ND-SERIES

NETWORK TIME PROTOCOL

CLOCK - DATE

DISPLAY

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See important *limited warranty* at the end of this document.

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Introduction

Network Display (ND) is a series of versatile, multi-featured Network Time Protocol (NTP) driven clock displays. These units decode and display standard Network Time Protocol.

The ND clock line includes the management software for configuration and maintenance. Other features include:

- Time zone offsets (to one second resolution) support any biasing requirements
- Complete flexibility in daylight savings time configurations
- Real-time clock backup retains time during loss of power and/or NTP
- Primary and secondary NTP source with fault-tolerant switching
- Supports NTP broadcasts
- Fully configurable network settings, including DHCP/BOOTP support.
- Security features include password protection of configuration, encrypted communication, and the ability to disable telnet management access.
- Display formats - 12 hour (with PM indicator) or 24 hour time, MM:DD:YY or DD:MM:YY date formats
- Adjustable brightness
- Status display to remotely 'see' clock display through WinDiscovery application.

Installation

Operating Environment

The ND series is not water or moisture proof and is designed for indoor use only. Treat it as you would any other delicate electronic device and do not expose it to water, excessive heat, or physical abuse.

Pre-Installation Checklist

Before installing an ND, one should be prepared with the following basic configuration information that the device will require. It may be necessary to obtain some or all of this information from a network administrator in your organization.

Static Networking Configuration

__ IP address and netmask designation for device
__ Primary and secondary DNS (domain name) servers
__ Gateway/router
__ Primary and secondary NTP time sources

Dynamic Networking Configuration

__ Confirm that a DHCP/BOOTP service is accessible on the local network
__ Determine if DHCP server will provide NTP server configuration
__ Determine if DHCP server will provide time zone configuration

All Symmetricom, Inc. ND- series network clocks can be provided with a verbose name. The name is arbitrary and may be useful for organizing and managing devices once installed at a facility. By default, device names are the product name abbreviation followed by the device's Ethernet address. Customers may wish to designate names relating to their own organizational requirements. It is recommended that a robust naming scheme be developed before devices are installed to different locations within an organization.

Quick Start Information

Plug the power cord into an appropriate AC source.

After application of power the ND will go through an internal self-test. Time from the real-time clock backup will then be displayed until the clock is configured to find an NTP reference. The colons will flash until an NTP source is found.

[Note: when configured to obtain network configuration through DHCP, the display may hesitate on startup while DHCP is resolved.]

Connect the ND to the Ethernet LAN using a cable with RJ45 connectors.

At this time the clock can be communicated with over the local network using the WinDiscovery application. WinDiscovery can find and identify clocks through the exchange of broadcast messages even when TCP/IP networking parameters are not configured on the same network.

[Note: networks separated by physical routers will often block UDP broadcasts preventing WinDiscovery from locating devices on a remote network. Under such circumstances, WinDiscovery must be operated from a computer within the remote network or routers separating the networks must be configured to pass through (both directions) UDP broadcasts on port 6163.]

Once the clock has a valid network configuration it can also be accessed via Telnet by computers in the same logical network.

In situations where providing basic network configuration via WinDiscovery application is not practical, the clock can also be configured through an RS232 terminal interface. To use this feature, connect an RS232 terminal (or PC serial port) to the DB-9 connector on the rear of the clock with a straight-through 9-pin cable. Once connected, press ENTER once to display the login/menu screen.

Display Behavior

The colons of the clock display will flash when the device is unable to obtain time from an NTP source. When NTP is available and valid, the colons will remain steady-on.

If the ND is configured for a 12-hour time display mode, an LED indicator will appear in the bottom right corner of the display during the PM hours.

Major Feature Overview

The ND Series clocks can be configured using one of the following:
- the WinDiscovery software application provided with your clock
- a terminal-style interface accessible via RS-232
- Telnet

Consult the section entitled Configuration for details on how to adjust settings through the aforementioned mediums.

DHCP/BOOTP Auto-Configuration

DHCP (Dynamic Host Configuration Protocol) is a mechanism for automating the configuration of networked devices that use TCP/IP. When DHCP is enabled, DHCP configuration acquisition will overwrite any manual configuration items. A precursor to DHCP is BOOTP. The ND can obtain configuration from a BOOTP server when no DHCP server is present. *Factory default: DHCP enabled.*

The following RFC2132-defined optional configuration items are, when available, used by the ND for configuration purposes:

Option	No.	Comments
Time Offset	2	The value provided will be used for the time zone offset configuration, unless it is defined as zero in which case it will be ignored and the ND will rely on internal configuration. Note: this option does not provide information appropriate for dynamic daylight savings time use.
Router	3	The first IP address provided will be used for router/gateway configuration.
Domain Name Server	6	Up to two server IP addresses may be specified. ND clock will treat addresses as primary and secondary DNS servers.
Network Time Protocol Server	42	Up to two server IP addresses may be specified. ND clock will treat addresses as primary and secondary NTP servers.

