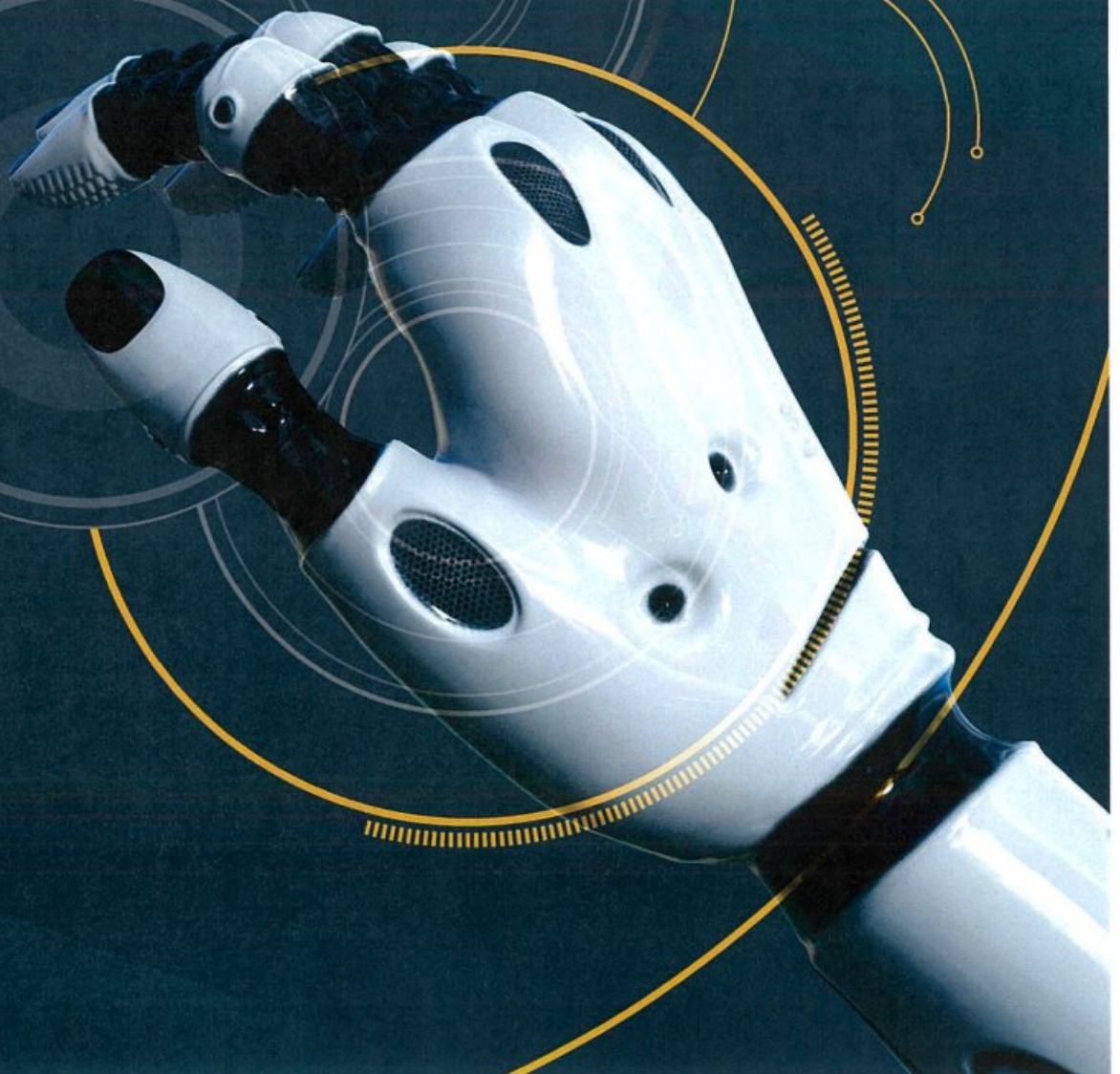


# Artificial Life on Robot

## Expert Group on Human Friendly Robot

- Torque Sensor
- Force/Torque sensor
- Predictive Maintenance
- Intelligent Control
- Smart Factory







