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DASH 10

Host Control Manual

REV. C

manual part number: 22834-311

Astro-Med,® Inc.

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Recorder Identification Data

Congratulations. Your Astro-Med purchase is an investment in the finest state-of-the-art recorder technology. Please take a moment now to enter the model number, serial number, and software version of your chart recorder.

The original software version number represents the software originally installed in your recorder. Any upgrades of the recorder's resident software should be noted in the space provided. If, for any reason, it should be necessary for you to contact Astro-Med regarding your recorder, the following information would enable us to expediently address your question or problem.

Model Number:_____

Serial Number:_____

Software Version:_____
(original installation)

Upgraded Software Version:_____
(date installed: ___/___/___)

Upgraded Software Version:_____
(date installed: ___/___/___)

Upgraded Software Version:_____
(date installed: ___/___/___)

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Table of Contents

1 Introduction to Host Control of the DASH 10 1-1

Design Considerations 1-1
The DASH 10's Software Structure 1-2
Host Control of the DASH 10 1-2
Operating Modes 1-3
Command Structure 1-5
Queries 1-6
Establishing Host Control 1-7
How is This Manual Organized? 1-8

2 Establishing Host Control 2-1

Linking Via RS-232 2-2
Pin Connection 2-2
Setting RS-232 Communications Attributes 2-3
Enabling and Exiting Remote Control 2-4
Local Lockout Command 2-5
Aborting Operation Under RS-232 2-6

Linking Via GPIB 2-7
Pin Connection 2-7
Setting GPIB Communications Attributes 2-8
GPIB Capabilities 2-10
Interface Commands 2-11
Serial Poll 2-12

3 SYSTEM SETUP: GENERAL 3-1

Initial Preparation 3-1
General Functions 3-2
Paper Advance Command 3-2
Help Sheet Command 3-2

System Setup and Management 3-3
General System Commands 3-5
Set Time Command 3-5
Set Date Command 3-5
Motor Clock Source Command 3-6
Set/Change Motor Speed Command 3-7
Set/Change Logging Speed Command 3-8
Status and Event Reporting 3-9
Serial Poll 3-10
Status Commands and Queries 3-12
Set IEEE-488 Service Request (SRQ) Enable Byte Command 3-12
Status Byte Query 3-14
Clear Status Command 3-14
Standard Event Status Enable Command 3-15
Standard Event Status Register Query 3-17
Set Power-On Status Clear Flag 3-18
Error Code Query Command 3-19
System Identification Query 3-20
Installed Options Query 3-21
Initiate Self-Test Command 3-21
Device Synchronization Commands 3-22
Reset Command 3-23
Operation Complete Command 3-23
Wait Command 3-24

Disk Management Commands 3-25
Disk Directory Query 3-26
Rename Disk File Command 3-26
Delete Disk File Command 3-26

4 SYSTEM SETUP: CHART & VF DISPLAY 4-1

VF Display 4-2

Chart Setup 4-2
Chart Formats 4-5
Edit Chart Name Command 4-5
Grids 4-7
Grid Type Command 4-7
Print Grid Command 4-8
Set Grid Size Command 4-8
Major Grid Configuration Command 4-9
Minor Grid Configuration Command 4-10
Define Grid Location Command 4-11
Chart Elements 4-12
Pen Lift Command 4-12
Trace Thickness Command 4-13
System Event Marker Command 4-13
Event Type Command 4-14
Event Markers Command 4-14
Event Marker Location Command 4-15
Time Mark Status Command 4-16
Time Mark Interval Command 4-17
Time Mark Location Command 4-18
Adding Text 4-19
Automatic Identification Command 4-20
Print System Log Command 4-21
Edit System Log Command 4-21
Annotation Buffer Command 4-22
Edit Annotation Buffer Command 4-23
Edit On-Demand Buffer Command 4-24
Signal Conditioner Reporting Command 4-25

5 SIGNAL SETUP 5-1

Ground Command 5-3
Calibrate Channel Query 5-4
Set Range Command 5-5
Zero Position Command 5-6
Zero Suppression Command 5-7
Signal Mode Command 5-8
Filter Command 5-9
Data Logger Print Command 5-10
User Scaling 5-11
User Scaling Status Command 5-12
User Scaling Translation Command 5-13
User Scaling Offset Command 5-14

6 REAL-TIME OPERATION 6-1

Real-Time Recording 6-1
Saving Recorder Setups 6-2
Modes of Real-Time Operation 6-2

Real-Time Operation 6-3
Start Real-Time Recording Command 6-4
Start and Stop Commands 6-4
Identification (ID) Command 6-5
Print On-Demand Buffer Command 6-6
Run/Freeze Display Command 6-7
Exit Real-Time Recorder Mode Command 6-7

Data Logging 6-8
Start Real-Time Data Logging Command 6-9
Start and Stop Commands 6-9
Enter Real-Time Measurement Mode Command 6-10
Real-Time Measurement Query 6-10
Exit Data Logging Command 6-10

Dual-Speed Operation 6-11
Set Dual Speeds Command 6-12
Dual-Speed Switch Command 6-13
Dual-Speed Duration Command 6-14
Start Dual-Speed Operation Command 6-15

Timed Operation 6-16
Set Start Time Command 6-17
Set Stop Time Command 6-17
Timer Chart Command 6-18
Start Timed Operation Command 6-19
Timer Abort Command 6-19

7 TRIGGERING 7-1

Trigger Source Command 7-4
Host Trigger Command 7-5
Periodic Trigger Command 7-5
Clock Trigger Command 7-6
Waveform Trigger Level Command 7-7
Trigger Logic 7-9
"And" Group Select Command 7-10
"Or" Group Command 7-11

8 DATA CAPTURE (DASH 10 W/DATA CAPTURE OPTION REQUIRED) 8-1

Data Capture Setup 8-2
Data Capture Record 8-3
Single Board Record 8-4
Linked Boards Record 8-4
Configuring the DASH 10 for Data Capture 8-5
Set Capture Board Status 8-7
Set Capture Board Link Status 8-7
Auto-Trigger Control Command 8-8
Data Capture Re-Arm Control Command 8-9
Automatic Archiving 8-12
Set Timebase Command 8-14
Record Size Command 8-15
Trigger/Window Relationship Command 8-16
Set Data Capture Channels Command 8-18
Erase Record Command 8-19
Request Record Information 8-19
Request Data Capture Information 8-20

Arm Data Capture 8-21
Arm Capture Command 8-22
Arm Abort Command 8-22

9 DATA PLAYBACK (DASH 10 W/DATA CAPTURE OPTION REQUIRED) 9-1

Playback Setup 9-3
Playback Device Command 9-4
Playback Trigger Mark Command 9-5
Playback Format Command 9-6
Playback Window Command 9-7
Playback Expansion Command 9-8
X and Y Channels Command 9-9
X and Y Format Command 9-9
Set Playback Report Status Command 9-11

Playing Back Data 9-12
Start Playback Command 9-14
Print Analysis Plot Command 9-15
Expand FFT Plot Command 9-16
Start and Stop Commands 9-17
Identification (ID) Command 9-17
Abort Playback Command 9-18

10 DATA ARCHIVAL & TRANSFER 10-1

Data Transfer 10-2
Data Upload 10-3
Upload Record Command 10-3
Upload Abort Command 10-3
Upload Record Review Command 10-4
Record Review Abort Command 10-4
Data Download 10-5
Download Record Command 10-5
Data Formats 10-6
GBIB and RS232 10-8

11 PRINTER MODES 11-1

Line Printer 11-1
Enter Line Printer Mode Command 11-2

APPENDICES

A COMMAND HEADERS A-1

General Functions A-1
General Setup A-2
Chart and Grid Setup A-4
Signal Setup A-6
Real-Time Operation A-7
Data Logging A-7
Dual-Speed Operation A-8
Timed Operation A-8
Triggering A-9
Data Capture Setup A-10
Capture Data A-11
Data Playback Setup A-12
Play Back Data A-13
Transfer Data A-14
Line Printer A-14

B DASH 10 SPECIFICATIONS B-1

C MULTILINE INTERFACE MESSAGES C-1

D DATA CAPTURE RECORD FORMAT D-1

DASH 10 Data Capture Record File Format D-2
Data Description for Data Capture Record Items D-4
Sample Packet Formats (1 sample period) D-9
Waveform and Event Data Formats D-12
Format 1 (Upload and Download) D-12
Format 2 (Record Review) D-12

Tables

Table 1-1	DASH 10 Mode Entry Commands	1-4
Table 2-1	RS-232 Pin Connection Data	2-2
Table 2-2	GPIB (IEEE-488) Pin Connection Data	2-7
Table 3-1	System Commands	3-3
Table 3-2	Event Error Codes	3-19
Table 4-1	Chart & Grid Setup Commands	4-3
Table 4-2	Saved Chart Parameters	4-6
Table 4-3	Codes for Time Mark Interval Periods	4-17
Table 5-1	Real-Time Setup Commands	5-2
Table 6-1	Real-Time Operation Commands	6-3
Table 6-2	Data Logging Commands	6-8
Table 6-3	Dual-Speed Operation Commands	6-11
Table 6-4	Timed Operation Commands	6-16
Table 7-1	Trigger Setup Commands	7-2
Table 8-1	Data Capture Setup Commands	8-6
Table 8-2	Data Capture Commands	8-21
Table 9-1	Data Playback Setup Commands	9-3
Table 9-2	Expansion Codes and Factors	9-8
Table 9-3	Data Playback Commands	9-13
Table 10-1	Data Transfer Commands	10-2
Table 10-2	Format 1 (Upload and Download)	10-7
Table 10-3	Format 2 (Record Review)	10-7

Illustrations

Figure 2-1	DASH 10 Rear View	2-1
Figure 3-1	DASH 10 Registers	3-9
Figure 3-2	DASH 10 Disk Drive	3-25
Figure 8-1	Sample Trigger/Window Relationships	8-17
Figure 10-1	Data Transfer	10-8

COMMANDS

General Functions

FEED	Paper Advance Command	3-2
HELP	Help Sheet Command	3-2

System

TIME	Set Time Command	3-5
DATE	Set Date Command	3-5
MSRC	Motor Clock Source Command	3-6
MSPD	Set/Change Motor Speed Command	3-7
DLSP	Set/Change Logging Speed Command	3-8
***SRE**	Set IEEE-488 Service Request (SRQ) Enable Byte Command	3-12
***STB?**	Status Byte Query	3-14
***CLS**	Clear Status Command	3-14
***ESE**	Standard Event Status Enable Command	3-15
***ESR?**	Standard Event Status Register Query	3-17
***PSC**	Set Power-On Status Clear Flag	3-18
ALLE?	Error Code Query Command	3-19
***IDN?**	System Identification Query	3-20
***OPT?**	Installed Options Query	3-21
***TST?**	Initiate Self-Test Command	3-21
***RST**	Reset Command	3-23
***OPC**	Operation Complete Command	3-23
***WAI**	Wait Command	3-24
FDIR?	Disk Directory Query	3-26
FREN	Rename Disk File Command	3-26
FDEL	Delete Disk File Command	3-26

ECHT	Edit Chart Name Command	4-5
GRTY	Grid Type Command	4-7
GRON	Print Grid Command	4-8
GRSZ	Set Grid Size Command	4-8
GRMA	Major Grid Configuration Command	4-9
GRMN	Minor Grid Configuration Command	4-10
GRLC	Define Grid Location Command	4-11
PENL	Pen Lift Command	4-12
THIC	Trace Thickness Command	4-13
SEST	System Event Marker Command	4-13
EVTY	Event Type Command	4-14
EVST	Event Markers Command	4-14
EVLC	Event Marker Location Command	4-15
TMST	Time Mark Status Command	4-16
TMTB	Time Mark Interval Command	4-17
TMLC	Time Mark Location Command	4-18
AUID	Automatic Identification Command	4-20
SLOG	Print System Log Command	4-21
EDSY	Edit System Log Command	4-21
BSET	Annotation Buffer Command	4-22
EDIT	Edit Annotation Buffer Command	4-23
EODB	Edit On-Demand Buffer Command	4-24
SREP	Signal Conditioner Reporting Command	4-25

Signal Setup

SGND	Ground Command	5-3
CALB?	Calibrate Channel Query	5-4
SRNG	Set Range Command	5-5
ZPOS	Zero Position Command	5-6
SZSP	Zero Suppression Command	5-7
SMDE	Signal Mode Command	5-8
SFIL	Filter Command	5-9
DLCH	Data Logger Print Command	5-10
USST	User Scaling Status Command	5-12
USTR	User Scaling Translation Command	5-13
USOS	User Scaling Offset Command	5-14

Real-Time Operation

CHRT	Start Real-Time Recording Command	6-4
STAR	Start Command	6-4
STOP	Stop Command	6-4
IDEN	Identification (ID) Command	6-5
PODB	Print On-Demand Buffer Command	6-6
DISP	Run/Freeze Display Command	6-7
EXIT	Exit Real-Time Recorder Mode Command	6-7

Data Logger

DLOG	Start Real-Time Data Logging Command	6-9
STAR	Start Command	6-9
STOP	Stop Command	6-9
MEAS	Enter Real-Time Measurement Mode Command	6-10
MEAS?	Real-Time Measurement Query	6-10
EXIT	Exit Data Logging Command	6-10

Dual-Speed Operation

DSPD	Set Dual Speeds Command	6-12
DSWT	Dual-Speed Switch Command	6-13
DDUR	Dual-Speed Duration Command	6-14
DREC	Start Dual-Speed Operation Command	6-15

Timed Operation

TRUN	Set Start Time Command	6-17
THLT	Set Stop Time Command	6-17
TCHT	Timer Chart Command	6-18
TREC	Start Timed Operation Command	6-19
EXIT	Timer Abort Command	6-19

Triggering

TRGS	Trigger Source Command	7-4
*TRG	Host Trigger Command	7-5
SPER	Periodic Trigger Command	7-5
CLKT	Clock Trigger Command	7-6
TRLV	Waveform Trigger Level Command	7-7
TAND	"And" Group Select Command	7-10
TROR	"Or" Group Command	7-11

Data Capture

CBRD	Set Capture Board Status	8-7
CLNK	Set Capture Board Link Status	8-7
ATRG	Auto-Trigger Control Command	8-8
CCON	Data Capture Re-Arm Control Command	8-9
SRAT	Set Timebase Command	8-14
RSIZ	Record Size Command	8-15
TRCD	Trigger/Window Relationship Command	8-16
CAPC	Set Data Capture Channels Command	8-18
EREC	Erase Record Command	8-19
RINF?	Request Record Information	8-19
CINF?	Request Data Capture Information	8-20
ARMC	Arm Capture Command	8-22
ARMA	Arm Abort Command	8-22

Data Playback

PDEV	Playback Device Command	9-4
PMRK	Playback Trigger Mark Command	9-5
PFMT	Playback Format Command	9-6
PWIN	Playback Window Command	9-7
TEXP	Playback Expansion Command	9-8
XYCH	X and Y Channels Command	9-9
XYFT	X and Y Format Command	9-9
PRPT	Set Playback Report Status Command	9-11

PLBK	Start Playback Command	9-14
SPLT	Print Analysis Plot Command	9-15
FFTZ	Expand FFT Plot Command	9-16
STAR	Start Command	9-17
STOP	Stop Command	9-17
IDEN	Identification (ID) Command	9-17
EXIT	Abort Playback Command	9-18

Transfer Data

UPLD?	Upload Record Command	10-3
EXIT	Upload Abort Command	10-3
RREV?	Upload Record Review Command	10-4
EXIT	Record Review Abort Command	10-4
DNLD	Download Record Command	10-5

Printer Mode

LPTR	Enter Line Printer Mode Command	11-2

1

Introduction to Host Control of the DASH 10

Design Considerations

The DASH 10 is a portable field and lab recorder that provides a high degree of configurability, as well as the ability to record up to 30 channels. The DASH 10 comes with ten isolated analog waveform input channels, and is expandable to 30 channels in increments of ten channels. Built-in signal conditioners accept signals from 50 mV to 500 V peak, with ±250 V of zero suppression, eliminating the need for external amplifiers. Voltage inputs can also be scaled to engineering units, allowing you to record values such as °C or °F, psi, mmHg, etc.

Both DASH 10 hardware and software provide the ability to structure a system customized to your unique recording needs. Up to 30 waveform channels can be placed on the chart wherever you wish, while grids for each waveform can be individually configured. In addition, the DASH 10 provides for each channel one event marker, which can also be placed anywhere that you desire on the chart.

The DASH 10's Software Structure

The DASH 10's software structure responds to the design flexibility in two general ways:

- The system, aware of how a particular recorder is configured, displays the menu options appropriate to that configuration.
- Within any given configuration, there is truly remarkable flexibility in controlling the recorder and custom tailoring it for specific uses.

Host Control of the DASH 10

Host control of the DASH 10 reflects this diversity of design, with the limitation that you need to know how the recorder is configured to know which commands are currently valid. DASH 10 configuration relates to the number of A/D board (1, 2, or 3), and whether each board contains the data capture option. The Installed Options Query (*OPT?) provides this information when necessary.

Like the menu structure, however, host control of the DASH 10 is accomplished through groups of commands that enable you to operate the recorder and to set up your system by defining

— ***1*** ——— the characteristics of the incoming data

— ***2*** ——— the representation of that data on the chart and display

Waveforms in either analog or digital representation, grids, text annotation, event marks, and timing marks comprise the chart recordings. These elements can be defined, sized, positioned, and enabled through host control commands.

Operating Modes

Host control of the DASH 10 permits use of the same modes as are available during stand-alone operation. In addition, there are several modes that are unique to host-control operation.

Through host control, the recorder is able to:

- Record real-time analog chart representations of signal data
- Record signal information as digital data
- Capture and store data to be played back (printed) at a later time
- Transfer data capture records to or from the host computer
- Function as a line printer

Each mode has a particular set of commands available to it, in addition to the system setup commands. (The only exception is Line Printer Mode, from which you must exit before system setup commands are accepted.)

Some modes of operation require specific options to be installed in the recorder. Wherever this is the case, it is noted at the beginning of the section describing the mode. Most commands, however, are available both while the recorder is idle or operating. The recorder while not performing any operation is in the idle state.

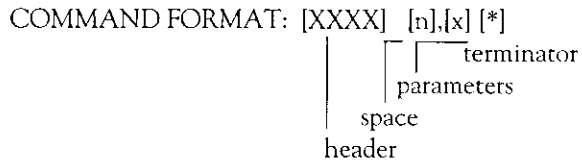
At power up, the recorder is either in the idle state or in real-time mode if it was in a real-time mode at power down. You enter any of the following modes by issuing the appropriate mode command.

Table 1-1: DASH 10 Mode Entry Commands

Real-Time Recording Modes:	CHRT	Analog Real-Time Recording
	DLOG	Data Logging
Data Capture and Playback Modes:	ARMC	Data Capture (can be concurrent with real-time modes)
	PLBK	Data Playback
Data Transfer Mode:	UPLD	Data Upload (transfer from data capture memory to host)
	DNLD	Data Download (transfer from host to data capture memory)
Additional Printing Mode:	LPTR	Line Printer
	FEED	Paper Advance
	HELP	Help Sheet

Command Structure

The DASH 10 Recorder responds to a simple mneumonic-based set of commands. To instruct the recorder to enter or exit a mode or to perform a function, you send it a command from the host. A command is comprised of a header and parameters and is concluded by a message terminator.



Command header: a four-character device command for any function. The command header may be either upper or lower case characters; they are depicted as upper case throughout this manual.

Parameters: program data that completes the command string.

Command terminator: a line feed <lf> if control is via RS-232; an EOI pulse only or an EOI pulse and line feed if control is via GPIB. Refer to Chapter 2 for further information on command termination.

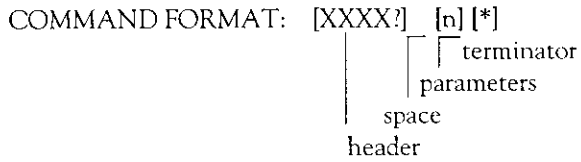
Separators: a minimum of one space between the header and parameters, a comma between parameters.

Queries

Host control of the DASH 10 Recorder includes query capability, allowing the host computer to request current recorder settings while under host control through the RS-232 or IEEE-488 interface. As with the other host control commands, the query commands are simple mneumonic-based commands.

To request a setting, the host computer sends a query command to the recorder. This query consists of the normal command header followed immediately by a question mark. The response message format is similar to the command parameters used for setting the attribute.

The full query request is comprised of the normal command header followed immediately by a question mark, parameters (if any), and a concluding message terminator. A space is required after the question mark, and commas are required to separate parameters if there are more than one. To request information, send a query command in the following format.



Queries from the host via RS-232 are terminated by a line feed <lf>. A carriage return <cr> may also be included. In this manual the terminator is indicated as <lf>. Queries from the host via GPIB are terminated by an EOI pulse only (EOI) or an EOI pulse and line feed (<lf> and EOI).

The DASH 10 will send RS-232 responses with a <lf> terminator, which is used as the terminator in examples throughout this manual. The DASH 10 will send GPIB query responses terminated by an EOI pulse only (EOI) or an EOI pulse and line feed (<lf> and EOI).

If the DASH 10 is addressed to talk under GPIB control and no data is yet available to send, or if an invalid query was sent, the DASH 10 will not send any data until valid response data is generated.

Establishing Host Control

Host control of the DASH 10 Recorder can be established through either an RS-232 serial port or a GPIB (IEEE-488) port. Virtually all functions available through local (front-panel) control of the DASH 10 are available through the host interface.

In addition to controlling operation of the recorder, the host computer can receive data from and transfer data to the recorder over the communications interface.

Each interface offers different advantages, which should be considered when selecting the interface you will use. The GPIB interface allows a number of IEEE-488-compatible devices on the same bus, each of which has its own address. Since GPIB is a parallel interface, transmission speed is much higher than when using the RS-232 serial interface. The RS-232 interface, however, can accommodate much longer distances without using repeaters or bus extenders.

Requirements for both interfaces are explained in Chapter 2 of this manual.

How is This Manual Organized?

Astro-Med's DASH 10 Recorder comes with a documentation package that can help you to exploit the full potential of the recorder. If you plan to operate the recorder under the control of a host computer, you would derive most benefit by becoming familiar with both manuals:

> The *DASH 10 Host Control Manual* provides information on the operation of the DASH 10 Recorder under the control of a host computer. You will use this manual as your primary source of information on the recorder's operating modes and associated commands.
>
> The *DASH 10 Operations Manual* provides information on the operation of the DASH 10 Recorder as a stand-alone instrument and contains much valuable information about the recorder and its modes of operation. Whenever additional information is desired about a mode of operation, a recorder option, any theory of operation, or recorder feature, refer to this manual.

The chapters of this manual present information as follows:

1	introduction and preparation
2	physical recorder setup to enable host control
3	system-wide recorder setup
4	chart features and grid formats
5	signal input
6	real-time operation
7	triggering
8	data capture
9	data playback
10	data transfer
11	line printer

2 Establishing Host Control

The DASH 10 Recorder can be linked to a host computer via either its RS-232 or IEEE-488.1 (GPIB) interface. Each interface offers different advantages, which should be considered when selecting the interface you will use.

The GPIB interface allows a number of IEEE-488-compatible devices on the same bus, each of which has its own address. Since GPIB is a parallel interface, transmission speed is much higher than when using the RS-232 serial interface. The RS-232, however, can accommodate much longer distances without using repeaters or bus extenders.

The RS-232 and GPIB D-shell interfaces are located on the DASH 10 rear panel. Figure 2-1 illustrates the rear panel.

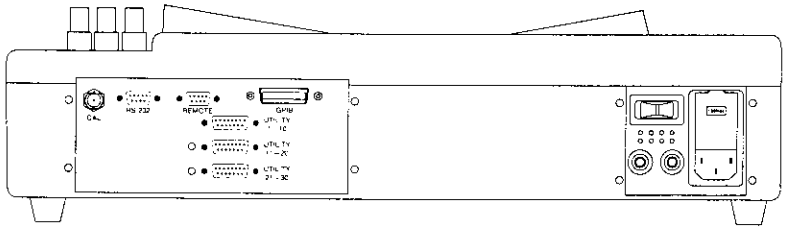


Figure 2-1: DASH 10 Rear View

The first step in setting up host control is to ensure proper cable connection and set the transmission protocol. Communications attributes include different baud rates and handshake protocols. These parameters are set on the recorder itself through the SYSTEM menu.

2.1 Linking Via RS-232

Pin Connection

The RS-232 9-pin D-shell connector is the RS-232 communications interface between the DASH 10 Recorder and various host-computer configurations. It is important to establish the proper connection based upon the handshaking method chosen. Pin connection data for the RS-232 connector is provided in Table 2-1. The DASH 10 uses the DTR/DSR handshake method in both listening and talking modes.

Table 2-1: RS-232 Pin Connection Data

H/W Handshaking		XON/XOFF Handshaking	
Pin #	Signal Description	Pin #	Signal Description
2	TXD	2	TXD
3	RXD	3	RXD
4	CTS/DSR	5	Signal Ground
5	Signal Ground		
6	DTR		

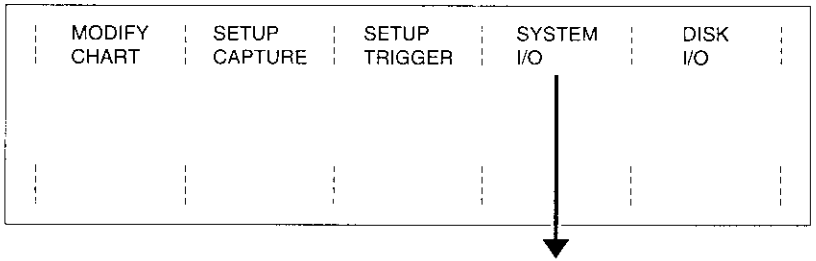
Note: All other pins are reserved and should not be used. Pins 7 and 8 are connected internally.

Setting RS-232 Communications Attributes

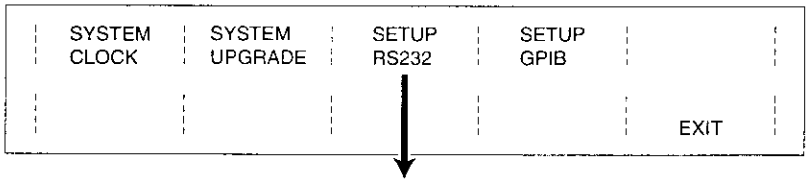
Data transmission specifications for RS-232 are as follows:

Baud rate:	300, 1200, 2400, 4800, 9600, and 19,200
Parity:	none
Data bits:	8
Stop bits:	2
Handshake:	hardwire (DSR/DTR) or XON/XOFF

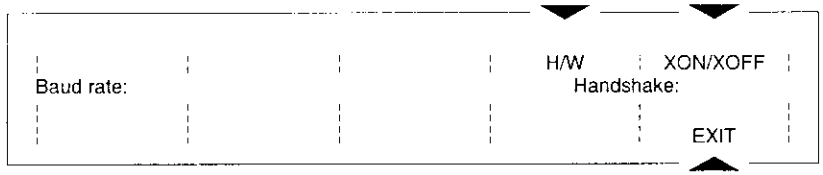
To select RS-232 as the communications type, press the SYSTEM key on the recorder. The following menu will display:



Press the soft key above SYSTEM I/O to invoke the communications menu, which allows you to define the communications setup for host control operation:



Press the soft key above SETUP RS232 to specify RS-232 communications and to access the menu that allows you to set the attributes.



From this menu, press the soft key above H/W or XON/XOFF to set the handshake method. To set the baud rate, use the NEXT or PREV keys to scroll either forward or backward through six available rates: 300, 600, 1200, 2400, 4800, 9600, or 19,200. If XON/XOFF handshaking is selected, DASH 10 limits the baud rate to a maximum of 1200 baud.

Current selections are indicated on the display. This information is stored in non-volatile memory, allowing the device to power up in these conditions from that point on. Press the soft key below EXIT to return the recorder to the Communications type display.

