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Tempus Cntp Network Time Server

User's Manual

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Preface

Thank you for purchasing the Tempus Cntp Network Time Server. Our goal in developing this product is to bring precise, Universal Coordinated Time (UTC) into your network quickly, easily and reliably. Your new Tempus Cntp is fabricated using the highest quality materials and manufacturing processes available today, and will give you years of troublefree service.

About EndRun Technologies

Founded in 1998 and headquartered in Santa Rosa, California, we are the leaders in the exciting new time and frequency distribution technology based on the Code Division Multiple Access (CDMA) mobile telecommunications infrastructure. Our innovative designs and painstaking attention to the details of efficient manufacturability have made us the first to bring this technology to the broad synchronization market at prices small businesses can afford.

EndRun Technologies markets this technology in three major product lines:

Network Time Sources/Servers – These units are configured for optimum performance in operation with network servers/networks running the Internet protocol known as the Network Time Protocol (NTP).

Instrumentation Time and Frequency References – These products provide UTC traceable time and frequency signals for use in precision test and measurement instrumentation.

OEM Time and Frequency Engines – These products provide the core time and frequency capabilities to our customers who require lower cost and tighter integration with their own products.

About this manual

This manual will guide you through simple installation and set up procedures.

Introduction – The Tempus Cntp, how it works, where to use it, its main features.
Basic Installation – How to connect, configure and test your Tempus Cntp with your network.
Client Set-Up – Two sections; one for Unix-like platforms and one for Windows NT/2000.

If you detect any inaccuracies or omissions, please inform us. EndRun Technologies cannot be held responsible for any technical or typographical errors and reserves the right to make changes to the product and manuals without prior notice.

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Tempus Cntp User's Manual	**Revision 3**
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Warranty

This product, manufactured by EndRun Technologies, is warranted against defects in material and workmanship for a period of two years from date of shipment, under normal use and service. During the warranty period, EndRun Technologies will repair or replace products which prove to be defective.

For warranty service or repair, this product must be returned to EndRun Technologies. Buyer shall prepay shipping charges to EndRun Technologies and EndRun Technologies shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to EndRun Technologies from another country.

Products not manufactured by EndRun Technologies but included as an integral part of a system (e.g. peripherals, options) are warranted for ninety days, or longer as provided by the original equipment manufacturer, from date of shipment.

Extended Warranty

The standard warranty may be extended beyond the standard two-year period. A record of warranty extensions is documented on the sales order for the product purchased. All other conditions of the standard warranty apply for the extended period.

Limitation of Warranty

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. ENDRUN TECHNOLOGIES SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

Warranty Repair

If you believe your equipment is in need of repair, call EndRun Technologies and ask for a customer service agent. It is important to contact us first as many problems may be resolved with a phone call. Please have the serial number of the unit and the nature of the problem available before you call. If it is determined that your equipment will require service, we will issue an RMA number. You will be asked for contact information, including your name, address, phone number and e-mail address.

Ship the unit prepaid in the original container or a container of sufficient strength and protection to EndRun Technologies. EndRun will not be responsible for damage incurred during shipping to us. Be sure the RMA number is clearly identified on the shipping container. Our policy is to fix or repair the unit within 5 business days. If it is necessary to order parts or if other circumstances arise that require more than 5 days, an EndRun service technician will contact you.

Repair After Warranty Expiration

If the warranty period has expired, we offer repair services for equipment you have purchased from EndRun. Call and ask for a customer service agent. It is important to contact us first as many problems may be resolved with a phone call. Please have the serial number of the unit and the nature of the problem available before you call. If it is determined that the equipment has failed and you want EndRun to perform the repairs, we will issue you an RMA number. Ship the unit prepaid in the original container or a container of sufficient strength and protection to EndRun Technologies. EndRun will not be responsible for damage incurred during shipping to us. Customer is responsible for shipping costs to and from EndRun Technologies. Be sure the RMA number is clearly identified on the shipping container. After the equipment has been received we will evaluate the nature of the problem and contact you with the cost to repair (parts and labor) and an estimate of the time necessary to complete the work.

Limitation of Liability

The remedies provided herein are Buyer's sole and exclusive remedies. EndRun Technologies shall not be liable for any direct, indirect, special, incidental or consequential damages, whether based on contract, tort or any other legal theory.

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Chapter 1

Introduction

The Tempus Cntp is a precision server of Universal Coordinated Time (UTC) that can be connected via a 10/100Base-T ethernet port to any TCP/IP network. In its most basic operation, it sends Network Time Protocol (NTP)/Simple Network Time Protocol (SNTP) reply packets in response to NTP/SNTP request packets which it has received from clients. The timestamps it sends in its NTP/SNTP reply packets are accurate to less than one-hundred microseconds. NTP/SNTP client software is available for virtually all operating systems.

The Tempus Cntp is composed of a Praecis Cntp Code Division Multiple Access (CDMA) time and frequency engine, an IBM-PC compatible single board computer with fanless, convection-cooled 133 MHz CPU with integral ethernet interface, a graphic vacuum-fluorescent display, a keypad, and a power supply. Non-volatile storage of the embedded Linux operating system and the Tempus Cntp application software on the single board computer is via a solid state FLASH disk.

For more detailed information that is not included in this manual, and links to other sites, please visit our website: http://www.endruntechnologies.com. There you can also download firmware upgrades, the latest manuals and other documentation.

CDMA Timing–How it Works

CDMA mobile telecommunications base stations must be synchronized.

The CDMA time and frequency engine in the Tempus Cntp receives transmissions from base stations, also known as cell sites, that are operating in compliance with the TIA/EIA IS-95 standard for Code Division Multiple Access (CDMA) mobile telecommunications. This system requires a means of synchronizing the base stations throughout the network so that neighboring cells do not interfere with each other and so that calls can be efficiently transferred between the base stations, without interruption, as the mobile user traverses the cell coverage areas. This 'soft hand-off' feature means that the mobile telephone must be able to 'hitlessly' drop one base station and pick up the next one. To do this, the telephone must be able to calculate the relative difference in time between the codes that modulate the signals from each of the base stations, which again, requires that the base stations be synchronized.

Each base station contains at least one state-of-the art GPS timing receiver with an ultra-stable local oscillator.

The system designers chose the Global Positioning System (GPS), which is itself a CDMA-based system, as the means of maintaining synchronization, and they defined *system time* to be *GPS time*. Each base station throughout the system contains one or more high-performance GPS timing receivers with sophisticated algorithms that control either an extremely stable ovenized quartz crystal oscillator or a Rubidium vapor atomic frequency standard. Such elaborate means are needed to meet the very difficult operating specifications required by the TIA/EIA IS-95 standard. The base station time synchronization must remain within 10 microseconds of GPS time over periods as long as twenty-four hours during which GPS satellite signals might not be available (typically due to antenna/cable failure, damage or vandalism) and in an environment where large ambient temperature swings may occur. Equipment capable of meeting these requirements is at the current state-of-the-art.

The base stations transmit a sync signal that all of the phones must use to establish and maintain system time.

The CDMA time and frequency engine in the Tempus Cntp receives the same initialization signals transmitted by the base stations that are used by the mobile telephones to establish their synchronization to system time. The mobile telephones cannot communicate in the system until they have established synchronization with the received spread spectrum encoded waveform. Unlike the mobile telephones, once this synchronization has occurred, the CDMA time and frequency engine in the Tempus Cntp has all of the information that it needs to perform its function of delivering accurate UTC time to a network of computers. The mobile telephone must decode much more information, establish two-way communications with the base station, and be a paid subscriber to performs its function of placing and receiving calls.

Spread spectrum modulation allows near perfect extraction of the timing information. We call it 'indirect GPS'.

All of this means that during normal operation, the quality of the timing information being transmitted from each of the base stations is virtually a repeat of that directly obtainable from the GPS. The big difference is that the received signal strengths from the base stations are a minimum of 30 dB larger than those from the GPS satellites, which is why you can usually talk on your cell phone indoors. Due to the nature of the IS-95 spread spectrum CDMA modulation scheme, this timing information may be extracted by a well-designed receiver with a precision of a few nanoseconds. The CDMA time and frequency engine in the Tempus Cntp does just that, and for this reason, we call our technology 'indirect GPS'.

Where to Use It

You must have *cellular*, IS-95 CDMA coverage.

First, the Tempus Cntp must be deployed in a *cellular* IS-95 CDMA coverage area. *Cellular* is a commonly used term implying that the frequency band for the base station carrier transmissions is 824-895 MHz. This is in contrast to *PCS*, which implies operation in the 1850-1990 MHz frequency band. The Tempus Cntp uses the cellular frequency band because it provides much better propagation characteristics in regards to building penetration and maximum receivable range from the transmitter. In general, if your cellular CDMA telephone works where you plan to install the Tempus Cntp, then your Tempus Cntp will work properly there.

Just about any computer network using TCP/IP can use the Tempus Cntp

Because the Tempus Cntp has been designed to operate in conjunction with existing public domain NTP/SNTP client software that has been created for use with similar time servers, it may be used in any computer network environment that is using TCP/IP protocols. Although client software is available for all platforms, for the most precise applications, the Unix-like operating systems are best supported.

Main Features

Performance, reliability and economy

The Tempus Cntp provides high performance and reliability combined with low power consumption and cost. Its internal sub-assemblies are fabricated using state-of-the-art components and processes and are integrated in a solid, high-quality chassis.

Flexibility

It supports a variety of TCP/IP network protocols compatible with a variety of platforms and operating systems.

Easy Installation

Its standard 1U high, 19” rack-mountable chassis and rooftop *or window-mounted* antenna make installation simpler compared to competing products that *require* rooftop installation of the antenna. The rack-mount chassis may be mounted in any convenient location. Connect it to your network via the rear panel mounted, 10/100Base-T RJ-45 connector and plug in the AC power cord. Initial network configuration is automatic on networks using the Dynamic Host Configuration Protocol (DHCP). Manual network configuration is via the RS-232 serial I/O port and a simple Linux shell script.

Free FLASH Upgrades

Firmware and configurable hardware parameters are stored in non-volatile FLASH memory, so the Tempus Cntp can be easily upgraded in the field using FTP and TELNET or the local RS-232 serial I/O port. Secure upgrades are possible via SSH and SCP. We make all firmware upgrades to our Tempus products available to our customers free of charge.

Chapter

2

Basic Installation

This chapter will guide you through the most basic checkout and physical installation of your Tempus Cntp. Subsequent chapters and appendices will give you the information needed to configure your installation for the maximum performance in your operating environment. General NTP client setup instructions will also be supplied to get you started using your Tempus Cntp quickly.

Basic familiarity with TCP/IP networking protocols like **`ping, telnet`** and **`ftp`** is required. Though some familiarity with Linux or other Unix-like operating systems would be helpful, it is not essential. If you satisfy these conditions, the instructions provided herein should guide you to a successful installation.

Checking and Identifying the Hardware

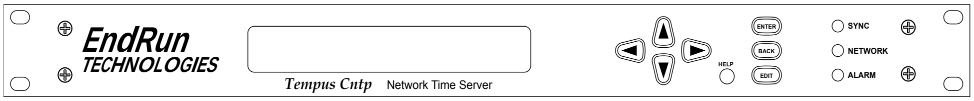
Unpack and check all the items using the following check list. Contact the factory if anything is missing or damaged.

The Tempus Cntp Hardware Pack (part # 4007-0000-000 or # 4007- variant) contains:

- ❑ Tempus Cntp (part # 3013-0000-000 or # 3013- variant)
- ❑ Tempus Cntp User's Manual (part # USM3013-0000-000)
- ❑ IEC 320 AC Power Cord (part # 0501-0003-000)
  (This part will not be present if using the DC power option.)
- ❑ DB-9F to DB-9F Null Modem Serial I/O Cable (part # 0501-0002-000)
- ❑ RJ-45 to RJ-45 CAT-5 patch cable, 2 meters (part # 0501-0002-000)
- ❑ Magnetic mount antenna/cable assembly (part # 0502-0001)

Tempus Cntp Physical Description

Front Panel



Sync Status LED

This green LED flashes to indicate synchronization status..

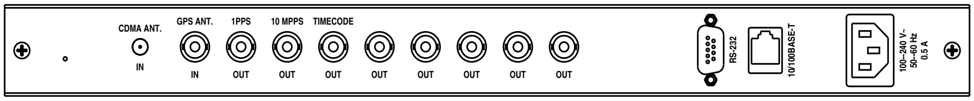
Network LED

This amber LED illuminates when the Tempus Cntp is connected to the network and flashes when receiving or transmitting packets.

Alarm Status LED

This red LED illuminates briefly at power-up, and thereafter whenever a serious fault condition exists.

Rear Panel



CDMA ANT. Jack

This SMA connector mates with the cable from the external, magnetic mount antenna.

1PPS Jack

This BNC connector provides the optional 1PPS TTL output.

10 MPPS Jack

This BNC connector provides the optional 10 MPPS TTL output.

Timecode Jack

This BNC connector provides the optional IRIG-B time code output.

**10 MHz, 5 MHz, 1 MHz,
5 MPPS, 1 MPPS,
Time Code TTL Jacks**

These BNC connectors are additional optional outputs and may or may not be present on your unit.

RS-232 Serial I/O Jack

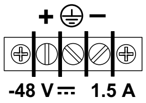
This DB-9M connector provides the RS-232 serial I/O console interface to the Tempus Cntp. This console allows the user to initialize and maintain the Tempus Cntp. A null modem adapter is required to connect this port to another computer.

10/100Base-T Jack

This RJ-45 connector mates with the ethernet twisted pair cable from the network.

AC Power Input Jack This IEC 320 standard three-prong connector provides AC power.

DC Power Input Block This optional 3-position terminal block provides connection to the DC power source, and replaces the AC power input jack.



Performing an Initial Site Survey

Using the status LED indicators, it's easy to find out if your Tempus Cntp will work in your desired location:

1. Screw the SMA plug on the end of the antenna cable onto the SMA antenna input jack on the chassis rear panel of the Tempus Cntp.
2. Plug one end of the supplied AC power cord into an 85-270 VAC outlet.
3. Plug the other end into the AC input connector on the chassis rear panel of the Tempus Cntp.

> **NOTE**
>
> After power is applied, the front-panel display will remain blank for approximately 60 seconds while the Tempus Cntp is initializing.

Place the antenna on a flat, preferably metallic surface while the unit is searching for the signal. Make sure that it is not blocked by large metallic objects closer than one meter. Although the antenna should normally be installed in a vertical orientation, usually multipath conditions due to signal reflections indoors cause at least some of the signal to be horizontally polarized, so do not be surprised if you find that the unit will work with the antenna oriented either way. Multipath conditions can also cause another effect: signal cancellation. Since the wavelength of the signal is only about thirty centimeters, movement of the antenna just a few centimeters can sometimes cause significant signal strength changes.

Initially upon power up:

1. The unit will light the red Alarm Status LED for about ten seconds.

2. Then it will continuously light the green Sync Status LED.
3. When the unit has detected a CDMA signal, the green Sync Status LED will begin to flash very slowly (about a .4 Hz rate).
4. As the unit locks onto the CDMA signal and begins to decode the timing data, the green Sync Status LED will flash very rapidly (about a 6 Hz rate) until the data is fully decoded.
5. Then the green Sync Status LED will pulse at precisely a 1 Hz rate, synchronized to UTC seconds, with a short on duration relative to the off duration.

At this point, the CDMA time and frequency engine has fully synchronized, and you may procede to permanently mounting the chassis and antenna in the desired location.

If this sequence has not occurred within twenty minutes, you should move the antenna and/or change its orientation and re-try. If you are unable to find an antenna location where the unit will acquire the CDMA signals, you may not have coverage in your area or the signal might be too weak in your facility. You should continue to try for at least a day, however since base stations are taken down for service from time to time.

If you have a cellular CDMA phone, see if it will work in *digital* mode. If it will, then your Tempus Cntp may be damaged and should be returned to the factory for repair or exchange.

Installing the Tempus Cntp

Mount the Tempus Cntp

Using standard 19” rack mounting hardware, mount the unit in the previously surveyed location.

CAUTION

Ground the unit properly with the supplied power cord.

Position the power cord so that you can easily disconnect it from the Tempus Cntp.

Do not install the Tempus Cntp where the operating ambient temperature might exceed 122°F (50°C).

Connecting DC Power (option)

Connect the safety ground terminal to earth ground. Connect the “+” terminal to the positive output of the DC power source. Connect the “-” terminal to the negative output of the DC power source. Note that the Tempus Cntp has a “floating” internal power supply, therefore either the positive or negative output of the DC power source can be referenced to earth ground.

CAUTION

This unit will not operate while the "+" and "-" power terminals are reverse connected.

Installing the antenna

Make sure that the antenna is not blocked by metallic objects that are closer than about one meter. A good location is the top surface of the equipment rack into which the unit has been installed. Ideally it should be mounted vertically, as the transmitted signals are vertically polarized. When indoors, however, multipath conditions may exist. This means that reflected signals may be present with either vertical or horizontal polarization, so your antenna might work in either orientation. After mounting the unit and antenna, verify that it still acquires and tracks a CDMA signal.

Connecting and Configuring Ethernet

Connect one end of the CAT-5 patch cable supplied with your Tempus Cntp to the rear panel mounted RJ-45 connector labeled 10/100BASE-T. Connect the other end of the patch cable to your network through a 'straight' port on your hub. Do not connect it to a 'crossover' port on your hub.

By factory default, the Tempus Cntp will attempt to configure the ethernet interface automatically via the Dynamic Host Configuration Protocol (DHCP). The Tempus Cntp will attempt to set the netmask, its IP address, the IP address of the default gateway, the domain name and the IP addresses of any nameservers, if the DHCP server is configured to provide them. You may optionally configure the Tempus Cntp to also set its hostname via DHCP, if your DHCP server is configured to provide it. You can do this by running a simple shell script called **`netconfig`** after your unit is up on the network.

If your network *does* use DHCP for host configuration, and you are in a hurry to get your Tempus Cntp up and running, you may proceed to *Verifying Network Configuration* to make sure that the network parameters were set up correctly. Otherwise, it is recommended that you read the following sections on use of the RS-232 serial I/O port now, since they will help you in debugging any problems that you may encounter with the automatic configuration via DHCP.

