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Errata

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Programming Reference

HP 16530A/16531A
Oscilloscope Module

for the HP 16500A Logic Analysis System



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Programming the HP 16530A/16531A

1

Introduction

This manual combined with the *HP 16500A Programming Reference* manual provides you with the information needed to program the HP 16530A oscilloscope module. Each module has its own manual to supplement the mainframe manual since not all mainframes will be configured with the same modules.

About This Manual

This manual is organized into ten chapters. The first chapter contains:

- General information and instructions to help you get started
- Mainframe system commands that are frequently used with the oscilloscope module
- HP 16530A Oscilloscope command tree
- Alphabetic command-to-subsystem directory

Chapter two contains module level commands. Chapters three through ten contain the subsystem commands for the oscilloscope.

Error messages for the HP 16530A are included in generic system error messages and are in the *HP 16500A Programming Reference* manual.

Programming the HP 16530A Oscilloscope

This section introduces you to the basic command structure used to program the oscilloscope. Also included is an example program that displays a waveform and makes automatic parametric measurements.

Selecting the Module

Before you can program the oscilloscope, you must first "select" it, otherwise, there is no way to direct your commands to the oscilloscope.

To select the module, use the system command :SELect followed by the numeric reference for the slot location of the oscilloscope (1...5 refers to slot A...E respectively). For example, if the oscilloscope timebase card is in slot E, then the command:

```
:SELect 5
```

would select this module. For more information on the select command, refer to the *HP 16500A Programming* manual.

Setting up an Oscilloscope

The easiest and fastest way to set up the oscilloscope is to use the AUTOSCALE command. The AUTOSCALE command causes the oscilloscope to automatically select the vertical sensitivity, vertical offset, trigger source, trigger level and timebase settings for optimum viewing of any input signals. The trigger source is the lowest channel on which the trigger was found. If no signal is found, the oscilloscope defaults to auto-trigger.

To demonstrate a quick oscilloscope setup, we will use the compensation signal available at the timebase card rear panel. This square wave is normally used for calibration and probe compensation.

Connect the COMPENSATION SIGNAL from the timebase card to INPUT 1 of the oscilloscope. Ensure that the mainframe is connected to a controller. Enter the program listed on the next page and execute it.

Example Program

```
10 OUTPUT XXX;":SELECT 5"
20 OUTPUT XXX;":AUTOSCALE"
30 DIM Me$[200]
40 OUTPUT ;":MEASURE:SOURCE CHANNEL1;ALL?"
50 ENTER XXX;Me$
60 PRINT Me$
70 END
```

Note

The three Xs (XXX) after the OUTPUT and ENTER statements in the above example refer to the device address required for programming over either HP-IB or RS-232-C. Refer to your controller manual and programming language reference manual for information on initializing the interface.

Program Comments

Line 10 selects the oscilloscope in slot E.
Line 20 causes the oscilloscope to execute the AUTOSCALE command.
Line 30 dimensions and reserves memory for the string array
Line 40 causes the oscilloscope to make all the parametric measurements of the Measure subsystem. The source for the measurements is channel 1.
Line 50 enters data from the oscilloscope.
Line 60 causes the data to be printed either on controller screen or hardcopy, depending on the output device chosen.

For more information on the specific oscilloscope commands, refer to chapters 2 through 10 of this manual.

Mainframe Commands

These commands are part of the HP 16500A mainframe system and are mentioned here only for reference. For more information on these commands, refer to the *HP 16500A Programming Reference* manual.

CARDcage? Query

The CARDcage query returns a series of integers which identify the modules that are installed in the mainframe. The returned string is in two parts. The first five two-digit numbers identify the card type. The identification number for the HP 16530A oscilloscope is 11. A "-1" in the first part of the string indicates no card is installed in the slot.

The five single-digit numbers in the second part of the string indicate which slots have cards installed, which card has the controlling software for the module, and where the master card is located.

Example: `12,11,-1,-1,31,2,2,0,0,5`

A returned string of 12,11,-1,-1,31,2,2,0,0,5 means that an oscilloscope timebase card (ID number 11) is loaded in slot B and the oscilloscope acquisition card (ID number 12) is loaded in slot A. The next two slots (C and D) are empty (-1). Slot E contains a logic analyzer module (ID number 31).

The next group of numbers (2,2,0,0,5) indicate that a two card module is installed in slots A and B with the master card in slot B. The "0" indicates an empty slot or the module software is not recognized or not loaded. The last digit (5) in this group indicates a single module card is loaded in slot E. Complete information for the CARDcage query is in the *HP 16500A Programming Reference* manual.

MENU
Command/query

The MENU command selects a new displayed menu. The first parameter specifies the desired module. The optional second parameter specifies the desired menu in the module (defaults to 0 if not specified). The query returns the currently selected (and displayed) menu.

For the HP 16530A Oscilloscope:

- X,0 - Channel Menu
- X,1 - Trigger Menu
- X,2 - Display Menu
- X,3 - Auto-Measure Menu
- X,4 - Calibration Menu

X = slot number that contains the oscilloscope timebase card

SELect
Command/query

The SELect command selects which module or intermodule will have parser control. SELect 0 selects the intermodule, SELect 1 through 5 selects modules A through E respectively. Parameters -1 and -2 select software options 1 and 2. The SELect query returns the currently selected module.

STARt
Command

The STARt command starts the specified module or intermodule. If the specified module is configured for intermodule, STARt will start all modules configured for intermodule.

STOP
Command

The STOP command stops the specified module or intermodule. If the specified module is configured for intermodule, STOP will stop all modules configured for intermodule.

RMODe Command/query The RMODe command specifies the run mode (single or repetitive) for a module or intermodule. If the selected module is configured for intermodule, the intermodule run mode will be set by this command. The RMODe query returns the current setting.

SYSTem:ERRor? Query The SYSTem:ERRor query returns the oldest error in the error queue. In order to return all the errors in the error queue, a simple FOR/NEXT loop can be written to query the queue until all errors are returned. Once all errors are returned, the queue will return zeros.

SYSTem:PRINt Command/query The SYSTem:PRINt command initiates a print of the screen or listing buffer over the current printer communication interface. The SYSTem:PRINt query sends the screen or listing buffer data over the current controller communication interface.

MMEMory Subsystem The MMEMory Subsystem provides access to both internal disc drives for loading and storing configurations.

INTermodule Subsystem The INTermodule Subsystem commands are used to specify intermodule arming between multiple modules.

Command Set Organization

The command set for the HP 16530A is divided into module level commands and subsystem commands. Module level commands are listed in Chapter 2 and each of the subsystem commands are covered in their individual chapters starting with Chapter 3.

Each of these chapters contain a description of the subsystem, syntax diagrams and the commands in alphabetical order. The commands are shown in longform and shortform using upper and lowercase letters. For example, TRIGger indicates that the longform of the command is TRIGGER and the shortform is TRIG. Each of the commands contains a description of the command and its arguments, the command syntax, and a programming example.

Figure 1-1 is the command tree for the HP 16530A oscilloscope module.

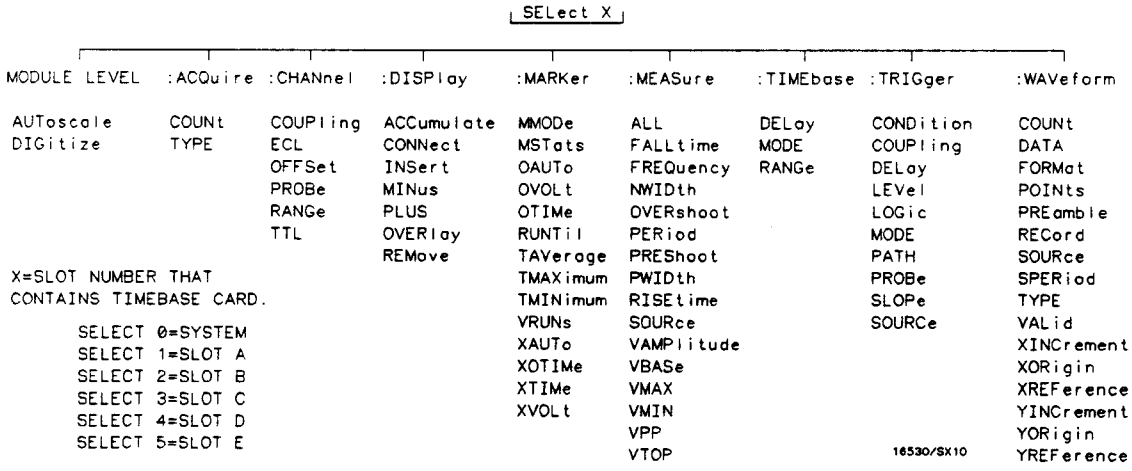


Figure 1-1. HP 16530A Command Tree

Table 1-1. Alphabetical Command to Subsystem Directory

COMMAND	WHERE USED
ACCumulate	DISPlay
AUToscale	MODULE LEVEL
ALL	MEASure
CONDition	TRIGger
CONNect	DISPlay
COUNt	ACQuire
	WAVeform
COUPling	CHANnel
	TRIGger
DATA	WAVeform
DELay	TIMebase
	TRIGger
DIGitize	MODULE LEVEL
ECL	CHANnel
FALLtime	MEASure
FORMat	WAVeform
FREQuency	MEASure
INSert	DISPlay
LEVel	TRIGger
LOGic	TRIGger
MINus	DISPlay
MMODe	MARKer
MODE	TIMebase
	TRIGger
MSTats	MARKer
NWIDth	MEASure
OAUTo	MARKer
OFFSet	CHANnel
OTIMe	MARKer
OVERlay	DISPlay
OVERshoot	MEASure
OVOLt	MARKer
PATH	TRIGger
PERiod	MEASure
PLUS	DISPlay
POINts	WAVeform
PREambie	WAVeform
PREShoot	MEASure
PROBe	CHANnel
	TRIGger
PWIDth	MEASure
RANGe	CHANnel
	TIMebase
RECord	WAVeform
REMove	DISPlay
RISetime	MEASure
RUNtil	MARKer
SLOPe	TRIGger
SOURce	MEASure
	TRIGger
	WAVeform
SPERiod	WAVeform
TAVerage	MARKer
TMAXimum	MARKer
TMINimum	MARKer
TTL	CHANnel
TYPE	ACQuire
	WAVeform
VALid	WAVeform
VAMPlitude	MEASure
VBASe	MEASure
VMAX	MEASure
VMIN	MEASure
VPP	MEASure
VRUNs	MARKer
VTOP	MEASure
XAUTo	MARKer
XINCrement	WAVeform
XORigin	WAVeform
XREFerence	WAVeform
XOTime	MARKer
XTIMe	MARKer
XVOLt	MARKer
YINCrement	WAVeform
YORigin	WAVeform
YREFerence	WAVeform

16530/SX11

Module Status Reporting

Each module reports its status to the Module Event Status Register (MESR<N>) which in turn reports to the Combined Event Status Register (CESR) in the HP 16500A mainframe (see *HP 16500A Programming Reference* manual Chapter 6). The Module Event Status Register is enabled by the Module Event Status Enable Register (MESE<N>).

The following descriptions of the MESE<N> and MESR<N> commands provide the module specific information needed to enable and interpret the contents of the registers.

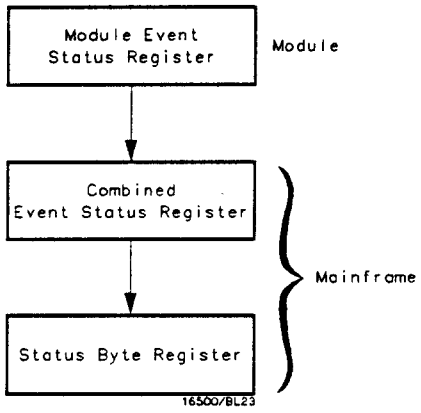


Figure 1-2. Module Status Reporting

MESE<N> command/query

The MESE<N> command sets the Module Event Status Enable register bits. The MESE register contains a mask value for the bits enables in the MESR register. A one in the MESE will enable the corresponding bit in the MESR, a zero will disable the bit.

The first parameter specifies the module, and the second parameter specifies the enable value. 1...5 refers to the module in slot A...E.

The MESE query returns the current setting.

Refer to table 1-2 for information about the Module Event Status register bits, bit weights, and what each bit masks for the module.

Command Syntax: :MESE<N> <enable_mask>

where:

<N> ::= {1|2|3|4|5} number of slot in which the module resides
<enable_mask> ::= integer 0 to 255

Example: OUTPUT XXX;":MESE5 2"

Query Syntax: :MESE<N>?

Returned Format: [MESE]<enable_mask><NL>

Example:
```
10 OUTPUT XXX;":MESE5?"
20 ENTER XXX; Mes
30 PRINT Mes
40 END
```

Table 1-2. Module Event Status Enable Register

Module Event Status Enable Register (A "1" enables the MESR bit)		
Bit	**Weight**	**Enables**
7	128	Not used
6	64	Not used
5	32	Not used
4	16	Number of averages met
3	8	Auto triggered
2	4	Trigger received
1	2	RNT-Run until satisified
0	1	MC-Measurement complete

The Module Event Status Enable Register contains a mask value for the bits to be enabled in the Module Event Status Register (MESR). A one in the MESE enables the corresponding bit in the MESR, a zero disables the bit.

MESR < N > query

The MESR < N > query returns the contents of the Module Event Status register.

Note

Reading the register clears the Module Event Status Register.

Table 1-3 shows each bit in the Module Event Status Register and their bit weights for this module. When you read the MESR, the value returned is the total bit weights of all bits that are high at the time the register is read.

The parameter 1...5 refers to the module in slot A...E respectively.

Query Syntax: :MESR < N > ?