Enabling and Exiting Remote Control

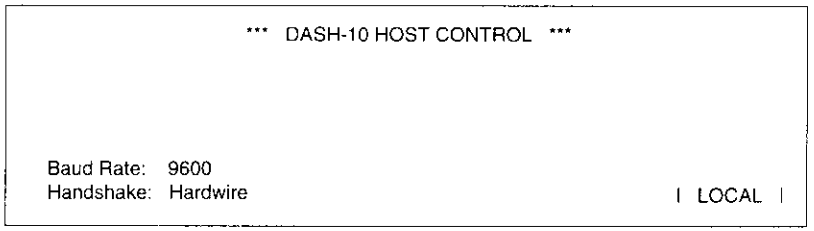
RS-232 communication can be enabled or disabled by sending the following commands from the host computer to the DASH 10:

RCTL<lf>	to enable remote control
EXHC<lf>	to exit host (remote) control

After remote control via RS-232 has been established, you need only to follow the command structure presented in the following chapters. Command strings from the host via RS-232 are to be terminated by a line feed <lf>. A carriage return <cr> may also be included. In this manual the terminator is indicated as <lf>.

The DASH 10 will send RS-232 responses with a <lf> terminator, which is used as the terminator in examples throughout this manual.

While under host control via RS-232, the recorder displays:



You can also exit host control by using the front panel soft key below LOCAL on the display. Return to local control from the front panel can be disabled by sending the Local Lockout Command.

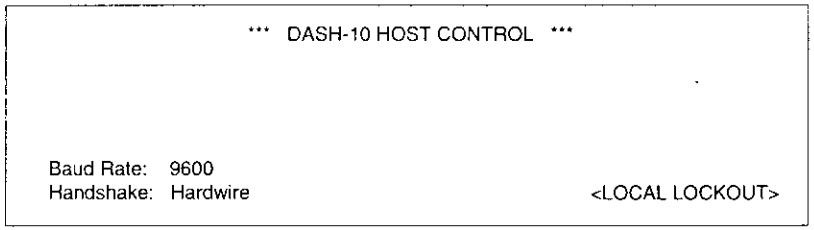
Local Lockout Command

causes the DASH 10, under RS-232 control only, to lock out the front-panel Local key.

Command [LOCK] [x] [*]
Parameters x = 0 to permit use of front-panel Local Key to return the DASH 10 to local control
1 to disable front-panel Local Key
Example LOCK 1 <lf>
disables use of front-panel Local Key.

Query [LOCK?] [*]
Parameters none
Valid Responses 0 to permit use of front-panel Local Key
1 to disable front-panel Local Key
Example LOCK? <lf>
Sample Response 1 <lf>
indicates that the front-panel Local Key is disabled.

When local control is disabled, the display reads:



Aborting Operation Under RS-232

The Abort Command can be sent over the RS-232 communication link while under local or host control. This command CTRL-X (18H) places the DASH 10 in the idle state and clears all input and output buffers.

When you send the Remote Control Command (RCTL), you gain host control of the DASH 10 in whatever state it is in currently, whether idle or recording. If you send the Abort Command before gaining host control, you can be assured that the recorder is in the idle state.

2.2 Linking Via GPIB

Pin Connection

The GPIB D-shell connector is the IEEE communications interface between the DASH 10 Recorder and various host-computer configurations. The GPIB connection on the DASH 10 Recorder is located on the recorder's rear panel, as illustrated in Figure 2-1. Pin connection data for the GPIB (IEEE-488) connector is provided in Table 2-2.

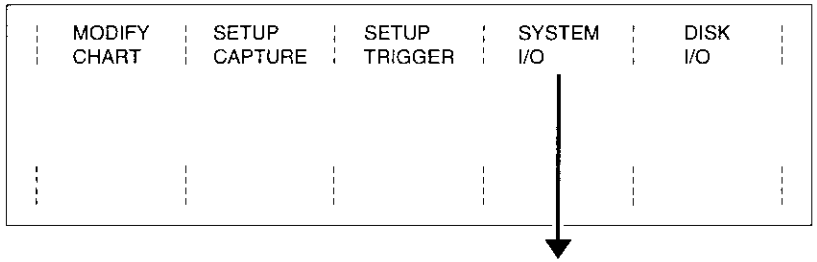
Table 2-2: GPIB (IEEE-488) Pin Connection Data

PIN #	DESCRIPTION	PIN #	DESCRIPTION
1	DIO1	13	DIO5
2	DIO2	14	DIO6
3	DIO3	15	DIO7
4	DIO4	16	DIO8
5	EOI	17	REN
6	DAV	18	GROUND (6)
7	NRFD	19	GROUND (7)
8	NDAC	20	GROUND (8)
9	IFC	21	GROUND (9)
10	SRQ	22	GROUND (10)
11	ATN	23	GROUND (11)
12	SHIELD	24	GROUND LOGIC

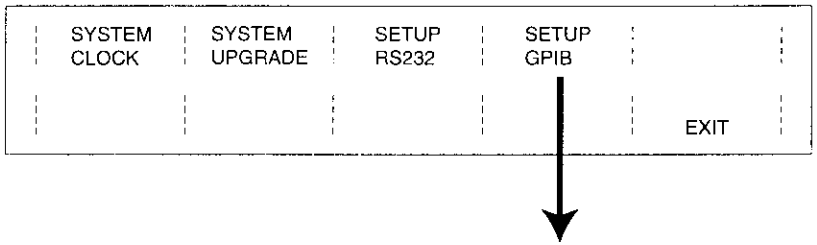
GROUND (X) = the signal ground return of the referenced contact

Setting GPIB Communications Attributes

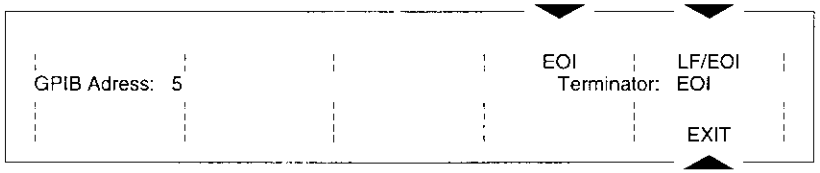
To set the attributes for GPIB communication, press the SYSTEM key on the recorder to access the following menu:



Press the soft key above SYSTEM I/O to invoke the communications menu, which allows you to define the communications setup for host control operation.



From this menu, press the soft key above SETUP GPIB to specify GPIB communications and to specify a GPIB address and a terminator for all command sequences.

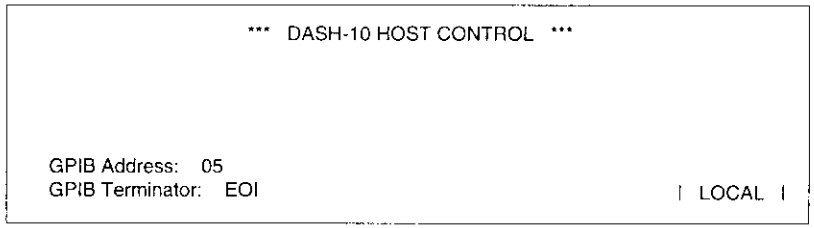


Press the soft key above NEXT to increase the GPIB address to the next higher address number. Press the soft key above PREV to decrease the GPIB address to the next lower address number. Valid addresses for any device are 00-30 inclusive. This address is stored in non-volatile memory and will not be affected by power loss.

Press the soft key above EOI (end or identify) to specify that only an EOI pulse will be recognized as a terminator. Press the soft key above lf/EOI to specify that a line feed <lf> control character or an EOI pulse will be recognized as a terminator. If EOI only is selected, it is required that EOI = 1 be sent on the last byte of the data transfer or command sequence. In this manual the GPIB terminator is indicated as (EOI = 1 on last byte).

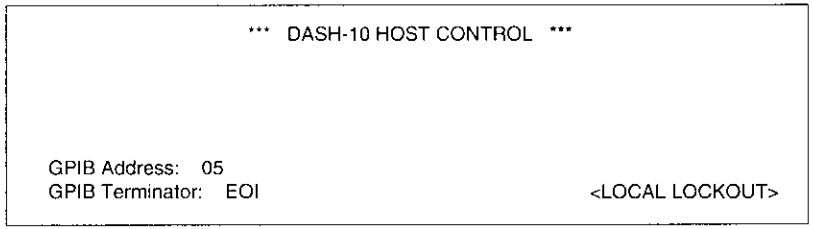
Both current selections are indicated on the display. Press the soft key below EXIT to return the recorder to the Communications type display.

After remote control via GPIB has been established, you need only to follow the command structure presented in the following chapters. While in this state, the recorder displays:



To return to local control, simply press the soft key below LOCAL on the display.

Return to local control from the front panel can also be disabled by sending the Local Lockout (LLO) command, as described on page 2-11. When local control is disabled, the display reads:



To return to stand-alone operation, the host must send the Go To Local (GTL) command or REN false.

GPIB Capabilities

The DASH 10 Recorder supports the following level of IEEE-488 interface functions:

Source handshake	SH1	complete capability
Acceptor handshake	AH1	complete capability
Talker	T6	basic talker with serial poll
Extended talker	TE0	no capability
Listener	L4	basic listener
Service request	SR1	complete capability
Remote/local	RL1	complete capability
Device trigger	DT1	complete capability
Device clear	DC1	complete capability
Parallel poll	PP0	no capability
Bus drivers	E2	tri-state drivers

Terminator for input to the DASH 10: (EOI) or (<lf> or EOI)
Terminator for output from the DASH 10: (EOI) or (<lf> or EOI)

Interface Commands

The following commands are sent from the host to the recorder(s) for the purposes described. With the ATN (attention) line true, multiline messages are interpreted as interface messages. See Appendix C for codes.

GTL (Go to Local)	Allows local operation of the recorder
GET (Group Execute Trigger)	Causes a valid trigger
DCL (Device Clear)	Clears the input and output buffers and places the unit at Idle Mode command level
SDC (Selected Device Clear)	Causes an addressed DASH 10 to clear input and output buffers and place the unit at Idle Mode command level
LLO (Local Lockout)	Locks out the operator from returning to local control from the front panel
SPE (Serial Poll Enable)	Notifies all devices on the GPIB that the controller has placed the GPIB in the serial poll mode
SPD (Serial Poll Disable)	Notifies all devices on the GPIB that the controller has completed the serial poll
MLA (My Listen Address)	Message/address to device whose address is specified to enable listener status
MTA (My Talk Address)	Message/address to device whose address is specified to enable talker status
UNL (Unlisten)	Message to device(s) to enter unlisten state
UNT (Untalk)	Message to device(s) to enter untalk state

Serial Poll

In certain applications it may be necessary for the host to know the state of the DASH 10 Recorder. This may include troubleshooting command errors or completion of an operation. Several methods are available for obtaining this information. You can send the Status Byte (*STB?) Query to read the status byte and/or the Standard Event Status Register (*ESR?) Query to read the Standard Event Status Register. These queries are described in detail in Chapter 3. Alternatively, you can allow the DASH 10 to interrupt the host with an SRQ signal, responding with a serial poll to determine the cause of the signal.

By use of service requests (SRQ), the recorder informs the host of its status. Upon receiving an SRQ, the controller in charge should perform a serial poll in search of the device(s) that has requested service; the device that has been enabled and addressed responds with a status byte (STB) message.

The status byte returned by the recorder contains information as to whether that recorder requested service (rsv = 1) and, if so, the reason. A bit is set to 1 to indicate that the condition is present or to 0 to indicate that the condition is not present. Each bit of the status byte has a unique message, as shown:

Status Byte Message:	7	6	5	4	3	2	1	0
	x	**RQS MSS**	**ESB**	**MAV**	x	x	x	x

x (bit 7) Reserved

RQS (bit 6) **Request Service**
Bit 6 set to 1 can indicate that, in response to a serial poll, this device on the GPIB bus is in need of service.

MSS (bit 6) **Master Status Summary**
Bit 6 set to 1 can also indicate that, in response to a Status Byte Query (*STB?), one of the bits in the Status Byte Register is enabled and active.

ESB (bit 5) **Event Status Byte**
Bit 5 set to 1 indicates that at least one enabled condition in the Standard Event Status Byte is active and should be read using the *ESR? Query. Additionally, you could use the Error Code (ALLE?) Query to read the Event Error Queue, which might provide further information.

MAV (bit 4) **Message Available**
Bit 4 set to 1 indicates that the output queue has data in it to be read. This bit is useful to determine when the host computer can read the response message from a particular query.

x (bit 3) Reserved

x (bit 2) Reserved

x (bit 1) Reserved

x (bit 0) Reserved

You define the information that the status byte will convey to the host computer via the Set Service Request Enable Register (*SRE) Command. Any or all of the SRQ's may be enabled or disabled by this command, described in Chapter 3, "System Setup: General."

3 System Setup: General

Initial Preparation

All Dash 10 system parameters are saved in non-volatile memory. These parameters are remembered when the recorder is powered down and then powered on again. They can also be saved to disk in the DASH 10 disk drive. Refer to the *DASH 10 Operations Manual* for information about saving system setups to disk.

System setup commands can be executed at any time — while the recorder is in the idle state or in operation. However, maximum efficiency is achieved when setup commands are sent while the recorder is idle. Once a system setup has been designed to your satisfaction, you can begin the desired operation.

A subset of the system setup are those parameters that comprise one of four saved chart formats. When modifying these parameters, you are changing the setup of the chart format that is currently running, or of the last chart to run if the unit is in the idle state. Refer to Chapter 4 for a list of the parameters that are saved within a chart format.

You can easily change chart formats by using the Start Real-Time Recording (CHRT) Command, as described in Chapter 6, to designate another format.

The following commands can be issued to perform the following functions. As you begin, you can use the Form Feed and Help Sheet commands to correctly position the chart paper and print out basic information in condensed form.

Paper Advance Command

causes the recorder to perform a form feed of the chart paper (about 1 centimeter) and return to the idle state.

Command	[FEED] [x] [*]	
Parameters	x = 0	to move the paper one centimeter
	1	to advance to top of form
	2	to advance to next top-of-form mark
Example	FEED 0 <lf>	
	moves the paper one centimeter and returns the DASH 10 to idle.	

Help Sheet Command

causes the DASH 10 to print a status or help sheet with the requested information.

Command	[HELP] [x] [*]	
Parameters	x = 1	for general help information
	2	for general system status report
	3	for channel status report
	4	for buffer status report
	5	for analog status report
	6	for trigger status report
	7	for data capture status report
Example	HELP 2 <lf>	
	prints out the general status report for the DASH 10.	

System Setup and Management

The *System Commands* allow you to set system time, define timing sources, and query the system for status and installed options. Table 3-1 lists the System commands and queries.

Table 3-1: System Commands

Header	Function
TIME	Set system time.
DATE	Set system date.
MSRC	Define source of motor clock.
MSPD	Change the current motor speed.
DLSP	Set or change the current data logging speed.
*SRE	Define what information the SRQ status byte will convey to the host computer.
*CLS	Clear both the SRQ Status Byte and Standard Event Status Registers.
*ESE	Determine which conditions will set bit 5 of the SRQ status byte to ON (to 1).
*PSC	Allow the host to either clear or maintain the contents of the status registers upon power-up of the DASH 10.
*RST	Cancel the Operation Complete Command or Query and return the DASH 10 to the idle state.
*OPC	Set the operation complete bit (bit 0) of the Standard Event Status Register to be set ON, when the pending operation has completed.
*WAI	Make the system refrain from processing any host commands until the pending operation has completed.
FREN	Rename a file on the DASH 10 disk drive.
FDEL	Delete a file on the DASH 10 disk drive.

System Queries

Header	*Function*
TIME?	What is the current system time?
DATE?	What is the current system date?
MSRC?	Is the motor clock source internal or external?
MSPD?	What is the current motor speed?
DLSP?	What is the current data logging speed?
*SRE?	What information will the SRQ status byte convey to the host computer?
*STB?	Allow host to read the status byte.
*ESE?	Which conditions will set bit 5 of the SRQ status byte to ON?
*ESR?	Begin a destructive read of the Standard Event Status Register.
*PSC?	Will the host clear or maintain the contents of the status registers upon power-up of the DASH 10?
ALLE?	Query the events in the Event Error Queue.
*IDN?	Provide identifying information about the current DASH 10 system.
*OPC?	Is the operation complete bit (bit 0) of the Standard Event Status Register set to be turned ON, when the pending operation has completed?
*OPT?	What options are installed in the DASH 10?
*TST?	Perform self-test and report on results.
FDIR?	List the names of the files on the disk in the DASH 10 disk drive.

Set Time Command

sets the time on the recorder. The time is transmitted as a string.

Command	[TIME] [s] [*]
Parameters	s = hours, minutes, and seconds in "hh:mm:ss" format, with quotation marks
Example	TIME "10:05:35" <lf> sets the current time at 10:05:35.

Query	[TIME?] [*]
Parameters	none
Valid Responses	00:00:00 to 23:59:59
Example	TIME? <lf>
Sample Response	"10:05:35" <lf> informs you that the current time is 10:05:35.

Set Date Command

sets the date on the recorder. The date is transmitted as a string.

Command	[DATE] [s] [*]
Parameters	s = string for date in "mm/dd/yy" format, with quotation marks
Example	DATE "11/01/94" <lf> sets November 1, 1994 as the current date.

Query	[DATE?] [*]
Parameters	none
Valid Responses	01/01/00 to 12/31/99
Example	DATE? <lf>
Sample Response	"11/01/94" <lf> informs you that November 1, 1994 is the current date.

defines the source of the motor clock. External sources allow control of the motor speed via an external frequency up to 800 Hertz. Resolution is 16 steps per millimeter, so the maximum chart speed with an external motor clock is 50 millimeters per second.

Command	[MSRC] [x] [*]
Parameters	x = 1 for internal clock 2 for external control
Example	MSRC 1 <lf> sets the motor to be controlled by the internal clock.

Query	[MSRC?] [*]
Parameters	none
Valid Responses	1 for internal clock 2 for external control
Example	MSRC? <lf>
Sample Response	1 <lf> indicates that the motor is controlled by the internal clock.

changes the current motor speed. Valid speeds are up to 200 mm/sec.

Command	[MSPD] [x],[y] [*]
Parameters	x = 1 to 200 y = 1 for mm/second 2 for mm/minute
Example	MSPD 100,1 <lf> sets the speed at 100 millimeters per second.

Query	[MSPD?] [*]
Parameters	none
Valid Responses	x,y where: x = 1 to 200 y = 1 for mm/second 2 for mm/minute
Example	MSPD? <lf>
Sample Response	100,1 <lf> indicates that the recorder speed is currently set at 100 millimeters per second.

changes the current data logging speed to the selected range. This command is valid only when the current real-time chart is set to data logger format.

In the Data Logger Mode, speed is determined in a different manner than in other modes. In other modes, speed is determined as millimeters of print per unit of time. When in data logger format, speed is determined as a line of data printed during a particular span of time. Data logging speed can be specified as a line of data printed every so many milliseconds, seconds, or minutes, up to a maximum speed of one line every 200 milliseconds.

Command [DLSP] [x],[y] [*]

Parameters x is an integer in the ranges specified

y = 1 for milliseconds (200-999)
2 for seconds (001-999)
3 for minutes (001-999)

Example DLSP 200,1 <lf>

sets speed at one line every 200 milliseconds.

Query [DLSP?] [*]

Parameters none

Valid Responses x,y

where x is an integer in the ranges specified and

y = 1 for milliseconds (200-999)
2 for seconds (001-999)
3 for minutes (001-999)

Example DLSP? <lf>

Sample Response 200,1 <lf>

indicates that the speed is currently one line every 200 milliseconds.

Status and Event Reporting

In certain applications it may be necessary for the host to know the state of the DASH 10 Recorder, including error conditions or completion of an operation. By use of the serial poll and/or the status commands and queries, the host has access to the information contained in the DASH 10 registers, illustrated in Figure 3-1.

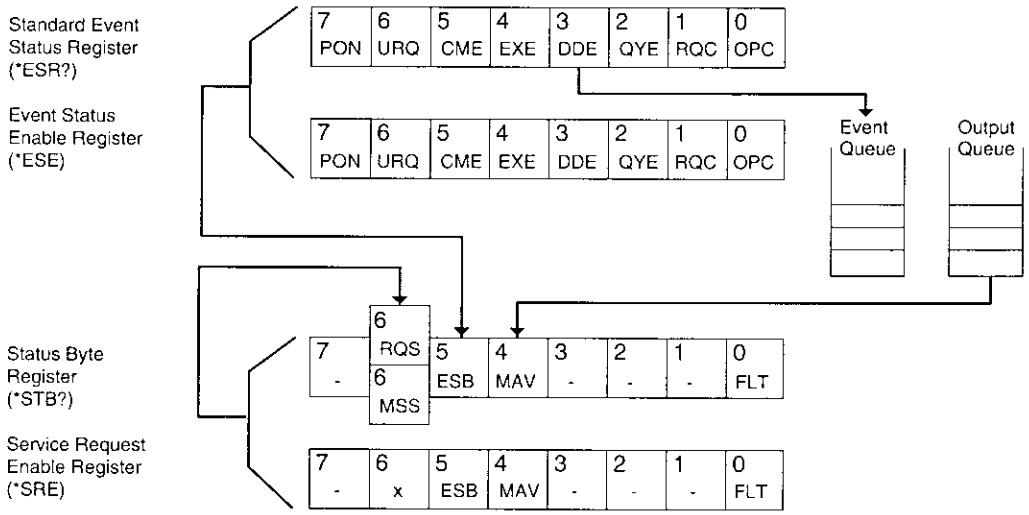


Figure 3-1: DASH 10 Registers

Serial Poll

By use of service requests (SRQ) the host computer can be informed of the status of the DASH 10. The controller in charge can perform a serial poll in search of the device(s) that has requested service. The DASH 10 that needs attention has bit 6 of the status byte set to 1 (RQS = 1). When addressed by the host computer, the DASH 10 returns the status byte, with bit definitions as follows:

FLT (bit 0) **Fault**
Bit 0 set to 1 indicates a fault or interlock condition. If a fault condition has occurred, the DASH 10 will continue to accept data as long as the input buffer is not full, but the recorder will be prevented from moving or printing.

The fault condition is usually corrected by restocking paper and/or closing the paper chamber door. Bit 0 will be reset to 0 when the fault condition has been corrected.

X (bit 1) Reserved

X (bit 2) Reserved

X (bit 3) Reserved

MAV (bit 4) **Message Available**
Bit 4 set to 1 indicates that the output queue has data in it to be read. This bit is useful to determine when the host computer can read the response message from a particular query.

ESB (bit 5) **Event Status Byte**
Bit 5 set to 1 indicates that at least one enabled condition in the Standard Event Status Byte is active and should be read using the *ESR? Query.

RQS (bit 6) **Request Service**
Bit 6 set to 1 can indicate that, in response to a serial poll, this device on the GPIB bus is in need of service.

MSS (bit 6) **Master Status Summary**
Bit 6 set to 1 can also indicate that, in response to a Status Byte Query (*STB?), one of the bits in the Status Byte Register is enabled and active.

X (bit 7) Reserved

The Requested Service (RQS) bit is set to 1 whenever the SRQ line is set by the DASH 10. The status byte returned by the DASH 10 contains information as to whether that recorder requested service and, if so, the reason. The host computer can execute a serial poll to find the instrument on the bus that sent the SRQ. The bus line returns to normal after the serial poll has been executed. This bit is used for IEEE-488 only.

SRQ is un-asserted when the serial poll has completed or when the Clear Status (*CLS) Command is sent.

Status Commands and Queries

The host can also be kept informed of recorder status through the use of commands and queries issued by the host computer. These commands and queries work with the following two registers:

> The *SRQ Status Byte Register* is provided to inform the host computer when data is in the output queue or when event information is available in the Standard Event Status Register.
>
> The *Standard Event Status Register* is provided to allow various conditions to set the Event Status Byte (ESB) of the SRQ Status Byte Register to 1 (ON). This, in turn, can generate a Service Request (SRQ). The contents of the Standard Event Status Register can be polled. All bits (except for the DDE bit, if a paper-out condition exists) are cleared each time this register is read.

Set IEEE-488 Service Request (SRQ) Enable Byte Command

defines what information the SRQ status byte will convey to the host computer, that is, what conditions will generate an IEEE-488 SRQ. In each case, a 1 enables the SRQ and a 0 disables the SRQ. Bits 0 through 3, 6, and 7 are not used. The generation of IEEE-488 SRQs may be enabled or disabled by this command as follows:

Command [*SRE] [n] [*]

Parameters n = 0 to 191 a decimal number whose binary representation is defined with 0 = off and 1 = on, as follows:

- bit 0 = 1 to enable Fault (FLT) status
- bit 1 = reserved
- bit 2 = reserved
- bit 3 = reserved
- bit 4 = 1 to enable Message Available (MAV)
- bit 5 = 1 to enable Standard Event (ESB)
- bit 6 = not used (always 0)
- bit 7 = reserved

Example *SRE 48 <lf>
defines the following conditions to generate an IEEE-488 SRQ: MAV enabled and ESB enabled.

(That is, 48 = 30 Hex = 0011 0000 Binary)

Bit 7 Bit 0

Query [*SRE?] [*]
Parameters none
Valid Response the status byte
(always two ASCII digits, decimal representation)
Example *SRE? <lf>
Sample Response 048 <lf>
indicates that both conditions will generate an IEEE-488 SRQ.

The SRQ register is cleared (set to zero) on power up, if the Power-On Status Clear Flag is set. (Refer to the description of the Clear Status Command.)

Status Byte Query

allows the host to read the status byte of the DASH 10. This query is useful if serial polling is not desired or if the system is under RS-232 control. The format for the query status command is as follows.

Query	[*STB?] [*]
Parameters	none
Valid Responses	000-255 the STB (status byte) message, always 3 ASCII digits, a decimal number whose binary representation is defined with 0 = off and 1 = on
Example	*STB? <lf>
Sample Response	032 <lf> indicates that bit 5 of the status byte is set on (to 1).

(That is, 32 = 20 Hex = 0010 0000 Binary)

Bit 5 Bit 0

There is information about a condition in the Event Status Byte. This information can be acquired by issuing the Event Status (*ESR?) Query.

Clear Status Command

clears both the SRQ Status Byte and the Standard Event Status Register. SRQ is no longer asserted and the system returns to operation complete idle state (OCIS and OQIS). Refer to the section about device synchronization later in this chapter for additional information.

Command	[*CLS] [*]
Parameters	none
Example	*CLS <lf> un-asserts SRQ, clears the status bytes, and returns the system to operation complete idle state.

is used to determine which conditions will set bit 5 of the SRQ (Service Request) status byte to 1 (ON). This means that, when bit 5 is set on, the system will generate an SRQ, assuming that the event status bit (bit 5) of the SRQ has been enabled. [Refer to the description of the Set SRQ Enable Byte (*SRE) Command.]

If the Power-On Status Clear Flag is set on, this bit is cleared (set to zero) upon power up; if the Power-On Status Clear Flag is not set on, this register will retain the information. [Refer to the description of the Set Power-On Status Clear Flag (*PSC) Command.]

Upon receiving an SRQ, the controller in charge performs a serial poll in search of the device(s) that has requested service; the device that has been enabled and addressed responds with the event status byte (ESB).

A bit is set to 1 to indicate that the condition is present or to 0 to indicate that the condition is not present. Each bit of the event status byte has a unique message, as shown:

Event Status Byte:	7	6	5	4	3	2	1	0
	PON	**URQ**	**CME**	**EXE**	**DDE**	**QYE**	**RQC**	**OPC**

OPC (bit 0) **Operation Complete**
A particular operation (for example, data acquisition, playback, calibration, auto-ranging) has finished.

RQC (bit 1) **not used**

QYE (bit 2) **Query Error**
The output queue cannot be read, due to lost data or no data present in queue.

DDE (bit 3) **Device Error**
This bit is set on when a condition arises that requires attention, such as a disk write error. You can use the Error Code (ALLE?) Query to read the error code(s).

EXE (bit 4) **Execution Error**

An execution error occurs when a command is sent that corrupts the current operating mode, data fields are out of range, or an internal condition prevents the command from completing successfully.

CME (bit 5) **Command Error**

A command error usually indicates an improper command header or command format (for example, query header where a query is not available or the wrong number of fields).

