HPS-FT-USER

6-Axis Force Torque Sensor User Manual

Version: HPS-FT-USER 1.8
Host software version: Host 1.11.1.A
The manual is issued in February 2022

Please read this manual carefully before use.

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Please read this manual before installing and using the product.
Please keep this manual so that it can be read and referenced at any time.
The figures in this manual are for reference only. The actual product shall prevail.

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Table of Contents

1 Product introduction 5
1.1 Sensor introduction 5
1.1.1 Introduction 5
1.1.2 Product features 5
1.1.3 Physical dimensions 6
1.1.4 Cable definition 8
1.1.5 Packaging information 8
1.2.1 Product description 8
1.2.2 Physical dimensions 9
1.2.3 Wiring and indicator light definition 9
1.2.4 IO protection alarm function 10
1.2.5 Ethernet bus communication port 10
2 Precautions for use 11
2.1 Sensor overload protection 11
2.1.1 Calculation of the total torque during use 11
2.1.2 Robot emergency stop IO control 12
2.1.3 Setting of the overload protection threshold 12
2.2 Sensor and robotic arm connection 13
3 Warranty 13
3.1 Product warranty 13
3.2 Disclaimer 14
4 Installation 14
4.1 Tools and accessories 14
4.2 Mechanical structure installation 15
4.3 Electrical cable installation 17
4.4 IO protection wiring 18
4.4.1 Robot emergency stop IO wiring (NPN, no-load IO) 19
4.4.2 Robot protective stop wiring (NPN, no-load IO) 19
4.4.3 Setting and enabling of the protection mode of the robot 20
5 Host demonstration software 21
5.1 Ethernet-based host demonstration software 21

5.1.1 Ethernet connection steps 21
5.1.2 Filtering and coordinate system conversion functions 23
5.1.3 Port setting 24
5.1.4 Save data 25
5.1.5 IO alarm function (version 1.9.5 or above) 26
5.1.6 One-time acquisition mode function 27
5.1.7 Crosstalk compensation function 27
5.1.8 Overload information receiving function 28
5.1.9 Voltage check function 28
5.2 RS485 interface–based host software 29
5.2.1 RS485 connection 29
5.2.2 Filter 30
5.2.3 One-time acquisition mode function 31
5.2.3 Crosstalk compensation function 31
5.2.4 Overload information receiving function 31
5.2.5 Voltage check function 31
5.2.6 Baud rate setting 31
6 Host monitoring software 32
6.1. Host demonstration software connection steps 32
7 Firmware update software 34
7.1. Sensor firmware update 34
7.2. Ethernet firmware update 34
8 Troubleshooting 35
8.1 Ethernet adapter failure 35
Revision history 37

1 Product introduction

1.1 Sensor introduction

1.1.1 Introduction

The HPS-FT series sensors are high-performance digital 6-axis force torque sensors, which can precisely measure the force and torque components along the three-dimensional coordinate system axes X, Y and Z. Thanks to a structure with good durability and a high overload withstanding capacity, the strain gauge can withstand several times safety overload when working.

Compared to traditional structure, the HPS-FT series sensor has a higher signal-to-noise ratio and sensitivity. The integrated temperature compensation algorithm significantly reduces the temperature drift of the sensor due to temperature change. The product can measure the six components of a force: Fx, Fy, Fz, Mx, My and Mz, in real time with high precision. Besides, the integrated professional compensation algorithm ensures a high measurement linearity and extremely low crosstalk.

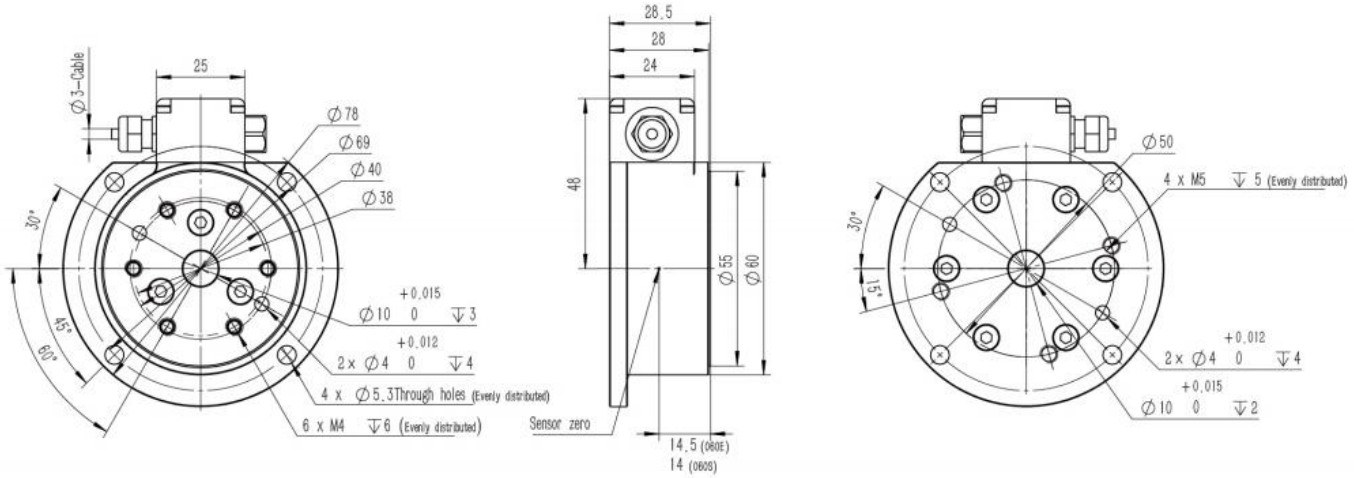
1.1.2 Product features

Measure the force and torque along the axes X, Y and Z quickly and precisely
—High resolution
—High signal-to-noise ratio
—Waterproof and dustproof design (IP65)
—High anti-overload capacity
—Compact design for easy integration

A fully integrated compact structure, which includes:
—an anodized aerospace aluminum housing (HPS-FT060E)
—a stainless steel housing (HPS-FT060S)
—a highly sensitive elastic piece and strain gauge
—a high-precision ACD conversion circuit
—a high performance embedded microprocessor
—advanced embedded data processing, filtering and decoupling algorithms
—a high-speed RS-485 bus port
—EtherCAT and Ethernet adapters

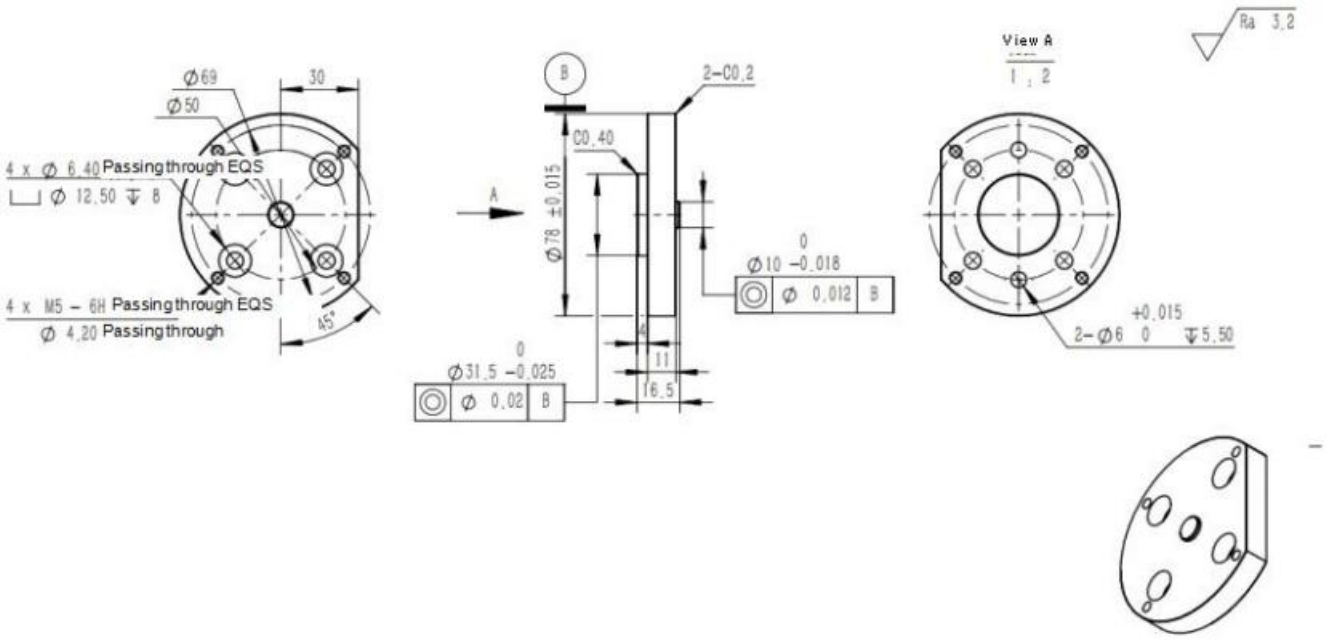
1.1.3 Physical dimensions

HPS-FT060E/FT060S dimension diagram

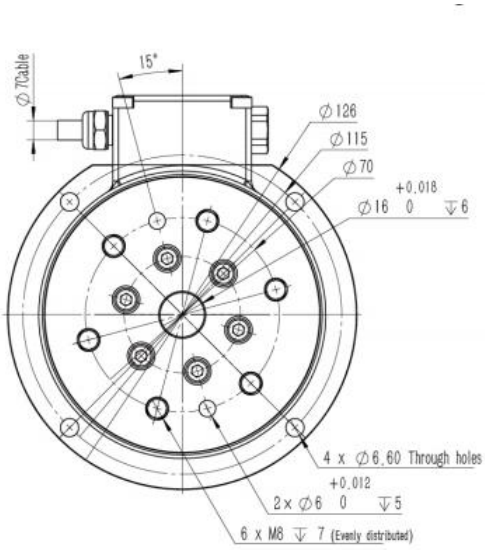


(Front side - Force measuring side) Side view (Back side - Mounting side)

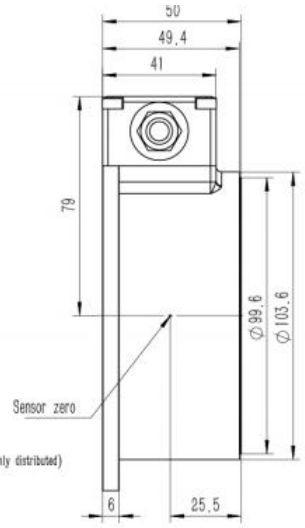
Flange adapter dimension diagram to install HPS-FT060E/FT060S on Cobots



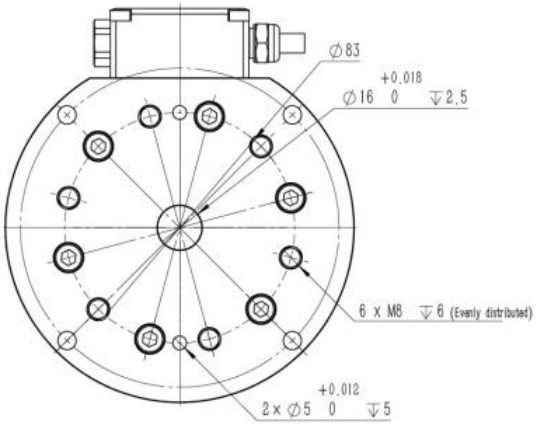
HPS-FT025 dimension diagrams



(Front side - Force measuring side)

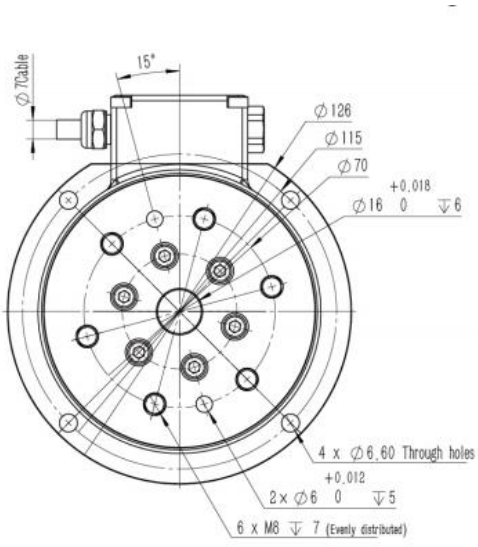


Side view

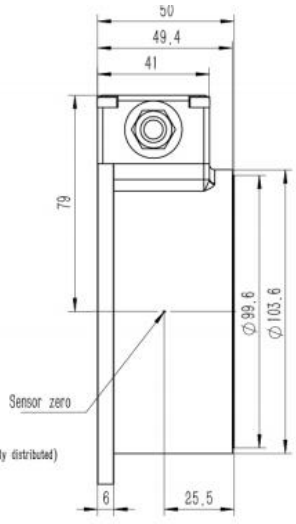


(Back side - Mounting side)

