



UFACTORY

6 AXIS FORCE TORQUE SENSOR



SHENZHEN UFACTORY CO., LTD.

V 2.7.0

1.Introduction

1.1 Brief Introduction

The UFACTORY 6 Axis Force Torque Sensor is designed for force and torque data acquisition on Arm, it can simultaneously measure the force and torque in three-dimensional space. It is installed on the tool flange, establishes power and communication with the UFACTORY robotic arm via pogo pins or a signal cable.

1.2 Safety

The operator must read and understand all the instructions below before running the 6 Axis Force Torque Sensor.

1.2.1 Warning

1. The 6 Axis Force Torque Sensor needs to be properly installed before operating.
2. Do not install or operate the 6 Axis Force Torque Sensor that is damaged or lacking parts.
3. Never supply the 6 Axis Force Torque Sensor with an alternative current (AC) source.
4. Make sure all cord sets are always secured at both ends, the 6 Axis Force Torque Sensor end & Robot end.
5. Always satisfy the 6 Axis Force Torque Sensor's load specifications.
6. Be sure nothing is in the robot and the 6 Axis Force Torque Sensor path before using.

Caution

The term "operator" refers to anyone responsible for any of the following operations on the 6 Axis Force Torque Sensor:

- Installation
 - Control
 - Maintenance
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"Overload" refers to exceeding the measurement range specified by the torque sensor. Please note that overloading, collision, and falling from a high place may cause damage to the torque sensor.

	Fx, Fy, Fz	Tx, Ty, Tz
Overload Value	±600N	±30Nm

This documentation explains the various components of the 6 Axis Force Torque Sensor and general operations regarding the whole life-cycle of the product from installation to operation and decommissioning.

The drawings and photos in this documentation are representative examples and differences may exist between them and the delivered product.

1.2.2 Risk Assessment and Final Application

The 6 Axis Force Torque Sensor is meant to be used on an industrial robot. The robot, force torque sensor and any other equipment used in the final application must be evaluated with a risk assessment.

The robot integrator must ensure that all local safety measures and regulations are respected. Depending on the application, there may be risks that need additional protection/safety measures, for example, the work-piece 6 Axis Force Torque Sensor is manipulating may be inherently dangerous to the operator.

1.2.3 Validity and Responsibility

Always comply with local and/or national laws, regulations and directives on automation safety and general machine safety.

The unit may be used only within the range of its technical data. Any other use of the product is deemed improper and unintended use.

UFACTORY will not be liable for any damages resulting from any improper or unintended use.

2.Installation

2.1 Delivery List

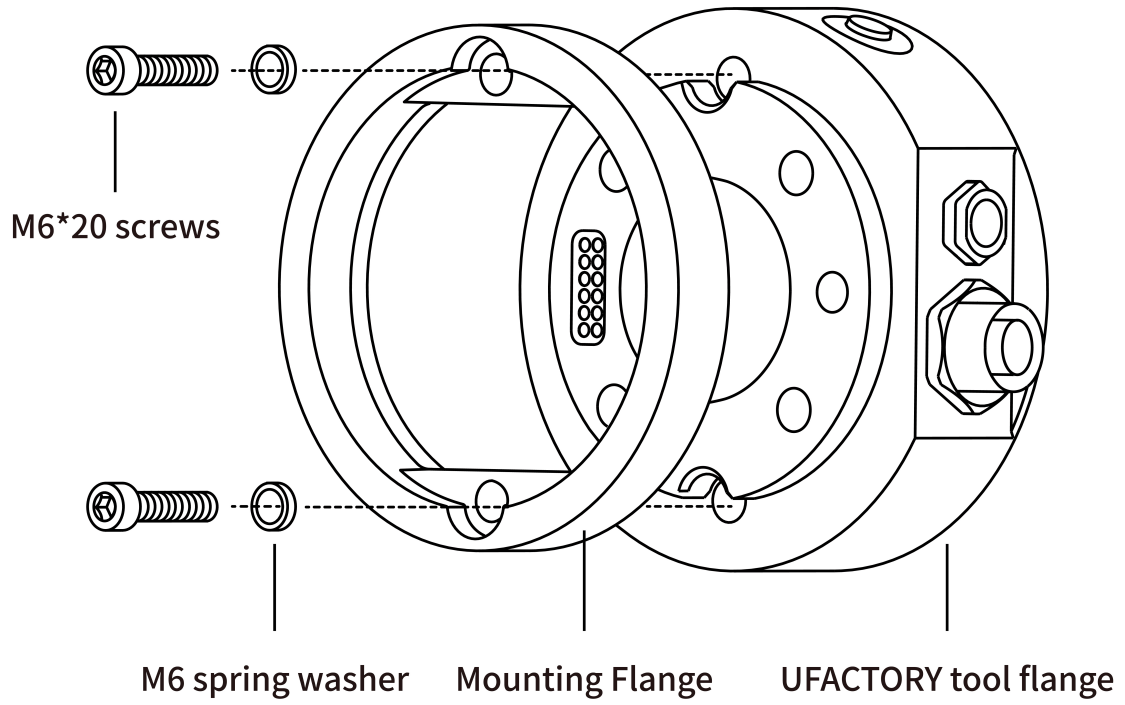
The 6 Axis Force Torque Sensor Kit generally includes these items:
(Please refer to the packing list for the actual items shipped)

