HP 8115A
PROGRAMMABLE
PULSE GENERATOR

OPERATING and
PROGRAMMING MANUAL

Serial Numbers:

This manual applies to all instruments.

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front cover photograph

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PRINTING HISTORY

CONTROL SERIAL NUMBER

Edition 1 applies directly to all instruments.

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Title Page (i)		A-1 to A-7	
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INTRODUCTION

The manual information is arranged into four categories:

INSTRUMENT DESCRIPTION

Descriptions of selected operating principles:
Chapters 1-6.

QUICK REFERENCE GUIDES

Local and remote programming and editing information:
Chapters 7-9.

REFERENCE DATA

Supporting information of a non-operational nature:
Appendicies A-F.

CUSTOMER ASSISTANCE

Sales and Service information:
Customer Assistance Information
Sales and Support Offices Directory.

Application programming level knowledge of IEEE Standards 488.1 and 488.2 is desirable for programming the HP 8118A.

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CONTENTS

CHAPTER 1 INSTRUMENT FEATURES

INTRODUCTION

The HP 8115A is a 50 MHz programmable pulse generator

The instrument has internal(RAM) and external(disc) storage capability and external printer capability.

The interface (HP-IB) is a byte-serial, bit-parallel, asynchronous interface. It is defined in Appendix A, Specifications.

Specifications: see Appendix A.
Options and Accessories: see Appendix B.

FEATURES

TRIGGER (EXTERNAL INPUT)
- Automatic
- Trigger
- Gate

CONTROL (CONTROL INPUT)
- Timing
  - Period
  - Width
  - Delay
- Level
  - High Level

OUTPUT (CHANNELS 1 AND 2)
- State
- Polarity
- Addition
- Levels
  - Limit

TIMING
- Period
- Delay
- Double Pulse
- Width
- Transition Type
- Leading Edge
- Trailing Edge

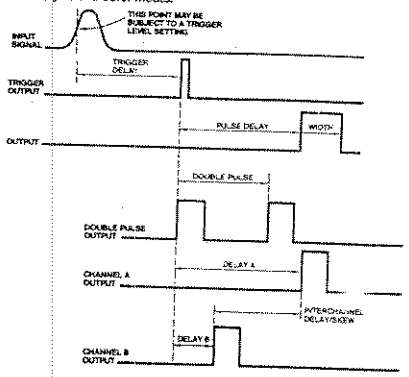
TRIGGER OUTPUT

PULSE PARAMETERS

Time Reference Point: Median (50 % amplitude point on pulse edge).

Pulse Period: The time interval between the leading edge medians of consecutive trigger output pulses.

Trigger Delay: Interval between trigger point of input signal and the trigger output pulse's leading edge median. Applies in trigger, external width, gate and burst modes.



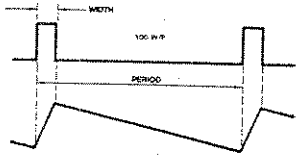
Pulse Delay: Interval between leading edge medians of trigger output pulse and output pulse.

Double Pulse: Interval between leading edge medians of the double pulse.

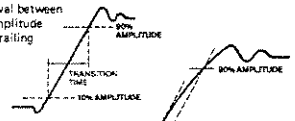
Interchannel Delay/Skew: Interval between corresponding leading edge medians.

Pulse Width: Interval between leading- and trailing-edge medians.

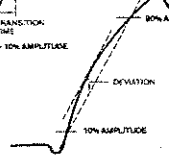
Duty Cycle: Percentage ratio of pulse width to period. In pulse/function generators, this term is also used to define sine and triangle symmetry.

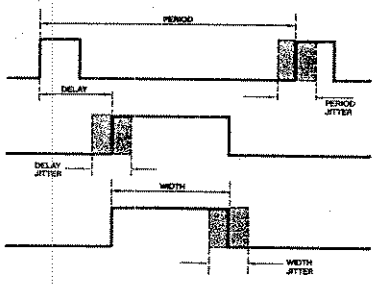


Transition Time: Interval between the 10 %- and 90 %-amplitude points on the leading/trailing edge.



Linearity: Peak deviation of an edge from a straight line through the 10 %- and 90 %-amplitude points, expressed as percentage of pulse amplitude.



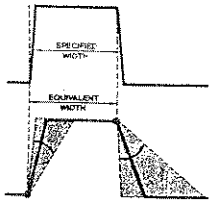


Stability: Long-term average instability, expressed as percentage of main parameter over a specific time duration, e.g. hour, year. Excludes jitter.

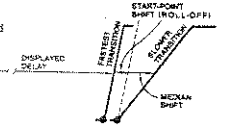
Pulse Width: The specified and displayed value is that obtained with fastest edges; essentially equal to the interval from the start of the leading edge to the start of the trailing edge.

By designing so that the pulse edges turn about their start points, the interval from leading edge start to trailing edge start stays unchanged* when transition times are varied. This is more convenient for programming and the width display is easy to interpret.

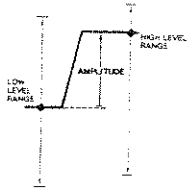
**In practice, start points may shift with change in transition time.*



Delay: The specified and displayed value is that obtained with the fastest leading edge. For a slower edge, the actual delay exceeds the displayed delay by the combined shift of start-point and median.

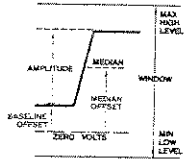


Pulse Level: High level and low level. Any limitation is expressed by an amplitude specification.



Pulse Amplitude (alternative to level definition): Pulse amplitude and offset* are specified. Any limitation is expressed by a window (max high level, min low level).

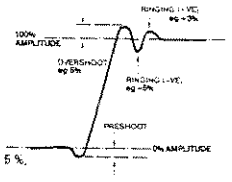
**Pulse generators use baseline offset. Function generator outputs are symmetrical and consequently use median offset.*



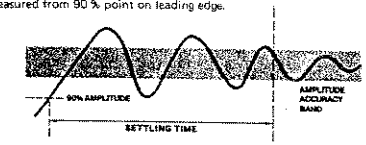
Preshoot, Overshoot, Ringing: Preshoot and overshoot are peak distortions preceeding/following an edge. Ringing is the positive peak and negative peak distortion excluding overshoot, on pulse top or base. A combined preshoot overshoot, ringing specification of e.g. ± 5 % implies:

- Overshoot/undershoot < 5 %,
- Largest pulse-top oscillation < ± 5 %,

of pulse amplitude.



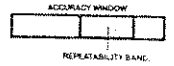
Settling Time: Time taken for pulse levels to settle within level specification, measured from 90 % point on leading edge.



Output Impedance/Resistance: Effective pulse source impedance/dc resistance.

Reflection Coefficient: Reflection at pulse generator output expressed in percent of incident pulse amplitude. (Test pulse edges correspond to generator's fastest transitions).

Repeatability: When an instrument operates under the same environmental conditions, and with the same settings, the value of a parameter will lie within a band inside the accuracy window. Repeatability defines the width of this band.



Jitter: Short term timing instability: rms jitter is based on 1000 measurements and is identical to the standard deviation.

CONTENTS

FIGURES

INTRODUCTION

Getting Started defines several fundamental operating principles for the first time user of the instrument.

POWER-ON

At power-on, the instrument:

1. Performs a power-on test and
2. Enters the normal or abnormal operating state as described below.

Power-on Test

The instrument performs the following tests.

1. Processor Board Test
2. Board Test (Amplifier)

See Appendix F, Table F-1.

Normal State

In the normal state (error free condition):

1. The instrument is initialized and enters the IDLE state.
2. The display defaults to the system configuration display.
3. The instrument is now ready for normal operation.
4. The instrument's setting is restored to the setting stored at power-off; however, outputs 1 and 2 are disabled.

Abnormal State

In the abnormal state (error condition exists):

1. If the processor board test fails, the instrument is not operable. The message **'cannot continue'** is displayed.

2. If a parametric board test fails, the message **'Press any key to continue'** is displayed (The BLUE key is excluded.).

   It is possible to operate the instrument. Check the errors displayed, and determine where the failures are and how they effect the required performance.

POWER-OFF

At power-off, the instrument's setting is stored in RAM.

HELP

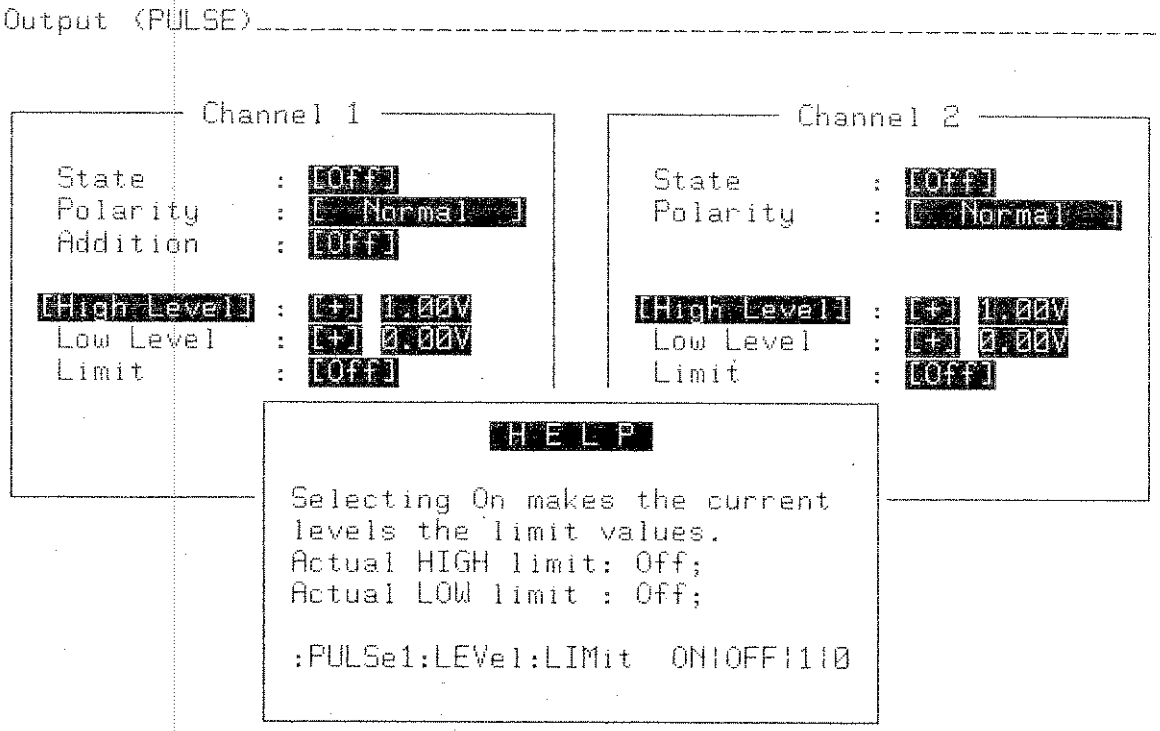
HELP information is available by pressing the GREEN key.

Programming Information

1. In an error free state, HELP provides programming information about the field in which the cursor appears and lists the corresponding remote commands. See the following figure.

   The limits are given in the limit, level, amplitude and offset fields.

   THE System [Configuration] HELP messages list commands not listed in other HELP messages.



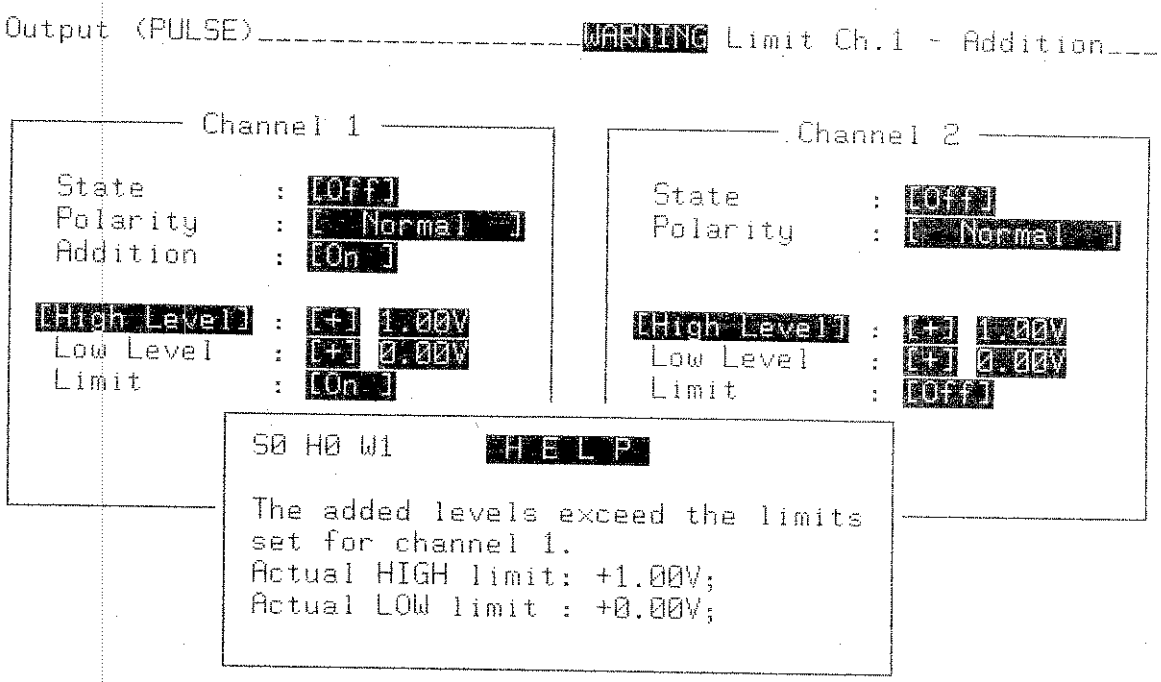
Operating State Information

2. If an error or warning condition exists, HELP provides information about the error or warning condition and a summary of the errors present in the instrument. See the following figure.

The summay information is contained in the three fields in the upper left corner of the HELP message.

S = total number of software errors
H = total number of hardware errors and warnings
W = total number of software warnings.

See STATUS BYTE, Chapter 6, for additional information.



LOCAL CONTROL PROGRAMMING

In the local mode, formatted displays guide instrument programming.

1. Chapter 4 describes the common characteristics of the formatted displays.
2. Chapters 7 describes the specific capabilities of each display.

There are seven displays:

1. System [Configuration]
2. System [Peripherals]
3. Save [Internal]
4. Save [External]
5. Control (Pulse)
6. Timing (Pulse)
7. Output (Pulse)

Display Selection

The displays are selected by:

1. Pressing a main display key, for example, SAVE.

2. Placing the cursor in the [Alternate] display field (See Message Lines, Chapter 4.) and pressing the NEXT key.

   For example, when the save internal display is displayed, [Internal] appears in the first line of the display. By placing the cursor in this field and pressing the NEXT key, the save external display is selected and [External] appears in line one.

3. Pressing a pulse parameter key, for example, press the BLUE key and then WIDTH to access the WIDTH field at the TIMING display.

Message Lines

The top two lines of the display contain configuration, status, and operating information. The message lines are described in Chapter 4.

Data Entry

The displays contain fields shown in inverse video into which the cursor can be placed. When the cursor is in a field, changes can be made to that field or HELP can be requested, GREEN key.

Fields with square brackets, [], are option fields. The current entry is changed by pressing the NEXT or PREV keys.

Fields without the square brackets require direct entry of data. This is accomplished with the alpha-numeric, POINT, CLEAR ENTRY, and DON'T CARE keys. The special actions of the CLEAR ENTRY and DON'T CARE keys are described in Chapter 3.

Controls

All controls are defined in Chapter 3.

REMOTE CONTROL PROGRAMMING

The instrument is programmed via program messages in the remote mode.

The remote messages are:

1. Defined in Chapter 5
2. Diagrammed in Chapters 8 and 9.

UNDER and OVER PROGRAMMING

Under and over programming is allowed. See Chapters 8 and 9 for the allowed programming ranges.

PROGRAMMING A SETTING

Programming a setting involves up to four steps.

1. **Known state selection:**
   The current setting,
   a stored setting, or the reset setting
   can serve as a known starting state.

2. **Timing specification:**
   Pulse timing

3. **Control selection:**
   a. Trigger (external input)
   b. Control (control input)

4. **Output formatting:**
   a. Channel 1/2 polarity
   b. Channel 1/2 addition
   c. Channel 1/2 pulse levels and limits
   d. Channel 1/2 state
   NOTE: Make all level changes before enabling the outputs.

CHAPTER 3 CONTROLS

CONTENTS

FIGURE

KEY DESCRIPTIONS

KEY FUNCTIONS

Almost all keys have two functions.

1. One function is printed on the keycap and requires only one key press.
2. One function is printed in blue letters directly above the corresponding key. The blue lettering indicates that these functions require shifted entry. Thus, the BLUE key (shift key) must be pressed first. To cancel the shift, press the BLUE key a second time. When the shift function is active, the message SHIFT is displayed in the second message line except when the messages REMOTE and LOCAL LOCKOUT are displayed.

0-9

See ALPHA-NUMERIC keys.

A-F

See ALPHA-NUMERIC keys.

ALPHA-NUMERIC

Alpha-numeric keys are used:

1. To enter values in data and parameter input fields.
2. Write file names and file descriptions.

ARROWS

See CURSOR, ROLL, or VERNIER keys.

BLUE

The BLUE key is the shift key. See KEY FUNCTIONS.

CLEAR ENTRY

CLEAR ENTRY sets a field to a default value except for interface addresses (See Chapter 7.).

CNTRL

CNTRL, control, selects the pulse control display.

CURSOR

CURSOR keys (4) are marked with arrows. They move the cursor about the display as indicated by the arrow.

The display alphabet used at the save internal and external displays operates as follows:

1. Place the cursor in the required name or description field.

2. Hold the shift key down, and move the character marker to the required alpha character with the left or right arrow cursor keys. Release the shift key. The character marker is the character displayed in inverse video, for example, the character A in the following figure.

3. Press the shift key to activate the shift function, and press the up arrow cursor key to write the alpha character into the name or description field.

DELAY

DELAY moves the cursor to the delay field or the delay range field (if control mode 'delay' is enabled). If the timing display is not currently displayed, the display will change to the timing display.

DISPLAY ALPHABET

See CURSOR keys.

DON'T CARE

DON'T CARE is defined as follows: 'the value of this field position is not significant'.

DON'T CARE has the effect of deleting the entry at the cursor's position.

DON'T CARE can also effect digits to the right of the cursor's current position.

EXECUTE

EXECUTE is used to execute SAVE operations.

GREEN

The GREEN key selects the HELP function which provides information regarding:

1. Programming requirements
2. Error and warning conditions.

The information provided is for the field where the cursor is located. See HELP, Chapter 2.

HIGH

HIGH moves the cursor to the high level or amplitude field at the output display except when control mode 'high level' is enabled. If the output display is not currently displayed, the display will change to the output display unless the exception described applies.

LEADING

LEADING moves the cursor to the leading edge field at the timing display. If the timing display is not currently displayed, the display will change to the timing display. There are seperate LEADING (edge) keys for each channel.

LOW

LOW moves the cursor to the low level field or the offset field at the output display. If the output display is not currently displayed, the display will change to the output display. There are seperate LOW (level) keys for each channel.

MAIN DISPLAY KEYS

SYSTEM, SAVE, CONTROL, TIMING, and OUTPUT

MANUAL

MANUAL has two functions.

1. Triggers one output pulse/press.
2. Gates output pulses until released.

If the trigger(external input) state = ON, it changes to OFF when the MANUAL key is pressed.

NEXT

NEXT selects the next available option in an option field.

OUTPUT

OUTPUT selects the pulse output display.

PERIOD

PERIOD moves the cursor to the period field except when trigger mode 'trigger' is enabled or to the period range field if control mode 'period' is enabled. If the timing display is not currently displayed, the display will change to the timing display unless the exception described applies.

POINT

POINT is used as

1. A parameter field entry (decimal point)
2. Part of a file description

POLARITY

POLARITY defines the output signal format:

1. NORMAL=as specified by the pulse parameters
2. COMPLEMENT=inverted form of NORMAL.

PREV

PREV selects the option before the current option displayed in an option field.

PRINT

The current display is printed.
PRINT can be terminated by pressing the STOP key.

PRINT ALL

The current display is printed for all displays except the save display.

With the save displays, only directory files beginning with the file marked by the right bracket,>, are printed.

PRINT ALL can be terminated by pressing the STOP key.

RETURN TO LOCAL

RETURN TO LOCAL returns the instrument to the LOCAL control programming mode unless local lockout is active.

SAVE

SAVE selects the internal or external display.

SHIFT

See KEY FUNCTIONS.

STATE

STATE moves the cursor to the Channel 1/2 state field at the output display.

SYSTEM

SYSTEM selects either the configuration display or the peripherals display.

TIMING

TIMING select the timing display.

TRAILING

TRAILING moves the cursor to the trailing edge field on the timing display. If the timing display is not currently displayed, the display will change to the timing display. There are seperate keys for each channel.

VERNIER

The VERNIER keys:

1. Allow continuous changing of values
2. Change a value outside a limit to the limit value
3. Reformat decimal values to integer values
4. Resolve slope conflicts.

When changing the leading or trailing edges, auto-ranging can occur which results in a change to a slope's value or resolution. See Figure 3-1.

Example 1. Up-ranging (value change).

1. One edge is not within overlapped ranges, for example, 48.8 ns.
2. The other edge is within overlapped ranges, for example, 99.9 ns.
3. When the 99.9 ns edges is changed to 100 ns, the 48.8 ns edge is auto-ranged to 488 ns(multiplied by 10).

Example 2. Up-ranging (resolution change).

1. Both edges are within overlapped ranges, for example, 78.3 ns and 99.9 ns.
2. When the 99.9 ns edge is changed to 100 ns the 78.3 ns edge changes to 78. ns.

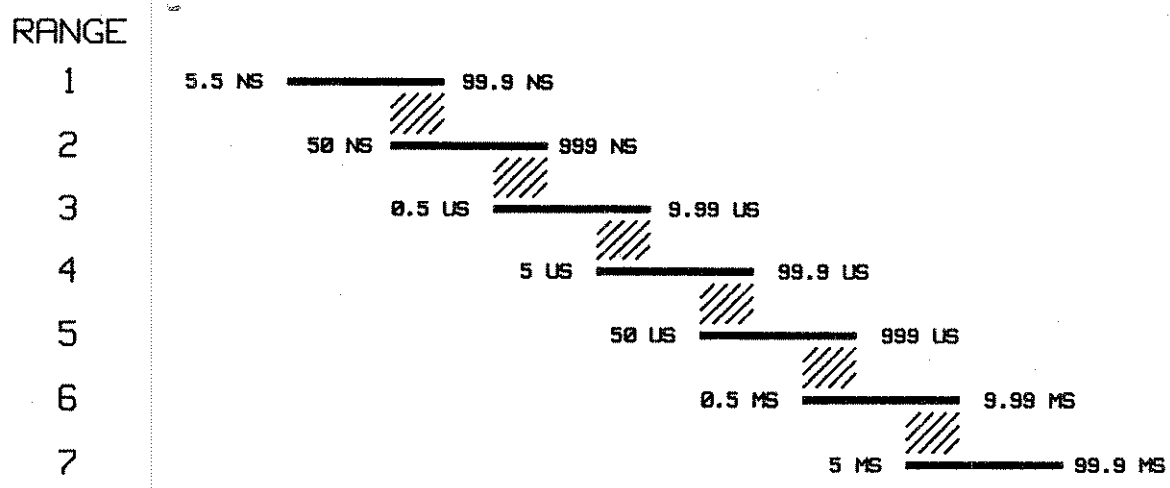
Example 3. Down-ranging (value change).

1. One edge is not within overlapped ranges, for example, 333 ns.
2. The other edge is within overlapped ranges, for example, 050. ns.
3. When the 050. ns edge is changed to 49.0 ns, the 333 ns edge is auto-ranged to 33.3 ns(divided by 10).

Example 4. Down-ranging (resolution change).

1. Both edges are within overlapped ranges, for example, 078. ns and 050. ns.
2. When the 050. ns edge is changed to 49.0 ns the 078. ns edged changes to 78.0 ns.

FIGURE 3-1. EDGE RANGES



WIDTH

WIDTH moves the cursor to the width field or the width range field (if control mode 'width' is enabled) except when data formats NRZ and DNRZ are selected. If the timing display is not currently displayed, the display will change to the timing unless the exception described applies.

INPUTS

External Input

Trigger mode: One pulse or pulse pair is generated per trigger event.

Gate mode: Pulse or pulse pairs are generated for the duration of the gate. The last pulse is always completed.

External input programming is accomplished with the trigger function at the control display or via the :INPut:TRIGger command path.

Control Input

The control input controls the period, delay, double pulse delay, width, and high level of channels 1 and 2.
The input is located on the rear panel.

Control input programming is accomplished with the control function at the control display or via the :INPut:CONTrol command path.

OUTPUTS

Output 1/2

Outputs 1/2 are the generator's main outputs and correspond to channels 1/2.

The outputs can be disabled at the output display or with the :OUTPut:PULSe comamand path.

Trigger Output

One output trigger pulse is generated for each pulse, pulse pair, bit, or word.

INTERFACE

HP-IB

The interface (HP-IB) is a byte-serial, bit-parallel, asynchronous interface.

Interface specifications are listed in Appendix A.

The port is located on the rear panel.

CHAPTER 4 DISPLAY

CONTENTS

FIGURES

INTRODUCTION

The characteristics common to all displays are described in this chapter. Unique display characteristics are described in Chapter 7.

DISPLAY TYPES

Seven formatted displays are used to program the instrument locally.

1. System [Configuration] display
2. System [Peripherals] display
3. Save [Internal] Display
4. Save [External] Display
5. Control (Pulse)
6. Timing (Pulse)
7. Output (Pulse)

Display Selection

The displays are selected by:

1. Pressing a main display key, for example, SAVE.

2. Placing the cursor in the [Alternate] display field (See MESAAGE LINES.) and pressing the NEXT key.

   For example, when the save internal display is displayed, [Internal] appears in the first line of the display. By placing the cursor in this field and pressing the NEXT key, the save external display is selected and [External] appears in line one. See Figures 4-2A and 4-2B.

3. Pressing a pulse parameter key, for example, press the BLUE key and then WIDTH to access the WIDTH field at the TIMING display.

Labels

Labels (Period , [Delay], etc.) identify the programming fields where parameters are entered or changed. In most cases the labels do not change; however, in three cases, they can change:.

1. Optional labels inclosed in brackets,[ ], can be changed by placing the cursor at the label and pressing the NEXT or PREV keys; for example, [Delay] can be changed to [Double] in the pulse generator. See Figures 4-1A and 4-1B.

2. Some labels change as a result of another action; for example, if control mode [Width] is enabled, the width label at the timing display changes to Width Range. See Figures 4-1A and 4-1B.

3. Some labels are deleted when the programming they describe is not allowed; for example, the period label is not displayed when trigger mode [trigger] is selected. See Figure 4-1B.

Fields

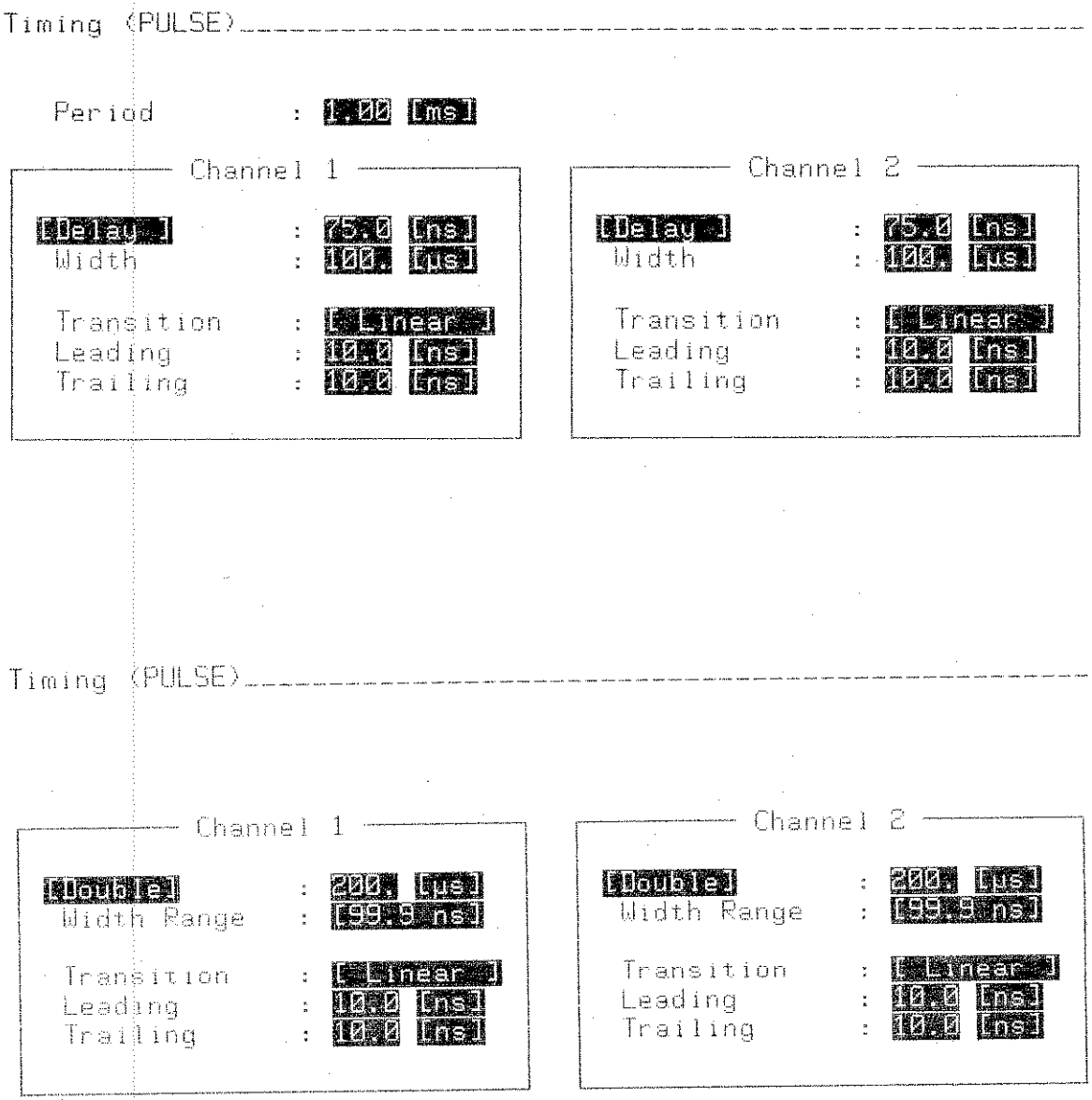
There are two types of fields.

1. Direct Entry Field. Data is entered as required with the alpha-numeric keys and SAVE display alphabet. The use of the VERNIER, DON'T CARE, POINT, and CLEAR ENTRY keys are described in Chapter 3.

2. Option Field. Square brackets, [ ], enclose the current option. By placing the cursor in the field and pressing the NEXT or PREV (previous) key the option is changed.

These fields are displayed in inverse video.

FIGURE 4-1A/B. LABEL AND FIELD EXAMPLES



Message lines

The message lines are the top two lines of the display and report the following types of information. See Figure 4-2. All local messages are listed in Appendix F except device command paths (See Chapter 9.).

