ATI INDUSTRIAL AUTOMATION
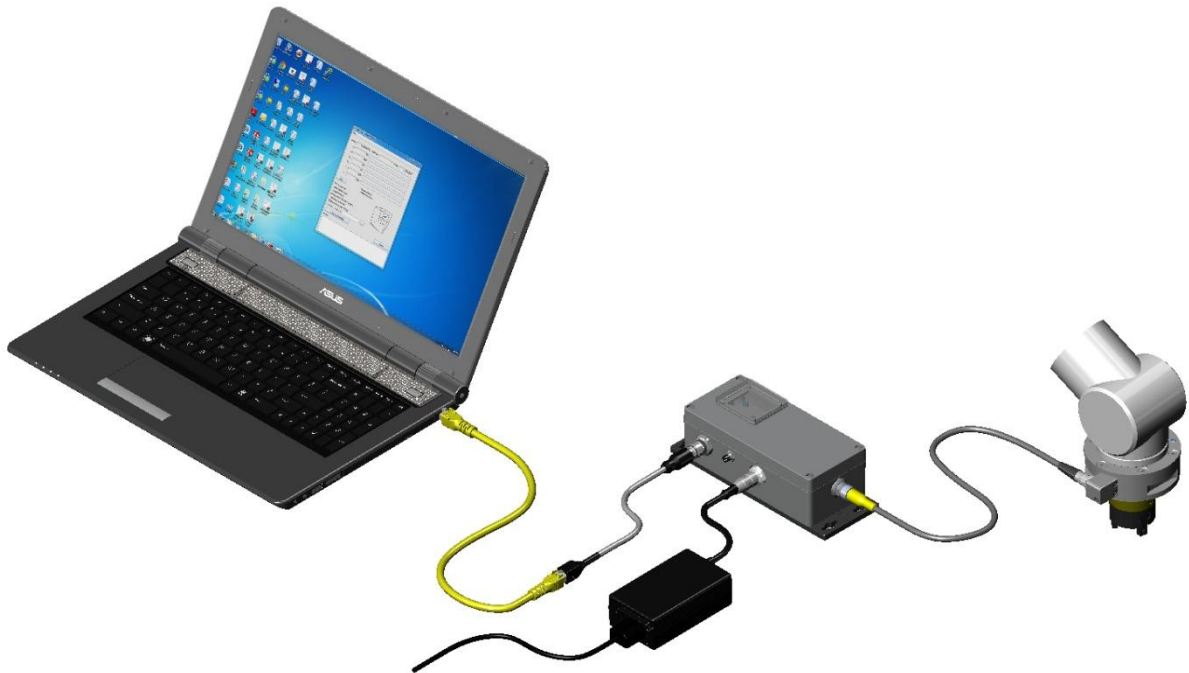
ISO 9001 Registered

Net F/T

Network Force/Torque Sensor System

Quick Start Guide

For Firmware Versions up to 2.0.012 Standard

EtherNet√IP™
conformance tested

Document #: 9610-05-1022 Quick Start

May 2013

Engineered Products for Robotic Productivity

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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.

FCC Compliance - Class A

This device complies with Part 15 Subpart B of the FCC Title 47. 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.

CE Conformity　　　　CE

This device complies with EMC Directive 2004/108/EC and conforms to the following standards: EN55022:1998+A1:2000 +A2:2003, EN61000-4-2:1995 +A1:1998+A2:2001, EN61000-4-3:2002, EN61000-4-4:2004, EN61000-4-5:1995 +A1:1996, EN61000-4-6:1996 +A1:2001, EN61000-4-8:1995, EN61000-4-11:2001.

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Net F/T Quick-start Guide

This quick-start guide will provide information to set up the Net F/T system and guide you through unpacking the equipment, setting the Net Box DIP switches, connecting the equipment, powering up the Net Box, configuring the computer Ethernet using Windows 7 or Windows XP, connecting the Computer to the Net Box, running the Net F/T Demo, Changing the IP Address Settings, mounting the transducer while monitoring the forces, mounting the Tool while monitoring the forces, and routing the Cable.

To use the Java demo you will need the Java application on your computer, you can download Java from www.java.com/getjava; do this before beginning this Quick Start. Your computer will need to have a LAN Ethernet connector. Once the system has been setup, the transducer will be used to monitor the forces while installing the transducer to the robot arm (or other device) and attaching the tool to the transducer.

1. Unpacking the Equipment

Provide a clear work area to unpack the equipment and set up the Net F/T system. The equipment is secured in a retention or suspension packing container to secure the contents. Check the shipping container and components for damage that occurred during shipping. Any damage should be reported to ATI Industrial Automation.

Check the packing list for omissions.
- Standard components of a Net F/T system are:
    - Net F/T Transducer
    - Transducer cable (which may be integral to the transducer)
    - Net Box
    - ATI Industrial Automation CD containing software, calibration documents, and manuals.
- Optional components:
    - Power supply: Plugs into a 100–240 VAC (50–60Hz) power outlet and supplies power to the Net Box through the *Pwr/CAN* connector
    - Ethernet switch supporting Power-over-Ethernet: Provides network connection and supplies power over the Ethernet connector
    - RJ45 to M12 Ethernet cable adapter
    - Mini to Micro (M12) DeviceNet adapter (for the *Pwr/CAN* connector)
    - DeviceNet cabling (for the *Pwr/CAN* connector)
    - Ethernet cabling
    - Robot-grade transducer cables of different lengths.

1.1 Suspension Packaging for Large Transducers

1. Open the container and remove any cabling, manuals, and loose equipment from the container.
2. Remove the top suspension packaging.
3. Remove the equipment and place on the work area.

1.2 Retention Packaging for Small Transducers

1. Open the container and remove any cabling, manuals, and loose equipment from the container.
2. Lift out the retention package. Do not let the package handles separate.
3. Place the package on the work area and allow the package handles to separate.
4. The bottom flaps will release and free the equipment.

Figure 1.1—Retention Packaging

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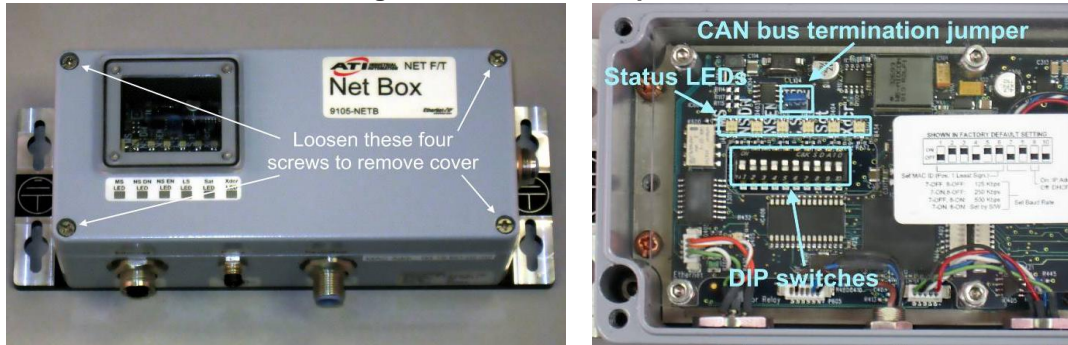
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2.   Set the Net Box DIP Switch 9 to ON

The configuration DIP switches are located inside of the Net Box. Before opening the Net Box, make sure that the box is unpowered and that you and the Net Box are electrically grounded.

