HPDIAL Command Set for the 16500A

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CONTENTS

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1. System Commands Definitions

System commands control the basic operation of the instrument. They can be called at anytime and after the command has been executed, the next unit in the message will be parsed in the module (or System level) that was selected before the system command was executed.

(1) - Indicates that these commands also apply to individual modules when used in conjunction with the SELect command.

(2) - Indicates that this command only applies to individual modules when used in conjunction with the SELect command.

(3) - This command needs to be resolved with ISL.

1.1 System Command Summary

This table is a summary of the System command set. Those commands prefixed with a colon have a position in the command tree. The commands which are not prefixed are common commands.

KEYWORD	PARAMETER	TYPE
*CLS		COMMAND
*ESE	<nrf>	COMMAND/QUERY
*ESR		QUERY
*IDN		QUERY
*IST		QUERY
*OPC		COMMAND/QUERY
*OPT		QUERY
*PRE	<nrf>	COMMAND/QUERY
*PSC	<nrf>	COMMAND/QUERY
*RST		COMMAND
*SRE	<nrf>	COMMAND/QUERY
*STB		QUERY
*TRG		COMMAND
*TST		QUERY
*WAI		COMMAND
:BEEPer	ON|OFF|1|0"	COMMAND/QUERY
:CAPability		QUERY
:CARDcage		QUERY
:DEBug	ON|OFF|1|0	COMMAND/QUERY
:EOI	ON|OFF|1|0	COMMAND/QUERY
:LER?		QUERY
:LOCKout		COMMAND
:MENU	<nrf>[,<nrf>]	COMMAND/QUERY
:RMODe	SINGle|REPetitive	COMMAND/QUERY
:ROOT	<str>	COMMAND/QUERY

:SELect	<nrf>	COMMAND/QUERY
:SETColor	<nrf>[,<nrf>[,<nrf>[,<nrf>	COMMAND/QUERY
:SOUNd	ON|OFF|1|0	COMMAND/QUERY
:STARt		COMMAND
:STOP		COMMAND
:SYSTem		
:DSP	<string>	COMMAND/QUERY
:ERRor	NUMeric|STRing	QUERY
:HEADer	ON|OFF|1|0	COMMAND/QUERY
:LONGform	ON|OFF|1|0	COMMAND/QUERY
:PRINt	SCReen|LISTing	COMMAND/QUERY
:SETup	<block data>	COMMAND/QUERY
:MMEMory		
:AUTOload	{OFF|0}|	
	{ON|1},<string>[,<msus>]	COMMAND/QUERY
:CATalog?	[<msus>]	QUERY
:COPY	[<string>][,<msus>],[<string>][,<msus>]	COMMAND
:DOWNLOAD	<string>[,<msus>],<nrf>,<block_data>	COMMAND
:INITialize	[<msus>]	COMMAND
:LOAD	<string>[,<msus>],<string>	COMMAND
:MSI	[<msus>]	COMMAND
:PACK	[<msus>]	COMMAND
:PURGe	<string>[,<msus>]	
:REName	<string>[,<msus>],<string>	COMMAND
:STORe	<string>[,<msus>],<string>,<string>	COMMAND
:UPLoad?	<string>[,<msus>],integer	QUERY
:INTermodule		
:DELete	ALL|<nrf>|OUT	COMMAND
:INPort	ON|OFF|1|0	COMMAND/QUERY
:INSert	<nrf>|OUT,GROUP|<nrf>	COMMAND
:SKEW	<nrf>,<nrf>	COMMAND/QUERY
:TREE	<nrf>,<nrf>,<nrf>,<nrf>,<nrf>,<nrf>	COMMAND/QUERY

1.2 IEEE-488.2 Common Command Definitions

1.2.1 *CLS

The *CLS common command clears the status data structures, including the device defined error queue. If the *CLS command immediately follows a PROGRAM MESSAGE TERMINATOR, the output queue and the MAV bit will be cleared.

1.2.2 *ESE <nrf>

The *ESE command sets the Standard Event Status Enable Register bits. The query returns the current contents of the register.

returned format: <NR1>

1.2.3 *ESR?

This query returns the contents of the Standard Event Status Register. Reading the register clears it.

returned format: <NR1>

1.2.4 *IDN?

This query allows the instrument to identify itself.

returned format: HEWLETT PACKARD,16500A,0,REV 00.00

1.2.5 *IST?

This query returns the value of the instruments 488 defined "ist" local message.

returned format: <NR1>

1.2.6 *OPC

This command causes the device to generate the operation complete message in the Standard Event Status Register when all pending device operations have been finished. The query places an ASCII "1" in the output queue when all pending device operations have been completed.

returned format: 1

1.2.7 *OPT?

This query returns a the software options available to the 16500A.

1.2.8 *PRE <nrf>

This command sets the parallel poll register enable bits. The query returns the current value of the register.

returned format: <NR1>

1.2.9 *RST

This command places the instrument in a known predefined state.

1.2.10 *SRE <nrf>

The *SRE command sets the Service Request Enable Register bits. The query returns the current value.

returned format: <NR1>

1.2.11 *STB?

This query returns the current value of the instrument's status byte. The MSS (Master Summary Status) bit and not RQS is reported on bit 6. The MSS indicates whether or not the device has at least one reason for requesting service.

returned format: <NR1>

1.2.12 *TRG

This command has the same effect as a Group Execute Trigger (GET). That effect is as if the START command had been sent for Internodule run.

1.2.13 *TST?

The *TST query causes the instrument to perform a self test. The result of the test will be placed in the output queue.

returned format: <NR1>

1.2.14 *WAI

This command causes the device from executing any further commands or queries until all Overlapped commands have been completed. An Overlapped Command is a command that allows execution of subsequent commands while the device operations initiated by that Overlapped Command are still in progress. The following is a list of Overlapped Commands for Vulcan:

STARt
STOP
AUToscale (For the Scope module)

1.3 General System Commands

1.3.1 BEEPer ON|OFF|1|0

This command sets the beeper mode, which controls the sound of the instrument. When BEEPer is sent with no argument, the beeper will be sounded without effecting the current mode. The query returns the mode currently selected.

returned format: 1|0

1.3.2 CAPability?

The capability query returns the HP-SL and lower level capability sets implemented in the device. The response shall be formatted as definite length arbitrary block response data. This query has not been fully defined by ISL.

Example: CAPability? -> IEEE488,1987;SH1,AH1,T6,L4,SR1,RL1,PP1,DC1,DT1,C0,E2

1.3.3 CARDcage? (3)

This query returns the a string which specifies which cards are in the cardcage. The first five numbers returned are the card id numbers (a -1 means no card in slot). The remaining five numbers returned describe the module assignment for each card. The possible values for the module assignment are -1,1,2,3,4,5 where -1 is a don't care and 1..5 is the number of the slot that controls this card.

Example: CARDCAGE? -> CARDCAGE -1,22,21,12,11,-1,3,3,5,5

1.3.4 DEBug ON|OFF|1|0

This command allows the debug mode to be controlled. When the debug mode is on the instrument will display the messages it is receiving and sending. Error conditions will be flagged. The query returns the current setting. This command is not implemented yet.

returned format: 1|0

1.3.5 EOI ON|OFF|1|0

This command specifies whether or not the last byte of a reply from the instrument is to be sent with the EOI bus control line set true or not. If EOI is turned off, the box will no longer be sending 488.2 compliant responses. The query returns the current status of EOI.

returned format: 1|0

1.3.6 LER?

The LER query allows the LCL Event Register to be read. After the LCL Event Register is read, it is cleared. A one indicates a remote- to-local transition has taken place. A zero indicates a remote-to-local transition has not taken place.

1.3.7 LOCKout ON|OFF|1|0

This command locks out or restores front pannel operation.

1.3.8 MENU <nrf>[,<nrf>]

This command puts a menu on the display. The first parameter specifies the desired module. The optional second parameter specifies the desired menu in the module (defaults to 0).

For the System the menu:

MENU 0,0 - System Configuration menu
MENU 0,1 - Rear disc menu
MENU 0,2 - Front disc menu
MENU 0,3 - Utilities menu
MENU 0,4 - Test menu For the Intermodule menu:
MENU 3,0 - Intermodule menu

(See individual module for menu number definitions.
The query returns screen menu numbers.

Example: MENU 0,1
MENU? -> MENU 0,1

1.3.9 RMODe SINGle|REPETITIVE (1)(3)

This command specifies the run mode for a module (or Intermodule). The query returns the current setting. If the selected module is in the intermodule configuration, then the "intermodule" run mode will be set by this command.

Example: RMODE SINGLE
RMODE? -> RMODE SINGLE

1.3.10 ROOT [<string>]

This command specifies the root node for all subsequent commands. If the <string> parameter is omitted then the root is reset to the top of the command tree for the select module. If the <string> parameter is specified the root node is set by the path described by the string. The query returns the current ROOT setting.