URQ (bit 6) **not used**

PON (bit 7) **Power On**

Power to the recorder has been turned on. Set to 1, this bit indicates that the OFF-to-ON transition has occurred.

Command [*ESE] [n][*]

Parameters n = 0 to 189 a decimal number whose binary representation is defined with 0 = off and 1 = on, as follows:

bit 0 = Operation Complete
bit 1 = Request Control (always 0)
bit 2 = Query Error
bit 3 = Device Dependent Error
bit 4 = Execution Error
bit 5 = Command Error
bit 6 = not used (always 0)
bit 7 = Power On

Example *ESE 57 <lf>

indicates that the following conditions will result in bit 5 of the SRQ status byte becoming active (set to 1): operation complete, device error, execution error, or command error.

(That is, 57 = 39 Hex = 0011 1001).

Bit 7 Bit 0

Query	[*ESE?] [*]
Parameters	none
Valid Responses	0 to 189
Example	*ESE? <lf>
Sample Response	057 <lf> signifies that a command error, execution error, device error, or operation complete will cause bit 5 of the SRQ status byte to be set to 1.

Standard Event Status Register Query

initiates a destructive read operation of the Standard Event Status Register. The register is set to zero after it is read. Device clear and the Clear Status (*CLS) Command also set this register to zero.

Query	[*ESR?][*]
Parameters	none
Valid Response	000-189 the ESR (Standard Event Status Register) message, always 3 ASCII digits, a decimal number whose binary representation is defined with 0 = off and 1 = on
Example	*ESR? <lf>
Sample Response	016 <lf> Indicates that there has been an execution error since the last time the Standard Event Status Register was cleared. (That is, 16 = 10 Hex = 0001 0000)

allows the host to choose whether old status register masks are to be maintained or cleared upon power up of the DASH 10.

Command	[*PSC] [a][*]
Parameters	a = 1 to clear registers (ESE and SRE) on power up = 0 to maintain registers as they were on power up
Example	*PSC 1<lf> causes the DASH 10 to clear the ESE and SRE registers on power up.

Query	[*PSC?] [*]
Parameters	none
Valid Responses	1 to clear registers (ESE and SRE) on power up 0 to maintain registers as they were on power up
Example	*PSC? <lf>
SampleResponse	1<lf> indicates that the ESE and SRE registers will be cleared on power up.

allows the host to query all the conditions in the Event Error Queue. Up to 20 events may be in the queue. Refer to Table 3-2 for a description of these error codes. This command will return 1 to 20 three-digit numbers, separated by commas. If the Event Error Queue is empty, 000 will be returned. The queue will be empty after this command or the Clear Status (*CLS) Command is executed.

Query	[ALLE?] [*]
Parameters	none
ValidResponses	1 to 20 codes, separated by commas
Example	ALLE? <lf>
Sample Response	000 <lf> indicates that the Event Error Queue is empty.

Table 3-2: Event Error Codes

Event Code	*Event description*
101	Disk error - General error
102	Disk error - Read error
103	Disk error - Write error
104	Disk error - Insufficient disk space
105	Disk error - Disk drive not found
106	Disk error - Write protection on
107	Disk error - File not found
108	Disk error - No disk in drive
109	Disk error - Maximum files exceeded
110	Disk error - Duplicate file name
111	Disk error - No files present
112	Disk error - Timeout
999	Event queue error - Too many events

returns information on the current identity of the DASH 10 system, including the manufacturer, model, system ID number, and software revision level. The system ID number will be "0."

Query	[*IDN?] [*]
Parameters	none
Valid Response	a,b,c,d where: a = ASTRO-MED (9 characters) b = DASH-10 (10 characters) c = 0 (1 character) d = software revision level (13 characters)
Example	*IDN? <lf>
Sample Response	ASTRO-MED,DASH-10 ,0,11.0-1.1-1.0 <lf> indicates that the manufacturer of the recorder is Astro-Med, Inc., the recorder model is the DASH 10, the system ID number is 0, and the software revision is SCN 11.0 with version 1.1 boot EPROM and version 1.0 display EPROM.

Installed Options Query

requests the number of A/D boards installed, and whether a board has the data capture option installed.

Query	[*OPT?] [*]
Parameters	none
Valid Response	a,a,a where: a = 0 for no board installed 1 for installed without data capture option 2 for installed with data capture option
Example	*OPT? <lf>
Sample Response	2,1,0 <lf> indicates that two boards are installed, and board #1 has the data capture option.

Initiate Self-Test Command

causes the DASH 10 to perform a self-test of its host communication interface by sending a "0" (pass) to the host.

Query	[*TST?] [*]
Parameters	none
Valid Response	0
Example	*TST? <lf>
Sample Response	0 <lf> indicates that the DASH 10 self-test passed.

Device Synchronization Commands

Most DASH 10 host commands execute very quickly and do not require feedback to tell the host that the command has completed. In some instances, however, an operation requires a significant amount of time to complete and the host computer needs to know when that operation has finished.

The following commands begin operations that might require significant time to complete, and thus could require synchronization:

ARMC	Arm DASH 10 for data capture.
PLBK	Play back captured data.
CALB	Calibrate specified channel.

The host computer has several methods of synchronization available:

1. Most commonly, the host will use the Event Status (*ESR?) Query to ascertain the state of the operation complete bit, or, if the communication interface is GPIB, the host will allow the DASH 10 to generate an SRQ. In either case, the host must issue the Operation Complete (*OPC) Command immediately before or after the command that starts the operation in question. The host must then wait for the operation complete bit to be set ON, indicating completion.

2. Another method to determine when the operation is complete is to use the Operation Complete (*OPC?) Query. This query puts a "1" in the host output buffer when the operation is complete. (With this method, the host must assure that its interface will not time out.)

3. Another method is to use the Wait (*WAI) Command after the command used to start the operation in question. This will prevent the processing of any further host commands until the operation is complete. The only way to cancel the Wait Command before the operation is complete is to cycle the power to the recorder or to send a Device Clear or Selected Device Clear Message to the recorder.

Reset Command

cancels an Operation Complete (*OPC) Command or (*OPC?) Query and returns the system to operation complete idle state (OCIS) and operation complete query idle state (OQIS) from operation complete active state (OCAS) and operation complete query active state (OQAS).

Command	[*RST] [*]
Parameters	none
Example	*RST <lf> Cancels any pending Operation Complete Command or Query and resets system as described above.

Operation Complete Command

sets the operation complete state to operation complete active state (OCAS) and allows the operation complete bit of the Standard Event Status Register to be set ON (to 1), when the pending operation is complete. The query version of this command sets the operation complete state to operation complete query active state (OQAS) and places an ASCII "1" in the host output buffer, when the pending operation is complete.

Command	[*OPC] [*]
Parameters	none
Example	*OPC <lf> sets the operation complete bit of the Standard Event Status Register to be set ON (to 1), when the pending operation is complete.

Query	[*OPC?] [*]
Parameters	none
Valid Response	1
Example	*OPC? <lf>
Sample Response	1 <lf> Indicates that the operation is now complete.

causes the system to refrain from processing any host commands until the pending operation is complete.

Command [*WAI] [*]
Parameters none
Example *WAI <lf>
Holds the system from processing any host commands until the pending operation is complete.

Disk Management Commands

The DASH 10 disk drive, illustrated in Figure 3-2, enables the following primary functions:

- saving system setups to disk
- restoring system setups from disk
- saving data capture records to disk
- restoring data capture records from disk
- performing system software upgrades

These functions are all done locally on the DASH 10, and are described in detail in the *DASH 10 Operations Manual*.

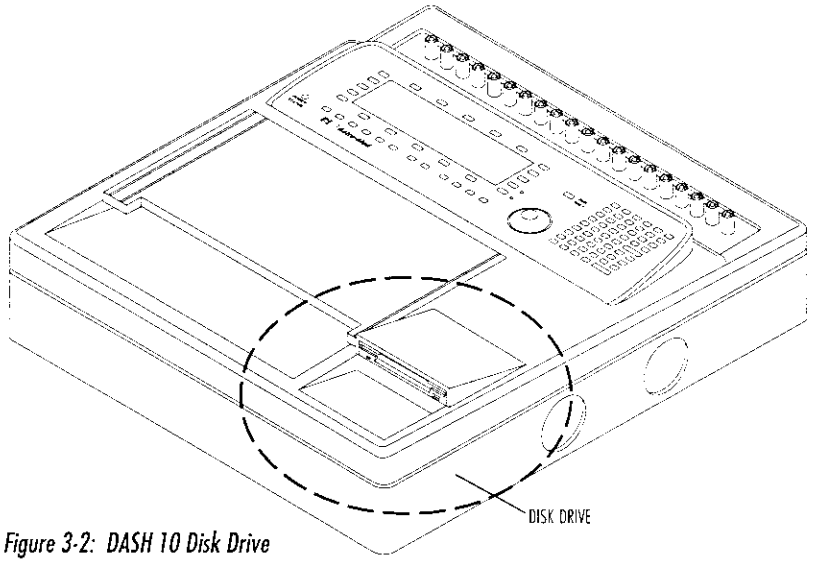


Figure 3-2: DASH 10 Disk Drive

If a disk is currently in the DASH 10 disk drive, the following functions can be accomplished by host command:

- request a list of the names of the files on the disk
- rename a file on the disk
- delete a file from the disk

Disk Directory Query

returns a list of file names of the files on the disk in the DASH 10 disk drive.

Query	[FDIR?] [*]
Parameters	none
Valid Responses	string of file names, separated by commas, or "NO FILES" if no files are on the disk, or "NO DISK" if no disk is in the drive
Example	FDIR? <lf>
Sample Response	FOUR-25.STP,REC02.DCR,REC08.DCR <lf> Lists the names of the three files on the disk in the DASH 10 disk drive.

Rename Disk File Command

renames a particular file on disk in the DASH 10 disk drive.

Command	[FREN] [x],[y] [*]
Parameters	x = current file name (up to 12 characters in double quotation marks) y = new file name (up to 12 characters in double quotation marks)
Example	FREN "REC02.DCR","POWR02.DCR" <lf> Renames file REC02.DCR to POWR02.DCR.

Delete Disk File Command

deletes a particular file from a disk in the DASH 10 disk drive.

Command	[FDEL] [x] [*]
Parameters	x = name of file be deleted (up to 12 characters in double quotation marks)
Example	FDEL "POWR02.DCR" <lf> Deletes file named POWR02.DCR from the disk in the DASH 10 disk drive.

4

System Setup: Chart & VF Display

The commands discussed in this chapter are commands that control the representation of data on the chart and the VF Display. Some of these commands involve parameters that can be saved into any of four chart formats, each of which can be instantly recalled while operating the DASH 10. These saved parameters are listed in Table 4-2.

When modifying these parameters, you are changing the setup of the chart format that is currently running, or, if the unit is in the idle state, of the last chart to run. You can easily change chart formats by using the Start Real-Time Recording (CHRT) Command, as described in Chapter 6, to designate another format.

All DASH 10 system parameters are saved in non-volatile memory. These parameters are remembered when the recorder is powered down and then powered on again.

Like all system setup commands, the chart setup commands can be executed at any time — while the recorder is in the idle state or in operation.

VF Display

The DASH 10's Vacuum Flourescent (VF) Display is an electronic display on the recorder's front panel. The VF Display is tied to the chart setup parameters. The features and format of the display, for the most part, will mimic those of the chart. However, the running of the display can be controlled independently via the Run/Freeze Command described in Chapter 6.

On the display, waveforms and text are displayed at a resolution of two dots per millimeter; waveforms are displayed in the vertical "waterfall" format. Character text buffers indicate whether the DASH 10 is under host control as described in Chapter 2.

Chart Setup

The *Chart Setup Commands* control the way in which printable elements will appear on the chart. This includes whether or not elements will print, where they will print, and the size of the grid.

The chart setup commands allow you to:

- Enable or disable printing of all grid lines on the chart
- Determine the number of major and minor grid divisions
- Select grid type: distance-based or time-based
- Enable or disable printing of waveforms on the chart
- Enable or disable printing of other chart elements: annotation buffer, event markers, system event marker, system log channel, waveform identification
- Position the grid on the chart
- Position other chart elements: time marks, interchannel text, event markers, annotation buffer
- Define the event type
- Determine the content of each buffer: system log, annotation buffer, interchannel text buffer, on-demand
- Set the time interval for the printing of time marks

Refer to the *DASH 10 Operations Manual* for an in-depth discussion of custom chart design.

Table 4-1: Chart and Grid Setup Commands

Header	Function
ECHT	Define or change the name of one of the four saved charts.
GRTY	Select either distance-based or time-based grid.
GRON	Enable/disable printing of grids.
GRSZ	Define the size of the grid in millimeters.
GRMA	Set the number of major divisions on the chart.
GRMN	Specify the number of minor grid divisions per major division.
GRLC	Specify the location of the grid on the chart.
PENL	Enable/disable printing for an analog channel.
THIC	Set the thickness of the waveform trace in pixels.
SEST	Enable/disable printing of system event marker.
EVTY	Define the event type.
EVST	Enable/disable printing of event markers for a channel.
EVLC	Position each event marker on chart.
TMST	Enable/disable printing of right-edge and left-edge time marks.
TMTB	Set the time interval for the printing of time marks.
TMLC	Position the time marks.
AUID	Enable/disable automatic printing of signal identification.
SLOG	Enable/disable printing of system log channel.
EDSY	Edit content of the system log.
BSET	Turn on and position annotation buffer.
EDIT	Edit content of each annotation buffer.
EODB	Edit content of on-demand buffer.
SREP	Specify which channels are to have signal conditioner reporting in the interchannel text buffer.

Chart and Grid Setup Queries

Header	*Function*
ECHT?	What is the name of the specified saved chart?
GRTY?	Is the grid based on distance or time?
GRON?	Is the printing of major chart grids enabled?
GRSZ?	What is the size of the grid in millimeters?
GRMA?	How many major divisions are in the grid?
GRMN?	How many minor grid divisions appear between major divisions?
GRLC?	What is the location of the grid on the chart?
PENL?	Is printing enabled for an analog channel?
THIC?	How many pixels thick is the waveform trace?
SEST?	Is printing of the system event marker enabled?
EVTY?	What is the print format of all event markers?
EVST?	Is printing of event markers enabled?
EVLC?	Where is an event marker located on the chart?
AUID?	Is automatic printing of signal identification enabled?
TMST?	Is printing of right-edge and/or left-edge time marks enabled?
TMTB?	What is the time interval for the printing of time marks?
TMLC?	Where is the time mark located?
SLOG?	Is printing of the system log channel enabled?
EDSY?	What is the current content of the system log?
BSET?	Is an annotation buffer on and, if so, what is its location?
EDIT?	What is the current content of an annotation buffer?
EODB?	What is the current content of the on-demand buffer?
SREP?	Which channels have signal conditioner reporting in the interchannel text buffer?

Chart Formats

The DASH 10 has four saved chart formats available for instant recall. You can easily change chart formats by using the Start Real-Time Recording (CHRT) Command, as described in Chapter 6, to select another saved format.

When modifying these parameters, you are changing the setup of the chart format that is currently running, or, if the unit is in the idle state, of the last chart to run. All DASH 10 system parameters are saved in non-volatile memory. These parameters are remembered when the recorder is powered down and then powered on again. However, to permanently save an altered format, you must use the DASH 10 front panel soft keys and the procedure described in Chapter 4 of the *DASH 10 Operations Manual*. The parameters saved with a chart format are listed in Table 4-2.

If you want to restore the saved format originally selected, you can use the CHRT Command again.

The four formats are identified on the DASH 10 front panel by their assigned names. The following host command allows you to change these names if desired.

Edit Chart Name Command

defines or changes the name assigned to one of the four saved chart formats.

Command [ECHT] [c],[s] [*]

Parameters
c = 1 to 4 for the chart format
s = ASCII text string in quotation marks (up to 7 characters)

Example
ECHT 3,"ECG #12"<lf>
specifies that "ECG #12" is the name assigned to saved chart number 3.

Query	[ECHT?] [*]
Parameters	c = 1 to 4 for the chart format
Valid Responses	the text string in quotation marks
Example	ECHT? 3 <lf>
Sample Response	"ECG #12" <lf> indicates that "ECG #12" is the name assigned to saved chart number 3.

Table 4-2: Saved Chart Parameters

Parameter	*Command*
Chart Name	CHNM
Pen Lift Status	PENL
Grid Status	GRON
Grid Size	GRSZ
Number of Major Grid Divisions	GRMA
Number of Minor Grid Divisions	GRMN
Grid Type (distance- or time-based)	GRTY
System Log Status	SLOG
Text Buffer Location	BSET
Text Buffer State	BSET
On-Demand Buffer Location	EODB
Event Style	EVTY
Event Marker Location	EVLC
Event Marker Status	EVST
System Event State	SEST
System Event Location	SEST
Trilevel Mark State	TMLC
Trilevel Mark Rate	TMLC
Trilevel Mark Location (Right)	TMTB
Trilevel Mark Location (Left)	TMTB

Grids

Grid design is extremely flexible in the DASH 10 Recorder. The horizontal grid lines, those that print across the chart, can print based on distance or based on time. The vertical grid lines, those that print along the chart, can be configured to specify:

- Number of major grid divisions
- Number of minor grid divisions

Grid Type Command

sets the grid to print based on distance (x-based) or on time (t-based):

- An x-based grid prints a major mark at the recorder's standard 5-mm intervals.

- A time-based grid prints a major mark only when there is a timer pulse, thereby allowing the grids to be synchronized with the tri-level timing marks. Refer also to the description of the Time Mark Interval (TMTB) Command.

Command	[GRTY] [x] [*]
Parameters	x = 0 for x-based grids 1 for t-based grids
Example	GRTY 1 <lf> sets the grids to print based on units of time.

Query	[GRTY?] [*]
Parameters	none
Valid Responses	0 for x-based grids 1 for t-based grids
Example	GRTY? <lf>
Sample Response	1 <lf> indicates that the grids will print based on units of time.

Print Grid Command

defines whether the grids will be printed during recording.

Command	[GRON] [n],[x] [*]
Parameters	n = 1 to 30 for channel number
	x = 0 for grid off
	1 for grid on
Example	GRON 16,1 <lf>
	turns the grid on for channel 16.

Query	[GRON?] [n] [*]
Parameters	n = 1 to 16 for channel number
Valid Responses	n,x
	where: x = 0 for grid off
	1 for grid on
Example	GRON? 16 <lf>
Sample Response	16,1 <lf>
	indicates the grid is turned on for channel 16.

Set Grid Size Command

defines the size of the grid in millimeters.

Command	[GRSZ] [n],[x], [*]
Parameter	n = 1 to 30 for the channel number
	x = 1 to 250 millimeters
Example	GRSZ 3,100 <lf>
	specifies that the grid for channel 3 is 100 millimeters wide.

Query	[GRSZ?] [n] [*]
Parameters	n = 1 to 30 for the channel number
Valid Responses	n,x where: n = 1 to 30 for the channel number x = 1 to 250 millimeters
Example	GRSZ? 03 <lf>
Sample Response	03,100 <lf> indicates that the grid for channel 3 is 100 millimeters wide.

Major Grid Configuration Command

defines the number of major divisions on a grid. The number of major divisions should not exceed the size of the grid.

Command	[GRMA] [n],[x], [*]
Parameter	n = 1 to 30 for the channel number x = 1 to 250 for the number of major divisions
Example	GRMA 3,4 <lf> specifies that the grid for channel 3 will print 4 major divisions.

Query	[GRMA?] [n] [*]
Parameters	n = 1 to 30 for the channel number
Valid Responses	n,x where: n = 1 to 30 for the channel number x = 1 to 250 for the number of major divisions
Example	GRMA? 3 <lf>
Sample Response	03,004 <lf> indicates that the grid for channel 3 will print 4 major divisions.

defines the number of minor divisions per major division on a grid. The number of minor divisions should not exceed the number of major divisions.

Command [GRMN] [n],[y] [*]

Parameter

n	= 1 to 30	for the channel number
y	= 1 to 250	for the number of minor divisions per major division

Example GRMN 3,5 <lf>
specifies that the grid for channel 3 will print 5 minor divisions per major division.

Query [GRMN?] [n] [*]

Parameters

n	= 1 to 30	for the channel number

Valid Responses n,y
where:

n	= 1 to 30	for the channel number
y	= 1 to 250	for the number of minor divisions per major division

Example GRMN? 3 <lf>

Sample Response 3,005 <lf>
indicates that the grid for channel 3 will print 5 minor divisions per major division.

establishes the location of the bottom of a grid on the chart. Location 0 is on the bottom or far right side of the chart, while location 250 is on the top or far left side of the chart. Up to 30 grids can be placed on the chart.

Command [GRLC] [n],[p][*]

Parameters
n = 1 to 30 for the channel number
p = 0 to 250 for the location in millimeters from the bottom-most print element of the printhead

Example GRLC 2,20 <lf>
places the bottom edge of the second grid 20 millimeters from the bottom-most print element of the printhead.

Note: The bottom-most print element of the printhead is 6 to 7 millimeters from the bottom of the chart.

Query [GRLC?] [n] [*]

Parameters
n = 1 to 30 for the channel number

Valid Responses
n, p
where: n = 1 to 30 for the channel number
p = 0 to 250 for the location in millimeters

Example GRLC? 2 <lf>

Sample Response 2,020 <lf>
indicates that the bottom edge of the second grid is located 20 millimeters from the bottom-most print element of the printhead.

Chart Elements

The following commands control the way in which all other printable elements (waveforms, event markers, time marks, text) will appear on the chart. This includes whether or not elements will print, where they will print, and the size of a channel.

Pen Lift Command

enables or disables chart printing of the signal trace for any of the analog channels during real-time recorder output. (The name of the command is a hold-over from old recorder technology; no pen is actually lifted.)

Command	[PENL] [n],[x] [*]
Parameters	n = 1 to 30 for channel number
	x = 0 for down (print/record)
	1 for lifted (no printing)
Example	PENL 1,0 <lf>
	enables printing of trace for channel 1.

Query	[PENL?] [n] [*]
Parameters	n = 1 to 30 for channel number
Valid Responses	n,x
	where: x = 0 for down (print/record)
	1 for lifted (no printing)
Example	PENL? 1 <lf>
Sample Response	1,0 <lf>
	indicates that the waveform for channel 1 is printing.

Trace Thickness Command

sets the thickness (number of dots or printhead pixels) of the waveform trace. The default value is 3.

Command [THIC] [x] [*]
Parameter x = 1 to 24 for trace thickness (number of dots)
Example THIC 4 <lf>
sets the thickness of the waveform trace to 4 dots.

Query [THIC?] [*]
Parameters none
Valid Responses 1 to 24 for trace thickness
Example THIC? <lf>
Sample Response 4 <lf>
indicates that the thickness of the waveform trace is 4 dots.

System Event Marker Command

enables or disables printing of the system event marker during recorder output. This marker is located on the left side of the chart and normally indicates the occurrence of a trigger.

Command [SEST] [x] [*]
Parameters x = 0 for disabled
1 for enabled
Example SEST 0 <lf>
disables printing of the system event marker.

Query [SEST?] [*]
Parameters none
Valid Responses 0 for printing disabled
1 for printing enabled
Example SEST? <lf>
Sample Response 0 <lf>
indicates that the system event marker is disabled (not printing).

Event Type Command

selects the print format of all event markers. If there is no event input, this command affects only the system event.

Command	[EVTY] [x] [*]
Parameters	x = 0 for standard square wave 1 for block/line 2 for block/off 3 for tick mark
Example	EVTY 0 <lf> causes all event markers to print as square waves.

Query	[EVTY?] [*]
Parameters	none
Valid Responses	0 for standard square wave 1 for block/line 2 for block/off 3 for tick mark
Example	EVTY? <lf>
Sample Response	0 <lf> indicates that all event markers will print as square waves.

Event Markers Command

enables or disables the printing of an event marker. Generally, an event marker indicates a change in the state of signal input to an event channel. Refer to Chapter 4 in the *DASH 10 Operations Manual* for information about event markers.

Command	[EVST] [n],[x] [*]
Parameters	n = 1 to 30 for event number x = 0 for event marker disabled 1 for event marker enabled
Example	EVST 15,1 <lf> enables event marker 15. (Event marker 15 will print.)

Query	[EVST?] [n] [*]	
Parameters	n = 1 to 30	for event number
Valid Responses	n,x	
	where: x = 0	for event marker disabled
	1	for event marker enabled
Example	EVST? 15 <lf>	
Sample Response	15,1 <lf>	
	indicates that event marker 15 is enabled.	

Event Marker Location Command

defines each event marker's location, designated as positions on 32-bit word boundaries. There are 94 word boundaries, each representing 2.72 millimeters.

Command	[EVLC] [n],[x] [*]	
Parameters	n = 1 to 30	for event number
	x = 0 to 93	for location on a 32-bit word boundary
Example	EVLC 3,17 <lf>	
	places the third event marker 46.24 (17 x 2.72) millimeters from the bottom-most (right-edge) print element.	

Query	[EVLC?] [n] [*]	
Parameters	n = 1 to 30	for event number
Valid Responses	n,x	
	where: x = 0 to 93	for location on a 32-bit word boundary
Example	EVLC? 3 <lf>	
Sample Response	03,17 <lf>	
	indicates that the third event marker is located 46.24 millimeters from the bottom-most (right-edge) print element.	

Time Mark Status Command

turns time marks on or off for the right and left edges of the chart.

Command [TMST] [x] [*]

Parameters

x =	0	to turn the marks off
	1	to turn the left edge marks on
	2	to turn the right edge marks on
	3	to turn both on

Example TMST 3 <lf>
causes time marks to print on both the right and left edges of the chart.

Query [TMST?] [*]

Parameters none

Valid Responses
0 for marks off
1 for left edge marks on
2 for right edge marks on
3 for both on

Example TMST? <lf>

Sample Response 3 <lf>
indicates that time marks are printed on both the right and left edges of the chart.

sets the time interval for the printing of time marks from .01 to 60 seconds.

Command	[TMTB] [x] [*]	
Parameters	x = 0 to 37	for the code to specify the interval period (See Table 4-3.)
Example	TMTB 9 <lf>	
	causes printing of a time mark every .1 second.	

Table 4-3: Codes for Time Mark Interval Periods

Code	Rate	Code	Rate	Code	Rate
0	.01 sec	12	.4 sec	25	8 sec
1	.02 sec	13	.5 sec	26	9 sec
2	.03 sec	14	.6 sec	27	10 sec
3	.04 sec	15	.7 sec	28	15 sec
4	.05 sec	16	.8 sec	29	20 sec
5	.06 sec	17	.9 sec	30	25 sec
6	.07 sec	18	1 sec	31	30 sec
7	.08 sec	19	2 sec	32	35 sec
8	.09 sec	20	3 sec	33	40 sec
9	.10 sec	21	4 sec	34	45 sec
10	.2 sec	22	5 sec	35	50 sec
11	.3 sec	23	6 sec	36	55 sec
		24	7 sec	37	60 sec

Query	[TMTB?] [*]
Parameters	none
Valid Responses	0 to 37 (See Table 4-3.)
Example	TMTB? <lf>
Sample Response	9 <lf>
	indicates printing of a time mark every .1 second.

defines the location of the time mark, designated as positions on 32-bit word boundaries. There are 94 word boundaries, each representing 2.72 millimeters.

Command [TMLC] [n],[x] [*]

Parameters
n = 1 for time mark #1
2 for time mark #2
x = 0 to 93 for location on a 32-bit word boundary

Example TMLC 1,0 <lf>
places time mark #1 at the right side of the chart.

Query [TMLC?] [n] [*]

Parameters
n = 1 for time mark #1
2 for time mark #2

Valid Responses n,x
where: n = 1 for time mark #1
2 for time mark #2
x = 0 to 93 for location on a 32-bit word boundary

Example TMLC? 1 <lf>

Sample Response 1,0 <lf>
indicates that time mark #1 is positioned at the right side of the chart.