1.   Loosen the four screws that secure the cover on the Net Box.

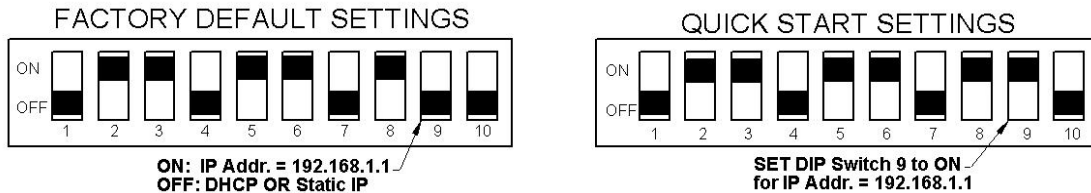2.   Lift the cover straight up and off the chassis.

Figure 2.1—Net Box Dip Switches

NOTICE: The internal electronics have a shield to help protect them from debris or errant tool movements. There are access holes in the shield for the DIP switches and termination resistor jumper.

3.   Set DIP switch 9 to the ON position.

Figure 2.2—Dip Switch Settings

NOTICE: Before replacing the Net Box cover, you must ensure that no debris or liquids are in the chassis.

4.   Place the cover back on the chassis (verify that the window is above the LEDs and DIP switches).

5.   Tighten the four screws to secure the cover.

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3. Connect the Transducer to the Net Box

Some transducers have an integral cable; others have a cable that must be connected to the transducer. Connect the transducer cable to transducer connector on the end of the Net Box.
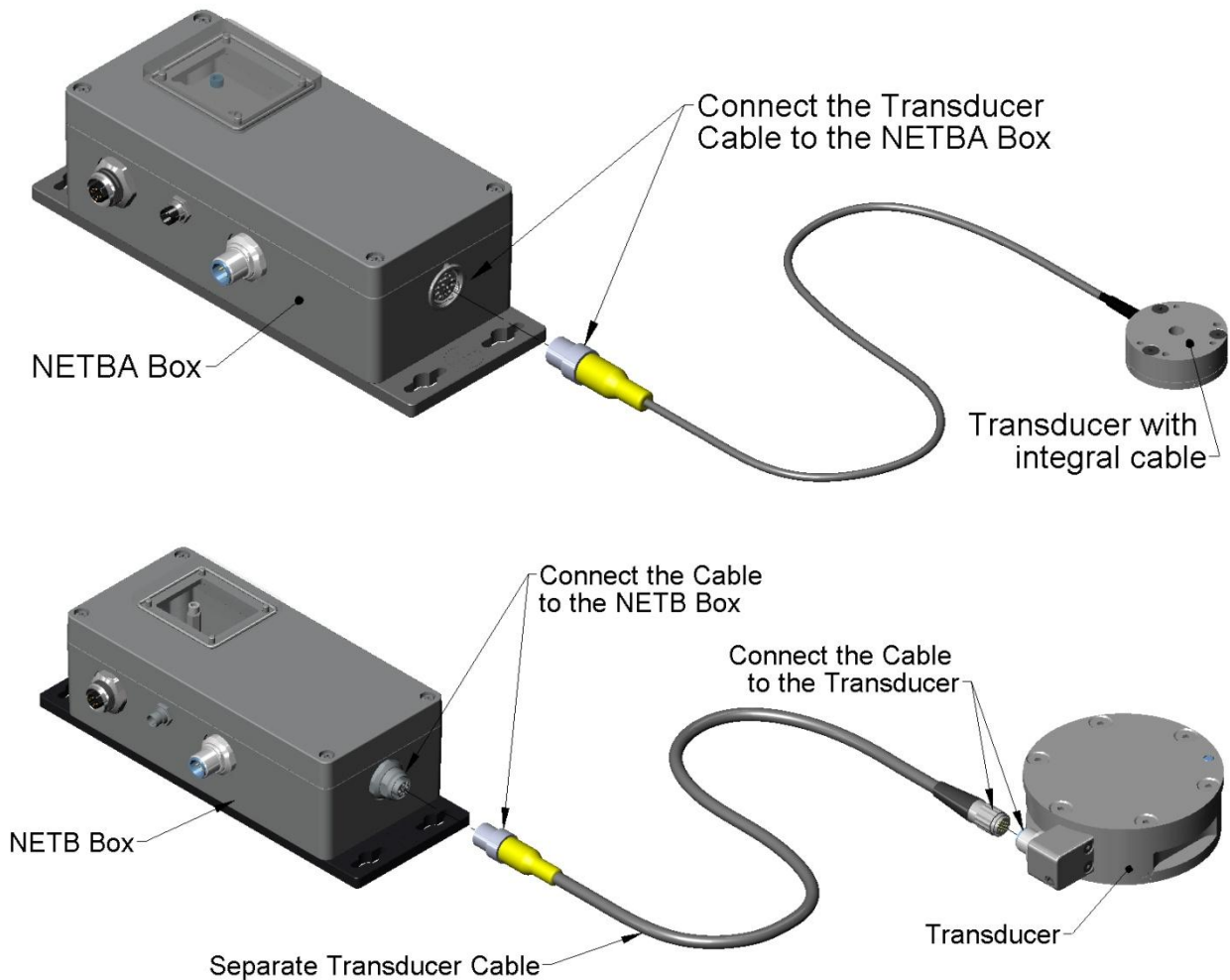
⚠️ **CAUTION:** Do not exert excessive force on the transducer. The transducer is a sensitive instrument and can be damaged by applying force exceeding the single-axis overload values of the transducer and cause irreparable damage. Refer to the *F/T Transducer Installation and Operation Manual (9620-05-Transducer Section)* for transducer overload values.

⚠️ **CAUTION:** When setting up the Net F/T system only bend cables greater than the minimum bend radius. Bending the cables tighter than the minimum will cause damage to the cable. Refer to *Section 9.3-Routing the Transducer Cable* for minimum bend radii.

Figure 3.1—Transducer Connection

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4. Power the Net Box

There are two ways to power the Net F/T system. Power needs to be provided using either a separate power supply or Power-over Ethernet (PoE).

