Wireless Force/Torque Sensor System

Installation and Operation Manual

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Engineered Products for Robotic Productivity
Pinnacle Park • 1031 Goodworth Drive • Apex, NC 27539 USA • Tel: +1.919.772.0115 • Fax: +1.919.772.8259 • www.ati-ia.com • Email: info@ati-ia.com

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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: 919.772.0115
Fax: 919.772.8259
E-mail: *info@ati-ia.com*

Technical support and questions:

Application Engineering
Tel: 919.772.0115, Option 2, Option 2
Fax: 919.772.8259
E-mail: *ft_support@ati-ia.com*

Table of Contents

Glossary of Terms

Terms	Definitions
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.
Sensor System	The assembly consisting of all components from the transducer to the WNet box.
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.

1. Safety

The safety section describes general safety guidelines to be followed with this product, explanation of the notification found in this manual, and safety precaution that apply to the product. More specific notification are imbedded within the sections of the manual where they apply.

1.1 Explanation of Notifications

The notifications included here 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.

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

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

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

NOTICE: Notification of specific information or instructions about maintaining, operating, 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, or 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.

CAUTION: Do not remove any fasteners or disassemble transducers without a removable mounting adapter plate, these include Nano, Mini, IP-rated, and some Omega transducers. This will cause irreparable damage to the transducer and void the warranty. Leave all fasteners in place and do not disassemble the transducer.

CAUTION: Do not exert excessive force on the transducer. The transducer is a sensitive instrument and can be damaged by applying force exceeding the single-axis overload values of the transducer and cause irreparable damage. Small Nano and Mini transducers can easily be overloaded during installation, refer to the F/T Transducer manual (9620-05-Transducer Section) for specific transducer overload values.

CAUTION: When setting up the Wireless F/T system adhere to the minimum bend radius. Bending the cables tighter than the minimum will cause damage to the cable. Refer to the F/T Transducer manual (9620-05-Transducer Section) for minimum bend radii.

CAUTION: Damage to the outer jacketing of the transducer cable could enable moisture or water to enter an otherwise sealed transducer. Ensure the cable jacketing is in good condition to prevent transducer damage

2. System Overview

The Wireless F/T can stream data to an existing wireless access point on the network. The Wireless F/T can stream six-axis measurements to the user's host device for data collection, real-time motion control, or user-defined signal processing.

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 signal conditioner and IEEE 802.11 wireless device for up to six ATI Multi-Axis Force/Torque transducers. The device supports TW transducers (such as Nano and Mini); transducers with integrated electronics are not supported. The Wireless F/T can stream F/T six-axis measurements to the user's host device for data collection, real-time motion control, or user-defined signal processing. The device is equipped with a slot for a MicroSD™ card, the card can be used to collect and store data. Transducer calibration settings can be downloaded into the Wireless F/T to allow users to easily replace transducers in the field for new configurations. The Wireless F/T is contained in an impact, splash, and dust resistant housing.

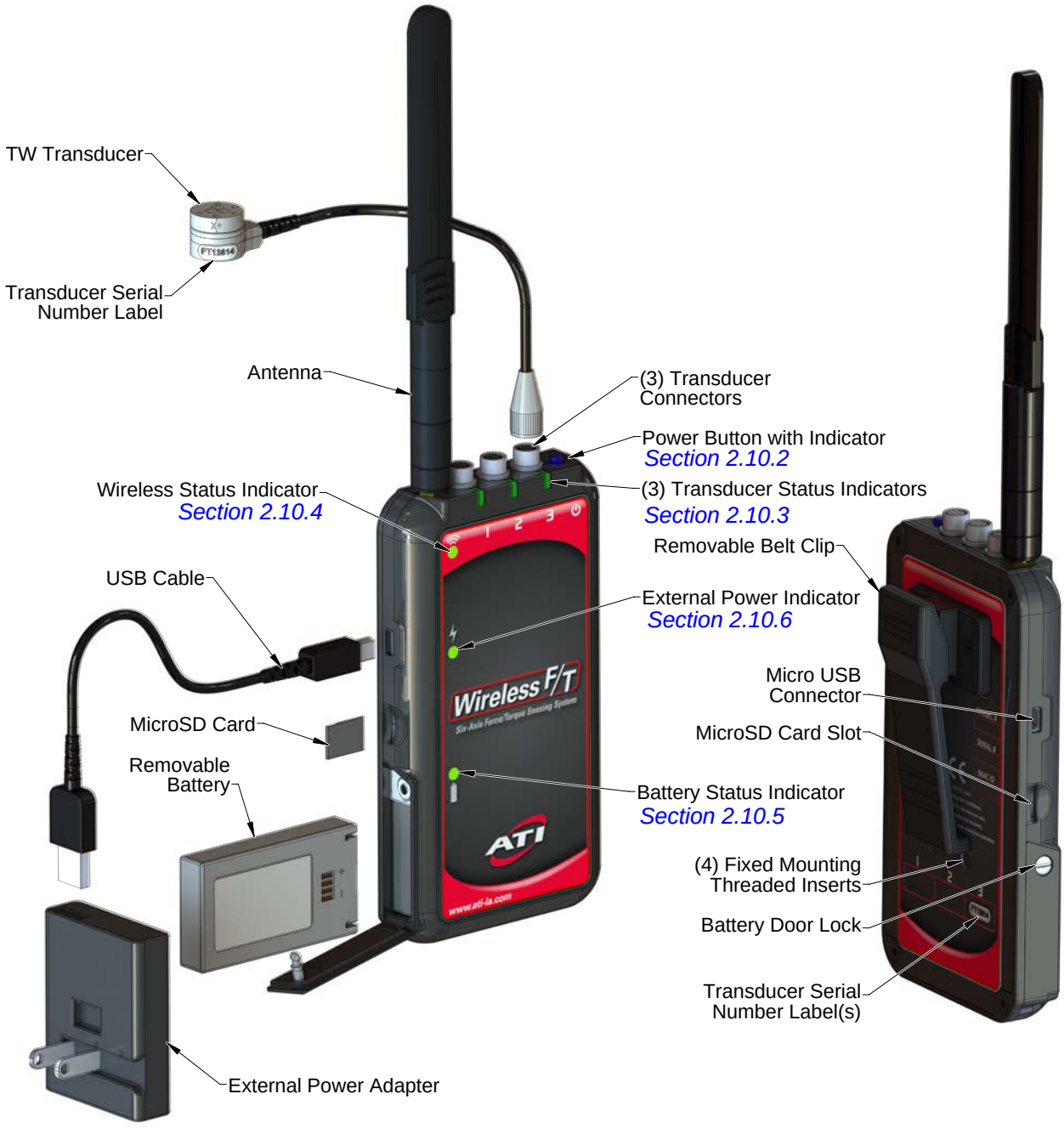
The Wireless F/T unit is certified with the antenna attached, the antenna can be pivoted 90° so the unit can be use in small confined spaces. Fixed mounting is accommodated with the four robust threaded inserts on the back plate of the housing. The unit can also be attached with a quick-removable belt clip for mobile applications. Both Wireless F/T models can be powered by an internal rechargeable battery for more mobile applications. The units can also be powered with a 5VDC external power adapter using the USB connector. The Wireless F/T has a battery charge status indicator that provides a low-battery warning. The battery can be charged internally or externally. The external power indicator is active when charging the battery internally or an external power adapter is used.

Wireless F/Ts include a rechargeable battery, antenna, external battery charger and USB cable. Optional desktop battery charger and international power cords are available, refer to *Section 8—Serviceable Parts* for more details.

2.1 Wireless F/T WNet-3

The Wireless F/T WNet-3 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 can be extended at lower rates and/or by disabling one or more transducers.

Figure 2.2—Wireless F/T WNet-3



2.2 Wireless F/T WNet-6

The Wireless F/T WNet-6 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 can be extended at lower rates and/or by disabling one or more transducers.

Figure 2.3—Wireless F/T WNet-6

2.3 Antenna

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

2.4 Micro USB Conector

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

2.5 MicoSD™ Card Slot

The WNet 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 5V 10W battery charging adapter that provides a power source to operate the unit and charge the battery. The adapter operates on 100 to 240 AC Input voltage and provides a USB Micro-A output connector. Interchagable AC clips that fit over the US prongs are available for international use.

2.7 USB Cable

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

2.8 Removable Belt Clip

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

2.9 Removable Battery

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

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*—Wireless F/T WNet-3 or *Figure 2.3*— Wireless F/T WNet-6 for location of controls and indicators.

2.10.1 Power Button

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

- Press the button once to power the unit up.
- Press button for approximately 2 seconds to power the unit down.
- Press the button for about 10 seconds to power cycle the system.

The 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 switch.

Table 2.1—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 WNet-3 has three transducer status indicators on the front of the device, below its corresponding connector. The Wireless F/T WNet-6 has six transducer indicators, three on the front of the device and three on the back below its corresponding connector.

Table 2.2—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 2.3—Wireless Status Indicator	
Behavior	**Description**
Steady Green	Indicates the unit is connected to an Access Point and there have been no recent 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, or the WLAN is set to off.

2.10.5 Battery Status Indicator

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

Table 2.4—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 almost depleted.
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 2.5—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.

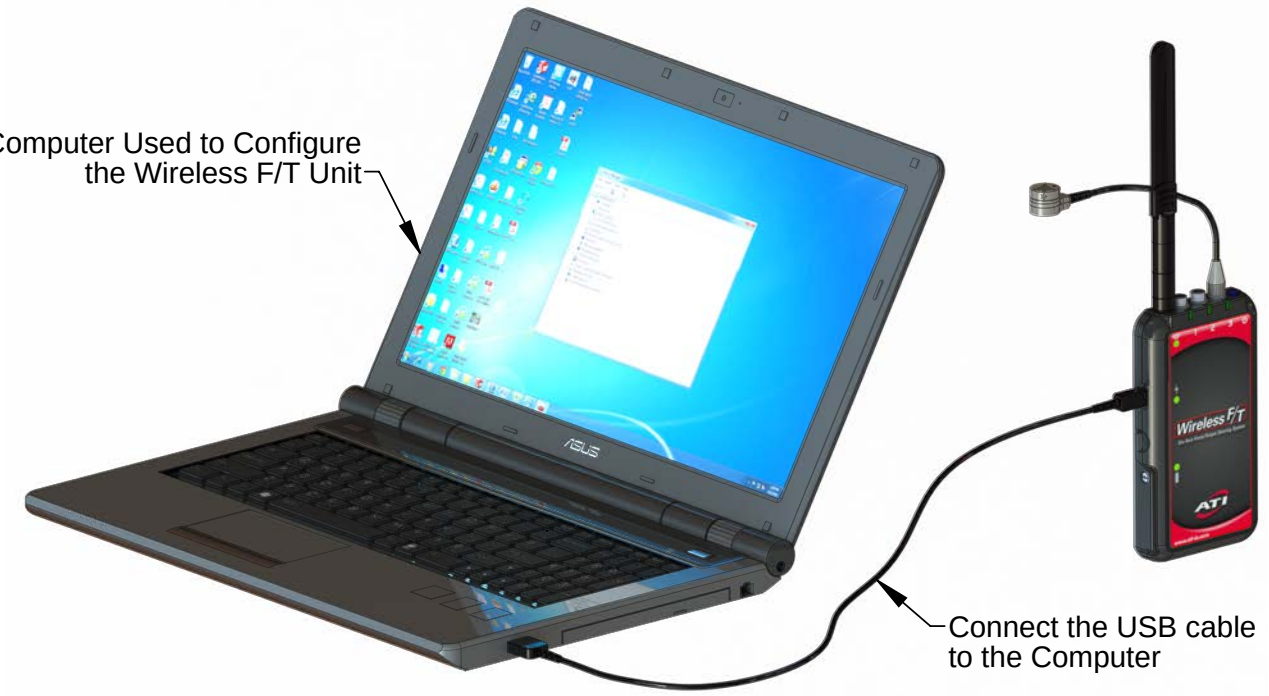
3. Installation

The Wireless F/T system consist of several components: Wireless F/T unit, transducer, external power adapter, USB cable, and software CD. The Wireless F/T unit must be set up and configured before installing the transducer so that forces can be monitored during installation.

The Wireless F/T has a removable belt clip that can be used for mobile application. There is also a fixed mounting option that uses four threaded inserts on the rear of the housing. To set up the Wireless F/T system, perform the following steps:

1. Unpack the system components from the container.
2. Using a flat head screw driver, turn the quarter turn screw and open the battery door (Note: 90 degrees clockwise to open and 90 degrees counterclockwise to close). Insert the battery, close and secure the battery door. (Note: the battery will only fit in one way with the label on the battery facing the front of the Wireless F/T Unit as shown in *Figure 2.2* or *Figure 2.3*). If the unit is to be powered by an external power adapter refer to *Section 3.3—External Power Adapter Installation*.
3. Attach the antenna to the Wireless F/T Unit.
4. Ensure each Transducer and the corresponding Wireless F/T connector are labeled with the same serial number, refer to *Figure 2.2* or *Figure 2.3*. Connect the transducer cable to the connector on the Wireless F/T unit. (Note: The cable connector has a notch that ensures the proper orientation to the connector on the Wireless F/T unit. The connector may have to be rotated until the notch lines up with the connector on the wireless unit. The connector will drop into place when they are lined up). Tighten the connector finger tight.
5. Connect the USB cable to the Wireless F/T unit and the external power adapter provided. Plug the power adapter into the wall.
6. Wait for the battery charge Status indicator to transition from flashing to solid green indicating the battery is fully charged. This will take approximately XXX minutes with a factory-new battery.
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:** The computer connected to the USB port does not provide sufficient source to keep the battery charged.

