NL100/105 NETWORK LINK INTERFACE
INSTRUCTION MANUAL

REVISION: 4/03

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NL100/105 Network Link Interface

1. Introduction

The NL100 and NL105 Network Link Interfaces are devices used to communicate with Campbell Scientific dataloggers using an Ethernet 10 Base-T communications link. The NL100 includes a CS I/O port (see Appendix A) and an RS-232 port for communication; the NL105 adds a TLink interface for communication with a CR9000(C) system. An RS485 port is also available on the NL100/105; however, this is reserved for future use. No dataloggers or datalogger interfaces are capable of RS485 communication at this time.

The NL100/105 can be configured to act as a Serial Server in a standard TCP/IP network, to act as a PakBus node in a PakBus network, or to transfer MODBUS/TCP packets. All of the available settings are described in Section 2.3. However, not all settings are required for all configurations. This manual will focus mainly on setting up the NL100/105 for a standard TCP/IP network. For PakBus and MODBUS configurations, please contact Campbell Scientific for applications notes or other information that may be available.

Campbell Scientific's LoggerNet software is used to communicate with the dataloggers once the NL100/105 is configured properly and connected to a network (refer to Section 2.). Communication with CSI's array-based dataloggers (CR10X, CR510, CR23X, CR7, and 21X) and table-based dataloggers (CR10X-TD, CR510-TD, CR23X-TD, CR5000, and CR9000) requires LoggerNet version 2.0 or greater. Communication with PakBus dataloggers (CR10XTD-PB, CR510TD-PB, CR23XTD-PB, and CR200) requires LoggerNet 2.1 or greater. PC208W version 3.2 or higher may also be used with array-based dataloggers (CR10X, CR510, CR23X, CR7, 21X). PC9000 may also be used for CR9000 and CR5000 dataloggers.

1.1 Physical Description of the NL100/105

The NL100/105 is housed in a rectangular case with all power and communication connections on one edge. On the opposite outside edge are tabs for mounting the NL100/105 in an enclosure. Figure 1 below shows the position of these connections and the mounting tabs.

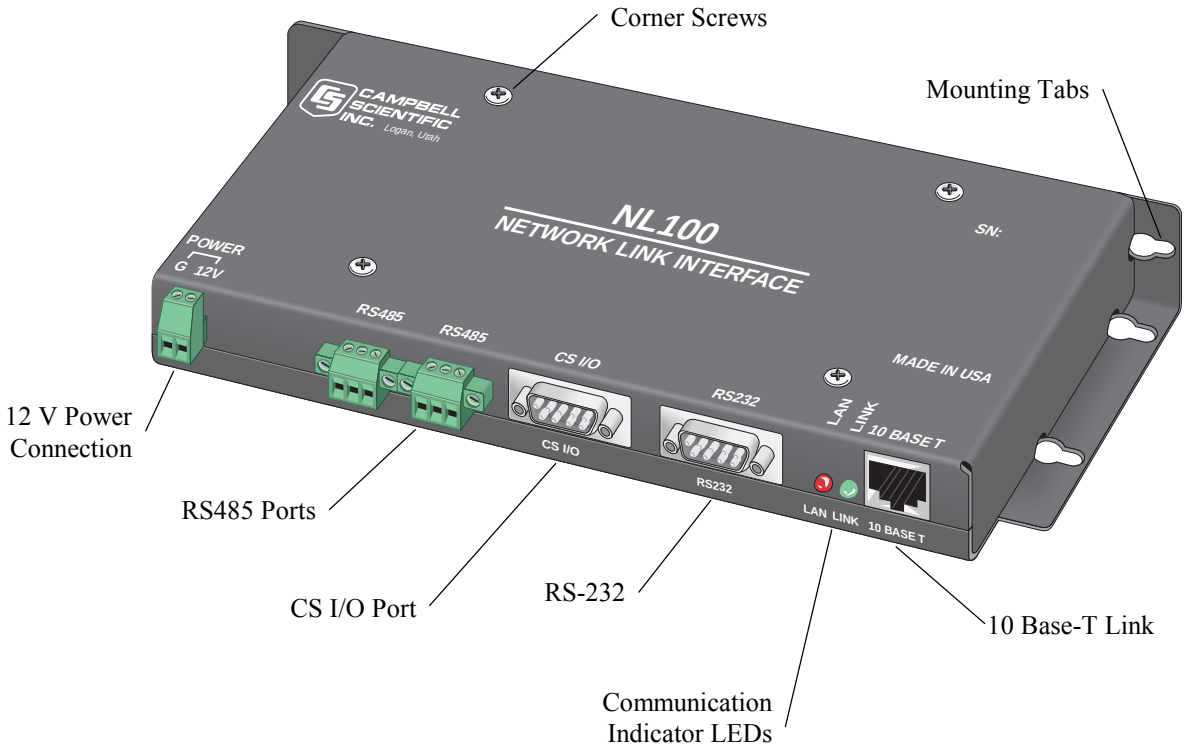

FIGURE 1. NL100/105

1.2 Specifications

Standards

Ethernet Standard IEEE 802.3 (CSMA/CD Access Method)
TCP/IP Protocol

Case Dimensions

9 ¼" x 4 ¼" x 1"

Environment

Temperature: -25 to +50 °C

Power Supply Requirements

The NL100/105 is powered via the green G 12V connector (11 to 16 VDC at 140 mA average current) on the front panel of the unit.

Cable Specifications

The Ethernet 10 Base-T cable should be a Category 5 twisted pair cable. The two active pairs in an Ethernet 10 Base-T network are pins 1 & 2 and pins 3 & 6. Use only dedicated wire pairs (such as blue/white & white/blue, orange/white & white/orange) for the active pairs.

RJ-45 Pin-Outs: Pin 1 = TD+, Pin 2 = TD-, Pin 3 = RD+, Pin 6 = RD-

The RS-232 should be a standard straight through cable. It is recommended that the cable be kept at lengths of ≤ 6 feet to maintain high data throughput rates.

The CS I/O 9 Pin cable is a straight through cable with all 9 pins connected. Campbell Scientific's SC12 cable is recommended.

Compliance

The NL100/105 is encased in metal and meets requirements for a Class A device under European standards:

APPLICATION OF COUNCIL DIRECTIVE(S)
89/336/EEC as amended by 89/336/EEC and 93/68/EEC.

STANDARD(S) TO WHICH CONFORMITY IS DECLARED:
ENC55022-1; 1995 AND ENC 50082-1: 1992

EUROPEAN REGULATIONS
WARNING: This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to correct the interference at the user's expense.

2. Setting up the NL100/105 for Communication

The NL100/105 must be set up by configuring one or more of the communications ports for communication with your datalogger or other devices in the network. To do this, you must establish a direct communication link with the NL100/105 using a PC computer. You will need a null modem cable between the computer and the NL100/105 and a terminal communication software package (such as HyperTerminal, which ships with Microsoft Windows operating system software).

2.1 Computer to NL100/105 Physical Connection

An RS-232 null-modem cable is required to establish communication between the NL100/105 and your computer. One end of the cable is connected to the computer's 9-pin RS-232 communications port and the other end is connected to the RS-232 port of the NL100/105. If the null-modem cable does not have a female connector on both ends, you may also need a female-to-female adapter. For additional information on null-modem cables, refer to Appendix B.