[WARNING: An ND clock will not function properly if configured to use DHCP services when no DHCP server is present on the network.]

Time Zone Offsets

All ND clocks maintain time as UTC (sometimes equated with GMT) internally. A time zone offset (or bias) can be provided to adjust the time for display purposes. A bias can be set as a positive (+) or negative (-) value with a resolution of one second. *Factory default: no offset.*

Daylight Savings Time

A daylight savings time (summer time) adjustment can be configured separately and in addition to a time zone offset.

ND displays provide flexible configuration options supporting most world daylight time standards. Traditional daylight/summer time is configured as one (1) hour positive bias. For the U.S. and Canada, daylight savings time begins on the first Sunday of April at 2:00AM and ends on the last Sunday of October at 2:00AM.

Daylight time standards vary widely throughout the world. In the European Union, daylight change times are defined relative to the UTC time of day instead of local time of day (as in U.S.). European customers, please carefully consult the section entitled Device Settings for details on setting daylight time.

To ensure proper hands-free year-around operation, daylight time adjustments must be configured using the daylight time option and not with the time zone offset option. *Factory default: daylight savings time is disabled. You must enable and configure the settings.*

Configuration

An ND maintains its configuration in memory so that it is maintained even when power is off.

Reset Factory-Default Configuration

In some situations (such as a lost password) it may be necessary to return the ND to its factory default configuration. A recessed button labeled "RESET", located on the back of the ND chassis, performs this function. To reset configuration to factory default – 1) remove power from the ND, 2) depress and hold the reset button, and 3) apply power to ND and continue holding the reset button down for five seconds. The ND will now be reset, including the password, and the unit will need to be reconfigured.

Default Password

The factory-default password for an ND is: *"public"*

Configuration Methods

Basic operation of the ND series is configured via the WinDiscovery software supplied with the clock, or via Telnet or the RS-232 interface.   Only one configuration method should be used at a time.

WinDiscovery

The *WinDiscovery* (WD) program is a Windows based program supplied with the ND clock. *WinDiscovery* is supported under Windows 95/98/Me/NT and 2000 operating systems. To install the *WinDiscovery* program on your server/workstation/PC, complete the following steps:

1. Insert the software distribution diskette that shipped with your ND.
2. Run the 'setup.exe' application from the diskette.
3. By default, the setup utility will suggest installing files to C:\Program Files\WinDiscovery. (Another path may be selected if desired.)
4. Press the *Unzip* button to unpack the files to the specified location.
5. Optional: create a shortcut to the 'windiscovery.exe' application in your Start Menu or on the Desktop.

Open the WD program by clicking the shortcut on your desktop (or other fashion dictated by your installation).   Only one user should be using WD at a time, and other methods should not be used to manage the clock while using WD. Click the Discover button on the lower left of the screen. All Symmetricom, Inc. ND- series network clocks accessible on the network will announce their presence. The real-time status bar will display the count of devices found. When complete, a list of

device families and groups will be displayed in the left pane of the WD window. ND clocks are members of the Symmetricom, Inc. Digital Displays family. Click on the plus [+] sign to the left of any family or group to open and view device types that were found.

Clicking on any device group will list in the right pane of the WD window all devices of that type found. To configure another device group, click on the device name in the left window and the device names will then appear in the right window, ready to be managed.

To view the properties of the device, right click on the device name to be managed and select "Properties". To configure and manage a device, right click the device name and a menu appears. The choices are:

> Network Settings
> Device Settings
> Set Password
> Set Time
> Status
> Reset Device
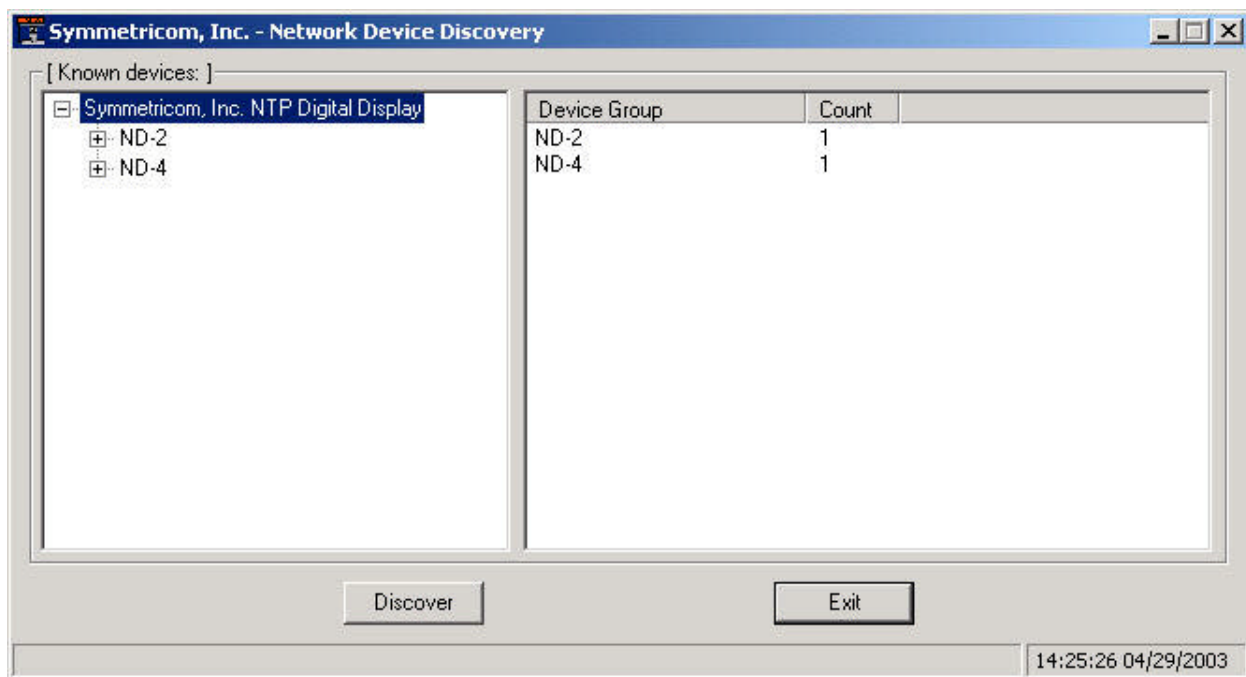
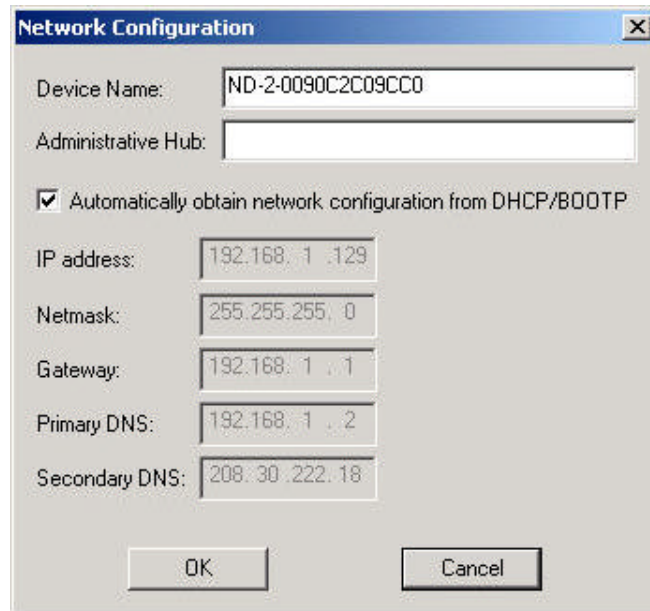**Figure 1 - Network Device Discovery screen**

Clicking a menu choice opens a new window for that function. When working in the management windows, use the *Apply* and *OK* button to accept changes that you have made. Use the *Cancel* button to exit the screen without applying changes. NOTE: *Cancel* does not undo changes that have been saved using the *Apply* button.

Network Settings
The network settings must be established for the clock to operate on the network. You must be a network administrator or have their support to complete these functions. Your network administrator determines the information for the Network Settings. To use DHCP/BOOTP, click the checkbox on the screen, and click *OK*. Each clock is programmed at the factory with a factory device name. You can change the device name to one convenient for your site – preferably one that helps you to later identify the exact physical location of the device. You must enter the IP address, Netmask, Gateway, Primary DNS, and may enter a Secondary DNS. See Figure 2 below.

*[Note: the Administrative Hub configuration item is reserved for future use.]*

Figure 2 - Network Configuration screen

<u>Device Settings</u>

Each clock can be configured for Primary and Secondary NTP servers and to show time or date in the format that you prefer, using time zone offsets and DST settings to completely customize it. Any changes made in this window will not be applied until you click the OK button to exit the window or the Apply button to immediately see the changes.

The Primary Source must be configured to acquire an NTP source. Enter the IP or Internet address for the NTP source. If available, enter a Secondary Source for backup. The top right section of the Window shows a snapshot of the ND display, constantly updated. This update is not precise, but is meant to give you a view of the clock display for troubleshooting and maintenance purposes.

