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EndRun TECHNOLOGIES

Præcis Cfr II Time and Frequency Reference

User's Manual

ENDRUN TECHNOLOGIES

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User's Manual

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Preface

Thank you for purchasing the Præcis Cfr II Time and Frequency Reference. Our goal in developing this product is to bring precise, Universal Coordinated Time (UTC) and Frequency into your system quickly, easily and reliably. Your new Præcis Cfr II 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 Præcis Cfr II, how it works, where to use it, its main features.
Basic Installation – How to test operation and connect your Præcis Cfr II to your equipment.
Setting Up with Computers– Three sections, one for Unix-like platforms and two for Windows NT
Operation – Details of the software and hardware operation.

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 Cfr II User's Manual **Revision 4**

Part No. USM3022-0000-000 **January 2009**

Warranty

This new 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 pre-pay 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.

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 Præcis Cfr II is a precision source of Universal Coordinated Time (UTC) and Frequency that provides 1 Pulse-Per-Second (1PPS) and 10 MHz outputs. Instrumentation applications may use these signals to achieve time synchronization to typically less than ten microseconds and frequency syntonization to less than one part in 10^{11}.

In addition, the Præcis Cfr II provides a similar computer time synchronization functionality of its sister products, the Præcis Cf and Praecis Cfr and can be connected to any computer having an RS-232 serial I/O port. 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. Differences between the Praecis Cfr and the Praecis Cfr II are summarized in Appendix A.

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 Cfr II 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 Cfr II 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 Cfr II has all of the information that it needs to perform its function of delivering accurate UTC time to a computer. 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 Cfr II does just that, and for this reason, we call our technology 'indirect GPS'.

Where to Use It

You must have IS-95 CDMA coverage.

First, the Præcis Cfr II must be deployed in an 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. If available, the Præcis Cfr II 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 regions lacking cellular coverge, the unit can be set to receive the PCS signals. With the dual-band cellular/PCS receiver the unit should operate properly throughout North America, Australia, Korea and many other parts of the world. An alternate unit can be provided for operation in Japan.

Main Features

Reliability

The Præcis Cfr II provides high performance and reliability combined with low power consumption. Its internal subassemblies are fabricated using state-of-the-art components and processes and are integrated in a solid, high-quality chassis.

Flexibility

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

Easy Installation

Its standard 1U high, 19" rack-mountable configuration and indoor-mounted, magnetic-base antenna make installation a snap compared to competing *direct* GPS products. The unit and antenna may be mounted in any convenient location. Once the unit is placed near the instrument or computer requiring synchronization, connect the needed signals between the instrument and/or computer and the Præcis Cfr II. Then just plug in the AC power cord.

Free FLASH Upgrades

All firmware and configurable hardware parameters are stored in non-volatile FLASH memory, so the Præcis Cfr II 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 products available to our customers free of charge.

Notes

Chapter 2

Basic Installation

This chapter will guide you through the most basic checkout and physical installation of your Præcis Cfr II. Subsequent chapters and appendices will give you the information needed to configure your installation 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.

- Præcis Cfr II (part # 3022-0001-xxx or #3023-0001-xxx)
- Præcis Cfr II User's Manual (part # USM3022-0000-000)
- IEC 320 AC Power Cord (part # 0501-0003-000)
- DB-9F to DB-9F Null-Modem Serial I/O Cable (part # 0501-0002-000)
- Magnetic mount antenna/cable assembly (part # 0502-0007-001)

Præcis Cfr II Physical Description

Front Panel

Lock Status LED — This green LED flashes to indicate synchronization status.

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

Unlabeled LED — This LED is nonoperational in this unit and will be always off.

Rear Panel

Antenna Jack — This TNC connector mates with the cable from the external, magnetic mount antenna.

1 PPS Jack — This BNC connector provides the 1 PPS TTL output.

10 MPPS Jack — This BNC connector provides the 10 MPPS TTL output.

RS-232 Connector — This DB-9M connector provides the RS-232 serial I/O interface to the Præcis Cfr II. A DB-9F to DB-9F null-modem cable is required to connect this port to a computer. See *RS-232 Port Signal Definitions* in Chapter 3.

