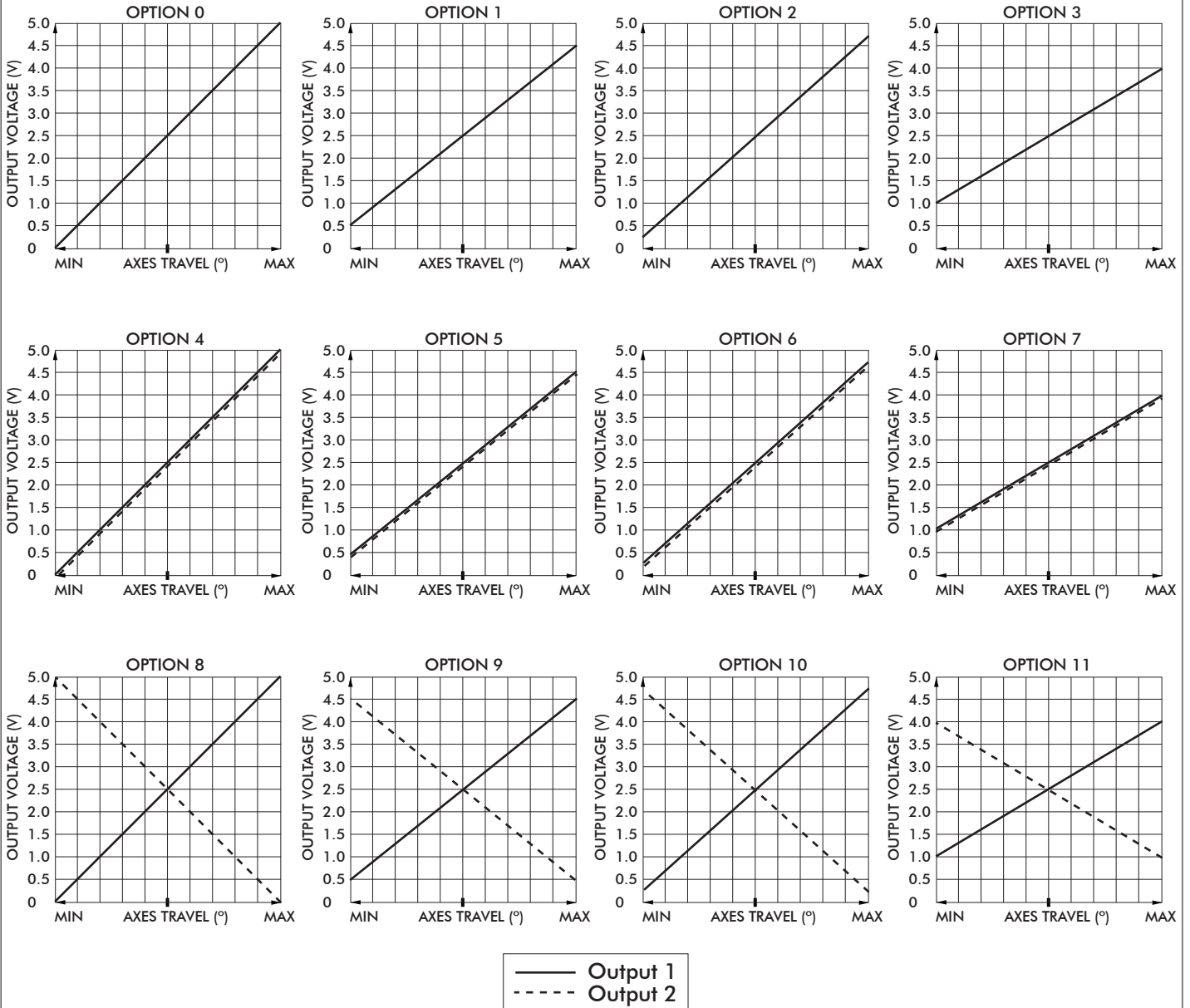


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## Mid-size Hall effect joysticks

### CONFIGURATION OPTIONS

#### LINEAR OUTPUT OPTIONS



# MS series

## Mid-size Hall effect joysticks

### CONFIGURATION OPTIONS - continued

#### ADDITIONAL OUTPUT OPTIONS

### CANbus J1939

CH Products MS CANbus joysticks conform to the SAE J1939 serial bus specification used for communications between electronic control units and vehicle components.