4.1 Power-over-Ethernet

Use a Power-over-Ethernet (PoE) switch to deliver power to the Net box. To do this you will need an Ethernet switch that supports PoE. Power will be automatically delivered to the Net F/T when you make the Ethernet connection to a PoE port on the switch. **Net F/Ts that have the optional fieldbus, do not support PoE.**
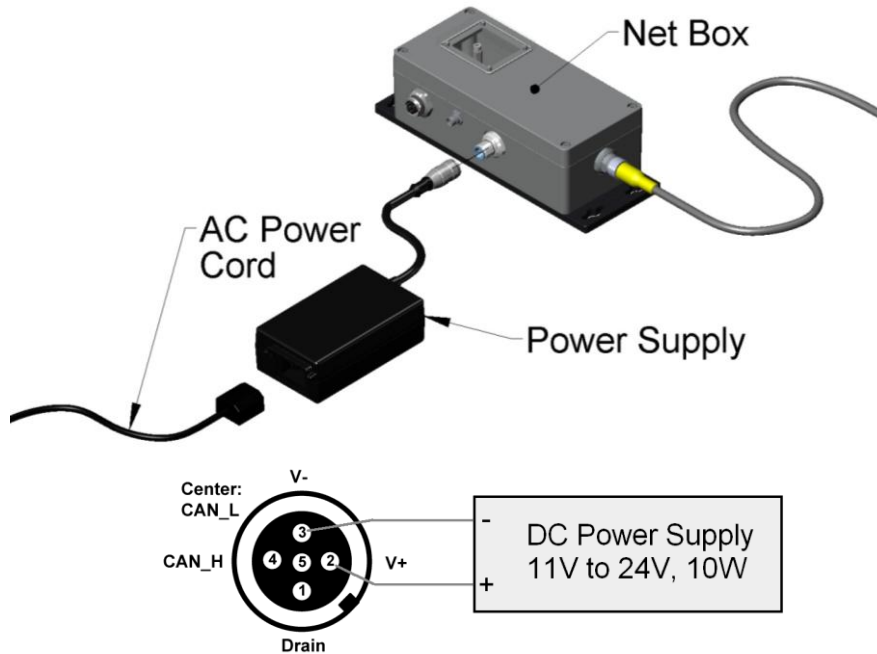
Figure 4.1—Power-over-Ethernet Connection
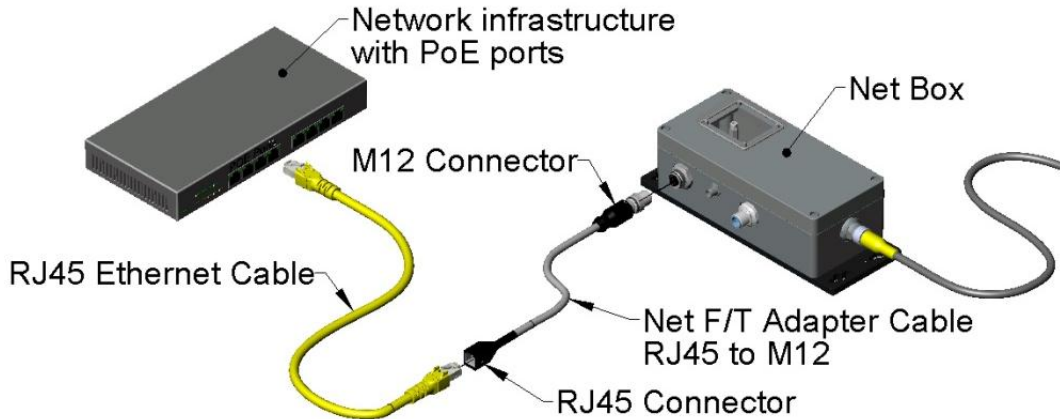
4.2 Separate Power Supply

Connect a 24VDC power supply to the Net box's *Pwr/CAN* connector. The power supply will need to be able to supply 10 Watts of power, and should be Class 1 (has an earth ground connection).

Figure 4.2—Separate Power Supply Connection

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5. Configure the Computer Ethernet Connection

For purposes of this quick start, your computer will be connected directly to the Net F/T and disconnected from your LAN. You will be temporarily giving your computer a fixed IP address of 192.168.1.100. It is important that the Ethernet cable to the Net F/T is disconnected from your computer during this step.
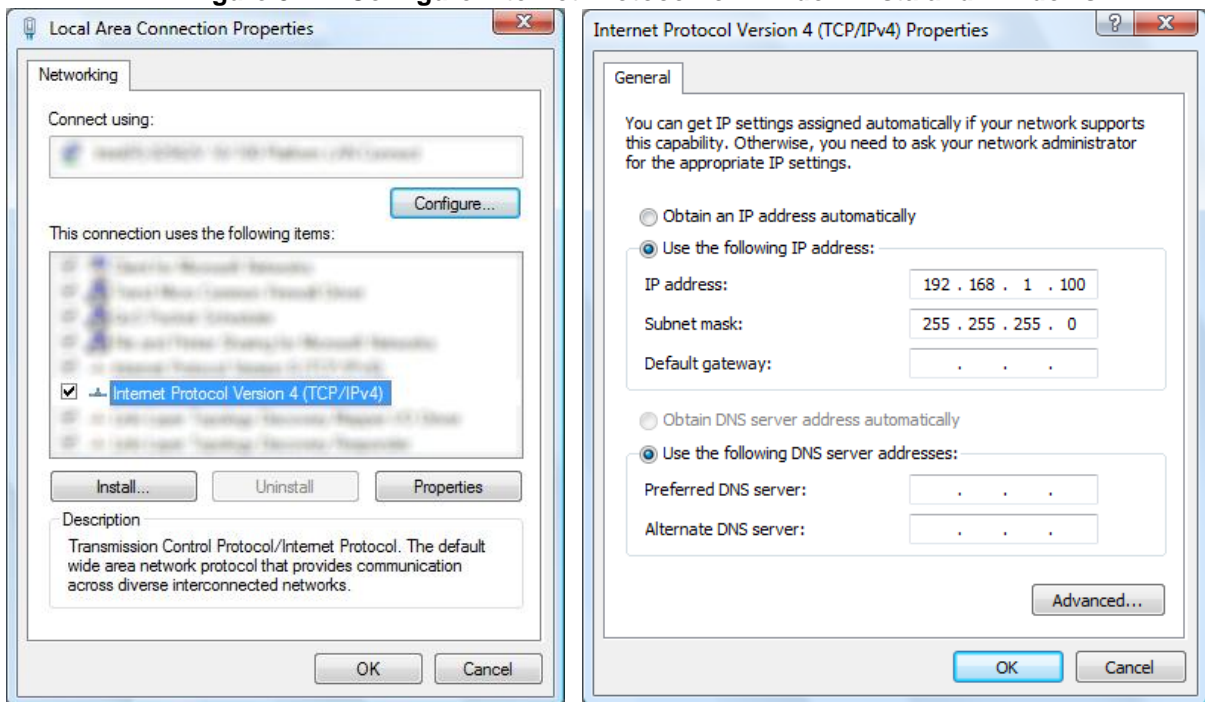
Please contact your IT department for assistance if you are uncomfortable making the following temporary changes to your computer's network configuration.

