Key Features

▶ Designed for OEM integration

▶ Smooth and low profile design

▶ Internal and customizable connections

▶ High stiffness with minimal weight

▶ Through-hole design

▶ Waterproof IP68 ready

Configurations

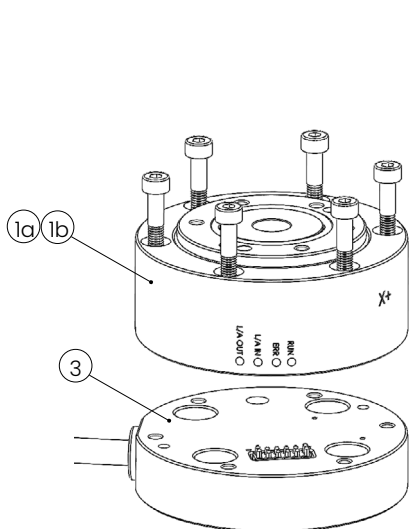| Ordering number	Description
BFT-SH1-IND-BD	PixONE T25 Industrial 6-axis F/T sensor
BFT-SH1-CAT2-BD	PixONE T25 EtherCAT 6-axis F/T sensor
KIT-SH1-IND	PixONE T25 industrial 6-axis F/T sensor with Ethernet ISO50 Adapter
KIT-SH1-CAT2	PixONE T25 EtherCAT 6-axis F/T sensor with EtherCAT ISO50 Adapter
BFT-MH1-MLP-BD	PixONE T60 multiprotocol 6-axis F/T sensor
KIT-MH1-CAT2	PixONE T60 EtherCAT 6-axis F/T sensor with EtherCAT ISO50 Adapter
KIT-MH1-ENET	PixONE T60 Ethernet 6-axis F/T sensor with Ethernet ISO50 Adapter
KIT-MH1-SER	PixONE T60 Serial 6-axis F/T sensor with Serial ISO50 Adapter

Technical Specifications

Please refer to the table for all sensor specifications. For additional information, feel free to consult our team of engineers at support@botasys.com

		F_x	F_y	F_z	M_x	M_y	M_z
Range	BFT-SH1-XXX-XXX	1000 N	1000 N	1800 N	25 Nm	25 Nm	25 Nm
	BFT-MH1-XXX-XXX	1800 N	1800 N	4000 N	60 Nm	60 Nm	50 Nm
Overload limit[1]	BFT-SH1-XXX-XXX	2800 N	2800 N	7500 N	80 Nm	80 Nm	140 Nm
	BFT-MH1-XXX-XXX	7200 N	7200 N	12800 N	160 Nm	160 Nm	200 Nm
NFR[2]	BFT-SH1-XXX-XXX	0.15 N	0.15 N	0.15 N	0.008 Nm	0.008 Nm	0.001 Nm
	BFT-MH1-XXX-XXX	0.35 N	0.35 N	0.20 N	0.010 Nm	0.010 Nm	0.003 Nm
Size (D x H), Weight	BFT-SH1-XXX-XXX	72 mm x 30 mm, 236 grams					
	BFT-MH1-XXX-XXX	85 mm x 41.5 mm, 436 grams					
Maximum sampling rate		3800 Hz					
IMU, Max acceleration & angular rate		6 DoF accelerometer & Gyroscope, ±16g & ±2000°/sec					
Power supply		5 – 60 V, 1.5 W					
Ingress protection		Dust and water resistant					
Operating temperature		0°C – 55°C					

	PixONE Industrial & Multiprotocol	PixONE EtherCAT & Multiprotocol
Communication	Ethernet 100 mbps, RS422/RS485, USB	EtherCAT in/out, USB
Protocol[5]	MODBUS TCP/RTU, Ethernet IP, VCP[4]	CoE[3], VCP[4]

1. Overload limit values are simulated using FEA methods. Actual values results may deviate from simulation results.
2. NFR (noise-free resolution) refers to (6σ) peak-to-peak noise distribution of sensor signal at 100 Hz.
3. CANopen over EtherCAT.
4. Virtual COM port over USB.

