Cs4000 User Guide

Cs4000 User Guide

Installation, Configuration, and Operation

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AMENDMENT NOTICE

Symmetricom, Inc. makes every attempt to provide up-to-date manuals with the associated equipment. Occasionally, changes are made to the equipment wherein it is necessary to provide amendments to the manual. If any amendments are provided for this manual they are printed on paper stock other than white and will be found at the rear of this manual.

Note: The contents of any amendments may affect operation and/or maintenance of the equipment.

Table of Contents

List of Figures

List of Tables

Chapter 1 - Introduction

This *User Guide* contains information about installing, operating, and maintaining the Symmetricom Cs4000. The Cs4000 Cesium Beam Primary Reference Source is an accurate and stable frequency reference designed for Stratum 1 applications.

Who Should Read This User Guide

This *User Guide* is designed for the following categories of users:

- **Systems Engineers** – Chapters 2 and 3 provide an overview of the product, options, and theory of operation. Cross references in these sections direct readers to detailed system configuration information in Chapter 4. Chapter 6 provides information about product ordering, shipping, and storage.

- **Installation Engineers** – Chapter 3 provides installation information and procedures.
  Chapters 4 and 5 provide specific configuration and operation information to ensure proper operation or, modify the systems configuration.

- **Maintenance Engineers** – Chapter 6 provides preventive and corrective maintenance guidelines. Chapter 6 also provides procedures for diagnosing and troubleshooting fault indications and alarms.

Certain sections, particularly Chapters 1 and 2, are intended for non-technical audiences. Others, such as Chapters 3 through 6 contain instructions which are intended to be performed by qualified personnel only.

About This User Guide

This *User Guide* is intended to be used as a reference for the Cs4000 Primary Reference Source. This *User Guide* has an introduction to the Cs4000 product, system and configuration specifications, and procedures for installation, power-up, operation, maintenance, and troubleshooting.

This *User Guide* contains the following sections and appendixes:

- Chapter 1 - Introduction: This section includes an overview of this User Guide, the intended audience, and the stylistic and typographical conventions used.

- Chapter 2 - Product Overview: This section includes a product and functional description, as well as a theory of operation of the Cs4000.

- Chapter 3 - Installing the Cs4000: This section includes environmental considerations of the Cs4000 unit, a guide to mounting the Cs4000 unit, and electrical (cable) connection procedures for the Cs4000 unit.

- Chapter 4 - Configuring the Cs4000: This section includes information on connecting the Cs4000 unit to a laptop, PC, or terminal for installing software and setting the systems configuration options.
- Chapter 5 - Operating the Cs4000: This section provides Power-on and Power-off procedures, as well as normal operating indications.
- Chapter 6 - Maintenance & Troubleshooting: This section provides information about preventive and corrective maintenance, troubleshooting, re-ordering procedures, and re-shipment of the product.
- Appendix A - Specifications: This section provides system specifications information.

Typographical and Other Conventions

This *User Guide* uses the following conventions:

- **Acronyms and Abbreviations** – Terms are spelled out the first time they appear in this *User Guide*. Thereafter, only the acronym or abbreviation is used. In addition, the glossary defines the acronyms and abbreviations.
- **Revision Control** – The title page lists the printing date and part number of this *User Guide*. Table 1-1 describes the typographical conventions that this *User Guide* uses to distinguish between the different types of information according to how they are used.

Table 1-1. Typographical Conventions

When Text Appears This Way …	It Means …
Cs4000 User Guide	The title of a document.
CRITICAL PORT-A J1	An operating mode, alarm state, status, or chassis label.
Press the **Enter** key. Press the **Print Scrn** key.	A named keyboard key. The key name is shown as it appears on the keyboard. An explanation of the key's acronym or function immediately follows the first reference to the key, if required.
A *re-timing* application …	A term or a word being emphasized.
Symmetricom ***does not*** recommend …	A word or term given special emphasis so that you do not miss the idea being presented.

Warnings, Cautions, Recommendations, and Notes

Warnings, Cautions, Recommendations, and Notes attract attention to essential or critical information in this *User Guide*. The types of information included in each are explained as follows:

WARNING …

All warnings have this symbol. *Do not* disregard warnings. They are installation, operation, or maintenance procedures, practices, or statements that if not strictly observed, may result in personal injury or loss of life.

ELECTRICAL SHOCK HAZARD …

All electrical shock hazard warnings have this symbol. To avoid serious personal injury or death, *do not* disregard electrical shock hazard warnings. They are installation, operation, or maintenance procedures, practices, or statements that if not strictly observed, may result in personal injury or loss of life.

CAUTION …

All cautions have this symbol. *Do not* disregard cautions. They are installation, operation, or maintenance procedures, practices, conditions, or statements that if not strictly observed, may result in damage to or destruction of equipment or may cause a long-term health hazard.

CAUTION …

All Electrostatic Discharge (ESD) cautions have this symbol. They are installation, operation, or maintenance procedures, practices, conditions, or statements that if not strictly observed, may result in electrostatic discharge damage to, or destruction of, static sensitive components of the equipment.

RECOMMENDATION …

All recommendations have this symbol. Recommendations indicate manufacturer-tested methods or known functionality. They contain installation, operation, or maintenance procedures, practices, conditions, or statements that provide you with important information for optimum performance results.

NOTE …

All notes have this symbol. Notes contain installation, operation, or maintenance procedures, practices, conditions, or statements that alert you to important information which may make your task easier or increase your understanding.

Chapter 2 - Product Overview

The Symmetricom Cs4000 Cesium Frequency Standard is designed for high precision applications providing multiple RF sine wave outputs, as well as 1 PPS output. Included software provides comprehensive system monitoring and control from any Windows PC.

The Cs4000 comes in a standard 19-inch wide rack mount housing. It is 3U high (5.25 inches) and weighs 45 lbs (20.4 kg). Refer to “Appendix A - Specifications” on page 43 for performance specifications.

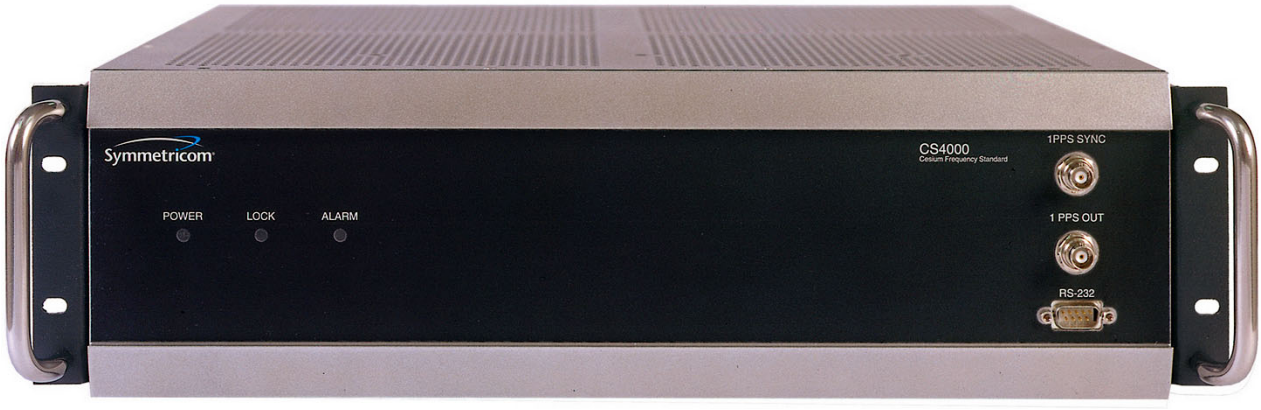

Figure 2-1. Cs4000 Front View

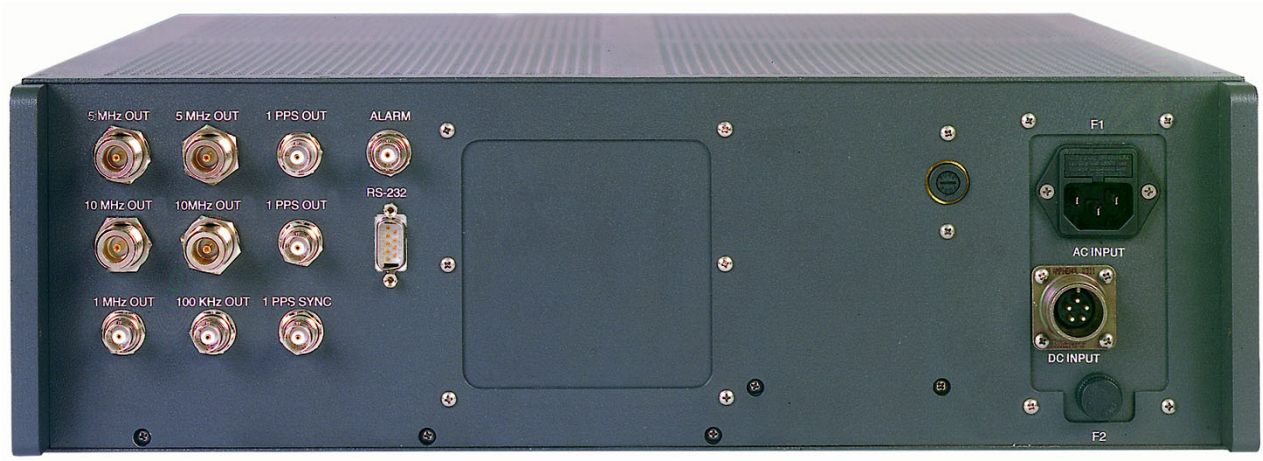

Figure 2-2. Cs4000 Rear View

The major function of the Cs4000 is to produce accurate and stable RF sine wave and 1PPS outputs for timing and frequency applications. To accomplish this, a Cesium beam tube

resonator is used to stabilize the output of a quartz crystal oscillator that provides the frequency source for the output generators.

A **Microprocessor** performs the following tasks:

- Digital demodulation and integration of the servo loop signals
- Monitoring of system parameters
- Control of adaptive servos
- Diagnostic functions to aid in troubleshooting
- Communication for monitoring and control

Software – The Cs4000 has a number of software controllable features. **Monitor 2** is a software utility program for monitoring and configuring the Cs4000. It requires a PC or laptop running Windows NT 4, Windows 95, Windows 98, Windows ME, or Windows 2000. The software comes standard and is quickly installed and easy to use. Refer to"Installing the Monitor 2 Software" on page 18 for more information.

Event Logging – A portion of the non-volatile memory in the system is reserved for storage of event records. Event records consist of a time stamp and an event description. Any change in the system status is recorded as a new event in the log. The Event log stores two distinct time stamps and can be cleared by an external command. The first is a 6-byte calendar date and the second is a 32-bit value representing the total system power-on hours. A maximum of 128 events can be stored in the Cs4000.