1. Unplug the Ethernet cable from the LAN port on your computer.

2. Open your computer's *Internet Protocol (TCP/IP) Properties* window. Follow the instructions below for your computer's operating system.

5.1 Windows Vista and Windows 7:

1. From the Start menu, select Control Panel.

2. For Vista, click on *Control Panel Home*.

3. Click on the *Network and Internet* icon.

4. Click on the *Network and Sharing Center* icon.

5. For Vista, click on the *Manage Network Connections* task link. For Windows 7, click on the *Local Area Connection* link.

6. For Vista, right-click on *Local Area Connection* and select the *Properties* button. For Windows 7, click on the *Properties* button.

7. Select *Internet Protocol Version 4 (TCP/IPv4)* connection item and click on the *Properties* button.

Figure 5.1— Configure Internet Protocol for Window Vista and Windows 7

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5.2 Windows XP:

1. From the Start menu, select Control Panel.

2. Open the *Network Connections* icon from within the Control Panel. If your Control Panel says *Pick a Category* at the top, you will need to first click on the *Network and Internet Connections* icon.

3. Click on the *Network Connections* icon.

4. Right-click on *Local Area Connection* and select *Properties*

5. Select *Internet Protocol (TCP/IP)* connection item and click on the *Properties* button.

Figure 5.2— Configure Internet Protocol for Windows XP
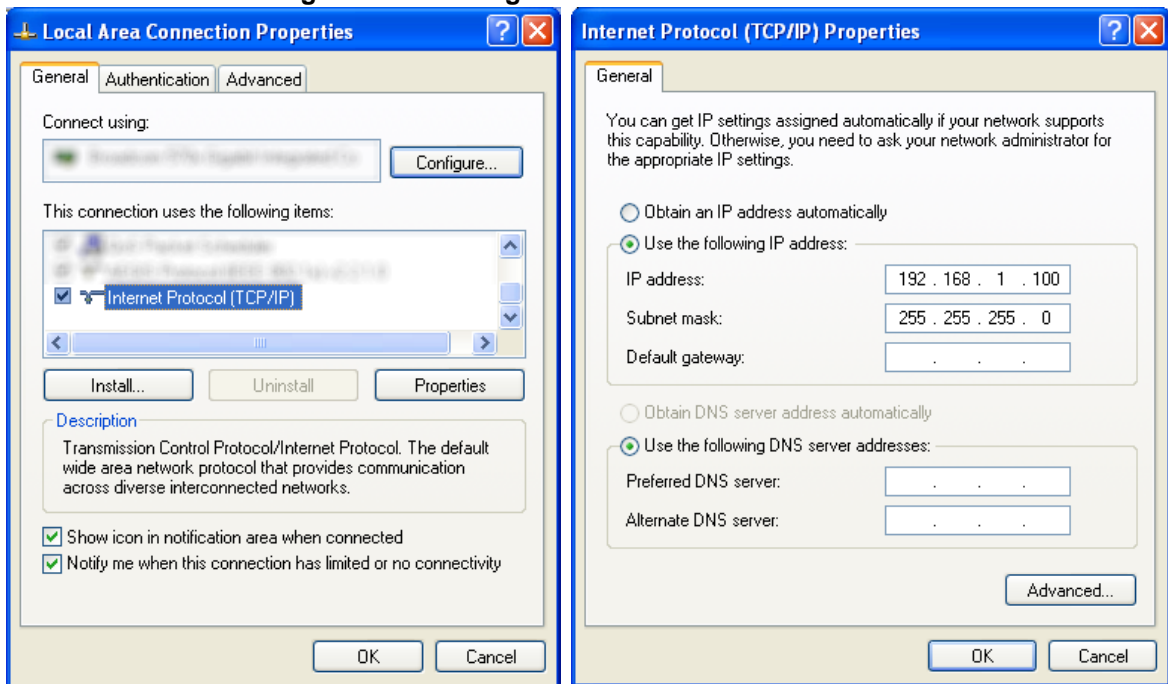
6. Record the values and settings shown in the properties window. You will need these later to return your computer to its original configuration.

7. Select the *Use the following IP address:* button.

8. In the *IP address:* field, enter *192.168.1.100*.

9. In the *Subnet mask:* field, enter *255.255.255.0*.

10. Click on the *OK* button.

11. Click on the *Local Area Connection Properties* window's *Close* button.

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6. Connect the Computer to the Net Box

Connect the computer to the Net Box, this will allow you to connect to the Net Box and later run the demo software. You will be able to monitor the forces during installation of the transducer.

1. Connect the RJ-45 to M12 Ethernet adapter to the Net Box, if not previously connected.

2. Connect the Ethernet cable to the Ethernet adapter, if not previously connected.

3. Connect the other end of the Ethernet cable to your computer's LAN connection. You may need to wait a short while so your computer has time to recognize the connection.

Figure 6.1—Connect the Computer
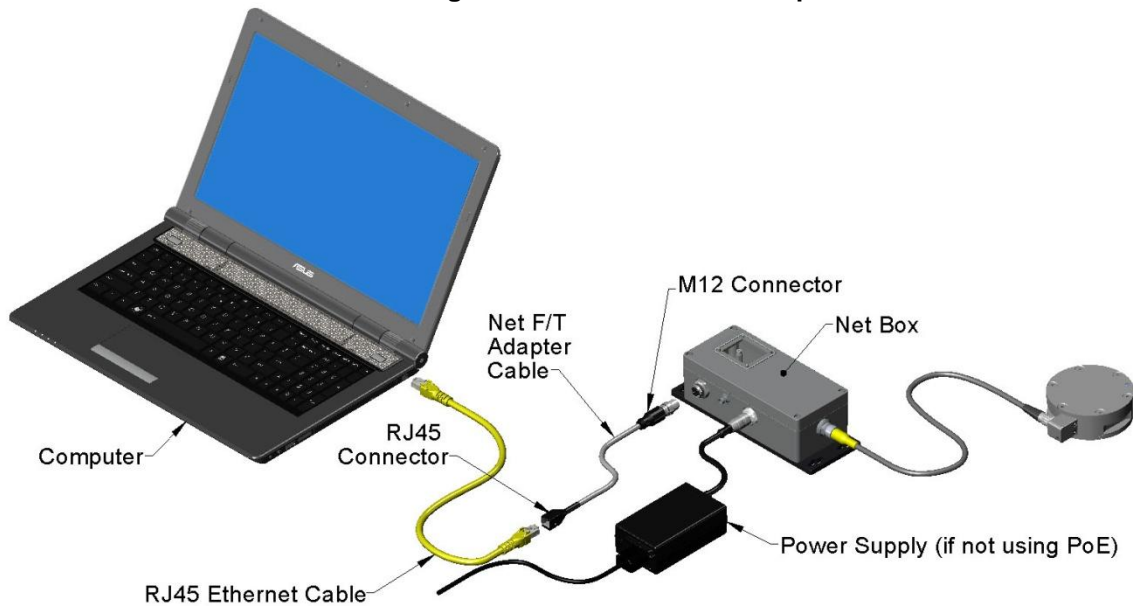
7. View the Net F/T's Web Pages

Enter the address *192.168.1.1* in your browser to view the Net F/T's *Welcome* page. (If the page is not found, you may need to clear previous 192.168.1.1 device entries from the $_{computer}$ by restarting the computer or, if you have administrative privileges, by going to the computer's *Start* menu, selecting *Run...*, and entering "`arp -d *`".)