RS-232/1PPS Connector — This optional DB-9M connector provides the RS-232 serial I/O interface to the Præcis Cfr II. There is a 1PPS signal on the DTR/DCD output of this connector. See *Optional RS-232/1PPS Port Signal Definitions* in Chapter 3.

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

AM Code Jack — This BNC connector provides the optional amplitude-modulated timecode output. See signal definition in *Appendix D - Specifications* for the AM Code output.

Performing an Initial Site Survey

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

1. Screw the TNC plug on the end of the antenna cable onto the TNC antenna input jack on the chassis rear panel of the Præcis Cfr II.
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 Præcis Cfr II.

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 Lock Status LED.
3. When the unit has detected a CDMA signal, the green Lock 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 Lock Status LED will flash very rapidly (about a 6 Hz rate) until the data is fully decoded.
5. Then the green Lock 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 *cellular* coverage in your area or the signal might be too weak in your facility. First, using the CDMACHANNEL command, try changing the channelset on your unit to operate with the PCS frequencies. (If you have a unit for operation in Japan you will be unable to

to alter the channelset.) If you are still unable to receive signals, you should continue to try for at least a day, since basestations 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 Præcis Cfr II may be damaged and should be returned to the factory for repair or exchange.

Installing the Præcis Cfr II

Mount the Præcis Cfr II

CAUTION

Ground the unit properly with the supplied power cord.

Position the power cord so that you can easily disconnect it from the Præcis Cfr II.

Do not install the Præcis Cfr II where the operating ambient temperature might exceed 122°F (50°C).

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

Connect the Serial Port

1. Disconnect power from the Praecis Cfr II.
2. Connect one end of the DB9F-to-DB9F null-modem adapter cable to the RS-232 DB9M connector on the Praecis Cfr II.
3. Connect the other end of the cable to the appropriate serial I/O port on the computer. If the serial I/O port on your computer does not have a DB9M connector, you may need to use an adapter. Refer to Chapter 3 – *Serial I/O Control and Status Commands* for details on the signal wiring. *Remember which port you are using because you will need to know that in order to set up the terminal software.*

Test the Serial Port

To test serial communications with the Præcis Cfr II you will need a terminal program. You must configure your terminal program to use the serial I/O port you used in *Con-*

nect the Serial Port. You must also configure your terminal program 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 Cfr II 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 terminal program, apply power to the Præcis Cfr II. Within a few seconds, your terminal program should display a sequence of boot messages similar to these:

```
Tempus Bootloader 6010-0050-000 v 1.00 - May 28 2004 17:31:05
Praecis Cfr II FW 6010-0020-101 v 1.00 - Jun 07 2006 16:41:39
Praecis FPGA 6020-0004/5-000 v 0408
```

The first line gives the part number and version of the BootLoader firmware and the date and time of its compilation. The second line gives the part number and version of the Praecis Cfr II 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 EndRun 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 green LED begins to flash at the 1 Hz rate, you should see the character change to a '6', which means that the time is accurate to less than 100 microseconds and the frequency is phase locked.

If you do not see characters displayed by your terminal program when the unit is powered up, you must troubleshoot your setup. An incorrectly wired cable is the most common problem. Refer to Chapter 3 – *Serial I/O Control and Status Commands* for the signal connections for the Præcis Cfr II.

Note

It *is* necessary to use a *null modem* cable or adapter to connect the Præcis Cfr II with a computer.

Once you have successfully established communications with the Præcis Cfr II, you may procede to installing and configuring the software you intend to use to synchronize your computer's clock to UTC.

Connecting Instruments to the Præcis Cfr II

Rear-panel mounted BNC jacks provide the means of connecting your equipment to the Præcis Cfr II. The standard Præcis Cfr II provides two precision output signals capable of driving properly terminated coaxial cables: 1PPS and 10 MHz. These two signals are DC coupled and sourced from Advanced CMOS (ACMOS) drivers which are able to maintain output TTL levels into a 50 ohm load. Care should be taken not to short circuit these outputs or to connect them to other voltage sources.