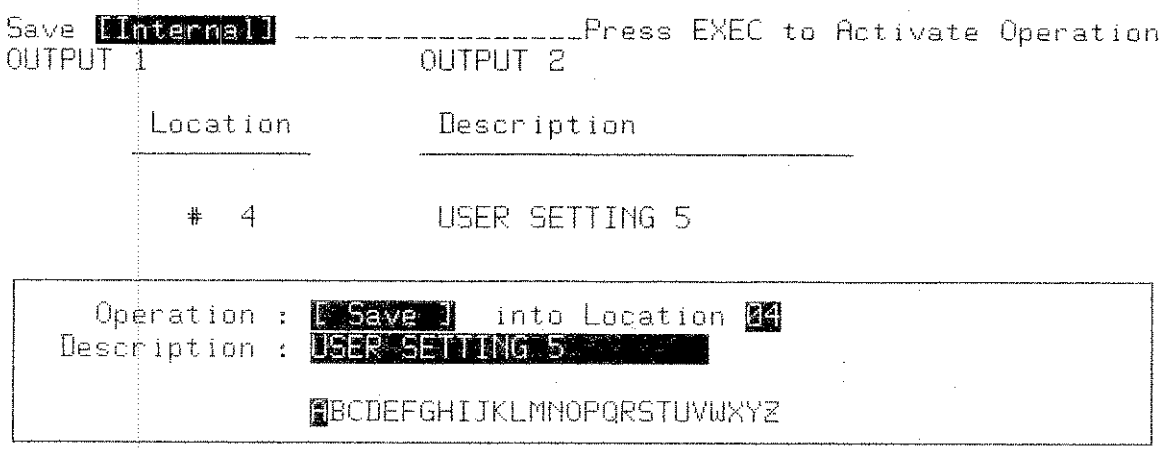
Display-Line number one:

1. **Main Display Label**: This label identifies which type of display is selected, for example, Save in Figure 4-2A.
2. **[Alternate] display field**: This option field is displayed when a SYSTEM or SAVE main display is selected, for example, [Internal] in Figure 4-2A and [External] in Figure 4-2B.
3. **(Configuration)**: This label identifies the current instrument configuration at the CONTROL, TIMING, and OUTPUT main displays.
4. **Instructions**: Operating instructions.
5. **Status**: Error conditions and disallowed events are reported.

Display-Line number two:

6. **OUTPUT 1/2**: OUTPUT 1 or OUTPUT 2 is displayed when the output is enabled.
7. **Command Path**: When a remote programming error occurs, the erroneous command path is listed within angle brackets, < >, followed by three question marks, ???.
8. **REMOTE**: Indicates that the instrument is in the remote control programming mode.
9. **LOCAL LOCKOUT**: Indicates when the front panel controls are disabled.
10. **SHIFT**: Indicates when the shift function is enabled except when the REMOTE and LOCAL LOCKOUT messages are displayed.

FIGURE 4-2A/B. MESSAGE LINE EXAMPLES



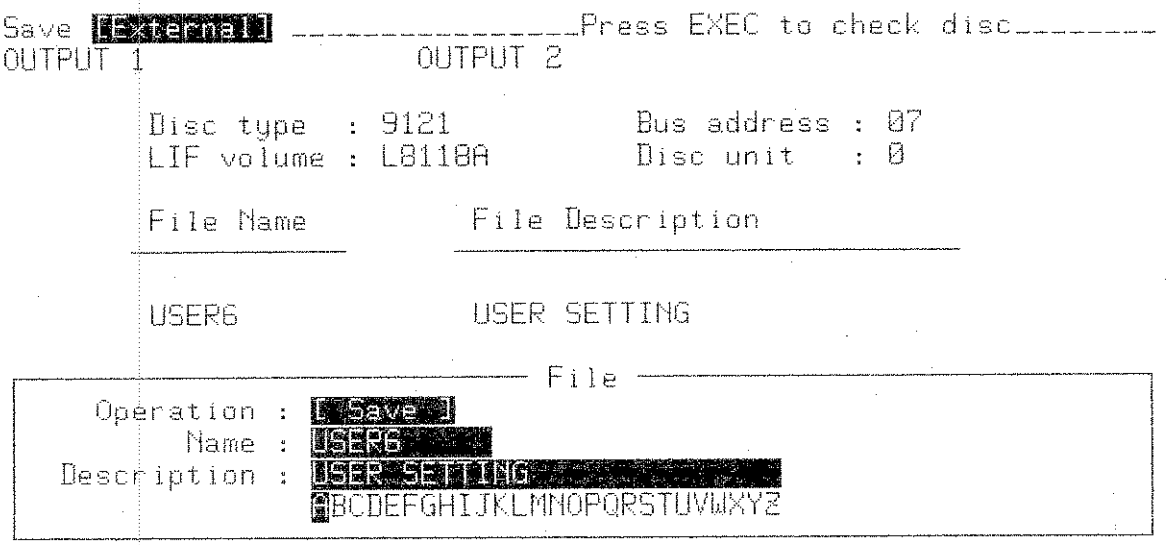


FIGURE 4-3. SYSTEM [CONFIGURATION]

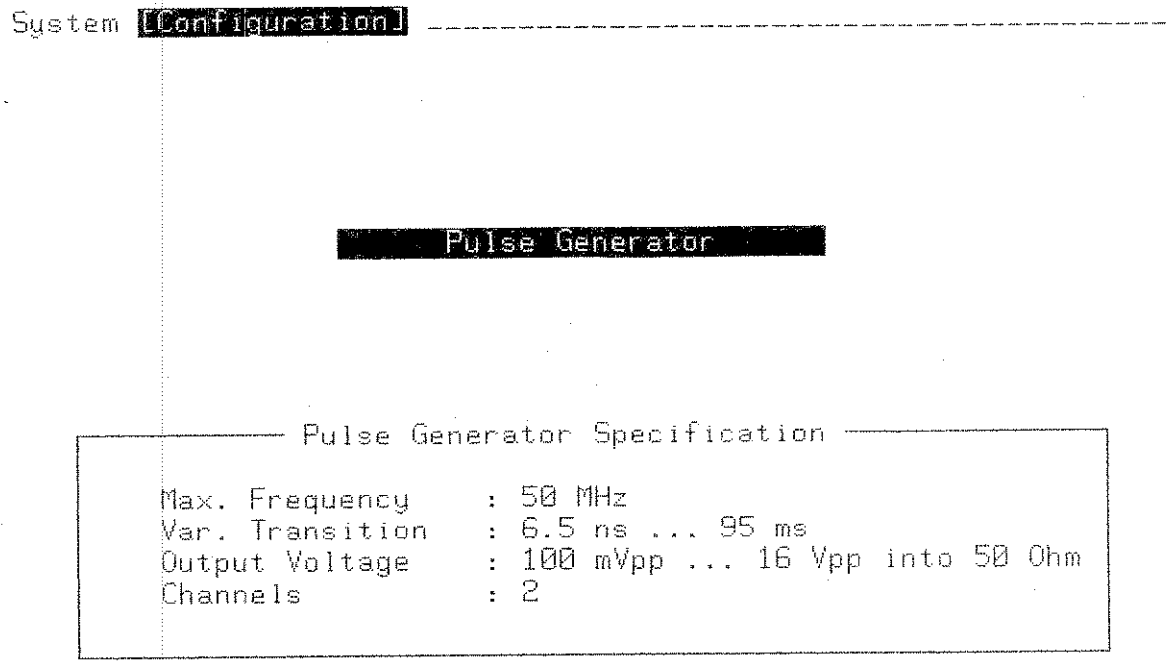


FIGURE 4-4. SYSTEM [PERIPHERALS]

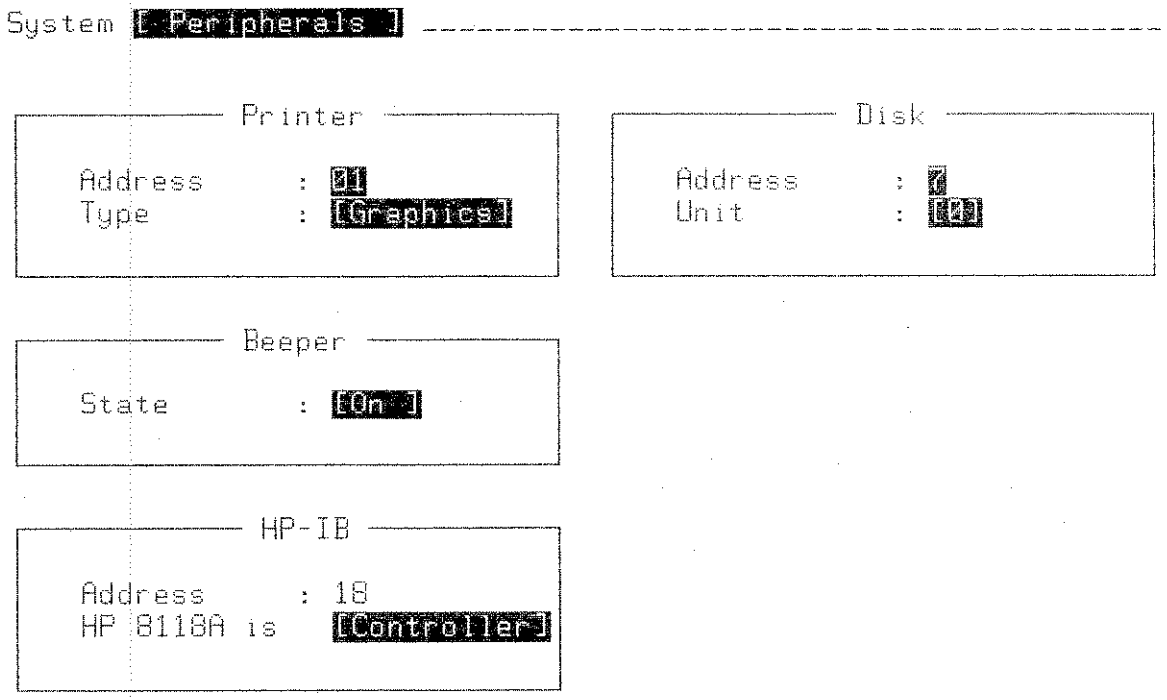


FIGURE 4-5. SAVE [INTERNAL]

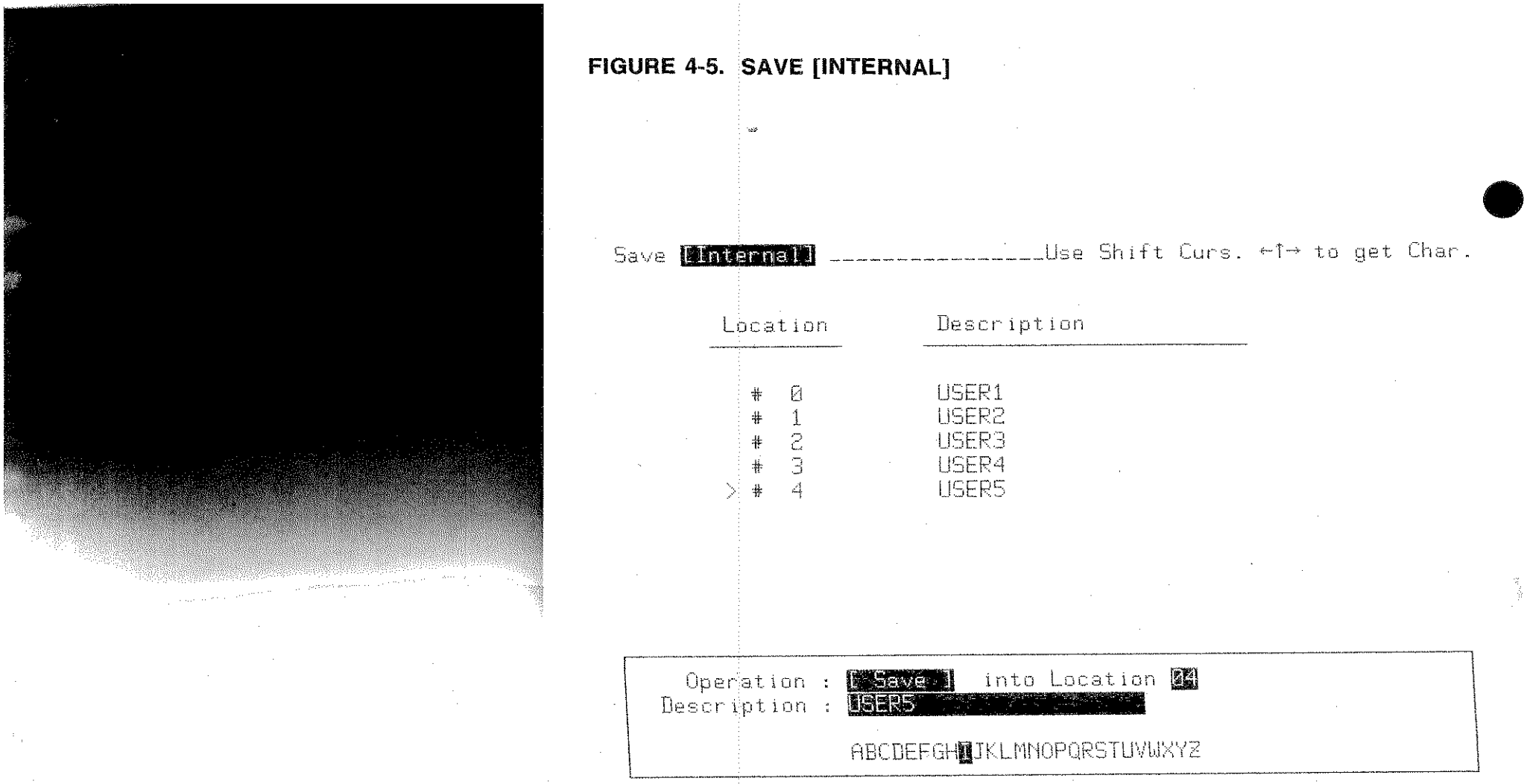


FIGURE 4-6. SAVE [EXTERNAL]

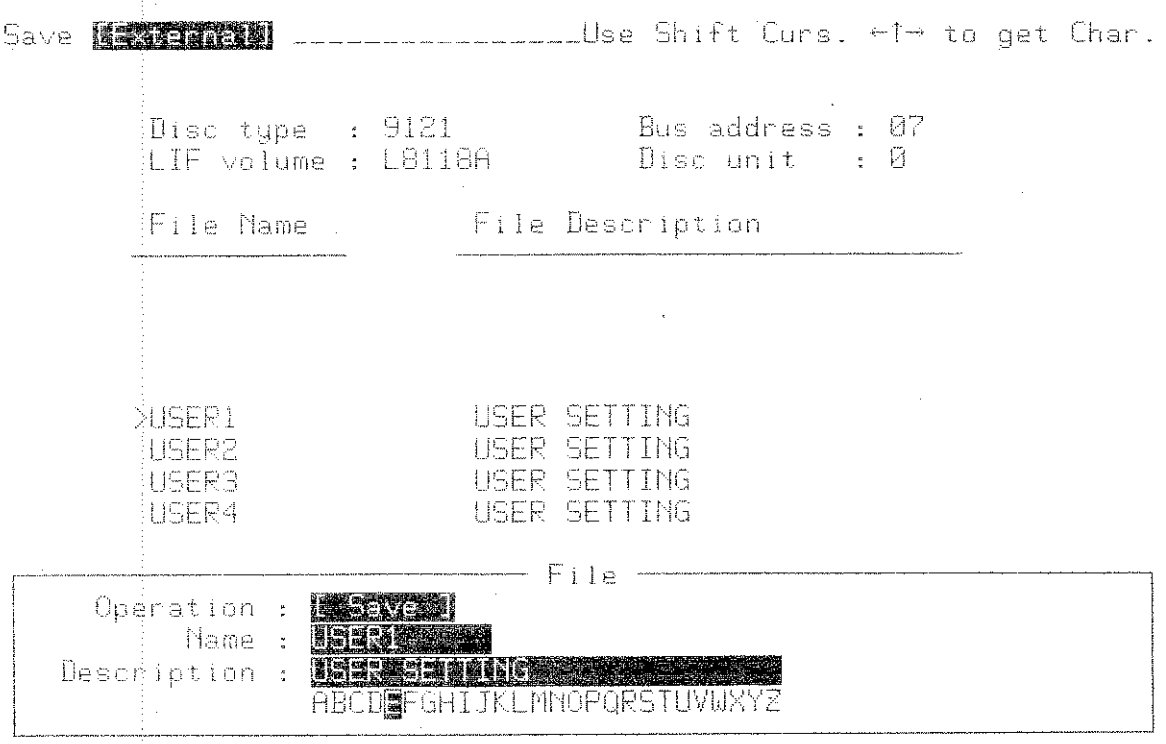


FIGURE 4-7. CONTROL (Pulse)

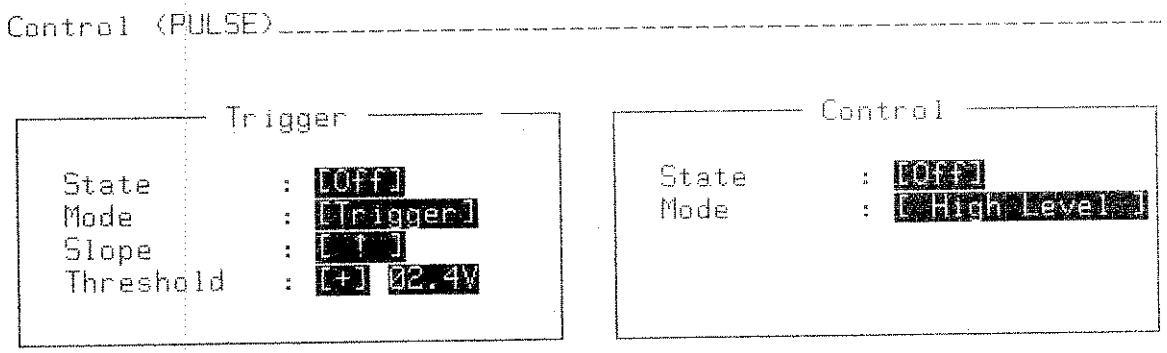


FIGURE 4-8. TIMING (Pulse)

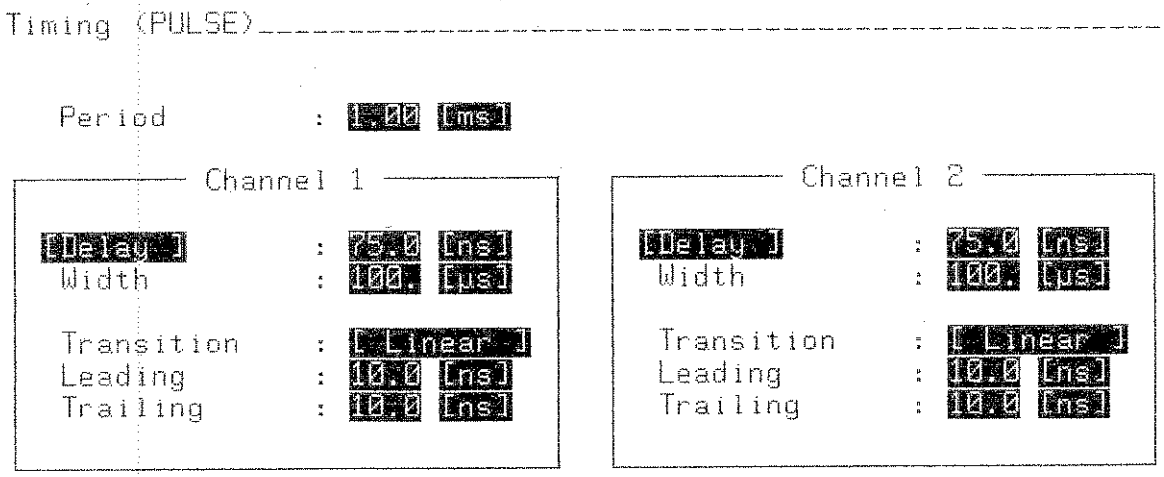
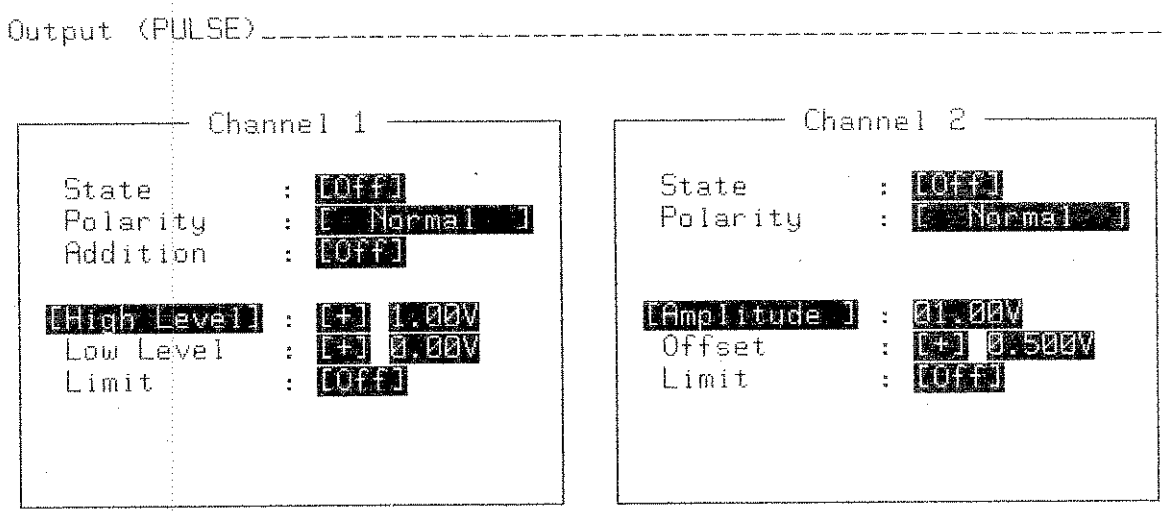


FIGURE 4-9. OUTPUT (PULSE)



CHAPTER 5 REMOTE MESSAGES

CONTENTS

FIGURE

INTRODUCTION

Messages, commands, and syntax are described in this chapter.

MESSAGE TYPES

Two types of messages are used.

1. Program messages which are sent from a remote controller to the HP 8115A.
2. Response messages which are sent from the HP 8115A to the controller.

COUPLED COMMANDS

The following commands are coupled.
:PULS:LEV:HIGH, :PUL:LEV:LOW,
:PULS:LEV:AMPL, and :PULS:LEV:OFFS

High Level = Offset + (Amplitude/2)
Low Level = Offset - (Amplitude/2)
Amplitude = (High level) - (Low level)
Offset = (High level) + (Low level) / 2.

SHORT FORM LONG FORM

The instrument will accept the short and long forms of the commands in upper and lower case. The short form appears in upper case type and the long form is the short form plus the lower case type which completes the keyword.

EXAMPLE:
Long form = :INPut:TRIGger:STATe
Short Form = :INP:TRIG:STAT

PROGRAM MESSAGE SYNTAX

Program messages = <ASCII-string><pmt>:

1. <ASCII-string> is one or more program message units.

   Message units are seperated by a program message unit seperator (<pmus> = ;).

   Each path in the syntax diagrams of Chapters 8 and 9 represent a complete program message unit

2. <pmt> = program message terminator

   There are three possible <pmt>:
   1. <lf>
   2. <^END>
   3' <lf><^END>

   '^' indicates that the 'end' message is asserted at the last byte of the program message.

   NOTE: <lf> is equivalent to NL.

PROGRAM MESSAGE EXAMPLE

```
OUTPUT 718; "*RST;
            :PULSe:EDGE:TRANsition GAUSsian;
            LEAD 15.0NS;
            TRAILING 15.0NS;
            :pulse:level:high 3.5v;
            low 1"
```

RESPONSE MESSAGE SYNTAX

Response messages = <ASCII-string><rmt>

1. <ASCII-string> is one or more response message units.

   The message units are defined in Chapters 8 and 9.

2. <rmt> = response message terminator

   <lf><^END> is the only <rmt> used by the instrument. '^' indicates that the 'END' message is asserted at the last byte of the response message.

   NOTE: <lf> is equivalent to NL.

Responses return values only; the base units are implied.

The local message "Response can be Read" indicates that the output queue contains a query response.

A query response must be read before the next program message is parsed or the message is deleted from the output queue.

See Chapters 8 and 9 for examples.

SYNTAX DIAGRAM CONVENTIONS

Non-terminals, substitute the required characters: **wsp, value, unit, data, mnemonic.**

Terminals: all terms not defined as non-terminals are terminals and are input as given. Short and long forms of the commands are allowed.

The instrument accepts character strings in upper and/or lower case equally.

MIN = minimum.

1. MIN in a program message unit sets up the minimum setting allowed for that parameter.
2. MIN in a query message unit returns the minimum value allowed for that parameter.

MAX = maximum.

The action is the same as for MIN except that maximum values are used.

value = integer (12), decimal (85.5), exponential format (99.9E-9) (E-12, E-9, E-6, or E-3 are allowed.)

unit bypass and base units:

S (seconds)
V (volts)

units = ps/PS, ns/NS, us/US, ms/MS, s/S uv/UV, mv/MV, v/V

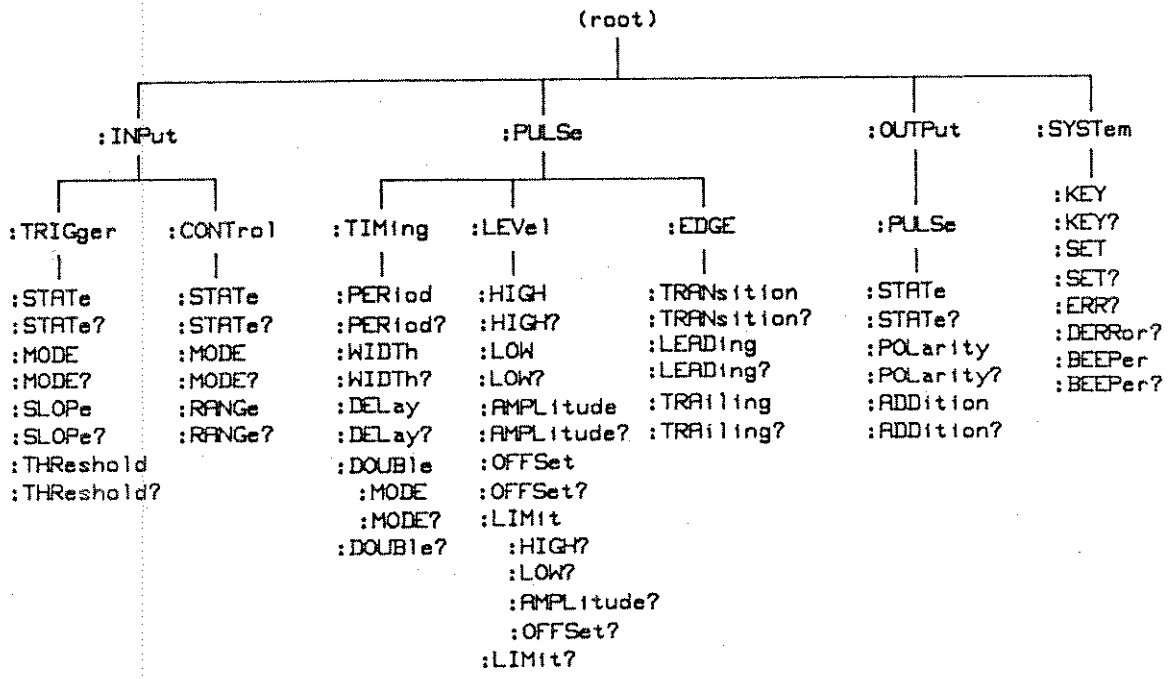
channel bypass is explained in the diagrams.

NL = ASCII <lf>.

| = either/or
<...> = non-terninal
[...] = optional

white space, wsp = ASCII control characters and the space but excludes the newline.

FIGURE 5-1. COMMAND HIERARCHY (tree)



CHAPTER 6 OPERATING STATE

CONTENTS

FIGURE

INTRODUCTION

Power-on, parser operation, and status data structures are described in this chapter.

POWER-ON

At power-on, the instrument:

1. Initializes itself:
   a. The input buffer is cleared.
   b. The output queue is cleared.
   c. The key queue is cleared.
   d. STB, SRE, ESR, ESE and the error queue are cleared.
   e. The parser is reset.
   f. The execution Control is reset.
   g. The response formatter is reset.
2. Enters the IDLE state awaiting a command.
3. The setting at power-off is restored as the current setting; however, outputs 1/2 are disabled.

PARSER OPERATION

Normally, the instrument removes all DABs , END, and GET bytes from the interface. Then it parses the bytes in the input buffer.

The exception is when the input buffer is full, and additional bytes remain to be input. In this case, the parser removes one byte from the input buffer and parses it. Then a byte is removed from the interface. If additional bytes remain to be input, the process of parsing one byte and inputting one byte continues until all bytes are input. Then the entire input buffer is parsed.

ERROR TYPES

There are four categories of instrument errors. All errors are listed in Appendix F.

1. Power-on Test errors identify power-on test failures. See Appendix F, Table F-1 for the extent of the test.

2. Self-test (*TST?) errors identify parametric failures. The test is identical to the parametric tests performed at power-on. See Appendix F, Table F-1.

3. Command, execution, device dependent, and query error events are reported in the standard event status register (ESR). These errors can be read in response to the :SYST:ERR? query. See Appendix F, Table F-2.

4. Device dependent error conditions are reported in bits 2-0 of the status byte register. These errors can be read in response to the :SYST:DERR? query. See Appendix F, Table F-3.

LOCAL MESSAGES

Power-on error messages are displayed immediately after the power-on tests are completed.
See Appendix F, Table F-1 for a list of messages.

Other error/warning messagess are reported in the top message line of the display.

There are two types:

1. Temporary messages which are deleted after 2-3 seconds or when the next key is pressed. These messages indicate attempted actions which are not allowed, for example, an attempt to update the hardware while the pattern generator is running.

2. Permanent messages which remain until a condition in the instrument is corrected, for example, if two conflicting modes are enabled, one mode must be disabled or changed before the message is deleted and operation can continue.

REMOTE MESSAGES

Remote error/warning messages can be read in response to the following queries:

1. *TST? (See Appendix F, Table F-1.
2. :ERR? (See Appendix F, Table F-2)
3. :DERR? (See Appendix F, Table F-3)

POLLING

The instrument's interface talker subset is T6. Thus, the serial poll method of requesting service is used.

Bit 1 Behavior

In the following discussion, the only status byte bit enabled in the status byte register is Bit 1. The only error condition is related to a pulse period and width incompatibility.

Bit 1 of the status byte register:

1. Is updated once every second. If Bit 1 is set (1), a service request is generated if a service request is not pending.

   For example, if the pulse width is too long, Bit 1 is set and remains set. Thus, each time Bit 1 is updated, a service request is generated if the prior service request has been serviced (polled).

2. Reports only the conditions present at the time of updating.

   The controller must poll the instrument in less than one second from the time service is requested to insure that Bit 1's state reflects the condition that caused the service request.

   For example, if the width which caused the service request is corrected before the next updating, Bit 1 is cleared at the updating.

   If the controller polls the instrument before the updating,as it should, it will read Bit 1 = 1. But if the controller polls the instrument after the updating, it will read Bit 1 = 0.

   In both examples, the :SYST:DERR? query provides detailed information regarding the error.

STATUS BYTE

The status byte is transmitted in bits 7 and 5-0 of the status byte register.

Bits 2-0 have the following behavior:

Bit 2: Bit 2 is a software-error summary-condition-bit. It reports state and mode conflicts (errors) detected by the software. It is updated after a program message terminator is parsed.

Bit 1: Bit 1 is a hardware-error-and-warning summary-condition-bit. It reports conditions not allowed by the hardware(errors) or states and modes which are not totally under control of the hardware(warnings). It is:

1. Updated once every second
2. Reports only the conditions present at the time of the update. NOTE: See POLLING.

Bit 0: Bit 0 is a software-warning summary-condition-bit. It reports conditions allowed by the hardware but which require special attention. It is updated after a program message terminator is parsed.

The errors related to bits 2-0 are reported in response to a :DERR? query:

Bit 2 = Error numbers 100-199
Bit 1 = Error numbers 200-299
Bit 0 = Error numbers 300-399

See Appendix F, Table F-3 for a listing of the :SYST:DERR? query errors.