#### FEATURES

- CANbus J1939
- Extended I/O extension for up to 16 digital and 3 analog inputs.
- Accommodates a 6-40VDC power supply

#### ELECTRICAL SPECIFICATIONS

Supply Power:	-	6 – 40 VDC
Supply Current:	-	15mA min, +5mA per LED, +6mA per axis

#### WIRING SPECIFICATION

Red Wire	-	Supply Power
Black Wire	-	Ground
Green Wire	-	CAN high data
White Wire	-	CAN low data
Blue Wire	-	Identifier Select
Orange Wire	-	Identifier Select

#### CONNECTOR OPTIONS:

- Cable assembly with Deutsch DT04 style plugs
- External I/O harnessing per customer specification

#### CANbus CONFIGURATION CHART

- Contact factory for assistance

BAUD RATE (Check one)		250K	500K	1000K	BLUE WIRE	ORANGE WIRE					
11 BIT IDENTIFIER (CAN2.0A) (Hex)	#1	TX	1	0		G					
		RX				G					
	#2	TX					G				
		RX									
	#3	TX				G					
		RX									
	#4	TX									
		RX									
29 BIT IDENTIFIER (CAN2.0B) (Hex)	#1	TX	3	2	1	0	G				
		RX					G				
	#2	TX						G			
		RX									
	#3	TX						G			
		RX									
	#4	TX									
		RX									
8 BYTE TX DATA FRAME (Binary)		7	6	5	4	3	2	1	0	IDENTIFIER SELECT WIRES	
8 BYTE RX DATA FRAME (Binary)										(SUPPLIED IN PIGTAIL)	
AXIS DATA TYPE (Check one)		SIGNED CHAR (+/-127)	UNSigned CHAR (0-255)	UNSigned INT (0-1023)	UNSigned INT (0-4095)						G-TIED TO 0V (BLACK WIRE)



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### CONFIGURATION OPTIONS - continued

#### ADDITIONAL OUTPUT OPTIONS

#### PLUG-AND-PLAY SOLUTIONS:

#### USB

Featuring USB 1.1 HID compliant interface, CH Products' USB joysticks are recognized as standard HID "game controller" devices. Adhering to the HID specification, CH Products' USB joysticks are plug-and-play with most versions of Windows and Linux. Joystick button and axes assignments are dependent upon the controlled application.