The NL100/105 requires 12 VDC for operation. This power source can be supplied by the datalogger's 12 V supply or by a regulated external power source. When connecting the power leads, the ground lead should be connected first and then the 12 V lead.

2.2 Communication with the NL100/105

2.2.1 Establishing the Initial Communication

Once the physical connection has been made, communication should be established with the NL100/105 using a terminal communications package. The steps below demonstrate configuring the NL100/105 using HyperTerminal, which is shipped with Windows operating systems.

NOTE The NL100/105 is shipped from the factory with its RS-232 port set in the ConfMon mode (configuration monitor). Refer to Section 2.2.2 if the RS-232 port has been set to some other configuration and direct communication is necessary.

Ensure the NL100/105 has an appropriate power source applied. (Refer to Section 2.1, above.)

Create a new connection in HyperTerminal. Choose the COM port to which the null-modem cable is connected, and set the baud rate to 115,200 bps. Most of the other settings can be left at the default (data bits = 8, parity = none, stop bits = 1). Flow control should be set to none.

Once HyperTerminal indicates you are connected, press <Enter> a couple of times to gain the attention of the NL100/105. When communication is established, the current port settings will be returned, followed by the NL100/105 prompt line:

```
NL100/105 (ver, show, edit, defaults, reset, help, bye):
```

To set up the NL100/105 for communication with the network, go into the Edit menu (Section 2.3.3 Edit) and complete the appropriate information. Note that the Ethernet 10 Base-T connection must be configured (Section 2.3.3.5) and at least one of the other port options.

2.2.2 Establishing Communication Outside of ConfMon Mode

If the RS-232 port has been disabled or set to some configuration other than ConfMon, communication can still be established with the NL100/105 by connecting the boot jumper.

To access the boot jumper, remove the NL100/105's cover by removing the four screws at the corners.

The boot jumper is shown in Figure 2 below. The NL100/105 ships with this jumper connected to only one post. Place the jumper so that it connects the two posts.

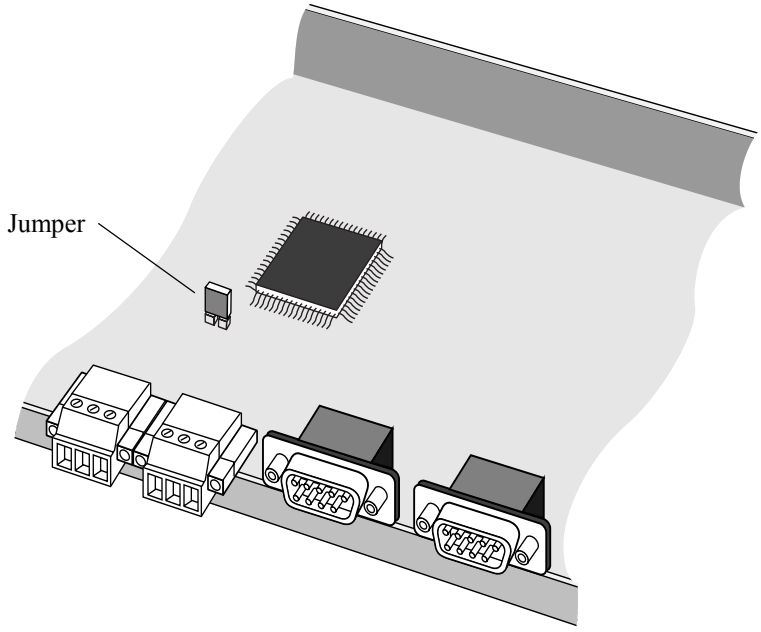

FIGURE 2. NL100/105 Jumper Placement

When the jumper is in place, open the HyperTerminal connection to the NL100/105 and power up the device. The prompt "NL100 boot" will appear. At this prompt, press <Enter> a few times to ring up the NL100/105. If communication is successfully established, a message will be returned indicating that the NL100/105 is initialized, along with the jumper setting (1 = on, 0 = off), the TCP/IP address, Telnet port address, and current communication configuration. If <Enter> is pressed again, the NL100/105 menu prompt will appear.

WARNING

After reconfiguring the NL100/105 for communication, the jumper should be disconnected. If this jumper remains in place and power to the NL100/105 is cycled off and back on, the NL100/105 will remain at the "NL100 boot" prompt and will not boot up. This will render the NL100/105 inaccessible via remote communications.

2.3 NL100/105 Menu Options

The NL100/105 prompt lists all of the available menu options. Only the first few characters of the main menu options need to be typed – the remaining characters will be completed automatically. Press <Enter> to execute the command. Each menu option is explained below.

2.3.1 Ver

Ver returns version information about the NL100/105. The ROM number, OS version, Ethernet physical address, and some diagnostic statistics are displayed.

Version information may be requested by a Campbell Scientific Applications Engineer when troubleshooting a communication problem.

NOTE The Ethernet physical address that is displayed is a hexadecimal representation of the address assigned to this device. An Ethernet address is unique to the specific device to which it is assigned. This assignment is made at the factory and cannot be changed by the user. The Ethernet physical address is not the same as the TCP/IP address.

2.3.2 Show

The Show command displays the current settings for the NL100/105 ports, the user password, and watchdog time-out.

2.3.3 Edit

The Edit menu option is used to set up the communications link for the NL100/105. You should work closely with your network administrator to determine the correct settings for your specific network.

You can progress through the menu options by pressing <Enter>. If you make a mistake after entering a setting, press the up cursor arrow on your keyboard to return to the previous setting. All available selections will be listed on the prompt line enclosed in parenthesis, with the current setting displayed in brackets at the end of the selections (e.g., [disabled]). Help for a setting can be displayed by pressing F1 or the ? key.

Once changes have been made and you have come to the end of the prompts for the communication options, you can choose "save" to put the new settings into effect or "cancel" to disregard the changes and keep the current settings.

2.3.3.1 TLink Config

This setting is applicable to the NL105 only, and is used when communicating with a CR9000 datalogger. TLink is an interface used to communicate with a CR9000 datalogger over an Ethernet connection. A physical connection is made between the TLink port on the CR9000's 9031 CPU module and the port marked TLink on the NL105. TLink Config is used to set the TLink communications port to one of three options:

TcpSer - The NL105 acts as a serial server for the TLink port. A serial server is a device that allows serial communication over a TCP/IP communications link. When configured as a serial server, there is one parameter to set:

> TLink Serial Server Port Number - Enter the port number, in the range of 3000 to 65000, that will be used for TLink communication. The default port number is 6781.

232-Bridge - The NL105 transparently passes data between the TLink port and its RS-232 ports. The 232-Bridge configuration has only one setting, RS-232 bps. This is the bits per second (bps) at which the NL105 will communicate

with the device connected to the RS-232 port. This is a fixed rate (i.e., it is not a maximum baud rate or an autobaud rate). The default is 115k bps.

Disabled - The TLink communications port is disabled.

2.3.3.2 RS485 Config

Currently there are no dataloggers with RS485 ports, or RS485 to RS-232 interfaces for a datalogger's CS I/O port. The RS485 communication option will be implemented in the future.

