**thermo**scientific

# iQ Series
# Communications Manual

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**ThermoFisher**
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# Contents

**Contents**

# Chapter 1
# ePort PC Software

For users that wish to utilize the instrument's Ethernet port to download instrument data, users may install the ePort software on a Windows personal computer (PC) connected to the same network as the instrument that data will be downloaded from. At the same time the ePort software is installed, the installer will install Microsoft .NET Framework software if the PC does not already have the proper version of .NET Framework.

## Installing ePort

Use the following procedure to install the ePort software.

1. Locate and double-click on the "setup_ePort_XX.exe" file (where "XX" is the version number) available over the company website at:

   www.thermofisher.com/42iQ

   www.thermofisher.com/42iQD

   www.thermofisher.com/42iQHL

   www.thermofisher.com/42iQLS

   www.thermofisher.com/42iQTL

   www.thermofisher.com/43iQ

   www.thermofisher.com/43iQHL

   www.thermofisher.com/43iQTL

   www.thermofisher.com/48iQ

   www.thermofisher.com/48iQTL

   www.thermofisher.com/49iQ

   www.thermofisher.com/49iQPS

   www.thermofisher.com/146iQ

   www.thermofisher.com/410iQ

   www.thermofisher.com/410iQHL

   www.thermofisher.com/450iQ

2. The "Welcome to InstallShield Wizard" screen will display.
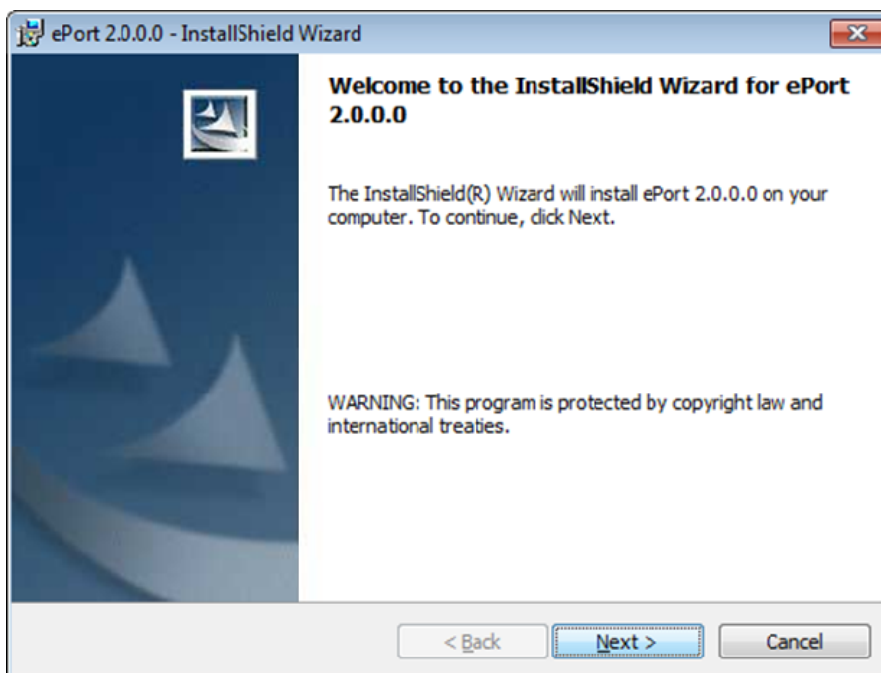


3. Select the **Next >** button.

4. The wizard will display the software license agreement. Read the agreement and select "I accept the terms in the license agreement" (if you accept the terms) then select the **Next >** button.
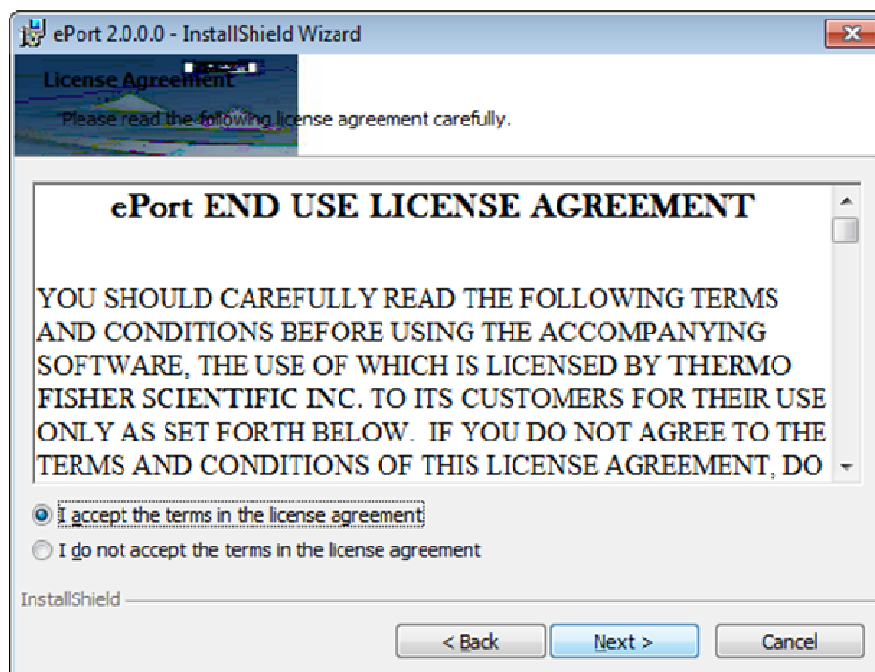
5.  The Windows update screen will display. If you have recently updated your Windows software, select the **Next >** button.

**Note** The ePort software MUST be installed on a PC with the latest Windows updates. If you have not updated your Windows system, select the "Cancel" button and use the Windows Update function of the PC to update the operating system before attempting to install the ePort software. ▲

**Note** During this installation, .NET 3.5 is also installed. Note that the installation of .NET 3.5 requires a connection to the internet. If no connection is available, please see your IT service provider for an alternative method of installation. ▲
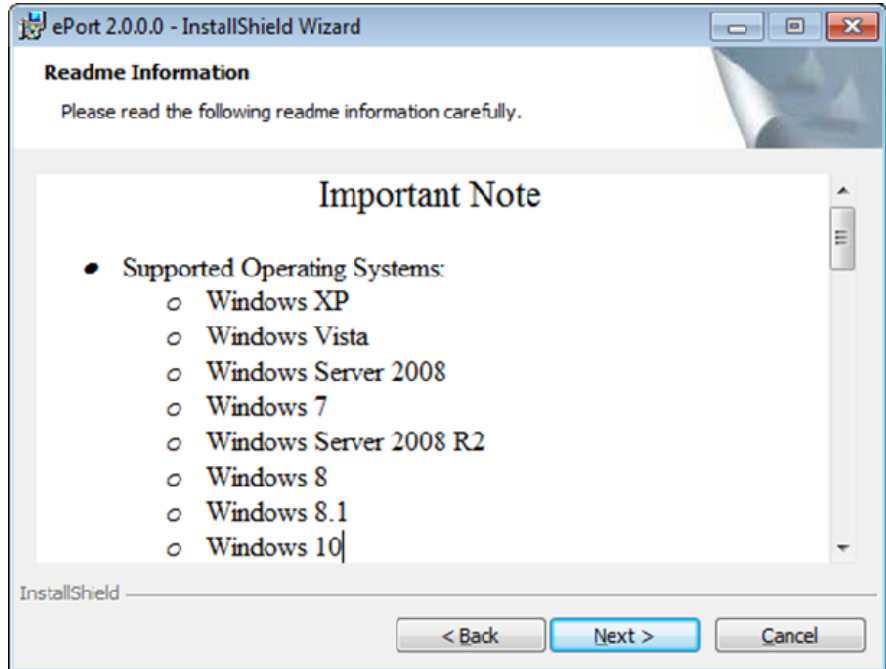
6. The Customer Information screen will display. Type in the information and select the **Next >** button.
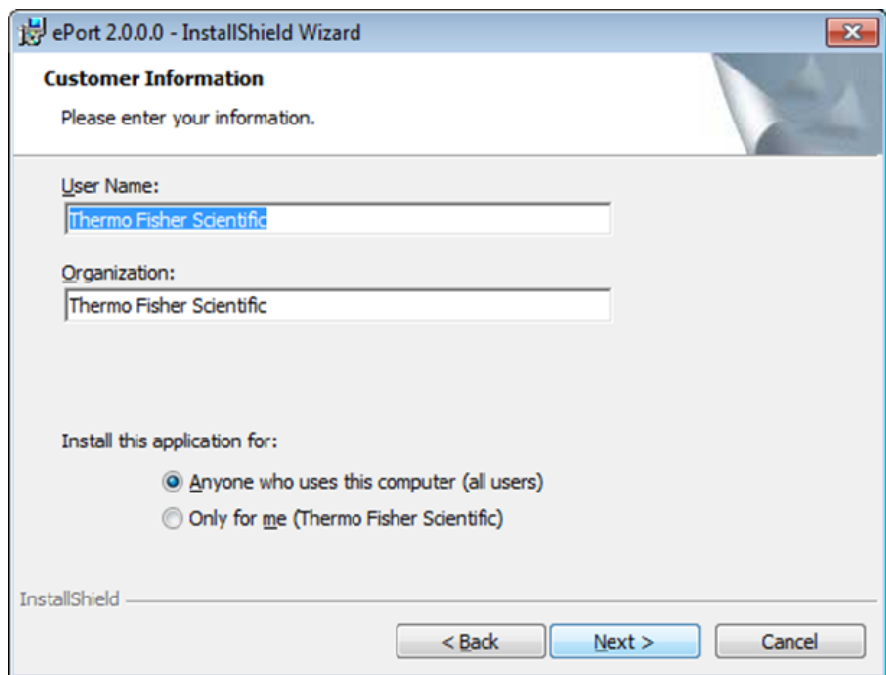


7. Choose the destination folder for the installation and select the **Next >** button.
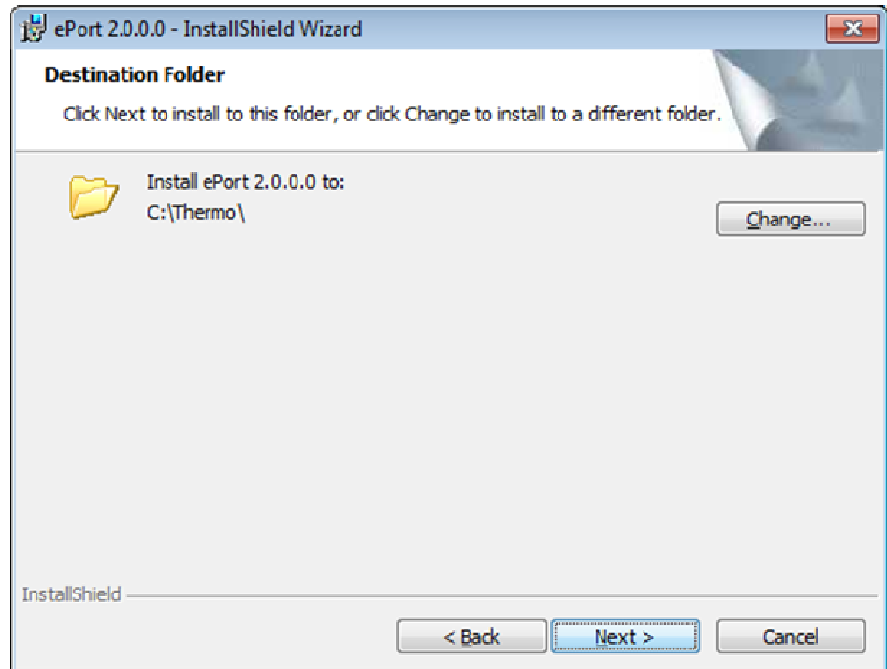
8. The Ready to Install Program screen will display. Select the **Install** button.
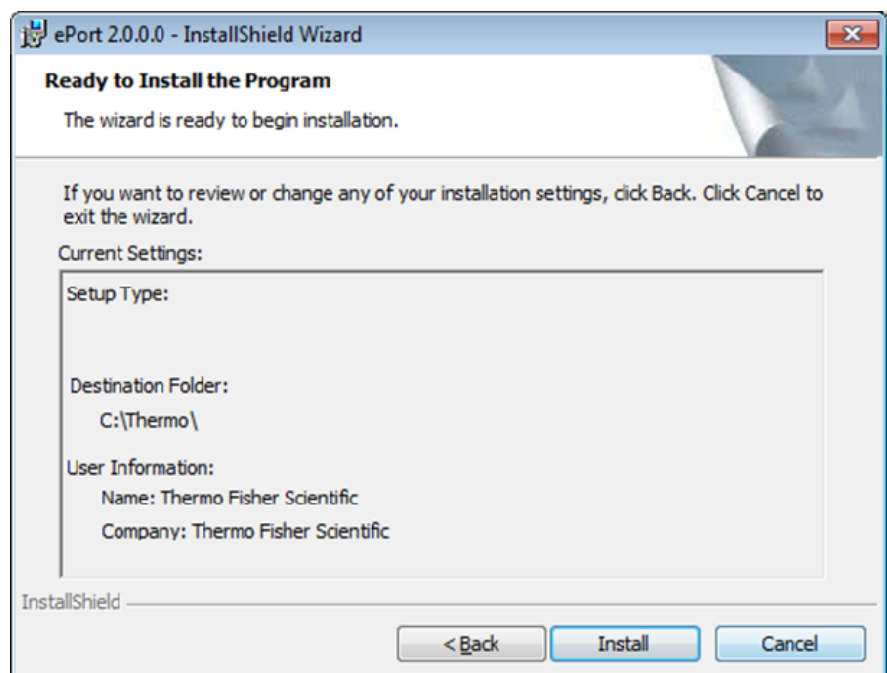


9. The wizard will post messages showing the progress of the installation. When the process is complete, the Finish screen will display. Select the **Finish** button.

**Note** Read all notes for important information on installing ePort. ▲
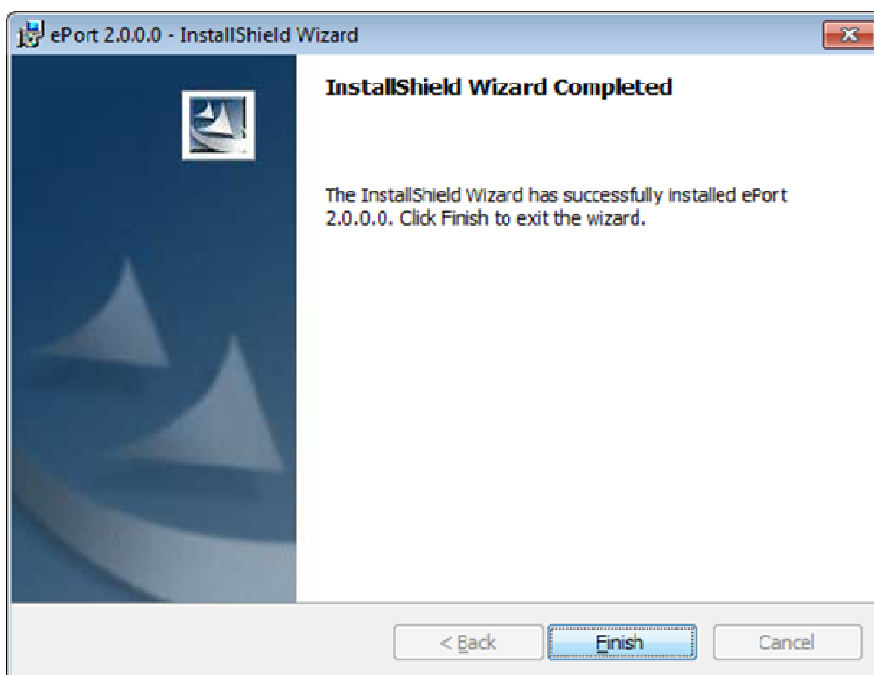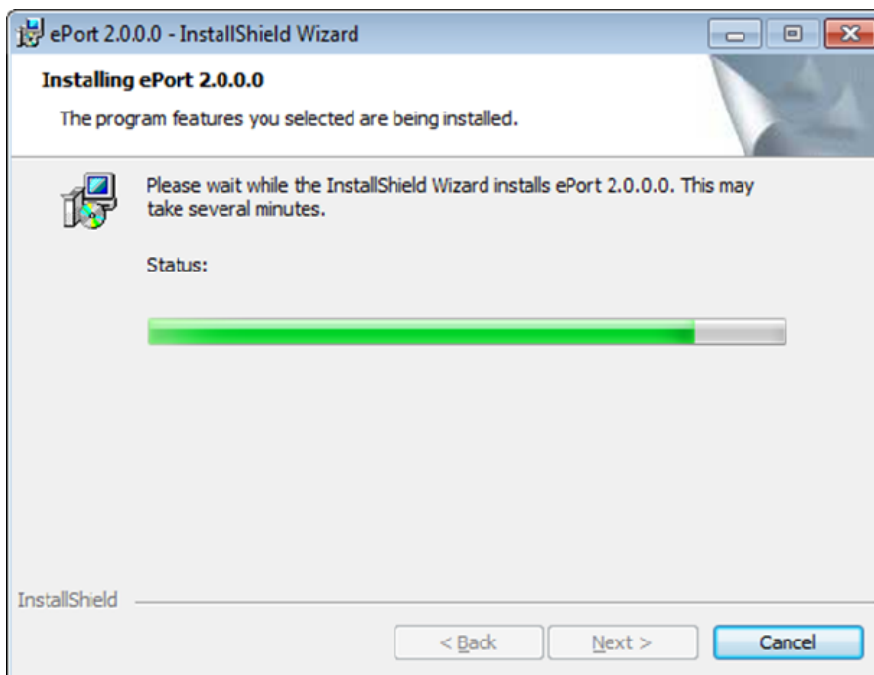
# Connecting to the Instrument

When the ePort software is installed, and the instrument and the PC are connected to the same network, the software can find and connect to the instrument and download data.