#### FEATURES

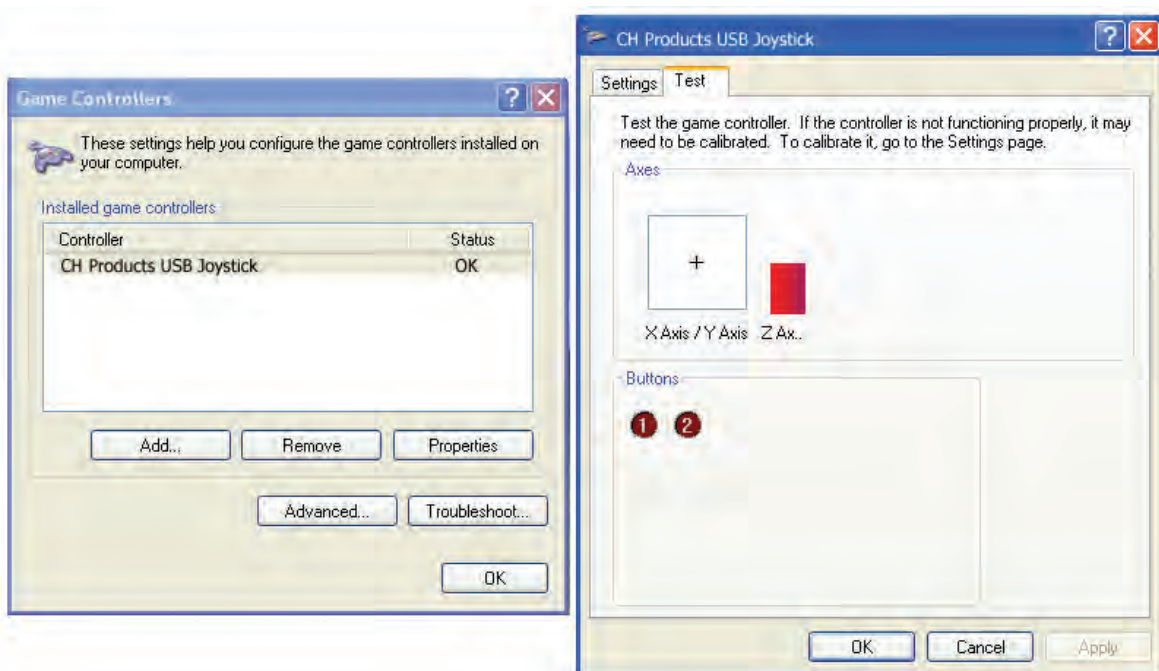
- USB 1.1 HID compliant "game controller" device
- Easy to install and operate
- Functions determined by controlled application
- Standard Male Type A Connector



USB Male Type A Connector

#### SUPPLIED WIRING

USB: USB Male Type A Connector with overmolded cable  
(Optional ruggedized military connectors are available.)



# MS series

## Mid-size Hall effect joysticks

### CONFIGURATION OPTIONS - continued

#### ADDITIONAL OUTPUT OPTIONS

##### PLUG-AND-PLAY SOLUTIONS:

##### JOYBALL (CURSOR EMULATION)

The Joyball option converts multi-axis joystick output into a mouse, trackball, or cursor control device. The joystick's internal microprocessor converts absolute axis position into a cursor velocity, which is translated as a relative trackball or mouse position. Supported protocols include Sun Microsystems (mouse systems 5vdc serial) and USB.

##### APPLICATIONS

The Joyball option is ideal for vehicle applications subjected to dirt and high vibration which makes operating a traditional cursor control device difficult. The Joyball option is widely used in shipboard and military applications.

##### FEATURES

- HID compliant "pointing device"
- Plug-and-play with USB option
- Ideal for marine GPS and navigation
- Environmental sealing up to IP68