The NTP digital display can be configured to either listen to NTP broadcasts only, or to query the NTP time server at a selected interval. The default configuration is to query the NTP server at 10-minute intervals. To configure the ND device to only listen to NTP broadcasts, click the checkbox for "Listen for NTP broadcasts only", and enter a "Broadcast timeout" in minutes. The default timeout is 60 minutes.
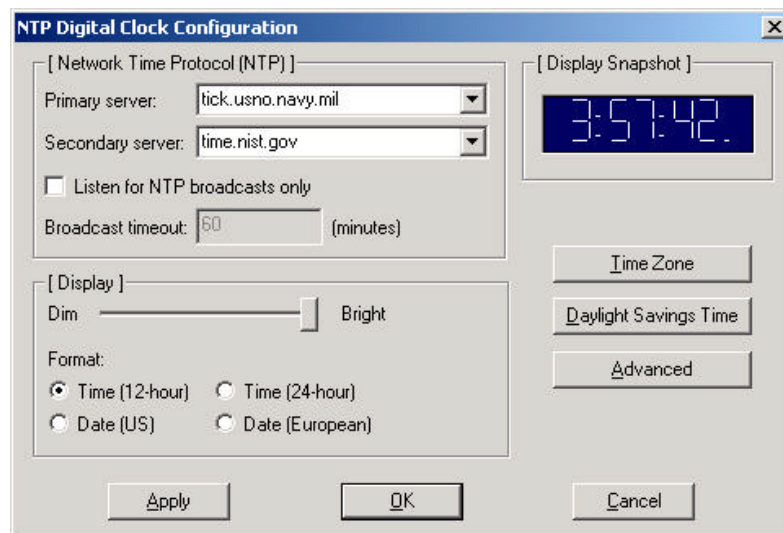
Figure 3 - NTP Digital Clock Configuration screen

The lower half of the window configures the time/date displayed on the clock. The brightness control is a sliding bar to vary the brightness of the clock. This feature is useful to accommodate lighting conditions and viewer needs. The clock can be configured to display time in 12 or 24 hour format, or date in MM:DD:YY, indicated as US, or DD:MM:YY, indicated as European format.

The Time Zone and Daylight Savings Time setting buttons, also included in the lower half of the window, give the clock complete flexibility to display any time zone, DST combination. First select the time zone, by clicking the Time Zone button. This opens a new window that gives you a list of time zones, including descriptions to help with the selection. Select the Time Zone and click *OK* to close the window. Changes are not applied until you click *OK* or the *Apply* button on the main NTP Digital Clock Configuration window. Next click the *Daylight Savings Time* button to configure the Daylight Savings Time, if appropriate. Click *OK* to close the Window. The change will be applied when you click *OK* or *Apply* on the Main NTP Digital Clock Configuration Screen.
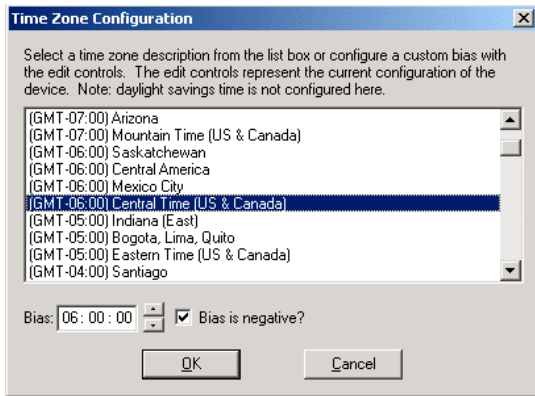
Figure 4 - Time Zone Configuration screen
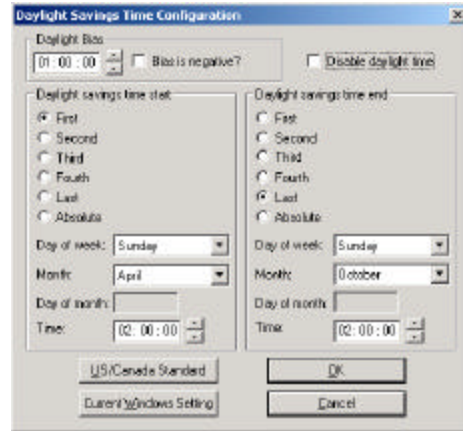
**Figure 5 - Daylight Savings Time
Configuration screen**

The *Advanced* button adjusts Telnet configuration. If Telnet is allowed, the port must be defined. The default Telnet port is 23.   See your network administrator if you need additional information.

Set Password
The third option on the clock configuration pull down menu allows you to set a password for each individual device. The password must be entered twice to confirm the entry. The password is a maximum of 11 characters and a minimum of 1 character, and is case-sensitive. Click the OK button to save the password or cancel to discontinue the change. **Warning: If the password is lost, the user must reset the clock using the Reset button on the rear of the clock. This will cause the clock to return all configurations to factory-default settings.**

To remove a password, select the Set Password command. You will be prompted to enter the old password. Do not enter anything into the New Password or Confirm Password fields. Click OK to save. Click Cancel to leave the old password unchanged.

When a password is set for a clock, each time you click OK or Apply for that clock you will be asked for the password. You may enable the 'Remember this password for the session' checkbox to eliminate typing the password for each configuration change. WinDiscovery will not remember the password after it is closed so maintain passwords in a safe place.