Examples: ROOT
ROOT "MACHINE1:SFORMAT"
ROOT? -> ROOT "MACHINE1:SFORMAT"

1.3.11 SELect <nrf> (3)

This command selects which module (or Intermodule) will have parser control. SELECT 0 selects intermodule, SELECT 1 thru 5 selects modules A thru E. The query returns the currently selected system.

Example: SELECT 0
SELECT? -> SELECT 4

1.3.12 SETColor <nrf>[,<nrf>[,<nrf>[,<nrf>]]] | DEFault

This command allows you to change one of the color selections on the CRT. The command has four parameters: Color Number, Hue, Saturation, and Luminosity.

The fields have the following ranges:

Color Number - 0 to 7 (*)

Hue - 0 to 100

Saturation - 0 to 100

Luminosity - 0 to 100

(*) Color Number 0 cannot be changed - HSL values will be ignored.

The query form returns the HSL values for a specified color:

```
SETColor? 3  -> SETCOLOR 3,60,100,60
```

1.3.13 SOUNd ON|OFF|1|0

This command turns sound on or off. The query form returns the current setting.

```
Example: SOUND ON
         SOUND? -> SOUND 1
```

1.3.14 START (1)

This command starts the specified module (or Intermodule) running. If the specified module is in the Intermodule configuration, then the "Intermodule" run will be started.

```
Example: START
```

1.3.15 STOP (1)

This command stops the specified module (or Intermodule). If the specified module is in the Intermodule configuration, then the "Intermodule" run will be stopped.

```
Example: STOP
```

1.4 System subsystem

1.4.1 PRINt SCReen|LISTing (3)

This command initiates a print of the screen or listing buffer over the current printer communication interface. The query sends the screen or listing buffer data over the current controller communication interface. Note, the print query never returns a header and the data is not in block mode since it may be sent directly to a printer without modification. NOTE: the print query should not be sent in conjunction with any other command or query on the same command line.

```
Example: PRINt SCREEN
         PRINt? LISTING -> <LISTING DATA THAT MAY BE SENT TO A PRINTER>
```

1.5 System Subsystem

1.5.1 DSP <string>

This command writes the specified string to a device dependent portion of the instrument display. The DSP query returns the string last written to the display area (written either by the user or the instrument).

```
Example: DSP "The message goes here"
         DSP? -> DSP "The returned message"
```

1.5.2 ERRor? [NUMeric|STRing]

This query returns the oldest error from the error queue. The optional parameter determines whether the error string should be returned along with the error number. If no parameter is received, or if the parameter is NUM, then only the error number is returned. If the value of the parameter is STRing, then the error should be returned in the following form:

<err number (nr1)>,<error message (string)>

Example: ERRor? -> -100
ERRor? NUM -> -100
ERRor? STRING -> -100,"Error string goes here"

1.5.3 HEADer ON|OFF|1|0

The HEADer command specifies the header mode to be used. If headers are on, then the header will be returned with a query. the query returns the current setting.

returned format: 1|0

Example: HEADER ON
HEADER? -> HEADER 1

1.5.4 LONGform ON|OFF|1|0

This command sets the longform for the instrument's responses to queries. If the LONGform command is set OFF command headers and alpha arguments are sent from the instrument in the abbreviated form. If the the LONGform command is set ON the whole word will be output. This command does not affect the input data messages to the instrument -- headers and arguments may be input in either the long or short form regardless of how the LONGform command is set. The query returns the status of the LONGform command.

returned format: 1|0

Example: LONGFORM ON
LONGFORM? -> LONGFORM 1

1.5.5 SETup <block_data> (1)

This command receives the selected module's (or System's) learn string. The query returns the selected module's (or System's) learn string.

Example: SETUP? -> setup block data gets sent
SETUP #NDDDDD<block data>

1.6 MMEMory Subsystem

Disc commands are defined to provide access to both internal disc drives.

1.6.1 CATalog? [<nsus>]

This query command returns the directory of the source disc in block data form. Each entry consists of a 51 character string formatted as follows:

"NNNNNNNNNN TTTTTTTT DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD"

where N is the filename, T is the file type (a number), and D is the file descriptor. If the <nsus> is not specified the disc drive specified by the MSI command will be used.

Examples: MMEM:CATALOG?
MMEM:CATALOG? INTERNAL1

1.6.2 INITialize [<nsus>]

This command formats the specified disc.

Examples: MMEM:INITIALIZE
MMEM:INITIALIZE INTERNAL0

1.6.3 AUToload {OFF|0}|{ON|1},<string>[,<nsus>]

This command controls the Autoload feature. When the autoload feature is turned ON, the <string> parameter specifies the filename from the specified mass storage device to be autoloaded on powerup.

Examples: MMEM:AUTOLOAD OFF
MMEM:AUTOLOAD ON,"FILE1"
MMEM:AUTOLOAD ON,"FILE2",INTERNAL1
MMEM:AUTOLOAD? -> AUTOLOAD 1,"FILE2_?",INTERNAL1

1.6.4 COPY [<string>][,<nsus>],[<string>][,<nsus>]

This command copies one file to a new file or an entire disc's contents. The two <string> parameters are the file names. The first pair of parameters specifies the source file. The second pair specifies the destination file. An error is generated if the source file doesn't exist, or if the destination file already exists.

If the file name is not specified for both the source and destination, then the entire contents of the source are transfered to the destination (same as the Duplicate Disc front panel operation). The previous contents of the destination media are destroyed.

Examples: MMEM:COPY "FILE1","FILE2"
MMEM:COPY "FILE1",INTERNAL0,"FILE2",INTERNAL1
MMEM:COPY "FILE1","FILE2",INTERNAL0
MMEM:COPY "FILE1",INTERNAL0,"FILE2"
MMEM:COPY INTERNAL0,INTERNAL1

1.6.5 DOWNLOAD <string>[,<nsus>],<string>,<nrf>,<block_data>

This command downloads a file to the specified nass storage device. The first <string> paranter specifies the file nane, the second <string> parameter specifies the file descriptor, the <nrf> paraneter specifies the filetype, and the <block_data> contains the contents of the file to be downloaded.

Examples: NNEM:DOWNLOAD "RUN1","DATA FROM 9AM RUN",-16127,#41234.....
NNEM:DOWNLOAD "RUN2",INTERNAL0,"10AM DATA",-16127,#41234....

1.6.6 LOAD <string>[,<nsus>],<string>

This command load a nodule or Systen configuration fron disc. The first <string> parameter specifies the filenane from the specified nass storage device. The second <string> paraneter specifies the nodule or System, or all. The text for this paraneter should natch exactly the text choices available for the top left key of any nenu. The text to specify all nodules is "ALL".

Examples: NNEM:LOAD "FILE1","System"
NNEM:LOAD "FILE1",INTERNAL1,"System"

1.6.7 NSI [<nsus>]

This command selects a default nass storage device. If the paranter is onnitted the default nass storage device is selected. The query returns the current NSI setting.

Examples: NNEM:NSI
NNEM:NSI INTERNAL1

1.6.8 PACK [<nsus>]

This command performs a disc pack on the specified nass storage device.

Examples: NNEM:PACK
NNEM:PACK INTERNAL1

1.6.9 PURGe <string>[,<nsus>] (3)

This command renoves a file from the specified nass storage device. The <string> paraneter specifies the file nane.

Examples: NNEM:PURGE "FILE1"
NNEM:PURGE "FILE1",INTERNAL0

1.6.10 RENane <string>[,<nsus>],<string>

This command renanes a file fron the specified nass storage device. The first <string> paraneter specifies the filenane to be changed, the second specifies the new file nane.

Examples: NNEM:RENAME "OLDFILE","NEWFILE"

```
MMEM:RENAME "OLDFILE",INTERNAL1,"NEWFILE"
```

1.6.11 STORe <string>[,<nsus>],<string>,<string>

This command stores module or system configurations onto disc. The first <string> parameter specifies the file from the specified mass storage device. The second <string> parameter specifies the file descriptor. The third <string> parameter specifies the module or System or all modules. See the load command for more information on this parameter.

```
Examples: MMEM:STORE "FILE1","Scope config for slot B","Oscilloscope B"
          MMEM:STORE "FILE1",INTERNAL 1,"Scope config","Oscilloscope B"
```

1.6.12 UPLoad? <string>[,<nsus>]

This command uploads a file. The <string> parameters specifies the file to uploaded from the specified mass storage device. Only the contents of the file are sent out of the instrument and none of the information regarding the file length or file descriptor is sent.

```
Examples: MMEM UPLOAD "FILE1"
          MMEM UPLOAD "FILE1",INTERNAL1
```

1.7 Intermodule Subsystem

Intermodule commands are used to specify intermodule arming between multiple modules.

1.7.1 DELete ALL|<nrf>

This command deletes a subtree or the entire intermodule tree.

```
Example: INTERMODULE:DELETE ALL
```

1.7.2 INPort ON|OFF|1|0

This command causes Intermodule runs to be armed from the Input port. The INPort query returns the current setting.