Returned Format: [MESR] < status > < NL >

where:

< N > ::= {1|2|3|4|5} number of slot in which the module resides
< status > ::= 0 to 255

Example:
```
10 OUTPUT XXX;":MESR5?"
20 ENTER XXX; Mer
30 PRINT Mer
40 END
```

Table 1-3. Module Event Status Register

Module Event Status Register		
Bit	**Weight**	**Condition**
7	128	Not used
6	64	Not used
5	32	Not used
4	16	1 = Number of averages satisfied 0 = Number of averages not satisfied
3	8	1 = Auto trigger received 0 = Auto trigger not received
2	4	1 = Trigger received 0 = No trigger received
1	2	1 = Run until satisified 0 = Run until not satisified
0	1	1 = Measurement complete 0 = Measurement not complete

Module Level Commands 2

Introduction

Oscilloscope Module Level commands control the basic operation of the oscilloscope. Refer to figure 2-1 for the module level syntax diagram.

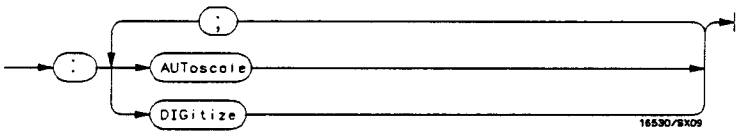


Figure 2-1. Module Level Command Syntax Diagram

AUToscale

Command

The AUToscale causes the oscilloscope to automatically select the vertical sensitivity, vertical offset, trigger source, trigger level and timebase settings for optimum viewing of any input signals. The trigger source is the lowest channel on which the trigger was found. If no trigger is found, the oscilloscope defaults to auto-trigger. The display window configuration is not altered by AUToscale.

Command Syntax: :AUToscale

Example: OUTPUT XXX;":AUTOSCALE"

DIGitize Command

The DIGitize Command is used to acquire waveform data for transfer over HP-IB. The command initiates the Repetitive Run for the oscilloscope and any modules that are grouped together in Group Run through the Intermodule Bus. If a RUNTIL condition has been specified in any module, the oscilloscope and the grouped modules will acquire data until the RUNTIL conditions have been satisfied.

The Acquire subsystem commands may be used to set up conditions such as acquisition type and average count for the DIGITIZE command. See the Acquire subsystem for the description of these commands.

When a count number in the average acquisition type has been specified, the oscilloscope and all grouped modules will acquire data until these conditions have been satisfied.

When both the RUNTIL and the AVERAGE COUNT have been satisfied, the acquisition will stop.

For a faster data transfer rate over the interface bus, display a menu that has no waveforms on screen.

Note

The DIGITIZE command is an overlap command, thus ensure that all data has been acquired and stored in the channel buffers before executing any other commands. The MESE command and the MESR query may be used to check for run complete or a WAIt instruction may be inserted after the DIGITIZE command to ensure enough time for command execution.

Command Syntax: :DIGitize

Example:

```
10 CLEAR 707
20 OUTPUT XXX;":SELECT 4"
30 OUTPUT XXX;":SYSTEM:HEADER OFF;:EOI ON"
40 OUTPUT XXX;":ACQUIRE:TYPE NORMAL"
50 OUTPUT XXX;":WAVEFORM:SOURCE CHANNEL1"
60 OUTPUT XXX;":WAVEFORM:FORMAT BYTE"
70 OUTPUT XXX;":WAVEFORM:RECORD FULL"
80 OUTPUT XXX;":AUTOSCALE"
90 DIM Header$[20]
100 OUTPUT XXX;":DIGITIZE"
110 Length = 4096
120 ALLOCATE INTEGER Waveform(1:Length)
130 OUTPUT XXX;":WAVEFORM:DATA?"
140 ENTER XXX; USING "#10A";Header$
150 ENTER XXX; USING "#,B";Waveform(*)
160 ENTER XXX; USING "#,B";Lastchar
170 END
```

ACQuire Subsystem 3

Introduction

The Acquire subsystem commands are used to setup acquisition conditions for the DIGitize command. The subsystem contains commands to select the type of acquisition and the number of averages to be taken if the average type is chosen. Refer to Figure 3-1 for the Acquire Subsystem Syntax Diagram.

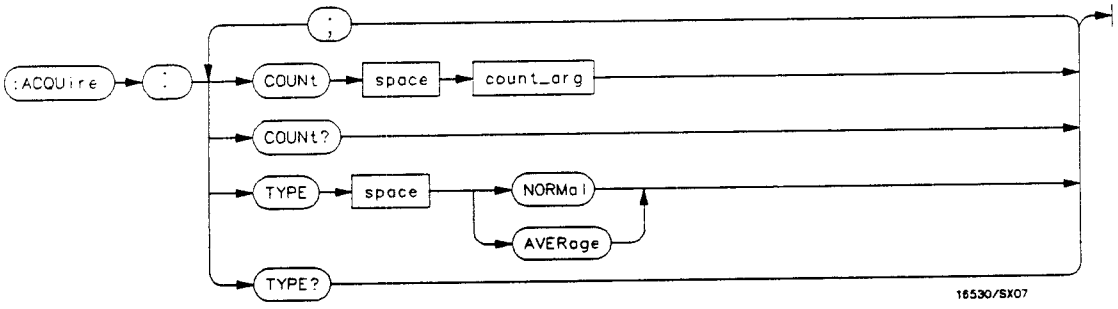
Acquisition Type Normal

In the Normal mode, with the ACCUMULATE command OFF, the oscilloscope acquires waveform data and then displays the waveform. When the oscilloscope makes a new acquisition, the previously acquired waveform is erased from the display and replaced by the newly acquired waveform.

When the ACCUMULATE command is ON, the oscilloscope displays all the waveform acquisitions without erasing the previously acquired waveform.

Acquisition Type Average

In the Average mode, the oscilloscope averages the data points on the waveform with previously acquired data. Averaging helps eliminate random noise from the displayed waveform. In this mode the ACCUMULATE command is OFF. When Average mode is selected, the number of averages must also be specified using the COUNt command. Previously averaged waveform data is erased from the display and the newly averaged waveform is displayed.



count_arg = *An integer that specifies the number of averages to be taken of each time point. The choices are 2, 4, 8, 16, 32, 64, 128, or 256.*

Figure 3-2. Acquire Subsystem Syntax Diagram

COUNt — Command/Query

The COUNt command specifies the number of acquisitions for the running weighted average. This command generates an error if Normal acquisition mode is specified. The query returns the last specified count.

Command Syntax: :ACQuire:COUNt <count>

where

<count> ::= {2|4|8|16|32|64|128|256}

Example
```
OUTPUT XXX;":ACQUIRE:COUNT 16"
```

Query Syntax: :ACQuire:COUNt?

Returned Format [:ACQuire:COUNt] <count><NL>

Example:
```
10 DIM Ac$[100]
20 OUTPUT XXX;":ACQ:COUN?"
30 ENTER XXX;Ac$
40 PRINT Ac$
50 END
```

TYPE — Command/Query

The TYPE command selects the type of acquisition that is to take place when a DIGITIZE or START command is executed. One of two acquisition types may be chosen: the NORMAL or AVERAGE mode. The query returns the last specified type.

Command Syntax :ACQuire:TYPE {NORMal|AVERage}

Example: OUTPUT XXX;":ACQUIRE:TYPE NORMAL"

Query Syntax: :ACQuire:TYPE?

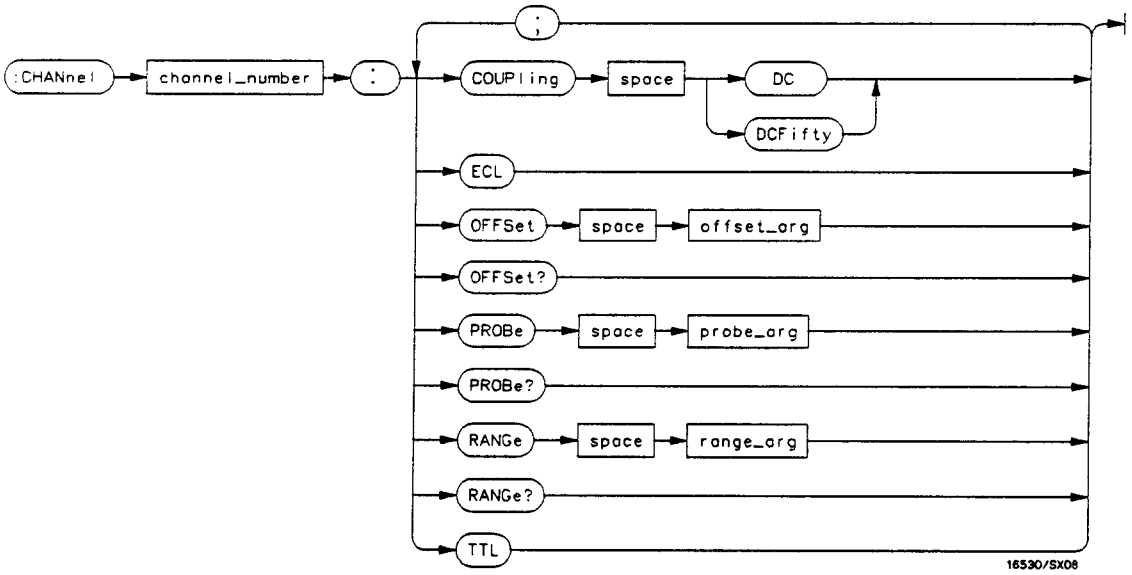
Returned Format: [:ACQuire:TYPE] {NORMAL|AVERAGE}<NL>

Example:
```
10 DIM At$[100]
20 OUTPUT XXX;":ACQUIRE:TYPE?"
30 ENTER XXX;At$
40 PRINT At$
50 END
```

CHANnel Subsystem 4

Introduction

The Channel Subsystem commands control the channel display and the vertical axis of the oscilloscope. Each channel must be programmed independently for all offset, range and probe functions. When ECL or TTL commands are executed, the vertical range, offset and trigger levels are automatically set for optimum viewing. Refer to figure 4-1 for the channel subsystem Syntax Diagram.



channel_number = *An integer from 1 through 8, depending on how many acquisition cards are installed in the oscilloscope*

P/O Figure 4-1. Channel Subsystem Syntax Diagram

offset_arg = *a real number defining the voltage at the center of the display. The offset range is as follows: up to 800 mV for any vertical range less than 800 mV, up to 16 V for any vertical range equal to or greater than 800 mV.*

probe_arg = *an integer from 1 through 1000, specifying the probe attenuation with respect to 1.*

range_arg = *a real number specifying vertical sensitivity. The allowable range is 40 mV to 16 V for a probe attenuation of 1. The specified range is equal to 4 times Volts/Div.*

P/O Figure 4-1. Channel Subsystem Syntax Diagram

COUPling — Command/Query

The COUPling command sets the input impedance for the selected channel. The choices are either 1M Ohm (DC) or 50 Ohms (DCFIFTY). The query returns the current input impedance for the specified channel.

Command Syntax: :CHANnel<N>:COUPling {DC|DCFifty}

where:

<N> ::= 1 through the number of channels in the oscilloscope.

Example:
```
OUTPUT XXX;":CHANNEL1:COUPLING DC"
```

Query Syntax: :CHANnel<N>:COUPling?

Returned Format: [:CHANnel<N>:COUPling:] {DC|DCFifty}<NL>

Example:
```
10 DIM Cc$[100]
20 OUTPUT XXX;":CHANNEL1:COUPLING?"
30 ENTER XXX;Cc$
40 PRINT Cc$
50 END
```

ECL Command

The ECL command sets the vertical range, offset, and trigger levels for optimum viewing of ECL signals. The ECL values are:

Range: 2.0 V
Offset: -1.0 V
Trigger level: -1.3 V

Command Syntax: :CHANnel<N>:ECL

where:

<N> ::= 1 through the number of channels in the oscilloscope.

Example: OUTPUT XXX;":CHANNEL1:ECL"

To return to "Preset User", redefine CHANnel RANGe, OFFSet or TRIGger LEVel.

OFFSet — Command/Query

The OFFSET command sets the voltage that is represented at center screen for the selected channel. The allowable offset is 800 mV on any vertical range less than 800 mV and 16 V for any vertical range greater than or equal to 800 mV. The offset value is recompensated whenever the probe attenuation factor is changed. The query returns the current value for the selected channel.

Command Syntax: :CHANnel<N>:OFFSet <value>

where:

<N> ::= 1 through the number of channels in the oscilloscope.
<value> ::= 800 mV for any vertical range less than 800 mV, 16V for any vertical range equal to or greater than 800 mV

Example:
```
OUTPUT XXX;":CHAN1:OFFS 1.5"
```

Query Syntax: :CHANnel<N>:OFFSet?

where:

<N> ::= 1 through the number of channels in the oscilloscope

Returned Format: [:CHANnel<N>:OFFSet] <value><NL>

Example:
```
10 DIM Co$[100]
20 OUTPUT XXX;":CHANNEL1:OFFSET?"
30 ENTER XXX;Co$
40 PRINT Co$
50 END
```

PROBe — Command/Query

The PROBe command specifies the attenuation factor for an external probe connected to a channel. The command changes the channel voltage references such as range, offset, trigger levels and automatic measurements. The actual sensitivity is not changed at the channel input. The allowable probe attenuation factor is an integer from 1 to 1000. The query returns the probe attenuation factor for the selected channel.

Command Syntax: :CHANnel<N>:PROBe <atten>

where:

<N> ::= 1 through the number of channels in the oscilloscope.
<atten> ::= 1 to 1000 (integer)

Example:
```
OUTPUT XXX;":CHAN1:PROB 10"
```

Query Syntax: :CHANnel<N>:PROBe?

Returned Format: [:CHANnel<N>:PROBe]<atten><NL>

Example:
```
10 DIM Att$[100]
20 OUTPUT XXX;":CHANNEL1:PROBE?"
30 ENTER XXX;Att$
40 PRINT Att$
50 END
```

RANGe — Command/Query

The RANGe command defines the full-scale (4 * Volts/Div) vertical axis of the selected channel. The values for the RANGe command are dependent on the current probe attenuation factor for the selected channel. The allowable range for a probe attenuation factor of 1:1 is 40 mV to 16 V. For a larger probe attenuation factor, multiply the range limit by the probe attenuation factor. The query returns the current range setting.