2.3.3.3 CS I/O Config

This option is used to configure the NL100/105's CS I/O port. The port can be configured for PakBus communication, as a TcpSer serial server, or as a PakSer serial server.

NOTE CR10X, CR510, CR23X, 21X, and CR7 dataloggers ship with an array-based operating system. Array-based dataloggers do not support the PakBus communications protocol. Therefore, you cannot communicate with them over a port configured for PakBus. However, the CR10X, CR510, and CR23X dataloggers can be special-ordered with a PakBus operating system. Check with your technical support representative for details.

PakBus - This option is only used when setting up the NL100/105 to communicate with other PakBus devices in the network. Packets transferred over the CS I/O port in this mode are framed as PakBus packets; therefore, any device attached to the port must be capable of PakBus communication. PakBus is a packet based communications protocol developed by CSI. One of the advantages of PakBus is that other communications protocol packets, such as TCP/IP or MODBUS, can be "wrapped" in a PakBus packet and transferred among PakBus devices in the network, thus allowing various communication protocols within one network. When configured for PakBus, the NL100/105's CS I/O port has the following settings:

CS I/O SdcAddr/bps - This option is used to set up the CS I/O port to communicate with the datalogger as an addressable SDC device or a modem enabled device. If SDC7 or SDC8 is chosen, the NL100/105 will use that address to communicate with the datalogger in a synchronous communication mode. If one of the baud rates is chosen, the NL100/105 will communicate with the datalogger as a modem enabled device using the selected baud rate. If another SDC device is connected to the NL100/105, the two devices must use different SDC addresses.

CS I/O Beacon Interval - The NL100/105 can be set to transmit a beacon to a PakBus network via the selected port. The beacon allows the NL100/105 to determine which devices in the PakBus network it can communicate with. Note that because a beacon is broadcast to all devices, it can interfere with other communication in the network (such as RF), so a frequent beacon may not be desirable. If 0 is entered, no beacon will be sent; the default beacon is 60 seconds.

TcpSer - This option configures the NL100 to act as a TCP/IP based serial server when communicating with the datalogger over its CS I/O port. This is the most common setup option for this port.

CS I/O SdcAddr/bps - This option is used to set up the CS I/O port to communicate with the datalogger as an addressable SDC device or a modem enabled device. If SDC7 or SDC8 is chosen, the NL100/105 will use that address to communicate with the datalogger in a synchronous communication mode. If one of the baud rates is chosen, the NL100/105 will communicate with the datalogger as a modem enabled device using the selected baud rate. Note that array-based dataloggers (CR10X, CR510, CR23X, 21X, CR7) can be configured only as modem enabled devices; e.g., they do not support communication using SDC7 or SDC8.

CS I/O serial server port number - Enter the port number, in the range of 1 to 65000, that will be used for communication. The default port number is 6783.

PakSer - The CS I/O port of the NL100/105 can be configured as a PakBus serial server. This sets up the device as a serial server. In this mode, PakBus framing is removed from the packet and routed via the CS I/O port. Typically, the attached device would be one that does not support PakBus communication (such as an array-based CR10X).

CS I/O SdcAddr/bps - This option is used to set up the CS I/O port to communicate with the datalogger as an addressable SDC device or a modem enabled device. If SDC7 or SDC8 is chosen, the NL100/105 will use that address to communicate with the datalogger in synchronous communication mode. If one of the baud rates is chosen, the NL100/105 will communicate with the datalogger as a modem enabled device using the selected baud rate.

CS I/O Serial Server AppId number - Enter the application ID, in the range of 1 to 65000, that will be used to identify the PakSer in the network. The default ID is 6783.

NOTE The usual AppId for MODBUS devices is 501.

2.3.3.4 RS-232 Config

This option configures the NL100/105's RS-232 port for communication. The port can be set up to communicate with a datalogger or other communications device (short haul modem, RF modem, phone modem), or to be connected to directly and configured for communication. The setup options for the port are PakBus, TcpSer serial server, PakSer PakBus serial server, or ConfMon (configuration monitor).

NOTE CR10X, CR510, CR23X, 21X, and CR7 dataloggers ship with an array-based operating system. Array-based dataloggers do not support the PakBus communications protocol. Therefore, you cannot communicate with them over a port configured for PakBus. However, the CR10X, CR510, and CR23X dataloggers can be special-ordered with a PakBus operating system. Check with your technical support representative for details.

PakBus - This option is only used when setting up the NL100/105 to communicate with other PakBus devices in the network. Packets transferred over the RS-232 port in this mode are framed as PakBus packets; therefore, any device attached to the port must be capable of PakBus communication. PakBus is a packet based communications protocol developed by CSI. One of the advantages of PakBus is that other communications protocol packets, such as TCP/IP or MODBUS, can be "wrapped" in a PakBus packet and transferred among PakBus devices in the network, thus allowing various communication protocols within one network. When configured for PakBus, the NL100/105's RS-232 port has the following settings:

RS-232 bps - This is the bits per second (bps) at which the NL100/105 will communicate using the RS-232 port. This is a fixed rate (i.e., it is not a maximum baud rate or an autobaud rate). Note that the CR10XTD-PB and the CR510TD-PB can communicate at a maximum baud rate of 9600 bps, so to communicate with one of those dataloggers, this setting must be 9600 bps or less. The default rate is 115K bps.

PakBus Beacon Interval - The NL100/105 can be set to transmit a beacon to a PakBus network via the selected port. The beacon allows the NL100/105 to determine which devices in the PakBus network it can communicate with. Note that because a beacon is broadcast to all devices, it can interfere with other communication in the network (such as RF), so a frequent beacon may not be desirable. If 0 is entered, no beacon will be sent; the default beacon is 60 seconds.

TcpSer - This option configures the NL100 to act as a TCP/IP based serial server when communicating with a datalogger over its RS-232 port.

RS-232 bps - This is the bits per second (bps) at which the NL100/105 will communicate using the RS-232 port. This is a fixed rate (i.e., it is not a maximum baud rate or an autobaud rate). Note that the CR10(X) and the CR510 can communicate at a maximum baud rate of 9600 bps, so to communicate with one of those dataloggers, this setting must be 9600 bps or less. The default setting is 115K bps.

RS-232 serial server port number - Enter the port number, in the range of 1 to 65000, that will be used for communication. The default port number is 6784.

PakSer - The RS-232 port of the NL100/105 can be configured as a PakBus serial server. This sets up the device as a serial server. In this mode, PakBus framing is removed from the packet and routed via the RS-232 port. Typically, the attached device would be one that does not support PakBus communication (such as an array-based CR10X).

RS-232 bps - This is the bits per second (bps) at which the NL100/105 will communicate using the RS-232 port. This is a fixed rate (i.e., it is not a maximum baud rate or an autobaud rate). Note that the CR10(X) and the CR510 can communicate at a maximum baud rate of 9600 bps, so to communicate with one of those dataloggers, this setting must be 9600 bps or less. The default setting is 115K bps.

RS-232 Serial Server AppId number - Enter the application ID, in the range of 1 to 65000, that will be used to identify the PakSer in the network. The default ID is 6784.

NOTE The usual AppId for MODBUS devices is 501.