STB

STATUS BYTE REGISTER

The status byte register (STB) is described in the following figure.

The Master Summary Status (MSS) message is true when any enabled bit of the STB register is set excluding Bit 6.

[BIT 7] [BIT 6] [BIT 5] [BIT 4] [BIT 3] [BIT 2] [BIT 1] [BIT 0]

Bit 7: Not used, value = 0
Bit 6: RQS / MSS (Request Service / Master Summary Status)
Bit 5: ESB (Event Status Bit)
Bit 4: MAV (Message Available)
Bit 3: Not used, value = 0
Bit 2: S (Software-error summary-condition-bit)
Bit 1: H (Hardware-error-and-warning summary-condition-bit)
Bit 0: W (Software-warning summary-condition-bit)

READING THE STB REGISTER

After reading the status byte register with:

1. **An *STB? query:**
   a. The status byte, RQS message, and the master summary message, MSS, are not directly altered as a result of the query.
   b. MSS is reported in bit six of the status byte register.

   NOTE: MSS can be indirectly altered by the query when MAV is enabled.
2. **A serial poll:**
   a. The request for service, RQS, message is cleared; the status byte and the MSS message are not altered as a result of the query.
   b. RQS is reported in bit six of the status byte register.

SERVICE REQUEST ENABLE REGISTER

The service request enable register (SRE) allows enabling of status byte register (STB) bits. See Chapter 8, *SRE command.

Bit six of the status byte register cannot be disabled. Thus, the bit value of sixty-four, if transmitted in an *SRE message, will be ignored.

The register is masked with the *SRE command and cleared with an '*SRE 0' message.

[BIT 7] [BIT 6] [BIT 5] [BIT 4] [BIT 3] [BIT 2] [BIT 1] [BIT 0]

Bit 7: Not used, value = 0
Bit 6: Not used, value = 0
Bit 5: ESB (Event Status Byte)
Bit 4: MAV (Message Available)
Bit 3: Not used, value = 0
Bit 2: S (Software-error summary-condition-bit)
Bit 1: H (Hardware-error-and-warning summary-condition-bit)
Bit 0: W (Software-warning summary-condition-bit)

READING THE SRE REGISTER

The service request enable register (SRE) is non-destructively read with the *SRE? query.

ESR

STANDARD EVENT STATUS REGISTER

The standard event status register (ESR) is described in the following figure.

[BIT 7] [BIT 6] [BIT 5] [BIT 4] [BIT 3] [BIT 2] [BIT 1] [BIT 0]

Bit 7: PON, Power-on
Bit 6: Not used, value = 0
Bit 5: CME, Command Error
Bit 4: EXE, Execution Error
Bit 3: DDE, Device Dependent Error
Bit 2: QYE, Query Error
Bit 1: Not used, value = 0
Bit 0: OPC, Operation Complete

READING THE STANDARD EVENTS STATUS REGISTER

The standard events status register is read with the *ESR? query.

The register is cleared after being read.

Additional CME, EXE, DDE, and QYE status is obtained with the :SYST:ERR? query.
See Chapter 12 and Appendix F, Table F-2.

STANDARD EVENT STATUS ENABLE REGISTER

The standard events status enable register(ESE) described in the following figure, enables bits of the standard events status register, ESR.

The register is masked with the *ESE command and cleared with an '*ESE 0' message.

[BIT 7] [BIT 6] [BIT 5] [BIT 4] [BIT 3] [BIT 2] [BIT 1] [BIT 0]

Bit 7: PON, Power-on
Bit 6: Not used, value = 0
Bit 5: CME, Command Error
Bit 4: EXE, Execution error
Bit 3: DDE, Device Dependent Error
Bit 2: QYE, Query Error
Bit 1: Not used, value = 0
Bit 0: OPC, Operation Complete

READING THE ESE REGISTER

The standard event status enable (ESE) register is non-destructively read with the *ESE? query.

INPUT BUFFER

The input buffer is:

1. FIFO buffer (first-in first-out)
2. 100 bytes long.

OUTPUT QUEUE

The output queue is:

1. FIFO queue (first-in first-out)
2. 40 response messages long

The message available, MAV, message is reported in bit four of the status byte when the output queue contains a message.

The output queue and the MAV message are cleared when a new program message is received directly after a program message terminator.

ERROR QUEUE

The error queue is a:

1. FIFO queue (first-in first-out)
2. 10 errors long

If the queue overflows, message '-350 <too many errors>' overlays the last message in the queue.

KEY QUEUE

The key queue records real key presses, not :SYST:KEY simulated key presses.

The key queue is a:

1. FIFO queue (first-in first-out)
2. 15 keys long
3. The queue is cleared when the last key press is read.

If the queue is empty, message '??' is returned in response to the :SYST:KEY? query.

REGISTER BIT ASSIGNMENT

BIT	WEIGHT	SIGNIFICANCE	INTERFACE ASSIGNMENT
[BIT 7]	128	Most (MSB)	DIO8
[BIT 6]	64		DIO7
[BIT 5]	32		DIO6
[BIT 4]	16		DIO5
[BIT 3]	8		DIO4
[BIT 2]	4		DIO3
[BIT 1]	2		DIO2
[BIT 0]	1	Least (LSB)	DIO1

NOTE: Unused register bits have a value of zero or are ignored.

SYNCHRONIZATION

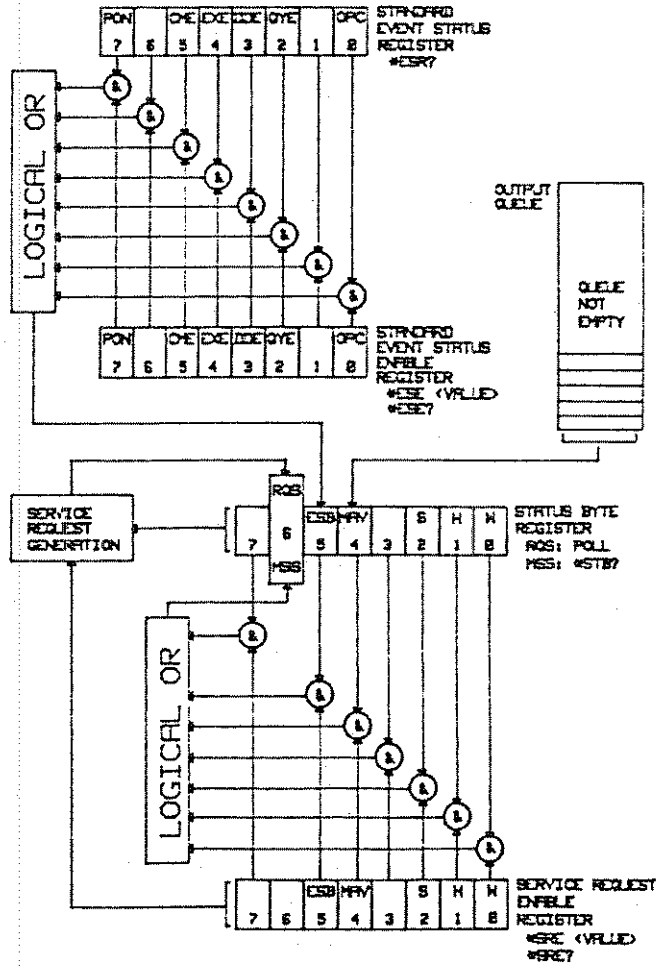
All commands are sequential commands.

If *OPC or *OPC? is parsed, a delay of two seconds occurs before the OPC bit is set or an ASCII coded '1' is placed in the output queue.
See Chapter 11.

If *WAI is parsed, a delay of two seconds occurs before executing any other commands.
See Chapter 11.

At the end of two seconds, all operations are complete.

FIGURE 6-1. STATUS REPORTING



CHAPTER 7 DISPLAY FUNCTIONS

CONTENTS

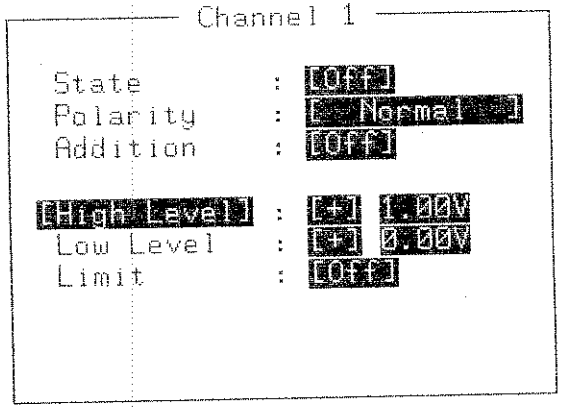
TABLES

FIGURES

ADDITION

DISPLAY

OUTPUT



LABEL

Addition:

FIELD

[Off], default state
Addition is disabled.

Channels (outputs) 1/2 are output seperately.

[On]
Addition is enabled.

Channels (outputs) 1/2 are added together and output at Output 1.

Observe the maximum level for channel 1 when adding channels 1 and 2.

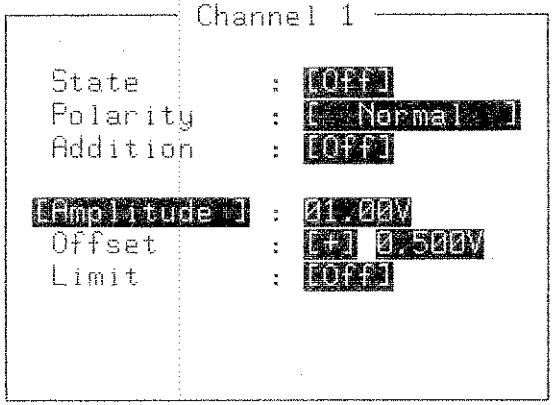
If channel 2 output state = [On], it will change to [OFF] when addition is enabled.

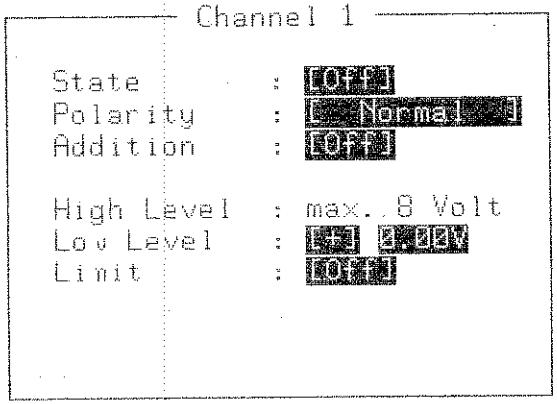
Conflict: Addition and control mode 'high level' are incompatible.

Device command:
:OUTP:PULS:ADD ON|OFF|1|0

AMPLITUDE

DISPLAY	LABEL	FIELD
OUTPUT	**[Amplitude]:** [High Level]	**0.08 V <= Amplitude <= 16.40 V** See HIGH LEVEL. Resolution = 0.01 V Default value = 1.00 V Amplitude = High Level - Low Level Amplitude, offset, and the levels are coupled. The limits are given in the HELP message.



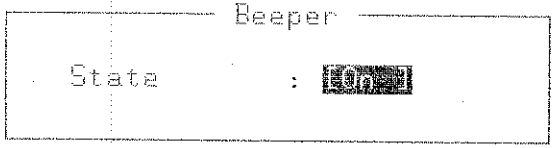


If control mode 'high level' is enabled, High Level: max. 8 Volt is displayed.

Device command:
:PULS:LEV:AMPL <value>|MIN|MAX

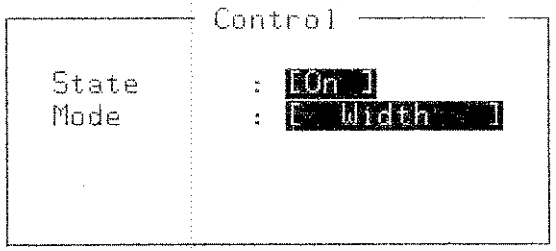
BEEPER

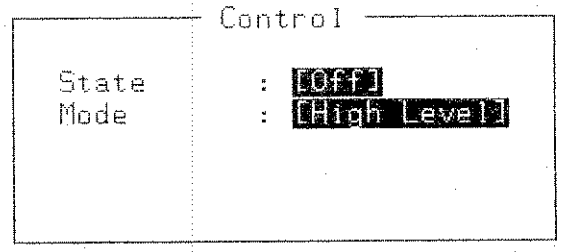
DISPLAY	LABEL	FIELD
PERIPHERALS	**State:**	**[Off], default state** The beeper is disabled. **[On]** The beeper is enabled. An audible tone occurs when a disallowed action is attempted. **Device command:** :SYST:BEEP ON|OFF|1|0



CONTROL (input)

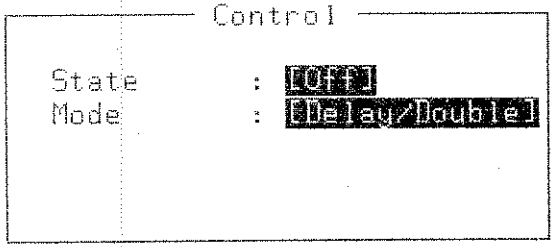
DISPLAY	LABEL	FIELD
CONTROL	**State:**	**[Off], default** The control function is disabled. **[On]** The control function is enabled. **Device command:** :INP:CONT:STATE ON|OFF|1|0
CONTROL	**Mode:**	**[High Level]** The high levels of channels 1 and 2 are controlled by an external voltage. The output voltage equals the input voltage. **CAUTION:** The limit function is not active when control mode 'high level' is enabled even though the state = On. Control voltage: -8.0V to 8.0V Output voltage: -8.0V to 8.0V **Conflict:** Control mode 'high level' and output 'addition' are incompatible. **Device command:** :INP:CONT:MODE HLEV





CONTROL (input)

DISPLAY	LABEL	FIELD
CONTROL	**Mode:** (contd.)	**[Delay/Double]:, default mode.** The pulse delay or double pulse delay of channels 1 and 2 are controlled by an external voltage.



Control voltage: 1.0V to 10.0V

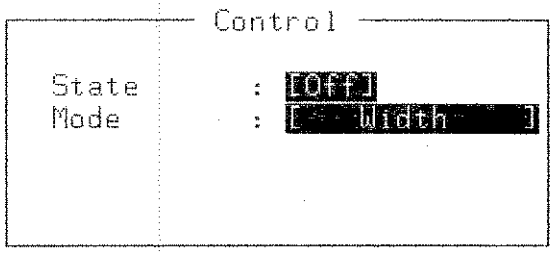
Pulse delay or double pulse delay is selected at the timing display.

A range specification is required at the timing display.

Device command: :INP:CONT:MODE DEL

CONTROL (input)

DISPLAY	LABEL	FIELD
CONTROL	**Mode:** (contd.)	**[Width]** The widths of channels 1 and 2 are controlled by an external voltage.

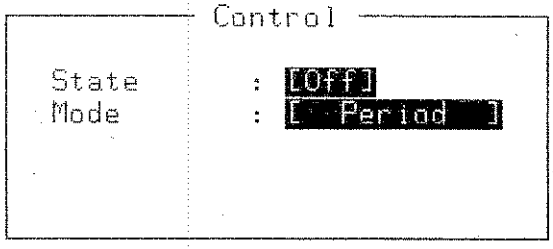


Control voltage: 1.0V to 10.0V

A range specification is required at the timing display.

Device command: :INP:CONT:MODE WIDT

DISPLAY	LABEL	FIELD
CONTROL	**Mode:** (contd.)	**[Period]** The periods of channels 1 and 2 are controlled by an external voltage.



Control voltage: 1.0V to 10.0V

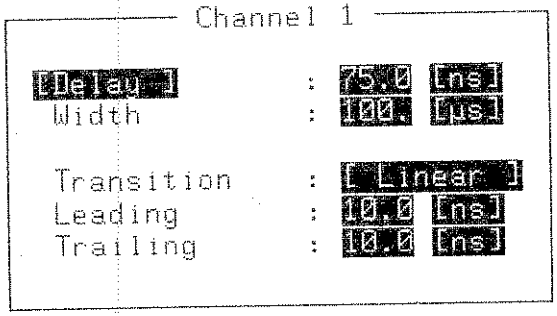
A range specification is required at the timing display.

Conflict: control mode 'period' is incompatible with trigger mode 'trigger'.

Device command: :INP:CONT:MODE PER

DISPLAY LABEL FIELD

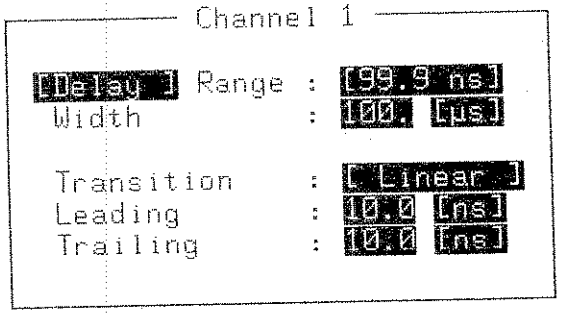
TIMING **[Delay]:**



74.0 ns <= Delay <= 999 ms
Resolution = LSD/See Table 8-1.
Default value = 75.0 ns

Device command:
:PULS:TIM:DEL <value>|MIN|MAX

[Delay] Range:



Ranges: See Table 8-1/Figure 8-1.
Default range: 75.0 ns to 99.9 ns

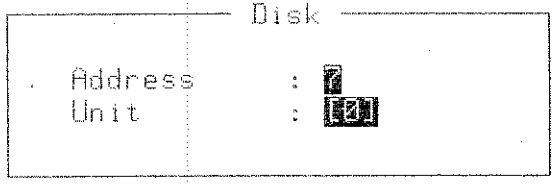
The minimum delay occurs at 7.5 V on Range 1.

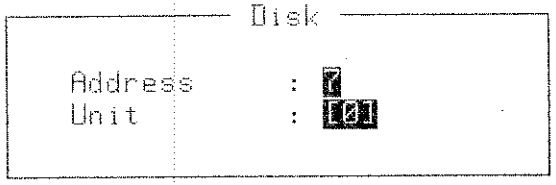
If the control mode 'delay' is enabled, the parameter label is changed to a range label which is used to specify the delay range.

Device command:
:INP:CONT:RANG <value>|MIN|MAX

DISC (drive)

DISPLAY	LABEL	FIELD
Peripherals	**Address:**	**0-7** Disc drive interface address: A unique interface address is required. CLEAR ENTRY will clear address conflicts by assigning the lowest unused address. At power-off, the address is saved in RAM and is restored at power-on. If the RAM data is invalid at power-on, the address is set to 0.
	Unit:	**[0], default** **[1]** Unit specifies which drive is selected in a disc drive. If there is only one drive, unit = 0. **A recommended disc drive is listed in Appendix B.** **Device command:** none





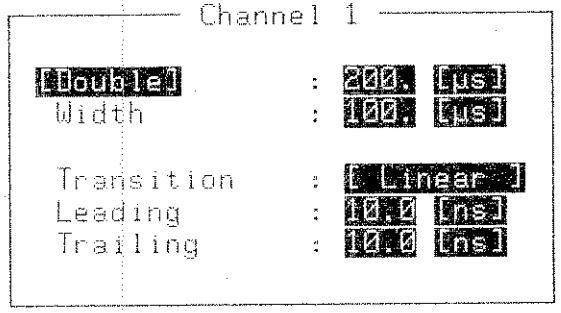
DOUBLE PULSE

DISPLAY

LABEL

FIELD

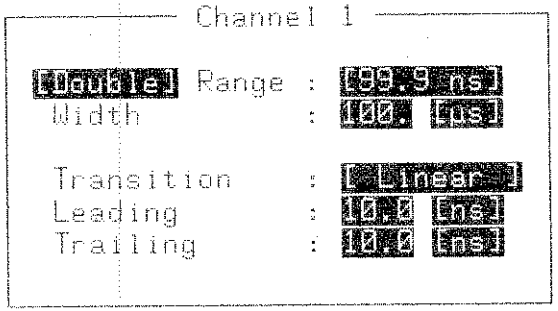
TIMING **[Double]:**



18.0 ns <= Double Pulse <= 999 ms
Resolution = LSD/See Table 8-1.
Default value = 200 us

Device command:
:PULS:TIM:DOUB <value>|MIN|MAX

TIMING **[Double] Range:**



Ranges: See Table 8-1/Figure 8-1.
Default range: 20.0 ns to 99.9 ns

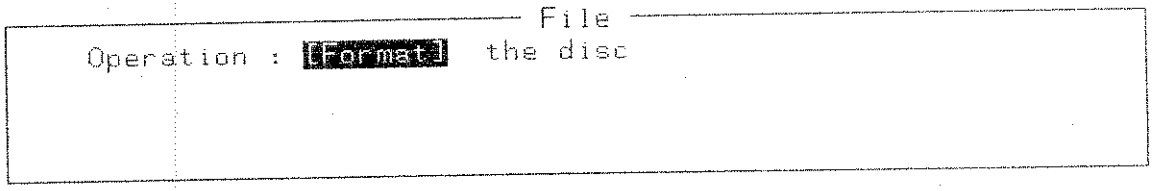
The minimum double pulse delay occurs at a control voltage of 2.0V on Range 1.

If control mode 'delay/double' is active the [Double] Range label replaces the [Double] label and is used to specify the double pulse delay range.

Device command:
:INP:CONT:RANG <value>|MIN|MAX

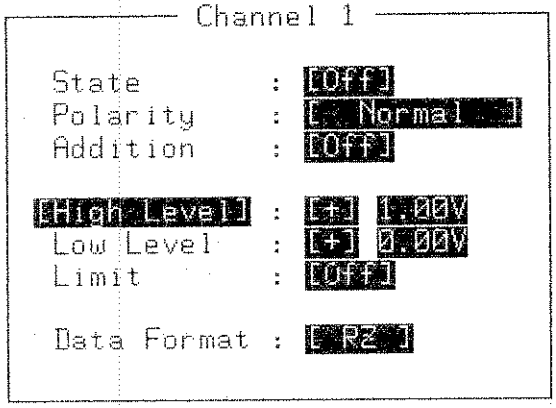
FORMAT (disc)

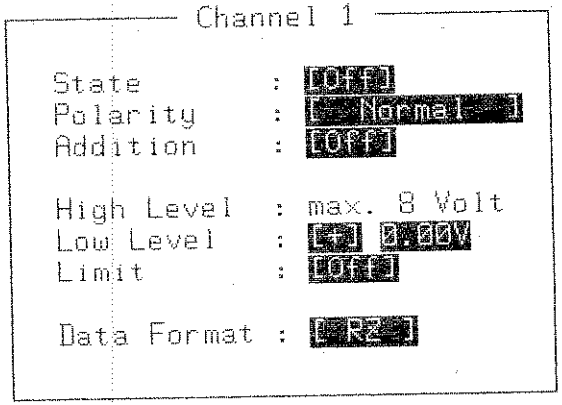
DISPLAY	LABEL	FIELD
SAVE EXTERNAL	Operation:	**[Format]** Formatting prepares a magnetic disc for data storage. **CAUTION**: Formatting deletes all data. The instrument must be a controller. **Execution:** Press EXEC to activate the operation. **Device command:** none



HIGH LEVEL

DISPLAY	LABEL	FIELD
OUTPUT	**[High Level]:** [Amplitude]	**-8.12 V <= High Level <= 8.20 V** See AMPLITUDE. Resolution = 0.01 V Default level = 1.00 V High Level = Offset + (Amplitude/2) High level, low level, amplitude, and offset are coupled. The limits are given in the HELP message.





If control mode 'high level' is active, the high level label changes to 'High Level: Max. 8 Volt' (Max. = maximum).

Device Command:
:PULS:LEV:HIGH <value>|MIN|MAX

HP-IB (interface)

DISPLAY	LABEL	FIELD
PERIPHERALS	**Address:**	**0-30** Interface address: a unique interface address is required. CLEAR ENTRY will clear address conflicts by assigning the lowest unused address. At power-off, the address is saved in RAM and is restored at power-on. If the RAM data is invalid at power-on, the address is set to 18. **Device commmand:** none.
	HP 8118A is	**[Controlled], default mode** As a device, the instrument can be controlled by a remote controller. **[Controller]** As a controller,the instrument can control a printer and a disc drive. Address and mode changes are not allowed while the instrument is addressed or a service request is pending. First take the instrument to the listen idle state and/or serial poll the instrument. **Device Command:** none

HP-IB

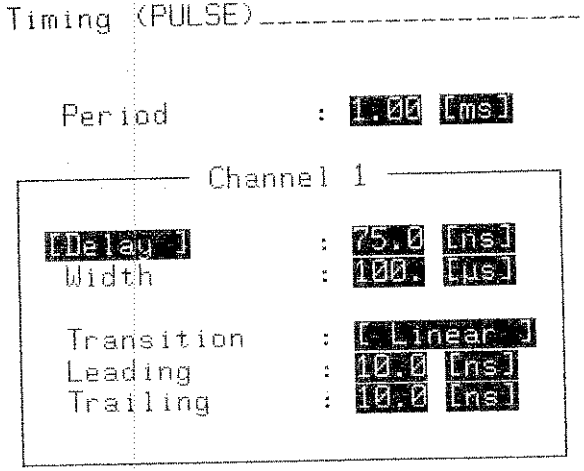
Address : 18
HP 8118A is [Controller]

HP-IB

Address : 18
HP 8118A is [Controller]

LEADING EDGE

DISPLAY	LABEL	FIELD
TIMING	**Leading:**	**05.5 ns <= Leading <= 99.9 ms** Resolution = LSD/See Table 8-2. Default value = 10.0 ns Fixed value = 5.5 ns (linear)



The leading and trailing edges must be programmed within a common range. See Table 8-2 and Figure 8-2 for edge information.

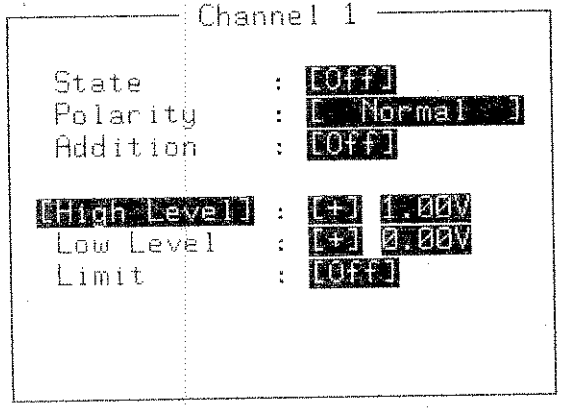
The pulse amplitude is reduced if the edge values are long (excessive) with respect to other timing values.

See VERNIER, Chapter 3, for a description of the vernier function, auto-ranging, and edges.

Device Command:
:PULS:EDGE:LEAD <value>|MIN|MAX

LIMIT

DISPLAY	LABEL	FIELD
OUTPUT	**Limit:**	**[Off], default** The limit function is disabled.



[On]
High and low level limiting for channels 1 and 2 is enabled.

CAUTION: the limit function is not active if control mode 'high level' is enabled even though the state = ON.

The levels, amplitude, and offset are coupled.

The high and low level limits are set as follows:

1. Disable the limit function if it is enabled.
2. Set the levels to the required limit value.
3. Enable the limit function.

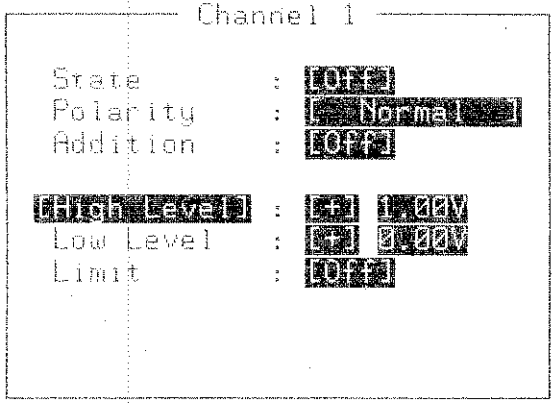
The limit values are included in the limit and level HELP messages.

Device Command:
:PULS:LEV:LIM ON|OFF|1|0

LOW LEVEL

DISPLAY

OUTPUT



LABEL

Low Level:
Offset

FIELDS

-8.20 V <= Low Level <= 8.12 V
See OFFSET.

Resolution = 0.01 V
Default level = 0.00 V

Low Level = Offset - (Amplitude/2)

Low level, high level, amplitude, and offset are coupled.

The limits are given in the HELP message.

The low level label changes to the offset label when the amplitude function is selected.

Device Command:
:PULS:LEV:LOW <value>|MIN|MAX

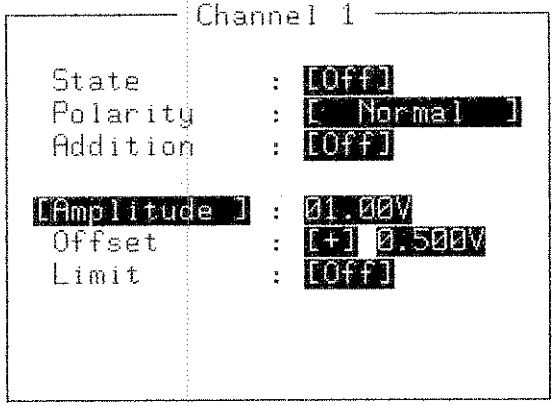
OFFSET

DISPLAY

TIMING

LABEL

Offset:
Low Level



FIELD

-8.160 V <= value <= 8.160 V
See LOW LEVEL.

Resolution = 0.005 V
Default value = 0.500 V

Offset = High Level + Low Level / 2

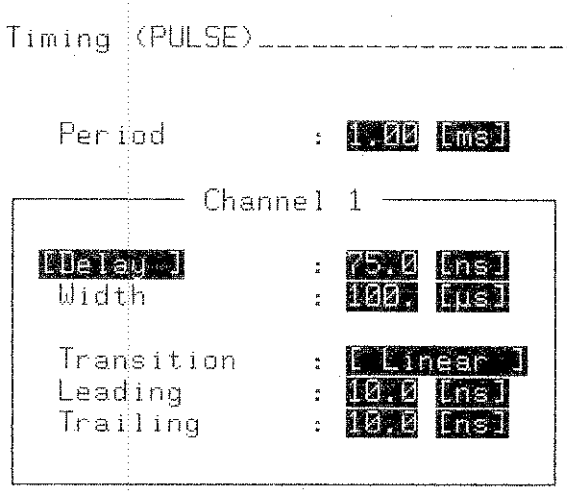
Offset, amplitude, and the levels are coupled.

When the amplitude function is selected, the low level label automatically changes to the offset label.

The limits are given in the HELP message.

Device Command:
:PULS:LEV:OFFS <value>|MIN|MAX

DISPLAY	LABEL	FIELD
TIMING	Period:	18.0 ns <= Period <= 999 ms



Resolution = LSD/See Table 8-1.
Default = 1.00 ms

The period parameter is common to channels 1 and 2.

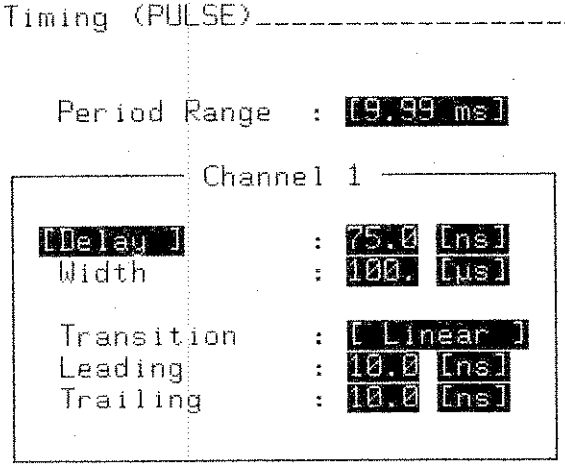
When trigger mode 'trigger' is enabled, the period is controlled by the external input trigger signal. The period label is removed from the display.

