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PORTABLE SCSI bus ANALYZER
Models
D S C - 2 1 6
D S C - 2 1 7

USER's MANUAL

Revision: 2.2

March 1994

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SECTION 1

DESCRIPTION OF EQUIPMENT

1.1 INTRODUCTION

The DSC-216/217 is a highly 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 DSC-216/217 Tracer/Analyzer provides a comprehensive SCSI event tracer and debugger with powerful triggering capability. It provides displays of SCSI Bus activity in a variety of formats for easy interpretation.

Please note, that from the users standpoint, almost all functions in both models - the DSC-216 (with EL screen and keypad) as well as the DSC-217 (without EL screen or keypad) - are identical. Therefore in the following text, we will be referring to model DSC-216/217 or simply DSC-216, meaning both models.

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 32K events (standard) or 128K events (optional). The recording method is 'event driven', which is very efficient; 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 a built-in electroluminescent (EL) flat screen, or sent to a printer to provide a hard copy. Recorded data can also be up-loaded to a host computer, and 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.

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1.3 SYSTEM OVERVIEW

A simplified block diagram of the DSC-216/217 SCSI Bus Analyzer is shown below:

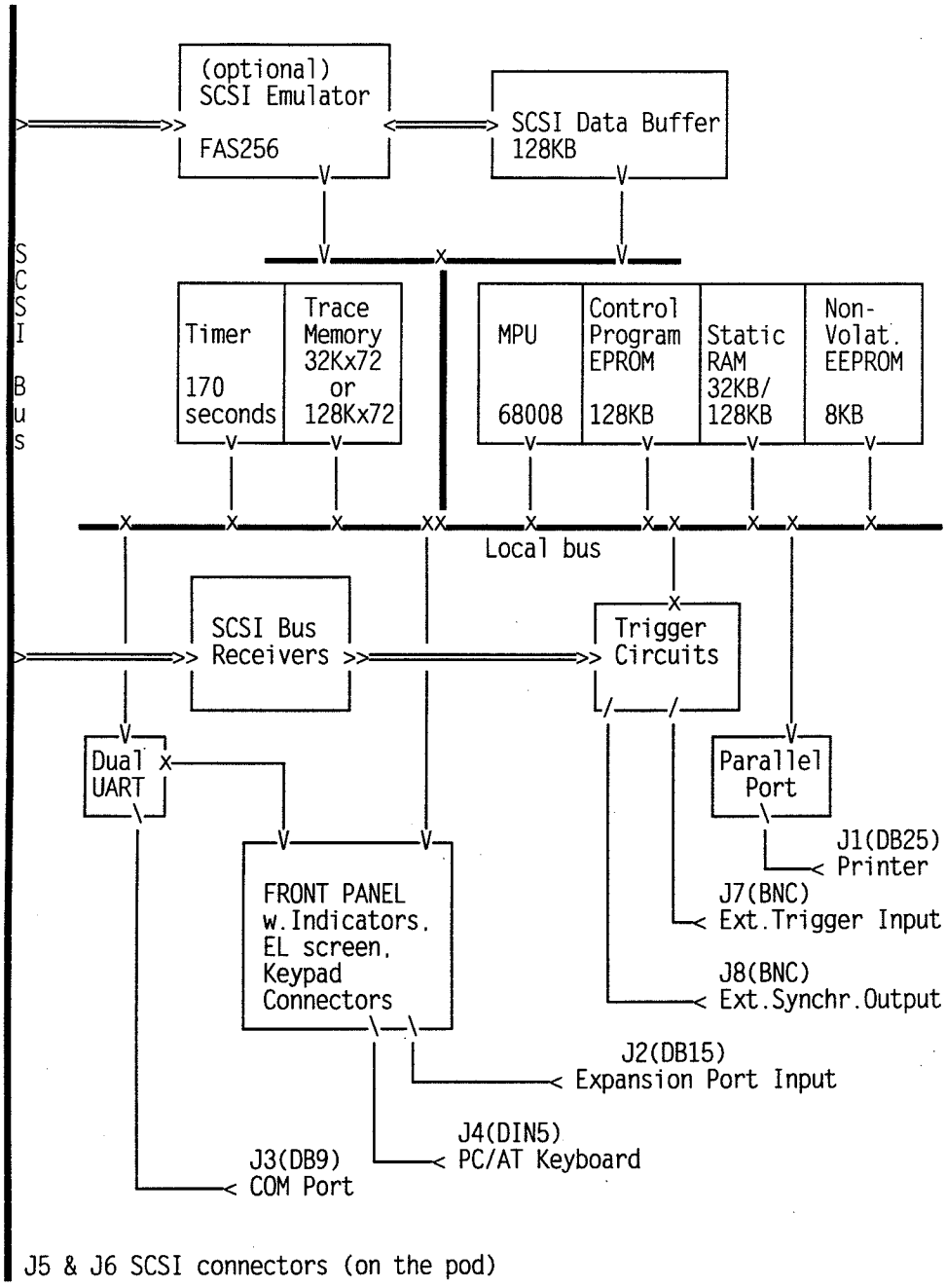


Fig.1 DSC-216/217 Block Diagram

The system carries out several major functions:

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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 minimal - one 74LS14 input load (or equiv.) per line.

From line receivers, the signals are directed to separate circuits: the trace memory, the trigger circuitry, and to the front panel to be displayed using LED indicators. All parts of the DSC-216/217 are internally controlled by the local MPU (Motorola's MC68008) running at 8MHz. The control program for the MPU is saved in EPROM with up to 128KB (256KB on Emulator models) capacity.

Communication with the operator is by a built-in keypad, and electroluminescent (EL) flat screen display. A parallel printer may be connected for hard-copy output. In addition, a PC/AT type keyboard can be attached. The Analyzer can also be placed in 'Remote Control' mode, controlled 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), status of the SCSI Bus signals is recorded in the Trace Memory following the leading edge of REQ signal
     During WRITE operations (Data from Initiator to Target), status of the 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) recording of data during data-in or data-out phase can be skipped (after the leading 8 or 32 bytes). Note that all bytes transferred are counted, and the total count will appear in the trace.
  d) 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 (J2)

- certain changes on data lines when tracing the SCAM protocol

For more on recording modes read Section 2.2.5.

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1.5 NOTATIONAL CONVENTIONS

The primary operator interface with the DSC-216/217 is through the keypad on the front panel, or 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 Cntrl key is depressed. 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 "(", and ")". Current selections or defaults are displayed in square brackets "[", and "]".

1.6 USER INTERFACE

The user interface is via **screen** and **keypad** built into the front panel on the DSC-216, via an external keyboard (connected to J4), or via screen and keyboard of a remote control PC/CRT used with the DSC-217.

The **SYSTEM RESET** switch, on the lower left side of the DSC-216/217 front panel, 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.

SCSI RESET switch, near the SYSTEM RESET switch, if pressed, will generate Reset condition (continuous level) on the SCSI bus; it will not affect operation of the DSC-216/217 however.

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 **TRM.PWR** LED indicates whether TERMINATOR POWER is being supplied on the SCSI Bus, and that it is 4.0 Volt or higher. It is the responsibility of the system integrator to decide which device will supply it. This TRM.PWR 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 TRM.PWR line on the SCSI Bus.

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The **TRACING** LED indicator lights up when the DSC-216/217 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 that the DSC-216/217's power is turned ON.

The operator interface from the keypad, or from the external PC/AT keyboard, is completely menu-driven. The main menu at the root of the DSC-216/217 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. The function will execute, or if more input is needed, 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.

Several keys have a characteristic function:

By pressing **<Enter>, <Space>**, or **<Yes>** while at the root level, the main menu will be re-displayed.

<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>/<q>**, eventually you will return to the main menu at the root. The **<Esc>** or **<Quit>** from the keypad have similar effect.

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

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

<^Print> or <^P> is a toggle switch which will turn "parallel printing" ON or OFF. Printing mode is indicated by a small LED at the <^Print> key. By "parallel printing" we mean sending all data that is being 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 **<^C>, <^S>**, and **<^P>** work the same as on any PC system.

OTHER GENERAL RULES:

If a question is asked in a selection dialog expecting a "Y/N" answer, use keys marked <Yes> and <No> from the keypad. If an external keyboard is used, typing a "Y" is interpreted as YES, and anything else is interpreted as NO.

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. By

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typing "." (period), <Esc>, or <Q> the edit session is terminated.
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.

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.

1.7 FRONT PANEL

The front panel of the DSC-216 contains a flat panel display screen, a 24-key keypad, two pushbutton switches, and 31 LED indicator lights. Several connectors, a cooling fan, and the main power switch module also share the front panel. The DSC-217 is configured the same, except it does not have the built-in screen and keypad.

The **DISPLAY SCREEN** is a high-visibility electroluminescent (EL) flat panel, capable of displaying 25 lines of 80 characters each.

The **SYSTEM RESET** switch is used for restarting the system.

The **SCSI RESET** switch is used for generation of the RESET condition on the SCSI bus.

The **LED indicators** are:

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

CONNECTORS located on the front panel of the DSC-216/217 are:

J1 - Parallel Printer (DB25 female)
J2 - Expansion 3-bit port Input (DB15, female)
J3 - Serial I/O port (DB9 female)
J4 - 5-pin connector for PC/AT keyboard
J5 - SCSI connector (50-pin, female, alternative-2 - on S/E pod)
J6 - SCSI connector (68-pin 'P' type, female - on S/E pod)
J7 - External Trigger Input (BNC connector)
J8 - External Synch Output (BNC connector)

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The J5 and J6 connectors are on a plug-in unit which optionally can be of a different type.

EXTERNAL TRIGGER INPUT - The J7 connector (coaxial BNC type), located on the right side of the front panel of the DSC-216/217 serves for input of an external trigger signal. The DSC-216/217 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), located on the right side of the front panel of the DSC-216/217 serves for providing a trigger signal, which may be used for triggering external instruments like oscilloscopes, logic analyzers, etc. This signal is a low-going pulse which occurs at the same time the trigger event occurs.

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 J2 connector is available. This input port allows for 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. The bit-0 (LSB) can be used as a clocking signal if "external clock" is enabled from the recording mode menu.

See Appendix A for the J2 connector pinout. Note that on this connector there are two pins that carry Vcc (+5V up, available up to 100mA), and two pins for GND. The Vcc and GND may be used to power external devices like AD converters, or other adapters.

The integrated **AC POWER MODULE** consists of the AC main switch, fuse and a three-pin receptacle for the AC line cord.

The **24-key KEYPAD** - allows using keys at three levels: the basic function, the 'ALT' and the 'CTRL' modified function. Note that the keypad and the external keyboard can be used interchangeably. You can be using both at the same time: press a key on the keypad, press several keys on the external keyboard, go back to the keypad, etc.

The names of keys on the keypad were selected so that their starting letter corresponds to the letter on the external keyboard as close as possible. For example the <Run> key is the same as the <R>, or the <Stop> key is the same as <S>, etc. The number-keys on the keypad are the 'ALT' set, and the special less frequently used functions are the 'CTRL' set.

The table in Appendix D lists all keys of the keypad, their corresponding keys on the external keyboard, and their functions.

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1.8 TIMER AND TIME-STAMPING OF RECORDED SCSI EVENTS

There is a 4-byte, 50 MHz counter in the DSC-216/217 Analyzer which is used for marking each recorded event in trace memory with a time stamp. The resolution is 20 nanoseconds. The timer will wrap around after 170 seconds.

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 (including possible 3-minute wrap-arounds). This selection is done from the keypad by pressing the **<^TmFmt>** key while in the display mode.

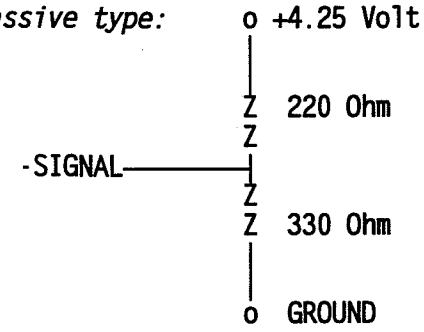
1.9 ELECTRICAL CONNECTION ON THE SCSI BUS

There are two alternatives for connecting the SCSI bus: the SINGLE-ENDED and DIFFERENTIAL alternatives. These are mutually exclusive, and can not be mixed on the same bus system. Many implementations today use the SINGLE-ENDED interface, mainly for its relative simplicity, and lower cost. In environments where noise immunity is important, or if the SCSI bus is used over distances longer than 6 meters, the DIFFERENTIAL interface is used. Maximum distance for the DIFFERENTIAL interface is specified at 25 meters. All signals should be terminated at both ends of the cable. FAST SCSI (over 5 MHz) should use only the differential alternative.

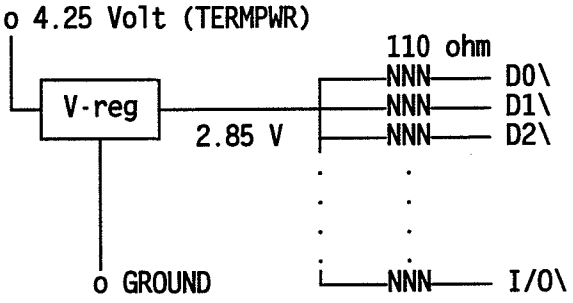
SINGLE-ENDED ALTERNATIVE transfers signals over a single "live" line in reference to GROUND. The "True" signal is defined as low level (0.0 Volt to .8 Volt DC), and the "False" signal is defined as high level (2.0 Volt to 5.25 Volt DC). The driver device should be open-collector or three-state type with 48mA (sinking) minimum driver output capability. All signals should be terminated with 220 Ohms to +5 Volt (nominal) and 330 Ohms to ground.

SINGLE ENDED TERMINATION:

Passive type:



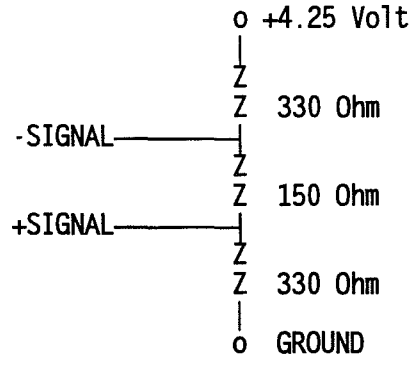
Active type:



DIFFERENTIAL ALTERNATIVE transfers signals over two electrically symmetrical lines denoted +SIGNAL and -SIGNAL. The "True" signal is defined as +SIGNAL more positive than -SIGNAL, and the "False" signal is defined as +SIGNAL more negative than -SIGNAL. All signals should be terminated as shown below:

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DIFFERENTIAL TERMINATION:



The DSC-216/217 SCSI Bus Analyzer was designed so that either type of interface can be used. The SINGLE-ENDED alternative (with 'active' terminator) is the standard (installed) version when shipped from the factory. Optionally, the DIFFERENTIAL adapter, or 50/68 pin SE-DIFF combination adapters, can be purchased from ANCOT and installed in the DSC-216/217 in the field. Remember that with either interface, the appropriate External SCSI Terminator should be used.

1.10 SCSI Bus TERMINATION AND TERMINATION POWER

The SINGLE-ENDED SCSI interface signals in the DSC-216/217 are terminated by a built-in active terminator. This terminator is enabled by a sliding switch marked "TERM" positioned to the left from the J5 SE SCSI connector.

The DIFFERENTIAL SCSI interface signals are NOT terminated (i.e., there is no internal termination provided). Use the external SCSI-DIFFERENTIAL Terminator. Power (TERMPWR) for this Terminator, if enabled by the "Trm.Pwr" switch (positioned to the left from the J5 SCSI connector), is supplied over pin 26 in both SCSI connectors, the J5 and J6.

The TERMPWR line in the external SCSI-Terminator is interconnected (pin 26) to both connectors; therefore Terminator Power (+4.25 Volt) can be supplied from either side, by the external SCSI device, or by the DSC-216/217.