Chapter 3

Serial I/O Control and Status Commands

This chapter describes the ASCII protocol supported by the Præcis Cfr II. In addition to the Præcis Cfr II native commands, the emulation modes which enable use of the Præcis Cfr II 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 Cfr II 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 Cfr II terminates all status messages that it sends in response to commands with a <CR><LF> pair. The Præcis Cfr II does not 'echo' any user input.

The Præcis Cfr II 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 Cfr II outputs a time-of-day message once-per-second. The factory default emulation mode is NONE, and the Præcis Cfr II 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, one of A for North America cellular, K for North America plus Korea cellular, P for North America PCS and J for Japanese cellular.
CHANNELSET=s	Select the channel set, either A, K or P. (J can only be set at the factory.)
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, or TRUETIME.
EVENT	Show the status of event timetagging.
EVENT=OFF	Disable event timetagging, (for compatibility with previous Praecis Cfr only). There is no event timetagging function in the Praecis Cfr II.
FLTSTAT	Show the summary fault status of the Præcis Cfr II.
HELP	Show the Help menu.
LEAP	Show the current and future leap seconds setting.
LEAP=c,f	Set the 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 width of the 1PPS output pulse in milliseconds.
PPSWIDTH=*w*	Set the width of the 1PPS output pulse in milliseconds, where *w* may be 500ms, 100ms, 1ms, 20us.
REACQUIRE	Force new signal processor acquisition sequence.

RESET	Reset the unit (equivalent to cycling the power).
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.
TCODE	Show the time code output setting.
TCODE=c	Set the time code output, where c may be IRIGB, IRIGB+SBS, NASA36, 2137 or IEEE1344.
TFOMFLTLVL	Show the current TFOM fault level setting.
TFOMFLTLVL=*t*	Set the TFOM fault level, where *t* may be 7, 8 or 9.
TIME	Show the current time in native EndRun 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.

Command Descriptions

CAL

This command allows the user to query and set the value of a calibration offset that the Præcis Cfr II can make to the Præcis Cfr II 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 Cfr II timing outputs will be advanced in time. The Præcis Cfr II 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 Cfr II. 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 Cfr II response:	`-.000123452<CR><LF>`
Set:	`CAL=.00015<CR><LF>`
Præcis Cfr II 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 American cellular, K for Korea plus North American cellular, P for North American PCS. Set value is retained in non-volatile FLASH memory.

For Praecis Cfr II products configured for use in Japan the user will not be allowed to change the channelset. When doing a query the value returned will be J for Japan.

Usage:

Query:	`CHANNELSET<CR><LF>`
Præcis Cfr II response:	`NORTH AMERICA<CR><LF>`

Set: `CHANNELSET=K<CR><LF>`
Præcis Cfr II response: `OK<CR><LF>`

Factory Default Setting: **NORTH AMERICA**

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 Cfr II response: `OFF<CR><LF>`

Set: `CTIME=ON<CR><LF>`
Præcis Cfr II 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 Cfr II response: `4,1,2<CR><LF>`

Set: `DSTSTART=4,1,2<CR><LF>`
Præcis Cfr II 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 Cfr II response:	`10,L,2<CR><LF>`
Set:	`DSTSTOP=10,L,2<CR><LF>`
Præcis Cfr II 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. There are four allowable emulation modes: NONE, SPECTRACOM, and TRUETIME. See the *Clock Emulation Modes* section of this chapter for details. Set value is retained in non-volatile FLASH memory.

Usage:

Query:	`EMUL<CR><LF>`
Præcis Cfr II response:	`NONE<CR><LF>`
Set:	`EMUL=truetime<CR><LF>`
Præcis Cfr II response:	`OK<CR><LF>`

Factory Default Setting: NONE

EVENT

The event timetagging capability is not operational in the Praecis Cfr II. To maintain compatibility with the Serial Port interface the Praecis Cfr II will accept an input string of EVENT=OFF.

