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SCSI BUS ANALYZER

Model # U l t r a - 2 1 6 0 / L I T E

USER-S MANUAL

Revision 1.0

September 1999

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COMPANY PROFILE

Ancot Corporation designs and manufactures SCSI and Fibre Channel testing equipment and other computer products based on the SCSI, Fibre Channel, and Gigabit Ethernet protocols for OEM markets. Ancot=s instruments are used worldwide by leading computer companies. Applications include development, manufacturing and repair. Ancot=s policy is to provide quality products and to support its customers with qualified engineering support to maximize the return on their investment.

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SECTION 1

DESCRIPTION OF EQUIPMENT

1.1 INTRODUCTION

The Ultra-2160Lite is a portable, advanced, versatile, user-configurable SCSI Bus Analyzer. This instrument was designed for the following applications:

- development work in the laboratory
- production test
- field service applications

The Ultra-2160Lite Tracer/Analyzer provides a comprehensive SCSI event tracer,a debugger with powerful triggering capability, and an optional SCSI initiator emulator (not available yet). It provides displays of SCSI bus activity in a variety of formats for easy interpretation.

The Ultra-2160 Lite Analyzer comes in the following configurations:
The /LQ model has circular trace buffer holding up to 16M events. The /LJ model has 8M events buffer, the /LC model has 4M events buffer, and the /LV model has 2M events buffer..

1.2 GENERAL DESCRIPTION

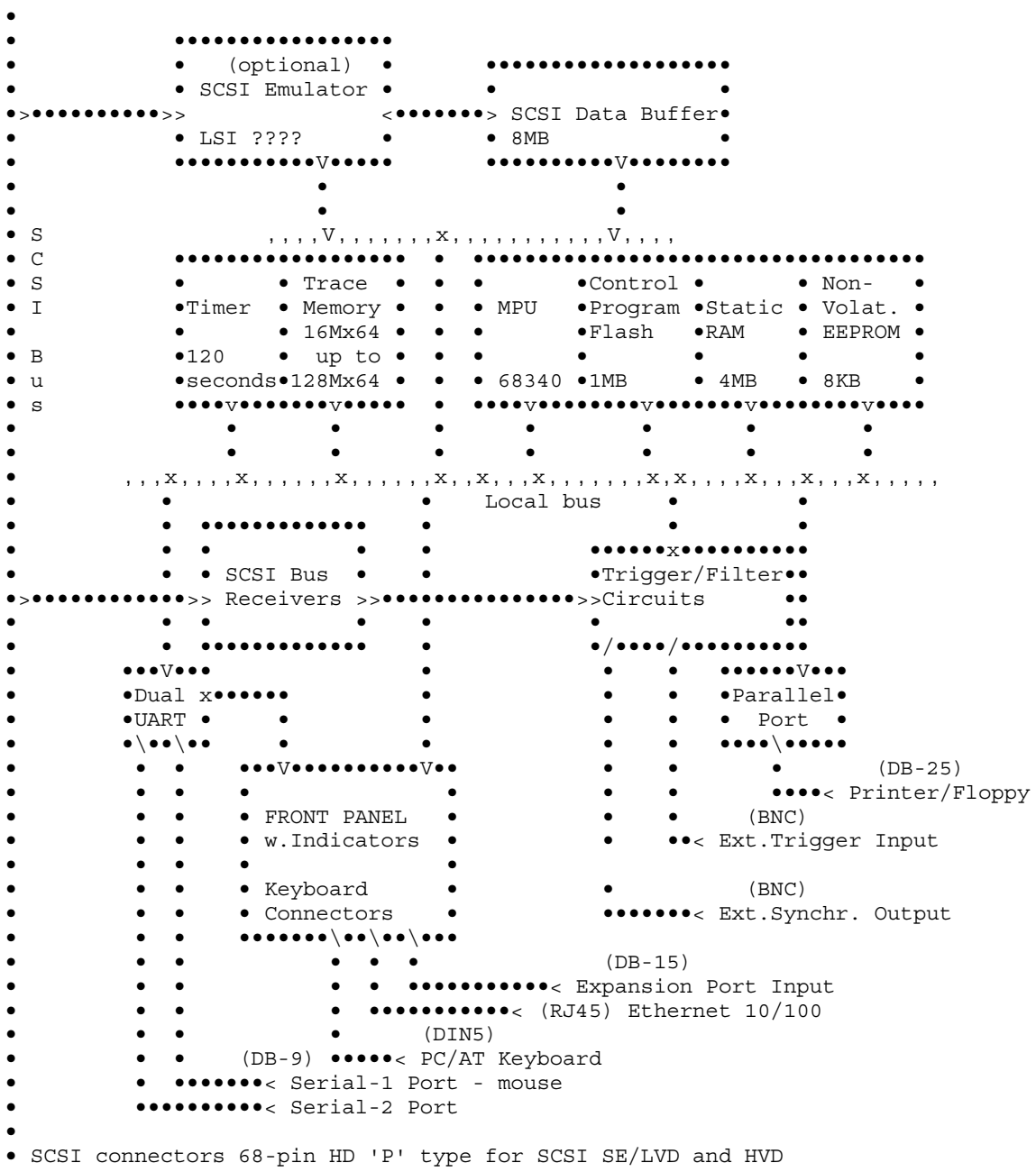
The SCSI Bus Analyzer is used for recording activity on the SCSI Bus to which it is non-intrusively connected. Its circular buffer can hold up to 16M events (standard for the Ultra-2160 Lite/LQ). The recording method is event-driven; only valid data or transitions on certain SCSI signals are recorded. At the time of recording, each event is time-stamped. The recording can later be played back in several forms: it can be displayed on the screen of the external host computer, It can be viewed with a web brouser. Recorded data can be sent to a printer to provide a hard copy, up-loaded to a host computer, or saved on a disk to build a data base for post processing.

The display of recorded SCSI bus activity can be in two basic forms: a "binary" format similar to a time-domain form of logic analyzers, or a "structured" format which is an interpreted "SCSI-English" form, easily understandable. Other, more specialized display formats are also available. For more detail, see the Section 3.

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1.3 SYSTEM OVERVIEW

A simplified block diagram of the Ultra2160 SCSI Bus Analyzer is shown below:



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The system carries out several major functions:

The Tracer/Analyzer unit is connected to the SCSI bus by its line receivers. Note that the tracer is a non-intrusive device, which merely senses activity on the SCSI Bus through isolating receivers. The load on the tested SCSI bus is less than 25 pF.

From line receivers, the signals are directed to separate circuits: to trace memory, to the trigger/filter circuitry, and to the front panel to be displayed using LED indicators. All parts of the Ultra-2160 Lite are internally controlled by the local MPU (Motorola's MC68340). The control program for the MPU is saved in EPROM with 64KB capacity, and flash memory with 1MB capacity.

Communication with the operator is by an external PC or VT-100 type monitor.

Non-volatile EEPROM memory provides for storage of setup parameters, and user option settings.

1.4 TIMING CONDITIONS IN RECORDING

Recording in the Trace Memory is event-driven. This means that only transitions on the SCSI bus are recorded. A valid change (event) is determined by the recording mode, and is defined as follows:

- a positive or negative transition on the BUSY, SEL, ATN, and RST lines,

- during Information Transfer Phases, a SCSI event can be

a) qualified by valid edge of REQ or ACK signals:
During READ operations (Data from Target to Initiator), the status of SCSI bus signals is recorded in Trace Memory following the leading edge of REQ signal. During WRITE operations (Data from Initiator to Target), status of SCSI bus signals is recorded following the leading edge of ACK signal.

b) recorded during any transition of the REQ or ACK signals, i.e., following all 4 edges of REQ and ACK.

c) During the data phases, if the Ultra3 Double-clocking (DT) mode is invoked, the status of SCSI bus signals is recorded following the leading and trailing edges of the REQ signal for Data-In (READ operations), or following the leading and trailing edges of the ACK signal for the Data-Out (WRITE operation).

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d) Recording of data during a data-in or data-out phase can be skipped (after the leading 1 through 255 bytes). Note that all bytes transferred are counted, and the total count will appear in the trace if the command completes successfully.

e) any transition on the MSG, C/D, or I/O SCSI Control lines can be recorded.

- status of the SCSI bus and 3 external signals can be recorded on every negative transition of the bit-0 of the expansion port.
- certain changes on data lines when tracing the SCAM protocol and during Arbitration phase.

For more on recording modes read Section 2.2.5.

1.5 FRONT PANEL OF THE Ultra-2160 LITE/LX

The front panel of the Ultra-2160 Lite contains one push-button switch, and 30 LED indicator lights. The **SCSI RESET** switch is used for generation of the RESET condition on the SCSI bus.

The **LED INDICATORS** are:

POWER
TRACING
DISK ACTIVE
SCSI Control Signals: BUSY, SEL, C/D, I/O, MSG, REQ, ACK, RST and ATN
SCSI Data Signals: D0 - D15, and Data-Parity (2)

1.6 BACK PANEL OF THE ULTRA-2160/LX

The back panel contains seven connectors (including the main power connector), **SYSTEM RESET** switch, and four LEDs.

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CONNECTORS on the back panel are:

- Floppy disk drive or Parallel Printer (DB-25 female)
- Expansion 3-bit port Input (DB-15, female)
- One Serial I/O port (DB-9 female)
- External Trigger Input (BNC connector)
- External Synch Output (BNC connector)
- 10/100 Ethernet (RJ45)

LEDs on the back panel: S-E, LVD, (HVD) DIFF, and Term Power
The **SYSTEM RESET** switch is used for restarting the system.

The seven **CONNECTORS** are:

FLOPPY/PARALLEL PRINTER - This 25-pin connector (DB-25) serves for connecting either the external floppy disk drive for offloading or downloading traces of loading new firmware revisions to the internal flash memory.

EXPANSION 3-BIT PORT INPUT - There is often a need to compare the relationship of external signals with the SCSI bus signals. For this purpose, the "Expansion" connector is available. This input port can receive up to 3 signals to be recorded together with the SCSI trace. This additional data, after being recorded, will be displayed as three "0" or "1" digits, in the binary display mode. Pin-1 can be used as a clocking signal if "external clock" is enabled from the recording mode menu.

See Appendix A for the Expansion connector pinout. Note that on this connector there are two pins that carry Vcc (+5V, available up to 100mA), and two pins for GND. The Vcc and GND may be used to power external devices, such as AD converters, or other adapters. An external AC power supply with 5V output is also supplied.

EXTERNAL TRIGGER INPUT - The connector (coaxial BNC type), on the right side of the front panel of the Ultra-2160 Lite, serves for input of an external trigger signal. The Ultra-2160 Lite will trigger on negative transition if enabled from the trigger menu.

The basic trigger functions, which most users would need, have been implemented in the system. Additional unique trigger functions may be added by using this external trigger.

EXTERNAL SYNCH OUTPUT - The J8 connector (coaxial BNC type), on the right side of the front panel of the Ultra-2160 Lite, serves for providing a trigger signal, which may be used for triggering external instruments like oscilloscopes, logic analyzers, etc. See Section 5 for more details.

SERIAL I/O PORT - is for connecting to the host if serial (RS-232) interface is used.

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10/100 ETHERNET PORT - This is a standard Ethernet port using a RJ-45 connector. The hardware automatically detects the proper speed when an Ethernet cable is connected. If you use 100Mbit, make sure that the cable is rated for 100 Mbit operation.

DC POWER CONNECTOR - the DIN-5 (5-pin) connector is for bringing in external +5V DC power.

1.7 SIDE PANEL OF THE ULTRA-2160/LX

The side panel contains the SCSI connectors.

- J1,J2 - SCSI connectors (68-pin, female) for S/E interface
- J3,J4 - SCSI connectors (68-pin, female) for Diff HVD or LVD interface

1.8 NOTATIONAL CONVENTIONS

The primary operator interface with the Ultra-2160 Lite is through the PC/AT keyboard. In this manual the following notation is used when referring to keys and key sequences:

Keys are referred to by their legend, enclosed in angle brackets "<" and ">". Examples: **< Esc >**, **< Enter >**, **< Run >**, **< R >**, **< SP >** (for space key) etc.

Keys that are to be depressed together (the "control combinations") are shown with a "^" (Up-Arrow) preceding the other character. For example **<^C>** or **<Ctrl-C>** means that you type the "C" key while the Ctrl key is depressed. Other combinations may also appear, as e.g., **<Alt-C>**, which means that you type the "C" key while the **<Alt>** key is being depressed.

In menus or in various prompts, the optional suggested selections are displayed in parentheses. Current selections or defaults are displayed in brackets "[", and "]".

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1.9 USER INTERFACES

1.9.1 Configuring For The First Time

When starting your unit for the first time, you must use the serial interface. This is configured at the factory for 9600 Baud, No parity, 8 data bits, and 1 stop bit (9600, N, 8, 1). You can also force these settings by pressing the SCSI reset button and keeping it pressed while the system is performing a system reset (about 10 seconds). Use a straight through cable to connect the Ultra2160 to a computer or terminal. Your terminal emulation program should be set to emulate a VT100 terminal and to use software flow control (XON/XOFF).

Once communication is established, you may change the baud rate for the serial port. You may set up the Ethernet port IP address and server options by using the Utilities menu (see section 7.3.1) if you prefer the Ethernet interface.

1.9.2 Control Over the Ethernet Port using a Browser

After you have configured the Ethernet port (from the serial port) as described in Section 7.3.1, by assigning an IP address to the Ultra2160 and starting the web server, you may control the Ultra2160 by using a web browser such as Netscape or Internet Explorer.
In Netscape=s ALocation:@ field or Internet Explorer=s AAddress:@ field, type Ahttp://@ followed by the IP address which you have assigned to the Ultra2160. For instance if you assigned the IP address 192.168.1.1 to the Ultra2160, type Ahttp://192.168.1.1" in the location or address field and your browser will access the main page of the Ultra2160.

If you need to access files on the Ultra2160, start the FTP server and use and FTP client on your computer (such as WS_FTP from Ipswitch). Choose the AC@ drive and a file/directory tree should be displayed by your FTP program.

Do not delete any files in the Ahttp@ directory. These files are the web pages for the Ultra2160. You may have to replace these from time to time as new pages become available from Ancot=s web site. Do not delete the file Aancot.hlp@. This is the main helpfile for the briefcase version.

1.9.3 Control Over the Serial Port

Once a serial connection has been established, you are able to control the Ultra2160 through your remote terminal=s keyboard. Menu items may be selected by using the highlighted letter or number or by using the arrow keys. Other sections in this manual describe how to control tracing and display a trace.

1.9.4 Indicators, Connectors, & Switches

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The **SYSTEM RESET** switch, on the back panel of the Ultra-2160 Lite, if pressed, will reset the system to its initial Power-On state. Remember that selected setup values, stored in EEPROM non-volatile memory, do not change after reset, or if the system is powered OFF. The SYSTEM RESET switch does NOT generate Reset on the SCSI bus.

The **SCSI RESET** switch on the front panel, if pressed, will generate Reset condition (continuous level) on the SCSI bus; however, it will not affect operation of the Ultra-2160 Lite.

LED indicators on the front panel display instantaneous status of the SCSI data lines and SCSI control lines. These indicators will typically be useful during a major malfunction, when the object system stalls. In these situations the LEDs will help to determine which SCSI bus phase the system is stopped in, and what condition the active SCSI device is waiting for. For example, an Initiator may be trying to select a non-existing Target device and is not receiving a BUSY signal, or Target may be asserting REQ signal for a data transfer, and is waiting for ACK from the Initiator.

The **TERMPWR** LED on the back panel indicates whether TERMINATOR POWER is being supplied on the SCSI bus, and whether it is 4.0V or higher. It is the responsibility of the system integrator to decide which device will supply the TERMPWR. This TERMPWR LED may be an important indicator, because without the TERMINATING POWER applied, the SCSI bus may still work, but its reliability may be affected. Also remember, that some SCSI bus configurations drive their terminators internally and do not need to drive the TERMPWR line on the SCSI bus.

The **TRACING** LED indicator lights up when the Ultra-2160 Lite is in the tracing mode following **<R>** (RUN). It will stay ON until the tracing is stopped either by the **<S>** (Stop) key, the **<P>** (Pause) key, or as a result of a trigger condition.

The **POWER** LED indicates when the power to the Ultra-2160 Lite is ON.

The operator interface from the external PC/AT keyboard is completely menu-driven. The main menu at the root of the Ultra-2160 Lite firmware system serves for selection of functions related to tracing, trigger selection, and display of recorded data.

Most of the functions are actuated by a single key stroke; selection is recognized by the system, and the rest of the word is filled in automatically. If the function doesn't execute, more input is needed, and a menu or prompt will appear on the screen. If a wrong key is pressed, the system will either beep, and give the operator a second chance, or in some situations will abort and exit that function. The type of each individual operation will determine which of the two actions will be taken.

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Several keys have characteristic functions:

Pressing **<Enter>, <Space>**, or **<Yes>** while at the root level, will re-display the main menu.

<Q> or **<q>** keys will cause exit from a current function, or exit the current menu, and stepping one level back. By repeating the **<Q>** or **<q>**, eventually you will return to the main menu at the root.

<Ctrl-C> There may be several prompts to be answered before a selected function is started. If you change your mind in the middle of this selection process, then by pressing the **<Ctrl-C>** key you can quit that selection sequence and exit immediately to the root. You can also use the **<Ctrl-C>** to exit any selection and return directly to the root menu level.

<Pause> or **<Ctrl-S>** causes the system to pause. Press **<Ctrl-Q>** to continue.

<Ctrl-P> is a toggle switch that will turn "parallel printing" ON or OFF. The printing mode is indicated by a message at the bottom of the main menu. "Parallel printing" means sending all data displayed on the screen also to the printer port. Note that only the trace data will be printed, not the menus, etc.

Note that the keys **<Ctrl-C>, <Ctrl-S>**, and **<Ctrl-P>** work the same as on any PC system.

1.10 OTHER GENERAL RULES

If a question is asked in a selection dialog expecting a "Y/N" answer, "Y" is interpreted as YES, and anything else is interpreted as NO. In some cases AN@ is interpreted as NO, and all other responses are rejected.

In edit sessions typically the current selection is displayed. If a different value is required, the operator should type it in. If only **<Enter>** is typed, the current value will stay unchanged. Typing "." (period), **<Esc>**, or **<Q>** terminates the edit session.

Numeric values, except the timing information (e.g., Time-Stamp), or unless marked, are displayed in Hex format. Similarly, all numeric answers are expected to be in Hex unless marked otherwise.

Currently selected values are displayed in "[ ]" brackets. If such a value appears at the cursor for input, typing **<Enter>** selects that value.

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From menus displaying a highlighted entry, the arrow keys move the highlight from one entry to the next. Most menu selections also have a "selector" key, which will move the highlight directly to that entry.

1.11 TIMER AND TIME-STAMPING OF RECORDED SCSI EVENTS

There is a 6-byte, 50 MHZ counter in the Ultra-2160 Lite Analyzer, used for marking each recorded event in trace memory with a time stamp. The resolution is 20 nanoseconds. The timer will wrap around after 200 days. The REQ/ACK signals are sampled each 1/5 cycle (4 ns) to give finer granularity resolution.