## ABOUT AL. Robot

AL Robot (エーエルロボット) は、ロボットに必要な力/トルクセンサーを開発および製造する専門メーカーです。お客様のニーズに応じて迅速にカスタマイズおよび開発できる経歴30年以上のプロフェッショナルエンジニアたちが集まり、2017年に設立しました。

現在、主力商品は容量10~500Nmの関節型トルクセンサーと6軸力/トルクセンサーで、機械学習(Machine Learning)アルゴリズムを活用したキャリブレーション装置などの検査自動化装置を開発・運用し、高品質・高性能の製品をロボットメーカーに提供しています。

当社の 関節型トルクセンサーと6軸力/トルクセンサーは、大手ロボット製造会社から優れた性能と品質で認められ、産業用ロボットや協働ロボットに活用されております。

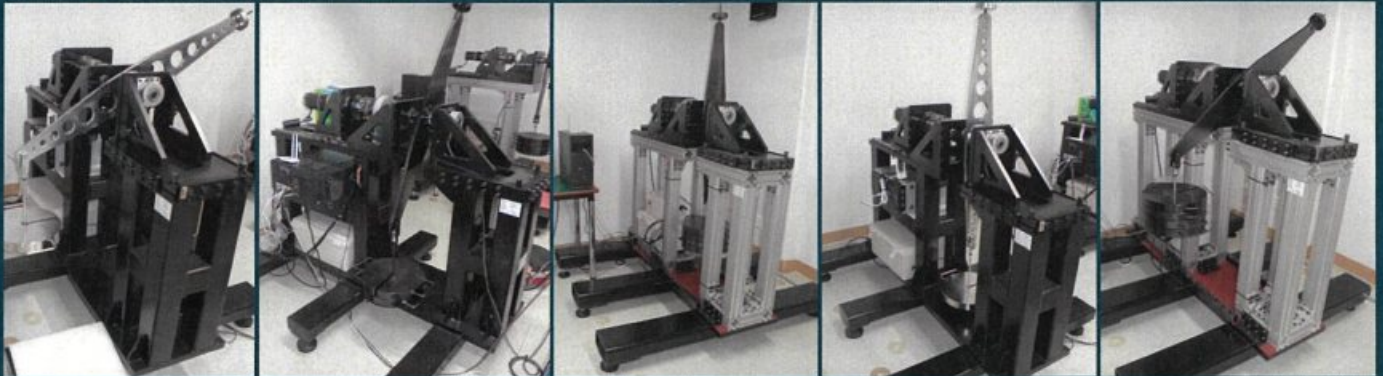
特に、カスタマイズとインストールが簡単なため、ロボットの多様な要求に迅速に対応できます。

今後とも常に顧客満足を第一に考え、世界一のセンサー技術企業となることをお約束します。





# Challenge new Torque Sensor



## Key Technology

### 1 : Cross-Talk Cancelation algorithm

- Embedded within sensor

### 2 : High Stiffness

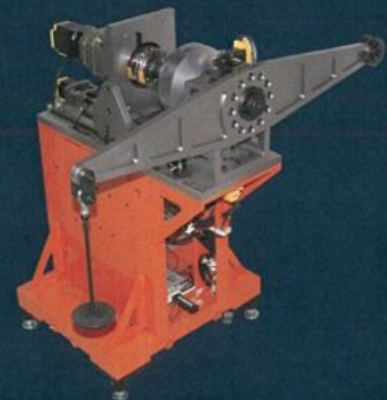
- Unique Structure
- 4-times stiffer than Harmonic Drive

### 3 : Calibration & Compensation

- Smart & Intelligence
- Machine learning algorithm
- Temperature, Hysteresis & Linearity Compensation

### 4 : Total Solution

- 6-Axis Force/Torque sensor
- Joint Torque sensor
- Wireless Torque sensor
- Realtime monitoring S/W
- Algorithm suggest