FLTSTAT

This query-only command displays the current summary status of the Præcis Cfr II. 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 ALARM LED. 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	Bad Time Input	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 equal to or greater than the TFOM fault level. 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 or has failed. 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.
Bad Time Input	This bit indicates that the time being received from the CDMA sync channel information has changed enough to warrant an error condition. It will NOT affect the time being output on the serial port. This is an extremely rare and temporary condition. If this fault persists for more than a day please call the factory.

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:	`STAT<CR><LF>`
Præcis Cfr II response:	`0x001A<CR><LF>`
Set:	N/A
Præcis Cfr II 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 Cfr II, along with the syntax of their usage.

Usage:

Query:	**HELP<CR><LF>**
Præcis Cfr II response:	Full menu of available commands and syntax is displayed
Set:	N/A
Præcis Cfr II 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 Ct will properly perform a leap second transition at UTC midnight.

If you choose this mode of operation you need to determine the current UTC leap second (alternatively called the GPS-UTC offset). The International Earth Rotation Service (IERS) publishes a bulletin 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. Leap seconds are inserted about every 18 to 24 months. Bulletin C is available at: www.iers.org. If there is no upcoming leap second at the next transition point then just set the command with current=future.

Usage:

Query:	**LEAP<CR><LF>**
Præcis Cfr II response:	**0 0<CR><LF>**
Set:	**LEAP=13,14**
Præcis Cfr II response:	**OK**

Factory Default Setting: 0,0

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 Cfr II response:	`-7:00<CR><LF>`
Set:	`LO=+12:30<CR><LF>`
Præcis Cfr II 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 Cfr II response:	`TCXO<CR><LF>`
Set:	N/A
Præcis Cfr II 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 Cfr II. 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 Cfr II response:	`9600,8,N,1<CR><LF>`
Set:	`PORT=19200,7,o,2<CR><LF>`
Præcis Cfr II 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 one of four settings (500ms, 100ms, 1ms, and 20us).

Usage:

Query: `PPSWIDTH<CR><LF>`
Præcis Cfr II response: `1ms<CR><LF>`

Set: `PPSWIDTH=500ms<CR><LF>`
Præcis Cfr II 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 Cfr II response: N/A

Set: `REACQUIRE<CR><LF>`
Præcis Cfr II 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. It is equivalent to cycling the power on the CDMA time and frequency engine.

Usage:

Query: N/A
Præcis Cfr II response: N/A

Set: `RESET<CR><LF>`
Præcis Cfr II response: `OK<CR><LF>`

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 chap-

ter. 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>`

Prœcis Cfr II response:
```
RESPMODE = VERBOSE<CR><LF>
TERSE<CR><LF>
```

Set: `RESPMODE=TERSE<CR><LF>`

Prœcis Cfr II 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>`

Prœcis Cfr II response:
```
Cal = +0.000000000<CR><LF>
ChannelSet = NORTH AMERICA PCS<CR><LF>
Ctime = OFF<CR><LF>
DSTStart = 0,0,0<CR><LF>
DSTStop = 0,0,0<CR><LF>
Emul = NONE<CR><LF>
Leap = 0 0<CR><LF>
Lo = +0:00<CR><LF>
Port = 57600,8,N,1<CR><LF>
PPSwidth = 1ms<CR><LF>
Respmode = TERSE<CR><LF>
Tcode=IRIGB<CR><LF>
TFOMFltLvl = 9<CR><LF>
Tmode = UTC<CR><LF>
```

Set: N/A

Prœcis Cfr II 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, one of PRIA (Primary A), PRIB (Primary B), SECA (Secondary A), SECB (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 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 Cfr II response: `LKD PRIB 132 161 28495  6.9 0.000<CR><LF>`
Set: N/A
Præcis Cfr II response: N/A

Factory Default Setting: N/A

TCODE

This command allows the user to query and set the optional time code output. This is an amplitude-modulated (AM) output via a rear panel BNC. There are four settings available: IRIGB, IRIGB+SBS, NASA36, 2137 and IEEE1344. The IRIGB setting corresponds to IRIGB122. The IRIGB+SBS setting corresponds to IRIGB123. Refer to Appendix C - *Code Formats*, for detailed descriptions of the time codes.

