



Strain Gauge - Six Axis Force/Torque Sensor KWR75 Series

User Manual

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■ Introduction

This is the user manual for the strain gauge six-axis force/torque sensor (KWR75 series - external box with EtherCAT communication), pls note that there will be a data acquisition module for EtherCAT put outside



This manual mainly introduces the product's specifications, functions, methods of use and interface forms, and informs the user of the precautions associated with this product. Please read this manual before and during the use of the product as improper operation may lead to product failure or accidents.

■ Statement

1. The information contained in this manual is current at the date of publication. If modified, further notice is not available.
2. This manual uses two representations: decimal and hexadecimal. All unspecified values are expressed in decimal representation.
3. This product is a precision instrument and it is important to use the product within the specification range specified in this manual. In particular, use of the product under conditions where the load is greater than the rated load may cause the product to malfunction. Please ensure that all six axes (3 force axis and 3 torque axes) are within the rated load range.
4. Different batches of products may have color difference or scratch, which has no impact on performance.
5. If specific environment is necessary, such as radiation environment, dustless room, strong magnetic field, spray oil or chemicals, please contact sales for further information.
6. This product complies with protection class IP64, but only if the product is installed correctly. Please read the installation instructions described in this manual carefully and install it correctly.
7. This product has not been designed or manufactured for inclusion in systems requiring a high degree of safety and reliability such as nuclear power, aviation, railways, safety equipment, etc. If this product is incorporated into such equipment and control systems, there may be a risk of serious impact or damage to human life, health, property, etc., for which we cannot be held responsible.
8. Kunwei Tech shall not be liable for damage related to natural disasters such as earthquakes, snow, wind, floods, fires other than those for which the Company is responsible, as well as for acts of third parties and other accidents such as damage caused by the intentional or negligent use or misuse of the Customer or other unusual circumstances.



9. Kunwei Tech shall not be liable for any incidental damage (loss of business interests, business interruption, etc.) arising from the inability to use or disable the product.
10. We are not responsible for any damage caused by failure to comply with the contents of this manual.
11. We are not responsible for any damage caused by malfunctions caused by equipment and software combinations that do not involve our company.
12. When exporting overseas, please comply with the relevant laws and regulations of China's foreign trade and the relevant laws and regulations of the importing country, and carry out the necessary procedures. Please contact our sales representatives if you require relevant information or qualification certificates.
13. The warranty period for this product is twelve months from the date of delivery of the product. Repairs after the warranty period will be subject to a charge depending on the repair. In addition, the warranty does not cover 'faults caused by the use of external specifications', 'faults caused by user negligence' or 'disassembly of the product without permission' during the warranty period.
14. KWR75 is one of the product names of our strain gauge six-axis force/torque sensors and is owned by Kunwei (Beijing) Technology Co., Ltd.
15. The copyright of this user manual belongs to Kunwei (Beijing) Technology Co., Ltd.

■ Terms and definitions

Terms	Definitions
Rated load	The maximum load that meets the sensor specification. If this value is exceeded, there is no guarantee that the technical specifications required by the specification will be met.
Overload	The load exceeds the rated load. Failure may occur when the sensor is overloaded.
Zero output	Output value without load when the mounting section and the ground are horizontal and the mounting section is facing the ground.
Precision	Precision is an evaluation indicator of the degree of agreement between multiple measured values, i.e. the degree of consistency of the output curve obtained when the sensor measure the same load group (combined of three-directional force and three-directional torque) multiple times. Repeatability precision is the standard deviation of the output error as a percentage of the rated output (%FS).
Accuracy	Accuracy is an evaluation indicator of the degree of deviation of the measured value from the true value. Accuracy is the standard deviation of the amount of deviation between the output and the theoretical true value as a percentage of the rated output (%FS)

**Zero point
temperature
characteristics**

Changes in zero output with changes in ambient temperature. The difference between the maximum and minimum values of the zero output over the operating temperature range is divided by the operating temperature range and expressed as a percentage change per 1°C relative to the rated output (%FS /°C), expressed in absolute terms.