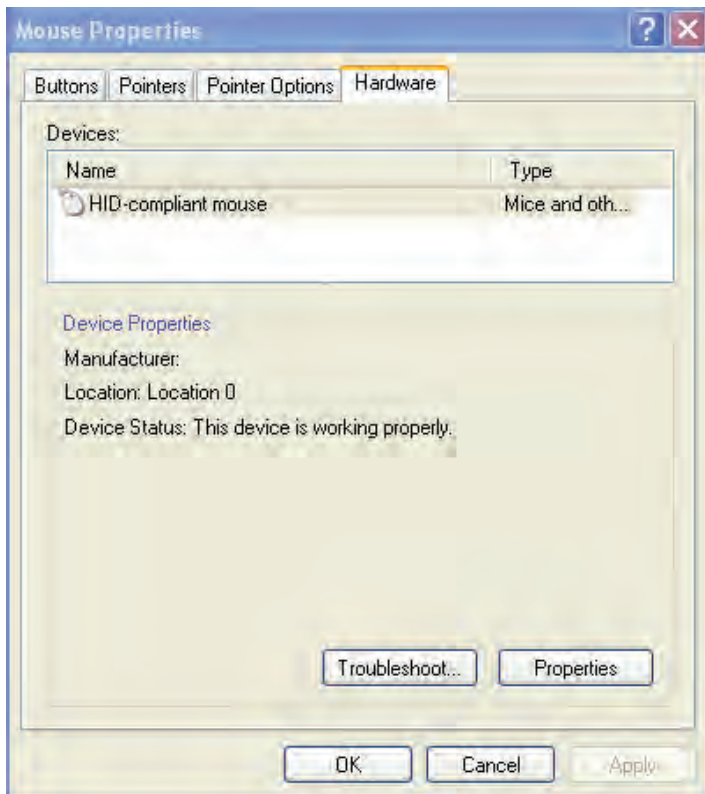
##### SUPPLIED WIRING

USB: USB Male Type A Connector with overmolded cable

SUN: SUN mini-DIN plug with overmolded cable and strain relief

##### I/O COMPLEMENT/ USER SPECIFIED PARAMETERS:

- USB 4 pushbuttons 2 or 3 axes (X, Y, and Z "scroll")
- SUN 2 pushbuttons and 2 axes (X, Y)



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### CONFIGURATION OPTIONS - continued

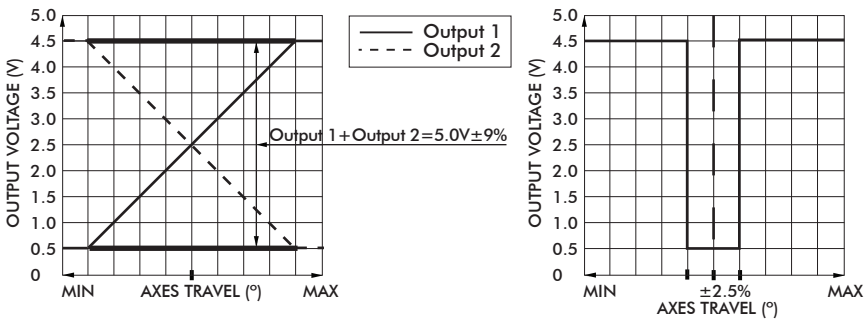
#### ADDITIONAL OUTPUT OPTIONS

#### DUAL DECODE

Dual Decode utilizes a microprocessor to monitor two linear opposite-ramp signals for each joystick axis and provides one proportional (0.5VDC – 4.5VDC) and one logical output accordingly. The dual inversed signals are continuously monitored and a logical signal of 0VDC is provided for over-range (>4.5VDC), under-range (<0.5VDC) and signal tracking (sum of both signals equals 4.5V +/-10%) error. A logical signal of 5.0VDC is provided for a properly functioning joystick deflected from center.

#### APPLICATIONS

Dual Decode provides a center detect function as well as error tracking, making it ideal for high liability, safety critical applications.



#### ELECTRICAL SPECIFICATIONS

Supply Power	-	4.5VDC to 5.5VDC
Supply Current	-	30mA + 10mA per axis

#### WIRING SPECIFICATION

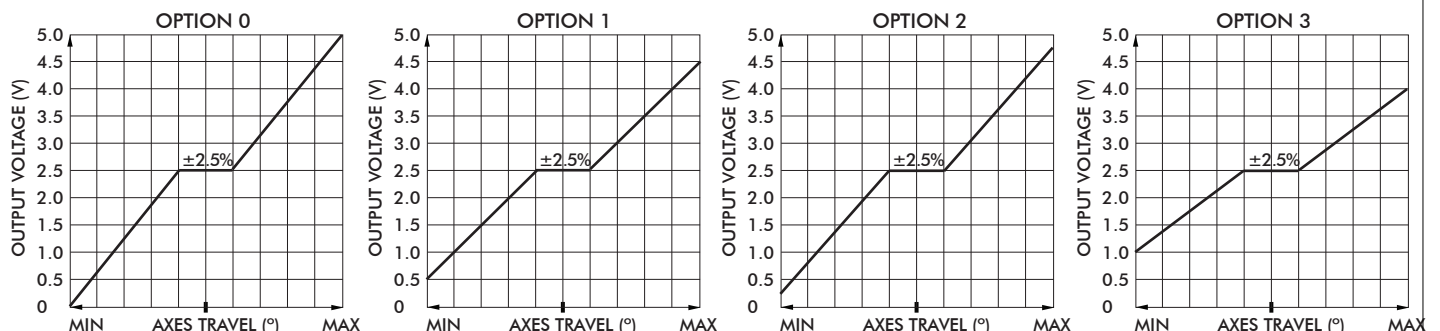
Red wire	-	Customer power supply 4.5VDC-5.5VDC
Black wire	-	Ground
Blue wire	-	X axis output
Yellow wire	-	Y axis output
Green wire	-	Z axis output
Blue/White wire	-	X axis dual decode logic output
Yellow/Black wire	-	Y axis dual decode logic output
Green/Black wire	-	Z axis dual decode logic output
White wire	-	Pushbutton common wire
Orange,violet,gray,brown,pink,bl/wt/y/bk,gn/bk,gy/w wire	-	Pushbutton outputs