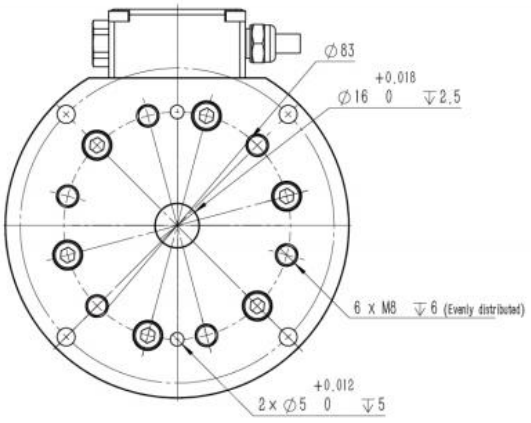
HPS-FT120 dimension diagrams



(Front side - Force measuring side)



Side view



(Back side - Mounting side)

1.1.4 Cable definition

Cable Color	Signal Name	Signal Type	Description
Red	Positive pole of power supply	VCC	Connected to +12V–+24V DC
Black	Negative pole of power supply	GND	Connected to the grounding terminal of power supply
White	RS-485A	Digital	Connected to terminal A of the RS-485 transceiver (the “+” terminal)
Green	RS-485B	Digital	Connected to terminal B of the RS-485 transceiver (the “-” terminal)
Yellow	Shielded cable	SHIELD	Connected to the grounding terminal of the housing

1.1.5 Packaging information

Model	HPS-FT025	HPS-FT060E	HPS-FT060S	HPS-FT120
Sensor size	23(H) x 26.2(D) mm	87(L) x 78(W) x 28.5(H)mm	87(L) x 78(W) x 28.5(H)mm	142(L) x 126(W) x 49.9(H)mm
Sensor weight	28g	255g	465g	1450g
Packaging box size	312(L) x 196(W) x 62(H)mm	312(L) x 196(W) x 62(H)mm	312(L) x 196(W) x 62(H)mm	310(L) x 290(W) x 80(H)mm

1.2 Ethernet adapter

1.2.1 Product description

The HPS-FT-EN2000-IO adapter is used to convert the RS485 port of the 6-axis force torque sensor into a 100M Ethernet interface, supporting more and simpler command settings. Its data output frequency can reach up to 2000HZ.

1.2.2 Physical dimensions

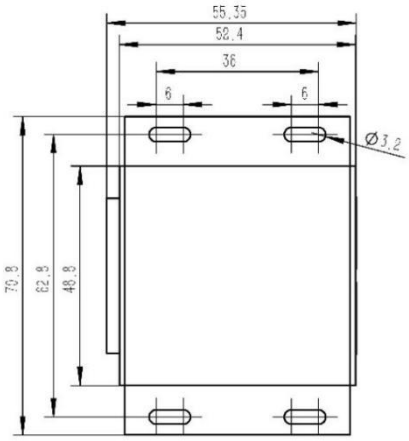


Figure 1 Top view of the adapter

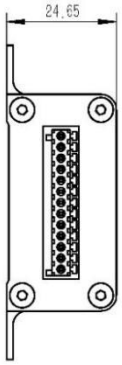


Figure 2 Left view of the adapter

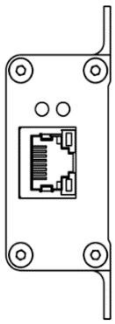


Figure 3 Right view of the adapter

1.2.3 Wiring and indicator light definition

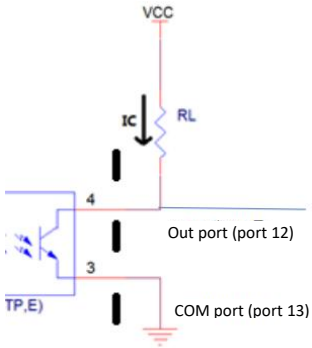
Port Number	Signal Name	Signal Type	Description
1	Positive pole of adapter power supply	VCC	Connected to +12V–+24V DC
2	Negative pole of adapter power supply	GND	Connected to the grounding terminal of power supply
3	Adapter shield grounding terminal	SHIELD	Connected to the grounding terminal of the housing
4	Positive pole of CH1 sensor power supply	VCC	Connected to positive pole of sensor power supply (red cable)
5	Negative pole of CH1 sensor power supply	GND	Connected to negative pole of sensor power supply (black cable)
6	485A of CH1 sensor	Digital	Connected to terminal A of RS-485 interface of the sensor (white cable)
7	485B of CH1 sensor	Digital	Connected to terminal B of the RS-485 interface of the sensor (green cable)
8	Positive pole of CH2 sensor power supply	VCC	Connected to positive pole of sensor power supply (red cable)
9	Negative pole of CH2 sensor power supply	GND	Connected to negative pole of sensor power supply (black cable)
10	485A of CH2 sensor	Digital	Connected to terminal A of the RS-485 interface of the sensor (white cable)

11	485B of CH2 sensor	Digital	Connected to terminal B of the RS-485 interface of the sensor (green cable)
12*1	Optocoupler Output	Digital	Output port of optocoupler
13*2	Optocoupler COM port	GND	COM port of optocoupler

Upper indicator light	Lit constantly	Channel 1 sensor communication is normal
	Not lit	Channel 1 sensor communication is abnormal
Lower indicator light	Lit constantly	Channel 2 sensor communication is normal
	Not lit	Channel 2 sensor communication is abnormal

1.2.4 IO protection alarm function

The alarm signal output (port 12) is a non-powered NPN output port, which needs an external GPIO to provide drive current. COM port (port 13) and the grounding terminal of the signal are not connected. You can choose to connect them from the outside or isolate them. It is recommended to use RL and VCC so that the current IC (collector current) after energizing is controlled to 5mA–40mA. When the output current is greater than 40mA, it is recommended to add a primary power amplifier at the back to avoid equipment failure due to excessive current.



1.2.5 Ethernet bus communication port

The Ethernet adapter has a UDP or TCP communication port, a UDP port by default. You can also use a TCP port by switching the jumper 2 inside the adapter. The default IP is 192.168.1.100, the mask is 255.255.255.0, the gateway is 192.168.1.1, and the port number is 8080. You can use commands to modify the IP, mask, gateway and port number (port 50000 is the debugging port, which is disabled for users). If jumper 1 inside the adapter is switched to a different position instead of the default position, all parameters will be initialized to the default parameters every time the adapter is restarted.

2 Precautions for use

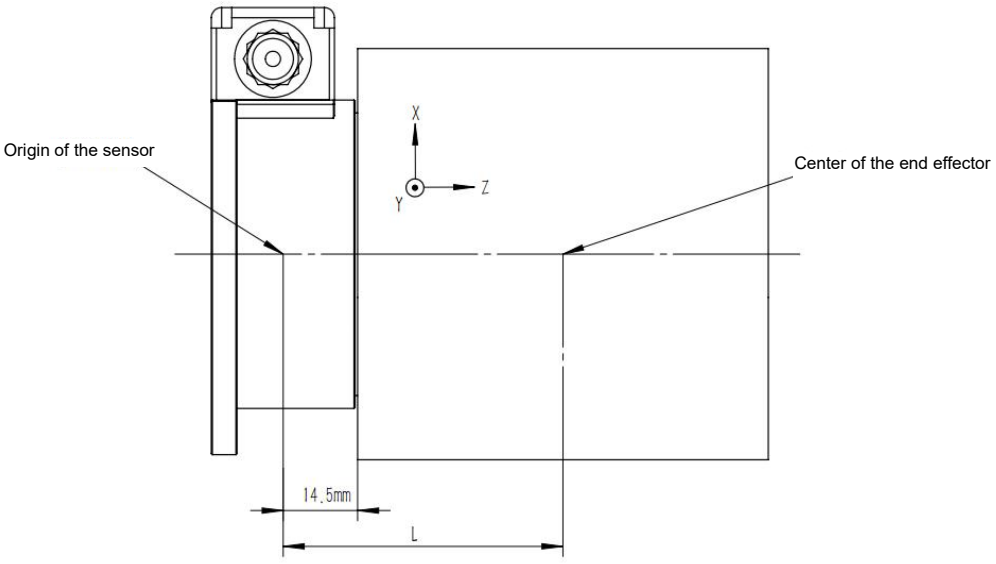
The 6-axis force torque sensor is a high-precision device. You should use the sensor properly. Improper use may cause permanent damage to the sensor. Before use, please read the user manual carefully.

2.1 Sensor overload protection

Before use, be sure to determine the range of the force and torque to be measured, so that an appropriate model of the sensor can be used. When using it, be sure to **add an overload protection function** to the program or use the **IO alarm** function of our company's EtherCAT/Ethernet adapter to carry out an overload emergency stop of the robot. Especially in the early debugging process, the sensor is often subjected to unexpected forces and torques that exceed the measuring range. Without any overload protection of the sensor, the sensor can easily be damaged by impacts.

2.1.1 Calculation of the total torque during use

The following is a calculation example of the torque received by the sensor while it is employed. You can use this method to calculate whether or not the torque received by the sensor is overloaded under a static load.
Calculation example:
Conditions: The distance between the center of gravity of the end effector (the center of gravity can be estimated with 3D software) and the origin of the sensor (including the distance between the center of the elastic piece and the sensor’s upper surface, 14.5mm,) is L. The axis X of HPS-FT060E is placed vertically downward (the maximum measuring range of HPS-FT060E is 15Nm), and the weight of the end effector is M. Then there will be the following formula: Mg × L ≤ 15Nm (g = 9.8N/kg)



Distance from the end effector to the origin of the sensor (L)	50mm	100mm	200mm	500mm
Maximum weight of the end effector (kg)	30.6kg	16.3kg	7.6kg	3.1kg

The above is only the calculation of the torque received by the sensor under static conditions, and the dynamic torque will be greater than this value when the robot is moving.
Conclusion: When the sensor is used for the first time, in order to ensure that the torque received by the sensor during the entire operation process is within the measuring range, the torque of the end effector at the end of the sensor should be roughly estimated.

2.1.2 Robot emergency stop IO control

You can connect the IO of our company's EtherCAT/Ethernet adapter to the emergency stop IO of the robot, and set an appropriate alarm threshold. When the threshold is exceeded, the adapter will use an IO signal to trigger an emergency stop of the robot so as to prevent damage to the sensor. Considering the response speed of the robot to the IO signal, the speed of the robot shall not be too fast.
Calculation example:
Conditions: Use the sensor model HPS-FT060E with an Ethernet adapter of 2k fps sampling rate. (The fastest time for the sensor to trigger the robot's emergency stop IO $\geqslant$ 0.5ms).
If:

1. T1 = The minimum time for the sensor to trigger the robot's emergency stop IO: 0.5ms
2. T2 = The total response time of the robotic arm to an IO signal
3. v = The speed of the robotic arm/manipulator when it hits the object: 1m/s
4. L = The robotic arm's theoretical movement distance during T1 and T2

Then,

$$L = v \times (T_1 + T_2)$$

T_2	1ms	5ms	10ms	20ms	50ms
L	1.5mm	5.5mm	10.5mm	20.5mm	50.5mm

Conclusion: The slower the response of the robotic arm to the overload emergency stop IO, the lower speed at which the robotic arm shall move when the end effector touches the object.

2.1.3 Setting of the overload protection threshold

Either the overload protection threshold set by the program or the IO alarm threshold of the adapter should be within a reasonable range. It is recommended to set the protection threshold of force and torque to approximately 1.5 times the maximum for normal use while taking into account the force and torque generated by the end effector itself. The thresholds should not exceed the measuring range of the sensor. Besides, you should set the torque protection threshold within the measuring range. Otherwise, the sensor will be deformed significantly and is inclined to be damaged.

2.2 Sensor and robotic arm connection

Do not mount the sensor directly on the robot flange. An intermediate flange needs to be installed between the robot mounting flange and the sensor. Connect the side of the sensor marked “XY” to the end effector, and the other side to the intermediate flange as shown in the figure. Locking pins need to be installed on both the front and back sides of the sensor to ensure the sensor to be fixed properly.
The sensor needs to be installed as close as possible to the end effector, so that the loss of the collected force information can be as little as possible. And the end effector should be as lightweight as possible. When a heavy effector is used, the force detected by the sensor while the robot’s end posture attitude is changed is the actual force plus the force and torque components of the end effector.

3 Warranty

3.1 Product warranty

The warranty period of HPS-FT series 6-axis force torque sensor is 12 months.
If the new equipment and its components are found to be defective due to manufacturing or poor materials within 12 months (no more than 15 months if shipping time is taken into account) after being put into service, Hypersen Technologies Co., Ltd. shall provide necessary spare parts for replacement or repair relevant parts.
The equipment or components that are replaced or returned to Hypersen Technologies Co., Ltd. are owned by Hypersen Technologies Co., Ltd.
If the product is not within the warranty period, Hypersen Technologies Co., Ltd. reserves the right to charge the customer for replacement or repair.
Hypersen Technologies Co., Ltd. is not liable for any injury or loss such as production loss or damage to other production equipment, which arises from the product found defective beyond the warranty period.