The time stamp is displayed together with the recorded data in the BINARY display format. It can be selected to show as time differential (time increment from the previous event), or as time elapsed from the beginning of the tracing. Timing information is also available in the STRUCTURED display. When enabled, the duration of each phase will be displayed on the last line of that phase, if space permits.

1.12 ELECTRICAL CONNECTION ON THE SCSI BUS

There are three alternatives for connecting the SCSI bus: the SINGLE-ENDED LVD (Low Voltage Differential), DIFFERENTIAL HVD (High Voltage Differential), and LVD (Low Voltage Differential) connectors. Pinouts of all connectors used are listed in Appendix A.

1.13 SCSI Bus TERMINATION AND TERMINATION POWER

There is no internal termination provided. Use external SCSI DIFFERENTIAL HVD or LVD Terminator. Power (TERMPWR) for this Terminator is supplied in all SCSI connectors, the J1 through J4.

The TERMPWR is protected by a serial (Schottky) diode for protection against back flow, and by a 1A fuse for protection against electrical short. The fuse acts as a circuit breaker with automatic reset. In case of a short on TERMPWR, the breaker disconnects the circuit; when the short is removed, the breaker restores TERMPWR within 20 seconds.

!!! WARNING !!!

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IF TERMPWR IS SUPPLIED BY MULTIPLE SOURCES TO THE SCSI BUS, AND IF THE 'TERMPWR' PIN OF THE SCSI BUS CABLE ACCIDENTALLY GETS GROUNDED, THEN THE 'TERMPWR' LEAD OF THE SCSI BUS CABLE WILL HAVE TO WITHSTAND THE SUM OF THE CURRENTS FROM ALL THE SOURCES, 1A EACH (EACH FUSED AT 1A) BEFORE THE FUSES BEGIN TO FAIL !

As a rule, there should be exactly two terminators on a SCSI bus, one on each physical end. Therefore, before connecting the analyzer to a system to be tested, see whether you should add the terminator. This depends on where you are connecting the analyzerCin the middle or at the physical end of the SCSI cable.

1.14 TECHNICAL SPECIFICATIONS

- Compatible with SCSI specifications as defined by the ANSI X3T9.2 committee for SCSI-1 and SCSI-2, and the current NCITS T10 Comittee draft SCSI-3 SPI/SIP, including Fast/80 and Fast/160

- Asynchronous data transfer rates to over 6 MBps
- Synchronous data transfer rates to over 80M transfers per sec (160 Mbytes)
- Three interfaces are standard: Single-ended (S-E), differential HVD (High Voltage Differential), and LVD (Low Voltage Differential). All SCSI connectors are the 68-pin female type for wide interface. Use a 68-to-50 pin adapter for the narrow interface.
- Non-intrusive tracer. Only signal changes are stored, therefore recording time is not limited.
- Trace memory is up to 16M events deep and 64 bits wide.
- Up to three external signals can be recorded together with SCSI in trace memory to allow tracing in the tested device. External port pin 1 can be used as "clocking" (both edges are used).
- Recording modes: record all; skip data; record one, or all four edges of REQ and ACK (for Double Transition (DT) Data Phases, Data is latched on both edges of REQ or ACK); phase changes; capture expansion port changes; filtering by SCSI ID; recording selections only; and recording SCSI-3 SCAM protocol
- Display of recorded trace data in several formats: in structured (Pascal-like) expanded or compact form, binary, hexadecimal, or Command Profile format.
- Hard copy of all displays printed via parallel I/O port on an optional printer
- Event time-stamping function for more than 200 days before timer counter wrap around, with 4 ns resolution for REQ, ACK, and Data, and 20ns for all other signals.
- Non-volatile EEPROM memory for storage of current setup and mode parameters
- 4 Mbyte system or program memory, and 8MByte data read/write SCSI buffer

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- Motorola 68340 local MPU with resident firmware in 64K byte EPROM and 1MB of flash memory.
- Configuration selectable through menu driven software, stored in non-volatile EEPROM memory
- One 10/100 Mbit Ethernet port
- One serial RS-232 I/O port with a selectable baud rate up to 115K with data format and parity options
- One serial I/O port for a PC compatible serial mouse
- Powerful triggering capability, menu selectable: delayed-trigger (trigger position in trace) Internal triggering by: selected command, status or message pattern/code combination of command and status and ID, or message and ID
  (re)select, (re)select timeout data parity error Trace Memory is full (post-trigger)
  External triggering through trigger-input BNC connector
  External synch (trigger) output through a BNC connector

- Physical dimensions: 15.5"W x 9.5"D x 2"H. Weight: 5 lbs

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1.15 SCSI STANDARD SPECIFICATIONS AND REFERENCES

1.15.1 SCSI STANDARD SPECIFICATIONS

Mechanical, electrical and functional definitions of the SCSI-1 are described in:

SCSI-1 Specification: ANSI X3.131-1986
Title: Information Systems - Small Computer Systems Interface (SCSI)

Can be purchased from:
American National Standards Institute, Inc. (ANSI)
1430 Broadway, New York, N.Y. 10018
Phone: (212)642-4900, Fax: (212)302-1286

SCSI-2 and SCSI-3 (SIP & SPI) Specifications are available from:
GLOBAL ENGINEERING DOCUMENTS,
3130 South Harbor Blvd, Suite 330, Santa Ana, California 92704
(800)854-7179 or (303)792-2181, Fax: (303)792-2192

For SCSI2, refer to document X3.131-1994.

1.15.2 OTHER LITERATURE

Basics of SCSI - Fourth Edition by Ancot Corporation - 1998
a quick introduction to SCSI, SCSI terms description, and glossary.

Available from Ancot Corporation
115 Constitution Drive, Menlo Park, CA 94025
(650) 322-5322 Fax (650) 322-0455
Internet: http://www.ancot.com
This publication is FREE

The Book of SCSI by Peter M. Ridge - 1995
contains chapters on anatomy of SCSI, connecting SCSI HW, installing SCSI in a PC, troubleshooting, cables, ASPI programming, CAM, etc.

Available at many bookstores, or purchased directly from:
NO STARCH PRESS
1903 Jameston Lane, Daly City, CA 94013-3466
(415)334-7200

The Programmer's Guide to SCSI by Brian Sawert (1998)

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is a very thorough description of the SCSI. Starting with fundamentals, explaining ASPI, SCRIPTS, programming the Target mode, running SCSI under Windows or Unix, etc. Published by Addison-wesley, available in many bookstores.

The SCSI Bus & IDE Interface by Friedhelm Schmidt (second edition 1997)
Published by Addison-wesley, available in many bookstores.

1.15.3 INTERNET RESOURCES

http://www.ancot.com	- Ancot's web site
http://www.sta.com	- SCSI Trade Association web site
http://www.T10.org	- NCITS (SCSI) web site

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SECTION 2

TRACER / ANALYZER FUNCTIONS AND COMMANDS

2.1 TRACE MEMORY

Trace Memory is a circular buffer 2M, 4M, 8M, or 16M events deep, with each event 64 bits wide. The content of trace memory is explained in more detail in Appendix C.

Trace Memory is used in a very efficient way: only valid data, and transitions on certain SCSI bus signals cause recording. The qualifier for Data, Command, Status, and Message recording is REQ or ACK strobe. In standard recording mode, when REQ for Data-In is asserted, or ACK is asserted for Data-Out, a snapshot of the SCSI bus (within less than 4 ns) is taken, latched, and written in the trace memory. Other recording modes are available. See Section 2.4.6.

There are several SCSI control signals that cause recording whenever a transition on these is detected. They are: RST, ATN, SEL, and BSY. Again, as with the data, a snapshot of the SCSI bus is taken at the time of the transition (within 20 ns) and the event is subsequently recorded in the trace memory.

The recording can be started or stopped in one of two ways:

a. - without trigger: operator starts recording by pressing **<Run>** or by typing **<R>**, and stops it by pressing **<Stop>** or by typing **<S>**.
b. - with trigger, either immediate or delayed.

Whether recording with or without trigger, **<Run>** has to be used to set the Ultra2160 in the TRACING mode. This mode is indicated by the "TRACING" LED on the front panel and a message on the screen. When activity on the SCSI bus starts, the trace memory starts filling. When the memory is full, it will wrap around and continue writing from the physical beginning. The recording will continue until stopped by the **<Stop>** key, or by a post-trigger condition, if enabled. At that point the current (internal) trace memory physical address is detected, and beginning of valid data is calculated. This is done automatically without operator intervention. The earliest event still in the trace is at logical address 00000h. The operator does not have access to the physical address however, but deals with logical addressing only.
When recording with trigger disabled (internal or external), the trace memory acts as a FIFO buffer. The recording starts with the first SCSI activity following **<Run>**, and continues until stopped by **<Stop>**. If trace memory (physical) capacity is exceeded, it wraps around and

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starts writing from the physical beginning. Although the trace memory uses internally a linear physical address space, the internal firmware translates physical address to logical before displaying it, to make the trace memory appear circular. The last recorded event is at trace memory (logical) address FFFFFF for the 16M version.

When triggering is used, recording starts as described above, and continues until a trigger condition occurs. When the trigger finally occurs, then depending on trigger position, the recording either:

- stops immediately
- continues to the end of the current command when BUS-FREE Phase is detected
- or records a certain number of additional events before stopping (post trigger delay).

When External Trigger is used and the last location is filled, recording stops immediately.

TRACING will stop immediately, without delay, when **<Stop>** is pressed.

2.2 FUNCTIONS AND COMMANDS

2.2.1 MAIN MENU

The main menu lists the basic functions of the SCSI bus tracer. From this level various sub-menus can be accessed. As with all menus, selections can be made as follows :

- By moving the highlight bar to the desired entry using the arrow keys and then pressing **<Enter>**.

- By pressing the selector key, shown either in angle brackets < and > at the start of the line before the entry, or by an typing the underlined character in the item text.

```
                    Ultra-2160 Lite MAIN MENU
••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••
  TRACING                 TRACE MEMORY             UTILITIES

  <R> - start tracing     <1> - Clear trace        <6> - <Ctrl-Find> event
  <P> - tracing           <2> - R/W trace to disk  <7> - Calc. <Ctrl-Time> diff
  <S> - tracing           <3> - Save/Restore trace <8> - <Util>ities
```


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```
<M> - of tracing        <4> - <Display> trace
<T> - trigger set [Pre] <5> - Set display format
```

2.2.2 <R> - START TRACING (RUN)

Pressing the **<R>** key puts the Ultra-2160 Lite into tracing mode. From that point on, all activity on the SCSI bus will be recorded, subject to the trigger conditions in force.

See Section 2.1 for a discussion of tracing itself.
See Section 2.2.5 for a discussion of recording modes.
See Section 2.2.6 and Section 5 for a discussion of triggering.

2.2.3 <P> - PAUSE TRACING

Pressing the **<P>** key temporarily halts recording of SCSI bus activity. Pressing **<R>** will then restart recording. A message "Tracing PAUSE at **<addr>**" will appear. The 'seam' location will be marked in the trace memory, and can later be found using the 'Find Event' command.

2.2.4 <S> - STOP TRACING

Pressing the **<S>** key will halt tracing.

2.2.5 <M> - MODE OF TRACING

Press the **<M>** key to select the recording mode from the TRACE MODE SETUP menu as shown below.

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```
     TRACE MODE SETUP MENU
••••••••••••••••••••••••••••••••••••
<0> - Save All/Skip Data       [All]
<1> - Capture phase changes    [ ]
<2> - ID Filtering     [0081]  [ ]
<3> - Capture Selection Only   [ ]
<4> - Capture 4 Edges REQ/ACK  [E]
<5> - Capture 1 Edge REQ/ACK   [ ]
<6> - Capture on Exp(0)        [ ]
<7> - Capture SCAM protocol    [ ]

Your selection (0../Quit) ?
```

Individual functions are described below.

2.2.5.1 <0> - SAVE ALL / SKIP DATA

With this entry you select the 'Skip Data' recording mode. The number in the brackets shows the number of data transfers which will be recorded. When this function is disabled, 'All' will be indicated. If 'Skip Data' is enabled (selected by the left and right-arrow keys) then either 8, 16, 32, or 64 in the brackets indicate that only that many data transfers will be recorded. In either case, the total number of data transfers is counted and recorded in the trace memory, and will appear in the structured display. Skipping data does not inhibit the transfer of data across the SCSI bus. Only recording is affected.

2.2.5.2 <1> - CAPTURE PHASE CHANGES

This entry enables or disables the recording of transitions on the SCSI control lines : MSG, C/D and I/O. When enabled, an 'E' character appears in the set of brackets, and any transition on the information transfer phase-determining lines is recorded as a SCSI event. When disabled, transitions on these lines do not cause an event to be recorded.

2.2.5.3 <2> - FILTERING BY SCSI ID

This entry enables or disables the Filter mode of recording. When enabled, the tracing circuits will record all transactions up to and including the selection phase. However, unless the pattern of ID bits during the selection phase matches the user-defined pattern, all other activity until the next Bus Free state will not be recorded. Note that it is the exact pattern of bits during Selection phase that determines whether later events are recorded. Therefore you can choose to observe only events between a particular pair of devices.

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The following example is provided to clarify this subject. Assume the bus being monitored has Initiators as ID 6 and ID 7 and Targets as ID 0, ID 1 and ID 2. You might think that you could capture all traffic to Target ID 1 from both Initiators. However, if you try this by setting only bit number 1 in the pattern, that pattern will never be matched, since both the Initiator's and Target's ID numbers are set during Selection phase. You might also try setting bits 1, 6 and 7. That will not work either, since only two bits may be set during selection phase. You can, however, capture all transactions between a pair of ID numbers, for example ID 0 and ID 6. You could even capture only transactions between ID 0 and ID 2 (although this situation would be questionable, since both of those ID numbers belong to Targets).

When this function is enabled, you can set the bit pattern to match. Note that 16 bits are provided in the pattern. This causes matching of SCSI WIDE Selection IDs. The default pattern is for ID-7, commonly used by Initiators, and ID 0, commonly used by Targets, and shows as the pattern [0081] in the menu.

2.2.5.4 <3> - CAPTURE SELECTION ONLY

This function enables or disables skipping of all events except transitions on the SCSI BSY and SEL control lines. This mode is extremely economical of trace events when all that is desired is to see which IDs are being most utilized, or to determine the proportion of idle to active time on the bus.

2.2.5.5 <4>, <5> - CAPTURE EDGES OF REQ/ACK

With this function you specify the number of edges of REQs and ACKs to capture for a transfer of a byte of data.

- 1 edge - The Ultra-2160 Lite will record only one event for each byte of data. The recording will be made on the valid edge of REQ or ACK. The valid edge of these two is determined by the I/O signal. For data from the target to the initiator, REQ and I/O are both asserted. For data from the initiator to the target, ACK is asserted and I/O is de-asserted.

- 4 edges - The Ultra-2160 Lite will record four events for each byte of data. The recording will be made on each edge, leading and trailing, of both REQ and ACK.

2.2.5.6 <6> - CAPTURE ON EXP(0)

This function enables or disables recording of events when Exp(0) changes. When enabled, any transition, up or down, on expansion connector bit 0 (DB-15 type connector, pin-1) will

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cause recording of a snapshot of the SCSI bus within 30 ns of the transition. This mode is useful to relate the timing of signals internal in tested system to the contents of the SCSI bus.

2.2.5.7 <7> - CAPTURE SCAM PROTOCOL

This mode allows recording of events during the auto-configuration process of the SCSI-3 SCAM Protocol. In this mode, whenever both BSY and SEL signals are active, transitions on D5, D6, or D7 (the SCAM Handshake lines) cause an event to be recorded. Since transitions on the certain data lines cause recording (which in normal trace mode would be ignored), more of the trace memory is used than in the normal trace mode.

The reader is referred to Appendix E and the SCSI-3 ANSI specification (document: SCSI-3 Parallel Interface 'SPI', Annex B) for detailed description of the SCAM protocol.

2.2.6 TRIGGER SETUP

Pressing the **<T>** key loads the trigger sub-menu for selecting the trigger mode and conditions of the trigger event. See Section 5 for a complete discussion of the Trigger Setup Menu and triggering.

2.2.7 <1> - CLEAR TRACE

The **<C>** key is the selector for this function. The CLEAR TRACE function is a two-step operation. When selected, a prompt will appear, asking you to confirm that the trace memory should be cleared. If you press **<Y>** the trace memory will be cleared to all zeros.

2.2.8 < 2 > R/W TRACE TO DISK

With the R/W TRACE TO DISK function you can save traces and setup parameters to the hard disk in the Ultra 2160 Lite. There are also commands for manipulating files and directories on the disk. When you press **<2>**, or **<W>** from the main menu, the following menu will appear.

```
R/W TRACE TO DISK / DISK OPERATIONS
••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••
MENU COMMANDS                   KEYBOARD COMMANDS
<0> - Write Trace to disk       wt      write trace
<1> - Read Trace from disk      rt      restore trace
<2> - Write setup to disk       ws      write setup
<3> - Read setup from disk      rs      restore setup
<4> - List files                dir     directory listing
                                copy    copy file/dir
```


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```
                                    del      remove file/dir
                                    attrib   change attributes
        <5> - Change Directory      cd       change directory
                                    mkdir    make directory
                                    move     move file/dir
                                    diff     compare files
        <6> - Format Disk           format   format disk
```

The up and down arrows on the keyboard will scroll through the numbered selections (**<1> - <6>**) on the left hand side. You may also enter one of the numbers directly to highlight your desired selection. When you press <Enter>, the highlighted selection will be run. Notice that some commands require the use of a keyboard.

To access the keyboard commands, select A**<4>** - List files@ or type Adir@ at the prompt. This will clear the screen and show the familiar DOS directory display followed by a prompt, e.g., "\>", for the top directory. It is suggested that you make a "traces" directory and a "setup" directory in order to keep saved files better organized.

If you type "?" or "help" at the keyboard "\>" prompt the following help menu will be displayed.

```
\>: help
      Command        Description        Parameters
      ?,HELP         Help
      X, Q           Exit DOS shell
      CD             Change Directory    PATH or CD to display CWD
      COPY           Copy file           FROMPATH TOPATH
      DEL            Delete file/dir     PATH
      DIFF           Compare files       PATH PATH
      DIR            Directory listing   PATH
      FORMAT         Format Disk
      MKDIR          Make Directory      PATH
      MOVE           Move file/dir       PATH NEWNAME
      ATTRIB         Change attributes
                          PATH RDONLY|HIDDEN|SYSTEM|ARCHIVE|NORMAL
      WT             Write Trace         START END PATH
      WS             Write Setup         PATH
      RT             Read Trace          PATH
      RS             Read Setup          PATH
\>:
```

2.2.8.1 MENU COMMANDS

<0> - Write Trace to disk

Write a trace or part of a trace to the disk. The address range of the current trace in memory is displayed in brackets and may be changed. A file name in brackets is suggested in the form of date_number.trc@ (e.g., 0225_001.trc). This may also be changed. The A.trc@ extension is only a suggestion for trace files. Any DOS filename may be used. The menu is shown below

```
WRITE TRACE TO DISK

Address range:  [00000] - [007c2]
```


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```
Path/filename:  [\TRACES\0225_005.TRC.............]
```

Pressing AEnter@ writes the trace to the disk and AESC@ cancels the operation.