- 6 Axis Force Torque Sensor *1
- Mounting Flange *1
- 1300 Mounting Flange *1
- Ft sensor communication cable *1
- Signal Hub *1
- Power cable for the Robotic Arm *1
- Communication cable for the Robotic Arm *1
- M6*16 Head hexagon socket screws(2pcs) & M6 spring washer(2pcs)
- M6*20 Head hexagon socket screws(2pcs) & M6 spring washer(2pcs)
- M4*8 Head hexagon socket screws(4pcs) & M4 spring washer(4pcs)
- Velcro(3 meters)
- 2.5MM(1pcs) & 5MM(1pcs) L type wrench

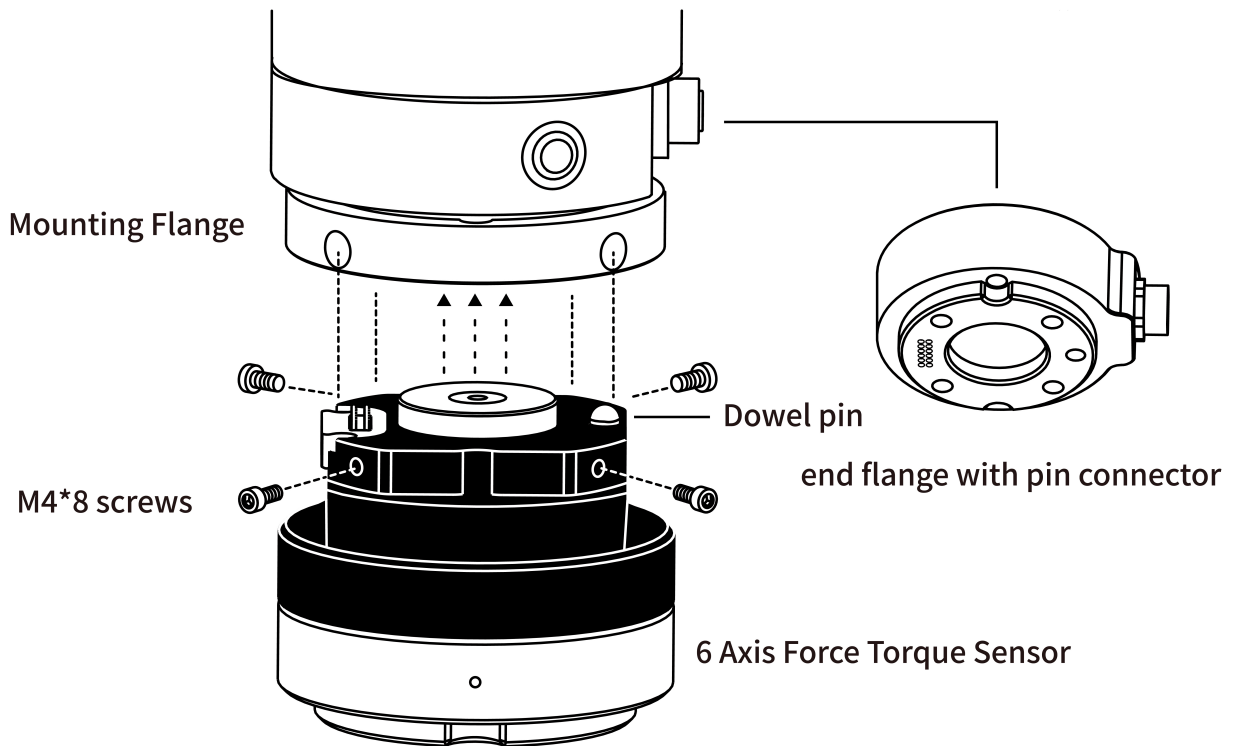
2.2 Mechanical Installation

2.2.1 For pin contact(pogo pins) connection(UF850,XX1305)

1. Press down the E stop button on the control box.
2. Install the Mounting Flange on the end flange using 4 M6*20 screws(spring washer must be used together).



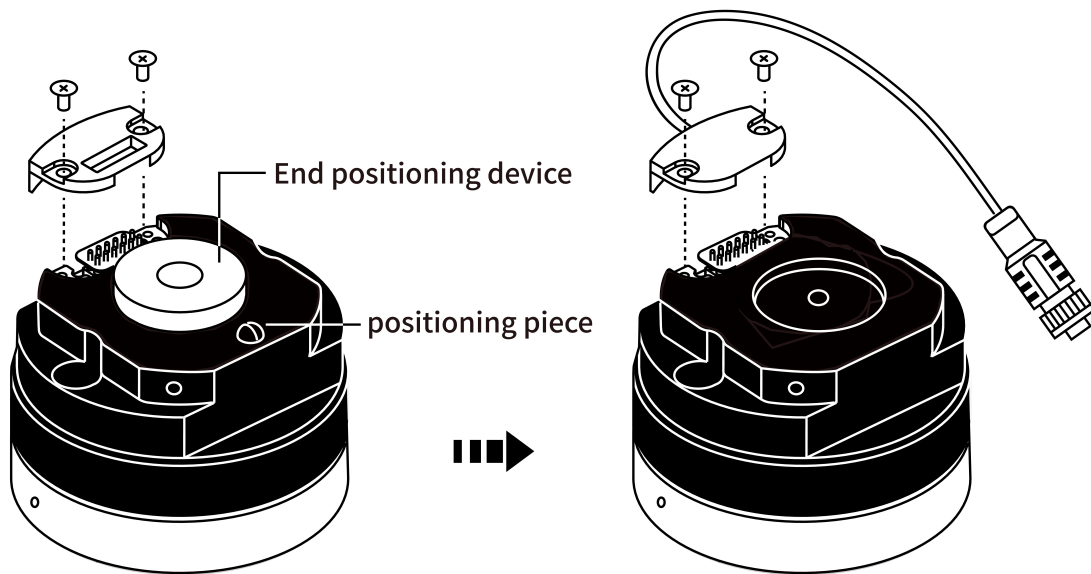
3. Install the Force Torque Sensor on the Flange using 4 M4*8 screws.



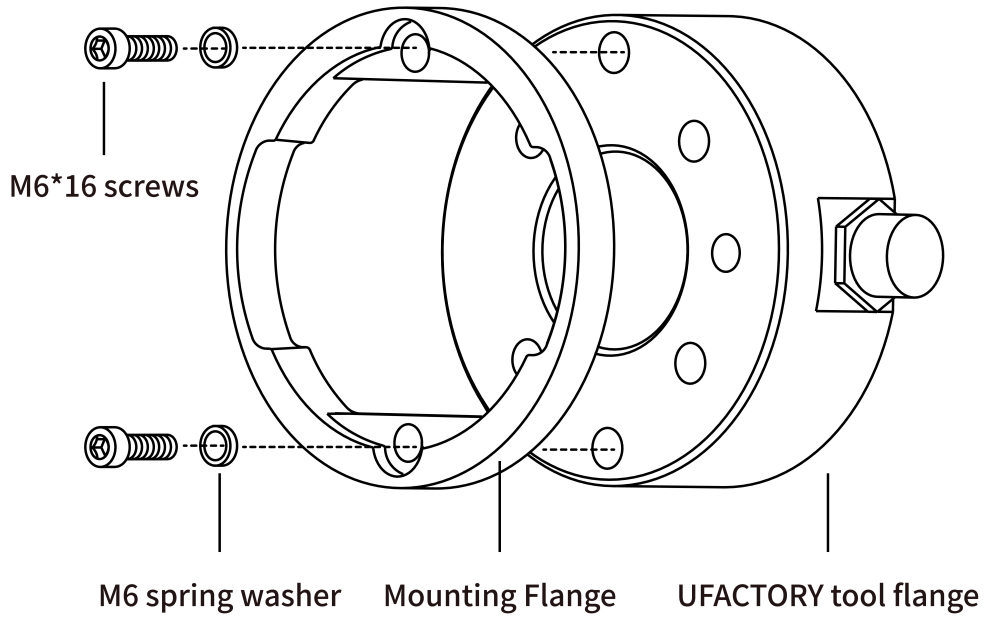
4. Press up E stop button on the control box.