List of Components
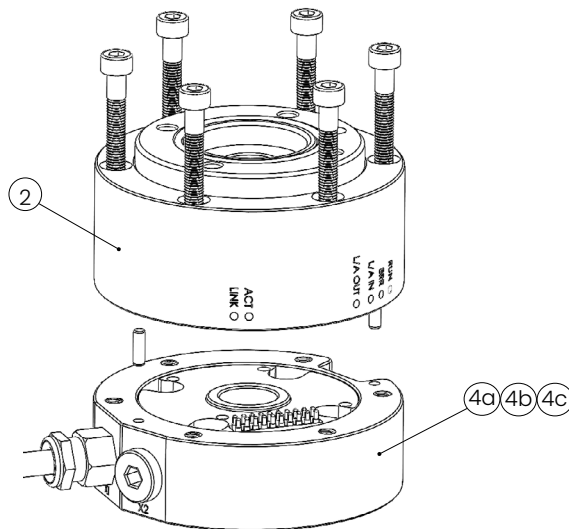
**PixONE T25**   **PixONE T60**

#	Component	Description	Included in configuration
1a	**BFT-SH1-IND-BD**	PixONE T25 Industrial 6-axis F/T sensor	**BFT-SH1-IND-BD** **KIT-SH1-IND**
1b	**BFT-SH1-CAT2-BD**	PixONE T25 EtherCAT 6-axis F/T sensor	**BFT-SH1-CAT2-BD** **KIT-SH1-CAT2**
2	**BFT-MH1-MLP-BD**	PixONE T60 multiprotocol 6-axis F/T sensor	**BFT-MH1-MLP-BD** **KIT-MH1-CAT2** **KIT-MH1-ENET** **KIT-MH1-SER**
3	**ACC-PIX-T25-ISO**	ISO50 adapter for PixONE T25 Industrial or EtherCAT (EtherCAT/Ethernet wiring)	**KIT-SH1-IND** **KIT-SH1-CAT2**
4a	**ACC-PIX-T60-ISO-CAT2**	ISO50 adapter for PixONE T60 Multiprotocol with EtheCAT wiring	**KIT-MH1-CAT2**
4b	**ACC-PIX-T60-ISO-ENET**	ISO50 adapter for PixONE T60 Multiprotocol with Ethernet wiring	**KIT-MH1-ENET**
4c	**ACC-PIX-T60-ISO-SER**	ISO50 adapter for PixONE T60 Multiprotocol with Serial wiring	**KIT-MH1-SER**

Integration

The PixONE series has been designed for higher level of Integration than other products. It allow OEMs and Robotic system developers to seemlessly integrate 6-axis F/T sensing in their system with a factory look and without external cabling. Below are illustrated two ways of integration: fully integrated where the system has been designed for the sensor and retro integrated for exisiting systems using an adapter like the ones from the available kits.
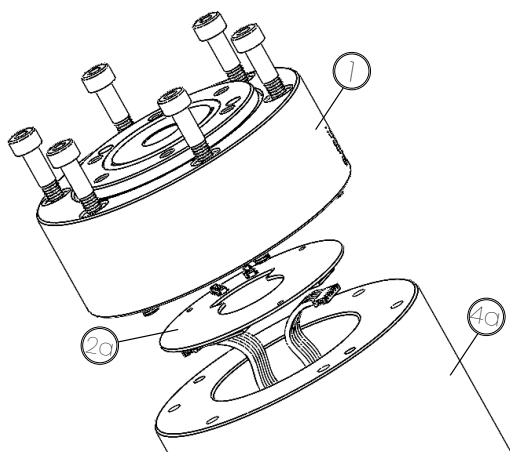

Fully Integrated
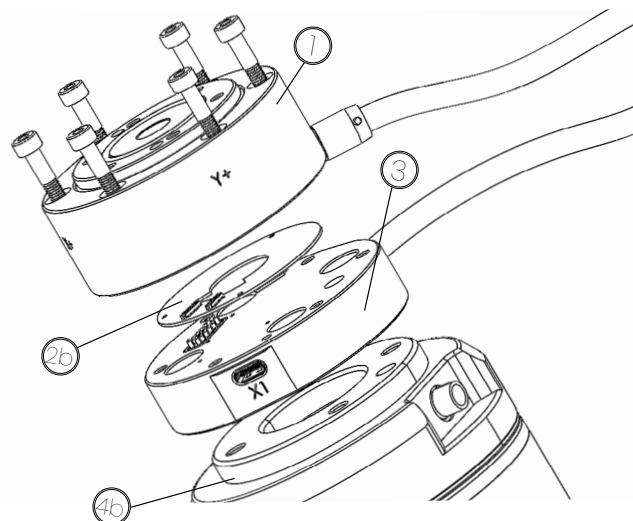
Retro Integrated

| #	Description
1	PixONE 6-axis F/T sensor
2a	Sensor Interface board (connectors can be customized)
2b	Sensor Interface board (connectors can be customized)
3	Mechanical adapter designed for or by customer
4a	Customer robot designed with PixONE flange
4b	Customer robot using mechanical adapter

Combined Loading Graphs

During single-axis loading, the sensor can operate up to its normal range. Above the sensor's normal range, the readings become inaccurate. The sensor should not work outside of its normal operating range. When more than one axis is loaded, it becomes a combined loading, and the range of the sensor reduces. The following graphs represent the combined loading scenarios, and the orange area represents the sensor's normal operating range.

