Wireless Force/Torque Sensor System

Document #: 9620-05-Wireless FT

Foreword

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Note

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

1. Serial number (e.g., FT01234)

2. Transducer model (e.g., Nano17, Gamma, Theta, etc.)

3. Calibration (e.g., US-15-50, SI-65-6, etc.)

4. Accurate and complete description of the question or problem

5. Computer and software information. Operating system, PC type, drivers, application software, and other relevant information about your configuration.

If possible, be near the F/T system when calling.

How to Reach Us

Sale, Service and Information about ATI products:

ATI Industrial Automation
1031 Goodworth Drive
Apex, NC 27539 USA
www.ati-ia.com
Tel: +1.919.772.0115
Fax: +1.919.772.8259
Application Engineering
Tel: +1.919.772.0115
Fax: +1.919.772.8259
E-mail: *ft_support@ati-ia.com*

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Glossary

Terms	Definitions
ADC	Analog to Digital Converter.
Big-endian	Indicates the most significant byte of a value is stored first.
DHCP	Dynamic Host Configuration Protocol (DHCP) is an automatic method for Ethernet equipment to obtain an IP address. The WNet system can obtain its IP address using DHCP on networks that support this protocol.
Ethernet Network Switch	Ethernet network switches are electronic devices that connect multiple Ethernet cables to an Ethernet network while directing the flow of traffic.
F/T	Force/Torque.
Gateway Settings	The address of the router that handles a network's Ethernet traffic.
IEEE	The Institute of Electrical and Electronics Engineer, inc.
IP Address	An Internet Protocol Address (IP Address) is an electronic address assigned to an Ethernet device so that it may send and receive Ethernet data. IP addresses may be either manually selected by the user or automatically assigned by the DHCP protocol.
IPv4	Internet Protocol version 4 (IPv4) is a standard used for specifying the electronic address of an Ethernet device. The Wireless F/T supports only IPv4.
MAC Address	Media Access Control Addresses (MAC Addresses) are the unique addresses given to every Ethernet device when it is manufactured, to be used as an electronic Ethernet serial number.
Network Order	The order in which data values are placed on a network. The WNet's network order is big-endian
RDT	Raw Data Transfer (RDT) is a fast and simple WNet protocol for control and data transfer via UDP.
RSSI	Received Signal Strength Indicator.
Scaling Factor	A Counts per Force or Counts per Torque value that is obtained from the calibration file.
Sensor System	The assembly consisting of all components from the transducer to the WNet box.
SSID	The name of a wireless local area network.
Subnet Mask	A string of numbers used to indicate which portion of a network's IP addresses is common to all devices on the local network.
TCP	Transmission Control Protocol (TCP) is a method of exchanging information frequently used over Ethernet.
UDP	User Datagram Protocol (UDP) is a low-level method of transmitting data over Ethernet. While UDP is faster than TCP, unlike TCP lost UDP data is not resent.
USB	Universal Serial Bus (USB). The WNet's USB port conforms to this computer peripheral cabling standard.
WLAN	Wireless Local Area Network (WLAN). The WNet system conforms to the IEEE 802.11 WLAN standard.
WNet	Wireless F/T

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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. More specific notifications are imbedded within the sections of the manual where they apply.

1.1 Explanation of Notifications

The following notifications are specific to the product(s) covered by this manual. It is expected that the user heed all notifications from the robot manufacturer and/or the manufacturers of other components used in the installation.

	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.

	ATTENTION: Le non-respect des informations ou des instructions contenues dans la notice peut entraîner des blessures moyennement graves ou causer des dommages à l'équipement. La notice fournit des informations sur la nature de la situation dangereuse, les conséquences si le danger n'est pas évité, et la méthode pour éviter la situation.

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

1.2 General Safety Guidelines

The customer should verify that the transducer selected is rated for maximum loads and moments expected during operation. Refer to F/T Transducer Manual (9620-05-Transducer Section—Installation and Operation Manual) or contact ATI Industrial Automation for assistance. Particular attention should be paid to dynamic loads caused by robot acceleration and deceleration. These forces can be many times the value of static forces in high acceleration or deceleration situations.

1.3 Safety Precautions

	CAUTION: Do not remove any fasteners or disassemble the Wireless F/T. This will cause irreparable damage to the Wireless F/T and void the warranty. Leave all fasteners in place and do not disassemble the Wireless F/T.

	ATTENTION: Ne pas retirer les attaches ni démonter le Wireless F/T. Cecicausera des dommages irréparables au Wireless F/T et annulera la garantie. Laisser toutes les attaches en place et ne pas démonter le Wireless F/T.

2. System Overview

The Wireless F/T can measure six degrees of freedom forces and torques (Fx, Fy, Fz, Tx, Ty, and Tz) from multiple transducers and streams the data to an existing wireless access point on the network. This data can be used for data collection, real-time motion control, or user-defined signal processing by the user's host device. The Wireless F/T can also store the data on a memory card.

The range and performance of the Wireless F/T device is derived from the IEEE 802.11 standard. Actual performance may vary due to conditions, wireless infrastructure, and other variables. Refer to *Section 9— Specifications* for more details.

Figure 2.1—Signal Path to a Computer, Using a Wireless Access Point
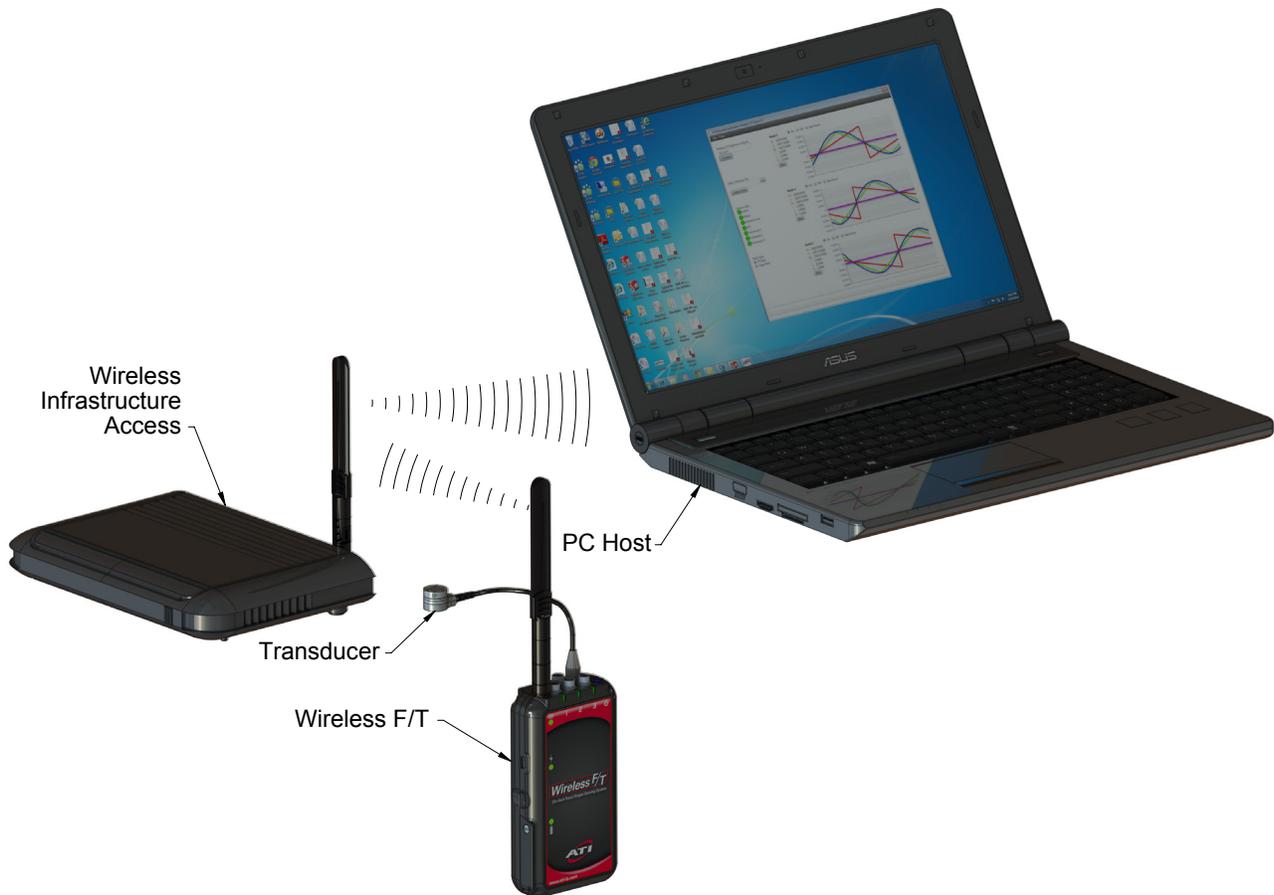
The Wireless F/T is a small wireless device for controlling up to six ATI Multi-Axis Force/Torque transducers. The device supports ATI's TW-type transducers such as the Nano and Mini. Transducers with integrated electronics are not supported. The device is equipped with a MicroSD card slot used to collect and store data. The Wireless F/T is contained in an impact, splash, and dust resistant housing.

The Wireless F/T unit is provided with an external antenna that can be pivoted 90° so the unit can be used in small confined spaces. Fixed mounting is accommodated with the four robust threaded inserts on the back plate of the housing. The unit is provided with a removable belt clip for mobile applications. The Wireless F/T can be powered by a rechargeable battery, or can be powered with the 5 VDC external power adapter using the USB connector. The battery can be charged internally or externally.

The Wireless F/T includes a rechargeable battery, antenna, external power adapter, USB cable, and removable belt clip. Optional desktop battery charger and international power cords are available, refer to *Section 8—Serviceable Parts* for more details.

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2.1 Three Transducer Wireless F/T

The three Transducer Wireless F/T model can interface with up to three ATI Multi-Axis Force/Torque transducers simultaneously. Each of the three transducer connectors has a transducer status indicator. The device has a rechargeable battery that can power the device for approximately two hours at full measurement rate with all three transducers enabled. The battery life is extended significantly when using fewer transducers.

Figure 2.2—Three Transducer Wireless F/T
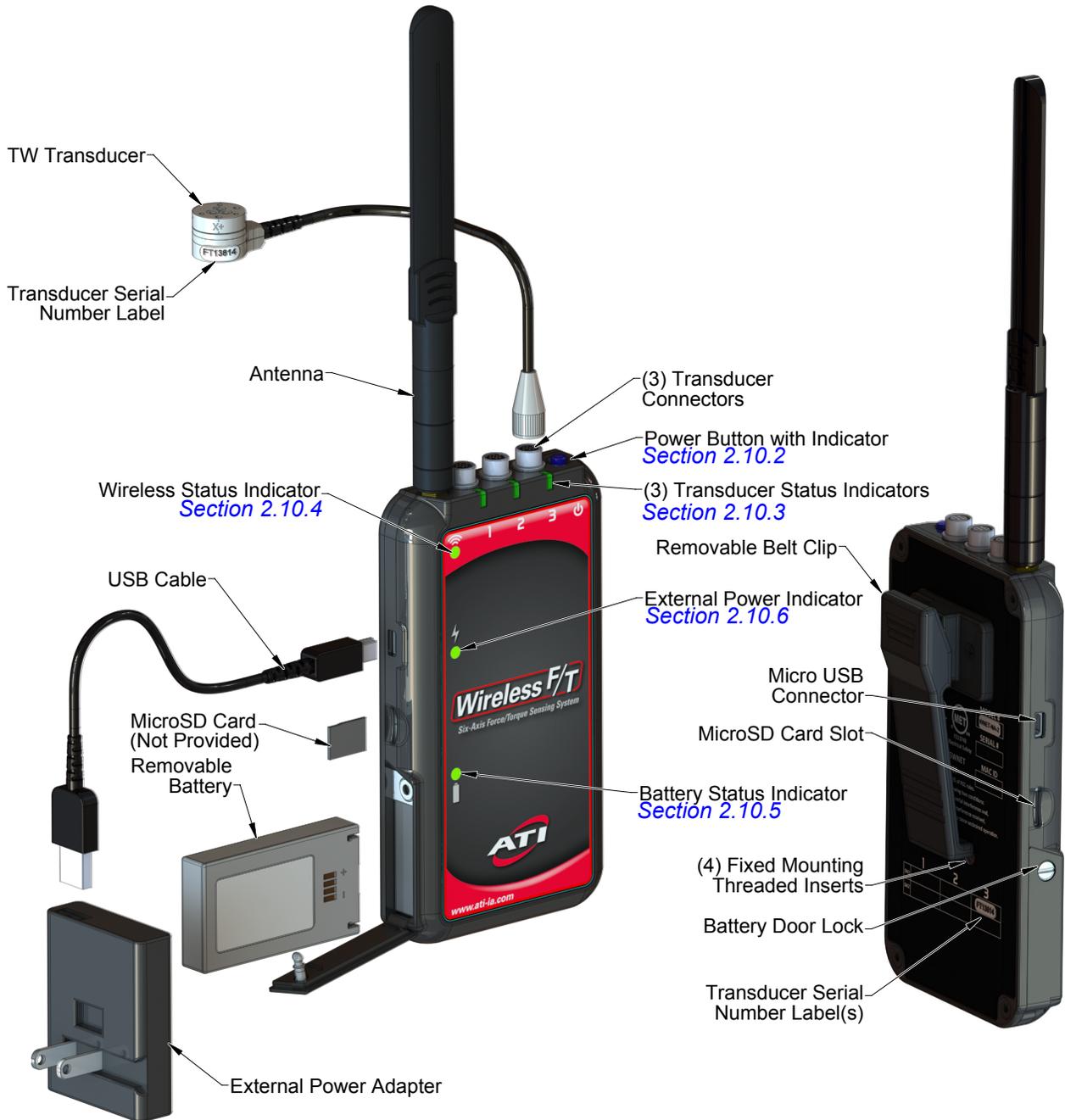
2.2 Six Transducer Wireless F/T

The six Transducer Wireless F/T model can interface with up to six ATI Multi-Axis Force/Torque transducers simultaneously. Each of the six transducer connectors has a transducer status indicator. The device has a rechargeable battery that can power the device for approximately one hour at full measurement rate with all six transducers enabled. The battery life is extended significantly when using fewer transducers.

Figure 2.3—Six Transducer Wireless F/T

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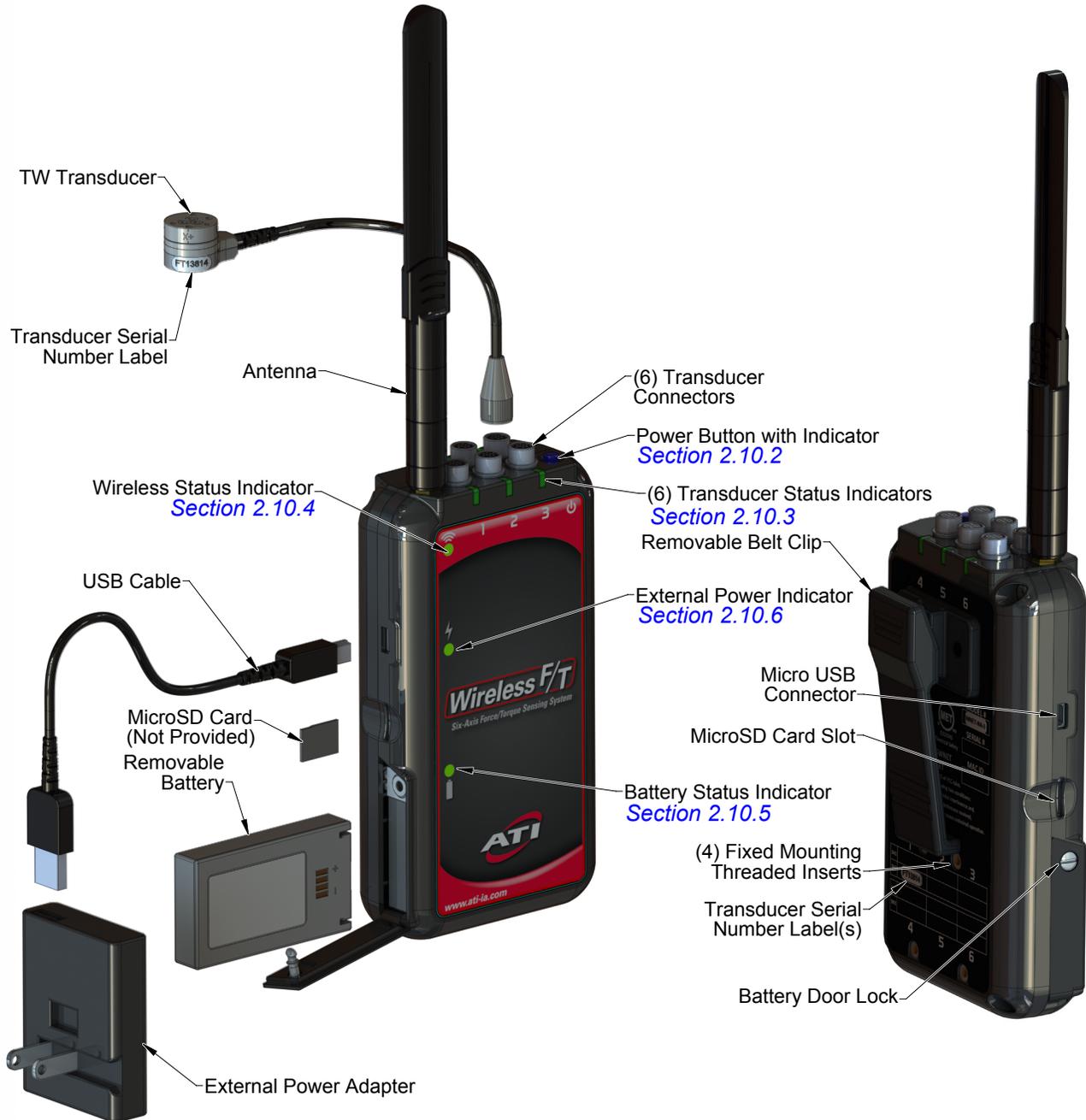
2.3   Antenna

The Wireless F/T Unit has been certified for use with the antenna provided. The antenna can pivot 90° to allow the Wireless F/T unit to fit into small confined spaces.

2.4   Micro USB Connector

The Wireless F/T unit has a Micro USB connector that can be used to power the unit and charge the battery using the external power adapter.

2.5   MicroSD Card Slot

The Wireless F/T unit has a MicroSD card slot that can be used to store data on a customer supplied MircoSD card. The file system supports files sizes up to 4 G bytes. If using a MicroSD card to store data, the system will create a subdirectory *\ATI* and a *Fn.dat* data file on the MicroSD card. If multiple sessions are saved on the MicroSD card the system will sequence the data file *F1.dat*, *F2.dat* ... etc. Refer to *Section 5— Command Interface* for more information.

2.6   External Power Adapter

The external power adapter is a 5 V 10 W plug mounted power supply that can operate the unit and charge the battery. The adapter operates on 100 to 240 VAC and provides a USB Micro-A output connector. Removable plug adapters are available for use with various power socket types.

2.7   USB Cable

The USB cable connects the external power adapter to the Wireless F/T unit by way of its USB Type A and Micro-B USB connectors.