If your network *does not* use DHCP, you will need to configure your ethernet interface using either the front-panel keypad or the RS-232 serial I/O port. The following sections contain brief descriptions on how to do that.

Configuring Ethernet with the Front-Panel Keypad

Configuring your ethernet interface with the front-panel keypad is quite simple. After the unit has powered on press the ENTER key once or twice until you see a display called Main Menu. Now press the RIGHT arrow key until the "Network" selection is highlighted. Press ENTER again. You will see the IP address, gateway and netmask settings displayed here. Press the EDIT key to modify these settings. The sequence of edit displays will guide you through the setup process. Press the HELP key at any time to view context-sensitive help information. When you are finished the unit will reset. Skip to the section called "Check Network Operation" later in this chapter to continue with the basic installation procedures.

Configuring Ethernet with the Serial Port

To configure your ethernet interface with the serial port, after logging in as the *root* user, you must run a simple shell script called **`netconfig`** from the **`ash`** shell prompt. This shell script will prompt you for the needed information and perform some syntax checking on your inputs. Then it will create or modify the appropriate files needed to configure the ethernet interface. The following sections will guide you in setting up communications with the Tempus Cntp using its RS-232 serial I/O port.

Connect the RS-232 Serial I/O Port

To test serial communications with the Tempus Cntp you will need either a VT100 compatible terminal or a terminal emulation program running on your computer. We will refer to either of these as "terminal" for the remainder of this instruction.

1. Disconnect power from the Tempus Cntp.

2. Connect one end of the DB9F to DB9F null modem adapter cable to the serial I/O jack on the Tempus Cntp.

3. Connect the other end of the DB9F to DB9F null modem adapter cable to the terminal. If the serial I/O port on your terminal does not have a DB9M connector, you may need to use an adapter. Refer to Chapter 6 – *RS-232 Serial I/O Port Signal Definitions* for details on the signal wiring. *If you are using a computer for your terminal, remember which port you are using because you will need to know that in order to set up your terminal software.*

Test the Serial Port

You must configure your terminal to use the serial I/O port you used in *Connect the RS-232 Serial I/O Port*. You must also configure your terminal to use the correct baud rate, number of data bits, parity type and number of stop bits. *Be sure to turn off any hardware or software handshaking*. The settings for the Tempus Cntp are:

- ❑ 19200 is the Baud Rate
- ❑ 8 is the number of Data Bits
- ❑ None is the Parity
- ❑ 1 is the number of Stop Bits

After configuring these parameters in your terminal, apply power to the Tempus Cntp. After about 20 seconds, your terminal should display a sequence of boot messages similar to these:

```
LILO
Low memory: 0262 Kb
boot:
```

These three lines are the Linux Loader (LILO) boot prompt. This prompt will timeout after 5 seconds and the Linux kernel and the factory default Tempus Cntp root file system will be loaded. When the Linux kernel is loaded from the FLASH disk into RAM a long list of kernel-generated, informational messages is displayed as the kernel begins execution and the various device drivers are initialized:

```
Loading TempusCntp_0...........................................
Linux version 2.2.13-DOC (root@endrun1) (gcc version egcs-2.91.66 19990314/Linux
(egcs-1.1.2 release)) #14 Fri Jun 21 10:53:55 PDT 2002
Calibrating delay loop... 52.63 BogoMIPS
Memory: 28280k/32768k available (580k kernel code, 440k reserved, 532k data, 32k
init)
Checking if this processor honours the WP bit even in supervisor mode... Ok.
CPU: Cyrix Cx486DX2
Checking 386/387 coupling... OK, FPU using exception 16 error reporting.
Checking ‘hlt’ instruction... OK.
POSIX conformance testing by UNIFIX
PCI: PCI BIOS revision 2.10 entry at 0xfb180
PCI: Probing PCI hardware
Linux NET4.0 for Linux 2.2
Based upon Swansea University Computer Society NET3.039
NET4: Unix domain sockets 1.0 for Linux NET4.0.
NET4: Linux TCP/IP 1.0 for NET4.0
IP Protocols: ICMP, UDP, TCP
Starting kswapd v 1.5
Serial driver version 4.27 with no serial options enabled
ttyS00 at 0x03f8 (irq = 4) is a 16550A
ttyS01 at 0x02f8 (irq = 3) is a 16550A
ttyS03 at 0x02e8 (irq = 0) is a 16550A
RAM disk driver initialized:  16 RAM disks of 8192K size
Flash disk driver for DiskOnChip2000
Copyright (C) 1998,2000 M-Systems Flash Disk Pioneers Ltd.
Copyright (C) 2000 Lineo
DOC device(s) found: 1
Fat Filter Enabled
rtl8139.c:v1.07 5/6/99 Donald Becker http://cesdis.gsfc.nasa.gov/linux/drivers/
rtl8139.html
eth0: RealTek RTL8139 Fast Ethernet at 0xe400, IRQ 11, 00:d0:c9:91:18:0a.
fl_geninit: registered device at major: 100
partition: 0: start_sect: 0, nr_sects: 3e30 Fl_blk_size[]: 1f18kb
partition: 1: start_sect: 0, nr_sects: 0 Fl_blk_size[]: 0kb
Partition check:
 fla: fla1 fla2 fla3 fla4
RAMDISK: Compressed image found at block 0
VFS: Mounted root (ext2 filesystem).
Freeing unused kernel memory: 32k freed
INIT: version 2.76 booting
Parallelizing fsck version 1.15 (18-Jul-1999)
ext2fs_check_if_mount: No such file or directory while determining whether
/dev/msys/fla1 is mounted.
/dev/msys/fla1: clean, 39/80 files, 562/639 blocks
ext2fs_check_if_mount: No such file or directory while determining whether
/dev/msys/fla2 is mounted.
/dev/msys/fla2: clean, 15/32 files, 175/240 blocks
 fla: fla1 fla2 fla3 fla4
```

```
/dev/msys/fla1 o fla:n /boot type ext fla12 (rw)
 fla2 fla3 fla4
/dev/msys/fla2 on /logs type ext2 (rw)
/proc on /proc type proc (rw)
hwclock: Can't open /dev/tty1, errno=19: No such device.
INIT: Entering runlevel: 3
Entering multiuser...
Attempting to configure eth0 by contacting a DHCP server...
```

At this point, if you do not have a DHCP server configured on your network the unit will time-out and print these messages:

```
Tempus Cntp DHCP Client was unable to find the DHCP Server!
Fix the problem and re-boot or set up static IP address
by running netconfig.
dnsdomainname: Host name lookup failure
(none)
```

Then these messages are printed, in either case.

```
Activating IPv4 packet forwarding...
Starting daemons:  syslogd klogd inetd
Starting the Network Time Protocol daemon...
Starting the SNMP daemon...
Starting the system logfile manager...
Starting the system watchdog...woof!
PCM9340 CPU
Starting Keypad/Display Process
```

During this process, the factory default TempusCntp_0 root file system is loaded from FLASH disk to an 8MB ramdisk and the remainder of the boot process completes. At this point, the Tempus Cntp login prompt is displayed:

```
*********************************************************************************
*           Welcome to Tempus Cntp console on:  cntp.your.domain
*           Tue Feb 20  2001 21:47:03 UTC
*********************************************************************************

cntp login:
```

Here you may log in as "cntpuser" with password "Praecis" or as the "root" user with password "endrun_1". When logged in as "cntpuser", you may check status information and view log files but you will not be able to modify any system settings or view secure files. In order to perform system setup procedures, which includes configuring the IP network settings, you must log in as the "root" user. After correctly entering the password at this prompt,

```
password:
```

the sign on message is shown. It identifies the host system as Tempus Cntp and shows the software part number, version and build date:

```
Tempus Cntp 6010-0005-000 v 1.00 Wed May  9 14:17:44 UTC 2002
Tempus Cntp->
```

This last line is the standard Tempus Cntp shell prompt. The Tempus Cntp uses the **ash** shell, which is a reduced functionality, **bash**-compatible shell. After configuring the unit, you should change the passwords using the **cntppasswd** command issued from the shell prompt.

If you do not see characters displayed by your terminal program within 30 seconds after the unit is powered up, you must troubleshoot your setup. An incorrectly wired cable or incorrect port setting in your terminal emulation program are the most common problems. Refer to Chapter 6 – *RS-232 Serial I/O Port Signal Definitions* for the signal connections for the Tempus Cntp.

> **NOTE**
>
> You must use a null-modem cable or adapter if you are connecting the Tempus Cntp to another computer or other equipment configured as Data Terminal Equipment (DTE). The supplied cable is a null modem cable.

Once you have successfully established communications with the Tempus Cntp, you may procede to configuring the network parameters. Then you can communicate with the Tempus Cntp over the network using **telnet** or **ssh** and synchronize your network computers to UTC using NTP.

Using netconfig to Set Up Your IP

The following is a sample transcript which illustrates the use of **netconfig**. The entries made by the user are underlined and are provided purely for illustrative purposes. You must provide equivalent entries that are specific to your network. Those shown here are appropriate for a typical network that does not use DHCP. Start the configuration process by typing **netconfig** at the shell prompt:

```
Tempus Cntp-> netconfig

********************************************************************************
******************** Tempus Cntp Network Configuration  ************************
********************************************************************************
*                                                                             *
*   This script will configure the TCP/IP network parameters for your         *
*   Tempus Cntp. You will be able to reconfigure your system at any time      *
*   by typing:                                                                *
*                                                                             *
*   netconfig                                                                 *
*                                                                             *
*   The settings you make now will not take effect until you restart your     *
*   Tempus Cntp, so if you make a mistake, just re-run this script before     *
*   re-booting.                                                               *
*                                                                             *
*   You will be prompted to enter your network parameters now.                *
*                                                                             *
********************************************************************************
********************************************************************************

---DHCP Settings
```

```
Use a DHCP server to configure the ethernet interface? ([y]es, [n]o) n

---HOST name setting

Set the hostname of your Tempus Cntp. Only the base
hostname is needed, not the domain.
Enter hostname: cntp

---DOMAIN name setting

Set the domain name. Do not supply a leading '.'
Enter domain name for cntp: your.domain

---STATIC IP ADDRESS setting

Set the IP address for the Tempus Cntp. Example: 111.112.113.114
Enter IP address for cntp (aaa.bbb.ccc.ddd): 192.168.1.245

---DEFAULT GATEWAY ADDRESS setting

Set the default gateway address, such as 111.112.113.1
If you don't have a gateway, just hit ENTER to continue.
Enter default gateway address (aaa.bbb.ccc.ddd): 192.168.1.241
---NETMASK setting

Set the netmask. This will look something like this: 255.255.255.0
Enter netmask (aaa.bbb.ccc.ddd): 255.255.255.248

Calculating the BROADCAST and NETWORK addresses...
Broadcast = 192.168.1.247     Network = 192.168.1.240

Your Tempus Cntp's current IP address, full hostname, and base hostname:
192.168.1.245       cntp.your.domain    cntp

---DOMAIN NAMESERVER(S) address setting

Will your Tempus Cntp be accessing a nameserver ([y]es, [n]o)? y

Set the IP address of the primary name server to use for domain your.domain.
Enter primary name server IP address (aaa.bbb.ccc.ddd): 192.168.1.1

Will your Tempus Cntp be accessing a secondary nameserver ([y]es, [n]o)? y

Set the IP address of the secondary name server to use for domain your.domain.
Enter secondary name server IP address (aaa.bbb.ccc.ddd): 192.168.1.2

Setting up TCP/IP...
Creating /etc/HOSTNAME...
Creating /etc/rc.d/rc.inet1...
Creating /etc/networks...
Creating /etc/hosts...
Creating /etc/resolv.conf...

******************************************************************************
******************************************************************************
*                                                                            *
*          The Tempus Cntp network configuration has been updated.           *
*                                                                            *
*             Please re-boot now for the changes to take effect.             *
*                                                                            *
******************************************************************************
******************************************************************************

******************************************************************************
```

Verify Network Configuration

If you have made changes to your network configuration using **netconfig**, you should shutdown the Tempus Cntp and re-boot it. There are two ways to do this:

1. Cycle power to the Tempus Cntp.

2. Issue the shutdown with re-boot command at the shell prompt:

```
Tempus Cntp-> shutdown -r now
```

If you are using the RS-232 serial I/O port to communicate with the Tempus Cntp, you will be able to see the kernel generated boot messages when the unit re-boots. You should note the line

```
Configuring eth0 as 192.168.1.245...
```

if you have set up a static IP address, or this line

```
Attempting to configure eth0 by contacting a DHCP server...
```

if you are using DHCP. It appears near the end of the kernel generated boot messages.

If you are using DHCP and are not using the RS-232 serial I/O port, you will have to check the DHCP configuration information maintained by your DHCP server to determine the expected IP address and log in to the Tempus Cntp using **telnet** or **ssh** to verify successful DHCP configuration. Refer to the subsequent topics in this section *Using Telnet* and *Using SSH*, for details on logging in to the Tempus Cntp that way. Once you have logged in, you may perform the following checks.

If you are not using DHCP, the IP address shown should match the static IP address which you entered during the **netconfig** procedure. If so, log in as "root" at the login prompt and check the other configuration parameters using **ifconfig:**

```
Tempus Cntp-> ifconfig

eth0      Link encap:Ethernet  HWaddr 00:D0:C9:11:33:41
          inet addr: 192.168.1.245 Bcast:192.168.1.247 Mask:255.255.255.248
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:3779 errors:0 dropped:0 overruns:0 frame:0
          TX packets:727 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:100
          Interrupt:5 Base address:0x300

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          UP LOOPBACK RUNNING  MTU:3924  Metric:1
          RX packets:170 errors:0 dropped:0 overruns:0 frame:0
          TX packets:170 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
```

Pay particular attention to the settings shown for **eth0** and in particular the **Mask:** setting, which should match that which is appropriate for your network. Now check the remaining configuration parameters using **route**:

```
Tempus Cntp-> route

Kernel IP routing table
Destination     Gateway         Genmask          Flags Metric Ref Use Iface
localnet        *               255.255.255.248  U     0      0   0   eth0
loopback        *               255.0.0.0        U     0      0   0   lo
default         192.168.1.241   0.0.0.0          UG    1      0   0   eth0
```

Here you are interested in the default gateway address. It should match the appropriate one for your network. If so, then the ethernet interface of your Tempus Cntp has been successfully configured to operate on your network and you are ready to check operation of the Tempus Cntp over the network. If not, you should re-check your configuration and/or repeat the **netconfig** procedure.

If you have configured a nameserver(s) for your network, you may check that by issuing this shell command:

```
Tempus Cntp-> cat /etc/resolv.conf

search your.domain
nameserver 192.168.1.1
nameserver 192.168.1.2
```

Which displays the contents of the */etc/resolv.conf* file containing your domain name and the nameserver IP address(es) to use for that domain.

Check Network Operation

With your Tempus Cntp network parameters properly configured, you are ready to test the setup using **ping** from a server or workstation that is able to access the network connected to the Tempus Cntp. Alternatively, you could **ping** one of your servers or workstations from the Tempus Cntp shell prompt to test the setup.

Once you have successfully established network communications with the Tempus Cntp, you may perform all maintenance and monitoring activities via **telnet** and **ftp**. The Tempus Cntp provides both client and server operation using **telnet.** For security reasons as well as to reduce the memory footprint in the Tempus Cntp, only client operation is supported using **ftp**.

Security conscious users will want to use **ssh**, the *secure shell* replacement for **telnet**, as the login means. The companion utility, **scp** provides a secure replacement for **ftp** as a means of transferring files to and from the Tempus Cntp. Both of these protocols are supported in the Tempus Cntp via the OpenSSH implementations for Linux. Refer to Appendix A – *Security* for more information about the *secure shell* protocol and its configuration.

Using Telnet

When establishing a **`telnet`** connection with your Tempus Cntp, logging in directly as *root* is not permitted. This is a security measure that makes it slightly more difficult to gain access by simply trying passwords, since it is also necessary to know the name of a user. When you initiate a **`telnet`** session with the Tempus Cntp, this banner will be displayed:

```
********************************************************************************
*           Welcome to Tempus Cntp telnet console on:  cntp.your.domain
********************************************************************************

Cntp login:
```

Here you may log in as "cntpuser" with password "Praecis". When logged in as "cntpuser", you may check status information and view log files but you will not be able to modify any system settings or view secure files. After correctly entering the password at this prompt,

```
Password:
```

the sign on message is shown. It identifies the host system as Tempus Cntp and shows the software part number, version and build date:

```
Tempus Cntp 6010-0005-000 v 1.00 Wed May 16 14:17:44 UTC 2002
Tempus Cntp->
```

This last line is the standard Tempus Cntp shell prompt. The Tempus Cntp uses the **`ash`** shell, which is a reduced functionality, **`bash`**-compatible shell. After configuring the unit, you should change the passwords using the **`cntppasswd`** command issued from the shell prompt.

To gain *root* access, you must now issue the "super user" command at the shell prompt:

```
Tempus Cntp-> su root
```

You will then be prompted for the password, which is "endrun_1", and be granted *root* access to the system. To leave "super user" mode, issue the shell command **`exit`**. Issuing **`exit`** again will close the **`telnet`** session.

Using SSH

When establishing a **`ssh`** connection with your Tempus Cntp, logging in directly as *root* is permitted. When you log in as *root* via a **`ssh`** session with the Tempus Cntp, this banner will be displayed:

```
********************************************************************************
*             Welcome to Tempus Cntp SSH console on:  cntp.your.domain
********************************************************************************

root@cntp.your.domain's password:
```

Here you may log in as "root" with password "endrun_1". After correctly entering the password the sign on message is shown. It identifies the host system as Tempus Cntp and shows the software part number, version and build date:

```
Tempus Cntp 6010-0005-000 v 1.00 Wed Jan 02 14:17:44 UTC 2002
Tempus Cntp->
```

This last line is the standard Tempus Cntp shell prompt. The Tempus Cntp uses the **`ash`** shell, which is a reduced functionality, **`bash`**-compatible shell. After configuring the unit, you should change the passwords using the **`cntppasswd`** command issued from the shell prompt.

Issuing **`exit`** will close the **`ssh`** session.