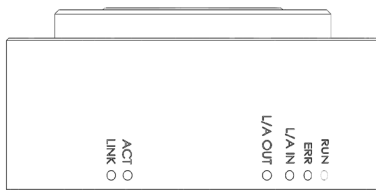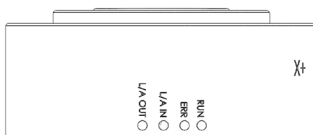BFT-SH1-XXX-XXX
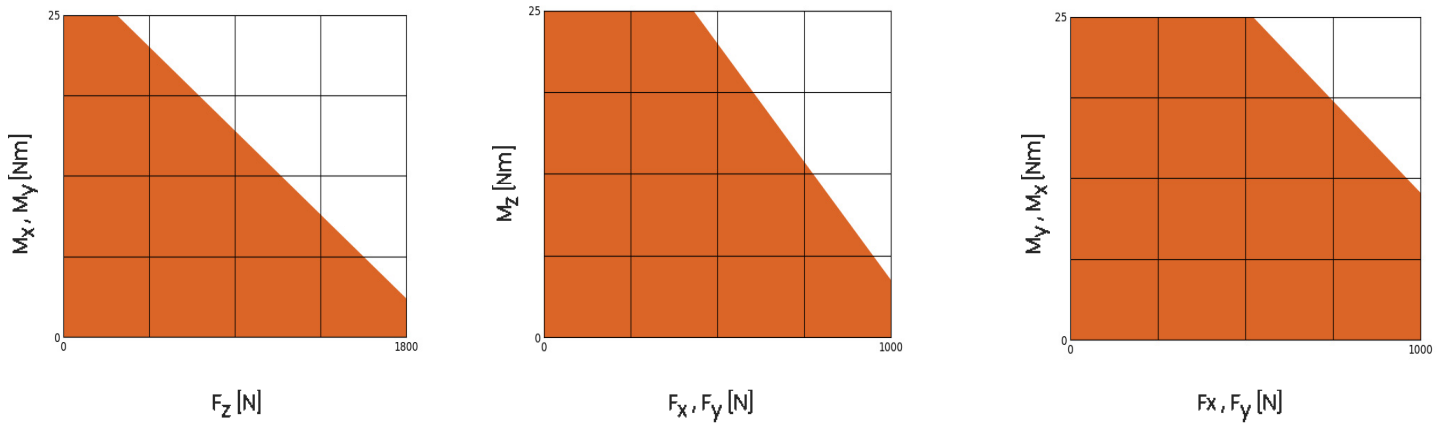