2.8   Mounting features

Refer to *Section 11—Drawings* for information on mounting features.

2.8.1   Removable Belt Clip

The Wireless F/T unit has a removable belt clip for easy mounting and removal from human or humanoid robot applications.

2.8.2   Threaded Holes

Four threaded holes are available when the belt clip is removed.

2.9   Removable Battery

A rechargeable lithium-polymer battery is provided with the Wireless F/T unit. The battery can be charged inside the Wireless F/T using the external power adapter through the micro USB connector or using the optional desktop battery charger. Refer to *Section 6.2—Battery Recharging and Replacement* for more information.

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2.10 Controls and Indicators

The Wireless F/T has controls and integrated status indicators. The Status indicator information is periodically transmitted over the wireless network to the host device. See *Figure 2.2*—three Transducer Wireless F/T model or *Figure 2.3*— six Transducer Wireless F/T model for location of controls and indicators.

2.10.1 Power Button

The Power Button turns the unit on and off, has an integrated system status indicator, and supports auto power-off. The Power Button supports the following functionality:

Table 2.1—Power Button Functionality	
Press Duration	**Description**
Momentary	Powers on the unit.
(2) Seconds	Powers off the unit.
(10) Seconds	Power cycles the system.

Power cycling the system will reset the DHCP, IP address, subnet mask, gateway settings, and authenticated user password to the last saved settings.

2.10.2 Power Button Indicator

This indicator is located within the recessed Power Button.

Table 2.2—System Status Indicator	
Behavior	**Description**
Off	Indicates the system is either off or in charging-only mode.
Steady Blue	Indicates the system is on.

2.10.3 Transducer Status Indicators

The Wireless F/T has a transducer status indicator on the top of the device, beside its corresponding connector.

Table 2.3—Transducer Status Indicators	
Behavior	**Description**
Steady Green	Indicates normal transducer operation.
Steady Red	Indicates a fault with the transducer.
Off	Indicates the transducer is off, the entire unit is off, or the unit is in charging-only mode.

2.10.4 Wireless Status Indicator

The wireless status indicator is on the front of the Wireless F/T below the antenna connector.

Table 2.4—Wireless Status Indicator	
Behavior	**Description**
Steady Green	Indicates the unit is connected to an Access Point and there are no current wireless errors.
Flashing Green	Indicates the unit is attempting to connect to an Access Point.
Steady Red	Indicates the unit is connected to an Access Point, and an error has been recently detected.
Flashing Red	Indicates the wireless subsystem is recovering from a lock-up condition. Refer to *Section 7—Troubleshooting*
Off	Indicates the unit is either off or in charging-only mode.

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2.10.5 Battery Status Indicator

The battery indicator is on the front of the device next to the battery compartment.

Table 2.5—Battery Status Indicator	
Behavior	**Description**
Steady Green	Indicates the battery is charged.
Flashing Green	Indicates the battery is charging.
Flashing Red	Indicates the battery charge is below 25%.
Steady Red	Indicates a battery fault, such as the battery voltage is too low, or the battery is too warm, or is missing.
Off	Indicates the unit is off.

2.10.6 External Power Indicator

The external power indicator is on the front of the unit next to the left-side located USB connector.

Table 2.6—External Power Status Indicator	
Behavior	**Description**
Steady Green	Indicates the external power source connected to the USB port is operating normally.
Steady Red	Indicates the external power source connected to the USB port is not supplying proper voltage.
Off	Indicates there is no external power adapter connected to the USB port, or it is not functioning.

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3. Initial Configuration and Installation of the Wireless F/T System

This section explains how to configure the basic functionality of your Wireless F/T system. The Wireless F/T system consist of several components: Wireless F/T unit, transducer(s), external power adapter and plugs, USB cable, and software. The Wireless F/T unit must be set up and configured before installing the transducer so that forces can be monitored during installation.

3.1 Preparing your Wireless F/T for Configuration

1. Unpack the system components from the container.

2. Use a flat head screw driver to open the battery door (Note: ¼ turn clockwise to open and ¼ turn counterclockwise to close). Insert the battery with the label facing the front of the Wireless F/T Unit, then close and secure the battery door.

3. Connect the USB cable to the Wireless F/T unit and the external power adapter provided. Plug the power adapter into the wall.

4. Wait for the battery charge status indicator to transition from flashing to solid green indicating the battery is fully charged. Note: This could take a few hours with a factory-new battery.

5. Attach the antenna to the Wireless F/T Unit.

6. Connect the transducer cable to the connector on the Wireless F/T unit. Ensuring each Transducer and the corresponding Wireless F/T connector position are labeled with the same serial number, refer to *Figure 2.2* or *Figure 2.3*. (Note: Transducer cable will need to be rotated until the alignment notch is oriented properly). Tighten the connector finger tight.

7. Disconnect the USB cable from the power supply and plug into USB port on the computer to be used to configure the Wireless F/T unit. Refer to *Figure 3.1*. Note: A computer connected to the USB port may not provide sufficient power to keep the battery fully charged.

> **NOTICE:** You will need Java version 1.7 or higher on your PC to run the provided Wireless F/T Java Demo. This can be downloaded at *http://www.java.com/* while you wait for the battery to charge.

Figure 3.1—Connect the USB cable from the Wireless unit to the Computer

Computer Used to Configure the Wireless F/T Unit

Connect the USB cable to the Computer
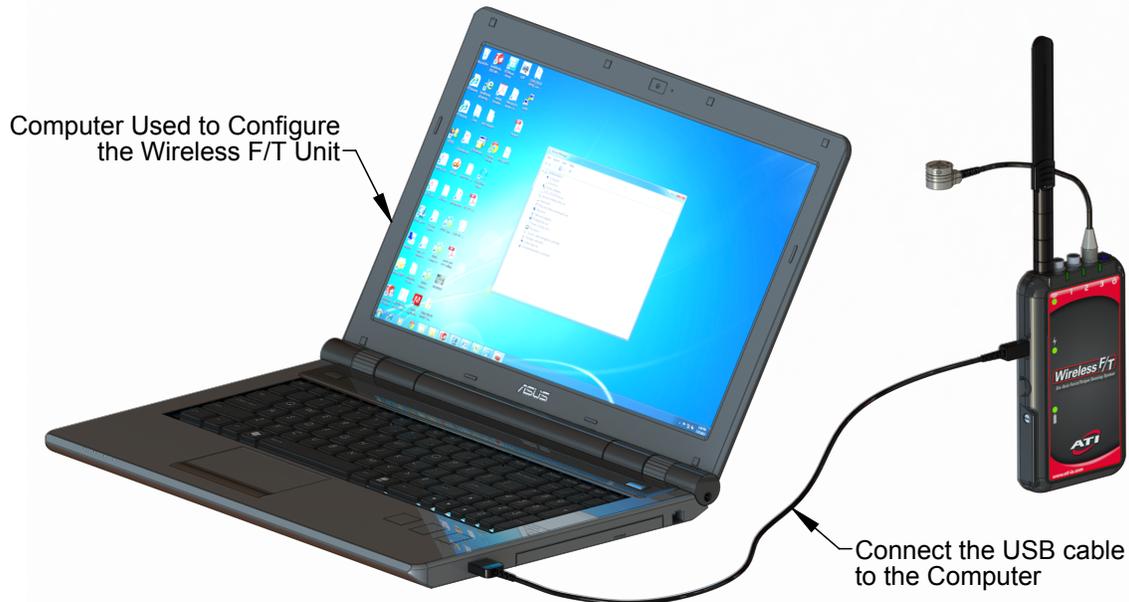
3.2   Initial Configuration

The Wireless F/T must be configured for your wireless network before you can communicate with the device. The following procedure provides the steps needed to properly configure the Wireless F/T.

1. After connecting the Wireless F/T to the computer with the provided USB cable, it will begin to obtain the proper COM port drivers. This may take a few minutes. If they do not install on their own, install the Virtual Communication Port Driver per the instructions for your operating system found at: *http://www.ftdichip.com/Support/Documents/InstallGuides.htm*

2. Power on the Wireless F/T unit by momentarily depressing the power button on the top of the device. The device initiates a power up sequence and the Wireless Status Indicator LED begins flashing green as it scans for wireless networks.

3. Visit the ATI website (*http://www.ati-ia.com/library/download.aspx*) to locate the setup.exe file.

4. Copy or download the file to the directory desired and double click to open the program.

5. Follow the instructions within the Setup Wizard to install the Wireless F/T Settings Editor.

Figure 3.2—Setup Wizard
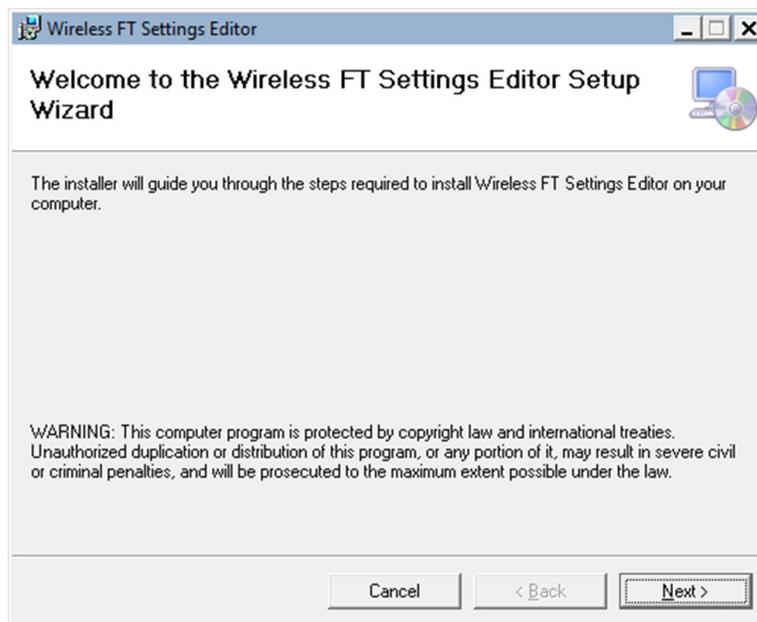
6. Locate the Wireless F/T Setup Editor in the ATI Industrial Automation folder under All Programs on your Windows Start bar and double click to open the program.

Figure 3.3—Wireless F/T Setup program

7. Select the COM port corresponding to your Wireless F/T and press the connect button. You may need to press the "Refresh" button if no COM ports are shown.

8. Obtain your WLAN Network Name (SSID), password, and frequency band (bandwidth 2.4 GHz or

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5 GHz) from your network administrator. If your wireless network is not shown, press the "Refresh" button. Note: This will result in the Wireless F/T unit resetting while it attempts to locate nearby wireless networks. If you are switching between the 2.4 GHz and 5 GHz bands, you will need to input the Network Name manually as the Wireless F/T cannot scan one band for networks while connected to the other, consequently the networks will not show in the pull down list.

NOTICE: For 5 GHz Band, due to the Indoor/Outdoor rating of the Wireless F/T, the device is only allowed to connect to channels 149, 153, 157, 161, and 165. Many 5 GHz routers will default to a restricted "indoor only" channel. If you have connection issues, you may need to check your router settings and ensure it is connected to one of the channels listed above.

Figure 3.4—Network (SSID) Settings
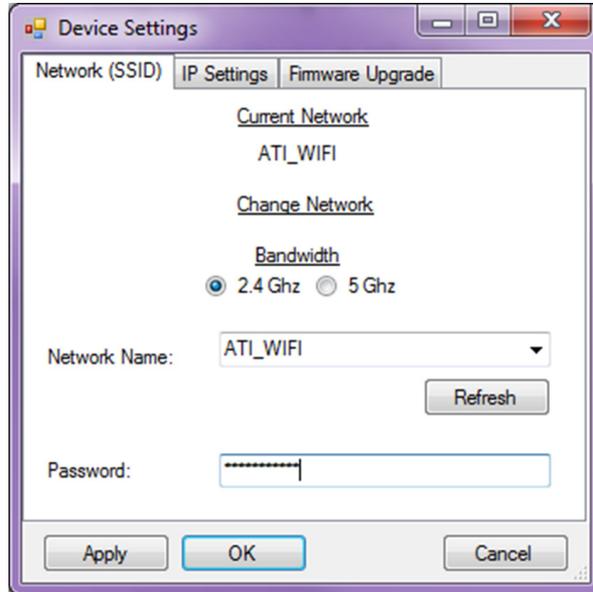
9. Select the "IP Settings" tab. Note that in this example DHCP is enabled. If a static IP address is desired, deselect DHCP and enter the Device IP dedicated to the Wireless F/T, the access point Default Gateway, and Subnet Mask into the fields shows in *Figure 3.5*.

Figure 3.5—IP Settings

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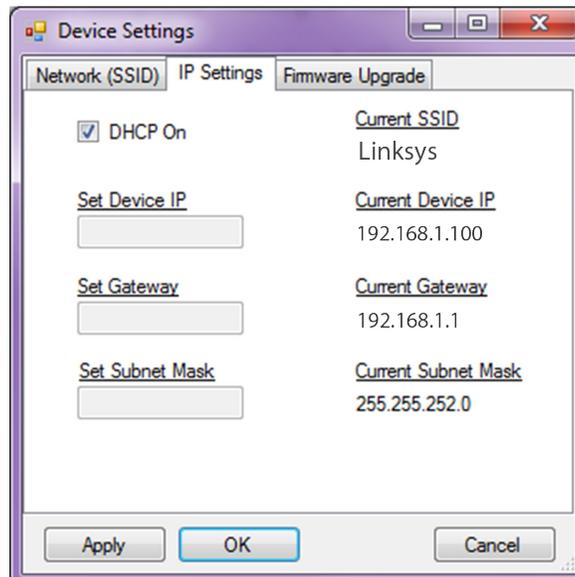
10. When you have made all the appropriate changes to the device settings, press the "OK" button to apply the changes. The window will automatically close at this point and the Wireless F/T will reset upon exit.

11. Once the Wireless F/T has been powered up completely, the Wireless Status Indicator LED will transition from flashing to solid green if it has properly connected to your wireless network.   If the device does not connect properly, verify the network settings entered above.

> **NOTICE:** The Wireless F/T can transmit a large volume of data across a wireless network. It is suggested that you use a dedicated wireless access point so that you do not affect other wireless devices on your network. A dedicated high strength local wireless network will result in the most reliable connection.

3.3   The Wireless F/T Java Demo Application

3.3.1   Creating a test profile

The following steps are provided to create a test profile on the Wireless F/T Java Demo application.

1. Visit the ATI website (*http://www.ati-ia.com/library/download.aspx*) and locate the WirelessFTJavaDemo.jar file.

2. Copy or download the file to the directory desired and double click to open the program.

3. Use the Wireless F/T Profile Wizard to create a new profile for the device by pressing the "Create new…" button.

Figure 3.6—Profile Creation

4. Use this initial welcome page to add any notes that you'll want to be able to reference when you review this profile in the future.

Figure 3.7—Welcome

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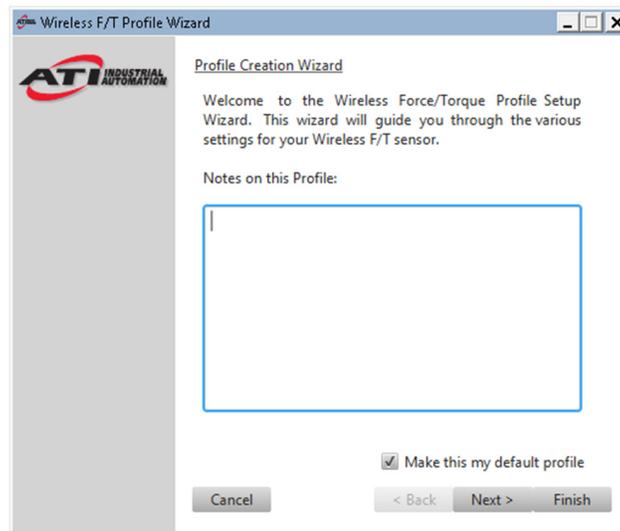
5. Use this page to configure the basic settings of your Wireless F/T system.

Figure 3.8—Transducer Settings
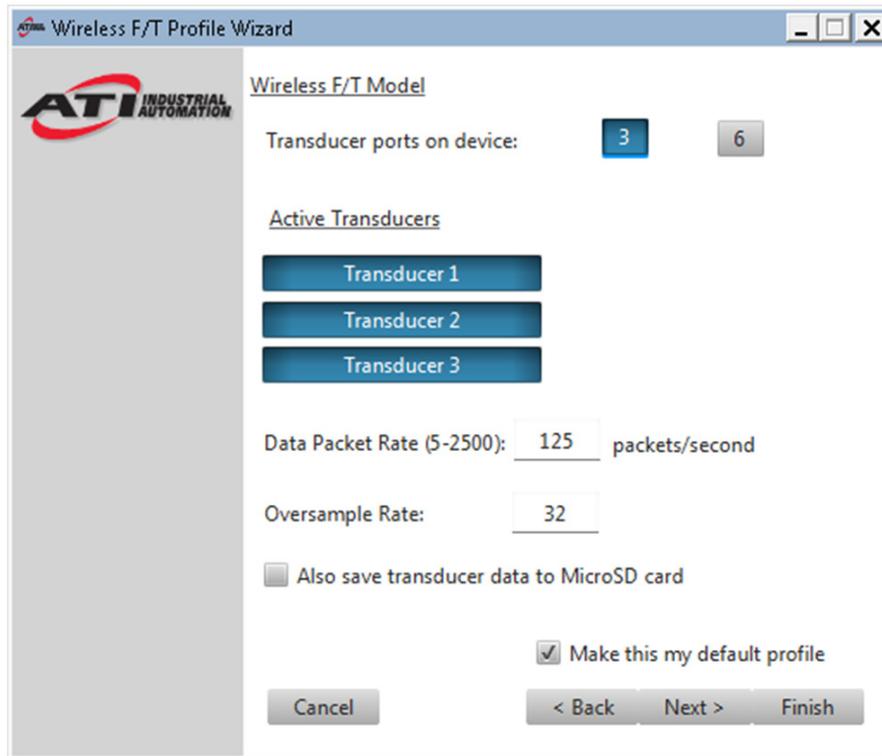
6. Use this page to add any filters to your data and to select the proper calibration for each transducer (if a sensor contains multiple calibrations).