Baud rate

Baud rate is the number of symbols transmitted per second. It is a index to measure the rate of data transmission. It is expressed by the number of carrier modulation state changes per unit time. In the information transmission channel, the signal unit carrying data information is called a code element, and the number of code elements transmitted through the channel per second is called the code element transmission rate, or baud rate for short.

IP64

The IEC (International Electrotechnical Commission) has drawn up a classification of electrical appliances according to their resistance to dust and moisture. IP64 has the following properties:

Dust protection: protection against foreign objects and dust

Waterproof: prevents splashing water from soaking in

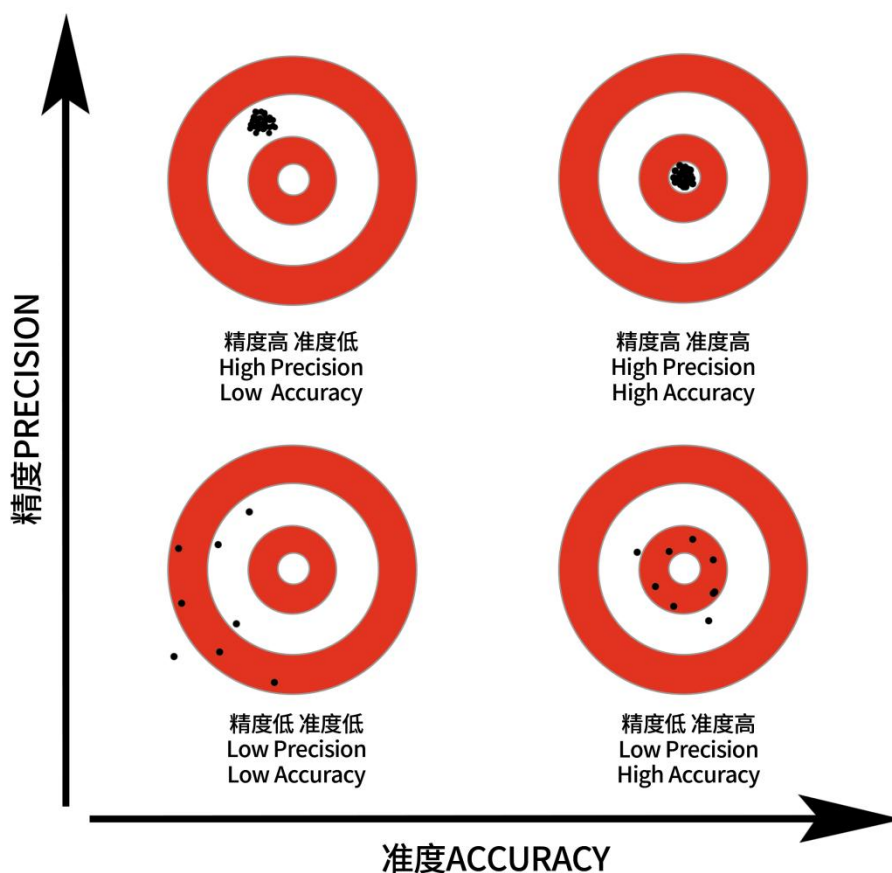


Fig.1 Precision and accuracy schematic diagram



■ Brief description of product specifications

Model	Rated force (N)		Rated torque (Nm)		Dimensions (mm)	Power supply (VDC)
	Fx, Fy	Fz	Mx, My	Mz		
KWR75A	50	50	2	2	$\Phi 75.0 \times H31.5$	9~24
KWR75B	200	200	8	8	$\Phi 75.0 \times H31.5$	9~24
KWR75C	350	500	12	12	$\Phi 75.0 \times H33.5$	9~24
KWR75D	500	700	18	18	$\Phi 75.0 \times H33.5$	9~24
KWR75E	30	30	1.5	1.5	$\Phi 75.0 \times H31.5$	9~24
KWR75F	100	100	4	4	$\Phi 75.0 \times H31.5$	9~24

Note: The overall dimensions do not include the connector housing and the input/output connection interface. For more information, please see the installation dimensions drawing.



