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**Modbus TCP/IP Communications
Using an iSIC Data logger
Interface Manual
Revision 07.11.01**

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About NexSens Technology, Inc.

NexSens software and real-time data logging systems are designed to simplify the setup and operation of environmental monitoring networks. NexSens products automate much of the tedious programming, data collection, and manual data processing common with other systems.

iChart is an easy-to-learn, easy-to-use Windows-based software program designed to interface with the industry's most popular environmental monitoring sensors and systems. A large multi-vendor instrument library makes setup quick and easy. iChart automates much of the tedious programming, data collection and manual data processing common with other environmental data collection systems.

The NexSens iSIC (Intelligent Sensor Interface and Control) is a state-of-the-art line of data loggers that simplify the collection of real-time data from environmental sensors and monitoring instruments. The iSIC data logger supports multi-vendor sensor connections and is designed for environmental data monitoring with NexSens communication equipment and software.

How to Use This Manual

This manual is designed to provide you with detailed instructions for interfacing specific sensors to the NexSens iSIC data logger.

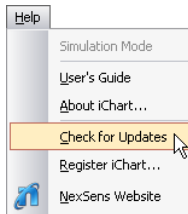
This manual provides you with all the information needed to interface your sensor with the iSIC data logger. For advanced system and sensor reference material:

- Review the material in the iSIC operations manual:
 - <http://www.nexsens.com/support/manuals.htm>
- Review the sensor manufacturer's operations manual. This information should have been provided with the purchase of the sensor. This material can also typically be found at the instrument manufacturer's website. If you are still having difficulty, email your technical support question to:

support@nexsens.com

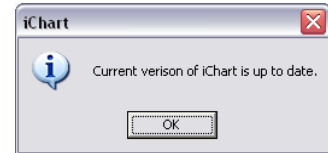
Keeping iChart Up to Date

NexSens periodically releases new versions of iChart software and iSIC firmware to be downloaded free of charge. The updated versions typically add new features, improve existing features, and/or add more reliability to the system. It is important that iChart is updated to the latest version before connecting a new sensor to your iSIC data logger. Your computer will require internet access to update automatically.

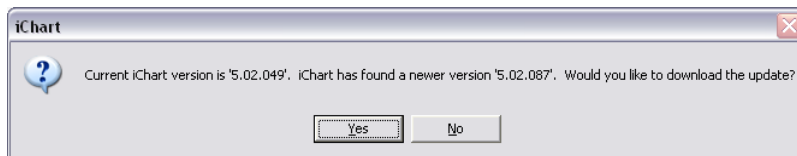


To obtain the latest version of iChart software, open the program on your computer. In the **Help** menu, select **Check for Updates**.

If your software is up to date, iChart will confirm that your computer is running the current software release.

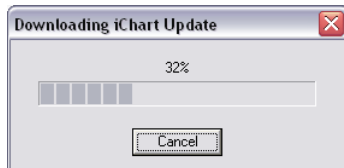


If a newer version of iChart is available, a dialog box will appear asking if you would like to upgrade to download the update.



Click **Yes**. iChart will begin downloading the update.

Note: Depending on your connection speed, this update may take a few minutes. You can continue running other applications on your computer while the download is progressing.



When the update has finished the downloading process, click **OK** and close iChart.

Reopen iChart. When the program opens, iChart will automatically begin the installation process. Follow the step-by-step installation windows to complete the iChart software update.

Note: If an internet connection is unavailable on the computer, iChart can be downloaded onto another computer and then moved to the computer where it needs installed. The latest version of iChart can be downloaded here:

<http://www.nexsens.com/support/downloads.htm>

Pre-iSIC modbus setup

Communication

The NexSens iSIC supports Modbus RTU communications over RS232 or RS485.

Implementation:

- Modbus RTU over RS232 or RS485.
- Baud rates: 19200 or 9600 at No Parity, 8 Data Bits, and 1 Stop Bit
- Modbus address: same as the iSIC address (1-249 possible).
- Input registers 0 to n-1 correspond to parameters 0 to n-1 where n = the number of parameters that the iSIC logs. Registers are 16 bit integers.
- Each input register holds the corresponding parameter reading scaled up 100. So for example 74.52 degrees Fahrenheit would be stored as 7452. Registers are 16 bit integers.
- 32 bit IEEE floating point number format are also supported. It is requested though registers 0x2000 to n-1 correspond to parameters 0 to n-1 where n = the number of parameters that the iSIC logs. The output is in big endian format (most significant word is on the low register ie. Lo word stored in register 0 and Hi stored in register 1). Each parameter value occupies 2 modbus registers.

Supported commands:

0x04 - read input register

Perform sensor read and return result in the requested registers.

Depending on sensors installed, this could take anywhere between 1 seconds to several minutes. For example, analog sensors are instantaneous,

0x06 - write register

Register 0x1000: set the iSIC startup mode:

LOBYTE = mode

1 = iSICMODE_LOG

2 = iSICMODE_POLL

3 = iSICMODE_POLLNLOG (not supported)

4 = iSICMODE_MODBUS_RTU

8 = iSICMODE_MODBUS_ASCII (not supported)

HIBYTE = 1 if the iSIC is to be reset after successfully set the startup mode.

This will soft reset the iSIC and go to the new mode. If the flag is 0, the iSIC will stay in Modbus mode after successfully set the iSIC startup mode. The user will need to cycle the power or wait until the hourly reset to enter the new mode.

Error Codes:

0x01 = MODBUS_ECODE_ILLEGAL_FUNCTION

0x02 = MODBUS_ECODE_ILLEGAL_ADDRESS

0x03 = MODBUS_ECODE_ILLEGAL_DATAVAL

0x04 = MODBUS_ECODE_SLAVEDEV_FAIL

0x05 = MODBUS_ECODE_ACK

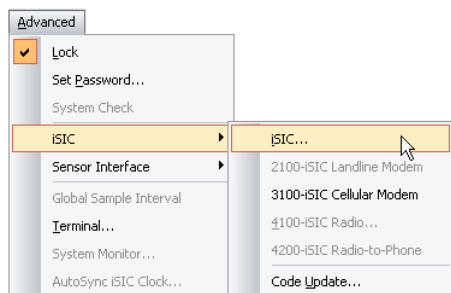
0x06 = MODBUS_ECODE_SLAVEDEV_BUSY

To setup the iSIC data logger for Modbus protocol, first setup the iSIC with the specific sensors connected to it. For information on how to setup and wire these sensors you can read one of the NexSens Interface Manuals found here: <http://www.nexsens.com/support/manuals.htm>