BFT-MH1-XXX-XXX
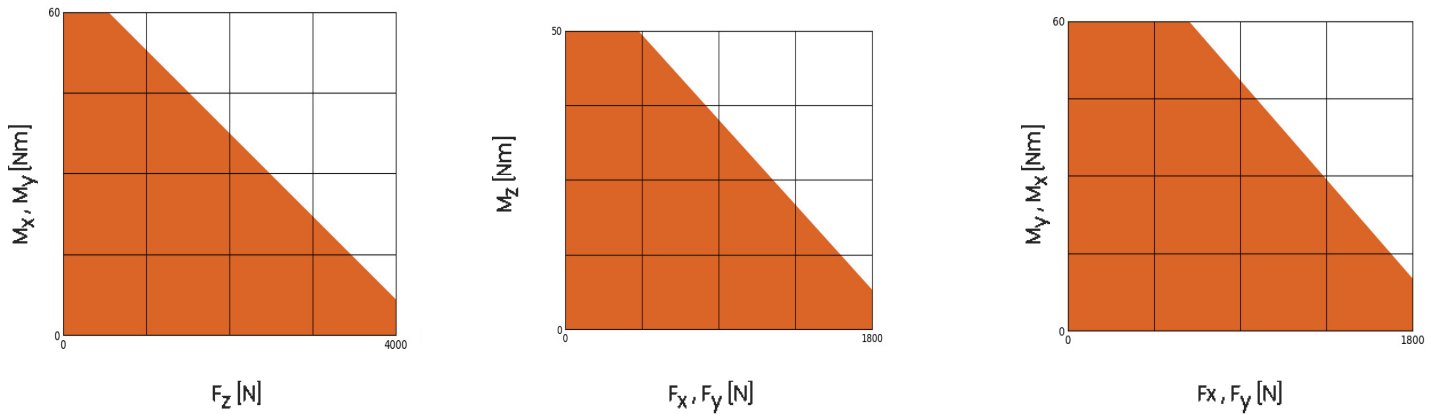
LEDs Indicators

BFT-MH1-XXX-XXX

BFT-SH1-XXX-XXX

- ACT: Indicates EtherNET network activity. ⟶ Yellow
- LINK: Indicates EtherNET network connection. ⟶ Green
- RUN: Shows the system's operational state (EtherCAT Run Led). ⟶ Green
- ERR: Shows the system's operational errors (EtherCAT Err Led). ⟶ Red
- L/A IN: Displays link and activity on the EtherCAT input. ⟶ Yellow
- L/A OUT: Displays link and activity on the EtherCAT output. ⟶ Yellow

Sensor Interface Board Pinout

The pinout configuration is based on the "evaluation breakout board," designed to simplify prototyping by exposing all physical communication layers via EZMATE 6-pin board connectors. These connectors are labeled with "J" identifiers and are linked to the sensor electronics board through one or more B2B connectors. This setup allows for seamless access to multiple communication protocols, such as USB, RS422/485/UART, EtherCAT, and Ethernet.

#	PixONE T60 Multiprotocol	PixONE T25 Industrial	PixONE T25 EtherCAT
1	EtherCAT Out	Ethernet	EtherCAT Out
2	USB/UART	USB/UART	USB/UART
3	EtherCAT In	RS422/RS485	EtherCAT In
4	RS422/RS485		
5	Ethernet		
6	Contactcts (All Protocols)	Contactcts (All Protocols)	Contactcts (All Protocols)

PixONE T60 Multiprototocol

PixONE T25 Industrial & EtherCAT
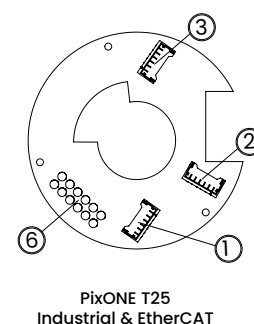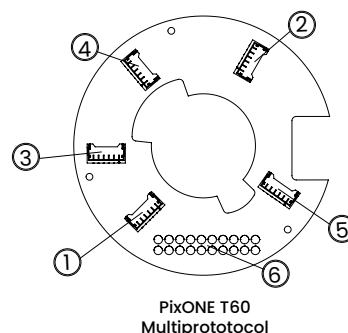
USB/UART Connector	
P1	GND
P2	POWER
P3	USB+
P4	USB-
P5	UART Rx
P6	UART Tx

EtherCAT (In & Out) Connector	
P1	GND
P2	POWER
P3	Tx+ (PWR PoE)
P4	Tx- (PWR PoE)
P5	Rx+ (PWR PoE)
P6	Rx- (PWR PoE)

Ethernet Connector	
P1	GND
P2	POWER
P3	Tx+ (PWR PoE)
P4	Tx- (PWR PoE)
P5	Rx+ (PWR PoE)
P6	Rx- (PWR PoE)

RS422/RS485 Connector	
P1	GND
P2	POWER
P3	Y (Tx+ / Rx+)
P4	Z (Tx- /Rx-)
P5	A (Rx+)
P6	B (Rx-)

P1 P2 P3 P4 P5 P6

Molex 0781715006
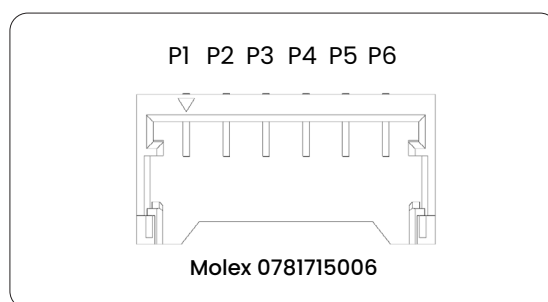
Is required to connect: Molex 781725006 connector with molex pre crimped wires 79758-1010

The provided pinout serves as an example for interface design in custom applications. The breakout board simplifies prototyping by exposing physical layers and is fully customizable to align with system requirements. Modifications to pinout configuration, connector types, or signal routing can be implemented as needed. For optimized integration into your OEM system, adapt this design or contact Bota Systems for tailored configurations.