Use the following procedure to connect to the instrument.

1. Ensure that the PC and the instrument are connected to the same network subnet using the Ethernet connection on the back of the instrument.

2. In the Wired TCP/DHCP screen of the machine from which you want to download data, locate and record the IP address of that unit.

**Note** Instead of looking up the address on the TCP/IP Settings screen, users can also scan for instruments when the instruments are on the same subnet. Refer to "Finding Instruments on a Network" on page 1-10. ▲

**Note** When DHCP is on, the dynamic IP address is being used. When DHCP is off, the static IP address is being used. ▲

**Home Screen>Settings>More>Communications>Wired TCP/DHCP (with DHCP on)**



**Home Screen>Settings>Communications>Wired TCP/DHCP (with DHCP off)**

| DHCP<br>Disabled | Static IP Address<br>192.168.1.200 | Static Netmask<br>255.255.255.0 |
|---|---|---|
| Static Gateway<br>192.168.1.1 | Static DNS Server<br>0.0.0.0 | Wired MAC Address<br>60:89:3C:7F:08:15 |
| | Host Name<br>iQSeries | |
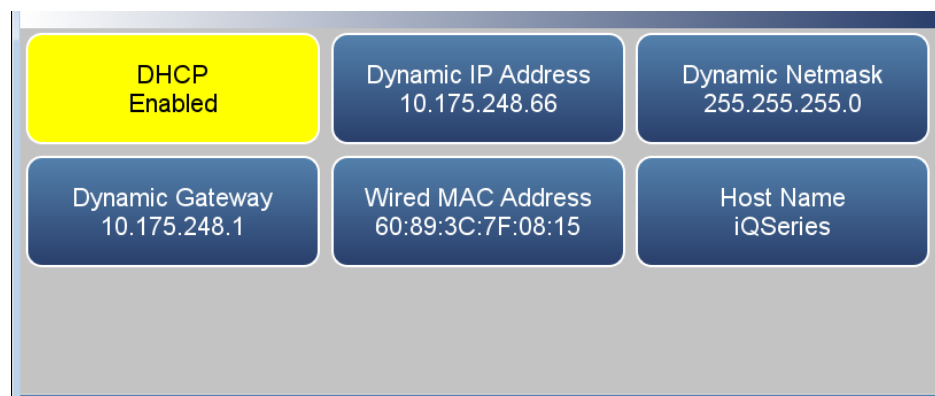
3. Start the ePort PC software, using the icon on the PC desktop or the Start menu of the PC. The ePort Main screen with the Open screen will display.
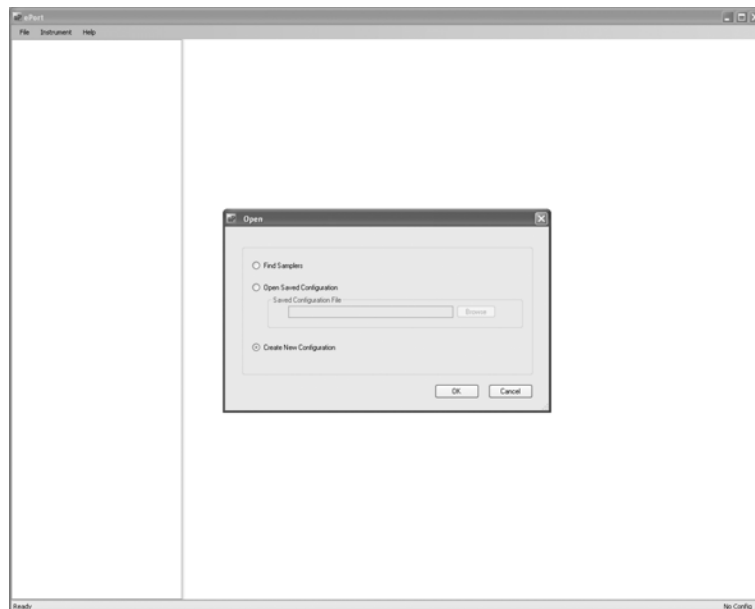


4. In the ePort Open screen, select create new configuration. A blank ePort Main screen will display.

5. Select **Instrument** then **New Instrument** from the menu bar at the top of the ePort Main screen.
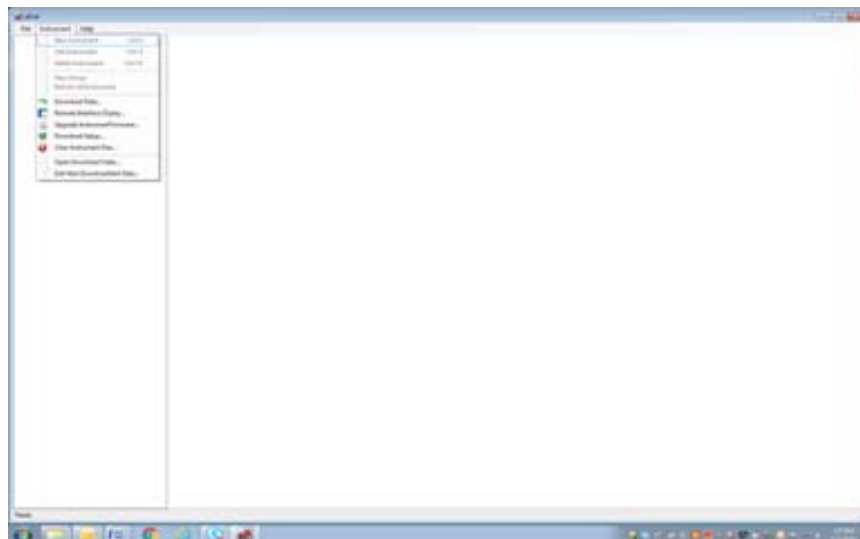
6. The Add New Instrument screen will display. Enter the IP address, the name assigned to the instrument and the group name (required) assigned to the instrument and select the **OK** button.
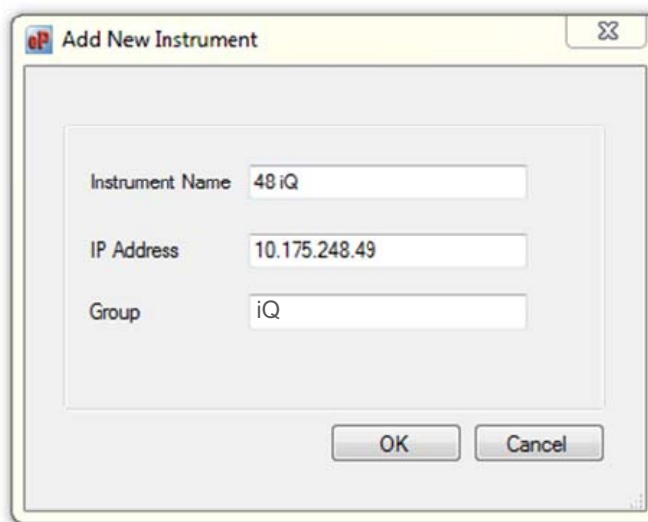


7. The ePort Main screen will display with the selected instrument displayed in the top window. Repeat the process to add additional instruments to the list.

8. To save this as a configuration, select **File** then **Save** from the menu bar at the top of the Main screen. The Save As screen will display. Type in the desired name for the configuration and select **Save**.

**Note**  Once you have connected to an instrument (or instruments) and saved a configuration file, select **Open Saved Configuration** in the ePort Open screen to open that configuration and automatically connect to all the instruments that were saved in that configuration. ▲
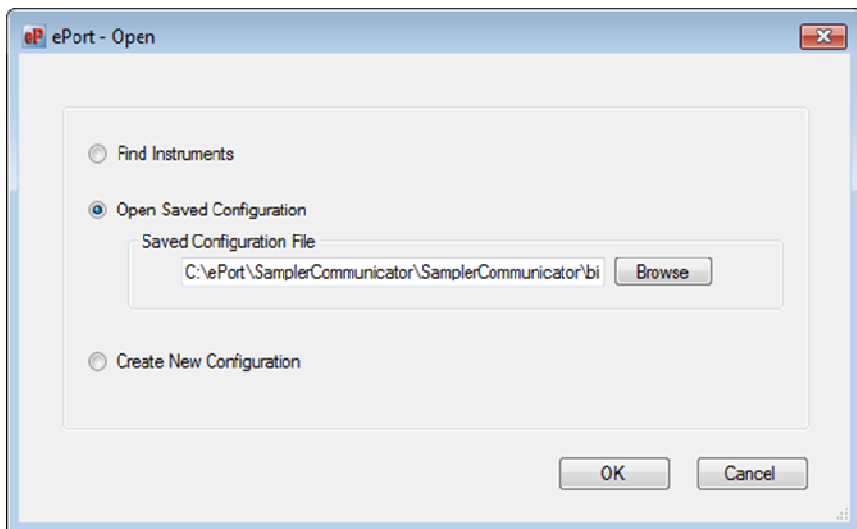


# Finding Instruments on a Network

You may use the ePort software to search for all instruments connected to the local network.

**Note**  This function will only locate instruments on a local network. To connect to instruments on other connected networks, you must know the IP address of the instruments and connect to the unit manually using the **New Instrument** function of the software. Refer to the previous section for information on connecting to an instrument off the local network. Instruments on a network must have a unique IP address, or be connected through a router. ▲

Use the following procedure to locate all instruments on the network.

1. Open the ePort software program and select "Find Instruments" in the Open screen.
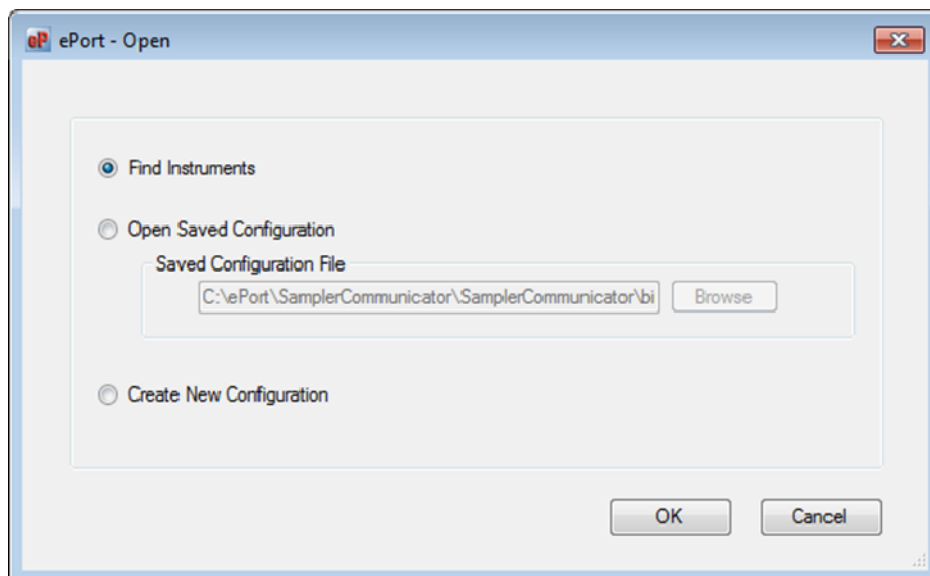
2. The ePort Main screen will display with a "Searching for Instruments..." message. As instruments are located by the software they will be added to the list in the Instrument frame on the left side of the screen.
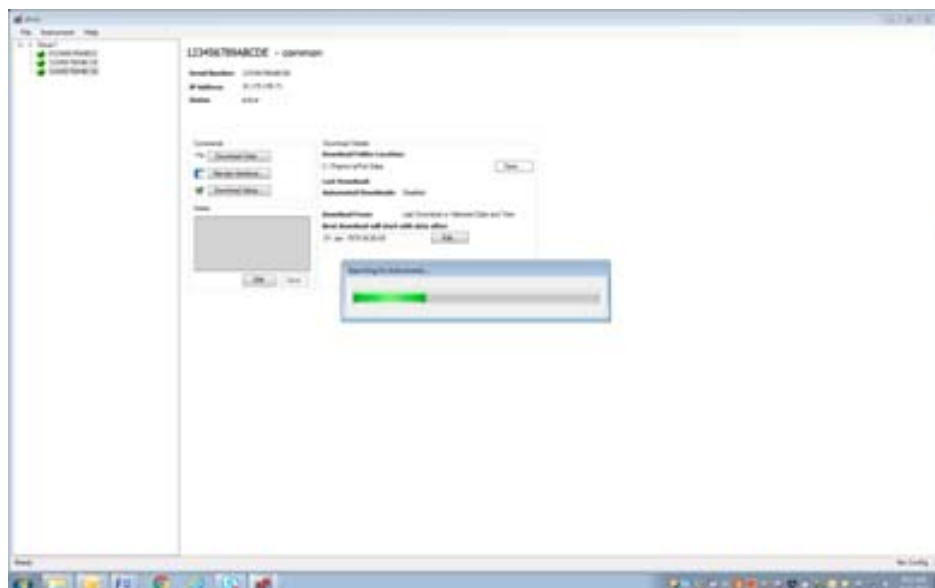


3. All instruments located on the local network will be displayed in the Instrument frame on the left side of the Main screen. To edit a displayed instrument or delete an instrument from the list, right-click on the instrument and select Edit Instrument or Delete Instrument.
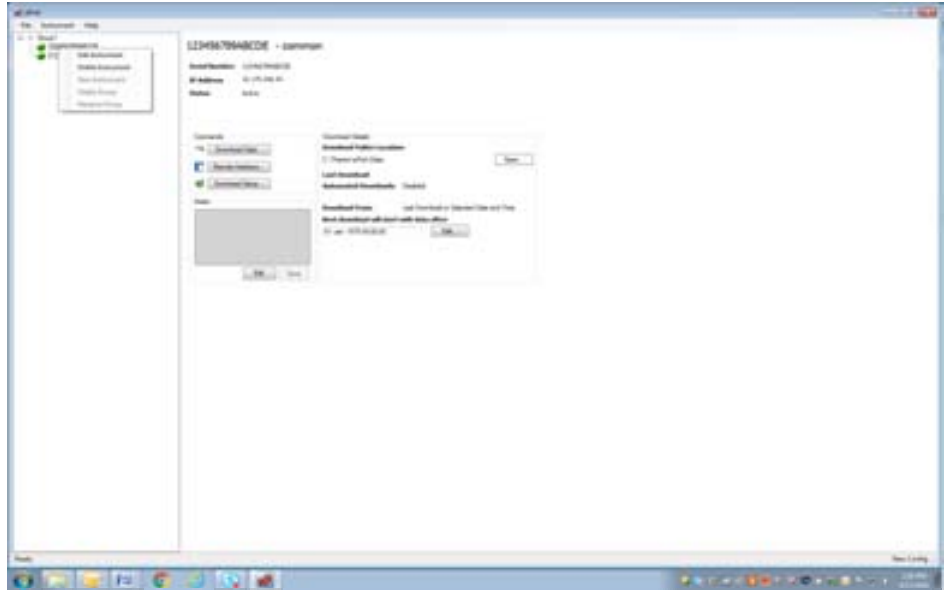
**Note** To add an instrument from another network connected to the local network select Instrument then New Instrument from the menu bar. Refer to the previous section for more information on manually adding an instrument to the configuration. ▲

4. To save this list as a configuration, select File then Save from the menu bar at the top of the Main screen. The Save As screen will display. Type in the desired name for the configuration and select Save.