Figure 7.1—FT Web Page

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8. Use the Net F/T's Demo Program to Monitor Loads During Installation

The demo program must be configured to monitor raw stain gage values used to monitor for gage saturation during installation. This will give feedback to help to avoid overloads and causing irreparable damage to the transducer. Smaller transducers can easily be irreparably damaged by apply small loads using tools (moment arm increases applied loads) when mounting the transducer.

> **NOTICE:** Each transducer has a maximum measurement range and a maximum overload capacity. **Exceeding the transducer's overload capacity can cause permanent damage.** Smaller transducers have lower overload capacities. Tx and Ty are usually the easiest axes to accidentally overload. Strain gage saturation is the first indication that you are approaching a mechanical overload condition, and saturation **always** causes inaccurate F/T data, so it is critical that you monitor the F/T system for strain gage saturation.

8.1 Configure, Download, and run the Demo Application.

1. Click on the **Configuration** link on the left side of the web page.
2. Click the down arrow in the Calibration Select field and select **#16-FT00000**. (**Note**: Must be the factory default setting for #16-FT00000).
3. Click the down arrow in the Force Units field and select **lbf.**
4. Click the down arrow in the Torque Units field and select **lbf-in.**
5. Click the **Apply** at the bottom of the page.
6. Verify the Counts per Force: field value is **1** and the Counts per Torque field value is **1**. If not Make sure you have selected **lbf** for the Force Units and **lbf-in** for the Torque units and you have clicked on **Apply** to activate the changes.
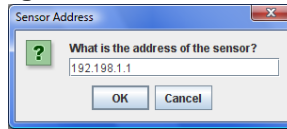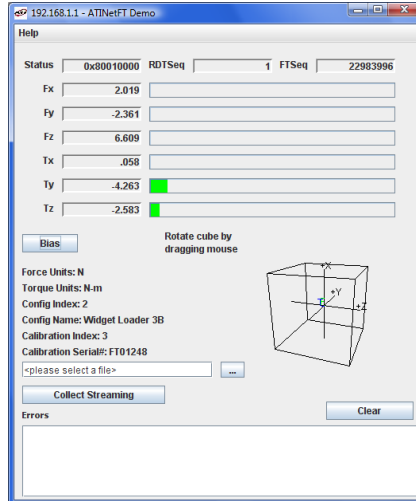
Figure 8.1—Configuration

7. Click on the **Download Demo Application** button. This will launch the demo application.
8. The demo application will ask you for the address of the Net F/T. Enter *192.168.1.1* as the address.

Figure 8.2—Sensor Address

9. Click *OK* to run the demo.

Figure 8.3—Net FT Demo Application

10. If the demo lists *IO Exception* errors without updating the values and bar graphs and the LEDs in the Net Box are all green, then visit 192.168.1.1/comm.htm and enable the RDT interface and click the *Apply* button.

11. Use the demo application to monitor for raw strain gage saturation for the transducer. This will help avoid reaching the overload value of the transducer. If a gage saturation error is reported stop applying force immediately and wait until error clears.

> **NOTICE:** The Demo application list F_x, F_y, F_z, T_x, T_y, and T_z, but has been configured to display gage values. After the transducer has been installed, the demo application has to be reconfigured to display force and torque values.

9. Installing the Transducer

This section will provide information on, the environment and transducer IP rating, mounting the transducer, and routing the transducer cable.

9.1 Transducer Environment

To ensure proper operation, the IP rating of the transducer must match or exceed the transducer's environment. Unless otherwise specified, a transducer has no special IP protection. In this case, the transducer may be used only in benign environments with no dust or debris and no liquids or spray. Refer to the *Accuracy over Temperature Section* of the *F/T Transducer Installation and Operation Manual (9620-05-Transducer Section)* for information on the transducer's temperature performance.

> ⚠️ **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.

> **NOTICE:** Transducers may react to exceptionally strong and changing electro-magnetic fields, such as those produced by magnetic resonance (MRI) imaging machines.

> **NOTICE:** Transducers without an IP protection may exhibit a small offset in readings when exposed to strong light.

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9.2   Mounting the Transducer

There are two different mounting types for transducers. The first type has a fixed bolt pattern on the tool side of the transducer and a removable adapter plate on the mounting (robot or other device) side. The adapter plate needs to be removed from the transducer and machined with the mounting bolt pattern to match the robot or other device. You will not be able to use the removable adapter plate alone, if your device covers the mounting fasteners used to connect the transducer. If this is the case a user designed interface will be needed between the transducer and the robot or other device. The second type has non-removable adapter plates with fixed bolt patterns on both the tool and mounting sides of the transducer (Nano, Mini, IP-rated and some Omega transducers). This type may require a user designed interface plate to attach the transducer to the robot or other device.

> ⚠ **CAUTION:** Do not remove any fasteners or disassemble transducers without a removable adapter plate, these include Nono, 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.

Refer to the product drawings in the *Transducer Specifications Section* of the *F/T Transducer Installation and Operation Manual (9620-05 Transducer Section)* to determine if the adapter plate is removable for our transducer. Mount the transducer to a structure with sufficient mechanical strength. Not doing so can lead to sub-optimum performance.