When control mode 'period' is enabled, the period is controlled by an external voltage. The period label changes to period range (See the next page.).

Device Command:
:PULS:TIM:PER <value>|MIN|MAX

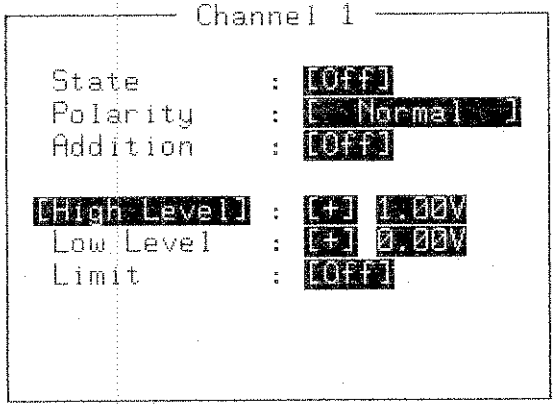
PERIOD

DISPLAY	LABEL	FIELD
TIMING	**Period Range:**	**Ranges: See Table 8-1/Figure 8-1.** Default range: 20.0 ns to 99.9 ns The minimum pulse period (20.0 ns) occurs at a control voltage of 2.0V. If control mode 'period' is active, the period range label replaces the period label and is used to specify the period range. **Device Command:** :INP:CONT:RANG <value>|MIN|MAX



POLARITY

DISPLAY	LABEL	FIELD
OUTPUT	**Polarity:**	**[Normal], default polarity** Channels (outputs) 1/2 are output as specified.

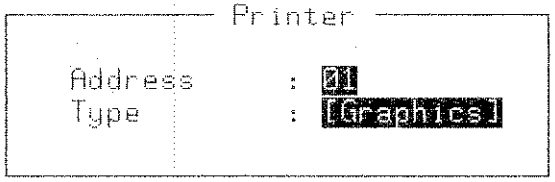


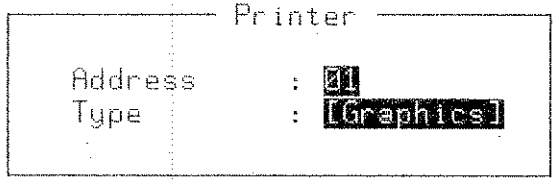
[Complement]
Channels (outputs) 1/2 are inverted.

Device Command:
:OUTP:PULS:POL NORM|COMP

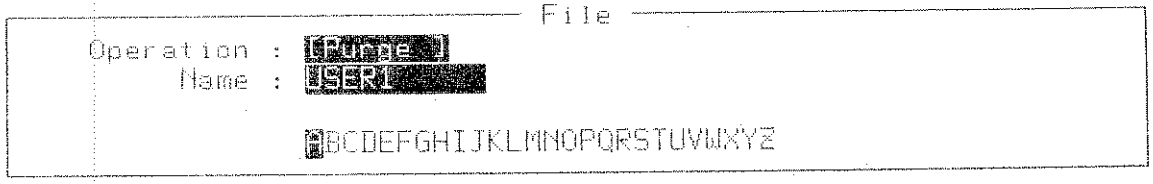
PRINTER

DISPLAY	LABEL	FIELD
PERIPHERALS	**Address:**	**0-30** Printer interface address: A unique address is required. CLEAR ENTRY will clear address conflicts by assigning the lowest unused address. At power-off, the address is saved in RAM and is restored at power-on. If the RAM data is invalid at power-on, the address is set to 5. **Device Command:** none
	Type:	**[None], default** A printer type is not declared. **[Graphics]** Display text appearing in inverse video is printed in an inverse format. **[Text]** The display text appearing in inverse video is printed in the normal manner and underlined. Printing is described in Chapter 3 **A recommended printer is listed in Appendix B.** **Device Command:** none





DISPLAY	LABEL	FIELD
SAVE EXTERNAL	**Operation:**	**[Purge]** A specified file is deleted from a magnetic disc. The instrument must be a controller.
	Name:	**File name** File names are built with the alpha-numeric keys and the display alphabet,for example, USER1 in the following figure. See Chapter 3, CURSOR keys. **Execution:** Press EXEC to activate the operation. **Device Command:** none

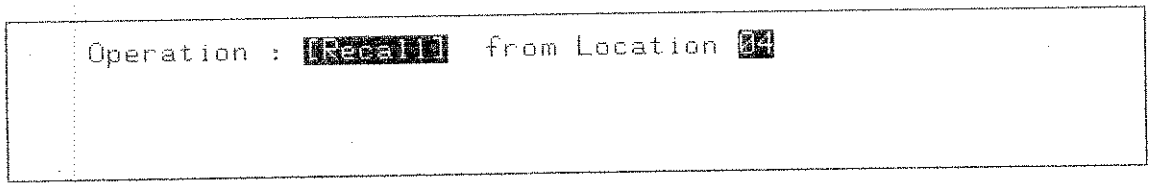


RECALL (external)

DISPLAY	LABEL	FIELD
SAVE EXTERNAL	**Operation:**	**[Recall], default operation** A setting stored on a magnetic disc is made the instrument setting. The instrument must be a controller. The hardware is automatically updated for all parameters that are part of the recalled setting.
	Name:	**File name** File names are built with the alpha-numeric keys and the display alphabet, for example, USER1 in the following figure. See Chapter 3, CURSOR keys. **Execution:** Press EXEC to activate the operation. **Device Command:** none

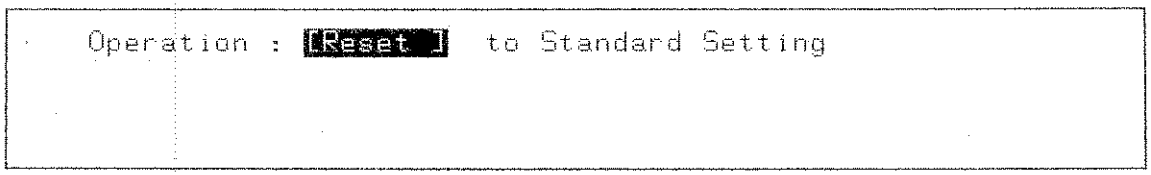
RECALL (internal)

DISPLAY	LABEL	FIELD
SAVE INTERNAL	**Operation:**	**[Recall], default** Location = 0-13 A setting stored in RAM is made the instrument setting. The hardware is automatically updated for all parameters that are part of the recalled setting. **Execution:** Press EXEC to activate the operation. **Common command:** *RCL <location> **Related command:** *SAV <location>



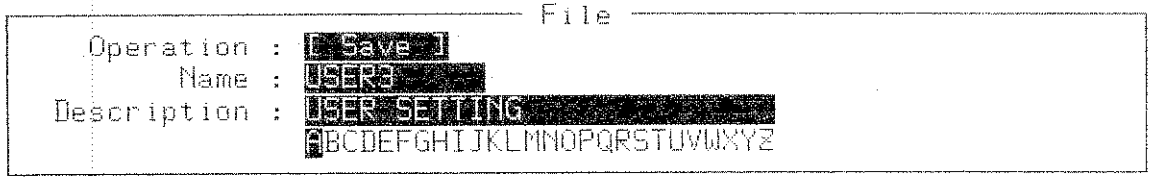
RESET

DISPLAY	LABEL	FIELD
SAVE INTERNAL	Operation:	**[Reset]** A copy of the reset setting (standard setting) stored in ROM is made the instrument setting. Updating is automatic for all parameters of the standard setting. See Chapter 11, *RST, for a description of the standard setting. **Execution:** Press EXEC to activate the operation. **Common Command:** *RST



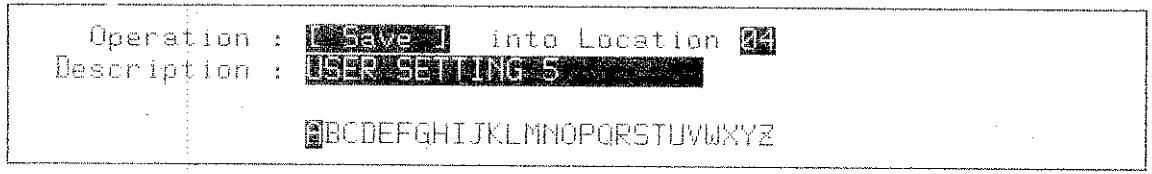
SAVE (external)

DISPLAY	LABEL	FIELD
SAVE EXTERNAL	**Operation:**	**[Save]** The instrument setting is stored on a magnetic disc. The instrument must be a controller. Save before editing because a pattern cannot be retrieved from the hardware. The scope of the generator's saved setting is identical to the scope of the standard setting (pattern commands do not apply to the pulse generator).
	Name: **Description:**	**File name** **Setting identification** File names and descriptions are built with the alpha-numeric keys and the display alphabet. See Chapter 3, CURSOR keys. **Execution:** Press EXEC to activate the operation. **Device command:** none



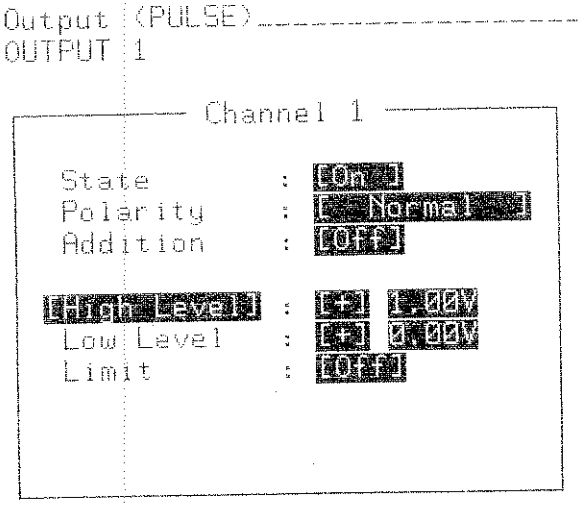
SAVE (internal)

DISPLAY	LABEL	FIELD
SAVE INTERNAL	**Operation:**	**[Save]** Location = 0-13 A copy of the instrument setting is stored in RAM. Save before editing because a pattern cannot be retrieved from the hardware. The scope of the generator's saved setting is identical to the scope of the standard setting (pattern commands do not apply to the pulse generator).
	Description:	**Setting Identification** The description is built with the alpha-numeric keys and the display alphabet,for example, USER SETTING in the following figure. See Chapter 3, CURSOR keys. **Execution:** Press EXEC to activate the operation. **Common command:** *SAV <location> **Related command:** *RCL <location>



STATE (output)

DISPLAY	LABEL	FIELD
OUTPUT	**State:**	**[OFF], default state** Channels 1/2 are disabled.



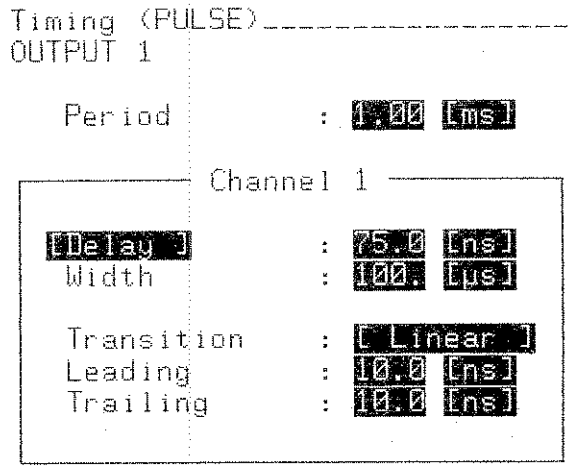
[On]
Channels 1/2 (Outputs 1/2) are enabled.

When enabled, the messages 'Output 1' and 'Output 2' appear in the second message line.

Device Command:
:OUTP:PULS:STAT ON|OFF

TRAILING EDGE

DISPLAY	LABEL	FIELD
TIMING	**Trailing:**	**05.5 ns <= Trailing <= 99.9 ms** Resolution = LSD/See Table 8-2. Default value = 10.0 ns Fixed value = 5.5 ns (linear)



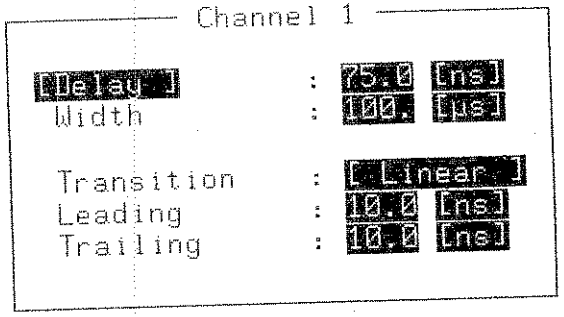
The leading and trailing edges must be programmed within a common range. See Table 8-2 for the ranges.

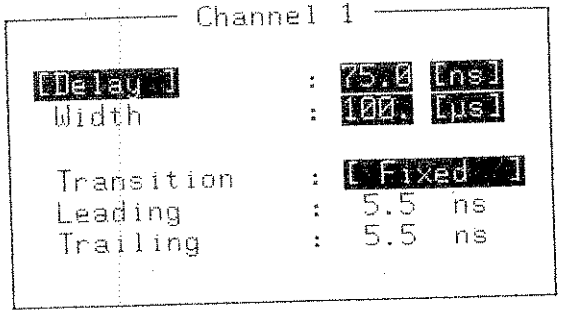
The pulse amplitude is reduced if the edge values are long (excessive) with respect to other timing values.

See VERNIER, Chapter 3, for a description of the vernier function, auto-ranging, and edges.

Device Command:
:PULS:EDGE:TRA <value>|MIN|MAX

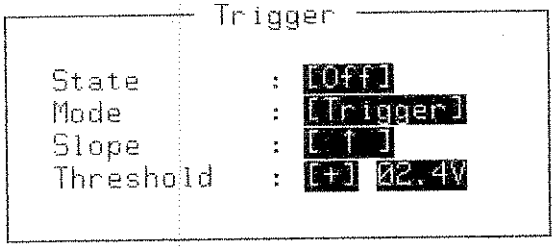
DISPLAY	LABEL	FIELD
OUTPUT	Transition:	**[Linear], default transition** Linear edges: programmable. See LEADING and TRAILING.
		[Gaussian] Cosinusoidal edges: programmable. See LEADING and TRAILING.
		[Fixed] The leading and trailing edges are fixed at 5.5 ns each (linear).
		Device command: :PULS:EDGE:TRAN LIN|GAUS|FIX





TRIGGER (external input)

DISPLAY	LABEL	FIELD
CONTROL	**State:**	**[Off], default state** The external input is disabled.



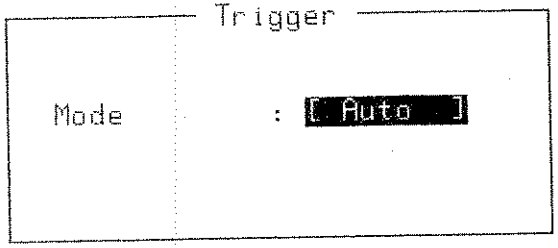
[On], trigger and gate only
The external input is enabled.

When a MANUAL function is executed, the trigger state changes to [OFF].

Device Command:
:INP:TRIG:STAT ON|OFF|1|0

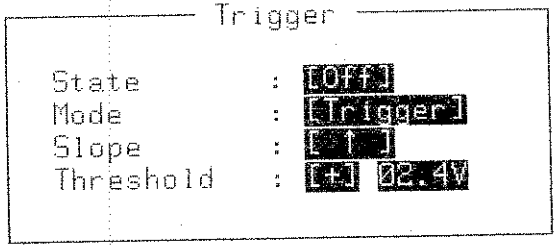
CONTROL	**Mode:**	**[Auto], default mode**

Pulse generator: A continuous pulse stream is generated.



TRIGGER (external input)

DISPLAY	LABEL	FIELDS
CONTROL	**Mode:** (Contd.)	**[Trigger]** One pulse or double pulse is generated per trigger (external input) signal.

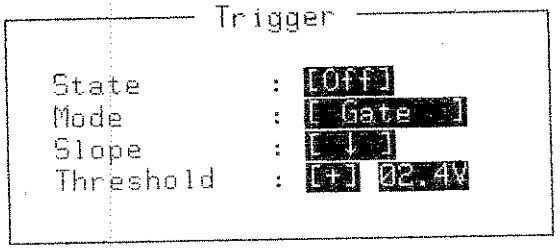


The period label at the timing page is not displayed.

Conflict: The trigger mode 'trigger' and control mode 'period' are incompatible (pulse generator).

Device Command: :INP:TRIG:MODE TRIG

CONTROL	**Mode:** (Contd.)	**[Gate]** Pulses or double pulses are generated for the duration of the gate. The last pulse is completed.

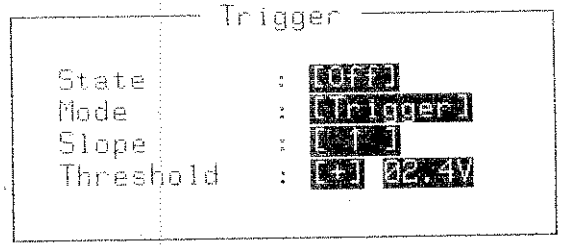


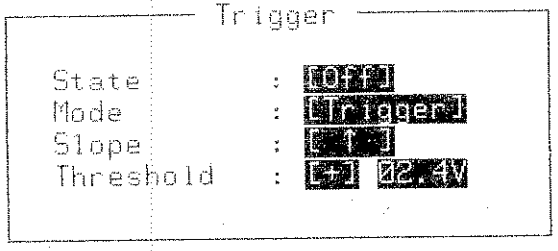
Conflict: the GATE mode and slope 'Both' are incompatible.

Device command: :INP:TRIG:MODE GATE

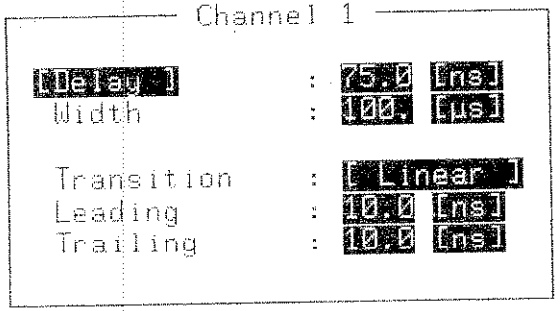
TRIGGER (external input)

DISPLAY	LABEL	FIELD
CONTROL	**Slope**	**[positive slope]**, up arrow, default **[negative slope]**, down arrow **[Both]**, double headed arrow Conflict: 'Both' and trigger mode 'gate' are incompatible. **Device command:** :INP:TRIG:SLOP POS|NEG|BOTH
CONTROL	**Threshold**	**-12.0 V <= Threshold <= 12.0** Resolution = 0.1 V Default threshold = 2.4 V **Device command:** :INP:TRIG:THR <value>|MIN|MAX





DISPLAY	LABEL	FIELD
TIMING	**Width:**	**9.0 ns <= Width <= 999 ms** Resolution = LSD/See Table 8-1. Default value = 100 us **Device Command:** :PULS:TIM:WIDT <value>|MIN|MAX



	Width Range:	**Ranges: See Table 8-1/Figure 8-1.** Default range: 10.0 ns to 99.9 ns If control mode 'width' is enabled, the width range label replaces the width label and is used to specify the width range. **Device Command:** :INP:CONT:RANG <value>|MIN|MAX

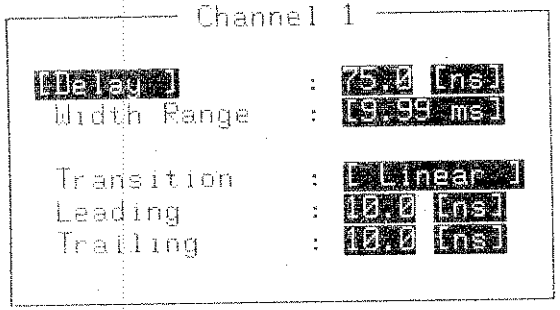


TABLE 8-1. PERIOD, DELAY, DOUBLE and WIDTH RANGES

RANGE NUMBER	RANGE			RESOLUTION
1	***	-	99.9 ns	100 ps
2	100 ns	-	999 ns	1 ns
3	1 us	-	9.99 us	10 ns
4	10 us	-	99.9 us	100 ns
5	100 us	-	999 us	1 us
6	1 ms	-	9.99 ms	10 us
7	10 ms	-	99.9 ms	100 us
8	100 ms	-	999 ms	1 ms

*** Delay: Pulse delay = 75 ns
Double pulse delay = 20 ns
Period: 20 ns
Width: 10.0 ns.

FIGURE 8-1. CONTROL INPUT

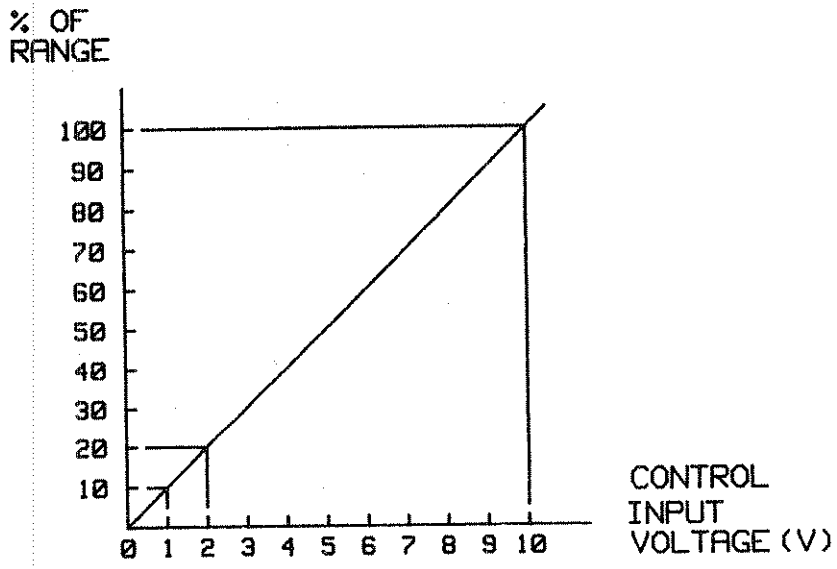
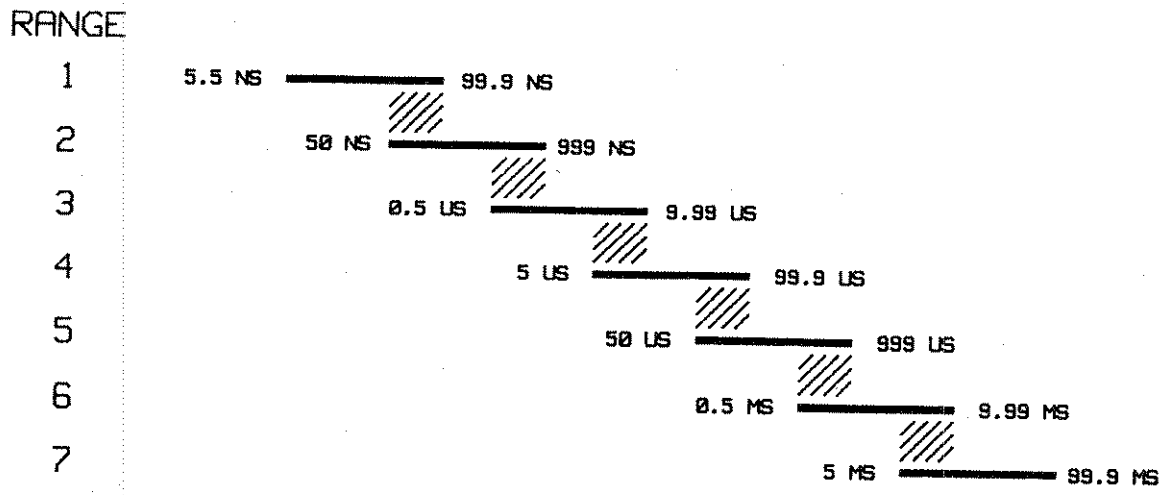


TABLE 8-2. EDGE RANGES

NUMBER	RANGE			RESOLUTION
1	5.5 ns	-	99.9 ns	100 PS
2	50 ns	-	999 ns	1 NS
3	0.50 us	-	9.99 us	10 NS
4	5.0 us	-	99.9 us	100 NS
5	50 us	-	999 us	1 US
6	0.50 ms	-	9.99 ms	10 US
7	5.0 ms	-	99.9 ms	100 US

FIGURE 8-2. EDGE RANGES



CHAPTER 8 COMMON COMMANDS

MNEMONIC	NAME
*CLS	Clear Status
*ESE	Standard Event Status Enable
*ESE?	Standard Event Status Enable Query
*ESR?	Standard Event Status Register Query
*IDN?	Identification Query
*LRN?	Learn Device Setup Query
*OPC	Operation Complete
*OPC?	Operation Complete Query
*RCL	Recall
*RST	Reset
*SAV	Save
*SRE	Service Request Enable
*SRE?	Service Request Enable Query
*STB?	Read Status Byte Query
*TRG	Trigger
*TST?	Self Test Query
*WAI	Wait to Continue

*CLS

CLEAR STATUS COMMAND

-----*CLS-----

DEFINITION

The *CLS command clears the following:

1. Error queue
2. Standard event status register (ESR)
3. Status byte register bit 5 (STB)
4. A service request
5. OCAS and OQAS

No changes are made to the following:

1. Status byte register bits 6, 4, 2-0 (STB)
2. Output queue
3. Event status enable register (ESE)
4. Service request enable register (SRE)

State:

1. IDLE state
2. Setting prior to *CLS
3. *OPC/*OPC? actions are cancelled.

If the *CLS command occurs directly after a program message terminator, the output queue and MAV, bit 4, in the status byte register are cleared, and if condition bits 2-0 of the status byte register are zero, MSS, bit 6 of the status byte register is also zero.

Related commands: none

EXAMPLE

```
OUTPUT 718;"*CLS"
```

STANDARD EVENT STATUS ENABLE COMMAND

-----*ESE-----<value>-----

0 <= value <= 255

DEFINITION

The *ESE command sets bits in the standard event status enable register (ESE) which enable the corresponding bits in the standard event status register (ESR).

The register is cleared:

1. At power-on
2. By sending a value of zero

The register is not changed by the *RST and *CLS commands.

BIT	MNEMONIC	BIT VALUE
7	PON	128
6	Not used	0
5	CME	32
4	EXE	16
3	DDE	8
2	QYE	4
1	Not used	0
0	OPC	1

Related commands: *ESE?

EXAMPLE

```
OUTPUT 718;"*ESE 21"
```

*ESE?

STANDARD EVENT STATUS ENABLE QUERY

-----*ESE?-----

DEFINITION

The standard event status enable query returns the contents of the standard event status enable register.

0 <= contents <= 255

BITS	MNEMONICS	BIT VALUE
7	PON	128
6	Not used	0
5	CME	32
4	EXE	16
3	DDE	8
2	QYE	4
1	Not used	0
0	OPC	1

Related commands: *ESE

EXAMPLE

```
OUTPUT 718;"*ESE?"
ENTER 718: A$
```

STANDARD EVENT STATUS REGISTER QUERY

-----*ESR?-----

DEFINITION

The standard event status register query returns the contents of the standard event status register. The register is cleared after being read.

0 <= contents <= 255

BITS	MNEMONICS	BIT VALUE
7	PON	128
6	Not used	0
5	CME	32
4	EXE	16
3	DDE	8
2	QYE	4
1	Not used	0
0	OPC	1

Related commands: *ESR

EXAMPLE

```
OUTPUT 718;"*ESR?"
ENTER 718: A$
```

*IDN?

IDENTIFICATION QUERY

-----*IDN?-----

DEFINITION

The identification query commands the instrument to identify itself over the interface.

Response: HEWLETT-PACKARD, 8115A, 0, 1.0

HEWLETT-PACKARD	=	manufacturer
8115A	=	instrument model number
0	=	indicates serial numbers are not provided.
1.0	=	firmware revision level

EXAMPLE

```
DIM A$ [100]
OUTPUT 718;"*IDN?"
ENTER 718; A$
```

LEARN DEVICE SETUP QUERY

-----*LRN?-----

DEFINITION

The learn query returns the status of the instrument's setting.

The response message can be retransmitted as a program message without requiring any alterations.

The returned commands are listed in Table 7-1.

The learn response message is a single ASCII string without image specifiers. The format of Table 7-1 is for legibility only.

EXAMPLE

```
DIM A$ [25000]
OUTPUT 718;"*LRN?"
ENTER 718; A$
```

*LRN?

TABLE 8-1. PULSE *LRN?

:SYST	:GEN
:INP:TRIG	:STAT :MODE :SLOP :THR
:INP:CONT	:STAT :MODE :RANG
:PULS:TIM	:PER
:PULS1:TIM	:WIDT :DEL :DOUB :DOUB:MODE
:PULS2:TIM	:WIDT :DEL :DOUB :DOUB:MODE

:PULS1:LEV	:AMPL :OFFS :LIM
:PULS2:LEV	:AMPL :OFFS :LIM
:PULS1:EDGE	:TRAN :LEAD :TRA
:PULS2:EDGE	:TRAN :LEAD :TRA
:OUTP2:PULS	:POL :STAT
:OUTP1:PULS	:POL :ADD :STAT

*OPC

OPERATION COMPLETE COMMAND

-----*OPC-----

DEFINITION

The instrument parses all program message units in the message and after a wait period of two seconds, sets the operation complete bit in the standard event status register (ESR).

Related commands: *OPC?, *WAI

EXAMPLE

```
OUTPUT 718;"*CLS;*ESE 1;*SRE 32"
OUTPUT 718;"*OPC"
```

OPERATION COMPLETE QUERY

-----*OPC?-----

DEFINITION

The instrument parses all program message units in the message and after a wait period of two seconds, places an ASCII '1' in the output queue.

Related commands: *OPC, *WAI

EXAMPLE

```
OUTPUT 718;"*OPC?"
ENTER 718;A$
```

*RCL

RECALL COMMAND

-----*RCL-----<location>-----

0 <= location <= 13

DEFINITION

A setting stored in RAM is made the instrument setting.

The instrument can store five settings, locations 0-13.

The *RCL command is identical to 'recall' at the save internal display.
See Chapter 8, SAVE (internal).

Related commands: *SAV

EXAMPLE

```
OUTPUT 718;"*RCL 3"
```

RESET COMMAND

-----*RST-----

DEFINITION

The reset setting (standard setting) stored in ROM is made the instrument setting.

Pending *OPC/*OPC? actions are cancelled.

Instrument state: the instrument is placed in the IDLE state awaiting a command.

The *RST command clears the key queue.

The following are not changed:

1. HP-IB (interface) state
2. Instrument interface address
3. Output queue
4. Service request enable register (SRE)
5. Standard event status enable register (ESE)

The commands and parameters of the reset state are listed in the following table.

Related commands: none

EXAMPLE

```
OUTPUT 718;"*RST"
```

*RST

TABLE 8-2. RESET STATE

COMMANDS	PARAMETERS (DEFAULTS)	CHANNEL
:INPUT		
:TRIG		
:STAT	OFF	
:MODE	AUTO	
:SLOP	POS	
:THRE	+2.4V	
:CONT		
:STATE	OFF	
:MODE	DEL	
:RANG	99.9 ns	
:PULS		
:TIM		
:PER	1.00ms	
:WIDT	100us	1/2/3
:DEL	75.0ns	1/2/3
:DOUB	200.0us	1/2
:MODE	OFF	1/2
:LEV		
:HIGH	1.00V	1/2
:LOW	0.00V	1/2
:AMPL	1.00V	1/2
:OFFS	0.500V	1/2
:LIM	OFF	1/2
:EDGE		
:TRAN	LIN	1/2
:LEAD	10.0ns	1/2
:TRA	10.0ns	1/2

COMMANDS	PARAMETERS	CHANNEL
:OUTP		
:PULS		
:STAT	OFF	1/2
:POL	NORM	1/2
:ADD	OFF	1
:SYST		
:BEEP	OFF	

*SAV

SAVE COMMAND

-----*SAV-----<location>-----

0 <= location <= 13

DEFINITION

The instrument setting is stored in RAM.

