USING THE XPERT2 / 9210B ON A TCP/IP NETWORK

Prepared by:
R&D
January, 2009
Updated September 26, 2013

Sutron Corporation
22400 Davis Drive
Sterling, Virginia 20164
TEL: (703) 406-2800
FAX: (703) 406-2801
WEB: http://www.sutron.com/

1. INTRODUCTION

This application note discusses how to use the Xpert2/9210B in a TCP/IP networked environment. While basic network functionality was included as early as Xpert firmware version 3.0, the majority of the capabilities described in this document require Xpert firmware version 3.2 or higher. Note: from here out, the term "Xpert" is used to refer to both the Xpert2 and 9210B Sutron data loggers.

2. CONNECTION TO A NETWORK

Connect the Xpert to a TCP/IP network using an Ethernet cable. The Ethernet cable plugs into the "ETH" jack on the end panel of the Xpert (see pictures, below). The other end of the Ethernet cable plugs into a router connected to the network. Alternatively, the other end may connect directly to a PC/Laptop, when you are using a crossover cable and static IP. To connect in this latter fashion, see "Direct Connection to a PC or Laptop", later in this document.
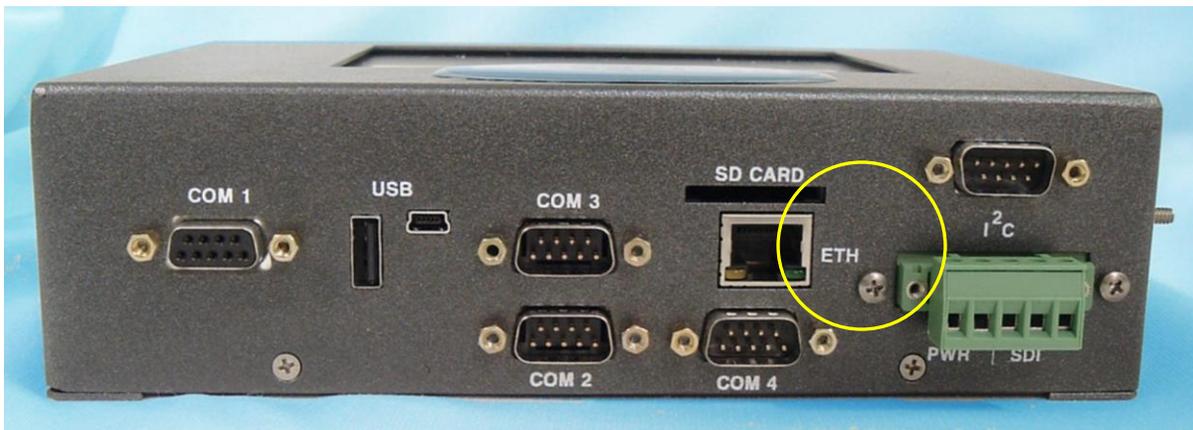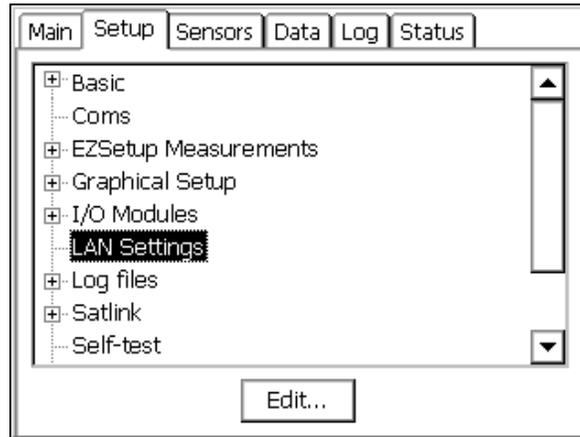

End panel of the Xpert2, showing Ethernet port
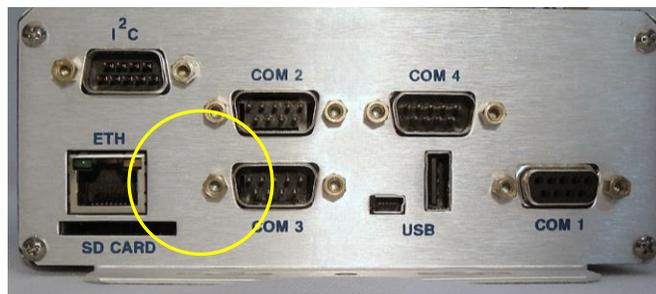
End panel of the 9210B, showing Ethernet port

3. LAN SETTINGS

Once the Xpert is connected to a network (or PC/Laptop via crossover cable), the next step is to configure the Xpert's LAN Settings. You do this using the LAN Settings entry on the Xpert Setup tab.

The Xpert setup tab, showing LAN Settings entry

Highlight the LAN Settings entry and click "Edit". The following dialog is shown.
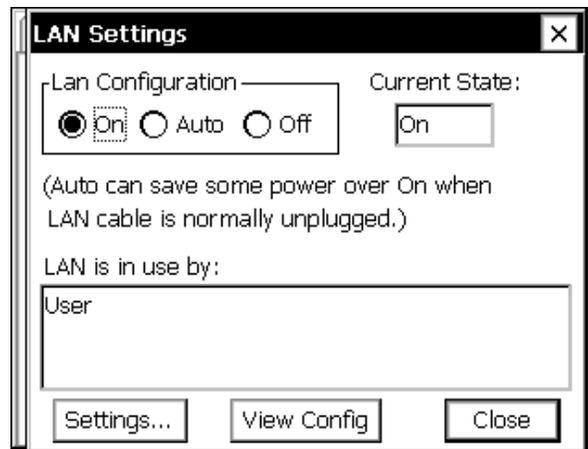
The LAN Settings Entry on the Setup Tab

The current state of the LAN (its power state, i.e., "On" or "Off"), is shown in the "Current State" text box.

The Lan Configuration buttons ("On", "Auto", and "Off") determine the state of the LAN when the Xpert first boots. "On" causes the LAN to be turned on at boot, and stay on until explicitly turned off. "Auto" turns the LAN on only when something is connected to the Ethernet jack. "Auto" is typically only set when you plan to connect your PC or laptop directly to the Xpert (which requires a special Ethernet *crossover* cable; see below). When "Auto" is selected and a device is not connected to the Ethernet port, the system draws only about 1mA more power than if the state was set to "Off".

The "LAN is in use by" area displays the list of elements that have requested the LAN to be on. The list includes "User" when the LAN Configuration setting is "On", "Modbus" when a Modbus process has requested the LAN to be on, and so on. This can be useful when trying to determine why the LAN is on,

when you have requested it to be off.

Press the "View Config" button to view details (IP address, DNS server, etc.) about the current connection.

When you press the "Settings…" button, the system will ask whether you want to run the Network Wizard, which will ask several questions and then set LAN settings based on your answers. If you answer "No" to running the wizard, you instead are prompted with a dialog from which you can manually configure network properties, as shown below:
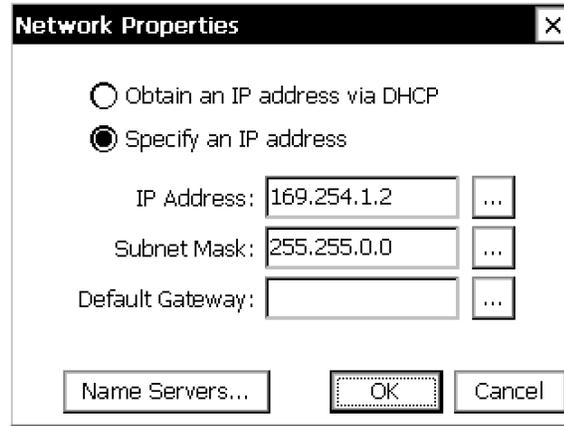
The Network Properties dialog, accessed from the LAN Settings dialog

The Network Properties dialog is used to specify how the Xpert gets an IP address. Typically, when the Xpert is connected to a network that provides DHCP services, select "Obtain an IP address via DHCP". If DHCP services are not available, or if you desire a static IP address for other reasons, select "Specify an IP address", and enter the IP address and Subnet Mask. You can press the "Name Servers…" button to enter DNS and WINS address information, if desired.