ConfMon - Configuring the RS-232 port as a ConfMon allows you to connect directly to the NL100/105 via a computer. There are no parameters; the baud rate is automatically set to 115,200 bps. Refer to Section 3.2.1 for additional information.

2.3.3.5 Ethernet 10 Base-T

The 10 Base-T communications link is used to connect the NL100/105 to a TCP/IP network using a Category 5 twisted pair cable. The Ethernet 10 Base-T link must be configured, or you will not be able to communicate with the NL100/105 over a TCP/IP connection. The following options must be configured. These values should be provided by your network administrator.

10BASE-T Port IP Address - This number is the address of the NL100/105 on a TCP/IP network. It is written as 32-bit number written in four 8-bit decimal-equivalent syllables separated by periods, in the format XXX.XXX.XXX.XXX. The IP Address must be a static IP Address -- the NL100/105 does not support DHCP (dynamic host configuration protocol).

10BASE-T Port Network Mask - The network mask is used to help a network router to more efficiently transfer information. Typically, a class C mask will be 255.255.255.0, a class B mask will be 255.255.0.0, and a Class A mask will be 255.0.0.0. The tighter the mask, the more the NL100/105 will rely on the default gateway to route packets.

If you enter Yes for "Is there a default gateway", you will also need to configure the following option:

IP Address of the Default Gateway - Enter the IP address of the device that is responsible for forwarding information to destinations outside the internal network, defined by the network mask.

2.3.3.6 PakBus Node ID

If the NL100/105 is to be used in a PakBus network, a PakBus Node ID must be assigned. If the NL100/105 will not be used in a PakBus network, this setting can be ignored. All devices in the network must have a unique PakBus Node ID. Valid IDs are 1 through 4094. The default ID is 678.

Clock Neighbor Node ID - In a PakBus network, a "neighbor" is another PakBus device that the NL100/105 can communicate with directly (e.g., it does not have to route data through another PakBus device to reach the neighbor). A neighbor can be designated for the NL100/105 as the device from which the NL100/105 will accept a clock set command. If this setting is enabled, once the NL100/105 has received a clock set from its designated neighbor, it will broadcast its clock information along with its beacon. Thus, the NL100/105 can be used to set the clock of other PakBus devices in the network. Set this ID to 0 to disable the function.

2.3.3.7 PakTcp Server Config

Enabling this option will set up the NL100/105 to act as a server in a PakBus network. The NL100/105 can support up to three concurrent connections. This option must be enabled when the NL100/105 uses an Ethernet connection to communicate with other PakBus devices in the network. The NL100/105 will listen for incoming TCP/IP packets on the socket designated by the PakTcp server port number setting. If the NL100/105 will not be used in a PakBus network, or if the PakBus communication among PakBus devices in the network will take place over a port other than the Ethernet connection, this setting can be disabled.

2.3.3.8 PakTcp Client Config

Enabling this option will set up the NL100/105 to act as a client in a PakBus network. In this mode, the NL100/105 will actively maintain a TCP/IP connection with a PakTcp server over the 10 Base-T connection. The Server IP address is the address of the server to which the NL100/105 will attempt to connect and act as a client. The Server IP port number is used to specify the port for that server. This setting is typically used when the NL100/105 is configured to communicate with another NL100/105 over an Ethernet connection, so that the two PakBus networks served by the NL100/105s can be merged. In most situations, this setting can be disabled.

2.3.3.9 MODBUS/TCP Gateway Config

When this setting is enabled, the NL100/105 will translate MODBUS/TCP packets that arrive on the 10 Base-T link for use in a PakBus network. The translation provided by this mode is MODBUS/TCP message format to MODBUS RTU serial message format. Unless you are setting up a PakBus network to also handle MODBUS communication packets, this setting can be disabled. Refer to Appendix I in the CR10X, CR510, and CR23X manuals for additional information on MODBUS.

2.3.3.10 Configuration Monitor Telnet Port

TCP/IP Telnet communications can be used to remotely connect to the NL100/105. The only option to configure is the port number, which is typically set to 23. Valid numbers can be 0 to 65,000.

2.3.3.11 Telnet Session Password

The Telnet Session Password is the string that must be entered to communicate with the NL100/105 over a Telnet session. The string can range from 1 to 20

alphanumeric characters and is case-sensitive. This security measure is implemented to help prevent unauthorized users from gaining access to the NL100/105 device.

2.3.3.12 Serial Server Watchdog

If no communication is detected for a specified number of minutes, the NL100/105 will drop the communications link. This feature is called a "watchdog". The watchdog alleviates the problem of a communications port being held open, thus rendering the device inaccessible, if the NL100/105 and the remote device failed to terminate the communications link in a "normal" manner. The number of minutes that the NL100/105 should wait for activity on a port before timing out is entered for this menu item. This setting affects all communication modes, including when the NL100/105 is configured as a PakBus based or TCP/IP based serial server, and when communicating with the NL100/105 during a Telnet session.

2.3.4 Defaults

The Defaults option displays the factory default settings for the different telecommunication options. Following the display is a prompt to Save or Cancel. If Save is selected, the NL100/105 will be reset to the factory defaults. If Cancel is chosen, the current settings will remain in effect and the user will be returned to the main menu prompt. The default settings are as follows:

TLink config: [disabled]

RS485 config: [PakBus]
    RS485 bps: [38k]
    RS485 beacon interval (sec): [60]

CS I/O config: [PakBus]
    CS I/O SdcAddr/bps: [SDC7]
    CS I/O beacon interval (sec): [60]

RS-232 config: [ConfMon]

EtherNet 10BASE-T: [enabled]
    10BASE-T port IP address: [0.0.0.0]
    10BASE-T port network mask: [255.255.0.0]
    Is there a default gateway: [no]

PakBus node Id: [678]
    Clock neighbor node Id: [0]

PakTcp server config: [enabled]
    PakTcp server port number: [6785]

PakTcp client config: [disabled]

MODBUS/TCP gateway config: [disabled]

Configuration monitor telnet port: [23]

Telnet session password: [nl100]

Serial server watchdog (minutes): [2]

This option is different from the Reset menu item. The Default menu item resets the NL100/105 back to the factory defaults. Reset reboots the device using the last-saved configuration.

After the NL100/105 reboots, it may take a few moments to reestablish communication. Press enter a few times until the NL100/105 status line is returned.

2.3.5 Reset

This option reboots the NL100/105, using the last saved settings that have been programmed by the user. This option is different from the Defaults menu item. The Defaults menu item resets the NL100/105 back to the factory defaults.

After the NL100/105 reboots, it may take a few moments to reestablish communication. Press enter a few times until the NL100/105 status line is returned.

NOTE When using the NL100/105 in a PakBus network, resetting the NL100/105 (or making other changes to the network that might change the known route to remotes), may result in lengthy communication interruptions until the new routes can be learned by all the devices in the network.

2.3.6 Help

The Help option provides tips for navigating within the NL100/105 menu prompts and gives a brief description of each menu item. Help for a particular setting can be displayed by pressing F1 or ? at the prompt for that setting.

2.3.7 Bye

The Bye option is used to close the Socket connection at the end of a Telnet session.

