



# ATI FANUC™-Ready Force/Torque Sensors Manual



Document #: 9620-05-D-ATI FANUC-Ready Force Torque Sensors

*Engineered Products for Robotic Productivity*

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Please read the manual before calling customer service, and have the following information available:

1. Serial number (e.g., FT01234)
2. Sensor model (e.g., Axia90-M50)
3. Calibration (e.g., US-15-50, SI-65-6, etc.)
4. Accurate and complete description of the question or problem.
5. Robot model, controller model, controller software version, and installed FANUC Force Control options.

Be near the F/T system when calling (if possible). For questions specific to FANUC-provided software or hardware, please contact FANUC technical support.

Please contact an ATI representative for assistance, if needed:

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## Glossary

Term	Definitions
ADC	Analog-to-digital converter
Command ID	An index number that correlates to a specific Force Control function. Command IDs are used when calling a general command.
Console Mode	A serial functionality on ATI serial sensors that allows them to communicate with devices not compatible with <b>Yellow Mode</b> .
Data Rate	How fast data is output over the RS422 interface.
Force	A force is a push or pull action on an object caused by an interaction with another object. Force = mass x acceleration
Force Control	A FANUC-provided functionality that allows sensor systems to perform advanced operations.
FT or F/T	Force and Torque.
ID	Identification code that the user inputs into the robot program.
IP20	Ingress protection rating "20" designates that the device can withstand basic touch and protection from rudimentary dust.
IP64	Ingress protection rating "64" designates protection against dust and splashing of water. An IP64 rating does not guarantee protection when a user submerges a device in water or any type of fluid.
IP67	Ingress protection rating "67" designates protection against dust and submersion under 1 m of fresh water.
IP68	Ingress protection rating "68" designates that a device is dust-tight and can be submerged under 1 m of fresh water.
KAREL	FANUC programming language for robots and robot controllers. The KAREL language is typically used in the back-end of applications. KAREL programs cannot be opened from or edited on the teach pendant (TP). However, compiled KAREL programs can be called from TP programs.
N/A	Not applicable.
P/N	Part Number
Parameter ID	An optional value within a range for a specific Command ID. Not all Command IDs require a Parameter ID.
Power Cycle	When a user removes and then restores power to a device.
RS422	A serial software interface for communicating F/T data and sensor commands.
Sample Rate	How fast the ADCs are sampling inside the unit.
Sensor	The component that converts a detected load into electrical signals.
Sensor System (or configuration)	The entire assembly consisting of a sensor body and a system interface to translate force and torque signals into a specific communication interface/protocol.
Teach Pendant Programming (TPP) or Teach Pendant (TP) Programs	The FANUC programming language used on the robot teach pendant.
Torque	The application of a force through a lever or moment arm that causes something to want to turn. For example, a user applies torque to a screw to make it turn. Torque = force x moment arm
Yellow Mode	A setting on ATI RS422 "FANUC-Ready" Sensors which allows them to communicate with FANUC's Force Control software. ATI's FANUC-Ready sensor kits come pre-programmed to use <b>Yellow Mode</b> and ready to communicate with FANUC Force Control.

## 1. Safety

The safety section describes general safety guidelines to be followed with this product, explanations of the notifications found in this manual, and safety precautions that apply to the product. Product specific notifications are imbedded within the sections of this manual (where they apply).

### 1.1 Explanation of Notifications

These notifications are used in all of ATI manuals and are not specific to this product. The user should heed all notifications from the robot manufacturer and/or the manufacturers of other components used in the installation.



**DANGER:** Notification of information or instructions that if not followed will result in death or serious injury. The notification provides information about the nature of the hazardous situation, the consequences of not avoiding the hazard, and the method for avoiding the situation.



**WARNING:** Notification of information or instructions that if not followed could result in death or serious injury. The notification provides information about the nature of the hazardous situation, the consequences of not avoiding the hazard, and the method for avoiding the situation.



**CAUTION:** Notification of information or instructions that if not followed could result in moderate injury or will cause damage to equipment. The notification provides information about the nature of the hazardous situation, the consequences of not avoiding the hazard, and the method for avoiding the situation.

**NOTICE:** Notification of specific information or instructions about maintaining, operating, installing, or setting up the product that if not followed could result in damage to equipment. The notification can emphasize, but is not limited to: specific grease types, best operating practices, and maintenance tips.