Command Syntax: :CHANnel<N>:RANGe <range>

where:

<N> ::= 1 through the number of channels in the oscilloscope

<range> ::= 40 mV to 16 V for a probe attenuation factor of 1:1

Example:
```
OUTPUT XXX;":CHANNEL1:RANGE 4.8"
```

Query Syntax: :CHANnel<N>:RANGe?

Returned Format: [:CHANnel<N>:RANGe] <range><NL>

where:

<range> ::= 40 mV to 16 V when probe attenuation factor is set to 1:1

Example:
```
10 DIM Pr$[100]
20 OUTPUT XXX;":CHANNEL1:RANGE?"
30 ENTER XXX;Pr$
40 PRINT Pr$
50 END
```

TTL Command

The TTL command sets the vertical range, offset, and trigger level for the selected channel for optimum viewing of TTL signals. The set TTL values are:

Range: 6.0 V
Offset: 2.5 V
Trigger Level: 1.62 V

Command Syntax: :CHANnel<N>:TTL

where:

<N> ::= 1 through the number of channels in the oscilloscope

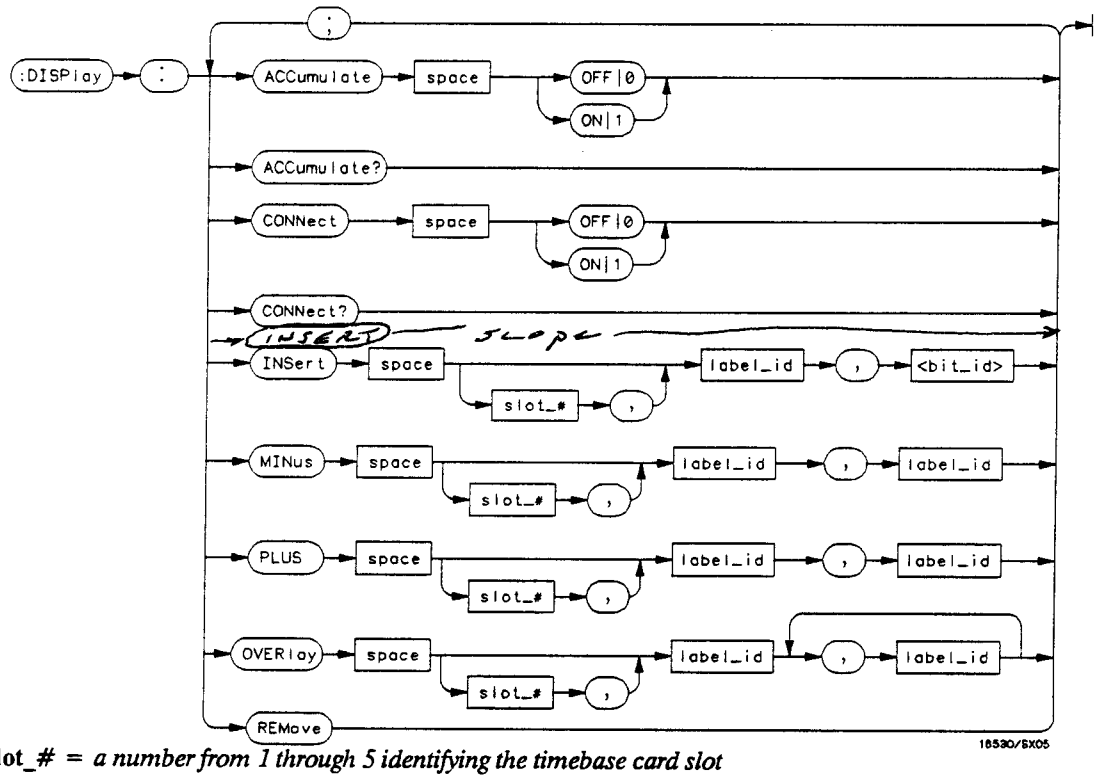
Example: OUTPUT XXX;":CHANNEL1:TTL"

To return to "Preset User" redefine CHANnel RANGe, OFFSet or TRIGger LEVel.

DISPlay Subsystem 5

Introduction

The Display subsystem is used to control the display of data. Refer to Figure 5-1 for the syntax diagram of this subsystem.



slot_# = *a number from 1 through 5 identifying the timebase card slot*

label_identification = *a string of 1 alpha and 1 numeric character for the oscilloscope, or 6 characters for the timing modules.*

Figure 5-1. Display Subsystem Syntax Diagram

ACCumulate

Command/Query

The ACCumulate command works in conjunction with the commands in the Acquisition Subsystem. In the Normal mode, the ACCumulate command turns the infinite persistence on or off. The query reports if accumulate is turned on or off.

Command Syntax: :DISPLAY:ACCumulate {{ON|1}|{OFF|0}}

Example: OUTPUT XXX;":DISPLAY:ACC ON"

Query Syntax: :DISPLAY:ACCumulate?

Returned Format: [:DISPlay:ACCumulate] {1|0}<NL>

Example:
```
10 DIM Ac$[100]
20 OUTPUT XXX;":DISPLAY:ACCUMULATE?"
30 ENTER XXX;Ac$
40 PRINT Ac$
50 END
```

CONNect — Command/Query

The CONNect command sets the Connect Dots mode. When ON, each displayed sample dot will be connected to the adjacent dot by a straight line. The waveform in this mode is easier to see. When OFF, only the sampling points will be displayed. The query reports if connect is on or off.

Command Syntax: :DISPlay:CONNect {{ON|1}|{OFF|0}}

Example: OUTPUT XXX;":DISPLAY CONNECT ON"

Query Syntax: :DISPlay:CONNect?

Returned Format: [:DISPlay:CONNect] {1|0}<NL>

Example:
```
10 DIM Dots$[100]
20 OUTPUT XXX;":DISPLAY:CONNECT?"
30 ENTER XXX;Dots$
40 PRINT Dots$
50 END
```

INSert Command

The INSert command inserts waveforms into the current display. Time-correlated waveforms from another oscilloscope module, logic analyzer or high speed timing modules may also be added to the current display. The waveforms are added to the top of the screen. Only eight oscilloscope waveforms can be displayed at any time.

The first parameter is optional and specifies the module from where the waveform is to be taken. The module number is the same as the slot number in which the timebase card is installed. If a module is not specified, the current module is assumed. The second parameter is the label of the waveform that is to be added to the current display. The label names depend on the slot in which the acquisition cards are installed. The example of figure 5-2 shows the labeling scheme for six acquisition channels (three acquisition cards).

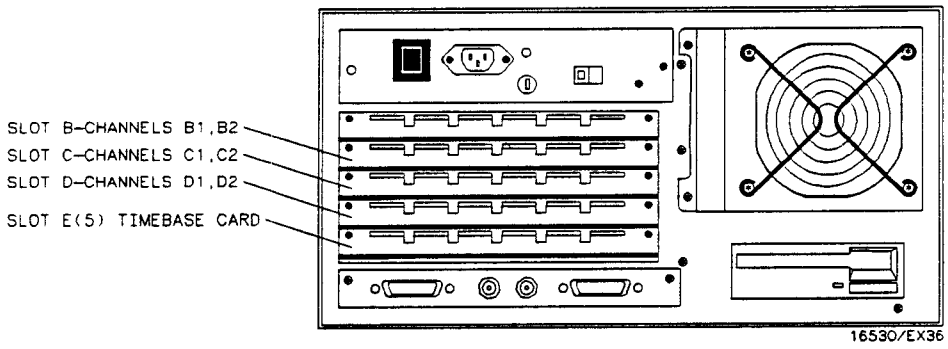


Figure 5-2. Oscilloscope Label Identification.

Command Syntax: Inserting a waveform from the oscilloscope to the oscilloscope display:

:DISPlay:INSert [<module number>]<label>

where:

<module number> ::= slot in which timebase card is installed.
<label> ::= string of 1 alpha and 1 numeric character

Example: OUTPUT XXX;":DISPLAY:INSERT 'C1'"

Command Syntax: Inserting a waveform from a logic analyzer or high speed timing module to the oscilloscope display:

:DISPlay:INSert <slot no>,<label>,<bit-id>

where:

<slot no> ::= module from which waveform is to be taken
<label> ::= string of up to 6 alphanumeric characters
<bit-id> ::= integer from 0 to 31

Example: :OUTPUT XXX;":DISPLAY:INSERT 4'WAVE'10"

For a complete explanation of the label name and the , refer to the *HP 16510A Logic Analyzer Programming Reference* manual or the *HP 16515A High Speed Timing Programming Reference* manual.

MINus Command

The MINus command algebraically subtracts one channel from another and inserts the resultant waveform to the display. The first parameter is an optional module specifier. The module is identified by the slot number that contains the timebase card. If a module is not specified, the current module is assumed. The next two parameters are the labels of the waveform selected is be added to the display. The label names are defined in the same manner as the INSERT command.

Command Syntax: :DISPlay:MINus [<module number>]<label>,<label>

where:

<module number> ::= slot number in which timebase card is installed
<label> ::= string of 1 alpha and 1 numeric character

Example: OUTPUT XXX;":DISPLAY:MINUS 5,'C1','C2'"

OVERlay Command

The OVERlay command overlays oscilloscope waveforms. The syntax parameters are the labels of the waveform that are to be overlaid. Only waveforms sharing a common master card can be overlaid. A label may be used only once with each OVERLAY command.

Command Syntax: :DISPlay:OVERlay <label>,<label>[,...]

where:

<label> ::= string of 1 alpha and 1 numeric character

Example: OUTPUT XXX;":DISPLAY:OVERLAY 'C1','C2'"

or: OUTPUT XXX;":DISPLAY:OVERLAY 'C1','C2','B1','B2'"

PLUS Command

The PLUS command algebraically adds two channels and inserts the resultant waveform to the current display. The first parameter is optional module specifier and needs to be used only if a second timebase card is installed or an other module is displayed. The next parameters are the labels of the waveform that are to be added.

Command Syntax: :DISPlay:PLUS [<module number>,]<label>,<label>

where:

<module number> ::= slot number in which timebase card is installed
<label> ::= string of 1 alpha and 1 numeric character

Example: OUTPUT XXX;":DISPLAY:PLUS 5,'B1','B2'"

REMove Command

The REMove command removes all displayed waveform from the current display.

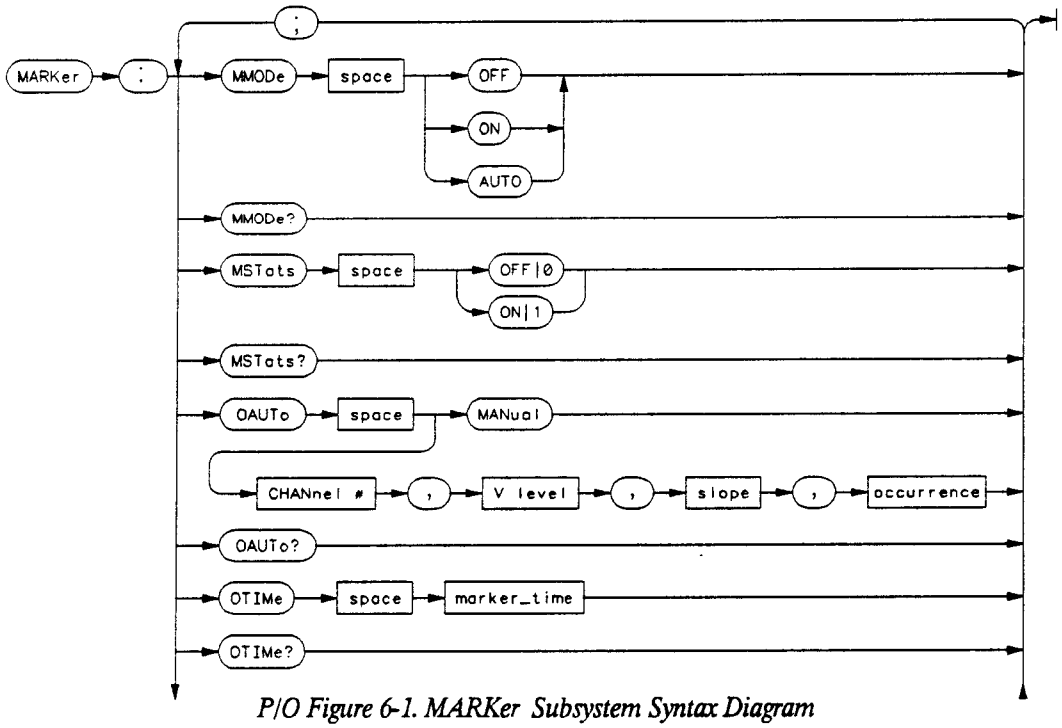
Command Syntax: :DISPlay:REMove

Example: OUTPUT XXX;":DISPLAY:REMOVE"