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



8. Momentarity press the power button, the system status indicator will turn on blue once then turn off indicating system normal.

> **NOTICE:** The system will take a moment to initialize; after initialization the Battery indicator should illuminate steady green indicating charged. The Transducer status indicator that the Transducer is connected to should illuminate steady green indicating normal condition. The Transmit Status Indicator will flash green until the Wireless F/T is configured and connected to a wireless network.

9. Install the Wireless F/T unit, refer to *Section 3.1—Typical Belt Clip Installation* or *Section 3.2—Typical Fixed Installation*.
10. If using an external Power adapter, refer to *Section 3.3—External Power Adapter Installation* for instructions
11. Configure the Wireless FT unit, refer to *Section 3.4—Initial Configuration*.

> **CAUTION:** Damage to the outer jacketing of the transducer cable could enable moisture or water to enter an otherwise sealed transducer. Ensure the cable jacketing is in good condition to prevent transducer damage.

3.1 Typical Belt Clip Installation

The location of the Wireless F/T is important, keep in mind that a unobstructed environment from the Wireless F/T to the wireless access point will improve signal strength. 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. If an external power adapter is being used, refer to *Section 3.3—External Power Adapter Installation* for information.

3.2 Typical Fixed Installation

To install the Wireless F/T in a fixed location refer to *Section 11—Drawings* for details on the threaded insert hole pattern dimensions. The location of the Wireless F/T is important. 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 3.3—External Power Adapter Installation* for information. Refer to *Section 4—Installing the Transducer* for installation instruction for the transducer and routing the transducer cable.

3.3 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.

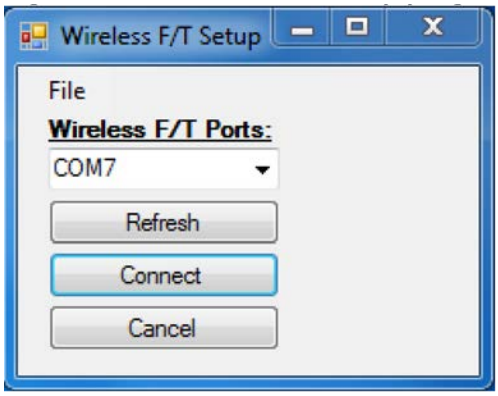
For installations that will repeatedly bend the USB cable, route the external power adapter cables so that it is not stressed, pulled, kinked, cut, or otherwise damaged throughout the full range of motion. If the desired application results in the cable rubbing, then use a loose plastic spiral wrap for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

3.4 Initial Configuration

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 the Virtual Communication Port Driverper the instructions found at:
   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. Remove the WNet software CD from the package and insert it into the CD drive on your computer or visit our website (*http://www.ati-ia.com/library/download.aspx*) and locate the WirelessFTSetup.exe file. The example in *Figure 3.2* shows the Wireless F/T Setup program main screen.

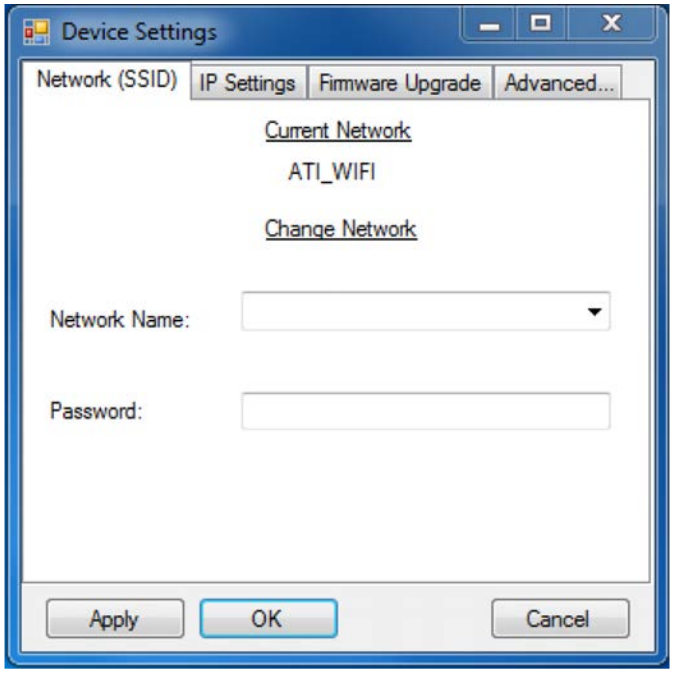
Figure 3.2—Wireless F/T Setup program



3. Select the COM port corresponding to your Wireless F/T. If you have more than one device connected, you can use Windows Device Manager to differentiate between them. You may need to press the "Refresh" button if your device was just connected to the PC or is still booting up. When you have selected the appropriate device, press the "Connect" button.
4. If your device is not already connected to the appropriate network, you can use the "Network (SSID)" tab to select from a list of networks the device found while powering up. If your network does not appear on the list, you can still type it in manually. If your network is password-enabled, you may enter that here as well.

NOTICE: The Wireless F/T will not connect to the new network until the device is reset.

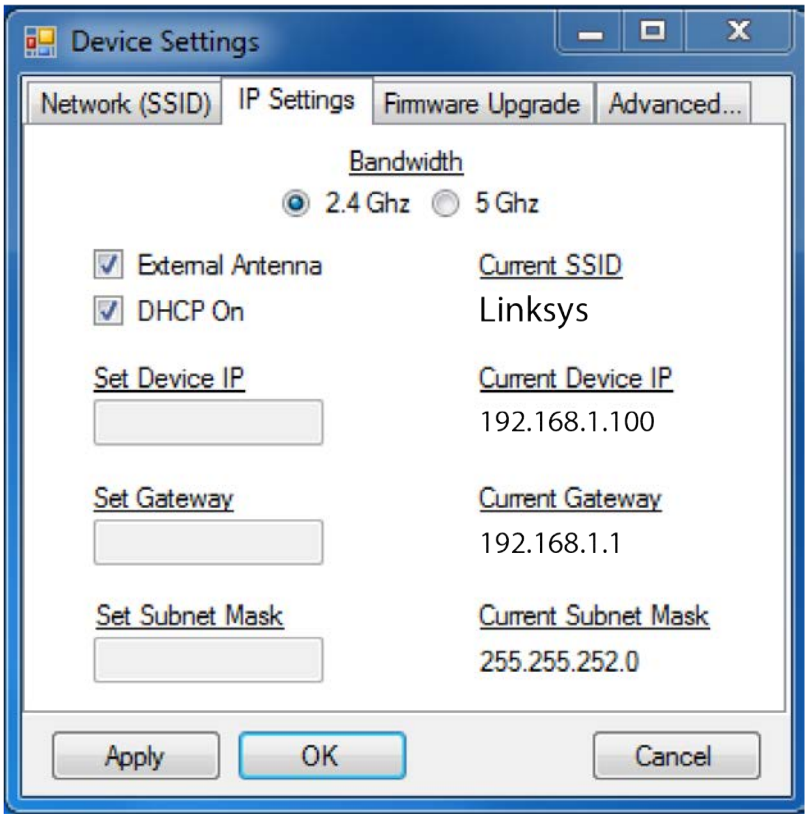
Figure 3.3—Network (SSID) Settings



5. Obtain the following information from your network administrator: IP Address to use for the unit, Subnet Mask, Default Gateway, SSID, and whether the Wi-Fi network operates on the 2.4 or 5 gigahertz spectrum. You may not need all of this information if your device operates on DHCP.

6. Select the "IP Settings" tab in the setup program and enter the appropriate information from step #5, as below. Note that in this example DHCP is enabled, so editing the Device IP, Gateway, and Subnet mask settings is not necessary.

Figure 3.4—IP Settings



7. When you have made all the appropriate changes to the device settings, press the "OK" button to apply the changes to the connected WNet unit and close the window.

NOTICE: The Changes will not take effect until AFTER the Wireless F/T has been reset. Do this by pressing the power button on the side of the device for two seconds to power off. Press it again to power up.

3.5 Installing the Wireless F/T Java Demo Application on a PC

The following steps are provided to install the Wireless F/T Java Demo application on a PC.

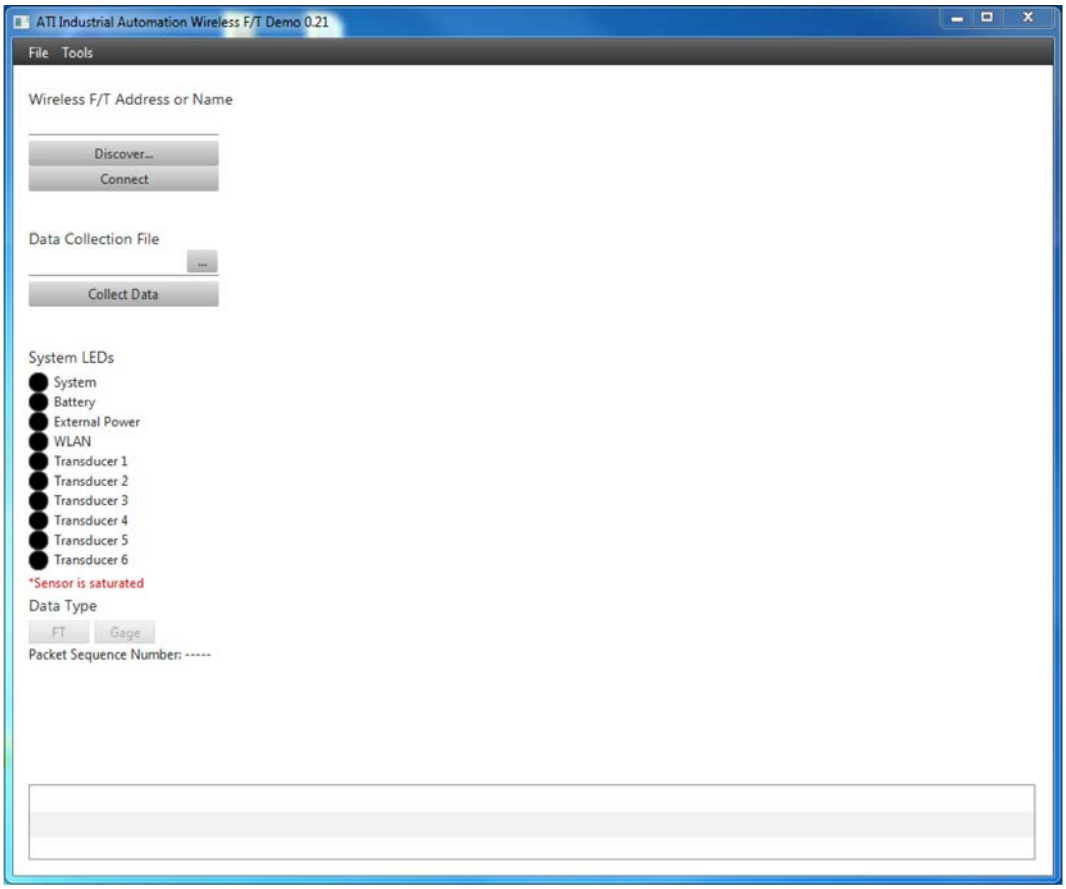
1. Remove the WNet software CD from the package and insert it into the CD drive on your computer or visit our website (*http://www.ati-ia.com/library/download.aspx*) and locate the WirelessFTJavaDemo.jar file.
2. Copy or download the WirelessFTJavaDemo.jar file to the directory desired.

NOTICE: Java version 1.7 or later must be installed on the PC, if not visit *http://java.com/en/* to download and install the latest version of Java.

3.6 Starting the Wireless F/T Java Demo Application

Locate the WirelessFTJavaDemo.jar file in windows explorer and double click on it. The Initial screen will appear.