### 1.2 General Safety Guidelines

The customer should verify that the sensor is rated for the maximum load and torque expected during operation. Because static forces are less than the dynamic forces from the acceleration or deceleration of the robot, be aware of the dynamic loads caused by the robot.

## 2. Product Overview

The ATI kit for FANUC Force Control allows users to program and use ATI F/T sensors on certain FANUC robots equipped with FANUC Force Control and General Force Sensor Interface. When in **Yellow Mode**, F/T sensors output the FANUC-specified command/response structure over RS422 serial software protocol. ATI ships sensors purchased as part of a FANUC-Ready kit with **Yellow Mode** as the default setting.

For more information about FANUC products, refer to <https://www.fanuc.com/>. For assistance with the FANUC Force Control interface, refer to the *FANUC Force Control* manuals/documentation. To access FANUC product manuals, customers should log-in to their account on the FANUC website or contact their FANUC representative.

For more information about ATI sensor models, refer to the *ATI website* or the applicable manual in [Table 2.3](#).

### 2.1 FANUC System Requirements

To use ATI F/T sensors within a FANUC system, verify the following hardware and software requirements are met:

#### 2.1.1 RC232C/RS422 Converter Unit

- A05B-2650-J080 (for R-30iB Mate Plus)
- A05B-2601-J358 (for R-30iB Plus A cabinet)
- A05B-2696-J010 (for R-30iB Mini Plus)

#### 2.1.2 Software Options

- General force sensor interface (A05B-2600-S506)
- Force sensor basic (A05B-2600-J876)

Depending on the force control functions used, “Force Control Insert Function” or “Force Control Contouring Function” may also be required. For more information, refer to Table 1.3 (b) in the “Basic Functions Guide: 1.3 Force Control Instructions” of the FANUC manual.

#### 2.1.3 Supported Controller Software Version

- 7DF3/P12 or later

### 2.2 Default Settings In Yellow Mode

Filtering : Off

Data Output Rate: 200 Hz

Baud Rate: 115, 200

1 Stop Bit, No Parity, No Flow Control, Data Length: 8 Bits

## 2.3 Kit Part Number Format

ATI can provide F/T sensor kits that are configured for a specific robot model. Kits include an F/T sensor, interface plate, mounting hardware, and cables. The components inside these kits are listed in the following sections.

The part numbering format for all ATI kits is as follows:

- 9105-FTKIT-FANUC-BCSIZE-SENSORMODEL-MXX (Axia sensors)

*BCSIZE* indicates the bolt circle diameter of the robot's wrist tool flange.

*SENSORMODEL* and *XX* indicate the ATI F/T sensor model.

## 2.4 Axia80/90 F/T ATI Kits

The kits include these components (refer to [Figure 3.1](#)):

Item	Description	P/N
Axia F/T Sensor	Axia80 or Axia90 F/T Sensor with RS422 serial communication interface with <b>Yellow Mode</b> as the default setting	9105-FTS-FANUC-BCX <sup>1</sup> -X <sup>2</sup> -MX <sup>3</sup>
Axia80/90 F/T Sensor Cable	Cable that routes from the 8-pin M8 connector on the sensor to the M12 connector on the Axia splitter cable	Cable is included in ATI kit P/N 9105-CKIT-ZC27-ZC28-4 <sup>4</sup>
ATI Axia Splitter Cable	Cable with (2) branches. One branch for connecting to the FANUC serial conversion unit. Another branch is for connecting to a power supply cable.  The power supply branch terminates in a field-wireable M12 connector, compatible with the included power supply cable. Alternatively, users may remove this M12 connector for direct wiring to other, user-provided, power supplies.	9105-C-ZC28-MS-ZC51-4
Power Supply Cable with a built-in AC adapter.	Plugs in to customer's wall power (international plug adapters included) and provides 24 VDC power to the M12 connector on the branch of the Axia splitter cable.	9105-CBL-S-G1-Q5F-WWPS1-1.5
Note: 1. X = bolt circle size: indicates the bolt circle diameter of the robot's wrist tool flange 2. X = sensor option: Axia80 or Axia90 3. X = model option: M8, M20, or M50 4. For all components such as mounting hardware included in this ATI kit, refer to the ATI F/T sensor manual in <a href="#">Table 2.3</a> .		