<1> - Read Trace from disk

Read a trace from the disk to trace memory. After so reading, the trace may then be viewed in the normal manner. As shown in the menu below, two windows are presented. The left hand window lists files and the right hand window list directories. Movement between the windows is with the left or right arrows. Scrolling is done with the up or down arrows. The current selection is shown in reverse video. To accept the selection, press **<Enter>**.

```
SELECT FILE OR CHANGE DIR

Files         Dirs
trace1.trc      ..
0225_000.trc
0225_001.trc
0225_002.trc
```

<2> - Write setup to disk

This saves all the current setup parameters to the current directory on the disk. The parameters include mode, trigger, utilities and emulator variables. For example, you could set up certain trigger conditions and save them with the **ws** command (**ws mytrig**). You could then read the settings back later using the **rs** command (**rs mytrig**).

A file name in brackets is suggested in the form of date_number.set@ (e.g. 0225_001.set). This may also be changed. The A.set@ extension is only a suggestion for setup files. Any DOS filename may be used. The menu is shown below:

```
WRITE SETUP TO DISK

Path/filename [\setup\-224_001.set.................]
```

<3> - Read setup from disk

Read a setup file from the disk and change setup parameters. After reading the file, the new setup parameters take effect immediately. As shown in the menu below, two windows are presented. The left hand window lists files and the right hand window list directories. Movement between the windows is with the left or right arrows. Scroll with the up or down arrows. The current selection is shown in reverse video. To accept it, press **<Enter>**

```
SELECT FILE OR CHANGE DIR

Files         Dirs
setup1        ..
0225_000.set
0225_001.set
0225_002.set
```


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<4> - List files
This will clear the screen and display a list of files in the current directory as shown below. The display includes the time and date of creation and the size of the file. Following this, a prompt showing the current working directory is shown. To return to the menu prompt, enter return. To run other commands, enter the command at the prompt.

```
TRACES    .              <DIR> 02-24-97 16:46
SETUP     .              <DIR> 02-24-97 16:47
TEMP1     .      4,608         02-25-97 13:00
TEMP2     .      4,608         02-26-97 12:34
      3  File(s)    540,123,456 bytes free
\>
```

<5> - Change Directory
With this selection you can change the current working directory. As shown in the menu below, two windows are presented. The left hand window lists files and the right hand window list directories. Movement between the windows is with the left or right arrows. Scrolling up and down is done with the up or down arrows. The current selection is shown in reverse video. To accept the selection, press **<Enter>.**

```
SELECT FILE OR CHANGE DIR

Files          Dirs
TEMP1          SETUP
TEMP2           TRACES
```

<6> - Format Disk
This will format the hard disk. An additional prompt will ask you to confirm your intent to format the disk.

```
WARNING: Format will erase the contents of the hard disk.
```

2.2.8.2 KEYBOARD COMMANDS

? or HELP Help
The "?" or "help" commands display a brief list of the commands and their parameters.

X, Q Exit Shell
Pressing the Ax@ or Aq@ will exit the DOS shell.

CD Change Directory
"cd" by itself will display the current directory path. "cd" with a path will change to the selected directory.

```
EXAMPLE:
cd traces -   This will change to the "traces" directory.
```


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```
cd \ -   This will change to the root directory.
```

COPY Copy file/dir
Acopy@ will copy one file to a new file. If the new file already exists, the copy will not take place and a warning will be printed.

EXAMPLE:
```
copy trace1 trace2 - This will copy "trace1" to "trace2"
```

DEL Delete file/dir
Delete a file or directory. A directory must be empty in order to delete it. The Adel@ command will not delete files with the RDONLY attribute set.

EXAMPLE:
```
del trace1 - delete the file Atrace1"
```

DIFF Compare files
Compare two files. This function will not show differences, but will simply show whether they are the same.

EXAMPLE:
```
diff trace1 trace2 - compare file Atrace1" with file Atrace2"
(TRACE1) (TRACE2) Files are the same
```

DIR Directory listing
This will display a list of files in the current directory. The display includes the time and date of creation and the size of the file.

FORMAT Format Disk
This will format the hard disk. An additional prompt will ask you to confirm your intent to format the disk.

```
WARNING: Format will erase the contents of the hard disk.
```

MKDIR Make Directory
Create a subdirectory in the current directory.

EXAMPLE:
```
mkdir mytrace - creates the directory Amytrace:
```

MOVE Move file/dir
This renames a file or directory.

EXAMPLE:
```
move trace1.trc mytrace.trc - moves (renames) Atrace1.trc@ to
Amytrace.trc@
```


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ATTRIB Change attributes

With this selection you can examine or change a file-s attributes. If no attributes are given, the file-s current attributes are displayed. The attributes are RDONLY, HIDDEN, SYSTEM, ARCHIVE, NORMAL. The DIRENT attribute is reserved for directories and cannot be changed. At the present time, only the presence or absence of the RDONLY attribute is used.

EXAMPLES:

```
attrib mytrace - list the attributes of the file Amytrace@
Attributes: ARCHIVE

attrib mytrace rdonly - make the file Amytrace@ read only

attrib mytrace - list the attributes of the file Amytrace@
Attributes: ARDONLY|ARCHIVE

attrib mytrace normal - remove all file attributes

attrib mytrace - list the attributes of the file Amytrace@
Attributes: NORMAL FILE (No bits set)
```

WT Write Trace

Write a trace or part of a trace to the disk. You must supply the start and end addresses of the trace or you may use the default dash A-@ for either or both addresses. If the end address of the trace is past the end of the current trace, the end of trace address will be used.

EXAMPLES:

```
wt 0 1ffff trace1 -   saves the entire trace to disk in file Atrace1".
wt - - trace1 -     saves the entire trace to disk (using default
                    addresses) in file Atrace1"
wt 1000 2000 Lite trace1 - saves trace from address 1000 to 2000 Lite
to                                  disk in file Atrace1".
```

WS Write Setup

This saves all the current setup parameters to the current directory on the disk. The parameters include mode, trigger, utilities and emulator variables. For example, you could set up certain trigger conditions and save them with the ws command (ws mytrig). You could then read the settings back later using the **rs** command (**rs mytrig**).

EXAMPLE:

```
ws setup1 - saves current setup to disk in the file Asetup1".
```

RT Read Trace

Read a trace from the disk to trace memory. After reading the trace, it may then be viewed in the normal manner.

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EXAMPLE:
```
rt trace1 - read Atrace1" from the disk to trace memory.
```

RS Read Setup
Read a setup file from the disk and change setup parameters.

EXAMPLE:
```
rs setup1 - read Asetup1" from the disk and update all parameters.
```

2.2.9 <3> - SAVE/RESTORE TRACE

With this function you can place some or all of the current recorded trace of SCSI bus activity into a file on an external computer or the floppy disk. You can also read from a previously stored trace back into the active trace memory for display, or download a file (using ›1K Xmodem-) directly to the hard disk. See Section 2.3 for description.

2.2.10 <4> - DISPLAY TRACE

The **<D>** or **<3>** keys are the selectors for this function. With it you can see the activity recorded while tracing. See Section 3 for a complete discussion of the display modes and how to interpret the various parts of the display.

2.2.11 <5> - SETUP DISPLAY FORMAT

The **<F>** or **<4>** keys are selectors for this function. With it you can specify how the recorded activity is displayed. See Section 3 for a complete discussion of the display modes. .

2.2.12 <6> - FIND EVENT

This function searches the trace memory for a particular pattern of control or data bits. See Section 5 for a complete discussion of the searching function. Note that searching is accessible from the trace display mode as well, by pressing the **<Ctrl-F>** key.

The **FIND-NEXT** function repeats a previous search for the next matching event. If no previous search was made, it searches for the next Bus Free event. Note that this function is also accessible from the trace display mode, by pressing the **<Ctrl-L>** key.

A **FIND-PREVIOUS** function is also available. Press **<Ctrl-K>** to select it. It is similar to FIND-NEXT, but it searches backwards through the trace.

The **FIND EVENT** function can use a occurrence count, i.e., you can find the nth occurrence of a certain event. The **FIND-NEXT** or **FIND-PREVIOUS** will always find the next first occurrence, however.

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2.2.13 <7> - CALCULATE TIME DIFFERENTIAL

The **<Ctrl-T>** key combination is the selector for this function. With it you can select two trace events by specifying their addresses, and calculate the elapsed time between the two events. It uses the 20 ns resolution time stamp. Note that the time in ns is approximately modulo 170 seconds, due to timer counter wrap-around. If the two events are actually 175 seconds apart, the difference reported will be approximately 5 seconds. This function is also accessible from the trace display mode by pressing the **<Ctrl-Time>** key.

2.2.14 <8> - UTILITIES

The **<U>** key is the selector for this function. With it you can access utility functions not falling in any other category. See Section 7 for a complete discussion of the miscellaneous utility functions.

2.3 SAVE/RESTORE TRACE FUNCTIONS

Choosing **<3>** from the system main menu displays the following:

```
 SAVE / RESTORE TRACE MENU
<0> - Save trace to host via serial port (ASCII Transfer)
<1> - Save trace to host via serial port (XMODEM Transfer)

<2> - Restore trace from host via serial port (ASCII Transfer)
<3> - Restore trace from host via serial port (XMODEM Transfer)

<4> - Save trace to floppy disk
<5> - Restore trace from floppy disk

<6> - Download File (XMODEM Transfer)

Serial port setup : 115.2k 8N1
Your selection (0../Quit) ?
```

In order to save/restore the trace to floppy, you must have the floppy disk option installed.

Selecting the method and direction of trace transfer results in other prompts and menus to lead you through the process.

Only the Raw Data format can be restored from a host computer file back into trace memory. The other save file formats are provided for human-readable archiving. A utility will be

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available in a C-source and IBM PC executable format for converting from Raw Data to human readable format. Contact the factory for more information.

2.3.1 <0> or <1> - SAVE TRACE TO HOST VIA SERIAL PORT (<0>=ASCII, <1>=XMODEM)

You can transfer and save a trace captured by the Ultra-2160 Lite to a file on a host computer for later post processing or archival purposes.

At the host computer end, you will need a communications program capable of transferring ASCII files and storing them using the host computer file system. Most UNIX systems provide these programs as system utilities. Apple Macintosh systems and MS-DOS systems will require an add-on program. BITCOM or PROCOMM are perhaps the most popular of these programs for the PC.

Select **<0> or <1>** from the SAVE/RESTORE TRACE menu to get a choice of file formats to transfer. For selection **<0>** the following menu will be displayed. The XMODEM transfer uses only the raw trace data format.

```
FILE FORMAT MENU
••••••••••••••••••••••••••••
<0> - Raw trace data format
<1> - Structured format
<2> - Binary format
<3> - Hex Dump format
<4> - Compact format

Your selection (0../Quit) ?
```

The 'Raw Data' format is the only one which can be downloaded back into the Ultra-2160 Lite later. This format ensures that all characters are printable ASCII. See Appendix C for a description of the format.

The other formats are text files which are duplicates of the trace display formats, identical to what appears on the screen of the Ultra-2160 Lite. These formats may be useful for comparisons and post-processing of the trace information, but cannot be reloaded into the Ultra-2160 Lite. Note that they are not compressed, and files are much larger than the 'Raw Data' format. For this reason, post-processing of 'NON-Raw Data' formats will typically take much longer.

After you select the format, you will be asked for the trace memory range to be saved, then confirm the transfer by pressing **<Y>** to start communications. Most communications programs can be set to echo received characters to the screen, so you can follow the transfer as it is progressing.

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The transfer is completed when the EOT character (04 Hex) is sent to the host. When the EOT is finally received, you disable reception at the host end. This will automatically close and save the file with most communications packages.

See Appendix H for an example of using the PC and the PROCOMM PLUS communication package for saving the trace on a PC host.

2.3.2 <2> or <3> - RESTORE TRACE FROM HOST VIA SERIAL PORT (<2>=ASCII, <3>=XMODEM)

A trace saved to a file in 'Raw Data' format or XMODEM format can be loaded back into the Ultra-2160 Lite trace memory for more study. This function is analogous to saving the trace, as described in Section 2.3.2, except that the direction of transfer is different.

Connect the Ultra-2160 Lite to the host using a null-modem cable. At the host computer end, start the communications program and ready it to send either or ASCII or an XMODEM file.

Select **<2> or <3>** from the SAVE/RESTORE TRACE menu and the following prompt will be displayed:

```
Download (receive) trace: Raw Data format.
Start Transfer (Y/N) ?
          or
Ready: Begin XMODEM upload protocol on your host machine . . .
```

Press **<Y>** to confirm, then start the transfer from the host end.

> *Care has been taken to ignore any modem initialization characters your communications package may send out before the actual file, but it is impossible to allow for every possibility. If you repeatedly get the message "Unrecognized format" when attempting downloads, disconnect the null-modem cable until the next keystroke at the host-end will initiate.*

Note again that only the 'Raw Data format' file or the XMODEM format can be reloaded into the Ultra-2160 Lite. Any other file format will result in the "Unrecognized format" message.

See Appendix H for an example of using the PC and the PROCOMM PLUS communication package for restoring the trace from a PC host.

2.3.3 <4> SAVE TRACE TO FLOPPY DISK

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Select **<4>** from the SAVE/RESTORE TRACE menu to get a choice of file formats to use. The following menu will be displayed.

```
FILE FORMAT MENU
------------------------
<0> - Raw trace data format
<1> - Structured format
<2> - Binary format
<3> - Hex Dump format
<4> - Compact format

Your selection (0../Quit) ?
```

The ›Raw Data= format is the only one that can be downloaded back into the Ultra-2160 Lite later. This is an encrypted format which ensures that all characters are printable ASCII. See Appendix C for a description of the encryption algorithm.

The other formats are text files, duplicates of the trace display formats, identical to what appears on the screen of the Ultra-2160 Lite. These formats may be useful for comparisons and post-processing of the trace information, but cannot be reloaded into the Ultra-2160 Lite. Note that they are not compressed, and the files are much larger than the ›Raw Data= format.

After you select the format, you will be asked for the trace memory range to be saved and the filename to use. Once the file is written on the diskette, you may view the file on a PC.

2.3.4 <5> RESTORE TRACE FROM FLOPPY DISK

A trace saved to the floppy in ›Raw Data= format can be loaded back into the Ultra-2160 Lite trace memory for more study. This function is analogous to saving the trace, as described in Section 2.3.5, except that the direction of transfer is different.

Place the floppy diskette in the drive and select **<5>** from the SAVE/RESTORE TRACE menu; a file selection menu will be displayed. The left half shows the files and the right half shows the directories and drives. The <up> and <down> arrows move the cursor up and down in the window, and the <right> and <left> arrows move the cursor between the two windows. Once the proper file has been selected, enter <return>; the file will be read from the floppy disk to trace memory. If the format of the file is not ›Raw Data=, the file will not be loaded.

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2.3.5 <6> DOWNLOAD FILE (›1K Xmodem= transfer)

With this selection, you may download any file (using the ›1K Xmodem= protocol) directly to the hard disk on the Ultra2160. This is most commonly used to download the file Aancot.sys@ to the root directory of the C drive (C:\). This is a self extracting file which installs additional files needed to the Ultra2160.

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SECTION 3

DISPLAYING THE TRACE MEMORY

3.1 INTRODUCTION

The Ultra-2160 Lite has several display formats for the data captured by tracing. Each format has its own characteristics and special capabilities to let you view the events recorded. See Appendix E for a discussion of the SCSI-3 SCAM protocol and its display on the Ultra-2160 Lite.

When you select the **<D>** option from the main menu, a message will appear showing which format of display is currently selected, and prompting for a starting address. You may select a different display format at this point; just press **<N>.** The Display Format menu will appear, as described in Section 3.7.

To start the display, select a starting (and optionally an ending) address in any of the formats which follow. Addresses must be in hexadecimal in the range 0-1FFFF (0-7FFFF if you have the optional 512K deep trace). The address must also be within the recorded range, i.e., less than the address at which recording stopped, as reported when you pressed **<S>**, or when the trigger occurred. If you type an address out of range, it will be rejected and you will be given another opportunity to select an address.

1) Press **<Enter>** with no numeric entry to start displaying at the start of trace memory, with a pause at the end of each page displayed.
2) Type an address and press **<Enter>** to display one page beginning at the address typed.
3) Type two addresses separated by a hyphen and press **<Enter>** to display the entire range of events between and including the two addresses. This is the option you may want to select if you are printing a trace in hard copy through the parallel port, and you need to print more than one screen.
4) Type an address followed by a hyphen and press **<Enter>** to display all events from the address typed to the end of trace.
5) Type a hyphen followed by an address and press **<Enter>** to display all events from the start of trace up to and including the address typed.
6) Type just a hyphen and press **<Enter>** to display the entire recorded trace.

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Displaying a range longer than one screen length would usually be selected when also generating hard copy on a printer. Use **<^P>** to toggle the printer **ON** and **OFF**.

When displaying a range longer than one screenful, press any key on the keyboard to pause the display. A prompt will be displayed at the bottom of the screen explaining how to stop displaying (AQ@ or A**<ESC>**) or continue displaying (any key).

After the initial display, the Ultra-2160 Lite will pause for more input from you. At that time, you can access the Search functions (see Section 5), the Time difference calculator (see Section 2.2.13), the Trigger (Section 4), the Trace-Mode (Section 2.2.5) or Utilities (Section 7) menus.

The following table describes the keys you can use while displaying a trace:

```
MOVING AROUND IN A TRACE:
Key                   Meaning
---                   -------
<down arrow>          Scroll down one line
<up arrow>            Scroll up one line
<PgDn>,<Space>,+      Scroll down one screen
<PgUp>,-              Scroll up one screen
<Home>                Display one screen starting at the beginning of the trace
<End>                 Display one screen ending with the end of the trace
A                     Display one screen starting at a given address

Changing to another trace format:
Key                   Meaning
---                   -------
F                     Flip between structured and binary display or flip from
                      any other display format to structured format
B                     Display trace in binary format.
C                     Display trace in compact format.
D                     Display trace in hex dump format.
P                     Display trace in command profile format.
S                     Display trace in structured format.
^d                    Display trace in diagnostic format.

Changing the appearance of a trace:
Key                   Meaning
---                   -------
W                     Flip between wide (16-bit) and narrow (8-bit) data
                      display.  When displaying wide data, the low byte appears
                      first, separated by a hyphen from the high byte.  The
                      separator character may be an asterick (*) if a parity
                      error occurs or a plus-sign (+) if the ATN line is
                      active.
H                     Structured display only.
                      Flip between ASCII or hexadecimal display of the data
                      bytes.  Unprintable characters appear as periods.
E                     Binary format - flip the time display between total
                      elapsed time since the start of tracing or differential
```


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```
                    time between successive events.
                    Structured format - Turns on and off the displaying of
                    differential time on the right edge of the screen if
                    there is sufficient room.
<right arrow>,      Flip between displaying coarse and fine time for time
<left arrow>        displays which exceed approximately 83 seconds.  Times
                    exceeding 83 seconds are indicated with a "<" or ">"
                    to the left of a time.
Misc.:
Key                 Meaning
---                 -------
Q,ESC               Quit and return to previous menu
R                   Start recording a new trace and return to the main menu.
^t                  Compute the time difference between two trace events.
^f                  Open the find menu to search trace for selected events.
^k                  Find the previous occurence of an event.
^l                  Find the next occurence of an event.
^p                  Toggle the printer ON and OFF.
```

3.2 THE STRUCTURED DISPLAY FORMAT

This format is the easiest to read and interpret. Each line of display starts with the trace memory address of the first event of the line. Each SCSI phase is labeled with its name. In addition, the first byte of the Command Descriptor Block (CDB) is interpreted, as are each Message byte and Status byte. Phases are indented as with program structure. The Reset condition and Bus Free phases are aligned with the left edge of the display after the address. Arbitration, Selection and Reselection phases are indented one tab stop, 3 spaces. Command, Status, Message-In and Message-Out phases are indented a further tab stop, 6 spaces. ST-Data-In (Single-Transition), ST-Data-Out and the DT-Data-In (Double-Transition), DT-data-Out are indented another tab stop, 9 spaces.