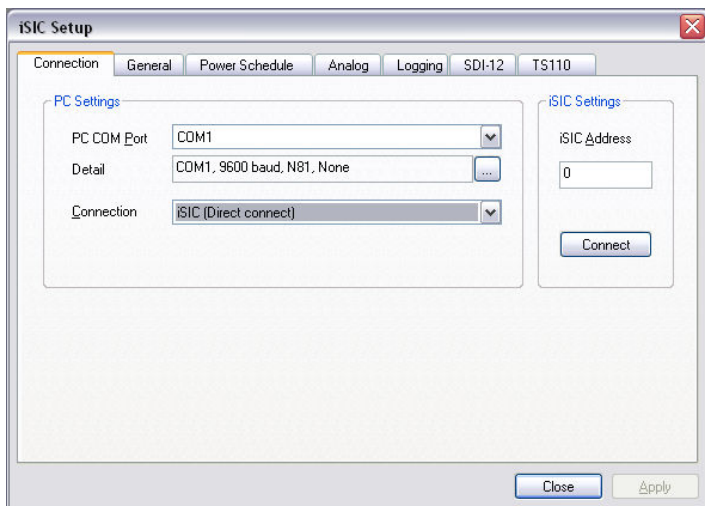
It is recommended that a 1 minute log interval is selected when setting up a data logger for Modbus telemetry for testing purposes. This allows you to make sure you are receiving good readings from the sensors after a few minutes in the lab.

After receiving a few readings, the data logger should be set to a 0 minute log and sample interval.

After you have setup the data logger and have received a few good readings, go to the **Advanced | iSIC | iSIC** menu.

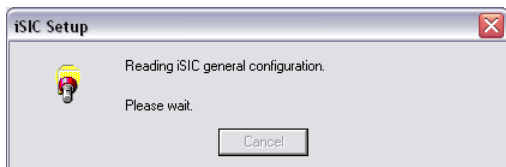


The **iSIC Setup** dialog box will appear.



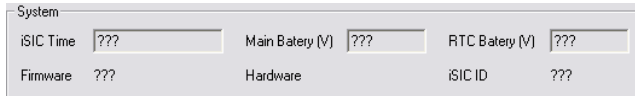
Check to make sure the **COM Port** field has selected the correct COM port the direct connect cable is attached to. If it is not, click on the **Change COM Port, Baud...** button and select the correct COM port from the menu. By default the iSIC Data logger will use 9600 baud, N81 (No parity, 8 data bits, 1 stop bit). The address can be left as **0** and the connection should be set to **Direct connect**.

Next, click **Connect** and go to the general tab.

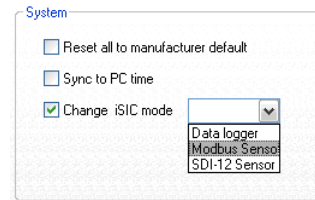
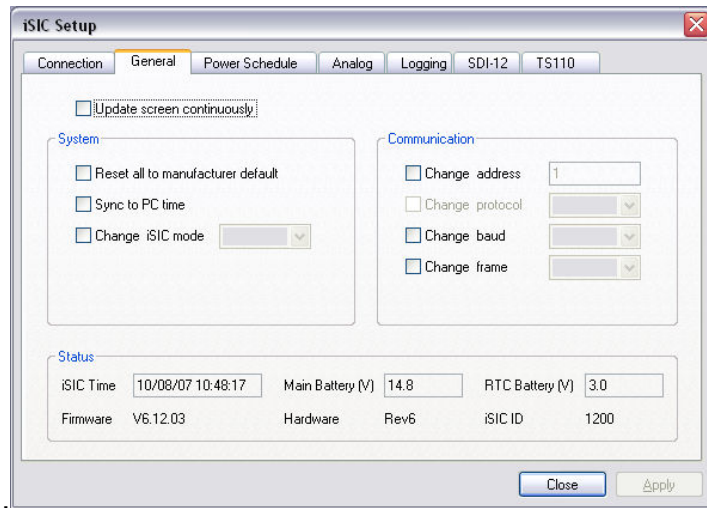


iChart will read the current configuration settings of the iSIC. This will take a few seconds. After the above screen goes away, if there are all ??? on the bottom of the general tab, hit

Close. Then simply reset power to the iSIC (by removing power and then reapplying it) and try again. Also double check to make sure you have selected the right COM port and communication settings.



After iChart has successfully read the status information, it will be displayed on the bottom of the screen



Here you will be able to setup the iSIC for your Modbus network. Place a check mark near the Communication options you would like to change. For example, place a check mark next to **Change iSIC mode**, then select **Modbus** and click **Apply**.

If needed for your network, you can also change the baud rate using **Change baud** and the parity, data bits, and stop bits using **Change frame**. If you will be using this iSIC on a RS485 Modbus network, be sure to also change the iSIC protocol to 485. Follow the wiring instructions in the **iSIC 485 Telemetry** section. When you have finished making changes hit **Apply** and reset power to the iSIC. Note: changes to communication settings will not take affect until after power has been reset.

Directly connecting to a Modbus data logger

Once configured for modbus, a data logger is by default, setup to communicate over an modbus instead of direct to a PC using its DB9.



To configure your modbus data logger to communicate directly to a PC instead of modbus:

1. First select **Help | Check For Updates** and get the latest version of software from the NexSens website.
2. Open iChart and select **Edit | Preferences**.
 - From the **GUI** tab, place a check box in **Enable Advanced Interface**
3. Next, select **Advanced | Terminal**. Connect the data logger to a COM port on your computer and then select that COM port in the dialog box and direct connect as the connection type. Click connect and you should see a white window appear.
 - Power the iSIC (or cycle power by removing both fuses)
 - After seeing the word "NexSens" enter **<Esc>+2+3+2**
 - You should see a message that ends with %RS232
 - If you see %Modbus, cycle power again and try entering **<Esc>+2+3+2**
4. Close the white window and select **Advanced | iSIC | iSIC**
 - Select the COM port the iSIC is connected to and click connect. Click on the general tab to make sure you can see a firmware version and battery voltage.
 - Place a check in the **Change protocol** check box.
 - Select **Direct** from the drop down menu and then click **Apply**.
5. Close the **iSIC Setup** dialog box and cycle power to the iSIC by removing the two fuses. The iSIC is now setup to communicate directly to a PC instead over spread spectrum radio telemetry. To switch back to modbus follow the instructions in the previous section for modbus configuration.