## 2.5 Axia130 F/T ATI Kits

The kits include the following components (refer to [Figure 3.2](#)):

Table 2.2—Common Components Included In All Axia130 Kits		
Item	Description	P/N
Axia F/T Sensor	Axia130 F/T Sensor with RS422 serial communication interface with <b>Yellow Mode</b> as the default setting	9105-FTS-FANUC-BCX <sup>1</sup> -Axia130-MX <sup>2</sup>
Axia130 F/T Sensor Cable	Cable that routes from the M12 8-pin connector on the sensor to the M12 8-pin connector on the Axia splitter cable.	Cable is included in ATI kit P/N 9105-CKIT-ZC28-ZC28-5 <sup>3</sup>
ATI Axia Splitter Cable	Cable with (2) branches. One branch is for connecting to the FANUC serial conversion unit. The other branch is for connecting to a power supply cable.  The power supply branch terminates in a field-wireable M12 connector, compatible with the included power supply cable. Alternatively, users may remove this M12 connector for direct wiring to other, user-provided, power supplies.	9105-C-ZC28-MS-ZC51-4
Power Supply Cable with a built-in AC adapter.	Plugs in to customer's wall power (international plug adapters included) and provides 24 VDC power to the M12 connector on the branch of the Axia splitter cable.	9105-CBL-S-G1-Q5F-WWPS1-1.5
Note: 1. X = bolt circle size: indicates the bolt circle diameter of the robot's wrist tool flange 2. X = model option: M125 or M300 3. For all components such as mounting hardware included in this ATI kit, refer to the ATI F/T sensor manual in <a href="#">Table 2.3</a> .		

## 2.6 Electrical/LED

For more information on the sensor models, electrical and software features of a specific communication interface version (for example: a reference for LED lights on the sensor body or components in cable kits) refer to the ATI manual in the following table. Note that to use the RS422 commands described in these manuals, the user must switch the sensor from **Yellow Mode** to **Console Mode**.

Table 2.3—ATI Manual Reference		
Sensor Model ATI P/N	Refer to the ATI Manual	
	Sensor (ATI Document#)	Software/Communication Interface (ATI Document#)
9105-FTS-FANUC-BCX <sup>1</sup> Axia80-MX <sup>2</sup> -FX <sup>4</sup>	ATI F/T Axia80 manual (#9620-05-B-Axia80)	ATI F/T RS422 Axia manual (#9620-05-C-RS422 Axia)
9105-FTS-FANUC-BCX <sup>1</sup> Axia90-MX <sup>2</sup> -FX <sup>4</sup>	ATI F/T Axia90 manual (#9620-05-B-Axia90)	
9105-FTS-FANUC-BCX <sup>1</sup> Axia130-MX <sup>3</sup> -FX <sup>4</sup>	ATI F/T Axia130 manual (#9620-05-B-Axia130)	
Note: 1. X = bolt circle size: indicates the bolt circle diameter of the robot's wrist tool flange 2. X = model option: M8, M20, or M50 3. X = model option: M125 or M300 4. X = frame option which corresponds to the interface plate kit for a robot flange mounting pattern		

## 3. Configurations



**WARNING:** Performing maintenance or repair on the sensor when circuits (for example: power, water, and air) are energized could result in death or serious injury. Discharge and verify all energized circuits are de-energized in accordance with the customer's safety practices and policies.



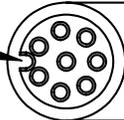
**CAUTION:** Avoid damage to the sensor from electrostatic discharge. Ensure proper grounding procedures are followed when handling the sensor or cables connected to the sensor. Failure to follow proper grounding procedures could damage the sensor.



**CAUTION:** Do not apply excessive force to the sensor and cable connector during installation, or damage will occur to the connectors. Align the keyway on the sensor and cable connector during installation to avoid applying excessive force to the connectors.



Keyway on the sensor connector.