Power - External power is supplied by a standard AC power cord or by a DC power connection. The optional internal battery provides automatic backup power for more than one hour if the external power goes offline.

The power hierarchy is as follows:

- If AC power is available, the unit works off of AC power.
- If no AC power is available, and DC power is available, the unit uses DC.
- If neither AC or DC are available, and the optional internal battery is available, the unit runs on its battery.

Battery capacity is one hour. The battery is guarded from a deep discharge by limiting the lowest voltage on the battery (nominal 24v) to be 21 volts. The battery is charged either from AC or DC power. It takes 16 hours to fully charge a discharged battery.

Factory Configurations

The Cs4000 can be ordered with eight different configurations. Refer to Table 2-1 for configurations and part number reference information.

Table 2-1. Factory Output Configuration Options

Part Number	Part Number
14645-101	Std. Performance, 48VDC Input, w/o Batteries
14645-102	Std. Performance, 24VDC Input, w/o Batteries
14645-103	High Performance, 48VDC Input, w/o Batteries
14645-104	High Performance, 24VDC Input, w/o Batteries
14645-105	Std. Performance, 48VDC Input, w. Batteries
14645-106	Std. Performance, 24VDC Input, w. Batteries
14645-107	High Performance, 48VDC Input, w. Batteries
14645-108	High Performance, 24VDC Input, w. Batteries

Theory of Operation

This section provides a Theory of Operation for the Cs4000 which complements the functional description and offers a better understanding of the instrument's operation.

Introduction

The Cs4000 Cesium Frequency Standard (CFS) generates signals that are:

- Accurate
- Spectrally pure
- Stable

Accuracy is obtained by comparing the output frequency of a quartz crystal oscillator to the atomic resonance of a beam of Cesium atoms. Spectral purity (absence of all frequencies in the output signal except the fundamental frequency) is provided by using a high performance quartz crystal oscillator. Stability (maintaining the specified frequency over a specified time interval) is derived from the invariant resonance frequency of Cesium atoms.

The major components of the Cs4000 are indicated in Figure 2-3.

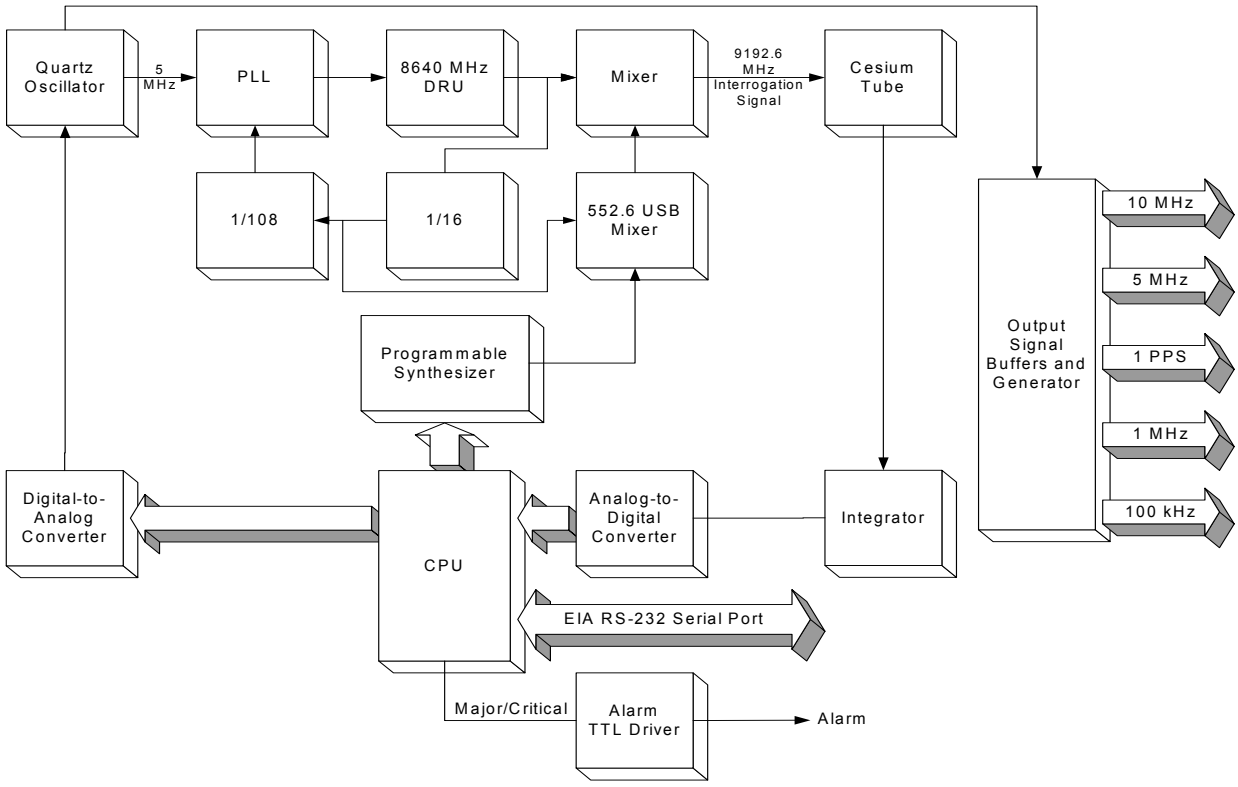

Figure 2-3. Cs4000 Block Diagram (A1)

Cesium Frequency Standard (CFS)

The Cesium frequency standard is based on a hyper-fine transition in the ground state of the Cesium 133 atom. The frequency of this transition defines the international time unit: the second. The CFS contains the following elements:

- A quartz oscillator frequency-locked to the hyper-fine transition frequency (clock transition) of the Cesium atom.
- A Cesium atomic beam resonator (Cesium tube).
- Frequency Multiplexer Synthesis circuits, driven by the quartz oscillator frequency, delivering an interrogation signal. This signal is fed to the atomic resonator. The response of the resonator is a signal whose amplitude is maximum when the interrogation signal frequency is equal to the clock transition frequency.
- Servo loop circuits, fed by the tube output signal, which control the quartz oscillator frequency so that the interrogation frequency is locked to the clock transition.
- Power supplies.

A Cesium tube can be thought of as a high Q resonator: when the frequency of the input signal scans the atomic transition, the output signal is a micro-current of variable amplitude; the tube acts as a very narrow band-pass filter coupled to an amplitude detector.

When the frequency of the microwave interrogation signal scans the clock frequency, the output signal of the Cesium tube has the schematic behavior shown in Figure 2-4. A large resonance, called pedestal or Rabi resonance, is topped by interference fringes or Ramsey fringes (Ramsey pattern). The central fringe, or central line, provides the reference to which the interrogation signal frequency and, consequently, the quartz oscillator frequency are locked.

The microwave spectrum displays six other resonances of similar structure, symmetrically disposed and regularly spaced about the central resonance. One of these is shown in Figure 2-4. The central frequency of this resonance pattern (Zeeman line) is linearly dependent on the magnetic field inside the Cesium tube: by measuring this frequency it is possible to know and to stabilize the magnetic field inside the tube.

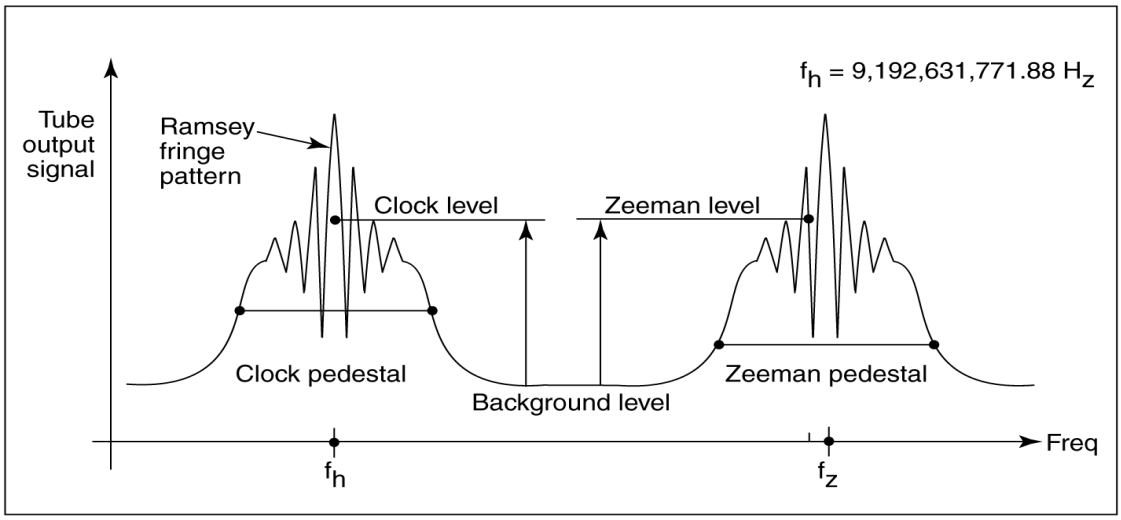

Figure 2-4. Cesium Tube Output Signal vs. Microwave Input Signal Frequency

A programmable frequency synthesizer, controlled by a microprocessor and with a short response time, periodically probes several characteristic points of the tube response. This probing is based on two principles:

First Principle: When two frequencies symmetrically disposed about fh (central line) are alternately programmed, the tube output current switches between two levels; their difference is related to the offset of the quartz oscillator frequency from the resonant frequency. Digitized, this difference is processed by the central unit and then fed back to the quartz oscillator.

Second Principle: Since the servo loop time constant is much longer than the measuring cycle time, it is possible to periodically “steal” one measuring cycle which is then used to program other frequencies in order to check the different useful characteristic points of the tube response.

By using this flexible frequency synthesizing technique and the many possibilities offered by a microprocessor-driven system, the time frequency standard performs permanently and in real-time operation, the following functions:

- Measurement and control of the central line centering through symmetrical testing of the pedestal.
- Measurement and control of the Cesium servo loop bandwidth and resolution through gain optimization.
- Measurement and control of the magnetically dependent transitions to provide continuous feedback to the frequency-determining C-field.
- Measurement and control of the microwave power applied to the tube, providing for optimum power over environment and time.

Output Signals

The output signals are generated from the 5 MHz from the oscillator.

