XF series

Multi-axis rugged fingertip controllers • non-contacting Hall effect technology

DISTINCTIVE FEATURES

Rugged design for vehicle applications

Up to three axis

CAN bus J1939 & CANopen protocol options

USB protocol options

Panel sealed up to IP67

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: Up to IP67 (subject to final specifications)

• EMC Immunity Level (V/M): EN61000-4-3

• EMC Emissions Level: EN61000-6-3:2001

• ESD: EN61000-4-2

• Output linearity: ±200mV

• Dual output interlinearity (X/Y): ±400mV

• Dual output interlinearity (Z): ±600mV

SENSOR SPECIFICATIONS

• Sensor: Hall effect, single or dual

• Supply Voltage Range: 5VDC ±0.01VDC

• Supply Current: 15mA, +10mA per axis (single sensor)

• Reverse Polarity Max: -10VDC

• Transient Overvoltage Max: 16VDC

• Ratiometric Output Voltage: see output options

• Output Impedance: 2Ω

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MECHANICAL SPECIFICATIONS (X/Y AXIS)

- Break Out Force: 1.3N (0.3lbf)
- Operating Force: 2.8N (0.63lbf)
- Maximum Applied Force: 350N (78.00lbf)
- Deflection Angle: 36° (±18° from center)
- Expected Mechanical Life: 5 million lifecycles
- Lever Action: Single spring, omnidirectional

MECHANICAL SPECIFICATIONS (Z AXIS)

- Break Out Torque: 0.09Nm (0.80lbf in)
- Operating Torque: 0.121Nm (1.07lbf in)
- Maximum Allowable Torque: 9.0Nm (80lbf in)
- Degrees of rotation: 60° (30° from center)
- Expected Mechanical Life: 5 million lifecycles
- Handle Action: Spring centering

MATERIALS

- Shaft: Stainless Steel
- Boot: Silicone
- Handles: Glass filled nylon*
- Body: Glass filled nylon

TERMINATION

NOTES
The XF series (Output options: AA – HH) is configured with a Hirose DF11-12DP-2DS9(24) connector (male receptacle)(Fig 1).
The mating cable is not included but may be selected from the configuration guide.
The mating cable features a Hirose DF11-12DS-2C (female socket)(Fig 2).
Connector specifications: 12 position, 2mm pitch dual row (2x6) pin header.

Wire Color	Description
Black	Ground
Red	Power
Blue/White	X-Axis (Dual Output)
Blue	X-Axis
Yellow/Black	Y-Axis (Dual Output)
Yellow	Y-Axis
Green/Black	Z-Axis (Dual Output)
Green	Z-Axis
Orange	Button 1
White	Button Common
Violet	Button 2

Fig 1F

ig 2

* Most handles, dependent upon configurations

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GENERAL MOUNTING DIMENSIONS & SUGGESTED PANEL OPENING

.0625in

4-40 x 9/16
Phil Panhead
4x

Brass insert
4x

[30.75mm]
1.21in

CAN bus Outputs
(output options: NN-QQ)

4-40 x 9/16
Phil Panhead
4x

Brass insert
4x

[23mm]
.91in

Analog Outputs
(output options: AA-HH)

4-40 x 9/16
Phil Panhead
4x

Brass insert
4x

[29.35mm]
1.16in

Votage Regulator
(output options: AA-VV)
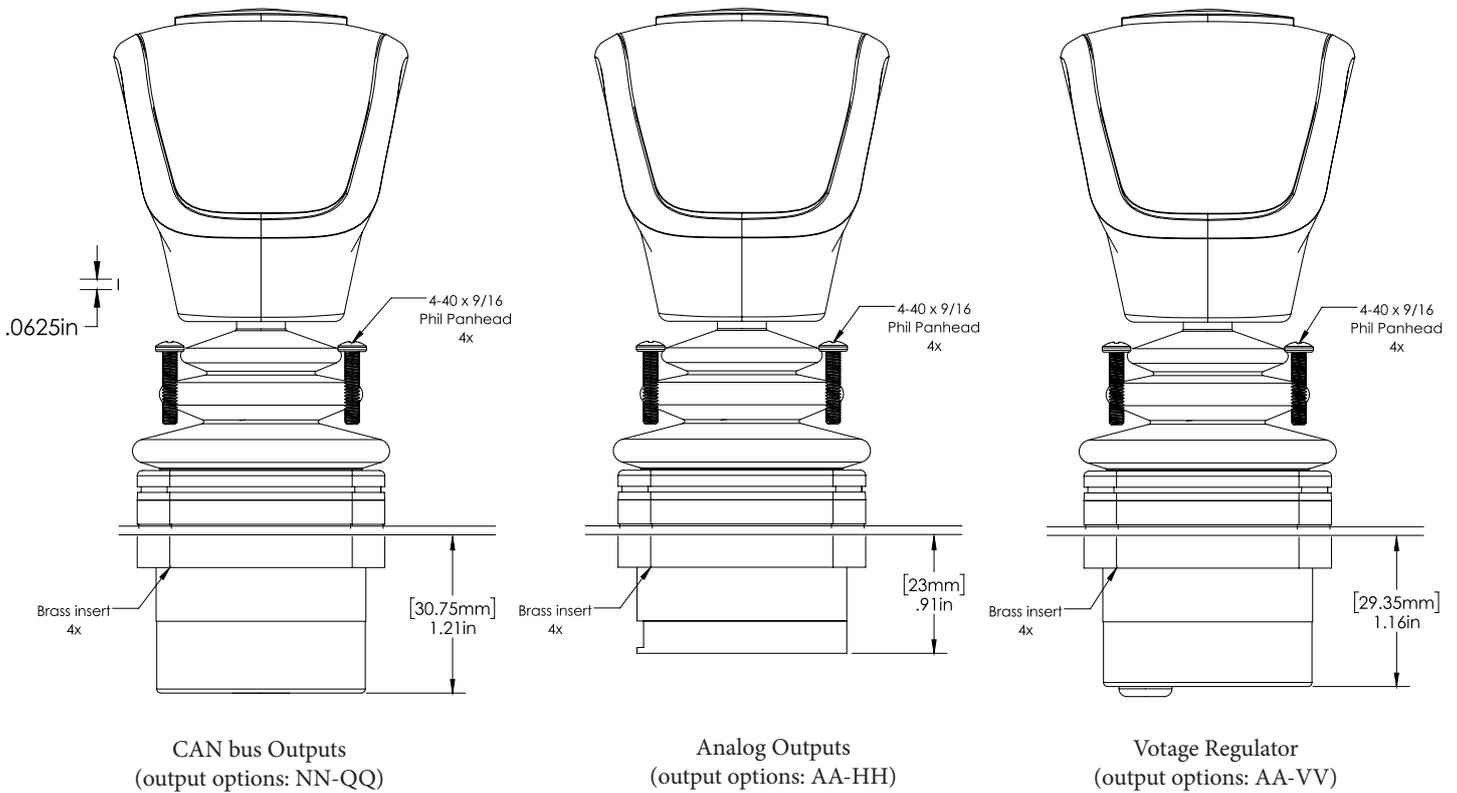
PANEL CUT-OUT