Technical

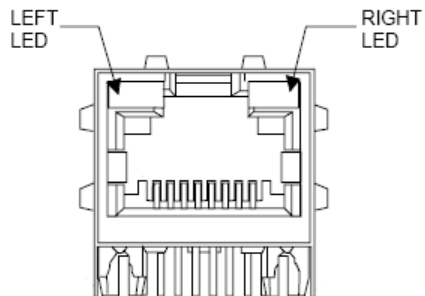
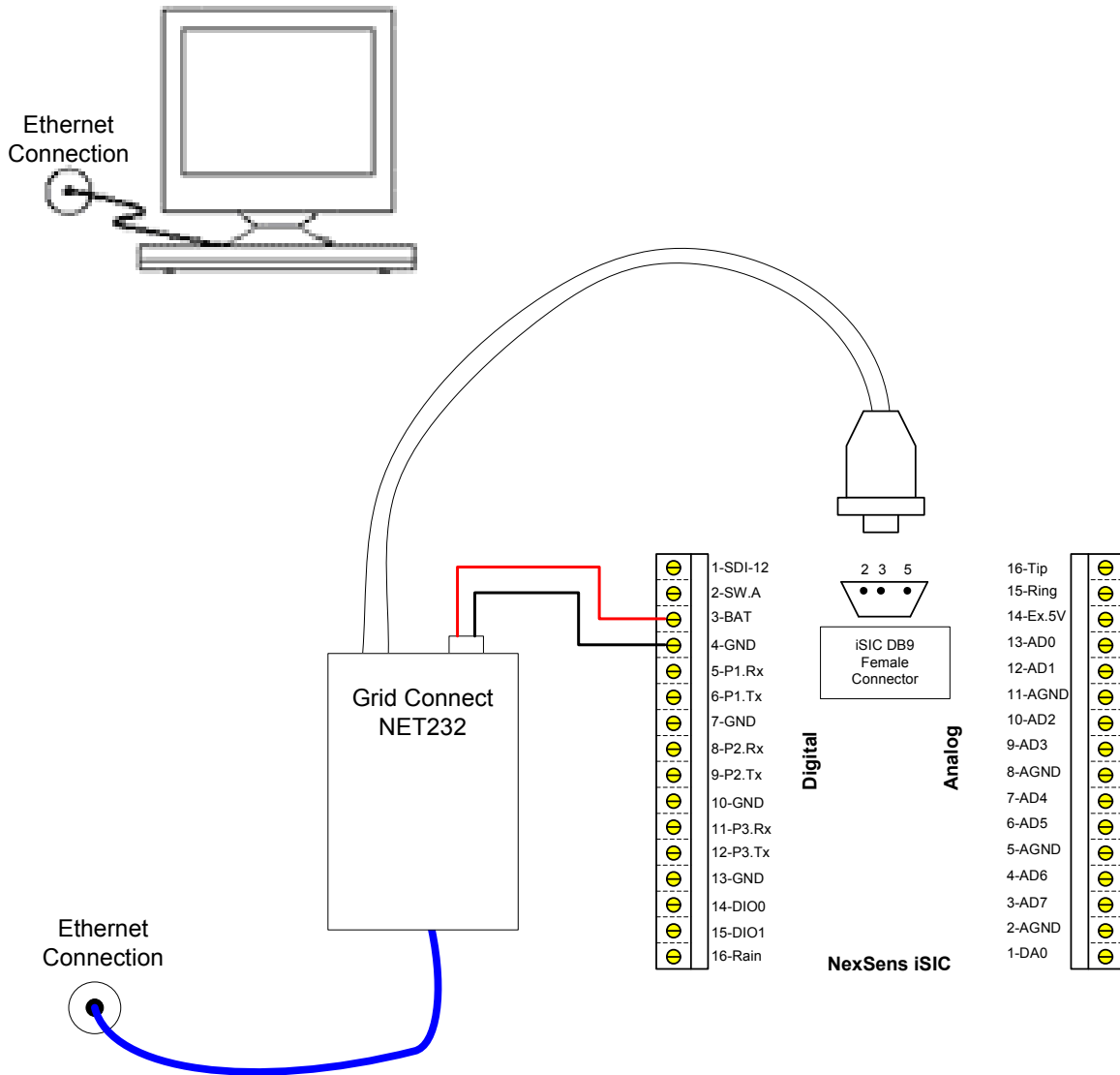


The Grid Connect NET232 Serial to Ethernet Adapter allows a computer connected to the internet or internal network to communicate to an iSIC datalogger over that Ethernet connection.

The NET232-MB model allows for Modbus TCP/IP from Modbus RTU conversion.