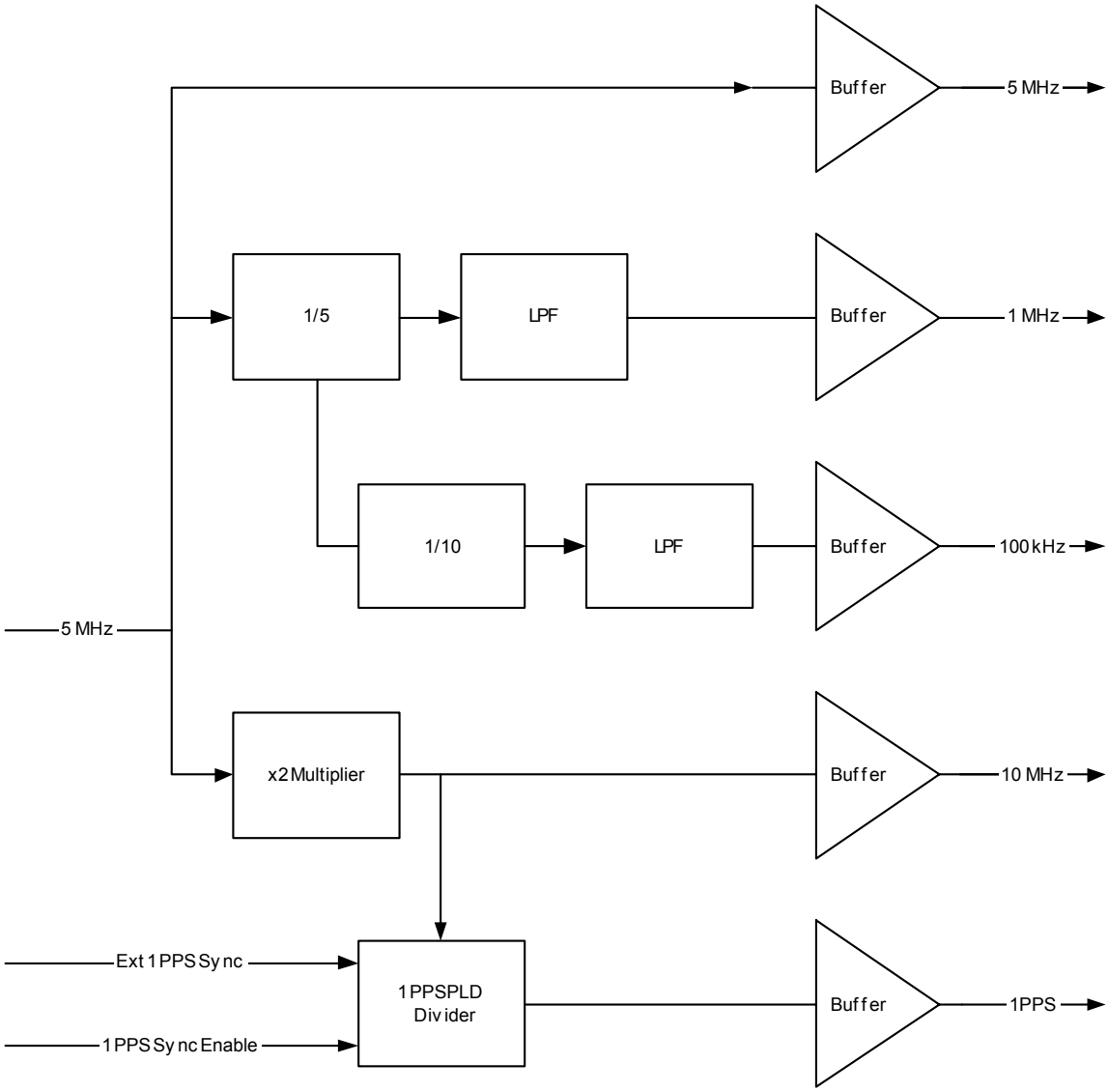

Figure 2-5. Output Signal Generator and Buffers

- A buffered signal from the 5 MHz oscillator is connected to the main Cs4000 PCB (servo) and is the master reference for the all of the Cs4000's output signals.
- The 5 MHz output is generated by running the 5 MHz signal from the oscillator through a buffer and making it available on the 5 MHz output connector.
- The 10 MHz output is generated by multiplying the 5 MHz signal from the oscillator times two, buffering it, and making it available on the 10 MHz output connector.
- The 1 PPS output is generated by running the 10 MHz signal through the 1 PPS PLD (Programmable Logic Device) Divider, which divides it by 10 million. The resulting 1 PPS signal is buffered and made available on the 1 PPS output connector.

- An external 1 PPS signal can be enabled under CPU control to synchronize the internal 1 PPS to the external signal.
- The 1 MHz output is generated by dividing 5 MHz by 5, passing it through a low pass filter, and buffering it to the output connector.
- The 100 kHz output is generated by dividing 1 MHz by 10, passing it through a low pass filter, and buffering it to the output connector.

Alarm Output

The Alarm output (TTL) is available from the rear panel BNC connector labelled ALARM.

The output TTL is as follows:

High, normal

TTL low, fault

The circuit is a TTL open collector with internal pull-up resistor. The circuit can sync up to 10mA

Chapter 3 - Installing the Cs4000

This section provides unpacking instructions and installation procedures for the Cs4000 as well as warnings, cautions, notes, and recommendations that pertain to the procedures being performed. To prevent serious injury and/or equipment damage, **do not** ignore these safety, environmental, and operational messages.

NOTE

If you encounter problems during any of the following procedures, contact Customer Assistance. See “Appendix B - Customer Assistance” on page 47 for contact information.

Unpacking Instructions

CAUTION

To avoid electrostatic discharge (ESD) damage to sensitive internal parts in the Cs4000, observe proper ESD handling procedures.

1. Inspect the container for signs of damage. If the container appears to be damaged, notify both the carrier and the Symmetricom distributor. Retain the shipping container and packing material for the carrier to inspect.
2. Unpack all components in the shipping container.
3. Inventory, and set aside all items and paperwork that are included in the container.
4. Verify that the model and item number shown on the shipping list agrees with the model and item number on the equipment. The item number can be found on a label affixed to the rear panel. Contact the Symmetricom distributor if the model or item numbers do not match.

CAUTION

This instrument must be operated only as specified by the manufacturer. Use other than as specified may compromise the safety precautions of the system.

Environmental Considerations

When installing the instrument, consider the standard environmental factors (temperature, humidity, vibration, etc.) and the presence of magnetic fields that might affect the accuracy of the Cs4000. Avoid installing or using the instrument near large motors, generators, transformers, or other equipment which radiates strong AC or DC fields of 2-gauss or more.

Pre-Installation Checklist

Before installation, ensure that the following preparations are in place:

- The equipment rack is grounded and has power available
- The power supply fuse has been removed from the power input of the Cs4000 rear panel
- The proper tools and materials are available as listed in

Tools and Materials

The following is a list of recommended tools and materials **NOT** supplied by Symmetricom:

- Standard tool kit
- Rack mounting hardware
- Laptop or PC with Windows NT4, Windows 95, Windows 98, Windows ME, or Windows 2000 installed
- Null Modem cable

Installing the Cs4000

The Cs4000 is designed to be mounted in a standard 19-inch equipment rack. The front panel occupies a height of 5.25 inches.

CAUTION

To avoid damage to the Cs4000, access covers must not be removed except by trained service personnel.

WARNING

For continued protection against risk of fire, ensure that only the specified fuse type and rating are used. Fuse specifications are contained in“Appendix A - Specifications” on page 43 and the label on the instrument’s rear panel.

CAUTION

To prevent damage to the instrument during installation, ensure power is disconnected by removing the fuse from the rear panel. The fuse is the emergency disconnect for the device – there is no ON/OFF switch.

CAUTION

The Cs4000 is convection cooled. To prevent the instrument from overheating, allow for a one rack unit (1.75 in./4.44 cm) space above and below the unit for cooling.

CAUTION

To avoid electrostatic discharge (ESD) damage to components in the Cs4000, observe the appropriate electrostatic discharge (ESD) precautions and procedures.

Mounting and Installation – Refer to , then perform the following procedures:

1. Mount the Cs4000 in the desired location in the equipment rack using standard rack mount hardware.

2. Remove the fuse from the fuse holder on the rear panel.

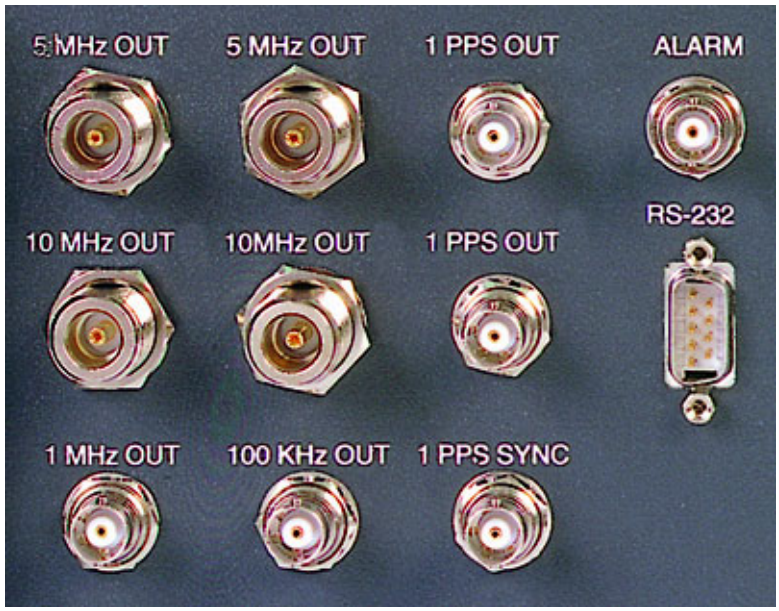

Figure 3-1. Cs4000 Output/Communication Connectors

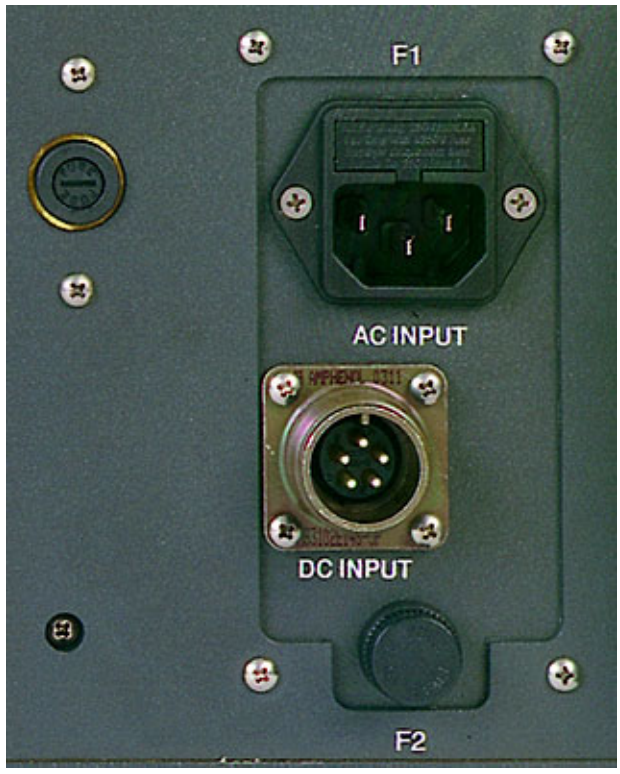

Figure 3-2. Cs4000 Fuses and Power Connectors

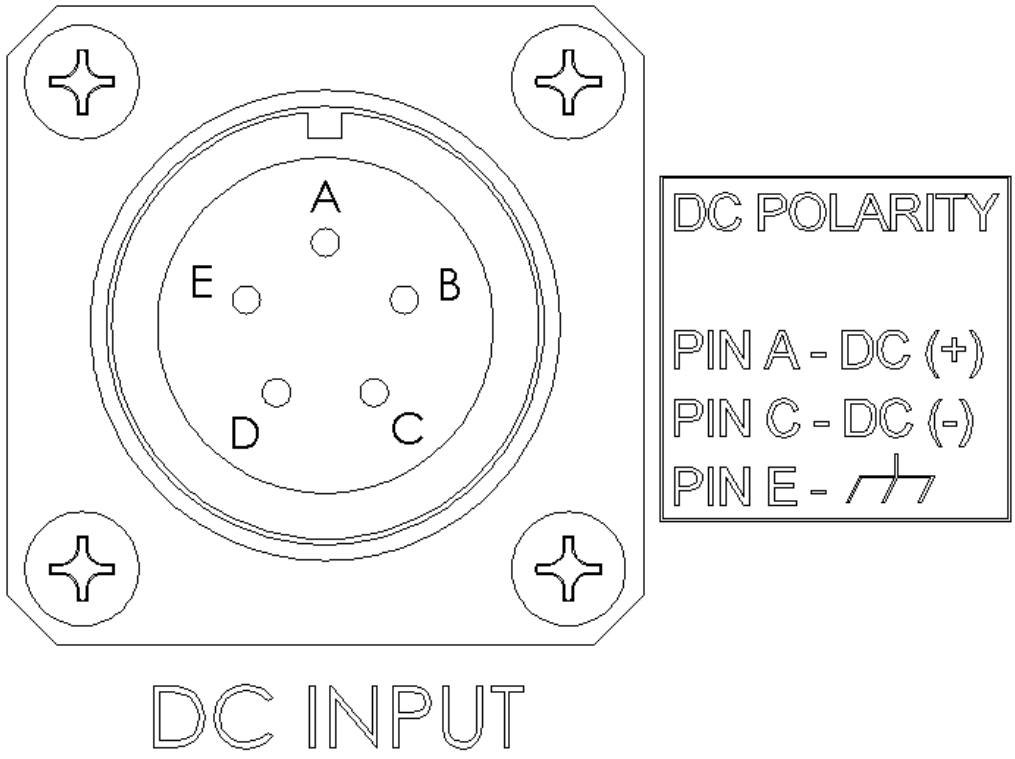

Figure 3-3. DC Input Polarity

Table 3-1. ALARM Output

TTL	Alarm (Female)
High	Normal
Low	Fault

3. Install the proper fuse into the fuse holder labeled F2 on the rear panel. (Refer to"Appendix A - Specifications" on page 43 or to the label on the instrument's rear panel.)

4. The Cs4000 is powered from an AC source by a detachable power supply cord. This instrument input connector is the disconnect device. Install the power cord and connect it to the AC mains.

NOTE

Applying power initiates the warm-up and automatic lock acquisition sequence. During this time, the ALARM relay is activated and the signal outputs are not active.

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5. Observe that the POWER and ALARM indicators are illuminated.

6. Wait for the unit to stabilize the frequency control loop. This may take up to 30 minutes. When stabilized, the ALARM indicator turns off and the LOCK indicator illuminates. The ALARM relay is also reset. At this time the signal outputs are ready for use.

Refer to Table 3-2 for a description of all the front panel indicators.

Table 3-2. Front Panel Indicators

Indicator name	Description
POWER	Turns green when AC or DC power is present
LOCK	Turns green when the frequency control loop is stable. Indicates normal operation. Outputs are active
ALARM	Turns red when the unit is initialized and when a minor or critical alarm is present (alarm relay is activated)

Installing the Monitor 2 Software

The Cs4000 has a number of software controllable features. **Monitor 2** is a software utility program that will help you configure your Cesium instrument. It requires a PC or laptop operating with Windows NT 4, Windows 95, Windows 98, Windows ME, or Windows 2000.

Note: If you are writing your own communications software, you can use the serial port commands provided in “Appendix C - RS-232 Interface” on page 49

Connecting the Serial Cable

Connect one end of an RS-232 cable to the serial communications port on your computer and the other end to the connector labeled RS-232 on the Cs4000. Use a NULL Modem cable with pins connected as shown in the following tables.

If you have a DB25 connector on your computer refer to Table 3-3 for connector pinout information.

Table 3-3. RS-232 Port DB9 to DB25 Connector Pinout

DB9-F	DB25-F	Function
3	3	RX (Receive Data)
2	2	TX (Transmit Data)
5	7	GND (Signal Ground)

If you have a DB9 connector on your computer refer to Table 3-4 for connector pinout information.

Table 3-4. RS-232 Port DB9 to DB9 Connector Pin out

DB9-F	DB9-F	Function
3	2	RX (Receive Data)
2	3	TX (Transmit Data)
5	7	GND (Signal Ground)

Loading the Monitor 2 Software

1. Locate the **Monitor 2** software on the CD-ROM provided in the shipping container. If unable to locate the CD-ROM, contact Customer Service at 1-512-721-4032 during normal business hours (8 a.m. to 5 p.m. CST) or 1-512-721-4000 (after hours, on weekends, and holidays) for a replacement CD-ROM.

2. Install the CD-ROM into the computer.

3. Run the program **m2setup.exe** located on the CD-ROM by clicking the Start button, selecting Run, and from the command line typing *A:\m2setup.exe,* then press Enter.

4. This installs the **Monitor 2** application files onto your hard drive. A folder is added to your Start menu containing icons for Monitor2 and its documentation. An uninstall icon is also added so that you can easily remove the program in the future. All the necessary files will be copied to your Program Files directory.

Establishing Communications

Monitor 2 will initially attempt to communicate with the Cs4000 using the default settings of the communications port COM 1, 9600 baud, odd parity, 7 data bits, 2 stop bits. If you wish to use COM 2, COM 3, or COM 4 on your PC, you must change this setup. This only needs to be done once; Monitor 2 will remember any changes you make. Refer to , to perform this operation.

1. Click the Start button, select **Programs**, **Monitor 2**, and the program icon **Monitor 2**. The **Monitor 2** interface appears.

2. Verify that the Cs4000 is operational and responding. To do this, select **View** from the menu and click **Monitors**. This will open a large window showing the complete real-time status of the Cesium instrument, as shown in Figure 3-4.

3. Select **View** from the menu and click **Monitors** again to hide the window.

4. If the window opens and closes, the unit is operational.

5. At this time close the program by selecting **File** and **Exit**. To configure the Cs4000, refer to "Chapter 4 - Configuring the Cs4000" on page 23.

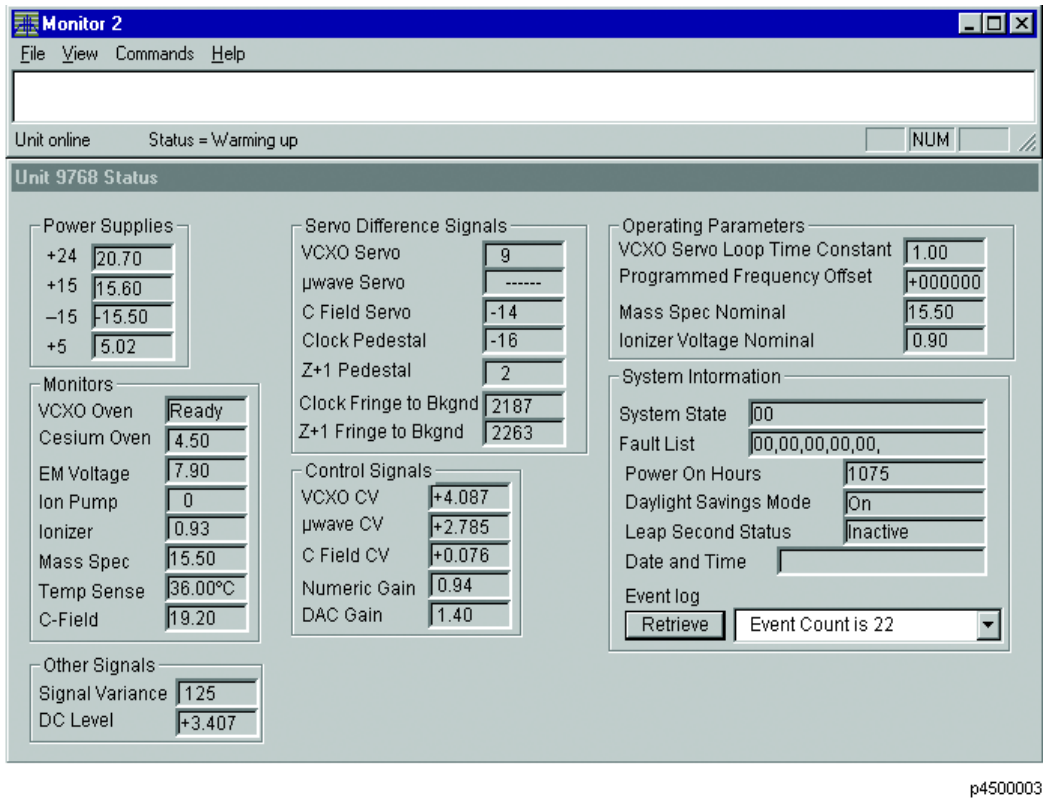

Figure 3-4. Monitor 2 Initial Start-up Screen

Chapter 4 - Configuring the Cs4000

Before beginning the configuration procedures outlined in this section, ensure that the installation procedures in “Chapter 3 - Installing the Cs4000” on page 13 have been performed.

If you are writing your own communications software, you can use the serial port commands provided in “Appendix C - RS-232 Interface” on page 49

NOTE

If you encounter problems during any of the following procedures, contact Customer Assistance. See “Appendix B - Customer Assistance” on page 47 for contact information.

Preliminary Procedures

CAUTION

To avoid electrostatic discharge (ESD) damage to components in the Cs4000, observe the appropriate electrostatic discharge (ESD) precautions and procedures.

WARNING

For continued protection against risk of fire, ensure that only the specified fuse type and rating are used. Fuse specifications are contained in “Appendix A - Specifications” on page 43 and on the label on the instrument’s rear panel.

1. Connect a serial cable from the computer to the RS-232 serial port.

2. Apply power to the Cs4000. The green POWER LED should be illuminated. Disregard other LED indications at this time.

3. On your PC, start the **Monitor 2** software by selecting it from the Windows **Programs** menu.The Monitor 2 interface should look similar to the one shown in Figure 4-1.