The TERMPWR is protected by a serial (Schottky) diode for protection against back flow, and by a 1.0 Amp 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 !!!

NOTE THAT IF TERMPWR IS SUPPLIED BY MULTIPLE SOURCES TO THE SCSI Bus, AND IF ACCIDENTALLY THE PIN 26 OF THE SCSI Bus CABLE GETS GROUNDED, THEN THE TERMPWR LEAD (26) OF THE SCSI Bus CABLE WILL HAVE TO WITHSTAND THE SUM OF THE CURRENTS FROM ALL THE SOURCES 1 AMP EACH (EACH FUSED AT 1 AMP) BEFORE THE FUSES START BLOWING UP !

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1.11 TECHNICAL SPECIFICATIONS

- Compatible with SCSI specifications as defined by the ANSI X3T9.2 committee for SCSI-1 and SCSI-2.

- Asynchronous data transfer rates to over 10 MHz

- Synchronous data transfer rates to over 10 MHz

- Single-ended interface is standard; differential interface is optional

- Non-intrusive tracer. Only signal changes are stored, therefore recording time is not limited

- Trace memory is 32K events deep, and 72 bits wide. Optionally it can be expanded to 128K

- Up to three external signals can be recorded together with SCSI in the trace memory to allow tracing in the tested device.
  External port bit-0 can be used as "clocking" (negative edge is used)

- Recording modes: record all, or skip data, record one or all four edges of REQ and ACK, phase changes, external clock, and filtering by SCSI ID, or recording of selections only

- Display of recorded trace data in several formats:
  in structured (Pascal-like) expanded or compact form, binary, or hexadecimal format

- Hard copy of all displays printed via parallel I/O port J1 on an optional printer

- Event time-stamping function up to over 170 seconds before timer counter wrap around, with 20 nanosec resolution

- Non-volatile EEPROM memory for storage of current setup and mode parameters

- 128K byte (SRAM) system or program memory, and 32K(128K) byte data read/write buffer

- Motorola 68008 local MPU, at 8MHz, with resident firmware in 128K/256K-byte EPROM

- Configuration selectable through menu driven software, stored in non-volatile EEPROM memory

- Serial I/O port (RS-232) with selectable baudrate of up to 19.2K baud with data format and parity

- Powerful triggering capability is menu selectable
  - pre-triggering
  - post-triggering
  - delayed-trigger

  internal triggering by:
  - selected command, status or message
  - combination of command and status and ID, or message and ID

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(re)select, (re)select timeout
data parity error
Trace Memory is full (post-trigger)
External pre- or post-triggering through trigger-output BNC connector
External synch (trigger) input through a BNC connector

- SCSI Bus termination for Single-Ended I/F switch selectable (standard), for Differential I/F external (optional)

- Physical dimensions: 11"W x 14.5"D x 5"H

- Housed in an elegant transportable high-quality fan-cooled attache case type enclosure, with detachable top cover.
  Built-in EL flat screen & keypad (DSC-216 only), and switching power supply for 110-220 Volt, 50-60Hz operation

1.12 SCSI STANDARD SPECIFICATIONS AND REFERENCES

1.12.1 SCSI STANDARD SPECIFICATIONS

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

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

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

SCSI-2 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

Refer to document X3.131-1994.

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1.12.1 OTHER LITERATURE

"Basics of SCSI" by ANCOT (1993)
is a quick intruduction to SCSI, SCSI terms description, and glossary.

Available from ANCOT Corporation
115 Constitution Drive, Menlo Park, CA 94025
(415) 322-5322
This publication is FREE

"Understanding The Small Computer System Interface" by NCR (1988)
is a quick introduction to basic operations of the SCSI Bus

Available at many bookstores, or can also be purchased directly from:
NCR Corporation
SCSI Technology Group
3718 North Rock Road, Wichita, KS 67226

"The SCSI Encyclopedia" by Jeffrey D. Stai, published by ENDL
Provides a detailed description of basic and advanced operations of SCSI-1 and SCSI-2 interfaces.

Available at many bookstores, or can also be purchased directly from:
ENDL Publications
14426 Black Walnut Court, Saratoga, California 95070
(408)867-6630

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SECTION 2

TRACER / ANALYZER FUNCTIONS AND COMMANDS

2.1 TRACE MEMORY

Trace Memory is a circular buffer 32K, optionally 128K, or 512K events deep, with each event 72 bits wide. The 72 bits are used as follows:

2 bytes (16 bits) for SCSI data
6 bits for SCSI control signals (BSY,SEL,RST,MSG,C/D,I/O)
4 bits each (12 bits total) for fast SCSI control signals (REQ,ACK,ATN)
2 bits for low and high parity error flags
4 bytes (32 bits) for the time stamp
3 bits for expansion port (J2)
1 bit for internal use

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 that 20 nanosec) is taken, latched, and written in the trace memory. Other recording modes are available. See Section 2.2.5.

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

The recording can be started or stopped in three ways. Recording mode can be:

a. - without trigger: operator starts recording by typing <R>, and stops it by <S>
b. - with pre-trigger
c. - with post-trigger, either immediate or delayed

Whether recording with or without trigger, the **<Run>** (<R>) command has to be used to set the DSC-216/217 in the TRACING mode. This mode is indicated by the "TRACING" LED on the front panel and a "RUN" 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>** (<S>) key, or by a post-trigger condition, if enabled. At that point the current trace memory physical address is

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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 $00000. The operator does not have access to the physical address however; he/she deals with logical addressing only.

When recording without trigger is enabled (internal or external), writing into the trace memory starts with the first SCSI activity following **<Run>** start. It will continue until stopped by **<Stop>**. If trace memory capacity is exceeded, it wraps around and starts writing from the physical beginning. Although it is a linear physical address space, the internal firmware will translate physical address to logical to make it appear as a circular memory. When recording is stopped, it reports "STOPPED AT xxFFF(WRAP)". The last recorded event is at trace memory address 7FFF (1FFFF in 128K, or 7FFFF in 512K versions).

When trigger is used in POST - TRIGGER mode, recording starts as described above, and continues until a trigger condition occurs. When the trigger finally occurs, then depending on trigger delay selection, 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 (delayed trigger)

However, when "Trigger on Trace Memory full" is selected, or External Trigger is used and the last location is filled, recording stops immediately.

When the PRE-TRIGGER mode is used, the tracer has to be enabled by **<Run>**, and the trace memory records all activity on the SCSI Bus. However, whenever a BUS-FREE phase is detected, the internal trace memory address counter is reset, causing the next recording to be written over previously recorded data. This will repeat until the trigger condition occurs; when that happens, the resetting of the trace memory address counter will be disabled, and thus the most recent command will be preserved in the trace memory. All successive recording will continue, until the trace memory fills up. At that point the TRACING mode is reset, even in the middle of a command, and the recording stops.

TRACING will stop immediately, without waiting for a BUS-FREE phase, when the **<Stop>** (<S>) key 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

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then pressing <Enter>

- By pressing the selector key, shown either in angle brackets < > or at the start of the line before the entry

- In some cases, letter keys from the PC/AT keyboard act as selector keys.

```
                        DSC-216/217 MAIN MENU
-------------------------------------------------------------------------

TRACING                 TRACE MEMORY              UTILITIES

<Run  > start tracing  <1> - Clear trace         <5> - <^Find> event
<Pause> tracing        <2> - Write trace         <6> - <^Find next>
<Stop > tracing        <3> - <Display> trace     <7> - Calc. <^Time> diff
<Mode > of tracing     <4> - Setup display format <8> - <Util>ities
<Trig >ger setup [Pre ]                          <9> - SCSI Emulator
                                                 <A> - User Program
>
```

2.2.2 <R> - START TRACING (RUN)

Pressing the <Run> key puts the DSC-216/217 into tracing mode. From that point on, all activity on the SCSI bus will be recorded, subject to the trigger conditions in force. From the external keyboard, the <R> key is a selector for this function.

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 <Pause> key temporarily halts recording of SCSI bus activity. Pressing <Run> 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. From the external keyboard, the <P> key is a selector for this function.

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2.2.4 <S> - STOP TRACING

Pressing the <Stop> key will halt tracing. From the external keyboard, the <S> key is a selector for this function.

2.2.5 <M> - MODE OF TRACING

Press the <Mode> key to select the recording mode from a sub-menu. From the external keyboard, the <M> key is a selector for this function.

```
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 on external clk [ ]
<6> - Capture SCAM protocol   [ ]

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

2.2.5.1 <0> - SAVE ALL/SKIP DATA

This entry allows selection of the 'Skip Data' recording mode. 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 or 32 in the brackets indicate that only so 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.

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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.

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 are allowed to set the bit pattern to match. Note that 16 bits are provided in the pattern. This is to allow 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. When you set the pattern desired, you will be warned if the pattern chosen does not have exactly two bits set, but if you choose to retain the pattern, it will be allowed.

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> - CAPTURE FOUR EDGES REQ/ACK

This function enables or disables capture of an event on any transition of the REQ or ACK SCSI control lines. When enabled, each transfer of information during the Command, Status, Message or Data phases will cause up to four events to be recorded (on some extremely fast systems, two of the edges may occur so close together as to be telescoped into one recorded event). This recording mode is very valuable in tracing synchronous data transfers, or when checking timing of the REQ and/or ACK signals.

When this function is disabled, the tracer will record only one event for each byte of information

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transferred. The recording will be qualified by the edge of REQ or ACK that signifies valid data : the transition to active REQ for data from the Target, or the transition to active ACK for data to the Target.

2.2.5.6 <5> - CAPTURE ON EXTERNAL CLOCK

This function enables or disables recording of events qualified by an external clock input. When enabled, any low-going transition on expansion connector bit 0 (DB-15 type connector J2, pin 1) will cause recording of a snapshot of the SCSI bus (within 20 nanosec 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 <6> - 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.

2.2.6 TRIGGER SETUP

Press the <Trig> key to specify 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 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 <Yes> on the keypad, or <Y> on the external keyboard, the trace memory will be cleared to all zeros. From the PC/AT keyboard, the <C> key is a selector for this function.

2.2.8 <2> - WRITE TRACE

The WRITE TRACE function allows you to set the contents of trace memory. For each event, you

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can specify the exact contents of the control-bits word (16 bits), data word (16 bits) and time stamp long word (32 bits). From the external keyboard, the <W> key is a selector for this function.

When you select this function, a prompt will appear asking for a starting address. You should type an address in hex in the range 0 - 7FFF (or 0 - 1FFFF if you have the deep trace option). Other values will be rejected. After specifying the starting address, a line will appear showing the current contents of that address's control-bits word. The cursor will be positioned on the first character to allow editing. If you do not wish to change the contents, press the right-arrow key. Otherwise, type the new value and press <Enter>. The new contents will be displayed, and the cursor will move to the data word, as the current contents are displayed. Edit the data word just like the control-bits word and the cursor will move to the time stamp long word, which you can also edit.

At any time, press the down-arrow key to move to the next event. Any unedited portion of the event at the cursor will remain as it was, and you will be able to edit the next event. When all is finished, press <Quit> to return to the main menu.

2.2.9 <3> - DISPLAY TRACE

The DISPLAY TRACE function allows you to 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. From the external keyboard, the <D> or <3> key is a selector for this function.

2.2.10 <4> - SETUP DISPLAY FORMAT

This function allows you to specify how the recorded activity is displayed. See Section 3 for a complete discussion of the display modes. From the external keyboard, the <F> or <4> key is a selector for this function.

2.2.11 <5> - 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 by pressing the <^Find> key, as well. From the external keyboard, the <Ctrl-F> key combination is a selector for this function.

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2.2.12 <6> - FIND NEXT

This 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 <^FndNxt> key. From the external keyboard, the <Ctrl-L> key combination is a selector for this function.

2.2.13 <7> - CALCULATE TIME DIFFERENCE

This function allows you to select two trace events by specifying their addresses. It then calculates the elapsed time between the two events. Note that the time in nanoseconds is approximately modulo 170 seconds, due to timer counter wrap-around. In other words, if the two events are actually 175 seconds apart, the difference reported will be approximately 5 seconds. Note that this function is also accessible from the trace display mode by pressing the <^Time> key. From the external keyboard, the <Ctrl-T> key combination is a selector for this function.

2.2.14 <8> - UTILITIES

This function allows access to utility functions which do not fall into any other category. See Section 7 for a complete discussion of the miscellaneous utility functions. Press the <Util> key to access this function. From the external keyboard, the <U> key is a selector for this function.

2.2.15 <9> - SCSI EMULATOR

Press the <9> key to enter the SCSI Emulator menu. See Section 6 for a detailed description of all of the SCSI Initiator Emulator functions.

2.2.16 <A> - USER PROGRAMS

Press <A> to start a user program. Such programs include ANTEST, sold as an optional disk testing utility by ANCOT, other user programs provided by ANCOT, or programs developed using the C cross compiler developed by ANCOT. (See section 9.2.3 for more information on the cross compiler.)

Pressing <A> results in another option menu, at the bottom of the screen. You can choose:

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<1> - to start a program loaded into EPROM in the expansion socket,
<2> - to load and start a program in SRAM,
<3> - to load and start a program in EEPROM, or
<4> - to start a program loaded earlier in SRAM.

Programs are loaded into the DSC-216 using the serial port, at connector J3. You will need a communications package on your host computer capable of transmitting files in ASCII format. Also the file must be written in Motorola S-record format, in order to be executed on the DSC-216. The cross compiler available from ANCOT produces S-record format files. Finally, you will need a null modem cable to connect your host computer's serial port to the DSC-216 J3 connector.

To load a program, first start your communications program on the host computer. Get everything ready so that a single keystroke will start transmitting the file, but do not start transmitting yet.

Next, get the DSC-216 ready to receive the file. Do this by selecting a user program as described above, and choose either RAM or EEPROM as the target of the loading operation. The screen on the DSC-216 will clear and a message will appear showing the number of S-records transferred (0 at this point). The DSC-216 is waiting for your host computer to transmit the file.

Now press the key to start the transfer. This order of operations is important because some communications programs start by issuing an initialization string to the modem presumed to be connected. Such strings contain characters which could be interpreted as S-records, and could confuse the software in the DSC-216 which receives the file. By starting the communications program before setting the DSC-216 to receive, the buffer holding any initialization string is flushed before the file is sent.

If the transfer process seems to hang, you may need to send the ASCII character EOT (value 4) from your communications program. You can usually do this by pressing <^D>. When the entire file has been transferred, the program will start automatically on the DSC-216. You may need to tell your communications program that the transfer is complete. (For example, in Procomm, press <Esc>.)

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SECTION 3

DISPLAYING THE TRACE MEMORY

3.1 INTRODUCTION

The DSC-216 affords 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.

When you select the <**Display**> option from the main menu, a message will appear showing which format of display is currently selected, and prompting for a starting address. To change the format, press <**No**> on the built-in keypad, or <**N**> from an external keyboard. The display format menu will appear, as described below. 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 0-7FFF (0-1FFFF or 0-7FFFF if you have the optional 128K or 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 <**Stop**>, or 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.

Displaying within a range longer than one screen length would usually be used when also generating hard copy on a printer. Use <**Ctrl-^Print**> key on the keypad or <**^P**> on the external keyboard to toggle the printer ON and OFF.

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After the initial display, the DSC-216 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.

You can also continue displaying with the following options.

1) Press **<Next>** from the keypad or **<Space>** from the keyboard to display the next full page of trace memory in the current format. The **<PgDn>** key also accomplishes this action.

2) Press **<Prev>** from the keypad or **<->** from the keyboard to display the previous page of trace memory in the current format. The **<PgUp>** key also accomplishes this action. Note that in the structured format, because of the unpredictability of the number of events making up one page of display, moving backward may not always go exactly one page. However, in the other formats, page length is determinate, and moving backward goes exactly one page at a time.

3) Press a number from **<1>** to **<9>** to display that many more lines forward in the current display format.

4) Press **<Home>** to display one page starting at the beginning of trace.

5) Press **<End>** to display (about) a page starting about half page before end of trace.

6) **<A>** allows entry of a starting address for the next page to be displayed.

7) Press the **<16-8 bit>** key on the keypad, or the **<W>** key on the external keyboard, to flip between wide (16-bit) and narrow (8-bit) data display. Note that wide data can only occur during a Data-In or Data-Out phase, and only that part of the display is affected. When displaying wide data, the low byte appears first, separated by a hyphen from the high byte. The separator character may be an asterisk (*) if a parity error occurs or a plus-sign (+) if the ATN line is active.

8) Press the **<Alph-Hx>** key on the keypad or the **<H>** key on the external keyboard to flip between ASCII representation and hexadecimal display of data bytes. This will only affect the Structured display. When displaying data in ASCII format, unprintable characters will appear as periods (.).

9) Press the **<Flip>** key on the keypad or the **<F>** key on the external keyboard to toggle between the Structured, Compact, and Binary display formats. The page displayed will start at the same address as did the one being replaced.

10) While displaying in Binary format, press **<^BinFmt>** on the keypad or **< L >** on the remote keyboard to toggle between character display and state line display.

11) While still in Binary format, press **<^TmFmt>** key on the keypad or **< E >** on the remote keyboard to toggle between cummulative time and differential time.

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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. Data-In, Data-Out and the two Reserved phases 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. At all times except during Arbitration (when parity is not considered), if a **parity error** occurs, that is shown as an **asterisk** following 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. 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.

> NOTE:
> There are situation when the tested system hangs during the data phase, and you need to find out how many data bytes were actually transferred. Normally, when system hangs, you press <Stop> or <S> to stop the tracing, then <Esc> to exit to main menu, and <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 Bus Free phase is entered. (DSC-216/217 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>, and 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 similarly are labeled only on the first line.

Several samples of Structured displays, showing the various recording and display modes, follow.

3.2.1 Structured Display with WIDE data transfers

This display is shown here with data in ASCII format. Recording captures all data. This recording was made with 'capture 4 edges REQ/ACK' mode turned OFF, as can be discovered by observing the progression of addresses. 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. In line 18, notice the hyphen separating the two bytes of data transferred together. This trace shows a typical boot sequence for a host adapter card at ID 7 finding out about the Target device at ID 0.

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```
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)
00018:          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)   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)   Data-In / . -.  . -.  . -.  . -.
0008A:       Status     /00 (Good)
0008B:       Message-In /00 (Cmd Cmplt)
0008C: Bus Free
0008D: ---- End of Trace ----
```