[Note: the factory default password is: "public"]

Set Time

The Set Time menu item lets you manually set the time and date for the clock. The function may be most useful for lab situations as the clocks keep time via their internal oscillator when NTP is not present. The time can either be set to the time of the PC or a manual time and date can be entered. When the ND has access to NTP servers, information obtained via NTP will overwrite any manually established time/date. Therefore, practical use of this feature requires the clock to be removed from the network, or for NTP server configuration to be left undefined.

[Note: for the purpose of refreshing its internal clock, the ND assumes the time entered is UTC. Any configured time zone/daylight time settings will then be applied to this time for display purposes.]
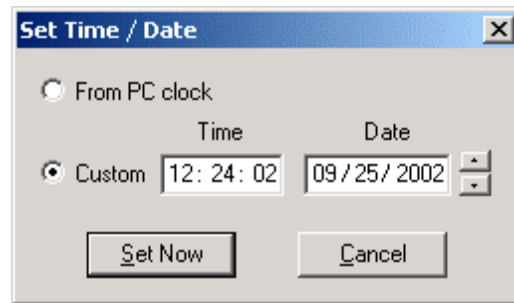
Figure 6 - Set Time / Date screen

Status

The Status window is a display-only window that gives you the current information on the ND's display and synchronization activity. The status window shows a snapshot of the ND display. This update is not precise, but is meant to give you a view of the clock display for troubleshooting and maintenance purposes. The Status also shows the active NTP server – Primary or Secondary, the current synchronization status, and Time Adjustment information. Time Adjustments will be caused by loss of NTP, changing the NTP source, or changing Network Configuration settings. The Ceiling Exceeded field describes the event where the time adjustment exceeded a value that will be set in the NTP Digital Clock Configuration - Advanced – Ceiling. Note the warning that the statistics will reset if you change the NTP server.
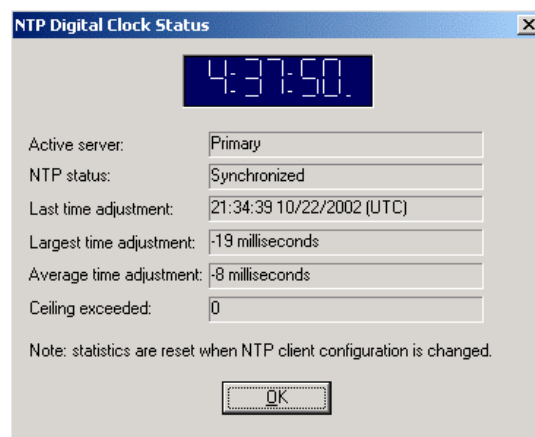
Figure 7 - NTP Digital Clock Status screen

Telnet Terminal Configuration

A terminal-style configuration interface is available via Telnet. To connect with the ND in this manner use any standard Telnet client application, specifying the IP address of the clock as the server with which to connect. The factory default port is well-known Telnet server port 23.
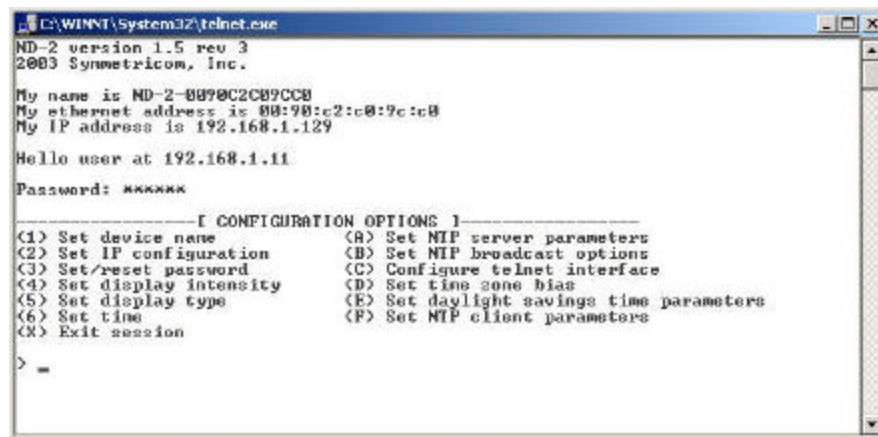
Configuration via Telnet may not be convenient for devices operating with a factory default configuration since the IP address is not known. Use the WinDiscovery application or the RS-232 interface to establish first-time networking configuration.

If you are not familiar with the Telnet application, ask your network system administrator for assistance.

[Note: for security purposes, the Telnet interface can be disabled. When disabled, you will no longer be able to access the device with Telnet. To re-enable the Telnet feature, one of the other configuration methods must be used, or the clock must be reset to factory default configuration.]

Upon entering the ND clock via Telnet, the initial screen is shown below. The clock displays its firmware version, its name, Ethernet address, IP address, and the IP address of the PC with which you are accessing it. A login prompt is presented if a password has been configured for the device. The configuration menu will be displayed when the correct password has been provided.

Enter the Number or Alpha Letter corresponding to the command and press the enter key. Current configuration or default answers are displayed in brackets. 'Enter key only' will retain the current entry/default.