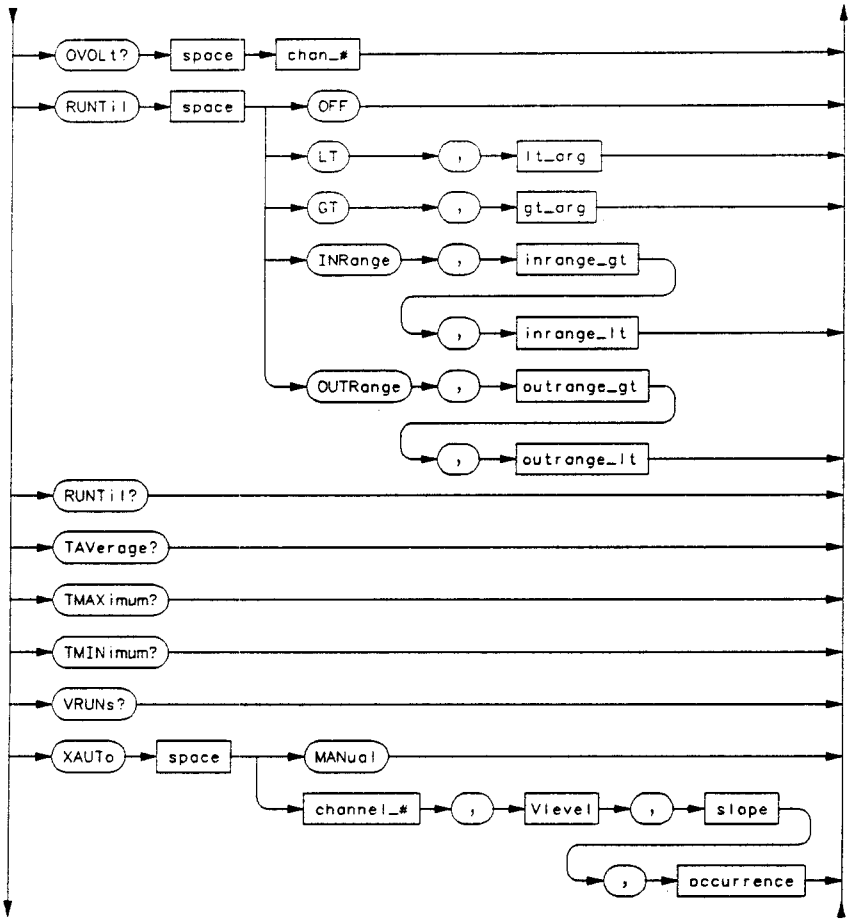
MARKer Subsystem 6

Introduction

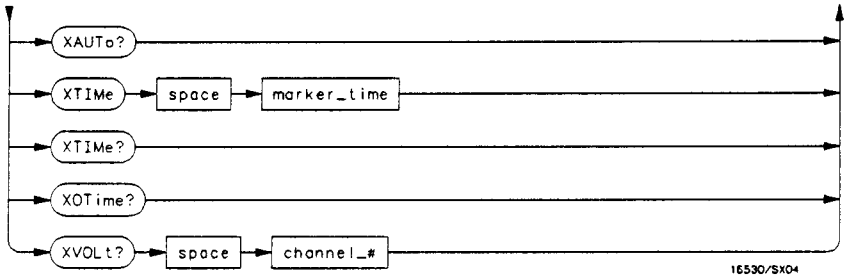
In addition to automatic parametric measurements, the oscilloscope has two markers for making time and voltage measurements. These measurements may be made automatically or manually. Another feature is the RUN UNTIL TIME mode. This feature allows you to set a stop condition based on the time interval between X marker and O marker. When this condition is met, the oscilloscope will stop acquiring data. Refer to Figure 6-1 for the Marker Syntax Diagram.



P/O Figure 6-1. MARKer Subsystem Syntax Diagram



P/O Figure 6-1. MARKer Subsystem Syntax Diagram



channel_# = *An integer from 1 through 8, depending on how many acquisition cards are installed.*
marker_time = *time in seconds from trigger marker to X or O marker*
lt_arg = *time in seconds that specifies the less than (lt) RUNtil time*
gt_arg = *time in seconds that specifies the greater than (gt) RUNtil time*
inrange_gt = *time in seconds specifying the lower limit of the INRange runtime*
inrange_lt = *time in seconds specifying the upper limit of the INRange runtime*
outrange_gt = *time in seconds specifying the lower limit of the OUTRange runtime*
outrange_lt = *time in seconds specifying the upper limit of the OUTRange runtime*
V level = *voltage level from 10% to 90%*
slope = *positive or negative slope*
occurrence = *integer from 1 to 100*

P/O Figure 6-1. MARKer Subsystem Syntax Diagram

MMODe — Command/Query

The MMODe command allows you to select the marker mode. The choices are: OFF, ON and AUTO. When OFF, marker measurements can not be made. When the markers are turned on, the X and O markers can be moved to make time and voltage measurements. The AUTO mode allows you to make automatic marker placements by specifying channel, voltage level, slope and occurrence count for each marker. Also the Statistics mode may be used when AUTO MARKER is chosen. This mode allows you to make minimum, maximum and mean time interval measurements from marker X to O. The query returns the current marker choice.

Command Syntax: :MARKer:MMODe {OFF|ON|AUTO}

Example:
```
OUTPUT XXX;":MARKER:MMODE ON"
```

Query Syntax: :MARKer:MMODe?

Returned Format: [:MARKer:MMODe] <state><NL>

where:

<state> ::= ON or OFF or AUTO

Example:
```
10 DIM Mm$[100]
20 OUTPUT XXX;":MARKER:MMODE?"
30 ENTER XXX;Mm$
40 PRINT Mm$
50 END
```

MSTats — Command/Query

The MSTats command allows you to turn statistics ON or OFF in the auto marker mode. When statistics is turned on, Min X-O, Max X-O, and Mean X-O times are displayed on screen. When off, X-O, Trig-X, Trig-O times will be displayed on screen. The query returns the current setting.

Command Syntax: :MARKer:MSTats {{ON|1}|{OFF|0}}

Example:
```
OUTPUT XXX;":MARKER:MSTATS ON"
```

Query Syntax: :MARKer:MSTats?

Returned Format: [:MARKer:MSTats]{1|0}<NL>

Example:
```
10 DIM Time$[100]
20 OUTPUT XXX;":MARKER:MSTATS?"
30 ENTER XXX;Time$
40 PRINT Time$
50 END
```

OAUTo

Command/Query

The OAUTo command specifies the automatic placement specification for the O marker. The first parameter specifies if automarker placement is to be in the manual mode or on a specified channel. If a channel is specified, three other parameters must be included in the command syntax. The three parameters are: voltage level in percent, the slope, and the occurrence count. The query returns the current settings.

Command Syntax: :MARKer:OAUTo{ MANual|CHANnel<N>,<level>,<slope>,<occurrence>}

where:

<N> ::= 1 through the number of channels in the oscilloscope
<level> ::= voltage level from 10% to 90%
<slope> ::= POSitive or NEGative
<occurrence> ::= integer from 1 to 100

Example:
```
OUTPUT XXX;":MARKER:OAUTO CHANNEL1,50,POSITIVE,5"
```

Query Syntax: :MARKer:OAUTo?

Returned Format: [:MARKer:OAUTo] CHANnel<N>,<level>,<slope>,<occurrence><NL>

Example:
```
10 DIM Oam$[100]
20 OUTPUT XXX;":MARKER:OAUTO?"
30 ENTER XXX;Oam$
40 PRINT Oam$
50 END
```

OTIMe — Command/Query

The OTIMe command moves the O marker to the specified time with respect to the trigger marker. The query returns the time in seconds between the O marker and the trigger time.

Command Syntax: :MARKer:OTIMe <O marker time>

where:

<O marker time> ::= time in seconds from trigger marker to O marker.

Example:
```
OUTPUT XXX;":MARKER:OTIME 1E-6"
```

Query Syntax: :MARKer:OTIMe?

Returned Format: [:MARKer:OTIMe] <O marker time> <NL>

Example:
```
10 DIM Otime$[100]
20 OUTPUT XXX;":MARKER:OTIME?"
30 ENTER XXX;Otime$
40 PRINT Otime$
50 END
```

OVOLt

Query

The OVOLt query returns the current voltage level of the selected source at the O marker.

Query Syntax: :MARKer:OVOLt? CHANNEL<N>

where:

<N> ::= 1 through the number of channels in the oscilloscope

Returned Format: [:MARKer:OVOLt]<level><NL>

where:

<level> ::= level in volts that O marker is set to.

Example:

```
10 DIM Ovm$[100]
20 OUTPUT XXX;":MARKER:OVOLT?"
30 ENTER XXX;Ovm$
40 PRINT Ovm$
50 END
```

RUNTil

Command/Query

The RUNTil command allows you to set a stop condition based on the time interval between the X marker and the O marker. In repetitive runs, when the time specifications are met, the oscilloscope stops acquiring data and the advisory Stop condition satisfied will be displayed on screen. The query will return the current Run Until X - O setting.

Command Syntax: :RUNTil
{OFF|LT,<time>|GT,<time>|INRange,<time>,<time>|OUTRange,<time>,<time>}

where:

<time> ::= a real number specifying the time in seconds between the X and O markers

Example:
```
OUTPUT XXX;":RUNTIL LT,1MS"
```

Query Syntax: :MARKer:RUNTil?

Returned Format: [:MARKer:RUNTil]
{OFF|LT,<time>|GT<time>|INRange<time>,<time>|OUTRange<time>,<time>}<NL>

Example:
```
10 DIM Run$[100]
20 OUTPUT XXX;":MARKER RUNTIL?"
30 ENTER XXX;Run$
40 PRINT Run$
50 END
```

TAVerage

Query

The TAVerage query returns the average time between the X and O markers. If there is no valid data, the query returns 9.9E37.

Query Syntax: :MARKer:TAVerage?

Returned Format: [:MARKER:TAVERAGE] <time value> <NL>

where:

<time value> ::= real number

Example:

```
10 DIM Tv$[100]
20 OUTPUT XXX;":MARKER:TAVERAGE?"
30 ENTER XXX;Tv$
40 PRINT Tv$
50 END
```

TMAXimum

Query

The TMAXimum query returns the value of the maximum time between the X and O markers. If there is no valid data, the query returns 9.9E37.

Query Syntax: :MARKer:TMAXimum?

Returned Format: [:MARKer:TMAXimum] <time value> <NL>

where:

<time value> ::= real number

Example:

```
10 DIM Tx$[100]
20 OUTPUT XXX;":MARKER:TMAXIMUM?"
30 ENTER XXX; Tx$
40 PRINT Tx$
50 END
```

TMINimum

Query

The TMINimum query returns the value of the minimum time between the X and O markers. If there is no valid data, the query returns 9.9E37.

Query Syntax: :MARKer:TMINimum?

Returned Format: [:MARKer:TMINimum] <time value> <NL>

where:

<time value> ::= real number

Example:

```
10 DIM Tm$[100]
20 OUTPUT XXX;":MARKER:TMINIMUM?"
30 ENTER XXX;Tm$
40 PRINT Tm$
50 END
```

VRUNs — Query

The VRUNs Query returns the number of valid runs and the total number of runs made. Valid runs are those where the edge search for both the X and O markers was successful, resulting in valid marker time measurement.

Query Syntax: :MARKer:VRUNs?

Returned Format: [:MARKer:VRUNs] <valid runs>,<total runs><NL>

where:

<valid runs> ::= positive integer
<total runs> ::= positive integer

Example:

```
10 DIM Vr$[100]
20 OUTPUT XXX;":MARKER:VRUNS?"
30 ENTER XXX; Vr$
40 PRINT Vr$
50 END
```

XAUTo

Command/Query

The XAUTo command specifies the X marker placement. The first parameter specifies if the automatic placement specification is to be in the Manual mode or on a specified channel. If a channel is specified, three other parameters must be included in the command syntax. The three parameters are: voltage level in percent, the slope and the occurrence count. The query returns the current settings.

Command Syntax: :XAUTo [MANUal |CHANnel<N>],<level>,<slope>,<occurrence]>

where:

<N> ::= 1 through the number of channels in the oscilloscope
<level> ::= voltage level from 10% to 90%
<slope> ::= POSitive or NEGative
<occurrence> ::= integer from 1 to 1000

Example:
```
OUTPUT XXX;":MARKER:XAUTO CHANNEL1,50,POSITIVE,5"
```

Query Syntax: :MARKer:XAUTo?

Returned Format: [:MARKer:XAUTo] CHANnel <N>,<level>,<slope>,<occurrence><NL>

Example:
```
10 DIM Xam$[100]
20 OUTPUT XXX;":MARKER:XAUTO?"
30 ENTER XXX;Xam$
40 PRINT Xam$
50 END
```

XOTime

Query

The XOTime query returns the time in seconds from the X marker to the O marker. If data is not valid, the query returns 9.9E37.

Query Syntax: :MARKer:XOTime?

Returned Format: [:MARKer:XOTime] <time> <NL>

where:

<time> ::= real number

Example:

```
10 DIM Xo$[100]
20 OUTPUT XXX;":MARKER:XOTIME?"
30 ENTER XXX;Xo$
40 PRINT Xo$
50 END
```

XTIMe

Command/Query

The XTIMe command moves the X marker to the specified time with respect to the trigger marker. The query returns the time in seconds between the X marker and the trigger time.

Command Syntax: :MARKer:XTIMe <X marker time>

where:

<X marker time> ::= time in seconds from trigger marker to X marker

Example:
```
OUTPUT XXX;":MARKER:XTIME 1E-6"
```

Query Syntax: :MARKer:XTIMe?

Returned Format: [:MARKer:XTIMe] <marker time> <NL>

Example:
```
10 DIM Xt$[100]
20 OUTPUT XXX;":MARKER:XTIME?"
30 ENTER XXX;Xt$
40 PRINT Xt$
50 END
```

XVOLt

Query

The XVOLt query returns the current voltage level of the selected channel at the X marker.

Query Syntax: :MARKer:XVOLt? CHANnel < N >

where:

< N > ::= 1 through the number of channels in the oscilloscope

Returned Format: [:MARKer:XVOLt] < level > < NL >

where:

< level > ::= level in volts that the X marker is set to on the waveform

Example:

```
10 DIM Xvm$[100]
20 OUTPUT XXX;":MARKER:XVOLT? CHANNEL1"
30 ENTER XXX;Xvm$
40 PRINT Xvm$
50 END
```

MEASure Subsystem 7

Introduction

The commands/queries in the Measure Subsystem are used to make automatic parametric measurements on displayed waveforms. Measurements are made on the displayed waveform(s) specified by the SOURCE command. If the source is not specified the last waveform source is assumed. Measurements are made in the following manner:

Frequency The frequency of the first complete cycle displayed is measured using the 50% level.