3. Connecting the NL100/105 to a Network

3.1 Network to NL100 Connection

The connection from the computer network to the NL100/105 10 Base-T port should be a twisted pair cable. A male RJ-45 plug connector should be on the cable end going into the 10 Base-T port.

If the cable is to be run directly from the computer to the NL100/105, a crossover cable is required. If the cable will be run from a hub to the NL100/105, a straight through cable should be used. Appendix C shows the pin-outs for these two cable types.

3.2 NL100/105 to Datalogger Connections - Array Based Dataloggers

The cases below assume the NL100/105 is being connected to an array-based datalogger using the datalogger's CS I/O port (CR10X, CR510 CR23X) or RS-232 port (CR23X). TD-based dataloggers (CR10X-TD, CR510-TD, and CR23X-TD) are configured similarly. In these instances, the communication port(s) being used on the NL100/105 should be set up as TcpSer (TCP/IP based serial server).

For all cases, the network map for the LoggerNet software should depict an IPPort root device with the datalogger attached directly to the IPPort (see Figure 3) unless otherwise noted. In some instances, extra response time (3 to 4 seconds) may need to be added to the IPPort and/or the datalogger to account for network traffic delays over a TCP/IP connection.

NOTE The IP Address entered in the software for the NL100/105 should not contain leading zeros. If leading zeros are used, the communications attempts will fail.

Some of the communication links require additional peripherals or cables that can be purchased from Campbell Scientific. In some cases, a standard RS-232 9 to 25 pin or 25 to 25 pin cable is required. RS-232 cables can be purchased from Campbell Scientific or from a computer accessories supplier.

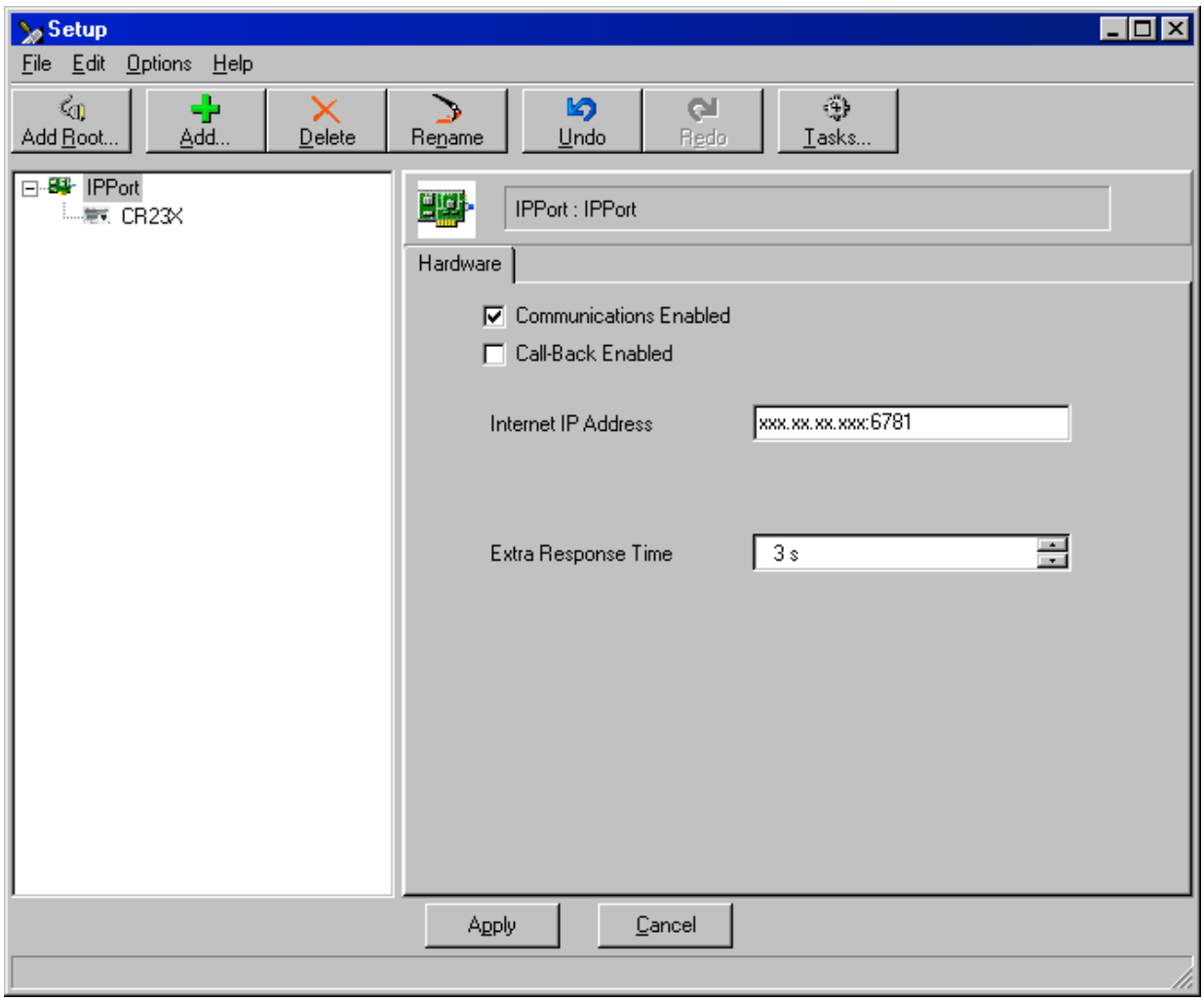

FIGURE 3. Typical NL100/105 Setup in LoggerNet

3.2.1 Direct Connect from the NL100/105 to a Datalogger

Either the CS I/O port or the RS-232 port can be used to directly connect a datalogger to the NL100/105. Cabling or additional peripherals are required as listed below. Note that two dataloggers can be connected to one NL100/105 by using combinations of the connections described below. Each port must be assigned a unique port number.

NL100/105 CS I/O port to datalogger CS I/O port - An SC12 cable is connected to the CS I/O ports on both devices. An SC12 is typically shipped with all datalogger peripherals.

NL100/105 RS-232 port to datalogger RS-232 port - A standard 9 to 9 pin communications cable should be connected to the RS-232 port on both devices.

NL100/105 RS-232 port to datalogger CS I/O port - A serial communications cable should be connected to the RS-232 port of the NL100/105. This cable should be connected to an SC32A or SC32B optically isolated interface, and

the datalogger should be connected to the 9 pin port of the SC32A/B with an SC12 cable.

3.2.2 MD9 Connection from NL100/105 to Datalogger

Campbell Scientific's MD9 Multidrop Interface can be used to connect one or more dataloggers to the NL100/105 via the NL100/105's RS-232 port. A multidrop network is capable of addressing up to 254 dataloggers, but the actual number of dataloggers that can be connected depends upon attenuation of the signal due to coax cable length, the number of devices on the network, and the number of coax terminator pairs used. Refer to the MD9 manual for determining the maximum number of dataloggers that can be connected based on these factors.