4.   DIRECT CONNECTION TO A PC OR LAPTOP

The Xpert may be connected directly to a PC or Laptop Ethernet port using a special kind of Ethernet cable called a "crossover" cable. An Ethernet crossover cable is a special kind of Ethernet cable that acts similar to a null modem cable where Tx and Rx are crossed in order to facilitate host to host communications. The crossover cable allows you to connect the Xpert directly to a PC or laptop, without the need for a router between the two. This cable can be purchased most anywhere standard Ethernet cables can be purchased.

To configure the Xpert for use with a crossover cable, run the LAN Settings Wizard and answer the questions regarding how you intend to use the Xpert in a networked environment, answering "Do you wish to be able to access the unit using a laptop (or PC) using a crossover cable?" with a "Yes". To run the LAN Settings Wizard, go to the Setup tab, open the "LAN Settings" entry, and press the "Settings…" button.

If you prefer to set the settings manually, then set the LAN Configuration either to "On" or to "Auto", and set a static IP using the Network Properties dialog. The static IP should be in the range 169.254.x.x/255.255.0.0, if you want it to be compatible with the way a laptop will assign itself a default IP.

NOTE: Upgrading via Xterm using the /LAN switch is not supported by crossover cables! To upgrade using Xterm with the /LAN command line switch active, the Xpert/9210 must be connected to a network.

5.   NETWORK SECURITY

The Xpert does not provide any means of securing a network beyond its standard user name and password access facilities. All network security needs must be provided through the network routers and other hardware. Note that Xpert does not encrypt user names and passwords in network communications.

5.1   FireWalls

If you have "Windows Firewall" enabled (like most PCs do these days) you will need to add an "exception" for XTerm.exe in order for it to support all of it's networking features. If you use a different type of firewall, you may need to add an explicit access rule for some of the following service ports that are used by XTerm or the Xpert :

Service	Port	Protocol	Host	Description
GUI	52732	TCP	Xpert, XTerm	Used by XTerm to perform log dumps and detect that the Xpert application is running. XTerm also hosts this port in order to support proxy connections. Serial and Telnet connections make use of XTerm's proxy.
Remote	52733	TCP	Remote, XTerm	Used by XTerm to access GUI screens and perform file transfers. XTerm also hosts this port in order to support proxy connections. Serial and Telnet connectons make use of XTerm's proxy.
Auto Detect	52733	UDP	Remote	Used by XTerm to detect Xperts running on the network.
SSP	52734	TCP	Xpert	Used by Remote when it needs to communicate with the Xpert application. This port is used locally by the Xpert and there's no reason to open the port on the PC or in a firewall. Doing so may create a security risk.
Telnet	23	TCP	Remote	Used to support both SSP and Command Line operations, with automatic detection of Telnet protocol. Auto-detect allows this port to support communications with all expected tools, i.e., XTerm, XConnect, and Hyperterminal.
Telnet	24	TCP	Remote	Used to support both SSP and Command Line operations, without support for Telnet protocol. Hence, don't use Hyperterminal with this port, but XTerm and XConnect communications will work fine)
Telnet	1023	TCP	Remote	Used to support Telnet based command line access (e.g., Hyperterminal). Telnet protocol is assumed (rather than auto-detected, as with port 23). Hence, don't use this port with XTerm or XConnect.
Web	80	TCP	Xpert, XTerm	Used by the the Xpert's web server and XTerm's proxy web server.

6.   XTERM OVER TCP/IP

XTerm can connect to an Xpert using TCP/IP, making for a very fast connection, as compared to a serial connection. Of course, many Xpert's in the field are not connected to a network. Even so, you can still take advantage of this speedy connection using a crossover cable and the "Auto" mode as set in "LAN Settings". See "Direct Connection to a PC or Laptop" above, for more information on how to make this connection.

To connect using TCP/IP, if the IP address of the Xpert is known, simply enter it and a User Name and Password, if required, in the XTerm Communications connect dialog that appears after first starting XTerm (see below).
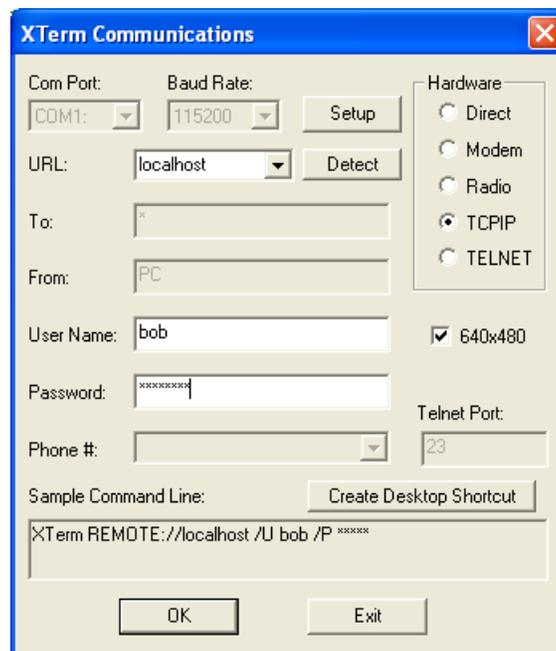
XTerm Connect Dialog

6.1   Detecting Xperts with XTerm

If the IP address of the Xpert is unknown, you can press the "Detect" button to have XTerm attempt to detect any Xpert's on the network. Only Xpert's having firmware version 3.2 or greater can be detected. After pressing the Detect button, you'll see the following dialog:
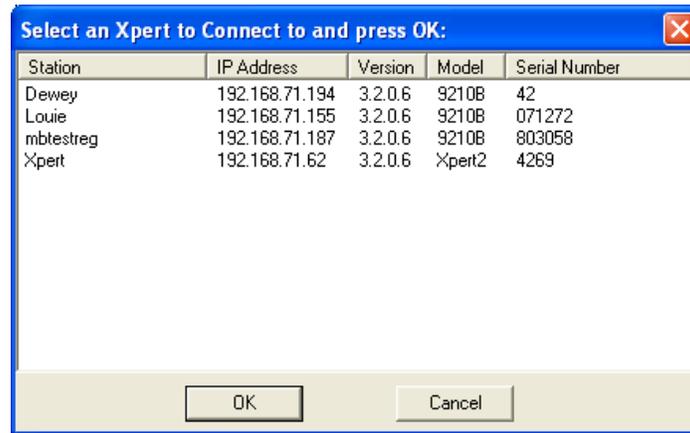
List of Xpert's found after pressing Detect button

To connect to one of the stations found during the detect process, simply select the Xpert in the list and press OK.

Refer to the section, "Firewalls", for information on how to ensure your firewall allows detect operations.

6.2 Using XTerm as a Proxy

A lesser known feature of XTerm is its ability to serve as a network proxy for connection to a non-networked Xpert. To make this proxy connection, start the XTerm to serve as a proxy on a PC or laptop that is connected to the network. Then open a connection in the proxy XTerm to the Xpert. Then connect the remote XTerm via a TCP/IP connection to the IP address of the proxy machine. At this point, the remote XTerm is connected to the Xpert via proxy.

Refer to the section, "Firewalls", for information on how to ensure your firewall allows proxy operations.