2.2.2 For Plug-in connection(XX1304 or below)

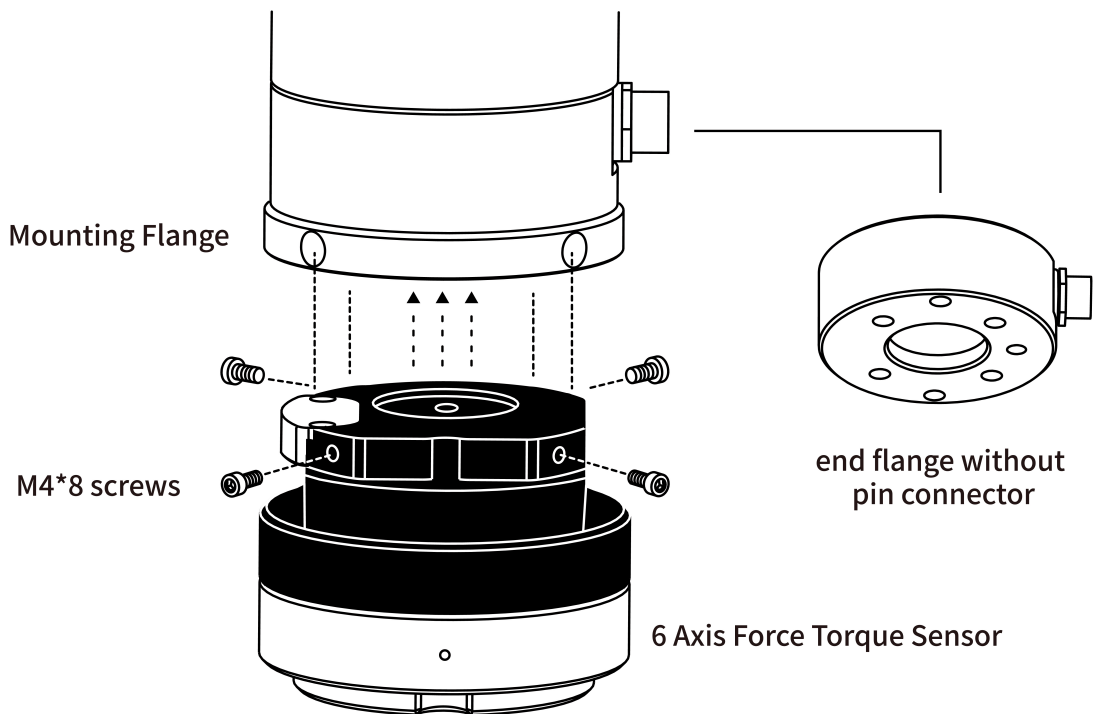
1. Press down the E stop button on the control box.
2. Remove the 2 screws on the force sensor flange, take off the black cover, and replace it with the one that have a signal cable.
Take off the positioning dowel and positioning piece.