#### ANALOG DEADBAND

Analog Deadband utilizes an analog circuit to monitor proportional joystick outputs and enhance return to center accuracy over multiple axes. Specified for joysticks with normally ranged outputs of 0VDC – 5VDC at full axis travel, a constant output of 2.5VDC is provided for the joystick's position +/-2.5° from center.

#### APPLICATIONS

Analog Deadband effectively eliminates mechanical return-to-center error, making it ideally suited for safety critical applications susceptible to drift and motion control systems lacking center position trim.



# MS series

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### CONFIGURATION OPTIONS - continued

#### ADDITIONAL OUTPUT OPTIONS

##### ELECTRICAL SPECIFICATIONS

Supply Power	-	4.5VDC to 5.5VDC
Supply Current	-	10mA per axis

##### WIRING SPECIFICATION

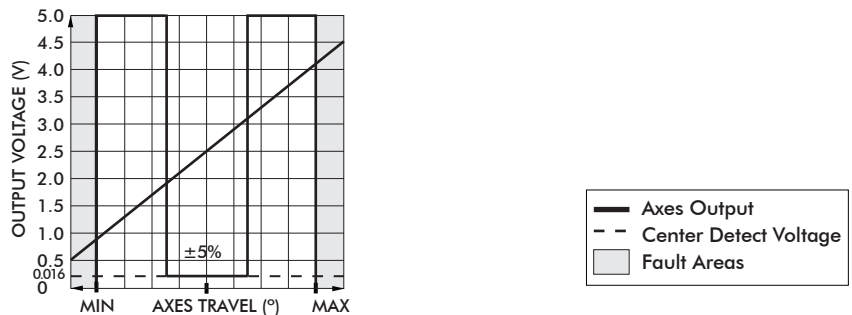
Red wire	-	Customer power supply 4.5-5.5vdc
Black wire	-	Ground
Blue wire	-	X axis output
Yellow wire	-	Y axis output
Green wire	-	Z axis output
White wire	-	Pushbutton common wire
Orange,violet,gray,brown,pink,bl/wt/y/bk,gn/bk,gy/w wire	-	Pushbutton outputs

## CENTER DETECT

Center Detect utilizes a microprocessor to monitor joystick output and provides both logic and proportional signals for enhanced operator safety. Specified for a joystick normally ranged 0.5VDC to 4.5VDC, the microprocessor continuously monitors the proportional output and provides HI logic signal (5.0VDC) when moved off center and a LO logical signal (0VDC) for an over-range (>4.5VDC) or under-range (<0.5VDC).

### APPLICATIONS

Center Detect is ideal for safety critical applications including master relay control "MRC" for a motion control system or as a brake release for an overhauling load.



