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EndRun TECHNOLOGIES

Præcis Ce Time and Frequency Engine

User's Manual

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Preface

Thank you for selecting the Præcis Ce Time and Frequency Engine for your OEM application. Our goal in developing this product is to allow you to bring precise, Universal Coordinated Time (UTC) and Frequency into your system quickly, easily and reliably. Your new Præcis Ce 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 – These units are configured for optimum performance in operation with network servers 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 integration and interfacing procedures.

Introduction – The Præcis Ce, how it works, where to use it, its main features.
Basic Integration – How to integrate your Præcis Ce with your host system and test operation.
Operation – Details of the software and hardware interface.

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.

Trademark acknowledgements

Præcis Ce User's Manual **Revision 9**

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Warranty

This product, manufactured by EndRun Technologies, is warranted against defects in material and workmanship for a period of one year 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.

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.

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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 Præcis Ce is a precision source of Universal Coordinated Time (UTC) and Frequency that can be integrated with any host system having a serial I/O port operating at TTL levels and a source of +5 VDC power. In its most basic operation, it broadcasts an ASCII time-of-day message each second with a specific character being the 'on-time' character. The transmission time of this character is accurate to less than one millisecond. More critical applications may take advantage of the other special time and frequency input and output signals available on the interface which allow time synchronization to typically less than ten microseconds and frequency syntonization to less than one part in 10^{11}.

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, manuals and other documentation .

CDMA Timing–How it Works

CDMA mobile telecommunications base stations must be synchronized.

The Præcis Ce 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 Præcis Ce 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 Præcis Ce has all of the information that it needs to perform its function of delivering accurate UTC time to a host system. 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 and the underlying frequency stability of the CDMA base station transmissions may thereby be reproduced as well. The Præcis Ce 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 Præcis Ce must be deployed in a *cellular* IS-95 CDMA coverage area. *Cellular* is a commonly used term that implies 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 Præcis Ce 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 equipment containing the Præcis Ce, then your Præcis Ce will work properly there.

Just about any application can use the Præcis Ce.

Because the Præcis Ce has been designed from the ground up to be a time and frequency engine, its interface is straightforward and there are no clever tricks needed to attain the time and frequency performance that the CDMA infrastructure is capable of providing. This is in contrast with the popular GPS devices, which are optimized for navigation use and are generally difficult, for all but the most knowledgable practitioners of the art, to use effectively for time and frequency applications.

Main Features

Reliability

The Præcis Ce provides high performance and reliability combined with low power consumption. Its ARM7TDMI RISC microprocessor is the global standard for high-performance, battery-powered applications and is the current processor-of-choice in most phones today.

Flexibility

It supports operation in a variety of modes with a variety of platforms and operating systems.

Easy Integration and Installation

Host system integration is implemented via a single dual-row header and an SMA antenna input jack. Its indoor mounted antenna makes installation by the end user a snap compared to competing *direct* GPS products.

Free FLASH Upgrades

All firmware and configurable hardware parameters are stored in non-volatile FLASH memory, so the Præcis Ce can be easily upgraded in the field with any terminal program capable of performing file uploads using XMODEM. We make all firmware upgrades to our Præcis products available to our customers free of charge.

Notes

Chapter 2

Hardware Integration

This chapter will guide you through the most basic physical integration and checkout of the Præcis Ce. Subsequent chapters and appendices will give you the information needed to configure your software and hardware for the maximum performance in your operating environment.

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.

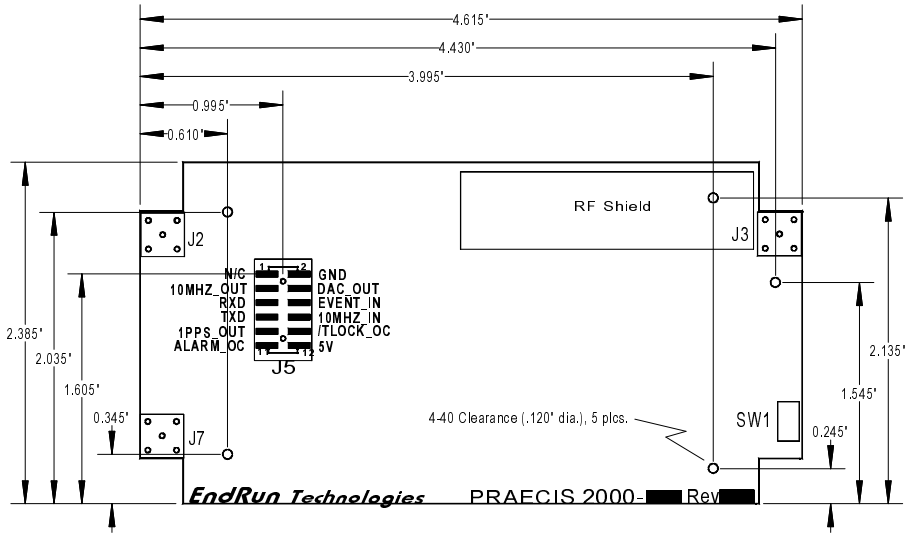
The Præcis Ce Hardware Pack (part # 4002-0000 or # 4002-variant) contains:

- Præcis Ce OEM board (part # 2000-0000-variant (-003, -005, -032, etc.))

Antenna Options:

- Helical antenna (part # 0502-0000-000)
- Magnetic mount antenna/cable assembly (part # 0502-0007-000)

Præcis Ce Physical Description



J3, Antenna Jack

This right angle, SMA connector jack mates with the antenna or with the cable from the external antenna.

SW1, Factory Defaults Restore Button

This horizontally actuated, momentary pushbutton switch is used for restoring the factory default settings.

J5, Host Interface Header

This 12 pin, .100" pitch, dual row header provides the power input, serial I/O, open collector status outputs and time and frequency I/O signals needed to interface with the host system.