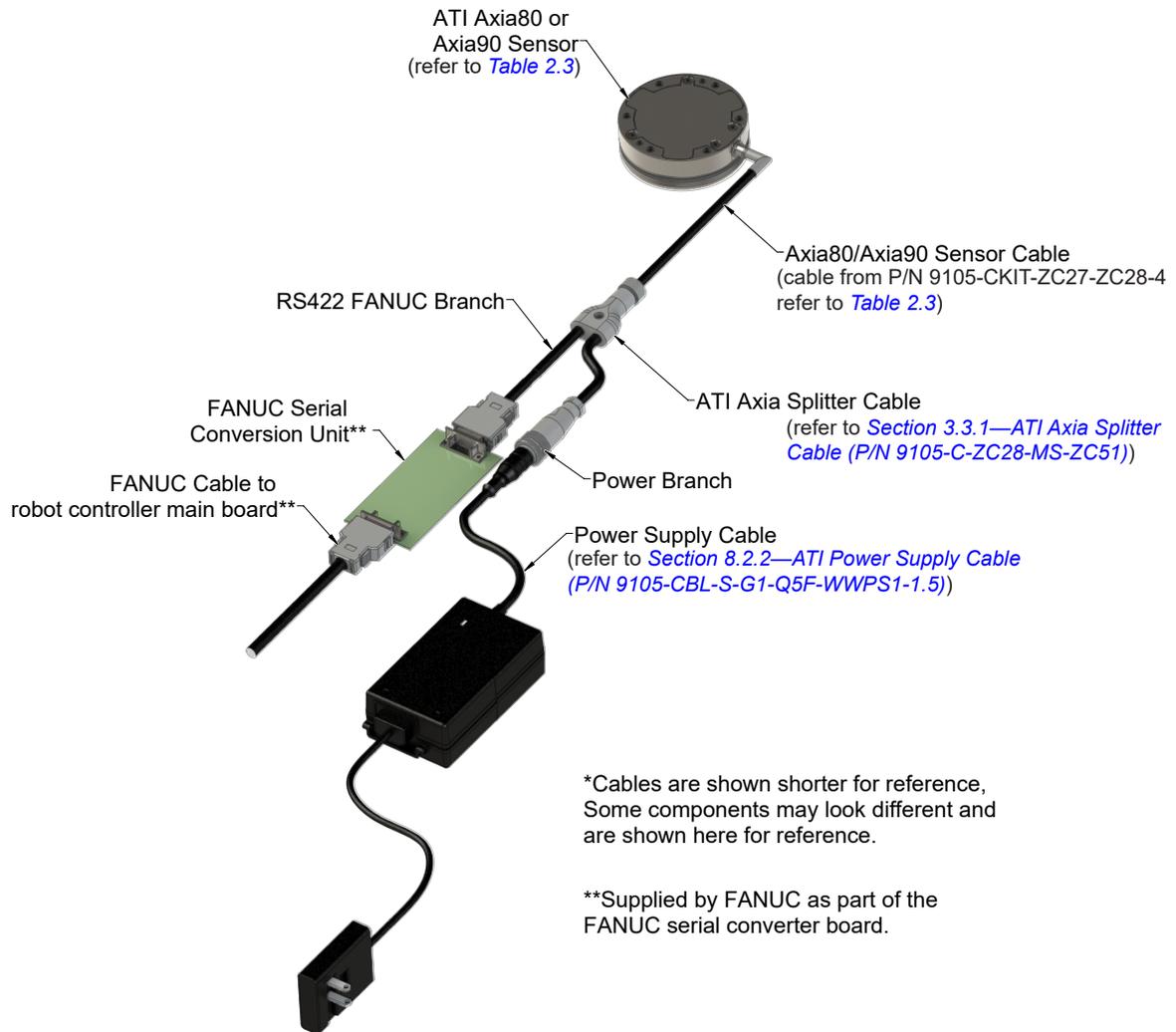


Keyway on the cable connector.

For guidance on routing cables and installing the sensor, refer to the applicable ATI sensor manual in [Table 2.3](#). Common configurations are depicted in the following sections.