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3.2.2 Structured Display with NARROW data transfers

This display is shown here with data in Hex. Recording was done in Skip-Data (32 transfers) mode, with 'capture 4 edges REQ/ACK' mode turned ON. Block size is 512 bytes. This trace shows a typical continuation of the boot process on PC DOS: the Initiator reads the disk's partition table, boot sector, and then a 22-block file, which could be an executable code, or a file allocation table, etc. 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:          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:          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 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)
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:          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 of SCAM Protocol :

In the structured display, you will see the SCAM Protocol in simple 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

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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.

Example:

```
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 ----
```

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, accurate to the 20-nanoseconds resolution of the DSC-216/217.

There are several options in how the information is presented in the Binary format.

First, the control lines can be shown in logic analyzer style, as a rectangular waveform traveling down the page. In this format, 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. Alternatively, you can set the display to be character-based. Active signals show as a mnemonic character, while inactive signals show as periods. The mnemonics are shown in the table below. This option is toggled by pressing the **<Ctrl+^BinFmt>** key on the front panel, or **<L>** from an external keyboard.

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Signal	Character
BSY	B
SEL	S
ATN	A
RST	R
MSG	M
C/D	C
I/O	I
REQ	R
ACK	A

The REQ and ACK signals use the same symbol ('R' or 'A'), but can be distinguished from the RST and ATN signals by their position on the display.

Data can be shown as wide or narrow. If the wide data format is chosen, then 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.

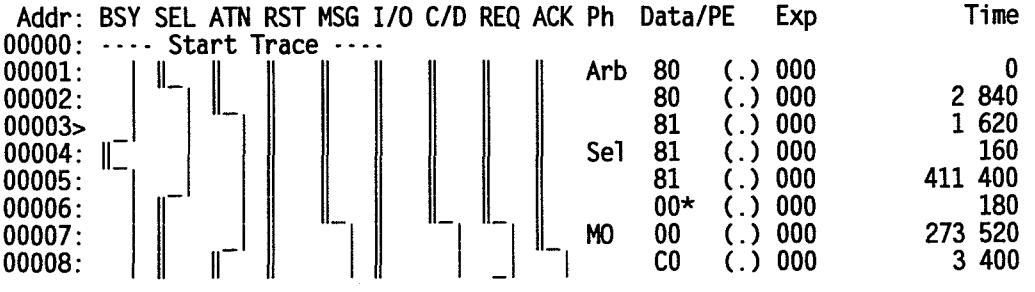
Time stamp information comes in either of two formats also. In the [Total] format, the total elapsed time since the start of the recording (modulo about 170 seconds) is shown in the time column. In the [Diff] format, the time differential from the preceding event is shown in the time column. All times are expressed as decimal nanoseconds, with a space between each group of three digits.

Each line of display also shows whether the data byte on that line is valid. If it is valid, then the address is followed by a right angle bracket (>). If not, the address is followed by a colon (:).

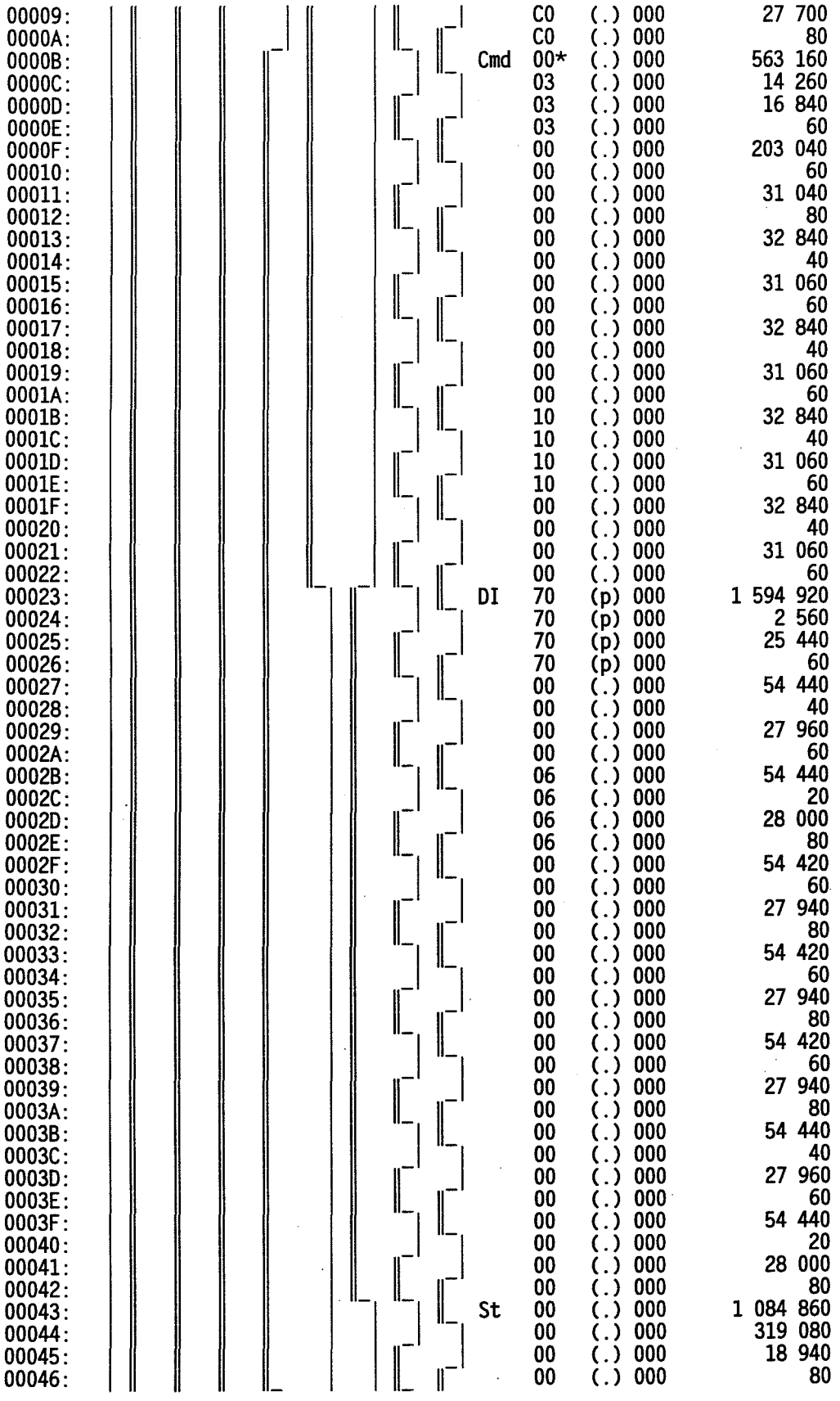
Each line of display also shows the state of the three signals received through the expansion connector J2 (DB-15) marked as 'Exp' in the examples below. E2 is the most significant bit, shown on the left of the triad. It is followed by E1 and then E0.

The various display options are shown in the following sample displays.

This first display example shows the logic analyzer style of control signals, with 8-bit data and differential time display. This trace also shows 'capture 4 edges REQ/ACK' and 'capture-all-data' mode of recording. Note that the data word at the Bus Free event after the command holds the number of data transfers (0008) during the command.

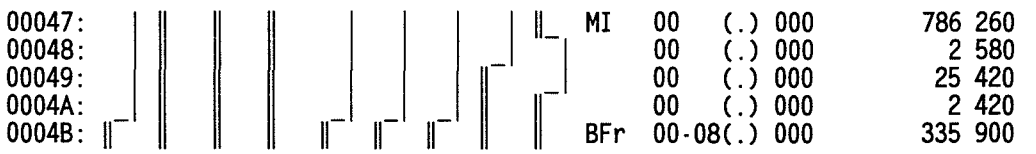


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00009:		C0	(.) 000	27 700
0000A:		C0	(.) 000	80
0000B:	Cmd	00*	(.) 000	563 160
0000C:		03	(.) 000	14 260
0000D:		03	(.) 000	16 840
0000E:		03	(.) 000	60
0000F:		00	(.) 000	203 040
00010:		00	(.) 000	60
00011:		00	(.) 000	31 040
00012:		00	(.) 000	80
00013:		00	(.) 000	32 840
00014:		00	(.) 000	40
00015:		00	(.) 000	31 060
00016:		00	(.) 000	60
00017:		00	(.) 000	32 840
00018:		00	(.) 000	40
00019:		00	(.) 000	31 060
0001A:		00	(.) 000	60
0001B:		10	(.) 000	32 840
0001C:		10	(.) 000	40
0001D:		10	(.) 000	31 060
0001E:		10	(.) 000	60
0001F:		00	(.) 000	32 840
00020:		00	(.) 000	40
00021:		00	(.) 000	31 060
00022:		00	(.) 000	60
00023:	DI	70	(p) 000	1 594 920
00024:		70	(p) 000	2 560
00025:		70	(p) 000	25 440
00026:		70	(p) 000	60
00027:		00	(.) 000	54 440
00028:		00	(.) 000	40
00029:		00	(.) 000	27 960
0002A:		00	(.) 000	60
0002B:		06	(.) 000	54 440
0002C:		06	(.) 000	20
0002D:		06	(.) 000	28 000
0002E:		06	(.) 000	80
0002F:		00	(.) 000	54 420
00030:		00	(.) 000	60
00031:		00	(.) 000	27 940
00032:		00	(.) 000	80
00033:		00	(.) 000	54 420
00034:		00	(.) 000	60
00035:		00	(.) 000	27 940
00036:		00	(.) 000	80
00037:		00	(.) 000	54 420
00038:		00	(.) 000	60
00039:		00	(.) 000	27 940
0003A:		00	(.) 000	80
0003B:		00	(.) 000	54 440
0003C:		00	(.) 000	40
0003D:		00	(.) 000	27 960
0003E:		00	(.) 000	60
0003F:		00	(.) 000	54 440
00040:		00	(.) 000	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

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The following display example shows the character style of control signals with 'Wide' data (16 bits + parity) and total elapsed time display. This trace also shows the single-edge REQ/ACK mode of recording (REQ and ACK not shown) and skip data (after 8 events). Note also the presence of the trigger event, marked with a 'T' next to the 00015 address.

```
 Addr: BSY SEL ATN RST MSG I/O C/D Ph  Data/PE   Exp            Time
00000: ---- Start Trace ----
00001> B   .   .   .   .   .   .   Arb 80-00*(..)000              0
00002: B   S   .   .   .   .   .       80-00*(..)000          2 600
00003> B   S   A   .   .   .   .       81-00*(..)000          4 220
00004: .   S   A   .   .   .   .   Sel 81-00*(..)000          4 360
00005: B   S   A   .   .   .   .       81-00*(..)000        388 240
00006: B   .   A   .   .   .   .       00*00*(..)000        388 440
00007: B   .   .   .   M   .   C   MO  C0-00*(..)000        665 280
00008> B   .   .   .   .   .   C   Cmd 08-00*(..)000      1 270 560
00009> B   .   .   .   .   .   C       00-00*(..)000      1 490 540
0000A> B   .   .   .   .   .   C       00-00*(..)000      1 554 560
0000B> B   .   .   .   .   .   C       00-00*(..)000      1 618 560
0000C> B   .   .   .   .   .   C       01-00*(..)000      1 682 560
0000D> B   .   .   .   .   .   C       00-00*(..)000      1 746 560
0000E> B   .   .   .   M   I   C   MI  04-00*(..)000      3 400 680
0000F: .   .   .   .   .   .   .   BFr 00*00*(..)000      3 673 280
00010: B   .   .   .   .   .   .   Arb 01-00*(..)000      4 735 200
00011: B   S   .   .   .   .   .       01-00*(..)000      4 782 420
00012> .   S   .   .   .   I   .   Rsl 81-00*(..)000      4 819 440
00013: B   S   .   .   .   I   .       81-00*(..)000      4 820 160
00014: B   .   .   .   .   I   .       81*00*(..)000      4 835 840
00015>T B   .   .   .   M   I   C   MI  80-00*(..)000      5 264 660
00016> B   .   .   .   .   I   .   DI  FF-00 (..)000      7 000 000
00017> B   .   .   .   .   I   .       FE-01 (..)000      7 002 800
00018> B   .   .   .   .   I   .       FD-02 (..)000      7 003 080
00019> B   .   .   .   .   I   .       FC-03 (..)000      7 003 380
0001A> B   .   .   .   .   I   .       FB-04 (..)000      7 003 660
0001B> B   .   .   .   .   I   .       FA-05 (..)000      7 003 960
0001C> B   .   .   .   .   I   .       F9-06 (..)000      7 004 240
0001D> B   .   .   .   .   I   .       F8-07 (..)000      7 004 540
0001E> B   .   .   .   .   I   C   St  00-00*(..)000      7 958 880
0001F> B   .   .   .   M   I   C   MI  00-00*(..)000      8 773 220
00020: .   .   .   .   .   .   .   BFr 00*08*(..)000      9 139 520
00021: ---- End of Trace ----
```