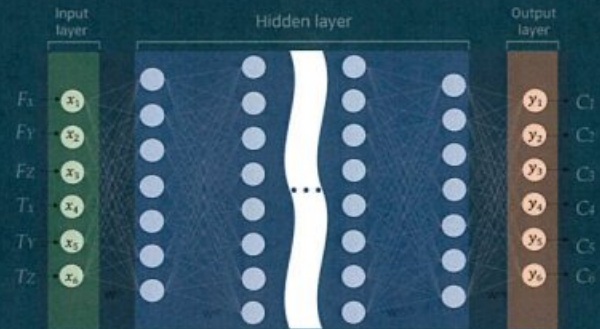


## Sales Point

### 1 . High performance : 0.1% Accuracy

- Machine learning calibration
- Fault tolerance for Safety sensor
- Redundancy design

Cross-Talk with Machine learning Algorithm



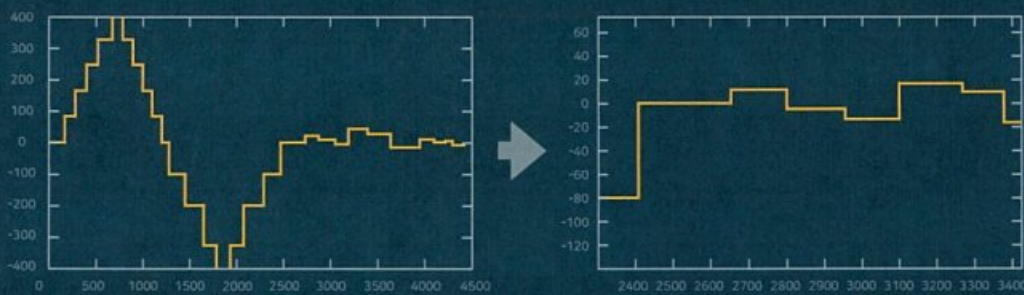
### 2 : Reasonable Price & High quality

- Calibration Automation
- Mass production line
- Automatic inspection process

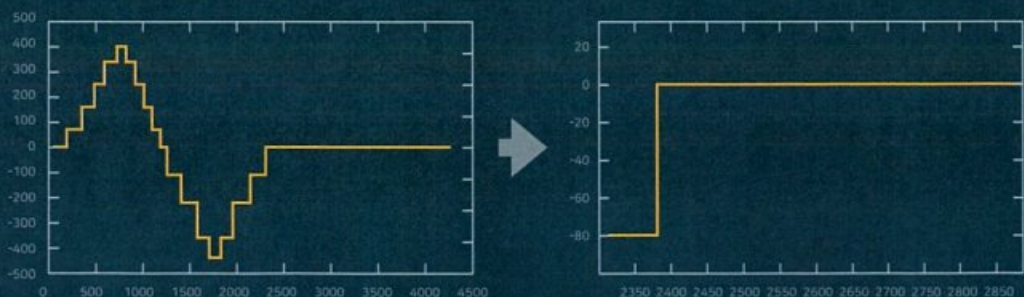
### 3 : Easy Customize

- Supporting various Communication Protocol
- Easy Mechanical installation

[Cross talk w/o algorithm]



[Cross talk by our algorithm]





# Challenge new Torque Sensor Named TSR-J series

## New Concept/Structure for only Robot

- Easy installation on Harmonic Drive
- Light weight
- High Precision

## Fault Tolerance

- Fault Injection Test
- SW redundancy
- Communication line redundancy
- Sensor element redundancy

## Joint Torque Sensor for Robot



### 1. Cross-talk Compensation

- Bending force & moment cancelation

### 2. High stiffness

- Four times higher than harmonic drive's
- Minimize torsional angle error of Robot

### 3. Precise Calibration

- Minimize Hysteresis error
- Linearity calibration
- Zero Balancing & temperature compensation

### 4. Wide measuring range

- three times wider range than rated scale

### 5. Patented technology

### 6. Serial Communication protocol support

- Standard: dual CAN, option: EtherCat, single CAN, etc.