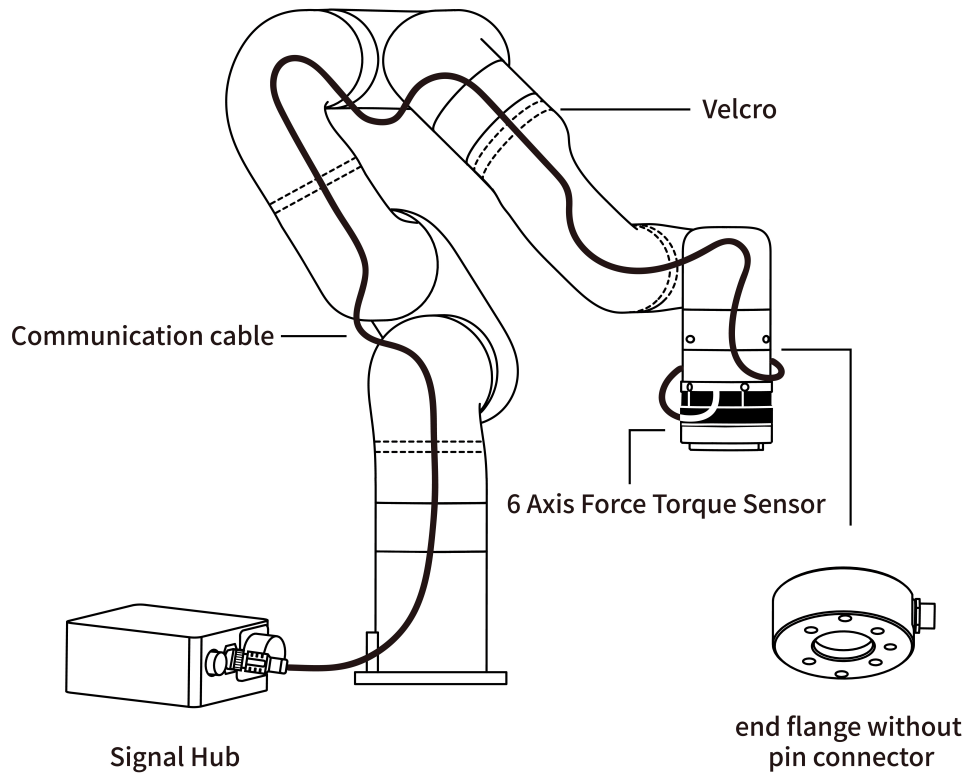
3. Install the Mounting Flange on the end flange using 4 M6*16 screws(spring washer must be used together).



4. Install the Force Torque Sensor on the Flange using 4 M4*8 screws.



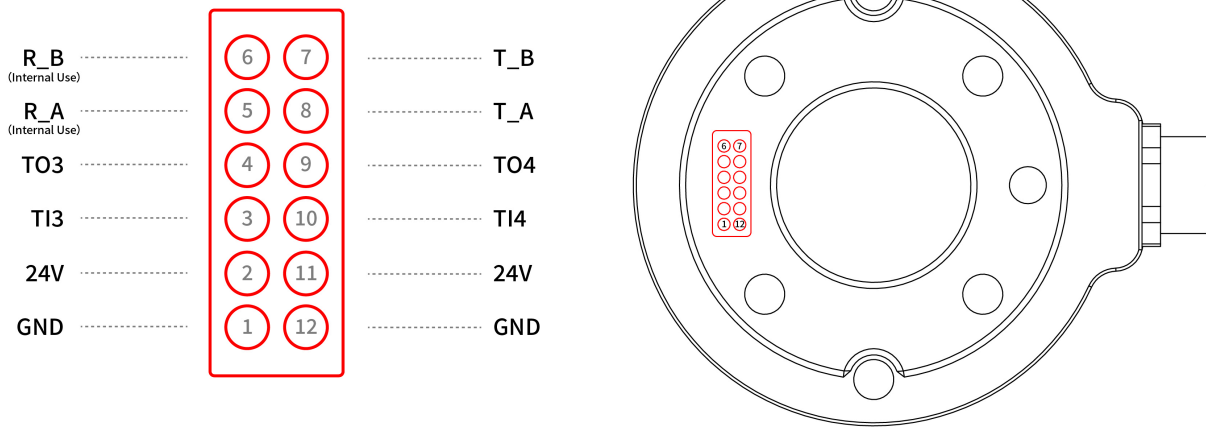
5. Connect the 6 Axis Force Torque Sensor communication cable to the signal hub.