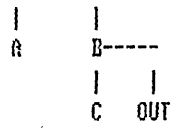
```
Example: INTERMODULE:INPORT ON
         INTERMODULE:INPORT?
```

1.7.3 INSERT {1|2|3|4|5|OUT3<,>{GROUP|1|2|3|4|5}

This command adds module or PORTOUT to the Intermodule configuration. There is no query form for this command (See the TREE? query).

```
Example: INTERMODULE:INSERT 1,GROUP;INSERT 2,GROUP;INS 3,2;INS OUT,2
```

Group run



1.7.4 SKEW <nrf>,<nrf>

This command sets the skew value for a module. The query returns the current skew setting. The first value is the module number (1..5 correspond to modules A..E respectively) and the second parameter is the skew setting (-1.0 to 1.0) in seconds.

Example: INTERMODULE:SKEW 3.0E-9
INTERMODULE:SKEW? -> INTERMODULE:SKEW 3.0E-9

1.7.5 TREE

The tree command allows an intermodule set up to be specified in one command. The query returns a string that represents the intermodule tree. A -1 means the module is not in the intermodule tree, a 0 value means the module is armed from the Intermodule run button (Group run), and a positive value indicates the module is being armed by another module with that number. The first five numbers are the intermodule arm values for modules A thru E respectively, the last number corresponds to the intermodule arm value for PORT OUT.

Example: INTERMODULE:TREE? -> 0,0,2,-1,-1,2 (This return list corresponds
(to the example tree given above)

2. Pattern Generator Command Definitions

2.1 Pattern Generator Command Summary

This table is a summary of the Pattern Generator command set. Those commands prefixed with a colon have a position in the command tree. The commands which are not prefixed are common commands

KEYWORD	PARAMETER	TYPE
:FORMat		
:CLOCk	INTernal|EXTernal	COMMAND/QUERY
:DELETE	<str>|ALL	COMMAND
:DIVide	<nrf>	COMMAND/QUERY
:LABel	<str>[,<nrf>...<nrf>]	
	[,][POSitive|NEGative]	COMMAND/QUERY
:PERiod	<nrf>	COMMAND/QUERY
:STRobeN		
:DELay	<nrf>	COMMAND/QUERY
:WIDth	<nrf>	COMMAND/QUERY
:THReshold	ECL|TTL	COMMAND/QUERY
:LIST		
:COLumn	<nrf>[,][<str>[,]	
	[BIN|OCT|DEC|HEC] | INStruct]	COMMAND/QUERY
:DELete	[<nrf>[,]<nrf>] | ALL]	COMMAND/QUERY
:PROGram	<nrf>[,][REPeat|WAIT|WIMB|BREak|SIGnal]	
	[,]<nrf>],<str>...<str>	COMMAND/QUERY
:MACroN		
		COMMAND/QUERY
:COLumn	<nrf>[,][<str>[,]	
	[BIN|OCT|DEC|HEC] | INStruct]	COMMAND/QUERY
:DEFine	<str>[,]<str>...<str>]	COMMAND/QUERY
:DELete	[<nrf>[,]<nrf>] | ALL]	COMMAND/QUERY
:PARameter	<str>[,]<str>...<str>]	COMMAND/QUERY
:PROGram	<nrf>[,][REPeat|WAIT|WIMB|BREak|SIGnal]	
	[,]<nrf>],<str>...<str>	COMMAND

2.2 Format Subsysten

The Format subsysten commands are used to set-up clocking, threshold, strobe and label specifications which appear in the Format menu.

2.2.1 CLOCk INTernal|EXTernal

Chooses between internal and external clocking. The query returns the current clock setting.

Example: FORMAT:CLOCK INTERNAL
FORMAT:CLOCK? -> FORMAT:CLOCK INTERNAL

2.2.2 DELete <string>|ALL

This command deletes a label or all the labels from the format screen.

Example: DELETE "A"
DELETE ALL

2.2.3 DIVide <nrf>

Specifies the clock divide if externally clocked. The query returns the current setting.

Example: FORMAT:DIVIDE 5
FORMAT:DIVIDE? -> FORMAT:DIVIDE 5

2.2.4 LABel <str>{<,><nrf>...<nrf>}{<,>{POSitive|NEGative}}

This command adds a label to the format screen. The first parameter specifies the labelname, This will be followed by one or more assignment values. The last parameter is an optional polarity value. The query returns the current setting for a label.

Examples: FORMAT:LABEL "A",38,240,POS - sets Label A with assignments ".*..**." and "****...." with positive polarity.

FORMAT:LABEL? "A" -> FORMAT:LABEL "A",38,240,POSITIVE

2.2.5 PERiod <nrf>

This command specifies the clock period. The query returns the current clock period setting.

Example: FORMAT:PERIOD 1.0E-6
FORMAT:PERIOD? -> FORMAT:PERIOD 1.0 us

2.2.6 STRobe Sublevel

The strobe sublevel commands are used to specify the three strobe settings.

2.2.6.1 DELAY <nrf>
This command sets a strobe delay value. The query returns the current delay setting.

Examples: FORMAT:STROBE2:DELAY 30E-6
FORMAT:STROBE1:DELAY? ->FORMAT:STROBE1:DELAY 100 ns

2.2.6.2 WIDth <nrf>
This command sets a strobe width value. The query returns the current width setting.

Examples: FORMAT:STROBE2:WIDTH 100E-6
FORMAT:STROBE1:WIDTH? ->FORMAT:STROBE1:WIDTH 100 ns

2.2.7 THReshold ECL|TTL

This command specifies the output threshold. The query form returns the current setting.

Example: FORMAT:THRESHOLD TTL
FORMAT:THRESHOLD? -> FORMAT:THRESHOLD TTL

2.3 **Listing Subsystem**

The listing subsystem commands are used to specify the main pattern generator program.

2.3.1 COLumn <nrf>[,]{<str>[,][BIN|OCT|DEC|HEX] | INSTruct}

This command specifies the ordering of labels on the listing screen. The first parameter specifies the column number, the second parameter specifies a label name followed by an optional base parameter. The INSTruct parameter may be used instead of a label name and base this specifies the position of the instruction field.

Examples: LIST:COLUMN 1,INSTRUCT;COLUMN 2,"A",HEX;COL 3,"B",DEC

2.3.2 [DELete <nrf>{[,]<nrf>} | ALL]

This command deletes lines from stimulus listing.

Examples: LIST:DELETE 3
LIST:DELETE 1,3
LIST:DELETE ALL

2.3.3 PROGram <nrf>[,]{NOOP|REPeat|WAIT|WINB|BREak|SIGNal|MACRO#|PARameter}

[<,><nrf>]<string>[<,><string>]" This command creates pattern generator program lines. The first parameter specifies the line number to be programmed, the second parameter specifies the instruction field. There will be an extra <nrf> parameter for REPeat and WAIT instructions - this parameter may be omitted for other instructions or it will be ignored. The remaining parameters are

strings that correspond to defined labels in the pattern generator program. These label field strings may contain X (don't cares) for the BIN, HEX and OCT bases. A don't care in one of these fields implements the 'autofill' feature which corresponds to the double quote marks in the pattern generator listing.

A MACRO instructions creates two lines in the pattern generator listing. The first line is the macro invocation and the second line contains additional parameters.

Examples:

```
LIST:PROG 1,REPEAT,255,"#B01X10111"
LIST:PROG 2,BREAK,"#B10001000"
LIST:PROG 3,HOOP,"0"
LIST:PROG 4,MIMB,"#H2ABC"
LIST:PROG 5,BREAK,"#0567"
LIST:PROG 6,SIGNAL,"1234"
LIST:PROG 7,WAIT,#B01010101,"#H2XBC"
  The third parameter for the WAIT instruction
  is a bit pattern corresponding to the 8 possible
  External input bit patterns.

LIST:PROG 8,MACRO2,"H3X45"
LIST:PROG 9,PARAMETER,"B0101111100001111"
```

2.4 Macro Subsystem

The macro subsystem commands are used to specify on or four possible macro pattern generator programs. Each macro can be used with up to four parameters. program.

2.4.1 COLumn <nrf>[,]{<str>[,]}[BIN|OCT|DEC|HEX] | INSTruct]

Specifies the ordering of labels on the listing screen.

Examples: MACRO1:COLUMN 1,INSTRUCT;COLUMN 2,"A",HEX;COL 3,"B",DEC

2.4.2 DEFine <string>[{,}<string>]

This command defines the first line in a macro program. The first parameter is a string that specifies the macro name, and the next two parameters specify two parameter names.

Example: MACRO1:DEFINE "MACRO1","PARAM1","PARAM2"

2.4.3 [DELete <nrf>[{,}<nrf>] | ALL]

Deletes lines from stimulus listing.

```
Examples: MACRO1:DELETE 3
          MACRO1:DELETE 1,3
          MACRO1:DELETE ALL
```

2.4.4 PARameter <string>[<,><string>]

This command defines the parameter line in a macro listing. Both parameters are strings and specify two additional parameter names.