The instrument can store five settings, locations 0-13.

The scope of the saved setting is identical to the scope of the standard setting.

The *SAV command is identical to 'Save' at the internal display.
See Chapter 8, SAVE (internal).

Related commands: *RCL

EXAMPLE

OUTPUT 718;"*SAV 3"

SERVICE REQUEST ENABLE REGISTER

-----*SRE-----<value>-----

0 <= value <= 255

DEFINITION

The service request enable command sets bits in the service request enable register which enable the corresponding status byte register bits

The register is cleared:

1. At power-on
2. By sending a value of zero.

The register is not changed by the *RST and *CLS commands.

BITS	MNEMONICS	BIT VALUE
7	Not used	0
6	RQS/MSS	64
5	ESB	32
4	MAV	16
3	Not used	0
2	S	4
1	H	2
0	W	1

Related commands: *SRE?, *STB?

EXAMPLE

```
OUTPUT 718;"*SRE 48"
```

*SRE?

SERVICE REQUEST ENABLE QUERY

-----*SRE?-----

DEFINITION

The service request enable query returns the contents of the service request enable register.

0 <= contents <= 255

BITS	MNEMONIC	BIT VALUE
7	Not used	0
6	MSS/RQS	64
5	ESB	32
4	MAV	16
3	Not used	0
2	S	4
1	H	2
0	W	1

Related commands: *SRE, *STB?

EXAMPLE

```
OUTPUT 718;"*SRE?"
ENTER 718; A$
```

READ STATUS BYTE QUERY

-----*STB?-----

DEFINITION

The read status byte query returns the contents of the status byte register.

0 <= contents <= 255

The MSS message is reported in bit six of the status byte register.

BITS	MNEMONICS	BIT VALUE
7	Not used	0
6	MSS	64
5	ESB	32
4	MAV	16
3	Not used	0
2	S	4
1	H	2
0	W	1

Related commands: *SRE, *SRE?

EXAMPLE

```
OUTPUT 718;"*STB?"
ENTER 718; A$
```

*TRG

TRIGGER COMMAND

-----*TRG-----

DEFINITION

The trigger command has the same effect as a GROUP EXECUTE TRIGGER (GET).

If the trigger mode 'trigger' is selected, a trigger event occurs, and one pulse or double pulse is generated.

Related commands: GET (interface command)

EXAMPLE

OUTPUT 718;"*TRG"

SELF-TEST QUERY

-----*TST?-----

DEFINITION

The self-test query commands the instrument to perform a self-test and place the results of the test in the output queue.

Returned value: 0 <= value <= 657.

A value of zero indicates no errors.

Explanations of the non-zero results of the self-test are given in Appendix F, Table F-1.

No entries are allowed while the test is running.

The instrument is returned to the setting that was active at the time the self-test query was processed.

The self-test does not require operator interaction beyond sending the *TST? query.

Related command: none

EXAMPLE

```
OUTPUT 718;"*TST?"
ENTER 718; A$
```

*WAI

WAIT-TO-CONTINUE-COMMAND

-----*WAI-----

DEFINITION

The wait-to-continue command prevents the instrument from executing any further commands for two seconds. All pending operations are completed during the wait period.

Related commands: *OPC, *OPC?

EXAMPLE

```
OUTPUT 718;"*WAI"
```

CHAPTER 9 DEVICE COMMANDS

:INPut

COMMAND	PARAMETER
:INPut	
:CONTrol	
:MODE	PERiod|DELay WIDTh|HLEVel
:MODE?	
:RANGe	<value>|MIN|MAX
:RANGe?	
:STATe	ON|OFF|1|0
:STATe?	
:TRIGger	
:MODE	AUTO|TRIG|GATE
:MODE?	
:SLOPe	POSitive|NEGative|BOTH
:SLOPe?	
:STATe	ON|OFF|1|0
:STATe?	
:THReshold	<value>|MIN|MAX
:THReshold?	

:OUTPut

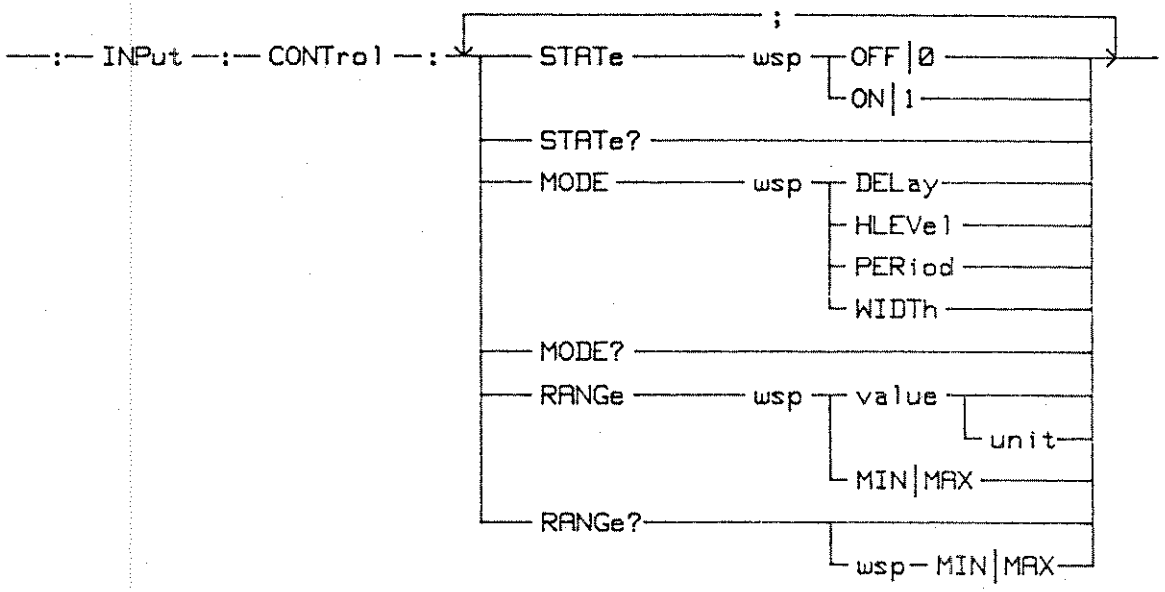
COMMAND	PARAMETER
:OUTPut	
:PULSe	
:ADDition	ON|OFF|1|0
:ADDition?	
:POLarity	NORMal|COMPlement
:POLarity?	
:STATe	ON|OFF|1|0
:STATe?	

COMMAND	PARAMETER
:PULSe	
:EDGE	
:LEADing	<value>|MIN|MAX
:LEADing?	
:TRAILing	<value>|MIN|MAX
:TRAILing?	
:TRANsition	LINear|GAUSsian|FIXed
:TRANsition?	
:LEVel	
:AMPLitude	<value>|MIN|MAX
:AMPLitude?	
:HIGH	<value>|MIN|MAX
:HIGH?	
:LIMit	ON|OFF|1|0
:HIGH?	
:LOW?	
:AMPLitude?	
:OFFSet?	
:LIMit?	
:LOW	<value>|MIN|MAX
:LOW?	
:OFFSet	<value>|MIN|MAX
:OFFSet?	
:TIMing	
:DELay	<value>|MIN|MAX
:DELay?	
:DOUBle	<value>|MIN|MAX
:MODE	ON|OFF|1|0
:MODE?	
:DOUBle?	
:PERiod	<value>|MIN|MAX
:PERiod?	
:WIDTh	<value>|MIN|MAX
:WIDTh?	

:SYSTem

COMMAND	PARAMETER
:SYSTem	
:BEEPer	ON|OFF|1|0
:BEEPer?	
:DERRor?	[NUMeric|STRing]
:ERRor?	[NUMeric|STRing]
:KEY	<mnemonic>
:KEY?	
:SET	<data>
:SET?	

:INP:CONTrol



:INP:CONTrol:MODE

:MODE

DELay, default mode

The delay or double pulse delay of channels 1 and 2 are controlled by an external voltage.

The minimum delay (75.0 ns) occurs at 7.5 V on Range 1.

The minimum double pulse delay (20.0 ns) occurs at 2.0 V on Range 1.

A range specification is required. See :INP:TRIG:RANG.

Related command: :PULS:TIM:DOUB MODE OFF|ON
Off selects delay and on selects double pulse.

PERiod

The periods of channels 1 AND 2 are controlled by an external voltage.

Control Voltage: 1.0 V to 10.0 V

A range specification is required. See :INP:TRIG:RANG.

The minimum period (20.0 ns) occurs at 2.0 V on Range 1.

Conflict: :INP:CONT:MODE PER AND :INP:TRIG:MODE TRIG are incompatible.

:INPut:CONTrol:MODE

WIDTh
The width of channels 1 and 2 are controlled by an external voltage.

Control Voltage: 1.0 V to 10.0 V

A range specification is required.
See :INP:TRIG:RANG.

HLEVel
The high level of channels 1 and 2 are controlled by an external voltage.

CAUTION: :PULS:LEV:LIM is inactive when HLEV is enabled.

Control Voltage: -8.0 V to 8.0 V
Output Voltage: -8.0 V to 8.0 V

Conflict: :INP:CONT:MODE HLEV and :OUTP:PULS:ADD ON are incompatible.

Display: Control (Control)

:MODE?

Response: PER, DEL, WIDT, or HLEV.

EXAMPLE:

```
OUTPUT 718;":INP:CONT:MODE DEL"

OUTPUT 718;":INP:CONT:MODE?"
ENTER 718;A$
```

:INPut:CONTrol:RANGe

<value>[<unit>]|MIN|MAX

The :RANG command specifies the operating range of the period, delay, or width when they are externally controlled. See :INP:CONT:MODE.

See the following table for the values and units.

A parameter can be varied within a range of values. If the required value is outside the current range, a new range specification is required.

Programming any value within a range makes that range the current range.

RANGE	value			unit	RESOLUTION
1	***	-	99.9	ns	100 ps
2	100	-	999	ns	1 ns
3	1	-	9.99	us	10 ns
4	10	-	99.9	us	100 ns
5	100	-	999	us	1 us
6	1	-	9.99	ms	10 us
7	10	-	99.9	ms	100 us
8	100	-	999	ms	1 ms

*** The lower limit of RANGE 1 depends on the parameter being controlled:
- DEL: Pulse delay = 75 ns
  Double pulse delay = 20 ns
- PER: 20 ns
- WIDT: 10.0 ns

Default: Range 1

Display: Timing (Delay, Double, Period, or Width)

:INPut:CONTrol:RANGe?

:RANGe?

Response: the upper limit value of the current range in exponential format|MIN|MAX Example: 99.9 E-6.

EXAMPLE:

```
OUTPUT 718;":INP:CONT:MODE DEL"
OUTPUT 718;":INP:CONT:RANG 95.5 E-6"
or
OUTPUT 718;":INP:CONT:RANG 95.5 US"

OUTPUT 718;":INP:CONT:RANG?"
ENTER 718;A$
```

:INPut:CONTrol:STATe

:STATe

OFF = 0, default state
The control input is disabled.

ON = 1
The control input is enabled.

Display: Control (Control)

:STATe?

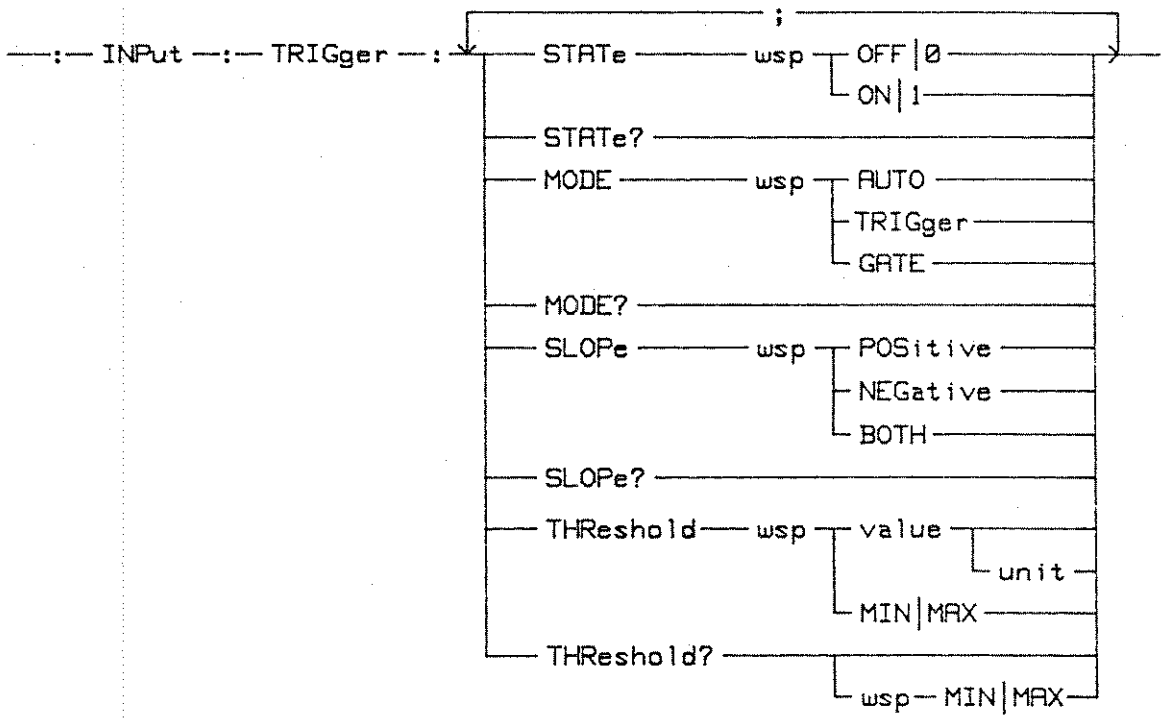
Response: 1 or 0

EXAMPLE:

```
OUTPUT 718;":INP:CONT:STAT ON"

OUTPUT 718;":INP:CONT:STAT?"
ENTER 718;A$
```

:INPut:TRIGger



:INPut:TRIGger:MODE

:MODE

AUTO, default mode

A continuous pulse stream is generated. The external input is disabled.

TRIGger

One pulse or double pulse signal is generated per trigger (external input) signal or *TRG command.

Conflict: :INP:TRIG:MODE:TRIG and :INP:CONT:PER are incompatible.

GATE

Pulses are generated for the duration of the gate. The last pulse is completed.

Conflict: :MODE GATE and :INP:TRIG:SLOP BOTH are incompatible.

Display: Control (Trigger)

:MODE?

Response:AUTO, TRIG, or GATE

EXAMPLE:

```
OUTPUT 718;":INP:TRIG:MODE AUTO"

OUTPUT 718;":INP:TRIG:MODE?"
ENTER 718;A$
```

:INPut:TRIGger:SLOPe

:SLOPe

POSitive, default mode
Positive edge triggering

NEGative
Negative edge triggering

BOTH
Either positive or negative edge triggering

Conflict: :INP:TRIG:SLOP BOTH and :INP:TRIG:MODE:GATE are incompatible.

Display: Control (Trigger)

:SLOPe?

Response: POS, NEG, or BOTH

EXAMPLE:

```
OUTPUT 718;":INP:TRIG:SLOP POS"

OUTPUT 718;":INP:TRIG:SLOP?"
ENTER 718; A$
```

:INPut:TRIGger:STATe

:STATe

OFF = 0, default state
The external input is disabled.

ON = 1
The external input is enabled.

Display: Control (Trigger)

:STATe?

Response: 1 or 0

EXAMPLE:

```
OUTPUT 718;":INP:TRIG:STAT ON"

OUTPUT 718;":INP:TRIG:STAT?"
ENTER 718;A$
```

:INPut:TRIGger:THReshold

:THReshold

-12.0 <= value <= 12.0|MIN|MAX
Range: -12.0V to 12.0V
Resolution: 00.1V
Default: 2.4V

Display: Control (Trigger/Threshold)

:THReshold?

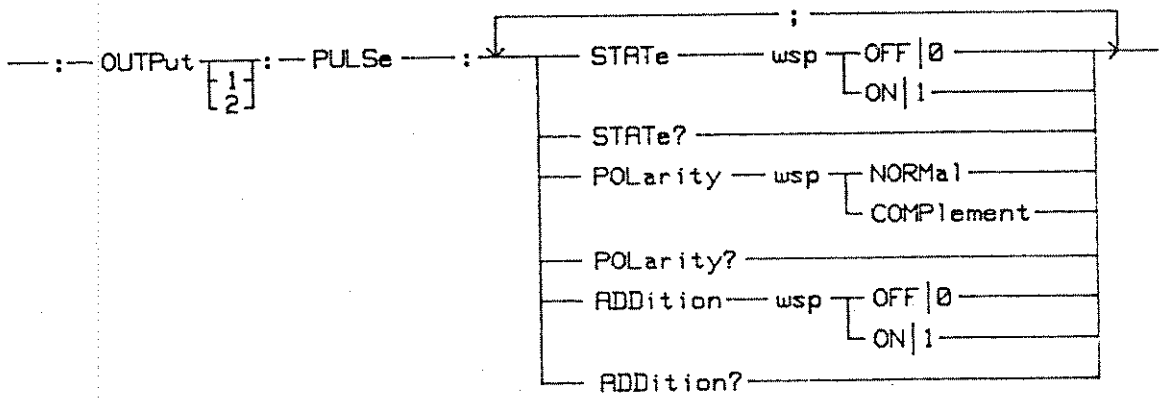
Response: -12.0 <= response <= 12.0|MIN|MAX

EXAMPLE:

```
OUTPUT 718;":INP:TRIG:THR 3.5V"

OUTPUT 718;":INP:TRIG:THR?"
ENTER 718;A$
```

:OUTPut:PULSe



:OUTPut <channel>

:OUTPut

Bypass
No channel specified
Application:
All commands: Channel 1

1
Channel 1 (Output 1)
Application:
All commands Channel 1

2
Channel 2 (Output 2)
Application:
ADD command: not allowed
All other commands: Channel 2

:OUTPut:PULSe:ADDition

:ADDition

OFF = 0, default
Addition is disabled. Channels 1/2 are output seperately.

ON = 1
Addition: channel 1 is added to channel 2 and output at Output 1.

Observe the maximum levels for channel 1 when adding channels 1 and 2.

If channel 2's output state = [On], it will change to [Off] when addition is enabled.

Conflict: :OUTP:PUL:ADD and :INP:CONT:MODE HLEV are incompatible.

Display: Output (Addition)

:ADDition?

Response:1 or 0

EXAMPLE:

```
OUTPUT 718;":OUTP1:PULS:ADD ON"

OUTPUT 718;":OUTP1:PULS:ADD?"
ENTER 718;A$
```

:OUTPut:PULSe:POLarity

:POLarity

NORMal, default
Output 1 and 2 are output as specified.

COMPlement
Output 1 and 2 are inverted.

Display: Output (Polarity)

:POLarity?

Response:NORM or COMP

EXAMPLE:

```
OUTPUT 718;":OUTP1:PULS:POL COMP"

OUTPUT 718;":OUTP1:PULS:POL?"
ENTER 718;A$
```

:STATe

OFF, default
Output 1 or 2 is disabled.

ON = 1
Output 1 or 2 is enabled.

When enabled, the messages 'Output 1' and 'Output 2' appear in the second message line.

Display: Output (State)

:STATe?

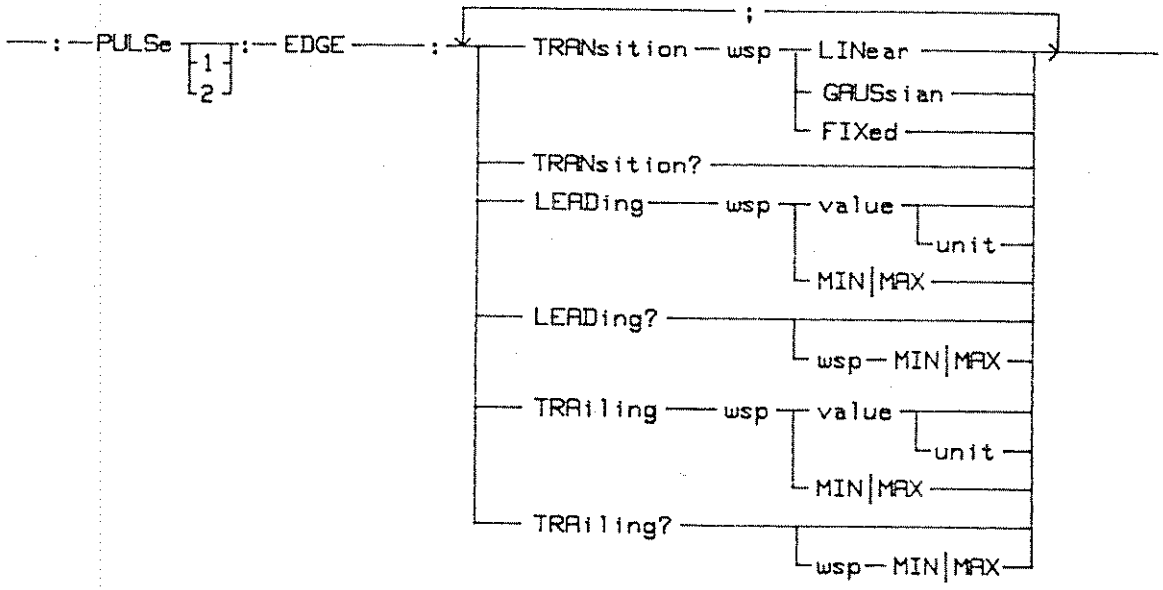
Response: 1 or 0

EXAMPLE:

```
OUTPUT 718;":OUTP1:PULS:STAT ON"

OUTPUT 718;":OUTP1:PULS:STAT?"
ENTER 718;A$
```

:PULSe:EDGE



:PULSe <channel>

:PULSe

Bypass
No channel specified
Application;
All commands: Channel 1/Output 1

1
Channel 1 (Output 1)
Application:
All commands: Channel 1/Output 1

2
Channel 2 (Output 2)
Application:
All commands: Channel 2/Output 2

:LEADing

05.5 <= value <= 99.9|MIN|MAX
Range: 05.5 ns to 99.9 ms
Resolution: LSD/See Table 8-1.
Default: 10.0 ns

The amplitude is reduced if the edge values are long (excessive) with respect to other timing values.

Leading and trailing edges must be programmed within a common range. See Table 9-2 and Figure 9-2 for edge information.

Display: Timing (Leading)

:LEADing?

Response:leading edge value in exponential form|MIN|MAX
Example: 25.5E-9.

EXAMPLE:

```
OUTPUT 718;":PULS1:EDGE:LEAD 25.5E-9"
or
OUTPUT 718;":PULS1:EDGE:LEAD 25.5NS"

OUTPUT 718;":PULS:EDGE:LEAD?"
ENTER 718;A$
```

:PULSe:EDGE:TRANsition

:TRANsition

LINear, default
Linear: linear edges, programmable

GAUSsian
Gaussian: cosinusoidal edges, programmable

FIXed
Fixed linear edges, 5.5 ns

The leading and trailing edges must be programmed within a common range. See Table 9-2/Figure 9-2 for edge information.

Display: Timing (Transition)

:TRANsition?

Response: FIX, GAUS, or LIN

EXAMPLE:

```
OUTPUT 718;":PULS1:EDGE:TRAN LIN"

OUTPUT 718;":PULS1:EDGE:TRAN?"
ENTER 718;A$
```

:PULSe:EDGE:TRAiling

:TRAiling

05.5 <= value <= 99.9|MIN|MAX
Range: 05.5 ns to 99.9 ms
Resolution: LSD/See Table 8-1.
Default: 10.0 NS

The amplitude is reduced if the edge values are long (excessive) with respect to other timing values.

Leading and trailing edges must be programmed within a common range. See Table 8-1 and Figure 8-2 for edge information.

Display: Timing (Trailing)

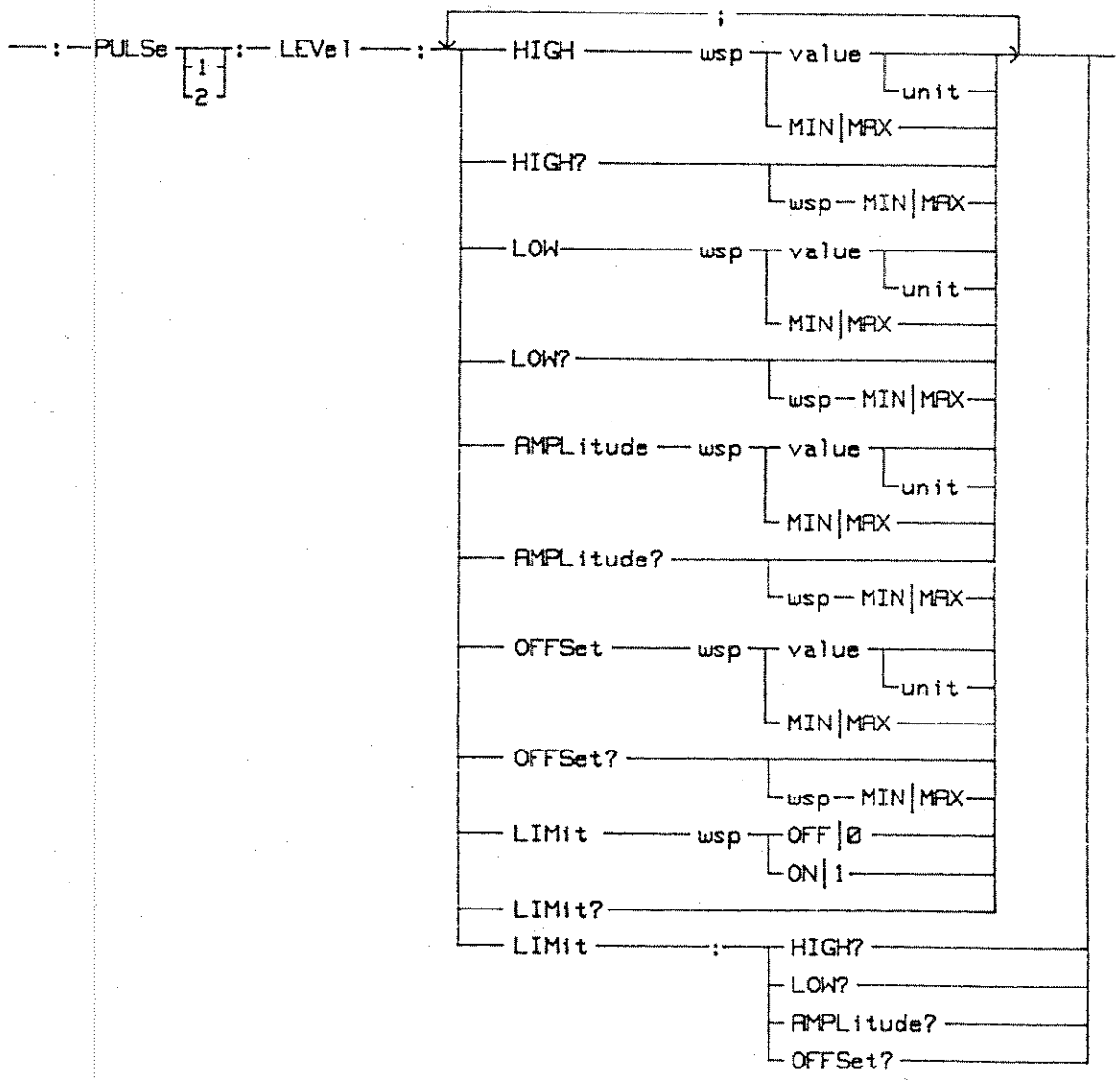
:TRAiling?

Response:trailing edge value in exponential form|MIN|MAX
Example: 25.5E-9.

EXAMPLES:
OUTPUT 718;":PULS1:EDGE:TRA 25.5E-9"
or
OUTPUT 718;":PULS1:EDGE:TRA 25.5NS"

OUTPUT 718;":PULS1:EDGE:TRA?"
ENTER 718;A$

:PULSe:LEVel



:PULSe:LEVel <channel>

:PULSe

Bypass
No channel specified
Application:
All commands: Channel 1/Output 1

1
Channel 1 (Output 1)
Application:
All commands: Channel 1/Output 1

2
Channel 2 (Output 2)
Application:
All commands: Channel 2/Output 2

:PULSe:LEVel:AMPLitude

:AMPLitude

00.08 <= value <= 16.40|MIN|MAX

Range: 0.08V to 16.40 V
Resolution: 0.01V
Default: 1.00V

Amplitude = High Level - Low Level

Amplitude, offset, and the levels are coupled.

Display: Output (Amplitude)

:AMPLitude?

Response: amplitude value in decimal form|MIN|MA)
Example: 3.55.

EXAMPLE:

```
OUTPUT 718;":PULSI:LEV:AMPL 3.55V"

OUTPUT 718;":PULSI:LEV:AMPL?"
OUTPUT 718;A$
```

:PULSe:LEVel:HIGH

:HIGH

-8.12 <= value <= 8.20|MIN|MAX
Range: -8.12V to 8.00V
Resolution: 0.01V
Default: 1.00V

High Level = Offset + (Amplitude/2)

High level, low leve, amplitude, and offset are coupled.

Display: Output (High Level)

:HIGH?

Response: high level value in decimal form|MIN|MAX
Example: 6.55.

EXAMPLE:

```
OUTPUT 718;":PULS1:LEV:HIGH 6.55V"

OUTPUT 718;":PULS1:LEV:HIGH?"
ENTER 718;A$
```

:PULSe:LEVel:LIMit

:LIMit:HIGH?
:LIMit:LOW?
:LIMit:AMPLitude?
:LIMit:OFFSet?

Response: limit value queried in decimal form, for example, 2.5.

EXAMPLE:

```
OUTPUT 718;":PULS:LEV:LIM:OFFS?"
OUTPUT 718;A$
```

:LIMit

OFF = 0, default
The limit function is disabled.

ON = 1
The limit function is enabled.

CAUTION: the limit function is inactive if control mode 'high level' is enabled.

NOTE: The levels, amplitude, and offset are coupled commands and are processed before a limit enabling command within the same progaram message.

The high and low level limits are set as follows:

1. Disable the limit function if it is enabled.
2. Set the levels to the required limit values.
3. Enable the limit function.

The limit values are included in the limit and level HELP messages.

Display: Output (Limit)

:LIMit?

Response: 1 or 0

EXAMPLE:

```
OUTPUT 718;":PULS:LEV:LIM ON"

OUTPUT 718;":PULS:LEV:LIM?"
ENTER 718;A$
```

:LOW

-8.20 <= value <= 8.12|MIN|MAX

Range: -8.20V to 8.12V
Resolution: 0.01V
Default: 0.00V

Low Level = Offset - (Amplitude/2)

Low level, high level, amplitude, and offset are coupled.

Display: Output (Low Level)

:LOW?

Response: low level value in decimal form|MIN|MAX
Example: 1.45.

EXAMPLE:

```
OUTPUT 718;":PULSI:LEV:LOW 1.45V"

OUTPUT 718;":PULSI:LEV:LOW?"
ENTER 718;A$
```

:PULSe:LEVel:OFFSet

:OFFSet

-8.160 <= value <= 8.160|MIN|MAX

Range: -8.160 V to 8.160 V
Resolution: 0.005V
Default: 0.500V

Offset = (High Level + Low Level) / 2

Offset, amplitude, and the levels are coupled.

Display: Output (Offset)

:OFFSet?