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1 Product Overview

1.1 Product features

The model KWR75 series is a strain gauge six-axis force/torque sensor that detects three forces and three moments in real time. The sensor detects the relative deformation between the 'tool side flange' and the 'main body' caused by the applied force, and the change in the sensor's elastic unit could be measured based on the principle of strain electric measurement. The sensor contains an embedded system that collects and processes the signal changes from strain gauges and outputs the magnitude and direction of the applied force in real time, providing high accuracy and responsiveness. When using the sensor, please install it correctly to avoid any interference with the output effect.

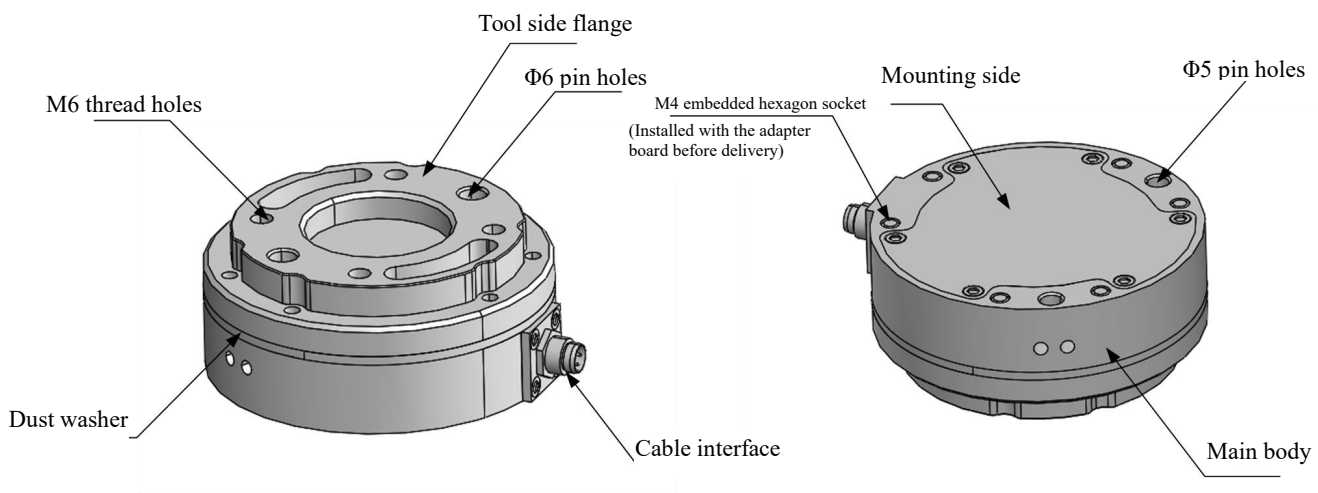


Fig.2 Sensor appearance

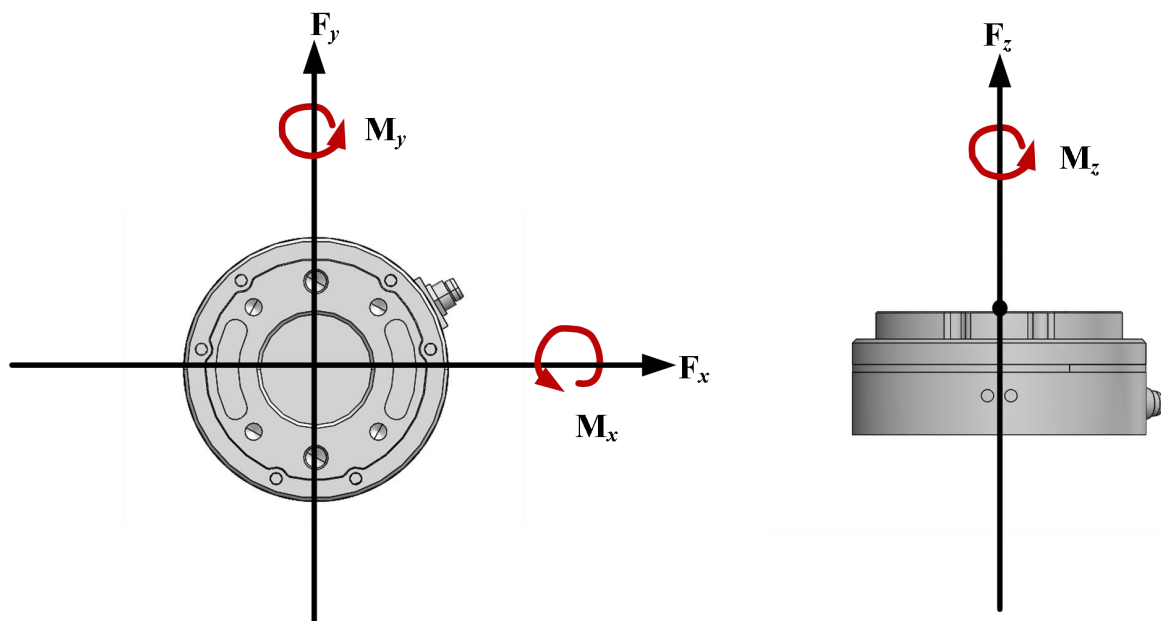


Fig.3 Definition of the sensor coordinate system (the direction of the torque conforms to the right-hand system)



1.2 Electrical characteristics

The voltage signal from the strain gauges is processed in real time by the embedded acquisition system, which built in the sensor and converted to the actual load value and output in the form of a digital signal.

2 Installation of the sensor

For details of the sensor mounting holes and mounting dimensions see "Section 4.2 Mounting Dimensions".

2.1 Operating procedures for sensor installation

The operating procedures given in this manual are typical of those for applications such as robotic arm mounting.