Usage:

Query: `TCODE<CR><LF>`
Præcis Cfr II response: `NASA36<CR><LF>`

Set: `TCODE=IRIGB+SBS<CR><LF>`
Præcis Cfr II response: `OK<CR><LF>`

Factory Default Setting: IRIGB

TFOMFLTLVL

This command allows the user to query and set the Time Figure of Merit level at which a "No Signal Timeout" fault will be indicated in the summary fault status word. Refer to the FLTSTAT command for details of the interpretation of the fault status word. Refer to the manual sections *Clock Emulation Modes* and *Time Figure of Merit/Time Quality* for details on the meanings of these levels in terms of worst case accumulated time error. Allowable entries for setting this parameter are 7, 8 or 9.

Usage:

Query: `TFOMFLTLVL<CR><LF>`
Præcis Cfr II response: `6<CR><LF>`

Set: `TFOMFLTLVL=7<CR><LF>`
Præcis Cfr II response: `OK<CR><LF>`

Factory Default Setting: 9

TIME

This query-only command displays the current time-of-day in the native EndRun 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 Cfr II response: `6 2000 155 13:45:01 +23 L<CR><LF>`

Set: N/A
Præcis Cfr II 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 or TrueTime clock types. They are always sent in UTC time.** The time mode setting affects the *native* CTIME 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>`
Prœcis Cfr II response: `GPS<CR><LF>`

Set: `TMODE=LOCAL<CR><LF>`
Prœcis Cfr II 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 Prœcis Cfr II. Refer to Appendix B – *Upgrading the Firmware* for detailed instructions for performing the UPLOAD procedure.

Usage:

Query: N/A
Prœcis Cfr II response: N/A

Set: `UPLOAD<CR><LF>`
Prœcis Cfr II 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 Cfr II response:

```
Praecis Cfr II FW 6010-0020-101 v 1.00 - Jun 07 2006 16:41:39
Praecis FPGA 6020-0004/5-000 v 0408
```

Set: N/A

Præcis Cfr II response: N/A

Factory Default Setting: N/A

Clock Emulation Modes

The Præcis Cfr II emulates two 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 EndRun 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.

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 Cfr II 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 Cfr II reports this value as accurately as possible, even during periods of CDMA signal outage where the Præcis Cfr II is unable to directly measure the relationship of its timing outputs to UTC. During these CDMA outage periods, assuming that the Præcis Cfr II had been synchronized prior to the outage, the Præcis Cfr II extrapolates the expected drift of the Præcis Cfr II timing signals based on its knowledge of the characteristics of the internal 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, brief removal of the antenna from a normally operating Præcis Cfr II 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 TFOM fault level state will eventually be reached (See the TFOMFLTLVL command). If the Præcis Cfr II is unable to achieve re-synchronization within one hour after reaching this state, the red LED will illuminate, and in units equipped with the Alarm Output option, the open collector output will transition to the high impedance 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.

RS-232 Port Signal Definitions

DB9M Pin	Signal Name
1	N/C
2	Receive Data (RX)
3	Transmit Data (TX)
4	N/C
5	Ground
6	N/C
7	N/C
8	N/C
9	N/C

Transmit Data (TX) is driven by the Præcis Cfr II.

Receive Data (RX) is driven by the host computer.

Ground is connected to the power supply ground on the Præcis Cfr II.

Optional RS-232/1PPS Port Signal Definitions

DB9M Pin	Signal Name
1	N/C
2	Receive Data (RX)
3	Transmit Data (TX)
4	Data Terminal Ready (DTR) (1PPS)
5	Ground
6	N/C
7	N/C
8	N/C
9	N/C

Transmit Data (TX) is driven by the Præcis Cfr II.

Receive Data (RX) is driven by the host computer.

Ground is connected to the power supply ground on the Præcis Cfr II.

Data Terminal Ready (DTR) is driven by the 1PPS signal from the Praecis Cfr II. The falling edges are on-time. The pulse width is determined by the PPSWIDTH command and the default is 1 millisecond wide. When connected to a null-modem this signal will convert to DCD on pin 1.