An SC532 or SC532A Interface device should be connected to the serial port of the NL100/105. The cable to an SC532 should be a standard 9 to 25 pin RS-232 cable, with the 25 pin male connection mated to the RS-232 side of the SC532. The cable to an SC532B should be a standard 9 to 9 pin RS-232 cable. Note, however, that the RTS line in the cable must be disabled (pin 7 on the 9-pin connector or pin 4 on the 25-pin connector). An SC12 cable is used to connect the 9 pin peripheral connection of the SC532/A to the serial I/O port of the MD9. Coax cable, running from the coax port of the base MD9, is run to each of the remote MD9 devices, which are connected to the dataloggers with SC12 cables. Refer to the MD9 User's Manual for additional information.

The Setup window in LoggerNet should depict an MD9 Base modem attached to the IPPort, with the datalogger attached to an MD9Remote Modem. Refer to Figure 4 below.

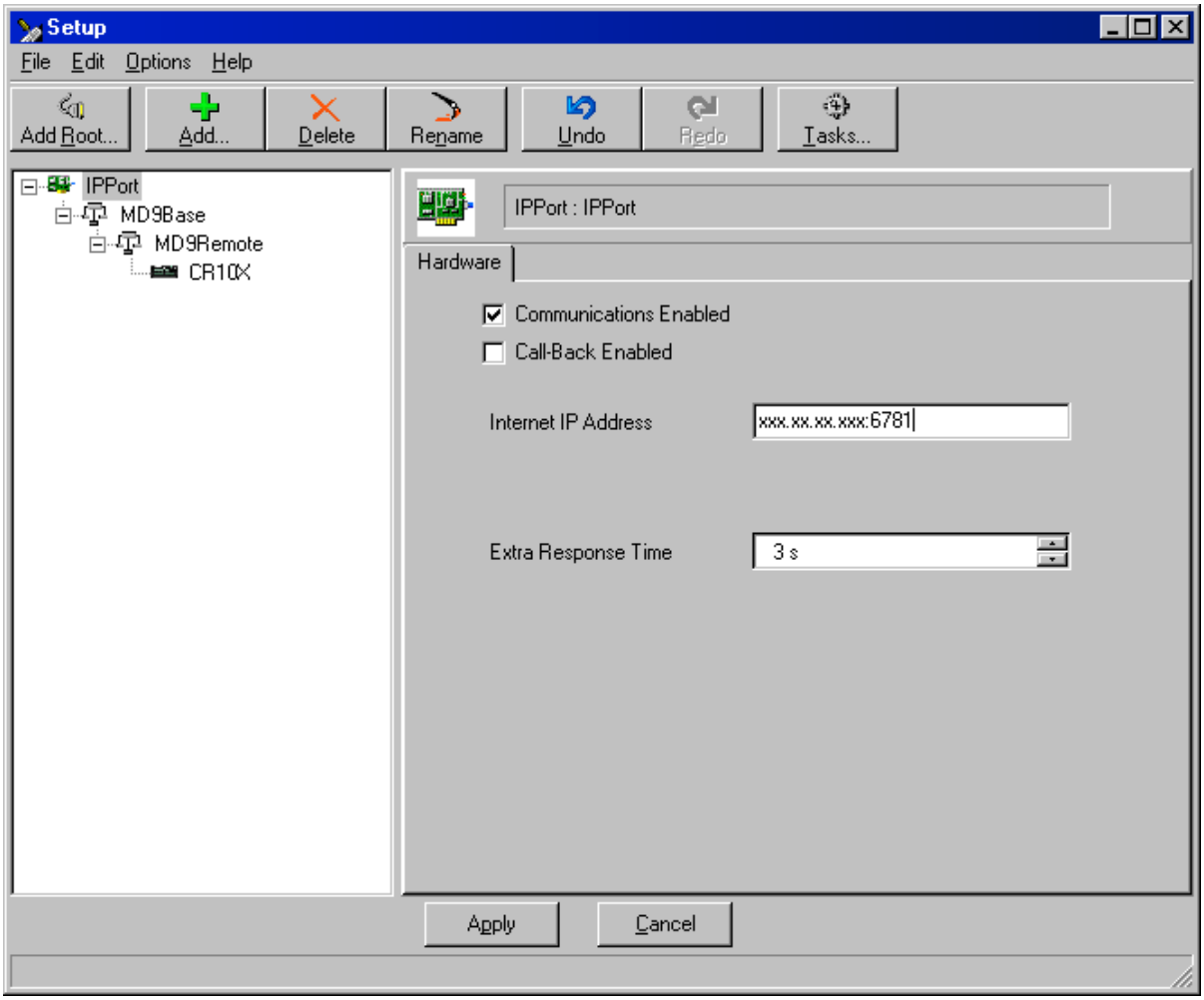

FIGURE 4. LoggerNet Setup for NL100/105 to MD9 to Datalogger Connection

3.2.3 RF Connection from NL100/105 to Datalogger

NL100/105 to radio frequency (RF) modems to datalogger connections allow wireless communication to remote dataloggers stations over a TCP/IP network. Up to 254 datalogger sites can be addressed in an RF network.

The communication link requires an RF base station connected to the NL100's RS-232 port via a standard RS-232 9 to 25 pin cable. Note, however, that the RTS line in the cable must be disabled (pin 7 on the 9-pin connector or pin 4 on the 25-pin connector). The base station can be made up of an RS-232 RF Base Station or the combination of an SC532, RF modem (e.g., RF95A) and a transceiver (e.g., RF300). The remote datalogger is connected to an RF station that typically consists of an RF modem, transceiver, and power supply.

The Setup window in LoggerNet should depict an RF Base modem attached to the IPPort, with the datalogger attached to an RFRemote Modem. Refer to Figure 5 below.