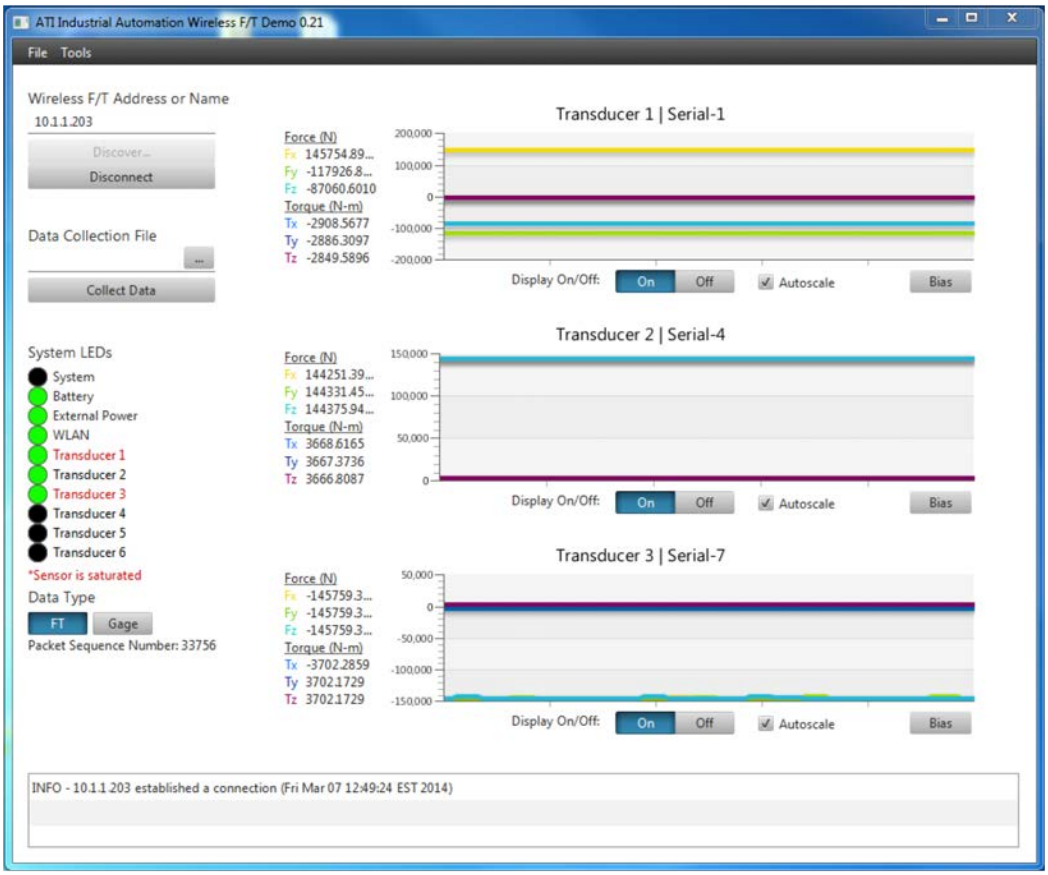
Figure 3.5—Initial Screen



3.7 Establishing a Connection to the Wireless F/T and Monitoring Data

To establish a connection to the Wireless F/T, enter the IP address from the *Section 3.4—Initial Configuration* that was designated for the Wireless F/T Unit into the "Wireless F/T Address or Name" field. If you don't know the IP Address, you can press the "Discover…" button to find which devices are currently on the network. Once you have selected your Wireless F/T, press the "Connect" button. The application will immediately begin displaying streaming data from the Transducers connected to the Wireless F/T Unit. The LED status from the Wireless F/T unit will also be displayed graphically and an on screen log of the error messages is displayed at the bottom of the screen.

Figure 3.6—Establish a Connection



The data type displayed can be switched from FT Data to raw Gage data by clicking the corresponding buttons. The Bias buttons for each transducer will set the current load level as the new zero point. If the maximum overload value of a transducer is exceeded, the demo program will display red text for the transducer which exceeded its max value (i.e. became "saturated").

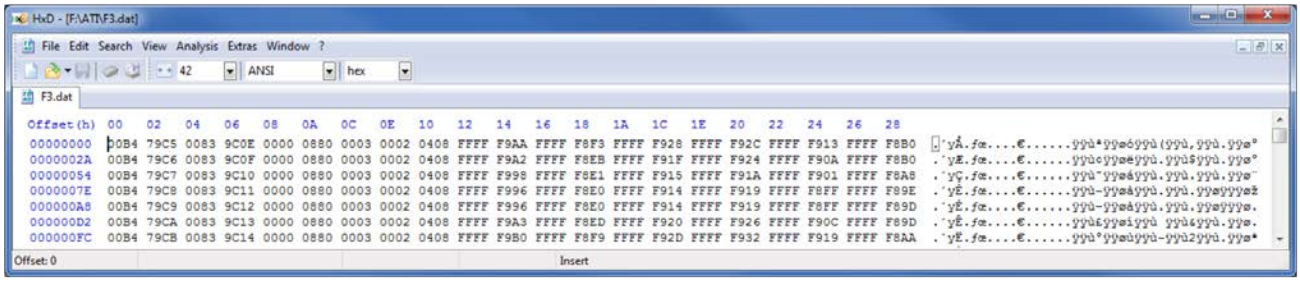
3.8 Data Collection

There are two ways data can be stored, data can be collected and stored on a file on a PC or network directory or it can be collected and stored on the customers MicroSD™ card plugged into the Wireless F/T unit.

3.8.1 Collecting and Storing Data on a MicroSD™ Card

To collect and store data on a MicroSD™ card .....

Figure 3.7—Sample F.dat Data File

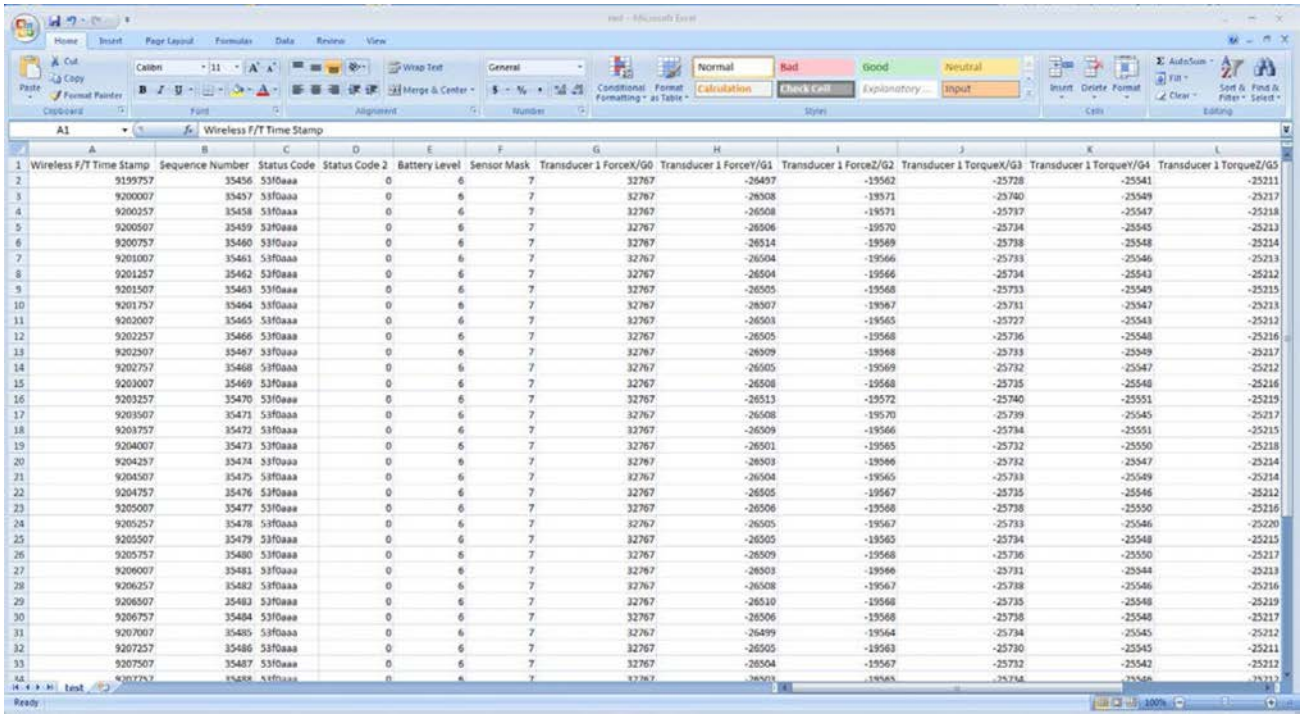


3.8.2 Collecting and Storing Data on a PC or Network File

To collect data to a file, enter the path and file name or click the "…" button to the left of the field and select an existing file (or enter the name of a new file). Click the "Collect Data" button to begin collecting data. Once you have the desired amount of data, click the "Stop" button to stop collecting data.

The measurement data is stored in comma-separated value format (CSV) so it can 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 work with.

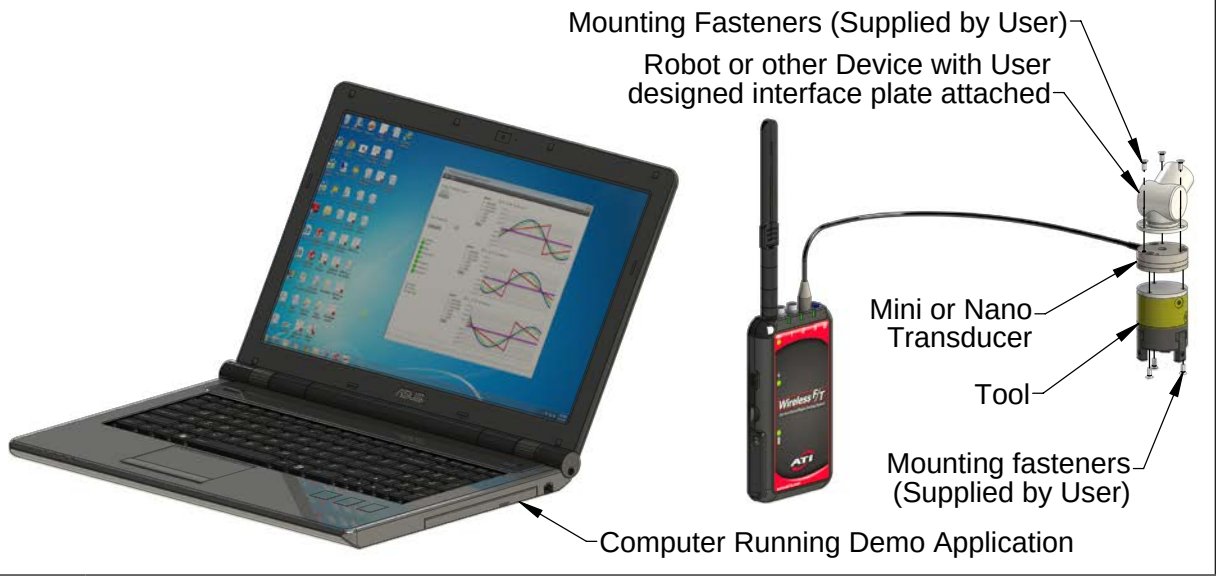
Figure 3.8—Sample CSV Data File Opened in MS Excel



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 3.7—Establishing a Connection to the Wireless F/T and Monitoring Data* 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 apply 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.



5. Command Interface

The WNet unit must be installed, setup and configured prior to using any command interfaces. Refer to *Section 3—Installation* 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:

- Commands can be sent over the USB Connection over the wireless connector as a virtual serial port
- Telnet server listening on TCP Port 23

5.2 UPD Interface

The WNET 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 WNET 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.

5.3 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__));
```

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.

5.4 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.

H, HELP, or "?"

These commands print a summary of the Console commands supported by the WNet unit.

A [S] => ADC Single read (Analog Board)

This command reads the ADC converters from the Analog Board one time, and prints the results. For example:

```
Tr Ch ADC-Raw
-- -- -------
 1  0 -12976
 1  1 -25950
 1  2 -31035
 1  3      0
 1  4      0
 1  5      0
 2  0 -12971
 2  1 -25940
 2  2 -31024
 2  3      0
 2  4      0
 2  5      0
 3  0 -12961
 3  1 -25920
 3  2 -31020
 3  3      0
 3  4      0
 3  5      0
```

AD => read all processor analog inputs

This command reads the processor analog inputs (Digital Board) and prints the results. For example:

```
Pin Voltage
--- -------
PD7 2.037
PE2 2.407
PE3 2.409
PE4 2.237
PE5 2.233
PE6 2.141
Temperature 33*C
```

ADCBW [FULL | 1/4] => set ADC bandwidth

This command selects the bandwidth for low-pass filter to either FULL or 1/4. Refer to the Selectable Low-Pass Filter section in the ADC data sheet for details. For ADC testing only.

```
1/4  →    1/4 of bandwidth, uses an additional series resistor to further
bandwidth limit the noise. Maximum throughput must also be reduced to ¼.

FULL →    full bandwidth
```

ADCDEL [1 -> 2000] => set minimum ADC conversion time in 12.5 nS units

This command sets the conversion delay time for the ADCs on the Analog Board when samples are being read from the same physical ADC. Each count = 1 / 80,000,000 second = 12.5 nS. If the delay is too short, the analog measurements will have additional noise. If the delay is too long, time is wasted. Because sampling from multiple transducers is interleaved, this value usually matters only if you reading samples from a single Transducer. For ADC testing only.

ADCINCC [0 -> 7] => set the ADC Input Channel Configuration

This command controls the input channel configuration, which consists of the selection of pseudo bipolar, pseudo differential, pairs, single-ended, or temperature sensor. Refer to the Input Configurations section of the ADC data sheet for details. Note that the firmware will automatically convert unipolar to bipolar as needed after each sample is read.