Example: MACRO1:PARAMETER "PARAM3","PARAM4"

2.4.5 PROGram <nrf><,><NOOP|REPEAT|WAIT|WHNB|BREAK|SIGNAL>

[<,><nrf>]<string>[<,><string>]"

Example of a Macro program:

```
MACRO2:DEFINE "MACROA","PARAM1","PARAM2"
MACRO2:PARAMETER "PARAM3","PARAM4"
MACRO2:PROGRAM 1,"#B1*1*0010","#B0001001O1"
MACRO2:PROGRAM 2,"PARAM3","PARAM2"
MACRO2:PROGRAM 3,"#B01010010","PARAM4"
```

3. High Speed Timing Command Definitions

3.1 High Speed Timing Command Summary

This table is a summary of the High Speed timing command set. Those commands prefixed with a colon have a position in the command tree. The commands which are not prefixed are common commands

KEYWORD	PARNAMETER	TYPE
:DISPlay		
:INSert	[A|B|C|D|E],<str>,[<nrf>|OVERLAY]	COMMAND
:MINUS	[A|B|C|D|E],<str>,<str>	COMMAND
:PLUS	[A|B|C|D|E],<str>,<str>	COMMAND
:OVERLAY	[A|B|C|D|E],<str>[,<str>]	COMMAND
:REMOVE		COMMAND
:FORMat		
:DELETE	<str>|ALL	COMMAND
:LABel	<str>{<,><nrf>...<nrf>}	
	{<,>[POSitive|NEGative]}	COMMAND/QUERY
:PODN		
:THReshold	ECL|TTL|<nrf>	COMMAND/QUERY
:MARKer		
:MODe	OFF|TIME|PATtern|MSTats	COMMAND/QUERY
:OTIME	<nrf>	COMMAND/QUERY
:XTIME	<nrf>	COMMAND/QUERY
:MEAN		QUERY
:MIN		QUERY
:MAX		QUERY
:HITS		QUERY
:RUNS		QUERY
:XPATtern		
:OPATtern		
:CONDITION	ENTering|EXITing	COMMAND/QUERY
:LABel	<STR><,><STR>	COMMAND/QUERY
:SEArch	<nrf>[<,>X|TRIGGER]	COMMAND/QUERY
:UNTil	OFF|	
	LT <,><nrf>	
	GT <,><nrf>	
	INRANGE <,><nrf><,><nrf>	
	OUTRANGE <,><nrf><,><nrf>	COMMAND/QUERY
:TRACe		
:DURation	LT|GT <,><nrf>	COMMAND/QUERY
:EDGE	<str><,><str>	COMMAND/QUERY
:PATTern	<str><,><str>	COMMAND/QUERY
:MATch	EQUal|NEQual	COMMAND/QUERY
:COLumn	<nrf>	COMMAND/QUERY
:WAVeform		
:ACCumulate	ON|OFF|0|1	COMMAND/QUERY
:DELay	<nrf>	COMMAND/QUERY
:RANGe	<nrf>	COMMAND/QUERY

3.2 Display Subsystem

The Display subsystem commands are used to manipulate waveforms on the High speed timing display.

3.2.1 INSert [{A|B|C|D|E}],<str>,[{<nrf>|OVERlay}]

This command adds waveforms to the the display. The first parameter is an optional module specifier. If it is not specified, the selected module is assumed. The second parameter is the waveform to be added. The third parameter is an optional bit-no specifier or OVERlay parameter. This parameter is only needed for timing waveforms. If a number is specified then only the waveform for that bit number is added to the screen. If OVERLAY is specified then all the waveforms for the label are added to the screen in overlayed form. If no parameter is specified the waveforms for all the bits are added to the display in a sequencial manner.

3.2.2 MINUS [A|B|C|D|E],<str>,<str>

This commands inserts A-B scope waveforms to the screen. The first parameter is an optional module specifier. If it is not specified, the selected module is assumed. The next two parameters specify the scope waveforms to be subtracted together.

3.2.3 OVERLAY [A|B|C|D|E],<str>[,<str>]

This command adds overlayed scope waveforms to the screen. The first parameter is an optional module specifier. If it is not specified, the selected module is assumed. The next n parameters specify the scope waveforms that are to be overlayed.

3.2.4 PLUS [A|B|C|D|E],<str>,<str>

This commands inserts A+B scope waveforms to the screen. The first parameter is an optional module specifier. If it is not specified, the selected module is assumed. The next two parameters specify the scope waveforms to be added together.

3.2.5 REMove

This command removes all the waveforms from the display.

3.3 Format Subsystem

The format subsystem commands specify format labels and pod thresholds.

3.3.1 LABel <string><,><nrf>[<,><nrf>]<,>{POSitive|NEGative}

This command adds a label to the format screen. The first parameter specifies the labelname, This will be followed by one or more assignment values. The last parameter is an optional polarity value. The query returns the current setting for a label.

Examples: FORMAT:LABEL "A",3,2,POSITIVE
FORMAT:LABEL? "A" -> FORMAT:LABEL "A",3,2,POSITIVE

3.3.2 DELete ALL|<string>

This command either deletes all the labels or a specified label

Examples: FORMAT:DELETE ALL
FORMAT:DELETE "A"

3.3.3 PODN

3.3.3.1 THReshold TTL|ECL|<nrf>|?
This command specifies the threshold level for a High speed timing pod. The query returns its current setting.

Examples: FORMAT:POD0:THRESHOLD TTL
FORMAT:POD1:THRESHOLD -3.5V
FORMAT:POD1:THRESHOLD? -> FORMAT:POD1:THRESHOLD -3.5V

3.4 Marker Subsystem

The Marker subsystem commands specify marker placement settings.

3.4.1 MODE OFF|TIME|PATtern|MSTATS|?

This command chooses the marker mode for High speed timing. The query form returns the current setting.

Examples: MARKER:MODE TIME
MARKER:MODE? -> MARKER:MODE TIME

3.4.2 OTIME <nrf>|?

This command sets the O marker position. The query form returns its current value.

Examples: MARKER:OTIME 540ns
MARKER:OTIME? -> MARKER:OTIME 540ns

3.4.3 XTIME <nrf>|?

This command sets the X marker position. The query form returns its current value.

Examples: MARKER:XTIME 540ns
MARKER:XTIME? -> MARKER:XTIME 540ns

3.4.4 MEAN?

This query returns the mean X to O measurement.

Example: MARKER:MEAN? -> MARKER:MEAN 8.0E-9

3.4.5 MIN?

This query returns the minimum X to O measurement.

Example: MARKER:MIN? -> MARKER:MIN 8.0E-9

3.4.6 MAX?

This query returns the maximum X to O measurement.

Example: MARKER:MAX? -> MARKER:MAX 8.0E-9

3.4.7 HITS?

This query returns the number of hits in auto-marker placement.

Example: MARKER:HITS? -> MARKER:HITS 10

3.4.8 HITS?

This query returns the number of runs completed in auto-marker placement.

Example: MARKER:RUNS? -> MARKER:RUNS 20

3.4.9 XPATTERN

3.4.10 OPATTERN

3.4.10.1 CONDITION ENTERING|EXITING|?
The command specifies whether the marker is to be placed on entry or exit of the specified pattern. The query returns the current setting.

Examples: MARKER:XPATTERN:CONDITION EXITING
MARKER:XPATTERN:CONDITION? -> MARKER:XPATTERN:CONDITION EXITING

3.4.10.2 LABEL <STR><,><STR>
This command specifies the marker search pattern for a given label. The first pattern specifies the label and the second paraneter specifies the search pattern. The query returns the specified pattern for a given label.

Examples: MARKER:OPATTERN:LABEL 'A','#B01001XX011'
MARKER:OPAT:LABEL? 'A' -> MARK:OPAT:LAB 'A','#01001XX011'

3.4.10.3 SEARCH <nrf>[<,>X|TRIG]
This command specfies the occurance number and the starting point from which the marker pattern is placed. The query returns the specified setting.

Examples: MARKER:OPATTERN:SEARCH 5,TRIGGER
MARKER:OPATTERN:SEARCH? -> MARKER:OPATTERN:SEARCH 7,X

3.4.11 UNTIL OFF | LT<,><nrf> | GT<,><nrf> | INRANGE<,><nrf><,><nrf> | OUTRANGE

This command specifies the run until condition for pattern marker placement. The query return the current setting.

Examples: MARKER:UNTIL OFF
MARKER:UNTIL LT,10E-9
MARKER:UNTIL GT,10E-9
MARKER:UNTIL INRANGE,10E-9,20E-9
MARKER:UNTIL OUTRANGE,10E-9,20E-9
MARKER:UNTIL? -> MARKER:UNTIL GT 10E-9

3.5 Trace Subsystem

The Trace subsystem commands specify high speed timing patterns, edges and durations.