Host Interface Signal Descriptions

J5 Pin	Function
1	N/C
2	Ground
3	10 MPPS Squarewave output, TTL Levels. 50 Ω drive capable. If not used, leave unconnected. This output is an option.
4	DAC Voltage output, 0 to 3.3V with 16 bit resolution. Z_{out} = 110 Ω. For use with external oscillators (consult factory regarding this capability). If not used, leave unconnected.
5	Serial I/O Receive Data input, TTL Levels. Connect to the host UART TxD output.
6	Event Timetag input, TTL Levels. Z_{in} > 1MΩ. Rising edge is timetagged with 32.5 nanosecond resolution. If not used, connect via a 1K ohm resistor to ground.
7	Serial I/O Transmit Data output, TTL levels. Connect to the host UART RxD input.
8	10 MHz input, TTL Levels. Z_{in} > 1MΩ. For use with external oscillators (consult factory regarding this capability). If not used, leave unconnected.
9	1 PPS output, TTL Levels. 50 Ω drive capable. Rising edge is on-time. Pulsewidth is settable with 1 millisecond resolution. If not used, leave unconnected.
10	Time Locked Open Collector output. Low impedance to ground state is TRUE. Pull up with a 1 to 10KΩ resistor to use as a logic input to your host system processor. If not used, leave unconnected.
11	Alarm Open Collector output. High impedance to ground state is TRUE. Pull up with a 1 to 10KΩ resistor to use as a logic input to your host system processor. If not used, leave unconnected.
12	Regulated +5 VDC, +/- 5% input. Current is 375 mA, maximum.

Hardware Interfacing Considerations

Mounting the Præcis Ce

The host printed circuit board (PCB) or chassis should accommodate mounting of the Præcis Ce using the four accessible mounting holes, which are sized for 4-40 screws and 3/16" round or hex spacers or standoffs. A fifth mounting hole exists but is not useable due to the placement of the RF electromagnetic shield.

Connecting to the Præcis Ce

Ideally, the host PCB should be designed with a 12 pin, dual-row female header properly located and oriented with respect to the Præcis Ce mounting standoffs so that it will mate with J5, the dual-row male header on the Præcis Ce when it is mounted to the standoffs. Alternatively, a ribbon cable could be used to make the connection. Due to the high speed transitions of several of the signals on the interface, the length of such ribbon cable should be kept as short as possible and in no case should it be longer than about 6" or 15 cm.

Typically, the host chassis should be configured with an SMA bulkhead jack to accomodate the Præcis Ce antenna. The antenna (either the helical or the magnetic mount antenna/cable assembly) should be connected to the exterior side of this chassis-mounted bulkhead jack. Depending upon the intended mounting orientation of the host chassis, a right angle SMA adapter may be needed to vertically orient the helical antenna. A short cable will be needed to route the antenna signal from the interior side of the chassis-mounted bulkhead jack to the Præcis Ce antenna input jack.

Functional Checkout of the System

Using an evaluation unit, you should have previously verified cellular CDMA signal availability in your laboratory. The checkout procedure described here is intended to verify correct configuration of your host system interface to the Præcis Ce as well as proper operation of the Præcis Ce itself. Using the two open collector status outputs and/or the serial I/O port, the general verification procedure consists of these steps:

1. Screw the antenna (helical or magnetic mount antenna/cable assembly) onto the host chassis antenna input jack. The antenna should be oriented vertically and be unobstructed by large metallic surfaces closer than a few meters.
2. Power up the host system.
3. Monitor the Alarm and Time Lock open collector outputs from the Præcis Ce. If the host system is configured to pull up these outputs, use a voltmeter, otherwise use an ohmmeter, to determine the state of these outputs.
4. Monitor the serial I/O characters received from the Præcis Ce via any means which you may have in your development environment.

5. Using an oscilloscope verify the presence of the 1PPS and optional 10 MPPS output signals at the appropriate host interface terminals.

Note

Although the antenna should be oriented vertically, 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 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.

Verify Basic Operation

Initially upon power up, you should see this sequence of behaviors:

1. The unit will set the Alarm open collector output to the high impedance, 'Alarm' state and the Time Lock open collector output to the high impedance, 'Unlocked' state. The Præcis bootloader will send its boot message from the serial I/O transmit data output.
2. After about ten seconds, if there are no hardware faults, then the Præcis Ce application firmware will begin execution. It will set the Alarm open collector output to the low impedance, 'Unalarm' state and send its boot messages from the serial I/O transmit data output. Then it will begin transmitting a time-of-day message once each second. The Time Figure of Merit (TFOM) character of this message will indicate the unsynchronized condition.
3. The 1PPS and optional 10 MPPS outputs will be active, although unsynchronized.
4. The Event Timetag input will be functional, although unsynchronized.
5. As the unit locks onto the CDMA signal and begins to decode the timing data, the 1PPS output will be stepped to align it with UTC. The frequency of the optional 10 MPPS output will be adjusted via electronic frequency control to maintain phase lock with UTC.
6. When the unit is fully locked, the Time Lock open collector output will be set to the low impedance, 'Locked' state and the TFOM character of the time-of-day message transmitted by the Præcis Ce will indicate the synchronized state.
7. Once locked, the unit will maintain time synchronization via electronic frequency control adjustments. There will be no further phase stepping of the 1PPS output. In this way, the 1PPS and optional 10 MPPS outputs maintain a fixed phase relationship to each other and the short term stability of the 1PPS

output is essentially that of the on-board, temperature compensated crystal oscillator.

At this point, the unit is fully synchronized. If you are unable to verify steps 1 – 4, then you must troubleshoot your interface to isolate the fault to either a damaged or defective Præcis Ce or an error in the interface configuration.

If you are able to verify steps 1 – 4 but are unable to verify steps 5 – 7 within twenty minutes, you should move the antenna and/or change its orientation and re-try.

If you continue to be unable to verify steps 5 - 7 and you have a Præcis Ct evaluation unit, see if it will work. If it will, then either your Præcis Ce is damaged or you have a problem in your interface to it. If you are unable to find anything wrong with your interface, the Præcis Ce should be returned to the factory for repair or exchange.