```
0.  Bipolar  differential pairs; INx– referenced to       VREF/2 ± 0.1 V.
1.  “
2.  Bipolar;                     INx  referenced to COM = VREF/2 ± 0.1 V.
3.  Temperature sensor.
4.  Unipolar differential pairs; INx– referenced to       GND    ± 0.1 V.
5.  “
6.  Unipolar,                    INx  referenced to COM = GND    ± 0.1 V.
7.  Unipolar,                    INx  referenced to       GND.
```

ADCREF [0 -> 7] => set the ADC reference

This command controls the selection of internal, external, external buffered, and enabling of the ADC on-chip temperature sensor. Refer to the Voltage Reference Output/Input section of the ADC data sheet for details. For ADC testing only.

```
0.  Internal reference, REF = 2.5   V output, temperature enabled.
1.  Internal reference, REF = 4.096 V output, temperature enabled.
2.  External reference,                       temperature enabled.
3.  External reference, internal buffer,      temperature enabled.
4.  Undefined
5.  Undefined
6.  External reference,                       temperature disabled.
7.  External reference, internal buffer,      temperature disabled.
```

ANALOG [ON | OFF] => Turns Analog power (ANALOG_SHDN) on or off

This command controls the ANALOG_SHDN bit to the Analog Board.

ANTENNA [INT | EXT] => select internal or external antenna

This command selects whether the WLAN Module uses its internal antenna or an external antenna.

AUTOZ => Auto Zero the Active Transducer/Calibration

This command auto zeros the offset settings for the active Transducer and Calibration.

BAND [2.4 | 5] => select 2.4 or 5 GHz Band

This command selects whether the WLAN Module uses the 2.4 GHz or the 5 GHz band.

BAT [ON | OFF | seconds] => Battery log on, off, toggle, or number of seconds

This command turns a battery status log on and off. This log is used for testing the operation of the battery, the Battery Charger, and the Gas Gage. A log entry is generated once per second. The log records the following data items:

a. day and time since last system restart

b. charging voltage, as measured by the processor (at VPROG = PE3)

c. battery voltage, as measured by the Gas Gauge (at SENSE-)

d. Gas Gage Accumulated Charge Register (Ah)

e. USB power present flag (yes or no)

f. USB Battery Charger Detect (yes or no)

g. generated battery level (0 to 10)

h. Basis of the battery charge estimate method, voltage or current

i. Battery Charger status message

j. USB current limit USBILIM (mA)

k. battery temperature (°C)

l. CPU temperature (°C)

m. Gas Gauge temperature (°C)

n. ADC temperature for each powered Transducer (°C).

Day-Time	VPROG	GGVolt	Charge:Ah	USBPwr	USBBCD	BatLvl	Based	BatteryChargerStatus	USBILIM	Batt*C	CPU*C	GG*C	T4*C	T5*C	T6*C
0-18:42:43	0.000	3.806	1.443	No	No	6	Volt	ChargerOff	100	-19.0	39.8	37.5	25.0	24.8	27.2
0-18:42:44	0.000	3.806	1.443	No	No	6	Volt	ChargerOff	100	-19.0	39.8	37.5	25.1	24.7	27.2
0-18:42:45	0.000	3.806	1.443	No	No	6	Volt	ChargerOff	100	-19.0	39.9	37.5	25.1	24.7	27.2
0-18:42:46	0.000	3.806	1.443	No	No	6	Volt	ChargerOff	100	-19.0	39.9	37.5	24.9	24.7	27.2
0-18:42:47	0.000	3.802	1.443	No	No	6	Volt	ChargerOff	100	-19.0	39.9	37.5	25.0	24.7	27.2
0-18:42:48	0.000	3.802	1.443	No	No	6	Volt	ChargerOff	100	-19.0	39.9	37.5	24.9	24.7	27.2

BC => print all Battery Charger registers

This command prints all Battery Charger registers in a decoded format. For example:

```
BC: 0 = 60 DISABLE_INPUT_UVCL = Enabled
           EN_BAT_CONDITIONER = Enabled > 60*C
           LOCKOUT_ID_PIN     = Autonomous Start-up Disabled
           USBILIM            = 100 mA max
BC: 1 = 20 PRIORITY           = Wall Input Prioritized
           TIMER              = 8 Hr or C/x indication
           WALLILIM           = 100 mA max
BC: 2 = fe ICHARGE            = 100 % => 2238 mA with RPROG = 536 Ohms
           CXSET              =   2 % =>   44 mA
           VFLOAT             = 4.20 V
BC: 3 = 03 CHARGER_STATUS     = Charger Off
           ID_PIN_DETECT      = No Detection: We are USB OTG-B peripheral
           OTG_ENABLED        = Step-Up Switching Regulator Inactive
           NTCSTAT            = too cold:  <  0*C
           LOWBAT             = not meaningful
BC: 4 = 00 EXT_PWR_GOOD       = Battery Power Only
           USBSNS_GOOD        = Voltage Invalid
           WALLSNS_GOOD       = Voltage Invalid
           AT_INPUT_ILIM      = Input Current Limit Inactive
           INPUT_UVCL_ACTIVE  = Input UVCL Inactive
           OVP_ACTIVE         = No Fault
           OTG_FAULT          = No Fault
           BAD_CELL           = No Fault
BC: 5 = ff NTCVAL Temperature = 127 => -19*C
           NTC_WARNING        = Too Warm or Too Cold to Charge
BC: 6 = 00 ENABLE_CHARGER_INT = Disabled
           ENABLE_FAULT_INT   = Disabled
           ENABLE_EXTPWR_INT  = Disabled
           ENABLE_OTG_INT     = Disabled
           ENABLE_AT_ILIM_INT = Disabled
           ENABLE_INPUT_UVCL_INT= Disabled
           REQUEST_OTG        = Step-Up Voltage Regulator Automatic or Disabled
```

BC [reg 0 -> 7] [hex byte] => write a Battery Charger register

This command allows you to modify any writable Battery Charger register.

BIAS [* | Transducer 1 -> 6] [OFF] => Set Bias on selected Transducer

This command allows you to set (or turn off) the bias on any or all Transducers.

BRIGHT [0 -> 100%] => Set Analog Board LED brightness

This command sets the brightness level of all LEDs on the Analog Board as a group. Brightness ranges from 0% to 100%.

C => Exit Continuous Mode

The continuous mode commands are provided as a test mode for the Analog Board. This command exits the continuous mode.

C [A] [channels 012345678 any combination ordered list]

This command will cause the ADC input from the selected channels (for the Active Transducer) to be printed continuously as fast as possible in the order requested.

C [D] [DAC 0 -> 7]

This command causes the selected DAC (for the Active Transducer) to be written continuously.

C [E] [EEPOT 0 -> 5]

This command causes the selected EEPOT output (for the Active Transducer) to be written continuously.

CAL => View Active Transducer/Calibration

This command allows you to view the Calibration Matrix for the Active Transducer and Calibration. This includes all of its associated parameters. For example, in a test system this command printed the following report:

```
Tr Cal   Gain Offset Row           G0        G1        G2        G3        G4        G5  Properties
-- ---   ---- ------ ---           --        --        --        --        --        --  ----------
 1   0      0  32768   0 Fx         1         0         0         0         0         0  Serial: Serial-1
 1   0      0  32768   1 Fy         0         1         0         0         0         0  Date:   1970/01/01
 1   0      0  32768   2 Fz         0         0         1         0         0         0  Part:   Part-1
 1   0      0  32768   3 Tx         0         0         0         1         0         0  Force:  12 counts/N
 1   0      0  32768   4 Ty         0         0         0         0         1         0  Torque: 34 counts/N
 1   0      0  32768   5 Tz         0         0         0         0         0         1  Mult:   OFF
 1                 0 MaxRatings:
 1                 0               0         0         0         0         0         0
```

CAL [MATRIX] [Row: 0 -> 5] [Gage: 0 -> 5] [float-values] => Change Active Matrix element(s)

This command allows you to modify a multiple elements of the active calibration matrix. You can initialize an entire matrix by typing CAL MAT 0 0 followed by 36 values. Array overflow is checked so that you cannot exceed the limits of the matrix.

CAL [GAIN] [* | Row: 0 -> 5] [0 -> 1023] => Change Active gain

This command allows you to set the gain for any or all of the 6 strain gages. This command operates on the Active Transducer and Active Calibration.

CAL [OFFSET] [* | Row: 0 -> 7] [0 -> 65535] => Change Active offset

This command allows you to set the offset for any or all of the 6 strain gages, and also the two unused channels 6 and 7. This command operates on the Active Transducer and Active Calibration.

CAL [MAX] [Row: 0 -> 5] [float-value] => Set Max Rating value

This command allows you to set any of the 6 floating-point Max Rating values.

CAL [SERIAL] [10-character string] => Change Active serial number

This command allows you to set the serial number associated with the active calibration.

CAL [DATE] [12-character string] => Change Active date

This command allows you to set the date associated with the active calibration.

CAL [PART] [32-character string] => Change Active part number

This command allows you to set the part number associated with the active calibration.

CAL [FORCE] [integer-value] [10-byte string] => Set Force Counts & Units

This command allows you to set the Force Counts and Force Units associated with the active calibration.

CAL [TORQUE] [integer-value] [20-byte string] => Set Torque Counts & Units

This command allows you to set the Torque Counts and Torque Units associated with the active calibration.

CAL [MULT] [*] [ON | OFF] => Matrix Multiply on/off

This command allows you to turn matrix multiplication on and off for the Active (or all) Transducers. This command applies only to the active calibration of each Transducer.

CPLD [ON | OFF] => Turns CPLD Chip Select on or off

This command allows you to set the CPLD JTAG Chip Select bit PD7. This command is for board test purposes only. If this bit is left on, no other SSI0 communications will work.

TRANS [Transducer 1 -> 6] => Set Active Transducer

This command allows you to change the active Transducer. It will also show you the Active Calibration for each Transducer, and which Transducer is currently active.

```
Tr Active-Calibrations
-- ------------------
 1  0 <-- Active Transducer
 2  0
 3  0
```

CALIB [Calibration 0 -> 2] => Set Active Calibration

This command allows you to change the active Calibration. It will also show you the Active Calibration for each Transducer, and which Transducer is currently active.

```
Tr Active-Calibrations
-- ------------------
 1  0 <-- Active Transducer
 2  0
 3  0
```

G [* | channel 0 -> 5] [gain 0 -> 1023] => Change Active Gain

This command allows you to change the gain for any or all of the 6 strain gages. This command is a shorthand version of CAL GAIN. This command operates on the Active Transducer and Active Calibration.

O [* | channel 0 -> 7] [offset 0 -> 65535] => Change Active Offset

This command allows you to change the offset for any or all of the 6 strain gages, and also the two unused channels 6 and 7. This command is a shorthand version of CAL OFFSET. This command operates on the Active Transducer and Active Calibration.

D [ON | OFF] => Dump packet on, off, or toggle

This command turns the dumping of outgoing UDP data packets to the console on and off.

DEVICES => print device list

This command prints a list of all devices that communicate with the processor through I2C or SPI busses. The list includes the device, the status, the bus, the bus address (when applicable), the Transducer associated with the device (if any), and the device temperature (if available). For example, the DEVICES command was issued in a system with only Analog Board 1, no Transducers connected, and the battery temperature sensor disconnected. It produced the following report:

```
Device          State Bus  Ad Tr Temperature Voltage Current
------          ----- ---  -- -- ----------- ------- -------
Processor       Good              49.5 *C
SDCARD          Good  SSI0
Serial Flash    Good  SSI0
Battery         NTC              -19.0 *C
Battery Charger Good  I2C0 64
Gas Gage        Good  I2C0 09      39.8 *C   3540 mV
WLAN Module     Good  SSI1
-------------------------------------------------------------------------------
Analog Board 1:
CPLD v.02       Good  SSI0 3c
EEPROM          Good  SSI0 3b

ADC             Good  SSI0 20  4   27.4 *C   4936 mV    5 mA
DAC             Good  SSI0 24  4
EEPOT0          Good  SSI0 25  4
EEPOT1          Good  SSI0 26  4
EEPOT2          Good  SSI0 27  4

ADC             Good  SSI0 28  5   27.2 *C   4884 mV    0 mA
DAC             Good  SSI0 2c  5
EEPOT0          Good  SSI0 2d  5
EEPOT1          Good  SSI0 2e  5
EEPOT2          Good  SSI0 2f  5

ADC             Good  SSI0 30  6   30.1 *C   4888 mV    0 mA
DAC             Good  SSI0 34  6
EEPOT0          Good  SSI0 35  6
EEPOT1          Good  SSI0 36  6
EEPOT2          Good  SSI0 37  6
```

DESTIP [n.n.n.n] => Set Destination IP

This command sets the 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.

EEPOT => print resistance-tolerance & end-to-end resistance of all EEPOTs

This command prints the resistance tolerance and end-to-end resistance of all powered EEPOTs on the Analog Board. For example:

```
>eepot
Tr Chip  Raw Tolerance(%) Resistance(K-Ohms)
-- ----  --- ------------ ------------------
 1   0  810b     1.042      25.260
 1   1  8582     5.507      26.376
 1   2  8522     5.132      26.283
 2   0  809e     0.617      25.154
 2   1  8507     5.027      26.256
 2   2  80d6     0.835      25.208
 3   0  806f     0.433      25.108
 3   1  854f     5.308      26.327
 3   2  82ed     2.925      25.731
```

EEPOT TEST [Transducer 1 -> 6] [Chip 0 -> 2] [24-bit command] => Send command to selected EEPOT & see the response

This command allows you to send any arbitrary command to an EEPOT and see the response. For possible commands please consult the ADN2850 data sheet, under "Theory of Operation". For example, to read the EEMEM content from Transducer 1, Chip 0, memory location 15:

```
>eepot test 1 0 0x9f0000
Tr=1 Chip=0 Tx=9f0000 Rx=9f810b
```

EEPOT DUMP => Dump the memory of all EEPOTs

This command allows you to dump the memory of all EEPOTs in a system. This includes both RDACs and the 16 EEMEM locations. For example:

```
>eepot dump
Tr Ch  DAC0 DAC1    0    1    2    3    4    5    6    7    8    9   10   11   12   13   14   15
-- --  ---- ----    -    -    -    -    -    -    -    -    -    -   --   --   --   --   --   --
 1  0  0000 0005 0200 0200 0007 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 810b
 1  1  0003 0004 0200 0200 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 8582
 1  2  0002 0001 0200 0200 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 8522
 2  0  0000 0000 0200 0200 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 809e
 2  1  0000 0000 0200 0200 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 8507
 2  2  0000 0000 0200 0200 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 80d6
 3  0  0000 0000 0200 0200 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 806f
 3  1  0000 0000 0200 0200 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 854f
 3  2  0000 0000 0200 0200 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 82ed
```

FACTORY => Restore all calibrations and IP settings to factory defaults

This command restores all parameters, calibrations, and IP settings to the factory defaults. Use with caution, as this command also erases the parameters in serial flash.

FCLOSE => Close all files

This command closes all files in the serial flash file system. The file system is saved to serial flash, and can now survive a processor reset.

FDEL [filename] => File delete

This command deletes the specified file in the serial flash file system. The file system is saved to serial flash, and can now survive a processor reset.

FDIR => File System directory

This command prints the directory of the serial flash file system. For example:

```
>fdir
File-name                          Length Attr Cluster CRC
---------                          ------ ---- ------- ---
abc                                    52 fffb       7 963d
123                                    20 fffb       8 3444
abcdef                                 26 fffb       9 44fe
3 File(s)  98 bytes  2,056,192 bytes free
```

FDUMP [filename] => File dump

This command prints the contents of the specified file in hex and characters. For example:

```
>fdump abc
000000 6162 6364 6566 6768 696a 6b6c 6d6e 6f70 abcdefghijklmnop
000010 7172 7374 7576 7778 797a 4142 4344 4546 qrstuvwxyzABCDEF
000020 4748 494a 4b4c 4d4e 4f50 5152 5354 5556 GHIJKLMNOPQRSTUV
000030 5758 595a                               WXYZ
```

FHEX [filename][hexdata] => File Write

This command allows you to enter data into a file as hex characters. Hex characters should be entered as whole bytes only (i.e. only enter pairs of hex characters). New data is appended onto the end of existing files. To write a brand-new file you must first delete any existing file. After you are finished writing a file use FCLOSE to make sure that everything is saved. This command is intended to be used for downloading Processor and WLAN Module files to be used for upgrading the Wireless F/T unit. For example, this series of commands:

```
>fhex abcdef abcdef
>fhex abcdef 0123456789
>fhex abcdef 00112233445566778899aabbccddeeff
```

creates the file:

```
>fdump abcdef
000000 abcd ef01 2345 6789 0011 0011 2233 4455 ....#Eg.....”3DU
000010 6677 8899 aabb ccdd eeff                fw........
```

FWRITE [filename][data] => File Write.

This command allows you to enter data into a file as a text string. New data is appended onto the end of existing files. This command is for testing the file system, as it is impossible to use it to enter binary images.

GATEIP [n.n.n.n] => Set the Gateway IP

This command sets the gateway IP address.

GG => print all Gas Gage registers

This command prints all sixteen Gas Gage registers in a decoded format. For example:

```
GG: A = 0c Chip=LTC2942
           Charge Alert High
           Charge Alert Low
GG: B = fc Mode=auto PrescalerM=7 AL/CCpin=alert Shutdown=off
GG: C = 00
GG: D = 2b Charge      accumulated    =    43 => 0.009 Ah
GG: E = 29
GG: F = 8b Charge      threshold high = 10635 => 2.259 Ah
GG: G = 04
GG: H = 27 Charge      threshold low  =  1063 => 0.225 Ah
GG: I = 89
GG: J = 04 Voltage     at SENSE-      = 35076 => 3.211 V
GG: K = ea Voltage     threshold high = 59904 => 5.484 V
GG: L = 73 Voltage     threshold low  = 29440 => 2.695 V
GG: M = 87
GG: N = c0 Temperature at Gas Gage    = 34752 =>    45 *C
GG: O = 98 Temperature threshold high =   152 =>    83 *C
GG: P = 63 Temperature threshold low  =    99 =>   -41 *C
```

GG [reg A -> P] [hex byte] => write a Gas Gage register

This command allows you to modify any writable Gas Gage register.

IP => Display IP parameters

This command prints the communication parameters in a decoded format. For example:

```
>ip
Parameter       Active          Default         MAC
---------       ------          -------         ---
SSID            ATI_WIFI        ATI_WIFI
DESTIP          0.0.0.0         0.0.0.0
GATEIP          10.1.1.20       192.168.0.1     00-20-a6-b4-5a-34
DEVIP           10.1.2.102      192.168.0.3     00-23-a7-0c-01-03
NET MASK        255.255.252.0   255.255.255.0
ANTENNA         External
BAND            2.4 GHz
NET CHANNEL     1
NET DHCP        On
NET MODE        Normal CLIENT Mode
NET UDPACT      BUFFER
TXPWR           2
Firmware        Version 2.1.0 - Mar 17 2014 16:46:05
WLAN Module     Version 2.4.0.1.5.4
WLAN: 18:50:35 Network parameters:
WLAN Connected  Yes
Channel number  1
Network type    Infra
Security level  WEP
Open sockets    4
Sock Type   MyPort RemPort  RemIP
---- ----   ------ -------  -----
   1 UDPout  49152   49152  0.0.0.0
   2 UDPin   49152       0  0.0.0.0
   3 TCPin      23       0  0.0.0.0
   4 UDPin   51000       0  0.0.0.0
```

LED [RED | GREEN] [ON | OFF | AUTO] => Controls indicated Digital Board LED

This command allows you to manually control the Red and Green LEDs on the Digital Board for testing, and then return the LEDs to automatic control.

LED1 [board: 0 | 1] [byte | AUTO] => Write byte to LED1 on the selected Analog Board

This command allows you to manually control the LEDs on LED Port 1 of the selected Analog Board for testing, and then return the LEDs to automatic control. For example:

```
>LED1 0 0x51
Board Port Value Mode
----- ---- ----- ----
    0 LED1 51    TEST-output
    0 LED2 22    AUTO-output
    0 PWR  3f    AUTO-output
```

LED2 [board: 0 | 1] [byte | AUTO] => Write byte to LED2 on the selected Analog Board

This command allows you to manually control the LEDs on LED Port 2 of the selected Analog Board for testing, and then return the LEDs to automatic control. For example:

```
>LED2 0 0x51
Board Port Value Mode
----- ---- ----- ----
    0 LED1 aa    AUTO-output
    0 LED2 51    TEST-output
    0 PWR  3f    AUTO-output
```

PWR Port [board: 0 | 1] [byte | AUTO] => Write byte to PWR on the selected Analog Board

This command allows you to manually control either Analog Board PWR port for testing, and then return it to automatic control. PWR with no operands gives you a report on the status of the power ports:

```
>pwr 0 0x0f
Board Port Value Mode
----- ---- ----- ----
    0 LED1 aa    AUTO-output
    0 LED2 22    AUTO-output
    0 PWR  0f    TEST-output
```

FILTER [* | Transducer 1 -> 6] [MEAN | MEDIAN | IIR] [taps | tc] => Set filter type & number of taps or time constant

This command allows you to set the filter type and the number of taps in the filter that the ADC inputs pass through for any or all Transducers. The default is 1 (no filtering). MEAN is a simple running mean, which is a form of low-pass filter. MEDIAN is a simple running median, which is another form of low-pass filter. Note that a 31-tap MEAN filter running in all 6 Transducers executes in about 65 µS, while a 31-tap MEDIAN filter in all 6 Transducers executes in about 480 µS, on average. This means that the maximum possible packet rate (RATE) is lower if you use a MEDIAN filter as compared to a MEAN filter of the same size. If a number of taps is not given, the number of taps is not changed. For IIR filters only, the time constant of the filter is the "number of taps" samples. Taps range from 1 to 32. Time Constants range from 1 to 32767. This command will also give you a report of the current filter settings:

```
Tr Filter Taps    TC
-- ------ ----    --
 1 MEAN     32
 2 MEDIAN   31
 3 MEDIAN   15
 4 IIR            32
 5 IIR            64
 6 IIR           128
```

FILTER S

This command displays statistics on how long it is taking to generate packets. This includes the time that filtering takes. For example:

```
>filter s
TimeConstant = 2048 Packet generation time mean = 37.163 uS stdev = 0.197 uS
```

LPF [* | Transducer 1 -> 6] [taps 1 -> 32] => Set MEAN low-pass filtering & number of taps

This command allows you to enable a running-mean low-pass filter, along with its number of taps. This is the filter that the ADC inputs pass through for any or all Transducers. The default is 1 (no filtering). This command will also give you a report of the current filter settings. If a number of taps is not given, the number of taps is not changed. This command is the equivalent of issuing:

```
FILTER [* | Transducer 1 -> 6] MEAN [taps 1 -> 32]
```

MYIP [n.n.n.n] => Set My IP

This command sets the IP address of this WNET unit.

NET AP => Display Access Points found in the last scan

This command displays any Access Points that were found during the last Scan. For example :

```
>net ap
# Ch  Secur RSSI  SNR NType        MAC        SSID
- --  ----- ----  --- -----        ---        ----
1   1 WPA2   -39  -39 Infra 00-21-a7-a4-49-ff ATI_WIFI
2   6 WPA2   -69  -13 Infra 00-22-a8-c4-3a-34 ATI_WIFI
```

NET CHANNEL [1 -> 13 | 149 | 153 | 157 | 161 | 165] => Channel to use if AP or GO

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).

NET DHCP [ON | OFF] => DHCP on or off

This command turns DHCP support on and off.

NET DNS [up to 90 characters] => Get IP address(es) of given URL

This command allows you to find the IP address(es) associated with a given URL. It tells you if network that you are connected to has connectivity to the wider internet. For example:

```
>net dns microsoft.com
WLAN: 03:16:39
## IP-Address
-- ----------
 1 64.4.11.37
 2 65.55.58.201
```

NET KEY [up to 64 characters] => Set encryption key

This command sets the network key (sometimes called PSK) that is used with WEP, WPA, and WPA2 encryption. For WEP it must be exactly 5 or 13 characters (direct WEP entry in hex is not supported). For WPA and WPA2 it must be no more than 64 characters.

NET MASK [n.n.n.n] => Set Subnet Mask

This command sets the subnet mask. A subnet mask is a 32-bit mask that is used to determine what subnet an IP address belongs to. If you AND a packet's IP address with the subnet mask and the result is the same as the original IP address, the IP address is in the local subnet. If the result is different from the original IP address, the IP address is in some other subnet, so the packet must be sent to the gateway device for further routing.

NET MODE [CLIENT | DIRECT] => Set Client or Direct operating mode

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

NET UDPACT [BUFFER | DROP] => Packet action during flow control

This command controls the action that the unit takes while the WLAN Module has told it to stop sending packets.

a. BUFFER means that the unit will buffer data packets during the flow control period, and then send them when it is possible to do so. Data will only be lost if the flow control period lasts longer than available storage for the buffer. This mode minimizes missing data, and is preferred for data logging applications.

b. DROP means that the unit will drop all data packets generated during the flow control period. Packet transmission will resume at the end of the flow control event. This mode minimizes latency, and is preferred for robotic control applications.

PORTS => print list of all GPIO ports

This command prints a list of all GPIO ports of the processor. Each entry of the list contains the port, the bit on that port (0 through 7), the purpose of the bit, the current value of the bit (either 0 or 1), the GPIOPCTL setting for the bit (either GPIO or some peripheral device number), the direction of the port if it is GPIO (either in or out), the strength of the port in mA, the pin-type, and any interrupts triggered from the pin. For example:

```
Bit V Purpose  GPIOPCTL Dir Strength Pin-Type                    GPIO-Interrupt
--- - -------  -------- --- -------- --------                    --------------
PA0 1 UART0_RX        1     2 mA     Push-pull, weak pull-up
PA1 1 UART0_TX        1     2 mA     Push-pull
PA2 0 SPI0_CLK        1     8 mA     Push-pull
PA3 1 SD_CS           1 Out 2 mA     Push-pull
PA4 1 SPI0_MISO       1     2 mA     Push-pull, weak pull-up
PA5 1 SPI0_MOSI       1     8 mA     Push-pull
PA6 0 WLAN_RDY     GPIO In  2 mA     Push-pull, weak pull-up
PA7 0 PWM_Sync     GPIO In  2 mA     Push-pull

PB0 0 JTAG_ENA     GPIO Out 2 mA     Push-pull
PB1 0 LED_SYS      GPIO Out 2 mA     Push-pull
PB2 1 I2C0_CLK        1     2 mA     Open-drain, weak pull-up
PB3 1 I2C0_SDA        1     2 mA     Open-drain, weak pull-up
PB4 1 MODE_SEL0    GPIO Out 2 mA     Push-pull
PB5 0              GPIO In  2 mA     Analog comparator
PB6 0 BUTTON       GPIO In  2 mA     Push-pull, weak pull-down
PB7 0              GPIO In  2 mA     Analog comparator

. . .
```

RATEADC [rate: 5 -> 4000 Hz] => Set ADC read rate

This command allows you to set the rate at which the ADCs are read. The default is 2500 Hz, or one ADC read every 0.4 mS = 400 μS. Reading the ADCs more often results in more accurate ADC reads if smoothing is in use, at the cost of using more compute time.

RATE [rate: 1 -> 2500 ADC reads] => Set packet transmit rate

This command allows you to set the rate at which UDP packets are sent to the destination IP address. The rate is set in terms of multiples of the ADC read rate (see below). The default is to send one UDP packet every 250 ADC reads. At this default rate, and at the 2500 Hz default ADC read rate one UDP packet is sent every 100 mS (10 Hz).

The fastest packet rate that is useful in an application depends on:

a. The ADC read rate RATEADC.

b. The number of Transducers in the system.

c. Filter type and number of taps.

d. Matrix Multiply on or off.

e. If using UDP, any other wireless radio traffic and radio interference in your environment.

f. If using UDP, whether you are in BUFFER mode (minimizing dropouts) or DROP mode (minimizing latency).

g. If using MicroSD™, the hardware characteristics of the particular MicroSD™ card that you are using, especially its maximum write latency.

h. Your application's tolerance for dropped packets.

REDPINE => Switch to RedPine Console Mode. Exit with +++

This is a special mode that allows you to communicate with the RedPine Console. This is used during radio frequency acceptance testing.

RESET => Reset processor

This command resets the processor. Use with caution, especially if you are accessing the console through Telnet.

RESTIP => 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.

RSSI => display RSSI from AP

This command displays the RSSI value (in dBm) for the signal from the device that the Module is connected to, as measured by the Module. RSSI (Received Signal Strength Indicator) is a measurement of the power present in a received radio signal. For example:

```
>RSSI
WLAN: 00:19:59 RSSI from ATI_WIFI using External antenna: -45 dBm
```

SAVEALL => Save all calibrations & IP settings to Serial Flash

This command saves all calibrations and IP settings to Serial Flash, so that they will survive a processor reset.

SD => print SDCARD device info

With no operands, this command prints a multitude of technical information about the SDCARD card. For example:

```
SD: Card in
SD: Card type = V2
SD: CSD register:
 CSD_STRUCTURE          1
 SPEC_VERS              0
 TAAC                   1.0 mS
 NSAC (clocks)          0
 TRAN_SPEED             25.0 Mbit/s
 CCC                    5b5: CMD6 enabled
 READ_BL_LEN (bytes)    512
 READ_BL_LEN_PARTIAL    0
 WRITE_BLK_MISALIGN     0
 READ_BLK_MISALIGN      0
 DSR_IMP                0
 ERASE_BLK_EN           1
 ERASE_SECTOR_SIZE      128
 WP_GRP_SIZE            1
 WP_GRP_ENABLE          0
 DEFAULT_ECC            0
 R2W_FACTOR             4
 WRITE_BL_LEN (bytes)   512
 WRITE_BL_PARTIAL       0
 CONTENT_PROT_APP       0
 FILE_FORMAT_GRP        0
 COPY                   1
 PERM_WRITE_PROTECT     0
 TMP_WRITE_PROTECT      0
 FILE_FORMAT            0
 ECC                    0
 C_SIZE                 60,872
 Sectors                62,333,952
 Capacity (bytes)       31,914,983,424

SD: SD Status register:
 DAT_BUS_WIDTH          1 bit
 SECURED_MODE           No
 SD_CARD_TYPE           Regular SD RD/WR Card
 SIZE_OF_PROTECTED_AREA 0
 SPEED_CLASS            Class 4
 PERFORMANCE_MOVE       2M bytes/second
 AU_SIZE                4M bytes
 ERASE_SIZE             11 AU
 ERASE_TIMEOUT          1 seconds
 ERASE_OFFSET           1 seconds
 UHS_SPEED_GRADE        < 10M bytes/second
 UHS_AU_SIZE            0

SD: CMD6: Switch Functions:
Field       Bits Select
-----       ---- ------
Max Current 100 mA
Group 1     8001 0
Group 2     c001 0
Group 3     8001 0
Group 4     8001 0
Group 5     8001 0
Group 6     8001 0
Version     0
Misc        0000 0000 0000 0000 0000 0000

SD: OCR register: Ready CCS=1=SDHC Vdd: 2.7V to 3.6V

SD: CID register:
 MID  03   = SanDisk
 OID  5344 = SD
 PNM  SU32G
 Rev  80
 PSN  73bb8e
 Date  6/2013
```

SD [sector-1] [sector-n] => dump MicroSD sectors

If sector numbers are given (in hex) this command will dump the contents of the specified sectors on the MicroSD This command is provided for MicroSD firmware testing only. For example, to dump the contents of sector 0x300 (which appears to be part of a directory):

```
>sd 300
SD: Card in
SD: Card type = V2
SD: CSD:
 Capacity (bytes)     1,015,808,000
 Sectors              1,984,000
000000 2e20 2020 2020 2020 2020 2010 000b 238b .          ...#.
000010 0a37 0a37 0000 238b 0a37 0200 0000 0000 .7.7..#..7......
000020 2e2e 2020 2020 2020 2020 2010 000b 238b ..         ...#.
000030 0a37 0a37 0000 238b 0a37 0000 0000 0000 .7.7..#..7......
000040 4172 0069 006e 0067 0074 000f 0015 6f00 Ar.i.n.g.t....o.
000050 6e00 6500 7300 0000 ffff 0000 ffff ffff n.e.s...........
000060 5249 4e47 544f 7e31 2020 2010 000c 238b RINGTO~1   ...#.
000070 0a37 0a37 0000 238b 0a37 0300 0000 0000 .7.7..#..7......
000080 4170 0069 0063 0074 0075 000f 00c8 7200 Ap.i.c.t.u....r.
000090 6500 7300 0000 ffff ffff 0000 ffff ffff e.s.............
0000a0 5049 4354 5552 7e31 2020 2010 000e 238b PICTUR~1   ...#.
0000b0 0a37 0a37 0000 238b 0a37 0400 0000 0000 .7.7..#..7......
0000c0 416d 0075 0073 0069 0063 000f 009f 0000 Am.u.s.i.c......
0000d0 ffff ffff ffff ffff ffff 0000 ffff ffff ................
0000e0 4d55 5349 4330 7e31 2020 2010 000f 238b MUSIC0~1   ...#.
0000f0 0a37 0a37 0000 238b 0a37 0500 0000 0000 .7.7..#..7......
000100 4176 0069 0064 0065 006f 000f 000e 7300 Av.i.d.e.o....s.
000110 0000 ffff ffff ffff ffff 0000 ffff ffff ................
000120 5649 4445 4f53 7e31 2020 2010 0000 248b VIDEOS~1   ...$.
000130 0a37 0a37 0000 248b 0a37 0600 0000 0000 .7.7..$..7......
000140 4173 0079 0073 0074 0065 000f 0072 6d00 As.y.s.t.e...rm.
000150 0000 ffff ffff ffff ffff 0000 ffff ffff ................
000160 5359 5354 454d 7e31 2020 2012 0002 248b SYSTEM~1   ...$.
000170 0a37 0a37 0000 248b 0a37 0700 0000 0000 .7.7..$..7......
000180 0000 0000 0000 0000 0000 0000 0000 0000 ................
000190 => 0001ff same as above
```

SD [FORMAT] => Format MicroSD

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. Any data streaming over the WLAN will be interrupted while the format is taking place.

SD [ON | OFF] => Control MicroSD power

This command allows you to control power to the MicroSD™ card. Issuing other MicroSD™ card commands will also turn the MicroSD power back on. This command is provided for MicroSD firmware testing only.

SDW [start] [data] => write MicroSD sector

This command writes the given data to the specified MicroSD sector. This command is provided for MicroSD firmware testing only.

SCD [directory] => Similar to the standard CD command

This command allows you to display and change the path on the MicroSD.

SDEL => [filename] => delete file(s), wild cards * and ? may be used

This command deletes the selected files in the current directory on the MicroSD. For example:

```
>sdel f2.dat
F2.DAT deleted
Files deleted: 1
```

SDIR => Print Directory

This command prints a directory of all files in the current path on the MicroSD. For example:

```
Directory of 0:/ATI
 2010/01/01 00:06 <DIR>              .
 2010/01/01 00:06 <DIR>              ..
 2010/01/01 00:56                 4     ATI.ini
 2010/01/01 00:49        66,446,898     F2.dat
 2010/01/01 01:21        20,995,230     F3.dat
 2010/01/01 00:07        56,057,184     F4.dat
 2010/01/01 00:08         6,677,154     F5.dat
 2010/01/01 00:09         4,886,082     F6.dat
 2010/01/01 00:09         3,938,868     F7.dat
 2010/01/01 00:05               756     F8.dat
 2010/01/01 00:05            68,586     F9.dat
 2010/01/01 00:05            79,338     F10.dat
 2010/01/01 00:05            61,530     F11.dat
 2010/01/01 00:05            66,570     F12.dat
 2010/01/01 00:02     1,188,993,882     F13.dat
 2010/01/01 00:23        11,860,926     F14.dat
 2010/01/01 00:14        66,858,426     F15.dat
 2010/01/01 16:02     4,294,967,220     F16.dat
         16 File(s)  5,721,958,654 bytes
          2 Dir(s)
```

SDREC [ON | OFF] => Stream packets to MicroSD: on, off, or toggle

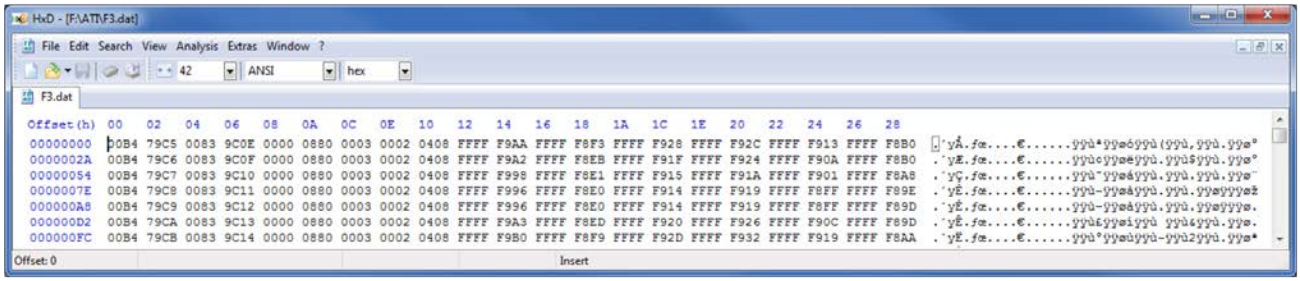
This command streams data (in the standard packet format, which is also used for UDP packets) to the MicroSD™ card. All data is placed in the \ATI subdirectory, which is created if it is not already present. The file ati.ini is also created within this subdirectory if it is not already present. Each time that the SDREC ON command is issued, a new file Fn.dat file is created. Note that n is the next sequential file number.

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

The data can be read by placing the MicroSD™ card into a computer that supports the FAT file system. A Micro SD to USB adapter may be required.

When viewed with the HxD utility, 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. As the WNET unit does not contain a file system repair utility, 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 and selecting Properties, clicking the Tools tab, pressing the Check Now… button, and the pressing Start.

SDUMP[filename] => File dump

This command prints a hex dump of the specified file on the MicroSD.

SF => print Serial Flash device info

This command prints information about the Serial Flash device. This command is provided for serial flash firmware testing. For example:

```
SF: Maker  = Silicon Storage Technology
SF: Device = SST25VF010A => 128K bytes
SF: Status = 00 BlockProtect = None
```

SFR [address] [length] => print Serial Flash memory of length given

This command prints Serial Flash memory starting at the given address for the given length. This command is provided for serial flash firmware testing. For example, here we dump the first calibration area for a unit that has no calibrations saved:

```
>sfr 1000 2000
SF: 001000 ffff ffff ffff ffff ffff ffff ffff ffff ................
SF: 001010 => 002fff same as above
```

SFW [address] [byte] => write byte to Serial Flash address given

This command allows you to write a single byte to the Serial Flash. This command is provided for serial flash firmware testing.

SS [A] [012345678 any combination or order] => read specified ADC channels once

This command reads the specified ADC channels once.

SS => repeats last SS command

This command repeats the last SS command, without the need to retype the whole thing.

SSI [ADC | DAC | EEPOT | PORTS | SDCARD | SF | WLAN] [bit rate: bits/second] => Set selected SSI bit rate

This command allows you to view information about and set the bit rate for all devices that communicate over an SSI port (SSI is the Stellaris name for SPI). Any new rate takes effect immediately. For example:

```
Device Rate(Hz) Pol Pha Format
------ -------- --- --- ------
ADC    10000000  0   0  Freescale
CPLD   10000000  0   0  Freescale
DAC     1000000  0   0  Freescale
EEPOT   1000000  0   0  Freescale
EEPROM 10000000  0   0  Freescale
PORTS  10000000  0   0  Freescale
SDCARD 10000000  0   0  Freescale
SF     10000000  0   0  Freescale
WLAN   10000000  0   0  Freescale
```

With an 80 MHz clock, the highest bit rates that are supported by the processor hardware are:

```
1.  40,000,000 Hz (no SPI peripherals work at this speed)
2.  20,000,000 Hz
3.  13,333,333 Hz
4.  10,000,000 Hz
5.   8,000,000 Hz
```

SSID [case-sensitive string] => Set SSID

This command allows you to view and set the SSID. The new SSID will be effective after the next Join to an Access Point. An SSID is the name of a wireless local area network. SSIDs are case sensitive text strings. The SSID is a sequence of alphanumeric characters (letters or numbers). SSIDs have a maximum length of 32 characters.

STACK => Print stack available message

This command allows you to view how much of the processor stack is free. Whenever a new low in stack bytes free occurs that is less than 1024 bytes this message will also appear without the command being typed. For example:

```
>stack
STACK: 1184 of 4096 bytes free
```

STATS => Print packet statistics, [0] to clear

This command prints how many total packets, dropped packets, the maximum length of event that have occurred since power up or the last STATS 0 command in MicroSD writing (due to write latency) and UDP packet transmitting (due to flow control), and the average length of event. For UDP packets this command also prints the average flow control event duration, how many flow control events occurred, and how many times the WLAN Module locked-up and had to be reset. For example:

```
>stats
00:03:54 CARD Packets: Generated= 200,678 Dropped= 0 Write Latency: Max=  92 mS Mean=  1.406 mS
00:03:54 WLAN Packets: Generated= 200,678 Dropped= 0 Flow Control:  Max=  92 mS Mean= 11.178 mS Events= 2,278 Module: Lock-Ups= 0
```

T [ON | OFF] => Transmit packet on, off, or toggle

This command turns the transmission of outgoing UDP data packets to the WLAN Module on and off.

TEST [* | Transducer 1 -> 6] [OFF | ZERO | DAC] => Set Self-Test mode on selected Transducer(s)

This command sets the self test mode for the selected Transducers:

TEST Setting	ADC Input for this Transducer connected to:
OFF	Normal sensor input
ZERO	Zero signal (2.5V = 0x8000)
DAC	DAC Channel 6 for this Transducer

Set DAC channel 6 output procedure for one Transducer:

a. Set active Transducer: TRANS [1 □ 6]

b. Set DAC Channel 6 output: O 6 [value: 0 □ 65535 or 0xFFFF]

This command generates a report of the self-test status of the unit:

```
>TEST 5 ZERO
Tr Self-test-mode
-- --------------
 1 OFF
 2 OFF
 3 OFF
 4 OFF
 5 ZERO
 6 OFF
```

TXPWR [0 | 1 | 2] => Set transmit power after next Join

This command allows you to set the WLAN Module's transmit power. The power level change takes place after the next Join to an Access Point.

Band	0 = low		1 = medium		2 = high	
GHz	dBm +/- 1	mW	dBm +/- 1	mW	dBm +/- 2	mW
2.4	7	5	10	10	15	32
5	5	3	7	5	12	16

`USBILIM [value in mA] => set USB current limit`

This command sets the USB Input Current Limit (USBILIM) value in Battery Charger Register 0. You must enter an exact value from the following table:

Value mA	Meaning	Notes
100	Max (USB Low Power)	Default setting CLPROG1 and CLPROG2 shorted. Refer to the Input Current Regulation section for information when this register is modified by the LTC4155.
500	Max (USB High Power)	
600	Max	
700	Max	
800	Max	
900	Max (USB 3.0)	
1000	Typical	
1250	Typical	
1500	Typical	
1750	Typical	
2000	Typical	
2250	Typical	
2500	Typical	
2750	Typical	
3000	Typical	
2	2.5 mA Max (USB Suspend)	
0	Select CLPROG1	Default setting two CLPROG resistors. Refer to the Input Current Regulation section for information when this register is modified by the LTC4155.

`USER => Switch to User Mode`

This command switches the Console to User Mode.

`WLAN [ON | OFF] => Turns WLAN Module power (WIFI_PWREN) on or off`

This command controls the WIFI_PWREN bit to the WLAN Module on the Digital Board. The WLAN OFF command also turns off transmission of the regular UDP data packet.

`WFLOAD => Load WLAN Module, 2-file method`

This command allows you to load the WLAN Module with new firmware using the shorter 2-file method. This is the method that is normally used. This command takes about 5 minutes to execute. Before committing to the WLAN Module update, this command checks to make sure that the necessary files (WiSe_Con and WiSe_WLA) are present in the Serial Flash, have a termination record (so they are probably complete), and have no checksum errors.

`WFLOAD4 => Load WLAN Module, 4-file method`

This command allows you to load the WLAN Module with new firmware using the longer 4-file method. This longer method is necessary for WLAN Modules that have had the RF Test firmware loaded into them. This command takes about 8 minutes to execute. Before committing to the WLAN Module update, this command checks to make sure that the necessary files (WFU_Cont, WLAN_CON, WiSe_WLA, and WiSe_Con) are present in the Serial Flash, have a termination record (so they are probably complete), and have no checksum errors.

WFLOADRF => Load WLAN Module, for RF testing

This command allows you to load the WLAN Module with new firmware for RF testing. This command takes about 2 minutes to execute. Before committing to the WLAN Module update, this command checks to make sure that the necessary files (WiSe_Con.t and WiSe_WLA.t) are present in the Serial Flash, have a termination record (so they are probably complete), and have no checksum errors. These two files must be loaded into the WNET unit, and then renamed by added the .t suffix to each file name before using this command.

XPWR [* | Transducer: 1 -> 6] [ON | OFF| BRIDGE | AFE] => Transducer power control

This command allows you to control the Analog Board power settings for each of the Transducers. The choice for each Transducer is:

1. ON. The Analog Front End (AFE) for this Transducer (on the Analog Board) and the external Transducer (BRIDGE) are fully powered.
2. OFF. The AFE and the external Transducer are off.
3. BRIDGE power only. The AFE is off and the external Transducer is on.
4. AFE power only. The AFE is on and the external Transducer is off.

The WNET reduces power surges by turning power on gradually. When you issue this command for a Transducer:

1. If Transducer ON or BRIDGE-only was selected, and the Analog Power (ANALOG_SHDN bit PF0) was off, Analog Power is turned on, and there is a 0.5 second delay.
2. If Transducer OFF was selected, and all Transducers are now off, Analog Power is turned off.
3. If Transducer ON was selected, power to the Transducer's BRIDGE and AFE is turned on.
4. If Transducer OFF was selected, power to the Transducer's BRIDGE and AFE is turned off.
5. If Transducer BRIDGE was selected, power to the Transducer's BRIDGE is turned on and AFE is turned off.
6. If the Transducer's BRIDGE or AFE state changed to on, there is now a 0.5 second delay.
7. If the Transducer's AFE state changed to on, the Transducer's DAC and EEPOTs are now written with their calibration values.
8. If the Transducer's BRIDGE or AFE state changed to on, a Current Limit Reset is now performed.

This command will also generate a report of the current Transducer power status. The Auto column is what the software is commanding, based on the XPWR command. The Now column is what is actually going out to the power port. If the columns are different, it is because direct test outputs to the Analog Board ports are in use (see the LED1, LED2, and PWR commands).

```
 Tr Auto   Now
-- ----   ---
 1 ON     ON
 2 ON     ON
 3 ON     ON
 4 ON     ON
 5 ON     ON
 6 ON     ON
Analog power ON
```

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 with the external power adapter included. 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.

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.
Wireless status indicator is flashing red	This typically happens when trying to transmit to a UDP address that does not exist	

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

9. Specifications

The specifications section covers characteristic 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

9.3 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

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.

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.

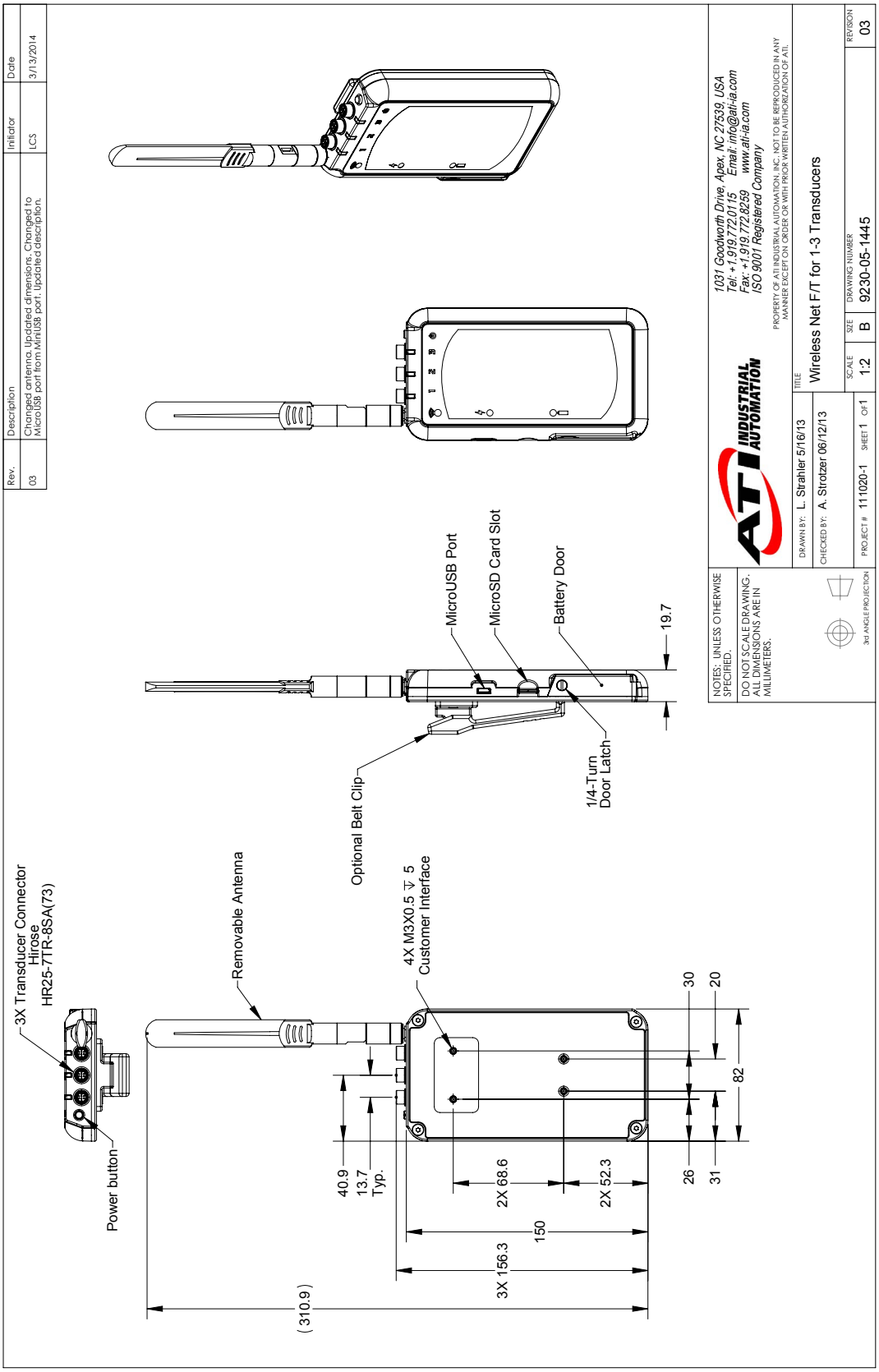
IC Statement

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

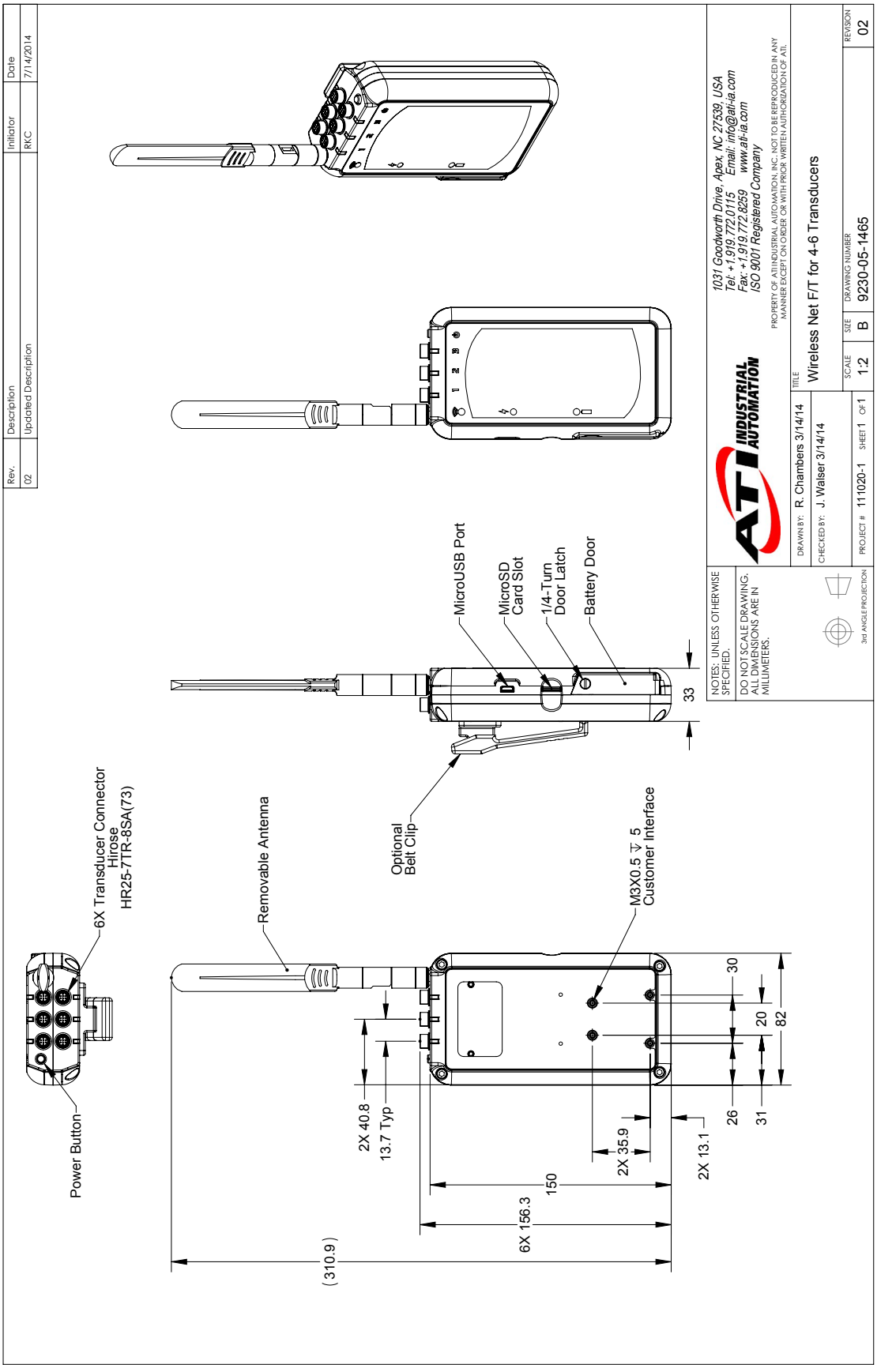
Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

11. Drawings

11.1 Wireless Net F/T for 3 Transducers



11.2 Wireless Net F/T for 6 Transducers



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 TI 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().