With a null-modem cable connected, this unit will have a pinout similar to the original Praecis Cfr. The pinout will also be similar to that of the Praecis Cf with its factory-supplied RJ-45 to DB9 converter cable. The only difference is that the CTS signal is not connected.

Appendix A

Comparison of Praecis Cfr/Praecis Cfr II

The Praecis Cfr is a discontinued product. The Praecis Cfr II is a new, specially-modified unit providing a full CDMA cellular/PCS/Japanese capability with a user interface similar to that of the Praecis Cfr. Below is a brief summary of the main differences between the Praecis Cfr and the Praecis Cfr II. This list may be incomplete.

The major difference is that the Praecis Cfr II has a dual-band receiver that can operate using CDMA cellular or CDMA PCS signals. In addition, an alternate configuration is available to operate in the Japanese CDMA cellular frequency band.

The 1PPS signal on the DTR/DCD pin via the RS-232 serial port is optional and is usually not installed.

There is no event timetagging capability via the CTS pin on the RS-232 serial port. However, the EVENT=OFF command is allowed.

The CHANNELSET command allows for a new parameter "P" for North American PCS. For Japanese units the user cannot change the channelset command. A query will return a response of: CHANNELSET=J.

The allowable PPS pulse width is limited to four settings: 500 milliseconds, 100 milliseconds, 1 millisecond and 20 microseconds. The factory default is 1 millisecond, which is the same as the Praecis Cfr.

There is no Trimble Palisade emulation mode. The EMUL command is limited to NONE, SPECTRACOM, and TRUETIME.

There is no indicator mode button and no "signal quality mode" indication. The user cannot reset the factory defaults.

The bit definitions for the FLTSTAT command are slightly different. Bit 0x20 now indicates a bad time input.

Notes

Appendix B

Upgrading the Firmware

Periodically, EndRun Technologies will make bug fixes and enhancements to our products available for download. 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 Cfr II.

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 Cfr II is in a *binary* format.

Using the higher baud rates will reduce the time needed to transfer the image file to the Præcis Cfr II. 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 Cfr II to communicate at the desired baud rate by using the settings facility for your terminal program and the **port** command for the Præcis Cfr II. Refer to Chapter 3 - *Serial I/O Control and Status Commands* for details on using the **port** command.

After establishing communications with the Præcis Cfr II 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 Cfr II respond with this message:

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

You will then see the Præcis Cfr II 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 Cfr II. 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 Cfr II 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 Cfr II. If it is, you have successfully upgraded the firmware in your Præcis Cfr II.

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 Cfr II 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.

If the boot load/application launch sequence appears to be caught in a loop, type "recover" right after the bootloader versions 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

Time Code Formats

Your Præcis Cfr II has an *optional* single time code output available at the rear panel BNC connector identified as AM CODE. The output code format is user selectable (see serial command TCODE). Each format is described below. IRIG B is the most widely used code format. Time codes are commonly used to provide time information to external devices such as displays, magnetic tape devices, strip chart recorders and several types of embedded computer peripheral cards.

IRIG B122
The IRIG B122 format contains seconds through day-of-year coded in BCD.

IRIG B123
In addition to the time information identified in B122 above, this format also contains Straight Binary Seconds of day. SBS is provided in the 17 bits shown in the IRIG B figure below with the first bit starting in position 80.

IEEE Std 1344-1995
This standard provides for the addition of time/status data in the control bit positions of IRIG B. The information provided there is, Unit and Tens of Years, Leap Second, Daylight Savings, Local Time Offset, Time Quality and Parity. The IEEE 1344 table provided below shows each bit position with detailed information.

NASA 36 Bit
NASA 36 bit time code is a 100 bit, pulse width modulated format containing seconds, minutes, hours and days. The format is used by several military ranges.

2137
The 2137 code is a pulse width modulated format containing seconds, minutes and hours. The format is used by certain security organizations.