Test the Serial Port

Refer to Chapter 3 – *Serial I/O Control and Status Commands* for detailed information on the Præcis Ce serial I/O protocol. To test serial communications with the Præcis Ce you will need a way to monitor the serial interface between your host system and the Præcis Ce. Your host system serial I/O port must be configured to use the correct baud rate, number of data bits, parity type and number of stop bits. Turn off any handshaking. The factory default settings for the Præcis Ce are:

- 9600 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 host system, apply power to the system and monitor the characters transmitted by the Præcis Ce to the host system. Within a few seconds, your monitor should display a sequence of boot messages similar to these:

```
Praecis Bootloader 6010-0000-000 v 1.00 - Oct 06 2000 12:31:03
Praecis Ce FW 6010-0003-000 v 1.00 - Oct 07 2000 16:41:39
Praecis FPGA 6020-0001-000 v 01
```

The first line gives the part number and version of the Præcis BootLoader firmware and the date and time of its compilation. The second line gives the part number and version of the Præcis Ce application firmware and the date and time of its compilation. The third line gives the part number and version of the Field Programmable Gate Array (FPGA) configuration.

Following these three lines, factory default operation is to send a time-of-day message once-per-second. The factory default continuous, once-per-second, time-of-day message format is the native Prœcis Ce format:

T YYYY DDD HH:MM:SS zZZ m<CR><LF>

where:

T is the Time Figure Of Merit (TFOM) character and is one of:

- 9 indicates error > +/- 10 milliseconds, or unsynchronized condition
- 8 indicates error < +/- 10 milliseconds
- 7 indicates error < +/- 1 millisecond
- 6 indicates error < +/- 100 microseconds

YYYY is the year,

DDD is the day of the year,

HH is the hour of the day,

MM is the minute of the hour,

SS is the second of the minute,

z is the sign of the offset to UTC, + implies time is ahead of UTC

ZZ is the magnitude of the offset to UTC in units of half-hours. Non-zero only when Time Mode is Local.

m is the Time Mode character and is one of:

G = GPS,
L = Local,
U = UTC

<CR> is Carriage Return control character (0x0D)

<LF> is Line Feed control character (0x0A)

Initially, you should see that the TFOM character is a '9'. When the Time Lock open collector output transitions to the 'Locked' state, you should see the character change to a '6', which means that the time is accurate to less than 100 microseconds.

If you do not see characters displayed by your monitor when the unit is powered up, you must troubleshoot your setup. If you are unable to find any errors in your setup, as a last resort you should restore the factory default settings to the Prœcis Ce. It is possible that its serial port parameters are incorrect, so restoring the factory default settings will correct that. Refer to Appendix A – *Factory Defaults Restore Button* for the procedure to restore the factory default settings.

Once you have successfully received characters as described from the Præcis Ce, you may proceed to send commands to it to complete the serial I/O interface verification. Send these characters to the Præcis Ce via any means that you may have in your host development system:

```
ctime=off<CR><LF>
```

The unit should respond with an

```
OK<CR><LF>
```

and stop sending the once-per-second, time-of-day message. If you see no response to the command, not even an 'ERROR' response, then the Præcis Ce is not receiving characters from the host system. You must troubleshoot the interface.

Once you have successfully established two-way communication with the Præcis Ce you are ready to develop the application software that will be needed to synchronize your host system.

Check the 1PPS and 10 MPPS Signals

Using an oscilloscope, verify that these time and frequency output signals are present at the appropriate inputs to your host interface. If they are terminated in 50 ohms, verify that they are achieving TTL levels. If terminated in a high impedance, you should see the high level reaching 3.3V. The 10 MPPS output is an option and may not be present on your unit.

Chapter 3

Serial I/O Control and Status Commands

This chapter describes the ASCII protocol supported by the Præcis Ce. In addition to the Præcis Ce native commands, the emulation modes which enable use of the Præcis Ce with existing public domain drivers for various operating systems and platforms are described. The serial I/O port physical and electrical characteristics are defined as well.

General Serial I/O Operation

The Præcis Ce accepts input commands that are terminated with either an ASCII Carriage Return (CTRL-M, 0x0A) control character (denoted by <CR>) or an ASCII Carriage Return (CTRL-M, 0x0A) - Line Feed (CTRL-J, 0x0D) pair of control characters (denoted by <CR><LF>). Commands are *not* case sensitive. The Præcis Ce terminates all status messages that it sends in response to commands with a <CR><LF> pair. The Præcis Ce does not 'echo' any user input.

The Præcis Ce responds to invalid commands with:

ERROR<CR><LF>

Numerical inputs are accepted in any standard format. For example, all of these formats are acceptable for the decimal number 10:

10, 1E1, 1.0e+1, 10.0, 10E0

At power-up with factory default settings, the Præcis Ce outputs a time-of-day message once-per-second. The factory default emulation mode is NONE, and the Præcis Ce sends the time-of-day message in its native format. See *Clock Emulation Modes* for details on these formats.

Available Commands

COMMAND	FUNCTION
CAL	Show the timing calibration factor in seconds
CAL=*c*	Set the timing calibration factor in seconds, where *c* may be -.0005 to +.0005, and + advances the timing outputs.
CHANNELSET	Show the setting of the selected channel set.
CHANNELSET=s	Select the channel set, either A for North America, K for North America plus Korea, or I for India.
CTIME	Show the status of the continuous, once-per-second, time-of-day output
CTIME=*e*	Enable or disable the continuous, once-per-second, time-of-day output, where *e* may be ON or OFF.
DSTSTART	Show the setting for the start date of the Daylight Savings Time transition.
DSTSTART=m,s,h	Set the Daylight Savings Time start date, where: m is month: 1-12 s is Sunday of month: 1-4,L for 1st, 2nd, 3rd, 4th, or Last h is the hour of the transition: 0-23 where 0=midnight DSTSTART=0,0,0 will disable Daylight Savings Time.
DSTSTOP	Show the setting for the stop date of the Daylight Savings Time transition.
DSTSTOP=m,s,h	Set the Daylight Savings Time stop date, where: m is month: 1-12 s is Sunday of month: 1-4,L for 1st, 2nd, 3rd, 4th, or Last h is the hour of the transition: 0-23 where 0=midnight DSTSTOP=0,0,0 will disable Daylight Savings Time.
EMUL	Show the continuous, once-per-second, time-of-day emulation mode