In the process of tightening the screws, gradually tighten the screws in the diagonal order shown in the illustration. Make sure that the sensor is in even contact with the device or adapter to be mounted.

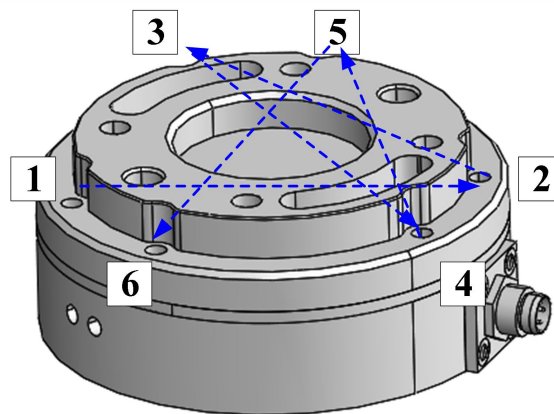


Fig.4 Screw tightening sequence

- (1) Check the equipment to be installed, the transfer flange and the sensor

Verify that the equipment to be installed, the transfer flange, and the sensor surfaces are free of damage or foreign matter.

*If the contact is not uniform due to factors such as inclusions of foreign matter, gaps will form between the devices (or transfer flange) to be installed, which will not guarantee the IP64 performance of the product and will have an effect on the actual sensor output.

- (2) The sensor is separated from the transfer flange and the transfer flange is mounted on the device to be installed.

The sensor is shipped with the transfer flange connected to the sensor body by six socket head cap screws. Use a 3mm Allen key to loosen six socket head cap screws and separate the transfer flange from the sensor body.

The arm end transfer flange is positioned to the equipment to be installed by means of a $\Phi 6$ pin. The transfer



flange is fixed to the equipment to be installed by means of the four M6 hexagon socket screws included in the packaging.

*The pins are used to obtain a consistent connection for the installation of the device. If the pins are not used, the sensor performance will not be affected.

(3) Fasten the sensor to the transfer flange.

Use the pins to position the sensor to fit the transfer flange and confirm that the sensor is mounted in the same direction as the equipment is used.