3.2 Disclaimer

If the product defect is caused by improper handling or noncompliance with the relevant information described in the user manual, the Product Warranty will be void.
Failures arising from the following are not covered by the warranty:

1. installation, wiring or connection to other control equipment not in accordance with industrial standards or the user manual and the operation precautions manual;
2. the specifications or standards shown in the user manual and data sheet are exceeded when used;
3. this product is used for any purpose other than those specified;
4. the storage way, operation or operating environment is beyond the scopes specified in the user manual and the product data sheet (e.g., pollution, salt damage, condensation, lightning strike, unauthorized disassembly, power surge, water ingress, overload, abnormal power supply);
5. product damage due to improper transportation;
6. damage caused by an accident or collision;
7. any non-original genuine part or accessory is installed.

4 Installation

Take the installation of the 6-axis force torque sensor and the EtherNet adapter on a UR robot as an example.

4.1 Tools and accessories

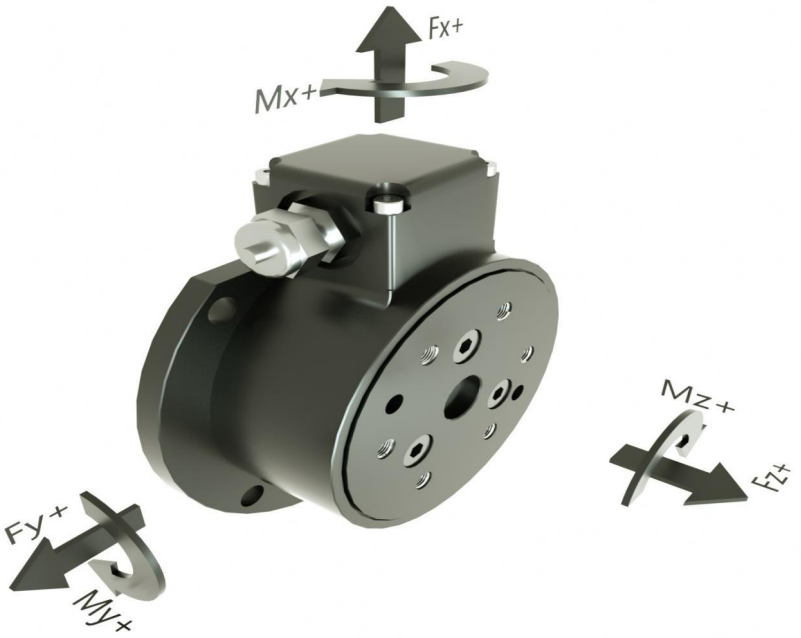
Sensor and accessories:

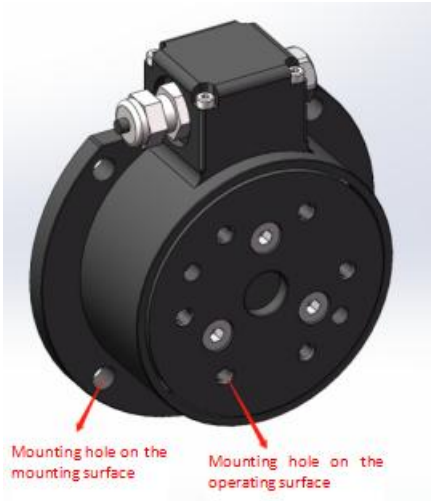
1. 6-axis force torque sensor (HPS-FT060E)
2. EtherNet adapter for the 6-axis force torque sensor (HPS-FT-EN2000-I0)
3. EtherNet adapter terminal block
4. 12v DC adapter
5. URCAP software package (optional, only for UR robots)
6. Intermediate flange (optional for collaborative robots)
7. Φ6×10 cylindrical pin (optional for collaborative robots)
8. TAC21-M6-L12 hexagon socket head cap screw (4 Pcs) (optional for collaborative robots)
9. TAC21-M5-L20 hexagon socket head cap screw (4 Pcs) (optional for collaborative robots)

Self-provided:

1.Ethernet cable

4.2 Mechanical structure installation





List of standard torque			
Product Model	Location	Screws Used	Standard Torque (N·m)
HPS-FT025	Mounting surface	Class 10.9 M3	1.5–1.7
	Operating surface	Class 10.9 M3	1.5–1.7
HPS-FT060E	Mounting surface	Class 10.9 M5	6.5–7.5
	Operating surface	Class 10.9 M4	3.5–4

HPS-FT060S	Mounting surface	Class 10.9 M5	6.5–7.5
	Operating surface	Class 10.9 M4	3.5–4
HPS-FT120	Mounting surface	Class 10.9 M6	12–14
	Operating surface	Class 10.9 M8	32–34

Notes:
1. When installing the screws, you need to use spring washers and flat washers, and a small amount of medium-strength thread glue (as shown in the figure).
2. Loctite 243 medium-strength thread glue is recommended.

Steps:

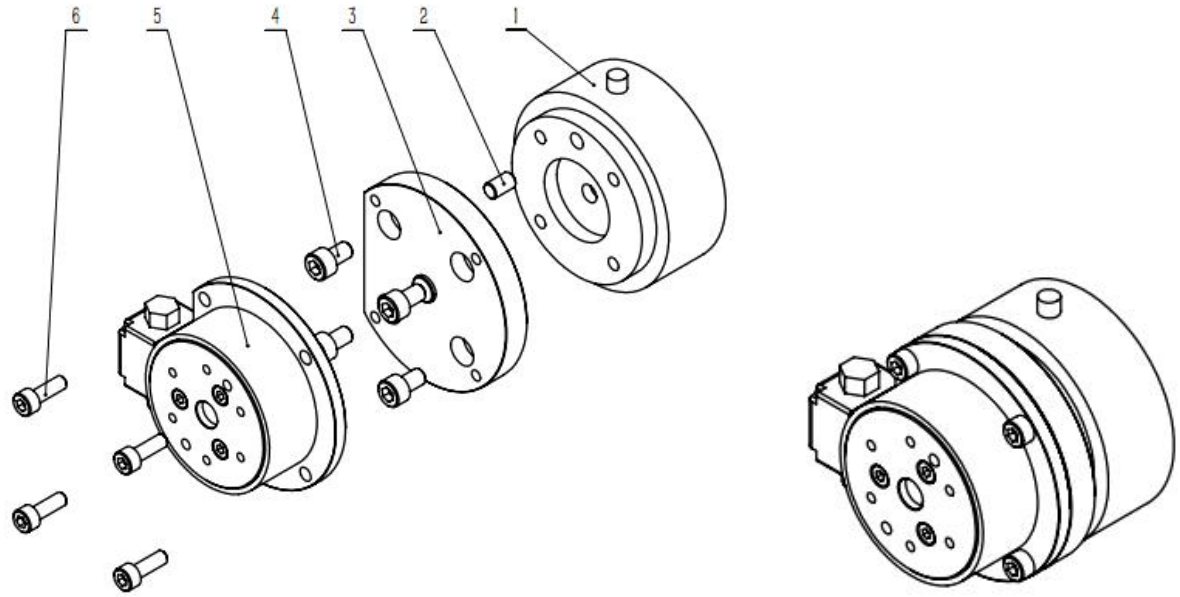
Step 1 Fix ②(Φ6×10 cylindrical pin) on ③(flange adapter).

Step 2 Align ②(Φ6×10 cylindrical pin) on the back of ③(flange adapter) with the locating pin of ①(connecting flange at the end of UR robot arm) and insert it.

Step 3 Fix ③(flange adapter) to ①(connecting flange at the end of UR robot arm) with M6 hex key and ④(TAC21-M6-L12×4).

Step 4 Align the back of ⑤ (6-axis force torque sensor) with the missing corner on the front of ③ (flange adapter).

Step 5 Fix ⑤(6-axis force torque sensor) and ③(flange adapter) with M5 hex key and ⑥(TAC21-M5-L20×4).



Note Make sure that the parts are installed firmly.

4.3 Electrical cable installation

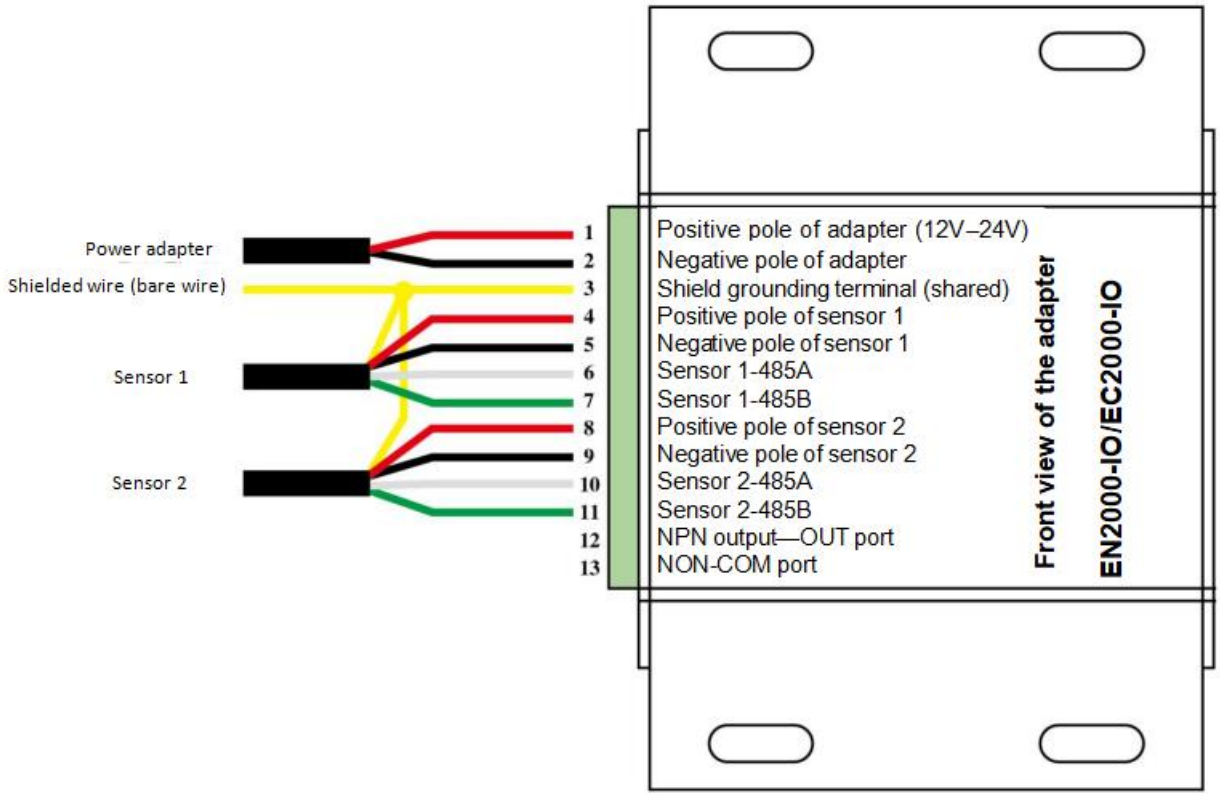
Steps:

1. Route the sensor cable from axis 6 to 1 at the end of the robot and fix it.

> **Note** Make sure that there is enough room for all joints of the robot to move and take protective measures to prevent pinch, dragging, abrasion, etc. to avoid cable damage.

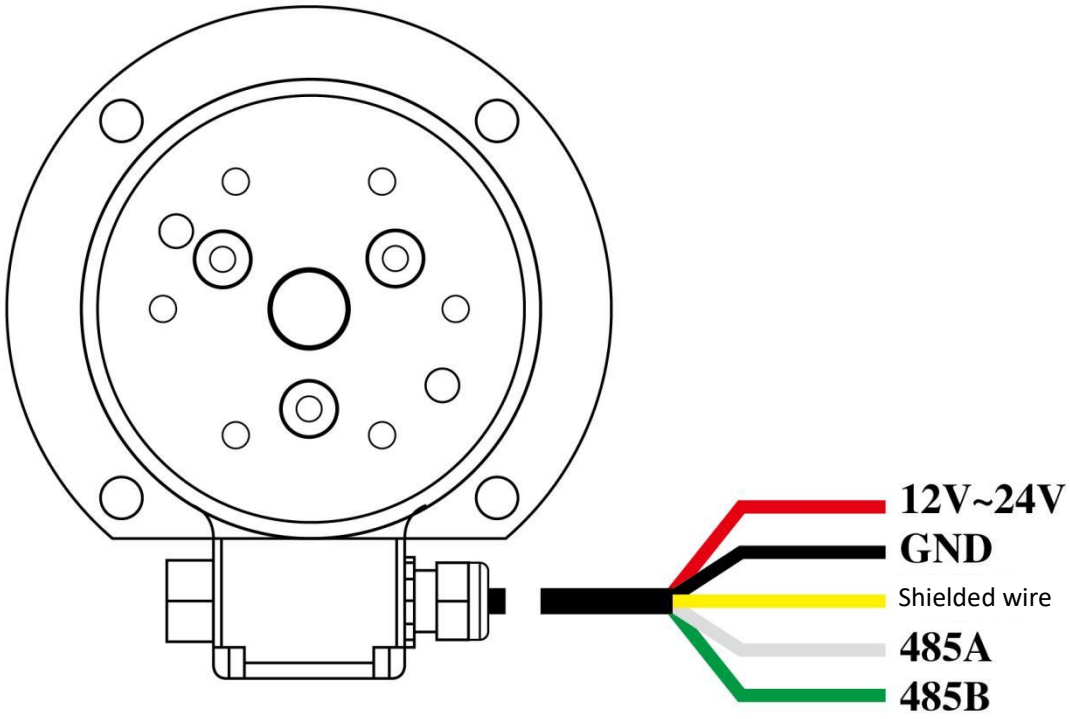
2. Check the wiring of the sensor and the EtherNet (which are pre-wired before leaving the factory).