PixONE T60 Multiprotocol Contacts Connector

P1	ECAT In Tx- (PWR PoE)	P11	Tx- (PWR PoE)
P2	ECAT In Tx+ (PWR PoE)	P12	Tx+ (PWR PoE)
P3	ECAT Out Tx- (PWR PoE)	P13	Y (Tx+ / Rx+)
P4	ECAT Out Tx+ (PWR PoE)	P14	Z (Tx- /Rx-)
P5	USB -	P15	DC-
P6	USB +	P16	DC+
P7	A (Rx+)	P17	ECAT Out Rx- (PWR PoE)
P8	B (Rx-)	P18	ECAT Out Rx+ (PWR PoE)
P9	Rx+ (PWR PoE)	P19	ECAT In Rx+ (PWR PoE)
P10	Rx- (PWR PoE)	P20	ECAT In Rx- (PWR PoE)
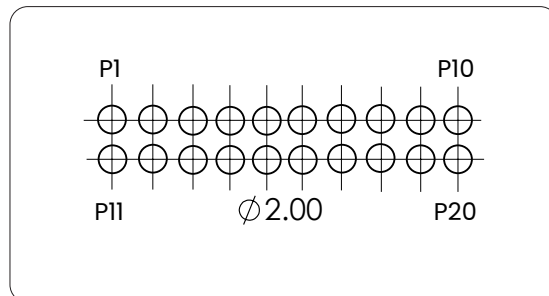
PixONE T25 EtherCAT Contacts Connector

P1	ECAT Out Rx- (PWR PoE)
P2	ECAT Out Rx+ (PWR PoE)
P3	USB -
P4	USB +
P5	ECAT In Rx+ (PWR PoE)
P6	ECAT In Rx- (PWR PoE)
P7	ECAT Out Tx+ (PWR PoE)
P8	ECAT Out Tx- (PWR PoE)
P9	DC-
P10	DC+
P11	ECAT In Tx- (PWR PoE)

PixONE T25 Industrial Contacts Connector

P1	A (Rx+)
P2	B (Rx-)
P3	USB -
P4	USB +
P5	ETH Rx+ (PWR PoE)
P6	ETH Rx- (PWR PoE)
P7	Y (Tx+ / Rx+)
P8	Z (Tx- /Rx-)
P9	DC-
P10	DC+
P11	ETH Tx- (PWR PoE)
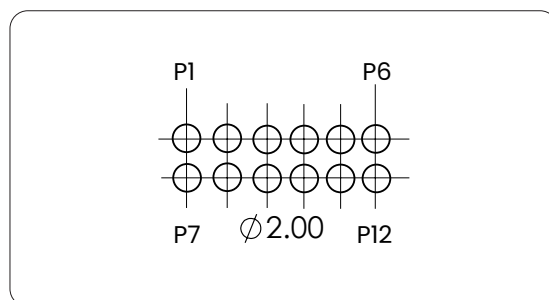
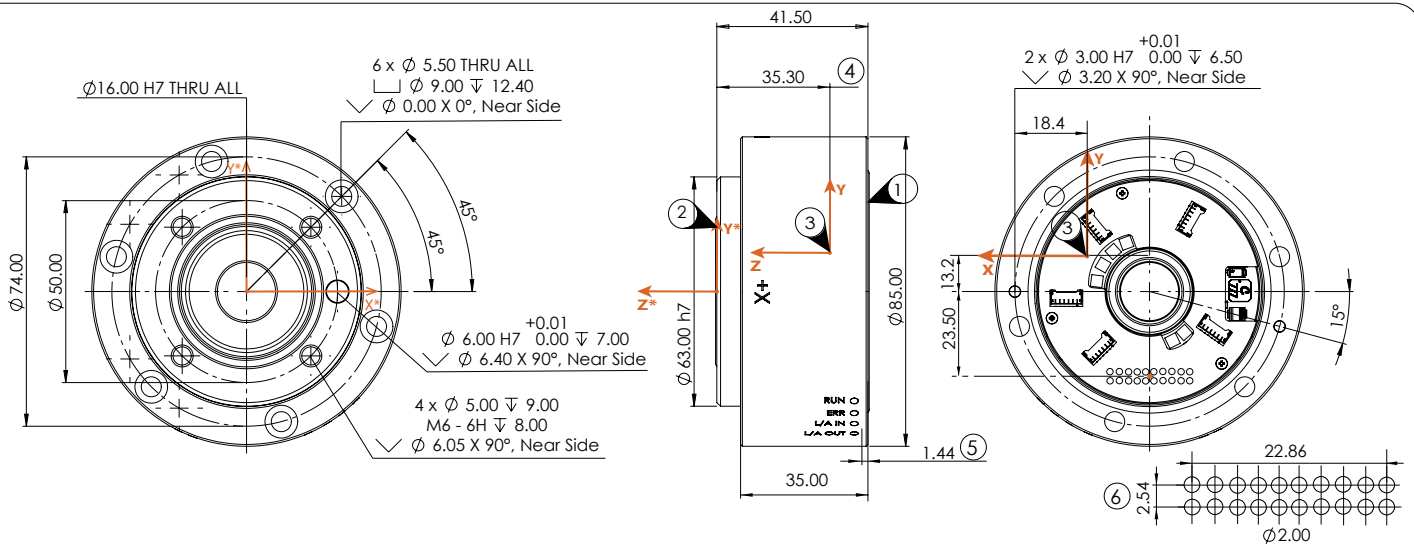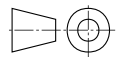**Is required to connect:** Mill-Max 814-22-0XX-30-00X101.