The programs screen size and shape can be adjusted. Adjust the screen according to the user's preference.

NOTE

Monitor 2 initially attempts to communicate with the Cs4000 using the default settings of COM 1, 9600 baud, odd parity, 7 data bits, 2 stop bits. If you wish to use COM 2, COM 3, or COM 4 on your PC, you must change this setup, see "Configuring the Serial Port" on page 24. This only needs to be done once. Monitor 2 stores any changes you make.

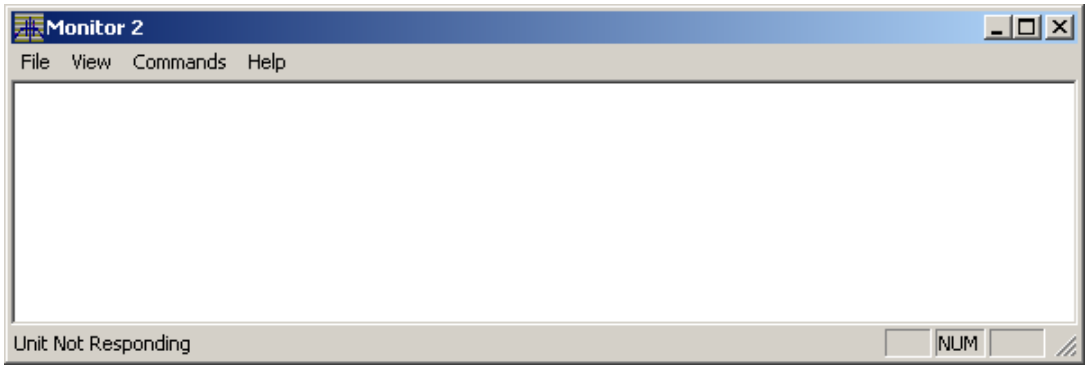

Figure 4-1. Monitor 2 Start-up Screen

Configuring the Serial Port

1. In Monitor 2, select the following items from the menu bar: **File => Configure Serial Port**.

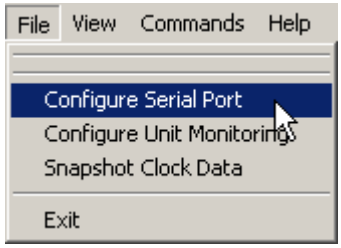

Figure 4-2. Configuring the Serial Port

2. The Serial Communications Setup window appears.

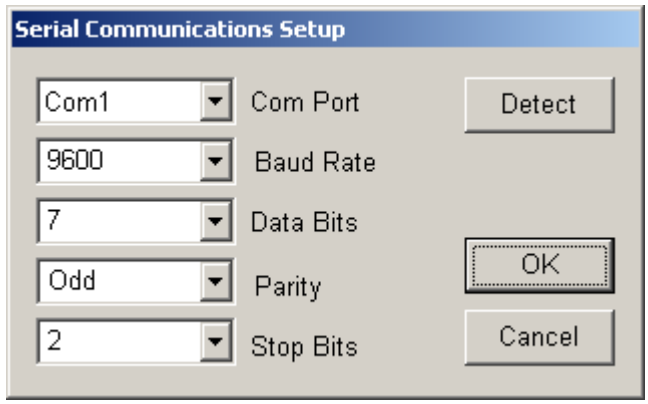

Figure 4-3. Serial Communications Setup

3. The factory default settings on the unit are as follows:

   - COM Port: COM 1
   - Baud Rate: 9600
   - Data Bits: 7
   - Parity: Odd
   - Stop Bits: 2

4. If needed, change the settings in the Serial Communications Setup to match those of the unit.

   If communications cannot be established, check cabling, power to the Cesium instrument, and make sure that no other programs are running which use the communications port on your computer.

NOTE

If you do not know what the correct settings are, click the **Detect** button in the dialog box and **Monitor 2** will attempt to discover the correct settings for you. This can take anywhere from a few seconds to several minutes. As the scan progresses, the communications settings change. At the end of the scan, a message appears, indicating whether or not the Cesium instrument was located. If you click Cancel to stop the process, communications will not be established.

---

5. Once communications are established, close the serial port communications setup dialog window by clicking **OK**. The main window now indicates that the unit is online and show you the status of the Cesium instrument.

Unit Monitoring Options

1. In Monitor 2, select **Configure Unit Monitoring** from the **File** menu.

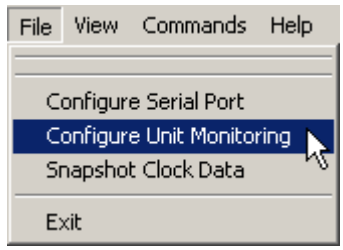

Figure 4-4. Configuring Unit Monitoring

2. This displays the Unit Monitoring Options window.

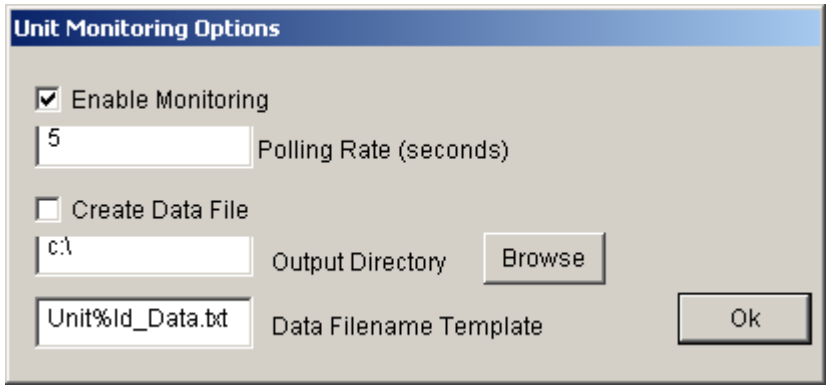

Figure 4-5. Unit Monitoring Options

3. Select **Enable Monitoring** and enter an appropriate polling rate.

4. To log unit monitoring data, select **Create Data File** and, if needed, set the **Output Directory** and **Data Filename Template**.

5. Click **OK** to close Unit Monitoring Options.

Displaying Real-Time Status

1. Select **View** from the menu and click **Monitors** from the menu option. This will open a large window showing the complete real-time status of the Cesium instrument, see Figure 4-6.

2. Select **View** from the menu and click **Monitors** again to hide the window.

NOTE

The real-time display window is a status window only. The operating parameters cannot be changed from this window.

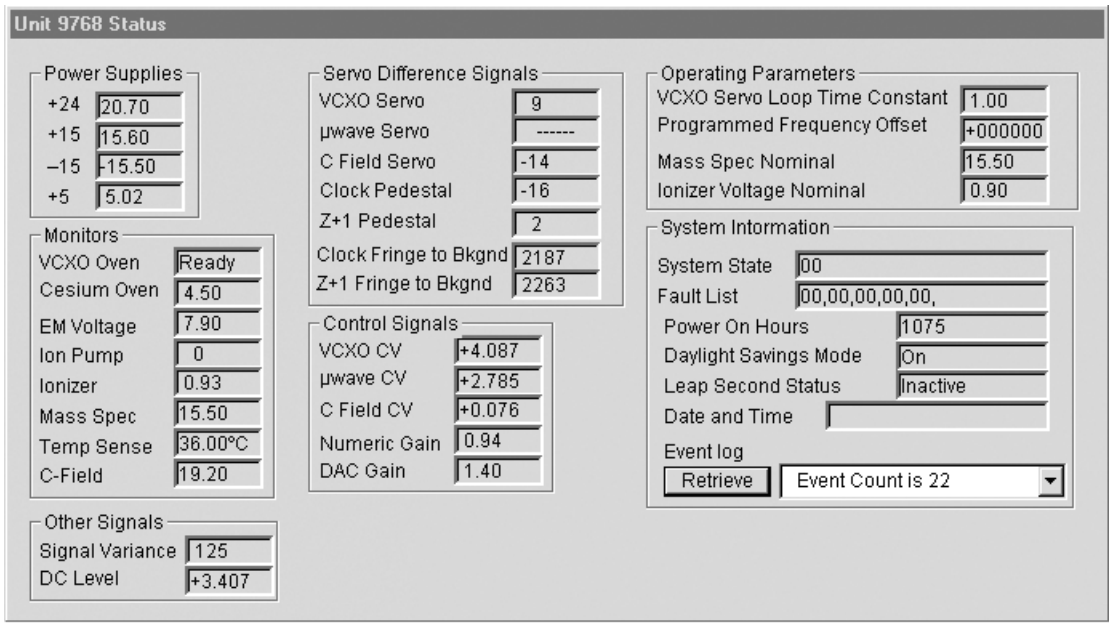

Figure 4-6. Real-Time Status Display

Refer to Table 4-1 for a description of each parameter.

Reset Unit Alarms

1. Select **Commands** from the menu and click **Reset Unit Alarms** from the menu option. This resets the alarm LED and alarm contacts.

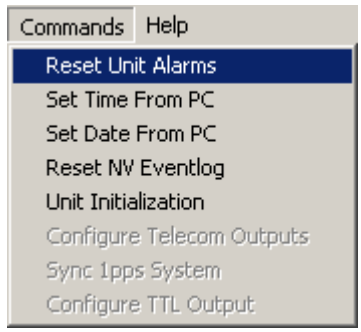

Figure 4-7. Resetting the Unit's Alarms

2. Verify that the alarm has been cleared by observing that the Alarm LED is not lit.

Setting the Time from a PC

Select **Commands** from the menu and click **Set Time From PC** from the menu option. This opens a dialog box as shown in Figure 4-8. The time is automatically set from the current time of the computer.

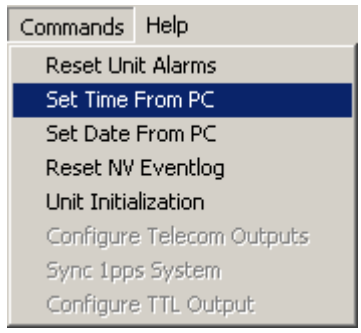

Figure 4-8. Setting the Time from a PC

Setting the Date from a PC

Select **Commands** from the menu and click **Set Date From PC** from the File menu. This opens a dialog box as shown in Figure 4-9. The date is automatically set from the current date of the computer.

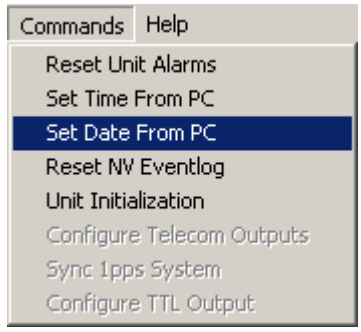

Figure 4-9. Setting the Date from a PC

Unit Initialization Options

1. Select **Commands** from the menu and click **Unit Initialization** from the menu option. This opens a dialog box as shown in Figure 4-10.