> **Note** Please check it for confirmation. Incorrect wiring may damage the sensor.



3. Wire the 24v power adapter to the power supply port of the EtherNet adapter (which are pre-wired before leaving the factory) and power it up.

> **Note** ①. If you do not use the provided power adapter, please be sure to use a 12–24V DC power supply and use terminal blocks to protect the wire ends. There may be a risk of sensor damage arising from this operation. Please be careful.



(Optional) 4. Connect the EtherNet adapter to the PC network port with an Ethernet cable, and set the IP address of the PC network port to 192.168.1.X (the sensor 192.168.1.100 by default). Check whether or not the sensor is working normally through the “6-axis force torque sensor host”. (Refer to Chapter 8)

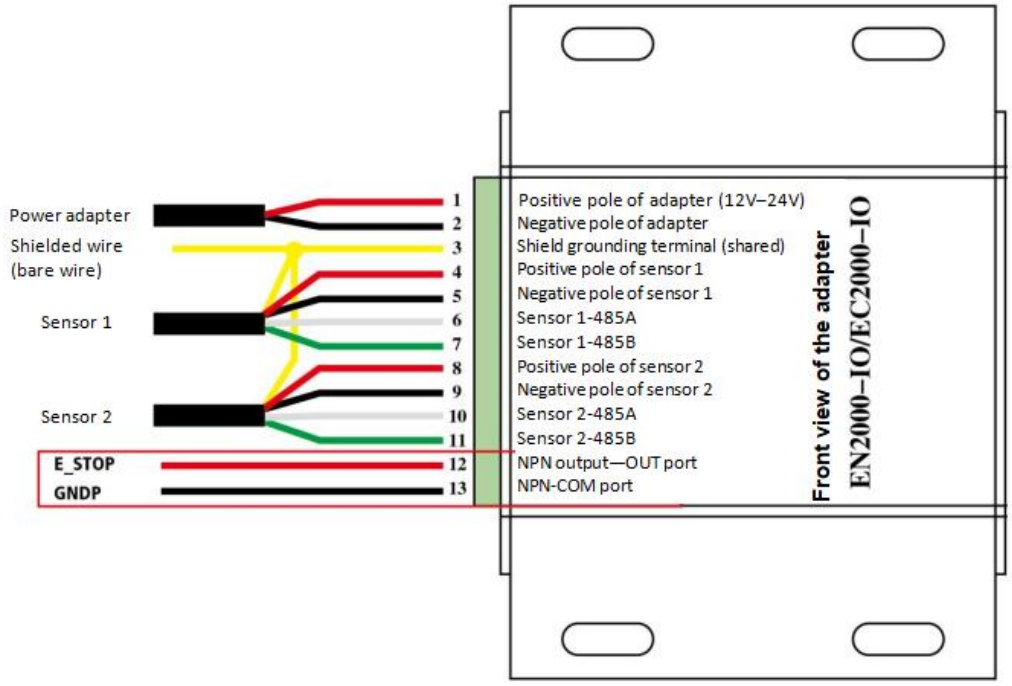
5. Connect the EtherNet adapter to the network port of the robot with an Ethernet cable.

4.4 IO protection wiring

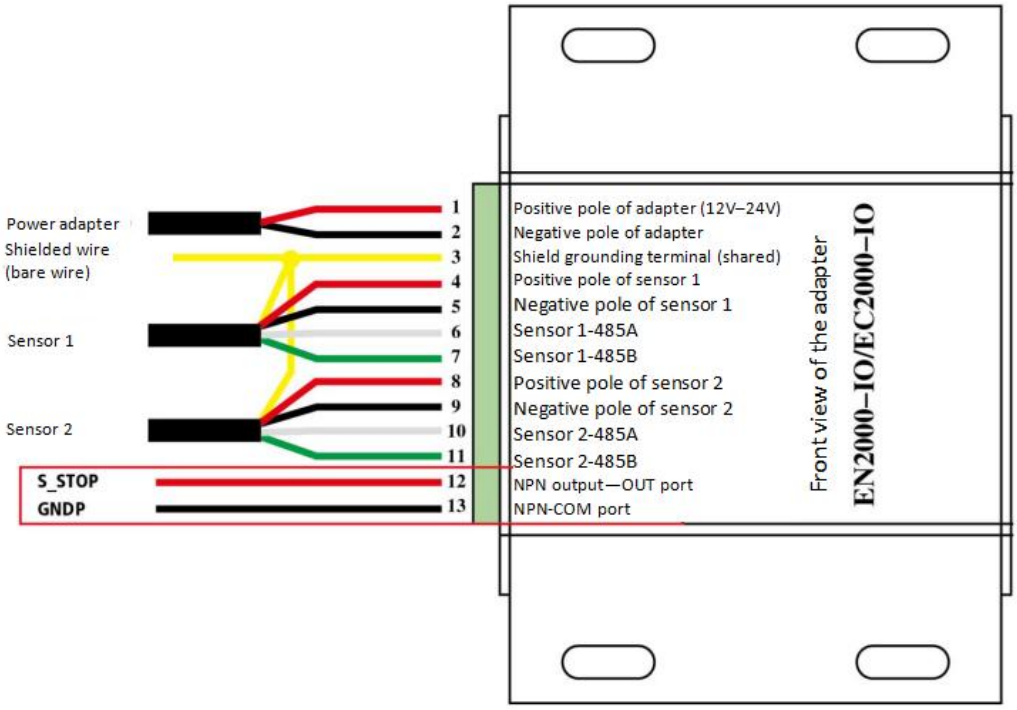
The IO port of the adapter is of NPN no-voltage output type. If the IO port of the robot is also of NPN type, directly connect the OUT port of the adapter to the emergency stop IO port of the robot, and the COM port to the NPN COM port of the robot. If there is no pull-up resistor inside the IO port of the robot, an external pull-up resistor is required.

If the IO port of the robot is of PNP type, an external NPN-PNP signal conversion module is required to convert the NPN signal of the adapter into a PNP signal to be transmitted to the IO port of the robot.

4.4.1 Robot emergency stop IO wiring (NPN, no-load IO)



4.4.2 Robot protective stop wiring (NPN, no-load IO)



4.4.3 Setting and enabling of the protection mode of the robot

You can set the basic alarm threshold through the host demonstration software, and carry out a simple test through the host computer software. For details, see 5.1.5. More functions can be implemented by commands (see the Ethernet data sheet for details of the commands). The commands are listed as follows:

Function Name	Meaning	Example of Setting
ALARM_CLEAR	Clear IO alarm information	<ALARM_CLEAR 0>
ALARM_THRE_VALUE	Set the IO alarm signal threshold	<ALARM_THRE_VALUE 0 200,200,200,10,10,10>
ALARM_ON	Enable sensor IO alarm	<ALARM_ON 0 1>
ALARM_AXIS	Receive the axis information that triggers the IO alarm	<ALARM_AXIS 0>
ALARM_SET	Manually trigger sensor IO alarm	<ALARM_SET>
ALARM_NORMAL_OPEN	Set the IO alarm port to be constantly enabled or constantly disabled	<ALARM_NORMAL_OPEN 1>

Example of operation process:

```
//Set (usually only once)
<ALARM_NORMAL_OPEN 1>//Set IO alarm to be constantly enabled
<ALARM_THRE_VALUE 0 200,200,200,10,10,10>//Set the alarm threshold
<ALARM_ON 0 1>//Enable the alarm function
<ALARM_CLEAR 0>//Reset alarm
<SAVE>//Save settings

//Normal operation process (loop reading or check overload information after an alarm is triggered)
① The sensor triggers an alarm, and the robot feeds back the alarm information and stops
②<ALARM_AXIS 0>//Receive the alarm information and make a judgment according to the return value
③<SINGLE>//Receive the current force value information of the sensor
④<ALARM_ON 0 0>//Temporarily disable the alarm function (otherwise the alarm will be triggered all the time)
⑤<ALARM_CLEAR 0>//Clear alarm information
⑥ The robot stops operating either by manual intervening or performing collision processing
```

(In general, the robot is controlled to move 10mm along axis Z- of the end tool. You can decide whether or not to open the gripper or change the tool quickly according to the different stations of the robot to ensure that its withdrawal from the collision will not cause secondary damage.)

⑦ The robot returns to the safe area after withdrawing from the collision area

⑧<ZERO>//Reset sensor

<⑨<ALARM_ON 0 1>////Re-enable the alarm function

⑩<ALARM_CLEAR 0>//Clear alarm information

5 Host demonstration software

You can use this software to connect to the 6-axis force torque sensor via Ethernet or serial port. With the host software, you can view the waveform graph and 3D vector graphics of the sensor to familiarize yourself with the force sensor, and carry out communication diagnosis.

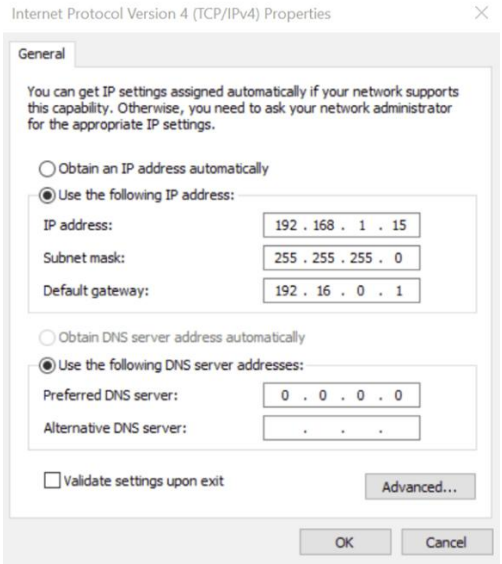
5.1 Ethernet-based host demonstration software

It is suitable for 6-axis force torque sensor + Ethernet adapter.

5.1.1 Ethernet connection steps

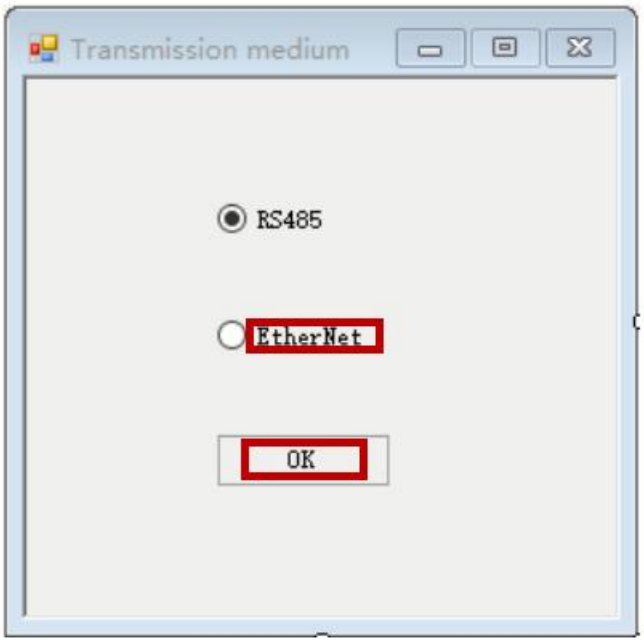
Steps: 1. Provide a PC with Windows system.

2. Set the network port of the PC. Make sure that the PC and the sensor are in the same network segment 192.168.1.X and do not conflict with each other.



3. Copy and decompress the host demonstration software. Find the file “6-axis force torque sensor host V1.x.x.exe” in the Release folder and double-click it to open it.