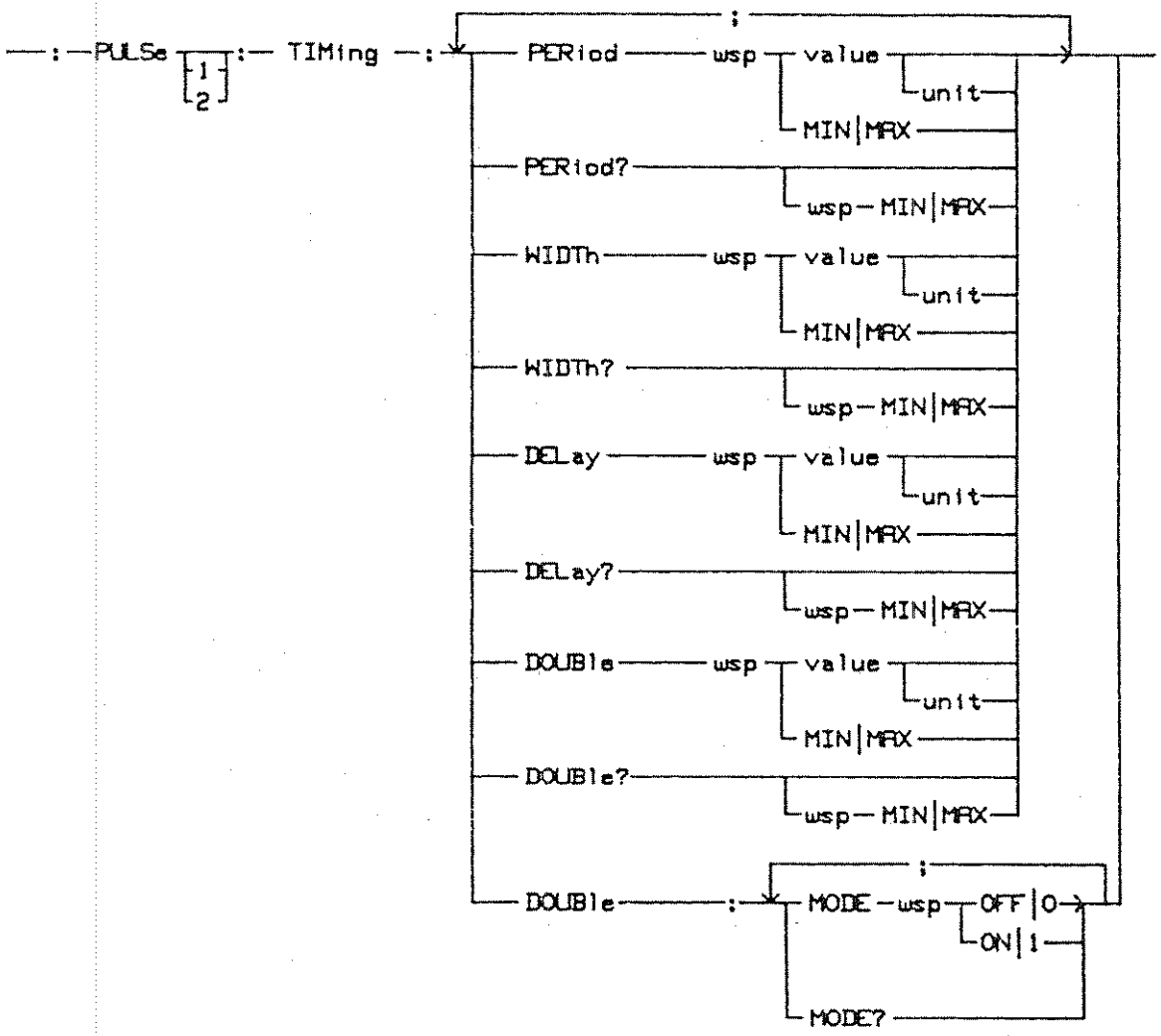
Response: offset value in decimal form|MIN|MAX
Example: 2.555.

EXAMPLE:

```
OUTPUT 718;":PULS:LEV:OFFS 2.555V"

OUTPUT 718;":PULS:LEV:OFFS?"
ENTER 718:A$
```

:PULSe:TIMing



:PULSe <channel>

:PULSe

Bypass
No channel specified
Applications:
All commands: Channel 1/Output 1

1
Channel 1 (Output 1)
Applications:
All commands: Channel 1/Output 1

2
Channel 2 (Output 2)
Applications:
All commands: Channel 2/Output 2

:DELay

74.0 <= value <= 999|MIN|MAX

Range: 74.0 ns to 999 ms
Resolution: LSD/See Table 8-1.
Default: 75.0 ns

Related command: :PULS:TIM:DOUB:MODE OFF|ON
OFF selects delay, and ON selects double pulse.

Display: Timing (Delay)

:DELay?

Response:delay value in exponential form|MIN|MAX
Example; 75.5E-9.

EXAMPLE:

```
OUTPUT 718;":PULS1:TIM:DEL 75.5E-9"
or
OUTPUT 718;":PULS1:TIM:DEL 75.5NS"

OUTPUT 718;":PULS:TIM:DEL?"
ENTER 718;A$
```

:PULSe:TIMing:DOUBle

:DOUBle

18.0 <= value <= 999|MIN|MAX

Range: 18.0 ns to 999 ms
Resolution: LSD/See Table 8-1.
Default: 200 us

Related command: :PULS:TIM:DOUB:MODE OFF|ON
OFF selects delay, and ON selects double pulse.

Display: Timing (Double)

:DOUBle?

Response: double pulse delay value in exponential form|MIN|MAX
Example: 95.5E-9.

EXAMPLE:

```
OUTPUT 718;":PULS1:TIM:DOUB 95.5E-9"
or
OUTPUT 718;":PULS1:TIM:DOUB 95.5NS"

OUTPUT 718;":PULS1:TIM:DOUB?"
ENTER 718;A$
```

:PULSe:TIMing:DOUBle:MODE

:DOUBle:MODE

OFF = 0, default mode
Pulse delay is selected>

ON = 1
Double pulse is selected

:DOUBle:MODE?

Response:1 or 0

Display: Timing Double.

EXAMPLE:

```
OUTPUT 718;":PULS1:TIM:DOUB:MODE ON"

OUTPUT 718;":PULS1:TIM:DOUB:MODE?"
ENTER 718;A$
```

:PULSe:TIMing:PERiod

PERiod

18.0 <= value <= 999|MIN|MAX
Range: 18.0 ns to 999 ms
Resolution: LSD/See Table 8-1.
Default: 1.00 ms

The period parameter is common to Channels 1 and 2.

When the trigger mode 'trigger' is enabled, the period is controlled by the external input triggr signal.

When control mode 'period' is enabled, the period is controlled by an external voltage.

Display: Timing (Period)

:PERiod?

Response:the period value in exponential form|MIN|MAX
Example: 95.5E-3.

EXAMPLE:

```
OUTPUT 718;":PULS2:TIM:PER 95.5E-3" or
OUTPUT 718;":PULS2:TIM:PER 95.5MS"

OUTPUT 718;":PULS2:TIM:PER?"
ENTER 718;A$
```

:WIDTh

9.0 <= value <= 999|MIN|MAX
Range: 09.0 ns to 999 ms
Resolution: LDD/See Table 8-1.
Default: 100 us

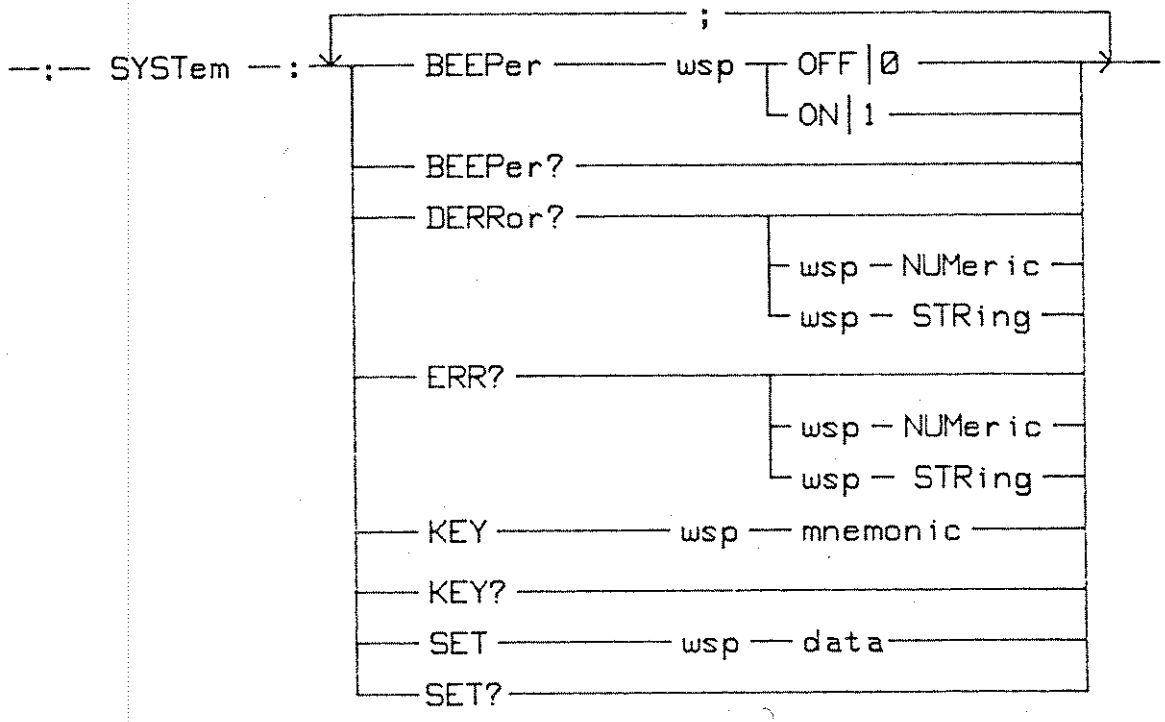
:WIDTh?

Response: width value in exponential form|MIN|MAX
Example: 55.5E-9.

EXAMPLE:

```
OUTPUT 718;":PULS1:TIM:WIDT 55.5E-9"
or
OUTPUT 718;":PULS1:TIM:WIDT 55.5NS"

OUTPUT 718;":PULS1:TIM:WIDT?"
ENTER 718;A$
```



:SYSTem:BEEPer

:BEEPer

OFF = 0, default
The beeper is disabled.

ON = 1
The instrument beeper is enabled. An audible tone is generated when a disallowed action is attempted.

:BEEPer?

Response:1 or 0

EXAMPLE:

```
OUTPUT 718;":SYST:BEEP ON"

OUTPUT 718;":SYST:BEEP?"
ENTER 718;A$
```

:DERRor?

Bypass, default
Device dependent error codes are returned, for example, 100.

NUMeric
Device dependent error codes are returned, for example, 100.

STRing
Device dependent error codes are returned plus a brief description of the error, for example, 100,<Ext. Input Mode - Slope>.

See Chapter 6 for additional information.

Appendix F contains a list of errors reported by the :DERR? query.

EXAMPLE:

```
DIM A$ [5000]

OUTPUT 718;":SYST:DERR?"
or
OUTPUT 718;":SYST:DERR? NUM"
or
OUTPUT 718;":SYST:DERR? STR"

ENTER 718;A$
```

:SYSTem:ERRor?

:ERRor?

Bypass, default
The oldest error code is returned, for example, -350.

NUMeric
The oldest error code is returned, for example, -350.

STRing
The oldest error code plus a brief description of the error is returned, for example, -350,<Too Many Errors>.

Only one error is returned per query.

Appendix F contains a list of errors reported by the :ERR? query.

EXAMPLE:
```
DIM A$ [1000]

OUTPUT 718;":SYST:ERR?"
or
OUTPUT 718;":SYST:ERR? NUM"
or
OUTPUT 718;":SYST:ERR? STR"

ENTER 718;A$
```

:KEY **<mnemonic>**

The :KEY command simulates the pressing of a front panel key. The mnemonics are listed in the following table.

:KEY? **Response:a key mnemonic, for example, PR.**

Only real key presses are recorded in the key queue. See Chapter 6, Key Queue.

The mnemonics are listed in the following table.

If the queue is empty, two question marks (??) are returned.

See Chapter 6 for additional information.

EXAMPLE:

```
OUTPUT 718;":SYST:KEY PR"

OUTPUT 718;":SYST:KEY?"
ENTER 718;A$
```

:SYSTem:KEY

KEY	MNEMONIC
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
A	A
ABORT	AB
SAVE DISPLAY	AM
B	B
C	C
CLEAR ENTRY	CE
CONTINUE	CN
CONTROL DISPLAY	CM
COPY	CP
CURSOR DOWN	CD
CURSOR LEFT	CL
CURSOR RIGHT	CR
CURSOR UP	CU
D	D
DELAY CHANNEL 1	D1
DELAY CHANNEL 2	D2
DATA DISPLAY	DM
DECIMAL POINT	DP
DELETE	DE
DON'T CARE	DC
E	E
EXECUTE	EX

KEY	MNEMONIC
F	F
HELP	HE
HIGH CHANNEL 1	H1
HIGH CHANNEL 2	H2
INSERT	IN
RETURN TO LOCAL	LO
LEADING CHANNEL 1	L1
LEADING CHANNEL 2	L2
LOW CHANNEL 1	O1
LOW CHANNEL 2	O2
MANUAL	MA
MODIFY	MD
MOVE	MO
NEXT	NX
OUTPUT DISPLAY	OM
PERIOD	PE
POLARITY CHANNEL 1	P1
POLARITY CHANNEL 2	P2
PREVIOUS	PV
PRINT	PR
PRINT ALL	PA
RETURN TO LOCAL	LO
ROLL DOWN	RD
ROLL LEFT	RL
ROLL RIGHT	RR
ROLL UP	RU
SAVE DISPLAY	AM
SHIFT CURSOR DOWN	SD
SHIFT CURSOR LEFT	SL
SHIFT CURSOR RIGHT	SR
SHIFT CURSOR UP	SU

:SYSTem:KEY

KEY	MNEMONIC
START	SA
STATE CHANNEL 1	S1
STATE CHANNEL 2	S2
STOP	SO
SYSTEM DISPLAY	SM
TIMING DISPLAY	TM
TRAILING CHANNEL 1	T1
TRAILING CHANNEL 2	T2
UPDATE	UD
WIDTH CHANNEL 1	W1
WIDTH CHANNEL 2	W2

:SET **<data>**

The :SYST:SET command transfers binary data.

See the example for the application of :SYST:SET.

Execution: The pattern generator must be in the stopped state.

:SET?

Response: binary data is returned which contains the instrument's current setting.

The block of data is identical to the block of data saved and recalled by the *SAV and *RCL commands.

:SYSTem:SET

EXAMPLE:

```
10      DIM Query$[100],Setting$[11000]BUFFER
20      !
30      ASSIGN @Hpib_device TO 718
40      ASSIGN @Path TO BUFFER Setting$
50      !
60      !Read current setting from the HP 8115A
70      Query$=":SYST:SET?"
80      GOSUB Fetch
90      !
100     !Write stored setting to the HP 8115A
110     Count_out=10258
120     GOSUB Write
130     !
140     STOP
150     !
160   Fetch: !
170     Output @Hpib_device;Query$
180     TRANSFER @Hpib-device TO @Path;END,WAIT
190     RETURN
200     !
210   Write: !
220     TRANSFER @Path TO @Hpib_device;
        COUNT count_out, WAIT
230     RETURN
240     !
250   END
```

A SPECIFICATIONS

INTRODUCTION

The specifications describe the instrument's warranted performance characteristics unless indicated as being supplemental or typical in nature. The performance tests and recommended test equipment listed in Appendix E can be used to verify the performance characteristics.

Supplemental, Specifications

Supplemental specifications are typical, non-warranted, performance characteristics provided for customer convenience.

Restrictions

The specifications apply to 50 ohm loads unless stated otherwise.

Ambient temperature.

0 to 55 degrees Celcius: The first or only value specified is for this range.

20 to 30 degrees Celcius: The specified values for this range are given in brackets, [ ], following the 0 to 55 degree Celcius specification.

The instrument warm-up period is thirty minutes.

Period, width, delay, and double pulse are specified at:

1. Minimum transistion times
2. Amplitude 50% points.

Edges are measured at the amplitude 10% and 90% points.

Under and over programming is allowed.

Accuracy refers to the programmed values.

WARRANTED SPECIFICATIONS

TIMING

Period

Range: See the following table.
Accuracy: ±5% ±2 ns [±2% ±1 ns]

Delay

Range: 75 ns to 950 ms (max: Period + 55 ns)
Accuracy: ±5% ±4 ns [±2% ±4 ns]

Double Pulse

Range: 20 ns to 950 ms (max: Period - Width)
Accuracy: ±5% ±2 ns [±2% ±2 ns]

Width

Range: 10 ns to 950 ms (max: Period - 10 ns)
Accuracy: ±5% ±2 ns [±2% ±2 ns]

Linear Transitions

Range: 6.5 ns to 95 ms (low limit can increase to 7.0 ns if the low level < -5 V)
Accuracy: ±5% ±2 ns

Resolution: 3 digits (best case: 100 ps)
Repeatability: factor of 4 better than accuracy
rms-jitter: 0.05% of the programmed value plus 30 ps

OUTPUT

High Level -7.90 V to +8.00 V
Low Level -8.00 V to +7.90 V

Resolution	3 digits (best case: 10 mV)
Accuracy	±1% of programmed value ±3% of amplitude ±40 mV [±1% ±1% ±20 mV]
Repeatability	Factor of 4 better than accuracy
Settling Time	100 ns + transition time
Preshoot, Overshoot, Ringing	±5% ±10 mV (% may increase to ±7% for edges <10 ns)

Output levels double when driving into open circuits.

INTERFACE

HP-IB

The interface conforms to IEEE Standard 488.1, Digital Interface for Programmable Information.

IEEE Std. 488 interface function subsets:
AH1, SH1, T6, L4, SR1, RL1, PP0, DC0, DT1, CO.

For information regarding interface codes, formats, protocols, and common commands, use IEEE **Draft** Standard 488.2, Codes, Formats, Protocols, and Common Commands, as a guide. No claim of conformance is made.

SUPPLEMENTAL PERFORMANCE CHARACTERISTICS

CONTROL MODES

Period, Delay, Width

Control Voltage	1 V to 10 V
Bandwidth	10 kHz
Ratio	1:10
Range	Same ranges as specified under TIMING

High Level

Control Voltage	-8 V to +8 V input which varies the high level over the same range.
High Level Window	-8 V to +8 V into 50 ohms, regardless of the low level.
Settling Time	200 us (within 5% of final value).

INPUTS

External Input

Threshold	±9.9 V, programmable
Maximum input voltage	±20 V
Minimum amplitude	600 mV (p-p)
Minimum overdrive	250 mV or 30% of amplitude, whichever is greater
Minimum pulse width	10 ns
Input impedance	10 k ohms

Control Input

Maximum input voltage	±20 V
Input Impedance	10 k ohms

OUTPUTS

Channels 1/2

Amplitude	100 mVpp to 16 Vpp into 50 ohms
Source impedance	50 ohms ±5 %
Maximum external volt	±5 V

Trigger

Levels	TTL level into 50 ohms
Output impedance	50 ohms

ADDITIONAL FEATURES

Battery

After 10 hours of operation, all stored settings are maintained for at least 3 weeks.

GENERAL

Environmental

Storage Temperature	-40 to +65 degrees C
Operating Temperature	0 to 55 degrees C
Humidity	95% R.H. (0 to 40 degrees C)

Power

100-120/220-240 Vrms ±10%
450 VA maximum
48-66 Hz

Weight

Net	17,5 kg (38.8 lb)
Shipping	24,0 kg (53.0 lb)

Dimensions

Height x width x depth
190mm x 426mm x 584mm
7.5in x 16.75in x 23in

Recalibration Period

1 year recommended

B

OPTIONS ACCESSORIES

OPTIONS

908	Rack Flange Kit (P/N 5061-9678)
910	One Operating and Programming Manual and one Service Manual
915	One Service Manual (P/N 08115-90001)
916	One Operating and Programming Manual (P/N 08115-90011)
H01	The instrument's frame hardware is outfitted for rack-slide mounting (P/N 1494-0059 required)
W30	Two additional years of Return-to-HP service

ACCESSORIES

Slide kit	Rack Slide Kit for HP 8118A #H01) P/N 1494-0059

PERIPHERALS

Printer	HP 2225A Thinkjet graphics printer
Disc Drive	HP 9122D dual disc-drive, 3.5 inch/double sided

C INSTALLATION and MAINTENANCE

CONTENTS

FIGURES

SAFETY

The HP 8115A is a Safety Class 1 instrument.

It has an exposed metal chassis that is directly connected to earth potential through the line power cord.

Before installing the instrument, review:

1. The Safety Summary (red page)
2. The Instrument Reference Manuals
3. The instrument safety markings.

ALTERNATING CURRENT (AC) POWER

Requirements

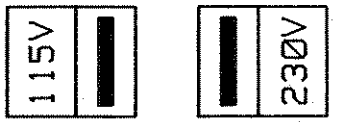
The alternating current power requirements are:

1. 100-120 Vrms ±10%
2. 220-240 Vrms ±10%
3. 50 to 60 Hz
4. Single Phase
5. 450 VA maximum.

Line Voltage Selection

Before connecting the line power cord to the instrument, check the line voltage selector setting.

Slide the switch to the 115V position to select the 100V-120V range or to the 230V position to select the 220V-240V range.



Line Fuse Selection

Before connecting the line power cord to the instrument, check the line fuse rating.

1. 115 Volt operation requires an 8 A, fast blow fuse.

2. 230 Volt operation requires a 4 A, fast blow fuse.

Cord

In accordance with international safety standards, this instrument is equipped with a three wire alternating current power cord.

WARNING

The following precautions must be followed before the instrument is connected to the line power:

1. If this instrument is to be energized via an auto transformer for voltage reduction, the common terminal must be connected to the earth terminal of the power source.

2. The line power cord plug must only be inserted into an outlet with a protective earth contact.

   The protective earth action must not be interrupted.

3. Before switching on the instrument, the protective earth terminal of the instrument must be connected to the protective earth conductor of the power cord.

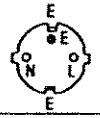
   This is accomplished by using the power cord which is supplied with the instrument.

4. Intentional interruption of the protective earth connection is prohibited.

Cords, Types of

See the following figure for the types of cords and part numbers of available power cords.

FIGURE C-1. POWER CORDS

POWER CORD (MALE PLUG) OPTIONS					
OPTION NO.	PLUG CONFIGURATION*	SPEC. CONT. DWG. MJR. USING ENTRYS	OPTION NO.	PLUG CONFIGURATION*	SPEC. CONT. DWG. MJR. USING ENTRYS
900		A-8120-9051-1 U.K.	905		A-8120-9052-1 (SYSTEMS, CABINET, USE)
901		A-8120-9085-1 AUSTRALIA, NEW ZEALAND CHINA	906		A-8120-9100-1 SWITZERLAND
902		A-8120-9059-1 EUROPEAN CONTINENT	912		A-8120-9134-1 DENMARK
903		A-8120-9050-1 USA, CANADA (120 V)	917		A-8120-9239-1 SOUTH AFRICA, INDIA
904		A-8120-0698-1 USA, CANADA (240 V)	918		A-8120-9252-1 JAPAN**
NOTE: OPTION NO. 904 CANADA: REQUIRES NEUTRAL CONDUCTOR IDENTIFIED RELATED TO 3 PHASE, 4 WIRE, 416 V CIRCUITS. USA: REQUIRES NO POLARITY BECAUSE BOTH "L" AND "N" TERMINALS ARE CONSIDERED TO BE LINE TERMINALS. **NOTE: OPTION 918 USE OPTION 918 FOR CORD SETS ONLY, FOR POWER CORDS USE OPTION 903					

Power Cable Modification

WARNING

Modification must be performed only by a qualified electrician.

All local electrical codes must be observed.

If a new plug is to be connected, the plug must meet local safety requirements and include:

1. Adequate load carrying capacity (see the instrument Specifications).

2. Three terminals
    1. Line
    2. Neutral
    3. Earth

3. Cable Clamp.

HP-IB INTERFACE

Networks

The network may be:

1. A star network
2. A linear network
3. A combination star and linear network.

Limitations:

1. The total cable length cannot exceed 20 meters
2. The maximum cable length per device is 2 meters
3. No more than 15 devices may be interconnected on one bus.

CAUTION

1. It is recommended that no more than three connectors be stacked one on top of the other.
2. Hand tighten the connector lock screws. Do not use a screwdriver.

Cables and Adapter

The HP-IB connector is compatible with the connectors on the following cables and adapter.

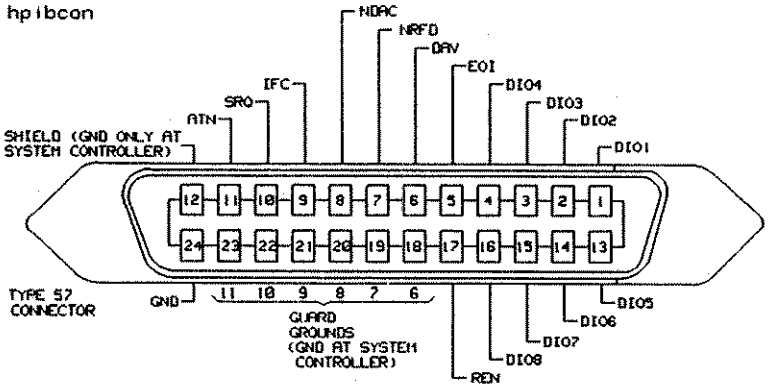
1. HP-IB Cable, 10833A, 1 m (3.3 ft.)
2. HP-IB Cable, 10833B, 2 m (6.6 ft.)
3. HP-IB Cable, 10833C, 4 m (13.2 ft.)
4. HP-IB Cable, 10833D, 0.5 m (1.6 ft.)
5. HP-IB Adapter, 10834A, 2.3 cm. extender.

Connector

The following figure shows the connector and pin assignments.

Connector Part Number: 1251-0293

FIGURE C-2
HP-IB CONNECTOR



CAUTION

Connector Lock Screw Compatibility

HP products delivered now are equipped with connectors having ISO metric-threaded lock screws and stud mounts (ISO M3.5x0.6) which are black in color.

Earlier connectors may have lock screws and stud mounts with English-threaded lock screws and stud mounts (6-32 UNC) which have a shiny nickel finish.

OPERATING ENVIRONMENT

See appendix A.

MOUNTING HARDWARE

See appendix B.

PREVENTIVE MAINTENANCE

None required.

CUSTOMER SELF-SERVICE

The Service Manual contains the following service information:

1. Performance Tests
2. Adjustment Procedures
3. Theory and schematics
4. Replaceable Parts List.

HP SERVICE

HP offers the following services:

1. Performance Testing
2. Adjustment
3. Repair
4. Calibration

E

PERFORMANCE TESTS

CONTENTS

TABLE

FIGURE

INTRODUCTION

The performance tests verify the instruments specified performance characteristics.

They are suitable for incoming inspection, preventative maintenance, troubleshooting, and final test.

Make the Performance Tests in the order of occurrence in the manual.

Recommended test equipment is listed in Table 1.

SAFETY

The HP 8115A is a Safety Class 1 instrument. It has an exposed metal chassis that is directly connected to earth potential through the line power cord.

Before testing the instrument review:

1. The Safety Summary, page ix (red page)
2. The Instrument Reference Manuals
3. The instrument safety markings.

TEST RECORD

A test record is located at the end of this chapter.

The test results are identified as TR ENTRIES in the performance tests and on the test record.

1. PERIOD TEST

SPECIFICATIONS

Range:	20.0 ns to 950 ms
Resolution:	3 digits (best case: 100 ps)
* Accuracy:	5 % [2 %] of programmed value ± 2 ns [1 ns]
rms Jitter:	0.05 % of programmed value + 30 ps
Repeatability:	Factor 4 better than accuracy

* [value] at 20 dec C to 30 dec C ambient temperature.

EQUIPMENT

1. Counter.
2. Cable, 50 ohm, BNC to BNC, coaxial.

SET-UP

1. Connect the HP 8115A's OUTPUT (1/2) to the counter's channel A input (HP5335A) / FREQ input (HP5370B).
2. Set the HP 8115A to a defined status:
   SAVE = Operation : [Reset] to Standard Setting
   EXEC
3. Set the HP 8115A:

a.	SYSTEM	= Pulse Generator (PULSE)			
b.	TIMING	= Period	: 20 [ns]		
c.		Width	: 10 [ns]	|	10 [ns]
d.		Leading	: 6.5 [ns]	|	6.5 [ns]
e.		Trailing	: 6.5 [ns]	|	6.5 [ns]
f.	OUTPUT	= State	: [On]	|	[On]
g.		[High Level]	: [+] 1.00 V	|	[+] 1.00 V
h.		Low Level	: [-] 1.00 V	|	[-] 1.00 V

4. Set counter:
   a. FUNCTION = PERIOD
   b. CHANNEL A = 50 ohm
   c. TRIGGER LEVEL= PRESET

PROCEDURE

1. Check the HP 8115A period at the following settings:

	Period	ACCEPTABLE RANGE				TR ENTRY
1.*	20.0 ns	17 ns	[18.6 ns	-	21.4 ns]	23 ns	1-1
2.	99.9 ns	93 ns	[96.6 ns	-	102.9 ns]	107 ns	1-2
3.	100 ns	93 ns	[97 ns	-	103 ns]	107 ns	1-3
4.	500 ns	473 ns	[489 ns	-	511 ns]	527 ns	1-4
5.	999 ns	947 ns	[978 ns	-	1.02 us]	1.05 us	1-5
6.	10 us	9.5 us	[9.8 us	-	10.2 us]	10.5 us	1-6
7.	500 us	475 us	[490 us	-	510 us]	525 us	1-7
8.	1.0 ms	950 us	[980 us	-	1.02 ms]	1.05 ms	1-8
9.	950 ms	902.5 ms	[931 ms	-	969 ms]	997.5 ms	1-9

*Underprogramming to 18 ns is allowed to meet this specification.

2. Disconnect the cables from the 8115A.

2. DELAY TEST

This test consists of two parts:

1. Minimum Delay Test
2. Long Delay Test

NOTES: Repeat the entire delay test procedure for the second channel.

The specifications and tests are for the 50 % point of amplitude and fastest edges (LINEAR 6.5 ns).

SPECIFICATIONS

Range:	75 ns to 950 ms (max.: Period + 55 ns)
Resolution:	3 digits (best case: 100 ps)
* Accuracy:	5 % [2 %] of programmed value ± 4 ns
rms Jitter:	0.05 % of programmed value + 30 ps
Repeatability:	Factor 4 better than accuracy

* [value] at 20 dec C to 30 dec C ambient temperature.

EQUIPMENT

1. HP 54120T Digitizing Oscilloscope with Accessory
2. Pulse Generator
3. Counter
4. Cable, 50 ohm, BNC to BNC, coaxial, 2 each.

PART 1 MINIMUM DELAY TEST

SET-UP

1. Set pulse generator:
   a. PER = 500 ns
   b. WID = 50 ns
   c. HIL = 1.0 V LOL = 0.0 V
   d. Fixed Transition Time

2. Set HP 8115A:
   SAVE = Operation : [Reset] to Standard Setting
   EXEC

3. Set the HP 8115A:

a.	SYSTEM	= Pulse Generator (PULSE)			
b.	CNTRL	= Trigger			
c.		State	: [On]		
d.		Mode	: [Trigger]		
e.		Slope	: [pos]		
f.		Threshold	: [+] 0.5 V		
g.	TIMING	= Width	: 50 [ns]	|	50 [ns]
h.		Leading	: 6.5 [ns]	|	6.5 [ns]
i.		Trailing	: 6.5 [ns]	|	6.5 [ns]
j.	OUTPUT	= State	: [On]	|	[On]
k.		[High Level]	: [+] 1.4 V	|	[+] 1.4 V

4. Connect the pulse generator's Output via a 50 ohm feedthrough to the HP 8115A's EXT INPUT.
5. Connect the HP 8115A's TRIG OUTPUT via a BNC (m) - SMA (f) Adapter, Cable assy-coaxial SMA (m-m), and APC 3.5 mm 20dB Attenuator (f-m) to the Input 3 of the HP 54121A.
6. Connect the HP 8115A OUTPUT 1/2 via a similar second accessory assembly to the Input 4 of the HP 54121A.
7. Connect the pulse generator's Trigger Output via a similar third accessory assembly to the TRIG input of the HP 54121A.