3.5.1 PATTERN <string> , <string>

This command specifies trace patterns for High speed timing. The first parameters specifies the label and the second parameter specifies the pattern.

Examples: TRACE:PATTERN "A","#B01X00X01"
TRACE:PATTERN? "A" -> TRACE:PATTERN "A","#B01X00X01"

3.5.2 DURATION LT|GT <,> <nrf>

This command specifies pattern duration time. The query form returns the current setting.

Examples: TRACE:DURATION LT 10ns
TRACE:DURATION? -> TRACE:DURATION GT,10E-9

3.5.3 EDGE <string> , <string>

This command specifies trace edge patterns for High speed timing. The first parameter specifies the label and the second parameter specifies the pattern (R - Rising, F - Falling, . - done care).

Examples: TRACE:EDGE "A",".RF...RF..."
TRACE:EDGE? "A" -> TRACE:EDGE "A",".RF...RF..."

3.5.4 MATCH EQUal|NEQual

This command specifies the trace match specification. The query returns the current setting.

Examples: TRACE:MATCH EQUAL
TRACE:MATCH? -> TRACE:MATCH NEQUAL

3.6 Waveform subsystem

The Waveform subsystem commands specify the waveform range, delay and accumulate settings.

3.6.1 ACCumulate ON|OFF|0|1|?

This command specifies High speed timing accumulate mode. The query form returns the current setting.

Examples WAVEFORM:ACC ON
WAVEFORM:ACC? -> WAVEFORM:ACCUMULATE 1

3.6.2 DELay <nrf>|?

This command specifies High speed timing delay. The query form returns the current setting.

Examples WAVEFORM:DELAY 400E-9
WAVEFORM:DELAY? -> WAVEFORM:DELAY 400ns

3.6.3 RANGe <nrf>|?

This command specifies High speed timing sec/div range. The query form returns the current setting.

Examples WAVEFORM:RANGE 4E-9
WAVEFORM:RANGE? -> WAVEFORM:RANGE 4ns

3.6.4 DATA? NOTE: This is now a system command

This query returns the raw data record.

4. Oscilloscope Command Definitions

4.1 Oscilloscope Command Summary

KEYWORD	PARAMETER FORM	TYPE
AUToscale		COMMAND
DIGitize	CHANnelN[,CHANnelN]...	COMMAND
ACQuire		
:COUNT	<nrf>	COMMAND/QUERY
:TYPE	NORMal|AVERAGE	COMMAND/QUERY
CHANnelN		
:COUPling	DC|DCFifty	COMMAND/QUERY
:ECL		COMMAND
:OFFset	<nrf>	COMMAND/QUERY
:PROBe	<nrf>	COMMAND/QUERY
:RANGe	<nrf>	COMMAND/QUERY
:TTL		COMMAND
DISPlay		
:ACCumulate	SINGle|INFinite	COMMAND/QUERY
:CONNect	ON|OFF|1|0	COMMAND/QUERY
:INSert	[A|B|C|D|E],<str>,[<nrf>|OVERLAY]	COMMAND
:MINUS	[A|B|C|D|E],<str>,<str>	COMMAND
:PLUS	[A|B|C|D|E],<str>,<str>	COMMAND
:OVERLAY	[A|B|C|D|E],<str>[,<str>]	COMMAND
:REMOVE		COMMAND
MARKer		
:Duration	OFF| {LT|GT}<,><nrf> {INRange|OUTRange}<,><nrf><,><nrf>	COMMAND/QUERY
:MODE	AUTO|OFF|ON|1|0	COMMAND/QUERY
:MSTATs	OFF|ON|1|0	COMMAND/QUERY
:OAUTo	MANual| CHANnel#,<nrf>,{POSitive|NEGative},<nrf>	COMMAND/QUERY
:OTIMe	<nrf>	COMMAND/QUERY
:OVOLt?	CHANnel#	QUERY
:UNTIL	OFF| LT,<nrf>| GT,<nrf>| INRange,<nrf>,<nrf>| OUTrange,<nrf>,<nrf>	COMMAND/QUERY
:XAUTo	MANual| CHANnel#,<nrf>,{POSitive|NEGative},<nrf>	COMMAND/QUERY
:XTIMe	<nrf>	COMMAND/QUERY
:XVOLt?	CHANnel#	QUERY

MEASure		
:ALL?		QUERY
:FALLtime?		QUERY
:FREQuency?		QUERY
:NWIDth?		QUERY
:OVERshoot?		QUERY
:PERiod?		QUERY
:PREShoot?		QUERY
:PWIDth?		QUERY
:RISEtime?		QUERY
:SOURce	CHANnel#	COMMAND/QUERY
:VAMPlitude?		QUERY
:VBASe?		QUERY
:VMAX?		QUERY
:VMIN?		QUERY
:VPP?		QUERY
:VTOP?		QUERY
TIMebase		
:DELay	<nrf>	COMMAND/QUERY
:MODE	AUTO|TRIGgered	COMMAND/QUERY
:RANGe	<nrf>	COMMAND/QUERY
TRIGger		
:CONDition	ENTer|EXIT	COMMAND/QUERY
:DELay	<nrf>|	
	EVENt,<nrf>	COMMAND/QUERY
:LEVel	<nrf>	COMMAND/QUERY
:LOGic	LOW|HIGH|DONTcare	COMMAND/QUERY
:MODE	EDGE|PATTern|IMMediate	COMMAND/QUERY
:PATH	CHANnel#|EXTernal	COMMAND/QUERY
:SLOPe	POSitive|NEGative	COMMAND/QUERY
:SOURce	CHANnel#|EXTernal	COMMAND/QUERY
WAVeform		
:DATA	<block data>	COMMAND/QUERY
:FORMat	BYTE|WORD|ASCii	COMMAND/QUERY
:POINts?		QUERY
:PREamble?	<preamble block>	QUERY
:RECord	FULL|WINDow	COMMAND/QUERY
:SOURce	CHANnelN	COMMAND/QUERY
:TYPE		QUERY
:VALID		QUERY
:XINCrement		QUERY
:XORigin		QUERY
:XREFerence		QUERY
:YINCrement		QUERY
:YORigin		QUERY
:YREFerence		QUERY

4.2 Oscilloscope Common commands

4.2.1 AUToscale

The AUTO command causes the scope 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 trigger was found. If no signal is found, the scope defaults to the previous settings for those channels with no signal. The display window configuration is not altered by AUToscale and auto-trigger will be worked on the channels with no signal.

4.2.2 DIGitize CHANnelNI,CHANnelNI...

This command is used to acquire waveform data for transfer over the HP-IB. It causes an acquisition to take place on the specified channel(s). Once the data is acquired, the scope is stopped. The resulting data is read from the channel buffers. The ACQuire subsystem commands are used to setup conditions such as TYPE and average COUNt for the next DIGitize command. When ACQuire TYPE is average, the scope makes the acquisition of COUNt (the average number) times.

4.3 Acquire Subsystem

The Acquire Subsystem commands are used to setup conditions that are used when a DIGitize system command is executed. This subsystem is used to select the type of data and the number of averages.

4.3.1 COUNt <nrf>

This command specifies the number of average by which the data at each acquisition are averaged once the number of acquisition is reached the specified average value. This command has no effect if the TYPE is NORMal. The query returns the last specified count.

4.3.2 TYPE NORMal|AVERage

This command selects the type of acquisition that is to take place when a DIGitize command is executed. The query returns the last specified type. With the NORMal type, the display mode in the front panel can be either SINGle or CUMulative; with the AVERage type, the display mode can only be AVERage.

returned format: NORMal|AVERage

4.4 Channel Subsystem

The Channel Subsystem allows you to control all vertical functions of an Oscilloscope.

4.4.1 COUPling DC|DCFifty

This command sets the input impedance for the selected channel to either 1 Mohm (DC) or 50 ohms. The query returns the current impedance setting for the channel.

4.4.2 ECL

This command sets the vertical range, offset, and trigger level for the selected channel for optimum viewing of ECL signals. The ECL values used are as follows:

range: 2.0 V offset: -1.0 V trigger level: -1.3 V

4.4.3 OFFSet <nrf>

This command sets the voltage that is represented at the center screen for the selected channel. The allowable offset is +/- 800 mV on vertical range < 800 mV and +/- 16V on range >= 800 mV (for probe 1). The query returns the current offset setting for the selected channel. As vertical range, offset value for both command and query is affected by the current probe setting for the channel.

returned format: <NR3>

4.4.4 PROBe <nrf>

This command specifies the attenuation factor for an external probe on selected channel. This command does not change the actual sensitivity at the input. It changes all the voltage references such as vertical range, offset, trigger level, and automatic measurements. The allowable probe is any integer number from 1 to 1000. The query returns the current probe setting for the select channel.

returned format: <NR3>

4.4.5 RANGe <nrf>

This command sets vertical range for the selected channel. The query returns the current vertical range setting. The RANGe command and query are dependant on the current probe setting for the selected channel. The allowable range setting for the probe setting 1 is 40mV to 16V (for higher probe settings, just multiply the range limit by the probe setting.)

returned format: <NR3>

4.4.6 TTL

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

range: 6.0 V offset: 2.5 V trigger level: 1.62V

4.5 Display Subsystem

The Display Subsystem is used to control the display of data The commands which control the display mode and the number of averages are listed in the ACQuire subsystem (TYPE and COUNT).