4. Check the EtherNet option. Click OK, as shown in the figure.



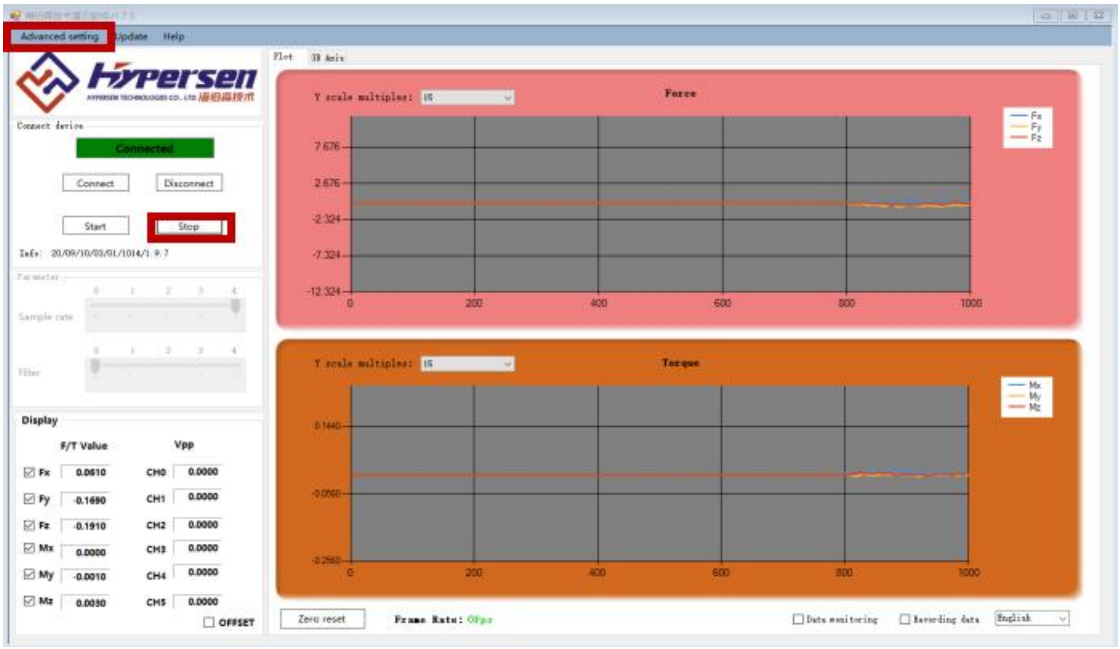
5. Enter the Port IP and communication port of the sensor (IP: 192.168.1.100; Port: 8080; UDP by default). Click OK.

6. Enter the host interface. Click the Connect button and then the Start button. Then you can reset the sensor and view the Plot and 3D Axis interfaces.

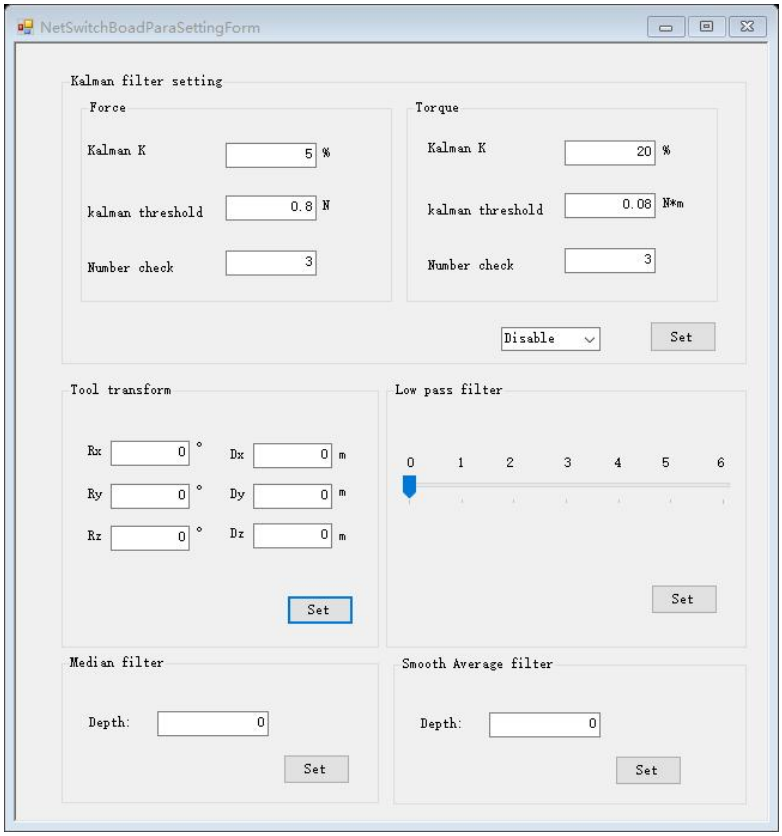
5.1.2 Filtering and coordinate system conversion functions

Steps: 1. Connect the host software to the sensor according to 5.1.1.

2. Click the Stop button to stop the data acquisition and then click the Advanced setting menu.



3. Open the Parameter setting window.



4. Then you can set the Kalman filter, low pass filter, median filter, moving average filter and sensor coordinate rotation function.

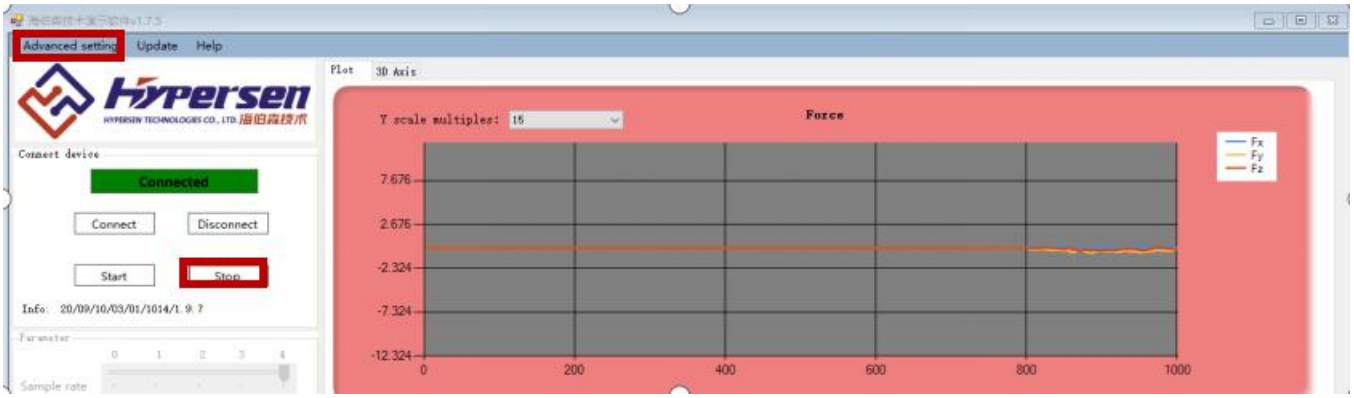
5. Set according to the parameters specified in the manual, and then click the Set button to make the settings take effect immediately.

6. If you want the settings to remain valid after shutdown, after completing the setting and making the settings take effect, you can close the Para Setting window and click the Save user setting button on the Advanced setting menu, and then the relevant parameters will remain valid after shutdown.

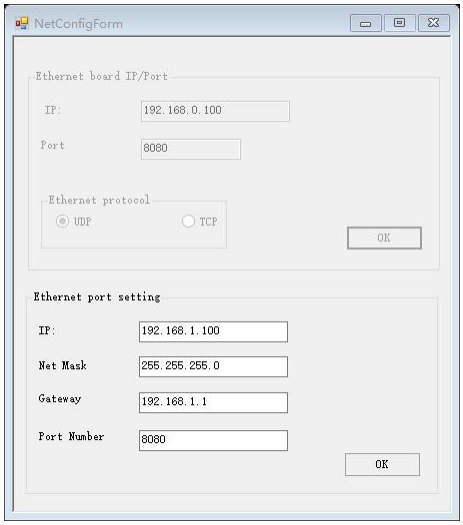
5.1.3 Port setting

Steps: 1. Connect the host software to the sensor according to 5.1.1.

2. Click the Stop button to stop the data acquisition and then click the Advanced setting menu.



3. Open the Port Setting window.



4. After setting the ports of the sensor, click OK, and wait until it is prompted that the setting is successful and reconnection is recommended.

5.Click the Save user setting button on the Advanced setting menu, and then the relevant parameters will remain valid after shutdown.

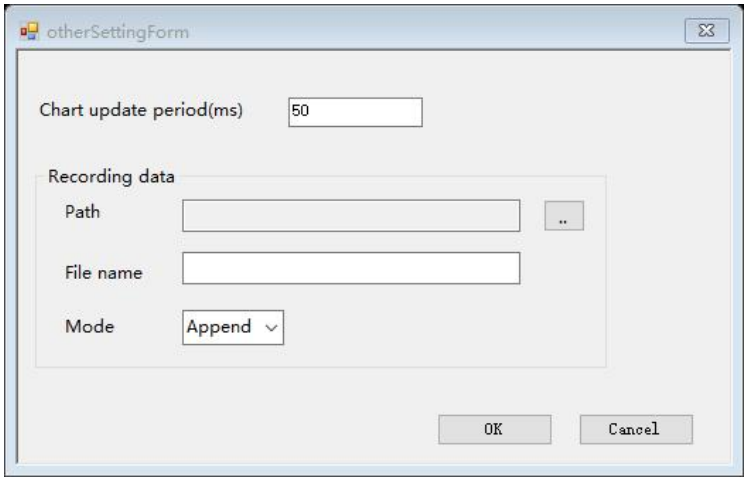
6. Turn off the sensor and then restart it. Set the computer and the sensor to the same network segment. Connect it to the host again with the new port settings.

5.1.4 Save data

Steps: 1. Connect the host software to the sensor according to 5.1.1.

2. Click the Stop button to stop the acquisition performed by the sensor.

3. Click the Advanced setting menu to open the Other Setting window.



4. You can set the refresh period of the “Plot” by setting the Chart update period (ms).

5. Set the file save path and filename in Recording data.

6. Set the data save mode to “Append” or “Overwrite”. Click OK to make the settings take effect.

7. Close the window and click Start to start acquiring data.

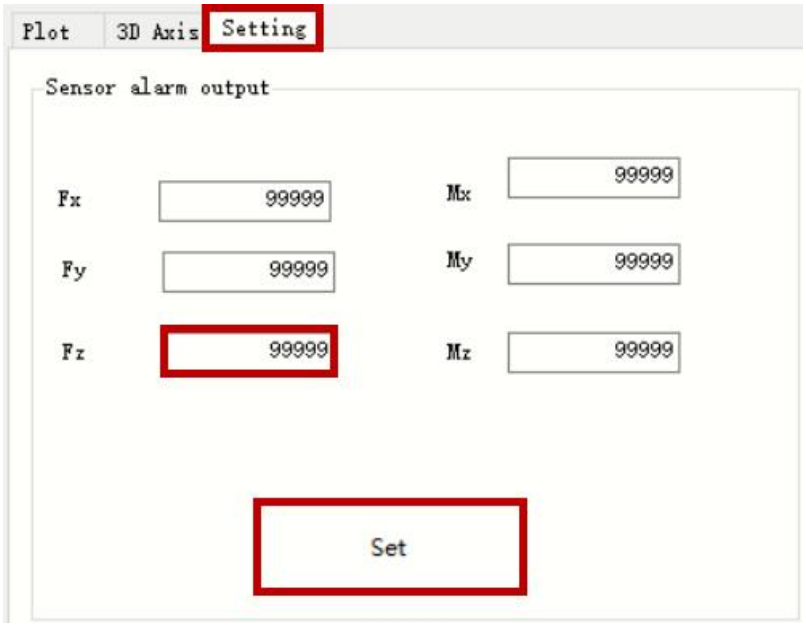
8. In the lower right corner of the "Plot", check Recording data, and the data will be saved.

9. Uncheck it again to stop saving the data. The data is acquired at a frame rate, which is not suitable for long data recording.

5.1.5 IO alarm function (version 1.9.5 or above)

Steps: 1. Connect the host software to the sensor according to 5.1.1.

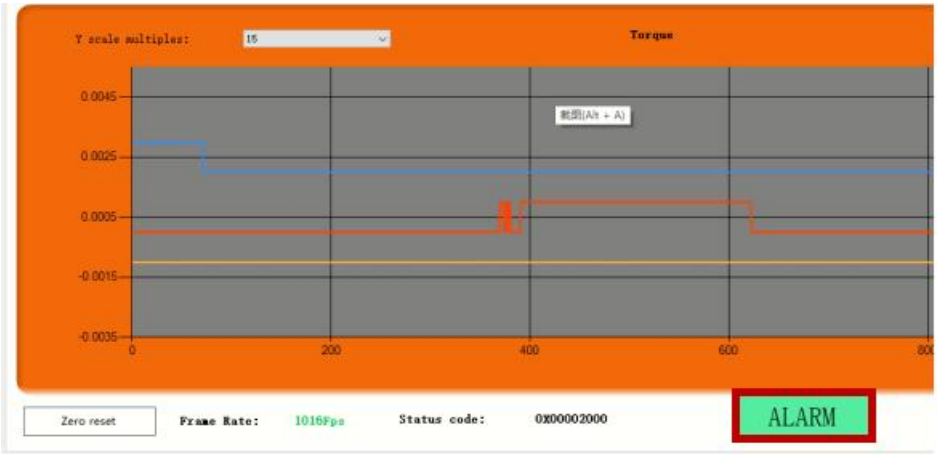
2. Click Setting to enter the alarm threshold setting interface.