Adding Text

When you need to add alphanumeric text to the your charts, the DASH 10 provides a variety of annotation tools. The DASH 10 is equipped with:

- thirty 128-character annotation buffers each of which can be moved to any of 95 positions across the chart.
- one 128-character on-demand annotation buffer that can be printed when you want in any of 95 locations across the chart.
- one system log buffer containing the time, date, and chart speed fixed near the top of the chart.
- capacity to print channel identification numbers either on-demand or automatically and continuously.

enables or disables the repetitive (approximately once per page) printing of the channel number for signal identification. In non-overlapped formats, the ID is printed in each channel. In overlapped formats, the ID is printed on each waveform.

The identification numbers provide a quick way to locate each waveform. This is particularly helpful when waveforms are overlapped on the chart.

In addition, when automatic identification is activated, grid edges are labelled with corresponding values, such as voltages or frequencies.

Command	[AUID] [x] [*]
Parameters	x = 0 to disable automatic identification 1 to enable automatic identification
Example	AUID 1 <lf> enables automatic identification.

Query	[AUID?] [*]
Parameters	none
Valid Responses	0 for automatic identification disabled 1 for automatic identification enabled
Example	AUID? <lf>
Sample Response	1 <lf> indicates automatic identification is enabled.

Print System Log Command

controls whether or not the system log on the left edge of the chart will print during real-time and playback recording.

Command	[SLOG] [x] [*]
Parameters	x = 0 turns printing off 1 turns printing on
Example	SLOG 1 <lf> turns the system log on.

Query	[SLOG?] [*]
Parameters	none
Valid Responses	0 for printing off 1 for printing on
Example	SLOG? <lf>
Sample Response	1 <lf> indicates that the system log will print.

Edit System Log Command

defines or changes the content of the 28-character system log.

Command	[EDSY] [s] [*]
Parameters	s = ASCII text string in quotation marks (up to 28 characters)
Example	EDSY "Pressure vs. Time"<lf> specifies that "Pressure vs. Time" should print in the system log area.

Query	[EDSY?] [*]
Parameters	none
Valid Responses	the text string in quotation marks
Example	EDSY? <lf>
Sample Response	"Pressure vs. Time" <lf> indicates that "Pressure vs. Time" will print in the system log area.

enables or disables printing of individual annotation buffers and specifies each buffer's location on the chart. The DASH 10 accommodates up to 30 annotation buffers. Annotation buffers are synchronized with one another and, when turned on, are printed repeatedly and continuously at a standard distance on the chart. Each buffer can hold up to 128 alphanumeric characters.

You can position the text buffers to print with specific channels or you can position them completely independently of the channels. You can even group any or all of the text buffers together on the chart to create an extended block of annotation comments. Locations are designated as positions on 32-bit word boundaries. There are 94 word boundaries, each representing 2.72 millimeters.

Command [BSET] [n],[x],[y] [*]

Parameters

n =	1 to 30	for the annotation buffer
x =	0	for disable
	1	for enable
y =	0 to 93	for location on a 32-bit word boundary

Example BSET 2,1,14 <lf>
enables annotation buffer 2 and places it 38.08 (14 x 2.72) millimeters from the bottom-most (right-edge) print element.

Query [BSET?] [n] [*]

Parameters

n =	1 to 30	for the annotation buffer

Valid Responses n,x,y

where: x =	0	for buffer disabled
	1	for buffer enabled
y =	0 to 93	for location on a 32-bit word boundary

Example BSET? 1 <lf>

Sample Response 02,1,14 <lf>
indicates that annotation buffer 2 is enabled and is located 38.08 millimeters from the bottom-most (right-edge) print element.

defines or changes the content of the annotation buffers.

Command	[EDIT] [n],[s] [*]
Parameters	n = 1 to 30 for annotation buffer s = ASCII text string in quotation marks (maximum 128 characters, including quotation marks)
Example	EDIT 1, "CHANNEL 1"<lf> specifies that "CHANNEL 1" should print in annotation buffer 1.

Query	[EDIT?] [n] [*]
Parameters	n = 1 to 30 for annotation buffer
Valid Responses	n,s where: s = the text string in quotation marks
Example	EDIT? 1 <lf>
Sample Response	01, "CHANNEL 1" <lf> indicates that "CHANNEL 1" will print in annotation buffer 1.

defines or changes the content of the 128-character on-demand buffer and places it on the chart. Locations are designated as positions on 32-bit word boundaries. There are 94 word boundaries, each representing 2.72 millimeters. The system default for this buffer is all spaces (no printing).

Command [EODB] [x],[s] [*]

Parameters
x = 0 to 93 for location on a 32-bit word boundary
s = ASCII text string in quotation marks (up to 128 characters)

Example EODB 50, "Pressure has reached 3.5 pounds/sq. in."<lf> specifies that the text "Pressure has reached 3.5 pounds/sq. in." should be printed 136 (50 x 2.72) millimeters from the bottom-most print element, when the Print On-Demand Buffer (PODB) Command is sent.

Note: The Print On-Demand Buffer Command is described in Chapter 6, since it is used during real-time recording.

Query [EODB?] [*]

Parameters none

Valid Responses x,s
where:
x = 0 to 93 for location on a 32-bit word boundary
s = the text string in quotation marks (always 128 characters)

Example EODB? <lf>

Sample Response 050, "Pressure has reached 3.5 pounds/sq. in." <lf> indicates that "Pressure has reached 3.5 pounds/sq. in." will be printed 136 millimeters from the bottom-most print element.

defines which channels will have signal conditioner reporting in the last 38 characters of the annotation buffer associated with the specified channel. Signal conditioner reporting refers to the gain and zero position settings associated with each channel.

Command	[SREP] [n],[x] [*]	
Parameters	n = 1 to 30	for the channel number
	x = 0	for disable
	1	for enable
Example	SREP 2,1 <lf>	
	enables signal conditioner reporting on channel 2.	

Query	[SREP?] [n] [*]	
Parameters	n = 1 to 30	for the channel number
Valid Responses	n,x	
	where: x = 0	for disabled
	1	for enabled
Example	SREP? 2 <lf>	
Sample Response	02,1 <lf>	
	indicates signal conditioner reporting is enabled for channel 2.	

5 Signal Setup

This chapter explains the commands that determine how incoming signals are handled by the DASH 10. The Real-Time Setup Commands allow the host to modify the settings for each individual channel's input and to automatically calibrate the system.

Signal setup involves:

- specifying whether a signal will be input or grounded
- selecting a voltage range for each channel
- positioning zero volts on the chart
- suppressing a DC bias to enable the use of higher gains without exceeding the recorder's range
- selecting either peak-to-peak or RMS input
- turn filtering on or off
- enabling chart printing of signal data for up to 8 channels, while the DASH 10 is in data logger format.
- establishing user-defined criteria for numeric data logging, if applicable

Table 5-1: Real-Time Setup Commands

Header	Function
SGND	Specify signal in or ground for a channel.
SRNG	Set input range for each channel, expressed as voltage full scale.
ZPOS	Position zero volts (ground) on chart.
SZSP	Set units of zero suppression for a channel.
SMDE	Specify whether input is peak to peak or RMS.
SFIL	Enable/disable 10 Hz low-pass filter for a channel.
DLCH	Enable/disable printing of signal data for a channel in Data Logger mode.
USST	Enable/disable scaling of numeric output for a channel, when the chart is in data logger format.
USTR	Specify the ratio of internal units (volts) to external units (user-defined).
USOS	Specify the offset (define 0 volts) for a channel, when user scaling is in effect.

Real-Time Setup Queries

Header	Function
SGND?	Is the signal in or grounded for a channel?
CALB?	Calibrate specified analog channel and return status.
SRNG?	What is the input range for each channel, expressed as full-scale voltage?
ZPOS?	Where is zero volts (ground) positioned on the chart?
SZSP?	How many units of zero suppression are set for a channel?
SMDE?	Is input peak-to-peak or RMS?
SFIL?	Is the 10 Hz low-pass filter enabled for a channel?
DLCH?	For which channels is printing of signal data in Data Logger mode enabled?
USST?	Is scaling of numeric output for a channel enabled or disabled, for data logger format?
USTR?	What is the ratio of internal units (volts) to external units (user-defined) during data logging?
USOS?	What is the offset for a channel, when user scaling is in effect?

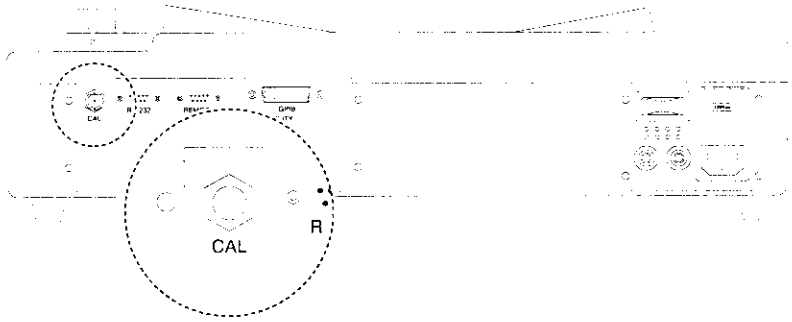
changes the status of any one of the channels to either DC (signal in) or ground. That is, it specifies that the channel be connected either to the input signal or to ground.

Command	[SGND] [n],[x] [*]	
Parameters	n = 1 to 30	for the channel number
	x = 0	for ground
	1	for DC (signal in)
Example	SGND 1,1 <lf>	
	specifies signal in for channel 1.	

Query	[SGND?] [n] [*]	
Parameters	n = 1 to 30	for the channel number
Valid Responses	n,x	
	where: x = 0	for ground
	1	for DC (signal in)
Example	SGND? 1 <lf>	
Sample Response	1,1 <lf>	
	specifies that DC signal is in for channel 1.	

causes the DASH 10 to perform an automatic self-calibration for a specified channel. This procedure tests and corrects both baseline offset and gain for each range.

A cable must be connected from the calibration (CAL) connector to the input for the channel to be calibrated. Otherwise, an error will result.



Refer to Chapter 6 of the *DASH 10 Operations Manual* for information about calibration.

Note that, if this command is used in conjunction with the Operation Complete (*OPC?) Query, the DASH 10 will first send a '1' to indicate operation complete, and then return the calibration result.

Query	[CALB?] [n] [*]
Parameters	n = 1 to 30 for the channel number
Valid Responses	0 for passed 1 for failed baseline calibration 2 for failed gain calibration
Example	CALB? 2 <lf>
Sample Response	0 <lf> indicates that calibration of channel 2 was performed and passed.

Note: The calibration will take a number of seconds to complete, which may cause some host computer interfaces to time out while waiting for a CALB? response. To avoid this possibility, you can send the Calibration (CALB) Command, without the question mark.

specifies the input range for each channel, expressed as full-scale voltage. The range determines the signal sensitivity (gain), which in turn determines the amplitude of the signal displayed.

Note: This command is invalid while a data capture is in progress.

Command [SRNG] [n],[v] [*]

Parameters
n = 1 to 30 for the channel number
v = .05 to 500 for the full-scale voltage
(.05 to 250 RMS)

Example
SENS 2,312.50 <lf>
sets the range for channel 2 to 312.5 volts full scale.

Query [SRNG?] [n] [*]

Parameters
n = 1 to 30 for the channel number

Valid Responses
n,v
where:
n = 1 to 30 for the channel number
v = .05 to 500 for the full-scale voltage
(always 6 ASCII characters)
(.05 to 250 RMS)

Example
SRNG? 2 <lf>

Sample Response
02,312.50 <lf>
indicates that the range for channel 2 is 312.50 volts full scale.

Note: Regardless of whether user scaling is in effect, range is always specified in volts.

defines the position of zero volts (ground) on the chart. To position zero volts, you specify percentage of full scale, from the center of the grid. The center is represented by 0%, with -50% representing the right edge and 50% representing the left edge. Thus, the baseline can be positioned anywhere on the chart.

Note: This command is invalid while a data capture is in progress.

Command [ZPOS] [n],[x] [*]

Parameters

n =	1 to 30	for the channel number
x =	-60% to 60%	for percentage of offset based on full scale

(The sign must immediately precede the number; if no sign is entered, a positive value is assumed.)

Example ZPOS 16,+25 <lf>
places the signal's zero position 25% above the center of the chart for channel 16.

Query [ZPOS?] [n] [*]

Parameters
n = 1 to 30 for the channel number

Valid Responses
n,x
where:

n =	1 to 30	for the channel number
x =	-60% to 60%	for percentage of offset based on full scale

Example ZPOS? 16 <lf>

Sample Response
16,+25.00 <lf>
indicates that zero position for channel 16 is 25% above the center of the chart.

allows you to to adjust the zero suppression for the selected channel by specifying the number of volts you wish suppressed. Zero suppression allows you to eliminate an unwanted direct current (DC) component of the signal so that you can expand the portion of the AC signal that is of interest and move the output waveform anywhere on the chart. That is, you can determine a new baseline value and then position the waveform where you like.

If you wish to suppress a positive voltage, specify a negative zero suppression value; if you wish to suppress a negative voltage, specify a positive zero suppression value.

Note: This command is invalid while a data capture is in progress.

Command [SZSP] [n],[x] [*]

Parameters
n = 1 to 30 for the channel number
x = -500.0 to +500.0 in 0.25-volt increments (if range ≥ 5 volts)
-5.0 to +5.0 in .0025-volt increments (if range< 5 volts)
(The sign must immediately precede the number; if no sign is entered, a positive number is assumed.)

Example
SZSP 2,-91.25 <lf>
sets zero suppression for channel 2 to -91.25 volts.

Query [SZSP?] [n] [*]

Parameters
n = 1 to 30 for the channel number

Valid Responses
n,x
where:
n = 1 to 30 for the channel number
x = -500.0 to +500.0 (if range ≥ 5 volts)
-5.0 to +5.0 (if range< 5 volts)

Example
SZSP? 2 <lf>

Sample Response
2,-091.25 <lf>
indicates that zero suppression for channel 2 is set for -91.25 volts.

specifies type of input: peak to peak or RMS.

Command [SMDE] [n],[x] [*]
Parameters n = 1 to 30 for the channel number
x = 0 for peak to peak
1 for RMS
Example SMDE 12,0 <lf>
sets the mode for channel 12 to peak to peak.

Query [SMDE?] [n] [*]
Parameters n = 1 to 30 for the channel number
Valid Responses 0 for peak to peak
1 for RMS
Example SMDE? 12 <lf>
Sample Response 12,0 <lf>
indicates that the mode for channel 12 is peak to peak.

enables or disables filtering for the selected channel. The DASH 10 allows the use of a low-pass filter to help shape the representation of the signal on the chart, and consequently the information provided by a signal. The filter removes the 10-Hz frequency from the signal.

Note: This command is invalid while a data capture is in progress.

Command	[SFIL] [n],[x] [*]
Parameters	n = 1 to 30 for the channel number
	x = 0 for filter off
	1 for 10-hertz low-pass filter
Example	SFIL 2,1 <lf>
	turns on the low-pass filter for channel 2.

Query	[SFIL?] [n] [*]
Parameters	n = 1 to 30 for the channel number
Valid Responses	0 for filter off
	1 for 10-hertz low-pass filter
Example	SFIL? 2 <lf>
Sample Response	2,1 <lf>
	indicates that the low-pass filter for channel 2 is turned on.

enables or disables chart printing of signal data for any of the channels while the DASH 10 is in data logger format. A maximum of 8 channels may be enabled for numeric output at one time. A data error will occur if more than 8 channels are enabled for numeric output.

Command	[DLCH] [c1],[c2],[c3],[c4],[c5],[c6],[c7],[c8] [*]
Parameters	c1—c8 = 0 for off 1 to 30 for channel on
Example	DLCH 1,0,12,14,0,19,0,20 <lf> enables printing of numeric data for channels 1, 12, 14, 19, and 20.

Query	[DLCH?] [*]
Parameters	none
Valid Responses	c1,c2,c3,c4,c5,c6,c7,c8 where: 0 = off (do not print) 1 to 30 = channel on
Example	DLCH? <lf>
Sample Response	01,00,12,14,00,19,00,20 <lf> indicates printing of numeric data is enabled for channels 1, 12, 14, 19, and 20.

User Scaling

All signal information comes into the DASH 10 as electrical voltage. However, if you are measuring temperature, pressure, or any quantity other than voltage, it can be more useful to have those quantities represented in the corresponding engineering units, rather than as voltage values or waveforms on a grid. User scaling converts the voltage values into numeric data that corresponds directly to the units being monitored.

Each channel may be calibrated to the units most representative of the input signal. For example:

Quantity		*Engineering Units*
Pressure	can be represented in	PSI, KPA, mmHg
Temperature	can be represented in	degrees Celsius, degrees Fahrenheit
Current	can be represented in	amps, mA

User scaling performs this conversion by taking the voltage sensitivity of the channel in millivolts or volts per centimeter and translating this sensitivity into the engineering units specified with the User Scaling Translation Command.

The conversion factors represent the values of the left and right edges of the waveform in the selected channel. The numeric data is printed and/or displayed in tabular columns. Refer to Chapter 6 in the *DASH 10 Operations Manual* for a detailed discussion of numeric conversion for data logging.

turns user scaling of a specified channel on or off. With user scaling turned on, items such as grid labels or data logger units can be represented in user-defined engineering units.

Note: This command is invalid while a data capture is in progress.

Command	[USST] [n],[x] [*]	
Parameters	n = 1 to 30	for the channel number
	x = 0	for user scaling OFF
	1	for user scaling ON
Example	USST 21,1 <lf>	
	turns user scaling on for channel 21.	

Query	[USST?] [n] [*]	
Parameters	n = 1 to 30	for the channel number
Valid Responses	0 for OFF	
	1 for ON	
Example	USST? 21 <lf>	
Sample Response	21,1 <lf>	
	indicates that user scaling is on for channel 21.	

specifies the scale to be used for a channel, when user scaling is in effect. The internal value sets the number of volts that are to correspond to the given external value (the units being measured).

Command [USTR] [n],[a],[b],[u] [*]

Parameters

n	=	1 to 30	for the channel number
a	=	0.001 to 25.0	for the internal scaling value
b	=	0.001 to 999.9	for the external scaling value
u	=	20h to 7Fh	for the units label (1 to 4 ASCII characters within double quotation marks)

Example USTR 3,1.0,10.0,"PSI" <lf>
determines that, for channel 3, one volt represents 10 PSI, when user scaling is enabled.

Query [USTR?] [n] [*]

Parameters n = 1 to 30 for the channel number

Valid Responses n,a,b,u
where: a = 0.001 to 25.0 for the internal value
b = 0.001 to 999.9 for the external value
u = units label

Example USTR? 3 <lf>

Sample Response 03,001.000,010.000,"PSI" <lf>
indicates that, for channel 3, one volt represents 10 PSI.

specifies the offset for a channel, when user scaling is in effect. The offset determines how many external units (the units being measured) are equivalent to 0.0 volts.

Command	[USOS] [n],[x] [*]
Parameters	n = 1 to 30 for the channel number
	x = -999.9 to +999.9 for the offset value
Example	USOS 13,20.0 <lf>
	determines that 0.0 volts represents 20 external units for channel 13, when user scaling is enabled.

Query	[USOS?] [n] [*]
Parameters	n = 1 to 30 for the channel number
Valid Responses	n,x
	where: x = -999.9 to +999.9 for the offset value
Example	USOS? 13 <lf>
Sample Response	13,020.000 <lf>
	indicates that 0.0 volts represents 20 external units for channel 13.

6 Real-Time Operation

The DASH 10 begins operating upon receiving a command from the host computer that causes the recorder to leave the idle state and begin the specified operation. The command sent determines the operation to be performed. Additional commands, also described in this chapter, control the recorder while operating. System parameters can also be changed while the recorder is operating.

Real-Time Recording

You enter the DASH 10 into operation by sending the Start Real-Time Recording (CHRT) Command, which includes the selection of a particular chart format. The DASH 10 will instantly establish the selected chart format, and all parameters associated with that chart, as the new format.

You can alter the current chart format. All DASH 10 system parameters are saved in non-volatile memory. These parameters are remembered when the recorder is powered down and then powered on again.

However, to permanently save an altered format, you must use the DASH 10 front panel soft keys and the procedure described in Chapter 4 of the *DASH 10 Operations Manual*. Refer to Table 4-2 in Chapter 4 for a list of parameters saved with a chart format.

If you want to restore the saved format originally selected, you can use the CHRT Command again.

Saving Recorder Setups

If you wish to save a complete set of DASH 10 system parameters, including all of the chart formats, you must save them to a disk file. Refer to the *DASH 10 Operations Manual* for information on saving to disk.

Modes of Real-Time Operation

The commands that govern the real-time operation of the DASH 10 cover real-time recording, data logging, dual-speed operation, and timed operation.

Real-Time Recording — The DASH 10 records the analog signals as established by the signal input commands described in Chapter 5.

Data Logging — The DASH 10 prints out real-time data in numeric format, in standard units or in units defined by the user. Commands that set user-defined output are described in Chapter 5.

Dual-Speed Operation — In response to a trigger or pre-defined time, the DASH 10 toggles between two pre-set speeds while running in real time.

Timed Operation — The DASH 10 begins running at a pre-set time and continues running until a pre-set ending time.

While under data logger, timed, or dual-speed operation, the DASH 10 still operates according to the parameters established for real-time signal input. When you establish parameters for timed and dual-speed operation, you also select chart formats.

6.1 Real-Time Operation

The commands listed in Table 6-1 enter the DASH 10 into real-time operation, select the chart format, and control recording on both the chart and VF display.

Table 6-1: Real-Time Operation Commands

Header	Function
CHRT	Begin real-time recording in the specified format.
STAR	Start recorder output.
STOP	Stop recorder output.
IDEN	Label the waveforms with numeric identification.
PODB	Print content of on-demand buffer.
DISP	Run or freeze the VF display.
EXIT	Exit real-time recording and return to idle.

Real-Time Operation Queries

Header	Function
STAR?	Is the recorder currently running?
STOP?	Is the recorder currently running?
PODB?	Is the On-Demand Buffer currently printing?
DISP?	Is the VF display currently running?

Start Real-Time Recording Command

begins real-time recording and specifies the chart format:

Command	[CHRT] [x] [*]
Parameters	x = 0 to start recording using the last active chart 1 to 4 to specify a specific chart format
Example	CHRT 1 <lf> begins real-time recording using chart format 1.

Query	[CHRT?] [*]
Parameters	none
Valid Responses	1 to 4 for one of the saved chart formats
Example	CHRT? <lf>
Sample Response	4 <cr><lf> indicates that the current chart format is chart 4.

Start and Stop Commands

control the running of the recorder during operation.

Command	[STAR] [*] or [STOP] [*]
Parameters	none
Example	STAR <lf> starts real-time recording.

Query	[STAR?] [*] or [STOP?] [*]
Parameters	none
Valid Responses	0 for motor is stopped 1 for motor is running
Example	STAR? <lf>
Sample Response	1 <lf> indicates that the motor is running.

can function in two different ways:

- Numeric identification can be printed on all signals to clearly identify which trace represents which input signal. This feature is particularly useful during overlap recording.

- Numeric identification, voltage levels, and right and left grid edges for a specific signal or for all signals can be noted on the chart. If user scaling is active, the numeric information will be in the appropriate user units.

Command [IDEN] [n] [*]

Parameters

n =	0	to print ID only on all channels
	1 to 30	to print ID, voltage level, and right and left grid edges for the specified channel
	31	to print ID, voltage level, and right and left grid edges for all channels

Example IDEN 0 <lf>
causes a numeric ID to print once on each signal as soon as the command is received.

Note: Issuing this command has the same effect as pressing the front-panel ID Button.

(To print numeric IDs automatically, refer to the description of the Automatic Identification Command in Chapter 4.)

causes the content of the on-demand buffer to be printed one time during real-time recording at the location currently specified. The query allows you to determine whether the buffer is currently printing so that you do not interrupt it with another PODB command before printing is done.

Command	[PODB] [*]
Parameters	none
Example	PODB <lf> causes the contents of the on-demand buffer to be printed immediately one time at the location currently specified.

Note: To define the content of the on-demand buffer, use the Edit On-Demand Buffer (EODB) Command, as described in Chapter 4.

Query	[PODB?] [*]
Parameters	none
Valid Responses	0 to indicate the on-demand buffer is not printing 1 to indicate the on-demand buffer is printing
Example	PODB? <lf>
Sample Response	1 <lf> indicates the on-demand buffer is currently printing.

Run/Freeze Display Command

starts or freezes the flow of waveforms on the VF display.

Command	[DISP] [x] [*]
Parameters	x = 0 to run the VF display 1 to freeze the VF display
Example	DISP 0 <lf> causes the VF display to run.

Query	[DISP?] [*]
Parameters	none
Valid Responses	0 indicates the VF display is running 1 indicated the VF display is not running
Example	DISP? <lf>
Sample Response	0 <lf> indicates the VF display is running.

Exit Real-Time Recorder Mode Command

ends real-time recording and returns the recorder to the idle state.

Command	[EXIT] [*]
Parameters	none
Example	EXIT <lf>

6.2 Data Logging

The DASH 10 Data Logger allows discrete real-time data to be printed on the chart in a numerical format. Data can be printed in standard units of voltage, or in user-defined units if user scaling is enabled.

The Real-Time Measurement Query allows the host to ascertain the signal level on the inputs of each channel, just as could be ascertained by viewing the chart during data logging.

The commands listed in Table 6-2 begin and control recording in data logging format.

Table 6-2: Data Logging Commands

Header	*Function*
DLOG	Begin real-time recording in data logging format.
STAR	Start recorder output.
STOP	Stop recorder output.
MEAS	Enter real-time measurement mode.
EXIT	Exit data logging and return to idle.

Data Logging Queries

Header	*Function*
MEAS?	Report to host the current input signal level for a channel, or for all data logger channels.
STAR?	Is the recorder currently running?
STOP?	Is the recorder currently running?

Start Real-Time Data Logging Command

prints the real-time data in a numeric format. The data will print in standard units of voltage, unless user scaling is enabled. With user scaling enabled, the numeric data will follow the user-specified translation.

Command	[DLOG] [*]
Parameters	none
Example	DLOG <lf> begins real-time data logging.

Start and Stop Commands

control the running of the recorder during operation.

Command	[STAR] [*] or [STOP] [*]
Parameters	none
Example	STAR <lf> starts recording.

Query	[STAR?] [*] or [STOP?] [*]
Parameters	none
Valid Responses	0 for motor is stopped 1 for motor is running
Example	STAR? <lf>
Sample Response	1 <lf> indicates that the motor is running.

Enter Real-Time Measurement Mode Command

places the recorder into real-time measurement mode. The Real-Time Measurement Query can then be used to retrieve data logging information.

Command	[MEAS] [*]
Parameters	none
Example	MEAS <lf> enters real-time measurement mode.

Real-Time Measurement Query

reports to the host the level of the current input signal for a single channel or for all data logger channels (up to 8), by returning data to the host in the same format as presented on the chart in data logger mode.

Query	[MEAS?] [n] [*]
Parameters	n = 0 to specify all data logger channels 1 to 30 to specify one of the channels
Valid Responses	the numerical value of the signal (ASCII string), followed by the applicable units as displayed by data logger (If all channels are reporting, data is separated by commas.)
Example	MEAS? 0 <lf>
Sample Response	1.468V,-0.730V,0.880V,1.500KW <lf> indicates the current voltage values for the first three data logging channels, as well as the user-defined value for the fourth data logging channel.

Exit Data Logging Command

ends data logging and returns the recorder to the idle state.

Command	[EXIT] [*]
Parameters	none
Example	EXIT <lf>

6.3 Dual-Speed Operation

Dual-speed operation allows the DASH 10 to be set up to automatically toggle between two different chart speeds while operating in a real-time recording mode. The switch from one speed to the other can be initiated either in response to a trigger or to a specific time.

The dual-speed commands set up the conditions for dual-speed operation and enter the DASH 10 into dual-speed operation. They can be used while the recorder is in real-time operation or while the recorder is idle.

Table 6-3: Dual-Speed Operation Commands

Header	*Function*
DSPD	Set dual speeds.
DSWT	Define whether the timer or a trigger will cause the change from one speed to another.
DDUR	Set the duration of time, if timer is selected.
DREC	Start dual-speed operation.