Mechanical Dimensions
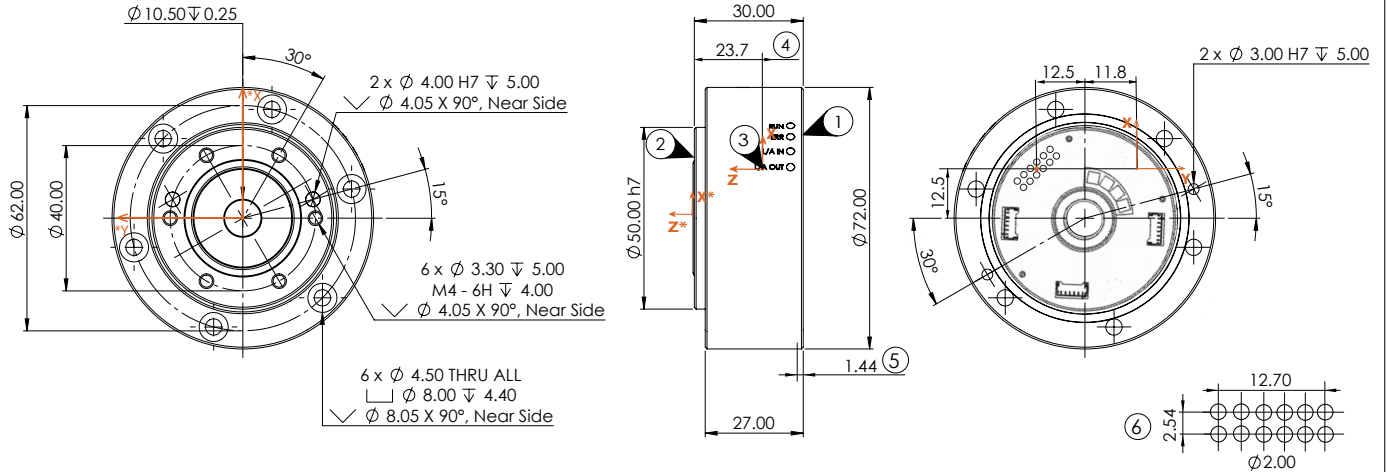
PixONE T25 by Bota Systems AG

1. Robot mounting side
2. Tool mounting side
3. 6-DoF IMU location
4. Distance between IMU and F/T sensor coordinate systems
5. Distance between robot mounting side and PCB surface
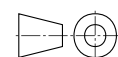6. Spring contacts dimension
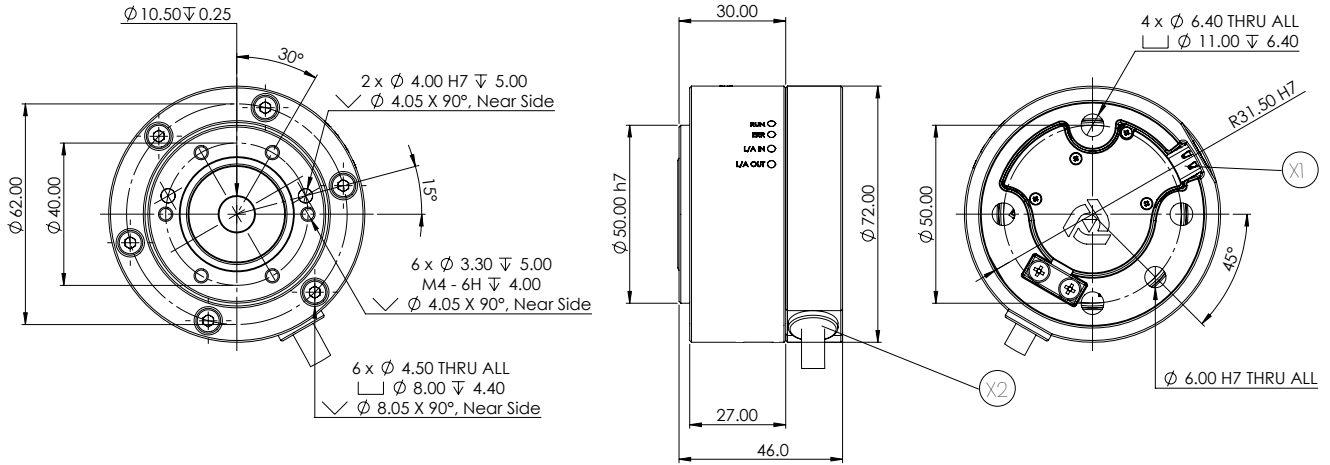
BFT-SH1-IND/CAT2-BD
BFT-SH1-IND/CAT2-XX