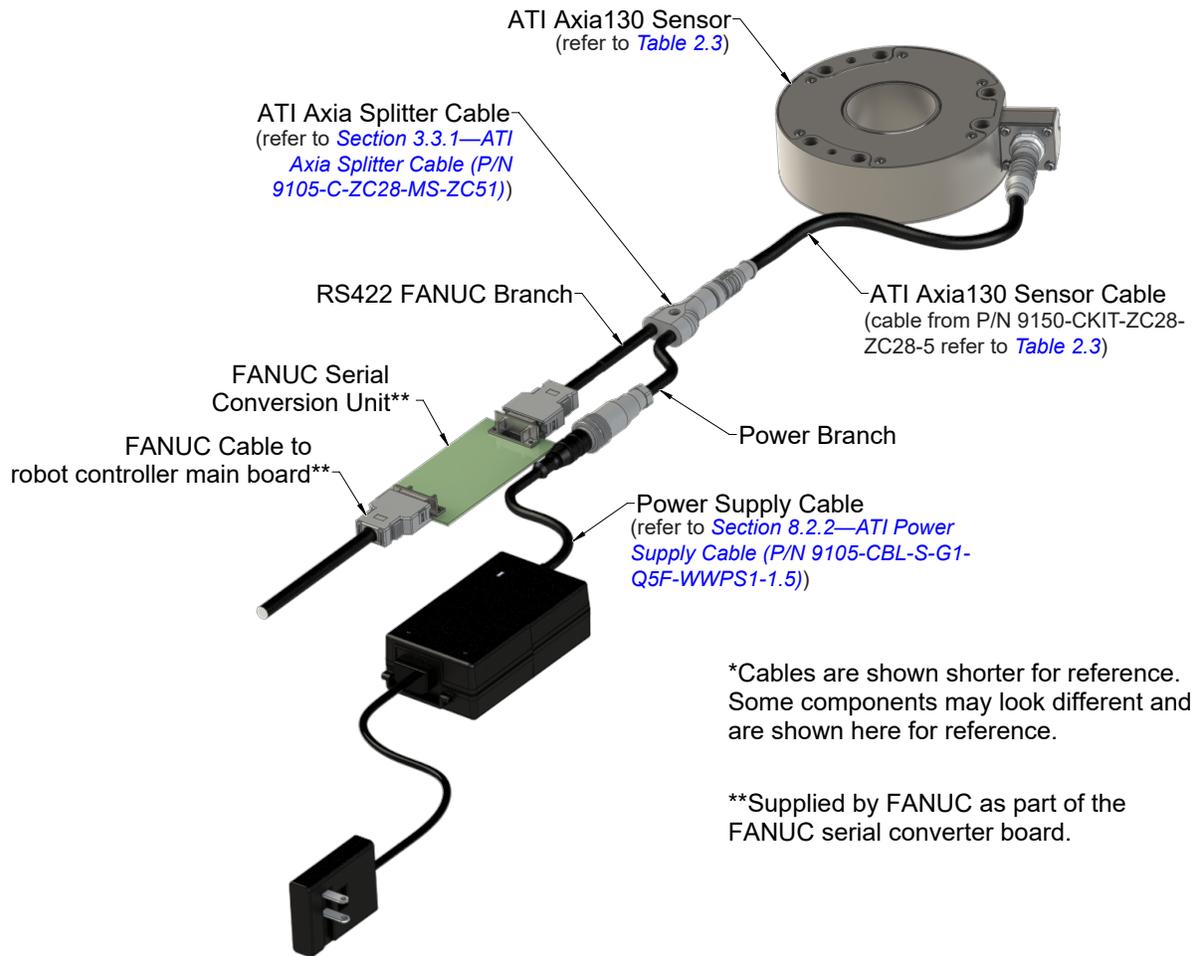
### 3.1 Axia80/Axia90 Sensor Configuration

Figure 3.1—Axia80/Axia90 Sensor Configuration



### 3.2 Axia130 Sensor Configuration

Figure 3.2—Axia130 Sensor Configuration



### 3.3 Pin and Wire Assignments for ATI FANUC-Ready Cables

The following section provides the pin assignment for the connectors on the cables used specific to ATI FANUC-Ready Configurations. For additional cable technical specifications, refer to [Section 8.2—Cables](#).

For supply voltage ratings of the ATI F/T sensor, refer to the following table or [Section 8.1—F/T Sensor](#). For ATI F/T sensor cables, refer to the applicable communication interface ATI manual in [Table 2.3](#).

#### 3.3.1 ATI Axia Splitter Cable (P/N 9105-C-ZC28-MS-ZC51)

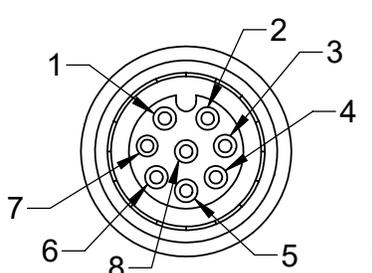
Table 3.1—Sensor Cable ZC28 Connector, M12, 8-pin, Female		
Connector Schematic	Pin Number	Signal
	1	Sync (unused)
	2	V +
	3	V- / Ground
	4	RS422_TX -
	5	RS422_RX +
	6	RS422_TX+
	7	Sync Ground (unused)
	8	RS422_RX -
Shell	Shield	