Configuring the Network Time Protocol

Now that the network has been configured and tested, you may configure the operation of the NTP server. By default, the Tempus Cntp is configured to respond to NTP requests from clients that may or may not be using MD5 authentication. If the clients are using MD5 authentication, they must be configured properly with the same MD5 authentication keys as the Tempus Cntp. If you need to modify the factory default Tempus Cntp MD5 keys (recommended) or set up broadcast/multicast operation, then you will need to re-configure the NTP subsystem.

NOTE

If you would like to configure your server for multicast operation, configure it as you would for broadcast operation, with the exception that you must enter this specific NTP multicast address: 224.0.1.1, when you are prompted to enter the broadcast address.

You may perform the configuration from either a **`telnet`** or **`ssh`** session, the front-panel keypad, or the local RS-232 console.

Configuring NTP Using the Front-Panel Keypad

To configure NTP using the front-panel keypad go to the Main Menu display. Press the RIGHT arrow key until the "NTP" selection is highlighted. Press ENTER again. Press the RIGHT arrow key to highlight "Setup" and press ENTER. From this display you can configure broadcast/multicast mode. You can also select previously configured

MD5 authentication keys from this display. However, to configure new keys you will need to run **ntpconfig**.

Configuring NTP Using the Network Interface or Serial Port

The following is a transcript of the question and answer configuration utility provided by **ntpconfig**. The user entered parameters are underlined:

```
Tempus Cntp-> ntpconfig

*******************************************************************************
**********************Network Time Protocol Configuration**********************
*******************************************************************************
*                                                                             *
*   This script will allow you to configure the ntp.conf and ntp.keys files   *
*   that control Tempus Cntp NTP daemon operation.                            *
*                                                                             *
*   You will be able to create new MD5 authentication keys which are stored   *
*   in the ntp.keys file.                                                     *
*                                                                             *
*   You will be able to update the authentication related commands in the    *
*   ntp.conf file.                                                            *
*                                                                             *
*   You will be able to configure the "broadcast" mode of operation, with    *
*   or without authentication.  If you supply the multicast address instead   *
*   of your network broadcast address, then you will be able to configure    *
*   the time-to-live of the multicast packets.                                *
*                                                                             *
*   The changes you make now will not take effect until you re-boot the      *
*   Tempus Cntp.  If you make a mistake, just re-run ntpconfig prior to      *
*   re-booting.                                                               *
*                                                                             *
*   You will now be prompted for the necessary set up parameters.            *
*                                                                             *
*******************************************************************************
*******************************************************************************

---MD5 Keyfile Configuration

Would you like to create a new ntp.keys file? ([y]es, [n]o) y

You will be prompted for a key number (1 - 65534), then the actual key.
When you have entered all of the keys that you need, enter zero at the next
prompt for a key number.

MD5 keys may contain from 1 to 31 ASCII characters.  They may not contain
SPACE, TAB, LF, NULL, or # characters!

Enter a key number (1-65534) or 0 to quit: 1

Enter the key (1-31 ASCII characters): EndRun_Technologies_LLC

Writing key number: 1 and Key: EndRun_Technologies_LLC to ntp.keys

Enter a key number (1-65534) or 0 to quit: 2

Enter the key (1-31 ASCII characters): Tempus_Cntp

Writing key number: 2 and Key: Tempus_Cntp to ntp.keys
Enter a key number (1-65534) or 0 to quit: 0
---NTP Authentication Configuration
Do you want authentication enabled using some or all of the keys in
```

```
the ntp.keys file? ([y]es, [n]o) y

You will be prompted for key numbers (1 - 65534), that you want NTP to
"trust".  The key numbers you enter must exist in your ntp.keys file.  If you
do not want to use some of the keys in your ntp.keys file, do not enter them
here.  NTP will treat those keys as "untrusted".

Clients that use any of the "trusted" keys in their NTP polling packets will
receive authenticated replies from the Tempus Cntp.  When you have entered
all of the "trusted keys" that you need, enter zero at the next prompt for a
key number.

Enter a trusted key number (1-65534) or 0 to quit: 1

Enter a trusted key number (1-65534) or 0 to quit: 2

Enter a trusted key number (1-65534) or 0 to quit: 0

---NTP Broadcast/Multicast Configuration

Would you like to enable broadcast/multicast server operation? ([y]es, [n]o) y

Set the network broadcast/multicast address for the Tempus Cntp to use.  For
broadcast mode, this address is the all 1's address on the sub-net.
Example: 111.112.113.255
For multicast operation, it is this specific address:  224.0.1.1

Enter IP address for NTP broadcast/multicast operation (aaa.bbb.ccc.ddd): 224.0.1.1

You have selected multicast operation.  Enter the number of hops that
are needed for the multicast packets on your network (positive integer): 1

It is highly recommended that authentication be used if you are using NTP in broadcast/
multicast mode.  Otherwise clients may easily be "spoofed" by a fake NTP
server.  You can specify an MD5 key number that the Tempus Cntp will use in its
broadcast/multicast packets.  The clients on your network must be configured to use
the same key.

Would you like to specify an MD5 key number to use with
broadcast mode? ([y]es, [n]o) y

Enter the MD5 key number to use (1-65534): 2

********************************************************************************
********************************************************************************
*                                                                              *
*    The Tempus Cntp Network Time Protocol configuration has been updated.     *
*                                                                              *
*              Please re-boot now for the changes to take effect.              *
*                                                                              *
********************************************************************************
********************************************************************************
********************************************************************************
```

Chapter

3

Setting Up NTP Clients on Unix-like Platforms

To configure your Unix-like computer to use your Tempus Cntp, you must have successfully completed the *Basic Installation* procedures in Chapter 2. This manual is not a 'How-To' on installing and using NTP; basic approaches to NTP client configuration for operation with the Tempus Cntp will be described. It is expected that you are, or have access to, a capable Unix/Linux system administrator and know more than a little about installing distributions from source code. Installation must be performed by a user with *root* priviledges on the system. If you have never used NTP, then you should spend some time reading the on-line documents, especially the Distribution Notes, FAQ and Configuration subject matter, which are available at:

http://www.ntp.org

Although all the information is available at the above site, the following are excellent tutorials on setting up NTP and are easier to understand:

http://www.sun.com/solutions/blueprints/0701/NTP.pdf

http://www.sun.com/solutions/blueprints/0801/NTPpt2.pdf

http://www.sun.com/solutions/blueprints/0901/NTPpt3.pdf

Many problems may also be solved by the helpful people who participate in the Internet news group devoted to NTP:

news://*your_news_server*/comp.protocols.time.ntp

Three methods of using the Tempus Cntp with NTP clients on Unix-like platforms will be described:

Basic This is the simplest, and will operate without MD5 authentication. **NTP beginners should always perform this setup first.**

MD5 This method is trickier only because MD5 keys must be set up and distributed accurately to the NTP clients in a secure way. The Tempus Cntp is factory configured to authenticate its replies to NTP MD5 clients using its default set of keys.

Broadcast/Multicast This method simplifies configuration of the clients on large networks since specific server addresses need not be configured in each client's */etc/ntp.conf* file. It can be configured either with or without MD5 authentication. However, it is highly recommended that authentication be configured when using broadcast/multicast mode due to the relative ease with which a fake NTP server can take over the clock setting of the broadcast/multicast clients on the network.

Basic NTP Client Setup

Basic setup is relatively simple, if:

- You have been able to successfully communicate with the Tempus Cntp on your network.
- You have installed NTP on your client computer.

Configure NTP

You must edit the *ntp.conf* file which **ntpd**, the NTP daemon, looks for by default in the the */etc* directory. Add this line to the ntp.conf file:

```
server 192.168.1.245
```

This line tells **ntpd** to use the NTP server at address 192.168.1.245 in addition to any other servers which might also be configured in the client's *ntp.conf* file.

Re-start **ntpd** to have it begin using the Tempus Cntp server. Use the NTP utility **ntpq** to check that **ntpd** is able to communicate with the Tempus Cntp. After issuing the command

```
ntpq
```

you will see the **ntpq** command prompt:

```
ntpq>
```

Use the command

```
peers
```

to display the NTP peers which your computer is using. One of them should be the Tempus Cntp server which you have just configured. You should verify that it is being 'reached'. (You may have to continue issuing the peers command for a minute or two before you will see the 'reach' count increment.) If you have other peers configured, verify that the offset information for the Tempus Cntp server peer and your other peers is in agreement to within a few milliseconds, assuming that the other peers are synchronized to that level of accuracy.

It may also be useful to start the NTP daemon in 'debug' mode (**`ntpd -d`**) to confirm successful configuration. Refer to the NTP documentation for detailed usage of these debug utilities.

MD5 Authenticated NTP Client Setup

MD5 authenticated setup is relatively simple, if:

- You have been able to successfully communicate with the Tempus Cntp on your network.
- Your Tempus Cntp has been configured to perform authentication either by factory default, or by running the **ntpconfig** shell script. The example Tempus Cntp authentication configuration shown in Chapter 2 – *Configuring the Network Time Protocol* will be assumed in the example configuration commands shown here.
- You have installed NTP on your client computer.
- You have successfully performed the *Basic NTP Client Setup* on your client computer.

Create the *ntp.keys* file

You must create a file named *ntp.keys* in the */etc* directory. It must be a copy of the one residing in the */etc* directory of your Tempus Cntp. You can **`telnet`** into your Tempus Cntp and start an **`ftp`** session with your client computer to send the Tempus Cntp's */etc/ntp.keys* file to your client computer, use the secure copy utility **`scp`**, or you can just use a text editor on your client computer to create an equivalent file.

IMPORTANT

Handling of the */etc/ntp.keys* file is the weak link in the MD5 authentication scheme. It is very important that it is owned by *root* and not readable by anyone other than *root*.

After transferring the file by **ftp**, and placing it in the */etc* directory on the client computer, issue these two commands at the shell prompt:

```
chown root.root /etc/ntp.keys
chmod 600 /etc/ntp.keys
```

Configure NTP

You must edit the *ntp.conf* file which **ntpd**, the NTP daemon, looks for by default in the */etc* directory. Assuming that you have created two trusted keys as shown in the example in the previous chapter, add these lines to the end of the *ntp.conf* file:

```
keys /etc/ntp.keys
trustedkey 1 2
```

Modify the line added previously in *Basic NTP Client Setup* so that authentication will be used with the Tempus Cntp server using one of the trusted keys, in this case key # 1:

```
server 192.168.1.245 key 1
```

Re-start **ntpd** to have it begin using the Tempus Cntp server with MD5 authentication. Use the NTP utility **ntpq** to check that **ntpd** is able to communicate with the Tempus Cntp. After issuing the command

```
ntpq
```

you will see the **ntpq** command prompt:

```
ntpq>
```

Use the command

```
peers
```

to display the NTP peers which your computer is using. One of them should be the Tempus Cntp server which you have just configured. You should verify that it is being 'reached'. (You may have to continue issuing the peers command for a minute or two before you will see the 'reach' count increment.)

You can verify that authentication is being used by issuing the command

```
associations
```

to display the characteristics of the client server associations. In the "auth" column of the display, you should see "OK" for the row corresponding to the Tempus Cntp server. If you see "bad", you should wait a few minutes to be sure that there is a problem since "bad" is the initial state of this setting. If the "bad" indication persists then you must check your configuration for errors. Typically this is due to a typing error in creating the */etc/ntp.keys* file on the client that causes a mismatch between the keys being used by the server and client. (If you transfer the file by **`ftp`** or **`scp`**, this shouldn't be a problem.) It is also possible to have a typing error in the */etc/ntp.conf* file that causes the needed key to not be included in the "trustedkey" list.

Broadcast/Multicast NTP Client Setup

Broadcast/multicast client setup is relatively simple, if:

- You have been able to successfully communicate with the Tempus Cntp on your network.
- Your Tempus Cntp has been configured to perform broadcasts or multicasts via the front-panel keypad or by running the **`ntpconfig`** shell script. (This is not the factory default configuration, so be sure to run **`ntpconfig.`**) If you are going to use MD5 authentication, your Tempus Cntp must have been configured to operate with authentication in the broadcast/multicast mode, and you must know which of the trusted keys it is using for broadcast/multicast operation. The example Tempus Cntp configuration shown in Chapter 2 – *Configuring the Network Time Protocol* will be assumed in the example configuration commands shown here.
- You have installed NTP on your client computer.
- You have successfully performed the *MD5 Authenticated NTP Client Setup* on your client computer, if you plan to use MD5 authentication.

Configure NTP

You must edit the *ntp.conf* file which **`ntpd`**, the NTP daemon, looks for by default in the the */etc* directory. Assuming that your Tempus Cntp server has been configured to use key 2 for broadcast authentication as shown in the example in Chapter 2, make sure that key 2 is included in the **`trustedkey`** line, and add this line to the end of the *ntp.conf* file:

```
broadcastclient
```

If you are not using MD5 authentication, you would add these lines:

```
disable auth
broadcastclient
```

If you are using multicast instead of broadcast mode, you would replace the **`broadcastclient`** keyword with the **`multicastclient`** keyword. You may remove the line added previously in *Basic NTP Client Setup*:

```
server 192.168.1.245
```

or the authenticated version added in *MD5 Authenticated NTP Client Setup*:

```
server 192.168.1.245 key 1
```

Re-start **`ntpd`** to have it begin using the Tempus Cntp as a broadcast or multicast server. Use the NTP utility **`ntpq`** to check that **`ntpd`** is able to communicate with the Tempus Cntp. After issuing the command

```
ntpq
```

you will see the **`ntpq`** command prompt:

```
ntpq>
```

Use the command

```
peers
```

to display the NTP peers which your computer is using. One of them should be the Tempus Cntp server which you have just configured. You should verify that is is being 'reached'. (You may have to continue issuing the peers command for a minute or two before you will see the 'reach' count increment.)

If you are using authentication, you can verify that authentication is being used by issuing the command

```
associations
```

to display the characteristics of the client server associations. In the "auth" column of the display, you should see "OK" for the row coresponding to the Tempus Cntp server. If you see "bad", you should wait a few minutes to be sure that there is a problem since "bad" is the initial state of this setting. If the "bad" indication persists then you must check your configuration for errors. Typically this is due to a typing error in creating the */etc/ntp.keys* file on the client that causes a mismatch between the keys being used by the server and client. (If you transfer the file by **`ftp`** or **`scp`**, this shouldn't be a problem.) It is also possible to have a typing error in the */etc/ntp.conf* file that causes the needed key to not be included in the "trustedkey" list.

Chapter
4

Setting Up NTP Clients on Windows NT 4.0/2000

To configure your Windows NT 4.0/2000 computer to use your Tempus Cntp, you must have successfully completed the *Basic Installation* procedures in Chapter 2. This manual is not a 'How-To' on installing and using NTP; basic approaches to NTP configuration for operation with the Tempus Cntp will be described here. Installation must be performed by a user with administrative priviledges on the system. If you have never used NTP, then you should spend some time reading the on-line documents at:

http://www.ntp.org

Although all the information is available at the above site, the following are excellent tutorials on setting up NTP and are easier to understand:

http://www.sun.com/solutions/blueprints/0701/NTP.pdf

http://www.sun.com/solutions/blueprints/0801/NTPpt2.pdf

http://www.sun.com/solutions/blueprints/0901/NTPpt3.pdf

Many problems may also be solved by the helpful people who participate in the Internet news group devoted to NTP:

news://*your_news_server*/comp.protocols.time.ntp

Three methods of using the Tempus Cntp with NTP clients on Window NT 4.0 platforms will be described:

Basic This is the simplest, and will operate without MD5 authentication. **NTP beginners should always perform this setup first.**

MD5 This method is trickier only because MD5 keys must be set up and distributed accurately to the NTP clients in a secure way. The Tempus Cntp is factory configured to authenticate its replies to NTP MD5 clients using its default set of keys.

Broadcast/Multicast This method simplifies configuration of the clients on large networks since specific server addresses need not be configured in each client's *\winnt\system32\drivers\etc\ntp.conf* file. It can be configured either with or without MD5 authentication. However, it is highly recommended that authentication be configured when using broadcast /multicast mode due to the relative ease with which a fake NTP server can take over the clock setting of the broadcast/multicast clients on the network.

Basic NTP Client Setup

Basic setup is relatively simple, if:

- You have been able to successfully communicate with the Tempus Cntp on your network.
- You have installed NTP on your client computer.

Configure NTP

You must edit the *ntp.conf* file which **ntpd.exe**, the NTP daemon, looks for by default in the the *\winnt\system32\drivers\etc* directory of the boot partition. If your NTP installation placed this file in a different place, you must find it and edit it. Add this line to the *ntp.conf* file:

```
server 192.168.1.245
```

This line tells **ntpd.exe** to use the NTP server at address 192.168.1.245 in addition to any other servers which might also be configured in the *ntp.conf* file.

Re-start **ntpd.exe** to have it begin using the Tempus Cntp server. By default, the NTP installation program installs **ntpd.exe** as a service called Network Time Protocol, and starts it. You must use the Services utility in Control Panel to stop the Network Time Protocol service and then re-start it.

Use the NTP utility **ntpq.exe** to check that **ntpd.exe** is able to communicate with the Tempus Cntp. By default it is installed in the *\Program Files\Network Time Protocol* sub-directory of your Windows NT partition. From a console window, after issuing the command

```
ntpq
```

you will see the **ntpq** command prompt:

```
ntpq>
```

Use the command

```
peers
```

to display the NTP peers which your computer is using. One of them should be the Tempus Cntp server which you have just configured. You should verify that it is being 'reached'. (You may have to continue issuing the peers command for a minute or two before you will see the 'reach' count increment.) If you have other peers configured, verify that the offset information for the Tempus Cntp server peer and your other peers is in agreement to within a few milliseconds, assuming that the other peers are synchronized to that level of accuracy.

It may also be useful to start the NTP daemon in 'debug' mode (**ntpd -d**) to confirm successful configuration. The debug version of the NTP daemon is located in the *debug* sub-directory of your NTP directory. Refer to the NTP documentation for detailed usage of these debug utilities.