Period The period of the first displayed waveform is measured at the 50% level.

Peak-to-Peak The absolute minimum and the maximum voltages for the selected source are measured.

Positive Pulse Width Pulse width is measured at the 50% level of the first displayed pulse.

Negative Pulse Width Pulse width is measured at the 50% level of the first displayed pulse.

Risetime The risetime of the first displayed rising edge is measured. To obtain the best possible measurement accuracy, select the fastest sweep speed while keeping the rising edge on the display. The risetime is determined by measuring time at the 10% and the 90% voltage points of the rising edge.

Falltime Falltime is measured between the 10% and the 90% points of the first displayed falling edge. To obtain the best possible measurement accuracy, select the fastest sweep speed possible while keeping the falling edge on the display.

Preshoot and Overshoot Preshoot and overshoot measure the perturbation on a waveform above or below the top and base voltages.

Preshoot is a perturbation before a rising or a falling edge and measured as a percentage of the top-base voltage.

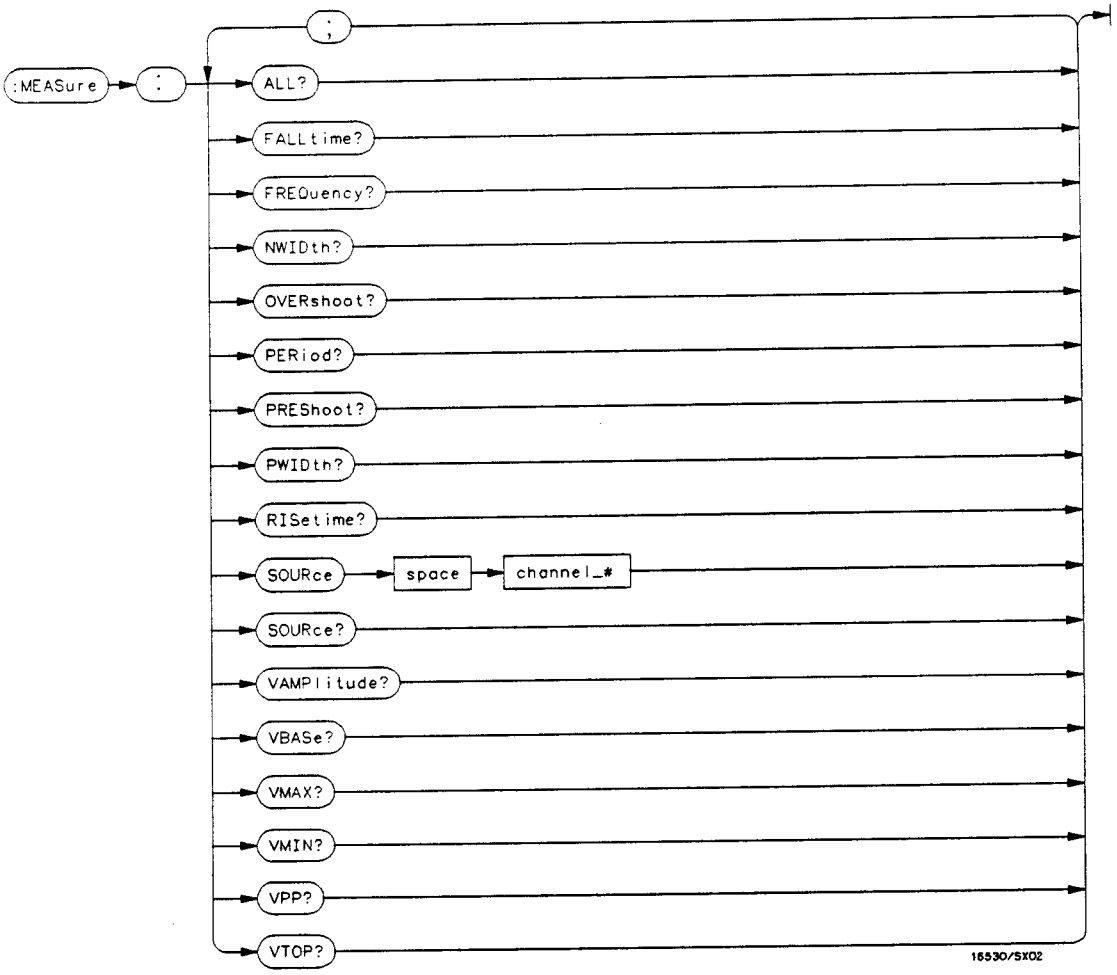
Overshoot is a perturbation after a rising or falling edge and is measured as a percentage of the top-base voltage.

For complete details of the measurement algorithms, refer to the Front-panel Operating Reference Manual.

Refer to Figure 7-1 for the Measure Subsystem Syntax Diagram

Before using any of the Measure Subsystem queries, note that the SOURce command is part of every query of this subsystem. The SOURce command specifies the channel that is to be used for making the measurements.

If a parameter cannot be measured, the instrument responds with 9.9E+37.



channel_# = *an integer from 1 through 8, depending on how many acquisition cards are installed*

Figure 7-1. MEASure Subsystem Syntax Diagram

ALL

Query

The ALL Query makes a set of measurements on the displayed waveform using the selected source.

Query Syntax: :MEASure:ALL?

where:

<N> ::= 1 through the number of channels in the oscilloscope

Returned Format:

```
[:MEASure:ALL PERiod] <real number>;
[RISetime] <real number>;
[FALLtime] <real number>;
[FREQuency] <real number>;
[PWIDtH] <real number>;
[NWIDtH] <real number>;
[VPP] <real number>;
[VAMPlitude] <real number>;
[PREShoot] <real number>;
[OVERshoot] <real number> <NL>
```

Example:

```
10 DIM All$[300]
20 OUTPUT XXX;":MEASURE:SOURCE CHANNEL1;ALL?"
30 ENTER XXX;All$
40 PRINT All$
50 END
```

FALLtime

Query

The FALLtime query makes a fall time measurement on the selected channel. The measurement is made between the 90% to the 10% voltage point of the first falling edge displayed on screen.

Query Syntax: :MEASure:FALLtime?

where:

<N> ::= 1 through the number of channels in the oscilloscope

Returned Format: [:MEASure:FALLtime] <value><NL>

where:

<value> ::= time in seconds between 10% and 90% voltage points

Example:

```
10 DIM Ft$[100]
20 OUTPUT XXX;":MEASURE:SOURCE CHANNEL2;FALLTIME?"
30 ENTER XXX;Ft$
40 PRINT Ft$
50 END
```

FREQuency

Query

The FREQency query makes a frequency measurement on the selected channel. The measurement is made using the first complete displayed cycle at the 50% voltage level.

Query Syntax: :MEASure:FREQuency?

where:

<N> ::= 1 through the number of channels in the oscilloscope

Returned Format: [:MEAsure:FREQuency] <value> <NL>

<value> ::= frequency in Hertz

Example:

```
10 DIM Frcy$[100]
20 OUTPUT XXX;":MEASURE:SOUR CHAN1;FREQ?"
30 ENTER XXX;Frcy$
40 PRINT Frcy$
50 END
```

NWIDth

Query

The NWIDth query makes a negative width time measurement on the selected channel. The measurement is made between the 50% points of the first falling and the next rising edge displayed on screen.

Query Syntax: :MEASure:NWIDth?

where:

<N> ::= 1 through the number of channels in the oscilloscope

Returned Format: [:MEASure:NWIDth] <value> <NL>

<value> ::= negative pulse width in seconds

Example:

```
10 DIM Nw$[100]
20 OUTPUT XXX;":MEASURE:SOURCE CHAN2;NWID?"
30 ENTER XXX;Nw$
40 PRINT Nw$
50 END
```

OVERshoot

Query

The OVERshoot query makes an overshoot measurement on the selected channel. The measurement is made by finding a distortion following the first major transition. The result is the ratio of OVERshoot vs. VAMPlitude.

Query Syntax: :MEASure:OVERshoot?

where:

<N> ::= 1 through the number of channels in the oscilloscope

Returned Format: [:MEASure:OVERshoot] <value> <NL>

<value> ::= ratio of overshoot to Vamplitude

Example:

```
10 DIM Ovs$[100]
20 OUTPUT XXX;":MEASURE SOURCE CHAN1;OVER?"
30 ENTER XXX;Ovs$
40 PRINT Ovs$
50 END
```

PERiod

Query

The PERiod Query makes a period measurement on the selected channel. The measurement equivalent to the inverse of frequency.

Query Syntax: :MEASure:PERiod?

where:

<N> ::= 1 through the number of channels in the oscilloscope

Returned Format: [:MEASure:PERiod] <value><NL>

where:

<value> ::= waveform period in seconds

Example:

```
10 DIM Pd$[100]
20 OUTPUT XXX;":MEASURE:SOURCE CHANNEL1;PERIOD?"
30 ENTER XXX;Pd$
40 PRINT Pd$
50 END
```

PREShoot — Query

The PREShoot query makes the preshoot measurement on the selected channel. The measurement is made by finding a distortion which precedes the first major transition on screen. The result is the ratio of PREshoot vs. VAMPlitude.

Query Syntax: :MEASure:PREShoot?

where:

<N> ::= 1 through the number of channels in the oscilloscope

Returned Format: [:MEASure:PREShoot] <value><NL>

<value> ::= ratio of preshoot to Vamplitude

Example:

```
10 DIM Prs$[100]
20 OUTPUT XXX;":MEASURE:CHANNEL2;PRES?"
30 ENTER XXX;Prs$
40 PRINT Prs$
50 END
```

PWIDth

Query

The PWIDth query makes a positive pulse width measurement on the selected channel. The measurement is made by finding the time difference between the 50% points of the first rising and the next falling edge displayed on screen.

Query Syntax: :MEASure:PWIDth?

where:

<N> ::= 1 through the number of channels in the oscilloscope

Returned Format: [:MEASure:PWIDth] <value> <NL>

where:

<value> ::= positive pulse width in seconds

Example:

```
10 DIM Pw$[100]
20 OUTPUT XXX;":MEASURE:SOURCE CHANNEL2;PWIDTH?"
30 ENTER XXX;Pw$
40 PRINT Pw$
50 END
```

RISetime

Query

The RISetime query makes a risetime measurement on the selected channel by finding the 10% and 90% voltage levels of the first rising edge displayed on screen.

Query Syntax: :MEASure:RISetime?

where:

<N> ::= 1 through the number of channels in the oscilloscope

Returned Format: [:MEASure:RISetime] <value> <NL>

where:

<value> ::= risetime in seconds

Example:

```
10 DIM Tr$[100]
20 OUTPUT XXX;":MEASURE:SOURCE CHANNEL1;RISETIME?"
30 ENTER XXX;Tr$
40 PRINT Tr$
50 END
```

SOURce

Command/Query

The SOURce command specifies the source to be used for subsequent measurements. If the source is not specified, the last waveform source is assumed. The query returns the presently specified channel.

Command Syntax: :MEASure:SOURce <source>

where:

<source> ::= 1 through the number of channels in the oscilloscope

Example:
```
OUTPUT XXX;":MEASURE:SOURCE CHAN1"
```

Query Syntax: :MEASure:SOURce?

Returned Format: [:MEASure:SOURce] CHANnel<N><NL>

Example:
```
10 DIM So$[100]
20 OUTPUT XXX;":MEASURE:SOURCE?"
30 ENTER XXX;So$
40 PRINT So$
50 END
```

VAMPlitude

Query

The VAMPlitude query makes a voltage measurement on the selected channel. The measurement is made by finding the relative maximum and minimum points on screen.

Query Syntax: :MEASure:VAMPlitude?

where:

<N> ::= 1 through the number of channels in the oscilloscope

Returned Format: [:MEASure:VAMPlitude] <value> <NL>

where:

<value> ::= difference between top and base voltage

Example:

```
10 DIM Va$[100]
20 OUTPUT XXX;":MEASURE:SOURCE CHANNEL2;VAMP?"
30 ENTER XXX;Va$
40 PRINT Va$
50 END
```

VBASe

Query

The VBASe query returns the base voltage (relative minimum) of a displayed waveform. The measurement is made on the selected source.

Query Syntax: :MEASure:VBASe?

where:

<N>t ::= 1 through the number of channels in the oscilloscope

Returned Format: [:MEASure:VBASe] <value> <NL>

<value> ::= voltage at base level of selected waveform

Example:

```
10 DIM Vb$[100]
20 OUTPUT XXX;":MEASURE:SOURCE CHAN1;VBAS?"
30 ENTER XXX;Vb$
40 PRINT Vb$
50 END
```

VMAX — Query

The VMAX query returns the absolute maximum voltage of the selected source.

Query Syntax: :MEASure:VMAX?

where:

<N> ::= 1 through the number of channels in the oscilloscope

Returned Format: [:MEASure:VMAX] <value><NL>

where:

<value> ::= maximum voltage of selected waveform

Example:

```
10 DIM Vma$[100]
20 OUTPUT XXX;":MEASURE:SOURCE CHAN2;VMAX?"
30 ENTER XXX;Vma$
40 PRINT Vma$
50 END
```

VMIN

Query

The VMIN Query returns the absolute minimum voltage present on the selected source.

Query Syntax: :MEASure:VMIN?

where:

<N> ::= 1 through the number of channels in the oscilloscope

Returned Format: [:MEASure VMIN] <value> <NL>

where:

<value> ::= minimum voltage of selected waveform

Example:

```
10 DIM Vmi$[100]
20 OUTPUT XXX;":MEASURE:SOURCE CHAN1;VMIN?"
30 ENTER XXX;Vmi$
40 PRINT Vmi$
50 END
```

VPP — Query

The VPP query makes a peak to peak voltage measurement on the selected source. The measurement is made by finding the absolute maximum and minimum points on the displayed waveform.