PixONE T60 by Bota Systems AG

1. Robot mounting side
2. Tool mounting side
3. 6-DoF IMU location
4. Distance between IMU and F/T sensor coordinate systems
5. Distance bttween robot mounting side and PCB surface
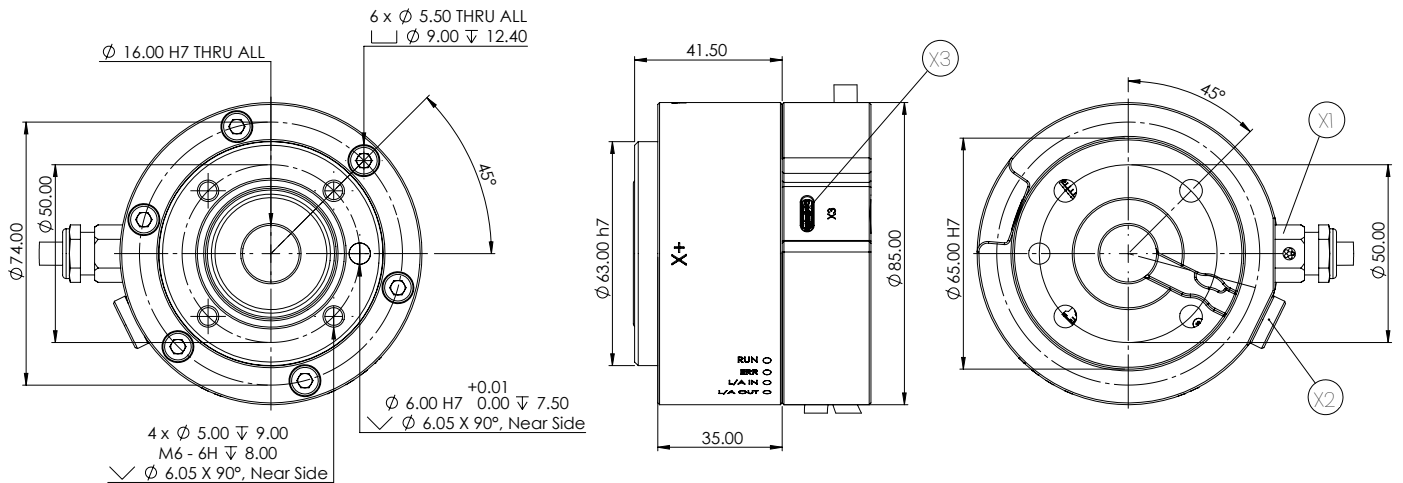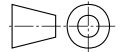6. Spring contacts dimension

BFT-MH1-MLP-BD
BFT-MH1-MLP-XX

PixONE T25 by Bota Systems AG with evaluation kit

X1 - USB (Can be used to configure the sensor and get data)

X2 - EtherCAT IN (KIT-SH1-CAT2) or Ethernet (KIT-SH1-IND)
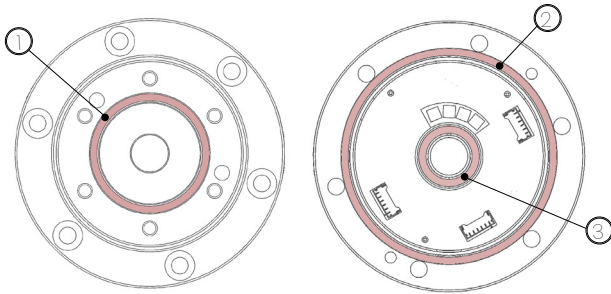
KIT-SH1-IND
KIT-SH1-CAT2