**Note** Once you have connected to an instrument (or instruments) and saved a configuration file, select Open Saved Configuration in the ePort Open screen to open that configuration and automatically connect to all the instruments that were saved in that configuration. ▲

## Setting Up for Manual Data Downloads

Data can be remotely downloaded manually from the instrument through the built-in Ethernet connection using the ePort software.

Use the following procedure to set up the software to manually download data.

1. Ensure that the PC and the instrument are connected to the same network using the Ethernet connection on the front of the instrument. (Refer to the previous section for information on connecting the instrument to a network.)

2. Use the ePort PC software to connect to the instrument and display the ePort Main screen. (Refer to the previous two sections for information on connecting to the instrument or instruments.)
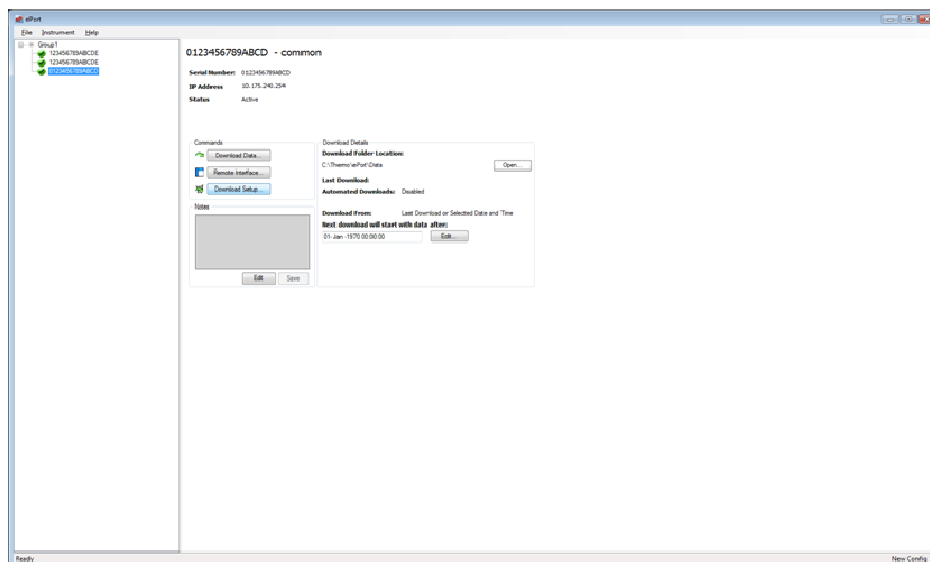


3. Select **Download Setup** in the Commands window of the ePort Main screen. The Download Setup Wizard will display. Select the **Next >** button.
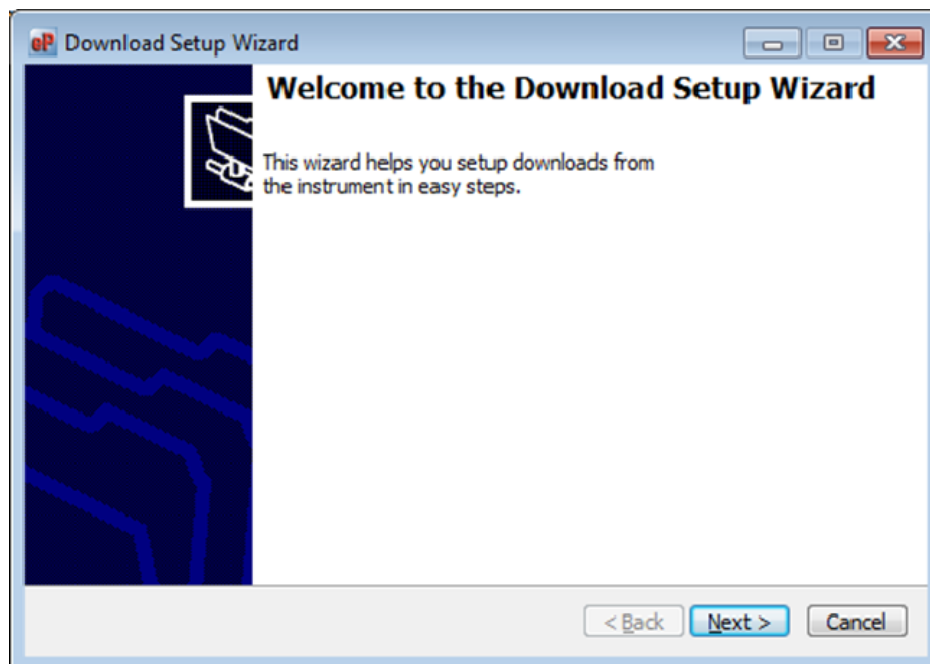


4. The Select Data screen will display. Select the data to download (either all data on the instrument or the data since the last download). Select the **Next >** button.
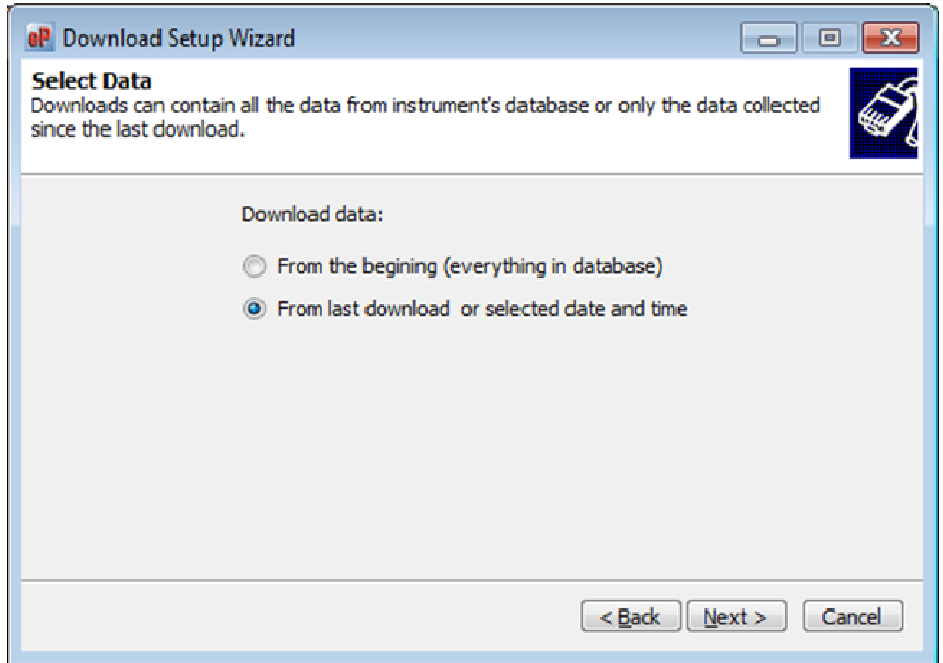
5.  The Select Location screen will display. Use the Browse button to select a location for the data file downloaded by the software. Select the **Next >** button.
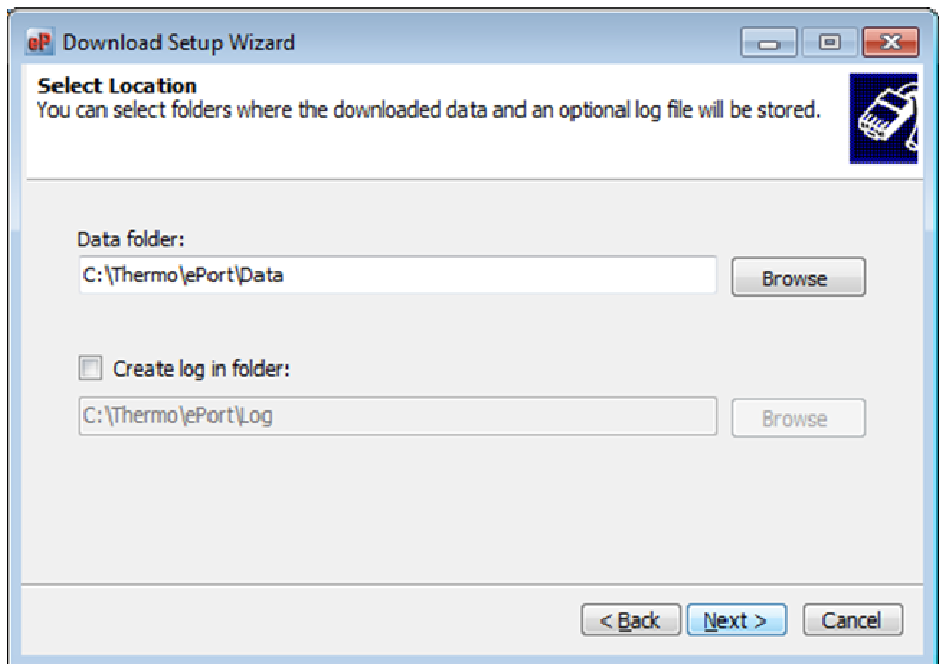


6.  The Download Type screen will display. Select manual downloads. Select the **Next >** button.

7. The Completing the Download Setup Wizard screen will display. Select the **Finish** button.

# Setting Up for Automatic Data Downloads

Users can set up automatic downloads for the instrument monitor using the ePort software.

Use the following procedure to set up the software to automatically download data.

1. Ensure that the PC and the instrument are connected to the same network using the Ethernet connection on the back of the instrument. (Refer to the previous section for information on connecting the instrument to a network.)

2. Use the ePort PC software to connect to the instrument and display the ePort Main screen. (Refer to the previous sections for information on connecting to the instrument or instruments.)

3. Select **Download Setup** in the Commands window of the ePort Main screen. The Download Setup Wizard will display. Select the **Next >** button.
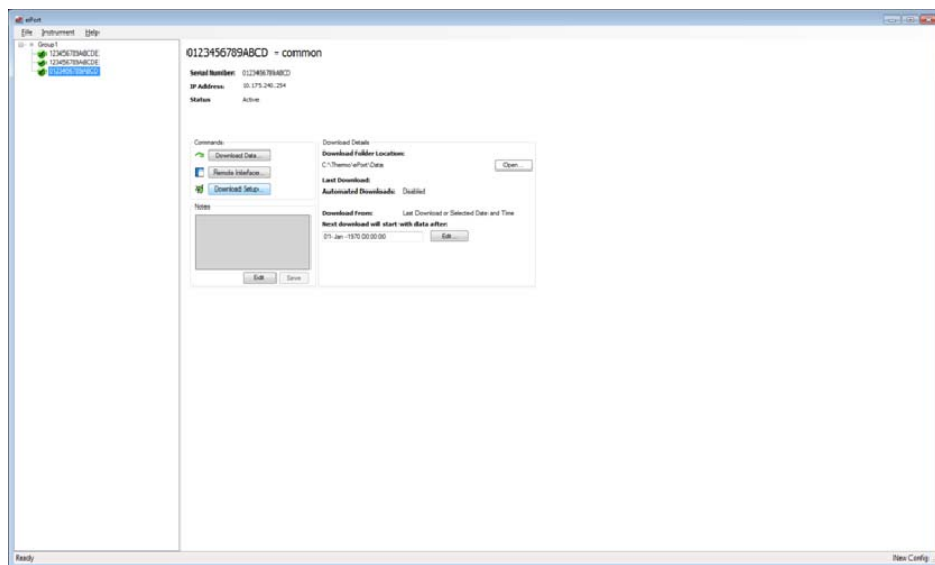


4. Select Data screen will display. Select the data to download (either all data on the instrument or the data since the last download). Select the **Next >** button.

5. The Select Location screen will display. Use the Browse button to select a location for the data file downloaded by the software. Select the **Next >** button.

6. The Download Type screen will display. Select automatic downloads. Select the **Next >** button.

7. The Download Schedule screen will display. Select a starting date and time, and a download frequency (daily, weekly, hourly). Select the Next > button.
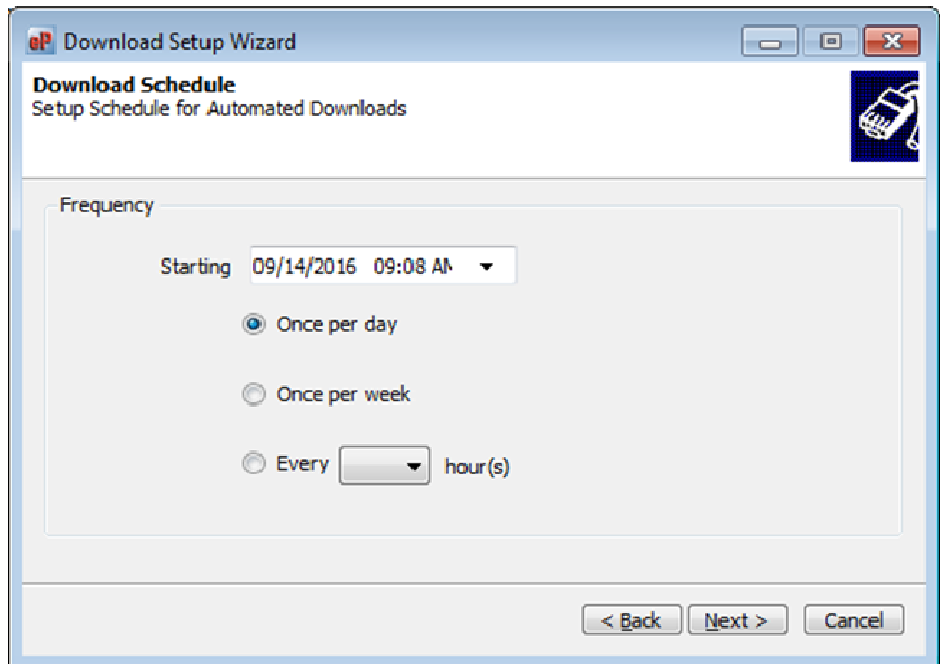


8. The Completing the Download Setup Wizard screen will display. Select the **Finish** button.

## Performing a Data Download

Use the following procedure to download data.

1. Ensure that the PC and the instrument are connected to the same network using the Ethernet connection on the back of the instrument. (Refer to the Connecting to the instrument section for information on connecting the instrument to a network.)