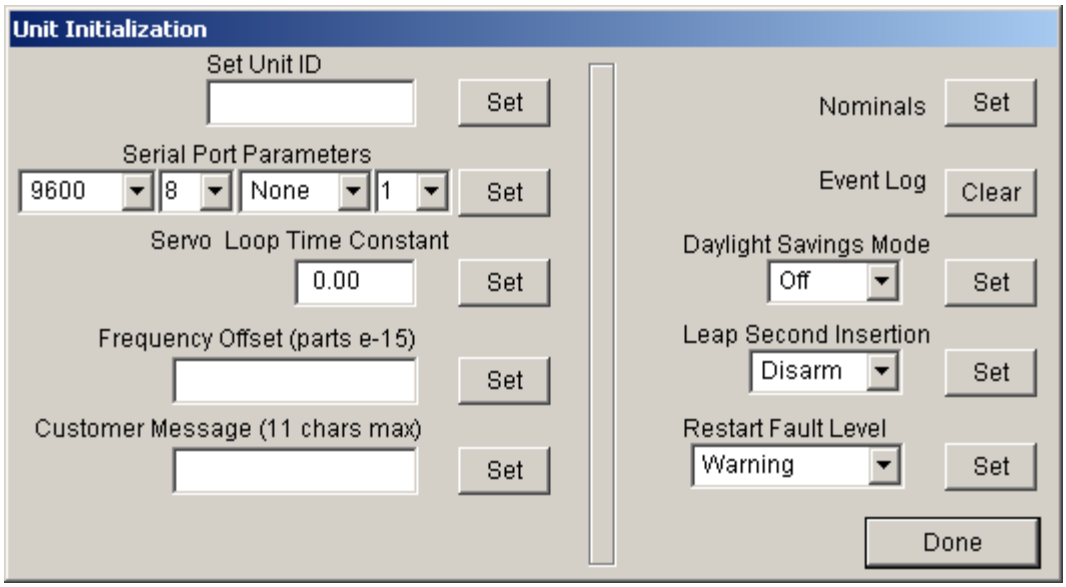

Figure 4-10. Selecting Unit Initialization Options

NOTE

The Unit Initialization dialog allows you to set various parameters. Refer to Figure 4-10 and Table 4-1 for the appropriate settings for the Cs4000.

CAUTION

Changing the serial communications parameters can cause your unit to stop responding. If this happens, refer to *Establishing Communications between Monitor 2* and the Cs4000 and the appropriate default configuration settings in Table 4-1 for the Cs4000.

NOTE

The Unit is factory configured with the Restart Fault Level in the *Warning* mode. In this mode the Alarm Relay is automatically cleared if the unit is restarted (power removed and restored). However, it will set the fault code (16), which will be displayed in the Unit Initialization dialog box. If the Restart Fault Level is changed to **Critical** mode, the operator will have to issue the Clear Unit Alarms command from the Command menu in the **Monitor 2** program to clear the alarm after the unit is restarted.

2. Set the parameters to your system's requirements.
3. Click Set after each parameter that is changed.
4. Click Done when complete**.**

Set Frequency

1. In Monitor 2, select:
   Commands => **Unit Initialization**

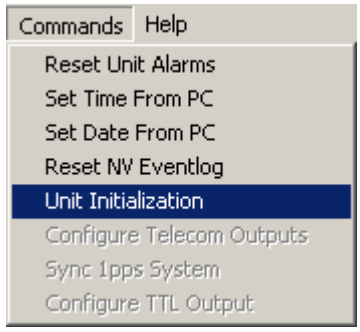

Figure 4-11. Configuring the Unit Initialization settings

2. In the Unit Initialization window, enter the frequency offset. Units are 1x10-15. For example, a frequency offset of -1.2x10-12 would be entered as "**-001200**"

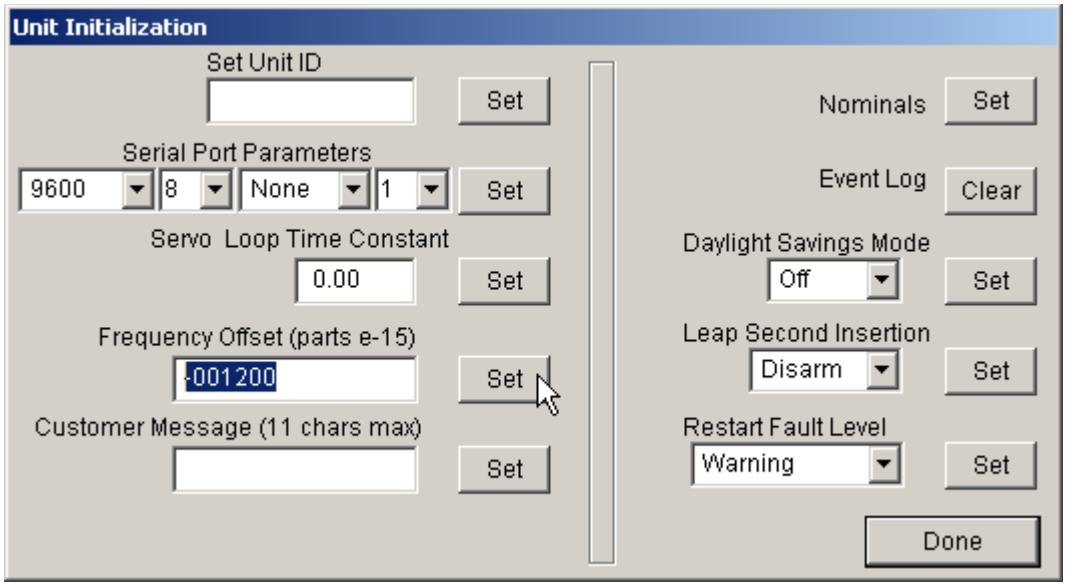

Figure 4-12. Setting the Frequency Offset

3. Click **Set** and **Done**.

Synchronizing the Unit with a 1 PPS Input

1. Connect the source 1 PPS to the 1 PPS SYNC input connector on either the front or the rear panel.

2. In Monitor 2, select:
Commands => **Sync 1pps**

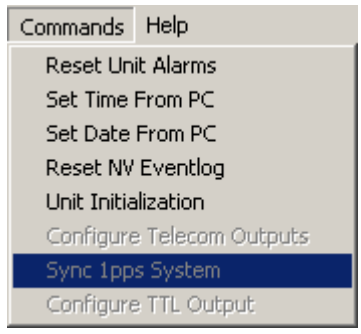

Figure 4-13. Synchronizing the Unit with the 1 PPS input

3. Remove the source 1 PPS.

Factory Default Settings

The Cs4000 is shipped from the factory with default configuration settings. Refer to Table 4-1 for a list of the factory default settings.

Table 4-1. Default Configuration Settings

Parameter	Setting
RS-232 Serial Port	
COM Port	1
Baud Rate	9600
Data Bits	7
Parity	Odd
Stop Bits	2
Unit Monitoring	
Polling Rate	5
Data File Output Directory	C:\
Data File Name Template	Unit%ID_Data.txt
Unit ID	(Unit Serial #)
Filter Order	1
Time Constant	1.00
Language	English
Daylight Savings Time	On
Leap Second Insertion	Disarm
Restart Fault Level	Warning

Chapter 5 - Operating the Cs4000

This section describes the operational procedures for power-on and monitoring, and power-off of the Cs4000.

NOTE

If you encounter problems during any of the following procedures, contact Customer Assistance. See “Appendix B - Customer Assistance” on page 47 for contact information.

Power-On

Except for the application of power, no specific user actions are required to turn on the Symmetricom Cs4000 and obtain the specified output signals. Application of AC or DC power initiates the warm-up and automatic lock acquisition sequence. However, if monitoring and communicating with the unit is necessary, all of the following steps must be performed.

WARNING

For continued protection against risk of fire, ensure that only the specified fuse type and rating are used. Fuse specifications are contained in“Appendix A - Specifications” on page 43 and on the label on the instrument’s rear panel.

1. Connect one end of a NULL Modem RS-232 cable to the serial communications port on your computer and the other end to the connector labeled RS-232 on the Cs4000. (Perform this step only if it is necessary to monitor or communicate with the unit.)

2. Activate power to the Cs4000 by installing the power cord and connecting to the AC mains.

3. Observe that the POWER and ALARM indicators are illuminated.

4. Wait for the unit to stabilize the frequency control loop. This may take up to 30 minutes. When the unit stabilizes, the ALARM indicator turns off and the LOCK indicator illuminates. The ALARM relay is also reset. At this time the outputs are ready for use.

5. Click the Start button, then select Programs, Monitor 2, and the program icon Monitor 2. The Monitor 2 interface appears. Monitor 2 attempts to communicate with the Cs4000 using the default settings (COM 1, 9600 baud, odd parity, 7 data bits, 2 stop bits) or the settings last saved in non-volatile memory. To change the serial port settings, refer to“Configuring the Serial Port” on page 24. The unit is now operational.

Power-Off and Restart

1. De-activate power to the Cs4000 by removing the power cord.

2. To restart the instrument, re-connect the power cord and wait for the LOCK indicator to illuminate.

Chapter 6 - Maintenance & Troubleshooting

This section provides information about preventive maintenance, re-ordering parts, accessories, and re-shipment of the product.

CAUTION

To avoid electrostatic discharge (ESD) damage to components in the Cs4000, observe the appropriate electrostatic discharge (ESD) precautions and procedures.

CAUTION

To avoid damage, under no circumstances should the interior of the Cs4000 unit be allowed to come in contact with water.

CAUTION

To avoid electromagnetic discharge and damage to the circuitry, never attempt to clean the Cs4000 with a vacuum.

NOTE

If you encounter problems during any of the following procedures, contact Customer Assistance. See “Appendix B - Customer Assistance” on page 47 for contact information.

NOTE

Please retain the original packaging of the unit for re-shipping the product as needed. If the original packaging has been discarded, contact the Customer Service department for assistance.

Preventive Maintenance

The Cs4000 unit requires minimum preventive maintenance. Care should be taken to insure the unit is not exposed to hazards such as direct sunlight, open windows, or extreme heat. Should the unit require cleaning, the exterior chassis may be wiped off using a soft cloth dampened with mild soapy water.

Table 6-1 lists suggested preventive maintenance measures to be performed at the user's discretion, as time permits. These procedures are not required to be performed. Do not disassemble components solely for the purpose of inspection. During a component disconnection procedure, such as a cable removal or replacement, inspect components according to the inspection procedures.