3. The default value 99999 means that the axis is not monitored. After setting the alarm, click Set to make the settings take effect immediately.

4. If you need to save the alarm threshold settings, please click the Save user setting button on the Advanced setting menu, and then the relevant parameters will remain valid after shutdown.

5. Return to the “Plot” interface, and then you can see an ALARM button at the bottom. When the button is green, it means that no IO alarm has been triggered. When the button is red, it means that an IO alarm has been triggered. Click the button to reset the IO alarm.



Precautions:

1. The IO alarm is in overload alarm mode by default.
2. In the overload alarm mode, the alarm must be reset manually after it is triggered.
3. In the overload alarm mode, make sure that the sensor is not pressed when resetting the alarm. Otherwise, the alarm will be triggered again.
4. In the overload alarm mode, the alarm threshold of the sensor is not affected by

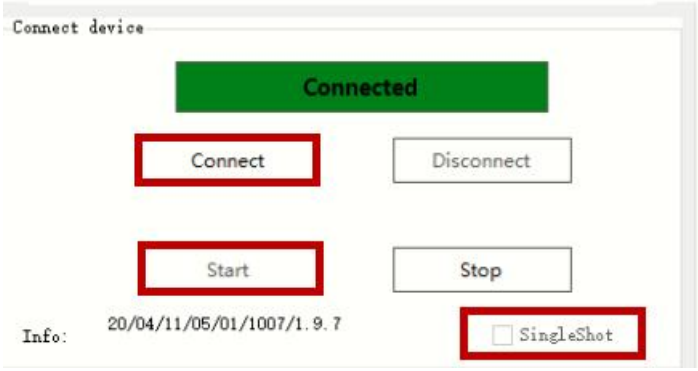
filtering.

5. If there is a need for contact force monitoring, you can contact the aftersales personnel to change the IO alarm mode.
6. In the contact force monitoring mode, the resetting will be performed automatically after the contact force disappears.
7. In the contact force monitoring mode, the contact force threshold is affected by filtering, and touches by mistake can be avoided.

5.1.6 One-time acquisition mode function

Steps:

1. Connect the host software to the sensor according to 5.1.1.
2. Click the Stop button to stop the data acquisition.
3. Check Single Shot, and then click Connect to enable the one-time acquisition mode of the sensor.



4. You can check the frame rate in the lower part of the “Plot” interface to compare the frame rate differences in different communication modes and filtering.

5.1.7 Crosstalk compensation function

Steps: 1. Connect the host software to the sensor according to 5.1.1.

2. Click the Stop button to stop the data acquisition.

3. Check Crosstalk correct Enable, and then it will take effect immediately and the crosstalk compensation mode will be enabled (which is enabled by default for the factory settings).

4. Click the Save user setting button on the Advanced setting menu, and then the relevant parameters will remain valid after shutdown.

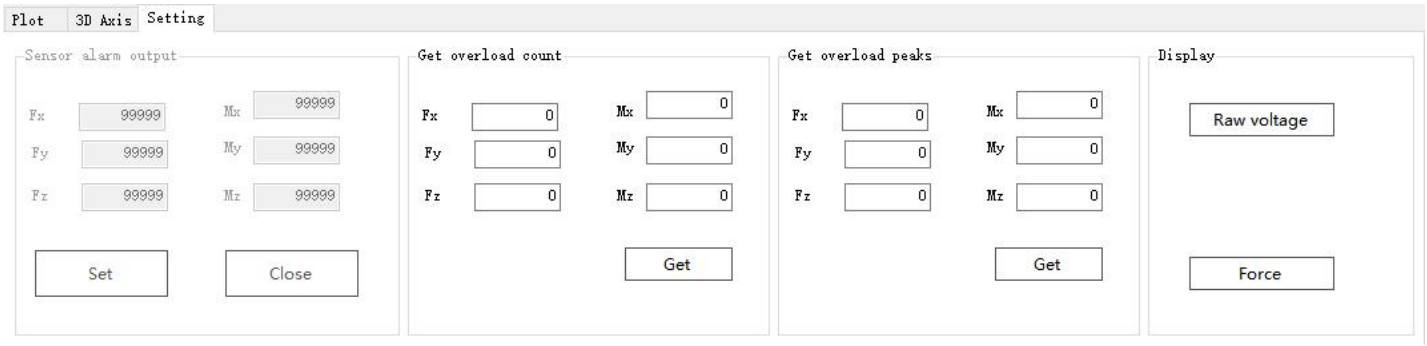
Precautions:

1. By default, the sensor enables crosstalk compensation mode, which has a strong inhibitory effect on crosstalk, but will slightly affect the single-axis precision.
2. If the operating scenario is single-axis measurement, you can try to disable the crosstalk compensation mode.

5.1.8 Overload information receiving function

Steps:

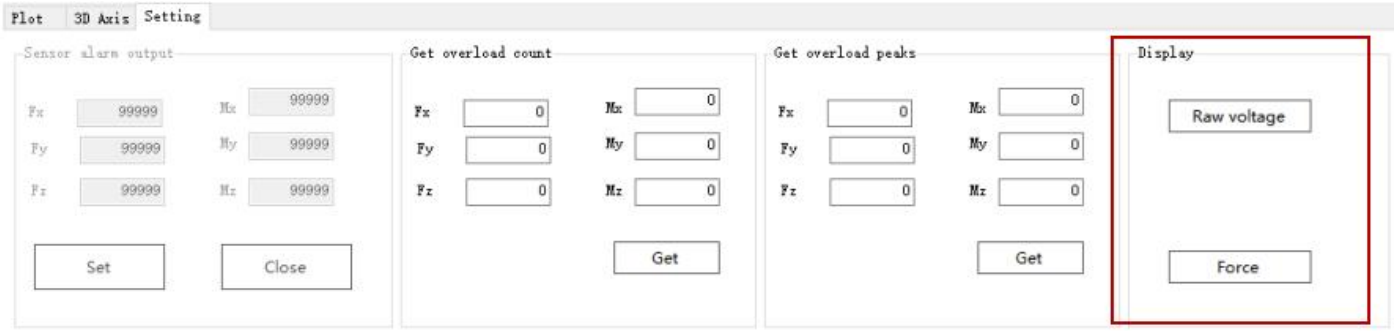
1. Connect the host software to the sensor according to 5.1.1.
2. Click the Stop button to stop the data acquisition.
3. Click Setting to enter the overload information receiving interface.
4. You can get the sensor overload times (counted once every 20ms based on the measuring range of the sensor, where the count is updated once every 2min) and overload peak (which may be abnormal if the sensor is damaged).

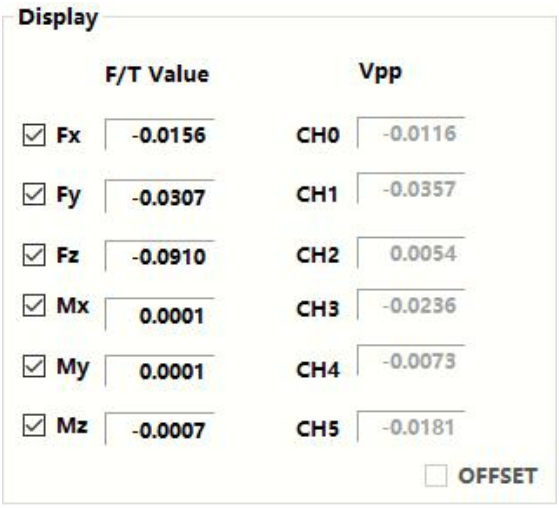


5.1.9 Voltage check function

Steps:

1. Connect the host software to the sensor according to 5.1.1.
2. Click the Stop button to stop the acquisition performed by the sensor.
3. Click Setting to enter the Display interface.
4. Click the Raw Voltage to check the voltage value (the calculation method will change and it is recommended to clear it after switching). Click Force to hide the voltage value.
5. Return to the “Plot” interface, and click Start to start acquiring data.



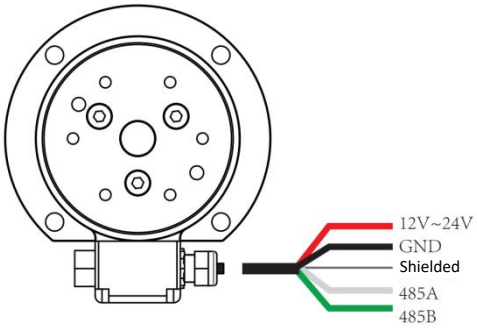


5.2 RS485 interface–based host software

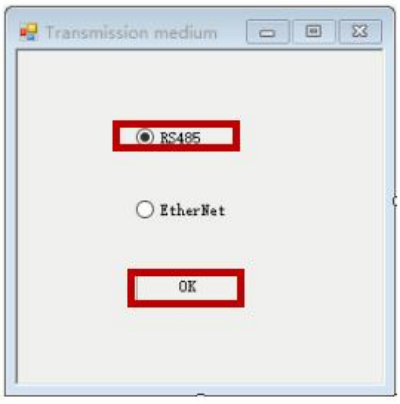
It is suitable for 6-axis force torque sensor + EtherCat adapter.

5.2.1 RS485 connection

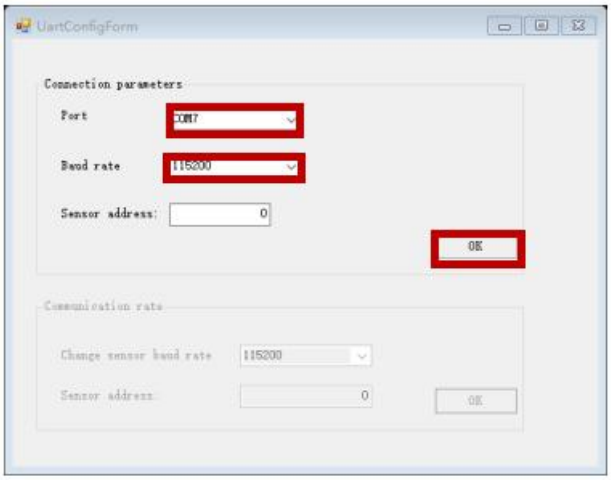
Prerequisites: 1. Connect the power cable of the sensor to a 12–24V DC power supply.
2.Connect the communication cable (485A, 485B) of the sensor to the RS485-to-serial-port adapter (A+, B-).



Steps: 1. Find the file “6-axis force torque sensor host V1.x.x.exe” in the Release folder and open it.
2. Check the RS485 option. Click OK, as shown in the figure.



3. Select the appropriate port.



4. If the sensor with an RS485 interface is purchased, the default baud rate is 115200. If the sensor with an EtherCat or EtherNet adapter is purchased, the default baud rate of the sensor is 1500000.

5. Click OK to enter the main interface of the host software. Click the Connect button to connect the sensor.

6. If it is prompted that the connection fails, it means that the power supply, wiring, port or baud rate of the sensor is incorrect. Please check it before reopening the host software for connection.

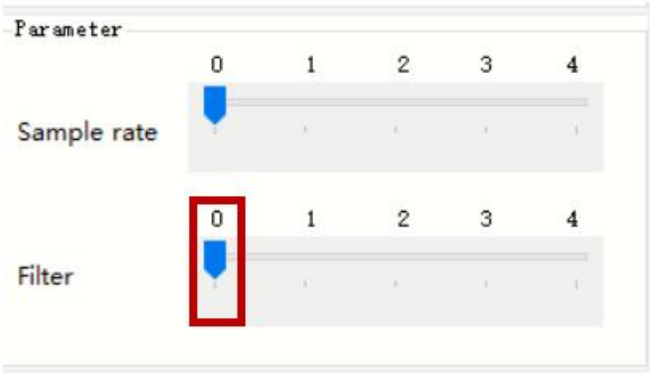
5.2.2 Filter

Use a low pass filter inside the sensor.

Steps: 1. Complete the connection according to 5.2.1.

2. Click the Stop button to stop acquiring data.

3. On the Parameter bar of the main interface, move the Filter slider to set the filter level.



4. Click the Start button to start acquiring data.

5. Check the filtering effect and the change of the communication rate in the “Plot” interface.

5.2.3 One-time acquisition mode function

See 5.1.6 for details.

5.2.3 Crosstalk compensation function

See 5.1.7 for details.

5.2.4 Overload information receiving function

See 5.1.8 for details.