6.3 Upgrading Over TCP/IP

The Xpert firmware can be upgraded much more quickly when TCP/IP is used to perform the image transfers. However, since upgrading Xpert firmware involves the use of the command line during system boot, you cannot upgrade an Xpert using a TCP/IP connection alone. Instead, you must use a Direct connect, but specify the /LAN switch to enable TCP/IP support.

The best way to achieve this kind of connection is to create a shortcut with the required settings. To do so, start XTerm and configure the connection properties as you would to connect serially, and then press the "Create Desktop Shortcut" button. Then edit the shortcut created, adding the text "/LAN" to it. Hence, if the shortcut were originally "XTerm COM1:115200 /U M", it would be "XTerm COM1:115200 /U M /LAN" after your edit. Start XTerm using the shortcut.

Once XTerm is connected with the /LAN switch active, you initiate a firmware upgrade the same as any other upgrade, i.e., by pressing the "Upgrade" button on the right pane of the XTerm window. The upgrade will occur much more quickly since most operations occur over TCP/IP, as opposed to the serial port.

Note: make sure the LAN Configuration setting in LAN Settings on the Setup tab of the Xpert software is set to either "On" or "Auto" before attempting to upgrade in this way.

7. TELNET (COMMAND LINE OVER TCP/IP)

The Xpert supports telnet connections, allowing a terminal program like HyperTerminal to connect to an Xpert over TCP/IP and provide access to command line functions, including downloading the log, setting system time, etc.

The Xpert listens for telnet connections on port 23. To open a telnet session using HyperTerminal, start HyperTerminal and set the properties of the session to connect to the IP address of the target Xpert, using Port number 23. See the picture below for an example.
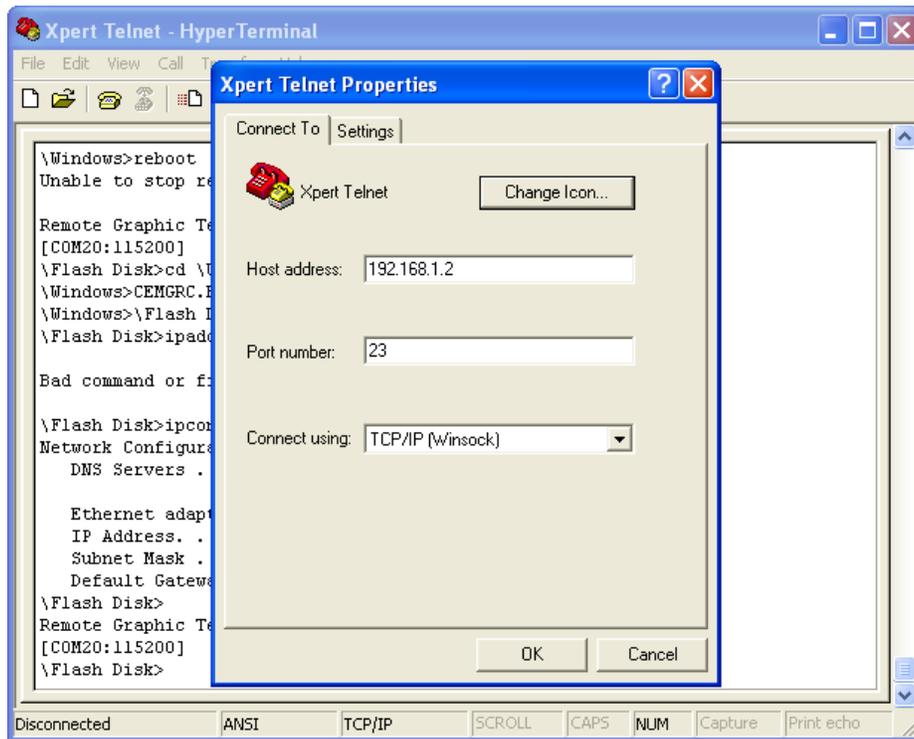

HyperTerminal's connection properties dialog. Note port 23 for telnet.

Once you have made a telnet connection to the Xpert, you will see the "\Flash Disk>" prompt, and you can interact with the unit in the same way you would if you were connected serially to COM1. See the Xpert or 9210 user manual's "Appendix G: Autoexec.bat and Remote.exe" for more information on using the Xpert command line.
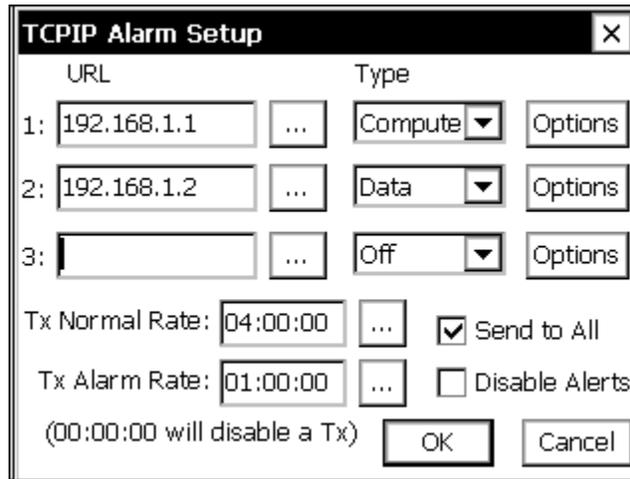
8. NORMAL AND ALARM REPORTING OVER TCP/IP

The Xpert can be configured to report tagged data over TCP/IP to a remote host, at "normal" and "alarm" intervals. "Tagged data" means all "ComsTag" blocks entered in the graphical setup, all sensors created in EzSetup that have the "COM: TAG" checkbox checked, and any Tags created in a basic program on the Flash Disk. The report can be formatted for SSP (Sutron Standard Protocol) or text, and can therefore be consumed by both computers that know how to read and interpret SSP, and by humans. The "normal" reporting rate is the rate at which the report would be sent when the system is not in alarm. The "alarm" rate is the rate at which the report is sent when the system is in alarm.

The reporting intervals and other properties are setup in the Coms control panel entry on the Setup tab. Select the "Coms" entry and press the "Edit…" button. Then press the "TCPIP" button on the Com Port Setup dialog.
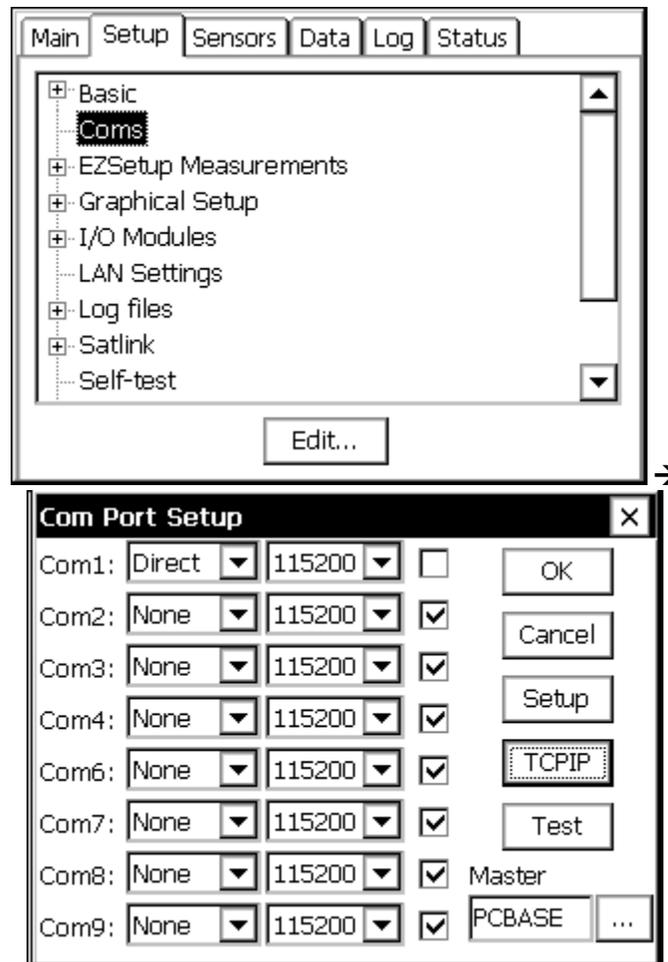
The Xpert setup tab showing the Coms entry, and the Com Port Setup dialog