PixONE T60 by Bota Systems AG with evaluation kit

X1 - EtherCAT IN (KIT-MH1-CAT2) or Ethernet (KIT-MH1-ENET) or Serial (KIT-MH1-SER)

X2- Can be used to acces the throug-hole externally or for EtherCAT OUT internally (KIT-MH1-CAT2)

X3- USB (Can be used to configure the sensor and get data)

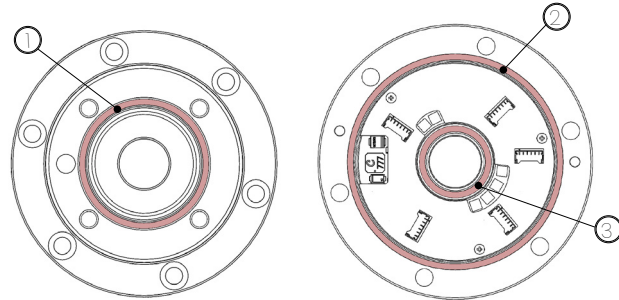KIT-MH1-CAT2
KIT-MH1-ENET
KIT-MH1-SER
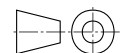
O-ring Indicator

BFT-SH1-XXX-XXX

1. O-ring (28.3 x 1.78 mm) NBR 90, black color
2. O-ring (53.42 x 1.78mm) EPDM 70 black color
3. O-ring (12.42 x 1.78mm) NBR 70, black color

BFT-MH1-XXX-XXX

1. O-ring (37.82 x 1.78mm) NBR 70, black color
2. O-ring (63.22 x 1.78mm) EPDM 70 black color
3. O-ring (18.77 x 1.78mm) EPDM 70 black color

Crosstalk

Crosstalk in multi-axis force-torque sensors refers to the measurements in other axes when the sensor is excided only in a single axis. Crosstalk is reported as the percentile deviation from reference with respect to the full scale of that axis. Bota Systems provides a crosstalk certificate for your sensor tested according to ISO 21612:2021 standard upon request. An exemplary crosstalk table is provided below as a reference.

Affected axis	F_x	F_y	F_z	M_x	M_y	M_z
F_x (%)	–	0.00	0.05	0.02	1.17	0.18
F_y (%)	0.01	–	0.07	1.40	0.12	2.08
F_z (%)	0.08	0.03	–	1.66	0.32	0.01
M_x (%)	0.03	0.67	0.09	–	0.03	0.13
M_y (%)	0.13	0.36	0.22	0.85	–	0.07
M_z (%)	0.23	0.06	0.03	0.67	0.68	–

For more information, please refer to the user manual.

Signal Noise

Signal noise is any unwanted modification that may arise during capture, storage, transmission, processing, or conversion of a communication signal. The upper limits for the standard deviation of noise distribution are reported in the following tables.

Sampling rate		F_X	F_Y	F_Z	M_X	M_Y	M_Z
100 Hz	BFT-SH1-XXX-XX	29.98 mN	28.39 mN	13.30 mN	0.43 mNm	0.46 mNm	0.28 mNm
	BFT-MH1-XXX-XX	47.3 mN	45.8 mN	30.9 mN	1.26 mNm	1.45 mNm	0.40 mNm
250 Hz	BFT-SH1-XXX-XX	33.75 mN	29.96 mN	17.63 mN	0.62 mNm	0.66 mNm	0.30 mNm
	BFT-MH1-XXX-XX	74.08 mN	71.60 mN	45.84 mN	1.96 mNm	2.21 mNm	0.62 mNm
1000 Hz	BFT-SH1-XXX-XX	62.43 mN	62.01 mN	35.26 mN	1.27 mNm	1.29 mNm	0.54 mNm
	BFT-MH1-XXX-XX	137.82 mN	142.07 mN	87.26 mN	3.92 mNm	4.26 mNm	1.24 mNm
2100 Hz	BFT-SH1-XXX-XX	92.44 mN	91.91 mN	53.97 mN	1.90 mNm	1.95 mNm	0.81 mNm
	BFT-MH1-XXX-XX	202.77 mN	213.97 mN	126.95 mN	5.9 mNm	6.28 mNm	1.85 mNm
3800 Hz	BFT-SH1-XXX-XX	135.02 mN	133.71 mN	77.06mN	2.77 mNm	2.84 mNm	1.18 mNm
	BFT-MH1-XXX-XX	296.67 mN	314.89 mN	182.32 mN	8.55 mNm	9.02 mNm	2.81 mNm