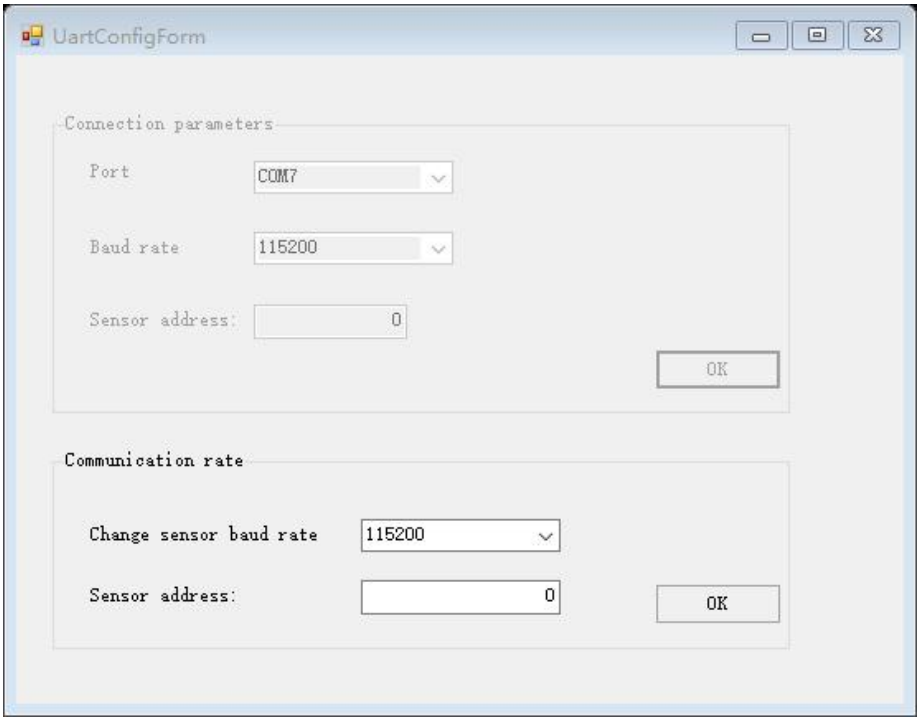
5.2.5 Voltage check function

See 5.1.9 for details.

5.2.6 Baud rate setting

Modify the baud rate of the sensor.

Steps: 1. Complete the connection according to 5.2.1.
2. Click the Stop button to stop the data acquisition.
3. Click the Advanced setting menu to open the Port Setting window.



4. After modifying the baud rate, click OK to make it take effect immediately.

5.Click the Save user setting button on the Advanced setting menu, and then the relevant parameters will remain valid after shutdown.

6. Turn off the sensor and then restart it. Connect it to the host again with the updated baud rate.

6 Host monitoring software

The sensor has a reserved monitoring port in addition to the main communication port. You can monitor and acquire data in real time through the host monitoring software without affecting the communication between the main port of the sensor and the equipment. This is convenient for debugging and data analysis.

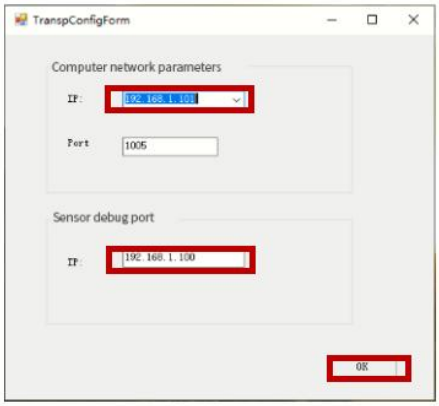
6.1. Host demonstration software connection steps

Steps: 1. Provide a PC with Windows system.

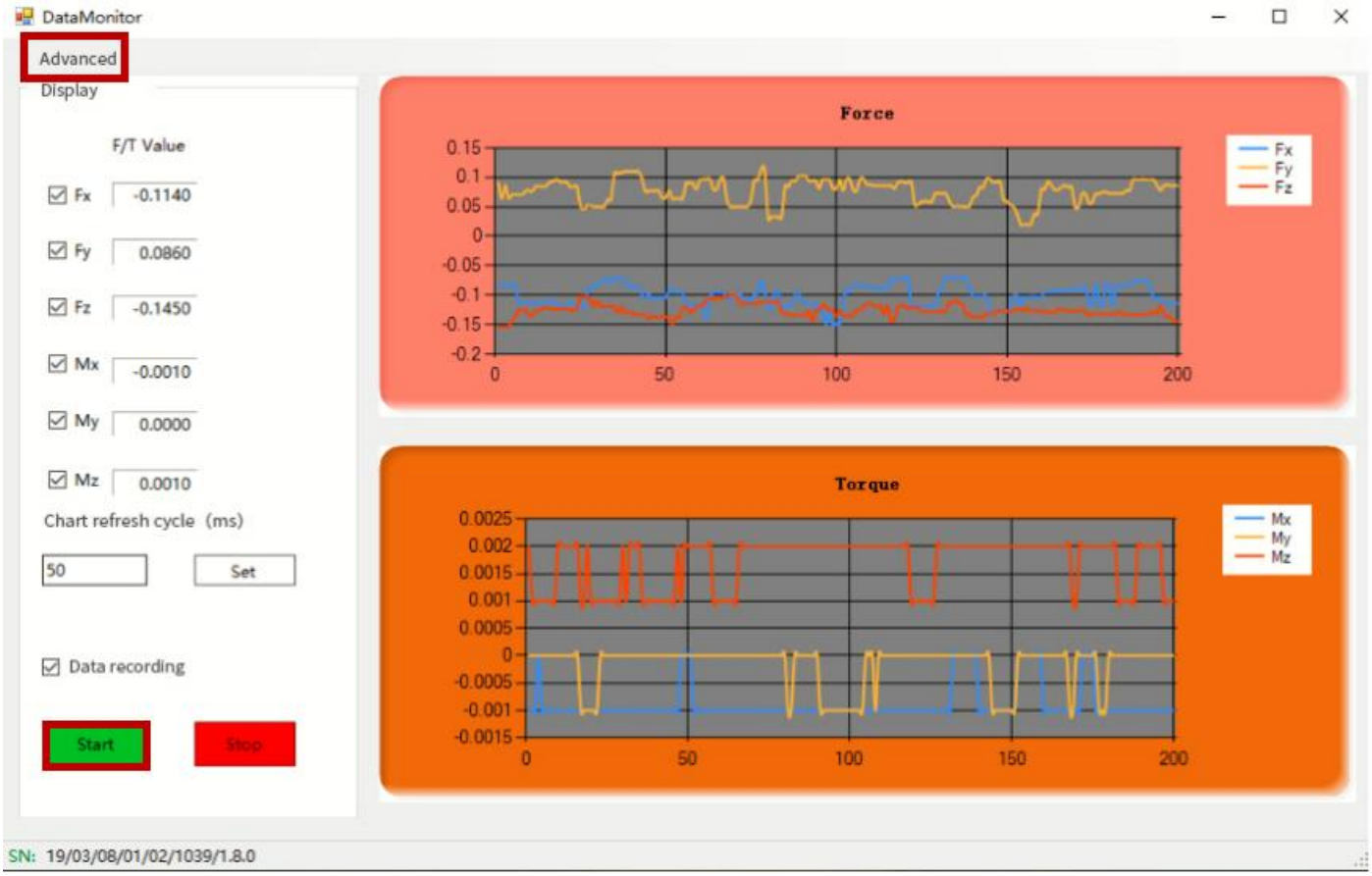
2. Set the network port of the PC. Make sure that the PC and the sensor are in the same network segment 192.168.1.X and do not conflict with each other.

3. Copy and decompress the host monitoring software. Find the file “Monitoring.exe” in the Release folder and double-click it to open it.

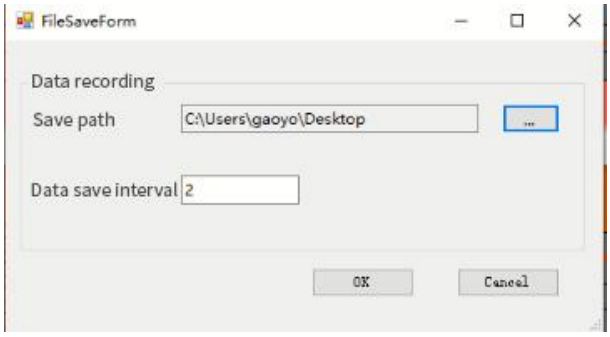
4. Enter the PC port IP and the sensor IP. Click OK, as shown in the figure.



5. Click Start to start monitoring the sensor data.



6. You can also set the data acquisition path and interval in the Advanced setting.



7. Return to the main interface and check “Data recording” and click the Start button to start acquiring data. When you click the Stop button, the current acquisition will be stopped and the data will be saved as a .csv file. The data format is shown in the figure below.

Fx	Fy	Fz	Mx	My	Mz	Time
-0.109	0.11	-0.118	-0.001	-0.001	0.003	########
-0.094	0.116	-0.118	-0.001	-0.001	0.003	########
-0.108	0.116	-0.118	-0.001	-0.001	0.003	########
-0.108	0.116	-0.118	-0.001	-0.001	0.003	########
-0.125	0.116	-0.113	-0.001	-0.001	0.003	########
-0.125	0.108	-0.115	-0.001	-0.001	0.003	########
-0.092	0.123	-0.115	-0.001	-0.001	0.003	########
-0.083	0.117	-0.115	-0.001	-0.001	0.003	########
-0.083	0.105	-0.117	-0.001	-0.001	0.003	########
-0.082	0.105	-0.117	-0.001	-0.001	0.002	########
-0.082	0.117	-0.113	-0.001	-0.001	0.002	########
-0.082	0.132	-0.117	-0.001	-0.001	0.003	########
-0.096	0.128	-0.113	-0.001	-0.001	0.002	########
-0.096	0.123	-0.113	-0.001	-0.001	0.002	########
-0.094	0.109	-0.112	-0.001	-0.001	0.002	########

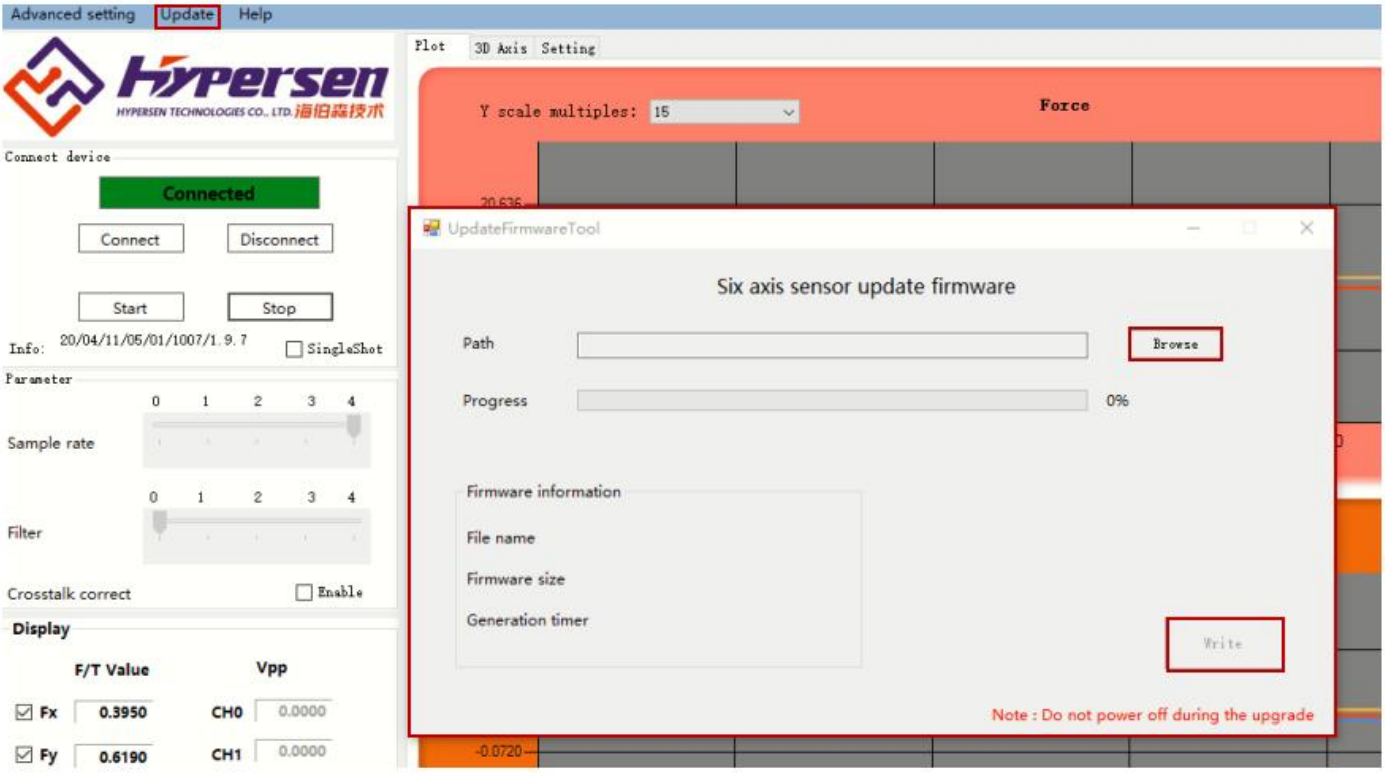
7 Firmware update software

The sensor and the adapter can be upgraded online through the firmware update software. Make sure that there is no power-down occurring during the update. Otherwise there will be a risk of irreparable damage.