DROP-IN MOUNT

[41.275mm]
∅1.625in

4 places x
[3.175mm]
∅.125in

[35.56mm]
1.40in

[35.56mm]
1.40in
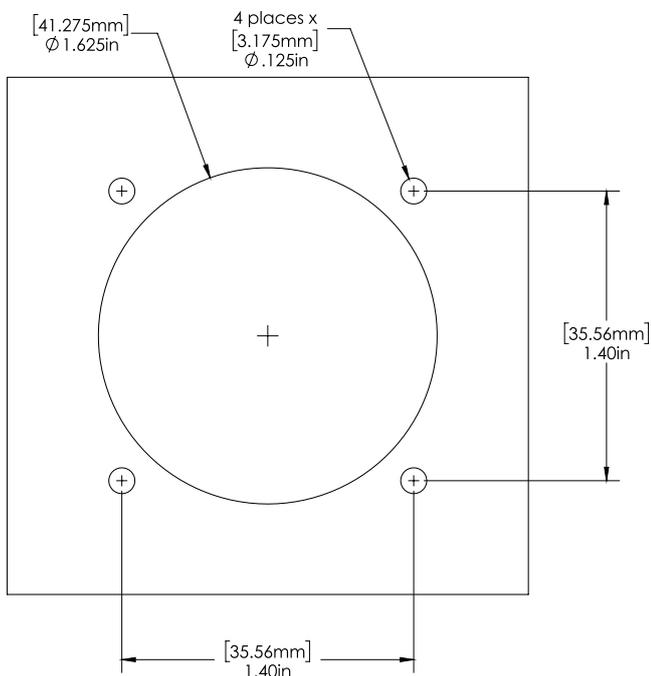
REAR MOUNT
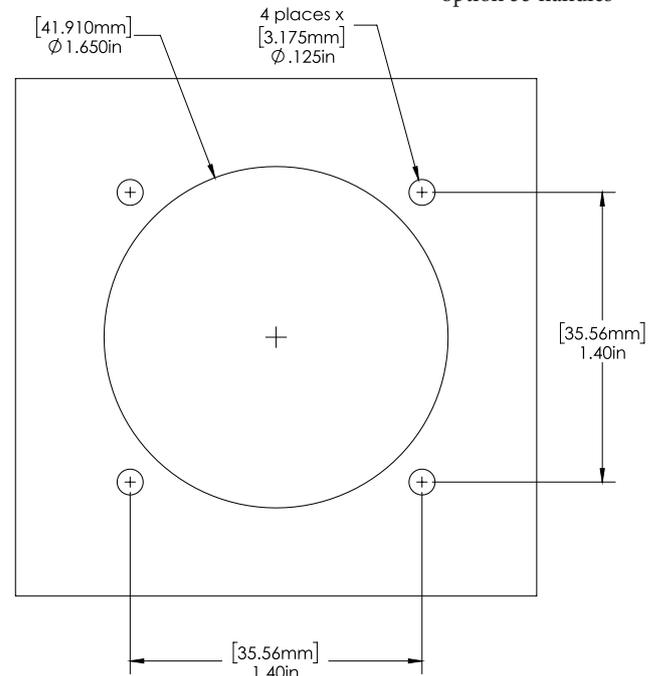
Not available for
option 55 handles

[41.910mm]
∅1.650in

4 places x
[3.175mm]
∅.125in

[35.56mm]
1.40in

[35.56mm]
1.40in

APEM

XF series

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CAN J1939 INTERFACE SPECIFICATION

The XF Series joystick can be configured with a maximum of three axis and two buttons. All axis and button data are delivered on a CAN 2.0B compliant physical interface. Two additional signals allow configuration of the controller Source Address. Controller messages are delivered per the SAE J1939-71 message protocol.