4.5.1 ACCumulate SINGle|INFinite

This command sets infinite persistence for the acquired signal on the display in the NORMal display mode. For average mode, it is automatically single. The SINGle and AVERage display mode in the front panel corresponds to the SINGle persistence and the CUMulative display mode to the INFinite persistence here.

4.5.2 CONNect ON|OFF

This command sets the connect-the-dots mode. The query returns the current setting.

4.5.3 INSert [CA|B|C|D|E)],<str>,[[<nrf>|OVERlay)]

This command adds waveforms to the the display. The first parameter is an optional module specifier. If it is not specified, the selected module is assumed. The second parameter is the waveform to be added. The third parameter is an optional bit-no specifier or OVERlay parameter. This parameter is only needed for timing waveforms. If a number is specified then only the waveform for that bit number is added to the screen. If OVERLAY is specified then all the waveforms for the label are added to the screen in overlayed form. If no parameter is specified the waveforms for all the bits are added to the display in a sequencial manner.

4.5.4 MINUS [A|B|C|D|E],<str>,<str>

This commands inserts A-B scope waveforms to the screen. The first parameter is an optional module specifier. If it is not specified, the selected module is assumed. The next two parameters specify the scope waveforms to be subtracted together.

4.5.5 OVERLAY [A|B|C|D|E],<str>[,<str>]

This command adds overlayed scope waveforms to the screen. The first parameter is an optional module specifier. If it is not specified, the selected module is assumed. The next n parameters specify the scope waveforms that are to be overlayed.

4.5.6 PLUS [A|B|C|D|E],<str>,<str>

This commands inserts A+B scope waveforms to the screen. The first parameter is an optional module specifier. If it is not specified, the selected module is assumed. The next two parameters specify the scope waveforms to be added together.

4.5.7 REMove

This command removes all the waveforms from the display.

4.6 Marker Subsystem

4.6.1 MODE OFF|ON|AUTO

This command allows you to select the marker mode. The query returns the current marker mode choice.

4.6.2 MSTATS OFF|ON

This command allows you to turn statistics on or off in auto-marker placement. With statistics on, min, max and mean statistics will show on the screen; otherwise, x to o, trigger to x, and trigger to o will show on the screen. The query returns the current setting.

4.6.3 OAUTo MANual|CHANnel#,<nrf>,{POSITIVE|NEGATIVE},<nrf>

This command specifies the automarker placement mode for the O marker. The first parameter specifies if automarker placement is to be in Manual mode or on a specified channel. If a channel is specified there are three additional parameters. The 2nd parameter specifies the voltage level in percent), the 3rd specifies the slope, and the 4th parameter specifies the occurance count. The query returns the current setting.

4.6.4 OTIMe <nrf>

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

4.6.5 OVOLt? CHANnel#

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

4.6.6 UNTIL OFF|LT,<nrf>|GT,<nrf>|INRange,<nrf>,<nrf>|OUTrange,<nrf>,<nrf>

This command allows you to select the run until time x-o specification with the associated time value or range. The query returns the current run until x-o setting.

4.6.7 XAUTo MANual|CHANnel#,<nrf>,{POSITIVE|NEGATIVE},<nrf>

This command specifies the automarker placement mode for the X marker. The first parameter specifies if automarker placement is to be in Manual mode or on a specified channel. If a channel is specified there are three additional parameters. The 2nd parameter specifies the voltage level in percent), the 3rd specifies the slope, and the 4th parameter specifies the occurance count. The query returns the current setting.

4.6.8 XTIMe <nrf>

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

4.6.9 XVOLt? CHANnel#

This query returns the current voltage level of the selected source at the marker X.

4.7 Measure Subsystem

The automatic measurements are made based on what you see on screen and they are not continuously updated.

4.7.1 ALL

This query makes all of the above measurements on the selected channel. If any measurement cannot be made, the answer will be returned as 9.9 E37.

4.7.2 FALLtime

This query makes a fall time measurement on the selected channel by finding the 90% and 10% points of the first falling edge on screen.

4.7.3 FREQuency

This query makes a frequency measurement on the selected channel. It finds the fifty percent points, locates the first and third edges on screen, and takes the time difference between them. Inverting this gives the frequency.

4.7.4 NWIDth

This query makes a -width time measurement on the selected channel. The measurement is made between the 50% points of the first falling and the next rising edges.

4.7.5 OVERshoot

This query makes a overshoot voltage measurement on the selected channel. The measurement is made by finding a distortion which follows the first major transition on screen. The result sent over the bus is the ratio of overshoot vs. Vamplitude (between 0 and 1).

4.7.6 PERiod

This query makes a period measurement on the selected measurement channel. This is done just like the frequency measurement except that the result is not inverted.

4.7.7 PREShoot

This query makes a preshoot voltage measurement on the selected channel. The measurement is made by finding a distortion which precedes the first major transition on screen. The result sent over the bus is the ratio of preshoot vs. Vamplitude (between 0 and 1).

4.7.8 PWIDth

This query makes a +width time measurement by finding the time difference between the 50% points of the first rising and the next falling edges.

4.7.9 RISEtime

This query makes a rise time measurement on the selected channel by finding the 10% and 90% points of the first rising edge on screen.

4.7.10 SOURce CHANnelN

This command selects the source to be used for subsequent measurements.

4.7.11 VAMPlitude

The VAMP query makes the voltage measurement on the selected channel by finding the relative maximum and minimum points on screen.

4.7.12 VBASe

This query returns the voltage at the base (relative min) of a waveform on the selected source.

4.7.13 VMAX

This query returns the absolute maximum voltage present on the selected source.

4.7.14 VMIN

This query returns the absolute minimum voltage present on the selected source.

4.7.15 VPP

This query makes a peak-to-peak voltage measurement on the selected channel by finding the absolute maximum and minimum points on screen.

4.7.16 VTOP

This query returns the voltage at the top (relative max) of a waveform on the selected source.

4.8 Timebase Subsystem

The Timebase Subsystem commands control the horizontal axis functions of the oscilloscope.

4.8.1 DELay <nrf>

The DELay command assigns 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 plus the delay time. The query returns the current delay setting.

4.8.2 MODE TRIGgered|AUTO

This command is used to specify whether or not the acquisitions should wait for the specified trigger condition to be true after the timeout. The query returns the current auto-triggered setting. The AUTO command cannot be used in the IMMediate trigger mode.

4.8.3 RANGe <nrf>

This command defines the full screen diameter. The Query returns the current time range setting.

4.9 Trigger Subsystem

This Trigger Subsystem allows you to control the trigger related settings.

4.9.1 CONDition ENTer|EXIt

This command specifies whether the trigger is generated on entry to the specified logic pattern or when exiting it in the PATTERN trigger mode. If the CONDition selected was ENTER, a trigger will be generated on the first transition that makes the pattern specification for every channel to be true. With the EXIT condition, a trigger will be generated on the first transition that causes the pattern specification to be false, after the pattern was true once.

4.9.2 DELay <nrf>|EVENt,<nrf>

This command is used specify the number of events which should occur after the trigger. The time delay is counted after the events delay. The query returns the current trigger events count. The COUNts command cannot be used in the IMMEDIATE trigger mode.

4.9.3 LEVel <nrf>

This command sets the trigger voltage level for the selected SOURCE or PATH. The query returns the trigger level of the current trigger source or path. This command cannot be used in IMMERDIATE trigger mode. With EDGE trigger mode, trigger source is used; with PATTERN mode, trigger path is used for the source of trigger level.

4.9.4 LOGic LOW|HIGH|DONTcare

This command is used to specify the relation between the signal and the predefined voltage level that must exist before that part of the pattern is considered valid. HIGH indicates a requirement for an input of the selected source or path to be greater than its own trigger level and LOW indicates a requirement for an input of the selected source or path to be less than its own trigger level. The query returns the current condition of the previously selected trigger source or path. This LOGIC command can be used only in the PATTERN trigger mode.

4.9.5 MODE EDGE|PATTern|IMMediate

This command allows you to select the trigger mode. The EDGE mode will trigger an oscilloscope on an edge whose slope is determined by the SLOPE command at a voltage determined by the LEVel command. The PATTern mode will trigger on entering or exiting a specified pattern of all internal channels and the external trigger. In the IMMediate mode, the oscilloscope will trigger by itself. kThe query will return the current trigger mode.

4.9.6 PATH CHANnel#|EXTernal

This command allows you to select a trigger path which is used for the subsequent LOGIC and LEVEL commands. It cannot be used in the IMMEDIATE trigger mode. The query returns the current trigger path.