3.3.1 Binary display of SCAM Protocol :

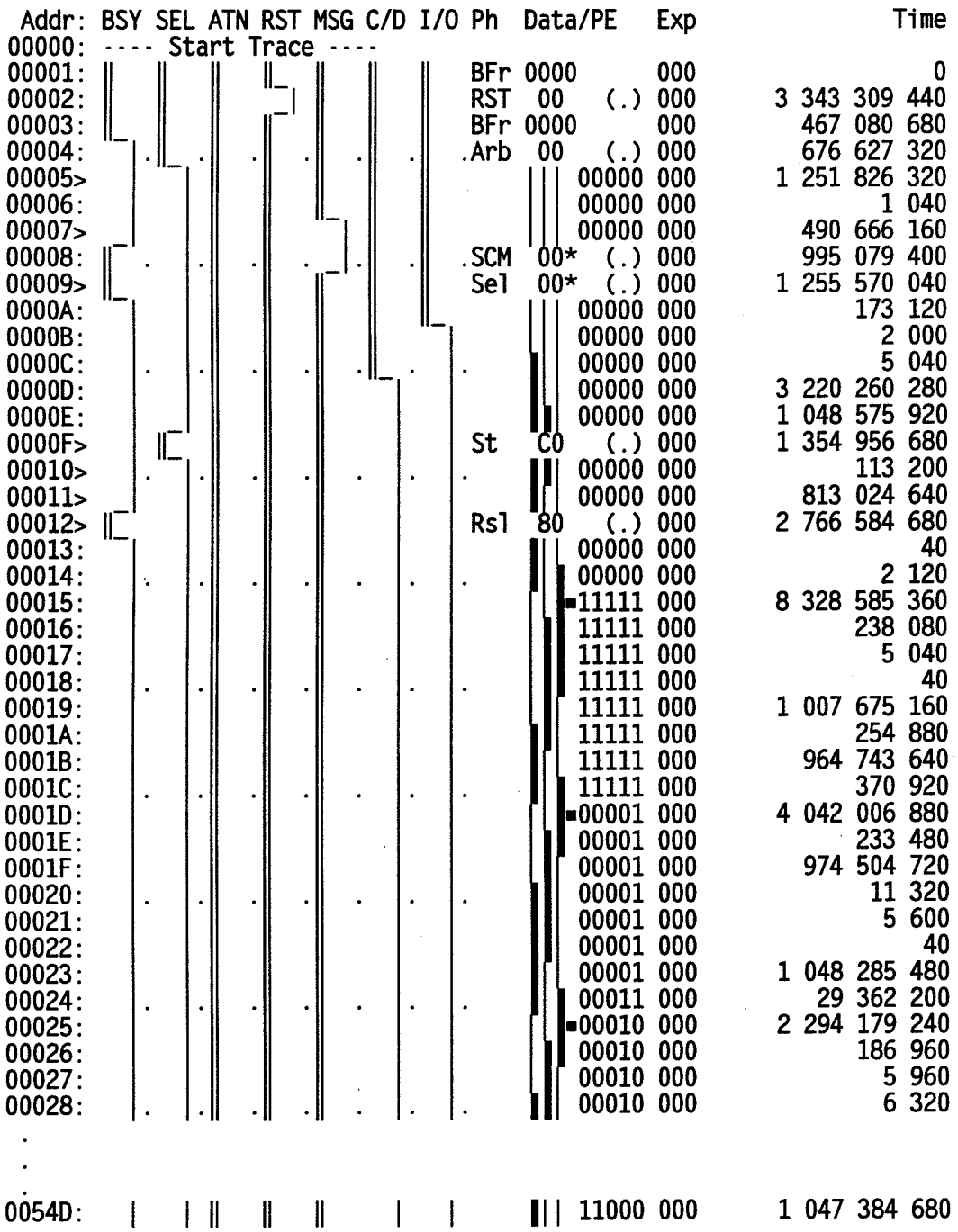
In the binary display format, you will see the SCAM data handshake near the horizontal middle of the screen. The SCAM data and handshake take the place of the normal display of data in Hexadec-

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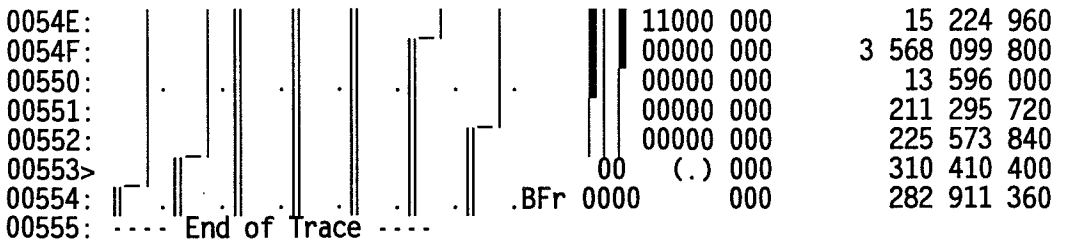
imal and ASCII. Only the SCAM Selection is interpreted in the Phase column (between the SCSI control lines and the data). It is shown as SCM.

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.

Example:



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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 the following two addresses, separated by slash(es).

The format of each event is : four characters of control bits, a space, another two characters of control bits, a space, four characters of data bits, a space, and eight characters of time stamp bits. In the following text, the "res" stands for "reserved".

The first four control bits are in the order: [res, ATN0, res, ATN1], [TRG, E2, E1, E0], [PEH, PEL, BSY, SEL], [RST, MSG, C/D, I/O]. The second group of control bits are: [res, ACK0, res, ACK1], [res, REQ0, res, REQ1]. The data bits are MSB (d15) to LSB (d0). The time stamp bits are in their raw form : the number of ticks (each 40 nanoseconds long) since the recording started.

```
00000:  0811 00 0000 75562E28 / 0801 00 0000 7556D1D1 / 0880 00 0080 755AD9BC
00003:  08C0 00 0080 755ADA3E / 48E0 00 0081 755ADA8F / 0860 00 0081 755ADA97
00006:  08E0 00 0081 7571905C / 08A1 00 0000 75719065 / 188A 00 00C0 7571C673
00009:  7882 00 0000 75723CA7 / 7882 0F 0000 757267A8 / 7882 C0 0000 75727428
0000C:  7882 00 0000 757280A8 / 7882 00 0000 75728D28 / 7882 00 0000 757299A8
0000F:  5886 00 0002 7573977C / 588E 00 0000 75743530 / 0801 00 0000 75747CBB
00012:  0880 FE 0080 7578C115 / 08C0 FE 0080 7578C198 / 48E0 00 0081 7578C1E8
e.t.c.
```

3.5 THE COMPACT DISPLAY FORMAT

This 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 pre-viewing 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 Address of Start of Connection
- SCSI ID of Initiator and Target and direction of connection (i.e. Selection vs Reselection)

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- 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

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 O            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 disconnect(s), reselection(s), 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.

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 (excluding disconnects) command time.

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```
          SCSI COMMAND PROFILE : Trace Address 00040 - 0025B
          Command Code - 08 Read/Rcv                IDs 7 -> 0

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%

Discon     :       36 317 960 ns          95.0%
Cmd Total  :       38 204 480 ns /      1 886 520 ns excl. discon.
```

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

Arb/Sel : from the assertion of BSY to the assertion of ACK for the Identify Message-Out.

ID Msg : from assertion of ACK for the Identify Message-Out to the next valid information transfer byte (assertion of REQ for transfer from the Target, or ACK for transfer to the Target).

Command : from assertion of ACK for the first Command Phase byte to the next valid information transfer byte of a different phase.

Data : from assertion of REQ or ACK (depending on data direction) to the next valid information transfer byte of a different phase. If more than one data phase is involved (for example because of a disconnect), all such phases are added together for the timing calculations.

Status : from assertion of REQ in the Status phase to the assertion of REQ for the Message-In phase.

End Msg : from assertion of REQ for the Message-In phase to Bus Free.

Disconnect : from assertion of REQ for the Disconnect Message-In to the first valid information transfer byte following the Reselection Identify Message-In. If more than one disconnect is involved in this command, they are added together for timing calculations.

Command Total : from the assertion of BSY (first time for this command) to the Bus Free following the final Message-In phase (for the Command Complete Message-In).

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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 **<Alt-4>** key on the keypad, or the **<F>** key (for "format") on the external keyboard. You can also access this menu after pressing **<Display>**, then at the prompt for the display starting address, press **<No>** on the keypad, or **<N>** on the external keyboard.

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

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 DSC-216/217 on.

<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 DSC-216/217 provides a powerful, easy-to-use searching utility. This feature gives you 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. The page of trace memory holding that pattern is then displayed. Section 3 covers the displays in detail. To see the events before or after the one you chose, scroll up or down.

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

```
                          FIND SCSI EVENT
-------------------------------------------------------------
<B> - Bus Free Phase              <C> - Command Phase
<N> - Attention Condition         <S> - Status Phase
<P> - Parity error                <M> - Message-In Phase
<A> - Arbitration Phase           <G> - Message-Out Phase
<L> - Selection Phase             <I> - Data-In Phase
<E> - Reselection Phase           <O> - Data-Out Phase
<R> - SCSI Reset Phase            <O> - Reserved Phase (In)
<T> - Trigger Condition           <V> - Reserved Phase (Out)
<X> - Trace PAUSE                 <D> - Data only (ignore phase)
                                  <Z> - Custom Control Bit Pattern
                                        xxxx xxxx 00x0 xxxx

                        SEARCH OPTIONS
<W> - Wide data pattern [ ]       <Y> - Data Bits Pattern
<F> - Forward/Backward  [F]           0 : xxxx xxxx (XX)
<H> - Occurrence        [ 1]

Use Arrow Keys to move HIGHLIGHT bar and make the search selection.
When the bar is on your selection, <Enter> executes the search.
When the bar is on an option, <Enter> toggles or increments the option.

< Quit> - Quit (make no selection - return to the next higher menu)
```


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4.2 SELECT THE EVENT WITH OPTIONS

The Search 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:
Use the arrow keys, or the selector letter on the external keyboard, to move the bar to the event or phase you want. Press <Enter> to execute the search.

- To change an option default value:
Use the arrow keys on the keypad, or the selector letter on the external keyboard, to choose the option you want to modify. Use the <Enter> key to toggle or increment your choice. Then use the arrow keys or the external keyboard to select the event you want to find. When the bar is on your event, press <Enter> to execute.

If the event exists in the trace, it will be displayed, marked in the address column by the symbol '>>>>>>', along with the events before and after it.

4.2.1 USE THE WIDE DATA PATTERN.

This selection, <W>, will affect searches only if a Data Bits Pattern (< Y >) is specified. The default value is a blank indicating wide data pattern not chosen. When <W> is not chosen, only the low byte of SCSI data will be considered in the search. If the wide data pattern is enabled, shown by a checkmark in the square brackets, 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.

If you enable this option, and later disable it, the square brackets will be empty.

Pressing <Enter> toggles between enabled (checkmark) and disabled (blank) when the bar is on this item.

4.2.2 SET THE DIRECTION

The current direction selection is shown in square brackets: 'F' for forward, 'B' for backward. The default is forward. Searching always starts at the last event found, if any, or at the top of the last page of trace memory displayed. Pressing <Enter> toggles between F and B when the bar is on this item.

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4.2.3 SET THE 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 n-th event. After you choose <H> and press <Enter>, the cursor will move into the square brackets, and you can type your selection. The maximum value is 99.

4.2.4 SET THE DATA PATTERN

When searching for certain phases (like Command, Data-In/Out, etc), you may want to define the desired data pattern. You can specify up to eight bytes long string. Select this option by pressing <Y> followed by <Enter>, or the cursor also moves to the 'Y' fields 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 <D>, <C>, and several other search options.

Use the up or down arrow keys to select the byte to edit. Use the left or 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 next byte and to 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. E.g. 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 down arrow key two times (to add the third and fourth bytes with 'Don't Care' pattern, then press <Enter>. To delete an undesired byte, place the cursor on the byte and press <Ctrl-Display> on the keypad or <Ctrl-D> on the external keyboard.

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> key, you can cancel your selection 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 'Y' data fields. Type the first byte 00001000, <down arrow>, XX000000, <down arrow>, 00000000, <down arrow>, 00110101, <down arrow>, <down arrow>, <Enter>, <Enter>.
This will be displayed on the screen at follows:

<Y> - Data Bits Pattern
1 : 0000 1000 (08)
2 : xx00 0000 (?0)
3 : 0000 0000 (00)
4 : 0011 0101 (35)
5 : xxxx xxxx (XX)
6 : xxxx xxxx (XX)

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4.3 SELECT A CONTROL PATTERN

When you select "Custom Control Bit Pattern" by pressing <Enter> key on the <Z> item, the bar moves into the phase pattern list. You then select the pattern you want to match. Select your pattern by typing a 1, 0, or X, for each bit, and then press <Enter> to execute the search.

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 "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)
<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 you want to find. When you press <Enter> with the bar on this item, you can edit the search pattern. Use the 0, 1 and X keys to set the state of each bit. Press <Enter> to execute the search.

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4.4 REPEATING THE SEARCH

After a successful search, you may want to find the next event which matches the same pattern. To do this, press **<ˆFndNxt>** on the keypad, or **<Ctrl-L>** on the external keyboard. The search will proceed in the forward direction as the previous search. You can press **<ˆFndPrv>** or **<Ctrl-K>** to search backward.

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SECTION 5

TRIGGERING

5.1 INTRODUCTION

All triggering control stems from the TRIGGER SETUP MENU. Triggering can only take place when the DSC-216/217 is tracing, as shown by a lit Tracing LED on the front panel.
See section 2.2.2 for starting the trace.

5.2 TRIGGER SELECTIONS

When you select the <Trigger> option from the main menu, the following will be displayed:

```
TRIGGER SETUP MENU
---------------------------------------
<0> - Trigger type            [None]
<1> - Post Trigger delay     [BFree]
<2> - Full trace memory          [ ]
<3> - External trigger           [ ]
<4> - Parity error (low byte)    [ ]
<5> - Parity error (high byte)   [ ]
<6> - SCSI Reset                 [ ]
<7> - (Re)Selection Time-out     [ ]
<8> - Selection IDs     [0081]   [ ]
<9> - Reselection IDs   [0081]   [ ]
<A> - Message code        [04]   [ ]
<B> - Command code        [12]   [ ]
<C> - Status code         [02]   [ ]
<D> -    Combine Cmd [OR ] Stat  [ ]
<E> -    Transaction IDs [0081]  [ ]

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

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 or down arrow keys 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 arrow keys 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

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that value, first press the <Enter> key, then type in the new value in Hex , and press <Enter> key again to confirm the new selection.

When a trigger item is enabled, the letter E appears in the square brackets at the right side of the menu, next to that item. When an item is disabled, the square brackets are empty. The first two menu items are exceptions to this rule. The legends which may appear in their brackets are described below.

Triggering can be completely disabled. In this case, tracing will be started or stopped only by pressing the appropriate keys. Choose the [None] option for Trigger type.

Tracing can be started by a trigger condition, called **PRE-TRIGGER**. Select the [Pre] trigger option for Trigger type in the TRIGGER SETUP MENU. Then start tracing. In this mode, the DSC-216/217 monitors all activity on the SCSI bus, and records it into the trace memory. However, until the trigger condition occurs, the trace memory address is reset to 0 on each Bus-Free phase, so the events are overwritten by later events. Finally, when the trigger condition occurs, this automatic resetting of the trace memory address is canceled, and all later events are recorded. This method ensures that the trace includes the entire command of the trigger condition. Tracing continues until either the trace memory is completely full or until you stop tracing from the keyboard.

Alternatively, tracing can be stopped by a trigger condition, called **POST TRIGGER**. Select [Post] trigger option for Trigger type from the TRIGGER SETUP MENU. Also select the desired amount of Trigger delay from the trigger condition to the end of tracing. There are four choices for delay:

1) Select no delay [None], to stop tracing at the instant the trigger condition occurs. If you choose this option, you will not see the remainder of the command, because tracing will already be stopped.