CAN 2.0B INTERFACE PARAMETERS

- Baud rate: 250 KHz
- Transmission repetition rate: 50ms
- BJMl/EJMl interval time: 20ms
- Terminating resistor: No
  (available by special request to factory)
- Standard 22 AWD harness 45cm
- Optional connection to Deutsch DTM04-6P connector

Pin	Color	Function
1	White	CAN Lo
2	Green	CAN Hi
3	Blue	ID Selection LSB
4	Orange	ID Selection MSB
5	Black	Ground
6	Red	7-35VDC

CAN MESSAGE PROTOCOL

- Primary Axis and button data on Basic Joystick Message 1 (BJM1):
  - Priority: 3
  - Base PGN: 0xFDD6
  - Source address: 0x16[1]
  - Data field: 8 bytes
- Redundant Axis data on Extended Joystick Message 1 (EJMl):
  - Priority: 3
  - Base PGN: 0xFDD7
  - Source address: 0x16[1]
  - Data field: 8 bytes

Note 1: Alternate source addresses can be configured by grounding of the blue and/or orange wires.
- Source address= Ox16: ORANGE= floating, BLUE= floating (default)
- Source address= Ox26: ORANGE= floating, BLUE= grounded
- Source address= Ox36: ORANGE= grounded, BLUE= floating
- Source address= Ox46: ORANGE= grounded, BLUE= grounded

BJM1 DATA FIELD STRUCTURE:

START POSITION (BYTE/BIT)	LENGTH (BITS)	FUNCTION
1/1	2	Primary X-axis neutral position status
1/3	2	Primary X-axis left position status
1/5	2	Primary X-axis right position status
1/7 to 2/8	10	Primary X-axis position data
3/1	2	Primary Y-axis neutral position status
3/3	2	Primary Y-axis down position status
3/5	2	Primary Y-axis up position status
3/7 to 4/8	10	Primary Y-axis position data
6/5	2	Button 2 status
6/7	2	Button 1 status

EJM1 DATA FIELD STRUCTURE:

START POSITION (BYTE/BIT)	LENGTH (BITS)	FUNCTION
1/1	2	Redundant X-axis neutral position status
1/3	2	Redundant X-axis left position status
1/5	2	Redundant X-axis right position status
1/7 to 2/8	10	Redundant X-axis position data
3/1	2	Redundant Y-axis neutral position status
3/3	2	Redundant Y-axis down position status
3/5	2	Redundant Y-axis up position status
3/7 to 4/8	10	Redundant Y-axis position data
5/1	2	Primary Z-axis neutral position status
5/3	2	Primary Z-axis counter-clockwise position status
5/5	2	Primary Z-axis clockwise position status
5/7 TO 4/8	10	Primary Z-axis position data

CUSTOM CAN BUS J1939 FIRMWARE*

- Baud rate: 125 kbps, 500kbps, 1Mbps
  (250 KHz default)
- Custom CAN addresses
- Custom CAN bus output

* Custom CAN bus firmware available upon request.

XF series

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CANOPEN INTERFACE SPECIFICATION

CANOPEN INTERFACE PARAMETERS

- Baud rate: 250 bps
- Node ID: 20h
- Buttons: 1A0H (180H + NODE ID)
- Analog (axis) outputs: 2A0h (280h + Node ID)
- Heartbeat (500ms): 720h (700h + Node ID)
- Axis resolution: 8 bit
- Network Management: Auto start enabled
- Standard 22 AWG harness 45cm
- Optional Deutsch DTM04-6P connector:

AWG22 WIRE CABLE HARNESS

Color	Signal
Red	Supply Power (7VDC to 35VDC)
Black	Ground
Green	CAN high data
White	CAN low data
Blue	Node ID Selection (LSB)
Orange	Node ID Selection (MSB)

DEUTSCH 6 PIN OPTIONAL

Pin	Color	Signal
1	Red	Supply Power (7VDC to 35VDC)
2	Black	Ground
3	Green	CAN high data
4	White	CAN low data
5	Blue	Node ID Selection (LSB)
6	Orange	Node ID Selection (MSB)

SELECTABLE NODE ID

#	Blue wire	Orange wire	Node ID
1	OPEN	OPEN	20H
2	GND	OPEN	21H
3	OPEN	GND	22H
4	GND	GND	23H

CUSTOM CANOPEN FIRMWARE*

- Baud rate: 125 kbps, 500kbps, 1Mbps (250 bps default)
- Custom Node IDs (default 20 hexadecimal)
- 10-bit axis resolution
- 12-bit axis resolution
- Signed resolution

BUTTON OUTPUT CONFIGURATION

Buttons status is transmitted in the 1-byte data field of frames with an identifier of 1A0 (default)	
Identifier	Byte 0

ANALOG OUTPUT CONFIGURATION

| 8-bit analog data is transmitted in the 3-byte data field of frames with an identifier of 2A0 (default)			
Identifier	Byte 0	Byte 1	Byte 2
2A0	A_IN0 [7:0]	A_IN1 [7:0]	A_IN2 [7:0]

* Custom CAN bus firmware available upon request.

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CAN BUS SPECIFICATIONS: DIMENSIONS