```
// 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);
}
```

```
#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;
}
```

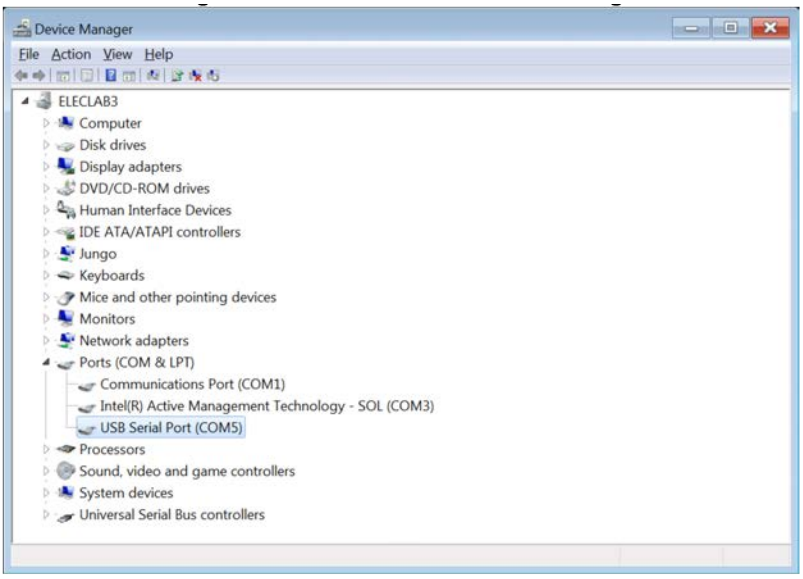
Appendix B – Initial Configuration Using a Telnet Progam (PuTTY)

B.1 Initial Configuration Using

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 Figure 5.2 shows Wireless F/T is connected to COM5.

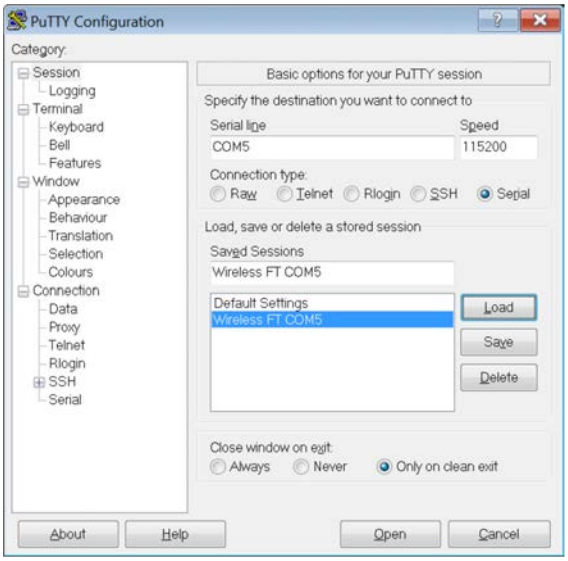
Figure 11.1—Windows 7® Device Manager



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.

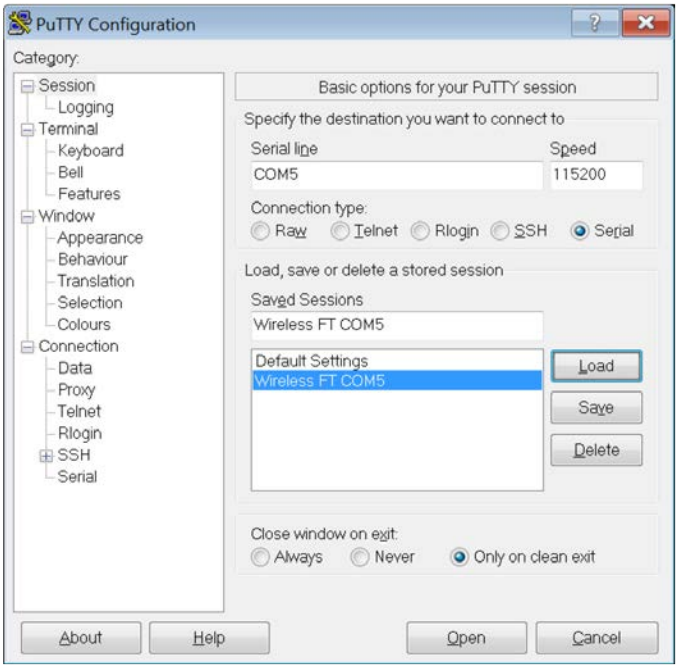
5. In the Category pane click on Connection > Serial and fill in the following fields:
    - Serial line to connect to COM5 (Enter the Com port the Wireless unit is using)
    - Speed (baud) 115200
    - Data bits 8
    - Stop bits 1
    - Parity None
    - Flow control None

Figure 11.2—PuTTy Terminal Program



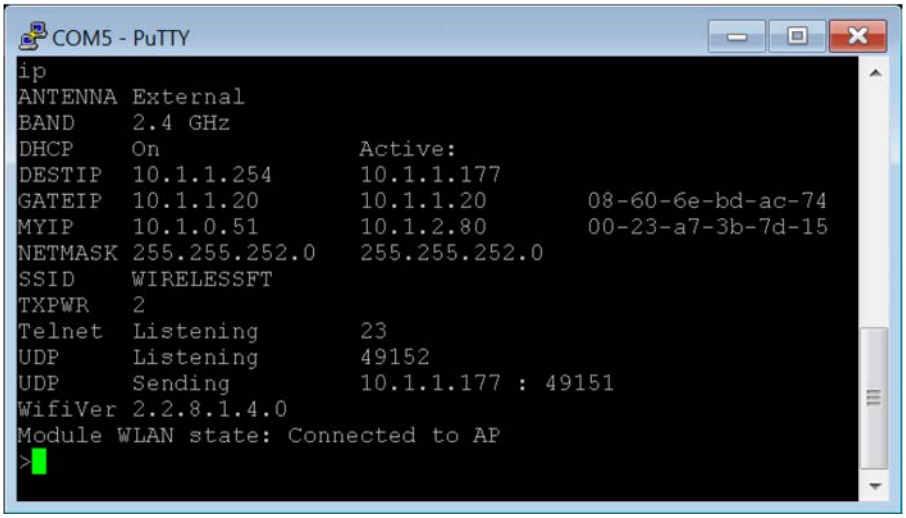
6. In the Category pane click on Session, The Serial Line should now be the COM port and Speed should be the values entered in the previous step. In the Saved Sessions field enter Wireless FT COM5 and select save. This will allow you to use this configuration at another time.

Figure 11.3—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.

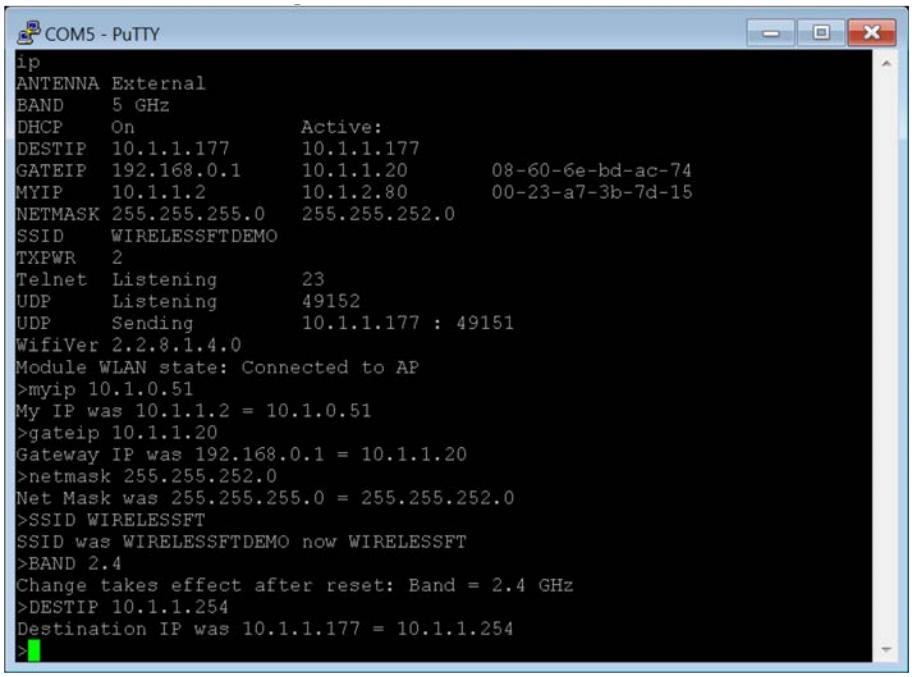
Figure 11.4—Test the Connection



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)
    c. "MYIP <unitip>", e.g. "MYIP 192.168.1.50"
    d. "NETMASK <subnetmask>"
    e. "GATEIP <defaultgateway>"
    f. "SSID <ssid>" Network<ssid> (Is case sensitive)
    g. "BAND <x>" where x is "2.4" for 2.4 gigahertz or "5" for 5 gigahertz.
    h. "DESTIP <yourcomputersip>"

Figure 11.5—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.