Dual-Speed Operation Queries

Header	*Function*
DSPD?	What are the two speed settings?
DSWT?	Will the timer or a trigger cause the change from one speed to another?
DDUR?	What is the time duration, if timer is selected?
DREC?	Is dual-speed operation in progress?

determines the two speeds of recorder output under dual-speed operation. If the recorder is already under dual-speed recording, this command will cause a change to the alternate speed at the next switch.

Command [DSPD] [n],[x],[y] [*]

Parameters

n = 1 or 2 to represent the speed number

x = 1 to 200 to represent speed in millimeters per unit of time

y = 1 for millimeters per second

2 for millimeters per minute

Example

DSPD 2,50,2 <lf>

sets speed #2 for 50 millimeters per minute.

Query [DSPD?] [n] [*]

Parameters

n = 1 or 2 to represent the speed number

Valid Responses

n,x,y

where: n = 1 or 2 for the speed number

x = 1 to 200 to represent speed

y = 1 or 2 for unit of time

Example

DSPD? 2 <lf>

Sample Response

2,50,2 <lf>

indicates that speed #2 is set for 50 millimeters per minute.

defines whether the timer or a trigger will cause the change from one speed to the other. If the recorder is already dual-speed recording, this command will take effect immediately.

Command [DSWT] [n],[x] [*]

Parameters
n = 1 for speed #1
2 for speed #2
x = 0 for timer
1 for trigger

Example DSWT 1,0 <lf>
causes recording to switch to speed #1 at the expiration of the time duration specified by the Dual-Speed Duration Command.

Query [DSWT?] [n] [*]

Parameters n = 1 or 2 for speed number

Valid Responses n,x
where: n = 1 for speed number 1
2 for speed number 2
x = 0 for timer
1 for trigger

Example DSWT? 1 <lf>

Sample Response 1,0 <lf>
specifies that recording will switch to speed #1 at the expiration of the time duration specified by the Dual-Speed Duration Command.

defines the durations of each speed if timer is selected.

Command [DDUR] [n],[s] [*]

Parameters
n = 1 for speed #1
2 for speed #2
s = time string in "hh:mm:ss" format (including leading zeroes) to represent the duration

Example
DDUR 1,"01:15:45" <lf>
sets the duration for operation at speed #1 to one hour, 15 minutes, and 45 seconds.

Query [DDUR?] [n] [*]

Parameters
n = 1 or 2 for speed number

Valid Responses
n,s
where: n = 1 for speed number 1
2 for speed number 2
s = time string in "hh:mm:ss" format to represent the duration

Example
DDUR? 1 <lf>

Sample Response
1,"01:15:45" <lf>
indicates that the duration for operation at speed #1 is one hour, 15 minutes, and 45 seconds.

Start Dual-Speed Operation Command

starts dual-speed recording on the DASH 10 Recorder at the first dual speed. Recording will switch to the other speed upon meeting the criteria established by the other dual-speed commands.

Command	[DREC] [*]
Parameters	none
Example	DREC <lf> starts dual-speed operation.

Query	[DREC?] [*]
Parameters	none
Valid Responses	0 for dual-speed operation not active 1 for dual speed #1 is active 2 for dual speed #2 is active
Example	DREC? <lf>
Sample Response	1 <lf> indicates that the DASH 10 is currently operating at speed number 1.

6.4 Timed Operation

Timed operation allows the DASH 10 to be set up to automatically operate between a predefined start time and end time at the speed and in the format specified. Once timed operation has begun, the front panel of the DASH 10 is locked, except for the Local Key.

You activate timed operation simply by issuing the Start Timed Operation (TREC) Command. When timed operation begins, it will be in the format selected via the Timer Chart (TCHT) Command. The other timed operation commands set up the conditions for timed operation and can be used while the recorder is in real-time operation or while the recorder is idle.

Table 6-4: Timed Operation Commands

Header	*Function*
TRUN	Set start time.
THLT	Set stop time.
TCHT	Select chart format for timed output.
TREC	Start timed operation.
EXIT	Abort timed operation.

Timed Operation Queries

Header	*Function*
TRUN?	What is the start time for timed operation?
THLT?	What is the stop time for timed operation?
TCHT?	What is the chart format for timed output?
TREC?	What is the status of timed operation?

Set Start Time Command

specifies the time at which timed recorder operation is to begin. Time is indicated in a 24-hour format.

Command [TRUN] [s] [*]

Parameters s = time string in "mm/dd/yy,hh:mm:ss" format, where:
mm/dd/yy = the date at which timed operation is to begin
hh:mm:ss = the time at which timed operation is to begin

Example TRUN "11/11/94,12:30:00" <lf>
sets the DASH 10 to start timed operation on November 11, 1994 at 12:30 p.m.

Query [TRUN?] [*]

Parameters none

Valid Responses mm/dd/yy,hh:mm:ss

Example TRUN? <lf>

Sample Response "11/11/94,12:30:00" <lf>
indicates that the start date and time for timed operation is November 11, 1994 at 12:30 p.m.

Set Stop Time Command

specifies the time at which timed recorder operation is to end. Time is indicated in a 24-hour format.

Command [THLT] [s] [*]

Parameters s = time string in "mm/dd/yy,hh:mm:ss" format, where:
mm/dd/yy = the date on which timed operation is to end
hh:mm:ss = the time at which timed operation is to end

Example THLT "11/11/94,13:30:00" <lf>
sets the DASH 10 to stop timed operation on November 11, 1994 at 1:30 p.m.

Query	[THLT?] [*]
Parameters	none
Valid Responses	mm/dd/yy,hh:mm:ss
Example	TP? <lf>
Sample Response	"11/11/94,13:30:00" <lf> indicates that the stop date and time for timed operation is November 11, 1994 at 1:30 p.m.

Timer Chart Command

specifies the chart format for recorder output during timed operation.

Command	[TCHT] [x] [*]
Parameters	x = 1 to 4 to specify chart formats 1 through 4
Example	TCHT 2 <lf> selects chart format 2 for recorder output during timed operation.

Query	[TCHT?] [*]
Parameters	none
Valid Responses	1 to 4 for chart formats 1 through 4
Example	TCHT? <lf>
Sample Response	2 <lf> indicates that recorder output during timed operation will be in chart format 2.

Start Timed Operation Command

activates timed operation of the DASH 10 Recorder. When the start time specified equals the current time, recording will begin in the chart format specified by the TCHT Command and will continue until the specified stop time is reached.

Command [TREC] [*]
Parameters none
Example TREC <lf>
activates timed operation.

Query [TREC?] [*]
Parameters none
Valid Responses 0 for timed operation not active
1 for DASH 10 waiting for start time
2 for DASH 10 waiting for stop time
Example TREC? <lf>
Sample Response 1 <lf>
indicates that the DASH 10 is waiting for the start time to begin timed operation.

Timer Abort Command

aborts timed operation of the DASH 10 Recorder, if the timer is running.

Command [EXIT] [*]
Parameters none
Example EXIT <lf>
aborts timed operation.

7

TRIGGERING

Triggers are used primarily to determine how data capture is to be performed, but may also be used to trigger a change in speed during dual-speed recording. Data capture with the DASH 10 refers to the acquisition and storage of real-time waveform data that can be played back immediately or at any later time. Data capture is typically performed by responding to a trigger.

The DASH 10 has a very flexible, built-in, triggering capability that includes:

Manual	Initiated by depressing the Trigger Key on the front panel
Host	Initiated by host command through the GPIB D-shell on the rear panel
External	Generated by TTL pulse or switch closure through the utility D-shell on the rear panel
Waveform	Sensed in the rise and/or fall of signal levels
Periodic	Generated automatically and continuously at specified time intervals
Clock	Initiated at a specific date and time

This chapter details the commands that determine the conditions that must be met to generate a trigger.

Table 7-1 lists the Triggering commands and queries. For more information on triggers, data capture, and playback, refer to the *DASH 10 Operations Manual*.

Table 7-1: Trigger Setup Commands

Header	Function
TRGS	Define trigger sources.
*TRG	Initiate a trigger from the host computer.
SPER	Set time interval for a periodic trigger.
CLKT	Enable/disable clock triggering and specify a specific date and time that a trigger is to occur.
TRLV	Define levels for a waveform trigger.
TAND	Associate channels in an "and" relationship.
TROR	Associate channels or a group of channels in an "or" relationship.

Trigger Setup Queries

Header	Function
TRGS?	What are the trigger source(s)?
SPER?	What is the time interval for a periodic trigger?
CLKT?	Is clock triggering enabled? If so, at what specific date and time will a trigger occur?
TRLV?	What are the levels for a waveform trigger?
TAND?	Which channels are associated in an "and" relationship in a particular group?
TROR?	Which channels are associated in an "or" relationship?

These commands allow you to:

- determine the sources of a trigger, that is , the methods allowed for trigger generation
- define voltage levels above or below which the input signal will cause a trigger condition
- set up simple equations that allow channels to interact in the generation of triggers

Trigger Source Command

defines the active source of a trigger, which is a mechanism that enables the recorder either to begin operation or alter operation in response to various stimuli. Trigger sources enabled via the Trigger Source Command are:

- manual — initiated by depressing the Trigger Key on the front panel
- host — initiated by host command through the GPIB D-shell on the rear panel
- external — generated by TTL pulse or switch closure through the utility D-shell on the rear panel
- waveform — sensed when a defined signal level is met or exceeded
- periodic — generated automatically and continuously at specified time intervals

Command [TRGS] [m],[h],[e],[w],[p] [*]

Parameters

m	=	1	for manual trigger on
		0	for manual trigger off
h	=	1	for host trigger on
		0	for host trigger off
e	=	1	for external trigger on
		0	for external trigger off
w	=	1	for waveform trigger on
		0	for waveform trigger off
p	=	1	for periodic trigger on
		0	for periodic trigger off

Example TRGS 1,0,0,0,1 <lf>
enables manual and periodic triggers only (in an "or" relationship). That is, either of these conditions individually will cause a trigger.

Query [TRGS?] [*]

Parameters none

Valid Responses 1 or 0 for each source

Example TRGS? <lf>
Sample Response 1,0,0,0,1 <lf>
indicates that manual and periodic triggers only are enabled.

Note: Waveform triggers are enabled or disabled by the Trigger Level Setup (TRLV) or the "Or" Channel (TROR) Command.

Host Trigger Command

initiates a trigger from the host computer under either RS-232 or GPIB, provided that the host trigger is enabled by the Trigger Source (TRGS) Command.

Note: A host trigger can also be caused by the GPIB group execute trigger (GET) function. Refer to Chapter 2.

Command [*TRG] [*]
Parameters none
Example *TRG <lf>
causes a system trigger if host triggering is enabled by the Trigger Source Command.

Periodic Trigger Command

sets the time interval at which a periodic trigger will occur (when periodic triggering is enabled).

Command [SPER] [s] [*]
Parameters s = time string in "hh:mm:ss" format with quotation marks
Example SPER "00:30:00" <lf>
causes a trigger to occur every 30 minutes when periodic triggering is enabled.

Query	[SPER?] [*]
Parameters	none
Valid Responses	time string in "hh:mm:ss" format
Example	SPER? <lf>
Sample Response	"00:30:00" <lf> indicates that a trigger will occur every 30 minutes when periodic triggering is enabled.

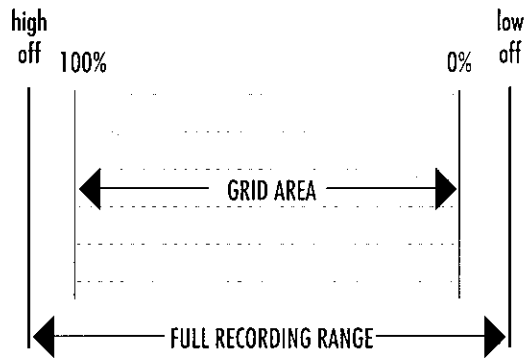
Clock Trigger Command

enables clock triggering and sets a specific date and time that a trigger will occur.

Command	[CLKT] [n],[d],[t] [*]
Parameters	n = 0 for off = 1 for on d = string for date in "mm/dd/yy" format, with quotation marks t = time string in "hh:mm:ss" format, with quotation marks
Example	CLKT 1,"04/17/96","10:30:00" <lf> enables clock triggering and sets 10:30 A.M. on April 17, 1996 as the time that a trigger will occur.

Query	[CLKT?] [*]
Parameters	none
Valid Responses	date/time string
Example	CLKT? <lf>
Sample Response	1,"04/17/96","10:30:00" <lf> indicates that clock trigger is enabled and a trigger will occur at 10:30 A.M. on April 17, 1996.

defines the voltage levels at which a signal will create a trigger condition. Voltage levels are specified as percentages of the recording range, within the grid, in 1% increments. Levels range from 0% (right edge of grid) to 100% (left edge of grid). If you choose to turn the high level and/or low level off, the trigger level can be outside the grid, using the full recording range.



You also choose whether a trigger will occur when the signal crosses the trigger level and is outside of the specified range or when the signal crosses the trigger level and is inside the specified range.

The waveform trigger itself will not become active unless a waveform trigger has been selected and is part of the trigger equation. This is determined by how the specific channel is set up by the trigger equations, defined by the "And" Group Select (TAND) and "Or" Group (TROR) Commands. Refer to the following section on "Trigger Logic" for descriptions of the TAND and TROR Commands.

Command [TRLV] [n],[w],[h],[l] [*]

Parameters

n	=	1 to 30	for the active channel
w	=	0	inside (inclusive)
		1	outside (exclusive)
h	=	0 to 100	in 1% increments for high level
		-1	for high level OFF
l	=	0 to 100	in 1% increments for low level
		-1	for low level OFF

Example 1 TRLV 10,1,55,45 <lf>
sets channel 10 to trigger when the amplitude of a signal progresses higher than 55% or falls below 45% of the grid size of channel 10.

Example 2 TRLV 10,0,55,45 <lf>
sets channel 10 to trigger when the amplitude of a signal falls between 55% and 45% of the grid size of channel 10.

Query [TRLV?] [n] [*]

Parameters

n	=	1 to 30	for the channel number

Valid Responses n,w,h,l
where:

n	=	1 to 30	for the active channel
w	=	0	inside (inclusive)
		1	outside (exclusive)
h	=	0 to 100	in 1% increments for high level
		-1	for high level OFF
l	=	0 to 100	in 1% increments for low level
		-1	for low level OFF

Example TRLV? 10 <lf>

Sample Response 1 10,1,55,45 <lf>
indicates that channel 10 is set to trigger when the amplitude of a signal progresses higher than 55% or falls below 45% of the grid size of channel 10.

Sample Response 2 10,0,55,45 <lf>
indicates that channel 10 is set to trigger when the amplitude of a signal falls between 55% and 45% of the grid size of channel 10.

Note: To turn waveform triggering off, use the Trigger Source Command (TRGS).

Trigger Logic

The following two commands permit the application of "and/or" logic to establishing triggers. An expanded discussion of trigger logic can be found in the *DASH 10 Operations Manual*.

The *"And" Group Select Command* allows you to identify a group that contains from one to ten channels. Channels grouped in this manner must *all* satisfy a condition in order for a trigger to occur.

The *"Or" Group Command* can then be used to connect the "And" group or individual channels through "or" logic, thereby producing the final trigger equation. Items related in this manner can *individually* satisfy a condition in order for a trigger to occur. Though slightly complex, using "and/or" logic in this manner permits a large number of trigger combinations.

specifies which channels on a board are grouped together as trigger sources. The group will generate a trigger if the trigger conditions for each channel are met simultaneously.

The board number determines which group of ten channels are used. Board #1 uses channels 1 to 10; board #2 uses channels 11 to 20; board #3 uses channels 21 to 30.

Command [TAND] [b],[w1],[w2],[w3],[w4],[w5],[w6],[w7],[w8],[w9],[w10] [*]
Parameters b = 1 to 3 for the board number
w1 — w10 = 0 to exclude from "and" group
1 to include in "and" group
Example TAND 3,0,0,0,1,0,0,0,1,0,0 <lf>
identifies channels 24 and 28 as triggers related with "and" logic. That is, a trigger occurs when both channels 24 and 28 simultaneously generate trigger conditions.

Query [TAND] [b] [*]
Parameters b = 1 to 3 for the board number
Valid Responses b,w1,w2,w3,w4,w5,w6,w7,w8,w9,w10
Example TAND? 3 <lf>
Sample Response 3,0,0,0,1,0,0,0,1,0,0 <lf>
indicates that channels 24 and 28 are related with "and" logic. That is, a trigger occurs when both channels 24 and 28 simultaneously generate trigger conditions.

specifies which individual channels or the group of channels selected as the "and" group will be associated with "or" logic.

Command
[TROR] [b],[w1],[w2],[w3],[w4],[w5],[w6],[w7],[w8],[w9],[w10],[a] [*]

Parameters
b = 1 to 3 for the board number
w1 — w10 = 0 for waveform trigger disabled
1 for waveform trigger enabled
a = 0 to exclude "and" group from trigger equation
1 to include "and" group as part of the equation

Example
TROR 2,0,1,0,0,0,0,0,0,1,0,1 <lf>
establishes the "and" group and channels 12 and 19 as related with "or" logic. That is, if *either* the "and" group *or* channel 12 *or* channel 19 meets the trigger conditions, a trigger will occur.

Query
[TROR] [*]

Parameters
b = 1 to 3 for the board number

Valid Responses
b,w1,w2,w3,w4,w5,w6,w7,w8,w9,w10,a
where:
b = 1 to 3 for the board number
w1 — w10 = 0 for waveform trigger disabled
1 for waveform trigger enabled
a = 0 to exclude "and" group from trigger equation
1 to include "and" group as part of the equation

Example
TROR? 2 <lf>

Sample Response
2,0,1,0,0,0,0,0,0,1,0,1 <lf>
indicates that the "and" group and channels 12 and 19 are related with "or" logic. That is, if *either* the "and" group *or* channel 12 *or* channel 19 meets the trigger conditions, a trigger will occur.

8

DATA CAPTURE (DASH 10 W/DATA CAPTURE OPTION REQUIRED)

In order to capture data, the DASH 10 must be equipped with data-capture memory and software.

With the Data Capture Option installed, the DASH 10 provides each channel with 768 kSamples of volatile, static RAM for data capture. The waveform input signal boards each contain 6 megasamples of volatile memory for the storage of data capture records. This means that a DASH 10 with three analog waveform boards can be equipped with a maximum of 18 megasamples of data-capture record storage.

Note: When capturing data, it is important to keep in mind that data-capture memory is volatile. If you want to retain the data, it is essential to store data-capture records to nonvolatile media such as floppy disks or to upload the data to the host computer. Automatic archiving to disk is an option when setting up data capture. If captured data is not stored to nonvolatile media, the data will be lost if power to the recorder is interrupted or if the recorder is shut off.

8.1 Data Capture Setup

Data capture with the DASH 10 refers to the acquisition and storage of real-time waveform data. Since the data being captured is the real-time waveform data, data capture occurs under the parameters established for real-time recording at the time of the capture.

All data capture occurs "in the background" — meaning that the ongoing active real-time mode is not interrupted and no real-time data is lost. Data capture can occur either during real-time operation or while the DASH 10 is in the idle state. Once the system is armed, data capture can be initiated immediately upon being armed, or upon meeting pre-established trigger criteria.

Once data has been captured, it can be saved for subsequent analysis. You can archive (save) the data to disk in the DASH 10 disk drive or to the host computer through the DASH 10's upload capability.

Note 1: In order to perform data capture and playback, the DASH 10 must have been purchased with at least one board containing the data capture option.

Note 2: Data capture memory is volatile. Records will be lost when the recorder is turned off. If you want to retain the captured data, you must save records to disk or upload them to the host computer.

Each bank of 10 channels is independent, allowing three different sets of data capture parameters to be established. When sending the host control commands, you specify which bank (board 1, 2, or 3) is being set.

Data Capture Record

Depending upon whether a data capture board is set up for segmented or non-segmented memory, one data capture board can hold either one 6-megaword (6-megasample) record or eight 768-kWord (768-kSample) records.

The number of samples per channel stored in a record depends upon the number of channels captured:

$$\text{\# of samples per channel} = \frac{\text{size of the record}}{\text{\# of channels captured}}$$

For example, one non-segmented record with 11 channels captured contains 558 kilosamples per channel. One segmented record with 11 channels captured contains 69 kilosamples per channel. The following table shows the relation between number of channels captured and the number of samples per channel.

Channel	Samples per Channel	
	segmented	non-segmented
1	768k	6144k
2	384k	3072k
3	256k	2048k
4	192k	1536k
5	153k	1228k
6	128k	1024k
7	109k	877k
8	96k	768k
9	85k	682k
10	76k	614k
11	69k	558k

Single Board Record

Each data capture board is capable of capturing data independent of the others. Therefore, you can set up and enable each board separately. Board 1 refers to channels 1 to 10; board 2 refers to channels 11 to 20; board 3 refers to channels 21to 30.

Each board can capture data simultaneously, but can support different settings (sample rate, trigger in record, number of channels, etc.). Each board will produce a separate record, identified as REC-BRD, where REC is the record number and BRD is the board number. The record number can be 1 to 8, and the board number can be 1 to 3. For example, in a thirty-channel system with three boards enabled, a data capture will produce three records — one from each board: 1-1, 1-2, and 1-3.

Linked Boards Record

In order to capture 20 or 30 channels, the boards must be linked. When boards are linked, the DASH 10 will capture to all boards enabled, but produce a single record.

In order to enable the link, each enabled board must be set to the same sample rate, trigger in record, number of channels, and record size. A linked record is identified as REC-BRD,BRD,BRD, where REC is the record number of the first linked board and BRD is the linked board numbers. The record number can be 1 to 8, and the board numbers can be 1 to 3. For example, in a thirty-channel system with three boards enabled and linked, a data capture will produce one record spanning all three boards: 1-1,2,3.

To perform data capture with the DASH 10, you must set up the system to function as you wish, by using the following sequence of procedures:

1 **Set Up Data Capture**
Use the commands described in this chapter to set up data capture.

2 **Arm The System**
To begin data capture, the system must be armed. The system can be armed manually or automatically. If manual re-arming is selected by the Data Capture Re-Arm (CCON)Command, you can arm the system by pressing the ARM Key on the DASH 10 front panel (if under local control), or by issuing the host command to arm the system (if under host control). If automatic re-arming is selected by the Data Capture Re-Arm Command, the system will re-arm automatically immediately upon completion of the previous data capture or playback.

3 **Initiate Data Capture**
Once armed for data capture, the system can begin data capture immediately upon being armed, or upon meeting trigger criteria, depending on the trigger/window relationship. Triggers can be generated as set by the commands described in Chapter 7.

4 **Determine Use of Captured Data**
Captured data can be stored and played back as you wish. Data playback is discussed in Chapter 9.

Table 8-1: Data Capture Setup Commands

Header	Function
CBRD	Enable/disable data capture for a board.
CLNK	Link records on boards that have data capture enabled.
ATRG	Enable/disable automatic trigger upon arming the system.
CCON	Set data capture options regarding arming, playback, and archiving.
SRAT	Set the sample rate for data capture.
RSIZ	Define record size.
TRCD	Define the trigger/window relationship.
CAPC	Select waveforms or events to be captured each sample period.
EREC	Delete specified records from data capture memory.

Data Capture Setup Queries

Header	Function
CBRD?	Is data capture enabled for a board?
CLNK?	Are records on boards that have data capture linked?
ATRG?	Will a trigger be automatically generated upon arming the system?
CCON?	Which data capture option is currently in effect?
SRAT?	What is the sample rate for data capture?
RSIZ?	What is the current size of a record?
TRCD?	What is the trigger/window relationship?
CAPC?	Which waveforms or events are to be captured each sample period?
RINF?	Report on the status of a particular data capture record.
CINF?	Report on captured records.

Set Capture Board Status

enables or disables a board for data capture.

Note: If the board is enabled and link is enabled, the system tests for valid link parameters. If parameters are not valid, link status will be disabled.

Command [CBRD] [b],[s] [*]
Parameters b = 1 to 3 for the board number
s = 0 for disable board
1 for enable board
Example CBRD 2,1 <lf>
enables board 2 for data capture.

Query [CBRD?] [b] [*]
Parameters b = 1 to 3 for the board number
Valid Response b,s
where: s = 0 for board disabled
1 for board enabled
Example CBRD? 2 <lf>
Sample Response 2,1 <lf>
indicates that board 2 is enabled for data capture.

Set Capture Board Link Status

links records on enabled boards. In order to link records, the sample rate, number of channels, and trigger position must all be the same. If this is not the case, an execution error will occur (the EXE bit in the ESR Register will be set on).

Command [CLNK] [s] [*]
Parameters s = 0 for disable link
1 for enable link
Example CLNK 1 <lf>
enables link for data capture among enabled boards.

Query [CLNK?] [*]
Parameters none
Valid Response s = 0 for link disabled
1 for link enabled
Example CLNK? <lf>
Sample Response 1 <lf>
indicates that link among enabled boards is enabled.

Auto-Trigger Control Command

enables or disables the DASH 10 to generate a trigger immediately upon being armed for data capture.

Command [ATRG] [x] [*]
Parameters x = 0 for immediate trigger disabled
1 for immediate trigger enabled
Example ATRG 0 <lf>
sets the DASH 10 to generate a trigger immediately upon being armed for data capture.

Query [ATRG?] [*]
Parameters none
Valid Response 0 for immediate trigger disabled
1 for immediate trigger enabled
Example ATRG? <lf>
Sample Response 0 <lf>
indicates that the DASH 10 is set to generate a trigger immediately upon being armed for data capture.

sets the DASH 10 for the following data capture options:

SINGLE RECORD ONLY —

Select this option to perform a data capture without automatically playing back the data or re-arming the system for another data capture. Upon arming the system, single records are acquired without data playback and without interrupting real-time recording. Acquisitions are individually added to the inventory of records in system memory.

SINGLE RECORD WITH PLAYBACK —

If you wish to automatically play back data upon completion of a data capture, select this option. Upon arming the system, single records are acquired. Playback immediately follows capture completion. Real-time recording is aborted during playback and the record is retained in the inventory of records in the system.

SINGLE RECORD WITH ARCHIVE —

If you wish to automatically archive data to disk upon completion of a data capture, select this option. Upon arming the system, single records are acquired, and are archived immediately upon capture completion.

SINGLE RECORD WITH PLAYBACK AND ARCHIVE —

If you wish to automatically archive and play back data upon completion of a data capture, select this option. Upon arming the system, single records are acquired. Data archival immediately follows capture completion, with playback following archival. Real-time recording is aborted during playback and the record is retained in the inventory of records in the system.

MULTI-CAPTURE —

The multi-capture option re-arms the DASH 10 for another data capture upon completion of a data capture. Multiple records are captured one after another, until data capture memory is full. Playback is not automatic. Records are saved in memory for later manipulation.

MULTI-CAPTURE WITH PLAYBACK —

This option sets up continuous data capture and playback. Records are acquired, played back, and deleted. Subsequent acquisitions are captured under the same record number. Records are not saved.

MULTI-CAPTURE WITH OVERWRITE —

Like the normal multi-capture option, multiple records are captured one after another. However, when memory is full, capture will continue, overwriting the previously captured data. This results in the most recently captured 7 or 8 records being stored, rather than the first 7 or 8 as with normal multi-capture. Playback is not automatic.

STACKED MULTI-CAPTURE WITH PLAYBACK —

Like normal multi-capture with playback, this option sets up continuous data capture and playback, until memory is full. However, captured records are not deleted after they are played back. The records will exist both in data capture memory and on paper.

If one of the automatic archive options is chosen, it will work only once. If "single capture with automatic archive" is chosen, the capture control method will change to "single data capture" after the capture and archival are completed. If "single capture with automatic playback and archive" is chosen, the capture control method will change to "single data capture with automatic playback" after the capture and archival are completed. If you want another automatic archival, the feature will have to be re-enabled by host command.

Command [CCON] [x] [*]

Parameters x = 0 for single capture
1 for single capture with automatic playback
2 for single capture with automatic archive
3 for single capture with automatic playback and archive
4 for multiple sequential data captures (that is, re-arm after completion of a data capture)
5 for multiple sequential data captures with automatic playback
6 for continuous multiple sequential data captures, with overwriting of data when memory is full
7 for stacked multiple sequential data captures with automatic playback

Example CCON 1 <lf>
sets DASH 10 to automatically play back data upon completion of a data capture.