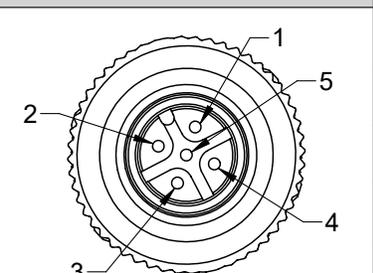
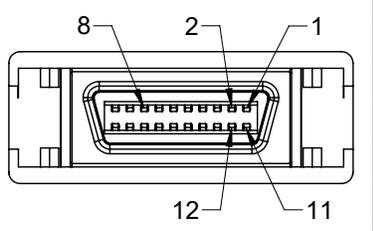
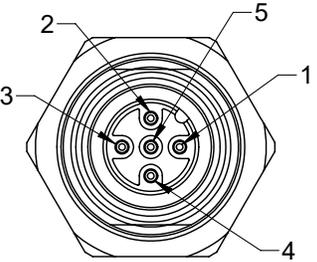
Table 3.2—Power Supply MS Connector, M12, 5-pin, Male		
Connector Schematic	Pin Number	Signal
	1	Shield
	2	V +
	3	Ground
	4	Sync (unused)
	5	Sync Ground (unused)

Table 3.3—RS422 FANUC Z51 Connector, 20-pin, Female		
Connector Schematic	Pin Number	Signal
	1	RS422_TX -
	2	RS422_TX +
	3-10	Reserved
	11	RS422_RX -
	12	RS422_RX +
	13-20	Reserved
	Shell	Shield

### 3.3.2 ATI Power Supply Cable (P/N 9105-CBL-S-G1-Q5F-WWPS1-1.5)

Table 3.4—Power Supply Connector, M12, 5-pin, Female		
Connector Schematic	Pin Number	Signal
	1	Reserved
	2	V +
	3	V - / Ground
	4	Sync (unused)
	5	Sync Ground (unused)

For information about the wall adapter connection, refer to the [manufacturer's data sheet](#).

## 4. Applicable FANUC-Provided KAREL Programs

With the General Force Sensor Interface, FANUC provides three (3) KAREL programs that can be called as commands to communicate with the ATI FANUC-Ready F/T sensor. These programs are not required for the usage of the sensor with FANUC Force Control and General Force Sensor Interface. They exist to provide additional sensor functionality that can be utilized within an application. To call these commands, follow the standard FANUC syntax.

### 4.1 General Command: FS\_COMMAND

This command gives instructions to the sensor. The first argument is the Command ID and the second argument is the applicable Parameter for that Command ID, if any. The robot also automatically sends a set of default commands on robot power-up, so commands for settings may need to be resent after every robot power cycle.

#### 4.1.1 Syntax for (1) Command and (1) Parameter

CALL FS\_COMMAND (<type Command ID from [Table 5.1](#)>, <if applicable, type Parameter ID from [Table 5.1](#)>), for example:

```
CALL FS_Command (6, 5) sets the baud rate to 57,600 bps.
```

#### 4.1.2 Syntax for (1) Command and Multiple Parameters:

CALL FS\_COMMAND (<type Command ID from [Table 5.1](#)>, <if applicable, type Parameter ID from [Table 5.1](#)>, <if applicable, type Parameter ID from [Table 5.1](#)>, <type as many Parameter IDs required per [Table 5.1](#)>), for example:

```
CALL FS_Command (8, 1, 1) sets the filter rate to a low-pass filter of 500 Hz.
```

### 4.2 Start Command: FS\_START

This command orders the sensor to output F/T data. The sensor sends data only after the user issues the command; otherwise, the ATI F/T sensor stays idle (even after power cycled). However, note that by default, the FANUC robot will automatically send this command at robot power-up. In most cases, it is not necessary for the user to manually send this command unless the communication was interrupted or the user previously sent the FS\_STOP command ([Section 4.3—Stop Command: FS\\_STOP](#)).

```
CALL FS_START
```

### 4.3 Stop Command: FS\_STOP

This command orders the sensor to stop outputting F/T data.

```
CALL FS_STOP
```

## 5. Commands

A FANUC robot equipped with Force Control and General Force Sensor Interface can use the **FS\_COMMAND** program to send the following commands to an ATI FANUC-Ready F/T Sensor in **Yellow Mode**. Some Command IDs must be sent with more than one parameter IDs to fully implement the command (refer to [Section 6—Parameters](#)).

Table 5.1—Force Control Software Commands			
Command	Command ID	Number of Parameters <sup>1</sup>	Parameter ID
Reserved	1-5	N/A	N/A
Set Baud Rate	6	1	refer to <a href="#">Table 6.1</a>
Reserved	7	N/A	N/A
Set Filter	8	2	refer to <a href="#">Table 6.2</a>
Reserved	9-14	N/A	N/A
Set Data Output Rate	15	1	refer to <a href="#">Table 6.3</a>
Reserved	16-255	N/A	N/A
Note:			
1. The number of parameters required to complete the command.			