Figure 3.9—Filters and Calibrations

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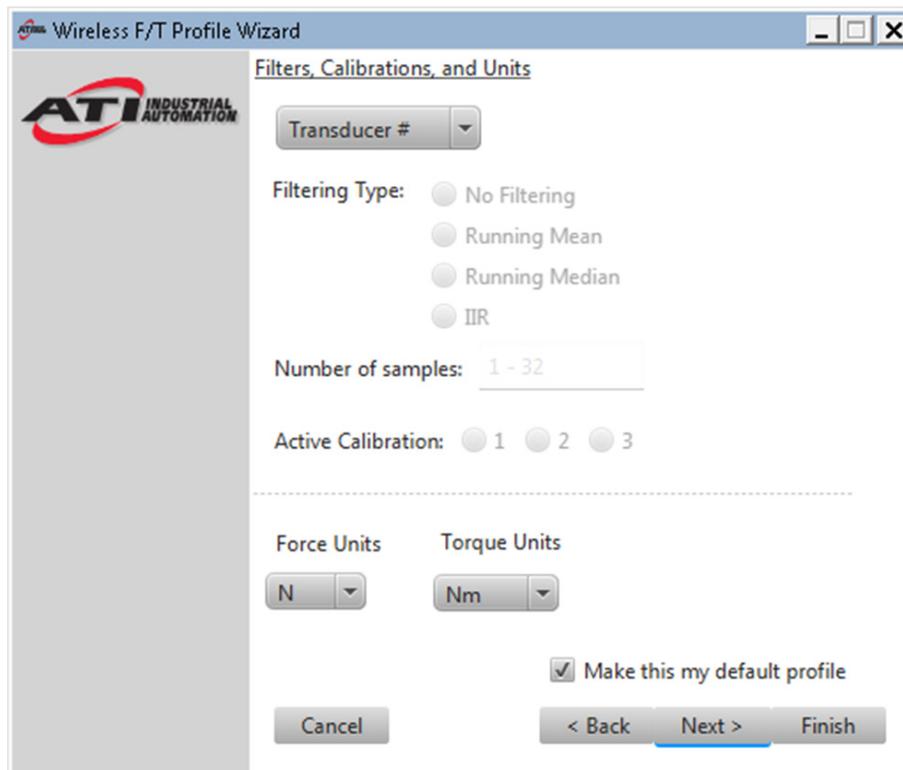
7. Your new Wireless F/T profile is now ready to use. Press the Finish button to exit.

Figure 3.10—Your Profile is Ready
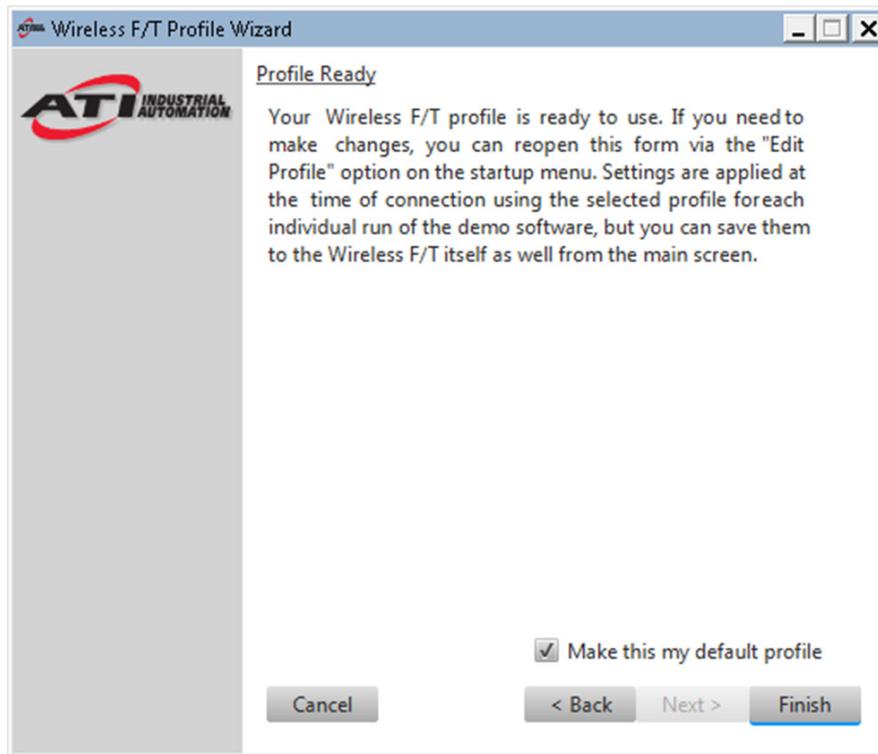
3.3.2 Connecting to the Wireless F/T

1. Select the proper profile and press the Start button as shown in *Figure 3.6*.

2. Press the "Discover…" button to find which Wireless F/T devices are currently on the network your PC is connected to.

3. Once you have selected the proper device, press the "Connect" button. The application will begin displaying streaming data from the active transducers connected to the Wireless F/T Unit.

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Figure 3.11—Establish a Connection
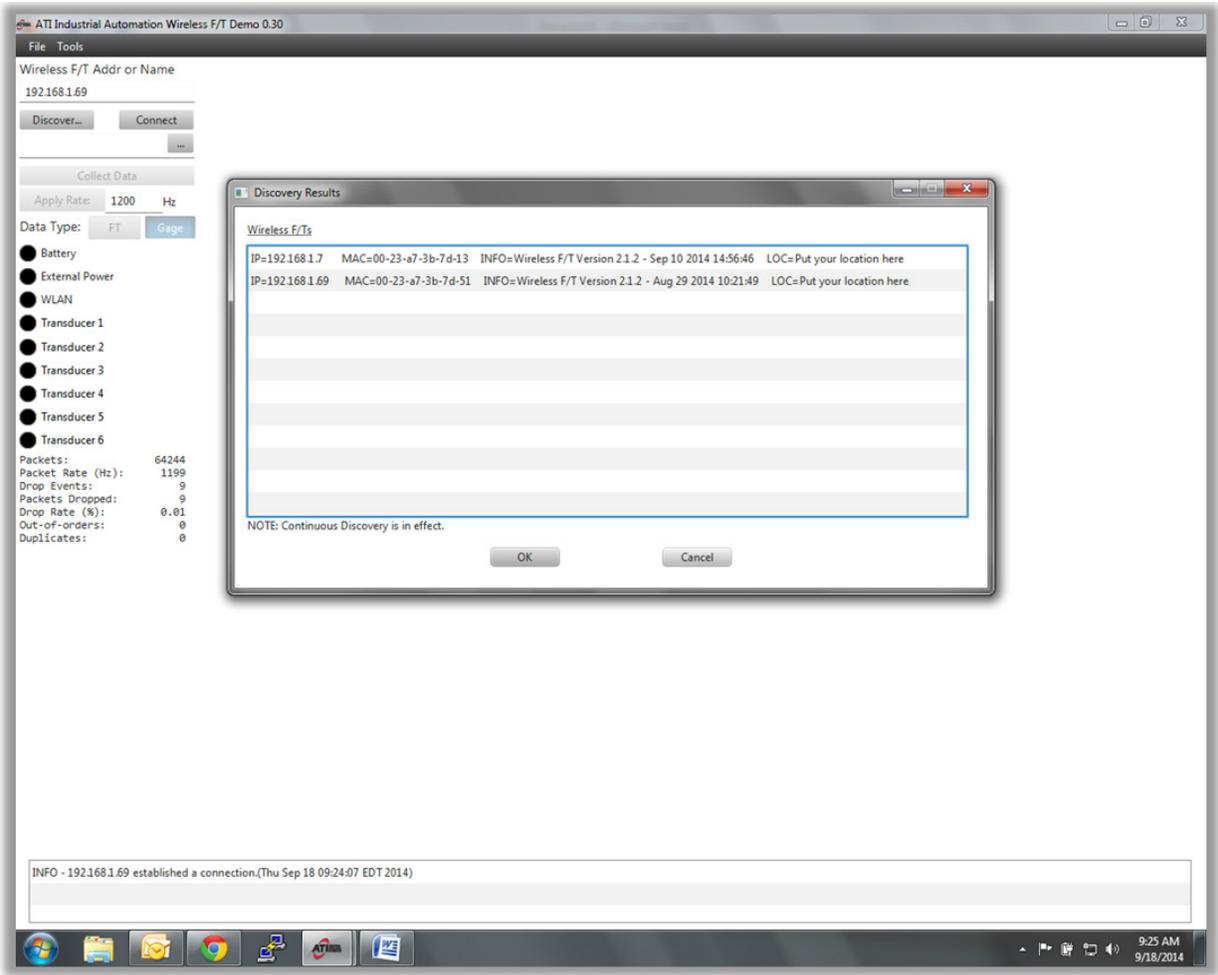
- See *Section 3.3.3—Data Collection* for using the data collection features
- The data rate can be dynamically adjusted by inputting a value (between 10-4000) and clicking the "Apply Rate" button.
- The data type displayed can be switched to F/T data or Gage (diagnostic) data by clicking the corresponding buttons.
- The LED Status from the Wireless F/T unit will also be displayed in this left column.
- Red text for a transducer indicates that the transducer is loaded beyond its measurement range and is saturated.
- Data packet transmission statistics are provided. This is useful for determining an optimal packet rate and also gives an indication of wireless network strength.
- The "Bias" button for each transducer will set the current load level as the new zero point.
- The "Unbias" button will remove the offset (if Bias had been pressed).
- An onscreen log of messages is displayed at the bottom of the screen.

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3.3.3 Data Collection

There are two ways data can be stored. Data can be collected and stored on a file on a PC or network directory, and/or it can be collected and stored on the customer's MicroSD card plugged into the Wireless F/T unit.

3.3.3.1 Collecting and Storing Data on a PC or Network File

To collect data to a file, click the "…" button to the left of the field and select a location and filename for your data. Refer to *Figure 3.11*. Click the "Collect Data" button to begin. Once you have completed your test, click the "Stop" button to finish collecting data.

The measurement data is stored in comma-separated value format (CSV) so it can easily be read by spreadsheets and data-analysis programs. Name your file with a .CSV extension. If you are planning on collecting large amounts of data, it is a good idea to understand any limitations your spreadsheet or data analysis program may have on the number of rows it can use.

Figure 3.12—Sample CSV Data File Opened in a Spread Sheet

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3.3.3.2 Collecting and Storing Data on a MicroSD Card

1. Check the "Record transducer data on MicroSD" field on the general Settings tab of the WNET Profile Wizard. Refer to *Figure 3.8*. FT samples are then sent by the device to be saved on its MicroSD card in the form of .dat files. These files are raw hex data (*Figure 3.13*), but can be converted to CSV files by the demo program.

2. When you are finished collecting wireless data, plug your WNET into a computer via USB.

3. Without changing your profile, press "Start" and the demo will begin like usual.

4. To retrieve your files, press File → Extract MicroSD Data and then select the file you wish to convert to user-friendly CSV. If you do not wish to convert the files, simply navigate to the WNET's MicroSD over USB like you would a flash drive and retrieve them with the file browser.

Figure 3.13—Sample Data File

3.4 Mounting the Wireless F/T Unit

Keep in mind that an unobstructed environment from the Wireless F/T to the wireless access point will improve signal strength. If an external power adapter is being used, refer to *Section 3.5— External Power Adapter Installation* for information.

3.4.1 Belt Clip Installation

Attach the Wireless F/T using the belt clip to a suitable and safe location. Refer to *Section 4— Installing the Transducer* for installation instruction for the transducer and routing the transducer cable.

3.4.2 Fixed Installation

Refer to *Section 11—Drawings* for details on the threaded insert hole pattern used when installing the Wireless F/T in a fixed location. Refer to *Section 4—Installing the Transducer* for installation instruction for the transducer and routing the transducer cable.

3.5 External Power Adapter Installation

The unit does not require a battery to be present in order to be powered by an external power adapter. The external power adapter can be used after the initial configuration is complete. Plug the external power adapter.

For installations that will repeatedly bend the USB cable, route the external power adapter cable so that it is not stressed, pulled, kinked, cut, or otherwise damaged throughout the full range of motion. If the desired application results in the cable rubbing, then use a loose plastic spiral wrap for protection. Connect the USB cable to the power supply and to the Wireless F/T's USB connector.

4. Installing the Transducer

Information on the environment, mounting the transducer, interface plate design, and routing the transducer cable can be found in the F/T Transducer Installation and Operation manual (9620-Transducer Section). The transducer must be monitored during installation for gage saturation errors. Refer *Section 3.3.2—Connecting to the Wireless F/T* to monitor the transducer during installation.

⚠	**CAUTION:** Do not exceed the single-axis overload value of the transducer. Smaller transducers can easily be irreparably damaged by applying small loads using tools (moment arm increases applied loads) when mounting the transducer. Always monitor the transducer using the demo application for Gage saturation errors during installation. Stop applying force to the transducer and wait until the error clears to continue installation. If error does not clear, it may indicate loss of power or the overload value has been exceeded.
⚠	**ATTENTION: Ne pas dépasser la valeur de surcharge de l'axe unique du transducteur. Les petits transducteurs peuvent être irrémédiablement endommagés suite à l'application de petites charges en utilisant des outils (le bras de levier augmente les charges appliquées) lors du montage du transducteur. Toujours surveiller le transducteur à l'aide de l'application de démonstration en cas d'erreurs de calibration saturée lors de l'installation. Cesser d'appliquer la force au transducteur et attendre que l'erreur disparaisse pour continuer l'installation. Si l'erreur ne disparaît pas, cela peut indiquer une perte de puissance ou un dépassement de la valeur de surcharge.**

Mounting Fasteners (Supplied by User)
Robot or other Device with User designed interface plate attached
Mini or Nano Transducer
Tool
Mounting fasteners (Supplied by User)
Computer Running Demo Application

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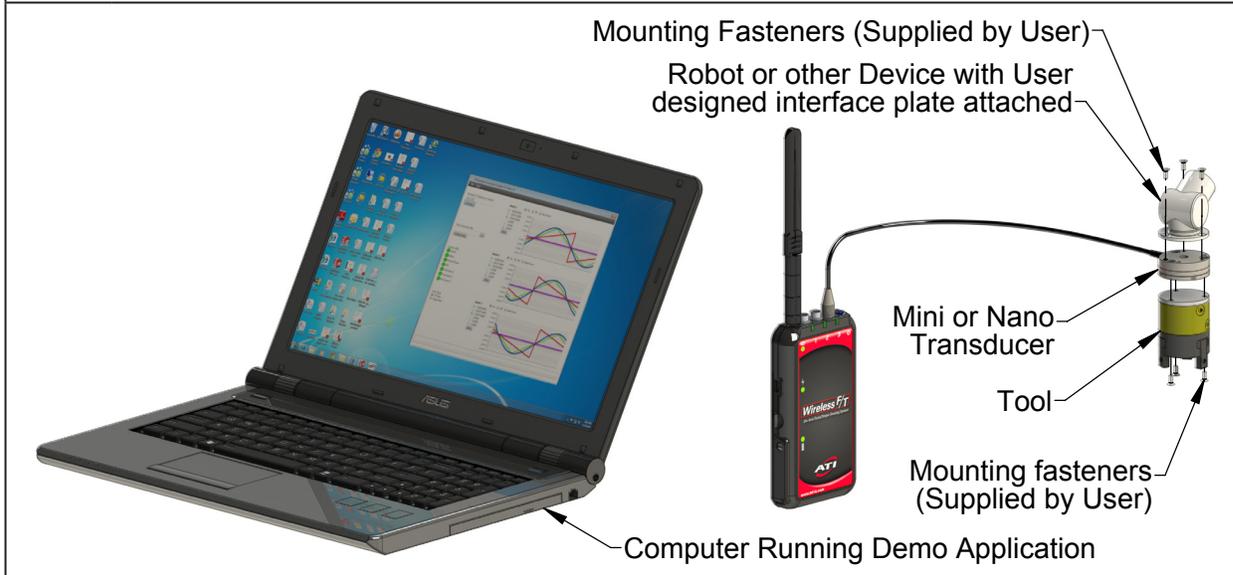
5. Command Interface

The Wireless F/T unit must be installed, setup and configured prior to using any command interfaces. Refer to *Section 3—Initial Configuration and Installation of the Wireless F/T System* for installation, setup, and configuration of the WNet unit.

5.1 Communication Interfaces

The Wireless F/T can be setup and configured using a text-based command prompt console interface.

The Console Interface can be accessed two ways:

- Over the USB connection by way of a virtual serial port
- Wirelessly by way of a Telnet connection. The unit listens on port 23.

5.2 Commands

These commands are available to any user, including commands to enter authenticated user and technician user modes. All users can read any information about the system, including values that only authenticated or technician users can write to.

The console interface is a text-based command prompt interface that allows the user to read and update system settings.

Enter most commands without operands to display current status.

5.3 Basic Wireless F/T Commands

HELP, H, or **?** – **Prints help text**

These commands print a summary of the console commands supported by the Wireless F/T.

BRIGHT *i* – **Set Indicator brightness**

> *where:*

> > *i* = integer from 0 to 100

This command sets the brightness level of the unit's indicators. Brightness ranges from 0 to 100, where 0 is completely dark and 100 is completely on.

D *s* – **Dump UDP Packets to Console**

> *where:*

> > *s* = ON or OFF

This command controls the dumping of outgoing UDP data packets to the console. See *Section 5.10—Data Packet* for information on the packets.

Command	Action
D ON	Console receives dump of outgoing UDP packets
D OFF	Console dumping of outgoing UDP packets disabled
D	Toggles the dumping of outgoing UDP packets to the console

```
>D

Dump Packet On
>8030cd06 000001be 06150216 00000000 0a 07 0000062f 00000c3d 0000040e f.
8030cd27 000001bf 06150216 00000000 0a 07 00000630 00000c3d 0000040d f.
8030cd47 000001c0 06150216 00000000 0a 07 0000062f 00000c3d 0000040c f.

                                  .
                                  .
                                  .
```

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POWER *s* – **Set Power Mode**

> *where:*
>> *s* = ON, OFF, or CHARGE

This command controls the unit's power mode.

Command	Action
POWER ON	Turns unit on (just like pushing the power button).
POWER OFF	Turns unit completely off and not charging (no USB connection).
POWER CHARGE	Turns unit off but charging (USB connection to power source)

The POWER command will also report the unit's power status when issued without arguments.

```
>POWER
POWER On
>
```

RESET – **Reset Unit**

This command resets the unit. This will cause a disconnect from the console when connected via the virtual serial port. Any settings not saved with the SAVEALL command will be lost. If the unit is connected to a computer via USB, the unit will enter charging mode.

SAVEALL – **Save All Settings**

This command saves all settings so that they will survive a unit reset or power cycle.

```
>SAVEALL
All parameters saved to Serial Flash Primary
All parameters saved to Serial Flash Secondary
>
```

T *s* – **Transmit UDP Packets to WLAN**

This command controls the transmission of UDP data packets to the WLAN.

Command	Action
T ON	Enable transmission of UDP packets to the WLAN
T OFF	Disable transmission of UDP packets to the WLAN
T	Toggles the transmission of UDP packets to the WLAN

VERSIONS – **Display Component Versions**

This command displays the versions of the four updatable components of the Wireless F/T. The following is an example of the command output:

```
>VERSIONS
Component   Version
--------   -------
Firmware    2.1.3 – Jan  1 2010 10:10:37
WLAN Module 1.2.3.4.5.6
CPLD 0      02
CPLD 1      none
>
```

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XPWR *s1 s2* – **Transducer Power Control**
where:

> *s1* = 1, 2, 3, 4, 5, 6, or *
>
> *s2* = ON or OFF

This command enables and disables transducers. Unneeded transducers may be powered down using the XPWR command to save battery power. The first argument to the XPWR command, s1, selects the transducer targeted. If the first argument is an asterisk, then the command applies to all transducers simultaneously. The second argument to the XPWR command, s2, determines the power state to be set.