Query [CCON?] [*]

Parameters none

Valid Response 0 for single capture
1 for single capture with automatic playback
2 for single capture with automatic archive
3 for single capture with automatic playback and archive
4 for multiple sequential data captures (that is, re-arm after completion of data capture)
5 for multiple sequential data captures with automatic playback
6 for continuous multiple sequential data captures, with overwriting of data when memory is full
7 for stacked multiple sequential data captures with automatic playback

Example CCON? <lf>

Sample Response 1 <lf>
indicates that the DASH 10 will automatically play back data upon completion of a data capture.

Automatic Archiving

When a diskette is used to archive a data capture record, there are storage limitations because of the size of the diskette, which holds 1.4 Mb of data. The smallest record that the DASH 10 will capture is 1.5 Mb. The amount of a record that will fit on a diskette depends on the record size per board and the number of linked boards.

The following table allows you to quickly ascertain the percentage of a record that would be archived, assuming a board with 11 channels enabled.

Record Size	Boards	Samples/channel	% of Record	Bytes Archived
11 x 69k	1	66212	93%	1457662
11 x 69k	2	33106	46%	1457662
11 x 69k	3	22070	31%	1457618
11 x558k	1	66212	12%	1457662
11 x558k	2	33106	6%	1457662
11 x558k	3	22070	4%	1457616

Automatic archiving uses the following criteria to determine which record and the portion of the record to be stored:

Record Always the last record captured. If more than one record is captured simultaneously from non-linked boards, the record on the lowest numbered board will be archived.

File Name Always 'ARCHIVE.DCR'. The auto-archive feature will not overwrite this file. To archive another record, auto-archive must be re-enabled and a new diskette supplied.

Window Always uses the maximum number of free bytes on the diskette. The trigger location of the captured record determines the portion of the record saved. For example, if only 46% of the record will fit on the diskette, a start trigger would cause 0 to 46% of the record to be archived, a center trigger 27 to 73%, and an end trigger 54 to 100%.

Channel All channels captured will be archived.

To ensure the safe storage of data to diskette:

1 Make sure that a blank diskette is readily available after the auto-archive feature is enabled.

2 Ensure that WRITE PROTECT is disabled on the diskette.

3 After the archive is completed, remove the diskette and enable WRITE PROTECT.

selects a sample rate specified as a frequency in Hz or kHz, which in turn corresponds to time per millimeter of data playback (non-expanded, that is, times 1). Selections are as follows:

selection #	*sample rate*	*timebase*
0	250 KHz	4 µs
1	125 KHz	8 µs
2	50 KHz	20 µs
3	25 KHz	40 µs
4	10 KHz	100 µs
5	5 KHz	200 µs
6	2.5 KHz	400 µs
7	1 KHz	1 ms
8	500 Hz	2 ms
9	250 Hz	4 ms
10	100 Hz	10 ms
11	50 Hz	20 ms
12	25 Hz	40 ms
13	10 Hz	100 ms
14	5 Hz	200 ms

Command [SRAT] [b],[r] [*]
Parameters b = 1 to 3 for the board number
r = 0 to 14 for the sample rate selection number
Example SRAT 1,2 <lf>
sets the sample rate for board 1 to 50 KHz, resulting in 1 millimeter of data playback in 20 µs.

Query [SRAT?] [b] [*]
Parameters b = 1 to 3 for the board number
Valid Response b,r
where: r = 0 to 14 for selection number
Example SRAT? 1 <lf>
Sample Response 0,2 <lf>
indicates that the sample rate for board 1 is set to 50 KHz.

defines the type of memory for data capture records: segmented or non-segmented. The size of each data capture record is further determined by the number of channels being captured.

Non-segmented capture uses all of the memory on a board (6 megasamples). Segmented capture divides the memory into eight 768-kilosample segments. The total number of samples captured in either of these types depends upon the number of channels captured. The total number of samples in a non-segmented capture is 6 megasamples, divided by the number of channels. The total number of samples in a segmented capture is 768 kilosamples, divided by the number of channels.

Command	[RSIZ] [b],[t] [*]
Parameters	b = 1 to 3 for the board number
	t = 0 for non-segmented memory
	1 for segmented memory
Example	RSIZ 2,0 <lf>
	sets board 2 for non-segmented data capture memory.

Query	[RSIZ?] [b] [*]
Parameters	b = 1 to 3 for the board number
Valid Response	1 to 3
Example	RSIZ? 2 <lf>
Sample Response	2,0 <lf>
	indicates that board 2 is set for non-segmented data capture memory.

locates the trigger within the captured window (record), thereby selecting the data that is to be captured in the record. If data is captured beginning at a trigger, all data is post-trigger. If only the data that occurred before a trigger is captured, all data is pre-trigger. To capture both pre-trigger and post-trigger data, specify the portions of each to be captured.

Trigger location within the window is set by specifying the percentages of pre-trigger and post-trigger data to be captured. For example, to record all post-trigger data, specify 0%; to record half pre-trigger and half post-trigger data, specify 50%; to record all pre-trigger data, specify 100%. Figure 8-1 illustrates some of the possible trigger/window relationships.

Command	[TRCD] [b],[x] [*]
Parameters	p = 1 to 3 for board number x = 0 to 100% in 1% intervals
Example	TRCD 1,25 <lf> sets board 1 to fill 25% of a record with data that occurred just prior to a trigger and the remaining 75% with data that occurs after the trigger.

Query	[TRCD?] [b] [*]
Parameters	b = 1 to 3 for board number
Valid Response	b,x where: x = 0 to 100% in 1% intervals
Example	TRCD? 1 <lf>
Sample Response	1,025 <lf> indicates that board 1 will fill 25% of a record with data that occurred just prior to a trigger and the remaining 75% with data that occurs after the trigger.

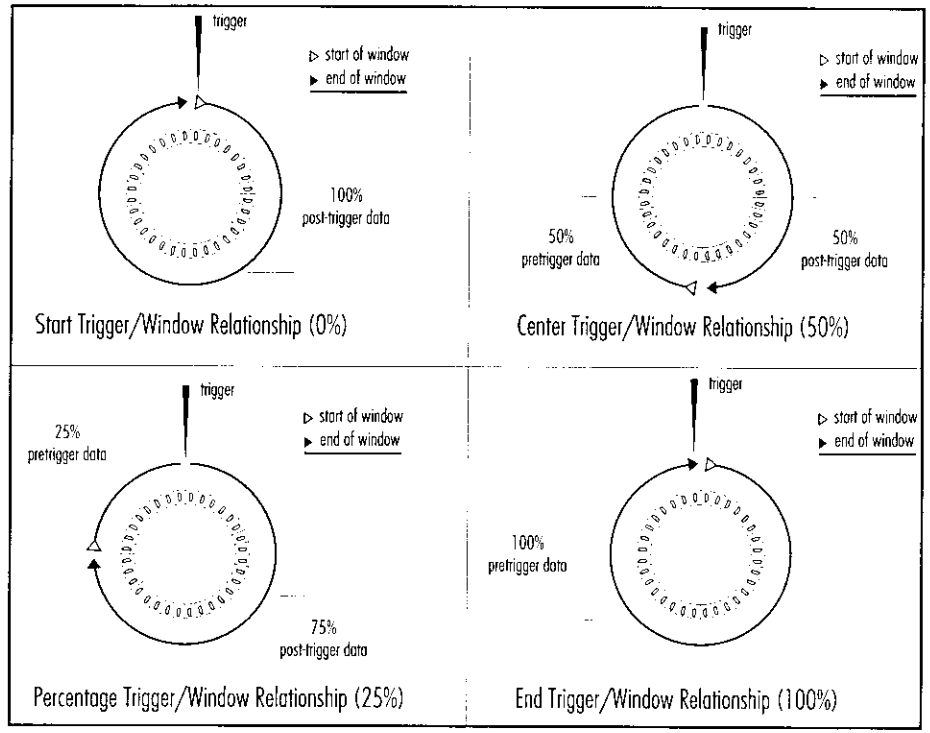


Figure 8-1: Sample Trigger/Window Relationships

selects which waveforms and events will be captured each sample period.

Command [CAPC] [b],[c] [*]

Parameters
b = 1 to 3 for board number
c = a decimal number whose binary representation is defined with 0 = off and 1 = on, as follows:
bit 0 = events
bit 1 = channel 1
bit 2 = channel 2
bit 3 = channel 3
bit 4 = channel 4
bit 5 = channel 5
bit 6 = channel 6
bit 7 = channel 7
bit 8 = channel 8
bit 9 = channel 9
bit 10 = channel 10

Example
CAPC 2,2047 <lf>
enables all signals and events to be captured on board 2.

(That is, 2047 = 7FF Hex = 0111 1111 1111).

Bit 10 Bit 0

Query [CAPC?] [b] [*]

Parameters
b = 1 to 3 for board number

Valid Responses
b,c
where: c = decimal number indicating channel and event status

Example
CAPC? 2 <lf>

Sample Response
2,2047 <lf>
indicates that all signals and events are to be captured on board 2.

Erase Record Command

erases a data capture record.

Command	[EREC] [b],[r] [*]
Parameters	b = 1 to 3 for board number
	r = 1 to 8 for the record number
Example	EREC 1,4 <lf>
	erases record 4 on board 1.

Note: If sent while a data capture is in progress, this command will result in an execution error.

Request Record Information

creates a data string that can be interpreted to report on the status of a particular data capture record, as well as on the amount of storage remaining for additional captures.

Query	[RINF?] [b],[r] [*]
Parameters	b = 1 to 3 for board number
	r = 1 to 8 for record number
Valid Responses	b,r,t,d,sr,s,se,cl1,cl2,cl3
	where: t = ("hh:mm:ss") for the time, always 8 characters between quotation marks
	d = ("mm/dd/yy") for the date, always 8 characters between quotation marks
	sr = 0 to 14 for the sample rate (2 digits)
	s = number of samples in record (7 digits)
	se = 0 for non-segmented memory
	1 for segmented memory
	cl1—cl3 = three decimal numbers whose binary representations define channels and events captured for each board, as described for the CAPC Command (0 = not captured; 1 = captured)
Example	RINF? 2,3 <lf>
Sample Response	2,3,12:16:32,11/23/94,10,0157286,1,0000,2047,0000 <lf>
	indicates that the third record on board 2 was captured on November 23, 1994 at 12:16:32. The sample rate was 100 Hz, collecting 157,286 samples into segmented memory from channels 1,2,3,4,5,6,7,8,9,10, plus events.

creates a data string that can be interpreted to report on the number of captured records on any specific board. Information returned states:

- number of records captured
- whether the board is full
- list of records captured

Query [CINF?] [b] [*]

Parameters b = 1 to 3 for board number

Valid Responses b,c,a,s,r

where:

c = number of records captured on board

a = number of records available for capture

s = 0 for board not full

1 for board full

r = 0 to 255 for the record list, a decimal number whose binary representation is defined with 0 = not captured; 1 = captured, as follows:

(bit 0 = record 1 — bit 7 = record 8)

Example CINF? 2 <lf>

Sample Response 2,4,2,0,180 <lf>

indicates that board 2 is not full, with 4 records captured and 2 available. Records 3, 5, 6, and 8 were captured.

That is: 180 = B4 Hex = 1011 0100

Bit 7 Bit 0

8.2 ARM DATA CAPTURE

Data capture can occur either during real-time operation or while the DASH 10 is in the idle state. Data capture can occur automatically if the system has been set up to do so. The following commands allow you to manually arm the system for a data capture, to abort any data captures in progress, and to report on the status of a data capture in progress.

Since data capture can take a noticable amount of time to complete, you may want to synchronize this operation with the host program. You can do so by using the Operation Complete Command or Query or the Wait Command. Refer to the explanation of device synchronization in Chapter 3 for information on using these commands.

Table 8-2: Data Capture Commands

Header	*Function*
ARMC	Arm system for data capture.
ARMA	Abort data capture.

Data Capture Query

Header	*Function*
ARMC?	Is the system armed for data capture? If so, is a data capture in progress? If so, at what point is the capture now?

Note: When arming the system for data capture, an execution error will result under the following conditions:

- the DASH 10 does not contain a board with the data capture option.
- a data capture is already in progress.
- insufficient memory remains for data capture.

Arm Capture Command

arms the DASH 10 for data capture.

Command	[ARMC] [*]
Parameters	none
Example	ARMC <lf> arms the DASH 10 for data capture.

Query	[ARMC?] [*]
Parameters	none
Valid Responses	0 for not armed 1 for pre-trigger 2 for post-trigger
Example	ARMC? <lf>
Sample Response	1 <lf> informs that a data capture is currently in progress and is in the pre-trigger state.

Arm Abort Command

aborts all data captures currently in progress.

Command	[ARMA] [*]
Parameters	none
Example	ARMA <lf> aborts all data captures.

9

DATA PLAYBACK (DASH 10 W/DATA CAPTURE OPTION REQUIRED)

Data playback refers to the playing out of data captured during a data capture. The data can be played out in waveform-versus-time format or in X/Y (waveform-versus-waveform) format. An FFT analysis capability is also available.

Data can be played out either:

- on the chart
- on the front-panel VF Display
- on both the chart and VF Display

Prior to playing out captured data, you must determine how the data will be represented and set up the playback parameters accordingly. During playback, the currently established playback setup parameters determine the format.

Note: In order to perform data capture and playback, the DASH 10 must have been purchased with at least one board containing the data capture option.

9.1 Playback Setup

The *Playback Setup Commands* determine how data will be played out during data playback. Table 9-1 lists the Playback Setup commands and queries.

Table 9-1: Data Playback Setup Commands

Header	Function
PDEV	Set playback data to print on the chart, on the VF Display, or on both.
PMRK	Specify whether the full-page trigger mark will be printed during data playback.
PFMT	Select the format in which data is to be played back.
PWIN	Determine the portion of a particular record that will be played back.
TEXP	Select magnification factor to control the expansion or compression of data during playback.
XYCH	Select channels to be used when plotting in X/Y or X/YY format on a square grid.
XYFT	Select the format, grid, and line style for X/Y or X/YY plots.
PRPT	Enable/disable printing of a Record Analog Settings Report before playback data.

Data Playback Setup Queries

Header	*Function*
PDEV?	Will playback data print on the chart, on the VF Display, or on both?
PMRK?	Will the full-page trigger mark will be printed during data playback?
PFMT?	In which format will data be played back?
PWIN?	Which portion of a particular record will be played back?
TEXP?	What is the magnification factor of data to be played back?
XYCH?	Which channels are to be used when plotting in X/Y or X/YY format on a square grid?
XYFT?	Which format, grid, and line style are selected for X/Y or X/YY plots?
PRPT?	Is printing of a Record Analog Settings Report before playback data enabled?

Playback Device Command

selects the destination for data playback to either the chart, the VF Display, or both.

Command [PDEV] [x] [*]

Parameters
x = 0 for playback to chart and VF Display
1 for playback to chart only
2 for playback to VF Display only

Example PDEV 1 <lf>
sets data to be played back on the chart only.

Query	[PDEV?] [*]
Parameters	none
Valid Responses	0 for playback to chart and VF Display 1 for playback to chart only 2 for playback to VF Display only
Example	PDEV? <lf>
Sample Response	1 <lf> indicates that data will be played back on the chart only.

Playback Trigger Mark Command

specifies whether the full-page trigger mark will be printed during data playback.

Command	[PMRK] [s] [*]
Parameters	x = 0 to disable printing of the trigger mark 1 to enable printing of the trigger mark
Example	PMRK 1 <lf> enables printing of the trigger mark during playback.

Query	[PMRK?] [*]
Parameters	none
Valid Responses	0 for printing of the trigger mark disabled 1 for printing of the trigger mark enabled
Example	PMRK? <lf>
Sample Response	1 <lf> indicates that printing of the trigger mark during playback is enabled.

Playback Format Command

selects the format in which data is to be played back. When the system is set up, there are four chart formats available. In addition, you can also choose to play back data with channels plotted against each other in the form of an X/Y grid. Refer to the discussion of the X and Y Channels (XYCH) Command.

Command	[PFMT] [x] [*]	
Parameters	x = 1 to 4	for one of the saved chart formats
	5	for X/Y format
	6	for numeric playback
Example	PFMT 5 <lf>	
	selects the X/Y format for data playback.	

Query	[PMFT?] [*]	
Parameters	none	
Valid Response	1 to 4	for one of the saved chart formats
	5	for X/Y format
	6	for numeric playback
Example	PMFT? <lf>	
Sample Response	5 <lf>	
	indicates that data will be played back in X/Y format.	

Note: If none of the saved chart formats are appropriate to the data being played back, you may have to establish a new format or download a saved format from disk.

determines the sample periods (that is, portion of a particular record) that will play back. A sample period contains one sample for each of the enabled channels. The starting sample period can be between 1 and one less than the highest sample period captured in the selected record. The ending period must not be less than the starting sample period. Refer to the description of the Request Record Information Query for details on obtaining the number of sample periods stored.

Alternatively, the window can be specified in terms of time or percentage of the record.

Command [PWIN] [x],[y],[u] [*]

Parameters
x = 1 to 6291456 for the start of the window
y = 1 to 6291456 for the end of the window
u = 0 for number of samples
1 for time period (µsec)
2 for percentage of record

Example
PWIN 1,2048 <lf>
sets the DASH 10 to play back data between the start of the record and the 2048th sample period, inclusive.

Query [PWIN?] [*]

Parameters none

Valid Responses x,y,u
where: x = 1 to 6291456 for the starting period
y = 1 to 6291456 for the ending period
u = 0 for number of samples
1 for time period (µsec)
2 for percentage of record

Example
PWIN? <lf>

Sample Response
0000001,0002048 <lf>
indicates that the DASH 10 is set to play back from the first sample period to the 2048th sample period of the record.

scales playback output, expanding or contracting the signals from 25 times to 1/25. You can expand data to examine detail, or compress data to obtain an overview.

Command	[TEXP] [x] [*]
Parameters	x = 0 to 48 for the expansion code (See Table 9-2.)
Example	TEXP 24 <lf> sets playback scaling to normal (no scaling).

Table 9-2: Expansion Codes and Factors

Code	Factor	Code	Factor	Code	Factor	Code	Factor
0	1/25	13	1/12	25	2	37	14
1	1/24	14	1/11	26	3	38	15
2	1/23	15	1/10	27	4	39	16
3	1/22	16	1/9	28	5	40	17
4	1/21	17	1/8	29	6	41	18
5	1/20	18	1/7	30	7	42	19
6	1/19	19	1/6	31	8	43	20
7	1/18	20	1/5	32	9	44	21
8	1/17	21	1/4	33	10	45	22
9	1/16	22	1/3	34	11	46	23
10	1/15	23	1/2	35	12	47	24
11	1/14	24	1	36	13	48	25
12	1/13						

Query	[TEXP?] [*]
Parameters	none
Valid Responses	0 to 48 for the expansion code
Example	TEXP? <lf>
Sample Response	24 <lf> indicates that playback scaling is set to normal.

X and Y Channels Command

selects three channels of captured data to be played back in X/YY format, wherein one channel is selected to be plotted on the X-axis and two channels are selected to be plotted on the Y-axis of a square grid.

Command [XYCH] [x],[y1],[y2] [*]

Parameters

x =	1 to 30	for X channel
y1 =	1 to 30	for first Y channel
y2 =	1 to 30	for second Y channel

Example XYCH 1,3,17 <lf>
sets channel 1 to the X-axis and channels 3 and 17 to the Y-axis.

Query [XYCH?] [*]

Parameters none

Valid Responses x,y1,y2
where:

x =	1 to 30	for X channel
y1 =	1 to 30	for first Y channel
y2 =	1 to 30	for second Y channel

Example XYCH? <lf>

Sample Response 01,03,17 <lf>
indicates that channel 1 is set to the X-axis and channels 3 and 17 to the Y-axis.

X and Y Format Command

chooses the plot type, grid status and drawing style for X/Y or X/YY format. The drawing style can be either plotting points or line segments.

Command [XYFT] [t],[g],[s1],[s2] [*]

Parameters

t =	0	for X/Y format
	1	for X/YY format
g =	0	for grid off
	1	for grid on

s1 = 0 for 1-dot plot
1 for 2-dot plot
2 for 3-dot plot
3 for 4-dot plot
4 for 5-dot plot
5 for line
s2 = 0 for 1-dot plot
1 for 2-dot plot
2 for 3-dot plot
3 for 4-dot plot
4 for 5-dot plot
5 for line

Example

XYFT 1,1,2,5 <lf>
sets an X/YY plot, with the grid on, where XY1 plots 3-dot points and XY2 plots line segments.

Query

[XYFT?] [*]

Parameters

none

Valid Responses

t,g,s1,s2
where: t = 0 for X/Y format
1 for X/YY format
g = 0 for grid off
1 for grid on
s1 or s2 = 0 for 1-dot plot
1 for 2-dot plot
2 for 3-dot plot
3 for 4-dot plot
4 for 5-dot plot
5 for line

Example

XYFT? <lf>

Sample Response

1,1,2,5 <lf>
indicates that an X/YY plot is set with the grid on, where XY1 plots 3-dot points and XY2 plots line segments.

Set Playback Report Status Command

determines whether a Record Analog Settings Report is printed before the playback output.

Command	[PRPT] [s] [*]
Parameters	s = 0 to suppress printing of status report 1 to print status report
Example	PRPT 1 <lf> sets the Record Analog Settings Report to be printed before playback output.

Query	[PRPT?] [*]
Parameters	none
Valid Responses	0 to indicate that the report will not be printed 1 to indicate that the report will be printed
Example	PRPT? <lf>
Sample Response	1 <lf> indicates that the Record Analog Settings Report will be printed before playback output.

9.2 Playing Back Data

Data that was captured by data capture or loaded into data capture memory from floppy disk or host upload can be played back on the chart and/or the VF Display. Data can be played out in waveform-versus-time format, in X/Y (waveform-versus-waveform) format, or in numeric format, as specified via the Playback Format Command. You can also print out an analysis plot or a frequency domain (FFT) plot of a portion of a data capture record.

Since data playback can take a noticable amount of time to complete, you may want to synchronize this operation with the host program. You can do so by using the Operation Complete Command or Query or the Wait Command. Refer to the explanation of device synchronization in Chapter 3 for information on using these commands.

During this mode, the commands listed in Table 9-3 are applicable.

Note: When attempting to play back data, an execution error will result under the following conditions:

- the DASH 10 does not contain a board with the data capture option.
- no data is available in the record specified for playback.

Table 9-3: Data Playback Commands

Header	Function
PLBK	Begin playback of specified data capture record.
APLT	Print an analysis plot of 1024 points of data from the specified portion of a captured record.
FFTZ	Expand a portion of an FFT analysis plot by establishing both the expansion factor and starting point.
STAR	Start data playback on the chart.
STOP	Stop data playback on the chart.
IDEN	Identify waveforms on the chart.
EXIT	Abort data playback.

Data Playback Queries

Header	Function
PLBK?	Is a data playback in progress? If so, how much has completed?
APLT?	Is an analysis plot currently in progress?
FFTZ?	What are the settings for the next FFT analysis plot?
STAR?	Is data currently playing back on the chart?
STOP?	Is data currently playing back on the chart?
*STB?	Report on the current system status.
*ESR?	Report on the current system status.

starts a playback from the specified data capture record. During a playback in X/Y format, only the *STB?, *ESR?, PLBK? and EXIT commands are functional.

Command [PLBK] [b],[r][*]

Parameters
b = 1 to 3 for the board
r = 1 to 8 for the data capture record

Example PLBK 3,1 <lf>
starts a playback of record 1 from board 3.

Query [PLBK?] [*]

Parameters none

Valid Responses a,b
where: a = 0 for playback not in progress
1 for playback in progress
b = 000 to 100 for the percentage of playback completed

Example PLBK?

Sample Response 1,050 <lf>
signifies that data playback is in progress and is 50% completed.

prints an analysis plot of 1024 points of data from a portion of a captured record. You can plot the data directly or transform it into the frequency domain by selecting Fast Fourier Transform (FFT). You must specify the starting point for the plot within the valid window. Additionally, there must be a minimum of 1024 points after the starting point in the record or else an execution error will result. The operation complete bit will be set upon completion, if set up to do so via the Operation Complete Command. Until completion, the only commands that are valid are EXIT to abort printing and QYST? to query status.

Command	[APLT] [b],[r],[n],[s],[t] [*]
Parameters	b = 1 to 3 for the board number r = 1 to 8 for data capture record n = 1 to 30 for captured channel s = starting sample period (1 to # of samples in the record minus 1,024) t = 0 for standard plot = 1 for FFT analysis
Example	APLT 1,3,2,3000,1 <lf> prints an FFT analysis plot on channel 2 data in record 3, from board 1, starting at sample point 3000.

Query	[APLT?] [*]
Parameters	none
Valid Responses	0 for no plot in progress 1 for plot in progress
Example	APLT? <lf>
Sample Response	1 <lf> indicates that an analysis plot is in progress.

allows you to expand a portion of an FFT analysis plot by establishing both the expansion factor and starting point. A selected portion of an FFT analysis plot can be expanded by 2, 4, or 8 times.

Command [FFTZ] [x],[y] [*]

Parameters
x = 0 for times 1
1 for times 2
2 for times 4
3 for times 8

y = starting point (within 512 points)
Valid ranges:
1 for times 1
1 to 257 for times 2
1 to 385 for times 4
1 to 449 for times 8

Example FFTZ 2,385 <lf>
expands an FFT analysis plot times four, for the last quarter of output data.

Query [FFTZ?] [*]

Parameters none

Valid Responses x,y
where: x = 0 to 3 for the expansion factor
y = 1 to 449 for the starting point

Example FFTZ? <lf>

Sample Response 2,385 <lf>
indicates that the next FFT analysis plot will be set at "times four," for the last quarter of output data.

Start and Stop Commands

control the running of the recorder during data playback.

Command	[STAR] [*] or [STOP] [*]
Parameters	none
Example	STOP <lf>
	halts recording during data playback.

Query	[STAR?] [*] or [STOP?] [*]
Parameters	none
Valid Responses	0 for recording is stopped
	1 for recorder is running
Example	STAR? <lf>
Sample Response	1 <lf>
	indicates that the recorder is running.

Identification (ID) Command

can function in two different ways:

- Numeric identification can be printed on all signals to clearly identify which trace represents which input signal. This feature is particularly useful during overlap recording.

- Numeric identification, voltage levels, and right and left grid edges for a specific signal or for all channels can be noted on the chart. If user scaling is active, the numeric information will be in the appropriate user units.

Command	[IDEN] [n] [*]		
Parameters	n =	0	to print ID only on all channels
		1 to 30	to print ID, voltage level, and right and left grid edges for the specified channel
		31	to print ID, voltage level, and right and left grid edges for all channels
Example	IDEN 0 <lf> causes a numeric ID to print once on each signal as soon as the command is received.		

Note: Issuing this command has the same effect as pressing the front-panel ID Button.

Abort Playback Command

aborts the current playback.

Command	[EXIT] [*]
Parameters	none
Example	EXIT <lf>

10 Data Archival & Transfer

Once data has been captured, it can be saved for subsequent analysis. Two methods of data archival and transfer are available:

- Captured data can be archived to and recalled from disk in the DASH 10 disk drive. This procedure can be done locally, or it can be automatically performed following data capture, as described in Chapter 8.

- Captured data can be uploaded to and downloaded from the host computer. This procedure can only be done by host command, as described in this chapter.

Data upload allows you to transfer captured records to the host computer, where the data can then be examined, manipulated, archived, or downloaded into DASH 10 data capture memory. The captured records can be transferred to the host computer by RS-232 or GPIB.

Data Transfer

The DASH 10 can transfer data capture records to the host computer for analysis or archival. This data can be processed or viewed by host programs or it can be downloaded to the DASH 10 data capture memory and played back on the chart.

Stored (archived) data can consist of three elements:

File Information Identifies the file with the ID 'DASH-10 ', followed by the file format version number (1.0) and the sizes of the file information header and the record information header.

Header Information Provides general information about the stored record.