[48.26mm]
1.90in

[35.56mm]
1.40in

[48.26mm]
1.90in

[35.56mm]
1.40in

[57.38mm]
2.26in

[134.46mm]
5.29in

[25.00cm]
9.84in

[39.42mm]
1.55in

[37.90mm]
1.49in

[33.15mm]
1.305in

[25.64mm]
1.01in

[47.79mm]
1.88in

XF series

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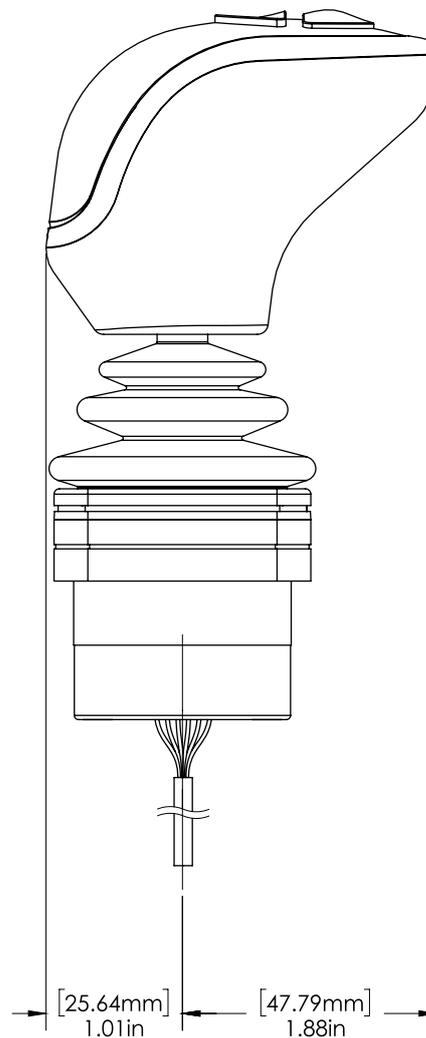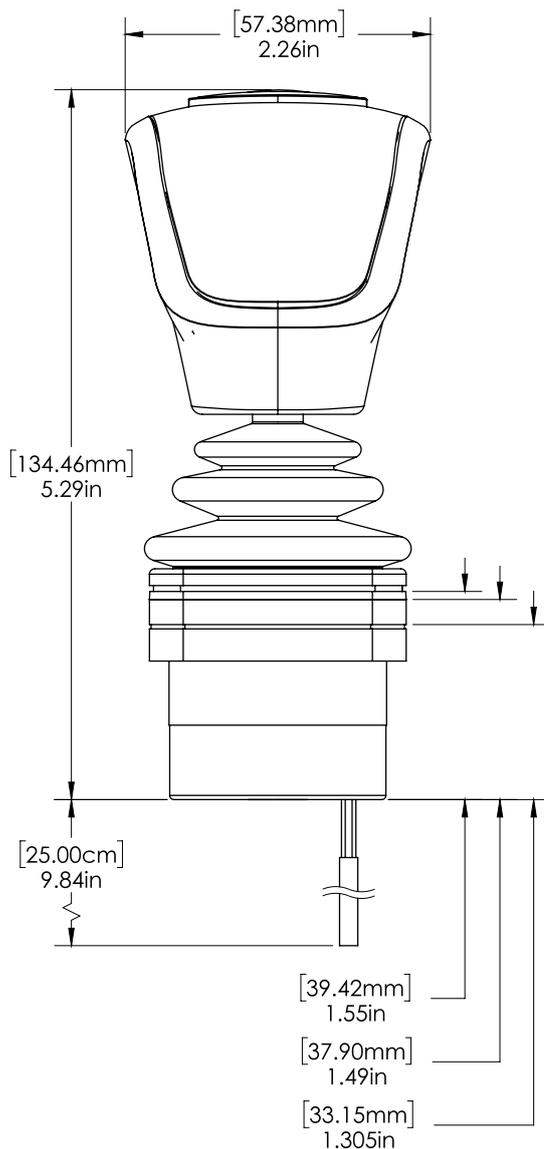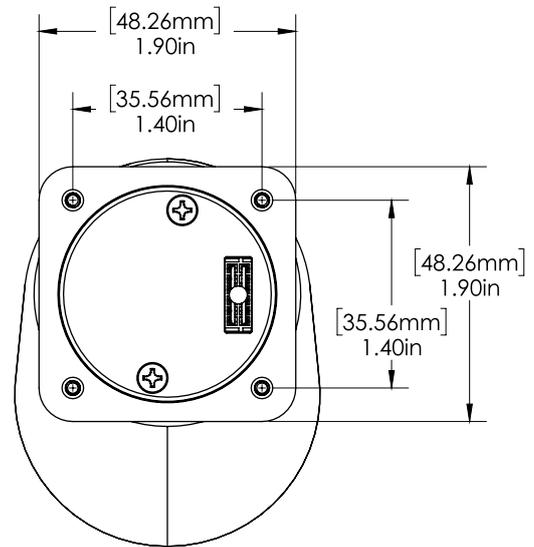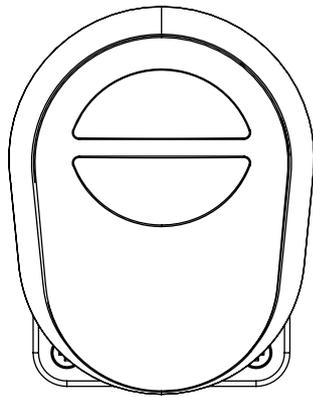
VOLTAGE REGULATOR SPECIFICATIONS