Command	Action
XPWR 1 ON	Enables transducer 1
XPWR * ON	Enables all transducers
XPWR 2 OFF	Disables transducer 2

The XPWR command returns a line that summarizes the state change followed by the system prompt. Following this are outputs for each transducer that has a change in power state. The XPWR command will output Analog power = OFF in AUTO mode when power to all transducers has been turned off. When all transducers are off and a transducer is turned on, Analog power = ON in AUTO mode will be output.

```
>XPWR
Tr Auto    Now
-- ----    ---
 1 OFF     OFF
 2 OFF     OFF
 3 OFF     OFF
Analog power = OFF in AUTO mode
>XPWR 1 ON
Transducer 1 = ON
>Analog power = ON in AUTO mode
PWR:  2010 Jan  1 10:10:37 Transducer 1 ON
XPWR * ON
Transducer 123 = ON
>PWR:  2010 Jan  1 10:10:43 Transducer 2 ON
PWR:  2010 Jan  1 10:10:43 Transducer 3 ON
XPWR * OFF
Transducer 123 = OFF
>PWR:  2010 Jan  1 10:10:49 Transducer 1 OFF
Analog power = OFF in AUTO mode
PWR:  2010 Jan  1 10:10:49 Transducer 2 OFF
PWR:  2010 Jan  1 10:10:49 Transducer 3 OFF
```

The XPWR command will also generate a report of the current transducer power status when issued without arguments. The Auto column is XPWR command setting. The Now column shows the power port's actual state.

```
>XPWR
Tr Auto    Now
-- ----    ---
 1 ON      ON
 2 OFF     OFF
 3 ON      ON
Analog power = ON in AUTO mode
>
```

5.4   Commands For Modifying Wireless Settings

BAND *s* – Selects WLAN Frequency Band
  where:

  s = 2.4 or 5

This command selects whether the Wireless F/T uses the 2.4 GHz or the 5 GHz frequency band for WLAN communications. The new frequency band selection will take place after either a WLAN OFF/ON cycle or after a unit reset or unit power cycle, assuming the new BAND setting has been saved with the SAVEALL command.

Command	Action
BAND 2.4	Selects the 2.4 GHz frequency band for the WLAN
BAND 5	Selects the 5 GHz frequency band for the WLAN

The BAND command will also generate a report of the current WLAN frequency band when issued without arguments:

```
>BAND
Band = 5 GHz
>BAND 2.4
Change takes effect after reset: Band = 2.4 GHz
>WLAN OFF
WLAN: 2010 Jan  1 10:10:37 Power OFF
>WLAN ON
WLAN: 2010 Jan  1 10:10:41 Power ON
>WLAN: 2010 Jan  1 10:10:43 Got WLAN ready response
```

DESTIP *n1.n2.n3.n4* – Set Default Destination IP Address
  where:

  n1, n2, n3, and *n4* are integers from 0 to 255 representing an IPV4 address

This command sets the WLAN destination IP address for outgoing UDP data packets. Note that this IP address will only stay in effect until modified, either by this command again, or by the receipt of a UDP command to send packets to some other IP address. The DESTIP command will also report the current destination IP address when issued without arguments.

```
>DESTIP
Destination IP = 192.168.1.22
>DESTIP 192.168.1.3
Destination IP was 192.168.1.22 = 192.168.1.3
>
```

DEVIP *n1.n2.n3.n4* – Set Default Device IP Address
  where:

  n1, n2, n3, and *n4* are integers from 0 to 255 representing an IPV4 address

This command sets the default IP address of the unit. The default IP address is active when DHCP is not used. The DEVIP command will also report the default device IP address when issued without arguments.

```
>DEVIP
Device IP = 192.168.1.100
>DEVIP 192.168.1.101
Device IP was 192.168.1.100 = 192.168.1.101
>
```

`GATEIP` *n1.n2.n3.n4* – **Set Default Gateway IP Address**
> *where:*

>> *n1, n2, n3*, and *n4* are integers from 0 to 255 representing an IPV4 address

This command sets the default gateway IP address for the WLAN. The default gateway IP address is active when DHCP is not used. The GATEIP command will also report the current default gateway IP address when issued without arguments.

```
>GATEIP
Gateway IP = 192.168.1.1
>GATEIP 192.168.1.2
Gateway IP was 192.168.1.1 = 192.168.1.2
>
```

`IP` – **Display IP Parameters**

This command prints the communication parameters. This can be useful for debugging WLAN connection issues. For example:

```
>IP
>ip
Parameter       Active          Default         MAC
---------       ------          -------         ---
SSID            MY_WIFI1        MY_WIFI1
DESTIP          0.0.0.0         0.0.0.0
GATEIP          192.168.1.22    192.168.0.2     32-24-3F-6A-88-85
DEVIP           192.168.1.123   192.168.1.100   31-41-59-26-53-59
NET MASK        255.255.255.0   255.255.255.0
DNS Server 1    192.168.1.1
DNS Server 2    192.168.1.2
ANTENNA         External
BAND            2.4 GHz
NET CHANNEL     1
NET DHCP        On
NET LOC         Balance Test #2
NET MODE        Normal CLIENT Mode
NET UDPACT      BUFFER
TXPWR           2
LOCALE          Europe
WLAN Connected  Yes
Channel number  3
Network type    Infra
Security level  WEP
DHCP Mode       DHCP
Open sockets    4
Sock State  Type   MyPort RemPort  RemIP
---- -----  ----   ------ -------  -----
   1 Open   UDPout 49152   49152   0.0.0.0
   2 Open   UDPin  49152       0   0.0.0.0
   3 Open   TCPin     23       0   0.0.0.0
   4 Open   UDPin  51000       0   0.0.0.0
>
```

NET AP – **Display Detected WLAN Access Points**

This command displays access points detected during the last scan of access points. If WLAN is OFF, NET AP will return the access points detected prior to setting WLAN to OFF. For example :

```
>NET AP

##  Ch Secur RSSI  SNR NType        MAC         SSID
--  -- ----- ----  --- -----        ---         ----
 1   1 WPA2   -39  -39 Infra 32-24-3F-6A-88-85 MY_WIFI1
 2   6 WPA2   -69  -13 Infra 31-41-59-26-53-59 MY_WIFI2

>
```

NET CHANNEL *n* – **Set WLAN Channel for AP or GO Modes**

    where:

        n = integer from 1 to 13, 149, 153, 157, 161, or 165

This command selects the channel number that the unit will use if it becomes an Access Point (AP) or a WiFi Direct™ Group Owner (GO). The NET CHANNEL command will also report its current value when issued without arguments.

```
>NET CHANNEL 6
NET CHANNEL 6
>NET CHANNEL
NET CHANNEL 6
>
```

NET DHCP *s* – **Turns WLAN DHCP On or Off**

    where:

        s = ON or OFF

This command turns DHCP support on and off. Enabling DHCP support allows the connected WLAN access point to automatically set the GATEIP, DEVIP, and NET MASK values if the access point supports DHCP. The NET DHCP command will also report its current value when issued without arguments.

```
>NET DHCP
NET DHCP Off
>NET DHCP ON
NET DHCP On
>
```

NET DATE *yyyy/mm/dd* - **Set System Date**

    where:

        yyyy = integer; the current year
        mm = integer; the current month from 1 to 12
        dd = integer; the current day from 1 to 31

This command allows you to change the system date. If NTP synchronization is running, it will overwrite any changes made by using the NET DATE command. The NET DATE command will also report its current value when issued without arguments

Note: The system date and time will default to 2010 Jan 1 00:00:00 at power up or reset.

```
>NET DATE 2010/01/01
2010 Jan  1 10:10:37
>NET DATE
2010 Jan  1 10:10:38
>
```

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NET TIME *hh:mm:ss* – **Set System Time**

> *where:*

> > *hh* = integer; the current hour from 0 to 23

> > *mm* = integer; the current minute from 0 to 59

> > *ss* = integer; the current second from 0 to 59

This command allows you to change the system time. If NTP synchronization is running, it will overwrite any changes made by using the NET TIME command. The NET TIME command will also report its current value when issued without arguments.

Note: The system date and time will default to 2010 Jan 1 00:00:00 at power up or reset.

```
>NET TIME 10:10:37
2010 Jan  1 10:10:37
>NET TIME
2010 Jan  1 10:10:38
>
```

NET DNS *s* – **Find IP Address(es) of Given URL**

> *where:*

> > *s* = a string of up to 89 ASCII characters making up a valid URL

This command allows you to find any IP addresses associated with a given URL. If the URL does not have an associated Internet IP address, the command will not generate a response. The NET DNS command can be used to determine if connected WLAN network has connectivity to the wider internet. For example:

```
>NET DNS fifa.com
>## IP-Address
-- ----------
 1 184.26.143.136
 2 184.26.143.147
NET DNS BadAddress.com
>
```

NET KEY *s* – **Set WLAN Network Key**

> *where:*

> > *s* = a string of up to 64 ASCII-encoded characters

This command sets the WLAN network key (sometimes called PSK) that is used with WEP, WPA, and WPA2 encryption. The WLAN network key, sometimes called network password, is required to connect to encrypted WLANs. The use of quotation marks is optional except when removing the network key (NET KEY ""). The WLAN system administrator should provide the required network key. The NET KEY command will also report its current value when issued without arguments.

```
>NET KEY
NET KEY = 'somepassword'
>NET KEY secretphrase
NET KEY = 'secretphrase'
>NET KEY ""
NET KEY = ''
>
```

NET LOC *"s"* – **Set Unit Location Description**

   where:

   s = a string of up to 39 ASCII-encoded characters

This command stores or recalls a location description. The location description is intended to help identify individual units when accessed remotely. The NET LOC command will also report its current value when issued without arguments.

```
>NET LOC "Balance Tester #2"
LOCATION was 'Widget Maker' now 'Balance Tester #2'
>NET LOC
LOCATION = 'Balance Tester #2'
>
```

NET MASK *n1.n2.n3.n4* – **Set WLAN Subnet Mask**

   where:

   n1, n2, n3, and *n4* are integers from 0 to 255 representing an IPV4 address

This command sets the default WLAN subnet mask. The subnet mask is used to determine what subnet an IP address belongs to. If DHCP is not used, the WLAN system administrator should provide the required subnet mask. The NET MASK command will also report its current value when issued without arguments.

```
>NET MASK 255.255.255.0
Net Mask was 255.255.255.254 = 255.255.255.0
>NET MASK
Net Mask = 255.255.255.0
>
```

NET MODE *s* – **Set WLAN Connection Mode**

   where:

   s = CLIENT or DIRECT

This command selects either client mode (connect to an existing wireless access point) or WiFi Direct™ mode.

Command	Action
NET MODE CLIENT	Selects WLAN access points as unit's wireless mode
NET MODE DIRECT	Selects WiFi Direct devices as the unit's wireless mode

```
>NET MODE
NET MODE DIRECT or Autonomous GO
>NET MODE CLIENT
NET MODE Normal CLIENT Mode
>
```

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NET UDPACT *s* **– Packet Action During WLAN Flow Control**

> *where:*
>
> > *s* = BUFFER or DROP

This command controls how the unit handles the transducer data when it needs to pause from sending data packets to the WLAN.

Command	Action
NET UDPACT BUFFER	Data will be buffered during the flow control period, and then sent when the period ends. Data will only be lost if the flow control period lasts longer than available buffer storage. This mode minimizes missing data, and is preferred for data logging applications.
NET UDPACT DROP	Data will be dropped (deleted) during the flow control period. Data transmission will resume at the end of the flow control event. This mode minimizes latency, and is preferred for control applications

```
>NET UDPACT
NET UDPACT DROP
>NET UDPACT BUFFER
NET UDPACT BUFFER
>
```

RESETIP **– Restore All IP Settings to Factory Defaults**

This command restores all IP settings to the factory defaults. Any changes take effect with the next join to an access point.

```
>RESETIP
All IP settings restored to factory defaults
>
```

RSSI **- Display WLAN Received Signal Strength Indicator**

This command displays the wireless power for the unit's WLAN reception. RSSI (Received Signal Strength Indicator) is a measurement of the power present in a received radio signal. For example:

```
>RSSI
RSSI from MY_WIFI using External antenna: -45 dBm
>
```

SSID *s* **– Set Access Point SSID (WLAN Network Name)**

> *where:*
>
> > *s* = a string of up to 32 ASCII characters

This command allows you to view and set the SSID. A new SSID setting will be effective after the next join to an access point. A SSID is the name of a WLAN. SSIDs are case-sensitive text strings. The WLAN system administrator should provide the required SSID. The SSID command will also report its current value when issued without arguments.

```
>SSID
SSID = 'OLD_WIFI'
>SSID MY_WIFI
SSID was 'OLD_WIFI' now 'MY_WIFI'
>
```

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`WLAN` *s* – **Enable or Disable WLAN Communications**

>*where:*

>>*s* = ON or OFF

The WLAN command turns on and off WLAN communications. Turning off WLAN communications will reduce battery consumption. The WLAN command will also report its current value when issued without arguments.

Command	Action
WLAN ON	Enables WLAN communications
WLAN OFF	Disables WLAN communications

```
>WLAN
WLAN: Power ON
>WLAN OFF
WLAN: 2010 Jan  1 10:10:37 Power OFF
>WLAN
WLAN: Power OFF
>WLAN ON
WLAN: 2010 Jan  1 10:10:39 Power ON
>WLAN: 2010 Jan  1 10:10:41 Got WLAN ready response
>
```

5.5 Commands Related to the Transducer Output

RATE *n1 {n2}* – **Set Packet Rate with Optional Oversampling**

  where:

      n1 = integer from 5 to 4000, representing the packet send rate in Hertz

      n2 = {optional} integer from 1 to 4000÷n1, representing the oversample value.

This command allows you to set the rate at which data packets are sent to the destination IP address or the MicroSD card, and how many times to oversample.

The packet send rate's units are Hertz. Packet send rates can be from 5 to 4000 Hz. The upper limit is the highest rate possible under ideal conditions: only one transducer, oversampling set to 1, filtering disabled, no matrix multiply, no other WLAN traffic or interference, MicroSD logging disabled, and an application that can tolerate a large number of dropped packets.

The oversample value defaults to 1 if no value is entered for that argument. The packet send rate multiplied by the oversampling value cannot exceed 4000.

There are three major reasons to use oversampling :

- Resolution. Oversampling can be used to achieve higher effective resolution when noise is present. For example, to add the equivalent of one extra bit of resolution read the transducer twice and average the results.

- Noise filtering. If multiple samples are taken of the same quantity with uncorrelated noise added to each sample, then averaging n samples reduces the noise power by a factor of 1/n.

- Anti-aliasing. Oversampling can make it easier to implement analog anti-aliasing filters.

The fastest packet rate usable in an application depends on (in approximate order of expected significance):

a. Processor speed on the receiving end. Examples:

- A desktop system running Windows 7 with an Intel Core i5 CPU (3.10 GHz, 8 GB of RAM) had no problem keeping up with a 1200 Hz packet rate.

- A laptop running Windows XP with an Intel Centrino Duo (1.66 GHz, 1 GB of RAM) had trouble keeping up with much more than a 100 Hz packet rate.

b. Your application's tolerance for dropped packets.

c. The number of active transducers in the system. Rates decrease as transducer data increases.

$$\text{Packet length} = 6 \times 4 \times \text{Number\_Of\_Transducers} + 18 \text{ bytes}$$

d. If using UDP:

- Any other wireless radio traffic.

- Any radio frequency interference in your environment

- Any other network traffic (for example in the router)

- The mode: BUFFER mode (to minimize dropouts) or DROP mode (to minimize latency).

e. If writing to a MicroSD card, its maximum write latency and other hardware characteristics.

f. The amount of oversampling in use.

g. Filter type

h. Number of filter taps for filters other than IIR.

i. Matrix Multiply enabling. If enabled, the maximum rate will be less than if disabled.

Best wireless performance will be achieved using a dedicated wireless access point free of other network traffic.

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The factory default is to send packets at 10 Hz (every 100 mS), with an oversample rate of 32. This means that one out of every 32 packets is sent.

```
>rate
Packet rate =   10 Hz
ADC    rate =  320 Hz
Oversample  =   32
>rate 125 32
Packet rate =  125 Hz
ADC    rate = 4000 Hz
Oversample  =   32
>
```

BIAS *s1 s2* – **Set Transducer Bias**

> *where:*

> > *s1* = 1, 2, 3, 4, 5, 6, or *

> > *s2* = ON or OFF

This command allows you to set or remove the bias point of any one or all transducers. The bias point is an offset to be applied to a transducer's output by the unit. Setting a transducer's bias point will make it read zero for the load applied at the time the bias was set.

```
>BIAS 1 OFF
Sensor bias cleared 1
>BIAS * ON
Sensor bias set 123
>
```

TRANS *n* – **Set Active Transducer**

> *where:*

> > *n* = integer from 1 to 6

This command allows you to change the active transducer. The active transducer is the transducer for which the CALIB command applies. The TRANS command will also report which transducer is active and show each transducer's active calibration, when issued without arguments.

```
>TRANS 2
Active: Transducer = 2 Calibration = 1
>TRANS
Tr Active-Calibrations
-- -------------------
 1  1
 2  1 <-- Active Transducer
 3  1
>
```

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CALIB *n* – **Set Active Calibration**

　　where:

　　　　n = 1, 2, or 3

This command allows you to change the active calibration. The active calibration is the one currently for data collection. The CALIB command will also report which transducer is active and show each transducer's active calibration, when issued without arguments.

```
>CALIB 3
Active: Transducer = 2 Calibration = 3
>CALIB
Tr Active-Calibrations
-- -------------------
 1  1
 2  3 <-- Active Transducer
 3  1
>
```

FILTER *s1 s2 n* – **Set Filtering**

　　where:

　　　　s1 = 1, 2, 3, 4, 5, 6, or *

　　　　s2 = MEAN, MEDIAN, or IIR

　　　　n = integer from 1 to 31 for MEAN and MEDIAN, from 1 to 32767 for IIR

This command allows you to set the low-pass filter type to be applied to transducer data. Low pass filtering can be applied to reduce unwanted noise in transducer data.

Filter Type	Description	*n* Range
Mean	Running average filter of the last n samples	1 to 31
Median	Running median filter with n samples	1 to 31
IIR	IIR filter with a time constant of n	1 to 32767

Note that a 31-sample MEAN filter running in all six transducers executes in about 65 μS, while a 31-sample MEDIAN filter in all six transducers executes in about 480 μS, on average. Consequently, the maximum possible packet rate, set by the RATE command, is lower for a n-sample MEDIAN filter than for an n-sample MEAN filter.

The FILTER command will also report the current filter settings for all transducers, when issued without arguments.

```
>FILTER 1 MEAN 8
Transducer 1 MEAN  8
>FILTER 2 MEDIAN 16
Transducer 2 MEDIAN 16
>FILTER 3 IIR 512
Transducer 3 IIR 512
>FILTER
Tr Filter  Taps
-- ------  ----
 1 MEAN       8
 2 MEDIAN    16
 3 IIR     TC 512
>
```

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5.6   Commands Related to the Functionality of the MicroSD Card Reader

`SD` - Print Memory Card Diagnostic Information

With no operands, this command prints a lengthy list of technical information about the user's memory card.