2) Select delay until Bus Free [BFree], to force tracing to continue to the end of the command containing the trigger condition, but not any commands after that.

3) Select [Short] delay to see a small number of events after the trigger event. The number of events is set in the factory for 64 events. This amount of delay may or may not take the trace to the end of the current trigger command and beyond.

4) Select [Long] delay to see a larger number of events after the trigger event. The number of events is set in the factory for 2048 (2K) events. This amount of delay will almost always extend past the end of the current trigger command, and may include several later commands.

The other items in the TRIGGER SETUP MENU are mostly self-explanatory. However, they are listed here to clarify any doubtful points.

<0> - Trigger type : This can be [None], [Pre] or [Post], as described above.

<1> - Trigger delay : This item only affects Post- triggering. It can be [None], [BFree], [Short] or [Long], as described above.

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<2> - Full trace memory : When enabled (shown as [E]), if the trace memory fills to the point where it would wrap around, tracing will stop immediately. This ensures that all events from the point where tracing started are retained. When disabled, shown as [ ], tracing will continue with later events overwriting the first events in the trace memory. At any time thereafter, the most recent 32K (or 128K) events will be retained in the trace memory.

<3> - External trigger : When enabled, a low-going signal at the external trigger connector J7 (BNC connector), is a trigger condition.

<4> - Parity error, low byte : When enabled, a byte on the SCSI low data lines (d0-7, DPL) with even parity is a trigger condition. Any SCSI information transfer phase, selection or reselection phase is a candidate for this trigger. This trigger is not guaranteed for synchronous Data (In/Out) phases.

<5> - Parity error, high byte : When enabled, a byte on the SCSI high data lines (d8-15, 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. This trigger is not guaranteed for synchronous Data (In/Out) phases.

<6> - SCSI Reset : When enabled, a transition to the active state of the SCSI RST line is a trigger condition.

<7> - (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.

<8> - 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 they match, that is a trigger condition. Note that this is different from item <E> 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 <9>. It is not possible to set them for different patterns. Note also that this selection will also affect ID filtering, if that recording mode is enabled.

<9> - Reselection IDs : see <8> above.

<A> - 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 they match, that is a trigger condition.

<B> - Command code : see <A> above.

<C> - Status code : see <A> above.

<D> - Combine Cmd [AND/OR] Stat : This item is enabled automatically whenever both

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<B> and <C> are enabled. If the contents of the first set of square brackets is [OR], either the matching Command code or the matching Status code is sufficient to cause triggering. If the contents are [AND], 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 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.

<E> - Transaction IDs : When enabled, the data pattern in the first set of square brackets MUST be present during Selection or Reselection in order for the matching of Message, Command or Status codes 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 POST 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 we want to find out what the cause is.

Set the trigger conditions as follows :

```
Trigger type                [Post]
Post trigger delay         [BFree]
Status code         [02]       [E]
   Transaction IDs [0084]      [E]
```

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

This setup will start recording when you press <Run>. 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 Transaction IDs); this will result in a Check Condition Status (as specified by the 02 in Status Code). It will continue to record until the next Bus Free phase (as specified by the Post trigger delay), and then stop. The final event address will be displayed on the screen as the DSC-216/217 informs you that the trigger condition has been met. You can then examine the trace to see what commands preceded the Check Condition Status.

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5.3.2 PRE TRIGGERING

The problem : Some command is resulting in a condition which causes your SCSI driver to crash. You think it is as a result of linked commands with the flag bit set.

Set the trigger conditions as follows :

```
Trigger type                [Pre ]
Message code        [0B]      [E]
```

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

This setup will start monitoring the bus as soon as you press <Run>, but will ignore all commands until one received with a message of 'Linked-Command-Complete-with-Flag', as specified by the 0B in Message code. That entire command will be recorded, starting at the Bus Free phase preceding it. Events will be recorded until the trace memory is completely full, and then will stop to prevent overwriting the trigger event. If you press <Stop> before the memory fills up, of course that will also halt tracing. You can then examine the trace to determine what happened after the suspect event.

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 type to [None]. Start tracing by pressing <Run>. The DSC-216/217 will record all activity on the bus, wrapping the circular buffer each time it fills completely. When the bus hangs, press <Stop> 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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SECTION 6

SCSI INITIATOR EMULATION

6.1 INTRODUCTION

In many instances it is not enough to passively observe events on the SCSI bus. You just have to get in there and send or receive SCSI commands. That requires an emulator which gives you exact control over the action on the bus, but which is easy to use. The emulator built into the DSC-216/217 /FTE meets those needs.

Using the emulator of the DSC-216/217 /FTE you can act as a SCSI Initiator. You can also define the type of SCSI Target, be it a disk drive, tape drive, printer, etc. You control the protocol for information transfers, deciding whether to use the wide SCSI or fast SCSI capability of the emulator, or whether to act as an asynchronous, narrow (single-byte) bus device. Via the hierarchical menu structure, you determine exactly how each command proceeds, and control exactly every byte of information transferred.

The current hardware version of the DSC-216/217 uses the Emulex FAS256 SCSI Protocol Controller chip, and the NCR 86C05 DMA Controller chip to afford you the fastest possible SCSI emulation capability. This combination can do asynchronous data transfers at up to 7 MHz (14 MBytes/sec if using wide SCSI) and up to 10MHz synchronous (20 MBytes/sec), the fastest rate allowed by the SCSI-2 standard. Using the proper adapter pods, the emulator can be used on either single-ended or differential interfaces.

6.2 INITIATOR EMULATION

To enter the SCSI INITIATOR EMULATION MENU from the MAIN MENU, select option **"<9> - Emulate"** or press <E> on external keyboard. This function will allow you to issue SCSI commands one at a time directly from this menu. You can select your commands from the upper part of the menu, or you can also access several auxiliary functions of the Emulator from the lower part. The menu is as follows:

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```
                              SCSI INITIATOR MENU
-------------------------------------------------------------------------------
SCSI COMMANDS:
A - (00) Test U Rdy     F - (12) Inquiry        K - (28) Read (10)
B - (03) Req Sense      G - (16) Reserve Unit   L - (2A) Write (10)
C - (04) Format Unit    H - (17) Release Unit   M - (3C) Read Buffer
D - (08) Read (6)       I - (1D) Send Diagn     N - (3B) Write Buffer
E - (0A) Write (6)      J - (25) Read Capacity

a - (01) Rezero         d - (1B) Start          h - (1E) Prvnt Med Rem
b - (0B) Seek (6)       e - (1B) Stop           i - (1E) Allow Med Rem
c - (2B) Seek (10)      f - (1A) Mode Select    t-z      Vendor Specific
                        g - (15) Mode Sense     1-8      Macro

AUXILIARY FUNCTIONS:
^X - Setup              ^E - Edit CDB           ^I - Initiator ID    [7]
^B - Build Macro  [D]   ^H - Autofill   [AXLU]  ^T - Target ID       [0]
^L - List Macros        ^N - Link Bit     [LF]  ^U - Logical Unit LUN[0]
^D - Data Buf Mgmt      ^Z - Repeat Cmd    [D]  ^A - LBA      [00000001]
^K - Compare Buffers    ^R - SCSI Reset         ^F - Incr LBA @ Wt   [D]
                                                ^G - Incr LBA @ Rd   [D]

Your Selection ?
```

The SCSI COMMANDS section is self explanatory. Remember, that format of commands, and consequently their execution may be affected by some of the auxiliary commands. Functions like <^H>, <^N>, <^F>, <^G> will affect the contents of the CDB sent for a command .

Execute individual SCSI commands either by typing their symbol (e.g. type <A> for Test-Unit-Ready,..) or move cursor over the <A> field then press <Enter>. The A through N and a through i are preprogrammed SCSI commands (saved in internal EEPROM). The u, v, w, x, w, and z are seven vendor specific commands; they are preset (in the EEPROM) to zeroes as a default. Use <^E> editing function to change them. The 1 through 8 are eight macro's.

Functions <R>, <P>, <S>, and <Q> are the same as in the MAIN MENU level, and they are not listed in this SCSI INITIATOR MENU. These are the RUN, PAUSE, or STOP used for starting, pausing, or stopping the trace, and QUIT for exiting from this menu. These functions are described in sections 2.2.2, 2.2.3, 2.2.4, and 1.6 respectively.

We strongly recommend using external keyboard for operating the SCSI Emulator. If you chose using the keypad however, move the highlight bar (using the arrow keys) over the selected command, then press the <Enter> key.

In the following paragraphs, individual auxiliary functions are explained in more detail. Functions are listed in alphabetical order. Functions such as **"^X - Setup"** and **"^D - Data Buffer Manage-men"** are rather complex; they are described in sections 6.4.x and 6.3.x respectively.

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6.2.1 <^A> - CHANGE LBA

This function lets you define the Logical Block Address to be used on the next command with such a field (e.g. a Read command). If the LBA bit of the Autofill variable (see section 6.2.10) is set, the LBA you define will be used for the next command.

6.2.2 <^B>, <^L> - MACROS

The DSC-216/217 Emulator's macro capability lets you define a sequence of commands and other functions which will execute sequentially at the press of a single key. The Emulator is shipped with several default macros installed. You can edit or rewrite them or you can use them as-is. However, each time you restore defaults, the original definitions will be restored as well.

The **"^B - Build Macro"** command allows you to construct a macro. The macro buffer is 64 characters long, so the macro can be quite complex. As you press each key, that character will become part of the macro, and will also be executed. When you complete your definition, press <^B> again. You can then save or discard the macro you have built. If you define an empty macro, it can be saved. This allows you to erase any previously defined macros.

Macros can be executed by pressing the number representing the desired macro. Macros can be repeatedly executed if **"^Z - Repeat Command"** is enabled (see section 6.2.13).

The **"^L - List Macros"** command displays all macros currently defined. It is important to realize that a macro is merely a list of keystrokes. This means that for items which merely toggle between states, like the "^G - Incr LBA @ Wt" command, will have an effect dependent on the initial state of the toggle. Some items require an <Enter> key press to end data input, like the "^A - Chng LBA" command. The <Enter> key is not shown as part of the macro, even though it will occur. Instead, the value entered as input is shown in curly brackets {}.

6.2.3 <^D> - DATA BUFFER MANAGEMENT

This item gives access to the Data Buffer Management Menu, which will display its own menu. See section 6.3 for a complete discussion of the buffer management functions.

6.2.4 <^E> - EDIT CDB

This function allows you to set or clear any bit of any defined CDB (Command Descriptor Blocks), including the Vendor Unique CDBs. The current contents of the CDB selected are displayed, and

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you can change any or all of the bytes. The modified CDB is retained until you either restore defaults or reset the system.

You have complete control over 7 custom CDBs, accessed via SCSI Command letters <t> through <z> (lower case). The defaults for these CDBs are all zeroes, making them 'Test-Unit-Ready' commands. Using the <^E> - Edit CDB function, you can define them to be any command, including non-standard commands, by editing them to be the value you desire. You will be asked to specify In, Out, or No buffer if it is required for that particular command. All CDBs are stored in non-volatile memory (EEPROM) and will retain their contents even after a system reset.

Editing the CDBs is done as follows:
Press the <^E> key to enter the 'Edit CDB' mode, and enter the letter representing the SCSI command CDB to be edited. Current CDB will be displayed in Hex format. Move cursor (using tab key) and change individual bytes. When finished, press <Q> to save the new edited values and return back to the Initiator Emulation menu.

Remember that while executing individual SCSI commands, certain fields will be filled in 'on the fly' if the ^H - Autofill function is enabled. Read more on this in section 6.2.6 below.

6.2.5 <^F>, <^G> - INCREMENT LBA AFTER WRITE/READ

These options affect the value of the LBA variable after each SCSI Read or Write command. Note that this will affect the CDB only if Autofill is enabled for LBA (see section 6.2.6). If the incrementation is enabled, then the LBA is incremented as a 32 bit value. The upper bits of the value may be truncated if the CDB does not have room for all of them.

6.2.6 <^H> - AUTOFILL

Of particular interest is the **"^H - Autofill"** selection. Autofill, if fully enabled will insert the current values for LBA, Allocation/Transfer Length, Link (and flag) bit and Target LUN into the CDB. Each of these items can be individually enabled or disabled, using the following values.

Selection Code	Affected field
U	LUN
L	Link and Flag bits
X	Alloc/transfer length
A	LBA

Using the selection codes, you can toggle individual selections ON & OFF; you can turn a particular bit ON to enable automatic fill of that field in any affected CDB. Turning it OFF leaves that field

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with the value it held on the previous use of the affected command. The selection code will toggle selections ON and OFF. The corresponding selection code will be displayed in 'upper case' for ON state, and in 'lower case' for OFF state. As an example, type <U> to enable and disable automatic filling of LUN in subsequent execution of commands. This autofill will be effective until the <U> is turned OFF (by typing <U> again). Similarly, it works with the L, X, or A selections respectively.

For example, to have the Emulator fill in the Link bit and the LBA, but to leave the LUN and transfer length alone, toggle the <L> and <A> codes; this selection will be displayed as 'uLxA'. The Emulator will then look at the current settings for the LBA to enter it into the CDB. It will also check how you want the Link and Flag bits set in the last byte of the CDB, and fill them in.

Note that the Autofill for LUN does not affect the LUN field of the Identify message. That field will always hold the current value of the LUN variable.

6.2.7 <^I> - INITIATOR ID

Determines the SCSI ID number to be used by the Initiator Emulator. The ID number currently selected is entered in hex (0 through F). The corresponding bit will be asserted on the data bus during Arbitration to identify the Initiator.

6.2.8 <^K> - COMPARE BUFFERS

Selecting this option causes a byte-by-byte comparison of the current contents of the SCSI Read Data Buffer and the SCSI Write Data Buffer. Both of these buffers should have their lengths defined beforehand - see section 6.3.5 for details. If their lengths are different, then the shorter one will be used for the comparison. The number of mismatches is reported if any exist. If the buffers compare correctly, only '-' is displayed on the screen and no report is issued.

6.2.9 <^N> - LINK BIT

This selection allows you to emulate linked commands. Using <Enter> you can change this variable to 3 possible states, as shown by the codes below.

Code	Function
blank	Link and Flag bits both cleared
L	Link bit set, Flag bit cleared
FL	Link and Flag bits both set

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6.2.10 <^R> - SCSI RESET

Selecting this option asserts the SCSI RST line, causing a Reset condition on the bus. The line is held asserted approximately 26 microseconds, then released. (The SCSI specification requires a minimum of 25 microseconds, with no maximum.)

6.2.11 <^T> - TARGET ID

Determines the SCSI ID number of the Target to be selected by the Initiator Emulator. The Target ID number currently selected is shown in hex (0 through F). The corresponding bit for currently selected Target ID will be asserted on the data bus during Selection.

6.2.12 <^U> - LOGICAL UNIT (LUN)

Determines the Logical Unit Number (LUN) to be selected by the Initiator Emulator. The current LUN is entered in decimal.

6.2.13 <^X> - EMULATOR SETUP

This selection allows setting up various operating parameters for the SCSI Emulator. See section 6.4 for a complete description.

6.2.14 <^Z> - REPEAT COMMAND

When enabled by <Enter>, this item causes the next command selected to be executed repeatedly until stopped by a keypress (any key). The halting keypress also disables repeating for subsequent commands until explicitly enabled again. Macros can also be repeated, just like individual commands. Macros can be repeated too.

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6.3 <D> - DATA BUFFER MANAGEMENT

This selection allows you to manipulate the data buffers used for SCSI commands. Menu selections allow you to fill the outgoing data with a variety of patterns, or to view and edit each individual byte. You can also view the contents of the incoming buffers from the previous SCSI command.