Fasten by using the sensor's six built-in screws. Insert a hexagonal wrench (width 3mm) from the mounting hole on the flange of the tool end of the sensor, and then turn it in the direction of the right-hand screw to fix it. The screw tightening sequence is performed in the order of Figure 4.

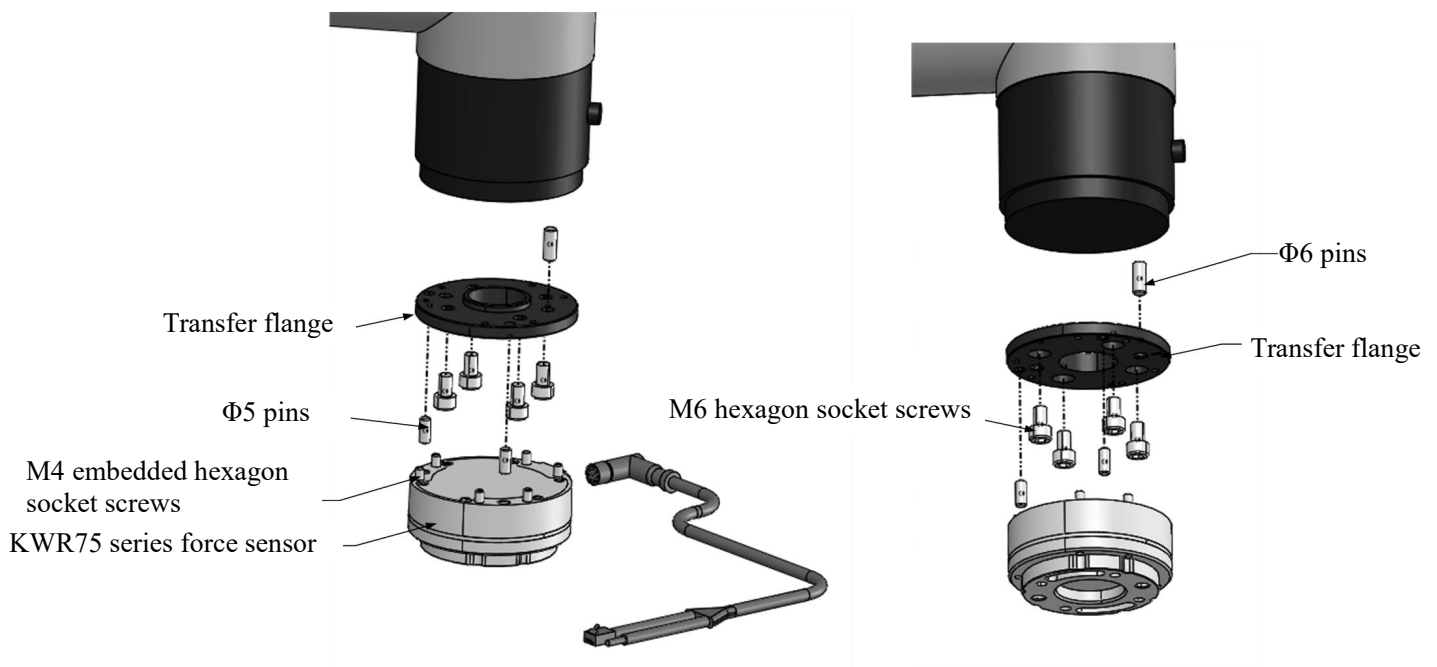


Fig.5 Diagram of the sensor and device connection installation

(4) Connect the tool interface of the device to the flange of the tool end of the sensor.

The sensor tool side flange provides four M6 screw holes and Φ6 pin holes in the form of a common interface for the connection of equipment tools.

*The sensor tool end flange locating pins are used to obtain a consistent installation of the equipment tool. If the locating pins are not used, the sensor performance will not be affected.