MD5 Authenticated NTP Client Setup

MD5 authenticated setup is relatively simple, if:

- You have been able to successfully communicate with the Tempus Cntp on your network.
- Your Tempus Cntp has been configured to perform authentication either by factory default, or by running the **ntpconfig** shell script. The example Tempus Cntp authentication configuration shown in Chapter 2 – *Configuring the Network Time Protocol* will be assumed in the example configuration commands shown here.
- You have installed NTP on your client computer.
- You have successfully performed the *Basic NTP Client Setup* on your client computer.

Create the *ntp.keys* file

You must create a file named *ntp.keys* in the *\winnt\system32\drivers\etc* directory. It must be a copy of the one residing in the */etc* directory of your Tempus Cntp. You can **telnet** into your Tempus Cntp and start an **ftp** session with your client computer to send the Tempus Cntp */etc/ntp.keys* file to your client computer, or use the secure copy utility **scp**, or use a text editor to create the equivalent file. Although you should first test your setup using the factory default */etc/ntp.keys* file in your Tempus Cntp server, you should create your own keys after you understand the process and have your clients operating correctly with the default file.

IMPORTANT

Handling of the */etc/ntp.keys* file is the weak link in the MD5 authentication scheme. It is very important that it is owned by "administrator" and not readable by anyone other than "administrator".

After transferring the file, make sure that it's security properties are set such that it is readable only by the "administrator".

Configure NTP

You must edit the *ntp.conf* file which **ntpd.exe**, the NTP daemon, looks for by default in the the *\winnt\system32\drivers\etc* directory. If your NTP installation placed this file in a different place, you must find it and edit it. Add these lines to the end of the *ntp.conf* file:

```
keys \winnt\system32\drivers\etc\ntp.keys
trustedkey 1 2
```

Modify the line added previously in *Basic NTP Client Setup* so that authentication will be used with the Tempus Cntp server using one of the trusted keys, in this case key # 1:

```
server 192.168.1.245 key 1
```

Re-start **ntpd.exe** to have it begin using the Tempus Cntp server with MD5 authentication. By default, the NTP installation program installs **ntpd.exe** as a service called Network Time Protocol, and starts it. You must use the Services utility in Control Panel to stop the Network Time Protocol service and then re-start it.

Use the NTP utility **ntpq.exe** to check that **ntpd.exe** is able to communicate with the Tempus Cntp. By default it is installed in the *\Program Files\Network Time Protocol* sub-directory of your Windows NT partition. From a console window, after issuing the command

```
ntpq
```

you will see the **ntpq** command prompt:

```
ntpq>
```

Use the command

```
peers
```

to display the NTP peers which your computer is using. One of them should be the Tempus Cntp server which you have just configured. You should verify that it is being 'reached'. (You may have to continue issuing the peers command for a minute or two before you will see the 'reach' count increment.)

You can verify that authentication is being used by issuing the command

```
associations
```

to display the characteristics of the client server associations. In the "auth" column of the display, you should see "OK" for the row corresponding to the Tempus Cntp server. If you see "bad", you should wait a few minutes to be sure that there is a problem since "bad" is the initial state of this setting. If the "bad" indication persists then you must check your configuration for errors. Typically this is due to a typing error in creating the *\winnt\system32\drivers\etc\ntp.keys* file on the client that causes a mismatch between the keys being used by the server and client. (If you transfer the file by **ftp** or **scp**, this shouldn't be a problem.) It is also possible to have a typing error in the *\winnt\system32\drivers\etc\ntp.conf* file that causes the needed key to not be included in the "trustedkey" list.

Broadcast/Multicast NTP Client Setup

Broadcast/multicast client setup is relatively simple, if:

- You have been able to successfully communicate with the Tempus Cntp on your network.
- Your Tempus Cntp has been configured to perform broadcasts or multicasts via the front-panel keypad or by running the **ntpconfig** shell script. (This is not the factory default configuration, so be sure to run **ntpconfig.**) If you are going to use MD5 authentication, your Tempus Cntp must have been configured to operate with authentication in the broadcast/multicast mode, and you must know which of the trusted keys it is using for broadcast/multicast operation. The example Tempus Cntp configuration shown in Chapter 2 – *Configuring the Network Time Protocol* will be assumed in the example configuration commands shown here.
- You have installed NTP on your client computer.
- You have successfully performed the *MD5 Authenticated NTP Client Setup* on your client computer, if you plan to use MD5 authentication.

Configure NTP

You must edit the *ntp.conf* file which **ntpd.exe**, the NTP daemon, looks for by default in the the *\winnt\system32\drivers\etc* directory. Assuming that your Tempus Cntp server has been configured to use key 2 for broadcast authentication as shown in the example in Chapter 2, make sure that key 2 is included in the **trustedkey** line, and add this line to the end of the *ntp.conf* file:

```
broadcastclient
```

If you are not using MD5 authentication, you would add these lines:

```
disable auth
broadcastclient
```

If you are using multicast instead of broadcast mode, you would replace the **broadcastclient** keyword with the **multicastclient** keyword. You may remove the line added previously in *Basic NTP Client Setup*:

```
server 192.168.1.245
```

or the authenticated version added in *MD5 Authenticated NTP Client Setup*:

```
server 192.168.1.245 key 1
```

Re-start **ntpd.exe** to have it begin using the Tempus Cntp as a broadcast or multicast server. By default, the NTP installation program installs **ntpd.exe** as a service called Network Time Protocol, and starts it. You must use the Services utility in Control Panel to stop the Network Time Protocol service and then re-start it.

Use the NTP utility **ntpq.exe** to check that **ntpd.exe** is able to communicate with the Tempus Cntp. By default it is installed in the *\Program Files\Network Time Protocol* sub-directory of your Windows NT partition. After issuing the command

```
ntpq
```

you will see the **ntpq** command prompt:

```
ntpq>
```

Use the command

```
peers
```

to display the NTP peers which your computer is using. One of them should be the Tempus Cntp server which you have just configured. You should verify that it is being 'reached'. (You may have to continue issuing the peers command for a minute or two before you will see the 'reach' count increment.)

If you are using authentication, you can verify that authentication is being used by issuing the command

```
associations
```

to display the characteristics of the client server associations. In the "auth" column of the display, you should see "OK" for the row corresponding to the Tempus Cntp server. If you see "bad", you should wait a few minutes to be sure that there is a problem since "bad" is the initial state of this setting. If the "bad" indication persists then you must check your configuration for errors. Typically this is due to a typing error in creating the */etc/ntp.keys* file on the client that causes a mismatch between the keys being used by the server and client. (If you transfer the file by **ftp** or **scp**, this shouldn't be a problem.) It is also possible to have a typing error in the */etc/ntp.conf* file that causes the needed key to not be included in the "trustedkey" list.

Chapter

5

Front-Panel Keypad and Display

This section describes the Tempus Cntp front-panel user interface which consists of a graphic vacuum-fluorescent display (VFD) and keypad. The keypad and display provide a convenient interface that allows the user to quickly check the operation of the instrument and setup many control parameters. If desired, the Network Administrator can disable the keypad EDIT key to prevent unauthorized tampering with the instrument setup. Even when disabled, all status and control parameters are available for reading only.

Display Description

The display consists of a graphic 16 x 280 dot-matrix vacuum-fluorescent array. The VFD technology offers very readable, bright alphanumeric characters with variable font sizes. Time information is readable at distances in excess of 15 feet. The keypad consists of an eight-key switch assembly designed to allow easy parameter selection and control.

NOTE

After power is applied, the front-panel display will remain blank for approximately 60 seconds while the Tempus Cntp is initializing.

Keypad Description

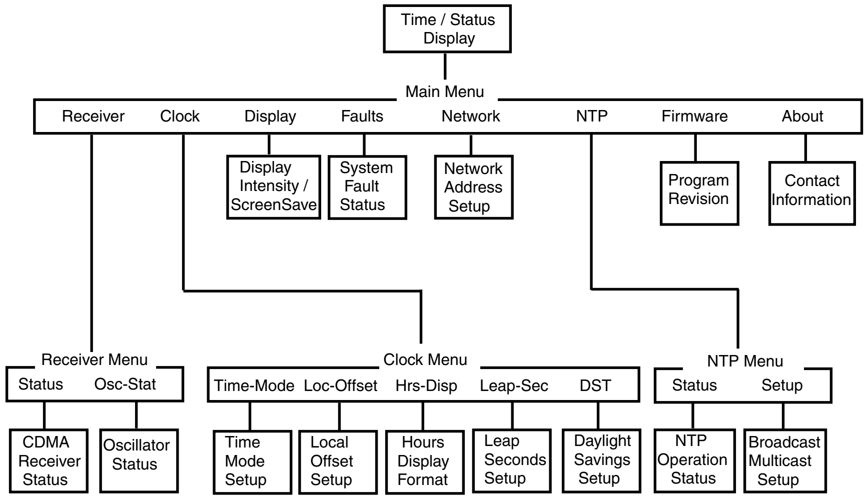
The front-panel keypad consists of eight switch keys identified as follows:

ENTER: Select a menu item or load a parameter when editing.
BACK: Return to previous display or abort an edit process.
EDIT: Edit the parameter currently in view.
HELP: Display context-sensitive help information.
LEFT arrow: Select a new item to the left.

RIGHT arrow: Select a new item to the right.
DOWN arrow: Scroll through parameter values in edit displays or through help lines in help displays. In all other displays this key has a secondary function where it will operate like the ENTER key to select menu items.
UP arrow: Scroll through parameter values in edit displays or through help lines in help displays. In all other displays this key has a secondary function where it will operate like the BACK key to return to the previous display.

Display and Keypad Operation

The display is organized like the inverted tree structure shown below.



Traversing the Display Structure

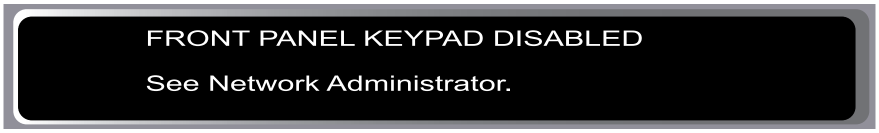
After power initialization the welcome message will appear. Press any key to go to the Time/Status display, which is described under the heading "Detailed Display Descriptions". From the Time/Status display, press ENTER (or DOWN arrow) to go to the Main Menu. As illustrated in the diagram above, several status and setup displays are accessible from the Main Menu. To traverse downward through the tree use the RIGHT and LEFT arrow keys to highlight a selection and then press ENTER. To traverse back up the tree press BACK (or UP arrow) to return to the previous display.

Editing

To modify a parameter, traverse to the appropriate display and push EDIT. Within the edit display, the modifiable parameter value is highlighted. Use UP and DOWN to scroll through all the possible parameter values. When editing a sequence of numbers, use LEFT and RIGHT to select other digits. When the parameter is correct, press ENTER to load the new value. All entered values are stored in non-volatile FLASH and restored after a power cycle. If you wish to abort the edit process, press BACK. This operation returns you to the previous display and the parameter will remain unchanged.

Keypad EDIT Lockout

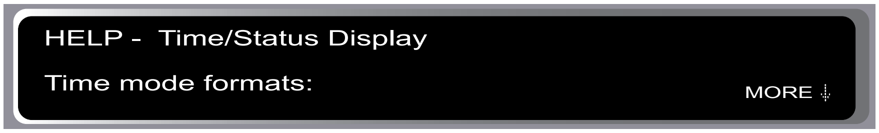
As a security feature, the Network Administrator can disable all editing processes done through the front-panel keypad. This action should be performed to prevent unauthorized modification of the instrument. The lockout feature will prevent editing only, the displays are always available for viewing. When the EDIT key has been disabled, the following message will display whenever a user attempts to edit a parameter.



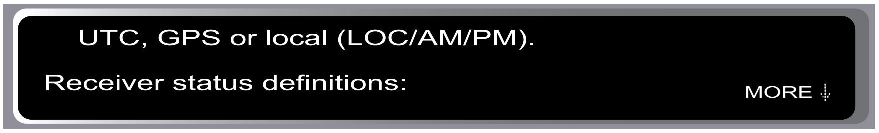
FRONT PANEL KEYPAD DISABLED
See Network Administrator.

Using Help

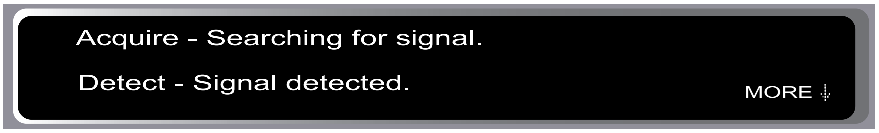
Press HELP at any time to read the context-sensitive help messages. Most Help messages have much more information than can be viewed within the two-line display. Use UP and DOWN to scroll through the help message. Press the HELP key a second time to exit Help (or press BACK).



HELP - Time/Status Display
Time mode formats:
MORE ↓



UTC, GPS or local (LOC/AM/PM).
Receiver status definitions:
MORE ↓

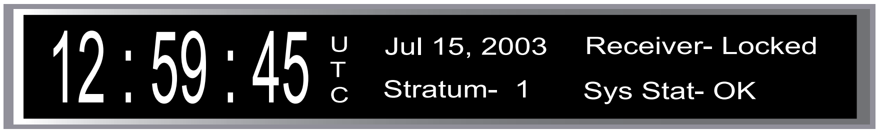


Acquire - Searching for signal.
Detect - Signal detected.
MORE ↓

Detailed Display Descriptions

Time/Status

The Time/Status display provides all the information necessary to determine that the instrument is working correctly.



```
12:59:45 U  Jul 15, 2003   Receiver- Locked
         T
         C  Stratum-  1    Sys Stat- OK
```

Time-of-Day: The large numeric digits shown on the left side of the display indicate the current time-of-day.

Time Mode: The indicator next to the time digits identifies the time mode as being UTC, GPS or LOC (for local time). If the user selects local time in the 12-hour mode, an AM or PM indicator will appear instead of LOC.

Date: Current month, day and year.

Stratum: The stratum field has three possible values:

Stratum 1: The server is fully synchronized and accurate.
Stratum 11: The server is synchronized to its local CPU clock with undependable accuracy. NTP clients will not use a Stratum 11 server.
Stratum 16: The server is unsynchronized. NTP clients will not use a Stratum 16 server.

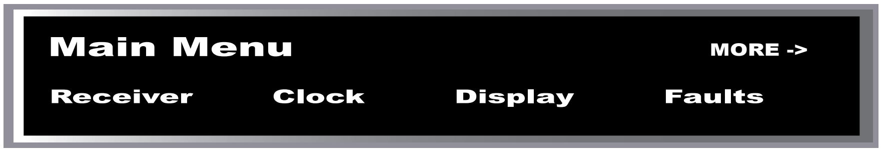
Receiver Status: CDMA receiver status as follows:

Acquire: Searching for a signal.
Detect: A signal is detected.
Locking: Locking to the PN Code (spread-spectrum of carrier).
Tracking: Locking to the carrier.
Locked: Synchronized to signal.

System Status: Indicates either OK or flashing FAULT. A fault status indicates that one or more of the built-in fault checking processes has detected an error condition. See Faults section for more information.

Main Menu

Press ENTER from the Time/Status display to select the Main Menu display. The Main Menu provides access to the following items: Receiver Menu, Clock Menu, Display, Faults, Network, NTP Menu, Firmware, and About. To select one of these items use the RIGHT and LEFT keys to highlight it. Then push ENTER to select the highlighted item. These displays are described in detail below.



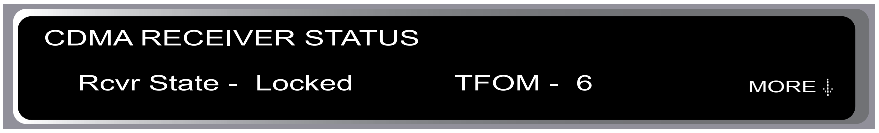
```
Main Menu                                   MORE ->
Receiver      Clock        Display      Faults
```

Receiver Menu

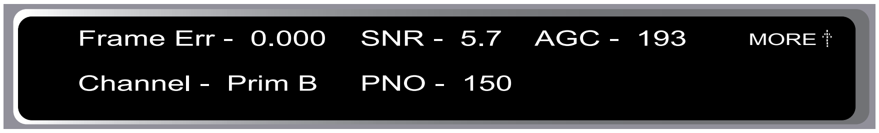
The Receiver Menu provides access to the receiver status and oscillator status displays described below. These are status displays only and cannot be edited.

Receiver Status

This display provides information associated with the operation of the CDMA receiver. Press DOWN to scroll through all the information.



```
CDMA RECEIVER STATUS
   Rcvr State -  Locked          TFOM -  6          MORE ↓
```



```
   Frame Err -  0.000   SNR -  5.7   AGC -  193      MORE ↑
   Channel -  Prim B    PNO -  150
```

Receiver State: This shows the current state of the CDMA receiver subsystem. The state may be: acquire, detect, locking, tracking, or locked. When locked, the CDMA receiver is synchronized to the signal and it is disciplining the internal oscillator to remove frequency and time errors.

Time Figure-of-Merit (TFOM): A detailed explanation of TFOM is in Appendix F. Briefly, TFOM indicates clock accuracy where:

6	time error is < 100 us
7	time error is < 1 ms
8	time error is < 10 ms
9	time error is > 10 ms, unsynchronized state if the unit has never been locked to CDMA.

Frame Err: The number shown represents the sync channel frame error rate, 0.000 to 1.000, with a higher number implying more Cyclical Redundancy Check (CRC) failures. Higher numbers will correlate with lower signal-to-noise ratios.

SNR: The signal-to-noise ratio is an indicator of the CDMA signal quality. This number must typically be greater than 2.5 for the instrument to lock.

AGC: This is the automatic gain control DAC byte, 0 to 255, with larger numbers implying higher RF gain. With good signal conditions this value is typically 150 to 220.

Channel: This is the CDMA frequency channel being used. The channel can be primary A, primary B, secondary A or secondary B.

PNO: This is the pseudonoise offset, 0 to 511 in units of 64 pseudonoise code chips. Each base station in an area has a different PNO.

Oscillator Status

This display provides the oscillator time base status and type. The oscillator control setting (DAC) value indicates the frequency control setting. The system automatically sets this value to remove frequency errors. Values may range from 0 to 65,535. Values less than 10,000 or greater than 55,000 will set the DAC fault flag that will appear in the fault status display. The Time/Status display will also indicate a fault condition.