##### ELECTRICAL SPECIFICATIONS

Supply Power	-	4.5V to 5.5V
Supply Current	-	30mA + 10mA per axis

##### WIRING SPECIFICATION

Red Wire	-	Power supply 4.5 - 5.5VDC
Black Wire	-	Ground
Blue Wire	-	X axis output
Yellow Wire	-	Y axis output
Green Wire	-	Z axis output
Blue/White Wire	-	X axis center detect logic output
Yellow/Black Wire	-	Y axis center detect logic output
Green/Black Wire	-	Z axis center detect logic output
White Wire	-	Pushbutton common wire
Orange,violet,gray,brown,pink,bl/wt/y/bk,gn/bk,gy/w wire	-	Pushbutton outputs

# MS series

Mid-size Hall effect joysticks

CONFIGURATION OPTIONS - continued

## ADDITIONAL OUTPUT OPTIONS

### DISCRETE OUTPUT

Discrete Output is a microprocessor based option that provides up to six hi voltage/hi current, on/off outputs as well as proportional signals. Featuring a microcontroller, an a/d converter, and four to eight optically isolated solid state switches, the Discrete Output provides an electronic "switch stick" function. Switch combinations and firing angles are programmed to the application's requirement.

#### APPLICATIONS

The Discrete Output option is designed for small motor, reversing starters or hydraulic solenoid actuations.

#### DC SPECIFICATIONS

Supply Voltage Operating	-	5.0- 40VDC input power
Supply Current	-	30mA + 10mA per Hall sensor
Sourcing Outputs	-	70V AC/DC @ 1.6A max.
Sinking Outputs	-	70V AC/DC @ 3.6A max.
Discrete Output Max	-	60VDC/AC, 3.2A per discrete output

#### WIRING

Red Wire	-	Customer power supply 5 - 40VDC
Black Wire	-	Customer power supply ground
Blue Wire	-	X axis output
Yellow Wire	-	Y axis output
Green Wire	-	Z axis output
Blue/White Wire	-	X axis discrete output
Yellow/Black Wire	-	Y axis discrete output
Green/Black Wire	-	Z axis discrete output
White Wire	-	Pushbutton common wire
Orange,violet,gray,brown,pink,bl/wt,y/bk,gn/bk,gy/w wire	-	Pushbutton outputs

#### I/O COMPLEMENT AND USER SPECIFIED PARAMETERS:

Up to three axes and six discrete sourcing or sinking outputs.

#### DISCRETE OUTPUT CONFIGURATION FORM:

Discrete Output	Sourcing	Sinking	AC	DC
Xfwd				
Xrev				
Yfwd				
Yrev				
Zfwd				
Zrev				

#### SAMPLE OF COMPLETED FORM:

(Please enter required choices for each applicable axis and return form to factory.)

Discrete Output	Sourcing	Sinking	AC	DC
Xfwd		X		X
Xrev		X		X
Yfwd	X			X
Yrev	X			X
Zfwd		X		X
Zrev		X		X

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### CONFIGURATION OPTIONS - continued

#### ADDITIONAL OUTPUT OPTIONS

#### VOLTAGE REGULATOR

The Voltage Regulator is a multi-wired analog option used to mate to a variety of industrial control voltages. The Voltage Regulator may be used when the supply or output voltage is greater than 5V or when bipolar output is required.

User Specified Supply Voltage:

- 5 VDC
- 10 VDC
- 12 VDC
- 24 – 30 VDC
- Custom supply options available.

User Specified Output Voltage:

- 0-5 VDC
- 0-10 VDC
- +/-5 VDC
- +/-10 VDC
- Custom outputs available.

#### ELECTRICAL SPECIFICATIONS

Supply Power	-	5VDC to 30VDC
Supply Current	-	90mA max

#### WIRING SPECIFICATION

Red wire	-	Supply power 5-30VDC
Black wire	-	Ground
Blue wire	-	X axis output
Yellow wire	-	Y axis output
Green wire	-	Z axis output
White wire	-	Pushbutton common wire
Orange,violet,grey,brown,pink,bl/wt/y/bk,gn/bk,gy/w wire	-	Pushbutton outputs