EMUL=*m*	Set the continuous, once-per-second, time-of-day emulation mode, where *m* may be NONE, SPECTRACOM, TRIMBLE or TRUETIME.
EVENT	Show the status of event timetagging
EVENT=*e*	Enable or disable event timetagging, where *e* may be ON or OFF.
FLTSTAT	Show the summary fault status of the Præcis Ce
HELP	Show the Help menu
LEAP	Show the current leap seconds setting.
LEAP=c,f	Set current and future leap seconds, where: c is current leap seconds f is future leap seconds
LO	Show the local offset setting.
LO=x	Set the local offset where x is a value from -12:30 to +12:30. The minutes field must be either 0 or 30.
OSCTYPE	Show the oscillator type.
PORT	Show the serial port settings
PORT=*b,d,p,s*	Set the serial port settings, where: *b* is baud rate: 9600, 19200, 38400 or 57600 *d* is data bits: 7 or 8 *p* is parity: o, e or n *s* is stop bits: 1 or 2
PPSWIDTH	Show the 1PPS pulsewidth in milliseconds
PPSWIDTH=*w*	Set the 1PPS pulsewidth in milliseconds, where *w* may be 1 to 999.
REACQUIRE	Force new signal processor acquisition sequence.
RESET	Reset the unit. (*Valid with Præcis Ce FW 1.04 or later.)*
RESPMODE	Show the command response mode

RESPMODE=*r*	Set the command response mode, where *r* may be TERSE or VERBOSE
SETTINGS	Show the current user settings
SPSTAT	Show the current signal processor parameters
TIME	Show the current time in native Præcis Ce time-of-day format
TMODE	Show the time mode
TMODE=*m*	Set the time mode, where *m* may be GPS, UTC, LOCAL, or LOCALMAN.
UPLOAD	Initiates the FLASH upload process
VER	Show the firmware and hardware versions

Detailed Command Descriptions

CAL

This command allows the user to query and set the value of a calibration offset that the Præcis Ce can make to the Præcis Ce timing outputs. It can be useful for compensating various delays present in a system. The units for the offset are seconds. The allowable range is -.0005 seconds to +.0005 seconds, where a positive calibration offset means that the Præcis Ce timing outputs will be advanced in time. The Præcis Ce performs this adjustment with a resolution of approximately 32.5 nanoseconds. The example response indicates that the outputs are currently retarded by 123.452 microseconds relative to UTC as received from the CDMA base station.

In urban areas, distances to base stations should normally be less than two miles. It could make sense to set the calibration offset to perhaps + 5 microseconds, half of the approximate light speed transit time over two miles, to improve the absolute accuracy of the Præcis Ce. If you have some way of knowing how far the closest base station is from your site, you could make a more educated adjustment using the approximate propagation delay of one nanosecond per foot, or 3.3 nanoseconds per meter and the CAL command. Set value is retained in non-volatile FLASH memory.

Usage:

Query:	`CAL<CR><LF>`
Præcis Ce response:	`-.000123452<CR><LF>`
Set:	`CAL=.00015<CR><LF>`
Præcis Ce response:	`OK<CR><LF>`

Factory Default Setting: 0

CHANNELSET

This command allows the user to set the frequency channels that the signal processor searches in order to find a timing signal. Most users will not need to use this command as the default setting is for the North American frequency channel set. There are three allowable entries: A for North America, K for Korea plus North America and I for India. Set value is retained in non-volatile FLASH memory. Korean and Indian users will need to change the default setting as below:

Usage:

Query:	`CHANNELSET<CR><LF>`
Præcis Ce response:	`NORTH AMERICA<CR><LF>`
Set:	`CHANNELSET=K<CR><LF>`
Præcis Ce response:	`OK<CR><LF>`

Set: `CHANNELSET=I<CR><LF>`
Præcis Ce response: `OK<CR><LF>`

Factory Default Setting: **NORTH AMERICA**

This is the setting as shipped by the factory but will not be affected by the Indicator Mode Button (see Appendix A - Restoring Factory Default Settings). Once the user modifies this setting it will stay that way regardless of resetting factory defaults.

CTIME

This command allows the user to query and set the status of the continuous, once-per-second, time-of-day message output. The status is either ON or OFF. Set value is retained in non-volatile FLASH memory.

Usage:

Query: `CTIME<CR><LF>`
Præcis Ce response: `OFF<CR><LF>`

Set: `CTIME=ON<CR><LF>`
Præcis Ce response: `OK<CR><LF>` Then the continuous, once-per-second, time-of-day output message starts, in the format previously selected using the EMUL command.

Factory Default Setting: ON

DSTSTART

This command allows the user to query and set the start time for the Daylight Savings Time transition. This setting is used to compute Local Time if TMODE = LOCALMAN (see TMODE command.) Set value is retained in non-volatile FLASH memory. Syntax for the command is DSTSTART=m,s,h. The month of the year, the Sunday of the month, and the hour of the transition all need to be set. For example, in the United States the DST start date is the first Sunday in April at 2:00 a.m. To set this, the command would be DSTSTART=4,1,2. You may disable DST by setting either the DSTSTART or DSTSTOP parameters to 0. For example, DSTSTART=0,0,0.

Month is 1-12.
Sunday is 1-4 for 1st, 2nd, 3rd, 4th or L for last.
Hour is 0-23 where 0 is midnight.

Usage:

Query: `DSTSTART<CR><LF>`
Præcis Ce response: `4,1,2<CR><LF>`

Set: `DSTSTART=4,1,2<CR><LF>`
Præcis Ce response: `OK<CR><LF>`

Factory Default Setting: 0,0,0

DSTSTOP

This command allows the user to query and set the stop time for the Daylight Savings Time transition. This setting is used to compute Local Time if TMODE = LOCALMAN (see TMODE command.) Set value is retained in non-volatile FLASH memory. Syntax for the command is DSTSTOP=m,s,h. The month of the year, the Sunday of the month, and the hour of the transition all need to be set. For example, in the United States the DST stop date is the last Sunday in October at 2:00 a.m. To set this, the command would be DSTSTOP=10,L,2. You may disable DST by setting either the DSTSTART or DSTSTOP parameters to 0. For example, DSTSTOP=0,0,0.