The oscillator type indicates the oscillator that is installed. Possible oscillator types are:

Temperature-compensated crystal oscillator (TCXO)
Medium-stability oven oscillator (MS-OCXO)
High-stability oven oscillator (HS-OCXO)
Rubidium oscillator (Rb)

Clock Menu

The Clock Menu display provides access to the parameters related to timekeeping. These are Time Mode, Local Offset, Hours Format, Leap Seconds, and Daylight Savings Time (DST). These displays are all described below.

Time Mode

Time mode defines the time format used for the front-panel time display and, if installed, the optional time code output. The time mode does not affect the NTP output, which is always UTC. Possible values for the time mode are GPS, UTC, and local time. GPS time is derived from the GPS satellite system. UTC is GPS time minus the current leap second correction. Local time is UTC plus local offset and Daylight Savings Time (DST). The options for local time are local-auto and local-manual. Local-auto derives the local offset and DST from the information embedded in the CDMA timing signal. Local-manual derives the local offset and DST from information entered by the user.

Local Offset

Local offset is used in calculating the current local time when the time mode is set to local-auto or local-manual (see time mode above). When the time mode is local-auto this display will show the local offset as derived from the CDMA timing information.

When the time mode is local-manual this display will allow the user to change the value by pressing EDIT. Enter a negative offset for time zones west of Greenwich and a positive offset for time zones to the east. If enabled, DST will add an additional hour.

Hours Display

The hours-display format affects the front-panel time display and is active only when the time mode is set to local time. Hours-display selections are either 12-hour format (1-12 hours with AM/PM indicator) or 24-hour format (0-23 hours).

Leap Seconds

This display will show the current and future leap seconds as broadcast over the CDMA system if the Tempus Cntp is in the automatic leap second mode. Leap second insertions occur about once every two years. The automatic leap second mode is the default setting.

While the CDMA system does provide an automatic mechanism for disseminating UTC leap second information, it may not occur precisely at midnight on the day of the transition. If you need your Tempus Cntp to precisely handle the leap second insertions then you should consider configuring your unit to operate in the user-entered leap second mode. In this mode you must provide the current and future leap seconds values. Press EDIT to enter these values. Refer to Appendix D for further information.

Daylight Savings Time (DST)

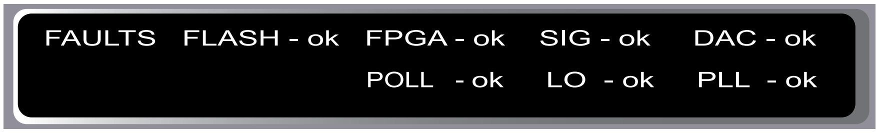
DST is used in calculating the current local time when the time mode is set to local-manual. When the time mode is local-auto this display has no affect because DST information is derived from the CDMA system. When the time mode is local-manual this display will allow the user to enable or disable DST by pressing EDIT. If DST is disabled then any previously set start and stop times will be ignored. If DST is enabled then the start and stop times can be set by pressing the arrow keys to scroll and then ENTER. DST is active within the start-stop interval and adds one hour to the local time. If DST is active the display will show an active indicator.

Display

This display contains parameters related to the functioning of the front-panel vacuum-fluorescent display. There are two parameters -- an intensity setting and a screensaver setting. The intensity setting allows you to set the brightness level of the vacuum-fluorescent display. Display intensity ranges from 12% to 100%. The screensaver capability allows you to increase the usable life of the display beyond the rated 100,000 hours. When the screensaver capability is enabled, then the intensity will be reduced to half of its normal operating intensity when the unit has not detected a keypress for one hour. Press EDIT to modify the intensity and screensaver settings.

Faults

This display provides system fault information. When a particular fault condition is asserted it will be followed by a flashing indicator. Otherwise the fault condition is followed by an "ok" indicator. The fault display and various fault conditions are described below:



```
FAULTS   FLASH - ok   FPGA - ok   SIG - ok    DAC - ok
                      POLL  - ok    LO  - ok    PLL  - ok
```

FLASH - FLASH Write Fault

This fault indicates that the microprocessor was unable to verify a write to the FLASH non-volatile parameter storage area. This should not ever occur under normal operation. This fault would cause erratic operation at the next power cycling since important parameters could be corrupt. The unit should be returned to the factory for repair.

FPGA - FPGA Config Fault

This bit indicates that the microprocessor was unable to configure the FPGA. This would be a fatal fault and the unit should be returned to the factory for repair .

SIG - No Signal Time-Out

This bit indicates that the unit has not been able to acquire a CDMA signal for one hour while the Time Figure of Merit has been 9, the unsynchronized condition. This could be due to a variety of reasons. If there are no other faults that could explain the inability to receive a signal, then there could be a base station outage or antenna blockage. If the condition persists indefinitely, the unit may need to be returned to the factory for repair.

DAC - Control Over-Range

This bit indicates that the electronic frequency control DAC for the oscillator has reached either the high (55000) or low (10000) limit while locked to the CDMA signal. Unless the unit is being subjected to out-of-specification environmental conditions, this would indicate that the oscillator frequency has drifted near to the end-of-life region. This should normally only occur after about ten years of operation. The unit will continue to function until the oscillator frequency finally reaches one of the actual DAC endpoints. The unit should be returned to the factory for oscillator replacement at the customer's convenience.

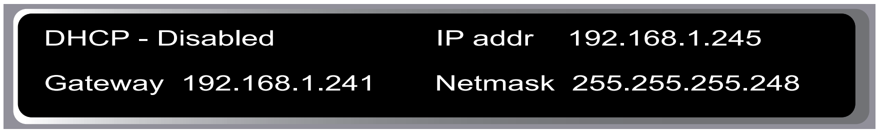
POLL - No Polling Events
This fault indicates that the CDMA timing subsystem is not receiving polling request from the NTP subsystem. This could be due to a hardware or software failure. If the condition persists after cycling the power to the unit, this is a fatal fault and the unit should be returned to the factory for repair.

LO - Local Oscillator Failure
This fault indicates that the Local Oscillator Phase Locked Loop (PLL) synthesizer has failed. This condition should not normally occur unless the unit is subjected to out-of-specification environmental conditions. This is a fatal fault and the unit should be returned to the factory for repair.

PLL - Local Osc. PLL Fault
This fault indicates that the Local Oscillator Phase Locked Loop (PLL) synthesizer is unlocked. This condition should not normally occur unless the unit is subjected to out-of-specification environmental conditions. Otherwise, this would be a fatal fault and the unit should be returned to the factory for repair.

Network

This display provides the ability to view and modify the network settings. The parameters include Dynamic Host Configuration Protocol (DHCP), IP address, gateway and netmask settings. Enable DHCP to allow automatic system configuration of the network interface. When DHCP is disabled the user must provide address information.



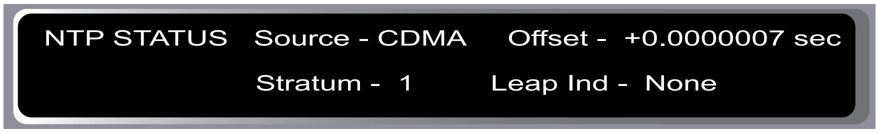
```
DHCP - Disabled              IP addr    192.168.1.245
Gateway  192.168.1.241       Netmask  255.255.255.248
```

NTP Menu

The NTP Menu provides access to the NTP Status and NTP Setup displays described below:

NTP Status

This display provides information associated with the NTP subsystem.



```
NTP STATUS   Source - CDMA    Offset -  +0.0000007 sec
             Stratum -  1     Leap Ind -  None
```

Source: The synchronization source is named here. For the Tempus Cntp the source is CDMA, CPU or none.

Stratum: This field has three possible values:

Stratum 1:	The server is fully synchronized and accurate.
Stratum 11:	The server is synchronized to its local CPU clock with undependable accuracy. NTP clients will not use a Stratum 11 server.
Stratum 16:	The server is unsynchronized. NTP clients will not use a Stratum 16 server.

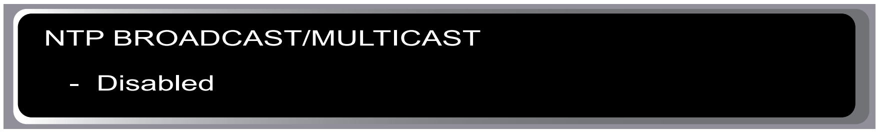
Offset: The NTP offset indicates the accuracy of the NTP system clock relative to the CDMA subsystem clock. Immediately after power-up the NTP system clock free runs using its internal crystal which is likely to be inaccurate. Initially, if the offset between the NTP system clock and the CDMA subsystem clock is large the display will indicate "not available". After the CDMA subsystem locks, the NTP clock will synchronize to the CDMA subsystem. Once synchronization is complete, the typical offsets will range over approximately ± 10 microseconds.

Leap Indicator: Shows the status of the leap indicator bits as sent by the Tempus Cntp time server to the clients in the NTP reply packets. Descriptions of the leap indicator bits are:

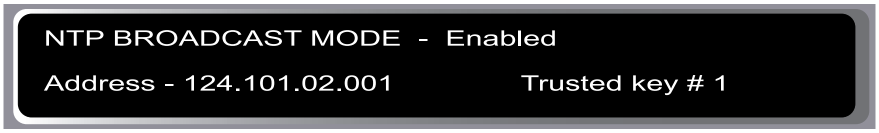
00 - None: No fault and no pending leap second.
01 - Insert PendingNo fault and a leap second insertion is pending.
10 - Delete Pending: No fault and a leap second deletion is pending.
11 - Fault: Unsynchronized fault condition exists.

NTP Setup

This display provides access to the NTP broadcast and multicast settings.



```
NTP BROADCAST/MULTICAST
  -  Disabled
```



```
NTP BROADCAST MODE  -  Enabled
Address - 124.101.02.001            Trusted key # 1
```

This display provides the user with a convenient means of checking the current configuration and allows limited setup. You may also perform a more complete broadcast/multicast configuration via a **`telnet`** or **`ssh`** session or the local RS-232 console using the **`ntpconfig`** utility. This utility provides a more secure means of setup and is more complete. It will allow you to create keys and identify trusted keys.

The display will indicate that the unit is either in broadcast, multicast or disabled. It allows broadcast or multicast configuration with selection of the broadcast address, multicast time-to-live (TTL) and trusted key for MD5 authentication. The broadcast/ multicast configuration may also be disabled.

Broadcast mode: In this mode the broadcast address is displayed. If MD5 authentication is selected the trusted key number will also be displayed.

Multicast Mode: The multicast address must be 224.0.1.1. The TTL value is the number of router hops that multicast traffic is permitted to pass through before expiring on the network. Multicast may also use MD5 authentication. If selected, the trusted key number will also be displayed.

Press EDIT to change the broadcast/multicast settings. Each of the edit windows has help information available to guide you through the setup process. Note that changing the NTP multicast/broadcast settings does not take effect until the system reboots. The new parameters are loaded to the ntp.conf file in the */boot/etc/* directory. Only the broadcast line in the ntp.conf file is modified. The final display in the edit sequence requires confirmation of your intent to change the instrument settings. Once confirmation takes place, the instrument will reboot.

Firmware

The Firmware display provides version information for the application software running on the CDMA subsystem and the NTP subsystem (Linux OS). Use UP and DOWN to toggle between the two information windows.

About

The About display provides contact information for EndRun Technologies. The website and toll-free phone number are listed.

Shortcut Menu

The Shortcut Menu allows the user quick access to particular displays from the Time/Status display. The displays available through the Shortcut Menu are the Receiver Status display, the Faults display, and the NTP Status display. While viewing the Time/Status display press ENTER for one second to select the Shortcut Menu.

Chapter 6

Control and Status Commands

This chapter describes the Tempus Cntp control and status commands. In addition to a subset of the standard Linux shell commands/utilities, the Tempus Cntp supports several application-specific commands for performing initialization/setup and for monitoring the performance and status of the NTP and CDMA subsystems. The standard Linux commands are not documented here. A wealth of information is available from a variety of sources on those. Only the Tempus Cntp specific commands will be described here. The serial I/O port physical and electrical characteristics are defined as well.

General Linux Shell Operation

The command shell used by the Tempus Cntp is a **bash** equivalent that is known as **ash**. **ash** offers good compatibility in running shell scripts written for **bash**, but lacks some of the niceties of **bash**. In particular, it lacks command line editing. All commands and file names are case sensitive, which is standard for Unix-like operating systems. If you are unfamiliar with Unix-like operating systems, and you would like to be able to more closely monitor or optimize the performance of your Tempus Cntp you should consult either the web

www.linuxdoc.org

or good Linux reference books like:

Linux in a Nutshell, Seiver, O'Reilly & Associates, 1999.

Running Linux, Welsh, Dalheimer & Kaufman, O'Reilly & Associates, 1999

to learn the ins and out of the Linux command console.

Available User Commands

COMMAND	FUNCTION
accessconfig	Interactive shell script that guides the user in configuring **`telnet, ssh`** and **`snmpd`** access to the Tempus Cntp that is limited to specific hosts. The resulting */etc/hosts.allow* and */etc/hosts.deny* files are saved to the non-volatile FLASH disk. Factory default configuration allows access by all hosts.
cdmaleapconfig	Guides the user in configuring the way in which UTC leap seconds are handled: either automatically via CDMA basestation transmissions or by user-entered current and future leap second parameters.
cdmaleapmode	Prints the current CDMA leap second mode of operation, either automatic or user-entered. If user-entered, prints the current and future leap second values.
cdmastat	Prints the CDMA subsystem status information to the console.
cdmaversion	Prints the CDMA firmware and FPGA version information to the console.
cntpenableupgrade	Enables a firmware upgrade by mounting the FLASH disk partitions that hold compressed root file system images.
cntphwaddr	Prints the ethernet hardware address, if the ethernet has been configured.
cntposctype	Prints the installed oscillator type, which is one of: TCXO, DIP-OCXO, MS-OCXO, HS-OCXO or Rubidium.
cntppasswd	Allows the *root* user to change the password for the two configured users on the Tempus Cntp: *cntpuser* and *root*. This script calls the standard Linux **`passwd`** binary and then saves the resulting */etc/shadow* file to the non-volatile FLASH disk.
cntprootfs	Prints the current root file system image, either 0 (factory default) or 1 (field upgrade) which is running in the Tempus Cntp to the console.
cntpstat	Parses the output of **`ntpq -c peers`** to obtain the system peer status of the NTP CDMA reference clock. It also retrieves the current reference clock polling status data and prints it to the console.

cntptimemode	Prints the time mode settings in effect for any optional timecode output or front-panel vacuum-fluorescent display.
cntptimemodeconfig	Interactive shell script that guides the user in configuring the time mode settings for any optional timecode output or front panel vacuum fluorescent display. Allows setting to the local, GPS or UTC timescale. If local-manual is selected, then the allows configuration of the local offset and Daylight Savings Time (DST) start/stop date parameters.
cntpversion	Prints the Tempus Cntp application software version information to the console.
inetdconfig	Interactive shell script that allows the user to configure the list of protocol servers which are started by the **`inetd`** server daemon running in the Tempus Gntp.
kplockstat	Prints the front-panel keypad lockout status.
lockoutkp	Locks out access to the front-panel keypad EDIT key.
netconfig	Interactive shell script that allows the user to configure the IP network subsystem of the Tempus Gntp.
ntpconfig	Interactive shell script that guides the user in configuring the Tempus Cntp NTP subsystem. Allows configuration of MD5 authentication and broadcast/multicast mode. All parameters are retained in non-volatile FLASH disk storage.
unlockkp	Unlocks access to the front-panel keypad EDIT key.
updatelilo	Shell script that must be run to update the Linux Loader (LILO) so that it will boot a new root file system image. **`cntpenableupgrade`** must have been previously executed in order to run this command.

Detailed Command Descriptions

accessconfig

This command starts an interactive shell script that will allow the root user to configure limitation of **`telnet`**, **`ssh`** and **`snmp`** access to the Tempus Cntp. By default, the unit is configured to allow access by all users. If you need to limit **`telnet`**, **`ssh`** or **`snmp`** access, e.g. for security reasons, you must run this script as *root* from either the RS-232 serial I/O port or from a **`telnet`** or **`ssh`** session.

This script modifies these files: */etc/hosts.allow* and */etc/hosts.deny*. These are non-volatilely stored in the FLASH disk */boot/etc* directory. You must re-boot the Tempus Cntp after running this script for the changes to take effect.

Usage:

```
    Set:                        accessconfig
    Tempus Cntp response:       Interactive shell script is started.
```

cdmaleapconfig

This command starts an interactive shell script that will guide the root user in configuring the way that UTC leap seconds are applied. Although the CDMA system provides an automatic mechanism for disseminating UTC leap second information to the mobile units, it may not be precise enough for many Tempus Cntp users. If you need your Tempus Cntp to precisely handle any UTC leap seond insertions at midnight on June 30th or January 31st (the times that leap seconds are inserted), then you should consider configuring your Tempus Cntp to operate in the user-entered leap second mode.

In the user-entered leap second mode, you must provide the current and future leap second values. The interactive script is very detailed in explaining how these values are obtained and used. There is also more information in Appendix D. The EndRun Technologies' website maintains a page devoted to notifying users of the appropriate current and future leap second values at:

www.endruntechnologies.com\leap.htm

Usage:

```
    Query:                      cdmaleapconfig
    Tempus Cntp response:       Interactive shell script is started.
```

cdmaleapmode

This command displays the CDMA leap mode of operation currently configured. There are two modes: automatic and user-entered. If the mode is user-entered, then the values of the configured current and future leap seconds are also displayed.

Usage:

```
    Query:                      cdmaleapmode
    Tempus Cntp response:
    CDMA Leap Second Mode is AUTO
    CDMA Leap Second Mode is USER:  Current LS = 13, Future LS = 13
```

cdmastat

This command allows the user to query the status of the CDMA timing subsystem. During normal operation, the NTP daemon polls the CDMA timing subsystem every 16 seconds. The results of this poll are used to steer the system clock and are saved to a log file. This command parses and formats the data contained therein and prints this fixed-length string having these fields:

```
LKSTAT TFOM = ? YEAR DOY HH:MM:SS.sssssssss LS S C PNO AGC VCDAC SN.R F.ERR FLTS
```

Where:

LKSTAT is the tracking status of the engine, either locked or not locked.