`SD [FORMAT]` - Format Memory Card

This command allows you to format the MicroSD card. All existing data on the MicroSD card will be lost. The command will ask you to verify that you want to format the disk before it actually deletes any data. To cancel, type N then press <ENTER>. To proceed, type Y then press <ENTER>. Any data streaming over the WLAN will be interrupted while the format is taking place.

```
>SD FORMAT
SD:   2010 Jan  1 10:10:28 Are you sure? ALL data on the SD card will be
lost!
nSD:   2010 Jan  1 10:10:34 Format canceled
>SD FORMAT
SD:   2010 Jan  1 10:10:41 Are you sure? ALL data on the SD card will be
lost!
ySD:   2010 Jan  1 10:10:46 Formatting Drive 0:
Erasing sectors 200 to 1dcfff AU: 239 timeout: 30,875 mS
SD:   2010 Jan  1 10:10:48 Format complete
>
```

`SCD` *s*   – Change Memory Card Directory

> *where:*

>> *s* = a string of ASCII characters that form a valid directory name

This command allows you to display and change the path on the memory card. The SCD command will report the current path when issued without arguments.

```
>SCD /ATI
0:/ATI
>SCD /
0:/
>
```

`SDEL` *s*   – Delete Memory Card File(s)

> *where:*

>> *s* = a string of ASCII characters that form a valid file name

This command deletes the selected file(s) in the current directory on the user memory card.

```
>SDEL F3.dat
Erasing sectors 380 to 3df AU: 1 timeout: 1,125 mS
F3.DAT deleted
Files deleted: 1
>SDEL BadFileName
Files deleted: 0
>
```

`SDIR` – Print Memory Card Directory

This command prints a directory of all files in the current path on the user memory card.

```
>SDIR
 Directory of 0:/ATI
 2010/01/01 10:10 <DIR>             .
 2010/01/01 10:10 <DIR>             ..
 2010/01/01 10:10              4    ATI.ini
 2010/01/01 10:11        112,398    F1.dat
 2010/01/01 10:14         33,792    F2.dat
```

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```
                2010/01/01 10:18           33,066      F3.dat
                      4 File(s)         179,260 bytes total
                      2 Dir (s)
          >
```

SDREC *s* **– Control Streaming Packets to Memory Card**

> *where:*

> > *s* = ON or OFF

This command controls the saving of streaming data to the user memory card. All data is placed in the \ ATI subdirectory, which is automatically created when necessary. The file ati.ini is also created within this subdirectory if it is not already present. Each time that streaming starts, a new file Fn.dat file is created, where n is the next sequential file number. The data is saved as binary data in the same format as the UDP data packets described in section 5.10 Data Packet.

Note that the file system only supports file sizes up to 4 G bytes.

```
    >SDREC ON
    SDFS: Opening F1.dat
    MicroSD streaming is On
    >SDREC OFF
    SDFS: Closed: F1.dat CARD Packets: Generated: 1,703 Dropped: 0 Max Write
    Latency: 64 mS
    MicroSD streaming is Off
    >
```

The data can be read by placing the memory card into a computer that supports the FAT file system. A MicroSD adapter may be required.

When viewed with the freeware HxD utility (http://mh-nexus.de/en/hxd/), data for a single transducer may look like:

Figure 5.1—Fn.dat file format

Note that if an interruption occurs while this data is being written (such as the removal of the MicroSD card or the battery) the open file will generally lose any data written within the last two seconds. The interruption may also cause lost file system clusters, which will reduce the storage capacity of the card. Lost clusters may be repaired either by formatting the card (using the SD FORMAT command, which will cause the loss of all data on the card), or by putting the card into a computer and running the SCANDISK utility. On Windows 7 machines this can be done by opening Windows Explorer, right-clicking on the drive letter of the MicroSD card, selecting Properties, clicking the Tools tab, pressing the Check Now… button, and then pressing Start

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5.7   Commands Related to NTP Time Synchronization:

Network Time Protocol is a protocol for synchronizing clocks between computer systems over packet-switched networks. The Wireless F/T uses NTP to synchronize its clock to that of a single user-selectable NTP server. Any other devices should be synchronized to the same NTP server. This NTP implementation has as its goal accuracy on the order of a millisecond, but it cannot be any more accurate than its time source. More information about NTP can be found at http://www.ntp.org/.

Every NTP command produces a short table containing its enable status, the current NTP server, the current time zone relative to UTC, and the daylight savings time status:

```
Parameter Value
--------- -----
Enable    1
Server    pool.ntp.org
TimeZone  -5:00
DST       OFF
```

All packets generated by the Wireless F/T have a time stamp in units of milliseconds. NTP settings are controlled using the NTP commands.

NTP ENABLE *n* – **Controls NTP Synchronization**

where:

$n = 0$ or 1

This command controls whether NTP synchronization is enabled or disabled. The NTP ENABLE command should not be used without an offset. Doing so will disable NTP synchronization.

Command	Action
NTP ENABLE 0	Disables NTP synchronization
NTP ENABLE 1	Enables NTP synchronization

After NTP synchronization is enabled, the unit will attempt to contact the time server previously set with the NTP SERVER command. If successful, the unit will output a table with NTP Field information. If unsuccessful, no NTP Field table will be output.

```
>NTP SERVER pool.ntp.org
Parameter Value
--------- -----
Enable    0
Server    pool.ntp.org
TimeZone  -5:00
DST       OFF
>NTP ENABLE 1
Parameter Value
--------- -----
Enable    1
Server    pool.ntp.org
TimeZone  -5:00
DST       OFF
>
NTP-Field     Value
---------     -----
Server        pool.ntp.org
LeapSecInd    None
Version       3
Mode          Server
Stratum       2 => Secondary reference
PollInterval  2 ^    4 seconds
Precision     2 ^  -22 seconds
RootDelay     0.000198 seconds
```

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```
            RootDispersion 0.022568 seconds
            ReferenceId    216.229.0.179
            Reference      2010 Jan  1 10:10:16.798053
            Originate      2010 Jan  1 10:10:20.212445
            Receive        2010 Jan  1 10:10:20.262260
            Transmit       2010 Jan  1 10:10:20.262286


            >NTP ENABLE 0
            Parameter Value
            --------- -----
            Enable    0
            Server    pool.ntp.org
            TimeZone  -5:00
            DST       OFF
            >
```

NTP SERVER *s* – Set NTP Server URL or IP Address

where:

> s = a string of up to 89 characters representing a valid URL or IPV4 address

This command selects a NTP server to use. The NTP SERVER command should not be used without an argument. Doing so will set the NTP server to an indeterminate value. Generally, closer NTP servers will provide better the time synchronization, assuming the servers have similar accuracies. If you are trying to synchronize multiple pieces of equipment you should use the same time server for all of them. The server can be entered as a URL or as an IP address, but a URL is preferred.

```
            >NTP SERVER pool.ntp.org
            Parameter Value
            --------- -----
            Enable    0
            Server    pool.ntp.org
            TimeZone  -5:00
            DST       OFF
            >
```

Your organization may already have its own NTP time server. You may want to install an NTP server in a PC or for additional accuracy buy a precision NTP server in dedicated hardware . Public NTP time servers are also available. NTP best practices discourage the use of Stratum 1 time servers by end-use devices, such as the Wireless F/T.

NTP ZONE *s* – UTC Time-Zone Offset

where:

> s = string representing the time zone offset in hours and minutes.

This command sets the difference between local time and Coordinated Universal Time (UTC) time. The string, s, cannot have leading zeros. Negative offsets must be preceded by a dash. Valid examples are: 1000, 100, 0, 500, 800. The NTP ZONE command should not be used without an offset. Doing so will set the UTC time zone offset to zero. Information on UTC time-zone offsets can be found at http://en.wikipedia. org/wiki/List_of_UTC_time_offsets.

```
            >NTP ZONE -500
            Parameter Value
            --------- -----
            Enable    0
            Server    pool.ntp.org
            TimeZone  -5:00
            DST       OFF
            >
```

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NTP DST *s* **– Daylight savings time**

> *where:*

> > *s* = ON or OFF

This command sets whether daylight savings time is on or off.

```
>NTP DST ON
Parameter Value
--------- -----
Enable    0
Server    pool.ntp.org
TimeZone  -5:00
DST       ON
>
```

5.8 UDP Interface

The Wireless F/T unit listens on UDP port 49152 for commands. Any streaming UDP packets are sent to the current Destination IP address until a UDP command is received. When the Wireless F/T unit receives a UDP command from any IP address, the UDP packets are sent to whichever port the request came from.

The UDP server uses binary format for commands and responses. All multi-byte values use big-endian, which is the same as network order.

5.9 UDP Command Format

All UDP commands to the WNET unit have the following format:

Table 5.1—UDP Command Format			
Field Name	**Format**	**Length (bytes)**	**Comments**
length	unsigned short	2	Total length of this message, including CRC
sequence	unsigned char	1	Sequence number. Used to identify missing messages.
command	unsigned char	1	Command number
payload	unsigned char(s)	length - 6	Command operands (if any)
crc	unsigned short	2	See Appendix A – UDP Command CRC Calculation, for details

This format can be rendered into C as:

```
struct udp_RecvFrame_S

{
    unsigned short length;        // Total length of this message
    unsigned char  sequence;      // sequence number of this message
    unsigned char  command;       // command number
    unsigned char  parameters[0]; // command operands
} __attribute__ ((__packed__));
```

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These commands are currently implemented:

Table 5.2—Current Command Implementation		
Number	**Name**	**Comments**
1	Start streaming	Start streaming for either a fixed or unlimited number of packets
2	Stop streaming	Stops streaming
3	Set packet transmission rate	Sets packet transmission rate. All transducers use the same rate.
4	Ping	Sends a no-payload Pong response back to the sender.
5	Reset telnet socket	Closes any open telnet socket.

1. Start Streaming.
    This command starts the transmission of UDP data packets for either a fixed or unlimited number of packets.

Table 5.3—UDP Command Format			
Field Name	**Format**	**Length (bytes)**	**Comments**
count	unsigned long	4	Number of samples to send, 0 = unlimited

2. Stop Streaming
    This command stops the transmission of UDP data packets. There are no parameters.

3. Set Packet Transmission Rate
    This command sets the UDP data packet transmission rate. The packet transmission rate will be truncated to the next lowest multiple of the Analog to Digital Converter (ADC) sampling rate. For example, if a packet transmission rate of 900 µS is requested when the ADC sampling rate is 400 µS, the packet transmission rate will be set to 800 µS. The packet transmission rate will be set no lower than the ADC sampling rate. All Transducers use the same packet transmission rate. The change in packet transmission rate takes effect immediately.

Table 5.4—UDP Command Format			
Field Name	**Format**	**Length (bytes)**	**Comments**
rate	unsigned long	4	Packet transmission rate in µS

4. Ping
    This command sends a no-payload Pong response back to the sender.

5. Reset Telnet Socket
    This command closes any open telnet socket. This command is useful to issue just before connecting to the unit, in case a previous session was not properly closed out.

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5.10 Data Packet

Streaming UDP and SD card data packets have the following format:

Field Name	Format	Length (bytes)	Comments
Table 5.5—UDP Command Format			
timeStamp	unsigned long	4	Internal time stamp in seconds (20-bits integer, 12-bits fraction). Seconds starts at 1/1/2010 if time synchronized, or since power up if not synchronized, modulo 20 bits.
sequence	unsigned long	4	Sequence number. Used to identify missing messages.
statusCode1	unsigned long	4	Wireless F/T Status Word 1 for Transducers 1 to 3 (see below).
statusCode2	unsigned long	4	Wireless F/T Status Word 2 for Transducers 4 to 6 (see below).
batteryLevel	unsigned char	1	Indication of battery life remaining.
transMask	unsigned char	1	Transducer data in block mask: 0x01 = Transducer 1, 0x02 = T2, …
Tr Ch0 (if present)	signed long	4	Data[1] for first Transducer: Channel 0 is ForceX.
Tr Ch1 (if present)	signed long	4	Data[1] for first Transducer: Channel 1 is ForceY.
Tr Ch2 (if present)	signed long	4	Data[1] for first Transducer: Channel 2 is ForceZ.
Tr Ch3 (if present)	signed long	4	Data[1] for first Transducer: Channel 3 is TorqueX.
Tr Ch4 (if present)	signed long	4	Data[1] for first Transducer: Channel 4 is TorqueY.
Tr Ch5 (if present)	signed long	4	Data[1] for first Transducer: Channel 5 is Torque Z.
Tr data (if present)	6 signed longs	24	Data[1] for next Transducer, Channels 0 to 5.
Tr data(if present)	6 signed longs	24	Data[1] for next Transducer, Channels 0 to 5.
Tr data (if present)	6 signed longs	24	Data[1] for next Transducer, Channels 0 to 5.
Tr data (if present)	6 signed longs	24	Data[1] for next Transducer, Channels 0 to 5.
Tr data (if present)	6 signed longs	24	Data[1] for next Transducer, Channels 0 to 5.
Notes:			
1. To convert the data into real force and torque values, refer to *Section 5.10.1—Calculating F/T values for Data Packages*.			

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For UDP, note that each individual UDP datagram may contain one or more of these packets.

For memory card files, note that F*.dat files usually contain more than one of these packets.

Table 5.6—Wireless F/T Status Word 1							
Bit	31	30	29	28	27	26	25	24
Field	spare		Bridge Voltage Too Low			Saturated Data		
			T3	T2	T1	T3	T2	T1

Bit	23	22	21	20	19	18	17	16
Field	Reserved		T3		T2		T1	
	0	0	Bridge	AFE	Bridge	AFE	Bridge	AFE

Bit	15	14	13	12	11	10	9	8
Field	Reserved		Reserved		Battery Indicator		External-Power Indicator	
	0	0	0	0	Green	Red	Green	Red

Bit	7	6	5	4	3	2	1	0
Field	WLAN Indicator		T3 Indicator		T2 Indicator		T1 Indicator	
	Green	Red	Green	Red	Green	Red	Green	Red

Table 5.7—Wireless F/T Status Word 2							
Bit	31	30	29	28	27	26	25	24
Field	spare		Bridge Voltage Too Low			Saturated Data		
			T6	T5	T4	T6	T5	T4

Bit	23	22	21	20	19	18	17	16
Field	Reserved		T6		T5		T4	
	0	0	Bridge	AFE	Bridge	AFE	Bridge	AFE

Bit	15	14	13	12	11	10	9	8
Field	Reserved		Reserved		Reserved		Reserved	
	0	0	-	-	-	-	-	-

Bit	7	6	5	4	3	2	1	0
Field	Reserved		T6 Indicator		T5 Indicator		T4 Indicator	
	-	-	Green	Red	Green	Red	Green	Red

The Bridge bits indicate if a transducer is powered. The AFE bits indicate if the Wireless F/T is ready to read that transducer's values.

The System indicator combines the results for all Digital Board faults.

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The length of the packet depends on the number of transducers that are powered, and can be calculated using the following equation:

PacketLength(in bytes) = 18 + NumberOfOneBits(transMask) × 24

This packet format can be rendered into C as:

```
#define NUMBER_OF_ANALOG_BOARDS 2
#define NUMBER_OF_TRANSDUCERS   6
#define NUMBER_OF_STRAIN_GAGES  6

struct TxPacket_S
{
    unsigned long  timeStamp;
    unsigned long  sequence;
    unsigned long  statusCode[NUMBER_OF_ANALOG_BOARDS];
    unsigned char  batteryLevel;
    unsigned char  transMask;
      signed long  sg[NUMBER_OF_TRANSDUCERS][NUMBER_OF_STRAIN_GAGES];
} __attribute__ ((__packed__));
```

More than one of these packets may be sent as in a single UDP datagram.

5.10.1 Calculating F/T values for Data Packages

To obtain the real force and torque values, each force value must be divided by Counts per Force factor, and each toque value must be divided by the Counts per Torque factor.

For example: If a calibration reports 1, 000, 000 counts per N and the F_z reports 4, 500, 000 counts, then the force applied in the Z axia, is 4.5 N.

The Counts per Force factor and Counts per Torque factor are also called scaling factors. The "CountsPerForce" and "CountsPerTorque" are obtained from the calibration file, which is available from an attachment sent via email when the product was shipped. The following figure shows the calibration file with XML Notepad. On the right side of the screen, the scaling factor is listed. XML Notepad can be downloaded for free from *https://www.microsoft.com/en-us/download/details.aspx?id=7973*. The calibration file can be opened with any text editor. Once the file is opened, look for the "CountsPerForce" XML tag.

Figure 5.2—"CountsPerForce" and "CountsPerTorque" in the Calibration File

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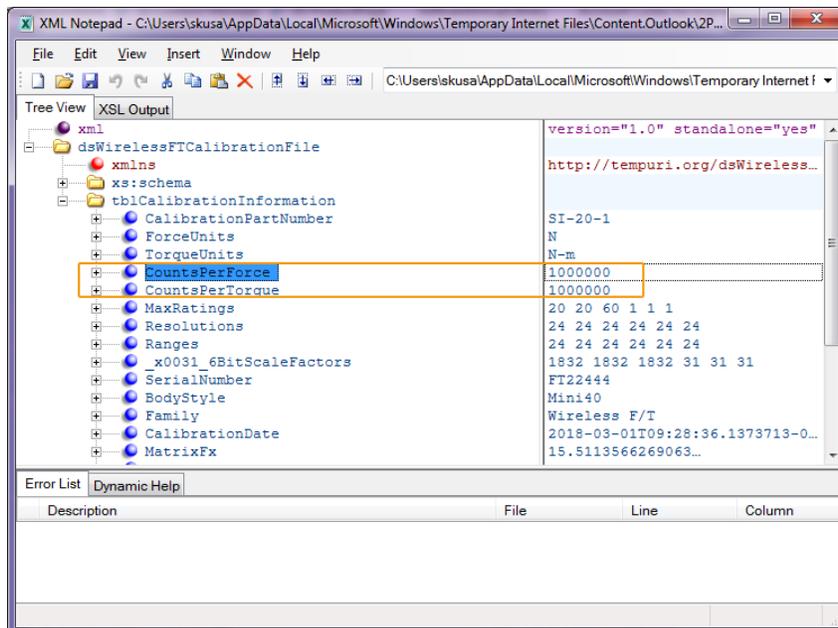
5.11 Processor Firmware Update Procedure

The Wireless F/T device may be updated in the field. From a user's perspective, the procedure is the following:

1. Use the Java demo application on the PC to download the binary image appl.bin to the Wireless F/T unit.

2. Reset the Wireless F/T unit.

Note: if you are operating over WLAN, contact with the unit will be lost when the update procedure starts, and will not resume until it is complete. If you are operating through a serial port, you will be able to watch the process as it occurs.

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6. Maintenance

Under normal conditions, no special maintenance is necessary, however it is recommended that periodic inspections be performed to assure long-lasting performance and to assure that unexpected damage has not occurred. Refer to *Section 6.1—Preventive Maintenance* for a schedule and items that should be visually inspected at regular intervals. Wireless F/T devices operating on battery power should be monitored periodically for battery status.

Spare parts are available from ATI Industrial Automation. Please call for recommendations.

6.1 Preventive Maintenance

The Wireless F/T is designed to provide a long life with regular maintenance. A visual inspection and preventive maintenance schedule is provided in the *Table 6.1*. Assembly details are provided in *Section 11—Drawings*.