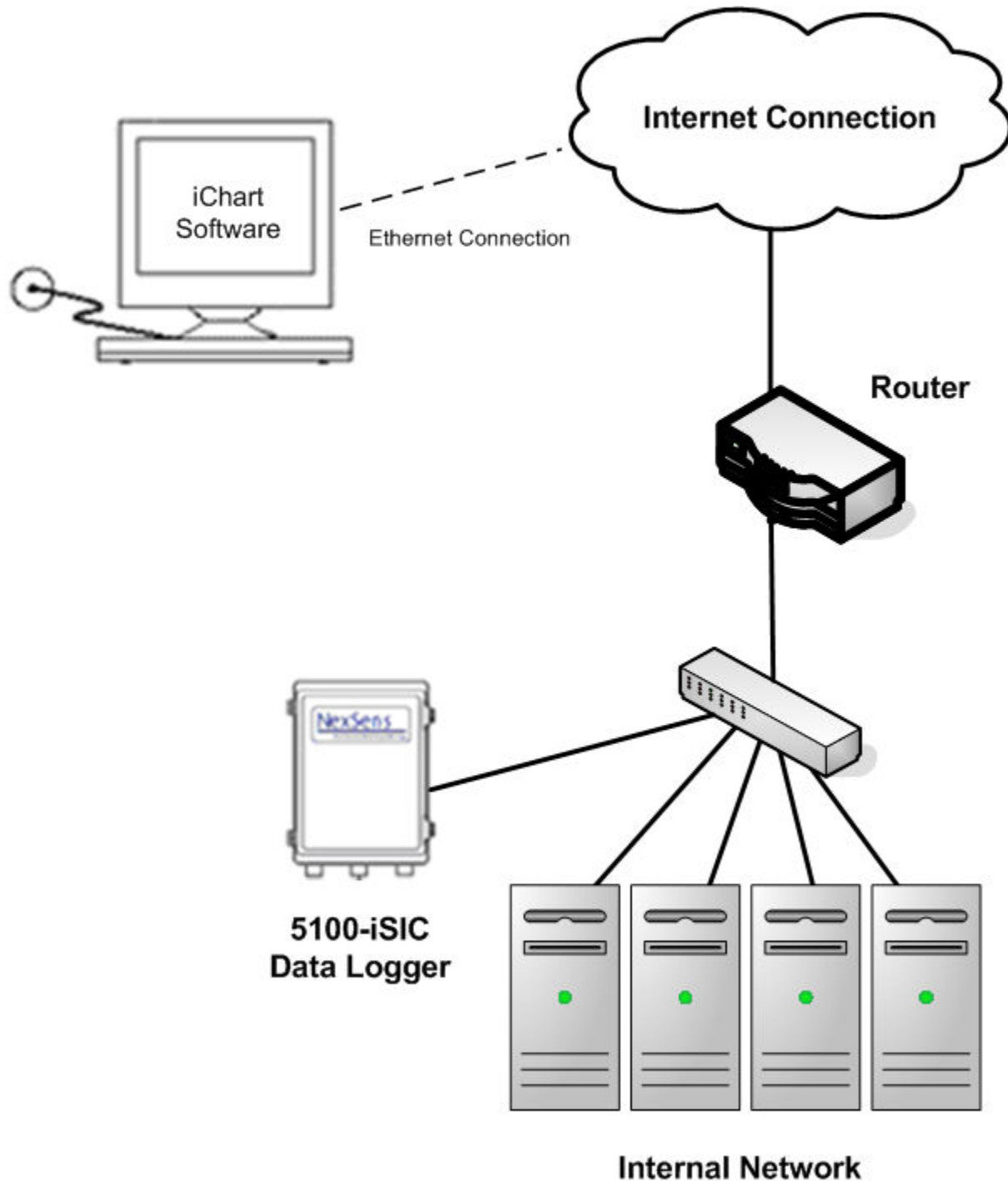
For NET232-DTE devices, the cable from the NET232 device will plug directly into the iSIC. For NET232-DCE devices, a cable connecting from the iSIC serial port to the NET232 serial cable which switches pins 2 and 3 will be required.

Wiring



After connecting the iSIC battery, and powering the NET232 device, you will see the large LED next to the Ethernet connector glow a solid green. This means you have power. Once an Ethernet cable is plugged into the NET232 device the Left LED (as shown to the left) will glow a solid color while the Right LED will blink. This means you have Ethernet connectivity.

Network Setup Information



iChart software communicates to a 5100-iSIC device through an internet connection. The 5100-iSIC will be assigned a static IP address. The Router that connects the 5100-iSIC to the internet should also have a static IP address and port forward external internet traffic to the internal 5100-iSIC IP address on ports 10001 and 9999.

What an IT Administrator Needs to Know

For iChart software:

iChart software is the main software tool used to communicate with data loggers and sensors. For a computer to use iChart software the user must have write access to:

C:\Program Files\NexSens\

Which is the default install folder. Additionally, when registered (the software comes with a FREE 30 day trial) the user must have Administrator writes to the computer as the registration information is stored in the Windows registry.

For WQData posting:

WQData is a web datacenter hosted on NexSens Technology servers. For iChart to be able to post data to WQData.com it must be able to FTP files to <ftp.wqdata.com> on port 21 and navigate to a URL on www.wqdata.com port 80. When using WQData-trial the ftp will be <ftp.nexsensdatacenter.com> and www.nexsensdatacenter.com respectively.

For NexSens Ethernet devices (ie. 5100-iSIC) usage:

The NexSens 5100-iSIC is an Ethernet data logger that transfers data over TCP/IP.

5100-iSIC Setup:

The 5100-iSIC must be assigned a static IP address on the router it is installed on. This can either be done by assigning the address statically based on the 5100-iSIC MAC address on the router itself, or by setting the 5100-iSIC to use a static IP that will not be assigned by your DHCP server. When assigning the address on the 5100-iSIC, the address must be assigned from a computer on the same subnet as the 5100-iSIC.

Network Setup for External Connection:

To grant external network access to a 5100-iSIC, port 10001 for TCP/IP traffic and 9999 for telnet traffic must be port forwarded from the incoming network router to the 5100-iSIC IP Address. This router must have a static IP address. Note this is not required if the computer running iChart software is on the same network as the 5100-iSIC. Both 9999 and 10001 are the default ports and can be changed if required. The telnet port does not need to be open for the system to work but it is recommended for remote diagnostics if communication issues occur.

Accessing a 5100-iSIC from the Internet

To access the 5100-iSIC from the internet, its address must be opened to the public. This typically is done with port forward on the router.

5100-iSIC Setup

IP: internal_IP

Port: 9999 and 10001

Router Setup

IP: public_IP

Port: 9999 and 10001

The public_IP is the IP address of the router that the public can access.

You want to set your router to open a pinhole (or port forwarding) to map the public_IP:9999 and public_IP:10001 to internal_IP ports 9999 and 10001.

So to access the 5100-iSIC from the internet, you would specify public_IP in your Port Redirector setup.

The router must have a static IP address. This is so that the IP address entered into the Port Redirector software does not need to change each time power is cycled to the router.

Port Forwarding [Port Triggering](#) [Port Blocking](#) [True Static IP Port Management](#)

PORT FORWARDING
 Port Forwarding is used to direct authorized inbound traffic to the appropriate server(s) or specifically identified application(s) on the network.