9.2.1   Mounting the Transducer with Removable Adapter Plates

Check that after the mounting adapter is attached to the robot or other device you will have access to the mounting screws for attaching the transducer. If not, a user designed interface plate will be needed, use Procedure *9.2.2—Mounting the Transducer with Non-removable Adapter Plates.*

1. Disconnect power from Net box.
2. Remove all mounting fasteners from the adapter plate and set aside.
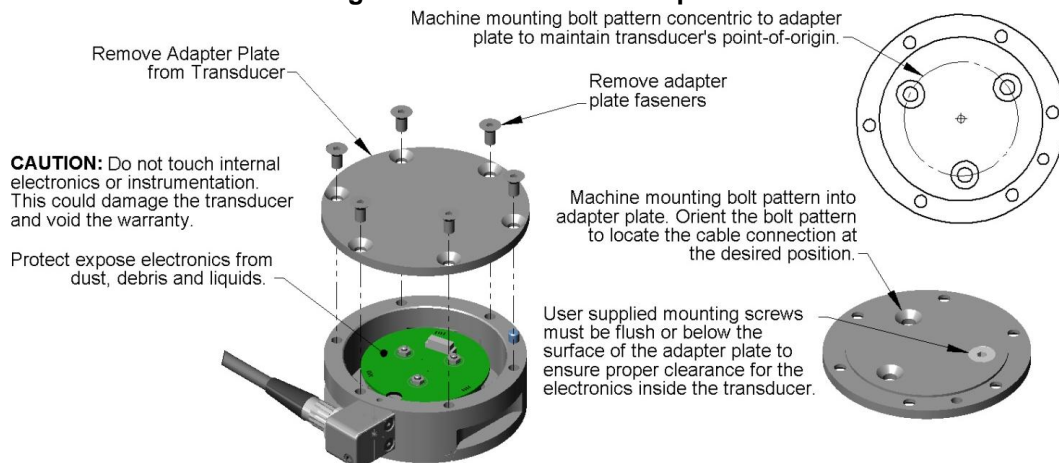
> ⚠ **CAUTION:** Do not touch internal electronics or instrumentation. This could damage the transducer and void the warranty. When the adapter plate is removed protect the exposed electronics from dust, debris, liquids, and other foreign objects.

3. Remove the adapter plate from the transducer. Machine the mounting bolt pattern from the robot or other device into the removable adapter plate.

> ⚠ **CAUTION:** Mounting fasteners should not extend into the transducer beyond the adapter plate surface. This could cause damage to the internal electronics. When machining the removable adapter plate, make sure the heads of the fasteners are flush or below the surface of the adapter plate.

Figure 9.1—Removable Adapter Plate

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4. Mount removable adapter plate to the Robot or other device using user supplied fasteners. If fasteners do not have pre-applied adhesive, apply Loctite 222® to the fasteners. **Note**: Make sure the adapter plate orients the transducer with the desired cable location.

5. Attach the transducer to the removable adapter plate, hand tighten fasteners.

6. Connect power to Net Box, wait until demo application displays load data when pressing on transducer.

> ⚠️ **CAUTION:** Do not exceed the transducer's overload ratings. 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.

7. Tighten the fasteners mounting the transducer to the removable adapter plate. Monitor the demo application for gage saturation errors. If an error is displayed stop applying the force to the transducer and wait until the error clears before continuing installation.

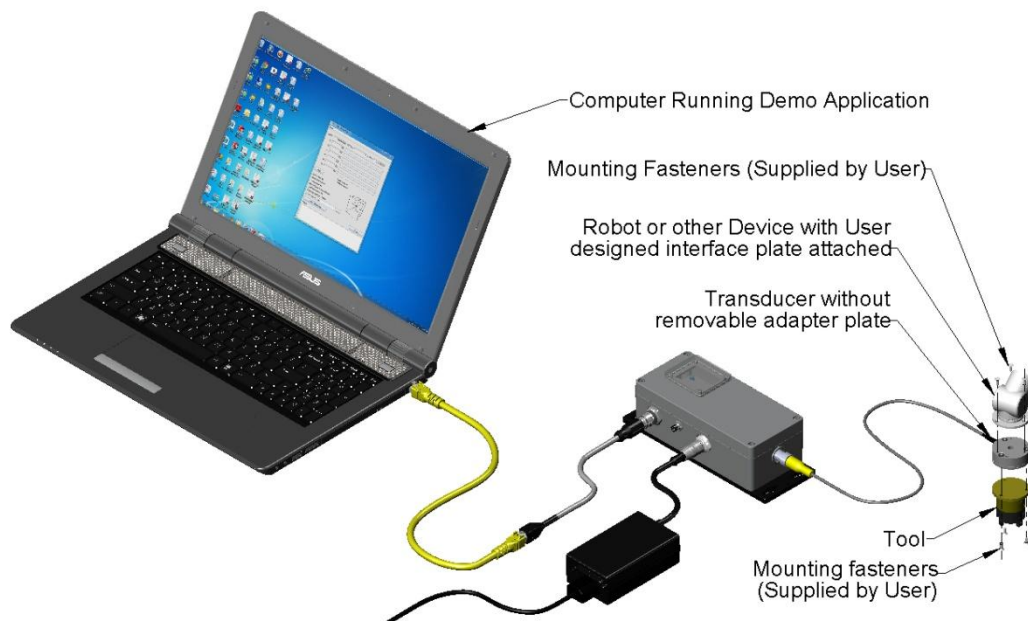**Figure 9.2—Monitor Load during Installation**
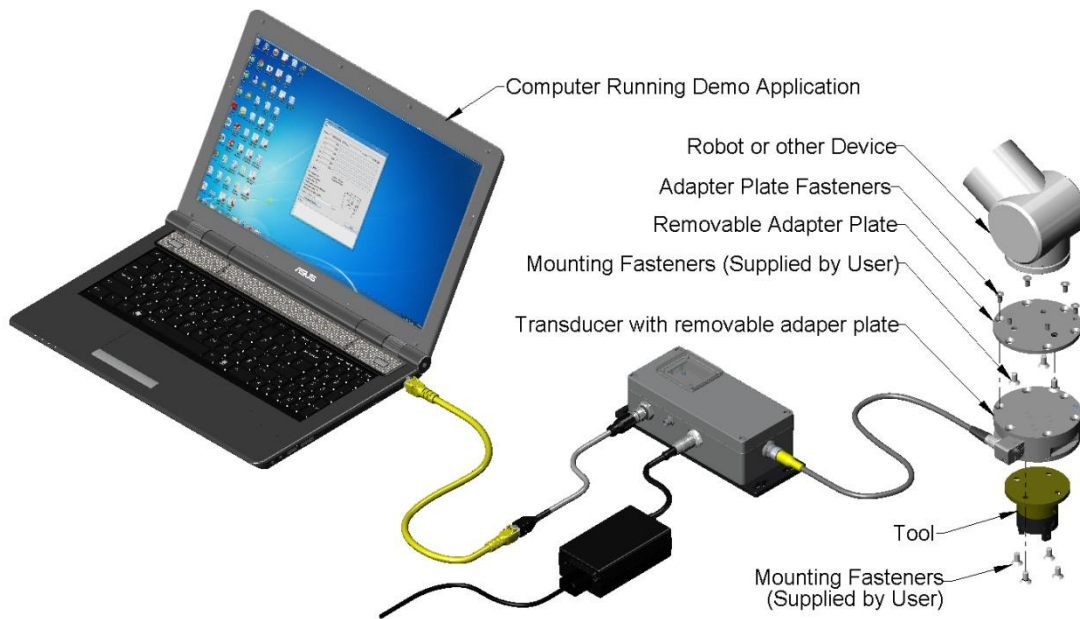
> ⚠️ **CAUTION:** Do not use fasteners that will exceed the customer interface depth specified on for the transducer. Using longer fasteners will penetrate the body of the transducer and damage the electronics, voiding the warranty. Use fasteners that provide the customer interface depth specified for the transducer. Refer to the transducer drawing.