Table 6.1—Preventative Maintenance Checklist	
Repetitive motion Frequency	**Inspection Schedule**
More than 1 per minute	Weekly
Less than 1 per minute	Monthly
Cabling	
□ Visually inspect the power supply and transducer cabling for wear or damage. If wear or damage is visible, replace cabling and adjust routing or protect cabling with a loose plastic spiral wrap. □ Visually inspect cable connection for looseness, tighten connection or replace cable as needed	
Mounting Fasteners	
□ Inspect mounting fasteners, verify they are tight and have the proper torque.	

6.2 Battery Recharging and Replacement

The batteries can be charged internally using the USB port above the battery compartment or externally in a battery charger.

6.2.1 Charging Battery Internally

The battery can be charged internally using the external power adapter and a USB cable that connects the external power adapter to the Wireless F/T. **Note:** The computer connected to the USB port does not provide sufficient source to keep the battery charged.

6.2.2 Charging Battery Externally

The battery can be charged externally and swapped out while a second battery is charging. It will result in a brief power-down condition.

1.   Loosen the quarter-turn fastener on the battery compartment and open the door.

2.   Slide the battery out and replace it with a fully charged battery.

3.   Close the door and tighten the quarter-turn fastener.

4.   Insert the battery in a battery charger.

7. Troubleshooting

The system contains few components and provides trouble-free operation once properly installed. The following table is provided to assist with troubleshooting the system.

Table 7.1—Troubleshooting		
Symptom	**Possible Cause**	**Correction**
Nonexistent or intermittent communication.	Low battery power	Charge battery, (if battery does not retain a charge replace battery).
	Worn or damaged cabling	Inspect and test power supply and transducer cabling and replace as needed.
	External power adapter failing or not functioning	Replace external power adapter
	Obstruction between Wireless F/T and wireless access point	Remove obstruction or reposition Wireless F/T, or the wireless access point to obtain an unobstructed environment
	Wireless network component failing or not functioning	Test components and replace as needed
	Wireless F/T failing or not functioning	Test Wireless F/T and replace as needed
	Transducer not functioning	Refer to the F/T Installation and Operation manual for troubleshooting information.
	External antenna not present or not correct part	Install correct external antenna
WLAN and transducers do not work but USB communications work fine.	Unit is in CHARGE power mode, not ON power mode	Momentarily press power button or issue POWER ON command
Wireless status indicator is flashing red.	This typically happens when trying to transmit to a UDP address that does not exist	Verify the correct UDP address; if incorrect, update.

8. Serviceable Parts

Description	Part Number
Wireless F/T WNet-3	9105-WNET3
Wireless F/T WNet-6	9105-WNET6
Battery	5515-3.70000-01
External Battery Charger	9105-WNETEBC
Antenna	9105-WNETANT
Wireless F/T Power Supply, Wall Adapter Type	9105-WNETPS
USB A Male to USB B Male cable, 0.9m	9105-C-USAA-MINIB-0.9

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9. Specifications

The specifications section covers characteristics of the Wireless F/T device. Other components such as transducer, cabling may be found in the specific product manual on our website. Drawings may also be found in the product catalog and on our website. 2-D and 3-D models are also available on our website.

Contact ATI for specific information and drawings regarding your installation. We encourage you to use our applications department to review your designs and answer your questions.

9.1 Wireless Characteristics

Wireless Local Area Network (WLAN)   IEEE 802.11 b/g/n 2.4 GHz / 5.0 GHz
Typical Range (Antenna attached)
Office Type Environment   30 m (98 ft)
unobstructed environment   100 m (328 ft)
Note: Only certified with the antenna attached.

9.2 Power Requirements

Battery Power
Internal battery   3.7V Lithium-polymer rechargeable
Typical battery life (Max, streaming rate and transducers used)
WNet-3   2 hrs
WNet-6   1 hr
Power consumption   2A at 5 VDC
External power adapter   5VDC

9.2.1 Wireless Power Levels

Table 9.1—Wireless Power Levels					
Supported Channels	**Frequency**	**US Locale**		**Euro Locale**	
	GHz	**dBm ±1**	**mW**	**dBm ±1**	**mW**
1	2.412	15	32	15	32
2	2.417	15	32	15	32
3	2.422	15	32	15	32
4	2.427	15	32	15	32
5	2.432	15	32	15	32
6	2.437	15	32	15	32
7	2.442	15	32	15	32
8	2.447	15	32	15	32
9	2.452	15	32	15	32
10	2.457	15	32	15	32
11	2.462	15	32	15	32
12	2.467	15	32	15	32
13	2.472	15	32	15	32
149	5.745	12	16	7	5
153	5.765	12	16	7	5
157	5.785	12	16	7	5
161	5.805	12	16	7	5
165	5.825	12	16	7	5

9.3 Physical Characteristics

Size

Wireless WNet-3 (Excluding Antenna & mating connectors)	156 mm x 82 mm x 19.7 mm (6.15 in x 3.23 in x 0.775 in)
Wireless WNet-6 (Excluding Antenna & mating connectors)	156 mm x 82 mm x 33 mm (6.15 in x 3.22 in x 1.3 in)
Antenna	100 mm (3.9 in)

Weight

Wireless WNet-3	0.6 lbs (0.27 kg)
Wireless WNet-6	0.6 lbs (0.27 kg)
Mounting	See Section 13—Drawings
Operating ambient Temperature (Non-Charging)	0°C to +50°C (Note: battery runtime may decrease above 35°C ambient).
Battery charging ambient temperature	0°C to +35°C
Storage ambient temperature	-20°C to 45°C
Humidity	85% maximum, non-condensing

9.4 Transducer Inputs

Figure 9.1—8-Pin Connector Female, Transducer Connector

Face Side
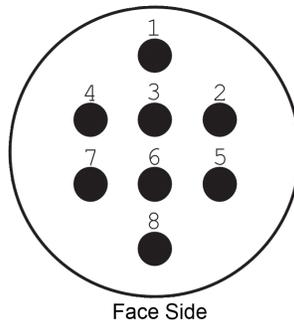
Table 9.2—Transducer Connector Specifications	
Pin Assignments	**Signal**
Pins 1,2,4,5,7,8	Strain gage input
Pin 3	Ground
Pin 6	5V bridge supply (20mA max)
Maximum Ratings	
Absolute maximum strain gage input range	-7 VDC to 7 VDC

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9.4.1 Analog Transducer Data Filtering

Figure 9.2 shows the frequency response of the WNet hardware filter. The graph does not include the effects of any mechanical filtering (which occurs in any spring and mass system).

Figure 9.2—WNet Analog Filtering Frequency Response (typical)
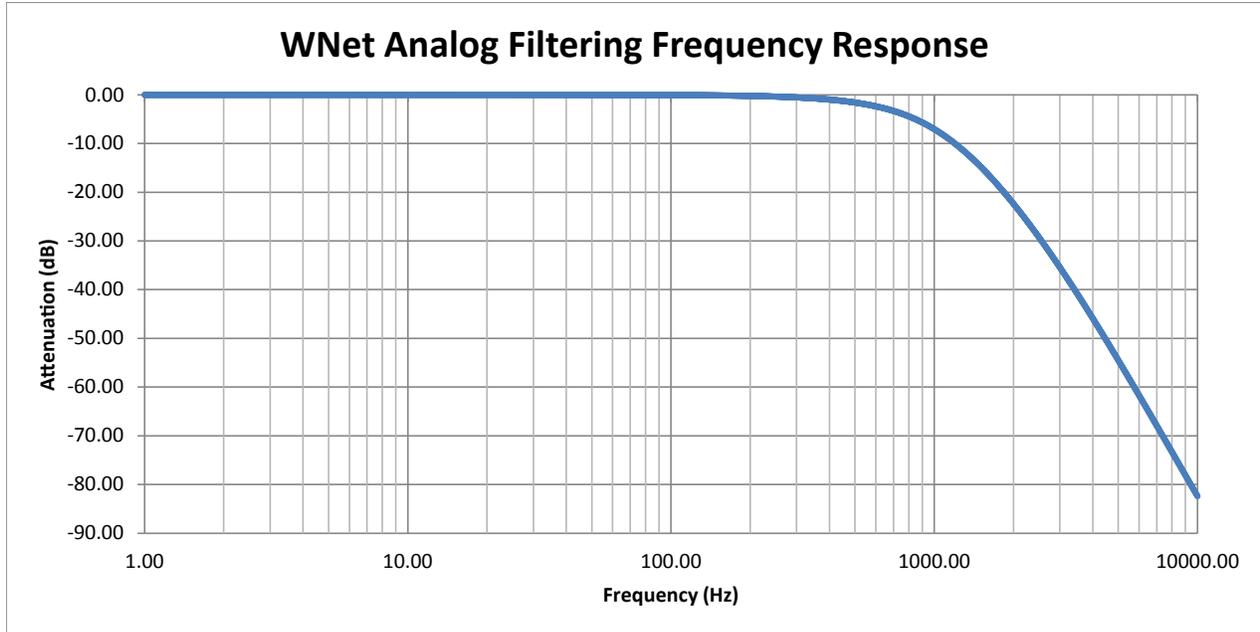
Figure 9.3 shows the group delay of the WNet hardware filter. These delays do not show the wireless delays in your network or computer. The WNet transmits F/T data to a wireless device with a delay of 1333μS with no software filtering enabled.

Figure 9.3—WNet Analog Filtering Group Delays (calculated)

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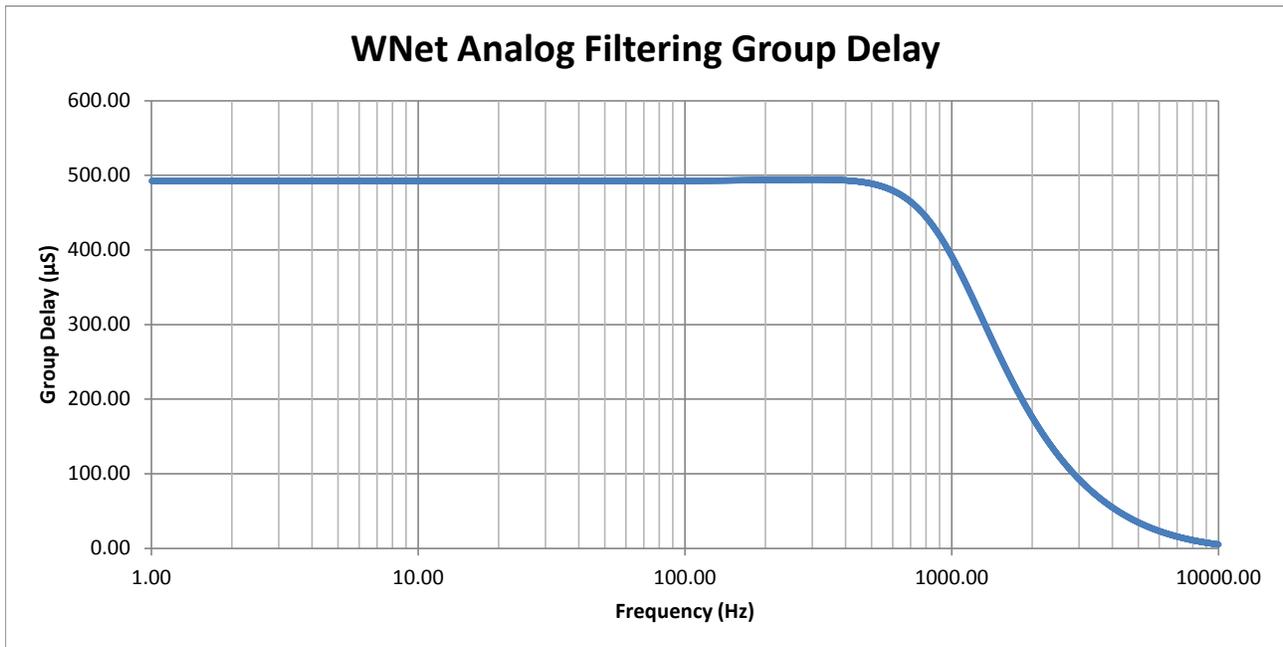
10. Regulatory Information

10.1 FCC Statement

Declaration of Conformity with FCC Rules for Electromagnetic Compatibility

We, ATI Industrial Automation of 1031 Goodworth Drive, Apex, NC 27539, declare under our sole responsibility that the Wireless Multi-Axis Force/Torque Transmitter models, WNET-NA-x, FTWN-NA-x, comply with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

IMPORTANT NOTICE:

Federal Communications Commission Notice

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at their own expense.

FCC Radiation Exposure Statement

The SAR limit for North America is 1.6 W/kg averaged over one gram of tissue. This product (FCC ID: 2ACKB-9105WNET) has also been tested against this SAR limit. The highest SAR value reported under this standard during product certification for use when properly worn on the body is 1.04 W/kg.

This device was tested for typical body-worn operations with the back of the device kept 0mm from the body. To maintain compliance with IC RF exposure requirements, use accessories that do not contain metallic components in its assembly. The use of accessories that do not satisfy these requirements may not comply with IC RF exposure requirements, and should be avoided.

Modifications

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

10.2 Canadian Compliance Statement

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

This device has been designed to operate with the antenna listed below, and having a maximum gain of 2 dBi. Antennas not included in this list or having a gain greater than 2 dBi are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.

- Pulse Electronics wireless external dual band antenna part number W1043

Cet appareil a été désigné pour opérer avec l'antenne listée ci-dessous, et ayant un gain maximal de 2 dBi. Les antennes qui ne sont pas incluses dans cette liste ou qui ont un gain plus de 2 dBi sont strictement interdites d'être utilisées avec cet appareil. L'impédance de l'antenne requise est de 50 ohms.

- Antenne externe bi-bande sans fil, de la compagnie 'Pulse Electronics', numéro de pièce W1043.

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IMPORTANT NOTICE:

IC Radiation Exposure Statement

The SAR limit for North America is 1.6 W/kg averaged over one gram of tissue. This product (IC ID: 12098A-9105WNET) has also been tested against this SAR limit. The highest SAR value reported under this standard during product certification for use when properly worn on the body is 1.04 W/kg.

This device was tested for typical body-worn operations with the back of the device kept 0mm from the body. To maintain compliance with IC RF exposure requirements, use accessories that do not contain metallic components in its assembly. The use of accessories that do not satisfy these requirements may not comply with IC RF exposure requirements, and should be avoided.

La limite SAR pour l'Amérique du Nord est de 1,6 W/kg en moyenne par gramme de tissu. Ce produit (ID IC: 12098A-9105WNET) a également été testé contre cette limite SAR.

La valeur SAR la plus élevée signalée sous cette norme lors de la certification du produit pour utilisation quand porté correctement sur le corps est de 1,04 W/kg.

Cet appareil a été testé pour des opérations portables typiques avec l'arrière de l'appareil maintenu à 0 mm du corps. Pour respecter les normes d'exposition RF IC, veuillez utiliser des accessoires qui ne contiennent pas de composants métalliques. L'utilisation d'accessoires ne satisfaisant pas à ces exigences peut ne pas se conformer aux exigences d'exposition RF IC et devrait être évitée.