2.3 Electrical settings

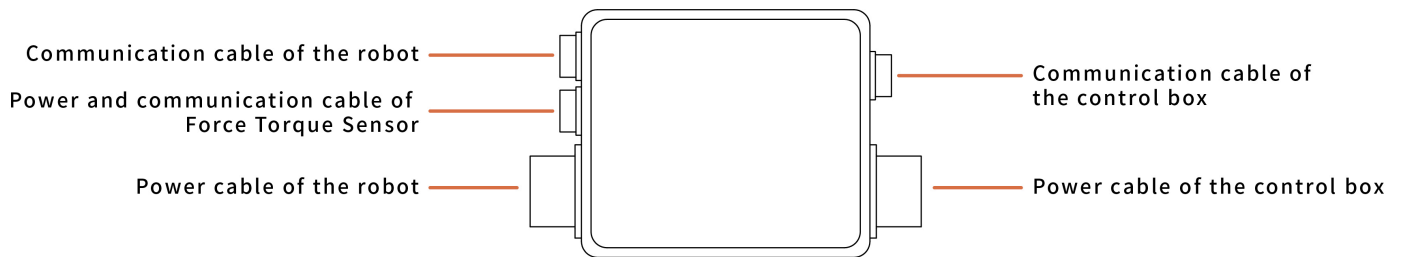
2.3.1 Pin Contact End Flange

The 6 Axis force torque sensor operates at 24V, GND, R_A, R_B, with a power consumption of less than 2.5W.



2.3.2 Signal hub

For the robotic arm 1304 or below version, need to use the signal hub to build the communication.



3.Control

3.1 UFACTORY Studio

3.1.1 Settings

State: Normal	X	Y	Z
Mode: Position	149.6 mm	-0.3 mm	238.1 mm
Payload: 0.00 Kg	Roll	Pitch	Yaw
Mounting: Floor	180 °	0 °	0 °

	J1	J2	J3	J4	J5	J6
	0	0	0	0	0	0

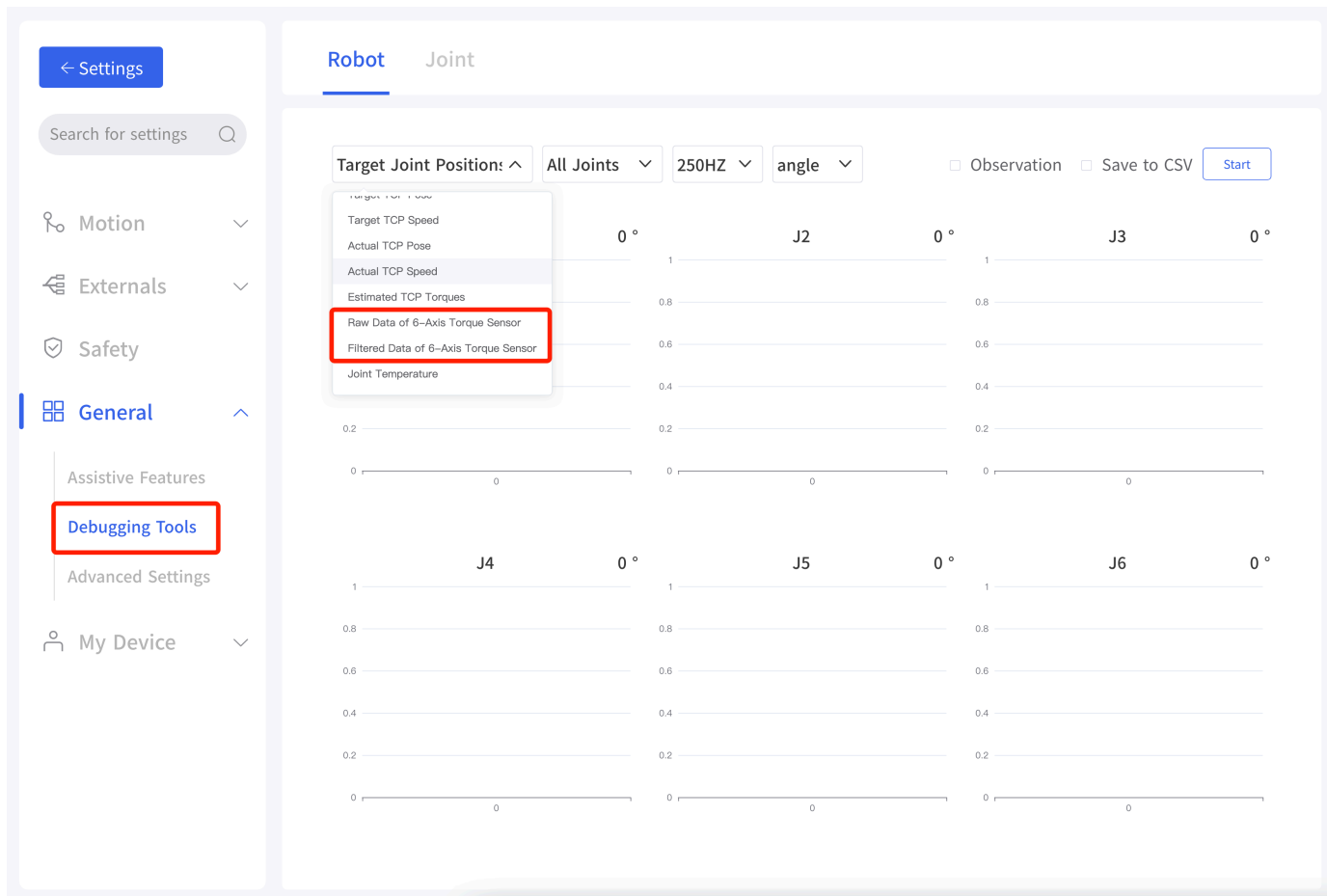
- **Enable Six-Axis Force-Torque Sensor:** Enable, obtain and display SN and Firmware Version.
- **Payload Identification:** During this process, the robotic arm will perform a series of actions, it will take around 5 minutes. It will get mass, centroid and sensor offset.
- **Manual Mode Direction:** The direction of translation or rotation can be selected. After activation, the torque manual mode will be enabled.
- **Use force torque sensor for manual mode and recording**
- **Six-Axis Force-Torque Sensor Collision Detection:** Set Detection Threshold, Rebound Distance, Rebound Angle.