Figure 8 - Terminal Menu screen

Set Device Name
To set the device name, select option '1'. Enter the desired device name.

Set IP Configuration
To set the IP Configuration, select option '2'. **NOTE: If you select this option, you will be disconnected from the session upon completion, whether you actually change any entries or not.** You have the choice of using DHCP for automatic IP Configuration or entering the data in these screens. If you select DHCP, no other questions will be displayed, you will be disconnected from the session, and

you will not be able to Telnet to this clock until you learn the DHCP-provided IP address. To manually enter the IP information, enter 'N' for the DHCP (or Enter for the default), and enter the IP, Netmask, Gateway, Primary DNS and Secondary DNS server.

```
Telnet - 192.168.1.129                                                    _ | □ | ×
Connect  Edit  Terminal  Help
(5) Set display type              (E) Set daylight savings time parameters
(6) Set time                      (F) Set NTP client parameters
(X) Exit session

> 1
Device name [ ND-2-0090C2C09CC0 ]:

----------------[ CONFIGURATION OPTIONS ]----------------
(1) Set device name               (A) Set NTP server parameters
(2) Set IP configuration          (B) Set NTP broadcast options
(3) Set/reset password            (C) Configure telnet interface
(4) Set display intensity         (D) Set time zone bias
(5) Set display type              (E) Set daylight savings time parameters
(6) Set time                      (F) Set NTP client parameters
(X) Exit session

> 2
Use DHCP for IP configuration (y/[n])?
IP address [192.168.1.129]:
Netmask [255.255.255.0]:
Gateway [192.168.1.1]:
Primary DNS server [192.168.1.2]:
Secondary DNS server [208.30.222.18]:
NOTE: settings will change now, and your session will disconnect.
```
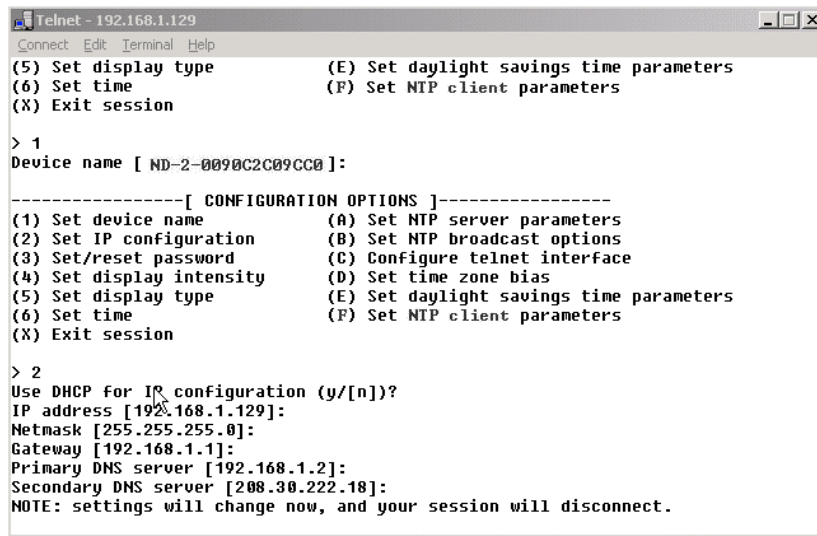
Figure 9 – Terminal - Device Name & IP Configuration

Set/Reset Password
To set, change or remove the password, enter '3' for this option. Bear in mind that a lost/forgotten password cannot be recovered.

[Note: the factory default password is: "public"]

Set Display Intensity
The clock display intensity is controlled with a scale of 1 to 14 with 14 being brightest. Enter the value for the desired intensity setting.

Set Display Type
Allows configuration for time display (12 and 24 hour) or date display (MM/DD/YY or DD/MM/YY).

Set Time
Allows UTC time and date to be set directly into the clock. This is useful in situation where NTP server synchronization is not available but reasonably correct time/date is desired on the display.

Set NTP Server Parameters
The ND clocks support a Primary and a Secondary NTP source. Select option A to setup or change the NTP reference sources. Enter the name or the IP address for the NTP reference server. Enter the server port for each NTP reference source (normally 123).

Set NTP Broadcast Options
The ND clocks are set to query for NTP on a regularly scheduled basis, factory set to 10-minute intervals. To set the clock to receive broadcasts, set the NTP broadcast option to 'yes' and enter the broadcast port (normally 123). If the clock is set to receive broadcasts, the clock will not query.