Disable all Port Forwarding rules

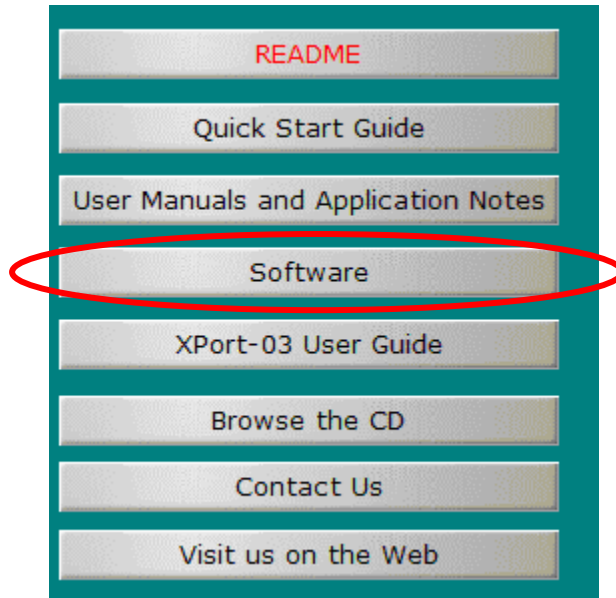
Select	#	Application Name	Port Range		Protocol	IP Address	Enable
			Public	Private			
<input type="radio"/>	1	iSIC 9999	9999 ~ 9999	9999 ~ 9999	TCP	10.1.10.240	<input checked="" type="checkbox"/>
<input type="radio"/>	2	iSIC 10001	10001 ~ 10001	10001 ~ 10001	TCP	10.1.10.240	<input checked="" type="checkbox"/>

Example Comcast router port forwarding setup

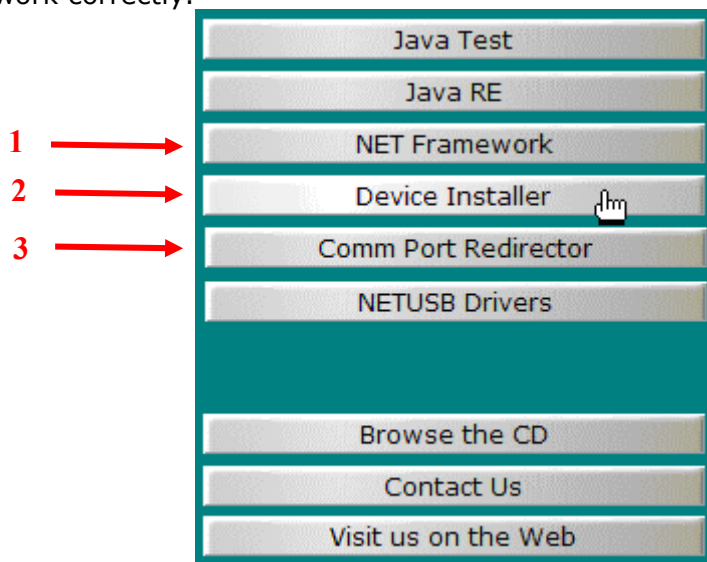
Installing Software

This manual is meant to be a quick guide to getting started. Insert the CD that came with the 5100-iSIC device. The installation screen should automatically be displayed. Click **Software**.

Note: The software may also be downloaded from <http://www.nexsens.com/downloads/5100-isic.zip>



Next click on the **NET Framework** and follow the installation wizard. This is required for the software to work correctly.



After successfully installing the **NET Framework** click on **Device Installer** and follow the installation wizard. This will allow you to setup your 5100-iSIC IP Address.

After successfully installing the **Device Installer** click **Comm Port Redirector** and follow the installation wizard. This will allow you to access the 5100-iSIC through a virtual COM port.

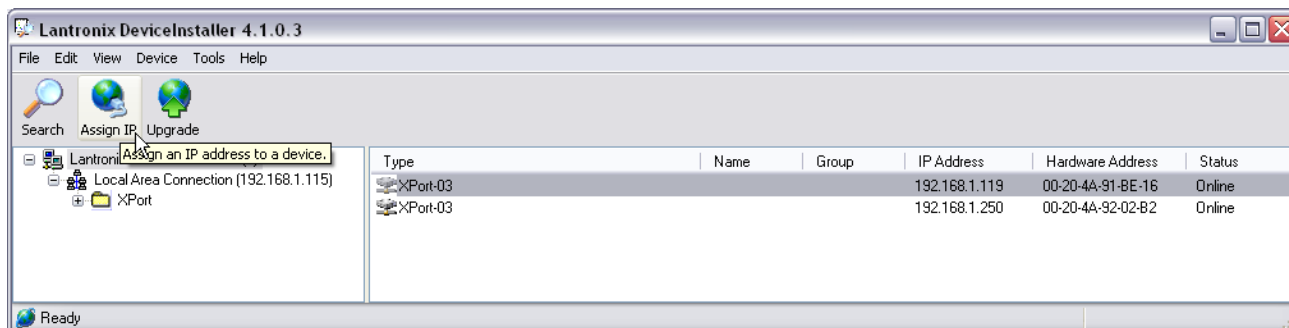
After installing the three pieces of software, you will need to restart your computer.

Note: you must restart your computer for the software to function properly.

On the local network the device is installed on...

Note: this step must be performed on the local network the 5100-iSIC is connected to. For example, the computer should be connected to the same switch or router the 5100-iSIC is connected to.

After restarting the computer, from the **Start Menu** run the Lantronix DeviceInstaller program. The program will automatically detect 5100-iSIC's on the network. Click **Search** to find devices powered after running the program.

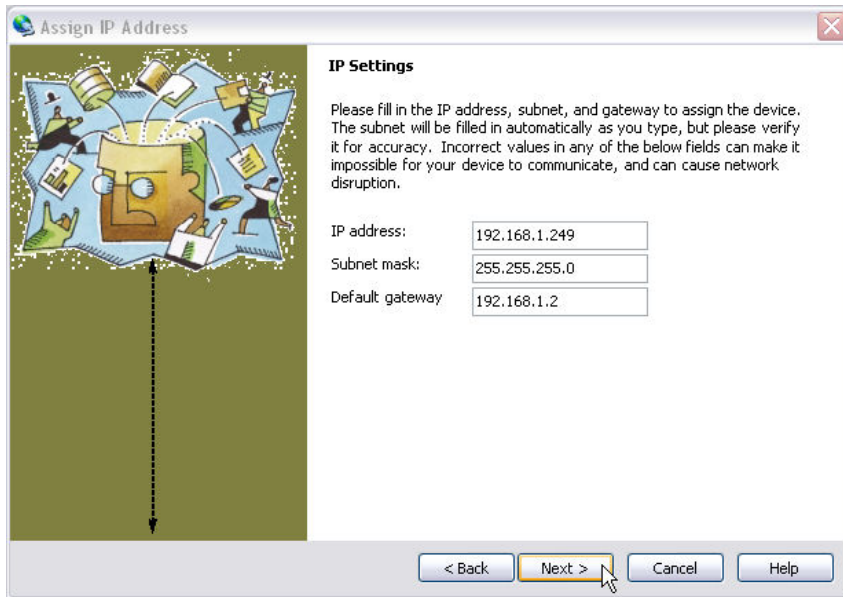


Click the **Assign IP** icon and select **Assign IP Address** from the Device menu. Follow the instructions to setup the device to use a static IP address. Note: the address assigned here should be based on the individual network. Contact the system administrator for allowable IP addresses.