IC Statement

This Class A digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

11. Drawings

11.1 Wireless Net F/T for 3 Transducers
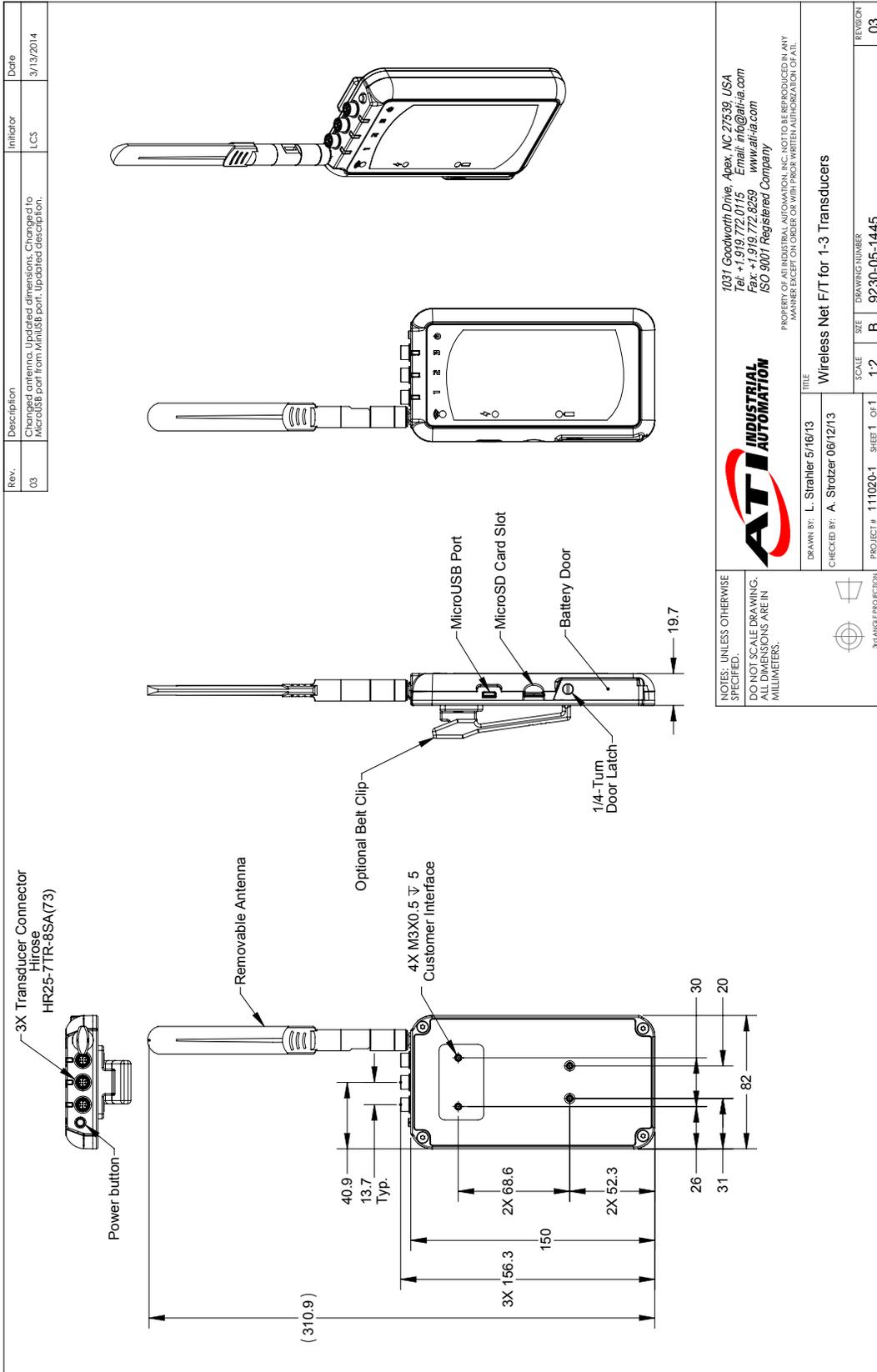
11.2 Wireless Net F/T for 6 Transducers

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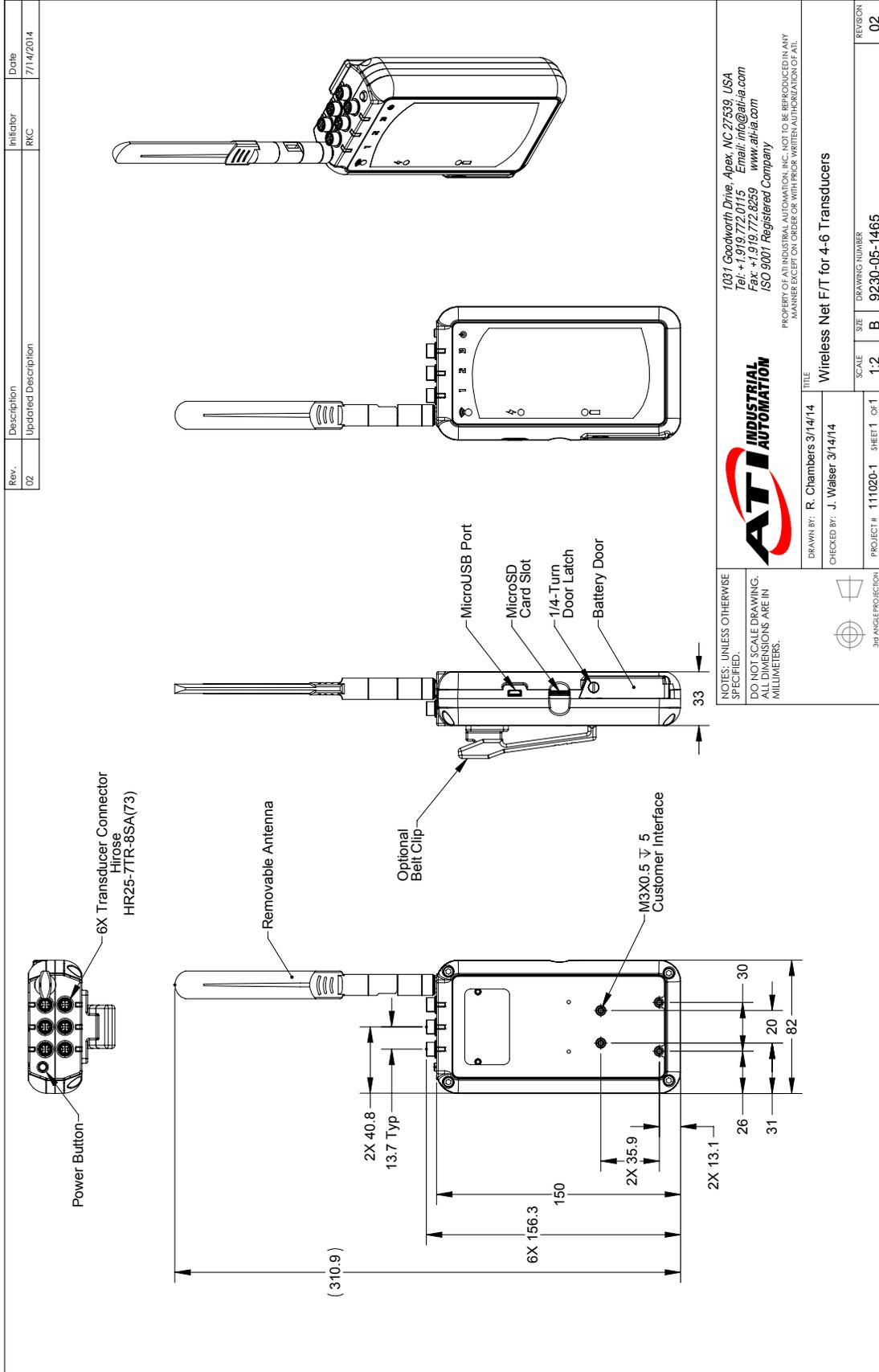
12. Terms and Conditions of Sale

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 year from the date of shipment. This warranty does not cover components subject to wear and tear under normal usage or those requiring periodic replacement. 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.

In the course of supplying products and services hereunder, ATI may provide or disclose to Purchaser confidential and proprietary information of ATI relating to the design, operation, or other aspects of ATI's products. As between ATI and Purchaser, ownership of such information, including without limitation any computer software provided to Purchaser by ATI, shall remain in ATI and such information is licensed to Purchaser only for Purchaser's use in operating the products supplied by ATI hereunder in Purchaser's internal business operations.

Without ATI's prior written permission, Purchaser will not use such information for any other purpose of 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.

Purchaser will not be liable hereunder with respect to disclosure or use of information which: (a) is in the public domain when received from ATI, (b) is thereafter published or otherwise enters the public domain through no fault of Purchaser, (c) is in Purchaser's possession prior to receipt from ATI, (d) is lawfully obtained by Purchaser from a third party entitled to disclose it, or (f) is required to be disclosed by judicial order or other governmental authority, provided that, with respect to such to maintain the confidentiality of such information.

Appendix A – UDP Command CRC Calculation

All UDP commands sent to the Wireless F/T must include a two-byte CRC (Cyclic Redundancy Check) value. This value is used for error checking the command request and is based on the data in the command structure to be sent.

The following C code performs the calculation of the CRC value. To calculate the value, pass a pointer to the command structure along with the command length in bytes minus two to the function crcBuf().

```c
// If FAST is defined, then the CRC is determined using a lookup table instead of
calculations
#define FAST 1

// Both versions use the CRC-16-CCITT polynomial: x^16 + x^12 + x^5 + 1 = 0x11021

#if FAST
unsigned short crcByte(unsigned short crc, unsigned char ch) // lookup table version
(bigger & faster)
{
        static const unsigned short ccitt_crc16_table[256] =
        {
                0x0000, 0x1021, 0x2042, 0x3063, 0x4084, 0x50a5, 0x60c6, 0x70e7,
                0x8108, 0x9129, 0xa14a, 0xb16b, 0xc18c, 0xd1ad, 0xe1ce, 0xf1ef,
                0x1231, 0x0210, 0x3273, 0x2252, 0x52b5, 0x4294, 0x72f7, 0x62d6,
                0x9339, 0x8318, 0xb37b, 0xa35a, 0xd3bd, 0xc39c, 0xf3ff, 0xe3de,
                0x2462, 0x3443, 0x0420, 0x1401, 0x64e6, 0x74c7, 0x44a4, 0x5485,
                0xa56a, 0xb54b, 0x8528, 0x9509, 0xe5ee, 0xf5cf, 0xc5ac, 0xd58d,
                0x3653, 0x2672, 0x1611, 0x0630, 0x76d7, 0x66f6, 0x5695, 0x46b4,
                0xb75b, 0xa77a, 0x9719, 0x8738, 0xf7df, 0xe7fe, 0xd79d, 0xc7bc,
                0x48c4, 0x58e5, 0x6886, 0x78a7, 0x0840, 0x1861, 0x2802, 0x3823,
                0xc9cc, 0xd9ed, 0xe98e, 0xf9af, 0x8948, 0x9969, 0xa90a, 0xb92b,
                0x5af5, 0x4ad4, 0x7ab7, 0x6a96, 0x1a71, 0x0a50, 0x3a33, 0x2a12,
                0xdbfd, 0xcbdc, 0xfbbf, 0xeb9e, 0x9b79, 0x8b58, 0xbb3b, 0xab1a,
                0x6ca6, 0x7c87, 0x4ce4, 0x5cc5, 0x2c22, 0x3c03, 0x0c60, 0x1c41,
                0xedae, 0xfd8f, 0xcdec, 0xddcd, 0xad2a, 0xbd0b, 0x8d68, 0x9d49,
                0x7e97, 0x6eb6, 0x5ed5, 0x4ef4, 0x3e13, 0x2e32, 0x1e51, 0x0e70,
                0xff9f, 0xefbe, 0xdfdd, 0xcffc, 0xbf1b, 0xaf3a, 0x9f59, 0x8f78,
                0x9188, 0x81a9, 0xb1ca, 0xa1eb, 0xd10c, 0xc12d, 0xf14e, 0xe16f,
                0x1080, 0x00a1, 0x30c2, 0x20e3, 0x5004, 0x4025, 0x7046, 0x6067,
                0x83b9, 0x9398, 0xa3fb, 0xb3da, 0xc33d, 0xd31c, 0xe37f, 0xf35e,
                0x02b1, 0x1290, 0x22f3, 0x32d2, 0x4235, 0x5214, 0x6277, 0x7256,
                0xb5ea, 0xa5cb, 0x95a8, 0x8589, 0xf56e, 0xe54f, 0xd52c, 0xc50d,
                0x34e2, 0x24c3, 0x14a0, 0x0481, 0x7466, 0x6447, 0x5424, 0x4405,
                0xa7db, 0xb7fa, 0x8799, 0x97b8, 0xe75f, 0xf77e, 0xc71d, 0xd73c,
                0x26d3, 0x36f2, 0x0691, 0x16b0, 0x6657, 0x7676, 0x4615, 0x5634,
                0xd94c, 0xc96d, 0xf90e, 0xe92f, 0x99c8, 0x89e9, 0xb98a, 0xa9ab,
                0x5844, 0x4865, 0x7806, 0x6827, 0x18c0, 0x08e1, 0x3882, 0x28a3,
                0xcb7d, 0xdb5c, 0xeb3f, 0xfb1e, 0x8bf9, 0x9bd8, 0xabbb, 0xbb9a,
                0x4a75, 0x5a54, 0x6a37, 0x7a16, 0x0af1, 0x1ad0, 0x2ab3, 0x3a92,
                0xfd2e, 0xed0f, 0xdd6c, 0xcd4d, 0xbdaa, 0xad8b, 0x9de8, 0x8dc9,
                0x7c26, 0x6c07, 0x5c64, 0x4c45, 0x3ca2, 0x2c83, 0x1ce0, 0x0cc1,
                0xef1f, 0xff3e, 0xcf5d, 0xdf7c, 0xaf9b, 0xbfba, 0x8fd9, 0x9ff8,
                0x6e17, 0x7e36, 0x4e55, 0x5e74, 0x2e93, 0x3eb2, 0x0ed1, 0x1ef0
        };

    return ccitt_crc16_table[((crc >> 8) ^ ch) & 0xff] ^ (crc << 8);
}
```

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```
#else
unsigned short crcByte(unsigned short crc, unsigned char ch) // direct calculation
version (smaller & slower)
{

        unsigned short crc_new = (unsigned char)(crc >> 8) | (crc << 8);
        crc_new ^= ch;
        crc_new ^= (unsigned char)(crc_new & 0xff) >> 4;
        crc_new ^=   crc_new          << 12;
        crc_new ^= (crc_new & 0xff) <<   5;
        return crc_new;
}
#endif

#define CRC_INIT 0x1234 // this is the seed value used for along with the buffer's
first byte
unsigned short crcBuf(const void * buff, unsigned long len)
{

        unsigned long  i;
        unsigned short crc = CRC_INIT;
        const char * buf = buff;