Query Syntax: :MEASure:VPP?

where:

<N> ::= 1 through the number of channels in the oscilloscope

Returned Format: [:MEASure:VPP] <value> <NL>

where:

<value> ::= peak to peak voltage of selected waveform

Example:

```
10 DIM Vpp$[100]
20 OUTPUT XXX;":MEASURE:SOURCE CHAN1;VPP?"
30 ENTER XXX;Vpp$
40 PRINT Vpp$
50 END
```

VTOP

Query

The VTOP query returns the voltage at the top (relative maximum) of waveform on the selected source.

Query Syntax: :MEASure:VTOP?

where:

<N> ::= 1 through the number of channels in the oscilloscope

Returned Format: [:MEASure:VTOP] <value> <NL>

where:

<value> ::= voltage at the top of the selected waveform

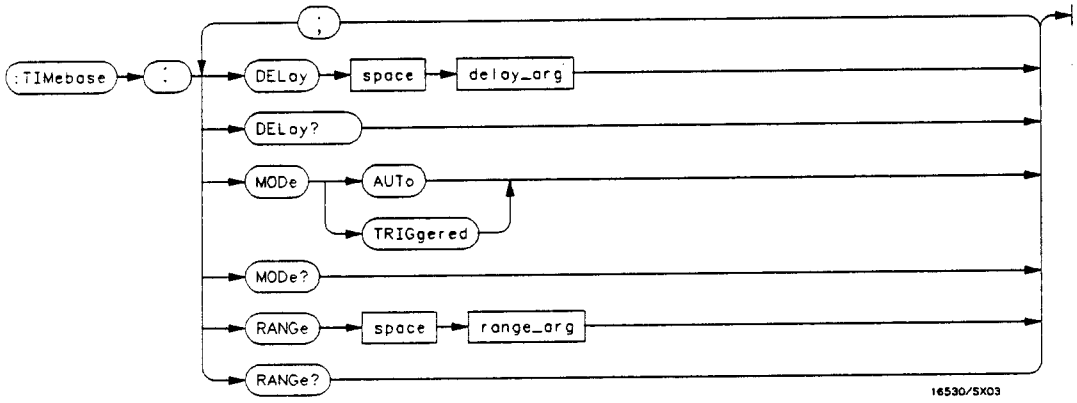
Example:

```
10 DIM Vt$[100]
20 OUTPUT XXX;":MEASURE:SOURCE CHAN2;VTOP?"
30 ENTER XXX;Vt$
40 PRINT Vt$
50 END
```

TIMebase Subsystem 8

Introduction

The commands of the Timebase Subsystem control the Timebase, Trigger Delay Time, and the Timebase Mode. If TRIGGERED mode is to be used, ensure that the trigger specifications of the Trigger Subsystem have been set. Refer to Figure 8-1 for the Timebase Subsystem Syntax Diagram.



delay_arg = *delay time in seconds, from -2500 seconds through +2500 seconds*
range_arg = *a real number from 5ns through 10s*

Figure 8-1. TIMebase Subsystem Syntax Diagram

DELay — Command/Query

The DELay command sets the time between the trigger and the center of the screen if the trigger events count is zero. If the trigger events count is non-zero, the center of the screen is the trigger events count plus the delay time. The query returns the current delay setting.

Command Syntax: :TIMebase:DELay <delay time>

where:

<delay time> ::= delay time in seconds

Example:
```
OUTPUT XXX;":TIM:DEL 2US"
```

Query Syntax: :TIMebase:DELay?

Returned Format: [:TIMebase DELay] <value><NL>

Example:
```
10 DIM Dt$[100]
20 OUTPUT XXX;":TIM:DEL?"
30 ENTER XXX;Dt$
40 PRINT Dt$
50 END
```

MODE

Command/Query

The MODE command sets the oscilloscope timebase to either Auto or Triggered mode. When the AUTO mode is chosen, the oscilloscope waits 25 ms for a trigger to occur. If a trigger is not generated within that time, then auto trigger is executed. If a signal is not applied to the input, a baseline is displayed. If there is a signal at the input and the specified trigger conditions have not been met within 25 ms, the waveform display will not be synchronized to a trigger.

When the TRIGGERED mode is chosen, the oscilloscope waits until a trigger is received before data is acquired. The TRIGGERED mode should be used when the trigger source signal is less than at a 40 Hz repetition rate, or when the trigger events counter is set so that the number of trigger events would not occur before 25 ms.

The Auto-Trig On field in the trigger menu is the same as the AUTO mode over HP-IB or RS-232-C. The TRIGGERED command is the same as the Auto-Trig Off on the front panel. The query returns the current Timebase mode.

Command Syntax: :TIMebase:MODE {TRIGgered | AUTO}

Example:
```
OUTPUT XXX;":TIME:MODE AUTO"
```

Query Syntax: :TIMebase:MODE?

Returned Format: [:TIMebase:MODE] {AUTO | TRIGGERED} < NL >

Example:
```
10 DIM Tm$[100]
20 OUTPUT XXX;":TIMebase:MODE?"
30 ENTER XXX;Tm$
40 PRINT Tm$
50 END
```

RANGe — Command/Query

The RANGE command sets the full-scale horizontal time in seconds. The RANGE value is ten times the front panel field of s/div.

Command syntax: :TIMebase:RANGe <range>

where:

<range> ::= time in seconds

Example:
```
OUTPUT XXX;":TIMEBASE:RANGE 2US"
```

Query Syntax: :TIMebase:RANGe?

Returned Format: [:TIMebase:RANGe] <range><NL>

Example:
```
10 DIM Tr$[100]
20 OUTPUT XXX;":TIMEBASE:RANGE?"
30 ENTER XXX;Tr$
40 PRINT Tr$
50 END
```

TRIGger Subsystem 9

Introduction

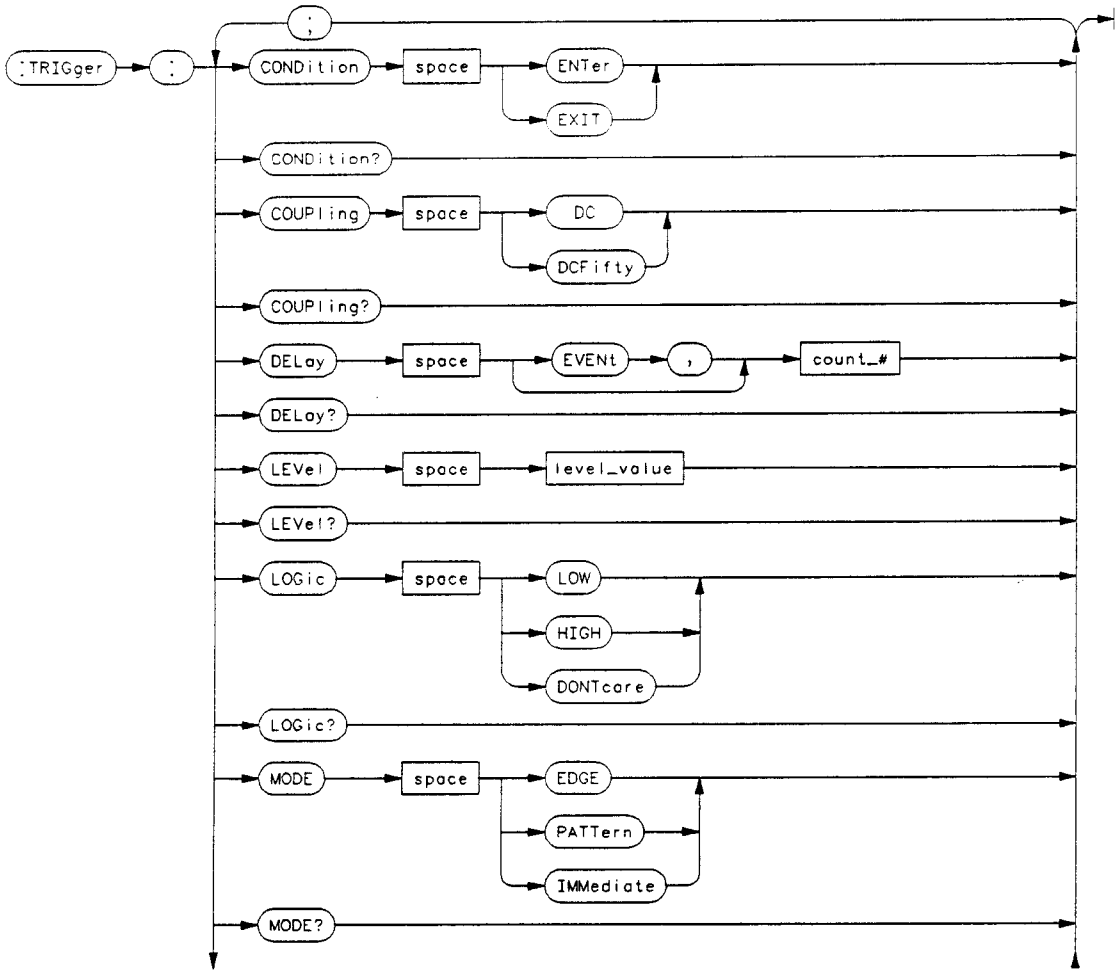
The commands of the Trigger Subsystem allow you to set all the trigger conditions necessary for generating a trigger. Many of the commands in the Trigger subsystem may be used in either the EDGE or the PATTERN trigger mode. If a command is a valid command for the chosen trigger mode, then that setting will be accepted by the oscilloscope. However, if the command is not valid for the trigger mode, an error will be generated. None of the commands of this subsystem are used in conjunction with Immediate trigger mode. See Figure 9-1 for the Trigger Subsystem Syntax Diagram.

The EDGE Trigger Mode

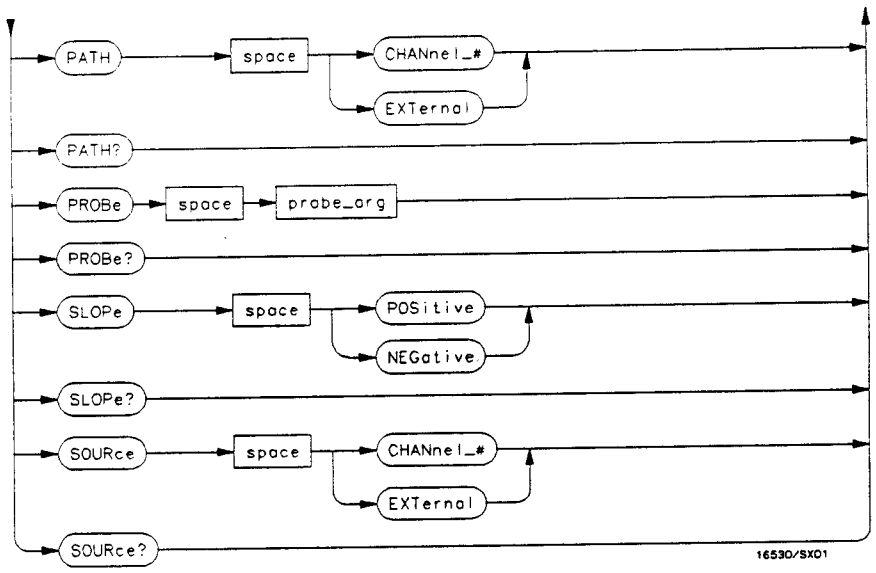
In the EDGE trigger mode, the oscilloscope triggers on an edge of a waveform, specified by the SOURCE, DELAY, LEVEL, and SLOPE commands. If a source is not specified, than the current source is assumed. If EXTERNAL source is specified, the COUPLING and PROBE commands may be used to specify the external input impedance and input attenuation factor.

The PATTERN Trigger Mode

In the pattern trigger mode, the oscilloscope triggers when a pattern is generated using the CONDITION, DELAY, LEVEL, LOGIC and PATH commands. The CONDITION command allows the oscilloscope to trigger when entering the specified pattern or exiting the pattern. The LOGIC command defines the pattern. The PATH command is used to change the trigger pattern and level. The path consists of all the acquisition channels used in the oscilloscope and external trigger input.



P/O Figure 9-1. TRIGger Subsystem Syntax Diagram



count_# = *an integer from 1 through 32000*
level _value = *trigger level in volts*
channel_# = *an integer from 1 through 8 depending on how many acquisition cards are installed in the mainframe*
probe_arg = *an integer from 1 through 1000 specifying the probe attenuation ratio with respect to 1*

P/O Figure 9-1. TRIGger Subsystem Syntax Diagram

CONDition

Command/Query

The CONDition command specifies if a trigger is to be generated on entry (ENTER) to a specific logic pattern or exiting (EXIT) the specified pattern. The specified pattern is defined by using the LOGIC command.

When ENTer is chosen, the oscilloscope will trigger on the first transition that makes the pattern specification true for every input the number of times specified by the trigger event count (DELay command).

When EXIT is selected, the oscilloscope will trigger on the first transition that causes the pattern specification to be false after the pattern has been true for the number of times specified by the trigger event count (DELay command). The query returns the present condition.

Command Syntax: :TRIGger:CONDition {ENTer|EXIT}

Example: OUTPUT XXX;":TRIG:COND ENT"

Query Syntax: :TRIGger:CONDition?

Returned Format: [:TRIGger CONDition] {ENTEr|EXIT}<NL>

Example:
```
10 DIM Ep$[100]
20 OUTPUT XXX;":TRIG:COND?"
30 ENTER XXX;Ep$
40 PRINT Ep$
50 END
```

COUPling

Command/Query

The COUPling command sets the input impedance for the external trigger. The choices are either 1 MOhm (DC) or 50 Ohms (DCFIFTY). The query returns the current input impedance for the external trigger. Use the SOURCE or PATH commands to select the external trigger source or path.

Command Syntax: :TRIGger:COUPling {DC|DCFifty}

Example:
```
OUTPUT XXX;":TRIG:EXT;COUP DC"
```

Query Syntax: :TRIGger:COUPling?