Configure Telnet Interface

Select option C to turn off the Telnet access. If Telnet is allowed, define the Telnet port (normally 123).
If turned off, the Telnet session will be ended and the user must use WinDiscovery, the RS232 access, or
the Reset button to reset it.   See NTP Digital Clock Configuration, Advanced button.
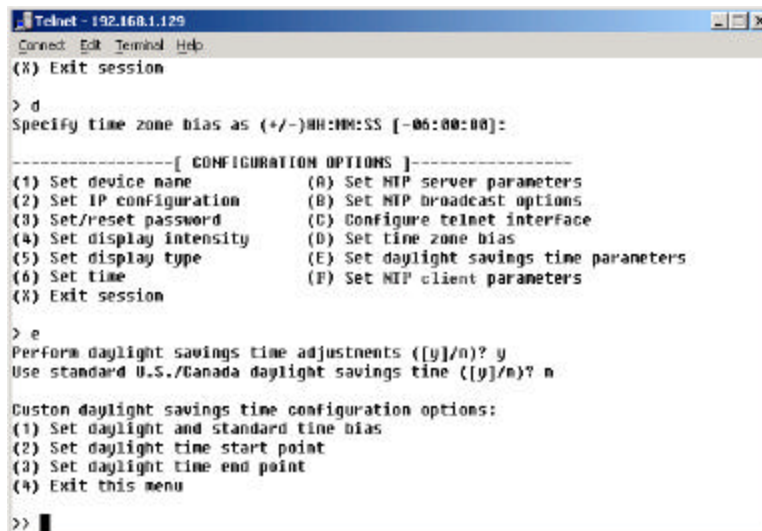
Set Time Zone Bias

To set the Time Zone Bias, select option D. The Time Zone Bias indicates the offset from UTC. Enter
the time in HH:MM:SS format as indicated, including the plus or minus sign to indicate positive or
negative bias. Remember that this field can also be set from DHCP, so check with your Network
Administrator if you are getting inexplicable results.

Set Daylight Savings Time Parameters

To set DST, enter E from the menu. The ND DST configuration allows you to completely configure the
DST (summer hour) settings for your location. To configure the DST, enter Y to 'Perform Daylights
Savings Time Adjustments'. For sites needing US/Canada standard DST, you can indicate yes to the
next question and the DST will be configured for you automatically. The US/Canada standard is: 1
hour positive bias, starting at 2:00am on the first Sunday in April, and ending at 2:00am on the last
Sunday in October. If you select the US/Canada standard, the configuration is complete. If you indicate
'no' for the US/Canada, then you continue to configure the DST by entering the number of each option
and completing the entries (masks are provided for required format of data):

- DST and standard time bias hour, with sign (DST normal bias is –01:00:00 hour, and standard time
  bias is normally +00:00:00)
- DST start point – can be set as absolute date, i.e. 04/01, or floating day, by entering Month such as 4
  for April, Day of week such as Sunday, and week in Month, 1st, 2nd,etc.
- DST end point –can be set as absolute date or floating day

Figure 10 – Terminal - Set Time Zone & Daylight Time

Enter 4 to exit the Daylight Savings Time setup menu.

<u>Set NTP Client Parameters</u>

The ND clocks are set to query for NTP on a regularly scheduled basis, factory set to 10-minute intervals. To adjust the settings for query interval and additional NTP client parameters select option F.

Enter X to exit the Telnet menu. This will disconnect your Telnet session from the clock.

<u>RS-232 Terminal Configuration</u>

The RS-232 configuration interface behaves identically to the Telnet interface. To communicate with the ND in this manner connect any RS-232 terminal or PC serial port and serial terminal application to the DB-9 connector on the rear of the ND chassis. A "straight-through" 9-wire cable should be used. The settings for the RS232 port are: 9600, 8 data bits, no parity, 1 stop bit.
Consult the section entitled <u>Telnet Terminal Configuration</u> for details on how to change configuration using the terminal interface.

Troubleshooting Tips

Problem: Unable to find the clock on the network with WinDiscovery.

Possible reasons/solutions:
1. Verify that the clock is on the same physical network as the computer from which you are running WinDiscovery. If the computer is separated from the clock by a router (on a remote network) it is likely that the router is blocking communication with the device. Run WinDiscovery from a computer within the remote network, or ask a network system administrator to configure the router in question to pass through (both directions) UDP broadcasts on port 6163.
2. If the clock has been configured to use DHCP for network configuration but no DHCP/BOOTP server is present, the clock may not respond to discovery requests for up to twenty seconds after power-on. *[Note: DHCP configuration is enabled as a factory-default.]*
3. Verify that the clock and the computer running WinDiscovery are attached to the network.
4. Verify that all network cables, hubs, etc. are in proper working order. Be sure that Ethernet cross-over cables are not being used where inappropriate.

Problem: Clock is unable to find NTP reference, either Primary or Secondary Source. (colons flashing and/or Status in WD says 'Unsynchronized')

Possible reasons/solutions:
1. Verify that the NTP server(s) specified are reachable, communicating, and are not flagging their reported time as invalid. Use a PC-based NTP client application to verify the server(s) if necessary.
2. Verify that a gateway/router has been configured that allows the clock to communicate outside of its local network.
3. Verify that the IP address configured for the clock is correct. If you enter an IP address that already exists on the network, the clock will reset its address to one within the link-local address space (169.254.xxx.xxx). If you see that the IP address starts with 169.254, obtain a new IP address for the clock or resolve the duplication.
4. Verify that the clock is connected to the Ethernet LAN.
5. Verify that all network cables, hubs, etc. are in proper working order. Be sure that Ethernet cross-over "patch cables" are not being used where inappropriate.