The actual data transferred, as well as the ID numbers during Arbitration, Selection and Reselection, are shown in Hex, following a slash. If a **parity error** occurs at any time, except in the arbitration phase, an **asterisk** will follow directly after the offending byte. If no parity error occurred, but the SCSI **ATN line** is active, that is shown as a **plus-sign** following the byte. **Data count**, i.e., the number of **transfers** during the Data-In or Data-Out phase, is shown in Hex format and in parentheses just after the trace memory address for the last line of the data phase.

Remember that **transfers** represent the number of REQ-s (or ACK-s). For Single Transition, Narrow (8 bit) transfers, this is the number of bytes sent. For Single Transition Wide (16 bit) transfers, this is one half the number of bytes sent. For Double Transition transfers (160MBytes), this is one forth the number of bytes sent.

NOTE:

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There are situations when the tested system hangs during the data phase, and you need to find out how many data bytes were actually transferred. Normally, when the system hangs, you press **<Stop>** or **<S>** to stop the tracing, then **<Disp>** or **<D>** to display the trace. You will not see the data count (in parentheses) at the end of the last (hung) data phase on the structured display. This is because the data count is recorded in the trace memory when the Bus Free phase is entered. The Ultra2160 Lite stores data count in the data byte memory of the Bus Free event. This recording is all done by hardware because of the recording speed requirement. If you need to see the data count, press the SCSI RESET pushbutton to reset the Target before you press **<Stop>**; this will result in Bus Free phase, and subsequent recording of the data count in the trace memory.

To avoid clutter, multi-byte messages have the phase label only on the first byte. Multi-line data phases are also labeled only on the first line.

When enabled, the duration of each phase is displayed on the last line of that phase, if space is available on the line. Press **<E>** to toggle between timing display enabled or disabled.

Several samples of Structured displays are shown below, with the various recording and display modes.

3.2.1 Structured Display with NARROW or WIDE data transfers

The example display on the next page shows the data in ASCII format. The recording captured all data. This recording was made with ACapture 1 edge of REQ/ACK enabled@. Note that in line 4 the IDs of the SCSI devices involved are shown both as the bits set on the SCSI bus, and as the decimal equivalent ID numbers of the two devices. Also note that during the first Message-Out phase, the Initiator held ATN active, as shown by the (+) following each message byte. This trace shows a typical boot sequence for a host adapter card at ID 7 finding out about the Target device at ID 0.

```
00000: ---- Start Trace ----
00001:   Arbitration     /80 (7)
00004:   Select w/ATN    /81 (0,7)
00007:      Message-Out  /C0+(Identify : LUN 0 Disconnect OK)
00008:      Message-Out  /01+(Ext Msg)
00009:                    03+(Length)
0000A:                    01+(SDTR)
0000B:                    28+(Period 160 nsec)
0000C:                    08 (Offset 8 bytes)
0000D:      Message-In   /01(Ext Msg)
0000E:                    03 (Length)
0000F:                    01 (SDTR)
00010:                    32 (Period 200 nsec)
00011:                    08 (Offset 8 bytes)
00012:      Command      /12 00 00 00 30 00 (Inquiry)
```


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```
00018:      ST-Data-In   / .  .  .  .  .  .  .  .  A N C O T
00028:                    D S C  -  3 0 2  /  J
00038: (0024)             3 . 4 0
0003C:      Status       /00 (Good)
0003D:      Message-In   /00 (Cmd Cmplt)
0003E: Bus Free
0003F:   Arbitration     /80 (7)
00042:    Select w/ATN   /81 (0,7)
00045:       Message-Out /C0+(Identify : LUN 0 Disconnect OK)
00046:       Message-Out /01+(Ext Msg)
00047:                    03+(Length)
00048:                    01+(SDTR)
00049:                    28+(Period 160 nsec)
0004A:                    08 (Offset 8 bytes)
0004B:       Message-In  /01 (Ext Msg)
0004C:                    03 (Length)
0004D:                    01 (SDTR)
0004E:                    32 (Period 200 nsec)
0004F:                    08 (Offset 8 bytes)
00050:       Command     /03 00 00 00 10 00 (Req Sense)
00056: (0008)ST-Data-In  / p  .  .  .  .  .  .  .
0005E:      Status       /00 (Good)
0005F:      Message-In   /00 (Cmd Cmplt)
00060: Bus Free
00061:   Arbitration     /80 (7)
00064:   Select w/ATN    /81 (0,7)
00067:      Message-Out  /C0 (Identify : LUN 0 Disconnect OK)
00068:      Command      /00 00 00 00 00 00 (Test U Rdy)
0006E:      Status       /00 (Good)
0006F:      Message-In   /00 (Cmd Cmplt)
00070: Bus Free
00071:   Arbitration     /80 (7)
00074:   Select w/ATN    /81 (0,7)
00077:       Message-Out /C0 (Identify : LUN 0 Disconnect OK)
00078:       Command     /25 00 00 00 00 00 00 00 00 00 (Rd Cap)
00082: (0008)ST-Data-In  / .  .  .  .  .  .  .  .
0008A:      Status       /00 (Good)
0008B:      Message-In   /00 (Cmd Cmplt)
0008C: Bus Free
0008D: ---- End of Trace ----
```

Press **<E>** to enable or disable display of the time stamp on the right margin. The format is the same as in the binary display, and it specifies time for that certain phase. The time stamp will not be displayed if there is no room on the right side of the screen, as with the data phase. To show time for the data phase, the byte count has to be short enough, e.g., by using the recording mode the with "skip data after 8 bytes" option.

```
00060: Bus Free                                          354 934 680
00061:   Arbitration     /80 (7)                               3 560
00064:   Select w/ATN    /81 (0,7)                           833 600
00067:      Message-Out  /C0 (Identify : LUN 0 Disconnect OK)  589 920
00068:      Command      /00 00 00 00 00 00 (Test U Rdy)   2 061 040
0006E:      Status       /00 (Good)                        1 061 720
0006F:      Message-In   /00 (Cmd Cmplt)                     663 920
00070: Bus Free                                           3 415 120
```


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When viewing WIDE data transfers, press **<W>** on the keyboard to toggle this display option. The WIDE data in the data-in/out phase will be shown as two bytes (the low byte first) separated by a hyphen. If the recording was made on a NARROW system, the upper byte (not driven) will be marked by an asterisk, indicating parity error.

```
00187: Bus Free
00188:    Arbitration       /01 (0)
0018A:    Reselection       /81 (0,7)
0018D:       Message-In     /80 (Identify : LUN 0)
00191:D         Data-In     /DE-E7 D4-D8 FD-FF DE-80 FD-D7 33-AD CF-77 D8-39
 001D1: (0200)               BA-6F 76-77 FE-7D B9-1E C3-F7 EF-E6 D7-8A EA-EC
0020F:       Status         /00 (Good)
00213:       Message-In     /00 (Cmd Cmplt)
00217: Bus Free
```

3.2.2 Structured Display with NARROW data transfers

The following display is shown with data in Hex. Recording was done in Skip-Data (32 transfers) mode, with '*capture 4 edges REQ/ACK*' mode turned ON. Note the byte count (in parentheses, in Hex format) on the last line of the data phase for each transfer.

```
00000: ---- Start Trace ----
00001:    Arbitration       /80 (7)
00004:       Select w/ATN   /81 (0,7)
00008:       Message-Out    /C0 (Identify : LUN 0 Disconnect OK)
0000C:       Command        /08 00 00 00 01 00 (Read/Rcv)
00023:       Message-In     /04 (Disconnect)
00027: Bus Free
00028:    Arbitration       /01 (0)
0002A:    Reselection       /81 (0,7)
0002D:       Message-In     /80 (Identify : LUN 0)
00031:       ST-Data-In     /00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00071: (0200)  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
000AF:       Status         /00 (Good)
000B3:       Message-In     /00 (Cmd Cmplt)
000B7: Bus Free
000B8:    Arbitration       /80 (7)
000BB:    Select w/ATN      /81 (0,7)
000BF:       Message-Out    /C0 (Identify : LUN 0 Disconnect OK)
000C3:       Command        /08 00 00 22 01 00 (Read/Rcv)
000DA:       ST-Data-In     /FF FF FF F7 FF FF 7F 15 FE FF FF FF FF FF F7 6F
0011A: (0200)                FF FF FF FF FF FF FF BB FF FF FF FF FF FF 9F
00158:       Status         /00 (Good)
0015C:       Message-In     /00 (Cmd Cmplt)
00160: Bus Free
00161:    Arbitration       /80 (7)
00164:    Select w/ATN      /81 (0,7)
```


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```
00169:       Message-Out   /C0 (Identify : LUN 0 Disconnect OK)
0016C:    Command          /08 00 00 5C 22 00 (Read/Rcv)
00183:       Message-In    /04 (Disconnect)
00187: Bus Free
00188:    Arbitration      /01 (0)
0018A:    Reselection      /81 (0,7)
0018D:       Message-In    /80 (Identify : LUN 0)
00191:       ST-Data-In    /DE E7 D4 D8 FD FF DE 80 FD D7 33 AD CF 77 D8 39
001D1: (4400)               BA 6F 76 77 FE 7D B9 1E C3 F7 EF E6 D7 8A EA EC
0020F:       Status        /00 (Good)
00213:    Message-In       /00 (Cmd Cmplt)
00217: Bus Free
00218: ---- End of Trace ----
```

3.2.3 Structured Display with DT transfers

The following example includes the DT-Data-In and DT-Data-Out double transition phases:

```
0000557:Bus Free
000055B:   Arbitration   /80 (7)
000055F:   Select w/ATN  /82 (1,7)
0000569:      Message-Out/C0+(Identify : LUN  0 Disconnect OK)
0000570:      Message-Out/01+(Ext Msg)
0000576:                  06+(Length)
000057C:                  04+(Parallel Protocol Req)
0000583:                  09+(Period: 12.5 nsec)
000058A:                  00+(Reserved)
0000591:                  7F+(Offset: 127 xfers)
0000598:                  01+(Width : 2 bytes)
00005A0:                  02 (Options: DT DATA Phases with CRC)
00005A7:      Message-In /01 (Ext Msg)
00005AD:                  06 (Length)
00005B3:                  04 (Parallel Protocol Req)
00005BA:                  09 (Period: 12.5 nsec)
00005C0:                  00 (Reserved)
00005C6:                  1F (Offset: 31 xfers)
00005CD:                  01 (Width : 2 bytes)
00005D3:                  02 (Options: DT DATA Phases with CRC)
00005DD:      Command    /3B 0A 00 00 00 00 00 80 00 (Wt Buf)
000061D:      Message-In /04 (Disconnect)
0000624:Bus Free
0000628:   Arbitration   /02 (1)
000062C:   Reselection   /82 (1,7)
0000634:      Message-In /80 (Identify : LUN  0 )
0000653:      DT-Data_Out/00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F
000065B:                  10 11 12 13 14 15 16 17 18 19 1A 1B 1C 1D 1E 1F
0000663:                  00 00 FF FF 00 00 FF FF 00 00 FF FF 00 00 FF FF
0000668:                  55 55 AA AA 55 55 AA AA 55 55 AA AA 55 55 AA AA
000066F:                  FF FF 00 01 FF FF 00 02 FF FF 00 04 FF FF 00 08
0000677:                  FF FF 00 10 FF FF 00 20 FF FF 00 40 FF FF 00 80
000067C:                  FF FF 01 00 FF FF 02 00 FF FF 04 00 FF FF 08 00
0000682:                  FF FF 10 00 FF FF 20 00 FF FF 40 00 FF FF 80 00
000068A:(000021)     CRC /E3 84 B4 2E
000068E:      Status     /00 (Good)
```


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```
0000696:      Message-In /00 (Cmd Cmplt)
000069C:Bus Free
```

3.2.4 Structured Display of SCAM Protocol

In the structured display, you will see the SCAM Protocol in plain English. A sample is shown below. During the Isolation phase, it is assumed that the identification string, after the 'type' code bytes, is printable ASCII, and is displayed that way. For the 'type' code, and for any non-printable character, the value is displayed in Hexadecimal between angle brackets **<xx>**.

Function codes are displayed both in Hexadecimal and in English. The Isolation phase is labeled as either 'Terminated' or 'Complete'. Command codes are given in English. In all cases, if an illegal handshake occurs, it is labeled as such. One example is at the end of the SCAM process, when the Master releases C/D.

```
00000: ---- Start Trace ----
00001: RESET Start
00002: RESET End
00002: Bus Free
00004:    Arbitration   /(no ID)
00005:    SCAM Selection
0000B:      SCAM Function : 1F Synch Pattern
00011:      SCAM Function : 00 Assign ID
00017:          Name : <12><00> ANCOT   SCAM Test 00001 (Complete)
000F8:             Assign ID 00
000FE:      SCAM Function : Invalid handshake
00102: Bus Free
00103: ---- End of Trace ----
```

Note that in order to analyze the SCAM Protocol, the trace needs to be recorded in the 'Capture SCAM Protocol' mode first.

3.3 THE BINARY DISPLAY FORMAT

If the Structured display format is compared to a computer program written in a high-level language, the Binary display format is like the same program written in assembly language. In the Binary format, each event captured gets one line of display. In this display format, you can see the exact state of each SCSI control line at the time of the event's capture, plus the state of the SCSI data lines and the Ancot expansion lines. Furthermore, the timing of the activity is shown,

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accurate to the 4ns resolution of the Ultra2160 Lite. There are several options in how the information is presented in the Binary format.
The control lines are shown in logic analyzer style, as a rectangular waveform traveling down the page. An active signal is shown as a thin line on the right side of the area dedicated to that control line. Inactive signals show as thick lines on the left side of their respective areas.

ST-Data can be shown as **wide** or **narrow.** If the wide data format is chosen, the low byte is shown first, separated from the high byte by a hyphen (-). If a **parity error** occurred, that is shown by an **asterisk (*)** following the offending byte. The asterisk (*) may replace the hyphen (-) separating the two bytes. The bytes are shown in hexadecimal first, followed by their ASCII equivalent in parentheses. DT-Data is always shown as Wide. The Bytes are shown without a space or hyphen. In the APE@ column, the AP/CRCA@ bit is shown.

Each line of display also shows the state of the three signals received through the expansion connector J2 (DB-15) marked as **'Exp'** in the examples below. E2 is the most significant bit, shown on the left of the triad. It is followed by E1 and then E0.

Time stamp information comes in either of two formats also. In the elapsed format, the total **elapsed** time since the start of the recording (modulo about 200 days) is shown in the time column. In the differential format, the time **differential** between the two events is shown in the time column. All times are expressed as decimal nanoseconds, with a space between each group of three digits. As an example, the "3 123 456 789" represents 3sec 123ms 456Fs 789ns.

If a less-than symbol ("<") appears to the left of the time stamp, the time exceeded approximately 83 seconds. To see the larger numbers of the time stamp, press the left or right arrow keys. The following illustration shows a time stamp with a large time.