Table 6-1. Preventive Maintenance

Item	Inspection	Corrective Action	Interval
Unit Case	Inspect for dirt or foreign material	Clean the exterior of shelf with a soft dry cloth	Periodically
Cables	Inspect for pinched, worn or damaged cable	Replace pinched, worn or damaged cable at the first opportunity	Periodically
Connectors	Inspect for loose or damaged connectors and jacks, bent or missing connector pins	Tighten loose connectors. If damaged, replace the connector and/or cable at the first opportunity	Periodically
Input Power Fuse	Inspect for loose or damaged fuse holder	If loose or damaged contact Symmetricom Service Support	Periodically
Unit Case Screws	Inspect for loose or missing screws or hardware on shelf	If loose, tighten securely, replace missing hardware	Periodically

Troubleshooting

If the alarm activates and the ALARM LED remains lit indicating a failure of the Cs4000, call Symmetricom Customer Service for instructions. lists the two-digit numeric fault codes, a description of each, and any comments associated with the specific code. If any of the following fault codes are observed, refer to the comment

in the Comments column. If unable to resolve the cause of the fault, contact Symmetricom Customer Service for further instructions.

Table 6-2. Fault Messages

Fault Code	Description	Comment
01	Clock Peak to Background	<1320 or >3080 mV
02	Clock Pedestal Symmetry	>50 mV
03	Zeeman Pedestal Symmetry	>160 mV
04	Mass Spectrometer	>5% of nominal (±0.7 V)
05	C-field Current	< 16.0 or >22.0 V
06	Electron Multiplier Supply	< 7.0 or >13 V
07	Signal Quality	
08	VCXO Control Voltage	<10% or >90% (±4000 mV)
09	Case Temperature	>80°C
10	not used	
11	not used	
12	+5 V Supply	<4.75 or >5.25 V
13	+15 V Supply	<13.5 or >16.5 V
14	–15 V Supply	>–13.5 or <–16.5 V
15	not used	
16	Unit Restarted	

Table 6-2. Fault Messages (Cont'd)

Fault Code	Description	Comment
17	Module configuration not set	
18	Digital Gain at lower limit	= 1
80	Software Failure	
81	Event Log Invalid	
F1	Cesium Oven Warm-up	>10.0 V (after warm-up)
F2	OCXO Oven Warm-up	>2.5 V after initial warm-up
F3	Ionizer Filament	>±0.16 V of nominal
F4	Ion Pump current	>175 uA
F5	+24 V Supply	<17 or >24 V

Shipping

To turn off the Symmetricom Cs4000 prior to shipment, remove the power. Remove all external connections and remove the unit from the rack or cabinet. Place the unit in the HAZMAT shipping container.

Hazardous Material (HAZMAT) Shipping Considerations

Symmetricom Cesium standards contain a small amount of Cesium metal. The Cesium isotope used (Cesium 133) is non-radioactive. However, because of its reactive chemical properties, Cesium is classified as a hazardous material by the U.S. Department of Transportation (USDOT) and the International Air Transport Association (IATA). During normal handling the Symmetricom Cs4000 presents no danger since the Cesium is encased within a vacuum-sealed metal enclosure. Hazardous materials, depending upon their specific nature, are subject to certain shipping regulations of the USDOT and the IATA. These regulations govern the shipping case as well as its labeling.

The initial shipment of every Symmetricom Cesium standard complies with HAZMAT regulations by using a shipping case which has been tested and certified. This case has been designed to prevent damage to the unit during shipment and to meet current hazardous-material shipping regulations. The case can be used repeatedly and should be retained for any future shipping requirements of the instrument. In addition, the following required labels have been placed on the case:

- FRAGILE
- DANGEROUS WHEN WET
- DANGER – NO PASSENGER AIRCRAFT
- CESIUM UN 1407

Shipping Products Back to the Factory

Return all units in the original packaging. After the standard packing procedure to protect the equipment, Cesium products being returned for repair require special preparation for shipment as described in“Shipping Carriers” on page 40. Connectors should be protected with connector covers or the equipment should be wrapped in plastic before packaging. Take special care to protect the front and rear panels.

To return equipment to the factory or local representative for repair:

1. Call Customer Service at 1-512-721-4000 to obtain a return material authorization (RMA) number before returning the product for service.
2. Provide a description of the problem, product item number, serial number, and warranty expiration date.
3. Provide the return shipping information (customer field contact, address, telephone number, and so forth).
4. Pack all items into the original shipping container.
5. Ensure the container is properly marked as described in“Shipping Carriers” on page 40.
6. Ship the product to Symmetricom, transportation prepaid and insured, with the RMA number and serial numbers clearly marked on the outside of the container to:

   Symmetricom, Inc.
   Attn: Service Dept.
   34 Tozer Road
   Beverly, Massachusetts 01915
   USA

   Tel: +1 978 927 8220
   Fax: +1 978 927 4099

Shipping Carriers

The shipper is responsible for the overall condition of the Hazardous Material shipping case; such as latches locked (if applicable), no visible damage to case and the proper placement of all labels on the case. “Typical Label Placement” on page 40 illustrates the proper placement of labels. Make sure an address label, proper HAZMAT labels, and packing slip (if necessary) are affixed to the shipping case and are clearly visible.

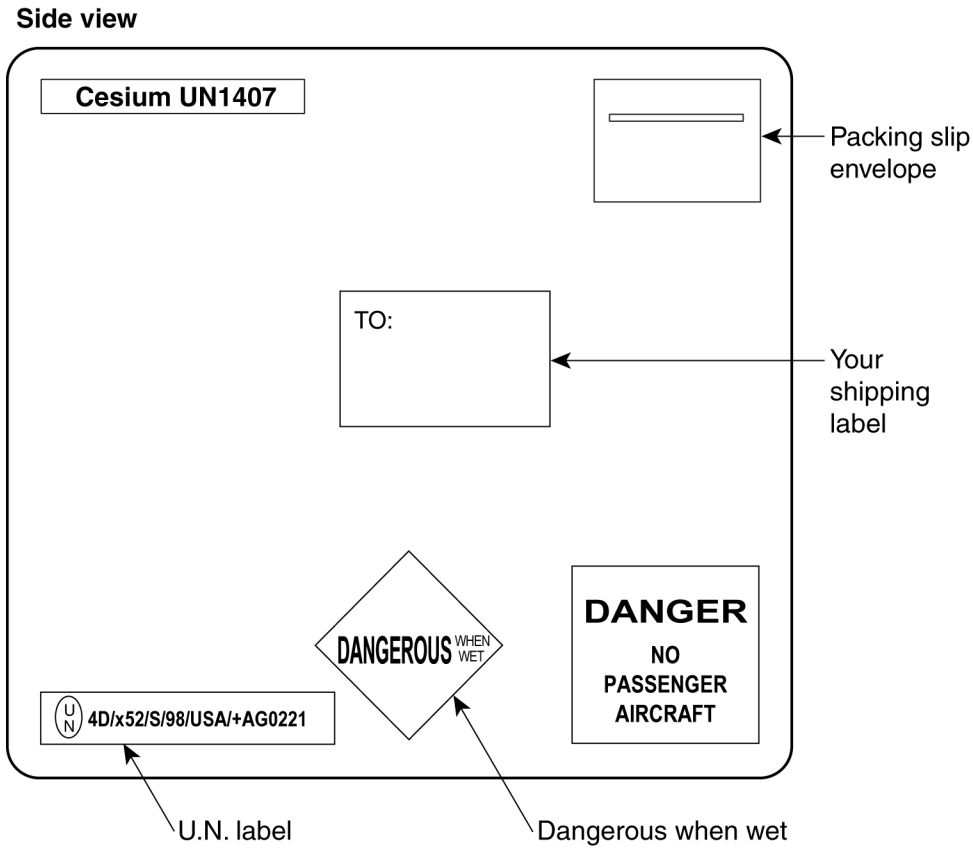

Figure 6-1. Typical Label Placement

Several United States and international shipping companies can accommodate properly packaged hazardous materials. United Parcel Service and Federal Express are examples for the United States. Intercontinental (617-569-4400) provides international shipping services. Contact one of these shipping companies for assistance. If you need additional help, call Symmetricom Technical Service at 512-721-4000.

The following information is typically requested by the carrier:

Table 6-3. Shipping information for carriers

Proper Shipping Name:	Caesium (Cesium) Dangerous When Wet
Class Or Division:	4.3
UN or ID No.:	UN1407
Type Of Packing:	One Fibre board Box x5 Grams
Packing Instructions:	412

Re-Ordering Information

Contact the sales office to re-order any subassembly or accessory or to obtain a current list of subassemblies, accessories, and part numbers (see). When you know what items you are ordering, supply the subassembly or accessory name and its part number along with the purchase order number to our sales office.

Storage

During storage of the Cs4000, there are two factors to consider: Cesium beam tube vacuum and shelf life.

Cesium Beam Tube Vacuum

If the Cs4000 is stored for extended periods of time (>6 months), periodic storage-mode operation cycles of 30 minutes should be performed in order to maintain the tube vacuum. The Cs4000 must be turned-on and operated for a minimum of 30 minutes on or before the six month storage interval.

Cesium Beam Tube Shelf Life

Extended high temperature storage (>50C) reduces the expected operating life of the Cesium beam tube. The reduction in tube life expectancy for each year at 70C is approximately 4 months.

Appendix A - Specifications

Electrical Specifications

Frequency outputs

1 ea 100kHz &1MHz Sine

Amplitude:	1Vrms
Harmonic:	<–40dBc
Non harmonic:	<–80dBc
Connector:	BNC
Load impedance:	50 Ohms
Location:	rear panel

2 ea 5 &10 MHz Sine

Amplitude:	1Vrms
Harmonic:	<–40dBc
Non harmonic:	<–80dBc
Connector:	Type N
Load impedance:	50 Ohms
Location:	rear panel

Timing outputs

Format:	Three 1 PPS
Amplitude:	>3.0V into 50 Ohms
Pulse width:	20µs positive pulse
Rise time:	<5ns
Jitter:	<1ns rms
Connector:	BNC
Load impedance:	50 Ohms
Location:	rear panel (2), front panel (1)

Timing inputs

Sync input:	Two 1PPS
Connector:	BNC
Load impedance:	50 Ohms
Location:	rear panel (1), front panel (1)

Remote system interface and control

RS-232-C (DTE Configuration) Complete remote control and interrogation of all instrument functions and parameters. Two 9-pin male rectangular D subminiature type (1 on rear panel and 1 on front panel)

Alarm (TTL): BNC (rear panel)

Output TTL:

High, normal

TTL low, fault

Circuit is TTL open collector with internal pull-up resistor.