Pressing the "TCPIP" button on the "Com Port Setup" dialog brings up the following "TCPIP Alarm Setup" dialog:

The TCPIP Alarm Setup dialog, showing the Normal and Alarm TCPIP reporting properties

TCPIP alarm reporting was introduced in Xpert firmware version 3.2. The TCPIP Alarm Setup dialog allows alert and/or alarm messages to be configured to be sent to a base station over the LAN connection. Each specified URL is attempted in order (1 then 2, then 3) until the message has been successfully delivered, unless Send to All is enabled, in which case the message is sent to all URLs, regardless of the success of the delivery. As long as alerts are not disabled, when an alert occurs, TCPIP delivery will be attempted first before other communication methods.

The properties in this dialog are defined in the following table:

URL	Machine name or IP address to send a message to. Leaving an entry blank will cause it to be skipped. Typically, this machine will be running a session of XConnect, AutoPoll, or HyperTerminal, in order to receive and process the TCPIP reports.
Type	The type of message to send. When the type is "SSP", an SSP message is sent, and the Xpert waits for an acknowledgement to be received to confirm reception. When the type is "Computer", a text message is sent, followed by a prompt to press ENTER to confirm reception. When the type is "Data", a text message is sent, but the Xpert does not wait for a confirmation, and instead assumes the message was delivered successfully, as long as the TCP/IP stack does not report an error making the connection and sending the message.
Tx Normal Rate	Defines the interval at which a message will be sent when the system is in the NORMAL state (entering 00:00:00 will disable reporting at the normal rate).
Tx Alarm Rate	Defines the interval at which a message will be sent when the system is in the ALARM state (entering 00:00:00 will disable reporting at the alarm rate).
Send to All	If checked, messages are sent to all defined URLs. If left unchecked, then each URL is tried in order until a message has been delivered.
Disable Alerts	If checked, alert messages are disabled (not sent). Note that this does not disable reporting on the normal and/or alarm intervals, just the alert message that would otherwise be sent on transition into, or out of, the alarm state.

Pressing the "Options" button next to any of the URL entries brings up a dialog used to configure more

11

details of the connection to be made:
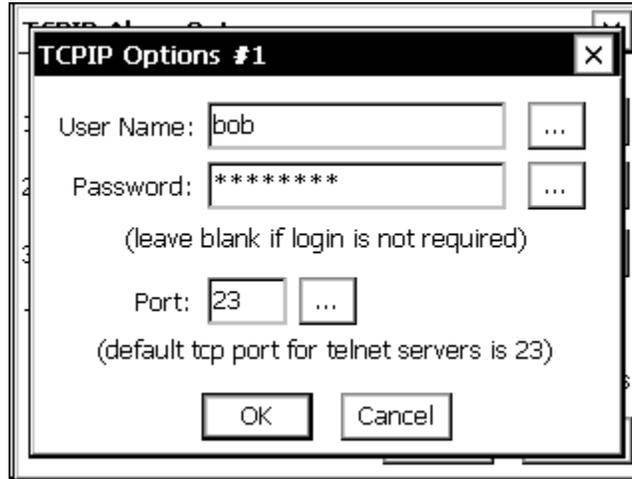
The TCPIP Options dialog

The TCPIP Options dialog is used to configure the connection properties for one of the URLs in the TCPIP Alarm Setup. The properties of the dialog are defined in the following table:

User Name	SSP alarms may require a user name in order to login to the server before the alarm message can be sent. Leave it blank if login is not required.
Password	SSP alarms may require a password in order to login to the server before the alarm message can be sent. Leave it blank if a password is not required.
Port	The messages are sent using TCP socket communications with auto-detection of the Telnet protocol. The standard port for a telnet server (including the Xpert's) is 23, but on a base station that port may not be available (or desirable).

8.1   Using AutoPoll to Receive TCPIP Reports

AutoPoll is a program for the PC developed by Sutron that can be used to receive and store TCPIP Data reports from Xperts in the field. "Data" reports are textual reports made without expectation of a response. AutoPoll simply collects these reports and stores them in a file you specify in the AutoPoll setup. An example AutoPoll setup is shown below. Note the IP address and port properties. They specify the IP address and port of the Xpert.
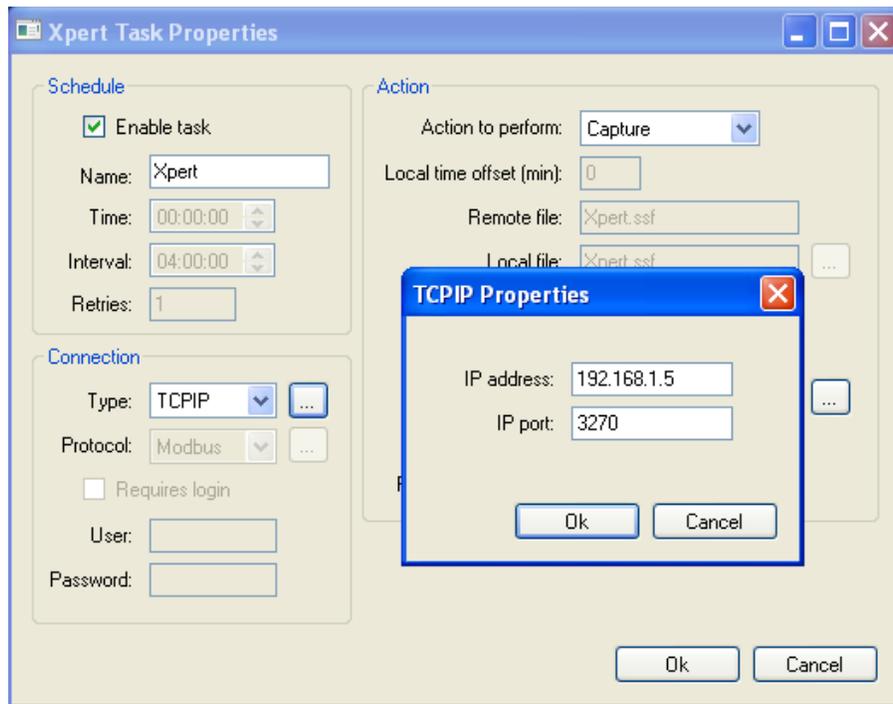
**An example AutoPoll setup used to receive and store TCPIP reports from an Xpert.**

A free-trial version of AutoPoll can be downloaded from here:
http://www.sutron.com/products/AUTOPOLL_SOFTware.htm.

9. XPERT TO XPERT TCP/IP COMMUNICATIONS

Xpert's can exchange tagged data using the GetTag and SendTag blocks in the graphical setup ("tagged data" means all "ComsTag" blocks entered in the graphical setup, all sensors created in EzSetup that have the "COM: TAG" checkbox checked, and any Tags created in a basic program on the Flash Disk). In addition, one Xpert can set the time in another unit using a SendTime block in the graphical setup. All of these transactions can occur over TCP/IP.