```
<51  371  901  220    or  >  0h  01m  51s
  s   ms   Fs   ns
```

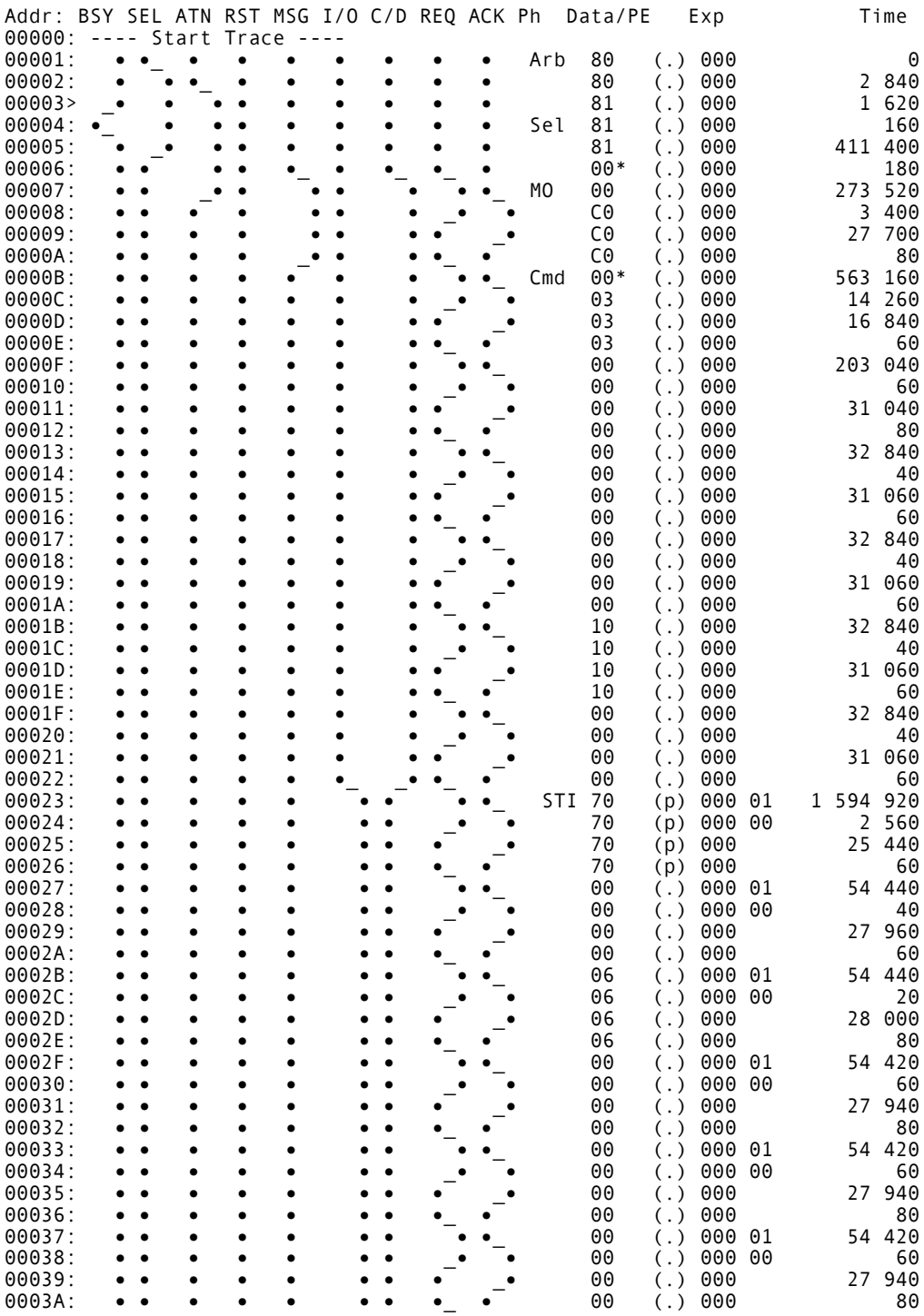
The total time shown by this time stamp is 0 hours, 1 minute, 51 seconds, 371 milliseconds, 901 microseconds, and 220 nanoseconds.

Each line of display shows whether the **data** byte on that line is **valid.** If it is valid, then the address on the left is followed by a right angle **bracket (>).** If not, the address is followed by a colon (:). The various display options are shown in the following sample displays.

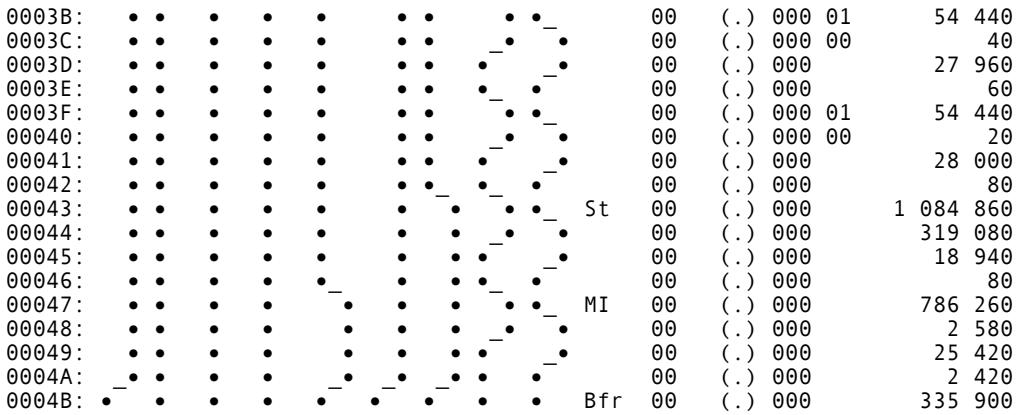
The display example on the next two pages shows the logic analyzer style of control signals, with 8-bit data and differential time display. This trace also shows the 'capture 4 edges REQ/ACK' and 'capture-all-data' modes of recording. Just to the right of the Exp column, during the data phase only, the current **REQ/ACK offset** is shown as a 2-digit hexadecimal number. This number is valid only in 4-edge mode. The number is generated from the recording of the REQ

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and ACK signals in the data phase; if the recording mode does not include 4-edge capture, the offset is not shown.



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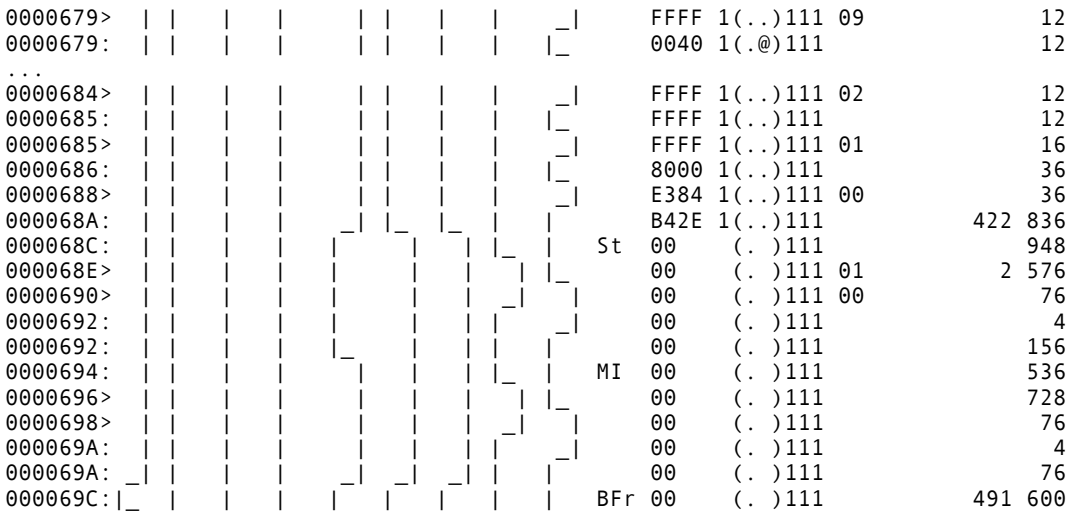


```
0003B:                                                  00   (.) 000 01       54 440
0003C:                                                  00   (.) 000 00           40
0003D:                                                  00   (.) 000          27 960
0003E:                                                  00   (.) 000              60
0003F:                                                  00   (.) 000 01       54 440
00040:                                                  00   (.) 000 00           20
00041:                                                  00   (.) 000          28 000
00042:                                                  00   (.) 000              80
00043:                                              St  00   (.) 000       1 084 860
00044:                                                  00   (.) 000         319 080
00045:                                                  00   (.) 000          18 940
00046:                                                  00   (.) 000              80
00047:                                              MI  00   (.) 000         786 260
00048:                                                  00   (.) 000           2 580
00049:                                                  00   (.) 000          25 420
0004A:                                                  00   (.) 000           2 420
0004B:                                              Bfr 00   (.) 000         335 900
```

The following example shows the start and the end of a DT transfer:

```
0000624:                                        BFr 00    (. )111           175 120
0000626:                                        Arb 02    (. )111             2 620
0000628:                                            02    (. )111             1 340
000062A:                                            82    (. )111               220
000062C:                                        Rsl 82    (. )111               460
000062E:                                            82    (. )111               300
0000630:                                            82    (. )111               120
0000632:                                        MI  80    (. )111               552
0000634>                                            80    (. )111             4 000
0000636>                                            80    (. )111                16
0000637:                                            80    (. )111                60
0000639:                                            80    (. )111            54 272
000063B:                                        DTO 8000 0(..)111               964
000063D:                                            8000 0(..)111 01             24
000063E:                                            8000 0(..)111                20
000063F:                                            8000 0(..)111 02             12
...
000064E:                                            8000 0(..)111 0E             12
000064F:                                            8000 0(..)111                12
000064F:                                            8000 0(..)111 0F             12
0000650:                                            8000 0(..)111                12
0000650:                                            8000 0(..)111 10          8 208
0000652>                                            0001 0(..)111 0F             28
0000653:                                            0203 0(..)111                12
0000654>                                            0405 0(..)111 0E             12
0000654:                                            0607 0(..)111                96
0000656:                                            0607 0(..)111                28
0000658:                                            0607 0(..)111 0F             12
0000658>                                            0809 0(..)111 0E              4
0000658>                                            0809 0(..)111                 8
0000659:                                            0A0B 0(..)111                 4
0000659:                                            0A0B 0(..)111 0F             12
000065A>                                            0C0D 0(..)111 0E             12
000065A:                                            0E0F 0(..)111                12
...
0000676:                                            0008 0(..)111 0C              8
0000676>                                            0008 0(..)111 0B              4
0000676>                                            FFFF 0(..)111                 8
0000677:                                            0010 0(..)111                16
0000678>                                            FFFF 1(..)111 0A             12
0000678:                                            0020 1(. )111                12
```


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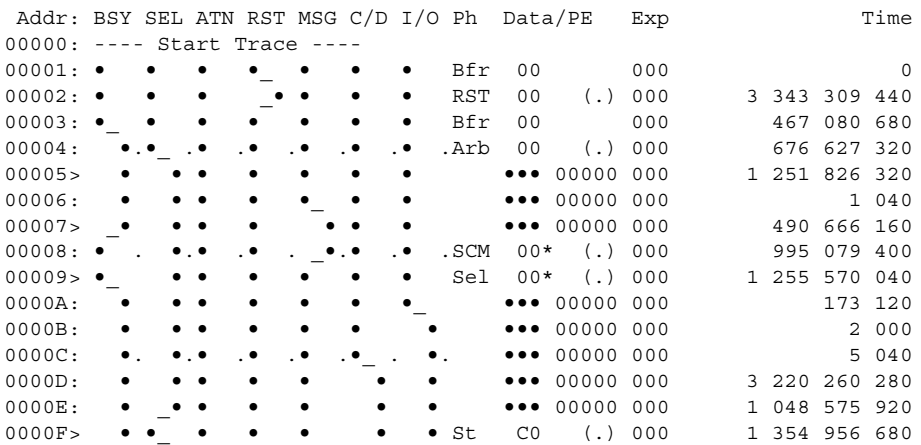


3.3.1 Binary display of the SCAM Protocol

In the binary display format, you will see the SCAM data handshake near the horizontal middle of the screen. The SCAM data and handshake take the place of the normal display of data in Hexadecimal and ASCII. Only the SCAM Selection is interpreted in the Phase column (between the SCSI control lines and the data). It is shown as SCM.

The handshake is shown as thick (active) or thin (inactive) lines for D7, D6 and D5 (left to right). The data is shown in binary from D4 to D0 (left to right). The event with valid data is shown with a square bullet between the handshake and the data. An example is shown below.

Note the short duration event at address 18. It seems that this is a spurious capture, since no change is evident from the preceding event. This is the "wired-or glitch" which must be filtered out by the software or hardware executing the protocol.



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```
00010>   •.  •.•  .•  .•  .  •.  •.    ••• 00000 000           113 200
00011>  _•   • •   •   •     •   •     ••• 00000 000       813 024 640
00012> •_    • •   •   •     •   • Rsl  80   (.) 000     2 766 584 680
00013:   •   • •   •   •     •   •     ••• 00000 000             40
00014:   •.  •.•  .•  .•  .  •.  •.    ••• 00000 000           2 120
00015:   •   • •   •   •     •   •     •••#11111 000     8 328 585 360
00016:   •   • •   •   •     •   •     ••• 11111 000         238 080
00017:   •   • •   •   •     •   •     ••• 11111 000           5 040
00018:   •.  •.•  .•  .•  .  •.  •.    ••• 11111 000              40
00019:   •   • •   •   •     •   •     ••• 11111 000     1 007 675 160
0001A:   •   • •   •   •     •   •     ••• 11111 000         254 880
0001B:   •   • •   •   •     •   •     ••• 11111 000       964 743 640
0001C:   •.  •.•  .•  .•  .  •.  •.    ••• 11111 000         370 920
0001D:   •   • •   •   •     •   •     •••#00001 000     4 042 006 880
0001E:   •   • •   •   •     •   •     ••• 00001 000         233 480
0001F:   •   • •   •   •     •   •     ••• 00001 000       974 504 720
00020:   •.  •.•  .•  .•  .  •.  •.    ••• 00001 000          11 320
00021:   •   • •   •   •     •   •     ••• 00001 000           5 600
00022:   •   • •   •   •     •   •     ••• 00001 000              40
00023:   •   • •   •   •     •   •     ••• 00001 000     1 048 285 480
00024:   •.  •.•  .•  .•  .  •.  •.    ••• 00011 000        29 362 200
00025:   •   • •   •   •     •   •     •••#00010 000     2 294 179 240
00026:   •   • •   •   •     •   •     ••• 00010 000         186 960
00027:   •   • •   •   •     •   •     ••• 00010 000           5 960
00028:   •.  •.•  .•  .•  .  •.  •.    ••• 00010 000           6 320
 .
 .
 .
0054D:   •   • •   •   •     •   •     ••• 11000 000     1 047 384 680
0054E:   •   • •   •   •    _•   •     ••• 11000 000        15 224 960
0054F:   •   • •   •   •   •     •     ••• 00000 000     3 568 099 800
00550:   •.  •.•  .•  .•  .•  .  •.    ••• 00000 000        13 596 000
00551:   •   • •   •   •   •    _•     ••• 00000 000       211 295 720
00552:   •  _• •   •   •   •   •       ••• 00000 000       225 573 840
00553>  _• •   •   •   •   •   •        00   (.) 000       310 410 400
00554: •  .•  .•  .•  .•  .•  .•  .Bfr  00       000       282 911 360
00555: ---- End of Trace ----
```

Note that in order to analyze the SCAM Protocol, the trace needs to be recorded in the 'Capture SCAM Protocol' mode first.

3.4 THE HEX DUMP FORMAT

The Hex display format is very compact but also hard to read. It is intended only for the most intractable problems. Each line of output shows the starting address plus the contents of trace memory for that address and for the following two addresses, each separated by slash.

The format of each event is: 2 longwords of 8 characters each.

```
0000002: 07C00000 00000000 / ACE00000 1D08ECE4 / 07E00000 00000000
0000005: 81F30000 1D08EED9 / 07F00000 00000000 / 860B0000 1D08F4E6
```


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```
0000008: 07F40000 00000000 / 806A0000 1D08F552 / 07D40000 00000000
000000B: AB8D0000 1DC7E0E1 / 07D00000 00000000 / 86150000 1DC7E6F8
000000E: 07F00000 00000000 / 80640000 1DC7E75E / 07F10000 00000000
0000011: 80F50000 1DC7E855 / 07A100C0 00200000 / 85FA0000 1DC7EE51
0000014: 07800000 00200000 / AEA30000 53559CF6 / 07C80000 00000000
0000017: 8A460000 5355A73E / 07C00000 00000000 / B5510000 69153C91
000001A: 07200080 00000000 / 807B0000 69153D0E / 07300080 00000000
000001D: 803D0000 69153D4D / 17300081 00200000 / 80030000 69153D52
0000020: 17100081 00200000 / B6B00000 69D8B404 / 17000000 00200000
0000023: 80150000 69D8B41B / 07800000 00200000 / B1CA0000 69D905E7
0000026: 07200080 00000000 / 807B0000 69D90664 / 07300080 00000000
0000029: 803C0000 69D906A2 / 17300082 00200000 / 80030000 69D906A7
000002C: 17100082 00200000 / AEF00000 69DC1599 / 17300082 00200000
000002F: 80070000 69DC15A2 / 17200082 00200000 / 87A40000 69DC1D48
0000032: 17260000 00200000 / 801A0000 69DC1D64 / 37261101 87A00000
0000035: 81460000 69DC1EAC / 07261101 9FA00000 / 80040000 69DC1EB2
0000038: 472600C0 1F21FFFF / 07261100 B8BF00C0 / 80010000 69DC1EB6
000003B: 07261100 C0BC00C0 / 80070000 69DC1EBF / 07221100 80A000C0
000003E: 801A0000 69DC1EDB / 27221101 87A000C0 / 80970000 69DC1F74
0000041: 47220012 3E2FFFFF / 80040000 69DC1F7A / 07221100 C0B80012
0000044: 80060000 69DC1F82 / 27221101 87A00012 / 80050000 69DC1F89
0000047: 47220000 3F270012 / 80040000 69DC1F8F / 07221100 C0BE0000
Addr   :  Ctrl     R A        Ctrl     R A        Ctrl     R A
```

3.5 THE COMPACT DISPLAY FORMAT

The compact display format is a condensed version, which can be used for viewing the captured SCSI activity with up to 24 commands per screen. Each recorded SCSI connection (from Bus Free to Bus Free) occupies only one line of display. You can use this format for previewing a certain area of trace memory, then switch to the Structured Display format or the Binary Display format to see it in more detail.

The information presented includes :

- Trace Memory Address of Start of Connection
- SCSI ID of Initiator and Target and direction of connection (i.e., Selection vs. Reselection)
- Command (CDB) transmitted
- Number of bytes of data transferred and the direction, In or Out
- SCSI Status transmitted
- Final Message of connection
- Elapsed time of connection

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Note that not all connections have all these types of information. Those which do not apply are left blank.

```
00000: ---- Start Trace ----
00001:  7->0 Req Sense       000012   I   Good      Cmd Cmplt        5 297 400
0002F:  7->0 Test U Rdy                 Good        Cmd Cmplt        1 406 200
00041:  7->0 Read/Rcv                               Disconnect         819 720
00052:  7<-0                 000200 I Good          Cmd Cmplt        2 464 400
              ...
00B0C:  7->0 Write/Send      000200 0 Disconnect    2 335 000
00D1E:  7<-0                          Good          Cmd Cmplt          946 480
                ...
07FFF:    ---- End of Trace ----
```

3.6 THE COMMAND PROFILE FORMAT

This format gives a graphical representation of the proportion of time spent in each phase. One full command is displayed on each screen, including disconnects, reselections, all information transfer phases, etc. The heading of the display shows the trace memory address range occupied by the command, the SCSI IDs of the Initiator and Target, and the opcode and interpretation of the command transmitted. This format assumes that each command is contiguous in the trace. If commands are interleaved, the resulting display is unpredictable.

The Command Total time is shown at the bottom of the screen. If one or more disconnects were involved in this command, then the Command Total will be shown as two values: first the time with disconnect included, followed by the time with disconnect excluded. The disconnect itself is shown on the line above the Command Total, both in raw time in nanoseconds, and as a percentage of total command time, including disconnects.

Each bar displayed also shows timing information, both in raw time in nanoseconds, and as a percentage of the total command time, excluding disconnects.

```
        SCSI COMMAND PROFILE

Trace Address     :  00040 - 0025B
IDs               :  I7 -> T0
Command Code      :  08 Read/Rcv
Data Transferred  :  512 Bytes

Arb/Sel:           71 600 ns         3.7%
ID Msg:            93 920 ns         4.9%
Command:          300 560 ns        15.9%
Data:             735 600 ns        38.9%
Status:           286 360 ns        15.1%
End Msg:          398 480 ns        21.1%
                      ••••••••••••

Cmd Total:               1 886 520 ns
```


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The following definitions of phases are used in calculating the timing:

Arb/Sel: from the assertion of BSY to the first event in Message-Out (for the Identify message).

ID Msg: from the start of the Message-Out phase to the first event which is neither Message-Out nor Message-In phase.

Command: from the first event in the Command phase to the first event not in Command phase.

Data: from the first event of either Data-In or Data-Out phase to the first event after the last event in the same phase, after subtracting any disconnect time.

Status: from the first event in Status phase to the first event not in Status phase.

End Msg: from the first event in the last Message-In phase of this command to the release of BSY (Bus Free).

Disconnect: from start of the Message-In phase for any disconnect message to the end of Message-In phase for the Identify message after reconnect. All such periods within this command are added together.

Command Total: from the assertion of BSY just before the Selection phase to the release of BSY after the Status phase. The time not including disconnect time is also shown for commands which involved a disconnect.

3.7 CHANGING THE DISPLAY FORMAT

The display format can be changed using the TRACE MEMORY DISPLAY FORMAT MENU. Access this menu from the main menu by pressing the **<F>** key, for "format". You can also access this menu after pressing **<D>;** then at the prompt for the display starting address, press **<N>.**

When in the TRACE MEMORY DISPLAY FORMAT MENU, use the up or down arrow keys to select an item to be changed, then use left or right arrow keys to change it. In a case of multiple choices, the left or right arrow keys will change the value by +1 or -1 respectively.

```
TRACE MEMORY DISPLAY FORMAT: [Structured]
••••••••••••••••••••••••••••••••••••••••
<0> - [24] Lines per page
<1> - Structured Display
<2> - Binary Display
<3> - Hex Dump Display
<4> - Compact Display
<5> - Command Profile
```


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```
Your selection (0../Quit) ?
```

<0> - Lines per page - controls the number of lines of display that will be printed between keypresses. The default number of lines is 24 decimal. If you change this value, your selection is saved in EEPROM to become the default next time you turn the Ultra-2160 Lite on. If you select value = 0, then display will run from the current line to the very end of the trace; this may be useful if you need to print the entire trace out using the **<^P>** option.