2. Use the ePort PC software to connect to the instrument and display the ePort Main screen. (Refer to the Connecting to the instrument section for information on connecting to the instrument.)
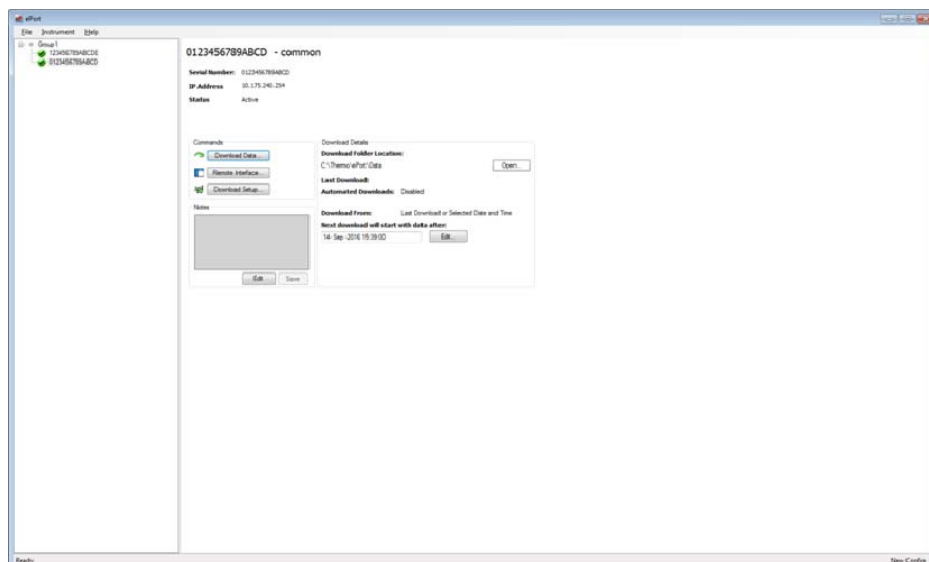


3. On the left side of the screen, click on the instrument you wish to download information from.

4. Select **Download Data** in the Commands window of the ePort Main screen. The Download Data screen will display.
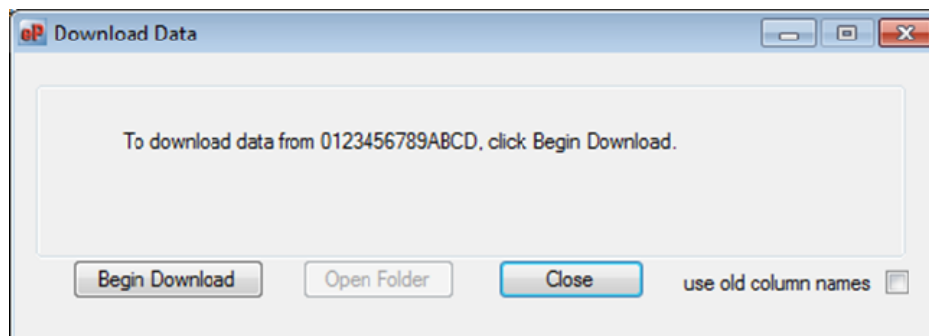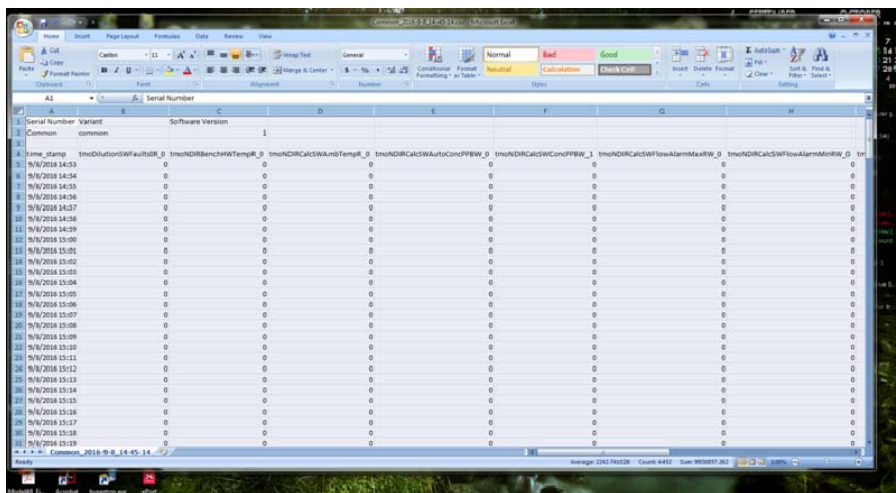


5. Select the Begin Download button. The ePort software will download data based on the settings created in the Download Setup wizard. (Refer to the previous section for information on setting up downloads.) The message window will display a "Downloading Data" message while the software is downloading data from the instrument. When the download is complete, it will display a "Download Complete" message. Select the Done button to exit the Download Data screen.

## Viewing Downloaded Data

Data files are downloaded and saved as ".csv" files that can be opened and viewed with Microsoft Excel. The file name format is the instrument serial number followed by a date/time stamp.

The data files will be saved to the folder selected using the Download Setup Wizard. Refer to the Setting Up for a Data Download section for information on setting up a data folder. The default folder location is: **Thermo\ePort\Data**



## Installing New Firmware

If the instrument needs new firmware, it can be uploaded to the instrument using the ePort software regularly used for data downloading. (Refer to "Installing ePort" for information on installing and starting the ePort software.) New versions of the instrument software are periodically made available over the company website at:

www.thermofisher.com/42iQ

www.thermofisher.com/42iQLS

www.thermofisher.com/43iQ

www.thermofisher.com/48iQ

www.thermofisher.com/410iQ

www.thermofisher.com/49iQ

www.thermofisher.com/49iQPS

www.thermofisher.com/146iQ

Use the following procedure to install new firmware.

1. Download the new firmware file onto a personal computer (PC) from the company website. Note the file name.

2. Ensure that the PC and the instrument are connected to the same network using the Ethernet connection on the back of the instrument. (Refer to "Finding Instruments on a Network" for information on connecting the instrument to a network.)

3. In the Wired TCP/DHCP screen of the machine you want to update, locate and record the IP address of that unit.

4. Use the ePort PC software to connect to the instrument. (Refer to "Connecting to the Instrument" for information on connection to the instrument.)

5. In the ePort Main screen, select **Upgrade Instrument Software**.
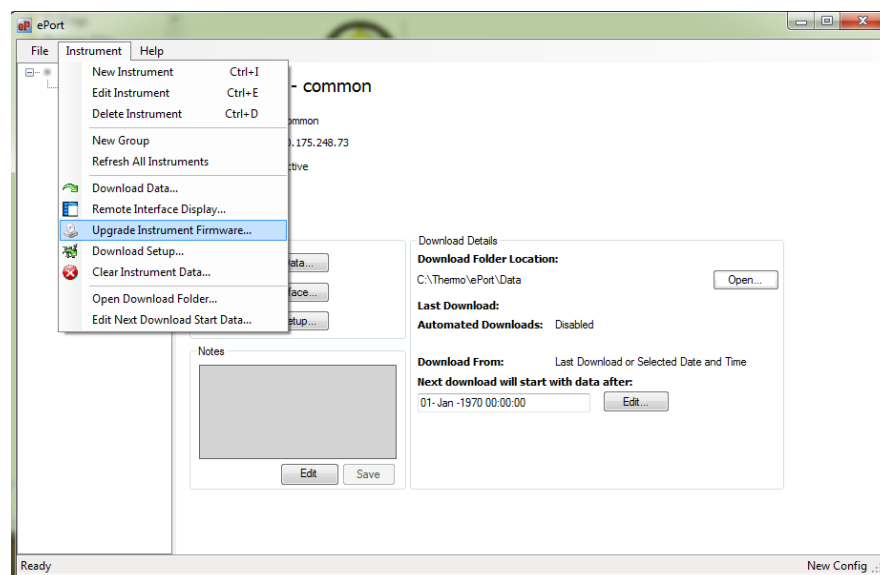


**Note** Data will not be collected during the upload procedure and the instrument will be restarted. ▲

6. The Thermo Installer Wizard screen will display. Select the **Next >** button.
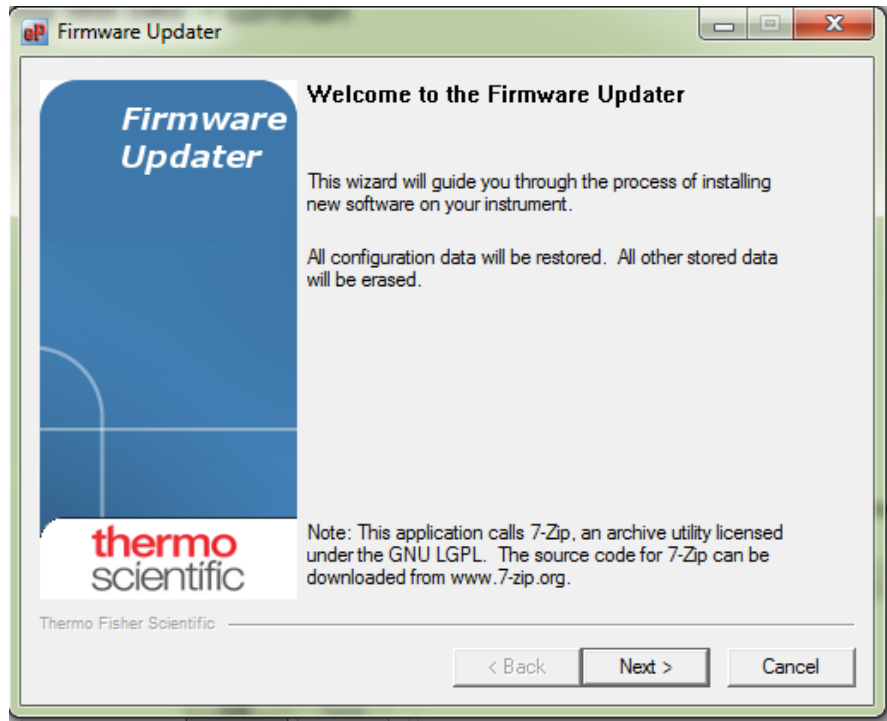
7. The Software File screen will display. Select the Browse button to locate and select the file that was downloaded from the company website. When the file is selected, it will display in the window below "Choose the File to Upload". Select the **Next >** button.

8. The Upload Software screen will display. The software will restart the instrument then install the firmware. The "Upload Progress" bar will show the status of the upload. When the process is complete, select the **Next >** button.
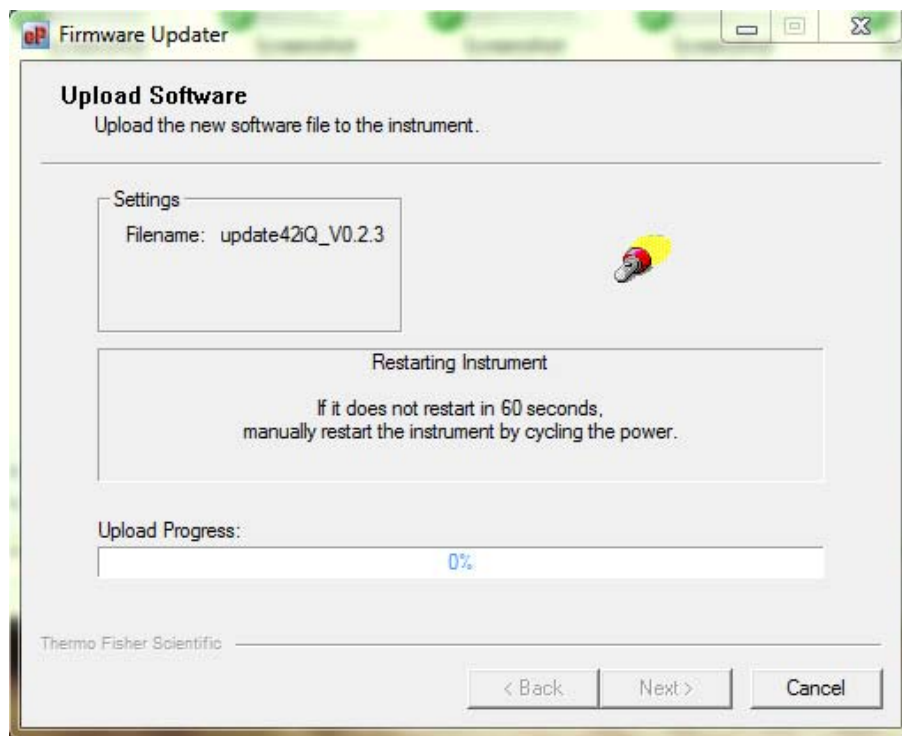
**Note** It may take several minutes to upload the new firmware, depending on the speed of the uploading PC and the speed of the network. During the upload, the instrument touch screen will display a text message, then a scrolling cursor to indicate progress. ▲

9. The Software Upload Completed screen will display. Select the **Finish** button. Close ePort and return to normal operation.

# Chapter 2
# Mobile VNC Viewer App

Remote access to the Thermo Fisher Scientific iQ Series instrument front panel GUI interface is possible using a mobile device using the VNC® Viewer app from RealVNC®. If you're on a mobile device, then its touchscreen acts as a mouse trackpad, with gestures mapped to mouse buttons. See the last section of this bulletin called "Using VNC Viewer" for help.

Thermo Fisher Scientific has conducted tests to determine compatibility of our iQ Series product's software with the VNC Viewer App.

## Instrument Setup

Before connecting to the instrument from a mobile device, the instrument must be set up to be accessible from that device. If the user requires remote access over the Internet or over a cellular network they will either need to configure VPN on the mobile device to access the instrument on a private network (preferred) or put the instrument directly on the Internet (not recommended). Either way, the user must record the host name or IP address of the instrument before accessing it remotely:

**Using Host Name (Preferred)**

● To get and set the Host Name, on the iQ Series screen go to Settings -> Communications -> Wired TCP/DHCP -> Host Name button. By default, the host name is "Common", but it may be changed to a more specific name such as "48iQ" or "StackCO".

### Using DHCP IP Address

**Note**  If using the DHCP address, it is possible that the address may change and would need to be re-entered in the VNC app. It is preferred to use a fixed IP Address or a host name for the instrument to avoid these issues. ▲

● To get and set the IP address, on the iQ Series screen go to Settings -> Communications -> Wired TCP/DHCP-> Dynamic IP Address button to obtain the IP Address.



### Using Static IP Address

● To get and set the IP address, on the iQ Series screen go to Settings -> Communications -> Wired TCP/DHCP-> Static IP Address. Note that the DHCP button is not yellow when using a Static IP Address.
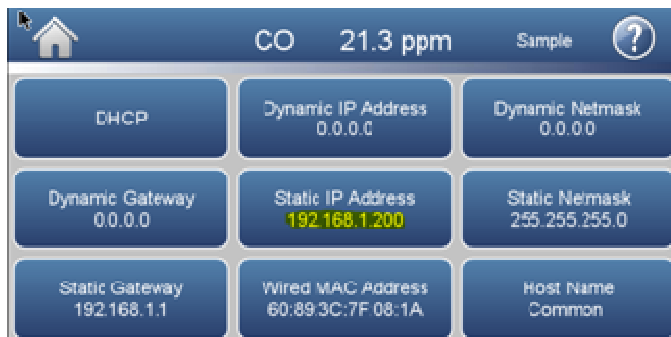


Record the instrument host name or IP address for setting up the VNC Viewer later in this document.

# App Installation and Setup

The VNC Viewer App is available for both iOS and Android mobile devices through the Apple AppStore or the Google Play Store.

1. On your mobile device search and download the latest version of VNC Viewer.
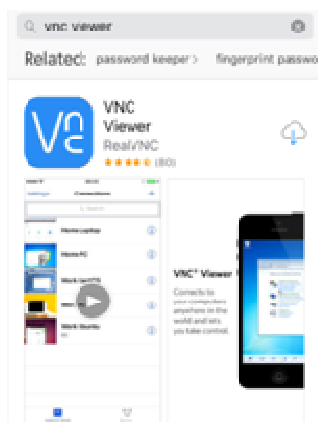


2. Once the VNC Viewer app has completely installed, open and select Next until you get to the "Automatic discovery" screen.



Access your computers on the go

Download VNC Connect to your computers to ensure seamless, secure remote access.

Next

Take control

Use your device's screen as a trackpad to accurately control a mouse-driven desktop.

Next

Sync connections between devices

Sign in to your RealVNC account on all your devices to backup and share your address book.

Next

3. At the Automatic discovery screen, click on "Get Started".

Automatic discovery with...

VNC **connect**

Automatically discover and seamlessly
connect to computers running VNC
Connect.

Get Started

Send anonymous usage data to
improve VNC Viewer

Privacy Policy

4. In the Address Book screen, select the plus sign (+) in the top right
   hand corner.

≡ **Address Book** +

**No Connections**

Tap + to create a direct connection to a
computer or device you know the IP
address or hostname for.