3.1.2 Blockly

The screenshot displays the UFACTORY control software interface. On the left, a sidebar contains navigation icons for 'Live Control', 'Blockly', 'Python', and 'GCode'. The main workspace is divided into 'Project' and 'Program' tabs, with 'Program' selected. The project name is 'UF_APPS/[UF]-1001_Joint_Motion'. The workspace shows a sequence of blocks: 'Direct Drive Linear Motor', 'Modbus RTU' (containing 'set RS-485 Port' and 'get RS-485 Port' blocks), 'Transparent Transmission' (containing 'set RS-485 Port' and 'get RS-485 Port' blocks), and 'Torque Sensor' (containing 'set torque sensor force control' and 'get torque sensor value' blocks). The 'Torque Sensor' section is highlighted with a red box.

- set torque sensor force control: Programmable parameters are as below.
coordinate Frame: base, tool
direction: Fx, Fy, Fz, Tx, Ty, Tz
value: -105~105N(Fx,Fy,Fz); -2.8~2.8N(Tx,Ty,Tz)
duration: 0-9999s
- get torque sensor value: Programmable parameters are as below.
direction: Fx, Fy, Fz, Tx, Ty, Tz

3.1.3 Data Observation



Enter Settings - General - Debugging Tools - Robot, check 'Observation' or 'save to CSV' box, click start, and obtain data via TCP port for plotting.

- Item: Raw Dat of 6-Axis Torque Sensor, Filtered Data of 6-Axis Torque Sensor.
- Joint: All joints, single joint
- Frequency: 200HZ, 5HZ
- Unit: angle, radian

3.2 Python SDK

For details on controlling 6 Axis Force Torque Sensor with python-SDK, please refer to the link below: <https://github.com/xArm-Developer/xArm-Python-SDK/tree/master/example/wrapper/common>

Refer to example 8000-8010.