TFOM = ? shows the Time Figure-of-Merit (TFOM) of the CDMA subsystem's internal timebase. ? may take values ranging from 6 to 9:

6	time error is < 100 us
7	time error is < 1 ms
8	time error is < 10 ms
9	time error is > 10 ms, unsynchronized state if the unit has never been locked to CDMA.

Refer to *Time Figure of Merit* in Appendix F for a detailed description of the meaning of this number.

YEAR is the year of the UTC timestamp of the most recent NTP polling request received by the CDMA subsystem from the NTP reference clock driver.

DOY is the day-of-year of the UTC timestamp of most recent NTP polling request received by the CDMA subsytem from the NTP reference clock driver.

HH:MM:SS.sssssssss is the hour, minute, second.subsecond UTC timestamp of the most recent NTP polling request received by the CDMA subsystem from the NTP daemon reference clock driver.

LS is the current number of leap seconds difference between the UTC and GPS timescales (13 at the time of this writing).

S is the signal processor state, one of 0 (Acquiring), 1 (Signal Detected), 2 (Code Locking), 4 (Carrier Locking), 8 (Locked).

C is the CDMA frequency channel being used, one of 0 (Primary A), 1 (Primary B), 2 (Secondary A), 3 (Secondary B).

PNO is the base station pseudonoise offset, 0 to 511 in units of 64 pseudonoise code chips.

AGC is the automatic gain control DAC byte, 0 to 255 with larger numbers implying higher RF gain. Typical range is 150 to 220.

VCDAC is the TCXO voltage control DAC word, 0 to 65535 with larger numbers implying higher TCXO frequency. Typical range is 20000 to

38000.

SN.R is the carrier signal-to-noise ratio, 0.00 to 99.9, measured in the CDMA sync channel symbol rate bandwidth. Typical range is 2.5 to 11.0.

F.ERR is the CDMA sync channel frame error rate, 0.000 to 1.000, with a higher number implying more Cyclical Redundancy Check (CRC) failures when processing the sync channel message frames. Higher numbers will correlate with lower signal-to-noise ratios.

FLTS is the fault status, which displays the current summary status of the CDMA timing subsystem. The summary status is contained in sixteen bits which are displayed in four hexadecimal characters. Assertion of any of these bits will also be indicated by illumination of the red LED. Each bit of each character indicates the status of a subsystem component:

Hex Character	Bit 3	Bit 2	Bit 1	Bit 0
0	FLASH Write Fault	FPGA Config Fault	No Signal Time-Out	DAC Control Over-Range
1	Not Used	No Polling Events	Local Oscillator Failure	Local Oscillator PLL Fault
2	Not Used	Not Used	Not Used	Not Used
3	Not Used	Not Used	Not Used	Not Used

DAC Control Over-Range This bit indicates that the electronic frequency control DAC for the oscillator has reached either the high (55000) or low (10000) limit while locked to the CDMA signal. Unless the unit is being subjected to out-of-specification environmental conditions, this would indicate that the oscillator frequency has drifted near to the end-of-life region. This should normally only occur after about ten years of operation. The unit will continue to function until the oscillator frequency finally reaches one of the actual DAC endpoints. The unit should be returned to the factory for oscillator replacement at the customer's convenience.

No Signal Time-Out This bit indicates that the unit has not been able to acquire a CDMA signal for one hour while the TFOM has been 9, the unsynchronized condition. This could be due to a variety of reasons. If there are no other faults that could explain the inability to receive a signal, then there could be a base station outage or antenna blockage. If the condition persists indefinitely, the unit may need to be returned to the factory for repair.

FPGA Config Fault

This bit indicates that the microprocessor was unable to configure the FPGA. This would be a fatal fault and the unit should be returned to the factory for repair .

FLASH Write Fault

This bit indicates that the microprocessor was unable to verify a write to the FLASH non-volatile parameter storage area. This should not ever occur under normal operation. This fault would cause erratic operation at the next power cycling since important parameters could be corrupt. The unit should be returned to the factory for repair.

Local Oscillator PLL Fault

This bit indicates that the Local Oscillator Phase Locked Loop (PLL) synthesizer is unlocked. This condition should not normally occur unless the unit is subjected to out-of-specification environmental conditions. Otherwise, this would be a fatal fault and the unit should be returned to the factory for repair.

Local Oscillator Failure

This bit indicates that the Local Oscillator Phase Locked Loop (PLL) synthesizer has failed. This condition should not normally occur unless the unit is subjected to out-of-specification environmental conditions. This is a fatal fault and the unit should be returned to the factory for repair.

No Polling Events

This bit indicates that the CDMA timing subsystem is not receiving polling request from the NTP subsystem. This could be due to a hardware or software failure. If the condition persists after cycling the power to the unit, this is a fatal fault and the unit should be returned to the factory for repair.

The example response indicates that there has been a period without tracking a CDMA signal that exceeded the time-out period, that there was a FLASH Write Fault and that there is a Local Oscillator PLL fault.

Usage:

Query: **cdmastat**

Tempus Cntp response:

```
LOCKED TFOM = 6 2001 092 04:48:56.347916732 13 8 1 132 179 28605 8.6 0.000 001A
```

cdmaversion

This command displays the firmware and hardware versions of the CDMA subsystem.

Usage:

Query: **cdmaversion**

Tempus Cntp response: **F/W 2.00 FPGA 06**

cntpenableupgrade

This command mounts the two FLASH disk root file system partitions as part of the firmware upgrade procedure. Refer to Appendix B – *Upgrading the Firmware* for detailed instructions for performing the upgrade procedure.

Usage:

Set: **cntpenableupgrade**

Tempus Cntp response: **Mounting root file system partitions.**

cntphwaddr

This command displays the ethernet hardware address, if the IP network is properly configured. Otherwise it returns nothing.

Usage:

Query: **cntphwaddr**

Tempus Cntp response: **00:D0:C9:25:78:59**

cntposctype

This command displays the installed oscillator type. It is one of TCXO, DIP-OCXO, MS-OCXO, HS-OCXO or Rubidium. The standard oscillator is the TCXO.

Usage:

Query: **cntposctype**

Tempus Cntp response: **Installed Oscillator is TCXO**

cntppasswd

This command allows the root user to change the passwords of the two configured users on the system: *root* and *cntpuser*. Arguments passed to **cntppasswd** on the command line are passed verbatim to the real **passwd** binary program. When **passwd** returns, the resulting modified */etc/shadow* file is copied to the non-volatile */boot/etc* directory.

Usage:

Set:	**`cntppasswd cntpuser`**
Tempus Cntp response:	***`The passwd interactive utility starts.`***

cntprootfs

This command displays the currently booted root file system image. It can be either TempusCntp_0 (factory image) or TempusCntp_1 (field upgrade image). Refer to Appendix B – *Upgrading the Firmware* for detailed instructions for performing the upgrade procedure.

Usage:

Query:	**`cntprootfs`**
Tempus Cntp response:	**`BOOT_IMAGE=TempusCntp_1`**

cntpstat

This command allows the user to query the status of the NTP subsystem. It retrieves information from the NTP distribution **`ntpq`** binary using the *peers* command to determine the current synchronization status of the NTP subsystem. It then retrieves the last line in the logfile */var/log/praecis0.monitor* controlled by the NTP daemon reference clock driver that communicates with the CDMA timing subsystem. This logfile is updated every 16 seconds under normal operation. It parses and formats the data contained therein and prints this fixed-length (generally, grossly unsynchronized states could cause the floating offset field to overflow momentarily) string having these fields:

```
LKSTAT TO CDMA, Offset = +S.ssssss, TFOM = ? @ YEAR DOY HH:MM:SS.sssssssss LS
```

Where:

LKSTAT is the system peer status of the NTP daemon relative to the CDMA subsystem engine, either locked or not locked. Not locked can imply several things: the system has just started, there is a fault in the CDMA subsystem which has caused NTP to either be unable to obtain timing information from the CDMA subsystem or to reject the timing information that it is obtaining from it

+S.ssssss is the offset in seconds between the NTP system clock and the CDMA subsystem clock. Positive implies that the system clock is ahead of the CDMA subsystem clock.

TFOM = ? shows the Time Figure of Merit (TFOM) of the CDMA engine's internal timebase. ? may take values ranging from 6 to 9:

6 time error is < 100 us

7 time error is < 1 ms
8 time error is < 10 ms
9 time error is > 10 ms, unsynchronized state if never been locked to CDMA.

Refer to Appendix F for a detailed description of the meaning of this number.

YEAR is the year of the UTC timestamp of most recent NTP polling request received by the CDMA engine from the NTP reference clock driver.

DOY is the day-of-year of the UTC timestamp of most recent NTP polling request received by the CDMA engine from the NTP reference clock driver.

HH:MM:SS.sssssssss is the hour, minute, second.subsecond UTC timestamp of the most recent NTP polling request received by the CDMA engine from the NTP daemon reference clock driver.

LS is the current number of leap seconds difference between the UTC and GPS timescales (13 at the time of this writing).

Usage:

Query: `cntpstat`

Tempus Cntp response:

```
LOCKED TO CDMA, Offset = +0.000024, TFOM = 6 @ 2001 092 06:03:10.904312858 13
```

cntptimemode

This command displays the current time mode settings for any optional timecode outputs or the front-panel vacuum-fluorescent display. The displayed local time offset from UTC is valid in either of the two local modes, but the Daylight Savings Time (DST) start/stop parameters are only valid in the local-manual mode. A positive local time offset implies a longitude east of the Greenwich meridian and that local time is ahead of UTC.

There are two local time modes: local-automatic and local-manual. In the local-automatic mode, the local offset from UTC is determined from the CDMA base station transmissions. For more precise and deterministic behavior at the DST changeover times, you should configure your unit for local-manual operation and set up the local offset and the DST start and stop times using **cntptimemodeconfig**.

Usage:

Query: `cntptimemode`

Tempus Cntp response:

```
Time Mode = UTC
Local Time Offset from UTC = -16 (half hours)
DST Start Month = Apr Sunday = 1st  Hour = 02
DST Stop  Month = Oct Sunday = Last Hour = 02
```

cntptimemodeconfig

This command starts an interactive shell script that will allow the user to configure the time mode of operation of any optional timecode outputs or the front-panel display of the Tempus Cntp. *These settings have no effect on the operation of the NTP daemon or the underlying Linux operating system time. These ALWAYS operate in UTC.*

By default, the unit is configured to operate in local-auto mode. If you need to modify this operation, you must run this script as *root*. Settings made using this command are non-volatile.

Usage:

Set:	`cntptimemodeconfig`
Tempus Cntp response:	***Interactive shell script is started.***

cntpversion

This command displays the firmware version and build date of the Tempus Cntp.

Usage:

Query:	`cntpversion`
Tempus Cntp response:	

```
Tempus Cntp 6010-0005-000 v 1.00 Wed Jan 16 22:38:21 UTC 2002
```

inetdconfig

This command starts an interactive shell script that will allow the user to configure the list of protocol servers which are started by the **inetd** server daemon running in the Tempus Cntp. Four protocol servers may be configured: TIME, DAYTIME, TELNET and SSH. By default, the unit is configured to start all of these protocol servers. If you need to disable start-up of some or all of these, e.g. for security reasons, you must run this script as *root* from either the RS-232 serial I/O port or from a **telnet** or **ssh** session.

This script modifies the */etc/inetd.conf* file, which is non-volatilely stored in the FLASH disk */boot/etc* directory. You must re-boot the Tempus Cntp after running this script for the changes to take effect.

Usage:

Set:	`inetdconfig`
Tempus Cntp response:	***Interactive shell script is started.***

kplockstat

This command prints out the status, either locked or unlocked, of the front-panel keypad EDIT key. When the EDIT key is LOCKED, it prevents unauthorized tampering with the unit. All other keys are still enabled so you may continue to read all the status and current settings of the Tempus Cntp. Also refer to the **`lockoutkp`** and **`unlockkp`** commands.

Usage:

Set: **`kplockstat`**

Tempus Cntp response: ***`LOCKED or UNLOCKED`***

lockoutkp

This command locks out access to the front-panel keypad EDIT key. When the EDIT key is locked, it prevents unauthorized tampering with the unit. All other keys are still enabled so you may continue to read all the status and current settings of the Tempus Cntp. Also refer to the **`kplockstat`** and **`unlockkp`** commands.

Usage:

Set: **`lockoutkp`**

Tempus Cntp response: ***`Front-panel keypad EDIT key disabled.`***

netconfig

This command starts an interactive shell script that will allow the user to configure the IP network subsystem of the Tempus Gntp. By default, the unit is configured to configure itself using the Dynamic Host Configuration Protocol (DHCP). If you need to set up static IP configuration, you must run this script as *root* from the RS-232 serial I/O port during the installation process. Refer to Chapter 2 – *Using netconfig to Set Up Your IP* for details on the use of the command.

This script creates or modifies these files: */etc/HOSTNAME*, */etc/hosts*, */etc/networks*, */etc/resolv.conf* and */etc/rc.d/rc.inet1*. All of these are non-volatilely stored in the FLASH disk */boot/etc* directory. You must re-boot the Tempus Gntp after running this script for the changes to take effect.

Usage:

Set: **`netconfig`**

Tempus Gntp response: ***`Interactive shell script is started.`***

ntpconfig

This command starts an interactive shell script that will allow the user to configure the NTP subsystem of the Tempus Cntp. By default, the unit is configured to authenticate its replies to clients using its default MD5 keys in the */etc/ntp.keys* file. If you need to create your own MD5 keys (recommended) or set up broadcast/multicast operation, you must run this script as *root*. Refer to Chapter 2 - *Configuring the Network Time Protocol* for details on the use of this command.

The two files that are modified are */etc/ntp.keys* and */etc/ntp.conf*. Both of these are non-volatilely stored in the FLASH disk */boot/etc* directory. You must re-boot the Tempus Cntp after running this script for the changes to take effect.

Usage:

Set: **ntpconfig**

Tempus Cntp response: ***Interactive shell script is started.***

unlockkp

This command unlocks access to the front-panel keypad EDIT key. When the EDIT key is locked, it prevents unauthorized tampering with the unit. All other keys are still enabled so you may continue to read all the status and current settings of the Tempus Cntp. Also refer to the **kplockstat** and **lockoutkp** commands.

Usage:

Set: **unlockkp**

Tempus Cntp response: ***Front-panel EDIT key enabled.***

updatelilo

This command allows the user to update the configuration of the Linux Loader (LILO) after a new root file system image has been uploaded to the upgrade root file system partition, */rootfs_1* of the Tempus Cntp FLASH disk. Refer to Appendix B – *Upgrading the Firmware* for detailed instructions for performing the upgrade procedure. Two arguments are accepted, first either 0 or 1 to tell LILO which root file system image should be made the default, second the file name of the new compressed root file system image. If no arguments or any value other than 1 is given for the first argument, the default root file system is set to TempusCntp_0. If the first argument is 1, then the second argument is read and LILO is re-configured to make the default root file system TempusCntp_1.

Upon completion, the root file system partitions are unmounted.

Usage:

Set: **/boot/updatelilo 1 rootfs1.01.gz**

Tempus Cntp response:

```
Added TempusCntp_0
Added TempusCntp_1 *

Unmounting root file system partitions now.  Run Cntpenableupgrade
again to remount them, should you need to re-run updatelilo.
```

The trailing asterisk '*' character indicates that the default root file system is set to TempusCntp_1.

RS-232 Serial I/O Port Signal Definitions

DB9M Pin on Tempus Cntp	Signal Name
1	Data Carrier Detect (DCD)
2	Receive Data (RX)
3	Transmit Data (TX)
4	Data Terminal Ready (DTR)
5	Ground
6	Data Set Ready (DSR)
7	Request To Send (RTS)
8	Clear To Send (CTS)
9	Ring Indicator (RI)

Null Modem Adapter Cable

In order to connect the Tempus Cntp to another computer, a null-modem adapter must be used. The provided adapter cable is wired this way:

DB9F Pin on Adapter	DB9F Pin on Adapter
1	4
2	3
3	2
4	1
5	5
7	8
8	7
9	9

Pin 6 is not connected.

Appendix

A

Security

Your Tempus Cntp incorporates several important security features to prevent unauthorized tampering with its operation. Many of these are standard multiple-user access control features of the underlying Linux operating system which controls the Tempus Cntp. Others are provided by the additional protocol servers selected for inclusion in your Tempus Cntp, and the way that they are configured.

Secure user authentication and session privacy while performing routine monitoring and maintenance tasks are provided by the OpenSSH implementations of the "secure shell" daemon, **`sshd`** and its companion "secure copy" utility, **`scp`**. The UCD-SNMP implementation of the Simple Network Management Protocol (SNMP) daemon, **`snmpd`** conforms to the latest Internet standard, known as SNMPv3, which also supports secure user authentication and session privacy. In addition, the Network Time Protocol daemon, **`ntpd`** supports client-server authentication security measures to deter spoofing of NTP clients by rogue NTP servers. This appendix describes these security measures and gives the advanced network administrator information that will allow custom configuration to fit specific security needs.

Linux Operating System

The embedded Linux operating system running in the Tempus Cntp is based on kernel version 2.2.13 and version 7 of the Slackware Linux distribution. As such it supports a complete set of security provisions:

- System passwords are kept in an encrypted file, */etc/shadow* which is not accessible by users other than *root*.
- Direct *root* logins are only permitted on the local RS-232 console or via SSH
- The secure copy utility, **`scp`** eliminates the need to use the insecure **`ftp`** protocol for transferring program updates to the Tempus Cntp

- Access via SNMP is configurable to provide the security of the latest version 3 Internet standard which supports both view-based access control and user-based security using modern encryption techniques. Previous versions v1 and v2c supported access control essentially via passwords transmitted over the network in plain text. Refer to *Appendix C – Simple Network Management Protocol*, which is dedicated to configuration of SNMP for details.
- Individual host access to protocol server daemons such as **in.telnetd, snmpd** or **sshd** may be controlled by the **tcpd** daemon and */etc/hosts.allow* and */etc/hosts.deny*
- Risky protocols like TIME, DAYTIME and TELNET may be completely disabled by configuration of the **inetd** super-server daemon.