A GetTag block gets the value of a tag defined in another Xpert. The Tag Properties dialog (below) is used to define from whom the tag should be retrieved. Set "Port" to TCP/IP, and enter the target Xpert's IP address in the Path/URL text box. Enter the name of the tag to be retrieved in the "Tag" text box. Press the "Options" button to enter the IP Port number used by the target Xpert (typically 23, the standard telnet port). You can also enter login information (user name and password) into the Options dialog, if the target Xpert requires a user login.
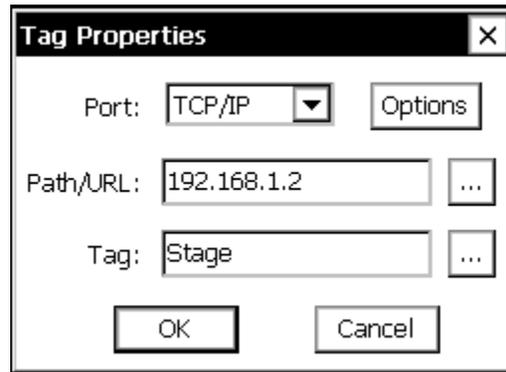
Properties dialog for the GetTag and SendTag blocks

A SendTag block sets the value of a tag defined in another Xpert. The same Tag Properties dialog is used as that for GetTag (see above), and the same properties should be defined.

For GetTag and SendTag operations, the target Xpert must be on the network, ready to communicate over TCP/IP, and must have a ComsTag (or basic tag) defined having the name given in the "Tag" text box.

A SendTime block sets the system time of a remote/target Xpert to the system time of the Xpert that defines the block.
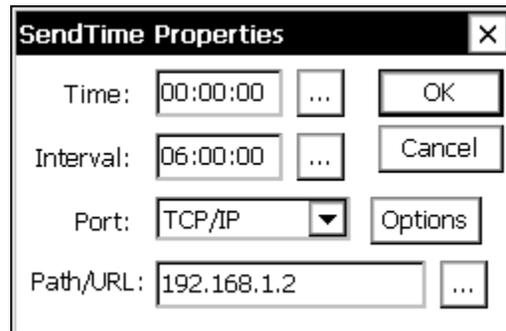


SendTime Properties dialog

To use the block to set the time in another Xpert, set the "Port" to TCP/IP and set the Path/URL to the IP address of the target Xpert. Set the IP Port number, and user login information, if required, in "Options". The target Xpert requires no configuration other than being on the network, ready to communicate over TCP/IP.

10. WEB SERVER

The Xpert can be configured to serve-up web pages over TCP/IP using the HTTP protocol. You can display current data on this web page, or customize it to display other information, as well.

The simplest way to display current data on a web page is to add WebLog blocks to the graphical setup, anywhere you want to establish a data point to display. When WebLog blocks are defined, you simply connect to the Xpert using your favorite browser, and the browser will display the current values of the WebLog blocks. The values are updated every 10 seconds.

The picture below shows an example where a browser is connected to "http://192.168.71.62", which defines 2 WebLog values, "Stage" and "RawTips", whose values are currently 42.00 and 69.00, respectively.
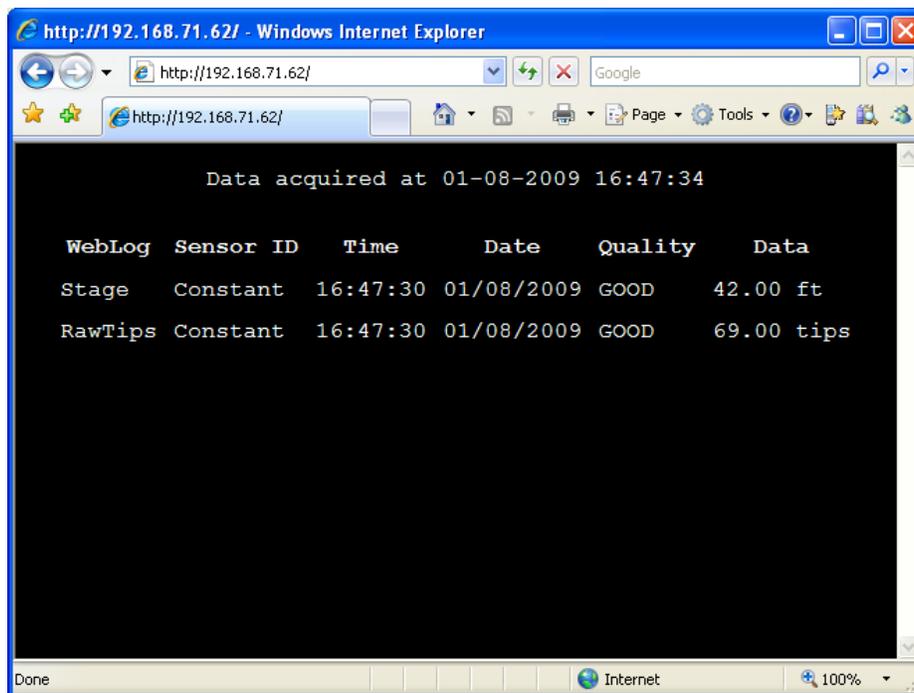
**Browser connected to Xpert showing WebLog block values**

You can override the display of web server values, and have the Xpert display your own custom web page stored on the Xpert's Flash Disk. To do this, create your web-page with the name index.html, and put it in a subdirectory off of "Flash Disk" named "Web" (i.e., "\Flash Disk\Web\Index.html"). You can still display the WebLog values in this case by adding a link in Index.html to the virtual "WebLog" page (i.e., <a href="WebLog">).

11. MODBUSTCP

The Xpert supports the ModbusTcp protocol, which is a version of the Modbus protocol, adapted for TCP/IP networks. The Xpert supports both Master and Slave modes over ModbusTcp.
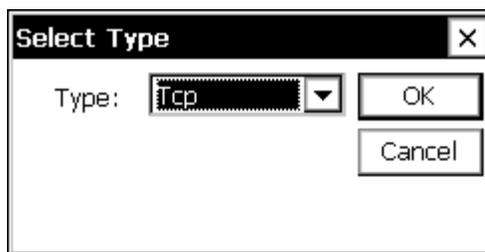
11.1 ModbusTcp Slave

To setup a ModbusTcp Slave, highlight the "Modbus Slaves" entry on the Setup tab and press "New".
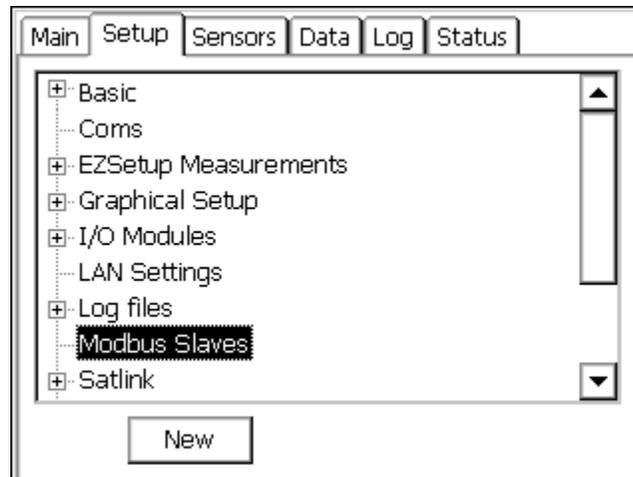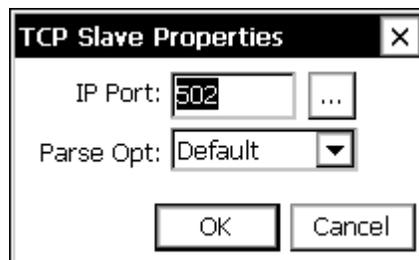

Setup Tab showing Modbus Slaves entry

The next dialog will prompt for the kind of slave to create, either "Serial" or "TCP". Select "TCP" and press OK.