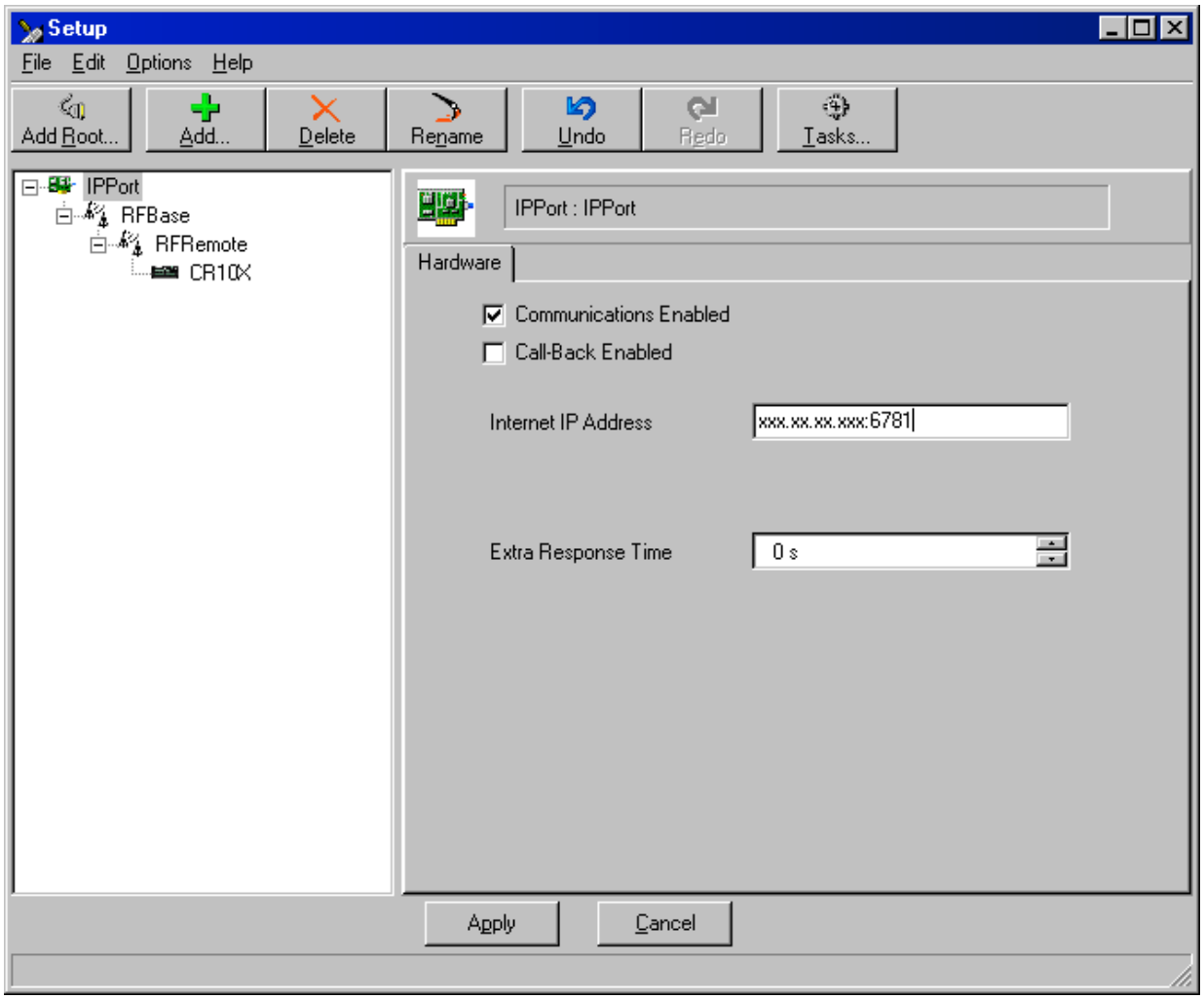

FIGURE 5. LoggerNet Setup for NL100/105 to RF to Datalogger Connection

Refer to Campbell Scientific's Radiotelemetry Network Instruction Manual for more information on setting up RF stations.

3.2.4 Short Haul Modem Connection from NL100/105 to Datalogger

The use of Short Haul Modems (SRM-5A, SRM6-A) allows a connection to a datalogger via TCP/IP to a twisted pair cable. The short haul modem at the NL100/105 should be connected to the device using a standard RS-232 9 to 25 pin communication cable. It is recommended that a short haul surge protection device (P/N 5563) be connected next and then the twisted pair cable. Another surge protection device is recommended between the cable and the remote short haul modem. The short haul modem should be connected to an SC932 RS-232 9 to 25 pin DCE interface, which is then connected to the datalogger's CS I/O port via an SC12 cable.

3.2.5 Phone Modem Connection from NL100/105 to Datalogger

A Hayes-compatible phone modem can be connected to the NL100/105 to allow a TCP/IP to phone link between a computer and a datalogger. The phone modem should be connected to the NL100/105's RS-232 port using an appropriate RS-232 serial cable. Connection of the remote phone modem to the datalogger will vary, depending upon the type of remote modem used. Refer to the user's manual for the system you purchased for additional information on assembling the remote site.

In the LoggerNet communications software, the phone modem on the NL100/105 side should be shown attached to the IPPort. The datalogger is then shown as connected to the remote phone modem. Refer to Figure 6 below.

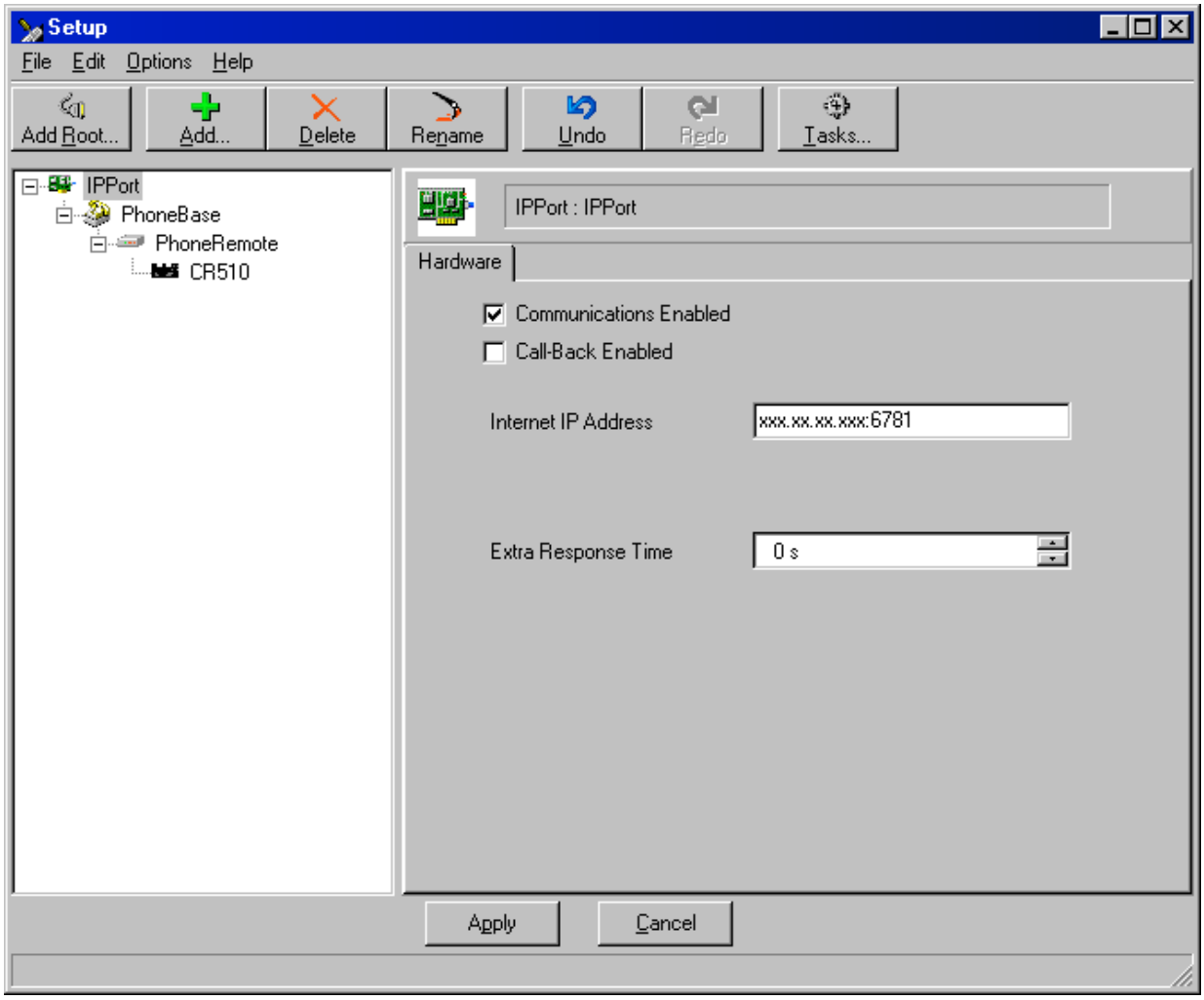

FIGURE 6. LoggerNet Setup for NL100/105 to Phone to Datalogger Connection

3.3 NL100/105 to Datalogger Connections - CR9000/CR5000

3.3.1 Software Setup

As an alternative to LoggerNet, PC9000 software (version 3.5 or higher) can be used to communicate with the CR9000 and CR5000 dataloggers via the NL100/105 and a TCP/IP Network. To configure the software for communication, choose the Tools | CommLink menu option. From the I/O Port drop-down list box, select NET. On the bottom left side of the screen, there are fields in which to type the TCP/IP address and the port number. The setup should look similar to Figure 7, below.