The Voltage Regulator allows APEM's Hall effect joysticks to operate with a range of supply voltages..
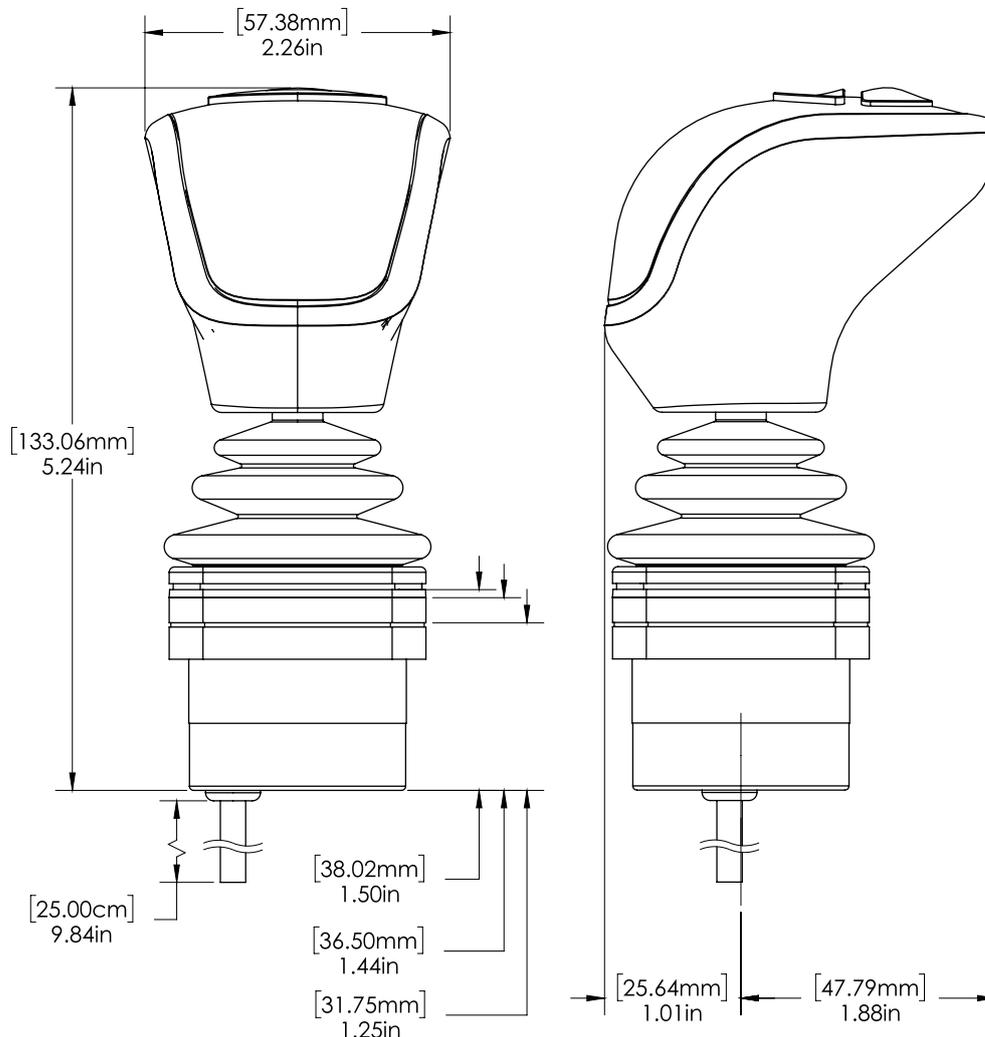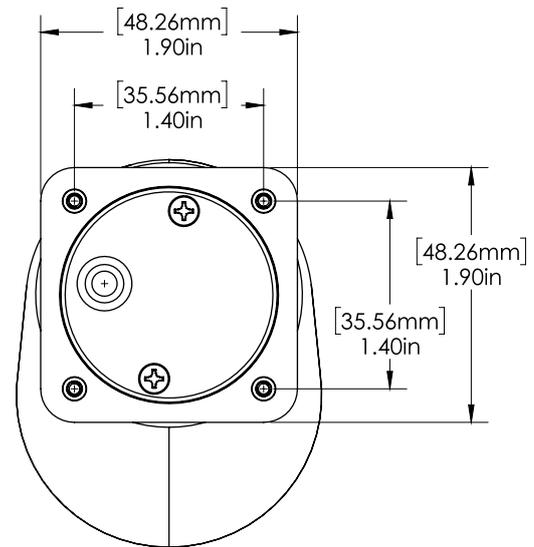
Voltage Regulator - Unipolar
- Supply Voltage Range: 8-35VDC
- Output Voltage Range: see output options
- Maximum Current: 90mA

Voltage Regulator - Bipolar
- Supply Voltage Range: 11-35VDC
- Output Voltage Range: ±10VDC
- Maximum Current: 90mA

Termination (supplied cable)
- 28 AWG 16.5cm ±1.25cm PTFE

$\begin{bmatrix}48.26mm\end{bmatrix}$
1.90in

$\begin{bmatrix}35.56mm\end{bmatrix}$
1.40in

$\begin{bmatrix}48.26mm\end{bmatrix}$
1.90in

$\begin{bmatrix}35.56mm\end{bmatrix}$
1.40in

$\begin{bmatrix}57.38mm\end{bmatrix}$
2.26in

$\begin{bmatrix}133.06mm\end{bmatrix}$
5.24in

$\begin{bmatrix}25.00cm\end{bmatrix}$
9.84in

$\begin{bmatrix}38.02mm\end{bmatrix}$
1.50in

$\begin{bmatrix}36.50mm\end{bmatrix}$
1.44in

$\begin{bmatrix}31.75mm\end{bmatrix}$
1.25in

$\begin{bmatrix}25.64mm\end{bmatrix}$
1.01in

$\begin{bmatrix}47.79mm\end{bmatrix}$
1.88in

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APEM

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⤫ USB SPECIFICATION

- Supply Voltage Range: 5.00VDC
- Maximum current: 70mA
- USB version: 2.0

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
- 12-bit (0 to 4095) axis resolution

Termination (supplied cable)

- USB Male Type A Connector (198cm)

USB CURSOR EMULATION
The Cursor Emulation option converts multi-axis joystick output into a mouse or cursor control device. The Cursor Emulation option is ideal for vehicle applications subjected to dirt and high vibration which makes operating a tradi- tional cursor control device difficult.

Features

- HID compliant "mouse" device

Button Function

- B1: Left Mouse Click
- B2: Right Mouse Click

Termination (supplied cable)

- USB Male Type A Connector (198cm)

SUPPORTED OPERATING SYSTEMS: USB GAME CONTROLLER AND CURSOR EMULATION
Windows Operating System

- Windows 7
- Windows 8.1
- Windows 10

Linux Operating System
APEM's USB joysticks are compatible with Linux, although system compatibility is not guaranteed. The user is responsible for verifying specific Linux OS compatibility.