Sign in to your RealVNC account to see
the computers in your team
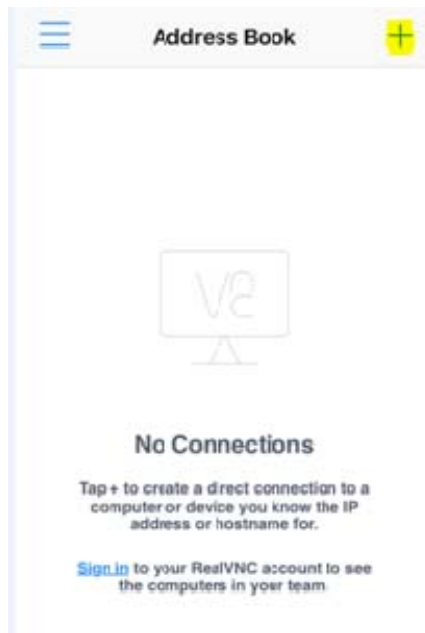
5. On the VNC Viewer App (Details screen) enter the Host Name or IP
   Address in the Address field and desired name in the Name field, then
   select Save.
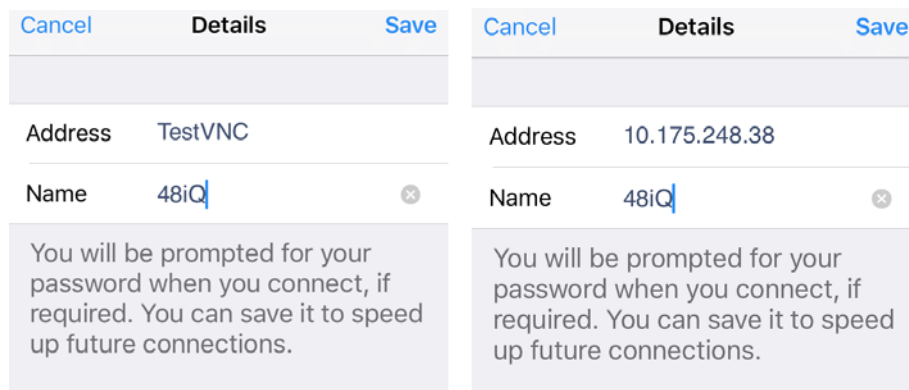
6. Once Name with IP Address is created in the Address Book, select Connect.
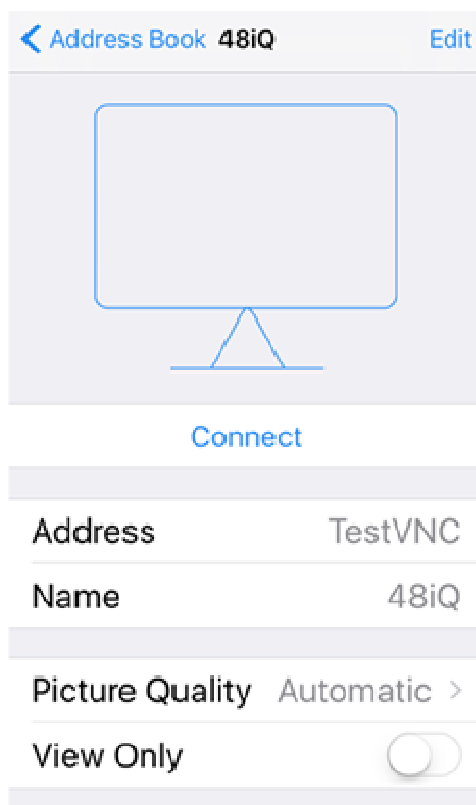


7. An Encryption screen will display for the first time. Slide the button to the left that says "Warn me every time" and then select Connect.
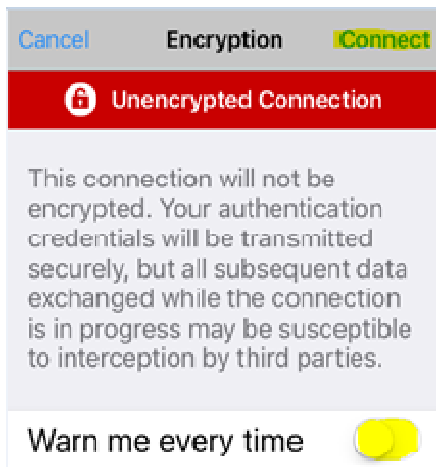
8. Once connected, you can select Skip or Next to view gestures to control GUI on your iQ Series Platform.
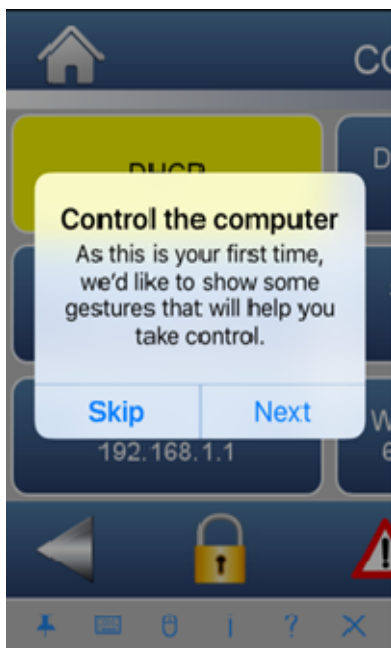


9. VNC Viewer is now ready to be use on your iQ Series instrument.

# Using VNC Viewer

Your finger moves the mouse cursor rather than clicking where you touch, as you might expect with a touchscreen. This gives you more precise control of a high-resolution computer desktop.

| | |
|---|---|
| | Pinch with two fingers to zoom. |
| | Touch with one finger and drag to position the mouse cursor. |
| | Tap with one finger to left-click. |
| | Double tap with one finger to double-click. |
| | Tap with two fingers to right-click. |
| | Tap with three fingers to middle-click. |
| | Touch with two fingers and drag to scroll. |
| | Double tap and drag to click and hold, or select text. |
| | Shake the device, or swipe up from the bottom, to show the toolbar. |
| | Note the toolbar can be pinned to prevent it from auto-hiding. |

**Notes**

- Tap  to open the virtual keyboard, above which a scrolling key bar containing function and other special keys is displayed. Double tap a modifier key (for example, Shift or Ctrl) to hold that key down. Some keys, such as Scroll Lock, are not available.

**Note** If a hardware keyboard is detected, the virtual keyboard is not displayed. However, tapping the keyboard icon will still open the scrolling key bar. ▲

- You can type international characters providing the target computer is running VNC and its operating system supports the language you want to type in (note this must be the currently-selected language under Mac OS X).

- You can copy and paste text between device and target computer providing the latter is running VNC. Note that if you background VNC Viewer in order to grab text from your device, the connection terminates after a few minutes.

- Tap  to open mouse mode. Virtual left, middle, and right mouse buttons, and a vertical scroll bar, are superimposed on the desktop, to provide an alternative to gestures.

If you have any questions or require technical assistance, please contact your local distributor or our Technical Support team at (508) 520-0430 or by e-mail at AQIservice@thermofisher.com.

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# Chapter 3
# iQ Series Mobile Phone App

The iQ Monitoring companion app for the iQ Series Gas Analyzers delivers the ultimate in ease of use and smart engineering. The iQ Monitoring app allows for:

- Remote monitoring of the iQ analyzer
- Easy access to product documentation
- Enhanced communication

**Remote Monitoring**

Always know the performance of your analyzer when the iQ Monitoring mobile app is connected to your network. Eliminate surprises and gain control over your day with 24/7 remote access to your instrument.

- Real time, continuous instrument readings
- Maintenance alerts allow you to plan your day rather than reacting to emergencies
- Secure connectivity utilizing your own network protocols
- Identify part number requirements and facilitate the easy online ordering with a credit card or PO

**Instant Access to Resources**

The iQ app gives you easy access to iQ Series Gas Analyzer user resources. Instrument connection is not required so you can look up the latest documents/videos available regardless of whether you are using the app for remote monitoring. Resources include:

- Operator manuals
- How to videos
- Quick start guides
- Spare parts lists
- FAQs
- Technical bulletins

**Enhanced Communication with the factory**

Get in touch with us in a few simple clicks. Instrument connection is not required to take advantage of the app's functionality to contact us, so download the app even if you are not monitoring remotely. Use the app to easily:

- Obtain a return authorization number

- Register for training

- Request field service visit

- Go to product website

- Easily order spare parts online

- Request a quote

## Downloading the App

Download the app from the Apple app store, open the app, then follow the onscreen instructions.

https://itunes.apple.com/us/app/iq-monitoring/id1214487266?mt=8
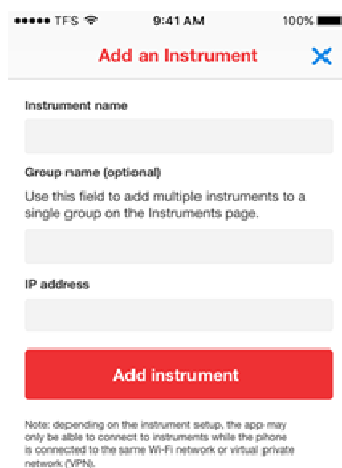
## Setting Up and Using the App

On first launch of the application, tap the "Add an instrument" button or the (+) button in the top right corner of the screen.
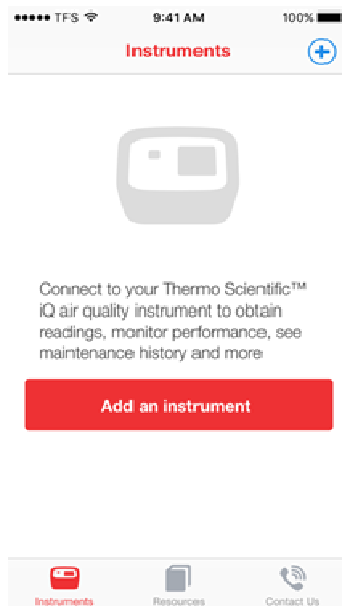
To add an instrument, you must enter the following and then tap the "Add instrument" button:

- Instrument name (required)

  - This can be any unique name that will assist you in identifying the instrument.

- Group name (optional)

  - This field allows you to optionally organize your instruments into groups. For example, you might use this field to specify a common location.

- IP address (required)

  - This is the IP address of the device.

  - You can find the IP address by viewing your instrument console and navigating first to Settings and then to Communications.



The Instruments tab will display a list of instrument you have added, including the following data:

- Friendly instrument name

- Instrument model

- Instrument serial number

- Current gas concentration reading

- Time the data was last refreshed

- Alarm icon if any instrument alarms are activated

- Preventive Maintenance alert icon if any maintenance is due
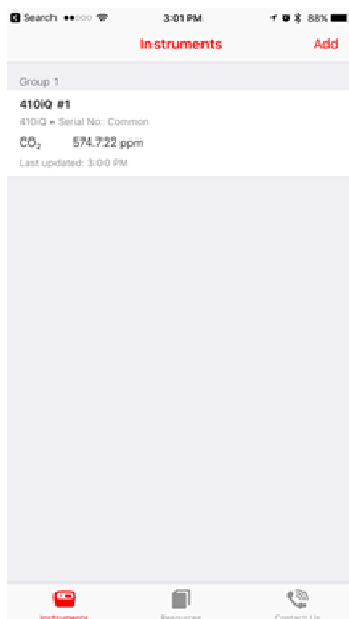


Tapping on an instrument row in the list of instruments will display the instrument details screen.

This screen provides the following information:

- Friendly instrument name

- Current gas concentration reading

- Access to edit instrument details by tapping the Information (i) button in the top right corner

- Access to Alarms, Status, and Maintenance views

The alarms view always displays first by default. It will list all current alarms, if any are present.

Tapping an alarm will in many cases display a list of possible troubleshooting tips to assist in resolving the issue.
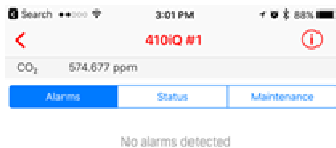
The Status view allows you to dive deeper into the current health status of individual modules.

Tapping on a module will display all available readings and details on any alarms if present.
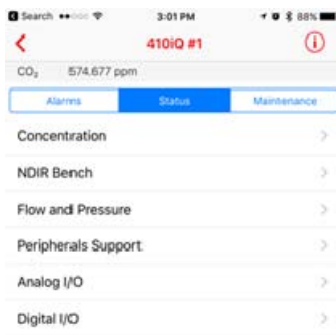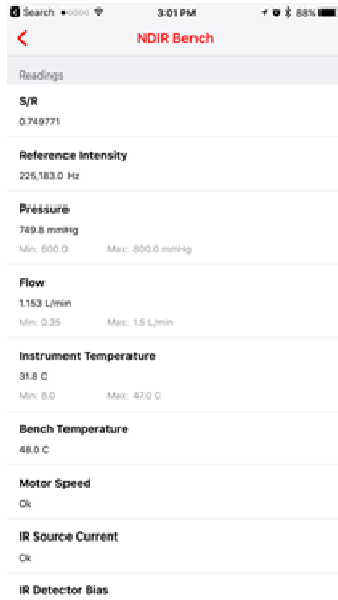
The Maintenance view displays a list of all Preventive Maintenance components, the number of months remaining until maintenance is due to be performed, and the part number likely to be needed to complete the maintenance.

Tapping a part number will allow you to view additional details about the part and add the part to your cart on analyticalinstrumentparts.com for easy ordering. (Online ordering available in United States only.)
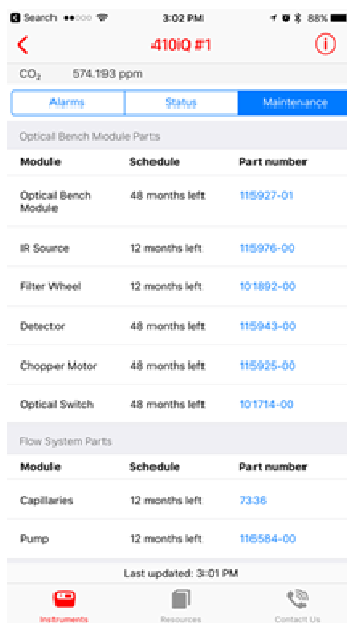
The instrument details screen allows you to modify the information you entered when adding the instrument.

This includes changing the friendly device name, changing the optional group name, and updating the instrument IP address.

In addition, you may view the current instrument firmware version.

You may also remove the instrument from the mobile application from this screen.
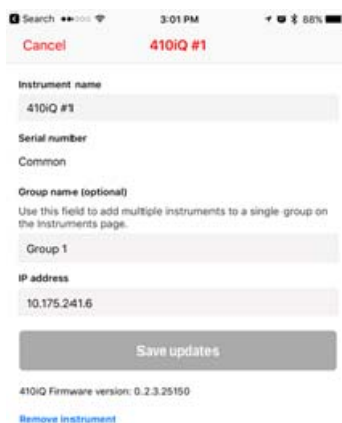


The Resources tab provides you with quick access to product manuals and literature.
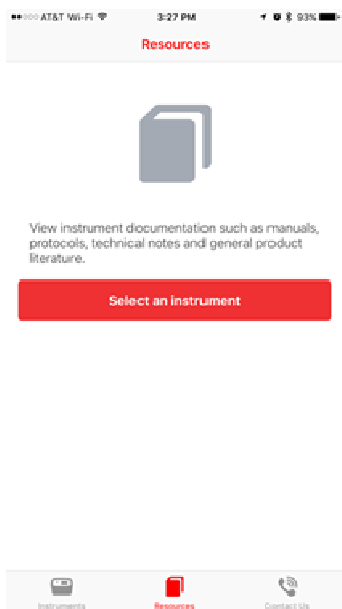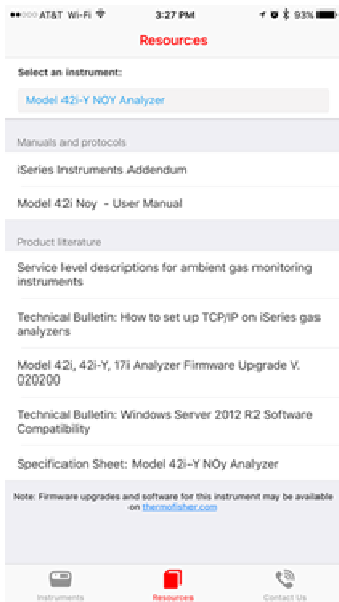
The Contact Us tab allows you to view a number of ways to contact us regarding your instrument.

In addition, you may easily request:

- field service visit

- return authorization

- calibration certificate

- technical support

- customer service
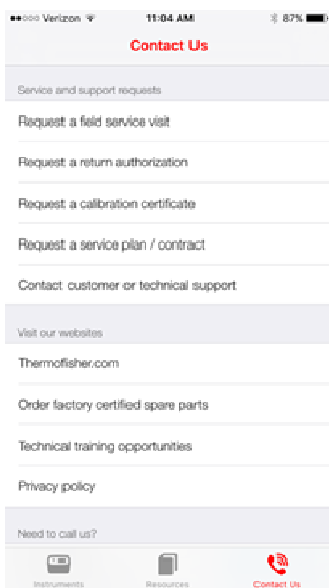
# Troubleshooting

The following table provides troubleshooting information for the iQ Series mobile app.

| Issue | Cause | Solution/Action |
|---|---|---|
| "Unsupported firmware version" alert displayed | This message indicates the instrument firmware version currently installed has not yet been tested with the iQ Monitoring mobile application | Check the App Store regularly for updates to the mobile application. The application should continue to function normally, however updated or new instrument features may not yet be supported. |
| Unable to add a new instrument | Your mobile device must be on the same network as the instrument | Connect your mobile device to the same network that the instrument is on. |
| Unable to add a new instrument | The instrument you attempted to connect to is not supported by this application | The 111iQ and 146iQ are not supported by the mobile app. Please view the individual product pages on www.thermofisher.com to determine which products are currently supported by the mobile app. |
| Unable to add a new instrument | Instrument was recently restarted | Please allow several minutes after an instrument is restarted before connecting with the mobile application. |
| "Connection Failed" alert displayed | Instrument does not have a valid IP address | Make sure the instrument is connected to an active Ethernet port, reboot the instrument. |
| | Instrument and mobile device are not on the same network | Connect the mobile device to the correct network or request VPN access to your secure network through your IT department. |

# Chapter 4
# MODBUS Protocol

This appendix provides a description of the MODBUS Protocol Interface that is supported both over RS-232/485 (RTU protocol) as well as TCP/IP over Ethernet.