## 6. Parameters

### 6.1 Set Baud Rate Parameters (Command ID 6)

Table 6.1—Baud Rate ID Parameters	
Baud Rate ID	Description (in bps)
0 <sup>1</sup>	115,200
1	921,600
2	460,800
3	230,400
4	115,200
5	57,600

Note:

1. Default setting

Example:

CALL FS\_Command (6, 5) sets the baud rate to 57,600 bps.

### 6.2 Set Filter Parameters (Command ID 8)

Table 6.2—Set Filter Parameters			
Filter Type ID	Description	Cutoff Frequency ID	Description (in Hz)
0 <sup>1</sup>	No filter	0 <sup>1</sup>	None
1	1st order low-pass filter	0	None
		1	500
		2	300
		3	200
		4	150
		5	100
		6	50
		7	40
		8	30
		9	20
		10	10
		11	5
		12	3
		13	2
14	1		

Note:

1. Default setting

Example:

CALL FS\_Command (8, 1, 1) sets the filter rate to a low-pass filter of 500 Hz.

### 6.3 Set Data Output Rate Parameters (Command ID 15)

Table 6.3—Set Data Output Parameters	
Output Rate ID	Description (in hz)
0 <sup>1</sup>	200
1	10
2	20
3	50
4	100
5	200
6	333
7	500
8	1000

Note:  
1. Default setting

Example:

CALL FS\_Command (15, 7) sets the data output rate to 500 Hz.

## 7. Troubleshooting Guidance

This section includes solutions to some issues that might arise when using the ATI FANUC-Ready F/T sensor. For more troubleshooting guidance, refer to the sensor model manual listed in [Table 2.3](#). Answers to frequently asked questions are available from the ATI website: [https://www.ati-ia.com/library/documents/FT\\_FAQ.pdf](https://www.ati-ia.com/library/documents/FT_FAQ.pdf).

Note:

Please read the manual before calling customer service, and have the following information available:

1. Serial number (e.g., FT01234)
2. Sensor model (e.g., Axia90-M50)
3. Calibration (e.g., US-15-50, SI-65-6, etc.)
4. Accurate and complete description of the question or problem
5. Robot model, controller model, controller software version, and installed FANUC Force Control options.

Be near the F/T system when calling (if possible). For questions specific to FANUC-provided software or hardware, please contact FANUC technical support.

For additional troubleshooting information or to speak with a customer service representative, please contact ATI at:

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Fax: +1.919.772.8259  
E-mail: [ft.support@novanta.com](mailto:ft.support@novanta.com)

24/7 Support  
Tel: +1.855.ATI-IA.00 (+1.855.284.4200)

### 7.1 Error Codes

These are the error codes that are reported by FANUC Force Control software in response to the **FS\_COMMAND**, **FS\_START**, or **FS\_STOP** commands.

Error Code ID	Cause	Solution
1	Unsupported Command: the program does not recognize the command.	Verify the command and resend.
2	Out of Range Error: A parameter such as ID, baud rate, or the filter setting is out of the allowable parameter range.	Verify the parameter and resend.
3	Failed to Set Parameters: the command issued to write the parameter did not save or could not be sent.	Resend the parameter.

## 7.2 FANUC-Ready Error Messages

**Symptom:** “F/S Output Data Frozen” warning: The F/T data was streaming to the robot, but has frozen.

**Cause:** A temporary gap in the data has occurred, for example: the sensor is busy with another low-level operation such as the user applying a filter or changing the ADC rate.

**Solution:** Reset the warning message on the robot. If it persists, power cycle the sensor, and then power cycle the robot.

**Cause:** The user has sent the **FS Stop** command from the robot to the sensor.

**Solution:** Send the **FS Start** command from the robot to the sensor. Alternatively, power cycle the robot.

**Symptom:** “F/S cable is cut” warning: The robot could not establish full communication with the sensor.

**Cause:** The cable is not properly connected.

**Solution:** Check all connections between F/T sensor and FANUC devices. Check connections between the FANUC serial conversion unit and the FANUC main board. Power cycle the sensor, and then power cycle the robot.