4.9.7 PROBe <nrf>

This command specifies the attenuation factor for an external probe on external channel. This command does not change the actual sensitivity at the input. It changes the trigger level voltage references of the external channel. The allowable probe is any integer number from 1 to 1000. The query returns the current probe setting for the external channel. To send both the command or the query, the trigger source (for EDGE mode) or trigger path (for PATTern mode) must be set to EXTernal.

4.9.8 SLOPe POSitive|NEGative

This command allows you to select the trigger slope for the previously specified trigger SOURCE. It can be used only in the EDGE trigger mode. The query returns the trigger slope of the current trigger SOURCE.

4.9.9 SOURce CHANnel#|EXTernal

This command is used to specify the trigger source. This command also identifies the source for any subsequent SLOPe and LEVel commands. The query returns the current trigger source. The SOURce command can be used only in the EDGE trigger mode.

4.10 Waveform Subsystem

The Waveform Subsystem commands are used to transfer waveforms. Wavefrom data consists of a preamble and a data records. The preamble contains the values set using the Waveform Subsystem: format, type, points, xincrement, xorigin, xreference, yincrement, yorigin, and yreference.

4.10.1 DATA <block data>

This query returns the waveform record stored in the channel buffer. The channel whose waveform data is being transferred is the one specified using the SOURCE command in WAVEFORM subsystem. The data is transferred based on the format (byte or word) specified. The transmission occurs after the specified count (set in ACQuire subsystem) has been reached.

4.10.2 FORMat BYTE|WORD|ASCii

This command specifies the data transmission mode for the waveform data. Word and Byte data is transmitted using the arbitrary block program data format specified in IEEE488.2 paragraph 7.7.6. The query returns the currently specified format.

BYTE data is 1 byte wide. The data values you would get are from 0 to 128. the 0 data values indicate the underflow and the 128 data values indicate the overflow.

WORD data is 2 bytes wide with the most significant byte of each word being transmitted first. If the type specified was NORMal, the upper bytes would be from 0 to 128 and the lower bytes zeros. With the AVERage type, the upper bytes would be from 0 to 128 and the lower bytes would be the fractions from the averaging. No data would be transferred as -1's.

ASCII data is WORD but in ascii format.

The data values sent in WORD or BYTE format can be converted to voltage and time values using the following formulas:

```
Voltage(j) = [(Yvalue(j) - Yreference) * Yincrement] + Yorigin
Time(j) = (j * Xincrement) + Xorigin
```

The data vales sent in ASCII have to be converted back in digital format to do the above conversion.

4.10.3 POINts? <nrf>

This query returns 4K, which is the number of points acquired in all DIGitize commands to the selected waveform.

4.10.4 PREamble <preamble block>

The query returns the preamble of the previously specified source.

<preamble block> ||= <FORMat>, <TYPE>, <POINts>, <XINCrement>,
<XORigin>, <XREFerence>, <YINCrement>,
<YORigin>, <YREFerence>

4.10.5 RECord FULL|WINDow

This command specifies the data user wants to receive over the bus. With FULLrecord choice, the user gets the whole 4K raw data of the specified channel. With WINDow choice, whatever shown on the display window will be sent over the bus.

If TYPE is set to AVERAGE and RECORD choice was FULL, you would lose the averaged data as average is done only on the window data.

4.10.6 SOURce CHANnelN

This command selects the channel that is to be used as the source in subsequent waveform commds. The query returns the currently selected waveform source.

4.10.7 TYPE NORMal|AVERage

This query returns the type set in the ACQUIRE subsystem.

4.10.8 VALID

This query returns 0 if there is no data acquired at the source. If there is any data acquired in the previously selected source the value returned will be 1.

4.10.9 XINCrement

This query returns the x-increment value currently in the preamble. This value is the time difference between consecutive data points for NORMAL and AVERAGED data.

4.10.10 XORigin

This query returns the x-origin value currently in the preamble. This value is the time of the first data point in the memory with respect to the trigger point.

4.10.11 XREFerence

This query returns the current x-reference value in the preamble. This value specifies the x-value of the first data point in the memory and is always zero.

4.10.12 YINCrement

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

4.10.13 YORigin

This query returns the y-origin currently in the preamble. This value is the voltage at center screen (the voltage at y-reference).

4.10.14 YREFerence

This query returns the y-reference value currently in the preamble. This value specifies the data value at center screen (where the y-origin occurs).

5. Status Reporting

5.1 Background

This is a description of the new status reporting structures for the 16500A, based on 488.2.

5.2 Bit descriptions

5.2.1 Event Status Register

This is a 488.2 defined register. The bits in this register are "sticky". That is, once an event happens which sets a bit, that bit will only be cleared if the register is read.

5.2.1.1 PON - Power On
Indicates power has been turned on.

5.2.1.2 URQ - User Request
Indicates that the touch screen, knob or mouse activity has occurred.

5.2.1.3 CME,EXE,DDE,QYE - Command,Execution,Device Dependent, and Query Error
Indicates that an error of the respective type has occurred. The error numbers and/or strings can be read from a device defined queue which is not part of the 488.2 status data structure. The query is "ERR?".

5.2.1.4 RQC - Request Control
Indicates that the device has requested control.

5.2.1.5 OPC - Operation Complete
Indicates that the device has completed all pending commands. This is set off by the *OPC common command. The *OPC command could appear after any other command, so it serves has a general purpose operation complete message generator.

5.2.2 Service Request Enable Register

Each bit enables the corresponding bit in the status byte to cause a service request. The 6th bit does not logically exist and is always returned as a zero. The register is read and written with the *SRE? and *SRE commands.

5.2.3 Status Byte

This contains the most basic status information which is sent over the bus during a serial poll. The status byte is cleared with the *CLS common command

5.2.3.1 RQS - Request Service
Indicates that the device is requesting service.

5.2.3.2 ESB - Event Status
Indicates that one of the enabled events in the Event Status Register has occurred.

5.2.3.3 MAV - Message Available
Indicates that a message is ready to be read from the output queue.

5.2.3.4 LCL - Remote to Local
Indicates that a remote to local transition has occurred.

5.2.3.5 MSB - Module Summary Bit
Indicates that an enable envent in one of the modules Status registers has occured.

5.3 Queue descriptions

5.3.1 Output Queue

Contains the responses placed in the queue due to the various scope commands.