The MODBUS commands that are implemented are explained in detail in this chapter. The MODBUS protocol support for the iQ Series enables the user to perform the functions of reading the various concentrations and other measurement values, read the status of the digital outputs of the analyzer, to trigger or simulate the activation of a digital input to the instrument and to change operational settings in the instrument. This is achieved by using the supported MODBUS parameters listed below.

Additional information on the MODBUS protocol can be obtained at http://www.modbus.org. References are from MODBUS Application Protocol Specification V1.1a MODBUS-IDA June 4, 2004.

## Serial Communication Parameters

The following are the communication parameters that are used to configure the serial port of the iQ Series to support MODBUS RTU protocol.

| | |
|---|---|
| Number of Data bits | : 7 or 8 |
| Number of Stop bits | : 1 or 2 |
| Parity | : None, Odd, or Even |
| Data rate | : 1200 to 115200 Baud (9600 is default) |

## TCP Communication Parameters

iQ Series instruments support the MODBUS/TCP protocol. The register definition is the same as for the serial interface. Up to three simultaneous connections are supported over Ethernet.

TCP connection port for MODBUS   : 502

# Application Data Unit Definition

Here are the MODBUS ADU (Application Data Unit) formats over serial and TCP/IP:

| Serial: | Slave Address | Function Code | Data | Error Check |
|---------|---------------|---------------|------|-------------|
| TCP/IP: | MBAP Header | Function Code | Data | |

## Slave Address

The MODBUS slave address is a single byte in length. This is the same as the instrument ID and can be between 1 and 255 decimal (i.e. 0x01 hex to 0xFF hex). This address is only used for MODBUS RTU over serial connections.

**Note** Device ID '0', used for broadcast MODBUS commands, is not supported. Instrument ID higher than 255 should not be set when using the Modbus protocol. ▲

## MBAP Header

In MODBUS over TCP/IP, a MODBUS Application Protocol Header (MBAP) is used to identify the message. This header consists of the following components:

| | | |
|---|---|---|
| Transaction Identifier | 2 Bytes | 0x0000 to 0xFFFF (Passed back in response) |
| Protocol Identifier | 2 Bytes | 0x00 (MODBUS protocol) |
| Length | 2 Bytes | 0x0000 to 0xFFFF (Number of following bytes) |
| Unit Identifier | 1 Byte | 0x00 to 0xFF (Passed back in response) |

A slave address is not required in MODBUS over TCP/IP because the higher-level protocols include device addressing. The unit identifier is not used by the instrument.

## Function Code

The function code is a single byte in length. The following function codes are supported by the instrument:

| | | |
|---|---|---|
| Read Holding Registers | : | 0x03 |
| Read Input Registers | : | 0x04 |
| Write Single Registers | : | 0x06 |
| Write Multiple Registers | : | 0x10 |
| Read/ Write Multiple Registers | : | 0x17 |

If a function code is received that is not in this list, an invalid function exception is returned.

## Data

The data field varies depending on the function. For more description of these data fields, see "Function Codes" below.

## Error Check

In MODBUS over serial, an error check is included in the message. This is not necessary in MODBUS over TCP/IP because the higher-level protocols ensure error-free transmission. The error check is a two-byte (16 bit) CRC value.

# Function Codes

This section describes the various function codes that are supported by the iQ Series.

## (0x03/0x04) Read Holding Registers/Read Input Registers

Read Holding/Input Registers reads the measurement data and current settings from the instrument. Issuing either of these function codes will generate the same response. These functions read the contents of one or more contiguous registers.

These registers are 16 bits each and are organized as shown below. Floating-point values are reported as 32-bit IEEE standard 754 floating point format. This uses 2 sequential registers, least significant 16 bits first.

The request specifies the starting register address and the number of registers. Registers are addressed starting at zero. Therefore, registers numbered 1–16 are addressed as 0–15. The register data in the response message are packed as two bytes per register, with the binary contents right justified within each byte. For each register, the first byte contains the high order bits and the second contains the low order bits.

**Request**

| | | |
|---|---|---|
| Function Code | 1 Byte | 0x03 or 0x04 |
| Starting Address | 2 Bytes | 0x0000 to 0xFFFF |
| Quantity of Registers | 2 Bytes | 0x0001 to 0x007D |

**Response**

| | | |
|---|---|---|
| Function Code | 1 Byte | 0x03 or 0x04 |
| Byte Count | 1 Byte | 2x*N |
| Register Value | 2x*N Bytes | 0x0000 to 0xFFFF |

*N = Quantity of Registers

**Error Response**

| | | |
|---|---|---|
| Function Code | 1 Byte | Function code + 0x80 |
| Exception Code | 1 Byte | 0x01=Invalid Function |
| | | 0x02=Invalid Count |
| | | 0x03=Illegal Address or Count |
| | | 0x04=Can't Process |

Here is an example of a request and response to read registers 10–13:

**Request**

| Field Name | (Hex) |
| --- | --- |
| Function | 0x03 |
| Starting Address Hi | 0x00 |
| Starting Address Lo | 0x09 |
| No. of Registers Hi | 0x00 |
| No. of Registers Lo | 0x04 |

**Response**

| Field Name | (Hex) |
| --- | --- |
| Function | 0x03 |
| Byte Count | 0x06 |
| Register Value Hi (10) | 0x02 |
| Register Value Lo (10) | 0x2B |
| Register Value Hi (11) | 0x00 |
| Register Value Lo (11) | 0x00 |
| Register Value Hi (12) | 0x00 |
| Register Value Lo (12) | 0x64 |
| Register Value Hi (13) | 0x00 |
| Register Value Lo (13) | 0x64 |

The contents of register 10 are shown as the two byte values of 0x02 0x2B. Then contents of registers 11–13 are 0x00 0x00, 0x00 0x64 and 0x00 0x64, respectively.

## (0x06) Write Single Register

The Write Single Register is used to write a single register value.

**Request**

| Function Code | 1 Byte | 0x06 |
| --- | --- | --- |
| Starting Address | 2 Bytes | 0x0000 to 0xFFFF |
| Register Value | 2 Bytes | 0x0000 to 0xFFFF |

**Response**

| Function Code | 1 Byte | 0x06 |
| --- | --- | --- |

| Register Address | 2 Bytes | 0x0000 to 0xFFFF |
|---|---|---|
| Register Value | 2 Bytes | 0x0000 to 0xFFFF |

*N = Quantity of Registers

**Error Response**

| Function Code | 1 Byte | 0x86 |
|---|---|---|
| Exception Code | 1 Byte | 0x01=Invalid Function |
| | | 0x02=Invalid Address |
| | | 0x03=Invalid Value |
| | | 0x04=Can't Process |

Here is an example of a request write to register 5100 (0x13EC) data 1 (0x0001):

**Request**

| *Field Name* | *(Hex)* |
|---|---|
| Function | 0x06 |
| Starting Address Hi | 0x13 |
| Starting Address Lo | 0xEC |
| Register Value Hi | 0x00 |
| Register Value Lo | 0x01 |

**Response**

| *Field Name* | *(Hex)* |
|---|---|
| Function | 0x06 |
| Starting Address Hi | 0x13 |
| Starting Address Lo | 0xEC |
| Register Value Hi | 0x00 |
| Register Value Lo | 0x01 |

## (0x10) Write Multiple Registers

The Write Multiple Registers is used to write multiple register values.

**Request**

| Function Code | 1 Byte | 0x10 |
|---|---|---|
| Starting Address | 2 Bytes | 0x0000 to 0xFFFF |
| Quantity of Registers | 2 Bytes | 0x0001 to 0x007B |
| Byte Count | 1 Byte | 2x*N |
| Register Value | 2x*N Bytes | 0x0000 to 0xFFFF |

*N = Quantity of Registers

**Response**

| Function Code | 1 Byte | 0x10 |
|---|---|---|
| Starting Address | 2 Bytes | 0x0000 to 0xFFFF |
| Quantity of Registers | 2 Bytes | 0x0001 to 0x007B |

*N = Quantity of Registers

**Error Response**

| Function Code | 1 Byte | 0x90 |
|---|---|---|
| Exception Code | 1 Byte | 0x01=Invalid Function |
| | | 0x02=Invalid Count |
| | | 0x03=Illegal Address or Count |
| | | 0x04=Can't Process |

Here is an example of a request write to 3 registers starting at 5100 (0x13EC) data 1, 2, 3 (0x0001, 0x0002, 0x0003):

**Request**

| Field Name | (Hex) |
|---|---|
| Function | 0x10 |
| Starting Address Hi | 0x13 |
| Starting Address Lo | 0xEC |
| Quantity of Registers Hi | 0x00 |
| Quantity of Registers Lo | 0x03 |
| Byte Count | 0x06 |

| | |
|---|---|
| Register 1 Value Hi | 0x00 |
| Register 1 Value Lo | 0x01 |
| Register 2 Value Hi | 0x00 |
| Register 2 Value Lo | 0x02 |
| Register 3 Value Hi | 0x00 |
| Register 3 Value Lo | 0x03 |

**Response**

| Field Name | (Hex) |
|---|---|
| Function | 0x10 |
| Starting Address Hi | 0x13 |
| Starting Address Lo | 0xEC |
| Quantity of Registers Hi | 0x00 |
| Quantity of Registers Lo | 0x03 |

## (0x17) Read/Write Multiple Registers

The Read/Write Multiple Registers is used to read and write multiple register values.

**Request**

| | | |
|---|---|---|
| Function Code | 1 Byte | 0x17 |
| Read Starting Address | 2 Bytes | 0x0000 to 0xFFFF |
| Read Quantity of Registers | 2 Bytes | 0x0001 to 0x007D |
| Write Starting Address | 2 Bytes | 0x0000 to 0xFFFF |
| Write Quantity of Registers | 2 Bytes | 0x0001 to 0x0079 |
| Write Byte Count | 1 Byte | 2x*N |
| Write Register Value | 2x*N Bytes | |

*N = Quantity of Registers

**Response**

| | | |
|---|---|---|
| Function Code | 1 Byte | 0x17 |
| Byte Count | 1 Byte | 2x*N |
| Read Register Value | 2x*N Bytes | 0x0000 to 0xFFFF |

*N = Quantity of Registers

**Error Response**

| Function Code | 1 Byte | 0x97 |
|---|---|---|
| Exception Code | 1 Byte | 0x01=Invalid Function |
| | | 0x02=Invalid Count |
| | | 0x03=Illegal Address or Count |
| | | 0x04=Can't Process |

Here is an example of a request Write to 3 registers starting at 5100 (0x13EC) data 1, 2, 3 (0x0001, 0x0002, 0x0003) and Read from 2 registers starting at 2 (0x02) data 2, 3 (0x0002, 0x0003):

**Request**

| Field Name | (Hex) |
|---|---|
| Function | 0x17 |
| Read Start Address Hi | 0x00 |
| Read Start Address Lo | 0x02 |
| Quantity to Read Hi | 0x00 |
| Quantity to Read Lo | 0x02 |
| Write Start Address Hi | 0x13 |
| Write Start Address Lo | 0xEC |
| Quantity to Write= Hi | 0x00 |
| Quantity to Write Lo | 0x03 |
| Byte Count | 0x06 |
| Write Reg 1 Value Hi | 0x00 |
| Write Reg 1 Value Lo | 0x01 |
| Write Reg 2 Value Hi | 0x00 |
| Write Reg 2 Value Lo | 0x02 |
| Write Reg 3 Value Hi | 0x00 |
| Write Reg 3 Value Lo | 0x03 |

**Response**

| Field Name | (Hex) |
|---|---|
| Function | 0x17 |
| Byte Count | 0x04 |
| Read Reg 1 Value Hi | 0x00 |
| Read Reg 1 Value Lo | 0x02 |

| Read Reg 2 Value Hi | 0x00 |
| Read Reg 2 Value Lo | 0x03 |

# MODBUS Parameters Supported

A complete list of the MODBUS addresses supported for the iQ Series is available over the company website at:

www.thermofisher.com/42iQ

www.thermofisher.com/42iQD

www.thermofisher.com/42iQHL

www.thermofisher.com/42iQLS

www.thermofisher.com/42iQTL

www.thermofisher.com/43iQ

www.thermofisher.com/43iQHL

www.thermofisher.com/43iQTL

www.thermofisher.com/48iQ

www.thermofisher.com/48iQTL

www.thermofisher.com/49iQ

www.thermofisher.com/49iQPS

www.thermofisher.com/146iQ

www.thermofisher.com/410iQ

www.thermofisher.com/410iQHL

www.thermofisher.com/450iQ

**IMPORTANT NOTE**  The addresses are Protocol Data Unit (PDU) addresses. Verify the register number on your MODBUS master to ensure that it matches the register number on the instrument. ▲

# Chapter 5
# Bayern Hessen Protocol

This chapter provides a description of the Bayern Hessen Protocol Interface that is supported both over RS-232/485 as well as TCP/IP over Ethernet.

The Bayern Hessen Commands that are implemented are explained in detail in this chapter. The Bayern Hessen protocol support for the iQ Series enables the user to perform the functions of reading the various concentrations and other measurement values, and to trigger the instrument to be in sample/zero/span mode if valid for that instrument. This is achieved by using the supported Bayern Hessen commands listed below.

## Serial Communication Parameters

The following are the communication parameters that are used to configure the serial port of the iQ Series to support Bayern Hessen protocol.

Number of Data bits          : 7 or 8

Number of Stop bits          : 1 or 2

Parity                       : None, Odd, or Even

Data rate                    : 1200 to 115200 Baud (9600 is default)

The "Communications Board" option needs to be configured and enabled on the instrument to be able to support the Bayern Hessen protocol through the serial port.

The aforementioned serial communication parameters are configured as follows through the User Interface:

**Home Screen>Settings>Communications>Serial RS-232/485**

| Protocol<br>Bayern Hessen | Baud Rate<br>9600 | Bits<br>8 |
|---|---|---|
| Parity<br>None | Stop Bits<br>2 | Serial Mode<br>RS-232 |
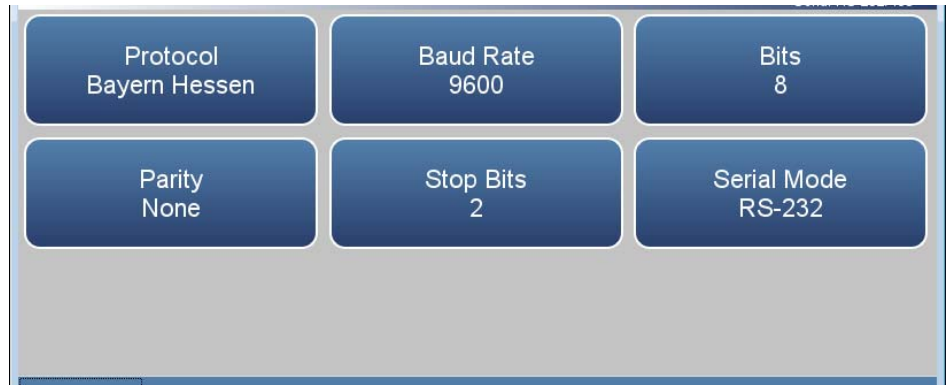
# TCP Communication Parameters

iQ Series Instruments support the Bayern Hessen protocol over TCP/IP. The register definition is the same as for the serial interface. Up to three simultaneous connections are supported over Ethernet.

TCP connection port for Geysitech:    9882

# Instrument Address

The Bayern Hessen instrument address should have a value between 1 and 999 and is represented by a 3 digit ASCII number with leading zeros if required (e.g. Instrument address of 1 is represented as 001.

The Instrument Address is the same as the Instrument ID used for MODBUS commands. This can be set via the front panel:

**Home Screen>Settings>Communications>Instrument ID**

| Wired TCP/DHCP | Serial RS-232/485 | Analog I/O |
|---|---|---|
| Digital I/O | Email Server<br>(SMTP) | Instrument ID<br>1 |
| | Bayern Hessen Settings | |

The Instrument Address is represented by <address> in the examples throughout this chapter.

**Note** Instrument IDs between 1000-9999 are not supported because of limitations imposed by the Bayern Hessen Protocol. ▲

# Abbreviations Used

The following is a list of abbreviations used in this document:

<CR> is abbreviation for Carriage Return (ASCII code 0x0D)

<STX> is abbreviation for Start of Text (ASCII code 0x02)

<ETX> is abbreviation for End of Text (ASCII code 0x03)

<SP> is abbreviation for space (ASCII code 0x20)

# Basic Command Structure

The following is the basic structure of a Bayern Hessen command:

<STX>Command text<ETX><BCC>

Each command is framed by control characters, <STX> at the start and terminated with <ETX>.