Problem: Clock is not displaying the correct local time or date.
Problem: Clock did not properly negotiate the Daylight Savings Time to standard time (or vice-versa) transition.

Possible reasons/solutions:
1. Time zone offset has been configured incorrectly. Provide the correct time zone configuration.
2. Daylight savings time has been configured incorrectly. This is configured separately from the time zone configuration. Provide the correct daylight time configuration.
3. If using DHCP/BOOTP for network configuration, consult with your network system administrator to see if the optional *Time Zone* option has been changed. This option as provided by DHCP can override manual settings.
4. If you have used the Set Time function, note that the clock assumes that you have entered UTC and will apply your Time Zone and DST configuration relative to the manually entered time.

Problem: Clock display appears to freeze momentarily.

Possible Reasons/solutions:
1. If DHCP is turned on and a DHCP server is not active on the local network the clock will hesitate periodically while attempting to resolve DHCP configuration. To correct the problem, switch to manual networking configuration or determine why the local DHCP server is not operating.
2. If the clock has not been configured with at least one valid DNS server (or that DNS server is down) hesitations similar to those described in #1 will occur. At least one valid DNS server is required for operation.

Problem:
You have lost your password.

Possible reasons/solutions:
1. The password cannot be recovered if it is lost. Reset the clock using the procedure described in the Configuration section.

If these troubleshooting tips do not solve your problem, contact customer service at:
support@symmetricom.com

or call: ….. 888-367-7966 in the USA
….. 408-428-7907 worldwide

Specifications

Communications – I/O

Ethernet (10mbps)..RJ45
RS-232 ....DB9 male
RS-485 ....RJ11

Power Requirements

AC Input Voltage ....100 – 240 VAC
AC Input Frequency...47 – 63 Hz
AC Input Connector...IEC male jack
Power Consumption...< 15 Watts

Physical

LED Characters - 6 each

Color ....Red

Height

ND-2 ....2.3 in/5.8cm
ND-4 ....4 in/10 cm

Chassis

Color ....Black

Dimensions

ND-2 ....19w x 3.48h x 6d (inches)
       48.3w x 8.8h x 15.2d (cm)
ND-4 ....25.25w x 6.25h x 4.25d (inches)
       64.1w x 15.9h x 10.8d (cm)

Weight

ND-2 ....4 lbs./1.82 kg
ND-4 ....7.7 lbs./3.5 kg

Power Supply Component Characteristics

- Approvals - UL, CSA, IEC & VDE.
- Built in output power limiting, over voltage and short circuit protection.
- Input AC fuse protection (Internal built in fuse designed to blow if a catastrophic failure occurs. Fuse does not blow on overload or short circuit.)

Operating/Storage Temperature & Humidity

- Operating Temperature ....0 to +40°C
- Relative Humidity ....Up to 90% (non condensing @ 25°C)
- Storage Temperature ....-40 to +70° C
- Relative Humidity ....Up to 90% (non condensing @ 25°C)

FCC Compliance

- Emissions Limit..Class A, Radiated and Line Conducted

This equipment has been tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a commercial installation.

 THIS DEVICE COMPLIES with PART 15 of the FCC RULES. Operation is subject to the following two conditions.
(1) This device may not cause harmful interference, and
(2) This device must accept any interference received, including interference that may cause undesired operation.

Limited Warranty

Each new product manufactured by Symmetricom is warranted for defects in material or workmanship for a period of one year from date of shipment ("Limited Warranty"). Defects in material or workmanship found within that period will be replaced or repaired, at Symmetricom's option, without charge for material or labor, provided the customer returns the equipment, freight prepaid, to the Symmetricom factory under this limited warranty. Symmetricom will return the repaired equipment, freight prepaid, to the customer's facility.

Limitation of Liability

By purchasing any product from Symmetricom, the Buyer consents to and agrees that the Buyer's sole and exclusive remedy for any damages or losses incurred by the Buyer, as a result of Symmetricom's breach of its one-year Limited Warranty for defects in materials and workmanship or otherwise in connection with any claim respecting the product, shall be limited to the repair or replacement of the product or a refund of the sales price of the product. In no event shall the Buyer be entitled to recover consequential damages or any other damages of any kind or description whatsoever.

Proprietary Notice

THIS DOCUMENT, WHETHER PATENTABLE OR NON-PATENTABLE SUBJECT MATTER, EMBODIES PROPRIETARY AND CONFIDENTIAL INFORMATION. IT MAY NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS FOR ANY PURPOSE EXCEPT THAT FOR WHICH IT IS PURCHASED OR LOANED.