<1> - Structured Display - causes the next page of trace to be presented in Structured format.
<2> - Binary Display - causes the next page of trace to be presented in Binary format.

<3> - Hex Dump Display - causes the next page of trace to be presented in Hex Dump format.

<4> - Compact Display - causes the next page of trace to be presented in a Compact format, showing one SCSI command per line.

<5> - Command Profile - causes the next page of trace to display a timing analysis of a single SCSI command by phase.

See also Section 3.1 for other display options.

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SECTION 4

SEARCHING FOR EVENTS IN THE RECORDED TRACE

4.1 INTRODUCTION

The Ultra-2160 Lite provides a powerful, easy-to-use searching utility. Searching is assisted by a AWarpSearch@ (TM) hardware search engine. This feature provides you with the ability to 'home in' on the event of interest in your recorded trace, without needing to wade through the uninteresting events either before or after. You can specify the exact combination of phase and data pattern you are interested in. If the event exists in the trace, the corresponding part of trace memory will be displayed, and the found event line will be marked.

When you select FIND, from the main menu or from a display, the following menu is displayed:

```
      FIND SCSI EVENT MENU
••••••••••••••••••••••••••••••••••••••••••••••••••••••••••
Bus Free Phase          Command Phase
Attention Condition     Status Phase
Parity error            Message-In Phase
Arbitration Phase       Message-Out Phase
Selection Phase         Data-In Phase
Reselection Phase       Data-Out Phase
SCSI Reset Condition    Reserved Phase (In)
Trigger Condition       Reserved Phase (Out)
<X> - Trace PAUSE       Data only (ignore phase)
                        <Z> - Custom Control Bit Pattern
                                 xxxx   xxxx  00x0  xxxx
Your selection (0../Quit) ?
```

Use the arrow keys and move the bar to the event or phase you want. For a single-key selection, press the selector letter, underlined on the screen. Then press **<Enter>,** and the following options menu is displayed:

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```
SEARCH OPTIONS MENU
••••••••••••••••••••••••••                Command Phase
Data Bits Pattern                         ••••••••••••••••••••••••••
Wide data pattern [ ]              1 : xxxx xxxx   XX
Forward/Backward  [F]              2 : xxxx xxxx   XX
Occurrence        [ 1]             3 : xxxx xxxx   XX
Addr Range [      ]-[      ]       4 : xxxx xxxx   XX
Start Addr [      ]                5 : etc
```

If the phase or event you selected allows a data pattern, the cursor will be placed in the right side, to edit the pattern. Otherwise, the data pattern will be ignored. The top line, as the 'Command Phase' in the example above, indicates the selected phase to be used.

4.1.1 SELECT A CUSTOM CONTROL BIT PATTERN

Most of the patterns are self-explanatory, but a few need additional comments. Notice as you move the bar through the phase selections that the bit pattern, shown below the "Custom Control Bit Pattern", changes to match the trace event.

<N> - Attention condition. This event is matched when BSY and ATN are both active, and RST is inactive. This commonly occurs during Selection, and during extended messages, as well as when the Initiator needs to send a message to the Target.

<P> - Parity error. This event is matched when BSY is active, data are valid (qualified by REQ/ACK for data In/Out, and during Selection and Reselection), and parity is EVEN (the parity error bit is set) for the low byte of SCSI data. If wide data pattern is enabled, the parity error bit for the high byte of SCSI data is also examined.

<T> - Trigger condition. There is at most one matching event in any recorded trace. The direction flag is ignored in searching for this event. The search automatically proceeds in the correct direction.

<X> - Trace PAUSE. Each time recording is paused, an artificial event (PAUSE marker) is written into the trace memory.

<D> - Data only (ignore phase). This pattern ignores the state of the control lines MSG, C/D and I/O. However, BSY will be active, SEL and RST will be inactive, and the data transfer will be qualified by REQ/ACK for transfers In/Out. The data pattern specified can even span more than one phase.

<V> - Reserved Phase (In)

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<U> - Reserved Phase (Out). The ANSI SCSI specification leaves undefined (reserved for future standardization) two of the eight possible configurations of information transfer phases. These patterns are matched when MSG is active and C/D is inactive, and the state of I/O matches the (In) or (Out). Data will also be qualified by REQ/ACK for transfers In/Out.

<Z> - Custom Control Bit Pattern. Use this selection if none of the patterns matches the event phase you want to find. When you press **<Enter>** with the bar on the **<Z>** item, the following screen will be displayed:

```
res res res ATN   TRG E2  E1  E0   PEH PEL BSY SEL   RST MSG C/D I/O
 0   0   0   0     0   0   0   0    0   0   0   0     0   0   0   0
```

The E0, E1, and E2 are the signals on pins 1, 2, and 3 of the Expansion connector J2, at the time of capture of this event.

You can edit individual bits of the search phase pattern using the 0, 1 and X keys, then press **<Q>** to return to the big menu. Move within the pattern using the left and right arrow keys.

After you select the phase pattern, you will also be given the option of selecting a qualifying data pattern for that same event. The SEARCH OPTIONS menu will be displayed with the cursor waiting in the first data pattern field. The default pattern is all data as 'Don't Care' starting with "1: xxxx xxxx" (binary); you may specify up to 16 bytes. Change the data pattern or simply press **<Enter>** to ignore it. The cursor will move over the "Execute find" message.

Press **<Enter>** again to execute the search.

4.2 SELECT THE SEARCH OPTIONS

The FIND SCSI EVENT MENU gives a list of phases and conditions to search for. It also lists several options to control the search. The options are explained in detail in the paragraphs below.

- To accept the option default values, press **<Enter>** to execute the search. You may have to press **<Enter>** again if the event allows a data pattern.

- To change an option default value, use the selector letter to choose the option you want to modify. Use the **<Enter>** key to toggle or increment your choice. Then press **<Enter>** to execute the search.

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4.2.1 SEARCH FOR WIDE DATA PATTERN.

This selection, **<W>**, will affect searches only if the Data Bits Pattern is also specified. The default value is a 'blank', indicating that wide data pattern is not chosen. When **<W>** is not enabled, only the low byte of SCSI data will be considered in the search. If the wide data pattern is enabled, both the low byte (bits 0-7) and the high byte (bits 8-15) of the captured trace will be examined for the data pattern. When using wide data, bytes are assumed to arrive low byte first. The search is smart enough that a pattern which spans two or more transfers will be found, no matter whether the first byte of the pattern is in the low or high byte of SCSI data.

4.2.2 SET THE SEARCH DIRECTION

The currently selected direction of search is shown in brackets: [F] for forward, [B] for backward. The default is forward.

Press **<F>** to toggle between the F (forward) and B (backward) search direction.

4.2.3 SET THE OCCURRENCE COUNTER

If occurrence is set to 0 or 1, the search will find the next event matching the pattern. The default is 1. If set to any higher number n, the search will display only the nth event. After you choose **<O>** the cursor will move into the brackets; type your selection and press **<Enter>**. The maximum value is 99.

The occurrence counting is used by the FIND function when it is executed for the first time. Any subsequent FIND-NEXT or FIND-PREVIOUS function will search for the very first occurrence of the event, ignoring the occurrence counter setting.

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4.2.4 SET THE SEARCH ADDRESS LIMITS

It might take a very long time to search for a selected item if searching over the entire trace memory, especially if the trace memory is 512K events long. You may need to limit the search range.

The default limits are set to the beginning and the end of trace most recently recorded, and are shown in brackets in the 'Addr Range [ ]-[ ]' message.

To change the address range, press **<A>** and the cursor will move to the first set of brackets showing the default low limit address. Type a new value, then press **<Enter>**. The cursor will move to the other field and you can change the ending point of the search. Press **<Enter>** again to start the search. The analyzer will automatically reorder the start and end points if necessary.

4.2.5 SET THE SEARCH STARTING ADDRESS

The starting address is initially set to the same value as the address range low limit. It is updated every time a successful search is executed. If you need to start searching from a different part of the trace memory, press **<S>** and type in the new starting address value. Then press **<Enter>** to start the search.

4.2.6 SET THE DATA BITS PATTERN

When searching for certain phases (like Command, Data-In/Out, etc), usually you may need to define the desired data pattern. You can specify a string up to eight bytes long. Select this option in the OPTIONS menu by pressing **<D>**. The cursor also moves to the data selections automatically if you select an appropriate phase to search for. The data bytes are displayed in both binary and hexadecimal, the default values are all 'X' ("don't cares"). This pattern is used along with Data, Command, and several other search options.

Use the up and down arrow keys to select the byte to edit. Use the left and right arrow keys to edit within one byte. The display shows each bit of the pattern as 0,1 or x ("Don't care"). Change the bit under the cursor by typing a 0,1 or x, which replaces any value already there. To select the next byte and edit it, press the down arrow key. If no byte is already displayed, a "don't care" byte will be created there. The length of the search pattern string will be the number of bytes displayed on the screen. For example, if you want to search for a string of four bytes, where only the first two bytes are defined, set the first two bytes, then press the down arrow key twice, to add the third and fourth bytes with the "Don't Care" pattern, then press **<Enter>**. The following **<Enter>** will execute the search.

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To delete an undesired byte, place the cursor on the byte and press **<Ctrl-D>.**

The data pattern can also be edited in hexadecimal. Press **<H>** when in the bit pattern and the cursor will move back to the parentheses at the right. Enter a hexadecimal value. To move back to the binary pattern, press **<H>** again. Pressing **<Enter>** accepts the pattern as displayed. By pressing the **<Esc>** or **<Q>** key, you can cancel your selection (of all data bytes) at any time. After all bits are set, press **<Enter>** to exit from the edit mode, and press **<Enter>** again to execute the search.

EXAMPLE: Searching for a READ command (6 byte CDB) at LBA=35 hex:
Press **<C>** and **<Enter>** - this will position the cursor to the data fields. Type the first byte 00001000, **<9>**, XXX00000, **<9>**, 00000000, **<9>**, 00110101, **<9>, <9>, <Enter>, <Enter>**.

This will be displayed on the screen as follows:

```
Data-In Phase
••••••••••••••
1 : 0000 1000  08
2 : xxx0 0000  ?0
3 : 0000 0000  00
4 : 0011 0101  35
5 : xxxx  xxxx XX
6 : xxxx  xxxx XX
```

4.3 REPEATING THE SEARCH

After a successful search, you may want to find the next event which matches the same pattern. To do this, press **<Ctrl-L>.** The search will proceed in the same direction as the previous search. You can press **<Ctrl-K>** to search in the opposite direction.

The FIND-NEXT or FIND-PREVIOUS functions will always search for the first next or first previous occurrence; these functions do not use the occurrence counter.

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S E C T I O N 5

TRIGGERING

5.1 INTRODUCTION

All triggering control stems from the TRIGGER SETUP MENU. Triggering can only take place when the Ultra-2160 Lite is tracing, as shown by a lit 'Tracing' LED on the bottom left side of the front panel. See Section 2.2.2 for starting the trace.

5.2 TRIGGER SELECTIONS

Select the **<Trigger>** option from the main menu by pressing the **<T>** key and the following will be displayed:

```
TRIGGER SETUP MENU
----------------------------------------
<0> - Trigger Master Enable          [ ]
<1> - Post trigger delay    [   0%]  (E)
<2> -            until Bus Free      ( )
<3> - Trigger on RUN (immediate)     [ ]
<4> - External trigger input         [ ]
<5> - Parity error (low byte)        [ ]
<6> - Parity error (high byte)       [ ]
<7> - SCSI Reset                     [ ]
<8> - (Re)Selection Time-out         [ ]
<9> - Selection IDs      [0081]      [ ]
<A> - Reselection IDs    [0081]      [ ]
<B> - Message code In      [04]      [ ]
                  Out      [07]      [ ]
<C> - Command code         [12]      [ ]
<D> - Status code          [02]      [ ]
<E> -    Combine Cmd AND Stat        [ ]
<F> -    Combine IDs AND B/C/D       [ ]

Your selection (0../Quit) ?
```


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When the TRIGGER SETUP MENU appears, one entry will be highlighted with a bar of inverse video. That is the active selection. Use the up and down arrows to move the highlight bar, or press the selector key, shown in < > next to the item you want to change. With the highlight bar on the item you want to change, press the left or right arrows key to cycle through the options for that item. If the item has a numerical value associated with it, shown in [ ], and you want to edit that value, first press the **<Enter>** key; then type in the new value in Hex , and press **<Enter>** again to confirm the new selection.

When a trigger item is enabled, the letter 'E' appears in the brackets at the right side, next to that item. When an item is disabled, the brackets are empty.

Triggering can be completely disabled. In this case, tracing will be started or stopped only by pressing the **<S>** key. Disable the "Trigger Master Enable" option.

Once the trigger has been selected and enabled with *'<0> Trigger Master Enable',* press the **<Q>** key to return to the main menu. From there, press the **<R>** key to start tracing. The Ultra-2160 Lite will then start recording all SCSI bus activity until the trigger condition has been met. Once the trigger condition has been met, the Ultra-2160 Lite will continue recording until either the condition selected by item ***'<1>** Post trigger delay [nnn%]'* or ***'<2>** until Bus Free'* has been met. If ***'<2>** until Bus Free'* is selected, tracing will stop at the next Bus Free, thus placing the trigger point near the end of the trace. If '***<1>** Post trigger delay [nnn%]'* is selected, tracing will continue until the selected percentage of trace memory is filled. If 0% is selected, tracing will stop after 10 more events and the trigger will be at the end of the trace. If 100% is selected, tracing will continue until all but the 10 events before the trigger have been recorded. This will place the trigger event at the start of the trace.

On selecting '***<2>** Post trigger delay [nnn%]'*, you can place the trigger point anywhere in trace memory. In this manner, the desired amount of early-trigger or late-trigger delay can be selected.

Other items in the TRIGGER SETUP MENU are mostly self-explanatory. They are listed below.

<0> - Trigger Master Enable : When enabled, the selected trigger options are enabled. When disabled, no triggering will occur.

<1> - Post Trigger delay : This item specifies the amount of trace memory to use for recording following the trigger. It is specified as a percent of trace memory.

<2> - Until Bus Free : Stops tracing at the first Bus Free following the trigger event.

NOTE: item **<1>** and **<2>** are mutually exclusive and one or the other is always selected. These two selections control when recording stops following a trigger.

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<3> - Trigger on RUN (immediate) : This causes tracing to begin immediately after the "RUN" push button is pressed.

<4> - External trigger input : When enabled, a transition, low or high, at the external trigger connector (BNC) is a trigger condition.

<5> - Parity error, low byte : When enabled, a byte on the SCSI low data lines D0-7 and DPL with even parity is a trigger condition. Any SCSI information transfer phase, selection or reselection phase is a candidate for this trigger.

<6> - Parity error, high byte : When enabled, a byte on the SCSI high data lines D8-15 and DPH with even parity is a trigger condition if it occurs during a Data-In, Data-Out, or Reserved information transfer phase. Other phases are not candidates for this trigger.

<7> - SCSI Reset : When enabled, a transition to the active state of the SCSI RST line is a trigger condition.

<8> - (Re)Selection Time-out : When enabled, a failed selection or reselection attempt is a trigger condition. Failed selection is defined as no response, by making BSY active, for a period of more than 250 milliseconds after the calling device drops BSY with SEL active.

<9> - Selection IDs : When enabled, the pattern of data bits on the SCSI bus during selection is matched against the pattern shown in the first set of square brackets. If match is found, it becomes the trigger condition. Note that this is different from item <F> below, where the ID pattern is considered only in conjunction with the Message, Command or Status code. Note that the pattern selected for this item is duplicated for item <A>. It is not possible to set these for different patterns. This selection will also affect ID filtering, if that recording mode is enabled (see Section 2.2.5).

<A> - Reselection IDs : see **<9>** above.

<B> - Message code : When enabled, the pattern of data bits on the SCSI bus during either Message-In or Message-Out phase is compared to the pattern shown in the first set of square brackets. If it matches, it becomes a trigger condition.

<C> - Command code : see **<B>** above.

<D> - Status code : see **<B>** above.

<E> - Combine Cmd [AND] Status : Both, the matching Command code and the matching Status code must be present in the same command to cause triggering. Note that a disconnect is

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considered a change of command. Thus a setup requiring a Read Command code [08] and Good Status code [00] will not be detected on a command for which the target disconnects. However, Command [08] and Status [02] normally will be detected, because most such commands will not have any disconnect.

<F> - Combine IDs [AND] B/C/D : When enabled, the data pattern in **<9>** or **<A>** (Selection or Reselection IDs) MUST be present during Selection or Reselection in order for the matching of Message, Command or Status codes, whichever occurs first, to take effect. Note that this is different from items **<8>** and **<9>** above, where the ID is considered independently of the other trigger conditions enabled.

Whenever setting up trigger conditions, exercise care in your selections to avoid undesired synergistic effects between the conditions enabled. Consider carefully the event you are trying to key on, to enable properly the conditions which will trigger on that event.

5.3 TRIGGER EXAMPLES

5.3.1 LATE TRIGGERING

The problem : Target ID 2 on the bus is sending Check Condition Status even after a Request Sense command during the power-up sequence. This prevents the boot procedure from completing, and you want to find out what the cause is.

Set the trigger conditions as follows :

```
<0> - Trigger Master Enable     [E]
<1> - Post trigger delay [50%]  ( )
<2> -           until Bus Free  (E)
<9> - Selection IDs    [0084]   [E]
<D> - Status code        [02]   [E]
<F> -   Combine IDs AND B/C/D   [E]
```

All other conditions are disabled; this is shown by empty brackets at the right edge of the Trigger Menu.

This setup will start recording when you press <**R**>. SCSI events will fill space in the buffer, perhaps wrapping the circular buffer, until a command occurs involving Initiator ID=7 and Target ID=2, as specified by the 0084 in Selection IDs; this will result in a Check Condition Status, as specified by the 02 in Status Code. Recording will continue until the next Bus Free phase, and then stops. The final event address will be displayed on the screen as the

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Ultra-2160Lite informs you that the trigger condition has been met. You can then examine the trace to see what commands preceded the Check Condition Status (=02).

5.3.2 EARLY TRIGGERING

The problem : A command results in a condition which causes your SCSI driver to crash. You think it is because of linked commands with the flag bit set.

Set the trigger conditions as follows :

```
<0> - Trigger Master Enable     [E]
<1> - Post trigger delay [ 87%](E)
<B> - Message code         [0B] [E]
```

All other trigger conditions are disabled as shown by empty brackets at the right edge of the Trigger Menu.

This setup will start recording events as soon as you press <**R**>, and will continue recording all commands until one received with a message of 'Linked-Command-Complete-with-Flag', as specified by the '0B'(hex) in Message code. At that point, having previously selected a post trigger delay of 87%, you will be able to examine commands before the 'OB'(hex) message code. Your trace looks like this:

```
••••••••••••••••••••••••••••••
•          T                  •
••••••••••••••••••••••••••••••
|    13%   >       87%        |
```

Events will be recorded until the trace memory is completely full, and then will stop to prevent overwriting the trigger event. If you press **<S>** before the memory fills up, that will also halt tracing. You can then examine the trace to determine what happened after the suspect event.

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5.3.3 NO TRIGGER REQUIRED

The problem: occasionally the bus will hang. You want to find out the IDs involved in the transaction hanging the bus, the command causing the hang, etc.

No trigger is required for this problem. Set the '*Trigger Master Enable to [ ]'*. Start tracing by pressing **<R>**. The Ultra-2160 Lite will record all activity on the bus, wrapping the circular buffer each time it fills completely. When the bus hangs, press **<S>** to halt tracing. The message will tell you the ending address in the trace memory. This is always the maximum trace memory address if the memory wrapped. You can then examine the events just before that address to find the cause of the hanging bus.

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S E C T I O N 6

SCSI INITIATOR EMULATION

TBA

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SECTION 7

UTILITIES

7.1 INTRODUCTION

Several utility functions are provided in the Ultra-2160Lite. See Section 5 for a discussion of the built-in search capability. The other functions are described below.

7.2 CALCULATING ELAPSED TIME IN TRACE

This function can only be accessed from any screen of trace memory display by pressing **<^T>.**

You must enter two trace memory addresses, in either order. The utility then examines the time stamp for each event, and reports the time elapsed from the earlier event to the later event. Note that elapsed time is modulo about 170 seconds, the timer wrap-around period. Thus if the actual elapsed time was 175 seconds, the utility function will report a time of about 5 seconds.