Additionally, when a command is terminated with <ETX>, two additional characters <BCC> are attached after <ETX>. These are the block checksum characters.

Block Checksum Characters <BCC> are added to the command to prevent processing invalid commands.

# Block Checksum Characters <BCC>

The Block Checksum Characters are calculated beginning with a seed value of 00000000, binary (0x00), and bitwise exclusive ORing with each of the characters of the command string (or response) including the framing characters <STX> and <ETX>. The checksum works as an error check.

The block checksum is represented by two characters, which represent a 2 digit hex number (1byte) (e.g. 1 byte 0xAB hex checksum will be represented by the two characters 'A' & 'B').

The checksum is referred to as <BCC> throughout this document.

# Bayern Hessen Commands

The following commands are supported by the Bayern Hessen protocol:

● Instrument Control Command (ST)

● Data Sampling/Data Query Command (DA)

# Instrument Control Command (ST)

There are three control commands supported by the Bayern Hessen protocol.

This <control command> is a single letter, which triggers an action in the instrument.

Command 'N' switches the instrument gas mode to Zero mode.

Command 'K' switches the instrument gas mode to Span mode.

Command 'M' switches the instrument gas mode to Sample mode.

The format of the ST command is as follows:

<STX>ST<address><SP><control command><ETX><BCC>

If the received command does not satisfy the above format, or if the <address> does not match the Instrument Address, the command is ignored.

The following is a sample command to switch the instrument to zero mode, Instrument Address 5:

<STX>ST005<SP>N<ETX>5D

Where 5D is the calculated <BCC>.

## Data Sampling/Data Query Command (DA)

This command DA initiates a data transfer from the instrument. The instrument responds with measured values, of the registers chosen by the user. (Refer to Bayern Hessen Settings section of the respective user manual.)

The command structure for a data query command is as follows:

<STX>DA<address><ETX><BCC>

The <address> is optional, which means it can be left out completely. The <address> if present must match the Instrument Address.

If the <address> is left out, no space is allowed in the query string.

The following are the acceptable formats of the DA command with Instrument Address 5:

<STX>DA<ETX><BCC>

OR

<STX>DA005<ETX><BCC>

The data query string is valid and will be answered with data transmission only if the command starts with <STX> which is followed by the characters DA, the <address> (if present) matches the Instrument Address, and the command is terminated with <ETX> followed by the correct checksum <BCC>.

**Sample Data Reply String in response to Data Query Command (DA):**

In response to a valid data query command (DA) the instrument responds in the following format:

<STX>MD02<SP><SP><register number><SP><measured value1><SP><status><SP><address><SP><SFKT><SP><SP><register number><SP><measured value2><SP><status><SP><address +1><SP><SFKT><ETX><BCC>

The response uses the same command terminators as used by the received command i.e. the response is terminated with<ETX> and the computed checksum <BCC>.

The 02 after the MD indicates that two measurements are present in the reply string, (a 03 for three measurements and so on.

<register number> is the register number associated with the following measured value. Each subsequent measurement attached to the response will have the corresponding <register number> preceding it.

<measured value> is the value of the register chosen by the user and is represented in exponential form with a 4 character mantissa and 2 character exponent, each with sign.

Mantissa: sign and 4 digits. The decimal point is assumed to be after the first digit and is not transmitted.

Exponent: sign and 2 digits.

**Example:**

-5384000.0     is represented as -5384+06

+0.04567       is represented as +4567-02

Up to 8 measured values can be chosen by the user to be transmitted.

<status>: is formed by < operating status > and < error status > and separated by a space i.e.

<operating status><SP><error status>

Each of the two (<operating status> and <error status>) are formed by two characters each representing a 2 digit hex number which is one byte (8 Bits) operation status and one byte (8 Bits) error status.

These two bytes contain the information about the main operating conditions of the instrument at that instant. For details on how to interpret the status bytes for each instrument family, refer to the respective tables at the end of this chapter.

<address> is the instrument ID. Each subsequent measurement attached to the response will have the <address+X>, where X is incremented by 1 for each additional measurement.

<SFKT>: is the space provided for future use for special function, it currently contains a string of six 0's i.e. <000000>.

**Example:**

Bayern Hessen Protocol with transmission of 8 measured values (Instrument ID is 5, Operation Status is 00, Error Status is 02):

Data Query String:     <STX>DA<ETX>04

Or

Data Query String:     <STX>DA005<ETX>31


Reply String:

<STX>MD08<SP><SP>101<SP>+0000+00<SP>00<SP>02<SP>005<SP>000000<SP><SP>1
05<SP>+0000+00<SP>00<SP>02<SP>006<SP>000000<SP><SP>109<SP>+1405+00<SP>
00<SP>02<SP>007<SP>000000<SP><SP>122<SP>+9743+04<SP>00<SP>02<SP>008<SP
>000000<SP><SP>123<SP>+9901+04<SP>00<SP>02<SP>009<SP>000000<SP><SP>126
<SP>+3150+00<SP>00<SP>02<SP>010<SP>000000<SP><SP>191<SP>+0000+00<SP>00
<SP>02<SP>011<SP>000000<SP><SP>403<SP>+8412-
01<SP>00<SP>02<SP>012<SP>000000<SP><ETX><BCC>

## Operating and Error Status

See the tables below for operating status and error status for the various instrument families.

**Table 1.** Operating Status for iQ Series 42

|  | D7 | D6 | D5 | D4 |  | D3 | D2 | D1 | D0 |
|---|---|---|---|---|---|---|---|---|---|
| → **Bit** | **8** | **7** | **6** | **5** |  | **4** | **3** | **2** | **1** |
| → Hex-value | 80 | 40 | 20 | 10 |  | 08 | 04 | 02 | 01 |
|  |  | MSB |  |  |  | LSB |  |  |  |
| **Operating status:** |  |  |  |  |  |  |  |  |  |
| Not Used | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 |
| Not Used | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 |
| Zero gas (On) | 0 | 0 | 0 | 0 |  | 0 | 1 | 0 | 0 |
| Span gas (On) | 0 | 0 | 0 | 0 |  | 1 | 0 | 0 | 0 |
| Not used | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 |
| Ozonator (Off) | 0 | 0 | 1 | 0 |  | 0 | 0 | 0 | 0 |
| PMT (Off) | 0 | 1 | 0 | 0 |  | 0 | 0 | 0 | 0 |
| Not Used | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 |

**Table 2.** Error Status for iQ Series 42

|  | D7 | D6 | D5 | D4 |  | D3 | D2 | D1 | D0 |
|---|---|---|---|---|---|---|---|---|---|
| → **Bit** | **8** | **7** | **6** | **5** |  | **4** | **3** | **2** | **1** |
| → Hex-value | 80 | 40 | 20 | 10 |  | 08 | 04 | 02 | 01 |
|  |  | MSB |  |  |  | LSB |  |  |  |
| **Error status:** |  |  |  |  |  |  |  |  |  |
| Instrument Temperature. Alarm | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 1 |
| Reaction Chamber Temp. Alarm | 0 | 0 | 0 | 0 |  | 0 | 0 | 1 | 0 |
| Cooler Temperature Alarm | 0 | 0 | 0 | 0 |  | 0 | 1 | 0 | 0 |
| $NO_2$ Converter Temp. Alarm | 0 | 0 | 0 | 0 |  | 1 | 0 | 0 | 0 |
| Pressure Alarm | 0 | 0 | 0 | 1 |  | 0 | 0 | 0 | 0 |
| Sample Flow Alarm | 0 | 0 | 1 | 0 |  | 0 | 0 | 0 | 0 |
| Ozonator Flow Alarm | 0 | 1 | 0 | 0 |  | 0 | 0 | 0 | 0 |
| Permeation/Oxygen Sensor Alarm | 1 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 |

**Table 3.** Operating Status for iQ Series 43

|  | D7 | D6 | D5 | D4 |  | D3 | D2 | D1 | D0 |
|---|---|---|---|---|---|---|---|---|---|
| → **Bit** | **8** | **7** | **6** | **5** |  | **4** | **3** | **2** | **1** |
| → Hex-value | 80 | 40 | 20 | 10 |  | 08 | 04 | 02 | 01 |
|  |  | MSB |  |  |  | LSB |  |  |  |
| **Operating status:** |  |  |  |  |  |  |  |  |  |
| Not Used | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 |
| Not Used | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 |
| Zero gas (On) | 0 | 0 | 0 | 0 |  | 0 | 1 | 0 | 0 |
| Span gas (On) | 0 | 0 | 0 | 0 |  | 1 | 0 | 0 | 0 |
| Not Used | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 |
| Test LED (On) | 0 | 0 | 1 | 0 |  | 0 | 0 | 0 | 0 |
| Flash Lamp (Off) | 0 | 1 | 0 | 0 |  | 0 | 0 | 0 | 0 |
| Not Used | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 |

**Table 4.** Error Status for iQ Series 43

|  | D7 | D6 | D5 | D4 |  | D3 | D2 | D1 | D0 |
|---|---|---|---|---|---|---|---|---|---|
| → **Bit** | **8** | **7** | **6** | **5** |  | **4** | **3** | **2** | **1** |
| → Hex-value | 80 | 40 | 20 | 10 |  | 08 | 04 | 02 | 01 |
|  |  | MSB |  |  |  | LSB |  |  |  |
| **Error status:** |  |  |  |  |  |  |  |  |  |
| Instrument Temperature Alarm | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 1 |
| Bench Temperature Alarm | 0 | 0 | 0 | 0 |  | 0 | 0 | 1 | 0 |
| Lamp Intensity Alarm | 0 | 0 | 0 | 0 |  | 0 | 1 | 0 | 0 |
| Lamp Voltage Alarm | 0 | 0 | 0 | 0 |  | 1 | 0 | 0 | 0 |
| Pressure Alarm | 0 | 0 | 0 | 1 |  | 0 | 0 | 0 | 0 |
| Sample Flow Alarm | 0 | 0 | 1 | 0 |  | 0 | 0 | 0 | 0 |
| Not Used | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 |
| Permeation Oven Alarm | 1 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 |

**Table 5.** Operating Status for iQ Series 48

|  | D7 | D6 | D5 | D4 |  | D3 | D2 | D1 | D0 |
|---|---|---|---|---|---|---|---|---|---|
| → **Bit** | **8** | **7** | **6** | **5** |  | **4** | **3** | **2** | **1** |
| → Hex-value | 80 | 40 | 20 | 10 |  | 08 | 04 | 02 | 01 |
|  |  | MSB |  |  |  |  | LSB |  |  |
| **Operating status:** |  |  |  |  |  |  |  |  |  |
| Not Used | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 |
| Not Used | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 |
| Zero Gas (On) | 0 | 0 | 0 | 0 |  | 0 | 1 | 0 | 0 |
| Span Gas (On) | 0 | 0 | 0 | 0 |  | 1 | 0 | 0 | 0 |
| Not Used | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 |
| Not Used | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 |
| Not Used | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 |
| Not Used | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 |

**Table 6.** Error Status for iQ Series 48

|  | D7 | D6 | D5 | D4 |  | D3 | D2 | D1 | D0 |
|---|---|---|---|---|---|---|---|---|---|
| → **Bit** | **8** | **7** | **6** | **5** |  | **4** | **3** | **2** | **1** |
| → Hex-value | 80 | 40 | 20 | 10 |  | 08 | 04 | 02 | 01 |
|  |  | MSB |  |  |  |  | LSB |  |  |
| **Error status:** |  |  |  |  |  |  |  |  |  |
| Instrument Temperature Alarm | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 1 |
| Bench Temperature Alarm | 0 | 0 | 0 | 0 |  | 0 | 0 | 1 | 0 |
| IR Source Current Alarm | 0 | 0 | 0 | 0 |  | 0 | 1 | 0 | 0 |
| Detector Bias Voltage Alarm | 0 | 0 | 0 | 0 |  | 1 | 0 | 0 | 0 |
| Pressure Alarm | 0 | 0 | 0 | 1 |  | 0 | 0 | 0 | 0 |
| Sample Flow Alarm | 0 | 0 | 1 | 0 |  | 0 | 0 | 0 | 0 |
| Motor Speed Alarm | 0 | 1 | 0 | 0 |  | 0 | 0 | 0 | 0 |
| Oxygen Sensor Alarm | 1 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 |

**Table 7.** Operating Status for iQ Series 49

|  | D7 | D6 | D5 | D4 |  | D3 | D2 | D1 | D0 |
|---|---|---|---|---|---|---|---|---|---|
| → **Bit** | **8** | **7** | **6** | **5** |  | **4** | **3** | **2** | **1** |
| → Hex-value | 80 | 40 | 20 | 10 |  | 08 | 04 | 02 | 01 |
|  |  | MSB |  |  |  | LSB |  |  |  |
| **Operating status:** |  |  |  |  |  |  |  |  |  |
| Not Used | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 |
| Purge Gas (On) | 0 | 0 | 0 | 0 |  | 0 | 0 | 1 | 0 |
| Zero Gas (On) | 0 | 0 | 0 | 0 |  | 0 | 1 | 0 | 0 |
| Span Gas (On) | 0 | 0 | 0 | 0 |  | 1 | 0 | 0 | 0 |
| Not Used | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 |
| Not Used | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 |
| Not Used | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 |
| Not Used | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 |

**Table 8.** Error Status for iQ Series 49

|  | D7 | D6 | D5 | D4 |  | D3 | D2 | D1 | D0 |
|---|---|---|---|---|---|---|---|---|---|
| → **Bit** | **8** | **7** | **6** | **5** |  | **4** | **3** | **2** | **1** |
| → Hex-value | 80 | 40 | 20 | 10 |  | 08 | 04 | 02 | 01 |
|  |  | MSB |  |  |  | LSB |  |  |  |
| **Error status:** |  |  |  |  |  |  |  |  |  |
| $O_3$ Lamp Temperature Alarm | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 1 |
| Instrument Temperature Alarm | 0 | 0 | 0 | 0 |  | 0 | 0 | 1 | 0 |
| Bench Lamp Temperature Alarm | 0 | 0 | 0 | 0 |  | 0 | 1 | 0 | 0 |
| Pressure Alarm | 0 | 0 | 0 | 0 |  | 1 | 0 | 0 | 0 |
| Flow Alarm | 0 | 0 | 0 | 1 |  | 0 | 0 | 0 | 0 |
| Not Used | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 |
| Intensity A Alarm | 0 | 1 | 0 | 0 |  | 0 | 0 | 0 | 0 |
| Intensity B Alarm | 1 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 |

# Chapter 6
# Streaming

The Streaming protocol is a simple text-based protocol that only outputs measurement data and status; it does not support any user commands. A user connects to the protocol server on Ethernet destination port 9881 or via the serial port and the server periodically sends out data. The first line of streaming data contains the column headers, which is output on power-up, when a user first connects over Ethernet, and when the streaming data configuration is changed.