The last two topics are supported on the Tempus Cntp by a pair of shell scripts which ease configuration for the inexperienced user of Unix-like operating systems. These are **accessconfig** and **inetdconfig**.

accessconfig modifies two files which are used by **tcpd** and the standalone daemon, **snmpd** to determine whether or not to grant access to a requesting host: */etc/hosts.allow* and */etc/hosts/deny*. These two files may contain configuration information for a number of protocol servers, but in the Tempus Cntp only access control to the protocol server daemons **in.telnetd, sshd** and **snmpd** is configured.

As shipped from the factory, these two files are empty. When the user runs **accessconfig**, these lines are added to the */etc/hosts.deny* file:

```
in.telnetd: ALL
sshd: ALL
snmpd: ALL
```

This tells **tcpd** to deny access to **in.telnetd** and **sshd** to all hosts not listed in the */etc/hosts.allow* file. The **snmpd** daemon also parses this file itself prior to granting access to a requesting host. Then the user is prompted to enter a list of hosts that will be granted access to **in.telnetd, sshd** and **snmpd**. These appear in the */etc/hosts.allow* as lines like this:

```
in.telnetd: 192.168.1.2, 192.168.1.3
sshd: 192.168.1.2, 192.168.1.3
snmpd: 192.168.1.2, 192.l68.1.3
```

This simple shell script handles the needs of most users, however the syntax of these two files supports elaborate configuration possibilities which are beyond the capabilites of this simple shell script. Advanced users who need these capabilities will need to edit these two files directly and then copy them to the */boot/etc* directory. (A very compact editor with WordStar command keystrokes is available on the system for this purpose:

`edit`. If you start **`edit`** without giving it a file name to open, it will display its help screen, showing the supported keystrokes.) Be careful to maintain the proper ownership and access permissions by using **`cp -p`** when copying the files.

`inetdconfig` modifies the */etc/inetd.conf* file which is read by **`inetd`** to start-up various protocol server daemons when requests from remote hosts are received. Currently, four servers are configurable via **`inetdconfig`**: TIME and DAYTIME, whose daemons are contained within the **`inetd`** daemon itself, and **`in.telnetd`** and **`sshd`**. Any one or all of these may be enabled or disabled for start-up.

OpenSSH

The secure shell protocol server running in the Tempus Cntp is based on the portable OpenSSH for Linux. As such it supports both SSH1 and SSH2 protocol versions. For more information about this protocol and to obtain client software, refer to the OpenSSH website:

www.openssh.com

An excellent book which describes operation and configuration of the various SSH implementations, including OpenSSH is available from O'Reilley & Associates:

SSH, The Secure Shell, Barrett & Silverman, O'Reilley & Associates, 2001

In the interest of conserving scarce system memory resources, only the secure shell server daemon, **`sshd`** and the secure copy utility, **`scp`** are implemented in the Tempus Cntp. This means that users on remote hosts may log in to the Tempus Cntp via an **`ssh`** client, but users logged in on the Tempus Cntp are unable to log in to a remote host via **`ssh`**. Since **`scp`** runs in concert with an **`ssh`** client, the same limitations exist for its use, i.e. users on remote hosts may transfer files to and from the Tempus Cntp via **`scp`** over **`ssh`** but users logged in on the Tempus Cntp are unable to transfer files to and from a remote host via **`scp`** over **`ssh`**.

The factory configuration contains a complete set of security keys for both SSH1 and SSH2 versions of the protocol. RSA keys are supported by both versions, and DSA keys are supported when using the SSH2 version.

In addition, the Tempus Cntp is factory configured with a set of public keys for passwordless, public key authentication of the root user. To use this capability, the corresponding set of private keys for each of the two SSH versions are provided in the */boot/root* directory of the Tempus Cntp. Three files contain these keys: *identity* (SSH1), *id_rsa* (SSH2) and *id_dsa* (SSH2). These must be copied to the user's *~/.ssh* directory on their remote computer. (Be careful to maintain the proper ownership and access permissions by using **cp -p** when copying the files. They *must* be readable only by *root*.) The corresponding public keys are by factory default resident in the */root/.ssh* directory of the Tempus Cntp. Two files contain these keys: *authorized_keys* (SSH1) and *authorized_keys2* (SSH2).

Since the provided private keys are not passphrase protected, the user should create a new set of keys after verifying operation with the factory default key sets. After creating the new keys, the public keys should be copied to the */boot/root/.ssh* directory of the Tempus Cntp. At boot time, the Tempus Cntp will copy these to the actual */root/.ssh* directory of the system ramdisk, thereby replacing the factory default set of public keys.

Advanced users wishing to modify the configuration of the **sshd** daemon should edit the */etc/sshd_config* file and then copy it to the */boot/etc* directory of the Tempus Cntp. Be careful to maintain the proper ownership and access permissions by using **cp -p** when copying the file. At boot time, it will be copied to the */etc* directory of the system ramdisk, thereby replacing the factory default configuration file.

Network Time Protocol

The NTP implementation in the Tempus Cntp is built from the standard distribution at the www.ntp.org site. By factory default, remote control of the NTP daemon **ntpd** is disabled. Query-only operation is supported from the two NTP companion utilities **ntpq** and **ntpdc**.

Control via these two utilities is disabled in the */etc/ntp.conf* file in two ways. First, MD5 authentication keys are not defined for control operation via a *requestkey* or *controlkey* declaration. Second, this default address restriction line is present in the file:

restrict default notrust nomodify

This line eliminates control access from ALL hosts. Query access is not affected by this restriction. Knowledgable NTP users who would like to customize the security aspects of the configuration of the NTP daemon in the Tempus Cntp should edit the */etc/ntp.conf* file directly and then copy it to the */boot/etc* directory. Be sure to retain the ownership and permissions of the original file by using **cp -p** when performing the copy.

CAUTION

If you are planning to make changes to the */etc/ntp.conf* file, you must not restrict query access from the local host to the NTP daemon. Various system monitoring processes running on the system require this access.

Appendix B

Upgrading the Firmware

Periodically, EndRun Technologies will make bug fixes and enhancements to our products available for download from our website. All such downloads are freely available to our customers, without charge. After you have downloaded the appropriate FLASH binary image file from the EndRun Technologies website, you are ready to perform the upgrade to your Tempus Cntp.

The firmware consists of two FLASH binary image files. One of these is the firmware for the Tempus Cntp itself. This firmware executes on the IBM-compatible single board computer and contains the embedded Linux operating system and NTP specific application software. The other file is the firmware for the CDMA receiver subsystem. This firmware executes in the Tempus Cntp CDMA time and frequency engine. Each of these files may be upgraded independently.

What You Need To Perform the Upgrade

You will need to use **`ftp`** or **`scp`** to transfer the FLASH binary image file(s) to the Tempus Cntp. This means that you must place the previously downloaded file(s) in a place on your network which is accessible to the Tempus Cntp.

Performing the Tempus Cntp Upgrade

There are two FLASH disk partitions which hold the compressed root file system images. These are normally unmounted. When an upgrade is to be performed they are mounted at */rootfs_0* and */rootfs_1*. The factory shipped image is always stored in the first of these partitions as */rootfs_0/rootfsX.XX.gz*. Where *X.XX* is the factory shipped version. It is stored with the immutable attribute set so that even *root* cannot inadvertently delete it or overwrite it. When performing an upgrade, you will be copying the new image to the partition that will be mounted on */rootfs_1*.

CAUTION

Some browsers will automatically unzip the gzip file when downloading from the website. Please make sure that the gzip file is less than 3M in size before proceeding. Upgrading the partition with a too-large file size can cause serious problems and the unit may have to be returned to the factory for repair.

To perform the upgrade, log in as the *root* user to the Tempus Cntp using the local console serial I/O port, **telnet** or **ssh** and perform these operations:

First enable the upgrade partition by issuing this command at the shell prompt:

```
cntpenableupgrade
```

This command will mount the FLASH disk root file system partitions. Now change the working directory to the upgrade partition:

```
cd /rootfs_1
```

Now remove any previously installed root file system image that may be on the upgrade partition:

```
rm /rootfs_1/*.gz
```

If you are using **ftp** to perform the upgrade, transfer the previously downloaded file using *binary* transfer mode from the remote host to the working directory, */rootfs_1* using FTP (substitute the name of the root file system image that you are installing for *rootfsupgrade.gz*):

```
ftp remote_host       {perform ftp login on remote host}
bin                   {set transfer mode to binary}
get rootfsupgrade.gz  {transfer the file}
quit                  {close the ftp session after the transfer }
```

If you are using **ssh**, you may open another command window on the remote computer and securely transfer the root file system image using **scp** from the remote computer. A command like this could be used:

```
scp -p rootfsupgrade.gz root@cntp.your.domain:/rootfs_1
```

Now you must leave the */rootfs_1* directory in order to execute the **updatelilo** command and complete the upgrade:

```
cd /root
```

Update the LILO configuration by executing this shell script (substitute the name of the root file system image that your are installing for *rootfsupgrade.gz*):

```
/boot/updatelilo 1 rootfsupgrade.gz
```

You should see these lines displayed if the update is successful:

```
Added TempusCntp_0
Added TempusCntp_1 *

Unmounting root file system partitions now.  Run cntpenableupgrade
again to remount them, should you need to re-run updatelilo.
```

The trailing asterisk following the second line indicates that the LILO configuration file is set to default to the new TempusCntp_1 root file system that you just installed on */rootfs_1*. Now reboot the system by issuing this command at the shell prompt:

```
shutdown –r now
```

Wait about 30 seconds for the system to shutdown and re-boot. Then log in to the Tempus Cntp using **`telnet`** or **`ssh`**. If all has gone well, you should be able to log in the usual way. After you have entered your password, the system message will be displayed. You should notice that it now indicates the software version and date of the upgrade that you previously downloaded. You can also check this at any time by issuing

```
cntpversion
```

which will cause the system message to be re-displayed.

You can also check to see which root file system image the system is currently booted under by issuing this command at the shell prompt:

```
cntprootfs
```

Which should cause this to be printed to the console:

```
BOOT_IMAGE=TempusCntp_1
```

If so, and your unit seems to be operating normally, you have successfully completed the upgrade. If your unit does not boot up successfully, and you are not able to **`telnet`** or **`ssh`** into the system after 30 seconds, then there has been some kind of problem with the upgrade. It is possible that the file downloaded was corrupt or that you forgot to set your FTP download file mode to binary when downloading the file--either from the EndRun Technologies website or when transferring it to the Tempus Cntp.

Recovering from a Failed Upgrade

To restore your Tempus Cntp to a bootable state using the factory root file system, you must use the serial I/O port and re-boot the Tempus Cntp by cycling the power. Refer to Chapter 1 – *Connect the Serial I/O Port* and *Test the Serial I/O Port* for setup details. When you have connected your terminal to the serial I/O port, apply power to the Tempus Cntp.

Pay close attention to the terminal window while the unit is re-booting. When the LILO prompt is displayed, you must press the ESC key once on your keyboard within five seconds to let LILO know that you are going to enter the name of a root file system label that it should boot in place of the default. Now type

```
TempusCntp_0
```

This tells LILO to boot the factory root file system. Now watch the rest of the boot process to make sure that you have successfully recovered from the failed upgrade. If the system boots normally, then you should resolve the problems with the previous upgrade and re-perform it.

Performing the CDMA Upgrade

To perform this upgrade, log in as the *root* user to the Tempus Cntp using either the local console serial I/O port, **telnet** or **ssh** and perform these operations:

Change the working directory to the */tmp* directory:

```
cd /tmp
```

If you are using **ftp** to perform the upgrade, transfer the previously downloaded file using *binary* transfer mode from the remote host to the working directory, */tmp* (substitute the name of the CDMA subsystem image that your are installing for *cdmaupgrade.bin*):

```
ftp remote_host       {perform ftp login on remote host}
bin                   {set transfer mode to binary}
get cdmaupgrade.bin   {transfer the file}
quit                  {close the ftp session after the transfer }
```

If you are using **ssh**, you may open another command window on the remote computer and securely transfer the CDMA subsystem image to the */tmp* directory using **scp** from the remote computer. A command like this could be used:

```
scp -p cdmaupgrade.bin root@cntp.your.domain:/tmp
```

Now issue the following command to the Tempus Cntp CDMA engine to initiate the upload:

```
echo –e "upload\r" > /dev/ttyS0
```

This command tells the CDMA engine to enter the 'waiting for download' mode. Now issue this command to start the transfer of the binary file using the XMODEM protocol:

```
lsz –Xk cdmaupgrade.bin < /dev/ttyS0 > /dev/ttyS0 2>&1
```

After issuing this command you will have to wait for about one minute for the transfer to complete before the prompt will be re-displayed. There will be no diagnostic error messages displayed if the upload is successful. Following a successful upload, you will see the front panel ALARM and LOCK LEDs go through the start-up sequence.

After about one minute, you should query the CDMA firmware version using the command:

```
cdmaversion
```

The new version information should be displayed.

Problems with the CDMA Upgrade

Should you have difficulties with the upgrade due to a corrupt file, power failure during upload, or other accident, do not be alarmed. Even though you may have lost the existing application program, the CDMA engine bootloader program will remain intact. On boot up, it will check to see if a valid application program is in the FLASH memory. If there is not, it will immediately go into the 'waiting for download' mode. You may verify this by issuing this command:

```
cat < /dev/ttyS0
```

You should now see the 'C' character being received every three seconds. This is the character that the Tempus Cntp CDMA engine bootloader sends to indicate to the XMODEM utility that it is wating for a download. You may now re-try the upload procedure, assuming that you have corrected any original problem with the binary file. First kill the **cat** command by typing CTRL-C. You should see a command prompt. Now issue this command to start the transfer of the binary file using the XMODEM protocol:

```
lsz –Xk cdmaupgrade.bin < /dev/ttyS0 > /dev/ttyS0 2>&1
```

Appendix C

Simple Network Management Protocol

Your Tempus Cntp includes the University of California at Davis (UCD)-SNMP version 4.2.5 implementation of a SNMP agent, **`snmpd`** and a SNMP notification/trap generation utility, **`snmptrap`**. It supports all versions of the protocol in use today: SNMPv1 (the original Internet standard), SNMPv2c (never reached standard status, often called "community SNMP") and SNMPv3 (the latest Internet standard).

The UCD-SNMP project has its roots in the Carnegie-Mellon University SNMP implementation. For more detailed information about the UCD-SNMP project and to obtain management software and detailed configuration information, you can visit this website:

http://www.net-snmp.org

An excellent book which describes operation and configuration of various SNMP managers and agents, including the UCD-SNMP implementations, is available from O'Reilley & Associates:

Essential SNMP, Mauro & Schmidt, O'Reilley & Associates, 2001

If you are planning to operate with SNMPv3, it is highly recommended that you make use of both of these resources to familiarize yourself with the agent configuration concepts.

SNMPv3 Security

Prior to SNMPv3, SNMP had definite security inadequacies due to using two community names in a manner analogous to passwords that were transmitted over the network as clear text. In addition, since no mechanism existed for authenticating or encrypting session data, any number of man-in-the-middle data corruption/replacement exploits were possible in addition to plain old snooping to learn the community names. SNMPv3 implements the User-based Security Model (USM) defined in RFC-2274 which employs modern cryptographic technologies to both authenticate multiple users and to encrypt their session data for privacy, much in the same way that SSH does for remote login shell users.

In addition, it implements the View-based Access Control Model (VACM) defined in RFC-2275. This RFC defines mechanisms for limiting the access of multiple users having various security levels (no authentication, authentication or authentication plus privacy) to specific "views" of the Structure of Management Information (SMI) object tree.

Enterprise Management Information Base (MIB)

In addition to providing the SNMP variables contained in MIB-II as described in RFC-1213, EndRun Technologies has implemented an enterprise MIB using the syntax of the SMI version 2 (SMIv2) as described in RFC-2578:

TEMPUS-MIB

Which is located on your Tempus Cntp in this ASCII file:

/usr/local/share/snmp/mibs/TEMPUS-MIB.txt

In addition to a complete set of NTP and CDMA status objects, the MIB defines four SMIv2 notification objects:

- NTP Leap Indicator Bits status change
- NTP Stratum change
- CDMA Fault Status change
- CDMA Time Figure of Merit change

Invocation of the SNMP daemon

The SNMP daemon, **snmpd** is started from the */etc/rc.d/rc.local* system start-up script with this line:

```
snmpd -s -c /etc/snmpd.conf
```

By default, it will listen on port 161 for SNMP queries from the network management system. If you would like to have it listen on another port, you could edit the file by adding **-p port** to the end of this line, where **port** is the number of the port you would like for the agent to listen on. If you would like to disable starting of the **snmpd** daemon altogether, you can either remove this line or place a **#** character at the beginning of the line so that it will not be executed. (A very compact editor with WordStar command keystrokes is available on the system for this purpose: **edit**. If you start **edit** without giving it a file name to open, it will display its help screen, showing the supported keystrokes.)

IMPORTANT

After editing */etc/rc.d/rc.local*, you must copy it to the */boot/etc/rc.d* directory and re-boot the system. It is very important to retain the access mode for the file, so be sure to use **`cp -p`** when performing the copy. During the boot process, the files contained in the */boot/etc/rc.d* directory are copied to the working */etc/rc.d* directory on the system RAM disk. In this way the factory defaults are over written.

Quick Start Configuration – SNMPv1/v2c

You should be able to compile the TEMPUS-MIB file on your SNMP management system and access the variables defined therein. The factory default community names are "Tempus" for the read-only community and "endrun_1" for the read-write community. This is all that is required for operation under v1 and v2c of SNMP. You can, and should, change the default community names by editing */etc/snmpd.conf* and modifying these two lines:

```
rwcommunity   endrun_1
rocommunity   Tempus
```

Configuring SNMPv1 Trap Generation

To have your Tempus Cntp send SNMPv1 traps (RFC-1215) you must configure the community and destination for SNMPv1 traps by uncommenting and editing this line in */etc/snmpd.conf*:

```
trapsink    xxx.xxx.xxx.xxx trapcommunity trapport
```

where `trapcommunity` should be replaced by your community, and `xxx.xxx.xxx.xxx` is the IP address or hostname of the destination host for receiving the traps generated by the Tempus Cntp. By default, the trap will be sent to port 162. You may optionally add another parameter, `trapport` to the end of the above line to override the default port setting. Otherwise leave it blank.