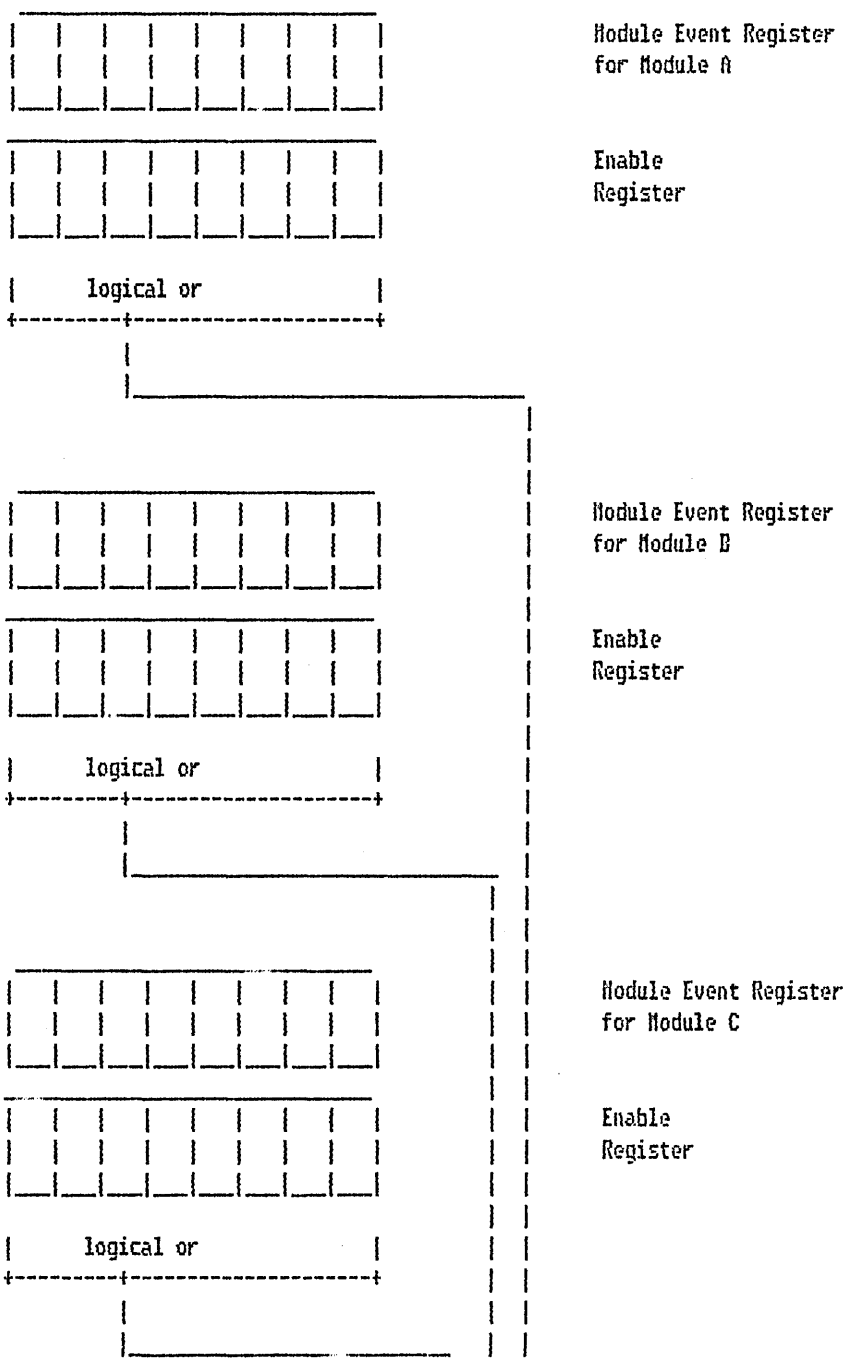
5.3.2 Error Queue

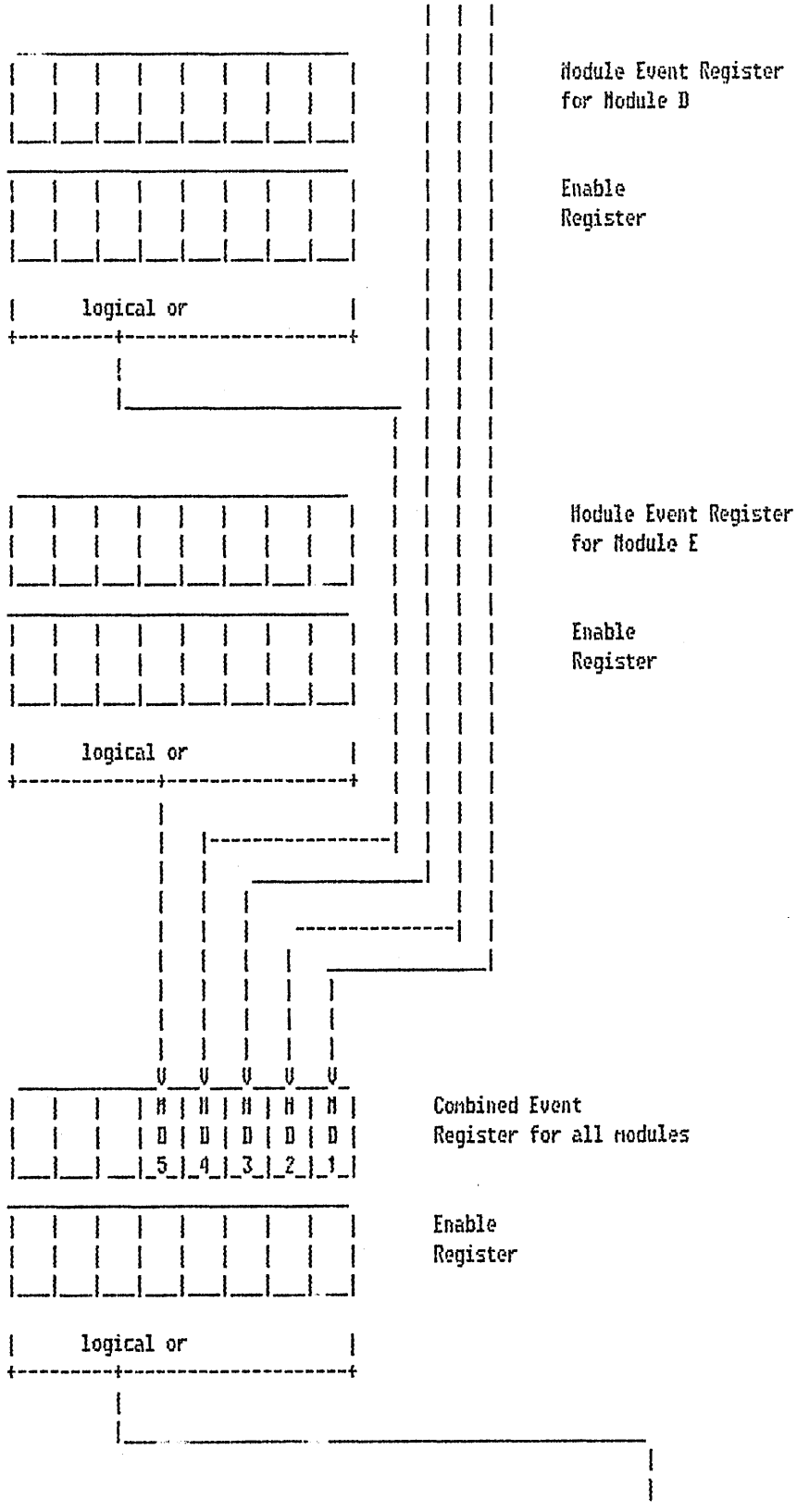
Contains the error numbers of the last n errors that have occurred. The queue is FIFO. The queue is read with the ERR query. It is not part of the 488.2 status structures.

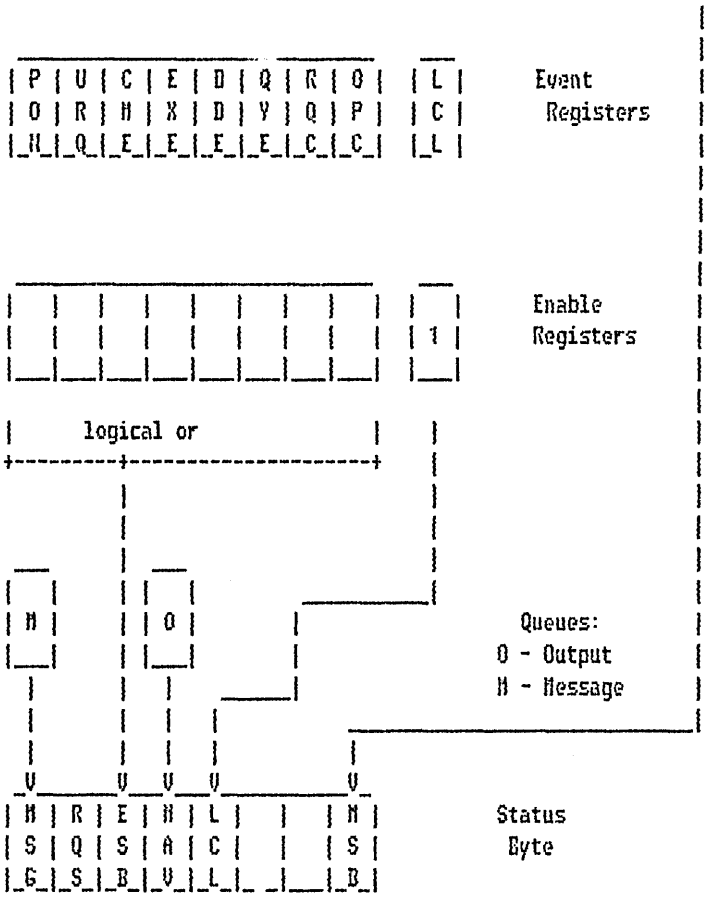
5.4 488.2 Status Reporting Data Structures

This diagram show the 16500A Status reporting structure.

Note: The individual bit assignments for the module Event Registers are module specific.




Module Event Register
for Module D
Enable
Register
logical or
Module Event Register
for Module E
Enable
Register
logical or
Combined Event
Register for all modules
MD5
MD4
MD3
MD2
MD1
Enable
Register
logical or


PON
URQ
CHE
EXE
DDE
QVE
RQC
OPC
LCL
Event Registers
1
Enable Registers
logical or
M
O
Queues:
O - Output
M - Message
MSG
RQS
ESB
MAV
LCL
MSB
Status Byte
Service Request Enable Register

6. Remote Operation; HP-IB Interface

6.1 HP-IB capabilities

The HP-IB capabilities as defined in 488.1 are: SH1, AH1, T5, TE0, L3, LE0, SR1, RL1, PP1, DC1, DT1, C0, E2

6.2 Remote Mode

In remote mode all program and response messages shall be processed by the device. The instrument will go from remote to local with any touch or mouse activity.

6.3 Local Mode

In local mode all program and response messages shall be processed by the device. All local controls shall be enabled.

6.4 Local Lockout

If the local lockout message has been sent, and the device is in the remote state, or is then put in the remote state, the touch screen and mouse will be disabled.

6.5 Clear Message

The device clear message shall:

1. Clear the input and output buffers,
2. Reset the parser
3. Discard all deferred commands.
4. Clear the Request-OPC-flag

6.6 Trigger Message

The trigger message shall have the same effect as sending the device dependent message "START" and will start the intermodule configuation.