Month is 1-12.
Sunday is 1-4 for 1st, 2nd, 3rd, 4th or L for last.
Hour is 0-23 where 0 is midnight.

Usage:

Query:	`DSTSTOP<CR><LF>`
Præcis Ce response:	`10,L,2<CR><LF>`
Set:	`DSTSTOP=10,L,2<CR><LF>`
Præcis Ce response:	`OK<CR><LF>`

Factory Default Setting: 0,0,0

EMUL

This command allows the user to query and set the current clock emulation mode for the continuous, once-per-second, time-of-day message output. Set value is retained in non-volatile FLASH memory. There are four allowable emulation modes: NONE, SPECTRACOM, TRIMBLE, and TRUETIME. See the *Clock Emulation Modes* section of this chapter for details.

Usage:

Query:	`EMUL<CR><LF>`
Præcis Ce response:	`NONE<CR><LF>`
Set:	`EMUL=trimble<CR><LF>`
Præcis Ce response:	`OK<CR><LF>`

Factory Default Setting: NONE

EVENT

This command allows the user to query and set the status of the CTS input event time-tagging. The status may be set to either ON or OFF. Set value is retained in non-volatile FLASH memory. When the clock emulation mode is set to TRIMBLE using the EMUL command, the CTS input event timetagging status is forced to

ON(TRIMBLE) and attempts to change the status using the EVENT command receive the response 'ERROR<CR><LF>' and are ignored. If CTIME is ON, its output takes priority over these event timetags. It is recommended that CTIME be turned OFF during event timetagging operation. Refer to Appendix C – *Technical Specifications* for event timetagging implementation details.

Usage:

Query: `EVENT<CR><LF>`
Præcis Ce response: `OFF<CR><LF>`

Set: `EVENT=ON<CR><LF>`
Præcis Ce response: `OK<CR><LF>.` Then an Event Time message will be sent following each positive transition of the CTS serial I/O input signal. The Event Time message format is:

`T YYYY DDD HH:MM:SS.sssssssss zZZ m<CR><LF>`

See the native Præcis Ce time-of-day message format for the definition of each of these character fields. The Event Time message differs only in that the T character is not on-time, and in the augmentation of the seconds with a decimal point and nine digits (.sssssssss) of sub-second information.

Factory Default Setting: OFF

FLTSTAT

This query-only command displays the current summary status of the Præcis Ce. 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 the Alarm Open Collector output state changing to the high impedance, 'Alarm' state. Each bit of each character indicates the status of a sub-system 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	Not Used	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 TCXO 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 TCXO 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 TCXO frequency finally reaches one of the actual DAC endpoints. The unit should be returned to the factory for TCXO 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 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.
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 con-

dition 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.

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:	`FLTSTAT<CR><LF>`
Præcis Ce response:	`0x001A<CR><LF>`
Set:	N/A
Præcis Ce response:	N/A

Factory Default Setting: N/A

HELP

This query-only command displays a menu of the available status and control commands supported by the Præcis Ce, along with the syntax of their usage.

Usage:

Query:	`HELP<CR><LF>`
Præcis Ce response:	Full menu of available commands and syntax is displayed
Set:	N/A
Præcis Ce response:	N/A

Factory Default Setting: N/A

LEAP

This command allows the user to set current and future leap seconds. Set value is retained in non-volatile FLASH memory. The CDMA mobile phone system does provide a mechanism for automatic UTC leap second insertion. However, there are some locations where this has not been implemented to the precision needed for a smooth leap second transition. This command will allow you to override the UTC leap second information received from the CDMA base station. In so doing, your Præcis Ce will properly perform a leap second transition at UTC midnight.

Leap seconds are inserted at UTC midnight on June 30 or December 31 only. If there is no leap second pending at the next transition point then enter the command with current=future. If there is a leap second pending then enter the command with cur-

rent=future+1. The EndRun Technologies website maintains a page devoted to notifying users of the appropriate current and future leap second values at:

http://www.endruntechnologies.com/leap.htm

Usage:

Query:	`LEAP<CR><LF>`
Præcis Ce response:	`0 0<CR><LF>`
Set:	`LEAP=13,14`
Præcis Ce response:	`OK`

Factory Default Setting: 0,0

The factory setting provides for automatic UTC leap second insertion via the CDMA mobile phone system. Once the user modifies this setting it will not be affected by pressing the Indicator Mode Button (see Appendix A - Restoring Factory Default Settings).

LO

This command allows the user to set or query the local offset setting. This setting is used to compute Local Time if TMODE = LOCALMAN (see TMODE command). The values entered can range from -12:30 to +12:30. The minutes field must be either 00 or 30. Set value is retained in non-volatile FLASH memory.

Usage:

Query:	`LO<CR><LF>`
Præcis Ce response:	`-7:00<CR><LF>`
Set:	`LO=+12:30<CR><LF>`
Præcis Ce response:	`OK<CR><LF>`

Factory Default Setting: +0:00

OSCTYPE

This command allows the user to query the oscillator type for this unit. This value is set at the factory and cannot be changed.

Usage:

Query:	`OSCTYPE<CR><LF>`
Præcis Ce response:	`TCXO<CR><LF>`
Set:	N/A
Præcis Ce response:	N/A

Factory Default Setting: Hardware dependent.

PORT

This command allows the user to query and set the current serial I/O port settings. Changes to the settings take place immediately and are retained in non-volatile FLASH memory. You must change your terminal program to match these settings in order to continue to communicate with the Præcis Ce. *Restoring the factory default settings may be necessary should you forget the current settings.* See Appendix B – *Factory Defaults Restore Button* for details on restoring the factory default settings. The baud rate, number of data bits, parity and number of stop bits may be set:

Baud rate may be 9600, 19200, 38400, 57600
Number of data bits may be 7 or 8
Parity may be E (even), O (odd) or N (none)
Number of stop bits may be 1 or 2

Usage:

Query:	`PORT<CR><LF>`
Præcis Ce response:	`9600,8,N,1<CR><LF>`
Set:	`PORT=19200,7,o,2<CR><LF>`
Præcis Ce response:	`OK<CR><LF>`

Factory Default Setting: 9600, 8, N, 1

PPSWIDTH

This command allows the user to query and set the current 1PPS output pulsewidth. The value is in units of milliseconds and may be 1 to 999.