```
CALCULATE TIME DIFFERENCE
      From address :  [    1]
        To address :  [000B0]
   Time difference : 1.689 994 440
```

The *'from'* and *'to'* addresses are automatically filled in as default values, and may be typed over. The *'from'* address is always = 1, and the *'to'* address is the currently used trace memory end. The time difference is shown down to nanoseconds. In the example above, it shows 1 second, 689 milliseconds, 994 microseconds, and 440 nanoseconds.

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7.3 THE UTILITY FUNCTIONS MENU

From the main menu, press **<Util>** or **<8>** or **<U>**. A second level menu will appear, the UTILITY FUNCTIONS MENU, in the following format:

```
UTILITY FUNCTIONS MENU
--------------------------------------
<0> - Ethernet setup
<1> - Echo trace display to printer [ ]
<2> - Show system configuration
<3> - Restore system defaults
<4> - Load new firmware
<5> - Remote control via serial port[ ]
<6> - Set serial port parameters
<7> - Set time/date

Your selection (0../Quit) ?
```

Make your selections either by entering the number directly (e.g., select **<3>** for "restore system defaults"), or by moving the highlight bar over the chosen line, using the arrow keys and pressing **<Enter>**. Individual functions are explained below.

7.3.1 <0> - Ethernet Setup

The Ultra2160Lite has a built in web server and FTP server. The web server allows you to control the Ultra2160Lite with a web browser and the FTP server allows you to upload and download files between a host and the Ultra2160Lite.

When using the web server, remember that more than one person may be connected to the unit at any one time. This feature can be an advantage if used properly. For axample, it allows a group of engineers to study the same trace and discuss the same situation. It also allows viewing a trace in more than one format, if, for example you use two browser windows and open the same trace but display it in different formats (e.g. one in structured, the other in binary format). This flexibility is an advantage however, care must be taken that users do not interfere. It is best if only one user controls the unit while the other users limit themselves to viewing.
Use functions in your browser to save copies of the trace to be used for later viewing or editing. Use the editing features in your browser if only a part of the trace is to be saved.

Select the <0> from the Utilities menu, and the following sub-menu will be displayed:

```
Web Server Status: STOPPED
 <0> - Start      ( )
```


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```
 <1> - Stop       ( )
 <2> - No Change  ( )

FTP Server Status: STOPPED
 <3> - Start      ( )
 <4> - Stop       ( )
 <5> - No Change  ( )

 <6> - My IP Address [192.168.  0.  0]
 <7> -       IP Mask [255.255.255.  0]
 <8> -       Gateway [192.168.  0.254]
 <9> - Ultra2160 Name[Ancot Ultra2160  ]

 <A> - Start Web server on power up  [ ]
 <B> - Start FTP server on power up  [ ]

Your selection (0../Quit) ?
```

This menu allows you to setup the Ethernet port and the servers in your Ultra2160 Lite. It also shows the current status of the web server and the FTP server (either STOPPED or RUNNING). You may start or stop one or both servers by checking the appropriate boxes. You must also set a valid IP address (My IP Address, Mask, and Gateway) for this particular Ultra2160 Lite. Consult your system administrator in order to obtain a valid IP address. In addition, you may configure the Ultra2160Lite to automatically start up one or both of the servers after power on. The default is NOT to start the servers.

When the Ultra2160Lite web server responds to a request, a packet is sent to the originating (destination) IP address. If both the Ultra2160Lite and the destination address are on the same network, the packet is sent to the destination IP address. If they are not on the same network, the packet is sent to the IP address of a gateway. The gateway will forward the packet. The mask is used to determine if the destination IP address is on the same network. A value of 255 means to match the corresponding value exactly, and a value of 0 means to ignore the value. For a value of 255.255.255.0, this means that the first three numbers must match exactly. For this mask, this gives a range of 256 IP addresses.

IP Address The IP address of the Ultra2160Lite on your local network. See your system administrator to obtain a valid IP address.
Mask The mask for your IP address. A value of 255 is an exact match. A value of 0 is ignored.
Gateway Address The IP address to send the packet to if the destination is not on your local network. The gateway will forward the packet.
Network Name This is a local name which you can assign to the Ultra2160 Lite. If you hard code a network name, set this string to match.

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The factory default IP address is 192.168.0.0. This is an Ancot assigned private address which should only be used in private settings, in LAN within an enterprise, where it would be unique. This address may run into conflict situations in settings where more enterprises are involved.

After entering the IP address and checking the desired selection boxes, press **<q>** (for Quit) to apply the settings and exit. Pressing **<ESC>** will not change anything and will return you to the main menu. Physical connection of the Ultra2160Lite to your network by is by cable connected to the RJ45 connector on the front panel. The Ethernet hardware will automatically detect the proper speed of your network (either 10 or 100 Mbit Ethernet).

When System Defaults are restored, both servers will be stopped (now and after power up), and Ancot factory default IP address will be set.

7.3.2 <1> - PRINT DISPLAY INFORMATION

You can print a hard copy of the trace information, just as it appears on the screen. A message near the bottom of the screen tells if printing is enabled. When it is, each line of trace memory displayed to the screen will also be sent to the parallel printer connector. Some displays use the IBM PC Extended Character Set for ASCII graphics. Be sure that your printer has this font selected. All trace display formats can be printed except the 'Command Profile'.

Printing can be enabled or disabled by pressing **<Ctrl-P>.** Another method is selecting item **<1>** in the UTILITY functions menu. The **<Enter>** key toggles between enabled shown as 'E' in the brackets, and disabled shown by empty brackets.

7.3.3 <2> - SHOW SYSTEM CONFIGURATION

Choosing this option will display on the screen all of the system options retained through the power Off-On cycle, stored in non-volatile memory. Scroll through the screens with **<Next>** or **<Prev>**. To print the configuration, enable printing before you choose this menu selection.

You can also see the default values for the system configuration. Press **<F>** to toggle between defaults and current values.

7.3.4 <3> - RESTORE SYSTEM DEFAULT PARAMETERS

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With this selection, all of the variables stored in EEPROM will be restored to their default values. Similarly, the variables in SRAM are restored to the power-on state.

7.3.5 <4> - LOAD NEW FIRMWARE

With this function you can download a new firmware version into the Ultra-2160Lite flash memory. You will be asked to confirm your choice. Read Section 8.6 for a more detailed description.

7.3.6 <5> - REMOTE CONTROL FROM AN EXTERNAL HOST (PC) or USING THE Ultra2160Lite AT A REMOTE LOCATION

This cannot be disabled in the Ultra2160Lite.

7.3.7 <6> - SET SERIAL PORT PARAMETERS

With this option you can specify the exact RS-232 protocol to be used for transfers, including baud rate, number of data bits, stop bits, and parity.

A list of the current settings will appear on the screen. Use the up or down arrows to move the highlight to the item you wish to change. Use the left or right arrows to scroll through the available options for that item. When all items are correct, press **<Enter>** to record them and exit. The settings are also stored in non-volatile EEPROM memory and will be used as a default the next time you do any communications, even after power OFF/ON.

The following settings are selectable:

Baud rates : 110, 300, 600, 1200, 2400, 4800, 9600, 38.4k, or 115.2k
Number of data bits : 5, 6, 7 or 8
Parity : even, odd or none
Stop bits : 1 or 2

When shipped from the factory, the Ultra2160Lite default setting is:

9600 baud
8 data bits

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no parity
1 stop bit

NOTE: While some communications programs allow setting the 115.2k baud, some computers may not be able to use this rate. This may result in lost characters or cause the computer to "hang". If this happens, use a lower baud rate.

7.3.8 <7> - Set Time/Date

With this selection you can change the date and time on the Ultra2160Lite. These entries are used by the disk software to assign a creation date and time for any saved traces or setups.

A one-line display appears below the utilities menu as shown here:

```
SET TIME & DATE:   15:01:37,  Tue,  Mar 11, 1997
```

The field currently being edited appears in reverse video. The up and down arrows change the value in the highlighted field, and the right and left arrows move to the adjacent field. AQ@ exits and saves the settings.

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SECTION 8

INSTALLATION

8.1 UNPACKING

Inspect the shipping carton for signs of damage before opening. If there is any evidence of damage, notify the carrier and Ancot immediately.

Remove the instrument and all accessories from the shipping carton, and compare the contents with the parts list accompanying the package, or listed on the packing slip. If any equipment is missing, contact the Ancot local representative, or Ancot directly as soon as possible.

You may want to save the shipping carton for return of the equipment for factory service, if that is required.

8.2 INITIAL TURN-ON

Turn the power ON. During the Power-UP sequence, all memories in the system are diagnosed automatically. You will be notified at this time if any errors are detected by the Power-UP diagnostic. If no errors are detected, the main menu will be displayed on the screen.

If you use a printer, connect it by a standard PC/AT printer cable to the DB-25 parallel port connector on the back panel of the Ultra-2160Lite. The printer should be any standard parallel type. For the parallel DB-25 connector pinout see Appendix A.

The unit has all setup values preset to their defaults at the factory; all basic functions should be operational. However, setup values may be changed using the various selections in the individual menus, or directly from the main menu.

Turn on the Ultra2160Lite by using a null cable (see a description in Appendix A) and connecting the external host (PC) to the Serial-1 port on the back panel of the Ultra2160Lite.

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Connect the external power supply to the 5-pin DIN power connector on the back panel of the Ultra2160Lite, and plug its power cord in the 110/220V outlet. The external power supply is auto-ranging. Turn the host on and start the communications program, PROCOMM or similar. See Appendix G for the PROCOMM setup and operation description. You should get the first screens on your host. From here on, everything is the same as with the Ultra2160Lite.

8.3 INITIAL CHECK-OUT

Connect a SCSI cable to an active SCSI bus. Be sure that the termination is appropriate. The TERMPWR LED on the back panel should be on.

Press **<R>**. Allow enough time for some activity to occur on the SCSI bus. You will see the SCSI Control and Data LEDs flash on and off with the activity. Press **<S>**. A message will appear on the screen showing the end address of the recording. If this address is 0 or 1, contact the factory.

Press **<D>** and **<Enter>**. You will see the recorded trace. Press **<F>** to change the display format. You may want to experiment with other recording modes and with triggering at this point.

8.4 COMMUNICATION, INTERFACING, AND SETUP

When using a remote CRT terminal or PC connected via the Serial-1 port directly or over a modem, use a compatible communication format and protocol. To help you install, the Serial-1 I/O port is programmed at the factory to a default set of parameters. These are:

Serial-1 port:	9600 baud
	8 data bits
	no parity
	1 stop bit
	RTS and CTS is not used

Note that Serial-1 when communicating with a CRT terminal uses the X-On/X-Off protocol; only signal pins 2 and 3 are used.

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Selections described above are stored in the non-volatile EEPROM, and do not need to be selected again, unless different values are required. Set different parameters using *'<6> - Setting Serial Port Parameters'* from the Utilities menu. See Section 7.3.7.

If you have problems communicating with the Ultra2160Lite because the serial port is configured wrong, press the SCSI RESET push button and hold it down while resetting the unit with the SYSTEM RESET push button. You may do the same by turning the power off and on again, while holding the SCSI RESET. This sequence will reset the Serial-1 port to its default setting, 9600 baud.

8.5 EPROM UPGRADES

Flash memory holds the executable programs that control all operation of the Ultra2160Lite Analyzer. Flash memory also holds the boot routine used for power up during normal operation. The EPROM holds the primary (very basic) boot code used only when there is no valid code in flash memory. After a valid executable program, including boot, is loaded to flash memory, the EEPROM takes over.

We expect that the user will never need to replace the EPROM with the primary boot code. However, in this chapter we describe the procedure for replacing the EPROM just in case.

The following instructions explain how to install an updated primary boot code EPROM into your Ancot Ultra2160Lite SCSI Bus Analyzer. If you decide that you want the factory to install your upgrade for you, contact Ancot directly.

- Remove the top cover.

- Make sure that all cables are disconnected from the front plate, including the power cable.

- Locate the main circuit board. It is the largest PCB, attached directly to the metal pan on the bottom. Find the firmware EPROM to be replaced: it is the big 32-pin (.600") chip

  on the left side of the main PCB, with an Ancot label. It has the Ultra2160Lite instrument identification and firmware revision number printed on it. Use a flat blade screwdriver to disengage the EPROM from its socket.

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- Insert the new version EPROM into the same socket. The small notch on the ceramic DIP chip should be on the same side with the marker on the PCB; orientation is the same as for the other chips on that PCB. Be sure that all the pins are aligned with the holes in the socket, before pressing the chip firmly into the socket. Check the pins again to be sure none of them were damaged during insertion.

- To verify correct installation, apply power and the unit should display the main menu with the new revision number in the bottom right corner. Then remove the power cable again.
- Replace the top cover.

Your Ultra2160Lite is now ready for use with the upgraded firmware.

8.6 FIRMWARE UPGRADES (Flash Memory)

Flash memory holds the executable programs that control all operation of the Ultra2160Lite Analyzer, and the hard disk contains other files used by the system (Help files, Web pages, etc.). The flash memory also holds the boot routine used on power up during normal operation. In order to upgrade the Ultra2160Lite operation, new firmware must be downloaded to the Flash memory through the Serial-1 port. Downloading new firmware at 115.2k baud will take about 90 seconds.

The download program can be entered by selecting **<5>** *Load new firmware'* from the Utilities menu. Another method of entering the download program is to press the SYSTEM RESET button on the Ultra2160Lite back panel, and then press the **<Esc>** key or the **<q**> key when the following message appears:

To download new firmware press ESC or Aq@ now!!

This message will last for about 2 seconds.
Once the download program has been entered, use the up and down arrows to select the fastest baud rate your communications program can use, and press **<Enter>.** Then press **<Y>** to put the Ultra2160Lite in the download mode. The message *"Waiting for S-Records"* will appear. At this point, start the download from the PC using the communications program with the baud rate set to match that on the Ultra2160Lite. The file to download is supplied as "u2160.chk" by Ancot.

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The progress of the download will be displayed on the screen. At the completion of downloading, the system will re-boot with the new firmware.

At this point, you must download the file Aancot.sys@ to the root directory of the Ultra2160Lite hard disk (AC:\@). The file Aancot.sys@ is a self extracting file which will install the necessary files during the next reboot.

The file Aancot.sys@ can be downloaded through the serial port using 1K Xmodem download protocol or through the Ethernet port using FTP. In either case, all settings were changed to the factory defaults after downloading the program (Au2080.chk@). You will have to change the serial port or the Ethernet settings to the desired values.

If you choose to download Aancot.sys@ using the serial port do the following:

1. Set the serial port to the proper settings (from the main menu, choose <8> - Utilities then choose <6> - Set serial port parameters). 115KBaud is recommended.

2. Start the download on the Ultra2160Lite (from the main menu, choose <3> - Save / Restore trace, then choose <6> - Download File (XMODEM Transfer).

3. On your computer, start the 1K Xmodem download of the file Aancot.sys@.

4. When the transfer is complete, re-boot the Ultra2160Lite by pressing System Reset. During the boot process, the Ultra2160Lite detects the presence of the file Aancot.sys@ and asks you if the new files are to be installed. Click < OK > or press return and the new files will be installed and the file Aancot.sys@ will be renamed to Aancotsys.bak@.

8.7 INSTALLING THE FLOPPY DISK DRIVE

Install the optional floppy disk drive by connecting one end of the supplied cable to the drive, and the other end to the PARALLEL PRINTER connector on the front panel of the Ultra2160Lite.

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The floppy diskettes are DOS compatible and may be used on any PC.

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A P P E N D I X A

EXTERNAL CONNECTOR PIN ASSIGNMENT AND CABLES

A.1 I/O INTERFACE CONNECTORS

Parallel PRINTER Port (DB•25)

1	STB•	14	AFD•
2	PD0	15	ERR•
3	PD1	16	INIT•
4	PD2	17	SLIN•
5	PD3	18	GND
6	PD4	19	GND
7	PD5	20	GND
8	PD6	21	GND
9	PD7	22	GND
10	ACK•	23	GND
11	BUSY	24	GND
12	PE	25	GND
13	SLCT		

Serial-1 I/O Port RS•232 (DB•9)

1	DCD
2	RXD
3	TXD
4	DTR
5	Signal GND
6	DSR
7	RTS
8	CTS
9	RI

A.2 AUXILIARY CONNECTORS

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```
Expansion Port (DB•15)
••••••••••••••••••••••••••••••••••••••••••••••
1     bit 0             9     +5 Volt   *
2     bit 1             10    Signal GND
3     bit 2             11    Reserved
4     Reserved          12    Reserved
5     Reserved          13    Reserved
6     Reserved          14    Signal GND
7     Reserved          15    +5 Volt   *
8     Reserved
_____________________
*) Up to 100 mA is available from this Vcc source.


External TRIGGER INPUT (BNC)
••••••••••••••••••••••••••••••••••••••••••••••
center pin  • Ext.Trigger signal
shell       • Chassis GND
```

The signal should be TTL level. It is received in the input side of the LS14-type receiver. This line is internally pulled up by a 1k ohm resistor to the +5 volt level.

```
External SYNCH OUTPUT (BNC)
••••••••••••••••••••••••••••••••••••••••
center pin • Ext.Synchr signal
shell      • Chassis GND
```

The signal is a standard TTL level, driven by a 20 mA driver.