**Cause:** The sensor is not a FANUC-Ready compatible sensor.

**Solution:** For FANUC-Ready compatible sensors, refer to the sensors listed in [Section 2.3—Kit Part Number Format](#). Only sensors sold in these configurations are guaranteed to work with FANUC Force Control and FANUC General Force Sensor Interface.

**Cause:** The sensor is not in **Yellow Mode**.

**Solution:** If the sensor was purchased as part of an ATI FANUC-Ready kit, the sensor is shipped in **Yellow mode** by default. If it has been switched into **Console Mode**, contact ATI support for help; for ATI contact information, refer to [page D-19](#).

## 8. Specifications

### 8.1 F/T Sensor

For specifications of the ATI sensor, refer to the appropriate ATI sensor manual in [Table 2.3](#).

### 8.2 Cables

#### 8.2.1 ATI Axia Splitter Cable (P/N 9105-C-ZC28-MS-ZC51)

Table 8.1—ATI Axia Splitter Cable	
Parameter	Value
Voltage Rating	> 40 V
Current Rating	> 0.25 A
IP Rating for M12 Connectors	IP67: When the connectors are attached at both ends.
Operating Temperature Range (Min-Max)	-5°C to 70°C
Cable Diameter	6 mm (0.24 in)
Static Bending Radius (at room temperature)	25 mm (1 in)
Dynamic Bending Radius (at room temperature)	50 mm (2 in)
Dynamic Cable Twist Angle per Unit Length	180°/m or 55°/ft
Note:	
<ol style="list-style-type: none"> <li>1. Temperature affects cable flexibility. ATI recommends increasing the minimum dynamic bending radius for lower temperatures.</li> <li>2. For more information on routing cables, refer to the ATI sensor manual in <a href="#">Table 2.3</a>.</li> </ol>	

#### 8.2.2 ATI Power Supply Cable (P/N 9105-CBL-S-G1-Q5F-WWPS1-1.5)

Table 8.2—ATI Power Supply Cable	
Parameter	Value
Voltage Rating	24 VDC
Current Rating	2.5 A
IP Rating	IP20
Operating Temperature Range (Min-Max)	-30°C to 70°C

## 9. Terms and Conditions of Sale

The following Terms and Conditions are a supplement to and include a portion of ATI's Standard Terms and Conditions, which are on file at ATI and available upon request.

ATI warrants to Purchaser that force torque sensor products purchased hereunder will be free from defects in material and workmanship under normal use for a period of one (1) year from the date of shipment. The warranty period for repairs made under a RMA shall be for the duration of the original warranty, or ninety (90) days from the date of repaired product shipment, whichever is longer. ATI will have no liability under this warranty unless: (a) ATI is given written notice of the claimed defect and a description thereof with thirty (30) days after Purchaser discovers the defect and in any event, not later than the last day of the warranty period and (b) the defective item is received by ATI not later than (10) days after the last day of the warranty period. ATI's entire liability and Purchaser's sole remedy under this warranty is limited to repair or replacement, at ATI's election, of the defective part or item or, at ATI's election, refund of the price paid for the item. The foregoing warranty does not apply to any defect or failure resulting from improper installation, operation, maintenance, or repair by anyone other than ATI.

ATI will in no event be liable for incidental, consequential, or special damages of any kind, even if ATI has been advised of the possibility of such damages. ATI's aggregate liability will in no event exceed the amount paid by the purchaser for the item which is the subject of claim or dispute. ATI will have no liability of any kind for failure of any equipment or other items not supplied by ATI.

No action against ATI, regardless of form, arising out of or in any way connected with products or services supplied hereunder, may be brought more than one year after the cause of action accrued.

No representation or agreement varying or extending the warranty and limitation of remedy provisions contained herein is authorized by ATI, and may not be relied upon as having been authorized by ATI, unless in writing and signed by an executive officer of ATI.

Unless otherwise agreed in writing by ATI, all designs, drawings, data, inventions, software, and other technology made or developed by ATI in the course of providing products and services hereunder, and all rights therein under any patent, copyright, or other law protecting intellectual property, shall be and remain ATI's property. The sale of products or services hereunder does not convey any expressed or implied license under any patent, copyright, or other intellectual property right owned or controlled by ATI, whether relating to the products sold or any other matter, except for the license expressly granted below.

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Without ATI's prior written permission, Purchaser will not use such information for any other purpose or provide or otherwise make such information available to any third party. Purchaser agrees to take all reasonable precautions to prevent any unauthorized use or disclosure of such information.

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