Custom Firmware
Custom configurations and firmware is available upon request. Available options include:

- 8-bit axis resolution
- Signed bit axis resolution
- 10-bit axis resolution
- Custom USB product name

XF series

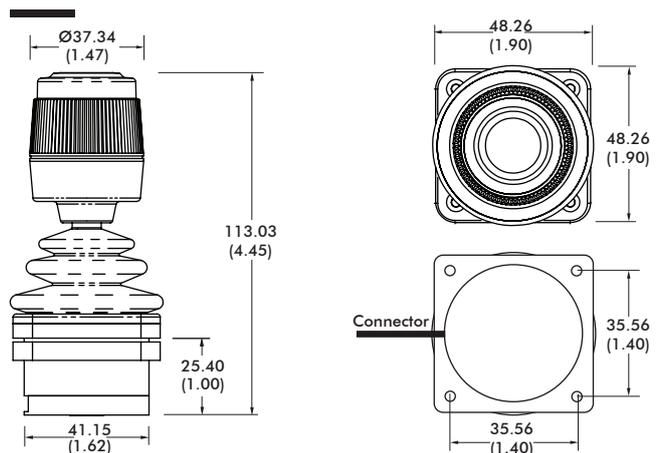## Multi-axis rugged fingertip controllers • non-contacting Hall effect technology

BUILD YOUR PART NUMBER

| XF | | A | N | | | | | | N | | | A | | |

SERIES

HANDLE

| 50 | Three axis No buttons |

HANDLE ROTATAION

| N | Locked Z axis |
| Z | Third axis Z active |

OPERATION

T	Two axis
X	One axis (X only)
Y	One axis (Y only)

CENTERING

| S | Spring Centering |

OPERATING TORQUE

| A | (900-825) |
| B | (900-1128) |

MECHANICAL FEATURES

| N | None |

OUTPUT

AA	0V-5V
BB	0.5V-4.75V
CC	0.5V-4.5V
DD	1V-4V
EE	(0V-5V)(5V-0V)
FF	(0.25V - 4.75V) (4.75V - 0.25V)
GG	(0.5V - 4.5V) (4.5V - 0.5V)
HH	(1V - 4V) (4V - 1V)
VV	±10V
NN	CAN bus J1939-71
PP	CANopen
QQ	CANopen LSS
UU	USB joystick, Game Controller
TT	USB mouse, Cursor Control

SEALING

| E | IP67 as standard |

TERMINATION

| A | None |
| B | Mating cable without connector (output AA-HH) * |

SPECIAL OPTIONS

| V | Voltage Regulator[1] |

1 Available for output options AA-HH

* Cable is supplied for output output NN-TT)

DIMENSIONS

Ø37.34 (1.47)

113.03 (4.45)

25.40 (1.00)

41.15 (1.62)

48.26 (1.90)

48.26 (1.90)

Connector

35.56 (1.40)

35.56 (1.40)

XF series

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BUILD YOUR PART NUMBER

| XF | ___ | A | N | ___ | ___ | ___ | ___ | ___ | N | ___ | ___ | A | ___ | ___ |

SERIES

HANDLE

| 51 | Three axis One button |

HANDLE ROTATAION

| N | Locked Z axis |
| Z | Third axis Z active |

OPERATION

T	Two axis
X	One axis (X only)
Y	One axis (Y only)

CENTERING

| S | Spring Centering |

OPERATING TORQUE

| A | (900-825) |
| B | (900-1128) |

MECHANICAL FEATURES

| N | None |

OUTPUT

AA	0V-5V
BB	0.5V-4.75V
CC	0.5V-4.5V
DD	1V-4V
EE	(0V-5V)(5V-0V)
FF	(0.25V - 4.75V) (4.75V - 0.25V)
GG	(0.5V - 4.5V) (4.5V - 0.5V)
HH	(1V - 4V) (4V - 1V)
VV	±10V
NN	CAN bus J1939-71
PP	CANopen
QQ	CANopen LSS
UU	USB joystick, Game Controller
TT	USB mouse, Cursor Control

SEALING

| E | IP67 as standard |

TERMINATION

| A | None |
| B | Mating cable without connector * |

SPECIAL OPTIONS

| V | Voltage Regulator[1] |

1 Available for output options AA-HH

* Cable is supplied for output output NN-TT)

DIMENSIONS

Ø37.34 (1.47)

120.22 (4.733)

25.40 (1.00)

41.15 (1.62)

48.26 (1.90)

48.26 (1.90)

Connector

35.56 (1.40)