## Technical Data

• Model name	TSR-J series	
• Rated Torque	10~400	Nm
• Axial Force Limit	0.1k~10k	N
• Radial Force Limit	0.1k~10k	N
• Weight	95~375	g
• Safety Overload	300	%
• Insulation Resistance	2M	Ohm
• Supply Voltage	4.5~6.0	V
• Stiffness	23,435~877,664	Nm/rad
• Accuracy Class	0.1	%
• Linearity	0.1	%FS
• Repeatability	0.1	%FS
• Hysteresis	0.1	%FS
• Zero Balance	0.1	%FS
• Crosstalk	0.2	%
• Temperature effect Sensibility	0.01	%FS/K
• Operating temperature	-10 ~ 85	°C
• Storage temperature range	-40 ~ 130	°C

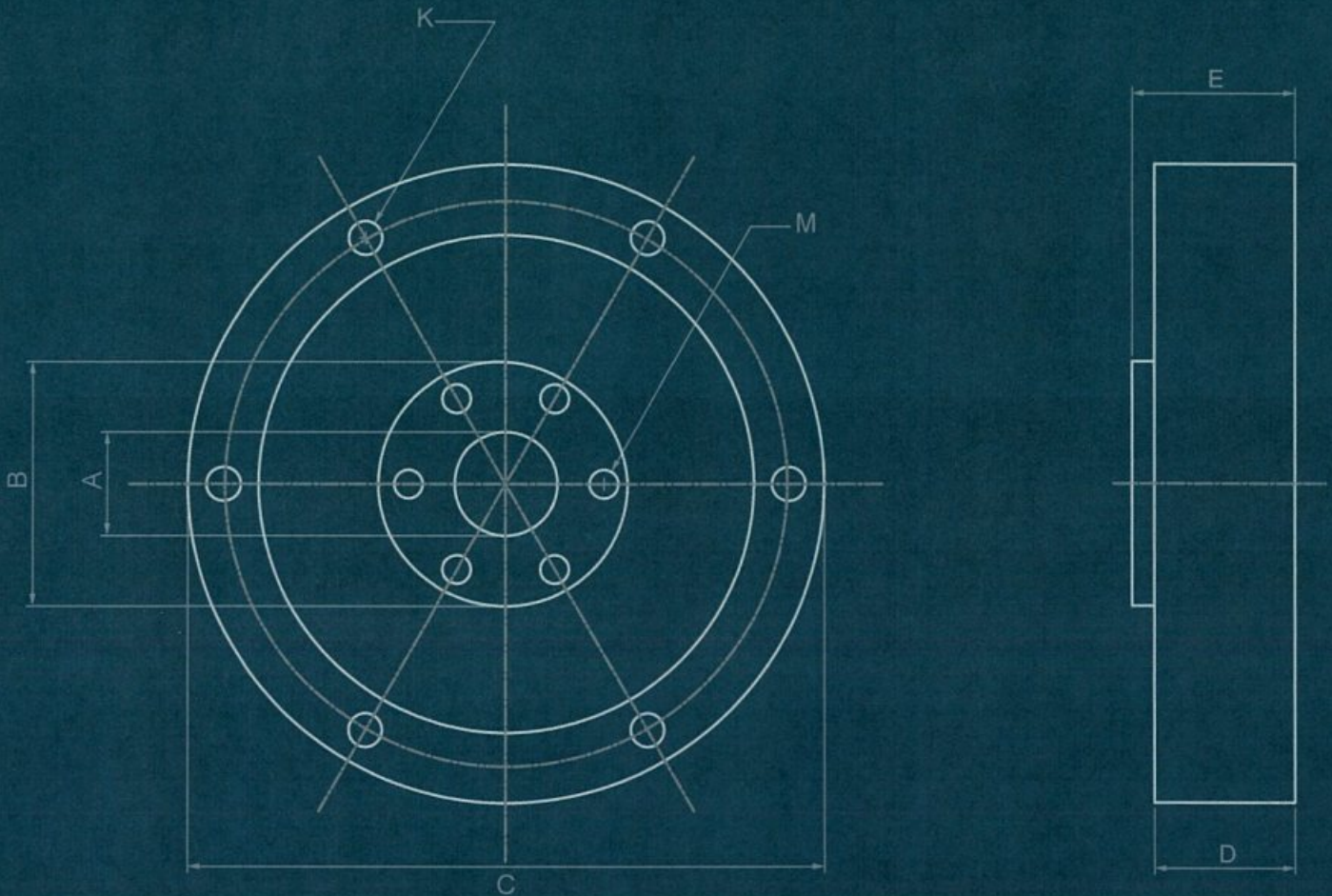
## Interface Type

- Mechanical Interface:
  - Suitable to harmonic drive
- Electrical interface:
  - Standard: CAN
  - Option: EtherCat, USB, SPI, I2C, etc.
- Maximum sampling frequency: 1,500Hz





## Dimension



### Dimension

	A	B	C	D	E	K	M	E	R*
10Nm	14	18	80	21	23	12-3.4(PCD72)	9-3.2(PCD25)	23	#14
20Nm									#14
50Nm									#17
100Nm	20	26	90	22.5	24.5	12-4.5(PCD80)	9-5.5(PCD35)	24.5	#20
200Nm			110	25.5	28	12-5.5(PCD98)		28	#25
400Nm			142	27.5	30	12-6.5(PCD127)		30	#32

R\* : Refer to Harmonic Drive



# Challenge New 6-Axis Force/Torque Sensor Named FTR-M series

## New Concept/Structure for only Robot

- Easy installation on robot end-effector
- Light weight
- High Precision