2.2 Connecting the cable

The connection cable is delivered with the product. The connection cable is a multi-core cable with an interface that matches the cable interface on the sensor. As shown in the figure 6, align the connector of the multi-core cable with



the sensor's cable connector, then push it into the sensor connector. Once pushed in, the threaded connection housing out of the multi-core cable interface must be tightened to avoid loosening of the cable and to achieve IP64 performance.



During installation, please make sure that the wiring of each cable core follows the color definitions of the given cores. If the positive and negative of the power supply are connected in the opposite direction, the sensor will be damaged, pls connect carefully.

3 Caution

- (1) Do not use in a temperature and humidity environment outside the allowable range of specifications.
- (2) The wiring must be completely correct. When switching on the power please check whether the colours of the connecting cables are connected one to the other according to the form provided in this manual. If an error is made in the connection terminals, the internal circuit of the sensor may be short-circuited and possibly damaged, so be sure to note and check this.
- (3) The sensors have been tested for vibrations and shocks due to the built-in embedded system and other sophisticated components. If the product is dropped, excessive vibration etc. It may still cause a malfunction.
- (4) Knocking is strictly forbidden during the installation of the sensor. Especially when fitting to the adapter flange, if the gap fit is tight due to the processing of the adapter flange and other factors, please do not knock the sensor, otherwise it will cause damage to the sensor performance.
- (5) If the device outputs this value for a long time, please check whether the sensor is under normal force and the force range is normal. Long-term over-range stress may cause irreversible damage to the equipment and cannot output data accurately. Due to space constraints, the circuit board does not have reverse polarity protection, please be sure to check whether the power cable connection is correct when powering up, reverse connection may cause the circuit power supply to burn out.
- (6) After the sensor has been installed and powered on, it is recommended that to preheating for an hour.
- (7) The actual use of the sensor requires consideration of the mass of the equipment mounted on it in order to avoid overloading.
- (8) If the original package is damaged or lost, please wrap the sensor well in all directions, and ensure there will be no heavy load during the delivery process.
- (9) If you have any doubts or malfunctions during use, please do not try to operate without permission, but contact us directly..