Common Interface:

`ft_sensor_enable` : Enable or disable the force torque sensor

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- `iden_ft_sensor_load_offset` : Identify the load of the force torque sensor.
 - `set_ft_sensor_load_offset` : Set the load identification result as the zero point of the force torque sensor.
 - `set_ft_sensor_mode` : Set the force control application type (0: non-force control, 1: admittance control, 2: force-position hybrid control).
 - `get_ft_sensor_data` : Get the compensated and filtered force torque sensor data.
 - `set_ft_sensor_admittance_parameters` : Set admittance control parameters (M, B, K), coordinate system and compliant axes.
 - `set_ft_collision_detection` : Set collision detection based on the force torque sensor
 - `set_ft_collision_rebound` : Set whether to rebound after a collision
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3.3 C++ SDK

For details on controlling 6 Axis Force Torque Sensor with C++ SDK, please refer to the link below.

<https://github.com/xArm-Developer/xArm-CPLUS-SDK/blob/master/example>

Refer to example 8000-8010.

4. Error Handling

Controller Error Code	Code(HEX)	Error Handling
C50	0x32	Six-axis Force Torque Sensor Error Please check the sensor error code, locate the problem, and power on again. If it cannot be resolved, please contact technical support.
C51	0x33	Six-axis Force Torque Sensor Mode Setting Error Please make sure that the robotic arm is not in Manual Mode, check whether the given value of this command is 0/1/2.
C52	0x34	Six-axis Force Torque Sensor Zero Setting Error Please check the sensor communication wiring and whether the power is normal.
C53	0x35	Six-axis Force Torque Sensor Overload Please reduce the payload or applied external force.
C54	0x36	The six-axis force torque sensor detected a collision.

Sensor Error Code	Code(Hex)	Error Handling
F64	0x40	Six-axis Force Torque Sensor Communication Failure Please check whether the wire between the Data Collector and the Six-axis Force Torque Sensor is connected properly.
F65	0x41	The Data detected by the Six-axis Force Torque Sensor is Abnormal Please contact technical support.
F66	0x42	Six-axis Force Torque Sensor X-direction Torque Exceeds Limit Please reduce the force applied in the X direction.
F67	0x43	Six-axis Force Torque Sensor Y-direction Torque Exceeds Limit Please reduce the force applied in the Y direction.
F68	0x44	Six-axis Force Torque Sensor Z-direction Torque Exceeds Limit Please reduce the force applied in the Z direction.

Sensor Error Code	Code(Hex)	Error Handling
F69	0x45	Six-axis Force Torque Sensor Tx Torque Exceeds Limit Please reduce the torque applied around the X axis.
F70	0x46	Six-axis Force Torque Sensor Ty direction Torque Exceeds Limit Please reduce the torque applied around the Y axis.
F71	0x47	Six-axis Force Torque Sensor Tz direction Torque Exceeds Limit Please reduce the torque applied around the Z axis.
F72	0x48	Six-axis Force Torque Sensor Configuration Write Failed.
F73	0x49	Six-axis Force Torque Sensor Failed to Initialize Please check 1. Whether the baud rate of the Data Collector and the Six-axis Force Torque Sensor are the same. 2. Whether the wire between the Data Collector and the Six-axis Force Torque Sensor is connected properly.
F74	0x50	Six-axis Force Torque Sensor is initializing.

5. Technical Specifications

	Fx, Fy, Fz	Tx, Ty, Tz	Description
Load capacity	400N	20Nm	-
Resolution	0.4N	0.01Nm	-
Hysteresis	0.5%FS	0.5%FS	-
Crosstalk	≤2%FS	≤2%FS	-
Overload capacity	±150%	±150%	-
Weight	-	-	600g(Including Adapter)
Frequency	-	-	200HZ

6. After-sales Service

After-sales policy:

For the detailed after-sales policy of the product, see the official website:

<https://www.ufactory.cc/warranty-and-returns/>

The general process of after-sales service is:

- Contact UFACTORY technical support (support@ufactory.cc) to confirm whether the product needs to repair and which part should be sent back to UFACTORY.
- After the bill of lading on UPS/DHL, we will send the invoice and label to you by mail. You need to make an appointment with the local UPS/DHL and then send the product to us.
- UFACTORY will check the product warranty status according to the after-sales policy.
- Generally, the process takes around 1-2 weeks except for shipment.

Note: Please keep the original packaging materials of the product. When you need to send the product back to get repaired, please pack the product with the original box to protect the product during the transportation.