Select "TCP" in Select Type dialog

After selecting the "TCP" slave type, the Xpert prompts for the IP port and parser type to use.
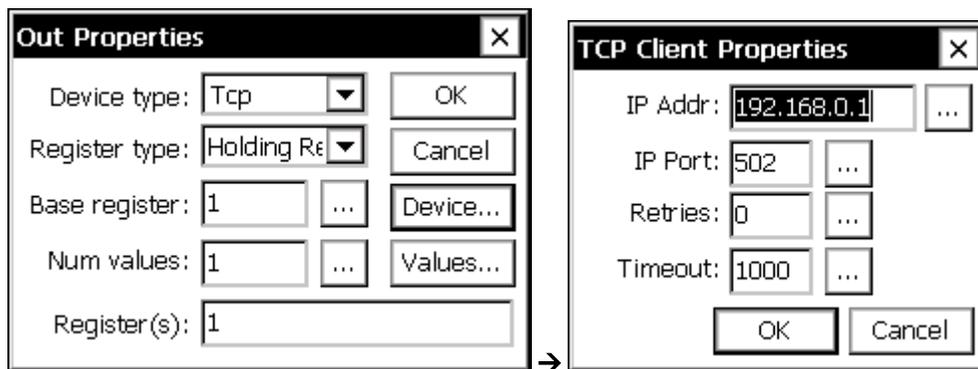

TCP Slave Properties dialog

The IP Port is the port on which to listen for ModbusTcp master commands. The Parse Opt selection should be left at "Default", unless you have defined a custom parser using the Xpert SDK (software development kit).

Pressing OK in the TCP Slave Properties dialog completes the creation of a ModbusTcp slave. The slave starts listening for messages from a Modbus master, and processes them as they come in.

11.2 ModbusTcp Master

The Xpert MBOut and MBSensor blocks in the graphical setup can act as ModbusTcp masters when performing their functions. The MBOut block writes registers in a Modbus slave, while the MBSensor block reads registers from a Modbus slave.

The following dialogs are used to configure MBOut block:

The MBOut dialog and the TCP Client Properties dialog obtained by pressing "Device…"

To create a ModbusTcp master with the MBOut block, set "Device type" to "Tcp", press the "Device…" button, and set the IP address and port of the target Xpert.

The MBSensor block is configured in much the same way. See the Xpert user manual for more information on how to setup the MBOut and MBSensor blocks.

12. XCONNECT TCP/IP

XConnect can connect to the Xpert using TCP/IP. (Also see XConnect documentation.)

Overview

XConnect was designed by Sutron to provide a complete solution for data collection, data processing, data viewing, and data storing. It is compliant with 32-bit Windows operating systems and provides several tools and options for users.

There are several applications within XConnect to perform different operations. XC Setup and XC Desktop are used for system setup and configuration of XConnect, such as conventional system or satellite system, communication facilities, data storage, data poll schedule, site and sensor setup, etc.

For conventional system, XC Rtu is used to retrieve data from a field site via SSP protocol with direct, radio, modem, and TCP/IP, to process data thru SSP decoder based on the configuration of each sensor and each site, and to store the data into the data storage such as a database. For satellite system, XC Mux, XC DAPS, XC DDS, and XC Decode are used to perform the data retrieval, data processing, and data storing processes.

XC RTDisplay, XC DataView, and XC Reports perform the data display from either the real-time data or

the database.

XC Calc, XC PostProc, and XC Export are used to perform the pre-calculation and post-calculation against the data, and also to export the SHEF format data.

12.1 Using TCP/IP in XConnect

This application note discusses how to use TCP/IP with XConnect and Xpert2/9210B. Although basic network functionality started from the Xpert firmware version 3.0, the most of capabilities were available from Xpert firmware version 3.2 or above.
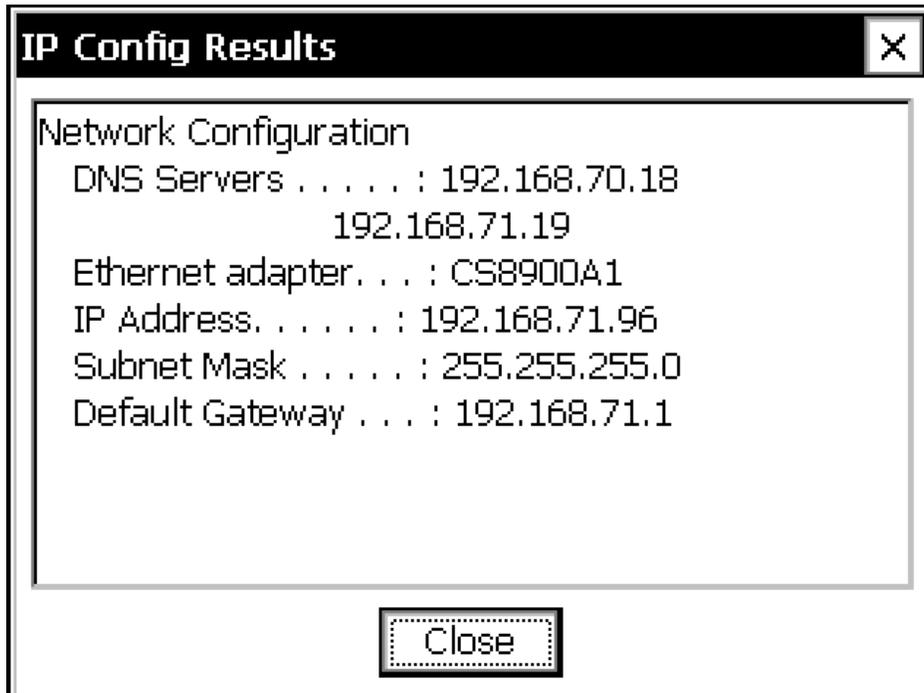
12.2 Configuration on 9210B Datalogger
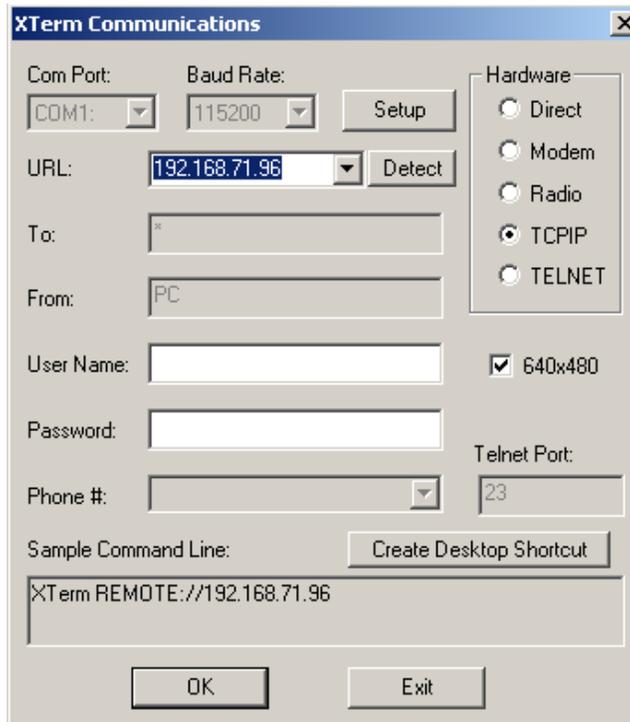
For version 3.2 or above of Xpert Data Logger

▸ Connect the data logger and your PC via a router with Ethernet cable. If you don't have a router, you can use a special Ethernet cable, a crossover cable, to directly connect the data logger to your PC.

▸ Connect to Xpert (the data logger) using Xterm over serial connection by choosing a certain COM port and Direct.

▸ Click on Setup Access button for station setup, go to Setup tab with highlighting LAN Settings, and then click Edit button.