Note: Though the agent will recognize multiple `trapsink` lines within */etc/snmpd.conf* and send the generic SNMP coldStart or authenticationFailure traps to each destination, the enterprise trap generation mechanism of the Tempus Cntp will only send a trap to the last declared `trapsink` in the file.

Configuring SNMPv2c Notifications and Informs

To have your Tempus Cntp send SNMPv2c notifications (SMIv2, RFC-2578) or informs, you must configure the communities and destinations by uncommenting and editing one or both of these lines in */etc/snmpd.conf*:

```
trap2sink    xxx.xxx.xxx.xxx trap2community trap2port
informsink   xxx.xxx.xxx.xxx informcommunity informport
```

where `trap2community` and `informcommunity` should be replaced by your communities, and `xxx.xxx.xxx.xxx` is the IP address or hostname of the destination host for receiving the notifications or informs generated by the Tempus Cntp. By default, the v2c trap or inform will be sent to port 162. You may optionally add another parameter, `trap2port` or `informport` to the ends of the above lines to override the default port setting. Otherwise leave it blank.

Note: Though the agent will recognize multiple `trap2sink` or `informsink` lines within */etc/snmpd.conf* and send the generic SNMP coldStart or authenticationFailure notifications and informs to each destination, the enterprise notification/inform generation mechanism of the Tempus Cntp will only send a notification to the last declared `trap2sink` and an inform to the last declared `informsink` in the file.

IMPORTANT

After editing */etc/snmpd.conf*, you must copy it to the */boot/etc* directory and re-boot the system. It is very important to retain the access mode for the file (i.e. readable only by *root*), so be sure to use **`cp -p`** when performing the copy. During the boot process, the files contained in the */boot/etc* directory are copied to the working */etc* directory on the system RAM disk. In this way the factory defaults are over written.

Configuration of SNMPv3

If you are planning to use SNMPv3, you should definitely make use of the two resources mentioned previously (UCD-SNMP website and *Essential SNMP*) and study them carefully. There are rather elaborate configuration options available when you are using v3. The instruction presented here will give you the flavor of the configuration but definitely not the full scope of possibilities. To access your Tempus Cntp via v3 of SNMP, you will have to configure two files:

/etc/snmpd.conf
/boot/ucd-snmp/snmpd.conf

The first file contains static configuration parameters that the agent uses to control access and to determine where to send notifications/traps. Other aspects of the agent's operation are also configurable in this file, but you should not need to modify those. To use the SNMPv3 capabilities of the Tempus Cntp, you must first set up user information and access limits for those users in */etc/snmpd.conf*. Uncomment and edit these two lines to define your v3 users and their access parameters:

```
rwuser root    priv .1
rouser ntpuser auth .1.3.6.1.4.1.13827
```

The first line defines a SNMPv3 read-write user *root* whose minimum security level will be authenticated and encrypted for privacy (choices are noauth, auth and priv), and who will have read-write access to the entire *iso(1)* branch of the SMI object tree. The second line defines a SNMPv3 read-only user *ntpuser* whose minimum security level will be authenticated but not encrypted, and who will have read-only access to the entire *iso(1).org(3).dod(6).internet(1).private(4).enterprises(1).endRunTechnologiesMIB(13827)* branch of the SMI object tree. After adding the user lines to */etc/snmpd.conf*, copy it to the */boot/etc* directory using **`cp -p`**.

The second file is located on the non-volatile FLASH disk and is used by the SNMP agent to store "persistent data" that may be dynamic in nature. This may include the values of the MIB-II variables sysLocation, sysContact and sysName as well as any configured SNMPv3 user crypto keys. In order to use SNMPv3, you must configure user keys in this file for each SNMPv3 user that you have set up in */etc/snmpd.conf*. To do this, you must add lines to */boot/ucd-snmp/snmpd.conf* like these for each user:

```
createUser root    MD5 endrun_1 DES endrun_1
createUser ntpuser SHA Tempus_0
```

The first line will cause the agent, **`snmpd`** to create a user *root* who may be authenticated via Message Digest Algorithm 5 (MD5) with password *endrun_1* and may use the Data Encryption Standard (DES) to encrypt the session data with passphrase *endrun_1*. The second line will cause a user *ntpuser* to be created who may be authenticated using the Secure Hash Algorithm (SHA) with password *Tempus_0*. Passwords and passphrases must have a *minimum* of 8 characters, or you will not be able to be authenticated.

IMPORTANT

You must kill the **`snmpd`** process prior to editing */boot/ucd-snmp/snmpd.conf*. Otherwise, the secret key creation may not complete properly. Issue the command **`ps -e`** to have the operating system display the list of running processes. Look for the PID of the **`snmpd`** process and issue the **`kill`** command to stop it. For example, if the PID listed for the **`snmpd`** process is 53, then you would issue this command: **`kill 53`**. You can verify that the process was terminated by re-issuing the **`ps -e`** command.

After re-booting, the agent will read the */boot/ucd-snmp/snmpd.conf* configuration file and compute secret key(s) for each of the users and delete the **`createUser`** lines from the file. It will then write the secret key(s) to the file. These lines begin with the string, **`usmUser`**. In this way, un-encrypted passwords are not stored on the system.

IMPORTANT

The encryption algorithms used by the agent are dependent upon the IP address of the Tempus Cntp. Because of this, new keys must be generated anytime your Tempus Cntp's IP address is changed. It also means that you cannot use the same */boot/ucd-snmp/snmpd.conf* file with multiple Tempus Cntp units. To generate new keys, stop the **`snmpd`** process, delete the existing **`usmUser`** key lines from the file and then add new **`createUser`** lines. Then re-boot the system.

This example gives the simplest configuration to begin using SNMPv3 but doesn't make use of the full capabilities of the VACM in defining groups and views for fine-grained access control. The factory default */etc/snmpd.conf* file contains commented blocks of lines that can be uncommented to give you a basic configuration that uses the User-based Security Model (USM) described in RFC-2274 and the View-based Access Control Model (VACM) described in RFC-2275. The comments included in the file should help you in modifying it for your specific requirements.

Appendix D

Leap Seconds

Your Tempus Cntp can automatically handle the leap second transitions that occur about once every two years. However, some of the CDMA providers have not implemented this to the level of precision needed for smooth transitions at UTC midnight on the day of a leap second insertion. If you need your Tempus Cntp to precisely handle any UTC leap second insertions at midnight on June 30th or January 31st (the possible times that leap seconds are inserted), then you should consider configuring your Tempus Cntp to operate in the user-entered leap second mode.

In the user-entered leap second mode, you must provide the current and future leap second values. The EndRun Technologies' website posts the appropriate current and future leap seconds setting for your Tempus Cntp when operating in this mode. The appropriate link is:

www.endruntechnologies.com/leap.htm

Alternatively, go to the International Earth Rotation Service (IERS) website. If a leap second is pending it will be posted by the IERS approximately six months in advance of insertion. This information is available in the latest Bulletin C at the (IERS) website:

www.iers.org

Leap seconds are inserted from time-to-time in order to keep UTC, which is derived from atomic time (TAI), in agreement with the Earth's rotation rate. Relative to TAI, the Earth's rotation rate is slowing down. This means that UTC must be retarded periodically in order to maintain agreement between UTC and the apparent daylength. If this were not done, eventually UTC would drift out-of-sync with Earth's day and many astronomical and navigational problems would ensue.

The International Earth Rotation Service (IERS) is the organization responsible for measuring the relationship between UTC and the rotation rate of the Earth. When the difference between UTC and apparent Earth time has exceeded a certain threshold, the IERS coordinates with the Bureau International of the Hour (BIH) to schedule the insertion of a leap second into the UTC time scale.

The IERS publishes Bulletin C about 6 months in advance of each possible leap second insertion point. Leap seconds may only be inserted at UTC midnight of June 30 or December 31. Bulletin C confirms either that a leap second will or will not be inserted at the next possible insertion point. Since the introduction of leap seconds in 1961, they have been added approximately once every 18 months.

By default, your Tempus Cntp will automatically determine the UTC leap second information from the CDMA transmissions. You can change to the user-entered leap second mode by using either the front-panel keypad (see Chapter 5) or the network/serial port command (see Chapter 6). If you choose this mode of operation, you will be responsible for setting the current and future leap seconds into your Tempus Cntp prior to a scheduled leap second insertion event.

Leap seconds are actually the difference between GPS-UTC. The GPS time scale began on January 6, 1980. At that time, the UTC timescale had undergone 19 leapsecond insertion events. If you are obtaining your leap second information from the IERS website, you will need to subtract 19 from the TAI-UTC leap second values published there to obtain GPS-UTC, the number needed to set the current and future leap seconds for the Tempus Cntp. At the time of writing in June of 2003, TAI-UTC was 32 seconds and GPS-UTC was 13 seconds.

If there is no leap second insertion scheduled at the next possible time, then you would enter the same value for both the current and future leap seconds. If there is a leap second insertion scheduled, then you would enter a future value that is one more than the current value. You may enter this information at any time during the six months prior to the actual insertion point. The Tempus Cntp will remember the setting and apply it at the proper time with a smooth transition at UTC midnight to the new UTC second.

Appendix E

Lithium Battery Replacement

Your Tempus Cntp incorporates a lithium battery on its IBM-PC compatible single board computer subsystem component. This battery is *not* user servicable and your Tempus Cntp should be returned to the factory should its replacement become necessary.

CAUTION

Danger of explosion if battery is incorrectly replaced..

Replace only with the same or equivalent type recommended by the manufacturer. Dispose of used batteries according to the manufacturer's instructions.

Appendix F

Time Figure of Merit (TFOM)

This appendix describes the Time Figure of Merit (TFOM) number. The Tempus Cntp displays this number on the front panel via the Receiver Status display. (see Chapter 5) The TFOM is also printed out in the time-of-day fields printed by the **`cdmastat`** and **`cntpstat`** commands (see Chapter 6). The TFOM number indicates the level of accuracy that should be included in the interpretation of the time-of-day and ranges from 6 to 9:

6	time error is < 100 us
7	time error is < 1 ms
8	time error is < 10 ms
9	time error is > 10 ms, unsynchronized state if never been locked to CDMA.

In all cases, the Tempus Cntp reports this value as accurately as possible, even during periods of CDMA signal outage where the Tempus Cntp is unable to directly measure the relationship of its timing outputs to UTC. During these CDMA outage periods, assuming that the Tempus Cntp had been synchronized prior to the outage, the Tempus Cntp extrapolates the expected drift of the Tempus Cntp timing signals based on its knowledge of the characteristics of the internal Temperature Compensated Crystal Oscillator (TCXO), Oven Controlled Crystal Oscillator (MS-OCXO/HS-OCXO) or Rubidium oscillator. The extrapolated TFOM is based on a conservative estimate of the performance of the oscillator and should be considered 'worst case' for a typical benign ambient temperature environment.

Due to this extrapolation behavior, after initial synchronization, brief periods without CDMA signal reeption will not induce an immediate alarm condition. If the condition persists for long enough periods, you should see the TFOM character change to indicate a gradually deteriorating accuracy of the timing outputs. If the signal loss condition persists longer, then the final, unsynchronized state will eventually be reached. If the Tempus Cntp is unable to achieve re-synchronization within one hour after reaching this state, the red LED will illuminate. The fault status field returned in either of the **cdmastat** or **cntpstat** commands will have the appropriate bit set to indicate a loss-of-signal time-out condition.

If the CDMA subsystem reaches the unsynchronized TFOM state, the NTP daemon will cease to use the timing information returned by the CDMA subsystem in its polling event timestamps. At this point, the NTP daemon will report in its replies to network NTP clients that are receiving synchronization from the Tempus Cntp that it is running at stratum 11. NTP clients will recognize that and cease to use the unsynchronized server.

Appendix G

Specifications

CDMA Receiver:

- AMPS Mobile Receive Band – 869-894 MHz
- TIA/EIA IS-95 CDMA Pilot and Sync channels.

Antenna:

- SMA jack on rear panel, $Z_{in} = 50\Omega$.
- 824-896 MHz, magnetic-base $\lambda/2$ monopole with integral 12 ft. RG-58/U cable and SMA plug.

Local Oscillator: TCXO. OCXO or Rubidium (options).

Time to Lock: < 5 minutes, typical.

Display: Brilliant 16x280 dot-matrix vacuum-fluorescent.

Keypad: Enter, Back, Edit, Right, Left, Up, Down, Help.

Network I/O (rear panel RJ-45 jack)**:**
10/100Base-T ethernet

System Status Indicators (front panel)**:**

- **Sync LED:** green indicator that pulses to indicate the current CDMA acquisition and lock status.
- **Network LED:** amber indicator that illuminates when the ethernet connection is up and flashes when packets are received or transmitted.
- **Alarm LED:** red indicator that illuminates when a serious fault condition exists.

Linux Maintenance Console:

RS-232 serial I/O on rear panel DB9M jack for secure, local terminal access. Parameters fixed at 19200 baud, 8 data bits, no parity, 1 stop bit. For communication with another computer, 2 meter DB9F—DB9F null modem adapter cable is included.

NTP Client Synchronization Accuracy:

Network factors can limit NTP client synchronization accuracy to .5-2 ms, typical. Timestamping accuracy is maintained to less than 100 us while processing hundreds of NTP packets per second.

Supported Protocols:

- SNTP, NTP v2, v3, v4 and broadcast/multicast mode; MD5 authentication
- SSH server with "secure copy" utility, SCP (Open SSH version 3.4p1)
- SNMP v1, v2c, v3 with Enterprise MIB
- MD5 authentication
- TIME and DAYTIME server
- TELNET client/server
- FTP client
- DHCP client

Power:

- 85-270 VAC, 47-63 Hz, .5 A Max. @ 120 VAC, .25 A Max. @ 240 VAC
- 110-370 VDC, 0.5A Max @ 120 VDC
- 3-Pin IEC 320 on rear panel, 2 meter line cord is included.

DC Power (option):

- 40-60 Vdc, 1.5A maximum.
- 3-position terminal block on rear panel: +DC IN, SAFETY GROUND, -DC IN (Floating power input: Either "+" or "-" can be connected to earth ground.)

Optional Timing Outputs (rear panel BNC jacks):

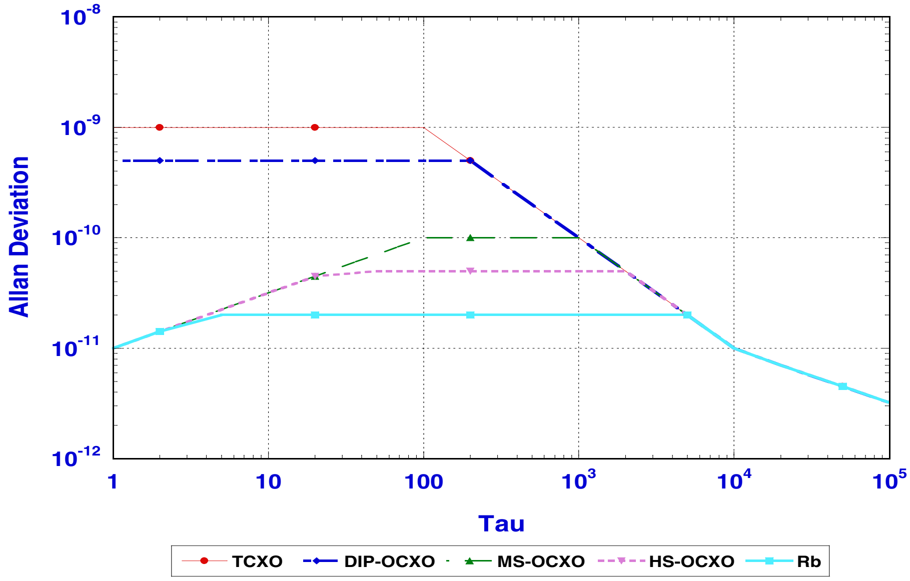
- **1 PPS:** 1 ms wide, positive TTL pulse @ 50Ω.
  Accuracy: < 10 microseconds to UTC when locked, typical. Range to base station may degrade this in fringe area applications, due to increased propagation delay.
  Stability: TDEV < 50 ns, $\tau < 10^4$ seconds.
- **Time Code:** 1 Vrms @ 50Ω.
  Format: IRIG-B122

Optional Frequency Output (rear panel BNC jack):

- **10 MPPS:** TTL squarewave @ 50Ω.

  Accuracy: < 1 x 10^{-11} to UTC for 24 hour averaging times when locked.

  Stability:



Additional Optional Time/Frequency Outputs (rear panel BNC jacks)**:**

- **10 MHz:** 1Vrms sinewave @ 50Ω, harmonics < -45 dBc
- **5 MHz:** 1Vrms sinewave @ 50Ω, harmonics < -45 dBc
- **1 MHz:** 1Vrms sinewave @ 50Ω, harmonics < -45 dBc
- **5 MPPS:** TTL squarewave @ 50Ω
- **1 MPPS:** TTL squarewave @ 50Ω
- **Time Code TTL:** IRIG-B022 DC-shift TTL @ 50Ω

Size:

- **Chassis:** 1.75"H x 17.0"W x 10.75"D
- **Antenna**: 14" H x 2.0" Dia. at base

Weight: < 5 lb. (2.70 kg.)

Environmental:

- **Temperature:** 0° to +50°C
- **Humidity:** 0 to 95%, non-condensing

CE/FCC Compliance: RTTE Directive 99/5/EC
Low Voltage Directive 73/23/EC
EMC Directive 89/336/EC
With Amendment 93/68/EC

Supplementary Compliance Data:

- **Safety:** EN 60950;1992, A1,A2: 1993, A3: 1995, A4: 1997, A11:1998
- **EMC:** EN 55024 (1998), EN61000-3-2 (1995 w/A1 & A2:98),
  EN61000-3-3 (1995 w/A1:98), EN55022 (1998 w/A1:00) Class A,
  VCCI (April 2000) Class A, CISPR 22 (1997) Class A,
  FCC Part 15 Subpart B Section 15.109 Class A,
  ICES-003 Class A (ANSI C63.4 1992),
  AS/NZS 3548 (w/A1 & A2: 97) Class A