> **NOTICE:** The tool may not touch any other part of the transducer except the tool mounting surface. If the tool touches any other part of the transducer it will not properly sense loads. Make sure the tool mounts to the tool mounting surface and does not touch any other part of the transducer.

8. Attach the Tool to the transducer with user supplied fasteners, the transducer provides a mounting pattern on the tool side of the transducer. If fasteners do not have pre-applied adhesive, apply Loctite 222® to the fasteners. Monitor the load on the transducer to make sure the single-axis overload is not exceeded.

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9.2.2 Mounting the Transducer with Non-removable Adapter Plates

> ⚠️ **CAUTION:** Do not attempt to drill, tap, machine, or otherwise modify or disassemble the transducer. This could damage the transducer and will void the warranty. Use the mounting bolt pattern provided to attach the transducer to the robot or other device and to mount the tool to the transducer. See the transducer drawings for details.

> ⚠️ **CAUTION:** Do not use fasteners that will exceed the customer interface depth specified on for the transducer. Using longer fasteners will penetrate the body of the transducer and damage the electronics, voiding the warranty. Use fasteners that provide the customer interface depth specified for the transducer. Refer to the transducer drawing.

> ⚠️ **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.

1. If needed design interface plate to mount to the transducer and robot or other device. Mount interface plate to robot or other device. Refer to drawing in the *Transducer Specifications Section* of the *F/T Transducer Installation and Operation Manual* (9620-05 Transducer Section) for mounting bolt pattern details.

2. Mount transducer to user-designed interface, directly to the robot, or other device with user supplied fasteners. If fasteners do not have pre-applied adhesive, apply Loctite 222® to the fasteners. Monitor the demo application for gage saturation errors. If an error is displayed stop applying the force to the transducer and wait until the error clears before continuing installation.

Figure 9.3— Monitor Load during Installation

Computer Running Demo Application

Mounting Fasteners (Supplied by User)

Robot or other Device with User designed interface plate attached

Transducer without removable adapter plate

Tool

Mounting fasteners (Supplied by User)

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> **NOTICE:** The tool may not touch any other part of the transducer except the tool mounting surface. If the tool touches any other part of the transducer it will not properly sense loads. Make sure the tool mounts to the tool mounting surface and does not touch any other part of the transducer.

3. Attach the tool to the transducer with user supplied fasteners, the transducer provides a mounting pattern on the tool side of the transducer. If fasteners do not have pre-applied adhesive, apply Loctite 222® to the fasteners. Monitor the demo application for Gage saturation errors. If an error is displayed stop applying the force to the transducer and wait until the error clears before continuing installation.

9.3   Routing the Transducer Cable

The transducer can be used in a variety of applications that will affect how best to route the cable and determine the proper bending radius to use. Some applications will allow the transducer and the cable to remain in a static condition, other applications require the transducer to be in a dynamic condition that requires the cable to be subjected to repetitive motion. It is important not to expose the transducer cable connectors to this repetitive motion, and properly restrain the cable close to the transducer connection.

Figure 9.4—Restrain Transducer Cable Close to Cable Connector
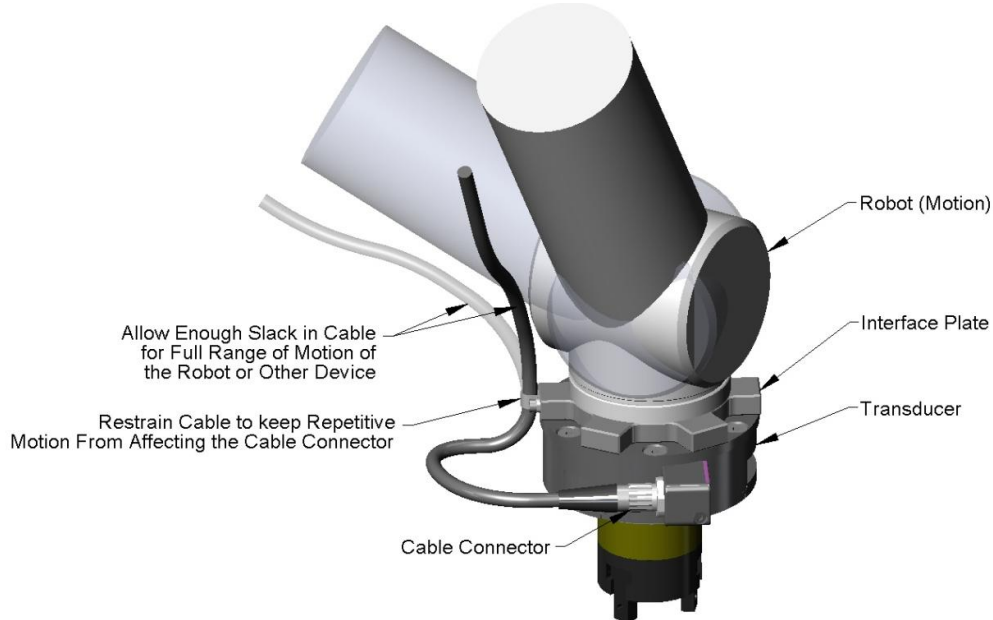
> **CAUTION:** Do not subject the transducer cable connector to the repetitive motion of the robot or other device. Subjecting the connector to the repetitive motion will cause damage to the connector. Restrain the cable close to the connector to keep the repetitive motion of the robot from affecting the cable connector.

> **CAUTION:** When routing cables do not bend less than the minimum bending radius required, refer to *Table 9.1* for minimum bending radius. The cable will fail due to fatigue from the repetitive motion. Make sure when routing the cable that the minimum dynamic bending radius is exceeded.

> **CAUTION:** Do not stress or over bend the transducer cable, especially where it is attached to the transducer. This is particularly important on the Nano and Mini series of transducers. For these transducers, do not bend the cable any closer than 25mm (1 inch) to the transducer. Sharp bends must be avoided as they can damage the cable and transducer and will void the warranty.