35.56 (1.40)
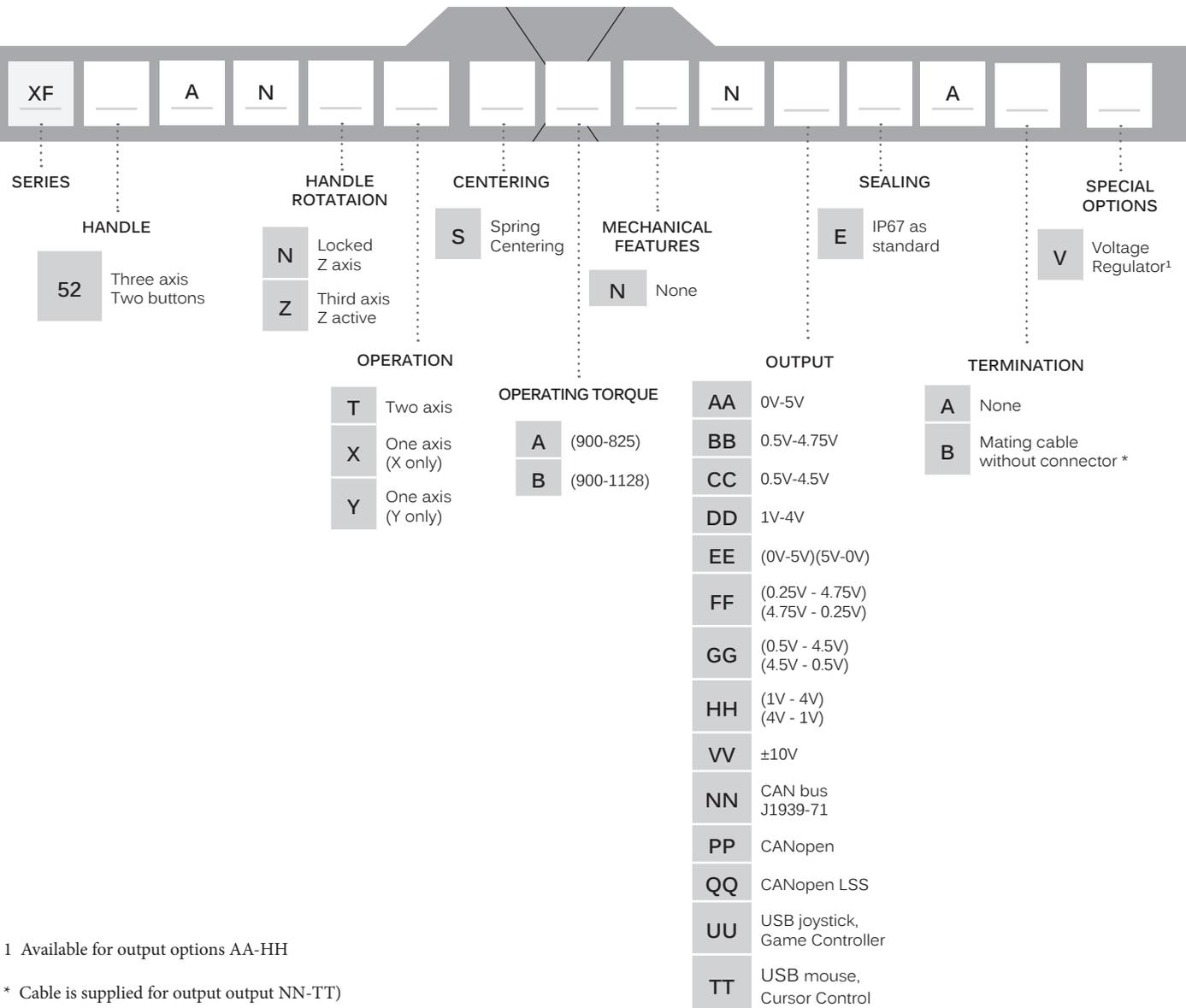
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BUILD YOUR PART NUMBER

| XF | | A | N | | | | | | N | | | A | | |

SERIES

HANDLE

| 52 | Three axis Two buttons |

HANDLE ROTATAION

| N | Locked Z axis |
| Z | Third axis Z active |

OPERATION

T	Two axis
X	One axis (X only)
Y	One axis (Y only)

CENTERING

| S | Spring Centering |

MECHANICAL FEATURES

| N | None |

OPERATING TORQUE

| A | (900-825) |
| B | (900-1128) |

OUTPUT

AA	0V-5V
BB	0.5V-4.75V
CC	0.5V-4.5V
DD	1V-4V
EE	(0V-5V)(5V-0V)
FF	(0.25V - 4.75V) (4.75V - 0.25V)
GG	(0.5V - 4.5V) (4.5V - 0.5V)
HH	(1V - 4V) (4V - 1V)
VV	±10V
NN	CAN bus J1939-71
PP	CANopen
QQ	CANopen LSS
UU	USB joystick, Game Controller
TT	USB mouse, Cursor Control

SEALING

| E | IP67 as standard |

TERMINATION

| A | None |
| B | Mating cable without connector * |

SPECIAL OPTIONS

| V | Voltage Regulator[1] |

1 Available for output options AA-HH

* Cable is supplied for output output NN-TT)

DIMENSIONS

Ø37.34
(1.47)

114.38
(4.503)

25.40
(1.00)

41.15
(1.62)

48.26
(1.90)

48.26
(1.90)

Connector

35.56
(1.40)