Place a check in **Assign a specific IP address** and click **Next**.

Next you will be asked about specific IP settings. Enter the desired IP (make sure it will not conflict with your DHCP server)

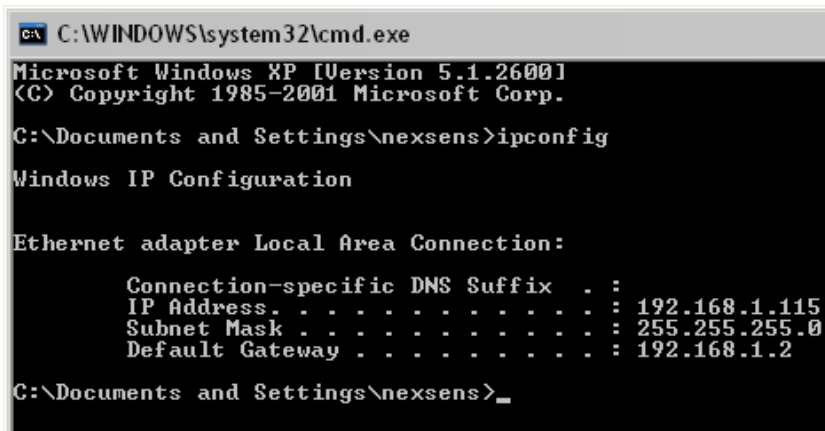


If the device will be running on the same subnet as your computer, run command prompt and enter 'ipconfig' to get the Subnet Mask and Default Gateway. Otherwise contact your system administrator for these values.

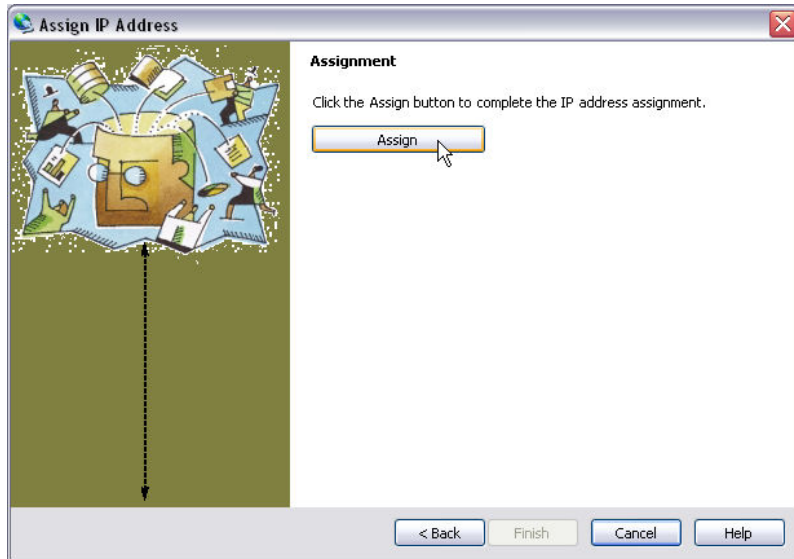
From the **Start Menu** select:

Start -> All Programs -> Accessories -> Command Prompt

At the prompt type **ipconfig** and hit enter



Click the Assign button when ready. Make sure the device is still powered and connected to the internet.



After successfully assigning an IP, record the IP Address shown as you will need this later.

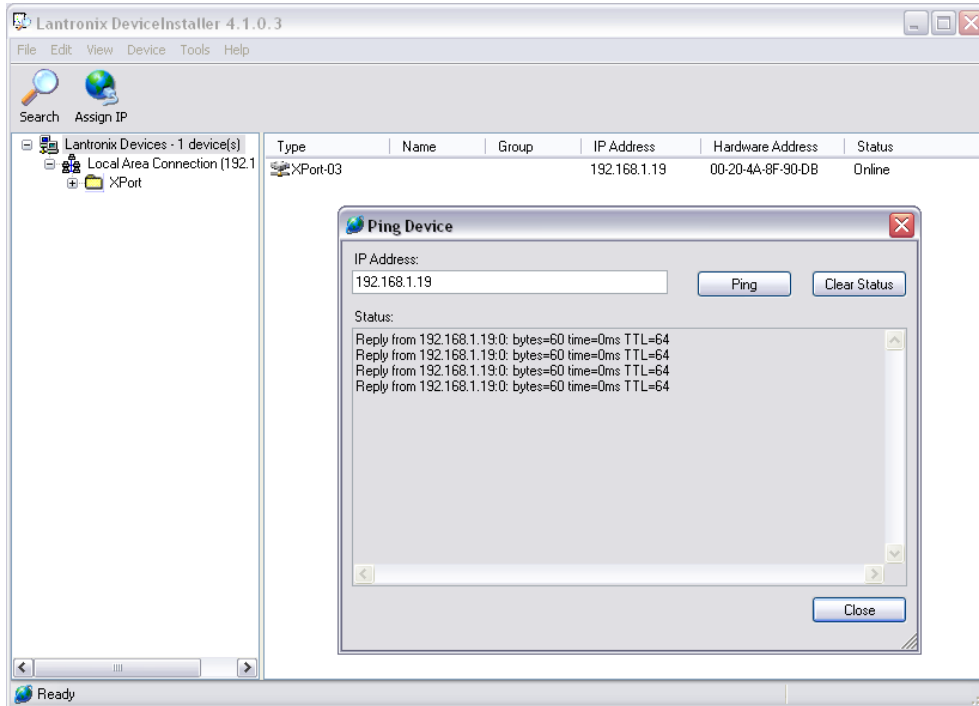
After the IP has been assigned, cycle the power to the 5100-iSIC.

Note: you must restart your computer for the 5100-iSIC to work properly.