▸ Once LAN Setting screen appears, user would see the LAN Configuration is Off.
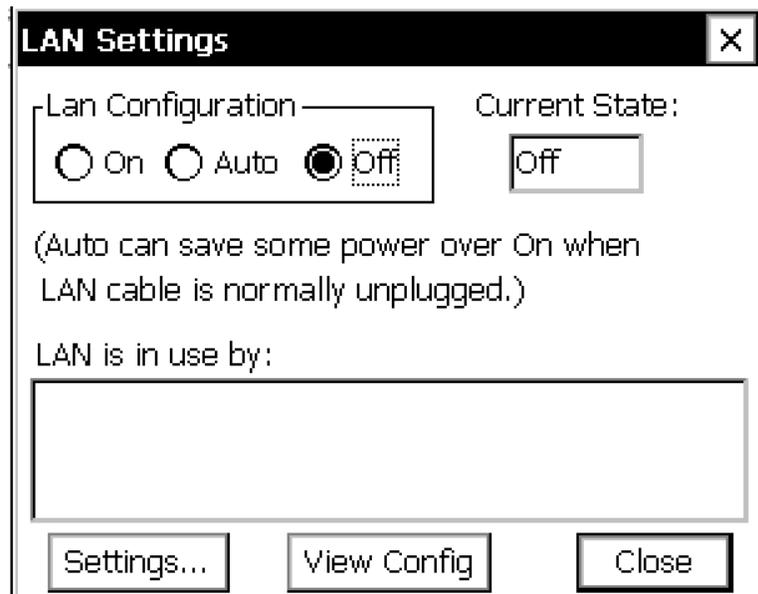
▸ By clicking on Settings button, you can use the Network Wizard to setup the TCP/IP configuration automatically until complete entire TCP/IP settings.

▸ Once the Xpert has been rebooted, user should be able to view the LAN configuration by clicking on View Config button after redoing (3) and (4).

▸ Remember the Xpert IP address (as the example here, it is 192.168.71.96) and make sure your PC IP address has the same first three numbers (i.e. 192.168.71) in order to communicate each other.

IP Config Results   ✕

Network Configuration
    DNS Servers . . . . . : 192.168.70.18
                    192.168.71.19
    Ethernet adapter. . . : CS8900A1
    IP Address. . . . . . : 192.168.71.96
    Subnet Mask . . . . . : 255.255.255.0
    Default Gateway . . . : 192.168.71.1

                    Close

▶ After that, you can close the IP Config Results window and the LAN Settings window, and then disconnect the Xterm from the Xpert via serial connection.

▶ To test TCP/IP communication from the Xterm, enter IP address into URL (192.168.71.96), select TCPIP, and then click OK.

XTerm Communications   ✕

Com Port: Baud Rate: Hardware
 COM1: ▼   115200 ▼   Setup   ○ Direct
                                                 ○ Modem
URL: 192.168.71.96   ▼   Detect   ○ Radio
                                                 ● TCPIP
To: *   ○ TELNET

From: PC

User Name: [   ]   ☑ 640x480

Password: [   ]

                                  Telnet Port:
Phone #:   [▼]   23

Sample Command Line: Create Desktop Shortcut
XTerm REMOTE://192.168.71.96

              OK   Exit

For the version below 3.2.x.x of Xpert

▸ Connect to Xpert using Xterm over serial connection.

▸ Exit Xpert app, if running, from status tab.

▸ Click in lower left of screen to bring up the Start bar.

▸ Click Start button, and navigate to "Network and Dial-up Connections".

▸ Highlight CS8900A1 and click properties button in toolbar.

▸ Select "Specify an IP address" radio button.

▸ Enter "IP Address" and "Subnet Mask" (192.168.1.1 and 255.255.255.0, should do, respectively). Leave "Default Gateway" blank. Press Ok. Make sure CS8900A1 is still highlighted. Right click your mouse button to enable it and press the refresh toolbar button a few times until the connection shows active (i.e., there's no X on the CS8900A1 icon).

▸ Configure your PC to have a static IP in similar fashion as the Xpert. Use a different IP address (e.g., 192.168.1.2).

▸ Connect Xpert and PC using an Ethernet crossover cable (this is a special kind of cable, not just a standard patch cable, and is readily available from Best Buy, etc.).

▸ Reconnect Xterm to Xpert, this time using "TCPIP" connection type, with URL field set to 192.168.1.1.