```
DATA BUFFER MANAGEMENT MENU        (Menu Level 3)
---------------------------------------
<0> - Select Buffer...          [Data-Out]
<1> - View and Edit Buffer
<2> - Fill Buffer...
<3> - Copy Buffer...
<4> - Set Buffer Size             [$0200]
```

6.3.1 <0> - SELECT BUFFER

Always select the proper buffer before viewing, editing, or filling it. Toggle the buffer selection using the arrow keys in selection **<0>**. When copying a buffer to buffer, the buffer selection <0> designates the source buffer. When you type **<3>** for Copy Buffer, you will be prompted to select the destination buffer. The following buffers can be selected:

- SCSI Data Out
- SCSI Data In
- Initial Message Out (Identify,..)
- Mode Select Data
- Mode Sense Data
- Request Sense Data
- Inquiry Data

The buffers of options 0,2,3 are for outgoing data, buffers of options 1,4-6 are for incoming data. All buffers can be changed using the edit, fill, or copy functions.

6.3.2 <1> - VIEW AND EDIT BUFFER

This selection allows you to examine each byte of the active buffer. You can modify any or all of the bytes.

Editing is very simple. Use the cursor control keys (arrows, PgUp, etc) to move to the byte you want to change. Then type the new value for the byte. As long as you type keys which are valid hexadecimal digits, the cursor will move along in the buffer and the new data will replace the old. You can also use the cursor control keys to skip over or move back within the buffer. If you type only single digit for a byte, then type <Enter> or some key which is not a valid hexadecimal digit,

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the digit you typed will be used as the value for the entire byte (it will appear as the low-order 4 bits). To end the editing session, press <Quit>. Keys which have no meaning in the context of the editor will be ignored. (But note that many of the keys on the built-in keypad are interpreted as single characters which may be valid hexadecimal digits).

6.3.3 <2> - FILL BUFFER

This option allows you to select or define a fill pattern which will replicate throughout the buffer. Using the <left arrow> or <right arrow>, select the following patterns:

zeros - every bit in the buffer will be turned off

ones - every bit in the buffer will be turned on

random - a pseudo-random pattern of byte value will be used to fill the buffer.

incr. - you will be asked for a pattern of up to 15 bytes. Type the desired pattern in Hex, separating bytes with spaces. The pattern will be used to fill the buffer. Each copy of the pattern will be incremented from the previous copy. For example, if you chose the pattern $A0 F2, the buffer will be filled with the following pattern:

```
address   Values

  0:      a0  f2  a0  f3  a0  f4  a0  f5  a0  f6  a0  f7  a0  f8  a0  f9
 10:      a0  fa  a0  fb  a0  fc  a0  fd  a0  fe  a0  ff  a1  00  a1  01
...
```

const - you will be asked for a pattern like that for an incrementing fill. The pattern will be used (unchanged) to fill the buffer.

6.3.4 <3> - COPY BUFFER

This selection allows you to copy from the active buffer to any other buffer for outgoing data. If the buffers are the same size, the entire length will be copied. If the buffers are different sizes, only the length of the shorter one will be copied. The remainder of the longer buffer will be unchanged. You can copy any source buffer into (almost) any destination buffer; the exception for destination are the input buffers.

Before copying, always select the proper source buffer. Toggle the (source) buffer selection using the arrow keys in selection **<0>**. When you type **<3>** for Copy Buffer, you will be prompted to select the destination buffer. Select the destination using the arrow keys, then press **<Enter>** to execute the copy.

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6.3.5 <4> - SET BUFFER SIZE

This selection allows you to specify the number of bytes in any of the buffers. Certain maximums must be observed, as shown in the table below:

Buffer	Maximum Size
Read	64 KBytes
Write	64 KBytes
ID Msg Out	16 Bytes
Req Sense Data	32 Bytes
Inquiry Data	64 Bytes
Mode Sense Data	256 Bytes
Mode Select Parms	256 Bytes

6.4 EMULATOR SETUP

Selecting option "<^X> - Emulator Setup" gives access to the various operating parameters of the SCSI emulator. Parameters can be changed through selections from this menu.

```
EMULATOR SETUP MENU              (Menu Level 3)
---------------------------------
<0> - Alloc/Xfer Lengths...
<1> - Arbitration                [E]
<2> - Identify Message           [E]
<3> - Disconnect/Reconnect...    [E]
<4> - Data Xfer Protocols (W/SDTR)
<5> - Mode Sense/Select setup...
<6> - Target type...        [0(Disk)]
<7> - SCSI Version               [2]
<8> - Command Timeout            [E]
```

You can make your selections by either moving the highlight bar and pressing the <Enter> key, or directly by pressing the selector key listed along the left side on this menu. The left- and right-arrow keys change the current value (in [ ] brackets).

6.4.1 <0> - ALLOCATION/TRANSFER LENGTHS

This selection gives access to control of the amount of data to be transmitted or received and saved during various data phases. The menu for these selections is as follows:

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```
ALLOCATION / TRANSFER LENGTHS      (Menu Level 4)
-----------------------------------------------
<0> - Xfer Len - Rand Acc       [00000001] blocks
<1> - Xfer Len - Seq Acc/Proc/Comm[000200] bytes
<2> - Target Block Size            [0200] bytes
<3> - Alloc Length for Request Sense [020] bytes
<4> - Alloc Length for Inquiry      [030] bytes
```

<0> - Initiator Transfer Length for random access device type - is a value which will be filled in the TxLgh field of Read/Write type commands if 'Autofill' is enabled.

<1> - Initiator Transfer Length for Seq.Access, , Processor, or Communications device type - is a value which will be filled in the TxLgh field of Read/Write type commands if 'Autofill' is enabled.

<2> - Target Block Size - defines the data block size expected in the Target. Data buffer used by the Read/Write type commands will be sub-divided based on this value.

<3> - Allocation Length for Request Sense - is a length of buffer allocated for Sense data received from the Target in a Request Sense command. This value will be filled in the Allocation Length field of a Request sense command if 'Autofill' is enabled.

<4> - Allocation Length for Inquiry - is a length of buffer allocated for Inquiry data received from the Target in a Inquiry command. This value will be filled in the Allocation Length field of an Inquiry command if 'Autofill' is enabled.

6.4.2 <1> - ARBITRATION

For SCSI-2, Arbitration is mandatory. However, in SCSI-1, it was optional and some very early systems did not arbitrate. This selection allows you to disable Arbitration in order to emulate those early (SCSI-1) systems. Note that by disabling Arbitration, the Disconnect/Reconnect option will also be disabled.

6.4.3 <2> - IDENTIFY MESSAGE

This selection determines whether Selection with Attention will be used (to signal a desire by the Initiator to send a Message Out to the Target before the CDB. This message phase is normally used for an Identify Message, for Queue Tag messages and for Protocol Negotiations. When Arbitration is disabled, Identify Message is also disabled.

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6.4.4 <3> - DISCONNECT / RECONNECT

This selection determines whether the Target will be allowed to disconnect during the command. When emulating a SCSI Initiator, the Identify message will have the "disconnect permission" bit (bit 6) cleared as a default. When Arbitration or Identify Message is disabled, the Disconnect is also disabled.

6.4.5 <4> - DATA PROTOCOLS

This selection allows you to control the way that data is transferred during either the Data-In or Data-Out phases. Selecting this option gives access to the following menu:

```
DATA PHASE TRANSFER PROTOCOLS              (Menu Level 4)
-----------------------------------------
<0> - Synchronous Transfers              [E]
<1> -    Offset                         [15]
<2> -    Period(ns)                    [100]
<3> -    Resp w/ Msg Reject             [N]
<4> -    Negotiation              [RqS/Inq]
<5> - Wide Transfers                     [E]
<6> -    Transfer Width                 [16]
<7> -    Resp w/ Msg Reject             [N]
<8> -    Negotiation              [  Never]
```

SCSI-2 provides for FAST (rates above 5MHz and below 10MHz) and WIDE (2 or 4 bytes) data transfer modes. Note, that only data phases In/Out will use these modes. All other phases (Command, Status, Message phases) always use below 5MHz and single-byte transfer mode. Also note, that before FAST and/or WIDE are used, they must be negotiated between each Initiator and Target. A SCSI system can have a mix of devices, each using a different mode. It is also provided for SCSI-1 devices, that do not recognize, and do not support these modes; these devices will reject the SDTR (Synchronous Data Transfer Request) and WDTR (Wide Data Transfer request) extended messages. SDTR and WDTR negotiation(s) usually occur during power-up sequence (positioned immediately after Identify message, just before the command phase). The SDTR and WDTR extended messages are attached to Request-sense and/or Inquiry commands. Consult the SCSI-2 specifications for detailed rules defining use of these messages.

When making selections from the menu, use arrow keys to toggle between values within allowed limits.

Items **<0>** and **<5>** are used for enabling the use of SDTR and WDTR extended messages to negotiate synchronous and wide data transfer modes. If enabled, format of the SDTR and WDTR will be defined by parameters, as currently selected. The **<5>** and **<6>** selections are tied together; both will change if either one of them changes.

Item **<1>** allows you to select the maximum synchronous offset allowed during data transfers.

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Offsets up to 15 (hex 0F) are supported.

Item **<2>** allows you to select the synchronous rate. Rates are selectable from 100 ns to 200 ns when using FAST synchronous transfers, and from 200 ns to 875 ns when using normal synchronous transfers. This gives a range of rates from approximately 1.4MHz up to the maximum of 10MHz allowed by SCSI-2.

Items **<3>** and **<7>** allow you to select how the Emulator responds to WDTR/SDTR negotiations when a particular transfer type is disabled. If "Respond w/ Msg Reject" is enabled, the emulator will reject WDTR and/or SDTR extended messages. If disabled, it will respond with an extended message which shows an inability to transfer data with the protocol requested. For example, if Wide Data Transfers are disabled, and the Emulator receives a WDTR extended message, it will respond with a WDTR extended message showing '0' for the width byte. Similarly, the SDTR message response will have a 0 offset byte.

Items **<4>** and **<8>** allow you to decide when WDTR / SDTR negotiation should be done:

a) never,
b) only once after Power-up or
c) on each Request Sense or Inquiry command.

The SCSI-2 specification recommends negotiating with each Request Sense or Inquiry command.

Item **<6>** allows you to select either 8-bit or 16-bit data transfers.

6.4.6 <5> - MODE SENSE / SELECT SETUP

Selecting this option gives access to the following menu.

```
MODE SENSE / MODE SELECT MENU        (Menu Level 4)
---------------------------------------
<0> - Mode Sense Alloc Length (In)  [$24]
<1> - Mode Select Param List Length [$0C]
<2> - Edit Mode Select Parameter List
<3> - Copy Mode Sense Data to Mode Select Parms
```

Item **<0>** specifies the buffer size (in bytes) allocated by the Initiator for Mode Sense data received from the Target.

Item **<1>** specifies the number of bytes which the Initiator will send (if the Target allows it) as parameters of the Mode Select Command.

Item **<2>** allows you to view and change the data sent as parameters. This acts the same as the Data Buffer Management menu.

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Item <3> allows you to copy Mode Sense Data (as received from the Target) to the Mode Select Parameter List buffer (before sending it back to the Target). This would be useful when you are experimenting (editing) with certain parameters, but want to preserve the rest as it is.

6.4.7 <6> - TARGET TYPE

This selection allows you to specify the type of target addressed on following commands. Several commands vary in the contents of the CDB and the meaning of the bits in the CDB depending on the target type. Currently the supported target types include :

Type 0 - Random Access Devices (Disk drives. Many of these commands will act the same way for Optical drives, CD-ROM drives and similar devices)
Type 1 - Sequential Access Devices (Tape drives)
Type 3 - Processor Devices

If interest warrants, other device types will be added in the future. Commands which apply to all devices can, of course, be sent to any device type. Also, using the vendor specific commands, you can define commands for other device types.

6.4.8 <7> - SCSI VERSION

This selection allows you to specify whether to use SCSI-1 or SCSI-2 protocols. Only a few commands are affected by the SCSI version. If you are not sure which version is supported by the device being addressed, we recommend that you select SCSI-2 version.

6.4.9 <8> - TIMEOUT SELECTION

Timeout options determine how the Emulator will behave if the device being addressed does not respond in a timely manner. If enabled, timeout will abort the current command by issuing a SCSI RESET condition if the command has not completed within approximately 2 seconds.

It is important, if you are going to issue a command which is not expected to complete within the timeout period (such as a tape rewind command, or a disk format command) to disable timeout.

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SECTION 7

UTILITIES

7.1 INTRODUCTION

Several utility functions are provided in the DSC-216/217. 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

From the main menu, press <7> or <Ctrl-T> to access this utility. You will be asked to provide two trace memory addresses. These may be entered 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 in nanoseconds. In the example above, it is 1 second, 689 milliseconds, 994 microseconds, and 440 nanoseconds.

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:

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```
UTILITY FUNCTIONS MENU
-------------------------------------
<0> - Screen saver                  [ ]
<1> - Echo trace display to printer [ ]
<2> - Printer timeout               [E]
<3> - Restore system defaults
<4> - Remote control via serial port[ ]
<5> - Upload trace to host computer
<6> - Download trace from host computer
<7> - Set serial port parameters

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 a certain line, using the Arrow keys and pressing <Enter>.

Individual functions are explained below.

7.3.1 <0> - USING THE SCREEN SAVER

Electroluminescent displays like the one in the DSC-216 are subject to 'screen burn-in' if the contents of the screen do not change for a long period of time; a screen may show a ghost of a previous image. To prevent this effect, the display has a screen saver feature. If a significant time passes with no keyboard or display activity, the screen will blank. To bring it back, press any key.

You can turn off the screen saver feature from the UTILITY FUNCTIONS MENU. Choose item <0> to toggle between enabled or disabled screen saver.

7.3.2 <1> - PRINTING DISPLAY INFORMATION

You can print a hard copy of the trace information, just as it appears on the screen. The LED near the bottom of the front panel, by the <^Print> key, tells if printing is enabled. When the LED is lit, each line of trace memory displayed to the screen will also be sent to the parallel printer connected to J1.

Printing can be enabled or disabled by pressing <Alt-P> anytime, from any menu level, even in the middle of displaying. Another method is changing the printer state by entering the UTILITY FUNCTIONS MENU and choosing item <1>. The <Enter> key toggles between enabled shown as 'E' in the square brackets, and disabled, shown by empty brackets.

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7.3.3 <3> - RESTORING DEFAULT PARAMETERS

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.

7.3.4 <4> - USING THE DSC-216/217 AT A REMOTE LOCATION

There are situations when it is needed to test or troubleshoot a SCSI system at a remote location. It is possible to connect the DSC-216/217 Analyzer to SCSI bus to be tested, and connect the controlling terminal over a modem, or via a NULL-modem cable.

The operator at the test site (we will call this site-A, and the receiving end site-B) simply connects the DSC-216/217 to the SCSI bus system as usual. He/she then connects the DSC-216/217 Serial Port J3 to the modem port. The engineer connects his/hers terminal (or host computer) at the other end to the telephone line. If site-A and site-B are close together, a NULL-modem cable can be used instead. See Appendix A for pinout.

Site-A setup: the operator connects the DSC-216 to the SCSI bus under test, and enables the remote control by selecting the UTILITIES menu, and starting selection <4>. A message will appear on the screen asking for confirmation. Press <Yes> to confirm this, and the message

'THIS UNIT IS UNDER REMOTE CONTROL - DO NOT DISTURB'

appears on the screen. At this point, the keypad, or a keyboard if connected to J4, is disabled. The DSC-216 can be restarted, to restore control from site-A, by pressing the SYSTEM RESET pushbutton, or by turning the power OFF and ON.

The DSC-217 model is automatically setup for remote control, and there is no need for any special setting up at the Site-A.