From the **Tools** menu in DeviceInstaller, select **Ping....**

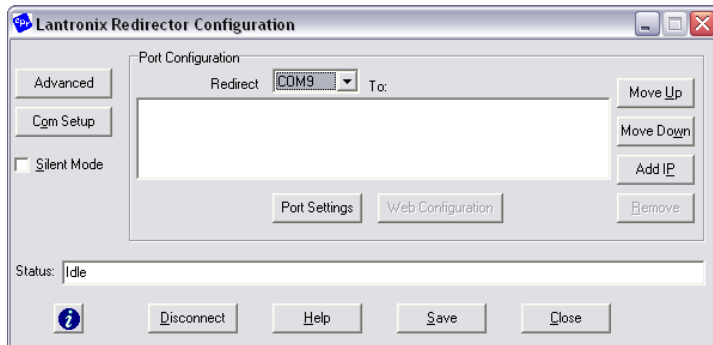
The **Ping Device** window will appear. Enter the **IP Address** of the 5100-iSIC device that was found during search and click **Ping**. You should see "Reply from...". This means the data logger is working.



If required, configure any router to port forward an external IP address to the internal 5100-iSIC IP address, so that computers offsite may access it. Port 10001 for TCP/IP traffic and port 9999 for telnet traffic must be open for the device to work properly.

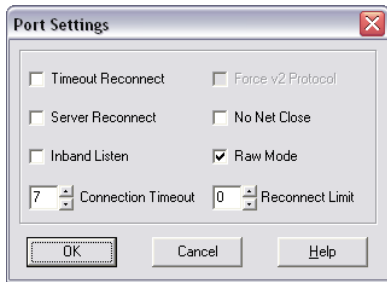
On the computer running iChart software...

After successfully pinging the device locally, close **DeviceInstaller** software and from the Start menu run **Labtronics Redirector** on the computer that will be running iChart software.

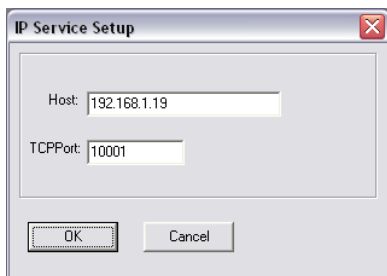


Record the COM port listed next to **Redirect** as this will be used later.

After recording the COM port, click on the **Port Settings** button and place a check in **Raw Mode** as shown below.

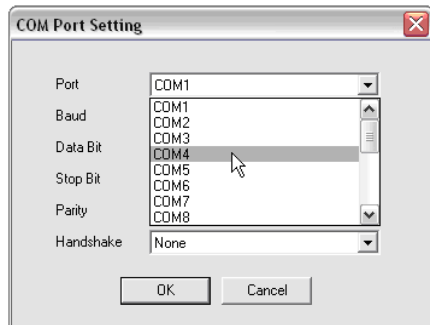


Click **OK** and then click on the **Add IP** button. Enter the IP address previously recorded and pinged in the **Host** field. Then enter "10001" into the **TCP Port** field.

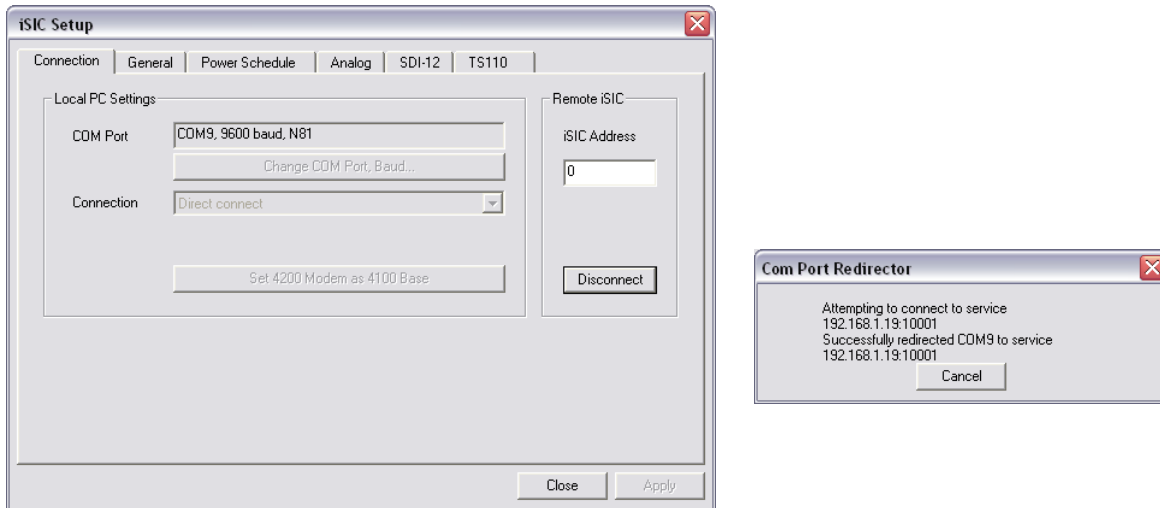


Click **OK** to this window and then the **Save** button. The software will state that the changes will take effect the next time the COM port is opened.

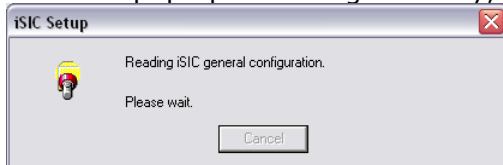
Click **Close** and run iChart. Select **Advanced | iSIC | iSIC** from the menu. The **iSIC Setup** window will appear. Click on **Change COM Port, Baud...** and select the COM port recorded earlier. By default the iSIC Datalogger will use 9600 baud, N81 (No parity, 8 data bits, 1 stop bit). The address can be left as 0 and the connection should be set to Direct connect.



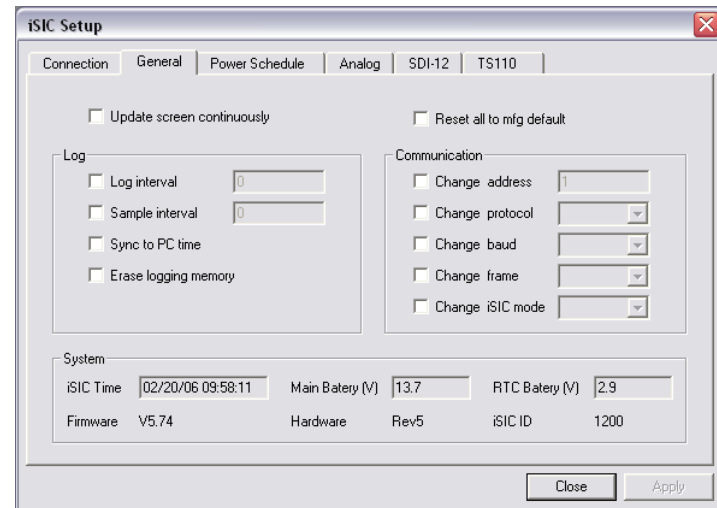
Click the **Connect** button. A pop up window should appear as shown below. This means the 5100-iSIC and redirector software is successfully working.