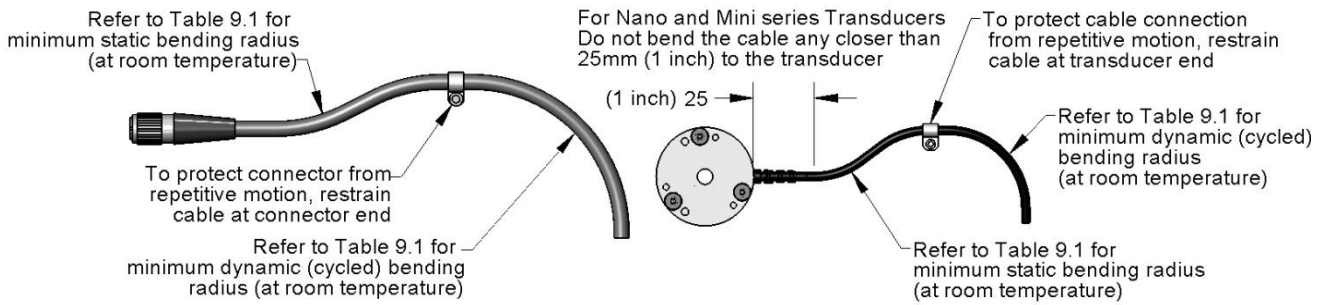**Figure 9.5—Transducer Cable Bending Radius**

Table 9.1—Transducer Cable Bending Radius					
Cable Type	**Cable Dia. (mm)**	**Static Bending Radius (at room temperature)**		**Dynamic Bending Radius (at room temperature)**	
		mm	**inch**	**mm**	**inch**
9105-TW	3.2	16	0.63	32	1.26
9105-C3	4.4	22	0.87	44	1.73
9105-CM	4.4	22	0.87	44	1.73
9105-CW	4.4	22	0.87	44	1.73
9105-CT	6.1	30.5	1.20	61	2.40
9105-C	3.2	16	0.63	32	1.26
	4.4	22	0.87	44	1.73
	6.1	30.5	1.20	61	2.40
	10.0	50	1.97	100	3.94
9105-C-MTR	8.4	42	1.65	84	3.31
9105-C-MTS	8.4	42	1.65	84	3.31
9105-CF-MTR	8.5	42.5	1.67	85	3.35
Note: Temperature will affect cable flexibility, ATI recommends increasing the minimum dynamic bending radius for lower temperatures.					

The transducer cable must be routed so that it is not stressed, pulled, kinked, cut, or otherwise damaged throughout the full range of motion. See the accompanying system manual for the transducer cable interfacing. If the desired application results in the cable rubbing, then use a **loose** plastic spiral wrap for protection.

> ⚠️ **CAUTION:** Be careful not to crush the cable by over tightening tie wraps or walking on the cable, since this may damage the cable.

> ⚠️ **CAUTION:** Cables on the Nano and Mini transducers are permanently attached to the transducer and cannot be disconnected. Do not attempt to disassemble these transducers, this will damage the transducer and void the warranty. Do not attempt to replace the cable. Contact ATI service for assistance.

> ⚠️ **CAUTION:** Nano and Mini integral cables and cables of the 9105-C-H type must not subject the transducer end connection to more than 10 lbf (45 N) of side-to-side or pull force or permanent damage will result.

> ⚠️ **CAUTION:** Larger transducers have removable cables. Do not attempt to disconnect these transducer cables by pulling on the cable itself or the connector boot; this can damage your system.

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10. Change the IP Address Settings

Ask your IT department if you should configure the Net F/T to use a static IP address or if you should use DHCP. If you will be using a static IP address, your IT department will need to give you an IP address, subnet mask, and gateway to use.

You will need to store this information on the Network Settings section of the Net F/T Communications page. Click on the *Communications* menu item to get to the Communications page (http://192.168.1.1/comm.htm).

If you are using a static IP address, select *Static IP*, enter the IP address, subnet mask, and gateway information as appropriate in the *Network Settings* section. If you are using DHCP select *DHCP*. See *Communications Page (comm.htm) Section of the Net F/T Installation and Operation Manual* for more information on these settings. See *Section 6.1–Finding Net F/Ts on the Network* to learn how to determine the DHCP-assigned IP address of a Net F/T.

Click on the *Apply* button to save the new settings.

11. Re-configure the Demo Application for Use

The demo application will have to be re-configured from monitoring gages to be used for the transducer application.

1. In your web browser click on the **Configuration** link on the left side of the web page.

2. Click the down arrow in the Calibration Select field and select the calibration that matches the transducer's serial number.

3. Click the **Apply** at the bottom of the page.

For more detailed information on configuring the Demo Application, refer to the *Web Pages Section of the Net F/T Installation and Operation Manual*.

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12. Exit Default IP Address Mode

Set the Net Box's DIP switch 9 to the *OFF* position. The settings that have been made will go into effect the next time the Net F/T is powered up.

1. Disconnect power from the Net box.

2. Disconnect the adapter and transducer cables from the Net box.

3. Loosen the four screws that secure the cover on the Net Box.

4. Lift the cover straight up and off the chassis.
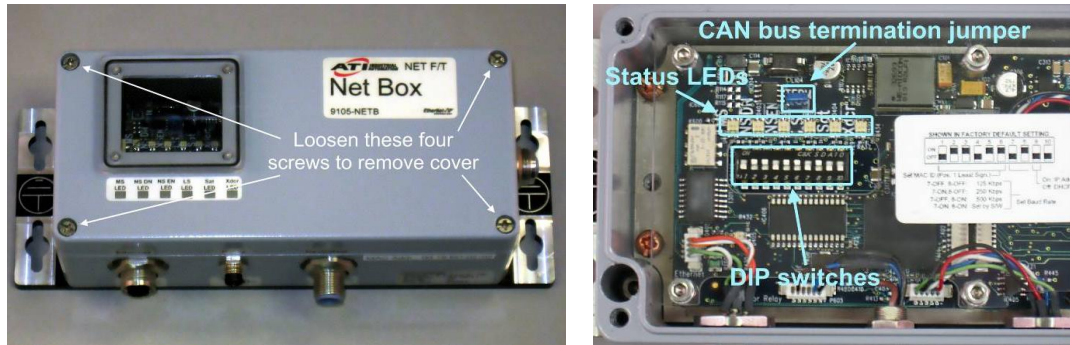
> **NOTICE:** The internal electronics have a clear shield to help protect them from debris or errant tool movements. There are access holes in the shield for the DIP switches and termination resistor jumper.

1. Set DIP switch 9 to the OFF position.
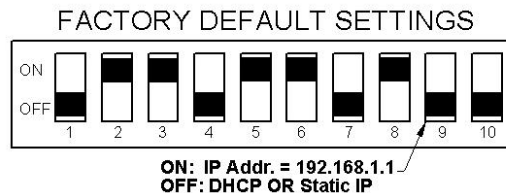
> **NOTICE:** Before replacing the Net Box cover, you must ensure that no debris or liquids are in the chassis.

2. Place the cover back on the chassis (verify that the window is above the LEDs and DIP switches).

3. Tighten the four screws to secure the cover.

4. Connect the adapter and transducer cables to the Net box.

5. Connect the power to the Net box.

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