Returned Format: [:TRIGger;COUPling] {DC|DCFifty}<NL>

Example:
```
10 DIM Tc$[100]
20 OUTPUT XXX;":TRIGGER:SOURCE EXTERNAL;COUPLING?"
30 ENTER XXX;Tc$
40 PRINT Tc$
50 END
```

DELay

Command/Query

The DELay command is used to specify the number of events after trigger. The time delay is counted after the events delay. The DELay command cannot be used in the IMMEDIATE trigger mode. The query returns the current trigger events count.

Command Syntax: :TRIGger:DELay [EVENt]<count>

where:

<count>::= integer from 1 to 32000

Example:
```
OUTPUT XXX;":TRIGGER:DELAY 5"
```

Query Syntax: :TRIGger:DELay?

Returned Format: [:TRIGger:DELay] <count><NL>

Example:
```
10 DIM Td$[100]
20 OUTPUT XXX;":TRIG:DEL?"
30 ENTER XXX;Td$
40 PRINT Td$
50 END
```

LEVel

Command/Query

The LEVel command sets the trigger level voltage for the selected source or path. This command cannot be used in the IMMEDIATE trigger mode. In EDGE trigger mode, the SOURCE command is used, in PATTERN mode, the trigger PATH is used for the trigger level source. The LEVEL command in PATTERN trigger mode sets the high/low threshold for the pattern. The query returns the trigger level for the current path or source.

Command Syntax:

For EDGE trigger mode: :TRIGger:LEVel <value>

where:

<value> ::= Trigger level in volts

For PATTERN trigger mode: :TRIGger:MODE PATTern;PATH Channel <N>;LEVEL <value>

where:

<N> ::= 1 through the number of channels in the oscilloscope
<value> ::= Trigger level in volts

Examples:

For EDGE trigger mode: OUTPUT XXX;":TRIG:MODE EDGE;SOUR CHAN1;LEV 1.0"

For PATTERN trigger mode: OUTPUT XXX;":TRIG:MODE PATTERN;PATH CHANNEL2;LEVEL 1.0"

LEVel

Query Syntax:

For EDGE trigger mode: :TRIGger:LEVel?

For PATTERN trigger mode: :TRIGger:PATH CHANnel<N>;LEVel?

Returned Format: [:TRIGger:LEVel] <value><NL>

Example: For EDGE trigger mode

```
10 DIM EI$[100]
20 OUTPUT XXX;":TRIGGER:SOURCE CHANNEL1;LEVEL?"
30 ENTER XXX;EI$
40 PRINT EI$
50 END
```

Example: For PATTERN trigger mode

```
10 DIM PI$[100]
20 OUTPUT XXX;":TRIGGER:PATH CHANNEL1;LEVEL?"
30 ENTER XXX;PI$
40 PRINT PI$
50 END
```

LOGic

Command/Query

The LOGic command sets the logic for each trigger path in the PATTERN trigger mode.The choices are HIGH, LOW and DONTcare. The trigger level set by the LEVEL command determines logic high and low threshold levels. Any voltage higher than the present edge trigger level is considered a logic high for that trigger path; any voltage lower than the trigger level is considered a logic low for that trigger path. The query returns the current logic of the previously selected trigger or path.

Command Syntax: :TRIGger:LOGic {HIGH|LOW|DONTcare}

where:

<N> ::= 1 through the number of channels in the oscilloscope

Example: OUTPUT XXX;":TRIG:MODE PATT;PATH CHAN1;LOG HIGH"

Query Syntax: :TRIGger:LOGic?

Returned Format: [:TRIGger:LOGic] {HIGH|LOW|DONTcare}<NL>

Example:
```
10 DIM Li$[100]
20 OUTPUT XXX;":TRIG:MODE PATT;PATH CHAN1;LOG?"
30 ENTER XXX;Li$
40 PRINT Li$
50 END
```

MODE

Command/Query

The MODE command allows you to select the trigger mode for the oscilloscope. The EDGE mode will trigger the oscilloscope on an edge whose slope is determined by the SLOPe command at a voltage set by the LEVel command. The PATTern mode will trigger the oscilloscope on entering or exiting a specified pattern of all internal channels and external trigger. In the IMMediate trigger mode, the oscilloscope goes to a freerun mode and does not wait for a trigger. This mode is used in intermodule applications.

Command Syntax: :TRIGger:MODE {EDGE|PATTern|IMMediate}

Example:
```
OUTPUT XXX;":TRIGGER:MODE PATTERN"
```

Query Syntax: :TRIGger:MODE?

Returned Format: [:TRIGger:MODE] {EDGE|PATTern|IMMediate}<NL>

Example:
```
10 DIM Md$[100]
20 OUTPUT XXX;":TRIGGER:MODE?"
30 ENTER XXX;Md$
40 PRINT Md$
50 END
```

PATH

Command/Query

The PATH command is used to select a trigger path for the subsequent LOGIC and LEVEL commands. This command can only be used in the PATTERN trigger mode. The query returns the current trigger path.

Command Syntax: :TRIGger:PATH {CHANnel<N>|EXTernal}

where:

<N> ::= 1 through the number of channels in the oscilloscope

Example: OUTPUT XXX;":TRIGGER:PATH EXTERNAL"

Query Syntax: :TRIGger:PATH?

Returned Format: [:TRIGger PATH] {CHANnel<N>|EXTernal}<NL>

Example:
```
10 DIM Tp$[100]
20 OUTPUT XXX;":TRIGGER PATH?"
30 ENTER XXX;Tp$
40 PRINT Tp$
50 END
```

PROBe

Command/Query

The PROBe command specifies the external trigger input attenuation factor. The command does not change the actual input sensitivity, rather it compensates the trigger level for different divider probes used at the input. Before using the PROBE command, set the trigger source or path to external.

Command Syntax: :TRIGger:PROBe <attenuation>

where:

<attenuation> ::= integer from 1 to 1000

Example:
```
OUTPUT XXX;":TRIG:SOUR EXT;PROB 10"
```

Query Syntax: :TRIGger:SOURce EXTernal;PROBe?

Returned Format: [:TRIGger:PROBe] <attenuation> <NL>

Example:
```
10 DIM Ta$[100]
20 OUTPUT XXX;":TRIGGER:SOURCE EXTERNAL;PROBE?"
30 ENTER XXX;Ta$
40 PRINT Ta$
50 END
```

SLOPe — Command/Query

The SLOPe command selects the trigger slope for the previously specified trigger source. This command can only be used in the EDGE trigger mode. The query returns the slope of the current trigger source.

Command Syntax: :TRIGger:SLOPe {POSitive|NEGative}

where:

<N>::= 1through the number of channels in the oscilloscope

Example: OUTPUT XXX;":TRIG:SOUR CHAN1;SLOP POS"

Query Syntax: :TRIGger:SLOPe?

Returned Format: [:TRIGger:SLOPe] {POSitive|NEGative}<NL>

Example:
```
10 DIM Ts$[100]
20 OUTPUT XXX;":TRIG:SOUR CHAN1;SLOP?"
30 ENTER XXX;Ts$
40 PRINT Ts$
50 END
```

SOURce

Command/Query

The SOURce command is used to select the trigger source and is used for any subsequent SLOPE and LEVEL commands. This command can only be used in the EDGE trigger mode. It is the equivalent to the PATH command for the PATTERN trigger mode. The query returns the current trigger source.

Command Syntax: :TRIGger:SOURce {CHANnel<N>|EXTernal}

where:

<N>::= 1 through the number of channels in the oscilloscope

Example:
```
OUTPUT XXX;":TRIG:SOUR CHAN1"
```

Query Syntax: :TRIGger:SOURce?

Returned Format: [:TRIGger:SOURce] {CHANnel<N>|EXTernal}<NL>

Example:
```
10 DIM Tso$[100]
20 OUTPUT XXX;":TRIGGER:SOURCE?"
30 ENTER XXX;Tso$
40 PRINT Tso$
50 END
```

WAVeform Subsystem 10

Introduction

The commands of the Waveform subsystem are used to transfer waveform data from the oscilloscope to a controller. The waveform record is actually contained in two portions; the waveform data and preamble. The waveform data is the actual data acquired for each point when a DIGITIZE command is executed. The preamble contains the information for interpreting waveform data. Data in the preamble includes number of points acquired, format of acquired data, average count and the type of acquired data. The preamble also contains the X and Y increments, origins, and references for the acquired data for translation to time and voltage values.

The values set in the preamble are based on the settings of the variables in the Acquire, Waveform, Channel, and Timebase subsystems. The Acquire subsystem determines the acquisition type and the average count, the Waveform subsystem sets the number of points and format mode for sending waveform data over the remote interface and the Channel and Timebase subsystems set all the X - Y parameters.

Refer to Figure 10-3 for the Waveform Syntax Diagram.

Data Acquisition Types

The two acquisition types that may be chosen are Normal or Average.

Normal Mode

In the Normal mode, with ACCUMULATE command OFF, the oscilloscope acquires waveform data and then displays the waveform. When the oscilloscope takes a new acquisition, the previously acquired waveform is erased from the display and replaced by the newly acquired waveform.

When the ACCUMULATE is set ON, the oscilloscope displays all the waveform acquisitions without erasing the previously acquired waveform.

Average Mode In the Average mode, the oscilloscope averages the data points on the waveform with previously acquired data. Averaging helps eliminate random noise from the displayed waveform. In this mode ACCUMULATE is set to OFF. When Average mode is selected the number of averages must also be specified using the COUNT command. Previously displayed waveform data is erased from the display and the newly averaged waveform is displayed.

Format for Data Transfer

There are three formats for transferring waveform data over the remote interface. These formats are WORD, BYTE, or ASCII.

WORD and BYTE formatted waveform records are transmitted using the arbitrary block program data format specified in IEEE-488.2. When you use this format, the ASCII character string "# <8> <DD...D>" is sent before the actual data.

The <D>'s are ASCII numbers which indicate how may data bytes will follow.

For example, if 4096 points of data are to be transmitted, the ASCII string #800004096 would be sent.

BYTE Format In BYTE format, the six least significant bits represent the waveform data. This means that the display is divided into 64 vertical increments. The most significant bit is not used. The second most significant bit is the overflow bit. If this bit is set to "1" and all data bits are set to "0" then the waveform is clipped at the top of the screen. If all "0" are returned, then the waveform is clipped on the bottom of the display (see figure 10-1).

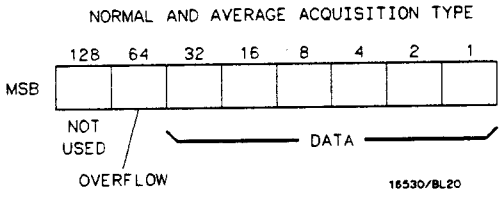


Figure 10-1. Byte Data Structure

The data returned in BYTE format is the same for either Normal or Average acquisition types. The data transfer rate in this format is faster than the other two formats.

WORD Format Word data is two bytes wide with the most significant byte of each word being transmitted first. Each 16 bit value effectively places a data point on screen. The screen therefore is divided into 16384 vertical increments. The WORD data structure for normal and average acquisition types are shown in figure 10-2.

The relationship between BYTE and WORD formats are similar. Byte data values equal word data values divided by 256. This is the reason that the least significant byte in the normal acquisition mode always contains "0"s. In the average acquisition mode, the extra bits of resolution gained by averaging occupy the least significant byte of the word.

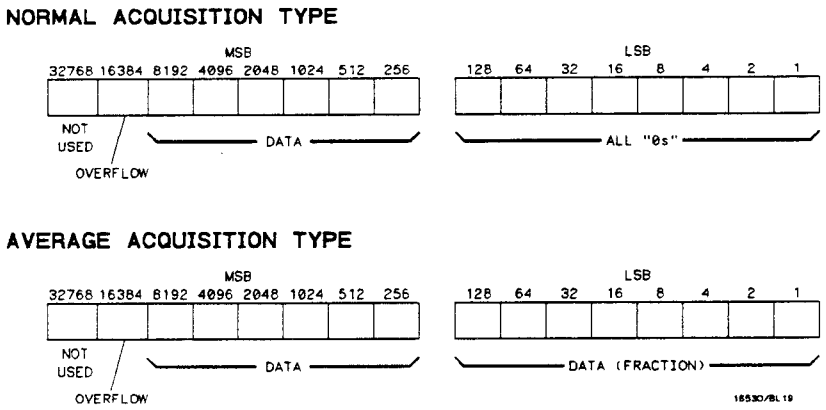


Figure 10-2. Word Data Structure

ASCII Format ASCII formatted waveform records are transmitted one value at a time, separated by a comma. The data values transmitted are the same as would be sent in the WORD format except that they are converted to an integer ASCII format (six or less characters) before being transmitted. The header before the data is not included in this format.

Data Conversion

Data sent from the HP 16530A is raw data and must be scaled for useful interpretation. The values used to interpret the data are the X and Y references, X and Y origins, and X and Y increments. These values are read from the waveform preamble or by the queries of these values.