Usage:

Query:	`PPSWIDTH<CR><LF>`
Præcis Ce response:	`1<CR><LF>`
Set:	`PPSWIDTH=500<CR><LF>`
Præcis Ce response:	`OK<CR><LF>`

Factory Default Setting: 1

REACQUIRE

This command allows the user to force another signal processor acquisition sequence and is generally only used in tightly-embedded systems. This will cause the unit to fly-wheel until it reacquires a signal.

Usage:

Query:	N/A
Præcis Ce response:	N/A
Set:	`REACQUIRE<CR><LF>`
Præcis Ce response:	`OK<CR><LF>`

Factory Default Setting: N/A

RESET

This set-only command allows the user to perform a software reset of the unit. *(Valid with Praecis Ce FW 1.04 or later.)*

Usage:

Query:	N/A
Præcis Ce response:	N/A
Set:	`RESET<CR><LF>`
Præcis Ce response:	`OK`

Factory Default Setting: N/A

RESPMODE

This command allows the user to query and set the current serial I/O command response mode. Set value is retained in non-volatile FLASH memory. In the factory default TERSE mode, all responses to query commands are as described in this chapter. When the response mode is set to VERBOSE, a string consisting of the command name, a space character, the equals sign character and a space character is prepended to the TERSE response string for all query commands except HELP and SETTINGS.

Usage:

Query:	`RESPMODE<CR><LF>`
Præcis Ce response:	`RESPMODE = VERBOSE<CR><LF>` `TERSE<CR><LF>`
Set:	`RESPMODE=TERSE<CR><LF>`
Præcis Ce response:	`OK<CR><LF>`

Factory Default Setting: TERSE

SETTINGS

This query-only command displays the current status of all of the user configurable settings. These settings are held in non-volatile FLASH memory.

Usage:

Query:	`SETTINGS<CR><LF>`

Præcis Ce response:	`Cal = 0.000000000<CR><LF>`
	`Ctime = OFF<CR><LF>`
	`Emul = NONE<CR><LF>`
	`Event = OFF<CR><LF>`
	`Port = 57600,8,N,1<CR><LF>`
	`PPSWidth = 1<CR><LF>`
	`Tmode = UTC<CR><LF>`

Set:	N/A
Præcis Ce response:	N/A

Factory Default Setting: N/A

SPSTAT

This query-only command displays the current status of selected signal processor parameters. This is a fixed-length message formatted as so:

SPS CHAN PNO AGC VCDAC SN.R F.ERR<CR><LF>

Where:

SPS is the Signal Processor State, one of ACQ (Acquiring), DET (Signal Detected), LKG (Code Locking), TKG (Carrier Locking), LKD (Locked).

CHAN is the CDMA frequency channel being used. For North American frequencies the reported channel will be: PRIA, PRIB, SECA, or SECB. These stand for Primary A, Primary B, Secondary A or Secondary B channels. For Korean frequencies the reported channel will be: PRKA, PRKB, SEKA, or SEKB. These stand for Primary A, Primary B, Secondary A or Secondary B channels. For Indian frequencies the reported channel will be: 185I, 226I, 267I, 308I, 369I, 410I, 451I, or 492I. There are multiple primary and secondary channels in the Indian channelset so the channel number is being used.

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 Sync Channel symbol rate bandwidth. Typical range is 2.5 to 11.0.

F.ERR is the Sync Channel Frame Error Rate, 0.000 to 1.000, with a higher number implying more Cyclical Redundancy Check failures when processing the Sync Channel message frames. Higher numbers will correlate with lower Signal to Noise Ratios.

Usage:

Query:	`SPSTAT<CR><LF>`
Præcis Ce response:	`LKD PRIB 132 161 28495  6.9 0.000<CR><LF>`
Set:	N/A
Præcis Ce response:	N/A

Factory Default Setting: N/A

TIME

This query-only command displays the current time-of-day in the native Præcis Ce format. See the *Clock Emulation Modes* section of this chapter for details. The example response shows the local time and indicates a local offset to UTC of +11.5 hours, meaning that local time is 11.5 hours ahead of UTC. So for this example, UTC time-of-day would be 02:15:01.

Usage:

Query:	`TIME<CR><LF>`
Præcis Ce response:	`6 2000 155 13:45:01 +23 L<CR><LF>`
Set:	N/A
Præcis Ce response:	N/A

Factory Default Setting: N/A

TMODE

This command allows the user to query and set the current clock time mode. Set value is retained in non-volatile FLASH memory. **The setting of the time mode has no effect on the continuous, once-per-second, time-of-day messages sent when emulating the Spectracom, Trimble or TrueTime clock types. They are always sent in UTC time.** The time mode setting affects the *native* CTIME, EVENT and TIME time-of-day messages. There are three available time modes:

GPS The GPS setting will cause the time-of-day to be displayed without the leap seconds which have been inserted between the UTC and GPS timescales since the beginning of GPS time: January 6, 1980. At the time of this writing, 13 leap seconds have been applied to UTC since the GPS epoch, so GPS time is currently 13 seconds ahead of UTC time.

UTC — The UTC setting will cause the time-of-day to be displayed as UTC time. UTC time is GPS time with the addition of leap seconds. Leap seconds can be determined by the unit automatically from data contained in the CDMA signal. Leap seconds can also be determined manually, via the user interface (refer to the LEAP command).

LOCAL — The LOCAL setting will cause the time-of-day to be displayed with the local time zone offset to UTC. The local time zone offset and daylight savings time transition is determined automatically from data contained in the CDMA signal.

LOCALMAN — The LOCALMAN setting will cause the time-of-day to be displayed with the local time zone offset to UTC. The local time zone offset is determined manually, via the user interface (refer to the LO, DSTSTART and DSTSTOP commands).

Usage:

Query: `TMODE<CR><LF>`
Præcis Ce response: `GPS<CR><LF>`

Set: `TMODE=LOCAL<CR><LF>`
Præcis Ce response: `OK<CR><LF>`

Factory Default Setting: UTC

UPLOAD

This set-only command allows the user to upload a new program to the FLASH memory of the Præcis Ce. Refer to Appendix B – *Upgrading the Firmware* for detailed instructions for performing the UPLOAD procedure.