Waveform/Event Data Two bytes for each sample, with the low byte preceding the high byte in the transfer. The upper nibble of the high byte contains data pertaining to the board, the trigger, and data type; the remaining 12 bits contain the waveform and/or event data as described later in this chapter.

Table 10-1: Data Transfer Commands

Header	*Function*
UPLD?	Upload data to the host from DASH 10 data capture memory.
RREV?	Upload the specified record to the host computer in a compressed format.
EXIT	Abort data upload currently in progress.
DNLD	Download data from the host to DASH 10 data capture memory.

Data Upload

Data upload allows all or part of a data capture record to be uploaded to the host computer for analysis or archival. You also have the option of choosing all captured channels or just one channel. For GPIB transfers, EOI-only termination must be set, since a line feed (0Ah) is valid binary data.

Upload Record Command

starts an upload of the specified record to the host computer. The data that will be uploaded will have a header as described in Appendix D. Each sample of data uploaded by IEEE-488 is represented by two binary bytes in low-byte/high-byte format.

Data formats described in the following sections are in binary format. For RS232 transfers, the same data is represented in four ASCII Hexadecimal bytes.

Command [UPLD?] [b],[r],[c],[s],[e] [*]

Parameters

b	=	1 to 3	for the board number
r	=	1 to 8	for the record number
c	=	0	for all channels
		1 to 30	for individual channel numbers
		31 to 33	for events
s	=	1 to 6291456	for the starting sample
e	=	1 to 6291456	for the ending sample

Example UPLD? 1,2,0,1,1024 <lf>
initiates a data upload from board 1 record 2, storing all channels from sample 1 to sample 1024.

Upload Abort Command

stops a data transfer that is currently in progress.

Command [EXIT] [*]

Parameters none

Example EXIT <lf>
aborts the data transfer that is in progress.

Upload Record Review Command

initiates an upload of the specified record to the host computer in a compressed format, which allows you to compress the data to an easily viewable screen size. The data to be uploaded will be compressed by the specified factor before being sent to the host. This is accomplished by sending only minimum and maximum values. To facilitate speed, no header is sent with this data.

Query	[RREV?] [b],[r],[c],[s],[e],[f] [*]		
Parameters	b	= 1 to 3	for the board number
	r	= 1 to 8	for the record number
	c	= 0	for all channels
		1 to 30	for a single channel number
		31 to 33	for events
	s	= 1 to 6291456	for the starting sample
	e	= 1 to 6291456	for the ending sample
	f	= 2 to 100000	for the compression factor
Example	RREV? 1,2,0,1,50000,100 <lf>		
	initiates a record review upload from board 1 record 2, storing all channels from sample 1 to sample 50000, compressed by a factor of 1/100.		

Record Review Abort Command

stops a data transfer that is currently in progress.

Command	[EXIT] [*]
Parameters	none
Example	EXIT <lf>
	aborts the data transfer that is in progress.

Data Download

Data download to the DASH 10 sends a record into empty data capture memory. In the event that the host sends more samples than available data capture memory can hold, the DASH 10 discards the extra data. Upon receiving the terminator (EOI for GPIB or <cr><lf> for RS232), the DASH 10 ends the data download. Data can then be played back, using the selected playback chart format and magnification, just as any other data capture record.

Data downloaded from the host computer requires that a header be sent to the DASH 10 in the form specified in Appendix D. This header is the same header that starts a data upload or starts a .DCR file archived to DASH 10 floppy disk.

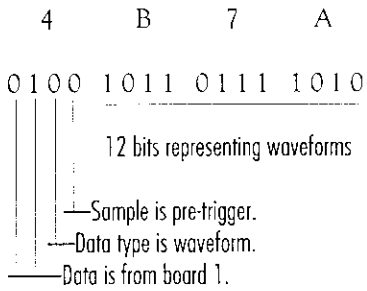
Download Record Command

begins a download of captured data from the host computer to the next available record in DASH 10 data capture memory. If using IEEE-488, data is in binary format; otherwise, the data is two ASCII characters for each binary byte of information. The stream of data must be terminated with the appropriate terminator depending on the type of communications (RS232 or GPIB), which will end the download procedure.

Command	[DNLD] [*]
Parameters	none
Example	DNLD <lf> initiates a data download of data from the host computer to the next available record in DASH 10 data capture memory.

Data Formats

Waveform data is 12-bit and requires two bytes for each sample, with the low byte preceding the high byte in the transfer. During data upload and download, data pertaining to the trigger position, data type, and board number is contained in the upper nibble of the high byte. For example, the 16-bit (two-byte) binary word 4B7A contains the following data:



For record review, only waveform data is used.

The detailed data format for upload and download is listed in Table 10-2; the detailed data format for record review is listed in Table 10-3.

Table 10-2: Format 1 (Upload and Download)

Waveform Data

bits	*data*
0 - 11	12-bit waveform (signal) data
12	Trigger: 0 = pre-trigger; 1 = post-trigger
13	Data type: 0 = waveform data; 1 = event data
14 - 15	Board #: 01 = board 1; 10 = board 2; 11 = board 3

Event Data

bits	*data*
0	unused
1 -10	Event 1 - 10, 11 - 20, or 21 - 30, based on board #
11	System event: 0 = not active; 1 = active
12	System trigger: 0 = pre-trigger; 1 = post-trigger
13	Data type: 0 = waveform data; 1 = event data
14 - 15	Board #: 01 = board 1; 10 = board 2; 11 = board 3

Table 10-3: Format 2 (Record Review)

Waveform Data

bits	*data*
0 - 11	12-bit waveform (signal) data
12 - 15	unused

Event Data

bits	*data*
0 - 12	unused
13	Data type: 0 = waveform data; 1 = event data
14 - 15	unused

GBIB and RS232

Waveform data is 12-bit data, such that 2048 (7FF hex) represents the center of the chart, with 0 representing the lowest possible value and 4095 (FFF hex) representing the highest possible value. Typically, the lowest and highest values are past the edges of the grid.

Depending upon whether the communications interface is GPIB or RS232, the data is uploaded as illustrated:

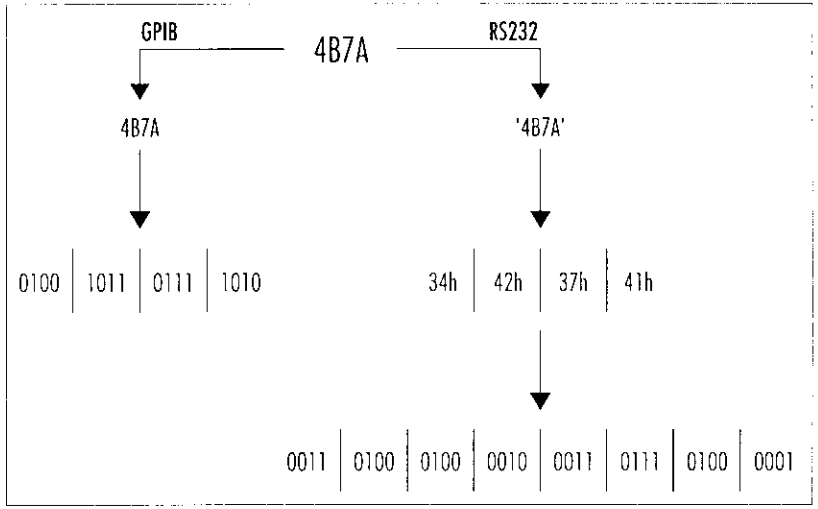


Figure 10-1: Data Transfer

Upload via GPIB is more efficient than via RS232 because data can be sent in binary at greater speed. The format for a RS232 transfer is the same except that data is in ASCII hexadecimal format, which will use twice as many bytes to represent the same data.

11 Printer Modes

Line Printer

The DASH 10 Recorder can operate as a normal line printer, printing all incoming data, except for the control codes listed below. Three formats are available:

- Normal 125-column printing is useful for printing text oriented on the paper in standard printer fashion.
- Inverted (180°) 125-column printing is oriented so that the text is readable while being printed, for example, the DASH 10 help sheets.
- Rotated printing causes the DASH 10 to use a rotated font that prints at 90°, thereby printing in the same direction as the DASH 10 system log and annotation.

Enter Line Printer Mode Command

enters the DASH 10 into line printer operation and specifies the page format.

Command	[LPTR] [x] [*]
Parameters	x = 1 for standard 125-column line printer 2 for inverted (180°) 125-column line printer 3 for rotated (90°) 125-column line printer
Example	LPTR 1 <lf> causes the recorder to function as a standard 125-column line printer.

While operating as a line printer, the DASH 10 functions similar to a normal printer, printing all incoming data, except for the control codes. The control codes, which typically are used for command termination, are interpreted as follows:

Horizontal tab (09H)	Tabs in 8-space increments
Line feed (0AH)	Advances the pointer to a new line
Form feed (0CH)	Performs a form feed of the paper
Carriage return (0DH)	Advances the pointer to the beginning of a new line
Control C (03H)	Exits the line printer mode of operation

In the printer modes of operation, the DASH 10 Recorder expects to receive a <lf> (line feed) at the end of each 125-column line. Upon receiving a <lf>, the recorder returns to the beginning of the same line and begins over-writing the buffer.

The only method for exiting printer operation to return to the idle state is sending 03H (ASCII Control-C) with the terminator appropriate for the given communication interface.

A Command Headers

General Functions

Commands:

Header	*Function*
FEED	Advance chart paper (approximately 1 centimeter).
HELP	Print a status or help sheet.

Commands:

Header	*Function*
TIME	Set system time.
DATE	Set system date.
MSRC	Define source of motor clock.
MSPD	Change the current motor speed.
DLSP	Set or change the current data logging speed.
*SRE	Define what information the SRQ status byte will convey to the host computer.
*CLS	Clear both the SRQ Status Byte and Standard Event Status Registers.
*ESE	Determine which conditions will set bit 5 of the SRQ status byte to ON (to 1).
*PSC	Allow the host to either clear or maintain the contents of the status registers upon power-up of the DASH 10.
*RST	Cancel the Operation Complete Command or Query and return the DASH 10 to the idle state.
*OPC	Set the operation complete bit (bit 0) of the Standard Event Status Register to be set ON, when the pending operation has completed.
*WAI	Make the system refrain from processing any host commands until the pending operation has completed.
FREN	Rename a file on the DASH 10 disk drive.
FDEL	Delete a file on the DASH 10 disk drive.

Queries:

Header	*Function*
TIME?	What is the current system time?
DATE?	What is the current system date?
MSRC?	Is the motor clock source internal or external?
MSPD?	What is the current motor speed?
DLSP?	What is the current data logging speed?
*SRE?	What information will the SRQ status byte convey to the host computer?
*STB?	Allow host to read the status byte.
*ESE?	Which conditions will set bit 5 of the SRQ status byte to ON?
*ESR?	Begin a destructive read of the Standard Event Status Register.
*PSC?	Will the host clear or maintain the contents of the status registers upon power-up of the DASH 10?
ALLE?	Query the events in the Event Error Queue.
*IDN?	Provide identifying information about the current DASH 10 system.
*OPC?	Is the operation complete bit (bit 0) of the Standard Event Status Register set to be turned ON, when the pending operation has completed?
*OPT?	What options are installed in the DASH 10?
*TST?	Perform self-test and report on results.
FDIR?	List the names of the files on the disk in the DASH 10 disk drive.

Chart and Grid Setup

Commands:

Header	*Function*
ECHT	Define or change the name of one of the four saved charts.
GRTY	Select either distance-based or time-based grid.
GRON	Enable/disable printing of grids.
GRSZ	Define the size of the grid in millimeters.
GRMA	Set the number of major divisions on the chart.
GRMN	Specify the number of minor grid divisions per major division.
GRLC	Specify the location of the grid on the chart.
PENL	Enable/disable printing for an analog channel.
THIC	Set the thickness of the waveform trace in pixels.
SEST	Enable/disable printing of system event marker.
EVTY	Define the event type.
EVST	Enable/disable printing of event markers for a channel.
EVLC	Position each event marker on chart.
AUID	Enable/disable automatic printing of signal identification.
TMST	Enable/disable printing of right-edge and left-edge time marks.
TMTB	Set the time interval for the printing of time marks.
TMLC	Position the time marks.
SLOG	Enable/disable printing of system log channel.
EDSY	Edit content of the system log.
BSET	Turn on and position annotation buffer.
EDIT	Edit content of each annotation buffer.
EODB	Edit content of on-demand buffer.
SREP	Specify which channels are to have signal conditioner reporting in the interchannel text buffer.

Queries:

Header	*Function*
ECHT?	What is the name of the specified saved chart?
GRTY?	Is the grid based on distance or time?
GRON?	Is the printing of major chart grids enabled?
GRSZ?	What is the size of the grid in millimeters?
GRMA?	How many major divisions are in the grid?
GRMN?	How many minor grid divisions appear between major divisions?
GRLC?	What is the location of the grid on the chart?
PENL?	Is printing enabled for an analog channel?
THIC?	How many pixels thick is the waveform trace?
SEST?	Is printing of the system event marker enabled?
EVTY?	What is the print format of all event markers?
EVST?	Is printing of event markers enabled?
EVLC?	Where is an event marker located on the chart?
AUID?	Is automatic printing of signal identification enabled?
TMST?	Is printing of right-edge and/or left-edge time marks enabled?
TMTB?	What is the time interval for the printing of time marks?
TMLC?	Where is the time mark located? EDSY? What is the current content of the system log?
SLOG?	Is printing of the system log channel enabled?
EDSY?	What is the current content of the system log?
BSET?	Is an annotation buffer on and, if so, what is its location?
EDIT?	What is the current content of an annotation buffer?
EODB?	What is the current content of the on-demand buffer?
SREP?	Which channels have signal conditioner reporting in the interchannel text buffer?

Signal Setup

Commands:

Header	*Function*
SGND	Specify signal in or ground for a channel.
SRNG	Set input range for each channel, expressed as voltage full scale.
ZPOS	Position zero volts (ground) on chart.
SZSP	Set units of zero suppression for a channel.
SMDE	Specify whether input is peak to peak or RMS.
SFIL	Enable/disable 10 Hz low-pass filter for a channel.
DLCH	Enable/disable printing of signal data for a channel in Data Logger mode.
USST	Enable/disable scaling of numeric output for a channel, when the chart is in data logger format.
USTR	Specify the ratio of internal units (volts) to external units (user-defined).
USOS	Specify the offset (define 0 volts) for a channel, when user scaling is in effect.

Queries:

Header	*Function*
SGND?	Is the signal in or grounded for a channel?
CALB?	Calibrate specified analog channel and return status.
SRNG?	What is the input range for each channel, expressed as full-scale voltage?
ZPOS?	Where is zero volts (ground) positioned on the chart?
SZSP?	How many units of zero suppression are set for a channel?
SMDE?	Is input peak-to-peak or RMS?
SFIL?	Is the 10 Hz low-pass filter enabled for a channel?
DLCH?	For which channels is printing of signal data in Data Logger mode enabled?
USST?	Is scaling of numeric output for a channel enabled or disabled, for data logger format?
USTR?	What is the ratio of internal units (volts) to external units (user-defined) during data logging?
USOS?	What is the offset for a channel, when user scaling is in effect?

Real-Time Operation

Commands:

Header	*Function*
CHRT	Begin real-time recording in the specified format.
STAR	Start recorder output.
STOP	Stop recorder output.
IDEN	Label the waveforms with numeric identification.
PODB	Print content of on-demand buffer.
DISP	Run or freeze the VF display.
EXIT	Exit real-time recording and return to idle.

Queries:

Header	*Function*
STAR?	Is the recorder currently running?
STOP?	Is the recorder currently running?
PODB?	Is the On-Demand Buffer currently printing?
DISP?	Is the VF display currently running?

Data Logging

Commands:

Header	*Function*
DLOG	Begin real-time recording in data logging format.
STAR	Start recorder output.
STOP	Stop recorder output.
MEAS	Enter real-time measurement mode.
EXIT	Exit data logging and return to idle.

Queries:

Header	*Function*
MEAS?	Report to host the current input signal level for a channel, or for all data logger channels.
STAR?	Is the recorder currently running?
STOP?	Is the recorder currently running?

Dual-Speed Operation

Commands:

Header	*Function*
DSPD	Set dual speeds.
DSWT	Define whether the timer or a trigger will cause the change from one speed to another.
DDUR	Set the duration of time, if timer is selected.
DREC	Start dual-speed operation.

Queries:

Header	*Function*
DSPD?	What are the two speed settings?
DSWT?	Will the timer or a trigger cause the change from one speed to another?
DDUR?	What is the time duration, if timer is selected?
DREC?	Is dual-speed operation in progress?

Timed Operation

Commands:

Header	*Function*
TRUN	Set start time.
THLT	Set stop time.
TCHT	Select chart format for timed output.
TREC	Start timed operation.
EXIT	Abort timed operation.

Queries:

Header	*Function*
TRUN?	What is the start time for timed operation?
THLT?	What is the stop time for timed operation?
TCHT?	What is the chart format for timed output?
TREC?	What is the status of timed operation?

Commands:

Header	*Function*
TRGS	Define trigger source.
*TRG	Initiate a trigger from the host computer.
SPER	Set time interval for a periodic trigger.
CLKT	Enable/disable clock trigger and set specific date and time for a trigger to occur.
TRLV	Define levels for a waveform trigger.
TAND	Associate channels in an "and" relationship.
TROR	Associate channels or a group of channels in an "or" relationship.

Queries:

Header	*Function*
TRGS?	What are the trigger source(s)?
SPER?	What is the time interval for a periodic trigger?
CLKT?	Is a clock trigger enabled? If so, at what specific date and time will a trigger occur?
TRLV?	What are the levels for a waveform trigger?
TAND?	Which channels are associated in an "and" relationship in a particular group?
TROR?	Which channels are associated in an "or" relationship?

Data Capture Setup

Commands:

Header	*Function*
CBRD	Enable/disable data capture for a board.
CLNK	Link records on boards that have data capture enabled.
ATRG	Enable/disable automatic trigger upon arming the system.
CCON	Set data capture arming, playback, and archiving to either automatic or manual.
SRAT	Set the sample rate for data capture.
RSIZ	Define record size.
TRCD	Define the trigger/window relationship.
CAPC	Select waveforms or events to be captured each sample period.
EREC	Delete specified records from data capture memory.

Queries:

Header	*Function*
CBRD?	Is data capture enabled for a board?
CLNK?	Are records on boards that have data capture linked?
ATRG?	Will a trigger be automatically generated upon arming the system?
CCON?	Is data capture arming, playback, and archiving set to automatic or manual?
SRAT?	What is the sample rate for data capture?
RSIZ?	What is the current size of a record?
TRCD?	What is the trigger/window relationship?
CAPC?	Which waveforms or events are to be captured each sample period?
RINF?	Report on the status of a particular data capture record.
CINF?	Report on captured records.

Capture Data

Commands:

Header	*Function*
ARMC	Arm system for data capture.
ARMA	Abort data capture.

Queries:

Header	*Function*
ARMC?	Is the system armed for data capture? If so, is a data capture in progress? If so, at what point is the capture?

Commands:

Header	*Function*
PDEV	Set playback data to print on the chart, on the VF Display, or on both.
PMRK	Specify whether the full-page trigger mark will be printed during data playback.
PFMT	Select the format in which data is to be played back.
PWIN	Determine the portion of a particular record that will be played back.
TEXP	Select magnification factor to control the expansion or compression of data during playback.
XYCH	Select channels to be used when plotting in X/Y or X/YY format on a square grid.
XYFT	Select the format, grid, and line style for X/Y or X/YY plots.
PRPT	Enable/disable printing of a Record Analog Settings Report before playback data.

Queries:

Header	*Function*
PDEV?	Will playback data print on the chart, on the VF Display, or on both?
PMRK?	Will the full-page trigger mark will be printed during data playback?
PFMT?	In which format will data be played back?
PWIN?	Which portion of a particular record will be played back?
TEXP?	What is the magnification factor of data to be played back?
XYCH?	Which channels are to be used when plotting in X/Y or X/YY format on a square grid?
XYFT?	Which format, grid, and line style are selected for X/Y or X/YY plots?
PRPT?	Is printing of a Record Analog Settings Report before playback data enabled?

Play Back Data

Commands:

Header	*Function*
PLBK	Begin playback of specified data capture record.
APLT	Print an analysis plot of 1024 points of data from the specified portion of a captured record.
FFTZ	Expand a portion of an FFT analysis plot by establishing both the expansion factor and starting point.
STAR	Start data playback on the chart.
STOP	Stop data playback on the chart.
IDEN	Identify waveforms on the chart.
EXIT	Abort data playback.

Queries:

Header	*Function*
PLBK?	Is a data playback in progress? If so, how much has completed?
APLT?	Is an analysis plot currently in progress?
FFTZ?	What are the settings for the next FFT analysis plot?
STAR?	Is data currently playing back on the chart?
STOP?	Is data currently playing back on the chart?
*STB?	Report on the current system status.
*ESR?	Report on the current system status.

Transfer Data

Commands

Header	Function
UPLD?	Upload data to the host from DASH 10 data capture memory.
RREV?	Upload the specified record to the host computer in a compressed format.
EXIT	Abort data upload currently in progress.
DNLD	Download data from the host to DASH 10 data capture memory.

Line Printer

Commands:

Header	Function
LPTR	Enter the DASH 10 into the line printer mode of operation.

B

DASH 10 Specifications

Basic System Specifications

recording method	direct thermal
frequency response	DC to 25 kHz (-3 dB)
RMS bandwidth	50 kHz
analog waveform channels	10, 20, or 30
amplitude resolution	12 dpm (300 dots per inch)
timebase resolution	■ 12 dots per mm (dpm) for 1 to 100 mm/sec ■ 6 dots per mm (dpm) for 101 to 200 mm/sec

event channels	■ 1 per waveform channel ■ 1 system event ■ 2 timer events
chart width	280 mm (11")
maximum waveform size	256 mm
grid sizes	30 independent grids up to 250 mm wide can be placed anywhere on the chart
speeds	1 mm/min to 200 mm/sec
speed accuracy	±2%
paper capacity	48 m per roll
input type	isolated, single-ended voltage amplifier
user input connector	guarded binding posts
input coupling	DC
range	50 mV to 500 V full scale
maximum differential input	500 V peak or 250 V RMS
maximum CMV (IMV)	250 V RMS
input impedance	1 Megohm
zero suppression	■ ±5V (2.5 mV step) for ranges <5V ■ ±500V (.25 V step) for ranges ≥5 V
zero suppression error	±2%
sample rate	250 kSamples/sec

RMS	handle crest factors to 7 with < 1% error
CMRR at 60 Hz	>95 dB
low pass filter	10 Hz
maximum intrinsic noise	<0.5 mm
non-linearity	<0.1% of full scale
baseline drift with time	<0.05 mm/24 hrs
baseline drift with temperature	<0.05 mm/°C
monitor type	built-in vacuum fluorescent display for both text and real-time waveforms
monitor resolution	256 dots (w) x 64 dots (h)
waveform format	waterfall scroll
monitor refresh rate	100 Hz
alphanumeric keypad	full alphanumeric keypad for annotation entry
encoder wheel	used for rapid entry of gain/zero position, chart layout, and many other recording parameters
chart speed keys	■ quick keys for 1, 5, 25, 50, 100, and 200 mm/sec or mm/min ■ 3 user-defined speed keys
indicators	battery status, arm, trigger
host interfaces	■ GPIB ■ RS232 (DTR/DSR and XON/XOFF)

disk drive	1.44 MByte, DOS compatible, 3.5" floppy drive for saving setups and annotation, archiving data, and upgrading software
remote start / stop	standard via switch closure or TTL
standard real-time recording	10 to 30 channels with annotation buffers in overlap and separate channel modes
user-defined formats	■ user can design unique charts using standard menus ■ maximum of 20 formats can be saved to floppy disk for quick chart setups
data logger	■ numeric reporting of waveform data in engineering units ■ 5 Hz maximum sample rate
timed recording	system can be programmed to start and stop recording at specific times
line print	125 columns
A/D converters	each channel has own A/D converter
ADC resolution	12 bits
annotation units	all annotation can be selected in either voltage or user-defined engineering units
system log	single line containing the time, date, chart speed, and time mark setting
channel annotation	each channel has a 128-character ASCII buffer printed at any user-specified chart location

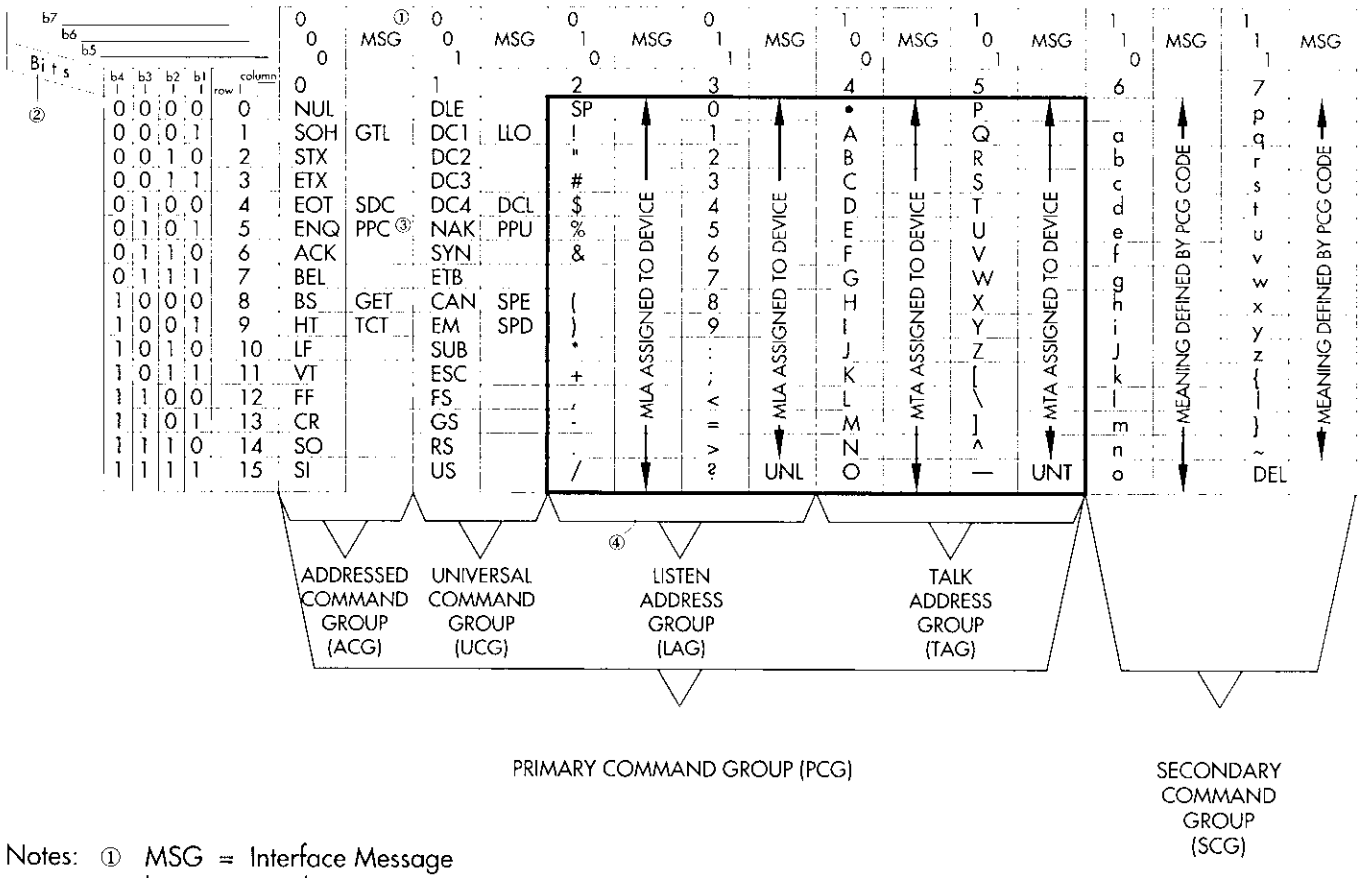
signal conditioner annotation	if enabled, uses last 32 characters of channel annotation
on-demand annotation	128-character buffer printed anywhere on the chart
channel ID	■ each channel is labeled with channel number on demand ■ full-scale top and bottom values of the grid can be printed in either voltage or engineering units
tri-state timing marks	x1, x10, x100 mark on left, right, or both edges
horizontal grid lines	may be synchronized to time mark
time mark intervals	0.01 - 0.09, 0.10 - 0.90, 1 - 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60
manual event mark	■ front-panel key or external TTL / switch closure ■ choice of bar on/off or binary level
external event marks	maximum of 30 event marks available (TTL or switch closure), non-isolated, glitch capture
power options	standard AC, DC, or optional internal battery
AC requirement	120/240 VAC nominal at 50 or 60 Hz
DC requirement	13-20 VDC
operating temperature	0°C to 45°C
storage temperature	-20°C to 80°C
relative humidity	0% to 95%, non-condensing

overall dimensions	height: 5" (127 mm) depth: 20" (508 mm) width: 18" (457 mm)
weight	■ 36 lbs (16 kg) with battery ■ 32 lbs (15 kg) without battery (10 channel)
data capture	■ each channel can capture a maximum of 558 kSamples of data to RAM during one capture ■ captures can be stacked in 69 kSample blocks or memory can be linked for a total of 6 megasamples per ten channels ■ events are also captured
background capture	standard
capture memory	DRAM
capture time stamping	all records are time stamped at end of capture
capture sample rates	5 to 250 kSamples per second per channel
capture record sizes	■ 69 kSamples/channel (stacked) ■ 558 kSamples/channel (not stacked or linked) ■ 6 megasamples (linked, 1 channel capture per 10 channels)
capture stacking	■ maximum of 8 records can be stacked ■ stack a maximum of eight 69 kSample blocks per channel

capture header	each record contains complete capture information including analog settings
manual trigger	with front-panel key
host trigger	RS232 or GPIB
periodic trigger	user-programmed, internal
waveform trigger	inside window, outside window, AND/OR combinations
battery	■ fits internal DASH 10 compartment and charges automatically whenever unit is connected to external power. ■ ideal for field use and in the lab as a UPS
battery life	30 minutes, nominal
battery charge time	19 hours with power off

C Multiline Interface Messages

(SENT AND RECEIVED WITH ATN=1)



Notes: ① MSG = Interface Message
② b_1 = DI01... b_7 = DI07
③ Requires secondary command
④ Dense subset (columns 2 through 5)

D

Data Capture Record Format

This appendix details the content and format of the DASH 10 data capture record file, which is used when saving to or restoring from disk or when uploading data to or downloading data from the host computer. In most cases, if these files are simply saved and later recalled to the recorder, you need not know their content. The information in this appendix is necessary only in cases where a programmer wishes to create or interface to these files.