Conversion from Data Value to Voltage

The formula to convert a data value returned by the instrument to a voltage is:

voltage = [(data value - yreference) * yincrement] + yorigin

Conversion from Data Value to Time

The time value of a data point can be determined by the position of the data point. As an example, the third data point sent with XORIGIN = 16ns, XREFERENCE = 0 and XINCREMENT = 2ns. Using the formula:

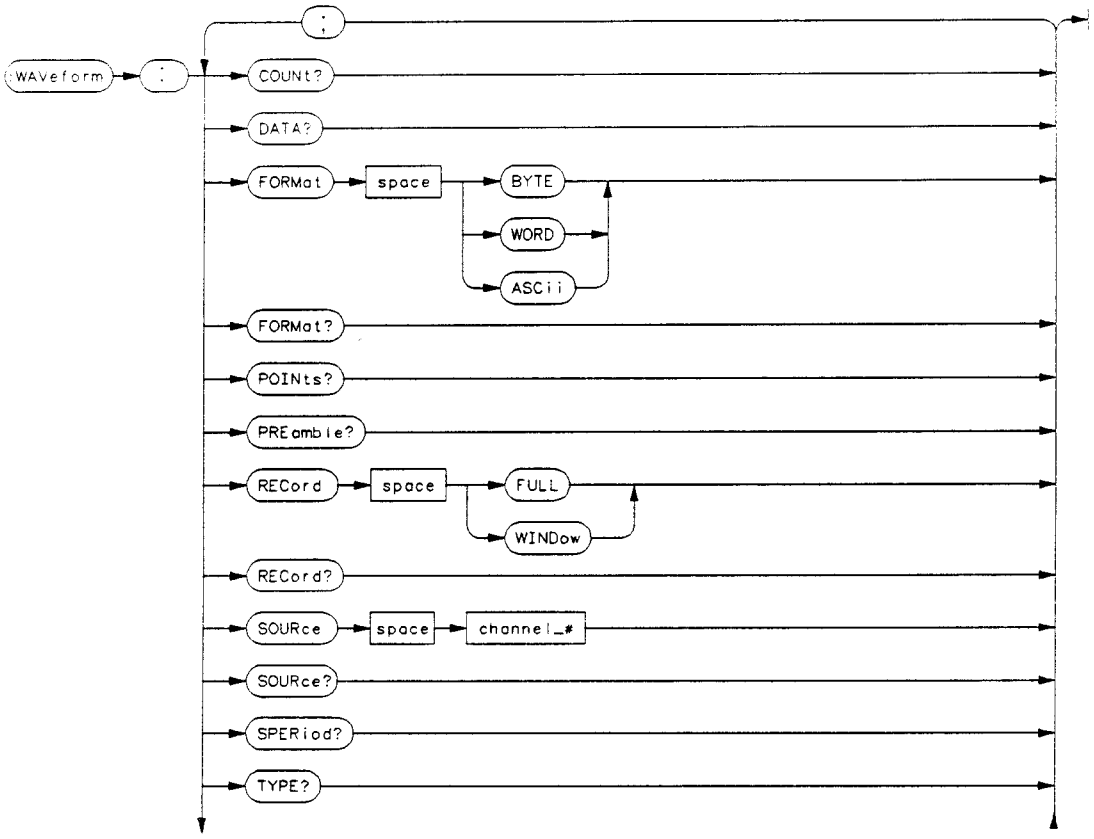
time = [(data point number - xreference) * xincrement] + xorigin

would result in the following calculation:

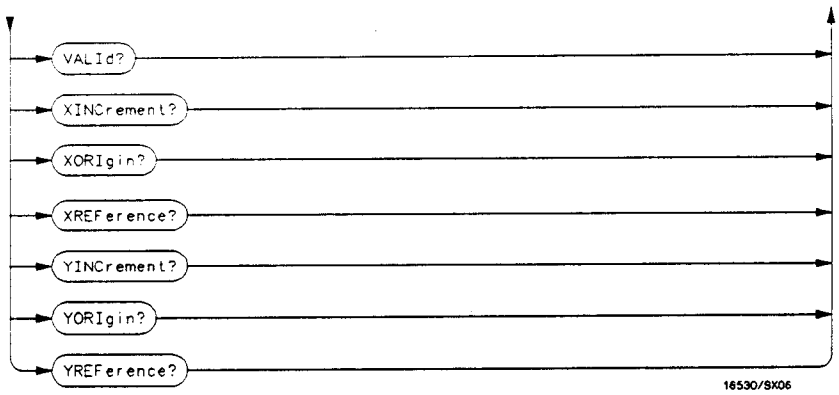
time = [(3 - 0 * 2ns] + 16ns = 22ns.

Conversion from Data Value to Trigger Point

The trigger data point can be determined by calculating the closest data point to time 0.



P/O Figure 10-3. WAVeform Subsystem Syntax Diagram



channel_# = *an integer from 1 through 8 depending on how many acquisition cards are installed in the mainframe*

P/O Figure 10-3. WAVeform Subsystem Syntax Diagram

COUNt — Query

The COUNt query returns the count that was last specified in the Acquire Subsystem.

Query Syntax: :WAVeform:COUNt?

Returned Format: [:WAVeform:COUNt] <count> <NL>

where:

<count> ::= {2|4|8|16|32|64|128|256}

Example:

```
10 DIM Ac$[100]
20 OUTPUT XXX;":ACQUIRE COUNT?"
30 ENTER XXX;Ac$
40 PRINT Ac$
50 END
```

DATA

Query

The DATA query returns the waveform record stored in a specified channel buffer. The SOURce command of this subsystem has to be used to select the specified channel. The data is transferred based on the FORMAT (BYTE, WORD or ASCII) chosen and the RECORD specified (FULL or WINDOW). Since WAVeform:DATA is a query only, it can not be used to send a waveform record back to the oscilloscope from the controller. If a waveform record is to be saved for later reloading into the oscilloscope, the SYSTem:DATA command should be used.

Query Syntax: :WAVeform:DATA?

Returned Format: [:WAVeform:DATA]#800004096 <block data> <NL>

The following example program moves data from the HP 16530A to a controller.

Example:

```
10 CLEAR XXX
20 OUTPUT XXX;":SELECT 4"
30 OUTPUT XXX;":SYSTEM:HEADER OFF;:EOI ON"
40 OUTPUT XXX;":ACQUIRE:TYPE NORMAL"
50 OUTPUT XXX;":WAVEFORM:SOURCE CHANNEL1"
60 OUTPUT XXX;":WAVEFORM:FORMAT BYTE"
70 OUTPUT XXX;":WAVEFORM:RECORD FULL"
80 OUTPUT XXX;":AUTOSCALE"
90 DIM Header$[20]
100 OUTPUT XXX;":DIGITIZE"
110 Length = 4096
120 ALLOCATE INTEGER WAVEFORM(1:Length)
130 OUTPUT XXX;":WAVEFORM:DATA?"
140 ENTER XXX;USING "#10A";Header$
150 ENTER XXX;USING "#,B";Waveform(*)
160 ENTER XXX;USING "#,B";Lastchar
170 END
```

FORMat — Command/Query

The FORMat command specifies the data transmission mode of waveform data over the remote interface. The query returns the currently specified format.

Command Syntax: :WAVeform:FORMat {BYTE|WORD|ASCii}

Example: OUTPUT XXX;":WAV:FORM"

Query Syntax: :WAVeform:FORMat?"

Returned Format: [:WAVeform:FORMat]{BYTE|WORD|ASCii}<NL>

Example:
```
10 DIM Fo$[100]
20 OUTPUT XXX;":WAVEFORM:FORMAT?"
30 ENTER XXX;Fo$
40 PRINT Fo$
50 END
```

POINts

Query

When WAVEFORM RECORD is set to FULL, the POINts query always returns a value of 4096 points. When WAVEFORM RECORD is set to WINDOW, then the query returns the number of points displayed on screen.

Query Syntax: :WAVeform:POINts?

Returned Format: [:WAVeform:POINts] <points> <NL>

where:

<points> ::= number of points depending on setting of WAVEFORM RECORD command

Example:

```
10 DIM Po$[100]
20 OUTPUT XXX;":WAVEFORM:POINTS?"
30 ENTER XXX;Po$
40 PRINT Po$
50 END
```

PREamble

Query

The PREamble query returns the preamble of the specified channel. The channel is specified using the SOURCE command.

Query Syntax: :WAVeform:SOURce CHANnel < N > ;PREamble?

< N > ::= 1 through the number of channels in the oscilloscope

Returned Format: [:WAVeform:PREamble]

< format >,
< type >,
< points >,
< count >,
< Xincrement >,
< Xorigin >,
< Xreference >,
< Yincrement >,
< Yorigin >,
< Yreference > < NL >

Example:

```
10 DIM Pr$[300]
20 OUTPUT XXX;":WAVEFORM:PREAMBLE?"
30 ENTER XXX;Pr$
40 PRINT Pr$
50 END
```

RECord

Command/Query

The RECord command specifies the data you want to receive over the bus. The choices are FULL or WINDOW. When FULL is chosen the entire 4096 point record of the specified channel is transmitted over the bus. In WINDOW mode, only the data displayed on screen will be returned. Use the SOURCE command to select the channel of interest. The query returns the present mode chosen.

Command Syntax: :WAVeform:RECord {FULL|WINDow}

Example: OUTPUT XXX;":WAV:SOUR CHAN1;REC FULL"

Query Syntax: :WAVeform:RECord?

Returned Format: [:WAVeform:RECord] {FULL|WINDow}<NL>

Example:

```
10 DIM Wr$[100]
20 OUTPUT XXX;":WAVEFORM:SOURCE CHANNEL1;RECORD?"
30 ENTER XXX;Wr$
40 PRINT Wr$
50 END
```

SOURce

Command/Query

The SOURce command specifies the channel that is to be used for all subsequent waveform commands. The query returns the presently selected channel.

Command Syntax: :WAVeform:SOURce CHANnel < N >

< N > :: = 1 through the number of channels in the oscilloscope

Example:
```
OUTPUT XXX;":WAVEFORM:SOURCE CHANNEL1"
```

Query Syntax: :WAVeform:SOURce?

Returned Format: [:WAVeform:SOURce] ChANnel < N > < NL >

Example:
```
10 DIM Ws$[100]
20 OUTPUT XXX;":WAVEFORM:SOURCE?"
30 ENTER XXX;Ws$
40 PRINT Ws$
50 END
```

SPERiod

Query

The SPERiod query returns the present sampling period. The sample period is determined by the DELAY and the RANGE commands of the Timebase subsystem.

Query Syntax: :WAVeform:SPERiod?

Returned Format: [:WAVeform:SPERiod] <period> <NL>

where:

<period> ::= time in seconds

Example:

```
10 DIM Sp$[100]
20 OUTPUT XXX;":WAVEFORM:SPERIOD?"
30 ENTER XXX;Sp$
40 PRINT Sp$
50 END
```

TYPE

Query

The TYPE query returns the presently ACQUIRE TYPE set in the ACQUIRE Subsystem.

Query Syntax :WAVeform:TYPE?

Returned Format: [:WAVeform:TYPE]{NORMal|AVERage}<NL>

Example:
```
10 DIM Wt$[100]
20 OUTPUT XXX;":WAVEFORM:TYPE?"
30 ENTER XXX;Wt$
40 PRINT Wt$
50 END
```

VALid

Query

The VALID query checks the oscilloscope for acquired data. If a measurement is completed, and data has been acquired by all channels, then the query reports a 1. A 0 is reported if no data has been acquired for the last acquisition.

Query Syntax: :WAVeform:VALid?

Returned Format: [:WAVeform:VALid] {0|1}<NL>

0 ::= No data acquired
1 ::= Data has been acquired

Example:
```
10 DIM Da$[100]
20 OUTPUT XXX;":WAVEFORM:VALID?"
30 ENTER XXX;Da$
40 PRINT Da$
50 END
```

XINCrement

Query

The XINCrement query returns the X-increment currently in the preamble. This value is the time difference between the consecutive data points.

Query Syntax: :WAVeform:XINCrement?

Returned Format: [:WAVeform:XINCrement] <value> <NL>

<value> ::= X-increment value currently in preamble)

Example:

```
10 DIM Xi$[100]
20 OUTPUT XXX;":WAVEFORM:XINCREMENT?"
30 ENTER XXX;Xi$
40 PRINT Xi$
50 END
```

XORigin

Query

The XORigin query returns the X-origin value currently in the preamble. The value represents the time of the first data point in memory with respect to the trigger point.

Query Syntax: :WAVeform:XORigin?

Returned Format: [:WAVeform:XORigin] <value> <NL>

<value> ::= X-origin currently in preamble

Example:

```
10 DIM Xo$[100]
20 OUTPUT XXX;":WAV:XOR?"
30 ENTER XXX;Xo$
40 PRINT Xo$
50 END
```

XREFerence

Query

The XREFerence query returns the current X-reference value in the preamble. This value specifies the X-value of the first data point in memory and is always 0.

Query Syntax: :WAVeform:XREFerence?

Returned Format: [:WAVeform:XREFerence] <value> <NL>

<value> ::= X-reference value in the preamble

Example:

```
10 DIM Xr$[100]
20 OUTPUT XXX;":WAVEFORM:XREFERENCE?"
30 ENTER XXX;Xr$
40 PRINT Xr$
50 END
```

YINCrement

Query

The YINCrement query returns the Y-increment value currently in the preamble. This value is the voltage difference between consecutive data values.

Query Syntax: :WAVeform:YINCrement?

Returned Format: [:WAVeform:YINCrement] <value> <NL>

<value> ::= Y-increment value in preamble

Example:

```
10 DIM Yi$[100]
20 OUTPUT XXX;":WAVEFORM:YINCREMENT?"
30 ENTER XXX;Yi$
40 PRINT Yi$
50 END
```

YORigin

Query

The YORigin query returns the Y-origin value currently in the preamble. This value is the voltage at center screen.

Query Syntax: :WAVeform:YORigin?

Returned Format: [:WAVeform:YORigin] <value> <NL>

<value> ::= Y-origin value in preamble

Example:

```
10 DIM Yo$[100]
20 OUTPUT XXX;":WAVEFORM:YORIGIN?"
30 ENTER XXX;Yo$
40 PRINT Yo$
50 END
```

YREFerence

Query

The YREFerence Query returns the Y-reference value currently in the preamble. This value specifies the data value at center screen where Y-origin occurs.

Query Syntax: :WAVeform:YREFerence?

Returned Format: [:WAVeform:YREFerence] <value> <NL>

<value> ::= Y-reference data value in preamble

Example:

```
10 DIM Yr$[100]
20 OUTPUT XXX;":WAVEFORM:YREFERENCE?"
30 ENTER XXX;Yr$
40 PRINT Yr$
50 END
```

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