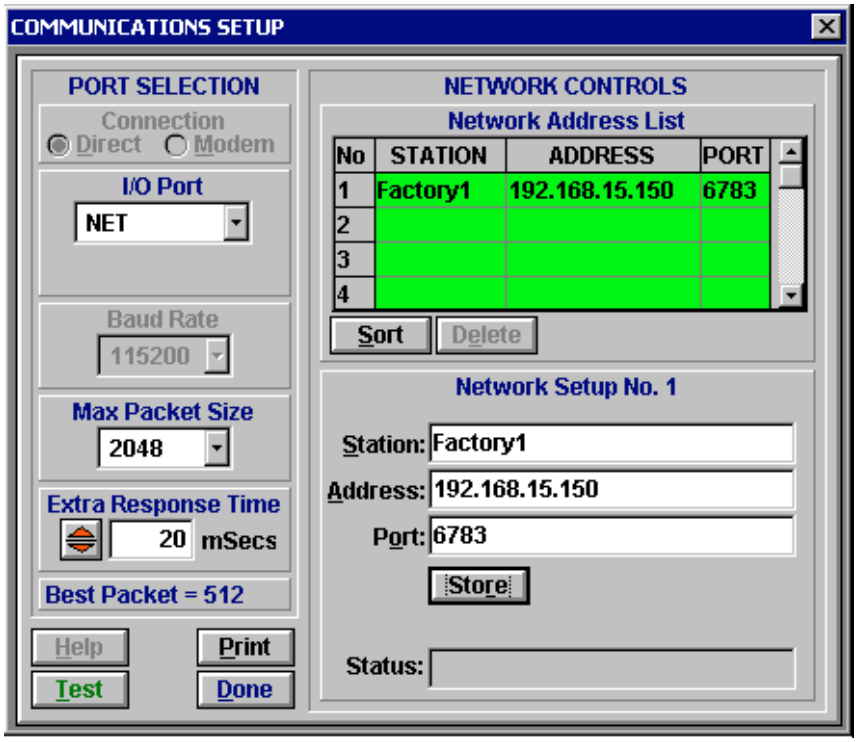

FIGURE 7. PC9000 Setup for TCP/IP Communication

3.3.2 Hardware Setup for NL105 Communication with the CR9000 via TLink

A CR9000 can be connected to a TCP/IP network by connecting the TLink port of the CR9000 9031 CPU module to the TLink port of the NL105 (note that the NL100 does not have this communication port). A twisted pair cable is used to make this connection.

Appendix A. CS I/O Port

The CS I/O port is Campbell Scientific's input/output port. It is not a standard RS-232 pin-out. The following table provides pin-out information on the port when connected to a datalogger.

Pin	Name	Signal Type	Description
1	5 V (supplied by the datalogger)	Input	Not used by NL100/105
2	Signal Ground		Provides reference for voltage levels
3	Ring	Output	Raised by a NL100/105 to put the datalogger into the telecommunications mode
4	RXD	Output	Serial data transmitted to the datalogger
5	Modem Enable	Input	Raised by the datalogger when it determines that the NL100/105 raised the ring line
6	Synchronous Device Enable	Input	Used by the datalogger to address the NL100/105 when the NL100/105 is configured as a synchronous device
7	Clock/Handshake	Input	Used by the datalogger with SDE and TXD lines to address and transfer data to synchronous devices
8	12 V (supplied by the datalogger)		Not used by the NL100/105
9	TXD	Input	Serial data received from the datalogger

Appendix B. Null-Modem Cable

A null-modem cable allows communication between two similar devices. It is sometimes called a crossover cable, because the transmit and receive lines are crossed so that the two devices can communicate. An RS-232 null modem cable usually also crosses other handshaking lines.

An RS-232 null-modem cable can be purchased at a local computer store. The pin-outs for this cable are provided below.

Carrier Detect	1	⇔	4	Data Terminal Ready
Transmit Data	2	⇔	3	Receive Data
Receive Data	3	⇔	2	Transmit Data
Data Terminal Ready	4	⇔	1, 6	Carrier Detect, Data Set Ready
Signal Ground	5	⇔	5	Signal Ground
Data Set Ready	6	⇔	4	Data Terminal Ready
Request to Send	7	⇔	8	Clear to Send
Clear to Send	8	⇔	7	Request to Send
Not Used	9		9	Not Used

Appendix C. 10 Base-T Cabling

The cable that runs from the computer to the NL100/105 should be a Category 5 twisted pair cable. If the NL100/105 will be connected directly to the computer, a crossover cable should be used. If the NL100/105 will be connected to the computer through a hub, a straight through cable should be used. The pin-outs for each of these cables is shown below.

Straight Through Cable

Twisted Pair 1	1	⇔	1
	2	⇔	2
Twisted Pair 2	3	⇔	3
	6	⇔	6

Crossover Cable

Twisted Pair 1	1	⇔	3
	2	⇔	6
Twisted Pair 2	3	⇔	1
	6	⇔	2

Glossary

Beacon Interval - Devices in a PakBus network may broadcast a message to other devices, in order to determine "neighbor" devices. Neighbor devices are devices that can be communicated with directly by the current device without being routed through an intermediate device. A beacon in a PakBus network helps to ensure that all devices in the network are aware of which other devices are viable in the network.

If configured to do so, a clock set command may be transmitted with the beacon interval. This function can be used to synchronize the clocks of devices within the PakBus network.

MODBUS - MODBUS is a communications protocol developed by Modicon which was designed to provide a common communications protocol among intelligent devices in the manufacturing industry.

Neighbor (PakBus Neighbor) - Neighbor devices are devices that can be communicated with directly by the current device without being routed through an intermediate device.

PakBus - PakBus is a packet-based communications protocol developed by Campbell Scientific. One of the advantages of PakBus is that other communications protocol packets, such as TCP/IP or MODBUS, can be "wrapped" in a PakBus packet and transferred among PakBus devices in the network, thus allowing various communication protocols within one network. Devices that are capable of PakBus communication include the CR10XTD-PB, CR510TD-PB, CR23XTD-PB dataloggers, the RF400 modem, and the NL100/105.

PakBus Node - A device in the PakBus network with a unique PakBus ID. The device can be a datalogger, a computer, or an NL100/105.

Serial Server - A serial server is a device that allows serial communication over a TCP/IP communications link.