Astro-Med reserves the right to expand the size and content of data capture record files, as dictated by the recorder's capabilities. Therefore, it is recommended that programs written to interface with this file format be written to handle special data, such as versions and data counts, to keep upward compatibility.

The content of the file generally includes information about the actual data (signals) stored and about how the data capture was performed. This signal data will also include event marker data.

Operation:

To load: Select file name of data capture record and begin.
Record will be added to inventory, if sufficient space exists.

To save: Specify record (by number) and file name and begin.
Record will be moved, if sufficient disk space exists.

DASH 10 Data Capture Record File Format

Address (decimal)	Byte(s)	Data Items	Description
0000-0007	8	8 char	File ID (DASH-10)
0008-0011	4	1 word	Version of data capture record/format (DCR)
0012-0015	4	1 word	Size of Window Information Header
0016-0019	4	1 word	Size of Record Information Header

Window Information Header

Address (decimal)	Byte(s)	Data Items	Description
0020-0023	4	1 word	Window size (in samples)
0024-0027	4	1 word	Start of Window (sample #)
0028-0031	4	1 word	End of Window (sample #)
0032-0033	2	1 short	Number of channels stored
0034-0035	2	1 short	Channel list of channels stored from board #1
0036-0037	2	1 short	Channel list of channels stored from board #2
0038-0039	2	1 short	Channel list of channels stored from board #3

Record Information Header

Address (decimal)	Byte(s)	Data Items	Description
0040-0047	8	8 chars	Time of record completion
0048-0051	4	1 word	Sample rate of record
0052-0055	4	1 word	Record size (in samples)
0056-0057	2	1 short	Number of channels captured
0058-0059	2	1 short	Channel list of channels captured on board #1
0060-0061	2	1 short	Channel list of channels captured on board #2
0062-0063	2	1 short	Channel list of channels captured on board #3
0064-0067	4	1 word	Trigger in record
0068-0187	120	30 floats	Conditioning - range
0188-0247	60	30 shorts	Conditioning - position
0248-0307	60	30 shorts	Conditioning - offset
0308-0367	60	30 shorts	Conditioning - filter
0368-0427	60	30 shorts	Conditioning - mode

Address (decimal)	Byte(s)	Data Items	Description
0428-0487	60	30 shorts	Conditioning - DC/ground
0488-0517	30	30 chars	Conditioning - scaling choice
0518-0637	120	120 chars	Conditioning - external units (ASCII chars)
0638-0757	120	30 floats	Conditioning - Equality (external quantity)
0758-0877	120	30 floats	Conditioning - Equality (internal quantity)
0878-0997	120	30 floats	Conditioning - External reference offset

Waveform Data Information

Address (decimal)	Byte(s)	Data Items	Description
0998-????			— Waveform data (beginning)

Note 1: File information header is fixed at 20 bytes.

Note 2: Waveform data begins at:

Address 20 (decimal) + Size of window info. header + Size of record info. header

Waveform data is stored in the file in repeating sets of 16-bit data items, with the low byte preceding the high byte (low-byte/high-byte format).

Note 3:

1 Char	=	1 byte
1 Short	=	2 bytes
1 Word	=	4 bytes
1 Float	=	1 4-byte (32-bit) IEEE-745 floating point number

File ID	Eight characters representing a fixed identification ('DASH-10 ') symbolic of a valid file.
Version	One data word representing the unique file format version. Valid: 1 decimal represents version 1.0. 2 decimal represents version 1.1.
Size of File Information Header	One data word, representing the size in bytes of the File Information Header. This number is useful for the programmer to index into the Record Information Header.
Size of Record Information Header	One data word, representing the size in bytes of the Record Information Header. This number is useful for the programmer to index into the Waveform Data section.
Window Size	One word representing the number of samples per channel that were saved to disk or to host computer. The window size is determined as follows: sample packet size (in bytes) = # of channels stored * 2 total window (in bytes) = window size * sample packet size The window size and the record size may or may not be the same.
Start of Window	One word representing the starting sample number of the window in the captured record. If the starting sample number is equal to one, then it is the beginning of the record.
End of Window	One word representing the ending sample number of the window in the captured record. If the ending sample number is equal to the record size, then it is the end of the record.

Number of Channels Stored One short specifying the number of channels stored. This value determines the layout pattern (sample packet) of the waveform data section. It may or may not be the same as the number of channels captured. Each board has the capability of capturing 11 channels of data (10 waveform and 1 event). The maximum count is 33 channels.

Channel List of Channels Stored Three shorts representing channels stored for boards 1, 2, and 3:

0 = not stored
1 = stored

Bit 0 reflects the event status. Bit 1 reflects the status of channel 1, bit 2 of channel 2, through bit 10, which reflects the status of channel 10. This list may or may not be the same as the list of channels captured.

Time of Capture Completion Eight data bytes containing date and time information as follows:

byte	*description*	*valid data*
1	seconds	0-59
2	minutes	0-59
3	hours	0-23
4	day	1-31
5	month	0-11
6	year	0-99
7	reserved	--
8	reserved	--

Sample Rate

One data word defining the sample rate for data capture. The data value corresponds to the DASH 10 selections as defined below.

selection #	*sample rate*
0	250 KHz
1	125 KHz
2	50 KHz
3	25 KHz
4	10 KHz
5	5 KHz
6	2.5 KHz
7	1 KHz
8	500 Hz
9	250 Hz
10	100 Hz
11	50 Hz
12	25 Hz
13	10 Hz
14	5 Hz

Record Size

One word representing the number of samples per channel that were captured. The record size is determined as follows:

sample packet size (in bytes) = # of channels captured * 2

total record size (in bytes) = record length * sample packet size

Number of Channels Captured

One short specifying the number of channels captured. It may or may not be the same as the number of channels stored. Each board has the capability of capturing 11 channels of data (10 waveform and 1 event). The maximum count is 33 channels.

Channel List of Channels Captured

Three shorts representing channels captured on boards 1, 2, and 3:

0 = not captured
1 = captured

Bit 0 reflects events captured. Bit 1 reflects whether channel 1 is captured, bit 2 whether channel 2 is captured, through bit 10, which reflects whether channel 10 is captured. This list may or may not be the same as the list of channels stored.

Trigger

One word representing the percentage, in increments of 1%, at which the trigger occurred in a record.

0 = start trace
50 = center trace
100 = end trace

Scaling Status

One data byte representing the state of the scaling choice.

0 = standard internal voltage units
1 = external user units

External Units

Four characters (20-7FH) representing the user-editable engineering units currently selected for this channel.

Equality

Two floating point numbers representing the external and internal elements of a ratio. This ratio is the scaling factor for recording in user-defined units.

Offset

Single floating point number offset constant that is equal to 0 volts.

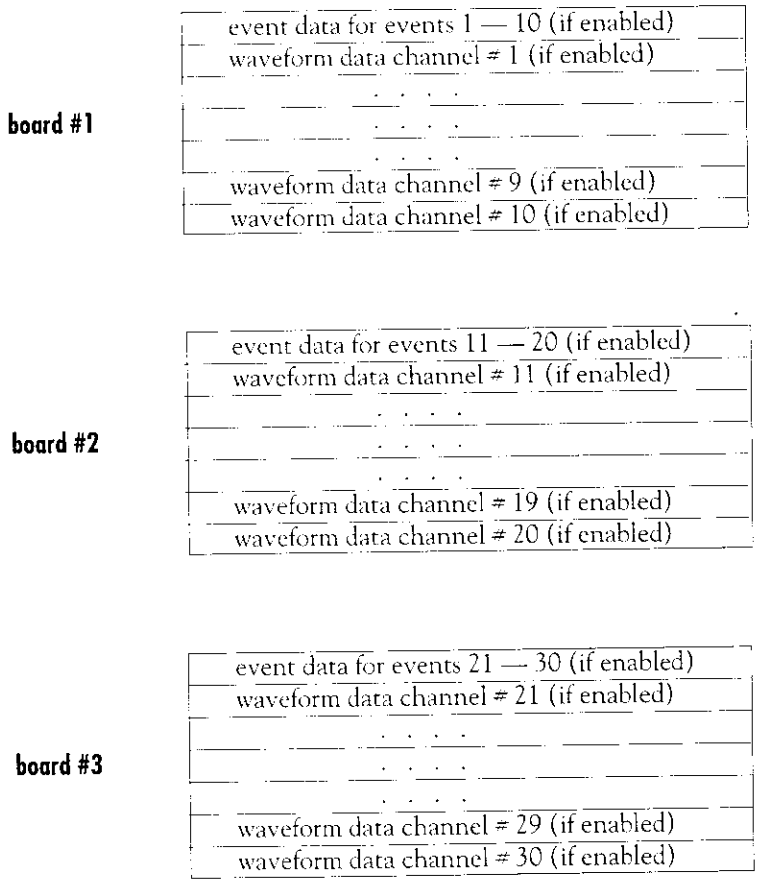
Range	.050 - 500.0	volts	50mV - 500 V
Zero Position	0 - 4095	offset	2048 = center of grid
Zero Suppression	0 - 4095 2048 = 0 volts	±500 volts ±5 volts	step = .25 V if range ≥ 5 volts step = .0025 V if range < 5 volts
Filter	0, 1	**off, on**	0 = off; 1 = 10 Hz low-pass
Mode	0, 1	pk-pk, rms	0 = pk-pk; 1 = rms
Gnd or DC	0, 1	gnd, dc	0 = gnd; 1 = DC

Sample Packet Formats (1 sample period)

Format 1 (Upload and Download)

A sample packet consists of signal and event data, based on the channel list of channels stored for each board. One sample period contains a 16-bit word of signal data for each waveform channel enabled on that board, plus a 16-bit word for events. If three boards are linked for the capture, there can be a maximum of 30 waveform data words plus three event words. The number of data elements in a packet is equal to the number of channels stored. The order of waveform data and event data is always as follows:

Waveform Packet Setup



Format 2 (Record Review)

A sample packet consists of signal and event data, based on the channel list of channels stored for each board. One sample period contains a 2- to 16-bit word of signal data for each waveform channel enabled on that board, plus a 2- to 16-bit word for events. If three boards are linked for the capture, there can be a maximum of 60 waveform data words plus six event words. The number of data elements in a packet is equal to the number of channels stored times 2. The order of waveform data and event data is always as follows:

Waveform Packet Setup

board #1

event data for board 1 (if enabled) - not used
event data for board 1 (if enabled) - not used
waveform data channel # 1 min (if enabled)
waveform data channel # 1 max (if enabled)
. . . .
. . . .
. . . .
waveform data channel # 9 min (if enabled)
waveform data channel # 9 max (if enabled)
waveform data channel # 10 min (if enabled)
waveform data channel # 10 max (if enabled)

board #2

event data for board 2 (if enabled) - not used
event data for board 2 (if enabled) - not used
waveform data channel # 11 min (if enabled)
waveform data channel # 11 max (if enabled)
. . . .
. . . .
. . . .
waveform data channel # 19 min (if enabled)
waveform data channel # 19 max (if enabled)
waveform data channel # 20 min (if enabled)
waveform data channel # 20 max (if enabled)

board #3

event data for board 3 (if enabled) - not used
event data for board 3 (if enabled) - not used
waveform data channel # 21 min (if enabled)
waveform data channel # 21 max (if enabled)
. . . .
. . . .
. . . .
waveform data channel # 29 min (if enabled)
waveform data channel # 29 max (if enabled)
waveform data channel # 30 min (if enabled)
waveform data channel # 30 max (if enabled)

Waveform and Event Data Formats

Format 1 (Upload and Download)

Waveform Signal Data (16 bits wide)

bits	*data*
0 - 11	12-bit waveform (signal) data
12	Trigger: 0 = pre-trigger; 1 = post-trigger
13	Data type: 0 = waveform data; 1 = event data
14 - 15	Board #: 01 = board 1; 10 = board 2; 11 = board 3

Event Data (16 bits wide)

bits	*data*
0	unused
1 -10	Event 1 - 10, 11 - 20, or 21 - 30, based on board #
11	System event: 0 = not active; 1 = active
12	System trigger: 0 = pre-trigger; 1 = post-trigger
13	Data type: 0 = waveform data; 1 = event data
14 - 15	Board #: 01 = board 1; 10 = board 2; 11 = board 3

Format 2 (Record Review)

Waveform Signal Data (16 bits wide)

bits	*data*
0 - 11	12-bit waveform (signal) data
12 - 15	unused

Event Data (16 bits wide)

bits	*data*
0 - 12	unused
13	Data type: 0 = waveform data; 1 = event data
14 - 15	unused

INDEX

A

Abort Command 2-6
abort, data capture 8-22
Abort Playback Command 9-18
acquisition, data 7-1, 8-2, 8-21, 9-1, 9-12, 9-15
amplitude, signal 5-5
analysis, data capture 9-15
analysis plot 9-15
"And" Group Select Command 7-7, 7-9, 7-10
Annotation Buffer Command 4-22
annotation buffer status 3-2
annotation buffers 4-22, 4-25
Arm Abort Command 8-22
Arm Capture Command 8-22
arm, data capture 8-5, 8-8, 8-9, 8-21, 8-22
Auto-Trigger Control Command 8-8
automatic archive 8-11, 8-12
automatic identification 4-20
Automatic Identification Command 4-20, 6-5

B

baseline 5-6
baseline offset 5-4
baud rate 2-3

C

Calibrate Channel Query 5-4
calibration 5-4
Calibration Command for One Channel 5-4
calibration, one channel 5-4
chart 4-1, 9-4
chart elements 4-2
chart format, timed operation 6-18
chart formats 3-1, 4-1, 6-1, 6-2, 6-3, 6-4, 9-6
chart paper 3-2
chart setup 4-2
Chart Setup Commands 4-2
Clear Status Command 3-14, 3-19
Clock Trigger Command 7-6
clock triggering 7-6
command error 3-16
command format 1-5
command header 1-5
command structure 1-5
command terminator 1-5, 1-6, 2-4, 2-9
communication interface 3-21

D

D-shell connector 2-1, 2-7
DASH 10 Registers 3-9
data acquisition 7-1, 8-2, 8-21, 9-1, 9-12, 9-15
data capture 7-1, 8-2, 8-21, 9-1, 9-12, 9-15
data capture board 8-3
Data Capture Commands 8-21

data capture memory 8-15, 8-21
data capture options 3-21, 8-2, 8-9, 8-21, 9-2
Data Capture Re-Arm Control Command 8-9
data capture record 3-25, 8-15, 8-19, 9-7, 9-14, 9-15
data capture setup 8-2
Data Capture Setup Commands 8-6
data logger format 3-8, 5-1, 5-10
Data Logger Mode 3-8
Data Logger Print Command 5-10
data logging 3-8, 5-11, 5-12, 6-2, 6-8, 6-10
Data Logging Commands 6-8
data logging speed 3-8
data playback 9-1, 9-3, 9-4, 9-12, 9-17
Data Playback Setup Commands 9-3
date, system 3-5
DC signal 5-3
Define Grid Location Command 4-11
Delete Disk File Command 3-26
destination, playback data 9-4
device error 3-15
device synchronization 3-22, 8-21, 9-12
Device Synchroniztion Commands 3-22
Disk Directory Query 3-26
disk drive 3-26
disk file 6-2
Disk Management Commands 3-25
display, run/freeze 6-7
distance-based grid 4-7
DTR/DSR 2-2
dual speeds 6-12
dual-speed duration 6-14
Dual-Speed Duration Command 6-14
dual-speed operation 6-2, 6-11
dual-speed recording 7-1
dual-speed switch 6-13
Dual-Speed Switch Command 6-13

E

Edit Annotation Buffer Command 4-23
Edit Chart Name Command 4-5
Edit On-Demand Buffer Command 4-24, 6-6
Edit System Log Command 4-5, 4-21
engineering units 5-11, 5-12
EOI (end or identify) 1-6, 2-9
Erase Record Command 8-19
Error Code Query Command 3-19
error conditions 3-9
ESR Register 8-7
event error codes 3-19
Event Error Queue 2-13, 3-19
Event Marker Position Command 4-15
event markers 4-14, 4-15
Event Markers Command 4-14
event marker's position 4-15
Event Status (*ESR?) Query 3-22
Event Status Byte 2-13, 3-10
event type 4-14
Event Type Command 4-14
execution error 3-16, 8-7, 8-19, 8-21, 9-12
Exit Data Logging Command 6-10
Exit Real-Time Recorder Mode Command 6-7
Expand FFT Plot Command 9-16
expansion factor 9-16

F

Fast Fourier Transform 9-15
fault condition 3-10
FFT analysis 9-15, 9-16
Filter Command 5-9
filtering 5-9
form feed 3-2
frequency domain 9-15

G

gain 5-4, 5-5
general status report 3-2
Go To Local Command 2-10
GPIB address 2-9
GPIB bus 3-11
GPIB D-shell 7-1, 7-4
GPIB interface 1-7, 2-1, 2-7, 2-8
GPIB interface commands 2-11
grid 4-8
grid divisions 4-7, 4-9, 4-10
grid lines 4-2, 4-7
grid location 4-11
grid size 4-8
grid type 4-2, 4-7
Grid Type Command 4-7
ground 5-3, 5-6
Ground Command 5-3

H

handshake method 2-3
help sheet 3-2
Help Sheet Command 3-2
Host Trigger Command 7-5
host-control operation 1-3

I

identification, signal 4-20, 6-5, 9-17
idle state 1-3, 6-7, 6-10
IEEE-488 interface 1-6, 2-1, 3-11
Initiate Self-Test Command 3-21
input buffer 2-6
input range 5-5
input signal 5-3, 5-8, 5-11, 6-5, 6-10, 9-17
installed options 3-21
Installed Options Query 3-21
interchannel text buffers 4-23, 4-25
interface commands, GPIB 2-11
interface messages 2-11, C-2
interlock condition 3-10
internal clock 3-6

L

link status, data capture 8-7
linked boards 8-4
linked record 8-4
local control 2-10
Local Lockout Command 2-5
location, time mark 4-18
logging speed 3-8
low-pass filter 5-9

M

Major Grid Configuration Command 4-9
major grid divisions 4-9, 4-10
Master Status Summary 2-13
memory, data capture 8-3, 8-15, 8-21
memory, non-segmented 8-3
memory, non-volatile 4-1, 4-5, 6-1
memory, segmented 8-3
Message Available (MAV) status 3-12
Minor Grid Configuration Command 4-10
minor grid divisions 4-10
mode entry commands 1-4
modes of operation 1-3
motor clock 3-6
motor clock source 3-6
Motor Clock Source Command 3-6
motor speed 3-7
Multiline Interface Messages 2-11, C-2
multiline messages 2-11, C-2

N

9-pin D-shell connector 2-2
non-volatile memory 3-1
numeric format 6-2, 6-9
numeric output 5-10, 5-11, 6-9

O

on-demand buffer 4-24, 6-6
operating modes 1-3
Operation Complete 3-15
operation complete 3-12
Operation Complete (*OPC?) Query 5-4
operation complete active state (OCAS) 3-23
Operation Complete Command 3-23, 8-21, 9-12
operation complete idle state (OCIS) 3-23
Operation Complete Query 3-22
operation complete query active state (OQAS) 3-23
operation complete query idle state (OQIS) 3-23
"Or" Group Command 7-7, 7-9, 7-11
output buffer 2-6
output queue 3-10, 3-12, 3-15
overlap recording 6-5, 9-17
overlapped formats 4-20

P

Paper Advance Command 3-2
paper chamber 3-10
paper-out condition 3-12
parallel interface 2-1
parameters 1-5
peak to peak 5-8
pen lift 4-12
Pen Lift Command 4-12
periodic trigger 7-5
Periodic Trigger Command 7-5
pin connection 2-7
Playback Device Command 9-4, 9-5
Playback Expansion Command 9-8
Playback Format Command 9-6
playback scaling 9-8
Playback Setup Commands 9-3
Playback Trigger Mark Command 9-5
Playback Window Command 9-7

Print Analysis Plot Command 9-15
Print Grid Command 4-8
Print On-Demand Buffer Command 4-24, 6-6
Print System Log Command 4-21

Q

queries 1-6
query capability 1-6
query error 3-15

R

RCTL Remote Control Enable 2-4
real-time data 6-2, 6-9, 6-10
Real-Time Measurement Query 6-8
real-time operation 6-2, 6-3
Real-Time Operation Commands 6-3
real-time recording 6-1, 6-2, 6-4, 6-7, 6-10
Real-Time Setup Commands 5-1
rear panel 2-1
Record Analog Settings Report 9-11
record, data capture 8-3, 8-15, 8-19, 8-20, 9-7, 9-14, 9-15
record, linked 8-4
Record Size Command 8-15
recorder setup 3-3
recording modes 6-1
Remote Control Command 2-6
remote control, enable 2-4
Rename Disk File Command 3-26
Request Data Capture Information 8-20
Request Record Information 8-19
Reset Command 3-23
RMS 5-8
RS-232 interface 1-6, 1-7, 2-1, 2-2, 2-3, 2-4
Run/Freeze Display Command 6-7

S

sample periods 8-18, 9-7
sample rate 8-14
saved chart 4-5
saved chart parameters 4-6
saving to disk 6-2
self-test 3-21
Sensitivity Command 5-5
sensitivity, signal 5-5, 5-11
separators 1-5
serial interface 1-6, 1-7, 2-1, 2-2, 2-3, 2-4
serial poll 2-11, 2-12, 3-9, 3-10, 3-11
service requests (SRQ) 2-12, 3-10, 3-12, 3-15
Set Capture Board Link Status 8-7
Set Capture Board Status 8-7
Set Data Capture Channels Command 8-18
Set Date Command 3-5
Set Dual Speeds Command 6-12
Set Grid Size Command 4-8
Set IEEE-488 Service Request (SRQ) Enable Byte Command 3-12
Set Playback Expansion Command 9-11
Set Playback Report Status Command 9-11
Set Power-On Status Clear Flag 3-18
Set Start Time Command 6-17
Set Stop Time Command 6-17
Set Time Command 3-5
Set Timebase Command 8-14
Set/Change Logging Speed Command 3-8
Set/Change Motor Speed Command 3-7
signal conditioner reporting 4-25
Signal Conditioner Reporting Command 4-25
signal identification 4-20, 6-5, 9-17
signal input 5-1, 5-3, 5-8, 5-11, 6-2, 6-5, 6-10, 9-17
signal level 7-1, 7-4
signal mode 5-8
Signal Mode Command 5-8
signal sensitivity 5-5, 5-11
signal trace 4-12, 4-13
signals 5-1, 5-3

software revision level 3-20
software upgrades 3-25
speed, change 7-1
speed, data logging 3-8
speed, motor 3-7
speeds, dual-speed 6-12
SRQ service request 2-12
SRQ Status Byte 3-14
SRQ Status Byte Register 3-12
stand-alone operation 2-10
Standard Event (ESB) status 3-12
Standard Event Status Enable Command 3-15
Standard Event Status Register 2-12, 3-12, 3-14, 3-17, 3-23
Standard Event Status Register Query 3-17
Start and Stop Commands 6-4, 6-9, 9-17
Start Playback Command 9-14
Start Real-Time Data Logging Command 6-9
Start Real-Time Recording (CHRT) Command 3-1, 4-1, 4-5, 6-1
Start Real-Time Recording Command 6-4
Start Timed Operation Command 6-19
status byte 2-12, 3-10, 3-11, 3-12, 3-14, 3-15
Status Byte Query 2-12, 3-14
status commands 3-9
Status Commands and Queries 3-12
status report 3-2, 9-11
storage, data 7-1, 8-2, 8-12, 8-13
storage, real-time waveform data 8-2
System Commands 3-3
system date 3-5
system event marker 4-13
System Event Marker Command 4-13
system identification 3-20
System Identification Query 3-20
system log 4-21
system parameters 3-1, 4-1, 4-5, 6-1, 6-2
system setups 3-25

T

10-hertz low-pass filter 5-9
terminator 1-6, 2-4, 2-9
text buffers 4-2, 4-22
time interval 4-17
Time Mark Interval Command 4-7, 4-17
Time Mark Status Command 4-17
time marks 4-16, 4-17, 4-18
time, system 3-5
time-based grid 4-7
timebase, data capture 8-14
timed operation 6-2, 6-16, 6-19
timer 6-13
Timer Abort Command 6-19
Timer Chart Command 6-18
trace, signal 4-12, 4-13, 6-5, 9-17
Trace Thickness Command 4-13
trigger 4-13, 6-2, 6-11, 6-13, 7-1, 8-5, 8-8, 8-16
trigger equation 7-9, 7-11
trigger logic 7-9
trigger mark 9-5
trigger source 7-4, 7-10
Trigger Source Command 7-4, 7-5
Trigger/Window Relationship Command 8-16
triggering 7-1
troubleshooting 2-12
TTL pulse 7-1, 7-4

U

user scaling 5-11, 5-12, 5-13, 5-14, 6-8, 6-9
User Scaling Offset Command 5-14
User Scaling Status Command 5-12
User Scaling Translation Command 5-13
utility D-shell 7-1, 7-4

V

Vacuum Flourescent Display 4-2, 6-7
VF Display 4-1, 4-2, 6-7, 9-1, 9-4
voltage level 7-7
voltage per centimeter 5-5

W

Wait Command 3-22, 3-24, 8-21, 9-12
waveform trigger 7-5, 7-7
Waveform Trigger Level Command 7-7
waveforms 6-7
window 8-16

X

X and Y Channels Command 9-6, 9-9
X/Y format 9-6, 9-9
X/YY format 9-9

Z

zero position 5-6
Zero Position Command 5-6
zero suppression 5-7
Zero Suppression Command 5-7
zero volts 5-6

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