Usage:

Query: N/A
Præcis Ce response: N/A

Set: `UPLOAD<CR><LF>`
Præcis Ce response:

```
Waiting for download using XMODEM 1K with CRC.<CR><LF>
Control X will abort download.<CR><LF>
CCCC…
```

The 'C' character is sent until the terminal program begins the upload.

Factory Default Setting: N/A

VER

This query-only command displays the firmware and hardware versions.

Usage:

Query: **VER<CR><LF>**
Præcis Ce response:

Praecis Ce FW 6010-0001-000 v 1.01 - Jan 25 2001 16:41:39 Praecis FPGA 6020-0001-000 v 02<CR><LF>

Set: N/A
Præcis Ce response: N/A

Factory Default Setting: N/A

Clock Emulation Modes

The Præcis Ce emulates three industry-standard, continuous, once-per-second, time-of-day message formats in addition to its own native format. Currently these emulated formats are:

NONE

This is the native Præcis Ce time-of-day message format. It is sent once-per-second, with the TFOM character being the on-time character that is sent during the first millisecond of each second.

T YYYY DDD HH:MM:SS zZZ m<CR><LF>

T is the Time Figure Of Merit (TFOM) character and is one of:

- 9 indicates error > +/- 10 milliseconds, or unsynchronized condition
- 8 indicates error < +/- 10 milliseconds
- 7 indicates error < +/- 1 millisecond
- 6 indicates error < +/- 100 microseconds

YYYY is the year,
DDD is the day of the year,
HH is the hour of the day,
MM is the minute of the hour,
SS is the second of the minute,
z is the sign of the offset to UTC, + implies time is ahead of UTC
ZZ is the magnitude of the offset to UTC in units of half-hours. Non-zero only when Time Mode is Local.
m is the Time Mode character and is one of:

G = GPS,
L = Local,
U = UTC

Spectracom

This is WWVB Format 0 and it is sent once each second with the leading <CR> being the on-time character, which is sent during the first millisecond of each second. *The time mode is always UTC in this emulation mode*:

```
<CR><LF>Q  DDD HH:MM:SS  TZ=zz<CR><LF>
```

Q is the Time Quality character,

- ? indicates unsynchronized,
- indicates locked (space character).

DDD is the day-of-year,
HH is the hour-of-the-day,

MM is the minute-of-the-hour,
SS is the second-of-the minute,
zz is the timezone relative to UTC, which is always 0, since time mode is always UTC in this emulation mode.

Trimble

This format is only useful in conjunction with the Trimble Palisade NTP reference clock driver as it is not human readable. It is sent in Trimble Standard Interface Protocol (TSIP) using a binary packet format: *Primary NTP Pkt 8F-AD*. It sends packets for both the CTS assertion events and, if CTIME=ON, the 1PPS events. *It is recommended that 1PPS events be turned off when using this emulation mode by setting CTIME=OFF*. These packets contain a timestamp with 32 nanosecond resolution. When this mode is selected, the native Præcis Ce CTS input event timetagging function is disabled. *The Time Mode is always UTC in this emulation mode.*

Byte 18, Receiver Status of NTP Pkt 8F-AD contains the synchronization status information. The Præcis Ce uses three of these codes and they are set in the following manner:

Code 1 (Static 1 Sat. Timing Mode) is set when the time error is < 1 ms
Code 2 (Approximate Time) is set when the time error is < 10 ms
Code 3 (Startup) is set when the time error is > 10 ms

TrueTime

This format is sent once each second with the <CR> being the on-time character, which is sent during the first millisecond of each second. *The Time Mode is always UTC in this emulation mode*:

```
<SOH>DDD:HH:MM:SSQ<CR><LF>
```

<SOH> is the ASCII Start-of-Header (CTRL-A, 0x01) control character,
DDD is the day-of-year,
HH is the hour-of-the-day,

MM	is the minute-of-the-hour,	
SS	is the second-of-the minute,	
Q	is the Time Quality character, and may be one of the following:	
	?	indicates the unsynchronized condition
	#	indicates error < +/- 50 ms
	*	indicates error < +/- 5 ms
	.	indicates error < +/- 1 ms
		indicates error < +/- .1 ms (space character)

Time Figure of Merit/Time Quality

The native and emulated time-of-day messages sent by the Præcis Ce contain a character that indicates the level of accuracy that should be included in the interpretation of the time-of-day contained in the message. In some cases this character is referred to as the 'Time Figure of Merit' (TFOM) while in others it is referred to as the 'Time Quality'.

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

Due to this extrapolation behavior, brief removal of the antenna from a normally operating Præcis Ce will not induce an immediate alarm condition. If the antenna is removed 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 Præcis Ce is unable to achieve re-synchronization within one hour after reaching this state, the Alarm Open Collector output will transition to the high impedance, 'Alarm' state. Queries using the FLTSTAT serial I/O command will return with the appropriate bit set to indicate a loss-of-signal time-out condition.

Notes

Appendix A

Factory Defaults Restore Button

The Factory Defaults Restore Button, SW1 is located on the same end of the Præcis Ce where the antenna input jack, J3 is mounted. It is a horizontally actuated, momentary switch. A non-conducting, small diameter, blunt tool is a good way to depress the button.

Caution

Do not use an excessive amount of force in depressing the Factory Defaults Restore Button. Damage to the switch and/or its connection to the printed circuit board could result from such excessive pressure.

Restoring Factory Default Settings

Should you wish to reset the Præcis Ce to its factory default settings, follow this procedure:

Press and hold in the Indicator Mode Button for at least five seconds. Since the Præcis Ce has no visible means of acknowledging that factory default settings have been restored, be sure to hold the button in long enough. You will have to verify over the serial I/O port that the procedure has been successfully accomplished.

The Præcis Ce is now reset to factory default settings. Some user command settings (CHANNELSET and LEAP) are not affected by resetting factory defaults.

Notes

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, you are ready to perform the upgrade to your Præcis Ce.