PROCEDURE

1. Set HP 54120T Oscilloscope:
   - press AUTOSCALE
   - set TIME/DIV = 20 ns/div and DELAY = 90 ns
   - select the Display menu and set the Screen function to Single
     set the Number of Averages to 64
   - select the Channel menu and set the Atten factor to 10
   - select the Delta V menu and turn the voltage markers On and assign marker 1 to channel 3 and marker 2 to channel 4
   - set Preset Levels = 50-50% and press Auto Level Set
   - select the Delta t menu and turn the time markers On
   - set START ON EDGE = POS1 and STOP ON EDGE = POS1
   - Press Precise Edge Find

2. Press the Precise Edge Find key for each new Delay setting.
3. Check the HP 8115A delay at the following settings:

	Delay	ACCEPTABLE RANGE				TR ENTRY
1.*	75 ns	[	-	80.5 ns]	82.75 ns	2-1
2.	80 ns	72 ns [74.4 ns	-	83.6 ns]	88 ns	2-2
3.	90 ns	81.5 ns [84.2 ns	-	95.8 ns]	98.5 ns	2-3
4.	99.9 ns	90.9 ns [93.9 ns	-	105.8 ns]	108.9 ns	2-4

*Underprogramming to 74 ns is allowed to meet this specification.

4. Disconnect the cables from the 8115A.

PART 2 LONG DELAY TEST

SET-UP

1. Set the HP 8115A:

a.	CNTRL	= Trigger			
b.		Mode	: [Auto]		
c.	TIMING	= Period	: 95 [us]		
d.		Width	: 100 [ns]	|	100 [ns]
e.		Leading	: 6.5 [ns]	|	6.5 [ns]
f.		Trailing	: 6.5 [ns]	|	6.5 [ns]
g.	OUTPUT	= State	: [On]	|	[On]
h.		[High Level]	: [+] 2.4 V	|	[+] 2.4 V

2. Set the counter:
   a. FUNCTION = TI A to B
   b. START = 50 ohm, POS (+) slope, DC, X1
   c. STOP = 50 ohm, POS (+) slope, DC, X1
   d. Gate Time = as necessary
   e. INPUT MODE = SEP (SEPARATE)
   f. START/STOP trigger levels = 50% of pulse amplitudes

3. Connect the HP 8115A TRIG OUTPUT to the counter's START input.
4. Connect the HP 8115A OUTPUT 1/2 to the counter's STOP input.

PROCEDURE

1. Check the HP 8115A delay at the following Period and Delay settings:

	Period	Delay	ACCEPTABLE RANGE			TR ENTRY
1.	95 us	100 ns	91 ns [94 ns	-	106 ns]	109 ns	2-5
2.	95 us	500 ns	471 ns [486 ns	-	514 ns]	529 ns	2-6
3.	95 us	999 ns	945 ns [977 ns	-	1023 ns]	1053 ns	2-7
4.	95 us	10 us	9.5 us [9.8 us	-	10.2 us]	10.5 us	2-8
5.	999 ms	10 ms	9.5 ms [9.8 ms	-	10.2 ms]	10.5 ms	2-9
6.	999 ms	950 ms	902.5ms [931 ms	-	969 ms]	997.5 ms	2-10

2. Disconnect the cables from the 8115A.

3. DOUBLE PULSE TEST

This test consists of two parts:

1. Minimum Double Pulse Test
2. Long Double Pulse Test

NOTES: Repeat the entire delay test procedure for the second channel.

The specifications and tests are for the 50 % point of amplitude and fastest edges (LINEAR 6.5 ns).

SPECIFICATIONS

Range:	20 ns to 950 ms (max.: Period - Width)
Resolution:	3 digits (best case: 100 ps)
* Accuracy:	5 % [2 %] of programmed value ± 2 ns
rms Jitter:	0.05 % of programmed value + 30 ps
Repeatability:	Factor 4 better than accuracy

* [value] at 20 dec C to 30 dec C ambient temperature.

EQUIPMENT

1. HP 54120T Digitizing Oscilloscope with Accessory
2. Counter
3. Cable, 50 ohm, BNC to BNC, coaxial, 2 each.

PART 1 MINIMUM DOUBLE PULSE TEST

SET-UP

1. Set HP 8115A:
   SAVE = Operation : [Reset] to Standard Setting
   EXEC

2. Set the HP 8115A:

a.	TIMING	= Period	: 500 [ns]		
b.		Width	: 100 [ns]	|	100 [ns]
c.		Leading	: 6.5 [ns]	|	6.5 [ns]
d.		Trailing	: 6.5 [ns]	|	6.5 [ns]
e.	OUTPUT	= State	: [On]	|	[On]
f.		[High Level]	: [+] 1.4 V	|	[+] 1.4 V

3. Connect the HP 8115A's TRIG OUTPUT via a BNC (m) - SMA (f) Adapter, Cable assy-coaxial SMA (m-m), and APC 3.5 mm 20dB Attenuator (f-m) to the TRIG Input of the HP 54121A.
4. Connect the HP 8115A OUTPUT 1/2 via a similar second accessory assembly to the Input 4 of the HP 54121A.

PROCEDURE

1. Setup HP 54120T Oscilloscope:
   - press AUTOSCALE
   - center one pulse horizontal and vertical on screen (TIME/DIV = 20 ns/div, VOLT/DIV = 500 mV/div)
   - select the Display menu and set the Number of Averages to 64
   - select the Channel menu and set the Atten factor to 10
   - select the Delta V menu and turn the voltage markers On
   - set Preset Levels = 50-50% and press Auto Level Set
   - select the Delta t menu and turn the time markers On
   - set START ON EDGE = POS1 and STOP ON EDGE = POS2

2. Change the HP 8115A Width to 10 [ns].
and the [Delay] to [Double] : 20 [ns].

3. Press the Precise Edge Find key for each new Double setting.

4. Check the HP 8115A double pulse delay at the following settings:

	Double	ACCEPTABLE RANGE				TR ENTRY
1.	20 ns	17 ns [17.6 ns	-	22.4 ns]	23 ns	3-1
2.	50 ns	45.5 ns [47 ns	-	53 ns]	54.5 ns	3-2
3.	80 ns	74 ns [76.4 ns	-	83.6 ns]	86 ns	3-3
4.	99.9 ns	93 ns [95.9 ns	-	103.9 ns]	107 ns	3-4

5. Disconnect the cables from the 8115A.

PART 2 LONG DOUBLE PULSE TEST

SET-UP

1. Set the HP 8115A:

a.	TIMING	= Period	: 95 [us]		
b.		Width	: 100 [ns]	|	100 [ns]
c.		Leading	: 6.5 [ns]	|	6.5 [ns]
d.		Trailing	: 6.5 [ns]	|	6.5 [ns]
e.	OUTPUT	= State	: [On]	|	[On]
		[High Level]	: [+] 1.0 V	|	[+] 1.0 V
		low level	: [-] 1.0 V	|	[-] 1.0 V

2. Set the counter:
   - a. FUNCTION = TI A to B
   - b. START = 50 ohm, POS (+) slope, DC, X1
   - c. STOP = 50 ohm, POS (+) slope, DC, X1
   - d. Gate Time = as necessary
   - e. INPUT MODE = COM
   - f. START/STOP trigger levels = Preset

3. Connect the HP 8115A OUTPUT 1/2 to the counter's START input.

PROCEDURE

1. Check the HP 8115A double pulse delay at the following Period and Double settings:

	Period	Double	ACCEPTABLE RANGE			TR ENTRY
1.	95 us	1 us	948 ns [978 ns	-	1.02 us]	1.05 us	3-5
2.	95 us	10 us	9.5 us [9.8 us	-	10.2 us]	10.5 us	3-6
3.	95 ms	100 us	95 us [98 us	-	102 us]	105 us	3-7
4.	95 ms	1 ms	950 us [980 us	-	1.02 ms]	1.05 ms	3-8
5.	95 ms	10 ms	9.5 ms [9.8 ms	-	10.2 ms]	10.5 ms	3-9
6.	999 ms	100 ms	95 ms [98 ms	-	102 ms]	105 ms	3-10
6.	999 ms	500 ms	475 ms [490 ms	-	510 ms]	525 ms	3-11

2. Disconnect the cables from the 8115A.

4. WIDTH TEST

This test consists of two parts.

1. Minimum Width Test
2. Long Width Test

NOTES: Repeat the entire width test procedure for the second channel.

The specifications and tests are for the 50 % point of amplitude and fastest transition edges (LINEAR 6.5 ns).

SPECIFICATIONS

Range:	10.0 ns to 950 ms (max.: Period - 10 ns)
Resolution:	3 digits (best case: 100 ps)
*Accuracy:	5 % [2 %] of programmed value ± 2 ns
rms Jitter:	0.05 % of programmed value + 30 ps
Repeatability:	Factor 4 better than accuracy

*[value] at 20 dec C to 30 dec C ambient temperature.

EQUIPMENT

1. HP 54120T Digitizing Oscilloscope with Accessory
2. Counter
3. Cable, 50 ohm, BNC to BNC, coaxial, 2 each.

PART 1 MINIMUM WIDTH TEST

SET-UP

1. Set HP 8115A:
   SAVE = Operation : [Reset] to Standard Setting
   EXEC

2. Set the HP 8115A:

a.	TIMING	= Period	: 500 [ns]		
b.		Width	: 100 [ns]	|	100 [ns]
c.		Leading	: 6.5 [ns]	|	6.5 [ns]
d.		Trailing	: 6.5 [ns]	|	6.5 [ns]
e.	OUTPUT	= State	: [On]	|	[On]
f.		[High Level]	: [+] 1.4 V	|	[+] 1.4 V

3. Connect the HP 8115A's TRIG OUTPUT via a BNC (m) - SMA (f) Adapter, Cable assy-coaxial SMA (m-m), and APC 3.5 mm 20dB Attenuator (f-m) to the TRIG Input of the HP 54121A.

4. Connect the HP 8115A OUTPUT 1/2 via a similar second accessory assembly to the Input 4 of the HP 54121A.

PROCEDURE

1. Setup HP 54120T Oscilloscope:
   - press AUTOSCALE
   - center one pulse horizontal and vertical on screen (TIME/DIV = 20 ns/div, VOLT/DIV = 500 mV/div)
   - select the Display menu and set the Number of Averages to 64
   - select the Channel menu and set the Atten factor to 10
   - select the Delta V menu and turn the voltage markers On
   - set Preset Levels = 50-50% and press Auto Level Set
   - select the Delta t menu and turn the time markers On
   - set START ON EDGE = POS1 and STOP ON EDGE = NEG1

2. Change the HP8118A Width to 10 [ns].

3. Press the Precise Edge Find key for each new Width setting.

4. Check the HP 8115A pulse width at the following settings:

	Width	ACCEPTABLE RANGE				TR ENTRY
1.	10 ns	7.5 ns	[7.8 ns	-	12.2 ns]	12.5 ns	4-1
2.	20 ns	17 ns	[17.6 ns	-	22.4 ns]	23 ns	4-2
3.	50 ns	45.5 ns	[47 ns	-	53 ns]	54.5 ns	4-3
4.	80 ns	74 ns	[76.4 ns	-	83.6 ns]	86 ns	4-4
5.	99.9 ns	93 ns	[95.9 ns	-	103.9 ns]	107 ns	4-5

5. Disconnect the cables from the 8115A.

PART 2 LONG WIDTH TESTS

SET-UP

1. Set the HP 8115A:

a.	TIMING	= Period	: 95 [us]		
b.		Width	: 500 [ns]	|	500 [ns]
c.		Leading	: 6.5 [ns]	|	6.5 [ns]
d.		Trailing	: 6.5 [ns]	|	6.5 [ns]
e.	OUTPUT	= State	: [On]	|	[On]
f.		[High Level]	: [+] 1.0 V	|	[+] 1.0 V
		low level	: [-] 1.0 V	|	[-] 1.0 V

2. Set the counter:
   a. FUNCTION = TI A to B
   b. START = 50 ohm, POS (+) slope, DC, X1
   c. STOP = 50 ohm, NEG (-) slope, DC, X1
   d. Gate Time = as necessary
   e. INPUT MODE = COM
   f. START/STOP trigger levels = Preset

3. Connect the HP 8115A OUTPUT 1/2 to the counter's START input.

PROCEDURE

1. Check the HP 8115A pulse width at the following Period and Width settings:

	Period	Width	ACCEPTABLE RANGE			TR ENTRY
1.	95 us	1 us	948 ns [978 ns	-	1.02 us]	1.05 us	4-6
2.	95 us	10 us	9.5 us [9.8 us	-	10.2 us]	10.5 us	4-7
3.	95 ms	100 us	95 us [98 us	-	102 us]	105 us	4-8
4.	95 ms	1 ms	950 us [980 us	-	1.02 ms]	1.05 ms	4-9
5.	95 ms	10 ms	9.5 ms [9.8 ms	-	10.2 ms]	10.5 ms	4-10
6.	999 ms	100 ms	95 ms [98 ms	-	102 ms]	105 ms	4-11
7.	999 ms	500 ms	475 ms [490 ms	-	510 ms]	525 ms	4-12

5. JITTER TESTS

This test consists of three parts: Period Jitter, Delay Jitter, and Width Jitter.

Repeat the tests for the second channel.

SPECIFICATIONS

rms Jitter: 0.05% of programmed value + 30 ps

EQUIPMENT

1. HP 54120T Digitizing Oscilloscope with Accessory

PART 1 PERIOD JITTER TEST

SET-UP

1. Set HP 8115A:

   SAVE = Operation : [Reset] to Standard Setting
   EXEC

2. Set the HP 8115A:

a.	TIMING	= Period	: 100 [ns]		
b.		Width	: 50 [ns]	|	50 [ns]
c.		Leading	: 6.5 [ns]	|	6.5 [ns]
d.		Trailing	: 6.5 [ns]	|	6.5 [ns]
e.	OUTPUT	= State	: [On]	|	[On]
f.		[High Level]	: [+] 5.00 V	|	[+] 5.00 V
g.		Low Level	: [-] 5.00 V	|	[-] 5.00 V

3. Connect an APC 3.5 mm 20dB Attenuator (f-m), 1 each to the TRIG Input and to the Input 4 of the HP 54121A.

4. Connect one output, APC 3.5 mm (f), of the Power Splitter HP 11667B via a SMA (m-m) Adapter to the 20dB Attenuator at the TRIG Input of the 54121A.

5. Connect to the other output of the Power Splitter a SMA (m) - BNC (f) Adapter and connect 4 BNC (m-m) cables (61 cm) together to this adapter (use BNC Adapters (f-f), 3 each).

6. Connect this cable assembly via a BNC (f) - SMA (m) Adapter to the 20dB Attenuator at the Input 4 of the 54121A.

7. Connect the 8115A OUTPUT 1/2 via a BNC (m) - SMA (f) Adapter, Cable assy-coaxial SMA (m-m) to the Input of the Power Splitter.

PROCEDURE

1. Setup HP 54120T Oscilloscope:
   - press AUTOSCALE
   - select the Display menu and set the Number of Averages to 128
   - select the Timebase menu and set the TIME/DIV to 500 ps/div
   - center the first positive going edge of the signal (approx. Delay = 21.x ns)
   - select the Channel menu and set the Atten factor to 1 (Channel 4)
   - set the VOLT/DIV to 20 mV/div
   - select the Delta V menu and turn the V Markers On
   - set the Marker 1 Position to -50 mV and the Marker 2 Position to -45 mV
   - select the Delta t menu and turn the T Markers On
   - set START ON EDGE = POS1 and STOP ON EDGE = POS1
   - press the Precise Edge Find key

2. Record the delta t! It is the risetime of the ref. signal within a 1% amplitude window of the signal connected to Input 4. This value is needed later to calculate the correct jitter.

3. Select the scopes Timebase menu and center the second positive going edge of the signal (actual Delay + 10x.x ns = approx. Delay 120 ns)

4. Press More and Histogram.

5. Select the Window submenu and set:
   Source is Channel 4
   choose the time Histogram
   press WINDOW MARKER 1 and set it to -50 mV
   press WINDOW MARKER 2 and set it to -45 mV

6. Select the Acquire submenu and set the Number of Samples to 1000.
   Press Start Acquiring.

7. After the data for the time histogram is acquired (#Samples = 100%), select the Result submenu.

8. Press Mean and Sigma. Notice the value of Sigma!

9. The rms jitter has to be calculated as follows:

$$\frac{(\text{Sigma} \times 6) - \text{delta t of ref. signal}}{6}$$

10. Max. rms jitter (period = 100 ns) is 80 ps TR ENTRY 5-1

PART 2 WIDTH JITTER TEST

SET-UP

1. Same set-up as before.

2. Set the HP 8115A:

a.	TIMING	= Period	: 1 [us]		
b.		Width	: 500 [ns]	|	500 [ns]

PROCEDURE

1. Setup HP 54120T Oscilloscope:
   - press the More key
   - select the Display menu and set the #Avgs = 256
   - select the Timebase menu and center the first negative going edge of the signal (approx. Delay = 52x.x ns)
   - select the Delta V menu and set the Marker 1 Position to +50 mV and the Marker 2 Position to +45 mV
   - select the Delta t menu and set START ON EDGE = NEG1 and STOP ON EDGE = NEG1
   - press the Precise Edge Find key

2. Record the delta t! It is the risetime of the signal within a 1% amplitude window of the signal connected to Input 4. This value is needed later to calculate the correct jitter.

3. Press More = Histogram.

4. Select the Window submenu and
   press WINDOW MARKER 1 and set it to +50 mV
   press WINDOW MARKER 2 and set it to +45 mV

5. Select the Acquire submenu and press Start Acquiring.

6. After the data for the time histogram is acquired (#Samples = 100%), select the Result submenu.

7. Press Mean and Sigma. Notice the value of Sigma!

8. The rms jitter is calculated as follows:

$$\frac{(\text{Sigma} \times 6) - \text{delta t of signal}}{6}$$

9. Max. rms jitter (width = 500 ns) is 280 ps TR ENTRY 5-2

10. Disconnect the cables from the 8115A.

PART 3 DELAY JITTER TEST

SET-UP

1. Set the HP 8115A:

	a.	TIMING	= Period	: 500 [ns]		
	b.		Delay	: 250 [ns]	|	250 [ns]
	c.		Width	: 50 [ns]	|	50 [ns]
!	d.	OUTPUT	= [High Level]	: [+] 2.50 V	|	[+] 2.50 V
!	e.		Low Level	: [-] 2.50 V	|	[-] 2.50 V

2. Connect the HP 8115A's TRIG OUTPUT via a BNC (m) - SMA (f) Adapter, Cable assy-coaxial SMA (m-m), and APC 3.5 mm 20dB Attenuator (f-m) to the TRIG Input of the HP 54121A.

3. Connect the HP 8115A OUTPUT 1/2 via a same second accessory assembly to the Input 4 of the HP 54121A.

PROCEDURE

1. Setup HP 54120T Oscilloscope:
   - press AUTOSCALE
   - select the Display menu and set the #Avgs = 128
   - select the Timebase menu and set the TIME/DIV = 200 ps/div
   - center the first positive going edge of the signal (approx. Delay = 24x.x ns)
   - select the Channel menu and set the VOLT/DIV = 20 mV/div

2. Press More = Histogram.

3. Select the Window submenu and
   press WINDOW MARKER 1 and set it to -50 mV
   press WINDOW MARKER 2 and set it to -45 mV

4. Select the Acquire submenu and press Start Acquiring.

5. After the data for the time histogram is acquired (#Samples = 100%), select the Result submenu.

6. Press Mean and Sigma. Notice the value of Sigma!

7. The rms jitter has to be calculated as follows:

$$\frac{(\text{Sigma} \times 6) - \text{delta t of ref. signal}}{6}$$

8. Max. rms jitter (delay = 250 ns) is 155 ps TR ENTRY 5-3

9. Disconnect the cables from the 8115A.

6. TRANSITION TIME TEST

This test consists of two parts.

1. Fast Transition Time Test
2. Slow Transition Time Test

NOTE: Repeat the entire transition time test procedure for the second channel.

SPECIFICATIONS

Range:	6.5 ns to 95 ms
Resolution:	3 digits (best case: 100 ps)
*Accuracy:	5 % of programmed value ± 2 ns

EQUIPMENT

1. HP 54120T Digitizing Oscilloscope with Accessory
2. Counter
3. DVM
4. Time Interval Probes and T. I. Probe Adapter
5. Cable, 50 ohm, BNC to BNC, coaxial, 4 each.
6. 50 ohm feedthrough termination, **0.1%, 10 W**
7. Adapter, BNC to dual banana plug

PART 1 FAST TRANSITION TIME TEST

1. Set HP 8115A:
   SAVE = Operation : [Reset] to Standard Setting
   EXEC

2. Set the HP 8115A:

a.	TIMING	= Period	: 1 [ms]		
b.		Width	: 500 [us]	|	500 [us]
c.		Leading	: 6.5 [ns]	|	6.5 [ns]
d.		Trailing	: 50 [ns]	|	50 [ns]
e.	OUTPUT	= State	: [On]	|	[On]
f.		[High Level]	: [+] 1.4 V	|	[+] 1.4 V

3. Connect the HP 8115A's TRIG OUTPUT via a BNC (m) - SMA (f) Adapter, Cable assy-coaxial SMA (m-m), and APC 3.5 mm 20dB Attenuator (f-m) to the TRIG Input of the HP 54121A.

4. Connect the HP 8115A OUTPUT 1/2 via a similar second accessory assembly to the Input 4 of the HP 54121A.

PROCEDURE

1. Setup HP 54120T Oscilloscope:
   - press AUTOSCALE
   - center one pulse horizontal and vertical on screen (TIME/DIV = 100 us/div, VOLT/DIV = 200 mV/div)
   - select the Display menu and set the Number of Averages to 64
   - select the Channel menu and set the Atten factor to 10
   - select the Delta V menu and turn the voltage markers On
   - set Preset Levels = 10-90% and press Auto Level Set
   - select the Timebase menu and set TIME/DIV = 20 ns, DELAY = 16 ns
   - select the Delta t menu and turn the time markers On
   - set START ON EDGE = POS1 and STOP ON EDGE = POS1

2. Set HP 8115A: Period: 500 [ns] Width: 250 [ns]
3. While the Oscilloscope is in the Delta t menu, press the Precise Edge Find Key.
4. For each new 8115A leading setting, CLEAR DISPLAY and after the #Avgs = 64 press the Precise Edge Find key.

5. Check the 8115A output signal rise times at the following leading edge settings.

	Leading	ACCEPTABLE RANGE		TR ENTRY
1.*	6.5 ns		8.83 ns	6-1
2.	10 ns	7.5 ns	12.5 ns	6-2
3.	50 ns	45.5 ns	54.5 ns	6-3
4.	99.9 ns	93 ns	107 ns	6-4

*Underprogramming to 5.5 ns is allowed to meet this specification.

6. Set HP 8115A: Leading: 50 [ns] Trailing: 6.5 [ns]
7. Select the scopes Timebase menu and set DELAY = 780 ns
   Select the scopes Delta t menu and set START ON EDGE = NEG1 and STOP ON EDGE = NEG1
8. While the Oscilloscope is in the Delta t menu, press the Precise Edge Find Key.
9. For each new 8115A trailing setting, CLEAR DISPLAY and after the #Avgs = 64 press the Precise Edge Find key.
10. Check the 8115A output signal fall times at the following trailing settings.

	Trailing	ACCEPTABLE RANGE		TR ENTRY
1.*	6.5 ns		8.83 ns	6-5
2.	10 ns	7.5 ns	12.5 ns	6-6
3.	50 ns	45.5 ns	54.5 ns	6-7
4.	99.9 ns	93 ns	107 ns	6-8

*Underprogramming to 5.5 ns is allowed to meet this specification.

11. Disconnect the cables from the 8115A.

PART 2 SLOW TRANSITION TIME TEST

SET-UP

1. Set the Multimeter (HP 3478):
   a. SGL TRIG = Single Trigger
   b. Blue/AUTO ZERO = Auto Zero off
   c. BLUE/4 = 4 digits

2. Set the counter:
   a. FUNCTION = TI A to B
   b. INPUT MODE = SEP (SEPARATE)
   c. START = 50 ohm, POS (+) slope, DC, X1
   d. STOP = 50 ohm, POS (+) slope, DC, X1
   e. START/STOP Trigger Levels = Preset
   f. EXT ARM
   g. EXT Level and Slope as necessary

3. Set the time interval probes:
   a. Start channel = 'A +0.5 POSITIVE SLOPE'
   b. Stop channel = 'A +4.5 POSITIVE SLOPE'

4. Connect the Time Interval Channel A probe to a TI probe adapter.
5. Attach the TI probe adapter to the TEE, BNC (f) .
6. Attach the 50 ohm feedthrough termination to the TEE, BNC (m).
7. Attach a BNC cable to the TEE, BNC (f).
8. **CALIBRATE** the time interval probes!
   Perform the LEVEL operation; hold the CAL switch in the LEVEL position until the channel leds are on.
   NOTE: Perform the calibration with the TEE, 50 ohm termination, and the cable attached.
9. Connect the TI Probe's rear panel outputs to the counter inputs.
   a. START output to Channel A input.
   b. STOP output to Channel B input.
10. Connect the BNC cable from the TEE, BNC to the HP 8115A's OUTPUT 1/2
11. Connect the 50 ohm terminator via a BNC/banana plug adapter to the DVM.
12. Connect the 8115A TRIGGER OUTPUT to the DVM trigger input and the counter's EXT Input.

PROCEDURE

1. Set the HP 8115A:

TIMING	= Period	: 100 [ms]		
	Delay	: 30 [ms]	|	30 [ms]
	Width	: 50 [ms]	|	50 [ms]
	Leading	: 500 [ns]	|	500 [ns]
	Trailing	: 500 [ns]	|	500 [ns]
OUTPUT	= State	: [On]	|	[On]
	[High Level]	: [+] 4.9x V	|	[+] 4.9x V

2. Change the high level with the up/down ROLL key = VERNIER to get the best 5.00x V reading on the DVM.
3. Set the HP 8115A:

TIMING	= Delay	: 30 [us]	|	30 [us]
OUTPUT	= Low Level	: [+] 0.0x V	|	[+] 0.0x V

4. Change the low level with the up/down ROLL key = VERNIER to get the best 0.00x V reading on the DVM.
5. Press the 8115A TIMING key and check the 8115A OUTPUT risetime at the following settings.

	Trailing	Leading	ACCEPTABLE RANGE		TR ENTRY
1.	500 ns	500 ns	473 ns	527 ns	6-9
2.		999 ns	947 ns	1.05 us	6-10
3.		5 us	4.75 us	5.25 us	6-11
4.		9.99 us	9.49 us	10.49 us	6-12
5.	50 us	50 us	47.5 us	52.5 us	6-13
6.		99.9 us	94.9 us	104.9 us	6-14
7.		500 us	475 us	525 us	6-15
8.		999 us	949 us	1.049 ms	6-16
9.	5 ms	5 ms	4.75 ms	5.25 ms	6-17
10.		10 ms	9.5 ms	10.5 ms	6-18
*11.		95 ms	90.25 ms	99.75 ms	6-19

NOTES: Repeat steps 1 to 4 to obtain the best +5.00x V/0.00x V reading on the DVM.

* Change the 8115A setting to Period : 500 ms Width : 250 ms

6. Set the time interval probes:
   a. Start channel = 'A +4.5 NEGATIVE SLOPE'
   b. Stop channel = 'A +0.5 NEGATIVE SLOPE'

7. Set the 8115A Period : 100 ms Width : 50 ms

8. Check the 8115A OUTPUT falltime at the following settings.

	Leading	Trailing	ACCEPTABLE RANGE		TR ENTRY
1.	500 ns	500 ns	473 ns	527 ns	6-20
2.		999 ns	947 ns	1.05 us	6-21
3.		5 us	4.75 us	5.25 us	6-22
4.		9.99 us	9.49 us	10.49 us	6-23
5.	50 us	50 us	47.5 us	52.5 us	6-24
6.		99.9 us	94.9 us	104.9 us	6-25
7.		500 us	475 us	525 us	6-26
8.		999 us	949 us	1.049 ms	6-27
9.	5 ms	5 ms	4.75 ms	5.25 ms	6-28
10.		10 ms	9.5 ms	10.5 ms	6-29
*11.		95 ms	90.25 ms	99.75 ms	6-30

NOTES: Repeat steps 1 to 4 to obtain the best +5.00x V/0.00x V reading on the DVM.

* Change the 8115A setting to Period : 500 ms Width : 250 ms

9. Disconnect the cables from the 8115A.

7. HIGH LEVEL AND LOW LEVEL TESTS

Repeat the high level and low level tests for the second channel.

SPECIFICATIONS

NOTE: This specification applies to 50 ohm sources and 50 ohm loads.

High Level:	-7.90 V to 8.00 V.
Low Level:	-8.00 V to 7.90 V.
Resolution:	3 digits (best case: 10.0 mV).
* Level Accuracy:	1% of programmed value ± 3% [1%] of pulse amplitude, ± 40 mV [20 mV].
Repeatability:	Factor 4 better than accuracy
Settling time:	100 ns + transition time.

* [value] at 20 dec C to 30 dec C ambient temperature.

EQUIPMENT

1. Multimeter
2. 50 ohm feedthrough termination, **0.1%, 10 W**
3. Adapter, BNC to dual banana plug
4. Cables, BNC to BNC, two each.

SET-UP

1. Set HP 8115A:
   SAVE = Operation : [Reset] to Standard Setting
   EXEC

2. Set the HP 8115A:

a.	TIMING	= Period	: 100 [ms]		
b.		[Delay]	: 30 [ms]	|	30 [ms]
c.		Width	: 50 [ms]	|	50 [ms]
d.		Leading	: 6.5 [ns]	|	6.5 [ns]
e.		Trailing	: 6.5 [ns]	|	6.5 [ns]
f.	OUTPUT	= State	: [On]	|	[On]

3. Set the Multimeter (HP 3478).
   a. SGL TRIG = Single Trigger
   b. Blue/AUTO ZERO = Auto Zero off
   c. BLUE/4 = 4 digits

4. Connect the HP 8115A OUTPUT 1/2 to the Multimeter's input via a 50 ohm feedthrough **(0.1%, 10 W)** and a BNC to dual banana plug adapter.
5. Connect the HP 8115A TRIG OUTPUT to the Multimeter's trigger input.

PROCEDURE

HIGH LEVEL TEST

1. Check the 8115A high level at the following [High Level] settings with the Low Level set to 0.00 V.

	High Level	ACCEPTABLE RANGE			TR ENTRY
1.	[+]0.1 V	56 mV [	78 mV -	122 mV]	144 mV	7-1
2.	[+]0.5 V	440 mV [	470 mV -	530 mV]	560 mV	7-2
3.	[+] 1 V	920 mV [	960 mV -	1.04 V]	1.08 V	7-3
4.	[+] 5 V	4.76 V [	4.88 V -	5.12 V]	5.24 V	7-4
5.*	[+] 8 V	7.64 V [	7.82 V -	8.18 V]	8.36 V	7-5

* Overprogramming to 8.2 V is allowed to meet this spec.

The low level 0.0 V may vary within ± 3% [1%] of pulse amplitude, ± 40 mV [20 mV].