## Fault Tolerance

- Fault Injection Test
- SW redundancy
- Communication line redundancy
- Sensor element redundancy

## Force/Torque Sensor for Robot



### 1. Cross-talk Compensation

- Using machine learning algorithm

### 2. High stiffness

- Four times higher than harmonic drive
- Minimize torsional angle error of Robot

### 3. Precise Calibration

- Minimize Hysteresis error
- Linearity calibration
- Zero Balancing & temperature compensation

### 4. Patented technology

### 5. Serial Communication protocol support

- Standard: dual CAN, option: EtherCat, single CAN, etc.



## Technical Data

• Model name	FTR-M series	
• Rated Torque Tx	30	Nm
• Rated Torque Ty	30	Nm
• Rated Torque Tz	30	Nm
• Rated Force Fx	300	N
• Rated Force Fy	300	N
• Rated Force Fz	300	N
• Weight	276	g
• Safety Overload	300	%
• Stiffness Fx, Fy	$35 \times 10^6$	N/m
• Stiffness Fz	$30 \times 10^6$	N/m
• Stiffness Mx, My	10,000	Nm/rad
• Stiffness Mz	20,000	Nm/rad
• Insulation Resistance	2M	Ohm
• Supply Voltage	4.5~6.0	V
• Accuracy Class	0.5	%
• Linearity	0.5	%FS
• Repeatability	0.5	%FS
• Hysteresis	0.5	%FS
• Zero Balance	0.5	%FS
• Crosstalk	0.2	%
• Temperature effect Sensibility	0.01	%FS/K
• Operating temperature	-10 ~ 85	°C
• Storage temperature range	-40 ~ 130	°C