Site-B operation: Log onto the remote terminal or host computer, and start the communications utility program (BITCOM, PROCOMM or similar). The screen should clear, and the UTILITY menu from the DSC-216 (from site-A by modem) should display on your screen. If using the DSC-217, the main menu will be displayed. At this point, the keyboard on your remote terminal should act as if connected directly to the DSC-216/217; all functions on the DSC-216/217 should be operational.

When finished with the session, select the Utilities menu from your remote terminal, select item 4 to disable remote control, and confirm the selection by pressing <Y>. Control will return to the DSC-216 local screen and keyboard. Remote control can also be disabled by pressing the SYSTEM RESET switch on the DSC-216 front panel, or by cycling power to the DSC-216.

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The terminal used for remote control should support the ANSI escape sequences for clearing, moving the cursor, and for inverse video. See Appendix B for definitions of the sequences used.

7.3.5 <5> - UPLOADING TRACE TO HOST COMPUTER

You can transfer any trace captured by the DSC-216/217 to a file on a host computer for comparison with other traces, post processing, or archival purposes. Enter the Utilities menu by pressing <Util> and select item 5 for "Upload trace to host computer".

You will be offered a selection of display/file formats to transfer.

The 'Raw Data' format is the only format which can be downloaded back into the DSC-216/217 at a later time. 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 duplicates of the trace display formats, resulting in text files identical to what appears on the screen of the DSC-216/217. These may be most useful for comparisons and post-processing of the trace information, but cannot be reloaded into the DSC-216/217. Realize that this format is 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 selecting the "upload file format", a message will appear showing the serial transmission parameters and asking you to confirm the transfer.

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.

The DSC-216/217 needs to be connected to the host computer using a null-modem cable. See Appendix A for the pinout. Make sure the connections are made and the host is communicating with the same baud rate and data format as the DSC-216/217, and is ready to receive a file. Then confirm the transfer by pressing <Yes> to start communications. Most communications programs can be set to echo received characters to the screen, so you can see if the transfer is happening.

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

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7.3.6 <6> - DOWNLOADING TRACE FROM HOST COMPUTER

A trace saved to a file in 'Raw Data format' can be reloaded into the DSC-216/217 for more study. At the host computer end, start the communications program and ready it to send an ASCII file.

Connect the DSC-216/217 to the host using a null-modem cable. See Appendix A for the pinout. Select the UTILITIES menu on the DSC-216/217 and choose item 6 - "Download trace from host computer". A message will appear showing the current settings for serial transfers, and will ask you to confirm the transfer. Press <Yes> to confirm, then start the transfer from the host end.

> *Some 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 that only the 'Raw Data format' file can be reloaded into the DSC-216/217. Any other file format will result in the "Unrecognized format" message.

7.3.7 <7> - SETTING SERIAL PORT PARAMETERS

This option allows you to 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 arrow keys to move the highlight to the item you wish to change. Use the left or right arrow keys 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 next time you do any communications again even after power OFF/ON.

The following settings are selectable:

Baud rates : 110, 300, 600, 1200, 2400, 4800, 9600 or 38400 (38.4k)
Number of data bits : 5, 6, 7 or 8
Parity : even, odd or none (No parity)
Stop bits : 1 or 2

When shipped from the factory, the DSC-216/217 default setting is:

9600 baud
8 data bits
No parity
1 stop bit

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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 to facilitate return of the equipment for factory service should that become required.

8.2 INITIAL TURN-ON

Connect the line cord to the AC module on the front panel of the DSC-216/217, and plug it in the three-pin 115 Volt wall outlet. If three-pin outlet is not available, use a two-pin socket with proper ground wire attached and connected to ground.

If you want to use an external keyboard with your DSC-216 rather than the built-in keypad, connect its cord to the J4 KBD connector. Note that this keyboard should be the newer PC/AT type, one which does not require initialization from the host (the DSC-216 does not initialize the keyboard).

Turn the power ON. The power switch is in the upper right corner of the front panel. 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 a printer is to be used, connect it by a standard PC/AT printer cable to connector J1 on the front panel of the DSC-216. The printer should be any standard parallel type. For J1 connector pinout see Appendix A.

The unit has all setup values preset to their defaults at the factory, and therefore 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.

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8.3 INITIAL CHECK-OUT

Connect a SCSI cable to an active SCSI bus. Be sure that termination is appropriate. The Trm.Pwr LED at the left side of the front panel should light. If it does not, turn on the Trm.Pwr switch on the SCSI connector pod.

Press <Run>. 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 <Stop>. A message will appear on the screen telling the end address of the recording. If this address is 0 or 1, contact the factory.

Press <Display> and <Enter>. You will see the recorded trace. Press <Flip> to change the display format. You may want to experiment with other recordings modes and triggering at this point.

8.4 COMMUNICATION, INTERFACING, AND SETUP

When using a remote CRT terminal or PC connected via the J3 serial port directly or over a modem, a compatible communication format and protocol have to be used. To aid the user in his/her installation, the serial I/O port is pre-programmed at the factory to a default set of parameters. These are:

J3 port: 9600 baud
8 data bits
No parity
1 stop bit
RTS and CTS enabled

Note that J3 when communicating with a CRT terminal uses the following signals:

pin 2 for RxData
pin 3 for TxData
pin 4 for CTS (to throttle the DSC-216/217 when sending Data out to remote host/CRT)
pin 5 for RTS (to control input from remote KBD)
pin 7 for Signal GND.

Pin-6 of J3 is HIGH (+5Volt through a 470-ohm resistor), and can be used for "Hot Wiring" the CTS (pin4) of the J3 port for initial startup if READY signal is not available in the terminal. In such a case the baud rate may have to be slowed down, to prevent data overruns.

All the selections described above are stored in the non-volatile EEPROM, and do not need to be selected again, unless different values are required.

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8.5 EPROM FIRMWARE UPGRADES

These instructions explain how to install an updated firmware EPROM into your Ancot DSC-216/217 SCSI Bus Analyzer (serial numbers xxxx0017 and higher). If you decide that you want the factory to install your upgrade for you, contact ANCOT directly.

- Remove the briefcase cover to reveal the instrument front plate.

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

- Remove the 8 black Phillips screws (2 on each edge) holding the front plate to the briefcase housing.

- Carefully lift the front plate and the attached circuit boards and metal pan from the briefcase housing. Place the assembly on a flat surface.

- Locate the main circuit board. It is the largest PCB which is attached directly to the metal pan on the bottom. Find the firmware EPROM to be replaced: it is the big 32-pin .600" chip at the extreme left rear of the main PCB, with an ANCOT label. It has the DSC-216/217 instrument identification and FW revision number printed on it. Use a flat bladed screwdriver to disengage the EPROM from its socket. If you use care in removing it, the EPROM can be erased and reused.

- Insert the new firmware EPROM into the same socket. The small notch on the ceramic DIP chip goes closest to the outside edge of the main PCB (same as the other chips on that PCB). Be sure that all the legs are aligned with the holes in the socket, before pressing the chip firmly into the socket. Check the legs again to be sure none of them was 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.

- Reinsert the electronics assembly into the briefcase housing. The handle of the attache case should be at the top of the flat display screen. Insert the 8 screws to hold the electronics assembly in the briefcase housing. Tighten the screws firmly (but not too tightly!). Attach the attache lid.

Your DSC-216/217 is now ready for use with the upgraded firmware.

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SECTION 9

OPTIONS

9.1 INTRODUCTION

ANCOT has developed several optional software applications which may be used with the DSC-216 SCSI Bus Analyzer/Emulator. These applications are available from the factory and are supplied in two formats:

- an EPROM for insertion into the "user ROM socket" of the DSC-216 main circuit board;
- and a file in Motorola S-Record format for downloading from a host computer to the DSC-216 via the serial port.

Each application has its own user manual. The descriptions which follow are not intended to be complete guides, but rather an indication of the capabilities of the applications.

9.2 THE APPLICATIONS

9.2.1 ANTEST - THE DISK TEST PROGRAM

ANTEST is ANCOT's Disk Exerciser/Tester Program. It is available on several platforms, including the DSC-216. It is useful for acceptance testing, production testing, or for debugging disk drives. ANTEST is completely menu driven for ease of use. Its reports are sent to the user's screen, a parallel printer, and through the serial port, to a file on a host computer.

ANTEST is capable of numerous tests, to check all aspects of operation of the disk drive under test. These tests include :

Write-Read-Compare
Read (Check for bad data blocks)
Seek time
Data transfer rate
Spin-up time

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Start-up time
Throughput rate (I/Os per second)
Comprehensive test
Conformance test

You have complete control over the test activity. With a setup menu you can select synchronous or asynchronous data transfers, wide (16-bit) or narrow (8-bit) data transfers, Initiator and Target ID numbers, and Logical Unit number.

With other setup menus you can control the length of tests, the actual bytes sent to the target, the range of scan of blocks on the disk, etc.

The reports generated by ANTEST are in 40-column format, suitable for printing by ticket printers, for attachment to the drives tested. Pass/Fail is clearly indicated for each test, based on criteria you select.

ANTEST requires the Emulator Board option to be installed on the DSC-216. It uses the emulator to issue the commands to the device under test. If the emulator is not installed, the program will hang.

Ask for #AST-220, which is the ANTEST program package for the DSC-216/217.

9.2.2 C LANGUAGE CROSS COMPILER

ANCOT offers a compiler which runs on an IBM PC or compatible, and produces native code to execute on the DSC-216. It includes a library of functions for easy use of the capabilities of the DSC-216.

Using this compiler, you can write programs to automate testing and monitoring of the SCSI bus using the DSC-216. ANCOT's disk testing program, ANTEST, was constructed using this compiler.

You can "burn" into EPROM the resulting executable programs, and insert the EPROM into the "user ROM socket" on the DSC-216's main circuit board. You can also load the programs into the system SRAM via the serial port from your host PC. Example programs are provided showing how to use the features in the ANCOT SCSI Library which accompanies the compiler.

Several of the functions in the ANCOT SCSI Library, supplied with the cross compiler, use the Emulation Board option of the DSC-216. If you call one of these functions in your program, and the emulator is not present, the program will hang.

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9.2.3 RS-232 SERIAL BUS ANALYZER

This option consists of a passive RS-232 adapter pod plus a program which executes on the DSC-216. The adapter pod has connectors for either 9- or 25-pin D-shell cables, with both male and female connectors for each size. A SCSI cable connects the pod to the DSC-216 for monitoring.

The program is menu driven for recording and analyzing the traffic on the RS-232 bus. Once captured, the data can be displayed in either of two formats, and timing can be calculated.

The two-line format displays the traffic in each direction on its own line. The sequential ordering of character arrival is shown in the display. Timing between arrival times of any two characters on the display is easily available.

The one-line format puts each character on its own line, along with the state of the control lines (e.g., RTS) and relative timing from the previous character arriving in each direction.

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APPENDIX A

EXTERNAL CONNECTOR PIN ASSIGNMENT AND CABLES

A.1 I/O INTERFACE CONNECTORS J1, J3

J1 – 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		

J3 – Serial 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

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A.2 AUXILIARY CONNECTORS J2, J4, J7, J8

J2 – 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.

! WARNING !

NOTE THAT PINS J2/9 AND J2/15 HAVE Vcc (+5V) CONNECTED TO IT. THIS VOLTAGE IS NOT FUSED, HOWEVER THE POWER SUPPLY WILL SHUT OFF AUTOMATICALLY IF OVERLOADED.

J4 – External KEYBOARD PC/AT type Port (DSC–216 only)

1	CLK	4	Signal GND
2	DATA	5	+5 Volt
3	N.C.		

J7 – External TRIGGER INPUT (BNC)

center pin – Ext.Trigger signal
shell – Chassis GND

J8 – External SYNCH OUTPUT (BNC)

center pin – Ext.Synchr signal
shell – Chassis GND

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A.3 SCSI CONNECTOR ADAPTER MODULES WITH J5, J6

The J5 and J6 SCSI connectors are mounted on the replaceable module. Several module types are available:

1. SINGLE—ENDED interface, with high-density 68-pin 'P' type connector J5 for WIDE SCSI, and Centronics style 50-pin 'A' type connector J6 for SINGLE-BYTE SCSI
(standard type, is shipped from the factory)
P/N: SA-216

2. DIFFERENTIAL interface, with same type connectors as 1. above. Optional.
P/N: DS-216

3. SINGLE-ENDED (J5) & DIFFERENTIAL (J6) interface combination, with two high-density 68-pin 'P' type connectors for WIDE SCSI (2 bytes). Optional.
P/N: UA68-216

4. SINGLE-ENDED (J5) & DIFFERENTIAL (J6) interface combination, with two digh-density 50-pin connectors for single byte SCSI, as used on Sun Microsystems computers. Optional.
P/N: UA50-216

Pinouts for all above listed modules follow.

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A.3.1 SCSI SINGLE-ENDED 68-pin & 50-pin CONNECTOR MODULE (standard) P/N: SA-216

J5 – 68 pin HD 'P' type

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	GND	50	GND
17	TRMPWR *	51	TRMPWR *
18	TRMPWR *	52	TRMPWR
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–

J6 – 50-pin (Centronics) 'A' type

1	GND	26	D0–
2	GND	27	D1–
3	GND	28	D2–
4	GND	29	D3–
5	GND	30	D4–
6	GND	31	D5–
7	GND	32	D6–
8	GND	33	D7–
9	GND	34	DPAR–
10	GND	35	GND
11	GND	36	GND
12	TRMPWR *	37	TRMPWR *
13	TRMPWR *	38	TRMPWR
14	open	39	open
15	GND	40	GND
16	GND	41	ATN–
17	GND	42	GND
18	GND	43	BSY–
19	GND	44	ACK–
20	GND	45	RST–
21	GND	46	MSG–
22	GND	47	SEL–
23	GND	48	C/D–
24	GND	49	REQ–
25	GND	50	I/O–

*) TRMPWR can be enabled by a jumper. Pin remains OPEN if disabled.

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A.3.2 SCSI DIFFERENTIAL 68—pin & 50-pin CONNECTOR MODULE (optional) P/N: DA-216

J5 – 68-pin HD 'P' type

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	GND	50	GND
17	TRMPWR *	51	TRMPWR *
18	TRMPWR *	52	TRMPWR
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–

J6 – 50-pin (Centronics) 'A' type

1	GND	26	GND
2	D0+	27	D0–
3	D1+	28	D1–
4	D2+	29	D2–
5	D3+	30	D3–
6	D4+	31	D4–
7	D5+	32	D5–
8	D6+	33	D6–
9	D7+	34	D7–
10	DPAR+	35	DPAR–
11	GND	36	GND
12	TRMPWR *	37	TRMPWR *
13	TRMPWR *	38	TRMPWR
14	open	39	open
15	ATN+	40	ATN–
16	GND	41	GND
17	BSY+	42	BSY–
18	ACK+	43	ACK–
19	RST+	44	RST–
20	MSG+	45	MSG–
21	SEL+	46	SEL–
22	C/D+	47	C/D–
23	REQ+	48	REQ–
24	I/O+	49	I/O–
25	GND	50	GND

*) TRMPWR can be enabled by a jumper. Pin remains OPEN if disabled.

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A.3.3 SCSI S-E and DIFF both 68-pin HIGH DENSITY CONNECTOR MODULE (optional) P/N: UA68-216

J 5 - SINGLE-ENDED 68-pin HD 'P' type

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	GND	50	GND
17	TRMPWR *	51	TRMPWR *
18	TRMPWR *	52	TRMPWR
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–

J6 - DIFFERENTIAL 68-pin HD 'P' type

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	GND	50	GND
17	TRMPWR *	51	TRMPWR *
18	TRMPWR *	52	TRMPWR
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–

*) TRMPWR can be enabled by a jumper. Pin remains OPEN if disabled.