```
5-VOLT DC POWER INPUT (5-pin DIN)
••••••••••••••••••••••••••••••••••••••••
1     +5 volt
2     GND
3     GND
4     GND
5     +5 volt
```

A.3 SINGLE-ENDED/LVD CONNECTORS

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68-pin HD 'P' type for S-E (Single-Ended)

1	GND	35	D12•
2	GND	36	D13•
3	GND	37	D14•
4	GND	38	D15•
5	GND	39	DPAR1•
6	GND	40	D0•
7	GND	41	D1•
8	GND	42	D2•
9	GND	43	D3•
10	GND	44	D4•
11	GND	45	D5•
12	GND	46	D6•
13	GND	47	D7•
14	GND	48	DPAR•
15	GND	49	GND
16	DIFFSENS	50	GND
17	TERMPWR	51	TERMPWR
18	TERMPWR	52	TERMPWR
19	open	53	open
20	GND	54	GND
21	GND	55	ATN•
22	GND	56	GND
23	GND	57	BSY•
24	GND	58	ACK•
25	GND	59	RST•
26	GND	60	MSG•
27	GND	61	SEL•
28	GND	62	C/D•
29	GND	63	REQ•
30	GND	64	I/O•
31	GND	65	D8•
32	GND	66	D9•
33	GND	67	D10•
34	GND	68	D11•

68-pin HD ›P: type for the LVD (Low Voltage Differential)

1	D12+	35	D12-
2	D13+	36	D13-
3	D14+	37	D14
4	D15+	38	D15-
5	DPAR1+	39	DPAR1-
6	D0+	40	DO-
7	D1+	41	D1-
8	D2+	42	D2-
9	D3+	43	D3-
10	D4+	44	D4-
11	D5+	45	D5-
12	D6+	46	D6-
13	D7+	47	D7-
14	DPAR+	48	DPAR-
15	GND	49	GND
16	DIFFSENS	50	GND
17	TERMPWR	51	TERMPWR
18	TERMPWR	52	TERMPWR
19	open	53	open
20	GND	54	GND
21	ATN+	55	ATN-
22	GND	56	GND
23	BSY+	57	BSY-
24	ACK+	58	ACK-
25	RST+	59	RST-
26	MSG+	60	MSG-
27	SEL+	61	SEL-
28	C/D+	62	C/D-
29	REQ+	63	REQ-
30	I/O+	64	I/O-
31	D8+	65	D8-
32	D9+	66	D9-
33	D10+	67	D10-
34	D11+	68	D11-

A.4 DIFFERENTIAL HVD CONNECTORS

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68-pin HD 'P' type for the HVD
(High Voltage Differential)

1	D12+	35	D12•
2	D13+	36	D13•
3	D14+	37	D14•
4	D15+	38	D15•
5	DPAR1+	39	DPAR1-
6	GND	40	GND
7	D0+	41	D0•
8	D1+	42	D1•
9	D2+	43	D2•
10	D3+	44	D3•
11	D4+	45	D4•
12	D5+	46	D5•
13	D6+	47	D6•
14	D7+	48	D7•
15	DPAR+	49	DPAR•
16	DIFFSENS	50	GND
17	TERMPWR	51	TERMPWR
18	TERMPWR	52	TERMPWR
19	open	53	open
20	ATN+	54	ATN•
21	GND	55	GND
22	BSY+	56	BSY•
23	ACK+	57	ACK•
24	RST+	58	RST•
25	MSG+	59	MSG•
26	SEL+	60	SEL•
27	C/D+	61	C/D•
28	REQ+	62	REQ•
29	I/O+	63	I/O•
30	GND	64	GND
31	D8+	65	D8•
32	D9+	66	D9•
33	D10+	67	D10•
34	D11+	68	D11•

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A P P E N D I X B

USING THE PC & PROCOMM or Win95 HYPERTERMINAL

There are several communications programs which could be used for the remote control or up/downloading of programs or traces from/to the Ultra-2160 Lite analyzer. In this Appendix, we will describe using the PROCOMM program and the Windows95 HyperTeminal, as examples.

B.1 REMOTE CONTROL - USING THE PROCOMM

B.1.1 SETTING UP PROCOMM OPTIONS

First, we assume that your copy of PROCOMM has been installed properly. Start the program by typing **PCPLUS** followed by **<Enter>**, and the initial screen will be displayed. Then press any key to enter the terminal emulation mode. There is a good chance that the PROCOMM interface is set up the way you need it, and that PROCOMM displays a good screen.

If you need to change the baud rate of PROCOMM to match that of the Ultra-2080, enter **<Alt-P>** and choose the correct settings.

However, if the setup of PROCOMM is wrong, almost any kind of erratic behavior can be expected. To correct it, type **<Alt-S>** and you will enter the PROCOMM SETUP so that you can select correct options. The following menu will be displayed:

```
   MODEM OPTIONS
<  TERMINAL OPTIONS
<  DISPLAY/SOUND OPTIONS
<  GENERAL OPTIONS
   HOST MODE OPTIONS
<  FILE/PATH OPTIONS
   COLOR OPTIONS
<  PROTOCOL OPTIONS
   EDITOR OPTIONS
   SAVE SETUP OPTIONS
```

You need to edit only the few selections marked by '<' above.
A. TERMINAL OPTIONS:

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```
A - Terminal emulation          VT-100
B - Duplex                      FULL
C - Soft flow ctrl (XON/XOFF)       ON
D - Hard flow ctrl (RTS/CTS)        OFF
E - Line wrap                   ON  (Don't Care)
F - Screen scroll               ON  (Don't Care)
G - CR translation                  CR
H - BS translation                  NON-DESTRUCTIVE
I - Break length (millisecs)        350 (Don't Care)
J - Enquiry (ENQ)               OFF (Don't Care)
K - EGA/VGA true underline      OFF (Don't Care)
L - Terminal width                  80  (Don't Care)
M - ANSI 7 or 8 bit commands        8 BIT
```

B. DISPLAY/SOUND OPTIONS

In this options menu, all selections are "Don't Care", except the 'F'.
Set it as follows:

```
F - Status line                 OFF
```

C. GENERAL OPTIONS

In this options menu, all selections are "Don't Care", except the 'B'.
Set it as follows:

```
B - CD high at exit             IGNORE
```

D. FILE/PATH OPTIONS

We recommend that you check the selected download path. The default path for the downloaded file is:

```
C:\PCPLUS\DOWNLOAD
```

You should change it to whichever directory you prefer to use.

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B. PROTOCOL OPTIONS

When selected, the following sub-menu will be displayed first:

```
  GENERAL OPTIONS
< ASCII PROTOCOL OPTIONS
  KERMIT PROTOCOL OPTIONS
  ZMODEM PROTOCOL OPTIONS
  EXTERNAL PROTOCOL OPTIONS
```

Select ASCII PROTOCOL OPTIONS and the following detailed selection sub-menu will be displayed. All selections here are "Don't Care", except the ones listed below.
Set them as follows:

```
D - Character pacing (millisec)  0
E - Line spacing (1/10)          0
G - Strip 8th bit                NO
I - CR translation (upload)      NONE
J - LF translation (upload)      NONE
K - CR translation (download)    NONE
L - LF translation (download)    NONE
```

When finished with all these selections, press **<Esc>** three times and save changes when prompted, or when PROCOMM returns to the terminal emulation screen.

The next two sections describe how to execute the SAVE TRACE TO HOST (upload) and RESTORE TRACE FROM HOST (download) functions using the PROCOMM program. It is assumed that you correctly connected together the serial ports of the Ultra-2160 Lite and the PC. Use the serial straight through cable supplied by Ancot (see the pinout in Appendix A) and connect the SERIAL-1 DB-9 connector on the Ultra-2160 Lite to the COM port on the PC.

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B.1.2 SAVE TRACE TO HOST

B.1.2.1 ASCII TRANSFER

ON THE PC:

- start PROCOMM as described in setup, and enter the terminal emulation mode.
- press **<PgDown>** to activate the upload function.
- select **<A>** for ASCII format from the intermediate menu (all Ultra-2160 Lite data formats are printable ASCII as transferred on the line).
- as a response to the prompt, type the filename where you want to save the trace.
- at this point, hold off pressing the **<Enter>** until the Ultra-2160 Lite is ready.

ON THE Ultra-2160 Lite:

Starting from the main menu

- select file
- select ASend Trace@
- select ASerial Port (ASCII)@. You can select any other format, but remember that only the raw data format can be restored.
- select the starting and ending addresses to the define section of the trace to be saved. (the default would be the full size used)
- select <OK>
- at this point, **hold off confirming** the transfer (i.e., do NOT press **<Y>** !!) until the PC is ready.

ON THE PC:

- press **<Enter>** to start the upload function.

ON THE Ultra-2160 Lite:

- press **<Y>** to see the address counter on the Ultra-2160 Lite counting and the data being listed on the PC. When the transfer is finished, message **"- finished -"** will be displayed on the Ultra-2160 Lite screen, and the EOT character (**ì**) will be displayed after the last data line on the PC.

Press **<Esc>** on the PC to stop the transfer and save the file.
The trace is now saved on the PC in the designated file.
Exit PROCOMM by typing **<Alt-X>** on the PC.
Return to the main menu on the Ultra-2160 Lite by typing **<Esc>**.

B.1.2.2 XMODEM TRANSFER

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ON THE PC:

- start PROCOMM PLUS, as described in setup, and enter the terminal emulation mode.
- press **<PgDown>** to activate the upload function.
- select **<X>** for XMODEM
- as a response to the prompt, type the filename where you want to save the trace.
- at this point, PROCOMM will display a progress box and wait for the transfer to begin.

ON THE Ultra-2160 Lite:

Starting from the main menu

- select AFile@
- select ASend Trace@
- select ASerial Port (XMODEM)@
- select the starting and ending addresses of the section of the trace to be saved (the default is the full trace)
- select <OK>
- at this point, the XMODEM transfer should start.

You will see the address counter on the Ultra-2160 Lite counting, and the progress box in PROCOMM will be counting. When the transfer is finished, you can exit PROCOMM by typing **<Alt-X>** on the PC. You can return to the main menu on the Ultra-2160 Lite by typing **<Esc>.**

B.1.3 RESTORE TRACE FROM HOST

B.1.3.1 ASCII TRANSFER

ON THE PC:

- start PROCOMM and enter the terminal emulation mode
- press **<PgUp>** to activate the download function
- select **<A>** for ASCII format from the intermediate menu (all Ultra-2160 Lite data formats are in ASCII as transferred on the line)
- in response to the prompt, type in the filename where the previously saved trace was stored
- at this point, **hold off pressing <Enter>** until the Ultra-2160 Lite is ready.

ON THE Ultra-2160 Lite:

From the main menu on the Ultra-2160 Lite:

- select AFile@
- select AReceive Trace@

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- select ASCII transfer
- press **<OK>** to confirm the start of transfer.

ON THE PC:

- press **<Enter>** on the PC to start the restore operation.

ON THE Ultra-2160 Lite:

The address counter on the Ultra-2160 Lite will count as the data is being transferred. When finished, the Ultra-2160 Lite clears the screen and returns to the main menu.

The trace has now been restored to the Ultra-2160 Lite trace memory and can be displayed using **<D>**.

Exit PROCOM by typing **<Alt-X>** on the PC.

B.1.3.2 XMODEM TRANSFER

ON THE Ultra-2160 Lite:

From the main menu

- select AFile@
- select AReceive File@
- select Xmodem transfer
- at this point, the Ultra-2160 Lite is waiting for the transfer to begin.

ON THE PC:

- start PROCOMM (as described in setup) and enter the terminal emulation mode
- press **<PgUp>** to activate the download function
- select **<X>** for XMODEM
- responding to the prompt, type the filename where the previously saved trace was stored
- at this point the transfer should start and PROCOMM will display a progress box.

You will see the address counter on the Ultra-2160 Lite counting, and the progress box in PROCOMM will be counting. When the transfer is finished, exit PROCOMM by typing **<Alt-X>** on the PC. Return to the main menu on the Ultra-2160 Lite by typing **<Esc>**.

B.2 REMOTE CONTROL - USING THE Win95 HYPERTERMINAL

The following is a step by step procedure for successfully setting up your unit to run remotely with HyperTerminal.

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Step 1: Turn the power to the Ultra2160 Lite on and attach the Ancot serial cable to the serial port on the Ultra2160 Lite.

Step 2: While your PC is off, insert the other end of the Ancot serial cable into an available COM port on your PC.

Step 3: Turn on your PC and select the Hypertrm icon (under Start / Programs / Accessories / /HyperTerminal). HyperTerminal will walk you through a set-up sequence for a new connection.

Step 4: In the dialog box titled "Connection Description" (if you don't see it pull it up by selecting File/New Connection). Enter a name that you will remember (e.g.U2160 Lite), and select an icon.
Click on the "OK" button.

Step 5: HyperTerminal will route you to a dialog box with the heading "phone Number". In the 'Connect Using" field select the COM port to which you attached the serial cable (under File/Properties/Phone Number/Connect using:).
Click on the "OK" button.

Step 6: You should now be looking at a dialog box titled COM Properties (under File/Properties/Phone Number (tab)/Configure (button)). Make the following selections:

Bits per second: 9600 (can be set as high as 115.2k)
Data bits: 8
Parity bits: None
Stop bits: 1
Flow Control: Xon/Xoff

Step 7: Next, click on the File menu and select Properties. Click the Settings tab and set emulation to VT100.
Click on the "O.K." button.

Step 8: On the Ultra2160 Lite, selectUtilities/Serial Port Settings ..
Make sure that the selections you chose in Step-6 are the same on the Ultra2160 Lite.
Step 9: On the Ultra2160 Lite, select Utilities/Remote Control

Step 10: You should now be connected to your Ultra2160 Lite.
Press the <Esc> key to display the Main Menu.

Note (1): With the Ultra2160 Lite press System Reset to return to the Main Menu.

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Note (2): Make sure that the baud rates match both on the Ultra2160 Lite and on HyperTerm. You should be using the highest baud rate which your computer can support.

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A P P E N D I X C

TRACE UPLOAD / DOWNLOAD FORMATS

C.1 HEADER / TRAILER INFORMATION:

Each file transmitted has a 128-byte header, consisting of the following fields:

```
     Byte                    Field
     ••••••••••••••••••••••••••••••••••
     0-9    "Ultra-2160 " (ASCII string)
     10-26  Address range. The first value is 8 hex digits, with leading 0's,
            representing the first trace address transferred.  A hyphen only
            (no spaces) separates the first value from the second.  The second
            value, also 8 hex digits, represents the last trace address
            transferred.
     27     " "   (an ASCII space character, 20 Hex)
     28     File format code.  The following codes are in use:
                            "B" = Binary display format
                            "D" = Diagnostic format (not accessible by
customers)
                            "H" = Hex dump format
                            "R" = Raw Data format
                            "S" = Structured display format
                            "X" = Xmodem
     29     space
     30-33  recording mode.  This is a 32-bit, bit-significant code for the
      recording mode used to obtain this trace.  The bits are :
                    bit      meaning
                    0-1      edge mode: 01=1 edge, 10=2 edges, 11=4 edges
                    2-4      not used
                    5        Phase changes before REQ enabled
                    6        Record on external clock enabled
                    7        Capture SCAM protocol
                    8-31     not used
     34-126  spaces
     127    "#"
```

After the file is transferred, a trailer character ASCII EOT (hex 04) is transmitted. This signals the end of transfer. If required by your communications package, halt the transfer and save the file on disk.

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C.2 RAW DATA FORMAT

The Raw Data format is the only one that can be loaded back into the Ultra-2160Lite for further viewing or more analysis. The determining factor is the presence of the header record that is transmitted during upload. If this record is missing, in the wrong format, or otherwise corrupted, downloading will be aborted. Also, if a SCSI event record cannot be interpreted, downloading will be aborted.

The Raw Data file format is ASCII coded hexadecimal. Each SCSI event (8 bytes) is followed by a line feed/carriage return combination.

C.3 READABLE FORMATS

In addition to the Raw Data format, it is possible to upload in either Structured, Diagnostic, or Hex Dump format. In these formats, the file will contain trace information just as it appears on the screen of the Ultra-2160 Lite when displaying in these formats. These formats cannot be downloaded back into the Ultra-2160 Lite .

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A P P E N D I X D

THE SCAM PROTOCOL

D.1 GENERAL

The ASCSI Configured AutoMatically@ (SCAM) protocol is a new addition to the SCSI-3 parallel standard, which enables assignment of SCSI IDs to individual devices automatically and totally under software control. The SCAM protocol has been designed to tolerate and to allow coexistence of legacy devices with hardwired IDs (jumpers) and the new SCAM-capable devices on the same SCSI cable.

We refer the reader to the SCSI-3 specification (document: SCSI-3 Parallel Interface 'SPI', Annex B) for detailed description of the protocol. In this document, we will only outline the concepts of SCAM.

The SCAM protocol is defined on two levels:

1. Level-1 SCAM master devices use hard IDs. Only a single level-1 SCAM master is allowed on the bus. The SCAM slave devices must power up before or at the same time as the master. This protocol level can be implemented using most of the currently available SCSI controller chips.

2. Level-2 SCAM master devices may use hard or soft IDs. There may be multiple level-2 SCAM masters on the bus. The SCAM masters and slaves may power up independently. This protocol level may require a new generation of SCSI controller chips.

The SCAM ID assignment sequence executes as the first thing after power up, or after SCSI reset. The sequence is as follows:

First, the SCAM master (the host adapter) scans the bus for hardwired IDs (the legacy devices), and builds a table of IDs already assigned. The SCAM devices are designed to ignore these short-duration selections.

Second, the SCAM master assigns the soft IDs to the SCAM capable devices. This is done using a modified Selection phase, with the MSG line asserted by the master, and with no data bits being driven on the data bus. The BSY and SEL stay asserted to hold off the legacy devices. All SCAM devices now "wake up" and participate in the protocol. The devices drive certain control lines (C/D and I/O); they execute certain sequences on the D5, D6, and D7 lines, and use the lower five data bits for transferring information about ID which they (the slaves) prefer. The slaves then receive ID confirmation from the SCAM master via these low order bits. The SCAM protocol will assign IDs 0 through 7 on a Narrow bus, and IDs 0 through F hex on a Wide bus. The soft IDs come from the pool of IDs available following the hard ID scan.

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The SCAM protocol executes during the boot process. This may take a few seconds, depending on how many devices are on the bus.

SPECIAL SITUATIONS:

What if there is no SCAM host adapter? Does that imply that all SCAM devices will respond slowly to Selection? "No". Each SCAM device is shipped with a preferred ID number. For example, external disk drives will ask for ID 6.

Can there be more than one SCAM host adapter on the bus? "Yes, but" there is a SCAM function code which initiates a "dominant master contention" protocol. The first host adapter to win an Isolation becomes the master for that SCAM protocol sequence. All others become slaves.

What if you have a non-SCAM master and several devices with the same preferred ID? In that case, the bus will have the same problems as SCSI-2 today, when multiple devices want the same ID. This is solved the same way, with jumpers on the devices to select a unique ID. SCAM doesn't magically make old devices work, but it also doesn't make them any worse.

D.2 USING THE Ultra-2160 Lite FOR SCAM

D.2.1 ACTIVATING THE SCAM DISPLAY

- Go to the Mode menu by selecting ATracing/Mode@ from the main menu.

- Select ACapture SCAM Protocol@ and press <Enter>. This will also turn ON capture of the Phase Changes (item 2). Both of these must be ON for SCAM tracing.

- Start tracing by pressing **<RUN>** from any of the normal places. The SCAM Protocol will be captured automatically when it occurs.

See Section 3 for a display of a SCAM trace in structured and binary display format.

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