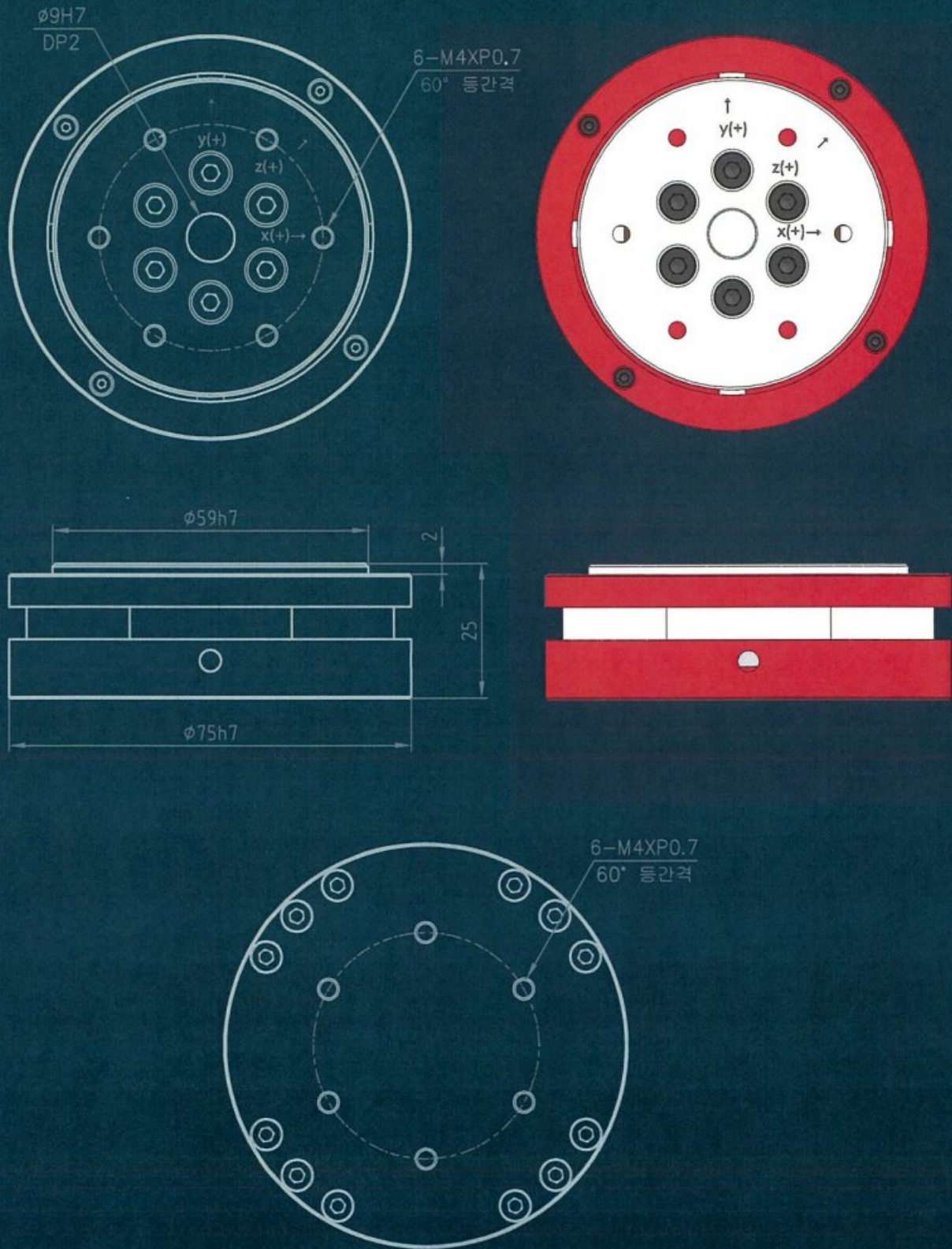
## Interface Type

- Mechanical Interface:
  - Suitable to Robot end-effector
- Electrical interface:
  - Standard: CAN
  - Option: EtherCat, USB, SPI, I2C, etc.
- Maximum sampling frequency: 1,500Hz





## Dimension





## TSR-J & FTR-M series Applications

### Robot



Mobile robot



Industrial robot

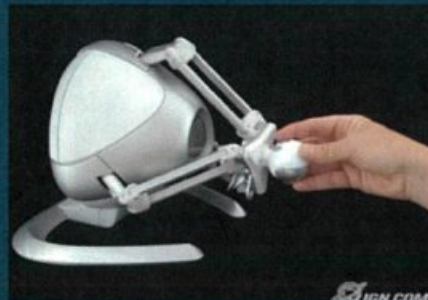


Wearable robot

### Medical



Rehabilitation



Haptic device



Medical robot

### Life



VR machine



PAS Bicycle



Auto mobile



Artificial Life on Robot



AL.Robot

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