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A.3.4 SCSI S-E and DIFF both 50-pin HIGH DENSITY CONNECTOR MODULE (optional) P/N: UA50-216

Note: This connector module uses both 50-pin High Density connectors (as used on Sun Microsystems computers and others)

J 5 – SINGLE-ENDED 50-pin

1	GND	26	D0–
2	GND	27	D1–
3	GND	28	D2–
4	GND	29	D3–
5	GND	30	D4–
6	GND	31	D5–
7	GND	32	D6–
8	GND	33	D7–
9	GND	34	DPAR–
10	GND	35	GND
11	GND	36	GND
12	TRMPWR *	37	TRMPWR *
13	TRMPWR *	38	TRMPWR
14	open	39	open
15	GND	40	GND
16	GND	41	ATN–
17	GND	42	GND
18	GND	43	BSY–
19	GND	44	ACK–
20	GND	45	RST–
21	GND	46	MSG–
22	GND	47	SEL–
23	GND	48	C/D–
24	GND	49	REQ–
25	GND	50	I/O–

J6 – DIFFERENTIAL 50-pin HD

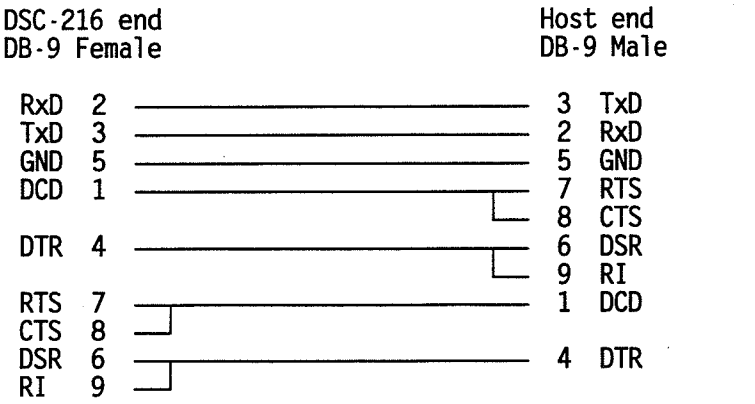
1	GND	26	GND
2	D0+	27	D0–
3	D1+	28	D1–
4	D2+	29	D2–
5	D3+	30	D3–
6	D4+	31	D4–
7	D5+	32	D5–
8	D6+	33	D6–
9	D7+	34	D7–
10	DPAR+	35	DPAR–
11	GND	36	GND
12	TRMPWR *	37	TRMPWR *
13	TRMPWR *	38	TRMPWR
14	open	39	open
15	ATN+	40	ATN–
16	GND	41	GND
17	BSY+	42	BSY–
18	ACK+	43	ACK–
19	RST+	44	RST–
20	MSG+	45	MSG–
21	SEL+	46	SEL–
22	C/D+	47	C/D–
23	REQ+	48	REQ–
24	I/O+	49	I/O–
25	GND	50	GND

*) TRMPWR can be enabled by a jumper. Pin remains OPEN if disabled.

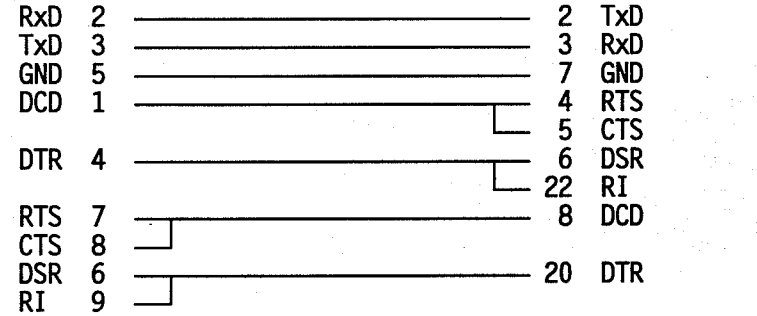
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A.4 NULL-MODEM CABLES

NULL MODEM CABLE WITH DB–9 HOST CONNECTOR

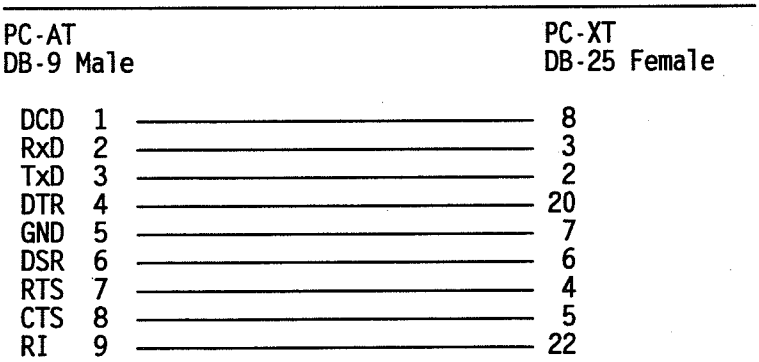


NULL MODEM CABLE WITH DB-25 HOST CONNECTOR



A.5 CABLE ADAPTER DB-9 TO DB-25

DB-9 TO DB-25 CABLE ADAPTER (PC-AT to PC-XT COM port)



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APPENDIX B

ESCAPE SEQUENCES USED IN SCREEN CONTROL

B.1 GENERAL

Any terminal or computer emulating a terminal connected as a remote display device for the ANCOT DSC-216/217 SCSI Bus Analyzer will need to recognize and act on the following Escape sequences. Each sequence begins with an introducer sequence, followed by one or more parameters, followed by a terminating character.

The introducer sequence is either a single Esc character (1b Hex) or the Esc character followed by a single '[' character (5b Hex).

Parameters are decimal numbers transmitted as the ASCII characters '0' (30 Hex) through '9' (39 Hex). Parameters are separated from each other by the ';' character (3b Hex). In cases where the parameter value is negative, the ';' character is replaced by a ':' character (3a Hex). There are no negative parameters in any of the sequences currently used.

The terminating character is always a printable ASCII character, usually either an upper or lower case letter. Terminating characters differ depending on the purpose to be accomplished by the escape sequence.

B.2.1 ESCAPE SEQUENCES - OUT (from DSC-216/217 to Terminal)

CHARACTER ATTRIBUTE SEQUENCES:

<Esc>[0m	Sets attribute to normal video (bright character on dark background)
<Esc>[7m	Sets attribute to inverse video (dark character on bright background)

SCREEN CLEARING SEQUENCES:

<Esc>[0J	Clears from cursor to end of screen
<Esc>[2J	Clears entire screen
<Esc>[0K	Clears from cursor to end of line
<Esc>[2K	Clears entire line

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CURSOR MOVEMENT SEQUENCES:

Sequence sent to the terminal to move the apparent location of the cursor displayed:

<Esc>[<row>;<column>H Move cursor to row <row> and column <column>.

For all movement commands, the screen is assumed to have 25 rows, numbered from 1 to 25, and 80 columns, numbered from 1 to 80. If a parameter is missing or outside the range, 1 is used.

B.2.2 ESCAPE SEQUENCES - IN (from Terminal to DSC-216/217)

<Esc>A	Move cursor up
<Esc>B	Move cursor down
<Esc>C	Move cursor right
<Esc>D	Move cursor left

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APPENDIX 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
0-7	"DSC-216 "
8-18	Address range. The first value is 5 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 5 hex digits, represents the last trace address transferred.
19	" " (an ASCII space character, 20 Hex)
20	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
21-126	ASCII space characters, 20 Hex
127	"#"

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

C.2 RAW DATA FORMAT

The Raw Data format is the only one that can be loaded back into the DSC-216/217 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 an encrypted format to ensure that all bytes transmitted are printable

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ASCII, regardless of the binary value found in the trace, while minimizing the number of bytes transmitted. The 9 bytes of each trace event are encoded into 12 bytes of printable ASCII data, using a scheme defined in section C.2.1 below. Each SCSI event (12 bytes) is followed by a line feed/carriage return combination.

C.2.1 NATURAL SCSI EVENTS

Natural events are those captured as a result of a transition on a SCSI control line. The exact recording mode is as set in the Mode Menu. See also section C.2.2 below.

Standard SCSI signal definitions apply to signals BSY, SEL, ATN, RST, MSG, C/D, I/O, REQ and ACK. Other abbreviations used below are:

Trg	If set, the trigger condition has occurred before this event.
Ex#	Expansion port pins 1,2 and 3 map respectively to bits 0,1 and 2.
PEL,PEH	If set, the Low or High byte has bad parity.

The DSC-216/217 SCSI Bus Analyzer uses a special high resolution recording method for the REQ, ACK and ATN signals. These signals show as Rq#, Ak# and At# here. The 0 (Rq0) bit is the state at the time of capture, the 2 bit (Rq2) is the state at 20 nanoseconds before capture.

Bit	C15	C14	C13	C12	C11	C10	C9	C8
Signal	–	At2	–	At0	Trg	Ex2	Ex1	Ex0
Bit	C7	C6	C5	C4	C3	C2	C1	C0
Signal	PEH	PEL	BSY	SEL	RST	MSG	C/D	I/O
Bit	R7	R6	R5	R4	R3	R2	R1	R0
Signal	–	Ak2	–	Ak0		Rq2		Rq0

Each SCSI event consists of the following parts:

SCSI control lines	C0-C15	(2 bytes)
SCSI data lines	D0-D15	(2 bytes)
Time stamp	T0-T31	(4 bytes)
High resolution REQ/ACK info	R0-R7	(1 byte)

The time stamp is a counter of ticks since recording started; each tick is 40 ns.

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The 9 bytes of the trace are encoded into 12 bytes for transmission by the following scheme:

Byte	Bits: 7	6	5	4	3	2	1	0
1	0	1	C5	C4	C3	C2	C1	C0
2	0	1	C11	C10	C9	C8	C7	C6
3	0	1	D1	D0	C15	C14	C13	C12
4	0	1	D7	D6	D5	D4	D3	D2
5	0	1	D13	D12	D11	D10	D9	D8
6	0	1	T3	T2	T1	T0	D15	D14
7	0	1	T9	T8	T7	T6	T5	T4
8	0	1	T15	T14	T13	T12	T11	T10
9	0	1	T21	T20	T19	T18	T17	T16
10	0	1	T27	T26	T25	T24	T23	T22
11	0	1	R1	R0	T31	T30	T29	T28
12	0	1	R7	R6	R5	R4	R3	R2

Note the pattern of bits 7 and 6. The only exception to this pattern is if all of bits 0-5 are 1's; in that case bits 6 and 7 are both 0's. This results in transmitted bytes which are all in the range of 3F hex to 7E hex, which are printable ASCII values.

C.2.2 ARTIFICIAL SCSI EVENTS

In addition to the events captured as a result of transitions on the SCSI control lines, there are three types of artificial events written to the trace during recording. Each time the tracer is started by pressing <Run>, a **'start trace'** event is written, which has the pattern FEFF hex in the SCSI control lines word. Similarly, a **'pause in tracing'** is marked by the pattern FDFF hex, and the **'end of tracing'** has the pattern FCFF hex. For these events, the timestamp and REQ/ACK bytes of the SCSI event will all be 0's, and the SCSI data word will contain a pattern telling the recording mode used during that tracing session. The recording mode bits are as follows:

Bit	Meaning
D0	If set, only transitions on the SCSI BSY and SEL control lines are captured. All others are ignored.
D1	Not used.
D2	If cleared, all data transfers are captured. If set, the number of data transfers captured depends on bit D7.
D3	If set, all transitions of SCSI control lines REQ and ACK are captured. If cleared, only the transition which makes the data lines valid is captured. See section 2.2.5.5.

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D4 If set, any transition of the SCSI control lines MSG, C/D or I/O is captured. If cleared, transitions on these lines are ignored.

D5 If set, transitions on expansion port pin 1 are captured.

D6 If set, all transitions up to the Selection phase are captured. All later transitions are ignored until the next Bus Free phase, unless the data pattern during selection matches the filtering pattern.

D7 See bit D2. If in Skip data mode, and this bit is set, capture continues until the 8th assertion of ACK in each Data-In or Data-Out phase. If cleared, capture continues until the 32nd assertion of ACK.

C.3 READABLE FORMATS

In addition to the Raw Data format, it is possible to upload in either Structured or Binary format. In these formats, the file will contain trace information just as it appears on the screen of the DSC-216 when displaying in these formats. These formats cannot be downloaded back into the DSC-216/217.

C.4 TRACE DUMP FORMAT

The Hex Dump format can be used to get the complete contents of the trace memory without having the problem of decrypting the transmitted data. Although the Hex Dump format requires more characters to transmit the same data as in the Raw Data format, it is less than it would be for the Structured or Binary formats. The Hex Dump format cannot be downloaded back into the DSC-216/217.

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APPENDIX D

THE KEYPAD AND EXTERNAL KEYBOARD FUNCTIONS

D.1 GENERAL

The table below lists the keys on the keypad, their corresponding keys on the external keyboard, and their functions. The table is organized so that it scans over the keypad column by column, starting at the upper left corner and ending with the bottom right corner. Each key is listed in its basic function, followed by its 'Alt' and/or 'Ctrl' function if they apply. All combinations not listed are reserved / undefined.

D.2 THE KEYPAD & KEYBOARD FUNCTIONS TABLE:

24-key keypad	ext.keyboard	Function
Esc	Esc	escape - cancel function
Ctrl-Esc(^Break)	BREAK	Break (Software Reset)
Quit	Q	Quit a function, or exit this menu
Alt-Quit(-)	-	'dash' or 'minus'
Alt	Alt	select Alternate function
Ctrl	Ctrl	select Control function
Run	R	RUN - start tracing
Alt-Run(C)	C	C hex
Stop	S	STOP - stop tracing
Alt-Stop(8)	8	8 hex
Display	D	Display
Alt-Display(4)	4	4 hex
Ctrl-Display	Ctrl-D	delete Data Pattern byte in Search Pattern
No	N	No
Alt-No(0)	0 (zero)	0 hex
Pause	P	Pause tracing
Alt-Pause(D)	D	D hex
Flip	F	flip (toggle) between display formats
Alt-Flip(9)	9	9 hex
Ctrl-Flip(^Find)	Ctrl-F	Find certain command/phase/.. in the trace
Next	<space>	display Next page of trace
Alt-Next(5)	5	5 hex
Ctrl-Next(^FNxt)	Ctrl-L	Find next occurence

(continued)

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(continued)

Yes	Y	yes
Alt-Yes(1)	1	1 hex
◄	◄	move cursor left (non-destructive)
Alt-◄(E)	E	E hex
Trig	T	display the trigger selection menu
Alt-Trig(A)	A	A hex
Ctrl-Trig(^Time)	Ctrl-T	calculate time differential between trace events
Prev	–	display Previous page (approximately) of trace
Alt-Prev(6)	6	6 hex
Ctrl-Prev	Ctrl-K	Find-Previous occurence
X	X	don't care
Alt-X(2)	2	2 hex
Ctrl-X(^Print)	Ctrl-P	toggle printing to external printer
►	►	move cursor right (non-destructive)
Alt-►(F)	F	F hex
Mode	M	display the mode-of-recording selection menu
Alt-Mode(B)	B	B hex
Alph-Hx	H	toggle between alpha and hex format in data phase
Alt-AlphHx(7)	7	7 hex
Ctrl-AlphHx(^TmF)	E	toggle differential & elapsed time-stamp format
Util	U	display Utilities menu
Alt-Util(3)	3	3 hex
▲	▲	move cursor up
Alt-▲(HM)	Home	Home
Ctrl-▲(PgUp)	Pg-Up	Page Up
▼	▼	move cursor down
Alt-▼(END)	End	End
Ctrl-▼(^PgDn)	Pg-Dn	Page Down
16/8	W	toggle NARROW and WIDE data display
Alt-16/8(BS)	BackSpace	Back Space
Ctrl-16/8(^BinF)	L	toggle binary display formats
Enter	Enter	ENTER selection

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