Here is an example of streaming data output with 3 items with timestamp, and labels on:

```
time date Bench_Pressure_(mmHg)_label Bench_Pressure_(mmHg) Concentration_(ppb_or_ug/m3)_label Concentration_(ppb_or_ug/m3)
Instrument_Temperature_(degC)_label Instrument_Temperature_(degC)
11:49:45 08-28-2017 Bench_Pressure_(mmHg) 767.782410 Concentration_(ppb_or_ug/m3) 10177.981445 Instrument_Temperature_(degC) 28.500376
11:49:46 08-28-2017 Bench_Pressure_(mmHg) 767.795837 Concentration_(ppb_or_ug/m3) 10177.814453 Instrument_Temperature_(degC) 28.500376
11:49:47 08-28-2017 Bench_Pressure_(mmHg) 767.788391 Concentration_(ppb_or_ug/m3) 10177.429688 Instrument_Temperature_(degC) 28.522186
11:49:48 08-28-2017 Bench_Pressure_(mmHg) 767.781738 Concentration_(ppb_or_ug/m3) 10177.341797 Instrument_Temperature_(degC) 28.543978
11:49:49 08-28-2017 Bench_Pressure_(mmHg) 767.795166 Concentration_(ppb_or_ug/m3) 10177.480469 Instrument_Temperature_(degC) 28.478550
11:49:50 08-28-2017 Bench_Pressure_(mmHg) 767.807312 Concentration_(ppb_or_ug/m3) 10177.396484 Instrument_Temperature_(degC) 28.456696
11:49:51 08-28-2017 Bench_Pressure_(mmHg) 767.818237 Concentration_(ppb_or_ug/m3) 10177.684570 Instrument_Temperature_(degC) 28.456696
11:49:52 08-28-2017 Bench_Pressure_(mmHg) 767.828125 Concentration_(ppb_or_ug/m3) 10177.381836 Instrument_Temperature_(degC) 28.500376
11:49:53 08-28-2017 Bench_Pressure_(mmHg) 767.836975 Concentration_(ppb_or_ug/m3) 10177.597656 Instrument_Temperature_(degC) 28.456696
11:49:54 08-28-2017 Bench_Pressure_(mmHg) 767.844910 Concentration_(ppb_or_ug/m3) 10178.408203 Instrument_Temperature_(degC) 28.434826
```

Here is an example of sample output with 3 items with timestamp and labels off:

```
time date Bench_Pressure_(mmHg) Concentration_(ppb_or_ug/m3) Instrument_Temperature_(degC)
11:50:10 08-28-2017 767.759033 10180.363281 28.478550
11:50:11 08-28-2017 767.755249 10180.886719 28.500376
11:50:12 08-28-2017 767.751892 10181.265625 28.478550
11:50:13 08-28-2017 767.748840 10181.050781 28.456696
11:50:14 08-28-2017 767.746094 10181.206055 28.434826
11:50:15 08-28-2017 767.743652 10180.843750 28.434826
11:50:16 08-28-2017 767.760925 10182.184570 28.412935
```

# Appendix A
# Customer Resource

## Customer Resources

Environmental Monitoring:

Within United States: 1 (866) 282-0430

Outside United States: 1 (508) 520-0430

www.thermofisher.com

For faster response, see email addresses below for your specific customer service needs.

## Customer Service

For orders or product information contact our prompt, professional in-house customer service team that is strategically integrated to handle a diverse level of support. Standard business hours Mon-Fri, 8:00am-6:00pm EST.

Orders.aqi@thermofisher.com

## Technical Support

Our dedicated factory certified experts will guide you through troubleshooting and maintenance solutions. Standard business hours Mon-Fri, 8:00am-6:00pm EST.

Epm.techsupport@thermofisher.com

## Factory Depot Service/Online Return Authorization Forms

Our depot repair is designed for our customers to easily ship the equipment for repair and maintenance directly to our factory. Return authorization forms are available online at www.thermosfisher.com/servicerepair.

Orders.aqi@thermofisher.com

## Field Service

Our regionalized Field Service team can be dispatched to your site to minimize downtime during an emergency or for routine preventive maintenance.

Epm.emfieldservice@thermofisher.com

## Technical Training

We offer in-depth technical training at customer sites, within our factory training centers and labs or via webinars. To view our catalog of training visit www.thermofisher.com/epmtraining.

Training.epm@thermofisher.com

## Comprehensive Service Solutions

Thermo Scientific™ Service Solutions are a vital component of your product's lifecycle. These comprehensive solutions are exclusively created to drive optimal performance of your critical instruments that demand maximum uptime. We offer a wide range of services that can be customized to fit all of your specific business needs. When you purchase an extended or post warranty service agreement, you are choosing an economical solution that provides predictable costs, faster response times, increased discounts and scheduled preventive maintenance

To view Extended Warranty and Post Warranty options plus available spare parts kits visit www.thermofisher.com/EMservice.

## The Online Library

The online library was created exclusively as a resource for customers to gain access to our most up-to-date materials. You will find manuals, software/firmware, datasheets, spare parts lists, technical bulletins, service documents and other product related materials.

You must create an account at www.thermofisher.com/theonlinelibrary.

When you access your account, be sure to set up your profile and select your subscriptions by clicking on Edit Profile. This will allow for updated documents and software/firmware links to be emailed to you for your specific instruments.
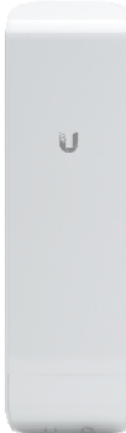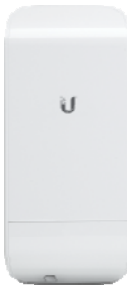
# Appendix B
# Wireless Ethernet Bridge for iQ Series

A Wireless Ethernet Bridge is a commercial-off-the-shelf intelligent network device that can be utilized to provide wireless Ethernet capabilities to Thermo Fisher Scientific's instruments that have only a wired Ethernet port. A single bridge may be used to provide wireless Ethernet to one or more instruments and may be mounted indoors or outdoors at a location up to 300 feet away from the instruments to provide optimal wireless coverage.

A wireless bridge may be configured to provide two different types of connectivity:

● To connect an instrument with only a wired Ethernet port to an existing Wi-Fi network.

● To connect a device such as a smartphone to an instrument over Wi-Fi.

Ubiquiti Networks provides an all-in-one solution that includes both the radio and antenna in a small package that may be mounted to a pole or a surface such as a wall, rack or window. There are four devices that Ubiquiti Networks offers for this purpose, each available commercially for under $100 US:

| NanoStation® M2/M5 | NanoStation® loco M2/M5 |
|---|---|
| 2.4 GHz / 5.8 GHz | 2.4 GHz / 5.8 GHz |
| 802.11n 150+ Mbps | 802.11n 150+ Mbps |
| 28 dBm / 27 dBm | 23 dBm / 23 dBm |
| M2 55°(H)/53°(V) BW M5 43°(H)/41°(V) BW | M2 60°(H)/60°(V) BWM5 45°(H)/45°(V) BW |
| 2 10/100 Ethernet Ports | 1 10/100 Ethernet Port |
| Passive PoE (supply incl.) | Passive PoE (supply incl.) |
| 294 x 31 x 80 mm (11.57 x 1.22 x 3.15") | 161 x 31 x 80 mm (6.31 x 1.22 x 3.15") |
| 400 g (14.11 oz) | 180 g (6.35 oz) |
| -30 to 75°C (-22 to 167°F) | -30 to 75°C (-22 to 167°F) |
| RoHS Compliant | RoHS Compliant |
| US and Worldwide Versions | US and Worldwide Versions |

This chapter discusses how to configure and utilize these Ubiquiti Networks NanoStation M family of devices to add wireless Ethernet access to an instrument or a rack of instruments. These concepts may also be applied to similar devices from other manufacturers.

Two versions of each of these devices are required, one for the U.S. to meet FCC requirements which is restricted to U.S./Puerto Rico/Canada and one worldwide. Ubiquiti has distributors in U.S, Canada, Latin America, Europe, Middle East, Africa, Russia, Asia, and Australia/New Zealand.

# Device Setup - Common

Make sure the NanoStation's "Main" LAN socket is connected to the included POE (Power Over Ethernet) power injector's "POE" LAN socket and the power injector's "LAN" socket is connected to a Windows PC. Also plug the power injector's AC plug into a power outlet.

By default, the NanoStation is set up with a static IP address of 192.168.1.20 with username "ubnt" and password "ubnt". Configure the PC to be on the same subnet as the NanoStation (instructions are for Windows 7):

● Press the Start orb typically in the lower left corner of the screen, then click on Control Panel.

● If the control panel is set up to View By: Category, then select "View network satus and tasks" under "Network and Internet". If the control panel is set up to View By: Large/Small Icons, then select "Network and Sharing Center".

● Select Change adapter settings.

● Right click on the wired connection that's connected to the power injector and chose "Properties" in the pop-up menu.

● Double-click on "Internet Protocol Version 4 (TCP/IP v4)".

● Set up the following the Properties as follows (note that the IP address may be set to anything between 1 to 254 inclusive, except for 20 which is the IP address of the NanoStation:

- Click OK twice.

- Verify there are now 2 LEDs lit or flashing on the NanoStation (the power LED and the LAN1 LED).

- Open a web browser (Internet Explorer, Chrome, etc) and go to http://192.168.1.20.  If a message appears indicating a problem with the website's security certificate, select "Continue to this website (not recommended)."

- Log in to the NanoStation using "ubnt" for both the username and the password (default settings).  Select the desired Country, in the US version of the NanoStation, choose from Canada, Puerto Rico or United States and in the worldwide version choose from Argentina, Armenia, Aruba, Australia, Austria, Azerbaijan, Bahrain, Barbados, Belarus, Belgium, Belize,Bolivia, Bosnia and Herzegovina, Brazil, Brunei Darussalam, Bulgaria, Cambodia, Canada, Chile, China, Colombia, Costa Rica, Croatia, Cyprus, Czech Republic, Denmark, Dominican Republic, Ecuador, Egypt, El Salvador, Estoria, Finland, France, Georgia, Germany, Greece, Greenland, Grenana, Guam, Guatemala, Haiti, Honduras, Hong Kong, Hungary, Iceland, India, Indonesia, Iraq, Ireland, Israel, Italy, Jamaica, Jordan, Kazakhstan, Kenya, Korea Republic, Kuwait, Latvia, Lebanon, Liechtenstein, Lithuania, Luxembourg, Macau, Macedonia, Malaysia, Malta, Mexico, Monaco, Montenegro, Morocco, Nepal, Netherlands, Netherlands Antilles, New Zealand, Nigeria, Norway, Oman, Pakistan, Panama, Papua New Guinea, Peru, Philippines, Poland, Portugal, Puerto Rico (U.S. territory), Qatar, Romania, Russia, Rwanda, Saint Barthelemy, Saudi Arabia, Serbia, Singapore, Slovakia, Slovenia, South Africa, Spain, Sri Lanka, Sweden, Switzerland, Taiwan, Thailand, Trinidad and Tobago, Tunisia, Turkey, Ukraine, United Arab Emirates, United Kingdom, United States, Uruguay, Uzbekistan, Venezuela or Viet Nam.  Select the desired Language.  Read the TERMS OF USE, then check the "I agree to these TERMS OF USE and the UBIQUITI FIRMWARE LICENSE AGREEMENT" box and click the "Login" button.

# Device Setup – Mobile Device Access

Follow these instructions to set up a NanoStation to allow mobile devices to access one or more instruments remotely over WiFi.

- Select the Wireless tab and change the settings as shown below:
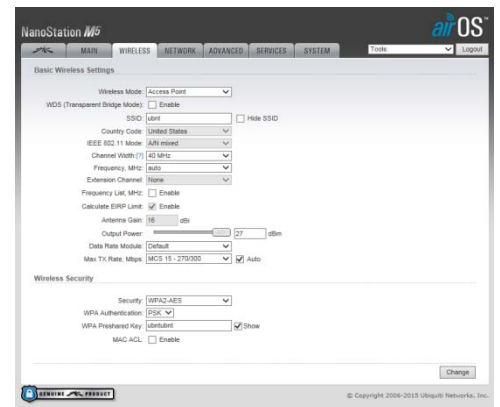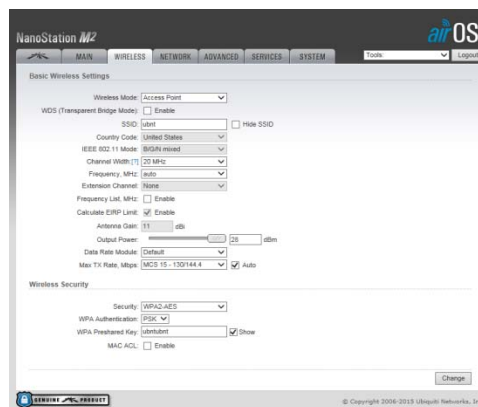


- Set Wireless Mode: "Access Point"

- Set SSID: to desired name for the wireless access point ("ubnt" shown here for example)

- Set Channel Width: to "20 MHz" for the NanoStation M2 (this is standard convention in the 2.4 GHz band, setting this to "40 MHz" will allow for faster data rates, but it will also interfere with other users on this band) or "40 MHz" for the NanoStation M5

- Set the Frequency, MHz to "auto" (in crowded areas in the United States on the 2.4 GHz band where all channels are occupied, the NanoStation may not find an open channel to utilize and won't show up, so in this case select either "2412", "2437" or "2462". Similar issues with setting this to "auto" may occur in the 5 GHz band)

- Set the Output Power: to the desired level to cover the desired area (max power by default)

● Set Security: "WPA2-AES" (this is recommended and commonly supported by most mobile devices)

● Set WPA Authentication: "PSK" (this is common for most mobile devices)

● Set WPA Preshared Key: to the desired key ("ubntubnt" shown for example)

● Click the "Change" button and the "Apply" button to save these settings

● Since this device will not likely be used to connect to another Ubiquiti network device, un-check the box for set airMAX: Enable (this is the same for the NanoStation M2 and M5):



● Select the Network tab and change the settings as shown below (these settings are the same for the NanoStation M2 and M5):



● Set the Network Mode: to "SOHO Router"

● Under WAN Network Settings, configure IP Address "DHCP" and DHCP Fallback IP: "192.168.1.1" assuming that the instrument is configured with its default static IP address of 192.168.1.200. Setting the device up this way will make it work if connecting directly to an instrument with a static IP address or if there's a DHCP server available on the wired network that the instrument is connected to. In the future, to reconfigure the NanoStation, connect to http://192.168.1.1 instead of the default address. Note: In this configuration, the "WAN" network is the wired network.

● Under LAN Network Settings, make sure the IP Address, Range Start and Range End are not within the address space of your local wired network (change these if they are). Note: In this configuration, the "LAN" network is the wireless network.

  ● IP Address: "192.168.2.1"

  ● Range Start: "192.168.2.2"

  ● Range End: "192.168.2.254"

Disconnect the PC from the power injector and connect the instrument to the power injector's "LAN" port. Configure the instrument for DHCP Off with the default static IP address of 192.168.1.200 (default) via the Settings> Communications> Wired TCP/DHCP menu, then cycle the power on the instrument:
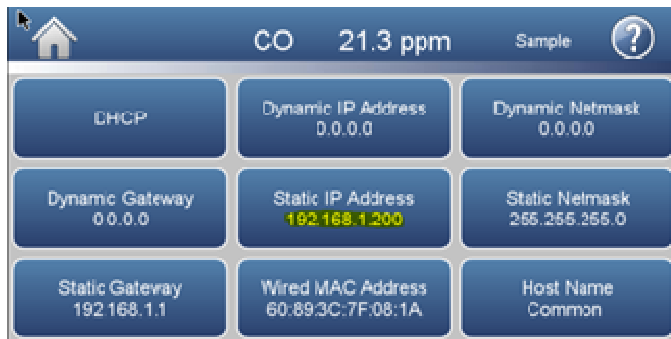


Once the instrument is set up for wireless access from a mobile device, the mobile device needs to be connected to the wireless access point, then mobile apps may be used to remotely access the instrument.

Refer to Technical Bulletin "Mobile Device Access for iQ Series" for information on how to setup and use the VNC Viewer app to remotely access the front panel of the instrument. Other apps are available to access via Modbus.

# Device Setup – Wireless Network Access

Follow these instructions to set up a NanoStation to allow one or more instruments to connect to an existing WiFi network.

● Select the Wireless tab and change the settings as shown below:



● Set Wireless Mode: "Station"

● Click the "Select…" button to the right of SSID: and a pop-up window will appear showing all available access points. Select the desired access point then click the "Select" button ("ASUS" selected here for example). Alternately, the "Lock to AP" button may be selected for a more secure network (locks the connection to a specific MAC address instead of just to the SSID).

● If the access point requires a key, enter it in the WPA Preshared Key: field at the bottom of the screen ("asusasus" showed for example).

● Set the Output Power: to the level required to access the network (max power by default)

● Click the "Change" button and the "Apply" button to save these settings

● Select the Network tab and change the settings as shown below (these settings are the same for the NanoStation M2 and M5):

- Set Network Mode: "Bridge"

- If the local network or remote networks use 192.168.1.20, then change the Management IP Address to a new value (and remember this setting if any changes need to be made to this configuration in the future).

- Click the "Change" button and the "Apply" button to save these settings

Disconnect the PC from the power injector and connect the instrument to the power injector's "LAN" port.

Configure the instrument for the desired wired network settings in Settings> Communications> Wired TCP/DHCP menu, then cycle the power on the instrument for these changes to take effect. If DHCP was enabled, go back to that screen to determine what IP address was defined. Additionally, a host name may be set in the instrument in this same menu so an easier to remember name may be used for the connections.

Connect to the instrument over the existing network infrastructure using Modbus, ePort or VNC using this IP address.

If you have any questions or require technical assistance, please contact your local distributor or the Thermo Fisher Scientific Technical Support team at (508) 520-0430 or by e-mail at AQIservice@thermofisher.com.

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