After the pop up window goes away, click on the **General** tab.



iChart will read the current configuration settings of the iSIC. This will take a few seconds. After iChart has successfully read the status information, it will be displayed on the bottom of the screen. If you see '???' displayed in the **iSIC Time** or **Firmware** fields then there is a problem with the cable connection between the iSIC and Ethernet modem.



Once you see the **iSIC Time** and **Firmware** version the system is all ready to go! Simply follow the sensor interface manuals of the sensors you are connecting with. Be sure to use **Direct Connect** as the connection type, and the COM port used by the Redirector software when setting up these sensors.

Changing Default Settings (such as ports)

From the **Start Menu** select:

Start -> All Programs -> Accessories -> Command Prompt

At the prompt type **telnet** and hit enter. The telnet client will appear.

```
Command Prompt - telnet
Welcome to Microsoft Telnet Client
Escape Character is 'CTRL+I'
Microsoft Telnet> _
```

At the prompt type **o <ip address> <telnet port>**. The default telnet port is 9999.

```
Command Prompt - telnet
Welcome to Microsoft Telnet Client
Escape Character is 'CTRL+I'
Microsoft Telnet> o 192.168.1.1 9999_
```

A password prompt, or device menu should appear. This means you can communicate to the device via telnet.

```
Telnet 192.168.1.1
MAC address 00204A91BD01
Software version U6.1.0.0 (051122) XPTXEXE
Password :_
```

If the communication times out, you cannot communicate to the device via telnet. A few things to check:

1. Make sure the 5100-iSIC is powered and the Ethernet cable is plugged into its internet connection
2. Check the router/switch status lights to make sure the Ethernet cable plugged in from the 5100-iSIC has a connection to the internet.
3. Check to see if the default port has changed from 9999. If you are unsure, try running the device installer program as described earlier in this manual to detect the device. Note: this must be done when connected to the same subnet as the 5100-iSIC.
4. If connecting from a remote network, make sure the router the 5100-iSIC is connected to has a static IP address and correctly port forwards the correct telnet port and 5100-iSIC address

```
Telnet 192.168.1.1
Welcome to Microsoft Telnet Client
Escape Character is 'CTRL+I'
Microsoft Telnet> o 192.168.1.1 9999
Connecting To 192.168.1.1...Could not open c
Connect Failed
Microsoft Telnet> _
```

After connecting to the device using telnet, the default settings can be. The settings that can be manually changed are the port number the data logger uses, etc. Be sure to leave the Baudrate at the same baud rate the data logger is configured for (default is 9600).

```
Change Setup:
0 Server
1 Channel 1
3 E-mail
5 Expert
6 Security
7 Defaults
8 Exit without save
9 Save and exit          Your choice ? 1

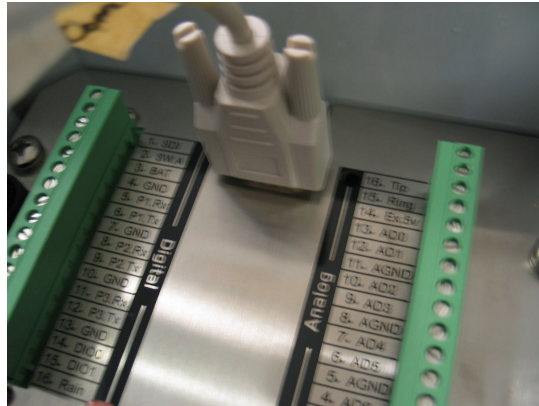
Baudrate <9600> ?
I/F Mode <4C> ?
Flow <00> ?
Port No <10001> ? 10001
ConnectMode <C0> ?
```

Connecting directly to the Ethernet Modem

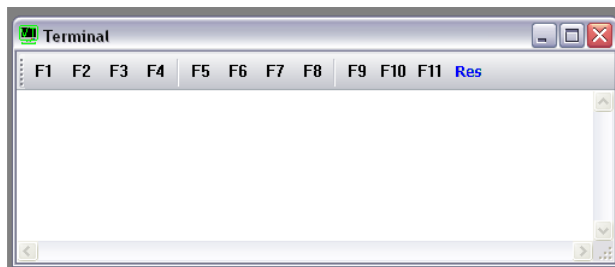
If the 5100-iSIC is set to a static IP address and then moved to a network with a different subnet, the only way to connect to it is through the device's serial port. The Device Installer software will only detect 5100-iSIC data loggers configured with an IP address on the same subnet.

To connect to the Ethernet modems serial port:

- Disconnect the modem RS232 cable from the 5100-iSIC data logger.



- Connect a null modem cable between the PC and Ethernet modem cable
- Open iChart and select **Advanced | Terminal** from the iChart menu system.
 - Make sure the COM port selected matches the COM port used on your system.
 - Click on the '...' next to the COM settings and change the baud rate to 9600.
 - Click **Connect**
 - A white screen should appear



- Cycle power to the 5100-iSIC by removing the two fuses

- Watch the LED light on the 5100-iSIC, after the light stops blinking there is 5 seconds to enter three lowercase 'x' in the terminal window. If the first set you type in does not pop up a message, try typing three 'x' again. If no message appears, cycle power again and repeat.
 - Remember: there is only 5 seconds after the LED light stops flashing to enter the 'x'
 - The LED light will flash for a few seconds before stopping. Do not enter the three 'x' until after the light has stopped.



- The following message should appear:

```
MAC address 00204A9200B2
Software version V6.1.0.0 (051122) XPTEXE
Press Enter for Setup Mode
```

- Press "Enter" on the keyboard and the setup mode will appear. At the prompt, select '0' and enter in the IP Address and Gateway IP address the 5100-iSIC should be using on the new network:

```
Change Setup:
 0 Server
 1 Channel 1
 3 E-mail
 5 Expert
 6 Security
 7 Defaults
 8 Exit without save
 9 Save and exit                Your choice ? 0

IP Address : (192) . (168) . (001) . (220)
Set Gateway IP Address (Y) ?
Gateway IP addr (192) . (168) . (001) . (002)
Netmask: Number of Bits for Host Part (0=default) (8)
Change telnet config password (N) ?
```