IEEE 1344 Bit Definition

Bit Position	Bit Definition	Explanation
P50	Year, BCD1	Unit Years
P51	Year, BCD2	
P52	Year, BCD4	
P53	Year, BCD8	
P54	Not used	
P55	Year, BCD10	Tens Years
P56	Year, BCD20	
P57	Year, BCD40	
P58	Year, BCD80	
P59	P6	Position Identifier
P60	Leap second pending	Set to one, 59 seconds prior to leap insertion
P61	Leap second	0 = Add second, 1 = delete second
P62	Daylight Saving pending	Set to one, 1 second prior to DST change
P63	Daylight Saving	1 = Daylight Saving active
P64	Local offset sign	0 = +, 1 = -
P65	Local offset binary 1	Local offset from UTC time
P66	Local offset binary 2	
P67	Local offset binary 4	
P68	Local offset binary 8	
P69	P7	Position Identifier
P70	Local offset ½ hour bit	0 = none, 1 = additional half hour time offset
P71	Time Quality binary 1	Time Quality indicates clock precision, where 4 = < 1 usec, 5 = < 10 usec, 6 = < 100 usec, 7 = < 1 msec, 8 = < 10 msec, 9 = clock unlocked
P72	Time Quality binary 2	
P73	Time Quality binary 4	
P74	Time Quality binary 8	
P75	Parity	Odd parity for all preceding data bits
P76 – P78	Not used	
P79	P8	Position Identifier

Appendix D

Technical Specifications

Receiver:
AMPS Mobile Receive Band – 869-894 MHz
PCS Mobile Receive Band - 1930-1990 MHz.
J-CDMA Mobile Receive Band - 832-870 MHz (option).
TIA/EIA IS-95 CDMA Pilot and Sync Channels

Antenna:
TNC jack on rear panel, Z_{in} = 50Ω
Dual-Band, 824-896 MHz/1850-1990 MHz, magnetic-base with integral 12 ft. RG-58/U cable and TNC plug

Local Oscillator: TCXO. OCXO (option).

Time to Lock: < 5 minutes, typical (TCXO)
< 10 minutes, typical (OCXO)

I/O Signals (on DB-9M jack)**:**
See Chapter 3 for pinout.

- **Serial I/O:** RXD, TXD at RS-232 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. Depending upon the time mode selected, the UTC offset and Leap Second are determined automatically.
- Optional 1PPS output on DTR. Using null-modem cable will convert this to DCD which makes it compatible with the Praecis Cfr and Praecis Cf.

Standard Timing Output (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.

Standard Frequency Output (rear panel BNC jack):

- **10 MPPS:** TTL squarewave @ 50Ω.
  Accuracy: < 10^{-11} to UTC for 24 hour averaging times when locked.
  Stability (Allan Deviation):

Tau in Seconds	TCXO Cell	TCXO PCS	OCXO Cell	OCXO PCS
1	$1x10^{-9}$	$1x10^{-9}$	$7x10^{-12}$	$7x10^{-12}$
10	$1x10^{-9}$	$1x10^{-9}$	$1x10^{-11}$	$2x10^{-11}$
100	$3x10^{-10}$	$5x10^{-10}$	$3x10^{-11}$	$1x10^{-10}$
1000	$3x10^{-11}$	$5x10^{-11}$	$1x10^{-11}$	$2x10^{-11}$
10000	$9x10^{-12}$	$1x10^{-11}$	$7x10^{-12}$	$8x10^{-12}$
100000	$3x10^{-12}$	$3x10^{-12}$	$3x10^{-12}$	$3x10^{-12}$

Optional Time/Frequency Outputs (rear panel BNC jacks)**:**
AM Code: 1 Vrms into 50Ω. Formats: IRIG-B, NASA-36, 2137, IEEE1344

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

- **Lock LED:** green indicator that pulses to indicate the current CDMA acquisition and lock status.
- **Alarm LED:** red indicator that illuminates when a serious fault condition exists.
- **Network LED:** This LED is not used in the Praecis Cfr II so is always off.

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.

Size:

- **Chassis:** 1.75"H x 17.0"W x 10.75"D
- **Antenna**: 3.75"H x 1.125" dia. at base.

Weight: < 5 lb. (2.70 kg.)

Environmental:

- **Temperature:** 0° to +70°C (TCXO)
  0° to +50°C (OCXO/Rubidium)
- **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 Information:

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

Notes