12.3 Configuration on XConnect

▸ From XC Desktop, right click on Communication Ports and check on New/Add from the dropdown menu to add a new communication component.
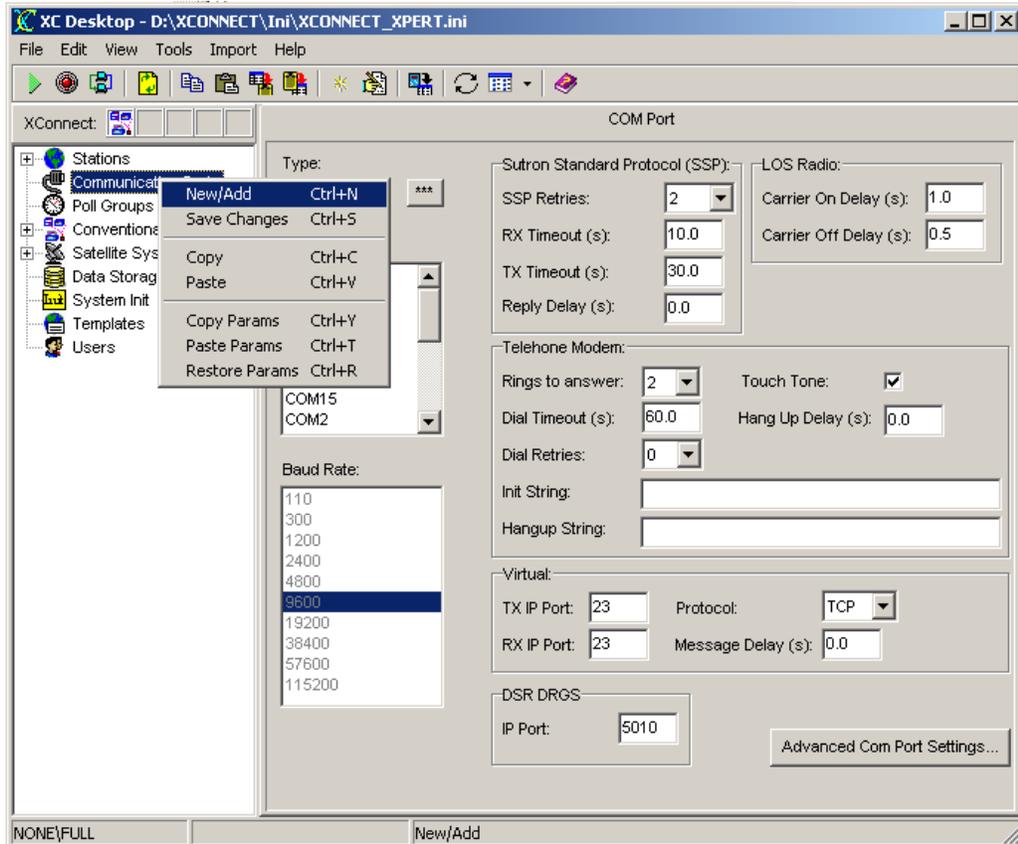
▸ From the Create New COM Port screen, select Virtual as COM Type and click OK button.
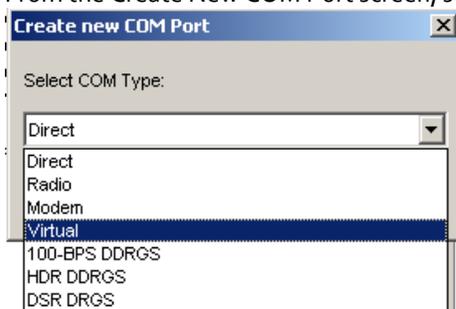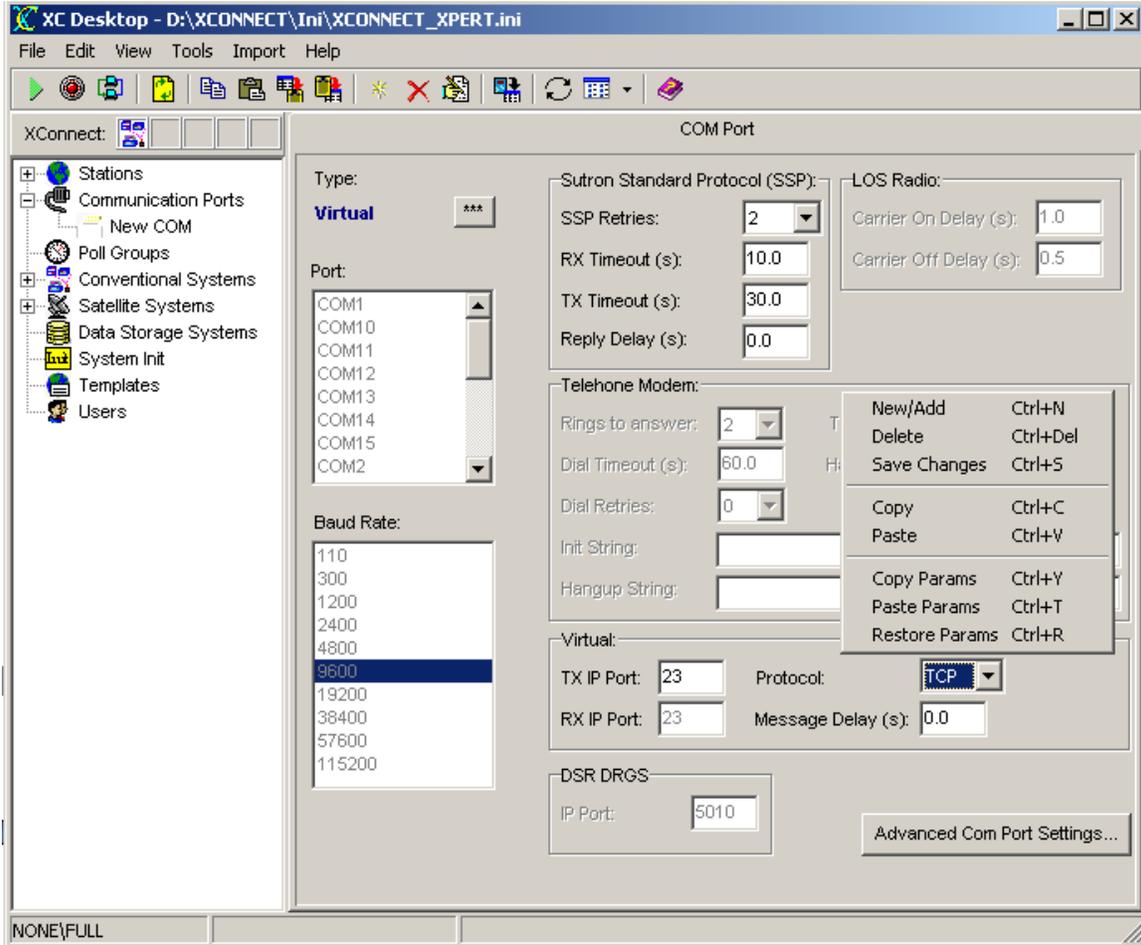

▸ Click OK button again when you see the screen.

▸ After then, enter 23 into TX and RX IP Port, select Protocol as TCP, and then save

changes by right clicking the mouse button.

****Note:

1. The Port Number has to be entered or modified under UDP protocol for the current version of XConnect;

2. 23 is the only port number for using TCP with Xpert 3.0 or above.

▸ From XC Desktop, select the station with using TCP/IP, chose the Connection Port as 23 for Primary Station Connection Parameters, enter the IP address for the station which is, as the example above, 192.168.71.96, and then save the configuration.
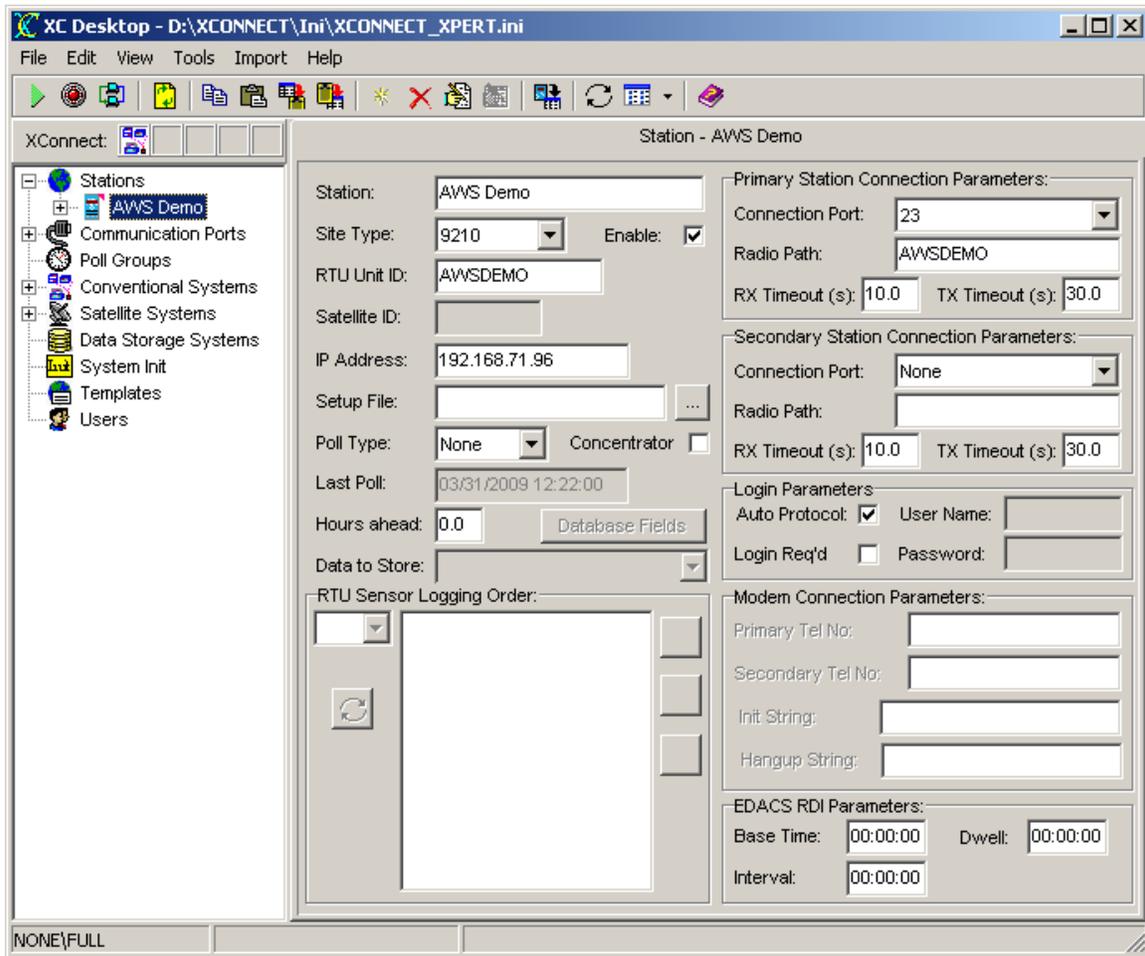
▶ Now you should be able to retrieve the data from XC Rtu.