What You Need To Perform the Upgrade

You will need a terminal program which supports file uploading using the XMODEM 1K protocol with CRC. This is a very common file transfer protocol and should be supported by virtually any terminal program.

Caution

You may perform the upload using any of the supported serial I/O parameter combinations, *except that 8 data bits must be used*. You must use 8 data bits because the FLASH image you will be uploading to the Præcis Ce is in a *binary* format.

Using the higher baud rates will reduce the time needed to transfer the image file to the Præcis Ce. The current image requires about one minute to transfer when using a baud rate of 57600.

Performing the Upgrade

Configure your terminal program and the Præcis Ce to communicate at the desired baud rate by using the settings facility for your terminal program and the **port** command for the Præcis Ce. Refer to Chapter 3 - *Serial I/O Control and Status Commands* for details on using the **port** command.

After establishing communications with the Præcis Ce using the desired port settings, issue the following command to initiate the upload:

```
upload<CR><LF>
```

After issuing this command, you will see the Præcis Ce respond with this message:

```
Waiting for download using XMODEM 1K with CRC.
Control X will abort download.
CCC…
```

You will then see the Præcis Ce send the character 'C' every three seconds while it is waiting for you to begin uploading the image file. Should you need to abort the upload process now, send CTRL-X to the Præcis Ce. If you abort at this time, your current firmware will remain intact. If you abort after the file transfer is in progress, you will not retain your original firmware. You will need to re-upload it.

Otherwise, start the upload using the appropriate method for your terminal program. During the upload, your terminal program will display some sort of status indication. If the upload is successful, you will see the Præcis Ce re-boot, displaying the firmware version information when it does. Note the firmware version information at this time and verify that it is indeed the firmware that you intended to upload to the Præcis Ce. If it is, you have successfully upgraded the firmware in your Præcis Ce.

Problems with the Upload

Should you have difficulties with the upload 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 Præcis Ce boot loader 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, sending the 'C' character every three seconds. You may then re-try the upload procedure, after you have corrected the original problem.

It is possible for the boot loader program to be fooled by a corrupted application program that has been previously downloaded into FLASH. In this case, it will attempt to start the application program. Generally this will result in a failure that will force a

watchdog initiated re-boot. This process will be repeated indefinitely unless you intervene.

For bootloader versions 3.00 and earlier: If the boot load/application launch sequence appears to be caught in a loop, hold down the 'b' key on your keyboard while the boot loader is coming up. This will cause the boot loader to ignore the presence of what it thinks is a valid application program in FLASH and force the boot loader to initiate the XMODEM upload sequence. When you see the character 'C' being displayed every three seconds, you may initiate the upload of a new application program file.

For bootloader versions 3.01 and later: If the boot load/application launch sequence appears to be caught in a loop, type "recover" right after the bootloader version string is displayed. This will cause the boot loader to ignore the presence of what it thinks is a valid application program in FLASH and force the boot loader to initiate the XMODEM upload sequence. When you see the character 'C' being displayed every three seconds, you may initiate the upload of a new application program file.

Notes

Appendix C

Technical Specifications

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

Antenna:
SMA bulkhead jack, J3. Z_{in} = 50Ω. 824-896 MHz ¼ wave helical, standard. Remotely mountable, magnetic base antenna/cable assembly optional.

Local Oscillator: Optional TCXO or OCXO.
Time to Lock: < 5 minutes, typical.

1PPS Timing Characteristics:
(when unit is protected from air currents)

- **Accuracy**: < 10 microseconds to UTC typical when locked. Fringe area reception may degrade the absolute timing accuracy due to increased propagation delay.
- **Stability:** TDEV < 50 ns, $\tau < 10^4$ seconds.

10 MPPS Frequency Characteristics (option):
(when unit is protected from air currents)

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

Tau in Secs	TCXO	OCXO
1	$1x10^{-9}$	$5x10^{-10}$
10	$1x10^{-9}$	$5x10^{-10}$
100	$3x10^{-10}$	$3x10^{-10}$
1000	$3x10^{-11}$	$3x10^{-11}$
10000	$9x10^{-12}$	$9x10^{-12}$
100000	$3x10^{-12}$	$3x10^{-12}$

Input Event Timetagging Characteristics:

- **Accuracy**: Same as the 1PPS Timing Accuracy.
- **Resolution:** 32 ns.
- **PulseWidth**: 100 ns, minimum.
- **Re-Arm Delay**: 1 ms, i.e. the first event during any millisecond will be timetagged.
- **Buffering**: No events are buffered. Events occurring at a rate higher than 10 Hz will be discarded due to system loading and serial I/O transmission limitations.

I/O Signals (on 12 pin dual row header, J5):

- **1PPS_OUT:** pulsewidth selectable, TTL levels @ 50Ω, rising edge is on-time.
- **10MPPS_OUT:** squarewave, TTL levels @ 50Ω (option).
- **EVENT_IN:** TTL levels, Z_{in} > 1MΩ, rising edge is timetagged.
- **DAC_OUT:** 0 to 3.3 VDC, 16 bit resolution, Z_{out} = 110Ω
- **10MHZ_IN:** 1 to 3 VAC_{p-p}, Z_{in} > 1MΩ
- **/TLOCK_OC:** Open Collector Time Lock status, active low impedance.
- **ALARM_OC:** Open Collector Alarm status, active high impedance.
- **5V:** Regulated power input, 5V +/- .25V @ 375 mA max.
- **Serial I/O:** RXD, TXD at TTL levels. 9600 to 57600 baud; 7 or 8 data bits; odd, even or no parity; 1 or 2 stop bits.
- **Time-of-Day:** ASCII string via serial I/O port. Seconds through years in GPS, UTC or Local Time.

Controls:

- **Factory Defaults Restore Button:** Restores factory defaults when depressed for five seconds.

Size:

- **PCB:** 4.95"L x 2.14"W x .64"H (including antenna input jack, J3)
- **Antenna**: 3.46"L x 0.43" dia.

Weight:

.3 lb. (136 g.)

Environmental:

- **Temperature:** 0° to +70°C
- **Humidity:** 0 to 95%, non-condensing