4 Product specifications

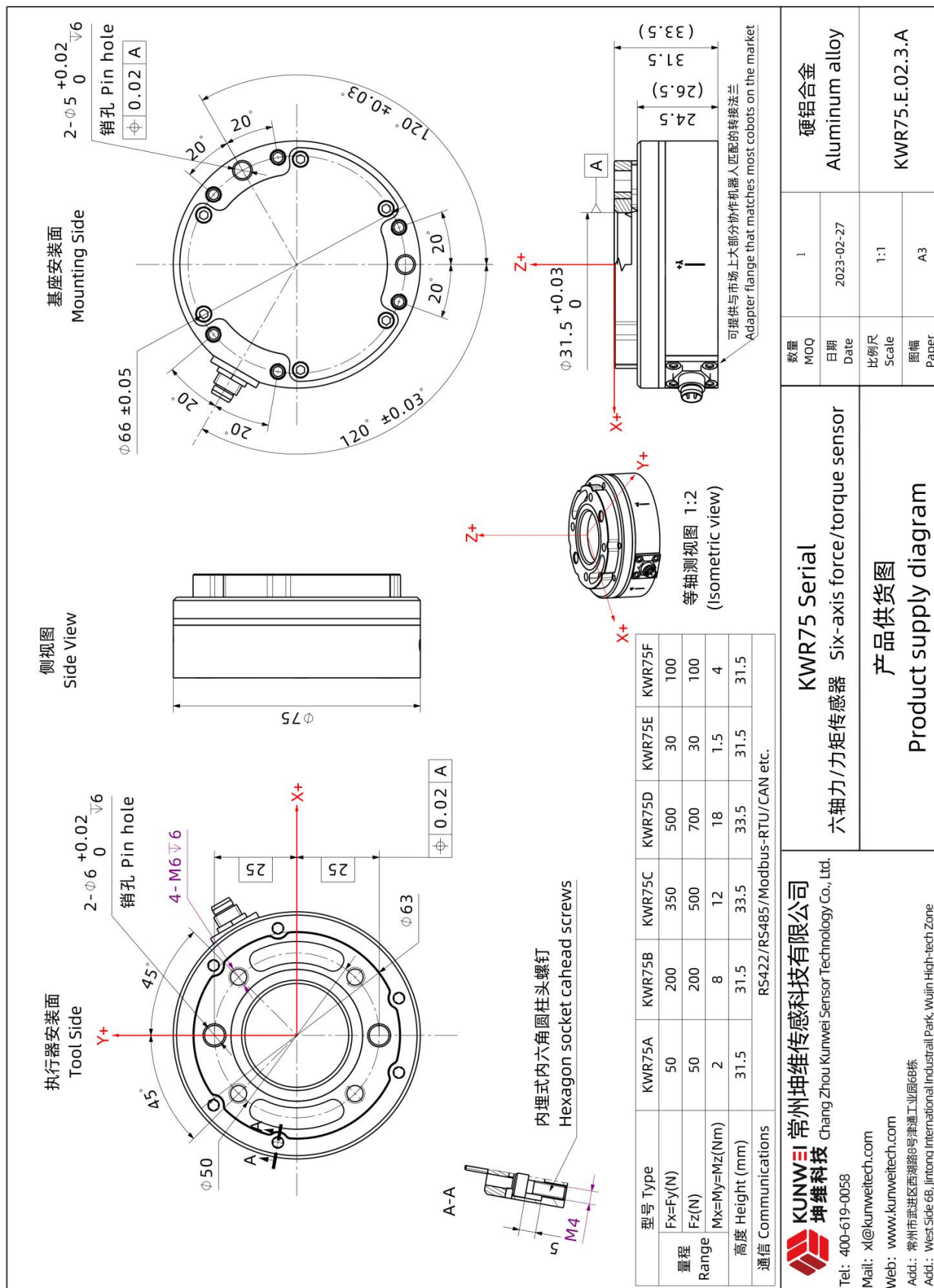
4.1 Basic specifications

The KWR75 series six-axis force/torque sensor is a high precision and high response sensor, which equipped with an embedded acquisition system to achieve a level of real-time response and output that meets the needs of most robot manufacturers. If the customer has other special size and interface requirements, we undertake a customization service to provide a one-to-one technical solution.

Model		KWR75A	KWR75B	KWR75C	KWR75D	KWR75E	KWR75F	KWR75G	KWR75K
F_x,F_y	(N)	50	200	350	500	30	100	800	1800
F_z	(N)	50	200	500	700	30	100	1000	3000
M_x,M_y	(Nm)	2	8	12	18	1.5	4	36	45
M_z	(Nm)	2	8	12	18	1.5	4	36	45
Diameter (mm)		75	75	75	75	75	75	75	75
Height (mm)		31.5	31.5	33.5	33.5	31.5	31.5	33.5	33.5
Material		Aluminum Alloy	Aluminum Alloy	Aluminum Alloy	Aluminum Alloy	Aluminum Alloy	Aluminum Alloy	Alloy Steel	Alloy Steel
Surface treatment		Anodization	Anodization	Anodization	Anodization	Anodization	Anodization	Sand blast	Sand blast
Overload level (%)		300	300	300	300	300	300	500	500
Precision (%FS)		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.3
Accuracy (%FS)		0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.5
Sampling resolution (Bit)		24	24	24	24	24	24	24	24
Weight (kg)		0.26	0.28	0.32	0.36	0.26	0.28	1.10	1.12
Protection class		IP64	IP64	IP64	IP64	IP64	IP64	IP64	IP64
Operating temperature (°C)		0~80	0~80	0~80	0~80	0~80	0~80	0~80	0~80
Supply voltage (VDC)		9~24	9~24	9~24	9~24	9~24	9~24	9~24	9~24
Communication Protocol		RS422/RS485/ModBUS/CAN/Ethernet/EtherCAT/USB etc.							