35.56
(1.40)
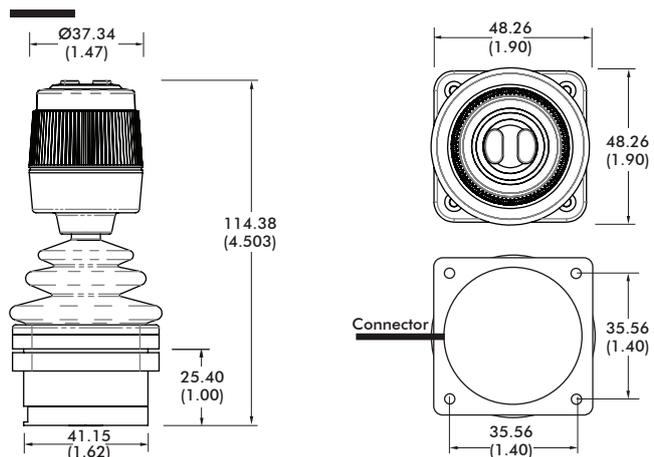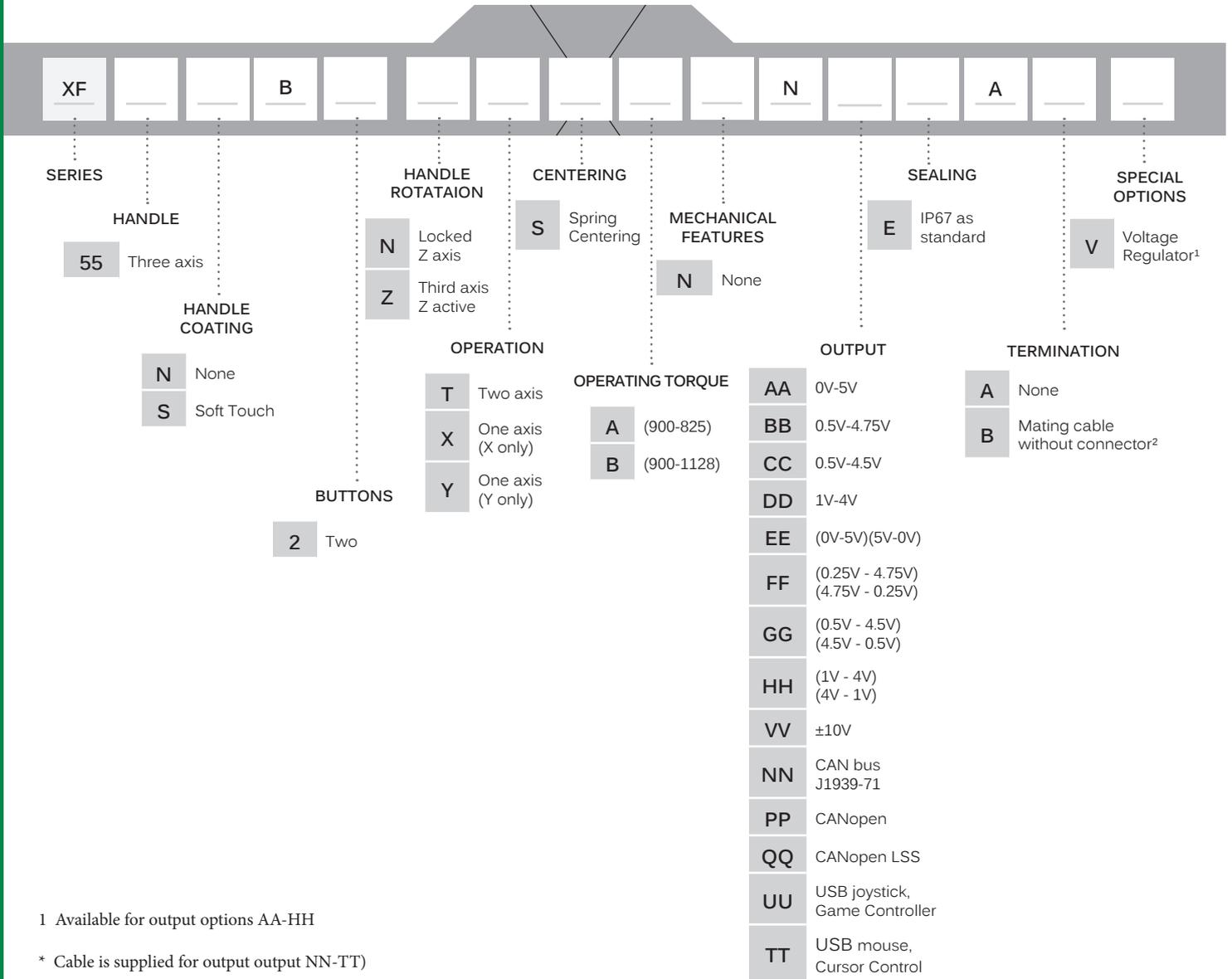
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BUILD YOUR PART NUMBER

XF	__	__	B	__	__	__	__	__	__	N	__	__	A	__	__

SERIES

HANDLE

55 Three axis

HANDLE COATING

N None
S Soft Touch

BUTTONS

2 Two

HANDLE ROTATAION

N Locked Z axis
Z Third axis Z active

OPERATION

T Two axis
X One axis (X only)
Y One axis (Y only)

CENTERING

S Spring Centering

OPERATING TORQUE

A (900-825)
B (900-1128)

MECHANICAL FEATURES

N None

OUTPUT

AA	0V-5V
BB	0.5V-4.75V
CC	0.5V-4.5V
DD	1V-4V
EE	(0V-5V)(5V-0V)
FF	(0.25V - 4.75V)(4.75V - 0.25V)
GG	(0.5V - 4.5V)(4.5V - 0.5V)
HH	(1V - 4V)(4V - 1V)
VV	±10V
NN	CAN bus J1939-71
PP	CANopen
QQ	CANopen LSS
UU	USB joystick, Game Controller
TT	USB mouse, Cursor Control

SEALING

E IP67 as standard

TERMINATION

A None
B Mating cable without connector[2]

SPECIAL OPTIONS

V Voltage Regulator[1]

1 Available for output options AA-HH

* Cable is supplied for output output NN-TT)

DIMENSIONS

Ø57.404 (2.26)
120.40 (4.74)
25.40 (1.00)
41.15 (1.62)
25.65 (1.01)
47.75 (1.88)
48.26 (1.90)
35.56 (1.40)
35.56 (1.40)
48.26 (1.90)

XF series

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DIMENSIONS

[48.26mm]
1.90in

[35.56mm]
1.40in

[48.26mm]
1.90in

[35.56mm]
1.40in

[57.38mm]
2.26in

[126.71mm]
4.99in

[25.00cm]
9.84in

[31.67mm]
1.25in

[30.15mm]
1.19in

[25.40mm]
1.00in

[25.64mm]
1.01in

[47.79mm]
1.88in

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