        for(i = 0; i < len; i++)
        {

                crc = crcByte(crc, buf[i]);
        }

        return crc;
}
```

Appendix B – Initial Configuration Using a Telnet Progam (PuTTY)

B.1 Initial Configuration Using a Telnet Program

The Wireless F/T must be configured before communicating with the device. The following procedure will help provide steps to configure the Wireless F/T.

1. Install Virtual Communication Port Driver from the following website: http://www.ftdichip.com/ Support/Documents/InstallGuides.htm
   Select the instructions for the operating system running on the computer being used to configure the wireless F/T system. Follow the instructions to load the device driver on the computer.

2. Find the serial port number used by the Wireless unit by opening Device Manager (you can get to it by typing "Device Manager" in the Windows 7 Start Menu search bar), expanding the "Ports (COM & LPT)" section, and finding a connection labeled "USB Serial Port (COMx)" If there's more than one serial port, you may have to disconnect the USB cable and see which COM port is removed in the device manager, then reconnect the USB cable. The example in the following figure shows Wireless F/T is connected to COM5.

Figure 14.1—Windows 7 Device Manager
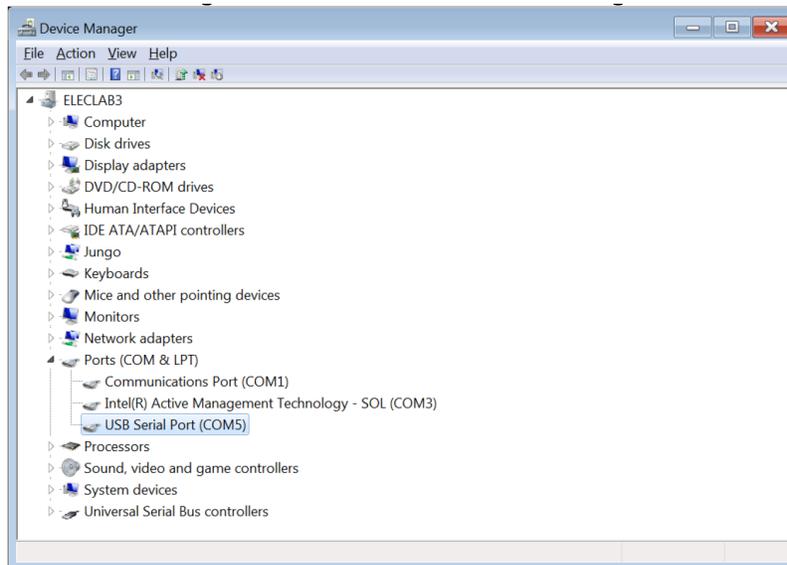
3. Install a telnet terminal program like PuTTY. Visit http://putty.org to download the executable file (putty. exe) for the PuTTY program.

4. Open (PuTTY) terminal program by clicking on the (putty) icon and selecting Run from the pop up window.

5. In the Category pane click on Connection > Serial and fill in the following fields:
   - Serial line to connect to COM5 (Enter the Com port the Wireless unit is using)
   - Speed (baud) 115200
   - Data bits 8
   - Stop bits 1
   - Parity None
   - Flow control None

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Figure 14.2—PuTTy Terminal Program
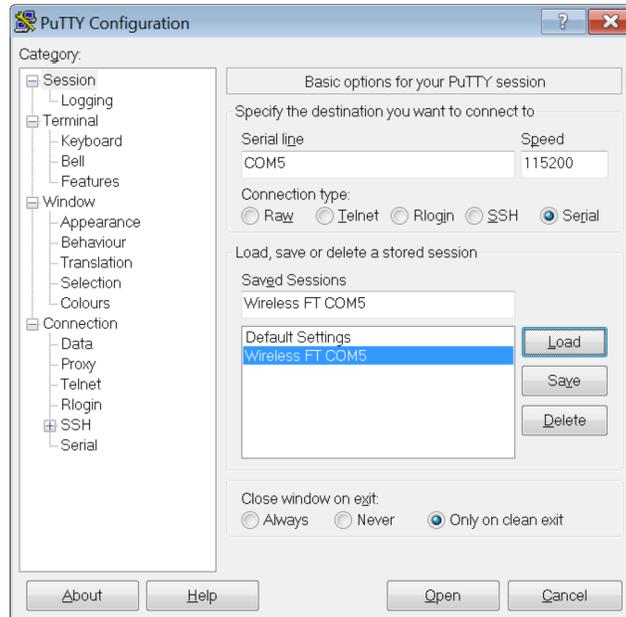
6. In the Category pane click on Session, The Serial Line should now be the COM port and Speed should be the values entered in the previous step. In the Saved Sessions field enter Wireless FT COM5 and select save. This will allow you to use this configuration at another time.

Figure 14.3—PuTTY Configuration
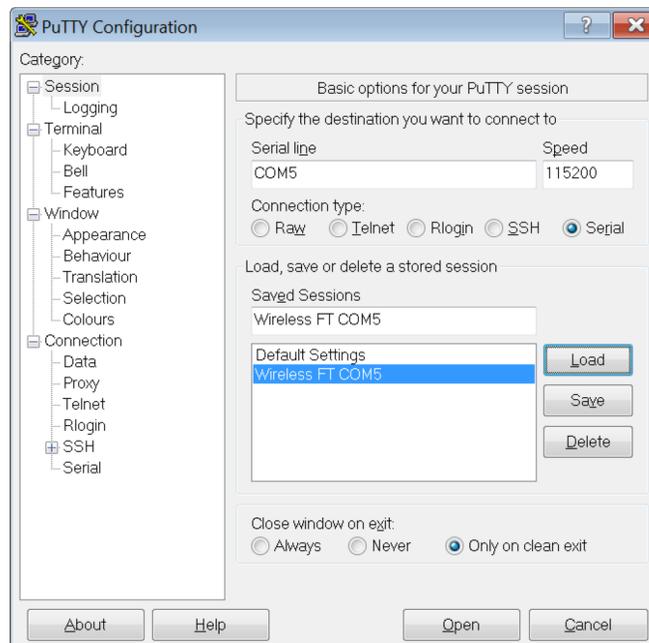
7. Connect to the console, e.g. by pressing "Open" in PuTTy. Information will appear as the unit attempts to connect to a wireless network.

8. In the COMx – PuTTY Window type "d" and press Enter key.

9. In the COMx – PuTTY Window type "t" and press Enter key. (Turns off the wireless connection on the unit).

10. Test that the unit is working by entering "IP" followed by the Enter key. This is the IP command, and will present the current IP settings. Refer to the following example screen.

Figure 14.4—Test the Connection
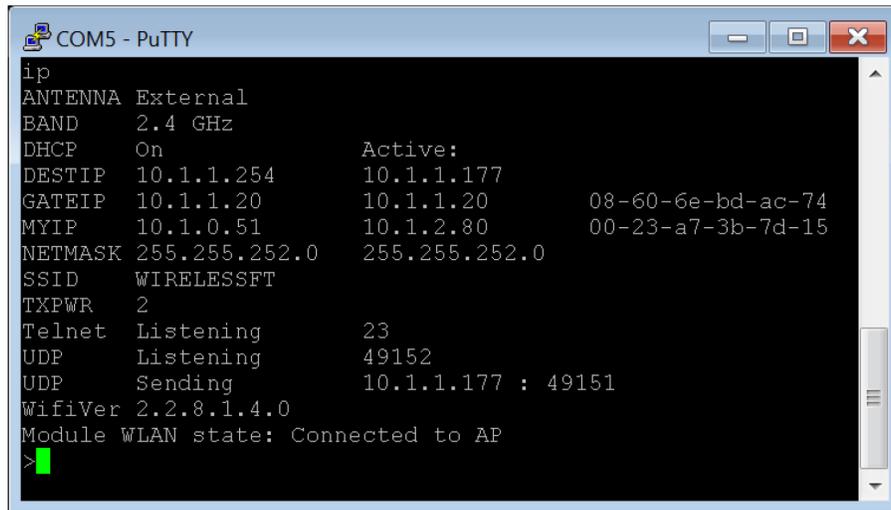
11. Obtain the following information from your network administrator: IP Address to use for the unit, Subnet Mask, Default Gateway, SSID, whether the Wi-Fi network operates on 2.4 or 5 gigahertz spectrum, IP address of the computer you're using to communicate with the unit.

12. Enter these commands in any order: (Commands are not case sensitive except where indicated)
    a. "MYIP <unitip>", e.g. "MYIP 192.168.1.50"
    b. "NETMASK <subnetmask>"
    c. "GATEIP <defaultgateway>"
    d. "SSID <ssid>" Network<ssid> (Is case sensitive)
    e. "BAND <x>" where x is "2.4" for 2.4 gigahertz or "5" for 5 gigahertz.
    f. "DESTIP <yourcomputersip>"

Figure 14.5—Test the Connection

13. Enter the "SAVEALL" command followed by the "RESET" command for the new settings to take effect.

14. Close the terminal program.

15. Press the On/Off switch for two seconds to power down. Then press again to power up. After initialization the unit will connect to the wireless network and begin streaming data.

16. Disconnect the USB cable from the Wireless F/T unit and the computer.

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Appendix C– Sampling Other Signals Using Wireless F/T inputs

C.1 Introduction

This appendix explains how to sample arbitrary analog or digital signals using transducer inputs on a Wireless F/T interface. These requirements include design of a signal conditioning circuit and calibration of the Wireless F/T inputs for analog signal sampling. This feature could be used to help synchronize F/T data with other sensors by using an empty transducer input to record a digital trigger signal.

C.2 Definitions

Internal Calibration – Wireless F/T analog signal calibration using only internal voltage references.

External Calibration – Wireless F/T analog signal calibration using external voltage references.

C.3 Wireless F/T Digital Input Sampling

Wireless F/T inputs can safely handle 3.3V or 5V logic signals. These signals will saturate the ADC and provide basic digital signal readings. The Wireless F/T amplifier electronics include a 2nd order 1kHz low-pass filter which will restrict usable digital signals to ~250 Hz.

C.4 Wireless F/T Analog Input Sampling

In order to sample an analog signal using a Wireless F/T you will probably need a signal conditioning circuit. The signal conditioning circuit must be designed to meet the requirements listed in *Table 15.1*. The following page shows an example signal conditioning circuit designed to take ±10 VDC in and output 2.5 VDC ±250 mVDC. The voltage data output by the Wireless F/T will not include the 2.5V input offset.

Table 15.1— Wireless F/T Input Specifications	
Absolute Maximum Input Voltage	See *Table 9.2*
Nominal Input Voltage	2.5 VDC
Maximum Full Scale Input Signal Range	2.5 VDC ±250 mVDC
Minimum Full Scale Input Signal Range	2.5 VDC ±30 mVDC
Input Impedance	5 MΩ
5V Supply Maximum Current	20mA
Note: 1. Exceeding this input voltage range could irreparably damage the Wireless F/T internal electronics.	

Figure 15.1—Rotating Reference Frame

Wireless F/T Analog Input Signal Conditioning

Switching Regulator

Wireless F/T Sensor Cable

2.5V Reference

Summation Amplifier

Signal Attenuator

CH_X Signal Conditioning

Input Buffer

Input Protection

$R1 = 40k * X - 10k$ where ±X is the input voltage range.

Notes:
1. The circuit as shown is designed for ±10V input range.
2. Input voltage range is limited by V+, V-, and the op amps that are used.
3. Input protection can be removed if the input comes from a safe and low noise source.
4. The input buffer can be removed if the input protection is removed and a low impedance source is used.
5. Noise can be reduced by using a low noise external power supply with linear regulators and low noise op amps with low value resistors.
6. Switching regulator selection is crucial for noise performance. The switching regulator must adequately power the circuit while consuming <20mA from the 5V source.
7. The Wireless F/T inputs should never exceed -7 VDC to +7 VDC.
8. Anyone attempting to implement this design should be an expert at designing and troubleshooting analog electronics.

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1031 Goodworth Drive
Apex, NC 27539
Phone: 919-772-0115
Fax: 919-772-8259

ISO 9001 Registered
Engineered Products for Manufacturing Productivity

Title: Wireless F/T Signal Conditioning
Size: Custom
ATI Part Number: 9230-05-1482
Project Number: 140930-3
Rev: 02
Drawn By: David Fleissner
Checked By: Alexander Stratzer
Date: Thursday, February 26, 2015
Sheet 1 of 1

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C.5 Wireless F/T Analog Input Calibration

Calibrating the Wireless F/T to read in an analog voltage can be performed using the Wireless F/T Java demo. Calibration slot 3 will be pre-calibrated by ATI using the Internal Calibration method below.

Access the Voltage Calibration window in the Java demo by going to Advanced->Voltage Calibration.

Figure 15.2—Access the Voltage Calibration Window
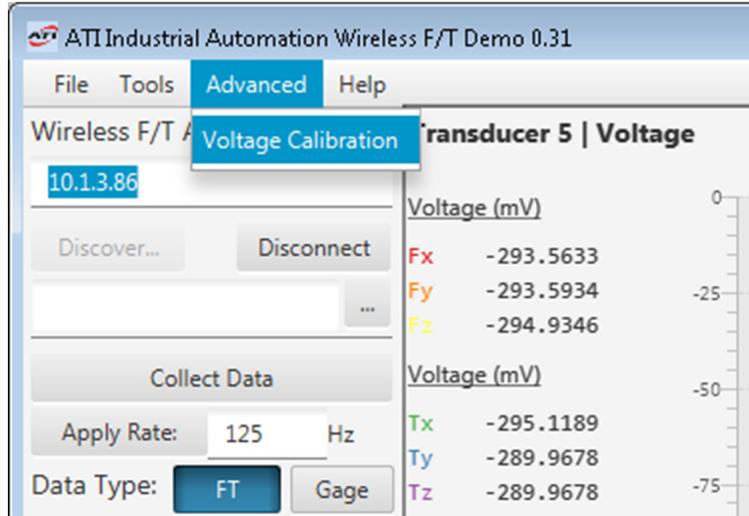
The Wireless F/T Java demo offers two methods to perform an analog input calibration:

C.5.1 Internal Calibration

The internal calibration method is performed only using the internal voltage references in the Wireless F/T. This calibration method is as simple as the press of a button and does not require external calibration equipment. However, expect some amount of gain error (±1% is common) when using the internal calibration method.

1. From the Voltage-Calibration window in the Wireless F/T Java demo click on the Auto-Calibrate button. The input range can be set using the Input Range box at the bottom of the window.

Figure 15.3—Set Input Range - Internal Calibration

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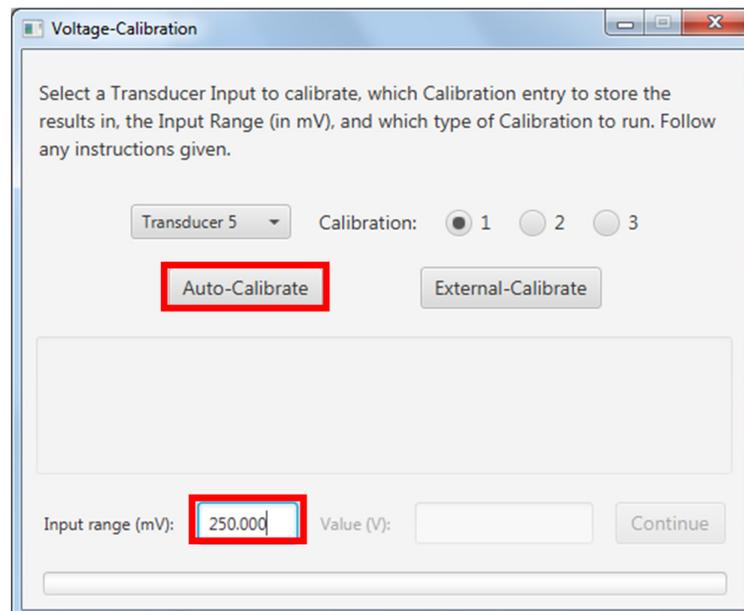
2. Once the internal calibration is complete, close the Voltage-Calibration window, apply your 2.5V reference to the inputs of the Wireless F/T, and bias the transducer input you just calibrated.

Figure 15.4—Apply the Input Range - Internal Calibration
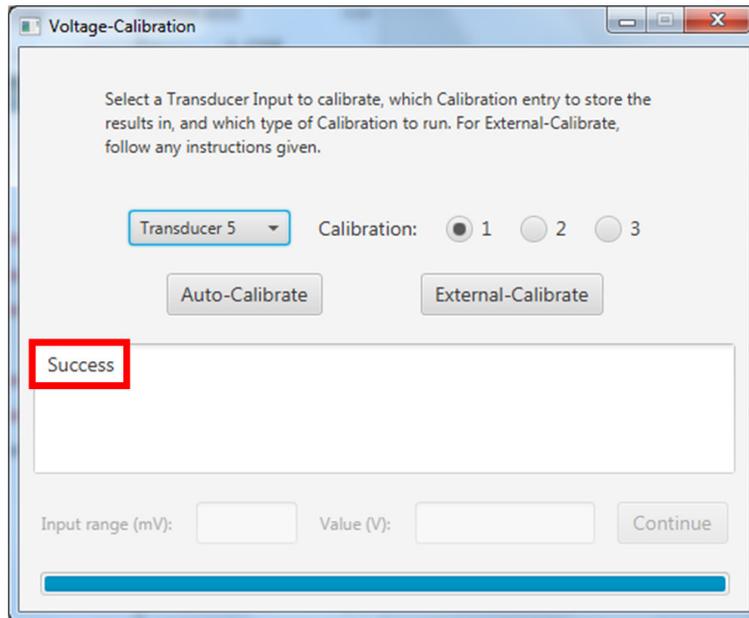

C.5.2 External Calibration

The external calibration method is performed by using external voltage references to calibrate the Wireless F/T inputs. This calibration method is more difficult to set up than the internal calibration but results in a more accurate calibration. The accuracy of this calibration method is primarily limited by the stability and accuracy of the external reference voltages.

1. From the Voltage-Calibration window in the Wireless F/T Java demo click on the External-Calibrate button. The input range can be set using the Input Range box at the bottom of the window.

Figure 15.5—Set Input Range - External Calibration
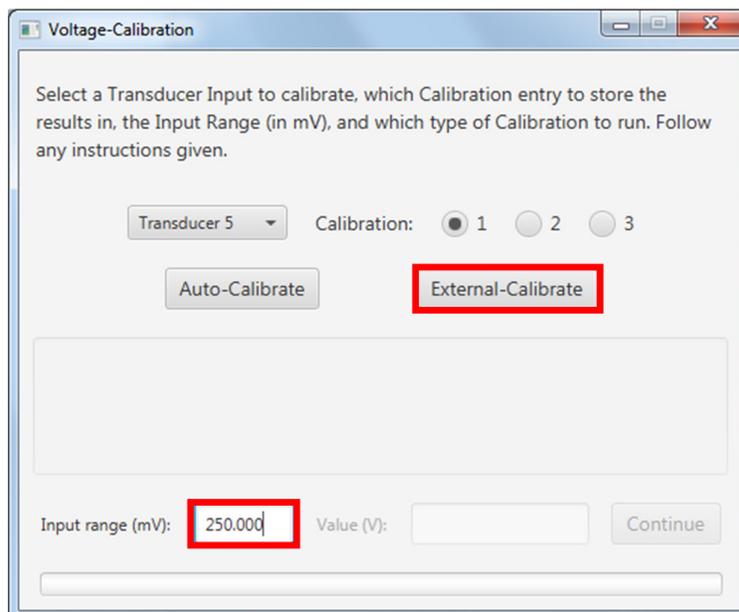
2. Follow the instructions given in the Voltage-Calibration window.

Figure 15.6—Select a Transducer to Calibrate - External Calibration
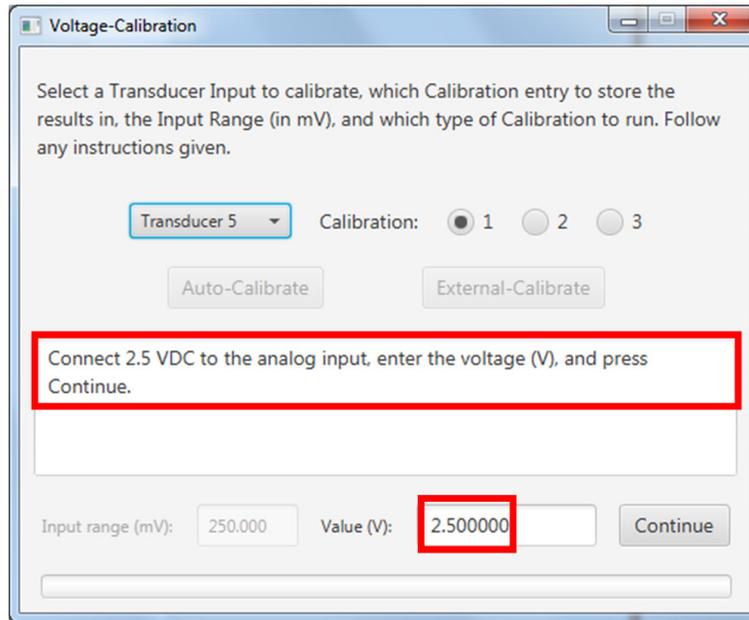

Figure 15.7—Select a Transducer Input to Calibrate - External Calibration
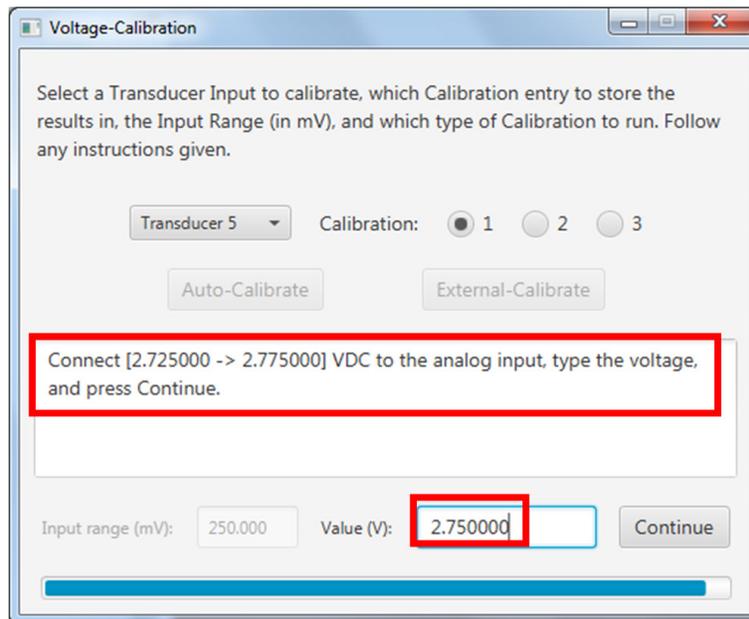
3. Once the external calibration is complete, close the Voltage-Calibration window, apply your 2.5 V reference to the inputs of the Wireless F/T, and bias the transducer input you just calibrated. See the Wireless F/T manual for more details about biasing a transducer input.

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Figure 15.8—Apply the Input Range - External Calibration
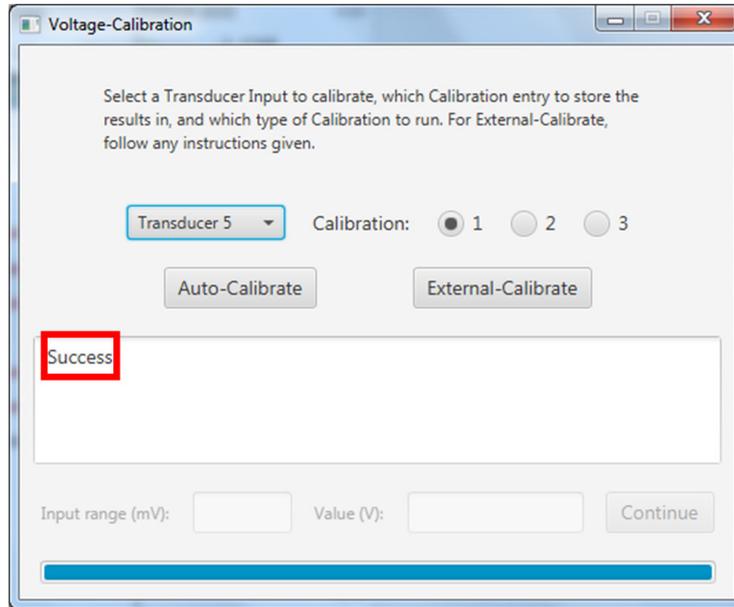
C.6 Troubleshooting

Figure 15.9— Troubleshooting		
Symptom	**Possible Cause**	**Correction**
Excessive noise	Too much power supply ripple	Use power supply with lower ripple voltage
	Op amps oscillating	Place ceramic decoupling capacitors near op amp supply pins
5V supply from Wireless F/T turns off unexpectedly	Drawing >20mA from 5V supply	Use power supply with higher efficiency at small loads
		Use 2.5V reference with lower supply current
		Use op amps with lower supply current
		Use external supply with higher current limit
Unexpected readings after calibration	Transducer input has not been biased	Bias transducer input with 2.5V reference connected to input
	External calibration had invalid input voltage	Repeat external calibration. Internal calibration can also be used to verify all hardware.

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Appendix D– Interpreting the Timestamp in Wireless F/T Demo Log

The timestamp in the Wireless F/T data log is a shortened version of the NTP timestamp format. The timestamp is represented as an unsigned 32-bit number. The upper 20 bits are the number of seconds and the lower 12 bits are the fractions of a second. The timestamp represents a fractional number of seconds, from the reference time period used by the NTP server. If the Wireless F/T is not connected to an NTP server, then its clock will default to January 1, 2010.

D.1 Converting NTP Format to Seconds

In post data processing, it is often useful to show the F/T data as a time series. To convert the Wireless F/T data log timestamp, to a useable value in seconds, treat the timestamp as a fixed point value with a q-point of 12.

In the datalog, sometimes the timestamp value represented as negative value. This is caused by Java interpreting the data as a signed 32-bit integer, rather than an unsigned 32-bit integer. To properly reflect the unsigned value, add 232 (4,294,967,296) to the negative number, before performing the fixed point conversion.

The conversion to seconds can be implemented as given in the equation below.

```
Timestamp in Seconds= (unsigned 32 bit Timestamp)*2^(-12)
```

D.2 Excel Conversion Example

Below is an example of how to easily add in the timestamp conversion to an excel sheet being used for analysis. The example assumes the timestamp is in column A.

Insert a new column into column B, and title it "Converted Timestamp [Sec]" in row 1. In row two of column B place the following formula.

```
=IF(A2<0,A2+2^32,A2)*2^(-12)
```

Apply the formula from cell B2 to the rest of the cells in column B. Column B now contains the timestamp in seconds.

Optionally if you would like to get the elapsed time, subtract the value in B2 from all other values in the data set.

Figure 16.1—Example Excel Sheet with Converted Timestamp and Elapsed Time

	A	B	C
1	Time	Converted Time [Sec]	Elapsed Time [Sec]
2	-964007418	813222.6265	0
3	-964007385	813222.6345	0.008056641
4	-964007352	813222.6426	0.016113281
5	-964007319	813222.6506	0.024169922
6	-964007287	813222.6584	0.031982422
7	-964007254	813222.6665	0.040039063
8	-964007221	813222.6746	0.048095703
9	-964007188	813222.6826	0.056152344

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