4.2 Installation dimension drawing

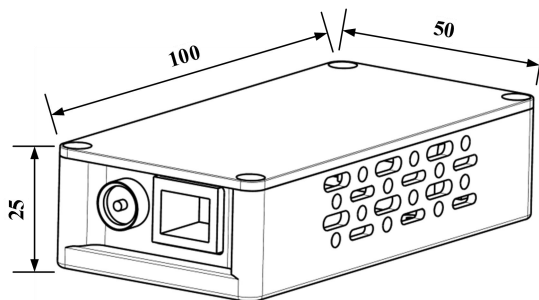




5 EtherCAT Serial Server

On the basis of serial communication (RS422), sensor communication can output signals in other formats through various converters, such as serial servers, USB, etc. If you have any requirements, please contact our company.

5.1 Definition of Serial Server Wiring



Serial Server Physical Image

The definition of serial server wiring is as follows:

Definition	Wire Color
Box Transmit + (T+)	Pink
Box Transmit - (T-)	Brown
Box Receive + (R+)	Black
Box Receive - (R-)	Grey
Power Voltage + (U+)	Blue
Power Voltage- (U-)	White



Fig.6 Diagram of the serial server wiring



5.2 Operation of Serial Server

(1) The sensor can respond to input commands with the communication specifications shown in the table below:

Communication parameters	Parameter values
Model	KWH00C100LEC
Output serial port	EtherCAT
Supply voltage	9~24VDC
Power supply current	Less than 0.5A

(2) The role of the EtherCAT serial device server is to convert the RS422 data output by the sensor into EtherCAT protocol data, and the xml file is matched with the EtherCAT data acquisition module, which describes the device information and data of the EtherCAT module . the following fields are present:

When TxPdo show the Index: 0x6020 Subindex 1, that means the data is INT32, and represents the force in the X direction. This data is in the format of 32-bit signed integer transform (DINT) in the XML file, with a unit of 0.0001kg.

When TxPdo show the Index: 0x6020 Subindex 2, that means the data is INT32, and represents the force in the Y direction. This data is in the format of 32-bit signed integer transform (DINT) in the XML file, with a unit of 0.0001kg.

When TxPdo show the Index: 0x6020 Subindex 3, that means the data is INT32, and represents the force in the Z direction. This data is in the format of 32-bit signed integer transform (DINT) in the XML file, with a unit of 0.0001kg.

When TxPdo show the Index: 0x6020 Subindex 4, that means the data is INT32, and represents the torque in the X direction. This data is in the format of 32-bit signed integer transform (DINT) in the XML file, with a unit of 0.0001kgm.

When TxPdo show the Index: 0x6020 Subindex 5, that means the data is INT32, and represents the torque in the Y direction. This data is in the format of 32-bit signed integer transform (DINT) in the XML file, with a unit of 0.0001kgm.

When TxPdo show the Index: 0x6020 Subindex 6, that means the data is INT32, and represents the torque in the Z direction. This data is in the format of 32-bit signed integer transform (DINT) in the XML file, with a unit of 0.0001kgm.

In addition, there are two LED lights on the side of the EtherCAT serial server. The LED1 indicator light is in a default

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off state when powered on. When the EtherCAT serial server is converting data, the LED1 indicator light remains on;

The LED2 indicator light turns off when powered on. The specific situation is as follows:

When LED2 is off, EtherCAT is in the Initialize state;

When LED2 flashes quickly, EtherCAT is in Pre-Operational state;

When LED2 flashes slowly, EtherCAT is in Safe-Operational state;

When LED2 is constantly on, EtherCAT is in Operational state.

The other data in the file is not meaningful for the conversion work, please keep it in the default state.

6 Product packaging

- | | |
|-----------------------------------|-------------------------------|
| ● KWR75 Series Sensor | 1 pcs |
| ● Cable (with plug) | 1 pcs |
| ● KWR75 Series Sensor User Manual | One copy (electronic version) |
| ● EtherCAT Serial Sever | 1 pcs |
| ● Package box | 1 pcs |
| ● Sensor transfer flange | 1 pcs |



7 Contact us

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