Circuit can sync up to 10mA

Performance Specifications

Performance

	Standard Perf.	**High Perf.**
Accuracy:	+/-1.0E-12	+/-5.0E-13
Warm-up time: (typical)	30 Min.	30 Min.
Reproducibility:	+/-2.0E-13	+/-2.0E-13
Settability Range:	+/-1E-9	+/-1E-9
Settability Resolution:	1E-15	1E-15

Stability

	Standard Perf.	**High Perf.**
AvgTime (s)	Allan Deviation	Allan Deviation
1	≤1.2E-11	≤5.0E-12
10	≤8.5E-12	≤2.7E-12
100	≤2.7E-12	≤8.5E-13
1,000	≤8.5E-13	≤2.7E-13
10,000	≤2.7E-13	≤8.5E-14
100,000	≤8.5E-14	≤2.7E-14
Floor	≤5.0E-14	≤1.0E-14

SSB Phase noise

Offset (Hz)	5MHz Output	5MHz Output
1	≤-95dBc	≤-102dBc
10	≤-130dBc	≤-130dBc
100	≤-145dBc	≤-145dBc
1,000	≤-155dBc	≤-155dBc
10,000	≤-155dBc	≤-155dBc
100,000	≤-160dBc	≤-160dBc

Environmental & Physical Specifications

General environment

Operating

Temperature:	0° C to 50° C
Humidity:	95% up to 50° C

Non-operating (transport)

Temperature (storage):	-30° C to 70° C
Temperature (short term):	-40° C to 75° C
Magnetic field:	0 to 2 gauss
Shock:	0g/11ms, 3 axis
Vibration:	MIL-T-28800E, Type III, Class 5
Altitude (operating):	0 to 50,000 feet

AC Power requirements

85 to 264 VAC
47 to 63 Hz
70VA, 64W (Operating)
90VA, 80W (Warm Up)

DC Power requirements

36 - 75VDC*
60W (Operating)
70W (Warm Up)
* 24VDC (18 - 36VDC) Power supply option available

Dimensions

17.22"W x 5.22"H x 20.63"D

Internal standby battery

Capacity:	1 hour @ 25° C from full charge
Charge time:	16 hours maximum (fully discharged)
Charge source:	AC or DC

Weight

45lbs (20.4Kg)

Options

DescriptionPart No.

Internal batteries	BAT
High performance tube	EP
Rack slides	6013
18 - 36VDC input	24DC

Appendix B - Customer Assistance

Symmetricom's Customer Assistance Centers are a centralized resource to handle all your customer needs. Our Centers are staffed with logistics personnel to handle product quotes, order status and scheduling as well as technical personnel for technical support, installations or service quotes.

Technical support is operated as a fee-based service, either under contract or on an hourly basis. Visa, Mastercard are accepted as well as Purchase Orders from established customers.

US Assistance Center

For the United States, Canada, Latin America, Caribbean, and the Pacific Rim (including Asia, Australia and New Zealand) call:

Tel +1 888 367 7966 (+1 888 FOR SYMM) or +1 408 428 7907 (Worldwide)

Customer Service

For product quotes, service quotes, installations, order status and scheduling
7:00 am to 5:00 pm Pacific Time, Monday through Friday, excluding U.S. Holidays.

Technical Support

For technical support 24 hours a day, 7 days a week, every day of the year contact us at:

support@symmetricom.com

EMEA Assistance Center

For Europe, Middle East, and Africa, call:

Tel +44 (0) 1189 699 799 or +1 408 428 7907 (Worldwide)

Customer Service

For product quotes, service quotes, installations, order status and scheduling
8:00 am to 5:00 pm UTC, Monday through Friday, excluding UK Holidays.

Technical Support

For technical support 24 hours a day, 7 days a week, every day of the year, contact us at:

emea_support@symmetricom.com

Comments, complaints and suggestions are always gladly accepted.

customer_relations@symmetricom.com

Appendix C - RS-232 Interface

Introduction

This section describes the protocol for the RS-232 Interface and includes general communication parameters as well as the command list.

General Parameters

The default for the RS-232 interface parameters are 9600 baud, 7 bits, odd parity, 2 stop bits.

Operating Notes

Only two operating functions require the use of the RS-232 interface: W22—*Arm 1 PPS Sync Circuit* and A18--*Set Restart Fault Level*. The other commands are for performance monitoring, diagnostic and factory use.

Command Reference

Commands are sent to the system via RS-232. The Cesium III command set is backwards compatible with the 5045A/4201A command set. Several new commands support the new capabilities of the Cesium III system.

General format: **<STX><Function Code>_<IDENT>_<DATA><ETX>**

All entries in the data field are left justified, and the remainder (if any) of the Data field must be filled in, to round it up to 9 characters in length

Table C-1. Command Format

Element	Description
STX	002
STX	002
_	Space character
[<DATA>]	Data: this string is of variable length
<IDENT>	5 character unit identification number - * Note 1
<Function Code>	Function code, see table
ETX	003

Table C-2. Command List - Standard Functions

Command	Description	Data Field
Standard functions		
W00	Reset alarms	No data required
W01	Set frequency offset (permanent, value is saved in NVRAM and restored on power up). The offset is in parts e-15	Sign plus 6 digits
W02	Unused	
W03	Time updating (advance or retard 10 MHz phase by n nanosecond)	Sign plus 4 digits
W04	Reset time updating (halts a time updating operation.	No data required
W05	**Reserved for Factory Use**	
W06	**Reserved for Factory Use**	
W07	Unused	
W08	**Reserved for Factory Use**	
W09	not used	
W10	**Reserved for Factory Use**	
W11	Set frequency offset (not saved in NVRAM). The offset is in parts e-15	Sign plus 6 digits
W12	**Reserved for Factory Use**	
W13	**Reserved for Factory Use**	
W14	**Reserved for Factory Use**	
W17	Alarm relay cut off	No data required
W18	Clear event log	No data required
W22	Arm 1pps sync circuit. Issue this command after connecting a 1pps source to the Cesium III. The sync will remain armed for 3 seconds.	No data required

Table C-3. Command List - Special Functions

Special functions		
T*1	Obsolete (Remote control off)	No data required
T*2	Obsolete (Remote control on)	No data required
D*1	Return Variables (250 characters)	No data required
D*2	Return Constants (129 characters)	No data required
D*3	Retrieve Event Log	No data required
D*4	**Reserved for Factory Use**	
D*5	**Reserved for Factory Use**	
S01	**Reserved for Factory Use**	
S02	**Reserved for Factory Use**	
S03	**Reserved for Factory Use**	
S04	**Reserved for Factory Use**	
S05	**Reserved for Factory Use**	
S06	**Reserved for Factory Use**	
S07	**Reserved for Factory Use**	
S08	**Reserved for Factory Use**	
S09	**Reserved for Factory Use**	

Table C-4. Command List - Console Functions & New Functions

Console functions		
C01	**Reserved for Factory Use**	
C02	**Reserved for Factory Use**	
C03	Return software version	No data required
C04	**Reserved for Factory Use**	
C05	Set serial port parameters	Baud, data, parity, stop bits
C06	Set Eudics Message	9 characters
New functions		
A01	**Reserved for Factory Use**	
A02	**Reserved for Factory Use**	
A03	**Reserved for Factory Use**	
A04	**Reserved for Factory Use**	
A05	**Reserved for Factory Use**	
A06	Set Date (year, month, day)	mm/dd/yy
A07	Set Time (hour, minute, second)	hh:mm:ss
A08	Return Date and Time	
A09	**Reserved for Factory Use**	
A10	**Reserved for Factory Use**	
A11	**Reserved for Factory Use**	
A12	**Reserved for Factory Use**	
A13	**Reserved for Factory Use**	
A14	Return power on hours	No data required
A15	**Reserved for Factory Use**	
A16	**Reserved for Factory Use**	
A17	**Reserved for Factory Use**	
A18	Set Restart Fault Level	1 = restart is critical fault 0 = restart is not a critical fault

Table C-5. Data returned by the "Return Variables" command

Variable	Field	Example
STX CR LF	1-3	
Unit serial number	4-10	ID00025
Day Meter	12-14	537
Time (hour minute second)	16-25	16h13mn22s
First or second order servo loop	27	2
Operating mode	29-31	R+Z
Alarms state * Note 2	33-54	ALM:00(00,00,00,00,00)
C-Field adjustment	55-59	C +015
Frequency fine tuning	61-68	F –006
24v power supply	70-76	+24.8V
Filtering time constant (seconds)	78-83	Ct05.0
CR LF	84-85	
Clock servo voltage difference	86-90	R–019
Clock pedestal servo voltage difference	91-98	RR +0045
Zeeman servo voltage difference	99-103	Z* + 0008
Zeeman pedestal servo voltage difference	104-111	RZ–0004
Oscillator servo output voltage	112-118	AR–0029
Clock peak to background level difference	119-124	PR2506
Zeeman servo output voltage	125-131	AZ+0007
Zeeman peak to background level difference	132-137	PZ1765
Preamplifier DC level servo output voltage	138-144	AO + 0690
Numerical gain	145-151	GN*1.53
Clock (ramsey) peak symmetry check	152-158	LA–0005
Microwave power servo control voltage	159-165	Pu–2875
CR LF	166-167	
+5V power supply	168-173	+5.08V
Internal case temperature	175-180	T+27.7
+15.5V power supply	182-187	+15.1V
–15.5v power supply	189-194	–16.2V
Quartz oscillator cold/warm	196-198	Olc
Cesium oven supply voltage	200-205	F0008.0
Mass spectrometer voltage	207-212	VS18.9
Cesium beam tube Ionizer voltage	214-219	VF1.5
C-Field coil current	221-226	IC14
HTEM control voltage	228-233	HT10.6
Ion Pump current	235-239	IP025
Allan deviation of clock servo voltage over 30 seconds	241-247	+137 mV
CR LF ETX	248-250	

Table C-6. Data returned by the “Return Constants” command

Variable	Field	Example
STX CR LF	1–3	
Unit serial number	4–10	ID00025
Day Meter	12–14	006
Time (hour minute second)	16–24	04h54mn32s
Spectrometer voltage nominal	26–33	Vs 14.0V
Tube ionizer voltage nominal	35–44	Vf 1.07V
Gain DAC	44–51	GDAC 008
F(t°) correction model at –15°C	48–54	–15:+10
F(t°) correction model at +15°C	54–59	+15:+00
F(t°) correction model at +45°C	61–67	+45:–03
F(t°) correction model at +75°C	69–75	+75:+04
CR LF	84–85	
12.6MHz level nominal (J1 max)	86–92	Pi+0345
Zeeman offset (Asymmetry compensation)	94–100	Oz–0045
Auxiliary output signal frequency	102–112	Fo:05.0MHz
Console mode language	114–119	CDU: GB
Comments	121–134	TXT(1234567890)
Eudics program version	136–138	370
Eudics program revision	140–142	1.8
CR LF ETX	143–145	

Index

Numerics

A

C

D

E

F

G

H

I

L

M

N

O

P

Q

R

S

T

U

W