7.1. Sensor firmware update

Steps:

1. Connect the host software to the sensor according to 5.1.1.
2. Click the Stop button to stop the acquisition performed by the sensor.
3. Click Update on the menu bar to open the UpdateFirmwareTool window .
4. Click the Browse button to load the file SixAxis_xxx.hyp.
5. Click the Write button and wait until it is prompted that the update is successful (Do not power it down halfway).
6. After making sure that the update is completed, close the software, turn on the sensor again, and connect it to the host software again and make sure that the sensor is working normally.

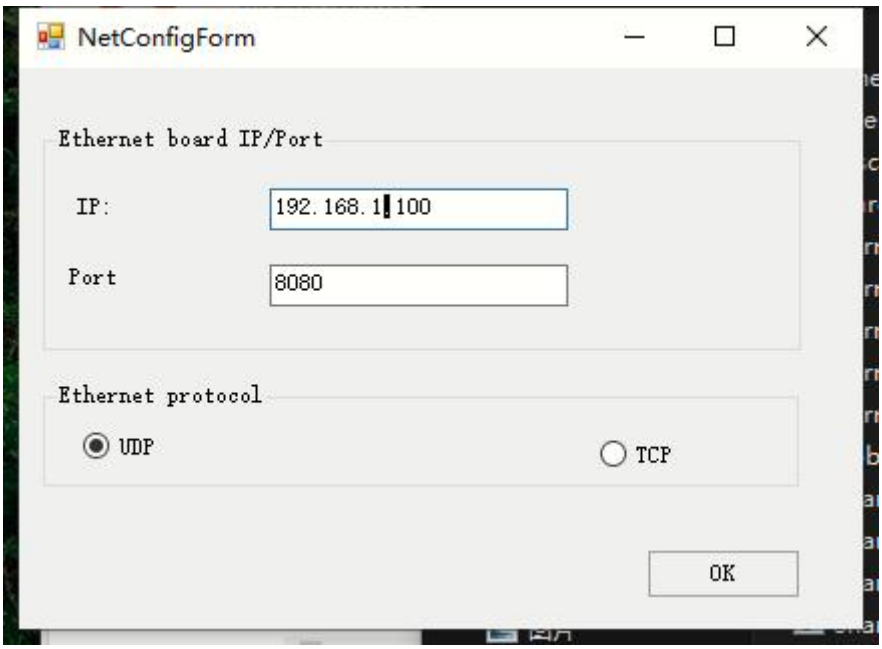


7.2. Ethernet firmware update

Steps:

1. Connect the host software to the sensor according to 5.1.1.
2. After making sure that the sensor and the adapter are working normally, close the software.

3. Open the EtherNet firmware update software.
4. Set the communication settings of the current adapter. Click the OK button to enter the UpdateFirmwareTool interface.



5. Click the Browse button to load the file FTxx_Lan_Convertor_xxx.hyp.
6. Click the Write button and wait until it is prompted that the update is successful (Do not power it down halfway).
7. After making sure that the update is completed, close the software, turn on the sensor again, and connect it to the host software again and make sure that the sensor is working normally.

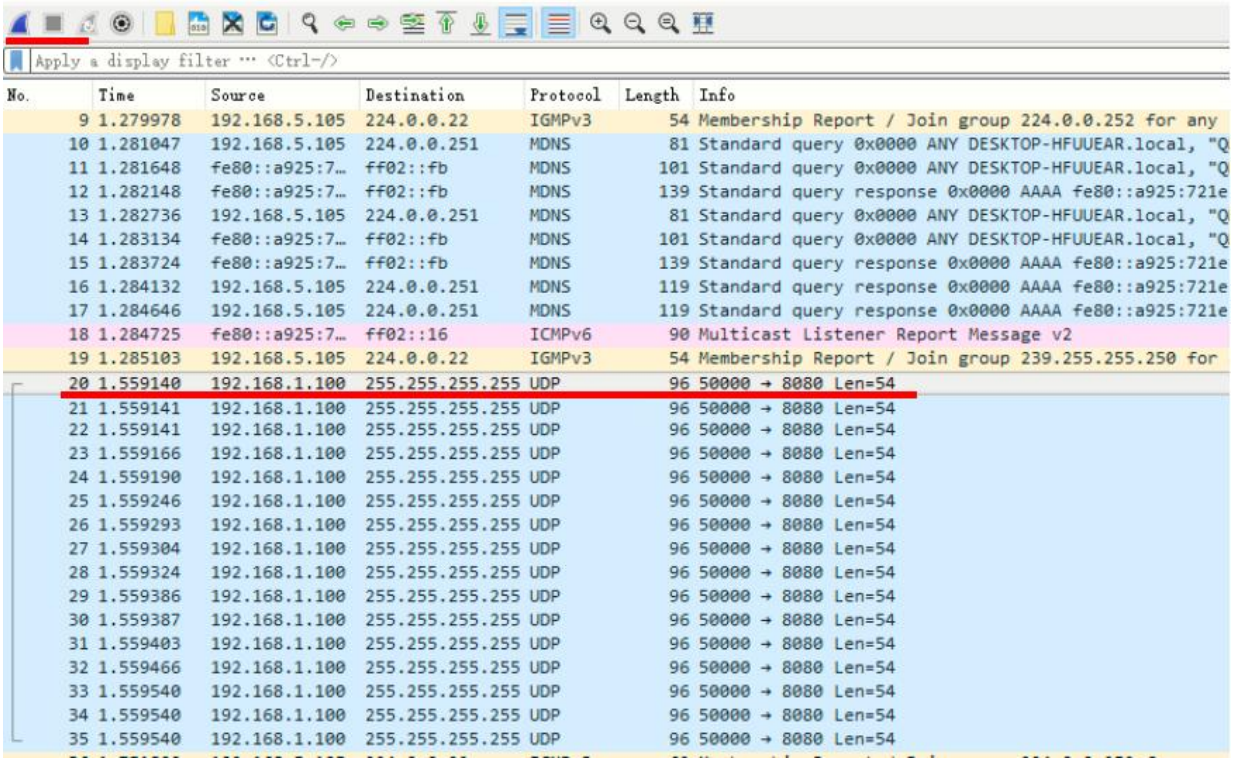
8 Troubleshooting

8.1 Ethernet adapter failure

When the adapter IP or port is missed, you can get the adapter IP and port through the following steps.

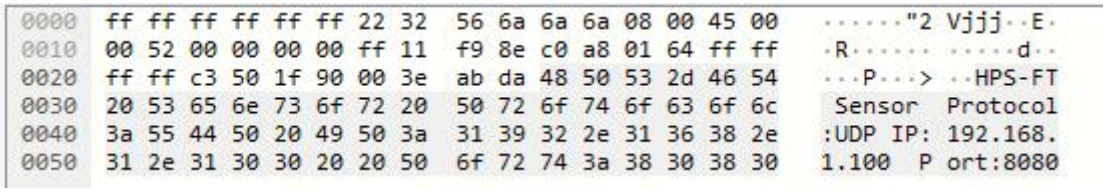
Steps:

1. Wire the sensor and the adapter properly.
2. Connect the adapter to a PC network cable (any computer network segment can be used).
3. Install and open the Wireshark software.
4. Double-click the network port currently connected to the sensor adapter to start the monitoring.
5. Turn off the sensor before restarting it again. Then the adapter will continuously send multiple broadcast packets.
6. Click on the UDP broadcast packet to view it. The content is the Port IP and UDP/TCP mode of the current adapter. With this information, you can reconnect the sensor adapter.



Apply a display filter ··· <Ctrl-/>

No.	Time	Source	Destination	Protocol	Length	Info
9	1.279978	192.168.5.105	224.0.0.22	IGMPv3	54	Membership Report / Join group 224.0.0.252 for any
10	1.281047	192.168.5.105	224.0.0.251	MDNS	81	Standard query 0x0000 ANY DESKTOP-HFUUEAR.local, "Q
11	1.281648	fe80::a925:7…	ff02::fb	MDNS	101	Standard query 0x0000 ANY DESKTOP-HFUUEAR.local, "Q
12	1.282148	fe80::a925:7…	ff02::fb	MDNS	139	Standard query response 0x0000 AAAA fe80::a925:721e
13	1.282736	192.168.5.105	224.0.0.251	MDNS	81	Standard query 0x0000 ANY DESKTOP-HFUUEAR.local, "Q
14	1.283134	fe80::a925:7…	ff02::fb	MDNS	101	Standard query 0x0000 ANY DESKTOP-HFUUEAR.local, "Q
15	1.283724	fe80::a925:7…	ff02::fb	MDNS	139	Standard query response 0x0000 AAAA fe80::a925:721e
16	1.284132	192.168.5.105	224.0.0.251	MDNS	119	Standard query response 0x0000 AAAA fe80::a925:721e
17	1.284646	192.168.5.105	224.0.0.251	MDNS	119	Standard query response 0x0000 AAAA fe80::a925:721e
18	1.284725	fe80::a925:7…	ff02::16	ICMPv6	90	Multicast Listener Report Message v2
19	1.285103	192.168.5.105	224.0.0.22	IGMPv3	54	Membership Report / Join group 239.255.255.250 for
20	1.559140	192.168.1.100	255.255.255.255	UDP	96	50000 → 8080 Len=54
21	1.559141	192.168.1.100	255.255.255.255	UDP	96	50000 → 8080 Len=54
22	1.559141	192.168.1.100	255.255.255.255	UDP	96	50000 → 8080 Len=54
23	1.559166	192.168.1.100	255.255.255.255	UDP	96	50000 → 8080 Len=54
24	1.559190	192.168.1.100	255.255.255.255	UDP	96	50000 → 8080 Len=54
25	1.559246	192.168.1.100	255.255.255.255	UDP	96	50000 → 8080 Len=54
26	1.559293	192.168.1.100	255.255.255.255	UDP	96	50000 → 8080 Len=54
27	1.559304	192.168.1.100	255.255.255.255	UDP	96	50000 → 8080 Len=54
28	1.559324	192.168.1.100	255.255.255.255	UDP	96	50000 → 8080 Len=54
29	1.559386	192.168.1.100	255.255.255.255	UDP	96	50000 → 8080 Len=54
30	1.559387	192.168.1.100	255.255.255.255	UDP	96	50000 → 8080 Len=54
31	1.559403	192.168.1.100	255.255.255.255	UDP	96	50000 → 8080 Len=54
32	1.559466	192.168.1.100	255.255.255.255	UDP	96	50000 → 8080 Len=54
33	1.559540	192.168.1.100	255.255.255.255	UDP	96	50000 → 8080 Len=54
34	1.559540	192.168.1.100	255.255.255.255	UDP	96	50000 → 8080 Len=54
35	1.559540	192.168.1.100	255.255.255.255	UDP	96	50000 → 8080 Len=54



```
0000  ff ff ff ff ff ff 22 32  56 6a 6a 6a 08 00 45 00   ......"2 Vjjj..E.
0010  00 52 00 00 00 00 ff 11  f9 8e c0 a8 01 64 ff ff   .R...... .....d..
0020  ff ff c3 50 1f 90 00 3e  ab da 48 50 53 2d 46 54   ...P...> ..HPS-FT
0030  20 53 65 6e 73 6f 72 20  50 72 6f 74 6f 63 6f 6c    Sensor  Protocol
0040  3a 55 44 50 20 49 50 3a  31 39 32 2e 31 36 38 2e   :UDP IP: 192.168.
0050  31 2e 31 30 30 20 20 50  6f 72 74 3a 38 30 38 30   1.100  P ort:8080
```

Revision history

Date	Revision	Description
7/10/2020	1.0	First version
8/11/2020	1.1	Add RS485 connection examples. Add each communication connection specifications and troubleshooting. Add debugging examples.
10/10/2020	1.2	Add precautions.
9/11/2021	1.3	Update icons. Add descriptions of the new functions of the host. Add string and binary command examples.
9/27/2021	1.4	Update drawings. Add IO protection function descriptions. Add precautions.
10/11/2021	1.5	Add standard torques for 6-axis force torque sensor installation. Modify some text descriptions. Add warranty.
10/13/2021	1.6	Add an introduction to new functions of 6-axis force torque sensor host 1.9.8
11/15/2021	1.7	Add installation diagrams. Modify the standard torques for installation.
2/22/2022	1.8	Modify the colors of the wiring legend. Modify the descriptions of the optional parts. Modify the functions compatible with the 6-axis force torque sensor host 1.11.1.A.

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