LOW LEVEL TEST

1. Set the HP 8115A:

a.	TIMING	= [Delay]	: 30 [us]	|	30 [us]
b.	OUTPUT	= [High Level]	: [+]0.00 V	|	[+]0.00 V
		[Low Level]	: [-]0.10 V	|	[-]0.01 V

2. Check the 8115A low level at the following Low Level settings with the High Level set to 0.00 V.

	Low Level	ACCEPTABLE RANGE				TR ENTRY
1.	[-]0.1 V	- 56 mV	[- 78 mV	-	-122 mV]	-144 mV	7-6
2.	[-]0.5 V	-440 mV	[-470 mV	-	-530 mV]	-560 mV	7-7
3.	[-] 1 V	-920 mV	[-960 mV	-	-1.04 V]	-1.08 V	7-8
4.	[-] 5 V	-4.76 V	[-4.88 V	-	-5.12 V]	-5.24 V	7-9
5.*	[-] 8 V	-7.64 V	[-7.82 V	-	-8.18 V]	-8.36 V	7-10

* Overprogramming to -8.2 V is allowed to meet this spec.

The high level 0.0 V may vary within ± 3% [1%] of pulse amplitude, ± 40 mV [20 mV].

3. Disconnect the cables from the 8115A.

8. PULSE ABERRATION TEST

Repeat this test for the second channel.

SPECIFICATIONS

Preshoot, Overshoot, and Ringing:	<= 5% of the pulse amplitude ± 10 mV. (may increase to <= 7% for edges < 10ns)

EQUIPMENT

1. HP 54120T Digitizing Oscilloscope with Accessory

SET-UP

1. Set HP 8115A:
   SAVE = Operation : [Reset] to Standard Setting
   EXEC

2. Set the HP 8115A:

a.	TIMING	= Period	: 500 [ns]		
b.		Width	: 250 [ns]	|	250 [ns]
c.		Leading	: 6.5 [ns]	|	6.5 [ns]
d.		Trailing	: 6.5 [ns]	|	6.5 [ns]
e.	OUTPUT	= State	: [On]	|	[On]
f.		[High Level]	: [+] 5.0 V	|	[+] 5.0 V

3. Connect the HP 8115A's TRIG OUTPUT via a BNC (m) - SMA (f) Adapter, Cable assy-coaxial SMA (m-m), and APC 3.5 mm 20dB Attenuator (f-m) to the TRIG Input of the HP 54121A.
4. Connect the HP 8115A OUTPUT 1/2 via a same second accessory assembly to the Input 4 of the HP 54121A.

8. PULSE ABERRATION TEST

Repeat this test for the second channel.

SPECIFICATIONS

Preshoot, Overshoot, and Ringing:	<= 5% of the pulse amplitude ± 10 mV. (may increase to <= 7% for edges < 10ns)

EQUIPMENT

1. HP 54120T Digitizing Oscilloscope with Accessory

SET-UP

1. Set HP 8115A:
   SAVE = Operation : [Reset] to Standard Setting
   EXEC

2. Set the HP 8115A:

a.	TIMING	= Period	: 500 [ns]		
b.		Width	: 250 [ns]	|	250 [ns]
c.		Leading	: 6.5 [ns]	|	6.5 [ns]
d.		Trailing	: 6.5 [ns]	|	6.5 [ns]
e.	OUTPUT	= State	: [On]	|	[On]
f.		[High Level]	: [+] 5.0 V	|	[+] 5.0 V

3. Connect the HP 8115A's TRIG OUTPUT via a BNC (m) - SMA (f) Adapter, Cable assy-coaxial SMA (m-m), and APC 3.5 mm 20dB Attenuator (f-m) to the TRIG Input of the HP 54121A.
4. Connect the HP 8115A OUTPUT 1/2 via a same second accessory assembly to the Input 4 of the HP 54121A.

PROCEDURE

1. Setup HP 54120T Oscilloscope:
   - press AUTOSCALE
   - select the Display menu and set the Number of Averages to 64
   - select the Channel menu and set the Atten factor to 10
   - center one pulse horizontal and vertical on screen (TIME/DIV = 50 ns/div, VOLT/DIV = 800 mV/div)
   - select the Delta V menu and turn the voltage markers On
   - set Preset Levels = variable
   - set the VARIABLE LEVELS to 93-107% and press Auto Level Set
   - select the Channel menu and center vertical the pulse top with OFFSET (Offset=5V)
   - set the VOLTS/DIV to 100 mV/div
   - select the Timebase menu
   - set the TIME/DIV to Sweep Speed = 50 ns/div and Delay to 70 ns

2. Check that the 8115A Overshoot, Ringing (and Preshoot) is within the limits (<= 7%).

   TR ENTRY 8-1.

   (Take the scopes trace flatness error (GaAs input circuit) into account.)

3. Change the 8115A leading and trailing edges to 10 ns.

4. Select the scopes Delta V menu and set the variable levels to 95-105%

5. Check that the 8115A Overshoot, Ringing (and Preshoot) is within the limits (<= 5%).

   TR ENTRY 8-2.

   (Take the scopes trace flatness error (GaAs input circuit) into account.)

6. Disconnect the cables from the 8115A.

PERFORMANCE TEST RECORD

MODEL: HP 8118A

TESTED BY:_____

SERIAL NUMBER:_____

DATE:_____

COMMENTS:_____

TEST	LIMIT MINIMUM	ACTUAL (TR ENTRY)	LIMIT MAXIMUM	PASS	FAIL
PERIOD:					
20 ns	17 ns	(1-1)_____	23 ns	_____	_____
99.9 ns	93 ns	(1-2)_____	107 ns	_____	_____
100 ns	93 ns	(1-3)_____	107 ns	_____	_____
500 ns	473 ns	(1-4)_____	527 ns	_____	_____
999 ns	947 ns	(1-5)_____	1.05 us	_____	_____
10 us	9.5 us	(1-6)_____	1.05 us	_____	_____
500 us	475 us	(1-7)_____	525 us	_____	_____
1 ms	950 us	(1-8)_____	1.05 ms	_____	_____
950 ms	902.5 ms	(1-9)_____	997.5 ms	_____	_____

TEST	LIMIT MINIMUM	ACTUAL (TR ENTRY)	LIMIT MAXIMUM	PASS	FAIL
MINIMUM DELAY:					
75 ns		(2-1)_____	82.75 ns	_____	_____
80 ns	72 ns	(2-2)_____	88 ns	_____	_____
90 ns	81.5 ns	(2-3)_____	98.5 ns	_____	_____
99.9 ns	90.0 ns	(2-4)_____	108.9 ns	_____	_____
LONG DELAY					
100 ns	91 ns	(2-5)_____	109 ns	_____	_____
500 ns	471 ns	(2-6)_____	529 ns	_____	_____
999 ns	945 ns	(2-7)_____	1053 ns	_____	_____
10 us	9.5 us	(2-8)_____	10.5 us	_____	_____
10 ms	9.5 ms	(2-9)_____	10.5 ms	_____	_____
950 ms	902.5 ms	(2-10)_____	997.5 ms	_____	_____
MINIMUM DOUBLE PULSE:					
20 ns	17 ns	(3-1)_____	23 ns	_____	_____
50 ns	45.5 ns	(3-2)_____	54.5 ns	_____	_____
80 ns	74 ns	(3-3)_____	86 ns	_____	_____
99.9 ns	93 ns	(3-4)_____	107 ns	_____	_____
LONG DOUBLE PULSE:					
1 us	948 ns	(3-5)_____	1.05 us	_____	_____
10 us	9.5 us	(3-6)_____	10.5 us	_____	_____
100 us	95 us	(3-7)_____	105 us	_____	_____
1 ms	950 us	(3-8)_____	1.05 ms	_____	_____
10 ms	9.5 ms	(3-9)_____	10.5 ms	_____	_____
100 ms	95 ms	(3-10)_____	105 ms	_____	_____
500 ms	475 ms	(3-11)_____	525 ms	_____	_____

TEST	LIMIT MINIMUM	ACTUAL (TR ENTRY)	LIMIT MAXIMUM	PASS	FAIL
MINIMUM WIDTH:					
10 ns	7.5 ns	(4-1)_____	12.5 ns	_____	_____
20 ns	17 ns	(4-2)_____	23 ns	_____	_____
50 ns	45.5 ns	(4-3)_____	54.5 ns	_____	_____
80 ns	74 ns	(4-4)_____	86 ns	_____	_____
99.9 ns	93 ns	(4-5)_____	107 ns	_____	_____
LONG WIDTH:					
1 us	948 ns	(4-6)_____	1.05 us	_____	_____
10 us	9.5 us	(4-7)_____	10.5 us	_____	_____
100 us	95 us	(4-8)_____	105 us	_____	_____
1 ms	950 us	(4-9)_____	1.05 ms	_____	_____
10 ms	9.5 ms	(4-10)_____	10.5 ms	_____	_____
100 ms	95 ms	(4-11)_____	105 ms	_____	_____
500 ms	475 ms	(4-12)_____	525 ms	_____	_____
PERIOD JITTER					
Period Jitter <= 80 ps		(5-1)_____		_____	_____
WIDTH JITTER					
Delay Jitter <= 280 ps		(5-2)_____		_____	_____
DELAY JITTER					
Delay Jitter <= 155 ps		(5-3)_____		_____	_____

TEST	LIMIT MINIMUM	ACTUAL (TR ENTRY)	LIMIT MAXIMUM	PASS	FAIL
FAST TRANSITION:					
6.5 ns		(6-1)_____	8.83 ns	_____	_____
10 ns	7.5 ns	(6-2)_____	12.5 ns	_____	_____
50 ns	45.5 ns	(6-3)_____	54.5 ns	_____	_____
99.9 ns	93 ns	(6-4)_____	107 ns	_____	_____
6.5 ns		(6-5)_____	8.83 ns	_____	_____
10 ns	7.5 ns	(6-6)_____	12.5 ns	_____	_____
50 ns	45.5 ns	(6-7)_____	54.5 ns	_____	_____
99.9 ns	93 ns	(6-8)_____	107 ns	_____	_____
SLOW TRANSITION, LEADING EDGE:					
500 ns	473 ns	(6-9)_____	527 ns	_____	_____
999 ns	947 ns	(6-10)_____	1.05 us	_____	_____
5 us	4.75 us	(6-11)_____	5.25 us	_____	_____
9.99 us	9.49 us	(6-12)_____	10.49 us	_____	_____
50 us	47.5 us	(6-13)_____	52.5 us	_____	_____
99.9 us	94.9 us	(6-14)_____	104.9 us	_____	_____
500 us	475 us	(6-15)_____	525 us	_____	_____
999 us	949 us	(6-16)_____	1.049 ms	_____	_____
5 ms	4.75 ms	(6-17)_____	5.25 ms	_____	_____
10 ms	9.5 ms	(6-18)_____	10.5 ms	_____	_____
95 ms	90.25 ms	(6-19)_____	99.75 ms	_____	_____

TEST	LIMIT MINIMUM	ACTUAL (TR ENTRY)	LIMIT MAXIMUM	PASS	FAIL
SLOW TRANSITION, TRAILING EDGE:					
500 ns	473 ns	(6-20)_____	527 ns	_____	_____
999 ns	947 ns	(6-21)_____	1.05 us	_____	_____
5 us	4.75 us	(6-22)_____	5.25 us	_____	_____
9.99 us	9.49 us	(6-23)_____	10.49 us	_____	_____
50 us	47.5 us	(6-24)_____	52.5 us	_____	_____
99.9 us	94.9 us	(6-25)_____	104.9 us	_____	_____
500 us	475 us	(6-26)_____	525 us	_____	_____
999 us	949 us	(6-27)_____	1.049 ms	_____	_____
5 ms	4.75 ms	(6-28)_____	5.25 ms	_____	_____
10 ms	9.5 ms	(6-29)_____	10.5 ms	_____	_____
95 ms	90.25 ms	(6-30)_____	99.75 ms	_____	_____
HIGH LEVEL:					
0.1 V	56 mV	(7-1)_____	144 mV	_____	_____
0.5 V	440 mV	(7-2)_____	560 mV	_____	_____
1 V	920 mV	(7-3)_____	1.08 V	_____	_____
5 V	4.76 V	(7-4)_____	5.24 V	_____	_____
8 V	7.64 V	(7-5)_____	8.36 V	_____	_____
LOW LEVEL:					
-0.1 V	-56 mV	(7-6)_____	-144 mV	_____	_____
-0.5 V	-440 mV	(7-7)_____	-560 mV	_____	_____
-1 V	-920 mV	(7-8)_____	-1.08 V	_____	_____
-5 V	-4.76 V	(7-9)_____	-5.24 V	_____	_____
-8 V	-7.64 V	(7-10)_____	-8.36 V	_____	_____
PULSE ABERRATION					
<= 7%		(8-1)_____		_____	_____
<= 7%		(8-2)_____		_____	_____

TABLE E-1. RECOMMENDED TEST EQUIPMENT

Other equipment can be used provided it meets the specifications of this equipment.

TYPE (QUANTITY)	MODEL	SPECIFICATIONS
1:1 Probe (1)	HP 10026A	100 V mam., 1:1, 50 ohm,
10:1 Probe (1)	HP 10017A	300 V max., 10:1, 1 M ohm, 8 pF.
50 ohm feedthrough (1) termination	HP 10100C	50 ohm, 2W, 1%.
50 ohm feedthrough (1) termination	See Figure 11-1.	50 ohm, 10 W, 0.1 %.
Adapter, (1) BNC to Banana	HP 1251-2277	BNC(f) to dual banana plug, 50 ohm.
Cable Assembly (5)	HP 8120-1839	50 ohm, 24 inches, coax, 2 BNC (m).

Counter (1)	HP 5335A/ HP 5370B	50 uHz to 50 MHz; 8 digit display; INPUT: 50 ohm/1M ohm, X1/X10, AC/DC, seperate/common; variable trigger level; TI/PERIOD/FREQUENCY.
Isolation Transformer (1)		Suitable for use with the variac.
Multimeter (1)	HP 3478A/ HP 3456A	4 1/2 digit display; VDC: 30 mV to 300 V; 30 to 35 readings/second; external trigger; input resistance: >10 M ohm.
Oscilloscope (1) (Realtime)	HP 1725A	275 MHz bandwidth; external trigger; 50 ohm/1 M ohm inputs; 0.1 to 5 V.
Oscilloscope (1) (Sampling)	HP 54120T	20 GHz
Sampling Scope Accessories		
Attenuator (3)	33340C	APC 3.5 mm (f-m), 20 dB
Adapter (2)	1250-1200	SMA (m) to BNC (f)
Cable (3)	8120-4948	SMA (m-m) coaxial
Adapter (1)	1250-1159	SMA (m-m)
Adapter (2)	1250-1700	SMA (f) to BNC (m)
Power Splitter (1)	11667B	APC 3.5 mm

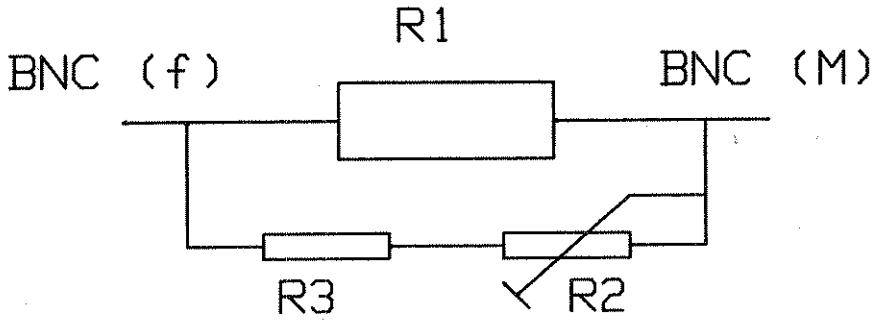
Power Supply (1)	HP 6205A/ HP 6237A	0-60 VDC, 0-3 A.
Pulse Generator (1)	HP 8112A/ HP 8161A	1 Hz to 50 MHz; variable delay; variable width; variable pulse; external trigger; output amplitude: > 5 V.
Signature Analyzer (1)	HP 5005A/ HP 5006A	TTL, 4 digit display, HEX, 25 M Hz clock, setup time = 20 ns, probe = 50 ohm to ground.
TEE (1)	HP 1250-0781	50 ohm, BNC(m)(f)(f).
Time Interval (1) Adapter	HP 10218A	50 ohm, BNC(m)
Time Interval Probes (1)	HP 5363B	Dynamic Range: +9.99 V to -9.99 V.
Variac (1) (Variable AC Poser Supply).		>= 5 A, 0-300 VAC

FIGURE 11-1.

50 OHM, 0.1%, 10 W FEEDTHROUGH TERMINATION

This feedthrough must be used only where specified for DC voltage measurements.

The following figure provides a schematic and a parts list except for the case. The case must provide shielding and maintain grounding integrity.



R1 = 53.6 ohm, 1%, 10 W;
HP Part Number: 0699-0146.
R2 = 200 ohm, 10%, 0.5 W, Variable trimmer;
HP Part Number: 2100-3350.
R3 = 681 ohm, 1%, 0.5 W;
HP Part Number: 0757-0816.
BNC (M): HP Part Number: 1250-0045.
BNC (F): HP Part Number: 1250-0083.

F ERRORS

Power-on Self-test

TABLE F-1

The instrument tests the microprocessor and amplifierboards. Error conditions are reported at the display immediately after performing the tests.

***TST?**

TABLE F-1

The self-test query causes the instrument to test the amplifier boards by performing the power-on parametric board tests.

:SYST:ERR?

TABLE F-2

Command, execution, device dependent, and query error events are reported in response to the :ERR? query.

:SYST:DERR?

TABLE F-3

Device dependent error conditions are reported in response to the :DERR? query. The table contains all local messages.

Local Messages

TABLE F-4

Status is reported locally in the message lines. Abnormal messages will be preceeded by one of the following labels: ERROR, CONFLICT, or WARNING.

All local messages are listed except device command paths (See Chapter 9.).

TABLE F-1.
POWER-ON and *TST?
ERROR MESSAGES

CPU BOARD TESTS

Processor Board Errors	**Dynamic RAM U407 and/or U408** Read/Write error
	Device Bus Failure Read/Write error.
	Static RAM U211 and/or U212 Read/Write error
	Program ROM U205 - U210 ROM contents invalid
	20 ms System Interrupt Circuit Interrupt circuit error
Configuration Errors	**Doubled Board** A non-required duplicate board is installed.
	False Board-Code The board address switch setting is inconsistent with the boards usage.
	Board located in wrong Slot
	Board missing

AMPLIFIER BOARD

MESSAGE	*TST CODE CHANNEL 1	CHANNEL 2	POWER-ON/*TST? ERROR
	210	430	Delay Timing Circuit Pulse timing
	211	431	Width Timing Circuit Pulse timing
	212	432	Slope Gen. Function Mode
	213	433	Offset +8V
	214	434	Offset -8V
	215	435	Amplitude +16V Normal
	216	436	Amplitude +16V Complement
	217	437	Gate ON +16V Amplitude
	320	540	Gate OFF +16V Amplitude
	321	541	Leading Edge 999us
	322	542	Trailing Edge 999us
	323	543	Leading Edge 9.99ms
	324	544	Trailing edge 2.5ms
	325	545	Amplitude +9.5V
	326	546	Amplitude +1.77V
	327		Addition

TABLE F-2.
:SYST:ERR?
ERROR MESSAGES

ERROR CODE	QUERY ERRORS
	The occurance of query errors also set bit two (QYE) of the standard event status register (ESR).
-400	**<Generic Query Error>**
	An unspecified query error has occured. Check for deadlock, unterminated, or interrupted actions.

ERROR CODE	DEVICE ERRORS
	The occurance of device dependent errors also sets bit three (DDE) of the standard event status register (ESR).
-350	**<Too Many Errors>**
	More than ten error conditions are present. Error code -350 was loaded into the error queue replacing the last error, error number 10.
-340	**<Self Test Failed>**
	Amplifier board failure. See Chapter 8, *TST? and Appendix F, Table F-1.
-330	**<Power-on Test Failed>**
	Error conditions are presented on the display. See Tables F-1.
-312	**<RAM Data Loss>**
	RAM memory failure.

ERROR CODE	EXECUTION ERRORS
	The occurance of execution errors also sets bit four (EXE) of the standard event status register (ESR).
-212	**<Argument Out of Range>**
	The received value is out of its allowed range.
	See the syntax diagrams for the ranges.
-211	**<Legal Command but Settings Conflict>**
	A command was received which is not a member of the command-set of the current generator configuration. See Chapter 9, Device Dependent Commands.
-200	**<Generic Execution Error>**
	A :SYST:SET binary transfer has failed.
	A remotely programmed level conflict occurred.

ERROR CODE	COMMAND ERRORS
	The occurance of command errors also sets bit five (CME) of the standard event status register (ESR).
-130	**<Non-Numeric Argument Error>,<Mnemonic>**
	The non-numeric argument is invalid. <mnemonic> = the command with the invalid argument.
-120	**<Numeric Argument Error>,<Mnemonic>**
	The numeric argument is invalid. <mnemonic> = the command with the invalid argument.
-100	**<Command Error>,<Mnemonic>**
	The command is invalid. 1. The required command is incorrectly transmitted. 2. The command is not allowed in: a. The current instrument configuration b. The command path transmitted. <mnemonic> = the command mnemonic.
0	**<No error>**

TABLE F-3.
:DERR?
ERRORS?

ERROR CODE	SOFTWARE ERROR MESSAGE
102	**<Limit Ch 1. - Addition>** <Limit Channel 1 - Addition> Addition = on and the added levels exceed the hardware limits of the instrument.

103 **<Slope Range Conf. Ch 2.>**

<Slope Range Conflict Channel 2>

Leading edge and
Trailing edge
in Channel 2 are incompatible.

Programming the leading and trailing edges
of channel 2 in different ranges is not allowed.
See slope generator ranges, Chapter 14.

104 **<Slope Range Conf. Ch 1.>**

<Slope Range Conflict Channel 1>

Leading edge
Trailing edge
in Channel 1 are incompatible.

Programming the leading and trailing edges
of channel 1 in different ranges is not allowed.
See slope generator ranges, Chapter 14.

105 **<Ext.Input Mode - Cont.Mode>**

<External Input Mode - Control Mode>

Tringgr mode = TRIGGER and
Control mode = PERIOD
are incompatible.

The period is regulated either by the period
of the external input trigger signal or by
the period set by control mode 'Period' but
not by both at the same time.

106 **<Ext.Input Mode - Slope>**

<External Input Mode - Slope>

Trigger mode = GATE and
Trigger slope = BOTH
are incompatible in the pulse generator.

Only positive or negative slopes are allowed in the GATE mode.

107 **<Control Mode - Addition>**

Control mode = HIGH LEVEL and
Pulse addition = ON
are incompatible.

When the high level control is active, adding output 2 to output 1 is not allowed.

ERROR CODE	HARDWARE ERROR MESSAGE
230	**<Period - Width Ch.2>** Channel 2: The pulse period and width are incompatible.
231	**<Double - Width Ch.2>** Channel 2: The double pulse delay and pulse width are incompatible.
232	**<Period - Double Ch.2>** Channel 2: the pulse period and double pulse delay are incompatible.
233	**<Period - Delay Ch.2>** Channel 2: the pulse period and delay are incompatible.
234	**<Period - Width Ch.1>** Channel 1: the pulse period and width are incompatible.

235 **<Double - Width Ch.1>**

Channel 2: the double pulse delay and pulse width are incompatible.

236 **<Period - Double Ch.1>**

Channel 1: the pulse period and the double pulse delay are incompatible.

237 **<Period - Delay Ch1.>**

Channel 1: the pulse period and delay are incompatible.

ERROR CODE	SOFTWARE WARNING MESSAGE
373	**<Excessive Slopes Ch. 2>** The values programmed for the slopes are long with respect to other pulse timing parameters; consequently, the pulse levels are reduced. Check the period, width, delay, or double pulse delay parameters.
374	**<Excessive Slopes Ch. 1>** See code 373.
375	**<Cont. Mode - Limit Ch.2>** Channel 2 Limit = on Control Mode = High Level The high level is hardware controlled via the rear panel control input. The limit function is inactive.
376	**<Cont. Mode - Limit Ch.1>** Channel 1 Limit = on Control Mode = High Level The high level is hardware controlled via the rear panel control input. The limit function is inactive.
377	**<Limit Ch. 1 - Addition>** Addition = on Limit = on The added levels exceed the limits set by the limit function.

TABLE F-4.
LOCAL MESSAGES

The numbers following the messages are Table 26-3 error codes.

"Actual Setting Destroyed"
A save or recall operation failed. The RAM data is invalid.

"Cannot Continue"
See Chapter 2, page 2-3, Abnormal State.

"Check HP-IB Bus Configuration"
Check at the peripherals display.

"Checking disc"

"Checking directory"

"Command Ignored"
The attempted action is not allowed. Thus, the command was not implemented. Check attempted action: is the configuration correct, is an edit function active, is the pattern generator running, is the command syntax correct, etc.

"Enter C to confirm"
Entering 'C' starts the disc formatting operation.

"Excessive Slopes Ch. 1/2"...373, 374

"Ext. Input Mode - Cont. Mode"...105
Ext. = external
Cont. = control

"Ext. Input Mode - Slope"...100/106
Ext. = external

"Ext. Input State: [OFF]"
Ext. = external

"File does not fit"
The recalled file is not an HP 8115A file.

"File not Found"

"Fix Problem First"
"Fix' means correct the conflicting conditions first.

"Format failed"

"Formatting disc"

"Generator type changed"

"High Level <= Low Level"

"HP-IB Address Conflict"
Interface addresses are duplicated. Check the address assignments at the peripherals display.

"HP-IB in Controlled Mode"
The instrument is in the device mode. The controller/controlled mode is set at the peripherals display.

"Illegal File Name"
File name contains spaces or a ':'.

"Internal: bad file length"
Disc error

"Internal: bad file type"
Disc error

"Internal: bad request"
Disc error

"Internal: disc error"

"Internal: undefined error"
Disc error

"Level conflict CH. 1/2"

"LIF directory too big"
Disc error

"Limit Ch. 1 - Addition"...102/377

"LOCAL LOCKOUT"
The front panel controls are inactive.

"No disc drive present"

"No disc media present"

"No room on disc"

"Numeric Entry Required"

"Only one point allowed"
Point = (.)

"Operation time out"
Disc error

"OUTPUT 1" or "OUTPUT 2"
Indicates when Output 1/2 output states are enabled.

"Output State Ch.2 [OFF]"

"Out of Range"

"Parameter not Available"
The selected parameter is not available. For example, if trigger mode trigger is enabled, the period parameter is not available.

"Period - Delay Ch.1/2"...233, 237

"Period - Double Ch. 1/2"...232/236

"Period - Width Ch. 1/2"...230, 234

"Power-up Complete"

"Press any key to continue"

This message appears after power-on-test parametric-failures. The BLUE key is not included.

"Press EXEC to Activate Function"

EXEC = execute. EXEC executes the selected internal or external storage operation.

"Press EXEC to check disc"

EXEC = execute

"Printer Down/Press Stop"

The printer is out of operation./Press the Stop key. Check the cable, power, interface address, paper, top-of-form, etc.

"Printing in Progress"

"Purging file"

"Reading description"

"Reading directory"

"Recalling Setting from File"

"REMOTE"
The instrument is remotely enabled.

"Resolution 10 ns"

"Resolution 10 us"

"Resolution 100 ps"

"Response can be Read"
The query response message is now in the output queue and can be read.

"Saving setting into File"

"SHIFT"
The shift function is active. See BLUE key, Chapter 3.

"Single Channel Disp. only"
Disp. = display
PRINT ALL at the data entry display is not possible when both channels are displayed and the word length is > 20 bits.

"Slope Range Conf. Ch. 1/2"...103/104

Conf. = conflict

Remote programming of the leading and trailing edges in different ranges is not allowed.

"To confirm, press EXEC"

EXEC = execute (EXEC key)

The purge file operation is active. Pressing EXEC will purge the specified file.

"To overwrite File, press EXEC"

EXEC = execute (EXEC key)

A setting is stored into an existing file and the old data is destroyed. Overwrite replaces data; it is a destructive process.

"Transfer Failed"

A storage operation or a binary transfer (:SYST:SET) failed.

"Transfer in Process"

"Unaddress or Poll First"

Take the instrument to the listener ilde state and/or serial poll.

"Unexpected EOI"

"Unused Key"

"Use 0 or 1"

"Use 0, 1, or '.'"

"Use 0 through 3"

"Use 0 through 3 or '.'"

"Use 0 through 7"

"Use 0 through 7 or '.'"

"Use Alphanumeric keys"

"Use [NEXT][PREV] Keys"

"Use Shift Curs. arrows to get Char."

Curs. = cursor
Char. = character
See Chapter 3, Cursor keys: display alphabet.

"Value is too Large"

"Value is Too Low"

"Value Not Allowed"

"Value out of Range"

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CUSTOMER ASSISTANCE

CONTENTS

INTRODUCTION

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales and Support Office.

SALES AND SUPPORT OFFICES

Sales and Support Offices are listed in the Sales and Support Office Directory at the back of all instrument reference manuals.

The Service Manual contains an expanded directory containing local offices.

INCOMING INSPECTION

Inspect the shipment for the following:

1. Packaging Material Condition
2. Invoice
3. Contents
4. Serial Number
5. Physical condition
6. Electrical condition.

NOTE: If the instrument is damaged during shipment, the packaging material must be saved for the carrier's inspection.

Contents

The contents of the shipment are:

1. Invoice
2. The standard instrument
3. Line power cord, 1 each
4. Line fuse, 1 each
5. Operating and Programming Manual, 1 each
6. Manual updates when required, 1 each

PLUS

8. Options as ordered
9. Accessories as ordered.

NOTE: Service Manuals are available as options. See Appendix B, Options and Accessories.

Discrepancies

If there are any discrepancies, contact a Hewlett Packard Sales and Support Office before doing anything further with the contents of the shipment.

PERFORMANCE TESTS

Performance Tests for checking the instrument's electrical operation are in Appendix E, which also contains a list of recommended test equipment.

The tests verify the instruments specified performance characteristics as described in Appendix A.

WARRANTY

The WARRANTY is on page iii.

CLAIMS

See the WARRANTY on page iii

Shipment Damage

If damage is caused during shipment, a Hewlett Packard Sales and Support Office will arrange for repair or replacement of the damaged items without waiting for settlement of a claim against the carrier.

The shipping material must be retained for the carrier's inspection.

RETURNS

See the WARRANTY on page iii.

Instrument Identification

Attach a tag with the following information to the instrument when returning it:

1. Owner Identification
   a. Contact's name
   b. Contact's telephone number
   c. Owner's return address
2. HP Identification
   a. Representative's name
   b. Telephone number
   c. Office name
3. Model number of the instrument
4. Instrument's complete serial number
5. Description of the service required.

Shipment

Shipment or storage:

1. The instrument can be shipped or stored at temperatures between -40 degrees Celsius and 65 degrees Celsius.
2. The instrument must be protected from conditions which cause condensation within the instrument.

Storage

The conditions are the same as those given for SHIPMENT.

Packaging

Use the original shipping carton and packaging material if they are not damaged.

A Hewlett Packard Sales and Support Office will provide recommendations on packaging material to be used.

General instructions for packing:

1. Wrap the instrument in heavy paper or plastic.

2. Use a strong shipping container.

   A double wall carton made of 350 pound/ 159 kg test material is adequate.

3. Protect the front panel with cardboard.

4. Use a 3 to 4 inch layer of shock absorbing material around the instrument to provide a firm cushion and to prevent instrument movement inside the container.

5. Seal the shipping container securely.

6. Mark the shipping container with "**FRAGILE**".

PARTS ORDERING INFORMATION

Parts and parts ordering information is contained in the Service Manual.

SERIAL NUMBER

The instrument's serial number (identification number) is located on the rear panel of the instrument.

SALES AND SUPPORT OFFICES

SALES AND SUPPORT OFFICE DIRECTORY

This directory contains Headquarters Offices only.

The Service Manual contains an expanded directory containing local Sales and Support Offices.

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